Proposed Habitat Conservation Plan and Incidental Take Permit for the Indiana Bat (*Myotis sodalis*) for the Buckeye Wind Power Project Champaign County, Ohio

Final Environmental Impact Statement
DES# 12-25

Volume I

Prepared by

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In cooperation with

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COVER SHEET

a. Title: Proposed Habitat Conservation Plan and Incidental Take Permit for the Indiana Bat (*Myotis sodalis*) for the Buckeye Wind Power Project Champaign County, Ohio

b. Subject: Final Environmental Impact Statement

c. Lead Agency: United States Fish and Wildlife Service

d. Cooperating Agency: U.S. Army Corps of Engineers

d. Abstract: The permit applicant, Buckeye Wind LLC, a wholly owned subsidiary of EverPower Wind Holdings, Inc., proposes to construct a commercial wind energy facility in Champaign County, Ohio (Project). The Project would occur within an approximately 32,395 ha (80,051 ac) area, consist of 100 turbines and associated access roads and infrastructure, and would generate up to 250 MW of electricity.

The Project has the potential to generate about 657,000 MWh of electricity annually with zero emissions. The energy generated by the Project would collect to an electric substation in Union Township in Champaign County.

The Project would be constructed in a location that supports the federally endangered Indiana bat (*Myotis sodalis*). Buckeye Wind has developed a Habitat Conservation Plan (HCP) to ensure that impacts to the federally listed Indiana bat are adequately minimized and mitigated in accordance with the requirements of Section 10 of the ESA. The USFWS received an application for an Incidental Take Permit (ITP) from Buckeye Wind for the Project on February 23, 2012.

On June 29, 2012, USFWS published a notice in the Federal Register stating the availability of the Draft Environmental Impact Statement (DEIS), Draft Habitat Conservation Plan (DHCP), and Draft Implementing Agreement (DIA). The public comment period for the abovementioned documents expired on September 27, 2012. Comments received during the public comment period and USFWS responses to those comments are included in Appendix K of this FEIS.

Key issues associated with construction of this Project include impacts to water resources; removal of native vegetation; impacts to wildlife (including migratory birds and bats); impacts to rare,

threatened, or endangered species; preservation of cultural resources; and impacts to visual resources.

The USFWS has selected the Proposed Action – Modified Operations and Habitat Conservation Plan as the preferred alternative. Of the alternatives evaluated in this FEIS, this alternative best fulfills the agency's statutory mission and responsibilities while meeting the purpose and need.

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f. Transmittal:

This Final Environmental Impact Statement prepared by the USFWS staff in cooperation with the U.S. Army Corps of Engineers on the proposed Habitat Conservation Plan and Incidental Take Permit for Permit for the Indiana Bat (*Myotis sodalis*) for the Buckeye Wind Power Project Champaign County, Ohio is being made available to the public in April 2013.

We request comments from the public on the FEIS and related documents, which are available at the locations specified below. We will accept comments received or postmarked within 30 days of the Environmental Protection Agency notice of the FEIS in the Federal Register. Comments submitted electronically using the Federal eRulemaking Portal must be received by 11:59 p.m. Eastern Time on the closing date. The Service's decision on issuance of the permit will occur no sooner than 30 days after the publication of the Environmental Protection Agency notice of the FEIS in the Federal Register and will be documented in a Record of Decision.

You may obtain copies of the FEIS and related documents on the Internet at *http://www.regulations.gov* (**Docket Number FWS–R3–ES–2012–0036**) or *http://www.fws.gov/midwest/endangered/permits/hcp/r3hcps.html*.

You may obtain the documents by mail from the Ecological Services Office in the Midwest Regional Office (see contact information above**).**

To view hard copies of the documents in person, go to the Ecological Services Office (8 a.m. to 4 p.m.) listed in the contact section above or to one of the following libraries during normal business hours: Champaign County Library, 1060 Scioto Street, Urbana, OH 43078–2228; or North Lewisburg Branch, 161 Winder Street, North Lewisburg, OH 43060.

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Acronyms and Abbreviations

$\mu g/m^3$	micrograms per cubic meter
AADT	Average Annual Daily Traffic
ABPP	Avian and Bat Protection Plan
CAA	Clean Air Act
CFR	Code of Federal Regulations
CO_2	Carbon dioxide
dB	Decibel
dBA	A-weighted decibel
DEIS	Draft Environmental Impact Assessment
EIS	Environmental Impact Statement
ESA	Endangered Species Act
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
ft	Feet
HCP	Habitat Conservation Plan
hp	Horse power
Hz	Hertz
IEC	International Electrotechnical Commission
IRAC	Interdepartment Radio Advisory Committee (IRAC)
ITP	Incidental Take Permit
ITP	Incidental Take Permit
kV	Kilovolts
kW	Kilowatts
L_{90}	Residual Sound Level
L_{eq}	Equivalent Energy Sound Level
m	Meters
m/s	Meters per second
MMT	Million Metric Tons
MW	Megawatt
MW	Megawatt
MWh	Megawatt hour
NAAQS	National Ambient Air Quality Standards
NO_2	Nitrogen dioxide
NOCO	North Country National Scenic Trail
NPS	National Park Service
NSPS	New Source Performance Standards
NTIA	National Telecommunications and Information Administration of the U.S. Department of Commerce
O&M	Operations and Maintenance
O_3	Ozone
OAC	Ohio Administrative Code
ODNR	Ohio Department of Natural Resources
ODOT	Ohio Department of Transportation
OEPA	The State of Ohio Environmental Protection Agency
OPSB	Ohio Power Siting Board

Pb	Lead
PCS	Personal Communication System
PM_{10}	Particulate Matter with less than 10 microns in diameter
$PM_{2.5}$	Particulate Matter with less than 2.5 microns in diameter
ppm	parts per million
PSD	Prevention of Significant Deterioration
PTI	Permit to Install
PTIO	Permit to Install and Operate
pW	Picowatt
SO_2	Sulfur dioxide
SR	State Road
SR	State Road
USACE	United Sates Army Corps of Engineers
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WCFZ	Worse Case Freznel Zone

Executive Summary

This *Proposed Habitat Conservation Plan and Incidental Take Permit for the Indiana Bat (Myotis sodalis) for the Buckeye Wind Power Project Champaign County, Ohio* Final Environmental Impact Statement (FEIS) evaluates the effects of issuing an Incidental Take Permit (ITP) for activities associated with the proposed Buckeye Wind Power Project (Project). This FEIS describes the components and potential impacts of three construction and operational alternatives for the proposed wind power facility. The Project would occupy approximately 32,395 hectares (ha; 80,051 acres [ac]) in portions of Union, Wayne, Urbana, Salem, Rush, and Goshen Townships in Champaign County in west central Ohio (Action Area). The Project would consist of up to 100 wind turbines, each with a nameplate capacity rating of 1.6 to 2.5 MW, resulting in a total generating capacity of up to 250 megawatts (MW) for the facility.

This FEIS evaluates the effects of issuing an ITP pursuant to Section 10(a)(1)(B) of the federal Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. § 1531 *et seq*.). The Proposed Action is USFWS' issuance of a Section 10(a)(1)(B) ITP for the Covered Activities proposed in the Habitat Conservation Plan (HCP). The HCP (Section 2.3 and Appendix B) describes what are considered Covered Activities, including construction, operation, maintenance, decommissioning, and mitigation. The HCP outlines specific measures to avoid and minimize impacts to the Indiana bat as well as mitigation to offset the impacts of take that cannot be avoided or minimized. The HCP describes the monitoring and adaptive management that will occur to ensure that permitted take is not exceeded and mitigation is successful. The proposed permit duration is 30 years. Accordingly, this FEIS analyzes the direct, indirect, and cumulative impacts of approving the HCP and issuing an ITP, including impacts of the Covered Activities and measures proposed to avoid, minimize, or mitigate potential impacts on the Indiana bat as well as the effects of the activities on the human environment.

The purposes for the proposed action and preparing this FEIS are to respond to Buckeye Wind's application for an ITP for the Indiana bat; protect, conserve and enhance the Indiana bat and its habitat for the continuing benefit of the people of the United States (U.S.); provide a means and take steps to conserve the ecosystems depended on by the Indiana bat; ensure the long-term survival of the Indiana bat through protection and management of the species and their habitat; and ensure compliance with the ESA, NEPA, and other applicable Federal laws and regulations.

Under the Proposed Action, up to 100 turbines and associated access roads, crane paths, electrical interconnection lines, staging areas, a substation, permanent meteorological towers, temporary concrete batch plants, and an operations and maintenance (O&M) facility would be constructed. Operational restrictions would include modifying cut-in speeds and feathering based on the location of each turbine in relationship to the season and suitability as Indiana bat habitat. Operation of the Proposed Action would result in the incidental take of approximately 130 Indiana bats over the life of the Project. Additionally up to 18,375 migratory birds and 32,200 bats (species other than Indiana bat) may be incidentally taken during the life of the Project. Under the Proposed Action, the Project would provide a clean source of energy for the region, as well as generate income for the local communities. The Project would implement avoidance, minimization, mitigation, and conservation measures including but not limited to implementation of the HCP to ensure protection and enhancement of natural resources.

Alternative A, the maximally restricted operations alternative, would consist of the same build-out as the Proposed Action; however, all 100 turbines would be non-operational during the period when Indiana bats could be present in the Action Area (sunset to sunrise from April 1 through October 31). This Alternative would have substantially lower migratory tree bat mortality than the Proposed Action, if not zero, and would reduce the collision risk to night-flying birds during this period. Thus, there would be negligible effects on Indiana bats under this alternative, and no mitigation would occur, including any research conducted on bat-turbine interactions, and no HCP would be implemented. Since under this Alternative all turbine activity would be curtailed from sunset to sunrise, a monitoring program for bat mortality would not be needed. This alternative would result in take of approximately 14,200 migratory birds over the life of the Project. A modified post-construction avian mortality monitoring program would be implemented for Alternative A to address bird mortality. Given the reduced operation time, this Alternative would generate 22.7 percent less energy than the Proposed Action.

Alternative B, the minimally restricted alternative, would consist of the same build-out as the Proposed Action; however, all 100 turbines would be feathered until a cut-in speed of 5.0 m/s (11 mph) during the first one to six hours after sunset from August 1 through October 31. This alternative would include the HCP. Operations under this Alternative would have greater adverse effects on spring/summer populations of Indiana bats than the Proposed Action. Additional mitigation for take of additional Indiana bats would be necessary to offset the impacts. The effects of feathering on birds are not well known, and reduced cut-in speeds have not been clearly shown to reduce bird deaths. Given the increased operation time, this Alternative would generate 1.8 percent more energy than the Proposed Action. However, given the minimal operational restrictions, this alternative would result in higher levels of bird and all bat mortality than under the Proposed Action or Alternative A. Specifically, operation of the Project under Alternative B would result in take of approximately 300 Indiana bats over the life of the Project. Additionally, up to 18,850 migratory birds and 65,000 non-listed bats may be incidentally taken during the life of the Project.

Under Alternative C, the no action alternative, the Project would not be built, and no Project-related activities (construction, operation, or decommissioning) would occur. Alternative C would have no effect on resources within the Action Area; however, Alternative C would not achieve the socioeconomic and environmental benefits including generation of clean energy, offset of emissions from existing power plants, generation of income from construction jobs, generation of tax revenues for municipalities and school districts, and generation of lease revenues for landowners. Implementation of this alternative would avoid direct and indirect impacts to Indiana bats from operation of the Project, including take of Indiana bats and Indiana bat habitat, but would not result in benefits derived from implementation of the mitigation and conservation measures proposed under the HCP.

See Chapter 5 for a full description of the effects of the Proposed Action and the three alternatives on resources within the Action Area.

In accordance with NEPA (40 CFR §1502.14(e)) and based on consideration of agency and public comments on the DEIS, the USFWS has selected the Proposed Action – Modified Operations and Habitat Conservation Plan as the preferred alternative. Of the alternatives evaluated in this FEIS, this alternative best fulfills the agency's statutory mission and responsibilities while meeting the purpose and need. The selection of the Proposed Action as the preferred alternative is based on the following:

1) The issuance of the ITP by the USFWS under the Proposed Action would result in protections (via mitigation and conservation measures) to the Indiana bat, as well as other bat species, not offered in the other action alternatives due to implementation of the HCP. The Avian and Bat Protection Plan (ABPP) that would be implemented under this and the other action alternatives would minimize impacts to migratory birds.
2) The 250 MW of power generated by the Project would provide a dependable source of electrical energy and eliminate the need for an equivalent amount of fossil-fueled derived energy and capacity, which reduces use of nonrenewable resources and limits atmospheric pollution.

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Chapter 1

Purpose of and Need for Action

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1 Purpose of and Need for Action

1.1 Introduction

This Environmental Impact Statement (EIS) has been prepared by the U.S. Fish and Wildlife Service (USFWS) pursuant to the National Environmental Policy Act (NEPA) (42 U.S.C. §4321 *et seq*.). The U.S. Army Corp. of Engineers (USACE) has cooperated in the preparation of this EIS by reviewing and providing comments back to the USFWS. This EIS evaluates the effects of issuing an Incidental Take Permit (ITP) pursuant to Section 10(a)(1)(B) of the federal Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. § 1531 *et seq*., 1539), for activities associated with the proposed Buckeye Wind Power Project (Project). Under Section 10(a)(2)(A) of the ESA, any application for an ITP must include a conservation plan that details, among other things, the impacts of the take and the steps taken to minimize and mitigate such impacts.

The permit applicant, Buckeye Wind LLC, a wholly owned subsidiary of EverPower Wind Holdings, Inc. (Buckeye Wind or the Applicant) proposes to construct and operate a commercial wind energy facility in Champaign County, Ohio. To achieve a generation capacity of 250 megawatts (MW), Buckeye Wind's Covered Activities include the installation of up to 100 wind turbines, to be built in the approximately 32,395-hectare (ha; 80,051 acre [ac]) Buckeye Wind project area (hereinafter referred to as the "Action Area") in Champaign County, Ohio. Within the Action Area, a relatively small portion of that land, approximately 0.16 percent (128.9 ac), will be permanently occupied by the Project facilities. The Project would be constructed in a location that supports the federally endangered Indiana bat (*Myotis sodalis*). Buckeye Wind has developed a Habitat Conservation Plan (HCP, located in Appendix B) to ensure that impacts to the federally listed Indiana bat are adequately minimized and mitigated in accordance with the requirements of Section 10 of the ESA. The USFWS received an application for an ITP from Buckeye Wind for the Project on February 23, 2012.

The ESA and its implementing regulations prohibit the take of any fish or wildlife that is designated as a threatened species or endangered species under Section 4 of the ESA (federally listed species) without prior approval pursuant to either Section 7 or Section 10(a)(1)(B) of the ESA. The ESA defines "take" as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (16 U.S.C. §1532(19)). Pursuant to the Code of Federal Regulations (CFR), "incidental taking" means "any taking otherwise prohibited, if such taking is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity" (50 C.F.R. 17.3). "Harm" is defined in the CFR as "an act which actually kills or injures federally listed wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures federally listed wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering" (50 C.F.R. 17.3). "Harass" means "an intentional or negligent act or omission which creates the likelihood of injury to federally listed 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" (50 C.F.R. 17.3).

Issuance of a Section 10 ITP constitutes a discretionary federal action by the USFWS and is thus subject to NEPA, which requires that all federal agencies assess the effects of their actions on the human environment by preparing an Environmental Assessment (EA) or Environmental Impact Statement (EIS) to document the potential effects of the federal action (42 U.S.C. § 4332). Accordingly, the USFWS, in cooperation with the USACE, has prepared this EIS to evaluate the potential impacts associated with issuance of an ITP and implementation of the HCP, and to evaluate alternatives. Three alternatives to the Proposed Action are considered in this EIS, including a No Action Alternative (see Chapter 3). The consequences of these actions on various resources are discussed in this EIS.

1.2 General Project Description and Location

The Action Area is an approximately 32,395-ha (ha; 80,051 ac) area that includes portions of Union, Wayne, Urbana, Salem, Rush, and Goshen Townships in Champaign County in west central Ohio (Figure 1-1). The Project would consist of up to 100 wind turbines, each with a nameplate capacity rating of 1.6 to 2.5 MW, resulting in a total generating capacity of up to 250 MW for the facility. The Project also would include construction of access roads, crane paths, electrical interconnection lines, staging areas, a substation, permanent meteorological towers, temporary concrete batch plants, and an operations and maintenance (O&M) facility. Additionally, the Project includes activities for operation, maintenance, decommissioning, and mitigation.

The Project is located in a rural setting, with the landscape primarily composed of agricultural properties with wooded areas interspersed throughout. Several small towns (such as Mutual and Cable) occur within the Project vicinity along with scattered individual homes and low-density residential areas. The Project is expected to operate at an average annual capacity factor[1] of approximately 30 percent, resulting in approximately 657,000 megawatt hours (MWh) of electricity generation per year (assuming an installed capacity of 250 MW). The energy generated by the Project would collect to an electric substation in Union Township in Champaign County (Figure 1-2). Section 3.1 of this EIS provides a detailed description of the Project.

[1] Capacity factor is a measure of the productivity of a wind turbine or any other power production facility. It compares the plant's actual production over a given period of time with the amount of power the plant would have produced if it had run at full capacity for the same amount of time. A wind power facility is "fueled" by the wind, which blows with variable strength. Although modern utility-scale wind turbines typically operate 65 to 90 percent of the time, they often run at less than full capacity. Therefore, a capacity factor of 25 to 40 percent is common, although they may achieve higher capacity factors during windy weeks or months. As a point of comparison, a capacity factor of 40 to 80 percent is typical for other (not operated by wind) types of power generation facilities (http://www.awea.org).

Figure 1-1 Project Vicinity

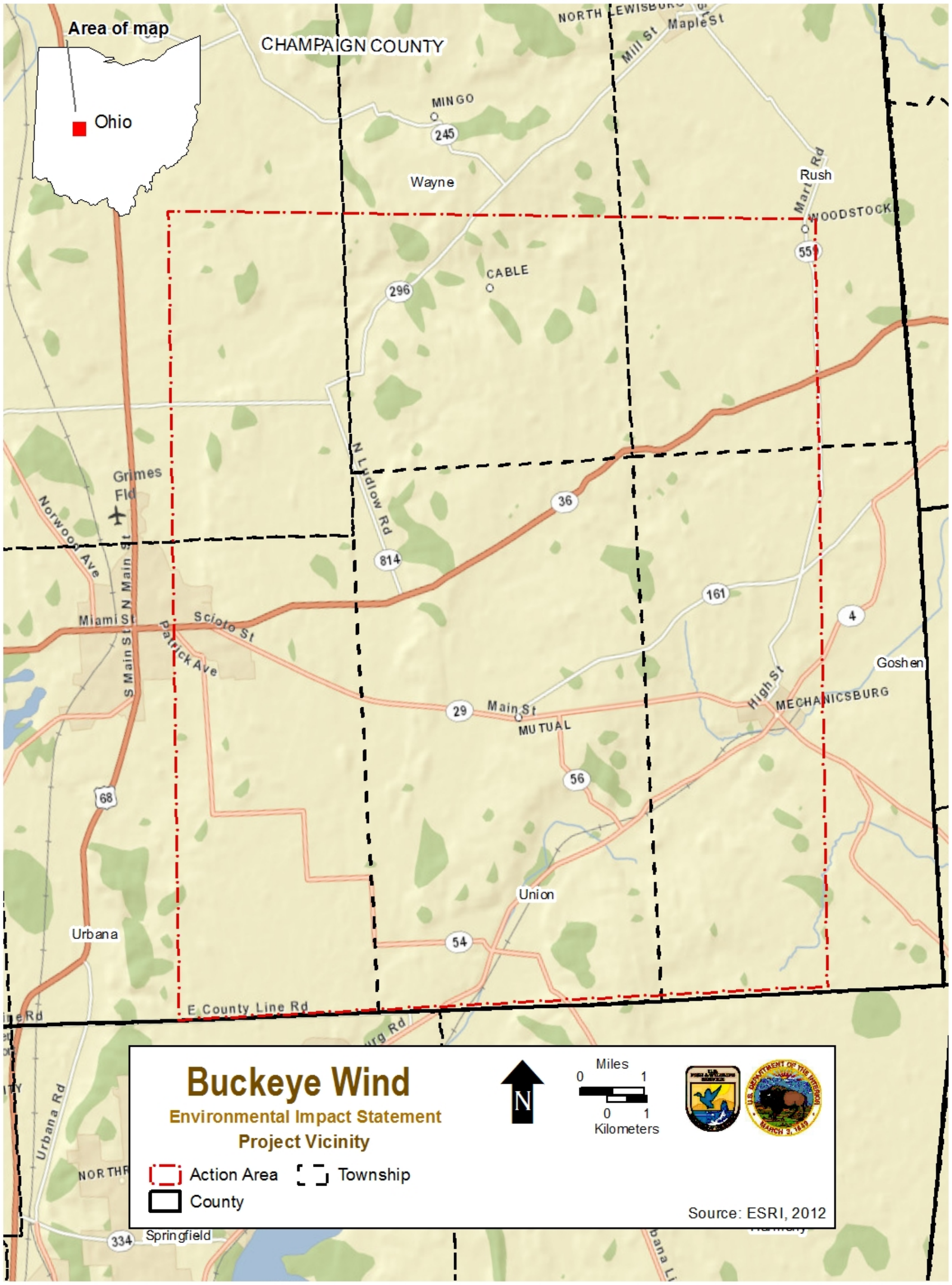
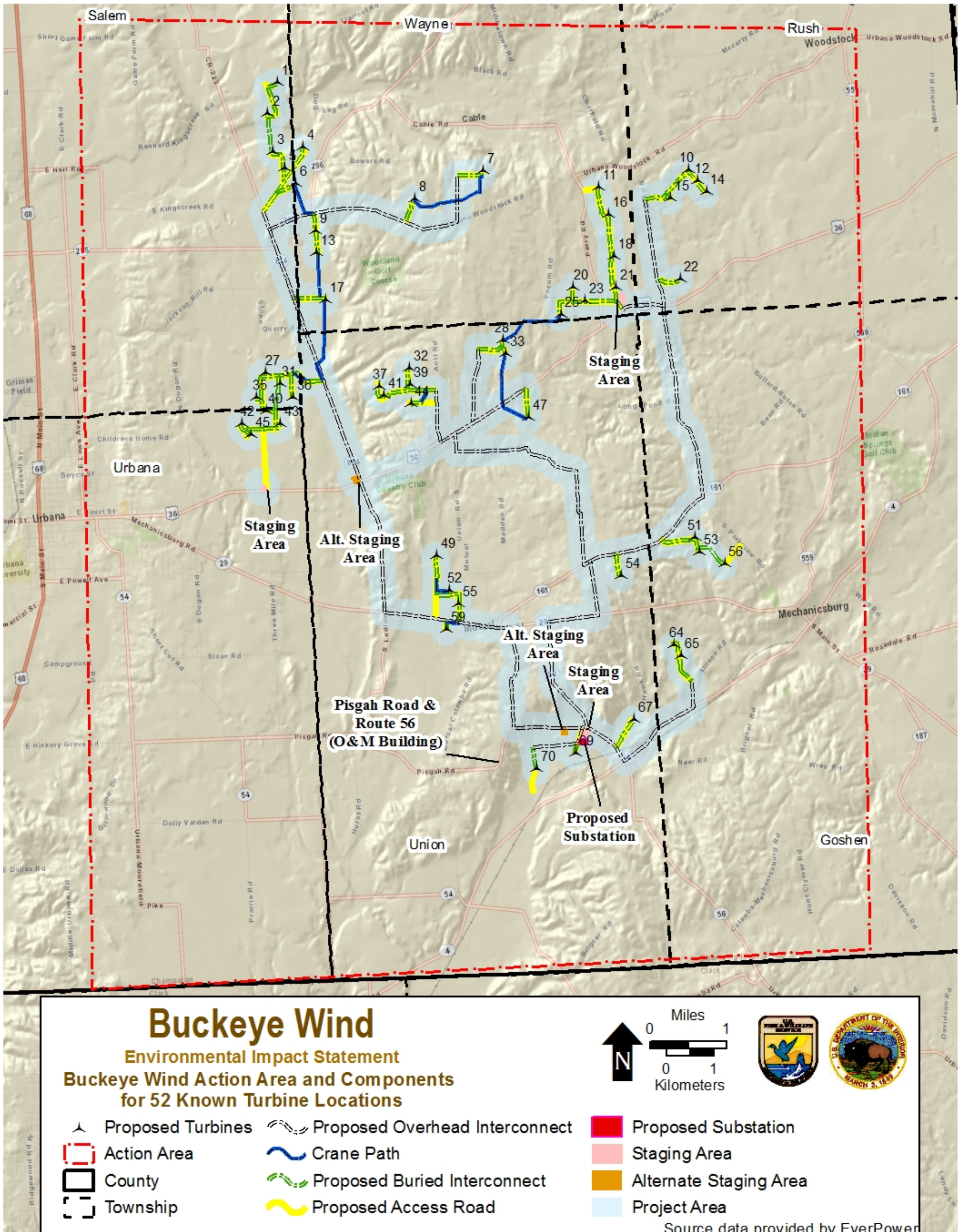


Figure 1-2 Buckeye Wind Action Area and Components for 52 Known Turbine Locations



Note: This figure depicts the locations for 52 of the possible 100 turbines. Exact locations for the remaining 48 turbines have yet to be determined, although they would occur within the Action Area and the Applicant would implement the siting criteria defined in Chapter 3 of this DEIS as well as the conservation program described in the HCP in siting the remaining turbines (see Chapter 6 of the HCP).

1.3 Species Covered by the HCP

The Indiana Bat (*Myotis sodalis),* a federally-listed endangered species under the ESA, is the single federally listed species covered by the HCP.

1.4 Proposed Action Addressed in this EIS

The Proposed Action is USFWS' issuance of a Section 10(a)(1)(B) ITP for the Covered Activities proposed in the HCP. The HCP (Section 2.3) describes what are considered Covered Activities, including construction, operation, maintenance, decommissioning, and mitigation. The HCP outlines specific measures to avoid and minimize impacts to the Indiana bat as well as mitigation to offset the impacts of take that cannot be avoided or minimized. The HCP describes the monitoring that will occur to ensure that permitted take is not exceeded and mitigation is successful. The proposed permit duration is 30 years. Accordingly, this EIS analyzes the direct, indirect, and cumulative impacts of approving the HCP and issuing an ITP, including impacts of the Covered Activities and measures proposed to avoid, minimize, or mitigate potential impacts on the Indiana bat as well as the effects of the activities on the human environment.

1.5 Purpose of and Need for the Proposed Action

1.5.1 Purpose of the Federal Action

The purposes for the proposed action and preparing this EIS are to:

- Respond to Buckeye Wind's application for an ITP for the federally endangered Indiana bat related to Project activities that have the potential to result in take, pursuant to the provisions of Section 10(a)(1)(B) of the ESA, as amended, and its implementing regulations (50 C.F.R. part 17.22(b)(1)) and policies.
- Protect, conserve and enhance the Indiana bat and its habitat for the continuing benefit of the people of the United States (U.S.).
- Provide a means and take steps to conserve the ecosystems depended on by the Indiana bat.
- Ensure the long-term survival of the Indiana bat through protection and management of the species and its habitat.
- Ensure compliance with the ESA, NEPA, and other applicable Federal laws and regulations.

1.5.2 Need for the Federal Action

The need for the action is based on the potential that activities proposed by Buckeye Wind could result in the incidental take of Indiana bats, and thus the need for an ITP. Consideration of issuance of the ITP and preparation of this EIS will help USFWS and other federal and state agencies address a number of important needs, as described below.

- Commercial wind facilities have been shown to cause high numbers of bat fatalities in many locations. There is a need to ensure that take of Indiana bats is avoided and minimized to the maximum extent practicable and to ensure that the impact of any remaining take is fully mitigated. There is also a need to protect the habitat of Indiana bats including their maternity trees, swarming areas near hibernacula, and nearby foraging and roosting habitat.
- The USFWS needs to consider all of the environmental impacts to the human environment that will occur if an ITP is issued for this Project.

1.6 Agency Roles and Responsibilities

1.6.1 USFWS

The primary responsibility of the USFWS is the conservation and enhancement of the nation's fish and wildlife populations and their habitats. The USFWS' mission is: "working with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people" (USFWS 2008a, pg 1). The USFWS has specific trust responsibilities for migratory birds, federally threatened and endangered species, and certain anadromous fish and marine mammals (USFWS 2008a). The USFWS is also responsible for enforcing certain Federal wildlife laws.

The USFWS' responsibilities for management of federally-listed species, including the Indiana bat, are authorized under the ESA (USFWS 2008a). There are several laws and treaties that comprise or inform the USFWS Migratory Bird Program; however, the two primary pieces of legislation focused on in this analysis are the Migratory Bird Treaty Act (MBTA) (16 U.S.C. §§703-712) and the Bald and Golden Eagle Protection Act (BGEPA) (16 U.S.C. §§668-668d). The USFWS is responsible for preparing the regulations that implement these two Acts. USFWS updates these regulations periodically to reflect the current status of migratory bird populations as well as the interests and needs of government agencies, the scientific community, and the public (USFWS 2002).

The USFWS has worked with the wind industry to avoid and minimize impacts to wildlife from construction and operation of wind energy facilities for many years. This has resulted in publication of the USFWS Land Based Wind Energy Guidelines (USFWS 2012c). The USFWS is concerned about any level of take from wind energy facilities, but is particularly concerned about take of ESA-protected species and species that are under additional protection, such as eagles and migratory birds. In its recently published Land Based Wind Energy Guidelines, the USFWS "urges voluntary adherence to the Guidelines and communication with the USFWS when planning and operating a facility" (USFWS 2012c, pg 6). USFWS will regard such actions as "appropriate means of identifying and implementing reasonable and effective measures to avoid the take of species protected under the MBTA and BGEPA" (USFWS 2012c, pg 6). USFWS will also consider such adherence and communication when exercising its discretion on potential referrals for prosecution related to the take of any MBTA or BGEPA protected species (USFWS 2012c).

1.6.1.1 Assessments and Decisions Required

(a) NEPA

The USFWS is the lead agency for preparation of this EIS. The USACE has cooperated on the preparation of this EIS by reviewing and providing comments back to the USFWS. As required by NEPA, the USFWS, as the lead agency, will use a systematic, interdisciplinary approach for the EIS, considering environmental amenities and values in decision-making along with economic and technical considerations. The purpose of NEPA is to ensure that the potential environmental impacts of any proposed federal action are fully considered and made available for public review.

Upon the completion of the EIS process (including a 90-day public comment period on the Draft EIS [DEIS]), the USFWS will issue a Final EIS and provide a concise record of its consideration of the environmental analysis in the Record of Decision (ROD). The ROD will discuss the agency's assessment of the alternatives considered in the EIS and its determination on whether to issue an ITP for the Project. No permit decision would be made until at least 30 days after completion of the ROD.

(b) ESA

As required by the ESA Section 10(a)(2)(B) and 50 C.F.R.17.22(b)(2) and 50 C.F.R. 17.32(b)(2) as well as the guidance in the USFWS' Five Point Policy (Fed.Reg. 65, 35241-35257), the USFWS must determine that the following criteria are met before issuing an ITP:

- The taking will be incidental;
- The applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such taking;
- The applicant will ensure that adequate funding will be provided for the HCP;
- The taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild;
- The HCP addresses the five concepts outlined in the Five Point Policy: permit duration, public participation, adaptive management, monitoring provisions, and biological goals;
- The HCP will be implemented; and
- Such other measures that the Secretary may require as being necessary or appropriate for purposes of the HCP will be implemented.

The USFWS' decision pursuant to the ESA may consist of one of the following:

- Issue an ITP conditioned on implementation of the Applicant's HCP;
- Issue an ITP conditioned on implementation of the Applicant's HCP together with other specified measures; or
- Deny the ITP application.

Section 7 of the ESA[2] requires intra-Service consultation to address the action of issuing the ITP. In the intra-Service consultation, the USFWS, in the case of this EIS, evaluates the potential effects relative to baseline conditions to determine whether the Proposed Action is likely to jeopardize the continued existence or result in destruction or adverse modification of designated critical habitat of the species under consultation. The USFWS then prepares its Biological Opinion (BO), which contains an effects assessment of issuing the ITP under the implementation of the HCP on listed species and their habitats. The BO includes an incidental take statement with take limits, reasonable and prudent measures, and other terms and conditions. The internal Section 7 consultation on the USFWS' action of ITP issuance will be completed before the ROD finding is reached under NEPA.

1.6.2 USACE

1.6.2.1 Section 10 of the Rivers and Harbors Act

The USACE is directed by Congress under Section 10 of the Rivers and Harbors Act (RHA) of 1899 (33 U.S.C. § 403) to regulate all work or structures in or affecting the course, condition or capacity of navigable waters of the U.S. The intent of this law is to protect the navigable capacity of waters important to interstate commerce. Navigable waters of the U.S. are defined in 33 C.F.R. 329 as those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce.

1.6.2.2 Section 404 of the Clean Water Act

The USACE is directed by Congress under Section 404 of the Clean Water Act (CWA) (33 U.S.C. §1251, 1344) to regulate the discharge of dredge and fill material into all waters of the U.S., including wetlands. The intent of the law is to protect the nation's waters from the indiscriminate discharge of material capable of causing pollution and to restore and maintain their chemical, physical and biological integrity. Waters of the U.S. are defined in 33 C.F.R. 328 and may include lakes, rivers, streams, mudflats, vegetated shallows, ditches, ponds, and wetlands.

1.6.2.3 USACE Permit Requirements

While the Applicant has had some initial discussions with the USACE regarding potential permit requirements, it has not been determined whether the Project would impact any areas within the USACE's jurisdiction. Buckeye Wind will continue to consult with USACE as the design phase of the Project progresses to determine the need for a permit. If the Project would impact a navigable water of the U.S., or if it would result in the placement of fill material into jurisdictional waters of the U.S., a USACE permit would be required.

[2] 16 U.S.C. § 1536(a)(2), Interagency cooperation. Requires federal agencies to ensure that their actions are not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of critical habitat of such species.

1.7 Statutory and Regulatory Framework

The Project is subject to a combination of federal, state, and local laws and regulations aimed at protecting human health and the environment. This section discusses the federal, state, and local laws and regulations that apply to the Project. Finally, this section summarizes the state and federal policies and goals related to renewable energy that are relevant to the Project.

1.7.1 Key Federal Statutes and Regulations

1.7.1.1 NEPA

NEPA requires that federal agencies consider the potential environmental consequences of proposed actions in their decision-making process. The law's intent is to protect, restore, or enhance the environment through well-informed federal decisions. The Council on Environmental Quality (CEQ) was established under NEPA for the purpose of implementing and overseeing federal policies as they relate to this process.

In 1978, the CEQ issued Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act (40 C.F.R. parts 1500-1508). Section 102(2)(C) of NEPA mandates that the lead federal agency must prepare a detailed statement for legislation and other major federal actions that significantly affect the quality of the human environment (42 U.S.C. § 4332(2)(C)). Such projects include any actions under the jurisdiction of the federal government or subject to federal permits; actions requiring partial or complete federal funding; actions on federal lands or affecting federal facilities; continuing federal actions with effects on land or facilities; and new or revised federal rules, regulations, plans, or procedures. Any action with the potential for significant impacts to the human environment requires the preparation of an EIS (40 C.F.R part 1508). During the Project development phase, it was determined that take of federally endangered Indiana bats is possible from construction/decommissioning and is likely to occur during operation of the proposed Project. To authorize take, Buckeye Wind has developed an HCP and has requested issuance of an ITP from the USFWS. Issuance of an ITP is considered a major federal action and is therefore subject to the requirements of NEPA and the CEQ regulations, which include preparation of an EA or EIS. In this case, the USFWS decided that an EIS was necessary because: 1) the effects of the Project, including effects on federally listed species, were uncertain and required thorough analysis in an EIS; and 2) if approved by USFWS, the Project would receive one of the first ITPs for Indiana bats associated with a wind project. To comply with NEPA and other relevant environmental statutes described below, this EIS involves a thorough examination of all pertinent environmental issues.

1.7.1.2 Federal ESA

The ESA is administered by the USFWS and National Marine Fisheries Service (NMFS). With some exceptions, Section 9 of the ESA[3] prohibits unauthorized take of any fish or wildlife species listed as endangered or threatened under the ESA. Subject to specified terms and conditions, Section 10 of the ESA allows for the incidental take of listed species by non-federal

[3] 16 U.S.C. § 1538 Prohibited acts. This section and ESA implementing regulations prohibit any action that causes a "taking" of any fish or wildlife species listed as endangered or threatened and also prohibits the import, export, interstate, and foreign commerce of listed species.

entities otherwise prohibited by Section 9 of the ESA. Pursuant to Section 10, an ITP is issued through adoption of an USFWS-approved HCP that demonstrates that take has been avoided, minimized, and mitigated to the maximum extent practicable.

Section 7(a)(2) of the ESA states that each federal agency shall ensure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of listed species or result in destruction or adverse modification of designated critical habitat. A federal action "means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies in the United States or upon the high seas" (50 C.F.R. 402.2). Actions of federal agencies that do not jeopardize the continued existence of listed species or result in destruction or adverse modification of their designated critical habitat, but that could result in a take, must be addressed under Section 7.

The Proposed Action is subject to the ESA because incidental take of federally listed Indiana bats may occur from construction, operation, maintenance, and/or decommissioning of the Project and the USFWS is considering issuing an ITP under Section 10(a)(1)(B) of the ESA to authorize this take, which would otherwise be prohibited under Section 9 of the ESA. Prior to issuing an ITP, the USFWS must internally conduct an ESA Section 7 analysis of the ITP to ensure the take will not jeopardize the continued existence of the species.

1.7.1.3 MBTA

A migratory bird is any individual species or family of birds that crosses international borders at some point during their annual life cycle to live or reproduce. The MBTA implements four treaties that prohibit take, possession, transportation, and importation of all migratory, native birds (plus their eggs and active nests) occurring in the wild in the U.S., except for House Sparrow, European Starling, Rock Pigeon, any recently listed unprotected species in the Federal Register (70 Fed. Reg. 12710), and non-migratory upland game birds, except when specifically authorized by the USFWS. The MBTA provides that it is unlawful to pursue, hunt, take, capture, kill, possess, sell, purchase, barter, import, export, or transport any migratory bird, or any part, nest, or egg or any such bird, unless authorized under a permit issued by the Secretary of the Interior. Some regulatory exceptions apply. Take is defined in regulations as: "pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect" (16 U.S.C. § 1532(19). In total, more than 1,000 bird species are protected by the MBTA[4], 58 of which can be legally hunted with a permit as game birds. The MBTA addresses take of individual birds, not population-level impacts, habitat protection, or harassment. Failure to comply with the MBTA can result in criminal penalties. As authorized by the MBTA, the USFWS issues permits to qualified applicants for the following types of activities: falconry, raptor propagation, scientific collecting, special purposes (rehabilitation, educational, migratory game bird propagation, and salvage), take of depredating birds, taxidermy, and waterfowl sale and disposal.

The USFWS regards voluntary adherence to its Land-Based Wind Energy Guidelines (USFWS 2012c) and communications as evidence of due care with respect to avoiding, minimizing, and mitigating adverse impacts to species protected under the MBTA and BGEPA, should a violation

[4] A revised list of birds protected by the MBTA can be found in the federal register notice at: http://www.fws.gov/migratorybirds/RegulationsPolicies/mbta/10-13%20Final%20Rule%201%20March%202010.pdf

of either act occur. Though compliance with the USFWS Guidelines does not limit or preclude the USFWS from exercising its authority under any law, statute, or regulation, or from conducting enforcement actions against any individual, company, or agency, the USFWS Office of Law Enforcement focuses its resources on investigating and prosecuting those who take migratory birds without identifying and implementing reasonable and effective measures to avoid the take of species protected under the MBTA and BGEPA (USFWS 2012c). According to the USFWS Guidelines, “The Chief of Law Enforcement or more senior official of the Service will make any decision whether to refer for prosecution any alleged take of such species, and will take such adherence and communication fully into account when exercising discretion with respect to such potential referral” (USFWS 2012c, pg 6).

Under the MBTA, a Federal Special Purpose – Utility Migratory Bird Mortality Monitoring Permit is required for utilities to collect, transport and temporarily possess migratory birds found dead on utility property, structures, and rights-of-way for mortality monitoring purposes. Utilities include communications, electric, wind power, solar, and other power generation and transmission entities. Migratory Bird Mortality Monitoring permits to collect carcasses and parts will be available to wind energy companies that submit an application that includes a project-specific monitoring plan and protocol that are of sufficient detail and rigor to enable the permittee to develop information needed to determine bias-corrected fatality rates or other metrics of affected species, and assess how different parts of the facility or operations affect those species. The permit will authorize collection of dead migratory birds for the purpose of monitoring mortality associated with operation of the wind facility. Any threatened or endangered species or bald or golden eagles encountered must be turned over to the USFWS immediately. Possession of a permit to collect carcasses of birds taken by the wind facility does not absolve the company from liability for such take, nor does it relieve the company of its obligations to comply with applicable Federal, state, tribal or local laws. Buckeye Wind will obtain a Migratory Bird Mortality Monitoring Permit to authorize collection of migratory bird carcasses during post-construction monitoring at the Project.

1.7.1.4 BGEPA

The BGEPA affords specific legal protection to bald eagles and golden eagles. Under this Act, it is a violation to “…take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or in any manner any bald eagle commonly known as the American eagle or any golden eagle, alive or dead, or any part, nest, or egg thereof….”(16 U.S.C. § 668). The BGEPA defines take as pursuing, shooting, shooting at, poisoning, wounding, killing, capturing, trapping, collecting, molesting, or disturbing (16 U.S.C. § 668c). “Disturb” is defined in regulation 50 C.F.R. 22.3 as “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.”

In fall 2009, USFWS implemented two rules (50 C.F.R. 22.26 and 22.27) authorizing limited legal take of bald and golden eagles “when the take is associated with, but not the purpose of an otherwise lawful activity, and cannot practicably be avoided” (USFWS 2011a, pg 1). Failure to comply with the BGEPA can result in criminal penalties.

Although take permits may be issued under these new rules, Buckeye Wind is not seeking an eagle take permit under the BGEPA at this time since the Project is not expected to result in activities that would incidentally take (harm or harass) eagles. While both bald and golden eagle use of the Action Area has been documented, to date use has been limited to the migration season when they occur as transients or to limited summer use by non-reproductive transient individuals (refer to Section 5.7 of this EIS for further details on eagle use of the Action Area). As such, the Project is considered to be of low risk to eagles.

1.7.1.5 CWA

The Clean Water Act (CWA, 33 U.S.C. §§ 1251 to 1387) is the principal law governing protection of the nation's surface waters. The CWA provides the basic structure for regulating discharges of pollutants into U.S. waters. USACE is directed by Congress under Section 404 of the Clean Water Act (33 USC 1344) to regulate the discharge of dredged and fill material into all waters of the U.S., including wetlands. As noted in Section 1.6.2.3, the Applicant has had preliminary discussions with the USACE regarding potential USACE permits required for this Project.

1.7.1.6 National Historic Preservation Act

The National Historic Preservation Act (NHPA, 16 U.S.C. §§ 470a to 470w-6) is the primary federal law governing the preservation of cultural and historic resources in the U.S. The NHPA establishes a national preservation program and the basic structure for encouraging the identification and protection of cultural and historic resources of national, state, tribal and local significance. Issuance of an ITP is a federal action requiring review under the NHPA.

1.7.1.7 Rivers and Harbors Act

The USACE is directed by Congress under Section 10 of the Rivers and Harbors Act (RHA) of 1899 (33 USC 403) to regulate all work or structures in or affecting the course, condition or capacity of navigable waters of the U.S. The intent of this law is to protect the navigable capacity of waters important to interstate commerce. Navigable waters of the U.S. are defined in 33 CFR 329 as those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce.

1.7.2 State Statutes and Regulations

1.7.2.1 Ohio Power Siting Board Process

The Ohio Power Siting Board (OPSB) has regulatory authority over all proposed wind power projects in Ohio capable of generating five or more MW of electricity. Prior to issuance of a Certificate of Environmental Compatibility and Public Need by the OPSB (OPSB Certificate), a wind developer must demonstrate that its wind facility is in compliance with a variety of requirements to ensure that potential impacts to the human environment, including natural resources, have been adequately addressed. The Project is the subject of one of the first applications submitted to the OPSB for a large-scale commercial wind powered electric generation facility in Ohio. Buckeye Wind initiated the OPSB application process on June 4, 2008 upon filing a letter of notification to apply for a certificate to install numerous electricity generating wind turbines in Champaign County (in accordance with Ohio Administrative Code [OAC] Rule 4906-5-02). Buckeye Wind filed its application for an OPSB Certificate (Case Record 08-0666-EL-BGN) in April 2009 (hereafter OPSB Application). The Project received its OPSB Certificate on March 22, 2010. The issuance of this Certificate was subject to specific conditions, including that Buckeye Wind develop and implement a USFWS-approved HCP for the Indiana bat and obtain an ITP for the species from the USFWS. Appendix A to this EIS contains a more detailed discussion of the OPSB process and the complete record is available at http://dis.puc.state.oh.us/CaseRecord.aspx?Caseno=08-0666&link=DI.

The Project proposed in Buckeye Wind's OPSB application included a 70-turbine layout. As part of the Certificate process, 16 turbines were prohibited by the OPSB due to unresolved Federal Aviation Administration (FAA) obstruction violations. Once the 16 turbines were omitted, two additional turbines became unviable due to cost associated with collection line construction and operation. As a result, 18 turbines were dropped from the original OPSB Application 70-turbine layout, resulting in a final layout of 52 turbines. The OPSB Certificate to Construct issued on March 22, 2010 covers these 52 turbines.

Up to 48 additional turbines could be erected within the Action Area to fully utilize Buckeye's request to connect with the PJM Interconnection network. Champaign Wind LLC has initiated the OPSB application procedure for the Buckeye II Wind Project, consisting of approximately 56 turbines (no more than 100 total turbines will be constructed for the Buckeye Wind and Buckeye II Wind projects combined). The Buckeye II Wind Project will be transferred to Buckeye Wind prior to construction. A public information meeting for Champaign Wind LLC was held on January 24, 2012. Champaign Wind LLC's record of public interaction is available through the PUCO Docketing Information System (http://dis.puc.state.oh.us/CaseRecord.aspx?CaseNo=12-0160-EL-BGN). Under no circumstances will more than 100 turbines be covered under the ITP Application.

1.7.2.2 Ohio Department of Natural Resources

State threatened and endangered species, including birds and bats, are protected under ORC § 1518.01–99; 1531.25, and 1531.99, which prevent the "taking or possession of native wildlife, or any eggs or offspring thereof, that [are found] to be threatened with statewide extinction" (ORC § 1531.25). Ohio Department of Natural Resources (ODNR) must issue a scientific collectors permit in accordance with ORC §1533.08 (and further defined under OAC Section 1501:31-25-01 and 02) to authorize collection of carcasses during post-construction monitoring. There is currently no state-specific permit system authorizing incidental take of state listed species.

1.7.3 Other Applicable Regulations

In addition to the regulations discussed above, there are numerous other federal, state, and local regulations that apply to the Project, some of which require permits or authorizations from authorizing agencies. Table 1.7-1 summarizes these regulations, their relevance to the Project, and permits or authorizations required where applicable.

Table 1.7-1 Applicable Federal, State and Local Statutes, Regulations and Permits and Authorizations Required for the Buckeye Wind Project

Agency	Statutes/Regulation	Permit/Approval	Reason Permit is (or May be) Needed
Federal			
U.S. Fish and Wildlife Service	Endangered Species Act Section 7	ITP and ITS - see section 1.6.1 above	Requires intra-Service consultation to address the actions of issuing both the ITP and the accompanying Incidental Take Statement (ITS).
U.S. Fish and Wildlife Service	Endangered Species Act Section 9	ITP – see Section 1.7 above	The Project is expected to result in incidental take of Indiana bats, listed as federally endangered and protected under the ESA.
U.S. Fish and Wildlife Service	Endangered Species Act Section 10	ITP – see Section 1.5 above	The Project is expected to result in incidental take of Indiana bats, listed as federally endangered and protected under the ESA.
U.S. Fish and Wildlife Service	Migratory Bird Treaty Act	MBTA Special Purpose Salvage Permit	The MBTA protects over 1,000 U.S. bird species. It is unlawful to take any migratory bird, or any part, nest, or egg of any such bird, unless authorized under a permit issued by the USFWS. MBTA Special Purpose – Utility Migratory Bird Mortality Monitoring Permit will be required to collect carcasses during post-construction monitoring.
U.S. Fish and Wildlife Service	Bald and Golden Eagle Protection Act	None – see Section 1.7.1 above	Prohibits the take of bald eagles and golden eagles. Permits may be issued for otherwise lawful activities that result in a take of bald and golden eagles on a limited basis. A risk assessment conducted by the USFWS concluded that there is low likelihood of Project-related impacts to eagles; therefore no permit will be sought at this time. Buckeye Wind has committed to working with USFWS and ODNR to develop a plan to periodically update the predicted risk of the Project.
U.S. Army Corps of Engineers	Clean Water Act – Section 404	Section 404 permit may be required	For discharge of dredge or fill material into waters of the United States, including special aquatic sites such as wetlands under the jurisdiction of the USACE.
U.S. Army Corps of Engineers	Rivers and Harbors Act – Section 10	Section 10 permit may be required	For work or structures in or affecting the course, condition or capacity of navigable waters of the United States.
U.S. Department of Agriculture – Natural Resources Conservation Service	Farmland Protection Policy Act	Compliance with guidelines	Federal programs (i.e., permitted by federal government) must be compatible with state, local and private efforts to protect farmland.
Lead Federal agency varies: is the Federal agency with the undertaking	National Historic Preservation Act - Section 106	Consultation with the Ohio Historic Preservation Office	Projects with federal undertaking (i.e., granting a federal ITP) must determine the potential for the proposed undertaking to affect historic properties and avoid or mitigate any adverse effects.

Agency	Statutes/Regulation	Permit/Approval	Reason Permit is (or May be) Needed
Lead Federal agency varies: is the Federal agency with the undertaking	American Indian Religious Freedom Act (AIRFA) of 1978	Compliance with regulation/Consultation	AIRFA requires federal agencies to respect the customs, ceremonies, and traditions of Native American religions. AIRFA also provides for access to sacred sites, freedom to worship through ceremonial and traditional rights and use, and possession of objects considered sacred. Tribes recognized both by the federal and state government may be consulted to ensure these rights are respected.
Environmental Protection Agency	Executive Order 11990 – Wetlands Protection	Compliance with guidelines	Federal agencies must avoid causing adverse impacts associated with the destruction or modification of wetlands.
Environmental Protection Agency	Executive Order 11988 – Floodplain Management	Compliance with guidelines	Federal agencies must avoid construction within the 100-year floodplain unless no other practicable alternative exists.
No lead Federal agency for this regulation	Executive Order 12898 - Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations	Compliance with guidelines	Federal agencies must incorporate environmental justice into their missions by identifying and addressing the disproportionately high and/or adverse human health or environmental effects of their programs and policies on minorities and low- income populations and communities.
No lead Federal agency for this regulation	Executive Order 13186 - Responsibilities of Federal Agencies to Protect Migratory Birds	Compliance with guidelines	Each Federal agency taking actions that have, or are likely to have, a measurable negative effect on migratory bird populations is directed to develop and implement a Memorandum of Understanding (MOU) with the USFWS that shall promote the conservation of migratory bird populations.
State			
Ohio Power Siting Board	OAC Chapter 4906-17	OPSB Certificate – see Section 1.7.2 above	OPSB has regulatory authority over all proposed wind power projects in Ohio capable of generating 5 or more MW of electricity.
Ohio Department of Natural Resources Division of Wildlife	ORC §1533.08, Ohio Administrative Code Section 1501:31-25-01 and 02	Scientific collectors permit	Would authorize salvage of birds and bats during post-construction monitoring.
Ohio Department of Transportation	ORC Chapter 5577.04, 05	Roadway Usage permit and Oversized/overweight permit may be required	A permit is required to move oversized and/or overweight loads along or across state roads.
Ohio Environmental Protection Agency	ORC Chapter 6111 – Water Pollution Control	National Pollutant Discharge Elimination System (NPDES) permit	To authorize the discharge of substances at levels that meet water quality standards with regard to water pollution control.
Ohio Environmental Protection Agency	ORC Chapter 6111.30	Water Quality Certification	Any action requiring a Clean Water Act Section 404 permit must receive a Section 401 WQC from the Ohio EPA.
Local			
Champaign County-County Engineer		Right-of-way permit/Road Use Agreement may be required	A permit to work on and change the existing condition of a county right-of-way.

1.7.4 Relevant Federal and State Guidelines and Policies

1.7.4.1 USFWS Land-Based Wind Energy Guidelines

The USFWS first addressed wind power and wildlife, specifically migratory birds, by adopting "Interim Guidance on Avoiding and Minimizing Wildlife Impacts from Wind Turbines" in 2003 (USFWS 2003).

A Federal Advisory Committee (FAC) was established in 2007 by the Secretary of the Interior to provide advice and recommendations on developing effective measures to avoid or minimize impacts to wildlife and their habitats related to land-based wind energy facilities. In April 2010, the FAC provided to the Secretary a set of Recommendations (http://www.fws.gov/habitatconservation/windpower/wind_turbine_advisory_committee.html).

The USFWS convened an internal working group to review the Recommendations and develop voluntary wind energy guidelines that consider the Recommendations. In March 2012, the USFWS Guidelines were published (USFWS 2012c). These Guidelines "use a 'tiered approach' for assessing potential adverse effects to species of concern and their habitats. The tiered approach is an iterative decision-making process for collecting information in increasing detail; quantifying the possible risks of proposed wind energy projects to species of concern and their habitats; and evaluating those risks to make siting, construction, and operation decisions…Subsequent tiers refine and build upon issues raised and efforts undertaken in previous tiers. Each tier offers a set of questions to help the developer evaluate the potential risk associated with developing a project at the given location…enabling a developer to abandon or proceed with project development, or to collect additional information if required" (USFWS 2012c, pg vi).

Further, the USFWS "urges voluntary adherence to the Guidelines and communication with the [USFWS] when planning and operating a facility" (USFWS 2012c, pg 6). The USFWS will regard such actions as "appropriate means of identifying and implementing reasonable and effective measures to avoid the take of species protected under the MBTA and BGEPA" (USFWS 2012c, pg 6). The USFWS will also consider such adherence and communication when exercising its discretion on potential referrals for prosecution related to the take of any such protected species (USFWS 2012c).

One methodology used by the electric utility industry and some wind power companies to document consideration of and intent to comply with the MBTA and BGEPA is the implementation of an Avian Protection Plan (APP) or Avian and Bat Protection Plan (ABPP). The USFWS Guidelines refer to such plans as "Bird and Bat Conservation Strategies" (USFWS 2012c, pg 55). Regardless of the name, the intent is that the document should provide a written record of the developer's actions to avoid, minimize and compensate for potential adverse impacts (USFWS 2012c). Typically the document will explain the analyses, studies, and reasoning that support progressing from one tier to the next in the tiered approach and describe the steps a developer could or has taken to apply the USFWS Guidelines to mitigate for adverse impacts and address the post-construction monitoring efforts the developer intends to undertake (USFWS 2012c).

Buckeye Wind has voluntarily developed an ABPP for the Project (Appendix C) to provide a detailed framework through which potential adverse impacts to migratory birds and nonfederally listed bats (including state-listed species) will be avoided and minimized during Project planning, siting, construction, operation, and decommissioning. Further the ABPP specifies a monitoring plan, and adaptive management and mitigation strategies based on monitoring results. The ABPP documents Buckeye Wind's consideration of the USFWS's (2003) Interim Guidance on Avoiding and Minimizing Wildlife Impacts from Wind Turbines as well as the 2010 FAC recommendations, which were used to guide project development. The ABPP is not part of the HCP, but a separate voluntary plan.

1.7.4.2 ODNR Protocol for Commercial Wind Energy Facilities in Ohio

The ODNR is one of the seven voting members of the OPSB, and provides input and recommendations to the OPSB regarding the potential impact a proposed wind power facility may have on Ohio's wildlife resources. Accordingly, the ODNR Division of Wildlife has established study guidelines for bird and bat pre- and post-construction monitoring at proposed on-shore wind energy facilities (ODNR Protocol, ODNR 2009[5]). This Protocol allows the ODNR Division of Wildlife to make broad-scale comparisons of wildlife impacts at multiple sites in Ohio in order to minimize wind power and wildlife interactions. Typically, implementation of the ODNR Protocol and pre-construction survey results are considered when determining if OPSB Certificate issuance is appropriate, and post-construction monitoring surveys approved by ODNR are a condition on every OPSB certificate issued to wind project developers.

The ODNR Protocol outlines pre-construction wildlife survey efforts based on the wildlife habitat within a proposed wind project area, standardized post-construction monitoring to detect bird and bat carcasses during the first one to two years of operation, and methods for correcting carcass counts for searcher efficiency and scavenger rates (ODNR 2009).

The Project began pre-construction wildlife monitoring prior to ODNR completing their Protocol; however, the pre-construction wildlife monitoring plan for the Project was reviewed and approved by both ODNR and USFWS. Post-construction monitoring proposed in the HCP is designed to document compliance with the ITP, while Buckeye Wind has committed to work with the ODNR to implement any additional monitoring efforts that may be necessary in order to ensure consistency with ODNR Protocol objectives. Over the ITP Term, modifications to this monitoring plan may be appropriate and will be made as part of the ongoing adaptive management of the Project and in compliance with the terms of the HCP.

1.7.4.3 Federal and State Policies and Goals Related to Renewable Energy

Federal policy has also promoted increased renewable energy generation in the United States. The Project is consistent with Executive Order 13212 (dated May 18, 2001), which states:

> "The increased production and transmission of energy in a safe and environmentally sound manner is essential to the well being of the American people. In general, it is the policy of this Administration that executive departments and agencies shall take appropriate actions, to the extent consistent with applicable law, to expedite projects that will increase the production, transmission, or conservation of energy" (Executive Order 13212, 2001, Section 1).

[5] Can be downloaded at: http://www.dnr.state.oh.us/LinkClick.aspx?fileticket=loJTSEwL2uE%3d&tabid=21467

The Obama-Biden administration affirms this goal within its comprehensive “Barack Obama and Joe Biden: New Energy for America” plan, which includes in its objectives the creation of five million new jobs over the next 10 years and ensuring that 10 percent of our electricity comes from renewable sources by 2012, and 25 percent by 2025 (Obama for America 2008).

The CEQ issued an internal memorandum, “Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions,” to heads of federal departments and agencies on February 18, 2010. The CEQ memorandum advises federal agencies to consider opportunities to reduce greenhouse gas (GHG) emissions caused by proposed federal actions, to adapt their actions to climate change impacts throughout the NEPA process, and to address these issues in their agency NEPA procedures (CEQ 2010). The CEQ memorandum states that “by statutes, Executive Orders, and agency policies, the federal government is committed to the goals of energy conservation, reducing energy use, eliminating or reducing GHG emissions, and promoting the deployment of renewable energy technologies that are cleaner and more efficient. Where a proposal for federal agency action implicates these goals, information on GHG emissions (qualitative or quantitative) that is useful and relevant to the decision should be used when deciding among alternatives” (CEQ 2010, pg 2). The memorandum also states that if a proposed action would be reasonably anticipated to cause direct emissions of 25,000 metric tons or more of CO_2-equivalent GHG emissions on an annual basis, agencies should consider this an indicator that a quantitative and qualitative assessment may be meaningful to decision makers and the public (CEQ 2010). The Project is expected to displace nearly 19 times this amount of CO_2 emissions (Table 5.11-1), which suggests that these offsets should be considered meaningful to decision makers and the public and should be considered when deciding among alternatives, according to the CEQ memorandum.

Ohio’s electricity law, substitute Senate Bill 221 signed into law by Governor Strickland on May 1, 2008, created the state’s Ohio Alternative Energy Portfolio Standard (AEPS). The AEPS requires that by 2025 at least 25 percent of electricity sold in the state by electric distribution utilities and electric services companies must be generated from alternative energy resources. At least half of that standard, or 12.5 percent of electricity sold, must be generated by renewable resources,[6] and at least half of this renewable energy must be generated in-state. The Applicant anticipates selling the power to Ohio entities, helping to satisfy the AEPS. Consistent with these state and federal policies, the Project would help fulfill the need for the production and transmission of renewable energy.

1.8 Scope and Organization of this EIS

1.8.1 Scope of this EIS

A total of 52 turbines have been sited and approved by the OPSB (see Section 1.5.2). Up to 48 additional turbines could be erected within the Action Area to fully utilize Buckeye’s request to connect with the PJM Interconnection network (i.e., the regional electricity grid, see OPSB Application Exhibit C for further details). The exact locations of the additional 48 turbines have not been determined so the impact of these additional 48 turbines is evaluated in this EIS using a

[6] In addition to renewables, the additional 12.5 percent of the overall 25 percent standard can also be met through alternative energy resources such as third-generation nuclear power plants, fuel cells, energy efficiency programs, and clean coal technology that can reduce or prevent carbon dioxide emissions.

maximum impact scenario. The layout for the remaining 48 turbines will be designed in accordance with the criteria and standards used for siting the 52 turbines as defined in the OPSB Certificate (e.g., minimum setbacks from residences, etc.) and as described in the HCP and this EIS.

1.8.2 Organization of this EIS

This EIS follows the CEQ's recommended organization (40 CFR 1502.10) and complies with guidance provided in the USFWS NEPA Reference Handbook, including Proposed National Environmental Policy Act – Compliance Guidance (550 FW 2). The EIS is organized as follows:

- Chapter 1.0 provides descriptions of the purpose of and need for the Proposed Action, agency roles in the EIS process, and the required permits and authorizations for the Project;
- Chapter 2.0 includes a summary of the scoping process and associated outcomes and also documents the public and agency participation, consultation, and coordination undertaken to prepare the EIS;
- Chapter 3.0 describes the Proposed Action and alternatives including the No Action Alternative;
- Chapter 4.0 summarizes the affected environment within the analysis area for the Proposed Action;
- Chapter 5.0 summarizes the direct, indirect, and cumulative effects of the Proposed Action and alternatives; possible mitigation measures to reduce or minimize impacts; and any residual adverse effects following the implementation of mitigation;
- Chapter 6.0 presents the comparison of alternatives (including mitigation measures), presents the USFWS's Preferred Alternative and the rationale for selection of the Preferred Alternative, presents the environmentally preferred alternative, and summarizes the irreversible and irretrievable commitment of resources;
- Chapter 7.0 contains the references; and
- Chapter 8.0 is the list of preparers.

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Chapter 2

EIS Scoping, Identification of Alternatives, and Public Consultation

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2 EIS Scoping, Identification of Alternatives, and Public Consultation

This section of the EIS describes the public and agency involvement process used to develop the scope of, and identify the major issues to be discussed in the EIS. This includes a discussion of the scoping process, issues identified during the scoping process, identification of alternatives to the Proposed Action, and opportunities for public and agency involvement during EIS development.

2.1 Scoping Process

2.1.1 Scoping Requirements

NEPA regulations (40 C.F.R. 1501) and USFWS guidelines (550 FW 2.3) specifically define the need for a public scoping process when preparing an EIS. The scoping process is an open public process initiated prior to the preparation of an EIS to define a reasonable scope for and reduce the magnitude of an EIS. In particular, the public scoping process should:

- Identify and invite the participation of affected agencies, tribes, and other parties through written comments, public meetings, or other forums;
- Identify the key issues and concerns regarding the Proposed Action;
- Identify only those potentially significant issues relevant to the Proposed Action (while eliminating unimportant issues from further study); and
- Define the form, level of detail, and content of the EIS.

Scoping typically begins with publication in the Federal Register of a notice of intent (NOI) to prepare an EIS. Public scoping for this EIS was first initiated in the form of an NOI to conduct a 30-day scoping period for a NEPA decision on the proposed HCP and ITP and request for comments, published in the Federal Register on January 29, 2010 (75 FR 4840-4842). Formal scoping began for the NEPA analysis on May 26, 2010 when the NOI to prepare a DEIS was published in the Federal Register (75 FR 29575-29577).

2.1.2 Issues Identified During Scoping

Many concerns raised during the Federal scoping process centered on potential impacts to the Indiana bat. These concerns included the need for a full EIS given the uncertainty of impacts and the implications of future wind projects, the need to implement the most protective alternative and mitigation measures, and the need for analysis of cumulative impacts that encompasses ongoing issues such as White Nose Syndrome (WNS), a fatal disease affecting bats in the eastern U.S. Other suggestions raised were to take into account the renewable energy generation aspects of the project, the use of innovative turbine lighting, and protection of cultural resources.

Public interaction and correspondence during the OPSB process was generally similar to the issues raised during an October 28, 2009 public hearing, required as part of the OPSB process. Concerns were expressed about the Project’s potential impacts to health and safety associated with noise, shadow flicker,[1] and ice shedding. Questions were raised about the potential economic benefits of the Project and if it would receive special tax status. Several of the raised concerns were related to environmental impacts, particularly potential effects to Indiana bats, other bats, and birds. Additional concerns were raised about the potential impacts that turbine siting may have on two Champaign County airports.

The public's comments were used to develop the significant issues listed below, along with other issues that were also considered in disclosing environmental impacts. The significant issues were used to drive the analysis and were important in the development of the alternatives. These issues include the following:

- The ITP issued should contain terms and conditions for protecting Indiana bats;
- The Project should implement the alternative that affords protection for the Indiana bat;
- The cumulative effects analysis should encompass activities likely to occur over the life of the Project;
- The renewable energy generated by the Project would be used to assist with compliance with Federal policies that encourage development of renewable energy;
- Noise generated by the Project has the potential to affect the solitude of the area; and
- Cultural resources potentially affected by the Project should be identified and protected.

Along with those listed above, many substantive issues were brought forward during the Project's OPSB Application process, many of which were not restated during the NEPA scoping. However, these issues were also integral to developing the EIS effects analyses.

2.1.3 Issues Considered But Eliminated During Scoping

Following the review of scoping comments, the USFWS reviewed the range of resources that should be considered in an EIS as per NEPA and CEQ guidelines.[2] This review determined that tourism is not relevant to the Proposed Action or alternatives and that expected impacts would be so minor that they did not need be addressed in the EIS.

[1] Shadow flicker is defined as moving blades passing between the sun and a receptor, creating alternating changes in light intensity of shadows. The spatial relationship between a wind turbine and a receptor, along with weather characteristics such as wind direction and sunshine probability, are key factors related to shadow-flicker impacts. Shadow flicker becomes much less noticeable at distances beyond approximately 1,000 feet, except at sunrise and sunset when shadows are long (NRC, 2007).

[2] Resources considered for analysis in the EIS included: geology and soils, water resources, air quality including greenhouse gases and climate change, noise, biological resources including vegetation, wildlife, and threatened and endangered species, land use, recreation, tourism, visual resources, socioeconomics and environmental justice, cultural resources, transportation, and safety.

2.2 Alternatives Identified During the EIS Scoping Process

2.2.1 The Applicant's Proposed Action Alternative

The Applicant's Proposed Action was developed with input from Buckeye Wind's application to the OPSB submitted in April 2009; public scoping in January and May 2010; and extensive consultation among Buckeye Wind, ODNR, and the USFWS regarding the HCP. The Applicant's Proposed Action includes issuance of an ITP for construction, operation, maintenance, and decommissioning of a 100-turbine Project and implementation of all measures described in the HCP, including post-construction monitoring, adaptive management, and mitigation. Under this alternative, an ITP for Indiana bats would be issued contingent upon implementation of the HCP in its entirety, including post-construction monitoring to ensure that take remains at or below what is authorized in the ITP and an adaptive management strategy based on the results of post-construction monitoring to address take levels relative to operational constraints over the life of the Project.

2.2.2 Alternatives to the Applicant's Proposed Action Alternative

The alternatives summarized in Table 2.2-1 were identified during scoping and development of the EIS. As shown in this table, two screening criteria (purpose and need and feasibility) were used to evaluate the potential alternatives. Some of the alternatives were excluded from further analysis for the following reasons: if they would not meet the underlying need for or purpose of the Project and associated federal action; if they would likely not have any significant environmental benefit compared to the Project as proposed; if they would likely have significantly greater adverse impacts compared to the Project, as opposed to another alternative; or if they lacked practicality or feasibility. Section 2.3 of this EIS discusses the alternatives that were considered but then eliminated from further analysis.

The reasonable alternatives included for consideration in this EIS are discussed in Section 3.2 and are noted under the column entitled "Recommended Actions" in Table 2.2-1.

Table 2.2-1 Alternatives Considered

	Purpose and Need				Feasibility		Recommended Action	Comments
Alternative	**Compliant with ESA, NEPA, and Other Applicable Federal Regulations**	**Supports Federal and/or State Renewable Energy Initiatives**	**Provides Air Quality Benefits**	**Protective of Indiana Bat[1]**	**Technical Feasibility**	**Economic Feasibility**		
No Action	Yes	No	No	Yes	N/A	No	A	Statutory requirement.
Applicant's Proposed Action Alternative: HCP, varied curtailment based on turbine risk category, Post Construction Mortality Monitoring (PCM), and Adaptive Management (AM)	U	Yes	Yes	U	Yes	Yes	A	Applicant's Proposed Action Alternative designed to meet USFWS goals for Indiana bat. Able to meet generation goal of 250 MW and commercial viability.
Maximally Restricted Operations Alternative: Full turbine curtailment at night from April 1 through October 31	U	Yes	Yes	Yes	Yes	U	A	Alternative would meet USFWS goals for Indiana bat. Applicant asserts that this alternative is not commercially viable (HCP Section 2.6.2.3 and Section 6.6.2). Alternative carried forward for detailed analysis.
Minimally Restricted Operations Alternative: HCP, full turbine curtailment at night with 5.0 m/s cut-in speed from August 1 through October 31, PCM, and AM	U	Yes	Yes	U	Yes	Yes	A	May not meet USFWS' goals for Indiana bat. Able to meet generation goal of 250 MW and commercial viability.
Fewer turbines	U	U	Yes	U	U	U	X	Fewer turbines still pose a risk to Indiana bats. Would not contribute as much to meeting State and Federal renewable energy generation goals (See Section 2.3.2).

	Purpose and Need				Feasibility		Recommended Action	Comments
Alternative	**Compliant with ESA, NEPA, and Other Applicable Federal Regulations**	**Supports Federal and/or State Renewable Energy Initiatives**	**Provides Air Quality Benefits**	**Protective of Indiana Bat[1]**	**Technical Feasibility**	**Economic Feasibility**		
Other locations in western Ohio	U	Yes	Yes	U	U	No[2]	X	Outside the Scope of Analysis. Not technologically or economically feasible to evaluate this alternative fully. Moving project may still put Indiana bats at risk in Ohio (See Section 2.3.3).
ITP of a shorter duration (<30 years)	U	Yes	Yes	U	U	No	X	Would not address all covered activities. Available information supports longer ITP duration. Likely that Applicant would not be able to obtain funding to construct and operate (see Section 2.3.1).

Definitions:
Purpose and Need: Yes = Meets stated purpose and need; No = Does not meet stated purpose and need; and U = Uncertain if meets stated purpose and need.
Siting Criteria: Yes = Meets project siting criteria; No = Does not meet project siting criteria; and U = Uncertain if meets project siting criteria.
Recommended Action: A = Alternative retained for detailed analysis in EIS; and X = Alternative removed from consideration in EIS.
[1]The determination of whether the Applicant's Proposed Action and alternatives are protective of Indiana bat is the primary subject of this EIS (see Chapters 5 and 6).
[2] Applicant asserts that it is not practicable to fully develop a commercially viable alternate location. As part of the OPSB Application process, Buckeye filed a Motion for Waiver for the Site Alternative Analysis requirements of the OPSB regulations. This motion included a description of why analysis of alternate sites for this type of project is not feasible (Exhibit Y of the April 2009 OPSB Application). This motion was granted. Further, the OPSB application contains a description of the site selection process and further explains why it would not be feasible to conduct Site Selection Analysis for multiple sites (section 4906-13-03 of the April 2009 OPSB Application).

2.3 Alternatives Considered but Eliminated from Detailed Study

Seven alternatives were identified during preparation of this EIS, including some derived from comments received during the federal and state scoping processes. Some alternatives were eliminated from further analysis because they did not meet the stated goals or objectives of the USFWS or Buckeye Wind. Other alternatives were eliminated because they lacked practicality or feasibility. The following three alternatives were considered to be potentially reasonable, but were eventually eliminated from detailed study.

2.3.1 ITP of a Shorter Duration

This alternative would involve an ITP of a shorter duration than the life of the Project (i.e., less than 30 years). Consistent with the USFWS' Five-Point Policy, the USFWS considers several factors in determining the term of an incidental take permit. USFWS, for instance, takes into account the expected duration of the activities proposed for coverage and the anticipated positive and negative effects on covered species that will likely occur during the course of plan implementation. USFWS also factors in the level of scientific and commercial data underlying the proposed operating conservation program, the length of time necessary to implement and achieve the benefits of the operating conservation program, and the extent to which the program incorporates adaptive management strategies. Additionally, 50 CFR 17.22(b)(4) states that the duration of permits "shall be sufficient to provide adequate assurances to the permittee to commit funding necessary for the activities authorized by the permit, including conservation activities and land use restrictions."

The description of the covered activities includes the construction, operation, maintenance, and decommissioning of the Buckeye Wind Project. This includes operation for up to 25 years. A growing body of scientific literature exists regarding wildlife and wind power interactions, and specifically that bat fatalities can be significantly reduced by implementation of feathering and cut-in speeds. Implementation of rigorous post-construction monitoring and adaptive management can be used over the life of the wind project to track take of Indiana bats and immediately respond if take nears certain thresholds. This addresses the need for flexibility over the long-term, should assumptions (e.g., the effectiveness of specific cut-in speeds) be proven inadequate or the status of the species (e.g., white nose syndrome) change.

Further, the Applicant has stated that it would be difficult to obtain financing for the Project if only a portion of the operational life was addressed in the permit. Given the significant operational implications of the HCP and the legal liabilities of non-compliance with the ESA, the potential to have the ITP expire in the middle of the Project life creates very difficult uncertainties for investors. Therefore, the USFWS acknowleges that financing could be extremely difficult to obtain if the term of the ITP were shorter than the life of the Project.

After considering the expected duration of the activities proposed for coverage, the effects on covered species, the data available to support the avoidance and minimization measures proposed, the length of time necessary to implement mitigation plans, the rigorous monitoring and adaptive management plan, and the difficulty in securing funding for a project with an ITP that does not cover the full operational life of the project, the USFWS has determined that a 30-year ITP term is appropriate, and that evaluating an alternative with a shorter ITP duration is not necessary to ensure protection of the Indiana bat and meet the other purposes and needs of this EIS.

2.3.2 Reduced Number of Turbines

This alternative would reduce the number of turbines being constructed for the Project. This alternative was eliminated from consideration because, while reducing the number of turbines may reduce the likelihood of Indiana bat take, it would not eliminate the possibility that Indiana bats would be taken. The presence of even one turbine still poses some level of risk to Indiana bats and as such, reducing the number of turbines would decrease the capacity for wind power development without providing a sufficient level of associated environmental benefits. Fewer turbines would generate less than 250 MW, and would therefore contribute less to meeting the requirements of the Ohio AEPS and Federal guidance promoting renewable energy generation (for example, Executive Order 13212, May 18, 2001). Further, a growing body of scientific literature is available to demonstrate that implementing feathering and cut-in speeds significantly reduces bat mortality at wind farms (Good et al. 2012, Good et al. 2011, Arnett et al. 2011, Baerwald et al. 2008) while having a minimal impact on renewable energy generation. Therefore, implementation of proven avoidance and minimization measures to minimize bat, mortality while still allowing renewable energy generation, is preferable over only reducing the number of turbines. Finally, it would not make sense for the Service to evaluate an alternative with less turbines than what is proposed, particularly if the proposed alternative meets the maximum extent practicable standard.

2.3.3 Alternate Location in Ohio

This alternative would construct the same facility in another area of Ohio. This alternative was eliminated from consideration in the EIS because siting of wind power facilities is a complex and technical process that is constrained by a number of factors including wind regime, ability to obtain land leases, proximity to the electrical grid, capacity of the grid to accept additional power, mandatory setbacks (e.g., from residences, roads, property lines, etc.), and many other factors. Buckeye Wind has conducted multiple years of study to select the proposed project location based on these factors, has received state siting certificates (or is in the process of doing so) for the Project, and has submitted an HCP and permit application for a wind project within the delineated Action Area. Therefore the USFWS is evaluating the permit application. It is beyond the scope of the analysis for the USFWS to evaluate other possible areas of the state where wind power could be developed and it is not technically or economically feasible for the USFWS to fully evaluate the entire state for areas that are appropriate for wind power development.

Further, the Applicant asserts that it is not practical or financially feasible for them to fully develop a commercially viable alternate location (see footnote to Table 2.2-1). The process for assessing the feasibility of a second (alternate) location would essentially double the effort and financial expenditure required to develop a single Project (study two but only develop one) and involve years of additional study. Finally, moving the facility would still present a risk (could be greater or lower risk) to Indiana bats. The range of the Indiana bat includes all of Ohio; therefore, moving the facility to another location in Ohio would not necessarily reduce the likelihood that Indiana bats would be affected.

2.4 Public and Agency Involvement

2.4.1 Public and Agency Involvement During EIS Development

Public scoping for the EIS was first initiated in the form of an NOI to conduct a 30-day scoping period for a NEPA decision on the proposed HCP and ITP and request for comments, published in the Federal Register on January 29, 2010 (75 FR 4840-4842). Formal scoping began for the NEPA analysis on May 26, 2010 when the NOI to prepare a DEIS was published in the Federal Register (75 FR 29575-29577). The USFWS also conducted outreach by press releases and public notification to inform interested parties or those potentially affected by the Proposed Action and to request comments on the scope of the NEPA analysis. Comments resulted in the identification of a number of issues related to the Project and the associated HCP. A total of 14 written or verbal comments were submitted during both scoping comment periods identifying issues and concerns about the Proposed Action and the preparation of the EIS. Comments were received via phone, voicemail, electronic mail, and hardcopy mail and are indexed and summarized in Appendix C. These comments were carefully reviewed and categorized into the issues that informed the analysis for the EIS, as described in Sections 2.1 and 2.2.

During the EIS development, USFWS and the Applicant consulted with the Ohio Historic Preservation Office (OHPO) and tribal consultation was initiated in conjunction with obligations to fulfill requirements under NEPA, Section 106 of the NHPA, and AIRFA (see Section 1.7 for a summary of these statutes and their regulations). All organizations identified as potential consulting parties under these cultural statutes and regulations were contacted by letter, and follow-up phone calls, emails, and personal meetings, as necessary, will be conducted in order to provide them with information about the proposed Project and to seek additional input regarding the identification and evaluation of archaeological and historic resources. This consultation process is ongoing.

Among the federally designated tribes consulted are the Absentee-Shawnee Tribe of Oklahoma, the Eastern Shawnee Tribe of Oklahoma, the Miami Tribe of Oklahoma, the Ottawa Tribe of Oklahoma, the Shawnee Tribe, the Hannahville Indian Community, the Citizen Potawatomi Nation, the Prairie Band of Potawatomi Nation, and the Forest County Potawatomi Community. These tribes were invited to comment and participate in accordance with Section 101(d)(6)(B) of the NHPA and 36 C.F.R. Part 800.2(c)(2), respectively. The Eastern Shawnee Tribe of Oklahoma indicated an interest in the Project and consultation with this tribe has been completed.

In addition to federal tribal consultation, the state-recognized Piqua Shawnee Tribe submitted a letter in January 2010 to demonstrate interest in this Project and USFWS formally acknowledged their interest in the Project via letter in August 2010. The Applicant met with Tribal representatives in August 2010 to discuss the Project. In an email to the USFWS, dated February 8, 2013, Mr. Gene Parks (Piqua Shawnee Tribe member) indicated that the Tribe has been in contact with the Applicant, has been granted permission to access all the turbine sites, will continue to monitor bird and bat life in the area, and will monitor construction activities that are near ancient mound sites. Mr. Parks also stated that the email “will conclude our comments on the proposed undertaking.”

The DEIS was published in the Federal Register for public review on June 29, 2012 (77 Fed. Reg. 38819-38821) in accordance with requirements set forth in the NEPA (42 U.S.C. § 4321 *et seq*.) and its implementing regulations (40 CFR 1500-1508). Public comments were accepted during a 90-day period following publication of the Federal Register Notice of Availability. One public information meeting was held during the comment period, on July 12, 2012 in Urbana, Ohio. Comments received were taken into account in assessing Project impacts and potential mitigation and resulted in some modifications in this EIS. Responses to substantive comments on the DEIS and Draft HCP can be found in Appendix K of this EIS.

Following issuance of this Final EIS, the USFWS will publish the ROD documenting its decision on whether to issue the ITP no earlier than 30 days after the Final EIS is published. The USFWS does not have a formal administrative appeal procedure for NEPA decisions. Judicial review of a USFWS NEPA decision can be accomplished in Federal court under the Administrative Procedure Act (5 U.S.C. §500 *et seq*).

2.4.2 Public and Agency Involvement During Project Development and the OPSB Process

During the Project planning phase and the OPSB application process, Buckeye Wind consulted with state and federal agencies to identify available information on sensitive resources, including water, wetlands, wildlife, and cultural resources. Agencies consulted included USFWS, USACE, FAA, ODNR Division of Wildlife, OHPO, Ohio Department of Transportation (ODOT), Ohio Environmental Protection Agency (OEPA), Ohio Department of Agriculture (ODA), Ohio Department of Development (ODOD), and Ohio Department of Health (ODOH) to obtain guidance on pre-construction surveys, site assessments, and OPSB process requirements.

Prior to filing the OPSB application, Buckeye Wind was required to hold a public informational meeting to advise potentially affected persons of the proposed project. Public input and concerns were gathered to aid in preparation of the OPSB application. Once the application had been submitted and deemed complete, it then was sent to local public officials and made available in area libraries for public viewing; legal notices also were published in area newspapers. At that time, interested parties had the opportunity to be recognized as interveners in the case.

Buckeye Wind held a public informational meeting on June 10, 2008. On April 24, 2009, Buckeye Wind filed its application for a certificate of environmental compatibility and public need with the OPSB. A public hearing was held on October 27, 2009, and evidentiary hearings began October 28, 2009. The OPSB Certificate was issued on March 22, 2010. Various interveners to the process filed applications for rehearing on April 27 and 29, 2010. The applications for rehearing by the interveners were denied on July 15, 2010. A local citizens group appealed to the Ohio Supreme Court, but the Court upheld the issuance of the certificate on March 6, 2012 (*In re Application of Buckeye Wind, L.L.C.*, Slip Opinion No. 2012-Ohio-878).

In addition, information has been shared through several organized activities and Buckeye Wind's active engagement in the community: participation in the Champaign County Wind Turbine Study Group (WTSG); participation in bus tours of operating wind energy facilities; official Board of Trustee and Planning Board meetings; presentations to various schools, churches, and clubs; information booths at the County fair; and through the Project website. In addition to these activities, public comments were received in response to Buckeye Wind's completed application to the OPSB.

The Project's record of public interaction is available through the PUCO Docketing Information System (http://dis.puc.state.oh.us/CaseRecord.aspx?Caseno=08-0666&link=DI).

Champaign Wind LLC, a separate EverPower Wind Holdings, Inc. subsidiary, has initiated the OPSB application procedure for the Buckeye II Wind Project, consisting of approximately 56 turbines (no more than 100 total turbines will be constructed for the Buckeye Wind and Buckeye II Wind projects combined). The Buckeye II Wind Project will be transferred to Buckeye Wind prior to construction. A public information meeting for Champaign Wind LLC was held on January 24, 2012. A public hearing was held on October 25, 2012, and evidentiary hearings began on November 8, 2012. Champaign Wind LLC is currently awaiting a decision by the OPSB regarding its application. Champaign Wind LLC's record of public interaction is available through the PUCO Docketing Information System (http://dis.puc.state.oh.us/CaseRecord.aspx?CaseNo=12-0160-EL-BGN).

Chapter 3

Proposed Action and Alternatives

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3 Proposed Action and Alternatives

This chapter of the EIS describes the Proposed Action, as well as the Project as proposed by the Applicant. NEPA requires that the environmental documents prepared for a proposed action discuss alternatives. Therefore this chapter also describes the three alternatives to the Proposed Action that were retained for detailed analysis, including a No Action alternative. The alternatives to the Proposed Action were primarily designed to address the potential for take of Indiana bats and are operational alternatives relating to the dates and times of operation and the speed at which turbines become operational. The alternatives do not address other aspects of the Project such as turbine siting. The Applicant has demonstrated that siting and design of the Project has incorporated avoidance and minimization of direct physical impacts to Indiana bats and migratory birds and their habitats (e.g., ground disturbance or habitat removal) to the maximum extent practicable (see HCP Sections 6.1 and 6.2).

3.1 Proposed Action - Modified Operations and Habitat Conservation Plan

The Proposed Action is USFWS' issuance of a Section 10 ITP for activities covered by the proposed HCP. The HCP describes what are considered Covered Activities, or those activities associated with the construction, operation, maintenance, and decommissioning of the Project. The Project would be one of the first large-scale commercial wind powered electric generation facilities in Ohio, and may be among the first wind facilities in the nation to operate with an ITP for the Indiana bat. The Project would be located within an approximately 32,395-ha (80,051-acre) Action Area that includes portions of Union, Wayne, Urbana, Salem, Rush, and Goshen Townships (Figure 1-1). The Project Area[1] includes those sites within the Action Area where Project components would be located, plus a 305-m (1,000-ft) buffer or setback from the turbines (see Figure 1-2). The permanent footprint (the area of permanent disturbance) for the Project would be a maximum of 52.2 ha (128.9 ac), or 0.16 percent of the Action Area.

The Project would consist of up to 100 turbines, each with a capacity rating of 1.6 to 2.5 MW, resulting in a total generating capacity of up to 250 MW for the Project. In addition to turbines, the Project would include construction of access roads, underground and overhead electrical collection lines, a substation, up to 4 temporary construction staging areas, 4 permanent meteorological (MET) towers, and an operation and maintenance (O&M) facility. The Applicant expects the Project to operate at an average annual capacity factor of approximately 30 percent, resulting in approximately 657,000 MWh of electricity generation per year. The energy generated by the Project would collect to a new electric substation in Union Township in Champaign County (Figure 1-1). The Applicant expects to remain as the owner and operator for both construction and operation of the Project. Figures 1-1 and 1-2 indicate the locations for 52 of the possible 100 turbines; locations for the remaining 48 turbines have yet to be determined.

[1] This definition of "Project Area" is derived from the OPSB rules 4906-17-01(B)(1). "Project area means the total wind-powered electric generation facility, including all associated setbacks." Section 4906-17-08(C)(1)(c)(ii) of the rule requires that the wind turbine must be at least 750 ft in horizontal distance from the tip of the turbine's nearest blade at 90 degrees to the exterior of the nearest habitable residential structure, if any, located on adjacent property at the time the OPSB application is filed. The maximum turbine height (tower height plus half the height of the rotor) of turbines under consideration for the Project is 150 m (492 ft). If the turbine blade were at 90 degrees, the tip would extend from the base of the tower one-half the length of the rotor diameter, or 164 ft, which added to 750 ft, yields a total setback of 914 ft. To standardize the analysis for the purposes of the OPSB Application and this EIS, resources were assessed within 1,000 ft.

In addition, Buckeye Wind has identified a possible redesign of the Project collection system that would allow a more efficient infrastructure that would result in greater ease of construction but would not significantly change the net effect on the Indiana bat and would not result in a higher level of take than described in the HCP. The potential redesign would move a portion of those lines to an underground system located on private land under easement ("Redesign Option"). This Redesign Option is under consideration and would require various state and local permits and amendments to those permits. As such, it is offered here as an optional Project design that would be implemented at Buckeye Wind's discretion. While the exact design is not known at this time, a maximum estimate of impacts with the Redesign Option is presented in this document. No turbine locations would be altered except as otherwise required as part of normal project micro-siting. The Redesign Option is described in further detail in Section 3.1.4.

The locations for all turbines and associated facility components will be sited using the following criteria (collectively, the Siting Criteria):

- Within the Action Area;
- On lands belonging to willing land lease participants;
- In accordance with all OPSB rules and regulations, as determined through the OPSB Certification process;
- Where the compatible land use would continue to be rural agricultural;
- No direct impacts to wetlands;
- Such that no more than 32 streams would be crossed for a total impact of 380.4 m (1248 ft; see Table 5.2-1). No more than 49 streams would be crossed for a total impact of 487.1 m (1,598 ft) for the Redesign Option (see Table 5.2-1):
    - For road crossings over high quality streams, specifically Ohio Exceptional Warmwater Habitat and Cold Water Habitat streams, open bottom culverts, elliptical culverts or arched bridges would be used such that ground within the delineated edge of the stream is not impacted (see HCP Section 5.2.1.2); and
    - When only underground collection lines cross perennial streams (i.e., no co-location of road crossings), these perennial stream crossings would utilize directional boring to avoid impacts. For intermittent or ephemeral streams, trenching would be done when the stream is dry, or if water is present at the time an intermittent or ephemeral stream is crossed, Buckeye Wind will horizontally directionally drill underneath the stream regardless of its beneficial use classification.
- No more than 6.5 ha (16.1 ac), or 6.8 ha (16.8 ac) for the Redesign Option, of trees would be cleared for the 100 turbine facility;
- The three known Indiana bat roost trees in the Action Area would not be removed, and no turbine would be located closer than 2.9 km (1.8 mi) to known maternity roost trees;
- No more than 11.3 ha (27.9 ac) or 12.4 ha (30.7 ac) for the Redesign Option, of Conservation Reserve Program (CRP) land will be impacted by the 100 turbine project, and of this no more than 2.3 ha (5.7 ac) of impact will be permanent;

- Turbines would be sited such that operational sound levels generated by the Project would not exceed 5 dBA above the average background noise (Leq), as measured at the nearest non-participating residential structure (see Section 5.10 – Noise for more detailed description of potential noise impact factors):
  - A compliant resolution procedure would be implemented in coordination with the staff of OPSB to address any complaints regarding construction or operational sound.
- Turbines would be sited such that exposure to shadow flicker[2] created by operational turbines would not exceed 30 hours in any calendar year, as measured at the nearest non-participating residential structure;
- Impacts to the cultural resources would be evaluated and avoided according to the methodologies developed in accordance with the NHPA. Buckeye Wind would implement the approach for assessment and mitigation as outlined in the preliminary reports completed by Cultural Resources Analysts, Inc. (CRA) (see Section 4.6 – Cultural and Historic Resources);
- The known 52 turbines would be setback from non-participating residential structures and non-participating property boundaries as indicated in the OPSB Certificate issued on March 22, 2010 (see Section 1.5.2 – State Regulations). For the additional 48 turbines, setbacks from non-participating residential structures would not be less than 305 m (1,000 ft). Setbacks to non-participating property boundaries would not be less than 1.1 times the total height of the turbine (165 m [541 ft] if the total turbine height is 150 m [492 ft]);
- The turbines would be positioned so as to avoid any likely impact to communications systems, including off-air television stations, AM/FM radio stations, microwave telecommunications systems and cellular/PCS telephone systems. If it is found that the turbines result in degradation to the communication services provided, Buckeye Wind would address and resolve each individual problem as commercially practicable.

Even though the exact location for the additional 48 turbines is not known, they would occur within the Action Area and the Applicant would implement the above Siting Criteria, as well as the conservation program described in the HCP (see Chapter 6 of the HCP). By implementing these Siting Criteria and the HCP conservation program, the USFWS is able to assess the degree of effects that would result from the full 100 turbine Project. All impacts to Indiana bats and the identified resources that occur within the Project Area are analyzed in this EIS and the HCP for a 100 turbine Project; hence, no additional analysis for the additional 48 turbines would be required under NEPA.

The Project contains the following elements:

- Construction of Project components and associated infrastructure:

[2] Shadow flicker is defined as moving blades passing between the sun and a receptor, creating alternating changes in light intensity of shadows. The spatial relationship between a wind turbine and a receptor, along with weather characteristics such as wind direction and sunshine probability, are key factors related to shadow-flicker impacts. Shadow flicker becomes much less noticeable at distances beyond approximately 1,000 feet, except at sunrise and sunset when shadows are long (NRC, 2007).

  - 100 turbines and workspaces;
  - 64.4 km; (40.0 mi) of new service roads that would connect wind turbines to existing access roads;
  - 113.5 km (70.5 mi) of 34.5-kV electrical interconnect lines that would connect individual turbines to the substation, of which:
    - 56.7 km (35.2 mi) would be installed underground with the majority (approximately 84%) installed parallel to Project access roads, requiring no additional clearing or soil impacts beyond those required for access road construction;
    - 56.8 km (35.3 mi) would be installed overhead in public road right-of-ways (mostly co-located with existing electric distribution facilities);
  - Temporary crane paths totaling approximately 22.7 km (14.1 mi);
  - Up to four temporary construction staging areas, occupying a cumulative area of approximately 9.2 ha (22.9 ac);
  - One substation that would allow connection with the existing transmission line, occupying an area of approximately 2.0 ha (5.0 ac);
  - One O&M facility and associated storage yard (likely to be refurbishment of existing facility; however, if a new building were needed, it would not be expected to exceed 557 m^2 (6,000 ft^2) or disturb an area of greater than 1.2 ha (3.0 ac), and would be designed to resemble an agricultural building similar in style to those found throughout the area);
  - Up to two temporary concrete batch plants occupying a cumulative area of 2.4 ha (6.0 ac); and
  - Four permanent MET towers occupying a cumulative area of 0.0008 ha (0.002 ac).
- Operational constraints in the form of feathering would be applied to each turbine based on its location relative to suitable Indiana bat habitat and the season of Indiana bat activity. Cut-in speeds would range from the manufacturer's cut-in speed, which varies by manufacturer and size, to 6.0 m/s (13.4 mph) and periods over which they would be applied would vary based on seasonal considerations, the habitat in which they are sited (e.g., low quality versus high quality), and other factors as described in the HCP (Chapter 6). See Section 3.1.2 for further details on operational constraints.
- HCP implementation, including post-construction monitoring, adaptive management, and mitigation focused on the Indiana bat.

The following sections describe the elements of the Project.

3.1.1 Project Components

3.1.1.1 Turbines

Development of the Project would include installation of up to 100 turbines, each with a generating capacity of 1.6 MW to 2.5 MW. The specific turbine model to be used for the Project has not yet been selected. Final selection depends on a number of factors including cost, performance, availability, and other site specific factors. Recent trends in the supply market have made it more practicable and efficient to delay capital commitments (i.e., turbine purchase agreements) until later in the Project planning process. Commercially available turbine models being considered for the Project are essentially uniform in terms of dimensions, appearance, and electrical output design and dimension. Any variation among turbine models selected for the Project would be small to insignificant (i.e., ranging from approximately 7 to 16 ft difference in total height). Table 3-1 summarizes turbine characteristics of the worst-case scenario in terms of total turbine height (see Figure 3-1).

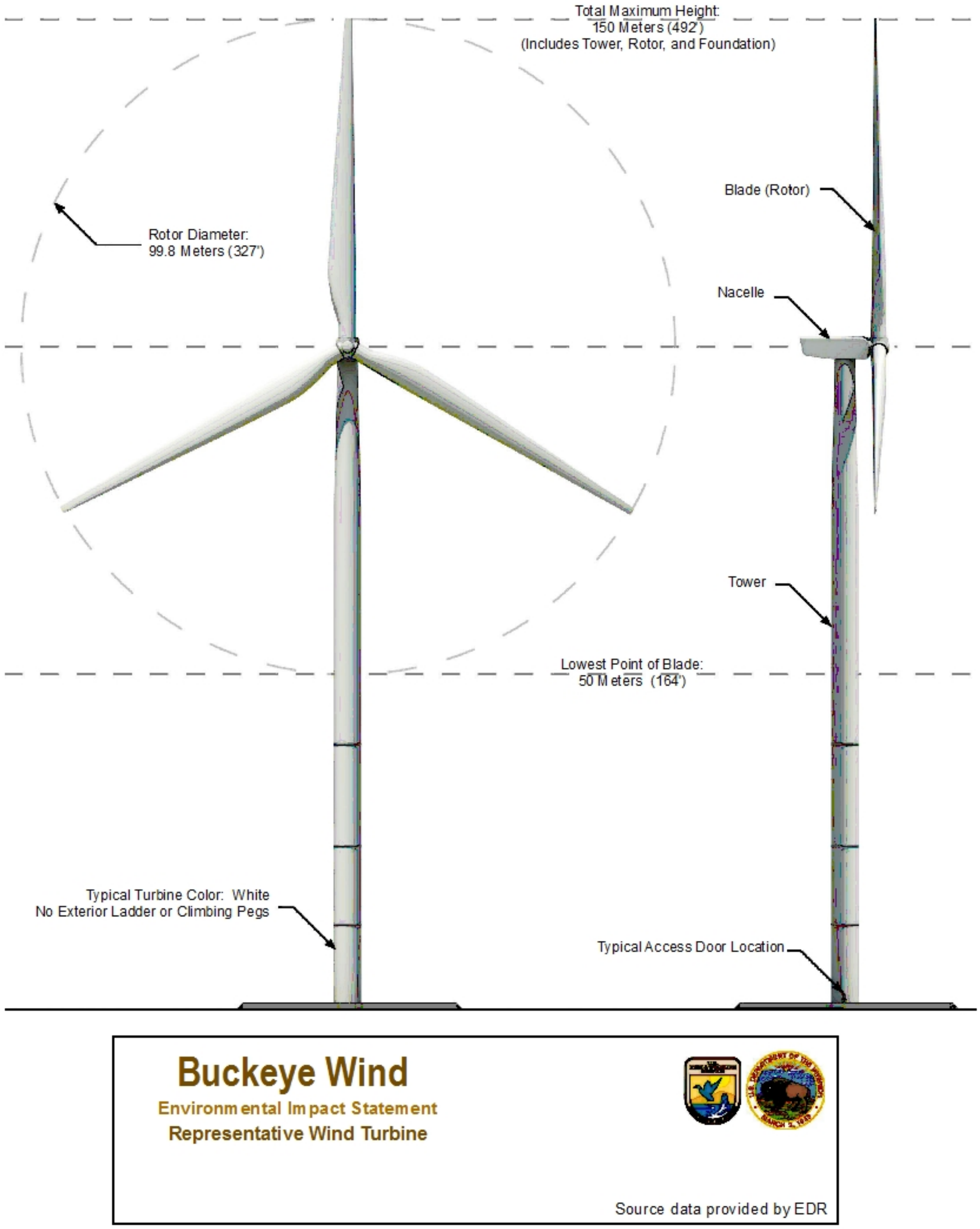
Table 3.1-1 Turbine Characteristics

Component or Feature	Size or Performance
Power Generation	2.5 MW per turbine
Hub Height	100 m (328 ft)
Rotor Diameter	100 m (328 ft)
Total Tower Height (Hub + ½ Rotor)	150 m (492 ft)[3]
Height of Lowest Rotor Blade Reach	50 m (164 ft)
Rotor Swept Area	7,823 m^2 (84,206 ft^2)
Rotor Speed (range possible)	9.6-14.9 rotations per minute (rpm)
Rotor Tilt Angle / Blade Cone Angle	5° / 3.5°
Wind Speed of Generator Initiation (Cut-in)	3 m/s (7 mph)
Wind Speed of Generator Cessation (Cut-out)	20 m/s (45 mph)
Maximum Tip Speed	77 m/s (172 mph)
Rated Wind Speed (Unit Reaches Maximum Output)	12.5 m/s (28 mph)

Each wind turbine consists of three major components: the tower, the nacelle, and the rotor (Figure 3-1). The tubular towers used for MW-scale turbines are conical steel structures manufactured in multiple sections. Each tower would have an access door and internal lighting, along with an internal ladder and mechanical lift to access the nacelle. The height of the tower, or “hub height” (height from foundation to top of tower) would be 100 m (328 ft). The nacelle sits atop the tower, and the rotor hub is mounted to the front of the nacelle. The rotor diameter would be 100 m (328 ft). Thus, the total turbine height at the highest blade tip position (i.e., rotor apex) would be 150 m (492 ft). The towers would be painted off-white in accordance with FAA regulations designed to make the structures more visible to aircraft when viewing from above, as light colors contrast sharply against the dark-colored ground. This also has the benefit of reducing visibility from ground vantage points, which are generally viewed against the background of the sky.

[3] There are some potential turbines that have a slightly longer rotor diameter (103 m), but are on a slightly lower tower such that the total height does not exceed 150 m.

Figure 3-1 Representative Wind Turbine



The main mechanical components of the wind turbine, including the drive train, gearbox, and generator, are housed in the nacelle. The nacelle is housed in a steel reinforced fiberglass shell that protects internal machinery from the environment and dampens noise emissions. The housing is designed to allow for adequate ventilation to cool internal machinery. The nacelle is equipped with an external anemometer and a wind vane that signals wind speed and directional information to an electronic controller. Attached to the top of some of the nacelles would be FAA approved aviation obstruction lights. These lights are anticipated to be flashing red strobes that operate only at night and in accordance with FAA guidelines (Advisory Circular 70/7460-1K). The nacelle is mounted on a bearing that allows it to rotate ("yaw") into the wind to maximize wind capture and energy production.

Each rotor consists of three composite blades that would be up to 50 m (164 ft) in length, with a total rotor length of up to 100 m (328 ft). Motors within the rotor hub feather each blade according to wind conditions, which enables the turbine to operate efficiently at varying wind speeds. The rotor can spin at varying speeds to operate more efficiently. Depending on the turbine model selected, the turbines would begin generating energy at wind speeds as low as 3 to 3.5 meters per second (m/s) (6.7 to 7.8 mph), and cut out when wind speeds reach 20 m/s (56 mph). The maximum rotor speed is approximately 15 rpm.

3.1.1.2 Electrical System

The Project's electrical system would consist of a maximum 113.5 km (70.5-mile [mi]) long system of 34.5-kV cables that would collect power from each wind turbine and connect to a new substation. No more than 56.8 km (35.3 mi) of lines would be built above ground on rebuilt poles in existing public road right-of ways. These lines would be over-hung on poles used by the local electric utilities to distribute power to local residences and businesses. No more than 56.7 km (35.2 mi) of the 34.5-kV interconnects would be buried underground parallel to Project access roads.

The Redesign Option collection system is described in Section 3.1.4.

The substation would transfer the power from the collector cables to existing transmission lines and the regional power grid. The substation would be located near the intersection of Pisgah Road and Route 56 in the Town of Union, at the southern end of the Action Area (Figure 1-2). The substation would step up voltage from 34.5 kV to 138 kV to allow connection with an existing transmission line. The substation would include dead-end structures, circuit breakers, air break switches, metering units, a step up transformer, relaying, communication equipment, and a control house. Construction of the substation would permanently impact no more than 2.0 ha (5.0 ac). The substation would be enclosed by a chain link fence, and be accessed from Pisgah Road by a new gravel-surfaced road no more than 0.2 km (0.1 mile) in length.

3.1.1.3 Met Towers

In order to record weather data to ensure turbine output is maximized, the Project layout includes four permanent meteorological test towers (MET towers). The permanent MET towers would support equipment used to measure wind speed (anemometers), wind direction (wind vanes), temperature and other pertinent weather data. The final locations of the permanent MET towers would be determined by turbine engineers and would be placed in open fields so that turbulence from trees and other structures would not interfere with equipment readings. The permanent MET towers would be non-guyed, free standing structures.

3.1.1.4 Access Roads

No more than 64.4 km (40.0 mi) of access roads would be constructed as new roads or improved farm lanes to provide access to the turbines and substation (Figure 3-1). The roads would be gravel-surfaced and typically 4.9 m (16 ft) in finished width with up to 0.6-m (2-ft) borders for side slope grading on each side (total of 6.1-m [20-ft] road width).

3.1.1.5 Construction Staging Areas

Project construction would require the development of up to four construction staging areas, collectively occupying no more than 9.2 ha (22.9 ac; Figure 1-2). Staging areas would only be located on previously disturbed or agricultural lands. These areas would accommodate material storage, parking for construction workers, and construction trailers enclosed by fencing (at one site only). Development of the staging areas would include a temporary disturbance, including a site for trailers. Lighting of the staging areas would be required for safety and security.

3.1.1.6 Operations and Maintenance Building

A permanent O&M building and associated storage yard would be located within the Action Area to house operations personnel, equipment, materials, and operations staff parking. The Applicant anticipates refurbishing one of numerous unused buildings in the area for this use. If a new building were needed, the Applicant states that it would not be expected to disturb an area of greater than 1.2 ha (3.0 ac), and would be designed to resemble an agricultural building similar in style to those found throughout the area.

3.1.1.7 Concrete Batch Plant

Up to two temporary concrete batch plants would be required to construct the 100-turbine Project. Concrete batch plants are expected to be located at existing, developed facilities located off-site from the Action Area that would require no vegetation clearing or soil disturbance. If a new batch plant(s) is required within the Action Area, it would be located in previously disturbed areas that would not impact trees, streams, or wetlands. Vegetation clearing and soil disturbance no greater than 1.2 ha (3.0 ac) would be required for each new batch plant, for a total temporary impact for two batch plants of 2.4 ha (6.0 ac), with no permanent impacts. Operation and permitting of the plant(s) would be handled by the sub-contractor selected to supply the Project construction.

3.1.1.8 Crane Paths

A large erection crane will set the tower segments on the foundation, place the nacelle on top of the tower, and place the rotor onto the nacelle. The erection crane(s) will move from one turbine site to another along access roads or temporary crane paths. To complete construction of the 100-turbine Project, approximately 22.7 km (14.1 mi) of temporary crane paths will be utilized. Temporary crane paths will require vegetation clearing that is 16.8 m (55 ft) wide and will result in no permanent soil disturbance.

3.1.1.9 Land Area Requirements

Table 3.1-2 summarizes the anticipated land area requirements for the Project components. The permanent footprint (the area of permanent disturbance) for the entire Project would be no more than 52.2 ha (128.9 ac) or 52.5 ha (129.8 ac) for the Redesign Option (see Section 3.1.4).

Table 3.1-2 Anticipated Land Area Requirements for the Project Components

Project Components	**Typical Vegetation Clearing Area**	**Area of Soil Disturbance (temporary and permanent)**	**Permanent Disturbance Area (fill/structures)**
Wind Turbines and Workspaces (100)	61 m (200 ft) radius per turbine	61 m (200 ft) radius per turbine	0.08 ha (0.2 ac) (pedestal plus crane pad)
Access Roads (64.4 km [40.0 mi])	16.8 m (55 ft) wide per linear foot of road	12.2 m (40 ft) wide per linear foot of road	6.1 m (20 ft) wide per linear foot of road
Buried Electrical Interconnects (except where located parallel to access roads) (56.7 km [35.2 mi], or 86.5 km [53.7 mi] for Redesign Option)	7.3 m (25 ft) wide per linear foot of cable	7.3 m (25 ft) wide per linear foot of cable	None
Overhead Electrical Interconnects (1,000 poles, or 200 poles for Redesign Option)	Clearing restricted to existing right-of-way	<0.01 ha (<0.03 ac) per pole	Negligible (0.00008 ha [0.0002 ac]), .00002 ha [.00005 ac] for Redesign Option)
Crane paths (22.7 km [14.1 mi])	16.8 m (55 ft) wide per linear foot of path	12.2 m (40 ft) wide per linear foot of path	None
O&M Building and Associated Storage Yard (1)	1.2 ha (3.0 ac)	1.2 ha (3.0 ac)	1.2 ha (3.0 ac)
Staging Areas (up to 4 areas)	9.2 ha (22.9 ac) total	9.2 ha (22.9 ac) total	None
Substation (1)	2.0 ha (5.0 ac)	2.0 ha (5.0 ac)	2.0 ha (5.0 ac)
Permanent MET Towers (4)	0.4 ha (1.0 ac)	< 0.01 ha (.03 ac) per tower	0.0008 ha (0.002 ac)
Concrete batch plants (2)	1.2 ha (3.0 ac) per plant	1.2 ha (3.0 ac) per plant	None
TOTAL		**220.9 ha (545.8 ac), or 219.9 ha (543.6 ac) for Redesign Option**	**52.2 ha (128.9 ac), or 52.5 ha (129.8 ac) for Redesign Option**

3.1.1.10 Construction Schedule, Project Life, Decommissioning

The Applicant proposes to begin construction as soon as practicable contingent upon approval of the HCP, issuance of an ITP, and receipt of other necessary permits/approvals. Construction of access roads, underground and overhead collection system lines, and concrete turbine foundations would begin first. The Project, including all 100 turbines, would be constructed within one to two construction phases, each phase expected to continue for 12 to 18 months. The exact timing of the two construction periods is not known and may overlap. Timing is dependent upon several factors such as turbine availability, OPSB certification and economic considerations. The Applicant anticipates a 25-year Project operational life, with the HCP and ITP in effect for 30 years to cover Project construction, operation and decommissioning.

Megawatt-scale wind turbine generators typically have a life expectancy of 20 to 25 years. The current trend in the wind energy industry has been to replace or “re-power” older wind energy projects by upgrading older equipment with more efficient turbines. If, at the end of the life of the Project, an upgrade or re-power is proposed that could result in additional take of Indiana bats (e.g., due to a taller structure or a larger rotor-swept zone) or if re-powering would extend the life of the Project beyond what is authorized in an ITP, an amended ITP would be required. A renewal to the ITP could be sought if no change in the Project is proposed and authorized take of Indiana bats has not been reached by the end of the ITP term. A major amendment to the ITP would be required if changes to the Project are proposed and impacts not already considered in this EIS could occur or if exceedance of authorized take is requested.

If the Project is not upgraded, or if the turbines were non-operational for an extended period of time (such that there was no expectation of their returning to operation), they would be decommissioned. Decommissioning would be conducted in accordance with a decommissioning plan to be approved by the OPSB that would address removal of Project components, improvements, and site/land reclamation. The ITP would cover Project decommissioning in the extremely unlikely event that Indiana bat(s) is/are taken during decommissioning activities.

3.1.2 Operational Adjustments

Under the Proposed Action, operation of each turbine within the Project would be modified based on turbine location in relationship to suitable Indiana bat habitat and the season of Indiana bat activity. The goal of the modified operations is to avoid and minimize take of Indiana bats to the maximum extent practicable, based on best available science and site-specific data.

Operational adjustments would dictate that turbines are feathered (i.e., reduce the blade angle to the wind to slow or stop the turbine from spinning) until a designated cut-in speed is reached. Cut-in speeds are the wind speed at which rotors begin rotating and producing power. Cut-in speeds would range from the manufacturer’s cut-in speed, which varies by manufacturer and size, to 6.0 m/s (13.4 mph) and periods over which they would be applied would vary on a nightly and seasonal basis and depending upon the habitat categories determined using the Habitat Suitability Model (4=least risk, 3= low risk, 2=moderate risk, and 1=highest risk, see HCP Appendix B). The higher the category of risk, the more suitable the habitat for the Indiana bat, and the more likely the Indiana bat may be found in that area. Table 3.1-3 summarizes the modified operations for each category.

Table 3.1-3 Summary of Modified Operations for Year One of Evaluation Phase

Habitat risk category	# Turbines[1]	Cut-in speed - m/s[3]		
		Spring (Apr 1 – May 31)	Summer (Jun 1 – Jul 31)	Fall (Aug 1 – Oct 31)
Category 1 - Highest Risk	10	5.0	6.0	6.0
Category 2 - Moderate Risk	15	5.0	5.75	5.75
Category 3 - Low Risk	15	5.0	5.5	5.75
Category 4 - Lowest Risk	85	None[2]	5.25	5.75
Totals	125			

[1]No more than the specified number of turbines would be placed in the specified habitat types for the 100 turbine build-out. The sum is greater than 100 turbines to allow some flexibility in siting. No more than 100 turbines would be built.

[2] Turbines in the spring would be feathered until manufacturer-set cut-in speed is reached.

[3] During all seasons turbines may be operated normally when temperatures are below 10 °C (50°F).

The feathering plan would vary seasonally, based on three periods in which Indiana bats display distinct behavioral characteristics that could differentially affect their exposure to wind turbines:

- Spring emergence and migration, or “spring” (April 1 to May 31);
- Early summer habitat use, or “summer” (June 1 to July 31); and
- Late summer and fall migration, or “fall” (August 1 to October 31).

Spring Feathering Plan

The spring feathering plan will be applied over a period of approximately 8.5 weeks from April 1 to May 31 during the nighttime period, one-half hour before sunset to one-half hour after sunrise. Because post-construction mortality studies at wind facilities across the country have consistently documented lower levels of bat mortality during the spring migration period, feathering levels during this period would be the least restrictive of all seasons in the Indiana bat active period. Feathering would be applied to turbines in the three highest habitat risk categories (Categories 1, 2, and 3) at wind speeds of 5.0 m/s (11 mph) (Table 3.1-3). Category 4 habitat has been established in the habitat suitability model as being unsuitable for roosting and foraging, and spring should represent the lowest risk time period for Indiana bats. As such, in Category 4 habitat in the spring, turbines would only be feathered until manufacturer-set cut-in speed (which varies by manufacturer and size) is reached.

Summer Feathering Plan

The summer feathering plan will be applied over a period of approximately 8.5 weeks from June 1 to July 31 during the nighttime period, one-half hour before sunset to one-half hour after sunrise. Although mortality monitoring at wind facilities during the early summer reproductive period has consistently documented less bat mortality than the fall period, feathering would be applied to all turbines until specific cut-in speeds are reached during this period because risk to Indiana bats in the Action Area during this time is uncertain and higher mortality during late summer has been demonstrated. The summer feathering plan was based on the results of the Habitat Suitability Model (Appendix B of the HCP). Using a tiered approach, the highest cut-in speeds (6.0 m/s [13.4 mph]) would be applied to turbines located within habitat Category 1, which was predicted to have the highest suitability for Indiana bat roosting and foraging activities. The cut-in speed in this Category is the most conservative of any cut-in speed throughout the active period because there is a higher level of uncertainty as to the impacts to Indiana bats and bats in general. Assuming there is a reduced risk in increasingly lower suitability habitats, cut-in speeds would be stepped down evenly in 0.25 m/s (0.6 mph) increments in habitat Category 2 through Category 4 (Table 3.1-3).

Fall Feathering Plan

The fall feathering plan will be applied over a period of approximately 13 weeks from August 1 to October 31 during the nighttime period, one-half hour before sunset to one-half hour after sunrise. Mortality monitoring at wind facilities during the fall period has consistently documented the greatest numbers of bat fatalities relative to other seasons. Therefore, equal or more restrictive cut-in speeds would be applied to all turbines during this period to minimize impacts to Indiana bats. The late summer/early fall cut-in speeds were selected based on acoustic monitoring studies that documented decreased bat activity at higher wind speeds (Fiedler 2004, Reynolds 2006), and post-construction mortality monitoring studies that consistently documented substantially reduced bat mortality at cut-in speeds of 5.0 m/s (11 mph) and 6.5 m/s (14.5 mph) (Arnett et al. 2010, Good et al. 2011). These cut-in speeds were also informed by three operational adjustment studies (Baerwald et al., 2009; Arnett et al., 2010; Good et al., 2011) that documented substantial reductions in bat fatalities between 38% and 93% (median of 68.3% across all studies) at curtailed and feathered turbines during the fall period when using cut-in speeds of 5.0 m/s (11 mph) and above. The seasonal definitions do not define a hard switch from foraging to migration behaviors and there would inevitably be cross-over of behaviors between the defined seasonal periods. In order to ensure that pre-migratory Indiana bats are afforded the same protection as is provided in the summer feathering plan, turbines located in Category 1 habitat areas would be feathered until a cut-in speed of 6.0 m/s (13.4 mph) is reached.

During all seasons, turbines would be allowed to operate at full capacity at temperatures below 10°C (50°F), based on a multitude of studies that have documented low levels or no bat activity at low temperatures (Fiedler 2004, Reynolds 2006). Turbines will be allowed to operate at manufacturer specified cut-in speeds if nighttime temperatures fall below 10 °C (50°F) for a period of 15 consecutive minutes. Likewise, the cut-in speeds as specified by the feathering plan and any subsequent adaptive management actions will be implemented if the nighttime temperature has risen to 10 °C (50°F) or above for a period of 15 consecutive minutes.

Feathering speeds would be applied to each of the additional 48 turbines based on final locations selected and habitat suitability at those locations as defined by the Habitat Suitability Model (Table 3.1-3 and Appendix B of the HCP).

3.1.3 Habitat Conservation Plan (HCP)

The Proposed Action is USFWS' issuance of a Section 10 ITP for activities covered by the proposed HCP. The full HCP is included as Appendix B to this EIS.

The HCP contains the following types of measures designed to avoid, minimize, mitigate, and monitor take of Indiana bats as a result of the Project:

- Project siting, construction, maintenance, and decommissioning measures (design features);
- Minimization Measures (operational adjustments described in Section 3.1.2);
- Mitigation measures;
- Conservation measures;
- Post-construction monitoring; and
- Adaptive management.

3.1.3.1 Project Siting, Construction, Maintenance, and Decommissioning Measures to Avoid or Minimize Impacts to Indiana Bat Roosting and Foraging Habitat

A series of Project design features would be used to avoid or minimize the potential for adverse effects to the Indiana bat and suitable roosting and foraging habitat from construction, maintenance, and decommissioning activities:

- The Applicant would site the Project to minimize tree clearing to the maximum extent practicable. No more than 6.5 ha (16.1 ac) of tree clearing would occur for the 100-turbine Project (for the Redesign Option, a maximum of 6.8 ha [16.8 ac]).
- The Applicant would not remove the three known Indiana bat roost trees in the Action Area. None of the 100 turbines would be located closer than 2.9 km (1.8 mi) to known maternity roost trees documented in 2009. The primary benefit from siting turbines at some distance from maternity roost trees is that it would tend to reduce risk of impact or barotrauma. While there is no evidence to suggest that shadow flicker or sound from operating turbines would impact Indiana bats in roost trees, greater distances also reduces the potential for disturbance.
- Buckeye Wind would conduct habitat assessments jointly with the USFWS for the areas of planned tree clearing once Project plans are finalized and before any clearing is conducted, during which all potential roost trees would be identified and flagged. Any potential roost trees observed within the clearing zone would be flagged and impacts avoided to the maximum extent practicable. Prior to the finalization of the detailed design of Project components, all reasonable attempts would be made to offset the clearing radii around turbines or adjust roads/interconnects to preserve any potential roosts and avoid any unnecessary clearing.
- Prior to tree removal, the limits of proposed clearing would be clearly demarcated on the site with orange construction fencing (or similar) to prevent inadvertent over-clearing of the site.

- The Applicant would conduct tree clearing during the period between November 1 and March 31 to avoid potential mortality of Indiana bats that could result from removal of previously unidentified roost trees.
- A natural resource specialist knowledgeable of Indiana bats and their habitat requirements would be present at the time of tree clearing.
- A plan note would be incorporated into the construction contract requiring that contractors adhere to all provisions of National Pollutant Discharge Elimination System (NPDES) permits and the Storm Water Pollution and Prevention Plan (SWPPP). The SWPPP would specify Best Management Practices for construction activities that would minimize degradation of water quality resulting from runoff of stormwater and sediment from construction areas into adjacent water bodies.
- Streams, wetlands, and associated riparian areas would be avoided or impacts minimized to the maximum extent practical. When only underground collection lines cross perennial streams (i.e., no co-location of road crossings), these perennial streams crossings would utilize directional boring to avoid impacts. For intermittent or ephemeral streams, trenching would be done when the stream is dry, or if water is present at the time an intermittent or ephemeral stream is crossed, Buckeye Wind will horizontally directionally drill underneath the stream regardless of its beneficial use classification. For road crossings, open bottomed culverts, elliptical culverts, or arched bridges would be used to avoid impacts to any high quality streams, specifically Ohio Exceptional Warmwater Habitat and Cold Water Habitat streams. Wetlands would not be impacted by construction activities for the 100-turbine Project. Crossing widths and clearing of wooded riparian areas for stream crossings would be limited to the minimum amount required for the crossing methods.
- Decommissioning measures will be identical to the commitments made for Project construction.

3.1.3.2 Minimization Measures

The primary method to minimize impacts to Indiana bats would be operational adjustments (i.e., the use of feathering and cut-in speeds) as described in Section 3.1.2.

3.1.3.3 Mitigation Measures

The Applicant would implement one or a combination of the following mitigation actions to compensate for the impact of the taking of Indiana bats:

- Acquiring and/or otherwise providing protection of 87.8 ha (217.0 ac) of suitable Indiana bat swarming habitat within 11.2 km (7.0 mi) of a Priority 2 Indiana bat hibernaculum[4] in Ohio, through acquisition of a conservation easement in perpetuity or purchase of the property and then assigning a conservation easement in perpetuity.
    - Within the conservation easement areas, restore travel corridors between woodlots and/or along stream corridors to increase availability of suitable Indiana bat habitat through enhanced connectivity.

[4] Hibernacula with a current or observed historic population of 1,000 or greater Indiana bats, but fewer than 10,000.

  - Within conservation easement areas, enhance suitable habitat through ensuring an adequate number of suitable roost trees and through managing woody invasive species.

- Buying credits from a USFWS-approved Indiana bat mitigation bank whose geographical range service area includes the Project. Currently, there are no USFWS-approved Indiana bat mitigation banks within Ohio. This option is included in the event that such a bank is approved in the future.
- To ensure that the habitat is adequately protected with the conservation easement, any conservation easement would be provided to the USFWS and the ODNR for comment, be held by a third-party conservation group approved by USFWS and ODNR, and would include, at a minimum, the following stipulations:
  - No industrial use;
  - No new residential use;
  - No commercial use;
  - No agricultural use;
  - No vegetative clearing;
  - Development rights extinguished; and
  - No subdivision.

The estimated cost to implement the above mitigation measures is $1.6 million. This amount would include the cost of identifying mitigation lands, purchasing the property or the related conservation easement, and restoration and/or enhancement of the mitigation land. Implementation of mitigation is proposed to occur in two stages. Stage 1 will include the first 10 years of operation. Stage 2 will include the last 15 years of operation. Funding for the mitigation measures will occur prior to Project operation in Stage 1 and prior to the 11th year of Project operation for Stage 2. Stage 1 mitigation will be completed prior to the end of the first year of operation; Stage 2 mitigation will be completed prior to the end of the 11th year of operation.

3.1.3.4 Conservation Measures

In cooperation with the USFWS and ODNR Division of Wildlife, the Applicant would implement one or a combination of the following conservation measures to advance the knowledge base of Indiana bat and wind energy interactions.

- Provide funding to a qualified research program(s) to conduct research on Indiana bat behavior relative to wind energy development. For example:
  - To better understand Indiana bat behavior in the vicinity of operating wind turbines, radio-telemetry, light-tagging, mist netting, and/or thermal infrared camera studies could be conducted on Indiana bats during summer in the Action Area. The three known roost trees in the northern portion of the Action Area or nearby suitable habitat could be targeted for mist-netting. Increased understanding of Indiana bat/wind power interactions will increase effectiveness of future minimization and avoidance measures at wind power facilities.

Research would include data collection of flight height relative to the rotor swept-zone, spatial use patterns relative to turbines, and potential attraction or avoidance of turbines; and

- There is a paucity of information about how Indiana bats migrate, particularly during the fall, when bats, in general, are most susceptible to collision or barotrauma at wind facilities. Such information could help to validate the assumptions of the collision risk model and help to understand the extent to which Indiana bats are at risk of barotrauma or collision with wind turbines during migration at the Project or other wind facilities. Telemetry studies could be conducted to better understand aspects of fall migration that may result in greater risk from wind power projects such as whether or not Indiana bats follow landscape or habitat features; migration flight height, speed, and duration; and avoidance behavior of potential barriers to migration, such as wind power projects, urban areas, or major transportation thoroughfares.

- Wing and Hair tissue samples from each dead bat may be collected to support USFWS-requested research projects by entities other than Buckeye Wind. Wing tissue and hair samples would be collected and stored following USFWS recommended protocol at the time of collection. Specimens would be stored such that details on the individual bat from which samples were collected are known (either store data sheet with sample, or cross reference sample to database of mortality records). Specimens would be provided to USFWS on a periodic basis, to be determined at the start of each post-construction monitoring period. Collection of specimens will not affect the subsequent use of the carcasses for searcher efficiency or carcass persistence trials.

See HCP Section 6.4 for further details on potential research topics, methods, and variables for measurement.

Funding in the amount of $200,000 for conservation measures would be made available from Project operating revenues to a qualified research program after one year of Project operation has been completed. The funding would be assigned within five years of the beginning of Project operation and would be provided to appropriate private or academic institutions to conduct research on Indiana bat behavior relative to wind energy development. Results of the research will be incorporated into the adaptive management of the Project, where appropriate. The assignment of funds and all research and sampling protocols will be developed in consultation with the USFWS, ODNR DOW, and appropriate scientific experts. Disbursement of funds would be decided in coordination with the USFWS and ODNR DOW.

3.1.3.5 Post-Construction Monitoring

The HCP includes a post-construction mortality monitoring plan that would measure the effectiveness of the minimization and mitigation measures outlined above and ensure that the Project does not exceed the permitted take of Indiana bats.

Post-construction mortality monitoring for Indiana bat mortality would be conducted within 3 phases: the Evaluation Phase, Implementation Phase, and Re-Evaluation Phase. The objective of the Evaluation Phase is to monitor Indiana bat mortality to ensure that it is at or below the expected levels, and if it is not, to use adaptive management (see Section 3.1.3.6) to arrive at a feathering regime that results in take that is at or below expected levels. The Evaluation Phase will last for a minimum of two years, and will be extended as necessary to find the appropriate feathering regime. At the completion of the Evaluation Phase, once a feathering plan demonstrates the ability to keep Indiana bat mortality at or below the expected levels, the Implementation Phase will begin. During the Implementation Phase, the operational feathering regime that was implemented at the end of the Evaluation Phase will be implemented long-term. Monitoring will be conducted during the Implementation Phase to ensure that incidental take of Indiana bats remains at or below expected levels, but will occur less frequently. Implementation Phase monitoring will occur biennially for the first four years of this phase, and provided that incidental take of Indiana bats remains at or below expected levels, will move to once every three years. Provided that annual Indiana bat take levels remain at or below the expected levels, the Implementation Phase will remain in effect until Buckeye Wind, at their discretion, implements a Re-evaluation Phase or until/if results from Implementation Phase monitoring dictate the need to alter operations in a way that would necessitate Re-evaluation Phase monitoring. Re-evaluation Phase monitoring would be implemented if modified feathering is triggered according to adaptive management criteria (see Section 3.1.3.6). Re-evaluation Phase monitoring will also allow Buckeye Wind to test new avoidance or minimization techniques that may become available to effectively minimize Indiana bat mortality while operating the Project in the most cost-effective manner. Re-evaluation Phase monitoring would occur for a minimum of two consecutive years.

Monitoring would be most intensive during the first years of Project operation, during the Evaluation Phase, which would last for a minimum of two years. Monitoring would occur at every turbine location with a three-day search interval from April 1 to November 15 during the first two years of monitoring. The search area would consist of an area that extends 2.0 times the blade length from the base of the turbine (i.e., radius of 100 m [328 ft] for a 50 m [164 ft] blade). The search area would be cleared at 25 percent of the turbines.

