Indiana Bat and Northern Long-eared Bat Habitat Conservation Plan for the Copenhagen Wind Farm, Lewis and Jefferson Counties, New York

Prepared by:
Copenhagen Wind Farm, LLC

In consultation with:
Western EcoSystems Technology, Inc.,
415 W. 17th St. Suite 200
Cheyenne, WY 82001

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1 INTRODUCTION

1.1 Overview and Background

Copenhagen Wind Farm, LLC (CWF), a subsidiary of EDF Renewable Energy, is proposing to develop a wind-powered generating facility in the Town of Denmark, Lewis County, and the towns of Rutland and Champion, Jefferson County, New York (Figure 1.1). The Copenhagen Wind Farm (Project) is proposed to consist of up to 40 Vestas 110-2.0 wind turbines that will deliver up to 79.9 megawatts (MW) of electrical power to the New York State grid. In addition to the wind turbines, the Project will consist of two permanent meteorological (met) towers, a system of gravel access roads, buried 34.5 kilovolt (kV) electrical collector lines, an operation and maintenance (O&M) building, and a collection and transforming station. To deliver power to the New York State power grid, the Project will also include construction of a 115-kV transmission line and a Point of Interconnection (POI) facility located adjacent to the existing National Grid Black River – Lighthouse Hill 115-kV transmission line in the Town of Rutland. The proposed transmission line route will be approximately eight miles (13 kilometers [km]) in length.

The proposed Project and transmission line are located on approximately 9,142 acres (3,700 hectares [ha]) of leased private land. Some preliminary tree clearing was completed during the fall of 2016. Project construction started in the fall of 2017 for the civil work and was paused during the winter period of 2017/2018. Construction resumed in April 2018, and the Project achieved commercial operation on December 27, 2018. The Project will employ up to six O&M personnel and contribute approximately $624,000 per year in payments in lieu of taxes revenues to local taxing jurisdictions.

The Project's business goal is to optimize electrical output to maximize the environmental benefits of renewable wind energy and thereby reduce potentially harmful greenhouse gas emissions from other energy sources. Energy generated by the Project will assist New York State in achieving the renewable energy goals and policy objectives outlined in the 2009 State Energy Plan (New York State Energy Planning Board 2009). The Project is expected to produce enough power to meet the average annual consumption of between approximately 120,000 to 127,000 households.

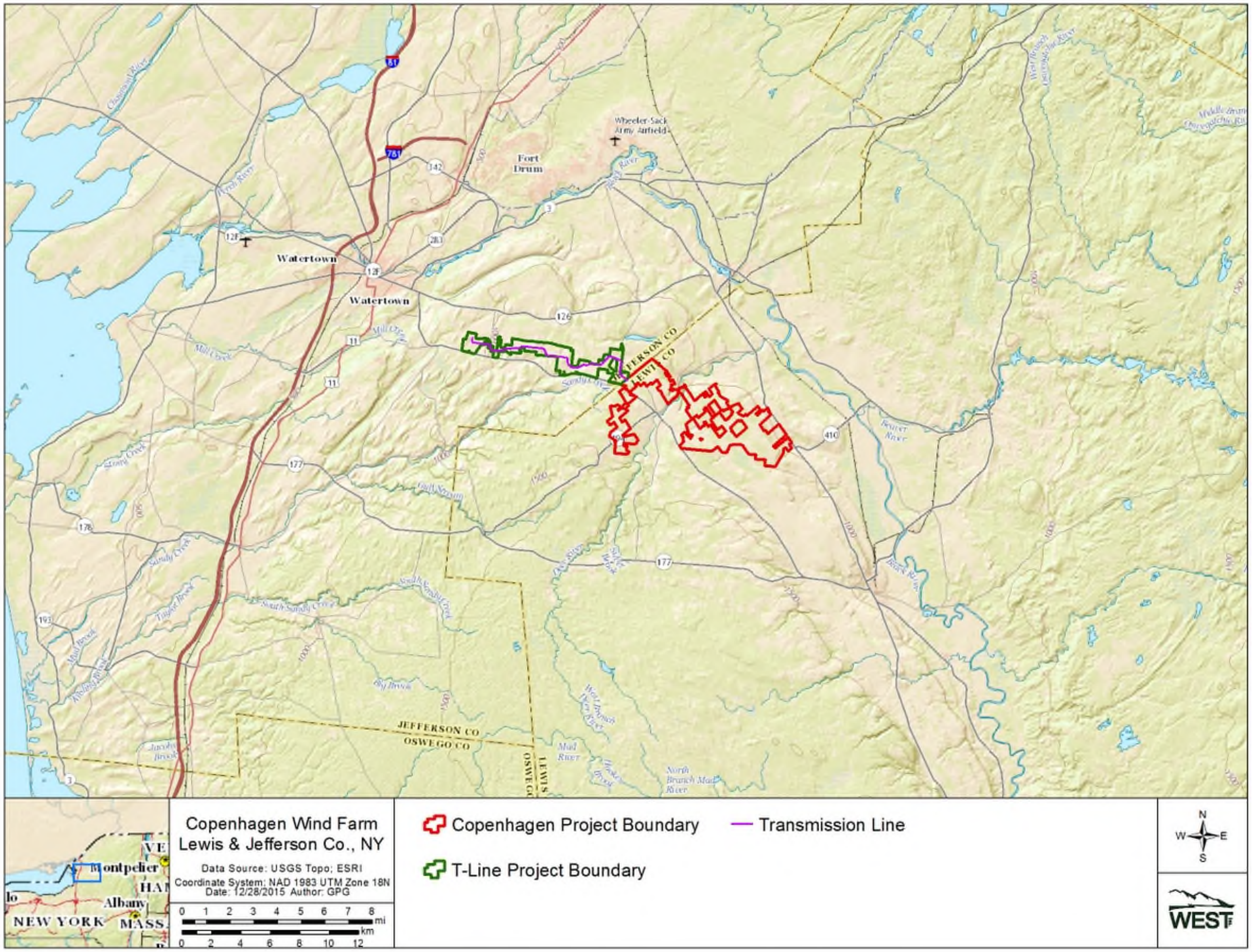

Figure 1.1 Copenhagen Wind Farm location.

Pursuant to Section 10(a)(1)(B) of the Endangered Species Act of 1973 (ESA), as amended (16 United States Code [USC] 1531 et seq.), CWF is applying for an Incidental Take Permit (ITP) for two bat species that have ranges overlapping the Project and that are listed under the ESA: Indiana bat (*Myotis sodalis*) and northern long-eared bat (*Myotis septentrionalis*). These two species are referred to as the Covered Species throughout this document and are described in detail in Section 5.1. The Indiana bat is listed as endangered under the ESA. The northern long-eared bat is currently listed as threatened under the ESA (United States Fish and Wildlife Service [USFWS] 2015b; 80 Federal Register [FR] 17974). However, any take that may occur associated with the Project is not prohibited under the final 4(d) rule for the species published January 14, 2016 (81 FR 1900), which includes incidental take of northern long-eared bats due to the operation of wind turbines. The northern long-eared bat is included in this HCP as a Covered Species so that the species is fully addressed commensurate with the other Covered Species, providing take authorization under the ITP that will apply even in the event the 4(d) rule is reversed or the species is up-listed to endangered status within the term of the permit.

This Habitat Conservation Plan (HCP) has been developed in support of the ITP application. The Project has completed an environmental review in accordance with the requirements of New York State's Environmental Quality Review Act (SEQRA) simultaneous to development of this HCP. The Town of Denmark Planning Board acted as the lead agency pursuant to SEQRA.

1.2 Regulatory Framework

1.2.1 Federal

1.2.1.1 Endangered Species Act

Section 9 of the ESA and its implementing regulations prohibit the "take" of any endangered or threatened species of fish or wildlife listed under the ESA. Under ESA Section 3(19), the term "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect species listed as endangered or threatened or to attempt to engage in any such conduct. "Harass" in the definition of "take" in the ESA means "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." (50 Code of Federal Regulations [CFR] Section (§) 17.3). "Harm" in the definition of "take" in the ESA means "an act that actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering." (50 CFR § 17.3).

Under ESA Section 10(a)(1)(B), the USFWS may authorize, under certain terms and conditions, any taking otherwise prohibited by Section 9(a)(1)(B) if such taking is incidental to, and not the purpose of, an otherwise lawful activity. This Section 10(a)(1)(B) take authorization is known as an ITP.

To qualify for an ITP, a non-federal landowner or land manager must develop, fund, and implement a USFWS-approved HCP. The HCP must specify the following information described in ESA Section 10(a)(2)(A), 50 CFR § 17.22(b)(1), and 50 CFR § 17.32(b)(1):

- The impact that will likely result from such taking;
- The measures the applicant will undertake to monitor, minimize, and mitigate such impacts, the funding that will be available to implement such measures, and the procedures to be used to deal with unforeseen circumstances;
- The alternative actions the applicant considered that would not result in take and the reasons why such alternatives are not proposed to be utilized; and
- Such other measures that the Director of the USFWS may require as necessary or appropriate for purposes of the HCP.

The USFWS will issue an ITP if it finds that the following issuance criteria of ESA Section 10(a)(1)(B), 50 CFR § 17.22(b)(2), and 50 CFR § 17.32(b)(2) are met:

- The taking will be incidental;
- The applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such takings;
- The applicant will ensure that adequate funding for the HCP and procedures to deal with unforeseen circumstances will be provided;
- The taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild;
- The applicant has met the measures, if any, required by the Director of the USFWS as being necessary or appropriate for the purposes of the plan; and
- The Director of the USFWS has received such other assurances, as he or she may require, that the plan will be implemented.

1.2.1.2 National Environmental Policy Act

The National Environmental Policy Act (NEPA; 42 USC § 4321, et seq.), requires federal agencies to examine environmental impacts of their actions and provide for public participation. Issuance of an ITP is a federal action subject to compliance with NEPA. To comply with NEPA, the USFWS must conduct detailed analyses of all direct, indirect, and cumulative impacts of issuing the permit on the human environment, not just on the covered species or resources. If the agency determines that issuance of the permit, as conditioned by the agreed-upon conservation measures to be incorporated into the ITP, does not have significant impacts, then the agency will issue a Finding of No Significant Impact. If the agency determines that the project, including any mitigation or conservation measures, is likely to have a significant impact, then the agency will issue a Notice of Intent to prepare an Environmental Impact Statement

(EIS), which involves a more detailed evaluation of the effects of the federal action and alternatives to mitigate these effects. Upon completion, the draft NEPA document will be made available for public review along with this draft HCP.

1.2.1.3 Migratory Bird Treaty Act

To avoid and minimize impacts to species protected under the Migratory Bird Treaty Act (MBTA; 16 USC § 703-712), CWF has prepared an Avian and Bat Protection Plan (ABPP [CWF 2016]) that documents pre-construction bird and bat assessments conducted for the Project and describes the avoidance and minimization measures to be implemented as part of the Project.

1.2.1.4 Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (16 USC §§ 668-668d) (BGEPA) prohibits the unauthorized take of bald and golden eagles. BGEPA defines the "take" of an eagle to include a broad range of actions, including to pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb. The term "disturb" is defined in regulations found at 50 CFR § 22.3 to include to "agitate or bother a bald or golden eagle to a degree that it causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment by substantially interfering with normal breeding, feeding, or sheltering behavior."

The USFWS published a final rule (Eagle Permit Rule) on September 11, 2009 (74 FR 46836-46879), under the BGEPA (50 CFR § 22.26) authorizing limited issuance of permits to take bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*). This rule was revised and finalized on December 16, 2017 (81 FR 91494-91554). Revisions included changes to permit issuance criteria and duration, definitions, compensatory mitigation standards, criteria for eagle nest removal permits, permit application requirements, and fees.

Bald and golden eagles may be included as Covered Species in HCPs; however, if they are included, the avoidance, minimization, and other mitigation measures in the HCP must meet the BGEPA permit issuance criteria of 50 CFR § 22.26 and include flexibility for adaptive management. CWF's draft ABPP explains the biological reasoning behind its conclusion that potential to take a bald or golden eagle at the site is low (CWF 2016), and thus, eagles are not included as Covered Species in this HCP.

1.2.1.5 National Historic Preservation Act

The USFWS' issuance of an ITP under ESA Section 10(a)(1)(B) is considered an "undertaking" as defined by regulation and must comply with Section 106 of the National Historic Preservation Act (NHPA; 16 USC § 470 et seq.) and its implementing regulations at 36 CFR Part 800. Section 106 of the NHPA requires USFWS to assess and determine the potential effects on historic properties that would result from the proposed undertaking. When an adverse effect to a historic property cannot be avoided, the USFWS must consult with State Historic Preservation Office (SHPO), the Tribal Historic Preservation Office, and other interested parties to identify ways to mitigate the effects of the undertaking. This process may result in the development of a Memorandum of Agreement (MOA), which identifies the steps the agency will take to reduce, avoid, or mitigate the adverse effect. The MOA will be submitted to the Advisory Council on Historic Preservation for review and comment. The USFWS must document NHPA compliance and include such documentation in the administrative record for the HCP. Details on the consultation process for resolution of adverse effects are found at 36 CFR 800.6.

CWF executed an MOA with the United States (US) Army Corps of Engineers (COE) and SHPO. Potential viewshed issues were resolved immediately prior to the execution of the MOA. CWF has provided documentation of the MOA to the USFWS.

1.2.1.6 Clean Water Act

Section 404 of the Clean Water Act (33 USC § 1344) provides for the issuance of permits to allow the discharge of dredged and fill material into waters of the US. CWF required a Clean Water Act permit from the COE for fill associated with the construction phase of the Project. CWF filed a Section 404 permit application and the Project's Section 404 permit was signed on October 31, 2016. As part of COE's responsibilities associated with issuing a permit, Section 7 of the ESA required the COE to consult with the USFWS for any federally-listed species that may be affected by the proposed action. CWF worked with the COE and USFWS to develop a strategy to avoid impacts to the Covered Species for the construction and temporary operations of the Project and the USFWS issued a Technical Assistance Letter (TAL) to CWF on October 26, 2015. The COE and USFWS Section 7 consultation concluded that the Project's construction and temporary operation may affect, but is not likely to adversely affect the Covered Species. CWF cannot operate the Project per the TAL long-term (Section 10.1) and has prepared this HCP in support of an ITP application.

1.2.2 State

1.2.2.1 New York's State Environmental Quality Review Act Process

New York's SEQRA requires all state and local government agencies to consider environmental impacts equally with social and economic factors during discretionary decision-making. Similar to the federal NEPA process, if an action is determined not to have significant adverse environmental impacts, a determination of non-significance (Negative Declaration) is prepared. If an action is determined to have potentially significant adverse environmental impacts, an EIS is required.

The Project has completed an environmental review in accordance with the requirements of SEQRA simultaneous to development of this HCP. On May 5, 2012, an application was submitted by CWF to the Town of Denmark, along with a full Environmental Assessment Form (EAF) for the proposed Project. The submittal of this application, which requires discretionary approval, initiated the SEQRA process for the subject action. On July 7, 2012, the Town of Denmark Planning Board forwarded a declaration of intent to become SEQRA Lead Agency, along with a copy of the EAF document, to potentially interested/involved SEQRA agencies. It was stated in the letter of intent to act as lead agency that, subject to the agreement of all

Involved Agencies, the lead agency determination would become effective 30 days from the date of the declaration letter. No agency objected to the Town of Denmark Planning Board assuming the role of Lead Agency. The Town of Denmark, as Lead Agency, subsequently issued a Positive Declaration on August 7, 2012, requiring the preparation of a Draft EIS (DEIS).

On September 4, 2012, the Town of Denmark Planning Board accepted the Draft Scoping Document and adopted a motion that set forth a 30-day public comment period. Following review of all written and oral comments on the Draft Scoping Document, the Planning Board adopted the Final Scoping Document on October 30, 2012. The Planning Board accepted the DEIS as complete and ready for public review and comment on June 4, 2013. A Public Hearing was held on July 9, 2013, at the Copenhagen Central School and comments were accepted through August 13, 2013. The DEIS was revised as necessary to address substantive comments, and the Final EIS was accepted by the Planning Board as complete on July 10, 2014. The review period for all Interested and Involved Agencies ended on July 30, 2014. The Town of Denmark Planning Board issued its Lead Agency Findings Statement on August 19, 2014, and no Involved Agencies issued additional Findings Statements.

1.2.2.2 Part 182

Part 182 of the New York Codes, Rules, and Regulations (6 NYCRR 182) regulates endangered and threatened species of fish and wildlife, species of special concern, and ITPs. The New York State Department of Environmental Conservation (NYSDEC) reviewed this HCP and found it to meet the Part 182 requirements (J. Farquhar, NYSDEC, pers. comm., May 24, 2016). The NYSDEC issued an Endangered/Threatened Species (Incidental Take) Permit under Article 11 to the Project on October 15, 2016. The NYSDEC Permit was issued with the condition that CWF will comply with this HCP pursuant to Section 10(a)(1)(B) of the ESA and pursuant to Part 182.

2 PURPOSE AND NEED

Although wind energy projects produce renewable, non-polluting energy, operating wind turbines present a source of mortality to bats occurring within a wind energy site (Arnett et al. 2008). CWF has determined that, although the proposed Project is not considered a high-risk site for bats (see Section 5.2), Project operation may result in incidental bat mortality, including mortality of the Covered Species. CWF is therefore applying for an ITP for bat species listed or proposed for listing under the ESA that have ranges overlapping the Project. These are the Indiana bat and the northern long-eared bat (Covered Species). This HCP has been developed in support of the ITP application. Through this HCP, CWF seeks to maximize production of non-polluting energy by the Project while minimizing and mitigating to the maximum extent practicable the impacts of any incidental take of the Covered Species from operation of the Project.

3 DESCRIPTION OF THE AREA TO BE ANALYZED

3.1 Plan Area

The Plan Area includes any and all areas that may be within the HCP's sphere of influence whether or not take is likely to occur. CWF has determined the Plan Area for the HCP to include all lands under lease by CWF for the Project and transmission line, as well as all lands involved in the off-site mitigation project associated with this HCP (see Section 6.4). Take of the Covered Species is only anticipated to occur within the lands under lease by CWF for the Project and transmission line, i.e., the Permit Area. However, the entire Plan Area (i.e., both the Project area and the off-site mitigation) is influenced by the HCP's biological goals and objectives and subject to the commitments associated with this HCP (see Chapter 6 *Conservation Program*).

The Permit Area is described in Section 3.2, below. The characteristics of the off-site mitigation parcels are described in Section 6.4.1.

3.2 Permit Area

The Permit Area is a subset of the Plan Area and consists of all areas where take of Covered Species is anticipated. CWF proposes that the Permit Area include the 9,142 acres of land leased by CWF for construction and operation of the Project and transmission line, as this area includes all areas where take of Covered Species is requested for ITP coverage (Figure 3.1). These lands include the locations for all proposed turbines, plus all proposed associated facilities such as roads, collection lines, the O&M facility, met towers, the electrical substation, and the transmission line. The Permit Area consists entirely of private land that is primarily used for agriculture and timber production and rural residential development in Lewis and Jefferson counties, New York.

The transmission line portion of the Permit Area lies within the Eastern Broadleaf Forest (Continental) Province while the turbines are located in the Coniferous Forest-Alpine Meadow Province (McNab and Avers 1994). Within these provinces, the transmission line portion is located in the Erie and Ontario Lake Plain Section and the turbines are located within the Adirondack Highlands Section. The Erie and Ontario Lake Plain Section is characterized by level to gently rolling till-plain and flat lake plain. Vegetation types include northern hardwood forest, beech-maple (*Fagus* spp.-*Acer* spp.) forest, and elm-ash (*Ulmus* spp.-*Fraxinus* spp.) forest, though approximately 50% of the section is used for agriculture. Precipitation averages 27 to 45 inches (69-114 centimeters [cm]) and is evenly distributed throughout the year. The Adirondack Highlands Section includes the Tug Hill Plateau south of the Black River Valley, where it overlaps the Project site. The Tug Hill Plateau is characterized by rolling hills and gentle slopes. Vegetation types in the section include northern hardwood-spruce (-*Picea* spp.) and northeastern spruce-fir (*Picea* app.-*Abies* spp.) forest. Precipitation averages 40 to 48 inches (102-122 cm) and is evenly distributed throughout the year.

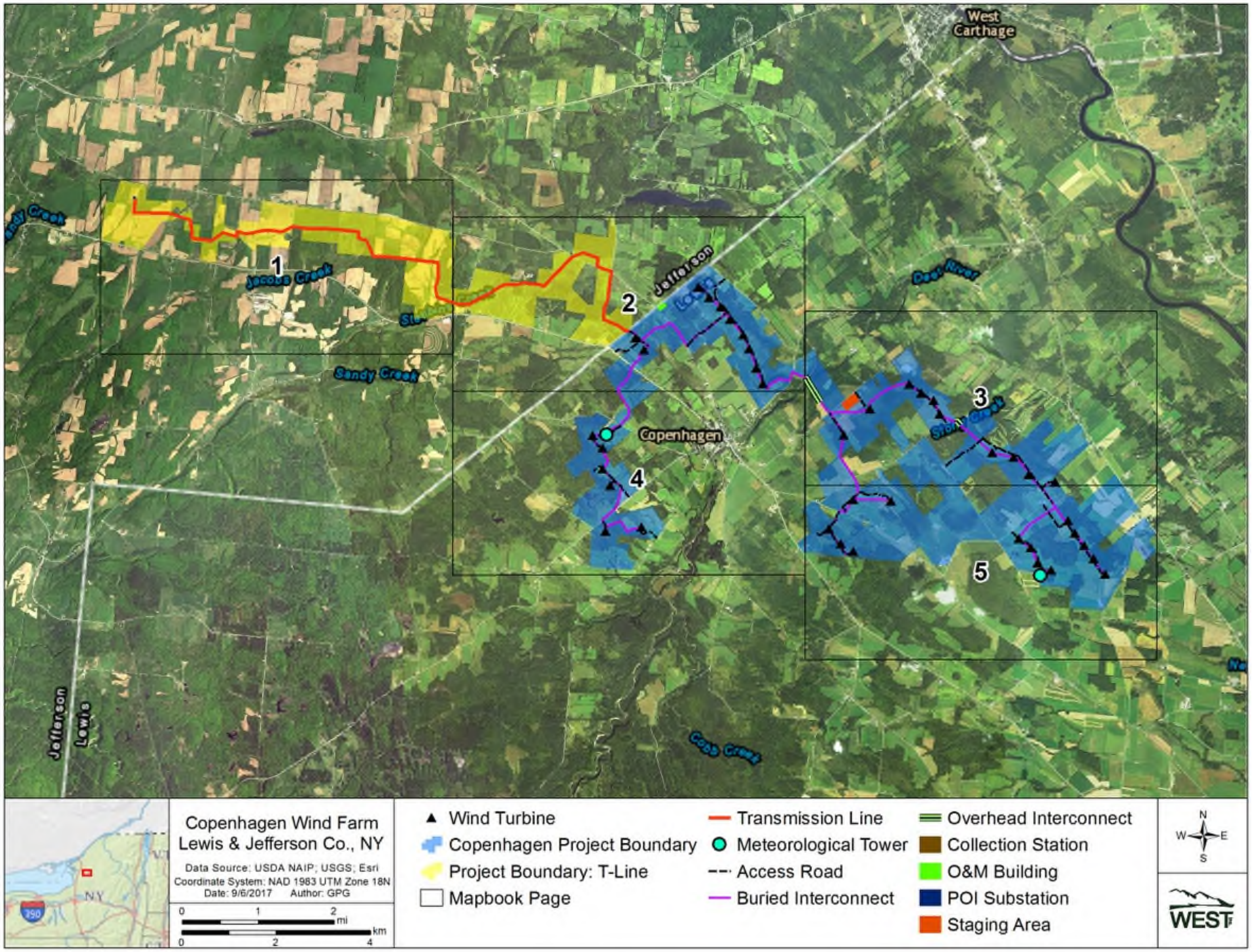

Figure 3.1a Permit Area of the Copenhagen Wind Farm Habitat Conservation Plan.

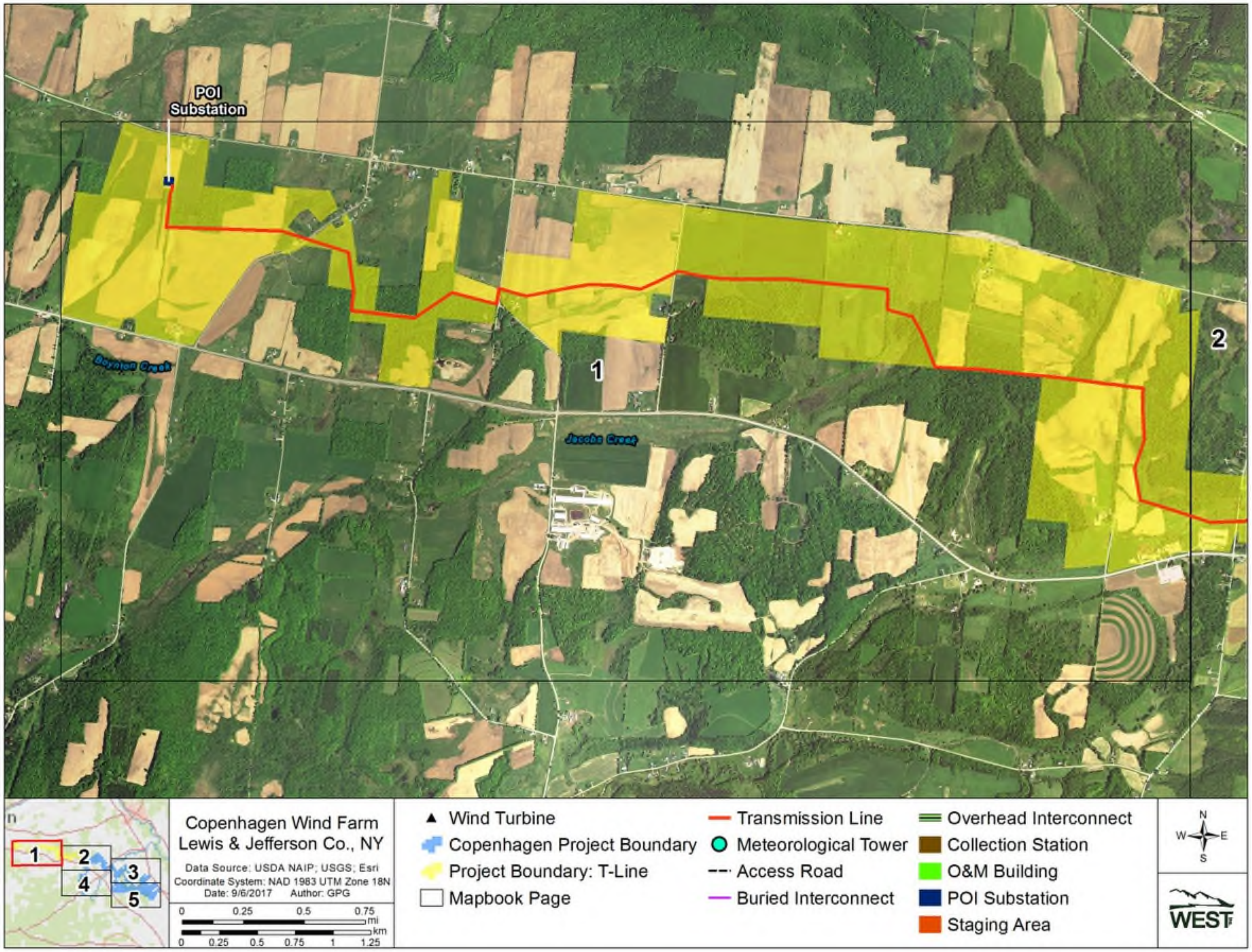

Figure 3.1b Detailed Permit Area of the Copenhagen Wind Farm Habitat Conservation Plan.

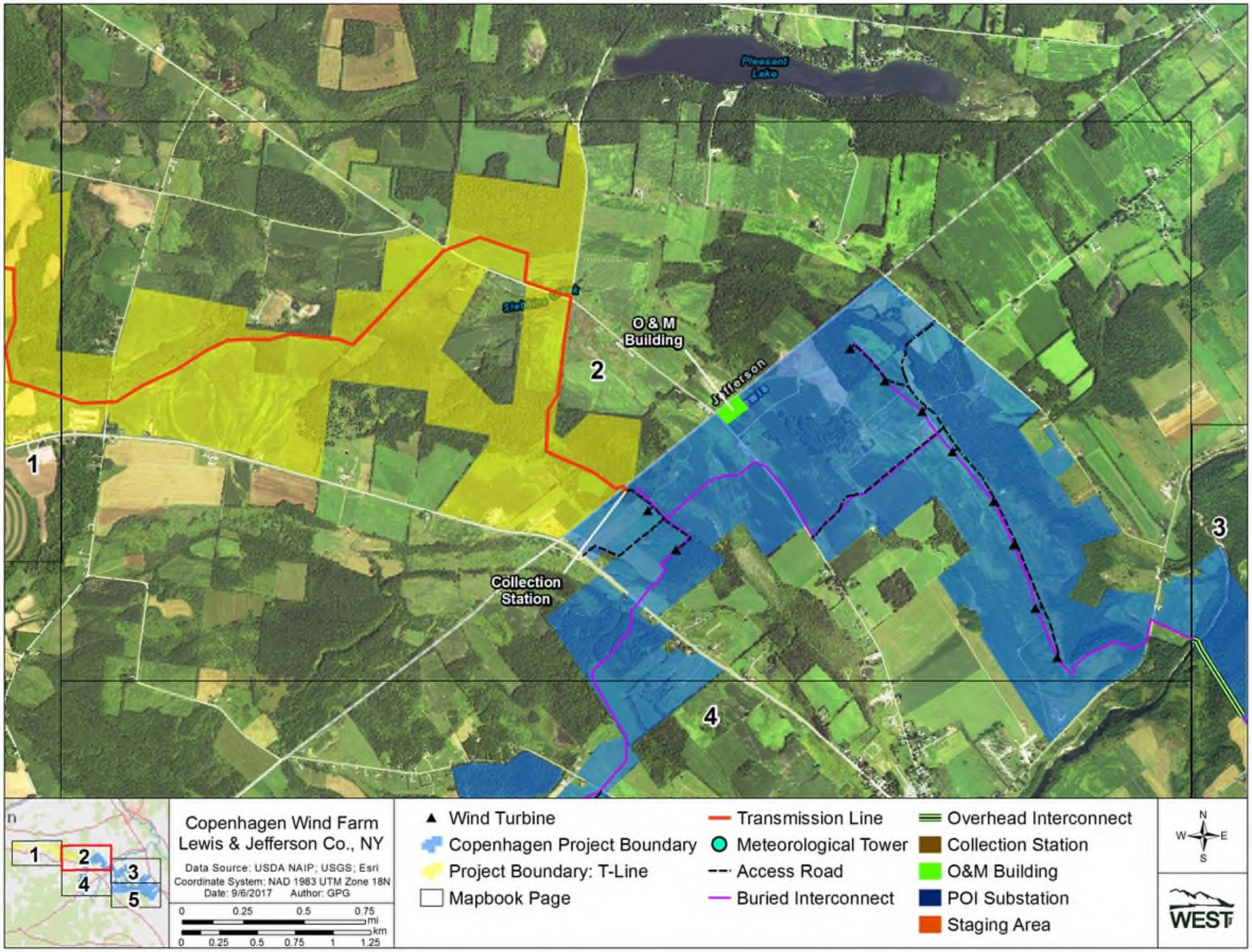

Figure 3.1c Detailed Permit Area of the Copenhagen Wind Farm Habitat Conservation Plan.

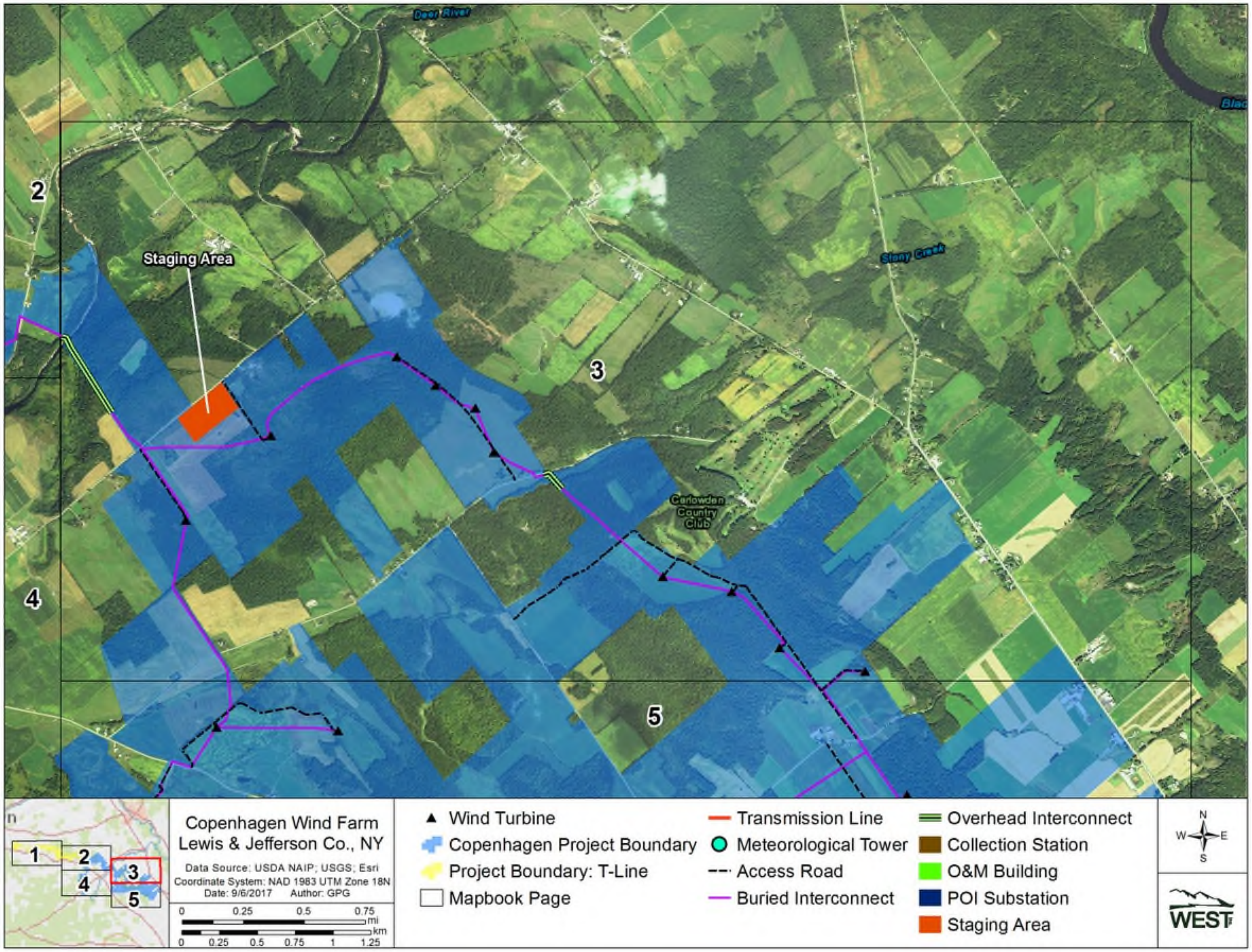

Figure 3.1d Detailed Permit Area of the Copenhagen Wind Farm Habitat Conservation Plan.

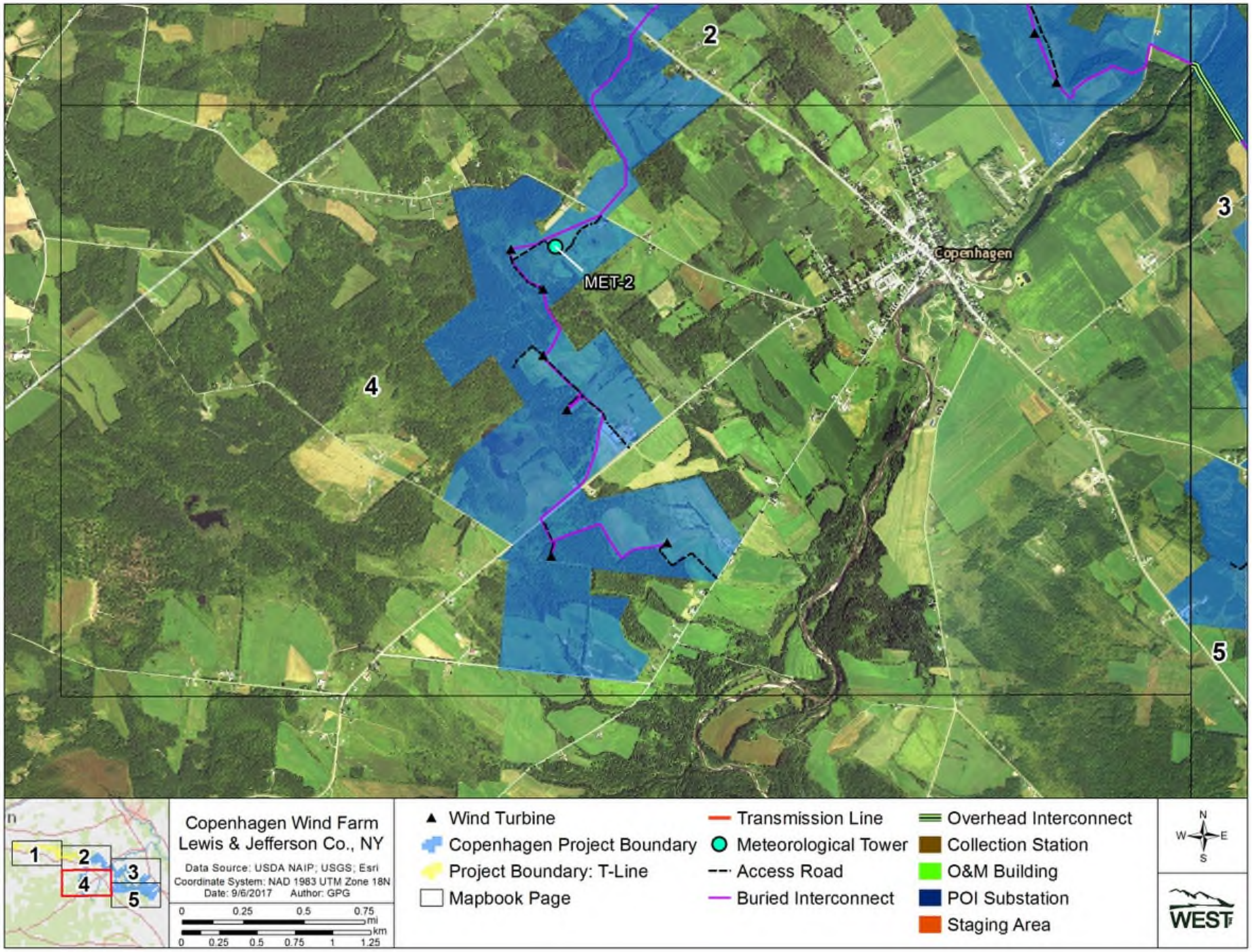

Figure 3.1e Detailed Permit Area of the Copenhagen Wind Farm Habitat Conservation Plan.

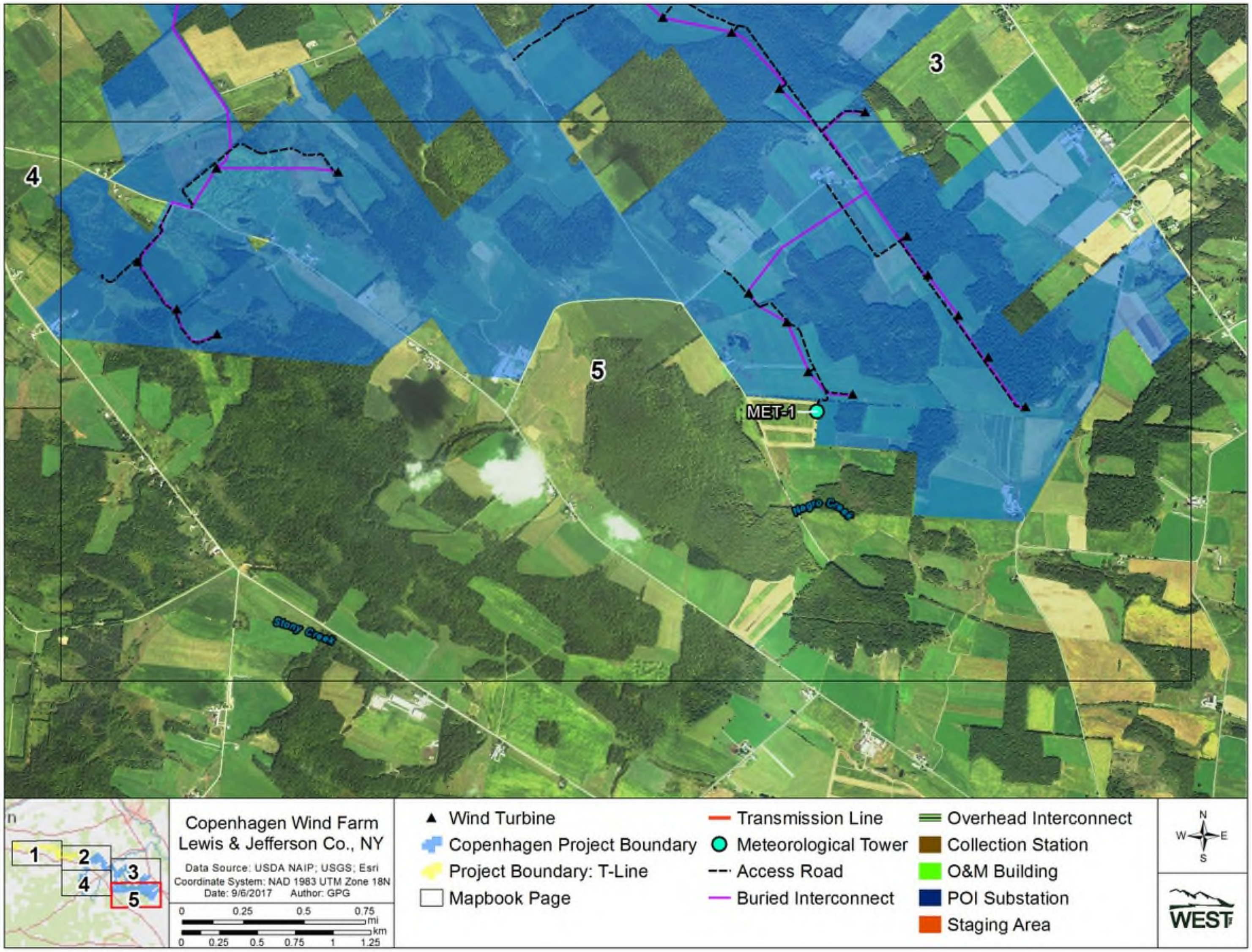

Figure 3.1f Detailed Permit Area of the Copenhagen Wind Farm Habitat Conservation Plan.

Elevations within the Permit Area range from approximately 835 feet (ft; 255 meters [m]) above sea level (ASL) near the end of the transmission line, to approximately 1,500 ft (460 m) ASL in the southwestern corner of the proposed turbine locations. Topography of the turbine locations is generally flat. The Deer River Valley bisects the center of the turbine locations, though most participating parcels are located away from the river valley. Several smaller creeks also occur within the Permit Area, including Stony Creek in the eastern part of the turbine locations, Sabbins Creek along the center of the transmission line, and Boynton Creek near the terminus of the transmission line.

Land cover within the Permit Area primarily consists of pasture/hay fields (30.7%) and cultivated crops (23.9%; Table 3.1, Figure 3.2). Deciduous forest composes 20.3% of the Permit Area, woody wetlands compose 10.1%, and other land uses each compose less than 10.0%. Corn (*Zea mays*) is the primary row crop cultivated within the Permit Area; hayfields are typically rotated into and out of row crop production and (less often) pastureland. Forests within the Permit Area generally consist of beech-maple mesic forest communities, with some conifer plantations also present. Shrub/scrub land occurs on the periphery between fallow agricultural fields and forested areas. Most of the wetlands within the Permit Area are associated with the creeks interspersed throughout the area.

Table 3.1 Land cover types within the Copenhagen Wind Farm Habitat Conservation Plan Permit Area.

Landcover Type	Acres	Hectares	Percent of Permit Area
Pasture/Hay	2,808	1,136	30.7
Cultivated Crops	2,189	886	23.9
Deciduous Forest	1,854	750	20.3
Woody Wetlands	926	375	10.1
Shrub/Scrub	625	253	6.8
Grassland	336	136	3.7
Evergreen Forest	160	65	1.7
Developed, Open Space	96	39	1.1
Emergent Herbaceous Wetlands	93	38	1.0
Open Water	23	9	0.3
Developed, Low Intensity	15	6	0.2
Mixed Forest	14	6	0.2
Developed, Medium Intensity	2	1	<0.1
Developed, High Intensity	2	1	<0.1
Total	**9,142**	**3,700**	**100**

Source: National Land Cover Database (NLCD; US Geological Survey [USGS] NLCD 2011, Homer et al. 2015).

