BIOLOGICAL OPINION

on the

APPLICATION FOR AN INCIDENTAL TAKE PERMIT FOR THE FEDERALLY ENDANGERED INDIANA BAT (*Myotis sodalis*) FOR THE BUCKEYE WIND POWER PROJECT

CHAMPAIGN COUNTY, OHIO

Prepared by:
U.S. Fish and Wildlife Service
Ohio Ecological Services Field Office
4625 Morse Road
Columbus, OH 43230
(614) 416-8993

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INTRODUCTION

This document transmits the U.S. Fish and Wildlife Service's (Service) Biological Opinion (BO) based on our review of the Final Buckeye Wind Project Habitat Conservation Plan (HCP) (Stantec Consulting Services, Inc. (Stantec), 2013), located in Champaign County, Ohio. The HCP was submitted by Buckeye Wind LLC (Buckeye Wind, Applicant), a wholly owned subsidiary of EverPower Wind LLC (EverPower). The HCP was submitted by the Applicant as part of their application for a section 10(a)(1)(B) permit for incidental take of Indiana bats (*Myotis sodalis*) resulting from actions associated with the Buckeye Wind Power Project (Project). This Biological Opinion is prepared in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.).

This BO is the culmination of formal section 7 consultation under the Act. The purpose of formal section 7 consultation is to ensure that any action authorized, funded, or carried out by the Federal government is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat of the species. This Biological Opinion evaluates the Service's issuance of an Incidental Take Permit (ITP, permit) pursuant to section 10 of the Act, as the issuance of this permit is considered a Federal action requiring consultation under section 7 of the Act.

This BO is based on information from the following sources: 1) the Applicant's HCP (Stantec 2013) (draft dated June 2012 and final dated March 2013); 2) the Final Environmental Impact Statement (EIS) for the Proposed Habitat Conservation Plan and ITP for the Indiana bat (*Myotis sodalis*) for the Buckeye Wind Power Project, Champaign County Ohio (Service 2013); 3) reports on Indiana bat research conducted in the action area (Stantec September 2008 and February 2009, and Jackson Environmental Consulting Services, LLC (Jackson) 2009); 4) meetings, phone calls, and written correspondence with the Applicant and their consultants; and 5) a demographic model developed by Thogmartin et al. (2013) designed to evaluate extinction risk in Indiana bat populations. Field investigations were also conducted by personnel from the Service's Columbus Ohio Ecological Service's Field Office (COFO). A complete administrative record of this consultation is on file at the COFO.

The purpose of this biological opinion is to document our analysis of whether the proposed action is unlikely to jeopardize the continued existence of listed species. The jeopardy analysis entails assessing whether the proposed action is unlikely to reduce appreciably the likelihood of both survival and recovery of the Indiana bat by reducing its reproduction, population, and distribution in the wild. The principal components of this analysis are, in brief: identifying the probability of individual Indiana bat exposure to action related stressors and its response to that exposure, integrating those individual risks (exposure risk and subsequent response) to discern the consequences to the populations those individuals belong to, and determining the consequences of any population-level risks to the species range-wide. If, at any point, we demonstrate that the risks are unlikely, we conclude that the agency has insured that their action is not likely to jeopardize the continued existence of the species and our analysis is completed.

CONSULTATION HISTORY

The Service has been coordinating with the Applicant on the proposed Project since 2007. The below list of items includes formal letters, meetings, site visits, and major milestones that occurred as part of the consultation process. In addition to the events listed below, the consultation history includes numerous phone calls, e-mails, draft document reviews, and teleconferences over the past six years. Weekly conference calls were initiated on July 26, 2010 and occurred nearly every week through May 2013.

Oct. 3, 2007: Meeting between Service, Buckeye Wind, and Ohio Department of Natural Resources (ODNR) regarding proposed Buckeye Wind Project components, description of Project area, and fall bird and bat surveys being conducted.

Nov. 28, 2007: Meeting between Service, Buckeye Wind, and ODNR regarding fall surveys that had been conducted for birds and bats and spring work plan.

Jan. 11, 2008: Buckeye Wind letter to Service requesting information on avian and bat habitat and recommended surveys for proposed Buckeye Wind Project.

Jan. 18, 2008: Service letter to Buckeye Wind regarding potential endangered and threatened species issues, general migratory bird issues, and recommending survey protocols.

March 5, 2008: Site visit to Project area by Service, Buckeye Wind and Stantec to identify suitable mist net locations.

Apr. 10, 2008: Meeting between Service, Buckeye Wind, ODNR regarding proposed avian and bat work plan for 2008 field season.

May 15, 2008: Stantec letter to Service requesting site-specific authorization for mist net surveys at Buckeye Wind Project in Champaign and Logan Counties, Ohio. Service emails concurrence with survey request.

Summer, Fall 2008: Stantec completes mist net surveys and swarming surveys for bats within initial study area, and detects Indiana bats during summer 2008.

Sept. 24, 2008: Meeting between Service, Buckeye Wind, ODNR, and Ohio Power Siting Board (OPSB), regarding options to modify Project to avoid take of Indiana bats. Discussed the potential need for an HCP or formal section 7 consultation if a Federal nexus exists.

Apr. 9, 2009: Service letter to Buckeye Wind regarding Indiana bat captures during mist net surveys, and revision of Project area to exclude all Indiana bat captures plus five mile buffer.

July 17, 2009: Meeting between Service, Buckeye Wind, OPSB, ODNR, regarding Indiana bats found within revised Buckeye Wind Project boundary, options for advancing Project development, and components of an HCP.

Aug. 20, 2009: Meeting between Service, Buckeye Wind, OPSB, and ODNR, regarding Indiana bats found within revised Buckeye Wind Project boundary, need for HCP, and general approach to developing HCP.

Jan. 29, 2010: Service publishes in Federal Register a Notice of Intent to conduct a 30-day scoping period under the National Environmental Policy Act (75 Fed. Reg. 4840-4842).

May 26, 2010: Service publishes in Federal Register a Notice of Intent to prepare a draft Environmental Impact Statement (EIS) (75 Fed. Reg. 29575-29577).

June 2, 2010: Meeting between Service and Buckeye Wind regarding HCP development, EIS development.

June 10, 2010: Buckeye Wind solicits proposals for 3rd party contractor to write EIS.

July 13, 2010: Buckeye Wind notifies Environmental Resources Management (ERM) that they are selected as the 3rd party contractor to write the EIS.

July 20, 2010: Meeting between Service, Buckeye Wind, ERM, and Stantec regarding development of EIS.

Nov. 17, 2010: Site visit between Service, Buckeye Wind, Stantec to evaluate Indiana bat habitat within Project footprint.

Dec. 2, 2010: Meeting between Service, Buckeye Wind, Stantec, ERM, and Indiana bat peer reviewers regarding HCP development, Collision Risk Model, Avian and Bat Protection Plan (ABPP), adaptive management and monitoring, extent of take, funding assurances, and timeline.

Aug. 2-3, 2011: Meeting between Service, Buckeye Wind, Stantec, ERM, and Solicitors regarding various aspects of HCP including take number, effects analysis, avoidance and minimization measures, mitigation, adaptive management, funding assurances, changed and unforeseen circumstances, ABPP.

Oct. 25, 2011: Site visit to Project area to look for bald eagle nests near Urbana.

Nov. 23, 2011: E-mail from Service to Buckeye Wind regarding eagle observations and evaluating risk to bald eagles within HCP/ABPP.

Jan. 10, 2012: Site visit between Service, Stantec, and State-permitted herpetologist to evaluate eastern massasauga habitat within Project area.

Jan. 12, 2012: Meeting between Service, Buckeye Wind, ERM, Stantec, Solicitors, and legal representatives regarding various aspects of HCP and Service comments on HCP.

Feb. 10, 2012: Email from Service to Buckeye Wind regarding avoidance and minimization measures for eastern massasauga.

Feb. 23, 2012: Service receives complete application package for section 10(a)(1)(B) ITP from Buckeye Wind.

June 29, 2012: Notice of Availability published in Federal Register for Draft HCP, Draft EIS, and Implementing Agreement (IA). Notification of 90 day comment period.

July 12, 2012: Service hosts Public Meeting during public comment period on Draft HCP and Draft EIS.

September 27, 2012: Public comment period on Draft HCP, Draft EIS and Draft IA closes.

April 19, 2013: Notice of Availability published in the Federal Register for Final HCP, EIS, IA, and Draft Programmatic Agreement. Notification of 30 day comment period.

May 20, 2013: Public comment period on Final HCP, EIS, IA and Draft Programmatic Agreement closes.

BIOLOGICAL OPINION

I. DESCRIPTION OF THE PROPOSED ACTION

The Federal action being evaluated in this biological opinion is the Service's issuance of a section 10(a)(1)(B) ITP to Buckeye Wind for the incidental take of Indiana bats. The ITP would cover the life of the Project, including the 25-year operational life of the turbines, and up to a 5-year period for construction and decommissioning activities. The proposed Project is described in detail in the HCP (Stantec 2013) and section 3.1 of the EIS (Service 2013). A summary of the action as described in these two documents follows.

Development of the Project will include installation of up to 100 turbines, each with a generating capacity of up to 2.5 MW. Based on an analysis of the wind resources data at the site, the Project is expected to operate at average annual capacity factor of about 30%, resulting in approximately 657,000 megawatt hours (MWh) of electricity generation per year (Stantec 2013). In addition to turbines, the Project will include construction of access roads, underground and overhead electricity collection lines, a substation, up to 4 temporary construction staging areas, temporary crane paths, two temporary concrete batch plants, four permanent meteorological towers and an Operation and Maintenance (O&M) facility. The energy generated by the Project will collect at a substation and be delivered to an existing transmission line in Union Township in Champaign County. Additionally, the Project includes operation of the project for 25 years, maintenance, and decommissioning of the Project. If the operational life of the turbines were to extend beyond 25 years, the ITP may be renewed, in accordance with Service regulations in force on the date of the renewal.

Two design options exist for the collection lines. The original design includes approximately

113.5 kilometers (km) (70.5 miles (mi)) of 34.5 kilovolt (kV) interconnect lines. Of this, 56.6 km (35.2 mi) would be built underground and mostly parallel with Project access roads, and 56.8 km (35.3 mi) would be built overhead in existing public road right-of-ways. However, the Applicant has identified a possible redesign of the Project collection system that they state would allow a more efficient infrastructure that would result in greater ease of construction. The redesign option would move a portion of the overhead lines to an underground collection system located on private land under easement, and would include 95.4 km (59.3 mi) of 34.5kV interconnect lines. Of this, 86.4 km (53.7 mi) would be installed underground and 9.0 km (5.6 mi) would be installed overhead. The redesign option would not alter the placement or operation of turbines in any way, and the difference in effects to the Indiana bat between the Project and the Project with the redesign option are extremely minor. The maximum estimate of impacts for the 100 turbine Project with and without the redesign option is presented in the HCP, and is analyzed in this Biological Opinion.

Action Area

In 50 CFR §402.02 "Action Area" is defined as, "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." The action area is not limited to the footprint of the action and should consider the effects to the environment resulting from the action. Within a set action area, all activities that can cause measurable or detectable changes in land, air, and water or to other measurable factors that may elicit a response in the species or critical habitat are considered. The action area is not defined by the range of the species that would be impacted, rather it is defined by the impacts to the environment that would elicit a response in the species (Service and NMFS 1998). Therefore, the Project Action Area includes the Project footprint and the geographic extent of the area that could be affected by construction or operational activities either directly, indirectly, or through interrelated or interdependent actions.

The Service has described the Action Area to include an area of 32,395 hectares (ha) (80,051 acres (ac)), which includes areas of direct impact and indirect impact from construction, operation, maintenance and decommissioning. It includes portions of Union, Wayne, Urbana, Salem, Rush, and Goshen Townships in Champaign County in west central Ohio (Figure 1). It includes all areas that will be physically impacted, as well as areas that may be impacted by noise, dust, vibrations, or downstream movement of sediments. At the time of completion of the HCP only the locations of 52 turbines were known, and an additional 48 were to be sited.[1] The additional 48 turbines will all be sited within the Action Area. The Action Area includes the area where all direct and indirect effects of all 100 turbines would occur.

The Action Area is primarily used for agriculture, but also contains scattered woodlands, low-density residential development, and small municipalities.

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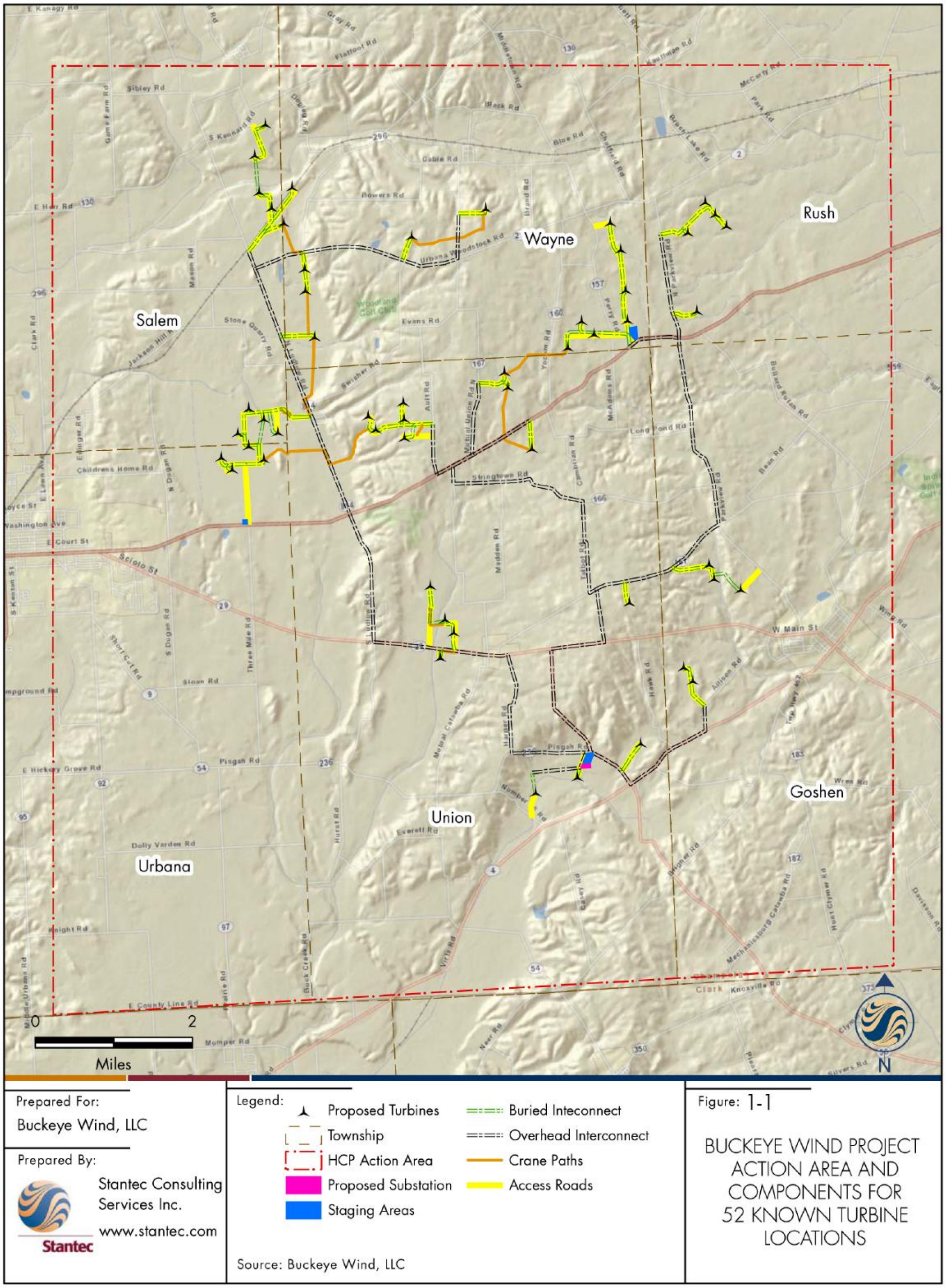
[1] The OPSB application for the Buckeye II Wind Project consists of 56 turbine locations. Of these 56, not more than 48 will be built. At the time of this BO, it was still uncertain which of those 56 would be built.

Project Schedule

The Applicant proposes to begin construction as soon as practicable subsequent to issuance of an ITP. According to the HCP, construction activities will regularly move from place to place within the Action Area. The Project, including all 100 turbines and associated infrastructure, will be constructed within 1-2 phases, each phase expected to continue for 12 to 18 months.

Figure 1. Buckeye Wind Project Action Area and 52-Turbine Layout (Stantec 2013).



Other Listed Species Potentially in the Action Area

Rayed bean (*Villosa fabalis*) (Federal endangered species)

The Action Area lies within the range of the rayed bean freshwater mussel species, and suitable habitat is thought to be present for this species in Champaign County. The rayed bean is known from the Big Darby Creek watershed, of which Little Darby Creek is a tributary. Portions of Little Darby Creek that could be impacted by road and utility line crossings associated with the Project are ephemeral (Hull and Associates, Inc. (Hull) 2010), and do not contain features necessary to support mussel populations (Hull 2010). A field assessment in November 2008 found the Little Darby Creek crossing point to be dry (Hull 2009). The rayed bean has the potential to occur in other perennial streams with suitable habitat within the Action Area. However, the Applicant has committed to either survey for rayed bean or to avoid in-water work in rayed bean suitable habitat throughout the Action Area. Rayed bean habitat will be avoided either through directional drilling, access road re-routing, arched bridge structures or temporary crossings (HCP Section 5.2.1.2). If no survey is performed, presence will be assumed and in-water work will be avoided as if rayed bean was determined to be present. Therefore, the Service has determined that the Project is not likely to adversely affect the rayed bean mussel, and therefore this species will not be evaluated further in this BO.

Eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*) (Federal candidate species)

The Action Area lies within the range of the eastern massasauga rattlesnake. Eastern massasaugas use both upland and wetland habitat at different times during the year, and therefore require large, contiguous, wetland areas immediately adjacent to upland grassland. There are no known occurrences of eastern massasauga rattlesnakes in the Action Area (M. Seymour, Service, personal communication). The only potential suitable habitat in the Action Area is a 20-acre wetland in Urbana Township. A field review was conducted by Service and Ohio state eastern massasauga experts on January 10, 2012. It was determined that this 20 acre site contains suitable habitat for the eastern massasauga. Project facilities avoid this habitat, and no direct loss of potential habitat would occur as a result of the Project. However Project components will be located near the wetland and if eastern massasaugas are present at the site, they could be affected by construction, operation, maintenance, and decommissioning of the Project.

In order to avoid potential adverse effects to the eastern massasauga, a presence/absence survey may be conducted at the site. The survey would be conducted by a Service and ODNR (Division of Wildlife (DOW) approved eastern massasauga surveyor. If no eastern massasauga is detected, no further avoidance and minimization measures will be necessary. If presence is detected, or if a survey is not conducted, presence will be assumed and the avoidance measures outlined in Section 3.2.1.1 of the HCP will be implemented. With implementation of these avoidance measures, the Service has determined that construction, operation, maintenance or decommissioning of the Project is not likely to adversely affect the eastern massasauga rattlesnake, and therefore this species will not be evaluated further in this BO.

Conservation Measures

The following conservation measures have been incorporated into the HCP; these measures are designed to avoid, minimize, and mitigate impacts of the proposed action on the Indiana bat, rayed bean mussel, and eastern massasauga rattlesnake. The Service has analyzed the effects of the proposed action based on the assumption that all conservation measures will be implemented. A more detailed description of the Project's conservation measures can be found in Chapter 6 of the HCP.

1) Avoidance Measures:

- Movement of the initial study area upon discovery of Indiana bats in 2008 (Stantec September 2008);
- Siting turbines to avoid large blocks of contiguous forest habitat and protected areas;
- None of the 100 turbines will be closer than 1.8 miles to known maternity roost trees documented in 2009 (Jackson 2009);
- No more than 10 turbines will be located in Category 1 habitat[2], the highest quality habitat for Indiana bats;
- The Applicant will not remove the 3 known Indiana bat roost trees in the Action Area;
- The Applicant will avoid potential direct effects from habitat loss to roosting Indiana bats in unidentified maternity roost trees by conducting all tree clearing activities outside the period when Indiana bats are expected to be roosting in the Action Area. Thus, any tree clearing will be conducted between 1 November and 31 March;
- Prior to any tree removal, the limits of proposed clearing will be clearly demarcated to prevent over-clearing of the site;
- A natural resource specialist knowledgeable about Indiana bats and their habitat requirements will be present at the time of tree clearing;
- Measures will be taken to avoid impacts to riparian habitat that may provide potential Indiana bat foraging riparian habitat, as well as aquatic habitat for the rayed bean mussel, and wetland habitat for the eastern massasauga rattlesnake. For example, horizontal directional boring will be used to avoid impacts to designated exceptional warm water or cold water habitat streams, as well as some perennial streams, wetlands will not be impacted (15.2 meter (m) (50 foot (ft)) buffer on delineated wetlands), and stream crossings will be avoided where possible.

2) Minimization Measures:

- The Applicant will limit the amount of tree removal to 6.5 ha (16.1 ac) (6.8 ha (16.8 ac) for redesign option), or 0.2% of the 2,743.5 ha (6,779.4 ac) of forested habitat available in the Action Area;
- Measures such as limiting the width of planned riparian disturbances to 30.5 m (100 ft) and conducting required tree clearing outside of the Indiana bat active period will be taken to minimize impacts to high quality potential Indiana bat foraging riparian habitat and the prey that it supports;

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[2] See "<u>Indiana Bat Habitat Suitability in the Action Area</u>" for discussion of habitat categories.