Through adaptive management, the search area may be modified to the distance within which 90 percent of the bat carcasses or 100 percent of Indiana bat carcasses were found, whichever is greater. After two years of study during the Evaluation Phase, if no Indiana bat carcasses are documented at the site after October 31, and if less than 5 percent of all documented bat carcasses occur after October 31, the monitoring period would be shortened to end on October 31. Each subsequent monitoring year, monitoring would occur from April 1 to October 31.

In order to decrease the probability of missing dead Indiana bats during post-construction monitoring, (see HCP Section 6.5.2.8 – Estimating Unobserved Mortality), at any point during the ITP Term Buckeye Wind may alter certain parameters of the mortality monitoring described above. With the approval of the USFWS and the ODNR DOW, Buckeye Wind may adjust searcher frequency, search area, number of turbines searched, and/or vegetation management to achieve a higher Detection Probability and, correspondingly, a lower Probability of Miss (see HCP Section 6.5.2.9 – Adaptive Management for Minimization Monitoring).

During all monitoring phases, searcher efficiency and carcass removal rates would be evaluated through a series of trials. Searchable area would be quantified for each turbine throughout the search period. Correction factors for these variables would be built into a formula for calculating annual mortality with as much accuracy as possible. Post-construction monitoring would also document annual mortality of birds and other bat species related to Project operations. Prior to initiation of mortality searches, the appropriate state and federal permits necessary for the collection and possession of Indiana bats (and other bats and birds) would be obtained (e.g., MBTA Special Purpose – Utility Migratory Bird Mortality Monitoring Permit, State Collectors

Permit). Surveyors would be trained by the post-construction monitoring manager on the proper handling of live birds and bats in the event that they are found. Any individual that handles live bats would maintain an up-to-date rabies vaccination. In addition, all *Myotis* species collected would be sent to USFWS/ODNR for species verification.

In order to enhance the understanding of the factors that contribute to increased risk of Indiana bats and potentially refine the feathering plan and maximize the operational output of the Project, the following factors that influence Indiana bat mortality would be monitored:

- Seasonal variation of mortality;
- Variation in mortality with respect to turbine location and habitat; and
- Variation in mortality with respect to weather characteristics, including:
    - Wind speed,
    - Temperature,
    - Barometric pressure, and
    - Humidity.

Monitoring efforts would also assess the condition of mitigation habitat. Mitigation monitoring would document the location, quantity, and land cover for each mitigation site and any restoration and/or enhancement actions that have occurred at the mitigation site to date. At each mitigation site, Buckeye Wind would monitor habitat features including number and diameter of potential roost trees, survival of planted trees, and percent cover of woody invasive species. Mitigation monitoring for each phase would be performed in each of Years 1 through 5 after the mitigation has occurred and every fifth year thereafter until the end of the ITP Term.

3.1.3.6 Adaptive Management

The Proposed Action would incorporate an adaptive management strategy to respond (primarily through modification of the HCP's minimization and mitigation measures) to monitoring results and new information on the impacts to Indiana bats from wind development. The goals of the adaptive management plan would be to ensure that authorized incidental take levels are not exceeded, and that mitigation lands provide suitable Indiana bat habitat. The adaptive management strategy is described in detail in the HCP Section 6.5.3.

The portion of the adaptive management plan that ensures incidental take levels are not exceeded is structured around a monitoring feedback loop that includes Evaluation Phase, Implementation Phase, and Re-Evaluation Phase Monitoring efforts. Mortality monitoring would be the primary method used to gather information about effects of the project on Indiana bat populations, and would be used to inform management actions.

Trigger points for immediate adaptive management actions have been established that would increase cut-in speeds at defined intervals based on the number of observed Indiana bat mortalities in a season in a single year. Two documented Indiana bat mortalities prior to the fall season, or less than two documented Indiana bat mortality prior to fall and two during the fall, or three documented Indiana bat mortalities during the fall would result in cut-in speeds immediately being increased by 1.0 m/s (2.2 mph) at all turbines. Additional documented mortality prior to the fall season, or two additional mortalities during the fall season, would immediately trigger all turbines operating with a cut-in speed of 7.0 m/s (15.7 mph). If additional Indiana bat mortality is documented after cut-in speeds are increased to 7.0 m/s (15.7 mph), all turbines would immediately be turned off from one hour before sunset to one hour after sunrise for the remainder of the active period. Should a trigger event occur in any given year, adaptive management strategies (i.e., increasing cut-in speeds) would also be implemented the following year and Evaluation Phase monitoring would be implemented for at least two years.

If no trigger points for immediate adaptive management are reached during Evaluation Phase monitoring, the decision to implement adaptive management actions in the subsequent year would be based on the estimated annual Indiana bat take calculated based on the results of that year's mortality monitoring. For example, at the end of the first year of Evaluation Phase monitoring, if the annual Indiana bat mortality estimate remains at or below expected levels, cut-in speeds can be reduced by 0.5 m/s or maintained at the same level. If the annual Indiana bat mortality estimate again remains at or below expected levels at the end of the second year of Evaluation Phase monitoring, the project could then enter into Implementation Phase monitoring at the same cut-in speeds as Year 2 of Evaluation Phase monitoring, or the cut-in speeds could be reduced by 0.5 m/s and an additional year of Evaluation Phase monitoring would occur. If the annual Indiana bat mortality estimate exceeds expected levels in any one Evaluation Phase monitoring year without reaching trigger points for immediate adaptive management, then the cut-in speeds would increase by 0.5 m/s and an additional year of Evaluation Phase monitoring would occur to confirm that the estimated Indiana bat mortality levels are at or below the expected levels. Further adjustments to cut-in speeds may be made if, after two years of Evaluation Phase monitoring, observed mortality patterns suggest greater or reduced risk in certain season, habitats, or weather conditions (see HCP Section 6.5.3 for a detailed description of the adaptive management strategy). In no instance would the cut-in speeds of any particular turbine be decreased by more than 0.5 m/s (1.1 mph) in any one year. Any adjustment to cut-in speeds (increase or decrease) would be subject to an additional year of Evaluation Phase monitoring before moving into the Implementation Phase.

In the case that no Indiana bats are observed in any one year, Buckeye Wind will also estimate the confidence that 5.2 Indiana bats or fewer were taken in that year. This will be estimated by first calculating the probability of detecting an Indiana bat, given parameters of the mortality monitoring methodology. Buckeye Wind will not reduce cut-in speeds if no Indiana bat mortality is documented and the Probability of Miss is greater than 0.10. If no Indiana bat mortality is detected in Year 1 or Year 2, and if Probability of Miss in Year 1 is greater than 0.10 but less than 0.20 and Probability of Miss in Year 2 is less than 0.20, Buckeye Wind may reduce cut-in speeds by 0.5 m/s. A minimum of one additional year of Evaluation Phase-level monitoring will be conducted to verify effectiveness of reduced cut-in speeds prior to the initiation of the Implementation Phase.

Once mortality rates are documented at expected levels or lower, for at least 2 years of Evaluation Phase monitoring, the feathering plan would remain in place and Implementation Phase monitoring would be implemented until such time that any one of the following occurs: 1) trigger points for immediate adaptive management occur in any one year; 2) greater than expected mortality is estimated in any two consecutive years without reaching trigger points; 3) results of Implementation Phase monitoring indicate that season, habitat, or weather extremes including wind speed, barometric pressure, temperature, or humidity contribute more or less risk to Indiana bats and Buckeye Wind elects to alter feathering strategies as a result; or 4) new techniques or new information are developed that can help reduce Indiana bat mortality and

Buckeye Wind elects to implement those new techniques or information with approval from the USFWS. These events would trigger adaptive management action and would result in Re-Evaluation Phase monitoring. Results of monitoring studies would inform any changes to the feathering plan and monitoring protocols for all turbines or a subset of turbines as deemed appropriate (e.g., higher than expected mortality levels observed at some turbines would lead to an appropriate adjustment of cut-in speeds at those turbines).

The adaptive management plan also would ensure that mitigation habitat remains suitable for Indiana bats throughout the duration of the ITP. Monitoring results from each mitigation site would be used to determine if girdling trees is necessary in order to maintain the desired density of snags, if additional woody invasive species control is needed to maintain less than five percent woody invasive cover, and whether 300 stems/ac on average per planting area have survived. If desired snag densities are not present, trees may be girdled to create snags. If woody invasive species cover exceeds five percent at any mitigation site in any monitoring year, control methods including manual pulling and digging and herbicides would be used to reduce cover to below five percent. In areas where tree planting occurred, adaptive management would be used to ensure survival of at least 300 planted stems/ac.

3.1.4 Collection System Redesign Option

The Redesign Option would move a portion of the Project's collection lines to an underground system located on private land under easement. This Redesign Option is under consideration and would require various state and local permits. As such, it is offered here as an optional Project design that would be implemented at Buckeye Wind's discretion. While the exact design is not known at this time, the Redesign Option would include no more than 95.4 km (59.3 mi) of 34.5 kV interconnect lines that would connect individual turbines to the substation, of which 86.5 km (53.7 mi) would be installed underground with about 32 percent installed parallel to Project access roads and 9.0 km (5.6 mi) would be installed overhead. No turbine locations would be altered except as otherwise required as part of normal Project micro-siting.

3.2 Alternative A – Maximally Restricted Operations Alternative, No HCP

Alternative A would require more operational restrictions than those described in the HCP, which would eliminate take of Indiana bats. Accordingly, an ITP would not be necessary and the HCP and associated conservation measures would not be implemented.

Alternative A contains the following elements:

- Use of the Siting Criteria described in Section 3.1;
- Project components and associated infrastructure identical to those described in the HCP;
- Tree clearing would only be conducted between November 1 and March 31 to avoid potential mortality of Indiana bats that could result from removal of previously unidentified maternity roost trees;

- Operational adjustments would be used to eliminate take of Indiana bats by having all 100 turbines non-operational from sunset to sunrise during the entire period over which Indiana bats are active (April 1 through October 31); and
- A modified post-construction avian mortality monitoring program would be implemented for Alternative A to address bird mortality only. This monitoring protocol would follow standard ODNR guidelines for post-construction mortality monitoring (ODNR 2009).

3.3 Alternative B – Minimally Restricted Operations Alternative with HCP

This alternative would require less operational restrictions than those described in the HCP. It would include implementation of the HCP and associated post-construction monitoring and adaptive management as described in the HCP. While this alternative would allow for greater operation of the wind facility and generation of more clean energy to displace other carbon-based energy sources, it would result in a take of approximately 12 Indiana bats per year (See Section 5.5.4), totaling 300 Indiana bats over the 25-year operational life of the project.

Alternative B contains the following elements:

- Use of Siting Criteria described in Section 3.1.
- Project components and associated infrastructure identical to those described in the HCP.
- Operational adjustments would be used to reduce take of Indiana bats by feathering all 100 turbines until a cut-in speed of 5.0 m/s (11 mph) is reached during the fall migration period (August 1 through October 31), which has consistently been documented to be the window of highest risk for mortality of *Myotis* and other bat species based on results from post-construction monitoring studies. This cut-in speed would be applied to the turbines for the hours of the night during which *Myotis* bats have been documented to be most active (i.e., the first one to six hours after sunset). Young et al. (2011) found that turbines that were feathered prior to reaching the manufacturer-set cut-in speed during the first 5 hours of the night from July 15 to October 13 resulted in significantly less bat mortalities than turbines that were not feathered during this period. Further, turbines would be feathered until the manufacturer's cut-in speed is reached from one-half hour before sunset to one-half hour after sunrise from April 1 to July 31.
- HCP as described for Proposed Action, including post-construction monitoring and adaptive management focused on Indiana bat.
- Under this alternative, additional mitigation would be required to offset the impacts of the taking of Indiana bats. Using the "Acres of Mitigation Calculation" method described in Section 6.3.1 of the HCP, 194.0 ha (479.4 ac) would be needed to mitigate for the take of 300 Indiana bats.

3.4 Alternative C – No Action

Under the No Action Alternative, the USFWS would not issue an ITP and the Project would not be developed. The No Action Alternative would avoid the potential take of the Indiana bat, but would also not provide a clean source of electricity, offset carbon emissions, or contribute to the

Nation's renewable energy portfolio. The No Action Alternative would also not provide the conservation, research, and advanced knowledge of bat- and bird-wind interactions that could help the overall health of the Indiana bat and other bat and bird species.

3.5 Summary of Proposed Action and Alternatives Considered in this EIS

Table 3.5.1 summarizes the key features of the Proposed Action and Action Alternatives (Alternatives A and B) considered in this EIS. The table does not include Alternative C – No Action because under this alternative the Project would not be developed.

Table 3.5-1 Summary of Proposed Action and Action Alternatives Considered in this EIS

Proposed Action - Modified Operations	Alternative A Maximally Restricted Operations Alternative	Alternative B Minimally Restricted Operations Alternative
Project Components 1. 250 MW wind-powered electric generation project. 2. Up to 100 turbines, total height up to 150 m (492 ft). 3. Electrical system: 113.5 km (70.5 mi) of buried and overhead cables (95.4 km [59.3 mi] of cables under the redesign option); 2.0 ha (5 ac) substation. 4. 64.4 km (40.0 mi) of access roads. 5. Approximately 22.7 km (14.1 mi) of crane paths. 6. Up to four construction staging areas, totaling 9.2 ha (22.9 ac). 7. A 557.4 m^2 (6,000 ft^2) operations and maintenance building within a 1.2 ha (3.0 ac) area. 8. Four permanent MET towers. 9. Up to 2 concrete batch plants; 1.2 ha (3 ac) each 10. Total permanent vegetation disturbance approximately 52.2 ha (128.9 ac) or 52.5 ha (129.8 ac) for Redesign Option. 11. 30-year life of the HCP and ITP. 12. Siting Criteria as specified in Section 3.1	Same as Proposed Action.	Same as Proposed Action.
Operational Adjustments Project operational adjustments (feathering and cut-in speeds) based on turbine location in relationship to identified suitable Indiana bat habitat, temperature, and season.	All 100 turbines would be non-operational during the period when Indiana bats could be present in the Action Area (sunset to sunrise from April 1 through October 31).	Turbine would be feathered until a cut-in speed of 5.0 m/s (11 mph) for all 100 turbines during the first one to six hours after sunset from August 1 through October 31. Turbines would be feathered until the manufacturer's cut-in speed is reached from ½ hour before sunset to ½ hour after sunrise from April 1 to July 31.
HCP 1. Conduct tree clearing between November 1 and March 31 to avoid potential mortality of Indiana bats that could result from removal of previously unidentified maternity roost trees. 2. Post-construction monitoring plan to measure the take of Indiana bat and the effectiveness of minimization and mitigation measures. 3. Adaptive management based on post-construction monitoring results. 4. Mitigation by conservation easement in perpetuity on 87.8 ha (217 ac) of suitable Indiana bat habitat within 11.3 km (7.0 mi) of a Priority 2 Indiana bat hibernaculum in Ohio or use of an approved Indiana bat mitigation bank in Ohio. 5. Funding for studies and research on Indiana bats and wind turbine interaction or migration behavior.	HCP would not be implemented. Conduct tree clearing between November 1 and March 31 to avoid potential mortality of Indiana bats that could result from removal of previously unidentified maternity roost trees. A modified post-construction avian mortality monitoring program would be implemented for Alternative A to address bird mortality only, which would be consistent with ODNR guidelines.	Same HCP as under Proposed Action, but 194.0 ha (479.4 ac) of mitigation would be needed to mitigate for the take of 300 Indiana bats.

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Chapter 4

Affected Environment

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4 Affected Environment

This chapter of the EIS describes the existing conditions at and in the vicinity of the Project[1]. For the purposes of this chapter and Chapter 5 (Environmental Consequences), resources were assessed within different spatial extents depending on the character of the resource and the extent to which the Project could have effects. This approach is consistent with the USFWS' regulations implementing NEPA, which indicate that the scope of analysis is dependent on the extent of reasonably foreseeable Project-related impacts (USFWS 2003). The spatial extent of analysis for each resource is documented at the start of its discussion in this chapter.

The following terms define the primary analysis areas for this EIS:

- Action Area – The Action Area is defined as the area that could be affected by the Proposed Action, which extends beyond the physical locations of Project facilities. The Action Area encompasses 32,395 ha (80,051 ac) within portions of Union, Wayne, Urbana, Salem, Rush, and Goshen Townships in Champaign County, Ohio and is roughly bounded by State Route 245 to the north, State Route 559 to the east, State Route 4 to the south, and State Route 54 and U.S. Route 68 to the west (see Figure 1-1).
- Project Area – The Project Area includes those sites within the Action Area where Project components (described in Chapter 3) would be located, plus a 305-m (1,000-ft) buffer or setback from turbine locations (see Figure 1-2). Such components include wind turbines and workspaces, access roads, buried electrical interconnects, overhead electrical interconnects, operations and maintenance buildings, a storage yard, meteorological towers, staging areas, crane paths, and a substation. As the locations for only 52 turbines and associated infrastructure are currently known, in some cases only these areas have been fully evaluated. In these cases, the maximum impact expected for the full 100 turbine build-out is described along with the evaluation methods, avoidance, minimization, and mitigation measures.
- Mitigation Area – The Proposed Action includes mitigation to offset the impacts of incidental taking of Indiana bats. The mitigation site(s) (Mitigation Area) is (are) not located within the Action Area and will consist of 88 ha (217 ac) of land within 11 km (7 mi) of a Priority 2 hibernaculum in Ohio. The Mitigation Area will not necessarily be a continuous tract of land depending on the choice of location for the mitigation acres within the Mitigation Area. The Mitigation Area and Action Area combined constitute the Covered Lands for the HCP (see HCP in Appendix B). Alternatively, the mitigation plan could utilize any mitigation bank that has been set up and approved by the USFWS for mitigation of Indiana bats in the Midwest RU. Any mitigation bank utilized must have a geographical range that includes the Project and include lands within Ohio.
- Direct and Visual Areas of Potential Effect (APEs) – APE is the standard terminology used by cultural resources agencies and professionals to describe impacts on archaeological and architectural resources. The direct APE refers to the actual footprint

[1] Resources considered for analysis in the EIS included: geology and soils, water resources, air quality including greenhouse gases and climate change, noise, biological resources including vegetation, wildlife, and threatened and endangered species, land use, recreation, tourism, visual resources, socioeconomics and environmental justice, cultural resources, transportation, and safety.

of the project including all turbines, collection lines, substations, and other structures. The indirect APE refers to the area from which Project infrastructure will be visible. In the case of this EIS, the indirect APE includes a 8-km (5-mi) buffer from the Project Area boundary.

- Five-County Analysis Area – The Five-County Analysis Area includes the counties that overlap with and/or surround the Action Area including Champaign, Clark, Logan, Madison, and Union Counties. This analysis area is used in the context of the potential Project interaction with broader regional systems, such as socioeconomics and transportation, that spread beyond the boundaries of the Action Area.

Scientific names of plants and animals discussed in this and the following EIS chapters are listed in Appendix E.

4.1 Soils and Geology

4.1.1 Scope of Analysis

This section presents a description of the existing soil and geologic resources in the Action Area, including topography, bedrock features, and seismicity. The soils and geology analysis in this EIS is based on information from a geotechnical review conducted for the Action Area (Hull 2009a) and publicly available online databases and/or documents produced by the following federal and state agencies: United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS), United States Geological Survey (USGS), and ODNR.

4.1.2 Existing Conditions

4.1.2.1 Soils

Based on the Soil Survey for Champaign County (USDA-NRCS 1979), soils in the Action Area are primarily composed of Celina, Fox, and Miami silt loams. Celina and Miami silt loams are well-drained, have a moderately high capacity to transmit water (0.51 to 1.52 cm/hr [0.20 to 0.60 inch/hour [in/hr]]), with the depth to water table being 61 to 91 cm (24 to 36 in) below surface. The Fox silt loams are well-drained and have a moderately-high to high capacity to transmit water (1.52 to 5.1 cm/hr [0.60 to 2.0 in/hr]), with the depth to water table being more than 203 cm (80 in) below surface. Celina, Fox, and Miami silt loams do not frequently flood or pond surface water runoff (USDA-SCS 1971). All three soils satisfy the USDA criteria for prime farmland (NRCS 2009a).

4.1.2.2 Topography and Geology

The Project components in relation to geological features including bedrock contours, karst areas, and known and speculated deep seismic structures within the Action Area are depicted in Figure 4.1-1. As shown on the map, features labeled the “Bellefontaine Outlier Faults” are located within the granitic basement rock underlying the Action Area (Hull 2009a). According to ODNR seismic data, three seismic events have been recorded in the history of Champaign County: one in 1843 (estimated 3.0 to 3.9 magnitude) and the other in 1875 (estimated 4.0 to 4.9 magnitude; ODNR 2006). A recent 5.8 magnitude earthquake that occurred on August 23, 2011 with an epicenter in Virginia was felt in Champaign County, but no damage was reported (ODNR 2012).

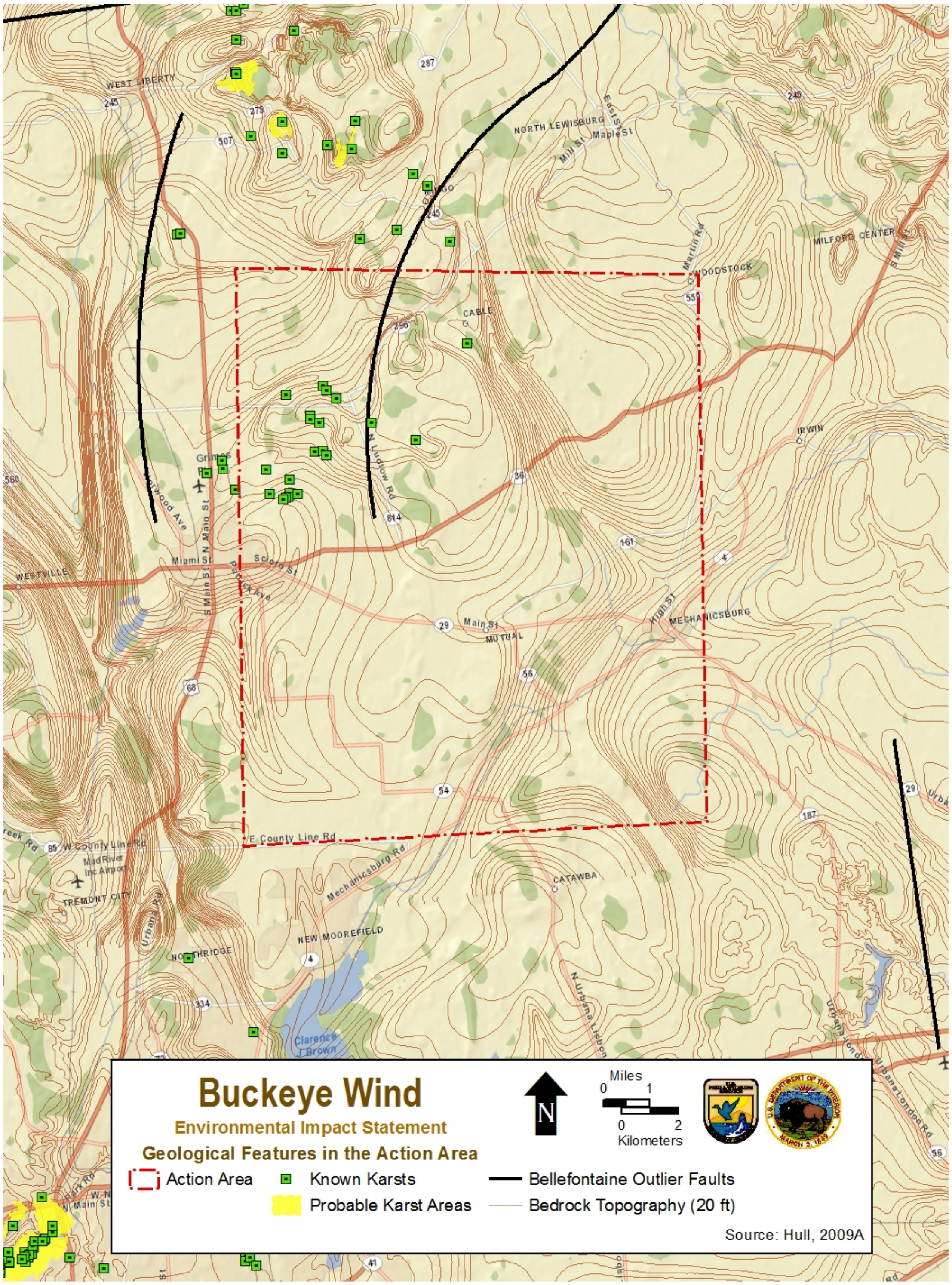
The Action Area is located in the glaciated Till Plains Section of the Central Lowland Physiographic Province. The topography is characterized by gently rolling hills and moderate slopes with elevations ranging from 396 to 549 m (1,300 to 1,800 ft) above mean sea level. Typical of west-central Ohio, the area experienced both the Illinoian and Wisconsinan glaciers and the surface topography is the result of glacial end moraine deposits (i.e., the Cable and Springfield Moraine complexes; EDR 2009a).

The Cable Moraine is characterized by thick deposits of glacial till intermixed with relatively thin sand or sand and gravel layers. Glacial till is a heterogeneous mixture of all sizes of soil particles inclusive of clay, silt, sand, and gravel, with occasional cobbles and boulders. Glacial till deposits may also contain streaks, seams, layers, or lenses of sand and gravel, which may or may not be water-bearing. Discontinuous, very thin to moderate lenses of sand and gravel deposits are common in this region. The till associated with the Cable Moraine is generally thicker in the southern portion of the Action Area and thins to the north, but typically exceeds 61 m (200 ft) in thickness throughout the Action Area. The Springfield Moraine is much thinner than the Cable Moraine (often less than 3 m [10 ft] in thickness), and overlies an outwash deposit called the Kennard Outwash. Outwash typically consists of coarser grained material, such as sand and gravel, deposited by the flowing water from melting ice. The Kennard Outwash is located between the two moraine complexes in the east-central portion of Champaign County and extends northward into the extreme southern portion of Logan County.

The uppermost bedrock within the majority of the Action Area is comprised primarily of limestone and dolomite, although shale with interbedded limestone is the uppermost bedrock in the northern-most portion of the Action Area. The depth to bedrock is highly variable.

According to well information included in the Ground-Water Resources of Champaign County (Schmidt 1985), limestone was encountered at a depth of approximately 105 m (345 ft) in a domestic well located to the north of Mechanicsburg. These well logs also indicate that the subsurface soils are a combination of clay, sand, and gravel that extend to underlying limestone bedrock, encountered at depths in excess of 30 m (100 ft). As part of the final Project design, a geotechnical engineer will conduct geotechnical surveys within the footprint of Project facilities.

Figure 4.1-1 Geological Features in the Action Area



4.1.2.3 Caves

Caves are hollow passages under or into the earth, generally having an opening to the surface. Caves can be natural or man-made. Caves are formed naturally when water-soluble rocks (e.g., limestone or sandstone) dissolve over time due to exposure of water in underground rivers or aquifers. Caves that form in water-soluble rocks are known as karst caves. Caves are also created by human activities such as mining. Numerous bat species, including Indiana bats, use man-made and natural caves for hibernation during winter. Sites used for hibernation are referred to as hibernaculum (singular) or hibernacula (plural). The largest known bat hibernaculum in Ohio occurs in a man-made cave system, Lewisburg Limestone Mine, located approximately 101 km (63 mi) southwest of the Action Area. In January 2012, it was reported that 9,243 Indiana bats used the Lewisburg Limestone Mine for hibernaculum, down from 9,594 the year before (M. Seymour, USFWS, personal communication). Unpublished data from a USFWS survey in 2005 found that approximately 30 percent (136,410 bats) of the range-wide population of Indiana bats hibernated in man-made hibernacula, including 24 mines, while the remainder (320,964 bats) hibernated in natural caves (USFWS 2009).

Some portions of the Action Area are underlain by karst geological features, and there are several caves in the vicinity, including Sanborn's Cave and a nearby unnamed cave (about 6.3 km [3.9 mi] north of the Action Area), where bat hibernacula and swarm surveys took place in 2008 (see Section 4.4.2).

4.2 Water Resources

4.2.1 Scope of Analysis

Water resources include groundwater and surface water. Groundwater is the subsurface hydrologic resource that is used for potable water consumption, agricultural irrigation, and industrial applications and is described in this EIS in terms of depth to aquifer, aquifer or well capacity, and surrounding geologic composition. Surface water resources described in this EIS include watersheds, streams, wetlands, and floodplains.

Water resources that could be affected by the Project extend beyond the geographical boundaries of the Project Area. Therefore, they are described at the Action Area scale.

The water resources analysis in this EIS is based on information from publicly available online databases and/or documents produced by the following federal, state, and local agencies: USGS, Federal Environmental Management Agency (FEMA), ODNR, OEPA, Champaign County Engineer and Health District, and the Ohio State University Agricultural Extension Office. Focused studies undertaken to support the Project design and the Project's OPSB Application supplied additional information for this analysis. These studies included a groundwater and hydrogeology study (Hull 2009b), a route evaluation study (Hull 2009c), and a delineation of surface water features (Hull 2009e and Hull 2011).

4.2.2 Existing Conditions

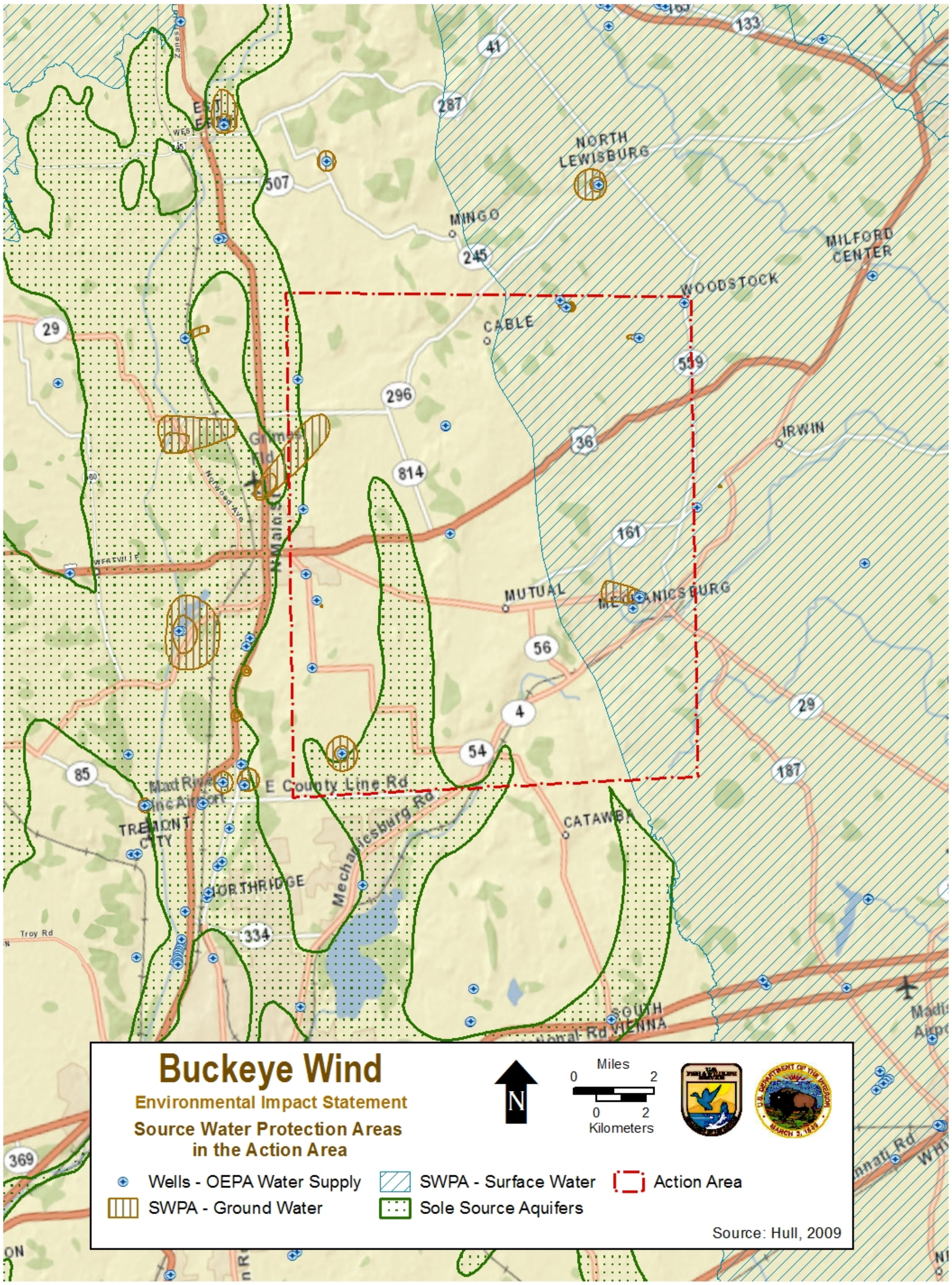
4.2.2.1 Groundwater

Groundwater resources exist in aquifers, which can be broadly defined as distinct water-bearing geologic features. The Greater Miami Sole Source Aquifer is a buried valley aquifer system underlying the Great Miami, Little Miami, and Mill Creek watersheds in the western portion of the Action Area (Figure 4.2-1). The "sole source" designation indicates that an aquifer supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer, and represents the only feasible source of drinking water for the local population. The Greater Miami Sole Source Aquifer provides drinking water to 1.6 million people (Hull 2009b). Depth to groundwater is less than 6 m (20 ft) in most parts of the aquifer, and supply wells in sand and gravel deposits within the aquifer commonly yield more than 3,785 liters per minute (L/min) (1,000 gallons per minute [gpm]) (USGS 1997).

The portion of the aquifer that underlies much of the Action Area is designated as a Class I aquifer, indicating that it has high to high-intermediate potential productivity based on aquifer characteristics and proximity to recharge (MVRPC 2005). Characteristics of the groundwater supply in the Action Area are discussed in Section 4.2.2.2.

Source Water Protection Areas (SWPAs) are areas where certain land uses and activities are regulated for the purposes of preserving water quality. SWPAs may be designated for protection of either groundwater or surface water resources. Multiple groundwater SWPAs exist in the eastern portion of Champaign County. Two groundwater SWPAs occur entirely within the Action Area: one in the eastern portion of the Action Area north of Route 4 and another in the southwestern corner of the Action Area southwest of Route 54. A third groundwater SWPA is located on the western boundary of the Action Area south of Route 296 (Figure 4.2-1) (Hull 2009b). Most of the eastern portion of the Action Area is within a surface water SWPA (Figure 4.2-1).

Figure 4.2-1 Source Water Protection Areas in the Action Area



4.2.2.2 Public and Private Groundwater Supply

Because of the rural nature of the Action Area, municipal water is generally unavailable. Rural residents rely upon private wells for drinking water and agricultural uses, such as watering livestock and irrigating crops. Based on a landowner survey, the majority of respondents indicated they have at least one well, with several landowners indicating the presence of two or three wells in order to provide additional water for livestock (Hull 2009b). None of the responding property owners indicated they were connected to a municipal water supply.

Based on the information provided in the landowner survey, wells completed at depths shallower than 30 m (100 ft) were, for the most part, installed in sand and gravel deposits (Hull 2009b). Half of the wells at depths between 30 and 61 m (100 and 200 ft) were completed in sand and gravel deposits, and half were completed in bedrock. Generally speaking, wells completed below 61 m (200 ft) were installed in bedrock. Flowing springs were noted at a property located near Mechanicsburg, and yields are reportedly sufficient to provide water for livestock.

Groundwater was typically encountered at depths ranging from 5 to 15 m (15 to 50 ft) in the wells completed in sand and gravel. The typical yield in these wells was reportedly between 19 and 132 L/min (5 and 35 gpm), although at least three of the wells had yields in excess of 379 L/min (100 gpm). Groundwater depths within the bedrock were typically deeper; of the six bedrock wells for which depth to water information was included, none had groundwater levels shallower than 30 m (100 ft). An estimated yield for one bedrock well was approximately 57 L/min (15 gpm) (Hull 2009b). Based on responses in the landowner survey, it did not appear that property owners have experienced problems related to lowered water tables or lower yields from their wells (Hull 2009b).

4.2.2.3 Watersheds

The Action Area lies within the Upper Scioto River and Upper Great Miami River drainages, both of which drain to the Ohio River (USGS 2008, as cited in EDR 2009a). These drainage basins can be divided into smaller sub-watersheds using the USGS hydrologic classification system in which hydrologic units are divided into successively smaller hydrologic units. Each hydrologic unit is identified by a unique hydrologic unit code (HUC) based on four levels of classification in the hydrologic unit system. Table 4.2-1 presents the 12-digit hydrologic units in the Action Area at the catalog unit or watershed level.

Table 4.2-1 Watersheds as Classified by the USGS 12-digit Hydrologic Unit Codes (HUC)[1] within the Action Area

12-Digit HUC Number	Waterbody Name	12-Digit HUC Name	Watershed Relationship
050600011902	Spain Creek (includes Pleasant Run)	Spain Creek – Big Darby Creek	Big Darby Creek to Scioto River
050600012001	Treacle Creek	Headwaters Treacle Creek	Little Darby Creek to Big Darby Creek to Scioto River
050600012002	Proctor Run	Proctor Run – Treacle Creek	Little Darby Creek to Big Darby Creek to Scioto River
050600012003	Little Darby Creek (includes Clover Run, Jumping Run, Lake Run)	Headwaters Little Darby Creek	Little Darby Creek to Big Darby Creek to Scioto River
050600012004	Spring Fork	Spring Fork	Little Darby Creek to Big Darby Creek to Scioto River
050800011501	Macochee Creek	Macochee Creek	Mad River to Great Miami River
050800011503	King's Creek	King's Creek	Mad River to Great Miami River
050800011602	Dugan Run	Dugan Run	Mad River-Nettle Creek to Mad River to Great Miami River
050800011701	East Fork Buck Creek	East Fork Buck Creek	Buck Creek to Mad River to Great Miami River
050800011702	Buck Creek	Headwaters Buck Creek	Buck Creek to Mad River to Great Miami River

[1] All watersheds drain into the Ohio River.

The OEPA identifies HUC watershed segments with impaired ambient water quality in the State of Ohio (OEPA 2008 as cited in EDR 2009a). The Big Darby Creek, Little Darby Creek, Mad River, and Buck Creek watersheds have all been designated impaired for both Aquatic Life Use and Recreation. Big Darby Creek has been impaired by organic enrichment, metals, nutrients, siltation, and direct habitat and flow alterations. In Little Darby Creek, impairment is attributed to unknown toxicity sources, siltation, and nutrient and organic enrichment. Above the confluence of King's Creek, major causes of impairment in the Mad River are direct habitat alterations. Below King's Creek, impairment is largely the result of organic enrichment, metals, nutrients, priority organics, siltation, and direct habitat alterations. In Buck Creek, habitat and flow alterations are the major causes of impairment.

The Big Darby Creek SWPA comprises the entire extent of the Big Darby Creek Watershed that falls within the Action Area. According to information provided by OEPA, this portion of the Big Darby Creek SWPA represents a small fraction of the Cincinnati Public Water Supply SWPA, which also includes the entirety of the Ohio River drainage basin upstream of the City of Cincinnati (Hull 2009b).

4.2.2.4 Streams

The surface water delineation (Hull 2009e and Hull 2011) identified 43 streams within 100 ft of known Project components (based on the 52 known turbine locations) (Figures 4.2-2, 4.2-3, and 4.2-4), all of which appear to meet the definition of jurisdictional Waters of the United States (as per 33 CFR 328), but have yet to be verified by USACE. Table 4.2-2 summarizes the characteristics of these streams. Most streams in the Action Area are generally small. Larger streams with deep pools include Dugan Run and the East Fork of Buck Creek. Another delineation will be performed to identify surface waters in the vicinity of the additional 48 turbines and associated infrastructure once siting for these structures is complete. All practical measures to avoid and minimize the effect on all surface waters will be taken such that the total impacts will not exceed those described and evaluated in Section 5.2.

Hull (2009e and 2011) delineated and described the streams located within 100 feet of Project components in the Action Area based on fluvial morphological characteristics. Hull evaluated streams using the Ohio Qualitative Habitat Evaluation Index (QHEI) scoring method or the Ohio Headwater Habitat Evaluation Index (HHEI) where applicable. Both methods are used to estimate the probable aquatic life in each stream. An additional survey method, the Visual Encounter Survey (VES), was used in a few streams thought to have physical aspects of higher-value headwater streams. Surface waters will be delineated in the same manner as described here for the additional 48 turbines.

The HHEI is used on primary headwater habitat (PHWH) streams with a drainage area less than 2.6 square km (1 square mi) and with maximum pool depths less than 40 cm (15.7 in). The OEPA (2003) defines a headwater stream as a stream with a watershed less than or equal to 52 square km (20 square mi). Many streams and drainage ways have a watershed of less than 2.6 square km (1 square mi). There are three possible categories to which PHWH streams may be assigned (OEPA 2003):

- Class I PHWH Streams – Lowest value; warm water intermittent or ephemeral; may contain ephemeral warm water communities, but are often dry for long periods of time.
- Class II PHWH Streams – Middle value; perennial or intermittent streams with warm water conditions; generally contain animal species adapted to warm water streams, including certain amphibians and pioneering fish species along with invertebrates such as odonate larvae.
- Class III PHWH Streams – High value; cold water perennial streams; often groundwater fed; contain animal species adapted to year-round cool water conditions, including certain amphibians or fish species, along with invertebrates such as mayflies, stoneflies, and caddisflies.

In addition to natural channels, there are many primary headwater streams that have been modified through channelization and/or riparian removal as part of activities related to agricultural activities and urban/suburban development. Such modification is the origin of habitat degradation in smaller streams and a leading source of impairment in larger streams into which they flow (OEPA 2003).

Figure 4.2-2 Perennial Streams and Wetlands in the Action Area

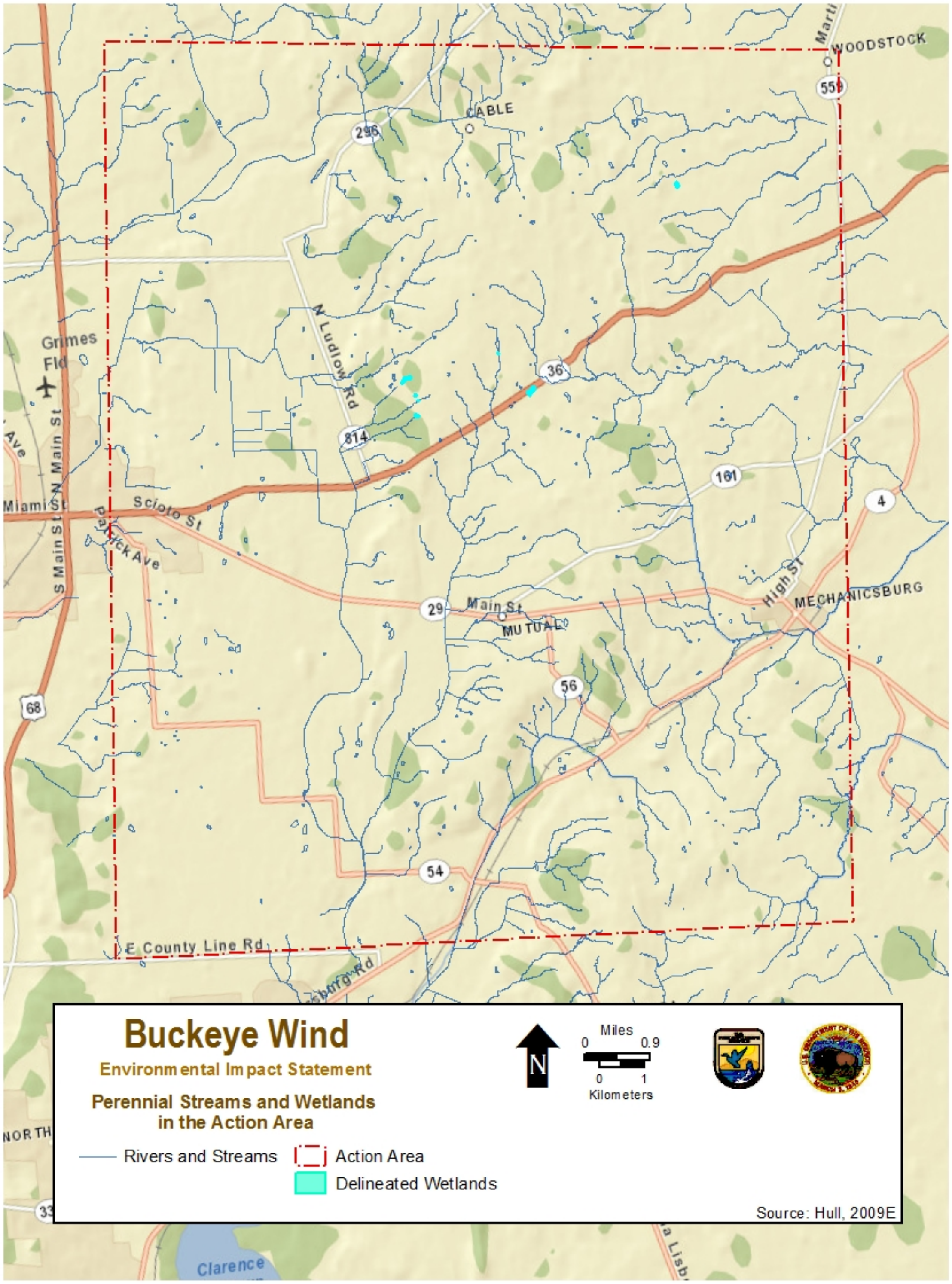
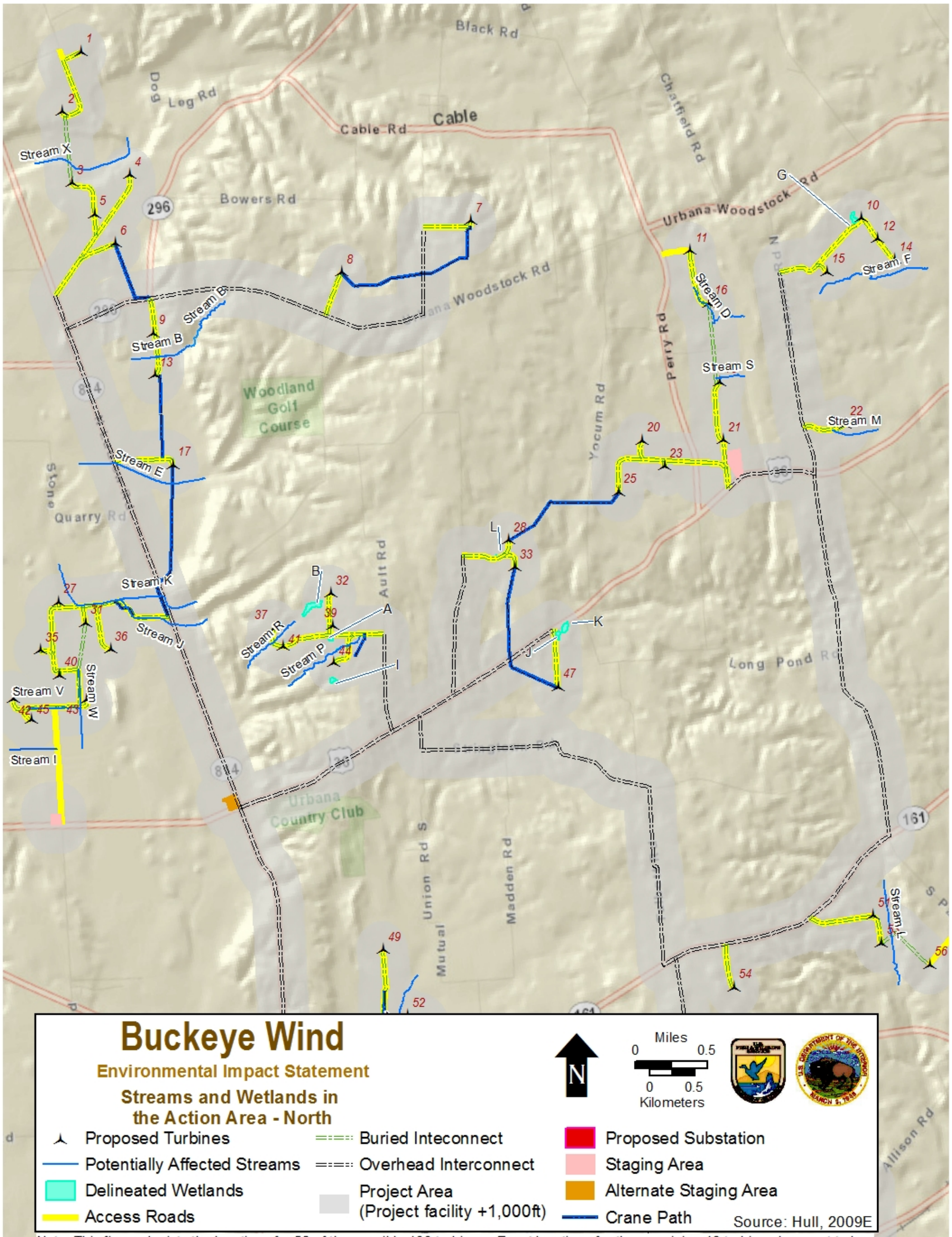
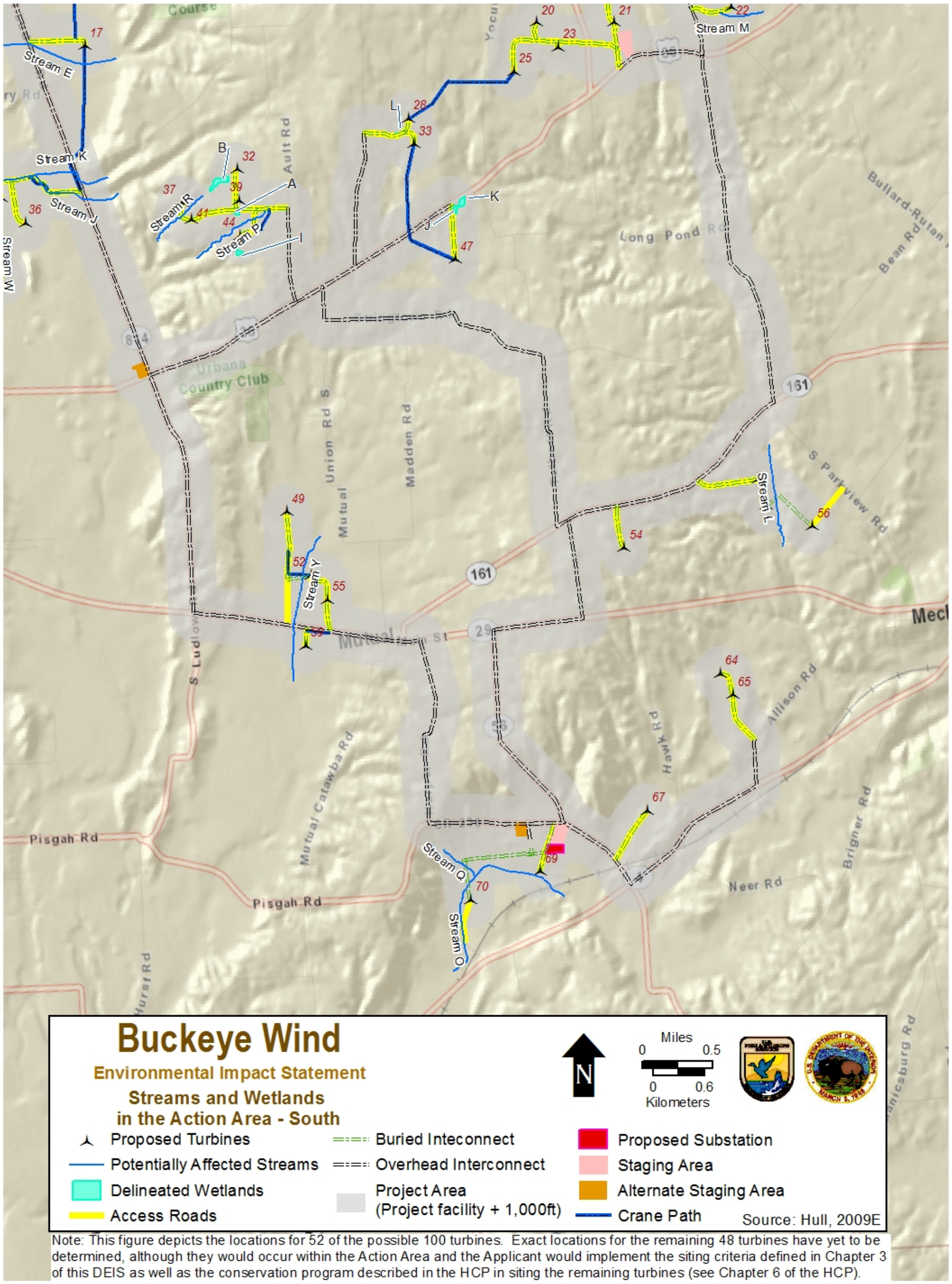


Figure 4.2-3 Streams and Wetlands in the Action Area - North



Note: This figure depicts the locations for 52 of the possible 100 turbines. Exact locations for the remaining 48 turbines have yet to be determined, although they would occur within the Action Area and the Applicant would implement the siting criteria defined in Chapter 3 of this DEIS as well as the conservation program described in the HCP in siting the remaining turbines (see Chapter 6 of the HCP).

Figure 4.2-4 Streams and Wetlands in the Action Area – South



The QHEI is used for streams with drainage areas typically greater than 2.6 square km (1 square mi). These larger streams have sufficient amounts of water throughout the year to support fish communities. This index was designed to provide a measure of habitat quality that corresponds to physical factors that affect communities of fish and aquatic invertebrates. Physical parameters include substrate, instream cover, channel morphology, channel and bank condition, pool and riffle quality, and gradient (Rankin 1989). Based on scores from the QHEI, each stream with a watershed size greater than 2.6 square km (1 square mi) was assigned one or more of the following aquatic life use designations as defined by the Ohio Water Quality Standards Water Use Designations (OAC 3745-1-07):

- Warmwater Habitat (WWH) – Capable of supporting and maintaining a balanced community of warmwater aquatic organisms. This is the most widely applied use designation assigned to rivers and streams in Ohio.
- Limited Warmwater Habitat (LWWH) – Does not meet specific warmwater habitat criteria (note: this aquatic life use designation is being phased out).
- Exceptional Warmwater Habitat (EWH) – Capable of supporting and maintaining an exceptional or unusual community of warmwater aquatic organisms.
- Modified Warmwater Habitat (MWH) – Incapable of supporting and maintaining a balanced community of warmwater aquatic organisms because of extensive and irretrievable modifications to the physical habitat.
- Seasonal Salmonid Habitat (SSH) – Capable of supporting the passage of salmonids from October to May, and large enough to support recreational fishing.
- Coldwater Habitat (CWH) – Capable of supporting populations of coldwater aquatic organisms on an annual basis.
- Limited Resource Water (LRW) – Incapable of supporting and maintaining a balanced community of aquatic organisms because of natural background conditions or irretrievable human-induced conditions.

Table 4.2-2 Jurisdictional Streams within the Action Area[1]

Stream ID	Stream Name	Flow Regime	Watershed Area (km^2) [mi^2]	Aquatic Life Use Designation[2]
B	Unnamed stream south of Kings Creek	Perennial	1.2 [0.46]	Modified Class II PHWH
B-2	Unnamed stream	Ephemeral	0.83 [0.32]	Modified Class II PHWH
D	Unnamed tributary to Treacle Creek	Ephemeral	0.60 [0.23]	Modified Class I PHWH
D-2	Unnamed stream	Ephemeral	1.4 [0.55]	Modified Class II PHWH
E	Dugan Run North Fork	Intermittent	7.07 [2.73]	Modified Class II PHWH
F	Unnamed tributary to Treacle Creek	Perennial	0.62 [0.24]	Modified Class II PHWH
I	Unnamed tributary to Dugan Run	Perennial	1.1 [0.43]	Modified Class II PHWH
J	Dugan Run South Fork	Intermittent	2.72 [1.05]	Modified Class II PHWH

Stream ID	Stream Name	Flow Regime	Watershed Area (km^2) [mi^2]	Aquatic Life Use Designation[2]
J-2	Unnamed stream	Intermittent	1.7 [0.65]	WWH
K	Unnamed tributary to Dugan Run South Fork	Ephemeral	0.62 [0.24]	Modified Class I PHWH
L	Little Darby Creek	Perennial	5.05 [1.95]	EWH and CWH
M	Unnamed tributary to Treacle Creek	Ephemeral	0.18 [0.07]	Modified Class I PHWH
O	East Fork Buck Creek	Perennial	10.6 [4.11]	CWH
O-2	East Fork Buck Creek	Perennial	10.3 [3.98]	CWH
P	Unnamed tributary to West Fork Buck Creek	Ephemeral	0.18 [0.07]	Modified Class I PHWH
Q	Unnamed tributary to East Fork Buck Creek	Intermittent	0.18 [0.07]	Modified Class II PHWH
R	Unnamed tributary to West Fork Buck Creek	Intermittent	0.31 [0.12]	Class II PHWH
S	Unnamed tributary to Treacle Creek	Ephemeral	0.21 [0.08]	Modified Class I PHWH
T	Unnamed tributary to Treacle Creek	Intermittent	0.21 [0.08]	Modified Class II PHWH
V	Unnamed tributary to Dugan Run	Perennial	0.31 [0.12]	Modified Class II PHWH
W	Unnamed tributary to Dugan Run	Perennial	0.39 [0.15]	Modified Class II PHWH
X	Kings Creek	Perennial	20.1 [7.75]	CWH
Y	Buck Creek	Intermittent	14.4 [5.56]	CWH
Y-2	Buck Creek	Intermittent	9.09 [3.51]	CWH
Y-3	Buck Creek	Intermittent	4.83 [1.87]	CWH
AA	Buck Creek	Intermittent	0.67 [0.26]	CWH
BB	Treacle Creek	Intermittent	2.87 [1.11]	EWH
CC	Unnamed stream	Ephemeral	1.6 [0.63]	Modified Class I PHWH
DD	Unnamed stream	Ephemeral	0.176 [0.068]	Modified Class I PHWH
EE	Unnamed stream	Ephemeral	0.80 [0.31]	Modified Class II PHWH
FF	Dugan Ditch	Intermittent	2.72 [1.05]	CWH
GG	Unnamed stream	Ephemeral	0.49 [0.19]	Modified Class II PHWH
HH	Unnamed stream	Ephemeral	0.65 [0.25]	Modified Class I PHWH
II	Unnamed stream	Ephemeral	0.10 [0.04]	Modified Class I PHWH
JJ	Unnamed stream	Intermittent	2.80 [1.08]	Modified WWH
KK	Unnamed stream	Ephemeral	0.5 [0.2]	Class III PHWH
LL	Unnamed stream	Ephemeral	0.13 [0.05]	Class II PHWH
MM	Unnamed stream	Ephemeral	0.34 [0.13]	Modified Class I PHWH
NN	Unnamed stream	Ephemeral	1.3 [0.51]	Modified Class II PHWH
OO	Unnamed stream	Ephemeral	1.8 [0.69]	Modified Class II PHWH
WW	Unnamed stream	Ephemeral	1.1 [0.42]	Modified Class II PHWH

Stream ID	Stream Name	Flow Regime	Watershed Area (km^2) [mi^2]	Aquatic Life Use Designation[2]
XX	Unnamed stream	Ephemeral	0.03 [0.01]	Modified Class II PHWH
AAA	Unnamed stream	Ephemeral	0.13 [0.05]	Modified Class II PHWH

[1] As described in Hull 2009e and 2011
[2] PHWH = Primary headwater habitat; EWH = Exceptional warmwater habitat; CWH = Coldwater habitat

4.2.2.5 Wetlands

An update to the National Wetlands Inventory (NWI) database, conducted by Ducks Unlimited using current (i.e., 2005 to 2007) aerial photographs, identifies 668 ha (1,651 ac) of wetlands in the Action Area (Ducks Unlimited 2009; Table 4.2-3). Most of the NWI wetlands are emergent or open water types characterized by low-lying herbaceous vegetation and open water, while approximately 24 percent of the NWI wetland area consists of forested or forested/emergent wetlands.

Table 4.2-3 Description and Size of Wetlands in the Action Area as Identified by the Ducks Unlimited 2009 Update to the National Wetlands Inventory (NWI) Database[1]

NWI System/Class Code	Wetland Classification	Hectares (Acres)
PAB	Palustrine Aquatic Bed	4.45 (11)
PUB	Palustrine Unconsolidated Bottom	155.0 (383)
L1UB	Lacustrine/Limnetic Unconsolidated Bottom	9.31 (23)
PEM	Palustrine Emergent	290.6 (718)
PFO	Palustrine Forested	152.6 (377)
PFO/PEM	Palustrine Forested/Emergent	4.86 (12)
PSS	Palustrine Scrub-Shrub	42.9 (106)
PSS/PEM	Palustrine Scrub-Shrub/Emergent	8.50 (21)
Total		668 (1,651)

The surface water delineation conducted for the 52 turbines and associated infrastructure (Hull 2009e) provided more detailed data on wetlands near the portions of the Project that have been sited to date. Another delineation will be performed to identify surface waters, including wetlands, in the vicinity of the additional 48 turbines and associated infrastructure once siting for these structures is complete. All practical measures to avoid and minimize all surface water impacts will be taken such that the total impacts will not exceed those described and evaluated in Section 5.2. The Hull 2009e study included wetland surveys within 100 ft of Project components, including the 52 known turbine locations, access roads, buried and above-ground electrical interconnect lines, and the substation (Hull 2009e). Wetlands and other surface waters were identified in accordance with the USACE *Wetlands Delineation Manual* (Environmental Laboratory 1987), subsequent regulatory guidance issued by the USACE, and the OEPA guidance on evaluation of streams and wetlands. Wetland functions and values were evaluated using the Ohio Rapid Assessment Method for Wetlands (OEPA 2001). This method involves a scoring system that assigns each wetland to the appropriate category of the Ohio Antidegradation

Policy for Wetlands (OAC 3745-1-54). There are three possible Ohio Wetland Antidegradation categories that may be assigned (OAC Rule 3745-1-54(C)):

- Category 1 Wetlands – Low value; low species diversity, no significant habitat or wildlife use, limited potential to achieve beneficial wetland functions, and/or a predominance of non-native species.
- Category 2 Wetlands – Middle value; wetlands in this category are of moderate diversity but do not contain rare, threatened or endangered species. They are generally degraded, but are capable of attaining higher value. Most wetlands in Ohio are expected to fall into this category.
    - Modified (also referred to as Degraded but Restorable) Category 2 Wetlands – Low to middle value: "...wetlands which are degraded but have a reasonable potential for reestablishing lost wetland functions."
- Category 3 Wetlands – High value; typified by high levels of diversity, a high proportion of native species, and/or high functional values. Category 3 wetlands include wetlands which contain or provide habitat for threatened or endangered species, are high quality mature forested wetlands, vernal pools, bogs, fens, or are scarce regionally and/or statewide.

The surface water delineation (Hull 2009e and Hull 2011) documented 23 wetlands totaling roughly 12.18 ha (30.1 ac) in the 52-turbine area (Figures 4.2-3 and 4.2-4). These 23 wetlands included 14 Category 1 wetlands, seven Modified Category 2 wetlands, and two Category 2 wetlands. No Category 3 wetlands were identified in the 52-turbine area. All wetlands were either emergent, emergent/scrub-shrub, emergent/forested, forested/scrub-shrub, scrub-shrub/ponded, or ponded; none of the delineated wetlands were classed as only forested, but several were classified as forested with another vegetation class (e.g., emergent/forested). Of the 23 wetlands, 16 were found to be non-isolated and under the Clean Water Act jurisdiction of federal and state government. Seven wetlands were found to be isolated and under the sole jurisdiction of the Ohio Isolated Wetland Permitting Program. The delineation report was used to categorize the wetlands as either isolated or jurisdictional, but status must ultimately be verified by USACE. Table 4.2-4 describes the delineated wetlands. Another delineation will be performed to identify wetlands in the vicinity of the additional 48 turbines once siting for these turbines is complete.

Table 4.2-4 Delineated Wetlands in the 52-Turbine Area*

Wetland ID	Nearest Turbine	Wetland Type[1]	Area (ha) [ac]	Ohio Category	Isolation Status	Wetland Type based on Field Observation
A	39	PEM/PSS	0.16 (0.39)	Modified 2	Isolated	Emergent with small shrub component
B	32	PEM/PSS	1.17 (2.90)	Modified 2	Non-isolated	Emergent/ Scrub-shrub
G	10	PEM/PSS	0.465 (1.15)	1	Non-isolated	Emergent/ Scrub-shrub
H	44	PEM	0.008 (0.02)	Modified 2	Non-isolated	Emergent
I	44	POW	0.27 (0.66)	Modified 2	Non-isolated	Ponded
J	47	PEM	0.30 (0.74)	1	Isolated	Emergent
K	47	PEM	0.583 (1.44)	1	Non-isolated	Emergent
L	28	PEM	< 0.004 (0.01)	Modified 2[2]	Non-isolated	Emergent
M	28	PEM	0.08 (0.19)	1	Isolated	Emergent
N	28	PEM	0.008 (0.02)	1	Non-isolated	Emergent
O	21	PEM	0.016 (0.04)	1	Isolated	Emergent
P	8	PEM/PFO	0.06 (0.15)	Modified 2	Non-isolated	Emergent/Forest ed
Q	120	PEM	0.016 (0.04)	1	Non-isolated	Emergent
R	9	PEM	0.28 (0.68)	1	Non-isolated	Emergent
S	16	PEM/PSS	0.12 (0.30)	1	Non-isolated	Emergent/Shrub scrub
T	90	PEM	0.08 (0.20)	1	Isolated	Emergent
U	54	PEM	0.028 (0.07)	1	Isolated	Emergent
V	67	PEM	0.08 (0.20)	Modified 2	Isolated	Emergent
X	120	PEM	0.036 (0.09)	1	Non-isolated	Emergent
JJ	18	PEM	0.08 (0.19)	1	Non-isolated	Emergent
KK	15	PFO/PSS	0.12 (0.30)	2	Non-isolated	Forested/Shrub scrub
NN	54	PSS/PUB	0.12 (0.30)	1	Non-isolated	Shrub scrub/Ponded
OO[3]	43	PEM/PSS	~8.09 (20.0)	2	Non-isolated	Emergent/Shrub scrub

Source: Modified from Hull 2009e and Hull 2011
*Wetland delineations have been completed at the Project Area scale (specifically within 30.5 m (100 ft) of the 52 known turbine sites and related Project infrastructure) rather than the Action Area scale. Once the additional 48 turbines have been sited, Buckeye Wind will follow the same approach for delineating wetlands in these areas.
[1] Based on Cowardin et al. 1979 classification
[2] Category not definitive as per Hull 2009e
[3] Wetland delineated using NWI and aerial imagery instead of using field wetland delineation methods as described in Section 4.2.2.5 (H. Crowell, Hull & Associates, Inc., personal communication)
PUBFh = palustrine, unconsolidated bottom, semi-permanently flooded, diked/impounded
PEMCd = palustrine, emergent, seasonally flooded, partially drained/ditched
PEMC = palustrine, emergent, seasonally flooded
PUBGh = palustrine, unconsolidated bottom, intermittently exposed, diked/impounded
PEMA = palustrine, emergent, temporarily flooded

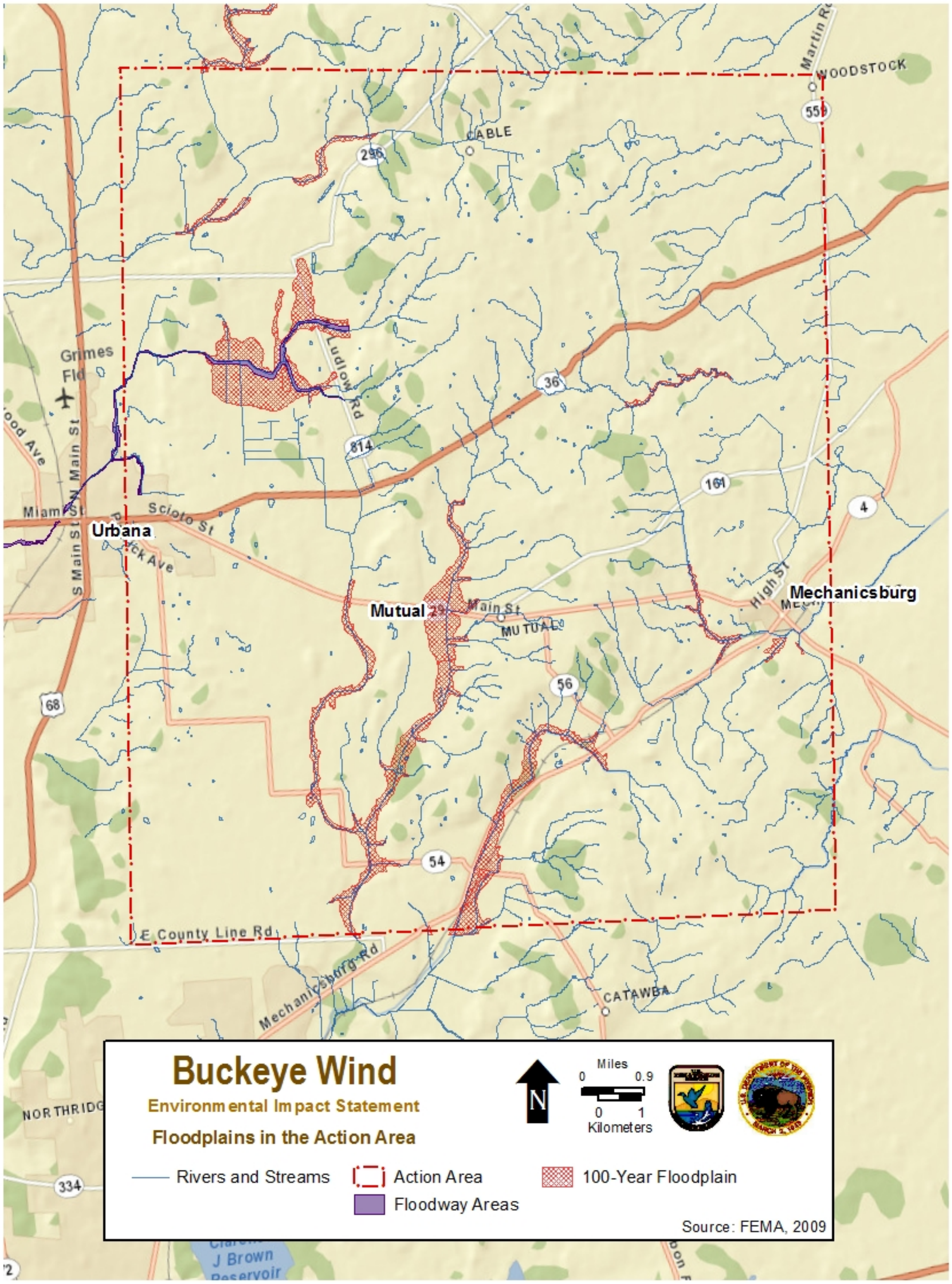
4.2.2.6 Floodplains

A floodplain is flat land adjacent to a stream or river that experiences occasional or periodic flooding. There are several FEMA-mapped floodplains in the Action Area (Figure 4.2-5). For regulatory purposes, the floodplain is divided into two areas: the floodway[2] and flood fringe. The floodway includes the channel and the portion of the adjacent floodplain required to pass the 100-year flood without increasing flood heights. Typically, this is the most hazardous portion of the floodplain where the fastest flow of water occurs. The flood fringe is the portion of the floodplain outside of the floodway, which is covered by floodwater during the 100-year discharge and is commonly referred to as the 100-year floodplain. Most floodplain regulations prohibit development within the floodway that could block the free flow of flood water. Most floodplain regulations allow development to occur in the flood fringe and 100-year floodplain, but require protection from floodwaters through flood proofing so that water cannot enter structures.

Based on the digital Flood Insurance Rate Map Database for Champaign County (FEMA 2007), the Action Area contains some floodways and flood fringe immediately adjacent to streams, particularly along Buck Creek, Dugan Run, and King's Creek (Figure 4.2-5).

[2] A "Regulatory Floodway" means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height. Development is regulated in these floodways to ensure that there are no increases in upstream flood elevations.

Figure 4.2-5 Floodplains in the Action Area



4.3 Vegetation

4.3.1 Scope of Analysis

The vegetation analysis in this EIS provides a spatial overview of vegetative cover at the Action Area scale and describes, in more detail, the characteristics of the major vegetative communities within the Project Area. This section does not discuss rare, threatened, or endangered plant species: these species are discussed in Section 4.5 of this EIS. The vegetation analysis in this EIS is based on information from publicly available databases and documents produced by USGS, ODNR, Ducks Unlimited, and OEPA. The surface water delineation conducted for the Project provided site-specific vegetation information (Hull 2009d).

4.3.2 Existing Conditions

The Action Area is located in the south-central portion of Ohio, in the Bellefontaine Uplands physiographic region, a sub-region of the Central Ohio Till Plains. This region is characterized by low to moderate relief hills formed by glacial processes. Prior to European settlement, Champaign County was a mix of woodlands, plains, and tall-grass prairies. Due to the rich soils, much of the county was converted to agriculture by the mid-19th century. Currently, the Action Area is characterized by flat and rolling terrain that is comprised largely of active agricultural lands (producing mostly corn and soybean crops) and pastures (agricultural lands and pastures collectively comprise approximately 82 percent of the Action Area), interspersed with relatively small, scattered stands of deciduous forest that have an average size of approximately 3.6 ha (9 ac; approximately nine percent of the Action Area; Figure 4.3-1 and Table 4.3-1). Remaining native vegetation cover types (e.g., grassland/ herbaceous, evergreen and mixed forest, and emergent wetland) each make up one percent or less of the Action Area (Hull 2009d).

Most of the land within the Action Area that is not cultivated cropland occurs in a patchwork of hayfields, pastures, and forest that forms a wide band across the eastern half of the Action Area. This band of non-cropland is centered between the north-central boundary of the Action Area and Mechanicsburg and south from Mechanicsburg on both sides of County Route 451 (Figure 4.3-1).

Figure 4.3-1 Vegetation Cover in the Action Area

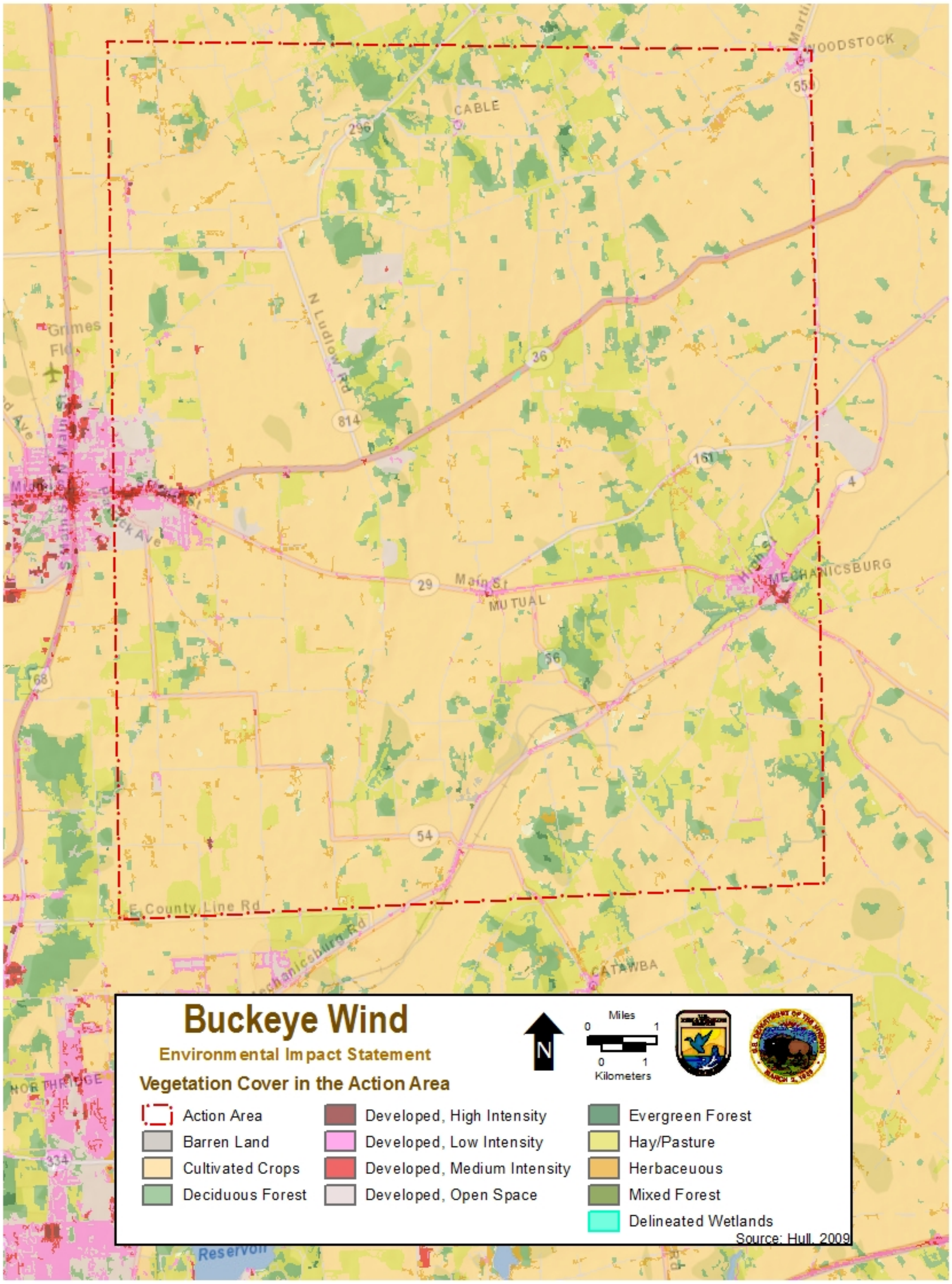


Table 4.3-1 National Land Cover Database Vegetation Cover Types in the Action Area

	Action Area	
Land Cover Type	**Hectares (Acres)**	**Percent of Action Area**
Cultivated crop	22,408.2 (55,371.9)	69.2
Hay/pasture	4,163.1 (10,287.2)	12.9
Deciduous forest	2,743.5 (6,779.4)	8.5
Developed, open space[1]	1,962.5 (4,849.4)	6.1
Grassland/Herbaceous	444.9 (1,099.3)	1.4
Developed, low intensity[2]	421.7 (1,042)	1.3
Open water	84.13 (207.9)	0.3
Developed, medium intensity[3]	54.6 (135)	0.2
Emergent herbaceous wetland	40.3[5] (99.6[5])	0.1
Evergreen forest	30.6 (75.7)	0.1
Developed, high intensity[4]	26.2 (64.7)	0.1
Barren land	13.2 (32.7)	<0.1
Mixed forest	2.35 (5.8)	<0.1
Unclassified		
TOTAL	32,395.33 (80,050.6)	100

Source: USGS 2001
[1] Includes areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses; most commonly includes large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings. Impervious surfaces account for less than 20 percent of total cover.
[2] Includes areas with a mixture of constructed materials and vegetation; most commonly includes single-family housing units. Impervious surfaces account for 20-49 percent of the total cover.
[3] Includes areas with a mixture of constructed materials and vegetation; most commonly includes single-family housing units. Impervious surfaces account for 50-79 percent of the total cover.
[4] Includes highly developed areas where people reside or work in high numbers, such as apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80 to100 percent of the total cover.
[5] Acreage of emergent wetlands presented in this table differs from Table 4.2-3 above due to the different mapping methodologies (NWI vs. National Land Cover data) and resulting different categorizations of vegetation cover and wetland types.

The following paragraphs describe the primary natural (non-agricultural or developed) vegetation communities that occur within the Action Area. Agricultural lands, specifically those enrolled by landowners in the Conservation Reserve Program (CRP), are discussed in Section 4.7.

4.3.2.1 Deciduous Forest

The deciduous forest habitat makes up approximately nine percent of the Action Area and includes a range of successional stages from early-successional scrub-shrub/forest to mature stands. Average forest age in the Action Area is approximately 30 to 50 years. The approximately 766 individual forest stands that fall entirely within the Action Area vary in patch size (0.08 ha to 106.4 ha [0.2 ac to 263 ac]), and are primarily bordered by agricultural fields. Eighty-two percent of the forest patches are less than 4.05 ha (10 ac) in size, and only two percent are larger than 40.5 ha (100 ac). Canopy species of these deciduous forests typically include honey locust, white oak, shagbark hickory, green ash, ironwood, American elm, black cherry, cottonwood, tupelo, white ash, osage orange, burr oak, sugar maple, red oak, and post oak, while the shrub layer is dominated by honeysuckle shrubs (Hull 2009d).

4.3.2.2 Hay/Pasture and Grassland/Herbaceous

Hayfields and pasturelands account for roughly 13 percent of the Action Area. These areas contain a variety of grass and forb species such as alfalfa, clover, orchardgrass, Kentucky bluegrass, ryegrass, tall fescue, timothy, switchgrass, and Eastern gamagrass. Grassland/herbaceous vegetation communities occur throughout the Action Area largely on land abandoned from agriculture and make up between one and two percent of the Action Area. This community type is dominated by upland herbaceous and grass species including goldenrods, Queen Anne's lace, teasel, asters, ragweeds, thistles, and upland grasses (Hull 2009d).

4.3.2.3 Wetlands

Wetlands in the Action Area primarily contain hydrophytic (growing wholly or partially in water), herbaceous and scrub-shrub vegetation, and emergent vegetation. Dominant herbaceous species include calico aster, beggar's ticks, red top, fox sedge, yellow nut sedge, reed canary grass, and broad-leaved cattails. The dominant scrub-shrub species include black willow, sand bar willow, and gray dogwood. One open water/ponded wetland dominated by duck weed also occurs within the Project Area. No wetlands will be impacted during implementation of the HCP. Section 4.2 of this EIS contains more detailed information on wetlands (Hull 2009d).

4.3.2.4 Evergreen Forest

The Action Area contains several stands of nearly monotypic (dominated by a single species), coniferous forest dominated by pine, particularly red pine and eastern white pine (Hull 2009d).

4.4 Wildlife and Fisheries

4.4.1 Scope of Analysis

This EIS describes the existing wildlife and fisheries resources within the Action Area. This section does not discuss rare, threatened, or endangered wildlife species: these species are discussed in Section 4.5 of this EIS. The wildlife and fisheries analysis in this EIS is based on data from the ODNR Division of Natural Areas and Preserves (DNAP) Natural Heritage Database (2010), the Ohio Breeding Bird Atlas II (2009), the Ohio Aquatic Gap Analysis Program (Covert et al. 2007), site-specific biological surveys, and standard biological literature for the region (Natureserve 2007). In order to establish baseline information regarding wildlife use of the Action Area and to evaluate the potential impacts from construction and operation of the Project, a number of wildlife studies were conducted (Stantec 2008a; Stantec 2008b; Stantec 2008c; Stantec 2009) according to survey plans that were developed in coordination with ODNR and USFWS, which are summarized in the following sections. A summary of the results of pre-construction bird and bat studies can be found in the ABPP (Appendix C) and detailed descriptions of survey methods, results, and discussion can be found in the respective seasonal reports (Appendix G). This analysis considered species that could potentially occur within the Action Area. Figure 4.4-1 depicts the area that was surveyed during the pre-construction bird and bat studies, which encompassed the current Action Area and an area to the north ("initial study area").

4.4.2 Existing Conditions

4.4.2.1 Terrestrial Wildlife

Vertebrate animals likely to use the Action Area are represented by those often detected in highly fragmented landscapes dominated by agriculture. Many of the animal species expected to occur are common and widely distributed throughout Ohio. Appendix E lists the common terrestrial and aquatic animals likely to use available habitat types in the Action Area and its vicinity. Most of the known biological effects of wind turbine facilities relate to flying animals; therefore, the terrestrial part of this section focuses on birds and bats but also includes a summary of other wildlife use of the Action Area.

Birds

North America contains four primary bird migration flyways: the Atlantic, Mississippi, Central, and Pacific (USGS 2006). Each of these flyways represents a generalized area rather than an exact course and the flyways often merge or overlap. Within and around these flyways, migrating birds have highly variable flight paths within a broad area. Typically, an individual bird's migratory pathway falls within an area that is roughly equal to the full width of their breeding range (USGS 2006). The Action Area lies within the Atlantic and Mississippi flyways, which include the majority of eastern and mid-western states (36 states and the District of Columbia), as well as the Great Lakes (Figure 4.4-2). The Atlantic and Mississippi flyways cover the migratory ranges of many bird species.

In addition to migratory bird use, the Action Area is also used by breeding birds that favor agricultural habitats and small woodlands. Accordingly, several studies of migratory and breeding bird use of the Action Area and surrounding region have been conducted, the results of which are described below. Full reports for these studies are included in Appendix G of this EIS.

Figure 4.4-1 Buckeye Wind Pre-construction Survey Locations

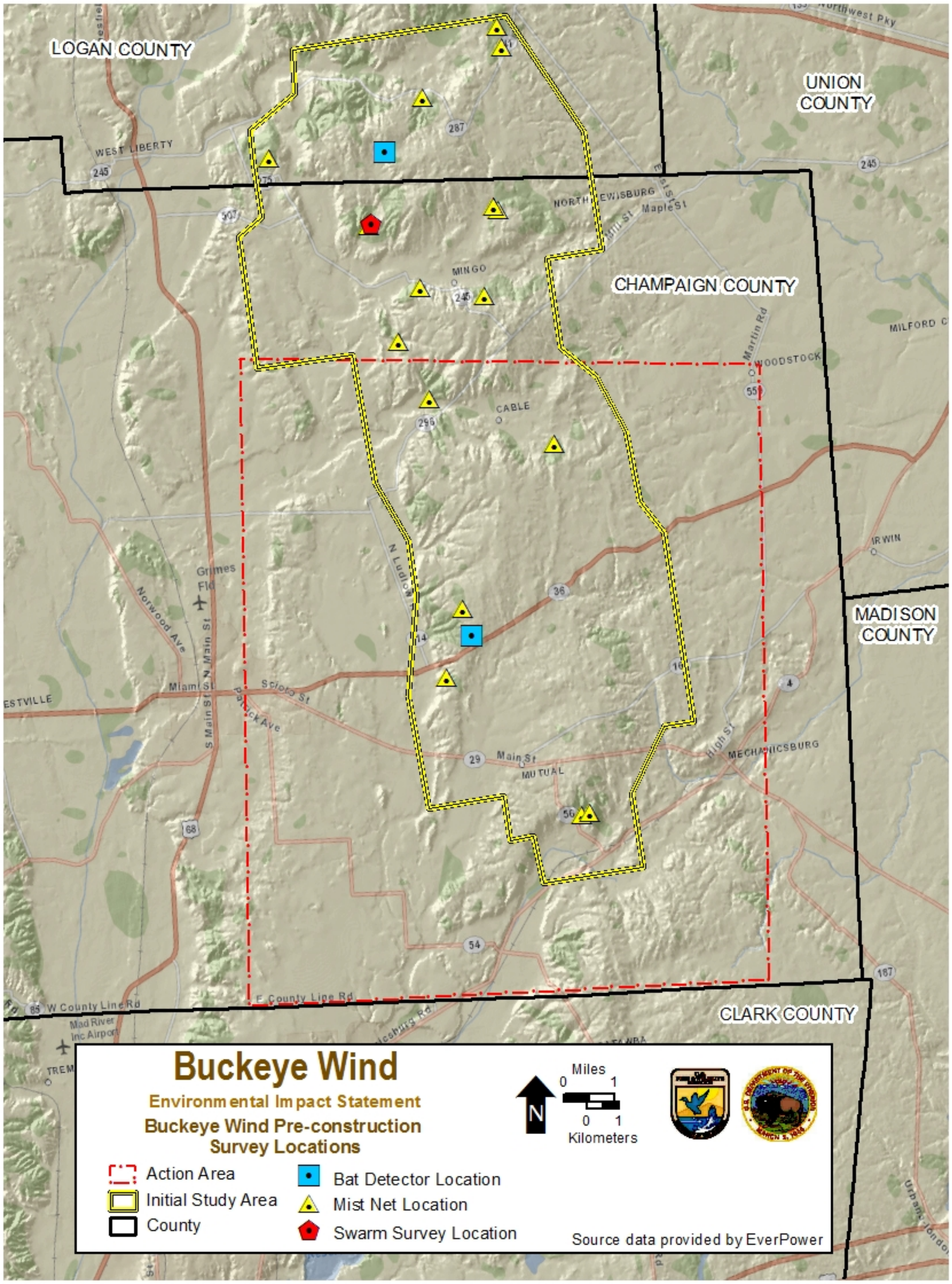
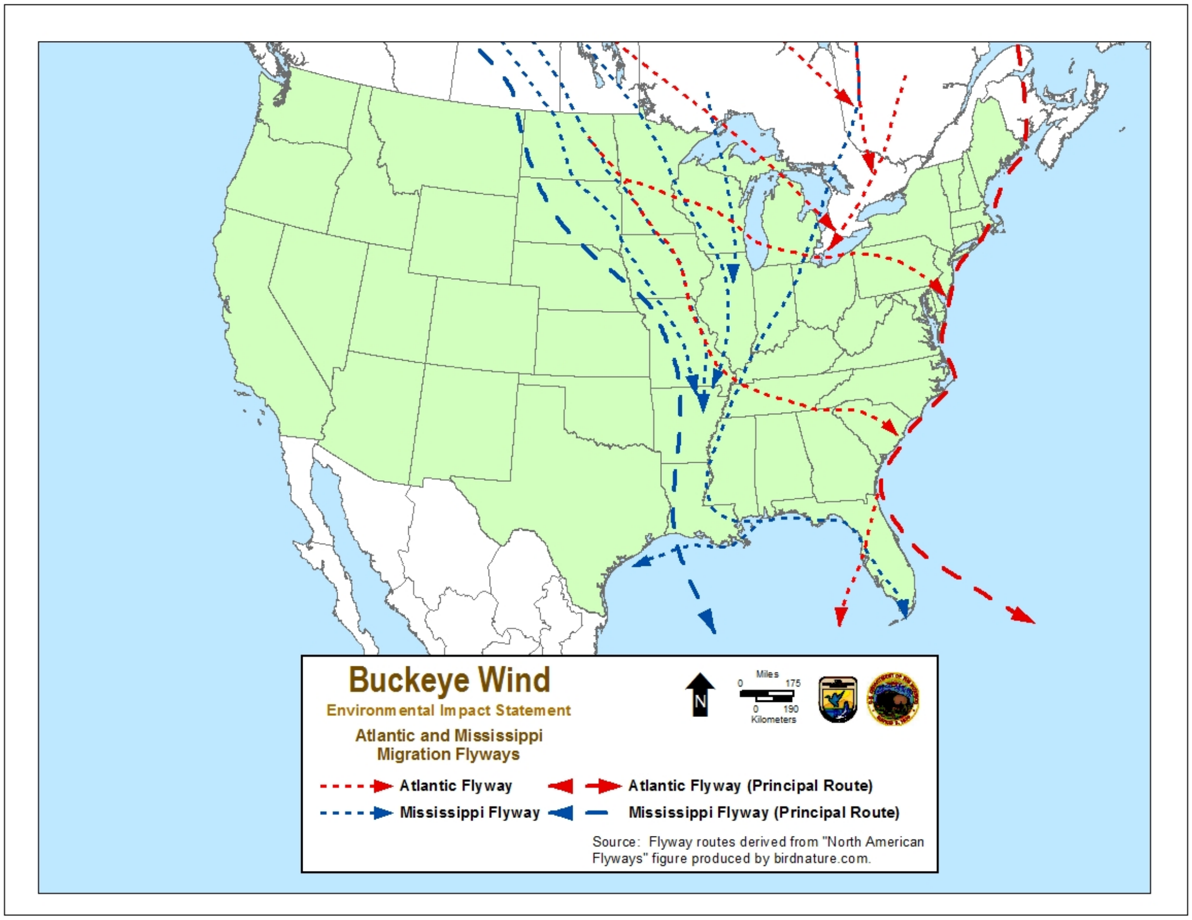


Figure 4.4-2 Atlantic and Mississippi Migration Flyways



Migratory Bird Use of the Action Area

Passerines

A fall 2007 radar survey was conducted from September 1 to October 15, 2007 and included 30 nights of sampling to detect night migrating birds (Stantec 2008a). The radar was positioned approximately 6.4 km (4 mi) north of the Action Area near the Champaign-Logan County line. Although outside the Action Area, this sampling location has similar habitat conditions and landscape features to the Action Area, so data collected there were considered to be representative of the Action Area. Moreover, birds migrate across a broad front, covering hundreds of miles each night, so the location of the survey point generally reflects the use patterns of the surrounding area. Surveys were conducted from sunset to sunrise using X-band radar, on nights when weather conditions permitted radar operation, to adequately document bird movements.

The overall passage rate for the entire survey period, measured as mean ± standard error, was 74 ± 15 targets/km/hr (t/km/hr) (119 ± 24 targets/mi/hr). Nocturnal passage rates were highly variable among nights, ranging from 0 to 404 t/km/hr (0 to 650 t/mi/hr). The mean flight direction through the survey area was 194° ± 144° (i.e., slightly southwest). The mean flight altitude of all targets observed on the radar was 393 m ± 12 m (1290 ft ± 39 ft) above ground level (agl) (Table 4.4-1). The average nightly flight altitude ranged from 252 m ± 43 m (828 ft ± 140 ft) agl to 506 m ± 27 m (1661 ft ± 88 ft) agl. The percentage of targets observed flying below 150 m (492 ft) agl (maximum turbine height) varied by night from two to 38 percent; however, on only four out of the 30 nights did it exceed 10 percent (Table 4.4-1). The survey period average for targets flying below 150 m (492 ft) was five percent (Table 4.4-1).

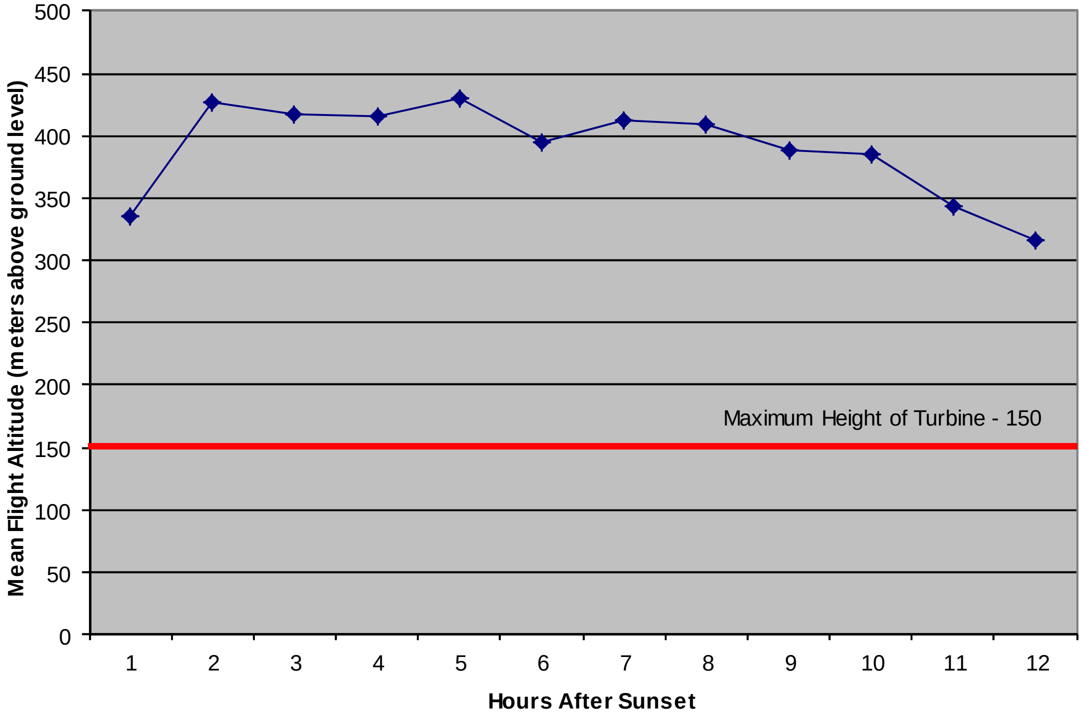
The results of the radar analysis indicate that passage rates were low when compared to other sites in the U.S. with publicly available data (Appendices F and G). Additionally, the mean flight altitude of night migrating passerines was well above the maximum height of the wind turbines (Table 4.4-1). Figure 4.4-3 shows that the hourly average was typically 200 m (656 ft) or more above the maximum height of the turbines.

Table 4.4-1 Summary of Mean Flight Altitudes of Night Migrating Passerines Recorded During 2007 Surveys Conducted Immediately North of the Action Area

Sample Night	Mean Altitude (m) [ft]	Standard Error (m) [ft]	Percent of targets below 150 m [492 ft]
9/5/2007	506 [1,660]	27 [88.6]	4%
9/6/2007	455 [1,493]	10 [32.8]	2%
9/9/2007	485 [1,591]	13 [42.7]	2%
9/10/2007	466 [1,529]	32 [105.0]	8%
9/11/2007	490 [1,608]	22 [72.2]	4%
9/12/2007	395 [1,296]	36 [118.1]	10%
9/13/2007	445 [1,460]	17 [55.8]	3%
9/14/2007	444 [1,457]	15 [49.2]	2%
9/15/2007	387 [1,270]	16 [52.5]	5%
9/16/2007	284 [932]	48 [157.5]	33%
9/17/2007	268 [879]	32 [105.0]	38%
9/18/2007	421 [1,381]	16 [52.5]	2%
9/21/2007	415 [1,362]	16 [52.5]	7%
9/22/2007	376 [1,234]	20 [65.6]	6%
9/23/2007	382 [1,253]	32 [105.0]	14%
9/24/2007	409 [1,342]	22 [72.2]	5%
9/25/2007	396 [1,299]	12 [39.4]	5%
9/27/2007	399 [1,309]	23 [75.5]	2%
10/1/2007	346 [1,135]	12 [39.4]	5%
10/2/2007	382 [1,253]	8 [26.2]	4%
10/3/2007	424 [1,391]	23 [75.5]	3%
10/4/2007	408 [1,339]	16 [52.5]	7%
10/5/2007	389 [1,276]	9 [29.5]	7%
10/6/2007	396 [1,299]	14 [45.9]	3%
10/7/2007	441 [1,447]	18 [59.1]	3%
10/9/2007	378 [1,240]	19 [62.3]	5%
10/10/2007	252 [827]	43 [141.1]	19%
10/11/2007	372 [1,220]	6 [20]	4%
10/12/2007	292 [958]	7 [23]	6%
10/13/2007	296 [971]	21 [68.9]	8%
Entire Sampling Period	**393 [1,289]**	**10 [32.8]**	**5%**

Source: Based on data provided in Stantec 2008a.

Figure 4.4-3 Mean Flight Altitude (Hourly Average) of Night Migrating Passerines Recorded During 2007 Surveys Conducted Immediately North of the Action Area



Raptors

Raptors are typically diurnal (i.e., daytime) migrants that use weather systems and topographic features to assist in migration. Daytime raptor surveys were conducted in fall 2007 and spring and fall 2008 (refer to Table 4.4-2 for survey dates) to document raptor species migrating through the Action Area, as well as behavioral characteristics such as flight altitude and direction (Table 4.4-2; Stantec 2009). In fall 2007 and 2008, a combined total of 35 days (233 hours) of survey were conducted. In spring 2008, 32 days (216 hours) of surveys were conducted. Continuous observation surveys were conducted on non-consecutive days on an open hillside in the central portion of the Action Area near the town of Mingo. A nearby communication tower provided a reference for raptor flight altitudes. Raptors also were counted during a sandhill crane survey conducted from November 16 through December 15, 2008 (Table 4.4-2; Stantec 2009).

Table 4.4-2 Summary of Raptor Observations from Four Surveys Conducted in the Action Area

	No. of observation days	No. of raptors observed	No. of Species	Observation rate (total survey hours)	Raptors observed at < 150 m (492 ft) AGL (%)
Fall 2007 Aug 30 – Oct 29	11	421	8	6.4 birds/hr (66)	84
Spring 2008 Mar 1 – May 15	32	1,476	12	6.8 birds/hr (216)	95
Fall 2008 Sept 1- Nov 15	24	481	7	3.5 birds/hr (167)	93
Fall 2008 Nov 16 – Dec 15 Sandhill Crane Survey	12	27	6	0.3 birds/hr (84)	96

Source: Stantec 2009

The majority of raptors observed during the survey periods were turkey vultures (fall 2007 n=380, 90% of total observed; spring 2008 n=1,347, 91%; fall 2008 n=527, 91%). Red-tailed hawks were the second most commonly observed species (fall 2007 n=14, 3%; spring 2008 n=98, 7%; fall 2008 n=32, 6%). Appendix G contains the full results of the raptor survey.

The overall number of raptors observed during the raptor surveys conducted in the Action Area was relatively low compared to numbers observed at several regional Hawk Migration Association of North America (HMANA) sites. Observation rates at regional HMANA sites ranged from 5.2 to 3,082.8 birds/hour during fall 2008 (Stantec 2009). The most active site was at Detroit River Hawk Watch (DRHW), Pointe Mouillee, Michigan, which is also the closest hawk watch site to the Action Area (approximately 217 km [135 mi] north from the center of the Action Area). At DRHW, a total of 323,691 raptors were counted during 105 survey hours (3,082.8 birds/hour) during fall 2008 (Hawk Watch 2008). This was likely due to the close proximity of the site to Lake Erie, which is historically known to concentrate large numbers of raptors.

When compared to 14 other publicly available spring pre-construction raptor surveys conducted from 1999 to 2006 for wind projects in the Northeast (Stantec 2009, Appendix B, Table 5), the passage rate observed for the Project in spring 2008 (6.8 birds/hr) was similar to that of many projects in agricultural settings. The average passage rate for these sites was 5.2 birds/hr (rate range 0.9-25.6 birds/hr) in spring. When compared to passage rates for 17 other fall pre-construction surveys conducted from 1996 to 2007 for wind projects (Stantec 2009, Appendix B, Table 6), the passage rate for the Action Area in fall 2008 (3.5 birds/hr) is among the lowest. Passage rates for other fall surveys averaged 4.4 birds/hr (range of 3.0-12.7 birds/hr). Appendix G contains full survey results.

Geographical location and topography can affect the magnitude of raptor migration at a particular site. Two geographical features primarily used by raptors during migration are ridgelines and the shorelines of large bodies of water. Updrafts formed as the wind hits the ridges and thermals created over land (and not water) make for energy-efficient travel over long distances (Liguori 2005). For this reason raptors tend to follow corridors or pathways, such as prominent ridges with defined edges or shorelines, during migration. The lower passage rate at the Action Area is likely due to a lack of prominent landscape features that concentrate raptor migration.

Waterbirds

The limited amount of wetlands, streams, and other open water habitats in the Action Area limits use of the area by waterbird species, and few waterbird species were observed during breeding bird surveys conducted in spring and summer 2008 (May 3 to July 29, 2008) (Stantec 2009; Hull 2009d). Canada geese, mallard, wood duck, and great blue heron were occasionally detected flying overhead or on the streams within the Action Area (Stantec 2009; Hull 2009d), and Canada goose is the only waterbird species commonly detected on the breeding bird survey (BBS) route within the Action Area. Suitable waterbird habitat is sparsely distributed within the Action Area, and there are very few large perennial bodies of open water. Larger perennial streams include Kings Creek, Buck Creek, Dugan Run, and Little Darby Creek. There are no lakes or large ponds within the Action Area.

Breeding Birds

A breeding bird survey was conducted from May 3 to July 29, 2008 at 90 point count locations within and in the vicinity of the Action Area (Stantec 2009). Point count locations were sampled four times throughout the breeding season. A total of 5,947 individual birds representing 97 species were documented during the breeding bird survey. The most commonly observed species were red-winged blackbird, horned lark, American robin, song sparrow, American crow, and European starling. Appendix E contains the complete results of the breeding bird survey.

In addition to the breeding bird data collected for the Project, other available breeding bird data for the Action Area were available through the BBS. The BBS is a cooperative effort between the USGS's Patuxent Wildlife Research Center and Environment Canada's Canadian Wildlife Service to monitor the status and trends of North American bird populations. Following a rigorous protocol, BBS data are collected annually along thousands of randomly established roadside routes throughout the continent. One BBS route occurs within the Action Area: Route 66031 passes through the northwest corner of the Action Area near Kings Creek. Seventy-six species of birds have been documented on this route at least once within the most recent 15 years of available data (1992 to 2007) (USGS 2007). The 13 most frequently observed species include: red-winged blackbird, European starling, American robin, house sparrow, common grackle, mourning dove, song sparrow, Canada goose, eastern meadowlark, American crow, horned lark, barn swallow, and savannah sparrow. Each of the most frequently observed species was observed an average of 15 or more times per year since 1993. The results of the breeding bird surveys conducted for the Project (Stantec 2009) are consistent with the BBS data.

Ohio Breeding Bird Atlas maps (OBBA 2010) depict the diversity of species found within the Action Area over the course of the past 25 years. The OBBA conducts surveys on a grid, and tracks the number of species observed in each grid square, or block. The Action Area encompasses all or part of 22 OBBA blocks, and the total number of species in each block varied from the 37 to 74 (Table 4.4-3). Bordering the Action Area to the west and south are blocks where more than 75 individual species have been observed. The OBBA identifies priority blocks that contain high species diversity, sensitive habitats, and/or species of concern. All or part of three priority blocks fall within the Action Area, one in the southwest corner, one in the northwest corner, and a small portion of one along the eastern boundary (OBBA 2010).

Table 4.4-3 Summary of Ohio Breeding Bird Atlas Surveys

Block name	Block ID	Number of Species				
		Observed	Possible	Probable	Confirmed	Total
Kingscreek 2	56C3CW	0	9	48	15	72
Kingscreek 3	56C3SW	0	6	32	1	39
Kingscreek 5	56C3CE	0	7	30	7	44
Kingscreek 6	56C3SE	0	6	31	6	43
Mechanicsburg 1	56D4NW	0	10	28	5	43
Mechanicsburg 2	56D4CW	0	8	42	9	59
Mechanicsburg 3	56D4SW	0	11	30	8	49
Mechanicsburg 4	57D4NE	1	7	38	19	65
Mechanicsburg 5	57D4CE	0	12	24	4	40
Mechanicsburg 6	57D4SE	0	7	32	3	42
North Lewisburg 2	56C4CW	0	11	36	7	54
North Lewisburg 3	56C4SW	0	7	37	3	47
North Lewisburg 5	57C4CE	1	13	33	11	58
North Lewisburg 6	57C4SE	0	11	18	8	37
Urbana East 1	56D3NW	0	7	29	8	44
Urbana East 2	56D3CW	0	12	50	12	74
Urbana East 3	56D3SW	0	10	55	9	74
Urbana East 4	56D3NE	0	6	35	8	49
Urbana East 5	56D3CE	0	11	40	7	58
Urbana East 6	56D3SE	0	1	43	2	46
Urbana West 5	56D2CE	0	25	46	24	95
Urbana West 6	56D2SE	0	8	60	6	74

Source: Ohio Breeding Bird Atlas II 2012: http://www.ohiobirds.org/obba2/

Bald and Golden Eagles

In response to successful recovery efforts, the bald eagle was fully delisted from the ESA on July 9, 2007 (72 FR 37345, July 9, 2007). However, bald eagles continue to be afforded federal protection under the BGEPA. Bald eagle nesting sites often occur in mature riparian habitat near lakes, rivers, or sea coasts (USFWS 2010). Features influencing nest location include distance to nearest water; diversity, abundance, and vulnerability of prey base; and absence of human development and disturbance (USFWS 2010). Migrant and wintering congregations of bald eagles also favor aquatic habitats with abundant food sources, and will use forested areas for roosting (USFWS 2010). No bald eagles were observed during breeding bird surveys conducted at 90 observation points located within and in the vicinity of the Action Area that were each sampled four times during May, June, and July 2008, and there are no known bald eagle nests within the Project vicinity (Stantec 2009). The nearest known bald eagle nest site is approximately 15.3 km (9.5 mi) from the Action Area in Logan County along the Mad River (M. Seymour, USFWS, personal communication, as cited in Stantec 2011). According to the Avian Knowledge Network database, no winter bald eagle records were found for Champaign County for December through February from 1991 to 2011 (Munson et al. 2011).

Golden eagles are not a federally-listed threatened or endangered species, but are protected under the BGEPA, the MBTA, and the Lacey Act (16 U.S.C. § 3371 *et seq*.). The Action Area is not within the breeding range for golden eagles; however, low densities of golden eagles may migrate through Ohio, or winter in Ohio, but they are a transient species in the region and are not expected to occur regularly in the Action Area.

Raptor migration surveys conducted in 2008 for the Buckeye Wind Project (Stantec 2009) documented a single bald eagle and single golden eagle in the Action Area during both the spring and fall 2008. Similarly, diurnal bird/raptor migration surveys were conducted during the fall 2008, 2009, and spring 2009 for an unrelated project within the Action Area and ten bald eagles were documented during the fall migration period.

The USFWS provided Buckeye Wind with documentation that private landowners observed two juvenile bald eagles within the southwestern portion of the Action Area during the spring and summer of 2011 and an adult bald eagle was reported in November 2011. Two adult bald eagles were reported east of Mutual by the public in April of 2012. One adult eagle was reported by a resident within the Action Area in May 2012. Additionally, a local newspaper reported an adult bald eagle within the Action Area during fall 2009. The USFWS further investigated specific areas from the local reports of bald eagle activity and searched for potential nests by conducting an on-site visual field inspection in October 2011. No bald eagle nests or activity were observed (M. Cota, USFWS, personal communication, as cited in Stantec 2011). Buckeye Wind has taken steps to proactively avoid or minimize impacts to eagles. These measures are described in more detail in Chapter 5.0 of the ABPP (Stantec 2011a). Should new information regarding eagle use of the Action Area become available from post-construction Breeding Bird surveys conducted by Buckeye Wind in accordance with ODNR Protocol, or from other verifiable information from public agencies during the 30-year term of the ITP, Buckeye Wind will work with USFWS to determine if potential risk exists and if a take permit under BGEPA is appropriate.

Bats

Several studies of bat use of the Action Area have been conducted, including acoustic surveys, radar studies, mist net surveys, and swarming surveys (Stantec 2008a; Stantec 2009). The following paragraphs summarize the results of these studies (Appendix G of this EIS contains the complete study reports).

Acoustic Surveys and Radar Studies

Acoustic bat calls were recorded using three Anabat SD1 detectors at each of two meteorological (met) towers during the periods from August 28 to October 29, 2007 and March 29 to September 3, 2008 (Stantec 2008a and 2009; Appendix G). One met tower was located in the central portion of the Action Area and one was located 4 km (2.5 mi) north of the Action Area. The three acoustic bat detectors were placed at each of the two met towers at the following heights: 2 m (7 ft), 20 m (66 ft), and 40 m (131 ft).

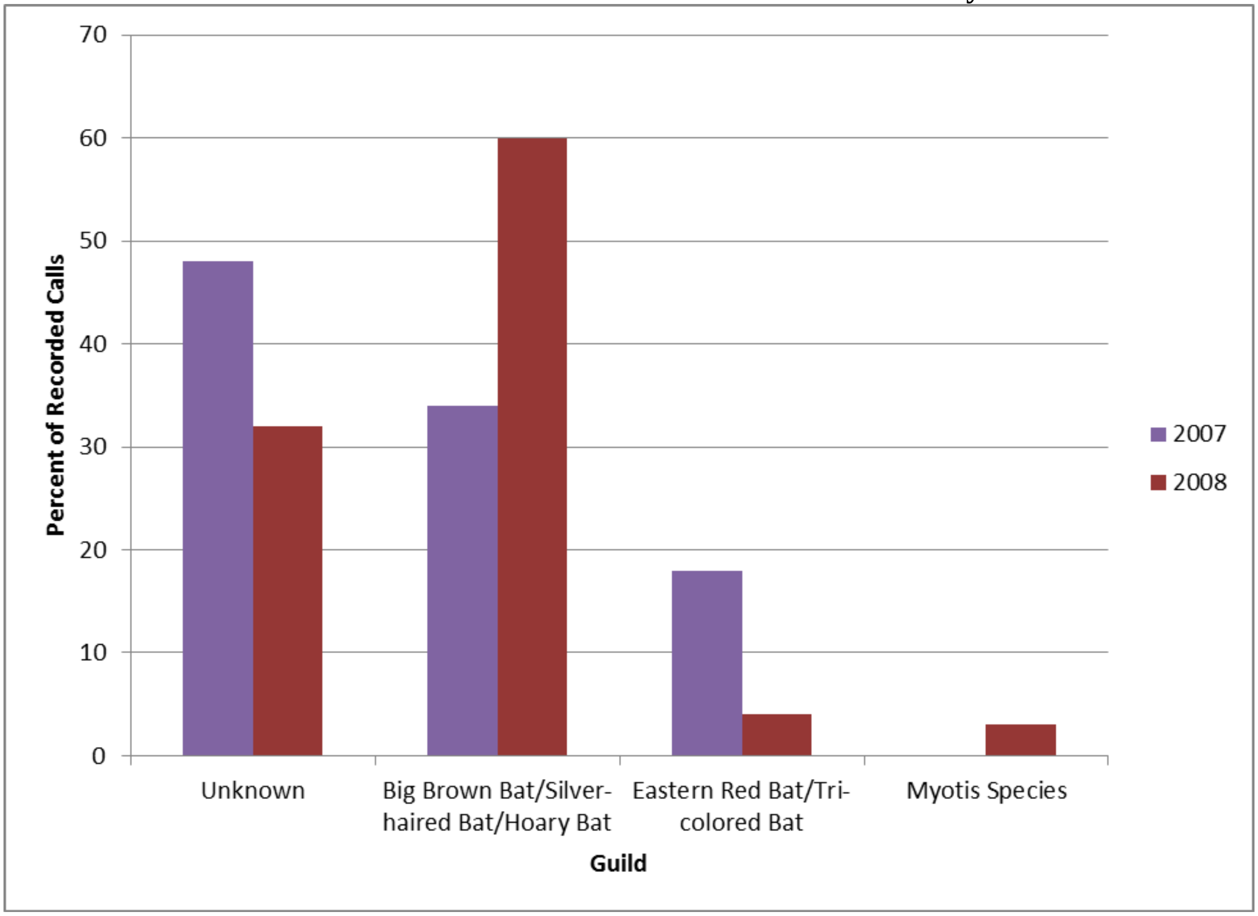
During the 2007 fall survey, a total of 1,522 bat call sequences were recorded, with a mean nightly detection rate of 6.7 call sequences/detector/night (s/d/n) for the entire survey period (Stantec 2008a). The majority of the recorded bat call sequences (48 percent) were identified to the UNKN (unknown) guild, followed by those identified to the BBSHHB (big brown bat/silver-haired bat/hoary bat) guild (34 percent), the RBTB (eastern red bat/tri-colored bat) guild (18 percent), and the MYSP (*Myotis* spp.) guild (< 1 percent) (Figure 4.4-4).

During the spring through fall 2008 survey period, a total of 18,715 bat call sequences were recorded, with a mean nightly detection rate of 23.7 s/d/n for the entire survey period (Stantec

2009). The majority of the recorded bat call sequences (60 percent) were identified as the BBSH (big brown/silver-haired bat) guild, followed by those identified to the UNKN guild (32 percent), the RBTB guild (4 percent), the MYSP guild (3 percent), and the HB (hoary bat) guild (separated from the BBSHHB guild in 2008; 1 percent). Mean nightly detection rate was variable across seasons, with the highest rates recorded during the fall sampling period (August 15 to September 3, 2008) (Figure 4.4-4).

Nocturnal radar surveys and hourly ceilometer surveys were conducted concurrently with the acoustic bat monitoring on 25 nights during the fall 2007 sampling period. Eleven bats were observed during the course of 276 five-minute ceilometer observation periods conducted during the course of the radar surveys. Analysis of the radar survey video data documented that, of the total 4,183 targets, 0.19 percent were identified as potential bats. Bat detections were generally evenly distributed throughout the sampling period (Stantec 2008a).

Figure 4.4-4 Summary of Bat Species Detected During Acoustic Surveys Conducted in 2007 and 2008 in the Action Area and Immediate Vicinity



Source: Based on Data Provided in Stantec 2008a and 2009

Mist Net Surveys

Bat mist netting surveys were conducted on 75 net-nights between June 17 and July 25, 2008 at 13 mist-net sites distributed within the Action Area and four mist-net sites immediately north of the Action Area (Stantec 2009). The average capture rate was 4.0 bats per net per night (b/n/n). Two hundred and ninety-eight bats representing seven species were captured: little brown bat, northern bat, big brown bat, tri-colored bat, hoary bat, eastern red bat, and Indiana bat. The full mist netting report can be found in Appendix G. Two reproductive adult female Indiana bats and one non-reproductive adult male Indiana bat were captured and radio-tagged north of the Action Area, with the closest capture location approximately 7.7 km (4.8 mi) north, in Logan County.

Fifty bats were captured during mist-net surveys conducted in summer 2009 for an unrelated wind power project in an area that overlapped with the Action Area. Mist-netting was conducted at 17 net sites for 136 net nights, from June 15, 2009 to July 6, 2009. Big brown bats made up 44 percent of individuals captured and northern bats made up 34 percent, Indiana bats 10 percent, eastern red bats eight percent, and little brown bats four percent (Jackson Environmental Consulting Services, LLC, 2009).

Swarming Surveys

Bat swarming surveys were conducted in fall 2008 at two cave openings located approximately 4 km (2.5 mi) north of the Action Area (Stantec 2009). Bats were captured during five capture events from September 15 to October 27, 2008. Bats were captured using harp traps placed at cave openings and using mist-nets placed across a nearby stream (during one capture event). A total of 884 bats were captured including 653 northern, 201 little brown, 18 tri-colored, and 12 big brown bats (Stantec 2009; Appendix G). Northern bats were the most common species captured during swarming surveys (74%), with males representing 58 percent of all northern bats captured. The second most frequently captured species was the little brown bat, representing 23 percent of all bats captured. Males represented the majority (82%) of all little brown bats captured. The least frequently captured bats were tri-colored bats (2%) and big brown bats (1%). No Indiana bats were captured during the fall 2008 swarming surveys. In addition to the 2 caves openings that underwent swarming surveys, 14 other areas in the Action Area were identified as having potential karst geological features, according to the Ohio Natural Diversity Heritage Database. Ten of these features were visited during a 2008 survey and no features capable of hosting bats were documented at any of those other areas surveyed.

Other Terrestrial Wildlife

Other terrestrial wildlife that inhabit the Action Area include mammals, amphibians, and reptiles. The white-tailed deer is the most commonly observed mammal in the Action Area and this species uses the croplands and fields as foraging and resting areas, particularly in the fall and winter. Other species likely to occur in grasslands or abandoned farmlands include white-footed mouse, short-tailed shrew, eastern mole, and meadow vole. The patches of deciduous forest provide habitat for the Virginia opossum, striped skunk, southern flying squirrel, eastern gray squirrel, eastern fox squirrel, eastern chipmunk, and groundhog. The Ohio GAP Analysis Project documents several amphibian species occurring in the Action Area, especially in wetland or other areas near water, including the redback salamander, eastern tiger salamander, Northern two-lined salamander, longtail salamander, four-toed salamander, American toad, Fowler’s toad, eastern cricket frog, gray treefrog, Northern spring peeper, green frog, pickerel frog, and northern leopard frog (USGS 2010).

Reptiles expected to occur in the Action Area include the midland painted turtle, northern brownsnake, and eastern gartersnake (USGS 2010). The painted turtle is found along most bodies of water, and the northern brown snake is often found under stones, logs, and old boards, so it is likely to be observed around farm outbuildings. The eastern gartersnake is found in various habitats across the state.

State-listed Species of Concern and Special Interest Species

ODNR maintains a list of species, designated as species of concern or special interest, that currently do not warrant designation as threatened or endangered under the Ohio Endangered Species law (ORC Chapter 1518.01–99; 1531.25, 1531.99), but that could become threatened under continued or increased stress (designated as species of concern), or are at low breeding densities within the state (typically because Ohio is at the edge of the species' natural range, designated as special interest).

Nineteen bird species, six bat, two small mammal, and two amphibian species listed as special concern or special interest have been documented within the Action Area (Stantec 2008a; Stantec 2009; and USGS 2010) (Table 4.4-4). One state species of concern, the northern bat, has been petitioned for federal listing by the Center for Biological Diversity. A status assessment of a second state species of concern, the little brown bat, is being completed to determine if threats to the species warrant federal listing.

Table 4.4-4 State Species of Concern and Special Interest Species Known to Occur in the Action Area and Vicinity

Species	General Habitat Description	Occurrence within Action Area and Vicinity
State Species of Concern		
Sharp-shinned hawk *Accipiter striatus*	Forests, agricultural, and suburban areas	• Possible breeding records 1982-1987 and 2006-2010 in 5-county area [a] • Observed in Action Area during migration [b] • Not observed on the BBS survey route that crosses the northern portion of the Action Area during 15 years of survey (1992-2007) [c]
Henslow's sparrow* *Ammodramus henslowii*	Large, continuous blocks of grassland habitat	• Rare in Champaign County, some records in Clark, Union, and Madison counties [a] • Not detected during surveys within and near the Action Area from 2007- 2009 [b] • Not observed on the BBS survey route that crosses the northern portion of the Action Area during 15 years of survey (1992-2007) [c]
Northern bobwhite *Colinus virginianus*	Forested edges	• Confirmed breeding record 1982-1987 and probable breeding records 2006-2010 in 5-county area and recent records exist for Champaign County [a] • Not detected during surveys within and near the Action Area from 2007- 2009 [b] • Observed on the BBS survey route that crosses the northern portion of the Action Area [c]

Species	General Habitat Description	Occurrence within Action Area and Vicinity
Black vulture *Coragypus atratus*	Lowlands along rivers and open landscapes	• Possible breeding records 2006-2010 in 5-county area [a] • Observed in Action Area during migration season [b] • Not observed on the BBS survey route that crosses the northern portion of the Action Area during 15 years of survey (1992-2007) [c]
Bobolink *Dolichonyx oryzivorus*	Grassy fields, hayfields, wet prairies, grassy marshes	• Confirmed breeding records 2006-2010 in 5-county area [a] • Observed in Action Area during breeding season [b] • Observed on the BBS survey route that crosses the northern portion of the Action Area [c]
Great egret *Ardea alba*	Shrubs and trees near freshwater pools and lakes, marshes	• Observed in Action Area during surveys for other wind project [d]
Yellow-bellied sapsucker *Sphyrapicus varius*	Breeds in young forests and along streams, especially in aspen and birch. Winters in variety of forests, especially semi open forests.	• Incidental observations recorded in Action Area during surveys for another wind project.[d]
Tri-colored bat *Perimyotis subflavus*	Edge habitats near mixed agricultural use areas; roost in foliage or tree cavities. Hibernate in caves and mines in winter	• Observed 6.4 km (4 mi) north of Action Area during fall [b] • Observed in Action Area during summer, reproductive females documented [b]
Big brown bat *Eptesicus fuscus*	Feed over water, fields, forest openings, urban and suburban areas; roost on buildings and under bridges. Hibernate in caves and mines in winter	• Observed 6.4 km (4 mi) north of Action Area during fall [b] • Observed in Action Area during summer, reproductive females documented [b]
Northern bat* *Myotis septentrionalis*	Caves and mines are used for hibernation in winter and tree cavities are used in summer	• Observed 6.4 km (4 mi) north of Action Area during fall [b] • Observed in Action Area during summer, reproductive females documented [b]
Little brown bat *Myotis lucifugus*	Caves and mines are used for hibernation in winter and tree cavities are used in summer	• Observed 6.4 km (4 mi) north of Action Area during fall [b] • Observed in Action Area during summer, reproductive females documented [b]
Eastern red bat *Lasiurus borealis*	Trees, shrubs, and clusters of weeds are used for roosting in summer and trees and tree cavities are used for hibernation in winter	• Observed 6.4 km (4 mi) north of Action Area during fall [b] • Observed in Action Area during summer, reproductive females documented [b]
Hoary bat *Lasiurus cinereus*	Forested habitat with small open areas. Trees in edge habitat are used during summer. Overwinter in coastal areas	• Observed 6.4 km (4 mi) north of Action Area during fall [b] • Observed in Action Area during summer, reproductive females documented [b]
Four-toed salamander *Hemidactylium scutatum*	Mature swamp forests, undisturbed vernal ponds, and surrounding forests during breeding season. During non-breeding season, lives in underground burrows or	• Ohio Gap Analysis documents species within Action Area [e]

Species	General Habitat Description	Occurrence within Action Area and Vicinity
	under logs and other debris	
Eastern cricket frog *Acris crepitans crepitans*	Perennial ponds and streams heavily vegetated with weeds	• Ohio Gap Analysis documents species within Action Area [e]
State Species of Special Interest		
Blackburnian warbler *Dendroica fusca*	Forests	• Observed in Action Area during breeding season [b] • Not observed on the BBS survey route that crosses the northern portion of the Action Area during 15 years of survey (1992-2007) [c]
Magnolia warbler *Dendroica magnolia*	Forests	• Observed in Action Area during breeding season [b] • Not observed on the BBS survey route that crosses the northern portion of the Action Area during 15 years of survey (1992-2007) [c]
Brown creeper *Certhia americana*	Forests	• Observed in Action Area during surveys for other wind project [d]
Northern waterthrush *Parkesia noveboracensis*	Forests, generally near water	• Observed in Action Area during surveys for other wind project [d]
Golden-crowned kinglet *Regulus satrapa*	Forests	• Observed in Action Area during surveys for other wind project [d]
Pine siskin *Spinus pinus*	Open woodland	• Observed in Action Area during surveys for other wind project [d]
Winter wren *Troglodytes troglodytes*	Forests	• Observed in Action Area during surveys for other wind project [d]
Wilson's snipe *Gallinago delicata*	Marshlands	• Observed in Action Area during surveys for other wind project [d]
Western meadowlark *Sturnella neglecta*	Open grasslands, prairies, meadows, and some agricultural fields	• Observed in Action Area during surveys for other wind project [d]
Mourning warbler *Geothlypis philadelphia*	Disturbed second-growth forested areas, with moderately closed canopy and thick understory	• Observed in Action Area during surveys for other wind project [d]
Purple finch *Carpodacus purpureus*	Forests	• Observed in Action Area during surveys for other wind project [d]
Least flycatcher *Empidonax minimus*	Deciduous forests.	• Possible breeding records 1982-1987 and 2006-2010 in 5-county area. Not observed on BBS survey route in Action Area during 15 years of survey (1992-2007)[a, c] but observed in Action Area during breeding season in 2007 and 2008.[b]
Dark-eyed junco *Junco hyemalis*	Breed in coniferous and deciduous forests. During winter and migration they use a variety of habitats including open woodlands, grasslands/pasture, roadsides, and gardens.	• Incidental sightings recorded in migration period in Action Area during surveys for another wind project [d]

Species	General Habitat Description	Occurrence within Action Area and Vicinity
Hermit thrush *Catharus guttatus*	Open areas inside forests, such as trails, pond edges, or areas partially opened up by fallen trees. In winter, this species occupies forests with dense understory and berry bushes.	• Incidental sightings recorded in migration period in Action Area during surveys for another wind project [d]
Red-breasted nuthatch *Sitta canadensis*	Forests	• Observed in Action Area during surveys for other wind project [d]

[*] Federal Species of Concern
[a] Ohio Breeding Bird Atlas (2009)
[b] Based on pre-construction surveys conducted for Project (Stantec 2008a, 2009)
[c] BBS data for Route 66031 from 1992-2007 (USGS 2010)
[d] West 2010
[e] USGS 2010

4.4.2.2 Aquatic Wildlife

Information from the Ohio Aquatic Gap Analysis Program and ODNR database, as well as known species ranges and existing habitat conditions, indicate that approximately 70 fish species and 25 mollusk species have the potential to occur in the Action Area (Appendix E). Most of these species are common in the region, although several of the fish and mollusk species with potential to occur are federally- or state-listed as endangered, threatened, or other special-status (see Section 4.5).