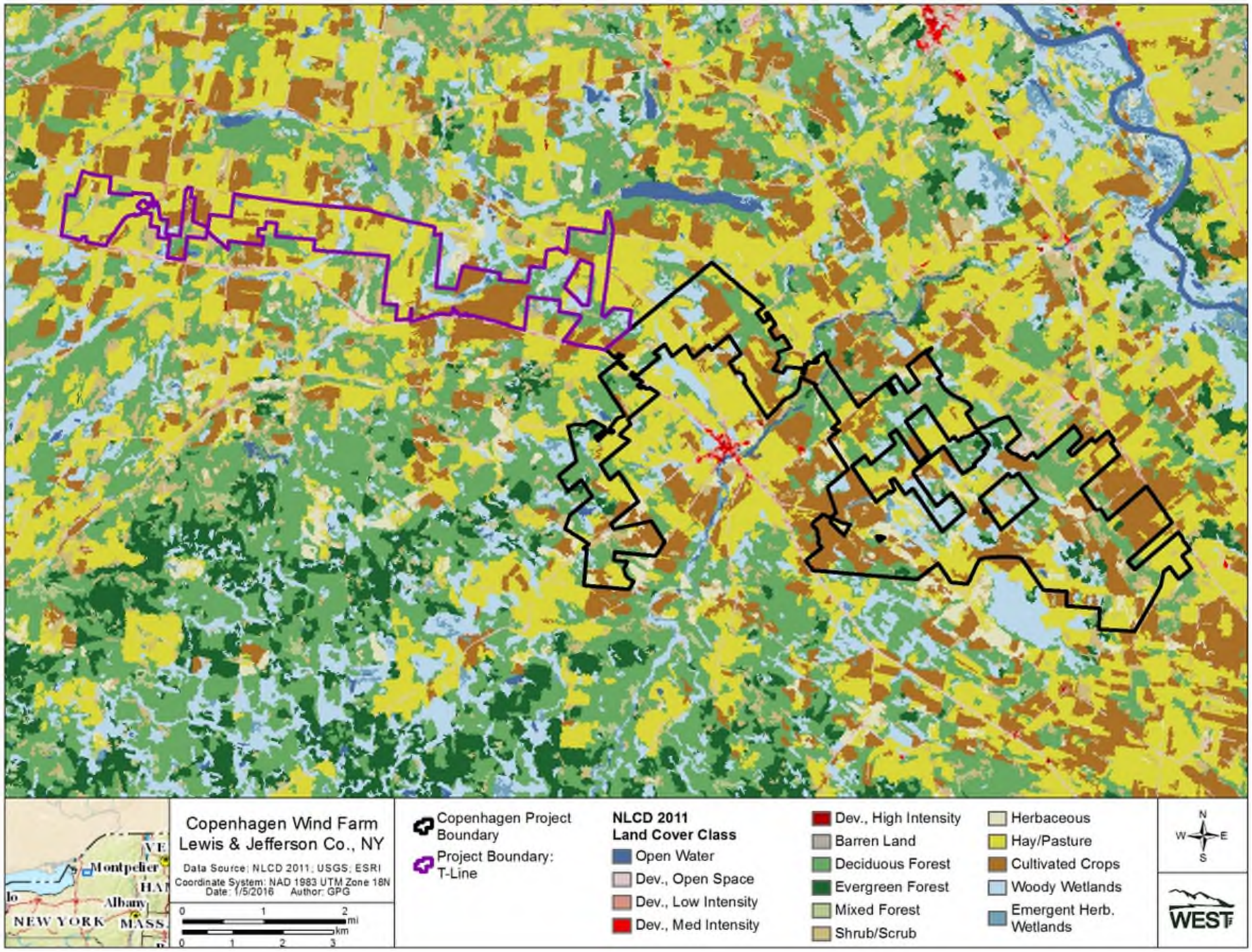

Figure 3.2 Land cover within the Permit Area of the Copenhagen Wind Farm Habitat Conservation Plan.

4 PROPOSED ACTION

4.1 Project Description

The proposed Project is a 79.9-MW facility located on approximately 9,142 acres of private land in Lewis and Jefferson counties, New York. The Project will consist of 40 wind turbines. The Project will also include two permanent met towers, a system of gravel access roads, buried 34.5-kV electrical collector lines, an O&M building, and a collection and transforming station. Construction of a new, overhead, 8-mile (13-km) 115-kV transmission line and POI facility is proposed to connect the Project to the existing National Grid Black River – Lighthouse Hill 115-kV transmission line in the Town of Rutland. The transmission line will be designed according to the Avian Power Line Interaction Committee (APLIC) recommendations for avoiding avian collisions and electrocutions (APLIC 2006, 2012). Project construction is planned to occur in a single phase, with ground breaking scheduled for September 5, 2017 and an anticipated commercial operation date of October or November, 2018. All tree clearing for the wind farm was conducted during the 2016 winter season and the tree clearing for the transmission line will be completed during the 2017 winter season.

4.1.1 Wind Turbines

The wind turbines for this Project are Vestas model 110-2.0. This wind turbine was selected because it is a state-of-the-art on-shore wind turbine, and because its performance and efficiency are suited to the wind resource/wind conditions on-site. The rated cut-in speed of the Vestas 110-2.0 is 3.0 m per second[1] (m/s; 9.8 ft per second [ft/s]) for any turbine model selected.

Each wind turbine consists of three major components: the tower, the nacelle, and the rotor. The height of the tower, or "hub height" (height from the base of the tower to the center of the rotor hub on top of tower) will be approximately 312 ft (95 m). The nacelle sits atop the tower, and the rotor hub is mounted on a drive shaft that is connected to the gearbox and generator contained within the nacelle. The rotor diameter for the Vestas 110-2.0 is approximately 361 ft (110 m), and the total turbine height (i.e., height at the highest blade tip position) will be approximately 492 ft (150 m). Descriptions of each of the turbine components are provided below.

Tower: The tubular towers used for the Project are tubular steel structures manufactured in four sections, each of which are trucked separately to the site and bolted together using internal flanges. The towers have a base diameter of approximately 15.0 ft (4.6 m) and a top diameter of approximately 12.5 ft (3.8 m). Each tower will have an access door,

[1] Although most units are given in imperial measurements in this document because they are more familiar to the intended reviewers and practitioners of this HCP, wind speeds are given in the metric measurement of m/s because it is much more widely recognized than ft/s.

internal lighting, and an internal ladder or personnel lift to access the nacelle. The towers will be painted light gray to make the structure less visually obtrusive.

Nacelle: The main mechanical components of the wind turbine are housed in the nacelle. These components include the drive train, gearbox, and generator. The nacelle is housed by a steel reinforced fiberglass shell that protects internal machinery from the environment and dampens noise emissions. The housing is designed to allow for adequate ventilation to cool internal machinery, and is approximately 29 ft (nine m) long, 12 ft (four m) tall, and 12 ft wide. The nacelle is externally equipped with an anemometer and a wind vane that measure wind speed and direction (this information is used by the turbine controller to turn the machine on and off, and to yaw it into correct position). Attached to the top of some of the nacelles will be a single, medium intensity aviation warning light, per specifications of the Federal Aviation Administration (FAA). These will be synchronized flashing red lights (L-864 or similar) and operated only at night (see FAA 2007). The nacelle is mounted on a sliding ring that allows it to rotate or "yaw" into the wind to maximize energy capture.

Rotor: A rotor assembly is mounted on the drive shaft, and is operated upwind of the tower. Each rotor consists of three fiberglass composite blades approximately 180 ft (55 m) long for the Vestas 110-2.0, for a total rotor diameter of 361 ft (110 m). The rotor attaches to the drive shaft at the front of the nacelle. Electric servo motors within the rotor hub vary the pitch of each blade according to wind conditions, which enable the turbine to operate efficiently at varying wind speeds. The wind turbines begin generating energy at wind speeds as low as 9.8 ft/s and automatically shut down, and yaw out of the wind, at wind speeds above 66 ft/s (20 m/s). The rotor speed range for the Vestas 110-2.0 is 8.1 to 15.0 revolutions per minute (rpm).

4.1.2 Electrical System

The proposed Project is anticipated to have an electrical system that consists of the following parts: 1) a system of buried 34.5-kV shielded and insulated cables that will collect power from each wind turbine (electrical collection lines), 2) a collection substation to step up the power from 34.5 kV to 115 kV, 3) an overhead 115-kV electrical line, and 4) a POI substation located adjacent to an existing 115-kV transmission line and substation. Each of these components is described below:

Electrical Collection System: A transformer located near the base of the tower, or the interior of the nacelle, will raise the voltage of electricity produced by the turbine generator from typically 690 volts up to the 34.5-kV voltage level of the collection system. From the transformer, three power cables will collect the electricity produced by wind turbine generators to be connected through underground circuits, along with the fiber optic communication cables. The electrical collection system will total approximately 24 miles (39 km) in length and will typically be installed adjacent to Project access roads (Figure 3.1b-f). Although underground cabling is the preferred option for the electrical collector system, steep slopes associated with crossings of Stony Creek between Turbine 51 and

Turbine 52 (south of Halifax Road) and Deer River will necessitate short spans of overhead cables. These short sections of overhead line will eliminate the impacts to ecologically sensitive resources (Stony Creek and Deer River) and address on-site constructability constraints. The spans will also greatly reduce the amount of forest clearing, erosion and sedimentation, and wetland impacts that would otherwise occur if overhead spans were not utilized.

Collection Substation: This is the terminus of the 34.5-kV collection system, which will likely consist of three to four incoming circuits, and will be located at the beginning of the 115-kV line. The proposed collection substation will be located in an agricultural field on the north side of Route 12 in the Town of Denmark. The collection substation transformer will increase the voltage of the buried collection system from 34.5 kV to 115 kV. The collection substation will include 34.5- and 115-kV busses, a transformer, circuit breakers, towers, a control building, and related structures, and will be enclosed by chain link fencing. The collection substation will occupy approximately 1.5 acres (0.6 ha), and has been selected based on being located away from existing residences and such that it will be well screened from adjacent public roads (Figure 3.1c). The soil conditions at the proposed location are assumed to be consistent with those occurring generally across the Project and hence CWF has not yet undertaken detailed geotechnical investigations to determine the extent of work required to achieve adequate grounding protection. Prior to construction, CWF will investigate the soil properties of the specific location and develop a suitable grounding plan for the substation.

4.1.3 Access Roads

The total length of access road required to service all proposed wind turbine locations, permanent met towers, and substations is approximately 13.5 miles (21.7 km), some of which will be upgrades to existing farm lanes/logging roads. Based on site-specific investigations and layout development, access roads to turbines 8-12, 33-34, 37-38, 53-54, and 55 use existing farm lanes/roads. These roads account for approximately 4.0 miles (6.4 km) of the 13.5 miles of total proposed access roads. The proposed location of Project access roads is shown in Figure 3.1b-f. Temporary access roads will be gravel surfaced and typically are 40 ft (12 m) wide to accommodate construction vehicles, component delivery, and crane travel (though crane travel will not be necessary on all Project access roads). The surface of all access roads constructed through agricultural fields shall be level with the adjacent field surface. Following construction, roads will be reclaimed and narrowed for use as permanent access roads. The permanent roads will be gravel-surfaced and typically are 16 ft (five m) in width. Graveled areas wider than 16 ft will be reclaimed: soil will be decompacted, stockpiled topsoil will be spread, and a suitable[2] seed mix will be applied. The stormwater best management practices, developed as part of the State Pollutant Discharge Elimination System/Stormwater Pollution Prevention Plan application to the COE, will be adjusted as needed to work with the new contours of the access

[2] Acceptable to the landowner and not considered invasive or problematic by the NYSDEC or New York State Department of Agriculture & Markets.

roads. Reclaimed areas will be inspected by the New York State Department of Agriculture and Markets to ensure that restoration efforts are successful, as determined by the agency and NYSDEC.

4.1.4 Meteorological Towers

Two permanent 328-ft (100-m) tall met towers will be installed to collect wind data and support performance testing of the Project. The towers will be galvanized tubular steel structure, and will be equipped with wind velocity and directional measuring instruments at three different elevations and temperature and humidity monitors near ground level. The met towers are located in upland areas (assumed agricultural land) in the Town of Denmark (the generation portion of the Plan Area) on leased private land (Figure 3.f). No tree removal is anticipated for construction of the met towers.

4.1.5 Staging Area

Construction of the Project will require the development of a temporary construction staging area, which will accommodate construction trailers, storage containers, large Project components, and parking for construction workers. The staging area is anticipated to be up to eight acres (three ha) in size and will be located on participating land immediately adjacent to the proposed O&M facility, south of the intersection of Route 12 and Number Three Road in the Town of Denmark (Figure 3.1d). The staging area is a temporary feature associated with construction of the Project and no additional permanent fencing or permanent lighting of the staging area is proposed. The staging area will be prepared by stripping and stockpiling the topsoil. The area will then be graded as necessary and a layer of geogrid material will be laid down. Crushed stone will be layered on top of the geogrid and temporary fencing and utility connections will be installed.

4.1.6 Operations and Maintenance Facility

An O&M facility and associated storage yard will be constructed initially to house a temporary construction site office, parking, operations personnel, equipment, and materials and provide staff parking. The permanent O&M staff offices will be located in the permanent O&M building, which will be an approximately 7,000-square ft (ft^2; 650-m^2) single-story structure. The Project will require full time (during normal working hours) technical and administrative staff to maintain and operate the facility. The primary workers will be up to six technicians (i.e., technicians who carry out maintenance on the turbines), along with a site supervisor and administrator. Staff will be on duty during normal business hours (eight hours a day, five days per week) with weekend shifts and extended hours as required. The O&M facility will also be used to store equipment as necessary, and is anticipated to be up to 3.5 acres (1.4 ha) in size and located adjacent to the staging area, as previously described. Approximately 2.5 acres (1.0 ha) are expected to be permanently impacted by the O&M facility. CWF anticipates construction of the O&M building will not require special or uncommon activities utilized in the construction of similarly sized agricultural buildings.

4.1.7 Facility Life Span

The Project's life span (i.e., the operational life of the turbines) is expected to be approximately 25 years.

4.2 Project Activities

4.2.1 Introduction

According to the *Habitat Conservation Planning and Incidental Take Permit Processing Handbook* (HCP Handbook; USFWS and National Marine Fisheries Service [NMFS] 2016), covered activities are "activities that a permittee will conduct for which take is authorized in an ESA Section 10 permit." To be eligible for incidental take authorization, covered activities must be "(1) otherwise lawful, (2) non-Federal, and (3) under direct control of the permittee." The HCP Handbook explains that "in addition to having legal authority to carry out the proposed project, the applicant must also have direct control over any other parties who will implement any portion of the proposed activity and the HCP (see 50 CFR 13.25, 50 CFR 222.305(b)).

As discussed below, CWF has determined that operation of the 40 turbines over the 25-year life of the Project is the only Project-related activity likely to result in incidental take of the Covered Species. CWF proposes a number of conservation measures to minimize potential take and mitigate the impact of the take that may occur as a result of Project operations; these measures are presented in Chapter 6 *Conservation Program*.

Construction, maintenance, and decommissioning of the Project are not expected to result in take of the Covered Species due to the implementation of avoidance measures during these processes. Additionally, no incidental take of the Covered Species is anticipated to occur as a result of the proposed mitigation project. At the identified winter habitat mitigation site, the gate to prevent human disturbance will be installed when bats of the Covered Species are not present. The mitigation project will use a gate with a bat-friendly design to ensure the gating does not hinder bat ingress and egress.

The following sections provide a summary of the: 1) activities with no anticipated take of the Covered Species (construction, maintenance, and decommissioning activities) and CWF's proposed avoidance measures for these activities; 2) a description of the proposed covered activities that have the potential for take of the Covered Species. Detailed impact analyses for the covered activities are presented in Chapter 5 *Analysis of the Impacts Which Will Likely Result from the Taking*.

4.2.2 Activities with No Anticipated Incidental Take of Covered Species

4.2.2.1 Construction

Project construction is anticipated to occur in a single phase. Pending the receipt of all required permits, construction is currently scheduled to start in the spring of 2017 and be completed by November of that year. All tree clearing will be conducted during the winter season prior to the start of construction in the spring. Construction activities are anticipated to employ approximately 125 workers and proceed in the following general order: a) civil engineering work (e.g., site establishment, public road improvements, access roads construction, turbine foundation construction); b) electrical engineering work (e.g., installation of buried collector and overhead interconnect and construction of the interconnection facility); c) wind turbine installation; d) Project testing and commissioning; and e) restoration. Project construction will be performed in several stages and will include the following main elements and activities:

- Pre-construction activities:
  - geotechnical sampling,
  - surveys, and
  - site preparation for construction and
  - erosion and sedimentation control measures.
- Vegetation removal;
- Grading of the staging/field construction office area and substation areas;
- Public road improvements or upgrades;
- Construction of access roads, crane pads, and turn-around areas;
- Construction of turbine tower foundations;
- Installation of the electrical collection system;
- Construction and installation of the substation;
- Construction of the transmission line and POI station;
- Assembly and erection of the wind turbines, and
- Plant commissioning and energization.

Migrating Indiana bats may occur within the Permit Area during the fall migration season while construction is underway; male Indiana bats may also occasionally occur within the Permit Area in the spring and/or summer seasons during construction (see Section 5.1.1.5). Northern long-eared bats may migrate through the Permit Area during the spring and/or fall migration seasons while construction is underway; northern long-eared bats may also occur within the Permit Area in the summer during construction (see Section 5.1.2.5). However, activities for construction of the turbines, transmission line, and other facilities are not expected to lead to impacts that rise to the level of take because during all seasons they would be conducted primarily during daylight hours when the Covered Species are not active. The USFWS *Northern Long-Eared Bat Interim Conference and Planning Guidance* (USFWS Interim Guidance; USFWS 2014) recommends that project developers avoid conducting construction activities after sunset in known or suitable summer habitat for northern long-eared bats to avoid harassment of foraging individuals. Additionally, the USFWS Interim Guidance recommends set-backs from hibernacula and seasonal restrictions only for activities that will produce noise above 75 decibels for more than 24 hours. Construction activities are not expected to disturb northern long-eared bats roosting during the daytime because activities will occur only in previously cleared areas, away from the three sites where northern long-eared bats were captured during pre-construction surveys. The nearest turbines to a capture site are approximately 0.5 mile (0.8 km) away and are separated from the capture site by a public road that already introduces traffic noise to the area. The transmission line construction will occur several hundred yards from the forested area in which a northern long-eared bat was captured, and construction will move steadily along the line, with a limited amount of activity in any one area. The last capture site is located more than 1.5 miles (2.4 km) from the western end of the transmission line.

The USFWS *Indiana Bat Section 7 and Section 10 Guidance for Wind Energy Projects* (USFWS Indiana Bat Wind Guidance; USFWS 2011d) does not make recommendations for minimizing or avoiding disturbance of Indiana bats from construction activities; however, it is reasonable to assume that minimizing nighttime Project construction would also be protective of Indiana bats based on the similarities of the Covered Species (USFWS 2014) and the expected infrequency of Indiana bat occurrence within the Permit Area (Section 5.1.1.5). Daytime construction activities are not expected to affect Indiana bats because the species was not detected during the pre-construction surveys and it is not expected to roost within the Permit Area.

Tree removal necessary for Project construction is unlikely to result in take of the Covered Species because: 1) tree removal will be minimized through Project siting and design, and 2) tree removal will be conducted while bats are hibernating. Several turbine locations were eliminated from forested areas as a result of Project evaluation to minimize the temporary and permanent impacts to forested habitat. The remaining turbines have been sited out of forested areas as much as practicable to minimize turbulence that might otherwise increase maintenance costs. Nine Project turbines are within forested habitat but are generally located adjacent to the edges of agricultural fields to reduce forest fragmentation. Five of the nine turbines are within 100 ft (30 m) of the forest edge, while the remaining four turbines are located 263 ft (80 m), 313 ft (95 m), 423 ft (129 m), and 585 ft (178 m) from the forest edge.

CWF worked with Project landowners to optimize the placement of all other improvements so as to minimize the loss of open agricultural land as well as valuable timber/forest land. This optimization effort included using the routing of existing logging roads and farm lanes for turbine access whenever possible. Approximately four miles (six km) of the 12.6 miles (20.3 km) of total proposed access roads use existing farm lanes/roads to minimize surface disturbance and tree clearing. CWF estimates that 107.8 acres (43.6 ha) of forest will be impacted by Project construction. Of this area, 7.3 acres (2.9 ha) will be occupied by Project facilities, 67.4 acres (27.3 ha) will be maintained as successional shrubland communities or fallow fields for the life of the Project, and 33.1 acres (13.4 ha) will be allowed to regenerate naturally once construction is completed. Northern long-eared bats were captured during summer mist-netting surveys at three locations within the Permit Area (see Section 5.1.1.5). The nearest tree clearing to these three capture locations will occur for construction of the transmission line and substation and will be approximately 3,713 ft (1,132 m), 6,409 ft (1,953 m), and 12,772 ft (3,893 m) from each of the three capture locations (see Section 5.1.1.5).

Clearing and tree removal for Project construction will be conducted during the late fall and winter months (October 1 – March 31) to avoid killing/injuring of the Covered Species. This measure is pursuant to the terms of the TAL issued to CWF by the USFWS on October 26, 2015. Clearing and tree removal is not expected to adversely affect Indiana bats or their habitat because the elevation of most of the Permit Area is too high to support Indiana bat maternity colonies (Section 5.1.1.2) and Indiana bats were not detected during the pre-construction surveys (Section 5.1.1.5). Clearing and tree removal, even conducted during the winter months, could indirectly affect summer maternity habitat (i.e., roost trees) for northern long-eared bats. However, all tree clearing will be approximately 3,713 ft or farther from the summer capture locations for northern long-eared bats within the Permit Area and thus will not affect known maternity habitat locations. In addition, any potential impacts are unlikely to result in reproductive consequences for the local population of northern long-eared bats due to the availability of alternative maternity colony habitat in the Permit Area and vicinity. As described in the USFWS Indiana Bat Wind Guidance, loss of a primary roost tree is a natural phenomenon that all colonial tree-roosting bats (such as northern long-eared bats) are well-adapted to address, mostly by having alternates available. Additionally, the loss of foraging areas as a result of tree clearing is not expected to displace northern long-eared bats because plenty of foraging habitat will remain intact in the Permit Area and vicinity and foraging habitat does not appear to be a limiting factor for the species (USFWS 2014).

Cutting and removal of occupied roost trees during the bat active period (April 1 – September 30) can result in death or injury of bats. Therefore, clearing will primarily be limited to the non-active bat season (October 1 – March 31). However, there may be instances where tree removal is necessary during the bat active season. If any emergency tree removal[3] is necessary it will be conducted as needed. If removal of high-risk[4] hazard trees is necessary from April 1 – September 30 during Project construction, maintenance, or decommissioning, CWF will notify the USFWS in advance to determine if it is appropriate to have a qualified biologist conduct an emergence survey at the tree(s) requiring removal. If so, and if no bats are observed during the emergence survey, the hazard tree(s) will be promptly removed. This will reduce the risk of removing an undiscovered roost tree. If bats are observed, then CWF will conduct further consultation with the USFWS.

4.2.2.2 Maintenance

Routine and preventative wind turbine maintenance activities will be scheduled at 6-month intervals with specific maintenance tasks scheduled for each interval. Maintenance will consist of removing the turbine from service and having two to three wind technicians climb the tower to spend a full day carrying out maintenance activities. The collector lines and substation will also require periodic preventative maintenance. Routine maintenance will include condition assessment for aboveground infrastructure and protective relay maintenance of the substation. Finally, vegetation control will be required around the transmission line to prevent any damage

[3] Emergency tree removal would be for trees that pose an imminent risk to human life or property damage.

[4] Trees that are likely to require removal prior to the next late fall/winter season would be considered high-risk.

to the line and ensure safe operation. Vegetation control will primarily entail mowing, limb trimming, and selective removal of dead trees that present a hazard of falling on the line. The use of herbicides is not anticipated, but if necessary, herbicides will be applied in a manner consistent with best utility practice. If herbicide use does occur, it is not likely to cause take because application of the herbicides would be limited and focused in areas around Project facilities. Herbicides would be deployed on the ground specifically for weed control on and near roads, turbines, and other Project facilities. No aerial spraying would occur and herbicides would not be applied to trees or vegetation other than weeds.

Unscheduled maintenance may be required at times, most often for small components such as switches, fans, or sensors. Typically, such repairs will take the turbine out of service for a short period of time until the component is replaced. These repairs can usually be carried out by a single technician visiting the turbine for several hours.

Events involving the replacement of a major component such as a gearbox or rotor are not typical. If they do occur, the use of large equipment, sometimes as large as that used to install the turbines, may be required. Typically only a small percentage of turbines need to be accessed with large equipment during their operating life.

General maintenance activities for the facility are not expected to lead to impacts that would rise to the level of take because maintenance activities involve periodic activities conducted during daylight hours and are typically conducted inside turbines or other structures. As described for Project construction above, the USFWS Interim Guidance for northern long-eared bats recommends avoiding nighttime construction activities to avoid harassment of foraging individuals, and this measure is also expected to be protective of Indiana bats.

Cutting and removal of occupied roost trees during the bat active period (April 1 – September 30) can result in death or injury of bats. Therefore, clearing will primarily be limited to the non-active bat season (October 1 – March 31). However, there may be instances where tree removal is necessary during the bat active season. If any emergency tree removal[5] is necessary it will be conducted as needed. If removal of high-risk[6] hazard trees is necessary from April 1 – September 30 during Project construction, maintenance, or decommissioning, CWF will contact the USFWS in advance for their determination if it is appropriate to have a qualified biologist conduct an emergence survey at the tree(s) requiring removal. If so, and if no bats are observed during the emergence survey, the high-risk hazard tree(s) will be promptly removed. This will reduce the risk of removing an undiscovered roost tree. If bats are observed, then CWF will conduct further consultation with the USFWS.

[5] Emergency tree removal would be for trees that pose an imminent risk to human life or property damage.

[6] Trees that are likely to require removal prior to the next late fall/winter season would be considered high-risk.

4.2.2.3 Decommissioning

CWF has proposed a general decommissioning plan in Section 2.8 of the Project's DEIS produced in accordance with the New York SEQRA. The proposal calls for CWF to set aside funds or a surety instrument prior to the commencement of construction to guarantee the decommissioning of Project components. The Decommissioning Plan shall include:

- Provision describing the triggering events for decommissioning of wind power facilities.
- Provisions for the removal of all above-ground structures and debris, but not the removal of anything below a 36-inch (91-cm) depth (e.g., tower foundations, buildings).
- Provisions for the removal of all below-ground structures to 48 inches (122 cm) in active agricultural land.
- Provisions for the restoration of the soil and vegetation.
- A timetable approved by the Town of Denmark for site restoration.
- An estimate of decommissioning costs certified by an independent Professional Engineer, to be repeated at reasonable intervals during the operational life of the Project.
- Form of Financial Security, secured by CWF, naming the Town of Denmark as the beneficiary in the event of a default by the Project Sponsor to comply with the terms of the Decommissioning Plan, for the purpose of adequately performing decommissioning, in an amount equal to the Professional Engineer's certified estimate of decommissioning cost, less the expected salvage cost of the Project components.
- Identification of procedures for the Town of Denmark to access Financial Security at reasonable intervals throughout the operational life of the Project.

Activities for removal of the turbines and other facilities during decommissioning are not expected to lead to impacts that rise to the level of take because they would be conducted during daylight hours and will not involve Covered Species habitat disturbance or removal, aside from the possibility of hazard tree removal described below. As described for Project construction above, USFWS Interim Guidance for northern long-eared bats recommends avoiding nighttime construction activities to avoid harassment of foraging individuals, and this measure is also expected to be protective of Indiana bats.

During decommissioning of the Project, occasional hazard tree removal or tree cutting may be conducted for safety reasons. Cutting and removal of occupied roost trees during the bat active period (April 1 – September 30) can result in death or injury of bats. Therefore, clearing will primarily be limited to the non-active bat season (October 1 – March 31). However, there may be instances where tree removal is necessary during the bat active season. If any emergency tree removal[7] is necessary it will be conducted as needed. If removal of high-risk[8] hazard trees is necessary from April 1 – September 30 during Project construction, maintenance, or decommissioning, CWF will notify the USFWS in advance to determine if it is appropriate to have a qualified biologist conduct an emergence survey at the tree(s) requiring removal. If so, and if no bats are observed during the emergence survey, the high-risk hazard tree(s) will be promptly removed. This will reduce the risk of removing an undiscovered roost tree. If bats are observed, then CWF will conduct further consultation with the USFWS.

4.2.2.4 Mitigation Activities

Implementation of the HCP will include measures to mitigate the impacts of the take. These measures are described in detail in Chapter 6 (*Conservation Program*). The mitigation measures as designed are intended to provide conservation benefits to the Covered Species and are unlikely to lead to any take. The design of the cave gate at the identified winter habitat mitigation site (see Section 6.4) has been developed in coordination with the USFWS and NYSDEC to minimize the potential for negative incidental impacts to the Covered Species. The gate will be installed when bats of the Covered Species are not present. Therefore, implementation of mitigation activities associated with this HCP is not expected to result in take of the Covered Species.

4.2.3 Proposed Covered Activities

4.2.3.1 Operation

The physical operation of the turbines (spinning rotors) may result in mortality (due to collision or barotrauma) of the Covered Species. Turbines are anticipated to operate for some portion of time every day during the windier months (October – April), when bats are generally inactive, and more intermittently during the summer. The wind turbines will be operating when the wind speed is within the operating range (the operating wind speed range for the Vestas 110-2.0 turbine is three m/s [nine ft/second; ft/s] – 20 m/s [66 ft/s]) and there are no component malfunctions or New York Independent System electricity market grid constraints, except under conditions requiring operational adjustments to minimize impacts to the Covered Species (see Section 6.3.3). Each turbine has a comprehensive control system that monitors the subsystems within the turbine and the local wind and temperature conditions to determine whether the conditions are suitable for operation. If an event considered to be outside the normal operating range of the turbine occurs (such as low hydraulic pressures, unusual vibrations, or high generator temperatures), the wind turbine will immediately and automatically shut down and report the condition to the operations center. A communication line connects each turbine to the operations center, which closely monitors and, as required, controls the operation of each turbine. The wind turbine system will be integrated with the electric interconnection supervisory control and data acquisition (SCADA) to ensure that the Project's critical controls, alarms, and

7 Emergency tree removal would be for trees that pose an imminent risk to human life or property damage.

8 Trees that are likely to require removal prior to the next late fall/winter season would be considered high-risk.

functions are properly coordinated for safe, secure and reliable operation. See Section 6.3.3 for detailed descriptions of minimization measures associated with turbine operation.

4.3 Requested Permit Duration

The proposed term of the ITP is 25 years, which allows for a 25-year minimum operational life of the turbines. Prior to expiration of the ITP term, CWF will determine whether to decommission or continue operating the Project. At that time, CWF will evaluate, in consultation with the USFWS, the need to apply for a permit extension or renewal to continue operating the Project.

5 ANALYSIS OF THE IMPACTS WHICH WILL LIKELY RESULT FROM THE TAKING

5.1 Covered Species

As stated in Section 1.1, CWF is applying for an ITP for the Indiana bat and the northern long-eared bat for the covered activities. The Indiana bat is currently listed as endangered under the ESA (USFWS 1967, 2016), and the northern long-eared bat is listed as threatened with a final 4(d) rule under the ESA (USFWS 2013d; 80 FR 17974, 81 FR 1900). The northern long-eared bat is included in this HCP as a Covered Species so that the species is fully addressed commensurate with the other Covered Species, providing take authorization under the ITP that will apply should the 4(d) rule be reversed or modified or the species be up-listed to endangered status within the term of the ITP. The ranges of both species overlap with the Permit Area and CWF has determined that these species may be impacted by the Project. Therefore, for purposes of this HCP, these two species are referred to as "Covered Species." No other listed species are known to occur in the Permit Area.

5.1.1 Indiana Bat

The Indiana bat is a small (seven – 10 gram [g; 0.2 – 0.4 ounce]), insectivorous bat in the genus *Myotis* that was not described as a separate species until 1928 (Miller and Allen 1928). Indiana bats resemble the little brown bat and the northern long-eared bat, but can be distinguished from the northern long-eared bat by having ears that do not extend more than 0.1 inch (three millimeters) beyond the nose, and lack a long and pointed tragus (Barbour and Davis 1969). Indiana bats are distinguished from the little brown bat (*Myotis lucifugus*) by having slightly smaller feet, short, inconspicuous toe hairs, a keeled calcar, more uniformly colored fur, and a pinkish colored nose (Whitaker and Hamilton 1998). The Indiana bat was included on the list of endangered species in 1967 prior to the enactment of the ESA (USFWS 1967). The *Indiana Bat (Myotis sodalis) Draft Recovery Plan* (2007 Recovery Plan) lists destruction/degradation of hibernation habitat; loss/degradation of summer habitat, migration habitat, and swarming habitat; disturbance of hibernating bats; disturbance of summering bats; disease and parasites; and natural and anthropogenic factors as threats to the species (USFWS 2007). More recently, Indiana bat populations in the northeastern and eastern US, including West Virginia, have experienced dramatic declines as a result of a transmissible fungus (*Pseudogymnoascus destructans* [*Pd*]; Blehert et al. 2009, 2011; Minnis and Lindner 2013), the outward manifestation of which in hibernating bats led to its common name: white-nose syndrome (WNS). Since the winter of 2007-2008, millions of bats in the US and Canada have died from WNS, which has become the single greatest threat to range-wide Indiana bat survival and recovery (more information on WNS is provided in Section 5.1.1.5).

5.1.1.1 Life History and Characteristics

Indiana bats exhibit life history traits similar to other temperate vespertilionid bats (Barclay and Harder 2005). Similar to most temperate *Myotis* species, female Indiana bats give birth to one offspring per year (Humphrey et al. 1977, Kurta and Rice 2002). Mating occurs in the vicinity of the hibernacula in late summer and early fall and fertilization is delayed until the spring (Guthrie 1933). Timings of parturition and lactation are likely dependent in part on latitude and weather conditions. For example, in Iowa, female bats arrive at maternity roosts at the end of April and parturition is completed by mid-July (Clark et al. 1987); in Michigan, young are born in late June or early July (Kurta and Rice 2002); and in southern Indiana, pregnant females are known from May 28 through June 30, while lactation has been recorded from June 10 to July 29 (Whitaker and Brack 2002).

It is likely that once the young are born, females leave their pups in the diurnal roost while they forage, returning during the night periodically to feed them (Barclay and Kurta 2007). Young bats are volant within three to five weeks of birth, at which time the maternity colony begins to disperse and use of primary maternity roosts diminishes. Indiana bat maternity colonies will use several roosts, known as alternate roosts. In Missouri, each maternal colony used between 10 and 20 separate roost trees during the period of tracking (Miller et al. 2002). In Kentucky, Gumbert et al. (2002) recorded 463 roost switches over 921 radio-tracking days of tagged Indiana bats, an average of one switch every 2.21 days. There are a number of suggested reasons for roost switching, including thermoregulation, predator avoidance, and reduced suitability of roost trees. Roost trees are an ephemeral resource and can become unusable if they are toppled by wind, lose large pieces of bark, or are otherwise destroyed (Kurta et al. 2002, Barclay and Kurta 2007).

Females and juveniles remain in the colony area until they migrate to hibernacula. Indiana bats return to the vicinity of the hibernaculum in late summer and early fall, where they exhibit a behavior known as swarming. This involves large numbers of bats flying in and out of the cave entrances from dusk to dawn, though relatively few of the bats roost in the cave during the day (Cope and Humphrey 1977). The fall swarm is a critical period in the Indiana bats' annual life cycle when they must build up their fat reserves to sustain them through the winter (Cope and Humphrey 1977). Therefore, forests around caves provide important habitat for swarming bats.

The 2007 Recovery Plan states that during the swarming period most Indiana bats roost within approximately 2.4 km (1.5 miles) of the cave (USFWS 2007). The USFWS provided guidance in 2011 (USFWS 2011d) suggesting that areas within 10 miles (16 km) of Priority 3 (P3; 50-999 Indiana bats) and Priority 4 (P4; one to 49 Indiana bats) hibernacula should be considered potentially occupied by swarming Indiana bats, whereas areas within 20 miles (32 km) of Priority 1 (P1; 10,000 or more Indiana bats) and Priority 2 (P2; 1,000-9,999 Indiana bats) hibernacula should be considered potentially occupied. The density of bats is believed to increase in areas closest to the cave, also known as a "funnel effect." The funnel effect is thought to be most pronounced for hibernacula with relatively large populations of wintering bats, due to increased competition for resources around the cave (USFWS 2011d). Mating occurs during the swarming period. While females enter the hibernaculum soon after arrival at the site, males remain active for a longer period and may also travel between hibernacula, which may increase mating opportunities (USFWS 2007).

Spring emergence from the hibernacula generally occurs from mid-April to the end of May and varies across the range, depending on latitude and weather conditions. Females typically emerge before males, traveling sometimes hundreds of miles to their summer habitat (Winhold and Kurta 2006).

5.1.1.2 Habitat Requirements

Indiana bats have two distinct habitat requirements: 1) a stable environment in which to hibernate during the winter, and 2) woodland habitat for maternity roosts and foraging in the summer (USFWS 2007). Males and non-reproductive females may use hibernacula or trees for roosting during the summer. Prior to hibernation, both males and females roost in wooded habitat in the vicinity of the hibernacula (USFWS 2007).

Winter Habitat

Indiana bats generally hibernate from October to April, although this may be extended from September to May in northern parts of their range (USFWS 2007). The majority of hibernacula are located in karst areas of the east-central US. Indiana bats are also known to hibernate in other cave-like structures. For example, Indiana bats have been found hibernating in man-made tunnels in Pennsylvania (Sanders and Chenger 2000, Butchkoski and Turner 2008), and, in 1993, an Indiana bat was discovered hibernating in a hydroelectric dam in Manistee County, Michigan, 281 miles (450 km) from the closest recorded hibernaculum for Indiana bats in LaSalle County, Illinois (Kurta and Teramino 1994). In 2005, approximately 30% of the population hibernated in man-made structures (predominantly mines), with the rest using natural caves (USFWS 2007).

Indiana bats typically require low, stable temperatures (37 to 46 degrees [°] Fahrenheit [F; 3 to 8 °Celsius (C)]) for successful hibernation (Brack 2004, Tuttle and Kennedy 2002). Cave configuration determines internal microclimate, with larger, more complex cave systems with multiple entrances more likely to provide suitable habitat for the Indiana bat (Richter et al. 1993, LaVal and LaVal 1980, Tuttle and Stevenson 1978). Most Indiana bats hibernate in caves or mines that tend to have large volumes, large rooms, and extensive vertical relief and passages, often below the lowest entrance. Cave volume and complexity help buffer the cave environment against rapid and extreme shifts in outside temperature, and vertical relief provides a range of temperatures and roost sites (USFWS 2007). Bats are also able to decrease exposure to fluctuating air temperatures by increasing surface contact with the cave or other individuals. As such, Indiana bats tend to hibernate in large, dense clusters, ranging from 300 to 500 bats per ft^2 (3,333 to 5,555 bats per m^2 USFWS 2007, Boyles et al. 2008). It is suggested that in hibernacula with small populations, Indiana bats cluster with other species (such as little brown bats) to gain this thermoregulatory advantage (USFWS 2007).

Spring Emergence and Dispersal

In the spring, female Indiana bats emerge from hibernacula and disperse to their summer habitat where they form maternity colonies (Winhold and Kurta 2006). Radio-telemetry studies and band return data have shown that dispersal or migration distances vary across the species' range. Individuals radio-tracked in the northeastern US appear to travel the shortest distances

(Hicks 2006, USFWS 2007). Recent radio-telemetry studies of 130 spring emerging Indiana bats (primarily females) from six New York hibernacula found that approximately 75% of these bats were later detected and all migrated less than 42 miles (68 km) to their summer habitat (Butchkoski et al. 2008). Migration distances for bats in the Appalachian Mountain region appear to be longer than those in the northeast (maximum distance reported for an adult female to date is 107 miles [173 km; Butchoski and Turner 2008), but not as long as those in the Midwest. Indiana bats in the Midwest appear to migrate the longest distances between hibernacula and their summer habitat. Twelve female Indiana bats from maternity colonies in Michigan migrated an average of 296 miles (477 km) to their hibernacula in Indiana and Kentucky, with a maximum migration of 357 miles (575 km; Winhold and Kurta 2006), which is the maximum migration distance recorded for the species. Gardner and Cook (2002) also reported long-distance migrations for Indiana bats traveling between summer ranges and hibernacula in the Midwest.

Some non-reproductive female and male Indiana bats do not migrate as far as reproductive females, and instead remain in the vicinity of their hibernacula throughout the summer (Gardner and Cook 2002, Whitaker and Brack 2002). Mist-netting studies conducted from 1978 to 2002 in southern Michigan showed that only about 11% of the adults captured were males (Kurta and Rice 2002). However, some males make longer movements away from hibernacula. Males captured in southern Michigan likely migrated over 249 miles (400 km) from hibernacula in southern Indiana and Kentucky, based on several band return records for bats captured in this area (Kurta and Murray 2002).

Little is known about behavior of Indiana bats during migration. Bats may try to minimize the time spent in transit, since migration is energetically expensive and dangerous (Fleming and Eby 2003). This may be especially true for reproductive females during the spring when they are pregnant and energetically constrained from spending the winter in hibernation. It appears that Indiana bat migration from winter to summer habitat is fairly linear and short-term, while in the fall, it is more dispersed and varied. Spring radio-telemetry studies have documented migrating Indiana bats traveling in relatively direct flight patterns towards their summer ranges shortly after they emerge from hibernacula (Butchkoski and Turner 2006, Britzke et al. 2006). Based on a combination of aerial and ground tracking, Indiana bats tracked from a hibernaculum in Pennsylvania flew almost straight lines to their roost trees 83 to 92 miles (135 to 148 km) away in Maryland (Butchkoski and Turner 2005). Similarly, a comparison between the range of initial bearings and the final bearings for 82 reproductive female bats radio-tracked to 65 maternity colonies in New York from 2000 to 2005 showed that bats followed more or less direct routes from the hibernacula to their summer ranges (Hicks et al. 2005). Evidence from radio-tracking studies in New York and Pennsylvania indicate that Indiana bats are capable of migrating at least 30-40 miles (48-64 km) in one night (Sanders et al. 2001, Hicks 2004, Butchkoski and Turner 2006).

There is some evidence that bats in the Appalachian Mountain region and Northeast follow landscape features while migrating. Based on observations of 22 Indiana 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). Several bats tracked during spring migration from the South Penn Tunnel in south-central Pennsylvania appeared to be moving along US Route 220, also known as the Appalachian Throughway, which follows a generally northeast-southwest direction in line with the Appalachian Mountains (J. Chenger, Bat Conservation Management, pers. comm.). Similarly, 12 bats tracked during spring migration in western Virginia generally followed ridges that 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), suggesting that bats used ridgeline corridors as migration flyways (McShea and Lessig 2005).

Summer Habitat

Suitable summer habitat includes roosting, foraging, and commuting areas. Suitable summer roosting habitat is characterized by trees (dead, dying, or alive) or snags with exfoliating or defoliating bark, or containing cracks or crevices that can be used as a roost. Foraging habitat includes forested patches, wooded riparian corridors, and natural vegetation adjacent to these habitats. Commuting habitat includes open corridors in wooded tracts, tree lines, wooded hedgerows, and other pathways that are connected to roosting or foraging areas (USFWS 2007).

In the summer, female Indiana bats predominantly roost under slabs of exfoliating bark, preferring not to use tree cavities, but occasionally using narrow cracks in trees (Kurta 2004). Due to their cryptic nature, the first Indiana bat maternity colony was not discovered until 1971 (Cope et al. 1974, Gardner and Cook 2002). Maternity colonies vary greatly in size in terms of number of individuals and number of roost trees used, with members of the same colony utilizing over 20 trees during one season (Kurta 2004). Roosts are usually located in dead trees, though partly dead or live trees (e.g., if the tree species has naturally peeling bark) may also be used (USFWS 2007). A meta-analysis of 393 roost trees in 11 states found 33 tree species that were used, with ash (*Fraxinus* spp.), elm (*Ulmus* spp.), hickory (*Carya* spp.), maple, poplar (*Populus* spp.), and oak (*Quercus* spp.) accounting for approximately 87% of trees documented (Kurta 2004). Roost trees also vary in size. Typically, roost trees are greater than nine inches (22 cm) diameter-at-breast-height (dbh; Kurta 2004). The mean size roost tree in the aforementioned meta-analysis was 18 ± 1.0 inch dbh, range 11 to 24 inches (45 ± 2.0 cm dbh, range 28 to 62 cm; Kurta 2004 and Britzke et al. 2006). The smallest maternity roost tree recorded was four inches (11 cm) dbh (Britkze 2003). Primary roosts can be much larger. For example, the average of five primary roosts used between 1997 and 2001 during long-term studies of the Indiana bat at the Indianapolis International Airport was 25.9 inches (65.8 cm) dbh (D. Sparks, unpublished data).

Maternity colonies use primary roosts and alternate roosts. Primary roosts were defined by Callahan (1993) in terms of number of bats (i.e., roosts used by more than 30 bats), but may also be defined by the number of bat-days the roosts are used over one maternity season (Kurta et al. 1996, Callahan et al. 1997, USFWS 2007). Primary roosts are used throughout the summer, while alternate roosts are used less frequently and may be important during changing weather conditions (temperature and precipitation), or when the primary roost becomes unusable (Callahan et al. 1997).

An important characteristic for the location of maternity roost sites is a mosaic of woodland and open areas, with the majority of maternity colonies having been found in agricultural areas with fragmented forests (USFWS 2007). Further, absolute height of the roost tree appears to be less important than the height of the tree relative to surrounding trees (Kurta 2004). Primary roosts usually receive direct solar radiation for more than half the day and are almost always located in either open canopy sites or above the canopy of adjacent trees (Kurta et al. 1996, Callahan et al. 1997, Kurta et al. 2002). Primary roosts are usually not located in densely forested areas, but rather occur along forest edges or within gaps in forest stands where they receive greater solar radiation (USFWS 2007), a factor that may be important in reducing thermoregulatory costs for reproductive females and their young (Vonhof and Barclay 1996). Female Indiana bats are able to use torpor to conserve energy during cold temperatures; however, torpor slows gestation (Racey 1973), milk production (Wilde et al. 1999), and juvenile growth, and is costly when the reproductive season is short (Hoying and Kunz 1998, Barclay and Kurta 2007).