- To the extent possible, all construction and decommissioning activities will be conducted between 15 November and 1 March to minimize impacts to the Indiana bat and eastern massasauga rattlesnake;
- Speed limits around suitable eastern massasauga rattlesnake habitat will be maintained at 16.0 km/h (10 mph);
- Project personnel will be made aware of the possible presence of the eastern massasauga rattlesnake in the Project area, that the eastern massasauga is protected by Ohio law and that the snake is venomous and should not be handled. Personnel will be provided information on how to identify the eastern massasauga, including at minimum photos and a description of defining features. Any snake that cannot be positively identified as not being an eastern massasauga rattlesnake will be immediately and completely avoided and will be reported to the eastern massasauga surveyor, or, if not present, the natural resource specialist.
- All streams with suitable rayed bean habitat will either be avoided during construction, or surveyed to document presence or likely absence of the species. If rayed bean are determined to be present, then impacts to habitat will be avoided either through directional drilling, access road re-routing, arched bridge structures or temporary crossings (HCP Section 5.2.1.2).
- Minimal Federal Aviation Administration (FAA) lighting will be utilized, and lighting of facilities for security will be controlled by motion detectors or infrared sensors;
- Regularly scheduled tree trimming for maintenance purposes will not be conducted during the active period for Indiana bats (1 April- 31 Oct);
- Access roads built for the Project will be posted with a 40.2 km/h (25 mph) speed limit to minimize risk of collision with Indiana bats and other wildlife;
- Between April 1 and October 31 of each year, operational restrictions (Table 1, and see HCP Section 6.2.3 - Feathering Plan Phases) will dictate that turbines are feathered (i.e. not spinning) from ½ hour before sunset to ½ hour after sunrise until a designated cut-in speed (dictated by season and habitat category) is reached, to reduce collision mortality of Indiana bats.

Table 1. Summary of nighttime (½ hour before sunset to ½ hour after sunrise) operational feathering that will 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 will 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.
** During all seasons, turbines may be operated normally when temperatures are below 10 °C (50°F).
*** 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 will be built.
**** Turbines will be cut-in at the manufacturer's specified cut-in speed. The turbine will be feathered below the cut-in speed.

- Best management practices for soil erosion and restoration will be implemented through a National Pollutant Discharge Elimination System (NPDES) storm water permit and associated Storm Water Pollution Prevention Plan (SWPPP), and a permit(s) under Section 404 of the Clean Water Act (CWA) will be secured;
- Temporary crossings and areas of temporary construction impact will be restored and re-vegetated per the erosion and sediment control plan.

3) Mitigation Measures

- Permanent preservation of 87.8 ha (217.0 ac) of habitat within 11.3 km (7 mi) of a Priority 2 (P2)[3] Indiana bat hibernaculum in Ohio;
- Mitigation habitat will be restored or enhanced if it does not meet the criteria addressed in HCP Section 6.3.4 - Restoration and Enhancement;
- Or, use of an approved Indiana bat mitigation bank within Ohio, whose geographical service area includes the Project.

[3] A hibernaculum where between 1,000 and 9,999 Indiana bats overwinter.

4) Research (termed “Conservation Measures” in the HCP)

- The Applicant will allocate $200,000 from operating revenues for research to help further the conservation of Indiana bats and increase knowledge related to Indiana bat - wind energy interactions. These projects may include Indiana bat wind turbine interaction studies, and/or Indiana bat migration studies.
- Wing and hair tissue samples from each dead bat found during post-construction monitoring may be collected to support Service-requested research projects by entities other than Buckeye Wind.

5) Monitoring, Adaptive Management and Reporting

- Post Construction Mortality Monitoring (PCMM) will be conducted throughout the life of the Project; at least annually for the first two years, at least biennially for the subsequent four years, and at least every third year thereafter, depending on monitoring results;
- PCMM will include carcass searches and corrections for scavenger removal, searcher bias (efficiency), and searchable area;
- Monitoring of mitigation actions, including monitoring of habitat features within the mitigation areas subject to enhancement;
- Monitoring of potential factors influencing Indiana bat mortality to help refine the feathering plan and maximize operational output, including: seasonal variation of mortality; variation in mortality with respect to turbine location and habitat; variation in mortality with respect to weather characteristics including wind speed, barometric pressure, temperature and humidity;
- Adaptive management will be implemented to maintain take numbers within the limits of the permit by adjusting the turbines’ cut-in speeds and feathering regime, based on the results of PCMM.
- Adaptive management may be used to refine PCMM methods to achieve a low probability of missing dead Indiana bats, should they be struck by turbines.
- Probability of carcass detection will be used to determine if adaptive management should be applied, if no Indiana bat carcasses are found;
- Adaptive management will be used to maintain habitat suitability at the mitigation site(s), by monitoring the mitigation sites, and taking corrective measures if necessary, to ensure sufficient number of suitable roost trees, control of woody invasive species, and survival of planted trees;
- An annual report describing methods and results of mortality and mitigation monitoring will be submitted to the ODNR DOW and the Service by 31 December of each calendar year that monitoring is actively conducted;
- The Applicant will also provide summaries of spring and summer Indiana bat mortality to the Service at the end of each of these seasons in order to inform potential adaptive management;
- Intermittent construction reports will also be submitted as new turbines are erected.

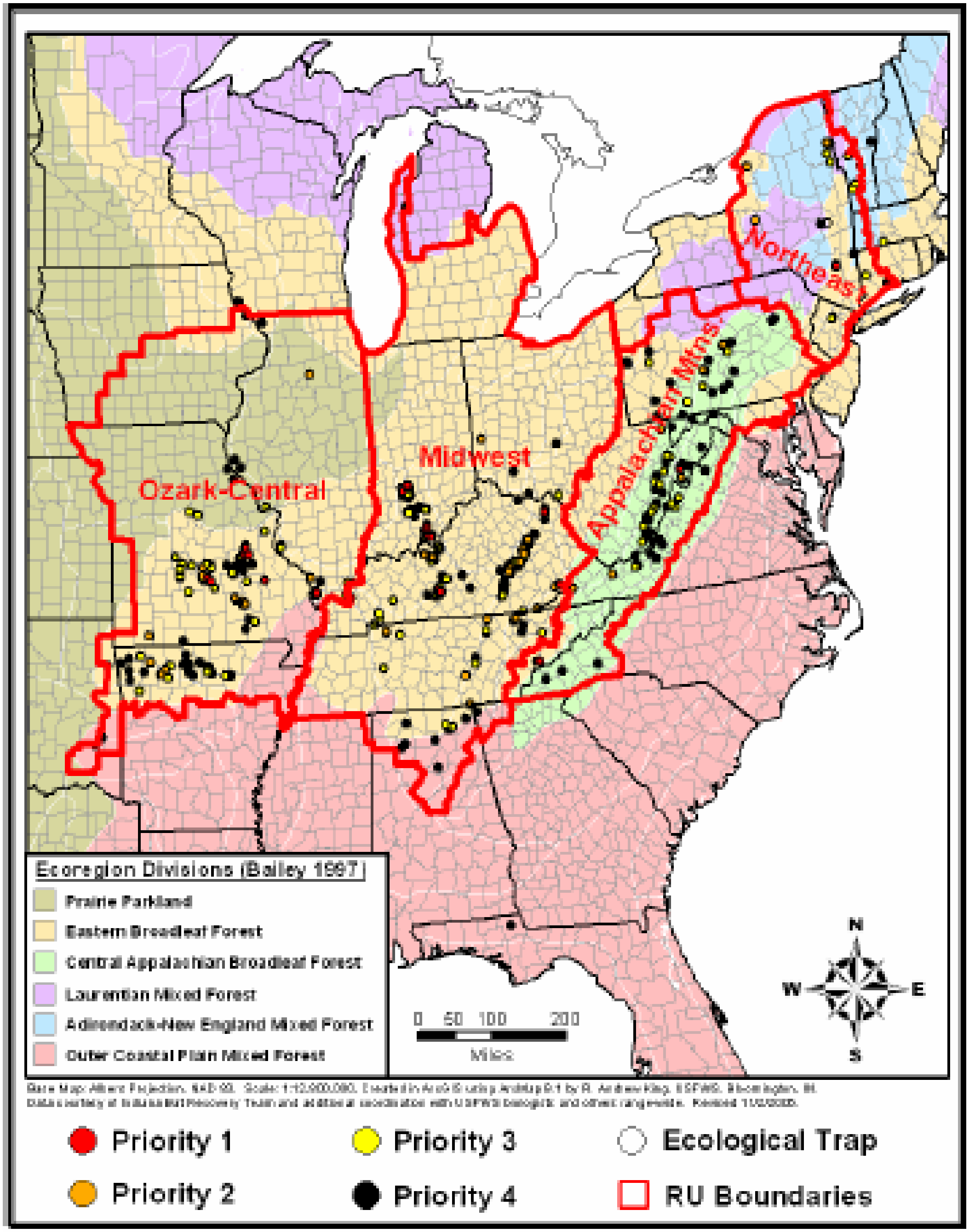
II. STATUS OF THE SPECIES

*Unless noted otherwise, the information in this section is summarized from the Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision 2007 (Service 2007).*

The Indiana bat was officially listed as an endangered species on March 11, 1967 (32 FR 4001) under the Endangered Species Preservation Act of October 15, 1966 (80 Stat. 926; 16 U.S.C. 668aa[c]). The Endangered Species Act of 1973 extended full protection to the species. Thirteen winter hibernacula (11 caves and two mines) in six states were designated as critical habitat for the Indiana bat in 1976 (41 FR 41914). No critical habitat occurs within or near the Action Area. The Service published a final recovery plan (Service 1983) which outlines recovery actions. Briefly, the objectives of the plan are to: (1) protect hibernacula; (2) maintain, protect, and restore summer maternity habitat; and (3) monitor population trends through winter censuses.

The Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision (Service 2007) was developed to update the original recovery plan, and though still draft provides the most current information on the status of the population recovery goals, and recovery program. The Draft Recovery Plan (Service 2007) states that the recovery program for this species has four broad components: 1) range-wide population monitoring at the hibernacula with improvements in census techniques; 2) conservation and management of habitat (hibernacula, swarming, and to a degree, summer); 3) further research into the requirements of and threats to the species; and 4) public education and outreach (Service 2007). This recovery program continues to have a primary focus on protection of hibernacula (Service 1983) but also increases the focus on summer habitat and proposes the use of Recovery Units (RU) (Service 2007). The recovery program for the Indiana bat delineates four recovery units: the Ozark-Central, Midwest, Appalachian Mountains, and Northeast RUs (Figure 2). “Recovery Units serve to protect both core and peripheral populations and ensure that the principles of representation, redundancy, and resiliency are incorporated” (Service 2007). The proposed Project would be constructed within the Midwest RU.

Figure 2. Indiana bat recovery units.



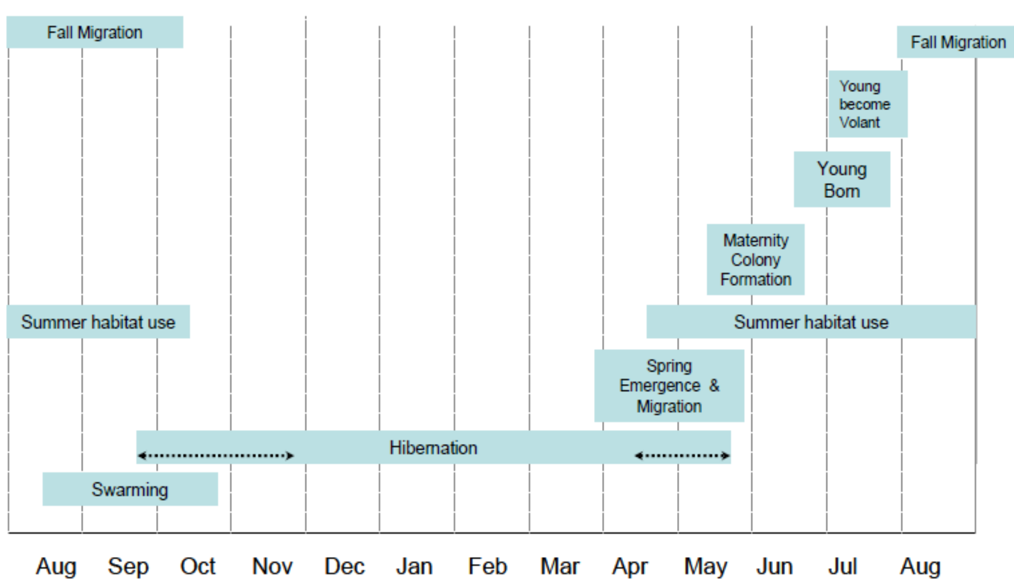
Description and Distribution

The Indiana bat is a medium-sized insectivorous bat in the *Myotis* genus with a head and body length that ranges from 41 to 49 mm (1.6 to 1.9 inches (in)). There are no recognized subspecies. The species range includes much of the eastern half of the United States, from Oklahoma, Iowa, and Wisconsin east to Vermont, and south to northwestern Florida. The Indiana bat is migratory, with the above described range including both winter and summer habitat. The winter range is associated with regions of well-developed limestone caverns. Major populations of this species hibernate in Indiana, Kentucky, and Missouri. Smaller winter populations have been reported from Alabama, Arkansas, Georgia, Illinois, Maryland, Mississippi, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Tennessee, Virginia, and West Virginia. More than 85% of the entire known population of Indiana bats hibernates in only nine caves. The Indiana bat closely resembles the little brown bat (*Myotis lucifugus*), but is distinguished from this species by its shortened toe hairs and a slightly keeled calcar.

Life History and Population Dynamics

The Indiana bat hibernates in caves and mines in the winter (typically October through April), often with other species (Figure 3). Indiana bats have been known to reach hibernation cluster densities of 300-484 bats per square foot (Service 2007). It is generally accepted that Indiana bats, especially females, are philopatric; that is, they return annually to the same hibernacula (LaVal and LaVal 1980). During hibernation, Indiana bats arouse naturally, as do all hibernating mammals (Thomas et al. 1990). Most Indiana bats hibernate in caves or mines where the ambient temperature remains below 10ºC (50.0ºF) but infrequently drops below freezing (Hall 1962, Myers 1964, Henshaw 1965, Humphrey 1978).

Figure 3. Indiana bat annual chronology.



The timing of spring emergence from hibernacula may vary across the range of the Indiana bat, depending on latitude and weather (Hall 1962). Females tend to emerge earlier than males, usually from the end of March to mid-April. Males usually exit by the beginning of May. Female Indiana bats may leave immediately for summer habitat or linger for a few days near the hibernaculum. Males and non-reproductive females may summer near hibernacula, or migrate to summer habitat some distance from their hibernaculum. In spring when fat reserves and food supplies are low, migration provides an additional stress and, consequently, mortality may be higher immediately following emergence (Tuttle and Stevenson 1978). Indiana bats can migrate hundreds of kilometers from their hibernacula (Service 2007). In the Midwest RU, the maximum documented migratory distance is 574.5 km (357 mi) (Winhold and Kurta 2006).

After arriving at their summer range, female Indiana bats form maternity colonies that can vary greatly in size. Female Indiana bats, like most temperate Vespertilionids, give birth to one young each year (Mumford and Calvert 1960, Humphrey et al. 1977, Thomson 1982). The thermoregulatory advantages of colonial roosting have been clearly demonstrated. Maternity roosts are thought to provide an environment where adequate metabolism and body temperatures can be maintained by both mother and young, allowing for optimal prenatal and postnatal growth. Kurta and Rice (2002) reported that most births occurred in mid- to late-June, with lactation occurring throughout July and lasting 3 to 5 weeks, and pups becoming volant (able to fly) between early July and early August. Maternity colonies typically use 10 to 20 trees each year, but only one to three of these are primary roosts used by the majority of bats for some or all of the summer (Callahan 1993, Callahan et al. 1997). Roost trees, although ephemeral in nature, may be occupied by a colony for a number of years until they are no longer suitable. Indiana bats appear to have a fission-fusion society as demonstrated by frequent roost changing (Kurta et al. 2002, Kurta 2005). Once the young become volant, the maternity colony begins to disperse.

Maternity colonies begin disbanding during the first two weeks in August, although some large colonies may maintain a steadily declining number of bats into mid-September (Humphrey et al. 1977, Kurta et al. 1993). Members of a maternity colony do not necessarily hibernate in the same hibernacula, and may migrate to hibernacula that are over 300 km (190 mi) apart (Kurta and Murray 2002, Winhold and Kurta 2006). Upon arrival at hibernacula, Indiana bats mate and build up fat reserves by foraging, usually in close proximity to the cave. This period of activity prior to hibernation is called swarming.

Status and Distribution

Reasons for Listing

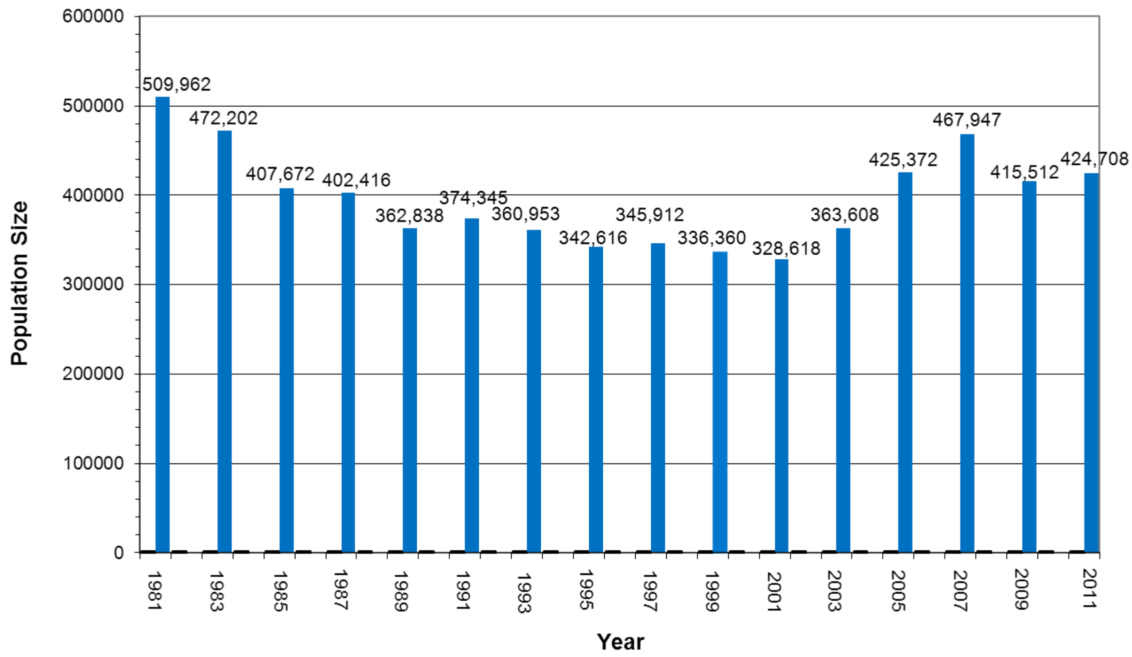
The Indiana bat was one of 78 species first listed as being in danger of extinction under the Endangered Species Preservation Act of 1966 because of large decreases in population size and an apparent lack of winter habitat (Service 1983, 1999). The 1967 Federal document that listed the Indiana bat as "threatened with extinction" (32 FR 4001, March 11, 1967) did not address the five factor threats analysis later required by Section 4 of the 1973 ESA. The subsequent recovery plans do address threats to the species in greater detail. Threats to the species discussed in the 2007 Recovery Plan (Service 2007) include the following: destruction/degradation of hibernation habitat (caves and mines); loss and degradation of summer habitat, migration habitat, and swarming habitat (especially forested habitats); disturbance of hibernating bats; predation; competition; inadequacy of existing regulations, particularly regulations that protect summer roosting habitat; natural catastrophes in hibernacula, such as flooding; and, environmental contaminants.

Range-wide trends

From 1965 to 2001, there was an overall decline in the range-wide population of the Indiana bat (Service 2007). Despite the discovery of many new, large hibernacula during this time, the range-wide population estimate dropped approximately 57% from 1965 to 2001. Contrary to the apparent long-term trend of decreasing population numbers of Indiana bats, the estimated range-wide population increased from 328,526 Indiana bats in 2001 to 467,947 Indiana bats in 2007 (Service 2012b). The first observed Indiana bat range-wide decline since 2001 was documented from 2007 to 2009 when the overall Indiana bat population declined by approximately 11% (i.e., loss of approximately 52,435 Indiana bats) (Service 2012b).

According to the 2011 Range-wide Population Estimate for the Indiana Bat (*Myotis sodalis*) by RU (Service 2012b), the total known Indiana bat population is estimated to be approximately 424,708 bats, a 2.2% increase from the 2009 range-wide estimate of 415,512 bats (Figure 2, Service 2012b). The Midwest RU (Indiana, Kentucky, Ohio, Tennessee, Alabama, SW Virginia and Michigan) supported approximately 71.9% of the 2011 total population estimate (Table 2). Biennial winter surveys for the Indiana bat were conducted in January and February of 2013, but not all states have reported their findings.