4.5 Rare, Threatened, and Endangered Species

4.5.1 Scope of Analysis

The species analysis in this EIS considers plant and animal species that are federally-listed as threatened, endangered, candidate, proposed, and species of concern; species that are state-listed as threatened, endangered, species of concern, and species of special interest; and/or species that receive specific protection defined in federal or state legislation. This analysis considered species that could potentially occur within the Action Area.

Information collected or reviewed for this analysis includes ODNR's Natural Heritage Database (2010), Ohio Breeding Bird Atlas II (2009), and biological data for the region (Natureserve 2007). In addition, as discussed in Section 4.4 above, site-specific surveys were conducted in and around the Action Area from 2007 to 2009 to determine the presence of threatened and endangered species and their habitats (Hull 2009d; Stantec 2008a; Stantec 2009). Wildlife surveys conducted in the Action Area for another wind project (West 2010) also provided other information for this analysis.

4.5.2 Existing Conditions

There are four federally-listed species, two candidate species for federal listing, two Federal Species of Concern, and 22 state-listed wildlife species with the potential to occur within the Action Area (note that there are a total of 22 species due to dual federal and state listing status of five species). Table 4.5-1 lists these wildlife species and summarizes their habitat preferences and known or potential occurrence within the Action Area. Of these 22 species, 12 are not expected to occur in the Action Area or are expected to occur only as transients due to lack of suitable habitat (Table 4.5-1).

Table 4.5-1 Federal- and State-listed Threatened and Endangered Wildlife Species with Potential to Occur in the Action Area

Species [a]	Listing Status	General Habitat Description [a]	Occurrence in Action Area Vicinity
Indiana bat *Myotis sodalis*	FE SE	Winter hibernacula are in caves and abandoned mines and summer roosts are in trees and tree hollows.	Maternity colonies documented in Logan County and in Champaign County. [b] Captured during summer 2009 mist net surveys in Action Area. [c]
Clubshell mussel *Pleurobema clava*	FE SE	Coarse sand and gravel areas of runs and riffles within streams and small rivers.	Once suspected to potentially occur in the Action Area in Little Darby Creek. However in January 2011, the USFWS removed this species from the list of federally listed or proposed species potentially present in Champaign County because current distribution and habitat data for Little Darby Creek within Champaign County indicate it is not suitable for this species. **Not expected to occur in Action Area.**
Eastern massasauga *Sistrurus catenatus*	FC SE	Wetlands, wet prairie, or nearby woodland or shrub edge habitat. Occurs seasonally in shallow wet lowlands and drier upland areas with gasses and forbs.	Documented to occur in Champaign County, limited suitable habitat in the Action Area. One wetland in the Action Area was identified as suitable habitat. Measures will be taken to avoid potential impacts to the species in this area.
Rabbitsfoot mussel *Quadrula cylindrica cylindrical*	FC SE	Small to medium-sized streams and some larger rivers in shallow areas along the bank and adjacent runs and shoals where the water velocity is reduced. Sometimes occupy deep water runs (2.7 – 3.7 m [9 – 12 ft]). Bottom substrate is typically sand and gravel.	Once suspected to potentially occur in the Action Area in Little Darby Creek. However in January 2011, the USFWS removed this species from the list of federally listed or proposed species potentially present in Champaign County because current distribution and habitat data for Little Darby Creek within Champaign County indicate it is not suitable for this species. **Not expected to occur in Action Area.**
Rayed bean mussel *Villosa fabalis*	FE SE	Smaller headwater streams, shoal or riffle areas with gravel and sand substrate, and shallow, wave-washed areas of lakes.	Historically known from Big and Little Darby Creeks, and may occur in these creeks or other perennial streams within the Action Area. [d]
Snuffbox mussel *Epioblasma triquetra*	FE SE	Swift currents of riffles and shoals over gravel and sand with occasional cobble and boulders.	Once suspected to potentially occur in the Action Area in Little Darby Creek. However in January 2011, the USFWS removed this species from the list of federally listed or proposed species potentially present in Champaign County because current distribution and habitat data for Little Darby Creek within Champaign County indicate it is not suitable for this species. **Not expected to occur in Action Area.**
Bobcat *Lynx rufus*	SE	Variety of habitat from forested mountain areas to lowland swamps. In Ohio they occur in forested areas near pastures and cultivated fields.	The known range for this species includes the Action Area, but they were extirpated from Ohio in 1850, and now have only rare occurrences throughout the state. [a] **Not expected to occur in Action Area.**

Species [a]	Listing Status	General Habitat Description [a]	Occurrence in Action Area Vicinity
Northern harrier *Circus cyaneus*	SE	Large contiguous grasslands, marshes, low intensity agriculture and pasture/hayfields.	Not observed on BBS survey route in Action Area during 15 years of survey (1992-2007).[e] Observed in Action Area during spring and fall 2007 and 2008.[c]
Sandhill crane *Grus Canadensis*	SE	Large contiguous wetlands, shallow/standing water, agricultural land.	Observed in the Action Area during migration.[c] Marginal habitat for this species exists within the Action Area. **Not expected to regularly occur or breed in Action Area or Mitigation Area – transient use only.**
Loggerhead shrike *Lanius ludovicianua*	SE FSC	Large, relatively contiguous grasslands and open areas with scattered trees.	One breeding record since 1980 in 5-county area. [e] Not observed on BBS survey route in Action Area during 15 years of survey (1992-2007).[e] Marginal habitat for this species exists within the Action Area. **Not expected to regularly occur or breed in Action Area – transient use only.**
Seepage dancer damselfly *Argia bipunctulata*	SE	Sunny sphagnum seepages, small lakes, ponds, and streams.	Known range for this species includes the Action Area but habitat in the Action Area is generally unsuitable for this species. **Not expected to occur in Action Area.**
Elfin skimmer dragonfly *Nannothemis bella*	SE	Bogs and calcareous fens.	Known range for this species includes the Action Area but the Action Area does not contain any suitable habitat (bogs or fens). **Not expected to occur in Action Area.**
Peregrine Falcon *Falco peregrinus*	ST	Roost on small ledges and rock outcroppings on steep, bare rock walls preferably under an overhang. Migrants sometimes overwinter in large cities where tall buildings are used as roost sites and vantage points for foraging on pigeons.	One individual observed in Action Area during the spring 2008 raptor migration survey. [c] **Not expected to regularly occur or breed in Action Area – transient use only.**
Black-crowned night heron *Nycticorax nycticorax*	ST	Various wetland habitats, including salt, brackish, and freshwater marshes, streams, lakes, and agricultural fields.	As cited in West 2010, this species was observed during BBS although no nesting was documented. [f] **Not expected to regularly occur or breed in Action Area – transient use only.**
Western tonguetied minnow *Exoglossum laurae hubbsi*	ST	Cool to warm clear creeks and small to medium rivers.	Historically occurred in King Creek, which flows west through the northern half of the Action Area. [d]
Lake chubsucker *Erimyzon sucetta*	ST	Ponds, lakes, impoundments, swamps, and other clear waters with little or no flow. In Ohio, generally occurs in glacially formed lakes (potholes, kettle lakes).	Known to occur in small pothole lakes between Bellefontaine and Urbana, west of the Action Area. No suitable habitat for this species in the Action Area. **Not expected to occur in Action Area.**

Listing Status: FE = Federally Endangered, FT = Federally Threatened, FC = Candidate for Federal Listing, FSC = Federal Species of Concern, SE = State Endangered, ST = State Threatened
[a] Species status and habitat descriptions based on ODNR Division of Wildlife (ODNR 2008).
[b] K. Lott, ODNR, personal communication
[c] Based on pre-construction surveys conducted for Project (Stantec 2008a, 2009)
[d] Hull 2009d
[e] Ohio Breeding Bird Atlas (2009) and BBS data for Route 66031 from 1992-2007
[f] West 2010

4.5.2.1 Federally Threatened, Endangered and Candidate Species

The only federally-listed threatened or endangered species known to occur in the Action Area is the Indiana bat, which is federally- and state-listed as endangered (USFWS 2011c). The Action Area lies within the geographic ranges of the clubshell mussel, rayed bean mussel, and snuffbox mussel, which are federal endangered species; and two candidate species for federal listing, the eastern massasauga rattlesnake and the rabbitsfoot mussel (USFWS 2011c). The following sections discuss these five species and their potential to occur in the Action Area. Section 3.2.1 of the HCP (Appendix B to this EIS) contains additional information on these species.

Indiana Bat

The Indiana bat is a small (0.25 to 0.35 ounce [7 to 10 grams]), insectivorous bat. It is physically very similar to the little brown bat, but can be distinguished by its short, inconspicuous toe hairs; smaller foot; keeled calcar; more uniform colored fur; and pinkish colored pug-nose (Whitaker and Hamilton 1998).

Population Status

Indiana bat populations have experienced marked population declines since the 1960s. From 1965 to 2001, there was a decline of approximately 57 percent in the range-wide population (USFWS 2007). The known population of Indiana bats has fluctuated since then, but overall has increased from 328,526 bats in 2001 to 424,708 bats in 2011 (USFWS 2012). Specifically, in the four USFWS-designated Recovery Units (RUs) identified in the Indiana bat Recovery Plan (USFWS 2007) - Ozark-Central, Midwest, Appalachian Mountains, and Northeast - the 2011 Indiana bat populations are as follows: Appalachian Mountains RU 32,529 bats; Midwest RU 305,297 bats; Ozark-Central RU 70,822 bats; and Northeast RU16,060 bats) (USFWS 2012).

This species was first listed as being in danger of extinction in 1967 under the Endangered Species Preservation Act of 1966 (32 FR 4001, March 11, 1967) because of large decreases in population size and an apparent lack of critical habitat in winter (USFWS 1983, 1999). It was listed as an endangered species under the ESA following its enactment in 1973. The Indiana bat Recovery Plan, first published in 1983 (USFWS 1983) and updated in 1999 and 2007 (USFWS 1999, USFWS 2007), outlines the Indiana bat's habitat requirements, critical habitat, potential causes for declines, and recovery objectives. The 2007 Draft Recovery Plan identifies the Recovery Priority for the Indiana bat as an 8, meaning that the species has a moderate degree of threat and high recovery potential. The Recovery Priority was changed to a 5 in the 5-Year Review (USFWS 2009a) in light of white-nose syndrome (WNS) (see below), meaning there is a high degree of threat and a low recovery potential for the species. Recovery of the species initially focused on minimizing disturbance at hibernacula and efforts were made to protect all major hibernacula in the years following its listing. Despite this protection, the species continued to decline in number, suggesting that issues on its summer range or other factors were also contributing to its decline (USFWS 2007).

Several factors have contributed to the decline in the number of Indiana bats, including the loss and degradation of suitable hibernacula; human disturbance during hibernation; pesticides; and the loss, fragmentation, and degradation of forested habitat, particularly stands of large, mature trees (USFWS 2007). Within the last several years, another source of mortality has been WNS. WNS is a condition of hibernating bats that, to date, has been responsible for the death of 5.7 to

6.7 million bats (six species, including Indiana bats) in the eastern U.S. (USFWS 2012b). A newly-described psychrophilic (cold-loving) fungus (*Geomyces destructans*) that grows on noses, faces, ears, and/or wing membranes of the majority of affected bats has been demonstrated to cause WNS (USGS 2011). WNS was first documented in bats in eastern New York at four sites in the winter of 2006 to 2007 and has been associated with substantial mortality of Indiana bats in Connecticut, Massachusetts, New Jersey, New York, Pennsylvania, Vermont, Virginia, and West Virginia during the three winters following its discovery. During winter of 2010 to 2011, WNS was confirmed in one hibernaculum in southern Ohio (Ironton Mine, known to support Indiana bats), as well as at sites in Indiana and Kentucky. As of the winter of 2010 to 2011, 74 hibernacula supporting 37.7 percent of the 2011 Indiana bat range-wide population were known or suspected of being infected by WNS (A. King, USFWS, personal communication). As of winter 2012, WNS has been confirmed in at least six counties in Ohio (Butchkoski 2012). While substantial Indiana bat population increases were observed range-wide between 2001 and 2007, since the onset of WNS in 2006 to 2007, significant population declines have been observed in the Northeast RU (70% decline between 2007-2011) (USFWS 2012). If mortality rates due to WNS at recently infected hibernacula (e.g., hibernacula in IN, KY, WV) are similar to those observed at hibernacula in the Northeast RU, substantial population declines range-wide may occur over the next few years.

Life History

During the winter (generally early November through mid-April), Indiana bats hibernate in underground habitat such as caves and mines, in large colonies sometimes numbering over 100,000 individuals. In spring (April through May), Indiana bats leave the hibernacula and migrate to their summer habitat. Individuals have been documented to travel as far as 575 km (357 mi) between hibernacula and summer habitat (Winhold and Kurta 2006), although some individuals may migrate only a few kilometers. Summer roosts are typically under the exfoliating bark of dead or live trees or in tree cavities, although some males may remain in underground habitat year-round (Whitaker and Brack 2002). Roost trees may be in open areas, forests, riparian habitat, or even residential developments.

Some males may remain near the hibernacula throughout the year, move short distances to other caves or mines, or migrate to distant areas (Whitaker and Brack 2002).

At their summer roosts, pregnant Indiana bats form maternity colonies (also referred to as maternity roosts) of between 25 and 100 bats (although sometimes more), and typically give birth to one pup. Pups are normally born in late June and early July and grow quickly, becoming capable of flight between early July and early August. Indiana bats begin their autumn migration to their hibernation sites beginning in late August.

Range-wide Distribution

The Indiana bat occurs from Iowa, Oklahoma, and Wisconsin, northeast to Vermont, and south to northwestern Florida and northern Arkansas (Barbour and Davis 1969). Figures 4.5-1, 4.5-2, and 4.5-3 show the winter and summer population distribution and the major migratory corridors for the Indiana bat. The largest hibernating populations of Indiana bats occur in the limestone cave regions of Kentucky, Missouri, and Indiana. Recently however, large hibernating colonies have been found in abandoned underground mines in Illinois, Ohio, New Jersey, and New York. Approximately 86 percent of the estimated range-wide population in 2005 was known from hibernacula in just four states: Indiana (49.0%), Kentucky (14.8%), Illinois (13.7%), and New York (8.4%). Currently, the USFWS has designated critical habitat for the Indiana bat at 11 caves and two non-coal mines: six in Missouri, two each in Indiana and Kentucky; and one each in Illinois, Tennessee, and West Virginia (USFWS 2007).

Figure 4.5-1 Indiana Bat Winter Population Distribution

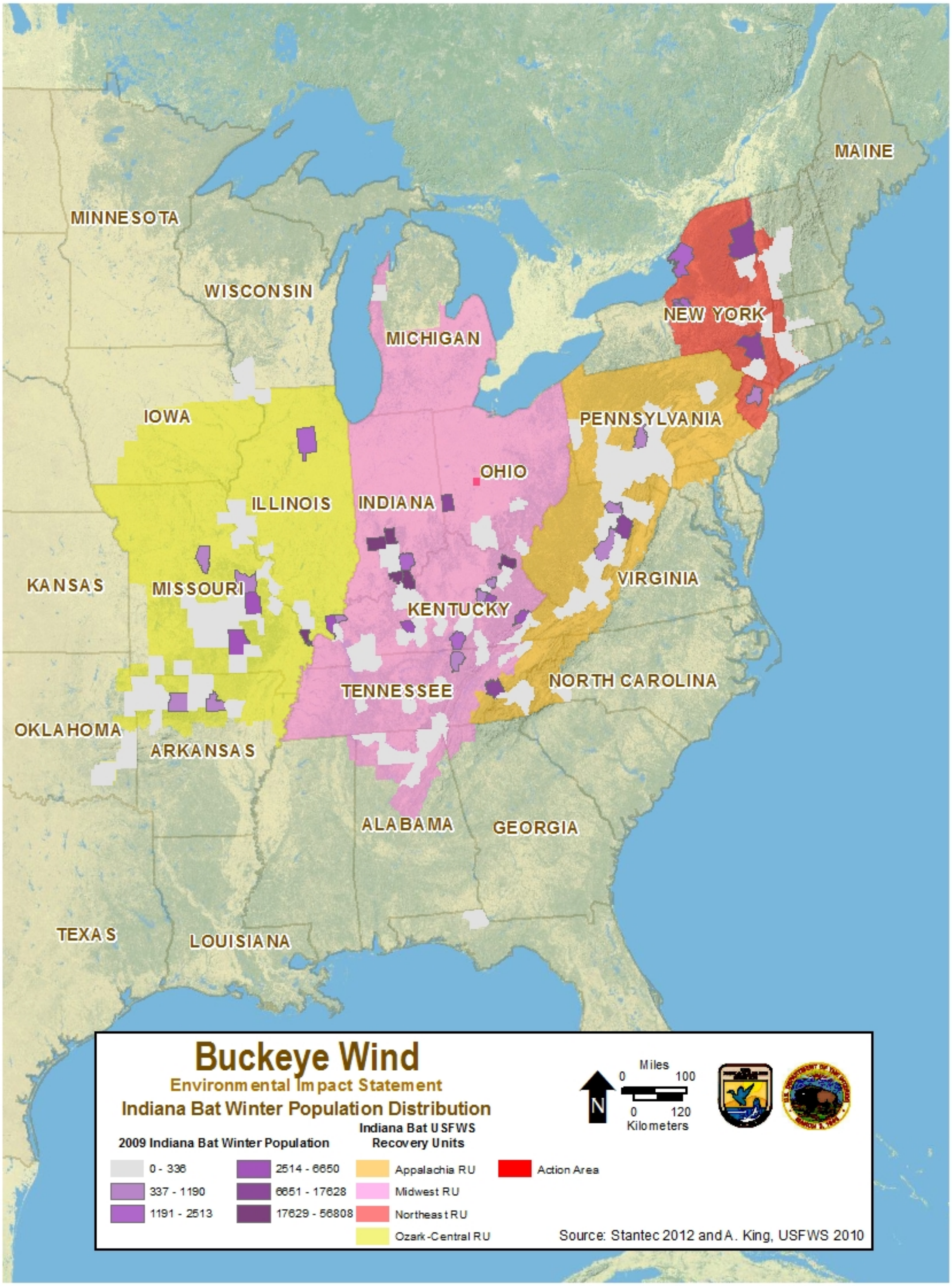


Figure 4.5-2 Indiana Bat Summer Records

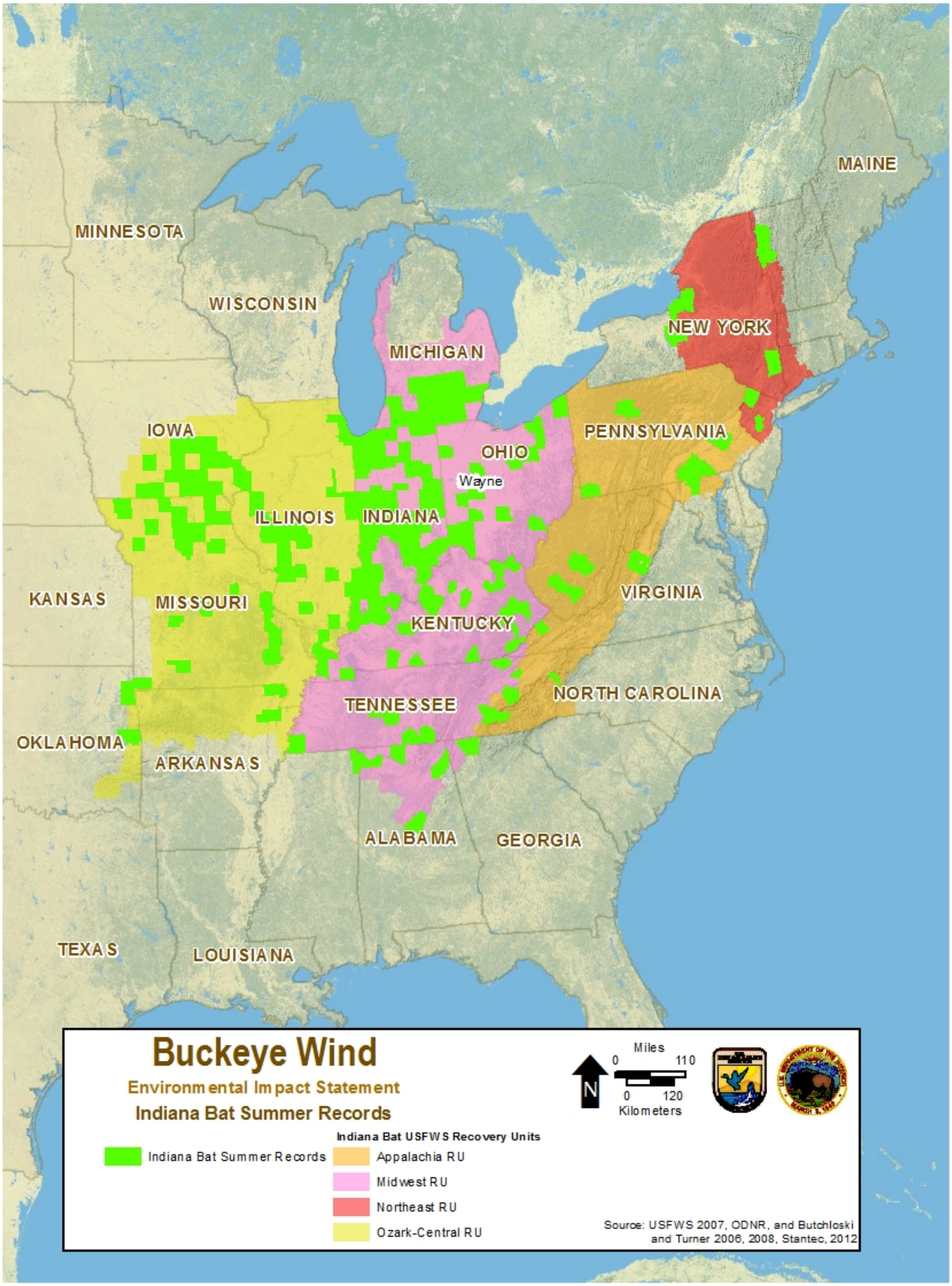
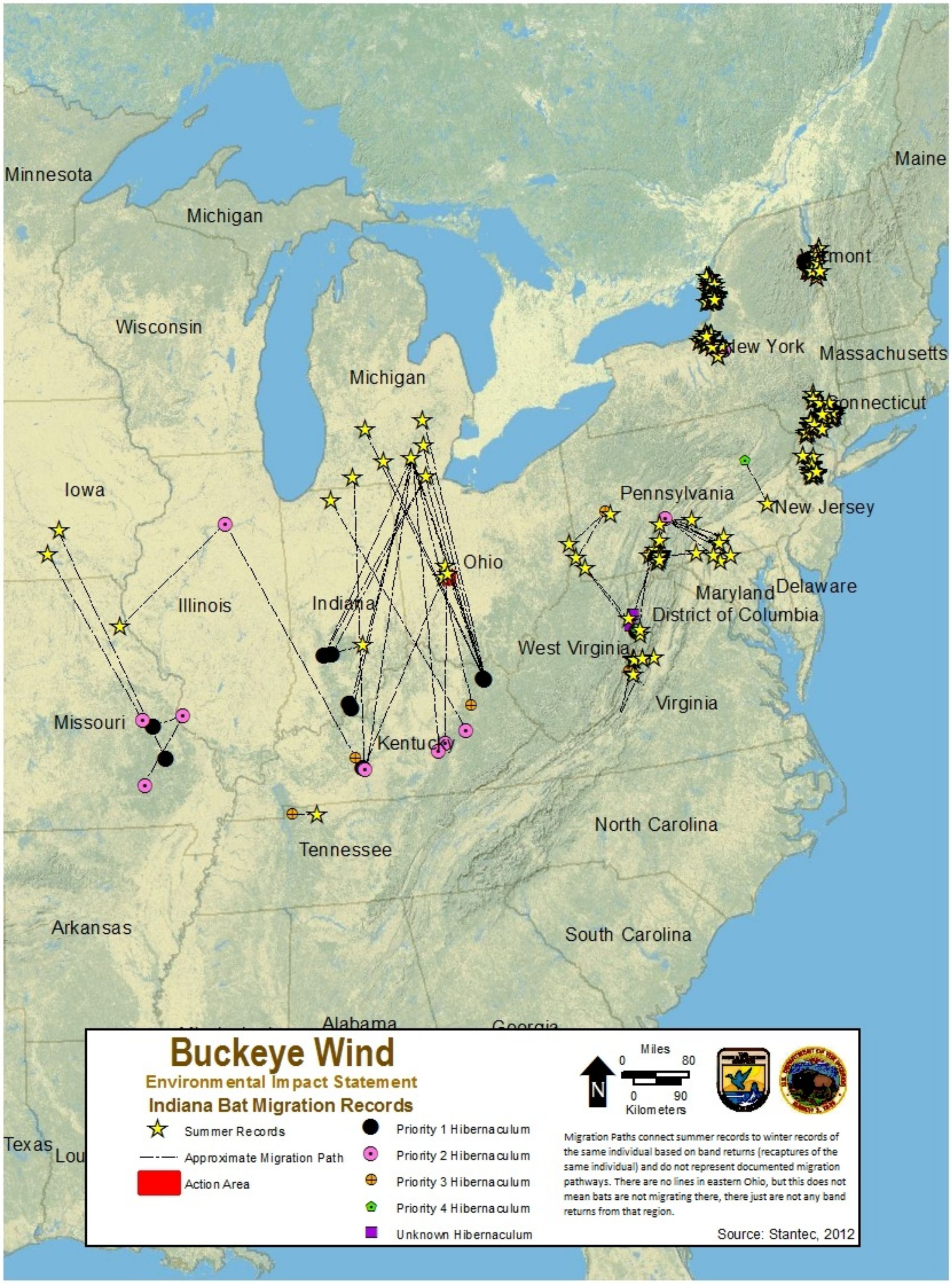


Figure 4.5-3 Indiana Bat Migration Records



There are two known major bat winter hibernacula within the state of Ohio: the Lewisburg Limestone Mine in Preble County, Ohio's largest known Indiana bat hibernaculum, and the Ironton Mine in Lawrence County. These sites support roughly two percent of the range-wide population. The 2011 population estimate for the Ironton Mine was 276 Indiana bats and for the Lewisburg Limestone Mine was 9,594 Indiana bats (M. Seymour, USFWS, personal communication). The Action Area is approximately 100.6 km (62.5 mi) southwest of the Lewisburg Limestone Mine and 164 km (102 mi) northwest of the Ironton Mine.

The distribution of Indiana bats expands during the spring and summer. Based on current records, the core Indiana bat summer range includes southern Iowa, northern Missouri, northern Illinois, northern Indiana, southern Michigan, and western Ohio. As of 2011, evidence of Indiana bat maternity colonies has been documented in 25 Ohio counties (M. Seymour, USFWS, personal communication).

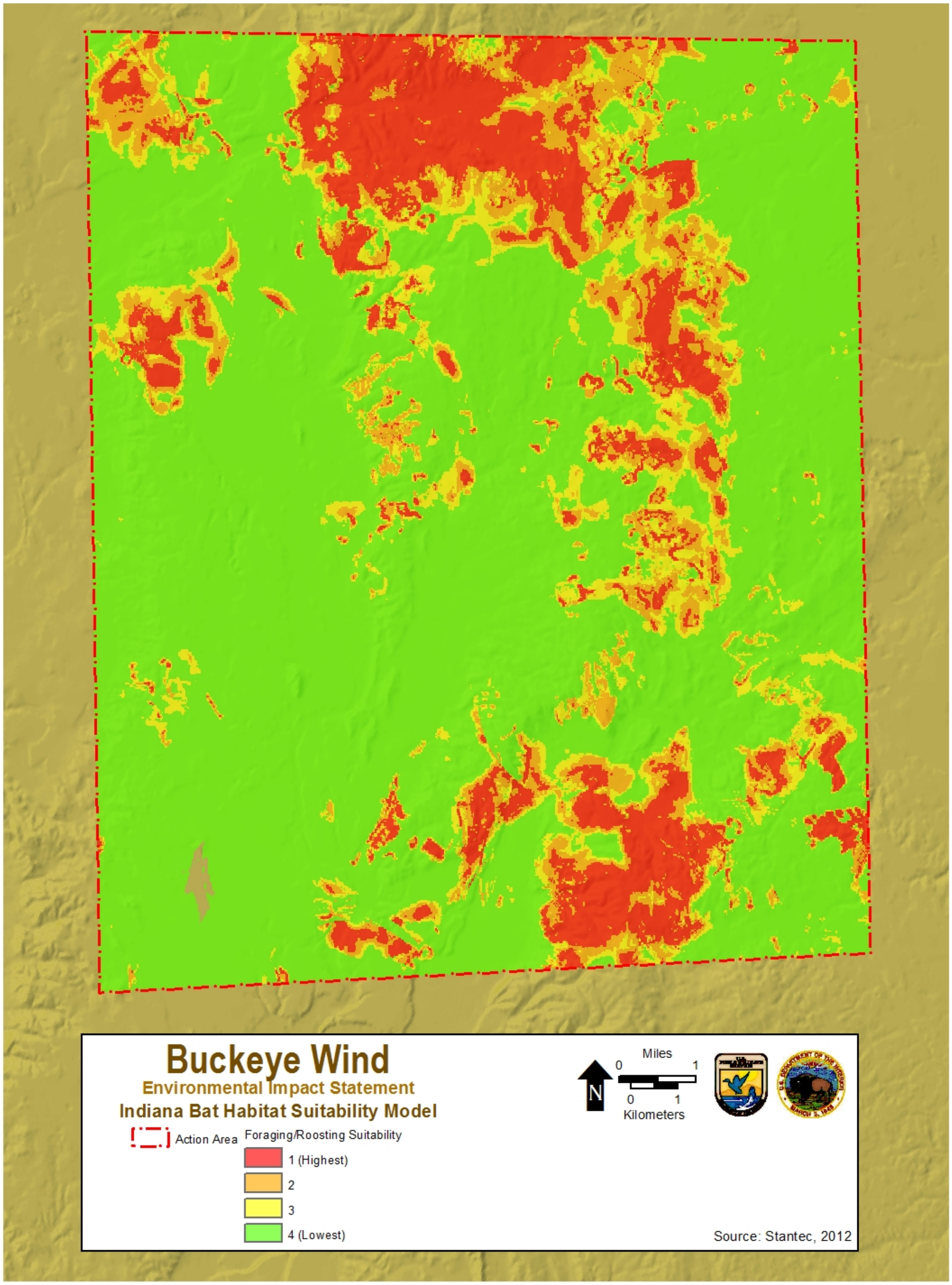
Distribution within the Action Area

Limited data exist on the presence of Indiana bats in west-central Ohio during summer. In 2008 to 2009, summer reproductive records were documented for Champaign, Hardin, and Logan Counties during mist-netting surveys for proposed wind power projects, including the proposed project (Stantec 2008a; K. Lott, ODNR, personal communication). Twenty-six Indiana bats (n=24 females, n= 2 males) were captured and 43 roost trees were identified in 2008 and 2009 in an area known as the Bellefontaine Ridge, which overlaps part of the northern portion of the Action Area (Stantec 2008a, K. Lott, ODNR, personal communication). Four female Indiana bats were captured within the Action Area during 2009 summer mist net surveys, and one additional Indiana bat escaped as it was being removed from the net. Three of these females were determined to have summer maternity roosts in the Action Area. The fourth Indiana bat roosted in a tree that was 2.4 km (1.5 mi) east of the Action Area, where her transmitter signal was subsequently lost. Through radio telemetry studies and an estimate of their summer home range using the minimum convex polygon (MCP) method (described in the HCP in Appendix B), it was determined that 93 percent of the summer home range[3] for the three bats that roost in the Action Area lies within an area constituting approximately three percent of the Action Area. Suitable Indiana bat summer foraging and maternity habitat is distributed throughout the Action Area (see Figure 4.5-2 and Appendix B).

In addition to summer use, Indiana bats may occasionally travel or roost throughout the Action Area during fall migration (approximately August 1 through October 31) and spring migration (approximately April 1 through May 31), and the species is assumed present throughout the entire Action Area (Figure 4.5-4). Appendix B of this EIS contains more detailed information on the results of these surveys and on Indiana bat use of the Action Area.

[3] The "home range" for an Indiana bat is the area where an Indiana bat forages, commutes, night-roosts, and drinks. This range varies from individual to individual, based on factors such as sex, age, habitat, and reproductive status.

Figure 4.5-4 Indiana Bat Habitat Suitability Model



Clubshell Mussel

The clubshell mussel is a federally-listed endangered species and an Ohio State endangered species. This mussel can be found in coarse sand and gravel areas of runs and riffles within perennial streams and small rivers and is known from the Little Darby Creek watershed. According to the USFWS, the clubshell was formerly suspected to occur in portions of Little Darby Creek within Champaign County. However, in January 2011, the USFWS removed clubshell mussel from the list of species potentially present in Champaign County because current distribution and habitat data for Little Darby Creek within Champaign County indicate it is not suitable for the species (USFWS 2011d).

Eastern Massasauga

The eastern massasauga rattlesnake is a candidate for federal listing and is an Ohio State endangered species. Since designated as a candidate species in 1999, it has declined significantly throughout its range, and populations in Ohio that were once spread throughout glaciated portions of the state are now small and isolated. Several factors have contributed to the decline of the species including habitat loss and fragmentation, indiscriminate killing, collection, gene pool contamination and incompatible land use practices.

Eastern massasaugas use both upland and wetland habitat and these habitats differ by season. During the winter, massasaugas hibernate in low wet areas, primarily in crayfish burrows, but may use other structures. Presence of a water table near the surface is important for a suitable hibernaculum. In the summer, massasaugas use drier, open areas that contain a mix of grasses and forbs such as goldenrods and other prairie plants that may be intermixed with trees or shrubs. Adjoining lowland and upland habitat with variable elevations between are critical for the species to travel back and forth seasonally.

There are records of this species in Champaign County outside of the Action Area (USFWS pers. comm. September 23, 2010). While there are no known occurrences of eastern massasauga rattlesnakes in the Action Area (M. Seymour, USFWS, personal communication), a desktop habitat assessment was conducted using recent aerial photographs, NWI wetland mapping, and field delineated wetland boundaries, to determine if suitable habitat for the massasauga is present within the Action Area. Specifically, emergent or scrub-shrub wetlands located immediately adjacent to upland grassland (e.g. native grassland, pasture, hayfield, etc.) were identified as potential habitat. Potential habitat areas identified during the desktop assessment were field-verified to determine if suitable habitat is present. The desktop assessment revealed that the majority of the small number of wetlands present in the Action Area do not have any adjacent grassland, and at those sites that do, the grassland present is very limited. Furthermore, while wetlands are present within the Action Area, there are no wetland impacts proposed as a result of construction, operation, and decommissioning of the Project (see Section 5.2). However, a field review was conducted by USFWS and Ohio State eastern massasauga experts who identified one area of suitable habitat at one location within the Action Area. Project facilities avoid that habitat and no loss of potential habitat would occur as a result of the Project; however construction activities will occur near that habitat. In addition, Buckeye Wind worked with USFWS and ODNR DOW to relocate an access road that was previously located in close proximity to the wetland. In order to evaluate the potential for impacts to massasauga, Buckeye Wind may elect to complete a massasauga survey to document the presence or likely absence of the species within this area, or they may assume that the species is present within this area. If a survey is completed and no massasaugas are found, they would be assumed absent from the area, no additional measures to protect the species would be warranted, and the project would have no effect on the species. If the survey documents the presence of the species, or if no survey is completed and presence of the species is assumed, multiple avoidance and minimization measures will be implemented such that the project is not likely to adversely affect the species (see Section 5.5).

Rayed Bean Mussel

The rayed bean mussel is a federally-listed endangered species and an Ohio endangered species. This species is generally known from smaller headwater creeks, although records also exist of occurrence in larger rivers and lakes. These mussels are usually found in or near shoal or riffle areas, and in the shallow, wave-washed areas of lakes. Favored substrates typically include gravel and sand, and they are often associated with, and buried under the roots of, vegetation, including water willow and water milfoil. Historically the rayed bean mussel occurred throughout much of the Ohio River system, including Big and Little Darby Creeks which flow through portions of the Action Area. Recent records (less than 30 years old) indicate that only relic shells are in these two creeks, and field investigations carried out in 2008 found the stream bed to be dry and the stream reach for this part of Little Darby Creek was scored as 46 using the Headwaters Habitat Evaluation Index (HHEI), indicating that the reach is Class II intermittent headwaters habitat and the substrate is dominated by cobble and sand (Hull 2009d). The required perennial base flow and the preferred substrates of the rayed bean are not present in this reach of Little Darby Creek.

The rayed bean has the potential to occur in other perennial streams with suitable habitat within the Action Area. Buckeye Wind will directionally drill beneath or otherwise avoid in-water work for any Ohio designated Exceptional Warmwater Habitat or Cold Water habitat streams[4] in the Action Area (i.e., underground crossings for electric collection lines) to avoid and minimize impacts to aquatic habitats. For perennial stream corridors that have the required base flow and substrate to support rayed bean mussels and would be crossed by access roads, crane paths and/or collection lines resulting in in-water work, a survey may be performed to detect the presence or absence of the rayed bean mussel, or presence of the species may be assumed. If no rayed bean are detected during the survey, the species will be assumed absent, no additional measures to protect the species would be warranted, and the project would have no effect on the species. If rayed bean are determined to be present or if no survey is performed and they are assumed present, in-water work would be avoided either through directional drilling, access road re-routing, arched bridge structures or temporary crossings such that the Project is not likely to adversely affect the rayed bean (see Section 5.5).

[4] According to Ohio Revised Code 3745-1-07, Exceptional Warmwater Habitat streams are capable of maintaining an exceptional or unusual community of warmwater aquatic organisms with the general characteristics of being highly intolerant of adverse water quality conditions and/or being rare, threatened, endangered, or species of special status. This is the most protective use designation assigned to warmwater rivers and streams in Ohio. A Coldwater Habitat stream is capable of supporting populations of coldwater aquatic organisms on an annual basis and/or put-and-take salmonid fishing. These water bodies are not necessarily capable of supporting the successful reproduction of salmonids and may be periodically stocked with these species. Both are afforded special protections under Ohio's CWA provisions.

Rabbitsfoot Mussel

The rabbitsfoot mussel is a candidate for federal listing under the ESA and an Ohio endangered species. The rabbitsfoot is primarily an inhabitant of small to medium-sized streams and some larger rivers. It usually occurs in shallow areas along the bank and adjacent runs and shoals where the water velocity is reduced. Specimens may also occupy deep water runs, having been reported in 2.7 to 3.7 m (9 to 12 ft) of water. Bottom substrates generally include sand and gravel. The Nature Conservancy has established bioreserves along several stream systems harboring extant populations of the rabbitsfoot, including Big and Little Darby Creeks. In Big Darby Creek, there is an extant population of rabbitsfoot at one site, and in Little Darby Creek, it is extant in several sites. According to the USFWS, it is unlikely to occur in the Action Area (M. Seymour, USFWS, personal communication), and therefore the project will have no effect on the rabbitsfoot mussel.

Snuffbox Mussel

The snuffbox mussel is listed as endangered under the ESA and is an Ohio endangered species. The snuffbox mussel occurs in freshwater swift currents of riffles and shoals over gravel and sand with occasional cobble and boulders. This species is known to be present in some portions of Little Darby Creek or drainages where preferred habitat exists. According to the USFWS, suitable habitat for this species formerly occurred within portions of Little Darby Creek that fall within the Action Area, but as of January 2011, the portion of Little Darby Creek within Champaign County has been determined as unsuitable for the snuffbox mussel (M. Seymour, USFWS, personal communication) and therefore the project will have no effect on the snuffbox mussel.

4.5.2.2 State Threatened and Endangered Species

In addition to the federally-listed species discussed above (five of which are also state-listed), sixteen other wildlife species listed by the ODNR as endangered or threatened are historically known from Champaign County and/or have the potential to occur within or in the vicinity of the Action Area (ODNR undated; ODNR 2009a) (Table 4.5-1). Five of these 16 species are not expected to occur in the Action Area due to unsuitable habitat (Table 4.5-1). Six of these 16 species were observed in the Action Area during wildlife surveys conducted in 2007 and 2008 (Stantec 2008a; Stantec 2009) and 2010 (West 2010) or are historically known from the area and have the potential to occur more frequently than transient use: bald eagles, northern harrier, yellow-bellied sapsucker, least flycatcher, dark-eyed junco, hermit thrush, and Western tonguetied minnow (Table 4.5-1).

4.6 Cultural and Historic Resources

Cultural resources include material remains of past human activities, both from historic and Pre-European contact. In addition, cultural resources include traditional cultural properties, such as areas used for ceremonies or other cultural activities that may leave no material traces, and may have on-going use important to the maintenance of cultural practices. Cultural resources management seeks to identify and protect all of these types of cultural resources with the goals of enhancing understanding of human behavior and protecting cultural practices. This section of the EIS describes the cultural history of Ohio and the Action Area. Throughout this section, the term "historic property" is used as a cultural resource considered eligible for listing on the National Register of Historic Places (NRHP) and requiring consideration of potential effects by federal agencies, per the NHPA (36CFR800) (see Chapter 1).

The cultural and historic resources analysis in this EIS is based on information from literature on the cultural background of the region and site-specific desktop and field studies. Cultural resources studies related to the Project that have been completed to date include a literature review conducted by ASC Group, Inc. in March of 2009 (Tonetti and Terpstra 2009), two field studies conducted by Cultural Resource Analysts, Inc. (CRA) in 2010 (CRA 2011a and 2011b), and a supplemental architectural study completed by CRA in 2013. The field studies conducted by CRA include a Phase 1 archaeological survey in the immediate vicinity of the 52 known turbine locations and associated infrastructure, a survey for historic structures (i.e., architecture survey) within the viewshed of the 52-turbine Project, and an amendment to the architectural survey to make final recommendations regarding the impacts of the final 100-turbine layout. Reports on the results of the CRA surveys were submitted to OHPO in May 2011, and the results of the updated architectural study were submitted to OHPO and USFWS in February 2013. Consultation is ongoing (CRA 2011a and 2011b).

4.6.1 Scope of Analysis

The standard methodology for assessment of cultural resources uses two distinct study areas: 1) the direct Area of Potential Effect (APE), which includes any areas of ground disturbance caused by project-related activities; and 2) the indirect APE, which includes the viewshed of a project, or the area within which project facilities can be viewed. APE is the standard terminology used by cultural resources agencies and professionals to describe impacts on archaeological and architectural resources. For this Project, the direct APE studied by CRA in their Phase I archaeological survey was the Project Area, specifically including the 52 known turbine locations, Project access roads and buried interconnect lines, the three construction staging areas, and the substation location. For the known turbine locations, a 61-m (200-ft) radius around the proposed turbine center point was studied. Access roads and interconnects were studied using 16.8- and 4.6-m (55- and 15-ft) wide corridors, respectively (CRA 2011a). The indirect APE employed by CRA in their historic structure survey was the area within 8 km (5 mi) of Project facilities in accordance with typical visual impact assessment practice in areas where topography is not a controlling factor in defining the viewshed. Within this area, research and survey attempted to identify historic properties that might be affected by the Project (CRA 2011b). CRA's field studies to identify archaeological sites were planned around the 52 known turbine locations and associated Project appurtenances. Following siting of the additional 48 turbines, additional archaeological identification efforts will be conducted in accordance with a Programmatic Agreement (PA) between USFWS, SHPO, and Buckeye Wind, with plans and reports submitted to OHPO for review, and findings reported through the OPSB process (see Section 1.2.1). In a letter from OHPO dated October 27, 2011, it was confirmed that the architectural studies conducted sufficiently encompassed the Action Area. Limited work was nonetheless performed by CRA to finalize recommendations regarding the complete 100-turbine project's impact to architectural resources.

4.6.2 Cultural Background

The Paleo-Indian period (ca. 15,000BC to 8,500BC) is traditionally considered the earliest period of human occupation in Ohio. Prior to 15,000BC, Ohio was largely covered by the Wisconsin glacier. As the ice receded and Pleistocene megafauna moved into Ohio, so did Paleo-Indians. The Paleo-Indians were organized in small nomadic hunting and gathering bands, and brought with them the technology and skill necessary to exploit the local resources (Blank 1982). Archaeological remains suggest that seasonal rounds were followed, exploiting hill, bluff, and terrace locations, and, very rarely, caves as campsites. These sites are recognized by archaeologists by scatters of lanceolate projectile points (Prufer and Baby 1963).

The Paleo-Indian people were followed by the Archaic people (ca. 8,500BC to 1,000BC). The Archaic period in Ohio shows a continuation of Paleo-Indian lifeways, modified to accommodate the disappearance of Pleistocene megafauna. A wide variety of small fauna were exploited within a more restricted seasonal round. Archaic tool kits differ significantly from Paleo-Indian tool kits. Projectile points of stemmed, corner-notched, and bifurcate base forms prevail (Prufer and Long 1984).

The Early Archaic (8,000BC to 6,000BC) tool kit shows a continued emphasis on hide working and hunting. Wood-working tools, groundstone tools, and atlatl weights become more prevalent in the Middle Archaic (6,000BC to 3,500BC) tool kit (Fiedel 1987). Middle Archaic sites also show an apparent increase in fishing, as suggested by net sinkers (Fowler 1959; Funk 1978; Griffin 1983). Regional diversity flourishes in the Late Archaic (3,500BC to 1,000BC) archaeological record (Funk 1982; Griffin 1983; Feidel 1987). Modern climate, environment, flora, and fauna were established in Ohio by ca. 4,000BC (Blank 1970; Funk 1978). Populations grew during the Late Archaic as regional cultures adapted to local conditions (Tuck 1977).

The transition from the Archaic to the Woodland period in Ohio is evidenced archaeologically by broad spear points (Shane 1967). The Woodland period (ca. 1,000BC to AD1,600) is distinguished archaeologically by continuously occupied habitation sites, horticulture, agriculture, and grit-tempered cord-marked ceramics. Burial practices are more elaborate than during the Archaic period.

The Early Woodland or Adena Phase (ca. 1,000BC to 100BC) is characterized by elaborate mortuary practices and circular earthworks. The Middle Woodland, or Hopewellian Phase (ca. 100BC to AD600) is characterized by burial mound clusters, geometric earthworks, exotic artifacts and raw materials. The Late Woodland period (AD600 to 1,600) shows continuation of Hopewellian Phase subsistence strategies, but not of the elaborate mortuary practices. Large nucleated village sites develop as maize agriculture becomes more important, and hunting less important.

At the end of the Woodland period, populations in Ohio began to decrease. While there is no conclusive evidence of the reason for this general population decline, the transmission of European diseases inland from the East Coast through trade goods and inter-group contact is a likely cause (Griffin 1978). Early historic records of which Native American groups had legitimate claim to territories in Ohio during the early contact period are not conclusive (Wallace 1969).

In the 1730s to the 1750s, the Shawnee, Wyandot, and Delaware moved into Ohio. This region was beyond the strongest reach of the Iroquois and served as a refuge for tribes avoiding the Iroquois (Hurt 1996). At this time, the French and the British were vying for control of the Ohio area. The allegiance of the Native American tribes in the area was sought by both the French and the British, not only for the capital gains to be made in trade, but also for military support. The British strategy for obtaining Native American support included generous trading practices. The French, on the other hand, were viewed by the Native Americans as greedy in trade, but they were more willing to take up arms alongside the tribes, or even against them if they were displeased. The balance of power, and the allegiance of the Ohio tribes, swung back and forth between the British and French in the early history of Ohio (Hurt 1996).

4.6.3 Existing Conditions

A literature review (Tonetti and Terpstra 2009) identified known cultural resources in or near the Action Area that may be historically significant using the following records available from the OHPO:

- Online Geographic Information Mapping System;
- NRHP;
- NRHP formal determination of eligibility list;
- NRHP preliminary and consensus determination of eligibility lists;
- Ohio Historic Inventory (OHI);
- Ohio Cemeteries: 1803–2003 (Troutman 2003 as cited in Tonetti and Terpstra 2009); and
- Ohio Archaeological Inventory (OAI).

In summary, the literature review revealed 33 cultural resources listed in the NRHP, including four historic districts, 29 historic sites, and one NRHP determination of eligibility within the Action Area (Tonetti and Terpstra 2009). There are also 839 OHI and 397 OAI records, and 70 cemeteries within the indirect APE (Tonetti and Terpstra 2009). OHI and OAI properties have been recorded by cultural resources management professionals and non-professionals and may or may not have an agency determination regarding eligibility for listing on the NRHP.

4.6.3.1 Preliminary Results of Archaeological and Architectural Field Studies

Archaeology

The archaeological survey report (CRA 2011a) states that the survey identified four historic period archaeological sites, five prehistoric sites, and five prehistoric isolated finds (Table 4.6-1). Of these 14 sites, only one (33CH0415) is considered potentially eligible for inclusion in the NRHP (CRA 2011a). The other 13 sites are not considered eligible for inclusion in the NRHP because they are isolated finds or small sites with low number of artifacts that lack historic significance or integrity and so are not likely to yield information important in prehistory (Table 4.6-1).

Archaeological site 33CH0415 is an historic site represented by a variety of artifacts and a cultural feature. An artifact is an object that has been used by humans. A cultural feature is a modification of the physical setting by humans—in this case, an excavated area representing a root cellar or storage pit. The site is located on small knob on a ground moraine overlooking Little Darby Creek. Seven shovel test probes (STPs) were excavated, of which three produced artifacts. The site appears to represent domestic remains, plus the associated pit feature or root cellar. A range of artifacts was recovered, totaling 54 pieces, including Architecture group artifacts such as brick, nails, and window glass; Domestic group artifacts such as ceramic ware and glass ware; and a Faunal group artifact--a single piece of animal bone. Since the site includes a range of artifact groups and a cultural feature, CRA recommended the site potentially eligible, and proposed that further study be conducted to determine the eligibility of the site for the NRHP if it cannot be avoided by Project-related activities (CRA 2010a).

The recommendations regarding potential NRHP eligibility of the identified sites presented in this EIS are considered preliminary until confirmed by the OHPO. In a letter dated October 27, 2011, OHPO concurred with the assessment that additional field work is needed at 33CH0415 and recommended further consultation to consider what treatment measures will be used at the site. The Applicant plans to avoid the site and no further consultation with OHPO on this site is currently planned.

Table 4.6-1 Preliminary Information Regarding Archaeological Sites Identified During the Phase 1 Archaeological Survey

Site Number	Description	Preliminary Finding
33CH0408	Late Woodland / Late Prehistoric site measuring 15 m (49.2 ft) N-S and 5 m (16.4 ft) E-W on terrace. Five STPs excavated to define site boundaries; of these, one STP produced 11 lithic artifacts including 10 pieces of lithic debitage and one flaked stone tool fragment.	Not considered eligible due to limited size, low number of artifacts, and lack of evidence for archaeological deposits likely to contain important information; no further action recommended.
33CH0409	Prehistoric site dating to an unknown temporal period measuring 20 m (65.6 ft) N-S and 10 m (32.8 ft) E-W. Four prehistoric lithic artifacts were recovered by pedestrian survey--four pieces of lithic debitage.	Not considered eligible due to limited size, low number of artifacts, and lack of evidence for archaeological deposits likely to contain important information; no further action recommended.
33CH0410	Late Woodland to the Late Prehistoric period site measuring 15 m (49.2 ft) N-S and 75 m (246 ft) E-W. Four prehistoric lithic artifacts were recovered within four STPs--three pieces of lithic debitage and one formal flaked stone tool fragment.	Not considered eligible due to limited size, low number of artifacts, and lack of evidence for archaeological deposits likely to contain important information; no further action recommended.
33CH0411	Historic site dating to the early to mid-nineteenth century, measuring 30 m (98.4 ft) N-S and 30 m (98.4 ft) E-W. The site assemblage consists of 21 historic artifacts, all recovered from three STPs, including Architecture, Domestic, and Maintenance/ Subsistence groups.	Not considered eligible due to limited size, low number of artifacts, and lack of evidence for archaeological deposits likely to contain important information; no further action recommended.

Site Number	Description	Preliminary Finding
33CH0412	Historic site dating to the early nineteenth century, measuring 35 m (115 ft) N-S and 15 m (49.2 ft) E-W. The artifact assemblage consists of 115 artifacts, all recovered from pedestrian survey, including Architecture, Domestic, Faunal, and Personal groups. Heavily disturbed through agricultural and amateur archaeological excavation activities.	Site has been heavily disturbed through agricultural and amateur archaeological excavation activities, but the amateur excavations lack a comprehensive analysis and write-up to determine if it has the potential to yield new and important information; however, given the preservation objectives established for this project and the lack of integrity of the archeological context within the direct APE, no further action is recommended.
33CH0413	Prehistoric site of unknown cultural affiliation measuring 40 m (131 ft) N-S and 30 m (98.4 ft) E-W. Four prehistoric lithic artifacts were recovered within four STPs--lithic debitage.	Not considered eligible due to limited size, low number of artifacts, and lack of evidence for archaeological deposits likely to contain important information; no further action recommended.
33CH0414	Prehistoric site of unknown cultural affiliation measuring 40 m (131 ft) N-S and 50 m (164 ft) E-W. Fourteen prehistoric lithic artifacts were recovered within six STPs--13 pieces of lithic debitage and one core fragment.	Not considered eligible due to limited size, low number of artifacts, and lack of evidence for archaeological deposits likely to contain important information; no further action recommended.
33CH0415	Historic site represented by a variety of artifacts and a cultural feature--a root cellar or storage pit. Seven STPs were excavated, of which three produced 54 artifacts--domestic remains including construction and kitchen materials and associated pit feature or root cellar.	Site includes a range of artifact groups and a cultural feature. Further study should be conducted to determine the potential eligibility of the site for the NRHP if it cannot be avoided by Project-related activities.
33CH0416	Prehistoric isolated find site located, from which a fragment of a prehistoric ground and pecked axe bit was recovered. The site was identified by pedestrian survey.	Not considered eligible due to limited size, low number of artifacts, and lack of evidence for archaeological deposits likely to contain important information; no further action recommended.
33CH0417	Middle Woodland prehistoric isolated find--a projectile point. The site was identified by pedestrian survey.	Not considered eligible due to limited size, low number of artifacts, and lack of evidence for archaeological deposits likely to contain important information; no further action recommended.
33CH0418	Prehistoric isolated find consisting of one formal flaked stone tool recovered during pedestrian survey.	Not considered eligible due to limited size, low number of artifacts, and lack of evidence for archaeological deposits likely to contain important information; no further action recommended.
33CH0419	Prehistoric isolated find consisting of one formal flaked stone tool, a projectile point fragment, recovered during pedestrian survey.	Not considered eligible due to limited size, low number of artifacts, and lack of evidence for archaeological deposits likely to contain important information; no further action recommended.
33CH0420	Prehistoric isolated find consisting of one informal flaked stone tool recovered during pedestrian survey.	Not considered eligible due to limited size, low number of artifacts, and lack of evidence for archaeological deposits likely to contain important information; no further action recommended.

Site Number	Description	Preliminary Finding
33CH0421	Historic site represented by an abandoned mid-nineteenth to twentieth-century railroad bed. The site dimensions are defined as 1400 m x 15 m (4,593 ft x 49.2 ft). The rails and railroad ties have been removed; the feature is no longer in use as a railroad route.	Due to disturbance the site does not have the potential to provide useful data for interpreting history so it is not considered eligible for listing on the NRHP; no further action needed.

Source: Data summarized from CRA 2010a.

Architecture

The architectural report (CRA 2011b) states that 1,475 historic properties were identified within the indirect APE (within 8 km [5 mi] of the 52-turbine Project). In addition, portions of Urbana and Mechanicsburg were surveyed for historic district potential. Property types encountered include farmsteads, schoolhouses, cemeteries, churches, crossroads communities, and potential historic districts in Urbana and Mechanicsburg (CRA 2011b). OHPO, in a letter dated October 27, 2011, stated that several buildings and structures warrant further evaluation to determine their eligibility for the NRHP, along with several main street districts listed by name in the letter, but that meaningful conclusions regarding the impacts of the proposed project can be drawn from the information provided in the survey report. OHPO also stated in this letter that no further surveys are required within the area surveyed for additional phases of construction for the Project.

The records search conducted prior to the architectural survey identified 839 resources with assigned OHI numbers and 70 previously recorded cemeteries within the indirect APE. The results show that the majority of the previously recorded OHI properties, NRHP listed, or NRHP eligible properties are located along the U.S. 68 corridor, as well as within, or within the vicinity of, Urbana and Mechanicsburg. The previously recorded cemeteries are scattered throughout the survey area. Per the work plan for the architectural survey, not all of these identified properties were surveyed.

Based on preliminary observations, mid-nineteenth to mid-twentieth century rural residences and farmsteads make up the majority of the surveyed properties. Though most of the farmsteads have undergone some change over the years, including changes to dwellings or the introduction of prefabricated ancillary structures that utilize different materials and are built at a different scale than the historic structures, Champaign County’s agricultural pattern of development remains apparent on the landscape. Additionally, the preliminary survey concluded that many of the rural residences and farmsteads appear to retain sufficient integrity to illustrate their historic associations.

The architectural work plan called for the further evaluation of both Urbana and Mechanicsburg for the presence of potential historic districts. Presently, Urbana contains two NRHP-listed historic districts; the Urbana Monument Square Historic District and Scioto Street Historic District. The survey documented a potential historic district along South Main Street comprised of nineteenth and early twentieth-century residences. Mechanicsburg has one NRHP historic district and a Multiple Resource Area (MRA); the Mechanicsburg Commercial Historic District and the Mechanicsburg MRA. The architectural survey identified additional nineteenth and early twentieth-century buildings, mainly residences, which could potentially be eligible for inclusion into the MRA or into a new historic district.

In 2013, the indirect APE was amended to account for the complete 100-turbine project design. The revised APE included a small area to the east of the project area and a larger area to the southwest of the project area that were not included in the original APE for the project. In consultation with OHPO and USFWS, CRA developed a work plan to account for the potential effects of the project to historic properties located within these previously undocumented areas. This supplemental architectural study included a windshield survey of these new areas to identify important property types and historic landscapes. No additional survey of the previously documented areas was called for at this time.

Tribal Resources

Pursuant to the NHPA and the American Indian Religious Freedom Act (AIRFA) (42 U.S.C. § 1996 *et seq*.), and in an effort to identify other significant cultural resources that may be affected by the Project, USFWS has initiated consultation with the following tribes, inviting them to comment on whether they attach any religious or cultural significance to the Project location:

- Absentee-Shawnee Tribe of Oklahoma;
- Eastern Shawnee Tribe of Oklahoma;
- Miami Tribe of Oklahoma;
- Ottawa Tribe of Oklahoma;
- Piqua Shawnee Tribe;
- Hannahville Indian Community;
- Citizen Potawatomi Nation;
- Prairie Band of Potawatomi Nation;
- Forest County Potawatomi Community; and
- Shawnee Tribe.

The USFWS has made multiple attempts to reach out to the tribes during the EIS process. During initial outreach, only the Eastern Shawnee Tribe of Oklahoma and Piqua Shawnee Tribe indicated an interest in this Project. In February 2013, the USFWS sent certified letters to all tribes inviting input. The Eastern Shawnee did not respond to the February letter. Only correspondence from the Piqua Shawnee Tribe was received in response to the February 2013 letters.

Ongoing correspondence with the Piqua Shawnee Tribe, a state recognized tribe, has occurred throughout the EIS process. While the Project Area is on private land, the Piqua Shawnee Tribe has historical connections to a reported burial mound located within the Action Area believed by the Piqua Shawnee to have been used by ancestors of the Shawnee nation. This mound is known to the Tribe and the local inhabitants of Champaign County as "Indian Mound" and is recorded in Mills' Archaeological Atlas of Ohio, and it also appears on the 1916, 1944, and modern USGS 7.5 minute topographic maps. Pursuant to the AIRFA the USFWS has an obligation to consult with the Piqua Shawnee Tribe regarding the potential impacts of the Project on "Indian Mound." The "Indian Mound" is not recorded in the OAI as an archaeological site, and there are no known archaeological artifacts or human remains associated with the mound reported in the OAI.

Buckeye Wind and CRA staff met with Piqua Shawnee Tribe representatives to discuss their concerns related to the Project in August 2010, and the Tribe stated that visual impacts to the mound are not a concern to the Tribe—only direct impacts to the mound itself (Michael Anslinger, CRA, Pers. Communication). Construction and operation of the Project would have no direct impact on the mound. In a press release dated September 7, 2010, and in a letter dated December 4, 2012, an elder of the Piqua Shawnee Tribe expressed support for the 52-turbine and 56-turbine projects described in the OPSB applications for the Buckeye I and Buckeye II Wind Farms respectively. The correspondence stated that the Project poses no threat to the mound (Parks 2010 and 2012). In response to USFWS's February 2013 letter requesting input, the Piqua Shawnee Tribe provided a letter dated February 8, 2013. This letter stated that they have worked closely with Dr. Kenneth B. Tankersley, the Native American Graves Protection Act representative for the Piqua Shawnee, to determine if construction of the turbines would endanger Native burial sites, ancient mounds, and earthworks over the entire construction site. They concluded that "A few turbine sites are located close to mounds, but should be out of danger during construction. Our Tribe has permission to monitor these sites and will do so, when construction gets underway…This will conclude our comments on the proposed undertaking."

4.7 Land Use and Recreation

4.7.1 Scope of Analysis

The land use and recreation analysis for the EIS provides a discussion of current and future land use; state, regional, county, and municipal comprehensive plans and regulations; residential structures; agricultural programming; and recreation within the Action Area and the immediate surrounding area. The immediate surrounding area for this analysis includes portions of Clark, Logan, Madison, and Union Counties. This analysis area was used because the Project has the potential to affect land use patterns and recreational resources beyond the Action Area.

The land use analysis in this EIS is based on publicly available state, regional, county, and municipal-level planning documents, as well as U.S. Census Bureau and USDA data and information provided in the Buckeye Facility Socioeconomic Report prepared by Saratoga Associates (Saratoga 2009).

4.7.2 Existing Conditions

4.7.2.1 Current Land Use

The Project would be located in portions of the Townships of Goshen, Rush, Salem, Union, Urbana, and Wayne in Champaign County (hereafter "host townships"). In addition, eleven townships, one city, five villages, one census designated place (CDP), and portions of four other counties lie within the Action Area's immediate vicinity. These jurisdictions are listed in Section 4.9.

Table 4.7-1 summarizes land use, by hectare (acre), in the host townships and the townships and communities within and immediately adjacent to the Action Area. Agriculture is the predominant land use. Residential is the largest non-agricultural land use, followed by vacant land and government land (which includes parks, schools, recreation, and other public facilities).

Table 4.7-1 Land Use within and in the Immediate Vicinity of the Action Area

Land Use Classification	Townships Hosting Project		Townships and Communities within and Immediately Adjacent to the Action Area	
	Total Hectares (Acres)	Land Use Percentage	Total Hectares (Acres)	Land Use Percentage
Agricultural	51,493 (127,243)	86.8	72,408 (178,923)	80.4
Commercial	319 (789)	0.5	668 (1,651)	0.7
Forestry	85 (211)	0.1	303 (749)	0.3
Government	851 (2,104)	1.4	2,453 (6,062)	2.7
Manufacturing	37.6 (93)	0.1	1,008 (2,491)	1.1
Minerals and Oil	94 (232)	0.2	0 (0)	0.0
Non-Commercial	52 (128)	0.1	206 (508)	0.2
Residential	4,778 (11,806)	8.1	9,428 (23,298)	10.5
Utilities	0 (0)	0.0	0 (0)	0.0
Vacant[1]	1,640 (4,052)	2.8	3,096 (7,650)	3.4
Undesignated	0 (0)	0.0	513 (1,267)	0.6

[1] Defined as unused agricultural, commercial, industrial, or residential land.
Saratoga Associates 2009

Residential development within 8 km (5 mi) of the Project consists almost entirely of single-family homesteads located on rural roads. Construction and operation of the Project would involve leasing privately owned predominantly agricultural land from between 100 and 140 landowners. The relatively small amount of land being used for commercial and industrial properties is consistent with the rural characteristics of the communities within the immediate vicinity of the Action Area.

4.7.2.2 State, Regional, and Local Land Use Planning

Within the State of Ohio, land use planning occurs at multiple levels of government, including state, region, county, township, and municipal jurisdictions. The goals and objectives stated in comprehensive plans and regulations written by these agencies provide indications of community values and attitudes relevant to new development and the use of the land. The plans and regulations provide guidance for important land use decisions that have the ability to affect more than one jurisdiction, such as wind energy.

State Land Use Planning

The Ohio Power Siting Board

The OPSB regulates all proposed wind power projects in Ohio capable of generating five or more MW of electricity (OPSB 2008). With regard to land use, OPSB siting requirements include, but are not limited to: an analysis of land use within a 8 km (5 mi) radius of the facility; a determination of the number of residential structures within 305 m (1,000 ft) of the boundary of the facility; a description of the turbine locations in relation to property lines; and an evaluation of established setbacks (OPSB 2008). The 52-turbine Project received its OPSB Certificate on March 22, 2010. In September of 2011, an appeal was filed with the Supreme

Court of Ohio by Goshen, Union and Salem Townships and Champaign County and by the Union Neighbors United against the certification. On March 6 2012, the Ohio Supreme Court upheld OPSB's certification of the Project. Refer to Section 1 and Appendix A of this EIS for a more detailed record of the OPSB process related to the Project.

Champaign Wind LLC has initiated the OPSB application procedure for the Buckeye II Wind Project, consisting of about 56 turbines (no more than 100 total turbines will be constructed between the already certificated turbines plus those proposed for the Buckeye II Wind Project). The Buckeye II Wind Project will be transferred to Buckeye Wind prior to construction. A public information meeting for Champaign Wind LLC was held on January 24, 2012. Champaign Wind LLC's record of public interaction is available through the PUCO Docketing Information System (http://dis.puc.state.oh.us/CaseRecord.aspx?CaseNo=12-0160-EL-BGN).

State Zoning and Land Use Controls

Cities and villages (i.e., incorporated areas) in Ohio have the authority to administer zoning and regulate their own land use. These geographic areas are not reliant upon a state board to assist in this regulation. However, these regulations must be consistent with the Ohio Revised Code (ORC) unless they have adopted a charter, which can give the municipality broader zoning and other powers (Stamm 1999).

Townships administer zoning in unincorporated areas (outside incorporated cities and villages) unless the township has voted to let the county administer zoning, which is called county zoning. Approximately 16 percent of counties in Ohio have county zoning in at least one township. Like municipalities, townships and counties must administer zoning according to the ORC (Stamm 1999).

While these zoning regulations generally apply within the Action Area, wind facilities that have capacity over 5 MW and receive OPSB certification are exempt from local regulatory oversight. While local approvals are not required for construction and operation of the Project, zoning regulations provide insight into future development of the region. Accordingly, the remainder of this section discusses regional and local land use planning.

Regional Land Use Planning

Regional/metropolitan planning councils provide assistance to local government agencies for land use decisions. These organizations assist member counties with land use planning by providing technical assistance and assuring that land use and development are compatible with community needs that extend beyond local jurisdictions. These organizations are also useful repositories of community statistics.

Champaign County is a part of the Logan-Union-Champaign Regional Planning Commission (LUCRPC). The LUCRPC is charged under Ohio Law with certain responsibilities for its member counties. Among them are the review and approval of subdivisions located in unincorporated areas and the review and recommendation to township zoning commissions concerning zoning amendments. The Commission also acts as an Area-Wide Clearinghouse for applicants who request federal and state assistance for selected projects. The LUCRPC has a number of committees that address specific land use topics. For instance, the Agricultural

Zoning/Farmland Preservation Committee provides assistance with agricultural model zoning regulations to help the conservation of this type of land (LUCRPC 2006).

Madison and Union Counties are members of the Mid-Ohio Regional Planning Commission (MORPC), which serves the metropolitan Columbus area. MORPC provides similar services for its member counties as the LUCRPC.

While the LUCRPC and the MORPC do not regulate land use within the individual counties, the organizations can assist in coordinating the development of wind farms that cross jurisdictional boundaries, especially among member counties.

Local Land Use Planning

The following sections describe land use planning within Champaign County, the Project's host county, as well as Clark, Logan, Madison, and Union Counties which fall partially within 8 km (5 mi) of the Project. Most county and local land use regulations, including zoning ordinances, apply to wind farms with a capacity under 5 MW and thus do not apply to the Project.

Champaign County

Like much of Central Ohio, Champaign County is primarily rural. According to its 2004 Comprehensive Plan update, however, one of the greatest challenges within the county is managing growth and development, while maintaining a rural character. The county is surrounded by six other counties, which include the Dayton-Springfield and Columbus metropolitan statistical areas (MSAs). These areas have spawned extensive urban and suburban growth, which has affected the development of Champaign County. Consequently, the County's Comprehensive Plan focuses on creating a development strategy to preserve the county's rural character (Champaign County 2004). This plan is a publicly accepted document used to guide future land use decisions.

Among the host townships, only Goshen and Union Townships have local ordinances related to wind power facilities. While these ordinances only apply to facilities generating less than 5 MW (and are thus not applicable to the Project), the Applicant has attempted to incorporate design standards, setback requirements, and other characteristics that are consistent with the intent of these local regulations. For instance, setback requirements from parcel lines for Union Township are 180 m (590 ft), whereas Chapter 4906-17-08(C)(1)(c)(i) of the OPSB requirements suggest that setbacks from parcel lines must be at least 165 m (541 ft). As indicated in the application for the OPSB Certificate, all known turbine locations in Union Township would comply with this township setback, unless exempted by waiver agreements with landowners (EDR 2009a). Buckeye Wind II will also comply with the required OPSB setback, at a minimum.

Clark County

Similar to other counties surrounding the Action Area, Clark County's 1999 Comprehensive Plan is intended to help the county guide their land use decisions and capital improvements. As stated within the Comprehensive Plan, the "essence of the Plan is to manage the County's growth while preserving farmland and open space, diversifying the economic base and ensuring sufficient utility services." Consequently, two of the primary goals of this plan are to conserve agricultural land and to focus growth and development in appropriate areas of the county (Clark County 1999).

Logan County

Logan County released an update to their county comprehensive plan in 2007. The majority of the land in the county is zoned U-1 Rural Undeveloped District. This designation is for land that is suitable for agriculture, conservation, very low-density residential and public and quasi-public purposes. Consequently, many of the county's land use goals involve preserving the rural character of the county, sustainable land use, the conservation of agricultural land, and respecting the integrity of the natural environment through land use decisions (Logan County Soil & Water Conservation District and Logan County Commissioners 2007).

Madison County

According to the 2005 Madison County Comprehensive Plan, the general character of land use in the County is predominantly agricultural—accounting for some 94 percent of the County's land area. Given the predominant agricultural land use, many of the county's primary land use goals involve the conservation of agricultural land and respecting the integrity of the natural environment through land use decisions (Madison County Commissioners 2005).

Union County

In Union County, the overall land use goal is to "…establish a coordinated and consistent land use system based on intergovernmental cooperation, planned controlled growth and innovative land use controls that facilitate and strengthen rural character, small towns and Union County's quality of life" (Union County 1999). Like Champaign County, Union County does not provide zoning regulations at the county level. However, as part of the comprehensive plan, township zoning is encouraged to provide for agricultural conservation. This is in part due to the importance of agriculture for the county economy (Union County 1999). According to the 1999 Comprehensive Plan, agricultural/vacant land use encompasses the largest land use category in the county. For instance, along the U.S. 33 corridor, agricultural/vacant land accounts for approximately 97 percent of the land use. The County also encompasses federal and state "Wild and Scenic Rivers," including the Big and Little Darby Creeks (Union County 1999).

Local Comprehensive Plans – Future Land Use

Comprehensive land use plans for Champaign, Clark, and Madison Counties do not recommend changes to the rural-agricultural land use pattern. The land use policies in these plans emphasize the need to preserve and protect agricultural lands and open space. In particular, the comprehensive plans seek to ensure viability of agricultural economy by limiting development that takes agricultural land out of production, limiting costly public infrastructure, and limiting land-intensive sprawling development patterns (Clark County 1999, Champaign County 2004, Madison County 2005).

4.7.2.3 Residential Structures

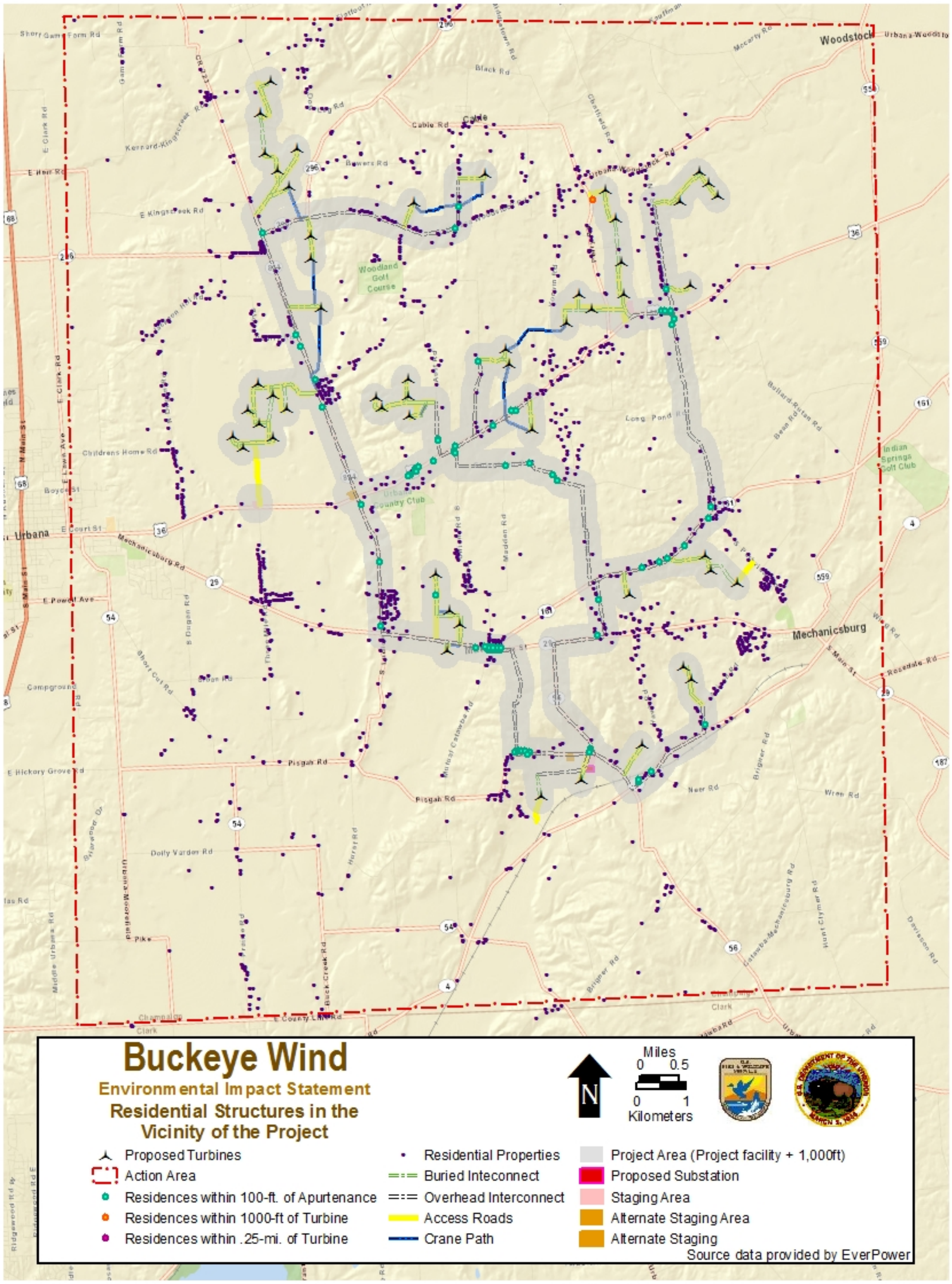
Because the Project is subject to the OPSB Certificate, local zoning and land use controls are not applicable. Therefore, property lines and residential structures are discussed in relation to the

Project Area boundary, pursuant to OAC Section 4906-17-08(C)(1)(b-c) (EDR 2009a). Key OAC requirements include:

- OAC Section 4906-17-08(C)(1)(c)(i) requires that "the distance from a wind turbine base to the property line of the wind farm shall be at least 1.1 times the total height of the turbine structure as measured from its tower's base (excluding the subsurface foundation) to the tip of its highest blade" (Stantec 2010b). Based on a turbine height of 150 m [492 ft], the approximate distance to the property line should be approximately 165 m (541 ft) (i.e., 150 m [492 ft] multiplied by 1.1).
- OAC Section 4906-17-08(C)(1)(c)(ii) requires that "the wind turbine shall be at least 750 ft in horizontal distance from the tip of the turbine's nearest blade at ninety degrees to the exterior of the nearest habitable residential structure, if any, located on adjacent property at the time of Certificate Application." The maximum rotor diameter of a turbine under consideration for the Project is 100 m (328 ft). If the turbine blade was at 90 degrees (i.e., parallel with the ground), the tip would extend from the base of the tower one-half the length of the rotor diameter, or 50 m (164 ft), which added to 228.6 m (750 ft), yields a total setback of 278.6 m (914 ft) (Stantec 2010b).

In compliance with OAC requirements, the Project has been designed so that all turbines would be a minimum of 278.6 m (914 ft) from the nearest permanent residential structure and 180 m (590 ft) from the nearest property line. Specifically, the distance between residential structures and the closest turbine ranges from 284 m (932 ft) to 1,373 m (4,503 ft) (Figure 4.7-1). Buckeye Wind II must also comply with required setbacks from property lines and residential structures.

Figure 4.7-1 Residential Structures in the Vicinity of the Project



4.7.2.4 Agricultural Preservation

The Action Area contains parcels of land enrolled by landowners in the Conservation Reserve Program (CRP), managed by the Farm Service Agency (FSA) of the USDA. Farmers with land enrolled in the CRP can receive financial reimbursements for the withdrawal of farmland from production for conservation purposes (FSA 2009b). For Champaign County, the average CRP rental payment was $243.99 per ha ($98.74 per ac) in fiscal year (FY) 2010, with 1,847 ha (4,563 ac) enrolled (FSA 2012).

As of August 2010, CRP enrolled land in the host townships containing the Action Area totaled 1,253 ha (3,096 ac), distributed as follows (USDA, 2010):

- Goshen Township – 480.90 ha (1,188.34 ac);
- Rush Township – 177.94 ha (439.69 ac);
- Salem Township – 26.56 ha (65.62 ac);
- Union Township – 255.72 ha (631.89 ac);
- Urbana Township – 26.52 ha (65.54 ac); and
- Wayne Township – 285.32 ha (705.05 ac).

CRP's national policy allows the construction and operation of wind turbines on formally enrolled properties. County CRP Committees may approve up to 2 ha (5 ac) of wind-powered generation devices per CRP contract. The 2 ha (5 ac) per contract threshold is a cumulative figure that is calculated by totaling the square footage of land area devoted to the footprint of the wind-powered generation device and any firebreak installed around the footprint. Access roads, transformers, and other ancillary equipment associated with the turbines are not considered part of the footprint, and may need to be withdrawn from CRP. Doing so may involve financial penalties, such as returning all CRP payments to USDA, including annual rental payments, interest, cost share plus interest, and liquidated damages (FSA 2009b). The CRP participant may also choose to remove the wind turbine's footprint from CRP (FSA 2009b).

Table 4.7-2 indicates the average crop rental payments per hectare (per acre) for FY 2007-2010, and Table 4.7-3 shows the number of hectares (acres) under contract during the period from 2006 to 2011. Within the Action Area, four landowners have lands currently under CRP contract, encompassing approximately1,253 ha (3,096 ac) (USDA 2010). Only a small portion of this land (roughly 1%) will be impacted by the project (see Table 5.3-1).

Table 4.7-2 Average Conservation Reserve Program Rental Payments ($ per hectare [$ per acre]) by County

County	FY 2007	FY 2008	FY 2009	FY 2010
Champaign	230.62 (93.33)	236.28 (95.62)	241.40 (97.69)	243.99 (98.74)
Clark	247.90 (100.32)	260.55 (105.44)	265.74 (107.54)	269.15 (108.92)
Logan	194.08 (78.54)	209.62 (84.83)	213.40 (86.36)	215.82 (87.34)
Madison	337.69 (136.66)	374.83 (151.69)	388.00 (157.02)	393.84 (159.38)
Union	265.44 (107.42)	300.48 (121.60)	322.92 (130.68)	340.26 (137.70)

Source: FSA 2012

Table 4.7-3 Hectares (acres) within the Conservation Reserve Program by County[1]

County	2006	2007	2008	2009	2010	2011
Champaign	1,942 (4,798)	2,056 (5,080)	2,006 (4,956)	1,955 (4,831)	1,847 (4,563)	1,966 (4,859)
Clark	606 (1,497)	616 (1,522)	567 (1,402)	652 (1,388)	558 (1,379)	564 (1,394)
Logan	4,910 (12,132)	4,964 (12,266)	3,973 (9,817)	3,764 (9,302)	3,677 (9,086)	3,620 (8,945)
Madison	2,647 (6,540)	3,194 (7,892)	3,073 (7,593)	2,894 (7,150)	2,849 (7,039)	2,694 (6,656)
Union	2,705 (6,685)	3,647 (9,013)	3,822 (9,445)	3,921 (9,688)	4,055 (10,019)	4,159 (10,278)

Source: FSA 2012
[1] Hectares (acres) under Contract as of September 30, 2011

4.7.2.5 Recreation

Recreational resources within the Action Area and immediate vicinity include state and municipal parks, state nature preserves, country clubs and golf courses, and lakes and waterways. A total of 16 designated recreational facilities have been identified within this area. In addition, the roads and trails within the area may be used by residents for recreational biking, walking, or running. No designated hiking trails or off-road vehicle (ORV) trails are located in close proximity to the Project (Stantec 2010b).

Figure 4.7-2 shows the location of the recreational facilities within the Action Area and immediate vicinity and Table 4.7-4 lists these recreational facilities. Detailed information is available only for some of the recreational parks and is provided in the section below.

Figure 4.7-2 Recreation Facilities in the Action Area and Immediate Vicinity

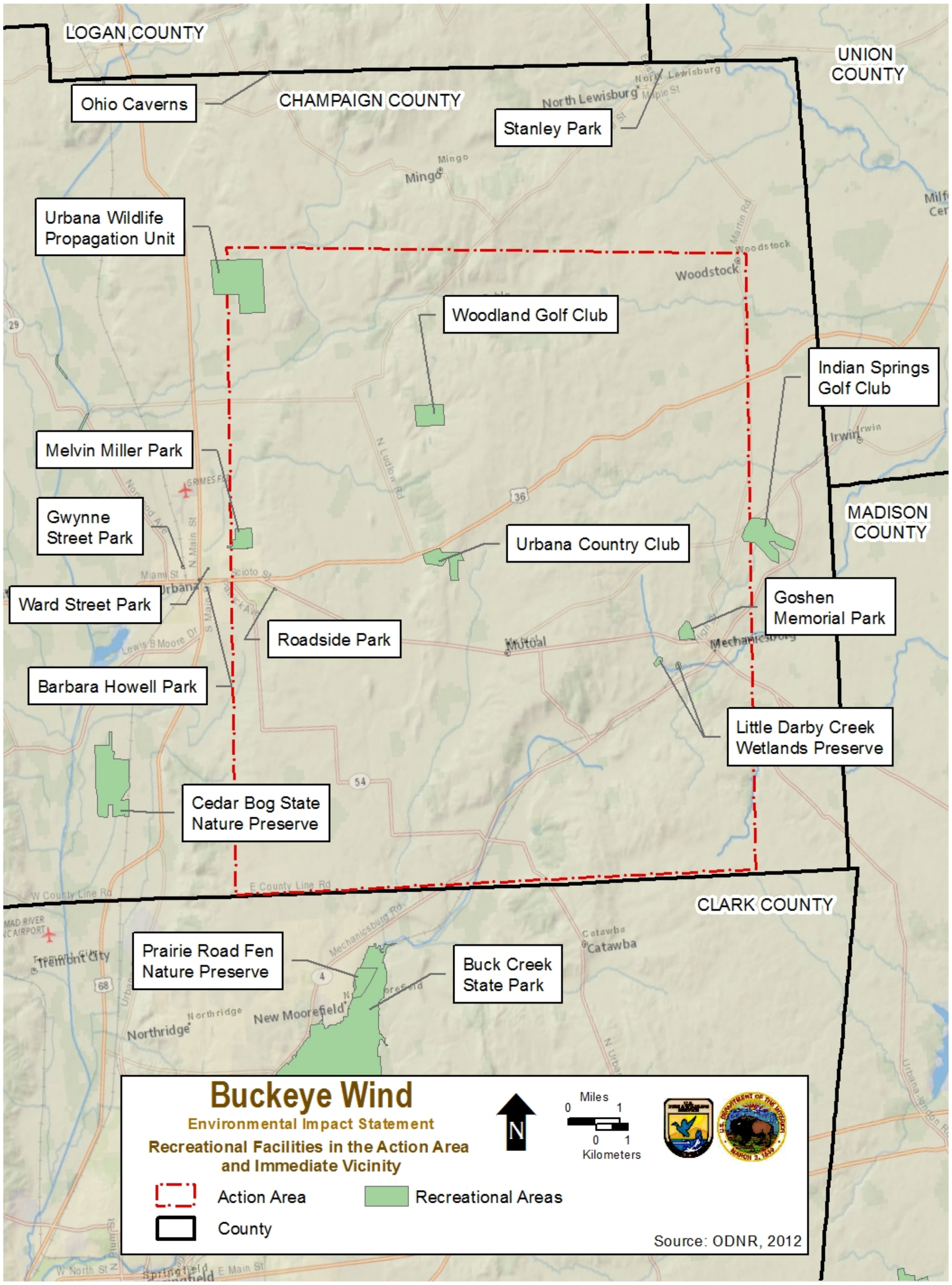


Table 4.7-4 Recreational Areas within and in the Immediate Vicinity of the Action Area

Recreational Area	Location and Approximate Distance to Project	Area Description
Barbara Howell Park	City of Urbana, Champaign County 0.8 km (0;5 mi) from Action Area	Small city park
Buck Creek State Park	Buck Creek Lane in Springfield Town of Monroe, Clark County 3.3 km (2.0 mi) from Action Area	858-ha (2,120-ac) reservoir with cottages, camping, boating, hunting, fishing, picnicking, hiking, sporting fields, disc golf owned by Ohio State Parks
Cedar Bog State Nature Preserve	Woodburn Road City of Urbana, Champaign County 3.7 km (2.3 mi) from Action Area	173-ha (427-ac) boreal and prairie fen complex owned by Ohio Historical Society
Little Darby Creek Wetlands Preserve	Mechanicsburg Town of Goshen, Champaign County Within Action Area	12-ha (30-ac) conservation easement protected by the Nature Conservancy
Goshen Memorial Park	Parkview Road in Mechanicsburg Town of Goshen, Champaign County Within Action Area	Public park with sporting fields, tennis courts, playground, picnic areas, pavilion, multi-purpose building, amphitheater
Gwynne Street Park	City of Urbana, Champaign County 1.5 km (0.94 mi) from Action Area	Small city park
Indian Springs Golf Club	State Route 161 in Mechanicsburg Town of Goshen, Champaign County Portions within Action Area	Public, 18-hole golf course
Melvin Miller Park	City of Urbana, Champaign County Within Action Area	City park including pond, municipal pool, sporting fields, tennis courts, basketball courts, playgrounds
Ohio Caverns	State Route 245 in West Liberty Town of Salem, Champaign County 4.3 km (2.7 mi) from Action Area	14-ha (35-ac) private park with 400 million-year old limestone caverns
Prairie Road Fen Nature Preserve	Town of Moorefield, Clark County 2.5 km (1.5 mi) from Action Area	38-ha (94-ac) state preserve; access by permit only
Roadside Park	City of Urbana, Champaign County Within Action Area	Small city park
Stanley Park	Village of North Lewisburg Champaign County 4.6 km (2.9 mi) from Action Area	Small village park
Urbana Country Club	US Highway 36 in Urbana Town of Union, Champaign County Within Action Area	Private facility with 18-hole golf course, swimming pool, tennis courts, restaurant, clubhouse
Ward Street Park	City of Urbana Champaign County 0.7 km (0.5 mi) from Action Area	Small city park
Woodland Golf Club	Swisher Road in Cable Town of Union, Champaign County Within Action Area	Public, 18-hole golf course
Urbana Wildlife Propagation Unit	Short Game Farm Road in Urbana Champaign County Within Action Area	Wildlife research area managed by ODNR

Parks

Parks within the Action Area and immediate vicinity include one state park, three nature preserves, and seven city or village parks (Figure 4.7-2). Privately owned caverns and a state wildlife breeding facility are also located within the analysis area. Larger parks, such as the Buck Creek State Park, offer a variety of recreational resources. Smaller parks, such as municipal parks, generally provide playgrounds and sport fields.

Buck Creek State Park is one of the largest recreational facilities in the area. The park includes a 855-ha (2,120-ac) lake surrounded by 767 ha (1,896 ac) of land. Only the northern section of the park is located within the area analyzed. Cottages and campground areas are available at the Buck Creek State Park, and recreational activities include boating, swimming, hunting (from October 15 to March 1), fishing, picnicking, biking, hiking, and bird watching. In wintertime, recreational activities permitted at the park include snowmobiling, sledding, ice fishing and cross-country skiing (ODNR 2010e).

Cedar Bog Nature Preserve comprises 173 ha (427 ac) of boreal and prairie fen habitat (ODNR 2010b). Boardwalks and gravel trails extend through the preserve, providing opportunities for wildlife and nature viewing. The preserve is open daily between April and September, and by appointment only from October through March (CBA 2004).

Goshen Memorial Park offers a variety of recreational facilities, including tennis courts, horseshoe pits, picnic tables, and grills. The park has two shelters, a multi-purpose building, a stage, a natural amphitheater, and a large shelter house (Champaign CVB 2010).

Melvin Miller Park is the City of Urbana's main park. It contains a pond, the Wendell Stokes Municipal Pool, 13 ball fields, 13 soccer fields, eight tennis courts, two basketball parks, a skate park, and several playgrounds. The Champaign County Arts Council sponsors Concerts in the Park here (Champaign CVB 2010).

Ohio Caverns are the largest cave system in Ohio and are open year-round to the public. Guided tours are offered through two sections of the caverns. A 14-ha (35-ac) park is located above the caverns and contains a shelter house and picnic tables (Ohio Caverns 2010).

Golf Courses

Three golf facilities are located within 8 km (5 mi) of the Project (Figure 4.7-2). The Indian Springs Golf Club offers a public 18-hole golf course and driving range located near the city of Mechanicsburg. The Urbana Country Club is a private 18-hole golf course that also contains tennis courts, a pool, and a club house with a restaurant (UCC 2010). The Woodlands Golf Course is a public 18-hole course with a driving range and a putting green. It also offers banquet facilities for groups of 40 to 160 people (Woodland 2010).

Waterbodies

The majority of water features within 8 km (5 mi) of the Project are small streams and ponds that occur on private land that receive little recreational use. The C.J. Brown Reservoir, located within the Buck Creek State Park, provides public access to the 858-ha (2,120-ac) lake through a four-lane launch ramp, as well as a marina with 186 seasonal dock spaces. Boating is considered a popular activity and the lake is used by power boats, sail boats, kayaks, and fishing boats (Buck Creek 2009).

Bike Trails

Simon Kenton Bike Path is a 28.8-km (17.9-mi) paved bike trail that connects the cities of Urbana and Springfield. Around 1.5 mi of the northeastern end of the trail falls within the Action Area. The trail follows the abandoned Erie-Lackawanna rail line, paralleling U.S. Route 68. Approximately 13 km (8 mi) of the trail are located in Champaign County, with the remainder of the trail located in Clark County. The trail connects with other bike trails beyond the Action Area and vicinity, and is adjacent to the Melvin Miller Park and the Cedar Bog State Nature Preserve (Miami Valley Trails 2010).

Hunting

Hunting within the State of Ohio is allowed (with a license, appropriate permits, and permission from landowners) on both public and private land. As in other states, annual limits may govern when and how much wildlife can be harvested (ODNR 2010c).

The following animals may be hunted during the appropriate season: white-tailed deer, wild turkey, waterfowl, mourning dove, ruffed grouse, ringneck pheasant, northern bobwhite quail, eastern cottontail rabbit, squirrel, fox, raccoon, opossum, skunk, weasel, crow, coyote, wild boar, and groundhog. Fur-bearing animals that may be trapped include fox, raccoon, opossum, skunk, weasel, mink, muskrat, beaver, and river otter (ODNR 2010c).

Buck Creek State Park provides hunting opportunities on public land during the park’s hunting season that runs from October 15 to March 1. No Wildlife Areas designated for hunting are located within 8 km (5 mi) of the Project (ODNR 2010a).

ODNR hunting statistics are limited for the five counties surrounding the Project. In 2011, 87 wild turkeys were noted in the spring harvest in Champaign County; 17 in Clark County; 159 in Logan County; four in Madison County; and 37 in Union County. These counties are not open to fall hunting of wild turkeys (ODNR 2010d and ODNR 2011a). During the 2010-2011 deer hunting seasons, 1,704 deer were harvested in Champaign County; 967 in Clark County; 2,315 in Logan County; 592 in Madison County; and 967 in Union County (ODNR 2011b).

Fishing

A fishing license is required to take fish, frogs, or turtles from Ohio waters. Fishing is also permitted in privately owned ponds, lakes, or reservoirs. In locations where fish do not migrate, licenses are not required to participate in fishing activities. For example, the C.J. Brown Reservoir, located in the Buck Creek State Park, is a public fishing lake stocked with walleye, channel catfish, and white crappies. A number of other species are also present. In addition to the C.J. Brown Reservoir, the streams and rivers located within 8 km (5 mi) of the Project may be used by recreational fishermen, although data on specific fishing efforts were not available.

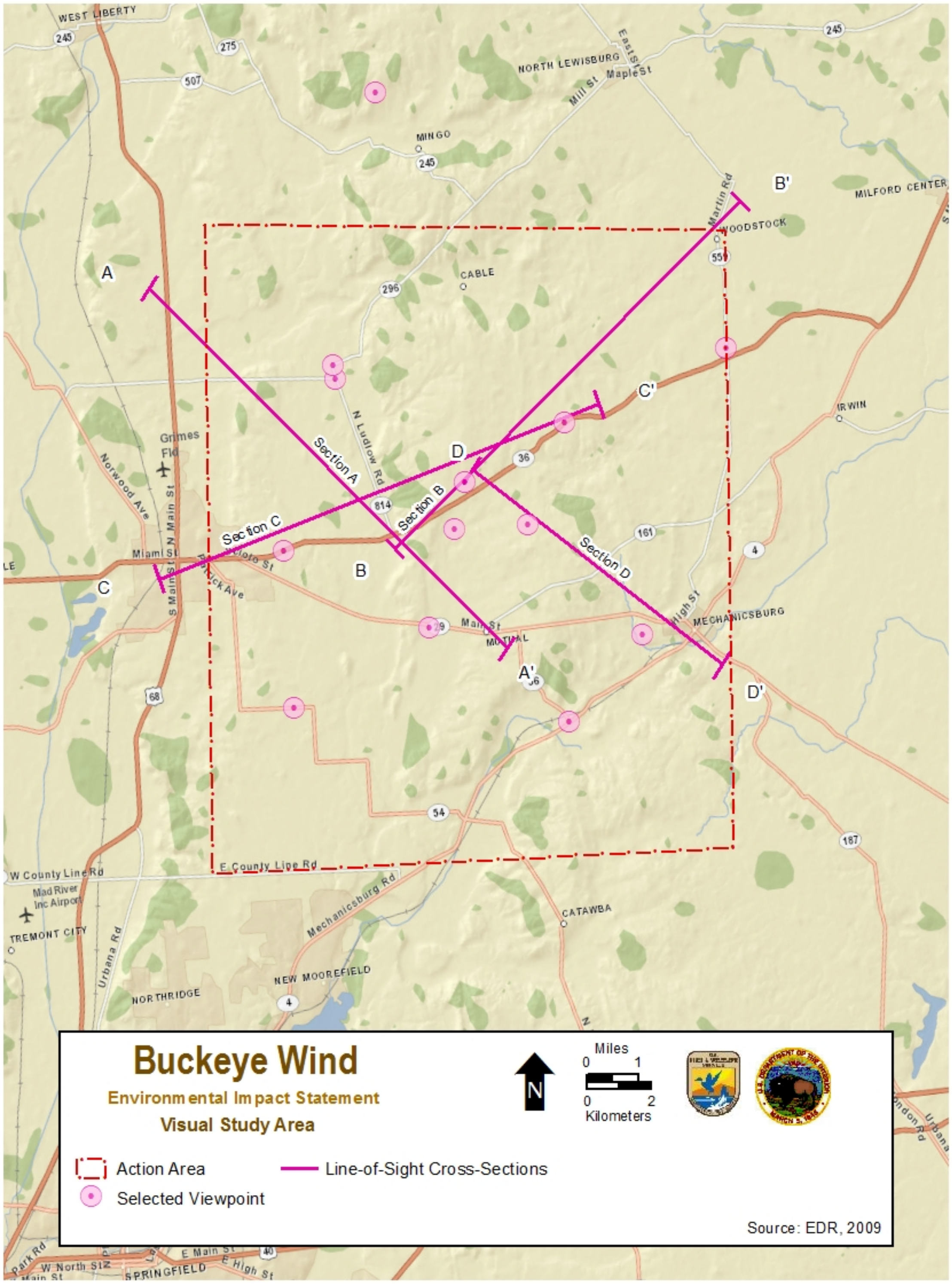
4.8 Visual Resources

4.8.1 Scope of Analysis

The following section describes the landscape and visual resources/receptors within the Action Area and the surrounding visual study area. This area encompasses a 5-mile radius around the proposed turbine sites, and includes much of eastern Champaign County and is illustrated in Figure 4.8-1. The analysis of visual resources in this EIS was conducted within the Action Area and surrounding viewshed, in accordance with typical visual impact assessment practice in areas where topography is not a controlling factor in defining the visual study area. This analysis is based on information gathered from review of aerial photography, site photographs, and the site-specific Visual Impact Assessment (VIA) conducted for the Project (EDR 2009b; Appendix H).

While the VIA conducted by EDR in 2009 focused on the 70 turbines that were included in the original OPSB Application, the general conclusions can be broadly applied to an incrementally larger 100 turbine Project in the same area. In addition, Buckeye Wind will include a VIA in any application to the OPSB for the additional turbine locations. The architectural studies completed for compliance with NHPA consider a 100-turbine layout, providing further assessment of the visual resources of the area (see Section 4.6).

Figure 4.8-1 Visual Study Area



4.8.2 Existing Conditions

4.8.2.1 Landform and Vegetation

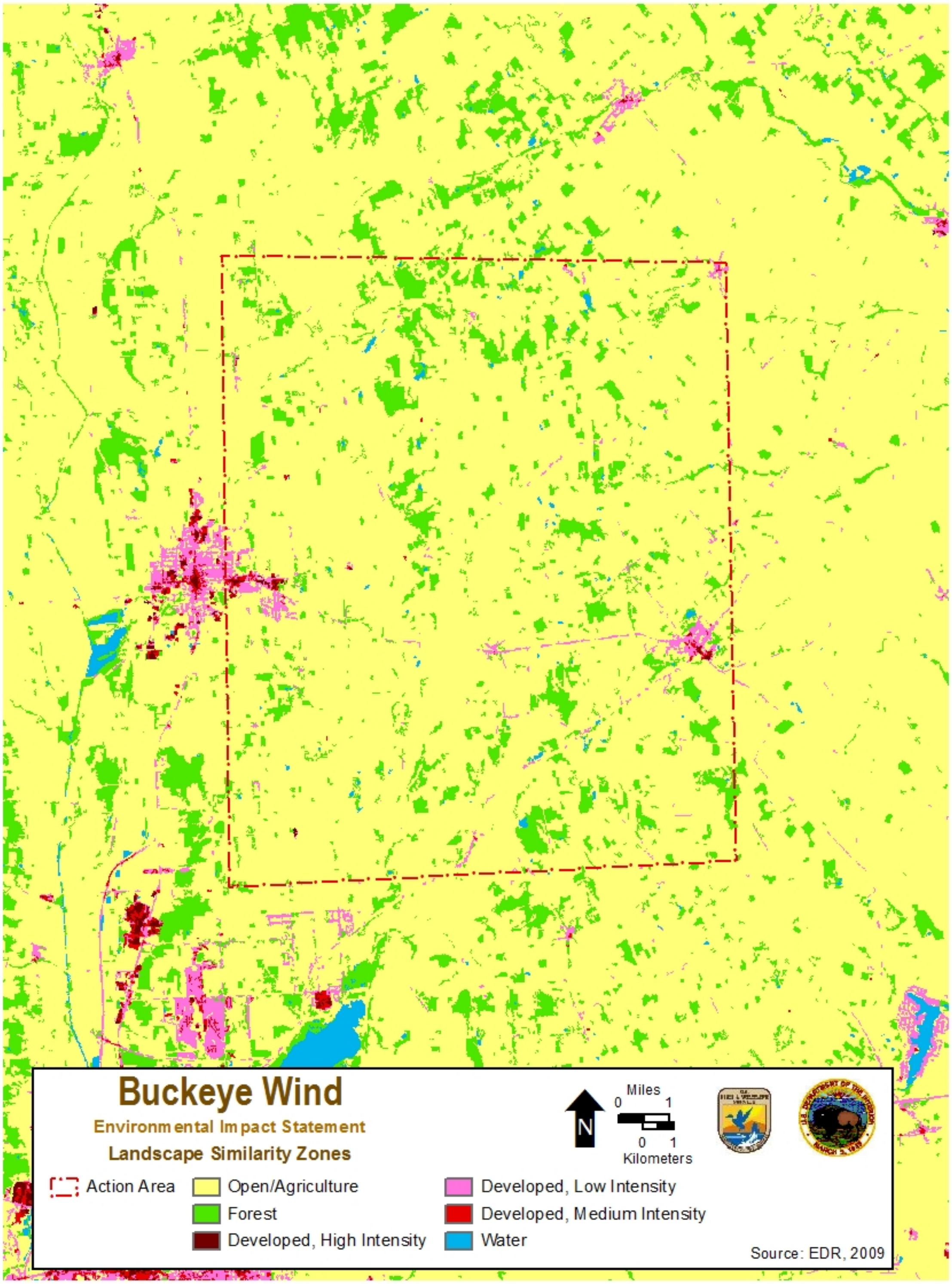
The Action Area and surrounding visual study area (VSA) is generally characterized by rolling hills and moderate slopes. Higher elevation land occurs along a dissected plateau that is oriented in a north-south direction through the central portion of the study area. Level, lower elevation plains occur to the east and west, and broad valleys associated with the Mad River and Buck Creek occur to the southwest and south, respectively.

The predominance of agricultural activity, typically pasture and crops such as soybeans, corn, wheat, and hay, defines the vegetation pattern in much of the Action Area and surrounding landscape. Forest and shrub land is interspersed through the Action Area and surrounding visual study area, frequently following water bodies or along steeper slopes. The city and villages are generally characterized by a main street business district surrounded by traditional residential neighborhoods with some commercial development along the outskirts. Hamlets within the study area are relatively small points of development within a rural/agricultural landscape. Suburban residential and commercial development occurs outside the cities and villages, primarily in the southwestern portion of the study area. Outside the areas of concentrated human settlement, commercial/industrial uses within the study area occur along certain portions of state and county highways in the area. These include automobile dealerships, retail/convenience stores, farm suppliers, and equipment yards (EDR 2009b).

4.8.2.2 Landscape Similarity Zones

Using criteria established by various federal agencies, there are several Landscape Similarity Zones (LSZs) within the Action Area and the surrounding visual study area. The LSZ "represents a physiographic area of land that has common characteristics of landform, water resources, vegetation/ecosystems, land use, and land use intensity" (Smarden et al. 1988). The major LSZs include Rural Residential – Agricultural; City – Village; Suburban Residential; and Hamlet (Figure 4.8-2). Descriptions of these LSZs, as presented in the Project Visual Impact Assessment (EDR 2009b), are provided below.

Figure 4.8-2 Landscape Similarity Zones



Rural Residential – Agricultural LSZ

The Rural Residential – Agricultural LSZ dominates the landscape and occurs throughout the Study Area. The landscape is characterized by level to gently rolling topography with a mix of farms and rural residences, open fields, hedgerows, and small woodlots. Open fields tend to occur on level ground while woodlots and bands of forest vegetation occur more commonly on steeper slopes and poorly drained areas. Due to the presence of open fields, views within this LSZ are more open and expansive compared to other zones. These views typically include a level to gently sloping foreground landscape with woodland vegetation in the background.

Typical View in the Rural Residential - Agricultural LSZ (source EDR 2009b)

City – Village LSZ

The City – Village LSZ includes the City of Urbana and various villages. This zone is characterized by high- to medium-density residential and commercial development. Buildings (typically 2 to 3 stories tall) and other man-made features dominate the landscape. These features are highly variable in their size, architectural style, and arrangement. Views within this zone are typically focused on the roadways and adjacent structures. Outward views occur most often at open road corridors, across yards and adjacent fields, and at the edges of the City – Village LSZ where structures and vegetation density decrease and screening is reduced.

Typical View in the City – Village LSZ (Source: EDR 2009b)

Suburban Residential LSZ

The Suburban Residential LSZ is dominated by low- to medium-density residential neighborhood development that typically occurs along the main road frontage or in cul-de-sacs. Examples can be found on the outskirts of the City of Urbana and in Northridge (a northern suburb of Springfield, Ohio). Buildings tend to be of relatively new construction, one to two stories in height, and are more spread out than in the City – Village LSZ. Open views are more available than in the City – Village LSZ, yet are generally more restricted than in the Rural Residential – Agricultural LSZ. The effect of vegetation on visibility is highly variable in the Suburban Residential LSZ. Adjacent agricultural fields offer open views in some places while hedgerows, woodlots, and yard trees significantly block views in others. Land use in this zone is almost exclusively residential; this suggests a relatively high sensitivity to visual quality and change.

Typical View in the Suburban Residential LSZ (Source: EDR 2009b)

Hamlet LSZ

The Hamlet LSZ generally consists of a cluster of residential and municipal structures often at the intersection of two or more highways. Houses are a mix of traditional and more modern architectural styles with spacing similar to that in a village setting. However, they also tend to have larger backyards and may border active or inactive agricultural land and/or woodlots. Occasional commercial establishments, churches, and historic structures are found in some of the Hamlet LSZs. Views within this zone are typically focused on the highway and adjacent structures; outward views occur across yards and adjacent fields. Extensive views occur from the edges of the Hamlet LSZ, where housing and vegetation density decrease and screening is reduced.

Typical View in the Hamlet LSZ (Source: EDR 2009b)

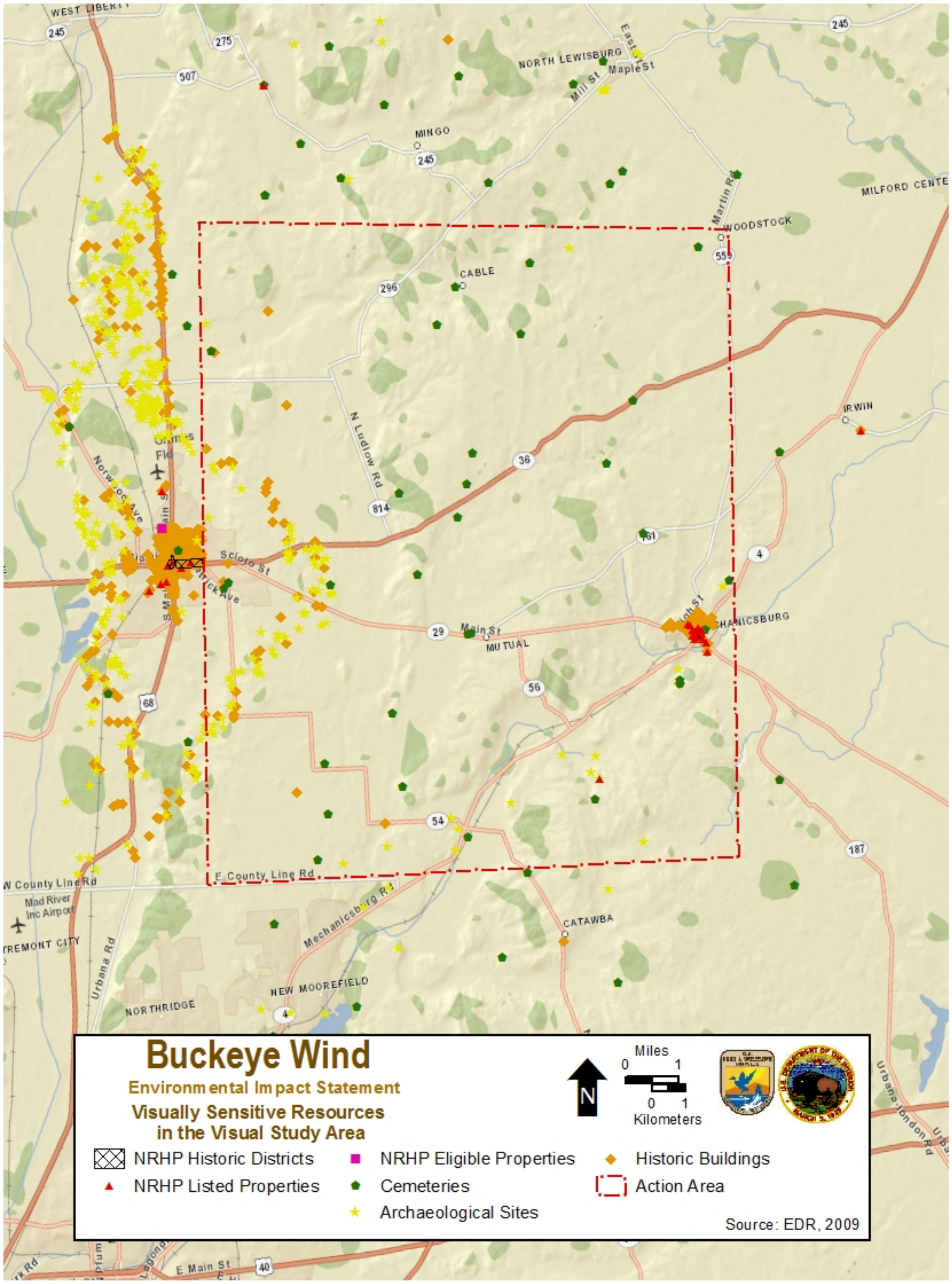
4.8.2.3 Visually Sensitive Resources

The Action Area and surrounding visual study area includes numerous resources (sites and locations) that are potentially sensitive to changes in the visual landscape. These are depicted in Figure 4.8-3:

- Historic Sites: At least 34 sites or districts are listed on the NRHP (see Section 4.6.3 for further detail). Of these sites, the vast majority are located in the City of Urbana and in the Village of Mechanicsburg.
- Numerous resources that are regionally or locally significant, such as schools, waterbodies, churches, and cemeteries.

While various recreational activities occur throughout the Action Area and surrounding viewshed, there are no State Forests; National Wildlife Refuges; National Park Service Lands; designated State or Federal trails; designated wild, scenic, or recreational rivers; or designated scenic roads or overlooks.

Figure 4.8-3 Visually Sensitive Resources in the Visual Study Area



4.8.2.4 Potential Viewers

The affected environment for visual resources includes the individuals or groups who would likely view the Project within the Visual Setting described above.

Local Residents

Local residents, those who live and work within and adjacent to the Action Area, generally view the landscape from their yards, homes, local roads, and places of employment. Except when involved in local travel, residents are likely to be stationary and have frequent or prolonged views of the landscape. Residents' sensitivity to visual quality is variable, and it is assumed that residents may be very sensitive to changes to particular views that are important to them (EDR 2009b).

Commuters and Through Travelers

Commuters and through travelers are typically moving, have a relatively narrow field of view, and are destination-oriented. Drivers on major roads in the area are generally focused on the road and traffic conditions, but do have the opportunity to observe roadside scenery. Passengers in moving vehicles have greater opportunities for prolonged off-road views than will drivers, and accordingly, may have greater perception of changes in the visual environment (EDR 2009b).

Recreational Users

Recreational users and tourists include bicyclists, hikers, recreational boaters, hunters, fishermen, and those involved in more passive recreational activities (e.g., picnicking, sightseeing, or walking), along with individuals visiting historic and cultural sites. There is not a significant concentration of recreational areas in the Action Area and surrounding visual study area. Most recreational viewers and tourists view the surrounding landscape from ground-level vantage points.

4.9 Socioeconomics and Environmental Justice

4.9.1 Scope of Analysis

This section of the EIS describes the population, housing, employment, income, tax structure, and property values within and outside the Action Area. In addition to socioeconomic resources, this evaluation also provides a discussion of environmental justice issues including information on minority and low-income populations.

Demographic, economic, and housing data were examined within five geographic areas (hereafter referred to as the "relevant geographies") to provide the context used to benchmark characteristics and trends in central Ohio: 1) the Project Area (the host townships); 2) the Action Area; 3) Champaign County; 4) the Five-County Analysis Area (Champaign County and four surrounding counties that are in the immediate vicinity of the Action Area); and 5) the State of Ohio. These study areas are used in the context of socioeconomics due to Project interaction with and potential impact on broader regional systems that spread beyond the boundaries of the Action Area. Communities within geographies #2 and #4 above include:

- Champaign County: Townships of Concord and Mad River, the City of Urbana, as well as the Villages of Mutual, Mechanicsburg, North Lewisburg and Woodstock;
- Clark County: the Townships of Moorefield, Pleasant and Northridge, and the Village of Catawba;
- Logan County: the Townships of Monroe and Zane;
- Madison County: the Townships of Pike and Somerford; and
- Union County: the Townships of Allen and Union.

The socioeconomic and environmental justice analysis in this EIS draws upon publicly available information from the counties and townships listed above, the Ohio Office of Policy Research and Strategic Planning (OPRSP), U.S. Census Bureau (decennial censuses and American Community Surveys), as well as information provided in the Buckeye Facility Socioeconomic Report prepared by Saratoga Associates (Saratoga 2009), a copy of which is provided in Appendix I of this EIS.

4.9.2 Existing Conditions

4.9.1.1 Population Characteristics

Population Growth

Table 4.9-1 provides a summary of recorded, estimated, and projected population within 8 km (5 mi) of the Action Area. The townships that would host the Project—Goshen, Rush, Salem, Union, Urbana, and Wayne in Champaign County—were home to approximately 25,302 residents in 1990, 27,017 in 2000, and 27,662 in 2010. These townships grew by 6.8 percent from 1990 to 2000 and another 2.4 percent from 2000 to 2010. Champaign County, where the Project would be located, experienced a population growth of 8.0 percent from 1990 to 2000 and 3.1 percent from 2000 to 2010 (U.S. Census Bureau 1990, 2000, 2010a). The county is projected to grow by another 9.9 percent between 2010 and 2020 (ODD n.d.).

Townships and communities in the Action Area have also experienced substantial growth since 1990 (10.4 percent from 1990 to 2000, and 4.6 percent from 2000 to 2010). Counties within the Five-County Analysis Area also grew in the 1990s and 2000s, albeit at a steadier pace. Collectively, these counties grew by 5.4 percent from 1990 to 2000, 3 percent between 2000 and 2010, and are projected to grow by 8.4 percent from 2010 to 2020 (U.S. Census Bureau 1990, 2000, 2010; ODD n.d.).

Table 4.9-1 Community Populations within 8 km (5 mi) of the Action Area

Governmental Unit	Population				Percentage Change		
	1990 [1]	2000 [1]	2010 [1]	2020 Projected[2]	1990-2000	2000-2010	2010-2020
Champaign County	36,020	38,890	40,097	44,050	8.0	3.1	9.9
Township of Goshen	3,172	3,383	3,696		6.7	9.3	
Township of Concord	1,122	1,408	1,422		25.5	1.0	
Township of Mad River	2,353	2,650	2,821		12.6	6.5	
Township of Rush	2,248	2,779	2,613		23.6	-6.0	
Township of Salem	2,045	2,307	2,539		12.8	10.1	
Township of Union	1,651	1,920	2,210		16.3	15.1	
Township of Urbana	14,770	14,968	14,795	n/a	1.3	-1.2	n/a
Township of Wayne	1,416	1,660	1,809		17.2	9.0	
City of Urbana	11,353	11,613	11,793		2.3	1.5	
Village of Mechanicsburg	1,803	1,744	1,644		-3.3	-5.7	
Village of Mutual	126	132	104		4.8	-21.2	
Village of North Lewisburg	1,160	1,588	1,490		36.9	-6.2	
Village of Woodstock	296	317	305		7.1	-3.8	
Clark County	147,548	144,742	138,333	141,660	-1.9	-4.4	2.4
Township Moorefield	9,621	11,402	12,436		18.5	9.1	
Township of Pleasant	2,700	3,134	3,238	n/a	16.1	3.3	n/a
Village of Catawba	268	312	272		16.4	-12.8	
Logan County	42,310	46,005	45,858	51,340	8.7	-0.3	12.0
Township of Monroe	1,274	1,503	1,739	n/a	18.0	15.7	n/a
Township of Zane	704	968	1,140		37.5	17.8	
Madison County	37,068	40,213	43,435	45,190	8.5	8.0	4.0
Township of Pike	506	531	580	n/a	4.9	9.2	n/a
Township of Somerford	2,544	2,939	2,898		15.5	-1.4	
Union County	31,969	40,909	52,300	64,570	28.0	27.8	23.5
Township of Allen	901	1,518	2,263	n/a	68.5	49.1	n/a
Township of Union	1,658	1,565	1,763		-5.6	12.7	
Action Area[3]	63,691	70,341	73,570	n/a	10.4	4.6	n/a
Host Townships[4]	25,302	27,017	27,662	n/a	6.8	2.4	n/a
Five County Analysis Area[5]	294,915	310,759	320,023	346,810	5.4	3.0	8.4

Notes:
[1] Source: U.S. Census Bureau, Decennial Census
[2] Source: Ohio Department of Development (ODD), Office of Strategic Research
[3] Includes all jurisdictions in Table 4.9-1 except counties
[4] Includes Goshen, Rush, Salem, Union, Urbana, and Wayne in Champaign County
[5] Includes Champaign, Clark, Logan, Madison, and Union Counties

Age Cohorts

Evaluating population age cohorts helps to understand the types of development that a community might demand or prefer in the future. Age cohort data is also used in evaluating whether an action could have disproportionate adverse health or safety risk effects on children. Age cohort information for various geographies in the vicinity of the Project is shown in Table 4.9-2. This analysis shows that the host townships, Champaign County, and jurisdictions in the Action Area have slightly higher proportions of preschool and school age children than the state as a whole. The Action Area has the highest proportion of residents between the ages of 55 to 64, while the host townships have the lowest proportion of Empty Nesters (U.S. Census Bureau 2010).

Table 4.9-2 Age Cohort Profile: 2010

Cohort (age in years)	Host Townships	Action Area	Champaign County	Five County Analysis Area	State of Ohio
Preschool (Under 5)	6.5%	6.0%	6.3%	6.4%	6.2%
School Age (5- 19)	21.1%	21.1%	21.6%	20.8%	20.3%
College Age (20-24)	6.1%	5.5%	5.6%	5.7%	6.6%
Working Adults (25 to 54)	39.4%	39.1%	39.5%	40.4%	40.2%
Empty Nesters (55 to 64)	12.3%	13.1%	12.7%	12.7%	12.6%
Seniors (65+)	14.7%	15.3%	14.4%	14.1%	14.1%
Median Age (years)	39.5	40.4	39.7	39.5	38.8

Source: U.S. Census Bureau, Census 2010

4.9.1.2 Housing Characteristics

Table 4.9-3 summarizes the number, tenure, and occupancy status of housing units in the relevant geographies in 2000 and 2010, while Table 4.9-4 summarizes housing unit value. The townships hosting the Project added housing at a slower rate than the state and the Five-County Analysis Area. However, jurisdictions in the Action Area collectively added housing at a rate similar to that of the region and state, and had lower vacancy rates. The percentage of occupied housing units and home ownership rates in the host townships, Action Area, Champaign County, and Five-County Analysis Area were consistently higher than in the state as a whole (U.S. Census Bureau 2000, 2010a).

Housing values in the host townships are similar to housing values in Champaign County, but are lower than housing values in the Action Area, Five-County Analysis Area, and the state. The median monthly rent in the host townships is the lowest among the five analysis categories. Housing values in the Action Area are higher than the host townships and the surrounding counties. This can be partially attributed to the substantially higher median housing values in the Townships of Somerford (Madison County) and Allen (Union County), which are $209,800 and $190,100, respectively (U.S. Census Bureau 2010b).

Table 4.9-3 Housing Characteristics: 2000 – 2010

		Host Townships		Action Area		Champaign County		Five-County Analysis Area		State of Ohio	
		2000	2010	2000	2010	2000	2010	2000	2010	2000	2010
Total Housing Units		11,283	11,756	29,029	31,149	15,890	16,755	128,132	136,723	4,783,051	5,127,508
Change, 2000-2010	**Number**		473		2,120		865		8,591		344,457
	Percent		4.2%		7.3%		5.4%		6.7%		7.2%
Occupied		93.3%	90.9%	94.3%	91.6%	94.1%	91.5%	91.8%	88.9%	92.9%	89.8%
Homeowner		72.8%	70.9%	75.7%	74.5%	75.9%	74.6%	73.5%	71.9%	69.1%	67.6%
Renter		27.2%	29.1%	24.3%	25.5%	24.1%	25.4%	26.5%	28.1%	30.9%	32.4%
Vacant		6.7%	9.1%	5.7%	8.4%	5.9%	8.5%	8.2%	11.1%	7.1%	10.2%

Source: U.S. Census Bureau, Census 2000 and 2010

Table 4.9-4 Housing Values and Median Monthly Rents: 2010

	Host Townships	Action Area	Champaign County	Five-County Analysis Area	State of Ohio
Median Housing Value (Owner-Occupied Units)	$123,928	$132,614	$122,800	$129,228	$136,400
Median Monthly Rent (Renter-Occupied Units)	$604	$608	$623	$656	$678

Source: U.S. Census Bureau, 2010 American Community Survey

4.9.1.3 Income Characteristics

Table 4.9-5 shows median household and per capita income information for the relevant geographies. While the median household incomes in the Action Area, Champaign County and the Five-County Analysis Area are higher than those for the state as a whole, the median household income in the host townships is lower than the median household income for the state or nearby counties. Per capita incomes in the host townships, Champaign County and the Five-County Analysis Area are lower compared to the state value. This indicates the presence of a relatively small number of high-income households, set amidst a community with average to slightly below-average income characteristics.

Table 4.9-5 Income Characteristics

	Host Townships	Action Area	Champaign County	Five-County Analysis Area	State of Ohio
Median Household Income	$45,656	$52,052	$48,315	$48,523	$47,358
Per Capita Income	$22,282 (2010)	$25,217 (2010)	$22,928 (2010)	$22,904 (2010)	$25,113 (2010)

Source: U.S. Census Bureau, 2010 American Community Survey

4.9.1.4 Employment Characteristics

Table 4.9-6 shows the types of jobs, by industry, in the Five-County Analysis Area. The region's three leading industries are manufacturing, health care and social assistance, and retail trade. The manufacturing industry is by far the largest industry in Champaign, Logan, Madison, and Union Counties. Manufacturing provided 25,000 to 30,000 jobs in the Five-County Analysis Area, one-quarter of the approximately 105,000 total existing jobs in that region in 2008. Health care provided some 15,000 jobs (14 percent). The retail trade sector has the greatest number of establishments in each county—nearly 1,000 establishments in the Five-County Analysis Area, or 16 percent of all establishments in that region—and provided more than 13,500 jobs.

4.9.1.5 Tax Value of Land Use

As part of the Applicant's analysis of socioeconomic trends, GIS land use data were evaluated to determine the local tax base composition, as a function of land use type. Table 4.9-7 summarizes the findings of this analysis. The Applicant's analysis indicates that, by hectares (acres), agriculture is the predominant revenue-generating land use in the host townships, but that residential land uses generate far more tax revenue than any other land use (Saratoga Associates 2009).