The distribution of Indiana bat summer habitat in the east appears to be less extensive than in the Midwest (see range maps in USFWS 2007), which may be due to the geographic distribution of important hibernacula or to differences in climate and elevation that may limit suitable summer colony sites in this location. The summer temperatures of portions of Indiana bat range in the east are slightly cooler than in the core part of the range in Indiana, Kentucky, and Missouri (Brack et. al. 2002, Woodward and Hoffman 1991), and temperatures typically decrease at increasing elevation (conditions may also become wetter), which may influence the energetic feasibility of reproduction in some areas (Brack et.al. 2002). Researchers in Virginia found that there is an 11.5 °F (6.4 °C) decrease in temperature for each increase of 3,300 ft (1,000 m) in elevation (Woodward and Hoffman 1991).

In the northeastern portions of the range, elevation appears to influence likely presence of maternity colonies (Brack et al. 2002). For example, roost trees in the Champlain Valley of Vermont and New York occur at elevations much lower (i.e., 100-490 ft [30-150 m] ASL) than the surrounding mountains, which have maximum elevations of 4,400 ft (1,340 m) and 4,360 ft (1,330 m) ASL (Britzke et al. 2006, Watrous et al. 2006). The Champlain Valley roosts are the farthest north of any known Indiana bat maternity roosts (USFWS 2007) at approximately 44° North (N). The Clayton maternity roost is the farthest north Indiana bat roost known in Jefferson County at 44° 13.32 N. All maternity roosts in New York to date have been located at or below 900 ft (274 m) in elevation. However, Indiana bat maternity colonies are found at higher elevations at lower latitudes. Maternity roosts in West Virginia have been recorded at elevations between 950 ft (290 m) and 3,000 (914 m) ASL (C. Stihler, West Virginia Department of Natural Resources, pers. comm.). The farthest south and highest known elevation for a female roost tree recorded to date was found at 3,800 ft (1,158 m) ASL in the Nantahala National Forest in Tennessee/North Carolina (Britzke et al. 2003). The specific location is not reported, but the latitude near the center of the Nantahala National Forest is 35.2° N. It is worth noting that the females tracked to this Nantahala Forest roost were not located in subsequent years, despite known philopatry to maternity roosts by Indiana bats (USFWS 2007), so the viability of these locations for maternity roosting is debatable. Brack et al. (2002) found it unlikely that Indiana bats reproduce at higher elevations in the three eastern states evaluated in their study (West Virginia, Virginia, and Pennsylvania).

Female Indiana bats exhibit high fidelity to summer roosting areas. Bats from the same maternity colony may use between 10 and 20 trees throughout the summer, but usually only one to three of these are considered primary roosts, where the majority of bats roost for part or all of the summer (Callahan 1993, Callahan et al. 1997). Alternate roost trees are typically used by individuals or small groups for only one day or a few days. Within the summer roosting area, Indiana bats typically switch roosts every two to three days, with the frequency of switching affected by reproductive condition of the female, roost type, weather conditions, and time of the year (Kurta et al. 2002, Kurta 2005).

While the primary and alternate roosts of a maternity colony may change over the years, it is thought that foraging areas and commuting paths are relatively stable (Barclay and Kurta 2007). Members of a maternity colony in Michigan used a wooded fence line as a commuting corridor for nine years (Winhold et al. 2005). In general, the distance from the roost to foraging areas varies from 0.3 to 5.3 miles (0.5 to 8.4 km; USFWS 2007); and this distance may be constrained by the need to return to the roost periodically to nurse once the young are born (Henry et al. 2002). Lactating females have been shown to return to the roost two to four times during a night (Butchkoski and Hassinger 2002, Murray and Kurta 2004). In Pennsylvania, the mean distance from the roost to the nearest edge of an activity center was 1.7 miles (2.7 km) and ranged from 0.8 to 3.3 miles (1.3 to 5.3 km; Butchkoski and Turner 2005). In Indiana, 11 females used foraging areas on average 1.9 miles (3.0 km), range 0.5 to 5.3 miles (0.8 to 8.4 km) from their roosts (Sparks et al. 2005); and, in Michigan, the distance between roosts and foraging areas was 1.5 miles (2.4 km), range 0.3 to 2.6 miles (range 0.5 to 4.2 km; Murray and Kurta 2004).

Although individuals from a maternity colony appear to show fidelity to a general home range within and between years (Sparks et al. 2004), due to the differences in methodology it is difficult to determine a common home range size (Lacki et al. 2007). In Indiana, mean home range was 358 ± 44 acres (145 ± 18 ha; Sparks et al. 2005); while on the Vermont-New York state line it was 205 ± 203 acres (83 ± 83 ha; Watrous et al. 2006). Both of these estimates are higher than for a single female in Pennsylvania, whose home range was estimated at 52 acres (21 ha; Butchkoski and Turner 2006). As well as differences in methodology, the range of home ranges estimated likely reflects differences in habitat quality between sites.

Fall Migration and Swarming

Indiana bats start leaving their summer habitat as early as late-July and begin arriving at hibernacula in August (USFWS 2007). Little is known about Indiana bat behavior during fall migration. During spring, Indiana bats emerge from their hibernacula at roughly the same time when weather conditions are appropriate and they are relatively easy to capture while roosting in their hibernacula. Therefore, many Indiana bats have been captured and tracked from their hibernacula to their summer ranges, providing information on spring migration movements and timing (Table 4.2 in Stantec 2013). Conversely, prior to fall migration, Indiana bats are dispersed throughout their summer range and it is thought that they begin migration in a staggered fashion, making capture and tracking of individuals from their summer range to their swarming areas and hibernacula difficult. Consequently, most of what is known about fall migration comes from band returns (i.e., individuals that are banded during the summer and subsequently documented during winter hibernacula counts), which provide information about migration distances and beginning and ending destinations, but not information about timing or migration routes. However, it is thought that fall migration takes longer and is less direct than the relatively direct and short-term spring migration (USFWS 2011d).

When Indiana bats arrive at hibernacula, they perform a behavior known as swarming, in which they fly around the entrances in an attempt to find mates (Cope and Humphrey 1977). Once arriving at hibernacula, females may only remain active for a few days, whereas males remain active, seeking mates into late October and early November (timing varies with latitude and annual weather conditions). During the swarming period, most male Indiana bats roost in trees in the area surrounding hibernacula during the day roost and fly to their hibernaculum at night (USFWS 2007). Clusters of active bats have also been observed roosting in caves during swarming events (Gumbert et al. 2002).

The maximum distance between identified roost trees and associated hibernacula varies among telemetry studies conducted during the fall roosting and swarming season. Most telemetry studies conducted during fall swarming have occurred outside of hibernacula with relatively small populations of Indiana bats. At two small P3 hibernacula in Kentucky, Indiana bats roosted primarily within 1.5 and 2.5 miles (2.4 and 4.1 km) of the cave entrances (Kiser and Elliott 1996, Gumbert 2001). In Virginia, all roost trees identified from eight male and three female Indiana bats were within 0.9 mile (1.4 km) of a P3 hibernaculum[9] (Brack 2006). In Michigan, Kurta (2000) tracked two male Indiana bats to roost trees located (1.4 and 2.1 miles) 2.2 and 3.4 km from a P4 hibernaculum.

Bats were documented roosting further from hibernaculum in areas with larger populations of hibernating bats. Outside of the Canoe Creek Mine (with a hibernating population of 774 Indiana bats in 2007), a male Indiana bat twice traveled nine miles (14 km) from the hibernaculum where it was captured (USFWS 2007). In Missouri, radio-tagged individuals traveled maximum distances of 4.0 miles (6.4 km) away from the nearby hibernacula that had a collective hibernating population of 2,495 individuals (Rommé et al. 2002). During telemetry studies outside Wyandotte Cave in Indiana, two females were relocated 19.1 miles (30.7 km) away from the cave (Hawkins et al. 2005, USFWS 2007). The longer distances traveled by bats at larger hibernacula seem to suggest that the density of bats influenced how bats used the area surrounding hibernacula (Hawkins et al. 2005). As the density of bats swarming outside of the

[9] The author noted that bats traveling outside of the study area (defined as the north side of a 2.0-mile [3.2-km] circle, centered on the hibernaculum) were not able to be located.

hibernaculum increases, bats may need to move farther from the site to find available roost and prey resources.

Indiana bats tend to roost more often as individuals in fall than in summer (USFWS 2007). Roost switching occurs every two to three days and trees used by the same individual tend to be clustered. Similar to summer roosts, fall roost trees most often are in sunny forest openings created by natural or human disturbance (USFWS 2007). Indiana bats show strong site fidelity (especially females) and typically return to the same hibernacula year after year (Hall 1962, LaVal and LaVal 1980, Gumbert et al. 2002). However, a bat captured during swarming at the Canoe Creek Mine in fall 2007 was captured in a cave in Tucker County, West Virginia, in winter 2009-2010, a distance of approximately 133 miles (214 km; C. Butchkoski, Pennsylvania Game Commission [PGC], pers. comm., and C. Stihler,, pers. comm.). Similarly, a female bat that was captured emerging from the South Penn Tunnel in Bedford County, Pennsylvania in the spring of 2007 was recaptured in winter 2009-2010 at Hellhole cave in Pendleton County, West Virginia, a distance of approximately 86 miles (138 km; C. Butchkoski, pers. comm., C. Stihler, pers. comm.). Hall (1962) also reported Indiana bats apparently switching between hibernacula.

5.1.1.3 <u>Demographics</u>

Female Indiana bats give birth to one young per year, similar to most bats of temperate regions (Mumford and Calvert 1960, Humphrey et al. 1977, Thomson 1982), and the birth rate of males to females appears to be essentially even (Hall 1962, Myers 1964, and LaVal and LaVal 1980). The age of reproductive maturity, or first breeding, is highly variable in insect-eating bats of the family Vespertilionidae (to which Indiana bats belong), ranging from three to 16 months in both sexes (Tuttle and Stevenson 1982). Guthrie (1933) reported that female Indiana bats are sexually mature by the end of their first summer, although there may be considerable intraspecific variation in the age of sexual maturity (Racey 1982). Butchkoski and Turner (2006) reported that one female Indiana bat in a Pennsylvania maternity colony, initially captured as a juvenile in July 2001 and recaptured each of the next four summers, did not reproduce until she was three years old. Age of reproductive maturity likely varies with latitude (Racey and Entwistle 2003).

Many studies of common bats of temperate regions show that within a species, the proportion of breeding females may vary dramatically among populations and between years, and this variation is typically due to weather and other environmental factors (e.g., amount of rainfall and temperature; Racey and Entwistle 2000, Barclay et al. 2004). The proportion of females in a population that produce young each year is thought to be fairly high (USFWS 2007). In one study, volant young were produced during two consecutive years of study by about 93% and 82% of female Indiana bats, respectively (Humphrey et al. 1977), and in another study it was estimated that approximately 89% of adult females were in reproductive condition (pregnant, lactating, or post-lactating; Kurta and Rice 2002).

Location and environmental factors likely influence reproductive rate and there is concern that threats, such as WNS, may lead to lower reproduction rates (Frick et al. 2009). However, site-specific information from WNS-affected Indiana bat maternity colonies is not currently available to evaluate these possible changes.

Relatively little is known about annual survival rates for Indiana bats, either for adults or juveniles, or about background mortality of the species (USFWS 2007). It is expected however, that, similar to many other species, survival of Indiana bats is lowest during the first year of life, and that threats and sources of mortality vary during the annual cycle.

During summer months, sources of mortality may include removal of occupied roost trees, predation, human disturbance, and other man-made disturbances (Kurta et al. 2002, USFWS 2007). In addition, it is plausible to assume that individual maternity roost trees occupied by both roosting female adults and pups are felled occasionally by natural forces such as high winds or storms. These impacts may vary based on whether relatively dense female colonies are affected compared to dispersed males. Collisions with wind turbines and removal of occupied roost trees may impact Indiana bats during the spring and fall migration or during fall swarming periods. Both male and female Indiana bats are dispersed over the landscape during the spring and fall migration periods and the bats are concentrated in areas close to hibernacula during the swarming period. During the winter months, impacts may include humans killing bats, human disturbance, or natural or human-caused modifications of hibernacula and surrounding areas that physically disturb the bats or change the microclimate within the hibernacula (USFWS 2007). Human disturbance during hibernation may cause direct mortality of large numbers of Indiana bats that are concentrated in a relatively small area as a result of disruption of normal hibernation patterns. In addition, other sources of winter mortality may include natural predation, natural disasters that impact hibernacula, and WNS, which currently is impacting hibernating bats more than any other perturbation (USFWS 2011e).

Age structure and survival rates among different life stages of Indiana bats are poorly understood, due in part to the lack of accurate techniques for aging individuals (Anthony 1988 and Batulevicius et al. 2001 as cited by USFWS 2007). The only comprehensive estimates of Indiana bat demographic rates currently available were developed by Humphrey and Cope (1977) based on banding of unknown-age bats over a 23-year period at hibernacula. These data suggest that although survival rates following weaning are unknown, the lowest survival occurred in the first year after banding. This differs from the findings of another study that suggest a juvenile mortality rate of about 8%; however, this was based on one season of observation at only one maternity colony (Humphrey et al. 1997).

Humphrey and Cope (1977) hypothesized that there are two distinct survival phases of adult Indiana bats: 1) annual survival rates from one year to six years after banding were constant at approximately 70% and 76% for males and females, respectively; and 2) from six to 10 years after banding, where there was a lower, constant annual survival rate of 36% and 66% for males and females, respectively. After 10 years, the survival rate for females dropped to only 4%. The authors suggested the lower rate may have been attributable to increased costs of migration and reproduction during old age, or due to sampling error, as a very small number of females remained alive after 10 years (Humphrey and Cope 1977). However, Indiana bats have been known to live much longer, with the oldest known Indiana bat captured 20 years after it was first banded (LaVal and LaVal 1980).

More recently Boyles et al. (2007) reanalyzed a subset of the Humphrey and Cope (1977) data with a newer, more flexible, and less biased Cormack-Jolly-Seber model. The Boyles et al. (2007) estimate suggested that apparent survival is considerably higher than estimated by Humphrey and Cope (1977) the first year after banding and lower the second year after banding. Following the first two years after banding, survival estimates were similar, but slightly lower than those reported by Humphrey and Cope (1977). More research is needed to define annual survival rates of Indiana bats more accurately; however, data from Humphrey and Cope (1977) suggest that annual mortality of adult females is likely to be between 24% and 34% up to the age of 10 years.

O'Shea et al. (2004) summarized survival rates for a number of species, including little brown bat, a closely related species. The range of survival rates cited varies considerably from approximately 13% to 86%, while other *Myotis* species also had variable survival rates, ranging from approximately 6% to 89% (O'Shea et al. 2004). However, in general, studies indicate that survival for first year juveniles was generally lower than for adults.

5.1.1.4 Range and Distribution

The range of the Indiana bat extends throughout much of the eastern US and includes 22 states that have summer or winter records (Gardner and Cook 2002, USFWS 2007; Figures 5.1 and 5.2). As of November 2006, there were 281 known extant Indiana bat hibernacula in 19 states (USFWS 2007). The 2007 Recovery Plan proposed use of four Recovery Units (RU): Ozark-Central, Midwest, Appalachian Mountains, and Northeast (Figure 5.3). To delineate RU boundaries, a combination of data on genetic differentiation and population discreteness (mostly associated with the Northeast RU [NERU]), broad-level differences in macrohabitats and land use, and differences in population trends were used (USFWS 2007). New York is within the NERU.

Historically, the Indiana bat winter range was restricted to areas of cavernous limestone in the karst regions of the east-central US, apparently concentrated in a relatively small number of large, complex cave systems. However, increasing numbers of Indiana bats have been found using man-made structures such as mines, tunnels, and buildings for hibernation, thereby extending their winter range into some caveless parts of the country, such as the central Great Lakes basin (Kurta and Teramino 1994). In 2013, almost 94% of the estimated total population hibernated in nine P1 hibernacula (A. King, USFWS, pers. comm.). These included Jug Hole, Wyandotte Cave, Ray's, Coon, Twin Domes, and Grotto in Indiana; Magazine Mine in Illinois; White Oak Blowhole in Tennessee; and a new hibernaculum discovered in Missouri in 2012 (USFWS 2013c). Due in part to WNS reductions in the eastern areas of the species' range, over 80% of the estimated range-wide population hibernated in Missouri and Indiana in 2013 (A. King, pers. comm.).

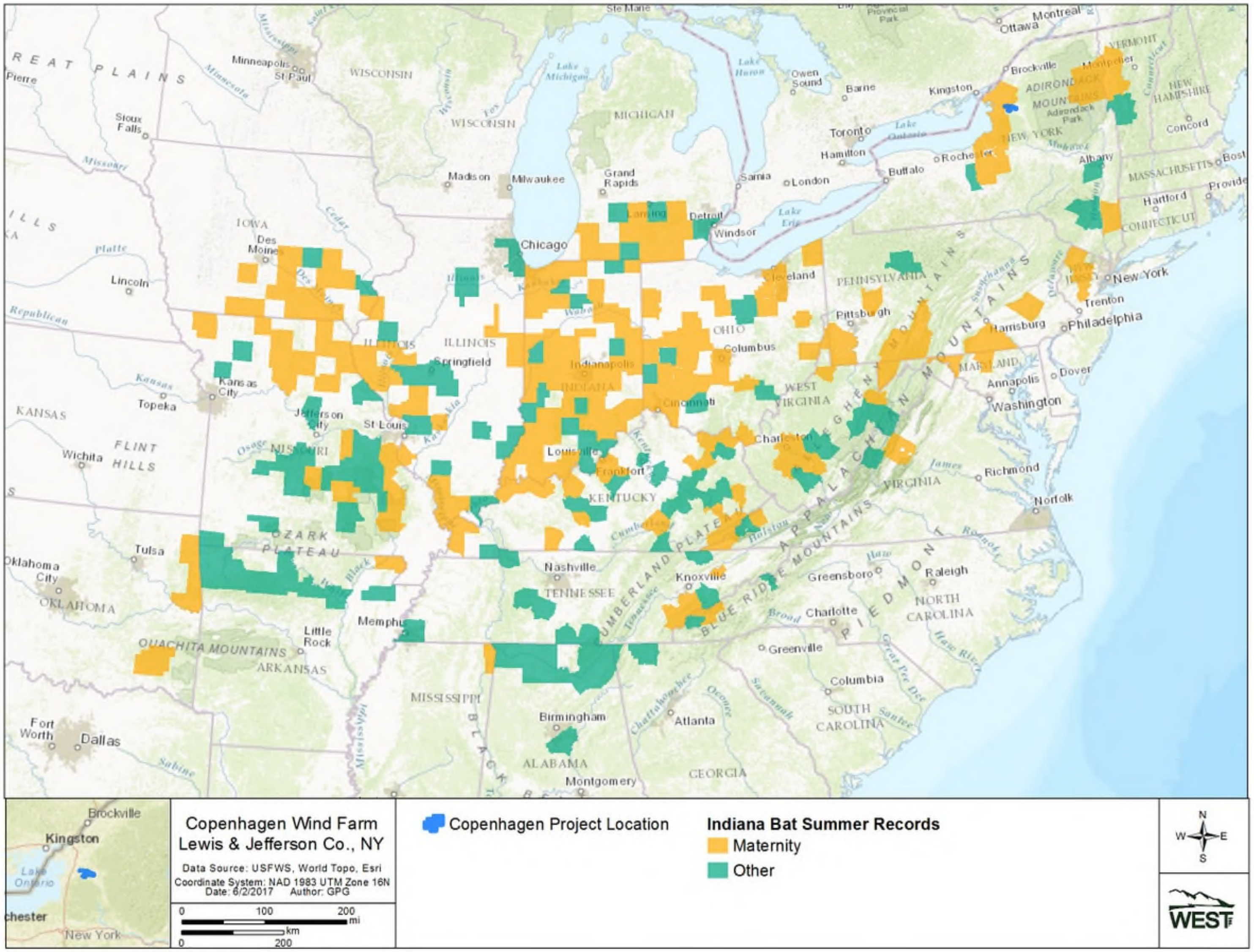

Figure 5.1 Counties with Indiana bat summer maternity colony records.

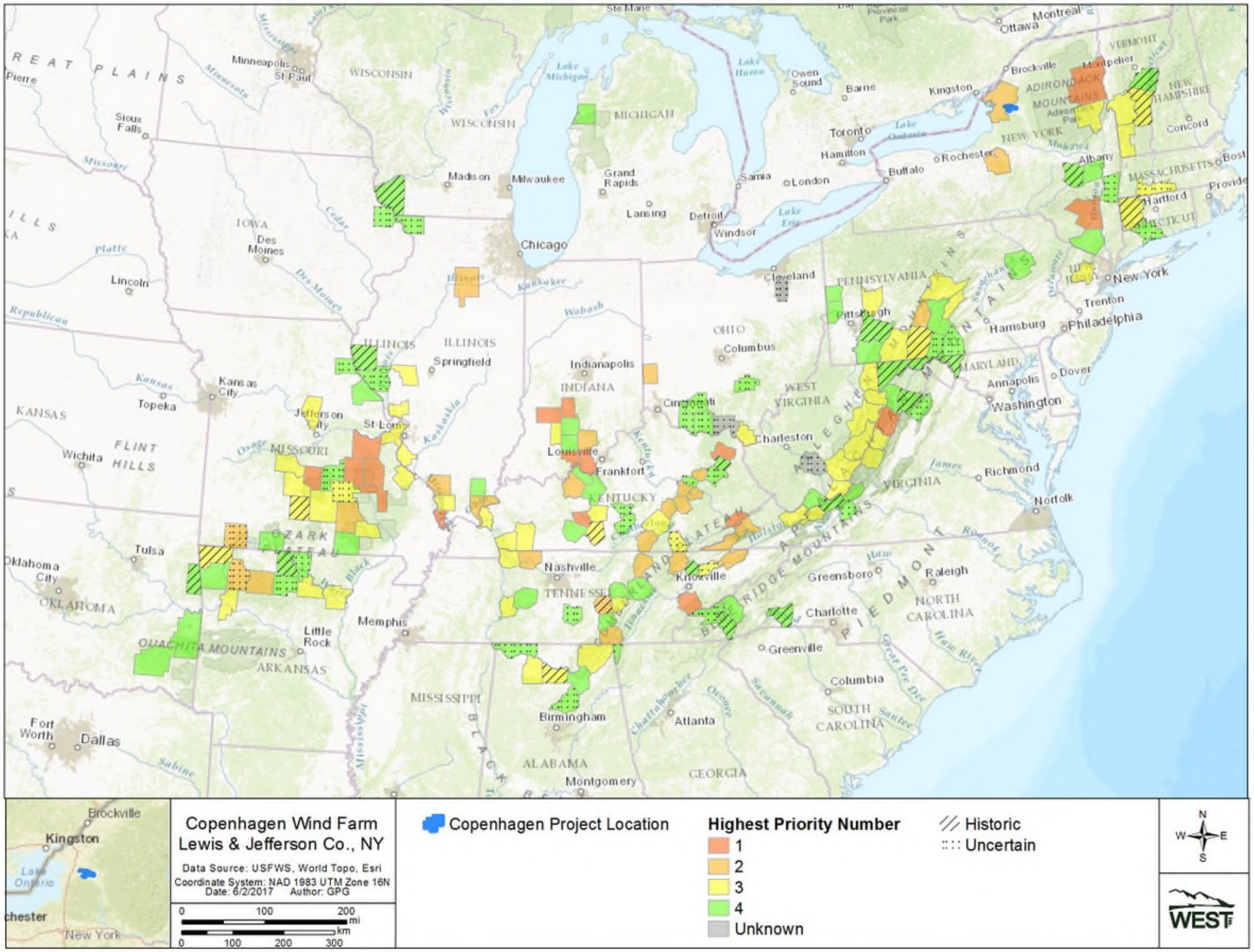

Figure 5.2 Counties with historic or extant Indiana bat hibernacula.

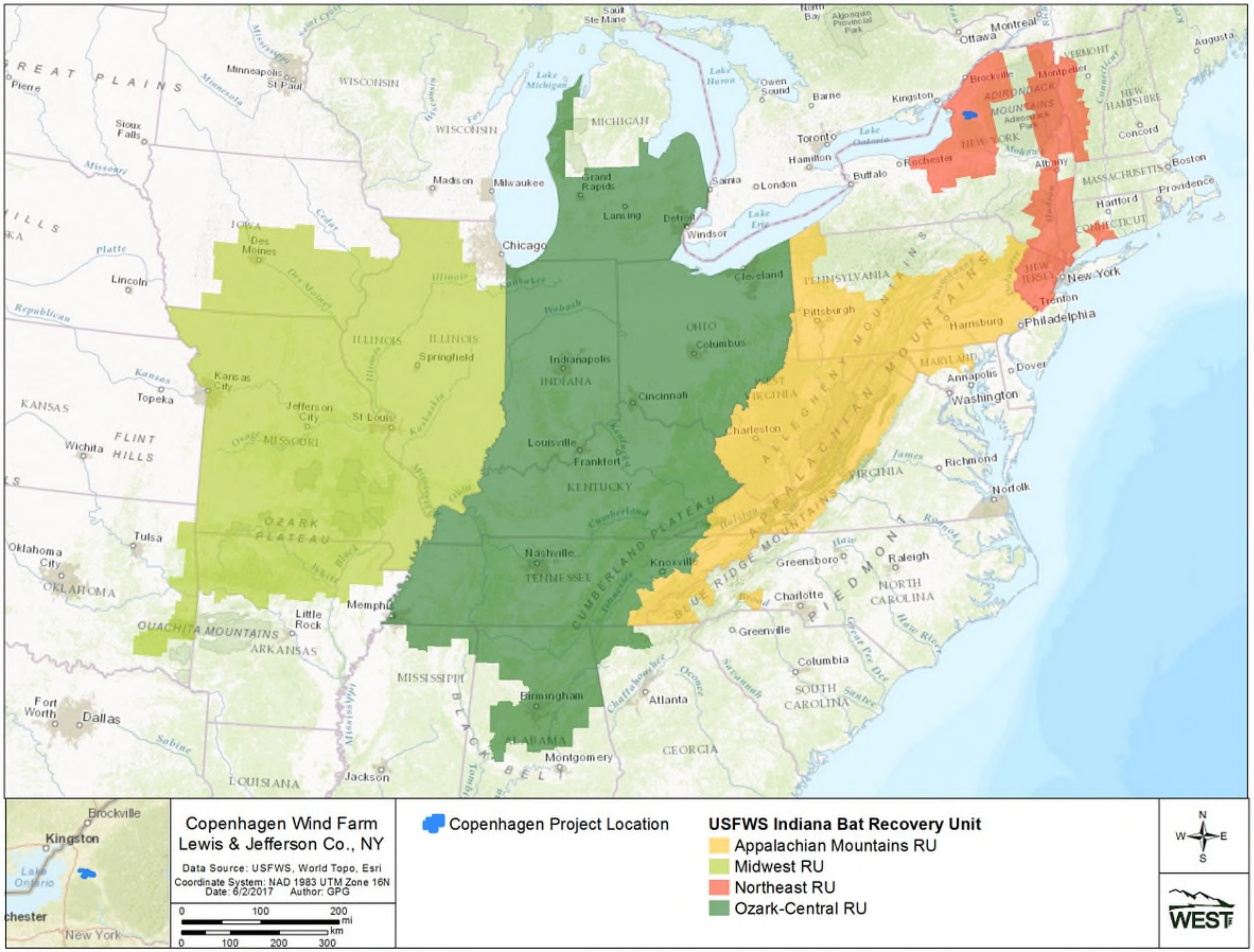

Figure 5.3 US Fish and Wildlife Service-defined recovery units (RU) for the Indiana bat.

Indiana bat maternity colonies are dispersed throughout the species' range as far north as Michigan, New York, and Vermont; as far south as Alabama, Missouri, North Carolina, and Tennessee; and as far west as Iowa. Although Indiana bat maternity colonies occur throughout much of the eastern US (e.g., West Virginia, Virginia, Pennsylvania, New York), they appear to be relatively more abundant in the Midwest or more central portion of the range (i.e., Indiana, Illinois, southern Iowa, southern Michigan, and northern Missouri; USFWS 2004). Additionally, the more rugged, unglaciated portions of the Midwest (Ozarks/southern Missouri, parts of southern Illinois, and south-central Indiana) appear to have fewer maternity colonies per unit area of forest than the upper glaciated Midwest (USFWS 2007). Based on current records, the core Indiana bat summer range includes southern Indiana, northern and central Missouri, northern and central Illinois, northern Indiana, southern Michigan, and western Ohio.

Maternity colonies appear to be highly philopatric, using the same foraging areas and same roosts during the summer in successive years (Humphrey et al. 1977, Callahan et al. 1997, Barclay and Kurta 2007). However, members of a maternity colony do not necessarily overwinter in the same hibernaculum, with individuals from a single maternity colony known to hibernate in locations almost 200 miles (322 km) apart (Kurta and Murray 2002, Winhold and Kurta 2006).

5.1.1.5 Species Status and Occurrence

The Indiana bat was listed as endangered in 1967 under the Endangered Species Preservation Act of 1966 (32 FR 4001) and later listed as a federally endangered species under the ESA when that statute was enacted.

Critical habitat was designated for the Indiana bat on September 24, 1976 (41 FR 41914) and included 11 caves and two mines. No Indiana bat critical habitat occurs in New York and thus no critical habitat is within proximity of the Permit Area.

The first *Indiana Bat Recovery Plan*, published by the USFWS in 1983, outlined the Indiana bat's habitat requirements, potential causes for declines, and recovery objectives (USFWS 1983). In 1999, the USFWS published the *Agency Draft Indiana Bat (Myotis sodalis) Revised Recovery Plan* (1999 Recovery Plan; USFWS 1999). In 2007, the USFWS completed an extensive literature search and provided updated information on the Indiana bat in the 2007 Recovery Plan.

Nationwide

Since the release of the *Indiana Bat Recovery Plan* in 1983, the USFWS has implemented a biennial monitoring program at P1 and P2 hibernacula in an effort to monitor the overall Indiana bat population (USFWS 2007). In 1965, the overall Indiana bat population was estimated at over 880,000 individuals. While variation in data collection methods apparently has led to variable estimates, in general, the USFWS reported a long-term declining population trend to about 328,617 individuals in 2001. Despite the discovery of many new, large hibernacula during this time, the range-wide population estimate dropped approximately 57% from 1965 to 2001. The causes of these population changes are unknown; however, climate change may play a role by negatively affecting hibernacula temperature (USFWS 2007).

The declining trend in population size from 1981 to 2001 was reversed between 2003 and 2007, during which time the population rebounded to 467,915 bats (USFWS 2011a). Even with the lack of standardization in census techniques, observer error, and lack of statistical accuracy, the USFWS regarded the apparent upward trend from 2003 to 2005 to be reliable due to a high level of surveyor consistency and obvious, large increases at some high-priority hibernacula in Illinois, Indiana, Kentucky, and New York during that time (USFWS 2007). The 2009 survey documented a 10.8% population decline from the 2007 estimate (USFWS 2011a), much of which is likely attributed to WNS. Contrary to the apparent long-term trend of decreasing population numbers of Indiana bats from 1965 to 2001, the estimated range-wide population increased 2003 to 2011 (USFWS 2012a). However, the 2013 population totaled 580,717, a 3.3% decrease from 2011 (adjusted for Missouri hibernaculum discovered in 2012 and presumed to have existed for several decades previously) and the 2015 population totaled 523,636, as 9.8% decrease from 2013 (USFWS 2015a).

Although the overall population distribution has not changed over the past several years, the abundance of Indiana bats in the eastern US has declined substantially (70.7% decline from 2007 to 2015 in USFWS Region 5, which includes the states of New York, New Jersey, Pennsylvania, Vermont, Virginia, and West Virginia), as a result of WNS.

As of October 2006, the USFWS had records of 269 maternity colonies in 16 states. This likely represented only about 6% to 9% of the 2,859 to 4,574 colonies thought to exist based on the estimated total wintering population in 2006 (Whitaker and Brack 2002, USFWS 2007). Most maternity colony locations remain unknown.

Northeast Recovery Unit

As shown in Figure 5.3, the Permit Area (as well as the rest of the Plan Area) falls within the NERU, which includes the range of Indiana bat in eastern New York, northern New Jersey, and western Vermont. According to the USFWS (2015a), the overall Indiana bat population in the NERU was approximately 53,763 in 2007, 33,855 in 2009, 16,124 in 2011, 18,273 in 2013, and 15,728 in 2015 (Table 5.1). This represents approximately 3.0% of the overall 2015 population estimate of Indiana bats (USFWS 2015a). The overall population estimate for the NERU decreased by approximately 70.7% between 2007 and 2015 (USFWS 2015a). Within the NERU, approximately 99% of Indiana bats hibernated in New York in 2015 (Table 5.1).

Table 5.1 Indiana bat population estimates for the Northeast Recovery Unit.

State	2007	2009	2011	2013	2015
New York	52,779	33,172	15,654	17,772	15,564
New Jersey	659	619	409	448	111
Vermont	325	64	61	53	53
Total	**53,763**	**33,855**	**16,124**	**18,273**	**15,728**

Source USFWS 2015a

New York

In 2005, approximately 7.6% of the estimated range-wide population of Indiana bats hibernated in New York (USFWS 2013a). This increased to approximately 8.9% in 2007, then decreased to 6.2% in 2009 and 2.8% in 2011 before increasing slightly to 3.3% in 2013 (USFWS 2013a). This number decreased again to 3.0% in 2015 (USFWS 2015a). Numbers of Indiana bats in New York have been affected by WNS since the disease was discovered in the state in 2006 (USFWS 2011e).

There are 15 known Indiana bat hibernacula in the state, and of these, 12 have extant winter populations (at least one record since 1995; USFWS 2007). Of the extant New York hibernacula, three hibernacula are classified as P1, three as P2, three as P3, two as P4, and one as an ecological trap[10] (USFWS 2007). Two of the P1 hibernacula, Walter Williams Preserve Mine and Williams Hotel Mine, are located in Ulster County in the southeast part of the state. The third, Barton Hill Mine, is located in Essex County in the northeastern part of the state.

Permit Area / Local Population

The nearest Indiana bat hibernaculum to the Project is the P2 hibernacula Glen Park Cave in Jefferson County, which is located approximately 10-15 miles (16-24 km) northwest of the Permit Area (Figure 5.4). The maximum population ever recorded in the hibernaculum was 3,129 Indiana bats; the maximum population since 2000 was 2,264 Indiana bats (USFWS 2007; Table 5.2). WNS was confirmed in Glen Park Cave in winter 2007-2008 (White-Nose Syndrome.org 2017), and the latest survey (2014-2015) recorded 239 Indiana bats in the hibernaculum (R. Niver, USFWS, pers. comm.). No other Indiana bat hibernacula are known to occur within 50 miles (80 km) of the Permit Area; therefore, because the maximum recorded migration distance for Indiana bats in the NERU is 42 miles (C. Herzog, NYSDEC, pers. comm.), the Glen Park hibernating population is believed to constitute the entire local population for the Permit Area.

[10] An ecological trap is defined as a hibernaculum with a history of repeated flooding or severe freezing events that have results in the mortality of most hibernating Indiana bats; Haile's Cave in New York has been designated an ecological trap due to flooding.

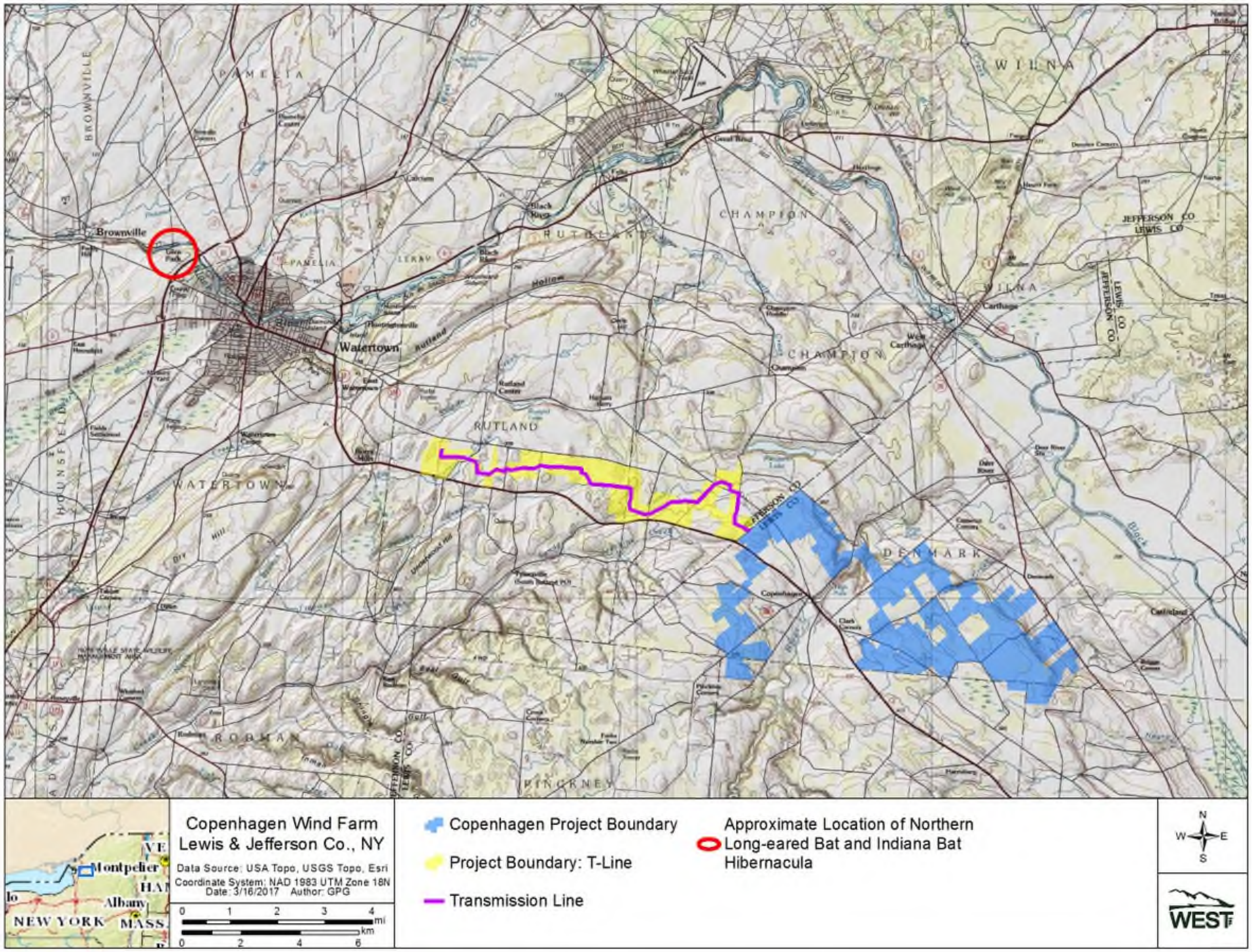

Figure 5.4 Approximate location of the Glen Park hibernaculum relative to the Copenhagen Wind Farm.

Table 5.2 The number of Indiana bats recorded at the Glen Park hibernaculum and white-nose syndrome (WNS) status from 1982-1983 to 2014-2015.

Survey Year	Number of Indiana Bats	WNS Status
1982-1983	631	Absent
1983-1984	1,228	Absent
1985-1986	1,313	Absent
1986-1987	1,582	Absent
1987-1988	1,579	Absent
1988-1989	1,499	Absent
1989-1990	1,777	Absent
1991-1992	2,614	Absent
1993-1994	2,371	Absent
1994-1995	1,668	Absent
1996-1997	2,535	Absent
1998-1999	3,129	Absent
2000-2001	2,264	Absent
2002-2003	1,704	Absent
2004-2005	2,065	Absent
2006-2007[7]	1,928	Absent
2007-2008[8]	1,247	Confirmed
2008-2009	1,719	Confirmed
2009-2010	509	Confirmed
2010-2011	433	Confirmed
2012-2013	330	Confirmed
2014-2015	239	Confirmed

Source: C. Herzog, pers. comm

Indiana bat maternity colonies have been documented in Jefferson County to the north and west of the Permit Area; on Fort Drum and dispersed across the landscape towards Lake Ontario (C. Herzog, pers. comm). No Indiana bat maternity colonies have been documented within 10 miles of the Project turbines and none are believed to occur within the Permit Area (see below). No Indiana bat maternity colonies have been documented in Lewis County.

Pre-construction bat acoustic and mist-net surveys were conducted in 2012 to evaluate bat use of the Project. Bat surveys included one season of acoustic monitoring conducted from mid-April to mid-October and one season of mist-net surveys conducted from late May to mid-June. Protocols for the pre-construction bat surveys followed the NYSDEC's 2009 *Guidelines for Conducting Bird and Bat Studies at Commercial Wind Energy Projects* and the protocols established in the Indiana Bat Mist Netting Guidelines in the USFWS' 1999 Recovery Plan. The following section provides a summary of results of the pre-construction surveys.

<u>Mist-net Surveys</u>

Mist-net surveys were conducted at 26 sites within the Project between May 25 and June 14, 2012 (Figure 5.5; Sander Environmental, Inc. 2013). In addition to the use of the nets, a full-spectrum acoustic detector (Pettersson D500X [Pettersson Elektronik AB, Sweden]) was run near each net site concurrent with netting to address concerns about the effectiveness of netting alone for WNS-affected populations. The detectors were attached to the top of 4-ft (1-m) poles and placed near the edges of open areas at each net site.

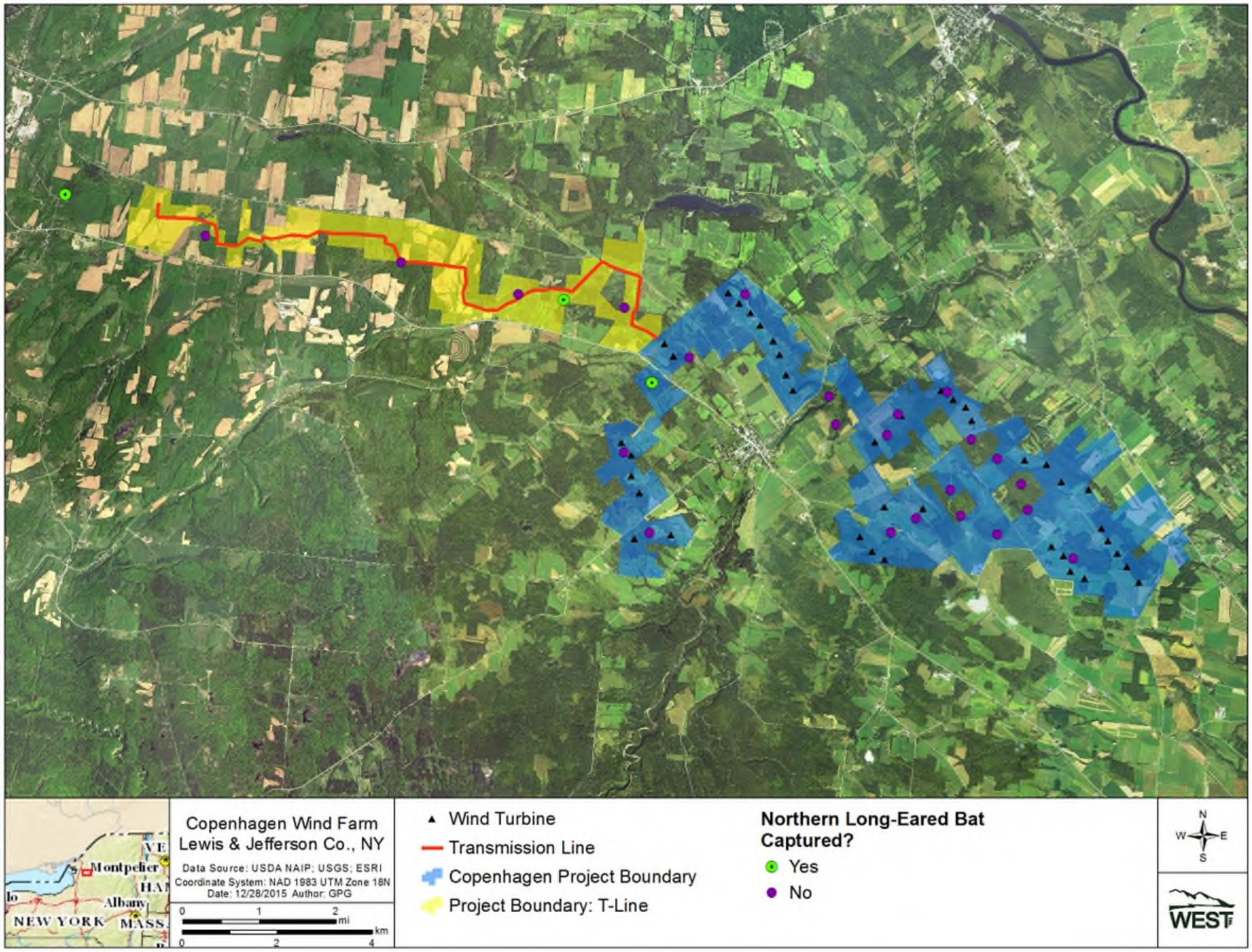

Figure 5.5 Locations of the mist-net sites and acoustic monitoring locations for the Copenhagen Wind Farm.

