United States Department of the Interior

FISH AND WILDLIFE SERVICE

Chesapeake Bay Field Office
177 Admiral Cochrane Drive
Annapolis, Maryland 21401
http://www.fws.gov/chesapeakebay

Memorandum

Date: January 17, 2014

To: Assistant Regional Director, Ecological Services, Hadley, MA

From: Field Supervisor, Chesapeake Bay Field Office, Annapolis, MD GPL

Subject: Biological Opinion: Application for Incidental Take Permit and Habitat Conservation Plan submitted by Criterion Power Partners, LLC for the Criterion Wind Project, Garrett County, Maryland.

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion which evaluates the Service's proposed action of issuing a section 10(a)(1)(B) incidental take permit (ITP) contingent on implementation of the Criterion Wind Project Habitat Conservation Plan (hereafter referred to as the HCP). The HCP was submitted by Criterion Power Partners, LLC (CPP), a wholly owned subsidiary of Exelon Generation Company, LLC., who owns and operates the Criterion Wind Project (hereafter referred to as the applicant). The HCP was submitted by the applicant as a component of their application for a permit for incidental take of Indiana bats (*Myotis sodalis*) resulting from actions associated with the Criterion Wind Project (hereafter referred to as the Project). This biological opinion (BO) is prepared in accordance with Section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.).

Section 7(b)(3)(A) of the Endangered Species Act (Act) requires that the Secretary of the Interior issue biological opinions on federal agency actions that may affect listed species or critical habitat. Biological opinions determine if the action proposed by the action agency is likely to jeopardize the continued existence of listed species or destroy or adversely modify critical habitat. Section 7(b)(3)(A) of the Act also requires the Secretary to suggest reasonable and prudent alternatives to any action that is found likely to jeopardize the continued existence of listed species or result in an adverse modification of critical habitat, if any has been designated. This BO only assesses impacts to federally listed species and does not address the overall environmental acceptability of the proposed action.

This BO evaluates the Service's issuance of an incidental take 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. It evaluates the potential direct and indirect effects to Indiana bats that may occur as a result of implementing the project as described in the associated HCP. 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.

The jeopardy analysis in this BO assesses whether the proposed action would be reasonably expected to reduce appreciably the likelihood of both survival and recovery of the Indiana bat by reducing their reproduction, population, and distribution in the wild. The principal components of this analysis are, in brief: identifying the likelihood of individual Indiana bat exposure to action related stressors and their responses to that exposure, integrating those individual risks (exposure risk and subsequent response) to discern the consequences to the populations to which those individuals belong, and determining the consequences of any population-level risks to the species rangewide.

Jeopardy determinations are ultimately made for the listed entity which is the rangewide distribution for the Indiana bat. However, as described in the Indiana Bat Section 7 and Section 10 Guidance for Wind Energy Projects (USFWS 2011, Q75), the jeopardy analysis is best conducted in the context of an analytical framework that addresses the effects at various scales, beginning with the smaller, local population levels. This BO evaluates impacts of the project following this analytical approach. If, at any point, we demonstrate that the risks are unlikely at the smaller, local population level, then risks also are unlikely at larger population scales, and we conclude that the action is not likely to jeopardize the continued existence of the species rangewide.

This BO is based on information from many sources, including but not limited to: 1) the applicant's final HCP (CPP 2014), 2) the Service's environmental assessment (USFWS 2013), 3) reports on Indiana bat surveys conducted at the project site (Gates et al. 2006, Gruver 2011), 4) information obtained from the scientific literature, and information provided by the applicant (and their consultants),[1] and 5) multiple runs of an Indiana bat demographic model developed by Thogmartin et al. (2013). Our model runs reflect: a) Indiana bat specific assumptions described in the model; b) an assumption that white nose syndrome (WNS) has and will continue to affect the population; and c) Service choices of appropriate scenarios, with and without the project, as described in appendix B of this BO.

I. CONSULTATION HISTORY

The Service began coordinating with the applicant on the proposed project in June 2010. Appendix A provides a list of key documents and activities including formal letters, meetings, site visits, and major milestones that occurred as part of the consultation process. In addition to the events listed, the consultation history includes numerous phone calls, e-mails, letters and teleconferences over the past three years. A complete administrative record of this consultation is on file at the Chesapeake Bay Field Office (CBFO) in Annapolis, Maryland.

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[1] Documents cited as a reference generally refer to the entire document as a source, but citations of larger documents may include the specific page number or questions (Q) that are being referenced as well.

II. DESCRIPTION OF THE PROPOSED ACTION

The Federal action being evaluated in this BO is the Service's issuance of a section 10(a)(1)(B) ITP for the incidental take of Indiana bats. The ITP will authorize incidental take of up to 12 Indiana bats over the next 20 years in association with wind turbine operations. As part of the requirements for obtaining an ITP, the applicant has prepared a HCP in coordination with the Service. The HCP details measures that the applicant will implement to avoid, minimize, monitor, and mitigate for the impacts of the take to Indiana bats. There are no other currently listed federally threatened or endangered species affected by this project.

Action Area

For purposes of consultation under section 7 of the Act, the "action area" is defined by 50 CFR 402.02 as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." However, in this case, the action area is the same as the project area and includes the 117-acre area leased for the project.

The wind farm, and all related infrastructure, is on a 117-acre leased parcel located near the town of Oakland in Garrett County, Maryland (Figure 1). Garrett County is in the Appalachian highlands and the project is located along the ridge of Backbone Mountain extending northeast approximately 9 miles from Alleghany Heights to just south of Wild Turkey Rock. Implementation of the project, including measures described in the HCP, is anticipated to result in adverse effects to Indiana bats that may be migrating through the project area in close proximity to the wind turbine locations (more specifically in the rotor swept zone of the individual turbines).

As the wind farm has already been constructed and the only action resulting in direct or indirect effects from the project is the actual operation of the turbines, the geographic extent of the project (i.e., project footprint) represents the action area for the purposes of this BO analysis. While the individual bats that may be impacted by the project may come from a broader migratory population, the project-level effects (e.g., noise, lighting, etc.) do not extend outside of the project footprint. Impacts of take of individual bats from a broader migratory population are assessed in the section of this BO that assesses the impacts of take. Thus the action area (described as the project area in the HCP) is the 117-acre leased parcel where the turbines are operating and effects to Indiana bats are anticipated to occur (Figure 1).

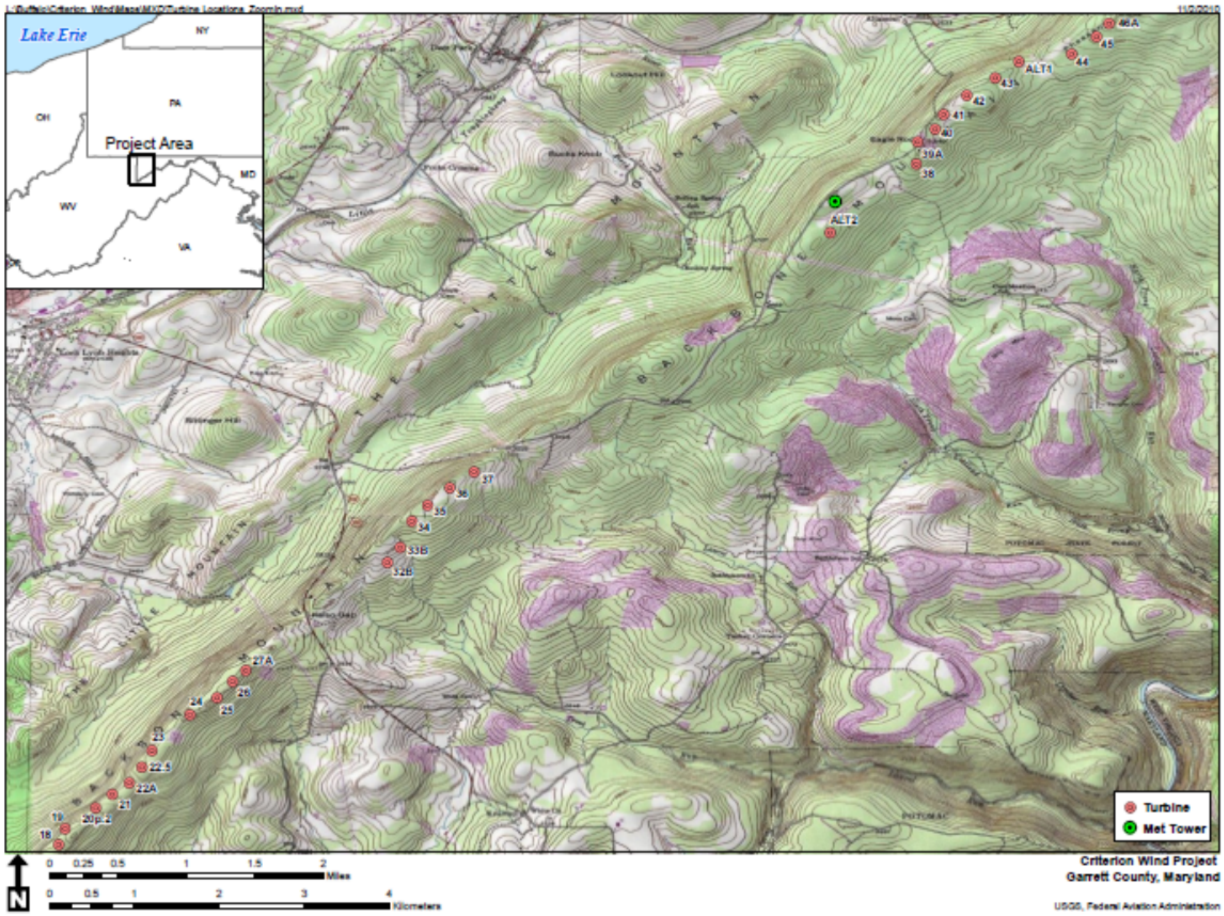


Figure 1. Location of Criterion Wind Project.

Project Description

The proposed project involves the operation, maintenance, and decommissioning activities for a 70 megawatt (MW) wind-energy facility. The wind farm consists of 28 fully constructed wind turbine generators (WTGs) and associated access roads, electrical collection system, operations and maintenance facility, and substation. The proposed term of the incidental take permit is 20 years which is the functional life of the project as planned.

The WTGs are Clipper 2.5-MW Liberty, each composed of a pad-mounted transformer, power distribution panel, turbine tower, and gravel access drive and buffer area, with a footprint of 1.62 acres for each turbine. The turbine towers are approximately 262 feet (80 m) in height with a nacelle and a three-bladed rotor that is approximately 305 feet (93 m) in diameter mounted at the top of each tower. The maximum height of the turbines from the tower base to the blade tip at its highest point is 416 feet (126 m). The WTGs are arranged in three groups, with 11 WTGs in the northern section, six in the center section, and the remaining 11 extending south (Figure 1).

Conservation Measures

The HCP's primary biological goal is to promote long term maintenance of Indiana bat populations in the Appalachian Mountain Recovery Unit (AMRU) through minimizing potential take of Indiana bats at the project and providing habitat conservation measures to improve survival of wintering bats off-site (HCP, section 5.1). The plan thus incorporates conservation measures designed to avoid, minimize, monitor, and mitigate impacts of the proposed action on Indiana bats. 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, as pertaining to project operations, maintenance, and decommissioning, can be found in section 5.0 of the final HCP but they are summarized briefly here. Note that the applicant implemented additional avoidance and minimization measures during project construction that are detailed in the final HCP (e.g., siting the project in an area with no Indiana bat captures in mist-net surveys, reduction in the number of storm water management ponds, etc.).

1) Avoidance Measures:

- In the event that hazard trees have to be removed during maintenance and decommissioning activities the applicant will make every effort to schedule the removal prior to April 1 or after November 15 of any given year or will otherwise survey to insure that bats are not occupying hazard trees prior to removal.

2) Minimization Measures

- The turbines will be fully feathered (i.e., spinning at less than 2 revolutions per minute [rpm]) up to wind speeds of 5.0 meters per second (mps) between July 15 and October 15 which is when the largest peak in bat mortality occurs. Based on existing research (Arnett et al. 2011, Young et al. 2011), we expect this to reduce total bat mortality, including Indiana bat mortality, by at least 50 percent.

3) Mitigation Measures

- Implement a hibernacula gating project that meets specific criteria that are outlined in section 5.3 of the HCP.

4) Monitoring, Adaptive Management and Reporting

- Post Construction Mortality Monitoring (PCM) was conducted during the first three years of operations.
- The objective of the first year of monitoring was to assess take of Indiana bats and to determine total bat mortality and seasonality of bat mortality while years 2 and 3 assessed take of Indiana bats (via the surrogate model) and total bat mortality with curtailment. Follow up monitoring occurring in permit years 5, 10, and 15 will be conducted to ensure that total bat mortality with curtailment has not increased and remains within expected levels.
- PCM included carcass searches of all turbines daily from April 1 to November 15 during the first year. In the following two years and permit years 5, 10, and 15 there will be weekly surveys of 14 turbines from April 1 to November 15. Monitoring results will include corrections for carcass removal, searcher bias (efficiency), and searchable area.
- Monitoring to evaluate implementation of the mitigation project will be conducted by the applicant. The benefit of the mitigation project to the hibernating bat populations will be

evaluated through the ongoing hibernacula monitoring conducted by State and Federal biologists.

- An annual report will be submitted to the Service by January 31 and will include the following: 1) cumulative assessment of take; 2) an assessment of the effectiveness of the conservation plan; 3) status of the mitigation project; 4) if applicable, recommendations for future research, monitoring, and mitigation; 5) a list of any changed circumstances that apply and strategies to address them; and 6) written confirmation that funding is available or committed for the full implementation of the HCP for the ensuing year.
- During years when monitoring is conducted, the following will be included in a monitoring report due no later than January 31 of the following year: 1) summarized results of monitoring conducted the previous year; 2) evaluation of the efficacy of monitoring methods; 3) comparison of the results of the monitoring to the authorized take; and 4) evaluation of the success of any on-site minimization strategies relative to the Indiana bat.

III. STATUS OF THE SPECIES

A. Status of the Species Rangewide

Listing status and critical habitat: Indiana bats are one of the 78 species first listed as an endangered on March 11, 1967 (Federal Register 32[48]:4001) under the Endangered Species Preservation Act of October 15, 1966 (80 Stat. 926; 16 U.S.C. 668aa[c]). In 1973, the Act subsequently extended full protection to the species. Thirteen winter hibernacula (11 caves and two mines) in six states are designated as critical habitat for Indiana bats (Federal Register, Volume 41, No. 187). No critical habitat occurs within or near the action area.

Description and rangewide distribution: Indiana bats are medium-sized insectivorous bats in the *Myotis* genus, with a head and body length of about 41-49 mm. They closely resemble little brown bats (*Myotis lucifucus*) but are distinguishable by shortened toe hairs and a slightly keeled calcar.

In the summer, Indiana bats occur in forested areas and forage for insects flying at or below the forest canopy, especially over streams or ponds where insects are abundant. They also forage in or along the edges of forested areas. Females raise their young in maternity colonies of 20 to 60 or more females located under the loose bark of trees or snags. During the summer, males roost alone or in small groups. In late summer and early fall, Indiana bats migrate from summer areas to winter hibernacula (e.g., caves, abandoned mines). The winter range is typically associated with areas of well-developed limestone caverns. Mating occurs during fall before Indiana bats enter their hibernacula. Females store sperm though winter and become pregnant in spring soon after they emerge from the hibernacula. Hibernation is a critical time for Indiana bats and undisturbed winter hibernacula that have a constant cool temperature are important components of their habitat needs and population success (Brack et al. 2002, Tuttle and Kennedy 2002).