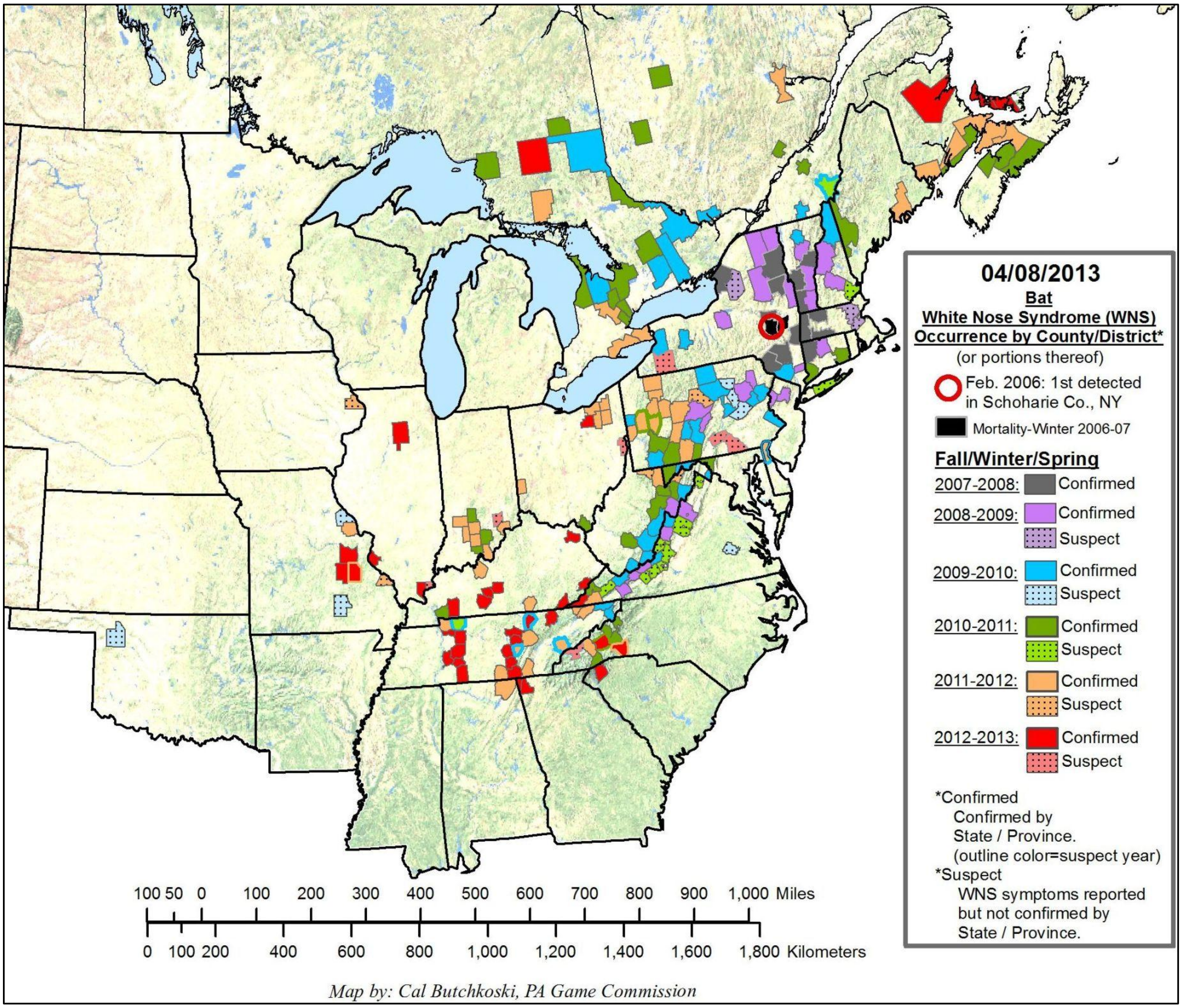
Figure 4. Indiana bat rangewide population estimates from 1981-2011.



Regardless of the range-wide population status, when considering populations within each RU, different trends emerge, with recent trends driven by the onset and spread of white-nose syndrome (WNS).

Since 2006, WNS has emerged as a new threat that may have serious implications for Indiana bat recovery, as well as the well-being of other hibernating North American bats. First documented in a photo taken in a New York Cave in 2006, WNS has now spread to 22 states (New York, Massachusetts, Vermont, New Hampshire, Connecticut, Virginia, West Virginia, Pennsylvania, New Jersey, Maryland, Missouri, Oklahoma, Tennessee, North Carolina, Indiana, Ohio, Kentucky, Georgia, Maine, South Carolina, Alabama, and Illinois) and three Canadian provinces (Ontario, Quebec, and New Brunswick), including over 50 known Indiana bat hibernacula (Figure 5). Some affected hibernacula, especially in New York and New England, have experienced 90 to 100 percent mortality (Service 2011).

Figure 5. 04/08/2013 Bat white-nose syndrome occurrence by County/District.



RU Trends

Until 2007, the Northeast RU was the fastest growing population of all the RUs (Thogmartin et al. 2012), peaking at 53,763 Indiana bats in 2007 (Service 2012b). But the Northeast RU population lost approximately 70% of its Indiana bats between 2007-2011 (Table 2, Service 2012b). This decline is attributable to the onset and rapid spread of WNS. Initial Indiana bat population estimates for 2013 indicate that the Northeast RU has increased by approximately 13% in the eighth year post-WNS infection (Service, unpublished data 2013), though it is unclear if this increase represents true population growth, immigration from other areas, or other factors. Continued monitoring of population status will yield more conclusive trends as WNS moves through the population over time.

The Appalachian RU also exhibited a strongly increasing trend between 1983 and 2011 (Thogmartin et al. 2012), peaking at 32,529 in 2011 (Service 2012b). WNS was first documented in the Appalachian RU in 2008 at several sites in Pennsylvania, but did not spread to the largest hibernacula in West Virginia and Tennessee until 2010 or later. Preliminary 2013 population estimates indicate a roughly 45% decline in population in the Appalachian RU from 2011 estimates (Service, unpublished data 2013), attributable to the impacts of WNS Appalachian RU-wide population declines due to WNS were not documented until six years post-WNS.

The Midwest RU population estimates show an increase in numbers between 1983 and 2009, however the wide confidence intervals around the estimates preclude definitive statements about population increase during that time period (Thogmartin et al. 2012). The population estimate peaked in 2007, at 320,342 Indiana bats (Service 2012b). WNS was first detected in multiple states within the Midwest RU in 2011. Preliminary 2013 population estimates indicate a roughly stable population estimate compared to 2011 estimates (Service, unpublished data, 2013). Significant declines have been observed at some individual hibernacula, while significant increases have been observed at others. The Midwest RU has not yet documented RU-wide declines from WNS that the Northeast saw in the first 3 years post-infection. It is possible that the Midwest RU may behave similarly to the Appalachian RU, in that there may be a time lag between when WNS is first observed and when RU-wide impacts are observed.

The Ozark RU declined by 81% between 1983 and 1999, to a low of approximately 34,000, but then increased significantly to 73,261 in 2005 (Thogmartin et al. 2012). The population hovered around 70,000 through 2011. In 2012-2013 a new Priority 1 (P1)[4] Indiana bat hibernacula was discovered in the Ozark RU, supporting approximately 110,000 Indiana bats, therefore the 2013 population estimate will be much larger than previous years. Presence of WNS was suspected in the Ozark RU in 2010, but not confirmed until 2012. Population estimates for 2013 and hibernaculum-specific WNS trends for this RU are not yet available.

According to the Service's Regional and National WNS coordinators (R. Geboy, J. Coleman, J. Reichard, and C. Kocer, personal communication), it is fully anticipated that Indiana bat populations in each of the RUs infected with WNS will experience WNS declines on par with the declines observed in the Northeast RU. Based on similarities in climate, population dynamics, and hibernation periods and behavior between the Indiana bat RUs, we have no reason to expect that Indiana bat populations in the Midwest, Appalachian, and Ozark RUs would behave any differently than the Northeast RU when exposed to WNS. Therefore over the next few years, we anticipate up to 70% declines in the Indiana bat populations within each of the RUs as WNS continues to run its course.

[4] A hibernacula where > 10,000 Indiana bats overwinter.

Table 2. Indiana bat populations 2003-2011 by Recovery Unit.

IBat Recovery Unit	State	2003	2005	2007	2009	2011	% Change from 2009	% of 2011 Total
Ozark-Central	Illinois	43,647	55,090	53,823	53,342	55,956	4.9%	13.2%
	Missouri	17,752	16,102	15,895	13,688	13,647	-0.3%	3.2%
	Arkansas	2,228	2,067	1,829	1,480	1,206	-18.5%	0.3%
	Oklahoma	5	2	0	0	13	0.0%	0.0%
	Total	63,632	73,261	71,547	68,510	70,822	3.4%	16.7%
Midwest	Indiana	183,337	206,610	238,068	213,170	222,820	4.5%	52.5%
	Kentucky	49,544	65,611	71,250	57,325	70,329	22.7%	16.6%
	Ohio	9,831	9,769	7,629	9,261	9,870	6.6%	2.3%
	Tennessee	3,246	3,221	2,929	1,663	1,690	1.6%	0.4%
	Alabama	265	296	258	253	261	3.2%	0.1%
	SW Virginia	430	202	188	217	307	41.5%	0.1%
	Michigan	20	20	20	20	20	0.0%	0.0%
	Total	246,673	285,729	320,342	281,909	305,297	8.3%	71.9%
Appalachian	West Virginia	11,443	13,417	14,745	17,965	20,358	13.3%	4.8%
	E. Tennessee	6,556	8,853	5,977	11,058	11,096	0.3%	2.6%
	Pennsylvania	931	835	1,038	1,031	518	-49.8%	0.1%
	Virginia	728	567	535	513	556	8.4%	0.1%
	North Carolina	0	0	0	1	1	0.0%	0.0%
	Total	19,658	23,672	22,295	30,568	32,529	6.4%	7.7%
Northeast	New York	32,529	41,745	52,779	34,045	16,052	-52.9%	3.8%
	New Jersey	644	652	659	416	5	-98.8%	0.0%
	Vermont	472	313	325	64	3	-95.3%	0.0%
	Total	33,645	42,710	53,763	34,525	16,060	-53.5%	3.8%
Rangewide Total:		363,608	425,372	467,947	415,512	424,708	2.2%	100.0%

New Threats

As described above, WNS is an emerging threat resulting in significant population declines in the Northeast and Appalachian RUs, and spreading rapidly throughout the rest of the Indiana bat's range. WNS is a condition primarily affecting hibernating bats. Affected bats usually exhibit a white fungus on their muzzles and often on their ears and wings as well (Blehert et al. 2009).

Some affected bats display abnormal behavior including flying during the day and in cold weather (before insects are available for foraging) and roosting towards a cave's entrance where temperatures are much colder and less stable (Service 2011). Fat reserves in these bats are also severely diminished or non-existent, making survival to spring emergence difficult.

The fungus associated with WNS has been identified as *Geomyces destructans*, a previously undescribed species (Gargas et al. 2009). The fungus thrives in the cold and humid conditions of bat hibernacula (Service 2011). The skin infection caused by *G. destructans* is thought to act as a chronic disturbance during hibernation (USGS 2010). Infected bats exhibit premature arousals, aberrant behavior, and premature loss of critical fat reserves which is thought to lead to starvation prior to spring emergence (Frick et al. 2010). It has been determined that *G. destructans* is the primary cause of death (Lorch et al. 2011). The fungus invades living tissue, causing cup-like epidermal erosions and ulcers (Meteyer et al. 2009, Puechmaille et al. 2010). These erosions and ulcers may in turn disrupt the many important physiological functions that wing membranes provide, such as water balance (Cryan et al. 2010).

It is believed that WNS is primarily transmitted through bat-to-bat contact. In addition, people may unknowingly contribute to the spread of WNS by visiting affected caves and subsequently transporting fungal spores to unaffected caves via clothing and gear (Service 2011). *G. destructans* has been found growing on hibernating bats in European countries, but does not appear to be causing widespread mortality there (Puechmaille et al. 2010). Within the U.S., WNS has been confirmed on the Indiana bat, cave myotis (*Myotis velifer*), gray bat (*M. grisescens*), little brown bat, eastern small-footed bat (*M. leibii*), northern long-eared bat (*M. septentrionalis*), southeastern bat (*M. austroriparius*), tri-colored bat (*Perimyotis subflavus*) and big brown bat (*Eptesicus fuscus*).

WNS continues to be found at an increasing number of sites throughout the Midwest RU, and is currently documented in seven Ohio counties and suspected in one county (J. Norris, ODNR 2013, personal communication). Declines in Indiana bat populations are apparent. Between 2007 and 2011, the Northeast RU lost 70 % of its Indiana bat population (Service 2012b). The Service, with the help of States, researchers, and others, is continuing to research this evolving threat. Methods are being evaluated to stop the spread of WNS and to minimize mortality where it currently exists.

Another emerging risk to Indiana bats is the recent increase in the number of wind turbines being constructed and operated around the country, as efforts to create domestic, alternative sources of renewable energy ramp up. To date, 5 Indiana bat fatalities have been documented in post-construction monitoring studies at wind energy facilities. Two of the fatalities occurred at the Fowler Ridge wind facility in Benton County, IN, during the fall migration period; the first occurred in September 2009 and the second occurred in September 2010 (Good et al. 2011). The third Indiana bat fatality occurred at the North Allegheny Wind facility in Cambria and Blair counties in Pennsylvania[5]. This fatality also occurred during the fall migration period in September 2011. The fourth Indiana bat fatality occurred on July 26, 2012 at the Laurel Mountain Wind Power facility near Elkins, WV[6]. The fifth Indiana bat fatality occurred on the night of October 2-3, 2012 at the Blue Creek Wind Farm in Paulding County, OH.[7] While it is assumed that other Indiana bat mortality at wind facilities have occurred, these fatalities

[5] See <http://www.fws.gov/northeast/pafo/>. Accessed October 2011.

[6] See http://www.fws.gov/westvirginiafieldoffice/ibatfatality.html. Accessed November 15, 2012

[7] See http://www.fws.gov/midwest/News/release.cfm?rid=604&utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+FwsMidwestNewsroom+%28FWS+Midwest+News+and+Highlights%29

represent the only documented takings at wind facilities to date.

The American Wind Energy Association (AWEA) maintains current statistics on wind power generation, construction, and the interconnection queue for each state.[8] The information available from AWEA indicates that within the Midwest RU, there is currently 2,307 MW of wind power in operation, and 674 MW under construction (Table 3). There are 22,081 MW in the interconnection queue, but it is likely that only a small percent of these projects will ultimately be built.[9]

Table 3. Total Megawatts of Wind generating capacity at operational and under construction projects, and in the queue in states within the Indiana bat Midwest RU.

State	**Operational MW**	**Under construction MW**	**MW in the queue**
Indiana	1343	200	11366
Michigan	515	472	4536
Ohio	420	2	6179
Tennessee	29	0	0
Alabama	0	0	0
Kentucky	0	0	0
Total	**2307**	**674**	**22081**

Minimum and maximum estimates of all-bat species[10] fatalities were calculated in Section 5.15 of the EIS (Service 2013), based on 17 studies at 15 sites within the range of the Indiana bat, where post-construction data was available that corrected for bias. The average minimum and maximum mortality rates for all bats were 9.6 to 16.1 bats per MW per year (Service 2013). These rates were applied to 2,981 MW of operational and under construction wind facilities located within the Midwest RU to quantify bat mortality rates. This results in between 28,617 and 47,994 all-bat mortalities per year within the Midwest RU that are currently occurring.

Data from the four wind facilities with documented Indiana bat mortalities were compiled to generate an estimate of Indiana bat mortality rates compared to all-bat mortality rates. Raw numbers of all carcasses detected (whether during scheduled searches or incidental finds) are presented below (Table 4).

During the spring and fall survey periods at Fowler Ridge (April 13 to May 15, 2010 and August 1 to October 15, 2010) one Indiana bat carcass was found out of a total of 845 all-bat carcasses. Indiana bat mortality was 0.12 percent of the total bat mortalities per year at the facility (Good et

[8] See http://awea.org/learnabout/publications/factsheets/factsheets_state.cfm, Accessed June 18, 2013.
[9] Between 2000-2007, only 3% of the total MW in the interconnection queue were built, 55% were withdrawn, and 42% were still in progress (National Renewable Energy Laboratory 2009).
[10] "All bats" for the purposes of mortality estimation in the Midwest RU includes the following species: red bat (*Lasiurus borealis*), silver-haired bat (*Lasionycteris noctivagans*), hoary bat (*Lasiurus cinereus*), big brown bat, little brown bat, northern long-eared bat, Indiana bat, eastern small-footed bat, tri-colored bat, evening bat (*Nycticeius humeralis*), and seminole bat (*Lasiurus seminolus*).

al. 2011). The Indiana bat found at Fowler Ridge in 2009 was found incidentally by maintenance workers, and no scheduled searches were being conducted during that time. Therefore no species composition data for that record is available. At the Blue Creek Wind Farm, 850 bat carcasses were collected from April 1-November 15, 2012, including one Indiana bat carcass (Ritzert et al. 2013). Indiana bat mortality comprises 0.12 percent of the total bat mortalities per year at this facility. At the Northern Allegheny wind project in 2011, one Indiana bat was found out of 162 all-bat carcasses (M. Turner, Service, personal communication). Indiana bats at this facility total 0.62 percent of the total bat mortalities per year. Finally, during monitoring at the Laurel Mountain wind project from August 15-October 31, 2011 and April 1-July 31, 2012, one Indiana bat was found out of 186 all-bat carcasses (L. Hill, Service, personal communication). Indiana bat mortality comprises 0.54 percent of all bat mortality at this facility.

Table 4 1. Indiana bat and all bat mortalities at four wind facilities. Mortalities include carcasses found during scheduled searches and those found incidentally.

	Indiana bats	All bats	Percent Indiana bats
Fowler Ridge, IN	1	845	0.12
Blue Creek, OH	1	850	0.12
North Allegheny, PA	1	162	0.62
Laurel Mountain, WV	1	186	0.54
Total	4.00	2043.00	

We used a weighted average of these four facilities to estimate the total Indiana bat to all-bat mortality rate. Indiana bat fatalities total 0.2 percent of all-bat fatalities at these facilities.

If all bat mortality ranges between 28,617 and 47,994 bats per year, and Indiana bat mortality is approximately 0.2 percent of that, then Indiana bat fatalities at all operational and under construction wind facilities within the Midwest RU is estimated to be between 57 and 96 Indiana bats each year. The actual numbers of Indiana bat fatalities per wind facility are likely dependent on the proximity to known bat hibernacula, migration routes, and summer roosting habitat (Service 2007).

This take of Indiana bats that is already occurring at existing wind facilities is reflected in the baseline population estimates generated biannually during winter surveys of hibernacula. Further, population growth rates (lambda values) generated for the Midwest RU based on biannual hibernacula survey data should capture this existing take. These lambda values will be used later in this BO to analyze the effect of the Buckeye Wind project take on the Indiana bat at multiple population scales.

Take of Indiana bats that may occur at future wind projects (represented by the total MW currently in the interconnection queue) may be addressed under HCPs such as the Buckeye Wind Project HCP being analyzed in this BO, or may be addressed under a formal section 7 consultation with another Federal Action Agency (though this is rare), or may go undetected and unpermitted. Within the Service's Region 3, a multi-state, multi-species HCP planning effort is underway to cumulatively address a large proportion of future wind projects. This planning effort covers much of the Midwest and Ozark RUs. Take of Indiana bats from wind projects that are to be addressed under other HCPs would be subject to Biological Opinions and jeopardy analyses such as this one, to ensure that take associated with the projects did not jeopardize the continued existence of the species. As section 7 is intended to prevent further harm to the species, it is those projects that do not obtain incidental take authorization either through section 7 or section 10 processes that put the species at risk.

Take of Indiana bats has been authorized in BOs for other actions. In the Midwest RU between 2009 and 2013, BOs have been issued for projects including road and bridge projects, bike trails, hazard tree removal, culverts, timber harvest, military training and land management, forest management plans, railroads, and prescribed burns[11]. Generally, these projects result in take through habitat modification and loss, or lethal take of only a few individuals over a short time frame. These types of projects generally have short term effects. Take of individuals that may occur from these projects is generally reflected in the baseline of the population estimates generated through the biannual winter surveys.

Range-wide and Recovery Unit Needs

To recover the Indiana bat, it is important to ensure genetic representation, redundancy (populations distributed across the landscape) and resiliency (sufficiently large populations). To do this, we must address the following needs:

1. Maintaining the current winter and summer range of Indiana bat.
The key steps of conserving and managing Indiana bats across the species range include establishing Indiana bat RUs, and maintaining self-sustaining Indiana bat populations in each RU.

2. Conserving and managing winter colonies and hibernacula.
The key steps in conserving and managing winter colonies and hibernacula include: Maintaining both large and small hibernating populations; maintaining or providing appropriate physical structure, airflow, and microclimate of the hibernacula; maintaining forest habitat surrounding hibernacula; avoiding disturbance of hibernating bats which can lead to excessive arousal and premature depletion of fat reserves; and minimizing disturbance of bats during the swarming period that can lead to disruptions in mating and foraging activity.