The mist-net surveys captured 41 bats of five species (Table 5.3). No Indiana bats were captured. The acoustic detectors at the mist-net sites recorded 995 bat calls (3.7 calls per hour) classifiable to species using the SonoBat™ 3.13 NY-PA-WV software (J. Szewczak, Arcata California). The majority (446 calls) of classifiable calls were classified to big brown bat (*Eptesicus fuscus*), followed by hoary bat (*Lasiurus cinereus;* 232), silver-haired bat (*Lasionycteris noctivagans;* 202), eastern red bat (*Lasiurus borealis;* 35), and northern long-eared bat (one); 44 call sequences were classified as either little brown bat or Indiana bat. A secondary analysis of the *Myotis* calls using three USFWS 'candidate' acoustic bat identification programs (Kaleidoscope Pro® [Wildlife Acoustics, Concord, Massachusetts], Bat Call Identification [BCID; R. Allen, BCID, Kansas City Missouri], and EchoClass [E. Britzke, US Army Engineer Research and Development Center, Vicksburg, Mississippi]) and a follow-up qualitative analysis determined that the 44 call sequences were all little brown bat calls. The remaining 35 calls were classified erroneously by SonoBat (based on known species' range) as evening bat (*Nycticeius humeralis*). Based on the results of the mist-net surveys and the accompanying acoustic analyses, it was determined that there was insufficient evidence to indicate the presence of an Indiana bat maternity colony at the Project.

All Indiana bat maternity roosts in New York to date have been located at or below 900 ft in elevation. Elevations in the Permit Area range from approximately 835 ft along the transmission line to approximately 1,500 ft ASL within the turbine sites.

Table 5.3 Summary of bat captures and detections during 2012 mist-net surveys of the Copenhagen Wind Farm.

Species	#Captures	#Sites with Captures	#Detections	#Sites with Detections
Big brown bat	29	12	446	18
Hoary bat	2	2	232	19
Silver-haired bat	6	3	202	18
Little brown bat	0	0	44	7
Eastern red bat	1	1	35	4
Northern long-eared bat	3	3	1	1
Total	**41**	**14**	**960[1]**	**23**

[1]35 calls were erroneously classified as evening bat calls-these calls are not included in this table

Acoustic Surveys

Acoustic surveys were conducted using two full-spectrum detectors (Pettersson D500X) deployed at 190 ft (58 m) and four ft (one m) above the ground on an existing met tower in the Permit Area from April 15 to October 15, 2012 (Sanders Environmental 2012). The detectors recorded from 0.5 hour before sunset to 0.5 hour after sunrise. The detectors recorded a total of 328 bat calls, of which 281 calls were classifiable to species by SonoBat: 182 of the classifiable calls were recorded at the upper detector and 99 were recorded by the lower detector. The calls were identified to five species and six species groups (Table 5.4). Hoary bats composed the majority (94 calls) of calls recorded at the upper detector and silver-haired bats were the most-recorded species (calls) at the lower detector.

Based on the lack of Indiana bat occurrence in the results of the mist-net surveys and the accompanying acoustic analyses, it is most likely that the little brown bat/Indiana bat call recorded during the acoustic surveys was attributable to a little brown bat.

Table 5.4 Summary of bat calls, by species and species group, recorded during the 2012 acoustic surveys of the Copenhagen Wind Farm.

	#Calls	
Species/Species Group	**Upper Detector**	**Lower Detector**
big brown bat	2	32
eastern red bat	7	1
hoary bat	94	18
silver-haired bat	59	41
Rafinesque's big-eared bat[1]	1	0
big brown bat/hoary bat	2	0
big brown bat/silver-haired bat	3	3
big brown bat/Rafinesque's big-eared bat	0	1
hoary bat/silver-haired bat	12	2
silver-haired bat/Rafinesque's big-eared bat	2	0
little brown bat/Indiana bat	0	1
Total	**182**	**99**

[1]The calls classified as Rasfinesque's big-eared bat (*Corynorhinus rafinesquii*) were errors by SonoBat (based on known species' range)

Bat activity was highest during July and August (83.3% of calls; Figure 5.6), with the highest number of calls recorded during the week of July 29, 2012, at both detectors (23.6% and 25.3% of calls at the upper and lower detectors, respectively). Temporally, most bat activity (76% of bat calls) was recorded between nautical[11] sunset and nautical sunrise (Figure 5.7). Night length varied throughout the survey period, with the longest nights around the summer solstice; therefore, calls recorded the same number of hours after sunset were sometimes before or after sunrise.

[11] Sun is 12 degrees below horizon. Determined based on data published by the National Oceanographic and Atmospheric Administration for the Town of Denmark, NY.

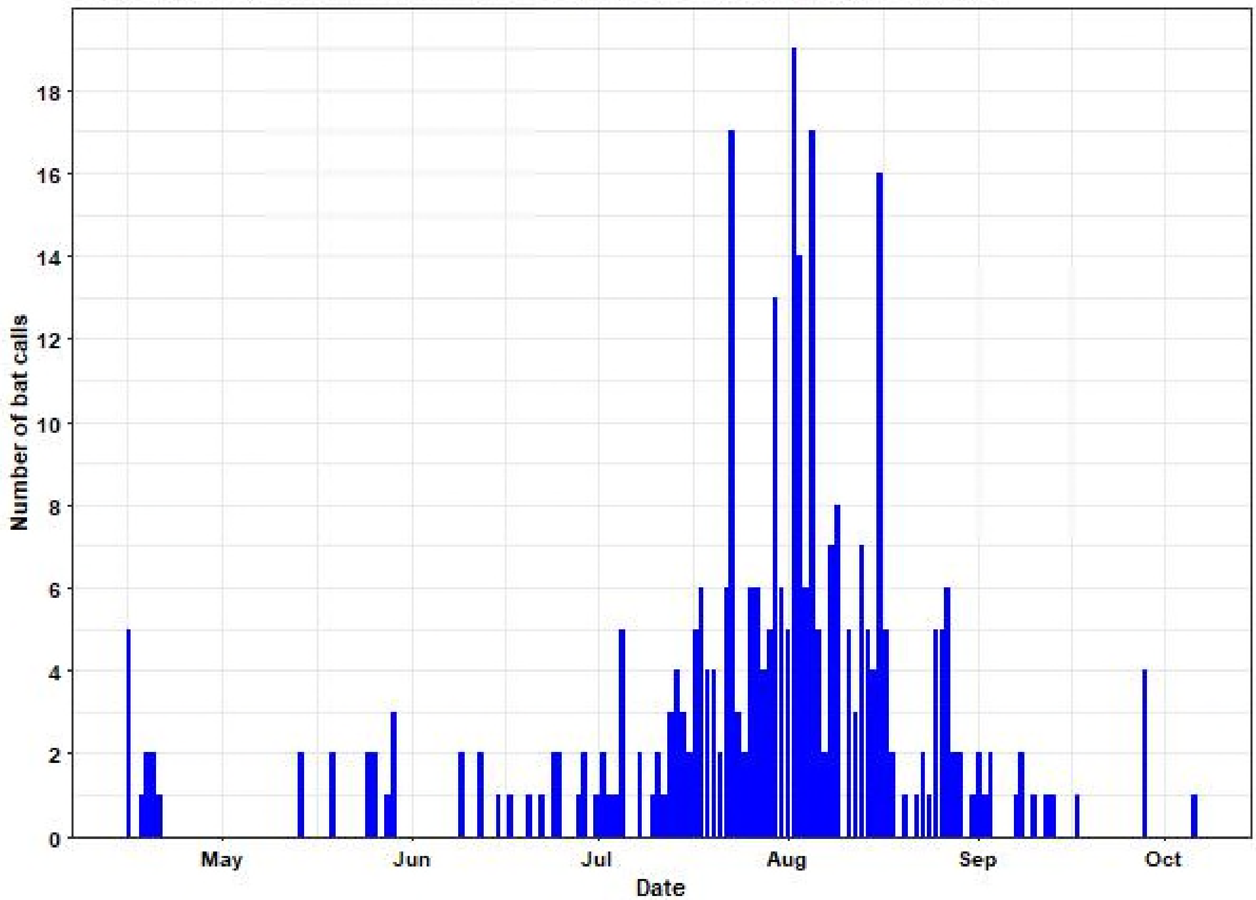

Figure 5.6 Seasonal distribution of bat calls recorded at the Copenhagen Wind Farm.

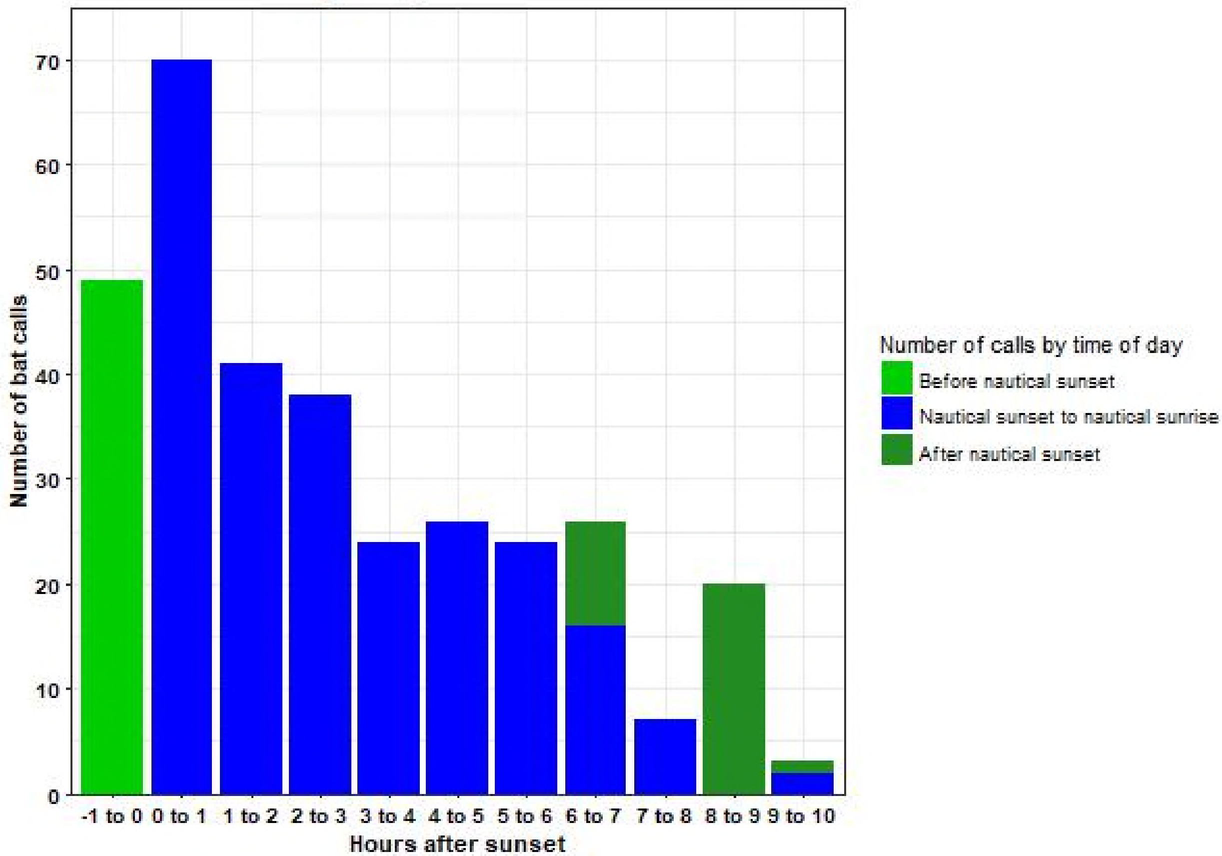

Figure 5.7 Hourly distribution of bat calls recorded at Copenhagen Wind Farm in relation to nautical sunrise/sunset.

A significant, positive relationship was found between temperature and bat activity at both the upper (p=0.000) and lower (p=0.000) detectors; as temperature increased so did bat activity. During the pre-construction acoustic survey period (April 15 – October 15, 2012), temperatures at 190 ft were below 50 °F (10°C) for approximately 21.34% of the time and below 40 °F (4.4 °C) for approximately 7.60% of the time acoustic detectors were operating. However, of the acoustic calls recorded during the survey period, only 1.83% occurred when temperatures at 190 ft were below 50 °F and 0.30% occurred when temperatures were below 40 °F[12] (Figure 5.8).

[12] The raw data files, recorded by Sanders Environmental on the Pettersson D500X detector, were processed by Western EcoSystems Technology Inc. (WEST) in the Wildlife Acoustics Kaleidoscope program. The eastern North America classifier was used to filter noise files out of the data set. After the calls were classified, the files labeled “Noid” were checked. All of those files that were not bat calls were deleted from the data set. Then, the time and date were added to the output file by looking up the information from the raw data files and used to reference the bat calls with the temperature data.

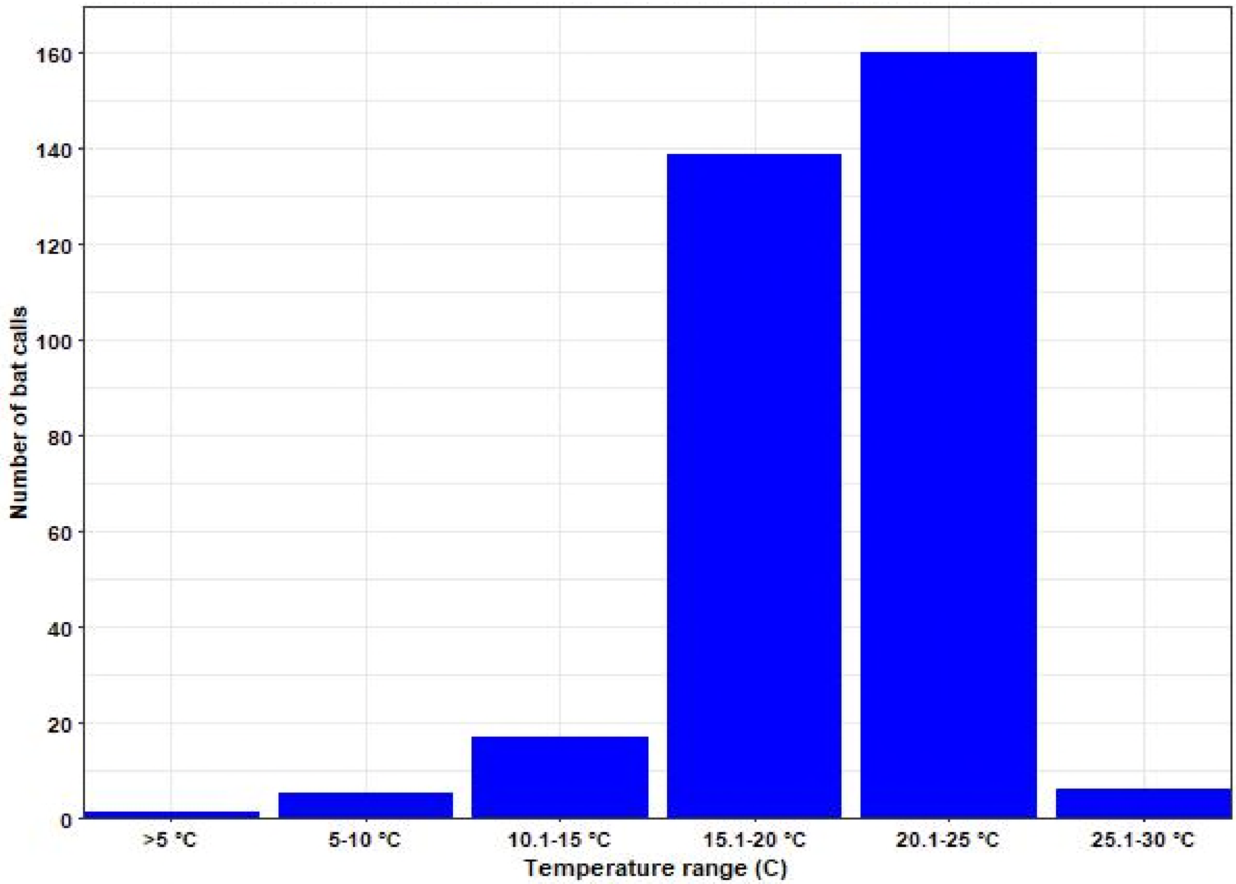

Figure 5.8 Temperature distribution of bat calls recorded at the Copenhagen Wind Farm.

A negative relationship was observed between wind speed and bat activity at both the upper and lower detectors, indicating that as wind speed increased bat activity decreased, although the relationship was not found to be statistically significant (p=0.098 at upper, p=0.118 at lower detector).

<u>*Current Threats*</u>
An extensive list of both historical and current threats to the species can be found in the original *Indiana Bat Recovery Plan* (USFWS 1983), the 2007 Recovery Plan, and the *Indiana Bat (Myotis sodalis) 5-Year Review* (USFWS 2009). The following section focuses on the threat currently expected to have the greatest short-term and long-term impact upon the species, WNS, and provides context for the take assessment and the final take estimate.

WNS is the most severe threat facing Indiana bat populations range-wide. WNS was first discovered during the winter of 2006/2007 in four caves in Schoharie County, New York, and has since spread steadily in all directions (White-Nose Syndrome.org 2017). Because of the severity of the disease in other geographic locations, its rapid spread, and the lack of effective management actions to reduce the virulence of the disease (USFWS 2011e), the effects of WNS on Indiana bats (Thogmartin et al. 2012) and other bat species are expected to be significant.

The origin of WNS remains uncertain, although anthropogenic introduction of the disease from Europe via cavers or commerce has been presented as a plausible hypothesis (Frick et al. 2010). To date, the disease is responsible for an estimated 5.7 to 6.7 million bat fatalities, primarily in the northeastern US (USFWS 2012d). Recent research has shown that the fungal growth is the causative agent in the bat deaths (Lorch et al. 2011). There is now strong support that WNS increases the frequency and duration of arousal bouts in hibernating bats and causes the premature expenditure of energy stores (Reeder et al. 2012). In addition to observed fatalities at hibernacula, WNS has also been linked to decreased bat abundance in summer habitat (Brooks 2010, Dzal et al. 2010). The disease has caused fatalities in at least six species of cave bats, including the Indiana bat, little brown bat, northern long-eared bat, eastern small-footed bat (*Myotis leibii*), big brown bat, and tri-colored bat (*Perimyotis subflavus*), and its presence has been confirmed in three additional species; gray bat (*Myotis grisescens*), southeastern bat (*Myotis austroriparius*), and cave bat (*Myotis velifer*; Turner et al. 2011).

Research efforts have led to increased understanding about the spread of WNS and its effect on different species over time (Thogmartin et al. 2012). There are now several years of population monitoring data that provide valuable insights into the effects of WNS. Varying levels of susceptibility by species have emerged over the past few years with susceptibility apparently density dependent and influenced by cave micro-climate and bat sociality (Langwig et al. 2012). Wilder et al. (2011) used yearly presence/absence data on WNS-related mortality among hibernating bat colonies in the northeast to determine factors influencing its spread. Distance to origin and colony size had the greatest effects on WNS hazard over the range of observations, while the type of hibernaculum and species composition had weaker effects. The distance effect showed a temporal decrease in magnitude, consistent with the pattern of an expanding epizootic. Large, cave-dwelling bat colonies with high proportions of little brown bats or other species that seek humid microclimates tended to experience early mortality.

The effects of WNS are realized over a multiple-year period. The largest population counts for Indian bats in affected regions appear to occur approximately one or two years after the disease is first discovered (USFWS 2012a). WNS was first found in 2006 in New York and the Indiana bat population in the state was the largest in 2007 and at the 5-year average in 2009 (USFWS 2012a). Similarly WNS was first detected in West Virginia in 2009 and the Indiana bat population in West Virginia was highest in 2011 (USFWS 2011a). However, large population declines have been observed over a five to six year period from the onset of the disease. Within a 5-state area affected by WNS for multiple years (New York, Pennsylvania, Vermont, Virginia, West Virginia), population monitoring at 42 hibernacula documented a 98% decline in northern long-eared bats, a 91% decline in little brown bats, a 75% decline in tri-colored bats, a 72% decline in Indiana bats, a 41% decline in big brown bats, and a 12% decline in eastern small-footed bats (Turner et al. 2011). At those same sites, Indiana bat census counts have decreased by nearly 40,000 bats (72%) since the introduction of *Pd* in 2006/2007. Thogmartin et al. (2012) estimates that since the onset of WNS in 2006, the range-wide Indiana bat population has experienced an annual decline of approximately 10.3% from the previous rate of change.

By 2010, WNS had been documented in all known Indiana bat hibernacula in New York. WNS was confirmed in Jefferson County by the winter of 2007/2008 and suspected in Lewis County by the winter of 2008/2009. However, the observed effects of WNS on Indiana bats have varied between affected hibernacula in New York. Declines of Indiana bat populations hibernating in the state have ranged from 21% to 100% since 2006 (Hicks and Newman 2007, Turner et al. 2011, Hicks et al. 2008). At Glen Park Cave, the Indiana bat population declined by 80.8% from the highest post-WNS[13] population size of 1,719 bats in the winter of 2008/2009, to the latest recorded population size of 230 bats in the winter of 2014/2015.

Researchers have noted a progressive lessening of mortality rates at some hibernacula, but no clear evidence of resistant hibernating populations or decreased susceptibility of survivors to infection has been found (Langwig et al. 2010). There is currently no evidence of resistance to WNS among survivors, although some affected New York hibernacula continue to support relatively low numbers of bats several years into WNS exposure, and a few hibernacula have substantially lower mortality levels than most. Additionally, some encouraging observations came from recent winter surveys at five hibernation caves in the greater Albany, New York area where the disease was first discovered (NYSDEC 2012). During 2011-2012 winter surveys, substantial increases in little brown bats at three out of five of the caves were documented. The largest and best documented of these sites had an increase from 1,496 little brown bats in 2011 to 2,402 little brown bats in 2012. However, it is premature to conclude that population recovery is underway for this species because of the comparatively small number of hibernation sites that experienced increases and the fact that alternate explanations for the increases are plausible. For example, bats are highly social animals and observed increases could be the result of consolidation of individuals from other hibernation sites (NYSDEC 2012).

If current trends for spread and mortality continue at affected sites, WNS threatens to drastically reduce the abundance of Indiana bat and other species of hibernating bats in much of North America. Population modeling indicates a 99% chance of regional extinction of the little brown bat over a 16-year period due to WNS (Frick et al. 2010). The closely related Indiana bat is just as vulnerable to regional extinction, if not more so, due to its smaller range-wide population and social behavior traits that increase the risk of bat-to-bat transmission (USFWS 2011e).

Thogmartin et al. (2012) created hierarchical log-linear change-point models to look at Indiana bat population trends before and after the onset of WNS. Trends were combined from 222 wintering populations before and after onset of WNS (which primarily took place from 2006-2009) to determine the trend for clusters of interacting wintering populations, RUs, and for the range-wide population. The authors found that from 1983 to just before the onset of WNS (i.e., 2006), a west-to-east gradient in trends existed, with western-most populations declining and

[13] Note: "Post-WNS" refers to the period after the first WNS impacts were detected in bat populations in an area. It does not imply that WNS impacts are no longer occurring in an area or that bat populations in an area will not continue to decline due to WNS.

eastern-most populations increasing in abundance. Before WNS, wintering populations in the Ozark-Central RU exhibited a median decline of 9% (95% CI: -4,-13%) between 1983 and 2005. Conversely, wintering populations in the Appalachian Mountain RU (AMRU) (+8% [3, 14%]) and NERU (+16% [3, 30%]) increased. Wintering populations in the core of the species range, the Midwest RU, exhibited no statistically significant change (+0.5% [-1, +3%]). For the range-wide population as a whole, the trend was stationary from 1983 and 2005 (-0.5% mean annual change; 95% CI -2.8% to +1.8%). Based on their models, Thogmartin et al. (2012) estimated that the mean population size in 2009 was 377,124 bats (195,398 to 957,348), with the large variance believed to be caused by WNS. With the onset of WNS, the species exhibited a 10.3% annual decline (95% CI -21.1, +2.0%) and the authors concluded that WNS was having an appreciable influence on trends of Indiana bat populations, stalling, and in some cases reversing, population gains made in the previous 20 years.

5.1.2 Northern Long-eared Bat

The northern long-eared bat was a common bat species in the mid- to northeastern US, with the continental range extending into southeastern and western Canada. The global status of the northern long-eared bat has been recently changed to G2, a designation that corresponds to species that are imperiled (NatureServe 2013), but it currently has no special status in the state of New York. The USFWS was petitioned to list northern long-eared bat as threatened or endangered in August 2010. In October 2013, the USFWS released a 12-month finding on the petition in which it determined that listing the northern long-eared bat is warranted and proposed to list the species as an endangered species under the ESA (78 FR 61046). The northern long-eared bat has since been listed as threatened under the ESA (80 FR 17974); however, any take associated with the Project is not prohibited under the final 4(d) rule for the species published January 14, 2016 (81 FR 1900). The northern long-eared bat is included as a Covered Species so that it can be added to the ITP should the 4(d) rule be reversed or modified or the species be up-listed to endangered status within the term of the permit.

Northern long-eared bat was formerly considered a subspecies of Keen's bat (*Myotis keenii*), though they are now considered to be two genetically distinct species (Caceres and Pybus 1997, Center for Biological Diversity [CBD] 2010). Most literature prior to the 1980's under the name Keen's bat actually pertains to the northern long-eared bat.

5.1.2.1 Life History and Characteristics

The northern long-eared bat is a small bat weighing approximately five – 10 g (0.17 – 0.35 ounce), and with yellow to brown coloration. Females tend to be larger and heavier than males (Caire et al 1979). The northern long-eared bat has large ears relative to other similar species; when pushed forward, the ears extend beyond the nose (Whitaker and Mumford 2009, CBD 2010).

In spring, females leave hibernacula and form maternity colonies of up to 60 individuals (Caceres and Barclay 2000). Parturition dates and subsequent weaning are likely dependent on regional conditions (Foster and Kurta 1999). Studies completed by Broders et al. (2006) over a three-year period in New Brunswick, Canada, found parturition to occur in mid- to late-July.

Other studies suggest that southeastern population parturition dates occur between mid-May and mid-June (Cope and Humphrey 1972, Caire et al. 1979).

Generally, female northern long-eared bats roost communally, while males select solitary roosts (Caceres and Barclay 2000). Northern long-eared bats have shown site fidelity related to summer roost habitat; however, studies by Foster and Kurta (1999) found that the bats changed roost trees approximately every two days. Movement to hibernacula occurs as early as late July and extends as late as October. Copulation occurs outside of hibernacula during swarming behavior; however, fertilization does not occur until spring (Caceres and Barclay 2000).

Northern long-eared bats are likely opportunistic insectivores that primarily glean prey from substrates (Faure et al. 1993). They are known to forage under the forest canopy at small ponds or streams, along paths and roads, or at the forest edge (Caire et al. 1979).

5.1.2.2 Habitat Requirements

Winter Habitat

Mine and cave sites have been most often reported as hibernacula for northern long-eared bats (Griffin 1940, Whitaker and Winter 1977, Stones 1981). This species reportedly hibernates in caves or abandoned mines with Indiana bats, little brown bats, big brown bats, and tri-colored bats (Mills 1971, Caire et al. 1979, Boyles et al. 2009). Northern long-eared bats generally compose a small proportion of the total hibernating population (less than or equal to 1% to 15%; NatureServe 2012). Hibernating northern long-eared bats do not form large aggregations or clusters typical of some eastern species. Instead, individuals or small groups seem to favor deep crevices for hibernation (Caceres and Barclay 2000), and often go unnoticed until spring emergence. Rarely are there more than 100 individuals per hibernation colony (Barbour and Davis 1969, Caire et al. 1979). Northern long-eared bats generally exhibit strong philopatry to hibernacula, and have also been reported to occasionally move between hibernacula during the winter (Whitaker and Rissler 1992).

Spring Emergence and Dispersal

There is little information available regarding spring emergence and dispersal of northern long-eared bats from hibernacula. However, the length of hibernation period can change with different regions and climate differences (Caceres and Barclay 2000). Depending on the specific climate patterns and which region the bats are hibernating in, spring emergence may occur from March to May (Fenton 1969, Caire et al. 1979, Nagorsen and Brigham 1993, Whitaker and Rissler 1992). Like other *Myotis* species in the eastern US, northern long-eared bats mate in the fall, with ovulation and fertilization occurring shortly after females awaken in the spring (Caceres and Barclay 2000). Shortly after emergence, northern long-eared bats migrate to their summer habitat. Spring migration direction of northern long-eared bats may be similar to little brown bats and appears to radiate outward from hibernacula during migration, with the bats migrating directly to the natal sites, rather than moving primarily north or south (Davis and Hitchcock 1965, Fenton 1970, Griffin 1970, Humphrey and Cope 1976). Little is known about male northern long-eared bat migrations, but male little brown bats have been captured outside of known hibernacula in midsummer, suggesting that some males may migrate short distances from their hibernacula (Davis and Hitchcock 1965). If male northern long-eared bats behave similarly to other *Myotis* species, then it can be expected that they form small bachelor colonies or stay close to known hibernacula (Davis and Hitchcock 1965).

Summer Habitat

Northern long-eared bats most frequently select mature-growth forests with decaying trees and/or live trees with cavities or exfoliating bark during the summer maternity season (Foster and Kurta 1999, Lacki and Schwierjohann 2001, Ford et al 2006). Day and night roosts are utilized by northern long-eared bats during spring, summer, and fall, with old-growth forest communities selected most frequently (Foster and Kurta 1999, Owen et al 2003, Broders and Forbes 2004). Variation in roost selection criteria has been reported between northern long-eared bat sexes, with females forming maternity colonies in snags and solitary males roosting in live tree cavities (Lacki and Schwierjohann 2001, Broders and Forbes 2004, Caceres and Barclay 2000). Broders and Forbes (2004) further reported that maternity colonies were more often in shade-tolerant deciduous stands and in tree species that are susceptible to cavity formation. This is supported by Lacki and Schwierjohann's (2001) findings that colony roosts were more likely to occur in stands with higher density of snags. Though some may roost alone, females often roost colonially. Maternity colonies are generally small, consisting of 30 (Whitaker and Mumford 2009 as cited in 80 FR 17974) to 60 (Caceres and Barclay 2000 as cited in 80 FR 17974) individuals, though maternity colonies of up to 100 individuals have been observed (Layne 1978, Dickinson et al. 2009, Whitaker and Mumford 2009 as cited in 80 FR 17974).

Northern long-eared bats do not forage in intensively harvested stands or open agricultural areas, containing movement to intact forest (Patriquin and Barclay 2003, Henderson and Broders 2008). They are known to forage under the forest canopy at small ponds or streams, along paths and roads, or at the forest edge (Caire et al. 1979). Northern long-eared bats have low wing loading, a low aspect ratio, and are highly maneuverable in forested habitat and therefore well-adapted to foraging in dense vegetation (Patriquin and Barclay 2003, Carter and Feldhamer 2005). This species is also frequently observed to forage in close proximity to ephemeral upland pools (Owen et al. 2003, Brooks and Ford 2005). In managed forests of West Virginia, northern long-eared bats utilized, on average, a 160.6-acre (65.0-ha) home range and patches smaller than this likely represent unsuitable habitat (Owen et al 2003). Females have been reported to move up to 6,500 ft (approximately 2,000 m) and males 3,300 ft between roost sites (Broders et al. 2006).

Fall Migration and Swarming

Little is known about migration for northern long-eared bats, but there is evidence that portions of the population may move seasonally. Late summer swarming behavior and relatively high concentrations at some caves indicate that there is some degree of local or regional movement prior to reproduction. Short migratory movements between 35 miles (56 km) and 55 miles (89 km) from hibernacula to summer habitat are most common (Nagorsen and Brigham 1993 as cited in 80 FR 17974, Griffin 1945), suggesting northern long-eared bats are regional migrants. The longest recorded migration distance for the species is 60 miles (97 km), reported by Griffin (1945).

Northern long-eared bats begin arriving at hibernacula in August and by mid-September large numbers can be seen flying about the entrances to certain caves and mines (Boyles et al. 2009). The majority of breeding occurs during this fall swarming period.

5.1.2.3 Demographics

The total population size of the northern long-eared bat is not clearly known; estimates suggest the population may be as small as 10,000 or as large as 1,000,000 individuals (NatureServe 2013). Similarly to other bat species, northern long-eared bat has a low reproductive rate, with females birthing one offspring per year. The sex ratio in northern long-eared bat populations appears to be dominated by males, with multiple studies reporting higher percentages of males compared to females (Griffin 1940, Hitchcock 1949, Pearson 1962, Stones 1981). The skewed ratio is believed due to greater mortality among females. The northern long-eared bat is a fairly long-lived species (Thompson 2006), with one individual reported living up to 19 years (Hall et al 1957).

5.1.2.4 Range and Distribution

Northern long-eared bats are known to occur from eastern US and southeastern Canada west to Montana and British Columbia and south to northern Florida (Figure 5.9). Common hibernacula locations include Quebec, Ontario, and the New England states (Caceres and Barclay 2000). Barbour and Davis (1969) reported that the winter and summer geographic ranges of the species appear to be identical.

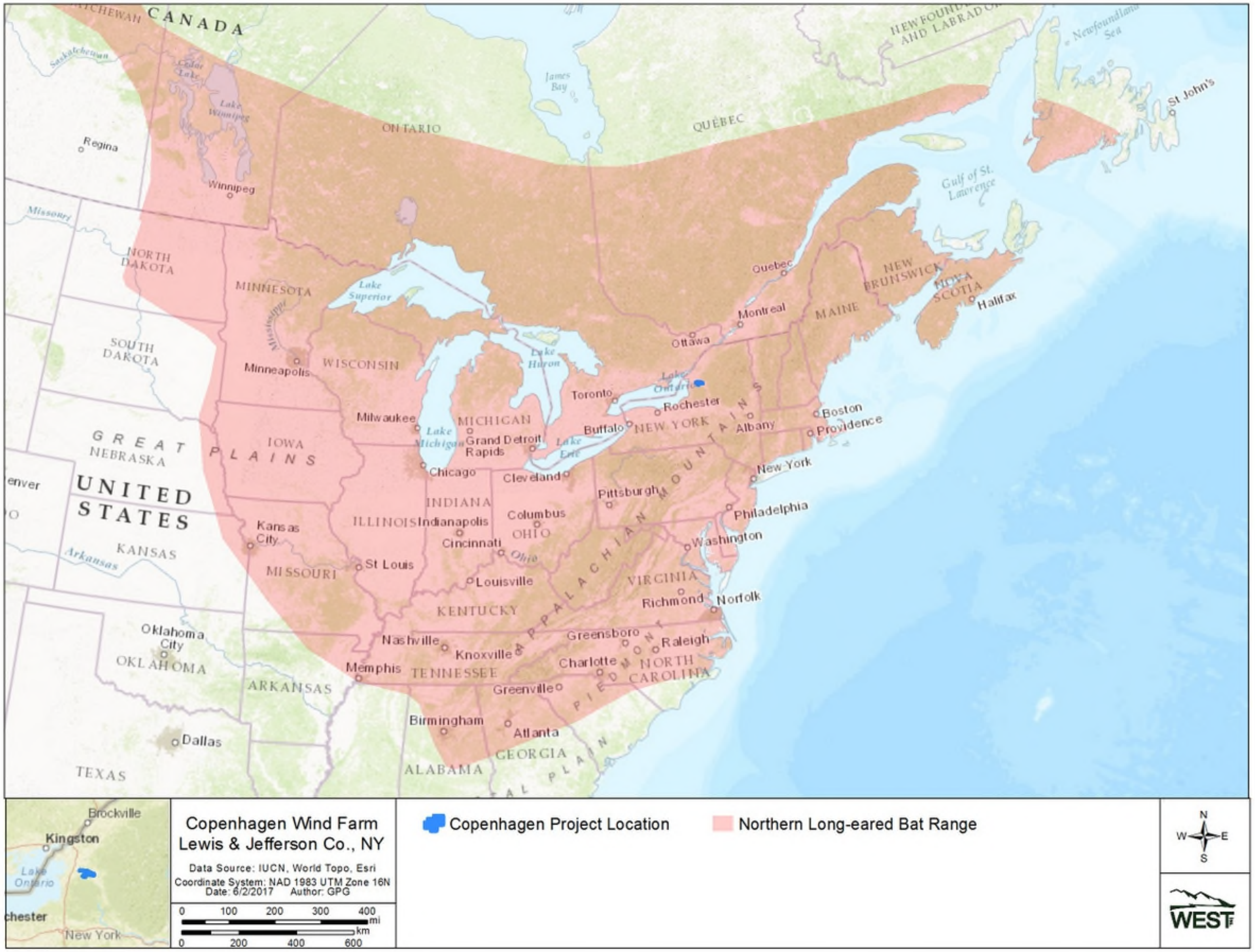

Figure 5.9 Approximate northern long-eared bat range, as described in the US Fish and Wildlife Service's Final Rule (80 FR 17974).

5.1.2.5 Species Status and Occurrence

The life history of the northern long-eared bat makes this species particularly vulnerable to a variety of threats. Because of their low reproductive rate, populations of northern long-eared bats are likely slow to recover from the loss of individuals, increasing the probability that mortality caused by WNS, development, or other factors will cause extirpation (e.g., US Geological Survey [USGS] 2009). Although population trends have not historically been recorded for the species, it is understood that WNS is currently causing severe population declines in the eastern parts of the species' range. Other sources of mortality may further diminish the species' ability to persist in areas where populations are significantly reduced due to WNS.

Due to the immediate and severe threat to the species from WNS, the USFWS was petitioned by the CBD to list northern long-eared bat under the ESA (CBD 2010). On October 2, 2013, the USFWS issued a 12-month finding on the petition to list the northern long-eared bat and proposed listing the northern long-eared bat under the ESA as an endangered species (78 FR 61046). The northern long-eared bat has since been listed as a threatened species under the ESA (80 FR 17974). The USFWS has determined that a critical habitat designation is not prudent (81 FR 24707). A recovery plan has not yet been developed for the species.

Nationwide

The northern long-eared bat occurs over much of the US and Canada (Bat Conservation International 2003, 2012) from the eastern US and southeastern Canada west to Montana and British Columbia and south to northern Florida. This species occurs in a widespread but irregular, patchy distribution, rarely in large numbers (Barbour and Davis 1969), and is more common in the northern part of its range (Harvey 1992, CBD 2010). Northern long-eared bats are found in eastern, Midwestern, and some southern US states (Caceres and Barclay 2000, Crnkovic 2003). A few northern long-eared bats have been reported in Montana and Wyoming (Schmidt 2001, CBD 2010).

Little is known about overall population size or historic, pre-WNS population trends of northern long-eared bat. Small population size is characteristic of all recorded occurrences (Schmidt 2001, CBD 2010). For example, hibernating groups are usually composed of fewer than 50 bats (NatureServe 2012). Across the species range, broader-scale population decline associated with habitat loss and disturbance to hibernacula have been noted (NatureServe 2012), while within portions of its range some surveys have reported stable populations (e.g., Trombulak et al. 2001, CBD 2010). However, recent losses due to WNS have been substantial. Dead northern long-eared bats have been recorded at many WNS-affected hibernacula (Blehert et al. 2009). Before the advent of WNS in 2006, this species was common in northeastern US bat surveys; after the arrival of WNS, survey numbers for northern long-eared bats declined to zero (Hicks et al. 2008, NatureServe 2012). While little is known about population size, information is available on population trends in both the winter and summer. Northern long-eared bat populations have declined an estimated 99% (from hibernacula data) in the northeastern portion of the species' range due to the emergence of WNS and the disease is likely to spread throughout the species' entire range within a short time (80 FR 17974).

<u>*New York*</u>

Northern long-eared bats have been recorded at 89 hibernacula consisting of abandoned mines, caves, and tunnels in New York, although many of the documented hibernating populations contain only a few individuals and more information is needed on the location of hibernation sites for the species (C. Herzog, pers. comm., Whitaker and Hamilton 1998 as cited in 80 FR 17974). Summer northern long-eared bat records have been documented in every New York county outside of New York City (USFWS 2017). Although population declines due to WNS have resulted in a significant decrease in the number of bats observed per sampling effort, it does not appear that the species has been extirpated from New York counties or that the distribution in New York has contracted (C. Herzog, pers. comm.).

Numbers of northern long-eared bats in New York have been affected by WNS since the disease was discovered in the state in 2006. The USFWS estimates that populations in New York and other northeastern states have decline by as much as 99% due to WNS (80 FR 17974). Each of 14 populations of northern long-eared bats in New York, Vermont, Connecticut, and Massachusetts studied by Langwig et al. (2012, as cited in 80 FR 17974) became locally extinct within two years due to WNS. Summer mist-net captures of northern long-eared bats in New York have declined from 0.21-0.47 bats/net night pre-WNS (2003-2008) to 0.012 bats/net night post-WNS (2011; Herzog 2012, unpublished data as cited in 80 FR 17974). Mist-net capture data provided by the NYSDEC from post-WNS surveys (2009-2012) conducted by the agency in areas where Indiana bat were expected to be found captured only seven northern long-eared bats over 1,693 net nights (compared to 139 little brown bats and 54 Indiana bats), or 0.004 bats/net night (C. Herzog, pers. comm.).

<u>*Permit Area/Local Population*</u>

Although the locations of maternity colonies and hibernacula for northern long-eared bats are largely unknown, northern long-eared bats are known to hibernate in Glen Park (in both the Glen Park Cave and the Glen Park Commercial Cave) and Limerick Cave, the hibernacula located nearest to the Permit Area. As described in Section 5.1.1.5, WNS was confirmed in Glen Park Cave in winter 2007-2008; based on the spread of the disease, it is likely that Limerick Cave was also impacted by WNS by the same winter (White-Nose Syndrome.org 2017). No other hibernacula are known to occur within 50 miles of the Permit Area; therefore, because the most common migration distances for northern long-eared bats are between 35 miles and 55 miles (USFWS 2014a), the Glen Park and Limerick Cave hibernating populations are believed to constitute the entire local population for the Permit Area.

Although the acoustic surveys conducted at the Project did not record any calls classified as northern long-eared bats (see Section 5.1.1.5), three northern long-eared bats were captured at three different sites (Figure 5.5) during the mist-net surveys. An adult female northern long-eared bat and a northern long-eared bat of unknown age, sex, and reproductive condition (the bat escaped prior to data being collected) were captured in the western part of the Project and a second adult female northern long-eared bat was captured along the transmission line corridor. Although the two female bats captured during the mist-netting were observed to be non-reproductive, the captures occurred early in the breeding season (June 8 – 13, 2012) before more obvious signs of reproductive activity (e.g., lactating, pregnancy) would have been apparent. The species was only acoustically detected by one call at one of the capture sites, Site #5. These survey results indicate that northern long-eared bats occur as residents and may also occur as migrants within the Project and along the transmission line during the entire active period for bats (spring, summer, and fall), although the local population appears to be very low based on the low number of captures during the pre-construction surveys and other post-WNS mist-netting surveys in New York (C. Herzog, pers. comm.).

Current Threats

An extensive list of both historical and current threats to the species can be found in the Final Rule (80 FR 17974) and the USFWS Interim Guidance. The following section focuses on the threat currently expected to have the greatest short-term and long-term impact upon the species, WNS, and provides context for the take assessment and the final take estimate. Although no significant declines due to factors other than WNS have been observed, other sources of mortality may have cumulative effects to populations that are reduced by WNS (80 FR 17974).

As described in Section 5.1.1.5 for Indiana bats, WNS is also the most severe threat facing northern long-eared bat populations range-wide and is the reason the species has been listed as threatened under the ESA (80 FR 17974). Populations of the northern long-eared bat in the northeastern US and eastern Canada have declined by up to 99% since the discovery of WNS in 2007, and the disease continues to spread westward throughout the species' range (80 FR 17974). Turner et al. (2011) compared the most recent pre-WNS count to the most recent post-WNS count and reported a 98% decline in the number of hibernating northern long-eared bats at 30 hibernacula in New York, Pennsylvania, Vermont, Virginia, and West Virginia. In Pennsylvania, researchers found a 99% decline in northern long-eared bat populations due to WNS (Turner 2013 unpublished data as cited in 80 FR 17974). Post-WNS (2010) mist-netting surveys in West Virginia found capture rates of northern long-eared bats were significantly reduced (22.9% of pre-WNS capture rate; Francl et al. 2012). Langwig et al. (2012) found that hibernacula surveys of 14 populations of northern long-eared bats surveyed in New York, Vermont, Connecticut, and Massachusetts indicated that hibernacula with larger pre-WNS populations of northern long-eared bats experienced greater declines, suggesting a density-dependent impact. Although Langwig et al. (2012) found that some populations of bat species affected by the disease stabilized at drastically reduced numbers compared to pre-WNS levels, each of the 14 northern long-eared bat populations in the study became locally extinct within two years, likely due to WNS.

5.2 Species Effects and Impacts Analysis

Bat fatalities and injuries have been reported due to collision with or barotrauma from[14] wind turbines at all wind power projects that have been monitored.