Indiana bats are found over most of the eastern half of the United States (USFWS 2007). States within the current range of the Indiana bat include Indiana, Missouri, Kentucky, Illinois, New York, Alabama, Arkansas, Connecticut, Iowa, Maryland, Michigan, New Jersey, North Carolina, Ohio, Oklahoma, Pennsylvania, Tennessee, Vermont, Virginia, and West Virginia.

Recovery plan and recovery units: The Service published a recovery plan (USFWS 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. An agency draft of a revised recovery plan was provided for public review and comment in the Federal Register on April 9, 1999, but has not yet been finalized. A revised draft recovery plan was noticed in the Federal Register for public review and comment on April 16, 2007 (USFWS 2007). This document identifies four recovery units (RU): the Ozark-Central, Midwest, Appalachian Mountains, and Northeast (Figure 2). This project is located in the AMRU.

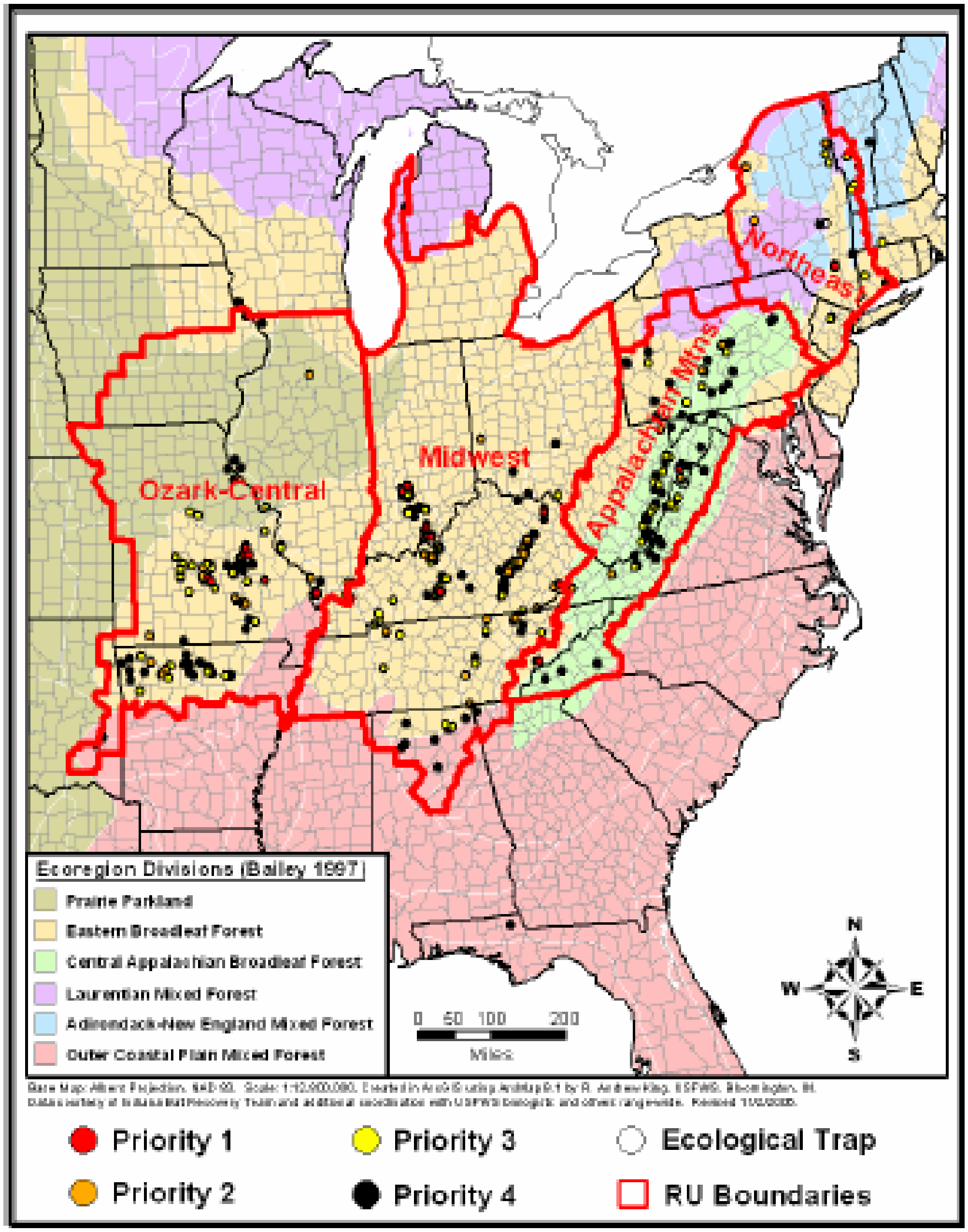


Figure 2. Indiana bat recovery units. (Note: Priority numbers of hibernacula are based on size of the population - P1: ≥10,000 bats. P2: 1,000-9,999 bats. P3: 50-999 bats. P4: 1-49 bats.)

Current rangewide population and trend: The 2013 rangewide Indiana bat population was estimated to be 534,239 bats, with the vast majority occurring in the Midwestern and Ozark-Central RUs (Table 1). About 56 percent of the entire rangewide population occurs in the Midwestern RU. The AMRU (all of West Virginia, most of Pennsylvania, and portions of western Maryland, eastern Virginia, western North Carolina, and eastern Tennessee) supported approximately 3.3 percent of the 2013 total population estimate.

In the 10 years prior to 2011, the rangewide population of Indiana bats had been generally stable with increases in eastern RUs and some declines in western RUs (Thogmartin et al. 2012). That trend has been reversed recently due to the spread of WNS. WNS was first detected in the Northeastern RU in 2006, and by 2011, the NERU had declined by approximately 50 percent (Table 1). Although Indiana bat population estimates in the NERU show a 13 percent increase from 2011 to 2013 (in the 8th year post-WNS), it is unclear if this increase represents true population growth, immigration from other areas, or other factors.

In the AMRU, the population declined between 2011 and 2013 by 46 percent as WNS has been documented in more and more hibernacula (Figure 3). As WNS continues to spread across the other RUs, the Indiana bat populations are expected to decline, though the nature and magnitude of population impacts from this disease may vary by RU. For the purposes of this BO, we assume the magnitude of the AMRU population declines will be similar to those occurring in the Northeast RU.

Table 1. Indiana bat population estimates rangewide and by recovery unit (RU). Estimates are based primarily on winter surveys at known priority 1 and 2 hibernacula. Additional data from priority 3 and 4 hibernacula were included when available; however, survey efforts for these smaller hibernacula vary over time (USFWS 2013a).

IBat Recovery Unit	State	2005	2007	2009	2011	2013	% Change from 2013	% of 2013 Total
Ozark-Central	Illinois	55,090	53,823	53,342	55,956	57,074	2.0%	10.7%
	Missouri*	139,038	138,831	136,624	138,379	139,772	1.0%	26.2%
	Arkansas	2,067	1,821	1,480	1,206	856	-29.0%	0.2%
	Oklahoma	2	0	0	13	5	0.0%	0.0%
	Total	196,197	194,475	191,446	195,554	197,707	1.1%	37.0%
Midwest	Indiana	206,610	238,068	213,244	225,477	226,365	0.4%	42.4%
	Kentucky	65,611	71,250	57,325	70,598	62,233	-11.8%	11.6%
	Ohio	9,769	7,629	9,261	9,870	9,259	-6.2%	1.7%
	Tennessee	3,221	2,929	1,657	1,791	2,337	30.5%	0.4%
	Alabama	296	258	253	261	247	-5.4%	0.0%
	SW Virginia	202	188	217	307	214	-30.3%	0.0%
	Michigan	20	20	20	20	20	0.0%	0.0%
	Total	285,729	320,342	281,977	308,324	300,675	-2.5%	56.3%
Appalachian	West Virginia	13,417	14,745	17,965	20,296	3,845	-81.1%	0.7%
	E. Tennessee	8,853	5,977	11,058	11,096	13,200	19.0%	2.5%
	Pennsylvania	835	1,038	1,031	519	120	-76.9%	0.0%
	Virginia	567	535	514	556	418	-24.8%	0.1%
	North Carolina	0	0	1	1	1	0.0%	0.0%
	Total	23,672	22,295	30,569	32,468	17,584	-45.8%	3.3%
Northeast	New York	41,745	52,779	33,172	15,654	17,772	13.5%	3.3%
	New Jersey	652	659	619	409	448	9.5%	0.1%
	Vermont	313	325	64	61	53	-13.1%	0.0%
	Total	42,710	53,763	33,855	16,124	18,273	13.3%	3.4%
Rangewide Total:		548,308	590,875	537,847	552,470	534,239	-3.3%	100.0%

*A previously unknown Indiana bat hibernaculum was discovered in Missouri in 2012 containing approximately 123,000 Indiana bats when surveyed in January 2013. The Service has included the same number of Indiana bats as was found in 2013 to each previous biennium through 1981 to avoid an artificial spike in population trends based upon first-hand accounts of very large numbers of bats observed at this site for several decades.

Threats rangewide: The original recovery plan (USFWS 1983) identified threats or "causes of decline" as: (1) natural hazards (i.e., flooding, freezing, mine ceiling collapse), (2) human disturbance and vandalism at hibernacula (identified as "the most serious cause of Indiana bat decline"), (3) deforestation and stream channelization, (4) pesticide poisoning, (5) indiscriminate scientific collecting, (6) handling and banding of hibernating bats by biologists, (7) commercialization of hibernacula, (8) exclusion of bats from caves by poorly designed gates, (9) man-made changes in hibernacula microclimate (blocking or adding entrances and/or by poorly designed gates), and (10) flooding of caves by dams/reservoir developments. Listing of the Indiana bat brought attention to the dramatic declines in the species' populations and led to regulatory and voluntary measures to alleviate disturbance of hibernating bats (Greenhall 1973).

The 2007 draft Recovery Plan (USFWS 2007) identified several additional threats including: (1) quarrying and mining operations (summer and winter habitat), (2) some silvicultural practices and firewood collection, (3) disease and parasites, (4) predation, (5) competition with other bat species, (6) environmental contaminants (not just "pesticides"), climate change, and (8) collisions with man-made objects (e.g., wind turbines, communication towers, airplanes, and vehicles) (USFWS 2007, pp. 71-100). However, the most significant threat to this species currently is WNS, which is a significant threat to the recovery of the Indiana bat (Thogmartin et al 2013).

WNS is an emergent disease of hibernating bats that has spread from the northeastern to the central United States at an alarming rate. First documented in a photo taken in a New York Cave in 2006, WNS has now spread to more than 24 states and four Canadian provinces (Figure 3). Some affected hibernacula, especially in New York and New England, have experienced 90 to 100 percent mortality (Frick et al. 2010).

The disease is named for the white fungus, *Pseudogymnoascus destructans,* as per Minnis and Lindner (2013). This fungus infects the skin of hibernating bats. Affected bats usually exhibit the white fungus on their muzzles and often on their ears and wings as well (Blehert et al. 2009, 2011). 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. Fat reserves in these bats are also severely diminished or non-existent, making survival to spring emergence difficult.

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 (USFWS 2011). Seven bat species have been confirmed with WNS to date including little brown bats, Northern long-eared bats (*M. septentrionalis*), Indiana bats, eastern small footed bats (*M. leibii*), tricolored bats

(*Perimyotis subflavus*), gray bats (*M. grisescens*), and big brown bats (*Eptesicus fuscu). P. 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).

According to 2013 rangewide population estimates, the Northeast RU population has lost approximately 66 percent of its Indiana bats since 2007 (USFWS 2013a). This mortality closely coincides with the onset and rapid spread of WNS. It is expected that declines will occur in all of the RUs as a result of this disease.

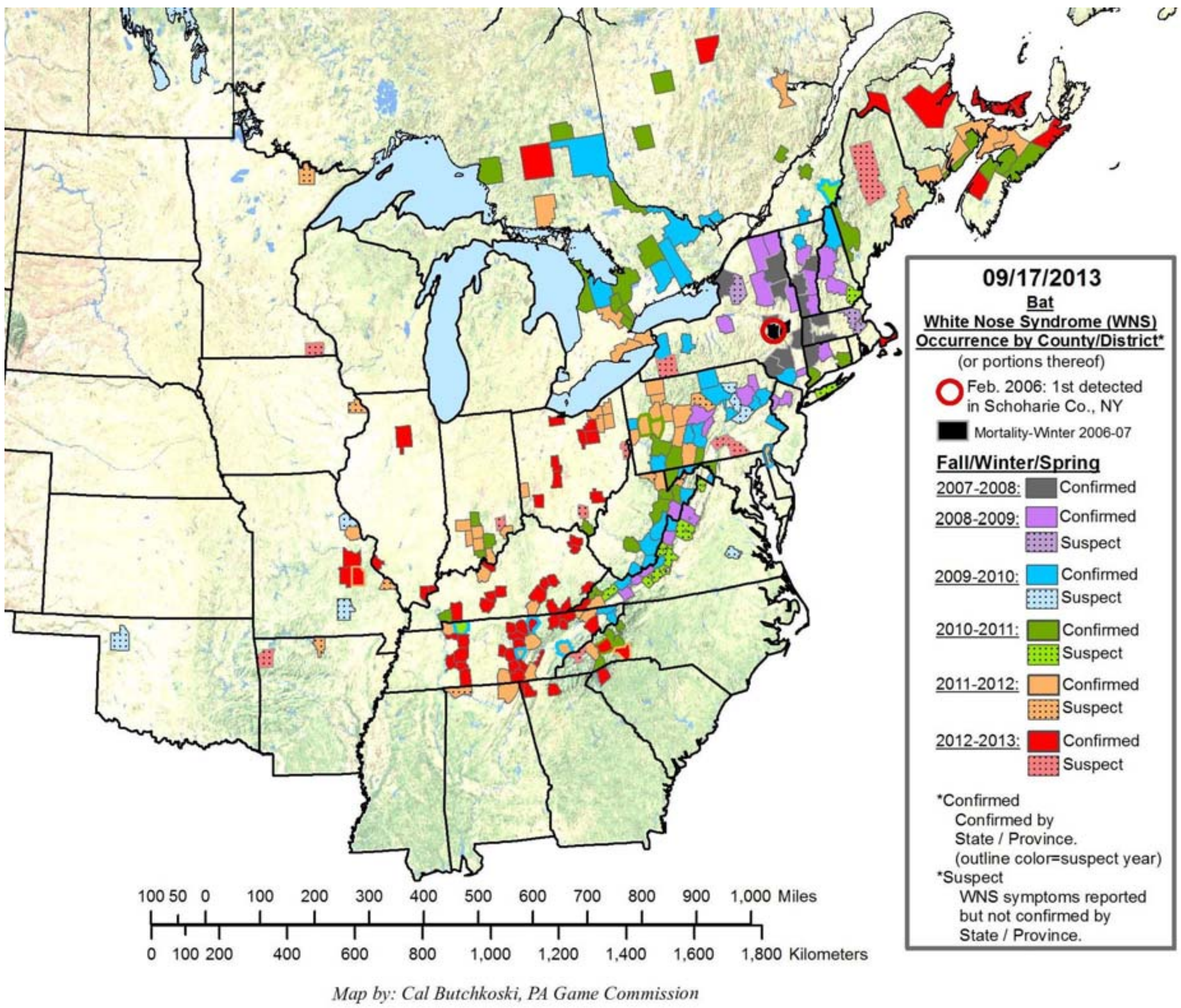


Figure 3. Bat White Nose Syndrome Occurrence by County/District 09/17/2013.