3. Conserving and managing maternity colonies.
The key steps in conserving and managing maternity colonies include: locating maternity colonies in each RU via spring emergence radio tracking or summer surveys; Ensuring a sufficient number of self-sustaining maternity colonies persist in order to support the regional population (i.e., RU population) by managing and controlling threats acting,

[11] See: http://www.fws.gov/midwest/endangered/mammals/inba/inbaBOs.html. Accessed June 27, 2013.

singly and cumulatively, upon the fitness of maternity colonies; and, maintaining the ecological processes that ensure the continued availability of roosting, foraging, and commuting habitat needed to support maternity colonies.

4. Conserving migrating Indiana bats.
The key steps in conserving and managing migrating Indiana bats include: understanding Indiana bat migration, including migratory routes , behaviors and differences between fall and spring migration; maintaining safe and suitable migration pathways across the species range; conserving and managing important stopover habitat, if such habitat is deemed necessary; and, identifying limiting factors and manage threats during migration at levels that will not impede recovery, including determining if stopover habitat is limiting to Indiana bats during migration, and if so, conserve and manage stopover habitat, minimizing/managing fatalities due to wind energy, and minimizing/managing other (yet to be identified) threats to successful migration.

5. Managing the effects of white-nose syndrome (WNS).
The key steps of managing the impacts of WNS may include: avoiding/minimizing the transmission of *Geomyces destructans*; implementing measures to control *G. destructans* should effective, non-harmful measures become available; and restoring and protecting populations affected by WNS, with emphasis on populations that are seemingly more resilient to the disease.

III. ENVIRONMENTAL BASELINE

This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat (including designated critical habitat), and ecosystem, within the Action Area. The environmental baseline is a "snapshot" of a species' health today given the impacts from all past, current, and ongoing factors. The status of the Indiana bat within the Action Area is summarized below. Additional information can be found in the HCP (Stantec 2013).

Status of the Indiana bat within the Action Area

Initial mist-netting surveys conducted for the Project in 2008 resulted in no Indiana bats captured in the Action Area (Stantec 2008). Two reproductive females and one non-reproductive male were captured approximately 7.7 km (4.8 mi) to the north of the Action Area. Based on the results of the 2008 survey, the Project boundary was adjusted to avoid impacts to these Indiana bats. Specifically, the northern Project boundary was moved to the south so that it was at least 8.0 km (5 mi) from the closest Indiana bat capture.

During mist-netting conducted for an unrelated proposed wind development project in 2009, a total of five Indiana bats were captured within the Action Area (Jackson 2009). One adult lactating female Indiana bat was captured in June 2009 in the central portion of the Action Area and flew 10.1 km (6.3 mi) southeast following her capture. Her roost tree was located approximately 2.4 km (1.5 mi) east of the Action Area, where her transmitter signal was lost. No home range was calculated for this female due to an insufficient sample size of radio locations. Five emergence counts were conducted at her roost tree with an average emergence count size of 32.6 ± 12.8 bats and a maximum count of 46 bats, all assumed to be adult females since surveys were conducted in late June, prior to juveniles becoming volant. These bats constitute one maternity colony and are included in calculations for the Action Area population because at least one member of the colony was documented using the Action Area, and potential foraging and commuting habitat for the colony has been identified within the Action Area.

Three additional adult lactating female Indiana bats were captured and radio-tagged in late June 2009 at a single mist net location in a riparian woodlot in the northernmost portion of the Action Area (Jackson 2009). An additional Indiana bat was captured during this same netting event, but escaped as it was being removed from the net. Radio telemetry data from the three female Indiana bats was used to generate homes ranges using the minimum convex polygon (MCP) method (Mohr 1947) producing a combined MCP home range of 1,099.3 ha (2,716.5 ac), ninety-three percent of which was situated within the Action Area (Jackson 2009). This portion of the MCP occupied 3% of the Action Area.

The radio telemetry data was also used to track the three females to roost trees in order to locate maternity colonies and conduct emergence counts. Three roost trees were identified in the Action Area. All three bats used the same roost tree on six nights, which had an average emergence count size of 21.0 bats ± 12.9 bats and a maximum of 38 bats at this one tree on one night. Average emergence count sizes at the other two roosts were 7.3 ± 3.6 (maximum of 12) and 2.3 ± 0.6 (maximum of 3). This grouping constitutes the second confirmed maternity colony within the Action Area. Simultaneous counts at all three identified roost trees only occurred on 2 nights, and totaled a maximum of 29 bats (Jackson 2009).

Potential Summer Population of Indiana Bats in the Action Area

This population was estimated using data from the three Indiana bats tracked within the Action Area in 2009, as well as seven adult female Indiana bats captured and radio-tagged in 2008 and 2009 during summer mist-netting surveys in the tri-county area[12] (for this Project as well as other wind power projects) along the Bellefontaine Ridge (Stantec 2013). Summer population estimates were based on 76 emergence counts at 23 roost trees in the tri-county area, the home range sizes (estimated from nighttime telemetry) of the female Indiana bats using those roost trees, and the number of maternity colonies the Action Area could support.

Based on simultaneous emergence counts conducted at known Indiana bat roost trees within or near the Action Area, a minimum Indiana bat summer population size of 99 was documented in 2009 (Stantec, 2013) and two maternity colonies were documented. Indiana bats were assumed to occur in suitable habitat throughout the Action Area when modeling maximum population size, to take the most conservative approach when estimating risk (Stantec 2013). Using a combination of site-specific, empirical data, models predicting and quantifying suitable habitat within the Action Area (Stantec 2011) and conservative assumptions based on relevant literature and professional judgment, and after increasing the estimated population by 8% to account for

[12] Champaign, Logan, and Hardin Counties.

males (based on the proportion of males captured in mist-netting surveys in 2008 and 2009 in the tri-county area), the estimated mean summer Indiana bat population within the Action Area was 415 Indiana bats (see HCP Appendix A, Section 2.1.1 for detailed methods).

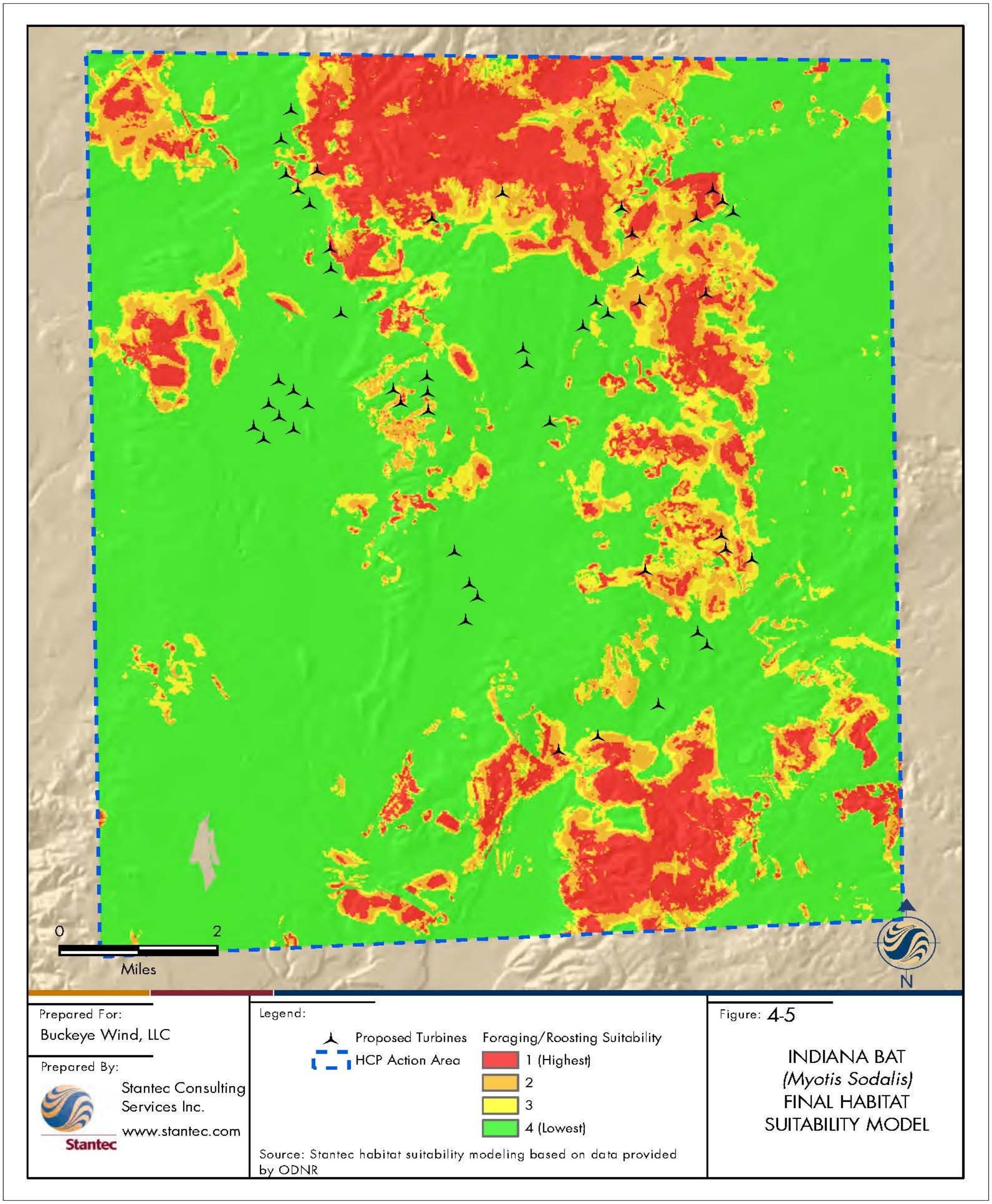
Indiana Bat Habitat Suitability in the Action Area

Data from Indiana bats captured in the tri-county area in 2008 and 2009 were also used to model Indiana bat habitat suitability in the Action Area (Figure 6, Stantec 2011, See HCP Appendix B). From the model results, four categories of habitat suitability were described: Category 1, Category 2, Category 3, and Category 4, representing most to least suitable habitat, respectively. Indiana bat foraging habitat was strongly associated with the configuration and spatial relationships of forested patches; the three most important variables were the degree of forest fragmentation, the connectedness of forest patches, and the total core area of forested habitat.

This differed from roosting habitat suitability, which was driven largely by distance to streams[13], distance to forested streams[14], and distance to the nearest forest edge. Habitat in Categories 1, 2 and 3 were considered suitable for roosting, foraging commuting and migrating, and Category 4 was considered unsuitable for roosting and foraging, but suitable for migratory Indiana bat use. Twelve percent of the Action Area (4,016.1 ha (9,923.9 ac)) was categorized as having the highest suitability (i.e., Category 1) for Indiana bat roosting and foraging activities (Figure 6). Categories 1, 2, and 3 habitats collectively comprised 9,846.4 ha (24,331 ac), which is equal to approximately 30% of the total Action Area (Stantec 2011).

[13] Distance to streams was derived from National Hydrography Dataset 2009 high resolution linear water features and include perennial, intermittent, ephemeral, and man-made streams.
[14] Distance to forested streams was derived from National Hydrography Dataset 2009 high resolution linear water features intersecting NLCD 2001 forest pixels codes 41, 42, and 43.

Figure 6. Indiana bat Final Habitat Suitability Model



Migrating Indiana Bats in the Action Area

According to the HCP, data from the 2008-2009 Indiana bat winter census were used to estimate the number of Indiana bats likely to pass through the Action Area during spring and fall migration (i.e., the migratory population within the Action Area). The Applicant's assumptions about the distances and directions of travel during migration were derived from literature, expert opinion, and Indiana bat band returns[15]. Appendix A of the HCP contains a detailed description of the Applicant's migration estimation methodology. These data were used to estimate the numbers of Indiana bats likely to pass through the Action Area during migration, which ranged from approximately 2,900 to 5,800 Indiana bats.

Factors Affecting Species Environment within the Action Area

This analysis describes factors affecting the environment of the species or critical habitat in the Action Area. The baseline includes the past, present and future impacts from federal, state, tribal, local, and private actions that have occurred or are presently occurring. This analysis also includes impacts from future federal actions that have undergone section 7 consultation.

As previously mentioned, the Indiana bat was listed as an endangered species in 1967. Section 4 of the Act states that a species may be listed due to any of the following five factors:

1) The present or threatened destruction, modification, or curtailment of its habitat or range;
2) Overutilization for commercial, recreational, scientific, or educational purposes;
3) Disease or predation;
4) Inadequacy of existing regulatory mechanisms; and
5) Other natural or man-made factors affecting it continued existence (16 U.S.C. § 1533 (a)(1)).

Of these factors, only the first three merit discussion in this section.

Destruction, Modification, or Curtailment of its Habitat or Range

Within the Action Area, the majority (69%) of vegetation in the Action Area is comprised of the National Land Cover Database's *Cultivated Crop* landcover type (mostly corn and soybeans), 13% is comprised of *Pasture/Hay*, 9% is comprised of *Deciduous Forest*, and 6% is comprised of *Developed Open Space* (Stantec 2013). These land use proportions have not changed substantially since listing of the Indiana bat, and it is unlikely that significant land use changes will occur in Action Area during the duration of the ITP.

Humphrey et al. (1977) observed that summer habitat did not appear to be limiting to the Indiana bat. Since that time, loss of forest cover and degradation of forested habitats have been cited as part of the decline of Indiana bats (Service 1983, Gardner et al. 1990, Garner and Gardner 1992, Drobney and Clawson 1995, Whitaker and Brack 2002). Prior to European settlement, the state

[15] When Indiana bats are captured a small aluminum band is placed over the humerus bone. The band has a unique number that allows agencies or researchers to identify specific individuals if they are encountered in the future.

of Ohio was approximately 95% forested; subsequent settlement and the dramatic growth of agriculture in the state resulted in the decline of forest cover to a low of 12% in 1940 (ODNR DOW 2011). Since 1940, Ohio's forestland has been increasing, and in 2001 comprised approximately 33% of the state's land area (Stantec 2013). There are 766 distinct forest patches in the Action Area that average 3.6 ha ± 10.0 ha (9.0 ac ±24.7 ac) in size and vary from 0.08 ha to 106.5 ha (0.2 ac to 263.09 ac). Eighty-two percent of the forest patches were less than 4.0 ha (10 ac) in size; Indiana bat habitat within the Action Area is highly fragmented.

No Indiana bat hibernacula occur within the Action Area although summer habitat is present. No activities have been identified within the Action Area that regularly occur and that would substantially affect the existence of forested habitat. The Action Area is primarily rural and used for agriculture and low density residential areas. The occasional tree/snag removal or timber harvesting by non-Federal entities may take place within the Action Area. Additional single family residences, out buildings, and other small scale development may also occur within the Action Area during the life of the Project. No quantification of the number or location of these activities is available. It is possible that tree harvest associated with these activities could affect Indiana bats, depending on the acreage of trees cleared, the proximity of the impacts to maternity colonies, and the time of year that tree clearing occurs.

Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

The Indiana bat population within the Action Area was surveyed via mist-netting in 2008 and 2009 and some bats were radio-tracked to determine roost trees and foraging areas. These activities were authorized under section 10(a)(1)(A) permits. Besides this temporary disturbance, the Service is unaware of any current or future tribal, state, local, or private actions that may result in overutilization of the Indiana bat for commercial, recreational, scientific, or educational purposes within the Action Area.

Disease or Predation

As introduced above, WNS is a devastating disease affecting many eastern U.S. bats including Indiana bats. The disease was first documented in the Midwest RU in 2011 and has since spread to multiple hibernacula throughout the RU. Both of the current Indiana bat hibernacula in Ohio (Preble and Lawrence Counties) are infected. To date, WNS has not been detected within the Action Area or Champaign County. ODNR obtained one bat specimen in the winter of 2012-2013 from neighboring Logan County, and submitted it to a lab for WNS testing, but no results have been received yet. Regardless, it is likely that bats within the Action Area have been exposed to WNS due to its ubiquitous spread to hibernacula across the RU.

Several survey events have occurred at the Lawrence County, OH hibernaculum over the past two years to attempt to document WNS population impacts. Between the first year WNS was documented in this hibernaculum (2011) and the 2013 survey event, the Indiana bat population declined by 94 percent (Schultes 2013, Table 5). However this hibernaculum has a small population overall, and has been variable over time, so the magnitude of the change that is attributable to WNS is unknown.

Table 5. Biennial bat census results between pre- and post-WNS mid-winter (2003-2011 and 2013, respectively) censuses for the Lawrence County Mine, Ohio. (From Table 1 in: Schultes 2013)

	Pre-WNS					Post-WNS
Species	**2003**	**2005**	**2007**	**2009**	**2011****	**2013**
Little brown	299	704	1344	593	916	213
Indiana	208	333	224	254	276	16
Tri-colored*	38	40	99	129	134	132
Big brown	5	6	6	3	3	5
Northern long-eared	0	3	11	2	1	14
Flying/Unidentified	13	3	0	0	4	0
TOTAL BATS	**563**	**1089**	**1684**	**981**	**1334**	**380**

*formerly *Pipistrellus subflavus*
***WNS first documented*

From a range-wide and RU perspective the impact of WNS has been variable. As explained in the Status Section, WNS in the Midwest RU has not yet followed the pattern documented in the Northeast. It is unknown how populations of Indiana bats within the Action Area have been affected by WNS in the last two years, compared to population estimates derived before the arrival of WNS in Ohio in the winter of 2010-2011.

IV. EFFECTS OF THE ACTION

In evaluating the *effects of the action*, section 7 of the Endangered Species Act and the implementing regulations (50 CFR §402) require the Service to consider both the direct and indirect effects of the action on the species, together with the effects of other activities that are interrelated or interdependent with the action that will be added to the environmental baseline. *Direct effects* are those effects that have immediate impacts on the species or its habitat while *indirect effects* are those that are caused by or will result from the proposed action and are later in time, but are still reasonably certain to occur. *Interrelated actions* are those that are part of a larger action and depend on the larger action for project justification. *Interdependent action*s are those actions that have no independent utility apart from the action under consideration.
The *effects* evaluation is necessary to make the required determination under 7(a)(2), of insuring the Federal action does not jeopardize the continued existence of the species, or result in the destruction or adverse modification of designated critical habitat.

Our analytical approach for our effect analyses is to identify: (1) the environmental consequences Indiana bats will be exposed to, (2) who will be exposed and when (males vs. maternity colonies), and (3) how these individuals will respond upon exposure. Once we understand how exposed individuals will respond in terms of reproductive and survival, we will assess whether the collective responses will affect the survivorship and reproductive potential of the populations to which they belong (i.e., maternity and winter colonies). Our analysis is structured to demonstrate that the weight of the evidence indicates reductions in survivorship and reproductive potential are unlikely to occur. This structure will assist the Action agency in demonstrating that it has "insured" that its action is unlikely to jeopardize the continued existence of the Indiana bat.

Indirect Effects

Construction and Decommissioning

Wooded Habitat Removal

Indiana bats use wooded areas, including upland, wetland, and riparian areas, for roosting, foraging, and traveling. Therefore, impacts to wooded habitats from Project activities have the potential to indirectly affect the Indiana bats by decreasing roost availability, decreasing foraging habitat availability, and requiring additional time to forage to acquire adequate nutrition and to search for suitable roost trees.

As previously mentioned, no more than 6.5 ha (16.1 ac) (6.8 ha (16.8 ac) for Redesign Option) of wooded area will be removed for the Project, which includes tree removal for stream crossings. All trees will be removed during the non-active period for the Indiana bat, which could indirectly affect returning adult females and their young. Forest patches to be cleared will be small, with an average size for the known 52 turbine locations of 0.2 ha ± 0.4 ha (0.4 ac ± 0.9 ac) and a maximum size of approximately 1.1 ha (2.7 ac). The other areas of tree clearing are less than 0.2 ha (0.4 ac). For the additional 48 turbines, a maximum forest patch size of approximately 1.1 ha (2.7 ac) may be cleared. None of the documented roost trees or habitat within approximately 2.9 km (1.8 mi.) of the roost trees will be cleared.

No wetlands will be impacted during the construction, operation, maintenance, or decommissioning phases of the Project.

Access roads, crane paths and collection lines for the 100 turbine Project are expected to cross no more than 49 streams under the redesign option (32 crossings without redesign option), most of which are drainage ditches or other waterways of low habitat quality. No more than 487 linear meters (1,598 linear ft) of streams would be impacted, and many of these impacts would be temporary in nature (e.g., trenching across an ephemeral stream during periods of no water flow for installation of collection lines). There will be no impacts to Exceptional Warmwater or Coldwater Habitat streams.

Runoff from Project activities will be managed under a NPDES construction storm water permit and associated SWPPP. Sediment and erosion control measures implemented through the NPDES permit will help to minimize sedimentation and other water quality impacts in the Action Area. Therefore, impacts to water quality within the Action Area are expected to be minimal, widely dispersed, and temporary in nature.

The Applicant will implement all appropriate low impact stream crossing techniques for road crossings and crane path crossings. Collection lines will be installed in the dry on ephemeral and intermittent streams or directional drilling will be used to cross the streams with no in-water work. Interconnect lines that cross perennial streams will be directionally bored, regardless of the streams' beneficial use classification. Permanent impacts to stream habitat would be expected at road crossings where culverts are used, but the footprint of these impacts would be very small (maximum of approximately 27.4 m (90 ft) of stream length) per crossing.