Although the level of mortality has been variable across regions, species, and seasons (Johnson 2005, Arnett et al. 2008), mortality studies of bats at wind projects in the US have shown several common trends:

- Impacts to bats from wind turbines are unequal across species. Despite there being differences in ecoregions, habitat, and location of wind projects, the majority of bat fatalities at wind projects in the US and Canada have been of hoary bat, eastern red bat, and silver-haired bat, all forest/tree dwelling long-distance migratory species (Johnson 2005, Arnett et al. 2008). The fatality pool for some eastern studies also includes a number of tri-colored bats, another regional migrant species (Arnett et al. 2008). The least common fatalities from wind energy projects in the eastern US are of big brown bats and mouse-eared bats (*Myotis* spp.; Johnson 2005, Arnett et al. 2008).
- Impacts to bats from wind turbines are unequal across seasons. The highest mortality occurs from roughly late July to mid-September, during what is believed to be the late summer dispersal or fall migration period for bats. Numerous studies across the US and Canada have shown this trend (Johnson 2005, Arnett et al. 2008).
- Impacts to bats from wind turbines are unequal across sites. Studies at different locations in the US and Canada indicate that bat mortality varies with site features or habitat, and while eastern deciduous forests in mountainous areas appear to be high-risk areas (Johnson 2005; Arnett et al. 2005, 2008), high bat mortality has also occurred at wind energy projects in prairie/agricultural settings (Baerwald 2007, BHE Environmental 2010) and mixed deciduous woods (Jain et al. 2007, Gruver et al. 2009).
- Impacts to bats from wind turbines appear to be unequal across various turbine heights and rotor sizes. Barclay et al. (2007) found that taller turbines have higher impacts based on a review of monitoring study results at wind projects; however, results of their analysis did not find a relationship between rotor diameter (blade length, rotor-swept area) and bat mortality. Good et al. (2011) observed higher bat mortality at turbines with longer blades and the same nacelle height but did not test for significance. Good et al. (2012) found differences in observed bat fatality rate by turbine type with the middle-sized turbine of three different types having the highest fatality rate, but again did not

[14] Based on results of a study in Alberta, Canada, it was hypothesized that a significant number of bat deaths at wind energy facilities were caused by barotrauma, described as lung tissue injuries caused by acute pressure changes as bats fly though air vortices near moving turbine blades (Baerwald et al. 2008). However, more thorough examination of bat carcasses salvaged at wind energy facilities has shown that barotrauma is not a significant source of bat mortality (Grodsky et al. 2011, Rollins et al. 2012) and additional evidence suggests that the pressure changes experienced by bats flying near a typical utility-scale turbine are at least an order of magnitude smaller than the threshold for lethality in mammals of equal mass (Houck et al. 2012).

test for significance. Differing results from these studies suggest that the relationship of turbine size characteristics with bat mortality is inconclusive and potentially varies depending on other factors, such as site-specific conditions, habitat, or location.

- Several studies (e.g., Mount Storm, West Virginia, Fowler Ridge, Indiana, and Summerview, Alberta; Table 6.1) have shown that turbines free-wheeling below cut-in wind speeds that are rotating slowly (e.g., only or two rpm) have less impact on bats compared to free-wheeling turbines with higher rpm, regardless of turbine type or size.

Little information is available regarding the circumstances under which Indiana bats and northern long-eared bats may collide with wind turbines. The two species compose an extremely low proportion of the total documented bat mortality at wind energy facilities. To-date, 13 Indiana bat fatalities have been reported to the USFWS and 48 northern long-eared bat fatalities have been reported in publicly-available post-construction monitoring studies in the US and Canada (Table 5.5). Although the power of most post-construction monitoring studies to detect a rare event (as fatalities of both species are considered to be) is weak, the low number of documented fatalities of the two species from the numerous post-construction monitoring studies conducted at many different facilities within the species' ranges over a time span longer than 10 years suggests that these species are less susceptible than other bats to wind turbine mortality, possibly due to aspects of their behavior.

Table 5.5 Publicly-available Indiana bat and northern long-eared bat fatalities recorded to-date at wind energy facilities in the US and Canada

Project Name	State/ Province	County	Date	Reference
Indiana bat fatalities (one per row)				
Fowler Ridge	IN	Benton	9/11/2009	Good et al. 2011
Fowler Ridge	IN	Benton	9/18/2010	Good et al. 2011
North Allegheny	PA	Blair, Cambria	9/26/2011	USFWS 2011c
Laurel Mountain	WV	Barbour, Randolph	7/8/2012	USFWS 2012c
Blue Creek	OH	Van Wert	10/2-3/2012	USFWS 2012b, Pruitt and Reed 2018
Anonymous	OH	Anonymous	10/7-9/2013	Pruitt and Reed 2018
Anonymous	OH	Anonymous	4/13-14/2014	Pruitt and Reed 2018
Anonymous	IN	Anonymous	8/23/2015	Pruitt and Reed 2018
Anonymous	IA	Anonymous	7/13/2016	Pruitt and Reed 2018
Anonymous	IL	Anonymous	9/23/2016	Pruitt and Reed 2018
Anonymous	IN	Anonymous	7/2017	Pruitt and Reed 2018
Anonymous	IN	Anonymous	5/1/2018	Pruitt and Reed 2018
Anonymous	IN	Anonymous	9/17/2018	Pruitt and Reed 2018
Northern long-eared bat fatalities (one per row)				
Anonymous	IA	Anonymous	8/10/2013	M. Turner, USFWS, pers. comm.
Anonymous	IA	Anonymous	8/22/2013	M. Turner, pers. comm.
Anonymous	IL	Anonymous	9/25/2013	M. Turner, pers. comm.
Fowler Ridge	IN	Benton	8/25/2009	Good et al. 2011
Criterion	MD	Garrett	7/22/2011	Young et al. 2013

Table 5.5 Publicly-available Indiana bat and northern long-eared bat fatalities recorded to-date at wind energy facilities in the US and Canada

Project Name	State/ Province	County	Date	Reference
Anonymous	MI	Anonymous	7/10/2014	M. Turner, pers. comm.
Anonymous	MO	Anonymous	2009[3]	M. Turner, pers. comm.
Cohocton/Dutch Hills	NY	Stueben	6/22/2010	Stantec 2011
Noble Ellenburg	NY	Clinton	8/na/2008	Jain et al. 2009
Noble Wethersfield	NY	Wyoming	6/11/2010	Jain et al. 2011
Noble Wethersfield	NY	Wyoming	7/17/2011	Kerlinger et al. 2011a
Noble Wethersfield	NY	Wyoming	8/6/2011	Kerlinger et al. 2011
Noble Wethersfield	NY	Wyoming	8/18/2011	Kerlinger et al. 2011
Noble Wethersfield	NY	Wyoming	9/2/2011	Kerlinger et al. 2011
Noble Wethersfield	NY	Wyoming	9/3/2011	Kerlinger et al. 2011
Steel Winds	NY	Erie	7/13/2007[1]	Grehan 2008
Steel Winds	NY	Erie	8/3/2007[1]	Grehan 2008
Steel Winds	NY	Erie	8/24/2007[1]	Grehan 2008
Steel Winds	NY	Erie	8/24/2007[1]	Grehan 2008
Steel Winds	NY	Erie	9/4/2007[1]	Grehan 2008
Steel Winds	NY	Erie	9/24/2007[1]	Grehan 2008
Erie Shores	Ontario	Norfolk	8/30/2007	James 2008
Erie Shores	Ontario	Norfolk	5/25/2007	James 2008
Erie Shores	Ontario	Norfolk	6/11/2007	James 2008
Erie Shores	Ontario	Norfolk	6/12/2007	James 2008
Erie Shores	Ontario	Norfolk	8/28/2007	James 2008
Erie Shores	Ontario	Norfolk	8/28/2007	James 2008
Kingsbridge I	Ontario	Huron	10/5/2006	Stantec Ltd. 2007
Ripley	Ontario	Bruce	9/5/2008	Jacques Whitford 2009
Ripley	Ontario	Bruce	8/4/2008	Jacques Whitford 2009
Bear Mountain	British Columbia	-	9/1/2010	Hemmera 2011
Bear Mountain	British Columbia	-	9/1/2010	Hemmera 2011
Bear Mountain	British Columbia	-	8/2010	Hemmera 2011
Bear Mountain	British Columbia	-	8/2010	Hemmera 2011
Bear Mountain	British Columbia	-	8 or 9/2010	Hemmera 2011
Meyersdale	PA	Somerset	9/13/2004	Arnett et al. 2005
Meyersdale	PA	Somerset	9/11/2004	Arnett et al. 2005
PGC site 2-14	PA	Anonymous	9/na/2009	J. Taucher, PGC, pers. comm.
PGC anonymous site	PA	Anonymous	7/na/2012	J. Taucher, PGC, pers. comm.
Mount Storm	WV	Grant	8/26/2008	Young et. al 2009
Mountaineer	WV	Tucker	8/18/2003	Kerns and Kerlinger 2004
Mountaineer	WV	Tucker	na/na/2003[2]	Kerns and Kerlinger 2004
Mountaineer	WV	Tucker	na/na/2003[2]	Kerns and Kerlinger 2004

Table 5.5 Publicly-available Indiana bat and northern long-eared bat fatalities recorded to-date at wind energy facilities in the US and Canada

Project Name	State/ Province	County	Date	Reference
Mountaineer	WV	Tucker	na/na/2003[2]	Kerns and Kerlinger 2004
Mountaineer	WV	Tucker	na/na/2003[2]	Kerns and Kerlinger 2004
Mountaineer	WV	Tucker	9/8/2003	Kerns and Kerlinger 2004
Anonymous	-	-	-	M. Seymour, USFWS, pers. comm.
Anonymous	-	-	-	M. Seymour, USFWS, pers. comm.

[1] The NYSDEC identified the bat species for this survey; species are not included in the study report.
[2] Study reported that northern long-eared bat fatalities were first recorded on 8/18/2003 and last recorded on 9/8/2003 but did not provide dates for every fatality of the species.
[3] The northern long-eared bat fatality occurred between 5/16/2009 and 11/15/2009.

Although the documented northern long-eared bat fatalities are more numerous than the documented Indiana bat fatalities, the available mist-netting data and post-construction monitoring data in New York and Pennsylvania indicates that mortality of northern long-eared bats at wind energy projects occurs substantially less often than their prevalence on the landscape would suggest. For example, a comparison of the ratios of northern long-eared bats to little brown bats (a similar *Myotis* species that is adapted to forage higher and in more open landscapes) in the mist-netting and post-construction monitoring datasets demonstrates that the species have different risk profiles for turbine collision mortality. Post-WNS (2009-2012) mist-netting survey data provided by the NYSDEC (C. Herzog, pers. comm.) indicate that throughout New York, northern long-eared bat captures composed 38.85% of the little brown bat captures. However, northern long-eared bat fatality records in the publicly available post-WNS mortality monitoring reports from throughout New York only composed 13.21% of the little brown bat fatality records, less than half the number of northern long-eared bat fatalities that would be expected if the risk profiles of the two species were the same. The data compiled by the PGC in the Third Annual Summary Report (Taucher et al. 2012) for wind projects across Pennsylvania further corroborate the conclusion that northern long-eared bats experience disproportionately less turbine collision mortality. Pre-construction mist-netting survey data conducted at project sites throughout Pennsylvania from 2004-2011 indicate that northern long-eared bat captures composed 87.72% of the little brown bat captures; however, northern long-eared bat fatality records in the 2007-2011 post-construction monitoring data provided in the same report composed only 0.43% of the little brown bat fatality records (Taucher et al. 2012).

The fatality records that have been documented to date for the Covered Species, although limited in number, indicate that turbine collision mortality varies seasonally. Fatality evidence to date suggests female migratory Indiana bats are most vulnerable during fall migration and swarming periods, and male Indiana bats could be vulnerable during the summer at facilities in close proximity to hibernacula. Two Indiana bat fatalities have been found at wind projects during spring (Table 5.5), but Indiana bat mortality during the spring period is not well understood. The distribution of maternity colonies (i.e., the destination for spring migration and areas of concentrated summer use) in relation to existing wind energy facilities is largely unknown. Range-wide, five of the 13 Indiana bat fatalities documented to date have occurred outside of the fall migration period (as defined for the regions in which the fatalities occurred) at monitored wind projects. However, mortality monitoring conducted within the Indiana bat range during spring and summer has, in some areas, been less intensive than monitoring conducted during fall, when mortality of all bats has been found to be highest (Kunz et al. 2007, Arnett et al. 2008).

Although most (75%) northern long-eared bat fatality records for which a date is known have occurred during the fall migration and swarming seasons (August 1 – October 31), records also exist for the summer season before it is overlapped by the fall migration season (25%; May 16 – July 31), indicating that northern long-eared bats are susceptible to turbine mortality during the entire bat active period, though mortality has been greater during fall migration. Because the species had not yet been proposed for listing under the ESA at the time the fatalities in Table 5.5 were recorded, dates were not recorded for all fatalities. Additionally, specific information on age and sex of the fatalities was not reported by most of the studies and it is currently unknown if males and females are more susceptible to turbine mortality in different seasons.

5.2.1 Indiana Bat

5.2.1.1 Seasonal Mortality

The following general seasons are used to define specific activity periods among which mortality of Indiana bats at the Project is expected to vary. The 2007 Recovery Plan provides additional details about Indiana bat seasonal activity and provides supporting information regarding the date ranges. Although there is overlap in seasonal behaviors, these seasons are presented as discrete for the purposes of management decisions. Variation in weather conditions and other stochastic factors could affect the timing of this annual chronology. However, these seasons as defined below represent the general activity periods that are expected to differentially affect collision mortality and reflect the periods used to establish the conservation program for the Project (Chapter 6 *Conservation Program*). Based on the results of site-specific survey results and the best available scientific literature, relative mortality by season of Indiana bats at the Project is expected to be as follows:

Winter Hibernation Season (November 1 to March 31)
During this period, Indiana bats are expected to be hibernating within caves and abandoned mines. Activity levels by hibernating bats outside the cave are non-existent or extremely low and mortality of bats at Project turbines is not expected to occur.

Spring Migration Season (April 1 to May 15)
The timing of spring bat emergence from hibernacula and migration to summer habitat varies depending on a number of factors, such as latitude, elevation, and weather patterns, but typically occurs between mid-April and the end of May in northern New York. During spring radio telemetry studies, the NYSDEC conducts emergence surveys in April/May when night time temperature exceeds 50 ^{o}F (C. Herzog, pers. comm.) because the likelihood of all bats exiting the roost tree is greatly increased. On-site acoustic surveys at the Project began on April 15, 2012, and did not show substantial increases in all-bat activity within the Project area until July (Figure 5.6; Sanders Environmental 2012).

The spring migration period appears to be somewhat compressed in time as some studies have shown female Indiana bats flying the entire distance to their maternity areas in one night (USFWS 2007). Due to the lack of maternity colonies (i.e., spring migration destinations, see below), Indiana bats are not expected to concentrate or linger within or near the Permit Area during spring migration. As discussed above, two of the 13 (15%) Indiana bat fatalities recorded to date at wind energy facilities occurred during spring (Table 5.5); this percentage was used to assign the proportion of take that may occur during the spring migration season.

Summer Maternity Season (May 16 to September 30)
Based on the elevation of the Permit Area and surrounding areas, Indiana bat maternity colonies are not expected to occur; this expectation was supported by the lack of Indiana bat detections during on-site mist-netting and acoustic surveys (Section 5.1.1.5). In the northern portions of the species' range, elevation appears to influence the location of Indiana bat maternity colonies. For example, roost trees in the Champlain Valley of Vermont and New York occur at elevations much lower (i.e., 100-490 ft ASL) than the surrounding mountains, which have maximum elevations of 4,400 ft and 4,360 ft ASL (Britzke et al. 2006, Watrous et al. 2006). Elevations within the Permit Area range from approximately 835 ft to 1,500 ft ASL and all maternity roosts in New York to date have been located at or below 900 ft ASL (A. Hicks, NYSDEC, pers. comm., and C. Herzog, pers. comm.). These results indicate that Indiana bat maternity colonies are unlikely to occur within the Permit Area.

It is currently unknown whether elevation affects male and non-reproductive female Indiana bat selection of foraging and roosting habitat in New York. Based on the proximity of the Glen Park hibernaculum (10-15 miles northwest of the Project), it is possible that male or non-reproductive female Indiana bats may occasionally roost and forage within the Permit Area; but unlikely given the results of surveys to date. Three of the 13 (23%) Indiana bat fatalities recorded to date at wind energy facilities occurred during the summer season (Table 5.5). However, because no Indiana bat maternity colonies are known to occur near the Project (Section 5.1.1.5), no summer fatalities are anticipated from the Project.

Fall Migration Season (August 1 to September 30)
Following the summer maternity season, there is a period when Indiana bats disperse away from the maternity areas and migrate back to the hibernacula. This period overlaps with the summer season as some bats may stay in summer habitat throughout much of this period. During this period there may be more "relaxed" movements between the maternity areas and the hibernacula, and thus Indiana bats may be more dispersed on the landscape (e.g., not concentrated around maternity areas). Hibernacula are a destination for Indiana bats migrating from their maternity area to wintering areas; the Glen Park hibernaculum (located west-northwest of the Permit Area) is expected to be the destination for most Indiana bats migrating in the vicinity of the Permit Area. Indiana bats which disperse to summer habitat east of the Permit Area may migrate through the Permit Area in fall during their movements towards Glen Park. The NYSDEC led a telemetry study that tracked 32 Glen Park Indiana bats during spring emergence and documented bats dispersing to the south, west, and north of the hibernaculum

to lower elevation areas (NYSDEC, unpublished data; Figure 5.10). The bats did not disperse to the southeast of the hibernaculum (i.e., towards or across the Permit Area). While not observed during the study, Glen Park Indiana bats were subsequently documented to disperse northeast to Fort Drum and it is possible that male and non-reproductive female Indiana bats occasionally disperse east-southeast of Glen Park to the Permit Area or areas east of the Permit Area, such as to areas of suitable summer habitat present near the Black River to the east of the Permit Area. The relatively low population (approximately 239 Indiana bats in 2014-2015) of the Glen Park hibernaculum and the concentrated maternity colonies within low elevation habitat in fairly close proximity to Glen Park indicate that few Indiana bats are likely to migrate across the Permit Area. However, mortality of Indiana bats during this season is expected to be higher than during all other seasons and most, or all, of the estimated Indiana bat take at the Project is expected to occur during the fall migration period. Based on the seasonal distribution of the 13 Indiana bat fatalities recorded to date at wind energy facilities (Table 5.5) and because take is considered unlikely during the summer, fall swarming, and late fall season (see below), approximately 85%[15] of the expected take may occur during the fall migration season.

Fall Swarming and Late Fall Season (October 1 to October 31)
When Indiana bats arrive at hibernacula in the fall, they engage in swarming (mating) activity in the habitat at the entrance and around the hibernacula. Recent USFWS guidance (USFWS 2011d) suggests that the area within 20 miles of P1 and P2 hibernacula and 10 miles of P3 and P4 hibernacula could be used for foraging and daytime roosting habitat during the swarming period. Glen Park is classified as a P2 hibernaculum because in the late 1980s, 1990s and early 2000s, the cave supported populations of 1,000 to over 3,000 Indiana bats (max of 3,129 bats in 1999). However, the Glen Park Indiana bat population has declined substantially due to WNS, with only 239 Indiana bats recorded in the 2014-2015 count, resulting in fewer Indiana bats on the landscape altogether. Given this reduced population size (now similar in size to a P3 hibernaculum), the Glen Park Indiana bats may not need as large of a geographic area during fall swarming and may be concentrated closer to the hibernaculum to find potential mates (i.e., within 10 miles instead of 20 miles). Because the Permit Area is not located closer than 10 miles to the hibernaculum, it is highly unlikely that fall swarming bats would forage and roost within the Permit Area. Additionally, pre-construction acoustic surveys at the site recorded only 1.1% of calls at the upper detector and no calls at the lower detector after September 29, 2012, indicating that bat activity within the Permit Area sharply declines after the fall migration season. Mortality of Indiana bats during the fall swarming and late fall season is considered unlikely. The potential for mortality of Indiana bats during this season to occur as a result of the Glen Park population recovering to the point of a functional P2 hibernaculum is addressed as a changed circumstance (Section 7.1.3).

[15] 15% in spring and 85% in fall

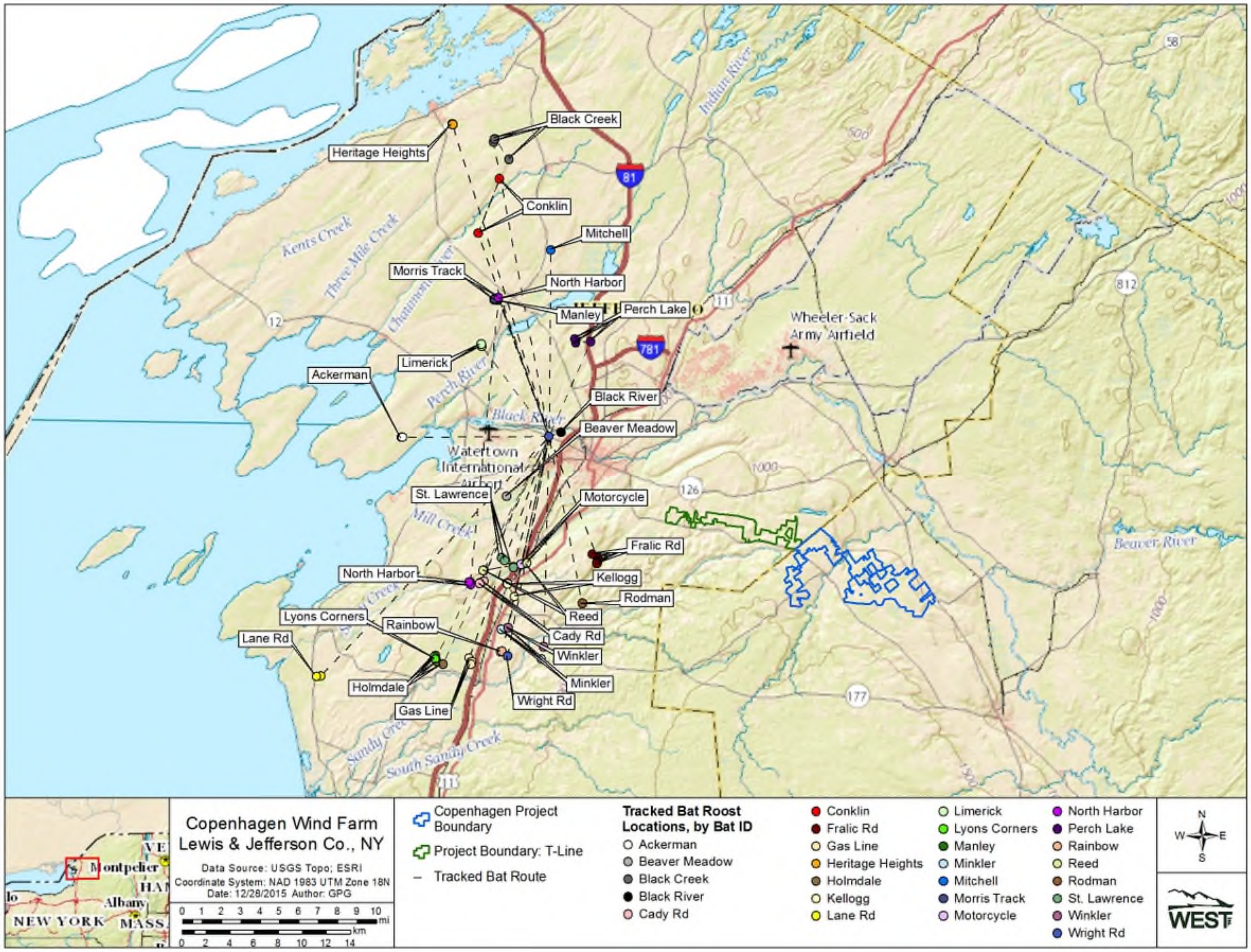

Figure 5.10 Map showing direction and destination of Indiana bats, tracked by the New York State Department of Environmental Conservation, leaving Glen Park hibernaculum.

5.2.1.2 Estimated Take

The population of Indiana bats that may be affected by the Project (i.e., the affected population) consists of the Indiana bats that hibernate within approximately 50 miles of the Permit Area, based on the maximum recorded migration distance for Indiana bats in the NERU (42 miles; C. Herzog, pers. comm.). Mortality of Indiana bats is qualitatively expected to be low at the Project based on the low likelihood of Indiana bat occurrence within the Permit Area (see Section 5.2.1.1 above).

The species composition method was determined to be the most appropriate take estimate approach based on the Project and the datasets available. The species composition method is based directly on fatality records of the Covered Species and assumes the fatality records from post-construction monitoring studies available for review are representative of bat fatalities in general and the bat fatalities at the Project (i.e. not just Covered Species at the Project). The closest Indiana bat fatality records to the Permit Area were recorded in Pennsylvania and West Virginia (see below). Although these fatalities occurred in a different RU from the Permit Area, a broad-scope dataset incorporating these fatalities was considered to be appropriate for estimating take at the Project based on the current lack of knowledge of Indiana bat risk factors and the limited post-WNS data available. Additionally, the inclusion of data from the AMRU is conservative (i.e., may over-estimate impacts from the Project) because although most wind facilities in the NERU and AMRU are located in similar landscapes, wind facilities located on forested ridgelines in the AMRU have reported many of the highest bat mortality rates in North America (Arnett et al. 2008). The method and datasets used to estimate take of Indiana bats at the Project using the species composition method are summarized below.

The first step in the species composition approach to estimating potential future take of a listed bat species at a wind energy facility is to determine the potential level of bat mortality (all species) at the facility. Because no post-construction monitoring data are available for the yet-to-be-constructed Project, all publicly available post-construction monitoring data collected after WNS impacts began ("post-WNS") at wind projects within the migratory range of the Covered Species (approximately 50 miles) from the Permit Area were considered. Although data from the AMRU were used in the species composition dataset out of necessity (no Indiana bat fatality records exist closer to the Project), all-bat mortality rate data were available from wind projects located nearer to the Permit Area. This dataset includes the landscape on which occur nearly all bats of the Covered Species that are likely to encounter the Project turbines and it is therefore considered to be most representative of the risk at the Project. This is why AMRU data were used for species composition, but were not the best available data for estimating all-bat mortality. Only post-WNS data were used to more closely represent the current and future risk at the Project. Based on the average annual bat mortality rate from this dataset, the bat mortality rate at the Project is estimated to be 8.629 bats/MW/year (Table 5.6), or 689.459 total bat fatalities per year over the Project's 79.9 MW.

Table 5.6 Adjusted bat mortality rates from publicly available, post-white nose syndrome, post-construction monitoring studies within 50 miles (80 kilometers) of the Copenhagen Wind Farm.

Project Name	State/ Province	Maximum Blade Height	Cut-in Speed	Study Period	Bat Mortality/ MW/Year	Notes	Reference
Maple Ridge	***NY***	397 ft (121 m)	3.5 m/s (11.4 ft/s)	7/12/2012 – 10/15/2012[1]	10.771	Adjusted to an April 1-November 15 estimate	Tidhar et al. 2013a
Wolfe Island, Report 2	***Ontario***	410 ft (125 m)	4.0 m/s (13.1 ft/s)	7/11/2009 – 12/31/2009[1]	8.875	Adjusted to an April 1-November 15 estimate	Stantec Ltd. 2010
Wolfe Island, Reports 3 & 4	***Ontario***	410 ft (125 m)	4.0 m/s (13.1 ft/s)	1/1/2010 – 6/30/2010 and 7/1/2010 – 12/31/2010	11.770	The two 6-month reports were combined into a 12-month estimate, then adjusted to an April 1-November 15 estimate	Stantec Ltd. 2011a, 2011b
Wolfe Island, Reports 5 & 6	***Ontario***	410 ft (125 m)	4.0 m/s (13.1 ft/s)	1/1/2011-6/30/2011 and 7/1/2011-12/31/2011	3.100	The two 6-month reports were combined into a 12-month estimate, using only the data from control turbines and turbines excluded from the fall 2011 curtailment study[3], then adjusted to an April 1- November 15 estimate	Stantec Ltd. 2011c, 2012
Average[2]					**8.629**		

[1]Mortality rates were adjusted from the rates provided in reports for those studies with periods lasting shorter than the bat active season (April 1 – November 15), based on the percent of the bat carcasses documented in other reports during the period(s) of the bat active season excluded from the study.
[2] No confidence interval calculated for the average due to the limited number of studies available for the dataset.
[3] Non-trial turbines were operated the same as the control turbines (i.e., normal operations) but the mortality rates were reported separately for the two turbine groups.

The next step in estimating potential future take of a listed bat species is to determine what proportion of the overall bat mortality rate may be attributable to the listed species. The level of potential mortality for particular bat species can be estimated based on the species composition of the fatalities reported in the post-construction studies from the region. Of the Indiana bat fatalities on record, the nearest to the Permit Area are the two fatalities that occurred in the AMRU, at the North Allegheny project in Blair and Cambria counties in Pennsylvania, approximately 280 miles (450 km) from the Permit Area, and at the Laurel Mountain project in Barbour and Randolph counties in West Virginia, approximately 400 miles (640 km) from the Permit Area. The North Allegheny fatality occurred in 2011, during the WNS transition period for Pennsylvania (R. Niver, pers. comm.); although the Indiana bat population in that area may not have been experiencing significant declines yet, the fatality and other species composition data from 2010 and 2011 in Pennsylvania were conservatively included as post-WNS data in the take estimate calculations. The Laurel Mountain fatality occurred in 2012 and is considered to be post-WNS data.

All publicly available post-WNS studies at wind projects within the NERU and the AMRU which reported the necessary species composition data were considered for this step of the analysis. Based on the species composition of the carcasses reported by the studies (Table 5.7), it is estimated that Indiana bats may compose 0.047% of the annual overall bat mortality at the Project (Table 5.8). Therefore, take of Indiana bats was estimated to be approximately one Indiana bat fatality every three years, or 0.327 Indiana bat fatality per year (689.459 total bats/year * 0.047% Indiana bat species composition = 0.327 Indiana bat/year). This would result in an estimated take of 8.175 Indiana bats during the 25-year ITP term (0.327 Indiana bat/year * 25 years = 8.175 Indiana bats), before the benefits of this HCP's minimization measures are considered.

Table 5.7 Publicly available, post-white nose syndrome, post-construction monitoring studies with reported species composition data in the Northeast Recovery Unit and Appalachian Mountain Recovery Unit.

Project Name	State/ Province	Recovery Unit	Reference
Noble Altona 2010	NY	NERU	Jain et al. 2011b
Noble Chateaugay 2010	NY	NERU	Jain et al. 2011c
Noble Clinton 2009	NY	NERU	Jain et al. 2010a
Noble Ellenberg 2009	NY	NERU	Jain et al. 2010b
Maple Ridge 2012	NY	NERU	Tidhar et al. 2013a
PGC 2010-2013[1]	PA	AMRU	Taucher et al. 2012, J. Taucher, PGC, pers. comm.
Mount Storm 2010	WV	AMRU	Young et al. 2010a, 2011b
Mount Storm 2011	WV	AMRU	Young et al. 2011a, 2012
Pinnacle 2012	WV	AMRU	Hein et al. 2013
Pinnacle 2013	WV	AMRU	Hein et al. 2014

[1] Includes all projects participating in the PGC Wind Energy Voluntary Cooperation Agreement

Table 5.8 Species composition of bat carcasses reported in publicly available, post-white-nose syndrome, post-construction monitoring studies with reported species composition data in the Northeast Recovery Unit and Appalachian Mountain Recovery Unit.

Species	Scientific Name	Total	Percent of All Bats
hoary bat	*Lasiurus cinereus*	344	8.157
eastern red bat	*Lasiurus borealis*	310	7.351
little brown bat	*Myotis lucifugus*	129	3.059
silver-haired bat	*Lasionycteris noctivagans*	121	2.869
tri-colored bat	*Perimyotis subflavus*	43	1.020
big brown bat	*Eptesicus fuscus*	33	0.783
Indiana bat[1]	*Myotis sodalis*	2	0.047
Seminole bat	*Lasiurus seminolus*	1	0.024
undisclosed, non-*Myotis* bat[2]	n/a	3,234	76.690
Total		**4,217**	**100.000**

[1] Indiana bat record from Laurel Mountain was included in the analysis despite the lack of publicly available species composition data for the project; the average number of total non-Indiana bat carcasses reported by the other projects in West Virginia was included as “unidentified bat” for this project.

[2] Although species composition data are not available by year in the PGC Third Annual Summary Report (Taucher et al. 2012) which spans 2007-2011, J. Taucher provided data on the number of little brown bats, northern long-eared bats, and Indiana bats reported in each year, as well as the total number of other bat carcasses found in 2010-2013 (represented as “undisclosed, non-*Myotis* bats”), to enable only WNS transitional and post-WNS data to be used in this analysis.

Sources: see Table 5.7.

5.2.1.3 Estimated Take with Minimization Measures and Authorized Take Limit

To avoid or minimize potential Indiana bat mortality at the Project, CWF will implement a seasonal turbine operational adjustment protocol that targets the seasonal period when mortality of both Covered Species (and all bats in general) is expected to be highest (see Section 6.3.3). The protocol will include:

1. fully feathering the Project turbines outside of the 3-mile (5-km) radius from the northern long-eared bat capture at wind speeds below the turbines’ manufacturer’s rated cut-in speed (3.0 m/s) from April 1 to July 31 (spring migration season and summer maternity season until overlapped by fall migration season);
2. fully feathering all Project turbines at wind speeds below 5.0 m/s (16.4 ft/s) from August 1 to September 30 (summer maternity season and fall migration season) from nautical sunset to nautical sunrise when temperatures are above 40 °F; and
3. Feathering the 16 Project turbines within the 3-mile radius from the northern long-eared bat capture at wind speeds below 5.0 m/s from May 16 to July 31 (summer maternity season until overlapped by fall migration season) from nautical sunset to nautical sunrise when temperatures are above 40 °F (primarily implemented to minimize mortality of summer resident northern long-eared bats).

The available information from curtailment effectiveness studies conducted to-date suggests that this seasonal turbine operational adjustment protocol will reduce annual bat mortality due to turbine operations by at least 30% during spring and summer and at least 60% during fall (see

Section 6.3.3 below). Because the expected 60% reduction will apply to the fall migration season, during which most bat mortality at the Project (and approximately 85% of the Indiana bat take) is expected to occur, the seasonal turbine operational adjustment protocol is expected to reduce the annual rate of all-bat mortality and Indiana bat take by 55.5% ([30% reduction * [15% of take in spring] + [60% reduction* 85% of take in fall] = 55.5% reduction). Assuming take of Indiana bats (0.327 Indiana bat/year) will be reduced by approximately 50% by this minimization measure, the estimated annual take from the Project with implementation of the minimization measures is 0.163 Indiana bat, or 4.087 Indiana bats over the 25-year ITP term. The level of take rounds to one Indiana bat every six to seven years and four total Indiana bats over the 25-year ITP term. Based on the expected seasonality of Indiana bat mortality at the Project (Section 5.2.1.1), it is most likely that one mortality may occur during spring and the other three may occur during fall.

5.2.1.4 Impacts of the Taking

Determining the significance of potential take on a population requires an understanding of population demographics and in particular annual survival or mortality rates. This section includes an evaluation of impacts at three population levels: the affected population (i.e., individuals that hibernate within approximately 50 miles of the Permit Area), the regional population (i.e., within the NERU), and the national population (i.e., range-wide).

The long lifespan and relatively low reproductive rate of Indiana bats (Section 5.1.1) means that the loss of reproductively active female bats has the potential to significantly affect the local population to which they belong. The impact of not only losing female bats but also the recruitment associated with those females must be considered. Of the maximum take of four Indiana bats estimated to occur over the 25-year permit term, approximately 50% (two) are expected to be female Indiana bats. Approximately 50% of the take in spring (15% of total take; one bat) and in fall (85% of total take; three bats) is expected to affect female Indiana bats (2 females). There is currently an insufficient amount of data to determine if one sex of Indiana bat is more susceptible to turbine mortality than the other as a large proportion of *Myotis* carcasses recorded in publicly available monitoring reports to-date were not identified to sex. Because there are no known Indiana bat maternity colonies near the Project that would cause female Indiana bats to migrate towards the Project and due to the proximity to the Glen Park hibernaculum, it was assumed that Indiana bats migrating through the Project in both spring and fall may comprise both male and female bats moving across the landscape. Therefore, take during both seasons is in general expected to affect both sexes equally. The seasonal distribution of female Indiana bat take was based on the relative proportion of expected Indiana bat fatalities in spring, summer, and fall, as described in Section 5.2.1.1.

Applying the simplified reproductive services model developed for Indiana bats by the USFWS (USFWS 2016a) under the assumption that the affected population is declining and will continue to decline over the permit term (an assumption made based on the current WNS status of the population and the lack of clear evidence of population stabilization or recovery in WNS-positive hibernacula) results in an estimated 3.2 female pups lost from the population due to the take of two adult females. Therefore, the impact of take from the Project is estimated to be approximately five (2.0 + 3.2 = 5.2) female Indiana bats.

Based on the most recent hibernacula surveys (winter 2014-2015), the estimated number of Indiana bats hibernating in Glen Park, the only known Indiana bat hibernaculum within 50 miles of the Permit Area, was approximately 239 Indiana bats (R. Niver, pers. comm.). The direct loss of five female Indiana bats (take of two adult females plus the reproductive loss of three females) will be spread out over the 25-year ITP term (0.2 bat/year or approximately one bat every five years). Based on the current Glen Park hibernaculum population estimate of 224 bats, the average annual impact of take would represent 0.09% of the affected population. Based on recent data for the regional and national population estimates (14,433 and 559,781 respectively; USFWS 2018), the average annual impact of take would represent approximately 0.001% of the regional and 0.00004% national Indiana bat populations (Table 5.9) if the populations remain the same. These proportions will change as the overall populations change, but the likelihood of take may also scale to the total population size (in years when the population size is lower, take may be less likely, but as population size increases, take could become more likely).

Table 5.9 Percent loss of Indiana bat populations based on estimated Indiana bat take under the Copenhagen Wind Farm Habitat Conservation Plan.

Population	Definition	Population Estimate (2018)	Annual Impact of Take	Population Loss (% 2018 Population Estimate)	Reference
Affected	Hibernacula within 50 miles (80 km) of Permit Area	224	0.2	0.09	R. Niver, USFWS, pers. comm.
Regional	Northeast Recovery Unit	14,433	0.2	0.001	USFWS 2015a
National	Range-wide	559,556	0.2	0.00004	USFWS 2015a

Therefore, although the affected, regional, and national Indiana bat populations are declining due to WNS, the average impact of the take at all three population levels is small (five female Indiana bats/25 years = 0.2 female Indiana bat/year) and the expected impact of take over the term of the permit (five Indiana bats) is also small relative to all three population levels. This impact of take will be fully offset by the mitigation, as described in Section 6.4.

5.2.2 Northern Long-eared Bat

5.2.2.1 <u>Seasonal Mortality</u>

Based on the most frequently recorded migration distances for northern long-eared bats (USFWS 2014), northern long-eared bats occurring within the Permit Area are expected to belong to the Glen Park hibernating population or populations from other, unknown hibernacula within approximately 50 miles of the Permit Area.

As described above for Indiana bats, the following general seasons are used to define specific activity periods among which mortality of northern long-eared bats at the Project is expected to vary and reflect the periods used to establish the conservation program for the Project (Chapter 6 *Conservation Program*). The USFWS Interim Guidance provides additional details about northern long-eared bat seasonal activity and provides supporting information regarding the date ranges. Based on the site-specific survey results and the best available scientific literature, relative mortality by season of northern long-eared bats at the Project is expected to be as follows:

Winter Hibernation Season (November 1 to March 31)
During this period, northern long-eared bats are expected to be hibernating within caves, abandoned mines, and habitat resembling caves (e.g., railroad tunnels, storm sewers, etc.). A low level of localized northern long-eared bat activity may occur outside caves during the winter. For example, 11 nights of trapping between January 16 and March 17 at a hibernaculum in Indiana yielded 50 little brown bats and 131 northern long-eared bats (Whitaker and Rissler 1992). Northern long-eared bats are also known to move from one hibernaculum to another during a winter season (USFWS 2014).

Flight distances by winter-active bats are unknown, but it seems likely that bats do not engage in long-distance movements as the physiological costs for doing so are likely to be too great. A study in Alberta tracked two males and a female captured during winter flights: the males roosted within 656 ft (200 m) of the capture site and the female roosted three miles away. Patterson and Hardin (1969) estimated average flight speed for little brown bats and Indiana bats as 12.7 miles per hour (mph; 20.4 km per hour [kph]) and 12.6 mph (20.1 kph), respectively. Using the midpoint of these two rates (12.6 mph [20.3 kph]) as an estimate of northern long-eared bat flight speed, it would take approximately two hours for a northern long-eared bat to travel to or from an alternate hibernaculum located 25 miles (40 km) away. Given that bats lose an estimated 0.02 g (0.0007 ounce) of body mass per minute of flight, a 90-minute flight would be fatal (Stebbings 1966). It is consequently unlikely that winter flight in northern long-eared bats involves either long distances or extended periods. Therefore, winter-active northern long-eared bats are not expected to occur near Project turbines due to the lack of hibernacula in the Permit Area and mortality of the species is not expected to occur at the Project during this season.

Spring Migration Season (April 1 to May 15)
The spring migration period for northern long-eared bats appears to be similar to that for Indiana bats (USFWS 2014). Northern long-eared bats occurring as summer residents in the western part of the Permit Area (see below) would migrate to the area from hibernacula during the spring season. However, the northern long-eared bat spring migration period is likely to be somewhat compressed in time similar to the Indiana bat spring migration period due to the similarities among the two species (USFWS 2014). Bats making direct, single-night migrations would spend less time exposed to turbines than bats migrating during the fall, when migration movements may be extended. This is supported by the lack of northern long-eared bat fatalities recorded during this period (Table 5.5). The earliest of the 48 northern long-eared bat fatalities recorded

to date at wind energy facilities for which a date is known occurred on May 25 (Table 5.5). However, at least one northern long-eared bat maternity colony is present in the area that may cause spring migrants to fly through the Permit Area. Therefore, it is conservatively assumed that approximately 13% of the northern long-eared bat fatalities, or half of the estimated summer take based on the relative length of the seasons, may occur during the spring season.

Summer Maternity Season (May 16 to September 30)

The capture of an adult female northern long-eared bat and a northern long-eared bat of unknown age, sex, and reproductive condition (the bat escaped prior to data being collected) in the western part of the Permit Area during pre-construction mist-netting surveys indicates that northern long-eared bats occur as summer residents and may have a maternity colony in that part of the Permit Area. Surveys in the eastern part of the Permit Area were negative for northern long-eared bats. Although the female bat captured during the mist-netting was observed to be non-reproductive, the capture occurred early in the breeding season (June 8, 2012) before more obvious signs of reproductive activity (e.g., lactating, pregnancy) are apparent and it is therefore possible that the bat belonged to a maternity colony in the area.

As described above, 16 Project turbines are within the 3-mile home range/foraging distance radius (USFWS 2014) of the northern long-eared bat capture sites. These turbines may cause mortality of resident northern long-eared bats during the summer maternity season, although the foraging behavior of the species is likely to limit exposure of the species to the rotor-swept area of the Project turbines. The forested habitat near 11 of the Project turbines within the home range/foraging distance radius has only limited connectivity (i.e., sparse trees and shelterbelt/fencerow lines) to the woodlots in which the northern long-eared bats were captured, indicating that northern long-eared bats occurring in the capture woodlots may be less likely to use the forested habitat near those 11 turbines.

Northern long-eared bats do not forage in intensively harvested stands or open agricultural areas, containing movement to intact forest (Patriquin and Barclay 2003, Henderson and Broders 2008). They are known to forage under the forest canopy at small ponds or streams, along paths and roads, or at the forest edge (Caire et al. 1979). Northern long-eared bats have low wing loading, a low aspect ratio, and are highly maneuverable in forested habitat and therefore well-adapted to foraging in dense vegetation (Patriquin and Barclay 2003, Carter and Feldhamer 2005). The species is generally understood to forage lower and more within the forest canopy than Indiana bats (USFWS 2014), indicating that flights into the rotor-swept zone of the Project turbines (which is far above the top of the forest canopy) by foraging summer resident bats are uncommon. The extensive post-construction monitoring dataset collected through standardized mortality searches at wind facilities across Pennsylvania from 2007 to 2013 (Taucher et al. 2012; J. Taucher, pers. comm.) indicates that collision mortality is rare for northern long-eared bats. Pennsylvania is a state in which northern long-eared bats have historically been widespread and relatively common (exemplified by the mist-netting data in Taucher et al. 2012) and in which most wind facilities are developed on forested ridgelines or in forested landscapes. Many of the wind energy facilities participating in the Pennsylvania Wind Energy Voluntary Cooperation Agreement therefore likely have summer resident northern long-eared bats on site or nearby, yet only two northern long-eared bat fatalities have been recorded among 4,245 total bat carcasses found during monitoring under the Agreement.

Mortality of northern long-eared bats during this season is therefore expected to be relatively low and infrequent; only a small amount of the estimated northern long-eared bat take at the Project is expected to occur during summer. Based on the seasonal distribution of the 48 northern long-eared bat fatalities recorded to date at wind energy facilities (Table 5.5), approximately 25% of the take may occur during the summer season.

Fall Migration Season (August 1 to September 30)

Similarly to Indiana bats, northern long-eared bats disperse away from maternity areas and migrate back to hibernacula following the maternity season; movements may be more "relaxed," more dispersed on the landscape, and may occur over a longer period of time than during the spring migration season. Hibernacula are a destination for northern long-eared bats migrating from their maternity area to wintering areas; northern long-eared bats in the Permit Area and surrounding landscape are most likely to migrate to the Glen Park hibernaculum based on its proximity to the Permit Area and the most frequently documented migration distances for northern long-eared bats (35-55 miles; see USFWS 2014). Most other hibernacula known to be used by northern long-eared bats in New York are located in the eastern part of the state, farther from the Permit Area than the longest recorded migration distance for the species of 60 miles, reported in Griffin (1945). Bats migrating to these hibernacula are therefore likely to migrate from maternity colonies located east of the Permit Area and are not expected to cross the Permit Area during migration. Mortality of northern long-eared bats during this season is expected to be higher than during all other seasons based on the current understanding of fall migration movements and the seasonal distribution of the northern long-eared bat fatalities (Table 5.5); consequently, most of the estimated northern long-eared bat take at the Project is expected to occur during the fall migration period. Based on the seasonal distribution of the 48 northern long-eared bat fatalities recorded to date at wind energy facilities (Table 5.5) and accounting for a lack of take during the fall swarming and late fall season (see below) and a conservative amount of spring and summer take (see above), approximately 62% of the take may occur during the fall migration season.