B. Status of the Species within the Appalachian Mountain Recovery Unit

The AMRU supported about 8 percent of the total rangewide Indiana bat population prior to WNS with a total of 32,529 bats in 2011. The post-WNS population estimates now reflect 3.3 percent of the total rangewide population. The following information summarizes the distribution and life history of the Indiana bat in the AMRU (USFWS 2011).

Winter distribution in the AMRU: Indiana bats over-winter in hibernacula (e.g., caves, abandoned mines). There are three areas in the AMRU with large hibernacula: 1) Blair County, Pennsylvania, where a Priority 2 hibernaculum occurs; 2) Pendleton County, West Virginia, where the largest Priority 1 hibernaculum occurs (Hellhole); and 3) Blount County, Tennessee, where a Priority 1 hibernaculum and several Priority 2 hibernacula occur (see Figure 2 for definitions of Priority numbers). There are many smaller hibernacula (Priority 3 and 4) scattered throughout the AMRU (Figure 2).

Spring migration in the AMRU: Indiana bats leave their winter hibernacula in the spring and migrate to summer habitat. The migratory distances traveled by Indiana bats between winter and summer areas can vary substantially among the RUs. Generally speaking, the routes in the AMRU are multi-directional and short (100 miles or less); most of the Northeast RU bats migrate less than 42 miles (Butchkoski et al. 2008). Migrations in the Midwest RU and Ozark-Central RUs are mostly south to north and can be short or long ranging between 5-357 miles (Winhold and Kurta 2006, Gardner and Cook 2002, Pruitt, pers. com. 2008).

Migration distances in the AMRU are generally 100 miles or less and most are much shorter. Of 79 records of migrating animals (from radio-tagged animals or band recoveries), 51 percent of the records are short distance movements of ≤ 20 miles, 75 percent of all records are ≤ 50 miles, and 95 percent are within 100 miles (L. Hill, USFWS WVFO, 2013).

During spring migration, females move quickly across the landscape. One radio-tagged female bat released from Canoe Creek Mine in Pennsylvania traveled approximately 60 miles in one evening (Cal Butchkoski, PA Game Commission, pers. com. 2005). A female Indiana bat from a hibernaculum in Luzerne County, Pennsylvania traveled 56 miles to her summer habitat in Berks County, Pennsylvania in two nights (Butchkoski and Turner 2006). Based on a combination of aerial and ground tracking, Indiana bats tracked from a hibernaculum in Pennsylvania took several nights and flew almost straight lines to their roost trees 83 to 92 miles away in Maryland (Butchkoski and Turner 2006).

The extent to which migrating bats follow landscape features during migration is not clearly understood. Most migration movements have been tracked during spring migration, not the fall migration which is when most of the mortality from wind turbines occurs (USFWS 2011). However, there is some evidence that bats follow landscape features while migrating in the spring. Based on observations of 22 bats tracked during spring telemetry studies in Pennsylvania from 2000 to 2006, bats appeared to go out of their way to follow tree lines, including riparian buffers along streams through otherwise developed areas, and avoided open areas (Turner 2006). Similarly, 12 bats tracked in western Virginia during spring migration generally followed the direction of the ridges and valleys in the area, which run northeast-southwest, with only one bat flying east (i.e., into the Shenandoah Valley) and none flying west (i.e., over the higher mountain ridges into West Virginia) (McShea and Lessig 2005). The authors think that these movement patterns suggest that bats were using these corridors as migration flyways.

Summer distribution in the AMRU: Indiana bats generally migrate to forested habitats during the summer period, with females congregating in maternity colonies and males staying solitary or congregating in small bachelor colonies. Trees used for roosting during this time generally are characterized as dead and dying trees (i.e. snags) greater than 5-inches in diameter-at-breast height with loose sloughing bark or crevices in the bark where bats can hide.

Summer maternity colonies are considered especially important for the long-term recovery of the species. There are at least 17 known maternity colonies in the AMRU (this estimate does not include the North Carolina and the Tennessee portion of the AMRU). Given that the average size of maternity colonies throughout the range of Indiana bat are 60 bats (Kurta 2004), and that half of the estimated Indiana bats in the AMRU (Table 1) are expected to be females, we assume that there currently are up to 129 additional maternity colonies in the AMRU that have not been detected (based on 2013 numbers), or 146 total colonies. It is difficult to predict the location of these additional maternity colonies, though they are thought to occur primarily in lower elevation forested habitats that have access to good foraging habitat. The AMRU includes extensive forested habitat that could meet these characteristics and we do not believe Indiana bats in general are limited at the landscape level by the availability of potential maternity habitat. For example, West Virginia is about 78 percent forested, Pennsylvania 59 percent forested, and western Maryland counties are about 70 percent forested (West Virginia Division of Forestry 2010; U.S. Forest Service 2008, 2013).

Brack et al (2002) describe the potential role of climate and elevation affecting the thermal suitability of forests. They suggest that some areas of forest at high elevations may be too cold to provide good maternity habitat. They analyzed mist net captures from West Virginia, Virginia and Pennsylvania, and found reproductive females of little brown bats were proportionately less common at high elevations though other species such as small footed bats had the opposite relationship (Brack et al. 2002). There were not sufficient numbers of Indiana bat captures in their study to specifically analyze the species.

Our general understanding of suitable maternity habitat for Indiana bats in the AMRU is that warm temperatures are important. Female bats generally raise their pups in colonies under loose bark of live trees or snags, often on the edge of forests where solar exposure can maintain warm temperatures. The physiology of reproducing female bats makes thermal conditions critical to successful reproduction. Thus major determinants of summer temperature which include latitude, elevation and microclimate, may all have an influence on where suitable maternity roosts are located.

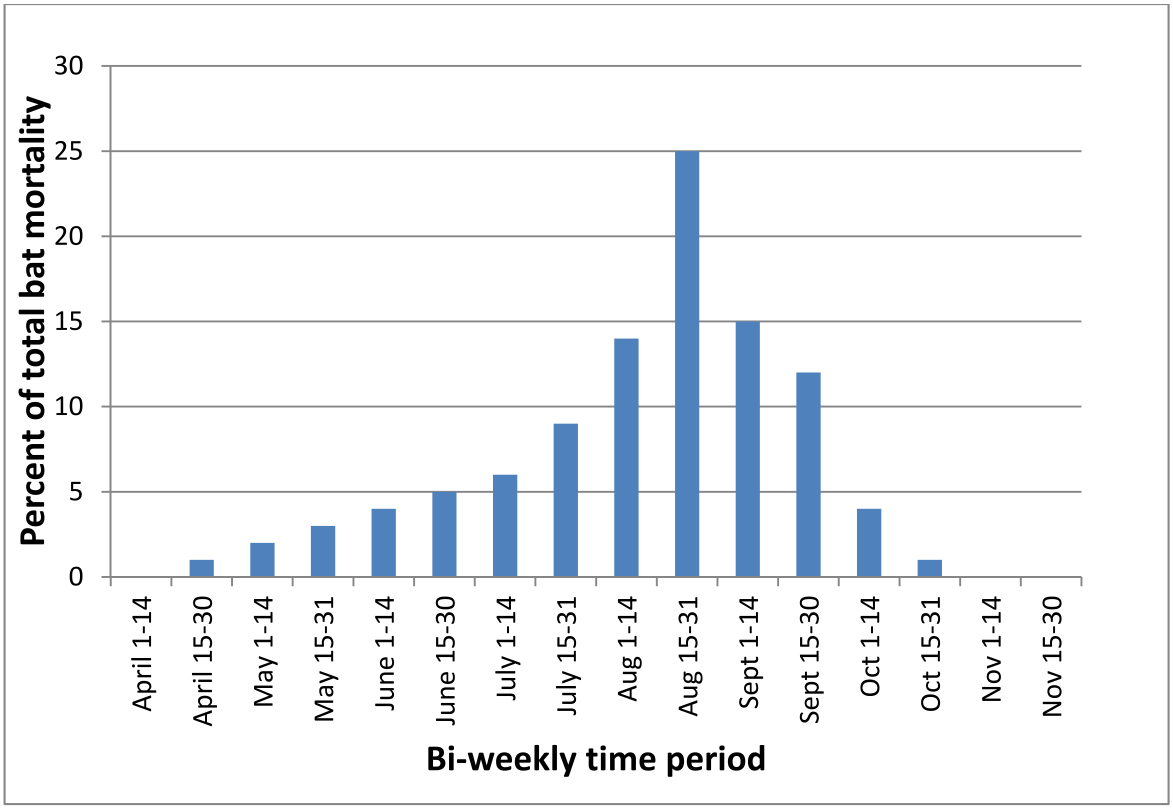
Generally, in northern areas, high elevations may be too cold for suitable maternity habitat. Britzke et al (2006) found female Indiana bats roosted extensively in the valleys and not the mountains of a Lake Champlain study area. And currently, the elevation limit for suitable summer habitat in the Northeastern RU is considered to be below 900 feet (USFWS, NYFO, R. Niver, pers. com. 2012). However, at the southern end of the Indiana bat range, such as North Carolina and Tennessee, maternity colonies have been found at much higher elevations, especially when they can find suitable micro-climates where solar exposure to the roost tree or snag is present (Britzke et al 2003). The range of conditions available may also be important in determining where maternity sites occur. At an Indiana bat maternity site in a mountainous area of Boone County, West Virginia, the only summer habitat available was forest with steep ravines, cool valley streams, and associated dirt roads (Beverly et al. 2009). Reproductive Indiana bats equipped with radio-transmitters foraged within a steep ravine containing a headwater stream between upper and mid slopes (in contrast to other studies where bats forage in riparian areas). Heavy fog and cool temperatures that settle in valleys associated with mountain streams may explain why these bats consistently foraged higher up the slope (Beverly et al. 2009). In addition, the ravine provided shelter from strong winds typical of the ridge tops. Thus foraging ravines may provide ideal conditions for both bat and insect prey (Beverly et al. 2009).

During spring and fall migration, male Indiana bats leave the hibernacula later than females and return to the hibernacula swarming area sooner. During summer, some males remain near their hibernacula (Whitaker and Brack 2002), while others disperse throughout the range and roost individually or in small numbers in the same types of trees (although males often use smaller trees and are more likely to roost in live trees, probably because the solar exposure possible for snags is not as important for males).

Fall migration in the AMRU: In late summer and early fall, Indiana bats return to their winter hibernacula. They migrate to areas within close proximity to the hibernacula, where swarming behavior and mating occurs. Indiana bat populations generally concentrate within 10 miles of P3 and P4 hibernacula and 20 miles of P1 and P2 hibernacula (USFWS 2011, Q32).

The majority of the bat mortality that occurs at wind turbines happens during the late summer and early fall as bats migrate from summer habitat to winter habitat. This seasonal pattern is seen in both cave dwelling bats and migratory tree bats and has been observed in many areas of the country (Kunz et al. 2007, Arnett et al. 2008, Taucher et al. 2012). In Pennsylvania, results from 26 post-construction monitoring studies conducted between 2004 and 2011 indicate that 79 percent of all bat mortality occurred between July 15 and October 15 (Figure 4), though the specific peak may vary by species (Taucher et al. 2012, from results in Table 10). For little brown bats, 73 percent of the mortality occurred in this time period. A similar pattern of high fall bat mortality has been found in studies from West Virginia, Pennsylvania, and states in the Northeast RU.

Figure 4. Percent of total bat fatalities (n=2,820 bats) found in each time period from 26 Pennsylvania studies (from Traucher et al. 2012, Table 10).



The cause of this peak in mortality during fall migration is not clear. It may relate to social behavior that happens at this time for migratory tree bats and Cryan (2008) hypothesizes that males displaying at tall sites may attract migratory tree bats to turbines. It is possible that social behavior is starting to occur in cave dwelling bats as they approach their swarming areas as well though there is no evidence that Indiana bats migrate in groups.

The following summarizes the Indiana bat life history information for this fall migration time period as described in the Service guidelines (USFWS 2011). There is little telemetry data for fall migrating Indiana bats; however, there is data from roost tree exit counts and fall swarming surveys that may provide some insights into fall migration behavior. Data from the eastern United States show that adult males, adult females, and young migrate separately, with adult males arriving at the hibernaculum first, followed by adult females and lastly juveniles (Brack et al. 2005, Brack 1983, Kurta and Rice 2002). Further, we know that females and juveniles do not usually congregate with males during the summer and that males are frequently solitary during the summer (USFWS 2007). This may indicate that at least some males migrate independently. It is further known that females depart from maternity colonies at different times, though just because the maternity colony disbands does not necessarily mean that bats have begun to migrate (Kurta, pers. com. 2011). Further, not all females from the same maternity colony hibernate in the same hibernacula (Kurta and Murray 2002, Winhold and Kurta 2006). This information suggests at least some females may migrate independently.

Threats to Indiana Bats in the AMRU:

WNS: Of all the threats impacting Indiana bats across the range (as summarized above and in the 2007 draft recovery plan), the threat of greatest significance in the AMRU are declines from WNS. Since 2011, WNS can now be considered prevalent in the AMRU and has been recently discovered in hibernacula in Garrett County (USGS 2011). While the Indiana bat population in the AMRU was generally increasing over the past 10 years (Table 1), the trend does not reflect the influence of WNS. All cave dwelling bats in the AMRU are now considered to be experiencing population declines. Despite significant effort by the Service and many partners to understand, combat, and control the disease, there are currently no solutions.

To conserve the species, it is important to maintain all hibernacula complexes and keep the population distributed as broadly as possible. The importance of some of the smaller hibernacula that might escape WNS infections and act as refugia for populations is increasing.

Impacts from operating wind turbines: A potential risk to Indiana bats is the recent increase in the number of wind turbines being constructed and operated in the AMRU, as efforts to create domestic, alternative sources of clean energy increase. Below we provide a current snapshot of the wind energy development within the AMRU and explain how it relates to the baseline condition of the AMRU's Indiana bat population. We separately analyze the effects to Indiana bats *from this project within the action area*, later in this BO.

State	Total # of Operational Turbines	Turbines under construction	Total # turbines
West Virginia	327	Unknown	327
E. Tennessee	18	0	18
Pennsylvania	720	Unknown	720
Maryland	51	0	51
Virginia	0	19	19
North Carolina	0	0	0
Total Turbines	1,116	19	1,135

There currently are about 1,135 wind turbines, that are active or under construction in the AMRU (American Wind Energy Association 2013, http://www.awea.org). The risk to Indiana bats is likely different for each project, depending on the project's size and proximity to hibernacula or maternity colonies. However, we provide the following generalized analysis.