Habitat loss, even small amounts, can have reproductive and survival consequences for reproductive Indiana bats. Owing to their strong site fidelity and their energetically stressed condition in spring, loss of a primary roost tree or portions of their foraging area can cause delayed fetal development, fetal abortion, and reduced body condition. We do not anticipate, however, that the projected habitat loss associated with the proposed action will induce reproductive or survival consequences for Indiana bats using the action area. The reasons for this are as follows: Tree clearing will only occur during the winter when Indiana bats would not be exposed to clearing activities; the total area proposed for tree clearing represents only 0.5% of the average home range of the 3 Indiana bats radio-tracked in the area (3,104 acres ± 2,223 acres); patches of habitat to be removed are small (no greater than 1.1 ha (2.7 ac)); and, the habitat loss will be dispersed throughout the Action Area.

Further, the Service conducted a habitat assessment of areas of forest to be impacted by the 52 turbines (and associated infrastructure) with known locations, on November 17, 2010. Eleven areas of tree clearing were evaluated, totaling 1.616 ha (3.994 ac). Five of the areas supported potential roost trees and two of those areas also supported potential maternity roost trees. While some of the potential roost trees may be cleared, Buckeye Wind committed to minimizing impacts to these trees to the extent possible by offsetting the 61 m (200 ft) clearing radius around specific turbines and shifting narrow utility line corridors slightly to avoid specific potential roost trees. In all of the areas where multiple potential roost trees were to be removed, additional potential roost trees would remain in the surrounding woodlot. Of the two potential maternity roost trees identified, one will likely be avoided by offsetting the clearing radius around the turbine to avoid the wetland within which it was located, and the other will be impacted. The Service will conduct a second habitat assessment of forested areas to be impacted by the remaining 48 turbines when those locations are determined. We will identify micro-siting options to minimize potential impact to suitable roost trees as was done for the 52 known turbine locations.

Given the amount of habitat that will be loss relative to what is available, and given that the loss will not be concentrated in any one area, we believe it is unlikely that quality and quantity of habitat will be reduced to the extent that reproductive or survival consequences are incurred. Therefore, any indirect adverse effects from tree removal during the non-active period for Indiana bats would be insignificant and not rise to the level of take.

<u>Operation and Maintenance</u>

Vegetative Control

Periodic tree trimming will occur within the Action Area for safety and accessibility. Only trimming of trees that are not suitable for Indiana bat roosting may occur during the active period, all other trimming activities will take place during the non-active period for the Indiana bat (1 November - 31 March). Trimming of trees is not expected to alter the suitability of the roost tree as a whole. Therefore, reproductive and survival consequences are unlikely to occur as result of vegetation control associated with operations and maintenance.

Direct Effects

Construction and Decommissioning

Noise, Vibration, and Disturbance

Increases in disturbance (i.e., in the form of increase in noise, human activity, and vibrations from equipment) are expected to result from construction and decommissioning activities, but the increases will be temporary. Construction activities are expected to occur during daylight hours throughout the year, and activity is likely to be heaviest during the spring, summer, and fall. Tree clearing will take place during Indiana bat hibernation, 1 November through 31 March. The Project, including all 100 turbines, will be constructed within one to two construction phases; each phase is expected to continue for 12 to 18 months. The maximum potential construction disturbance at any particular location would occur over a few days to up to a few weeks. Decommissioning activities will not exceed an approximate time period of one year.

None of the 100 turbines will be closer than 2.9 km (1.8 mi) to any maternity roost tree identified in 2009. However, as previously stated, 3% of the Action Area contains ninety-three percent of the 1,099.3 ha (2,716.5 ac) home range (including roosting, foraging and commuting habitat) identified for three females captured in 2009. This means that turbines could be located near foraging and commuting habitat within the Action Area. Further, though foraging and homerange data are available for 3 individuals, many other individuals are also foraging within the Project area and no data are available for these individuals. Finally, Indiana bats are known to use multiple roost trees each year, and to switch between roost trees regularly. To account for these possibilities, we assume that Indiana bats have the potential to occur in suitable habitat throughout the Action Area. Thus, Indiana bats in the Action Area could be exposed to noise levels and vibrations that they have not experienced in the past if unidentified maternity roost trees are located in close proximity to construction or decommissioning activities. This disturbance could cause Indiana bats to abandon primary roosts in the immediate vicinity of the disturbance, shift their centers of activity to secondary roosts, or temporarily avoid foraging areas near disturbances. Indiana bats may also tolerate the temporary disturbance, as they may be used to the sounds and vibration of farm equipment regularly used in the Action Area.

Construction related activities may disturb Indiana bats that roost or forage in habitat ranked as Category 1, 2, or 3 located near turbines, roads, collection lines, substation, O&M facility, met towers, or lay-down areas. Shifts in Indiana bat activity that may occur are likely to be temporary, since construction activity is not likely to exceed a few weeks at any one location. Shifts in Indiana bat activity that may occur are likely to be short-term, and disturbed bats may return to the area once the construction work has been completed and the noise/vibration/etc. has ceased. Shifts in Indiana bat activity that may occur are likely to be localized as the project components have a small physical footprint and are dispersed across the Action Area.

In summary, construction noise and vibration may cause adverse effects to Indiana bats via disruption of breeding, feeding, or sheltering, but these effects are expected to be temporary and localized. Thus, reproductive and survivorship consequences at the colony level are unlikely.

Collision with Vehicles

There is evidence that bats (including Indiana bats) can be killed by collision with vehicles. A single Indiana bat fatality along with multiple little brown bat fatalities were documented over a 36-day study resulting from presumed collision with vehicles on U.S. Route 22 in Pennsylvania (Russell et al. 2008). This study was conducted on a highway with a narrow corridor, surrounded by forest. Project vehicles within the Action Area will be traveling along established roads that already support significant traffic and which are surrounded mostly by agricultural fields, a landscape that does not concentrate traveling bats in high numbers. In addition, Project vehicles traveling along access roads between construction and decommissioning sites will be moving slowly and will be dispersed throughout the Action Area, providing little chance for collisions with bats. Traffic associated with the Project will also take place mostly during the day, when Indiana bats are not flying. For these reasons, we anticipate that collisions with vehicles associated with construction and decommissioning are unlikely to occur.

<u>Operation and Maintenance</u>

Sound from Operating Turbines

The influence of turbine-generated sound on wildlife varies with the auditory perception of the species and the extent to which their life history strategy depends on sound. We know little about the effects to Indiana bats, or other bats species, from increases in ambient sound generated by wind turbines. Studies have shown that gleaning bats, or bats that rely on prey-generated sounds to locate and capture insects while foraging (Neuweiler 1989), are susceptible to the masking effects of sound emissions. However, Indiana bats hunt prey in the air while flying, also known as hawking, using echolocation (an auditory behavior that uses ultrasonic signals to detect prey and maneuver through the environment) instead of prey-generated sounds. Little information is available in the literature regarding the specific effect turbine noise has on bat species utilizing echolocation in their search for prey. Instead, most studies on this topic have researched the ability of echolocating bats to detect and avoid spinning and stationary turbines (Long et al. 2009).

Operational turbines that occur in the vicinity of undocumented roost trees or foraging areas may create sound that is detectable to Indiana bats in these areas. However, sound from wind turbines is low (less than 50 dB) 61 m (200 ft) from a wind turbine (Hessler 2009). Additionally, feathering of turbines at low wind speeds at night will be used as tool to minimize impacts to Indiana bats and will help reduce turbine-generated increases to ambient sound levels during the Indiana bat foraging period. During summer months, when foraging success is critical for successful rearing of pups, more restrictive nightly cut-in (wind speed at which the turbine starts producing energy) speeds and feathering regimes would be applied to Project turbines located in the higher Habitat Categories (i.e. Categories 1-3). Therefore, cut-in speed prescriptions coupled with feathering will simultaneously reduce bat strike fatalities and keep ambient sound levels low during biologically sensitive periods and within ecologically important areas. Given minimal increase in ambient sound during the summer, we anticipate that reproductive and survival consequences are unlikely to occur.

Lighting

The Applicant will minimize turbine lighting per specifications of the Federal Aviation Administration (FAA). Attached to the top of some of the nacelles will be a single, medium intensity aviation warning light. Approximately one in every 5 turbines will be lit, and all lights within the Project will illuminate synchronously. FAA lights will be flashing red strobes (L-864) only at night, and the Applicant will use the lowest intensity lighting as allowed by the FAA. To the extent possible, Service-recommended lighting schemes will be used on the nacelles, including reduced intensity lighting and lights with short flash durations that emit no light during the "off phase." Meteorological (MET) towers will also utilize the minimum lighting as required by the FAA.

A limited number of security lights may be required at the substation and O&M facilities. This operational lighting will be minimized and Project design will incorporate minimum intensity lighting on all Project structures where feasible. No steady-burning lights will be left on at Project buildings; where lights are necessary for safety or security, motion detector lighting or infrared light sensors will be used to avoid continuous lighting. All security/safety lighting will be shielded downward to minimize skyward illumination. It is not anticipated that the flashing red FAA lighting, nor the low intensity security lighting will concentrate a significant amount of prey for the Indiana bat.

Arnett et al. (2008) synthesized available information on bat fatalities from 21 studies conducted at 19 wind energy facilities in 5 regions of the United States and 1 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 WV and at the Meyersdale facility in PA 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 thermal imaging 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.

Therefore, Indiana bats should not be attracted to Project lighting, and thus this lighting will not result in survival or reproductive consequences for Indiana bats using or traversing the Action Area.

Vegetative Control

Herbicides may be used around Project facilities to control invasive species or other types of vegetation (e.g., along roads), and the post-construction mortality monitoring calls for some clearing of search plots, which could involve either mowing or herbicides. The majority of Project facilities will be located in areas that are currently used for agricultural purposes, which commonly receive herbicide treatments. Herbicide use will not extend outside of disturbed areas.

Clearing the post-construction mortality monitoring search areas (described later) of at least 25% of the turbines to increase searcher efficiency rates will not result in the removal of Indiana bat habitat. Tree trimming will be performed only during the Indiana bat inactive period, and should be minimal (e.g. along roads). No additional wooded areas beyond those removed during Project construction would be cleared during the Indiana bat active period during operation and maintenance. Noise from mowing equipment is expected to be similar to that produced by agricultural practices that are ongoing within the Action Area. Therefore, survival and reproductive consequences to Indiana bats from vegetative control are not likely.

Collisions with Vehicles

The small amount of vehicular traffic associated with Project operation and maintenance of the 100 turbine Project will be insignificant compared to current traffic in the Action Area, and will occur mostly during daylight hours when Indiana bats are not active. It is anticipated that collisions with vehicles during operation and maintenance are unlikely to occur.

Collision/Barotrauma Mortality

Impacts to bats of multiple species from collisions with wind turbines or barotrauma are well documented. Barotrauma is defined as internal hemorrhaging due to an over-expansion of hollow respiratory structures, and is caused by a sudden drop in air pressure near turbine blades. Prior to 2009, no Indiana bats were known to have been killed at wind facilities. To date, 5 Indiana bat fatalities have been documented in post-construction monitoring studies at wind energy facilities. Two of the fatalities occurred at the Fowler Ridge wind facility in Benton County, IN, during the fall migration period; the first occurred in September 2009 and the second occurred in September 2010 (Good et al. 2011). The third Indiana bat fatality occurred at the North Allegheny Wind facility[16] in Cambria and Blair counties in Pennsylvania. This fatality also occurred during the fall migration period in September 2011. The fourth Indiana bat fatality occurred on July 26, 2012 at the Laurel Mountain Wind Power facility[17] near Elkins, WV. The fifth Indiana bat fatality occurred on the night of October 2-3, 2012 at the Blue Creek Wind Farm[18] in Paulding County, OH. Four of these mortalities confirm that Indiana bats are at risk of

[16] See <http://www.fws.gov/northeast/pafo/>. Accessed October 2011.
[17] See http://www.fws.gov/westvirginiafieldoffice/ibatfatality.html. Accessed November 15, 2012
[18] See
http://www.fws.gov/midwest/News/release.cfm?rid=604&utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+FwsMidwestNewsroom+%28FWS+Midwest+News+and+Highlights%29

collision with wind facilities during the fall migratory period. The July mortality indicates that male Indiana bats are also at risk during the summer. Risk in spring and summer to female Indiana bats from operation of wind facilities within the homerange of maternity colonies remains unknown. It is assumed that additional Indiana bat mortality has occurred at wind farms across the country, but has not been documented due to lack of or insufficient post-construction monitoring, inaccurate identifications, surveyor biases, decomposition, and removal by scavengers.

Collision Risk Model

It is expected that take of Indiana bats will occur during Project operation via collision with turbines and barotrauma. The Applicant has developed a collision risk model (Stantec 2010, see HCP Appendix A) to estimate Indiana bat mortality as a result of Project operation. This model is presented in full in Appendix A of the HCP; this section of the Biological Opinion offers a brief summary of the model development and results. It is important to note that the model assumed the 100 turbine layout, although only 52 turbine locations are known at this time.

Mortality of Indiana bats was estimated during 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" (1 April to 31 May), summer habitat use, or "summer" (1 June to 31 July), and fall migration, or "fall" (1 August to 31 October). It is important to note that although discreet activity periods were delineated for modeling purposes, a great deal of overlap is expected to occur, especially between the spring migration and summer habitat use, and also between summer and the fall migratory period (R. Niver, Service, 2012, personal communication). As Indiana bats travel from winter hibernacula to summer maternity sites, they move quickly across the landscape. This can set up a scenario where individuals are still passing through an area as other bats are setting up maternity colonies at the same site. Given the uncertainty in modeling Indiana bat collision in the Action Area, the Bolker et al. (2006) model was used, but expanded upon by incorporating empirical data and expert opinion on Indiana bat behaviors and conditions leading to risk. For model inputs whose distributions were based only partially or not at all on empirical data, a sensitivity analysis was conducted to investigate the degree to which changes in the input distributions affected model results.

According to the model, season-specific estimates of collision/barotrauma were influenced by five primary factors: seasonal population size, flight height, weather conditions that influence the number of bats that are active on a nightly basis, movement bouts within the turbine array, and mortality probability. A conservative approach was used to estimate the summer population of Indiana bats within the Action Area, whereby Indiana bats were assumed to have the potential to occur throughout the Action Area during the summer. This approach is more likely to overestimate the number of individuals currently in the Action Area, so the maximum likely impact is projected. Based upon empirical data from emergence counts and radio-telemetry, models predicting suitable habitat within the Action Area, and professional opinion, the mean summer Indiana bat population size was estimated to be 415 Indiana bats, including adult female, adult male, and juvenile bats. A minimum population size of 99 Indiana bats, including adult female, adult male, and juvenile bats, was estimated in the summer of 2009, based on simultaneous emergence counts conducted at multiple known Indiana bat roost trees within or near the Action Area.

The size of migratory populations of Indiana bats moving through the Action Area during the spring and fall migration periods was extrapolated from Service Indiana bat population estimates from winter 2008-2009 hibernacula surveys within the migratory range of the Action Area. This population was estimated to range from approximately 2,900 to 5,800 migrating Indiana bats.

Flight height was an input variable that strongly influenced the potential for collision. Assumptions about this variable were informed by the height distribution of *Myotis* call sequences recorded with acoustic devices, as well as observations of Indiana bat and *Myotis* flight height reported in the literature and expert opinion. To account for the uncertainty of Indiana bat flight height compared to the rotor swept zone, probability distributions were created for high (>153 m = above rotor-swept zone), moderate (>47m and <153m = within rotor-swept zone), and low (<47m = below rotor swept zone) flight height scenarios and run as separate models (Table 6). Cut-off altitudes of 47 m and 153 m reflect a 3m addition to rotor blade length to account for the potential for barotrauma effects in areas within 3m of turbine blades.

Table 6. Proportion of Indiana bats assumed to be flying within the rotor swept zone under high, moderate, and low flight height scenarios of the collision risk model (Stantec 2010).

Flight height scenario	Season		
	Spring	**Summer**	**Fall**
Low	5%	1%	10%
Moderate	15%	10%	20%
High	25%	20%	30%

Probability distributions for wind speed and temperature were developed from approximately three years of data collected at two MET towers in the Action Area. Movements across the turbine array were estimated separately for summer and fall migration. Mortality probability was estimated based on the average number of turbine encounters for all possible flight directions and all possible flight heights (weighted by probability), adjusted by a randomly selected survival probability between 0 and 1 that varied among 3 different survival scenarios with differing Beta distributions. The factors affecting the number of predicted turbine encounters are turbine location, height of turbine center (nacelle height), rotor length, angle of approach, probability of safe passage, and flight height.

Collision Risk Model Results

The predicted amount of mortality is based on the mean values predicted by model simulations, using various model inputs (Appendix A of HCP, Stantec 2010). Annual Indiana bat mortality for the low, moderate, and high flight height scenarios (without feathering or cut-in speeds) ranged from 6.9 Indiana bats per year to 25.4 Indiana bats per year, which includes adult female, adult male, and unborn and non-volant juveniles in the spring and summer (Table 7).

Table 7. Collision risk model-predicted seasonal and annual Indiana bat fatalities (median values) under high, moderate, and low flight height scenarios within the rotor swept zone for 100 turbine Buckeye Wind Project (Stantec 2010).

Flight height scenarios	**Mean fatalities of 3 survival scenarios**			
	Spring	**Summer**	**Fall**	**Annual**
Low	2.4	0.1	4.4	6.9
Moderate	6.8	0.7	8.7	16.3
High	10.9	1.5	13.0	25.4

Collision risk model results reported in Appendix A of the HCP (Stantec 2010) indicate that predicted mortality of Indiana bats is highest during migratory periods and lowest during summer residency in maternity colonies. As previously mentioned, the results of the collision risk model represent mortality probabilities under operating conditions that do not include feathering of turbines or cut-in speeds. However, for this Project, feathering will be applied to turbine operations with varying operational constraints (Table 8) as a condition of the HCP and associated ITP in order to minimize take of Indiana bats.

Table 8. Summary of nighttime operational feathering that will be applied to turbines during Evaluation Phase Year-1. Feathering will be applied to all turbines, using cut-in speeds that correspond to the habitat risk category assigned to each turbine location (Stantec 2013).*

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 will 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.
** During all seasons, turbines may be operated normally when temperatures are below 10 °C (50°F).
*** 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 will be built.
**** Turbines will be cut-in at the manufacturer's specified cut-in speed. The turbine will be feathered below the cut-in speed.

Various cut-in speed and feathering studies have been conducted to measure bat mortality reduction at different cut-in speeds during the fall migration period (Table 9).

Table 9. Summary of cut-in speed studies at wind facilities.

Study	Cut-in speed	Mean percent reduction in mortality	Mean percent reduction in mortality per cut-in speed	Source
Fowler Ridge (2011)	3.5	36	36	Good et al. 2012
Mount Storm*	4.0	35		Young et al. 2011
Summerview	4.0	58	47	Baerwald et al. 2009
Fowler Ridge (2011)	4.5	57	57	Good et al. 2012
Casselman (2008)	5.0	82		Arnett et al. 2010
Casselman (2009)	5.0	72		Arnett et al. 2010
Fowler Ridge (2010)**	5.0	50		Good et al. 2011
Criterion (2012)	5.0	62	67	Young et al. 2013
Summerview	5.5	60		Baerwald et al. 2009
Fowler Ridge (2011)	5.5	73	67	Good et al. 2012
Casselman (2008)	6.5	82		Arnett et al. 2010
Casselman (2009)	6.5	72		Arnett et al. 2010
Fowler Ridge (2010)**	6.5	79	78	Good et al. 2011

*Average reduction from first and second halves of the night.
**Study did not include feathering below the cut-in speed.

While the HCP was being drafted the Baerwald et al. (2009), Arnett et al. (2010), and Good et al. (2011) studies were available for use. The minimum, median, and maximum average reductions in bat fatalities in these studies were 44.0%, 68.3%, and 86.0% respectively. To estimate take from the Project, the Applicant has applied the median reduction in fatality among all three studies (68.3%) to the median results from the collision risk model (Stantec 2010). The Service believes that use of the median reduction of 68.3% is appropriate for the following reasons: Since the HCP was drafted, several other cut-in speed studies have been made publicly available, and show similar reductions in mortality (Table 9). The cut-in speeds proposed by Buckeye (5.0-6.0 m/s) fall within the range of cut-in speeds studied at other facilities, and therefore it is reasonable to assume that similar reductions in mortality will be observed at the Buckeye Wind project. Specifically, in the Arnett et al. (2010), Good et al. (2011), Young et al. 2013, Baerwald et al. (2009) and Good et al. (2012) studies, cut-in speeds of 5.0 and 5.5 m/s resulted in reduction in mortality of 67%, on average. Buckeye Wind proposes to use cut-in speeds ranging from 5.0-6.0 m/s, slightly higher than the afore-mentioned studies, therefore assuming a slightly higher (1.3%) reduction is acceptable. Further, Buckeye proposes to utilize cut-in speeds throughout the Indiana bat active season (spring through fall), while most other studies have only applied the cut-in speeds during fall migration, therefore it is likely that total bat mortality over the course of the entire active period may be reduced more than in these other studies.

To estimate take from the Project, the Applicant has applied the 68.3% reduction in fatality to the median results from the collision risk model (Stantec 2010), resulting in a take estimate for the Project of 5.2 Indiana bats per year (Table 10). The maximum predicted annual take was calculated by applying the lowest reduction in fatality among the Baerwald et al. (2009), Arnett et al. (2010), and Good et al. (2011) studies (44.0%) to the high flight height results from the collision risk model, resulting in a maximum annual take limit of 14.2 Indiana bats per year (Table 10).

Table 10. Collision risk model-predicted annual Indiana bat mortality for the 100-turbine Buckeye Wind Project with expected reductions from feathering (Stantec 2010).