Fall Swarming and Late Fall Season (October 1 to October 31)

When northern long-eared bats arrive at hibernacula in the fall, they engage in swarming activity in the habitat at the cave entrance and around the hibernacula. The maximum recorded distance from a swarming area to a roost tree for northern long-eared bats is 4.55 miles (7.32 km; USFWS 2014). Because the Permit Area is not located closer than 4.55 miles to any known hibernacula, it is highly unlikely that fall swarming bats would forage and roost within the Permit Area. Additionally, pre-construction acoustic surveys at the site recorded only 1.1% of call at the upper detector and no calls at the lower detector after September 29, 2012, indicating that bat activity within the Permit Area sharply declined after the fall migration season. Mortality of northern long-eared bats during the fall swarming and late fall season is considered unlikely.

5.2.2.2 Estimated Take

The population of northern long-eared bats that may be affected by the Project (i.e., the affected population) consists of the northern long-eared bats that hibernate within approximately 50 miles of the Permit Area, based on the most common migration distances for northern long-eared bats (35-55 miles; USFWS 2014) Mortality of northern long-eared bats is qualitatively expected to be low at the Project based on the recent severe declines in the local northern long-eared bat population due to WNS, the geographically limited summer use of northern long-eared bats within the Permit Area based on the pre-construction surveys, and post-construction mortality data and scientific literature that indicate the species in general experiences disproportionately low wind turbine mortality (see Section 5.2 above). Four years (2006-2008, 2012) of post-construction monitoring at the Maple Ridge Wind Farm, located adjacent to the Permit Area, did not record any northern long-eared bat fatalities (Jain et al. 2007, Tidhar et al. 2013a), and only seven post-WNS northern long-eared bat fatalities been recorded at other wind facilities in New York (Table 5.11). Furthermore, the avoidance and minimization measures implemented at the Project (see Chapter 6 *Conservation Program*) will be more protective than measures implemented at Maple Ridge (which, per Table 5.6, is not feathering turbines or raising the cut-in speed) or other New York wind facilities.

The species composition method was determined to be the most appropriate take estimate approach based on the Project and the datasets available. The species composition method is based directly on fatality records of the Covered Species and assumes the fatality records from post-construction monitoring studies available for review are generally representative of the mortality of bat species in general and that will occur at the Project. The closest northern long-eared bat fatality records to the Permit Area were recorded in Wyoming and Steuben counties in western New York (see below). Although these fatalities occurred in a different part of the state, a broad-scope dataset incorporating these fatalities was considered to be appropriate for estimating take at the Project based on the paucity of post-WNS data available. Inclusion of these fatalities is conservative and may overestimate mortality at most wind projects because six of the seven post-WNS fatalities were recorded at one wind energy project, Noble Wethersfield (Jain et al. 2011a, Kerlinger et al. 2011), and may consequently reflect an unidentified difference in mortality at that project. Therefore, the large and standardized post-construction mortality dataset for Pennsylvania wind projects was also included in the take estimate for northern long-eared bats to encompass a greater range of potential mortality. The method and datasets used to estimate take of northern long-eared bats at the Project using the species composition method are summarized below.

The same steps described in Section 5.2.1.2 for estimating take of Indiana bats were followed for estimating take of northern long-eared bats using the species composition method. Based on the average annual bat mortality rate from wind projects within 50 miles of the Permit Area, the bat mortality rate at the Project is estimated to be 8.629 bats/MW/year (Table 5.6), or 689.459 total bat fatalities per year over the Project’s 79.9 MW.

As for Indiana bats, the proportion of overall bat mortality attributable to northern long-eared bats was calculated based on the species composition of fatalities reported in publicly available post-construction studies. As with Indiana bats, no fatality records of northern long-eared bats currently exist for studies conducted within 50 miles of the Permit Area. However, fatalities have been recorded at wind facilities located elsewhere in New York State and Pennsylvania and at Wolfe Island, Ontario. Therefore, to best represent the risk at the Project, the scope of the analysis was expanded beyond post-WNS studies within 50 miles of the Permit Area to include those post-WNS studies conducted elsewhere in New York and Pennsylvania and on Wolfe Island, which reported the necessary species composition data.

Based on the species composition of the carcasses reported by the studies (Table 5.10), it is estimated that northern long-eared bats may compose 0.180% of the annual overall bat mortality at the Project (Table 5.11), or approximately one northern long-eared bat fatality every one to two years or 1.242 northern long-eared bat fatalities per year. This annual estimated take would result in an estimated 31.057 northern long-eared bats during the 25-year ITP term (1.242 northern long-eared bats/year * 25 years = 31.057 northern long-eared bats), before the benefits of this HCP's minimization measures are considered.

Table 5.10 Publicly available, post-white-nose syndrome, post-construction monitoring studies with reported species composition data in New York, Wolfe Island, and Pennsylvania.

Project Name	State/ Province	Reference
Cohocton/Dutch Hills 2010	NY	Stantec 2011
Noble Altona 2010	NY	Jain et al. 2011b
Noble Chateaugay 2010	NY	Jain et al. 2011c
Noble Clinton 2009	NY	Jain et al. 2010a
Noble Ellenberg 2009	NY	Jain et al. 2010b
Noble Wethersfield 2010	NY	Jain et al. 2011a
Noble Wethersfield 2011	NY	Kerlinger et al. 2011
Maple Ridge 2012	NY	Tidhar et al. 2013a
Sheldon 2010	NY	Tidhar et al. 2012a
Sheldon 2011	NY	Tidhar et al. 2012b
Wolfe Island 2009	Ontario	Stantec Ltd. 2010
Wolfe Island 2010	Ontario	Stantec Ltd. 2011
Wolfe Island 2011	Ontario	Stantec Ltd. 2012
PGC 2010-2013[1]	PA	Taucher et al. 2012; J. Taucher, PGC, pers. comm.

[1]Includes all projects participating in the PGC Wind Energy Voluntary Cooperation Agreement

Table 5.11 Species composition of bat carcasses reported in publicly available, post-white nose syndrome, post-construction monitoring studies with reported species composition data in New York, Wolfe Island, and Pennsylvania.

Species	Scientific Name	Total	Percent of All Bats
hoary bat	*Lasiurus cinereus*	357	9.189
silver-haired bat	*Lasionycteris noctivagans*	168	4.324
eastern red bat	*Lasiurus borealis*	145	3.732
little brown bat	*Myotis lucifugus*	150	3.861
big brown bat	*Eptesicus fuscus*	58	1.493
northern long-eared bat[1]	*Myotis septentrionalis*	7	0.180
tri-colored bat	*Perimyotis subflavus*	3	0.077
Indiana bat	*Myotis sodalis*	1	0.026
unidentified myotis	*Myotis spp.*	2	0.051
undisclosed, non-*Myotis* bat[2]	n/a	2,994	77.066
Total		**3,885**	**100.000**

[1] Incidental finds from Noble Wethersfield 2011 were included in carcass counts because they included two northern long-eared bats and were mostly found during thorough carcass sweeps prior to the search period.

[2] Although species composition data are not available by year in the PGC Third Annual Summary Report (Taucher et al. 2012) which spans 2007-2011, J. Taucher provided data on the number of little brown bats, northern long-eared bats, and Indiana bats reported in each year, as well as the total number of other bat carcasses found in 2010-2013 (represented as "undisclosed, non-*Myotis* bats"), to enable only WNS transitional and post-WNS data to be used in this analysis.

Sources: see Table 5.10.

5.2.2.3 Estimated Take with Minimization Measures and Authorized Take Limit

To avoid or minimize potential northern long-eared bat mortality at the Project, CWF will implement a seasonal turbine operational adjustment protocol designed to most effectively minimize impacts to the Covered Species by targeting the seasonal period when mortality of both Covered Species (and all bats in general) is expected to be highest (see Section 6.3.3). The protocol will include:

1. fully feathering the Project turbines outside of the 3-mile radius from the northern long-eared bat capture at wind speeds below the turbines' manufacturer's rated cut-in speed (3.0 m/s) from April 1 to July 31 (spring migration season and summer maternity season until overlapped by fall migration season);

2. fully feathering all Project turbines at wind speeds below 5.0 m/s from August 1 to September 30 (summer maternity season and fall migration season) from nautical sunset to nautical sunrise when temperatures are above 40 °F; and

3. Feathering the 16 Project turbines within the 3-mile radius from the northern long-eared bat capture at wind speeds below 5.0 m/s May 16 to July 31 (summer maternity season until overlapped by fall migration season) from nautical sunset to nautical sunrise when temperatures are above 40 °F (primarily implemented to minimize mortality of summer resident northern long-eared bats).

The available information from curtailment effectiveness studies conducted to-date suggests that this seasonal turbine operational adjustment protocol will reduce annual bat mortality due to turbine operations by at least 30% during spring and summer and at least 60% during fall (see

Section 6.3.3). Because the expected 60% reduction will apply to the fall migration season during which most bat mortality at the Project is expected to occur, the seasonal turbine operational adjustment protocol is expected to reduce the annual rate of all-bat mortality by approximately 50%. Because the 16 Project turbines, at which all or most of the summer northern long-eared bat mortality is likely to occur, will also be feathered under 5.0 m/s from May 16 to July 31 (resulting in an expected 60% reduction during the summer and fall periods when approximately 87% of the northern long-eared bat mortality is anticipated to occur) it is expected that the annual northern long-eared bat take will be reduced by at least 50%, and likely closer to 56% ([30% reduction * 13% of take in spring] + 60% reduction * [25% of take in summer + 62% of take in fall] = 56.1% reduction). Assuming take of northern long-eared bats (1.242 northern long-eared bat/year) will be reduced by approximately 50% by this minimization measure, the estimated annual take from the Project with implementation of the on-site minimization measures is 0.621 northern long-eared bat, or 15.528 northern long-eared bats over the 25-year ITP term. This level of take rounds to one northern long-eared bat every one to two years and 16 total northern long-eared bats over the 25-year ITP term. Based on the expected seasonality of northern long-eared bat mortality at the Project, mortality is most likely to occur in the following manner: two fatalities during spring, four during summer, and ten during fall.

5.2.2.4 Impacts of the Taking

As discussed for Indiana bats (Section 5.2.1.4), determining the significance of potential take on a population requires an understanding of population demographics and the population units impacted by the take. However, the current scientific understanding of northern long-eared bat population demographics and population units is limited.

It is understood that northern long-eared bats exhibit a long lifespan and relatively low reproductive rate, similar to Indiana bats, and the loss of reproductively active female bats may have an effect on populations. Of the maximum estimated take of 16 northern long-eared bats over the 25-year permit term, 11 are anticipated to be female bats. All of the take in spring and summer (38% of total take; six bats) is expected to affect female bats, and approximately 50% of the take in fall (62% of total take; ten bats) is expected to affect female northern long-eared bats (five female bats). As described for Indiana bats, there is currently an insufficient amount of data to determine if one sex of northern long-eared bat is more susceptible to turbine mortality than the other as a large proportion of *Myotis* carcasses recorded in publicly-available monitoring reports to-date were not identified to sex. Because most of the northern long-eared bat take is expected to occur during the fall migration season when both female and male bats are migrating across the landscape, it was assumed that northern long-eared bat take from the Project during this season will in general affect both sexes equally. However, due to the presence of a maternity colony within the Permit Area, spring and summer take is expected to affect primarily female northern long-eared bats. The seasonal distribution of northern long-eared bat take was based on the relative proportion of expected northern long-eared bat fatality in spring, summer, and fall, as described in Section 5.2.2.1.

Applying the simplified reproductive services model developed for northern long-eared bats by the USFWS (USFWS 2016b) under the assumption that the affected population is declining and will continue to decline over the permit term (an assumption made based on the current WNS status of the population and the lack of clear evidence of population stabilization or recovery in WNS-positive hibernacula) results in an estimated 18 female pups lost from the population due to the take of 11 adult females (six in spring or summer, five in fall). Therefore, the impact of take from the Project is estimated to be approximately 29 (11 + 18 = 29) female northern long-eared bats.

The size of the population affected by the Project (i.e., individuals hibernating within 50 miles of the Permit Area) is currently unknown, as is the size of the range-wide population of northern long-eared bats. Because hibernating northern long-eared bats do not form the large aggregations or clusters typical of Indiana bats and little brown bats (Section 5.1.2), hibernaculum surveys are not an effective method for estimating the population size of the species. No population numbers were provided for northern long-eared bat in the final rule to list the species as threatened (80 FR 17974) or in the final 4(d) rule (81 FR 1900).

However, based on mist-netting data in the eastern US, northern long-eared bats have been widespread and relatively abundant (compared to capture rates of other species; 80 FR 17974). Based on the assumption that northern long-eared bats remain at least as abundant as Indiana bats on the landscape, impacts were evaluated at two population levels: the affected population (i.e., individuals hibernating in counties within the migratory range of the Covered Species, approximately 50 miles, from the Project) and the national population (i.e., the overall range of the species). Regional populations (i.e., RUs) have not been established for the species.

The loss of 29 female northern long-eared bats (take of 11 adult females plus reproductive loss of 18 females) will be spread out over the 25-year ITP term (1.16 bat/year or approximately one bat every year). Reliable population estimates for northern long-eared bats in the region are not available. Recent mist-net results in New York (C. Herzog, pers. comm., October 26, 2016) indicate that northern long-eared bats are captured in post-WNS surveys at a ratio of 3.43 northern long-eared bats to 1.00 Indiana bat, which could be representative of the relative sizes of the species' regional populations. If the northern long-eared bat population in the region of the Permit Area is 343% of the current Glen Park Indiana bat population estimate of 239 bats, the northern long-eared bat population would be approximately 820 bats (239 * 3.43 = 819.8 bats). The average annual impact of take (1.16 bat/year) would represent 0.14% of this affected population. Similar data are not readily available across the species' range, but conservatively assuming the national population of northern long-eared bats is at least as abundant as the current range-wide Indiana bat population estimate of 523,636 bats, the average annual impact of take would represent 0.0002% of the national northern long-eared bat population (Table 5.12) if the populations remain the same. As described for Indiana bats, these proportions will change as the overall populations change, but the likelihood of take may also scale to the total population size.

Table 5.12 Percent loss of northern long-eared bat populations based on estimated northern long-eared bat take under the Copenhagen Wind Farm Habitat Conservation Plan.

Population	Definition	Population Estimate (2015)	Annual Impact of Take	Population Loss (% 2015 Population Estimate)	Reference
Affected	Hibernacula within 50 miles (80 km) of Permit Area	820[1]	1.16	0.14	R. Niver, USFWS, pers. comm. and C. Herzog, NYSDEC, pers. comm.
National	Range-wide	523,636[2]	1.16	0.0002	USFWS 2015a

[1] Based on the assumption that the mist-net capture ratio of northern long-eared bats to Indiana bats in post-WNS surveys in New York is representative of the relative regional species' population sizes.

[2] Based on the conservative assumption that the range-wide northern long-eared bat population is at least as abundant as the range-wide Indiana bat population (it is likely larger than the Indiana bat population).

Therefore, although the affected and national northern long-eared bat populations are declining due to WNS, the average impact of the take at all three population levels is small (29 female northern long-eared bats/25 years = 1.16 female northern long-eared bat/year) and the expected impact of take over the term of the permit (29 female northern long-eared bats) is also small relative to both population levels. This impact of take will be fully offset by the mitigation, as described in Section 6.4.

6 CONSERVATION PROGRAM

6.1 Biological Goals and Objectives

The biological goals of an HCP are the guiding principles for the proposed conservation program and the rationale for the minimization and mitigation measures. The biological objectives of an HCP are the specific measurable and attainable targets intended to meet or achieve the biological goals. As described in the 5-Point Policy, "Biological goals and objectives are inherent to the HCP process and as such explicit goals and objectives clarify the purpose and direction of the HCP's operating conservation program. They create parameters and benchmarks for developing conservation measures, provide the rationale behind the HCP's terms and conditions, promote an effective monitoring program, and, where appropriate, help determine the focus of an adaptive management strategy." (USFWS 2000). The biological goals and objectives of this HCP were designed to be SMART: specific, measurable, achievable, realistic, and timely. While conservation or recovery of a listed species is not required under Section 10 of the ESA, the biological goals and objectives of this HCP are consistent with actions to promote the recovery of the Indiana bat, as identified in the 2007 Recovery Plan. The biological goals and objectives of this HCP also focus on conservation of the northern long-eared bat, for which a recovery plan has not yet been developed.

Potential take of Indiana bat and northern long-eared bat from the Covered Activities would be a result of direct impacts, such as collision with Project turbines (see Chapter 4 *Proposed Action*). The take assessment determined that take of Indiana bat or northern long-eared bat in the form of harm through habitat impacts or due to harassment or other non-mortality take mechanisms as defined by the ESA is not likely to occur due to other activities associated with construction, operation, maintenance, and decommissioning of the Project. As such, the biological goals and objectives are intended to guide measures to minimize the potential for direct mortality of Indiana bats and northern long-eared bats and offset the impacts of the taking (which was determined to be removal of individuals from the Glen Park sub-population of Indiana bats and northern New York population of northern long-eared bats) through reducing direct mortality from the Project and improving survival and promoting reproduction of Indiana bats and northern long-eared bats during other periods of their annual cycle.

6.2 HCP Goals

- Goal 1: Minimize the potential that the Project affects the long-term persistence of Indiana bat and northern long-eared bat maternity colonies.
    - Objective to achieve Goal 1: Implement a seasonal turbine operational adjustment protocol designed to substantially reduce the number of bats killed, thereby working to ensure long-term persistence of maternity colonies.

- Goal 2: Support the survival of post-WNS bat populations and promote persistence of bat populations.
    - o Objective to achieve Goal 2: Protect a hibernaculum or habitat with confirmed post-WNS presence of Indiana bats and northern long-eared bats and subsequently monitor the protected habitat for human disturbance, enhancing protection measures if necessary.

Electrical output of the Project will offset demand for other energy generation technologies that produce carbon emissions that have been shown to contribute to global climate change, identified as a potential risk to Indiana bats (USFWS 2007) and northern long-eared bats (80 FR 17974). Therefore, within the context of the biological goals and objectives of this HCP, CWF aims to optimize electrical output of the Project to realize the environmental benefit of wind energy. To achieve this, an operational strategy will be implemented at the Project in each permit year that maximizes output of non-carbon-emitting, renewable energy (i.e., enables the Project to successfully compete with other wind energy facilities in the region) and also meets the biological Goal 1, minimization of the impacts of incidental take of Indiana bats and northern long-eared bats. This HCP has been designed so that the operational strategy may become less restrictive throughout the ITP term, so long as it continues to achieve the originally anticipated reduction (50%) in all-bat mortality as determined through operational monitoring.

6.3 Minimization Measures

6.3.1 Project Siting and Design

The Project has been sited in an area where Indiana bats are expected to occur infrequently (Sections 5.1.1.5 and 5.2.1.1). The majority of the Permit Area's elevation is above the maximum elevation at which Indiana bat maternity colonies are known to occur in New York. Additionally, the Permit Area is located more than 10 miles from the nearest Indiana bat hibernaculum and outside the expected swarming radius of the hibernaculum's current population, limiting the seasonal occurrence of Indiana bats within the Permit Area. The results of pre-construction mist-netting and acoustic surveys within the Permit Area indicate that Indiana bat maternity colonies are not present during the summer, although Indiana bats may migrate through the Permit Area during the spring and fall migration seasons and males/non-reproductive females may periodically occur in the Permit Area during summer. Northern long-eared bats had not yet been proposed for listing during the Project siting process. However, the Permit Area is located away from all known northern long-eared bat hibernacula, with the closest hibernaculum more than 10 miles from the Permit Area. Additionally, the results of the pre-construction surveys indicate that northern long-eared bats are summer residents in only the western part of the Permit Area (16 turbines are located within the 3-mile potential home range/foraging distance radius [USFWS 2014] from the capture site). Northern long-eared bats may also migrate through the Permit Area during the spring and fall migration seasons. Available post-construction fatality data and scientific literature indicate that both species in general experiences disproportionately low wind turbine mortality (Sections 5.2.1 and 5.2.2).

Construction of the transmission line associated with the Project will follow procedures, including seasonal restrictions, to avoid take of the Covered Species (Section 4.2.2).

6.3.2 Project Construction, Maintenance, and Decommissioning

As described in Section 4.2, Project construction, maintenance, and decommissioning are not expected to result in take of the Covered Species due to avoidance measures that will be implemented during these processes. Activities for construction, maintenance, and decommissioning of the turbines, transmission line, and other facilities are not expected to lead to impacts that rise to the level of take because they would be conducted primarily during daylight hours when the Covered Species are not active. The USFWS Interim Guidance for northern long-eared bats recommends that project developers avoid conducting construction activities after sunset in known or suitable summer habitat for northern long-eared bats to avoid harassment of foraging individuals. Additionally, the guidance recommends set-backs from hibernacula and seasonal restrictions only for activities that will produce noise above 75 decibels for more than 24 hours (USFWS 2014).

The amount of tree removal necessary for Project construction, maintenance, and decommissioning will be minimized through Project design (Figure 3.1a-f; Section 4.2.2) and measures will be implemented during these Project activities to avoid take of the Covered Species as a result of tree removal. Clearing and tree removal will be conducted during the late fall and winter months (October 1 – March 31) to avoid potential killing/injuring of the Covered Species. However, there may be instances where tree removal is necessary during the bat active season. If any emergency tree removal[16] is necessary it will be conducted as needed. If removal of high-risk[17] hazard trees is necessary from April 1 – September 30 during Project construction, maintenance, or decommissioning, CWF will notify the USFWS in advance to determine if it is appropriate to have a qualified biologist conduct an emergence survey at the tree(s) requiring removal. If so, and if no bats are observed during the emergence survey, the high-risk hazard tree(s) will be promptly removed. This will reduce the risk of removing an undiscovered roost tree. If bats are observed, then CWF will conduct further consultation with the USFWS to determine the appropriate course of action.

[16] Emergency tree removal would be for trees that pose an imminent risk to human life or property damage.

[17] Trees that are likely to require removal prior to the next late fall/winter season would be considered high-risk.

6.3.3 Project Operations

CWF will minimize potential impacts of take of the Covered Species from operation of the Project by implementing seasonal turbine operational adjustments for the term of the ITP. At the Project turbines outside of the 3-mile[18] buffer from the northern long-eared bat capture, CWF will:

1. Feather the turbine blades to minimize rotation to less than two rpm when wind speeds are below the turbine manufacturer's rated cut-in speed (3.0 m/s) between nautical sunset to sunrise each night from April 1 to May 15 (spring migration season) and from May 16 to July 31 (summer maternity season until overlapped by fall migration season);
2. Feather the turbine blades to minimize rotation to less than two rpm when wind speeds are below 5.0 m/s between nautical sunset to sunrise each night when temperatures are above 40 °F from August 1 to September 30 (summer maternity season and fall migration season); and
3. Operate turbines normally (no feathering and no change in cut-in speed) from October 1 to March 31.

At the 16 Project turbines within the 3-mile home range/foraging distance radius (USFWS 2014) from the northern long-eared bat capture, CWF will:

1. Feather the turbine blades to minimize rotation to less than two rpm when wind speeds are below the turbines' manufacturer's rated cut-in speed (3.0 m/s) between nautical sunset to sunrise each night from April 1 to May 15 (spring migration season);
2. Feather the turbine blades to minimize rotation to less than two rpm when wind speeds are below 5.0 m/s between nautical sunset to sunrise each night when temperatures are above 40 °F from May 16 to September 30 (summer maternity season and fall migration season) to minimize mortality of summer resident northern long-eared bats; and
3. Operate turbines normally (no feathering and no change in cut-in speed) from October 1 to March 31.

Turbines will be monitored and controlled based on wind speed and temperature on an individual basis (i.e., the entire facility will not alter turbine operations at the same time, rather operational changes will be based on wind speed and temperature conditions specific to each turbine). Turbines will begin operating under normal conditions when the 10-minute rolling average wind speed and temperature is above the seasonal threshold (i.e., 3.0 m/s or 5.0 m/s and 40 °F, see above); turbines will be feathered again if the 10-minute rolling average wind speed goes below the seasonal threshold during the course of the night. This turbine

[18] Home range/foraging distance radius from capture (USFWS 2014)

adjustment protocol is similar to the protocols used in the publicly available curtailment studies to date (Table 6.1) and is therefore expected to be similarly effective for reducing bat mortality.

The seasonal turbine operational adjustment protocol is designed to target the seasonal period when mortality of both Covered Species is expected to be highest. Approximately 72% and 62%, respectively, of the estimated Indiana bat and northern long-eared bat take at the Project is expected to occur during the fall migration season; therefore, curtailment will likely be highest at all Project turbines during the fall migration season. Indiana bat maternity colonies are not expected to occur within or near the Permit Area and occurrence of the species within the Permit Area during spring and summer is therefore expected to be rare and infrequent (Section 5.2.1.1). A northern long-eared bat maternity colony may be present near the western border of the Permit Area; 16 turbines are within the 3-mile home range/foraging distance radius (USFWS 2014) of the northern long-eared bat capture sites. Post-construction monitoring data suggest that northern long-eared bats experience disproportionately low mortality at wind energy facilities, most of which occurs during the fall migration season, despite northern long-eared bats being historically common and widespread residents in areas of wind energy development (Section 5.2.2.1). However, those 16 turbines will be feathered under 5.0 m/s from May 16 to July 31 (in addition to the fall curtailment) to minimize potential mortality of the summer resident northern long-eared bats. Take of the Covered Species, when reduced by 50%, is expected to have a minimal impact on the affected populations (Sections 5.2.1.4 and 5.2.2.4).

Based on the results of curtailment studies conducted to-date, feathering turbines under the manufacturer's rated cut-in speed (3.0 m/s) is expected to achieve at least a 30% reduction in all-bat mortality from the average fatality level documented at un-curtailed turbines in the region (Table 5.6) during the spring and summer seasons. Although feathering under a manufacturer's rated cut-in speed of 3.0 m/s has not been specifically studied, other studies have documented reductions in bat mortality of 35% to 57% at turbines feathered under the manufacturer's rated cut-in speed (Table 6.1). Based on the studies in Table 6.1, the implementation of various cut-in speed treatments has not demonstrated a simple linear relationship with bat mortality reduction (i.e., a higher cut-in speed does not appear to guarantee a greater reduction or have a predictable reduction magnitude). Reductions have varied both across treatments and within the same cut-in speed treatment. The expectation of a 30% reduction when other studies (which looked at feathering under different manufacturer's rated cut-in speeds) have achieved 35% to 57% reductions is thus considered conservative but appropriate. Additionally, 16 of the Project turbines will be feathered under 5.0 m/s from May 16 to July 31, further reducing all-bat mortality at the Project during the spring and summer seasons.

Table 6.1 Results from publicly available curtailment effectiveness studies.

Study Name	Normal Cut-in Speed (m/s [ft/s])	Treatment Cut-in Speed (m/s [ft/s])	Mean Percent Reduction in Mortality	Mean Percent Reduction in Mortality Per Cut-in Speed	Source
Fowler Ridge, IN 2011	3.5 (11.5)	3.5 (11.5)	36	36	Good et al. 2012
Mount Storm, WV 2010[a]	4.0 (13.1)	4.0 (13.1)	35	46	Young et al. 2011b
Summerview, Alberta	4.0 (13.1)	4.0 (13.1)	57		Baerwald et al. 2009
Fowler Ridge, IN 2011	3.5 (11.5)	4.5 (14.8)	57	51	Good et al. 2012
Anonymous Project (AN01), USFWS Region 3	3.5 (11.5)	4.5 (14.8)	47		Arnett et al. 2013
Wolfe Island, Lake Ontario	4.0 (13.1)	4.5 (14.8)	48		Stantec Ltd. 2011b
Casselman, PA 2008	3.5 (11.5)	5.0 (16.4)	82	61	Arnett et al. 2009
Casselman, PA 2009	3.5 (11.5)	5.0 (16.4)	72		Arnett et al. 2010
Fowler Ridge, IN 2010[b]	3.5 (11.5)	5.0 (16.4)	50		Good et al. 2011
Criterion, MD 2012[c]	4.0 (13.1)	5.0 (16.4)	62		Young et al. 2013
Pinnacle, WV 2012	3.0 (9.8)	5.0 (16.4)	47		Hein et al. 2013
Pinnacle, WV 2013	3.0 (9.8)	5.0 (16.4)	54		Hein et al. 2014
Summerview, Alberta	3.5 (11.5)	5.5 (18.0)	60	66	Baerwald et al. 2009
Fowler Ridge, IN 2011	4.0 (13.1)	5.5 (18.0)	73		Good et al. 2012
Anonymous Project (AN01), USFWS Region 3	3.5 (11.5)	5.5 (18.0)	72		Arnett et al. 2013
Wolfe Island, Lake Ontario	4.0 (13.1)	5.5 (18.0)	60		Stantec Ltd. 2011b
Sheffield, VT[d]	4.0 (13.1)	6.0 (19.7)	62	62	Martin et al. 2017
Casselman, PA 2008	3.5 (11.5)	6.5 (21.3)	82	77	Arnett et al. 2009
Casselman, PA 2009	3.5 (11.5)	6.5 (21.3)	72		Arnett et al. 2010
Fowler Ridge, IN 2010[b]	3.5 (11.5)	6.5 (21.3)	78		Good et al. 2011
Pinnacle, WV 2013	3.0 (9.8)	6.5 (21.3)	76		Hein et al. 2014
Beech Ridge, WV	3.5 (11.5)	6.9 (22.6)	89[e]	93	Tidhar et al. 2013b
Beech Ridge, WV	3.5 (11.5)	6.9 (22.6)	97[e]		Young et al. 2014

[a] Based on the average reduction of 47% and 22% from first and second halves of the night; note that an average reduction of 61% (72% and 50% from first and second halves of the night) was realized when comparing only nights when treatments were in place (32% and 40% of the time for the first and second halves of the night) to nights when treatments were not in place

[b] Study did not include feathering below cut-in speed

[c] Percent reduction is based on comparison to the previous year's results from mortality monitoring, since there were no control turbines during the year the study was implemented

[d] Raised cut-in speeds were applied only when temperatures were above 49.1 °F (9.5 °C)

[e] Percent reduction based on comparison to average bat mortality at two other West Virginia projects, likely most relevant to what impacts could have been at the site in the absence of feathering

Also based on the results of curtailment studies conducted to-date, feathering turbines under a raised cut-in speed of 5.0 m/s is expected to achieve at least a 60% reduction in all-bat mortality from the average fatality level documented at un-curtailed turbines in the region (Table 5.6) during the fall season. Other studies have documented reductions in bat mortality of 47% to 82%, averaging 61%, at turbines feathered under a cut-in speed of 5.0 m/s (Table 6.1). Based on the studies in Table 6.1, the reductions achieved through the implementation of various raised cut-in speeds have not demonstrated a simple linear relationship with the magnitude in change from manufacturer's rated cut-in speed (i.e., a greater increase in cut-in speed does not appear to guarantee a greater reduction or have a predictable reduction magnitude). This maybe in part because a raised cut-in speed (e.g., 5.0 m/s) means turbines are feathered when wind speeds equal the manufacturer's rated cut-in speed, regardless of what that cut-in speed is (e.g., 3.0 m/s or 3.5 m/s). In any case, feathering the Project turbines below 5.0 m/s is expected to achieve at least a 60% reduction in all-bat mortality. Because the expected 60% reduction at all turbines will apply to the fall migration season during which most bat mortality at the Project (and most take of the Covered Species) is expected to occur, the seasonal turbine operational adjustment protocol is expected to reduce the annual rate of all-bat mortality and Indiana bat mortality by at least 50% (see calculations in Section 5.2.1.3). Because the 16 turbines at which all or most of the summer northern long-eared bat mortality is likely to occur will also be feathered under 5.0 m/s from May 16 to July 31, it is expected that all northern long-eared bat take will be reduced by at least 50%, and likely closer to 55% (see calculations in Section 5.2.2.3).

It is currently unclear if operational adjustments will be equally effective at reducing mortality among different species or species groups. Collectively, hoary bats, eastern red bats, and silver-haired bats compose the vast majority of all bat fatalities documented at wind facilities (e.g., 78% of estimated fatalities 2000-2011, Arnett and Baerwald 2013); consequently, these three species have provided the bulk of the all-bat fatality data analyzed in the curtailment studies to-date.

Curtailment studies conducted to date have looked at the effectiveness of feathering blades in reducing all-bat mortality and have not looked at effects on specific species. However, it is plausible based on their morphology and flight behavior that smaller species of bats, such as *Myotis*, may be less active at higher wind speeds compared to larger species of bats that typically forage in more open habitats, and especially in the rotor-swept area of turbines. If this hypothesis is true and *Myotis* species are more active on low wind speed nights and less active as wind speed increases (which is considered plausible given their small size and typical behavior of not foraging in large open areas, where winds would typically be greater), then feathering turbine blades to reduce blade movement at low wind speeds would be most effective at reducing *Myotis* mortality. Conversely, response by smaller bats to turbine curtailment as wind speeds increase would be less compared to the response of larger species; that is, the benefit of feathering in higher wind speeds would not affect the smaller bats as they would not experience mortality during those higher wind speeds.

Although the curtailment studies (Table 6.1) were not able to estimate fatality reduction rates specifically for *Myotis* species, only seven *Myotis* fatalities were documented at cut-in speeds at or above 4.5 m/s (Table 6.2). Therefore, it is anticipated that the 5.0 m/s cut-in speed which has been documented to result in a 60% reduction in all-bat mortality would also reduce *Myotis* mortality by at least 60% and maintain take of the Covered Species below the estimated take levels (Sections 5.2.1.3 and 5.2.2.3).

Table 6.2 Publicly available *Myotis* fatalities recorded at wind energy facilities before and during curtailment effectiveness studies. IBAT=Indiana bat, NLEB=northern long-eared bat, LBB=little brown bat, LLM=long-legged myotis, UNK=unknown myotis.

Study Name	Year	WNS Status[1]	*Myotis* Recorded at Normal Cut-in Speed[2]	*Myotis* Recorded At or Below 4.0 m/s[3]	*Myotis* Recorded At or Above 4.5 m/s	Source
Fowler Ridge, IN	2009	Pre	1 IBAT, 1 NLEB	n/a[4]	n/a	Good et al. 2011
	2010	Pre	1 LBB	n/a	1 IBAT	Good et al. 2011
	2011	Pre	n/a	1 LBB	0[3]	Good et al. 2012
Mount Storm, WV	2008	Pre	19 LBB, 1 NLEB	n/a	n/a	Young et. al 2009b
	2009	Pre	26 LBB, 2 UNK	n/a	n/a	Young et. al 2009a, 2010b
	2010	Post	5 LBB	7 LBB	n/a	Young et al. 2010a, 2011b
	2011	Post	0	n/a	n/a	Young et al. 2011a, 2012
Wolfe Island, Lake Ontario	2009	Post	16 LBB	n/a	n/a	Stantec Ltd. 2010
	2010	Post	0	n/a	0	Stantec Ltd. 2011b
Casselman, PA	2008	Pre	3 LBB	n/a	0	Arnett et al. 2009
	2009	Pre	0	n/a	1 LBB	Arnett et al. 2010
Criterion, MD 2012	2011	Pre	30 LBB, 1 NLEB, 1 UNK	n/a	n/a	Young et al. 2013
	2012	Post	n/a	n/a	0	Young et al. 2013
Summerview, Alberta	2006	Pre	2 LBB	n/a	n/a	Baerwald 2008
	2007	Pre	n/a	8 LBB	4 LBB, 1 LLM	Baerwald et al. 2009
Sheffield, VT	2012	Post	n/a	n/a	0	Martin et al. 2017
Pinnacle, PA	2011	Post	0	n/a	0	Hein et al. 2013
	2012	Post	0	n/a	0	Hein et al. 2014
Beech Ridge, WV	2012	Post	n/a	n/a	0	Tidhar et al. 2013b
	2013	Post	n/a	n/a	0	Young et al. 2014
Total Pre-WNS			1 IBAT, 3 NLEB, 81 LBB, 3 UNK	9 LBB	1 IBAT, 5 LBB, 1 LLM	
Total Post-WNS			21 LBB	7 LBB	0	
Overall Total			1 IBAT, 3 NLEB, 102 LBB, 3 UNK	16 LBB	1 IBAT, 5 LBB, 1 LLM	

[1] WNS status provided by R. Niver, USFWS, pers. comm., and WNS map. White-Nose Syndrome.org 2017

[2] Refer to Table 6.1 for the normal cut-in speed of each study.

[3] Feathering under normal cut-in speed or raised cut-in speeds, up to and at 4.0 m/s (13.1 ft/s).

[4] n/a means those cut-in speeds were not evaluated in the study, 0 means those cut-in speeds were evaluated in the study and no *Myotis* were found

The only exception to feathering turbines below the seasonal thresholds would occur on nights when temperatures are below 40 °F from April 1 to September 30. Turbines will be allowed to operate at full capacity below these temperatures. Turbines will be monitored and controlled based on temperature on an individual basis (i.e., the entire facility will not alter turbine operations at the same time, rather operational changes will be based on temperature conditions specific to each turbine). Turbines will begin operating under normal conditions when the 10-minute rolling average temperature drops below 40 °F; raised cut-in speeds will be resumed if the 10-minute rolling average temperature goes above 40 °F during the course of the night.

The 40 °F temperature threshold is based on studies analyzing the relationship between temperature and bat activity (e.g., Anthony et al. 1981), insect activity (e.g., Taylor 1963), and bat mortality (e.g., Good et al. 2011, 2012, 2013), as well as guidance from the USFWS stating that activity of both Covered Species is likely to decrease below 50 °F (USFWS 2014, p. A15). The guidance note that 50 °F may not be a “hard cut-off” of activity of the Covered Species (USFWS 2014, p. A15), but this temperature is expected to represent a threshold below which minimal activity of the Covered Species occurs. In the northern states of New York and Vermont, where lower temperatures are more common, bat activity has been recorded between 50 °F and 40 °F, although activity below 40 °F is rare (R. Niver, pers. comm.). Additionally, the pre-construction acoustic surveys conducted for the Project found a significant, positive relationship between temperature and bat activity on-site, meaning that as temperature decreased, so did bat activity (Sanders Environmental 2012). Based on the temperatures at which bat activity has been recorded in New York and Vermont and within the Permit Area (R. Niver, pers. comm.; Sanders Environmental 2012), it is estimated that 40 °F will be a sufficient temperature threshold to meet the mortality reduction goal of the Project’s turbine operational adjustment protocol. During the pre-construction acoustic survey period (April 15 – October 15, 2012), temperatures at 190 ft were below 50 °F for 21.34% of the time and below 40 °F for 7.60% of the time between nautical sunset and nautical sunrise. However, of the acoustic calls recorded between nautical sunset and nautical sunrise during the survey period, only 1.83% occurred when temperatures at 190 ft were below 50 °F and 0.30% occurred when temperatures were below 40 °F[19] (Figure 5.8).

The nautical sunset to nautical sunrise timeframe is considered appropriate because the majority of bat activity recorded in the Permit Area occurred during this period (Figure 5.7). This is based on the site-specific pre-construction acoustic monitoring, during which approximately 76% of bat calls were recorded between nautical sunset and nautical sunrise. The one call identified as a *Myotis* bat call was also recorded during this nightly period.

[19] The raw data files, recorded by Sanders Environmental on the Pettersson D500X detector, were processed by WEST in the Wildlife Acoustics Kaleidoscope® program. The eastern North America classifier was used to filter noise files out of the data set. After the calls were classified, the files labeled “Noid” were checked. All of those that were not bat calls were deleted from the data set. Then, the time and date were added to the output file by looking up the information from the raw data files and used to reference the bat calls with the temperature data.

In addition to implementing the seasonal turbine operational adjustment protocol, CWF will monitor bat mortality and implement an adaptive management plan (Section 6.6) that includes modifications to the turbine operational adjustment protocol, if needed, to assure that the bat mortality reduction goal is being met and therefore the Project is in compliance with the authorized take thresholds.

6.4 Mitigation Measures

As described above, CWF will implement turbine operational adjustments that are expected to reduce mortality of the Covered Species (as well as mortality of all bats) at the Project. However, some level of incidental take (mortality) of the Covered Species is reasonably certain to occur. The estimated levels of Indiana bat and northern long-eared bat take (mortality) with minimization measures in place are expected to be less than or equal to four and 15 bats, respectively, over the 25-year ITP term (see Sections 5.2.1.3 and 5.2.2.3).

The USFWS' Region 3 Indiana Bat and Northern Long-eared Bat Resource Equivalency Analysis Models for Wind Energy Projects (REA Models; USFWS 2016a, 2016b) were used to estimate the lost reproductive capacity (i.e., the number of female pups that would have been produced had take not occurred) of the two female Indiana bats and the 11 female northern long-eared bats expected to be taken at the Project. Although the REA Models were developed for use in Region 3, the mitigation debt sub-models are based on bat biology (e.g., population demographic parameters such as survival rates, fecundity rates) and are not specific to a particular USFWS region. Although take of male bats may also occur (two male Indiana bats and four male northern long-eared bats, see Sections 5.2.1.4 and 5.2.2.4), the impact of take analysis, the REA Models, and consequently the mitigation project, are concerned with the take and reproductive loss of female bats because female bats are the limiting reproductive units of Indiana bat and northern long-eared bat populations. As described in Sections 5.1.1.1 and 5.1.2.1, female Indiana bats and northern long-eared bats may mate with several male bats during each fall swarming season, but only the female bats produce pups which they raise in maternity colonies composed of other female bats. The population growth of both species is therefore limited by the number of female bats in the population and the rate of female reproduction.

Based on the mitigation debt sub-model of the REA Model, the reproductive loss associated with the mortality of two female Indiana bats is expected to be approximately three Indiana bat pups, resulting in a total impact of take of five Indiana bats over the 25-year ITP term. The reproductive loss associated with the mortality of 11 female northern long-eared bats is expected to be approximately 18 northern long-eared bat pups, resulting in a total impact of take of 29 northern long-eared bats over the 25-year ITP term. Therefore, to mitigate for the impacts of the take for both species, CWF will fund the implementation of a mitigation project to protect the populations of both Indiana bats and northern long-eared bats.

The mitigation credit sub-models of the REA Models are currently specific to the predominant habitat type (e.g., agricultural landscape) and conservation priorities of Region 3 and therefore are not being routinely used in Region 5 at present. In lieu of mitigation credit models, CWF worked closely with the USFWS New York Field Office to identify mitigation options of high conservation priority. CWF has secured a project for mitigation: protection of winter habitat that is occupied post-WNS by both Indiana bats and northern long-eared bats, described in Section 6.4.1. The conservation value of this project (see Section 6.4.2) is expected to fully offset the impact of take for both Covered Species. CWF has made arrangements to acquire, implement, and fund the maintenance of this mitigation project to the extent permitted by New York law.

The identified mitigation project will be completed within one year of ITP issuance, providing mitigation credit to offset take of both of the Covered Species. The general timeline for completion of the primary tasks required to implement the identified mitigation project is provided in Table 6.3. This timeline is intended to keep the mitigation project on schedule, with the understanding that individual mitigation tasks may actually be completed before (but not after) they are estimated to occur in the timeline. The current status of each task is indicated in the column following the timeline for completion. It is anticipated that implementation of the identified mitigation project will be completed more quickly than required, as the initial tasks have already been completed and the project is ready for implementation upon issuance of the ITP.

Table 6.3 Timeline for completion of mitigation tasks for the Copenhagen Wind Farm Habitat Conservation Plan.

Task	Timeline for Completion	Current Status	Responsible Party(ies)
Hibernaculum gating mitigation project is selected	Less than six months after ITP issuance	Completed	CWF, USFWS
Gating plan is approved by USFWS/ NYSDEC	Less than one year after project selection	Completed	USFWS, NYSDEC
Gating is completed	Less than one year after ITP issuance	Pending ITP issuance	CWF

Although the mitigation project (a cave gate) is intended to remain in place in perpetuity, CWF's obligation to provide funding or other assurances to support maintenance of the gate, management of the habitat for bats, monitoring and reporting, adaptive management, and changed circumstances will apply only during the ITP term.

6.4.1 Identified Mitigation Project

To offset the impact of take for Indiana bats and northern long-eared bats and achieve biological Goal #2 (Section 6.1), CWF investigated the feasibility and value of gating several hibernacula identified as conservation priorities by the NYSDEC and USFWS New York Field Office. Various hibernacula with similar characteristics (e.g., habitat function, threat of disturbance) in New York identified as conservation priorities by USFWS were considered as potential sites for the winter habitat mitigation project before CWF selected one of the hibernacula as the preferred mitigation project for the HCP. The selected mitigation site is located in Ulster County, New York, and is part of a complex of hibernacula (multiple hibernacula within 10 miles of each other) utilized by both Indiana bats and northern long-eared bats (Figure 6.1).