Indiana bats can migrate up to100 miles between hibernacula and maternity colonies (USFWS 2011), thus Indiana bats from many areas may be flying near project sites. If we assume that the turbines across these three states in the AMRU will take Indiana bats at the same rate as calculated for CPP's project without minimization (0.04 Indiana bats/turbine/year) then we predict that 1,135 turbines in the AMRU would take 45 Indiana bats annually. We acknowledge that these are rough estimates because the actual impact of each project will be site specific and based on the avoidance and minimization measures being applied. However, this analysis allows some understanding of how much baseline fatality is potentially occurring cumulatively from turbines operating in the AMRU. The 2011 population size for Indiana bats in the AMRU was 32,468 bats (which we consider to primarily reflect pre-WNS population levels) (Table 1) and the 2011 project specific estimate of Indiana bat mortality is 0.04 Indiana bats/turbine/year. Therefore, an annual loss of 45 bats per year would represent 0.14 percent of the AMRU population. We anticipate that these bats are associated with multiple maternity colonies and hibernacula in the AMRU. To understand the impact the loss of these individuals would have to the overall species, we would need to know which local populations they are attributed to, since it is ultimately the fate of the local populations that impacts the sustainability of this species. Absent that information, we assume that there are multiple maternity colonies and hibernacula in the AMRU being affected at very low rates.

As WNS spreads across the AMRU, we anticipate declines comparable to those observed in the Northeastern RU which has reduced the population to about 30 percent of its 2007 population by 2011 (Table 1). We expect Indiana bat mortality that occurs from operating wind turbines during the fall migration will likely be reduced by approximately the same amount as the total population because fewer bats will be exposed to wind turbines. Thus we anticipate the proportion of the population that will be taken by wind turbines to be approximately the same as before WNS. However, it is clearly important to maintain as many bats as possible while they experience this population decline and minimization measures should be incorporated into every project.

Previous incidental take authorizations: All previously issued Service BOs involving the Indiana bat, including those within the AMRU, have been non-jeopardy. These formal consultations have involved a variety of actions including surface mining, forest management plans, road and bridge projects, natural gas pipelines, timber harvest, prescribed burns,[2] and other activities. 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.

The take of Indiana bats that is already occurring at existing wind facilities and by other land uses is reflected in the baseline population estimates generated biannually during winter surveys of hibernacula. Further, population growth rates (lambda values) generated for the AMRU 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 take of Indiana bat from operation of the Criterion Wind Project at multiple population scales.

C. Status of the species in Maryland

[2] See: http://www.fws.gov/midwest/endangered/mammals/inba/inbaBOs.html. Accessed November 8, 2013.

Winter distribution in Maryland: Currently, there are only four small historic Indiana bat hibernacula in Maryland (USFWS 2012, data from A. King, USFWS, Bloomington, IN) that occur in Garrett, Allegany, and Washington Counties. The largest number of Indiana bats ever recorded in a Maryland hibernaculum was five individuals, found in the John Friend hibernaculum in Garrett County, but none have been observed since 2000. Therefore, Indiana bats are not known to currently over-winter in Maryland.

Summer distribution in Maryland: There is evidence of only two maternity colonies in Maryland and these are in Carroll County. No maternity colonies have been identified in Garrett or Allegheny Counties. However, there have been summer records of males or non-reproductive females in Garrett and Washington Counties in the past (USFWS 2007). Therefore we assume that Indiana bats incidentally occur in Maryland during the summer and undetected maternity colonies may exist.

Spring and fall migration in Maryland: There is no information currently available about how Indiana bats migrate in Maryland. However, because Garrett County is within the migration distance of several hibernacula in West Virginia and Pennsylvania, we assume Indiana bats may migrate through Garrett County, Maryland, to and from summer habitat.

Threats to Indiana bats in Maryland: Indiana bats in Maryland face the same threats as previously described for the AMRU. Specific to the impacts of wind power, there are several wind projects present or proposed in western Maryland. One project with 20 wind turbines is currently operating along the ridge top of Backbone Mountain in Garrett County, Maryland, and four others projects are proposed in Garrett or Allegheny Counties. The entire ridgetop area of Backbone Mountain, spanning both CPP's project and the adjacent project, were surveyed for Indiana bat presence in 2003 and 2004 (Gates et al. 2006). No Indiana bats were captured during these surveys. We consider the risk posed by the adjacent project to be the same as that for CPP which is primarily for bats migrating in the fall. The cumulative effects of all active wind projects to Indiana bats in Maryland are addressed below in the jeopardy analysis.

IV. ENVIRONMENTAL BASELINE WITHIN THE ACTION AREA

Regulations implementing the Act (50 CFR 402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities leading to the current status of the species, its habitat (including designated critical habitat), and ecosystem in the action area. Also included in the environmental baseline are the anticipated impacts of all proposed Federal projects in the action area which have already undergone section 7 consultations and the impacts of State and private actions which are contemporaneous with the consultations in progress. The status of the Indiana bat within the action area is summarized below. Additional information can be found in the HCP (CPP 2014).

Status of the species within the action area

Acoustic data collected within the action area and summer mist net capture records in Garrett County suggest that Indiana bats may incidentally occur within the action area between April and

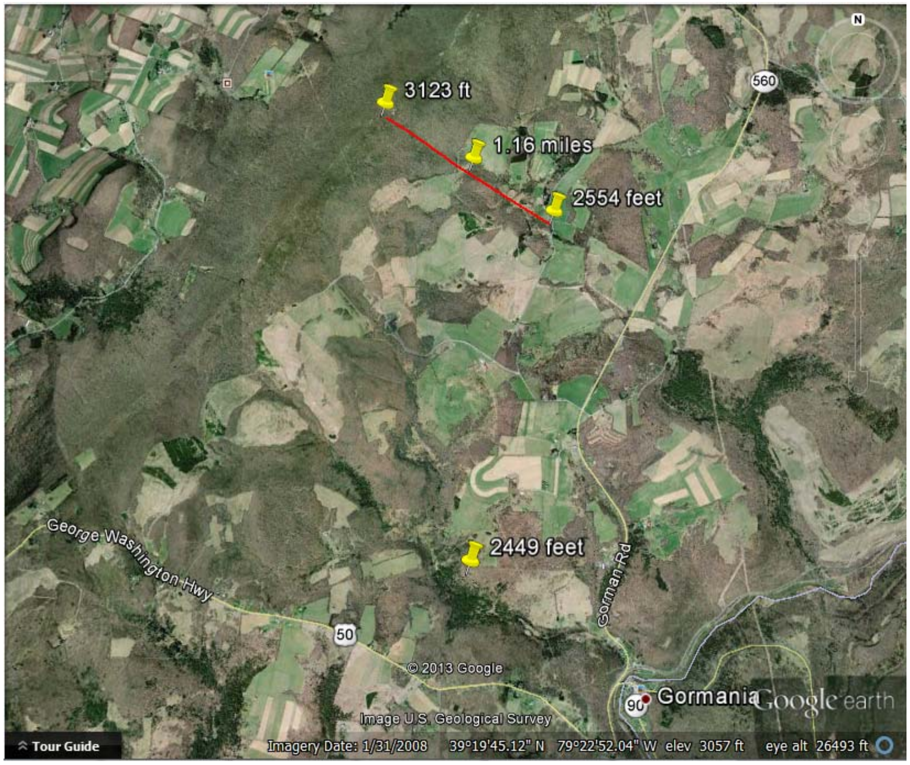
November. However, there is no evidence of summer maternity or bachelor colonies in the action area and there are no known hibernacula to support wintering populations. Therefore, we assume that Indiana bats may move through the action area during spring and fall as they migrate between winter and summer habitat. In addition, there may be incidental Indiana bat occurrences during the summer period.

Initial acoustic surveys conducted in 2006 failed to detect Indiana bat presence in the action area (Gates et al. 2006). However, additional acoustic surveys conducted in 2010 suggest Indiana bats may have been present in the action area in early June and mid-August (Gruver 2011). A total of 912 detectors-nights were accumulated from April 1 through November 15 and 57,112 bat calls were recorded. Of the bat calls, 43,953 (77 percent) were high-frequency calls (those >35 kHz) which generally include the *Myotis* species of bats. A total of 12,000 high-frequency calls were of sufficient quality to be screened with a discriminant function analysis to statistically classify the call sequence based on 11 parameters of the call. Of all the high-frequency calls, 46 (~0.10%) were classified as potential Indiana bat calls. However, the overall activity level for suspected Indiana bats was very low.

Summer mist net surveys conducted at the project site in 2010 did not capture Indiana bats in the action area (Gruver 2011). Combined with the acoustic results, this information suggests that Indiana bats may incidentally occur in the action area but that there are no maternity colonies or male bachelor colonies at the project site. Mist-netting surveys were conducted within the action area in September 4-10, 2003, May 18-24, 2004, and June 23-30, 2004 during which time 36, 10, and 11 bats were caught, respectively. No Indiana bats were caught within the project site (Gates et al. 2006). Additional mist-netting surveys conducted at the project site in June, July, and August 2010 also captured no Indiana bats (Gruver 2011).

There are additional reasons to suggest that maternity colonies or male bachelor colonies do not occur within the action area. First, there are no known maternity colonies in Garrett County, the county within which the action area occurs. Second, elevation and latitude affect the presence of maternity colonies (Brack et al 2002, Britzke et al. 2006) and we consider the high elevation ridge top of Backbone Mountain (i.e., 3,000 to 3,200 feet) to be unlikely maternity habitat. At higher elevations, forested habitats are likely to be thermally less suitable than the lower elevations forest blocks downslope of the project site. While it is difficult to predict the location and occurrence of maternity colonies across the landscape, we anticipate they would occur outside of the action area in the lower elevation valley forest edges where suitable riparian foraging habitat occurs (Figure 5).

Figure 5. Aerial photo of Backbone Mountain and adjacent lower elevation forest blocks. Yellow pin on the ridgeline of Backbone Mountain is located approximately in the center of the action area (which extends along the ridge top).



Despite no capture of Indiana bats in summer mist-net surveys at the project site, capture records in Garrett County indicate that Indiana bats occur in the County and therefore may incidentally occur within the action area. In August of 1995, several Indiana bats were captured in Garrett County, though 20 miles outside of the action area. The bats were not reproductive females, but it could not be distinguished as to whether they were males or non-reproductive females (G. Brewer, pers. com. 2010). The records of Indiana bats in the county, paired with the acoustic data suggesting that bats may occur within the action area support the Service's conclusion that individuals may pass though the project site either during migration seasons or simply as transient males or non-reproductive individuals during the summer, but the relative use is very low.

There are no known hibernacula in the action area and no habitat features (e.g., caves, mines, etc.) that could potentially serve as wintering bat habitat. The closest active hibernaculum (Cornwell Cave) is 23 miles away in Preston County, West Virginia, which means the project site is outside the 10 mile swarming habitat radius for that P3 hibernaculum. Therefore Indiana bats are not anticipated to be in the action area during fall swarming periods or during the winter period.

Factors affecting species environment within the action area: The factors affecting Indiana bats in the action area are a much smaller subset of the factors affecting the species rangewide and in the AMRU, as summarized above, because there are no hibernacula and likely no suitable maternity habitat. Thus the main factors affecting the species in the action area are wind turbine operations and WNS.

The Indiana bat population within the action area is a subset of the bats occurring in the AMRU.

The most recent population estimate (USFWS 2012) suggests that the population is increasing; however, we believe that WNS is now affecting Indiana bats in the AMRU and those that may use the action area. Therefore, we anticipate declining RU population trends in the future that are similar to the declines experienced in the Northeast RU. Therefore, the numbers of Indiana bats that may occur within the action area are also likely declining.

Environmental baseline for critical habitat within the action area: Critical habitat designations identify habitat areas that provide essential life cycle needs of the species, to the extent known using the best scientific and commercial data available.[3] Thirteen winter hibernacula (11 caves and two mines) in six states are designated as critical habitat for the Indiana bat (Federal Register, Volume 41, No. 187). Two of the hibernacula designated as critical habitat occur in the AMRU, with the closest to the action area being 40 miles away. While bats from these hibernacula potentially travel through the project site during migration periods, there will be no habitat related impacts from turbine operations and certainly none within the action area that could extend to hibernacula designated as critical habitat. As no critical habitat occurs within in the action area, there is no potential for the project to impact it.

V. EFFECTS OF THE ACTION

"Effects of the action" refers to the direct and indirect effects of an action on the listed species or critical habitat, together with the effects of other activities that are interrelated and or interdependent with that action which will be added to the environmental baseline. The Act defines direct effects as those considered immediate effects of the project on the species or its habitat. Indirect effects are those caused by the proposed action that are later in time, but are still reasonably certain to occur (50 CFR §402.02). Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consultation.

A. Direct and Indirect Effects of the action to Indiana bats

The Federal action being analyzed is the issuance of the ITP conditioned upon the implementation of the final HCP. Several components of the project associated with this HCP, have the potential to affect Indiana bats in the action area (see Section 2.0 in the HCP). These are 1) collision with vehicles, 2) disturbance to bats through noise, 3) attraction of bats to the site from lighting, 4) disturbance due to vegetation control, and 5) collision with turbine blades or barotrauma. We have determined that the first four components are not likely to adversely affect Indiana, as explained below. Collisions with turbine blades and barotrauma, however, have the

[3] The term "critical habitat" for a threatened or endangered species means—
(i) the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the provisions of section 1533 of this title, on which are found those physical or biological features **(I)** essential to the conservation of the species and
(II) which may require special management considerations or protection; and
(ii) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 1533 of this title, upon a determination by the Secretary that such areas are essential for the conservation of the species (16 USC 1532 (5)(A)).

greatest impacts and are likely to cause take of both species. That component is therefore discussed in the greatest detail. Compensatory mitigation for take through collision and barotrauma will be implemented as part of the HCP and will have long-term benefits. It is therefore also considered below as an effect of the action.

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. Within the action area, vehicles will travel along access roads to provide routine maintenance of turbines and other components of the project, and vehicles and heavy equipment will be used during decommissioning. However, these vehicles will be few in number and will be moving slowly compared to the highway project studied, providing little chance for collisions with agile bats. Vehicles will also be traveling within the action area mostly during the day-time, when Indiana bats are not flying. Given the slow moving, daylight traffic that will occur at the project, no collisions between Indiana bats and vehicles are anticipated. Therefore, effects to the Indiana bat from collision with vehicles during project operation, maintenance and decommissioning are unlikely to occur (i.e. are discountable). Discountable effects are those extremely unlikely to occur and for which we do not anticipate take.

Noise disturbance: We know little about the effects to Indiana bats, or other bats species, from increases in ambient sound generated by heavy equipment or 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 and this can cause avoidance of noisy areas or reduced foraging efficiency by gleaning bats (Schaub et al. 2008, Siemers and Schaub 2011). 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). Little information is available in the literature regarding the specific effect of noise on bat species utilizing echolocation in their search for prey. Instead, most studies on this topic have researched the ability of echo-locating bats to detect and avoid spinning and stationary turbines (Long et al. 2009).

There are several aspects of noise-related disturbance that have the potential to affect Indiana bats within the action area, including noise from heavy equipment and noise from operating wind turbines. The disturbance that might be caused by the sound of heavy equipment during project operations, maintenance, and decommissioning could be detectable by bats that occur within the project site at the time of the noise-generating activity. As explained previously, we assume that there may be Indiana bats moving through the action area during spring and fall as they migrate between winter and summer habitat and that there may be incidental Indiana bat occurrences flying over the site or occasional use of roost sites during the summer period. But given the low probability of Indiana bat occurrence in the action area, the sporadic nature of the need for heavy equipment, and the limited area within which heavy equipment noise will be heard, we anticipate only minor effects of sound on any roosting bats, and the Service considers these effects discountable. Sound from heavy equipment will be more frequent during the decommissioning phase of the project, but because the occurrence of roosting individuals is anticipated to be low, the effects from sound are considered discountable. Therefore, effects to the Indiana bat from heavy equipment related noise during project operations, maintenance, and decommissioning are expected to be discountable and therefore not likely to adversely affect Indiana bats.