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

The Service agrees with the use of the moderate flight height scenario to produce a reasonable estimate of collision risk. Based on published data, the Service has determined that Indiana bats typically forage and fly within an air space from 2 to 30 m (LaVal and LaVal 1980 and Humphrey et al. 1977). This would place most summer movement well below the rotor-swept zone (47m – 153m). Data regarding the height Indiana bats fly during migration are lacking. However, of all bat mortalities detected at wind power facilities, *Myotis* spp. bats comprise roughly 10% of total bat fatalities within the range of the Indiana bat (Service unpublished data), possibly indicating that these species are not occurring within the rotor-swept zone of turbines as frequently as the long-distance migrating tree bats. So while we know that *Myotis* bats, including Indiana bats, are occasionally struck at wind facilities and therefore must be flying at rotor-swept height sometimes, the incidence of mortality leads us to believe that either most *Myotis* bats do not fly at rotor-swept height, or that most of the time *Myotis* bats are not flying at rotor-swept height. The moderate flight height scenario accounts for the probability that most Indiana bat flights are below the rotor swept zone, but that a portion of the flights are within the rotor swept zone, and these bats are at risk for mortality.

Annual fluctuations in mortality can be expected, so although annual take is expected to be 5.2 Indiana bats per year, a single year take limit of 14.2 Indiana bats would be authorized. Multi-year levels of take would also be authorized, to ensure that large portions of take do not occur within a short time frame, which could have unintended consequences on Indiana bat populations. Accordingly, expected annual take of 5.2 Indiana bats per year was used to develop 5-year and 25-year take limits of 26.0 and 130.0 Indiana bats, respectively. The 5-year limit is based on the moderate flight height scenario with the mean expected reductions in Indiana bat mortality with feathering and/or curtailment (i.e. 5.2 Indiana bats x 5 years = 26.0 Indiana bats). In this way, take exceeding the yearly estimate of 5.2 Indiana bats/year will be allowed under the permit, provided the 5-year take limit is not exceeded during a consecutive five year period. These take estimates include mortality of adult female, adult male, and unborn and non-volant juveniles. Since most adult female Indiana bats give birth to one pup every year, adult female Indiana bat mortalities found between 1 April and 15 July will be counted as take of two individuals. All take limits are based on estimated take, which is calculated based on number of carcasses found corrected for searcher efficiency, scavenger removal, and searchable area. To ensure that the one-year take limit is not exceeded, immediate adaptive management will be used to adjust cut-in speeds in real-time as Indiana bat carcasses are found during monitoring. Additionally, adaptive management will result in increased cut-in speeds in subsequent years if the estimated take of Indiana bats exceeds 5.2 in any one year.

To account for the impact of WNS, the Applicant has committed to decreasing their requested take based upon future Indiana bat population reductions from WNS in the Midwest RU. Buckeye Wind and the Service will review the biennial winter census results compiled by the Service Indiana Bat Recovery Team and if the population of Indiana bats in the Midwest RU is reduced by 50% or more from 2011 pre-WNS mortality levels (305,297 for the Midwest RU), Buckeye Wind will commit to reducing requested 5-year take limits by 50%. In this event, the 1-year take limit would be 7.1 Indiana bats and the 5-year take limit would be 13.0 Indiana bats (or average of 2.6 Indiana bats per year) (see Section 5.1.2.6.4 of HCP).

The ITP term is 30 years, and includes construction, operation, maintenance, monitoring, mitigation, and decommissioning activities, although no Indiana bat take is expected during construction, decommissioning, and mitigation activities. Post-construction mortality monitoring will be used throughout the life of the Project to ensure compliance with the 1-year, 5-year and 25-year take limits (see HCP Section 6.5). Bias correction factors from searcher efficiency trials will be applied to observed Indiana bat mortality in order to estimate total fatality. These annual take estimates will then be used to inform adaptive management as outlined in Section 6.5 of the HCP, and will be placed into one of three threshold categories (Table 11). In addition, annual take allowances will be pro-rated according to the number of turbines that are operational in a given year (e.g., if only the 52 known turbines are built, then only 52% of the total take will be allowed, resulting in a 1-year take limit of 7.4, a 5-year take limit of 13.5, and a 25-year take limit of 67.6).

Table 11. Threshold categories for annual Indiana bat mortality estimated from observed and unobserved mortality based on the 100 turbine Buckeye Wind Project collision risk model and expected reductions in mortality from feathering (Stantec 2013).

Average Mortality category	**Estimated annual mortality**	**Reasoning**
Less than Expected	Fewer than 5.2 Indiana bats per year	Mortality expected with greater than the median maximum reduction from feathering – 86.0%
Expected	5.2 Indiana bats per year	Mortality expected with the median reduction from feathering – 68.3%
Greater than Expected	Greater than 5.2 Indiana bats per year (not to exceed 14.2)	Mortality expected with less than the median minimum reduction from feathering – 44.0%

Adaptive Management

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 will be the primary method used to gather information about the number of fatalities associated with given operational scenarios, ensure that take limits are not exceeded, and inform adaptive management actions. Mortality monitoring will occur at least annually for the first two years, at least biennially for the subsequent four years, and at least every third year thereafter, depending on monitoring results. In any year when adaptive management results in an increase or reduction in cut-in speeds, mortality monitoring must occur in the subsequent year.

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 within a season in a single year. These trigger points are below the 1-year take limit, but indicate that take levels are likely Greater than Expected (see Table 11) and that cut-in speeds should immediately be increased to avoid exceeding the 1-year take limit. For example, if 2 Indiana bat carcasses are found before the fall season in any one year, immediate adaptive management results in all cut-in speeds at all turbines immediately increased by 1.0 m/s for the remainder of the active period that year.

If no trigger points for *immediate* adaptive management are reached during the monitoring period, 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, corrected for bias. If the annual Indiana bat mortality estimate is at expected or less than expected levels, cut-in speeds can be reduced by 0.5 m/s or maintained at the same level for the subsequent year. If cut-in speeds are changed, mortality monitoring must occur in the subsequent year. If the annual Indiana bat mortality estimate is greater than expected in any one monitoring year without reaching trigger points for immediate adaptive management, then the cut-in speeds would increase by 0.5 m/s for the following year and an additional year of monitoring would occur to confirm that the estimated Indiana bat mortality levels are at or below the expected levels. The Adaptive Management Plan is described in detail in the HCP Section 6.5 and is focused on keeping take at or below the expected annual level of 5.2 Indiana bats per year, and not exceeding 1, 5, or 30 year take limits. Adaptive management can also be used to apply new techniques or new information gained over the life of the permit to help reduce Indiana bat mortality.

Population Response to the Proposed Action

Based on the 25-year project operation, the total number of Indiana bats to be taken under the ITP term is 130.0 (5.2 bats/yr x 25 years = 130). If WNS reduces the Midwest RU population by 50% of 2011 pre-WNS mortality estimates at any point during the permit term, then the take number will be less than 130 Indiana bats. In order to assess the biological significance of this amount of Indiana bat mortality, many factors must be considered, such as the species life history strategy, its sensitivity to change, resilience (ability to recover after a disturbance), and recovery rate (progress towards recovery over time). Similar to most other bat species, Indiana bats are a K-selected species (i.e. Pianka 1970) in that they exhibit a low birth rate, long life span, and naturally low mortality rate. We must also take into consideration the fact that WNS has arrived relatively recently (winter of 2010-2011) within the Midwest RU, and so mortality attributed to this devastating disease has yet to peak within populations of Indiana bats likely to be affected by the Project. Further, the Midwest RU has experienced a delay in post-WNS population declines, compared to those seen in the Northeast RU—after 3 years of WNS the Midwest RU remains stable. The Appalachian RU did not show RU-wide declines until six years post-WNS (45% decline observed in year 6 of WNS). Therefore, it is prudent to complete biological significance of take analyses employing post-WNS population scenarios using the most current scientific information available regarding WNS decline rates and timeframes. As stated previously, WNS has caused a significant decline in Indiana bat populations, especially in the Northeast RU (Thogmartin et al. 2012), and may have a similar effect on Indiana bats within the Midwest RU in the next few years.

Thogmartin et al. (2013) recently published an article describing a stochastic, stage-based population model developed to forecast the population dynamics of the Indiana bat, subject to WNS. The model explicitly incorporates environmental variability in survival and reproduction rates and demographic stochasticity. The model considers only the female portion of the population because of the polygynous nature of the species. It assumes individual wintering populations are closed (no immigration or emigration).

We used the Thogmartin et al. model to assess the impact of the anticipated take of Indiana bats at 2 levels: 1) maternity colony level (local colonies within the Action Area and colonies that migrate through the Action Area); and, 2) winter colony level. We also considered the impact of the take of Indiana bats at the Recovery Unit level. But based on the results of the analysis at the maternity colony and winter colony levels, we were able to conclude our analysis at the RU level without use of the Thogmartin et al. (2013) model.

To use the Thogmartin et al. model, we must evaluate only the take of adult females, therefore the annual expected take of 5.2 Indiana bats per year and the maximum take limit of 14.2 Indiana bats per year, must be parsed out into the proportion that is comprised of adult females. To do this, we look at several factors. As with all-bat mortality, *Myotis* spp. mortality at wind facilities has been shown to vary by season, with 8%, 34%, and 58% of mortality occurring in the spring, summer, and fall, respectively[19]. Proportion of females in the population also varies by season, with females comprising 92% of all Indiana bat captures during the summers of 2008-2009 within the tri-county area (Stantec 2010). Female Indiana bats are more likely to migrate farther distances than male Indiana bats (Service 2007). The Collision Risk Model (Stantec 2010) describes how the maximum migratory distance and negative linear relationship with increasing distance away from the hibernaculum of origin was used to estimate proportion of the migrating population that was male and female, with females comprising approximately 73% of the migratory individuals. The take calculations in the HCP also added in the take of one unborn or non-volant Indiana bat for each adult female Indiana bat estimated to be taken during spring and summer. Therefore take estimate of females during spring and summer must be divided by 2 to account for this. For the purposes of evaluating the impact to local maternity colonies, all adult female take that occurs in the summer is assumed to come from bats from the local maternity colonies. The local female population comprises 14% of the total migratory female population, therefore 14% of the migratory female mortality is attributed to the local maternity colonies. The remaining 86% of adult-female mortality that occurs during spring and fall is attributed to maternity colonies outside of the Action Area.

We developed “Baseline” scenarios for each of the following population segments: local maternity colonies, migratory maternity colonies, and winter colonies, for comparison with take scenarios.

The Baseline scenarios modeled the population trajectory with WNS using the Northeast RU WNS lambda values applied immediately. This is protective of the Indiana bat because WNS has been documented in the Midwest RU for several years, and the Midwest RU population of Indiana bats is expected to respond to WNS in a similar manner to the Northeast RU, and see significant population declines over the next few years (See “Status and Distribution” section above). However, we know that this scenario is extremely unlikely because if the Midwest RU was following the Northeast RU pattern completely, the Midwest RU population should have experienced substantial declines already. Instead it has remained stable for 3 years post-WNS. Based on 3 years of observation in the Midwest RU, it appears that WNS is not following the same pattern as in the Northeast RU. At minimum, it appears the timing of effect is slower than observed in the Northeast. There is too little data available for the Midwest RU to be able to determine a Midwest RU-specific WNS lambda value, so we applied the WNS lambda values from the Northeast starting in Year 1 of the project to project the maximum impact that WNS (and hence, project related take) could have on the population being analyzed.

[19] Using 7 studies within the range of the Indiana bat, that conducted monitoring spring through fall, and reported on dates and species composition of fatalities. With seasons defined as: Spring: April 1- May 30; Summer: June 1-July 31; and, Fall: August 1-November 30.

Further, we believe that take is commensurate with population size in the Midwest RU (as population size decreases, so too will take, as the take estimates are driven by population size). The model results show that under Northeast RU lambda values, the population size will decline drastically and quickly. Thus, the take anticipated will not occur if WNS plays out as indicated in the Northeast RU. Additionally, under the HCP, the Applicant will reduce take by 50% if the Midwest RU population declines by 50%. Using the Northeast RU rates, this decline will occur early on, if not at the outset, of the project. So, again, if we assume the Northeast RU pattern holds in the Midwest RU, the take anticipated will be greatly less than the take analyzed in this scenario.

Nonetheless, we ran the model assuming Northeast RU WNS lambda values and the full take amounts (5.2 bats per year for 25 years, not reduced regardless of population size). This is the most conservative scenario because it assumes full take allowable under the ITP with the most severe WNS rates applied over the fastest timeframe.

Using these assumptions, 2 of 6 scenarios (local maternity colony Expected Take and Worst-case Take scenarios) caused population reductions of more than 5% in 1 or more metric (probability of extinction, median time to extinction, and median ending lambda after 50 years). To further understand the effect of the project for these 2 scenarios, we re-ran the model assuming a different set of more realistic assumptions for these 2 scenarios at the local maternity colony level.

For the local maternity colonies we developed a more realistic Baseline scenario, based on what we have observed to date in the Midwest RU and the WNS impacts we expect to see over the next few years. WNS has been present in the Midwest RU for 3 years but the Midwest RU population remains stable. We assumed the Midwest RU would follow a similar delay in WNS-population declines as the Appalachian RU did—the Appalachian RU did not show WNS-declines until year 6 of WNS. Since WNS was observed in the Midwest RU during the winter of 2010-2011, we assigned that to be Year 1 of WNS. Year 6 of WNS would be 2016, which is 3 years from now. Therefore in the Baseline model scenario for local maternity colonies, we applied a delay of 3 years to when WNS lambda values were applied to the Midwest RU. After 3 years of non-WNS lambda values, we then applied the WNS lambda values derived from the Northeast RU in the same manner as the other baseline scenarios. Further, we allotted the full take amount in the first 5 years (5.2 Indiana bats per year), and then for the remaining 20 years, assumed that WNS had reduced the population by 50% and that take would also be reduced by 50% to 2.6 Indiana bats per year.

An Expected Take scenario and Worst-case Take scenario were devised for each of the 3 populations (local maternity colonies, migratory maternity colonies, and winter colonies), yielding 6 modeled scenarios for comparison to the baseline scenarios (Table 12). These populations are not mutually exclusive in that the maternity colonies, winter colonies, and Recovery Unit contain some of the same individuals. But the impacts of the loss of those individuals at the various levels may be different, so the impact at each level is analyzed.

Table 12. Explanation of populations and take numbers modeled for each population in Baseline, Expected Take, and Worst-case Take scenarios.

	Description of population	**Scenario**	**Take quantity and distribution**	**Take quantity when reduced by 50% due to WNS threshold reached**	**Scenario Number**
Local maternity colony	Two maternity colonies have been documented within the Action Area. Each is assumed to be comprised of 70 adult females.	Baseline	No take.	N/A.	1A
		Expected take	Take of 1.1 adult female per year distributed equally between 2 known local maternity colonies.	Take of 0.55 adult females per year distributed equally between 2 known local maternity colonies.	1B
		Worst-case take	Annual take of adult females distributed equally between 2 known local maternity colonies as follows: Year 1 = 3.1; Year 2 = 2.59; Years 3-5 = 0; Years 6-25 = 1.1.	Annual take of adult females distributed equally between 2 known local maternity colonies as follows: Year 1 = 1.55; Year 2 = 1.30; Years 3-5 = 0; Years 6-25 = 0.55.	1C
Migratory maternity colonies	Multiple maternity colonies are within the migratory range of the Action Area. A minimum of 114 maternity colonies have been modeled as likely to occur within the migratory range of the Project area. Each one is assumed to be comprised of an average of 70 adult females.	Baseline	No take.	N/A.	2A
		Expected take	Take of 2.01 adult females per year, distributed equally among 114 modeled maternity colonies.	Take of 1.005 adult females per year distributed equally among 114 maternity colonies.	2B
		Worst-case take	Annual take of adult females distributed as follows, and divided equally among 114 modeled maternity colonies: Year 1 = 5.50; Year 2 = 4.58; Years 3-5 = 0; Years 6-25 = 2.01.	Annual take of adult females distributed as follows, and divided equally among 114 modeled maternity colonies: Year 1 = 2.75; Year 2 = 2.29; Years 3-5 = 0; Years 6-25 = 1.005.	2C
Winter population	Assume taken bats are hibernating in at least 2 large hibernaculum in the Midwest RU. Used Wyandotte and Ray's cave complex lambda value in model.	Baseline	No take.	N/A.	3A
		Expected take	Take of 3.2 adult females per year divided equally among 2 hibernacula.	Take of 1.6 adult females per year divided equally among 2 large hibernacula.	3B
		Worst-case take	Annual take of adult females distributed as follows and divided equally among 2 hibernacula: Year 1 = 8.6; Year 2 = 7.17; Years 3-5 = 0; Years 6-25 = 3.2.	Annual take of adult females distributed as follows, and divided equally among 2 hibernacula: Year 1 = 4.3; Year 2 = 3.585; Years 3-5 = 0; Years 6-25 = 1.6 .	3C

The Expected scenarios were derived using the "Expected" take number of 5.2 Indiana bats per year. Using the take estimate generated in Section 5.1.2.5.3 of the HCP, we then determine what proportion of that take are adult female bats, and which populations they originate from (i.e., local maternity colonies inside the Action Area or colonies outside of the Action Area but migrating through it), and apply that same female take quantity each year over the 25 year operation of the facility.

The Worst-case Take scenarios were derived by assuming that all of the 5-year take limit would be used as quickly as possible. The "worst case" scenarios could occur during the first few years of Project operation, when the adaptive management program is first being used to refine the cut-in speed and feathering regime to maintain take at or below permitted levels. The maximum estimated take of 14.2 Indiana bats per year was applied in Year 1, then the remaining take of 11.8 Indiana bats was applied in Year 2. Years 3-5 would necessarily have 0 take, to maintain compliance with an ITP which allots take of not more than 26 Indiana bats over a consecutive 5 year period, starting in any one year in which take of more than 5.2 Indiana bats is estimated to have occurred. After 5 years of operation, we assume that adaptive management would have resulted in a cut-in speed and feathering regime that maintains take at or below "expected" take numbers of 5.2 Indiana bats per year. We calculate the maximum number of adult females that could be taken in Years 1 and 2 based on those maximum take numbers. We assume 0 take in Years 3-5, and then assume "expected take" in Years 6-25. We then estimated which populations the females originate from (local maternity colonies inside the Action Area or colonies outside of the Action Area but migrating through it), and apply the calculated take over the 25 year operation of the facility.

For all modeled scenarios, the following parameters apply: we use Indiana bat post-WNS population mortality rates derived from the Northeast RU; we apply the project take over a 25-year period, and model the population out to 50 years; we model only the female portion of the population; and, all take from the project is additive on top of other mortality (e.g., mortality from WNS).

Each scenario is explained more fully below.

<u>Local Maternity Colony</u>

Scenario 1A

Scenario 1A is the baseline condition of the two local maternity colonies documented within the Action Area, with no Project related take. An estimate of 70 adult females are expected to occur within each maternity colony, based on the average of two cumulative emergence counts in the tri-county area in 2008 and 2009 (see HCP Section 5.1.2.6.1).

For the local maternity colonies (colonies within the Action Area), we developed a realistic baseline scenario, based on what we have observed to date in the Midwest RU and the WNS impacts we expect to see over the next few years. WNS has been present in the Midwest RU for 3 years but the Midwest RU population remains stable. We assumed the Midwest RU would follow a similar delay in WNS-population declines as the Appalachian RU did—the Appalachian RU did not show WNS-declines until year 6 of WNS. Since WNS was observed in the Midwest

RU during the winter of 2010-2011, we assigned that to be Year 1 of WNS. Year 6 of WNS would be 2016, which is 3 years from now. Therefore in the Baseline model scenario we applied a delay of 3 years to when WNS mortality rates were applied to the Midwest RU. After 3 years of non-WNS mortality rates, we then applied the WNS rates derived from the Northeast RU in the same manner as the other baseline scenarios.

Persistence of the maternity colonies over time were modeled.

Scenario 1B

Scenario 1B is the Expected Take scenario for the two local maternity colonies documented within the Action Area. Section 5.1.2.5.3 of the HCP describes how the annual expected take estimate of 5.2 Indiana bats per year was generated, and it is summarized in the "Collision Risk Model" section above. The annual expected take estimate of 5.2 Indiana bats per year is broken down into the proportion of take that would occur within the two local maternity colonies. The proportion was based on: the season of take, percent of population that is from local maternity colonies, percent of population that is female, and dividing out unborn and non-volant juveniles (that were included in the annual take number) (Table 13). This analysis yields an annual take estimate of 1.1 adult females from the two local maternity colonies within the Action Area.

Table 13. Scenario 1B--Expected Take. Deriving number of adult females taken annually from local maternity colonies inside the Action Area.

Percent of total mortality by season	Estimated Seasonal Mortality	Proportion of mortality from local maternity colonies	Annual local mortality	Percent of females in local population	Divisor for unborn or non-volant juveniles lost	Annual local adult female mortality
Spring (8%)	0.4	0.14	0.1	0.73	2	0
Summer (34%)	1.8	1	1.8	0.92	2	0.8
Fall (58%)	3	0.14	0.4	0.73	--	0.3
Annual	**5.2**	**--**	**2.3**	**--**	**--**	**1.1**

In this Scenario it is reasonable to assume that take of adult females would be equally distributed across the 2 local maternity colonies for the following reasons: Both of the colonies would be similarly exposed to the wind turbines; members of both colonies have been documented foraging within the Action Area; and turbines will be distributed throughout the action area. For these reasons, take of 1.1 adult females per year was equally divided among both colonies, resulting in a model input of take of 0.55 adult females per year, per maternity colony, from a colony of 70 adult female bats. If WNS results in a 50% decline in the bat population of the Midwest RU, the annual take of local females would be 0.55 distributed among two colonies, or 0.275 adult female bats per colony per year (Table 12).