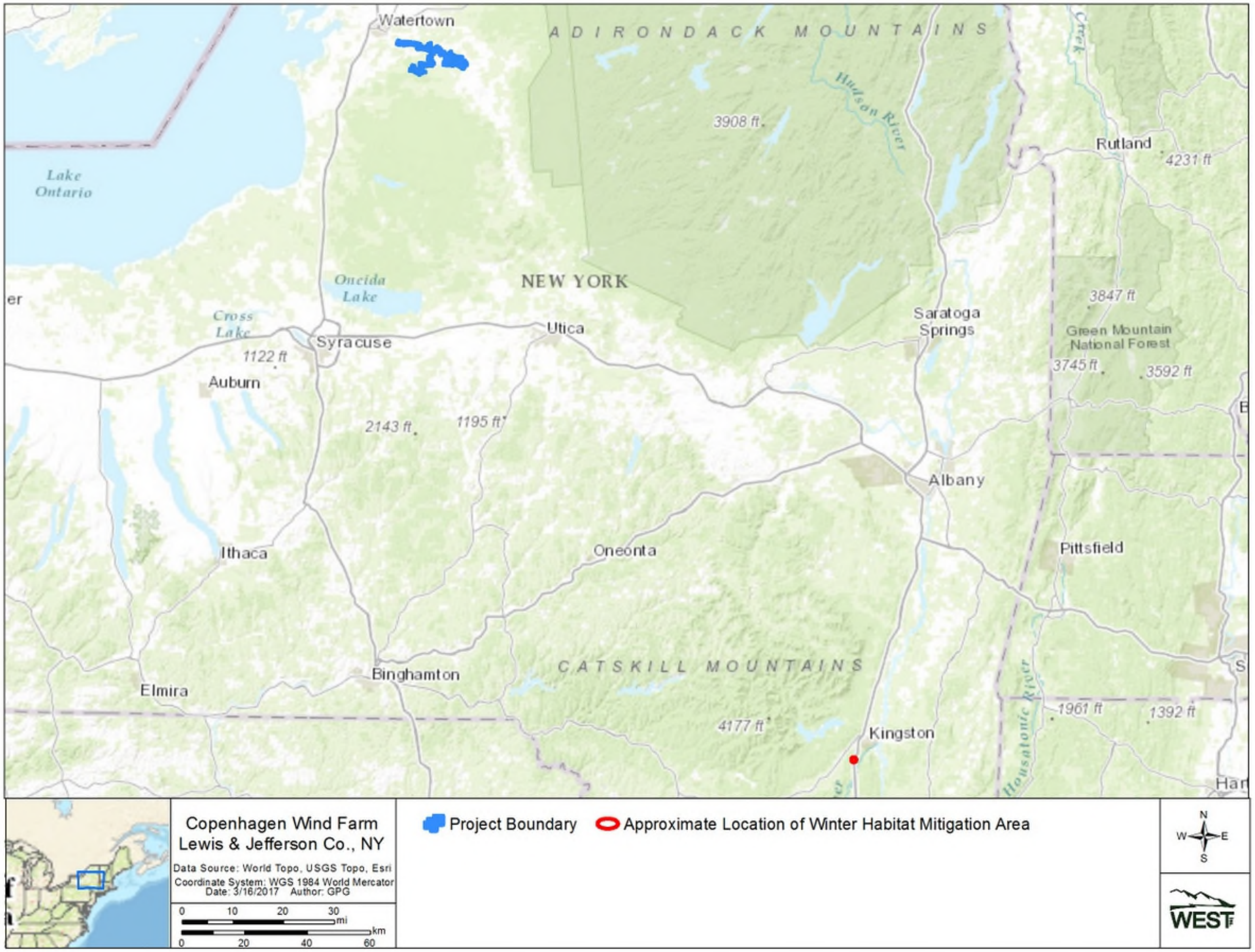

Figure 6.1 Approximate location of the winter habitat mitigation project relative to the Copenhagen Wind Farm.

The purpose of the winter habitat mitigation project is to reduce threats to wintering populations of northern long-eared bats and Indiana bats. The threats to the cave include human access during times when bats would be hibernating in the cave. Human access during this period can increase the frequency of arousal of hibernating bats and potentially cause more direct threats from vandalism or killing of bats. In the presence of WNS, the added arousal cycle(s) on the bats likely have detrimental effects. The cave gate is designed to prevent human access and thus eliminate added disturbance and arousal cycles. This is expected to increase the overwinter survivorship of the hibernating bats. Increased overwinter survivorship is expected to result in more female bats leaving the hibernacula each spring to raise pups than would otherwise be the case, preventing further reduction in the local population.

A high count of 13,014 Indiana bats was recorded in the hibernaculum in February 2007; the most recent count in March 2017 documented 134 Indiana bats in the hibernaculum, reflecting declines due to WNS. Although a severe population decline was observed from 2007 to 2008 (124 Indiana bats recorded in April 2008), counts of Indiana bats have been fairly steady since then (C. Herzog, unpublished data).

Northern long-eared bats are difficult to detect and count in hibernacula surveys and very few hibernating individuals can be found even when the species is known to use a given hibernaculum. Mist-netting surveys consistently suggest that northern long-eared bats are more numerous than hibernacula counts detect (Whitaker et al. 2002). Therefore, although at most two northern long-eared bats have been recorded during surveys of the hibernaculum (in January 1986; C. Herzog, unpublished data), it is reasonable to assume that more northern long-eared bats actually use the hibernaculum than have been recorded in survey counts (R. Niver, pers. comm.; Whitaker et al. 2002). This is also true of the other hibernacula identified as conservation priorities by USFWS. The most recent documentation of northern long-eared bats in the hibernaculum was recorded in March 2010. One northern long-eared bat was also captured just outside of the hibernaculum during fall swarming studies in November 2015 (C. Herzog, pers. comm.) These records indicate that the species persists in the cave post-WNS (C. Herzog, unpublished data), and similarly to Indiana bats, the expectation is that the cave remains viable winter habitat for this species.

CWF confirmed the biological sufficiency of the selected winter habitat mitigation project through the following steps:

Step 1: Estimate the number of <u>northern long-eared bats</u> hibernating in the cave and the hibernacula complex to which the cave belongs.

- Use mist-net survey results from within the Indiana bat range in New York State[20] (C. Herzog, pers. comm. October 26, 2016) to define the post-WNS (post-2009) ratio of northern long-eared bats to Indiana bats: 24 captured northern long-eared bats / seven captured Indiana bats = 3.43 northern long-eared bats : one Indiana bat.
- Use the ratio of northern long-eared bats to Indiana bats to estimate the northern long-eared bat hibernating population based on the 2017 Indiana bat survey count for: a) the cave, and b) the hibernacula complex to which it belongs in Ulster County:
    a) 134 hibernating Indiana bats (male and female) in the cave * 3.43 = 460 hibernating northern long-eared bats in the cave. Assuming a 50:50 sex ratio, this would be approximately 230 female northern long-eared bats;
    b) 1,377 hibernating Indiana bats (male and female) in the hibernacula complex * 3.43 = 4,723 hibernating northern long-eared bats in the hibernacula complex. Assuming a 50:50 sex ratio, this would be approximately 2,362 female northern long-eared bats within the complex that may periodically use the cave, but are all anticipated to use the cave simultaneously.

Step 2: Compare the benefit to northern long-eared bats from the mitigation project to the impact of take from the Project. As calculated in Step 1, the mitigation project is anticipated to protect and support approximately 230 female northern long-eared bats in the cave and approximately 2,362 female northern long-eared bats in the hibernacula complex. The gating implemented as mitigation will ensure that the cave and the complex remain safe, stable hibernation habitat for these northern long-eared bats, supporting the survival of these populations. Although there is a degree of uncertainty in the assumptions of the calculations in Step 1, the estimated impact of take from the Project (29 female northern long-eared bats) is well within the estimated female northern long-eared bat populations (230 in the cave, 2,362 in the complex) that will benefit from the mitigation project. Therefore, the mitigation is expected to fully offset the Project's impact of take.

CWF similarly confirmed the biological sufficiency of the selected winter habitat mitigation project for Indiana bats through the following steps:

Step 1: Identify the number of <u>Indiana bats</u> hibernating in the cave and the hibernacula complex to which the cave belongs.

- Use the 2017 Indiana bat survey count for: a) the cave, and b) the hibernacula complex to which it belongs in Ulster County :
    a) 134 hibernating Indiana bats in the cave. Assuming a 50:50 sex ratio, this would be approximately 67 female Indiana bats.

[20] With 2009 data from Fort Drum removed, based on USFWS recommendation (R. Niver, pers. comm., November 30, 2016), due to a substantial change in the northern long-eared bat : Indiana bat ratio from 2009 to 2010 through 2015.

b) 1,377 hibernating Indiana bats in the hibernacula complex. Assuming a 50:50 sex ratio, this would be approximately 689 female Indiana bats.

Step 2: Compare the benefit to Indiana bats from the mitigation project to the impact of take from the Project. As calculated in Step 1, the mitigation project is anticipated to protect and support approximately 67 female Indiana bats in the cave and approximately 689 female Indiana bats in the hibernacula complex. The gating implemented as mitigation will ensure that the cave and the complex remain safe, stable hibernation habitat for these Indiana bats, supporting the survival of these populations. Although there is a degree of uncertainty in the assumptions of the calculations in Step 1, the estimated impact of take from the Project (five female Indiana long-eared bats) is well within the estimated female Indiana bat populations (67 in the cave, 689 in the complex) that will benefit from the mitigation project. Therefore, the mitigation is expected to fully offset the Project's impact of take.

6.4.1.1 Threats Analysis

The 2007 Recovery Plan summarizes the five threat factors (ESA § 4) and identifies primary threats to the Indiana bat. Primary threats to this species include:

1. Destruction/degradation of hibernation habitat;
2. Loss/degradation of summer habitat, migration habitat, and swarming habitat; and
3. Disturbance of hibernating bats.

Significant progress has been made in reducing the number of caves in which disturbance threatens hibernating Indiana bats, but the threat has not been eliminated. In the 2007 Recovery Plan, "human disturbance" was identified as the primary threat at 39% of P1, P2, and P3 hibernacula. Additionally, human disturbance is considered a threat (not necessarily the primary threat) at 45% of P1, P2, and P3 hibernacula. The primary sources of human disturbance in these hibernacula are stated as being recreational cavers (66%), vandals (7%), commercial tours (1%), researchers (1%), other sources (1%), and unknown (24%). Human disturbance and vandalism pose significant threats to Indiana bats during hibernation through direct mortality and by inducing arousal and consequent depletion of fat reserves. These threats also impact other cave hibernating bats, including northern long-eared bat; the impact of these threats on northern long-eared bats may be greater because not all hibernacula for northern long-eared bats are known and therefore threats due to human activity are undocumented.

Several strategies have been employed to reduce unauthorized visits to caves. Properly designed and maintained gates are considered the most reliable management strategy. Additionally, many Indiana bat populations have responded positively to the control of disturbance during the hibernation period, including increased population levels, as evidenced in the 2007 Recovery Plan.

Although a recovery plan has not yet been developed for northern long-eared bats, human disturbance is also a threat to this species (80 FR 17974), particularly where northern long-eared bats co-occur with Indiana bats in hibernacula. There is no evidence to suggest that properly designed and maintained gates would not confer similar benefits to hibernating northern long-eared bats as observed for Indiana bats.

The preferred hibernaculum under consideration has been identified as a conservation priority by the USFWS due to the threat of disturbance or destruction of hibernating bats by unauthorized human visitation. The hibernaculum is located on NYSDEC property but is not currently protected by a gate. It is well-known by local residents, and NYSDEC has experienced at least two recent incidents of vandalism directed at research equipment installed in the hibernaculum, indicating unauthorized human visitation is occurring. Bats hibernating in it are considered to be under imminent threat from human visitation, disturbance, and vandalism because it is well-known, ungated, and recent vandalism events have occurred. The NYSDEC has determined that gating of the hibernaculum is appropriate and is willing to work with a funding partner, such as CWF, to accomplish the gating project (C. Herzog, pers. comm.).

Disturbance of hibernating bats due to human visitation causes premature depletion of energy reserves during the winter. Bats experiencing disturbances during hibernation emerge in the spring with fewer energetic resources for migration and reproduction and likely have reduced survivorship or reproductive success. Excessive human disturbance in the form of noise, frequent traffic, or fire can cause bats to abandon roosting areas or hibernacula. A single vandalism incident can result in the death of tens to hundreds of hibernating bats.

WNS is the primary threat to Indiana bats and northern long-eared bats hibernating in New York (R. Niver, pers. comm.; 80 FR 17974). Disturbances to hibernating bats, such as the waves of mass arousals documented in hibernating bats following human activity (P. Cryan, USGS, unpublished data), may exacerbate the effects of WNS as the disease itself results in increased energy expenditure in infected bats (R. Niver, pers. comm.; Verant et al. 2014). Additionally, a recent mark-recapture study of a WNS-impacted little brown bat population indicated that stabilization of remnant populations post-WNS may be due to improved over-winter survival and identified adult and juvenile survival as the most important demographic parameters to target to maximize recovery potential of bat populations impacted by WNS (Maslo et al. 2015). Therefore, the goal of the winter habitat mitigation project is to protect hibernating bats from disturbance due to human visitation, thereby improving overwinter survival.

6.4.1.2 Gating Project

CWF proposes to protect the hibernaculum through the installation of gates to secure the entrances to the hibernaculum and protect Indiana bats and northern long-eared bats hibernating within from unauthorized human visitation, disturbance, and vandalism. A new, bat-friendly, angle-iron gate will be constructed in a non-restricted part of the hibernaculum as near to each entrance as possible. The gates will be constructed once the bats have emerged from the hibernaculum in the spring and before they have returned in the fall to avoid impacting bats during gate construction. Cave gating will be designed, planned, and coordinated by CWF, the

NYSDEC, and a NYSDEC-approved cave gating contractor. To prevent further spread of WNS, the most current WNS decontamination protocol will be followed during gate construction (see White-Nose Syndrome.org 2017b). No protection of the surrounding lands is needed given the ownership by the NYSDEC specifically for the purposes of maintaining the hibernaculum.

Once gating is complete, management and monitoring of the hibernaculum will be conducted by the NYSDEC. Monitoring may include the use of speloggers and dataloggers to determine the effectiveness of the gating in preventing unauthorized visitation without negatively impacting the quality of the hibernaculum as winter bat habitat. Additionally, the hibernaculum entrances will be monitored by NYSDEC following gating to determine if the bats accept the gate during fall swarming. It is anticipated that NYSDEC will continue performing biannual surveys of the bat populations within the hibernaculum after gating.

6.4.2 Conservation Value of Winter Habitat Protection

Protection of a hibernaculum through the proposed winter habitat mitigation project will ensure a stable hibernaculum free of unauthorized human visitation for Indiana bats and northern long-eared bats. Secure hibernacula protected from disturbances such as human visitation are essential to improve over-winter survival and support the persistence of WNS-impacted bat populations in New York, which may have less of a chance of recovery if protected hibernacula are not available (R. Niver, pers. comm.; Maslo et al. 2015). As described in Section 6.4.1, the identified winter habitat mitigation project is expected to fully offset the impact of take for both of the Covered Species.

In the unlikely event the selected hibernaculum cannot be feasibly gated on reasonable terms, any of the other hibernacula identified by NYSDEC and USFWS as conservation priorities would serve as an adequate substitute for the winter habitat mitigation project (R. Niver, pers. comm.); however, substitution with any alternative mitigation project would require USFWS approval prior to implementation.

In addition to benefiting the Covered Species, protection of the mitigation lands under any of the mitigation options are also likely to benefit other species of bats, including those affected by WNS such as little brown bat. Protection in perpetuity of the winter mitigation lands will provide a secure hibernaculum for other cave-hibernating bat species.

6.5 Monitoring Plan

The overall goals of monitoring are to demonstrate compliance with the ITP and evaluate the effectiveness of the conservation plan in meeting the biological goals and objectives of the HCP (per directive of the HCP Handbook).

This is achieved through operational monitoring and mitigation monitoring. Operational monitoring will be conducted to measure the all-bat mortality rate (from which take of the Covered Species can be calculated using the species composition method), to document compliance with the ITP, verify effectiveness of the HCP minimization measures, and identify when adaptive management actions are necessary to ensure continued compliance. Mitigation monitoring will be conducted to document compliance with the ITP and verify mitigation effectiveness by ensuring that the mitigation project is functioning as planned. Together, operational monitoring and mitigation monitoring will provide information regarding the success of the conservation plan in achieving the biological goals and objectives of this HCP. Additionally, summer presence monitoring will be conducted periodically to enable appropriate responses to any changes in northern long-eared bat summer presence within the Permit Area, ensuring continued compliance with the ITP take limits and continued effectiveness of the HCP minimization measures.

6.5.1 Operational Monitoring

The focus of operational monitoring is on the turbine operations and the impact of turbine operations. CWF will: 1) document implementation of the seasonal turbine operational adjustments to demonstrate compliance with the ITP (operational monitoring for compliance), and 2) evaluate the effectiveness of those adjustments in meeting the biological objectives by comparing incidental take of the Covered Species against the take limits permitted by the ITP (operational monitoring for effectiveness). Operational monitoring will provide estimates of all-bat mortality which will serve as a surrogate for estimating take of the Covered Species. Incidental take of Indiana bats and northern long-eared bats will be calculated from the all-bat mortality estimates using the species composition method. Bird carcasses found during the monitoring will be recorded, but avian mortality estimates will not be calculated as part of the HCP operational monitoring effort. Operational monitoring will provide the basis for adaptive management decisions related to turbine operational adjustment protocol, the primary minimization measure implemented as part of this HCP.

There are three main objectives of operational monitoring:

1. To track implementation of the seasonal turbine operational adjustments;
2. To provide an accurate estimate of all-bat mortality that can be used as a surrogate to reliably determine the annual take of the Covered Species (based on the species composition method) and enable comparison of the estimated take against the permitted level; and
3. To detect changing trends in bat mortality over time.

SCADA data, tracking the temperature, timing, and actual wind speeds at which the Project turbines are operational and feathered, will be maintained for all Project turbines in each permit year. These data will be used to demonstrate that the seasonal turbine operational adjustments are being implemented in accordance with the minimization commitments in this HCP.

The ability to distinguish the effectiveness of turbine operational adjustments on individual species of bats, especially *Myotis* species which compose small percentages of the overall bat mortality, is difficult. It has been established that the proposed turbine operational adjustments are beneficial to all bat species because the act of controlling the rotation of turbine blades in low wind speeds reduces mortality by slowing blade rotation during conditions of highest bat activity (Section 6.3.3). Given that, it is valid to use overall bat mortality as a measure of the effectiveness of the proposed turbine operational adjustments (the minimization measures) in reducing potential mortality of Covered Species. With the understanding that there may not be any confirmed Covered Species fatalities over the permit term, this method will allow tracking of the total estimated take and the estimated effectiveness of the minimization measures, by which compliance with the take limits can be monitored. If new information becomes available to suggest improved methods for estimating bat mortality, or improved ways of assessing mortality of the Covered Species directly, CWF may consult with the USFWS over changes to the protocol and propose implementation of any new methods (Section 7.1.5).

Operational monitoring for the HCP will be conducted in two or three phases: the Research Phase, Implementation Phase, and Re-evaluation Phase (if needed; Table 6.4). Monitoring will be most intensive during the Research Phase in the first two operational years following issuance of the ITP to ensure the minimization measures are effective at maintaining take of the Covered Species below the limits authorized in the ITP. The Research Phase monitoring will provide the data by which the minimization measures will be refined, if needed. In all Phases, searches will be conducted following the monitoring protocol outlined below.

Table 6.4 Permit year and sample size for each phase of monitoring under the Copenhagen Wind Farm Habitat Conservation Plan.

Monitoring Phase	Permit Year	Number of Turbines Searched	Search Interval	Search Period
Research Phase	Years 1-2	15 full plots	Daily	April 1 – September 30
Implementation Phase	Years 3-25, except when pre-empted by Re-evaluation Phase monitoring	40 roads and pads	Daily	Eight weeks (August 1 – September 30)
Re-evaluation Phase	One year following any adaptive management threshold trigger and operational change in response	15 full plots	Daily	To be determined based on period of adaptive management response

6.5.1.1 Research Phase

Research Phase operational monitoring will be conducted for the first two years of the ITP generally following NYSDEC's 2016 *Guidelines for Conducting Bird and Bat Studies at Commercial Wind Energy Projects* (NYSDECD 2016 Guidelines). The protocol has been designed to ensure collection of a sufficient dataset to evaluate effectiveness of the seasonal turbine operational adjustments through comparison of the all-bat mortality rate to the average bat mortality rate of those reported by other wind energy facilities in the region (Table 5.6).

Of the 40 total Project turbines, 15 (37.5%) will be searched daily using cleared plots during the Research Phase monitoring. This is a modification from the NYSDEC 2016 Guidelines, which recommend searching 33% of turbines daily and an additional 33% weekly. The modification is made with the goal of collecting high quality data while reducing the number of plots that must be cleared. More bat carcasses that are fresh (which provide better information about the conditions at the time of the fatality) and more bat carcasses in general (which provide more data for mortality estimation and analyses) are likely to be found at plots that are searched daily than at plots that are searched weekly. Searching more plots daily rather than searching a separate set of plots weekly reduces the total number of cleared plots that must be maintained and consequently reduces the financial and logistical challenges associated with clearing plots. Furthermore, this protocol exceeds the sampling effort in the USFWS *Land-based Wind Energy Guidelines* (USFWS 2012e), which recommend searching 30% of the turbines to a maximum radius of half the tower height at an interval that is half the mean carcass removal time.

Search turbines will be selected using a spatially representative approach to ensure turbines within three miles of the northern long-eared bat capture are represented in the sample. Searches will be conducted from April 1 to September 30 at mowed plots with length and width equal to 394 ft x 394 ft (120 m x 120 m) per the NYSDEC 2016 Guidelines' recommended plot size adequate for most modern turbines in New York, or as close as possible to this size as allowed by site constraints (e.g., topography, land access, etc.) and cleared (i.e., non-forested) areas around the turbines. As predicted by the Hull and Muir (2010) model, this plot size will capture 95.7% of the bats, 89.7% of the small birds, and 74.2% of the large birds that collide with a turbine of the dimensions proposed for the Project. The actual search areas will be mapped prior to beginning each year of monitoring. Search transects will be 16 ft apart and data will be collected per the NYSDEC 2016 Guidelines. Search plots will be mapped and searcher efficiency trials and carcass removal trials will be conducted during both Research Phase monitoring years to establish the bias adjustment rates for searchable area, searcher efficiency, and carcass removal, respectively. It is expected that Research Phase monitoring will provide sufficient information to accurately assess the effectiveness of the seasonal turbine operational adjustment protocol and the rate of overall bat mortality, from which the level of take of the Covered Species can be calculated using the species composition method.

6.5.1.2 Implementation Phase

Implementation Phase monitoring is designed to detect changes in bat mortality that may occur over time by focusing search effort during the period when most of the take of the Covered Species, and most all-bat mortality, is expected to occur at the Project (5.2.1.1 and 5.2.2.1). Implementation Phase monitoring is practicable for implementation over the duration of the ITP term and has the objective of providing confirmation that bat mortality and take of the Covered Species at the Project remains at the level established during the Research Phase monitoring (i.e., remains minimized to levels compliant with the ITP). Implementation Phase monitoring will cover the period when it will be crucial to verify that the minimization measures are effective and the period when it will be crucial to collect data to inform the annual Covered Species take estimates. The focus of search effort during this period will enable collection of the most data in a limited search period. Because monitoring will be implemented when most of the bat mortality occurs at the Project, data collected during this period will be sufficient to provide an estimation of the annual bat mortality rate.

This stepped-down approach will enable monitoring in each permit year to ensure the minimization measures remain effective over the permit duration by targeting the period during which mortality has the potential to be highest. This approach will also keep the level of monitoring commensurate with the low impact of take and allow more of the HCP budget to be devoted to the minimization measures themselves and mitigation project benefitting the Covered Species (per directive of the HCP Handbook).

Implementation Phase monitoring will begin in Year 3 of the ITP. After completion of two years of Research Phase monitoring, provided those results confirm that the minimization measures are effective to maintain take of the Covered Species below the limits authorized in the ITP, CWF will implement the less intensive Implementation Phase monitoring for the rest of the permit duration. Implementation Phase monitoring will consist of monitoring only during the 8-week seasonal period during which most of the take of the Covered Species, and most all-bat mortality, is expected to occur at the Project: August 1 to September 30. This period may be adjusted (i.e., moved earlier or later in the year) if necessary based on the results of the Research Phase monitoring; this change would be proposed in the annual monitoring report and discussed with USFWS prior to the next monitoring year. An annual all-bat mortality estimate will be calculated by scaling up the mortality estimate from the 8-week period based on the relative proportion of the annual bat mortality estimate from the Research Phase monitoring that was attributable to periods outside of the 8-week period.

During Implementation Phase monitoring, all 40 Project turbines will be searched daily using road and pad searches out to 328 ft (100 m). The NYSDEC 2016 Guidelines allow for the use of road and pad searches after the first year of monitoring at a site and road and pad searches are a well-established method for assessing bat mortality rates at wind energy facilities. Road and pad searches only evaluate the gravel pad and road areas within the plot boundary. The time required to delineate and survey this plot type is less than the time needed to survey cleared plots and the plots will not need to be mowed. Reduced search time and reduced cost (due to not mowing plots) allows for more searches to be conducted, increasing the search coverage of the Project; all turbines can be searched, on a daily interval, using road and pad searches. Additionally, higher searcher efficiency rates can be realized and larger plots can be searched, aiding in the estimation of the carcass density distribution. Although road and pad searches on inadequate plot sizes can lead to insufficient data to model the distance distribution, road and pad searches conducted out to at least 328 ft, such as those proposed for the Project, generally avoid this problem (P. Rabie, Western EcoSystems Technology [WEST], pers. comm.).

Calculations of fatality rates for the road and pad searches will require an adjustment for the area searched along with the adjustments for searcher efficiency and carcass persistence. Several methods have been developed that estimate the proportion of carcasses captured by searches that are confined to roads and pads (Huso and Dalthorp 2012, Maurer et al. 2014, Rabie et al. 2016). To estimate the area correction, a truncated weighted likelihood model will be used because it has desirable statistical properties (in terms of bias, precision and ease of implementation; Riser-Espinoza et al. 2016). To inform the other adjustments, searcher efficiency and carcass removal trials will be conducted during each Implementation Phase monitoring year.

The Implementation Phase will remain in effect for the remainder of the operational life of the Project, unless the reduction in all-bat mortality is insufficient to maintain annual take of the Covered Species below the estimated level (indicating take of the Covered Species is on pace to exceed the ITP take limit, which equates to the adaptive management threshold, see Section 6.6) is observed.

6.5.1.3 Re-evaluation Phase

If an adaptive management threshold (Section 6.6) is met, operational changes will be made as needed in accordance with the adaptive management framework described below (Section 6.6), and a year of Re-evaluation Phase monitoring will be conducted following initiation of the operational change to confirm the altered operational adjustment protocol's effectiveness at reducing bat mortality to a level sufficient to maintain annual take of the Covered Species below the estimated level. The Service will evaluate the all-bat mortality level provided from the Re-evaluation Phase monitoring. The Re-evaluation Phase monitoring will use the same study design as the Research Phase monitoring (Table 6.3), except that the search period will be specific to the period of the adaptive management response. For example, if the adaptive management response involves a cut-in speed change from August 1 to September 30, that will be the search period of the Re-evaluation Phase monitoring. If the results suggest the adaptive management strategy was not successful, then adaptive management would again be triggered per the thresholds in Section 6.6 and CWF would again implement the adaptive management response protocols per Section 6.6. As required following the implementation of an adaptive management response, Re-evaluation Phase monitoring would again be conducted following initiation of the operational change.

6.5.1.4 Monitoring Protocol

Prior to starting the monitoring, appropriate NYSDEC permits will be obtained, allowing collection and storage of non-federally listed bat carcasses found. Any injured animals will be evaluated and if rehabilitation is possible and allowed by permit, injured wildlife will be brought to a nearby wildlife rehabilitation center, if available. If rehabilitation is not possible, injured animals will be euthanized, if allowed by permit, and recorded as a casualty. If euthanasia is not allowed and rehabilitation is not possible or a wildlife rehabilitation center is not available, any injured wildlife will be left in place and will be recorded as a casualty with as much information as possible.

Casualties found during the study could be discovered by: 1) searchers during scheduled searches; 2) searchers outside of search plots; 3) searchers within search plots outside of scheduled searches; or 4) facility personnel or others on site for other purposes, such as turbine maintenance. All casualties found within a search plot during or outside of a scheduled search within the study period will be included in the analysis of the mortality estimates. For those casualties found outside scheduled searches but within a search plot it is assumed that they would have been found during the next scheduled survey. Casualties found outside of search plots (by biologists or by operations and maintenance personnel) or outside of the study period will be documented as incidentals but not included in analysis of the mortality estimates.

All casualties found will be recorded using the methods described below. Cause of death will be determined, if possible, based on field inspection; however, due to the difficulty associated with obtaining accurate estimates of natural or reference mortality (Johnson et al. 2000), the assumption will be made that all casualties found were attributable to turbine collision or barotrauma. This assumption likely leads to an over-estimation for bird and bat fatalities attributable to the facility. Most wind energy facility monitoring studies have used this conservative approach because of the added costs associated with obtaining accurate estimates of natural or reference mortality (Strickland et al. 2011).

Observers trained in proper search techniques will conduct the carcass searches. All searches will begin at first light and be completed by 1:00 pm eastern time each day, if possible. When searching plots, observers will walk north-south oriented transects approximately 16 ft (five m) apart at a rate of approximately 148-197 ft/minute (45-60 m/minute) along each transect. Observers will scan the area on both sides out to approximately eight or nine ft (two or three m) for casualties as they walk each transect, thereby surveying the entire plot area and providing some visual overlap between transects to improve searcher efficiency.

Date, start time, end time, observer, turbine number, and weather data will be recorded for each search. When a bat or bird casualty is found, the observer will record the distance the observer is from the carcass when first observed. Observers will place a flag near the carcass and continue the search. After searching the entire plot, the observer will return to each carcass and record information on a fatality data sheet, including the date, observer, turbine number, species, sex and age (when possible), distance and direction from turbine, Universal Transverse Mercator coordinates, visibility class, condition (e.g., intact, scavenged, feather spot, partial), and estimated time of death (e.g., less than one day, two days, etc.). Digital photographs will be taken of the carcass, any visible injuries, and surrounding habitat. Rubber gloves will be used to handle all carcasses to eliminate possible transmission of diseases and to reduce any possible human scent bias for carcasses later used in scavenger removal trials. All bat carcasses found will be placed in a plastic bag and labeled with a unique number, and stored in a freezer on site for future reference and possible further study. A copy of the data sheet will be maintained with the carcass at all times. In addition to carcasses, all injured bats and birds observed in search plots will be recorded and considered as a fatality for analysis purposes. All *Myotis* bat fatalities found will be retained and not used in bias trials (see below) for species verification either by another expert or through genetic analysis.

Casualties found in non-search area, or outside of the scheduled search time, will be coded as incidental discoveries and will be documented in a similar fashion as those found during standard searches. Incidental discoveries found outside of scheduled search plots will not be included in the calculation of fatality estimates, but will be included in reporting on appropriate topics such as species composition and distance of fatalities from turbines.

6.5.1.5 Mortality Estimation

During all phases of monitoring, estimates of all-bat mortality will be calculated using a USFWS-approved mortality estimator (e.g., Shoenfeld [2004], empirical pi [per Good et al. 2013], Huso [2011]), based on the number of all bat fatalities adjusted for bias (e.g., searcher efficiency, carcass removal, area adjustments). The estimator used will be identified in each monitoring report. For the first year of monitoring, CWF intends to use the Generalized Estimator (Dalthorp et al. 2018) as the current best-available estimator for calculating all-bat mortality at wind energy facilities and an estimator that is comparable to the estimators used to estimate take of the Covered Species in this HCP. In subsequent monitoring years, new or alternative estimators may be discussed with the USFWS; however, the estimator used for the purpose of evaluating compliance with the ITP must remain comparable to the estimators used to estimate take of the Covered Species in this HCP (e.g., Shoenfeld [2004], empirical pi [per Good et al. 2013], Huso [2011]) to avoid triggering adaptive management in response to a change in statistical methods rather than a real change in bat mortality. Take of the Covered Species will be estimated from the overall bat mortality rate based on the proportion of mortality estimated to be attributable to the Covered Species (see Sections 5.2.1.2 and 5.2.2.2).

Data collected in each monitoring year will be used to update the estimate of all-bat mortality and the species composition ratios to provide a current take estimate for both of the Covered Species. In the event that a Covered Species fatality is documented during the operational monitoring, the record will also be used to update the species composition ratio. Adjustments to the estimated proportion of the Covered Species in the all-bat mortality will be made by adding the monitoring data collected to-date at the Project to the species composition dataset (Section 5.2.1.2). The monitoring data will be added to the dataset in Table 5.8 to update the Indiana bat species composition and to the dataset in Table 5.11 to update the northern long-eared bat species composition for the purposes of recalculating the percent composition of each Covered Species and consequently updating the take estimate(s). The USFWS and the NYSDEC will be notified by phone within 24 business hours of positive identification of any Covered Species or federally or state threatened or endangered species casualties discovered.

For measuring ITP compliance, the three-year rolling average of annual Covered Species take, estimated from all-bat mortality using the species composition approach and rounded to the nearest hundredth, will be compared to the annual averages of the authorized take limits (see Sections 5.2.1.3 and 5.2.2.3). The three-year rolling average will be calculated continuously over the duration of the ITP, utilizing a weighted average approach based on the variance (i.e., standard error) around each point estimate of annual take; this approach will enable averaging even in three-year periods that include a mixture of monitoring phases (e.g., Research Phase, Implementation Phase, Implementation Phase or Implementation Phase, Re-Evaluation Phase, Implementation Phase).

An averaging period of at least three years is considered necessary to provide adequate confidence in the take estimate due to the low expected annual take. This could create a delay in adaptive management response during the first three years after the ITP is issued if take is higher than expected. However, preliminary responses (before the first three years of monitoring have been completed) would prevent the establishment of the baseline take estimates for the HCP. Additionally, the requested take authorization is for the life of the Project. Should the average annual take at the end of the first three years be higher than the annual average of the predicted take limit, there will likely be sufficient time to adjust minimization measures and ensure that the life-of-project take stays within the ITP limit. However, if excessive levels of take are observed during the initial three-year averaging period (i.e., more than two Indiana bat carcasses or more than eight northern long-eared bat carcasses are discovered), CWF will proceed to implement an appropriate adaptive management response, per Section 6.6, to ensure compliance with the take limit over the full ITP term,

After the first three years, the three-year rolling average will be re-calculated and evaluated for take compliance at the end of each monitoring year (see Adaptive Management in Section 6.6.1).

6.5.2 Summer Presence Monitoring

Monitoring will be conducted periodically throughout the ITP term to reassess the summer presence of northern long-eared bats in the Permit Area. Summer use monitoring will consist of a two-pronged approach: 1) monitoring in Permit Year 10 and Year 20 for the summer presence of northern long-eared bats in previously undocumented locations within the Permit Area, and 2) monitoring initiated the summer after permit issuance for the continued summer presence of northern long-eared bats at the site documented within the Permit Area during pre-construction studies. The summer presence monitoring will enable appropriate responses to any changes in northern long-eared bat summer presence within the Permit Area, ensuring continued compliance with the ITP take limits and continued effectiveness of the HCP minimization measures.

Monitoring in Permit Year 10 and Year 20 will be conducted according to the current USFWS northern long-eared bat summer presence/probable absence survey protocol at the time. The objective of this monitoring effort will be to determine if northern long-eared bats occur during summer in previously undocumented locations within the Permit Area and consequently whether summer minimization measures need to be implemented at turbines within 3.0 miles (4.8 km) of these detections or within 1.5 miles (2.4 km) of any maternity roost trees, based on USFWS Interim Guidance concerning the home range of northern long-eared bat maternity colonies (Section 6.3.3).

Monitoring initiated in Permit Year 1 will be conducted according to the USFWS protocol at the time for summer surveys of areas where presence of northern long-eared bats has previously been documented. If such protocol is not yet available in Permit Year 1, CWF will coordinate with the USFWS to determine the appropriate protocol for the survey. CWF may alternatively opt to wait to conduct the surveys until such protocol becomes available. Depending on the results of the survey, CWF may opt to repeat the surveys at any point during the ITP term. The objective of this monitoring effort will be to determine if northern long-eared bats cease to occur during summer in the location in the western part of the Permit Area documented during the pre-construction studies and whether the summer minimization can consequently be discontinued (Section 6.3.3). Unless and until a probable absence determination is made by the USFWS based on the surveys, CWF will continue to assume summer presence of northern long-eared bats at the previously documented site.

6.5.3 Mitigation Monitoring

As described in Section 6.4, CWF will engage a NYSDEC-approved cave gating contractor to design, plan, and install a gate at the identified mitigation site in coordination with NYSDEC and the USFWS. After installation, the NYSDEC will monitor the mitigation project to confirm that the mitigation work has been implemented (e.g., prevention of human disturbance through gating) and that the gate remains intact and the hibernaculum has been effectively secured and protected from human disturbance/destruction (Mitigation Monitoring for compliance and effectiveness).

The NYSDEC conducts biannual surveys of protected bat hibernacula in the state. The hibernaculum identified for the cave gating mitigation project is on property owned by the NYSDEC and the NYSDEC will maintain ownership of and responsibility for monitoring and managing the hibernaculum after the gating project is implemented. It is anticipated that any biannual surveys of the bat populations within the hibernaculum conducted prior to the gating by the NYSDEC will continue to be conducted by the NYSDEC after gating. During these survey visits, the continued presence and function of the gate will be noted and reported to the Service.

6.6 Adaptive Management Plan

Adaptive management is commonly used as a method for addressing uncertainty in natural resource management. Broadly defined, it is a method for examining the effectiveness of the strategies chosen to meet the biological goals and objectives, and then, if necessary, adjusting future conservation management actions as needed according to what is learned. Specifically, for projects that may pose a risk to a species, but for which there are data/information gaps at the time the ITP is issued that make effectiveness of the selected minimization and mitigation measures uncertain, an adaptive management strategy can be applied to address those uncertainties and incorporate the results of monitoring, additional research or the availability of new information over the life of the project.

The Project will be monitored for the duration of the permit term to assess the level of take of Covered Species and confirm the effectiveness of the seasonal turbine operational adjustment protocol in reducing bat mortality. While there is confidence that curtailment above the temperature threshold will reduce total bat mortality based on the research conducted to-date (Table 6.1), the effectiveness of this minimization strategy will be verified at the Project after the ITP has been issued. Additionally, the location of the northern long-eared bat summer use within the Permit Area will be monitored periodically to ensure the summer turbine operational adjustment protocol is implemented at the turbines necessary to be effective. CWF will coordinate annually with the USFWS to interpret the results of the monitoring surveys and evaluate any new available data (e.g., from regional studies). If needed, CWF will adjust on-site minimization strategies in response to these results as described below to ensure the level of authorized take is not exceeded over the 25-year term of the ITP. CWF will determine the appropriate adaptive management response, if needed, following each monitoring year and provide a recommendation to the USFWS for discussion and a coordinated decision based on USFWS input, as described in Section 6.7.

6.6.1 Take Limit Compliance

The purpose of the adaptive management framework for take limit compliance is to ensure that take levels do not exceed the limits authorized in the ITP. Therefore, the adaptive management framework is designed to trigger additional minimization if annual take is on pace to exceed either of the predicted ITP limits (four Indiana bats and 16 northern long-eared bats; Figure 6.2). The adaptive management framework also allows for reduced minimization if the annual take is on pace to be less than the predicted ITP limits, indicating that a reduced minimization plan would maintain take below the predicted ITP limits. The ITP take authorization is based on whole bats; however, because the take estimates for both Covered Species are small (less than one whole bat per permit year), the annual monitoring and annual adaptive management triggers must consider partial bats. Therefore, the adaptive management triggers will assess how the rate of take over the remaining permit term, plus the cumulative estimated take to date, compares to the predicted ITP take limits..

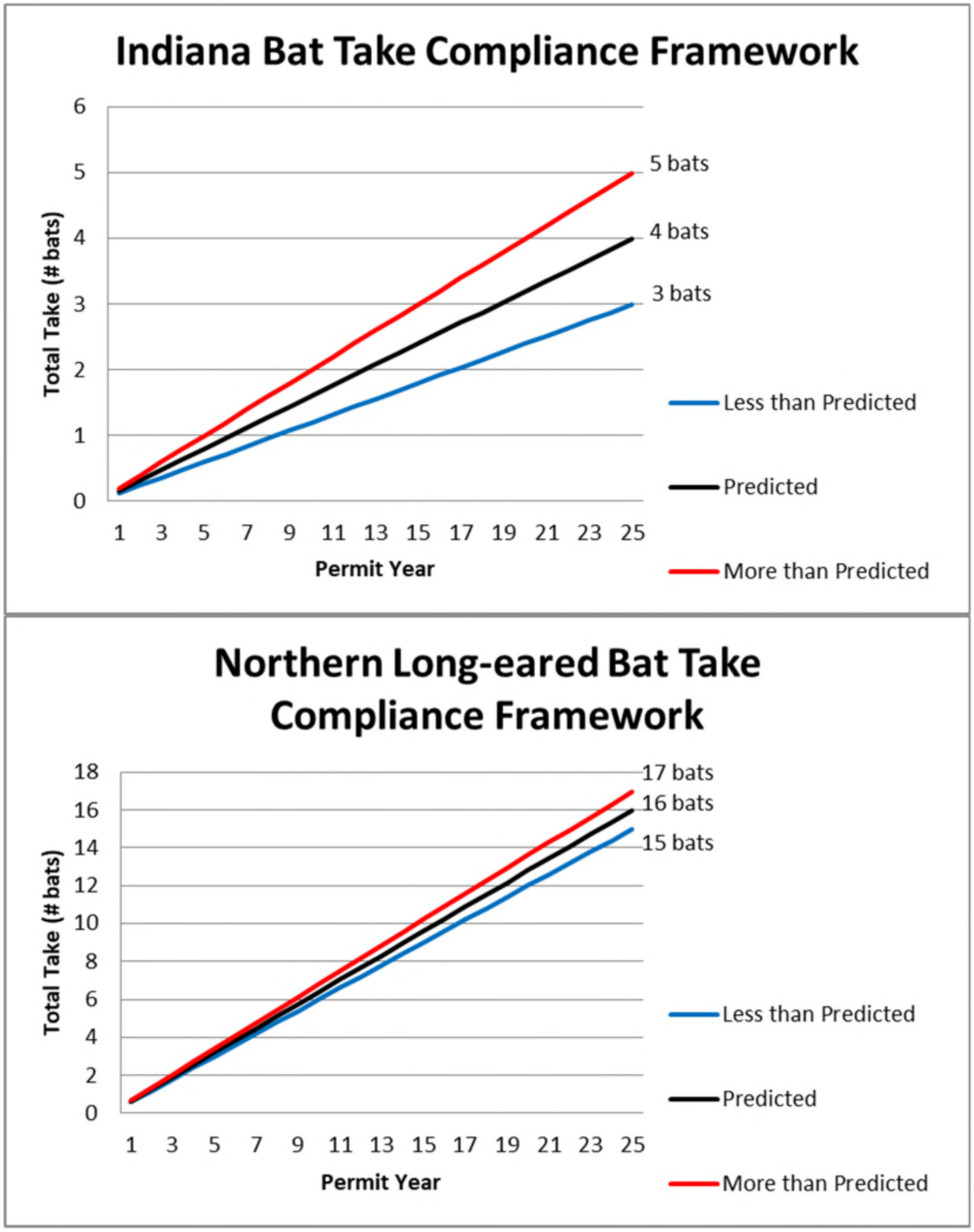

Figure 6.2 Take Compliance Framework for Indiana bats and northern long-eared bats under the Copenhagen Wind Farm Habitat Conservation Plan.

6.6.1.1 Indiana Bat

Under the adaptive management strategy for Indiana bats, changes may be made to the seasonal turbine operational adjustment protocol in the event that operational monitoring suggests that the estimated rate of take is higher than expected. The three-year rolling average of annual Indiana bat take, estimated from all-bat mortality using the species composition approach, will be projected over the remaining permit term. The cumulative estimated take to date will be added to this projection to develop a Projected Cumulative Estimate of the take that is on pace to occur over the full permit term. The Projected Cumulative Estimate of take will be compared to the ITP take limit of four Indiana bats over the 25-year ITP term to determine the need for an adaptive management response. If the Projected Cumulative Estimate of take is four or fewer Indiana bats, then no additional on-site minimization measures (beyond those described in Section 6.3) will be implemented. Mitigation measures will continue to focus on off-site conservation measures, as described in Section 6.4.

If the Projected Cumulative Estimate of take is five or more Indiana bats over the 25-year ITP term, it will serve as an indication that greater minimization measures are needed to bring the rate of take down to ensure compliance with the permit limit over the full permit term. Accordingly, CWF will adjust the seasonal turbine operational adjustment protocol in the manner described below to further reduce estimated Indiana bat take and ensure compliance with the overall take authorization of the ITP. If two or more Indiana bat carcasses are discovered during the initial three-year averaging period, this may indicate that excessive levels of take are occurring and, rather than wait for the analysis of take estimates, CWF will immediately adjust the seasonal turbine operational adjustment protocol.

After any adaptive management response is implemented, CWF will conduct a year of Re-evaluation Phase monitoring, which will provide robust estimates of the new take rates occurring under the adaptive management response to confirm the altered operational adjustment protocol's effectiveness at reducing the Projected Cumulative Estimate of take below the permit limit. The three-year take estimate averaging will re-start with the year of Re-evaluation Phase monitoring, to reflect take estimates under the new operational protocol. The more intensive Re-evaluation Phase monitoring effort will establish a robust baseline take estimate for the new protocol. If the Re-evaluation Phase monitoring shows that the updated Projected Cumulative Estimate of take is within the permit limit, CWF will resume Implementation Phase monitoring. If the Re-evaluation Phase monitoring shows that an adaptive management threshold is met, CWF will again adjust the seasonal turbine operational adjustment protocol, without waiting for additional years of monitoring data to inform the three-year average take estimate.