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) 200 feet from a wind turbine (Hessler 2009). Additionally, as a minimization measure for the HCP, the applicant will implement cut-in speed prescriptions coupled with turbine feathering at low wind speeds at night (further explained below), that will reduce turbine-generated noise at wind speeds when Indiana bats are most likely to be foraging. Therefore, cut-in speed prescriptions coupled with feathering will simultaneously reduce bat strike fatalities and keep ambient sound levels low. Therefore, effects to the Indiana bat from turbine generated noise during project operations are expected to be discountable and therefore not likely to adversely affect Indiana bats.

Lighting: There are several aspects of lighting that have the potential to affect Indiana bats within the action area, including Federal Aviation Administration (FAA) required lighting on wind turbines and towers, security/safety lighting at project facilities, and lighting that occurs within the wind turbine nacelles for maintenance purposes. As explained in the HCP, the applicant will comply with turbine lighting per specifications of the FAA. FAA lights are flashing red strobes (L-864) used only at night and are placed on select turbines. Meteorological towers will also utilize the minimum lighting as required by the FAA. It is not anticipated that the flashing red FAA lighting, nor the low intensity security lighting will concentrate a significant amount of prey to attract Indiana bats. There have been many post-construction monitoring studies at wind projects that compared bat mortality at wind turbines with and without the FAA red flashing strobe lights and a summary of 21 of these studies indicate none found differences between turbines that have FAA lighting (Arnett et al 2008). Thus the FAA lighting is not anticipated to result in any effects to Indiana bats.

A limited number of security lights may be required at the substation and operations and maintenance facilities. As explained in the HCP, the applicant will only operate the minimum amount of security/safety lighting and the lights will be shielded downward to minimize skyward illumination. In addition, as result of the HCP, the applicant has procedures in place to ensure that lights are not left on in the turbine nacelles at night. Lighting accidentally left on at night within turbines has been shown to cause increased mortality of birds during fall migration, especially on nights with low visibility, and this problem occurred during the first year of operation at the project (Young et al 2012). However, turbine lighting at night does not appear to be correlated with increased bat mortality, though data are limited. Based on the information and commitments presented in the HCP, the Service considers the effects to Indiana bats from security/safety lighting at project facilities and lighting that occurs within the wind turbine nacelles for maintenance purposes to be discountable and therefore not likely to adversely affect Indiana bats.

Vegetation control: Vegetation management will be largely used to maintain previously cleared areas at the project site and will primarily be accomplished by mowing. No additional forested areas beyond those removed during project construction will be cleared during the Indiana bat active period during operation and maintenance. Noise from mowing equipment is not expected to cause disturbance to bats in the action area. The rationale follows the previous discussion on noise related impacts from heavy equipment whereby there is only a low probability of Indiana bat occurrences in the action area, the sporadic nature of the need for mowing, the limited area within which noise from mowing will be heard, and the minor effects of sound on roosting bats. In addition, mowing will be conducted during the daytime, when bats are not active. Mowing will not result in the removal of Indiana bat habitat, as it will only be used to maintain previously cleared areas at the project site. Tree trimming will be performed only during the Indiana bat inactive period, and should be minimal (e.g. along roads).

Hazard tree removal is possible on the site. As described in section 5.2 of the HCP, hazard tree removal will be conducted outside the season when bats are active where possible. If a tree becomes a hazard and must be removed during the period when Indiana bats are active, the applicant will conduct a visual survey to see if any bats are exiting the tree and using it as a roost before removal. If the tree is being used, tree removal can occur at night when the bat or bats are not using present on the tree.

Based on the information and commitments presented in the HCP, effects to Indiana bats from vegetation clearing such as mowing and hazard tree removal are expected to be discountable and therefore not likely to adversely affect Indiana bats.

Collision/Barotrauma mortality: It is well documented that wind turbines kill bats of several different species through collision with turbine blades and barotrauma (Arnett et al 2008, Taucher et al, 2012). Barotrauma is internal hemorrhaging due to an over-expansion of hollow respiratory structures and is caused by a sudden drop in air pressure near wind turbine blades.

The species most commonly found as fatalities from wind projects are the long-distance migratory tree bats, such as red bats (*Lasiurus borealis*), hoary bats (*Lasiurus cinereus*), and silver haired bats (*Lasionycteris noctivagans*). These three species comprise 50 to 75 percent of bat mortality at all of the wind projects across the eastern and midwestern United States (Arnett et al. 2008, Kunz et al. 2007, Taucher et al 2012). Migratory tree bats do not winter in caves but migrate to warmer southern areas during the winter roosting in hollow trees, leaf litter or other protected areas.

The cave dwelling species of bats, like Indiana bats, are also killed at wind turbines but in smaller numbers and there appear to be species specific vulnerabilities. For example, the bat community in West Virginia can be described from the 330 summer mist net surveys conducted across the state from 2005 to 2009, which captured a total of 17,440 bats (compiled by C. Stihler, WVDNR, 2011). In this sample, the long-eared bat (*Myotis septentrionalis*) is the most common species in mist net surveys in West Virginia, but this species is rarely found in wind turbine mortality monitoring in vicinity of the project (Figure 6). Conversely, the tri-colored bat (*Pipistrellus subflavus*) is frequently found in wind turbine fatalities but less commonly found in mist net surveys. These differences may reflect the height at which species typically fly and whether they fly high enough to be within the rotor swept area or mist net area. For example, the long-eared bat may commonly fly low and within the heights of mist nets, but not within the much higher rotor swept areas. The species specific vulnerability of Indiana bats is not known. It is described as typically foraging at the canopy level or lower, which would place it below the rotor swept area, however, the height at which they migrate might be different than when foraging.

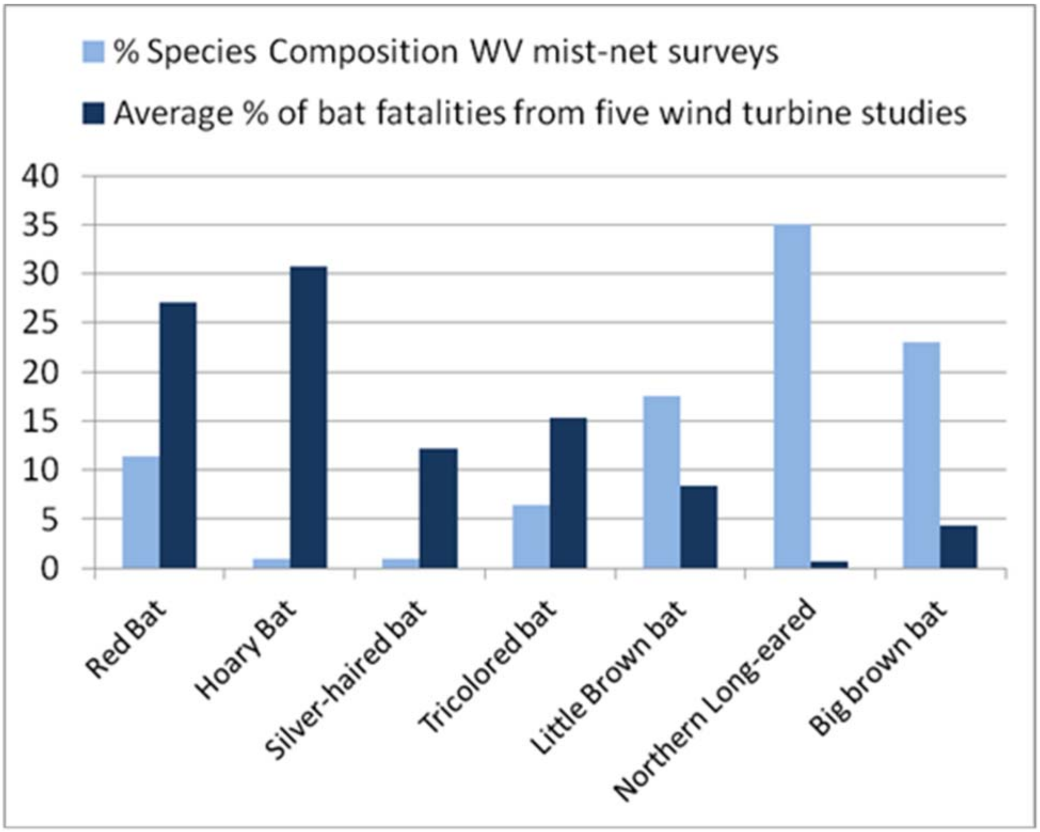


Figure 6. Species composition of bats captured in mist nets across West Virginia compared to the species composition of bat fatalities from five post-construction studies within 200 miles of the project.

Currently, there have been five Indiana bat fatalities documented at wind turbines across the country (Table 2). Most of these are females that have been killed in late September or early October, however, one male was killed in West Virginia in early July. And since two of the fatalities are from the AMRU, Indiana bats clearly have some vulnerable to wind turbines in the RU. It is likely that additional Indiana bat mortality has occurred at wind farms across the country, but has not been documented due to lack of post-construction monitoring, inaccurate identifications, or the difficulty of detecting rare species. Variables such as searcher efficiency and carcass persistence are measured and addressed in post-construction surveys and incorporated into the estimates of total bats killed, but cannot change the difficulty in detecting rare species. Thus, the five Indiana bat fatalities represent a larger number of estimated fatalities if adjusted for these variables.

Table 2. Indiana bat fatalities documented at wind turbine facilities.

Location	Date	Species	Project
Benton Co, IN	September 11, 2009	Adult female	Fowler Ridge
Benton Co, IN	September 18, 2010	Adult female	Fowler Ridge
Blair Co, PA	September 26, 2011	Juv. female	North Allegheny
Randolph Co, WV	July 8. 2012	Adult male	Laurel Mountain
Paulding Co, OH	October 3, 2012	Adult female	Blue Creek

Reducing or minimizing take of bats: Bat activity is highest at wind turbines on warm nights with low winds as these conditions are best for foraging bats. The effect of wind speed may be even greater on smaller bats like the Indiana bat. Several studies have investigated turbine curtailment strategies that feather turbine blades so they are not rotating at lethal speeds when wind speeds are low (Table 3). These strategies include curtailment of the turbine blades until winds reach a particular threshold such as 5.0 mps or 6.5 mps. Though there are slight differences in how these studies were conducted, generally we conclude that feathering turbine blades so that they do not rotate at greater than 2 revolutions per minute when wind speeds are 5.0 mps or less will reduce total bat fatalities by 50 percent or more. Feathering below 6.5 mps will reduce total bat mortality by about 75 percent. If feathering were conducted up to higher wind speeds, for example to 6.9 mps, we would expect even greater reductions in total bat mortality. These studies varied in length but were generally conducted during August or September when bat mortality is highest.

Based on review of existing studies and post-construction mortality reports from a variety of projects, feathering wind turbines at wind speeds below 5.0 mps is generally effective at reducing overall bat mortality, including the likelihood of Indiana bat mortality, by 60 percent during the time when curtailment is applied (Table 3). A similar pattern was evident at CPP. Comparison of the project 2011 data when no feathering occurred, and the 2012 data when feathering occurred up to 5.0 mps from July 15 to October 15 found a 51 percent in total bat reduction for the entire season (April 1- November 15) and a 62 percent reduction during the July 15 to October 15 period when operational changes were made. However, we recognize that this curtailment regime does not entirely eliminate risk to Indiana bats from operating turbines. For example, the second Indiana bat fatality at Fowler Ridge occurred at a turbine that was programmed to cut in at wind speeds below 5.0 mps. The night that the bat was killed, wind speeds were often higher than 5.0 mps (Figure 17, Good et al. 2011) and it is likely that the bat was killed when the turbine was operating at higher wind speeds. Therefore, we anticipate that curtailing wind turbines at wind speeds below 5.0 mps will minimize, but not fully avoid, take of Indiana bats.

Table 3. Summary of curtailment studies and associated bat fatality reductions at wind turbine projects.

Study	Start-up speed (m/s)	Study period	Fatality reduction for study period
Tidhar et al. (2013) WV	6.9 (feathered)	April 1 - Oct. 28, 2012	73% all night (compared to average fatality rate of non-curtailed turbines at other projects across

			many years)
Shoener Environmental (2013) PA	6.9 (feathered) when > 33.5°C (38°F)	July 1 to Sep. 30, 2012	74% to 92% all night (compared to 4.0 m/s unfeathered turbines for same study season in 2010 and 2011, respectively)
Stantec (2013a) WV	Variable speeds (feathered), dependent on site-specific weather variables	Sept. 6 to Nov. 15, 2012	87% all night (compared to 3.5 m/s unfeathered turbines for Aug. 15 to Oct. 31, 2011)
Stantec (2013b) WV	3.5 (control)	August 15 to Oct. 31, 2011 and Apr. 1 to Oct. 31, 2012	--
	3.5 (feathered)	Aug. 15 to Oct. 31, 2011	35% all night
	4.5 (feathered)	Aug. 15, 2011 to Oct. 31, 2012 and Apr. 1 to Oct. 31, 2012	72% all night
Hein et al. (2013) WV	3.0 (control)	July 15 to Sep. 30, 2012	--
	5.0 (feathered)		47% first half of night
	5.0 (feathered)		35% all night
Young et al. (2012a) WV	4.0 (control)	July 16 to Oct. 15, 2011	--
	4.0 (feathered)		9% all night
Young et al. (2013) MD			
	5.0 (feathered)	April 1 to Nov. 15, 2012	51% reduction in full season (April 1 to Nov 15) mortality compared to previous year with no feathering; 62% reduction compared to previous year during time (July 15-Oct 15) when feathering occurred.
Young et al. 2011, WV	4.0 (control)	July 15 to Oct. 15, 2010	--
	4.0 (feathered)		47% first half of night
			22% second half of night

Study	**Start-up speed (m/s)**	**Study period**	**Fatality reduction for study period**
Good et al.	3.5 (control)	Aug. 1 to Oct.	--

(2011) IN	5.0	15, 2010	50% all night
	6.5		79% all night
Good et al. (2012) IN	3.5 (control)	July 15 to Oct. 31, 2011 observed fatality	--
	3.5 (feathered)		36% all night
	4.5 (feathered)		58% all night
	5.5 (feathered)		75% all night
Arnett et al. (2011)	3.5 (control)	July 27 to Oct. 9, 2008	--
	5.0 (feathered)		87% all night
	6.5 (feathered)		74% all night
Arnett et al. (2011)	3.5 (control)	July 26 to Oct. 8, 2009	--
	5.0 (feathered)		68% all night
	6.5 (feathered)		76% all night
Baerwald et al. (2009)	4.0 (control)	Aug. 1 to Sep. 7, 2007	--
	4.0 (feathered)		58% all night
	5.5		60% all night
Mean fatality reduction	3.5 m/s and 4.0 m/s, feathered		Avg. = 34% (range: 9 to 58%) (n=6)
	5.0 m/s, feathered		Avg. = 60% all night (range: 35 to 87%) (n=5)
	6.5 m/s, feathered		Avg. = 76% all night, for a season (range: 74 to 79%) (n=3)
	6.9 m/s, feathered*		Avg,.= 82% all night for a season (range: 73 to 92%) (n = 4)

*Includes Stantec (2013b).