As with the Baseline scenario, for this scenario, we included a 3 year delay in the onset of WNS mortality rates, to comport with what has been observed in the Midwest and Appalachian RUs to date. We applied the Northeast WNS lambda values after the 3 year delay.

For project take, we analyzed take at the full amount (1.1 adult female per year distributed between 2 colonies, or 0.55 adult females per colony per year) for the first 5 years of the project.

The Appalachian RU observed WNS declines of approximately 45% after 6 years of WNS, and we assume after one more year of WNS, the RU population will have decreased by at least 50%. We assume the Midwest RU will follow the same timing of WNS declines as the Appalachian RU, based on trends to date. When the Midwest RU reaches a 50% decline from WNS, the HCP commits to reducing project take by 50%. Therefore, in our take inputs we assumed that take would be reduced by 50% in years 6-20 (take of 0.55 adult females per year distributed between 2 colonies, or 0.275 per colony per year). These inputs provide a realistic scenario of take that would occur in the face of WNS declines.

Scenario 1C

Scenario 1C is the Worst-case Take scenario for the two local maternity colonies documented within the Action Area. This scenario assumes that the 5 year take limit of 26 Indiana bats is met after only 2 years, and that no take occurs in years 3-5. Section 5.1.2.5.3 of the HCP describes how this take estimate was generated. Take of 14.2 Indiana bats would occur in Year 1, take of 11.8 Indiana bats would occur in Year 2, and necessarily 0 Indiana bats could be taken in years 2-5, to maintain compliance with the ITP. We anticipate that by Year 6, the adaptive management plan will have resulted in a feathering and cut-in speed regime that maintains take at expected levels, and that those expected take levels will be maintained throughout the permit duration.

Using the method described above, we calculated the proportion of annual take allocated to the local maternity colonies for years 1 and 2 (Tables 14 and 15). This analysis results in a take estimate of 3.1 adult females in Year 1 and 2.59 adult females in Year 2 from the two local maternity colonies within the Action Area.

Table 14. Scenario 1C--Worst-case Take. Deriving number of adult females taken from local maternity colony in Year 1.

Percent of total mortality by season	Estimated Seasonal Mortality	Proportion of mortality that is from local maternity colonies	Annual local mortality	Percent of females in local population	Divisor for unborn or non-volant juveniles lost	Annual local adult female mortality
Spring (8%)	1.1	0.14	0.2	0.73	2	0.1
Summer (34%)	4.8	1	4.8	0.92	2	2.2
Fall (58%)	8.2	0.14	1.1	0.73	--	0.8
Annual	**14.2**	--	**6.1**	--	--	**3.1**

Table 15. Scenario 1C--Worst-case Take. Deriving number of adult females taken from local maternity colony in Year 2.

Percent of total mortality by season	Estimated Seasonal Mortality	Proportion of mortality that is from local maternity colonies	Annual local mortality	Percent of females in local population	Divisor for unborn or non-volant juveniles lost	Annual local adult female mortality
Spring (8%)	0.94	0.14	0.13	0.73	2	0.05
Summer (34%)	4.01	1	4.01	0.92	2	1.84
Fall (58%)	6.84	0.14	0.96	0.73	--	0.7
Annual	**11.8**	**--**	**6.1**	**--**	**--**	**2.59**

As with the Baseline scenario, for this scenario, we included a 3 year delay in the onset of WNS mortality rates, to comport with what has been observed in the Midwest and Appalachian RUs to date. We applied the Northeast WNS lambda values after the 3-year delay. In this scenario it is reasonable to assume that take of adult females would be equally distributed across the 2 local maternity colonies for the same reasons as described in Scenario 1B.

For this scenario, our model inputs were: starting population size of 70, and take of 3.1 adult females in Year 1, 2.59 adult females in Year 2, 0 adult females in Years 3-5. As described in 1B above, when the Midwest RU reaches a 50% decline from WNS, the HCP commits to reducing project take by 50%. Therefore, in our take inputs we assumed that take would be reduced by 50% in years 6-20 (take of 0.55 adult females per year distributed between 2 colonies, or 0.275 per colony per year). These inputs provide a realistic scenario of take that would occur in the face of WNS declines.

<u>Migratory Maternity Colonies</u>

Scenario 2A

Scenario 2A is the baseline condition of maternity colonies that exist within the migratory range of the Action Area.

We know that take is expected to occur during spring and fall migratory periods, and that some of this take will occur to Indiana bats that may be passing through the Action Area while moving between summer and winter habitat. Therefore, we had to estimate how many maternity colonies these individuals could be originating from.

To do so, WEST Inc., developed a simulation model for Indiana bat migration (WEST 2013). The following is a summary of the development and results of this migration model: The model relied on data obtained from publicly-available sources on hibernacula locations and population sizes, known migration distances, and maternity colony habitat characteristics. Because maternity colony locations were largely unknown, suitable habitat for simulated locations was defined based on amount of forest cover. Maternity colonies were simulated in several stages. First, maternity colony sizes were randomly generated such that the total number of female bats in maternity colonies equaled the total number in hibernacula within the Midwest RU and within the migratory distance of the Action Area. Second, the number of bats "contributed" by each hibernaculum to each maternity colony was randomly generated such that, in general, each hibernaculum contributed to several colonies and each colony received contributions from several hibernacula. Third, maternity colonies were randomly placed on the landscape, but constrained so that colony locations were always within suitable habitat but not closer than 4.5 miles from each other. Migrations were defined by broad pathways between maternity colonies and the hibernacula that contributed to those colonies. Alternative path widths of 5, 10, 15, and 20 km were examined in simulations. An "encounter" was defined as any overlap of a migration path and the Action Area.

The model was designed such that there were 1,935 maternity colonies, ranging in size from 20 to 160 adult female bats within the Midwest RU. Results from 100 iterations of this simulation model indicated that on average, there were 6,381 migration paths connecting simulated maternity colonies with known hibernacula, and depending on path width, 157 – 254 (2.5 – 4.0%) of these paths encountered the Action Area. Some of these paths were connected to the same maternity colony, so that an average of 114 – 166 maternity colonies (5.9 – 8.6% of all colonies) had encounters with the project (i.e., were connected to paths that encountered the project), again depending on migration path width. Similarly, an average of 12 – 15 hibernacula (of 40 total hibernacula) supported bats that encountered the project.

To make sure that the full extent of the impact of the take was evaluated, we analyzed the smallest number of colonies predicted by the WEST (2013) model to have encounters with the project-- 114 colonies, and hence to which the take associated with the project is distributed among.

Whitaker and Brack (2002) indicated that average maternity colony size in Indiana was approximately 80 adult female bats, but to be protective, we used 70 adult females as the starting population size (see Scenario 1A for rationale). We modeled the population trajectory with WNS using the Northeast RU WNS lambda values applied immediately. This scenario is protective of the Indiana bat because WNS has been documented in the Midwest RU for several years, and the Midwest RU population of Indiana bats is expected to respond to WNS in a similar manner to the Northeast RU, and see significant population declines over the next few years (See "Status and Distribution" section above). Despite that the Midwest RU has not seen the same rate of population decline over the same timeframe as the Northeast RU did, we applied the WNS rates in Year 1 of the project to project the maximum impact that WNS (and hence, project related take) could have on the population being analyzed. As done for Scenario 1, persistence of the maternity colonies over time was modeled.

Scenario 2B

Scenario 2B is the Expected Take scenario for migratory females, which distributes a portion of all Indiana bat take to migrating adult females originating from maternity colonies outside of the Action Area. As described in Scenario 2A, it is reasonable to assume that at least 114 maternity colonies exist within the migratory range of the Action Area, and that females taken during migration could originate from these colonies.

Section 5.1.2.5.3 of the HCP describes how the expected take estimate of 5.2 Indiana bats per year was generated. The annual take estimate was broken down into the proportion of take that would occur only to females originating outside of the Action Area, based on the season of take, percent of seasonal population that is migratory, percent of population that is female, and dividing out unborn and non-volant juveniles (that were included in the annual take number) (Table 16). This analysis results in an annual take estimate of 2.03 adult females from the maternity colonies outside of the Action Area.

Table 16. Scenario 2B--Expected Take. Deriving number of migratory adult females taken annually from maternity colonies outside of Action Area.

Percent of total mortality by season	Estimated Seasonal Mortality	Proportion of mortality that is from migratory population	Annual migratory mortality	Percent of females in migratory population	Divisor for unborn or non-volant juveniles lost	Annual migratory adult female mortality
Spring (8%)	0.4	0.86	0.36	0.73	2	0.13
Summer (34%)	1.8	0	0	0.92	2	0
Fall (58%)	3	0.86	2.6	0.73	--	1.9
Annual	**5.2**	**--**	**2.96**	**--**	**--**	**2.03**

Based on the WEST (2013) migratory maternity colony model, it is likely that at least 114 maternity colonies are within the maximum migratory distance of the Action Area and portions of their populations would be exposed to the project.

It is reasonable to distribute the take among all colonies because individuals from all of the colonies would be similarly exposed to the wind turbines. Each individual that passed through the Action Area would do so one time in the spring and one time in the fall, resulting in an equal risk to any individual passing through the Action Area. For this reason, take of 2.03 adult females per year was equally divided among all 114 colonies, resulting in a model input of take of 0.02 adult females per year, per maternity colony, from a colony of 70 adult female bats, for a 25 year period. If WNS results in a 50% decline in the bat population of the Midwest RU, the annual take of migratory females would be 1.015 distributed among 114 colonies, or 0.009 adult female bats per colony per year.

Scenario 2C

Scenario 2C is the Worst-case Take scenario for migratory females, which distributes a portion of all Indiana bat take to migrating adult females originating from maternity colonies outside of the Action Area. This scenario assumes that the 5 year take limit of 26 Indiana bats is met within 2 years, and that no take occurs in years 3-5. Section 5.1.2.5.3 of the HCP describes how this take estimate was generated. Take of 14.2 Indiana bats would occur in Year 1, take of 11.8 Indiana bats would occur in Year 2, and necessarily 0 Indiana bats could be taken in years 2-5, to maintain compliance with the ITP. We anticipate that by year 6, the adaptive management plan will have resulted in a feathering and cut-in speed regime that maintains take at expected levels of 5.2 Indiana bats per year, and that those take levels will be maintained throughout the permit duration.

As done for Scenario 1C, the annual take estimate for Years 1 and 2 were broken down into the proportion of take that would occur only to migratory females originating from maternity colonies outside of the Action Area (Tables 17 and 18). This analysis results in a take estimate of 5.5 adult females in Year 1 and 4.59 adult females in Year 2 of females originating outside of the Action Area.

Table 17. Scenario 2C--Worst-case Take. Deriving number of migratory adult females taken from maternity colonies outside of Action Area in Year 1.

Percent of total mortality by season	Estimated Seasonal Mortality	Proportion of mortality that is from migratory population	Annual migratory mortality	Percent of females in migratory population	Divisor for unborn or non-volant juveniles lost	Annual migratory adult female mortality
Spring (8%)	1.1	0.86	0.95	0.73	2	0.35
Summer (34%)	4.8	0	0	0.92	2	0
Fall (58%)	8.2	0.86	7.05	0.73	--	5.15
Annual	**14.1**	**--**	**8**	**--**	**--**	**5.5**

Table 18. Scenario 2C--Worst-case Take. Deriving number of migratory adult females taken from maternity colonies outside of Action Area in Year 2.

Percent of total mortality by season	Estimated Seasonal Mortality	Proportion of mortality that is from migratory population	Annual migratory mortality	Percent of females in migratory population	Divisor for unborn or non-volant juveniles lost	Annual migratory adult female mortality
Spring (8%)	0.94	0.86	0.81	0.73	2	0.3
Summer (34%)	4.01	0	0	0.92	2	0
Fall (58%)	6.84	0.86	5.88	0.73	--	4.29
Annual	**11.8**	**--**	**6.69**	**--**	**--**	**4.59**

As described above, based on the WEST (2013) migratory maternity colony model, it is likely that at least 114 maternity colonies are within the maximum migratory distance of the Action Area and portions of their populations would be exposed to the project.

Our Worst-case Take scenario is: take of 5.5 adult females in Year 1, 4.59 adult females in Year 2, 0 adult females in Years 3-5, and 2.03 adult females in Years 6-25 distributed equally among the 114 modeled maternity within the migratory range of the Action Area. We assume each maternity colony supports 70 adult female bats, for reasons described previously. For each maternity colony this equates to the take of 0.048 adult females in Year 1, 0.040 adult females in Year 2, 0 adult females in Years 3-5, and 0.018 adult females in Years 6-25 (Table 12).

If WNS results in a 50% decline in the bat population of the Midwest RU, the take of migratory females in this scenario would be 2.75 adult females in Year 1, 2.29 adult females in Year 2, 0 adult females in Years 3-5, and 1.02 adult females in Years 6-25. Per maternity colony this equates to take of 0.024 adult females in Year 1, 0.020 adult females in Year 2, 0 adult females in Years 3-5, and 0.009 adult females in Years 6-25 (Table 12).

<u>Winter Population</u>

Scenario 3A

Scenario 3A is the baseline condition of winter populations at hibernacula within the Midwest RU, from which bats taken by the Project may belong to. As noted above, bats taken by the Project likely originate from multiple maternity colonies both within and outside of the Action Area; they also belong to wintering populations at multiple hibernacula. Indiana bats banded at maternity colonies within and north of the Action Area within the migratory range of the Project have been documented hibernating at Goochland, Bat (2 individual band returns), Jug Hole, Cave Branch, Colossall, Waterfall, Batwing, Ray's (2 individual band returns), Grotto, and Saltpeter Caves (see HCP section 4.4.3.1).

Given the multiple hibernacula, we chose our model lambda value as follows. As recommended in the draft user guide accompanying the Thogmartin (2013) model, we selected a hibernaculum-specific complex lambda value. Specifically, we used the complex value for Ray's Cave. This complex is composed of 61 hibernacula including 5 of the caves with bat band return data from the Action area or due north; this complex also includes Wyandotte Cave, which is a large P1 cave. Given the size of the complex and that many of the known bat returns are from this complex, we believe it is reasonable to assume that the majority of the bats traversing the Action Area belong to this complex.

We modeled the population trajectory with WNS using the Northeast RU WNS lambda values applied immediately. This scenario is protective of the Indiana bat because WNS has been documented in the Midwest RU for several years, and the Midwest RU population of Indiana bats is expected to respond to WNS in a similar manner to the Northeast RU, and see significant population declines over the next few years (See "Status and Distribution" section above). Despite that the Midwest RU has not seen the same rate of population decline over the same timeframe as the Northeast RU did, we applied the WNS rates in Year 1 of the project to project the maximum impact that WNS (and hence, project related take) could have on the population being analyzed. Again, as with Scenarios 1 and 2, persistence of the winter population over time was modeled.

Scenario 3B

Scenario 3B is the Expected Take scenario for winter populations, which distributes all Indiana bat take to 2 large hibernacula within the Midwest RU. We applied the take equally between these 2 hibernacula because we expect, based on band returns, that bats taken by the project will originate from at least 2, but probably many more hibernacula. The WEST (2013) migratory maternity colony model estimated that female bats exposed to the Buckeye Wind project during migration originated from 12-15 different hibernacula. To be protective of the Indiana bat, in our analysis below, we applied all take to just two hibernacula.

It is more likely that the bats will be from larger rather than smaller winter colonies because the majority of the Indiana bat population is concentrated in just a few hibernacula in the Midwest RU in 2011, the eight most populous hibernacula collectively held 85% of the total RU population (Service unpublished data 2013). For reasons described previously, we used the Ray's Cave complex lambda for our model runs. Section 5.1.2.5.3 of the HCP describes how the expected take estimate of 5.2 Indiana bats per year was generated. Again, the annual take estimate was broken down into the proportion of take that would occur only to females (Table 19). This analysis results in an annual take estimate of 3.16 adult females per year.

Table 19. Scenario 3B--Expected Take. Deriving number of total adult females taken from hibernacula.

Percent of total mortality by season	Estimated Seasonal Mortality	Percent of females in population	Divisor for unborn or non-volant juveniles lost	Annual adult female mortality
Spring (8%)	0.4	0.73	2	0.15
Summer (34%)	1.8	0.92	2	0.83
Fall (58%)	3	0.73	--	2.19
Annual	**5.2**	**--**	**--**	**3.16**

As explained above, it is reasonable to assume that take of adult females would be distributed within the Wyandotte/Ray's Cave complex. Our model inputs were as follows: take of 3.2 adult females per year distributed equally between 2 hibernacula (Wyandotte and Ray's Cave), resulting in a model input of take of 1.6 adult females per year, per hibernaculum for a 25 year period. If WNS results in a 50% decline in the bat population of the Midwest RU, the annual take of adult females would be 1.6 distributed among 2 hibernacula, or 0.8 adult female bats per hibernaculum per year (Table 12).

Scenario 3C

Scenario 3C is the Worst-case Take scenario for adult females, which assumes that the 5-year take limit of 26 Indiana bats is met within 2 years and no take occurs in years 3-5. Section 5.1.2.5.3 of the HCP describes how this level of take was generated. Take of 14.2 Indiana bats would occur in Year 1, take of 11.8 Indiana bats would occur in Year 2, and necessarily 0 Indiana bats could be taken in years 2-5, to maintain compliance with the ITP. We anticipate that by Year 6, the adaptive management plan will have resulted in a feathering and cut-in speed regime that maintains take at expected levels of 5.2 Indiana bats per year, and that those take levels will be maintained throughout the permit duration.

As done in Scenarios 1 and 2, the annual take estimate for Years 1 and 2 was broken down into the proportion of take that would occur to adult female Indiana bats (Tables 20 and 21). This analysis results in a take estimate of 8.6 adult females in Year 1 and 7.17 adult females in Year 2.

Table 20. Scenario 3C--Worst-case Take. Deriving number of total adult females taken from hibernacula in Year 1.

Percent of total mortality by season	Estimated Seasonal Mortality	Percent of females in population	Divisor for unborn or non-volant juveniles lost	Annual adult female mortality
Spring (8%)	1.1	0.73	2	0.4
Summer (34%)	4.8	0.92	2	2.21
Fall (58%)	8.2	0.73	--	5.99
Annual	**14.1**	**--**	**--**	**8.6**

Table 21. Scenario 3C--Worst-case Take. Deriving number of total adult females taken from hibernacula in Year 2.

Percent of total mortality by season	Estimated Seasonal Mortality	Percent of females in population	Divisor for unborn or non-volant juveniles lost	Annual adult female mortality
Spring (8%)	0.94	0.73	2	0.34
Summer (34%)	4.01	0.92	2	1.84
Fall (58%)	6.84	0.73	--	4.99
Annual	**11.8**	**--**	**--**	**7.17**

In this Worst-case Take scenario we allotted all take to 2 hibernacula, Ray's Cave and Wyandotte Cave. As noted above, we know that bats taken by the Project are likely from multiple hibernacula, so this scenario serves as a reasonable worst-case scenario.

Our Worst-case Take scenario is: take of 8.6 adult females in Year 1, 7.17 adult females in Year 2, 0 adult females in Years 3-5, and 3.2 adult females in Years 6-25, distributed equally between the two hibernacula in the Wyandotte and Ray's cave complex. Per hibernaculum this equates to take of 4.3 adult females in Year 1, 3.585 adult females in Year 2, 0 adult females in Years 3-5, and 1.6 adult females in Years 6-25 (Table 12).

If WNS results in a 50% decline in the bat population of the Midwest RU, the take of migratory females in this scenario would be 4.3 adult females in Year 1, 3.585 adult females in Year 2, 0 adult females in Years 3-5, and 1.6 adult females in Years 6-25. Per hibernaculum this equates to take of 2.15 adult females in Year 1, 1.79 adult females in Year 2, 0 adult females in Years 3-5, and 0.8 adult females in Years 6-25 (Table 12).

Model Results and Interpretation

For each modeled scenario (Scenarios 1A-1C, 2A-2C, and 3A-3C), we ran 5,000 model simulations and we summarized the median model simulation results for the following metrics: probability of extinction, median time to extinction, and median ending lambda after 50 years (Table 22). We compare the results of the baseline scenarios of each population unit (1A, 2A, and 3A) with the Expected Take and Worst-case Take results scenarios of each population unit (1B and 1C, 2B and 2C, and 3B and 3C). If there is an appreciable difference (e.g. loosely defined as greater than 5%) in the results between the baseline and any of the take scenarios for any of the population units, we completed an analysis of the how these population-level impacts will impact the likelihood of survival and recovery of the Indiana bat at the RU level.

Table 22. Model results for Baseline, Expected Take, and Worst-case Take scenarios, and significance of difference.