Table 4.9-6 Employment in the Five-County Analysis Area, 2008

	Champaign County				Clark County				Logan County			
	Employees[1]		Establishments		Employees[1]		Establishments		Employees[1]		Establishments	
Industry	**Num.**	**Pct.**	**Num.**	**Pct.**	**Num.**	**Pct.**	**Num.**	**Pct.**	**Num.**	**Pct.**	**Num.**	**Pct.**
Forestry, Fishing, Hunting, Ag. Support	a	<1	2	0.3	a	<1	1	0.1	-	-	-	-
Mining	a	<1	2	0.3	b	<1	6	0.2	b	<1	5	0.6
Utilities	a	<1	3	0.4	c	<1	6	0.2	b	<1	3	0.3
Construction	344	3.2	77	11.5	1,134	2.6	204	8.0	546	3.0	78	8.6
Manufacturing	3,866	36.3	47	7.0	6,311	14.7	176	6.9	i	27-55	54	5.9
Wholesale Trade	258	2.4	37	5.5	1,911	4.5	99	3.9	1,068	5.9	33	3.6
Retail Trade	1,145	10.7	109	16.3	6,417	15.0	458	17.8	1,935	10.7	156	17.2
Transportation and Warehousing	208	2.0	24	3.6	1,438	3.4	61	2.4	541	3.0	41	4.5
Information	89	0.9	7	1.1	429	1.0	30	1.2	c	<2	10	1.1
Finance and Insurance	243	2.3	47	7.0	2,543	5.9	161	6.3	354	1.9	62	6.8
Real Estate, Rental and Leasing	65	0.6	20	3.0	458	1.1	105	4.1	171	0.9	34	3.7
Prof., Scientific, Tech. Services	126	1.2	40	6.0	1,013	2.4	168	6.5	927	5.1	48	5.3
Mgmt. of Companies and Enterprises	b	<1	3	0.5	1,973	4.6	19	0.7	53	0.3	4	0.4
Admin., Support, Waste Mgmt and Remediation Services	682	6.4	31	4.6	1,716	4.0	104	4.1	1,707	9.4	46	5.1
Educational Services	e	2-5	3	0.4	g	2-6	19	0.7	a	<1	6	0.7
Health Care and Social Assistance	2,042	19.2	51	7.6	8,221	19.2	322	12.5	2,027	11.2	89	9.8
Arts, Entertainment and Recreation	62	0.6	12	1.8	479	1.1	42	1.6	471	2.6	22	2.4
Accommodation and Food Services	689	6.5	60	9.0	4,629	10.8	238	9.3	1,364	7.5	98	10.8
Other Services	493	4.6	92	13.8	2,050	4.8	344	13.4	722	4.0	119	13.1
Unclassified Establishments	a	<1	2	0.3	a	<1	3	0.1	a	<1	1	0.1
Total	**10,657**	**100.0**	**669**	**100.0**	**42,869**	**100.0**	**2,566**	**100.0**	**18,154**	**100.0**	**909**	**100.0**

Table 4.9-6 Employment in the Five-County Analysis Area, 2008 (Continued)

Industry	Madison County				Union County			
	Employees[1]		Establishments		Employees[1]		Establishments	
	Num.	Pct.	Num.	Pct.	Num.	Pct.	Num.	Pct.
Forestry, Fishing, Hunting, Ag. Support	b	0.5	2	0.3	a	<1	2	0.2
Mining	-	-	-	-	b	<1	3	0.3
Utilities	a	<1	1	0.1	b	<1	2	0.2
Construction	446	4.1	100	13.8	799	3.4	133	12.6
Manufacturing	2,866	26.3	46	6.3	7,208	30.9	54	5.1
Wholesale Trade	265	2.4	33	4.5	954	4.1	69	6.6
Retail Trade	1,814	16.7	113	15.5	2,250	9.6	140	13.3
Transportation and Warehousing	1,125	10.3	39	5.4	f	2-4	45	4.3
Information	51	0.5	7	1.0	106	0.5	12	1.1
Finance and Insurance	c	<3	44	6.1	274	1.2	54	5.1
Real Estate, Rental and Leasing	95	0.9	32	4.4	157	0.7	43	4.1
Prof., Scientific, Tech. Services	f	5-9	49	6.7	g	4-10	96	9.1
Mgmt. of Companies and Enterprises	a	<1	2	0.3	g	4-10	4	0.4
Admin., Support, Waste Mgmt and Remediation Svcs.	664	6.1	30	4.1	2,934	12.6	98	9.3
Educational Services	37	0.3	5	0.7	122	0.5	8	0.8
Health Care and Social Assistance	1,223	11.2	71	9.8	1,634	7.0	76	7.2
Arts, Entertainment and Recreation	41	0.4	12	1.7	199	0.9	23	2.2
Accommodation and Food Services	1,091	10.0	58	8.0	1,432	6.1	73	6.9
Other Services	373	3.4	81	11.1	817	3.5	117	11.1
Unclassified Establishments	a	<1	2	0.3	a	<1	1	0.1
Total	**10,884**	**100.0**	**727**	**100.0**	**23,361**	**100.0**	**1,053**	**100.0**

Notes:
Source: U.S. Census Bureau, 2008 County Business Patterns
[1] Exact employment data not provided due to confidentiality. a = 0-19 employees; b = 20-99 employees; c = 100-249 employees; e = 250-499 employees; f = 500-999 employees; g = 1,000-2,499 employees; i = 5,000-9,000 employees

Table 4.9-7 Total Hectares (Acres) and Assessed Valuation by Land Use Classification: Fiscal Year 2007

Land Use Classification	Host Townships		Action Area		Champaign County		Five-County Analysis Area	
	Total Hectares (Acres)	Assessed Valuation	Total Hectares (Acres)	Assessed Valuation	Total Hectares (Acres)	Assessed Valuation	Total Hectares (Acres)	Assessed Valuation
Agricultural	51,493 (127,243)	$152,025,230	72,408 (178,923)	$258,484,300	96,259 (237,861)	$303,286,440	464,122 (1,146,870)	$1,386,480,740
Commercial	319 (789)	$27,688,440	668 (1,651)	$110,360,770	469 (1,160)	$106,724,130	6,431 (15,892)	$776,169,190
Forestry	85 (211)	$231,880	303 (749)	$1,698,500	468 (1,157)	$2,856,280	630 (1,557)	$3,061,050
Government	851 (2,104)	$40,009,670	2,453 (6,062)	$59,878,160	1,544 (3,816)	$70,845,260	9,840 (24,315)	$654,065,060
Manufacturing	38 (93)	$10,145,330	1,008 (2,491)	$212,544,200	225 (557)	$83,634,670	4,735 (11,701)	$2,152,926,910
Minerals and Oil	94 (232)	$1,277,990	0 (0)	$0	94 (232)	$1,277,990	468 (1,157)	$4,681,440
Non-Commercial	52 (128)	$6,497,690	206 (508)	$47,513,120	164 (406)	$44,235,060	3,971 (9,813)	$331,159,480
Residential	4,778 (11,806)	$594,926,780	9,428 (23,298)	$1,382,140,460	9,328 (23,051)	$1,462,671,310	50,194 (124,031)	$6,973,052,240
Utilities	0 (0)	$1	0 (0)	$21,410	0 (0)	$21,410	99 (245)	$3,797,610
Vacant	1,640 (4,052)	$14,495,150	3,096 (7,650)	$31,111,160	2,714 (6,707)	$31,493,200	20,225 (49,978)	$214,337,910
Not Designated	0 (0)	$0	513 (1,267)	$2,619,810	0 (0)	$0	3,324 (8,213)	$6,346,340
Total	59,350 (146,658)	$847,298,161	90,083 (222,599)	$2,106,371,890	111,267 (274,948)	$2,116.045,750	564,040 (1,393,772)	$12,506,077,970

Source: Saratoga Associates 2009

4.9.1.6 Property Values

Property values are determined by a combination of property characteristics and local market trends. Property characteristics that affect overall value include size, age, condition, and any additional special features and amenities within a residential structure. Local market trends are determined from detailed analysis of property sales within a given area. For example, if individual property sales decrease in locations where wind turbines are present, other properties in the same area or comparable areas, even if they are not directly adjacent or in sight of the wind turbines, may be impacted.

There is a wide body of both professional and academic literature on the subject of wind turbines and residential property values. These studies do not establish a consensus as to whether property values are impacted by the presence of wind turbines (Appendix I). Instead, other factors and considerations, such as property type and condition, existing amenities, and distance to and size of wind turbines appear to be equally, if not more important when buyers evaluate property.

4.9.1.7 Socioeconomic Data Relevant to Environmental Justice Concerns

In response to Executive Order 12898, federal agencies are required to address potential environmental justice impacts to minority and low income populations. The information in this section provides the necessary background for the analysis—in Section 5.9—of whether the Project would have a disproportionately high and adverse effect on minority and low income populations. Except where noted, data for this section are from the 2010 U.S. Census (the most recent data available from public sources for all relevant jurisdictions) for all of the relevant geographies, as well as the state of Ohio.

Minority Populations

Table 4.9-8 summarizes the racial composition of the populations in the relevant geographies. The percentage of the population identified as Caucasian was higher than the state average in all the townships in the Action Area.

Low Income Populations

Table 4.9-9 shows the number of individuals below the poverty level and the percentage of the population within each geographic area. While median household income and per capita income (Table 4.9-6) help to depict the financial state of a community, poverty levels are used to determine whether or not there is economic hardship or need. In the American Community Survey (U.S. Census Bureau 2010b), poverty is determined through a sample of household or family income against a series of federal thresholds that take into account age, family size, and the presence of children. As shown in Table 4.9-9, the Action Area, Champaign County, and the Five-County Analysis Area had lower poverty rates (fewer individuals below the poverty rate) than the state as a whole. The combined poverty rate of the host townships is almost the same as that of the state.

Table 4.9-8 Minority Population, 2010

Jurisdiction		Total Population	One Race	Caucasian	African-American	Native American/ Alaska Native	Asian	Native Hawaiian/ Pacific Islander	Other	Multiple Races	Total Minority	Hispanic/ Latino
State of Ohio	Number	11,536,504	11,298,739	9,539,437	1,407,681	25,292	192,233	4,066	130,030	237,765	1,997,067	354,674
	Percent	100%	97.9%	82.7%	12.2%	0.2%	1.7%	0.0%	1.1%	2.1%	17.3%	3.1%
Host Townships												
Goshen Township	Number	3,696	3,630	3,568	37	15	2	2	6	66	128	24
	Percent	100%	98.2%	96.5%	1.0%	0.4%	0.1%	0.1%	0.2%	1.8%	3.5%	0.6%
Rush Township	Number	2,613	2,557	2,519	12	12	12	0	2	56	94	15
	Percent	100%	97.9%	96.4%	0.5%	0.5%	0.5%	0.0%	0.1%	2.1%	3.6%	0.6%
Salem Township	Number	2,539	2,511	2,455	33	12	4	0	7	28	84	16
	Percent	100%	98.9%	96.7%	1.3%	0.5%	0.2%	0.0%	0.3%	1.1%	3.3%	0.6%
Union Township	Number	2,210	2,190	2,147	24	1	10	3	5	20	63	19
	Percent	100%	99.1%	97.1%	1.1%	0.0%	0.5%	0.1%	0.2%	0.9%	2.9%	0.9%
Urbana Township	Number	14,795	14,378	13,420	711	65	89	1	92	417	1,375	270
	Percent	100%	97.2%	90.7%	4.8%	0.4%	0.6%	0.0%	0.6%	2.8%	9.3%	1.8%
Wayne Township	Number	1,809	1,781	1,740	22	8	8	0	3	28	69	13
	Percent	100%	98.5%	96.2%	1.2%	0.4%	0.4%	0.0%	0.2%	1.5%	3.8%	0.7%
Total, Host Townships	**Number**	**27,662**	**27,047**	**25,849**	**839**	**113**	**125**	**6**	**115**	**615**	**1,813**	**357**
	Percent	**100%**	**97.8%**	**93.4%**	**3.0%**	**0.4%**	**0.5%**	**0.0%**	**0.4%**	**2.2%**	**6.6%**	**1.3%**
Counties in the Five-County Analysis Area												
Champaign County	Number	40,097	39,335	37,986	892	143	153	13	148	762	2111	451
	Percent	100%	98.1%	94.7%	2.2%	0.4%	0.4%	0.0%	0.4%	1.9%	5.3%	1.1%
Clark County	Number	138,333	134,824	119,440	12,128	351	858	51	1996	3,509	18,893	3,805
	Percent	100%	97.5%	86.3%	8.8%	0.3%	0.6%	0.0%	1.4%	2.5%	13.7%	2.8%
Logan County	Number	45,858	44,981	43,722	742	115	242	16	144	877	2136	539
	Percent	100%	98.1%	95.3%	1.6%	0.3%	0.5%	0.0%	0.3%	1.9%	4.7%	1.2%
Madison County	Number	43,435	42,787	39,364	2,862	105	232	10	214	648	4,071	622
	Percent	100%	98.5%	90.6%	6.6%	0.2%	0.5%	0.0%	0.5%	1.5%	9.4%	1.4%
Union County	Number	52,300	51,558	48,587	1,231	119	1,428	19	174	742	3,713	661
	Percent	100%	98.6%	92.9%	2.4%	0.2%	2.7%	0.0%	0.3%	1.4%	7.1%	1.3%
Total, Counties	**Number**	**320,023**	**313,485**	**289,099**	**17,855**	**833**	**2,913**	**109**	**2,676**	**6,538**	**30,924**	**6,078**
	Percent	**100%**	**98.0%**	**90.3%**	**5.6%**	**0.3%**	**0.9%**	**0.0%**	**0.8%**	**2.0%**	**9.7%**	**1.9%**

Source: US Census Bureau, Census 2010

Table 4.9-9 Poverty Status of Individuals, 2010

	Host Townships	Action Area	Champaign County	Five-County Analysis Area	State of Ohio
Individuals below Poverty (2010)	3,948	8,106	4,562	43,765	1,586,292
Percent of Population below Poverty (2010)	14.3%	11.0%	11.5%	13.7%	14.2%

Source: US Census Bureau, 2010 American Community Survey

4.10 Noise

Noise is generally defined as unwanted sound. Sound travels in mechanical wave motion and produces a sound pressure level. This sound pressure level is commonly measured in decibels (dB), representing the logarithmic increase in sound energy relative to a reference energy level. Sound measurement is further refined by using an A-weighted decibel (dBA) scale to emphasize the range of sound frequencies that are most audible to the human ear (i.e., between 1,000 and 8,000 cycles per second). The dBA scale weighs the various components of noise based on the response of the human ear. Therefore, unless otherwise noted, all decibel measurements presented in this EIS are dBA. Because sound levels are expressed as relative intensities, multiple sound sources are not directly additive. Rather, the total noise is primarily a result of the source of highest intensity. For example, two sources, each having a noise rating of 50 dBA, will together be heard as 53 dBA, not 100 dBA.

4.10.1 Scope of Analysis

The noise analysis presented in this EIS covers the Action Area, with focus on the nearest potentially sensitive receptors to the wind turbine generators. The noise analysis is based on information from scientific literature, a background sound level survey that was conducted within and around the Action Area, and a sound modeling program (Hessler 2009).

4.10.2 Existing Conditions

The Project terrain consists mostly of gently rolling hills with some relatively flat areas. The area is primarily open farmland interrupted by a few scattered wooded areas. Although the area is composed of fairly large farms, a number of homes exist on smaller parcels of land among the larger properties. Private residences are more or less evenly distributed over the entire site area with intermittent areas of greater density around the small towns and other localities in the area. Turbines are planned throughout the Action Area on large tracts of open land between the residences. The noise analysis covers representative areas of the Action Area (see plots in Appendix J).

Review of aerial photography indicates that there are some noise sensitive areas such as residences, churches, schools, and recreational areas (two golf courses and a local park) within 1.6 km (1 mi) of Project facilities. Other noise sensitive areas such as schools, libraries, hospitals, and nursing homes are located more than 1.6 km (1 mi) away from Project Facilities. The plots in Appendix J show the locations of these noise sensitive areas.

4.10.2.1 Background Sound Level Survey

A background sound level survey was conducted to establish baseline noise levels at five locations evenly distributed within the Action Area and three locations north of the Action Area (Hessler 2009).[5] Seven of these locations were near residential houses, usually surrounded by open farm fields or adjacent to roads. The last location was near a church located close to a large open field. Sound level meters were placed at these eight locations and left to run continuously for 14 days from noon on January 11, 2008 to noon on January 25, 2008. Background sound levels are normally lowest at this time of the year (winter) because wind-induced leaf rustle noise is absent and no insects are present. During the survey, the only noticeable background sound was natural wind-induced sound.

Monitors recorded a number of statistical parameters in 10-minute increments, such as the average (L_{eq}), minimum, maximum, and residual (L_{90}) sound levels. Of these, the average (L_{eq}) and residual (L_{90}) levels are the most meaningful. The average, or equivalent energy sound level, is the average sound level over each measurement interval. This is the "typical" sound level most likely to be observed at any given moment. The L_{90} statistical sound level, on the other hand, is commonly used to conservatively quantify background sound levels. The L_{90} is the sound level exceeded during 90 percent of the measurement interval and has the quality of filtering out sporadic, short-duration noise events (such as cars passing by or tractor activity in a neighboring field), thereby capturing the quiet lulls between such events. It is this consistently present background level that forms a conservative or "worst-case" basis for evaluating the audibility of a new source since it represents essentially the lowest amount of masking sound.

Weather conditions during the survey period were observed at a weather station within the Action Area near the village of Cable. The weather conditions were mostly clear and cold with very little precipitation. Detailed records of wind speed at the site were measured at the project's two meteorological towers (met towers).

Background sounds such as natural tree and grass rustle mask potential wind turbine noise as a function of wind speed. Wind turbines operate and produce noise when the wind exceeds a minimum cut-in speed of roughly 3 to 4 m/s (10 to 13 ft/s) at hub height. Turbine sound levels increase with wind speeds up to about 8 to 10 m/s (26 to 33 ft/s) (measured at a standard elevation of 10 m [33 ft]) when the sound produced generally reaches a maximum and no longer increases with wind speed. Consequently, at moderate to high wind speeds, when turbine noise is most significant, the level of natural masking noise also is relatively high due to tree or grass rustle and will continue to increase with increasing wind speed, thus reducing the perceptibility of noise from the turbines. In order to quantify this effect, wind speed was measured over the entire sound level survey period at two on-site met towers for later correlation to the sound data.

The L_{90} sound levels recorded at the eight widely distributed monitoring locations closely followed the same trends. Sound levels increased with increasing wind speed regardless of time of the day. In general, the nighttime levels have a greater dependency on wind, and reach extremely low levels in the 20 to 25 dBA range during calm wind conditions. Daytime levels remain relatively elevated during low wind conditions, likely due to other ambient sounds. At higher wind speeds the daytime and nighttime sound levels are nearly the same. Table 4.10-1

[5] Originally nine locations were monitored, but one of the meters malfunctioned, and the data were eliminated from the analysis.

summarizes the residual (L_{90}) background levels that characterize the site environment over the range of wind speeds relevant to turbine operation. Appendix J includes detailed information on measurement locations, methodology, instrumentation, and weather conditions.

Table 4.10-1 Measured L_{90} Worst-case Background Sound Levels

Wind Speed at Height of 10 m [33 ft] (m/s) [ft/s]	Daytime L_{90} Sound Level (dBA)	Nighttime L_{90} Sound Level (dBA)
4 (13)	32	26
5 (16)	34	29
6 (20)	35	32
7 (23)	37	35
8 (26)	39	38
9 (30)	40	41
10 (33)	42	43

Source: Hessler 2009

As described above, the L_{90} sound levels displayed in Table 4.10-1 can be considered "worst-case" because these background levels represent the lowest levels that are likely to be observed. These low levels only occur during brief, intermittent lulls in all forms of environmental sound (both natural and man-made). By definition, the L_{90} sound level does not occur over long periods and does not characterize the sound level that is most commonly present. The sound level that is more likely to exist most of the time is the average, or L_{eq}, sound level, which may be regarded as the "typical" sound level. Like the L_{90} measurements, L_{eq} sound levels are also dependent on wind speed, with higher sound levels at higher wind speeds. Table 4.10-2 summarizes the average background sound levels that characterize the site environment over the range of wind speeds relevant to turbine operation.

Table 4.10-2 Measured L_{eq} Typical Background Sound Levels

Wind Speed at Height of 10 m [33 ft] (m/s) [ft/s]	Daytime L_{eq} Sound Level (dBA)	Nighttime L_{eq} Sound Level (dBA)
4 (13)	42	35
5 (16)	43	38
6 (20)	44	40
7 (23)	45	42
8 (26)	46	44
9 (30)	47	46
10 (33)	48	48

Source: Hessler 2009

4.11 Air Quality

This section describes the current ambient air quality concentrations for selected pollutants as well as the current major sources of air emissions within the Action Area and surrounding region.

4.11.1 Scope of Analysis

No air monitoring sites are located in Champaign County. Therefore, the air quality analysis presented in this EIS includes portions of four of the six counties adjacent to Champaign County (Clark, Madison, Miami, and Logan) because these counties contain the closest air monitoring stations to the Action Area. The land use type in Champaign County and these adjacent counties are similar (i.e., mostly rural and suburban); therefore, ambient concentrations obtained from these stations were assumed to be representative of the ambient concentrations in the Action Area. The air quality analysis in this EIS is based on the air quality data described above and information from publicly available online databases and/or documents produced by the USEPA, the primary federal agency mandated with protecting and regulating air quality in the U.S.

4.11.2 Existing Conditions

The most current ambient pollutant concentrations (2011 data) within the Action Area and overlapping counties were taken from the USEPA AirData website (USEPA 2012). Pollutants monitored in nearby counties include particulate matter with less than 2.5 microns in diameter ($PM_{2.5}$) (Clark County), particulate matter with less than 10 microns in diameter (PM_{10}) (Franklin County), sulfur dioxide (SO_2) (Clark County), ozone (O_3) (Clark, Madison, and Miami Counties) and carbon monoxide (Franklin County). The most conservative or "worst-case" ambient air quality data for 2011 are presented in Tables 4.11-1 to 4.11-5. Except for O_3, none of the pollutants measured at the monitoring stations exceeded the National Ambient Air Quality Standards (NAAQS). Table 4.11-1 shows that the 8-hour average concentration for O_3 (0.077 parts per million) slightly exceeds the NAAQS. There were no monitoring stations for nitrogen dioxide (1-hour and annual) and lead (rolling 3-month average) within the Project vicinity.

Air emissions in the Action Area and overlapping counties are related primarily to farm operations, vehicular travel, and manufacturing. Vehicles traveling on area roads and farm equipment both produce exhaust emissions, along with dust from unpaved road surfaces. In addition, routine odors are associated with certain farming practices (e.g., manure-spreading). The largest sources of manufacturing emissions in the vicinity of the Action Area originate from the Honda Plant in Logan County, Trutec Industries in Clark County, and Scotts Company in Union County, located approximately 14, 16, and 23 km (9, 10, and 14 mi) from the Action Area, respectively (USEPA 2009).

Table 4.11-1 Ambient Air Quality Monitoring for Ozone at Site 390230003, Spangler Road, Clark County, Ohio in 2011

Criterion	Maximums	Monitoring Data (ppm)	NAAQS Criteria (ppm)
1-hour averages[1]	4th Highest Daily Maximum	0.088	0.12
8-hour averages[2]	4th Highest Daily Maximum	0.077	0.075

Source: USEPA 2012
ppm = parts per million
[1] USEPA revoked the 1-hour ozone standard in all areas, although some areas have continuing obligations under that standard ("anti-backsliding"). The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is ≤ 1.
[2] To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm (effective May 27, 2008).

Table 4.11-2 Ambient Air Quality Monitoring for Sulfur Dioxide at Site 390230003, Spangler Road, Clark County, Ohio in 2011

Criterion	Maximums/ Mean	Monitoring Data (ppm)	NAAQS Criteria (ppm)
1-hour averages[1]	99th Percentile	0.022	0.075
3-hour averages[2]	Daily Maximum	Not monitored	0.5

Source: USEPA 2012
ppm = parts per million
[1] The final rule for the new NAAQS criterion for 1-hour SO2 was signed June 2, 2010. To attain this standard, the 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 75 parts per billion (ppb) or 0.075 ppm. The 1971 annual and 24-hour SO2 standards were revoked in that same rulemaking.
[2] Maximum concentrations not to be exceeded more than once per year.

Table 4.11-3 Ambient Air Quality Monitoring for Particulate Matter ($PM_{2.5}$) at Site 390230005, Fountain Avenue, Clark County, Ohio in 2011

Criterion	Percentile/ Mean	Monitoring Data (µg/m³)	NAAQS Criteria (µg/m³)
24-hour averages[1]	98th Percentile	28	35
Annual[2]	Mean	Not monitored	15

Source: USEPA 2012
µg/m³ = micrograms per cubic meters
[1] To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m³ (effective December 17, 2006).
[2] To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15 µg/m³.

Table 4.11-4 Ambient Air Quality Monitoring for Particulate Matter (PM_{10}) at Site 390490024, State Fairgrounds, Franklin County, Ohio in 2011

Criterion	Percentile/ Mean	Monitoring Data (µg/m³)	NAAQS Criteria (µg/m³)
24-hour averages[1]	Daily Maximum	86	150

Source: USEPA 2012
µg/m³ = micrograms per cubic meters
[1] Maximum concentrations not to be exceeded more than once per year on average over three years.

Table 4.11-5 Ambient Air Quality Monitoring for Carbon Monoxide (CO) at Site 390490005, Morse Road, Franklin County, Ohio in 2012

Criterion	Percentile/ Mean	Monitoring Data (ppm)	NAAQS Criteria (ppm)
1-hour averages[1]	Daily Maximum	2	9
8-hour averages[1]	Daily Maximum	2	35

Source: USEPA 2012
ppm = parts per million
[1] Maximum concentrations not to be exceeded more than once per year.

4.11.3 Greenhouse Gases

Greenhouse gases (GHGs) are gases that warm the earth's atmosphere by absorbing solar radiation reflected from the earth's surface. The most common greenhouse gases are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydro-fluorocarbons (HFCs), and sulfur hexafluoride (SF_6).

The atmospheric buildup of carbon dioxide and other greenhouse gases is largely the result of human activities such as the burning of fossil fuels (USEPA 2000). In the United States, more than 90 percent of greenhouse gas emissions come from the combustion of fossil fuels (USEPA

2000). Global carbon emissions from fossil fuels have significantly increased since 1900. Emissions increased by over 16 times between 1900 and 2008 and by about 1.5 times between 1990 and 2008 (USEPA 2012). According to USEPA (2009), scientists know with virtual certainty that increasing greenhouse gas concentrations are warming the planet and that rising temperatures may, in turn, produce changes in precipitation patterns, storm severity, and sea level, commonly referred to as "climate change." According to the Intergovernmental Panel on Climate Change (2007), the total temperature increase from 1850-1899 to 2001–2005 is 0.76°C and most of the observed increase in temperatures since the mid-20th century is likely due to the observed increase in anthropogenic greenhouse gas concentrations. Combustion of fossil fuels also produces air pollutants, such as nitrogen oxides, sulfur dioxide, volatile organic compounds and heavy metals, which negatively affect human health and air and water quality.

Nationwide, the United States currently obtains 71 percent of its electricity from fossil fuels, with 49 percent coming from coal. Coal has the highest carbon dioxide content per unit of electricity produced of all fossil fuels used to provide electricity in the United States (EIA 2007 as cited in EDR 2009a). Emissions from coal-fired power plants account for approximately 80 percent of carbon dioxide emissions by electric power plants (EIA 2010). Ohio is particularly heavily dependent upon coal for its electrical generation, with 86 percent of electricity generated from coal (PUCO 2008), and ranks fourth in terms of tons of carbon dioxide emissions produced annually, following California, Pennsylvania, and Texas.

Carbon dioxide emissions by domestic electric generating facilities were estimated to be 2,359 million metric tons (MMT) in 2008 (EIA 2009). Every 10,000 MW of wind energy installed can reduce carbon dioxide emissions by approximately 33 MMT annually, if it replaces coal-fired generating capacity, or 21 MMT, if it replaces generation from the United States average fuel mix (San Martin 1989).

4.12 Transportation

4.12.1 Scope of Analysis

This section of the EIS describes the conditions of and activity on transportation facilities within five miles of the Action Area. This analysis area was used to account for the potential regional effects of the Project on transportation infrastructure.

The transportation analysis in this EIS is based on review of maps and satellite imagery and publicly available information from ODOT and Champaign County.

4.12.2 Existing Conditions

4.12.2.1 Road Facilities

The Project would consist of up to 100 wind turbines, along with associated roads, electric transmission lines and an electric substation, located in a large portion of eastern Champaign County, Ohio. Major Project components, including sections of the turbines and construction materials (such as concrete), would be delivered to the site via truck. These components would arrive in the vicinity of the Action Area via Interstate 70, and/or U.S. Route 33. Deliveries to the

Action Area would be via U.S. Route 36 and State Route (SR) 56, with other state and local roads used to access specific turbine sites or other Project facilities. Table 4.12-1 summarizes the characteristics of Interstate, U.S., and state roads that would likely be affected, including the Average Annual Daily Traffic (AADT) in 2008 (the most recent year for which traffic data are available from ODOT) and the percentage of trucks in the traffic stream in 2008. Figure 4.12-1 shows the affected roads and other roads within the Action Area.

Table 4.12-1 Affected Roads

Road, Location	County	Lanes	2008 AADT[1]	Truck Percentage[2]
I-70, West of SR 56 [3]	Clark	4 eastbound; 3 westbound	49,280	35.7%
US 33, at US 36/SR 245 [3]	Madison	2 each direction	33,350	12.3%
US 36 at Milford Center [3]	Union	2	4,910	15.7%
US 36 at SR 559	Champaign	2	1,970	11.7%
US 36 at SR 814	Champaign	2	2,840	11.6%
SR 56 at SR 4	Champaign	2	1,060	2.8%
SR 56 at SR 29	Champaign	2	970	3.1%
SR 4 at SR 56	Champaign	2	4,060	15.5%
SR 29 in Mutual	Champaign	2	4,140	7.2%
SR 814 at US 36	Champaign	2	2,880	10.4%

Source for AADT: ODOT 2008
[1] AADT = Average Annual Daily Traffic. 2008 is the most recent year for which ODOT provides AADT information, except for I-70, which is from 2007.
[2] This category includes, "single unit trucks, tractor with semi-trailers, trucks with trailers, recreational vehicles, and school and commercial buses…FHWA 'Scheme F' Classes 4-13." Source: ODOT n.d.
[3] These locations are outside of the Action Area, but are part of the likely delivery route of Project materials, and are therefore included for reference.

4.12.2.2 Interstate Highways

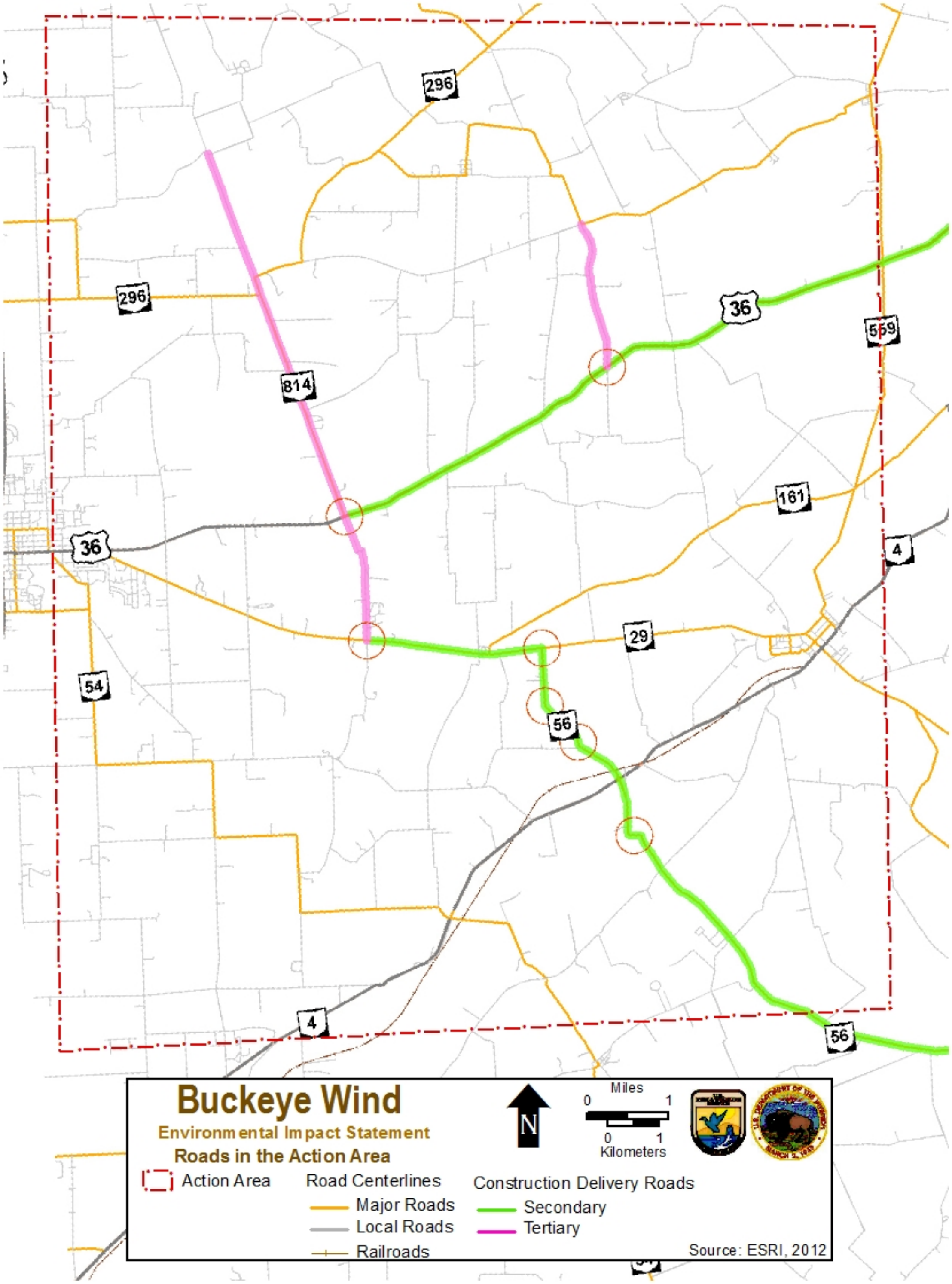
I-70 would likely be the primary route by which turbine components and other Project-related traffic would enter east-central Ohio and the Action Area. This highway is a very wide, multi-lane facility that is a major component of the nation's interstate highway system, stretching from Baltimore to Utah. As shown in Table 4.12-1 above, I-70 has a very large amount of truck traffic. Project-related traffic arriving from the west would likely exit I-70 at SR 56, while traffic arriving from the east would divert to I-270 and U.S. 33, before exiting at U.S. 36.

4.12.2.3 U.S. Routes

U.S. 33 is a four-lane freeway (no at-grade intersections or traffic signals) from I-270 (the beltway around Columbus, Ohio) to Marysville, Ohio, where Project-related traffic would exit at U.S. 36. Traffic volumes on U.S. 33 are somewhat lower than on I-70, but are still characteristic of a freeway environment. The percentage of trucks in the traffic stream is far lower on U.S. 33 than on I-70.

U.S. 36 is a much lower-capacity road of just one lane in each direction with at-grade intersections and some turn lanes, with a typical pavement width of 6 m (20 ft) (Stantec 2010b). Traffic on U.S. 36 is quite low. Except for its formal designation as a U.S. Route, U.S. 36 is very similar to other State Roads in the Action Area in terms of road character, traffic volume, and truck volume.

Figure 4.12-1 Roads in the Action Area



4.12.2.4 Other Roads

Numerous state roads would likely be used for Project-related traffic. The Applicant lists SR 56 as a primary access road for deliveries from the south and west. SR 56 is a two-lane road with at-grade intersections and a typical pavement width of 6 to 7 m (20 to 22 ft) (Stantec 2010b). Other State, County, Township, and local roads, including but not limited to those listed in Table 4.12-1 above, are similar in character (including width), traffic volume, and truck volume. All have low overall traffic volumes and relatively low truck traffic volumes.

Typical conditions on SR 56 and other Action Area roads (Source: Hull 2009c).

4.12.2.5 Planned or Potential Road Upgrades

Aside from resurfacing and drainage projects, there are no significant planned upgrades to State Roads in the Action Area. Ongoing rehabilitation of I-70 in Clark County (to the south of the Action Area) is expected to be completed by 2012 (ODOT n.d.).

4.12.2.6 Railroads

The Applicant has stated that all turbine components and other materials would likely be delivered via truck, and that railroads are not expected to be used. A segment of the Indiana and Ohio Railway (operated by RailAmerica) operates from Springfield, Ohio to Mechanicsburg, paralleling SR 4 in the Action Area (RailAmerica 2010).

Three CSX-operated rail lines also run through the Action Area and surrounding 8 km (5 mi). The first CSX line follows Interstate Highway 75 south, running north of the site through Marysville towards Columbus. Connection to this rail exists in Bellefontaine via a CSX connecting line. This provides the area with a transit and freight link to and from various regional locations. The second CSX line follows Interstates 40 and 70 south of the site, running from Columbus and points east through Springfield and Dayton before continuing west. The final CSX line runs between Bellefontaine and Urbana, providing a freight and passenger connection between the two cities.

The closest passenger rail (Amtrak) service is in Cincinnati, approximately 145 km (90 mi) away.

4.12.2.7 Airports

There are several small public or public-use airports within 8 km (5 mi) of the Action Area. The nearest airports with scheduled commercial service are located in Dayton (approximately 42 km [30 mi] away) and Columbus (approximately 72 km [45 mi] away). Table 4.12-2 summarizes the location and characteristics of these airports. Note that Weller Field is within the Action Area.

Table 4.12-2 Airports in the Vicinity of the Action Area

Airport	Location	Function	Distance, km (mi)[1]
Dayton International Airport	Dayton	Commercial Airport	45 (28)
Port Columbus International Airport	Columbus	Commercial Airport	56 (35)
Rickenbacker International Airport	Columbus	Commercial Airport	56 (35)
Bolton Field	Columbus	General Aviation/ Commercial Reliever	37 (23)
Ohio State University Airport	Columbus	General Aviation	40 (25)
Dayton-Wright Brothers Airport	Dayton	General Aviation	61 (38)
Wright-Patterson Air Force Base	Dayton	Military Airfield	32 (20)
Grimes Field	Urbana	General Aviation	< 1.6 (1.0)
Weller Airstrip	Urbana	Privately-Owned Public-Use	0 (0)

[1] Distances are calculated from the nearest edge of the Action Area using Google Earth.

4.12.2.8 Non-Motorized Transportation Facilities

There are no designated bikeways, scheduled public transit routes, or state-designated public recreational trails in the Action Area.

The ODNR's statewide trail plan, Trails for Ohioans, shows a "Potential" segment of the North Country National Scenic Trail (NOCO) - which is administered by the National Park Service in conjunction with state and local authorities - passing through Urbana and Champaign County, roughly following U.S. 68 from Clark County and U.S. 36 into Miami County (ODNR 2005).

This route would take NOCO within approximately 5 km (3 mi) of the nearest turbine. However, National Park Service mapping of NOCO shows a “Potential” route that avoids Urbana entirely. There is no indication of when this potential route might be fully developed and permanently mapped.

4.13 Communications

4.13.1 Scope of Analysis

The analysis of communications facilities in this EIS describes the communications facilities and transmissions in the Action Area and vicinity, including radio and television broadcasts, microwave, and cellular/PCS telephone communications (Comsearch 2008a, b, c, 2009, 2011).

4.13.2 Existing Conditions

4.13.2.1 Over-The-Air Television

Over-the-air television stations transmit broadcast signals from terrestrially located facilities that can be received directly by a television receiver or house-mounted antenna. There are 180 over-the-air television stations within 161 km (100 mi) of the center of the Action Area (Comsearch 2008a). The television stations most likely to produce over-the-air coverage to Champaign County are those at a distance of 64 km (40 mi) or less.

Of the 41 licensed stations identified within 64 km (40 mi) of the Action Area, 22 are fully operational television stations. Six of the operating television stations are translators, or stations that transmit at low power, with limited range and limited programming. As of 2008, there were five full-power analog television stations and four full-power digital television stations servicing the area. There were also three low-power analog television stations with full programming, and four full-power digital television stations operating on temporary Special Transmit Authority from the Federal Communications Commission (FCC) (Comsearch 2008a). The full-power analog stations have converted to digital broadcast, in accordance with federal law (FCC 2010). It is not known how many low-power analog stations have converted to digital broadcast.

Full-power channels provide a wide variety of over-the-air television to local communities, and are supplemented by the full-service, low-power analog channels, and the low-power, limited programming translator stations in the area. Based on the number of over-the-air television channels available, it appears that over-the-air television is an important method of reception for communities in the area.

4.13.2.2 AM/FM Broadcast

Comsearch (2008b) also found records of six AM stations and 16 FM stations licensed within 32 km (20 mi) of the approximate center of the Action Area. Two of the AM stations (WBLL and WULM) each have two database records indicating that they both operate at two distinct transmission intensities. This effectively increases the number of AM stations near the Action Area to eight. The distance of the closest AM station antenna would be approximately 24 km (15 mi) from the center of the Action Area.

Of the 16 FM station records, 10 stations are licensed and operational, with the remainder under application or otherwise non-operational. Two of the operational FM stations are full power stations (>10 kW), two are medium-power stations (between 1 and 10 kW), and six are very-low-power stations (<0.1 kW). Of the six non-operational stations, one will likely be a full-power station, while the other five are expected to be very-low-power stations. The distance of the closest FM station antenna would be approximately 16 km (10 mi) from the center of the Action Area.

4.13.2.3 Microwave Paths

Microwave telecommunication systems are wireless point-to-point links that communicate between two antennas and require clear line-of-sight conditions between each antenna. Comsearch identified 14 microwave paths in or near the Action Area (Comsearch 2011).

4.13.2.4 Cellular/PCS Telephone

Cellular and Personal Communication System (PCS) telephone coverage in the vicinity of the Project is based on the underlying counties. Champaign County is in Cellular Market Area 180 (Springfield, Ohio). For PCS coverage, Champaign County falls within Basic Trading Area 106 and Market Trading Area 018. Table 4.13-1 lists the cellular and PCS telephone operators in Champaign County.

Table 4.13-1 Cellular and PCS Telephone Operators in Champaign County, Ohio

Operator	Band of Operation	License
Cellular Telephone		
Verizon	A	KNKA641
AT&T	A	KNKA445
PCS Telephone		
Cincinnati Bell	A	WPOI243
AT&T	A	KNLF235
T-Mobile	B	KNLF236
Verizon	B	WPQN807
Verizon	C3	WQEM938
AT&T	C4	WQDU926
Spring Nextel	C5	WQDN639
Spring Nextel	D	KNLH509
T-Mobile	E	KNLG800
Cricket/Leap	F	KNLF998

Source: Comsearch 2008c

4.13.2.5 Military and Other Communications

At the Applicant's request, the National Telecommunications and Information Administration (NTIA) of the U.S. Department of Commerce provided plans for the Project to the federal agencies represented in the Interdepartment Radio Advisory Committee (IRAC), which include the Department of Defense, Department of Education, Department of Justice, and Federal Aviation Administration. NTIA's response states that IRAC agencies "have not identified any concerns regarding blockage of their radio frequency transmission" (NTIA 2008).

4.14 Health and Safety

4.14.1 Scope of Analysis

The analysis of health and safely in this EIS examines the issues related to public health and safety as they relate to a wind turbine facility such as the Project. Where applicable, discussion of Project-specific health and safety conditions is also included. The safety issues described in this section are related to operation and/or failure of one or more Project components. Therefore, this analysis is limited to the Action Area. The health and safely analysis in this EIS is based on information from scientific studies and data generated from wind projects currently operating in the U.S.

4.14.2 Existing Conditions—Generalized Issues

Public safety concerns associated with a wind farm arise during project construction, operation, and decommissioning. Construction-related safety issues are those typically associated with construction of tall structures, such as the potential for injuries to workers and the general public from the movement of construction vehicles, equipment, and materials; falls from structures or into open excavations; and electrocution. These types of incidents are generally well understood and background information is not presented here. However, several potential health and safety concerns associated with the operation of a wind energy facility are unique to this type of facility and merit further background discussion.

In general, wind farms are safer than other forms of energy production since combustible fuel sources and fuel storage are not required. In comparison to other types of generating facilities, the use and/or generation of toxic or hazardous materials are minor. However, risks to public health and safety can be associated with wind farms because they are generally more accessible to the public. Public safety concerns associated with wind projects are largely related to potential injury or death associated with falling overhead objects. In particular, examples of such safety concerns include ice shedding, tower collapse and blade failure, stray voltage, fire, and lightning strikes. Public safety concerns surrounding overexposure to shadow flicker are also addressed. Potential public health impacts related to noise are addressed in Section 5.10.

4.14.2.1 Ice Shedding

Ice shedding, or ice throw, refers to the phenomenon that can occur when ice accumulates on rotor blades and subsequently breaks free and falls to the ground. There are two common types of ice formation that can occur in cold climates that may impact wind turbine operations: glaze ice and rime ice. Glaze ice forms as a result of rain freezing on cold surfaces at temperatures close to 0 ºC (32 ºF). Glaze ice is typically transparent and forms sheets of ice over large surfaces. Rime ice results when super-cooled moisture in the atmosphere contacts cold surfaces at or below 0 ºC (32 ºF). Under such conditions, ice would build up on the rotor blades and/or sensors, slowing its rotational speed and potentially creating an imbalance in the weights of the blades. Turbine control systems are designed to sense such effects of ice accumulation and to shut down the turbine until the ice melts.

Ice buildup can occur on the towers, rotors and on the nacelle. Field observations and studies of ice shedding indicate that most ice shedding occurs as air temperatures rise and ice thaws from the rotor blades. Therefore, the tendency is for pieces of ice to drop off the rotors and land near the base of the tower (Morgan et al. 1998). Potential impacts from ice shedding may result if the wind turbine remains in operation when ice has built up on the rotors or when the turbine is shut down or idling. When a turbine is in operational mode, ice can potentially be “thrown” from the rotating blades to areas outside of the area directly underneath the wind turbine rotor. The potential safety hazard from ice shedding is people and/or property being struck by fragments of ice that could fall from the turbines. Blades with ice build-up turn slowly (only a few revolutions per minute) because the blade air foil has been compromised by the ice, and the blades are unable to pick up any speed until the ice is shed. Several observational studies and mathematical models examining this phenomenon have calculated how far ice potentially can be thrown from a moving rotor blade before hitting the ground (Morgan and Bossanyi 1996). The distance traveled by a piece of ice depends on a number of factors, including the position of the blade when the ice breaks off, the location of the ice on the blade when it breaks off, the rotational speed of the blade, the shape of the ice that is shed (e.g., spherical, flat, smooth), and the prevailing wind speed.

4.14.2.2 Tower Collapse and Blade Shear

The possibility of a wind turbine tower collapsing or a rotor blade dropping or being thrown from the nacelle is another potential safety concern for both the general public and site workers. These are rare occurrences, although tower collapses have been documented in Ohio and other parts of the country including at the Weatherford Wind Power Project in Oklahoma in May 2005 and at the Klondike III Wind Farm east of The Dalles, Oregon in August 2007 (Reuters 2007; Associated Press 2007). In Ohio in early 2012, two blades broke off of a 1.5-MW turbine at the Timber Road EDP Renewables facility. In April 2011, a turbine located on the Western Reserve High School campus collapsed. Two years prior, multiple blades broke off of the three turbines located at Perkins High School near Sandusky, Ohio (Buckeye Power 2012).

The reasons for a turbine collapse or blade failure vary depending on conditions and tower type. Past occurrences of these incidents have generally been the result of design defects during manufacturing, poor maintenance, wind gusts that exceeded the maximum design load of the turbine structure, or lightning strikes. Most instances of blade failure and turbine collapse on large turbines were reported during the early years of the wind industry and were often attributed to human error in interfacing with the control system. Occurrences of blade shear have been reduced significantly due to changes in the operating system that limit human adjustments in the field, better turbine design, and mandatory international engineering and safety standards that ensure a high level of operational reliability and include ratings for withstanding different levels of hurricane-strength winds, among other criteria (AWEA 2010). Although blade failure from lightning strikes occurs infrequently, recent occurrences of blade shear have been associated with lightning strikes, as was the case for a small turbine failure in Huron, Ohio (Morning Journal 2010).

4.14.2.3 Stray Voltage

Stray voltage is a natural phenomenon that can be found at low levels between two contact points on any property where electricity is grounded. Studied since at least the 1960s, it has been a concern of farmers in particular. Stray voltage typically originates from low levels of alternating current voltage on the grounded conductors of a wiring system. These voltages are termed “stray voltage" when they are large enough to form a circuit when a person or an animal simultaneously touches two objects which are part of the electrical system. Stray voltage may result from damaged, corroded or poorly connected wiring, or damaged insulation. It can also develop on incoming metallic pipes such as utility lines through induction from transmission lines if the transmission lines are in parallel with the utility lines over some distance. Such induced currents/voltages on utility lines can be transferred into surrounding buildings. Wind power projects and other electrical facilities can create stray voltage to varying degrees, based on factors such as operating voltage, geometry, shielding, rock/soil electrical resistivity, and proximity. Stray voltage from such facilities usually only occurs if the system is poorly grounded and located in proximity to ungrounded or poorly grounded metal objects (e.g. fences, buildings). Incorporating proper grounding techniques within and around project components can eliminate the occurrence of stray voltage.

4.14.2.4 Fire and Fuels

Emergency response at wind turbines can be challenging for local emergency service providers and fire departments due to their height, physical dimensions, and complexity. Although the turbines contain relatively few flammable components, the presence of electrical generating equipment and electrical cables, along with storage and use of various oils, including diesel fuels, lubricating oils, and hydraulic fluids, can create the potential for fire or medical emergencies within the tower or the nacelle, or in places where these oils may be stored such as the substation, electrical transmission structures, staging area(s), and the operations and maintenance building.

> *Historically, a small number of fires have been directly or indirectly attributed to operating wind turbines. The suspected causes of such fires include sparks or flames resulting from substandard machine maintenance, improper welding practices, electrical shorts, equipment striking power lines, and lightning. Instances of electromechanical failures in wind turbine generators that resulted in fire have also been documented. For the most part, they have been traced to the electrical systems of the turbines (AWEA 2008).*

The fire risks associated with Project operations and maintenance are similar to risks associated with other industrial and storage facilities. Wind turbine operations and maintenance personnel for the Project would be trained in fire safety and response.

4.14.2.5 Lightning Strikes

Wind turbines are susceptible to lightning strikes due to their height and metal/carbon components. The powerful energy discharge during lightning strikes can cause severe damage to blades and can subsequently lead to complete blade failure, although blade failure from lightning strikes is uncommon. Over a nine-year period from 1990 to 1998, statistics show that lightning caused four to eight electrical faults per 100 turbine-years in northern Europe (Hansen and Korsgaard 2005). In August 2011 in Conneaut, Ohio, lightning struck at a NexGen Energy facility and hit a 400 kW tower, shattering the blades (Buckeye Power 2012). Most lightning strikes hit the rotor and their effect is highly variable, ranging from minor surface damage to complete blade failure. All modern wind turbines include lightning protection systems which are designed to prevent catastrophic blade failure. However, lightning strikes are occasionally the cause of fires in wind turbines, as described above.

4.14.2.6 Shadow Flicker

Shadow flicker from wind turbines can occur when moving turbine blades pass in front of the sun, creating alternating changes in light intensity or shadows. These flickering shadows can cause an annoyance when cast on nearby residences ("receptors"). The spatial relationship between a wind turbine and a receptor, along with weather characteristics such as wind direction and sunshine probability, are key factors related to shadow-flicker impacts. Shadow flicker becomes much less noticeable at distances beyond about 305 m (1,000 ft), except at sunrise and sunset when shadows are long (NRC 2007).

There is some public concern that flickering light can have negative health effects, such as triggering seizures in people with epilepsy. According to the British Epilepsy Foundation (2008), approximately 5 percent of individuals with epilepsy have sensitivity to light. Most people with photosensitive epilepsy are sensitive to flickering around 16 to 25 hertz (Hz, or flashes per second), although some people may be sensitive to rates as low as 3 Hz and as high as 60 Hz. Because the maximum wind turbine rotor speed of 15 rotations per minute (rpm) translates to a blade pass frequency of 0.8 Hz (less than one flash per second), health effects to individuals with photosensitive epilepsy are not typically associated with wind facilities comparable to the Project.

No state or national standards exist for frequency or duration of shadow flicker from wind turbine projects. However, international studies/guidelines from Europe and Australia have suggested 30 hours of shadow flicker per year as the threshold of significant impact, or the point at which shadow flicker is commonly perceived as an annoyance (Dobesch and Kury 2001; Sustainable Energy Authority Victoria 2003 as cited in EDR 2009b).

4.14.2.7 Wind Turbine Syndrome

Wind Turbine Syndrome is a term created by Dr. Nina Pierpont to describe the collection of symptoms reported to her during interviews with people who live near wind turbines (2009, pre-publication draft). It has been suggested that the reported symptoms (sleep disturbance, headache, tinnitus, ear pressure, dizziness, vertigo, nausea, visual blurring, tachycardia, irritability, concentration and memory problems, and panic episodes) are related to the infrasound (below 20 Hz) emitted from wind turbines during operation. Although wind turbine syndrome is not a recognized medical diagnosis, the topic has led to health concerns over wind power projects.

Pierpont hypothesized that wind turbine syndrome is caused by the combined effect of (1) airborne infrasound from wind turbines at frequencies of 1 to 2 Hz affecting the body's vestibular system; and (2) airborne infrasound from wind turbines at frequencies 4 to 8 Hz entering the lungs and transmitting vibrations throughout internal organs. The combined effect of these frequencies is hypothesized to send confusing information to the position and motion detectors of the body, causing the symptoms (Pierpont 2009, pre-publication draft; Colby et al., 2009).

Chapter 5

Environmental Consequences

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5 Environmental Consequences

This chapter describes the environmental effects of the Proposed Action and Alternatives A-C, which are defined in Chapter 3 and summarized in Table 5-1 below. The Proposed Action and Alternatives A and B each involve a full build-out of the Project (i.e., the same number and location of turbines and other Project-related facilities). Alternatives A and B differ from the Proposed Action only with respect to operational adjustments. As such, many resources that are not affected by operational adjustments (e.g., resources such as soils, water resources, vegetation, cultural resources, etc. that are only affected by Project construction or the physical Project footprint) would be affected in a similar manner under the Proposed Action and Alternatives A and B. The full build-out of the Project would include up to 100 turbines. At the time of this EIS, siting has only been completed for 52 turbine locations. The additional 48 turbines would be sited primarily in agricultural fields, and all regulations, requirements, and minimization and avoidance measures for the 52 turbines described herein would be implemented for these additional turbines. The effects analysis in this chapter pertains to the worst-case scenario for all 100 turbines unless otherwise specified in the text.

Table 5-1 Summary of Alternatives

Alternative	Facility	Operations	HCP Implemented
Proposed Action	Up to 100 Turbines and associated facilities/ infrastructure	Operational restrictions: modified cut-in speeds and feathering based on turbine location in relationship to identified season and suitable Indiana bat habitat.	Yes
Alternative A - Maximally Restricted Alternative	Same as Proposed Action	All 100 turbines would be non-operational during the period when Indiana bats could be present in the Action Area (sunset to sunrise from April 1 through October 31).	No
Alternative B - Minimally Restricted Alternative	Same as Proposed Action	Turbines feathered until cut-in speed of 5.0 m/s (11 mph) for all 100 turbines during the first one to six hours after sunset from August 1 through October 31.	Yes
Alternative C – No Action	None	None	No

5.1 Soils and Geology

5.1.1 Impact Criteria

There are no specific federal regulations pertaining to soils that are pertinent to this analysis; however, impacts on soils can have indirect effects on other resources, and NEPA and CEQ guidelines state that protection of unique geological features, minimization of soil erosion, and the siting of facilities in relation to potential geologic hazards must be considered when evaluating impacts of the Project.

5.1.2 Proposed Action

5.1.2.1 Avoidance and Minimization Measures

The Proposed Action contains the following avoidance and minimization measures that would avoid or minimize impacts to geology and soils. These measures would be applied during both construction and decommissioning of the Project.

- A SWPPP including an Erosion and Sediment Control Plan would be implemented, consisting of stabilization of steep slopes with geotextiles or other similar devices (particularly during rain events), silt fences, hay bale dikes or other suitable methods of slowing sheetflow and retaining sediment onsite, as well as identifying designated crossings over streams to minimize erosion and sedimentation in riparian areas, wetlands, and streams.
- The NPDES General Construction Storm Water permit would also include restoration measures that would ensure that disturbed ground is stabilized, preventing ongoing erosion and sedimentation of storm water run-off. These restoration measures consist of revegetation (preferably using native species, but exceptions may be made based on land use), regrading, and permanent swales or catch basins as needed.
- Topsoil removed from disturbed areas would be stockpiled and retained for reapplication once site disturbance is complete.
- Compacted soils would be restored through manual or mechanical cultivation to re-aerate the soil and promote seed germination.
- Areas subject to temporary disturbance (outside the permanent Project footprint but disturbed during construction or decommissioning) would be revegetated in accordance with the Erosion and Sediment Control Plan. Temporary crossings and areas of temporary construction impact will be restored and re-vegetated per the Erosion and Sediment Control Plan, consisting of planting native plant species (see HCP Appendix D for a typical native plant mix) to provide ground stabilization. Where forest fragmentation results from construction activities, the areas will be restored using trees suitable for Indiana bat habitat, if practicable. A list of native trees suitable for planting to restore Indiana bat habitat is included in HCP Appendix D. If existing land-use precludes the use of native species (e.g. agricultural use), restoration and stabilization will be established consistent with that land-use. The construction footprint would be minimized by delineating and minimizing impacts to sensitive resources such as streams,

wetlands, cultural resources, etc. in the field prior to construction and adhering to work area limits during construction.

This effects analysis considers these measures in determining the effects of the Proposed Action.

Construction-related Effects

Construction activities for all 100 turbines would take place in one or two phases that would last for a period of 12 to 18 months each with possible overlap. The effects of the Project during the construction phase would be largely limited to surface soil disturbance. The Project would not impact karst formations or caves. To construct 100 turbines, no more than 220.9 ha (545.8 ac) of soil would be disturbed during construction. Much of this disturbance would be temporary and subject to restoration activities at the end of Project construction. Following restoration, the permanent operating footprint of the Project would be no more than 52.2 ha (128.9 ac) of built facilities. The specific locations of the impacts of 52 of the planned turbines and associated interconnects and roads are currently known, and most of these impacts would occur on land that is currently used for agricultural purposes, and is regularly disturbed through cultivation. The Project would cover the permanently disturbed soil in these areas with impervious surfaces and/or gravel which would remain in place for at least the life of the Project. As the Applicant has provided the maximum impacts expected for soil and vegetation for the 100-turbine Project (see also Section 5.3 – Vegetation), the USFWS is able to fully assess the impacts of the Project.

The soils within the Action Area would be suitable for grading, compaction, and drainage, when each construction site is prepared as discussed in the General Earthwork Recommendations for the Project (Hull, 2009a, Appendix A). In addition, the Applicant has developed Agricultural Mitigation Provisions (Stantec 2010b, Appendix I) for construction activities occurring on privately owned agricultural land. These provisions would help ensure that construction activities and mitigation measures are compatible with future agricultural land use. The Applicant would also utilize and improve existing entrances and field driveways for Project access roads when practicable, which would minimize erosion and new impacts to soils.

Six turbines northeast of the City of Urbana, four turbines west of the Village of Mutual, and two turbines southwest of the Village of Mechanicsburg would be located where surface and subgrade soils are susceptible to being soft and loose and typically contain a higher content of vegetation and organics due to the frequent presence of water (Hull 2009b). If these soils are determined to be unsuitable to support the turbines, they may need to be undercut and replaced with suitable soil material during sub-grade preparation for roadways and staging areas. Geotechnical investigations and test borings would be conducted on-site prior to construction to provide relevant engineering properties of the soils, which would be used to refine structural designs.

Due to the anticipated depth of bedrock in the Action Area, bedrock blasting is not anticipated to be necessary (Hull 2009a). Geotechnical investigation and test borings would be conducted prior to construction to confirm/refine information about the site geology and substrate suitability and to facilitate final foundation design and engineering. The locations of test borings would be at appropriate turbine sites, as determined necessary by the geotechnical engineer. In addition, road borings together with Ground Penetrating Radar Survey (GPRS) would be conducted approximately every 0.8 km (0.5 mi) along county and township roads that would be used for transport of Project components. These road borings and GPRS would allow the Applicant and the County Engineer to determine the suitability of the roads and the appropriate steps to ensure that the roads are returned to pre-construction quality following the construction phase of the Project.

Operation and Maintenance-related Effects

Under the Proposed Action, no impacts to site soils or geological resources are anticipated from the operation of the Project.

Decommissioning-related Effects

Impacts on soils and geology associated with decommissioning activities would be related to removal of the turbines, footers, and roads. Existing concrete pads or structures would be removed to a depth of 0.9 to 1.2 m (3 to 4 ft) below ground surface. Some roads would not be removed per landowner request. Where facilities would be removed, the impacts of decommissioning would be generally equivalent to construction-related impacts. Although the volume of concrete removed would not include the volume of concrete installed below 0.9 to 1.2 m (3 to 4 ft), the physical impacts of concrete removal would be generally equivalent to the impacts incurred during the construction phase, but could be significantly less if, as is expected, spread footing turbine foundations are used. The physical impacts of road removal (equipment footprints, ground disturbance, etc.) would be generally equivalent to the impacts incurred during the construction phase. Decommissioning activities could occur as early as 2037 and would last approximately one year.

Mitigation Measures for Unavoidable Impacts

No adverse impacts on soils and geologic resources would occur during the Project's operations phase. During the Project's construction and decommissioning phases, impacts would be temporary and localized. Therefore the Proposed Action contains no specific mitigation measures for geology and soils in addition to the avoidance and minimization measures listed above.

In summary, the Proposed Action would be expected to have minor negative impacts on soils and geologic resources. Most soil disturbances would occur during construction and decommissioning, but these impacts would be temporary and areas disturbed during these phases would be stabilized. Soils within the footprints of built structures would be impacted over a longer time period but would be rehabilitated during decommissioning. Construction activities would not exacerbate geological hazards, and the foundations required to support the Project facilities would not be large enough or deep enough to constitute a significant negative impact.

5.1.2.2 Redesign Option

The Redesign Option is an optional measure under the Proposed Action that includes a primarily buried collection system. The different collection system would affect soil and geologic resources in a similar manner to the Proposed Action, but the increased length of buried interconnects would also increase the area of new soils impacted by the Project as compared to the Proposed Action. Under the Redesign Option, no more than 9.0 km (5.6 mi) of the 34.5-kV interconnects would be above ground (on rebuilt distribution poles in existing public road right-of-ways) and 86.4 km (53.7 mi) would be buried underground. No more than 219.9 ha (543.6

ac) of soil would be disturbed during construction. The avoidance, minimization, and mitigation measures would be the same as described above for the Proposed Action.

5.1.3 Alternative A – Maximally Restricted Operations Alternative

Alternative A differs from the Proposed Action only with respect to operations. The operational differences would not affect soil and geologic resources. As such, the construction, operation, and decommissioning-related effects of Alternative A and the avoidance and minimization measures would be the same as under the Proposed Action. No mitigation measures would be warranted.

5.1.4 Alternative B – Minimally Restricted Operation Alternative

Alternative B differs from the Proposed Action only with respect to operations. The operational differences would not affect soil and geologic resources. As such, the construction, operation, and decommissioning-related effects of Alternative B and the avoidance and minimization measures would be the same as under the Proposed Action. No mitigation measures would be warranted.

5.1.5 Alternative C - No Action Alternative

Under Alternative C, the Project would not be built, and no Project-related activities (construction, operation, or decommissioning) would occur. Alternative C would have no effect on soil or geologic resources. As such, no mitigation measures would be warranted.

5.2 Water Resources

5.2.1 Impact Criteria

The extent of predicted deviation from existing conditions is the prime factor in the determination of whether impacts on water resources would be significant. The analysis of impacts on water resources considers the potential for the Proposed Action to alter existing resources such as surface water bodies, subsurface aquifers, SWPAs, or floodplains. This analysis also considers potential impacts on existing uses or standards, such as potability, general public health, and flood attenuation. Major changes in the current condition of these resources or their capacity to support established uses would be considered significant. In cases where otherwise minor impacts on water resources would cause major changes in other resources (e.g.; flora or fauna that are highly intolerant of habitat disturbance), impacts on water resources could be considered significant.

Impacts on water resources may be regulated at the federal level by the Federal Water Pollution Control Act (Clean Water Act) of 1972, Executive Order 11988: Floodplain Management (1977), the National Coastal Zone Management Act of 1972, the Wild and Scenic Rivers Acts of 1968, and/or the Safe Drinking Water Act of 1974. Inundation dangers associated with floodplains have also prompted federal, state, and local legislation that limit development in these areas largely for recreation and preservation activities.

5.2.2 Proposed Action

5.2.2.1 Avoidance and Minimization Measures

The Proposed Action contains the following avoidance and minimization measures that would avoid or minimize impacts to water resources during construction, operation and maintenance, and decommissioning.

- No discharges of contaminated effluent would occur directly to a receiving water body. Spill Prevention, Containment, and Countermeasure (SPCC) procedures would be implemented to prevent the release of hazardous substances into the environment. These procedures would not allow refueling of construction equipment within 30.5 m (100 ft) of any stream or wetland, and all contractors would be required to keep materials on hand to control and contain a petroleum spill, including a shovel, tank patch kit, and oil-absorbent materials. Any spills would be reported in accordance with Ohio EPA Division of Emergency and Remedial Response regulations.
- No blasting is currently planned. Should blasting be required, the exact location of private water supply wells within the Action Area would be determined and clearly marked to avoid potential damage. No blasting would occur within a 30.5-m (100-ft) buffer around private wells and would likely be located no closer than 274 m (900 ft) from a well due to setbacks from habitable residences of at least 279 m (914 ft) and the fact that private wells are typically located within 30.5 m (100 ft) of residences.
- Large built components of the Project, including wind turbines, staging areas, the operations and maintenance building, and the substation, would be sited to avoid wetlands.
- Large built components of the Project, including wind turbines, staging areas, the operations and maintenance building, and the substation, would be sited to avoid stream impacts, although streams will be impacted for construction of access roads and collection lines. Existing or narrow crossing locations over surface waters would be used whenever practicable to minimize potential impacts to streams. The Applicant would obtain USACE authorization for any discharge of fill material into jurisdictional streams. No more than 32 stream crossings totaling not more than 380.3 linear m (1,248 linear ft) of impact will result for the 100-turbine Project (see Table 5.2-1).
- The construction footprint would be minimized by delineating and avoiding sensitive areas in the field prior to construction and adhering to work area limits during construction. These measures would limit potential impacts of soil compression on normal infiltration rates.
- The Applicant and its contractors would follow strict guidelines dictating the use and handling of hazardous materials and other contaminants, which would minimize the potential for impacts to water quality and/or aquatic life.
    - A plan note would be incorporated into the construction contract requiring contractors to develop and comply with a project-specific emergency spill response protocol.

  - A plan note would be incorporated into the construction contract requiring contractors to adhere to a project plan for removal of regulated wastes from the work area or properties associated with the project.
  - Herbicide application guidelines that follow manufacturers' recommendations for protection of the environment would be developed for use at turbine pads, staging areas, maintenance facilities, and access roads.
- Contractors would develop and implement a comprehensive Erosion and Sediment Control Plan to minimize impacts to waterways.
  - A plan note would be incorporated into the construction contract requiring that contractors adhere to all provisions of NPDES permits and the SWPPP. The SWPPP plan must specify best management practices for construction activities that would minimize degradation of water quality resulting from runoff of storm water and sediment from construction areas into adjacent water bodies.
  - A plan note would specify that sedimentation and erosion control features be placed as soon as practicable during the construction process. Provisions for placement of primary sedimentation and erosion control features, necessary during advanced tree-cutting operations and access road construction, would be included.
  - Contractors would develop and incorporate provisions to protect surface and groundwater quality by using erosion control practices appropriate for the terrain and consistent with approved best management practices.
  - Contractors would develop and incorporate provisions for implementation of a post-construction revegetation plan for all temporary work spaces, staging areas, and access roads to control erosion and maintain water quality. Site revegetation would use seed mixtures and plants in accordance with the NPDES permit and Erosion and Sediment Control Plan (i.e., reseeding with native plants in non-cultivated areas).
- Low-impact crossing techniques, equipment restrictions, herbicide use restrictions, and erosion and sediment control measures would be implemented as required by the NPDES permit and Erosion and Sediment Control Plan.
- In those cases when only buried electrical interconnects cross a perennial stream, the Applicant would directionally drill underneath the stream regardless of its beneficial use classification. In cases where only buried electrical interconnects cross an intermittent or ephemeral stream, the Applicant would open trench through the stream and conduct the trenching during periods of no water flow, or horizontally directionally drill underneath that stream if the crossing is completed when water is present. Additionally, in order to continue to avoid any impacts to high quality potential Indiana bat foraging habitat, the Applicant would use horizontal directional boring for electrical interconnect crossings of any stream Ohio designated as exceptional warm water habitat or cold water habitat as well as any streams thought to have the characteristics necessary to support federally threatened or endangered species of freshwater mussels or freshwater mussel species proposed for listing (discussed in detail in Section 4.2).

- The minimum possible area along stream banks would be cleared of vegetation (55 ft for access roads or crane paths; 25 ft for buried electrical interconnects), and areas cleared during construction would be stabilized following construction by revegetation with native plants (outside of agricultural areas). Temporary crossings and areas of temporary construction impact will be restored and re-vegetated per the Erosion and Sediment Control Plan, consisting of planting native plant species (see HCP Appendix D for a typical native plant mix) to provide ground stabilization. Where forest fragmentation results from construction activities, the areas will be restored using trees suitable for Indiana bat habitat, if practicable. A list of native trees suitable for planting to restore Indiana bat habitat is included in HCP Appendix D. If existing land-use precludes the use of native species (e.g. agricultural use), restoration and stabilization will be established consistent with that land-use.
- Should groundwater be encountered during excavation, water removal would be conducted as follows:
  - A sump pit would be used to trap and filter water for pumping to a suitable discharge point.
  - Areas of cleared vegetation along streams would be stabilized.
  - Clean pumped water would be discharged to a vegetated and stabilized area (or to an appropriately sized level spreader or riprap energy dissipater) to minimize scouring of the receiving area.
  - Sediment-laden water would be pumped through a filter bag or into a sediment trapping device prior to discharge.
- Topsoil removal and decompaction would be conducted in agricultural areas where soil restoration is necessary to accommodate future agricultural uses. These practices would also minimize any potential impacts that soil compaction could have on infiltration of rain and snowmelt, thereby further reducing any potential impact to groundwater recharge.
- No project structures within any groundwater SWPA.

This effects analysis considers these measures in determining the effects of the Proposed Action.

Construction-related Effects

Groundwater

Construction of the Project could result in certain localized impacts to groundwater, but these impacts would not be significant. Installation of turbine foundations has the greatest potential for impacts on groundwater. Based on the preliminary turbine design information, the footing excavations would extend approximately 3 m (10 ft) below existing ground surface. Due to the anticipated depth of bedrock in the area, blasting is not anticipated for construction. When required, blasting can generate seismic vibrations, fracture bedrock, cause groundwater to migrate, and potentially impact groundwater levels. However, the site layout incorporates turbine setbacks from habitable residences of at least 279 m (914 ft). Since private wells are typically located within 30.5 m (100 ft) of residences, the turbine setbacks would minimize risks to private wells and well yields.

In addition, responses to well surveys mailed to Action Area residents indicated that local wells encountered water at a depth of 4.6 to 61 m (15 to 200 ft), most commonly in the range of 9 to 18 m (30 to 60 ft). This suggests that even if blasting should be required within 3 m (10 feet) of the surface, it would not likely encounter groundwater. Therefore, construction is not anticipated to physically damage private wells or affect well yields (Hull 2009b), cause groundwater migration, or otherwise alter the hydrological characteristics of the Action Area.

Buried electrical interconnect lines can also facilitate near-surface groundwater migration along trench backfill in areas of shallow groundwater. The impact would originate within the Project Area but groundwater could migrate across the boundary between the Project Area and the Action Area. However, as previously indicated, depth to groundwater is most commonly in the range of 9 to 18 m (30 to 60 ft). Therefore, near surface groundwater migration is anticipated to be minimal and would not affect groundwater levels or availability in the Action Area.

In addition to the potential impacts of installing turbine bases on wells, groundwater migration, and hydrogeology, other minor impacts to groundwater could result from construction activities. Soil compaction from the use of construction equipment could limit the efficiency of surface water infiltration to groundwater. When soils are compressed, the pore spaces within the soil are decreased, which reduces water percolation and aquifer recharge, and increases runoff. To the extent that soil compaction would occur, re-aeration as described in Section 5.1.2 would minimize the long-term influences on groundwater recharge.

Construction of access roads would result in minor increases in storm water runoff that otherwise would have infiltrated into the ground at the road locations, but this impact would be very minor. Assuming that infiltration would be completely eliminated and runoff increased across the entire 52.2 ha (129.8 ac) occupied by the permanent Project footprint, infiltration potential would be eliminated over less than 0.1 percent of the Action Area. The Project would not have a significant impact on infiltration, recharge of aquifers, or runoff.

Construction of the Project could introduce pollutants to groundwater through accidental discharges of petroleum or other chemicals during construction. Such discharges could occur in the form of minor leaks from fuel and hydraulic systems, as well as more substantial spills that could occur during refueling or due to mechanical failures and other accidents. If these impacts were to occur, contaminants could migrate through the Action Area via groundwater. As part of the Project, the Applicant would implement the appropriate spill response procedures, as outlined in the SPCC plan, to address spills and to mitigate the associated environmental impacts.

No Project structures for the 100-turbine array would be located within any designated Ground Water SWPAs (Figure 4.4-1).

Surface Water

Construction of the Project would have minor impacts on surface water, but most of these impacts would be widely dispersed and temporary in nature. Table 5.2-1 summarizes the locations and nature of these impacts. Construction activities would be dispersed over a large area resulting in a relatively low level of soil disturbance and minor amounts of additional impervious surfaces across the Action Area as a whole, although disturbance would be somewhat greater in some localized areas where a large number of individual stream crossings or other individual impacts would occur in a comparatively small area. One example of such an area is located between Route 814 and Urbana, where access roads and buried interconnects would intersect or parallel more than 1.6 linear km (1 linear mi) of stream channel in Streams J, K, V, and W within an approximately 2.6 square km (1 square mi) area of the Dugan Run and East Fork Buck Creek stream systems.

Access roads, collection lines, and crane paths for the 100-turbine Project would cross no more than 32 streams and cause no more than 380.3 linear m (1,248 linear ft) of impact (see Table 5.2-1). The Applicant would implement several methods to avoid impacts to surface waters and minimize unavoidable impacts. For example, in some cases the Project would utilize existing stream crossings constructed for farm equipment, although some improvements such as road widening could be necessary to accommodate turbine component delivery. In addition, impacts to perennial streams from electrical interconnect crossings would be avoided by direct boring beneath the bed of the stream or by aerial crossing on poles. In some instances, the discharge of fill material into jurisdictional streams would be unavoidable and USACE authorization would be required. It is expected that all collection line and crane path stream impacts will be temporary in nature. These impact areas will be restored per the conditions of the USACE and NPDES permits and Erosion and Sediment Control Plan (see section 5.2.1.2.1 of the HCP for additional details). Access road impacts are expected to be permanent and will be appropriately permitted through USACE permits. Any permanent or temporary activities occurring alongside or parallel to a wetland or water body that is associated with the construction and operation of the Project would follow best management practices to ensure that no degradation to water quality occurs. No mitigation for any stream impacts is expected to be required under the USACE permits.

Indirect impacts to wetlands and water bodies from the Project could result from sedimentation and erosion caused by construction activities (e.g., removal of vegetation and soil disturbance could result in runoff into wetland and stream areas). This indirect impact could occur at wetlands and water bodies adjacent to work areas where no direct wetland impacts are anticipated. To minimize the potential for erosion during construction, erosion and sediment control measures such as hay bales and silt fences would be placed as appropriate around disturbed areas and any stockpiled soils. Prior to commencing construction activities, erosion control devices would be installed between the work areas and downslope water bodies and wetlands to reduce the risk of soil erosion and siltation. Erosion control measures would also be installed downslope of any temporarily stockpiled soils in the vicinity of water bodies and wetlands. These minimization measures would be fully described in the SWPPP, which would incorporate applicable BMPs for erosion control and storm water management during construction.

Table 5.2-1 Activities for the 100-Turbine Project Relative to Potentially Jurisdictional Streams within the Action Area

Stream ID/Name	Flow Regime	Project Activity	Surface Water Impacts (Temporary or Permanent)	Estimated Stream Width (linear feet)	Maximum Impact length (linear feet)
B/ Unnamed tributary to Dugan Run	Intermittent	Access road and buried interconnect to Turbines 9 and 13 cross streams; Turbine 13 is located 194 m (636 ft) from stream. Disturbance within legally-defined buffer would trigger permit and appropriate storm water mitigation.	Use existing crossing; widening of crossing would result in some minor impacts Permanent	10.0	58
D/ Unnamed tributary to Treacle Creek	Ephemeral	Buried interconnect to Turbine 16 crosses stream; access road and buried interconnect between Turbines 11 and 16 must cross stream. Disturbance within legally-defined buffer would trigger permit and appropriate storm water mitigation.	If trenched, crossing would result in some minor impacts. If bored or carried on poles, no surface water impact. Road crossing would result in some minor impacts. Permanent	7.5	58
E/ Dugan Run	Intermittent	Turbine 17 located 220 m (722 ft) from stream. Buried interconnect and crane path must cross stream. Crane crossing would result in minor, temporary surface water impact only.	If trenched, crossing would result in some minor, temporary impacts Temporary	13	60
I/ Unnamed tributary to Dugan Ditch	Perennial	Access road for multiple turbines from SR 36 crosses stream. Disturbance within legally-defined buffer would trigger permit and appropriate storm water mitigation.	Culverted crossing would result in some minor impacts. Permanent	16.3	34
J/ Unnamed tributary to Dugan Run	Intermittent	Access road and interconnect for multiple turbines from SR 814 crosses stream. Disturbance within legally-defined buffer would trigger permit and appropriate storm water mitigation.	Use existing crossing; widening crossing would result in some minor impacts. Permanent	12.5	60
K/ Unnamed tributary Stream J	Ephemeral	Eleven turbines are located more than 488 m (1,600 ft) from stream. Crane path must cross stream	Minor, temporary surface water impact only. Temporary	4.0	0
R/ Unnamed tributary Dugan Ditch	Intermittent	Access road to Turbines 37 and 41 crosses stream. Disturbance within legally-defined buffer would trigger permit and appropriate storm water mitigation.	Crossing would result in some minor impacts. Permanent	13.0	90

Stream ID/Name	Flow Regime	Project Activity	Surface Water Impacts (Temporary or Permanent)	Estimated Stream Width (linear feet)	Maximum Impact length (linear feet)
S/ Unnamed tributary to Stream D	Ephemeral	Buried interconnect and access road must cross stream S to access Turbine 18; disturbance within legally-defined buffer would trigger permit and appropriate storm water mitigation.	Crossing would result in some minor impacts. Permanent	8.5	60
V/ Unnamed tributary to Dugan Ditch	Intermittent	Must cross stream V with access road and buried interconnect to access Turbine 35.	Crossing would result in some minor impacts. Permanent	16.0	60
W/ Unnamed tributary to Dugan Ditch	Intermittent	Access road and buried interconnect leading to Turbines 43 crosses stream. Disturbance within legally-defined buffer would trigger permit and appropriate storm water mitigation.	Crossing would result in some minor impacts. Permanent	16.0	48
Y/ Buck Creek	Intermittent	Buried interconnect and crane path must cross stream. Crane crossing would result in minor, temporary surface water impact only.	If trenched, crossing would result in some minor, temporary impacts Temporary	12.9	0
AA/Buck Creek	Intermittent	Must cross stream with access road and buried interconnect to access Turbines 28 and 33. To avoid impacts, bore under stream and cross with elliptical culvert.	No surface water impacts if elliptical culvert and directional bore is used, otherwise crossing would result in some minor impacts Permanent	12.0	0
BB/Treacle Creek	Intermittent	Buried interconnect between Turbine 25 and 28 must cross stream. To avoid impact, bore under stream or carry on poles	No surface water impact if directionally bored Temporary	11.9	0
CC/Unnamed tributary	Ephemeral	Must cross stream with access road and buried interconnect to access Turbines 52 and 55. No existing crossing.	Crossing would result in some minor impacts. Permanent	2.5	60
DD/Unnamed tributary	Ephemeral	Must cross stream with access road and buried interconnect to access Turbines 51and 53. No existing crossing	Crossing would result in some minor impacts. Permanent	20	60
Maximum of 16 Phase II crossings for additional 48 turbines	Various	Construction of crane paths, access roads, and collection lines.	Various Permanent	8-10	600

Stream ID/Name	Flow Regime	Project Activity	Surface Water Impacts (Temporary or Permanent)	Estimated Stream Width (linear feet)	Maximum Impact length (linear feet)
Maximum of 17 additional buried interconnect crossings (Redesign Option only)	Various	Buried interconnects.	Various Temporary	8-10	350
Total (without Redesign Option)					1,248
Total (with Redesign Option)					1,598

Source: Hull 2009d; 2009e and Hull 2010

Wetlands

According to the Ducks Unlimited update of the NWI (2009), the Action Area contains 668 ha (1,651 ac) of wetlands (Table 4.2-3). Temporary and permanent impacts to wetlands would be avoided during construction. However, some wetlands are close enough to Project components that specific avoidance steps would be taken during construction to ensure their protection. These steps may include flagging a buffer zone (15 m [50 ft] for jurisdictional wetlands) and erecting protective fencing prior to construction and proper implementation of a SWPPP. No turbines would be sited within 15 m (50 ft) of a federal or state jurisdictional wetland. Access roads and buried electrical interconnections would be designed and sited to avoid wetlands and adhere to above stated setbacks.

Permit Requirements for Surface Water and Wetland Impacts

Under Section 404 of the CWA, USACE authorization is required prior to the placement of any dredged or fill material into jurisdictional waters of the United States. Isolated waters may be regulated by the OEPA. Any activity that occurs alongside or abutting a wetland or water body would use best management practices in order to minimize any indirect effects to these areas. The Applicant intends to apply for approval for up to 32 streams crossings for a total of not more than 380.3 linear m (1,248 linear ft) of impact. The discharge of dredged or fill material into jurisdictional streams may meet the criteria for authorization under a USACE Nationwide Permit. By definition, Nationwide Permits only authorize activities that have minimal individual and cumulative adverse effects on the aquatic environment (77 Fed. Reg. 10184-10290). Nationwide Permits that have been utilized on other wind power projects include Nationwide Permit No. 12 (Utility Line Activities), Nationwide Permit No. 14 (Linear Transportation Projects), and Nationwide Permit No. 51 (Land-Based Renewable Energy Generation Facilities). The Applicant would implement compensatory mitigation for stream impacts if required through the USACE Permit process for specific crossings.

Impacts on surface water quality are typically permitted as part of the NPDES General Construction Storm Water Permit, which may be issued in conjunction with the necessary federal and state permits for dredge, fill, or crossings of jurisdictional surface waters. A SWPPP would be developed as part of the NPDES permit which would specify the best management practices for construction activities that would minimize degradation of water quality resulting from runoff of storm water and sediment from construction areas into adjacent wetlands and water bodies.

The Applicant would implement techniques to avoid stream impacts where practicable and minimize the impacts of unavoidable stream crossings such that no more than 32 streams will be crossed, totaling no more than 380.3 linear m (1,248 linear ft) of impact. In many cases, it would be possible to utilize existing stream crossings constructed for farm equipment, although some temporary improvements may be necessary to accommodate turbine component delivery. In addition, impacts to most high quality streams and perennial streams by electrical interconnect crossings would be avoided by direct boring beneath the bed of the stream or by aerial crossing on poles. Where access roads would cross perennial streams, culverted crossings will be used, which would cause some minor impacts to the stream and related buffer.

Non-permitted impacts

In cases where Project activities would occur near streams or wetlands permits may not be required, but indirect impacts could still occur to surface water features if uncontrolled discharges of sediment or contaminated water were to occur through runoff. The Applicant would implement appropriate measures to avoid unnecessary disturbance and minimize the extent of required soil disturbances. These measures would further reduce potential impacts to receiving water bodies from storm water runoff. For the 100-turbine array, impervious surface would increase less than 0.1 percent, equivalent to 52.2 ha (129 ac), over the entire Action Area. Consequently, no significant changes to the rate or volume of storm water runoff or the overall surface hydrology of the Action Area are anticipated.

Floodplains

The only activities that would potentially affect mapped 100-year floodplains would be construction of wind turbines, other structures, or impervious surfaces. The 100-turbine array and associated access roads and buried interconnections would require not more than 11.8 ha (29.2 ac) of 100-year floodplain disturbance during the construction phase of the Project. No more than 2.4 ha (5.9 ac) of this area would be permanently impacted and 9.4 ha (23.3 ac) would be temporarily impacted.

Impacts on floodplains as a result of the Project would include interference with the passage, storage, and infiltration of floodwaters. Construction of turbines and other structures within the floodplain would affect all three of these functions: turbines and other structures within the floodplain would cause a direct loss of flood storage capacity equivalent to the volume of the structure below the flood elevation, the surface area on the upstream side of the structures would impede the flow of floodwater, and capacity for infiltration would be lost within the structures' footprints. Access roads and buried electrical interconnection lines would have the capacity to interfere with infiltration as well, although not to the same extent as structures because the roads would consist of gravel so some infiltration would likely still be possible within the road beds and through the soil covering the interconnects. The effects of the Proposed Action on floodplains would likely be observed in the form of small localized increases in flood elevation and duration, although these effects would likely be minor and difficult to measure directly. Access roads and buried electrical interconnection lines would have no measurable effect on flood storage or passage provided they would not have any above-grade components (e.g., a raised roadbed). Overhead lines would have no effect on floodplains provided the supports were constructed outside the floodplain boundaries.

Although no turbines would be located directly in floodways, several turbine clusters would be located within mapped 100-year floodplains (Figure 4.2-5). Construction of turbines within the mapped 100-yr floodplains would pose certain engineering challenges in order to comply with relevant federal and local laws. Surface and subgrade soils in these areas are susceptible to being soft and loose, and typically contain a higher content of vegetation and organics due to the frequent presence of water. These unsuitable surface soils may need to be undercut and replaced with suitable soil material during sub-grade preparation for roadways and staging areas (Hull 2009b). Detailed geotechnical work to determine the need for undercut/fill would be completed prior to construction. Soil replacement is not expected to significantly affect floodplain function.

Typically, floodplain mitigation is only required if significant impervious area development occurs within the floodways or floodplain. Based on the minimal overall amount of disturbance and impervious area being created in the floodplain, no floodplain mitigation is anticipated.

Operation and Maintenance-related Effects

Groundwater

Operation of the Project would have minimal effect on groundwater resources. The Project would not use water to generate electricity; the only water use would be associated with drinking, washing, and sanitary purposes in the operations and maintenance office. The operations and maintenance building would be serviced by a private well and would use water at a rate comparable to a typical small business office. No other Project components would use measurable quantities of water. Therefore, operation of the Project would have very minor effects on the water supply or groundwater resources.

There is the possibility that minor oil spills from leaking transformers or gear boxes could occur. If they entered the groundwater, they could cause localized impacts on water quality, although this would be unlikely due to the small volume of oil that would be present in transformers or gearboxes and the depth to groundwater across much of the Action Area. Potential impacts from oil spills would be addressed in an SPCC plan.

Surface Water

Operation of the Project would have minor effects on surface water. Operation of the Project would not involve the discharge of water or waste into streams or water bodies, nor would the operation of the Project require the use of water for cooling or any other activities. Operation of the Project would not require discharges of wastewater, effluent, or other pollutants to surface waters. The operations and maintenance building would generate sewage and wastewater comparable to a typical small business office. These waterborne wastes would be disposed of through use of a septic system or municipal sewage treatment system. Thus, measurable impacts on the quality of surrounding water resources are not anticipated.

If minor oil spills from leaking transformers or gear boxes entered the surface water, they would cause localized impacts on water quality and would have the potential to impact vegetation and wildlife as well. These impacts are not likely to be significant due to the small volume of oil that would be present and the fact that the Project facilities would be sited as far away from surface water features as practicable. No turbines would be sited within 15 m (50 ft) of a federal or state jurisdictional wetland. Potential impacts from oil spills would be addressed in an SPCC plan.

Floodplains

Although no turbines would be located directly in floodways, seven of the currently sited turbines are located within mapped 100-year floodplains, including those northeast of the City of Urbana, west of the Village of Mutual, and southwest of the Village of Mechanicsburg (Figure 4.2-5). As such, implementation of the Proposed Action would have minor effects on floodplains. The Champaign County Engineer acts as the Champaign County Flood Coordinator and oversees all floodplain development permits. The Applicant would obtain all required floodplain permits prior to construction of Project components in designated 100-year floodplains.

Decommissioning-related Effects

Decommissioning the Project would have similar impacts on water resources as construction, but the magnitude of the impacts associated with decommissioning would be smaller than construction. The primary impact of decommissioning on water resources would be localized, temporary impacts on water quality associated with runoff from disturbed areas, although runoff would be contained within the disturbed areas to the extent possible through erosion and sediment control features installed at the work sites. There would be minimal stream crossings and demolition work near surface water features because the Project's road network would provide access to all work sites necessary for demolition, and some may be left in place following decommissioning as per landowner requests.

Mitigation Measures for Unavoidable Impacts

The Proposed Action would be expected to have minor negative impacts on water. Most impacts on water would occur during construction and decommissioning, but these impacts would be temporary. Some impacts (e.g., roads) would be permanent. The Applicant would minimize direct impacts to surface water features by adhering to the requirements of applicable permitting processes described above and using appropriate construction techniques (including setbacks from wells if blasting is required to construct the Project). The Applicant would implement compensatory mitigation for stream impacts if required through the USACE Permit process for specific crossings.

5.2.2.2 Redesign Option

The Redesign Option is an optional measure under the Proposed Action that includes a primarily buried collection system. The different collection system would affect water resources similarly to the Proposed Action, but has the potential to impact a total of 49 streams. As under the Proposed Action, wetlands would not be impacted by construction activities. A maximum of 17 additional stream crossings totaling an additional 106.7 m (350 lf) of impact would be required under the Redesign Option, for a total stream impact of not more than 49 crossings and 487.1 m (1,598 lf). In many cases buried electrical interconnects would be co-located with planned access roads and crane paths, so the number of new stream crossings would be minimized. In some cases, buried electrical interconnects would be the only Project component crossing a stream and these stream crossings would result in only temporary impacts to the water resource. Under the Redesign Option, for each stream crossing that is not Ohio designated exceptional warm water or cold water habitat and that would be temporarily impacted by open trenching to install buried interconnects, the Applicant would also secure any necessary permit for these impacts from the USACE. Streams that are open trenched would be restored to their pre-existing grade and revegetated with appropriate native riparian species. Temporary crossings and areas of temporary construction impact will be restored and re-vegetated per the Erosion and Sediment Control Plan, consisting of planting native plant species (see HCP Appendix D for a typical native plant mix) to provide ground stabilization. Where forest fragmentation results from construction activities, the areas will be restored using trees suitable for Indiana bat habitat, if practicable. A list of native trees suitable for planting to restore Indiana bat habitat is included in HCP Appendix D. If existing land-use precludes the use of native species (e.g. agricultural use), restoration and stabilization will be established consistent with that land-use. Thus, there would be no permanent impacts to any streams that are crossed with buried interconnects only. Potential impacts to wetlands due to changes to a buried interconnect system would be avoided.

5.2.3 Alternative A – Maximally Restricted Operations Alternative

Alternative A differs from the Proposed Action only with respect to operations. The operational differences would not affect water resources. As such, the construction, operation, and decommissioning-related effects of Alternative A on water resources and the avoidance and minimization measures would be the same as under the Proposed Action. The mitigation measures listed for the Proposed Action would also be applicable to this alternative.

5.2.4 Alternative B – Minimally Restricted Operations Alternative

Alternative B differs from the Proposed Action only with respect to operations. The operational differences would not affect water resources. As such, the construction, operation, and decommissioning-related effects of Alternative B on water resources and the avoidance and minimization measures would be the same as under the Proposed Action. The mitigation measures listed for the Proposed Action would also be applicable to this alternative.

5.2.5 Alternative C - No Action Alternative

Under Alternative C, the Project would not be built and no Project-related activities (construction, operation, or decommissioning) would occur. Alternative C would have no effect on water resources. As such, no mitigation measures would be warranted.

5.3 Vegetation

5.3.1 Impact Criteria

Vegetation could be impacted at the individual, population, or community scale. Potentially adverse effects on vegetation resulting from Project would include the following:

- Removal, crushing, or other events resulting in the death of individual plants;
- Sub-lethal effects from loss of leaves or other parts, stress from being covered in dust or other foreign material, altered sun/shade patterns or water flow, or other disturbances;

- Introduction of invasive species that outcompete native species;
- Reduction of the natural population below viable levels; and
- Fragmentation of natural vegetation communities.

Vegetation provides certain ecological functions that would be indirectly affected if it were impacted by the Project. Indirect effects on these functions could include the following:

- Loss of habitat for wildlife dependent on these areas for food, water, or shelter;
- Soil loss, erosion, or compaction impacting stream bank stability; and
- Disruption of surface hydrology and normal nutrient cycling.

The extent of predicted deviation from existing conditions is the prime factor in the determination of whether direct impacts on vegetation or indirect impacts on ecological functions would be significant. In cases where otherwise minor impacts on vegetation would cause major indirect impacts on the ecological functions it provides, impacts on vegetation could be considered significant.

5.3.2 Proposed Action

5.3.2.1 Avoidance and Minimization Measures

The Proposed Action contains the following avoidance and minimization measures that would avoid or minimize impacts to vegetation.

- Project components would be sited in previously disturbed areas (e.g., existing farmland) to the extent possible, and areas of vegetation and soil disturbance would be limited to the smallest size practicable (e.g., the permanent footprint for each turbine would be limited to 0.08 ha (0.2 ac) and a maximum road width of 6 m (20 ft) used for permanent access lanes), such that not more than 168.8 ha (416.9 ac) of temporary impacts and 52.2 ha (128.9 ac) of permanent impacts to vegetation would occur;
- Restoring pre-construction contours and soil/substrate conditions in temporarily disturbed areas, to the extent possible;
- Stabilizing disturbed stream banks per the conditions of any formal state/Federal-issued permit;
- Restoration of disturbed agricultural fields by decompacting soil, re-spreading stockpiled topsoil, and removing any large rocks or debris that would impact future cultivation; and
- Reseeding disturbed soils throughout the Project Area, as per the NPDES permit and Erosion and Sediment Control Plan, with appropriate vegetation (crops in agricultural areas, native species in uncultivated areas) to stabilize exposed soils and control sedimentation and erosion and prevent/discourage invasive plant colonization. To the extent allowable under the applicable permits, landowner preferences would be considered when planning vegetative re-stabilization.

This effects analysis considers these measures in determining the effects of the Proposed Action.

Construction-related Effects

Construction of the 100-turbine layout would result in a total initial disturbance of no more than 220.9 ha (545.8 ac), of which 52.2 ha (128.9 ac), or 23.5 percent, would be permanent. Table 5.3-1 provides a detailed breakdown of permanent and temporary vegetation impacts associated with construction of the Project.

The roads would initially be up to 17 m (55 ft) wide during construction, but after construction is complete they would be narrowed to 5 to 6 m (16 to 20 ft) wide. It is anticipated that the operations and maintenance facility would be an existing structure that would be leased and refurbished. If a new building is needed, it would not exceed 557 m^2 (6,000 ft^2) or permanently disturb more than 1.2 ha (3 ac). The substation would be located in the Town of Union and would occupy a maximum area of 2.0 ha (5.0 ac) of previously disturbed land.

Table 5.3-1 Vegetation Impacts Associated with the 100-Turbine Layout for the Project

	Area of disturbance						
	Total			Temporary		Permanent	
Land cover type[b]	Hectares	Acres	Percent of total	Hectares	Acres	Hectares	Acres
Cultivated crops	199.1	492.0	90.1%	157.1	388.2	42.0	103.8
Hay/pasture and herbaceous grassland (not including CRP land)	0.6	1.5	0.3%	0.2	0.5	0.4	1.0
CRP land	11.3	27.9	5.1%	9.0	22.2	2.3	5.7
Developed, open space	3.2	7.9	1.4%	2.3	5.7	0.9	2.2
Deciduous forest[c]	6.4	15.8	2.9%	0.0	0.0	6.4	15.8
Emergent herbaceous wetlands	0.0	0.0	0.0%	0.0	0.0	0.0	0.0
Developed, low intensity	0.2	0.4	0.1%	0.1	0.2	0.1	0.2
Evergreen forest	0.1	0.3	0.1%	0.1	0.1	0.1	0.2
Open water	0	0.0	0%	0	0.0	0	0.0
Barren land	0	0.0	0%	0	0.0	0	0.0
Developed, medium intensity	0	0.0	0%	0	0.0	0	0.0
Mixed forest	0	0.0	0%	0	0.0	0	0.0
Developed, high intensity	0	0.0	0%	0	0.0	0	0.0
Total	220.9	545.8	100%	168.8	416.9	52.2	128.9

Source: Homer et al. 2004

[a] Impacts are estimated from actual impacts calculations of the known 52 turbines and associated facilities and a reasonable maximum impact from the additional 48 turbines based on characteristics of the Action Area and the avoidance and minimization measures described in Sections 6.1 – Avoidance Measures and 6.2 – Minimization Measures of the HCP.

[b] Numbers based on the NLCD and adjusted for impacts to wooded areas as determined with the 2010 NAIP and specific avoidance measures such as avoidance of wetlands.

[c] Included in the mitigation acres calculation as an offset for cleared wooded areas

Agricultural land comprises 82 percent of the Action Area; therefore, most of the vegetation loss associated with construction would be in cultivated cropland. The 100-turbine Project would also be expected to result in permanent impacts to no more than 6.4 ha (15.8 ac) of deciduous forest habitat. The forested area that would be impacted occurs at the edges of relatively small forest blocks, hedgerows, or woodlots spread throughout the Action Area. As such, it is not anticipated that existing forested habitat would be significantly fragmented by the Project construction. It is not anticipated that any plant species occurring in the Action Area would be extirpated, or that populations would be significantly reduced as a result of construction activities. For the 100-turbine Project, no more than 11.3 ha (27.9 ac), or 12.4 ha (30.7 ac) of CRP land would be disturbed, which represents 0.9 percent of the 1,253 ha (3,096 ac) of CRP lands within the six townships included in the Action Area (USDA, 2010).

Construction activities that bring in vehicles and materials from outside locations have the potential to transplant invasive species into the Action Area, which could permanently colonize disturbed areas.

Temporary effects on vegetation would occur within the four staging areas, gravel access, and maintenance areas surrounding the turbine towers; the temporarily widened portions of the roads; and areas disturbed to install buried electrical interconnects. Construction of the 100-turbine Project would temporarily disturb not more than 168.8 ha (417.0 ac) of land.

The four temporary construction staging areas would accommodate material storage, parking for construction workers, and construction trailers (for one staging area only). The four staging areas would account for a cumulative total of not more than 9.27 ha (22.9 ac) of temporary impacts.

The 64.4 km (40.0 miles) of new service roads required to connect wind turbines to existing access roads would have a temporary width of up to 17 m (55 ft) during construction and a permanent width of 4.9 to 6.1 m (16 to 20 ft). The remaining portion of the roadway would be temporarily impacted and revegetated in accordance with the NPDES permit and Erosion and Sediment Control Plan.

The buried electrical interconnects would require the removal of 7.3 m (25 ft) wide corridors of vegetation per linear foot of cable, except in areas where the interconnects are located parallel to access roads. These lines would be completely below ground surface and the corridors would not be maintained following installation of the interconnects. Vegetation along the buried interconnects would gradually revert to pre-construction conditions; therefore vegetative impacts associated with the buried electrical interconnects would be expected to be temporary. Not more than 43.2 ha (106.7 ac) of land would be temporarily disturbed for the buried electrical interconnects required for the 100-turbine Project.

Approximately 1.2 ha (3 ac) around the operations and maintenance facility and 2.0 ha (5 ac) around the substation would be permanently impacted.

Operation and Maintenance-related Effects

Operation of the Project would have minor effects on vegetation. During Project operations, vegetative control would be implemented for general Project operation and as part of the HCP. Periodic tree trimming would occur for safety and accessibility of the Project facilities. For example, overhead collection lines would be cleared of all overhanging limbs, and trees around access roads may have to be trimmed to maintain open access. No additional clearing of wooded areas would be required during Project operations. Cleared areas required for permanent access would be maintained. Under the Proposed Action 56.7 km (35.2 mi) of the interconnects will be buried. There would be no impacts associated with maintenance along buried electrical interconnects.

Impacts on Vegetation Communities at the Population and Landscape Scale

Most of the Project's impacts would occur on agricultural land, where vegetation is monotypic and dependent on active cultivation to persist. The Project would fragment the agricultural monocultures across the Action Area and somewhat reduce the populations of crops within the Project footprint; however, fragmentation of these communities would have no impact on the viability of natural vegetation communities. Project-related impacts on natural vegetation communities would be minor and would occur almost exclusively at the edges of relatively small forest blocks (maximum clearing size of 1.1 ha [2.7 ac]), hedgerows, or woodlots. There would be no more than 11.3 ha (27.9 ac), or 12.4 ha (30.7 ac) of impacts to CRP lands. There would be no more than 6.5 ha (16.1 ac) of permanent impacts to forested habitat. Therefore, the Project would not significantly impact the viability of extant natural vegetation populations or communities.

Impacts on Vegetation's Function as Wildlife Habitat

Grassland habitat comprises just 1.4 percent of the Action Area, and few grassland species (e.g., loggerhead shrike, Northern harrier) are present in the proposed Action Area. These species may avoid the areas immediately surrounding the wind turbines, thus reducing the overall number of grassland species in the immediate area. In addition, increased human presence due to Project-related maintenance activities could decrease the reproductive success of birds nesting near Project facilities. Most permanent effects on native vegetation in the Action Area occur in deciduous forests (6.4 ha [15.8 ac]). However, most of the vegetation that would be impacted by the Project is in active agriculture, and therefore has limited value as wildlife habitat except for generalist species. Generalist species are, by definition, resilient to habitat perturbation and able to persist in impacted habitats; therefore, the Project would not be expected to have significant impacts on the value of the Action Area's vegetation as general wildlife habitat. See Section 5.4 for evaluation of impacts on wildlife habitat and see Section 5.5 for evaluation of impacts on Indiana bat habitat.

Decommissioning-related Effects

Impacts on vegetation associated with decommissioning activities would be related to removal of the turbines, footers, and roads. Some roads would not be removed, per landowner request, and concrete structures would be removed to a depth of 0.9 to 1.2 m (3 to 4 ft). Although some concrete and roads would remain in place, where facilities would be removed the impacts of decommissioning would be generally equivalent to construction-related impacts. Although the volume of concrete removed would not include the volume of concrete installed below 0.9 to 1.2 m (3 to 4 ft), the physical impacts of concrete removal would be generally equivalent to the impacts incurred during the construction phase, but could be significantly less if, as is expected, spread footing turbine foundations are used. The physical impacts of road widening and removal on vegetation (equipment footprints, ground disturbance, etc.) would be generally equivalent to the impacts incurred during the construction phase. It is anticipated that roads would need to be widened to a maximum of 55 ft to accommodate the necessary decommissioning equipment and impacts would be similar to those described for construction. Pre-construction contours and soil/substrate conditions would be restored in disturbed areas, and these areas would be revegetated. Decommissioning activities could occur as early as 2037.

Mitigation Measures for Unavoidable Impacts

Most impacts on vegetation would be associated with the construction phase of the Project. There would be no unique impacts on vegetation that would occur solely as a result of Project operation, although operation of the Project would perpetuate some impacts that originated during construction. Therefore, the Proposed Action contains no specific mitigation measures for impacts to vegetation in addition to the avoidance and minimization measures listed above.

5.3.2.2 Redesign Option

The Redesign Option is an optional measure under the Proposed Action that includes a primarily buried collection system. The different collection system would affect vegetation resources similarly to the Proposed Action, although an additional 0.3 ha (0.7 ac) of wooded areas would be disturbed in the Redesign Option. Implementation of the Redesign Option would result in a total initial disturbance of no more than 219.9 ha (543.6 ac) of which 52.5 ha (129.8 ac) or 21.4 percent would be permanent. Table 5.3-2 provides a detailed breakdown of permanent and temporary vegetation impacts associated with the 100-turbine Redesign Option. Cultivated crop and hay/pasture land cover types collectively comprise approximately 95% of the area that would be disturbed for the 100-turbine Project in the Redesign Option (Table 5.3-2). No more than 6.8 ha (16.7 ac) of wooded areas are expected to be permanently impacted by the 100-turbine Project with the Redesign Option.

Table 5.3-2 Vegetation Impacts Associated with the 100-Turbine Redesign Option for the Project

	Area of disturbance						
	Total			Temporary		Permanent	
Land cover type	Hectares	Acres	Percent of total	Hectares	Acres	Hectares	Acres
Cultivated crops	196.8	486.4	89.5%	154.8	382.6	42.0	103.8
Hay/pasture and herbaceous grassland (excluding CRP land)	0.7	1.8	0.3%	0.3	0.8	0.4	1.0
CRP land	12.4	30.7	5.6%	10.1	25.0	2.3	5.7
Developed, open space	3.0	7.5	1.4%	2.1	5.2	0.9	2.3
Deciduous forest[c]	6.7	16.5	3.0%	0.0	0.0	6.7	16.5
Emergent herbaceous wetlands	0.0	0.0	0.0%	0.0	0.0	0.0	0.0
Developed, low intensity	0.2	0.4	0.1%	0.1	0.2	0.1	0.2
Evergreen forest	0.1	0.3	0.1%	0	0.1	0.1	0.2
Open water	0	0.0	0%	0	0.0	0	0.0
Barren land	0	0.0	0%	0	0.0	0	0.0
Developed, medium intensity	0	0.0	0%	0	0.0	0	0.0
Mixed forest	0	0.0	0%	0	0.0	0	0.0
Developed, high intensity	0	0.0	0%	0	0.0	0	0.0
Total*	219.9	543.6	100%	167.4	413.9	52.5	129.8

Source: Homer et al. 2004

[a] Impacts are estimated from actual impacts calculations of the known 52 turbines and associated facilities and a reasonable maximum impact from the additional 48 turbines based on characteristics of the Action Area and the avoidance and minimization measures described in Sections 6.1 – Avoidance Measures and 6.2 – Minimization Measures of the HCP.

[b] Numbers based on the NLCD and adjusted for impacts to wooded areas as determined with the NAIP and specific avoidance measures such as avoidance of wetlands.

[c] Include in the mitigation acres calculation as an offset for cleared wooded areas

*Totals may not appear to accurate reflect the sum of the figures in the column due to rounding

Temporary effects on vegetation would occur within the staging areas, gravel access, and maintenance areas surrounding the turbine towers; the temporarily widened portions of the roads; and areas disturbed to install buried electrical interconnects. Construction of the 100-turbine Project under the Redesign Option would temporarily disturb no more than 167.4 ha (413.9 ac) of land. Similar to the Proposed Action, there would be no ongoing impacts associated with maintenance along buried electrical interconnects under the Redesign Option. Under the Redesign Option 86.5 km (53.7 km) of the interconnects will be buried. There would be no impacts associated with maintenance along buried electrical interconnects.

The avoidance and minimization measures would be the same as described above for the Proposed Action. No mitigation measures would be warranted.

5.3.3 Alternative A- Maximally Restricted Operations Alternative

Alternative A differs from the Proposed Action only with respect to operations. The operational differences would not affect vegetation. As such, the construction, operation, and decommissioning-related effects of Alternative A on vegetation and the avoidance and minimization measures would be the same as under the Proposed Action. No mitigation measures would be warranted.

5.3.4 Alternative B – Minimally Restricted Operations Alternative

Alternative B differs from the Proposed Action only with respect to operations. The operational differences would not affect vegetation. As such, the construction, operation, and decommissioning-related effects of Alternative B on vegetation and the avoidance and minimization measures would be the same as under the Proposed Action. No mitigation measures would be warranted.

5.3.5 Alternative C - No Action Alternative

Under Alternative C, the Project would not be built and no Project-related activities (construction, operation, or decommissioning) would occur. Alternative C would have no effect on vegetation. As such, habitat would remain in its existing condition and no mitigation measures would be warranted.

5.4 Wildlife and Fisheries

5.4.1 Impact Criteria

Several federal regulations pertaining to fish and wildlife are relevant to this analysis; however, most of those regulations pertain to impacts on rare, threatened, or endangered species and are discussed in Section 5.5. Non-listed migratory birds are also protected under the MBTA. This section is related primarily to non-listed species.

Assessment of effects on wildlife and fisheries resources are based on four major elements, as follows:

- The importance of the resource, in legal, commercial, recreational, ecological or scientific terms;

- The proportion of the resource that would be affected, relative to its abundance in the region;
- The sensitivity of the resource to proposed activities; and
- The duration of the ecological consequences.

Specifically, effects on wildlife and fisheries resources would be significant if important species or habitats (i.e., species or habitats considered significant by state or federal natural resource agencies) were adversely affected over relatively large areas; a large proportion of an important species or habitat within a region is adversely affected; or if disturbances related to the Proposed Action or alternatives cause substantial reductions in population size or distribution of an important species. The duration of an effect also affects its significance level, as do regulatory triggers and protocols such as those established by ODNR for bird and bat mortality that prompt adaptive management.

5.4.2 Proposed Action

5.4.2.1 Avoidance and Minimization Measures

The Proposed Action contains the following avoidance and minimization measures that would avoid or minimize impacts to wildlife and fisheries.

- Tree removal during construction would occur between November 1 and March 31, to reduce the potential for impacts on roosting bats and nesting/breeding birds.
- CRP land would be cleared only during the non-breeding season for grassland birds (before March 1 and after July 15).
- Although juvenile bald eagles were observed by local residents in 2011, no bald eagle nests or nests of other State-listed raptor species have been identified in the Action Area. Should any protected species of raptor nest be identified, impact minimization measures would be established in cooperation with the ODNR DOW.
- The Applicant would implement feathering at various cut-in speeds from one half-hour before sunset to one half-hour after sunrise from April 1 to October 31 as part of the minimization measures incorporated in the HCP for Indiana bat impact. A number of studies have now shown that use of feathering and cut-in speeds similar to those proposed for the Project have been demonstrated to reduce all bat mortality by 38 to 93 percent (Arnett et al. 2010, Baerwald et al. 2009, Good et al. 2011, and Good et al. 2012), therefore this action will substantially minimize all bat mortality. Cut-in speeds and feathering have not been shown to reduce bird deaths, but with greater curtailment[1] there could possibly be less bird mortality, especially for those bird species that migrate at night (see discussion in Section 5.5).
- Access roads built for the Project would be posted with a 25 mph speed limit to minimize risk of collision with Indiana bats and other wildlife.

[1] Curtailment or curtailing refers to turbines whose cut-in speed is increased above the manufacturing cut-in speed, but turbine blades may still rotate to some degree below the increased cut-in speed.

- Project siting was informed by FAC recommendations, ODNR's Protocol (ODNR 2009), agency input from the USFWS and ODNR, and general best management practices informed by research and experience.
- In addition to the aforementioned guidelines, the Project's design also incorporates aspects of the *Service Interim Guidance on Avoiding and Minimizing Wildlife Impacts from Wind Turbines* (USFWS 2003)2. This guidance preceded the current USFWS Guidelines (USFWS 2012c), but included similar site development, project design, turbine design, and operation recommendations, aimed to reduce potential wind farm impacts on wildlife such as birds and bats. Specifically, the following USFWS recommendations were incorporated into the Project design, and are followed by an explanation of how these recommendations were incorporated:
    - Implementation of a post-construction monitoring plan based on the ODNR recommendations and coordination with the USFWS, to determine the rates and species-specific patterns of avian and bat collision fatalities at turbines.
    - An annual estimate of bird and bat mortality would be calculated on a total project, per turbine, per MW, and per rotor-swept area basis.
    - The distribution of bird and bat carcasses would be investigated to determine any patterns related to Project design features. Potential features to be considered include FAA lighting; position of turbines in turbine strings (i.e. middle or end); influence of landscape features including proximity to wetlands and streams, proximity to forest edge, and proximity to open areas; location in Project Area (i.e. north or south edge); elevation; or season and weather patterns. If necessary, additional minimization measures would be made through adaptive management, to keep non-listed bird and bat mortality below levels in the ODNR Protocol (ODNR 2009). The Avian and Bat Protection Plan (ABPP) for this Project is provided in Appendix C.

Site Development and Maintenance Recommendations and Corresponding Project Elements

- *Avoid locating turbines in known bird migration pathways or in areas where birds are highly concentrated, unless mortality risk is low (e.g., birds present rarely enter the rotor-swept area). Examples of areas that could potentially support high concentration of birds are wetlands, State or Federal refuges, private duck clubs, staging areas, rookeries, leks, roosts, riparian areas along streams, and landfills. Avoid known daily movement flyways (e.g., between roosting and feeding areas) and areas with a high incidence of fog, mist, low cloud ceilings, and low visibility.* The Applicant incorporated avoidance and minimization of direct physical impacts to bat and migratory bird habitats (e.g., ground disturbance or habitat removal) as much as possible for the Project. None of the turbines are sited in wetlands, riparian areas along streams, in landfills, or near known rookeries or leks. Pre-siting assessments indicated that the area did not, at the time of survey, have high concentrations of sensitive birds or bats. Additionally, in order to continue to avoid any impacts to stream habitat, the Applicant would avoid direct impacts to designated exceptional

[2] The 2012 *US Fish and Wildlife Service Land-Based Wind Energy Guidelines* are now available; however, the *Interim Guidance* is cited here as it was the operative guidance document during project planning, and served as the basis for the 2012 document.

warm or cold water habitat streams, as well as any streams thought to have the characteristics necessary to support federally threatened, endangered, or candidate species of freshwater mussels.

- *Avoid placing turbines near known bat hibernation, breeding, and maternity/nursery colonies, in migration corridors, or in flight paths between colonies and feeding areas.* Stantec conducted several bat studies (i.e., mist netting, acoustic detection, radio telemetry, radar, and swarming studies) to determine the location of any bat hibernacula, maternity colonies, migration corridors, and flight paths in the Action Area. The Applicant considered these survey results to the maximum extent possible when designing the placement of the currently sited turbines. For example, the Applicant revised their initial turbine layout to avoid a documented hibernaculum for non-listed bat species. The Applicant would follow a similar process for the additional turbines and would fully consider the results of prior surveys when siting the additional turbines.
- *Configure turbine locations to avoid areas or features of the landscape known to attract raptors (hawks, falcons, eagles, owls). For example, golden eagles, hawks, and falcons use cliff/rim edges extensively; setbacks from these edges may reduce mortality. Other examples include not locating turbines in a dip or pass in a ridge, or in or near prairie dog colonies.* The Action Area was surveyed in 2007 and 2008 for raptors to determine if there were any areas with high raptor activity so that these areas could be avoided. However, no such area was identified during these surveys.
- *Configure turbine arrays to avoid potential avian mortality where feasible. For example, group turbines rather than spreading them widely, and orient rows of turbines parallel to known bird movements, thereby decreasing the potential for bird strikes. Implement appropriate storm water management practices that do not create attractions for birds (such as basins or ponds), and maintain contiguous habitat for area-sensitive species (e.g., sage grouse) to the extent practicable.* The Applicant could not identify any distinct avian use patterns within the Action Area, making it infeasible to define particular turbine array patterns that would reduce potential bird strikes. Ground and habitat disturbance would be minimized to the extent practicable (greater than 90 percent of total disturbed area is composed of cultivated crops), resulting in minimal habitat fragmentation for area-sensitive species. Temporary ponds would not likely be created given the lack of slope in the Action Area. Contiguous habitat would be maintained to the extent practicable.
- *Avoid fragmenting large, contiguous tracts of wildlife habitat. Where practical, place turbines on lands already altered or cultivated, and away from areas of intact and healthy native habitats. If not practical, select fragmented or degraded habitats over relatively intact areas.* For this Project, most (over 90%) of the turbines and associated facilities would be placed in agricultural fields and along the edge of small forest patches, and would avoid areas of native, intact habitat that have greater wildlife habitat value. Further, the limited removal of forest habitat and other vegetation areas would help maintain connectivity between forest areas, foraging corridors for bats, and movement corridors.

- *Avoid placing turbines in habitat known to be occupied by prairie grouse or other species that exhibit extreme avoidance of vertical features and/or structural habitat fragmentation. In known prairie grouse habitat, avoid placing turbines within 8 km (5 mi) of known leks (communal pair formation grounds).* No prairie grouse habitat was identified in the Action Area during Stantec's 2007 and 2008 avian surveys, and they are not expected to occur in the Action Area.
- *Minimize roads, fences, and other infrastructure. All infrastructure should be capable of withstanding periodic burning of vegetation, as natural fires or controlled burns are necessary for maintaining most prairie habitats*. The Project has minimized infrastructure to the extent possible and therefore minimized potential impacts to vegetation and wildlife habitat in the Action Area. Project buildings and infrastructure would be built according to applicable fire codes. Controlled burns are not anticipated to occur within the Action Area.
- *Develop a habitat restoration plan for the proposed site that avoids or minimizes negative impacts on vulnerable wildlife while maintaining or enhancing habitat values for other species. For example, avoid attracting high densities of prey animals (rodents, rabbits, etc.) used by raptors.* The Project Applicant would reseed all temporarily disturbed areas (outside of active agricultural fields) after construction and decommissioning with a native seed mix in accordance with the NPDES permit and Erosion and Sediment Control Plan. Temporary crossings and areas of temporary construction impact will be restored and re-vegetated per the Erosion and Sediment Control Plan, consisting of planting native plant species (see HCP Appendix D for a typical native plant mix) to provide ground stabilization. Where forest fragmentation results from construction activities, the areas will be restored using trees suitable for Indiana bat habitat, if practicable. A list of native trees suitable for planting to restore Indiana bat habitat is included in HCP Appendix D. If existing land-use precludes the use of native species (e.g. agricultural use), restoration and stabilization will be established consistent with that land-use.
- *Reduce availability of carrion by practicing responsible animal husbandry (removing carcasses, fencing out cattle, etc.) to avoid attracting golden eagles and other raptors.* Any observed road-kill or other dead animals that may attract scavenging raptors such as vultures or eagles would be cleared from within turbine areas, and access roads.

Project Design and Operation Recommendations

- *Use tubular supports with pointed tops rather than lattice supports to minimize bird perching and nesting opportunities. Avoid placing external ladders and platforms on tubular towers to minimize perching and nesting. Avoid use of guy wires for turbine or meteorological tower supports.* This Project would use tubular towers and internal ladders for the wind turbines. Permanent meteorological towers would be free-standing and guy wires would not be used.
- *High seasonal concentrations of birds may cause problems in some areas. If, however, power generation is critical in these areas, an average of three years monitoring data (e.g., acoustic, radar, infrared, or observational) should be collected and used to determine peak use dates for specific sites. Where feasible, turbines should be shut down*

during periods when birds are highly concentrated at those sites. The Applicant would implement an ABPP for the life of the Project, which includes avoidance and minimization measures, post-construction monitoring, and adaptive management focused on reducing impacts to migratory birds and bat species other than the Indiana bat.

- *When upgrading or retrofitting turbines, follow the above guidelines as closely as possible. If studies indicate high mortality at specific older turbines, retrofitting or relocating is highly recommended.* As addressed above, the Project Applicant would implement an ABPP for the life of the project, which includes avoidance and minimization measures and adaptive management to reduce impacts to wildlife that are identified during post-construction monitoring.

In addition to the measures listed above, the following design measures from the USFWS *Interim Guidance on Avoiding and Minimizing Wildlife Impacts from Wind Turbines* (2003) have been incorporated in the Proposed Action, and are specifically aimed to reduce potential impacts to birds and bats in flight.

- The minimum amount of pilot warning and obstruction avoidance lighting specified by the FAA would be used (FAA 2000).
  - Attached to the top of some of the nacelles would be a single, medium intensity aviation warning light.
  - Approximately one in every five turbines would be lit, and all lights within the facility would illuminate synchronously.
  - FAA lights are anticipated to be flashing red strobes (L-864) that operate only at night. Buckeye Wind would use the lowest intensity lighting as allowed by FAA.
  - To the extent possible, USFWS recommended lighting schemes would be used on the nacelles, including reduced intensity lighting and lights with short flash durations that emit no light during the “off phase”.
  - MET towers would also utilize the minimum lighting as required by the FAA.
  - No steady burning lights would be left on at Project buildings. Where lights are necessary for safety or security, motion detector lighting or infrared light sensors would be used to avoid continuous lighting.
- Where feasible, electric power lines would be placed underground or on the surface as insulated, shielded wire to avoid electrocution of birds. Avian Power Line Interaction Committee (APLIC) “Suggested Practices for Avian Protection on Power Lines” would be utilized to the extent the Applicant is able to dictate their use (in almost all cases, the overhead lines would be co-located on utility-owned poles. The ability to implement full APLIC compliance may be hindered as a result).

Construction-related Effects

Terrestrial Wildlife

Incidental Injury & Mortality

Incidental injury and mortality from the Project construction would be limited to sedentary/slow-moving species, such as small mammals, reptiles, and amphibians that are unable to move away from the active construction area. Clearing activities would not be conducted during the breeding season, as certain construction activities could destroy nests and kill or harm young birds and immature mammalian species that are not yet fully mobile. More mobile species and mature individuals should be able to vacate the areas being disturbed. Over ninety percent of Project components are sited in active agricultural land that has limited wildlife habitat value. For these reasons, impacts on terrestrial wildlife associated with the Project are anticipated to be minor.

Habitat Loss/Degradation

As discussed in Section 5.3 above, construction of the proposed 100 turbines would result in temporary and permanent impacts to no more than 220.9 ha (545.8 ac) of vegetation, most of which is agricultural land. Specifically, there would be no more than 157.3 ha (388.6 ac) of temporary disturbance and 42.4 ha (104.9 ac) of permanent disturbance to cultivated crop and hay/pasture vegetation (this excludes CRP land), which is approximately 90 percent of the total area of disturbance. This agricultural land is already disturbed by mowing, plowing, harvesting, etc., and it provides habitat for a limited number of animal species. Nevertheless, these hayfields and pasturelands may provide habitat for open country/grassland avian species (e.g., Northern harrier, bobolink, red-winged blackbird, and savannah sparrow), and temporary and permanent disturbance could adversely affect these species.

The 100-turbine array would result in no more than 6.5 ha (16.1 ac) of permanent disturbance (3.0 percent of total permanent impacts) to deciduous and evergreen forests. While forested habitat provides habitat for a variety of terrestrial wildlife species, most of the affected forest would occur along the edges of small forest blocks or woodlots (i.e., less than 12 ha [30 ac]), which is generally less valuable for forest wildlife species than larger tracts of forest. Grassland and CRP lands provide suitable habitat for many species of birds. A maximum of 2.3 ha (5.7 ac) of CRP land would be permanently impacted by the Project. This could have the potential to displace some species, but the area of impact is relatively small, and significant impacts to grassland species are not expected.

Earth-moving activities associated with Project construction have the potential to cause siltation and sedimentation impacts down slope of the area of disturbance and, in turn, affect surface water habitats used by foraging wildlife, such as bats, swallows, and muskrats. No turbines would be sited within 15 m (50 ft) of a federal or state jurisdictional wetland. Impacts to waterbodies may occur in localized areas where the Project intersects surface waters. To prevent adverse effects to water quality and aquatic habitat during construction, runoff would be managed under an NPDES construction storm water permit and associated SWPPP. Prior to construction, an Erosion and Sediment Control Plan would be developed and would use appropriate runoff diversion and collection devices. Also, because the majority of Project components would be sited in active agricultural land, soil disturbance/exposure due to Project construction would generally occur in areas already subject to regular plowing, tilling, harvesting, and other agricultural practices. Clearing activities would be conducted outside of the breeding season in order to avoid negative impacts to birds and terrestrial wildlife.

Project construction would affect no more than 32 jurisdictional streams, totaling 380.4 m (1,248 lf) for the 100-turbine Project, which, in turn, could affect wildlife species that are dependent on these. However, the Applicant would implement techniques to avoid impacts to streams to the extent practicable. Existing stream crossings would be used whenever possible. Existing crossings may need to be temporarily strengthened with steel plates to support heavy equipment (e.g., cranes) and turbine components. In situations where there is no existing crossing, low-impact crossing techniques would be utilized wherever practicable. Such techniques could include permanent bridge span above the ordinary high water mark for access roads and directional boring for buried electrical collection lines. Given the limited area of impacted riparian habitat relative to the available habitat in the area, tree removal in the vicinity of stream crossings would result in minor fragmentation of riparian wooded habitat potentially utilized terrestrial wildlife.

Disturbance/Displacement

Increased noise and human activity associated with construction would result in some short-term displacement of wildlife that use cropland, hayfield, and forest edges (e.g., deer, raccoon, skunk, grassland birds, and forest edge birds). However, due to the existing disturbance resulting from tractors, plows, and other agricultural equipment, most wildlife in the Action Area are likely accustomed to a certain amount of disturbance, so Project-related disturbance impacts would be minor.

Aquatic Wildlife

Impacts on aquatic wildlife would be limited to areas where water quality and/or habitat would be impacted by construction activities. Increased turbidity from excess sediment loads in runoff from disturbed area would decrease water quality and could lead to decreases in primary production, reduced foraging opportunities, decreased habitat value, and possibly displacement, injury, or death of organisms, such as mollusks, that are unable to tolerate degraded conditions. Most of these impacts would be associated with road crossings and interconnects. The avoidance and minimization measures including implementation of an Erosion and Sediment Control Plan, minimization of vegetation clearing and subsequent revegetation, horizontal directional boring, and other measures discussed in Section 5.2 would result in minor impacts to aquatic wildlife.

Operation and Maintenance-related Effects

Terrestrial Wildlife

Operational impacts to wildlife are expected to include displacement due to the presence of the wind turbines and avian and bat mortality and/or injury as a result of collisions (and barotrauma – damage to or rupture of the lungs due to sudden air pressure changes – for bats) with the wind turbines.

Disturbance/Displacement

The presence of turbines can result in direct effects to wildlife species associated with habitat loss or displacement. These types of impacts are potentially complex, involving shifts in species abundance, turbine avoidance, habitat use, and behavioral disruption. There are limited data available addressing impacts to birds associated with habitat loss due to wind farm developments in the U.S.; the majority of studies have focused on collision mortality. Additionally, the effects of wind turbines on those animal species found in agricultural landscapes are not fully understood. Wind facilities in agricultural landscapes create a less noticeable disruption of habitat associated with turbine pad clearings, new roads, and transmission lines as compared to wind facilities constructed in forested or grassland landscapes. Increased noise and human activity associated with maintenance and monitoring activity is expected; however, due to the existing disturbance resulting from tractors, plows, and other agricultural equipment, most wildlife in the Action Area are likely accustomed to a certain amount of disturbance, and therefore Project-related disturbance impacts would be minor.

There is evidence that certain grassland species do not respond favorably to the construction and operation of wind turbines within their habitat. Studies conducted at the Buffalo Ridge Wind Power Plant (Buffalo Ridge) in southwestern Minnesota found reduced numbers of grassland nesting birds in proximity to wind turbines (although other bird group numbers were not affected, such as waterfowl, shorebirds, doves, flycatchers, corvids, blackbirds, and thrushes) (Johnson et al. 2000). At Buffalo Ridge, Osborn et al. (1998) reported fewer birds and fewer species in survey plots with turbines as compared to reference survey plots. Osborn et al. (1998) also concluded that birds avoided flying in areas with turbines. Also at Buffalo Ridge, Leddy et al. (1999) observed that male songbird densities were four times greater in reference CRP grasslands as compared to CRP grasslands located within 180.0 m (590.6 ft) of turbines. At the Maple Ridge Wind Power Project in northeastern New York, Kerlinger and Dowdell (2008) found lower densities of bobolinks within 75.01 m (246.1 ft) of turbines in hayfields as compared to densities in hayfields without turbines. In a study at the Stateline Wind Project in Oregon and Washington, grasshopper sparrows and western meadowlarks showed a significant decrease in use within the first 50.0 m (164.0 ft) of the turbines (WEST and Northwest 2004).

For the 100-turbine Project, a maximum of 11.3 ha (27.9 ac) of CRP land in the Action Area would be impacted. The proposed 100-turbine Project would result in no more than 9.0 ha (22.2 ac) of temporary impacts and 2.3 ha (5.7 ac) of permanent impacts to grasslands (including both the hay/pasture and CRP land cover categories). A small number of grassland species (including bobolinks, grasshopper sparrows, and several warbler species among others) are present in the proposed Action Area, and these species may avoid the areas immediately surrounding the wind turbines, thus reducing the overall number of grassland individuals, species, or both in the immediate area. In addition, increased human presence due to Project-related maintenance activities could decrease the reproductive success of birds nesting near Project facilities.