Thus, as a minimization measure in the HCP, the applicant will be feathering turbine blades below wind speeds of 5.0 mps from July 15 to October 15 and we anticipate this will reduce the total year long estimated take of Indiana bats by 50 percent. Comparison of the CPP monitoring studies from 2011 (no curtailment) and 2012 (with curtailment) are consistent with this conclusion, as the 2012 bat fatalities are about 50 percent less than 2011 (Young et al., 2012, 2013). No Indiana bat fatalities were detected in either of these years. These data do not prove the curtailment strategy alone was the cause of the fatality reduction, as CPP did not operate control versus experimental turbines and annual variation is part of these differences. However, given the substantial reduction in total bat mortality seen in 2012 we feel the data are sufficient to verify our conclusion that CPP's curtailment strategy will greatly minimize the fatality of bats and, by extension, the take of Indiana bats.

Mitigation: As a mitigation measure in the HCP, the applicant will be implementing a mitigation project intended to offset the remaining take of Indiana bats that will occur during project operations. The mitigation project will be to implement a gating project at a hibernaculum in the AMRU that requires protection due to a demonstrated threat from human disturbance (see Section 5.3.1 of the HCP for criteria). Therefore, gating the hibernaculum is expected to eliminate threats and increase the survival probability of the Indiana bats that overwinter in the hibernaculum. The potential for short-term adverse effects from disturbance related to noise and human disturbance during gate installation are not expected because the project will be conducted outside the hibernation season. Therefore, installation of the gate is not expected to produce effects that rise to the level of take, and we anticipate a net benefit to the species from this mitigation project.

Quantifying take of individual bats by collision or barotrauma

Fatality-related impacts to individual Indiana bats will occur in the action area due to collision and barotrauma during turbine operations. As previously analyzed, there are potentially many other effects from the project (vehicle collisions, light emission, vegetation control, and noise disturbance) but they are not anticipated to adversely affect, or take, Indiana bats in the action area (especially because of implementation of HCP measures).

With respect to fatalities of individual Indiana bats in the action area from turbine operations, the Service and CPP worked together to develop a model (section 4.1.2 of the HCP) to estimate the take of Indiana bats based on surrogate variables that include the mortality of a more common species, the little brown bat. Following the public comment period on the draft HCP and draft EA, the Service independently revised the take estimate using the best available regional post-WNS data and CPP subsequently incorporated the results into their final HCP.

As explained in section 4.1.2 of the HCP, the surrogate model used to estimate take of Indiana bats is:

(Estimate of total annual bat fatality per turbine) x (28 turbines) x (Proportion of fatalities that are little brown bats) x (Proportion of Indiana bats to little brown bats in the population) x (number of years)

In this case, we were able to use the 2011 CPP post-construction monitoring data to determine a site-specific estimate of total bat fatalities per turbine per year (39.03) and the proportion of total fatalities that were little brown bats (0.045 or 4.5%). We consider these to be site specific values that reflect some of the declines from WNS. For the proportion of Indiana bats to little brown bats in the population, we used a large and long-term data set from West Virginia (summer mist-net surveys statewide) and only used data where Indiana bats had not been known to occur prior to the survey. This is less biased than including data where Indiana bats are known to occur and best reflects Indiana bat presence on the landscape. The ratio of Indiana bats to little brown bats averaged 2.38 percent for the post-WNS period from 2009 to 2012, versus an average of 0.81 percent for the pre-WNS period from 2003 to 2008. We used the more recent data as it best reflects current conditions. This change may reflect a faster decline in the little brown bat population than the Indiana bat population. Applying all of these variables to the surrogate formula resulted in a cumulative project take estimate of 12 Indiana bats (0.6 bats/year from the project or 0.02 bats/turbine/year) for the 20-year duration of the ITP with operational conservation measures in place. This is a 50 percent reduction from the 23 bats that would be killed by project operations without implementation of the HCP minimization measures. This reduction is further supported by comparison to the 2012 monitoring data collected while curtailment was conducted from July 15 to October 15. In 2012, total bat mortality for the entire season was reduced by 50 percent from the 2011 data and the reduction in mortality from July 15 to October 15, when conservation measures were in place was 60 percent.

It is possible that WNS may further reduce the number of little brown bats on the landscape and in subsequent fatalities from wind turbines. *Myotis* bat fatalities appears to be density dependent. The number of *Myotis* killed at wind turbines has been declining in recent years as *Myotis* populations have declined due to WNS. Based on analysis of post-WNS data, *Myotis* fatalities at wind power projects in the AMRU currently represent 4.5 percent or less of all bat fatalities and are trending toward zero. Thus the amount of take of both little brown bats and Indiana bats may decrease for some time until populations begin to recover from WNS. We consider the conservation measures to be important in conserving the remaining bats through this population decline, especially if these remaining bats can avoid WNS for some reason. However, we would expect the number of bats taken will also increase with population recovery and our estimate provides an overall average based on the best data available at this time.

Based on our understanding of how Indiana bats are using the action area, we anticipate that most, if not all, of this take will affect individuals that are migrating through the action area during the fall. While there is some potential for take during spring migration, it appears that Indiana bats migrate so quickly that they do not have much exposure to the wind turbines. These patterns of increased fatalities during the fall migration period are supported by existing studies (Arnett et al. 2008, Taucher et al. 2012). In addition, since we do not think Indiana bat maternity colonies occur within the action area, we do not anticipate take to occur during the summer.

The Service supports using a surrogate species based model to estimate Indiana bat take because when the listed species is rare and difficult to detect, the use of more easily measured variables is appropriate. The surrogate model assumes that Indiana bats are as likely to be killed at sites as the little brown bat. The little brown bat is a species with similar life history to the Indiana bat and is thus considered an appropriate surrogate species. However, we acknowledge that there are limitations and potential issues in relying on a surrogate model to estimate take (e.g., relying on surrogate species ratios), and the Service evaluated additional methods of estimating take.

Directly assessing Indiana bat fatalities at this project does not appear to be possible because of the low incidence of take of this rare species and the expectation that less than one individual is likely to be killed in any one year. The most intensive monitoring possible was conducted in 2011 when every turbine was surveyed every day and no Indiana bat fatalities were recorded. When this monitoring was adjusted for searcher efficiency, carcass removal and the proportion of the sample plots that cannot be surveyed, the total bat fatalities counted were approximately 60 percent of what was estimated to occur (Young et al 2012). Thus it is important to include these corrections in the final determination of the total number of bats killed per turbine. Thus the strongest evidence from our post-construction monitoring is the estimated take of total bats per turbine and the overall species composition of the fatalities.

The Service independently estimated take of Indiana bats using a second approach as well, by using the estimated number of bats killed per turbine at the project and the ratio of Indiana bat fatalities to total bat fatalities in a larger sample from the AMRU. Note that this annual bat fatality per turbine includes the corrections for searcher efficiency, proportion of the sample plot surveyed and scavenger removal rates. This value can be multiplied by the number of turbines to assess total bats killed at the project site annually. Then the proportion of bat fatalities that are Indiana bats in a much larger sample can be used to assess total number of Indiana bats killed at the project.

(Total bat fatality per turbine per year) x (28 turbines) x (Ratio of Indiana bats to total bat carcasses from a larger regional sample)

We again used the site specific value for total bat fatalities per turbine (39.04) and multiplied by 28 turbines to obtain the estimate of total annual bat fatalities at the project (1,093 bats). To determine the appropriate ratio of Indiana bat fatalities to total bat fatalities, we used two data sets that cover a large portion of the AMRU. The large sample of Pennsylvania studies have been summarized by Taucher et al (2012) and reported one Indiana bat recovered from 24 project studies that collected 2,820 bat fatalities (thus a ratio of 1/2,820 or 0.00035). Further refinement excluded a few studies that were considered to be outside the Indiana bat range so the corrected ratio was 1/2,560 fatalities or 0.00039 (Taucher, pers. com.). We also examined the West Virginia and Maryland studies that were available which had full season surveys and no curtailment of turbines (Table 4). Seven studies provided data that include one Indiana bat casualty among 2,133 bat casualties (thus a ratio of 1/2,133 or .000469). We combined these data to provide the ratio 2/4,693 Indiana bats to total bat carcasses or 0.0004262 which includes studies from Pennsylvania, Maryland, and West Virginia portions of the AMRU. Note that it is important to include the studies that did not collect an Indiana bat fatality as well the studies that did collect an Indiana bat when calculating this ratio as the majority of turbine studies do not detect an Indiana bat fatality because it is a rare event. If we only use the studies in which an Indiana bat fatality was discovered, the ratio will be an overestimate and will reflect an incident of mortality that suggests an Indiana bat is killed every year at a project. This is not the case and the growing set of data from post-construction monitoring confirms that. There is no reason to believe that an Indiana bat carcass is harder to detect, or responds differently to the turbines, than little brown bat fatalities as they are similar in size, shape and color. Thus the rarity of detections of Indiana bat fatalities is most likely a result of its rarity in the population of bats and bat fatalities.

Table 4. Studies from Maryland and West Virginia used to calculate the ratio of Indiana bat fatalities to total bat fatalities.

Project	# Indiana Bats	TOTAL Bats
Criterion, MD 2011	0	657
Roth Rock, MD 2011	0	75
Mountaineer, WV 2003	0	483
Laurel Mountain, WV 2012	1	186

Mt Storm, WV 2009	0	203
Mt Storm, WV 2010	0	374
Mt Storm, WV 2011	0	155
Total	1	2133

Using this ratio method, we estimate that about 10 Indiana bats would be killed at the project in 20 years without curtailment and 5 bats with curtailment (39.04 bats/turbine/year x 28 turbines x .0004262 Indiana bats/Total bats x 20 years = 10 Indiana bats in 20 years with no curtailment; 5 Indiana bats in 20 years with curtailment). This method provides a lower estimate of take (5 Indiana bats in 20 years) than the surrogate species model (12 Indiana bats in 20 years), however, both approaches have uncertainty associated with them; therefore, we went with the higher and more conservative estimate of take.

Both the surrogate species approach and ratio method have strengths and weaknesses. The surrogate species model is especially reasonable when there is little data and we must use the best information available to estimate take. As data from post-construction monitoring accumulates, the ratio method becomes possible and this has the advantage of being empirically based rather than based on several assumptions that have not been tested (e.g. Indiana bats are more likely to be killed where there are lots of little brown bat fatalities). Our estimates of take were first constructed using the surrogate species approach and we consider this to still be reasonable though the ratio method suggests a slightly lower take estimate. For the purposes of this analysis and our issuance of a 20-year incidental take permit, we assume between 5 and 12 Indiana bats will be incidentally killed and will use the higher number to be conservative. We know that take of Indiana bats is somewhat rare, and not anticipated to occur every year. However, we anticipate that some level of incidental take over the permit period is likely.

Although take of individual Indiana bats from project operations will occur within the action area, it is the impact from the loss of those individuals to their associated maternity colonies or hibernacula that will determine the impact of the take to the broader Indiana bat population. This will be further assessed in the jeopardy analysis below.

C. Effects of the action to designated critical habitat

Critical habitat designations identify habitat areas that provide essential life cycle needs of the species, to the extent known using the best scientific and commercial data available. No critical habitat has been designated within the action area and impacts from the proposed action are not anticipated to affect Indiana bat habitat conditions. Therefore, the proposed action will not impact critical habitat at broader geographic scales.

VI. CUMULATIVE EFFECTS WITHIN THE ACTION AREA

Cumulative effects include the effects of future State, tribal, local or private actions reasonably certain to occur within the action area considered in this BO. Future Federal actions unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

The Service is unaware of any future local, state, or private activities within the action area that would cause cumulative effects on the local Indiana bat population. The action area is located in a landscape dominated primarily by forest with some open agricultural areas. The remaining forested habitat is substantial and does not appear to be under immediate threat, aside from occasional small-scale and scattered timber harvesting. Additional residences may be constructed within ITP term, but are not expected to result in cumulative effects to Indiana bats. These actions will all be small scale with limited potential to affect Indiana bat habitat and unlikely to lead to direct lethal effects. The amount and intensity of these actions on private land in the action area will not change the scope or magnitude of effects anticipated from this project. Therefore, the cumulative level of effects anticipated from these activities, combined with the project effects, is not anticipated to have measurable changes to Indiana bat populations or habitat within the action area.

Cumulative effects to designated critical habitat

No Indiana bat critical habitat is designated within the action area. Impacts from the proposed action are anticipated to be localized and cumulative effects of the proposed action and any future State, tribal, local or private actions in the action area are not expected to impact critical habitat at broader geographic scales.

VII. CONCLUSION

Jeopardy analysis

Jeopardy determinations for Indiana bats are made at the scale of the listed entity, which is the rangewide distribution of the species (Federal Register 32[48]:4001). As described above, the jeopardy analysis in this BO follows an analytical approach that assesses the project impacts at several scales in a stepwise fashion. The analysis first examines the impacts of the take of individuals on the local populations (i.e., the closest hibernaculum and maternity colonies that may be within the distance bats migrate from the action area). If take of individual Indiana bats from the project will reduce the fitness (i.e., short or long-term persistence or reproductive potential) of these local populations, then the jeopardy analysis will need to further evaluate how reduced population fitness affects the likelihood of both survival and recovery of the species at the AMRU scale. If, however, take of individual Indiana bats from the project will not reduce the fitness of local populations, then there will not be impacts to survival and recovery of the species at broader population levels and no additional analysis is required. If project impacts may affect the likelihood of survival and recovery at the RU scale, then the jeopardy analysis will need to take the final step of evaluating whether the species' rangewide reproduction, numbers, or distribution will be impacted in order to reach a jeopardy determination for the listed entity.

As previously described in the effects of the action section in this BO, with effective implementation of the curtailment strategy we anticipate at least a 50 percent reduction in the take of Indiana bats or a cumulative take of up to 12 Indiana bats in the action area over the 20-

year period of the ITP. Further, we anticipate the Indiana bat take will largely occur during the fall migration period, thus bats that occur on site would be coming from a much larger area.

Modeling the effects of Indiana bat take to populations

We used the Thogmartin et al. (2013) model to forecast the population impact of the anticipated take of Indiana bats with curtailment, subject to ongoing and future spread of WNS. The model explicitly incorporates environmental variability in survival and reproduction rates and demographic stochasticity. It assumes individual wintering populations are closed (no immigration or emigration).

The model considers only the female portion of the population because of the polygynous nature of the species. We assumed a 50:50 sex ratio in mortality as the most likely ratio, though we recognize that four of the five Indiana bat mortalities identified so far have been females (Table 2). It is possible that female Indiana bats are more vulnerable, but currently we consider the sample size of five animals too small to accurately describe a sex ratio that is skewed and generally, there are higher numbers of males in bat fatalities from wind turbines. Of the little brown bat casualties found at the project during 2011, there were 8 females and 18 males of 26 animals where sex could be determined; thus 31 percent females and 69 percent males suggesting female little brown bats are not more vulnerable (Young, pers. com. 2013). In addition, the sex ratio for all 2,820 bat causalities, including all species from many sites and years in Pennsylvania was 29 percent females and 59 percent males, and 12 percent unknown (Traucher et al. 2012, p.22), though this might be skewed by the large numbers of migratory tree bats. Data for Indiana bats is very limited, but considering all of this information, we consider a 50:50 sex ratio an appropriate approach for the population modeling.