	Scenario	Run number	Probability of extinction in 50 years	Median time to extinction	Median Ending Lambda at 50 years	Appreciable difference?
Local Maternity colony	Baseline	1A	0.69	24	0	n/a
	Expected take	1B	0.70	23	0	no
	Worst-case take	1C	0.68	24	0	no
Migratory maternity colonies	Baseline	2A	0.8096	19	0	n/a
	Expected take	2B	0.8087	19	0	no
	Worst-case take	2C	0.8167	19	0	no
Winter population	Baseline	3A	0.000	n/a	0.94	n/a
	Expected take	3B	0.000	n/a	0.95	no
	Worst-case take	3C	0.000	n/a	0.94	no

Impact of take on the local maternity colonies

Scenario 1

For the Expected take scenario (1B) with the full take allotted in the first 5 years, followed by a 50% reduction in take from WNS starting in Year 6 of Project operation, the Thogmartin model (Thogmartin et al. 2013) predicts a 70% probability that the local colonies would be extinct with a median timeframe of extinction of 23 years. These results are not different than the Baseline scenario, therefore for the Expected Take scenario would not cause an appreciable decline in the fitness of the local maternity colonies within the Action Area.

For the Worst-case Take scenario (1C) with the full take allotted in the first 2 years, 0 take in years 3-5, and a 50% reduction in take due to WNS starting in Year 6 of Project operation, the Thogmartin model (Thogmartin et al. 2013) predicts a 68% probability that the local colonies would be extinct with a median timeframe of extinction of 24 years. These results are not different than the Baseline scenario, therefore for the Worst-case Take scenario would not cause an appreciable decline in the fitness of the local maternity colonies within the Action Area.

Impact of take on the maternity colonies within the migratory distance of the Project area

Scenario 2

For the Expected Take scenario (2B) with the full amount of take allotted evenly over the entire 25 year period, the Thogmartin model (Thogmartin et al. 2013) predicts a 0.8087% probability that the colonies from which migratory females are taken would be extinct with a median timeframe of extinction of 19 years. These results are not different than the Baseline scenario, therefore for the Expected Take scenario would not cause an appreciable decline in the fitness of the maternity colonies within the migratory distance of the Action Area.

For the Worst-case Take scenario (2C) where the full amount of take is front-loaded in the first two years, no take in Years 3-5, and then take allotted evenly among the remaining 20 years of Project operation, the Thogmartin model (Thogmartin et al. 2013) predicts a 0.8167% probability that the local colonies would be extinct with a median timeframe of extinction of 19 years. These results are not appreciably different than the Baseline scenario, therefore the Worst-case Take scenario would not cause an appreciable decline in the fitness of the maternity colonies within the migratory distance of the Action Area.

Impact of Take on the Wintering Populations

Scenario 3

For the Expected Take scenario (3B) with the full amount of take allotted evenly over the entire 25 year period, the results do not show appreciable reductions relative to the Baseline scenario in any of the metrics. Therefore, for the Expected Take scenario, appreciable reductions in the fitness of the winter population to which the taken individuals belong are unlikely.

Similarly, for the Worst-case Take scenario (3C) where the full amount of take is front-loaded in the first two years, no take in years 3-5 and then take allotted evenly among the remaining 20 years of Project operation, the results do not show appreciable reductions relative to the Baseline scenario in any of the metrics. Therefore, for the Worst-case Take scenario, appreciable reductions in the fitness of the winter population to which the taken individuals belong are unlikely.

Impact of Take on the Midwest RU

Because there was no appreciable reduction in the fitness of the maternity colonies or winter populations to which the taken individuals belong, there would also be no appreciable impact on the Midwest RU.

V. CUMULATIVE EFFECTS

In addition to the Effects from the proposed action, the implementing regulations require us to evaluate the effects of the action (above) taken together with cumulative effects. Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the Action Area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation under section 7 of the Act. This section analyzes the added impact from cumulative effects.

The Service is not aware of any non-Federal activities that would affect Indiana bat habitat that are planned within the Action Area. The Service contacted the Champaign County Chamber of Commerce to determine if there are any proposed commercial, industrial, or residential developments within the Townships of the Action Area (Goshen, Rush, Salem, Wayne, Union, and Urbana). The Chamber of Commerce and County Commissioners responded that they are not aware of any proposed developments of this type within the Townships of the Action Area (Sandi Arnold, Champaign County Chamber of Commerce, personal communication).

Though we have not identified any proposed developments that would affect Indiana bat habitat, we anticipate that occasional tree/snag removal or timber harvesting by non-Federal entities on private land may take place occasionally within the Action Area. A search of the Champaign County Auditor’s webpage for properties between 2 and 10,000 acres that were zoned for “timber” within the townships of the Action Area yielded 15 properties totaling 131 ha (323 ac). Timbering on these areas could harm or harass individual Indiana bats that inhabit the impacted area, depending on the acreage of trees cleared, the proximity of the impacts to maternity colonies, and the time of year that tree clearing occurs. However within the Action Area there are 9,846.4 ha (24,331 ac) of suitable habitat, so the total habitat impacted by timbering operations is only about 1.3 percent of the total habitat available. These impacts would not significantly impact the quantity or distribution of suitable habitat in the Action Area as a whole, and would not rise to the level of causing population-level impacts.

Most land in the Action Area is privately owned and used for agricultural purposes. Additional single family residences, out buildings, and other small scale development may also occur within the Action Area during the life of the Project. No quantification of the number or location of these activities is available. It is possible that tree harvest associated with these activities could harm or harass individual Indiana bats that inhabit the impacted area, depending on the acreage of trees cleared, the proximity of the impacts to maternity colonies, and the time of year that tree clearing occurs. However, the scale of these types of projects would not result in habitat loss on a scale that would significantly impact the quantity or distribution of suitable habitat within the Action Area and would not rise to the level of causing population-level impacts. Standard farming practices would not result in effects to Indiana bat or suitable habitat.

During 2008-2009, one other wind power facility was proposed by a separate wind company with a project area that overlapped with the Action Area. Subsequently, Buckeye Wind purchased the land leases from that wind company, for inclusion into the Buckeye Wind Project. Therefore the other wind power project is no longer proposed. The Service is not aware of any other proposed wind power projects within the Action Area.

The Service is unaware of any other tribal, state, local, or private actions presently occurring or that are reasonably certain to occur in the future, which would destroy, modify or curtail the remaining patches of Indiana bat summer habitat within the Action Area. Therefore we do not anticipate significant cumulative effects from the proposed action, combined with other reasonably foreseeable non-Federal actions.

Summary

After reviewing the current status of the Indiana bat, the environmental baseline for the action area, the effects of the proposed construction and operation of 100 wind turbines, and the cumulative effects, it is the Service's biological opinion that the Project, as proposed, is not likely to jeopardize the continued existence of the Indiana bat, and is not likely to destroy or adversely modify designated critical habitat. Critical habitat for this species has been designated at hibernacula in six states (Illinois, Indiana, Kentucky, Missouri, Tennessee, and West Virginia), however, this action does not affect these areas and no destruction or adverse modification to this critical habitat is anticipated.

The basis for this conclusion is as follows:

- Because of avoidance measures outlined in the HCP, take of the Indiana bat is not anticipated during Project construction, decommissioning, or mitigation activities;

- A maximum of 6.8 ha (16.8 ac) of potential roosting and foraging habitat will be removed for the Project, and this will be done during the non-active period for the Indiana bat;

- Minimization measures detailed as part of the Applicant's Conservation Program, including operational feathering of turbines, post-construction mortality monitoring and reporting, and informed adaptive management of these minimization measures, will allow flexibility and accountability to be incorporated throughout the life of the Project;

- The estimated taking of adult female Indiana bats throughout the operational-life of the Project (25 years) will not appreciably reduce the fitness maternity colonies within the Action Area, maternity colonies within the migratory range of the Action Area, or wintering populations of Indiana bats to which the taken individuals belong.

- Because the fitness of these populations will not be appreciably impacted by the proposed taking, the proposed taking will not appreciably reduce the likelihood of the survival and recovery of the Midwest RU, or the entirety of the population of the species in the wild.

- Mitigation activities will protect 87.8 ha (217.0 ac) of swarming habitat within seven miles of a P2 hibernacula in Ohio. This protection will aid the long-term stability and recovery of the Indiana bat at this site. Further, research conducted on Indiana bat migration and/or Indiana bat and wind turbine operations will help minimize take of Indiana bats at wind power projects in the future.

VI. CONCLUSION

Jeopardy analysis

Implementing regulations for section 7 of the ESA (50 CFR 402) defines “jeopardize the continued existence of” as, “to engage in an action that reasonably would be expected, directly or indirectly, to 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 that species.”

Jeopardy determinations for Indiana bats are made at the scale of the listed entity, which is the range wide distribution of the species (32 FR 4001). The jeopardy analysis in this BO follows a hierarchal relationship between units of analysis that characterize effects at the lowest level or smallest scale, and then aggregated to the highest level or largest scale of analysis.

As described in the effects of the action section in this BO, we anticipate the lethal take of 130 Indiana bats in the action area over the 30-year term of the ITP. Further, we anticipate a portion of the take will consist of bats summering within the Action Area, and a portion of the take will be composed of bats summering within the migratory range of, but outside of the Action Area. Adult and juvenile males and females will be taken by the Project. The analysis above demonstrates how loss of females and their reproductive capacity will affect the maternity colonies to which they belong as well as their wintering populations.

Using the Thogmartin model (Thogmartin et al. 2013) we have demonstrated the results of Expected Take and Worst-case Take scenarios compared to baseline scenarios without take on the local maternity colonies within the Action Area, maternity colonies within the migratory range of the Action Area, and wintering populations. We have demonstrated that the impact of the taking on these populations is not likely to appreciably reduce the likelihood of survival and recovery compared to the baseline condition.

Given that implementation of this Project is not likely to appreciably reduce the fitness of Indiana bat maternity colonies or wintering populations, the Project is also unlikely to reduce appreciably the likelihood of survival and recovery of Indiana bats at the Midwest RU and range-wide scales.

Thus, after reviewing the current status of Indiana bats, the environmental baseline for the action area, the effects of the proposed action and the Applicant's implementation of the HCP, and the cumulative effects, it is the Service's biological opinion that the actions as proposed, are not likely to jeopardize the continued existence of Indiana bats.

Critical habitat adverse modification analysis

No critical habitat for Indiana bats is designated within or near the action area. Physical impacts to suitable habitat from the proposed actions are anticipated to be localized and not likely to impact critical habitat at broader geographic scales. Therefore, it is the Service's biological opinion that the actions as proposed, are not likely to destroy or adversely modify Indiana bat critical habitat.

VII. Conservation Measures[20]: Avoidance, Minimization, and Mitigation Measures

The proposed action includes avoidance, minimization and mitigation activities. As explained under the Description of the Proposed Action section above, Buckeye Wind has proposed a number of measures to avoid and minimize the potential for take of Indiana bats. The primary methods for avoidance and minimization are limiting habitat impacts to not more than 6.8 ha (16.8 ac), clearing trees only during the winter period when bats are not active, and applying cut-in speeds and feathering. The effects of these avoidance and minimization measures are already incorporated into our effects analysis above.

To provide benefit to Indiana bats and offset the impact of the take, Buckeye Wind proposes to permanently protect occupied Indiana bat habitat. Mitigation activities will involve permanent protection of 87.8 ha (217.0 ac) of suitable Indiana bat swarming habitat within 11.2 km (7 mi) of a P2 hibernaculum in Ohio.[21] Within the mitigation area(s), travel corridors between woodlots and/or along stream corridors can be restored to increase availability of suitable Indiana bat

[20] In the Context of the HCP, the term "Conservation measures" is used to describe research that will be implemented to help further the conservation of Indiana bats and increase knowledge related to Indiana bat and wind energy interactions. In the context of this Biological Opinion, the term "Conservation Measures" refers to all of the avoidance, minimization, and mitigation measures the applicant proposes to implement, including the research component of the HCP.

[21] If WNS reduces the Midwest RU population by 50% of pre-WNS mortality levels, and the take is also reduced by 50%, then the mitigation acreage may also be reduced. The mitigation acres are calculated based on the total bats to be taken by the project, as reduced for WNS, see HCP Section 6.3.1.

habitat through enhanced connectivity. Further, within mitigation areas, suitable habitat can be enhanced through ensuring an adequate number of suitable roost trees and through managing woody invasive species.

A second mitigation option (in lieu of that described above) entails buying credits from a Service-approved Indiana bat mitigation bank whose geographical range service area includes the Project (Service 2009b; see Section 7.3.4 – Change in Mitigation Acres). If the mitigation bank has established a ratio of Indiana bat habitat acres to the number of Indiana bat fatalities, and such ratio is approved by the Service, then that ratio will be used to calculate the habitat mitigation required at the bank for the Buckeye Wind Project. If the mitigation bank has not established such a relationship, Buckeye Wind, ODNR DOW and the Service may agree upon a number of acres within the mitigation bank that could be used to fulfill the remainder of the mitigation obligation to offset the impacts of take by the Project.

Mitigation will occur in two stages: the first stage will mitigate for take during the first 10 years of project operation and will be completed no later than one year after the beginning of operation; the second stage will mitigate for take during years 11-25 of project operation and will be completed no later than one year after the eleventh year of operation.

Over the life of the ITP, proposed mitigation, whether it is habitat protection of the P2 hibernaculum or acquisition of credits, is expected to have a beneficial effect on Indiana bats. As explained below, permanent protection of swarming habitat will help enhance reproductive success and increase the survival probability of the Indiana bats that have overwintered in the hibernaculum by preserving foraging and roosting habitat critical to bats with depleted nutritional stores.

Preservation and enhancement Indiana bat habitat, and specifically, a P2 hibernaculum in OH will protect, restore, and enhance valuable fall roosting, foraging, and swarming habitat, in an area where habitat is limited. Ohio's only P2 hibernaculum is located in an area dominated by active agriculture; only 6.3% of the landcover within 7 miles of this hibernaculum is forested (Fry et al. 2011). The population of Indiana bats at this hibernaculum has remained stable over time, but has not significantly increased, supporting between 9,007 and 9,638 bats in all but one survey event since 1996 when regular surveys first began. During the fall swarming period, female, juvenile, and male Indiana bats arrive at hibernacula after migrating potentially long distances from summer habitat (distances up to 575 km [357 mi] have been documented; Winhold and Kurta 2006). Migration is an energetically expensive undertaking (Fleming and Eby 2003), and bats therefore require roosting and foraging opportunities outside hibernacula in order to increase fat stores prior to hibernation. Hall (1962) found that bats returning to Coach Cave, KY, in the fall had no stored fat reserves, and that weight was the lowest measured at any point during the annual cycle. Weight peaks in September or October as a result of foraging outside hibernacula (Hall 1962, LaVal and LaVal 1980). Entering hibernation with ample energy reserves is key to surviving winter hibernation for all bats, and for adult females it is critical for ovulation (Humphries et al. 2003, Jonasson and Willis 2011, Kunz et al. 1998). Increasing opportunities for juveniles to build up energy stores prior to their first winter hibernation has the potential to increase survivorship (Jonasson and Willis 2011).

In the face of WNS, presence of high quality habitat in close proximity to hibernacula may be even more important. WNS infected bats exhibit premature loss of critical fat reserves which is thought to lead to starvation prior to spring emergence (Frick et al. 2010). Indiana bats that survive winter hibernation in a WNS-infected mine such as Ohio's P2 hibernaculum will benefit from ample roosting and foraging habitat immediately outside cave/mine entrances, which they can utilize in order to quickly buildup fat stores prior to migration. Similarly, Indiana bats returning to the hibernaculum in the fall are in need of readily available foraging resources directly outside hibernaculum to encourage accumulation of fat stores for hibernation, particularly if WNS causes premature loss of fat. In both cases, presence of permanently available fall and spring habitat near hibernaculum has the potential to increase survivorship in the face of WNS, in particular in a setting where existing habitat is limited to only 6.3% of the surrounding landscape.

In sum, protection and enhancement of foraging and roosting habitat outside a P2 hibernaculum will provide roosting and foraging resources for swarming adult female, adult male, and juvenile Indiana bats in the fall, which will reduce competition for limited resources at a time when building energy reserves for the winter hibernation period is critical. Therefore, preservation or enhancement of land surrounding a hibernaculum will provide individuals with permanent roosting and foraging resources and reduce competition for those resources during swarming periods when replenishing energy reserves is critical, contributing towards a recovery need for the species.

Buckeye Wind will also allocate $200,000 towards research on Indiana bat and wind turbine interactions and/or Indiana bat migration. The results of this research will be incorporated into the Project's adaptive management plan if appropriate, and will inform collision risk estimates and refine avoidance and minimization measures for wind projects across the range of the species. Buckeye Wind may also collect wing and hair tissue samples from all bats collected during post-construction mortality monitoring to support Service-requested research projects by entities other than Buckeye Wind.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. Harm is further defined by FWS to include significant modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by FWS as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavioral behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The proposed Buckeye Wind HCP and its associated documents clearly identify expected impacts to affected species likely to result from the proposed taking and the measures that are necessary and proper to minimize those impacts. All conservation measures described in the proposed HCP, together with the terms and conditions described in an associated Implementing Agreement and any section 10(a)(1)(B) permit or permits issued with respect to the proposed HCP, are hereby incorporated by reference as reasonable and prudent measures and terms and conditions within the Incidental Take Statement under 50 CFR §402.14(I). Such terms and conditions are non-discretionary and must be undertaken for the exemptions under section 10(a)(1)(B) and section 7(o)(2) of the Act to apply. If the permittee fails to adhere to these terms and conditions, the protective coverage of the section 10(a)(1)(B) permit and section 7(o)(2) may lapse. The amount or extent of incidental take expected under the proposed Buckeye Wind HCP, associated reporting requirements, and provisions for disposition of dead or injured animals are as described in the HCP and its accompanying section 10(a)(1)(B) permit.

I. AMOUNT OR EXTENT OF TAKE

After reviewing the HCP and analyzing the effects of the proposed action, the Service anticipates that 130.0 Indiana bats may be taken as a result of the proposed action. The incidental take is expected to be in the form of death from collision with turbines and from barotrauma within blade vortices. Incidental take is not expected to result from construction, decommissioning or mitigation activities. Under this ITP, no more than 26 Indiana bats may be taken over any consecutive 5-year period, starting in any one year in which take of more than 5.2 Indiana bats is estimated to have occurred. No more than 14.2 Indiana bats may be taken in any 1 year.

II. EFFECT OF THE TAKE

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

III. REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measure is necessary and appropriate to minimize impacts of incidental take of the Indiana bat:

1. The Service has deemed all measures and requirements outlined in the Conservation Program of the HCP as necessary and appropriate to minimize the take of Indiana bats. Thus, the Ohio Field Office will ensure that the applicant strictly adheres to these measures and requirements. These include, but are not limited to:
    a. full implementation of the avoidance measures, minimization measures, mitigation measures, conservation measures, monitoring and adaptive management plan;
    b. funding as described in the Conservation Program (section 6.0) of the HCP; and
    c. full compliance with the conditions and compliance measures imposed as per the Ohio Power Siting Board's Certificate of Environmental Compatibility and Public Need (OPSB CECPN) (for both the Buckeye Wind Project and Buckeye II Wind Farm certificates).

The HCP's Conservation Program and associated requirements, as well as the OPSB CECPN conditions and measures are hereby incorporated by reference.

IV. TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the U.S. Fish and Wildlife Service must comply with the following terms and conditions, which implement the reasonable and prudent measure described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

The Ohio Field Office must ensure that the Conservation Program detailed in the HCP is fully implemented by the Applicant, and that the Project is in full compliance with the ITP. To this end, the Service will complete a compliance checklist by March 1 (following each monitoring year) to provide documentation that the Ohio Field Office is monitoring compliance of the Applicant to obligations made in the HCP. This annual checklist will be completed for the 30-year term of the ITP.

The Ohio Field Office will also ensure that Project personnel are aware and fully capable of carrying out procedures for the disposition of individuals taken (injured or dead bats), as provided in section 6.5.2.8.1 of the HCP.

The Service believes that no more than 130.0 Indiana bats will be incidentally taken as a result of the proposed action. No more than 26 Indiana bats may be taken over any consecutive 5-year period, starting in any one year in which take of more than 5.2 Indiana bats is estimated to have occurred. No more than 14.2 Indiana bats may be taken in any 1 year. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The applicant via Ohio Field Office must immediately provide an explanation of the causes of the taking and review the need for possible modification of the reasonable and prudent measures.

V. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

The Service provides the following conservation recommendations; these activities may be conducted at the discretion of the Service as time and funding allow:

1. Continue to develop and refine the Indiana Bat Section 7 and Section 10 Guidance for Wind Energy Projects, Revised: 26 October 2011, by incorporating information gained from recent wind projects, as well as current research on the topic;

2. Develop regional HCPs for wind projects that will effectively and efficiently streamline the ESA consultation process for impacts to the Indiana bat.

3. Fund or implement research focused on better understanding exposure of bats to wind turbines, measures to minimize collision risk, and monitoring methods.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

VI. REINITIATION NOTICE

This concludes formal consultation on the construction, operation, and decommissioning of the 100 turbine Buckeye Wind Power Project and the formal intra-Service consultation on the issuance of an incidental take permit to the Applicant. As a basis for this permit action, the Applicant submitted the required HCP requesting an incidental take permit for Indiana bats in the Action Area. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent incidental take is exceeded (more than 26 Indiana bats over any consecutive 5-year period, starting in any one year in which take of more

26 Indiana bats over any consecutive 5-year period, starting in any one year in which take of more than 5.2 Indiana bats is estimated to have occurred, or more than 14.2 Indiana bats in any 1 year); (2) new information reveals effects of the Buckeye Wind Project that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the Buckeye Wind Project is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

Signature: Mary Knapp

Title: Field Supervisor

Date: July 12, 2013

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