Although waterfowl are likely to use hayfields and cropland in the Action Area for foraging and roosting, there are no important waterfowl breeding or migratory stopover habitats (lakes or large ponds, large perennial streams) in the Action Area (Section 4.4). The largest perennial streams in the Action Area that could be frequented by waterfowl include Kings Creek, Buck Creek, Dugan Run, and Little Darby Creek. The average distance to the closest turbine from these streams ranges from approximately 25 m (82 ft) to 503 m (1,650 ft). As such, Project impacts to waterfowl are not expected to be significant. A two-year study conducted on the Top of Iowa Wind Farm in Worth County, Iowa, Koford et al. (2005) documented no effects on the use of fields by geese or other waterfowl species as a result of wind turbines. In a separate study, although the majority of grassland nesting birds decreased their use adjacent to the turbines at the Buffalo Ridge Facility, waterfowl were observed to continue using the area (Osborn et al. 1998). Based on these study results and observations at other wind power projects (Erickson 2002 and Jain 2005), the Project is not anticipated to have a significant short-term or long-term effect on resident or migrating waterfowl. Low densities of raptor species were observed in the Action Area, likely due to the lack of prominent landscape features such as ridges, and it is therefore anticipated that impacts to raptors from the Project would be minor. Some forest-breeding songbird species may be displaced due to forest clearing or avoidance of newly created edge habitat. Some species have been observed to have decreased nesting success as fragmented habitat may attract competitive generalist species, such as the nest-parasitic brown-headed cowbird (IDNR, 2007).

Some species have a greater tolerance than others for human activity and habitat modification in the vicinity of breeding and feeding areas. While habituation may not be immediate, species such as deer and wild turkey generally adapt quickly to the presence of man-made features in their habitat, as evidenced by the abundance of these species in suburban settings. Specific to wind turbines, deer and wild turkey have been observed foraging at the base of recently erected wind turbines (EDR 2009a), although at least one wild turkey fatality was documented at the Altamont Pass wind facility in California (Smallwood & Thelander 2008).

A study by Stewart et al. (2005), found that bird abundance declines after the construction of a wind facility. The same study also found that this decline in abundance becomes more pronounced over time, and may affect different group of species differently. Data suggested that Anseriformes (ducks) and Charadriiformes (sandpipers, plovers, auks, and gulls) suffer greater declines in abundance than other groups of species due to disturbance, displacement, and the creation of a barrier to movement, in contrast to raptors and songbirds that are more likely to be impacted by mortality as a result of collision.

Kunz et al. (2007) suggested that bats may become acoustically disoriented upon encountering turbines during migration or feeding. However, observations of bat flight activity using TIR cameras at wind energy facilities suggest that bats are able to normally fly and forage in close proximity to wind turbines (Ahlen 2003 as cited in Kunz et al. 2007, Horn et al. 2008). While these studies indicate that bats may not be affected by sound from operating turbines, there are no data that specifically addresses the impacts of sound from wind turbine operation on migrating or foraging Indiana bats. Bats could potentially be displaced or disturbed by the removal of trees used for foraging or roosting. However, given the small portion of the total wooded area that would be cleared for the Project, it is expected that Project-related clearing would not significantly decrease the availability of suitable habitat.

Overall, a literature review on the likelihood for disturbance/displacement of terrestrial wildlife suggests that some effects would likely occur as the result of the Project, and that grassland birds are the most likely group to be affected. The magnitude of these impacts would be minimal as the Project would result in a relatively small amount of habitat loss and disruption, relative to the size of the surrounding landscape. These impacts are expected to consist primarily of shifts in distribution of species within the Action Area that could also occur as the result of other types of impacts, such as agriculture and housing developments.

Avian Collision and Mortality

Collision with various man-made structures, including wind turbines, is a significant source of bird mortality (Trapp 1998, Kerlinger 2000, Shire et al. 2000). An estimated 20,000 to 37,000 birds were killed by approximately 17,500 wind turbines in the United States in 2003 (Erickson et al. 2003). After correcting for searcher efficiency and scavenger rates, fatalities ranged from zero to about nine birds/turbine/year (b/t/y), yielding an average of 2.1 b/t/y (Erickson et al. 2005).

General literature exists on behavior of migrating birds with respect to topography, seasonal timing, and general migration routes. Also, an increasing amount of information from radar surveys conducted at proposed wind projects is becoming publicly available and provides information on flight heights and passage rates. Several entities have conducted numerous radar surveys at proposed wind projects throughout the east between 1998 and 2007 (see Appendix F, Table F-4). Results of these surveys were compared to those from the Action Area to provide context and to characterize overall anticipated migration patterns in the vicinity of the Project.

Also available are the results of 24 publicly available post-construction mortality studies conducted at 19 different locations in the eastern and midwestern United States (Osborn et al. 2000; Johnson et al. 2000, 2002; Howe et al. 2002; Kerns and Kerlinger 2004; Koford et al. 2004, 2005; Arnett 2005; Piorkowski 2006; Derby et al. 2007; Fiedler et al. 2007; Jain et al. 2007, 2008, 2009a, 2009b, 2009c, 2009d; Miller 2008; Stantec 2009b, 2009c, 2010a; Vlietstra 2008; Arnett et al. 2009; Gruver et al. 2009; NJ Audubon Society 2009; Tidhar 2009; Young et al. 2009; Drake et al. 2010). These studies provide information regarding the numbers of individuals and species of birds that have been involved with collisions at wind farms.

Based on these 24 post-construction monitoring studies in the east and midwest, a total of 868 individual avian fatalities were documented either during standard searches or incidentally (Table 5.4-1). These mortality studies were conducted in a variety of habitats including agricultural upland, forested ridgeline, coastal, and grassland. Of the total fatalities, passerines represented the majority (n=628, 72.4 percent). Among passerine species, nocturnally migrating species such as warblers and vireos were most commonly found as fatalities.

Table 5.4-1 Documented Avian Fatalities at Wind Farms between 1994 and 2009 in the Eastern and Midwestern United States

Bird group	Number of individuals	Percent of total fatalities
Passerine	628	72.4
Unknown species	108	12.4
Raptor	46	5.3
Waterfowl	21	2.4
Game bird	41	4.7
Shorebird	14	1.6
Seabird	6	0.7
Owl	4	0.5
Total	**868**	**100.0**

Note: Not all fatality data were corrected for searcher efficiency or scavenger removal biases.

Sources: Osborn *et al*. 2000; Johnson *et al*. 2000, 2002; Howe et al. 2002; Kerns and Kerlinger 2004; Koford *et al*. 2004, 2005; Arnett 2005; Piorkowski 2006; Derby *et al.* 2007; Fiedler *et al.* 2007; Jain *et al*. 2007, 2008, 2009a, 2009b, 2009c, 2009d, Miller (2008; Stantec 2009b, 2009c, 2010a; Vlietstra 2008; Arnett *et al.* 2009; Gruver et al. 2009; NJ Audubon Society 2009; Tidhar 2009; Young *et al.* 2009;and Drake *et al.* 2010.

Rates of avian collision mortality at existing wind facilities in the east and upper Midwest of the United States have been documented to range from zero to approximately 10 bird fatalities per turbine per year (Erickson et al. 2001; Erickson et al. 2005). Although avian collision mortality can occur at any time of year, patterns in avian collision mortality at tall towers, buildings, wind turbines, and other structures suggest that the majority of fatalities occur during the spring and fall migration period (NRC 2007). Limited data from existing wind facilities suggest that migrant species represent roughly half the fatalities, while resident species represent the other half (NRC 2007).

The factors that influence increased risk of bird collision with wind turbines appear to be a combination of overall abundance, weather, and species-specific flight behaviors.

In addition, some researchers have described the concept of motion smear, defined as the "degradation of the visibility of rapidly moving objects" (Hodos et al. 2001). This concept applies primarily to the blade tips of wind turbines, and means that when they are moving at high speeds they may appear transparent, causing birds to be unable to avoid collision since they do not perceive the blade tip as a solid object. Experiments in developing anti-motion smear patterns to be placed on turbine blades have had some success in increasing blade visibility at distances of 23 m or greater in brightly lit conditions.

Passerines. In the midwestern and eastern United States, nocturnally migrating passerines have accounted for the majority of fatalities at wind projects (Table 5.4-1). In general, the documented levels of fatalities are small relative to the source populations of these species. When data are corrected for scavenging and observer efficiency biases, mortality studies estimate that each wind turbine accounts for 2.19 avian fatalities per year, of which approximately 72.4 percent are passerines (Erickson et al. 2001). Passerine activity levels within the Action Area during preconstruction avian surveys were low when compared to other sites in the U.S. with publicly available data (Appendix G). Additionally, the mean flight altitude of night migrating passerines was well above the maximum height of the wind turbines (Table 4.4-

1). These data suggest that passerine mortality at the Project is expected to be similar to or lower than rates observed at other wind facilities in similar settings.

Waterfowl. Because there are small wetlands in the vicinity of the Action Area, some waterbirds may be present, which could be at risk of colliding with turbines. Also, Canada geese that forage on nearby agricultural fields may be exposed to a slightly higher level of risk. However, research has demonstrated that waterfowl and other waterbirds rarely collide with wind turbines (Table 5.4-1). Of 868 avian fatalities documented in Table 5.4-1, waterfowl, shorebirds, and seabirds represented 2.4 percent (n=21), 1.6 percent (n=14), and 0.7 percent (n=6) of fatalities, respectively. A study at the Top of Iowa Wind Power Project site revealed no fatalities of waterfowl (Koford et al. 2005). Risk of collision to migrant waterfowl is likely to be minimal due to their tendency to migrate at high altitudes (Kerlinger and Moore 1989 and Bellrose 1976). Suitable waterbird habitat is sparsely distributed within the Action Area, and there are very few large perennial bodies of open water. Few waterbird species were observed during breeding bird surveys conducted in spring and summer 2008 (May 3 to July 29, 2008) (Stantec 2009; Hull 2009d). The potential for collision risk to resident waterbirds (waterfowl, long-legged waders, shorebirds, rails, etc.) in the Action Area is not likely to be significant.

Raptors. Raptors tend to migrate or travel locally along prominent landscape features, and wind turbines are typically built on prominent landscape features. Thus, wind farms on prominent ridges and within migration pathways can result in high raptor mortality (e.g., at the Altamont Pass in California). In addition, following development of this facility, there was an increase in mammal prey for raptors, increasing collision risk (Thelander et al. 2003). However, evidence suggests that the risk of raptor collision with turbines in the eastern and midwestern U.S. is generally relatively low, estimated at approximately 0.033 mortalities per turbine per year (Erickson 2001). Raptors represented only 5.3 percent (n=46) of the 868 avian fatalities shown in Table 5.4-1.

Impacts to migrating raptors as a result of Project operations would be low, because: (1) as described in Section 4.4.2, the number of migrating raptors detected in the Project site during the 2007 and 2008 surveys was low; (2) there are no prominent ridges or other landscape features in the Action Area; and (3) studies at other wind energy facilities found that the raptors most likely to be impacted are resident birds that forage in open country, such as red-tailed hawks, as opposed to migrating raptors that pass through the area (Table 5.4-2).

Table 5.4-2 Species Composition of Documented Raptor Fatalities at Wind Farms in the Eastern and Midwestern United States

Species	Number of individuals
American kestrel	4
Broad-winged hawk	2
Cooper's hawk	1
Osprey	2
Red-tailed hawk	16
Sharp-shinned hawk	5
Turkey vulture	16

Sources: Osborn *et al*. 2000; Johnson *et al.* 2000, 2002; Howe et al. 2002; Kerns and Kerlinger 2004; Koford *et al*. 2004, 2005; Arnett 2005; Piorkowski 2006; Derby *et al.* 2007; Fiedler *et al.* 2007; Jain *et al*. 2007, 2008, 2009a, 2009b, 2009c, 2009d; Miller 2008; Stantec 2009b, 2009c, 2010a; Vlietstra 2008; Arnett *et al.* 2009; Gruver et al. 2009; NJ Audubon Society 2009; Tidhar 2009; Young *et al*. 2009; and Drake *et al.* 2010.

Flight behavior. Flight behavior is also believed to be associated with rates of avian collision mortality. Species that migrate at higher altitudes or avoid migrating during inclement weather would be at decreased risk of collision. Conversely, birds taking off at dusk or landing at dawn, birds traveling in low cloud or fog conditions, or birds that migrate at altitudes that intersect with the rotor swept zone are likely at the greatest risk of collision.

Although nocturnally migrating passerines are expected to pass through the Action Area during spring and fall migration periods, most of these individuals are flying at consistently high altitudes above the height of the turbines, as has been documented in the vast majority of recent radar surveys conducted at proposed wind facilities in the northeast. The percentage of targets documented during the fall 2007 radar study (Appendix G) flying below 150 m (492 ft) above ground level (maximum turbine height) varied by night from 2 percent to 38 percent. However, only on four out of the 30 nights of sampling did targets flying below 150 m (492 ft) exceed 10 percent. The overall average for targets flying below 150 m (492 ft) during the entire survey period was 5 percent.

Lighting. Artificial lighting is known to influence rates of bird collision at guyed communication towers, buildings, and other tall structures, particularly during foggy conditions (C. Johnson-Hughes, USFWS, personal communication), but the blinking FAA lights typically installed on wind turbines do not appear to influence rates of collision (NRC 2007). Jain et al. (2008) found no significant correlation between mortality rates of nocturnally migrating birds at lit versus unlit turbines at Maple Ridge, NY, and this lack of correlation has been documented at other operational wind facilities (Kerns and Kerlinger 2004, NRC 2007). In addition, Joelle Gehring found that while pulsing lights have fewer impacts on night-migrating birds than steady-burning lights, there is no difference in impact between red and white pulsing lights (Gehring and Kerlinger 2007). Other lit structures with steady-burning lights at wind facilities have been documented as causing bird fatalities due. For example, it was reported at the Laurel Mountain wind facility in the Allegheny Mountains that 500 birds were killed after the lights at an electrical substation were left on overnight (Johns 2012). While no studies to date indicate increased collision risk at lit turbines, controlled studies comparing fatalities at red and white FAA lights have not been conducted and response to white lights is unknown (Arnett et al. 2008).

Quantification of avian collision mortality. There currently is no predictive model available to quantify expected avian collision mortality as a result of wind power project operation. Therefore, risk assessments must be based on pre-construction indices and indicators of risk (e.g., breeding bird and raptor migration surveys), along with empirical data (e.g., avian mortality surveys) from nearby operating facilities in similar habitat. Pre-construction surveys within and near the Action Area revealed no indicators of elevated risk (e.g., unusually high numbers, unusually low flight altitude, habitat that would act as an attractant, and/or abundance of rare species).

Two studies conducted in 2010 at the Fowler Ridge facility, which has total turbine heights ranging from 389 to 420 feet, documented 60 total carcasses (not corrected for scavenger removal or searcher efficiency), including four raptors (Good et al. 2011). None of the identified species were state or federally listed as endangered or threatened. The turbines proposed for the Project could be as tall as 150 m (492 ft), which is more than 20 percent taller than many of those studied at Fowler Ridge, which has some of the tallest turbines documented in these types of mortality studies. Increased turbine height increases the minimum flight altitude at which birds could be impacted by collision.

Erickson et al. (2005) calculated a national average of 2.1 birds killed per turbine per year (corrected for searcher efficiency and scavenging). Many new post-construction mortality studies have become available since that document was published. Table 5.15-3 presents the results of bird mortality estimates from 43 studies at 30 different wind power facilities in the Eastern Flyway, and calculates an average of 3.02 birds per MW per year. Because turbines under the Proposed Alternative would be spinning fewer hours of the night compared to other turbines in the eastern flyway due to the proposed feathering and cut-in speeds, we would expect this project to result in mortality rates of less than 3.02 birds per MW per year. By assuming that collision risk to birds is proportional to annual energy production (which is closely related to the time that turbines are spinning), we can generate a simplistic estimate of the reduction in risk from the proposed curtailment. Buckeye Wind calculated a 2.5 percent reduction in energy generated between the Proposed Alternative and the project operated without feathering (see HCP Section 6.6.2 – Practical Implementation by Buckeye Wind). If the project operating without feathering results in a collision risk similar to estimates from 43 studies at 30 different wind power facilities in the Eastern Flyway, and averages 3.02 birds per MW per year (Table 5.15-3), then the 2.5 percent reduction in risk from feathering and cut-in speeds would result in 2.94 birds/MW/year or 735 birds/year for the 100-turbine (250 MW) project.

This is a small fraction of individual populations that currently migrate through the area, as radar data indicate: passage rates averaged 74 t/km/hr (targets per kilometer per hour) during the fall 2007 radar surveys, with a maximum of 404 t/km/hr. Impacts to migratory birds would be addressed by the Project through implementation of the ABPP (Appendix C), the avoidance and minimization measures discussed earlier in this section, monitoring that would be conducted for life of the Project, and adaptive management triggers to maintain mortality at low levels. Significant take is a level of take that would impair the ability of a local or regional population to sustain itself. Therefore, the level of take that would be considered significant varies by species. Though some migratory bird mortality is still likely to occur, these measures would result in migratory bird mortality being not significant.

Though MBTA is a strict liability statute and indicates that actions resulting in a taking or possession of a protected species in the absence of a Service permit is a violation, the USFWS Office of Law Enforcement focuses its resources on investigating and prosecuting those who take migratory birds without identifying and implementing reasonable and effective measures to avoid the take (USFWS 2012). The USFWS will regard a developer's adherence to the USFWS Guidelines as appropriate means of identifying and implementing reasonable and effective measures to avoid the take of species protected under the MBTA and BGEPA (USFWS 2012). Buckeye has worked cooperatively with USFWS and ODNR throughout the planning process, and has used USFWS Interim Guidance (2003), ODNR recommendations, and FAC Guidance throughout project planning and would implement the ABPP and all associated avoidance, minimization, mitigation, monitoring, and adaptive management measures during operation.

Bald Eagles and Golden Eagles

Low numbers of migrating eagles were observed in and near the Action Area during pre-construction surveys conducted in 2007 and 2008. Surveys unrelated to the Project documented an additional 11 bald eagles and one golden eagle within the Action Area. The USFWS conducted an on-site visual field inspection of portions of the Action Area in 2011 and no bald eagle nests or activity were observed (M. Cota, USFWS, personal communication). Based on the best available information, bald and golden eagles use the Action Area infrequently and there is low potential for harm to breeding or nesting eagles as a result of the Project. Buckeye Wind has taken steps to proactively avoid or minimize impacts to eagles. These measures, along with measures targeted at other bird species, are summarized in the section below and are described in more detail in Chapter 5.0 of Appendix C.

The USFWS used the pre-construction survey results in a predictive bald eagle take model that it is developing in collaboration with modeling experts from outside and within the USFWS. The model predicts the following risks to eagles (USFWS 2011):

- A fatality estimate of 0.059 bald eagles per year, with a 95% confidence interval between 0 eagles and 0.127 eagles per year.
- A fatality estimate of 0.019 golden eagles per year, with a 95% confidence interval between 0 eagles and 0.059 eagles per year.

The risk summary concludes that, “there are no ‘important eagle use areas’ (including ‘eagle nests, foraging areas, or communal roost site that eagles rely on for breeding, sheltering, or feeding, and the landscape features surrounding such nest, foraging area, or roost site that are essential for the continued viability of the site for breeding, feeding, or sheltering eagles’) (Service 2009b) or migration corridors within the Action Area. We have determined that there is low risk to eagles during the breeding and winter seasons” (USFWS 2011).

While the USFWS concludes that the risk to eagles is low, there is uncertainty in the predicted model results, and the assessment includes the following recommendations (USFWS 2011):

1. A commitment to monitor for and report eagle mortality for the life of the Project.
2. An operational plan to minimize, where appropriate, the likelihood that eagles will use the project site (e.g., carcass management, maintain vegetation heights around turbines to reduce prey availability and raptor foraging).
3. A plan to periodically update the predicted risk of the project to eagles utilizing the best available sources of information such as updated nest location information, post-construction fatality monitoring data, migration data, incidental observations, and other sources of information. This may also include new research, monitoring, and surveys if the above information is not available.
4. Adaptive management plans that initiate action (i.e., minimization or mitigation) if risk to eagles is found to increase to moderate or high levels in the future. Specifically, the management plan should identify methodologies and quantitative risk assessment methods that will be used to identify changing risk and describe criteria that will trigger adaptive management. Thresholds for applying for a take permit under the Eagle Act in

the future should also be outlined, along with any "advanced conservation practices" (see ECP Guidance) that may be employed to avoid take should risk to eagles increase.

5. A commitment to consider and incorporate, where appropriate, the latest research findings and minimization measures concerning eagle mortality at wind power projects.
6. Ground wires and any guy wires (e.g., on met towers) used in the project should be marked with deflectors.
7. Follow APLIC guidelines for overhead utilities.

Buckeye Wind intends to follow the USFWS recommendations. Buckeye Wind will work with USFWS and ODNR to develop a plan to periodically update the predicted risk of the Project to bald eagles. In order to have an appropriate basis for the plan, it will be developed once the USFWS's Eagle Conservation Plan (ECP) Guidance is finalized and will incorporate portions of the ECP Guidance as appropriate for the level of risk and for a project that is in the advanced stages of development or has completed the development process. Buckeye Wind is committed to implementing any practicable advanced conservation practices. Buckeye will consider adaptive management plans and advanced conservation practices once the ECP Guidance is final. Any application of the final ECP Guidance will consider Project risk and Project economics and any specific treatment for already operating wind projects contained in the final ECP Guidance. If take of a bald or golden eagle occurs, Buckeye Wind will work with the USFWS to take the appropriate action. Based on the best available information, bald and golden eagles use the Action Area infrequently and there is low potential for harm to breeding or nesting eagles as a result of the Project. Buckeye Wind has taken steps to proactively avoid or minimize impacts to eagles. These measures, along with measures targeted at other bird species, are described in more detail in Chapter 5.0 of Appendix C.

Bat Collision and Mortality

Bat collisions and mortality at wind facilities are well documented in the United States (Johnson and Strickland 2003, Kunz et al. 2007, Arnett et al. 2008, and Horn et al. 2008), mostly involving tree-roosting long-distance migratory bat species (hereafter referred to as migratory tree bats) such as silver-haired, hoary, and eastern red bats. Hoary bats have constituted the highest proportions of fatalities at most facilities, ranging from 9 to 88 percent of all bat fatalities (Arnett et al. 2008). Bat mortality at 15 existing wind facilities within the range of the Indiana bat is presented in Table 5.15-8. Based on the studies summarized in this table, approximately 75 percent of total bat mortalities are migratory tree bats, 19 percent are *Myotis* bats, and six percent are other species (big brown, tricolor, etc.). Most known fatalities occur in late summer and early fall during migration (Johnson 2004). Using 10 studies within the range of the Indiana bat that conducted post-construction mortality monitoring for the spring through fall period, five percent, 24 percent, and 71 percent of all bat fatalities occurred in the spring, summer, and fall, respectively, with seasons defined as spring: April 1 to May 30; summer: June 1 to July 31; fall: August 1 to November 30 (M. Seymour and J. Szymanski, USFWS, personal communication). Some studies have indicated that migratory tree bats may be attracted to both moving and non-moving wind turbine blades and that many bat kills occur during low-wind nights (Arnett 2005). Fatality rates vary by facility, and studies have documented fatality rates as high as 41.6 bats per MW per year at a facility in Tennessee (Kunz 2007). However, the national average has been estimated to be closer to approximately 12.5 bats per MW per year (Arnett et al. 2008). Bat mortality at 15 existing wind facilities within the range of the Indiana bat is presented in Table 5.15-8, and the average adjusted bat mortality for all species ranges from 9.6 to 16.1 bats per MW per study period. Other factors that may influence mortality rates at wind power developments include:

- Species distribution
- Behavioral risk factors
- Weather (temperature, humidity, wind speed)
- Turbine height
- Turbine siting
- Habitat degradation and displacement
- Proximity to landscape features that may "funnel" bats in a certain direction, such as forested habitat, and proximity to streams and wetlands

All of these factors have the potential to influence bat mortality rates at wind power facilities; however the mechanisms of influence and relative importance of each factor can vary at each facility.

During Stantec's 2008 mist netting surveys, seven species of bats were captured: little brown (6%), northern myotis (12.8%), big brown (66.1%), tri-colored (1%), hoary (1%), eastern red (12.1%), and Indiana bats (1%). During acoustic surveys conducted from fall 2007 through spring 2008, Stantec identified a large number of recorded bat passes as big brown/silver-haired/hoary bat calls (the Anabat acoustic software did not differentiate between these three bat species) compared to the number of calls detected from other species. As mentioned above, migratory tree bats (e.g., eastern red, silver-haired, and hoary bats) have suffered high collision mortality rates at several wind facilities in the US. Thus, it is reasonable to assume that mortality of bat species, particularly of migratory tree bats, may occur within the Action Area as a result of the Project. Mortality of *Myotis* species, big brown bats and tri-colored bats is also likely, though in smaller quantities than mortality of migratory tree bats. All bats have low reproductive rates typical of long-lived species, and significant impacts to their numbers would not be sustainable over time. As stated at the beginning of this section, mortality of migratory tree bats, or other bats would be considered significant if substantial reductions in population size or distribution of those species were caused.

A detailed discussion of factors that would influence the predicted mortality rate of Indiana bats associated with construction, operation, and decommissioning of this Project is included in Section 5.5, and would apply to non-listed bat species as well. Furthermore, avoidance and minimization measures, mitigation measures for unavoidable impacts, and conservation measures that would be incorporated into this Project for the Indiana bat (discussed at the beginning of Section 5.4, and thoroughly in Section 5.5 under the Indiana bat discussion) would reduce or offset the potential impacts on these non-listed bats. The Project would implement operational adjustments including feathering and cut-in speeds to reduce impacts on local bat populations. Studies of varying feathering and cut-in speeds conducted at facilities in Pennsylvania, Indiana, and Alberta, documented an average reduction in bat mortality of 68.3

percent (see Table 5.4-3). Although site-specific factors such as turbine model, local weather patterns, and bat populations may affect the relative effectiveness of operational adjustments at different wind facilities, the finding that similar reductions in bat mortality were achieved in geographically diverse areas holds promising support for broad application of operational adjustments including feathering and cut-in speeds as a take minimization technique.

Table 5.4-3. Observed Reductions in Bat Fatalities for Four Operational Effectiveness Studies in the Range of the Indiana Bat

Study	Observed Fatality Reduction[a]			Source
	Min	Max	Average	
Casselman 2008[b]	52.0%	93.0%	82.0%	Arnett et al. 2010
Casselman 2009[b]	44.0%	86.0%	72.0%	Arnett et al. 2010
Fowler Ridge 2010[c]	38.0%	85.0%	64.5%[d]	Good et al. 2011
Southwest Alberta[e]	NA	NA	60.0%	Baerwald et al. 2009
Median fatality reduction	44.0%	86.0%	68.3%	

Note: Turbines were feathered at Casselman and Southwest Alberta, and curtailed at Fowler Ridge

[a] All studies used a combination of cut-in speeds of 5.0 m/s to 6.5 m/s except Baerwald et al. 2009, which used 5.5 m/s

[b] Based on a 95% confidence interval

[c] Based on a 90% confidence interval

[d] Based on the median of the reported average reductions from each treatment (5.0 m/s = 50%; 6.5 m/s = 79%)

[e] Study did not provide confidence intervals for appropriate min and max comparison to other studies

Good et al 2012, published after completion of the Draft HCP, considered fatality reductions when using feathering and cut-in speeds of 3.5 m/s, 4.5 m/s and 5.5 m/s at Fowler Ridge in 2011 with a mean reduction of 36.3%, 56.7% and 73.3%, respectively. It is noted that the reductions in mortality by 73.3% using feathering and cut-in speeds of 5.5 m/s (the only tested cut-in speed included in the HCP) is similar to the median fatality reduction (68.3%) presented in Table 5.4-3. Further a reduction in mortality of 73.3% at a cut-in speed of 5.5 m/s is within the range of reductions seen at cut-in speeds between 5.0 m/s-6.5 m/s at the facilities presented in Table 5.4-3.

Assuming that use of the feathering and cut-in speed regime was implemented as described in the HCP and in the EIS Section 5.5, reductions in mortality of all bats of at least 68 percent could reasonably be expected. Using the maximum average adjusted bat mortality from 15 existing wind facilities within the range of the Indiana bat (Table 5.15-8) of 16.1 bats per MW per study period, and assuming a 68 percent reduction in bat mortality based on the proposed feathering and cut-in speed regime, the Proposed Action would result in 5.15 bats per MW per year, or 1,288 bats per year for the 100 turbine, 250 MW facility. This mortality would likely include roughly 966 (75%) migratory tree bats, 245 (19%) Myotis bats (of which approximately 5.2 are Indiana bats), and 77 (6%) other bats (big brown, tri-color, etc.) per year, if the species composition of mortality follows patterns observed at wind facilities throughout the range of the Indiana bat.

Impacts to non-listed bats would be addressed by the Project through implementation of the ABPP (Appendix C), the avoidance and minimization measures discussed earlier in this section, monitoring that would be conducted for the life of the Project, and adaptive management triggers to maintain mortality at low levels. Though some non-listed bat mortality is still likely to occur, these measures would result in non-listed bat mortality being not significant.

Cleveland et al. (2006) described the economic value of the pest control services of Brazilian free-tailed bats in south-central Texas. They estimated an annual value of $741,000 per year for pest control services provided by colonies of 1.5 million bats. In a subsequent article Boyles et al. (2011) extrapolated this value to the entire U.S., per state, and by county, assuming a value of $74.10 per acre of harvested land. While bats are certainly of value to agriculture in the Midwest and Ohio, the specific bats studied do not occur in this region of the U.S. Therefore the applicability of the actual figures is questionable. Additionally, most bat mortality is likely to occur in fall, to individuals that migrate through the project area and are not resident species.

The resulting impact of the Project is not expected to appreciably reduce local and regional bat populations and would not appreciably reduce the pest control benefits of bats.

Aquatic Wildlife

There would be no substantive impacts on aquatic wildlife associated with operation of the Project.

Decommissioning-related Effects

Impacts on wildlife associated with decommissioning activities would be the same as for construction. The impacts would be intermittent, short-term, and localized. Similar avoidance, minimization, and mitigation measures to those that would be employed for the construction phase would address impacts associated with decommissioning. Decommissioning activities could occur as early as 2037.

Mitigation Measures for Unavoidable Impacts

The Proposed Action does not include any measures specifically to mitigate unavoidable impacts to non-listed wildlife and aquatic species. However, some mitigation measures identified to mitigate unavoidable impacts to Indiana bats (discussed in Section 5.5) may also benefit other wildlife species. For example, the Mitigation Measures for Unavoidable Impacts in Section 5.5 state that 217.0 ac of suitable habitat within seven miles of a Priority 2 hibernaculum in Ohio would be permanently protected and restored or enhanced to mitigate for the impact of taking Indiana bats. Conservation of these lands would benefit numerous non-protected wildlife species along with Indiana bats.

In addition, an ABPP (Appendix C) has been developed in coordination with USFWS and ODNR which would provide mitigative benefits to non-listed avian and bat species. The ABPP provides that, if avoidance and minimization measures are found to be ineffective at reducing impacts to non-listed bird and bat species, and mortality continues to exceed acceptable levels, the Applicant will consider mitigation options including, but not limited to, the following actions to offset impacts:

- Contribute to funding for protection, enhancement or restoration of habitat which is of particular importance to the impacted species.

- Contribute to funding of on-site or off-site research, such as bird displacement studies or acoustic bat studies to better understand the specific Project design, environmental, or behavioral factors contributing to mortality.
- Contribute to funding of off-site research that would contribute to knowledge of survival or breeding success of the impacted species.
- Contribute to funding for retrofitting of communication towers with bird flight diverters on guy lines, and/or retrofitting communication towers with lighting schemes that are less of an attraction to nocturnal migrants.
- Contribute to funding for the installation of off-site nesting platforms or nest boxes to increase breeding success of the impacted species.
- Other, unknown mitigation measures, determined in coordination with ODNR DOW and USFWS, which may satisfy a recently discovered (previously unforeseen) need in the area.

The specific measures to be taken would be developed in cooperation with ODNR DOW and the USFWS, would consider the best available science, and would occur in Ohio. The amount of funding available would be commensurate with the level of mortality relative to the thresholds and will not exceed $100,000 for the life of the Project. It should be recognized that there are adaptive management and mitigation measures outlined in the HCP that are geared toward mitigating impacts to Indiana bats, such as conservation and restoration of forested habitat and turbine feathering, that will coincidentally benefit other species of bats and birds. Any measures employed through the HCP will also be considered as mitigation measures to the extent that the Indiana bat mitigation also provided benefits to the affected species.

5.4.2.2 Redesign Option

The Redesign Option is an optional measure under the Proposed Action that includes a primarily buried collection system. Impacts to wildlife are expected to be similar to those described for the Proposed Action, although an additional 0.3 ha (0.7 ac) of wooded area would be permanently impacted. The amount of wooded habitat (both deciduous and evergreen forests) that would be permanently impacted is 6.8 ha (16.8 ac). This would equate to about 0.2 percent of the 2,743 ha (6,779 ac) of total wooded areas in the Action Area to be cleared. Permanent grassland habitat loss would amount to 2.3 ha (5.7 ac) including CRP land. The Redesign Option would impact a maximum of 49 streams for a total impact of 487.1 m (1,598 lf). This is 17 more stream crossings and 106.7 m (350 lf) of greater stream impact than the Proposed Action. Limited additional impacts may occur to aquatic species from these additional impacts, but all impacts would still be minor. The Redesign Option is the Proposed Action but with significantly more buried collection lines, which would result in less potential for bird collisions with overhead lines. However, avoidance, minimization, and mitigation measures would remain the same.

5.4.3 Alternative A – Maximally Restricted Operations Alternative

Under Alternative A, the Project would operate using a more restrictive operations scenario than under the Proposed Action. As such, the construction and decommissioning-related effects of Alternative A on wildlife would be the same as under the Proposed Action.

The operational adjustment under Alternative A would involve all 100 turbines being non-operational from sunset to sunrise from April 1 through October 31, which is the period when most bats are active. This Alternative would result in extremely low bat mortality of all species, if not zero.

This alternative would also result in a reduced collision risk to night-flying birds from April 1 through October 31. Birds would still experience collision risks associated with early spring and late-fall migration. Diurnally active migratory and resident birds, and winter resident birds would also be exposed to collision risk during their regular commutes within the Action Area. It can be assumed that mortality impacts to bird species would be similar to the Proposed Action during the period from November 1 through March 31, but somewhat lower from April 1 through October 31.

By assuming that collision risk to birds is proportional to annual energy production (which is closely related to the time that turbines are spinning), we can generate a simplistic estimate of reduction in risk from not operating the turbines during night-time hours from spring through fall. Buckeye Wind calculated a 24.6 percent reduction in energy generated between the maximally restricted operations alternative versus the project operated without feathering (see HCP Section 6.6.2 – Practical Implementation by Buckeye Wind).

Similarly, the number of hours that turbines would be shut down from April 1 through October 31 was calculated using the U.S. Naval Observatory's "Duration of Daylight/Darkness Table" (available at: http://aa.usno.navy.mil/data/docs/Dur_OneYear.php). Darkness hours were requested for the year 2014, at a longitude of 83 degrees, 38 minutes West and latitude of 40 degrees, six minutes North, and for a time zone five hours west of Greenwich. The resulting table provided hours and minutes of darkness for each day of the year. There are a total of 2,237 hours of darkness from April 1 through October 31, during which time no turbines would be spinning. There are 8,760 hours in a year, and not operating turbines at night from April 1 through October 31, would eliminate 2,237 hours of potential risk, resulting in 6,523 hours of potential risk. This is a 25 percent reduction in hours of risk, roughly equal to the 24.6 percent reduction in risk predicted using the reduction in energy generated.

If the project operating without feathering results in a collision risk similar to estimates from 43 studies at 30 different wind power facilities in the Eastern Flyway, and averages 3.02 birds per MW per year (Table 5.15-3), then a 25 percent reduction in risk from not operating at night from spring through fall would result in 2.27 birds/MW/year or 568 birds/year for the 100-turbine (250 MW) project.

Avoidance and minimization measures other than the operational adjustments associated with Alternative A would be similar to those described for the Proposed Action, but would not require an HCP, so no mitigation measures or conservation measures would be in place. In addition, a modified post-construction avian mortality monitoring program would be implemented for Alternative A to address bird mortality that would follow ODNR's standard protocol (ODNR 2009). Since under this Alternative all turbines would be non-operational from sunset to sunrise during the season when bats are active in the Action Area, a monitoring program for bat mortality would not be needed.

5.4.4 Alternative B – Minimally Restricted Operations Alternative

The operational adjustment under Alternative B would involve feathering and a cut-in speed of 5.0 m/s (11 mph) for all turbines for the first six hours after sunset during the fall Indiana bat migration period from August 1 through October 31. This corresponds to the seasonal timeframe when the majority of bat mortality occurs. The turbines would be feathered for the first six hours of the night during this period when wind speeds are 5.0 m/s (11 mph) or less. Good et al. (2011) documented an approximately 50 percent decrease in bat mortality during the fall migration period between turbines with no cut-in speeds and turbines with cut-in speeds of 5.0 m/s when cut-in speeds were applied during the entire night. Young et al. (2011) found that turbines that were feathered prior to reaching the manufacturer-set cut-in speed during the first five hours of the night from July 15 through October 13 resulted in significantly less (47 to 72% less) bat mortalities than turbines that were not feathered during this period. Turbines would also be feathered until the manufacturer's set cut-in speed is reached from one half hour before sunset to one half hour after sunrise from April 1 to July 31. This alternative would include the HCP.

Assuming that use of a fall feathering and cut-in speed regime of 5.0 m/s was implemented, and that turbines would be feathered until the manufacturer's cut-in speed is reached at night during spring and summer, reductions in all bat mortality during the fall of approximately 50 percent could reasonably be expected. Using 10 studies within the range of the Indiana bat that conducted post-construction mortality monitoring for the spring through fall period, five percent, 24 percent, and 71 percent of all bat fatalities occurred in the spring, summer, and fall, respectively, with seasons defined as spring: April 1 to May 30; summer: June 1 to July 31; fall: August 1 to November 30 (M. Seymour and J. Szymanski, USFWS, personal communication).

Using the maximum average adjusted bat mortality from 15 existing wind facilities within the range of the Indiana bat (Table 5.15-8) of 16.1 bats per MW per study period, assuming mortalities are distributed by season as follows: spring five percent; summer 24 percent; and fall 71 percent, and assuming a 50 percent reduction in fall bat mortality based on the proposed feathering and cut-in speed regime, Alternative B would result in the mortality of 10.4 bats per MW per year, or 2,600 bats per year for the 100 turbine facility. This mortality would likely include roughly 1,950 (75%) migratory tree bats, 494 (19%) *Myotis* bats (of which approximately 12 are Indiana bats), and 156 (6%) other bats (big brown, tri-color, etc.) per year, if the species composition of mortality follows patterns observed at wind facilities throughout the range of the Indiana bat.

Of all the bat mortality, approximately 76 percent would occur during spring and fall migration. Mortality during spring and fall would predominantly be comprised of migratory tree bats that are crossing through the project area, not local bats that reside in the project area during the summer. The impacts of the loss of these bats would be spread across a large area (eastern U.S., see Section 5.15.5). The resulting impact of the Project is not expected to appreciably reduce local and regional bat populations and would not appreciably reduce the pest control benefits of bats.

While the effects of feathering and cut in speeds on migratory birds are not as well understood as they are for bats, it is expected that Alternative B would pose a greater risk to migratory birds than would either the Proposed Action or Alternative A because the turbines would be spinning more often in this alternative than in either of the other alternatives. Birds would still experience collision risks associated with spring migration, summer residency periods, and late-fall migration. Diurnally active migratory and resident birds, and summer and winter resident birds would also be exposed to collision risk during their regular commutes within the Action Area. It can be assumed that mortality impacts to bird species would be similar to the Proposed Action during the period from November 1 through March 31, but somewhat higher from April 1 through October 31.

Attempting to quantify the impact to birds from this alternative is difficult for multiple reasons. Unlike Alternative A when all of the turbines would not be spinning at night, turbines under Alternative B would be spinning during some portion of every night when winds were above the manufacturer's set cut-in speed. Use of cut-in speeds to reduce bird mortality has not been studied to date, so it is uncertain how much use of cut-in speeds during only a portion of the night and only during the fall would influence bird mortality. Similar to the other alternatives, turbines under Alternative B would not have steady burning lights, so collision risk would not be substantially higher.

By assuming that collision risk to birds is proportional to annual energy production (which is closely related to the time that turbines are spinning), we can generate a simplistic estimate of reduction in risk from not operating the turbines during night-time hours from spring-fall. Buckeye Wind calculated a 0.07 percent reduction in energy generated between the minimally restricted operations alternative versus the project operated without feathering (submitted as Confidential Business Information; CBI Report).

If the project operating without feathering results in a collision risk similar to estimates from 43 studies at 30 different wind power facilities in the Eastern Flyway, and averages 3.02 birds per MW per year (Table 5.15-3), then a 0.07 percent reduction in risk from operating with the Minimally Restricted Operations Alternative would result in 3.018 birds/MW/year or 754 birds/year for the 100-turbine (250 MW) project, essentially the same as the average in the Eastern Flyway.

The same minimization and avoidance measures would be implemented for Alternative B as the Proposed Action, with the exception of the operational adjustment regime, and potentially more mitigation efforts required due to increased take of Indiana bats. Using the "Acres of Mitigation Calculation" method described in Section 6.3.1 of the HCP, 194.0 ha (479.4 ac) of mitigation land would be needed to mitigate for the take of 300 Indiana bats.

In addition, the same post-construction avian and bat fatality monitoring program would be implemented for Alternative B as for the Proposed Action.

The construction and decommissioning-related effects of Alternative B on wildlife would be the same as under the Proposed Action.

5.4.5 Alternative C - No Action Alternative

Under Alternative C, the Project would not be built and no Project-related activities (construction, operation, or decommissioning) would occur. Alternative C would have no effect on wildlife. As such, no avoidance, minimization, or mitigation measures would be warranted.

5.5 Rare, Threatened, and Endangered Species

5.5.1 Impact Criteria

Plant and animal species that are federally- and/or state-listed as threatened, endangered, or other listing status pursuant to the ESA and/or the ORC Chapter 1518.01–99, 1531.25, and 1531.99 are protected from unauthorized take, which includes actions such as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect (see Section 1). The ESA requires that federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of listed species or result in destruction or adverse modification of designated critical habitat. The following types of direct and indirect[3] effects were considered in evaluating the impact of the Proposed Action and alternatives on threatened and endangered species:

- Direct effects to federally- or state-listed species including the taking (removal or loss) of an individual or population due to Project construction and operation; or a change in an individual or population's habitat use due to noise and vibration, visual disturbance, and transportation activity;
- Indirect effects to federally or state-listed species such as increased competition for resources or habitat due to displacement of individuals from the affected area into the territory of other animals, habitat destruction, or other indirect effects which cause mortality, decreased fitness, or reduced breeding and recruitment in the future population; and
- Direct or indirect effects on habitat types that affect population size and long-term viability for federally and state-listed species.

Specifically, impacts to threatened and endangered species were considered significant if federally- or state-listed species or their habitats could be adversely affected over relatively large areas; a large proportion of a listed species' population within a region could be adversely affected; or if disturbances related to the Proposed Action or alternatives could cause significant reductions in population size or distribution of a listed species. The duration of an impact also affected its significance level: temporary impacts (e.g., noise associated with construction) were considered less significant than permanent impacts (e.g., land conversion).

5.5.2 Proposed Action

5.5.2.1 Avoidance and Minimization Measures

The Proposed Action contains the following measures that would avoid or minimize potential impacts to threatened and endangered species, particularly the Indiana bat.

[3] Per the definitions in the ESA, the discussion on threatened and endangered species uses the following terms: "direct effects" are those caused by the project and occur at the same time and place, and "indirect effects" are those caused by the Proposed Action and that are later in time, but are still reasonably certain to occur (50 CFR §402.02).

Project Design

- The Applicant would implement turbine feathering and cut in speeds during spring, summer, and fall, to reduce bat mortality during low wind-speeds (increasing cut-in speeds up to 6.0 m/s [13 mph]).
- The spring feathering and cut-in speed plan would be applied over a period of approximately 8.5 weeks from April 1 to May 31 during the nighttime period, one half-hour before sunset to one half-hour after sunrise. The feathering plan during the spring would be the least restrictive of all seasons in the Indiana bat active period. Feathering would not be applied to all turbines equally during the spring because risk is expected to be lower overall in this season. Feathering and cut-in speeds during the spring would be applied to turbines in the three highest habitat risk categories at wind speeds of 5.0 m/s (11 mph) to protect Indiana bats returning to the area for the maternity period. Feathering of turbines in Category 4 habitat (the lowest risk habitat) would occur up until the manufacturer-set cut-in speed is reached (Table 5.5-1). This accounts for the fact that the spring migratory period has been demonstrated to be the lowest risk to *Myotis* species, and that Category 4 represents the least suitable habitat so it is unlikely Indiana bats would use this habitat for maternity colonies should they arrive to summer maternity habitat early. All turbines in all habitat categories would be feathered at night (one half-hour before sunset to one half-hour after sunrise) until the specified cut-in speed is reached. The summer feathering and cut-in speed plan would be applied over a period of approximately 8.5 weeks from June 1 to July 31 during the nighttime period, one-half hour before sunset to one half-hour after sunrise. Feathering would be applied to all turbines during the summer because risk to Indiana bats in the Action Area during this time is uncertain and higher mortality during late summer has been demonstrated. Using a tiered approach, the highest cut-in speeds (6.0 m/s [13 mph]) would be applied to turbines located within habitat category 1, which was predicted to have the highest suitability for Indiana bat roosting and foraging activities, and cut-in speeds would be stepped down in equal increments for the decreasing habitat categories (Table 5.5-1).
- The fall feathering and cut-in speed plan would be applied to all turbines from August 1 to October 31, from one half-hour before sunset to one half-hour after sunrise. Cut-in speeds would range from 5.75 to 6.0 m/s (11 to 13 mph), depending on which habitat category the turbine was located in (see discussion in Section 3.1; Table 5.5-1). There is a minor difference in operational feathering (0.25 m/s) between Category 1 and Categories 2-4. This difference accounts for the possibility that some summer foraging and roosting Indiana bats may be present after August 1 due to annual weather and behavioral pattern changes. Therefore a slightly higher initial operational cut-in speed is warranted to maintain at least the same level of protection provided during the summer maternity period.

Table 5.5-1 Summary of Nighttime Operational Feathering that Would be Applied to Turbines During Evaluation Phase Year 1*

Habitat risk category	Estimate for 52 Turbine Layout	Maximum for 100-Turbine Layout**	Cut-in speed - m/s****		
			Spring (1 Apr - 31 May)	Summer (1 Jun - 31 Jul)	Fall (1 Aug - 31 Oct)
Category 1 - Highest Risk	4	10	5.0	6.0	6.0
Category 2 - Moderate Risk	9	15	5.0	5.75	5.75
Category 3 - Low Risk	6	15	5.0	5.5	5.75
Category 4 - Lowest Risk	33	85	None***	5.25	5.75
Totals	52	125			

* Any turbines installed after the first year of operation would be feathered using the cut-in speeds for the respective risk Category as adjusted through adaptive management, if those cut-in speeds differ from those in this table.

** The breakdown for the known 52 turbine locations is given for reference. The table shows the maximum number of turbines in each category, resulting in a sum > 100. No more than 100 turbines would be built.

*** Turbines would be cut-in at the manufacturer's specified cut in speed. The turbine would be feathered below the cut-in speed.

**** During all seasons, turbines may be operated normally when temperatures are below 10 °C (50°F).

Site Development and Maintenance

A series of Project design features would be used to avoid or minimize the potential for adverse effects to the Indiana bat and suitable roosting and foraging habitat from construction and maintenance activities:

- The Applicant would site the Project to minimize tree clearing to the maximum extent practicable. No more than 6.5 ha (16.1 ac) of tree clearing would occur for the 100-turbine Project;
- The Applicant would not remove the three known Indiana bat roost trees in the Action Area. None of the 100 turbines would be located closer than 2.9 km (1.8 mi) to known maternity roost trees documented in 2009. The primary benefit from siting turbines at some distance from maternity roost trees is that it would tend to reduce risk of impact or barotrauma. While there is no evidence to suggest that shadow flicker or sound from operating turbines would impact Indiana bats in roost trees, greater distances also reduce the potential for disturbance.
- Buckeye Wind would conduct habitat assessments jointly with the USFWS for the areas of planned tree clearing once Project plans are finalized and before any clearing is conducted, during which all potential roost trees would be identified and flagged. Any potential roost trees observed within the clearing zone would be flagged and impacts avoided to the maximum extent practicable. Prior to the finalization of the detailed design of Project components, all reasonable attempts would be made to offset the clearing radii around turbines or adjust roads/interconnects to preserve any potential roosts and avoid any unnecessary clearing.

- Prior to tree removal, the limits of proposed clearing would be clearly demarcated on the site with orange construction fencing (or similar) to prevent inadvertent over-clearing of the site or clearing of previously unidentified roost trees.
- The Applicant would conduct tree clearing during the period between November 1 and March 31, when Indiana bats would not be using the area, to avoid potential mortality of Indiana bats that could result from removal of previously unidentified roost trees.
- A USFWS-approved natural resource specialist knowledgeable of Indiana bats and their habitat requirements would flag roost trees and be present at the time of tree clearing.
- A plan note would be incorporated into the construction contract requiring that contractors adhere to all provisions of NPDES permits and the SWPPP. The SWPPP would specify Best Management Practices for construction activities that would minimize degradation of water quality resulting from runoff of stormwater and sediment from construction areas into adjacent water bodies.
- Wetlands would not be impacted by construction activities for the 100-turbine Project. Stream impacts would be limited to 380.4 m (1,248 lf) for the 100-turbine Project. When only underground collection lines cross perennial streams (i.e., no co-location of road crossings), all perennial stream crossings would utilize directional boring to avoid impacts. For intermittent or ephemeral streams, trenching would be done when the stream is dry, or directional boring would be used if there was water present. For road crossings, open bottomed culverts, elliptical culverts, or arched bridges would be used to avoid impacts to any high quality streams, specifically Ohio exceptional warm water habitat and cold water habitat streams. Crossing widths and clearing of wooded riparian areas for stream crossings would be limited to the minimum required for the crossing methods.
- Decommissioning measures would be identical to the commitments made for Project construction.
- The Applicant would adaptively manage the feathering speeds to maintain take of Indiana bats within the permitted level during Project operation. Adaptive management includes increased feathering of wind turbines if there are greater than 5.2 Indiana bat mortalities per year, or the option to decrease feathering if there are less than 5.2 Indiana bat mortalities per year. Cut-in speeds would increase incrementally as various mortality thresholds are met. Increased cut-in speeds would range from 5.0 (11 mph) to full curtailment, depending on the results of post construction monitoring during the summer, spring, and fall seasons (April 1 through October 31). Cut-in speeds could be incrementally reduced to the manufacturer specified cut-in speeds, depending on the results of post-construction monitoring, during the spring, summer, and fall months. The cut-in speeds and seasons are detailed in Chapter 6 of the HCP (Appendix B).

Additionally, the Project was developed consistent with the *Service Interim Guidance on Avoiding and Minimizing Wildlife Impacts from Wind Turbines* (USFWS 2003). Specifically, the following USFWS guideline recommendations were incorporated into the Proposed Action:

- *Avoid placing turbines near known bat hibernation, breeding, and maternity/nursery colonies, in migration corridors, or in flight paths between colonies and feeding areas.*

The Applicant commissioned several bat studies (i.e., mist netting, acoustic detection, radar, and swarming studies) to determine the location of any bat hibernacula, maternity colonies, migration corridors, and flight paths in the Action Area (Stantec 2008a and 2009). A Habitat Suitability Model and collision risk model (Appendices B and A of the HCP, respectively) for the Indiana bat was developed based on the Indiana bat survey results for the Action Area, other Indiana bat studies conducted in the Action Area vicinity, and the habitat in the Action Area in order to determine areas where impacts to this species would mostly likely occur.

- *Avoid fragmenting large, contiguous tracts of wildlife habitat. Where practical, place turbines on lands already altered or cultivated, and away from areas of intact and healthy native habitats. If not practical, select fragmented or degraded habitats over relatively intact areas. Minimize roads, fences, and other infrastructure.* For this Project, most (over 90%) turbines and associated facilities would be placed in agricultural fields and along the edge of small forest patches, and would avoid areas of native, intact habitat that have greater wildlife habitat value. Further, any state-required buffers around streams and wetlands would be followed in order to protect these resources, maintain connectivity to forest areas, provide foraging corridors for bats, and maintain Indiana bat movement corridors.
- *Develop a habitat restoration plan for the Project that avoids or minimizes negative impacts on wildlife while maintaining or enhancing habitat values for other species.* The Applicant would reseed all temporarily disturbed areas outside of active agricultural with a native seed mix in accordance with the Erosion and Sediment Control Plan and NPDES. Streams that are open-trenched will be restored to their pre-existing grade and revegetated with appropriate native riparian species. Temporary crossings and areas of temporary construction impact will be restored and re-vegetated per the Erosion and Sediment Control Plan, consisting of planting native plant species (see HCP Appendix D for a typical native plant mix) to provide ground stabilization. Where forest fragmentation results from construction activities, the areas will be restored using trees suitable for Indiana bat habitat, if practicable. A list of native trees suitable for planting to restore Indiana bat habitat is included in HCP Appendix D. If existing land-use precludes the use of native species (e.g. agricultural use), restoration and stabilization will be established consistent with that land-use.
- *Conduct post-construction monitoring during operation.* The Proposed Action includes a post-construction monitoring plan that would measure the effectiveness of the avoidance and minimization measures outlined above, and ensure that the Project does not exceed the allowable take of Indiana bats. Mortality searches would be conducted from April 1 to November 15 for a minimum of two consecutive years. The results of post-construction monitoring would be evaluated on an annual basis to determine whether adaptive management needs to be implemented to reduce impacts to Indiana bats. After the initial two consecutive years of mortality monitoring, post-construction monitoring would continue to occur at some level for the Project duration, never of a frequency of less than once every three years, with frequency and scope detailed in Section 6.5 of the HCP (Appendix B).

Indiana Bat

Construction-related Effects

Construction of the Project could affect Indiana bats through habitat loss and degradation and construction-related disturbance.

Habitat Loss and Degradation

A maximum 6.5 ha (16.1 ac) of forest would be removed for the construction of the full 100 turbines, and associated access roads, utility lines, and 61-m (200-ft) radius around the turbines that would need to be cleared. The loss of 6.5 ha (16.1 ac) of forest habitat comprises only 0.2 percent of available forest (2,744 ha or 6,779 ac) in the Action Area, and of that, about 3.2 ha (8.0 ac) of the forest that would be cleared is considered Category 1, 2, and 3 habitat for Indiana bat roosting or foraging activities (Figure 4.5-4).

The USFWS conducted a field visit on November 17, 2010 to assess Indiana bat habitat in eleven areas of proposed tree clearings for the 52-turbine Project. Six of the evaluated sites did not contain potential roost trees or maternity roost trees within the area proposed to be cleared.

The remaining five sites contained trees that may potentially be used for roosting by Indiana bats. The utility line crossing between Turbines 3 and 2 at the southern crossing of tree line (Site 2) contains one medium-sized potential roost tree next to the stream. Proposed clearing around Turbine 8 (Site 5) would impact the edge of a forested area with two potential roost trees located near the edge of the clearing area. Proposed clearing around Turbine 7 (Site 6) would impact a number of mature shagbark hickory trees that may serve as roosting trees and that would likely be removed. Proposed clearing for the access road between Turbines 37 and 41 and the radius around the two turbines (Site 9) would impact one large potential maternity roost tree. The tree is located in a forested area, and there may be additional potential roost trees found within the wooded area that may also be impacted by tree clearing. At Site 10, an access road between Turbines 11 and 16, multiple small potential roost trees and branches with peeling bark were observed along the edge of woods and in the forest. Some of these trees may be impacted by tree clearing.

For Site 2, the USFWS recommends avoiding impacts to the tree if relocation of the utility line is possible. Similarly, the USFWS recommends offsetting the clearing radius at Site 5 to avoid impacts to the wooded area and avoiding impacts to the woods containing shagbark hickory on the north side of Site 6 to the extent possible. A similar site visit and habitat evaluation will occur when the 48 additional turbine locations are determined, to recommend micrositing to avoid and minimize potential habitat impacts. Despite any micrositing that may be completed to minimize impacts to individual potential roost trees within the construction areas, the analysis in this EIS assumes that all 6.5 ha (16.1 ac) of forested habitat to be cleared, including any potential roost trees in those areas, will be permanently removed, and Indiana bats will no longer be able to use those areas.

The habitat suitability model for the HCP (Appendix B) classified all of the habitat in the Action Area into four categories, with Category 1 representing the most suitable foraging and roosting habitat for Indiana bats, and Category 4 representing the least suitable foraging and roosting habitat[4] (Table 5.5-2). No more than 3.2 ha (8.0 ac) of Category 1, 2, and 3 habitat for Indiana bat roosting or foraging activities would be removed for construction of the 100-turbine Project, representing 0.1 percent of the total 2,744 ha (6,779 ac) of total wooded areas in the Action Area.

Table 5.5-2. Areas Classified as Most to Least Suitable in the Habitat Suitability Model for Indiana Bats in the Action Area

Suitability Category	Total in Action Area ha (ac)	Percent of Action Area	Total Removed from Action Are Ha (ac)	Percent of Action Area Removed
1 (Most suitable)	4,016.1 (9,923.9)	12%	1.0 (2.5)	< 1%
2	2,973.9 (7,348.6)	9%	1.3 (3.3)	< 1%
3	2,856.6 (7,058.8)	9%	0.9 (2.2)	< 1%
4 (Least suitable)	22,505.4 (55,612.1)	69%	3.3 (8.2)	< 1%

Source: HCP Appendix B

Forest removal would be spread throughout the Project Area and is not expected to be extensive in any single area. Forest patches cleared would be small, with an average size of 0.2 ha ± 0.4 ha (0.4 ac ± 0.9 ac) and a maximum size of 1.1 ha (2.7 ac). The average size of tree clearing areas would be less than 0.2 ha (0.4 ac). The 1.1 ha (2.7 ac) forest patch is composed of ash, cottonwood, maple, and hawthorn trees of moderate age, with an understory of honeysuckle and hawthorn. This forest patch likely contains a number of potential Indiana bat roost trees.

The smaller forest patches range in age from young to mature, and include honey locust, cherry, cottonwood, willows, ash, maple, hawthorn, as well as some shagbark hickory and oak trees in certain forest patches. The forested stands generally include an understory layer that includes shrub species such as hawthorn, Osage orange, and honey locust.

Direct and indirect effects of removing roosting habitat

Although Indiana bats are known to exhibit site fidelity to individual roost trees (Callahan et al. 1997, Cope et al. 1974, Gardner et al. 1991, Humphrey et al. 1977, Murray and Kurta 2004, Sparks et al. 2005), they are also known to frequently shift from one roost tree to another in their home range. On average, Indiana bats switch roosts every two to three days, depending on female reproductive condition, roost type, and time of year (Kurta et al. 2002, Kurta 2005). Several studies have documented shifts in Indiana bat roosting activity of between 1.6 and 4.8 km (1.0 and 3.0 mi) (Kurta and Murray 2002, Tim Carter pers. comm.). In addition to roost switching, Indiana bat colonies can also shift their centers of activity across the landscape as resources change.

During their November 17, 2010 site visit, the USFWS identified five of the eleven forest patches that are proposed for removal for the construction of the 52 turbines as containing suitable roost trees for Indiana bats. The Applicant and the USFWS will conduct an additional site visit at the locations of the additional 48 turbines to identify and mark suitable roost trees as detailed Project planning progresses. Removal of an occupied roost tree while Indiana bats are

[4] Characteristics that best determined suitable foraging habitat were forest fragmentation, forest patch connectedness, and total core area of forested habitat, while characteristics that best determined suitable roosting habitat were distance to forested streams, distance to streams, and distance to forest edge.

present would likely result in the killing, injuring, or harassing of individual bats or potentially of multiple bats roosting together in a maternity roost tree. If an occupied primary roost tree is removed in the summer, nonvolant members of the colony would likely die, volant members of the colony could be killed if they did not escape in time, or would distribute themselves among several previously-used alternate roost trees, and the colony would become more dispersed (Service 2002; Kurta et al. 2002; Indianapolis Airport Authority 2003). The individuals from this displaced colony would experience increased stress from: (1) searching for a replacement primary roost tree(s) and depleting much-needed fat reserves; (2) roosting in alternate trees that are less effective in meeting thermoregulatory needs; and (3) roosting singly, rather than together, which decreases the likelihood of meeting thermoregulatory needs, thereby reducing reproductive success.

Roost tree removal could result in indirect impacts by depleting much-needed fat reserves while finding alternate roosts where Indiana bats can successfully rear young. However, roost trees are an ephemeral resource, as weathering, decay, and insect activity eventually makes roost trees less suitable over time (e.g., exfoliating bark eventually falls off or the snag falls over). It is likely that due to the ephemeral nature of roost trees, the Indiana bat has evolved to be able to locate replacement roosts when their previously-used roost trees become unsuitable. This may explain why, as mentioned above, Indiana bats have several roost trees, and they switch between these trees every few days.

The Applicant proposed to minimize tree clearing as much as possible, avoid tree clearing where there is high quality roosting habitat, delineate the areas where tree removal is necessary so that extra trees are not accidentally removed, flag potential roost trees and micro-site to preserve as many as possible, and retain the three known Indiana bat roost trees in the Action Area (described in Avoidance and Minimization Measures above). However, it is possible that the 6.5 ha (16.1 ac) of forest proposed for removal contains undocumented Indiana bat maternity roost trees or foraging areas that would be removed as a result of the Proposed Action. To avoid any direct impacts to Indiana bats resulting from the felling of roost trees, the Applicant would remove trees between November 1 and March 31, when Indiana bats are hibernating and so not present in the Action Area. Buckeye Wind will implement these measures to minimize or avoid impacts to Indiana bat roosts, resulting in negligible direct impacts on Indiana bats from removal of roosting habitat.

Indirect effects of removing foraging habitat and degradation of aquatic resources that serve as potential Indiana bat foraging habitat and movement corridors

Forest removal could negatively impact Indiana bats by reducing the amount of available foraging habitat, and increasing energetic costs for finding alternative foraging habitat. Individual Indiana bats would have to adjust to foraging habitat loss by adjusting the size or configuration of their foraging areas. Indiana bats using the affected forest areas for foraging would likely have to shift or expand their foraging ranges into areas previously unused by them to make up for the loss of foraging habitat.

However as noted above, the Project would result in a loss of a maximum of 6.5 ha (16.1 ac), or only 0.4 percent of the total 2,744 ha (6,779 ac) of total wooded areas in the Project Area. Impacts to foraging habitat in any one area would be minor, because forest would be removed in small patches as opposed to large blocks, and because clearing activities would be conducted when bats are not present. Considering the relatively small amount of habitat that would be lost with respect to the forest habitat that is available, and the small size of patches that would be removed, the adjustments in Indiana bat foraging ranges are not expected to result in physiological responses sufficient to cause death or injury, or to impair reproduction.

Aquatic resources are valuable foraging habitats for Indiana bats because there is high insect abundance associated with these resources, as well as drinking water. In addition, riparian corridors associated with aquatic resources are valuable movement corridors for Indiana bats, particularly when they are forested and when they provide connectivity to other forest areas.

Construction of the 100 turbines would impact no more than 380.4 linear m (1,248 linear ft) of streams, and could result in temporarily increased siltation and sedimentation to aquatic resources down-gradient of the area of disturbance. This would result in short-term declines in aquatic insect populations in adjacent wetlands and waterways, and corresponding localized prey reduction and water quality reduction. However, potential impacts from sedimentation are expected to remain near the source of sedimentation (e.g., roadway), and foraging Indiana bats would likely temporarily relocate upstream or downstream to forage. Implementation of construction best management practices would also minimize sedimentation. Furthermore, the diet of Indiana bats is not restricted to aquatic insects, since they also forage on terrestrial insects, and the surrounding landscape would continue to provide an abundant prey base of both terrestrial and aquatic insects during project construction. Therefore, any potential effects on Indiana bats from localized reductions in water quality are anticipated to be insignificant.

In addition, minor fragmentation of riparian wooded habitat potentially utilized by Indiana bat would occur at some stream crossings. For example, the utility line crossing between Turbines 2 and 3 would impact the narrow, two-tree wide riparian zone by creating a 7.6 m (25 ft) wide clearing. The riparian habitat contains large, mature trees and one potential roost tree in the clearing zone. In addition, the access road crossing between Turbines 37 and 41 would create a 16.8 m (55 ft) wide clearing in the riparian habitat of ash, cottonwood, maple, and hawthorn trees of moderate age. This riparian corridor leads to a larger forested area, over 80 ha (200 ac) in size, with fairly mature woods, good species diversity, and potential Indiana bat roost trees. Some studies indicate that Indiana bats will go out of their way to fly within a forested travel corridor instead of open area, but they can and will also cross wide open areas. Gaps of 7.6 – 27.4 m (25 – 90 ft) would not inhibit Indiana bat use of remaining tree lines as travel corridors since the remaining corridor would exceed 15 m (50 ft) in width (see Section 5.1.3.1 of the HCP for recommended minimum Indiana bat travel corridor width).

The Applicant would implement several measures to reduce or avoid impacts to aquatic resources: (1) Project components would not impact wetlands and stream impacts would be limited to a maximum of 32 stream crossings totaling 380.4 m (1,248 ft) for the 100-turbine Project; (2) construction activities would adhere to conditions set forth in the USACE permit, Ohio EPA WQC, NPDES permit, SWPPP, and any additional State or OPSB setback requirements; (3) an Erosion and Sediment Control Plan that includes use of appropriate runoff diversion and collection devices would be implemented; and (4) required collection line-only perennial stream crossings as well as exceptional warm and cold water habitat would be horizontally directional drilled to avoid unnecessary clearing of forested riparian areas. With implementation of these measures, and the limited area of impacted riparian habitat relative to the available habitat in the area, indirect impacts to Indiana bat aquatic foraging habitat and fragmentation of forested habitat would be minor.

Disturbance or Mortality Associated with Construction Activities

Project construction activities would occur during daylight hours throughout the year, although timing would favor non-inclement weather and activity would therefore likely be heaviest during the spring, summer, and fall. Construction activities for all 100 turbines would take place in one or two phases that would last for a period of 12 to 18 months each with possible overlap.

Direct impacts

Direct impacts to Indiana bats could occur if they collide with trucks or other moving equipment that is delivering material (e.g., turbine components and concrete) or constructing the turbines and electric interconnects. However, Indiana bat collision with construction vehicles would be unlikely because: (1) there would be a limited amount of additional traffic above existing conditions; (2) construction vehicles would be large, slow-moving, and easily avoidable by Indiana bats; and (3) construction activity and truck operations would be largely limited to daylight hours when Indiana bats are generally inactive. While there is evidence of Indiana bats being killed along highways, this is a very rare occurrence, and circumstances of these collisions were very different than those expected for the Project (Russell et al. 2008). Thus, Indiana bat mortality as a result of construction-related vehicle collision is considered unlikely.

Direct impacts to Indiana bats could occur as a result of Project construction activities, if the bats are disturbed by temporary increases in noise, human activity, and vibrations from construction equipment. Noise associated with Project construction would include sounds associated with diesel-powered earthmoving equipment such as irregular engine revs, back up alarms, gravel dumping, and the clanking of metal tracks (Hessler 2009). Construction would occur predominantly in agricultural areas where the sounds of tractors, trucks, and other agricultural machinery are commonplace. Indiana bats that currently inhabit the Action Area are likely already accustomed to roosting in proximity to loud noises and farming-related human activity.

Noise and vibration associated with construction activities could adversely affect nearby Indiana bat roosts. Individual bat disturbance levels would depend on several factors, such as noise level, vibration level, reproductive status, and nearby noise buffers. Noise levels from the construction activities would be intermittent, as equipment would be operated on an as-needed basis, mostly during daylight hours during the one or two phases of Project construction.

Some studies suggest that Indiana bats are tolerant of loud noises. For example, Indiana bats used roosts near Interstate 70 (I-70) and in close proximity to the Indianapolis Airport, including a primary maternity roost tree that was located 600 m (1,970 ft) south of I-70. In contrast, Callahan (1993) noted that a roost tree was abandoned after a bulldozer cleared brush in the area, and female bats in Illinois used roosts at least 500 m (1,640 ft) from paved roadways (Garner and Gardner 1992). Therefore, it is currently unknown but possible that noise and vibrations related to construction activities could result in short-term displacement to Indiana bats that roost near construction activities.

If roosting Indiana bats are disturbed by construction activities, previous studies suggest that they may be able to shift their activities to avoid the disturbance. As discussed above, Indiana bats frequently shift roosts, and have been known to shift their centers of activity in response to changing resources. Indiana bats have been documented shifting their centers of activity by up to 4.8 km (3.0 mi; Dr. Tim Carter, Ball State University, personal communication) and have been documented traveling up to 6.0 km (3.7 mi) between roosts (Carter 2003). Thus, Indiana bats can shift their activity centers relatively large distances when needed. Since construction activities at any one location are short term, Indiana bats may be able to resume use at these sites within the same season, and any disturbance would only be temporary in nature. Based on these data, it is reasonable to anticipate that Indiana bat colonies can shift to other suitable roost trees or foraging areas if they are disturbed during construction activities, and potentially return when activities have ceased.

In summary, construction-related disturbance would occur in one or two phases, each lasting 12 to 18 months (with possible overlap); the disturbance would occur predominantly in agricultural areas where noisy agricultural machinery currently operates; disturbance would not occur within 2.9 km (1.8 mi) of any known maternity colonies; and some Indiana bats have shown high tolerance levels to loud noise and vibration. Direct impacts resulting from Project-related construction activities could occur, but these impacts would be short-term and minor.

Operation and Maintenance-related Effects

Operation of the Project under the Proposed Action could affect Indiana bats during the summer maternity season as well as spring and fall migration season through direct collision-related mortality, barotrauma, disturbance, and displacement of Indiana bats from current roosting and/or foraging areas.

Collision Related Mortality

Direct Impacts

Impacts to bats from wind turbines are well documented (Johnson and Strickland 2003; Johnson et al. 2003; Kunz et al. 2007; Arnett et al. 2008; Horn et al. 2008), with migratory tree bats (primarily hoary, silver-haired, and eastern red bats) being the most affected, particularly during the late-summer through fall migratory period. Hoary bats have constituted the highest proportions of fatalities at most facilities, ranging from nine to 88 percent of all bat fatalities (Arnett et al., 2008). Some studies indicate that migratory tree bats may be attracted to both moving and non-moving wind turbine blades and that many bat kills occur during low-wind nights (less than 6.0 m/s [13 mph]) (Arnett et al. 2008). Numbers of *Myotis* species killed or injured at wind turbines are generally much lower than the migratory tree bats, although they made up nearly 25 percent of the fatalities at one facility in Canada and one in Iowa (Arnett et al. 2008). The Blue Sky Green Field wind facility in Wisconsin had 30 percent *Myotis* fatalities (Gruver et. al. 2009); 33 to 59 percent of fatalities were *Myotis* species at four different wind facilities in New York (Stantec 2010a); and about 14 percent of the fatalities at the Mountaineer Wind Farm in West Virginia were *Myotis* species (Johnson & Strickland 2004). Five instances of Indiana bat mortality at wind farms have been detected. The first Indiana bat (a *Myotis* species) mortality documented at a wind turbine occurred in fall 2009 at the Fowler Ridge Wind Facility in Benton County, Indiana. This likely was not the first time an Indiana bat had been killed at a wind facility – other Indiana bat mortalities probably went undetected due to lack of post-construction monitoring at many wind projects, inaccurate identification of the species, lack of detection due to small size of the species, decomposition of carcasses, or removal by scavengers. The first Indiana bat killed at Fowler Ridge was presumably a migratory bat and was not found near any known hibernacula or maternity colonies (USFWS Press Release at http://www.fws.gov/midwest/News/release.cfm?rid=177). The second Indiana bat fatality at Fowler Ridge occurred one year later around the same time in September and was also assumed to be a fall migrant (WEST 2011). A third Indiana bat fatality occurred at the North Allegheny Wind Facility in Pennsylvania, and like the Fowler Ridge incidents, happened in late September and was assumed to be a fall migrant (USFWS 2011b). The fourth Indiana bat fatality occurred on July 26, 2012 at the Laurel Mountain Wind Power facility near Elkins, WV. The fifth Indiana bat fatality occurred on the night of October 2, 2012 at the Blue Creek Wind Farm in Paulding County, Ohio.

Indiana bats could be injured or killed if individuals come in close proximity to wind turbines and suffer injury or mortality from collision or barotrauma. A collision risk model (Appendix A of the HCP) was developed to estimate mortality of Indiana bats as a result of Project operation. The collision risk model was based on best available scientific information and included site-specific, empirical data, as well as expert opinion and historical and current literature on Indiana bats. The collision risk model incorporated information on Indiana bat use of the Action Area, Indiana bat behavioral characteristics, weather conditions (i.e., wind speed and temperature), and wind turbine design and layout.

The collision risk model estimated Indiana bat mortality for three general periods in which Indiana bats display distinct behavioral characteristics that could influence their exposure to wind turbines: spring emergence and migration, or “spring” (defined as April 1 to May 31), summer habitat use, or “summer” (defined as June 1 to July 31), and fall migration and swarming, or “fall” (August 1 to October 31). Variation in weather conditions and other stochastic factors could affect the exact timing of this annual chronology. However, these periods are expected to adequately encapsulate seasonal behaviors that could differentially affect collision risk.

Collision Risk Model Results

Stantec estimated annual Indiana bat mortality (female, male, and unborn/non-volant juveniles) as a result of this project, by creating a collision risk model with three scenarios of Indiana bat flight height through the Action Area – low, moderate, and high. These three heights are described in detail in Appendix A of the HCP, but can be summarized as:

- Low flight height - 90 to 99 percent of Indiana bat flight activity in the Action Area occurs at less than 47.0 m (154.2 ft), and 1 to 10 percent occurs above 47.0 m (154.2 ft).
- Moderate flight height - 80 to 90 percent of Indiana bat flight activity in the Action Area occurs at less than 47.0 m (154.2 ft), and 10 to 20 percent of flight activity occurs above 47.0 m (154.2 ft).
- High flight height - 70 to 80 percent of Indiana bat flight activity occurs at less than 47.0 m (154.2 ft), and 20 to 30 percent of flight activity occurs above 47.0 m (154.2 ft).

The three flight height scenarios were developed to model the existing uncertainty regarding Indiana bat flight height above 50 m. Acoustic studies indicated that 99.9 percent of *Myotis* activity was recorded below 47 m (154 ft) (see HCP Appendix B, Section 2.4). This height was used to develop a baseline flight distribution of the proportion of activity expected below the rotor-swept zone (< 47 m), within the rotor-swept zone (> 47 m and < 153 m), and above the rotor-swept zone (> 153 m). This baseline flight distribution was used for the "low flight height." Moderate flight height and high flight height scenarios were derived by adjusting the proportion of the bats assumed to be flying within the rotor-swept zone upwards of the low flight height distribution indicated by acoustic studies conducted by Stantec (Appendix G).

As the highest blade tip position (i.e., rotor apex) of the wind turbines would be at 150.0 m (492.1 ft), and the lowest blade tip position would be at 50.0 m (164 ft), most of the Indiana bat activity would fly below the moving turbine blades in all three scenarios. This is based on the assumption that that non-linear flight occurs primarily during foraging, and foraging occurs primarily at or below tree canopy height. Median estimates of annual Indiana bat fatality for low, moderate, and high flight height scenarios ranged from 6.9 bats per year to 25.4 bats per year (Table 5.5-3). These estimates represent collision probabilities under operating conditions that do not include feathering and cut in speeds of turbines at low wind speeds. However, as discussed above in the Avoidance and Minimization Measures, feathering and cut in speeds would be applied to turbine operations with varying operational constraints as a condition of the HCP and associated Incidental Take Permit (ITP) (see Chapter 3 or HCP Section 6.2.3.1 for further discussion of the feathering plan).

Table 5.5-3 Estimated Indiana Bat Fatalities (Median Values) Under High, Moderate, and Low Flight Height Scenarios within the Rotor Swept Zone with No Operation Adjustment Applied to the 100-Turbine Project

Flight height scenarios	Mean Fatalities of Three Survival Scenarios			
	Spring	Summer	Fall	Annual
Low	2.4	0.1	4.4	6.9
Moderate	6.9	0.7	8.7	16.3
High	10.9	1.5	13.0	25.4

Use of feathering and cut-in speeds that would be implemented under the Proposed Action is expected to reduce fatality by 44 to 86 percent (see Table 5.4-3) based on reductions in mortality observed at three recent studies on the effectiveness of increasing cut-in speeds during periods of low wind (Baerwald et al. 2008, Arnett et al. 2010, Good et al. 2011).

Reductions in Indiana bat fatalities as a result of feathering have not been well documented, because only one Indiana bat fatality was reported in these operational adjustment studies. However, it is expected that similar reductions in mortality observed for migratory tree bats would be realized for Indiana bats. Under the most conservative assumptions (i.e., high flight height model and with the lowest expected reduction in fatality [44%]), the maximum potential annual take would be 14.2 Indiana bats per year (Table 5.5-4). Under the least conservative assumptions (i.e., low flight height model and with the highest expected reduction in fatality [86%]), the maximum potential annual take would be 1.0 Indiana bats per year. Using the moderate flight height scenario and the median reductions in mortality observed in feathering studies, total annual Indiana bat mortality, including adult females, adult males, and juveniles is estimated to be 5.2 Indiana bats per year. Buckeye has proposed that if estimated annual take is greater than 5.2 Indiana bats in any given year, take must not exceed 26 Indiana bats in the next four consecutive years, such that no more than 26 Indiana bats would be taken over the five consecutive year period. A maximum of 130 Indiana bats could be taken over the 30-year ITP term. Putting this mortality into context requires some knowledge of Indiana bat life-history characteristics and baseline information on population trends.

Table 5.5-4 Collision Risk Model-Predicted Annual Indiana Bat Mortality for the 100-Turbine Project with Expected Reductions From Feathering

Flight Height Scenario	Unadjusted Average Annual Mortality	Estimated Annual Mortality with Expected Reductions from Feathering		
		86.0%	68.3%	44.0%
Low	6.9	1.0	2.2	3.8
Moderate	16.3	2.3	5.2	9.1
High	25.4	3.6	8.1	14.2

Biological Significance of Collision Mortality

When evaluating the biological significance of Indiana bat mortality from the Project, it is important to consider their unique life-history strategies (Barclay and Harder 2003). Life-history characteristics of a given population determine the degree to which its viability is affected by increased mortality. Organisms whose populations are characterized by low birth rate, long life span, naturally low mortality rates (i.e., K-selected species, Pianka 1970), high trophic level, and small geographic ranges are likely to be most susceptible to cumulative, long-term impacts on population size, genetic diversity, and ultimately, population viability (McKinney 1997, Purvis et al. 2000, as cited in NRC 2007). Given the long lifespan of bats and their relatively low reproductive rate, loss of reproductive females can have significant impacts on the viability of the population.

Impacts to the Midwest Recovery Unit Population

Because of their long-standing endangered status and the ability to monitor their populations via hibernacula counts, there is fairly robust data on current and historical population levels of Indiana bats. The 2009 rangewide population of Indiana bats was estimated to be 415,512, and the 2009 population estimate for the Midwest Recovery Unit (Midwest RU) was 281,909. In 2009, the Midwest RU contained two-thirds (67.8%) of the rangewide Indiana bat population. By 2011 the estimated rangewide population increased by about 2.2% to 424,708, and the Midwest RU population increased by 8.3% to 305,297 (USFWS 2012a).

The loss of up to 5.2 Indiana bats per year represents 0.002 percent of the 2011 Midwest RU population. Over the 25-year life of the Project, loss of 5.2 bats per year would result in a total of 130 Indiana bat fatalities, or 0.04 percent of the Midwest RU population in 2011. This represents a conservative estimate because it does not take into account the reproductive potential of the current population over the next 25 years. Thus, at current population levels it is not anticipated that the Project would result in long-term effects that would substantially reduce the viability of Indiana bats within the Midwest RU. However, if the Midwest RU Indiana bat population were substantially reduced as a result of white-nose syndrome or other causes, this level of mortality could have greater implications for the viability of the population. Therefore, the Applicant has committed to reducing requested five-year take limits by 50 percent (i.e., 2.6 Indiana bats per year, 13.0 over five years) if the population of Indiana bats in the Midwest RU is reduced by 50 percent or more from 2011 pre-WNS mortality levels. The reduction in take should the population decline due to WNS would proportionately reduce the impact on overall population numbers, and therefore impacts of Project-related take are highly unlikely to significantly impact the Midwest RU population under predicted WNS scenarios.

Impacts to Summer Maternity Colonies

If multiple adult female bats were lost from a single maternity colony, there could be negative impacts that could lead to harm or mortality of other individuals, such as reduction in thermoregulatory benefits or loss of colony cohesiveness. Female bats in late pregnancy and their pups are poor thermoregulators (Speakman and Thomas 2003, as cited in USFWS 2007). Clustering within maternity colonies helps to maintain roost temperatures favorable for prenatal and postnatal development (USFWS 2007). Therefore, if colony size was appreciably reduced, there is a potential for roost temperatures to be reduced and for prenatal and postnatal growth to be slowed (Racey and Swift 1985). What constitutes an appreciable reduction depends on the size of a given maternity colony, which has been found to vary greatly. As such, the available literature does not cite a specific threshold at which viability of a colony would be compromised.

The summer population in the Action Area is estimated to be 435.5 bats, and there are two known maternity colonies. All Category 1, 2, and 3 habitat was assumed suitable for Indiana bats, and Indiana bats were assumed to be distributed throughout the Action Area wherever suitable habitat occurs. It is important to understand the long-term biological significance of sustained annual take of Indiana bats during Project operation. Impacts to local maternity colonies, assuming losses to the population under the one-year take estimate and five-year take limits projected over the operational life of the Project (i.e., 25 years), were modeled using expected and worst-case scenarios (Table 5.5-4).

The expected scenario is one in which take of 5.2 Indiana bats occurs in each year (based on collision risk model results for the moderate flight height scenario and the median reductions in mortality observed in feathering studies—see Table 5.5-4), and take of 26.0 Indiana bats occurs over a consecutive five-year period. The worst-case scenario is one in which the maximum allowable take occurs as quickly as possible during a consecutive five-year period. In the worst-case scenario take of 14.2 Indiana bats occurs in the first year (based on collision risk model results for high flight height and lowest (44%) observed reduction in mortality from feathering; see Table 5.5-4), and take of 11.8 Indiana bats occurs in the second year, and no take occurs in years 3, 4, or 5. This also results in take of 26.0 Indiana bats over a consecutive five-year period. In either scenario, take of Indiana bats would include adult males, adult females, and juveniles, and would likely be distributed throughout spring, summer, and fall. A portion of the Indiana bats taken during the spring and fall migration periods would likely be from areas outside of the Action Area, while a portion of the Indiana bats taken during the spring and fall migratory periods and all Indiana bats taken during the summer would likely be from local maternity colonies within the Action Area.

Based on the number and sex of Indiana bats expected within the Action Area during various seasons (see HCP Section 5.1.2.7.1 and Table 5-9a), 44 percent of total Indiana bat take was attributed to bats that summer within the Action Area ("local Indiana bats"). This equates to take of 2.3 local Indiana bats each year in the expected scenario, or 3.1 local Indiana bats in year 1 and 2.4 taken in year 2 in the worst-case scenario (Table 5.5-4). Only a portion of the local Indiana bats taken are females (see HCP Section 5.1.2.7.1 and Table 5-9a). Approximately 48 percent of the mortality that occurs to local Indiana bats is composed of adult females (the remainder are adult males or juveniles). Annual mortality of local adult female Indiana bats is expected to range from 1.1 bats per year (expected scenario) to 3.1 bats per year (worst-case scenario) (Table 5.5-4). This mortality equates to an estimate that up to 27.5 local adult female Indiana bats from maternity colonies within the Action Area would be taken over the 25-year operational life of the Project. A detailed description of modeling conducted to determine potential impacts to maternity colonies can be found in Section 5.7.2.7 of the HCP.

Table 5.5-4 Expected and Worst-case Scenarios of Total Local Indiana Bat and Local Adult Female Indiana Bat Mortality Over a 5-year Period for the 100-Turbine Project

	Expected Scenario*		Worst-case Scenario**	
Year	Total Local Indiana bat Mortality	Local Female Indiana bat Mortality	Total Local Indiana bat Mortality	Local Female Indiana bat Mortality
1	2.3	1.1	6.2	3.1
2	2.3	1.1	5.3	2.4
3	2.3	1.1	0	0
4	2.3	1.1	0	0
5	2.3	1.1	0	0
Total	11.5	5.5	11.5	5.5

*Assumes take of 5.2 Indiana bats per year based on Collision Risk Model results for moderate flight height and median (68%) reduction in mortality from feathering.

**Assumes maximum take allowable occurs as early in project operation as possible. Assumes take of 14.2 Indiana bats in the first year based on Collision Risk Model results for high flight height and lowest (44%)_observed reduction in mortality from feathering, and take of 11.8 Indiana bas occurs in year 2, with no take in years 3-5.

Indiana bat maternity colony size in the Action Area, based on the average of two cumulative emergence counts in or in proximity to the Action Area is estimated to be about 70 Indiana bats (Stantec 2010). The Buckeye Wind HCP evaluated the impact of take of local adult females on the local maternity colonies using the Leslie Model (Leslie 1945, see Section 5.1.2.7.1 of the HCP). Given assumptions about the starting population size, proportion of annual take attributed to local adult females each season, (see Section 5.1.2.6.1 of the HCP), and parameters provided by the USFWS, estimated Project-related mortality of local adult females is not expected to reduce the long-term viability of a single local maternity colony, even if all take of local females occurred within that single maternity colony. This was true for both the "expected scenario" and "worst-case scenario." No turbines would be sited closer than 2.9 km (1.8 mi) from the known roosts.

Based on the habitat suitability model, there are 6,989.93 ha (17,272.5 ac) of Category 1 and 2 habitat (i.e., the top two highest habitat suitability classes for Indiana bat roosting and foraging activities) in the Action Area. This high suitability habitat occurs throughout the Action Area, but is concentrated in the northern, southern, and eastern portions (Figure 4.5-4). While some turbines are located in closer proximity than others to high suitability habitat, the tiered feathering plan (discussed in Section 3.1.2) based on the results of the habitat suitability model is expected to account for any potential differences in risk exposure. Additionally, avoidance and minimization measures that are part of the HCP and discussed in Section 5.5.2 include adaptive management based on post-construction monitoring results. Monitoring data would provide sufficient information to detect disproportionately high mortality at individual turbines, and if necessary the Applicant would employ adaptive management, such as increased turbine feathering, to bring mortality within the limits of take allowed by USFWS.

When considering the potential effects of total annual mortality on maternity colonies in the Action Area or in other areas in the Midwest RU, it is important to consider that 58 percent of the estimated adult female mortality (i.e., 1.1 adult female Indiana bats under the Proposed Action) is expected to occur during the fall migratory period (see Appendix B, Section 5.1.2.7.1). Given that up to 5,800 Indiana bats are estimated to travel through the Action Area during migration from up to 575 km (357 mi) away, there is a high probability that Indiana bats killed during migration would be from multiple maternity colonies in different geographic areas. While it's possible that some summer resident bats migrating from the Action Area to their winter hibernacula would be killed en route, it is highly unlikely that all migrating individuals would be those belonging to maternity colonies in the Action Area. Thus, while the Project would result in some take of Indiana bats, it would not result in substantial adverse effects on Indiana bat summer populations in the Action Area. However, given the rate of spread of WNS and the impact it is having on bats in general and Indiana bats in particular, the impact to the maternity colony could become proportionally greater should the total population numbers decrease as a result of WNS. Therefore Buckeye has committed to reducing take by 50 percent should WNS result in population declines within the Midwest RU of 50 percent from the 2011 pre-WNS mortality population level.

The USFWS will be fully evaluating the impact of the taking in a Biological Opinion, which would be finalized prior to the issuance of the ROD, to document whether or not the Project would jeopardize the species, meaning it would not "reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of the species" (50 C.F.R. § 402.02).

Disturbance and Displacement

Direct impacts from noise, from operating turbines

Indiana bats could be directly impacted by noise emitted from operating turbines. Kunz et al. (2007) suggested that bats may become acoustically disoriented upon encountering turbines during migration or feeding, although observations of bat flight activity using thermal infrared (TIR) cameras at wind energy facilities suggest that bats are able to fly and forage normally in close proximity to wind turbines (Ahlén 2003 as cited in Kunz et al. 2007, Horn et al. 2008).

Indiana bats could also be attracted to and thus directly impacted by turbine noise. Some bat species are known to orient toward distant audible sounds (Buchler and Childs 1981 as cited in Kunz et al. 2007). Few empirical data exist regarding the potential attraction of bats to turbine noise. Szewczak and Arnett (2006) studied ultrasound emissions from a variety of wind turbines as a potential attractant to bats and concluded that ultrasound emissions, as measured from the ground-level, do not likely play a significant role in attracting bats toward wind turbines with consequential fatalities from rotor strikes. However, the authors cautioned that ultrasound could be emitted from turbines not tested during their investigation or from turbine nacelles. The results of the Szewczak and Arnett (2006) study are consistent with the common sense logic that if bats were attracted to sounds produced by turbines, it is likely that summer resident bats would be killed as frequently as bats during the fall migratory period, which is not the case.

Along similar lines, Indiana bats could be directly impacted if they are deterred from turbine noise. If this is true, then the noise would further reduce bat mortality at wind turbines, which would be beneficial for the overall species survival. However, as every well-studied operating wind facility has documented bat mortality during the fall migratory period, it is clear that turbine noise does not completely deter bats from the area, at least not during the fall migratory season. Furthermore, studies such as Ahlén's 2003 TIR study (mentioned above) have not shown any noticeable bat deterrence around turbines. Therefore, noise from the turbines is not expected to directly impact Indiana bats through either attraction or deterrence.

Indiana bats could be indirectly impacted if turbine operating noise results in decreased foraging success in proximity to the wind turbines, as a result of turbine noise muddling their echolocation calls. This is unlikely, given the fact that bats successfully echolocate when amongst millions of other echolocating bats. Furthermore, if turbine noise does decrease Indiana bat foraging success, then it is assumed that the bats would quickly leave the area of turbine noise disturbance. Thus, turbine noise is not expected to result in decreased foraging success of Indiana bats.

Direct impacts of lighting, from operating turbines

FAA lights that would be installed on some of the turbines are not expected to increase collision/barotrauma mortality or have any direct or indirect effects on Indiana bats. Arnett et al. (2008) synthesized available information on bat fatalities from 21 studies conducted at 19 wind energy facilities in five regions of the United States and one province in Canada. None of the studies reviewed demonstrated statistically significant differences in fatality between turbines equipped with FAA lights and those that were unlit. Further, Arnett (2005) studied bat activity and fatalities at the Mountaineer facility in West Virginia and at the Meyersdale facility in Pennsylvania and found that turbines with FAA lights did not appear to affect the incidence of foraging bats around turbines and there was no difference between numbers of bat passes recorded with acoustic detectors at lit and unlit turbines. Additionally, bat fatalities documented at the Mountaineer and Meyersdale facilities were not different between turbines equipped with FAA lights and those that were unlit. Finally, Horn et al. (2008) used TIR cameras to study behavioral responses of bats to operating wind turbines and concluded that aviation lighting did not appear to affect the incidence of foraging bats around turbines. However, controlled studies comparing fatalities at red and white FAA lights have not been conducted and response to white lights is unknown (Arnett 2008).

In addition to FAA lights, there may be a limited number of security lights required at the substation and O&M facilities. However, the Applicant would take steps to minimize any potential impacts associated with these lights by minimizing the amount of time these are lit, using motion-activated sensors, and shielding the light from being projected upward into the night sky. Direct impacts from lighting would be minor.

Direct impacts from displacement, from operating turbines

Indirect effects to Indiana bats could result if they are displaced by Project operation and suffer energetic losses associated with finding alternate roosts, foraging areas, or migratory routes. It is not known whether Indiana bats would be displaced by operating wind turbines, but limited data suggest that bats in general may become habituated to their presence. Observations of bat flight activity using TIR cameras at wind energy facilities have documented bats flying and foraging in close proximity to wind turbines and even investigating spinning turbine blades (Ahlén 2003, Horn et al. 2008). Also, the continuous bat fatality records for many wind facilities indicate that displacement is not occurring.

Migrating Indiana bats could be displaced if their regular migratory routes pass through the Action Area and they are forced to take an alternate route to avoid the Project. However, there is currently no empirical data to support this assumption. Further, if migrating bats fly low enough to the ground, they would not have to circumvent wind facilities to avoid turbines (there is relatively little information regarding the migratory height for Indiana bats). Even if Indiana bats do not typically fly below the rotor swept zone during migration, any energetic costs associated with having to circumvent the Project, which is approximately 16 km by 19 km (10 mi by 12 mi) at its widest points, would not be a substantial barrier to migrating Indiana bats that typically travel hundreds of miles during the course of their migrations. However, the possibility that Indiana bats would be forced to circumvent the Action Area is unlikely, because turbines are spread widely and occur somewhat randomly across the Action Area, rather than being arranged in a grid pattern. Thus, it is probable that a bat could readily fly across the Action Area without encountering a turbine. For these reasons, Indiana bats are not expected to avoid the Action Area and associated energetic costs or other indirect effects would have less than significant effects on this species.

Decommissioning-related Effects

Impacts on Indiana bats associated with decommissioning activities would be the same as for construction, which is minor or unlikely to occur. The impacts would be intermittent, short-term, and localized. Avoidance, minimization, and mitigation measures would be employed for the decommissioning activities, including reestablishing plant communities in accordance with the NPDES permit and Erosion and Sediment Control Plan in order to minimize habitat-related impacts. Decommissioning activities could occur as early as 2037.

Conservation Measures

In cooperation with the USFWS and ODNR Division of Wildlife, the Applicant would implement one or a combination of the following conservation measures to advance the knowledge base of the Indiana bat and wind energy interactions:

- Providing funding to a qualified research program to conduct research on Indiana bat behavior relative to operating wind turbines.
- Providing funding to a qualified research program to conduct fall migration telemetry studies at Indiana bat hibernacula in Ohio, where landowner permission allows. Results of the research would be incorporated into the adaptive management of the Project, where appropriate.

- Wing and Hair tissue samples from each dead bat found during post-construction mortality monitoring may be collected to support USFWS-requested research projects by entities other than Buckeye Wind. Wing tissue and hair samples would be collected and stored following USFWS recommended protocol at the time of collection. Specimens would be stored such that details on the individual bat from which samples were collected are known (either store data sheet with sample, or cross reference sample to database of mortality records). Specimens would be provided to USFWS on a periodic basis, to be determined at the start of each post-construction monitoring period. Collection of specimens will not affect the subsequent use of the carcasses for searcher efficiency or carcass persistence trials.

Other Listed Species

As summarized in Section 4.5 and Table 4.5-1, other federal and state-listed threatened and endangered species with the potential to occur in or migrate through the Action Area were considered in this EIS in addition to the Indiana bat including two aquatic species, one reptile, and six birds.

Aquatic species

The rayed bean mussel (*Villosa fabalis*) is a federal and Ohio endangered species, and the western tonguetied minnow (*Exoglossum laurae*) is an Ohio threatened species that may occur within the Action Area.

The Action Area lies within the range of the rayed bean, a freshwater mussel species currently listed as endangered both federally and by the State of Ohio. Suitable habitat for the rayed bean is still thought to be present in Champaign County. The rayed bean is generally known from smaller, headwater creeks, near shoal or riffle areas of rivers, and in the shallow, wave-washed areas of lakes. The rayed bean is known to occur in the Big Darby Creek watershed, of which Little Darby Creek is a tributary. Portions of the Little Darby Creek that could be impacted by road and utility line crossings associated with the Project are ephemeral and do not contain features necessary to support mussel populations (Hull 2010). A field assessment in November 2008 found the stream reach for this part of Little Darby Creek did not have the required perennial base flow or preferred substrates of the rayed bean. Additionally, the rayed bean is often associated with the root masses of aquatic plants, which are not present in this reach (Hull 2009e).

The rayed bean has the potential to occur in other perennial streams with suitable habitat within the Action Area. For perennial stream corridors where suitable habitat exists, mussel surveys may be done to determine the presence or probable absence of the species. If rayed bean are determined to be present, in-water work would be avoided either through directional drilling, access road re-routing, arched bridge structures or temporary crossings (see Section 5.2.1.2 of the HCP). Additionally, the Applicant would directionally drill beneath or otherwise avoid in-water work for any designated exceptional warm water or cold water habitat streams in the Action Area. If no mussel survey is performed, presence of rayed bean would be assumed and in-water work would be avoided as if rayed bean was determined to be present. No impacts to the rayed bean are anticipated.

The Action Area lies within the range of the western tonguetied minnow, a freshwater fish currently listed as threatened by the State of Ohio. The western tonguetied minnow may be found in the Mad River and tributaries of it in the Great Miami River system. This species is very intolerant of turbid (murky) waters and needs a clean gravel and pebble stream bottom. They also rely on forested and undercut stream banks, and alternating riffle pool sequences. Lastly they may need somewhat cooler water temperatures than the average Ohio stream has in summer.

As described in Section 5.2.2, impacts to streams will be avoided and minimized such that not more than 32 stream crossings totaling not more than 380.3 linear m (1,248 linear ft) of impact would result for the 100-turbine Project. Further, direct impacts to designated exceptional warm water habitat and cold water habitat streams would be avoided. Ephemeral or intermittent streams would be unlikely to support this species. Proposed impacts to perennial streams would generally consist of culverts for roads or trenching for collection lines, and would be temporary and localized. Best management practices associated with NPDES permits and USACE Permits would further minimize impacts from sedimentation and runoff in perennial streams. Based on the limited proposed impacts to suitable habitat for this species and the fact that this species may not even occur in the waterbodies potentially affected by the Project, impacts on this species from the project would be minor or nonexistent.

Reptiles

The Action Area also lies within the range of the eastern massasauga rattlesnake (*Sistrurus catenatus*), a federal candidate species and state-listed endangered species. The eastern massasauga uses both upland and wetland habitat at different times during the year, and therefore requires wetland areas immediately adjacent to upland grassland. Early successional herbaceous or scrub-shrub wetlands are used primarily during the fall, winter, and spring. During the winter, massasaugas hibernate in low wet areas, primarily in crayfish burrows, but may also use other structures. The presence of a water table at or near the surface is an important component of a suitable hibernation area. During the summer, male and non-gravid female massasaugas use open, upland grassland or prairie habitat that may be intermixed with scattered trees or shrubs. Adjacent lowland and upland habitat, with variable elevations between, are critical as the snakes travel back and forth seasonally between habitats.

There are no known occurrences of eastern massasauga rattlesnakes in the Action Area (M. Seymour, USFWS, personal communication). However, the species is known to occur outside of the Action Area at sites in Champaign and Clark counties (M. Cota, USFWS, personal communication). A desktop assessment revealed that the majority of the wetlands present in the portion of the Action Area do not have any adjacent grassland, and at those sites that do, the grassland present is very limited. The only potential suitable habitat in the Action Area was a 20 ac wetland, and a habitat evaluation was conducted by USFWS and eastern massasauga experts on 10 January 2012. It was determined that this 20 ac wetland contains suitable habitat for the eastern massasauga. A proposed access road near the wetland was subsequently relocated, and as a result, no proposed Project activities or infrastructure would impact this wetland, nor would loss of potential habitat occur as a result of the Project. A 50-foot setback of the access road from the wetland was deemed appropriate because none of the wetland or adjacent natural vegetation would be impacted, and the road would be entirely within active agricultural fields which would not provide suitable massasauga habitat. Furthermore, once the project is operational there will only be minimal traffic on the road associated with maintenance of the wind facility, the road will be gated to prevent unauthorized access, and signage will be posted to keep maintenance vehicles alert to speed limits and wildlife crossings. Collectively, these actions make roadkill mortality unlikely to occur during operation.

In order to avoid potential impacts to the eastern massasauga, a presence/absence survey approved by the USFWS and ODNR DOW may be conducted at the wetland. If no eastern massasaugas are detected during the survey, no further avoidance and minimization measures would be necessary. If presence is detected, or if a survey is not conducted before Project construction, presence of eastern massasaugas would be assumed. The Applicant would minimize the potential for construction, operation, and decommissioning-related impacts to eastern massasaugas near this specific wetland by implementing the following measures:

- To the extent practicable, all construction and decommissioning activities would be conducted between November 15 and March 1. If earth-moving activities occur after March 1 and before November 15 a USFWS and ODNR DOW approved and state-permitted herpetologist would be present to survey for snakes during earth-moving activities. If earth-moving activities occur between November 15 and March 1, the ODNR DOW permitted herpetologist would not be present.
- Any temporary ground disturbance for construction activities, as well as any construction of crane paths or buried or overhead interconnect would occur at least 15 m (50 ft) from the delineated wetland.
- Buried silt fences would be installed during construction and decommissioning between the planned Project facilities and the eastern massasauga habitat. These silt fences would be located at least 12 m (40 ft) from the wetland.
- A USFWS and ODNR DOW approved and state-permitted herpetologist would survey for snakes during installation of the silt fencing to ensure there are no eastern massasauga present that could be impact. If installation of the fencing occurs between November 15 and March 1, the ODNR DOW permitted herpetologist would not be present.
- Within one half-mile around the wetland, speed limits would be maintained at 10 mph and signs alerting drivers of a wildlife crossing would be posted.
- Gates would be installed at the access point from public roads onto the access roads in proximity to the wetland.
- Construction and O&M personnel would be trained on the appearance, protected status, and proper avoidance of the massasauga. Any snake that cannot be positively identified as *not* being an eastern massasauga would be immediately reported to the site manager.
- If an eastern massasauga is encountered or suspected in the Action Area during construction, operations and maintenance, or decommissioning, all work in or near the location of the eastern massasauga encounter would stop, ODNR DOW and USFWS would be contacted immediately for further direction, and a permitted and approved herpetologist would be immediately notified to ensure no potential risk to the snake or Project personnel occurs

With implementation of all of the avoidance and minimization measures outlined above, construction, operation and maintenance, and decommissioning of the Project is not likely to adversely affect the eastern massasauga. Any potential impacts to this species would likely be insignificant and discountable.

Birds

Chapter 4 identifies several state-listed threatened and endangered species with potential to occur in the Action Area: black-crowned night heron (Ohio threatened species), loggerhead shrike (Ohio endangered species), northern harrier (Ohio endangered species), peregrine falcon (Ohio threatened species), upland sandpiper (Ohio endangered species), and sandhill crane (Ohio endangered species).

Four sandhill cranes were documented in the aforementioned surveys by Stantec. Sandhill cranes are diurnal migrants, so their collision risk may be less, as collision risk has been found to be greatest for nocturnal migrants traveling in inclement weather (NRC 2007). The loggerheaded shrike has not been documented by any Breeding Bird Surveys, although there is one breeding record in the past 30 years within a five county radius of the Project. There is very marginal habitat for this species in the Action Area and it is not expected to regularly occur. Two black-crowned night heron were observed during the Breeding Bird Survey, although no nesting was observed.

Stantec observed the northern harrier (five in spring, four in fall) during their 2008 surveys, but did not identify any nests for this species, and the Ohio Breeding Bird Atlas does not have records for this species breeding in the proposed Action Area. Tree removal would occur November 1 through March 31, and thus would avoid most of the forest nesting bird season (nesting season is generally considered to be February 1 through August 31). Further, CRP land will be cleared only during the non-breeding season for grassland birds (before March 1 and after July 15). Therefore, Project construction is not expected to have significant impacts on Ohio threatened and endangered bird species.

Birds could be impacted during the proposed Project operation, and state-listed species have been observed within the Action Area. Thus, it is possible that state-listed species that infrequently migrate through the Action Area could be injured or killed by operational turbines. However, none of the state-listed species are species most commonly found as collisions at wind turbines or found in large numbers during episodic collisions (see discussion in Section 5.15.4), and individual state-listed species are only rarely observed within the Action Area (see Table 4.5-1), therefore overall collision risk to state-listed birds is low in this Alternative. The likelihood of substantial adverse impacts to state-listed species is also low. In the event that mortality of a state endangered or threatened species is documented, ODNR DOW would be immediately notified and appropriate next steps would be discussed. Results of post-construction monitoring for all bird and bat species will be provided to USFWS and ODNR DOW on a seasonal and annual basis. The Applicant would avoid and minimize the potential of operation-related impacts with the following measures:

- Using a design that doesn't support roosting or perching (e.g., tubular supports with pointed tops rather than lattice supports).

- Burying collector lines wherever feasible to minimize the potential risk of electrocution to raptors and other birds. Half of the 113.5 km (70.5 mi) of 34.5-kV interconnects for the 100-turbine Project would be buried underground.
- Equipping above-ground collector lines and distribution poles with insulated and shielded wire to avoid electrocution of raptors and other birds. All above ground electrical facilities would be designed in accordance with the APLIC guidelines developed jointly with the USFWS (APLIC 2006) where possible, and as dictated by Dayton Power and Light (DPL) construction guidelines[5].
- New distribution poles, where possible and as dictated by DPL construction guidelines, would be designed and maintained so that they are insulated in order to protect raptors from electrocution for, at least, the duration of the ITP.
- Permanent MET towers would be non-guyed, free-standing structures.
- Should insulating of lines associated with new poles not be possible, perch deterrents would be installed to prevent raptor (including eagle) perching activity.
- Implementing measures to avoid and reduce scavenging opportunities for raptors around the turbine locations by removing carcasses from access roads and turbine pads.
- Minimizing operational and FAA lighting to the maximum extent practicable to reduce attraction of birds. Any ground-based lighting at the turbines or substation necessary for safety or security would be controlled by motion detectors or infrared sensors.
    - Approximately one in every five turbines would be lit, and all lights within the Project would illuminate simultaneously.
    - Lights are anticipated to be flashing strobes that only operate at night.
    - To the extent possible, USFWS recommended lighting schemes would be used on the nacelles, including reduced intensity lighting and lights with shorter flash durations that emit no light during the "off phase".
    - MET towers would use the minimum lighting as required by the FAA.
    - No steady burning lights would be left on at Project buildings. Where lights are needed for safety or security, motion detector lighting or infrared sensors would be used.

With implementation of these measures, operation-related impacts on Ohio threatened and endangered birds would be minor.

Mitigation Measures for Unavoidable Impacts

In cooperation with the USFWS and ODNR Division of Wildlife, the Applicant would implement the following mitigation actions to further the recovery of the Indiana bat:

[5] While the Applicant would own the wires that carry electricity from the turbines, the above ground collection lines and distribution poles would be owned and maintained by DPL, and subject to DPL construction guidelines. While it is likely that DPL would utilize APLIC guidelines or similar, and the Applicant would encourage the use of APLIC guidelines, it is not possible to guarantee such measures.

1. Acquiring or otherwise providing protection to 87.8 ha (217.0 ac) of suitable Indiana bat swarming habitat within 11.2 km (7 mi) of a P2 Indiana bat hibernaculum in Ohio, either through acquisition of conservation easements into perpetuity or purchase of the property and then assigning conservation easements in perpetuity.
    A. Within the easement areas, restoring travel corridors between woodlots and/or along stream corridors to increase availability of suitable Indiana bat habitat through enhanced connectivity.
    B. Within easement areas, enhancing and restoring suitable habitat through ensuring an adequate number of suitable roost trees and through managing woody invasive species.

    OR

2. Buying credits from an USFWS-approved Indiana bat mitigation bank whose geographical range service area includes the Project (see Section 7.3.4 – Change in Mitigation Acres).

If avoidance and minimization measures are found to be ineffective at reducing impacts to other state-listed bird and bat species, and mortality continues to exceed acceptable levels, the Applicant will consider mitigation options including, but not limited to, the following actions to offset impacts:

1. Contribute to funding for protection, enhancement or restoration of habitat which is of particular importance to the impacted species.
2. Contribute to funding of on-site or off-site research, such as bird displacement studies or acoustic bat studies to better understand the specific Project design, environmental, or behavioral factors contributing to mortality.
3. Contribute to funding of off-site research that would contribute to knowledge of survival or breeding success of the impacted species.
4. Contribute to funding for retrofitting of communication towers with bird flight diverters on guy lines, and/or retrofitting communication towers with lighting schemes that are less of an attraction to nocturnal migrants.
5. Contribute to funding for the installation of off-site nesting platforms or nest boxes to increase breeding success of the impacted species.
6. Other, unknown mitigation measures, determined in coordination with ODNR DOW and USFWS, which may satisfy a recently discovered (previously unforeseen) need in the area.

The specific measures to be taken would be developed in cooperation with ODNR DOW and the USFWS, would consider the best available science, and would occur in Ohio. The amount of funding available would be commensurate with the level of mortality relative to the thresholds and will not exceed $100,000 for the life of the Project. It should be recognized that there are adaptive management and mitigation measures outlined in the HCP that are geared toward mitigating impacts to Indiana bats, such as conservation and restoration of forested habitat and turbine feathering, that will coincidentally benefit other species of bats and birds. Any measures employed through the HCP will also be considered as mitigation measures to the extent that the Indiana bat mitigation also provided benefits to the affected species.

5.5.2.1 Redesign Option

The Redesign Option is an optional measure under the Proposed Action that includes a primarily buried collection system. The different collection system would affect threatened and endangered species similarly to the Proposed Action. In the Redesign Option, no more than 6.8 ha (16.8 ac) of wooded habitat would be removed for the 100-turbine Project. Of this, 3.3 ha (8.2 ac) is considered Category 1, 2, and 3 habitat for Indiana bat roosting or foraging activities, which is only 0.1 ha (0.25 ac) more than the Proposed Action. Only 1.1 ha (2.6 ac) of Category 1 habitat would be removed. This represents 0.1 percent of the total 2,744 ha (6,779 ac) of total wooded areas in the Action Area and 0.5 percent of the average home range of Indiana bats in the area. Because Indiana bats regularly shift roosts and their centers of activity, and members of a maternity colony are known to have multiple roost sites, it is likely that removal of 6.8 ha (16.8 ac) of the 2,744 ha (6,779 ac) of wooded habitat available in the Action Area including a small number of potential roost trees would not result in indirect effects on Indiana bats resulting from increased energy expenditure or lost reproductive fitness. The Redesign Option would impact a maximum of an additional 106.7 m (350 ft) of streams. The difference in impact is small in comparison with the total linear feet of streams in the Action Area, and is not expected to have greater impact on Indiana bats than the Proposed Action. For these reasons, indirect effects from the additional tree clearing and stream crossings associated with the Redesign Option would not result in substantially different impacts to the Indiana bat than the Proposed Action.

Impacts to listed species of aquatic species, reptiles, and birds are expected to be similar to those described for the Proposed Action. Construction of the 100 turbines under the Redesign Option would impact no more than 487.1 linear m (1,598 linear ft) of streams (an additional 106.7 linear m [350 linear ft] over the Proposed Action without the Redesign Option), and could result in increased siltation and sedimentation to aquatic resources down-gradient of the area of disturbance.

5.5.3 Alternative A- Maximally Restricted Operations Alternative

Alternative A differs from the Proposed Action in that it would employ operational restrictions that would eliminate take of Indiana bats, such that all 100 turbines would be non-operational from sunset to sunrise during the entire period over which Indiana bats are active (April 1 through October 31) (see Section 3.2). No HCP for Indiana bats would be implemented.

Construction-related Impacts

Construction-related Impacts associated with the Maximally Restricted Operations Alternative are expected to be similar to those described for the Proposed Action.

Operational Impacts

Operational Impacts associated with the Maximally Restricted Operations Alternative would eliminate the potential take of Indiana bats, by prohibiting nighttime wind turbine operations when the bats are active (April 1 through October 31). Thus, there would be negligible effects on Indiana bats under this alternative, and no mitigation would occur, including any research conducted on bat-turbine interactions.

Cut-in speeds have not been shown to reduce bird deaths, but if the turbines are not operating at night there is likely to be less chance that endangered birds would collide with stationary turbine blades, especially for those species that migrate at night. These include: loggerhead shrike (Ohio endangered species), black-crowned night heron (Ohio threatened species), and sandhill crane (Ohio endangered species). State-listed bird species that migrate during the day, including northern harrier (Ohio endangered species) would have the same level of risk in Alternative A as they would for the Proposed Action. None of the state-listed species are species most commonly found as collisions at wind turbines or found in large numbers during episodic collisions (see discussion in Section 5.15.4), and individual state-listed species are only rarely observed within the Action Area (see Table 4.5-1), therefore overall collision risk to state-listed birds is not significant in this Alternative. A modified post-construction avian mortality monitoring program that follows ODNR's standard post-construction monitoring protocol (ODNR 2009) would be implemented for Alternative A to address bird mortality. Since under this Alternative all turbine activity would be curtailed from sunset to sunrise, a monitoring program for bat mortality would not be needed. Impacts to other state-listed species would likely be similar to the Proposed Action.

Impacts of Decommissioning

Due to similarities in construction and operation activities, impacts of decommissioning associated with the Maximally Restricted Operations Alternative are expected to be similar to those described for the Proposed Action.

5.5.4 Alternative B – Minimally Restricted Operations Alternative

The operational adjustment under Alternative B would involve feathering and a cut-in speed of 5.0 m/s (11 mph) for all turbines for the first six hours after sunset during the fall Indiana bat migration period from August 1 through October 31. This corresponds to the seasonal timeframe when the majority of bat mortality occurs. The turbines would be feathered for the first six hours of the night during this period when wind speeds are 5.0 m/s (11 mph) or less. Good et al. (2011) documented an approximately 50 percent decrease in bat mortality during the fall migration period between turbines with no cut-in speeds and turbines with cut-in speeds of 5.0 m/s when cut-in speeds were applied during the entire night. Young et al. (2011) found that turbines that were feathered prior to reaching the manufacturer-set cut-in speed during the first five hours of the night from July 15 to October 13 resulted in significantly less (47 to 72% less) bat mortalities than turbines that were not feathered during this period. Turbines would also be feathered until the manufacturer's set cut-in speed is reached from one half hour before sunset to one half hour after sunrise from April 1 to July 31.

This alternative would include the HCP.

When considering the projected take by season presented in Table 5.5-3, and using the "Moderate" flight height scenario, the take of Indiana bats is expected to be 6.9 in spring, 0.7 in summer, and 8.7 in fall. Assuming that use of a fall feathering and cut-in speed regime of 5.0 m/s was implemented for the first 6 hours of the night, and that turbines would be feathered until the manufacturer's cut-in speed is reached at night during spring and summer, reductions in Indiana bat mortality during the fall of approximately 50 percnet could reasonably be expected (as observed by Young et al. 2011, by feathering during the first five hours of the night). This alternative would result in take of 4.4 Indiana bats during fall, and take of a total of 12 Indiana bats per year in this Alternative.

Using the method described in the HCP Section 5.1.2.7.1, take of 12 Indiana bats per year would equate to take of 2.6 local adult females per year. Take of 2.6 local adult females per year was assessed in the Leslie matrix model (Leslie 1945), using all other inputs as described in the HCP Section 5.1.2.7.1 to determine the effect of this level of take on the maternity colony. Take of 2.6 local adult females per year resulted in a maternity colony population of 53 adult females after 25 years of operation. This demonstrates a declining maternity colony population compared to the starting size of 70 adult females. Whereas in the Proposed Action, the maternity colony continues to increase, albeit more slowly, when factoring in project related take, in Alternative B, the maternity colony declines with the project related take. This declining maternity colony projection is significant because it indicates that the mortality from the project cannot be compensated for by typical reproduction of the colony, resulting in lost reproductive capacity.

When considering effect of the take concurrent with effects from WNS, the Leslie model was used with the inputs described in Section 5.1.2.7.4 of the HCP, but assuming take of 2.6 local adult females from the maternity colony each year. With only WNS mortality and no project related take, the maternity colony population reached zero in year 8. With WNS mortality and project related take, the maternity colony reached zero in year 7. Similar to the take levels under the proposed action, in the WNS scenario, project-related take is masked by the drastic declines due to WNS. The difference in time between when the maternity colony reaches zero in the scenarios with and without project take is approximately one year, and is not considered to be appreciable (see discussion in EIS Section 5.4.2).

While the effects of feathering and cut in speeds on birds are not as well understood as they are for bats, it is expected that Alternative B would pose a slightly greater risk to state-listed birds than would either the Proposed Action or Alternative A because the turbines would be spinning more often in this alternative than in either of the other alternatives. State-listed birds would still experience collision risks associated with spring migration, summer residency periods, and fall migration. Diurnally active migrants including bald eagle (Ohio threatened species), osprey (Ohio threatened species), and northern harrier (Ohio endangered species) and resident state-listed birds would be exposed to collision risk during their regular commutes within the Action Area. State-listed birds that migrate through the area in spring would be at risk, and those that migrate through the area in fall would also be at risk, especially during the later part of the night. It can be assumed that mortality impacts to bird species would be similar to the Proposed Action during the period from November 1 through March 31, but slightly higher from April 1 through October 31.

Attempting to quantify the impact to state-listed birds from this alternative is difficult for multiple reasons. Unlike Alternative A when all of the turbines would not be spinning at night, turbines under Alternative B would be spinning during some portion of every night when winds were above the manufacturer’s set cut-in speed. Use of cut-in speeds to reduce state-listed bird mortality has not been studied to date, so it is uncertain how much use of cut-in speeds during only a portion of the night and only during the fall would influence state-listed bird mortality. Similar to the other alternatives, turbines under Alternative B would not have steady burning lights, so collision risk would not be substantially higher. None of the state-listed species are species most commonly found as collisions at wind turbines or found in large numbers during episodic collisions (see discussion in Section 5.15.4), and individual state-listed species are only rarely observed within the Action Area (see Table 4.5-1), therefore overall collision risk to state-listed birds is not significant in this Alternative.

The same minimization and avoidance measures would be implemented for Alternative B as the Proposed Action, with the exception of the operational adjustment regime, and potentially more mitigation efforts required due to increased take of Indiana bats. Using the "Acres of Mitigation Calculation" method described in Section 6.3.1 of the HCP, 488.3 acres of mitigation land would be needed to mitigate for the take of 297.5 Indiana bats.

In addition, the same post-construction avian and bat fatality monitoring program would be implemented for Alternative B as for the Proposed Action.

Construction-related Impacts

Construction-related Impacts associated with the Minimally Restricted Operations Alternative are expected to be similar to those described for the Proposed Action.

Operational Impacts

Operational Impacts associated with the Minimally Restricted Operations Alternative are expected to be similar to those described for the Proposed Action, but with potentially greater impacts to the Indiana bat during the spring and summer, due to no curtailment restrictions on the turbine speeds during these seasons. Thus, operations under this Alternative would have greater adverse effects on spring/summer populations of Indiana bats than the Proposed Action. Additional mitigation for take of additional Indiana bats would likely be necessary to offset the impacts. Cut-in speeds have not been shown to reduce bird deaths, but with less curtailment there could possibly be more state-listed bird mortality, especially for those that migrate at night. Impacts to other state-listed species would likely be similar to proposed action.

Impacts of Decommissioning

Impacts of decommissioning associated with the Minimally Restricted Operations Alternative are expected to be similar to those described for the Proposed Action.

5.5.5 Alternative C - No Action Alternative

Under Alternative C, the Project would not be built and no Project-related activities (construction, operation, or decommissioning) would occur. Implementation of this alternative would avoid direct and indirect impacts to Indiana bats from operation of the Project, including take of 130 Indiana bats and 16.1 acres of Indiana bat habitat, but would not result in benefits derived from implementation of the mitigation and conservation measures proposed under the HCP.

5.6 Cultural and Historic Resources

5.6.1 Impact Criteria

For cultural resources qualifying as historic properties, protection is afforded under the National Historic Preservation Act (NHPA). NHPA defines a historic property as follows:

> *…any Pre-European contact or historic district, site, building, structure, or object included in, or eligible for listing on the National Register, including artifacts, records, and material remains related to such a property or resource* (46 CFR 800, as amended 2006 Public Law 89-665; 16 U.S.C. 470, TITLE III, Section 301 (5)).

In general, in order for a property to be eligible for listing in the National Register of Historic Places (NRHP), it must be at least 50 years old and possess both historic significance and integrity. Significance may be found in four aspects of American history recognized by the National Register Criteria:

A. That are associated with events that have made a significant contribution to the broad patterns of our history; or

B. That are associated with the lives of persons significant in our past; or

C. That embody distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

D. That have yielded, or may be likely to yield, information important in prehistory or history.

A property must meet at least one of these criteria to be eligible for listing in the NRHP. Integrity must also be evident through historic qualities including location, design, setting, materials, workmanship, feeling, and association.

Impacts to cultural resources, including historic structures, archaeological sites, and traditional cultural properties, would be considered significant if they would result in adverse effects to historic properties. Once a cultural resource is identified, the historic significance of the property must be evaluated in terms of its ability to meet the National Register criteria (36 CFR 800.4 (c)(1)). A cultural resource that meets the criteria is considered a historic property entitled to the consideration afforded by Section 106 of the NHPA, as outlined in the Advisory Council on Historic Preservation's implementing regulations (36 CFR 800). Cultural resources are analyzed by direct and indirect APE, referring to the actual footprint of the Project and the area from which Project infrastructure would be visible, respectively. APE is the standard terminology used by cultural resources agencies and professionals to describe impacts on archaeological and architectural resources.

Archaeological and architectural surveys have been conducted in order to identify significant cultural resources and to evaluate the potential effects the Project may have on their continued significance. Additional archaeological surveys may be conducted, as discussed in the Archaeology section below. The surveys were conducted by CRA according to Work Plans submitted to and approved by the OHPO. Section 106 consultation was initiated with the OHPO on June 17, 2010 in a letter from David W. Kluth, Regional Historic Preservation Officer of USFWS, to Mark J. Epstein of the Ohio Historic Preservation Office.

Archaeology

The archaeological survey identified 14 archaeological sites within the direct APE, including one (33CH0415) potentially eligible for NRHP listing (CRA 2011a). Recommendations of NRHP eligibility were submitted to OHPO in May 2011. OHPO agreed in an October 2011 letter that additional field work is needed at 33CH0415 only to avoid ground disturbance in or immediately adjacent to the site, and recommended further consultation to consider what treatment measures would be used at the site. Site 33CH0415 is a historic site represented by a variety of artifacts including brick, nails, and window glass, and an excavated area representing a root cellar or storage pit. Buckeye Wind intends to avoid this site. CRA will develop a Work Plan for the follow up surveys of the alternate route and submit the plan for approval prior to commencing work. EIS-related archaeological surveys were conducted solely for the 52-turbine Project footprint. Therefore, additional effort would be required to identify archaeological sites and historic properties that may be adversely affected within the 100-turbine Project footprint. Following siting of the additional 48 turbines, additional archaeological identification efforts will be conducted as necessary, with plans and reports submitted to OHPO for review. A Programmatic Agreement (Appendix L) between USFWS, Buckeye Wind, and SHPO will be signed prior to issuance of the ROD and ITP, and will delineate all archaeological surveys that must be completed before the Section 106 process is complete.

Architecture

Architectural surveys identified 1,475 historic properties within 8 km (5 mi) of Project facilities, referred to as the indirect APE (CRA 2011b). In accordance with the agreed-upon work plan, these properties were not individually evaluated for eligibility for listing in the NRHP. Rather, the goal of the survey was to gain a general understanding of the character of the survey area’s historic landscape and to identify the character-defining property types that contribute to the qualities that make this historic landscape unique. Based on the archival research, field survey, and public involvement, it was determined that the agricultural heritage of the survey area is what makes the historic landscape unique.

Historic farmsteads and farmhouses, one-room schoolhouses, churches, cemeteries, and crossroads communities are character-defining property types that contribute to appreciation of the area’s historic landscape. Effects to these resources were evaluated on the landscape level, resulting in a finding that construction of the proposed project may adversely affect the perception of the traditional rural historic landscape, changing important qualities of the setting in which many of the character-defining historic property types are located. In the October 27, 2011 letter from OHPO, it was confirmed that the studies conducted sufficiently encompassed the Action Area of the 100-turbine project, and additional architectural surveys would not be required for the surveyed area. In 2013, the supplemental study of previously undocumented areas within the APE for the 100-turbine project confirmed that the conclusions of the 2011 survey report are appropriate for the complete 100-turbine project.

Pursuant to the NHPA and AIRFA, and in an effort to identify other cultural resources that may be affected by the Project, USFWS initiated consultation with the following tribes, inviting them to comment on whether they attach any religious or cultural significance to the Project location:

- Absentee-Shawnee Tribe of Oklahoma;
- Eastern Shawnee Tribe of Oklahoma;
- Miami Tribe of Oklahoma;
- Ottawa Tribe of Oklahoma;
- Piqua Shawnee Tribe;
- Hannahville Indian Community;
- Citizen Potawatomi Nation;
- Prairie Band of Potawatomi Nation;
- Forest County Potawatomi Community; and
- Shawnee Tribe.

The USFWS has made multiple attempts to reach out to the tribes during the EIS process. During initial outreach, only the Eastern Shawnee Tribe of Oklahoma and Piqua Shawnee Tribe indicated an interest in this Project. In February 2013, the USFWS sent certified letters to all tribes inviting input. The Eastern Shawnee did not respond to the February letter. Only the Piqua Shawnee Tribe responded to the USFWS's February 2013 invitation for input.

Discussions were also initiated with the state-recognized Piqua Shawnee Tribe in regards to "Indian Mound" (see Section 4.6.3.1). In a press release dated September 7, 2010, an elder of the Piqua Shawnee Tribe expressed support for the 52-turbine Project described in the OPSB application, and stated that the Project poses no threat to the mound (Park 2010). Further, in a December 4, 2012 letter to the Ohio Power Siting Board a local agent for the Piqua Shawnee Tribe stated, "The Buckeye Wind Farms pose no threat to the local artifacts, sites and culture of the tribe in the area. EverPower and the Shawnee Tribe have also agreed to work together during construction to ensure there is no impact."

In response to USFWS's February 2013 letter requesting input, the Piqua Shawnee Tribe provided a letter dated February 8, 2013. This letter stated that they have worked closely with Dr. Kenneth B. Tankersley, the Native American Graves Protection Act representative for the Piqua Shawnee, to determine if construction of the turbines would endanger Native burial sites, ancient mounds, and earthworks over the entire construction site. They concluded that "A few turbine sites are located close to mounds, but should be out of danger during construction. Our Tribe has permission to monitor these sites and will do so, when construction gets underway…This will conclude our comments on the proposed undertaking" (Park 2013). Based on the response from the Piqua Shawnee Tribe and the lack of responses from other Tribes, the Service has determined that there will be no effect on Tribal resources and that consultation with Tribes has been concluded.

5.6.2 Proposed Action

5.6.2.1 Avoidance and Minimization Measures

Archaeological and architectural surveys were conducted in the direct and indirect APE, respectively, to identify the location and character of significant cultural resources. The surveys were conducted according to Work Plans approved by the OHPO. The surveys included field documentation, archival research, and consultation with local groups and citizens.