In our demographic model runs we assumed that WNS was already affecting the population of interest and would continue to do so. The model uses Indiana bat specific assumptions about the response to WNS. For example, the model forecasts the trajectory of the WNS-affected population trend based on what we have observed in Indiana bat populations in the Northeast RU, i.e. a 70 percent population decline from its peak within four years after the on-set of WNS. This is a conservative approach as the response to WNS in the AMRU has been somewhat delayed (a 46 percent decline from the 2011 peak within 5 years of the on-set of WNS) compared to the Northeast RU. Nevertheless we want to be cautious and err on the side of the species. It is reasonable to expect the AMRU population will experience up to a 70 percent decline as has been seen in the Northeast RU.

If, however, at any time, the AMRU population decreases by 70 percent or greater than the peak 2011 level, this will constitute a changed circumstance as a key assumption of the population model will have been violated (HCP section 8.2), triggering further analysis to determine whether the level of Indiana bat take at the project is having an additive effect to the remaining Indiana bat population in the AMRU. If the analysis demonstrates that existing minimization and mitigation measures are no longer sufficient to prevent additive effects with the declining population, CPP will, after consultation with the Service, implement additional minimization measures (e.g., turbine operational restrictions) by the next bat spring emergence season (April) or additional mitigation measures within 24 months.

Impacts of Indiana bat take to local and regional hibernacula

As previously described, we consider it most likely that take of bats from this project will occur during fall migration. Given that Indiana bats can migrate up to 100 miles between summer and winter habitat, bats traveling through the project site could be going towards several different hibernacula. The likelihood that a bat in the project vicinity is from any particular hibernacula is not known, but probably depends on the number of bats in each hibernacula and the distance from the project site to the hibernacula. We conducted a geographic information systems (GIS) analysis to estimate how many Indiana bats could be flying past the project during migration and which hibernacula they are likely to be going towards as follows.

First, we buffered all the hibernacula in the AMRU by 100 miles as the maximum distance Indiana bats are anticipated to migrate between summer and winter habitat and consider this to be that hibernacula's migratory zone. Then we buffered the action area by 100 miles, as the area of potential project impacts. We clipped the hibernacula migratory zones that were within 100 miles of the project in order to capture the portion of the total hibernacula population that might be within 100 miles of the project site. Thus, if 25 percent of the migratory radius of a large hibernaculum that contained 1,000 bats was within the impact radius of the project, we considered 250 bats from that hibernaculum to have the potential to encounter the project.

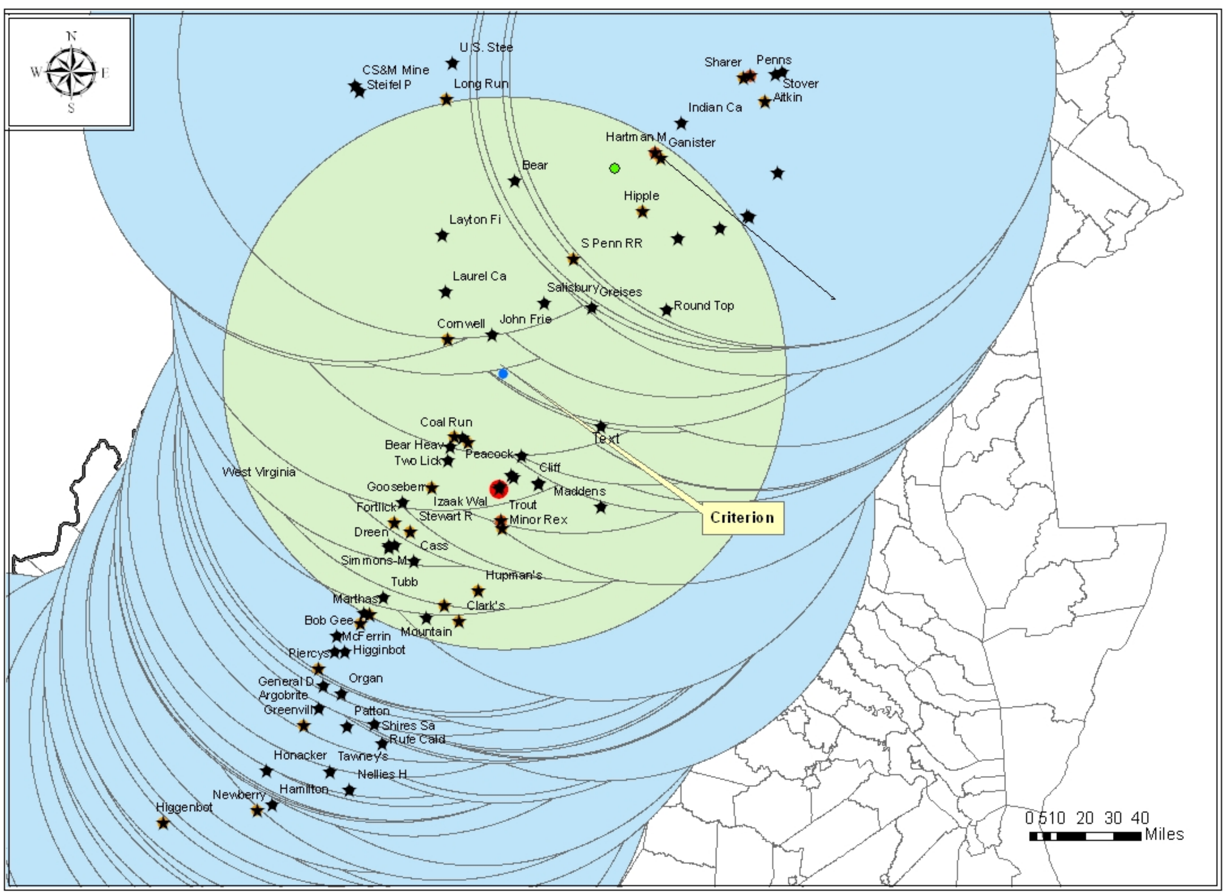


Figure 7. Project (blue dot) buffered by 100 mile radius action area (green) and the 100 mile

radius migratory zones of all hibernacula in the area (blue).

There were 31 hibernacula that currently had at least 1 Indiana bat as of 2011 and that had 100-mile radii overlapping with the project site. If we assume migrating bats are evenly distributed within a 100 mile radius of each hibernaculum, there could be 11,065 Indiana bats flying within 100 miles of the project. However, it is important to note that 94 percent of these bats are from only five hibernacula; Hellhole (87 percent), Big Springs (3 percent), Hartman Mine (1.5 percent), Arbogast (2.3 percent), and Cornwell (1.1 percent). While this is a simple analysis and assumes bats are evenly distributed across the landscape, it also underscores the likelihood of bats coming from more than one hibernaculum and that it is especially likely that some would come from Hellhole or other large hibernacula in the AMRU. Thus project mortality may include bats from the closest cave (Cornwell), but it is likely that it would only comprise about 1 percent of the bat mortality and most of the bats killed would likely be from Hellhole Cave and others simply because there are more bats likely to be entering the action area from larger hibernacula.

We have looked closely at the potential effects to the population at Cornwell Cave because it is the closest hibernacula and a conservation goal is to keep all hibernacula populations viable despite the take from wind projects. We examine the potential effects of take from this project by attributing 50 percent of the take to bats that use Cornwall Cave and 50 percent of the take to bats that use Hellhole Cave, the largest hibernacula in the area. This represents a reasonable worst case scenario since the GIS analysis suggests that only a small proportion of the take will be attributed to bats from Cornwell Cave. The allocation of 50 percent of the take to the closest hibernacula and 50 percent to the largest hibernacula is more skewed (i.e., more take is attributed to the smaller, closest cave) than we anticipate in reality, but we want to err on the side of caution in considering population affects. We assume WNS to be present and impacting both hibernacula populations for the purpose of our analysis.

We modeled the population-level effects of Indiana bat fatalities on both Cornwell Cave and Hellhole Cave from the project under this reasonably expected worst case scenario using a demographic model (Thogmartin et al. 2013) (Appendix B). The demographic model assumed that WNS is affecting the population of interest and used Indiana bat specific assumptions about the response to WNS. We assumed a 50:50 sex ratio in mortality as the most likely ratio, though we recognize that four of the five Indiana bat mortalities identified so far have been females (Table 2). It is possible that female Indiana bats are more vulnerable, but currently we consider the sample size of five animals too small to accurately describe a sex ratio that is skewed. Of the little brown bat casualties found at CPP in 2011, there were 8 females and 18 males of 26 animals where sex could be determined; thus 31 percent females and 69 percent males suggesting female little brown bats are not more vulnerable (Young, pers. com. 2013). In addition, the sex ratio for all 2820 bat causalities, including all species from many sites and years in Pennsylvania was 29 percent females and 31 percent males (Traucher et al. 2012, p.22), though this might be skewed by the large numbers of migratory tree bats. Data for Indiana bats is limited, but considering all of this information, we consider a 50:50 sex ratio an appropriate approach for the population modeling.

For each take allocation scenario, we evaluated model outputs that compared population trajectories over time with and without the estimated take from the wind project. In that way, we could evaluate whether take from the proposed action was influencing the population levels differently than how the populations would otherwise change over time. Because WNS was factored in to all of the model runs, the Indiana bat populations decline quickly over time for all scenarios. The ultimate question we were evaluating was whether take from the proposed action changes the nature of that decline or potential recovery.

Model results (appendix B) indicate that under the reasonable worst case scenario where 50 percent of the Indiana bat fatalities came from the closest cave and 50 percent of the fatalities came from Hellhole, the difference in these two hibernacula population trajectories with and without the project is largely indistinguishable. With or without the project related fatalities at Cornwell Cave, the results of the population model are essentially the same. Further, the probabilities of extirpation at year 25 or year 50 were low (less than 4 percent) under both scenarios.

The model projections for Hellhole Cave began with a population of 2,530 Indiana bats, which is the current estimate from 2013 after WNS has severely reduced the population in this large hibernacula. Similar to the results for Cornwell Cave, with or without the project related fatalities at Hellhole Cave, the results of the population model are essentially the same; the model projects recovery of the hibernacula using the model parameters with and without the project related losses. Overall, the model projected recovery of Hellhole Cave and did not project extirpation with or without the estimated project related losses.

Therefore, we conclude that implementation of the project is not likely to impact the continued existence of Indiana bats at the scale of the local hibernacula population.

Impacts of Indiana bat take to non-local maternity colonies

As discussed in the environmental baseline section, we consider it unlikely that there are any maternity colonies in the action area based on the mist-net and acoustic surveys at the site, and the high elevation of the site. However, female bats that may be killed in the action area during the fall migration period (estimated to be 6 females or 50 percent of the anticipated take over the life of the project) must be coming from a maternity colony somewhere on the landscape. Therefore, to evaluate the potential for population-level impacts from take within the action area, we also assessed the potential effects to maternity colonies by modeling a worst case take allocation scenario using a demographic model (Thogmartin et al. 2013). The same approach was used as described above for the local hibernacula impacts.

We evaluated the potential effects to a theoretical maternity colony of 60 females. This is the average population estimate for known maternity colonies (Kurta 2004, Table 2). We assumed that the fatalities from the project will include equal numbers of males and females, and thus we would expect 6 females to be killed in 20 years or 0.15 females per year. We evaluated the worst case scenario where all take from the project affects one maternity colony and WNS is present. Even under this worst case scenario, the model projections of the maternity colony population are essentially the same with or without project related fatalities (Appendix B). These model projections (using the Indiana bat assumptions for WNS) predict a 20 percent chance of extirpation by year 50 with or without the project. Overall, there is no difference in the population projections with and without the estimated Project related fatalities.

It is probably more likely that the females that migrate through the CPP project area during fall are coming from more than one maternity colony and that the losses are not likely to affect only one maternity colony. We assume that the most realistic scenario is that take of bats from the project will be distributed among several maternity colonies, which means the conclusions reached for this worst case scenario are conservative. In either case, however, this analysis shows that implementation of the project is not likely to impact continued viability of Indiana bats at the scale of local maternity colonies.

While the population models enable us to evaluate the effects of the take on the local populations, we recognize that any model prediction on the response of bat populations to WNS are speculative to some extent, and models using different assumptions on how populations respond to WNS will have different outcomes. However, models that use Indiana bat metrics are the best information we have currently, and they indicate the population projections with and without the project take do not have a discernible effect on the local populations.

We note that there are 20 turbines within the AMRU that are currently operating less than 10 miles from CPP's project on Back Bone Mountain. They may be affecting the same bat populations that migrate through CPP's project. If we assume these turbines are impacting Indiana bats at a similar level as CPP's project (0.02 bats/turbine/year) these turbines may result in the fatality of 0.4 Indiana bats per year. We do not anticipate this will change the impact of the project on the viability of local populations (i.e., maternity colonies or hibernacula).

<u>Impacts of Indiana bat take at the AMRU scale</u>

Given that take from this project is not likely to impact the fitness or viability of Indiana bats at the local population scale, we do not anticipate a reduction in the likelihood of survival and recovery of the species at the AMRU scale. An average annual loss of 0.6 Indiana bats per year (12 bats spread across 20 years) with the project take would represent 0.002 percent of the 2011 AMRU population of 32,468 individuals; and 0.14 percent of the 2011 AMRU population when added to estimated take of 45 Indiana bats per year from other existing wind energy projects in the AMRU. As described earlier, as WNS causes population declines we anticipate that the total annual take will decrease proportionally. No additional analysis is necessary since the annual loss of individuals from the project is small and will not result in population level effects.

<u>Impacts of take at the rangewide scale</u>

As previously explained implementation of this project is not likely to impact the continued existence of Indiana bats at the local population scale and therefore is not likely to appreciably reduce the likelihood of survival and recovery within the AMRU. By extension, the Service concludes that this project will not appreciably reduce both the survival and recovery of the Indiana bats at the rangewide scale, which is the listed entity for this species.

This conclusion is further supported by the following:

- The potential for take of Indiana bats from the project is greatest during the migratory period which means the population impacts from the low level of take will most likely be spread over many maternity colonies and hibernacula.

- The AMRU is one of four recovery units comprising the rangewide distribution of Indiana bats (USFWS 2007). Further, it only represents 3 percent of the current rangewide population. An average annual loss of 0.6 Indiana bats per year by the project represents only 0.002 percent of the 2011 AMRU population; and 0.14 percent of the AMRU population when added to ongoing estimated take from other existing wind energy projects in the AMRU. As populations continue to decline from WNS we anticipate that the take will decline proportionally.

- Our modeling assumed WNS and worst case scenarios for impacts to local and non-local Indiana bat populations, yet results were virtually indistinguishable with the project take versus without, indicating that the low level of annual take would not be additive to the effects of WNS.

After reviewing the current status of Indiana bats including declines associated with WNS, the environmental baseline for the action area, the effects of the proposed action and the applicant's implementation of the HCP, and the anticipated 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. This conclusion is based on the magnitude of the project effects (to reproduction, distribution, and abundance) in relation to the listed population. Implementing regulations for section 7 (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."

B. Critical habitat adverse modification analysis

No critical habitat for Indiana bats is designated within the action area. Impacts from the proposed actions are anticipated to be localized and not likely to impact critical habitat at broader geographic scales. Further, it is not anticipated that there will be habitat related impacts from implementation of the proposed action. 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.

VIII. 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 the Service 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 the Service 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 HCP and its associated documents clearly identify anticipated impacts to affected species likely to result from the proposed taking and the measures that are necessary and appropriate to minimize those impacts. All conservation measures described in the HCP, together with the terms and conditions described in any associated Implementing Agreement and any Section 10(a)(I)(B) permit issued with respect to the HCP, are hereby incorporated by reference as reasonable and prudent measures and terms and conditions within this incidental take statement pursuant to 50 CFR §402.14(i). Such terms and conditions are non-discretionary and must be undertaken for the exemptions under Section 10(a)(I)(B) and Section 7(0)(2) of the ESA 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(0)(2) may lapse. The amount or extent of incidental take anticipated from the Criterion Wind Project HCP, associated reporting requirements, and provisions for disposition of dead animals are described in the HCP and its accompanying Section 10(a)(1)(B) permit.

AMOUNT OR EXTENT OF TAKE

After analyzing the effects of the proposed action (issuance of the ITP and implementation of the HCP), the Service anticipates that up to 12 Indiana bats will be taken cumulatively as a result of the project over 20 years. The incidental take is expected to be in the form of direct mortality from collision with turbines blades or from barotrauma during project operations.

EFFECT OF THE TAKE

Through the analysis in this biological opinion, the Service has determined that this level of anticipated take is not likely to result in jeopardy to Indiana bats and that no critical habitat will be destroyed or adversely modified by this project.

IX. 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 (USFWS 2011) by incorporating information gained from recent wind projects, as well as current research on the topic.

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

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.

REINITIATION NOTICE

This concludes 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 of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action 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.

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Appendix A. Consultation History

June 4, 2010 – Meeting between CBFO, the applicant and their consultant WEST regarding summary of the project and how they are moving forward. They explain that they have already conducted clearing and construction of substation pads and explain they want to develop an HCP for operations. WEST describes a series of white papers that will be used to develop the HCP. March and April 2010, 30 percent of 47 acres was cleared; snow prevented complete clearing. Between April 6th and up until mid-May, the remaining 70 percent of the 47 acres was cleared. All of the substation pads have been poured where clearing has occurred. There are three acres remaining that need to be cleared in the southern most portion of the site. They also present results of bio-acoustic surveys conducted by WEST starting in April 2010 (4 Anabat detectors, 2 permanent stations, and 2 rotating on daily basis) and that will continue until October 31st, indicating some use of that area by Indiana Bat in mid-summer, using three screening tools.

June – July 2010 - Mist net surveys were conducted on June 30th and July 1st in the T20 area (double stacked nets at one site and triple stacked nets at the other site, separated 30 m apart, 5 hours each night for 2 consecutive nights). No Indiana bats were captured.

August 9th -13th, 2010- WEST conducts mist netting at 5 sites throughout the project area. No Indiana bats are captured.

August 12, 2010 - Constellation finishes clearing the remaining two acres of trees; used the Decision Tree on page 9 of the "Rangewide Indiana Bat Protection and Enhancement Plan Guidelines" for in season tree clearing.

November 8, 2010 - The CBFO received first draft of HCP.

November 30, 2010 - Meeting between CBFO, Constellation, and WEST to discuss our comments and issues with the first draft of the HCP. Issues identified included using little brown fatalities to track take since it is being used as a surrogate to estimate take of Indiana bat, lack of minimization measures (curtailment), and use of a mitigation fund instead of finding a mitigation project first.

November 2010 - The Service receive Draft Avian and Bat Protection Plan

December 7, 2010 - Receive draft EA from Ecology and the Environment (Service's consultant).

December 14, 2010 - Meeting between CBFO and Constellation and Ecology and Environment to discuss our comments on the Draft EA.

December 27th, 2010 - Received responses from Constellation to our comments on the HCP. Because they think take is negligible, they don't think minimization is necessary and a mitigation fund held by Bat Conservation International would be good because funds would be leveraged.

December 29th, 2010 - Complaint filed by Save Western Maryland, Maryland Conservation Council against Constellation for operating before they have an Incidental Take Permit.

January 20, 2011 - CBFO receives a description of the mitigation fund from Constellation.

February 1, 2011 - CBFO sends Ed Tracey at Constellation a prioritized list of types of projects we would want funded through the mitigation fund and state that the projects should be in the Appalachian Recovery Unit.

February 2, 2011 - Constellation submits Incidental Take Permit application and check, and preliminary draft document to CBFO.

February 4, 2011 - Further discussions on monitoring plan and curtailment study with WEST and Constellation. WEST is going to look at how doing a curtailment study in the first year affects probability of detecting an Indiana bat through intensive monitoring in the first year. May have to do curtailment study in second year if the probability of detection is affected.

March 8, 2011 - Call with Constellation, Paul Phifer-ARD of Ecological Services, CBFO Project Leader to discuss preliminary comments provided on Draft documents, ask to get formal comments from Service in one week, and schedule a meeting with the Service on March 21st to discuss the documents, and decide whether the package can be sent to the Regional Office.

March 15, 2011 - CBFO provides comments to CPP on draft HCP from the Regional Office, Field Office and Solicitor.

March 21, 2011 - Regional office and Field office staff meet with Constellation to discuss comments on draft documents. Primary FWS concerns included adequate justification for the minimization and mitigation approach, more specifics on the adaptive management triggers and the corresponding responses, more specifics on the monitoring plan, and additional explanation of how take levels will be quantified and assessed.

April 7, 2011 - Constellation provides an updated HCP, Avian and Bat Protection Plan and response to comments document to CBFO and the HCP coordinator.

May 5, 2011 - CBFO sends Ed Tracey of Constellation a letter stating that we acknowledge that they are withdrawing their Incidental Take Permit application; they requested we withdraw the application in an April 1, 2011 letter.

April 28, 2011- CBFO sends comments on Avian and Bat Protection Plan.

May 11, 2011 - Constellation sends CBFO and HCP coordinator an updated HCP, Avian and Bat Protection Plan, and response to comments document.

June 3, 2011 - Receive revised HCP and ABPP from Constellation.

June 8, 2011 - CBFO Project Leader sends Constellation comments on Avian and Bat Protection Plan.

CBFO August 8, 2011 - Constellation provides the Service a conceptual plan for moving forward with the HCP and agree to implement curtailment for minimization from July 15-October 15 each year from sunset to sunrise.

September 14, 2011 - Visit by Service staff members to the project site with staff from WEST and Constellation.

September 29, 2011 - Constellation sends revision of Draft HCP.

October 5, 2011 - Constellation sends revision of Draft APP.

October 12, 2011 - FWS provides comments on Draft HCP and APP.

December 2, 2011 - Criterion re-submits HCP application to the Service at CBFO.

December 8, 2011 - CBFO sends field office certification memo, Criterion ITP application, Draft HCP, and Federal Register Notice to Lowell Whitney, Regional HCP coordinator.

July 31, 2012 - Notice of Availability published in Federal Register for Draft HCP, Draft EA, and Implementing Agreement.

October 1, 2012 - The 60-day public comment period closes; the Service receives ten comment letters. The Service works with Ecology and the Environment to respond to the comments.

December 6, 2012 – CBFO and Lowell Whitney, Regional HCP Coordinator meet with Ecology and the Environment and Criterion to discuss responses to public comments and changes to the HCP based on the comments.

January 31st, 2013 – Cherry Keller from CBFO sends out first draft of the Biological Opinion to Laura Hill, West Virginia Field Office and Lowell Whitney, Regional HCP Coordinator.

March 14th, 2013 – Criterion provides justification/statistical analysis for weekly monitoring proposed in years 2,3, 8, 13, and 18 to CBFO and the Regional HCP Coordinator.

March 15, 2013 – E-mail from Lowell Whitney, HCP Coordinator, with proposed WNS Changed Circumstance language for the HCP to CBFO.

March 18th, 2013 – CBFO sends changed circumstance language to Criterion for review.

March 26, 2013 – e-mail from Laura Hill, West Virginia Field Office, transmitting 2013 hibernacula survey results for Hellhole Cave, documenting that the Indiana bat counts decreased by 86 percent (2,540 bats).

April 5, 2013 – Criterion sends edits to CBFO and Regional HCP Coordinator on WNS Changed Circumstance.

April 19, 2013 – Criterion sends revised APP to CBFO and Regional HCP Coordinator.

April 22, 2013 – E-mail from Laura Hill, West Virginia Field Office to Cherry Keller, CBFO, updating bat species composition tables for updating the Indiana bat take estimate for the Criterion HCP.

May 6, 2013 – Criterion send revised HCP to Lowell Whitney, Regional HCP Coordinator.

May 6, 2013 – E-mail from Lowell Whitney, Regional HCP Coordinator, to CBFO with attachment of updated Beech Ridge Take Estimate.

May 7, 2013 – E-mail from Cherry Keller, CBFO, to Lowell Whitney, Regional HCP Coordinator, discussing implications for changing the take estimate.

May 22, 2013 – Service provides text for HCP and an Appendix to the HCP for a revised take estimate; sends to Criterion for review.

May 23, 2013 – CBFO and Regional HCP Coordinator discuss revised take estimate with Criterion, and they suggest minor edits which the Service agrees with.

May 31^{st}, 2013 – CBFO finalizes Biological Opinion.

June 5^{th}, 2013 – CBFO sends comments to Criterion on minor edits to the APP.

June 6^{th}, 2013 – CBFO sends e-mail to Criterion stating that the HCP can be finalized for final Regional Office review.

January 17^{th}, 2014 – Criterion sends final version of the HCP and IA to CBFO.

Appendix B. Population Model Runs using the Thogmartin et al. 2013 model.

Each scenario was run 5,000 times with and without the project. All are the worst case scenarios where we assume WNS has affected the population (0.096 probability of infection in any year and infection starts in 2011), and these model runs use the Indiana bat specific assumptions.

We assessed three scenarios:

(1) All of the project mortality occurs during fall migration. Half of the bats killed hibernate in the local hibernacula (Cornwell Cave), with a starting population size of 183 bats in 2011 (based on the latest survey). Under this scenario, the other half of the project mortality would be spread among other hibernacula within the migration range of Indiana bats. The intent of this scenario was to determine if the estimated take from the project would cause measurable impacts to the Cornwell Cave population. Assuming that 50 percent of the estimated take would be of bats from Cornwell Cave was considered a worse-case scenario since there are many caves within the migration range of the project and many contain more bats than Cornwell.

(2) All of the project mortality occurs during fall migration. Half of the bats killed hibernate in the largest cave within 100 miles of the project (Hellhole), with a starting population size of 2,540 bats in 2013 (based on the latest survey). Under this scenario, the other half of the project mortality would be spread among other hibernacula within the migration range of Indiana bats. The intent of this scenario was to determine if the estimated take from the project would cause measurable impacts to the Hellhole population. Assuming that 50 percent of the estimated take would be of bats from Hellhole is possible given the large number of bats in Hellhole, however, the project is over 40 miles from Hellhole and migration distances indicate that about 50 percent of the bats migrating from a cave summer within 25 miles of the cave thus the number ranging as far as Criterion would be considerably reduced and the take would be spread among several populations.

(3) All of the project fatality occurs during fall migration. Half is comprised of females originating from a maternity colony somewhere within 100 miles of the Project, with a hypothetical starting population size of 60 females. Under this scenario, the other half of the project mortality would be of male Indiana bats. The intent of this scenario was to determine if the estimated take from the project would cause measurable impacts to a maternity colony somewhere within 100 miles of the Project. This is considered to be a worst case scenario as it is more likely that take would be spread among multiple maternity colonies.

Table 1. Worst case for local hibernacula - Comparison of model results for local hibernacula persistence (Cornwell Cave) experiencing WNS (**Indiana bat model**) with and without the project take assuming the worst case scenario where 50 percent of the take (6 bats) are taken from the closest hibernacula and it is experiencing WNS (Run 9).

	WITHOUT project (Scen2)	WITH project (Scen1)	% Difference*
Median population size at year 50	274	274	0.00
Median population size at year 25	104	106	1.89
% Probability of going to extirpation by year 50	3.70	3.06	-20.92
% Probability of going to extirpation by year 25	1.50	1.42	-5.63
Median years to extirpation	28.00	26.00	-7.69
Median growth rate at year 50	1.12	1.12	0.00
Median growth rate at year 25	1.20	1.21	0.12

*% difference = (WITH – WITHOUT)/WITH x 100

Conclusion: With or without the project related losses the results of the population model are essentially the same; in fact the probability of extirpation by year 50 was slightly higher (worse) without the project and better with the project. But probabilities of going to extirpation by year 25 or year 50 were all very low (less than 4%) and very similar with or without the project.

Table 2 . Worst case for Hellhole hibernacula - Comparison of model results for primary hibernacula population (Hellhole Cave) experiencing WNS (**Indiana bat model)**, without the project take and with the project take under the **worst case scenario** where 50 percent of the project take (6 bats) are taken from this hibernacula (Run 11). (Note starting population for the hibernacula was 2,540 bats as estimated in 2013).

	WITHOUT project (Scen2)	WITH project (Scen1)	% Difference
Median population size at year 50	27,836	27,836	0
Median population size at year 25	3,142	3,337	5.843572
% Probability of going to extirpation by year 50	0	0	0
% Probability of going to extirpation by year 25	0	0	0
Probability of becoming less than 500 bats in 50 years	0.02	0.02	0
Probability of becoming less than 500 bats in 25 years	0.86	0.82	-4.878049
Median number of years to extirpation (0 - no extirpations)	0	0	0
Median growth rate at year 50	1.23	1.23	0.00
Median growth rate at year 25	1.38	1.38	0.23

Conclusion: With or without the project related losses the results of the population model are essentially the same; the model projects recovery of the hibernacula using the model parameters with and without the project related losses. In fact the probability of the population becoming less than 500 bats was slightly higher (worse) without the project and better with the project. Overall, the model projected recovery of Hellhole Cave with and without the estimated project related losses.

Table 3. Worst case for local maternity colony - Comparison of model results for local maternity colony population experiencing WNS (**Indiana bat model assumptions)**, without the project take and with the project take under the **worst case scenario** where all of the take (6 females) are taken from the closest maternity colony (Run 13).

	WITHOUT project (Scen2)	**WITH project (Scen1)**	**% Difference**
Median population size at year 50	117	119	1.680672
Median population size at year 25	17	18	5.555556
% Probability of going to extirpation by year 50	20.5	20.6	0.485437
% Probability of going to extirpation by year 25	15.4	15.1	-1.98675
Median years to extirpation	18	18	0
Median growth rate at year 50	1.10	1.10	0
Median growth rate at year 25	1.12	1.12	0

Thogmartin Demographic Model: 5000 simulations per scenario; WNS (Indiana bat model) 0.096 probability of infection in any given year; 6 females or 0.15 females taken for 20 years in fall

Conclusion: Model projections of a maternity colony that begins with 60 females and looses 6 females in 20 years (0.15 female per year) are essentially the same with or without these losses. These model projections (using the Indiana bat assumptions for WNS) predict a 20 percent chance of extirpation by year 50 with or without the project. Overall, there is no difference seen in the population projections with and without the estimated project related losses.