Archaeology

The Proposed Action would implement the following measures that would avoid or minimize impacts to archaeological resources. Field methods were modified to extend the survey outside of the Project boundaries to delineate the full extent of the site 33CH0415. This was intended to aid in establishing a viable alternate route for the buried interconnect, since avoidance of any potentially important site is a major goal of the established Work Plan. This site has been recommended as potentially eligible for the NRHP under Criterion D, with recommendations for avoidance, or if avoidance is not possible, Phase II investigations to obtain information sufficient to determine the NRHP eligibility of the site. The Applicant has committed to avoiding this potential NRHP site, and any other NRHP site(s) identified in future field studies.

Architecture

Findings suggest that there are significant historic architectural resources in the indirect APE and that the proposed Project would likely affect their continued significance. Considering the nature of the Project, it is unlikely that these effects would be avoidable or that minimization efforts would substantially reduce the impacts. As a result, recommended mitigation measures were included in the final report to OHPO (Section VIII of CRA 2011b) proposing specific ways the Applicant can support local preservation efforts in a proportionate response to the project's effects. These measures are described below in the Mitigation Measures section.

Construction-related Effects

Archaeology

Results from the archeological survey identified 14 archaeological sites within the direct APE, one of which is potentially eligible for NRHP listing (33CH0415). These findings were submitted to OHPO for review, and in October 2011 OHPO agreed that further study and consultation is warranted at site 33CH0415. No further studies on the other 13 sites were deemed necessary. A final NRHP eligibility determination from OHPO has not yet been issued. Buckeye Wind has committed to avoiding this and all potentially eligible NRHP sites. Therefore, there would be no adverse impacts from construction activities.

A mound was identified within the Action Area, but it would not be affected by the Project, and the Piqua Shawnee Tribe confirmed that the construction of the turbines should not affect the mound (Park 2013). All 100 turbines would be sited to avoid the mound and the Piqua Shawnee would be consulted about the locations of all 100 turbines. OHPO concurred in the October 2011 letter that the mound would not be impacted due to conditions requiring that turbines be sited a "sufficient" distance from any mounds, and that no earth be removed from the area immediately surrounding a mound. An unanticipated discovery plan to address any unexpected artifacts uncovered during construction activities would be developed and followed during construction in the unlikely event that significant cultural resources not detected during the archeological survey are encountered during construction.

Archaeological surveys were conducted solely for the 52-turbine Project footprint. Therefore, additional effort would be required to identify archaeological sites and historic properties that may be adversely affected within the 100-turbine Project footprint. Following siting of the additional 48 turbines, additional archaeological identification efforts will be conducted as necessary, with plans and reports submitted to OHPO for review. A Programmatic Agreement (Appendix L) between USFWS, Buckeye Wind, and SHPO will be signed prior to issuance of the ROD and ITP, and will delineate all archaeological surveys that must be completed before the Section 106 process is complete.

Architecture

The draft architectural survey report states that 1,475 historic properties were identified within the indirect APE. These findings were submitted to OHPO, and in a letter dated 27 October 2011, OHPO stated that several buildings, structures, and main street districts warrant further evaluation to determine their eligibility for the NRHP. However, OHPO also stated that the additional eligibility surveys fall outside of the agreed-upon scope of this effort, and no further surveys are required at this time unless the project expands beyond the footprint of the potential 100-turbine array. Any impacts on historic structures during the construction phase are considered temporary.

Operation and Maintenance-related Effects

Archaeology

After the construction phase, the potential for effects to buried cultural resources such as archaeological sites diminishes significantly. As long as any ground-disturbing activities associated with operation are confined to previously surveyed areas and avoid buried cultural resources, there would be minimal potential for effects during operation. Even though the potential for impacts on buried cultural resources would be minimal during the operational phase, the unanticipated discovery plan would remain in effect during this phase.

Architecture

Effects on historic architectural resources would continue for the operational life of the Project. OHPO stated in the October 2011 letter that, “the undertaking will have effects, and cumulatively across the area within two miles of turbines the effects will alter the cultural landscape…” Along with the impacts findings, a draft mitigation plan addressing these impacts was developed and submitted to OHPO. The components of the mitigation plan are discussed in the Mitigation Measures for Unavoidable Impacts section below. The mitigation measures, if agreed upon by OHPO, USFWS, OPSB, and the Applicant, will be included in the Programmatic Agreement (Appendix L).

Decommissioning-related Effects

Archaeology

Decommissioning has the potential to impact buried cultural resources within the footprint of all turbines, facilities, and other components of the Projects that would be removed. If any previously unsurveyed areas would be directly affected by decommissioning, archaeological survey would be required to determine the presence of archaeological sites, and the potential effects. An unanticipated discovery plan would be followed during decommissioning activities within areas previously surveyed and known not to contain significant archaeological sites, in the unlikely event that previously unknown significant cultural resources are encountered during decommissioning.

Architecture

If the viewshed is restored to the pre-Project state, decommissioning would not affect historic structures. In fact, removal of the Project and restoration of the original view would return any historic structures that may be present to their pre-project setting. Therefore, decommissioning could potentially positively affect historic structures.

Mitigation Measures for Unavoidable Impacts

Archaeology

Buckeye Wind has committed to avoiding all impacts to all potentially NRHP eligible sites, therefore no mitigation measures would be warranted. The Programmatic Agreement (Appendix L) will specify the process for identifying and avoiding all potentially NRHP eligible sites found during the remaining archeological surveys, and mitigation that would be necessary if sites could not be avoided.

Architecture

Surveys documented that there are significant historic architectural resources in the indirect APE. Effects to these resources were evaluated on the landscape level, resulting in a finding that construction of the proposed project may adversely affect the perception of the traditional rural historic landscape, changing important qualities of the setting in which many of the character-defining historic property types are located. As a result, the Champaign County Historical Society and Champaign County Preservation Alliance were consulted in order to develop a mitigation plan to help minimize the effects. The Applicant received input from the USFWS Historic Preservation Officer, as well as from OHPO in a letter dated October 27, 2011, and is working to finalize the mitigation plans as proposed in the report. Mitigation measures presented in the plan include:

- A Multiple Property Listing (MPL) to the NRHP for historic one-room schoolhouses throughout the Action Area to promote awareness and preservation of these structures.
- Documentation and interpretation of the A.P. Howard house and the Obed Horr house, and development of a Teaching with Historic Places lesson plan presenting Champaign County's role in the Underground Railroad.

The mitigation measures, if agreed upon by OHPO, USFWS, OPSB, and the Applicant, will be included in the Programmatic Agreement (Appendix L).

5.6.2.2 Redesign Option

The Redesign Option is an optional measure under the Proposed Action that includes a primarily buried collection system. There is more ground disturbance under the Redesign Option, which could cause more impacts to unknown buried cultural resources. Surveys would be conducted in all additional areas where ground disturbance is planned, using a methodology consistent with the surveys conducted for the Proposed Action. There would be fewer overhead lines in the Redesign Option, but the primary source of impact on historic structures is the turbines, so any reduction of impacts would be minor and applicable only to those structures where overhead lines but not turbines would be seen. The avoidance, minimization, and mitigation measures would be the same as described above for the Proposed Action.

5.6.3 Alternative A - Maximally Restricted Operations Alternative

Alternative A differs from the Proposed Action only with respect to operations. The operational differences would not affect archaeological or historic resources. As such, the construction, operation, and decommissioning-related effects of Alternative A on cultural resources and the recommended avoidance, minimization, and mitigation measures would be the same as under the Proposed Action.

5.6.4 Alternative B - Minimally Restricted Operations Alternative

Alternative B differs from the Proposed Action only with respect to operations. The operational differences would not affect archaeological or historic resources. As such, the construction, operation, and decommissioning-related effects of Alternative B on cultural resources and the recommended avoidance, minimization, and mitigation measures would be the same as under the Proposed Action.

5.6.5 Alternative C - No Action Alternative

Under Alternative C, the Project would not be built and no Project-related activities (construction, operation, or decommissioning) would occur. Alternative C would have no effect on archaeological or historic resources.

5.7 Land Use and Recreation

5.7.1 Impact Criteria

Consideration of the effects of the Proposed Action and alternatives on the human environment, which includes land use and recreation, must be included as part of an overall NEPA analysis. In addition, the Farmland Protection Policy Act (FPPA) stipulates that federal programs and actions be compatible with state, local and private efforts to protect farmland. The following section addresses the key issues related to land use and recreation associated with the Project including: compatibility with local land use, zoning and comprehensive planning; compatibility with planned development; loss of use to landowners; and effects to recreational resources.

5.7.2 Proposed Action

5.7.2.1 Avoidance and Minimization Measures

The Proposed Action contains the following avoidance and minimization measures that would avoid or minimize impacts to land use and recreation.

The 100 turbines will be sited in locations consistent with OPSB-required setbacks from property lines and residential structures. Advanced engineering and micro-siting was used to ensure that turbines would not be constructed unless the setback requirement would be met or an appropriate waiver would be executed (EDR 2009a). In addition, significant impacts to agricultural land have been avoided through coordination with landowners and Project design, which sited Project components along field edges/hedgerows to the extent practicable. Each wind turbine location (along with the locations for associated infrastructure) was individually inspected during field efforts by the Applicant and/or their consultants (EDR 2009a), and the remaining turbines will be evaluated similarly.

Additional mitigation measures to lessen impacts to agricultural land include the following:

- Limiting permanent road widths to a maximum of 6 m (20 ft) or less, and where possible, following existing farm lanes, hedgerows and field edges to minimize loss and fragmentation of agricultural land.
- Avoiding disturbance of surface and subsurface drainage features.
- Repairing all inadvertently damaged tile lines.
- Minimizing vehicular access to turbine sites until topsoil has been stripped and permanent access roads have been constructed.
- Limiting vehicular access to construction roads only.
- Avoiding stripping of topsoil or passage of cranes across agricultural fields during saturated conditions (when soils capacity to assimilate water is exceeded, and standing water forms on the soils surface) when such actions would damage agricultural soils when practicable.
- Subsoil decompaction and rock picking prior to re-spreading of topsoil in temporarily disturbed areas.
- Avoiding blocking of surface water drainage due to road installation or stockpiled topsoil.
- Coordination with landowner to assure that interference with irrigation and subsurface drainage is appropriately minimized during construction and avoided during operation and maintenance (EDR 2009a, Stantec 2010b).
- Maintaining access roads throughout construction so as to allow continued use/crossing by farmers and farm machinery to the extent practicable.
- Temporarily fencing/securing open excavation areas in active pastureland to protect livestock.
- Removing and disposing of all construction debris offsite at the completion of restoration.
- Washing of concrete trucks into foundation holes, or outside of active agricultural areas in locations approved by the landowner and in appropriate locations where additional impacts to natural resources would not occur.

- Restricting crane set-up, erection, and breakdown activities to designated access roads and immediately adjacent areas and work pads at the turbine sites, and restoration of buried interconnect and crane paths.
- Restoration of temporarily disturbed areas.
- Stabilizing restored agricultural areas with seed and/or mulch.
- Compensation for damaged/lost crops.

Furthermore, landowners who participate in the lease program for the wind turbines would receive a payment for the use of the property.

Other measures would be intended to address the indirect effects associated with visual impacts to the surroundings areas, as well as noise. Section 5.8 provides more detailed measures to address visual impacts, while Section 5.10 provides additional measures to address construction and operational noise concerns.

Construction-related Effects

Construction of the Project would take place over one to two construction phases, each phase expected to continue for 12 to 18 months. The exact timing of the two construction periods is not known and may overlap. In general, the effects associated with the construction of the Project are anticipated to be temporary. The effects from construction are discussed as they relate to local land use planning, planned development, loss of use, and recreation.

Local Land Use, Zoning, and Comprehensive/Land Use Plans

Due to the small amount of land required for the construction of the Project relative to the overall Action Area, the Project would not directly impact the predominantly agricultural land use pattern of the Action Area and surrounding vicinity. However, construction activities would be inconsistent, albeit largely temporary, with "the preservation of the rural character," a common goal of the comprehensive plans for communities within 8 km (5 mi) of the Action Area.

The presence of heavy construction equipment, workers, and increased traffic are not typically associated with rural-agricultural or rural residential areas (although dust, noise, and the occasional presence of large construction equipment, large farm machinery on public roads are byproducts of agricultural operations). These impacts are not anticipated to occur in areas used for recreation, such as golf courses or parks. Any such effects would be short-term and would last only until construction activities were completed.

Planned Development

The construction of the Project would not directly affect the overall planned development within the Action Area or for the geographic locations included within the five counties overlapping the Action Area. Construction would not impact future land use categorizations due to the temporary nature of the activities. These activities would not interfere with other potential developments; therefore no effects to planned development would occur from the proposed action.

Loss of Use

Landowners may experience a temporary loss of use in areas during the construction. During this time, machinery would be present to allow for the placement of the turbines, access roads, and other appurtenances.

For example, access road construction through agricultural fields would include stripping a 12.2 m (40.0 ft) width of topsoil and placing it in wind-rows along the access road to prevent construction vehicles from driving over undisturbed soil and adjacent fields. Following turbine construction, these road widths would be reduced to 6 m (20 ft) or less (EDR 2009a).

In locations where buried cable crosses agricultural fields, construction equipment may disturb a width of up to 7.3 m (25 ft) of soil (EDR 2009a). However, this would represent a temporary disturbance. The cable would be buried in agricultural fields at a depth of 1.2 m (48 in), and agricultural practices would be able to resume (Stantec 2010b).

In areas where wind turbines are sited on agricultural land, topsoil within a 61 m (200 ft) radius of each tower would first be stripped and stockpiled. A backhoe then would be used to excavate a foundation hole. Excavated subsoil and rock would be segregated from topsoil during this process (Stantec 2010b).

As part of the HCP (Table 2-1) impacts to agricultural land were quantified based on the typical area of vegetative clearing including 61 m (200 ft) radius per turbine, 16.8 m (55 ft) wide per 0.3 linear m (1 linear ft) of road for access roads, 7.3 m (25 ft) per 0.3 linear m (1 linear ft) of cable, 1.2 ha (3 ac) for operations and maintenance facilities, and 9.2 ha (22.9 ac) total for the four staging areas (EDR 2009a). Table 5.7-1 provides the acreage of total disturbance, temporary disturbance, and permanent loss of acreage for the 100-turbine project. Construction of the Project would collectively disturb not more than of 199.1 ha (492 ac) of agricultural lands. As previously indicated, only 42.0 ha (103.9 ac) of impact would be permanent.

The Project would not require removal or relocation of any existing structures. Construction impacts primarily would be temporary in nature and confined to the properties of participating landowners. The Applicant has developed standards and policies for construction activities occurring partially or wholly on privately owned agricultural land, which would minimize adverse effects on these lands (see avoidance and minimization section above for further details) (Stantec 2010b).

Table 5.7-1 Impacts to Agricultural Land Associated with the Project

Agricultural Land	Total Disturbance ha (ac)	Temporary Disturbance ha (ac)	Loss for the Life of the Project ha (ac)
Confined Feeding Operations	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Croplands	199.1 (492.0)	157.1 (388.1)	42.0 (103.9)
Nurseries and Ornamental Horticulture	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Orchards and Groves	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Pasture	11.9 (29.4)	9.2 (22.7)	2.7 (6.7)
TOTAL	211 (521.4)	166.3 (410.8)	44.7 (110.6)

Recreation

During construction, Project visibility, construction noise, and access restrictions may all affect the quality of the recreational experience. For instance, visual impacts would be experienced due to the presence of heavy construction equipment, workers, and the potential for increased traffic. These types of views would not be typical to the recreational users within the Action Area.

In addition, increased noise levels from construction activities may affect the rural nature of the agricultural setting, negatively impacting recreational users in the vicinity of the turbines and access road construction. Construction noise may negatively affect the presence of wildlife, and may thus temporarily limit hunting opportunities in the vicinity of construction areas. Noise from construction activities is likely to constitute a moderate unavoidable impact at recreational areas within 1.6 km (1 mi) of the Project. However, construction noise impacts would be temporary in nature.

Although no recreational facilities would be closed during the construction of the Project, access restrictions may result during movement of oversized machinery and turbine parts. Recreational users may be required to use alternate roads or spend more time reaching their destination.

Operation and Maintenance-related Effects

During the operation of the Project, some effects would occur. These are discussed as they relate to local land use planning, planned development, loss of use, and recreation.

Local Land Use, Zoning, and Comprehensive/Land Use Plans

Due to the small amount of land required for the Project relative to the overall communities located within the Action Area of the Project, the Project would not directly impact local land use categorizations, which primarily consist of agricultural land. These current designations would not be altered by the operation of the Project.

However, positive and negative indirect impacts would result from the operation of the build alternatives. For the purpose of this analysis, the discussion of the indirect impacts associated with land use is provided in the context of consistency and compatibility with local comprehensive and land use plans.

With regard to local comprehensive and land use plans, the following provides a summary of the land use goals recommended within the various plans for communities within the Action Area:

- Ensure the conservation of agricultural land;
- Preserve the rural character of the County;
- Improve the overall quality of life for residents; and
- Respect the integrity of the natural environment.

Based on the local plans analyzed, the Project would be consistent with the goals set forth by the various communities (Clark County 1999; Union County 1999; Champaign County 2004; Madison County Commissioners 2005). The Project would provide income to local farmers, providing incentive to conserve agricultural land. In turn, the rural character of the communities also would be retained.

The Project also has the potential to improve the existing quality of life through the generation of a renewable energy source. For example, public services can be improved in part through the construction of new infrastructure such as roads to improve the overall well-being of the residents and visitors. While the infrastructure associated with the wind turbines would not change the current or future land use patterns recommended in the individual community plans, this Project would supply a renewable source of electrical services to the grid, which would in part support existing users. The Project would also make economic contributions to the local communities through service payments and taxes (addressed in Section 5.9, Socioeconomics and Environmental Justice).

The Project also seeks to respect the integrity of the natural environment. This would be accomplished through minimizing disturbance of natural vegetation and avoidance of sensitive natural resources where necessary.

Setback requirements would be met in accordance with local and state regulations in order to ensure consistency and compatibility with local land use decisions. The OPSB requires that the distance from the base of the turbine to the nearest property line be at least 1.1 times the total height of the turbine (i.e., distance from base to blade) and at least 750 ft from the "tip of the turbine's nearest blade at ninety degrees to the exterior of the nearest habitable residential structure" (OAC 4906-17-8 (3) (C) (1)).

More permanent indirect impacts would be associated with the visual presence of the wind turbines in agricultural areas as compared to the existing conditions. These impacts may be considered positive, negative, or neutral depending on the observer. Visual impacts are discussed in greater detail in Section 5.8, Visual Resources.

Maintenance activities associated with the operation of the wind turbines would not create significant impacts to the overall land use within the Action Area.

Planned Development

The Project would not directly affect the overall planned development for the geographic locations included within the Action Area. For the most part, the wind turbines would be located within agricultural properties. The introduction of the Project would not alter the future land use. In general, the parcels on which the Project would be located could be redeveloped in accordance with the goals and objectives outlined by the various comprehensive plans for locations within the Action Area.

Indirect impacts may affect planned development include concerns for future property values and the public's perception of the Project. As indicated in several professional and academic studies, no conclusive evidence is available to suggest that property values decrease when a wind farm is placed in proximity to a residential structure. However, the studies also indicated that perception can play a role in determining the value of a property. A more detailed discussion of property values is included in Section 4.9, Socioeconomics and Environmental Justice.

Loss of Use

Landowners may experience a permanent loss of use in areas during the operation of the Project. Following construction, the footprint of each turbine would be reduced to 0.08 ha (0.2 ac), which includes the turbine pedestal and a gravel crane pad. The remaining disturbed work area would be restored to agricultural use (Stantec 2010b). The 100-turbine array would cause no more than 52.2 ha (128.9 ac) to be converted to built structures. As shown in Table 5.9-1, most of this area (42.0 ha [103.9 ac]) is currently cropland. Given the predominant land use patterns in the Action Area, loss of agricultural land would similarly dominate the land use impacts associated with the 100-turbine array.

In addition, private land leases with more than 100 property owners are needed for the construction of the Project. For the 100-turbine Project, no more than 11.3 ha (27.9 ac) of CRP land would be disturbed, which represents 0.9 percent of the 1,253 ha (3,096 ac) in the six townships included in the Action Area. No more than 2.3 ha (5.7 ac) would be disturbed permanently. Based on consultation between the Applicant, the FSA, and the landowners, it is anticipated that the permanently affected lands would be withdrawn from the CRP. If the land is removed, landowners would no longer receive payments and may need to direct payments back to the FSA, but the Project would compensate landowners for these losses.

The Applicant does not anticipate the removal or relocation of any existing structures as a result of the operation of the Project. However, some loss of existing crops would occur, likely along with some damage to fences, gates, and subsurface tile drains. As previously indicated, the Applicant has developed standards and policies for construction activities occurring partially or wholly on privately owned agricultural land (Stantec 2010b).

During Project operation, additional impacts over the years on land use should be infrequent and minimal. Future impacts to land use would be similar in character to activities that already occur in the overall Action Area (i.e., residential and small manufacturing development). Aside from occasional maintenance and repair activities, Project operation should not interfere with on-going current land uses (Stantec 2010b).

Recreation

Project visibility, operation noise, and access restrictions may all affect the quality of the recreational experience. Recreational users are primarily concentrated in the 16 recreational facilities within the Action Area and include golfers, hikers, bicyclists, recreational boaters, hunters, fishermen, and those involved in more passive recreational activities such as picnicking, sightseeing, or walking. For some, visual quality of the scenery may be an important part of the recreational experience. Recreational users often have continuous views of landscape features over relatively long periods of time and the presence of large structural features, such as wind turbines, may affect the experience in a negative way. Shadow flicker from the operating wind turbines may also be considered an annoyance that diminishes the recreational experience. These impacts would be most significant within 1.6 km (1 mi) of the Project. There are three recreational facilities within this area: Goshen Memorial Park, Urbana Country Club, and Woodland Gold Club. At each of these recreational areas, depending on the location of the viewer within the area, turbines would be visible. The number of turbines that would be visible at once would vary depending on the location of the viewer but is generally expected to be below 25. Sound levels at these recreational areas would not exceed nominal impact thresholds (i.e., the point at which the turbines are expected to be audible under certain conditions) during the day (Hessler 2009) but slight nighttime exceedances are expected in very limited portions of the golf courses at Urbana Country Club and Woodland Gold Club. Nighttime exceedances at these clubs are not expected to reduce the quality of the recreational experience because the affected areas would not be used at night. Based on the low level of visual effects and noise that could be experienced at these recreational facilities, significant impacts to recreation are not expected. Noise and visual impacts resulting from the Project are described in detail in Sections 5.10 and 5.8 of this EIS, respectively.

Decommissioning-related Effects

Decommissioning-related effects of the Project would involve temporary land disturbance during dismantling of the turbines and other Project structures similar to construction activities, followed by return of the landscape to its pre-Project (i.e., largely agricultural) state. If the viewshed is restored to the pre-Project state, decommissioning would not affect land use in the Action Area; in fact, removal of the facility would return any land use practices to their pre-project status; therefore, decommissioning could potentially positively affect land use.

In summary, the Proposed Action would have minor impacts on land use and recreation. Some loss of use would occur within the footprints and immediate vicinities of the Project infrastructure, but these impacts would affect a small percentage of the overall area within the Action Area. Loss of use would be partially offset through lease payments.

Mitigation Measures for Unavoidable Impacts

The Project would not have significant impacts on land use or recreation; therefore, the Proposed Action contains no specific mitigation measures in addition to the avoidance and minimization measures listed above.

5.7.2.2 Redesign Option

The Redesign Option is an optional measure under the Proposed Action that includes a primarily buried collection system, which would cause more land disturbance than the overhead lines of the Proposed Action. Impacts to land use and recreation are expected to be largely the same as those described for the Proposed Action. The Redesign Option would permanently impact no more than 42.0 ha (103.8 ac) of cultivated crops, which is identical to the Proposed Action impact area, and would temporarily impact 154.8 ha (382.6 ac) in comparison to 157.1 ha (388.1

ac) for the Proposed Action. The avoidance and minimization measures would be the same as described above for the Proposed Action. No mitigation measures would be warranted.

5.7.3 Alternative A – Maximally Restricted Operations Alternative

Alternative A differs from the Proposed Action only with respect to operations. The operational differences would not affect land use or recreation in a manner largely different from the Proposed Action. Minor differences between Alternative A and the Proposed Action may alter the amount of operational noise experienced by residents and recreational users. This Alternative is anticipated to generate less operational noise than the Proposed Action (see Section 5.10, Noise), as turbines would be non-operational from sunrise to sunset April 1 through October 31. The remaining construction, operation, and decommissioning-related effects of Alternative A on land use and recreation and the recommended avoidance and minimization measures would be the same as under the Proposed Action.

5.7.4 Alternative B – Minimally Restricted Operations Alternative

Alternative B differs from the Proposed Action only with respect to operations. The operational differences would not affect land use or recreation in a manner different than the Proposed Action. Minor differences between Alternative B and the Proposed Action may alter the amount of operational noise experienced by residents and recreational users. Alternative B would generate more operational noise than the Proposed Action and Alternative A (see Section 5.10, Noise). The remaining construction, operation, and decommissioning-related effects of Alternative B on land use and recreation and the recommended avoidance and minimization measures would be the same as under the Proposed Action

5.7.5 Alternative C - No Action Alternative

Under Alternative C, the Project would not be built and no Project-related activities (construction, operation, or decommissioning) would occur. Alternative C would have no effect on land use or recreation.

5.8 Visual Resources

This section describes the extent and magnitude of the Project's effects on visual resources in the Action Area and surrounding visual study area (VSA) (5-mile radius around the proposed turbines), as defined by the Applicant. The regulatory framework for evaluating these impacts is described in Section 4.8.

5.8.1 Impact Criteria

While USFWS regulations do not establish guidelines for evaluating visual impacts, several other federal agencies do provide guidance. The Applicant's evaluation of the affected environment for visual resources was based on methodologies developed by the DOI Bureau of Land Management (BLM 1980), USDA National Forest Service (FS 1995), and the USDOT Federal Highway Administration (1981, as cited in EDR 2009b), as well as the New York State Department of Environmental Conservation (n.d., as cited in EDR 2009b). Based on review of these guidelines and other EIS documents (notably Mangi 2000), the following criteria are used to evaluate visual impacts from the Project:

A significant impact occurs when modifications to the visual setting dominate or begin to dominate the viewshed, attracts attention, and represents a marked departure in form, size, and/or color, compared to existing or reasonably expected aspects of the visual setting.

The OPSB rules (Chapter 4906-17 of the Ohio Administrative Code) governing applications for the construction of wind power facilities include the following requirement for minimizing impacts to visual resources:

4906-17-8 (D) (6). The applicant shall describe measures that will be taken to minimize any adverse visual impacts created by the facility, including, but not limited to, project area location, lighting, and facility coloration. In no event shall these measures conflict with relevant safety requirements.

5.8.2 Proposed Action

5.8.2.1 Avoidance and Minimization Measures

The Proposed Action contains the following measures that would avoid or minimize impacts to visual resources.

Project Design

- Turbines would be painted white or off-white using non-reflective paints. This color "minimizes contrast with the sky under most conditions, especially when viewed at distance against the horizon" (EDR 2009b). It is also mandated by the FAA to eliminate the need for daytime lighting.
- The electrical collection system would be installed below ground wherever feasible. For above-ground segments of the collection system, existing utility rights-of-way and existing utility poles would be used to the maximum extent possible. Above ground components of the collection system would not exceed 56.8 km (35.3 mi.) of interconnect lines.
- FAA lighting would be minimized to the maximum extent practicable:
  - A single, medium intensity aviation warning light would be attached to the top of some of the nacelles, per specifications of the FAA.
  - The minimum amount of pilot warning and obstruction avoidance lighting would be used, approximately one in every five turbines would be lit, and all lights within the Project would illuminate synchronously.
  - FAA lights are anticipated to be flashing red strobes (L-864) that operate only at night. The Applicant would use the lowest intensity allowed by the FAA.
  - To the extent possible, USFWS-recommended lighting schemes would be used on the nacelles, including reduced intensity lighting and lights with short flash durations that emit no light during the "off phase".

Site Development and Maintenance

- Turbines and turbine sites would be maintained to ensure that they are clean and attractive. In particular, rust spots or other flaws in exterior finishes would be corrected as quickly as possible.

Construction-related Effects

Construction of the Project, including all 100 turbines, would occur within one or two construction phases, each phase expected to continue for 12 to 18 months. The exact timing of the two construction periods is not known and may overlap. Timing is dependent upon several factors such as turbine availability, OPSB certification, and economic considerations. Construction of the turbines would include the presence of partially-completed turbines, large cranes, frequent trips by very large trucks, visible areas of disturbed earth, and fugitive dust. Areas of disturbed earth and dust could also be visible around other Project facilities, including the operations and maintenance building, construction staging areas, and electrical substation. However, these impacts would be minimized through the implementation of various construction management practices including sediment and erosion control and dust control plans. All areas temporarily disturbed during construction would be restored to natural vegetation or agricultural production following the conclusion of construction activities.

The visual disturbances associated with construction would be short-term in nature at any given turbine site (or the sites of other Project facilities). Given the pace of construction, most individual turbines could be erected in a matter of one to two days, although some may take longer depending on weather and other factors. The general pace of construction could be increased with the addition of multiple crews. The VSA is predominantly agricultural in nature, which means that the presence of working heavy machinery, stockpiles of materials, dust, and disturbed earth (i.e., plowed fields) are common. Although different in purpose, the construction-related visual effects are in many ways comparable to those associated with farming.

Due to this similarity, combined with the short-term duration of construction in any single location, construction activity would not create significant direct or indirect impacts on visual resources.

Operation and Maintenance-related Effects

This section describes the studies and analyses conducted by the Applicant to characterize the future conditions of the VSA during Project operations, as well as the effects of those future conditions. It is important to note that the Applicant has only identified locations for 52 of the proposed 100 turbines associated with the Project. By contrast, the Visual Impact Assessment (VIA) conducted by the Applicant evaluated a 70-turbine array (EDR 2009b). In evaluating potential effects on visual resources, it is important to consider the differences between these turbine arrays.

The visual analyses conducted for the 70-turbine Project included VSA analysis, cross section analysis, field evaluation, preparation of visual simulations, and evaluation of visual impact based on those simulations. Although each of these analyses was based on the specific turbine locations and specifications/dimensions proposed in the 70-turbine Project, the results/conclusions of these analyses are generally applicable to an incrementally larger (e.g., 100-turbine) or smaller (e.g., 52 turbine) wind power project. As will be discussed in the following section, the greatest impact typically occurs when numerous turbines are visible and/or where the turbines are close to the viewer. These conclusions remain accurate whether addressing the effect of adding 100 turbines or 70 turbines into the landscape.

The VIA was consistent with methodologies developed by the DOI Bureau of Land Management (1980, as cited in EDR 2009b), USDA National Forest Service (1974, as cited in EDR 2009b), USDOT Federal Highway Administration (1981, as cited in EDR 2009b), and New York State Department of Environmental Conservation (n.d., as cited in EDR 2009b). The following sections summarize the structure and findings of the VIA, as described in EDR 2009b. A detailed description of the VIA, reprinted from the Application (EDR 2009b), is included in Appendix H.

Visibility Analysis

As part of the VIA, the Applicant completed various analyses to estimate the extent of potential Project visibility. Digital viewshed maps were prepared based on topography, assumed turbine design (maximum blade tip height of 150 m [492 ft] above ground), and FAA-compliant turbine lighting (assumed nacelle height of 100 m [328 ft] above ground). The initial analysis included a "worst case" scenario, in which screening provided by vegetation and structures was not considered. A subsequent viewshed analysis also was prepared (based on USGS land cover data delineating forests with an assumed vegetation height of 12 m [40 ft]), as shown in Figure 5.8-1. A turbine count analysis was also included to indicate the number of turbines potentially visible within the viewshed.

The Visibility Analysis also included the following components:

- A cross section analysis, documenting "representative line-of-sight cross sections (ranging from 9.8 to 15.8 km [6.1 to 9.8 mi] long)….Cross section locations were chosen so as to include visually sensitive areas…and cover the various landscape similarity zones" in the VSA (Stantec 2010b).
- Field verification to photo-document potential views of turbines from various viewpoints that represented "the most open, unobstructed available views of the Project…photos were taken from 116 representative viewpoints within the study area" (EDR 2009b). Photographs were used for visual simulations of future conditions (see below).

Viewshed Analysis

The viewshed analysis included in the Applicant's VIA includes several measures of potential turbine visibility within the VSA (EDR 2009b):

- Blade Tip Visibility: Topography-Only Analysis (excludes screening from vegetation and buildings).
- Nacelle/Lighting: Topography-Only Analysis (excludes screening from vegetation and buildings); nighttime conditions.

- Blade Tip Visibility: Topography and Screening Analysis (includes screening from vegetation and buildings).
- Nacelle/Lighting: Topography and Screening Analysis (includes screening from vegetation and buildings).

Table 5.8-1 shows the percentage of the VSA that could view at least one turbine under each scenario, using the 70-turbine array modeled in EDR 2009b. These areas of potential visibility include anywhere from approximately 81 to 96 percent of the visual study area. This reflects the general lack of topographic and forest screening within this area, and suggests that viewshed analysis of the 52 turbine sites identified by the Applicant would likely be only slightly lower than shown in Table 5.8-1, while a similar analysis of the full 100-turbine array proposed by the Applicant would likely be only slightly higher than shown in Table 5.8-1. Regardless of the specific number of turbines, or whether forest vegetation is factored into the analysis, the overall conclusion of the viewshed analysis is that the Project has the potential to be visible throughout the majority of the VSA.

As indicated in the VIA, "Areas where there is no possibility of seeing the Project are generally limited to the backside of hills and some stream valleys…and some slopes along the far western edge of the study area," as well as within or near blocks of contiguous forest (EDR 2009b, p. 32). The majority of potentially sensitive sites would have views of turbines. This conclusion is accurate regardless of the specific number of turbines included in the Project.

Figure 5.8-1 (a) Viewshed Analysis

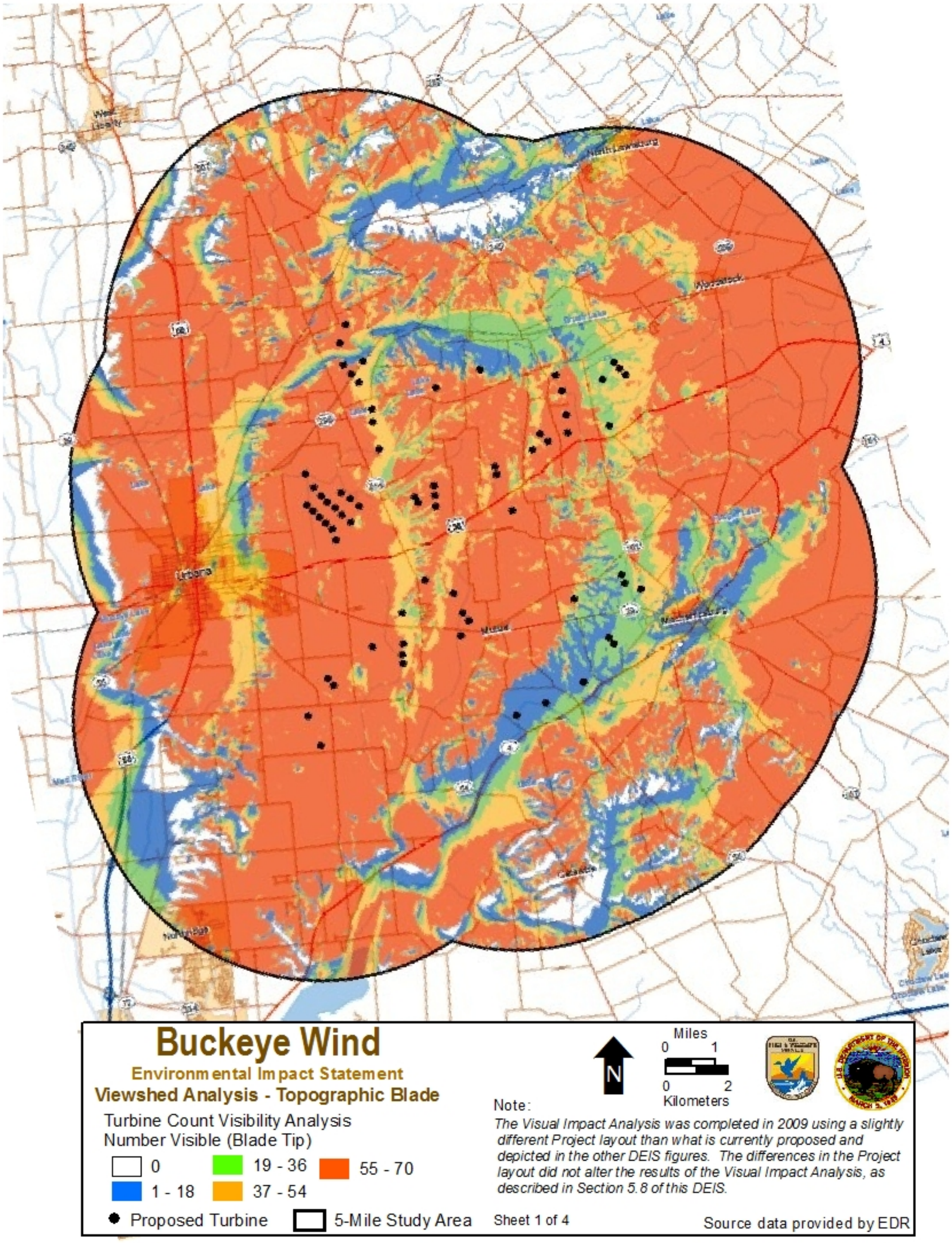

Figure 5.8-1(b) Viewshed Analysis

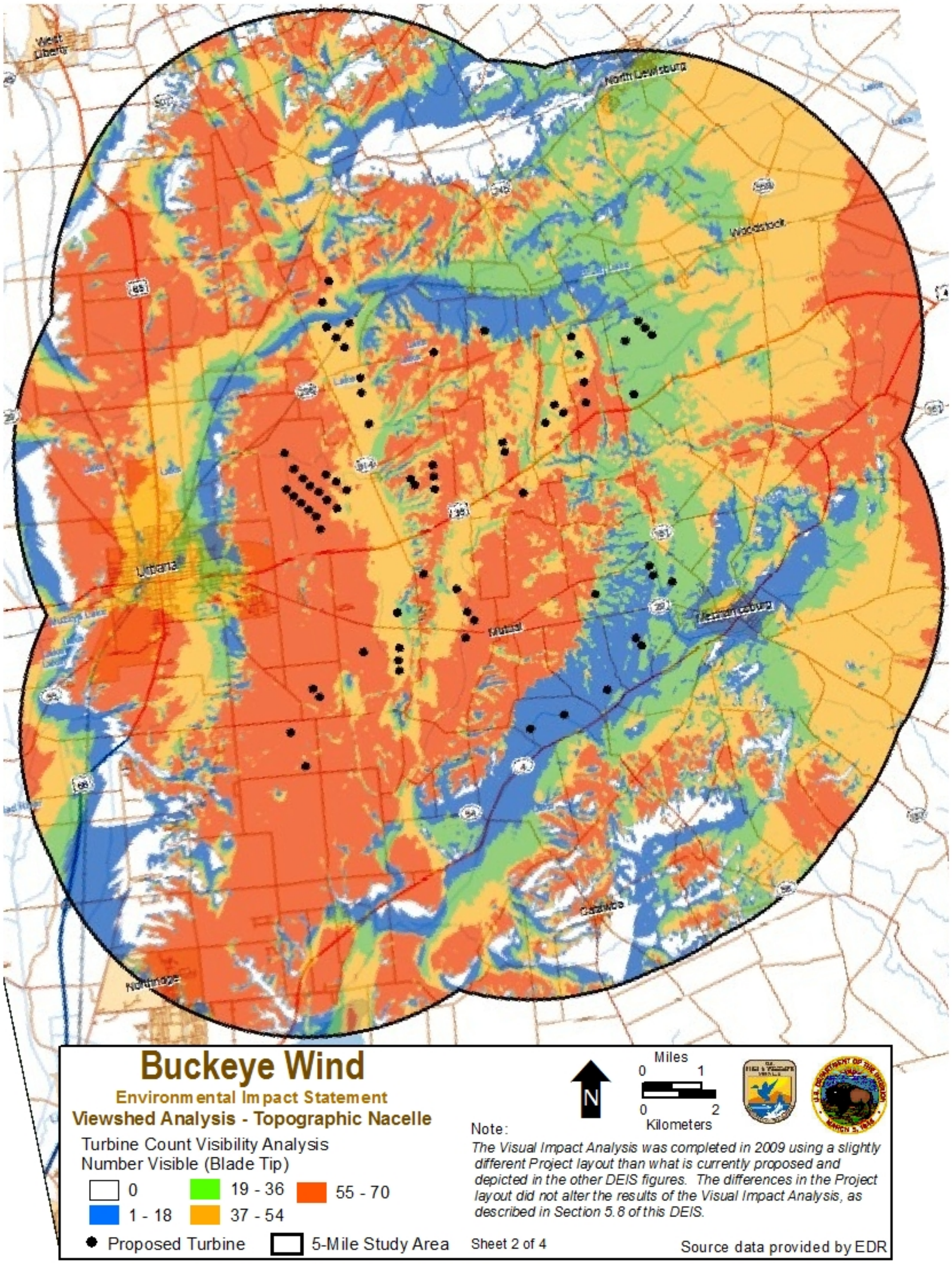

Figure 5.8-1(c) Viewshed Analysis

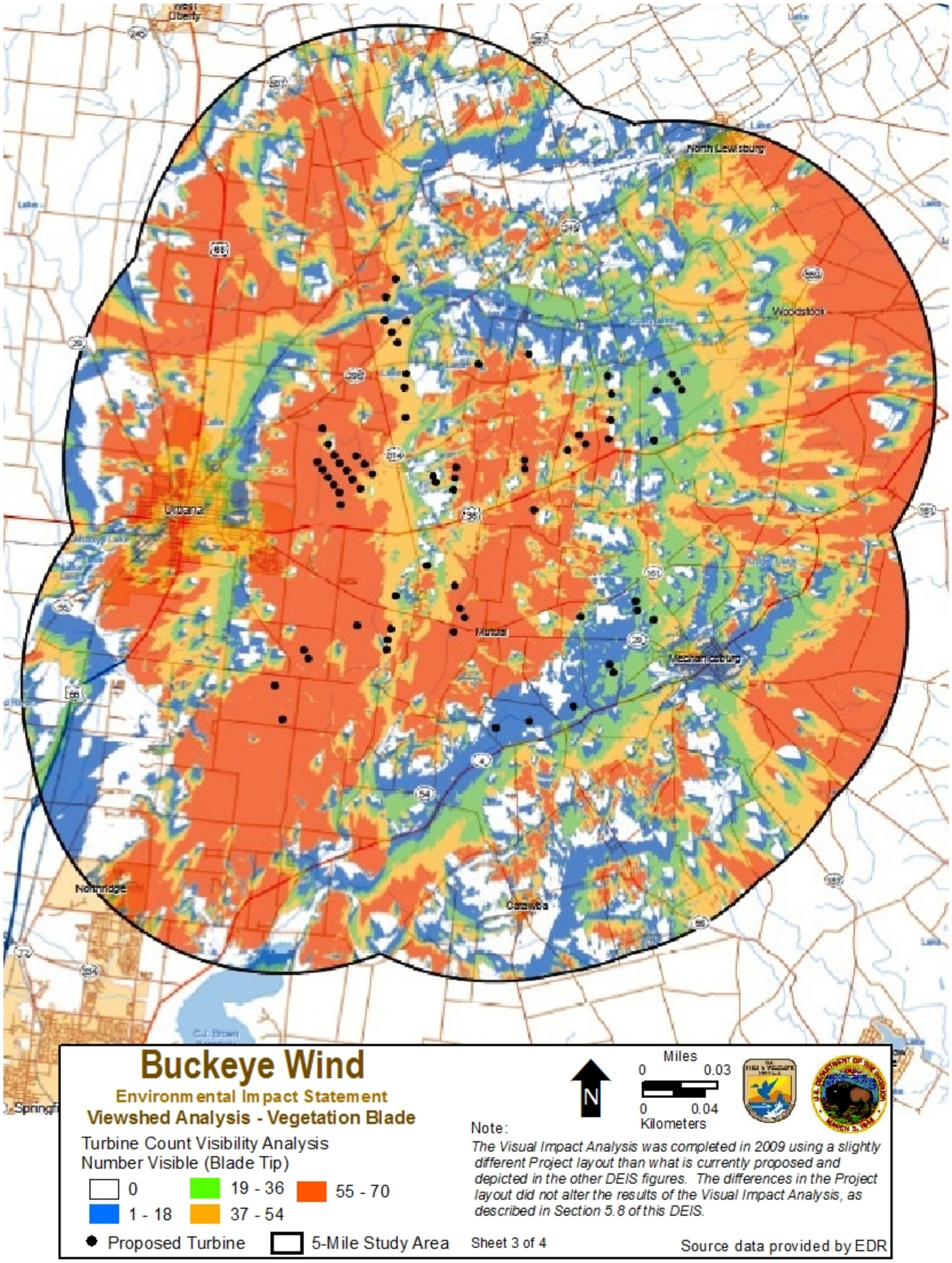

Figure 5.8-1(d) Viewshed Analysis

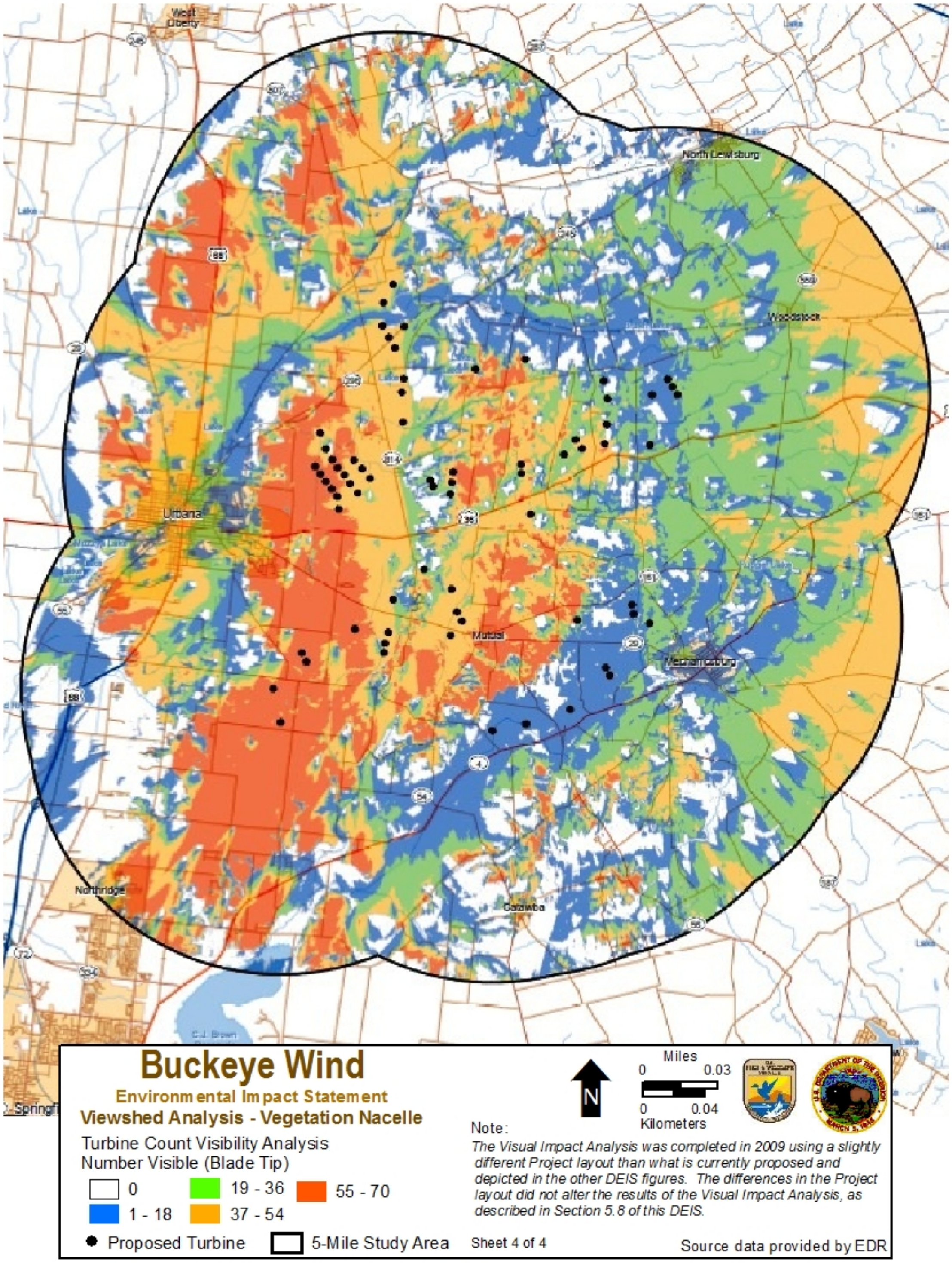

Table 5.8-1. Summary of Project Visibility Results

Turbine Visibility Analysis	Share of VSA Affected	
	ha (ac)	Percent of VSA
Blade Tip - Topography Only Analysis	66,173.8 (163,519)	95.5
Nacelle/Lighting - Topography Only Analysis	64,270.2 (158,815)	92.7
Blade Tip - Topography & Vegetation Analysis	58,619.9 (144,853)	84.6
Nacelle/Lighting – Topography & Vegetation Analysis	56,262.6 (139,028)	81.2

Source: EDR 2009b, as summarized in Stantec 2010b

It is worth noting that the Applicant's VIA weights all visibility equally – that is, the ability to see the tip of a turbine blade (e.g., the top 3 m [10 ft]) from several miles away is not specifically distinguished from the ability to see an entire turbine from one-half mile away. In reality, many distant/partial views of Project components might be barely perceptible to viewers, or even imperceptible in certain weather conditions. The Applicant's field verification also suggests that screening provided by vegetation and buildings may be more extensive than indicated by the mapping that served as the basis for the Viewshed Analysis (EDR 2009b). This is particularly true in more developed areas (e.g., the City of Urbana and the various villages in the VSA).

Cross-Section Analysis

"To…illustrate the screening effect of vegetation and structures within the [Action Area and surrounding viewshed], four representative line-of-sight cross sections" were defined in the Action Area and surrounding viewshed. "Cross section locations were chosen so as to include visually sensitive areas…and cover the various landscape similarity zones" (EDR 2009b). Although illustrating representative lines of sight from specific viewpoints/receptors to specific turbines, in effect, the cross-sections act as a representative sampling of all potential viewpoints and sources of screening throughout the VSA.

The cross-section analysis "suggests that views of the Project from many of the visually sensitive sites within the study area are likely to be at least partially screened by buildings and trees" (EDR 2009b, p. 38). In particular, views of turbines would be partially or fully screened from the City of Urbana, the Villages of Mutual and Woodstock, and most historic sites in the Action Area and surrounding viewshed. Because the cross sections are based on representative lines of sight, these conclusions are accurate for a 100-turbine Project as well as a 70-turbine Project. The overall conclusion of the cross section analysis is that screening provided by vegetation and structures not considered in the viewshed analysis are likely to reduce areas of actual Project visibility in comparison the areas of "maximum" potential visibility presented in Table 5.8-1.

Field Verification

Field review conducted as part of the Project VIA essentially confirmed the results of the cross section analysis, and indicated that actual Project visibility was likely to be more limited than suggested by the results of the viewshed analysis. This is due to the fact that screening provided by buildings and trees within the visual study area is more extensive and effective than assumed in these analyses (e.g., vegetation is more extensive than indicated on the USGS maps, and often taller than 40 feet in height). The result is that certain sites/areas where "potential" visibility was indicated by viewshed mapping were actually well screened from views of the proposed Project. Field review confirmed a lack of visibility from areas that were screened by structures and street/yard trees, particularly developed areas such as the City Urbana and the various villages (including Mechanicsburg, Woodstock, and Catawba) within the visual study area. Consequently, views of the Project from the majority of residences and historic sites within these areas are anticipated to be fully or partially screened. In general, only on the outskirts of these developed areas, where open fields adjoined residential areas, were open views available in the direction of the Project site. Even in the more rural/agricultural portions of the study area, hedgerows and trees not indicated on the USGS maps often blocked/interrupted views toward the Project site in many areas. However, open views that include at least some of the proposed turbines would be available from a broad range of distances/locations within the Rural Residential/Agricultural LSZ (EDR 2009b).

Visual Impact Evaluation

Evaluation of potential Project visibility was supplemented with visual simulations to illustrate the appearance of the Project and the potential change in views available within the VSA. These computer-based simulations inserted images of wind turbines into existing-condition field verification photos at selected locations, taking into account the screening provided by vegetation and buildings. “High-resolution computer-enhanced image processing was used to create realistic photographic simulations of the completed turbines from each of [these] viewpoints” (EDR 2009b, p. 30). Sample pairings of photos showing existing conditions and simulated future conditions are provided in Appendix H.

From the photo documentation conducted during field verification, 13 viewpoints were selected for visual simulations. The purpose of the study was to give a representative perspective of the visual impacts of the project, rather than to simulate the view from all potentially sensitive areas, or all areas in general. Viewpoints were selected based upon the following criteria:

- Provides clear, unobstructed views of the Project (as determined through field verification);
- Illustrates Project visibility from sensitive sites/resources within the Action Area and surrounding viewshed;
- Illustrates typical views from LSZs, where views of the Project would be available;
- Illustrates typical views of the Project that would be available to Potential Viewers (as described above); and
- Illustrates typical views of different numbers of turbines, from a variety of viewer distances, and under different lighting conditions, to illustrate the range of visual change that would occur with the Project in place (EDR 2009b).

The viewpoints selected for simulation are listed in Table 5.8-2. A summary of the evaluation of the visual simulations by a registered landscape architect are described in Table 5.8-3. As with Table 5.8-1, these tables reflect the findings for the 70-turbine array modeled in EDR 2009b. However, it is worth noting that none of the simulations include more than around 30 turbines. This is essentially the maximum number that can be included in a panoramic (60 degree field of view) photo. The simulations are meant to illustrate representative views of the Project from different distances, directions and landscape settings within the VSA. As such, they represent the appearance of a medium-sized wind power project(50 to 100 turbines), and conclusions regarding visual contrast or compatibility with the existing viewer groups and LSZs within the VSA are valid, regardless of the specific number or location of turbines proposed.

Table 5.8-2. Viewpoints Selected for Visual Impact Simulations

Viewpoint/Visual Resource[1]		LSZ[2]	Viewer Group	View Characteristics: Distance to nearest turbine km (mi)	View Characteristics: Azimuth
14	SR 29	RRA	Residents, commuters, travelers	0.8 (0.5)	NNE
29	SR 296	RRA	Residents, commuters, travelers	1.6 (1.0)	NE
41	US 36	RRA	Residents, commuters, travelers	1.6 (1.0)	NE
45	Mutual-Union Rd	RRA	Residents	1.6 (1.0)	NW
48	Stringtown Rd	RRA/SR	Residents	2.9 (1.8)	NNE
52	US 36	RRA/SR	Residents, commuters, travelers	2.6 (1.6)	WSW
54	Union Cemetery	RRA	Residents	1.4 (0.9)	W
61	SR 814	RRA	Residents	1.4 (0.9)	NNE
95	Bump Road	RRA	Residents	7.6 (4.7)	SSE
119	SR 54	RRA	Residents	1.0 (0.6)	NE
123	SR 4 at SR 56	RRA	Residents, commuters, travelers	0.8 (0.5)	NNE
128	Little Darby Creek Wetlands Preserve	RRA	Residents	1.1 (0.7)	WSW
131	State Route 559	RRA	Residents	5.6 (3.5)	WSW

[1] Corresponds to the viewpoint number in EDR 2009b.
[2] Landscape Suitability Zones: RRA = Rural Residential/Agriculture; SR = Suburban Residential
Source: EDR 2009b

Table 5.8-3. Summary of Results of the Photographic Simulations

Viewpoint	Existing View Description	Distance to Nearest Turbine km (mi)	No. of Visible Turbines	Summary[1]
14 – SR 29	Foreground: flat, agriculture; Background: structures, forests	0.8 (0.5)	3	Turbines create appreciable contrast
29 – SR 296	Foreground: flat, agriculture, farmhouse; Background: Forests	0.8 (0.5)	2	Turbines contrast moderated by existing man-made elements
41 – US 36	Foreground – roadway, agriculture, power poles; Background: hedgerows, farm buildings, ridgeline	1.6 (1.0)	>30	Turbines create visual clutter and dominate view
45 – Mutual Union Rd	Foreground: agriculture; Background: hedgerows, farm buildings	1.6 (1.0)	4	Turbines' contrast with horizontal lines of landscape is mitigated by vertical elements (trees, buildings)
48 – Stringtown Rd	Foreground: agriculture, house; Background: agriculture, farmhouses, farm buildings, suburban houses, forest patches, hedgerows	2.9 (1.8)	8	Turbines create moderate level of contrast

Viewpoint	Existing View Description	Distance to Nearest Turbine km (mi)	No. of Visible Turbines	Summary[1]
52 – US 36	Foreground: agriculture, Background: agriculture, farmhouses, farm buildings, suburban houses, forest patches	2.6 (1.6)	8	Turbines create minimal to moderate contrast
54 – Mutual Union Rd	Foreground: cemetery, agriculture; Background: agriculture, farm house, farm buildings, forest patches	1.4 (0.9)	5	Turbines' moderate contrast is mitigated by visual buffers (cemetery, farm, field)
61 – SR 814/County Rd 223	Foreground: agriculture; Background: farmhouse, farm buildings, hedgerows; power poles	1.4 (0.9)	6	Turbines dominate view; significant contrast associated with nearer turbines
95 – Bump Road	Foreground: agriculture, hedgerow, farmhouse, farm buildings; Background: valley, agriculture, ridge with forests, farms, radio towers	7.6 (4.7)	>10	Turbines create minor contrast
119- SR 54	Foreground: agriculture; Background: farmhouse, farm buildings, hedgerow, power poles, forest	1.0 (0.6)	>10	2 near turbines create moderate contrast and dominate view; far turbines are less distinct
123 – Intersection of SR 4 and SR 56	Foreground: power poles, roadway, grass; Background: hedgerow, forest	0.8 (0.5)	7	1 near turbine creates notable contrast; far turbines are screened
128 – Allison Road	Foreground: old fields, pasture, hedgerow; Background: old fields, pasture, hedgerows, agriculture, ridge with forest	1.1 (0.7)	2	Turbines create moderate contrast
131 – SR 559	Foreground: agriculture; Background: farm buildings, hedgerow, forest patches	5.6 (3.5)	>10	Turbines create some degree of clutter but are partially screened

[1] Based on interpretations in EDR 2009b.

Source: Stantec 2010b

As indicated in the Project VIA (EDR 2009b), the simulations, as a group, indicate that the Project would result in moderate to appreciable visual contrast from open viewpoints within 1.0 mile of the nearest turbine. At greater distances and with more screening, the contrast/impact of the Project should be significantly reduced. However, the contrast and visual impact of the wind turbines is likely to be highly variable based on the number of turbines visible, viewer sensitivity/acceptance, and/or existing land use characteristics. The greatest impact typically occurs when numerous turbines are visible and/or where the turbines are close to the viewer (i.e., less than 1.0 mile). These conditions tend to heighten the Project's contrast with existing elements of the landscape in terms of, line, form, and especially scale. Visual impact can also be significant where the turbines appear incongruous or out of place in a certain landscape setting, or where aesthetic quality and/or viewer sensitivity are high. However, it is worth noting that the lack of topographic and vegetative visibility in the Rural Residential/Agricultural LSZ, which dominates the study area, generally results in only average aesthetic quality in much of the area surrounding the proposed Project. The VIA also concluded that the Project did not appear inappropriate in a working agricultural landscape. In such settings, the proposed Project, although at times offering appreciable contrast with the landscape, would not necessarily be perceived by most viewers as having an adverse visual impact.

As indicated previously, these conclusions are based on simulations showing portions of the Project (from one to 30+ turbines) from a range of representative distances, directions and landscape settings. Consequently, the VIA's conclusions regarding a 70-turbine project would also apply to a somewhat smaller (e.g., 52-turbine) or somewhat larger (e.g., 100-turbine) project in the same area.

Other Project Components

In addition to the wind turbines, the Project would include an electrical collection system (i.e., overhead wires and buried cables), an operations and maintenance facility and storage yard, an electrical substation, and turbine access roads. Construction staging areas would not be present during operations. These facilities are shown in Figure 4.8-2.

Buried cables would result in minimal clearing of vegetation and would have no long-term impact on visual resources. A total of no more than 56.7 km (35.2 mi) of interconnection lines would be buried underground.

The overhead portion of the electrical collection system would follow existing public roads, where possible, likely using existing utility corridors. Where overhead transmission lines would be co-located with other lines, the existing poles would be replaced. However, the general size, location, and appearance of these lines would be similar to existing roadside utility lines, which are a common and generally accepted component of the landscape. A total of no more than 56.8 km (35.3 mi) of interconnection lines will be installed overhead in public road right-of-ways. The operations and maintenance facility would likely be an existing structure, or a moderately-sized new structure designed to reflect local building designs. The substation would occupy 2.0 ha (5.0 ac), and would be adjacent to an existing transmission line on agricultural property. Location of this facility adjacent to existing transmission infrastructure would minimize its visual contrast with the existing landscape. Access roads would be 6.1 m (20 ft) wide, paved with gravel, and would follow existing farm roads wherever possible. No more than 64.4 km (40.0 mi) of new access roads will be installed for the 100-turbine project. Following completion of construction these roads would take on the appearance of farm roads which are a common feature of the rural landscape that dominates the VSA.

Summary of Effects from Operations

Factors Influencing Effects from Wind Turbines

Upon completion, the Project's turbines would be visible from the vast majority of the Action Area and VSA. As evidenced by the potential visibility of a 70-turbine array, potential views of the proposed 100-turbine array would be available in the majority of the VSA – including most visually sensitive resources (particularly residences, schools and churches). However, this finding comes with some caveats. First, the visibility of some turbines might only consist of blade tips viewed above the tree line or between buildings – nuances that could not be modeled by the Applicant. Second, visibility alone does not necessarily determine significance. Rather, significance depends on a comparison of changes to the visual setting (due to the Project) against what might reasonably be expected to be visible. Thus, factors such as the distance from the nearest turbine(s) and the nature of the observer's LSZ are important.

Individual preference is also a crucial (if not overarching) factor in determining visual impact. Each person may react to the Project differently; while some may see a turbine as an eyesore, others may view the exact same turbine as a sign of economic and social progress. Views toward wind power and the alternative energy industry as a whole may also color an individual's reaction to alterations in the scenery. For an observer who considers views of turbines to be undesirable, the difference between 12 and 14 visible turbines is substantially less than the difference between zero and one visible turbine. Similarly, two additional turbines in the distance (e.g., beyond 1.6 km [1 mi] from the observer) would be substantially less intrusive than two turbines placed in the foreground (e.g., 0.5 km [0.25 mi] away from the observer). Viewers who favor wind power, or like the appearance of wind turbines, are likely to react positively to the project, regardless of the number of visible turbines or their distance from the viewer.

Effects from Wind Turbines

Based on the considerations described above, the Project would not result in significant adverse impacts for some portions of the VSA. These geographic areas include the following:

- The City – Village LSZ (where only limited portions of the Project would generally be visible among other significant human-made objects).
- Areas more than approximately 6 km (3.5 mi) from the closest turbine.[6] Beyond this point, turbines would likely blend into the background, or may have a similar impact within the visual setting as existing utility poles and lines.
- Working agricultural landscapes where the turbines generally appear compatible with existing land use.

Vehicle-based observers (e.g., travelers and commuters) also are unlikely to experience significant adverse impacts regardless of distance. While the agricultural land that makes up the majority of the VSA can be considered scenic, there are no scenic byways or other official indications of scenic quality along roads in the VSA. The length of a driver's (or passenger's) exposure to any single close-range view of a turbine would also be limited as compared to the permanent view from a residence.

Those exceptions notwithstanding, the Project would have a significant direct adverse impact on visual resources for some residents within 1.6 km (1 mi) of the nearest turbine and in sensitive locations, such as cemeteries, churches, schools, and sites of historic or cultural significance. A visual impacts analysis for historic structures has been completed, and proposed mitigations submitted to OHPO for review as discussed in Section 5.6, Cultural Resources. Effects on these resources were evaluated on the landscape level, resulting in a finding that construction of the proposed project may adversely affect the perception of the traditional rural historic landscape, changing important qualities of the setting in which many of the character-defining historic property types are located. Significant impacts would specifically occur in such locations whose views of nearby turbines are not screened by vegetation or buildings.

[6] This distance is cited in the Applicant's VIA (EDR 2009b) as distance within which significant effects of wind power projects are generally concentrated (Eyre 1995).

Effects from Other Facilities

Facilities other than turbines – the operations and maintenance facility, substation, access roads, and the electrical collection system – would have no significant direct or indirect impacts on visual resources. The access roads and electrical wires would be in the same general location as existing roads and wires (respectively) and would be similar in character to those existing features. The substation would be within 305 m (1,000 ft) of a few residences (for whom the Project might be more of a visual disturbance). The operations and maintenance facility would have no impact if an existing building were purchased and refurbished. If a new operations and maintenance building were built, it would presumably be located in an area that permits industrial buildings (i.e., through zoning) and would be designed to resemble agricultural buildings (Stantec 2010b).

Decommissioning-related Effects

Visual effects associated with decommissioning activities (the dismantling of the turbines and other Project facilities, and the restoration of the natural landscape) would be similar to those caused by construction of the Project except that the total area of disturbed earth would likely be smaller than during construction. These activities could occur as early as 2037. If the Action Area is restored to the pre-Project state, decommissioning would not affect visual resources in the Action Area and surrounding landscape; in fact, removal of the Project would return visual resources to their pre-project state; therefore, decommissioning could potentially positively affect visual resources.

Mitigation Measures for Unavoidable Impacts

In addition to the avoidance and minimization measures listed above (relating to turbine color/finish and FAA lighting), the Project would incorporate the following design and operational features to reduce visual impacts:

- All turbines would have uniform design, speed, color, height, and rotor diameter;
- Towers would include no exterior ladders or cat walks;
- Non-specular (i.e., non-reflective) conductor would be used on all overhead electrical lines;
- No advertising devices would be allowed on the turbines;
- The turbines and turbine sites would be maintained to ensure that they are clean, attractive, and operating efficiently;
- Lighting at the proposed substation would be turned on only as needed by switch or motion detector; and
- If the Project goes out of service, and is not repowered/redeveloped, all visible above-ground turbine components would be removed.

In summary, the Proposed Action would have a significant direct adverse visual impact on some residents and visually sensitive resources such as cemeteries, churches, schools, and sites of historic or cultural significance. Viewshed analysis and field verification indicate that the Project has the potential to be visible from the majority of the VSA. In most locations where any turbines would be visible, significant portions of the overall Project are also likely to be visible.

However, field review also indicates that in many areas a significant number of the turbines would be at least partially screened by trees and structures. Viewshed analysis indicates that views of the Project are likely to be available from the majority of the visually sensitive resources and areas of intensive land use that occur within the VSA. However, for many of these sites, including National Register-listed historic sites and others that occur in the City of Urbana and the various villages, field review suggests that the Project would either not be visible or would be significantly screened by foreground vegetation and structures.

Simulations of the proposed Project, indicate that the visibility and visual impact of the wind turbines would be highly variable, based on landscape setting, the extent of natural screening, the presence of other man-made features in the view, and distance of the viewer from the Project. Evaluation of the simulations by a licensed landscape architect indicates that the Project's overall contrast with the visual/aesthetic character of the area would generally be moderate. Minimal contrast was noted for viewpoints over 3.5 miles from the Project, while more appreciable contrast was noted where foreground and near mid-ground views of turbines (i.e., under 1.0 mile) are available, where substantial numbers of turbines span the field view, and/or where the turbines appear out of context/character with the landscape (i.e., in more suburban residential areas). However, in most cases the reviewing landscape architect felt the Project was compatible with the working agricultural landscape that makes up the majority of the visual study area (EDR 2009b). These conclusions are applicable to a 70-turbine Project as well as incrementally smaller or larger projects (e.g., 59 or 100 turbines). Based on experience with currently operating wind power projects elsewhere, public reaction to the Project is likely to be generally positive, but highly variable based on proximity to the turbines, the affected landscape, and personal attitude of the viewer regarding wind power.

5.8.2.2 Redesign Option

The Redesign Option is an optional measure under the Proposed Action that includes a primarily buried collection system. Impacts to visual resources are expected to be similar to those described for the Proposed Action. As under the Redesign Option more of the 34.5-kV interconnects would be buried underground (86.4 km [53.7 mi] with Redesign Option versus 56.6 km [35.2 mi] for the Proposed Action), their direct adverse impact on visual resources may be slightly higher during construction since the total area of disturbed earth would likely be larger than as for the Proposed Action. However, during operation the areas where the underground interconnects were buried would be revegetated, potentially reducing the impact on visual resources for some residents. However, as mentioned previously, overhead lines associated with the Project would look like typical roadside utility lines, which are a common and generally accepted component of the landscape. Thus, additional burial of the electrical lines would have limited mitigation value. All other avoidance and minimization measures would be the same as described above for the Proposed Action.

5.8.3 Alternative A - Maximally Restricted Operations Alternative

Alternative A differs from the Proposed Action only with respect to operations. The operational differences would not directly affect visual resources. However, research and anecdotal reports indicate that viewers find wind turbines more appealing when the rotors are turning (Stanton 1996). In general, the construction, operation, and decommissioning-related effects of

Alternative A on visual resources and the recommended minimization measures would be more-or-less the same as under the Proposed Action.

5.8.4 Alternative B - Minimally Restricted Operations Alternative

Alternative B differs from the Proposed Action only with respect to operations. The operational differences would not affect visual resources. As such, the construction, operation, and decommissioning-related effects of Alternative B on visual resources and the recommended minimization measures would be the same as under the Proposed Action.

5.8.5 Alternative C - No Action Alternative

Under Alternative C, the Project would not be built and no Project-related activities (construction, operation, or decommissioning) would occur. Alternative C would have no effect on visual resources, as land use and visual character in the area would remain largely agricultural. As such, no mitigation measures would be warranted.

5.9 Socioeconomics and Environmental Justice

5.9.1 Impact Criteria

Consideration of the effects of the Proposed Action and alternatives on socioeconomic conditions must be considered as part of an overall NEPA analysis. Section 4906-13-07 of the Ohio Administrative Code (OAC) also requires consideration of socioeconomic conditions. In addition, per the requirements of Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations) and Executive Order 13045 (Protection of Children from Environmental Health Risks and Safety Risks), socioeconomic impacts must be assessed for potential disproportionate effects on minority and low-income communities and children, respectively. Socioeconomic impacts are evaluated in the context of the Five-County Analysis Area, which includes the five counties that overlap the Action Area. The Five-County Analysis Area is used in the context of socioeconomics due to Project interaction with and potential impact on broader regional systems spread beyond the boundaries of the Action Area.

5.9.2 Proposed Action

This analysis provides a discussion of the Proposed Action’s potential impacts on socioeconomic resources. As part of their OPSB Application, the Applicant commissioned a socioeconomic study for the Project, focusing on three possible scenarios for the Proposed Action, including a Project with a 131.4 MW capacity, a 146 MW capacity, and a 182.5 MW capacity (Saratoga Associates 2009). Because the Proposed Action would have a capacity of up to 250 MW, the analyses in this section extrapolate the impacts described for lower-wattage scenarios as necessary and appropriate to account for the impacts of a 250 MW Project.

As part of its socioeconomic study, the Applicant applied a Regional Input-Output Modeling System (RIMS II) to determine the economic impacts of the Project. RIMS II was developed by the United States Department of Commerce, Bureau of Economic Analysis (USBEA). The RIMS and RIMS II models have been employed by federal and other agencies since the 1970s to estimate regional multipliers for impact analysis in output, earnings, and employment associated with a program or project under study.

The following terms are used for this economic impact analysis:

- Output: This refers to the sales receipts for the Project. During each phase of construction, output refers to the total cost for the construction of the Project. For the operations phase, output refers to the annual gross revenues derived from the operation of the Project.
- Earnings: During the construction phase, earnings refer to wages paid to construction workers. During the operations phase, wages come from two sources: from wages paid to wind farm employees and from leases paid to landowners.
- Employment: This refers to the number of short-term jobs created during the construction phase, as well as the number of permanent employees at the Project during operation.
- Multipliers: The use of regional economic multipliers is a standard method for identifying the potential effects of a major change in a region's economy, such as the Project. These measures estimate the changes in output, income, and employment resulting from an initial change in spending, specific to the region under study (Coughlin and Mandelbaum 1991 as cited in Saratoga 2009).

RIMS II multipliers were used to determine economic impacts during both the construction phase and the operations phase of the Project as a whole. Construction generally creates a one-time surge in economic activity, while the operation and maintenance phase provides an on-going economic contribution by creating long-term jobs, continuing income streams for landowners, and revenues for municipalities.

5.9.2.1 Avoidance and Minimization Measures

The Proposed Action contains the following measures that would avoid or minimize adverse impacts to socioeconomics.

- **Land Use:** Restore site per NPDES which would make permanent land use impacts minimal
- **Property Values:** Make land lease payments to participating landowners to offset any possible downward pressure on property values.
- **Jobs and Income.** The Applicant would commit to use local/regional labor, goods, and services when practicable. The Project would comply with Ohio Senate Bill (SB) 232, which reduces tax rates for renewable and advanced energy generators utilizing technologies such as wind, solar, co-generation and clean coal.
- **Health and Safety.** Implement construction and operation best management practices to minimize health or safety risks.

Indirect negative impacts to socioeconomic conditions are anticipated as a result of the construction and operation of the Project, such as visual impacts, noise, dust, and health and safety concerns. Avoidance and minimization measures for these impacts are addressed in their respective sections in this EIS.

Construction-related Effects

It is not expected that the Project would have significant negative socioeconomic impacts during the construction phase. The Project seeks to avoid or minimize adverse socioeconomic impacts by having an overall positive effect on local economic development. The creation of temporary and permanent jobs in the local economy, net gains in revenue to local governments, and land lease payments to participating land owners would have a positive economic impact on both residents and local government agencies. It is possible that a decrease in property values would occur, but could be partially offset by properties receiving land lease payments and tax revenue generated by the project. Construction activities would create a temporary increase in traffic volume and require some traffic diversions, and may cause additional noise and dust. However, these occurrences would be minimized by best management practices, and would likely have little effect on the socioeconomic activities of residents and visitors. Overall, the positive impacts of the Project including creation of new jobs during the construction phase of the project, and projected increases in direct, indirect, and induced total local benefits, would offset the temporary negative impacts of the Project.

Socioeconomic Effects

The socioeconomic impacts associated with construction are typically felt in the short-term. During the construction phase, opportunities for employment would offer both direct and indirect benefits for local and regional residents.

The Project is not expected to have negative, direct economic impacts during construction. However, short-term indirect impacts would be felt by individual landowners who may not be able to access or use portions of their land during construction. A 200-ft radius per turbine would be cleared and graded in preparation for equipment delivery, foundation construction, and assembly of each turbine (see Appendix B, Section 2.2). Once constructed, much of this cleared land would be available for use by the landowner; the loss of use would consist of the footprint of the wind turbines or other associated facilities, but only for the life of the project. The loss of use would be compensated through the lease agreement and payments.

Other short term, negative, indirect impacts may include diversions of traffic (see Section 5.12) and added noise (Section 5.10) and dust (Section 5.11). These occurrences may be seen as temporary inconveniences to residences or visitors. Construction activity may discourage some consumers from purchasing goods and services in the communities, but the extent of this occurrence likely is negligible.

Construction of the Project would also have positive direct and indirect economic effects. Construction of the Project would generate a number of full time construction jobs over the one or two 12 to 18 month construction phases, as well as many more indirect full-time jobs. Table 5.9-1 summarizes the projected number of jobs created by construction of the Project. Construction crews would also likely patronize local businesses during construction, stimulating additional short-term economic activity.

Table 5.9-1 Direct and Indirect Construction Employment for the Proposed Action

Category	Jobs Created
Full Time Direct Construction Jobs[1]	249
Jobs Multiplier	11.8647
Full Time Indirect Jobs	2,954
Total Jobs	**3,203**

[1] Calculations made by Saratoga Associates (2009) based on 12 wind facilities throughout Colorado, Minnesota, New York, Ohio, Oklahoma, Oregon, and Texas indicated that each MW of wind energy demanded 0.9968 construction workers ("Full Time Direct Construction Jobs").

Source: Saratoga Associates 2009 US BEA (RIMS II multiplier)

The direct construction jobs would create a spin-off of additional employment in other sectors of the economy. These estimated calculations for the additional employment were based on a multiplier of 11.8647 jobs (per the RIMS II model) for every construction job in the Five-County Analysis Area, as for Champaign, Clark, Logan, Madison, and Union Counties (Saratoga Associates 2009). This multiplier is comparable to those used for other projects, including the Dutch Hill Wind Farm in Cohocton, NY (Saratoga Associates, 2006).

Estimating the portion of employment that would be drawn from the local labor markets may be difficult. Local construction employment would primarily include equipment operators, truck drivers, laborers, and electricians. The balance of construction employment would include workers with necessarily special skills (such as specialized turbine engineers or mechanics) imported from outside the region for the duration of construction (Saratoga Associates 2009).

In addition to employment, the Project would provide a direct investment into the communities in the Five-County Analysis Area (and potentially beyond) through expenditures for business services, labor, and materials. The original construction investment also would generate an indirect and induced output. The RIMS II model assigns a multiplier of 1.5331 for every dollar in construction investment in the Five-County Analysis Area (Saratoga Associates 2009). Table 5.9-2 summarizes the direct and indirect investments that would be accrued during construction of the Proposed Action.

Table 5.9-2 Direct and Indirect Impacts on Investment for Construction of the Proposed Action

Investment Category	Dollars invested (millions)
Direct Construction Investment	$592.500
Construction Investment Multiplier	1.5331
Indirect and Induced Output	$908.362
Total Investment	**$1,500.862**

Source: Saratoga Associates 2009 US BEA (RIMS II multiplier)

As expected, additional household earnings also would be generated due to the employment of construction workers over an 18-month period. These earnings also would generate an economic spin-off contributing to the total economic impact of Project construction. RIMS II assigns a multiplier of 0.4049 for every dollar of wages earned in the construction industry in the Five-County Analysis Area (Saratoga Associates 2009). Table 5.9-3 summarizes these earnings for construction of the Proposed Action.

Table 5.9-3 Direct and Indirect Impacts on Household Earnings for Construction of the Proposed Action

Category	Household Earnings (millions)
Direct Household Earnings from Construction Jobs	$13.750
Earnings Multiplier	0.4049
Indirect Household Earnings	$5.564
Total Economic Impact	**$19.317**

Source: Saratoga Associates 2009 US BEA (RIMS II multiplier)

Alternative Tax Payments

The construction of the Project is anticipated to generate Alternative Tax revenues to all taxing jurisdictions that host the Project. These payments are addressed in the discussion of operations-related effects.

Property Values

The construction of the Project would not directly impact residential or commercial property values. However, these activities may indirectly affect the perceived value of these properties. Such indirect effects during construction are similar to those that might be experienced during Project operation, and are addressed in the discussion of operations-related effects.

Regional Effects

General population and housing trends in the vicinity of the Project are provided in Section 4.9 (affected environment for socioeconomics). As described above, approximately 249 short-term, full-time construction jobs would be created during Project construction. Local employees (e.g., those in the Five-County Analysis Area) would be hired to the extent possible, and hiring of non-resident workers would occur only when local residents with the required skills were not available or competitive (EDR 2009a). Most full-time construction employees likely would commute to the work site on a daily basis. Indirect employment (per Table 5.9-1) would likely be drawn from the existing labor pool in the Five-County Analysis Area, and could come in the form of jobs in construction supply, retail, food service, and related industries.

Such levels of employment are unlikely to affect the overall population of the host townships, and would not create an additional demand for housing. As shown in Table 4.9-3, housing vacancy rates in the host townships and the Five-County Analysis Area are comparable to statewide vacancy rates, albeit with some variation. Workers who do not already live within commuting distance could either buy or rent available residences, or in limited cases might choose to stay in regional transient housing or motels (EDR 2009a).

Since the Project is not expected to have significant growth-inducing effects on the surrounding locales, no significant impacts on local public services and facilities are expected. The construction of the Project would not likely bring families that might require family healthcare or additional school facilities. The principal impact on public services in the Action Area would be increases in traffic on routes leading to the site due to deliveries of equipment and materials during construction (see Section 5.12).

Environmental Justice

As previously discussed, Executive Order 12898 requires federal agencies to address potential environmental justice impacts to minority and low income populations. Because any construction impacts would be short-term in nature, the environmental justice analysis of the Proposed Action is included in the discussion of operation and maintenance-related effects.

Operation and Maintenance-related Effects

Socioeconomic effects

Socioeconomic effects of the Proposed Action would likely impact the long-term resources of the local and regional communities. For example, the long-term opportunities for increased income through the lease of land necessary to accommodate the Project would offer both direct and indirect benefits to participating landowners, as well as to the host townships.

This Project is not expected to have direct negative economic impacts during operation. Similar to the construction phase, some short-term indirect impacts may be felt by individual landowners who cannot access or fully use portions of their land during the initial years of operation, while the land is being re-vegetated and/or returned to its original conditions. These impacts would be temporary, and would involve only the 200-ft radius per turbine cleared for construction. Permanent loss of use would be limited to the footprint of each wind turbine or other associated facilities. Agricultural activities, for example, could continue up to the turbine footprint and the edge of access roads (EverPower n.d.). As previously discussed, the loss of use would be compensated through lease agreements and payments.

Once in operation, the Facility is expected to help meet the State of Ohio's goal for creating renewable energy sources. Therefore, during operation, increasing electrical capacity and reliability would be an economic benefit to the surrounding communities. Furthermore, additional jobs and revenues (e.g., through leases and tax revenue) would be created by the Facility, benefitting the host townships and communities in the Five-County Analysis Area.

The Proposed Action is expected to create approximately 12 full-time jobs.[7] These jobs include the following (Saratoga Associates 2009):

- One Operations Manager/Supervisor;
- Eight Operations and Maintenance technicians;
- One parts/logistics person; and
- Two customer service representatives.

[7] The Applicant's socioeconomic study (Saratoga Associates 2009) also calculated the creation of 12 permanent jobs for wind farms with three lower capacities. Given the economies of scale associated with operating large wind farm arrays, it is assumed that a 250 MW facility would not require more personnel than, say, a 131.4 MW facility (the lowest-capacity facility evaluated by the Applicant).

Annual wages for the 12 full time employees are estimated at $0.569 million.[8] The RIMS II model established a multiplier of 4.144 for every job created in the power generation and supply industry in the Five-County Analysis Area (Saratoga Associates 2009). Table 5.9-4 summarizes the direct and indirect employment that would be created by operation of the Project. The indirect jobs in Table 5.9-4 do not include other services to the Project, including but not limited to snow plowing, landscaping, and road repairs (Saratoga Associates 2009).

Table 5.9-4 Direct and Indirect Employment from Operation of the Proposed Action

Category	Jobs Created
Full Time Direct Jobs	12
Jobs Multiplier	4.144
Full Time Indirect Jobs	50
Total Jobs	**62**

Source: Saratoga Associates 2009 US BEA (RIMS II multiplier)

Total direct earnings associated with the Proposed Action comprise direct wages and leases paid to property owners during operation of the Project. These direct earnings are also projected to have indirect and induced impacts. Table 5.9-5 summarizes the Proposed Action's direct and indirect earnings during operation. The RIMS II model established a multiplier of 0.2414 for every dollar earned through wages and leases in the power generation and supply industry in the Five-County Analysis Area (Saratoga Associates 2009).

Table 5.9-5 Direct and Indirect Earnings from Operation of the Proposed Action

Earnings Type	Earnings (millions)
Total Direct Earnings[1]	$3.750
Earnings Multiplier	0.2414
Total Indirect Earnings	$0.905
Total Earnings	**$4.655**

[1] Direct Earnings were calculated by averaging the per-MW direct earnings from each of the three scenarios in Saratoga Associates 2009, and applying that factor ($0.15 million per MW) to a 250 MW facility.

Source: Saratoga Associates 2009 US BEA (RIMS II multiplier)

Output in the form of annual gross revenues from energy production (direct impacts) can also be projected, along with their indirect and induced impacts. Table 5.9-6 summarizes the Proposed Action's direct and indirect output during operation. The RIMS II model established a multiplier of 1.2606 for every dollar of investment in the power generation and supply industry in the Five-County Analysis Area (Saratoga Associates 2009).

[8] According to the Saratoga Associates' (2009) Report, total wages are derived from 2007 data for West Northwestern Ohio provided by the Bureau of Labor Statistics (BLS), as follows (parentheses indicate the BLS labor category): one Operations Manager (General and Operations Manager), with an average wage of $86,380; eight operations and maintenance technicians (Electrical and Electronic Engineering Technicians), with an average annual wage of $45,890 per person; and one Parts/Logistics Person (Logistician) and two Customer Service Representatives with average annual wages of $28,790 each.

Table 5.9-6 Direct and Indirect Output from Operation of the Proposed Action

Revenue Type	Revenue (millions)
Direct Gross Revenue[1]	$56.175
Indirect and Induced Impacts on Gross Revenue	$70.814
Multiplier	1.2606
Total Economic Impact	$126.989

[1] Gross Revenues were calculated by averaging the per-MW gross revenue from each of the three scenarios in Saratoga Associates 2009, and applying that factor ($0.2247 million per MW) to a 250 MW facility.

Source: Saratoga Associates 2009 US BEA (RIMS II multiplier)

Alternative Tax Revenues

The State of Ohio recently established a $7,000 flat tax rate per MW generated at wind power facilities in order to incentivize wind power development in the state and make Ohio's tax structure more comparable with other nearby states.[9] For a 250 MW facility, these tax revenues would total $1.75 million per year.[10]

These revenues would be distributed to all taxing jurisdictions that host the Project, including the townships of Goshen, Rush, Salem, Union, and Wayne in Champaign County, as well as the Urbana City School District, the Mechanicsburg Exempted Village School District, the Triad Local School District, and the West Liberty-Salem Local School District. These revenues would be distributed based on the prevailing composition of each township's tax base (Saratoga Associates 2009).

In addition, purchases of goods and services associated with the construction and operation of the Proposed Action would generate direct sales taxes for Champaign County and other jurisdictions where such purchases are made. Expenditures by Project employees and landowners who receive payments related to the Project could also be an indirect source of sales tax revenue. As of March 2012, the Ohio statewide sales tax is 5.5 percent. Local sales tax in Champaign, Clark, and Logan counties is an additional 1.5 percent; local sales tax in Madison and Union counties is an additional 1.25 percent.

Property Values

The construction and operation of the Project would not directly impact residential or commercial property values. Based on the information summarized in Appendix I, the presence of wind turbines alone is not consistently associated with a reduction in residential property value. Other factors and considerations, such as property type and condition, existing amenities, and distance to and size of wind turbines also affect a buyer's evaluation of property.

Those findings notwithstanding, the perceived and/or real market value of a property may decrease in response to one of the following indirect effects:

- The perceived potential health and safety impacts of the wind turbines;

[9] The $7,000/MWh rate is the standard rate codified in state law, but actual rates could vary from $6,000-$9,000/MWh depending on the number of workers domiciled in the state and the rate the county is able to negotiate.
[10] Source: Cartledge, 2010; Office of the State of Ohio Auditor and Buckeye Wind as cited in Saratoga Associates 2009; and Sub. S.B. 232, 2010.

- The perceived visual "unattractiveness" of the wind turbine; and
- Perceived reduction in quality of environment (i.e., changes to land use and/or character of the geographic settings).

Available studies show substantial variation in the rate of property value decrease in response to the above effects, making quantification of these impacts impossible. Moreover, amenities and factors must be considered when predicting changes in property values. Overall fluctuation in the housing market is one important consideration. Furthermore, predicting how people perceive property is difficult. For example, individuals who perceived wind energy as a clean source of power often perceived little or no decline in property value due to the presence of wind turbines compared to those who did not. Likewise, individuals who were more likely to participate in a "green" energy program were more willing to allow electrical generation windmills in their viewshed (Groothuis, Groothuis, and Whitehead 2007).

Conversely, the perceived and/or real market value of property could increase if:

- Potential lease payments increase the value of land used for the Project;
- Increased local electrical reliability enhances opportunities for development of residential or commercial interests; or
- The quality and quantity of public services (including education) was increased due to increased tax revenues generated by the Project.

The reliability of the power grid in Ohio is generally good, so the Project would not be expected to cause a significant increase in value based on power reliability. However, a general increase in property values may result from the lease payments. This increase would likely depend on the conditions of the lease, especially if a sale is made prior to the decommissioning of the Project.

Health and safety, visual, land use, and development factors can also affect residential property values, as discussed below.

Health and Safety

As discussed in Section 5.14, health and safety impacts associated with the Project are expected to be minimal. However, the perception of possible health effects can influence property buyers, potentially reducing the pool of potential buyers for properties near wind turbines (as compared to an equivalent property located elsewhere).

Visual

Aesthetic consideration is just one factor affecting the perceived and/or real market value of a property. As discussed in Section 5.8, the view of wind turbines can have a negative impact on the overall quality and feel of a community, although this point of view is highly dependent upon the feelings of the individual viewer. People who feel that wind turbines are incompatible with their desired viewshed may not be willing to purchase a property in the vicinity of a wind farm. Therefore, the pool of potential buyers could be smaller for a property with a view of wind turbines. Conclusions from studies cited in Appendix H and above suggest that impacts on property values from the Project could vary throughout the viewshed.

Land Use

As stated in Section 5.7, overall land use categorization would not be impacted by the construction or operation of the Project. A small percentage of agricultural land would be unavailable for use during the 25 year life of the project.

Development Opportunities

A reliable source of renewable energy could be an incentive to promote future development within the region and could therefore indirectly increase property values. As previously noted, electricity generated by the Project has the potential to displace electricity generated by fossil fuels, removing inefficient and environmentally harmful sources of power. However, also as noted, the reliability of the power grid in Ohio is generally good.

Regional Effects

General population and housing trends are discussed in Section 4.9. Only 12 permanent employees would be needed for the operation of the Project, with perhaps another 50 indirect jobs created by the Proposed Action. Even if all of these jobs were filled by employees not currently living or working in the Five-County Analysis Area, this additional employment would have negligible impacts on the population, housing supply, and demand for public services and facilities in the host townships and other jurisdictions in the Five-County Analysis Area.

Environmental Justice

This section describes the potential environmental justice effects of the Project, in accordance with Executive Order 12898. For this analysis, a disproportionately high and adverse effect on minority and low income populations means an adverse effect that "1.) is predominately borne by a minority population and/or a low income population, or 2.) would be suffered by the minority population and/or a low income population, and is appreciably more severe or greater in magnitude than the adverse effect that would be suffered by the non-minority population and/or a non-low income population" (USDOT 1997, p 18,377). In particular, disproportionate impacts typically occur when the following criteria are met:

- The minority or low-income population of the impacted geographic area exceeds 50 percent overall; and/or
- The minority or low-income population percentage of the environmental impact area is significantly greater (typically at least 20 percentage points) than the low-income or minority population percentage in the geographic area chosen for comparative analysis (in this case, the State of Ohio).

To determine if these criteria have been met, data from the host townships are compared to data for the state as a whole. Data for other geographic areas is provided only for additional information.

Table 5.9-7 shows the percentage of the population that is a minority (e.g., nonwhite), or that is categorized as being below the poverty level for each of the geographic areas evaluated in this EIS. None of the areas exceed 50 percent with regard to minority or poverty. Champaign County and the Counties in the Five-County Analysis Area have a smaller proportion of minority populations than the State of Ohio as a whole. The host townships' share of population below the poverty level is higher than the State of Ohio's, but the difference is de-minimis (0.1 percent).

Based on the information provided in Table 5.9-7, no disproportionately minority or low income population is located within any of the relevant geographic areas. Therefore, the Project would not place an undue burden on these populations.

Table 5.9-7 Minority and Poverty Populations in the Geographic Area of the Project

	Minority Population Percentage	Percentage of Population Below Poverty Level
Host Townships	6.6	14.3
Champaign County	5.3	11.5
Counties in the Five-County Analysis Area	9.7	13.7
State of Ohio	17.3	14.2

Source: US Census Bureau: Census 2010; American Community Survey 2010

Aesthetics and Quality of Life

Residents primarily would be affected by temporary and permanent aesthetic changes due to the Project. The introduction of wind turbines may be perceived by some people as an intrusion in the rural environment. While individuals would have different visual and aesthetic experiences, taken as a whole, all residents and visitors in the region would be affected by the Project in a similar manner. Thus the construction and operation of the wind turbines would not result in a disproportionate adverse impact to minority and low income populations.

Inconveniences related to access and mobility may occur along the properties where construction would take place. In addition, dust and noise would be present, along with visual intrusions as a result of construction activities and equipment. These impacts would be felt most by individual landowners who are participating in the lease program and adjacent landowners. Such effects would be temporary and would last only as long as construction of the components in question.

Economic and Employment Effects

The activities associated with the Project are not expected to result in an economic hardship—such as an increase in taxes—that would be disproportionate to minority or low income populations. If approved, the Project could instead increase the amount of tax revenue available to the host townships. As described above, the Proposed Action could also provide increased direct and indirect employment opportunities.

Health and Safety

Health and safety impacts associated with wind turbines are described in Section 5.14, and can include, but are not limited to, ice shedding, blade throw, and shadow flicker. The Project incorporates setbacks to ensure that safety standards are met. Shadow flicker would need to be addressed on a case-by-case basis. The Proposed Action is not expected to produce adverse health and safety impacts to the local population in general, nor to minority or low income populations or children in particular.

Decommissioning-related Effects

During decommissioning, turbines and other Project structures would be dismantled, and the landscape would be returned to its pre-Project state. Any socioeconomic impacts from (and impacts due to) decommissioning (including employment-related positive impacts) would be short-term and comparable to the impacts that might be expected during the construction phase.

Additional negative impacts would include the loss of lease payments and tax revenue. These sources of revenues are anticipated for the life of the Project. Once removed, landowners would be able to continue agricultural activities or other appropriate uses while tax revenues would decrease. To the extent possible, conditions would return to a similar state as before construction of the Project, although some workers associated with decommissioning may choose to remain in local communities.

Mitigation Measures for Unavoidable Impacts

The Proposed Action contains no specific mitigation measures in addition to the avoidance and minimization measures listed above.

In summary, the Proposed Action would have a combination of positive and negative socioeconomic effects. The Project would likely cause depreciation in some property values, particularly where turbines could be regarded as eyesores or are unwelcome by owners or prospective buyers. Possible downward pressure on some home prices would be at least partially offset by increases in values from properties receiving lease payments or increased desirability to prospective buyers that support wind power, although these two phenomena would not necessarily affect the same properties, and thus would not offset each other in all cases. Tax revenue generated by the project would increase services in the area and possibly increase property values. There would be short-term increases in the demand for workers during construction and decommissioning, but the long term effect on the job market is expected to be negligible (albeit positive). None of these impacts are expected to be significant because they would be at least partially offset or would affect a small part of the overall population in the Action Area.

The Project is not expected to have a disproportionate effect on disadvantaged populations. Accordingly, it would not have a significant impact on environmental justice.

5.9.2.2 Redesign Option

The Redesign Option is an optional measure under the Proposed Action that includes a primarily buried collection system, which would cause more ground disturbance but decrease the number of overhead lines as compared with the Proposed Action. Impacts to socioeconomic conditions or environmental justice issues are expected to be the same as those described for the Proposed Action. The avoidance and minimization measures would be the same as described above for the Proposed Action.

5.9.3 Alternative A – Maximally Restricted Operations Alternative

Alternative A differs from the Proposed Action only with respect to operations. Operations would be restricted from sunset to sunrise between April 1 and October 31, and would therefore produce less energy and generate less revenue than the Proposed Action. The lower energy production and revenue generated under Alternative A would not significantly alter the effects on socioeconomic conditions and environmental justice described for the Proposed Action. As such the construction, operation, and decommissioning effects of Alternative A on socioeconomic conditions and environmental justice issues would be the same as the Proposed Action.

5.9.4 Alternative B – Minimally Restricted Operations Alternative

Alternative B differs from the Proposed Action only with respect to operations. Operations would be restricted less than the Proposed Action, and therefore energy production would be slightly greater than the proposed action, increasing the amount of energy generated and therefore the amount of revenue produced. The slightly higher energy production and revenue generated under Alternative A would not significantly alter the effects on socioeconomic conditions and environmental justice described for the Proposed Action. As such the construction, operation, and decommissioning effects of Alternative A on socioeconomic conditions and environmental justice issues would be the same as the Proposed Action.

5.9.5 Alternative C – No Action Alternative

Under Alternative C, the Project would not be built and no Project-related activities (construction, operation, or decommissioning) would occur. Therefore, no effects on socioeconomic resources and environmental justice concerns would occur and conditions would remain the same as described in Section 4.9. Alternative C would not achieve the socioeconomic benefits associated with the Proposed Action or Alternatives A and B, including generation of income from construction jobs, generation of tax revenues for municipalities and school districts, and generation of lease revenues for landowners.

5.10 Noise

5.10.1 Impact Criteria

No existing national, state, or local laws specifically limit noise levels from wind power facilities. In the absence of any specific or absolute regulatory noise level limits, this EIS evaluates the potential effects of noise from the Project in terms of its likely audibility or perceptibility at residences (where people are most likely to spend most of their time) relative to the background sound level. This approach is commonly used in siting analyses for various types of new infrastructure projects.

A new broadband noise source without any distinctive character (such as tonality or impulsiveness) generally must have a sound level that is about 5 dBA higher than the background before it begins to be perceptible to most people. However, for wind turbines, the threshold of perception is somewhat lower. This is because the sound sometimes has a mildly periodic quality associated with blade “swish” that makes it more readily perceptible than a steady, bland sound of the same magnitude. Depending on the speed of the turbine rotation, the sound level rises and falls slightly in about one second intervals: the down-coming blade briefly generates aerodynamic noise, which is followed by a very short pause until the next blade comes around. This phenomenon, referred to as amplitude modulation, makes noise from wind turbines more readily perceptible than other sounds of comparable magnitude.

This assessment sets the nominal noise impact threshold at 5 dBA above the prevailing day and night background levels (L_{eq}) for non-participating residences. The nominal impact threshold at 5 dBA above prevailing background also is considered appropriate for application to existing permanent residences where people are found most of the time. This threshold represents the minimum change in sound level discernable by the average person. On one hand, the allowable sound level must not be so low and restrictive that, for all practical purposes, no viable wind power projects can be built. On the other hand, the Project's sound level must not be so loud that it leads to legitimate disturbance at a large number of homes. Setting a nominal threshold of 5 dBA above the prevailing background level for non-participating residences represents a reasonable design target that strikes a sensible balance between the interests of all parties and is consistent with other guidelines used for siting wind energy projects (NYSDEC 2001). OPSB does not have any specific thresholds for noise.

Since residences that would host a portion of the Project or have a lease, easement or other agreement with the Applicant are willing and voluntary participants in the Project, it is also appropriate to consider this threshold only at only at non-participating residences (residences that do not have a lease, easement, waiver or other agreement with the Applicant). Noise at participating residences may be higher than 5 dBA above background noise levels.

Some states in the U.S have absolute noise limits ranging from 50 to 55 dBA at residential property lines, which in the case of the Project is more than 5 dBA over background noise levels (described in detail in the Noise Modeling Methodology section below). For example, the States of New Jersey and Colorado have absolute nighttime maximum emission limits of 50 dBA at residential receptors regardless of the acoustic environment in those areas (i.e., whether quiet rural or noisy urban). Similarly, the State of Maryland, Washington D.C., and Delaware have absolute nighttime maximum emission limits of 55 dBA at residential receptors. Most of these states allow higher limits for daytime hours. The Applicant would adopt a 50 dBA limit as an additional design target for operational sound levels at the nearest boundaries between participating and non-participating properties (Hessler 2009), but there are a few places where sound levels may exceed 50 dBA for a short distance into a neighboring non-participating property (Stantec 2010b).

5.10.2 Proposed Action

5.10.2.1 Avoidance and Minimization Measures

Over the last decade, the wind industry has invested heavily in reducing turbine noise through improvements in turbine technology, engineering, and insulation. According to a 2006 report prepared by the Renewable Energy Research Laboratory, sound levels emitted by wind turbines have decreased as technology has advanced. Improvements in blade airfoil efficiency have resulted in more wind energy being converted into rotational energy and less into acoustic energy. Vibration dampening and improved mechanical design have also significantly reduced noise from mechanical sources.

Furthermore, aerodynamic sound generation is very sensitive to speed at the blade tips. Modern variable speed wind turbines, like those proposed for the Project, rotate at slower speeds in low winds, and increase as wind speeds increase. This results in quieter operation in low winds when compared to older, constant speed wind turbines (Rogers et al. 2006). These findings are consistent with a recent USDOE report (USDOE 2008), which concluded "advances in engineering and insulation ensure that modern turbines are relatively quiet; concerns about sound are primarily associated with older technology, such as the turbines built in the 1980s, which were considerably louder."

In addition to general improvements in wind turbine technology, significant site-specific impact avoidance and minimization efforts have occurred during the design phase for the Project. To reduce the potential for adverse noise impacts, many turbines were moved further away from non-participating residences or completely removed from the Project.

The Proposed Action contains the following avoidance and minimization measures that would further avoid or minimize noise impacts.

- Siting turbines such that an operational noise impact threshold of 5 dBA above the prevailing day and night background levels (L_{eq}) for non-participating residences is not exceeded;
- Implementing best management practices for sound abatement during construction, including use of appropriate mufflers, proper vehicle maintenance, and limiting hours of construction to normal daytime working hours, unless there is a compelling reason to work beyond those hours;
- Notifying landowners of certain construction sound impacts in advance, such as if blasting becomes necessary (however, blasting is unlikely to occur); and
- Implementing a reasonable complaint resolution procedure to assure that any complaints regarding construction or operational sound are adequately investigated and resolved.

Construction-related Effects

Project construction would consist of the following principal activities:

- Access road construction and electrical interconnect line trenching;
- Site preparation and foundation installation at each turbine site;
- Material and subassembly delivery; and
- Turbine erection.

Each of these principal activities would generate noise. Under the Proposed Action, noise from construction activities would likely be audible at some of the homes located within the Action Area. Assessing and quantifying these impacts is difficult, because construction activities would occur at various locations around the Action Area, leading to highly variable impacts at any given point.

Noise emissions would vary with each phase of construction depending on the construction activity, operating load, length of time the equipment is in use, and the amount of equipment used simultaneously for each phase. Noise levels from the construction activities would be intermittent, as equipment would be operated on an as-needed basis, mostly during daylight hours. In general, the maximum potential noise impact at any single residence might be analogous to a few days to a few weeks of repair or repaving work occurring on a nearby road or to the sound of machinery operating on a nearby farm. Typically, at houses that are some distance away, the sounds from Project construction are likely to be faintly perceived. Such sounds include diesel-powered, earthmoving equipment characterized by irregular engine revs, back-up alarms, gravel dumping, and the clanking of metal tracks (Hessler 2009). It is not anticipated that any blasting would be required.

Table 5.10-1 summarizes the types of equipment likely to be used for each construction phase and the typical noise levels generated by the equipment. Typical noise levels are as reported in Bolt et al. (1977). It should be noted that conservative values from a somewhat antiquated 1977 reference have been deliberately used for the equipment to illustrate the worst-case scenario. More recent measurements of modern construction equipment generally indicate significantly lower sound levels.

Table 5.10-1 also shows the maximum total sound levels that might temporarily occur at a typical minimum setback distance of 305 m (1,000 ft; minimum distance between home and turbine), and the distance at which construction sound levels are likely to become inconsequential (at a level of about 35 dBA). A value of 35 dBA is used here because construction noise has no dependency on wind speed and is likely to occur during times of inactivity when background sound levels are minimal. A sound level of 35 dBA during the day (when construction activities would occur) is generally considered a negligible sound level, even in the near absence of any natural environmental background sound (Hessler 2009).

Table 5.10-1 Typical Construction Equipment Sound Levels

Equipment Description	Typical Sound Level at 15 m (50 ft) (dBA)	Estimated Maximum[1] Total Level per Phase at 15 m (50 ft) (dBA)	Maximum[1] Sound Level at 30.5 m (1,000 ft) (dBA)	Distance Until Sound Level Decreases to 35 dBA (m) [ft]
Road Construction and Electrical Line Trenching				
Dozer, 200-700 hp	88	92	63	2,316 (7,600)
Front End Loader, 300-750 hp	88	92	63	2,316 (7,600)
Grader, 13-16-ft Blade	85	92	63	2,316 (7,600)
Excavator	86	92	63	2,316 (7,600)
Foundation Work, Concrete Pouring				
Piling Auger	88	88	59	1,798 (5,900)
Concrete Pump, 115 cubic yards per hour	84	88	59	1,798 (5,900)
Material and Subassembly Delivery				
Off-Highway Hauler, 115 ton	90	90	61	2,042 (6,700)
Flatbed Truck	87	90	61	2,042 (6,700)
Turbine Erection				
Mobile Crane, 75 ton	85	85	56	1,463 (4,800)

Source: Bolt et al. 1977, as cited in Hessler 2009

[1] Maximum sound level represents the highest level realistically possible at any given time. It should be noted that not all construction vehicles are likely to be in simultaneous operation.

Table 5.10-1 indicates that construction equipment sounds are likely to be at least intermittently audible at distances up to 2,316 m (7,600 ft). As a worst case scenario, sound levels ranging from 56 to 63 dBA might temporarily occur over several weeks at the homes nearest to turbine construction sites.

The noise impact of construction activities on the closest residences would be temporary and would occur only during daytime working hours when elevated sound levels are more tolerable. As a temporary daytime occurrence, construction noise of this magnitude may go unnoticed by many in the vicinity of the Action Area. This is especially true in agricultural areas, where the sounds of tractors, trucks, and other agricultural machinery are common.

All turbines are located more than 279 m (914 ft) from permanent non-participating residences, and most turbine sites are located more than 305 m (1,000 ft) from permanent non-participating residences. However, there may be some cases where road construction or trenching operations occur closer to homes. This could result in higher sound levels if this work occurs very close to residences. For example, a short-term sound level of approximately 80 dBA is theoretically possible where the distance to nearby work is about 61 m (200 ft). In such cases, every effort would be made to give affected residents advance notice of when this kind of work would occur and of its duration.

Operation and Maintenance-related Effects

Under the Proposed Action, nighttime (i.e., one-half hour before sunset to one-half hour after sunrise) varying operational constraints in the form of feathering would be applied based on a turbine's assigned risk category and the season of Indiana bat activity (see Section 3). When operations are constrained, select turbines would not be operating at specific wind speeds and, therefore, would not generate noise.

Noise effects would be reduced at the sites of those turbines where operations would be feathered nightly during the period from April 1 through October 31. Nonetheless, the analytical noise model developed to predict the sound level contours associated with the Project still applies to the Proposed Action and all other action alternatives, and so represents a worst-case noise scenario without considering reductions in noise from feathering.

Potential Operational Noise Sources

The major noise sources associated with the Project are expected to include up to 100 wind turbine generators, each with a nameplate capacity rating of up to 2.5 MW. Wind turbine noise originates from mechanical sound (the gearbox and control mechanisms) and aerodynamic sound (produced by the rotation of the turbine blade through the air). Aerodynamic noise is the dominant source generally present in the mid-frequency ranges (approximately 500 Hz to 1 KHz). Noise within this range rises and falls as the turbine blade rotates and this change (amplitude modulation) can be perceived by a listener as a fluctuation in sound occurring approximately every second. Turbines can also produce tonal sounds (a hum or whine) caused by mechanical components although this phenomenon is less common with new turbine designs than with older models. Modern wind turbines such as the ones proposed for this Project do not generate tonal noise to any significant extent. Therefore, tonal noise from the turbines, if any, is not expected to be a concern for this Project. Concerns regarding low frequency noise and vibrations have also been raised regarding wind turbines; both concerns are discussed below.

Another source of operational noise is the substation, which would be located near the intersection of Pisgah Road and Route 56 in the Town of Union. The substation would step up voltage from 34.5 kV to 138 kV to allow connection with the existing transmission line. Operation of the substation is not expected to generate any significant noise. The main sources of noise at the substation include the transformers and air conditioning equipment. The substation would comply with specific design measures to ensure noise levels are kept to a minimum. Such design measures would include establishing buffer distances between the equipment and property boundaries and installing low-noise equipment, as necessary.

Once operational, the Project would not significantly contribute to traffic on local roads. Therefore, impacts from traffic noise are not anticipated during Project operations.

As previously indicated, the dominant operational noise sources for this Project are the wind turbine generators (primarily mid-frequency aerodynamic noise). The following subsections discuss the operational noise impact assessment conducted for the Project, including the results of a noise propagation model (Hessler 2009), as well as the effects of low frequency noise (infrasound) and vibration.

Noise Modeling Methodology

At the time the noise assessment was conducted, the specific make and model of turbine to be installed in the Project Area had not yet been determined. However, Hessler (2009) evaluated two of the models under consideration, which include the following:

- Nordex N90/2500 LS – 90-m (295-ft) rotor, 2.5 MW power output
- REpower MM92 – 92-m (302-ft) rotor, 2.0 MW power output

Hessler's evaluation was intended to present a worst case assessment in that it considered the turbine model with the highest overall sound power level. The Applicant may utilize models different from those presented in the Hessler evaluation. The overall sound power levels of several turbine types are provided in Table 5.10-2, as a function of wind speed. As shown in Table 5.10-2, sound power levels for the Nordex N100/2500 model are higher than that of the other two models evaluated. For example, sound power levels for the Nordex N100/2500 model are higher than levels for the REpower MM92 model by 0.6 to 1.9 dBA depending on the wind speed. This difference is minimal and is not expected to cause any significant additional effect on nearby receptors (i.e., after accounting for spherical losses and other attenuation effects). These levels are derived from field tests of operating units carried out by independent acoustical engineers, in accordance with International Electrotechnical Commission (IEC) 61400-11. However, the modeling studies relied on the REpower MM92 model's higher sound power levels as inputs because at the time of the study the Nordex N100/2500 had not yet been added for consideration. However, a condition of the OPSB Certificate issued for the Project states that "Buckeye shall operate the facility within the noise parameters as set forth in its noise study and presented in its application." Buckeye has committed to not exceeding 5 dBA above ambient (Leq)[11] at any non-participating residence for all 100 turbines.

In general, sound power level is not the same as sound pressure level, which is the familiar quantity measured by instruments and perceived by the ear. A power level is a specialized calculated measure, expressed in Watts, which is primarily used for acoustical modeling and in design analyses. Sound power level is a logarithmic measure of the sound power in comparison to a reference level of 10^{-12} watts (1 picoWatt). It is a function of both the sound pressure level produced by a source at a particular distance and the effective radiating area, or physical size of the source. The ostensible magnitude of a sound power level is always considerably higher than the sound pressure level near a source (Hessler 2009)[12].

[11] L_{eq} is the average sound level over each measurement interval. This is the "typical" sound level most likely to be observed at any given moment.
[12] Sound pressure level accounts for attenuating characteristics of real-world environments such as atmospheric absorption and attenuation with distance.

Table 5.10-2 Sound Power Levels of Candidate Turbine Models Considered for the Buckeye Wind Project

Wind Speed at Height of 10 m (m/s)	Nordex 90/2500 LS (dBA re 1 pW)[1]	REpower MM92 (dBA re 1 pW)	Nordex 100/2500 (dBA re 1 pW)
4	98.0	NA[2]	97.3
5	101.0	101.6	102.2
6	103.0	103.6	105.5
7	104.0	104.4	106.1
8	104.5	105.0	106.8
9	104.8	105.0	-
10	105.0	105.0	-

[1] The units of power levels are denoted as decibels with reference to 1 picoWatt, or 10^{-12} Watts.

[2]Value not available

The field survey referenced in Section 4.10.2 indicated that background sound level varies with wind speed and time of day. Similarly, turbine sound levels also vary with wind speed (Table 5.10-2). The two values must be compared under the same wind conditions for the comparison to be meaningful. For example, it would be incorrect to compare the maximum turbine sound level, which occurs during high winds, to the background sound level on a calm night. In terms of potential noise impacts, the worst-case conditions would occur at the wind speed where the background level is lowest relative to the turbine sound level because the differential between the background sound level and turbine sound power level under these conditions would be greatest.

Table 5.10-3 compares the sound power levels of the REpower MM92 design turbine at different wind speeds to the daytime and nighttime L_{90} and L_{eq} background levels measured during the survey. The table is used to determine the critical wind speed during the daytime and at nighttime. The critical wind speed is the wind speed at which the maximum differential of sound level occurs (i.e., when the Project is most likely to be audible above the background level). In the daytime, the maximum differential occurs during 6 m/s (13 mph) wind conditions for both typical (L_{eq}) and residual (L_{90})[13] background levels. For example, during the daytime at a wind speed of 6m/s, the turbine sound power level of 103.6 dBA minus the background L_{eq} level of 40 dBA gives a differential of 59.6 dBA. This means the critical wind speed during the daytime is 6 m/s since it has the maximum sound differential. At nighttime, the maximum differential occurs during 5 m/s (11 mph) wind conditions for both L_{eq} and L_{90} background levels. At lower and higher wind speeds, the differentials are lower, indicating that turbine noise is less perceptible relative to the background level[14].

[13] L_{90} is the consistently present background level that forms a conservative or "worst-case" basis for evaluating the audibility of a new source since it represents essentially the lowest amount of masking sound.

[14] It should be noted that these differential levels do not represent increases from background levels that are noticeable by the human ear since the turbine levels are represented in terms of "sound power levels" rather than "sound pressure levels". To determine actual increases above background levels at receptor locations (homes), both turbine and background levels need to be converted to "sound pressure levels" at receptor locations after accounting for attenuation factors such as distance, atmospheric absorption, ground effects, etc (as used in the noise model). With the critical wind speed determined, noise modeling at each wind speed is not necessary.

Table 5.10-3 Comparison of Background and REpower MM92 Turbine Sound Levels at Different Wind Speeds during Daytime and Nighttime

Daytime							
Wind Speed at Height of 10 m (33ft) (m/s) [mph][1]	4 (9)	5 (11)	**6 (13)**	7 (16)	8 (18)	9 (20)	10 (22)
Turbine Sound Power Level (dBA re 1 pW)[2]	-	101.6	103.6	104.4	105	105	105
Typical Leq Background Sound Level (dBA)	42	43	44	45	46	47	48
Differential	-	58.6	59.6	59.3	58.9	57.8	56.8
Worst-case L90 Background Sound Level (dBA)	32	34	35	37	39	40	42
Differential (dB)	-	67.9	68.2	67.3	66.2	64.5	62.8
Nighttime							
Wind Speed at Height of 10 m (33ft) (m/s) [mph][1]	4 (9)	**5 (11)**	6 (13)	7 (16)	8 (18)	9 (20)	10 (22)
Turbine Sound Power Level (dBA re 1 pW) [2]	-	101.6	103.6	104.4	105	105	105
Typical Leq Background Sound Level (dBA)	35	38	40	42	44	46	48
Differential	-	64.1	64	62.8	61.3	59.2	57.1
Worst-case L90 Background Sound Level (dBA)	26	29	32	35	38	41	43
Differential (dB)	-	72.4[3]	71.6	69.6	67.3	64.5	61.6

Source: Hessler 2009

*Critical wind speed in bold font.

[1] This assessment accounts for wind speed as a function of elevation above ground level. Below about 100 m (328ft), wind speed varies with elevation above ground due to friction with surface and obstacles, such as trees. Because this roughness varies from place to place, measurements of wind turbine sound power levels carried out in accordance with IEC Standard 61400-11 are normalized to, and reported in terms of, the wind speed at a reference height of 10 m (33 ft). The conversion of wind speed at one elevation to the related speed at another elevation is calculated from a formula in the IEC standard (equation 7), which describes a logarithmic profile (See section 2.6 of the Hessler study, 2009).

[2] The units of power levels are denoted as decibels with reference to 1 picoWatt, or 10^{-12} Watts.

[3] During summer and fall all turbines would be cut in at speeds greater than 5.0; therefore, this may reduce noise impacts. In spring only some of the turbines would be feathered at 5.0, but this may still reduce noise impacts. This may change per adaptive management over time.

Operational Noise Impact Assessment for the Project

To determine the operational noise impact for the Project, a Noise Impact Assessment study (including background measurements and sound propagation modeling) was conducted by Hessler Associates in 2009 (Hessler 2009). The sound propagation modeling was based on a 70-turbine layout. The current Proposed Action and alternatives are based on a 100-turbine layout, so to maintain noise impacts relative to sensitive receptors to acceptable levels, the remaining turbines would also be sited using an approach and design goals that indicate the Project generated sound levels do not exceed 5 dBA above the prevailing background levels at non-participating residences.

Using the sound power level spectrum, sound level contour plots for the site were calculated using the CadnaA® version 3.7 sound modeling program (DataKustik undated). This software enables turbines and their surroundings, including terrain features, to be realistically modeled in three dimensions. The somewhat complex hill and valley topography of the selected location was digitized into the sound model from USGS topographic mapping. Each turbine is represented as a sound point source at a height of 80 m (262.5 ft) above the local ground surface. The model uses conservative assumptions regarding ground absorption of sound and wind speed, and predicts downwind sound levels from all directions simultaneously, to evaluate the "worst case" sound scenario (Hessler 2009). Sound contour plots based on L_{eq} and L_{90} for both daytime and nighttime conditions are included in Appendix J (see Plots 1A-3B), and impacts are described below.

Plots 1A and 1B (Appendix J) show the typical daytime noise conditions in the northern and southern portions of the Action Area, respectively. They illustrate the sound emissions of the Project during a critical 6 m/s (13 mph) wind, when the Project is most likely to be audible above the background level, with a nominal impact threshold of 49 dBA (i.e., 5 dBA above ambient, based on the measured L_{eq} background level of 44 dBA). These plots show that a sound level of 49 dBA occurs fairly close to each turbine and well short of any homes. Turbine sound levels would not be 5 dBA or more above the background sound level at any home. In fact, sound levels at homes may be comparable to the measured L_{eq} environmental sound level of 44 dBA. Consequently, there is a very low probability of an adverse impact during daytime hours during typical conditions.

However, if the daytime background sound level is based on the L_{90}, the potential area of impact is considerably larger, as shown in Plots 1C and 1D (Appendix J). They illustrate the sound emissions of the Project during a critical 6 m/s (13 mph) wind, when the Project is most likely to be audible above the background level, with a nominal impact threshold of 40 dBA (i.e., 5 dBA above ambient, based on the measured L_{90} background level of 35 dBA). In this instance, a few residences, most of which are project participants, fall inside the nominal 40 dBA. However, the vast majority of residences are outside of this nominal impact zone.

Plots 2A and 2B (Appendix J) show typical Project sound emissions during a critical 5 m/s (11 mph) wind, when the Project is most likely to be audible above the background level, with a nominal impact threshold of 43 dBA (i.e., 5 dBA above ambient, based on the measured L_{eq} background level of 38 dBA). As with the daytime model based on typical L_{eq} sound levels, all homes in the vicinity of the Project lie outside of the threshold. This suggests that there would not be a legitimate disturbance at a significant number of homes during daytime or nighttime hours and during typical (Leq) conditions.

When the nighttime background sound level momentarily decreases to L_{90} levels, the Project may become distinctly audible, at least intermittently, over a fairly wide area (Plots 2C and 2D) (Appendix J). The nighttime residual L_{90} sound level was measured at 29 dBA during the critical 5 m/s wind conditions, when the Project is most likely to be audible above the background level, yielding a nominal impact threshold of 34 dBA (equal to the L_{90} of 29 dBA plus a 5 dBA increase). Since the predicted worst-case L_{90} sound levels exceed 34 dBA at a number of non-participating residences near the Project, some impact from nighttime Project noise appears to be possible during these particular conditions. However, because these impacts were calculated using L_{90} sound levels, it is important to note that, by definition, these potential impacts could only occur 10 percent of the time.

The mean predicted level for the Project would be less than 45 dBA at all non-participating houses even during wind speeds of 8 m/s (18 mph) or more, when the turbine sound power level is maximum (D. Hessler, in testimony).[15] At critical wind speeds, where the differential between the turbine sound level and ambient background noise is greatest, Hessler predicted that only 5 non-participating residences are expected to experience nighttime sound levels slightly in excess of 40 dBA (in addition to the L_{90} plus 5 dBA metric) outside the house (D. Hessler, in testimony). These operational levels are well below the levels approved for other electricity generating projects in Ohio.

Although the nighttime model using residual L_{90} sound levels indicates the potential for a moderate noise impact at some homes in the vicinity of the Project Area, it is important to realize that this particular case combines a number of assumptions that together intentionally represent the worst possible impact during normal atmospheric conditions. These assumptions include the following:

- A 5 m/s (11 mph) Wind Speed – As shown above in Table 5.10-3, turbine audibility would be lower at all other wind speeds, both higher and lower.
- L_{90} Sound Levels – The background masking sound is based on the L_{90} level, which captures momentary lulls in the background level and excludes most noise-causing events, such as cars passing by on nearby roads.
- Winter Background Levels – The background sound level was measured during wintertime conditions, when environmental sound levels are normally the lowest. This ensures the greatest possible differential between background sound and turbine sound is used to determine nominal impact thresholds. During summer months, rustling leaves, bird, and insect sounds mask turbine noise.
- Observer Outside – The noise model predicts noise levels outside. Sound levels inside homes would be 10 to 20 dBA lower, particularly in wintertime when windows are closed.

[15] D. Hessler, Licensed Professional Engineer, Hessler Associates, Inc.; testimony during hearings before the OPSB.

- Wind Direction – The wind would need to be blowing from all of the nearest turbines directly toward the point of observation.

These conservative assumptions and worst-case conditions have been consciously adopted for the analysis because the perceptibility of turbine noise varies with atmospheric conditions, such as during temperature inversions and periods of unusual wind stratification.

Analyses were completed to determine the relationship between the 50 dBA sound contour and the boundaries of participating land parcels (Appendix J). As discussed in Section 4.10, no local, state, or federal laws regulate sound levels from wind farms at property lines. For purposes of this analysis, a 50 dBA design target is assumed, since it represents a conservative nighttime absolute limit for property line sound levels for some states such as New Jersey and Colorado. As the results of these analyses show, sound levels of 50 dBA or more are almost entirely confined to participating properties. There are only a few places where sound levels may slightly exceed 50 dBA for a short distance into a neighboring property. The feathering regime would decrease noise at wind speeds of 5, 5.5, 6, and 6.5 m/s (11, 12, 13, and 15 mph), which are the wind speeds at which noise is expected to be greatest. However, it should be noted that at night during summer and fall all turbines would be operating at cut-in at speeds greater than 5.0 m/s, which would likely reduce the noise levels. In spring, only some of the turbines would be feathered at 5.0 m/s, but may still reduce noise impacts. Further, the feathering regime would occur at night, the time when noise impact is of most concern. Per adaptive management, cut-in speeds may change over time.

In summary, based on the typical L_{eq} sound levels, all homes in the vicinity of the Project lie outside the nominal threshold. Therefore, there would not be a perceivable disturbance at a significant number of homes during daytime or nighttime hours during average or typical conditions. The predicted L_{90} sound levels exceed 34 dBA (the nominal nighttime impact threshold) at numerous non-participating residences near the Project and 40 dBA (the nominal daytime impact threshold) at a few non-participating residences. In absolute terms, sound levels in the 35 to 45 dBA range are often considered “faint” (RSG 2006) or “very quiet to quiet” (NYSDEC 2001). Therefore, while the turbines would be audible at some non-participating residences inside the nominal impact thresholds, these predicted noise levels would not necessarily constitute a nuisance. It is important to note that these nominal impact thresholds were calculated relative to the worst-case background noise level, and exceeding these relative thresholds does not necessarily mean that the Project would be perceived as “noisy.” It is also important to note that because these impacts were calculated using L_{90} sound levels, by definition, these potential impacts would occur a maximum of 10 percent of the time.

In addition to residential structures, the predicted sound contour plots in Appendix J depict recreational areas, such as golf courses and parks and possible noise-sensitive structures (including schools, libraries, churches, hospitals and nursing homes) in the Action Area. Recreational areas within 1.6 km (1 mi) of the Project include two golf courses and a local park. Possible noise-sensitive areas within 1.6 km (1 mi) of the Project consist of several churches and a school. Although libraries, hospitals, and nursing homes beyond 1.6 km (1 mi) are depicted on the plots, none are located within 1.6 km (1 mi) of the Project.

As shown on Plots 1A-1D (Appendix J), predicted daytime sound levels would not exceed nominal impact thresholds at any of the noise-sensitive sites. Plots 2A-2B portray predicted nighttime sound contours with a nominal impact threshold based on typical L_{eq} sound levels, and as shown, sound levels would not exceed the impact thresholds at any noise sensitive sites. To further minimize potential sound impacts at non-participating residences, daytime L_{eq} sound levels would not exceed the impact thresholds at any non-participating residence for the full 100-turbine array. When nighttime sound contours are predicted based on the worst-case L_{90} sound levels, sound levels at a few noise-sensitive sites exceed the nominal impact threshold, including the Chapel Hill Church of God on Ludlow Road and portions of both Urbana Country Club and Woodland Golf Club. Although churches often offer evening or nighttime services, the sound level of 37 dBA predicted would occur outside the structure, with indoor sound levels 10-20 dBA lower (well below any threshold of concern). Since golf is not typically played at night, and other activities such as weddings or receptions are likely to generate a significant amount of background noise, the sound levels should not affect recreational use of the clubs' courses.

The noise profiles described above and the contour plots in Appendix J are based on a 70-turbine array, but the Project consists of 100 turbines. The impacts associated with the Project would be similar to the 70-turbine array in terms of magnitude, but sound contour plots for L_{eq} and L_{90} for both daytime and nighttime conditions in Appendix J would be larger to accommodate the additional turbines in the 100-turbine array. The Applicant has committed that the design for the 100-turbine Project would ensure that the sound levels at any non-participating residence or possible noise-sensitive structures (including schools, libraries, churches, hospitals and nursing homes) would not exceed 5 dBA above the typical ambient background level as defined by the L_{eq} sound level.

Therefore, adverse sound impacts to noise-sensitive areas from the Project are not anticipated.

Low Frequency Noise

Although concerns are often raised with respect to low frequency or infrasonic noise emissions from wind turbines, no adverse impact of any kind related to low frequency noise is expected from this Project. Early wind turbines were designed with the blades downwind of the support tower and were prone to producing a periodic thumping noise each time a blade passed the tower. The widespread belief that wind turbines generate excessive or even harmful amounts of low frequency noise likely originated with this phenomenon. Modern wind turbines have been reconfigured, with blades arranged upwind of the tower, and therefore no longer produce the thumping noises.

The concerns related to excessive low-frequency noise may have perpetuated due to confusion of the amplitude modulation typical of wind turbines (i.e., the periodic swishing sound with a frequency of about 1 Hz) with low frequency sound. Another possible explanation is that measurements taken during windy conditions can erroneously exhibit elevated levels of low frequency noise caused by wind flowing over the microphone tip, whether a wind turbine is present or not. This self-induced, false signal distortion is commonly mistaken for actual noise from wind turbines (Hessler 2009).

Recent studies have demonstrated that the low frequency content in the sound spectrum of a typical modern wind turbine, like those proposed for this Project, is no higher than that of the natural background sound level in rural areas. Sondergaard and Hoffmeyer (2007, as cited in Hessler 2009) conducted a study with the specific objective of determining whether large wind turbines produce significant low frequency noise. Multiple elaborate microphone windscreens were used to preclude low frequency self-noise contamination during extremely careful measurements, based on the IEC 61400-11 procedure. The results of this testing show that for a typical turbine, sound levels steadily taper down in magnitude toward the low end of the frequency spectrum. As shown in Figure 3-1 in Appendix J (Hessler 2009), the measured sound energy below 40 Hz is comparable to or less than the sound energy in the natural rural environment, where the measurements were made.

Vibration

Operation of the Project would not result in significant vibration impacts. A comprehensive study of vibration measurements in the vicinity of a modern wind farm undertaken in 1997 found that vibration levels 100 m (328 ft) from the nearest turbine were a factor of 10 less than those recommended for human exposure in sensitive buildings, such as hospitals or laboratories (ETSU 1997).

Decommissioning-related Effects

Noise impacts associated with decommissioning activities (the dismantling of the turbines and other Project facilities and the restoration of the natural landscape) would be similar to those associated with construction. The impacts would be intermittent, short-term, and localized. Decommissioning activities could occur as early as 2037. Removal of the Project and restoration of the original setting would return noise levels to their pre-project status; therefore, decommissioning could potentially positively affect noise levels.

Mitigation Measure for Unavoidable Impacts

The Proposed Action contains no specific mitigation measures in addition to the avoidance and minimization measures listed above.

In summary, the Project would be expected to have minor negative noise-related impacts. Some non-participating residences, particularly those nearest the turbines, would be able to perceive turbine sound under certain conditions when the Project is operating. Noise from the turbines could be highest as compared to background noise at night; however, residents would likely be indoors during those periods where all sounds can be 10 to 20 dB lower. Some people who are highly sensitized to noise may be annoyed or otherwise negatively impacted by the Project, but the noise impacts would not have a significant adverse effect on most of the population. In addition, feathering proposed as part of the Proposed Action may reduce noise impacts at night during the spring, summer, and fall.

5.10.2.2 Redesign Option

The Redesign Option is an optional measure under the Proposed Action that includes a primarily buried collection system. Impacts from noise under the Redesign Option are expected to be the same as those described for the Proposed Action. The avoidance and minimization measures would be the same as described above for the Proposed Action. No mitigation measures would be warranted.

5.10.3 Alternative A - Maximally Restricted Operations Alternative

Construction and decommissioning-related effects associated with Alternative A would be similar to those described for the Proposed Action. Noise from construction and decommissioning activities associated with the Project would temporarily constitute a moderate, unavoidable impact at some of the homes located within the Action Area. Operation and maintenance-related effects associated with Alternative A would be similar to those described for the Proposed Action with the exception of nighttime operations from April 1 through October 31. During this period at night, all 100 turbines would be non-operational; therefore, generating no noise. Therefore, this alternative would result in lower overall noise impacts than the Proposed Action.

5.10.4 Alternative B - Minimally Restricted Operations Alternative

Construction and decommissioning-related effects associated with Alternative A would be similar to those described for the Proposed Action. Noise from construction and decommissioning activities associated with the Project would temporarily constitute a moderate, unavoidable impact at some of the homes located within the Action Area. Operation and maintenance-related effects associated with Alternative B would be similar to those described for the Proposed Action except that feathering would occur less than with the Proposed Action, for the first one to six hours after sunset from August 1 through October 31 when wind speeds are 5.0 m/s (11 mph) or less. During these feathering periods, no operational noise would occur. Therefore, this alternative would result in greater overall noise impacts than the Proposed Action and greater noise impacts than Alternative A.

5.10.5 Alternative C - No Action Alternative

Under Alternative C, the Project would not be built and no Project-related activities (construction, operation, or decommissioning) would occur. Alternative C would have no effect on noise. As such, no mitigation measures would be warranted.

5.11 Air Quality

5.11.1 Impact Criteria

The Clean Air Act of 1970 (CAA) and the CAA Amendments of 1990 have established National Ambient Air Quality Standards (NAAQS) for selected pollutants (criteria pollutants) including ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter less than 10 microns in diameter (PM_{10}), particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), and lead (Pb). The NAAQS represent the maximum levels of background pollution that are considered safe, with an adequate margin of safety to protect public health and welfare. State and local agencies may set their own standards, as long as they are at least as stringent as the NAAQS. The OEPA's Division of Air Pollution Control administers and enforces air quality regulations in Ohio. The state has adopted all the NAAQS.

In accordance with Section III of the CAA of 1970 and the CAA Amendments of 1990, the USEPA established New Source Performance Standards (NSPS) to regulate emissions of air pollutants from new stationary sources. The Ohio Administrative Code (OAC) regulations do not contain any NSPS regulations beyond those promulgated at the federal level. These standards apply to a variety of facilities including landfills, boilers, cement plants, and electric generating units fired by fossil fuels. Because wind turbines generate electricity without releasing pollutants into the atmosphere, NSPSs do not apply to the Project.

All new sources of air emissions in Ohio are required to obtain a Permit to Install (PTI) for Title V facilities or a Permit to Install and Operate (PTIO) for non-Title V facilities.[16] Because wind turbines generate electricity without releasing pollutants into the atmosphere, the Project would not require a PTI or PTIO.

Administered by the EPA, the Acid Rain Program was established by the Clean Air Act Amendments of 1990 to reduce emission of sulfur dioxide (SO_2) and nitrogen oxides (NO_x) through regulatory and market based approaches. Because wind turbines generate electricity without releasing pollutants into the atmosphere, the Project would not require an acid rain permit.

Prevention of Significant Deterioration (PSD) applies to new major sources of pollutants, or major modifications at existing sources for pollutants, where the area the source is located is in attainment or unclassifiable with the NAAQS. The Project would not be a major source of any pollutants. Therefore, PSD does not apply.

The General Conformity regulations, as described in 40 CFR 93, Subpart B, require federal agencies to conduct a conformity determination if a federal action would generate emissions (usually construction emissions and non-permitted operational emissions) exceeding the conformity threshold levels (de minimis) of the pollutant(s) for which an air basin is designated as a nonattainment area or a maintenance area. Since Champaign County is classified as in attainment for all criteria pollutants, a General Conformity Determination is not required.

Over the past decade, the United States climate change policy has focused on voluntary initiatives to reduce the growth in greenhouse gas (GHG) emissions. On February 18, 2010, the CEQ drafted a guidance memorandum for public consideration and comment on the ways in which Federal agencies can improve their consideration of the effects of GHG emissions and climate change in their evaluation of proposals for Federal actions under the NEPA. Specifically, the draft memorandum indicates that if a proposed action would be reasonably anticipated to cause direct emissions of 25,000 metric tons or more of carbon dioxide equivalents (CO_2e) emissions on an annual basis, agencies should consider this an indicator that a qualitative assessment may be meaningful to decision makers and the public. The CEQ does not propose this as an indicator of a threshold of significant effects, but rather as an indicator of a minimum level of GHG emissions that may warrant some description in the appropriate NEPA analysis for agency actions involving direct emissions of GHGs.

Wind turbines generate electricity without releasing pollutants into the atmosphere. Therefore, air pollution operating permits would not be required for the Project.

[16] A Title V facility is a facility or source that is subject to the Title V operating permit program either because of the type and amount of air pollutants it emits or because a standard such as New Source Performance Standards (NSPS) or National Emission Standards for Hazardous Air Pollutants (NESHAPS.) require the source to obtain an operating permit.

The impact criterion used for the evaluation of potential impacts on air quality from the Proposed Action or an alternative is whether it would cause any of the following conditions:

- Exceedance of NAAQS (because Ohio has accepted the NAAQS); or
- Result in consumption of PSD increments as defined by the CAA, Title I, PSD rule.

5.11.2 Proposed Action

5.11.2.1 Avoidance and Minimization Measures

The Proposed Action contains the following avoidance and minimization measures that would avoid or minimize impacts on air quality (criteria pollutants and GHGs).

- Implementing best management practices to minimize the amount of dust generated during construction and decommissioning activities;
- Maintaining all construction vehicles in good working condition to minimize emissions from construction and decommissioning-related activities;
- Limiting idle times and practicing shutdowns of construction and decommissioning equipment when not in use;
- Minimizing the extent of exposed/disturbed areas on the site at any one time and restoring/stabilizing the affected area as stipulated in the NPDES permits;
- Applying water or calcium carbonate to suppress dust on unpaved roads (for both public roads and Project access roads), as needed throughout the duration of construction and decommissioning activities; and
- Identifying any unanticipated construction and decommissioning-related dust problems and ensuring immediate reporting to the construction manager and contractor.

Construction-related Effects

Construction of the Project would take place over one or two construction phases, each phase expected to continue for 12 to 18 months. The exact timing of the two construction periods is not known and may overlap. Timing is dependent upon several factors such as turbine availability, OPSB certification and economic considerations. During the site preparation and construction phase, temporary impacts to air quality would result from the operation of construction equipment and vehicles. Impacts would occur as a result of emissions from engine exhaust (criteria pollutants and GHGs), fugitive dust generation during earth-moving and vegetation removal, and travel on unpaved roads. Dust could annoy existing residents and guests and potentially could be deposited on surfaces at certain locations or residences. These impacts would be expected to be intermittent, short-term, and localized. Fugitive dust associated with agricultural practices is a normal occurrence in the Action Area.

Operation and Maintenance-related Effects

During Project operations, adverse impacts to air quality would not occur as the Project would not release pollutants to the atmosphere. Operation of the Project is expected to have a positive impact to the overall air quality in the region[17] due to its potential to offset/displace future emissions from existing power plants.

The operation of this Project is anticipated to have a positive impact on air quality (criteria pollutants and GHGs) by producing approximately 635,823 MWh of electricity annually with zero emissions (assuming a nameplate capacity of 250 MW and operating at 29 percent capacity). Power delivered to the grid from this Project would directly offset the generation of energy at existing conventional power plants (Jacobsen and High 2008). Table 5.11-1 summarizes anticipated emission displacements for the Project based on 100 turbines. The range of air quality benefits are based on the typical rated capacity of modern turbines and emissions rates for electricity used in Ohio.

Table 5.11-1 Estimated Annual Pollutant Emission Displacements from the Project Based on 100 Turbines

	Estimated Annual displacement in tons[1]
Pollutant	**2.5 MW Turbines (100 turbines; 250 MW total generation capacity) 635,823 MWh with a net capacity factor of 29%[1]**
Carbon dioxide equivalents(CO_2e)	486,010
Nitrogen oxides (NO_x)	417
Sulfur dioxide (SO_2)	1,877

Sources: Emission factors for each pollutant were taken from US EPA's eGRID2012 version 1 data base (http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html).
[1] The annual energy production of 635,823 MWh/year accounts for feathering conditions (Buckeye Wind 2012).

Decommissioning-related Effects

Air quality impacts associated with decommissioning activities would be similar to those from construction. The impacts would be intermittent, short-term, and localized. Beneficial impacts from emissions offsets would be lost if decommissioned. Decommissioning activities could occur as early as 2037.

In conclusion, the Project would not have any significant negative effects on air quality as defined by exceedance of the NAAQS or consumption of PSD increments. The Project's long term-effect on air quality (criteria pollutants and GHGs) would be limited to the beneficial effect of displacing approximately 486,000 tons of CO_2e and over 2,000 tons per year of nitrogen dioxides and sulfur dioxides.

Mitigation Measures for Unavoidable Impacts

Adverse impacts to air quality would not occur during the Project's operations phase, as the Project would not release pollutants to the atmosphere. Therefore, mitigation for air quality impacts is not warranted during the operations phase. During the Project's construction and

[17] Carbon emissions and air pollution associated with non-renewable electricity generation occurs at the point of generation, so the pollution offsets associated with this Project would occur at numerous points throughout the US wherever existing generation capacity would be offset by the Project's generating capacity. This impact area could shift over time as generation capacity fluctuates to meet changing demand.

decommissioning phases, air quality impacts would be intermittent, short term, and localized. No mitigation measures would be implemented.

In summary, the Proposed Action would have short term negative impacts on air quality in the Action Area due to increased emissions from vehicles and equipment during construction and demolition as well as more long term emissions from other small equipment used at the Project during its operation lifetime. These impacts would not be significant.

The Project would have a long term beneficial impact on air quality by replacing polluting sources of energy with clean, renewable energy. The direct impact of this improvement would not likely rise to the level of significance in any one particular location because electrical generation occurs at multiple sites throughout the Midwest. The beneficial effects of the Project on air quality would be widely dispersed throughout the airsheds of all the generating stations that currently supply power to the customers that would ultimately receive power from the Project. Therefore the Proposed Action contains no specific mitigation measures for impacts to air quality in addition to the avoidance and minimization measures listed above.

5.11.2.2 Redesign Option

The Redesign Option is an optional measure under the Proposed Action that includes a primarily buried collection system. Impacts to air quality are expected to be the same as those described for the Proposed Action. The avoidance and minimization measures would be the same as described above for the Proposed Action. No mitigation measures would be warranted.

5.11.3 Alternative A - Maximally Restricted Operations Alternative

Construction and decommissioning-related effects associated with Alternative A would be similar to those described for the Proposed Action. Operational effects associated with Alternative A would be similar to those described for the Proposed Action except that this Alternative has more feathering than the Proposed Action; therefore, less energy (491,597 MWh/year with a net capacity factor of 22 percent) would be generated, which would ultimately result in less air emissions offset. Based on the reduced energy generation of this alternative, annual emissions displaced would be approximately 23 percent less than emissions shown in Table 5.11-1. The avoidance and minimization measures would be the same as under the Proposed Action. No mitigation measures would be warranted.

5.11.4 Alternative B - Minimally Restricted Operations Alternative

Construction and decommissioning-related effects associated with Alternative B would be similar to those described for the Proposed Action. Operational effects associated with Alternative B would be similar to those described for the Proposed Action except that this Alternative would feather less of the time than the proposed action; therefore, more energy (647,726 MWh/year with a net capacity factor of 29.6 percent) would be generated and more air emissions would be offset. Based on the increased energy generation of this alternative, annual emissions displaced would be approximately two percent more than emissions shown in Table 5.11-1. The avoidance and minimization measures would be the same as under the Proposed Action. No mitigation measures would be warranted.

5.11.5 Alternative C - No Action Alternative

Under Alternative C, the Project would not be built and no Project-related activities (construction, operation, or decommissioning) would occur. Implementation of this alternative would indirectly affect air quality because if the Project were not built, approximately 250 MW of electrical power from a source that produces no air pollution or greenhouse gases would not be generated. This clean source energy would not be available to offset electrical power produced by sources that adversely affect air quality, such as coal and other fossil fuel-burning power plants.

5.12 Transportation

This section evaluates the potential effects that implementing the Project would have on transportation facilities within 8 km (5 mi) of the Action Area for each of the alternatives. Three distinct phases of Project activity would impact transportation infrastructure in the region. Construction of the Project would occur in one or two construction phases, each phase expected to continue for 12 to 18 months. The exact timing of the two construction periods is not known and may overlap. Operations would occur during a 25-year project life. Decommissioning could occur as early as 2037.

5.12.1 Impact Criteria

As stated in Chapter 1 of this EIS, the OPSB has regulatory authority over all proposed wind power projects in Ohio capable of generating five or more MW of electricity. Chapter 4906-17 of the Ohio Administrative Code contains the requirements for applications for the construction of wind power facilities, including the evaluation of any impacts to transportation facilities:

> *4906-17-8 (E) (5). Evaluate and describe the anticipated impact to roads and bridges associated with construction vehicles and equipment delivery. Describe measures that will be taken to repair roads and bridges to at least the condition present prior to the project.*

In order to evaluate the impact of Project activities on the transportation network, it is necessary to project the future-year traffic volumes on affected roads, which represent the overall road network in and around the Action Area. One simplified method for estimating future traffic volumes is to tie increases in average annual daily traffic (AADT) to increases in local population. Table 5.12-1 shows the projected population change in each of the counties that have affected roads.

Table 5.12-1. Population Growth Rates for Future Traffic Estimates

County	Projected Population 2010	Projected Population 2030	Annual Increase
Champaign	41,270	47,020	0.7%
Clark	142,300	143,960	0.1%
Madison	43,130	46,520	0.4%
Union	50,740	85,190	2.6%

Source: Ohio Department of Development. Accessed 29 July 2010 at http://www.development.ohio.gov/research/files/p200.htm

Based on these projected rates of annual population increase, Table 5.12-2 shows the projected AADT for affected roads in 2011 (during construction) and 2037 (the potential start of decommissioning). These projected volumes are “baseline” volumes, representing what is likely to occur in the No Action Alternative (e.g., if the Project were never built).

Table 5.12-2. Projected Baseline AADT on Affected Roads

Road, Location	County	Projected AADT 2011	Projected AADT 2037
I-70, West of SR 56	Clark	49,366	49,942
US 33, at US 36/SR 245	Madison	33,731	36,382
US 36 at Milford Center	Union	5,307	8,910
US 36 at SR 559	Champaign	2,009	2,289
US 36 at SR 814	Champaign	2,896	3,299
SR 56 at SR 4	Champaign	1,081	1,232
SR 56 at SR 29	Champaign	989	1,127
SR 4 at SR 56	Champaign	4,140	4,717
SR 29 in Mutual	Champaign	4,222	4,810
SR 814 at US 36	Champaign	2,937	3,346

It will also be important to consider the size and types of vehicles needed to deliver the turbine equipment. This will depend on the model and manufacturer of the turbine being hauled. Turbine components and associated vehicles can be classified as follows:

- Blade Sections: Blades are transported on trailers with one to three blades per vehicle. Blades typically control the length of the design vehicle, and the radii of the curves that can be navigated along the travel route to the site. Specialized transport vehicles are designed with articulating (manual or self-steering) rear axles to allow maneuverability through curves.
- Tower Sections: Towers are typically transported in four to six sections depending on the supplier. Although towers do not generally control design vehicle length, they often determine vertical clearance.
- Nacelle and Hub: The turbine nacelle, hub, and related elements are typically the heaviest components transported.

- Escort Vehicles: Light trucks with signs and banners that travel immediately in front or behind oversized loads to provide warning to motorists of the oversized vehicle.

5.12.2 Proposed Action

5.12.2.1 Avoidance and Minimization Measures

The Proposed Action contains the following avoidance and minimization measures that would avoid or minimize impacts to transportation resources.

Special hauling permits are required when loads exceed legal dimensions or weights. Table 5.12-3 summarizes these maximum legal dimensions for State of Ohio highways, along with the approximate dimensions for Project delivery vehicles. Transportation of the blades, nacelles, and tower sections would require Special Hauling Permits for criteria that exceed state highway limits. Each individual vehicle must receive a separate Special Hauling Permit from the ODOT Central Office. The specifications of the Special Hauling Permit depend on the characteristics of the vehicle, its cargo, and the duration of the delivery schedule. Nacelles can weigh up to 200,000 pounds, and when combined with the transport vehicle, the total weight can exceed 380,000 pounds. If any vehicle exceeds 120,000 pounds, 14 feet wide, or 14.5 feet in height, a permit via the "super load" process is required (Hull, 2009c).

Table 5.12-3. State Highway Limits and Dimension of Project Components[1]

Vehicle Characteristic	State Highway Limit[2]	Assumed Dimension of Component to be Transported, Inclusive of Vehicle		
		Blade	Nacelle	Tower Sections
Vehicle width, inclusive of load	2.6 m (8.5 ft)	2.7 m (9.0 ft)	3.51 m (11.5 ft)	4.30 m (14.1 ft)
Vehicle height, inclusive of load	4.11 m (13.5 ft)	4.11 m (13.5 ft)	4.63 m (15.2 ft)	4.63 m (15.2 ft)
Vehicle length, inclusive of load	25.9 m (85.0 ft)	64.01 m (210.0 ft)	35.05 m (115.0 ft)	41.15 m (135.0 ft)
Total vehicle weight	80,000 lbs	78,000 lbs	380,000 lbs	255,000 lbs

[1] Reprinted from Table 5-12 in Stantec 2010b. Original Source: Hull 2009c.

[2] Values above any of these thresholds require a special permit from state and/or county authorities.

The township and county roads to be used for delivering Project equipment and materials would be video-documented prior to the commencement of construction to establish existing conditions. Upon completion of the Project, the Applicant would return all roadways to their pre-construction conditions. Pavement or structures damaged during construction would be replaced. The process of documenting roadway conditions and restoring impacted roads would be performed in conjunction with state and local permitting.

As required by state law (SB 232) and OPSB conditions, to the extent that township and county roads would be utilized and potentially damaged from construction-related traffic, the Applicant would work with the Champaign County Engineer to ensure that roads and bridges are adequate to support the construction of the Project. Any road, bridge, or culvert that the Champaign County Engineer determined to be inadequate would be rebuilt or reinforced to the specifications established by the Champaign County Engineer. Furthermore, a road bond, or other similar surety, would be established through the Engineer's Office or the Champaign County Board of Commissioners to provide adequate funds to repair any damage to public roads.

As described throughout this analysis, turbine components delivered to the Action Area by truck would all qualify as oversize and/or overweight loads. Movement of such loads along or across county and township roads in Champaign County would be subject to a permit issued by the County Engineer. The County permit application states that applicants are responsible for all damage to public roads due to oversize/overweight loads (even with an approved permit).

The permit application also states that special measures may be required prior to oversize/overweight movements. These include, but are not limited to, prior engineering analysis, route detours, special traffic controls, and temporary bridge shoring. Planning and management of traffic and the movement of oversize/overweight vehicles (e.g., delivery of turbine and crane components) would include the following measures:

- Where practicable, aggregate deliveries of turbine components in truck caravans to reduce frequency and uncertainty in road closures. Less frequent, slightly longer closures would have less impact to non-Project traffic than more frequent closures.
- Buckeye Wind would communicate with county engineers and local police officials as necessary to accommodate the deliveries, and the vast majority of deliveries would not require scheduled road closures. Delivery timing restrictions should be confirmed through route evaluation studies. Very early morning, mid-day, late evening, or even nighttime deliveries (only if these can be accomplished safely and without undue disruption to residents due to excessive noise or light) would likely impact fewer motorists.
- Coordinate deliveries with state and local police, using chase vehicles and/or police vehicles, as necessary to ensure that non-Project traffic does not mix with oversize/overweight loads.

Construction-related Effects

Construction of the Project would take place over one or two construction phases, each phase expected to continue for 12 to 18 months with possible overlap, and would involve frequent trips by very large trucks carrying turbine components, as well as “light trucks” (e.g., escort trucks), and “normal” heavy trucks (e.g., tractor-trailers, dump trucks, concrete trucks, and trucks carrying sections of the large cranes used to erect the turbines) carrying construction equipment, building materials, and other items (Stantec 2010b).

Construction Vehicle Traffic Volumes

Table 5.12-4 summarizes the anticipated traffic generated by Project Construction activities. The remainder of this section discusses the information presented in this table.

Table 5.12-4. Estimated Daily Vehicle Traffic—Construction

Vehicle Type	Total Construction Trips[1]	Average Daily Construction Trips[2]
Turbine Components	2,200	20
Normal Heavy Trucks (Concrete Trucks, Dump Trucks, etc)	22,240	74
Construction Workers (182 workers @ 1.3 persons per vehicle)[3]	n/a	140
Total Traffic	n/a	234

[1] Source: Hull 2009c. The figures were modified to represent construction of 100 turbines, whereas Hull assumed 70 turbines. They include the average daily trips to and from the Project site (e.g., delivery of a turbine component on a single truck would count as two trips).

[2] For Turbine components, assumes delivery of one complete “package” of ten vehicles—see “Traffic Associated with Turbine Components.” For other vehicles, assumes 304 work days (including weekends) during the construction period and rounds up to the nearest full vehicle trip.

[3] Source for vehicle occupancy: CH2MHILL 2009.

The Project would involve the construction of up to 100 wind turbines. The number of overweight/oversize truck deliveries per turbine would depend on the turbine technology selected for the Project. This document assumes that ten oversize/overweight truck deliveries, accompanied by an escort truck, would be required for each turbine (i.e., five tower segment trucks, one truck for each of the three turbine blades, a nacelle truck, and the rotor hub truck), with ten corresponding return trips by empty vehicles. Given the anticipated construction schedule, this analysis assumes that an average of one complete turbine “package” (i.e., ten trucks) would be delivered to the Project site every three days (100 turbines in one or two construction phases, each phase expected to continue for 12 to 18 months with possible overlap).

Table 5.12-3 shows the assumed dimensions of the trucks that would deliver turbine components. Based on this information, all deliveries of turbine components would require Special Hauling Permits issued by ODOT. The Applicant also indicates that trucks used to deliver components of heavy cranes would also require Special Hauling Permits.[18]

[18] Once delivered, it is assumed that cranes would remain on site for the duration of Project construction. Thus, crane deliveries are not included in Table 5.12-4.

Large cranes used for turbine assembly (Source: EDR 2009b).

Anticipated Haul Routes

Most Project-related construction traffic would be likely to originate in the Columbus or Dayton metropolitan areas and would reach the Project site via either I-70/SR 56 or US 33/US 36. It is assumed that construction-related traffic would use the shortest route available to reach the locations of turbines and other Project facilities. The analysis of transportation impacts, therefore, evaluates each affected road individually, assuming that the total Average Daily Construction Trips shown in Table 5.12-4 would be added to that road segment.

Internal Road Network

Project construction activities would include upgrades to existing public roads and the creation of other roads to allow construction vehicle access to the turbine sites, laydown yards, operations and maintenance facilities, and other Project facilities. These roads would be developed to a standard sufficient to safely support the volume and type of construction vehicles anticipated for Project construction activities. Upgraded public roads would remain available for public use; temporary access roads would not be available for public use.

Typical upgrades to public roads during construction of wind turbine facilities (Source: EDR 2009a).

Other Transportation Facilities

There are no known plans to substantially alter the railroad infrastructure in or around the Action Area. As described in Section 4.12.5, there are no planned bikeways or major trails in the Action Area.

Traffic Volumes on Road Facilities

One common basis for evaluating transportation impacts is the degree to which a given project would increase traffic volumes and cause unacceptable levels of congestion on affected roads. In the case of the Project, background traffic volumes on most affected roads are very low. Volumes on I-70 and US 33 in the vicinity of the Action Area are somewhat higher relative to facility capacity, but are far lower than traffic volumes on the more urban portions of these roads – such as the 120,000 to 140,000 vehicles per day on I-70 in central Columbus in 2006 (ODOT (a)).

Given the low background traffic volumes likely to be present during construction, the addition of 240 vehicle trips per day to the affected roads would not create any direct or indirect adverse impacts on transportation.

Traffic Operations

While traffic volume would not create impacts, the nature of the vehicles associated with Project construction could create temporary impacts on traffic operations and safety. Normal heavy trucks – those delivering gravel, concrete, and other materials – would likely be absorbed into the existing traffic stream. These vehicles are common on public roads in general (although they may not be especially common on the affected roads in the Action Area). Assuming normal safe operating procedures, normal heavy trucks would not create impacts to traffic operations and safety.

However, oversize/overweight vehicles delivering turbine and crane components would cause direct, temporary impacts to traffic operations and safety. It should be noted that all overweight/oversize loads would require permits and must meet highway axle load and dimension restrictions within the permit requirements as determined by ODOT. Vehicle width is a particular concern. With widths up to 4.3 m (14 ft) – on roads whose paved surfaces are 6.1 to 6.7 m (20 to 22 ft) wide – it may not be possible to safely operate oversize/overweight vehicles in a normal traffic stream; there would not be adequate pavement to allow oncoming vehicles to safely pass.

Without minimization measures, such as widening of Project Area roads, direct impacts would take the form of temporary road and intersection closures. Background traffic would need to find alternative routes, or to wait until oversize/overweight vehicles pass. Indirect impacts would include temporarily increased traffic on alternative routes.

Physical/Engineering Considerations

Delivery and eventual removal of turbine and crane components during construction and decommissioning phases could create the following direct and indirect impacts on transportation infrastructure:

- At intersections and along relatively sharp curves, existing pavement width may not be wide enough to accommodate the turning movements of overweight/oversize vehicles.
- There are no permanent structures (e.g., bridges) that cross the affected roads, but some utility cables (particularly at intersections) may need to be temporarily raised in order to allow oversize trucks to pass underneath.
- Road surfaces may be damaged by overweight vehicles, even if procedures outlined in Special Hauling Permits are followed.
- Bridges along the anticipated haul routes may not be strong enough to support overweight trucks (Stantec 2010b).

Railroads

Freight rail is not expected to be used to transport Project-related materials to or from the Action Area, but could be used to deliver to a point outside of the Action Area and then transported by truck as described herein. Project-related traffic (including turbine and crane components) would only cross a railroad at-grade along SR 56 and possibly along SR 4, both southwest of Mechanicsburg. This rail line is a short-line spur (i.e., not part of the CSX system) extending eastward from Springfield, Ohio to Mechanicsburg. Although rail traffic data are not available for the railway in the Action Area, activity is presumed to be relatively low. Thus, construction would have no direct or indirect adverse impacts on railroad facilities.

Air Travel

The FAA reviews turbine locations as it relates to air travel and has found that the 52 known locations "would have no substantial adverse impact on the safe and efficient utilization of the navigable airspace by aircraft or in the operation of air navigation facilities" (FAA, 2009). The FAA letters to this effect are included in Appendix A. The Applicant would not site additional turbines where the FAA determines that a turbine would be a hazard to air navigation.

Non-Motorized Transportation Facilities

There are no designated bikeways or major non-motorized pathway systems in the Action Area. While bicyclists, hikers, and pedestrians may use the affected roads for travel, there is no evidence that the Action Area is a hub for such activities; in particular, none of the affected roads appear to include dedicated bicycle lanes or adequate shoulders to comfortably allow bicycling. Bicyclists and pedestrians would experience some of the same effects as drivers (i.e., travel delays or the need to alter travel routes in order to safely travel). The "Potential" NOCO route alternative through Urbana would not cross any of the affected roads. Accordingly, during Project Construction, the Project would have no significant direct or indirect adverse impact on non-motorized transportation facilities.

Operation and Maintenance-related Effects

The Project would have an operational lifespan of approximately 25 years. During this period, vehicle trips associated with the Project would typically be limited to commuting to and driving around the Project site by permanent employees. This EIS assumes that during the operations period, approximately 12 permanent employees would work on the site during an average day, which would generate 24 vehicle trips per day (Stantec 2010b). This analysis assumes that these trips would be evenly distributed along the road network, with employees commuting to and from the site from various locations, such as Columbus, Dayton, and Urbana.

Traffic Volumes on Road Facilities

Operation of the Project would have no direct or indirect adverse impacts on transportation, since only a small number of employees would commute to and/or travel around the Project site each day.

Traffic Operations

Operation of the Project would have no direct or indirect adverse impacts on traffic operations, since only a small number of employees would commute to and/or travel around the Project site each day.

Physical/Engineering Considerations

Operation of the Project would have no direct or indirect adverse impacts on transportation infrastructure, since permanent employees would use standard vehicles to commute to and/or travel around the Project site for routine maintenance activity. Major repairs requiring the use of oversize vehicles for repair or replacement of major components are expected to be very rare.

Railroads

Operation of the Project would have no direct or indirect adverse impacts on railroads, since only a small number of employees would commute to and from the Project site (crossing over local rail lines) each day.

Air Travel

As described in Section 5.12.2.1.1, the Project would have no impacts to air travel.

Non-Motorized Transportation Facilities

Operation of the Project would have no direct or indirect adverse impacts on non-motorized travel, since traffic volumes due to permanent employees would be very low.

Decommissioning-related Effects

Traffic volumes and other transportation characteristics associated with decommissioning activities would be similar to those for construction. These activities could occur as early as 2037.

Mitigation Measures for Unavoidable Impacts

The Proposed Action contains no specific mitigation measures in addition to the avoidance and minimization measures listed above.

In summary, the Proposed Action would not have significant impacts on transportation. Use of the existing road network is very low, and the Applicant would work with county engineers to establish a road use agreement and bond the roads (if necessary) to cover any potential damage that would occurs as a result of construction and decommissioning traffic. There would be very little traffic during the operational phase. Therefore the Proposed Action contains no specific mitigation measures for impacts to transportation in addition to the avoidance and minimization measures listed above.

5.12.2.2 Redesign Option

The Redesign Option is an optional measure under the Proposed Action that includes a primarily buried collection system. Impacts to transportation resources are expected to be the same as those described for the Proposed Action. The avoidance and minimization measures would be the same as described above for the Proposed Action. No mitigation measures would be warranted.

5.12.3 Alternative A - Maximally Restricted Operations Alternative

Alternative A differs from the Proposed Action only with respect to operations. The operational differences would not affect transportation resources. As such, the construction, operation, and decommissioning-related effects of Alternative A on transportation and the recommended avoidance and minimization measures would be the same as under the Proposed Action.

5.12.4 Alternative B - Minimally Restricted Operations Alternative

Alternative B differs from the Proposed Action only with respect to operations. The operational differences would not affect transportation resources. As such, the construction, operation, and decommissioning-related effects of Alternative B on transportation and the recommended avoidance and minimization measures would be the same as under the Proposed Action.

5.12.5 Alternative C - No Action Alternative

Under Alternative C, the Project would not be built and no Project-related activities (construction, operation, or decommissioning) would occur. Alternative C would have no effect on transportation facilities. As such, no mitigation measures would be warranted.

5.13 Communications

This section evaluates the potential effects that implementing the Project would have on communications facilities in the Action Area and vicinity. No significant issues specifically relating to telecommunications were identified during the public scoping process. Indicators for potential effects included: interference to microwave, TV, radio, cellular/PCS telephone, and land mobile radio reception; inconvenience to local businesses and residents; and compliance with federal telecommunication standards.

5.13.1 Impact Criteria

The OPSB rules (Chapter 4906-17 of the Ohio Administrative Code) governing applications for the construction of wind power facilities include the following requirements related to communications facilities and operations:

> *4906-17-8 (E) (3). The applicant shall…evaluate and describe the potential for the facility to interfere with radio and TV reception and, if warranted, describe measures that will be taken to minimize interference.*

In addition, the National Telecommunications and Information Administration (NTIA) of the U.S. Department of Commerce reviews applications to determine whether proposed projects (including, but not limited to wind power projects) would interfere with military or civilian radio or other communications, such as those used for air traffic control.

5.13.2 Proposed Action

5.13.2.1 Avoidance and Minimization Measures

While the Project would not result in significant communications impacts, some measures would be considered to minimize potential minor adverse impacts, specifically related to television and microwave paths.

- All 100 turbines would be sited greater than 3 km (2 mi) from AM transmitters, such that degradation of AM broadcast would not occur.
- Prior to final Project design, updated telecommunication assessments would be performed to ensure that any changes to communication pathways are accounted for in the final 100-turbine array. The Applicant commits to having no impact on Fresnel Zones for the entire 100-turbine array.

Construction-related Effects

Construction of the Project would take place over one or two construction phases, each phase expected to continue for 12 to 18 months. The exact timing of the two construction periods is not known and may overlap. Construction of the turbines would include the presence of partially-completed turbines and associated construction vehicles and activities. Any interference from (and impacts due to) the partially or fully completed turbines during the construction phase would be comparable to, but less intense than, the interference that might be expected during the operations phase, when all 100 turbines are constructed and operating.

Operation and Maintenance-related Effects

The findings in this section are based on reports generated by Comsearch (2008a, 2008b, 2009). This section provides a discussion of over-the-air television, AM/FM broadcasts, microwave paths, and military and other communication systems. As shown, the Project could have some minor effects on over-the-air television stations, specifically for any remaining low-power analog stations, very low-power FM radio stations (to the degree that they are located near turbines), and, in one case, microwave paths. Such effects are likely to be sporadic and would impact only a few residents or businesses. Accordingly, operation of the Project would have no significant negative direct or indirect impacts on communications.

Over-the-Air Television

All full-power and some low-power television stations serving the Action Area and vicinity have transitioned from analog to digital signals, thus reducing the likelihood that the Project would adversely impact television reception. Digital television would not have shimmering, ghosting, or poor picture quality (Polisky 2009) due to the Project.

The remaining analog low-power over-the-air television channels may suffer some degradation of over-the-air television signal reception during Project operations. This degradation would be the result of television signal attenuation or reflection caused by one or more of the Project wind turbines. The strength of this effect depends on the relative location of the over-the-air television broadcast antenna, the wind turbines, and the point of reception.

Some communities may not be affected at all, while others may have multiple channels affected (Comsearch 2008a). Specific impacts to television reception could include noise generation at low VHF channels within 0.8 km (0.5 mi) of turbines, reduced picture quality (e.g., ghosting, shimmering, or contrast variation), and signal interruption (NWCC, 2005).

AM/FM Broadcast

No degradation of AM broadcast coverage due to the presence of the wind turbines is anticipated because the distance between the nearest wind turbine in the Action Area and an AM transmitter is greater than 3 km (2 mi) (Comsearch 2008b). All turbines would be sited such that degradation of AM broadcast would not occur.

Very-low-power FM stations are designed for limited coverage, typically less than 0.8 km (0.5 mi), and would likely be unaffected as long as turbines are installed at distances greater than the coverage of the stations. For full- and medium-power FM stations, a separation distance of 4.0 km (2.5 mi) would allow a station to maintain normal operation and coverage. Because the nearest FM station antennas are more than 16 km (10 mi) from the center of the Action Area, no degradation of FM radio broadcast coverage is anticipated (Comsearch 2008b).

Microwave Paths

To assure an uninterrupted line of communications, a microwave link should be clear, not only along the axis between the center point of each antenna, but also within a mathematical distance around the center axis known as the Fresnel Zone. Comsearch (2009) calculated a Worst Case Fresnel Zone (WCFZ) for each of the microwave paths identified in Section 4.13. Based on the calculated WCFZ and subsequent Comsearch analysis, only one turbine[19] has the potential to interfere with an identified Fresnel Zone. Buckeye Wind will shift that turbine (incorporating all other siting considerations defined herein for other resources) to avoid potential impacts to microwave paths. All WCFZ interference would be avoided for the remaining turbines.

Military and Other Communication Systems

As described in Section 4.13, the NTIA provided plans for the Project to the federal agencies represented in the IRAC, which include the Department of Defense, Department of Education, Department of Justice, and Federal Aviation Administration. NTIA's response states that IRAC agencies "have not identified any concerns regarding blockage of their radio frequency transmission" (NTIA 2008).

Decommissioning-related Effects

During decommissioning, turbines and other Project structures would be dismantled and the landscape would be returned to its pre-Project state. Any interference from (and impacts due to) the partially or fully dismantled turbines during the decommissioning phase would be comparable to the interference that might be expected during the construction phase.

Mitigation Measures for Unavoidable Impacts

In addition to the avoidance and minimization measures listed above, if Project operations result in any impacts to existing over-the-air television coverage, the Applicant would address and resolve each individual problem as commercially practicable. Such resolutions could include the provision of stronger digital antennas, or cable or satellite television service in lieu of non-functional over-the-air television.

5.13.2.2 Redesign Option

The Redesign Option is an optional measure under the Proposed Action that includes a primarily buried collection system. Impacts to communications are expected to be the same as those described for the Proposed Action. The avoidance and minimization measures would be the same as described above for the Proposed Action. No mitigation measures would be warranted.

5.13.3 Alternative A - Maximally Restricted Operations Alternative

Alternative A differs from the Proposed Action only with respect to operations. In this alternative, turbines would operate less frequently than under the Proposed Action. The construction and decommissioning-related effects of Alternative A on communication systems

[19] Identified in Stantec 2010b as Turbine 37.

and the recommended avoidance and minimization measures would be the same as under the Proposed Action. Operational turbines may be slightly more likely to interfere with communications signals than non-operational turbines. Thus, if interference does occur, transmissions during hours when turbines are not operational may experience slightly less interference. As a result, Alternative A would have slightly lower effects on Communications than the Proposed Action.

5.13.4 Alternative B - Minimally Restricted Operations Alternative

Alternative B differs from the Proposed Action only with respect to operations. The operational differences would not affect communication systems. As such, the construction and decommissioning-related effects of Alternative B on communication systems and the recommended avoidance and minimization measures would be the same as under the Proposed Action. Operational turbines may be slightly more likely to interfere with communications signals than non-operational turbines. To the extent that interference is expected, Alternative B would have slightly larger effects on communications than the Proposed Action because Alternative B proposes more operational hours than the Proposed Action.

5.13.5 Alternative C - No Action Alternative

Under Alternative C, the Project would not be built and no Project-related activities (construction, operation, or decommissioning) would occur. Alternative C would have no effect on existing communication systems. As such, no mitigation measures would be warranted.

5.14 Health and Safety

This section evaluates the potential effects that implementing the Project would have on health and safety in the Action Area.

5.14.1 Impact Criteria

The OPSB rules (Chapter 4906-17 of the Ohio Administrative Code) governing applications for the construction of wind power facilities include the following requirements related to analysis of health and safety concerns:

> *4906-17-8 (A)*
>
> *(4) Ice throw. The applicant shall evaluate and describe the potential impact from ice throw at the nearest property boundary, including its plans to minimize potential impacts if warranted.*
>
> *(5) Blade shear. The applicant shall evaluate and describe the potential impact from blade shear at the nearest property boundary, including its plans to minimize potential impacts if warranted.*
>
> *(6) Shadow flicker. The applicant shall evaluate and describe the potential impact from shadow flicker at adjacent residential structures and primary roads, including its plans to minimize potential impacts if warranted.*

5.14.2 Proposed Action

5.14.2.1 Avoidance and Minimization Measures

The Proposed Action contains the following avoidance and minimization measures that would avoid or minimize impacts to health and safety.

Project Design and Operation

- Proper grounding techniques incorporated within and around project components would eliminate the occurrence of stray voltage.
- The Project would implement minimum setbacks of 279 m (914 ft) between turbines and permanent non-participating residences and 180 m (590 ft) from adjacent property lines.

Site Development and Maintenance

- Operations and maintenance staff would be trained and, in virtually all cases, would be the first level of response to in-tower emergencies. Local fire and emergency service personnel would also receive training in providing response services that are appropriate for activities, materials, and risks associated with the Project. This could include, for example, hazardous materials training related to the fuels and other potentially hazardous materials stored at the operations and maintenance facility.
- Local emergency service personnel would be given material safety data sheets for potentially hazardous construction materials.
- Construction managers would coordinate with local emergency service personnel to ensure that they are aware of the location and nature of various construction activities.
- As described in Section 5.12 (Transportation), construction managers would coordinate with police and ODOT to ensure that deliveries of Project materials (specifically overweight and oversize turbine and crane components) are achieved safely.
- The 100 turbines would be sited such that non-participating residences and other sensitive receptors (including schools, libraries, churches, hospitals and nursing homes) would not be subject to Shadow Flicker exceeding 30 hours per year. For residences (or businesses, if applicable) where initial modeling indicates that they may receive more than 30 hours per year of Shadow Flicker, site-specific evaluations would be conducted to determine whether adequate trees or buildings exist to provide screening (EAPC 2009). If necessary, trees would be planted in appropriate locations on these properties to minimize shadow flicker or other appropriate mitigation measures would be employed.

Construction-related Effects

Most of the safety concerns associated with construction of the Project are similar to those associated with construction of other tall structures, such as the potential for injuries to workers and the general public from the movement of construction vehicles, equipment, and materials; falls from structures or into open excavations; and electrocution.

The Applicant states that "the risk of construction-related injury will be minimized through regular safety training and use of appropriate safety equipment" (EDR 2009a). A Health and Safety (H&S) Plan would also be developed for the Project to address health and safety risks to

Project-related workers and to the general public and to address applicable regulatory requirements during construction. Such a plan should address issues such as personal protective equipment, housekeeping, maintaining a safe workplace, fire prevention, and safe work practices. Coordination with emergency responders in the region is also assumed, specifically to address risks related to fire, collapse, transportation of Project materials, and other risks to members of the general public.

Beyond the general construction issues described above, the Project would have no adverse impacts on health and safety. Ice shedding, blade shear, shadow flicker, and other concerns described in Section 4.14 are associated with operational turbines, and thus are not applicable to the construction phase.

Assuming proper planning and monitoring of typical construction-related health and safety risks, construction of the Project would have no substantial adverse impact on health and safety.

Operation and Maintenance-related Effects

Operation-related effects include ice shedding, tower collapse and blade shear, stray voltage, fire and fuels, lightning strikes, shadow flicker, and wind turbine syndrome, each of which is discussed below.

Ice Shedding

Ice accumulations on turbine rotor blades either cause an imbalance or otherwise alert turbine sensors, which are designed to shut down the turbine until the ice has melted or has been shed from the stationary blades (Garrad Hassan 2007, as cited in Stantec 2010b). Most ice shedding prior to blade rotation drops to the ground in the vicinity of the turbine (Morgan et al. 1998). In some cases, residual ice can potentially be shed from the blades as they begin to rotate again. In such cases, ice thrown from turbine blades usually breaks down into small fragments and falls near the tower base (Global Energy Concepts 2005, as cited in Stantec 2010b). As the ice fragments into smaller pieces, the potential for injury or damage is reduced. In general, the operational characteristics of the turbines, together with incorporated setbacks and the behavior of ice as it melts, combine to make injury from ice throw highly unlikely.

In rare cases, aerodynamic and centripetal forces can cause ice fragments to be thrown far enough from the tower and in large enough sizes to potentially cause injury or damage. Data gathered at existing wind farms have documented ice fragments on the ground from 15 to 100 m (50 to 328 ft) from the base of the tower (i.e., from turbines with rotor diameters less than 10 to 60.0 m [33 ft to 197 ft]). These fragments were in the range of 0.1 to 1.0 kg (0.2 to 2.2 lbs) in mass (Morgan et al. 1998). The risk of ice landing at a specific location is found to drop dramatically as the distance from the turbine increases. One study (Garrad Hassan 2007, as cited in EDR 2009a) indicates a negligible risk at distances beyond approximately 220 m (722 ft) from a wind turbine. Moreover, “there has been no reported injury caused by ice being ‘thrown’ from an operating wind turbine” (Global Energy Concepts 2005, as cited in EDR 2009a).

Public access to the turbine sites would not typically be authorized, further reducing health and safety risks. Based on these siting constraints, the Project would not have any significant adverse impacts on health and safety due to ice shedding.

Tower Collapse and Blade Shear

Occurrences of tower collapse and blade shear are potentially very dangerous, but are also fairly rare. Since 2009, three instances of tower collapse and/or blade sheer have occurred in the state of Ohio. Such incidents have been largely eliminated due to technological improvements and mandatory safety standards during turbine design, manufacturing, and installation. Modern utility-scale turbines are certified according to international engineering standards, which include ratings thresholds for withstanding different levels of hurricane-strength winds and other criteria (AWEA 2008c, as cited in EDR 2009a). "The engineering standards of the wind turbines proposed for this Project are required to meet all applicable federal, state, and local codes" (EDR 2009a, p. 107). Beyond these standards, additional controls would be in place, which are described as follows:

> *State-of-the-art braking systems, pitch controls, sensors, and speed controls on wind turbines have greatly reduced the risk of tower collapse and blade throw. The wind turbines proposed for the Facility will be equipped with two fully independent braking systems that allow the rotor to be brought to a halt under all foreseeable conditions. In addition, the turbines will automatically shut down at wind speeds over the manufacturer's threshold...the turbines will also cease operation if significant vibrations or rotor blade stress is sensed by the monitoring systems (EDR 2009a).*

A study by the University of California evaluated the risk from tower collapse and blade shear (University of California, Berkeley 2005). The study concluded that the annual risk of a person situated 50.3 m (165 ft) from a wind turbine (far closer than any non-Project employee would be allowed under the Applicant's proposed operating regulations) being struck by a collapsing tower or a detached blade is very low, approximately one in 667,000. By comparison, the risk of being struck by lightning in a given year is approximately one in 500,000 (NWS 2010).

Studies have found that the farthest a blade is likely to be thrown is 152 m (500 ft) from the tower (KPFF 2006, as cited in EDR 2009a). This is within the Project's 180-m (590-ft) setback from property lines (and therefore from any non-Project structure), and well within the 279-m (914-ft) setback from permanent non-participating residences. Based on these siting constraints and the extreme rarity of collapse and blade shear events, the Project would not have significant adverse impacts on health and safety due to tower collapse or blade shear.

Given the known incidence rate of blade shear, tower collapse, ice throw, and the setbacks that would be enforced surrounding the Project, the risks from these phenomena are remote. In order for injury or property damage to occur from any of these phenomena, a person or their property would have to penetrate the setback zones at the same time as one of these very rare events take place. In the case of ice throw and blade shear, these events would also have to coincide with windy conditions in order for injury or damage to occur.

Stray Voltage

Stray voltage can be prevented using proper electrical installation and grounding practices. To the degree that the Project's electrical collection system meets applicable design and safety regulations, it would be properly grounded, would have adequate spacing from other electrical cables, and would not be connected to the local electrical distribution lines that provide service to homes and farm buildings. As a result, the Project would not have any adverse impacts on health and safety due to stray voltage.

Fire and Fuels

The most significant fire risks for turbines are due to lightning strike, short circuit, or mechanical failure/malfunction. In the event that a wind turbine catches fire, standard industry practice is to allow the fire to burn itself out while maintenance and fire personnel maintain a safety area around the turbine and protect against the potential for spot ground fires that might start due to sparks or falling material. Power to the section of the Project with the turbine fire would also be disconnected. Risk to public safety during a fire event would be minimal, due to the distance between the turbines and private property and residences.

The Project operator would be responsible for any emergency/fire situations at a wind turbine site or substation that are beyond the capabilities of the emergency service providers. Maintenance personnel would be trained and have equipment to deal with emergency situations that may occur at a wind turbine site (e.g., tower rescue, confined spaces, high voltage, etc.). Consequently, such an incident would generally not expose local emergency service providers or the general public to any public health or safety risk.

The storage and use of various oils including diesel fuels, lubricating oils, and hydraulic fluids in electrical transmission structures and the operations and maintenance building can also create the potential for fire or a medical emergency. Response to an emergency would not pose a difficulty to local fire and emergency personnel due to the accessibility of the storage and use areas from public or access roads. However, the presence of potentially hazardous materials as well as high-voltage electrical equipment at the substation could present potential safety risks to local emergency service responders.

With appropriate training in place for emergency response personnel, and given the industry standard of minimizing exposure of local emergency responders to unusual situations, the Project would have no significant adverse impact on health and safety due to fire and fuels.

Lightning Strikes

Lightning strikes have occurred at wind facilities, including in 2011 at a facility in Conneaut, Ohio. However, the turbines would have lightning protection systems, which typically include automatic shutdown procedures in the case of damage to the blades or turbine. Most impacts due to lightning strikes would be in the form of localized structural damage to the turbines. Fire risks due to lightning strike are described above. Accordingly, the Project would have no substantial adverse impact on health and safety due to lightning strikes.

Shadow Flicker

As described in Section 4.14.7, there are no uniform health and safety thresholds for shadow flicker. However, based on available research (NWCC 2005, Stantec 2010b), studies and guidelines from Europe and Australia have suggested 30 hours of shadow flicker per year as the threshold of significant impact, or the point at which shadow flicker is commonly perceived as an annoyance. Therefore, this EIS uses 30 hours of shadow flicker per year as the threshold for significant impacts.

Based on the computerized simulations prepared by the Applicant (EAPC 2009) for a 70-turbine array, seven permanent non-participating residences could be exposed to shadow flicker exceeding this 30-hour threshold, with some homes receiving as much as 57 hours of annual shadow flicker. The OPSB conditions require that turbine 70, which contributes to these violations at each of the seven non-participating residences of the 30-hour limit, be moved to comply with the 30-hour standard, or not be built at all. Therefore, no non-participating residence would experience a level of shadow flicker exceeding the 30-hour threshold. The full 100-turbine array has not been evaluated in a similar manner. If modeling indicates more than 30 hours per year, a site visit will be conducted to evaluate site specific conditions. If the model results are confirmed valid based on site specific conditions, then measures such as planting trees or moving the turbine would be implemented to reduce flicker to less than 30 hours per year. The Applicant has committed that the 100-turbine array would not result in any non-participating residence experiencing more than 30 hours of shadow flicker.

Actual exposure would depend on weather and the presence of screening, such as trees or buildings. In addition, the Applicant's study did not model the position of each home's windows. Thus, while the residence itself may be exposed, the residents inside may not experience the shadow flicker.

Travelers along nearby roads could also experience shadow flicker from turbines. However, overall exposure to Project-related flicker would be comparatively minimal and would not be substantially different in nature from shadow flicker experienced during the course of normal driving (e.g., the sun shining through trees, utility poles, and other obstructions).

Based on the Applicant's commitment to not exceed 30 hours of shadow flicker per year, the Project's shadow flicker is not likely to have an adverse impact on permanent non-participating residences.

Wind Turbine Syndrome

Although wind turbine syndrome is not a recognized medical diagnosis, the topic has led to health concerns over wind power projects. Pierpont (2009, pre-publication draft) hypothesized that wind turbine syndrome is caused by the combined effect of: (1) airborne infrasound from wind turbines at frequencies of 1 to 2 Hz affecting the body's vestibular system; and (2) airborne infrasound from wind turbines at frequencies 4 to 8 Hz entering the lungs and transmitting vibrations throughout internal organs. The combined effect of these frequencies is hypothesized to send confusing information to the position and motion detectors of the body, causing the symptoms (Pierpont 2009, pre-publication draft; Colby et al. 2009). Several literature reviews that have been conducted on the health effects of wind turbine sound have examined Pierpont's hypotheses, none of which have been found to be supported by sufficient verifiable scientific evidence (Colby et al. 2009, Knopper and Ollson 2011, Ellenbogen et al. 2012). One study surveyed the published measurements of infrasound from wind turbines and determined that turbines with the rotor positioned upwind produced levels of infrasound that were below the limit of perception, and are so low that they are not useful for evaluating the environmental effects of wind turbines. However, turbines with downwind rotors produce 10 to 30 dB higher infrasound levels, which may exceed relevant assessment criteria in distances up to several hundred meters. It was also stated that due to the differences in individual hearing thresholds, infrasound that is inaudible to one person may be loud and bothersome to another (Jakobsen 2005).

A 2007 perception survey conducted in the Netherlands with 725 respondents concluded that wind turbine sound is easily distinguished and, compared with sound from community transportation or industry sources, considered an annoyance (Pedersen et al. 2009). The results were found to be similar to a study conducted in Sweden (Pedersen and Halmstad 2003). Another study compared data from three field studies in which levels of wind turbine noise were compared to self-reported health status of people living near wind power facilities. It was found that many of the self-reported health effects can be associated with noise annoyance. In fact, annoyance was the only response to wind turbine noise that was directly associated with A-weighted[20] sound pressure levels in the three studies. The author concluded that the health effects could be explained by cognitive stress theory, in which an individual assesses an environmental stressor as either beneficial or not and behaves accordingly (Pedersen 2011). This finding is supported by evidence that health effects from noise annoyance can be addressed through behavioral and cognitive behavioral therapies (Leventhall et al. 2008).

The research shows that people have complained of annoyance resulting from wind turbine sound, and there is reason to be prudent in turbine siting, but there is no evidence of any direct relationship between wind turbine sound and adverse physiological health impacts. impacts.

As discussed in Section 5.4 and 5.5, mortality of bats is not expected to be significant, and the impact on bats' ability to control insect populations within the Action Area is not expected to rise to the level of significance. Therefore no changes in the rate of insect-bourne diseases would result and no changes in the current use of pesticides to control insects would be expected.

Decommissioning-related Effects

Effects on health and safety from the decommissioning phase of the Project would be similar to those from the construction phase. Assuming that health and safety plans are established and followed, and that proper coordination exists with local emergency service responders, decommissioning of the Project would have no significant adverse impacts on health and safety.

Mitigation Measures for Unavoidable Impacts

The Proposed Action contains no specific mitigation measures for health and safety in addition to the avoidance and minimization measures listed above. The Project is not expected to have significant adverse impacts on health and safety.

5.14.2.2 Redesign Option

The Redesign Option is an optional measure under the Proposed Action that includes a primarily buried collection system. Impacts to health and safety are expected to be the same as those described for the Proposed Action. The avoidance and minimization measures would be the same as described above for the Proposed Action. No mitigation measures would be warranted.

5.14.3 Alternative A - Maximally Restricted Operations Alternative

Alternative A differs from the Proposed Action only with respect to operations. Construction- and decommissioning-related effects associated with Alternative A would be similar to those described for the Proposed Action. The operational differences would have minor effects on health and safety in that there would be a slightly reduced risk of ice shedding due to time-of-

[20] A-weighting is a commonly arithmetic curve used for low-frequency noise.

year restrictions and reduced hours of operation and slightly reduced risk of blade shear due to reduced hours of operation. These risks would be lower under Alternative A than under the Proposed Action. The avoidance and minimization measures would be the same as under the Proposed Action. No mitigation measures would be warranted.

5.14.4 Alternative B - Minimally Restricted Operations Alternative

Alternative B differs from the Proposed Action only with respect to operations. Construction- and decommissioning-related effects associated with Alternative B would be similar to those described for the Proposed Action. The operational differences would have minor effect on health and safety in that there would be a slightly increased risk of ice shedding due to time-of-year restrictions and increased hours of operation and slightly increased risk of blade shear due to increased hours of operation. These risks would be slightly higher under Alternative B than under the Proposed Action. The avoidance and minimization measures would be the same as under the Proposed Action. No mitigation measures would be warranted. .

5.14.5 Alternative C - No Action Alternative

Under Alternative C, the Project would not be built and no Project-related activities (construction, operation, or decommissioning) would occur. Alternative C would have no effect on health and safety. As such, no mitigation measures would be warranted.

In summary, the full 100-turbine array is not likely to have an adverse flicker impact on non-participating permanent residences. There are several types of rare events that present remote safety risks associated with the Project, but these events are sufficiently rare that they are not considered significant.

5.15 Cumulative Effects

The CEQ defines cumulative effects as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions” (40 CFR 1508.7). In 1997, the CEQ published *Considering Cumulative Effects under the National Environmental Policy Act* as a comprehensive guidance document for cumulative analyses. The CEQ guidelines acknowledge that while “in a broad sense all the impacts on affected resources are probably cumulative,” it is important to “count what counts” and narrow the focus of the analysis to important national, regional, and local issues. While the CEQ recommends this be done through scoping, they also caution that “not all potential cumulative effects issues identified during scoping need to be included” in an EIS, but only those effects with direct influence on the Project and Project decision-making.

This section analyzes the cumulative effects on each of the specific resources discussed in Sections 5.1 to 5.14, and provides an overall, synergistic analysis of the cumulative effects of the Proposed Action and action alternatives and other past, current, and reasonably foreseeable actions in the region surrounding the Project. Reasonably foreseeable actions are future actions that have been proposed. The geographic scope of this cumulative effects analysis varies for each resource depending on the spatial extent of potential cumulative impacts. The temporal scope of the cumulative analysis extends approximately 30 years into the future, the duration of the ITP.

5.15.1 Methodology for Cumulative Effects Analysis

The 1997 CEQ guidelines recommend analyzing cumulative effects according to a tiered approach among specific resources, interconnected systems, and human communities. This hierarchical approach allows for a quantitative, resource-specific analysis as well as a synergistic and additive discussion of the system-level influence of regional actions. As per the CEQ guidelines, resources that would not be impacted by the Proposed Action or action alternatives, have beneficial effects, or are only subject to temporary effects were excluded from this analysis (CEQ 1997). The No Action Alternative would not result in cumulative impacts to any resource since there would be no change in the existing conditions and so is not included in the cumulative effects analysis. Table 5.15-1 summarizes the screening process to determine the resources included in the cumulative effects analysis.

Table 5.15-1 Summary of Potential Cumulative Effects of the Project

Resource	Potential Long Term Adverse Effect of the Proposed Action and/or Action Alternatives Possible?	Potential Effect	Cumulative Effects Analysis Required?	Analysis Area
Geology and Soils	No	No significant effect.	No	NA
Water Resources	Yes	Project would result in 0 acres of permanent wetland impacts and no more than 1,248 linear feet (1,598 for Redesign Option) of stream impacts.	Yes	Action Area
Vegetation	Yes	Project would have minor adverse impacts on vegetation.	Yes	Action Area
Wildlife and Fisheries, Including Migratory Birds and Migratory Bats	Yes	Project would have minor adverse impacts on migratory birds and bats.	Yes	Eastern Migratory Bird Flyway and Eastern US
Rare, Threatened, and Endangered Species	Yes	Project would have minor adverse impacts on the Indiana bat.	Yes	Indiana Bat Midwest Recovery Unit and maternity colony
Cultural Resources	Yes	Project would have minor adverse impacts on historic architectural resources in the Project Area.	Yes	Action Area
Land Use and Recreation	No	No significant effect.	No	NA
Visual Resources	Yes	Project would have minor adverse impact on visual resources.	Yes	Viewshed

Resource	Potential Long Term Adverse Effect of the Proposed Action and/or Action Alternatives Possible?	Potential Effect	Cumulative Effects Analysis Required?	Analysis Area
Socioeconomic Resources	No	Project would have minor beneficial effect on socioeconomic resources.	No	NA
Noise	No	No significant effect.	No	NA
Air Quality	No	Project would have minor beneficial effect on air quality.	No	NA
Transportation	No	Project would have only temporary minor adverse impact during construction.	No	NA
Communications	No	No significant effect.	No	NA
Health and Safety	No	No significant effect.	No	NA

Reasonably Foreseeable Actions That Could Contribute to Cumulative Effects

Much of the Action Area and surrounding vicinity is zoned agricultural, and the Champaign, Union, Madison, Clark, and Logan County Comprehensive Plans and other local land use planning documents (see Section 4.7) reflect the intent of the Counties to remain largely agricultural in the foreseeable future. According to information provided by the Logan-Union-Champaign Regional Planning Commission and Champaign County, no residential subdivisions or large scale retail or commercial developments have been approved or are currently proposed for the Action Area and immediate vicinity (LUC Regional Planning Commission 2006; W. Dodds, LUC Regional Planning Commission, personal communication). For the reasonably foreseeable future, development in the Action Area is expected to be limited to residential and small scale retail commercial development. County building permits have been issued for several new residences (individual homes), pole barns, and an Ohio DOT equipment storage yard. Lot splits[21] are a common practice but do not indicate plans for development (P. Rittenhouse, Champaign Co Building Regulations, personal communication; W. Dodds, LUC Regional Planning Commission, personal communication).

Within the larger five-county area (Champaign, Union, Madison, Clark, Logan Counties), numerous existing residential subdivisions (particularly in Clark, Champaign, and Union Counties) have continuing phases already approved, but these have been on hold for some time and it is unknown if and when they would resume development. The only major industrial/commercial development is associated with expansion of the existing Honda facilities near SR 33 and Northwest Highway in Union County (Allen Township) (P. Rittenhouse, Champaign Co Building Regulations, personal communication; W. Dodds, LUC Regional Planning Commission, personal communication).

[21] A lot split is defined as the division of parcels less than five acres in size which do not involve the opening, widening or extension of any street or road, or easement of access, and does not involve more than five lots, including the remainder of the original tract (ORC, Section 711.131).

Accordingly, reasonably foreseeable actions that could contribute to cumulative effects include:

- Road maintenance and building projects within Champaign County;
- Small scale residential and business developments[22] within the Action Area and immediately adjacent lands;
- Agricultural practices[23] within the Action Area;
- Operational, under construction, or proposed wind projects, communications towers and buildings within the Eastern Flyway zone (Atlantic and Mississippi Flyways) and Indiana Bat Midwest Recovery Unit); and
- Habitat loss within the Bird Conservation Region and Midwest Recovery Unit.

5.15.2 Water Resources

The cumulative effects analysis of water resources focuses on source water protection areas, floodplains, drainages, and wetlands within the Action Area. Neither the Proposed Action nor any of the action alternatives would affect any major waterbodies. Past human activities that have impacted water resources include agricultural practices, road maintenance practices, and residential and commercial development. Agricultural practices, such as clearing, draining, and filling, have had significant impacts on water resources since the days of early settlement in Ohio. During the early settlement period, common agricultural practice included draining swamps, and since 1850 approximately 90 percent of Ohio's wetlands have been converted to other uses (Brown and Ward not dated). Impacts to water resources from these activities may have included erosion and sedimentation, similar to what is expected from the Project. The greatest source of past water quality impacts in the Project vicinity is from agricultural practices.

Reasonably foreseeable future actions in the Action Area that may impact water resources include road maintenance projects, continued agricultural use, and development of residences and small businesses. No major land developments are currently proposed in the Action Area. If a major development were to be proposed it would be subject to local, state, and possibly federal review, and would be required to comply with the USACE regulations pertaining to impacts to wetlands and streams and Ohio's EPA rules for minimizing impacts to water resources.

Any cumulative effects to water resources from the combination of the Proposed Action with past, present, and reasonably foreseeable future actions would be minor because the state and/or federal permitting process(es) would require avoidance, minimization, and mitigation (in some cases) of impacts.

Alternative A – Maximally Restricted Operations Alternative

Alternative A differs from the Proposed Action only with respect to operations. The operational differences would not affect water resources. As such, the cumulative effects of Alternative A would not differ from those of the Proposed Action.

[22] In this case, small scale residential development was defined as developments of up to four residential units per residential lot (i.e., excludes larger multifamily housing, such as condominiums, apartments and other complexes).
[23] In this case, agriculture includes individual and commercial farming and animal husbandry and related land clearing, tilling, water management, etc.

Alternative B – Minimally Restricted Operations Alternative

Alternative B differs from the Proposed Action only with respect to operations. The operational differences would not affect water resources. As such, the cumulative effects of Alternative B would not differ from those of the Proposed Action.

Alternative C - No Action Alternative

Under Alternative C, the Project would not be built and no Project-related activities (construction, operation, or decommissioning) would occur. Alternative C would have no effect on water resources. As such, there would be no cumulative effects on water resources from Alternative C.

5.15.3 Vegetation

The cumulative effects analysis of vegetation focuses on the loss or alteration of natural vegetation within the Action Area. According to the ODNR Division of Wildlife (DOW) prior to settlement, the state of Ohio had 95% forest cover. However, as settlements and agriculture spread throughout Ohio, forested cover declined to a low of 12% in 1940 (ODNR DOW 2012). The spread of settlements also introduced many exotic diseases such as Dutch Elm disease and the chestnut blight, which altered the remaining composition of the Ohio's forested areas. The year of 1940 was, however, the turning point for forest decline, as since 1940 there has been an increase of forest cover (ODNR DOW 2012).

Past actions that have impacted vegetation within the Action Area include timber harvesting, draining of wetlands, conversion of natural land to agriculture, and the expansion of development of single family residences, small subdivisions, and small businesses. As structures and associated road accesses were built, these activities cleared existing vegetation and altered the structure and composition of the natural communities. Expansion of agricultural activities in the Project Area required the clearing of natural vegetation and planting and maintaining of row crops or pasture. The majority (69%) of vegetation in the Action Area is cultivated crop, 13% is hay/pasture land cover, 9% is deciduous forest, and 6% is comprised of developed open space (i.e., recreational parks) (Figure 4.3-1). The remaining land cover types include grassland/herbaceous and low intensity development comprise 1% of the Action Area, while evergreen forest, barren land, mixed forest, and high intensity development each comprise less than 0.1% of the Action Area (Table 5.15-2, Figure 4.3.1).

Table 5.15-2 Historic Land Cover in the Action Area

Land Cover Type	Hectares	Acres	Percent of Action Area
Cultivated crop	22,372	55,284	69.5%
Hay/pasture	4,131	10,208	12.8%
Deciduous forest	2,723	6,729	8.5%
Developed, open space	1,901	4,699	5.9%
Grassland/Herbaceous	406	1,004	1.3%
Developed, low intensity	401	993	1.2%
Open water	83	206	0.3%
Developed, medium intensity	51	127	0.2%
Emergent herbaceous wetland	34	84	0.1%
Evergreen forest	29	73	0.1%
Developed, high intensity	25	64	0.1%
Barren land	13	32	0.0%
Mixed forest	2	5	0.0%
Total	32,171	79,508	100%

Source: Homer et al. 2004.

Reasonably foreseeable future actions in the Action Area that may impact vegetative communities over the next 30 years include conversion of natural land to agriculture and the development of single family residences and small businesses. No major road projects or developments involving a large amount of vegetation and habitat conversion have been proposed. The Project is estimated to result in a permanent loss of approximately 6.5 ha (16.1 ac) of forested land, 2.3 ha (5.7 ac) of CRP land, and 0.4 ha (1.0 ac) of hay/pasture/grassland (see Section 5.3 of this EIS for further details).

Any cumulative effects to vegetation from the combination of the Proposed Action with past, present, and reasonably foreseeable future actions would be minor because most of the impacts from the Project (over 90%) would impact cropland as opposed to natural vegetation communities and only small amounts of vegetation loss or habitat conversion are anticipated in the Action Area as a result of reasonable foreseeable future actions. Cumulatively, these actions would affect a very small proportion of the Action Area.

Alternative A – Maximally Restricted Operations Alternative

Alternative A differs from the Proposed Action only with respect to operations. The operational differences would not affect vegetation. As such, the cumulative effects of Alternative A would not differ from those of the Proposed Action.

Alternative B – Minimally Restricted Operations Alternative

Alternative B differs from the Proposed Action only with respect to operations. The operational differences would not affect vegetation. As such, the cumulative effects of Alternative B would not differ from those of the Proposed Action.

Alternative C - No Action Alternative

Under Alternative C, the Project would not be built and no Project-related activities (construction, operation, or decommissioning) would occur. Alternative C would have no effect on vegetation. As such, there would be no cumulative effects on vegetation from Alternative C.

5.15.4 Wildlife and Fisheries: Migratory Birds

The analysis of cumulative effects on wildlife focuses on mortality of migratory birds from collisions with man-made structures including communication towers, windows, and wind turbines including the Project and other existing, planned, or potential structures within the Eastern (Atlantic and Mississippi) flyway (Figure 4.4-2). The analysis for migratory birds also includes an evaluation of potential habitat impacts within the designated Bird Conservation Region(s) that incorporates the Action Area.

Cumulative effects to non-listed bats and the Indiana bat and other rare, threatened, and endangered wildlife species are addressed in Section 5.15.5.

Bird Mortality from Collisions with Human-made Structures

Fatalities as a result of collision with communication towers and the associated guy wires has been under increasing study and scrutiny as the number of towers increases exponentially. In 2002, there were 138,000 listed FCC towers, of which approximately 106,000 were lighted (Erickson et al. 2005). The FAA Digital Obstacle File for 2010 shows 3,060 communication towers in the state of Ohio, including 72 towers over 152.4 m (500 ft) and 44 over 243.8 m (800 ft).[24] As of February 1, 2012, there were 96,039 communications towers nationwide, including in the five US territories, identified in the FCC database (FCC 2012). Approximately 2,800 new registered communications towers are conservatively projected to be constructed annually in the US over the next 10 years (FCC 2012). This represents an approximate 30 percent increase over the 96,039 communications towers in the existing environment as of February 1, 2012 (FCC 2012).

Bird collisions with communication towers have been documented and studied since the 1940s and collision estimates range from the USFWS's conservative estimate of 4 or 5 million fatalities a year to as many as 40 or 50 million per year by some researchers (Manville 2005; Longcore et al 2011). Episodic bird fatality events have been documented at numbers ranging from less than 10 to more than 12,000 at a single tower in Wisconsin in 1963 (Kemper 1996). Studies have shown that the highest number of fatalities occur at lit towers in inclement weather, when birds become disoriented and circle the tower until they collide with the tower, guy wires, or simply collapse of exhaustion (Erickson et al. 2005). Taller towers, which tend to have more lights and guy wires, have higher collision rates. Towers with solid and pulsating red lights have higher collision rates than towers with white lights. Studies conducted by Gehring et al. (2009) found that by extinguishing solid burning red lights, the number of fatalities could be reduced by 50 to 71 percent. In March 2012, the Wireless Telecommunications Bureau (WTB) issued a Final Programmatic Environmental Assessment (PEA) that assesses the effects of its communication tower/antennae registration program on migratory birds (FCC 2012). The PEA concluded that the existing tower registration program has no significant effect on the environment (including

[24] This figure is not comprehensive but indicates all towers that the FAA is aware of.

migratory birds) at the national level but that individual towers may have unaddressed significant effects on local populations of migratory birds and bald and golden eagles (FCC 2012). The PEA also concluded that tower siting restrictions and lighting requirements aimed at minimizing bird collisions would lessen the potential local population level effects of telecommunication towers on birds.

The USFWS developed a set of voluntary guidelines in 2000 for siting, constructing, operating, and decommissioning communication towers in a manner that minimizes potential impacts. In addition, the Federal Aviation Administration (FAA) released a report in May 2012 making a number of recommendations on changes to how communications towers are lighted in an effort to curb bird deaths. Among its recommendations is a proposal to omit or flash steady-burning red lights from several obstruction lighting configurations (FAA 2012). Adoption of these guidelines and recommendations would reduce bird deaths from telecommunications towers in the future.

Bird fatalities associated with buildings are typically the result of collision with windows (Erickson et al. 2005). Klem (1990) conducted research at residential homes and found that about 55 percent of bird-window collisions result in a fatality. Due to a paucity of long-term systematic research conducted across multiple regions, and the large and ever-changing number of structures in the US, fatality estimates vary widely, but the generally accepted figure is between one and 10 bird fatalities per structure per year, or between 97.6 to 976 million total bird deaths per year (Klem 1990; USFWS 2002; Erickson et al. 2005). Studies have shown that height or size of the window or building is not a significant contributing factor in these collisions, nor the age and sex of the bird, but rather the fact that the birds do not perceive transparent glass or reflective glass that mirrors the surrounding environment as a barrier (Klem 1989).

Current Wind Developments and Bird Mortality

In order to quantify bird mortality attributed to existing and near future wind power projects within the eastern flyways zone, Table 5.15-3 presents a summary of publically available data for avian mortality at wind power facilities that are located within the eastern flyways, relating annual avian mortality with the number of MW installed. Table 5.15-4 presents a summary of the total estimated number of turbines that were currently operating, under construction, or proposed as of 2011. This inventory did not include residential or small-scale industrial turbines as comprehensive data on the location and number of these turbines is unavailable.

Table 5.15-3. Results and Estimates of Annual Avian Mortality Based on Publicly Available Data from 43 Studies at 30 Different Wind Power Facilities that Fall within the Eastern Flyways

Site	Habitat type	Total # turbines / Total MW	Study Periods	Corrected for SESR? [4]	Estimated total bird fatalities per year (min – max) [1]	Estimated bird fatalities per MW per year (min – max) [1]	Reference
Mars Hill, ME	forested ridgeline	28 / 42	April 23 – June 3, 2007; July 15 - Sept 23 2007	Yes	12.32 - 69.2	0.29 - 1.65	Stantec 2008
Mars Hill, ME	forested ridgeline	28 / 42	April 19 - June 6, 2008; July 15 - Oct 8, 2008	Unknown	67.2 - 74.2	1.36 - 1.76	Stantec 2009a
Stetson I, ME	forested ridgeline	38 / 57	April 20 – Oct 21, 2009	Yes	153	2.68	Stantec 2009b
Massachusetts Maritime Academy, MA	coastal	1 / 0.66	April 24 – Nov 30, 2006	Unknown	1	2.1	Vlietstra 2008
Massachusetts Maritime Academy, MA	coastal	1 / 0.66	April 15 – Nov 30, 2007	Unknown	3	4.15	Vlietstra 2008
Jersey Atlantic, NJ	wetland wastewater treatment	5 / 7.5	Jan 1 - August 31, 2009	No	150 [3]	20 [3]	NJ Audubon Society 2009
Maple Ridge, NY	woodland, grassland, agriculture	120 / 198	June 17 - Nov 15, 2006	Yes	372 -1138	1.88 - 5.75	Jain *et al*. 2007
Maple Ridge, NY	woodland, grassland, agriculture	195 / 321.75	April 30 - Nov 14, 2007	Yes	1106 - 1230	3.44 - 3.82	Jain *et al.* 2008
Maple Ridge, NY	woodland, grassland, agriculture	195 / 321.75	April 15 - Nov 9, 2008	Yes	667 - 733	2.07 - 2.28	Jain *et al.* 2009b
Munnsville, NY	agriculture, forested uplands	23 / 34.5	April 15-Nov 15, 2008	Unknown	39 - 51	1.13 - 1.48	Stantec 2009c

Site	Habitat type	Total # turbines / Total MW	Study Periods	Corrected for SESR? [4]	Estimated total bird fatalities per year (min – max) [1]	Estimated bird fatalities per MW per year (min – max) [1]	Reference
Noble Clinton Windpark, NY	agriculture, woodland	67 / 100.5	April 26 to Oct 13, 2008	Yes	96 - 166 small birds; 59 med-large birds	0.96 - 1.65 small birds; 0.59 med-large birds	Jain *et al.* 2009d
Noble Ellenburg Windpark, NY	agriculture, woodland	54 / 81	April 28 to Oct 13, 2008	Yes	62 - 74 small birds; 51med-large birds	0.77 - 0.91 small birds; 0.63 med-large birds	Jain *et al.* 2009e
Noble Bliss Windpark, NY	agriculture, woodland	67 / 100.5	April 21 - Nov 14, 2008	Yes	50 - 271 small birds; 17-44 med-large birds	0.50 - 2.70 small birds; 0.17 - 0.44 med-large birds	Jain *et al.* 2009c
Cohocton / Dutch Hill, NY	agriculture	50 / 125	April 15 - Nov 15, 2009	Yes	147 - 235	1.18 - 1.88	Stantec 2009
Cohocton / Dutch Hill, NY	agriculture	50 / 125	April 26 - October 22, 2010	Yes	41-58	0.55 to 1.37	Stantec 2011
Casselman, PA	forested ridge, agriculture, reclaimed mine	23 / 34.5	April 19 - Nov 15, 2008	Unknown	9 - 108	0.24 - 3.13	Arnett *et al.* 2009b
Mountaineer, WV	forested ridgeline	44 / 66	April 4- Nov 11, 2003	Unknown	178 + 33 due to substation lighting	2.69	Kerns and Kerlinger 2004
Mount Storm, WV	forested ridgeline	82 /164	July 18 - Oct 17, 2008	Unknown	198 - 312	1.21 - 1.90	Young *et al.* 2009
Buffalo Mountain, TN	reclaimed mine on ridge	18 / 29	April - Dec, 2005	Yes	32	1.1	Fiedler *et al.* 2007
Top of Iowa, IA	agriculture	89 / 189.8	April 15 - Dec 15, 2003	Unknown	961	5.06	Koford *et al.* 2004
Top of Iowa, IA	agriculture	89 / 189.8	March 24 – Dec 10, 2004	Unknown	80	0.42	Koford *et al.* 2005
Buffalo Ridge (Phase I), MN	agriculture, grassland	73 / 25	April, 1994 – Dec, 1995	Unknown	24 - 48	0.96 - 1.92	Osborn *et al.* 2000
Buffalo Ridge (Phase II), MN	agriculture, grassland	138 /103.5	March 15 – Nov 15, 1996 - 1999	Yes	72	1.3	Johnson *et al.* 2000 2002

Site	Habitat type	Total # turbines / Total MW	Study Periods	Corrected for SESR? [4]	Estimated total bird fatalities per year (min – max) [1]	Estimated bird fatalities per MW per year (min – max) [1]	Reference
Buffalo Ridge (Phase II), MN	agriculture, grassland	138 /103.5	March 15 – Nov 15, 1999	Yes	614	5.93	Johnson *et al.* 2000 2002
Buffalo Ridge (Phase III), MN	agriculture	143 / 107.25	March 15 - Nov 15, 1998-1999	Yes	325	3.03	Johnson *et al.* 2000 2002
Blue Sky Green Field, WI	agricultural	88 / 145	July 21 - Oct 3, 2008	Yes	1041	7.18	Gruver *et al.* 2009
Blue Sky Green Field, WI	agriculture	88 / 145	March 17 - June 4, 2009	Yes	631	4.35	Gruver *et al.* 2009
Kewaunee County, WI	agriculture	31 / 20.4	1999 - 2001	Yes	40	1.96	Howe 2002
Oklahoma Wind Energy Center, OK	agriculture, wooded riparian	68 / 102	May - July, 2004 - 2005	Yes	3 - 8	0.03 - 0.08	Piorkowski 2006
NPPD Ainsworth Wind Farm, NE	sandhills, grassland pastoral	36 / 59.4	March 13 - November 4, 2007	Unknown	97	1.62	Derby *et al.* 2007
Forward Energy Center, WI	agriculture, deciduous woodlands	86 / 129	July 15 - November 15, 2008; April 15 - May 31, 2009 and 2010; July 15 - Oct 15, 2009	Yes	N/A	1.17	Drake *et al.* 2010; Grodsky and Drake 2011
Fowler Ridge Wind Farm, IN	agriculture, pastoral, grassland, wooded	355 / 600	April 13 - May 15, 2010 and July 30 – October 15, 2010	No	60	0.1	Good *et al.* 2011
6-3, PA	N/A	N/A	May 1 – November 15, 2007	Yes	N/A	0.9	Mumma and Capouillez 2011
6-3, PA	N/A	N/A	April 1 – November 15, 2008	Yes	N/A	1.2	Mumma and Capouillez 2011
2-2, PA	N/A	N/A	April 1 – November 15, 2008	Yes	N/A	1.5	Mumma and Capouillez 2011
2-2, PA	N/A	N/A	April 1 – November 15, 2009	Yes	N/A	3.0	Mumma and Capouillez 2011
2-14, PA [7]	N/A	N/A	April 1 – November	Yes, but did	N/A	3.1	Mumma and

Site	Habitat type	Total # turbines / Total MW	Study Periods	Corrected for SESR? [4]	Estimated total bird fatalities per year (min – max) [1]	Estimated bird fatalities per MW per year (min – max) [1]	Reference
			15, 2008	not follow PGC protocol [5]			Capouillez 2011
2-14, PA	N/A	N/A	April 1 – November 15, 2009	Yes	N/A	2.4	Mumma and Capouillez 2011
2-10, PA [7]	N/A	N/A	April 1 – November 15, 2008	Yes, but did not follow PGC protocol [5]	N/A	1.3	Mumma and Capouillez 2011
2-4, PA	N/A	N/A	April 1 – November 15, 2009	Yes	N/A	9.8	Mumma and Capouillez 2011
5-5, PA [7]	N/A	N/A	April 1 – November 15	Yes, but did not follow PGC protocol [5]	N/A	1.0	Mumma and Capouillez 2011
24-3, PA [7]	N/A	N/A	April 1 – November 15	Yes, but did not follow PGC protocol [5]	N/A	2.7	Mumma and Capouillez 2011
6-1, PA	N/A	N/A	April 1 – November 15, 2009	Yes	N/A	1.7	Mumma and Capouillez 2011
Average [6]	N/A	N/A	N/A	N/A	N/A	**3.02**	N/A

[1] Unless otherwise indicated, for reported fatality estimates, 'year' represents 'study year' or the study period.

[2] Author corrected number to estimate fatality on a year round basis.

[4] Searcher efficiency and scavenger removal.

[5] The site has an approved monitoring plan with the Pennsylvania Game Commission (PGC) that was not adhered to, resulting in inaccurate mortality estimates (Mumma and Capouillez 2011).

[6] Average calculated using maximum number if a range given. The studies that did not follow PGC protocol (Mumma and Capouillez 2011) were not included in the calculations to estimate average fatalities of birds.

[7] Studies colored in gray did not follow PGC protocol (Mumma and Capouillez 2011), so were not included in average mortality estimates.

Table 5.15-4. Total Number of Megawatts and Turbines at Operational, Under Construction, and Proposed Wind Facilities that Fall within the Eastern Flyways (Atlantic and Mississippi Flyways)

	Total Megawatts				Estimated Total Turbines [2]			
State	**Operational[3]**	**Under construction[3]**	**Proposed within the next three years[3]**	**Total**	**Operational[3] as of 2011**	**Under construction[3] as of 2011**	**Proposed[3] within next three years**	**Total**
Arkansas	10	0	210	220	7	0	140	147
Connecticut	0	4.8	0	4.8	0	3	0	3
Delaware	2	0	450	452	1	0	300	301
Illinois	2,743	615	16,284	19,642	1,829	410	10,856	13,095
Indiana	1,340	202	8,426	9,968	893	135	5,617	6,645
Iowa	4,322	470	14,569	19,361	2,881	313	9,713	12,907
Kansas	1,274	1,189	13,191	15,654	849	793	8,794	10,436
Maine	397	0	1,398	1,795	265	0	932	1,197
Maryland	120	0	13,191	13,311	80	0	8,794	8,874
Massachusetts	46	46	492	584	31	31	328	390
Michigan	377	348	2,518	3,243	251	232	1,679	2,162
Minnesota	2,733	36	20,010	22,779	1,822	24	13,340	15,186
Missouri	459	0	2,051	2,510	306	0	1,367	1,673
Nebraska	337	120	3,726	4,183	225	80	2,484	2,789
New Hampshire	26	147	396	569	17	98	264	379
New Jersey	8	2	1,416	1,425	5	1	944	950
New York	1,403	230	8,000	9,633	935	153	5,333	6,421
North Carolina	0	0	0	0	0	0	0	0
North Dakota	1,445	234	11,493	13,172	963	156	7,662	8,781
Ohio	112	309	3,683	4,104	75	206	2,455	2,736
Oklahoma	2,007	393	14,677	17,077	1,338	262	9,785	11,385
Pennsylvania	789	520	3,391	4,700	526	347	2,261	3,134
Rhode Island	2.4	4.8	347	354	2	3	231	236
South Dakota	784	0	30,112	30,896	523	0	20,075	20,598
Tennessee	29	0	0	29	19	0	0	19
Vermont	46	63	155	264	31	42	103	176
Virginia	0	38	820	858	0	25	547	571
West Virginia	564	19	1,045	1,628	376	13	697	1,086

	Total Megawatts				Estimated Total Turbines [2]			
State	**Operational[3]**	**Under construction[3]**	**Proposed within the next three years[3]**	**Total**	**Operational[3] as of 2011**	**Under construction[3] as of 2011**	**Proposed[3] within next three years**	**Total**
Wisconsin	631	5	908	1,544	421	3	605	1,029
Total	**22,006**	**4,996**	**172,959**	**199,961**	**14,671**	**3,330**	**115,306**	**133,307**
Adjusted Total[1]	**22,006**	**4,996**	**34,592**	**61,594**	**14,671**	**3,330**	**23,061**	**41,062**

Source: AWEA (2012)

[1] Based on the assumption that of the proposed projects a maximum of 20 percent would ultimately be constructed within the near future (i.e., next 3 years). Twenty percent represents an aggressive assumption of the number of proposed projects that will be built in the next 3 years, based on the history of the PJM interconnect queue (NREL 2009), and actual build out is likely to be far less based on industry experience and market factors. The U.S. Energy Information Administration (EIA) projection for long term (2035) installed capacity provides the best estimate for wind power capacity during the ITP Term (EIA 2012, see Table 5.15-6).

[2] Extrapolated using an average wind turbine rated capacity of 1.5 MW (Table 5.15-2).

[3] Operational refers to online capacity or turbines. Under construction refers to wind facilities that have been approved and are currently being built. Proposed refers to wind facilities that have been proposed to be built.

At the end of 2011, there were approximately 14,671 wind turbines, producing an estimated 22,006 MW of total electricity, in operation in the eastern flyways zone (AWEA 2012). Within the next 3 years, assuming only 20 percent of the proposed projects would be constructed (NREL 2009), approximately 41,062 wind turbines could be operational in the eastern flyways zone, producing an estimated 61,594 MW of electricity. Two percent of the total operational, under construction, and proposed wind facilities are located in Ohio (Table 5.15-4).

Based on data available from 43 studies at 30 wind power facilities (Table 5.15-3), it was determined that an average of 3.02 bird fatalities occur per MW per year (Table 5.15-3). Because turbines under the Proposed Action would be spinning fewer hours of the night compared to other turbines in the eastern flyway due to the proposed feathering and cut-in speeds, we would expect this project to result in mortality rates of less than 3.02 birds per MW per year. In Section 5.4 we calculated that the Proposed Project would result in mortality of 2.94 birds/MW/year or 735 birds/year for the 100-turbine (250 MW) project. Other wind projects in the reasonably foreseeable future (projects currently operational, under construction, and proposed) in the eastern flyways zone are estimated to cause 186,014 birds mortalities per year (Table 5.15-5). As such, projected bird mortality related to the Project would comprise 0.4% of the total projected near term wind power-related bird mortality in the eastern flyways zone.

Table 5.15-5. Projected Avian Mortality for the Buckeye Wind Power Project in Relationship to Estimated Wind Power Production in the Eastern Flyways Zone

Installation	MW	Annual Mortality (birds/year) [1]	Mortality Over the Operational Life of Buckeye Wind Project
Buckeye Wind Project2	250	735[2]	18,375
Operational, Under Construction, and Proposed Wind Projects3	61,594	186,014	4,650,347

[1] Based on calculated average of 3.02 birds per MW per year derived from results of 43 mortality studies conducted at wind energy facilities in the eastern and Midwestern US.

[2] Based on maximum build out scenario of 100 2.5 MW turbines and a 25-year operational life of the facility, and then reduced by 2.5% to account for feathering and cut-in speeds, as described in Section 5.4.

[3] Assumes all operational and under construction projects are built and operating. Assumes only 20% of proposed projects are built and operating (see footnote 1 Table 5.15-4). Assumes all of these facilities operate over the same 25-year life as Buckeye.

Future Wind Developments and Bird Mortality

In order to consider potential bird mortality at wind projects over the life of the Project, it was necessary to examine the projected growth of wind power construction and operation over the next 30 years. The US Department of Energy (US DOE) has set goals for wind energy to comprise 20 percent of America’s electricity supply by 2030. It was estimated based on data from AWEA (2012) and Annual Energy Outlooks commissioned by the US DOE EIA (2010, 2011, 2012), that wind energy production in the eastern flyways zone in the year 2035 would be approximately 81,441 MW of installed capacity (Table 5.15-6).

Table 5.15-6. Year 2035 Wind Energy Production for 29 States in the Eastern Flyways Zone

State	2011 Operating Wind Capacity (MW)	Projected Wind Power Capacity in 2035 (MW) [1]
Arkansas	10	37.0
Connecticut	4.8	17.8
Delaware	2	7.4
Illinois	2,743	10,149.1
Indiana	1,340	4,958.0
Iowa	4,322	15,991.4
Kansas	1,274	4,713.8
Maine	397	1,468.9
Maryland	120	444.0
Massachusetts	46	170.2
Michigan	377	1,394.9
Minnesota	2,733	10,112.1
Missouri	459	1,698.3
Nebraska	337	1,246.9
New Hampshire	26	96.2
New Jersey	8	29.6
New York	1,403	5,191.1
North Carolina	0	0.0
North Dakota	1,445	5,346.5
Ohio	112	414.4
Oklahoma	2,007	7,425.9
Pennsylvania	789	2,919.3
Rhode Island	2.4	8.9
South Dakota	784	2,900.8
Tennessee	29	107.3
Vermont	46	170.2
Virginia	0	0.0
West Virginia	564	2,086.8
Wisconsin	631	2,334.7
Total	**22,011**	**81,441.4**[1]

[1] Total represents projected capacity in 2035 based on operating capacity in 2011.

Assuming the Project is built in 2013 and becomes operational in 2014, and is operational for 25 years, it would be operational until 2039. This is four years beyond the DOE analysis. However, applying the annual take estimate (3.02 birds/MW/year) to the 2035 DOE projected estimate of 81,441 MW assuming the same 25-year operational timeframe as the Project still generates a reasonable worst-case estimate of bird mortality throughout the life of the Project--by assuming that the full 2035 build-out is occurring at the same time as the Project (which is not likely) and resulting in take of 3.02 bird/MW/year. In reality, wind projects will be built gradually over the years, old projects will be decommissioned over the years, and total bird mortality will increase gradually as installed MW increases. Therefore, although it is possible that more MW may be installed between 2035 and 2039, mortality resulting from those additional MW in those years is already captured in the estimate by attributing it in the early years.

Using the fatality rate of 3.02 bird fatalities per MW per year, total bird mortality in the eastern flyways zone due to the projected capacity by 2035 is estimated to be 6,148,796 (Table 5.15-7). Of this number, the Project would result in approximately 18,375 bird mortalities by 2035.

Table 5.15-7. Projected Avian Mortality for the Buckeye Wind Power Project in Relationship to Estimated Wind Power Production Projected for Year 2035 in the Eastern Flyways Zone

Installation	MW	Annual mortality (birds/year) [1]	Mortality over the Operational Life of Buckeye Wind Project
Buckeye Wind Power Project2	250	735[2]	18,375
Operational, under construction, and proposed wind projects3	61,594	186,014	4,650,347
Projected total wind capacity in 2035	81,441	245,952	6,148,796

[1] Based on calculated average of 3.02 birds per MW per year derived from results of 43 mortality studies conducted at wind energy facilities in the eastern and Midwestern US.

[2] Based on maximum build out scenario of 100 2.5 MW turbines and a 25-year operational life of the facility, and then reduced by 2.5% to account for feathering and cut-in speeds, as described in Section 5.4.

[3] Assumes all operational and under construction projects are built and operating. Assumes only 20% of proposed projects are built and operating (see footnote 1 Table 5.15-4). Assumes all of these facilities operate over the same 25-year life as Buckeye.

If each proposed wind facility implemented an ABPP similar to that developed for the Project and included lighting that is designed to minimize bird collisions such as that recommended by FAA (FAA 2012), mortality could be reduced. Episodic mortality events of single or multiple species related to lighting during migration could be minimized or avoided all together (see discussion below). If each wind facility implemented an adaptive management procedure similar to that outlined in the Project ABPP, bird mortality could be further reduced. While the projected mortality as a result of the Project (18,375 birds by 2035) still appears high, it is a substantial reduction compared to what is currently occurring at wind facilities across the nation and would reduce cumulative impacts to birds from collisions with structures.

Episodic Collision Events

Of particular concern relative to bird collisions with all types of structures are episodic events involving large numbers of one or a few bird species during migration. These have been recorded at multiple locations, and are associated with lighting that attracts or disorients birds. Two episodic mortality events were observed in West Virginia during 2011. In October 2011 a total of 484 bird carcasses were found at the Laurel Mountain Substation, near a wind facility, after several days of fog, cold weather, and winds. Eight 250-watt high pressure sodium lamps were on at night during the event and were assumed to have attracted birds during adverse weather conditions. Of the 484 birds found, Blackpoll warblers were the most common species (308 carcasses), comprising 64 percent of mortalities, followed by Ovenbird (37, 7.6%), Connecticut warbler (24, 5%), Common yellowthroat (22, 4.5%), Cape May warbler (18, 3.7%) and Red-eyed vireo (12, 2.5%) (Stantec 2011). The remaining species comprised one percent or less each of the total mortality.

Similarly in September 2011 at the Mount Storm Wind Energy Facility in West Virginia, 59 bird carcasses were found on one day, 31 of which were found at one turbine whose internal nacelle light had been inadvertently left on overnight. The previous night's weather had been foggy, and the nacelle light was thought to have attracted the birds to the turbine. Species composition of mortalities was dominated by Red-eyed vireo (13), Blackpoll warblers (5), Yellow-billed cuckoo (4), Black-throated blue warbler (4), Magnolia warbler (4), Gray-cheeked thrush (3), Common yellowthroat (3), and Chestnut-sided warbler (3) (WEST, Inc. 2011).

One episodic mortality event at a wind facility occurred in heavy fog during spring migration at Mountaineer Wind Energy Center in West Virginia and consisted of 33 passerine fatalities. After the event was recorded in the vicinity of a substation and three turbines which were brightly lit, the lights were extinguished and no other episodic events have been recorded since (Kerns and Kerlinger as cited in NRC 2007).

As described above, episodic bird fatality events have been documented at communications towers at numbers ranging from less than 10 to more than 12,000 at a single tower in Wisconsin in 1963 (Kemper 1996). Studies have shown that the highest number of fatalities occur at lit towers in inclement weather, when birds become disoriented and circle the tower until they collide with the tower, guy wires, or simply collapse of exhaustion (Erickson et al. 2005). Taller towers, which tend to have more lights and guy wires, have higher collision rates. Towers with solid and pulsating red lights have higher collision rates than towers with white lights.

Episodic events are of concern because they often result in large numbers of individual mortalities, and only a few species. As wind turbines, communication towers, and other tall lit structures continue to increase in number throughout the eastern flyways, episodic events may become more common, and could result in significant impacts to those species most frequently killed. All research on this phenomenon suggests that by altering the lighting protocol at tall structures, episodic mortality events can be substantially reduced, if not eliminated.

Species Composition of Bird Collisions

Species composition of bird fatalities at wind facilities varies. Passerines (e.g., perching birds or songbirds) represent approximately 70 percent of all observed wind turbine related fatalities. Species that could not be identified comprise approximately 12 percent of the total fatalities, followed by raptors (5.3 %), game birds (4.7 %), waterfowl (2.4 %), shorebirds (1.6 %), seabirds (0.7 %), and owls (0.5 %) (see Appendix C Table 4-1). Many of the species that suffer from high fatality rates in the western and mid-western US include horned larks, versper sparrows, bobolink, and western meadowlark. The first three aforementioned species are high-flying aerial displayers and are commonly observed at heights within the rotor-swept area of wind turbines. Meadowlarks, on the other hand, are not known for being high flyers, but have a high fatality rate. Other common high flyers (crows, ravens, vultures) are not typically recorded in fatalities at wind facilities. Abundance, behavior, and other factors interact to influence the likelihood of collisions. Birds of conservation concern found in prairie ecosystems, such as sage grouse and prairie chickens, are typically more likely to suffer from displacement than they are from collision with turbines, as they tend to avoid otherwise suitable habitats near wind turbines (NRC 2007).

Summary of Collision Impacts for Migratory Birds

Migratory bird collisions at man-made structures including wind turbines, communication towers, windows, and transmission lines, may account for 278 million to more than 1.1 billion birds per year and could equate to as many as 33.75 billion birds over the life the Buckeye Project, resulting in a significant cumulative impact. Mortality is likely to be distributed across many groups and species, but most (approximately 70%) would be comprised of passerines. Fatalities of a single passerine species could number as many as 12,700 in a year based on certain projections (NRC 2007). For many common species of migratory birds, this level of mortality would not significantly impact the ability of the larger population to survive, but for rare species and local populations of some species, this mortality level could affect long-term viability of the species or its distribution locally (NRC 2007). Many measures that Buckeye Wind is proposing within their ABPP would avoid and minimize the potential for bird strikes to occur at their facility. These measures would prevent large-scale episodic mortality events and minimize bird attraction to the facility. The proposed avoidance and minimization measures that would be implemented by Buckeye Wind should substantially reduce the likelihood that mortality of migratory birds at their facility would be significant or substantially additive from a regional cumulative effects perspective. Should other wind and communication towers and buildings in the eastern flyways zone implement lighting protocols to reduce attraction of birds and implement an ABPP similar to that proposed by Buckeye Wind, cumulative bird collision mortality could be substantially reduced.

Migratory Bird Habitat Impacts

The Action Area is located in the Eastern Tallgrass Prairie Bird Conservation Region (BCR). This region was formerly covered with tall, lush prairies and beech-maple forest with oak savanna at the borders between the two. Currently, this BCR is dominated by agricultural land use and is also becoming increasingly urbanized. Conversion to agriculture and developed land has led to the loss of a significant amount of habitat that migratory bird species rely on. The loss of tallgrass prairies, or grasslands, has caused serious population declines for many species such as Henslow's sparrows, grasshopper sparrows, and dickcissels. Between 1966 and 1993 dickcissel populations decreased by about 40 percent, grasshopper sparrows by about 70 percent, and Henslow's sparrows by about 90 percent (Swengel & Swengel 1998). Due to increased agricultural and urban development, habitat loss continues to increase across the region and this trend will likely continue over the life of the project. While historic and future migratory bird habitat loss within this BCR is significant, all forest habitat loss as a result of the Project would be offset by the proposed mitigation measures described in Chapter 5 of this EIS. As such, the Project would not contribute to cumulative habitat loss in the region.

Alternative A – Maximally Restricted Operations Alternative

The operational adjustment under Alternative A would involve all 100 turbines being non-operational from sunset to sunrise from April 1 through October 31, which would reduce the collision risk to night-flying birds during this period. Birds would still experience collision risks associated with early spring and late-fall migration, as described above for the Proposed Action. Diurnally active migratory and resident birds and winter resident birds would also be exposed to collision risk during their regular activities within the Action Area. Since operation would be similar, it can be assumed that mortality impacts to bird species would be similar to the Proposed Action during the period from November 1 through March 31, but somewhat lower from April 1 through October 31.

Section 5.4.3 describes that Alternative A would result in take of approximately 2.27 birds/MW/year or 568 birds per year for the 100-turbine (250 MW) project. If take of 2.27 birds/MW/year were applied to the projected total wind capacity in Eastern Flyway zone in 2035 of 81,441 MW (Table 5.15-7), take of migratory birds from wind facilities in this zone would be approximately 184,871 birds per year.

Mortality is likely to be distributed across many groups and species, but most (approximately 70%) would be comprised of passerines. Fatalities of a single passerine species could number as many as 12,700 in a year based on certain projections (NRC 2007). For many common species of migratory birds, this level of mortality would not significantly impact the ability of the larger population to survive, but for rare species and local populations of some species, this mortality level could affect long-term viability of the species or its distribution locally (NRC 2007). The operational regime proposed in this Alternative would avoid and minimize the potential for night-migrating bird strikes during the peak migratory period. Further the ABPP would be implemented and the measures described within it would prevent large-scale episodic mortality events and minimize bird attraction to the facility. The proposed avoidance and minimization measures that would be implemented under this Alternative should substantially reduce the likelihood that mortality of migratory birds would be significant or substantially additive from a regional cumulative effects perspective. Should other wind and communication towers and buildings in the eastern flyways zone implement lighting protocols to reduce attraction of birds, cease operation at night during peak migration periods, and implement an ABPP similar to that proposed by Buckeye Wind, cumulative bird collision mortality could be substantially reduced.

Alternative B – Minimally Restricted Operations Alternative

The operational adjustment under Alternative B would involve feathering turbines until cut-in speeds of 5.0 m/s (11 mph) for all 100 turbines during the first one to six hours after sunset from August 1 through October 31. Section 5.4.4 describes that it would be appropriate to assume that Alternative B may result in mortality of 3.018 birds/MW/year or 754 birds/year for the 100-turbine (250 MW) project, essentially the same as the average in the Eastern Flyway. If take of 3.018 birds/MW/year were applied to the projected total wind capacity in Eastern Flyway zone in 2035 of 81,441 MW (Table 5.15-7), take of migratory birds from wind facilities in this zone would be approximately 245,788 birds per year.

Mortality is likely to be distributed across many groups and species, but most (approximately 70%) would be comprised of passerines. Fatalities of a single passerine species could number as many as 12,700 in a year based on certain projections (NRC 2007). For many common species of migratory birds, this level of mortality would not significantly impact the ability of the larger population to survive, but for rare species and local populations of some species, this mortality level could affect long-term viability of the species or its distribution locally (NRC 2007). The operational regime proposed in this Alternative would minimize the potential for some night-migrating bird strikes during the fall migratory period. Further the ABPP would be implemented and the measures described within it would prevent large-scale episodic mortality events and minimize bird attraction to the facility. The proposed avoidance and minimization measures that would be implemented under this Alternative may reduce bird mortality somewhat compared to a facility operating without any cut-in speeds or ABPP, and would reduce the likelihood of episodic collisions. Should other wind and communication towers and buildings in the eastern flyways zone implement lighting protocols to reduce attraction of birds, reduce operation at night during the fall migration periods, and implement an ABPP similar to that proposed by Buckeye Wind, cumulative bird collision mortality could be reduced. At this time it is unknown whether or not the take of 245,788 migratory birds per year would rise to the level of significance from a regional cumulative effects perspective.

Alternative C - No Action Alternative

Under Alternative C, the Project would not be built and no Project-related activities (construction, operation, or decommissioning) would occur. Alternative C would have no effect on wildlife and fisheries. As such, there would be no cumulative effects on wildlife and fisheries from Alternative C.

5.15.5 Indiana Bat and Non-Listed Bat Species

The impact analysis for threatened and endangered species (Section 5.5 of this EIS) predicted the Project would not result in significant impacts to species other than the Indiana bat. Therefore, this cumulative effects analysis focuses primarily on cumulative impacts to the Indiana bat from the Project and other existing, planned, or potential wind facilities in the USFWS-defined Midwest Recovery Unit (RU) (Figure 4.5-1). Indiana bat populations that may be impacted by the Project over the 30-year timeframe include both summer resident populations and migratory bats. Mortality of Indiana bats would be considered significant if substantial reductions in population size or distribution of this species was caused.

Because the impacts on Indiana bats are similar to impacts on other non-listed bat species, impacts to all bats are also discussed collectively in this section. In general, the 11 species of bats found in Ohio are divided into those that hibernate in caves or abandoned mines in the winter (cave bats) and bats that migrate long distances to overwinter (migratory tree bats). Similar to the Indiana bat analysis area, impacts to non-listed cave and migratory tree bats are evaluated within the Midwest RU. While the range of the various species extends outside of the Midwest RU, there is little available population data available for non-listed bat species. Assessing the cumulative impacts to non-listed bats in the Midwest RU would evaluate impacts to portions of the populations that breed in this area and migrate through this area. Mortality of migratory tree bats or cave bats would be considered significant if substantial reductions in population size or distribution of those species within the Midwest RU were caused.

Current Wind Developments and Bat Mortality

Bat mortality at wind facilities is well documented in the United States (Johnson and Strickland 2003, Kunz et al. 2007, Arnett et al. 2008, Horn et al. 2008). About 75 percent of all observed bat mortality is comprised of three migratory tree bats: red, hoary, and silver-haired bats (Kunz et al. 2007). Some studies have indicated that migratory tree bats may be attracted to both moving and non-moving wind turbine blades (Arnett 2005). Most known fatalities occur in late summer and early fall during migration (Johnson 2004). Although these species are not listed as threatened or endangered, they have low reproductive rates typical of long-lived species, and significant impacts to their numbers would not be sustainable over time. Based on post-construction monitoring at wind facilities throughout the eastern U.S., it is reasonable to assume that mortality of bat species, particularly of migratory tree-roosting bats, may occur at the proposed facility.

To date, five Indiana bat fatalities have been documented in post-construction monitoring studies at wind energy facilities. Two fatalities occurred at the Fowler Ridge facility in Indiana, during the fall migration period in September 2009 and 2010 (Good et al. 2011). The third fatality occurred at the North Allegheny Wind facility in Pennsylvania during the fall migration period in September 2011 (USFWS 2012b). The fourth Indiana bat fatality occurred on July 26, 2012 at the Laurel Mountain Wind Power facility near Elkins, WV. The fifth Indiana bat fatality occurred on the night of October 2, 2012 at the Blue Creek Wind Farm in Paulding County, OH. While it is assumed that other Indiana bat mortalities at wind facilities have occurred, these fatalities represent the only documented takes of Indiana bats at a wind facility, and there is a lack of direct data specific to the Indiana bat.

In order to quantify bat mortality attributed to existing and near-future wind power projects within the Midwest RU, data were obtained from post-construction monitoring studies at operational wind power facilities. A review of 21 studies from 19 different wind facilities in the United States and Canada, found that estimates of bat fatalities were highest at facilities located on forested ridges in the eastern U.S., and lowest in the Rocky Mountain and Pacific Northwest regions (Arnett et al. 2008). Bat fatalities were lower and more variable among sites in the upper Midwest, with estimates ranging from 0.2 to 8.7 bats per MW (Table 4-4 of Appendix C). However, a 2009 post-construction study at Blue Sky Green Field in Wisconsin documented an unprecedented, high mortality rate for the Midwest, with total estimated mortality of 24.6 bat fatalities per MW (21.6 bats per MW when incidental finds were removed) for the 88-turbine facility (Gruver et al. 2009). Likewise, the Cedar Ridge wind facility in Wisconsin also documented high bat mortality rates, estimated at 50.5 bats per turbine per study period (BHE 2010).

It is clear from analysis of existing data that bats are being killed by wind turbines. Out of the 45 bat species in the United States, 13 have been documented as fatalities at wind power facilities, and 75 percent of all bat fatalities are migratory bat species (Kunz et al 2007). Data indicate that risk for *Myotis* species, like the Indiana bat, is significantly less than migratory species, although risk may vary by site (Arnett et al 2008). Indiana bats are at risk, as evidenced by five confirmed fatalities, and the likely occurrence of undocumented fatalities due to a lack of post-construction monitoring or difficulty of detecting the species. However, the five aforementioned fatalities represent the only Indiana bat fatalities documented to date, and therefore the degree to which Indiana bats are at risk is highly uncertain.

Given the relative lack of data in the Midwest RU, data from studies of 15 existing wind facilities in other RUs within the range of the Indiana bat were used to estimate bat mortality rates (Table 5.15-8). Seven of the studies, from five existing wind facilities, are also located within agricultural landscapes: Fowler Ridge Wind Farm (Indiana), Casselman Wind Project (Pennsylvania), and eight wind facility sites in Pennsylvania (Table 5.15-8). In 2007, the Pennsylvania Game Commission (PGC) collaborated with members of the wind industry to develop a Voluntary Wind Energy Cooperative Agreement. This Agreement requires at least one year of standardized pre-construction surveys and two years of standardized post-construction mortality monitoring at proposed or active wind facilities in the state. Currently, post-construction monitoring data for bat mortality is available for surveys conducted from 2007 to 2009. However, only five of the eight surveys followed PGC protocol, so only data from these facilities were used in the calculations to estimate bat mortality (Librandi-Mumma and Capouillez 2011).

For comparing impacts of wind turbines on bird and bat mortality, investigators estimate fatalities per MW per year based on periodic carcass searches, and data correction from scavenger removal and searcher error trials (Smallwood 2010). The data for all fifteen sites was corrected for searcher efficiency and scavenger removal (SESR) biases to obtain mortality estimates for bats.

According to the data from the 15 sites (only including Pennsylvania studies that followed PGC protocol), bat fatalities per MW per year ranged from 0.5 to 49.3, and averaged 9.6 to 16.1 (see Table 5.15-8). The combined total of estimated bat fatalities for the seventeen studies (only including Pennsylvania studies that followed PGC protocol) is between 14,704 and 43,766 bats per year. Of these, *Myotis* species represent an average of 19.1 percent (between 1,653 and 3,462 bats per year) of reported fatalities (see Table 5.15-8 data and references).

Table 5.15-8. Average Bat Mortality at 15 Existing Wind Facilities within the Range of the Indiana Bat

Project Name	No. Turbines	MW	Dates surveyed	*Myotis* fatalities documented	Corrected for SESR?	Adjusted bat fatalities/MW/period (min – max)	Extrapolated total bat mortality based on MW/year fatality estimates (min – max)	*Myotis* percent of total	Extrapolated *Myotis* mortality /MW/yr[1]	Reference
Maple Ridge Wind Power Project Phase I, NY	120	198	17 Jun to 15 Nov 2006	little brown bat: 25; unidentified *Myotis*: 8	Yes	9.2 to 14.8	1,822 to 2,930	9.60%	175.5 to 282.4	Jain *et al.* 2007, Arnett *et al.* 2008
Maple Ridge Wind Power Project Phase II, NY	195	321.8	30 Apr to 14 Nov 2007	little brown bat: 31; unidentified *Myotis*: 1	Yes	6.5 to 8.4	2,092 to 2,703	14.80%	310.4 to 401.1	Jain *et al.* 2008
Maple Ridge Wind Power Project Phase III, NY	195	321.8	15 Apr to 9 Nov 2008	little brown bat: 24; unidentified *Myotis*: 2	Yes	5.0 to 5.4	1,609 to 1,738	17.10%	275.6 to 297.6	Jain *et al.* 2009a
Munnsville Wind Farm, NY	23	34.5	15 Apr to 15 Nov 2008	little brown bat: 2	Yes	0.5 to 1.9	17 to 66	20.00%	3.5 to 13.1	Stantec 2009b
Noble Ellenburg Windpark, NY	54	81	28 Apr to 13 Oct 2008	little brown bat: 19	Yes	2.8 to 5.5	227 to 446	49.20%	115.5 to 219.0	Jain *et al.* 2009c
Noble Bliss Windpark, NY	67	100.5	21 Apr to 14 Nov 2008	little brown bat: 29	Yes	5.1 to 9.8	513 to 985	38.20%	195.8 to 376.3	Jain *et al.* 2009d
Cohocton/Dutch Hill, NY	50	125	15 Apr to 15 Nov 2009	little brown bat: 41	Yes	5.5 to 16.0	688 to 2,000	59.40%	408.5 to 1,188.4	Stantec 2010a
Cohocton/Dutch Hill, NY	50	125	26 Apr and 22 Oct	little brown bat:11; northern	Yes	3.36 to 17.08	420 to 2,135	20.69%	86.9 to 4411.7	Stantec 2011

Project Name	No. Turbines	MW	Dates surveyed	*Myotis* fatalities documented	Corrected for SESR?	Adjusted bat fatalities/MW/period (min – max)	Extrapolated total bat mortality based on MW/year fatality estimates (min – max)	*Myotis* percent of total	Extrapolated *Myotis* mortality /MW/yr[1]	Reference
			2010	long-eared bat: 1						
Fowler Ridge Wind Farm, IN	355	600	13 Apr to 15 May 2010; 1 Aug to 15 Oct 2010	little brown bat: 2; Indiana bat: 1;	Yes	11.4 to 49.3	6,840 to 29,580	0.40%	27.4 to 118.2	Good *et al.* 2011
Casselman Wind Project, PA	23	34.5	19 Apr and 15 Nov 2008	little brown bat: 14	Yes	13.8 to 34.3	476 to 1,183	9.50%	45.2 to 112.4	Arnett *et al.* 2009b
6-3, PA	NA	NA	2007		Yes & followed PGC protocol	21.4	NA	~13% (8 sites combined)	2.8	Librandi-Mumm and Capouillez 2011
6-3, PA	NA	NA	2008	Across all 8 PGC studies	Yes & followed PGC protocol	17.1	NA	~13% (8 sites combined)	2.2	Librandi-Mumma and Capouillez 2011
2-2, PA	NA	NA	2008	(2007 – 2009):	Yes & followed PGC protocol	21.5	NA	~13% (8 sites combined)	2.8	Librandi-Mumma and Capouillez 2011
2-2, PA	NA	NA	2009	12%; Northern long-eared: <1%	Yes & followed PGC protocol	21.5	NA	~13% (8 sites combined)	2.8	Librandi-Mumma and Capouillez 2011

Project Name	No. Turbines	MW	Dates surveyed	*Myotis* fatalities documented	Corrected for SESR?	Adjusted bat fatalities/MW/period (min – max)	Extrapolated total bat mortality based on MW/year fatality estimates (min – max)	*Myotis* percent of total	Extrapolated *Myotis* mortality /MW/yr[1]	Reference
2-14, PA [3]	NA	NA	2008		Yes. Did not follow PGC protocol	3.4	NA	~13% (8 sites combined)	0.4	Librandi-Mumma and Capouillez 2011
2-14, PA	NA	NA	2009		Yes & followed PGC protocol	3.2	NA	~13% (8 sites combined)	0.4	Librandi-Mumma and Capouillez 2011
2-10, PA [3]	NA	NA	2008	Across all 8 PGC studies	Yes. Did not follow PGC protocol	8.3	NA	~13% (8 sites combined)	1.1	Librandi-Mumma and Capouillez 2011
2-4, PA	NA	NA	2009	(2007 – 2009):	Yes & followed PGC protocol	11.8	NA	~13% (8 sites combined)	1.5	Librandi-Mumma and Capouillez 2011
5-5, PA [3]	NA	NA	2009	12%; Northern long-eared: <1%	Yes. Did not follow PGC protocol	6.7	NA	~13% (8 sites combined)	0.9	Librandi-Mumma and Capouillez 2011
24-3, PA [3]	NA	NA	2009		Yes. Did not follow PGC protocol	6.2	NA	~13% (8 sites combined)	0.8	Librandi-Mumma and Capouillez 2011

Project Name	No. Turbines	MW	Dates surveyed	*Myotis* fatalities documented	Corrected for SESR?	Adjusted bat fatalities/MW/period (min – max)	Extrapolated total bat mortality based on MW/year fatality estimates (min – max)	*Myotis* percent of total	Extrapolated *Myotis* mortality /MW/yr[1]	Reference
6-1, PA	NA	NA	2009		Yes & followed PGC protocol	15.2	NA	~13% (8 sites combined)	2	Librandi-Mumma and Capouillez 2011
Average	NA	NA	NA	NA		9.6 to 16.1	1,470 to 4,377	19.1%	97.3 to 203.7	NA
Total	1,132	1,817.1	NA	212 [2]		NA	14,704 to 43,766	NA	1,653.4 to 3,462.4	NA

[1] Mortality rate based on the total number of bats identified to species or genus (includes bats documented in standardized surveys and incidentals).

[2] Does not include fatalities from the PGC studies as these were only given as a percent.

[3]Studies colored in gray did not follow PGC protocol, so were not included in average or total mortality estimates.

The minimum and maximum bat fatality estimates of 9.6 to 16.1 per MW per year were applied to 5,226 MW of operational, under construction, and proposed wind facilities located within the Midwest RU to quantify bat mortality rates (Table 5.15-9). This results in mortality of between 50,166 and 84,132 bats per year within the Midwest RU (Table 5.15-10). Based on the studies summarized in Table 5.15-8, it is assumed that approximately 75 percent of total mortalities are migratory tree bats, 19 percent are *Myotis* bats, and 6 percent are other species such as big brown and tricolor bats. As such, the current estimate (2011) within the Midwest RU, is between 9,532 and 15,985 *Myotis* bats and between 37,624 and 63,099 migratory tree bats are killed each year as a result of interactions with wind turbines (Table 5.15-10).

Data from the Fowler Ridge Wind Farm in Indiana was used to estimate Indiana bat mortality rates. Only one year of data has been made available (2010) although monitoring is ongoing. During the spring and fall survey periods (April 13 to May 15, 2010 and August 1 to October 15, 2010) one Indiana bat carcass was found. This represents an average of 0.1 percent (6.8 to 29.6) of the total bat mortalities per year at the facility (Good et al. 2011). Using this number, the Indiana bat fatalities at all operational, under construction, and proposed wind facilities within next three years within the Midwest RU is estimated to be between 50 and 84 Indiana bats each year (Table 5.15-10). The actual numbers of Indiana bat fatalities per wind facility are dependent on the proximity to known bat hibernacula, migration routes, and summer roosting habitat (USFWS 2007).

Table 5.15-9. Total Megawatts (MW) of Wind Generating Capacity at Operational, under Construction, and Proposed Wind Facilities as of 2011 in States within the Midwest Indiana Bat Recovery Unit

State	Total Megawatts (MW)			
	Operational as of 2011	Under construction as of 2011	Proposed within the next three years	Adjusted total[1] operational, under construction, and proposed
Indiana	1,340.0	201.8	8,426.0	3,227.0
Michigan	377.0	348.0	2,518.0	1,228.6
Ohio	112.0	309.0	1,600.1	741.0
Tennessee	29.0	0.0	0.0	29.0
Alabama	0.0	0.0	0.0	
Kentucky	0.0	0.0	0.0	
Total	1,858.0	858.8	12,544.1	5,225.6
Adjusted Total	1,858.0	858.8	2,508.8	5,225.6

Source: AWEA (2012)

[1]Assumes only 20% of proposed projects are built and operating (see footnote 1 Table 5.15-4).

Table 5.15-10. Potential Minimum and Maximum Bat Fatalities at all Operational, Under Construction, and Proposed Wind Facilities in the Midwest Indiana Bat Recovery Unit (Data Corrected for SESR)

State	Annual estimated fatalities - all bats		Annual estimated fatalities – migratory tree bats[1]		Annual estimated fatalities - *Myotis* species[2]		Annual estimated fatalities - Indiana bats[3]	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Indiana	30,979.2	51,954.7	23,234.4	38,966.0	5,886.0	9,871.4	31.0	52.0
Michigan	11,794.6	19,780.5	8,846.0	14,835.4	2,241.0	3,758.3	11.8	19.8
Ohio	7,113.6	11,930.1	5,335.2	8,947.6	1,351.6	2,266.7	7.1	11.9
Tennessee	278.4	466.9	208.8	350.2	52.9	88.7	0.3	0.5
Alabama	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kentucky	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	50,165.8	84,132.2	37,624.4	63,099.2	9,531.5	15,985.1	50.2	84.1

[1] Based on the studies summarized in Table 5.15-8, we assume that approximately 75% of total mortalities are migratory tree bats.

[2] Based on the studies summarized in Table 5.15-8, we assume that approximately 19 % of total mortalities are *Myotis* bats.

[3] Based on Indiana bat fatality rates at the Fowler Ridge Wind Farm (Good et al. 2011), we assume that 0.1 % of total mortalities are Indiana bats.

Future Wind Developments and Bat Mortality

The US DOE predicts that renewable energy capacity will increase over the next 25 years, and the installed capacity in the entire United States will increase 48 percent (US DOE EIA 2011). Assuming that installed wind capacity increases at the same rate in all states, wind energy production in the Midwest RU would increase to 6,875 MW by 2035 (Table 5.5-11). Under these conditions, it is estimated that bat fatalities from wind developments in the Midwest RU in 2035 would range from 65,996 to 110,681 bats per year. Of these, it is estimated between 49,497 and 83,011 migratory tree bats, 12,539 and 21,029 *Myotis* species, and approximately 66 to 111 Indiana bats would be killed each year in the RU (Table 5.15-11).

Table 5.15-11. Projected Wind Power Production in 2035 and Estimated Annual Minimum and Maximum Numbers of Annual Bat Fatalities in the Indiana Bat Midwest Recovery Unit

State	2035 projected wind power production (MW)	Annual estimated fatalities - all bats[1]		Annual estimated fatalities – migratory tree bats[2]		Annual estimated fatalities - *Myotis* species[3]		Annual estimated Indiana bat fatalities [4]	
		Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Indiana	4,958.0	47,596.8	79,823.8	35,697.6	59,867.9	9,043.4	15,166.5	47.6	79.8
Michigan	1,394.9	13,391.0	22,457.9	10,043.3	16,843.4	2,544.3	4,267.0	13.4	22.5
Ohio	414.4	3,978.2	6,671.8	2,983.7	5,003.9	755.9	1,267.6	4.0	6.7
Tennessee	107.3	1,030.1	1,727.5	772.6	1,295.6	195.7	328.2	1.0	1.7
Alabama[5]	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kentucky[5]	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total	6,874.6	65,996.2	110,681.1	49,497.2	83,010.8	12,539.3	21,029.4	66.0	110.7

[1]Based on average bat fatalities in Table 5.15-8.

[2] Based on the studies summarized in Table 5.15-8, we assume that approximately 75% of total mortalities are migratory tree bats.

[3] Based on the studies summarized in Table 5.15-8, we assume that approximately 19 % of total mortalities are *Myotis* bats.

[4] Based on Indiana bat fatality rates at the Fowler Ridge Wind Farm (Good et al. 2011), we assume that 0.1 % of total mortalities are Indiana bats.

[5] Currently there are no operating, under construction, or proposed wind facilities in either Alabama or Kentucky, so projected wind power capacity for these states was not extrapolated.

Table 5.15-12. Projected Bat Mortality for the Buckeye Wind Power Project in Relationship to Estimated Wind Power Production Projected for Year 2035 in the Midwest Indiana Bat Recovery Unit

Installation	MW	Mortality – all bats		Mortality – migratory tree bats		Mortality – *Myotis* species		Mortality – Indiana bats	
		Annual mortality – all bats per year[1]	Mortality over the operational life of Buckeye Wind Power Project	Annual mortality – migratory tree bats per year[2]	Mortality over the operational life of Buckeye Wind Power Project	Annual mortality – *Myotis* species bats per year[3]	Mortality over the operational life of Buckeye Wind Power Project	Annual mortality – Indiana bats per year[4]	Mortality over the operational life of Buckeye Wind Power Project
Buckeye Wind Project[5]	250	1,288	32,200	1,043	26,082	245	6,118	5.2[7]	130[7]
Operational, under construction, and proposed wind projects[6]	5,226	84,132	2,103,304	63,099	1,577,478	15,985	399,628	84	2,103
Projected total wind capacity in 2035 (Midwest RU)	6,875	110,681	2,767,027	83,011	2,075,270	21,029	525,735	111	2,767

[1] Based on calculated maximum average of 16.1 bats per MW per year derived from Table 5.15-8 results.

[2] Based on the studies summarized in Table 5.15-8, we assume that approximately 75% of total mortalities are migratory tree bats.

[3] Based on the studies summarized in Table 5.15-8, we assume that approximately 19 % of total mortalities are *Myotis* bats.

[4] Based on Indiana bat fatality rates at the Fowler Ridge Wind Farm (Good et al. 2011), we assume that 0.1 % of total mortalities are Indiana bats

[5] Based on maximum build out scenario of 100 2.5 MW turbines, a 25-year operational life of the facility, and a 68% reduction in mortality due to feathering.

[6] Assumes all operational and under construction projects are built and operating. Assumes only 20% of proposed projects are built and operating. Assumes all of these facilities operate over the same 25-year life as the Buckeye Project

[7] Numbers are derived from predictive take modeling performed by Stantec (see HCP in Appendix B), and do not include the 68% reduction applied to the other categories.

Table 5.15-12 shows the estimated mortality as a result of Project activity over the life of the Project (25 years) as compared to totals for the Midwest RU. The Project includes feathering, which should reduce all bat mortalities by an average of 68 percent; therefore, it is estimated that 6,118 *Myotis* mortalities will occur as the result of the Project.

Annual mortality of 2,075,270 migratory tree bats is expected to occur from all wind projects in the Midwest RU over the life of the project. It is currently unknown whether mortality at this level represents a significant cumulative effect. Migratory tree bats are long-lived and have fairly low annual reproductive capacity. In species with this type of life history, high mortality rates of adults over long time frames may result in population declines. Unfortunately, little information is available on the population size of migratory tree bats within the Midwest RU, or across their range, so the magnitude of the population impacts from the projected mortality related to wind power cannot be quantified. Further, the summering locations and migratory patterns of these bat species are unknown, so it is difficult to predict which summering populations could be affected, and to what extent. Population size data for each of the effected species is needed to determine if continued and cumulative loss of migratory tree bats may represent a significant cumulative effect and if that could significantly impair the ability of the bat population to effectively control the insect population at local and/or regional levels.

Annual mortality of Myotis bats totaling 525,735 is expected to occur from all wind projects in the Midwest RU over the life of the project. It is currently unknown whether mortality at this level represents a significant cumulative effect. Similar to migratory tree bats, Myotis bats are long-lived and have low annual reproductive capacity (typically one offspring per female per year), and high adult mortality rates may result in population declines. Further, Myotis bats are colonial, and declining colony size has been linked to decreased survivorship due to decreased ability to thermoregulate (Appendix C). Unfortunately, population estimates for Myotis bats as a group are not as well studied as population estimates for Indiana bats specifically. Little information is available on the population size of Myotis bats within the Midwest RU or across their range, so the magnitude of the population impacts from the projected mortality related to wind power cannot be quantified. Population size data for each of the effected species is needed to determine if continued and cumulative loss of Myotis bats may represent a significant cumulative effect if that and could significantly impair the ability of the bat population to effectively control the insect population at local and/or regional levels.

Historically, Indiana bats have experienced long-term declines from a number of causes including habitat loss and degradation and human vandalism of hibernacula, but an increasing population trend has been documented over the past decade. The 2005 winter census estimate of the Indiana bat population was 457,000, with 281 hibernacula in 19 states and 269 maternity colonies in 16 states. By 2011 the estimated rangewide population increased by about 2.2 percent to 424,708, and the Midwest RU population increased by 8.3 percent to 305,297 (USFWS 2012a). Range-wide population increases over the past decade have recently been tempered by regional declines, primarily due to WNS.

WNS is a condition of cave bats characterized by the conspicuous white fungal growth on noses, faces, ears, and/or wing membranes of the majority of affected bats. As of winter 2011, the Northeast RU has experienced a 70 percent reduction in Indiana bat populations (King 2012), a 73 percent reduction of little brown bats (Barlow 2010), and has killed in excess of 90 percent of the bats in many caves and mines (NPS 2010) since the onset of WNS in 2007. Since 2010, WNS has been confirmed in five states within the Midwest RU, including in six counties in Ohio. The closest documented case to the Project Area occurred at the Preble County Mine in 2011 (personal communication with Megan Seymour, USFWS, March 3, 2012).

Thogmartin et al. (2012) used a modeling approach to examine Indiana bat population trends before and after the occurrence of WNS (from 1983 to 2009). They found that while the range-wide population of Indiana bats has been in a stationary state for at least 2 decades before the onset of WNS, WNS has caused regional decline of Indiana bats in the northeast US and has halted population increase in the Appalachians. The authors detected a 10.3 percent decrease in Indiana bat population size range-wide from 2006 to 2009 during the onset of WNS (Thogmartin et al. 2012). The authors conclude that WNS is having an appreciable influence on the status and trends of Indiana bat populations.

Although population numbers in the Midwest RU are still seemingly high, given the extremely rapid rate at which WNS has spread over just five years, and the high mortality rates observed in the Northeast RU, population reductions of all cave bat species as a result of WNS in the Midwest RU are expected to increase (A. Kurta, personal communication), which makes additional mortality from other sources (e.g., wind power) even more significant.

Turner et al. (2011) summarized cave bat population declines due to WNS from 42 sites in five states (NY, PA, VT, VA, and WV) that had confirmed WNS mortality for at least two years. They found that overall bat populations at these sites combined had declines by 88 percent from pre-WNS levels. They also noted species-specific decline rates for the sites combined. Declines were as follows: Northern long-eared bats, 98 percent; little brown bats, 91 percent; tricolored bats, 75 percent; Indiana bats, 72 percent; big brown bats, 41 percent; and eastern small-footed bats, 12 percent (Turner et al. 2011). The assumption in the HCP and in this EIS is that WNS spread within the Midwest RU will track declines seen in the Northeast. Population estimates for cave bats as a group are not as well studied as population estimates for Indiana bats specifically. Little information is available on the population size of cave bats within the Midwest RU or across their range. Certainly though, population declines due to WNS anticipated for species such as northern long-eared bats, little brown bats, and tricolored bats are significant, so additional mortality from wind power projects or other sources could be significant as well.

However, it is unclear if and how WNS population declines could influence mortality resulting from wind projects. As the population of these bats decline, their exposure to wind projects could likewise decline, as could mortality rates. Siting of wind power projects relative to large concentrations of cave bats could also potentially influence mortality rates, for example a wind project in Wisconsin near a large cave bat hibernaculum has resulted in greater than average cave bat mortality (30% *Myotis* fatalities) (Gruver et. al. 2009). Research has not yet documented the factors that influence cave bat mortality at wind facilities, so our ability to predict how population size and wind facility distribution relative to cave bat populations may influence mortality risk is limited.

If the Midwest RU Indiana bat population or other cave bat populations were substantially reduced as a result of WNS or other causes, the projected level of mortality resulting from wind turbines could have greater implications for the viability of the population and the cumulative effects of this Project and past, present, and reasonably foreseeable actions considered in this analysis could result in significant effects to the Indiana bat or other cave bat population size or distribution.

To qualify for an ITP, Buckeye Wind is required to minimize and mitigate the impacts of the take to the maximum extent practicable. Therefore, the Applicant has committed to reducing requested Indiana bat five-year take limits by 50 percent (i.e., 2.6 Indiana bats per year, 13.0 over five years) if the population of Indiana bats in the Midwest RU is reduced by 50 percent or more from the 2009 pre-WNS level. Project operations under reduced take would continue to be subject to adaptive management decisions. The measures implemented to reduce Indiana bat take would likely result in reduced take of other bat species as well. This would help to minimize the impact of the taking on other bats species that may also be suffering population declines due to WNS.

Minimization and Mitigation Measures

As a result of past and anticipated continued declines, the Indiana bat is increasingly endangered. Further, due to WNS the long-term survival of some cave bat species is in question. As such, recovery of the Indiana bat and the survival of cave bats in general are dependent upon slowing down and offsetting current rates of decline. Mitigation and conservation measures proposed for the Buckeye Project, identified in Section 3 and discussed below, have been developed to offset mortality of Indiana bats through protection and enhancement of habitat that would promote and protect reproductive success of local populations into the future.

Turbine feathering and curtailment are effective methods used to avoid and minimize bat fatalities. Feathering and curtailment studies at the Fowler Ridge Wind Farm (Good et al. 2011), Casselman Wind Facility (two studies conducted at Casselman in 2008 and 2009: Arnett et al. 2010), and Summerview Wind Farm (Baerwald et al. 2009) have documented substantial, but variable, rates of bat fatality reduction using cut-in speeds ranging from 5.0 m/s to 6.5 m/s (11.1 mph to 14.5 mph) (Table 5.4-3). The median average reductions in bat fatalities in these studies was 68.3% (range 44.0-86.0%). As different turbine models were used in each study, turbine blade rotation below the cut-in speed may be variable among studies (Good et al. 2011, Arnett et al. 2010). However, the studies provide evidence that use of increased cut-in speeds is an effective method to reduce bat mortality. Use of both feathering and cut-in speeds may reduce mortality more than just cut-in speeds alone. During a subsequent study at the Fowler Ridge Wind Farm in 2011, use of feathering and cut-in speeds of 3.5 m/s, 4.5 m/s and 5.5 m/s resulted in mean bat fatality reductions of 36.3 percent, 56.7 percent and 73.3 percent, respectively (Good et al. 2012).

The Buckeye Wind HCP proposes to implement a feathering and cut-in speed strategy to minimize mortality of Indiana bats and other non-listed bats (Table 5.5-1). Because the proposed cut-in speeds are similar to those used in the feathering and curtailment studies discussed above, Buckeye Wind anticipates a similar 68 percent reduction in overall bat fatalities below observed values at other wind facilities that did not implement feathering or curtailment. This means that as opposed to more than 100,000 total bat mortalities over the life of the Project, feathering will reduce that number to 32,200 (Table 5.15-12). The HCP also includes a post-construction monitoring program that will measure the effectiveness of operational curtailment by monitoring the mortality of all bats and birds, and an adaptive management strategy to maintain take of Indiana bats at authorized levels. The Indiana bat hibernaculum where mitigation for the Buckeye Project would occur also supports approximately 15,000 other cave bats, resulting in a benefit to these species as well.

If all wind facilities within the Indiana bat Midwest RU implemented similar feathering strategies as Buckeye Wind, mortality of Indiana bats and other non-listed bats, could be reduced by an average of 68 percent, based on reductions seen at other wind facilities (Good et al. 2011, Arnett et al. 2010, Baerwald et al. 2009). This is a substantial reduction over what is currently occurring. The Buckeye Wind HCP used the Leslie matrix model (Leslie 1954) to demonstrate that the proposed take of Indiana bats from the project would not cause an appreciable decline in the likelihood of survival of each maternity colony potentially impacted. Because maternity colonies are the reproductive units of the species, preserving them on the landscape ensures that the species will be able to reproduce throughout the life of the project and beyond, and continue to contribute to recovery of the species. If all wind facilities within the Indiana bat Midwest RU ensured that the take caused by their project did not cause the appreciable decline of individual maternity colonies, reproductive capacity of the species would not be hindered by wind projects and this would ensure that the survival and recovery of the species as a whole is not appreciably diminished by wind projects.

Further, if post-construction monitoring and adaptive management were implemented at all wind facilities to document levels of bat mortality at various feathering levels, the wind industry and the USFWS would gain a much more thorough understanding of bat and wind turbine interactions. This information could be used to further avoid and minimize bat mortality, such that it could be reduced to levels that would not result in population-level impacts. Finally, if all wind facilities within the Indiana bat Midwest RU implemented mitigation actions that would help to increase reproductive capacity of bat species, such as protecting, enhancing, and restoring forested habitat and hibernacula, the impact of any residual take may be effectively reduced, resulting in negligible cumulative effects. A reduction in the current rate of bat mortality from wind projects and minimization of future mortality coupled with mitigation for impacts would help insure that bat populations maintain their current capacity to control insect populations at local and regional levels.

Habitat Loss and Bat Impacts

The Action Area is composed of active agricultural areas, low density residential areas, and fragmented woodlots, which may provide spring, summer, and fall habitat for all bat species. The Action Area does not provide winter habitat for any bat species. Other than ongoing agricultural and small-scale and periodic timber harvesting activities, which are occurring or may occur in the Action Area over the ITP Term, the USFWS is not aware of future federal, state, or private activities in the Action Area that would directly or indirectly affect habitat for Indiana bats or other bats. According to the Logan-Union- Champaign Regional Planning Commission and Champaign County Building Regulations office, no known residential subdivisions or retail/commercial developments have been approved or are currently proposed in the general vicinity of the Action Area. However, several new private homes, pole barns, and an equipment storage yard have been approved (received building permits) and lot splits are common (personal communication between Joan Huston [ERM] and Phyllis Rittenhouse [Champaign Co Building Regulations] and Weston Dodds [LUC Regional Planning Commission], June 6, 2012).

Agriculture has been the predominant land use in the Action Area for the past several decades and wooded habitat suitable habitat for Indiana bats and other bats is already substantially fragmented. However, wooded habitat in the Action Area is likely to increase in the future, based on patterns of changing land use, such as the conversion of agricultural areas back to wooded areas. Wooded land has been increasing in Ohio since 1940, and in 2001 it comprised approximately 33 percent of the state's land area (ODNR DOW 2012). A similar trend has occurred throughout the Midwest RU (USGS, 2001).

Currently, the Midwest RU is dominated by agricultural land use in the northern areas (MI, OH, and IN), and is dominated by forested habitat in the southern areas (KY, TN, and portions of AL, GA and MS). Each state in the Midwest RU supports a mix of habitats and land use types, including forest, agriculture, and urban/suburban development. In all States in the Midwest RU land cover trends between 1982 and 2007 indicate increasing developed areas, and in all states but Tennessee, modestly increasing trends in forest cover (USDA 2009). While developed areas in the Midwest RU states increased by between 38 and 86 percent between 1982 and 2007, forest cover increases were generally much smaller, between 0.8 and 6 percent (Tennessee lost 2 percent forest cover) during the same period (USDA 2009).

Historically, conversion to agriculture and developed land within the Midwest RU led to the loss of a significant amount of habitat that bat species rely on. Current forest cover trends show a modestly increasing trend in the region over the past 25 years. All forest habitat loss as a result of the Project would be offset by the proposed mitigation measures described in Chapter 5 of this EIS. As such, the Project would not contribute to cumulative habitat loss in the region.

Alternative A – Maximally Restricted Operations Alternative

The operational adjustment under Alternative A would involve all 100 turbines being non-operational from sunset to sunrise from April 1 through October 31, which is the period during which most bats are active. This Alternative would have extremely low mortality of all bat species, if not zero. This action would also result in no Indiana bat mortality. Therefore, the cumulative effects of Alternative A on bat species would be negligible. Further, if this operational regime was applied to all existing and future wind projects across the Midwest RU, total bat mortality could be substantially reduced from current estimates and future projections. Mortality of approximately 2,767,027 bats by the year 2035 could be avoided (see Table 5.15-12). Further, the ability of bats to control insect populations could improve locally (for example in areas with existing wind farms that have high bat mortality rates), or at a minimum could be maintained at the current level.

Alternative B – Minimally Restricted Operations Alternative

Alternative B would employ operational restrictions during the fall migratory period (July 15 through October 31), when the highest bat mortality at wind turbines has been documented. That is, the cut-in speed for wind turbines would be set at 5.0 meters per second (11.2 mph) for all 100 turbines during the fall migration period (August 1 to October 31) during the first one to six hours after sunset. Due to no curtailment restrictions on the turbine speeds during spring and summer, operations under this Alternative would have greater adverse effects on spring/summer populations of Indiana bats than the Proposed Action or Alternative A. Therefore, the cumulative effects of Alternative B on bat species would be greatest of the action alternatives.

Section 5.5.4 describes that take of Indiana bats under this Alternative would be approximately12.0 per year, which includes take of 2.6 local adult females per year. This alternative would result in declining populations at local Indiana bat maternity colonies, which may result in lost reproductive capacity of the colonies and the population within the Midwest RU. If all wind projects in the Midwest RU were to implement an operational regime similar to this that resulted in declining maternity colonies, substantial declines in the Midwest RU's reproductive capacity could result.

Take of all bats under Alternative B was described in Section 5.4.4. Using the maximum average adjusted bat mortality from 15 existing wind facilities within the range of the Indiana bat (Table 5.15-8) of 16.1 bats per MW per study period, assuming mortalities are distributed by season as follows: spring, five percent; summer, 24 percent; and fall, 71 percent, and assuming a 50 percent reduction in fall bat mortality based on the proposed feathering and cut-in speed regime, Alternative B would result in the mortality of 10.4 bats per MW per year, or 2,600 bats per year for the 100 turbine facility. This mortality would likely include roughly 1,950 (75%) migratory tree bats, 494 (19%) *Myotis* bats (of which approximately 12 are Indiana bats), and 156 (6%) other bats (big brown, tri-color, etc.) per year, if the species composition of mortality follows patterns observed at wind facilities throughout the range of the Indiana bat. If all projected wind projects in the Midwest RU (totaling 6,875 MW) were to implement an operational regime similar to this that resulted in a reduction in fall take of 50 percent, take of approximately 71,568 bats per year would result.

Mortality at these levels may represent a significant cumulative effect. Bats are long-lived and have low annual reproductive capacity. In species with this type of life history, high mortality rates of adults over long time frames may result in population declines. Unfortunately, little information is available on the population size of bat species (except for Indiana bats) within the Midwest RU, or across their range, so the magnitude of the population impacts from the projected mortality related to wind power cannot be quantified. Further, the summering locations and migratory patterns of these bat species are unknown, so it is difficult to predict which summering populations could be affected, and to what extent. Regardless, continued and cumulative loss of bats may represent a significant cumulative effect and could significantly impair the ability of the bat population to effectively control the insect population at local and/or regional levels.

Alternative C - No Action Alternative

Under Alternative C, the Project would not be built and no Project-related activities (construction, operation, or decommissioning) would occur. Alternative C would have no effect on threatened and endangered species or non-listed bats. As such, there would be no cumulative effects on threatened and endangered species or non-listed bats from Alternative C.

5.15.6 Visual Resources

The cumulative effects analysis of visual resources focused on the regional impacts of the Project and action alternatives, specifically within the viewshed of the Project turbines (Figure 4.8.1).

The Project's 100 turbines would directly impact the visual resources for some residents within approximately one mile of the nearest turbine and in sensitive locations.

Past projects such as highway/road construction, commercial development, communication towers, or transmission lines may have had visual effects on the regional character of the landscape, as the Project area is predominantly agricultural in nature. Aside from the Proposed Action there are no reasonably foreseeable projects within the viewshed that would have additional adverse effects on visual resources, so cumulative effects are expected to be minor.

Alternative A – Maximally Restricted Operations Alternative

Alternative A differs from the Proposed Action only with respect to operations. The operational differences would not affect visual resources. As such, the cumulative effects of Alternative A would not differ from those of the Proposed Action.

Alternative B – Minimally Restricted Operations Alternative

Alternative B differs from the Proposed Action only with respect to operations. The operational differences would not affect visual resources. As such, the cumulative effects of Alternative B would not differ from those of the Proposed Action.

Alternative C - No Action Alternative

Under Alternative C, the Project would not be built and no Project-related activities (construction, operation, or decommissioning) would occur. Alternative C would have no effect on visual resources. As such, there would be no cumulative effects on visual resources from Alternative C.

5.15.7 Cultural Resources

The cumulative effects analysis of cultural resources focuses on regional impacts of the Project and action alternatives, specifically the areas of ground disturbance caused by Project related activities (direct area of potential effect or APE) and the five-mile indirect APE for viewshed analysis, as defined in Section 5.6. Past actions that have impacted cultural resources include agricultural activities, highway/road construction, residential development, commercial development, communication towers, and transmission lines, all of which have had a minor cumulative impact on both historic archaeological and historic architectural resources.

As indicated in Sections 5.6 and 5.8 of this EIS, the Project would have no direct or physical impacts to historic architectural resources; however, the Project's potential visual effects to historic architectural resources were determined to be significant and potential mitigation measures were presented that would minimize these impacts to the extent practicable. Other reasonably foreseeable projects that could affect the viewshed of historic architectural resources could include small-scale residential or commercial development, additional overhead utility lines, telecommunications towers, single residential or industrial wind turbines, and road construction and maintenance. These actions could visually impact historic architectural properties but these impacts are expected to be minimal. As such, the relatively minimal visual impacts of past and reasonably foreseeable future actions, when combined with the effects disclosed for the Project, would produce minor visual cumulative impacts to aboveground historic resources.

Sections 5.6 of this EIS also addresses the Project's potential direct effects to archaeological resources. Only one NRHP eligible site and has been identified in the APE. This site, and any other NRHP potentially-eligible sites that are identified as a result of the Project, would be avoided. Additionally, a mound located within the Action Area would also be avoided. An unanticipated discovery plan will be developed to address any unexpected artifacts uncovered during construction and decommissioning activities as stated in Section 5.6 of this EIS. Other reasonably foreseeable projects proposed could include expansion of agricultural activities, small-scale residential or commercial development, additional overhead utility lines, telecommunications towers, single residential or industrial wind turbines, and road construction and maintenance. While all the foreseeable future projects have potential to physically impact archaeological resources, the Action Area and surrounding areas will remain predominantly agricultural over the life of the project, and any ground disturbing activities that may impact archeological resources is likely to be localized and minor. The relatively minimal impacts of past and reasonably foreseeable future actions, when combined with the effects disclosed for the Project, would produce minor cumulative impacts to historic archaeological resources.

Alternative A – Maximally Restricted Operations Alternative

Alternative A differs from the Proposed Action only with respect to operations. The operational differences would not affect cultural resources. As such, the cumulative effects of Alternative A would not differ from those of the Proposed Action.

Alternative B – Minimally Restricted Operations Alternative

Alternative B differs from the Proposed Action only with respect to operations. The operational differences would not affect cultural resources. As such, the cumulative effects of Alternative B would not differ from those of the Proposed Action.

Alternative C - No Action Alternative

Under Alternative C, the Project would not be built and no Project-related activities (construction, operation, or decommissioning) would occur. Alternative C would have no effect on cultural resources. As such, there would be no cumulative effects on cultural resources from Alternative.

Chapter 6

Comparison of Alternatives

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6 Comparison of Alternatives

6.1 Comparison of Alternatives

NEPA (40 CFR 1501) and USFWS guidelines (550 FW 2.6) require that an EIS include a discussion and comparison of the effects of the Proposed Action and alternatives, including reasonable mitigation measures identified during the EIS development. Section 3 of this EIS describes the alternatives, and the resource-specific sections of Chapter 5 describe the effects and reasonable minimization, avoidance, and mitigation measures. This chapter compares the impacts of the Proposed Action and alternatives and their potential mitigation measures.

6.1.1 Effects Summary

Four alternatives were carried forward for analysis in the EIS: the Proposed Action, Alternative A – Maximally Restricted Operations Alternative, Alternative B – Minimally Restricted Operations Alternative, and Alternative C – No Action Alternative. The three action alternatives would all include the full build-out of the Project, with the same number of turbines within the same land area developed. The Alternatives are differentiated from one another by varying levels of operational adjustment that would result in different levels of incidental take of Indiana bats. In addition, the Applicant has identified a possible re-design of the Proposed Action's collection system (Redesign Option) that would allow a more efficient infrastructure resulting in greater ease of construction, but would not result in a higher level of take or significantly change the net effect on the Indiana bat. It is anticipated that the Redesign Option would however result in reduced impacts to migratory birds. The No Action Alternative would result in no effects to the identified resources because the Project would not be built. Table 6.1-1 compares the anticipated impacts of the Proposed Action with Alternatives A-C as defined above and in Chapter 3. Mitigation measures that address some or all of the anticipated impacts are described in Chapter 5 and summarized in Table 6.1-2.

Table 6.1-1 Comparison of Anticipated Impacts for Each Alternative

Resource	Proposed Action – Modified Operations	Alternative A – Maximally Restricted Operations Alternative	Alternative B – Minimally Restricted Operations Alternative	Alternative C – No Action
5.1 - Geology and Soils	Temporary soil disturbance. Construction activities would be largely limited to surface soil disturbance. Bedrock blasting is not expected to occur. The Project would not impact karst formations or caves. Approximately 220.9 ha (545.8 ac), or 219.9 ha (543.6 ac) for the Redesign Option, of soil would be disturbed during construction. Following restoration, the permanent operating footprint of the Project would be approximately 52.2 ha (128.9 ac), or 52.5 ha (129.8 ac) for the Redesign Option, of built facilities. No impacts to geology and soils will result during operation. Where facilities would be removed, the impacts of decommissioning would be generally equivalent to construction-related impacts.	Same as Proposed Action	Same as Proposed Action	No effect
5.2 - Water Resources	Construction activities could result in localized insignificant impacts to groundwater and minor, temporary impacts on surface water at 32 jurisdictional streams, or 49 streams for the Redesign Option. No direct impacts to wetlands would occur, no turbines would be sited within 15 m (50 ft) of a federal or state jurisdictional wetland, and access roads and buried electrical interconnections would be designed and sited to avoid wetlands. The Applicant intends to apply for approval from the USACE for Section 404 Permits for up to 32 stream crossings for a total of not more than 380.3 linear m (1,248 linear ft) of impact, or 49 crossings for a total of not more than 487 m (1,598 ft) of impact for the Redesign Option. The Applicant would implement compensatory mitigation for stream	Same as Proposed Action	Same as Proposed Action	No effect

Resource	Proposed Action – Modified Operations	Alternative A – Maximally Restricted Operations Alternative	Alternative B – Minimally Restricted Operations Alternative	Alternative C – No Action
	impacts if required through the USACE Section 404 Permit process for specific crossings. The 100 turbine array and associated access roads and buried interconnections would require no more than 2.4 ha (5.9 ac) of permanent impact and 9.4 ha (23.3 ac) of temporary impact to the 100-year floodplain. Operational activities would have only minor effects on groundwater and surface water. Decommissioning activities may have localized, temporary impacts on water quality.			
5.3 - Vegetation	The proposed Project would have minor, localized effects on vegetation (primarily active crop fields). Approximately 6.5 ha (16.1 ac) of forest and 11.3 ha (27.9 ac) of CRP land would experience temporary or permanent impacts. For the Redesign Option, 6.8 ha (16.8 ac) of forest and 12.4 ha (30.7 ac) of CRP land would be impacted. Temporary impacts to vegetation would occur within the staging areas, gravel access, and maintenance areas surrounding the turbine towers; the temporarily widened portions of the roads; and areas disturbed to install buried electrical interconnects. Vegetative impacts associated with buried interconnects would be temporary. Under the Redesign Option more of the 34.5-kV interconnects will be buried underground (86.5 km [53.7 km] with Redesign Option versus 56.7 km [35.2 mi] for the Proposed Action). There is potential to spread existing invasive species within the Project area and for invasive species to be transported to the Project area via maintenance vehicles or repair materials. Operation of the Project would have minor effects on vegetation. Where facilities would be removed, the impacts of	Same as Proposed Action	Same as Proposed Action	No effect

Resource	Proposed Action – Modified Operations	Alternative A – Maximally Restricted Operations Alternative	Alternative B – Minimally Restricted Operations Alternative	Alternative C – No Action
	decommissioning would be generally equivalent to construction-related impacts.			
5.4 - Wildlife and Fisheries	Very minor impacts of incidental injury and mortality and displacement during construction phase. Operational impacts to wildlife are expected to include possible displacement due to the presence of the wind turbines and avian and bat mortality as a result of collisions with the wind turbines. Collision risk would be minimized by implementing the HCP, including use of feathering and modified cut-in speeds depending on habitat and season, and ABPP. Approximately 735 birds per year could be taken by operations. Approximately 1,288 bats (966 migratory tree bats, 245 *Myotis* bats, and 77 other bats (big brown, tricolor, etc.)) could be taken by operations. The impacts of decommissioning would be generally equivalent to construction-related impacts.	Same as Proposed Action; but since turbines would be non-operational from ½ hour before sunset to ½ hour after sunrise, collision risks to bats and night-flying birds would be less than that resulting from the Proposed Action from April 1 through October 31. Collision risk would be minimized by implementing an ABPP. Approximately 568 birds per year could be taken by operations. Extremely low numbers of bats, if not zero, would be taken by operations.	Same as Proposed Action; but collision risks to bats and night-flying birds would be greater than the Proposed Action because the feathering would only occur from August 1 through October 31 for the first six hours after sunset when wind speeds are 5.0 m/s (11 mph) or less. Collision risk would be minimized by implementing the HCP and ABPP. Approximately 754 birds per year could be taken by operations. Approximately 2,600 bats (1,950 migratory tree bats, 494 *Myotis* bats, and 156 other bats (big brown, tricolor, etc.)) could be taken by operations.	No effect
5.5 - Rare, Threatened, and Endangered Species	A minimal amount (6.5 ha [16.1 ac], or 6.8 ha [16.7 ac] for the Redesign Option) of forest habitat loss would occur during construction, but this would occur during the non-roosting season so as to preclude direct effects to Indiana bats. Impact to Indiana bats would occur from collision and/or barotrauma during operation, resulting in the estimated take of 5.2 Indiana bats per year. Potential take would be avoided and minimized to the maximum extent practicable at night when bats are active through the use of feathering at various cut-in speeds depending on habitat and season. Use of adaptive management would result in increased cut-in speeds if there are greater than	As per the Proposed Action, a minimal amount of habitat loss would occur during construction but this would occur during the non-roosting season so as to preclude direct effects to Indiana bats. Take of Indiana bats would be avoided during operation by restricting operation of all turbines from sunset to sunrise from April 1 through October 31. This alternative would not involve the implementation of the HCP and would thus not	As per the Proposed Action and Alternative A, a minimal amount of habitat loss would occur during construction but this would occur during the non-roosting season so as to preclude direct effects to Indiana bats. Impact to Indiana bats would occur from collision and/or barotrauma, resulting in the take of approximately 12 Indiana bats per year. Potential take would be minimized by feathering all turbines until a cut-in speed of 5.0 m/s (11 mph) is reached, from August 1 through October 31, for the first six hours after	No effect

Resource	Proposed Action – Modified Operations	Alternative A – Maximally Restricted Operations Alternative	Alternative B – Minimally Restricted Operations Alternative	Alternative C – No Action
	5.2 Indiana bat mortalities per year. Other federally or state-listed threatened or endangered species would potentially be affected by the Proposed Action including two aquatic species, one reptile, and six birds. Perennial streams in the Action Area have the potential to support the rayed bean mussel and western tonguetied minnow. However, no in-water work would occur in Exceptional Warmwater Habitat or Coldwater Habitat streams, crossing locations that are documented or assumed to support rayed bean will avoid in-water work, and the Applicant would adhere to NWP, OEPA WQC, NPDES, and SWPPP conditions (see Section 5.2) for work in streams or adjacent riparian areas. Construction of the 100 turbines would impact approximately 1,248 linear feet of streams (1,598 under the Redesign Option), and could result in increased siltation and sedimentation to aquatic resources down-gradient of the area of disturbance. No impact is expected on rayed bean, and only minor potential impacts are expected to tonguetied minnow. There is only a low potential for the eastern massasauga to occur in the Action Area, and with implementation of minimization and avoidance measures described in Section 5.5.2, the Project is not likely to adversely affect the eastern massasauga. Several state-listed threatened and endangered bird species were observed infrequently within the Action Area: black-crowned night heron, peregrine falcon, upland sandpiper, loggerhead shrike, northern harrier, and sandhill crane. Stantec observed the northern harrier during their 2008 breeding bird surveys, but did not identify any nests for this species, and the	result in mitigation or conservation measures provided for in the HCP. Impacts to Rayed bean, western tonguetied minnow, and eastern massasauga would be the same as the Proposed Action. Impacts to state-listed birds would be similar to the Proposed Action.	sunset. This corresponds to the times when most turbine-induced bat mortality has been detected at other operational wind facilities. Impacts to Rayed bean, western tonguetied minnow, and eastern massasauga would be the same as the Proposed Action. Impacts to state-listed birds would be similar to the Proposed Action.	

Resource	Proposed Action – Modified Operations	Alternative A – Maximally Restricted Operations Alternative	Alternative B – Minimally Restricted Operations Alternative	Alternative C – No Action
	Ohio Breeding Bird Atlas does not have records for this species breeding in the proposed Action Area. As tree removal would occur October 1 through April 1, and thus would avoid most of the nesting bird season, Project construction is not expected to have significant impacts on Ohio threatened and endangered bird species. Though State-listed birds were infrequently observed in the Action Area, they could be impacted by operation of the Project. However with implementation of specific avoidance and minimization measures within the ABPP, operation related impacts would be minor. Decommissioning impacts on all Federal and State endangered and threatened species are anticipated to be minor.			
5.6 - Cultural and Historic Resources	There is one archaeological site in the Project Area that is potentially eligible for NRHP listing that has been identified to date. The Applicant has committed to avoiding this site, and any other potentially eligible NRHP site(s) identified in future field studies during construction or decommissioning. A mound was identified within the Action Area, but it would not be affected by the construction or decommissioning of the Project and the Piqua Shawnee Tribe confirmed that the Tribe supports the Project and has no concerns regarding the sanctity of the mound. The 1,475 historic properties identified within the indirect APE would be impacted for the operational life of the Project. Any impacts on historic structures during the construction phase are considered temporary. A mitigation plan and Programmatic Agreement are in	Same as Proposed Action	Same as Proposed Action	No effect

Resource	Proposed Action – Modified Operations	Alternative A – Maximally Restricted Operations Alternative	Alternative B – Minimally Restricted Operations Alternative	Alternative C – No Action
	development with consultation from OHPO to address impacts to historic properties.			
5.7 - Land Use and Recreation	Temporary risk of soil erosion and loss of soil productivity, as well as some damage to existing crops, fences, gates, and subsurface tile drains may result from construction and decommissioning activities. Landowners may experience a temporary or permanent loss of use in areas during the construction and operation. Approximately 42.0 ha (103.9 ac) of agricultural land would be permanently impacted. Visual impacts and temporary moderate construction noise impacts may occur at recreational areas within 1.6 km (1 mi) of the facility.	Same as Proposed Action	Same as Proposed Action	No effect
5.8 - Visual Resources	Short term visual disturbances associated with construction and decommissioning may occur. A significant direct adverse impact on visual resources may result for some residents within 1.6 km (1 mi) of the nearest turbine, and in sensitive locations such as cemeteries, churches, schools, and sites of historic or cultural significance. As under the Redesign Option more of the 34.5-kV interconnects will be buried underground (86.5 km [53.7 km] with Redesign Option versus 56.7 km [35.2 mi] for the Proposed Action), the adverse impact on visual resources may be slightly higher during construction since the total area of disturbed earth would likely be larger than as for the Proposed Action. However, during operation of the Redesign Option the areas where the underground interconnects were buried would be revegetated, potentially reducing the impact on visual resources for some residents compared to the Proposed Action.	Same as Proposed Action	Same as Proposed Action	No effect

Resource	Proposed Action – Modified Operations	Alternative A – Maximally Restricted Operations Alternative	Alternative B – Minimally Restricted Operations Alternative	Alternative C – No Action
5.9 - Socioeconomics and Environmental Justice	No significant impacts on land use categorization or local public services and facilities are expected from construction, operation, or decommissioning. No adverse impacts to minority or low income populations are expected. The construction and operation of the Facility is anticipated to have a moderate positive impact from generation of Alternative Tax revenues to all taxing jurisdictions that host the Facility.	Operations would be restricted from ½ hour before sunset to ½ hour after sunrise between April 1 and October 31, and the Project would therefore produce less energy and generate less revenue than the Proposed Action.	Operation would be restricted less than the proposed action and therefore energy production would be slightly greater than the Proposed Action, increasing the amount of energy generated and therefore the amount of revenue produced.	No effect; no generation of Alternative Tax revenue
5.10 - Noise	Temporary moderate unavoidable impact would result from construction noise at some of the homes in the Project Area. During Project operation the predicted operational Leq sound levels (average case) would not exceed thresholds at any non-participating residence, while the L_{90} sound levels (worst case scenario) exceed 34 dBA (the nominal nighttime impact threshold) at numerous residences near the proposed Facility and exceed 40 dBA (the nominal daytime impact threshold) at a few residences.	Same as Proposed Action; but no noise impacts associated with turbine operation from ½ hour before sunset to1/2 hour after sunrise during the entire period over which Indiana bats are active (April 1 through October 31) as all turbines would be non-operational.	Same as Proposed Action; but no noise impacts from August 1 through October 31 from ½ hour before sunset to ½ hour after sunrise during periods when wind speeds are 5.0 m/s (11 mph) or less as all turbines would be non-operational.	No effect
5.11 - Air Quality	Temporary impacts to air quality from the operation of construction equipment and vehicles; positive moderate impact to the overall air quality in the region due to its potential to offset/displace future emissions from existing power plants	Construction impacts would be the same as the Proposed Action. Alternative A would feather more of the time than the Proposed Action; therefore, less energy would be generated and approximately 23 percent less air emissions would be offset, compared to the Proposed Action.	Construction impacts would be the same as the Proposed Action. Alternative B would feather less of the time than the Proposed Action; therefore, more energy would be generated and approximately 2 percent more air emissions would be offset, compared to the Proposed Action.	No effect; no overall positive impact to air quality due to offsetting of current emissions from existing power plants
5.12 - Transportation	Temporary impacts to roads, traffic operations and safety due to turbine component shipment during construction and decommissioning. No impact during operation.	Same as Proposed Action	Same as Proposed Action	No effect

Resource	Proposed Action – Modified Operations	Alternative A – Maximally Restricted Operations Alternative	Alternative B – Minimally Restricted Operations Alternative	Alternative C – No Action
5.13 - Communications	Minor effects on over-the-air remaining low-power analog stations or very low-power FM radio stations, though impacts are sporadic and localized. No significant negative direct or indirect impacts on radio broadcasts, microwave transmission, and military radar from construction, operation or decommissioning.	Same as Proposed Action, but to the extent that interference is expected, Alternative A would have slightly lower effects on communications than the Proposed Action due to reduced total hours of operation.	Same as Proposed Action, but to the extent that interference is expected, Alternative B would have slightly larger effects on communications than the Proposed Action because Alternative B proposes more operational hours than the Proposed Action.	No effect
5.14 - Health and Safety	No significant adverse impacts on health and safety due to ice shedding, tower collapse and blade shear, stray voltage, fire and fuel, lightning strike, and wind turbine syndrome. Based on the Applicant's commitment to not exceed 30 hours of shadow flicker per year, the Project's shadow flicker is not likely to have an adverse impact on permanent non-participating residences.	Same as Proposed Action; a very slightly reduced risk of ice shedding (due to time-of year restrictions and reduced total hours of operation) and slightly reduced risk of blade shear events (due to reduced total hours of operation).	Same as Proposed Action; a very slightly increased risk of ice shedding (due to time-of year restrictions and increased total hours of operation) and slightly increased risk of blade shear events (due to increased total hours of operation),	No effect

Table 6.1-2 Mitigation Measures

Resource	Avoidance, Minimization, and Mitigation Measures
5.1 - Geology and Soils	A SWPPP including an Erosion and Sedimentation Control Plan would be implemented, consisting of stabilization of steep slopes with geotextiles or other similar devices (particularly during rain events), silt fences, hay bale dikes or other suitable methods of slowing sheetflow and retaining sediment onsite, as well as identifying designated crossings over streams to minimize erosion and sedimentation in riparian areas, wetlands, and streams.
	Removal of topsoil from disturbed areas would be stockpiled and retained for re-application once site disturbance is complete.
	The construction footprint would be minimized by delineating and avoiding sensitive resources such as streams, wetlands, cultural resources, etc. in the field prior to construction and adhering to work area limits during construction.
	Compacted soils would be restored through manual or mechanical cultivation to re-aerate the soil and promote seed germination.
	Areas subject to temporary disturbance (not within the permanent Project footprint but disturbed during construction) would be revegetated with native seed in accordance with the NPDES permit and erosion and sedimentation plan.
5.2 - Water Resources	No discharges of contaminated effluent or hazardous materials would occur directly to a receiving water body. SPCC procedures would be implemented to prevent the release of hazardous substances into the environment.
	Should blasting be required, the exact location of private water supply wells within the Project Area would be determined and clearly marked to avoid potential damage and no blasting would occur within a 30.5-m (100-ft) buffer around private wells.
	Large built components of the Project, including wind turbines, staging areas, the operations and maintenance building, and the substation, would be sited to avoid wetlands, and minimize necessary in-stream work.
	The applicant would comply with all manufacturer’s recommendations and applicable permit conditions regarding application of herbicides.
	The construction footprint would be minimized by delineating and avoiding sensitive areas in the field prior to construction and adhering to work area limits during construction. These measures would limit potential impacts of soil compression on normal infiltration rates.
	Buckeye Wind and its contractors would follow strict guidelines dictating the use and handling of hazardous materials and other contaminants, which would minimize the potential for impacts to water quality and/or aquatic life.
	Contractors would develop and implement a comprehensive sediment and erosion control plan to minimize impacts to waterways.

	In those cases when only buried electrical interconnects cross a perennial stream, the Applicant would horizontally directionally drill underneath the stream regardless of its beneficial use classification. In cases where only buried electrical interconnects cross an intermittent or ephemeral stream, the Applicant would open trench through the stream and conduct the trenching during periods of no water flow, or horizontally directionally drill underneath that stream if the crossing is completed when water is present.
	Existing or narrow crossing locations over surface waters would be used whenever practicable. Low-impact crossing techniques, equipment restrictions, herbicide use restrictions, and erosion and sedimentation control measures would be implemented. It is expected that all collection line and crane path stream impacts will be temporary in nature. These impact areas will be restored per the conditions of the USACE and NPDES permits and erosion and sediment control plan (see section 5.2.1.2.1 of the DHCP for additional details). Access road impacts are expected to be permanent and will be appropriately permitted for through USACE permits.
	Clearing of vegetation along stream banks would be minimized, and areas cleared during construction would be stabilized following construction. Temporary crossings and areas of temporary construction impact will be restored and re-vegetated per the erosion and sediment control plan, consisting of planting native plant species (see HCP Appendix D for a typical native plant mix) to provide ground stabilization. Where forest fragmentation results from construction activities, the areas will be restored using trees suitable for Indiana bat habitat, if practicable. A list of native trees suitable for planting to restore Indiana bat habitat is included in HCP Appendix D. If existing land-use precludes the use of native species (e.g. agricultural use), restoration and stabilization will be established consistent with that land-use.
	Should groundwater be encountered during excavation, water removal would be conducted as follows: a sump pit would be used to trap and filter water for pumping to a suitable discharge point, areas of cleared vegetation along streams would be stabilized, and clean pumped water would be discharged to a vegetated and stabilized area (or to an appropriately sized level spreader or riprap energy dissipater) to minimize scouring of the receiving area. Sediment-laden water would be pumped through a filter bag or into a sediment trapping device prior to discharge.
	Unavoidable impacts to streams would be mitigated in accordance with any required permits issued by the USACE or Ohio EPA under the CWA, Section 401 or 404 or the Ohio Isolated Wetlands Program.
	Topsoil removal and decompaction would be conducted in agricultural areas where soil restoration is necessary to accommodate future agricultural uses. These practices would also mitigate any potential impacts that soil compaction could have on infiltration of rain and snowmelt, thereby further reducing any potential impact to groundwater recharge.
	No Project components would be sited within any groundwater SWPA.
5.3 - Vegetation	Project components would be sited in previously disturbed areas (e.g., existing farm lanes) to the maximum extent possible and areas of vegetation and soil disturbance would be limited to the smallest size practicable.
	Disturbed areas outside of active agricultural fields would be re-seeded with vegetation native to the Project area.

	Conduct regularly scheduled invasive species monitoring to identify any occurrences of invasive species, and develop an eradication plan as needed.
	Targeting a minimum of six different tree species from the list found in Appendix L of the Rangewide Indiana Bat Protection and Enhancement Plan Guidelines (PEP Guidelines) (USFWS et al. 2009) for planting in riparian and wooded corridor restoration areas.
	Pre-construction contours/soil/substrate conditions to be established in disturbed areas to the extent practicable.
	Disturbed stream banks would be stabilized per the conditions of any formal state/Federal-issued permit.
	Disturbed agricultural fields would be restored by decompacting soil, re-spreading stockpiled topsoil, and removing any large rocks or debris that would impact future cultivation.
5.4 - Wildlife and Fisheries	Tree removal during construction would occur between November 1 and March 31, to reduce the potential for impacts on roosting bats, and nesting/breeding birds. CRP land would be cleared only during the non-breeding season for grassland birds (before March 1 and after July 15).
	The Applicant would implement various cut-in speeds at different times of the day and year as part of the minimization measures incorporated in the HCP for Indiana bat impact. This approach would also reduce mortality of other bat species and birds during low wind-speed nights.
	The Project's design incorporates aspects of the Service Interim Guidance on Avoiding and Minimizing Wildlife Impacts from Wind Turbines (details presented in Section 5.4.2).
	For any protected species of raptor nest identified within the Action Area, impact minimization measures would be established in cooperation with the ODNR.
	Meteorological (MET) towers would be free standing without guy wires.
	The minimum amount of pilot warning and obstruction avoidance lighting specified by the Federal Aviation Administration (FAA) would be used. The lights used on turbines or MET towers would be the minimum number, minimum intensity, and minimum number of flashes per minute (longest duration between flashes) allowable by the FAA.
	Where feasible, electric power lines would be placed underground or on the surface as insulated, shielded wire to avoid electrocution of birds. Above-ground lines would be marked in accordance with the Avian Power Line Interaction Committee (APLIC), "Suggested Practices for Avian Protection on Power Lines," to the extent practicable.
	Access roads built for the Project would be posted with a 25 mph speed limit to minimize risk of collision with Indiana bats and other wildlife.
	Implementation of a post-construction monitoring plan based on the ODNR recommendations and coordination with the USFWS, to determine the rates and species-specific patterns of avian and/or bat collision fatalities at turbines.

	Implementation of an Avian and Bat Protection Plan for the life of the Project that includes avoidance and minimization measures, post-construction monitoring, and adaptive management and mitigation to reduce impacts to migratory birds and bats that are not federally-listed. The Applicant will minimize potential impacts on bald eagles by implementing a series of measures including: monitoring for and reporting eagle mortality for the life of the Project; minimize, the likelihood that eagles will use the Project site by carcass management and maintenance of vegetation heights around turbines to reduce prey availability and raptor foraging; developing a plan to periodically update the predicted risk of the Project to eagles; developing an adaptive management plans that initiate action if risk to eagles is found to increase to moderate or high levels in the future; committing to consider and incorporate, where appropriate, the latest research findings and minimization measures concerning eagle mortality at wind power projects; ground wires would be marked with deflectors; and following APLIC guidelines for overhead utilities, to the extent possible.
5.5 - Rare, Threatened, and Endangered Species	Turbine curtailment would be implemented during spring, summer, and fall, to reduce Indiana bat mortality during low wind-speed nights (6 m/s [13 mph] or less). The cut-in speeds would be highest for turbines in habitat most suitable for Indiana bats, and during the fall season when Indiana bats in general are most at risk of collision/barotrauma.
	Tree clearing would be minimized to the maximum extent practicable — the 100-turbine layout would require 6.5 ha (16.1 ac) of tree clearing. The Applicant proposes to add an additional 6.5 ha (16.1 ac), of proposed mitigation land to compensate for habitat lost during construction land to the 81.3 ha (200.9 ac) of mitigation land needed to compensate for take of individual bats to compensate for habitat lost during construction.
	The Applicant will not remove trees that are known to have been used as a roost site for Indiana bats.
	The Applicant will avoid removal of potential roost trees identified during the November 2010 habitat assessment to the maximum extent practicable.
	Prior to finalizing the detailed design of Project components, the Applicant will make all reasonable attempts to offset the clearing radii around turbines or adjust roads/interconnects to preserve flagged potential roosts to avoid and minimize impacts of potential roost removal to the maximum extent practicable.
	At the time of tree clearing, a natural resource specialist who is familiar with Indiana bat habitat requirements will be present and any potential roost trees not identified previously (including maternity roosts) within the clearing zone will be flagged.
	Tree clearing would be conducted during the period between November 1 and March 31, when Indiana bats would not be using the area, to avoid potential mortality of Indiana bats that could result from removal of previously unidentified maternity roost trees. Prior to tree removal, the 6.5 ha (16.1 ac) acres of forest proposed for removal would be assessed for maternity roost trees and the limits of clearing would be clearly demarcated on the site with orange construction fencing (or similar), to prevent inadvertent over-clearing of the site.

	Streams, wetlands, and associated riparian areas would be avoided or impacts minimized to the maximum extent practical, in order to minimize impacts to aquatic and riparian habitat, forest connectivity, and wildlife movement corridors. Construction contractors would be required to adhere to all conditions of the NWP, Ohio EPA WQC, NPDES permit, SWPPP, and any additional State or OPSB requirements. Required steam crossings would be horizontally directional drilled to avoid unnecessary clearing of forested riparian areas. Wetlands and streams near proposed Project-related facilities would be flagged for avoidance prior to construction.
	A monitoring and adaptive management program would be implemented to keep Indiana bat mortality at or below permitted levels.
	The Applicant would minimize the potential for construction and decommissioning-related impact to rayed bean mussels by avoiding in-water work in perennial streams where the species is known or assumed to be present.
	The Applicant would minimize the potential for construction, operation, and decommissioning-related impacts to the eastern massasauga by restricting construction activities to the extent practicable between November 15 and March 1, conducting temporary ground disturbance at least 15 m (50 ft) from the wetland containing potential massasauga habitat, use buried silt fences during construction and decommissioning, post 10 mph speed limits within one half-mile around the wetland, installing gates at access points along the road, and training O&M personnel on the appearance, protected status, and proper avoidance of the massasauga.
	The Applicant would minimize potential impacts on tonguetied minnow by avoiding direct impacts to designated Exceptional Warmwater Habitat and Coldwater Habitat streams, and implementing best management practices associated with NPDES permits and Nationwide Permits to minimize impacts from sedimentation and runoff in perennial streams.
	Tree removal would occur November 1 through March 31, and thus would avoid most of the forest nesting bird season (nesting season is generally considered to be February 1 through August 31). Further, CRP land will be cleared only during the non-breeding season for grassland birds (before 1 March and after 15 July). Thus, direct impacts to state-listed birds that may nest in the Project area would be avoided.
	The Applicant would avoid and minimize the potential of operation-related impacts to state-listed birds with the following measures: using a turbine design that doesn’t support roosting or perching; burying collector lines wherever feasible to minimize the potential risk of electrocution to bald eagles and other birds; equipping above-ground collector lines and distribution poles with insulated and shielded wire to avoid electrocution of eagles and other birds; designing and maintaining new distribution poles, where possible and as dictated by DPL construction guidelines, so that they are insulated in order to protect raptors from electrocution; ensuring permanent MET towers would be non-guyed, free-standing structures; installing perch deterrents to prevent raptor perching activity should insulating of lines associated with new poles not be possible; removing carcasses from access roads and turbine pads to prevent raptor scavenging; minimizing operational and FAA lighting to the maximum extent practicable to reduce attraction of birds; and, controlling any ground-based lighting necessary for safety or security at the turbines or substation by use of motion detectors or infrared sensors.

	Two mitigation options for Indiana bats are proposed: 1) Acquire or otherwise provide protection to 87.8 ha (217.0 ac) of suitable Indiana bat swarming habitat within 11.2 km (7 mi) of a P2 Indiana bat hibernaculum in Ohio, either through acquisition of conservation easements into perpetuity or purchase of the property and then assigning conservation easements in perpetuity. Within the easement areas, restore travel corridors, ensure an adequate number of suitable roost trees and manage woody invasive species. OR 2) Buy credits from an USFWS-approved Indiana bat mitigation bank whose geographical range service area includes the Project.
	Implementation of an Avian and Bat Protection Plan for the life of the Project that includes avoidance and minimization measures, post-construction monitoring, and adaptive management and mitigation to reduce impacts to State-listed birds.
	Applicant would implement one or a combination of the following conservation measures to advance the knowledge base of the Indiana bat and wind energy interactions: 1) Providing funding to a qualified research program to conduct research on Indiana bat behavior relative to operating wind turbines; 2) Providing funding to a qualified research program to conduct fall migration telemetry studies at Indiana bat hibernacula in Ohio, where landowner permission allows; and 3) Wing and Hair tissue samples from each dead bat may be collected to support USFWS-requested research projects by entities other than Buckeye Wind. Results of research would be incorporated into the adaptive management of the Project, where appropriate.
5.6 - Cultural and Historic Resources	Avoid site 33CH045 during construction and decommissioning, as well as any other NRHP sites identified by future field studies.
	A Multiple Property Listing (MPL) to the NRHP for historic one-room schoolhouses throughout the Action Area to promote awareness and preservation of these structures.
	Documentation and interpretation of the A.P. Howard house and the Obed Horr house, and development of a Teaching with Historic Places lesson plan presenting Champaign County's role in the Underground Railroad.
	A Programmatic Agreement (Appendix L) between USFWS, Buckeye Wind, and SHPO will be signed prior to issuance of the ROD and ITP, and will delineate all archaeological surveys that must be completed before the Section 106 process is complete.
5.7 - Land Use and Recreation	Permanent road widths would be limited to a maximum of 6 m (20 ft) or less, and where possible, following existing farm lanes, hedgerows and field edges to minimize loss and fragmentation of agricultural land.
	Disturbance of surface and subsurface drainage features would be avoided.
	All inadvertently damaged tile lines would be repaired.
	Vehicular access to turbine sites would be minimized until topsoil has been stripped and permanent access roads have been constructed.
	Vehicular access would be limited to construction roads only.

	Stripping of topsoil or passage of cranes across agricultural fields would be prohibited during saturated conditions (when soils capacity to assimilate water is exceeded, and standing water forms on the soils surface) when such actions would damage agricultural soils.
	Blocking of surface water drainage due to road installation or stockpiled topsoil would be avoided.
	Access roads throughout construction would be maintained so as to allow continued use/crossing by farmers and farm machinery to the extent practicable.
	Open excavation areas in active pastureland would be temporarily fenced/secured to protect livestock.
	Excess concrete would be disposed in appropriate locations where additional impacts to natural resources would not occur.
	Concrete trucks would be washed into foundation holes, or outside of active agricultural areas in locations approved by the landowner and in appropriate locations where additional impacts to natural resources would not occur.
	Crane set-up, erection, and breakdown activities would be restricted to designated access roads and immediately adjacent areas and work pads at the turbine sites.
	Subsoil decompaction and rock picking would occur prior to re-spreading of topsoil in temporarily disturbed areas.
	Restored agricultural areas would be stabilized with seed and/or mulch.
	All construction debris would be removed and disposed offsite at the completion of restoration.
	Compensation would be provided for damaged/lost crops.
	Coordination with landowner would occur to assure that interference with irrigation and subsurface drainage is appropriately minimized during construction and avoided during operation and maintenance.
5.8 - Visual Resources	Turbines would be painted white or off-white using non-reflective paints.
	The electrical collection system would be installed below ground wherever feasible. For above-ground segments of the collection system, existing utility rights-of-way and existing utility poles would be used to the maximum extent possible.
	Restore site per NPDES which would make permanent land use impacts minimal.
	Turbine lighting would be kept to the minimum allowable by the FAA.
	Turbines and turbine sites would be maintained to ensure that they are clean and attractive. In particular, rust spots or other flaws in exterior finishes should be corrected as quickly as possible.
	All turbines would have uniform design, speed, color, height, and rotor diameter.
	Towers would include no exterior ladders or cat walks.

	Non-specular (i.e., non-reflective) conductor would be used on all overhead electrical lines.
	Lighting at the proposed substation would be turned on only as needed by switch or motion detector.
	No advertising devices would be allowed on the turbines.
	If the Project goes out of service, and is not repowered/redeveloped, all visible above-ground turbine components would be removed.
5.9 - Socioeconomics and Environmental Justice	Make land lease payments to participating landowners to offset any possible downward pressure on property values.
	Health and Safety concerns that may indirectly impact socioeconomic resources also would be addressed through design techniques and compliance with health and safety standards. Implement construction and operation best management practices to minimize health or safety risks.
	The Applicant would commit to use local/regional labor, goods, and services when practicable. The Project would comply with SB 232.
5.10 - Noise	Best management practices would be implemented for sound abatement during construction, including use of appropriate mufflers, proper vehicle maintenance, and limiting hours of construction to normal daytime working hours, unless there is a compelling reason to work beyond those hours.
	Landowners would be notified of certain construction sound impacts in advance such as if blasting becomes necessary (however, blasting is unlikely to occur).
	Siting turbines such that an operational noise impact threshold of 5 dBA above the prevailing day and night background levels (Leq) for non-participating residences is not exceeded.
	A reasonable complaint resolution procedure would be implemented.
5.11 - Air Quality	Best management practices would be implemented to minimize the amount of dust generated during construction and decommissioning activities.
	All construction vehicles would be maintained in good working condition to minimize emissions from construction and decommissioning-related activities.
	Idle times would be limited and shutdowns of construction and decommissioning equipment would occur when not in use.
	The extent of exposed/disturbed areas would be minimized on the site at any one time and restoring/stabilizing the affected area as stipulated in the NPDES permits.
	Water or calcium carbonate would be applied to suppress dust on unpaved roads (for both public roads and Project access roads), as needed throughout the duration of construction and decommissioning activities.

	Any unanticipated construction and decommissioning-related dust problems would be identified and immediate reporting to the construction manager and contractor would be ensured.
5.12 - Transportation	Special hauling permits will be obtained when necessary to transport Project components to and from Project site.
	The township and county roads to be used for delivering Project equipment and materials would be video-documented prior to the commencement of construction to establish existing conditions. Upon completion of the Project, the Applicant would return all roadways to their pre-construction conditions.
	Ensure that roads and bridges are adequate to support the construction of the Project. Any road, bridge or culvert that the Champaign County Engineer determined to be inadequate would be rebuilt or reinforced to the specifications established by the Champaign County Engineer.
	A road bond, or other similar surety, would be established through the Engineer's Office or the Champaign County Board of Commissioners to provide adequate funds to repair any damage to public roads.
	Where practicable, deliveries of turbine components would be aggregated in truck caravans to reduce frequency and uncertainty in road closures.
	Buckeye Wind would communicate with county engineers and local police officials as necessary to accommodate the deliveries, and the vast majority of deliveries would not require scheduled road closures. Delivery timing restrictions should be confirmed through route evaluation studies.
	Deliveries would be coordinated with state and local police, and chase vehicles and/or police vehicles would be used, as necessary, to ensure that non-Project traffic does not mix with oversize/overweight loads.
5.13 - Communication	All 100 turbines would be sited greater than 3 km (2 mi) from AM transmitters, such that degradation of AM broadcast would not occur.
	If Project operations result in any impacts to existing over-the-air television coverage, the Applicant would address and resolve each individual problem as commercially practicable. Such resolutions could include the provision of stronger digital antennas, or cable or satellite television service in lieu of non-functional over-the-air television.
	Prior to final Project design updated telecommunication assessments would be performed to ensure that any changes to communication pathways are accounted for in the final 100-turbine array.
5.14 - Health and Safety	Proper grounding techniques incorporated within and around Project components would eliminate the occurrence of stray voltage.
	The Project would implement minimum setbacks of 279 m (914 ft) between turbines and permanent non-participating residences and 180 m (590 ft) from adjacent property lines.
	Operations and maintenance staff would be trained and, in virtually all cases, would be the first level of response to in-tower emergencies Local fire and emergency service personnel would also receive training in providing response services that are appropriate for activities, materials, and risks associated with the Project. This could include, for example, hazardous materials training related to the fuels and other potentially hazardous materials stored at the operations and maintenance facility.

	Local emergency service personnel would be given material safety data sheets for potentially hazardous construction materials.
	Construction managers would coordinate with local emergency service personnel to ensure that they are aware of the location and nature of various construction activities.
	Construction managers would coordinate with police and ODOT to ensure that deliveries of Project materials (specifically overweight and oversize turbine and crane components) are achieved safely.
	The 100 turbines would be sited such that non-participating residence and other sensitive receptors (including schools, libraries, churches, hospitals and nursing homes) would not be subject Shadow Flicker exceeding 30 hours per year. For residences (or businesses, if applicable) with the potential to receive more than 30 hours per year of Shadow Flicker, site-specific evaluations would be conducted to determine whether adequate trees or buildings exist to provide screening. If necessary, trees would be planted in appropriate locations on these properties to minimize shadow flicker or other appropriate minimization measures would be employed.

6.1.2 Irreversible and Irretrievable Commitment of Resources

Irreversible commitment of resources refers to the loss, as a result of the Project, of future options for resource development or management, especially of nonrenewable resources such as minerals and cultural resources (40 CFR 1508.1 1). Irretrievable commitment of resources refers to the lost production or use value of renewable natural resources as a result of the Project (40 CFR 1508.1 1). Construction and operation of the Buckeye Wind Project involves the irreversible and irretrievable commitment of material resources, energy, and biological resources.

To date, no irreversible or irretrievable loss of resources associated with the Project has occurred. Further, the USFWS will not approve any proposal that would result in irreversible or irretrievable loss of resources prior to publication of the ROD, and issuance of an ITP.

6.1.2.1 Irreversible and Irretrievable Commitment of Material Resources and Energy

Material resources used for the Project for all action alternatives (Proposed Action and Alternatives A and B) include building materials for new turbines, access roads, underground and overhead electricity collection lines, MET towers, and other facilities. Construction of the Project would also require use of fossil fuels, a nonrenewable natural resource; however, operation of the Project would result in lower overall fossil fuel use since power delivered to the grid from this Project would offset the generation of energy at existing conventional power plants that use fossil fuels.

Proposed Action

Construction of the Proposed Action would result in an irreversible or irretrievable loss of some biological resources over the life of the Project, including the irretrievable loss of approximately 46.9 ha (115.8 ac), or 47.0 ha (116.2 ac) of vegetation for the Redesign Option. The relative amount of wooded habitat within Indiana bat habitat categories 1, 2 or 3 that would be impacted by construction activities is expected to be minor: 6.5 ha (16.1 ac), or 6.8 ha (16.8 ac) for the Redesign Option, of forest habitat loss would occur during construction. This would equate to about 0.1% of the 2,744 ha (6,779 ac) of total wooded areas in the Action Area to be cleared. The 100-turbine array would result in 6.5 ha (16.1 ac) of disturbance to deciduous and evergreen forests, or 6.8 ha (16.8 ac) for the Redesign Option. Grassland and CRP habitat loss totals 2.7 ha (6.7 ac) of impacts for the Proposed Action and Redesign Option. The Proposed Action would have minor impacts on up to 32 streams totaling not more than 380.3 linear m (1,248 linear ft) , while the Redesign Option would have minor impacts to 49 streams totaling not more than 487 m (1,598 ft). The Applicant would implement compensatory mitigation for stream impacts if required through the USACE Section 404 Permit process for specific crossings.

Operation of the Proposed Action would result in the incidental take of approximately 130 Indiana bats over the life of the Project. Additionally up to 18,375 migratory birds and 32,200 bats (species other than Indiana bat) may be incidentally taken during the life of the Project based on average numbers at other wind facilities (see Section 5.14 of this EIS) and implementation of the Project’s ABPP and HCP.

Alternatives A and B

Construction of the Project under Alternatives A or B would result in the same irreversible or irretrievable loss of resources as described for the Proposed Action. Operation of the Project under Alternative A (Maximally Restricted Alternative) would result in no (or very limited) impacts to Indiana bats and other non-listed bat species since the wind turbines would not operate when bats are active. This alternative would result in take of approximately 14,200 migratory birds over the life of the Project.

Operation of the Project under Alternative B would result in take of approximately 300 Indiana bats over the life of the Project. Additionally, up to 18,850 migratory birds and 65,000 non-listed bats may be incidentally taken during the life of the Project.

No Action Alternative

The No Action Alternative would result in no irretrievable or irreversible commitment of resources because the Project would not be built.

6.2 Identification of Preferred Alternative

The "preferred alternative" is a preliminary indication of the federal responsible official's preference of action, which is chosen from among the Proposed Action and alternatives analyzed in an EIS. The preferred alternative may be selected for a variety of reasons (such as the priorities of the particular lead agency) in addition to the environmental considerations discussed in the EIS. The preferred alternative is not a final agency decision; rather, it is an indication of the agency's preference. The final agency decision is presented in the ROD.

In accordance with NEPA (40 CFR §1502.14(e)) and based on consideration of agency and public comments on the DEIS, the USFWS has selected the Proposed Action – Modified Operations and Habitat Conservation Plan as the preferred alternative. Of the alternatives evaluated in this FEIS, this alternative best fulfills the agency's statutory mission and responsibilities while meeting the purpose and need. The selection of the Proposed Action as the preferred alternative is based on the following:

1) The issuance of the ITP by the USFWS under the Proposed Action would result in protections (via mitigation and conservation measures) to the Indiana bat, as well as other bat species, not offered in the other action alternatives due to implementation of the HCP. The ABPP that would be implemented under this and the other action alternatives would minimize impacts to migratory birds.
2) The 250 MW of power generated by the Project would provide a dependable source of electrical energy and eliminate the need for an equivalent amount of fossil-fueled derived energy and capacity, which reduces use of nonrenewable resources and limits atmospheric pollution.

6.3 Identification of Environmentally Preferred Alternative

The environmentally preferred alternative is the alternative that would promote the requirements expressed in section 101(b) of NEPA. It is the alternative that causes the least damage to the biological and physical environment and that best protects, preserves, and enhances historic, cultural, and natural resources (CEQ 1981, Q6a). The environmentally preferred alternative has not been selected at this time. USFWS will select an environmentally preferred alternative in the ROD.

Chapter 7

References

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7 References

Ahlén, I. 2003. Wind turbines and bats: a pilot study. Final Report Dnr 5210P-2002- 00473, Swedish National Energy Commission, Eskilstuna, Sweden.

American Wind Energy Association (AWEA). 2008. Wind Energy Siting Handbook, Chapter 5. Washington, D.C. http://www.awea.org/sitinghandbook/download_center.html. Accessed 6 April 2010.

American Wind Energy Association (AWEA). 2010. U.S. Wind Energy Projects. http://www.awea.org/projects/. Accessed 6 April 2010.

American Wind Energy Association (AWEA). 2012. U.S. Wind Energy Projects. http://www.awea.org/projects/. Accessed June 2012.

Arnett, E. B., technical editor. 2005. 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.

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. Takersley, Jr. 2008. Patterns of bat fatalities at wind energy facilities in North America. Journal of Wildlife Management 72:61-78.

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. Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas.

Associated Press. 2007. Oregon Wind Tower Collapse Kills Worker. http://www.seattlepi.com/local/329155_worker27.html. Accessed 10 August 2010.

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(6). http://www.wbwg.org/conservation/papers/BaerwaldetalCurrentBiology2008.pdf. Accessed 6 April 2010.

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. Journal of Wildlife Management 73:1077-1081.

Barbour, R. W., and W. H. Davis. 1969. Bats of America. University of Kentucky Press, Lexington, Kentucky.

Barclay, R. M. R., and L. D. Harder. 2003. Life histories of bats: life in the slow lane. Pages 209–253 *in* T. H. Kunz and M. B. Fenton, editors. Bat ecology. University of Chicago Press, Chicago, Illinois.

Bellrose, F.C. 1976. Ducks, Geese, and Swans of North America. Wildlife Management Institute Publication. Stackpole Books, Mechanicsburg, Pennsylvania.

Blank, John E. 1970. The Ohio Archaic: A Study in Culture History. Unpublished PhD Dissertation, University of Massachusetts, Amherst, Massachusetts.

Blank, John E. 1982. Results of a Phase I and II Archaeological Resource Assessment of a Portion of the Ravenna Army Ammunition Plant, Ravenna, Ohio. Ohio Historic Preservation Office, Columbus, Ohio.

Bolt, Beranek & Newman, Inc. 1977. Power Plant Construction Noise Guide. Prepared for Empire State Electric Energy Research Corporation. Report No. 3321. New York, New York.

Boyles, J.G., P.M. Cryan, G.F. McCracken, and T.H. Kunz. 2011. Economic Importance of Bats in Agriculture. Science 332: 41-42 + supporting online materials.

Brown, L.C., and A.D. Ward. Undated. Understanding Agricultural Drainage. Ohio State University Extension. http://ohioline.osu.edu/aex-fact/0320.html. Accessed 22 June 2012

Buchler, E. R. and S. B. Childs. 1981. Orientation to distant sounds by foraging big brown bats (*Eptesicus fuscus*). Animal Behaviour, 29:428-432.

Buck Creek State Park. 2009. http://www.buckcreekstatepark.org/index.htm. Accessed 9 August 2010.

Buckeye Power, 2012. http://www.buckeyepower.com/news/2012/05/11/ohio-wind-farm-shuts-down-after-turbine-malfunction Accessed 11 May 2012.

Buckeye Wind LLC. 2012. Memorandum on Confidential Business Information – Feathering Calculations, 29 March 2012.

Callahan, E. V. 1993. Indiana bat summer habitat requirements. Thesis, University of Missouri, Columbia, USA.

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

Carter, T. C. 2003. Summer habitat use of roost trees by the endangered Indiana bat (*Myotis sodalis*) in the Shawnee National Forest of southern Illinois. Dissertation, Southern Illinois University, Carbondale, Illinois.

Cedar Bog Association (CBA). 2004. http://www.cedarbognp.org/. Accessed 9 August 2010.

CH2MHILL. 2009. Wyoming Industrial Development and Information and Siting Act, Section 109 Permit Application, Campbell Hill Windpower Project.

Champaign County. 2004. Comprehensive Plan Update. Part I and II. http://www.lucplanning.com/Champaign%20County.html. Accessed 3 August 2010.

Champaign County Visitors Bureau (CVB). 2010. Recreation. http://champaignoh.com/stay-and-play/recreation.html. Accessed 10 August 2010.

Clark County. 1999. Clark County Comprehensive Land Use Plan. http://www.clarkcountyohio.gov/planning/pdf/CompPlan/Comp%20Plan%202001new2009.pdf. Accessed 30 July 2010.

Cleveland, C.J., M. Betke, P. Federico, J.D. Frank, T.G. Hallam, J. Horn, J.D. Lopez Jr., G.F. McCracken, R.A. Medellin, A. Moreno-Valdez, C.G. Sanson, J.K. Westbrook and T.H. Kunz. 2006. Economic Value of the pest control service provided by Brazilian free-tailed bats in south-central Texas. Frontiers in Ecology and Environment 4(5): 238-243.

Colby, W.D., R. Dobie, G. Leventhall, D.M. Lipscomb, R.J. McCunney, M.T. Seilo, and B. Søndergaard. 2009. Wind Turbine Sound and Health Effects - An Expert Panel Review. White Paper Prepared for American Wind Energy Association and Canadian Wind Energy Association. 85 pages. http://awea.org/learnabout/publications/upload/AWEA_and_CanWEA_Sound_White_Paper.pdf. Accessed 22 May 2012.

Comsearch. 2008a. Over-the-air TV Reception Analysis at the Buckeye Wind Power Project in Logan and Champaign Counties, Ohio. Prepared for Everpower Wind Holdings, Inc.

Comsearch. 2008b. Analysis of AM and FM Broadcast Station Operations in the Vicinity of the Buckeye Wind Power Project in Champaign County, Ohio. Prepared for Everpower Wind Holdings, Inc.

Comsearch. 2008c. Cellular/PCS Telephone Analysis in the Vicinity of the Buckeye Wind Power Project in Champaign County, Ohio. Prepared for Everpower Wind Holdings, Inc.

Comsearch. 2009. Executive Summary - Wind Power GeoPlanner: Licensed Microwave Search and Worst Case Fresnel Zone. Prepared for Buckeye Wind, LLC. February 11, 2009.

Comsearch. 2011. Wind Power GeoPlanner: Licensed Microwave Report. Prepared for EverPower. September 29, 2011.

Cope, J. B., A. R. Richter, and R. S. Mills. 1974. A summer concentration of the Indiana bat, *Myotis sodalis*, in Wayne County, Indiana. Proceedings of the Indiana Academy of Science 83:482-484.

Council on Environmental Quality (CEQ). 1997. Environmental Justice under the National Environmental Policy Act. http://clinton4.nara.gov/media/pdf/EJ.pdf. Accessed 22 June 2012.

Covert, S. A., Kula, S. P., and L. A. Simonson. 2007. Ohio Aquatic Gap Analysis: An Assessment of the Biodiversity and Conservation Status of Native Aquatic Animal Species: U.S. Geological Survey. http://pubs.usgs.gov/of/2006/1385/. Accessed 2 March 2010.

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C.

Cultural Resource Analysts, Inc. (CRA). 2011a. Phase I Archaeological Survey for the Proposed Buckeye Wind Farm in Champaign County, Ohio. Prepared for Everpower Wind Holdings, Inc. Cultural Resource Analysts, Inc., Hurricane, West Virginia.

Cultural Resource Analysts, Inc. (CRA). 2011b. Architectural Survey for the Proposed Buckeye Wind Farm in Champaign County, Ohio. Prepared for Everpower Wind Holdings, Inc. Cultural Resource Analysts, Inc., Lexington, Kentucky.

Derby, C., A. Dahl, W. Erickson, K. Bay, and J. Hoban. 2007. Post-Construction Monitoring Report for Avian and Bat Mortality at the NPPD Ainsworth Wind Farm. Prepared for Nebraska Public Power District, Columbus, Nebraska. Western EcoSystems Technology, Inc., Cheyenne, Wyoming.

Dobesch, H., and G. Kury. 2001. Basic Meteorological Concepts and Recommendations for the Exploitation of Wind Energy in the Atmospheric Boundary Layer. Central Institute for Meteorology and Geodynamics, Vienna, Austria.

Drake, D., J. Garvin, S. Grodsky, and M. Watt. 2010. Post-construction bird and bat monitoring at the Forward Energy Center. Prepared for Forward Energy, LCC., Chicago, Illinois.

Ducks Unlimited. 2009. Updating the National Wetlands Inventory (NWI) for Ohio Final Report Submitted to: Ohio Department of Natural Resources. Great Lakes/Atlantic Regional Office, Ann Arbor, Michigan. http://www.ducks.org/Conservation/GLARO/3822/GISNWIData.html#oh. Accessed 1 June 2010.

EAPC Architects Engineers (EAPC). 2009. Final report: Buckeye Wind shadow flicker study, Champaign County, Ohio. EAPC Architects Engineers, Grand Forks, North Dakota.

Ellenbogen, J.M., S. Grace, W.J. Heiger-Bernays, J.F. Manwell, D.A. Mills, K.A. Sullivan, , M.G. Weisskopf, and S.L. Santos. 2012. Wind Turbine Health Impact Study: Report of Independent Expert Panel. Prepared for: Massachusetts Department of Environmental Protection and Massachusetts Department of Public Health.

Energy Information Administration (EIA). 2009. Emissions of Greenhouses in the United States 2008. U.S. Department of Energy, Office of Integrated Analysis and Forecasting. DOE/EIA-0573 (2008). December 2009.

Energy Information Administration (EIA). 2010. Electric Power Annual 2008. U.S. Department of Energy, Office of Coal, Nuclear, Electric, and Alternate Fuels, Washington, DC. Report No. DOE/EIA-0348 (2008). January. http://www.eia.doe.gov/cneaf/electricity/epa/epa_sum.html. Accessed 3 March 2010.

Energy Information Administration (EIA). 2011. Annual Energy Outlook 2011 with Projections to 2035. http://205.254.135.7/forecasts/aeo/pdf/0383(2011).pdf. Accessed 22 June 2012.

Energy Information Administration (EIA). 2012. Annual Energy Outlook 2012 with Projections to 2035. http://205.254.135.7/forecasts/aeo/er/. Accessed 22 June 2012.

Energy Technology Support Unit (ETSU). 1997. Low Frequency Noise and Vibration Measurement at a Modern Wind Farm. ETSU W/13/00392/REP. Department of Trade and Industry, 1997.

Environmental Design and Research (EDR). 2009a. Application to the Ohio Power Siting Board for a Certificate of Environmental Compatibility & Public Need for the Buckeye Wind Project. Buckeye Wind, LLC., Syracuse, New York.

Environmental Design & Research (EDR). 2009b. Visual Impact Assessment, Buckeye Wind Project, Champaign County, Ohio. Prepared for Everpower Wind Holdings, Inc., New York, NY. Prepared by Environmental Design and Research, Syracuse, NY.

Environmental Laboratory. 1987. Corps of Engineers Wetland Delineation Manual. Technical Report Y-87-1. U.S. Army Corps of Engineers: Waterways Experiment Station, Vicksburg, Mississippi.

Erickson, W. P., G. D. Johnson, M. D. Strickland, D. P. Young, Jr., K. J. Sernka, and R. E. Good. 2001. Avian collisions with wind turbines: A summary of existing studies and comparisons to other sources of avian collision mortality in the United States. National Wind Coordinating Committee, Washington, DC and Western EcoSystems Technologies, Inc., Cheyenne, Wyoming.

Erickson, W.P., 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. Prepared for Bonneville Power Administration. Western EcoSystems Technologies, Inc., Cheyenne, Wyoming.

Erickson, W. P., J. Jeffrey, K. Kronner, and K. Bay. 2003. Stateline Wind Project: Wildlife monitoring annual report, results for the period July 2001 – December 2002. Technical report submitted to FPL Energy, Oregon Office of Energy, and Stateline Technical Advisory Committee. WEST, Inc., Cheyenne, Wyoming.

Erickson, W. P., G. D. Johnson, and D. P. Young. 2005. A summary and comparison of bird mortality from anthropogenic causes with an emphasis on collisions. USDA Forest Service, General Technical Report PSW-GTR-191.

Everpower. N.D. Buckeye Wind Project Fact Sheet. UNU Exhibit 17.

Farm Service Agency (FSA). 2009. Wind-Powered Generation Devices on CRP Acres. Ohio Notice CRP-09-07; Ohio Notice EQ-9.

Farm Service Agency (FSA). 2012. Average CRP Rental Payments by County. http://www.fsa.usda.gov/Internet/FSA_File/enrolrentalcounty11.xls. Accessed 13 April 2012.

Federal Aviation Administration (FAA). 2009. Determination of No Hazard to Air Navigation. November 8, 2009.

Federal Communications Commission (FCC). 2010. Digital TV Transition: DTV Transition Statistics. http://www.dtv.gov/dtv_stats.htm. Accessed 11 August 2010.

Federal Communications Commission (FCC). 2012. Final Programmatic Environmental Assessment for the Antenna Structure Program. FCC, Washington D.C. http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-312921A1.pdf. Accessed 22 June 2012.

Federal Emergency Management Administration (FEMA). 2007. Digital flood insurance rate map database, Champaign County, OH, metadata. FEMA, Washington, D.C. http://www.fema.gov/msc. Accessed 10 August 2010.

Fiedel, Stuart J. 1987. Prehistory of the Americas. Cambridge University Press, Cambridge, Massachusetts.

Fiedler, J. K. 2004. Assessment of bat mortality and activity at Buffalo Mountain Windfarm, eastern Tennessee. Thesis, University of Tennessee, Knoxville, USA.

Fiedler, J. K., T. H. Henry, R. D. Tankersley, and C. P. Nicholson. 2007. Results of bat and bird monitoring at the expanded Buffalo Mountain Windfarm, 2005. Tennessee Valley Authority. http://www.tva.gov/environment/bmw_report/results.pdf. Accessed 12 April 2010.

Fowler, Melvin L. 1959. Summary Report of Modoc Rock Shelter 1952, 1953, 1955, 1956. Report of Investigations, No. 8, Illinois State Museum, Springfield, Illinois.

Funk, Robert E. 1978. Post-Pleistocene Adaptations. In Handbook of North American Indians, Northeast, Vol. 15, Bruce G. Trigger, editor. Smithsonian Institution, Washington, D.C.

Funk, Robert E. 1982. The Northeastern United States. In Ancient North Americans, Jesse D. Jennings, editor. W. H. Freeman and Company, San Francisco, California.

Gardner, J. E., J. D. Garner, and J. E. Hofmann. 1991. Summary of *Myotis sodalis* summer habitat studies in Illinois: with recommendations for impact assessment. Indiana/Gray bat Recovery Team Meeting, Columbia, USA.

Garner, J. D. and J. E. Gardner. 1992. Determination of summer distribution and habitat utilization of the Indiana bat (*Myotis sodalis)* in Illinois. Project E-3, Illinois Department of Conservation, Springfield, Illinois.

Gehring, J., Kerlinger, P., and A.M. Manville. 2009. Communication towers, lights, and birds: successful methods of reducing the frequency of avian collisions. Ecological Applications. 19: 505-514.

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. Western EcoSystems Technology, Inc., Cheyenne, Wyoming.

Good, R. E., A. Merrill, S. Simon, K. L. Murray, and K. Bay. 2012. Bat Monitoring Studies at the Fowler Ridge Wind Farm, Benton County, Indiana. Final Report: April 1 – October 31, 2011. Prepared for Fowler Ridge Wind Farm, Fowler, Indiana. Prepared by Western EcoSystems Technology, Inc. Bloomington, Indiana.

Griffin, James B. 1978. Late Prehistory of the Ohio Valley. In Handbook of North American Indians, Northeast, Vol. 15, Bruce G. Trigger, editor. Smithsonian Institution, Washington, D.C.

Griffin, James B. 1983. The Midlands. In Ancient North Americans, Jesse D. Jennings, editor. W. H. Freeman and Company, San Francisco, California.

Grodsky, S.M., and D. Drake. 2011. Assessing Bird and Bat Mortality at the Forward Energy Center. The University of Wisconsin Madison, Madison, Wisconsin. http://www.wiwindinfo.net/impacts/psc-eis/BirdBatFinalForwardWind-Aug2011.pdf. Accessed 22 June 2012.

Groothuis, Peter A., Jana D. Groothuis, and John C. Whitehead. 2007. Green vs. Green: Measuring the Compensation Required to Site Electrical Generation Windmills in a Viewshed. http://www.realtor.org/library/library/fg509. Accessed 2008.

Gruver, J.C., M. Sonnenberg, K. Bay, and W.P. Erickson. 2009. Results of a post-construction bat and bird fatality study at Blue Sky Green Field Wind Energy Center, Fond du Lac County, Wisconsin, July 2008 May 2009. Final Report for WE Energies, Milwaukee, WI. Western Ecosystems Technology, Inc., Cheyenne, Wyoming.

Hansen, L., and Korsgaard, J. 2005. Improved Lightning Protection System Enhances the Reliability of Multi-MW Blades. LM Glassfiber.

Hessler Associates, Inc. 2009. Environmental Sound Survey and Noise Impact Assessment, Buckeye Wind Project, Champaign County, Ohio. Prepared for Everpower Wind Holdings, Inc. Report No. 1819-041708-C. Hessler Associates, Inc., Haymarket, Virginia.

Hessler, D. Licensed Professional Engineer, Hessler Associates, Inc. Undated. Testimony during hearings before the OPSB.

Homer, C., C. Huang, L. Yang, B. Wylie and M. Coan. 2004. Development of a 2001 National Landcover Database for the United States. Photogrammetric Engineering and Remote Sensing 70:829-840.

Horn, J. W., E. B. Arnett, and T. H. Kunz. 2008. Behavioral responses of bats to operating wind turbines. Journal of Wildlife Management 72:123-132

Howe, R. W., W. Evans, and A. T. Wolf. 2002. Effects of wind turbines on birds and bats in northeastern Wisconsin. Wisconsin Public Service Corporation, Green Bay, Wisconsin.

Hull & Associates, Inc. (Hull). 2009a. Geotechnical desktop document review summary report for the Buckeye Wind Project located in Champaign County, Ohio. Buckeye Wind, LLC., Toledo, Ohio.

Hull & Associates, Inc. (Hull). 2009b. Groundwater hydrogeology desktop review summary report for the Buckeye Wind Power Project Located in Champaign County, Ohio. Prepared for Buckeye Wind, LLC. Hull & Associates, Toledo, Ohio.

Hull & Associates, Inc. (Hull). 2009c. Phase I Route Evaluation Study. Prepared for Everpower Wind Holdings, Inc. Hull & Associates, Toledo, Ohio.

Hull & Associates, Inc. (Hull). 2009d. Surface Waters, Ecological Communities, and Threatened and Endangered Species. Buckeye Wind, LLC., Toledo, Ohio.

Hull & Associates, Inc. (Hull). 2009e. Draft Surface Water Delineation Report for the: Buckeye Wind Power Facility, Champaign County, Ohio. Prepared for Buckeye Wind LLC. Hull & Associates, Toledo, Ohio.

Hull & Associates, Inc. (Hull). 2011. Surface Water Delineation Report for the: Buckeye Wind Power Facility, Champaign County, Ohio. Prepared for Buckeye Wind LLC. Hull & Associates, Toledo, Ohio. December 2011.

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

Hurt, R. Douglas. 1996. The Ohio Frontier: Crucible of the Old Northwest, 1720-1830. Indiana University Press, Bloomington, Indiana.

Illinois Department of Natural Resources (IDNR). 2007. The Possible Effects of Wind Energy on Illinois Bats and Birds. Report of the Illinois Department of Natural Resources to Governor Rod Blagojevich and the 95th Illinois General Assembly, June 2007.

Indianapolis Airport Authority. 2003. Habitat Conservation Plan Report for Monitoring Year 2002.

Intergovernmental Panel on Climate Change (IPCC). 2007. Climate Change 2007: The Physical Science Basis. S. Solomon, D. Qin, and M. Manning, editors. Contribution of Working Group to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Paris, France.

Jackson Environmental Consulting Services, LLC, 2009. Bat Species Inventory of Champaign County Wind Turbine Project. Champaign, County, Ohio.

Jacobsen, D. and C. High. 2008. Wind Energy and Air Emission Reduction Benefits: A Primer. U.S. Department of Energy, National Renewable Energy Laboratory, Office of Energy Efficiency and Renewable Energy. NREL/SR-500-42616.

Jain, A. A. 2005. Bird and bat behavior and mortality at a northern Iowa windfarm. Thesis, Iowa State University, Ames, Iowa.

Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2007. Annual report for the Maple Ridge Wind Power Project: Postconstruction bird and bat fatality study – 2006. Prepared for PPM Energy, Horizon Energy, and the Technical Advisory Committee for the Maple Ridge Wind Farm. Curry & Kerlinger, Cape May Point, New Jersey.

Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2008. Annual report for the Maple Ridge Wind Power Project: Postconstruction bird and bat fatality study – 2007. Prepared for PPM Energy, Horizon Energy, and the Technical Advisory Committee for the Maple Ridge Project Study. Curry & Kerlinger, Cape May Point, New Jersey.

Jain, A., P. Kerlinger, R. Curry, and L. Slobodnick. 2009a. Annual report for the Maple Ridge Wind Power Project: Postconstruction bird and bat fatality study - 2007. Prepared for PPM Energy, Horizon Energy and Technical Advisory Committee for the Maple Ridge Project Study. Curry & Kerlinger, Cape May Point, New Jersey.

Jain, A., P. Kerlinger, R. Curry, L. Slobodnick, and M. Lehman. 2009b. Annual report for the Maple Ridge Wind Power Project: Postconstruction bird and bat fatality study - 2008. Prepared for Iberdrola Renewables, Inc., Horizon Energy and Technical Advisory Committee for the Maple Ridge Project Study. Curry & Kerlinger, Cape May Point, New Jersey.

Jain, A., P. Kerlinger, R. Curry, L. Slobodnick, J. Quant, and D. Pursell. 2009c. Annual Report for the Noble Bliss Windpark, LLC, Postconstruction Bird and Bat Fatality Study - 2008. Prepared for Noble Environmental Power, LLC, Essex, Connecticut.

Jain, A., P. Kerlinger, R. Curry, L. Slobodnick, J. Histed, and J. Meacham. 2009d. Annual Report for the Noble Clinton Windpark, LLC, Post-construction Bird and Bat Fatality Study - 2008. Prepared for Noble Environmental Power, LLC, Essex, Connecticut.

Jakobsen J. 2005. Infrasound emission from wind turbines. J Low Freq Noise Vib Active Contr. 24(3):145-155. http://windland.ch/doku_wind/noise/Infrasound_Emission_Wind_Turbines.pdf. Accessed 22 May 2012.

Johns, R. 2010. Massive Bird Kill at West Virginia Wind Farm Highlights National Issue. American Bird Conservancy media release. http://www.abcbirds.org/newsandreports/releases/111028.html. Accessed 25 May 2012.

Johnson, G. D., W. P. Erickson, M. D. Strickland, R. E. Good, M. F. Shepherd, and D. A. Shepherd. 2000. Final report, avian monitoring studies at the Buffalo Ridge, Minnesota Wind Resource Area: Results of a 4-year study. Prepared for Northern States Power Company. Western EcoSystems Technology, Inc., Cheyenne, Wyoming.

Johnson, S. A., V. Brack, and R. K. Dunlap. 2002. Management of hibernacula in the State of Indiana. Pages 100-109 *in* A. Kurta and J. Kennedy, editors. The Indiana bat: biology and management of an endangered species. Bat Conservation International, Austin, Texas.

Johnson, G. D., and M. D. Strickland. 2003. Biological assessment for the federally endangered Indiana bat (*Myotis sodalis*) and Virginia big-eared bat (*Corynorhinus townsendii virginianus*). Prepared for NedPower Mount Storm LLC, Western Ecosystems Technology, Inc., Cheyenne, Wyoming.

Johnson, G. D., and M. D. Strickland. 2004. An assessment of potential collision mortality of migrating Indiana bats (*Myotis sodalis*) and Virginia big-eared bats (*Corynorhinus townsendii virginianus*) traversing between caves. Prepared for NedPower Mount Storm LLC, Western Ecosystems Technology, Inc., Cheyenne, Wyoming.

Johnson, G. D., W. P. Erickson, M. D. Strickland, M. F. Shepherd, D. A. Shepherd, and S. A. Sarappo. 2003. Mortality of bats at a large-scale wind power development at Buffalo Ridge, Minnesota. American Midland Naturalist 150:332-342.

Johnson, G. 2004. A review of bat impacts at wind farms in the United States. Proceedings of the wind energy and birds/bats workshop: understanding and resolving bird and bat impacts, May 18-19, 2004, Washington, D.C.

Kemper, C. 1996. A Study of Bird Mortality at a West Central Wisconsin TV Tower from 1957-1995. The Passenger Pigeon. 58(3):219-235.

Kerlinger, P. 2000. Avian mortality at communication towers: A review of recent literature, research, and methodology. Prepared for: United States Fish and Wildlife Service Office of Migratory Bird Management. Curry & Kerlinger, L.L.C., Cape May Point, New Jersey.

Kerlinger, P., and J. D. Dowdell. 2008. Effects of wind turbines on grassland/hayfield nesting songbirds at the Maple Ridge Wind Power Project, Lewis County, New York. Prepared for PPM and Horizon. Curry & Kerlinger, LLC, Cape May Point, New Jersey.

Kerlinger, P., and F.R. Moore. 1989. Atmospheric structure and avian migration. Current Ornithology 6:109-142.

Kerns, J., and P. Kerlinger. 2004. A study of bird and bat collision fatalities at the Mountaineer Wind Energy Center, Tucker County, West Virginia: Annual Report for 2003. Prepared for FPL Energy and the MWEC Technical Review Committee. Curry and Kerlinger, LLC, McLean, Virginia.

Klem, D. 1990. Collisions Between Birds and Windows: Mortality and Prevention. Journal of Field Ornithology. 61(1)120-128.

Klem, D. 1989. Bird-Window Collisions. Wilson Bulletin 101:606-620.

Knopper, LD and CA Ollson. 2011. Health effects and wind turbines: a review of the literature. Environmental Health. 10:78.

Koford, R., A. Jain, G. Zenner, and A. Hancock. 2004. Avian Mortality Associated with the Top of Iowa Wind Farm. Progress Report: Calendar Year 2003. Iowa State University, Ames, Iowa.

Koford, R., A. Jain, G. Zenner, and A. Hancock. 2005. Avian mortality associated with the Top of Iowa Wind Farm, Progress Report, Calendar Year 2004. Iowa Cooperative Fish & Wildlife Research Unit, Iowa State University, Ames, Iowa and the Iowa Department of Natural Resources, Clear Lake, Iowa.

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. 2007. Ecological impacts of wind energy development on bats: Questions, research needs, and hypothesis. Frontiers of Ecology and Environment 5:315-324.

Kurta, A. 2005. Roosting ecology and behavior of Indiana bats (*Myotis sodalis*) in summer. Pages 29-42 *in* K.C. Vories and A. Harrington, editors. Proceedings of the Indiana bat and coal mining: a technical interactive forum. Office of Surface Mining, U.S. Department of the Interior. http://www.mcrcc.osmre.gov/PDF/Forums/Bat%20Indiana/TOC.pdf. Accessed 17 October 2006.

Kurta, A. and S. W. Murray. 2002. Philopatry and migration of banded Indiana bats (*Myotis sodalis*) and effects of radio transmitters. Journal of Mammalogy 83:585-589.

Kurta, A., S. W. Murray, and D. H. Miller. 2002. Roost selection and movements across the summer landscape. Pages 118-129 *in* A. Kurta and J. Kennedy, editors. The Indiana bat: biology and management of an endangered species. Bat Conservation International, Austin, Texas.

Leddy, K. L., K. F. Higgins, and D. E. Naugle. 1999. Effects of wind turbines on upland nesting birds in Conservation Reserve Program grasslands. Wilson Bulletin 111:100-104.

Leslie, P.H. 1945. On the use of matrices in certain population mathematics. Biometrica 33: 183-212.

Leventhall, G, Benton, S, and D Rebertson. 2008. Coping strategies for low frequency noise. Journal of Low Frequency Noise, Vibration, and Active Control 27:35-52.

Liguori, J. 2005. Hawks from Every Angle: How to Identify Raptors in Flight. Princeton University Press, Princeton, New Jersey.

Logan County Soil & Water Conservation District and Logan County Commissioners 2007. Logan County Comprehensive Plan.

Logan-Union-Champaign Regional Planning Commission (LUCRPC). 2006. LUC Regional Planning Commission. http://www.lucplanning.com/History%20of%20LUC.htm. Accessed 28 July 2010.

Longcore et al. 2012. An Estimate of Avian Mortality At Communication Towers in the United States and Canada. PLoS ONE 7(4):e34025. Doi:10.1371/journal.pone.0034025.

Madison County Commissioners. 2005. Madison County, Ohio Comprehensive Plan. http://www.co.madison.oh.us/Final%20Co%20Comp%202005.pdf. Accessed 2 August 2010.

Mangi Environmental Group. 2000. Draft Environmental Impact Statement, Jackson County Lake Project. USDA Rural Utilities Service. http://www.usda.gov/rus/water/ees/deis-jcfiles.htm. Accessed 6 August 2010.

Manville, A.M. 2005. Bird Strikes and electrocution at power lines, communication towers, and wind turbines: state of the art and state of the science-next steps toward mitigation. Pages 1051–1064 in Bird conservation implementation in the Americas: Proceedings of the Third International Partners in Flight Conference 2002. General Technical Report PSW-GTR-191. USDA Forest Service, Pacific Southwest Research Station, Albany, California.

McKinney, M. L. 1997. Extinction vulnerability and selectivity; combining ecological and paleontological views. Annual Review Ecological Systems 28:495-516.

Miami Valley Regional Planning Commission (MVRPC). 2005. Sole Source Aquifer Designation. http://www.mvrpc.org/atlas/pdf/resources/wqSSA.pdf. Accessed 6 March 2008.

Miami Valley Trails. 2010. Simon Kenton Trail. http://www.miamivalleytrails.org/simon.htm#Route. Accessed 10 August 2010.

Miller, A. 2008. Patterns of avian and bat mortality at a utility-scaled wind farm on the southern high plains. Thesis, Texas Tech University, Lubbock, Texas.

Morgan, C., and E. Bossanyi. 1996. Wind Turbine Icing and Public Safety – A Quantifiable Risk? Wind Energy Production in Cold Climates, Bengt, Tammelin, Kristiina, Santti.

Morgan, C., E. Bossanyi and H. Seifert. 1998. Assessment of Safety Risks Arising from Wind Turbine Icing. BOREAS IV. March 31 – April 2, 1998. Hetta, Finland.

Mumma, T.L. and W. Capouillez. 2011. Pennsylvania Game Commission Wind Energy Voluntary Cooperation Agreement. Second Summary Report 4 March 2011. Bureau of Wildlife Habitat Management, Pennsylvania Game Commission.

Murray, S. W. and A. Kurta. 2004. Nocturnal activity of the endangered Indiana bat (*Myotis sodalis)*. Journal of Zoology 262:197-206.

National Research Council (NRC) of the National Academies. 2007. Environmental Impacts of Wind Energy Projects. Committee on Environmental Impacts of Wind Energy Projects, Board on Environmental Studies and Toxicology. Division of Earth and Life Sciences. The National Academies Press, Washington, DC.

National Renewable Energy Laboratory (NREL). 2009. Generation Interconnection Policies and Wind Power: A Discussion of Issues, Problems, and Potential Solutions. http://www.nrel.gov/docs/fy09osti/44508.pdf. Accessed 22 June 2012.

National Telecommunications and Information Administration (NTIA). 2008. Re: Buckeye Wind Energy Project, in Logan and Champaign Counties, Ohio. July 24, 2008.

National Weather Service (NWS). 2010. Medical Aspects of Lightning. http://www.lightningsafety.noaa.gov/medical.htm. Accessed 30 August 2010.

National Wind Coordinating Collaborative (NWCC). 2005. Technical Considerations in Siting Wind Developments: Research Meeting. Conference held in Washington, D.C. December 1-2, 2005.

NatureServe. 2007. NatureServe Explorer: an Online Encyclopedia of Life. http://www.natureserve.org/explorer.

New Jersey Audubon Society. 2009. Post-construction wildlife monitoring at the Atlantic City Utilities Authority - Jersey Atlantic Wind Power Facility. Report submitted to New Jersey Board of Public Utilities, Newark, New Jersey.

New York State Department of Environmental Conservation (NYSDEC). 2001. Program Policy: Assessing and Mitigating Noise Impacts. DEP-00-1. Division of Environmental Permits, Albany, New York. Issued October 6, 2000; revised February 2, 2001.

Obama for America. 2008. Barack Obama and Joe Biden: New Energy for America. http://www.barackobama.com/pdf/factsheet_energy_speech_080308.pdf. Accessed 15 May 2010.

Ohio Breeding Bird Atlas (OBBA). 2010. http://www.ohiobirds.org/obba2/coverage.php. Accessed 23 September 2010.

Ohio Breeding Bird Atlas II. 2009. Ohio Breeding Bird Atlas II. Ohio State University and Ohio Department of Natural Resources, Columbus, Ohio. http://www.ohiobirds.org/obba2/. Accessed 16 January 2009.

Ohio Breeding Bird Atlas II. 2012. http://www.ohiobirds.org/obba2/index.php. Accessed 15 May 2012.

Ohio Caverns. 2010. http://www.ohiocaverns.com/. Accessed 9 August 2010.

Ohio Department of Development (ODD). ND. Office of Strategic Research

Ohio Department of Natural Resources (ODNR). 2005. Trails for Ohioans: A Plan for the Future. Columbus, Ohio.

Ohio Department of Natural Resources (ODNR). 2006. Catalogue of Ohio Earthquakes. http://www.dnr.state.oh.us/geosurvey/html/eqcatlog/tabid/8302/Default.aspx. Accessed 9 August 2010.

Ohio Department of Natural Resources (ODNR). 2008. Species A – Z Guide. http://www.ohiodnr.com/Home/species_a_to_z/speciesguide_default/tabid/6491/Default.aspx. Accessed 4 February 2008.

Ohio Department of Natural Resources (ODNR). 2009. On-Shore Bird and Bat Pre- and Post-Construction Monitoring Protocol for Commercial Wind Energy Facilities in Ohio.http://www.dnr.state.oh.us/LinkClick.aspx?fileticket=loJTSEwL2uE%3d&tabid=21467. Accessed 17 April 2012.

Ohio Department of Natural Resources (ODNR). 2010a. Alphabetical Listing of Wildlife Area Maps. http://www.dnr.state.oh.us/Home/wild_resourcessubhomepage/WildlifeAreaMapsLandingPage/tabid/19694/Default.aspx. Accessed 11 August 2010.

Ohio Department of Natural Resources (ODNR). 2010b. Cedar Bog. http://www.dnr.state.oh.us/location/dnap/cedar_bog/tabid/881/Default.aspx. Accessed 9 August 2010.

Ohio Department of Natural Resources (ODNR). 2010c. Division of Wildlife. http://ohiodnr.com/tabid/4414/Default.aspx. Accessed 11 August 2010.

Ohio Department of Natural Resources (ODNR). 2010d. Turkey Season Results, Spring 2009. http://www.dnr.state.oh.us/Portals/9/pdf/pub005.pdf. Accessed 4 August 2010.

Ohio Department of Natural Resources (ODNR). 2010e. Buck Creek State Park. http://www.dnr.state.oh.us/parks/buckck/tabid/716/Default.aspx. Accessed 9 August 2010.

Ohio Department of Natural Resources (ODNR). 2011a. Turkey Season Results, Spring 2011. http://www.dnr.state.oh.us/Portals/9/pdf/pub005.pdf. Accessed 22 February 2011.

Ohio Department of Natural Resources (ODNR). 2011b. Summary of 2010-11 Ohio Deer Seasons. http://www.dnr.state.oh.us/Portals/9/pdf/pub304.pdf. Accessed 22 February 2011.

Ohio Department of Natural Resources (ODNR). 2012. Division of Geological Survey Ohio Seismic Network. Virginia Earthquake, August 23, 2011 Earthquake Felt Throughout Ohio. http://www.dnr.state.oh.us/tabid/23550/Default.aspx. Accessed 23 August 2011.

Ohio Department of Transportation (ODOT). 2008. Traffic Count Information & Maps (AADT for 2007 and 2008). http://www.odotonline.org/techservapps/traffmonit/countinformation/default.htm. Accessed 27 July 2010.

Ohio Department of Transportation (ODOT). n.d. Traffic Survey Reports (readme file). http://www.odotonline.org/techservapps/traffmonit/countinformation/TSR_ReadMe_POP.htm. Accessed 27 July 2010.

Ohio Environmental Protection Agency (OEPA). 2001. Ohio Rapid Assessment Method for Wetlands v. 5.0. User Manual and Data Forms. February 1, 2001. Ohio EPA Wetland Ecology Unit Division of Surface Water.

Ohio Environmental Protection Agency (OEPA). 2003. Ohio EPA's primary headwater stream project: Key findings. Division of Surface Water. Columbus, Ohio. http://www.epa.ohio.gov/dsw/wqs/headwaters/index.aspx. Accessed 10 August 2010.

Ohio Power Siting Board (OPSB). 2008. OPSB Adopts Rules for Siting Wind Farms. http://www.opsb.ohio.gov/opsb/mediaroom/mediarelease.cfm?id=4294. Accessed 30 June 2010.

Ohio Supreme Court. 2012. *In re Application of Buckeye Wind, L.L.C.*, Slip Opinion No. 2012-Ohio-878. http://www.sconet.state.oh.us/rod/docs/pdf/0/2012/2012-ohio-878.pdf. Accessed 13 April 2012.

Osborn, R.G., C.D. Dieter, K.F. Higgins, and R.E. Usgaard. 1998. Bird flight characteristics near wind turbines in Minnesota. American Midland Naturalist 139:29-38.

Osborn, R. G., K.F. Higgins, R.E. Usgaard, C.D. Dieter, and R.D. Neiger. 2000. Bird mortality associated with wind turbines as the Buffalo Ridge Wind Resource Area, Minnesota. American Midland Naturalist 143:41-52.

Park. 2010. Piqua Shawnee Tribe's Sacred Burial Mound Not Threatened by Wind Farm. Press release issued by EverPower Wind Holdings. September 7, 2010.

Park, Gene. 2013. E-mail to Megan Seymour, USFWS, dated Feb. 8, 2013. Subject: Request for Final Comment Regarding Proposed Buckeye Wind Project Case No. 08-666-EL-BGN.

Pedersen, E, H Halmstad. 2003. Noise annoyance from wind turbines: a review. Swedish Environmental Protection Agency. ISBN 91-620-5308-6.pdf.

Pedersen, E, van den Berg, F, Bakker, R, and J Bouma. 2009. Response to noise from modern wind farms in The Netherlands. Journal of the Acoustical Society of America 126(2):634-643.

Pedersen, E. 2011. Health aspects associated with wind turbine noise – results from three field studies. Noise Control Engineering. 59(1):47-53.

Pianka, E.R. 1970. On r and K selection. American Naturalist 104:592-597.

Pierpont, N. 2009, pre-publication draft. Wind Turbine Syndrome: a report on a natural experiment. http://www.windturbinesyndrome.com/wpcontent/uploads/2009/03/ms-ready-for-posting-on-wtscom-3-7-09.pdf. Accessed 22 May 2012.

Piorkowski, M. D. 2006. Breeding bird habitat use and turbine collisions of birds and bats located at a wind farm in Oklahoma mixed-grass prairie. Master's Thesis, Oklahoma State University, Stillwater, Oklahoma.

Polisky. L. 2009. [Personal Communication, cited in Stantec 2010.] Electronic mail conversation with Sara Stebbins on March 5, 2009.

Prufer, Olaf H. and Raymond S. Baby. 1963. Indians of Ohio. Ohio Historical Society, Columbus, Ohio.

Prufer, Olaf H. and Dana A. Long. 1984. The Archaic of Northeastern Ohio. Kent State Research Papers in Archaeology, No. 6. Kent State University, Kent, Ohio.

Public Utilities Commission of Ohio (PUCO). 2008. Where Does Ohio's Electricity Come From? http://www.puco.ohio.gov/PUCO/Consumer/Information.cfm?id=7650. Accessed 14 January 2009.

Purvis, A., J. L. Gittleman, G. Cowlishaw, and G. M. Mace. 2000. Predicting extinction risk in declining species. Proceedings of the Royal Society of London Series B 267:1947-1952.

Racey, P. A. and S. M. Swift. 1985. Feeding ecology of *Pipistrellus pipistrellus* (*Chiroptera: Vespertilionidae*) during pregnancy and lactation. Journal of Animal Ecology 54:205-215.

RailAmerica. 2010. Indiana & Ohio Railway map. http://www.railamerica.com/RailServices/IORY.aspx. Accessed 30 August 2010.

Resource Systems Group, Inc (RSG). 2006. Noise Primer. White River Junction, Vermont.

Reuters. 2007. Corrected: First Death from U.S. Wind Tower Collapse Recorded. http://www.reuters.com/article/idUSN2720796920070828. Accessed 10 August 2010.

Reynolds, D. S. 2006. Monitoring the potential impact of a wind development site on bats in the northeast. Journal of Wildlife Management 70:1219–1227.

Rogers, A.L., J.F. Manwell, and S. Wright. 2006. Wind Turbine Acoustic Noise. Prepared by the Renewable Energy Research Laboratory, University of Massachusetts, Amherst, Massachusetts.

Russell, A. L., C. M. Butchkoski, L. Saidak, G. F. McCracken. 2008. Raod-killed bats, higheway design and the commuting ecology of bats. Endangered Species Research. doi: 10.3354/esr00121. http://amyrussell.net/docs/RussellEtAl2008ESR.pdf. Accessed 10 June 2010.

San Martin. 1989. Environmental Emissions from Energy Technology Systems: The Total Fuel Cycle. U.S. Department of Energy. Spring 1989.

Saratoga Associates. 2009. Buckeye Wind Project. EverPower Wind holdings, Inc. Buckeye Wind LLC. Buckeye Facility Socioeconomic Report.

Schmidt, J. J. 1985. Groundwater Resources of Champaign County. Ohio Department of Natural Resources, Division of Water, Columbus, Ohio.

Shane, Orrin C., III. 1967. The Mixter Site: An Early Woodland Village in Lorain County, Ohio. In Studies in Ohio Archaeology, edited by O.H. Prufer and D.H. McKenzie, The Press of Western Reserve University, Cleveland, Ohio.

Shire, G. G., K. Brown, and G. Winegrad. 2000. Communication towers: A deadly hazard to birds. American Bird Conservancy, Washington, D.C.

Smallwood, K.S., Thelander, C. 2008. Bird Mortality in the Altamont Pass Wind Resource Area, California. Journal of Wildlife Management 72(1): 215-223.

Smarden, R.C., et. al. (for USACOE). 1988. Visual Resources Assessment Procedure for U.S. Army Corps of Engineers. Instruction Report EL- 88-1. Department of the Army, U.S. Army Corps of Engineers. Washington, D.C. http://www.esf.edu/es/via/vrap.pdf. Accessed 3 August 2010.

Sondergaard, B. and D. Hoffmeyer. 2007. Low Frequency Noise from Wind Turbines. Proceedings from Wind Turbine Noise 2007. Lyon, France.

Sparks, D.W., J.O. Whitaker, Jr., and C.M. Ritzi. 2005. Foraging ecology of the endangered Indiana bat. Pages 15-27 *in* K.C. Vories and A. Harrington, editors. The Proceedings of the Indiana bat and coal mining: a technical interactive forum Office of Surface Mining, U.S. Department of the Interior, Alton, Illinois. http://www.mcrcc.osmre.gov/PDF/Forums/Bat%20Indiana/TOC.pdf. Accessed 17 October 2006.

Stamm, John M. 1999. Zoning. CDFS-1265-99. Land Use Series. Ohio State University Fact Sheet – Community Development. http://ohioline.osu.edu/cd-fact/1265.html. Accessed 28 July 2010.

Stantec Consulting. 2008. 2007 Spring, Summer, and Fall Post Construction Bird and Bat Mortality Study at the Mars Hill Wind Farm, Maine. Prepared for UPC Wind Management, LLC, Cumberland Maine. Stantec Consulting Inc., Topsham Maine.

Stantec Consulting. 2008a. Fall 2007. Bird and bat migration survey report: Visual, radar, and acoustic bat surveys for the Buckeye Wind Power Project in Champaign and Logan Counties, Ohio. Prepared for Everpower Renewables. Stantec Consulting Inc., Topsham, Maine.

Stantec Consulting. 2008b. Avian and bat studies work plan for the Buckeye Wind Project, Champaign and Logan Counties, Ohio. Prepared for Buckeye Wind Renewables. Stantec Consulting Inc., Topsham, Maine.

Stantec Consulting. 2009. Spring, summer, and fall 2008 bird and bat survey report for the Buckeye Wind Power Project in Champaign and Logan Counties, Ohio. Prepared for Everpower Wind Holdings, Inc. Stantec Consulting Inc., Topsham, Maine.

Stantec Consulting. 2009a. Post-construction Monitoring at the Mars Hill Wind Farm, Maine – Year 2. Unpublished report prepared for First Wind Management, LLC. Stantec Consulting Inc., Topsham Maine.

Stantec Consulting. 2009b. Stetson I Mountain Wind Project Year 1 Post-Construction Monitoring Report. Prepared for First Wind Management, LLC. Stantec Consulting Inc., Topsham. Maine.

Stantec Consulting. 2009c. Cohocton and Dutch Hill Wind Farms Year 1 Post-Construction Monitoring Report, 2009. Prepared for Canandaigua Power Partners, LLC and Canandaigua Power Partners II, LLC. Stantec Consulting Inc., Topsham, Maine.

Stantec Consulting. 2010a. Cohocton and Dutch Hill Wind Farms Year 1 Post-Construction Monitoring Report, 2009 for the Cohocton and Dutch Hill Wind Farms In Cohocton, New York. Prepared for Canandaigua Power Partners, LLC and Canandaigua Power Partners II, LLC. Stantec Consulting Inc., Topsham, Maine.

Stantec Consulting. 2010b. Draft Environmental Impact Statement for the Buckeye Wind Power Project, Habitat Conservation Plan, Champaign County, Ohio. Prepared for U.S. Fish and Wildlife Service. Stantec Consulting Inc., Topsham, Maine.

Stewart, G.B., Pullin, A.S., & Coles, C.F. 2005. Effects of wind turbines on bird abundance. Systematic Review No. 4. Collaboration for Environmental Evidence. Edgbaston, United Kingdom.

Swengel, A.B., and Swengel, S.R. 1998. Highlight Box-Tall Grass Prairie Butterflies and Birds. Status and Trends of the Nation's Biological Resources. 2:446-447.

Szewczak, Joseph M. and Ed Arnett. 2006. Ultrasound emissions from wind turbines as a potential attractant to bats: a preliminary investigation. Submitted to the Bats and Wind Energy Cooperative. Bat Conservation International, Austin, Texas, USA.

Thelander, C.G., K.S. Smallwood, & L. Rugge. 2003. Bird Risk Behaviors and Fatalities at the Altamont Pass Wind Resource Area. Prepared for the National Renewable Energy Laboratory.

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 93:1086-1098.

Tidhar, D. 2009. Post-construction wildlife monitoring study; study plan and spring 2009 interim report. Lempster Wind Project, Sullivan County, New Hampshire. Prepared for Lempster Wind LLC Lempster Wind Technical Advisory Committee, Iberdrola Renewables. Western EcoSystems Technology, Inc. Waterbury, Vermont.

Tonetti, Alan and Douglas Terpstra. 2009. Cultural Resources Literature Review, and Archaeological Visual Impact Assessment for the Buckeye Wind Facility Project in Champaign County, Ohio. ASC Group, Inc., Columbus, Ohio.

Trapp, J. L. 1998. Bird kills at towers and other human-made structures: An annotated partial bibliography (1960-1998). U.S. Fish and Wildlife Service, Office of Migratory Bird Management, Arlington, Virginia.

Tuck, James A. 1977. A Look at Laurentian. In Current Perspectives in Northeastern Archaeology, Robert E. Funk and Charles F. Hayes, editors. Researches and Transactions of the New York State Archaeological Association 17(1): 31-40.

Turner, G.G., D.M. Reeder, and J.T.H. Coleman. 2011. A Five-year Assessment of Mortality and Geographic Spread of White-nose Syndrome in North American Bats and a Look to the Future. Bat Research News 52(2):13-27.

Union County. 1999. Union County Comprehensive Plan. http://www.lucplanning.com/CompPlan/Union%20County%201999%20Comprehensive%20Plan.pdf. Accessed 30 July 2010.

United States Bureau of Economic Analysis (USBEA). 1997. Regional Multipliers: A User Handbook for the Regional Input-Output Modeling System (RIMS II).

United States Census Bureau (USCB). 2000. DP-1. Profile of General Demographic Characteristics: 2000. Data Set: Census 2000 Summary File 1 (SF 1) 100-Percent Data. Geographic Areas: Goshen Township, Rush Township, Salem Township, Urbana Township, and Wayne Township; Champaign County, Clark County, Logan County, Madison County, and Union County; Concord Township, Mad River Township, City of Urbana, Village of Mechanicsburg, Village of Mutual, Village of North Lewisburg, Village of Woodstock, CDP of Northridge, Moorefield Township, Pleasant Township, Village of Catawba, Monroe Township, Zane Township, Pike Township, Somerford Township, Allen Township, and Union Township (Union County); and Ohio. http://factfinder.census.gov. Accessed 4 August 2010.

United States Census Bureau (USCB). 2001. Geographic Changes for Census 2000 + Glossary. http://www.census.gov/geo/www/tiger/glossary.html. Accessed 2 August 2010.

United States Census Bureau (USCB). 2008. County Business Patterns. http://censtats.census.gov/cgi-bin/cbpnaic/cbpsect.pl. Accessed 2 August 2010.

United States Census Bureau (USCB). 2010. American Community Survey. http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk. Accessed 2 August 2010.

United States Census Bureau (USCB). 2010. American Community Survey. Poverty Statushttp://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_10_1YR_S1701&prodType=table. Accessed 2 August 2010.

United States Census Bureau (USCB). 2010. Decennial Census. Retrieved June 5, 2012 from http://factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml. Accessed 2 August 2010.

United States Department of Agriculture (USDA) Forest Service (FS). 1995. Landscape Aesthetics: A Handbook for Scenery Management. http://www.esf.edu/es/via/. Accessed 6 August 2010.

United States Department of Agriculture (USDA), Soil Conservation Service. 1971. Soil survey of Champaign County, Ohio. Ohio Department of Natural Resources, Division of Lands and Soil and Ohio Agricultural Research and Development Center. Washington, D.C.

United States Department of Agriculture (USDA). 2009. Summary Report: 2007 National Resources Inventory. Natural Resources Conservation Service, Washington, D.C., and Center for Survey Statistics and Methodology, Iowa State University, Ames, IA. 123 pp.

United States Department of Energy (USDOE). 2008. 20% Wind by 2030: Increasing Wind Energy Development on BLM-Administered Lands in Western United States. Bureau of Land Management.

United States Department of the Interior, BLM. 1980. Visual Resource Management Program. U.S. Government Printing Office. 1980. 0-302-993. Washington, D.C. http://www.blm.gov/nstc/VRM/vrmsys.html. Accessed 6 August 2010.

United States Department of Transportation (USDOT). 1997. Final “Department of Transportation Order to Address Environmental Justice in Minority Populations and Low-Income Populations,”[subsequent to draft in Federal Register, Vol. 60, No. 125, June 29,1995, pp.33899-33903.] signed by Secretary Pena on February 3, 1997; published in Federal Register, Vol. 62, No. 72, pp. 18377-18381. Officially formatted into DOT Order 5610.2. April 15, 1997.

United States Environmental Protection Agency (USEPA). 2000. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-1998, 236-R-00-01, Washington, D.C., USA. http://www.epa.gov/globalwarming. Accessed 14 March 2010.

United States Environmental Protection Agency (USEPA). 2009. Climate Change: Science, State of Knowledge. http://www.epa.gov/climatechange/science/stateofknowledge.html. Accessed 14 January 2010.

United States Environmental Protection Agency (USEPA). 2012. AirData website. http://www.epa.gov/airdata/ad_rep_mon.html. Accessed 24 February 2012.

United States Environmental Protection Agency (USEPA). 2012. United States Environmental Protection Agency (US EPA) eGRID2012 version 1 data base. Emission factors in units of lbs/MWh for CO2e, NOx and SO2 for the RFC West sub-region. http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html. Accessed 30 May 2012.

United States Environmental Protection Agency (USEPA). 2012. http://www.epa.gov/climatechange/ghgemissions/global.html. Accessed on 6 May 2012.

United States Fish and Wildlife Service (USFWS). 1983. Recovery Plan for the Indiana Bat. Washington, D.C.

United States Fish and Wildlife Service (USFWS). 1999. Agency Draft Indiana Bat (Myotis sodalis) Revised Recovery Plan. Fort Snelling, Minnesota.

United States Fish and Wildlife Service (USFWS). 2003. Interim Guidance on Avoiding and Minimizing Wildlife Impacts from Wind Turbines. Retrieved April 17, 2012, from http://www.fws.gov/midwest/wind/guidance/Serviceinterimguide.pdf. Accessed 17 April 2012.

United States Fish and Wildlife Service (USFWS). 2007. Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision. Fort Snelling, Minnesota
.

United States Fish and Wildlife Service (USFWS). 2009. Indiana Bat (*Myotis sodalis*) 5-Year Review: Summary and Evaluation. http://www.fws.gov/midwest/endangered/recovery/5yr_rev/pdf/INBA5Yr30Sept2009.pdf. Accessed 28 September 2010.

United States Fish and Wildlife Service (USFWS). 2010. Draft Considerations for Avian and Bat Protection Plans, USFWS Draft White Paper, July, 2010.

United States Fish and Wildlife Service (USFWS). 2011a. Eagle Conservation Plan Guidance Questions and Answers. http://www.fws.gov/windenergy/docs/Eagle_Conservation_Plan_Guidance_Q_and_A FINAL.pdf. Accessed 13 April 2012.

United States Fish and Wildlife Service (USFWS). 2011b. Indiana Bat Fatality at Pennsylvania Wind Facility. Pennsylvania Field Office News. http://www.fws.gov/northeast/pafo/. Accessed 4 April 2012.

United States Fish and Wildlife Service (USFWS). 2011c. County Distribution of Federally-Listed Threatened, Endangered, Proposed, and Candidate Species: Ohio. http://www.fws.gov/midwest/endangered/lists/ohio-cty.html. Accessed April 17 2012.

United States Fish and Wildlife Service (USFWS). 2011d. Federally Listed Species by Ohio Counties. http://www.fws.gov/midwest/ohio/documents/endangered_2011_county_list.pdf. Accessed 12 April 2012.

United States Fish and Wildlife Service (USFWS). 2011e. Indiana bat Section 7 and Section 10 Guidance for Wind Energy Projects, Revised 26 October 2011. Available at: http://www.fws.gov/midwest/endangered/mammals/inba/WindEnergyGuidance.html.

United States Fish and Wildlife Service (USFWS). 2012a. Rangewide Estimate for the Indiana Bat (*Myotis sodalis*). http://www.fws.gov/midwest/Endangered/mammals/inba/pdf/2011inbaPopEstimate04Jan12.pdf. Accessed 4 April 2012.

United States Fish and Wildlife Service (USFWS). 2012b. Information on White-Nose Syndrome in Bats (April 2012). http://www.fws.gov/whitenosesyndrome/pdf/White-nose_info_packet4.pdf. Accessed 13 April 2012.

United States Fish and Wildlife Service (USFWS). 2012c. U.S. Fish and Wildlife Service Land-Based Wind Energy Guidelines. http://www.fws.gov/windenergy/docs/WEG_final.pdf. Accessed 13 April 2012.

United States Fish and Wildlife Service (USFWS) Wind Federal Advisory Committee (FAC). 2012. Guidance regarding use of the Wind Turbine Guidelines Advisory Committee's recommendations. http://www.fws.gov/habitatconservation/windpower/wind_turbine_advisory_committee.html. Accessed 13 April 2012.

United States Fish and Wildlife Service (USFWS), Interstate Mining Compact Commission, and United Stated Department of Interior Office of Surface Mining. 2009. Range-wide Indiana Bat Protection and Enhancement Plan Guidelines. http://www.osmre.gov/guidance/docs/INBATPEPGuidelines.pdf. Accessed 16 April 2012.

United States Geological Survey (USGS). 1997. Great and Little Miami River Basins. National Water-Quality Assessment Program Fact Sheet FS-117-97. U.S. Geological Survey, Water Resources Division, Avenue, Columbus, Ohio. August 1997. http://oh.water.usgs.gov/miam/Background.html. Accessed 10 August 2010.

United States Geological Survey (USGS). 2001. National Land Cover Data. http://landcover.usgs.gov/landcoverdata.php#regional. Accessed 23 September 2010.

United States Geological Survey (USGS). 2006. Migration of Birds: Routes of migration. http://www.npwrc.usgs.gov/resource/birds/migratio/routes.htm. Accessed 23 September 2010.

United States Geological Survey (USGS) Patuxent Wildlife Research Center. 2007. North American Breeding Bird Survey Internet data set. http://www.mbr-pwrc.usgs.gov/cgi-bin/rtena07a.pl?34. Accessed 23 September 2010.

United States Geological Survey (USGS). 2010. The Ohio GAP Analysis Project – Amphibian Hexagon-of-occurrence Range Maps. http://oh.water.usgs.gov/ohgap/amphibans.htm. Accessed 28 September 2010.

University of California, Berkley. 2005. Analysis of Potential Safety Risks of the Ecogen Prattsburgh-Italy Wind Farm Project. Renewable and Appropriate Energy Laboratory, Berkeley, California.

Urbana Country Club (UCC). 2010. http://www.urbanacc.com/home.htm. Accessed 9 August 2010.

Vlietstra, L. 2008. Common and Roseate Tern Exposure to the Massachusetts Maritime Academy Wind Turbine: 2006 and 2007. Marine Safety and Environmental Protection. Massachusetts Maritime Academy.

Wallace, Anthony F.C. 1969. The Death and Rebirth of the Seneca. Vintage Books, New York, New York.

West Inc. 2010. Avian Studies for the Champaign Wind Farm, Final Report September 4, 2008 – January 28, 2010. West, Inc., Bloomington, Indiana, USA.

West Inc. and Northwest Wildlife Consultants, Inc. (Northwest). 2004. Stateline Wind Project wildlife monitoring: Final report, July 2001–December 2003. Prepared for FPL Energy, Stateline Technical Advisory Committee, and Oregon Department of Energy. Western EcoSystems Technology, Inc., Cheyenne, Wyoming and Walla Walla, Washington, and Northwest Wildlife Consultants, Inc., Pendleton, Oregon.

Whitaker, J. O., Jr. and V. Brack, Jr. 2002. Distribution and summer ecology in Indiana. Pages 48-54 *in* A. Kurta and J. Kennedy, editors. The Indiana bat: biology and management of an endangered species. Bat Conservation International, Austin, Texas.

Whitaker, J. and W. Hamilton. 1998. Mammals of the Eastern United States. Cornell University Press, Ithaca, New York.

Winhold, L. and A. Kurta. 2006. Aspects of Migration by the Endangered Indiana Bat, *Myotis sodalis*. Bat Research News 47:1-11.

Woodland Gold Club. 2010. http://golfwoodland.com/. Accessed 9 August 2010.

Young, D. P., W. P. Erickson, K. Bay, S. Normani, W. Tidhar. 2009. Mount Storm Wind Energy Facility, Phase 1: Post-construction avian and bat monitoring. Prepared for NedPower Mount Storm, LLC. Western EcoSystems Technologies, Inc. Cheyenne, Wyoming.

Young, D.P. Jr., S. Nomani, W.L. Tidhar, and K. Bay. 2011. Ned Power Mount Storm Wind Energy Facility Post-Construction Avian and Bat Monitoring. July-Oct. 2010. 52 pp.

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Chapter 8

List of Preparers

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8 List of Preparers

Name and Affiliation	EIS Responsibility and Qualifications
United States Fish and Wildlife Service	
Megan Seymour	Wildlife Biologist, EIS Project Manager B.S. Wildlife Management Thirteen years of experience in Endangered Species Act implementation, consultation, and recovery
Melanie Cota	Wildlife Biologist, EIS Support B.S. Ecology and Field Biology, Wildlife Emphasis Four years of experience in Endangered Species Act implementation, consultation, and recovery; eight years of experience working with Federal and State- listed species.
Keith Lott	Wildlife and Fisheries Biologist M.S. Applied Ecology and Conservation Biology Five years of experience in wind energy and wildlife impacts for State and Federal agencies.
Mary Knapp	Field Office Supervisor, Project Oversight Ph.D. Human Dimensions of Watershed Management Twenty-seven years of experience working with natural resources issues.
Jeff Gosse	Regional Wind Power Lead, NEPA expertise Ph.D. Wildlife Science (Fishery Biology) Five years of experience as the Regional Environmental Coordinator (internal NEPA review); seven years of experience as the Regional Energy Coordinator.
Rick Amidon	Regional HCP Lead B.S. Wildlife and Fisheries Management Twelve years of experience in HCPs, Safe Harbor Agreements, and Candidate Conservation Agreements under ESA.
TJ Miller	Chief, Endangered Species M.S. Fish and Wildlife Biology Seventeen years Administering the Endangered Species Program: Experience in Listing, Critical Habitat Designation, Consultation, Recovery Planning, Recovery Implementation, 5-year reviews, HCPs, Safe Harbor Agreements, and Candidate Conservation Agreements.
U.S. Army Corps of Engineers	
Susan Fields	Regulatory Project Manager, Energy Resource Branch B.S. Chemistry Seventeen years of experience with U.S. Army Corps of Engineers, Huntington District, including 10 years within the Regulatory Division.

Name and Affiliation	EIS Responsibility and Qualifications
Environmental Resources Management (ERM) and ERM sub-contractors	
Steve Koster, P.E.	Project Director B.S. Letters and Engineering, B.S. Civil Engineering, M.S. Environmental Engineering Twenty-two years of experience in environmental impact assessment, permitting, and impact mitigation and remediation
Julia Tims, C.W.S.	Project Manager, Wildlife, Endangered Species B.S. Entomology and Applied Ecology, M.S. Natural Resources/Ornithology Twenty-one years of experience in terrestrial ecology with specialty in ornithology, impact assessment, threatened and endangered species management.
Dave Blaha, A.I.C.P.	Senior QA/QC B.A. Biology, Master of Environmental Management Twenty-six years of experience with NEPA, stakeholder engagement and agency consultation
Angela Gillingham	Deputy Project Manager, Scoping, Vegetation, Wildlife B.A. Cultural Anthropology, M.E.M. Conservation Science and Policy Four years of experience with threatened and endangered species surveys, environmental impact assessments, and environmental condition assessments.
Adeyinka Afon, P.E.	Noise and Air Quality B.S. Chemical Engineering, M.S.E. Environmental Process Engineering Seven years of consulting experience in environmental impact assessments, feasibility studies, and environmental permitting and compliance with specialization in air quality, air emissions inventory, noise, vibration, surface water quality, and sediment quality
Jason Willey	Water Resources, Vegetation and Wildlife B.S. Biology; M.S. Environmental Science and Policy Ten years of experience in environmental impact assessment, permitting, and compliance specializing in aquatic biology and fisheries.
Benjamin Sussman, A.I.C.P.	Visual Resources, Transportation, Communications, Health and Safety B.S. Science, Technology, and Society; M.S. City and Regional Planning. Twelve years of experience in urban planning, transportation planning, and environmental impact assessment.
Jacquie Payette, RPA	Cultural Resources B.A. English, M.A. English, M.A. Anthropology Thirteen years of experience in analysis and interpretation of federal regulations, including tribal consultation, consultation with state and federal agencies for Section 106 and NEPA compliance
Denny Matheou	Geology and Soils B.S. Civil and Environmental Engineering Four years of experience in subsurface investigations and brownfield site remediation.

Name and Affiliation	EIS Responsibility and Qualifications
Anna Ruszaj	Land Use and Recreation B.S. Biology, M.S Conservation Biology Four years of experience in natural resources management on public and private lands and environmental impact assessments.
Dr. Leslie Kirchler, A.I.C.P., RPA	Land Use and Recreation, Socioeconomics, Cultural Resources B.S. City and Regional Planning; B.A. Archaeology and Anthropology; M.A. Landscape Archaeology; Ph.D. Urban, Technological, and Environmental Planning; and Ph.D. Landscape Architecture Over eight years of experience in urban and environmental planning, environmental impact statements, socio-economic evaluations, and cultural resource assessments.
Dr. Tim Carter Ball State University	Indiana Bat B.S. Forest Resources, M.S. Forest Resources, Ph.D. Zoology Assistant Professor in the Department of Biology, research focus on tree-roosting bats, particularly the Indiana bat.

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