If the Projected Cumulative Estimate of take is three Indiana bats or fewer, it will be an indication that alternative minimization measures may be sufficient to meet the HCP's conservation objectives. Accordingly, after discussion with USFWS and a coordinated decision based on USFWS input, CWF may adjust the seasonal turbine operational adjustment protocol in the manner described below to enable more energy production at the Project while maintaining compliance with the ITP. Once the adjustment is made, CWF will conduct a year of Re-evaluation Phase monitoring to confirm the altered operational adjustment protocol's effectiveness at maintaining a Projected Cumulative Estimate of take of four or fewer total Indiana bats. The three-year take estimate averaging will re-start with the year of Re-evaluation Phase monitoring, to reflect take estimates under the new operational protocol. The more intensive Re-evaluation Phase monitoring effort will establish a robust baseline take estimate for the new protocol. If the Re-evaluation Phase monitoring shows that the updated Projected Cumulative Estimate of take is within the permit limit, CWF will resume Implementation Phase monitoring. If the Re-evaluation Phase monitoring shows that an adaptive management threshold is met, CWF will again adjust the seasonal turbine operational adjustment protocol, without waiting for additional years of monitoring data to inform the three-year average take estimate.

After confirmation that an adaptive management threshold has been met, CWF will propose to USFWS the type and magnitude of operational adjustment(s) to implement in response. CWF will discuss the proposal with USFWS and make a coordinated decision based on USFWS input. CWF's objective will be to implement the adjustment that is expected (based on best available science) to most effectively maintain take at or below four total Indiana bats over the permit term. CWF will be incentivized to make the most effective adjustment to avoid: a) hitting the ITP limit prematurely if Indiana bat take is higher than expected, necessitating operation of the Project under an avoidance strategy unless and until the ITP is amended; or b) operating the Project under an unnecessarily restrictive strategy, if Indiana bat take proves to be lower than expected.

CWF will take the following steps to assess type and magnitude of changes to be implemented: 1) calculate how much the Projected Cumulative Estimate of take varies from the total authorized take; 2) evaluate why the Projected Cumulative Estimate of take varies from the total authorized take, based on a comparison of the monitoring data to the assumptions used to predict take; 3) identify the operational adjustment(s) that most specifically targets the reason for the deviation from the take prediction; 4) estimate the effectiveness of the operational adjustment(s), based on the effectiveness of the baseline seasonal operational adjustments (compared to all-bat mortality average from studies in the region [Table 5.6]) and publicly available minimization effectiveness studies; and 5) propose changes to the FWS for discussion and a coordinated decision based on USFWS input. The mortality reduction predicted for the operational change will be applied to the previous three years of monitoring data to confirm an adequate magnitude of change.

Operational adjustments that could be implemented in response to Indiana bat take that is higher than expected include, but are not limited to: extending the season within which the turbine operational adjustment is applied, raising the wind speed under which turbine blades are feathered, or additional curtailment at specific turbines if evidence shows that some turbines result in higher bat mortality. Operational adjustments that could be implemented in response to Indiana bat take that is lower than expected include, but are not limited to: restricting the season within which the turbine operational adjustment is applied, lowering the wind speed under which turbine blades are feathered, or reduced curtailment at specific turbines if evidence shows that some turbines result in lower bat mortality. CWF will coordinate with the USFWS to discuss and make a coordinated decision based on USFWS input if a different or novel approach appears to be warranted.

Changes to the turbine operation plan will not require additional funding assurance as they are tied to Project operations. CWF will determine the appropriate changes to the seasonal turbine operational adjustment protocol and present the revised protocol to the USFWS discussion and a coordinated decision based on USFWS input prior to the start of the bat active season (April 1) of the following year (per Section 6.7). Data collected in the subsequent monitoring years will verify the effectiveness of the new turbine operational changes in maintaining the estimated take of Indiana bats at a rate that is sustainable in light of the take authorization under the ITP.

6.6.1.2 Northern Long-eared Bat

Under the adaptive management strategy for northern long-eared bats, changes may be made to the seasonal turbine operational adjustment protocol in the event that operational monitoring suggests that the estimated rate of take is higher than expected. The three-year rolling average of annual northern long-eared bat take, estimated from all-bat mortality using the species composition approach, will be projected over the remaining permit term. The cumulative estimated take to date will be added to this projection to develop a Projected Cumulative Estimate of the take that is on pace to occur over the full permit term. The Projected Cumulative Estimate of take will be compared to the ITP take limit of 16 northern long-eared bats over the 25-year ITP term to determine the need for an adaptive management response. If the Projected Cumulative Estimate of take is 16 or fewer northern long-eared bats, then no additional on-site minimization measures (beyond those described in Section 6.3) will be implemented. Mitigation measures will continue to focus on off-site conservation measures, as described in Section 6.4.

If the Projected Cumulative Estimate of take is 17 or more northern long-eared bats over the 25-year ITP term, it will serve as an indication that greater minimization measures are needed to bring the rate of take down to ensure compliance with the permit limit over the full permit term. Accordingly, CWF will adjust the seasonal turbine operational adjustment protocol in the manner described below to further reduce estimated northern long-eared bat take and ensure compliance with the overall take authorization of the ITP. If eight or more northern long-eared bat carcasses are discovered during the initial three-year averaging period, this may indicate that excessive levels of take are occurring and, rather than wait for the analysis of take estimates, CWF will immediately adjust the seasonal turbine operational adjustment protocol. After any adaptive management response is implemented, CWF will conduct a year of Re-evaluation Phase monitoring, which will provide robust estimates of the new take rates occurring under the adaptive management response to confirm the altered operational adjustment protocol's effectiveness at reducing the Projected Cumulative Estimate of take below the permit limit. The three-year take estimate averaging will re-start with the year of Re-evaluation Phase monitoring, to reflect take estimates under the new operational protocol. The more intensive Re-evaluation Phase monitoring effort will establish a robust baseline take estimate for the new protocol. If the Re-evaluation Phase monitoring shows that the updated Projected Cumulative Estimate of take is within the permit limit, CWF will resume Implementation Phase monitoring. If the Re-evaluation Phase monitoring shows that an adaptive management threshold is met, CWF will again adjust the seasonal turbine operational adjustment protocol, without waiting for additional years of monitoring data to inform the three-year average take estimate.

If the Projected Cumulative Estimate of take of 15 northern long-eared bats or fewer, it will be an indication that alternative minimization measures may be sufficient to meet the HCP's conservation objectives. Accordingly, after discussion with USFWS and a coordinated decision based on USFWS input, CWF may adjust the seasonal turbine operational adjustment protocol in the manner described below to enable more energy production at the Project while maintaining compliance with the ITP. Once the adjustment is made, CWF will conduct a year of Re-evaluation Phase monitoring to confirm the altered operational adjustment protocol's effectiveness at maintaining a Projected Cumulative Estimate of take of 16 or fewer northern long-eared bats over the permit term. The three-year take estimate averaging will re-start with the year of Re-evaluation Phase monitoring, to reflect take estimates under the new operational protocol. The more intensive Re-evaluation Phase monitoring effort will establish a robust baseline take estimate for the new protocol. If the Re-evaluation Phase monitoring shows that the updated Projected Cumulative Estimate of take is within the permit limit, CWF will resume Implementation Phase monitoring. If the Re-evaluation Phase monitoring shows that an adaptive management threshold is met, CWF will again adjust the seasonal turbine operational adjustment protocol, without waiting for additional years of monitoring data to inform the three-year average take estimate.

As described for Indiana bats, after confirmation that an adaptive management threshold has been met, CWF will propose to USFWS the type and magnitude of operational adjustment(s) to implement in response. CWF will discuss the proposal with USFWS and make a coordinated decision based on USFWS input. CWF's objective will be to implement the adjustment that is expected (based on best available science) to most effectively maintain take at or below 16 northern long-eared bats over the permit term. CWF will be incentivized to make the most effective adjustment to avoid: a) hitting the ITP limit prematurely if northern long-eared bat take is higher than expected, necessitating operation of the Project under an avoidance strategy if and until the ITP is amended; or b) operating the Project under an unnecessarily restrictive strategy if northern long-eared bat take proves to be lower than expected.

CWF will take the following steps to assess type and magnitude of changes to be implemented: 1) calculate how much the Projected Cumulative Estimate of take varies from the total authorized take, 2) evaluate why the Projected Cumulative Estimate of take varies from the total authorized take, based on a comparison of the monitoring data to the assumptions used to predict take, 3) identify the operational adjustment(s) that most specifically targets the reason for the deviation from the take prediction; 4) estimate the effectiveness of the operational adjustment(s), based on the effectiveness of the baseline seasonal operational adjustments (compared to all-bat mortality average from studies in the region [Table 5.6]) and publicly available minimization effectiveness studies and 5) propose changes to the USFWS for discussion and a coordinated decision based on USFWS input. The mortality reduction predicted for the operational change will be applied to the previous three years of monitoring data to confirm an adequate magnitude of change.

Operational adjustments that could be implemented in response to northern long-eared bat take that is higher than expected include, but are not limited to: extending the season within which the turbine operational adjustment is applied, raising the wind speed under which turbine blades are feathered, or additional curtailment at specific turbines if evidence shows that some turbines result in higher bat mortality. Operational adjustments that could be implemented in response to northern long-eared bat take that is lower than expected include, but are not limited to: restricting the season within which the turbine operational adjustment is applied, lowering the wind speed under which turbine blades are feathered, or reduced curtailment at specific turbines if evidence shows that some turbines result in lower bat mortality. CWF will coordinate with the USFWS to discuss and make a coordinated decision based on USFWS input if a different or novel approach appears to be warranted.

6.6.2 Temperature Threshold

CWF will analyze the monitoring data to determine if the daily searches associated with Research Phase monitoring indicate that the number of bat carcasses found are directly and significantly correlated with the average temperature of the preceding night (as measured from nautical sunset to nautical sunrise at each turbine individually). If this relationship is found and the number of bat carcasses found after nights with an average temperature between 40 °F and 50 °F is comparable to the number of bat carcasses found after nights with an average temperature below 40 °F (i.e., the cumulative take estimates of both of the Covered Species calculated using only data from these temperature sets differ by less than one whole bat over the remaining permit term), CWF will present these data in the annual monitoring report (Section 6.7). These results will indicate that the cumulative take of the Covered Species over the remaining permit term would not change as a result of adjusting the temperature threshold; i.e., the temperature threshold can be changed to 50 °F without causing take of the Covered Species to be greater than predicted. CWF will coordinate with the USFWS to discuss and will make a coordinated decision based on USFWS input to raise the temperature threshold of the turbine operational adjustment protocol to 50 °F in the next operational adjustment period and conduct a year of Re-evaluation Phase monitoring. The three-year take estimate averaging will re-start with the year of Re-evaluation Phase monitoring, to reflect take estimates under the new operational protocol. The more intensive Re-evaluation Phase monitoring effort will establish a robust baseline take estimate for the new protocol. If the Re-evaluation Phase monitoring shows that the updated Projected Cumulative Estimate of take is within the permit limit, CWF will resume Implementation Phase monitoring. If the Re-evaluation Phase monitoring shows that take of the Covered Species is greater than predicted, CWF will adjust the temperature threshold of the turbine operational adjustment protocol back to 40 °F, without waiting for additional years of monitoring data to inform the three-year average take estimate.

6.6.3 Change in Summer Presence

If the summer presence/probable absence monitoring detects the presence of northern long-eared bats (as defined by the current USFWS summer survey protocol) at new location(s) within the Permit Area, CWF will notify the USFWS within 24 business hours and immediately feather all turbines within three miles of the detection location(s) at wind speeds below 5.0 m/s May 16 to July 31 from nautical sunset to nautical sunrise when temperatures are above 40 °F. If this summer minimization protocol has been modified as the result of adaptive management and has proven successful at achieving its goal through subsequent Re-evaluation Phase monitoring, the modified protocol will be implemented.

If a USFWS-approved protocol for surveying areas of previously documented summer presence is conducted and the survey indicates northern long-eared bats are no longer anticipated to occur at any previously documented summer use area within the Permit Area, CWF will notify the USFWS in the annual monitoring report (Section 6.7) and, beginning the following bat active season, will cease to implement the May 16 to July 31 5.0 m/s cut-in speed at the 16 turbines within three miles of the previously documented summer use area. These turbines will instead operate under the same seasonal turbine operational adjustment protocol as the rest of the Project turbines (Section 6.3.3) unless the summer presence/probable absence monitoring again detects presence at the site in the future, in which case CWF will immediately re-initiate the May 16 to July 31 5.0 m/s cut-in speed at all turbines within three miles of the documented summer use area. If this summer minimization protocol has been modified as the result of adaptive management and has proven successful at achieving its goal through subsequent Re-evaluation Phase monitoring, the modified protocol will be maintained.

6.7 Reporting

An annual report describing methods and results of operational monitoring will be prepared following completion of the field surveys and data analysis for each year of monitoring. Annual reports will include:

- Results from monitoring, including results of bias adjustments (e.g., searcher efficiency trials, scavenger removal trials, area adjustments) and estimates of total bat and Covered Species mortality (based on the species composition method);
- Description of any adaptive management changes that were implemented, if necessary; and
- A complete list of all bat and bird fatalities found and accompanying data.

All underlying data (e.g., acoustic calls, data sheets) associated with HCP monitoring commitments will be maintained from each ITP year and made available to the USFWS upon request at any point during the lifetime of the permit. The SCADA data tracking the temperature, timing, and actual wind speeds at which the Project turbines are operational and feathered will also be maintained for all Project turbines in each permit year and provided to the USFWS upon request at any point during the ITP term.

The operational monitoring results will be reported to the USFWS at the end of each monitoring year. An executive summary and a complete description of any adaptive management proposals will be provided to the USFWS by February 28 and the full operational monitoring report will be provided to the USFWS by March 31. A follow-up meeting with the USFWS will be held (in person or via conference call) to discuss each monitoring report and any changes necessary to implementation of the HCP's operational adjustment or monitoring protocols.

The results of summer presence/probable absence monitoring will be reported to the USFWS according to the reporting requirements of the 10(a)(1)(A) permit under which the work is conducted.

CWF will work with the NYSDEC to prepare reports that describe the methods and results of the winter habitat mitigation project and document the compliance and effectiveness of the mitigation project. Reports will include a description of the hibernaculum that has been protected, as well as the measurements of success criteria (as defined in the management plan), and a description of the gating project and hibernaculum monitoring results. Details of the winter habitat mitigation monitoring will be included in an annual report submitted by CWF to the USFWS by March 31 following each calendar year that mitigation actions or monitoring is actively conducted.

7 CHANGED CIRCUMSTANCES AND UNFORESEEN CIRCUMSTANCES

The federal "No Surprises Rule" (63 FR 8859; codified at 50 CFR §§ 17.3, 17.22(b)(5), 17.32(b)(5)) provides assurances to Section 10(a)1(B) permit holders that, as long as the permittee is properly implementing the HCP, no additional commitment of resources including financial compensation will be required with respect to Covered Species, and no restrictions on the use of resources will be imposed beyond those specified in the HCP without the consent of the permittee. Generally, the "No Surprises" provisions are addressed through two components, changed circumstances and unforeseen circumstances.

7.1 Changed Circumstances

Changed circumstances are defined in the No Surprises Rule as "changes in circumstances affecting a species or geographic area covered by [an HCP] that can reasonably be anticipated by [plan] developers and the Services and that can be planned for (e.g., the listing of new species, or a fire or other natural catastrophic event in areas prone to such events)" (50 CFR § 17.3). If additional conservation and mitigation measures are deemed necessary to respond to changed circumstances, and such measures were provided for in the HCP, the permittee will be required to implement such measures (50 CFR §§ 17.22(b)(5)(i), 17.32(b)(5)(i), 222.307(g)(1)). If additional conservation and mitigation measures are deemed necessary to response to changed circumstances, and such measures were not provided for in the HCP, the Services will not require any additional measures beyond those provided for in the HCP without the consent of the permittee, provided the HCP is being properly implemented (50 CFR §§ 17.22(b)(5)(ii), 17.32(b)(5)(ii), 222.307(g)(2)). The HCP must identify a suite of potential changed circumstances, the specific response to each, the costs of implementing the response, and the funding assurances for those responses, where appropriate. In doing so, potential problems can be identified in advance and specific strategies or protocols for dealing with them can be incorporated into the HCP, thus facilitating adjustments to the HCP's conservation program without having to amend the HCP.

CWF has identified the following as foreseeable changed circumstances warranting planning considerations:

- Change in Indiana bat distribution;
- Change in migration dates;
- Glen Park population recovers from WNS;
- Listing of additional species, such as little brown bat;
- New technology or information that improves monitoring mortality, estimating mortality, or minimizing mortality; and
- Changes in mitigation project viability.

7.1.1 Change in Indiana Bat Distribution

In the event that Indiana bat distribution changes, the seasonal mortality of Indiana bats could change, warranting a response by CWF (Figure 7.1).

<u>Trigger 1:</u>
Summer presence monitoring conducted in Year 10 or Year 20 documents the presence of a reproductively active female Indiana bat or a juvenile Indiana bat within the Permit Area.

<u>Response 1:</u>
CWF will notify the USFWS within 24 business hours and immediately feather all turbines within the Indiana bat maternity colony home range distance of five miles (USFWS 2011d) from the detection site(s) at wind speeds below 6.9 m/s May 16 to July 31 and from 0.5 hour before nautical sunset to 0.5 hour after nautical sunrise.

CWF will then evaluate the level of Indiana bat take estimated from operational monitoring conducted prior to the immediate response (i.e., data collected before turbines were feathered under 6.9 m/s), relative to the amount of Indiana bat take authorized in the ITP, to determine whether continued implementation of the HCP given the potential for take of Indiana bats during summer is likely to cause the ITP to be exceeded. The Research Phase of operational monitoring will inform the all-bat mortality rate during the summer season and the effectiveness of the operational minimization measures during the summer season. Furthermore, CWF will evaluate the impact of the take estimated from operational monitoring relative to the impact of the take analyzed in this HCP (Section 5.2.1.4) and offset by the mitigation project (Section 6.4.1). Although this HCP analyzed the impact of reproductive loss from take of female bats at the Project (Section 5.2.1.4), CWF will revisit the seasonal distribution and sex ratio of take at the Project to determine if a greater impact of take may result from Indiana bat summer presence and provide the analysis to the USFWS for review and approval.

If the level of estimated Indiana bat take with summer presence resulting from the evaluation described above is on pace to remain within the authorized amount and the impact of the take with summer presence is on pace to remain within the amount offset by the mitigation project, CWF will feather all turbines within five miles of the detection site(s) at wind speeds below 5.0 m/s May 16 to July 31 from nautical sunset to nautical sunrise when temperatures are above 40 °F. If this summer minimization protocol has been modified as the result of adaptive management, the modified protocol will be implemented.

If the level of estimated Indiana bat take with summer presence is on pace to exceed the authorized amount and/or the impact of the take with summer presence is on pace to exceed the amount offset by the mitigation project, CWF will continue to feather all turbines within five miles of the detection site(s) at wind speeds below 6.9 m/s May 16 to July 31 from 0.5 hour before nautical sunset to 0.5 hour after nautical sunrise. This will avoid the extra take and/or increased impact of take that could result from impacts to Indiana bats during the summer season. In this situation, CWF will coordinate with the USFWS to determine whether the HCP's minimization measures could be adjusted to maintain take of Indiana bats below the permitted level or whether an amendment is appropriate. Examples of adjustments to the HCP minimization measures include changes in the turbine cut-in speed or temperature for part or all of the Project's turbines, changes in timing of the seasonal turbine operational adjustment period, or deployment of bat deterrent technology if suitable technology is available.

<u>Trigger 2:</u>
The NYSDEC or USFWS notifies CWF of the documentation of an Indiana bat maternity colony in New York or Vermont at an elevation equal to or higher than the elevations within the Permit Area, either in peer-reviewed literature or recorded by or reported to the NYSDEC or USFWS.

<u>Response 2:</u>
CWF will conduct a survey following the then-current USFWS Indiana bat summer presence/probable absence survey protocol to evaluate summer Indiana bat presence/absence in areas of potentially suitable habitat within the Permit Area the first summer season (May 15-September 30) after the changed circumstance trigger. If the summer presence monitoring detects the presence of a reproductively active female Indiana bat or a juvenile Indiana bat within the Permit Area, CWF will notify the USFWS within 24 business hours and follow the steps outlined in Response 1, above.

<u>Trigger 3:</u>
The carcass of a reproductively active female Indiana bat or juvenile Indiana bat is discovered during operational monitoring or incidentally at the Project during the summer season.

<u>Response 3:</u>
CWF will notify the USFWS within 24 business hours of positive identification and follow the steps outlined in Response 1, above.

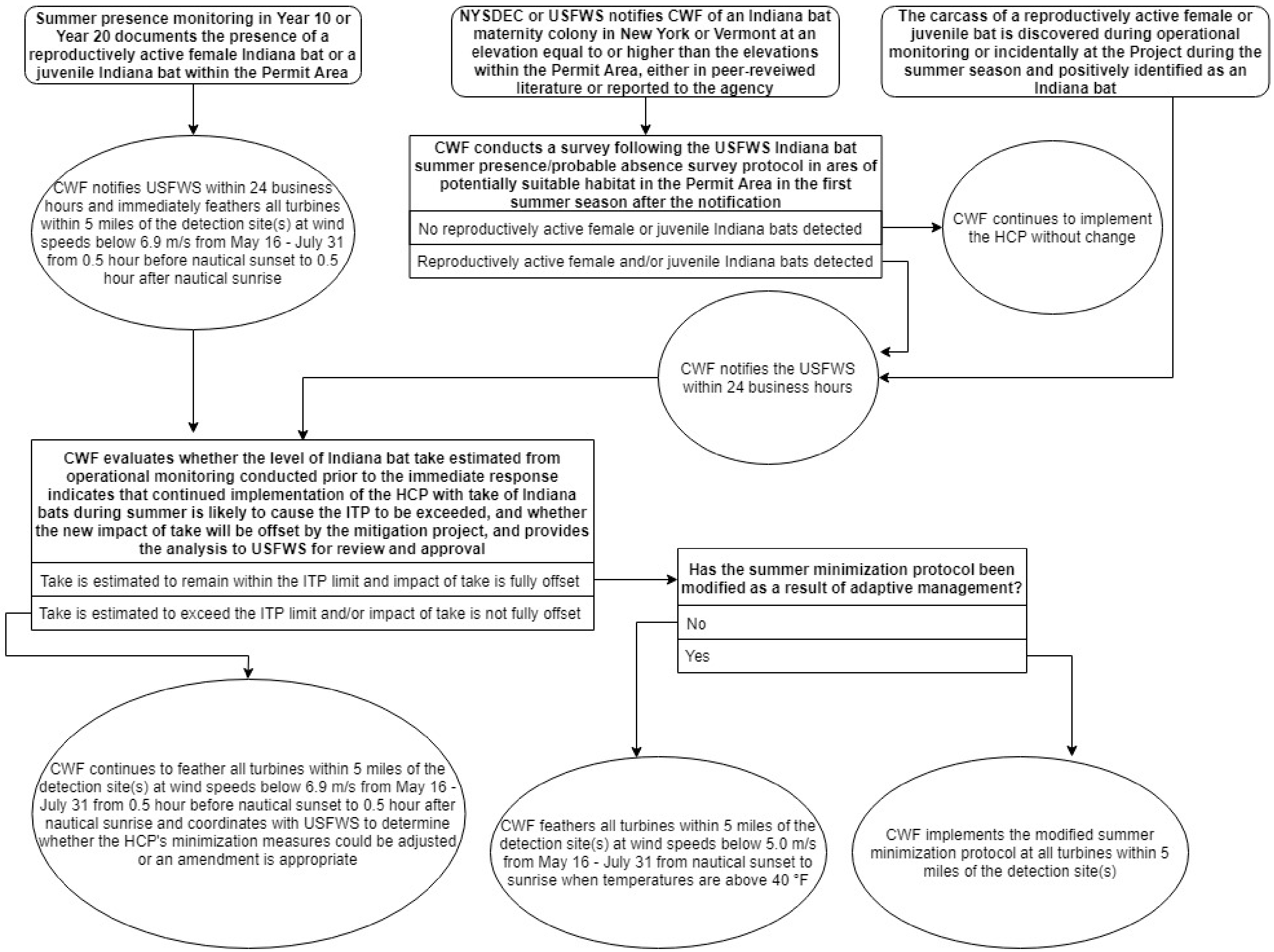

Figure 7.1 Flowchart of the changed circumstance response to a change in Indiana bat distribution.

7.1.2 Change in Migration Dates

Climate change is on-going and effects on species are considered reasonably foreseeable and may potentially influence the phenology of migratory species. This could result in changes in the timing of spring or fall migration. For example, warmer temperatures may allow Indiana bats and northern long-eared bats to remain in summer habitat longer, pushing the dates of fall migration later in the year.

In the event that the timing of Covered Species spring or fall migration changes due to increased seasonal temperatures, the timing of Covered Species mortality at the Project could change, warranting a response by CWF (Figure 7.2). This could potentially occur more than once during the ITP term, but is not expected to be a frequent or predictable event.

Trigger 1:
The NYSDEC or USFWS notifies CWF of the documentation of a shift in the timing of Covered Species spring or fall migration in New York, either in peer-reviewed literature or recorded by or reported to the NYSDEC or USFWS.

Response 1:
CWF will shift the timing of the spring or fall (whichever season triggered the changed circumstance) minimization period to encompass the new documented Covered Species migration dates. For example, if data are presented to CWF showing that Indiana bat migration has shifted two weeks later in the fall season, CWF would shift the timing of the fall minimization period from August 1 to September 30 to a new fall minimization period of August 15 to October 15. In the event of a shift in minimization timing, CWF will keep the other components of the minimization measures constant (Section 6.3.3), unless the measures have been modified in response to adaptive management, in which case the modified measures will be implemented. The summer minimization period will correspondingly be shortened or lengthened (i.e., a shift to earlier spring migration or later fall migration would not result in a gap between the end of spring and the beginning of summer, or the end of summer and the beginning of fall).

If a shift in the fall migration period occurs, CWF will evaluate whether it is appropriate, in light of the goal of monitoring when most bat mortality occurs, to shift the timing of Implementation Phase monitoring (Section 6.5.1.2) to an 8-week period encompassed by the corresponding fall minimization period and provide the analysis to the USFWS for review and approval. Adjustments to the monitoring period would be proposed in the annual monitoring report and discussed with the USFWS prior to the next monitoring year.

Trigger 2:
The carcass of a Covered Species is discovered incidentally at the Project during the late fall season (i.e., October 1 to October 31).

<u>Response 2:</u>
CWF will notify the USFWS within 24 business hours of positive identification. CWF will then shift the timing of the fall minimization period to encompass the date of the Covered Species fatality. CWF will keep the other components of the minimization measures constant (Section 6.3.3), unless the measures have been modified in response to adaptive management, in which case the modified measures will be implemented. The summer minimization period will correspondingly be lengthened (i.e., a shift to later fall migration would not result in a gap between the end of summer and the beginning of fall).

If a shift in the fall migration period occurs, CWF will evaluate whether it is appropriate, in light of the goal of monitoring when most bat mortality occurs, to shift the timing of Implementation Phase monitoring (Section 6.5.1.2) to an 8-week period encompassed by the corresponding fall minimization period and provide the analysis to the USFWS for review and approval. Adjustments to the monitoring period would be proposed in the annual monitoring report and discussed with the USFWS prior to the next monitoring year.

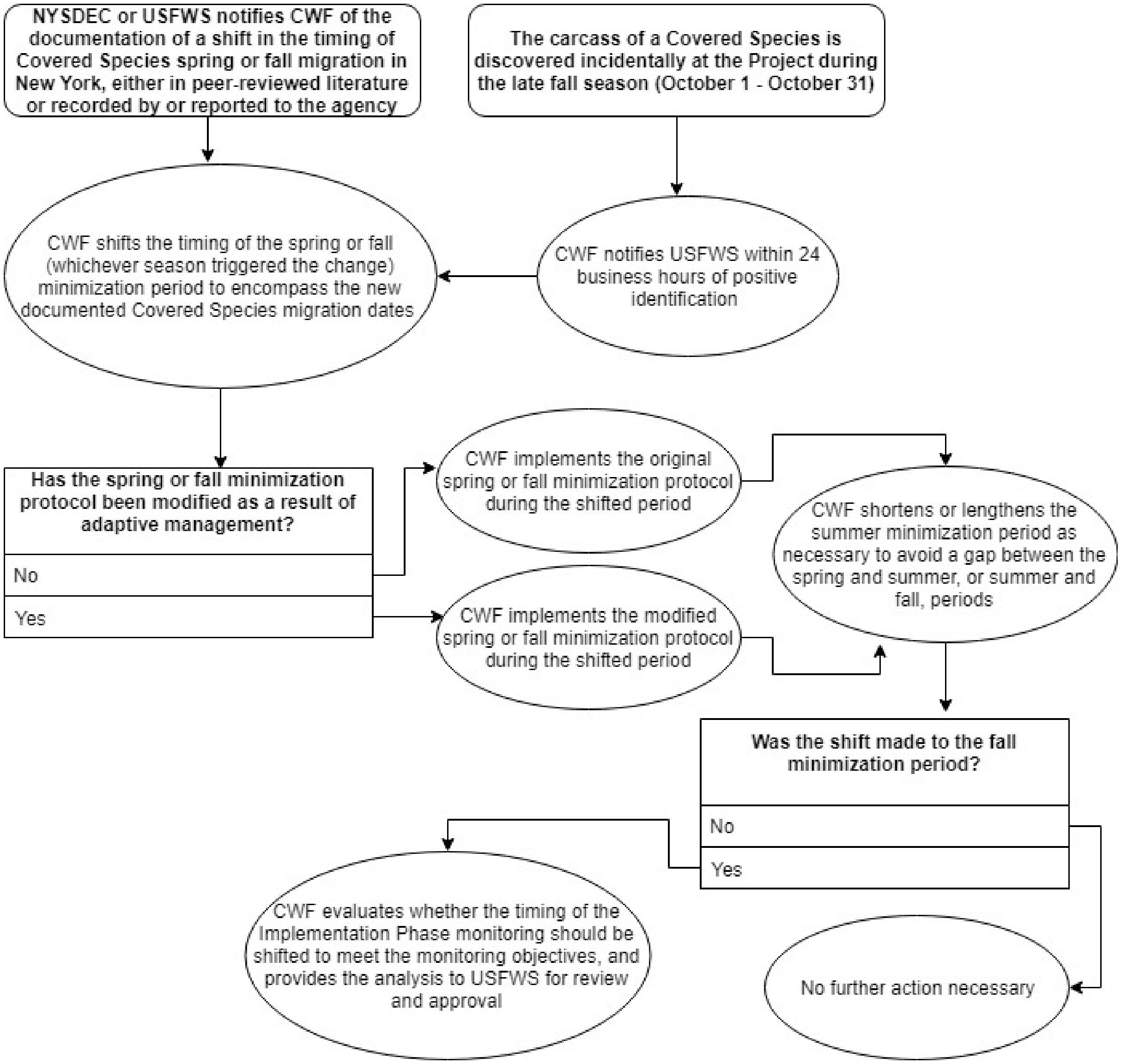

Figure 7.2 Flowchart for the changed circumstance response to a change in migration dates.

7.1.3 Glen Park Population Recovers from White-nose Syndrome

It is difficult to predict at this time what the long-term effects of WNS will be for the Northeast Region. Although the Northeast has been experiencing effects from WNS since 2006, understanding of WNS is still limited and the disease is too new to understand if certain species may recover from the disease and what the long-term impacts of the disease may be for the bat community. Indiana bat populations in the Barton Hill hibernaculum in the Northeast appear to be showing signs of population stabilization and possibly even recovery (USFWS unpublished data), though the same had not been observed for northern long-eared bats as of 2015 (NYSDEC 2015). In the event that the Glen Park hibernaculum recovers to the point of functioning as a P2 hibernaculum for Indiana bats, mortality of the species may occur during the fall swarming and late fall seasons at the Project. Provided this recovery occurs during the permit term, the minimization measures included in Section 6.3 may not continue to meet the conservation goals and objectives, warranting a response by CWF under this HCP (Figure 7.3).

Trigger:
The NYSDEC winter survey documents that Glen Park Indiana bat population meets P2 status (i.e., 1,000 individuals or more) in any winter census during the ITP term. CWF will request update from NYSDEC every other year on the status of the population.

Response:
CWF will conduct a survey following the current USFWS summer survey protocol (in lieu of a fall-specific survey protocol) to evaluate fall swarming or late fall Covered Species presence/absence within the Permit Area. If Indiana bats are not detected, CWF will continue to implement the HCP without change but will repeat the survey once every five years for the duration of the ITP. If Indiana bats are detected, CWF will feather all turbines at wind speeds below 5.0 m/s from October 1 to October 31 from nautical sunset to sunrise when temperatures are above 40 °F. If this fall minimization protocol has been modified as the result of adaptive management, the modified protocol will be implemented and CWF will conduct a year of Re-Evaluation Phase monitoring during the fall swarming/late fall period (October 1 to October 31).

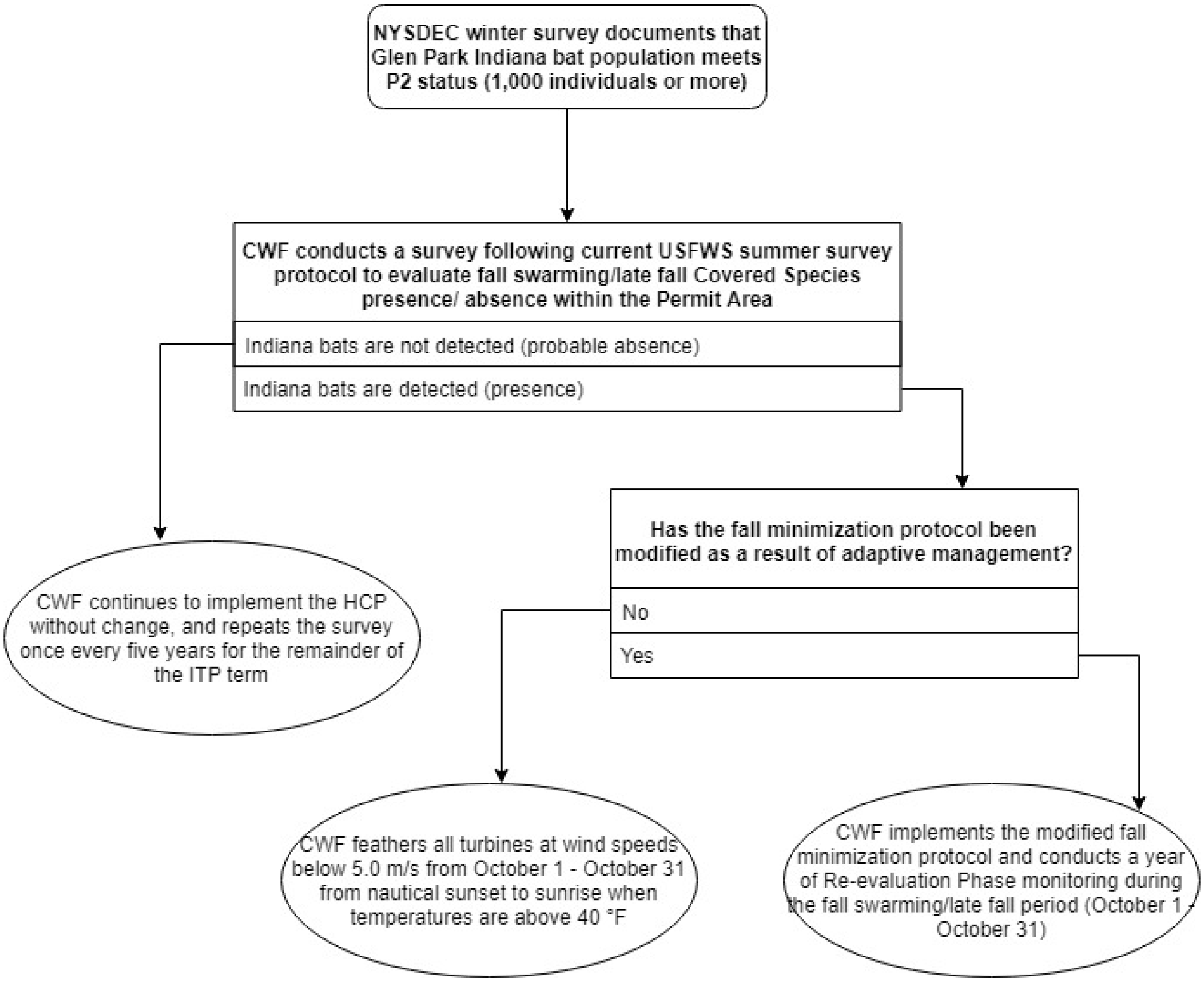

Figure 7.3 Flowchart for the changed circumstance response to Glen Park population recovering from White-nose Syndrome.

7.1.4 Listing of Additional Species

Due to current population declines due primarily to WNS, other bat species (specifically little brown bat) may become listed under the ESA during the term of the ITP. Other wildlife species may also become listed under the ESA during the term of the ITP. Therefore, CWF believes listing of a new bat species or other species of wildlife constitutes a foreseeable changed circumstance that warrants consideration in this HCP.

<u>Trigger:</u>
USFWS notification of a proposed rule to list under the ESA any bat species or other species of wildlife that may occur in the Permit Area, but is not covered by the HCP, will trigger a response by CWF.

<u>Response:</u>
CWF will evaluate data from all monitoring years up to the time of the proposed rule, and additional scientific information related to the impacts of the Project (i.e., operation of wind turbines, use of access roads) on the previously unlisted species, to determine if take of the species has occurred, or is likely to occur, and determine if the Project may result in future take of the species proposed for listing. In the event that impacts to the species have already been documented by CWF, or CWF and the USFWS determine that take is likely to occur, and the species is listed, CWF will initiate a major amendment to the HCP and ITP (see Section 8.1.3). The amendment will include an assessment of take and impacts or the take evaluation and any additional conservation measures required for the newly listed species, except in the case of a threatened listing that is accompanied by a 4(d) rule in which incidental take associated with Project activities is not prohibited.

7.1.5 New Technology or Information

Over the permit term, new information on the Covered Species and bat-wind power interactions is likely to become available, new methods for monitoring or estimating mortality are likely to be developed, and new technology may be developed to minimize bat mortality from wind turbines. CWF may wish to incorporate new information, methods, or technology into the operations and monitoring plans outlined in the HCP. For example, it is expected that over time, results of post-construction monitoring and research related to bat-wind power interactions will be useful in determining changes to improve the on-site minimization measures for the Project. New methods, procedures, or analysis for monitoring studies are likely to be developed during the course of the ITP that provide more accurate results for determining the appropriate Project management actions (e.g., adjusting the turbine operations) to minimize impacts. Currently, on-going studies addressing the influence of weather conditions on bat mortality may inform improved operations of turbines to meet the HCP conservation objectives and increase Project output. In addition, studies and research on the Covered Species are likely to provide useful information related to location, timing, and characteristics of migration or periods when risk is elevated; such information could inform mortality estimates and maximally effective curtailment conditions for minimizing take at the Project. Deterrent technologies (e.g., acoustic deterrents, visual deterrents) are also being investigated and new advances may make these technologies effective at avoiding and minimizing take while also improving Project output. Ideally, these types of technological advances and new information will be used to improve the ability to estimate mortality and develop more effective minimization and monitoring measures for the Project and this HCP.

Trigger:
CWF will notify the USFWS of the intent to utilize alternative monitoring, mortality estimation, or minimization methods that have been demonstrated, based on the best available science, to be as effective as or more effective than the methods described in this HCP. New methods or technology will only be considered if it has been demonstrated to be at least as effective as the methods in this HCP, is considered the best available science, will not require an increase in the take authorization for the Project, and is approved by the USFWS.

Response:
Prior to implementing any new measures for monitoring, estimating mortality, or minimizing take, CWF will meet and confer with the USFWS to discuss the new methods, how they will be implemented, and any special conditions that may be needed. CWF will work with the USFWS to ensure that any new information or techniques that are used are compatible with the biological goals and objectives of the HCP. Any changes to the minimization measures will result in at least one additional year of Re-Evaluation Phase monitoring to confirm the effectiveness of the new measures. The monitoring study plan will be determined in consultation with the USFWS.

7.1.6 Changes in Mitigation Project Viability

The purpose of the winter mitigation project is to offset the impacts of the anticipated take by protecting overwintering populations of Indiana bats and northern long-eared-bats. The mitigation project will be protected in perpetuity to reduce threats to winter habitat for Indiana bats and northern long-eared bats, as well as other bat species. To offset the impact of the take, the winter mitigation project must, at a minimum, remain accessible to bats but protected from disturbance for the ITP term. While not anticipated, this changed circumstance addresses the unlikely potential for the winter mitigation project to fail to offset the impacts of take of Indiana bats and northern long-eared bats (i.e., due to the accumulation of debris near the cave gate during the ITP term). The accumulation of debris or collapse of mine sections may block or impede the ingress and egress to the cave for bats and may also potentially affect the microclimate of the cave.

Trigger:
The regular mitigation effectiveness monitoring (Section 6.5.3) detects the accumulation of any debris or collapse of mine sections near the cave gate.

Response:
CWF will coordinate with the NYSDEC to hire a contractor to clear the debris from the gate entrance and repair any needed ceiling sections. Provided the NYSDEC approves the contractor and arranges access to the property, the debris will be cleared and section restored

prior to the start of the next fall swarming season (October 1). CWF has assured funding for the contractor (Section 9.1).

7.2 Unforeseen Circumstances

Unforeseen circumstances are defined as changes in circumstances affecting a species or geographic area covered by a conservation plan that could not reasonably have been anticipated by plan developers and the USFWS at the time of the negotiation and development of the plan and that result in a substantial and adverse change in the status of the Covered Species (50 CFR § 17.3).

The USFWS bears the burden of demonstrating that unforeseen circumstances exist using the best available scientific and commercial data available while considering certain factors. (50 CFR § 17.22(b)(5)(iii)(C)). In deciding whether unforeseen circumstances exist, the USFWS shall consider, but not be limited to, the following factors (50 CFR § 17.22(b)(5)(iii)(C)): 1) the size of the current range of the affected species, 2) the percentage of the range adversely affected by the covered activities, 3) the percentage of the range that has been conserved by the HCP, 4) the ecological significance of that portion of the range affected by the HCP, 5) the level of knowledge about the affected species and the degree of specificity of the conservation program for that species under the HCP, and 6) whether failure to adopt additional conservation measures would appreciably reduce the likelihood of survival and recovery of the species in the wild.

If unforeseen circumstances arise, the USFWS will not require the commitment of additional land, water or financial compensation or additional restrictions on the use of land, water or other natural resources otherwise available for development or use under the original terms of the conservation plan and beyond the level otherwise agreed upon for the species covered by the HCP without the consent of the permittee (50 CFR § 17.22(b)(5)(iii)(A)). If additional conservation and mitigation measures are deemed necessary to respond to unforeseen circumstances, the USFWS may require additional measures of the permittee where the HCP is being properly implemented only if such measures are limited to modifications within conserved habitat areas, if any, or to the HCP's operating conservation program for the affected species, and maintain the original terms of the plan to the maximum extent possible (50 CFR § 17.22(b)(5)(iii)(B)). Additional conservation and mitigation measures will not involve the commitment of additional land, water, or financial compensation or additional restrictions on the use of land, water, or other natural resources otherwise available for development or use under the original terms of the conservation plan without the consent of the permittee.

Notwithstanding these assurances, nothing in the No Surprises Rule "will be construed to limit or constrain the [Service], any Federal agency, or a private entity, from taking additional actions, at its own expense, to protect or conserve a species included in a conservation plan" (50 CFR § 17.22(b)(6)).

8 AMENDMENT PROCEDURES

The HCP and/or ITP may be modified in accordance with the ESA, the USFWS implementing regulations, and as described here. Modifications to the HCP or ITP may be requested by either CWF or the USFWS. The USFWS also may amend the ITP at any time for just cause, and upon a written finding of necessity, during the permit term in accordance with 50 CFR § 13.23(b). The categories of modifications are administrative changes, minor amendments, and major amendments.

8.1.1 Administrative Changes

Administrative changes are internal changes or corrections to the HCP that may be made by CWF, at its own initiative, or approved by CWF in response to a written request submitted by the USFWS. Requests from the USFWS shall include an explanation of the reason for the change as well as any supporting documentation. Administrative changes on CWF's initiative do not require preauthorization or concurrence from the USFWS.

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

Administrative changes include, but are not limited to the following, provided that they satisfy the definition above: corrections of typographical, grammatical, and similar editing errors that do not change intended meanings; corrections of any maps or exhibits to correct errors in mapping; technical clarifications of the HCP content; and updates of data in the HCP that do not influence or affect the effects analyses, take calculations, or assessment of impact of the taking.

8.1.2 Minor Amendments

Minor amendments are defined as changes to the HCP the effects of which on HCP species, the conservation strategy, and CWF's ability to achieve the biological goals and objectives of the HCP are either beneficial or not significantly different than those described in the HCP. Such amendments also will not increase impacts to species, their habitats, and the environment beyond those analyzed in the HCP, NEPA document, and the BO or increase the levels of take beyond that authorized by the ITP.

Minor amendments may require an amendment to the ITP, HCP, or both depending on circumstances. A proposed minor amendment must be approved in writing by the USFWS and CWF before it may be implemented. A proposed minor amendment will become effective on the date of the joint written approval.

CWF or the USFWS may propose minor amendments by providing written notice to the other party. The party responding to the proposed minor amendment shall respond within 30 days of receiving notice of such a proposed modification. Such notice shall satisfy the provisions of 50 § CFR 13.23 as well as include a description of the proposed minor amendment; the reasons for the proposed amendment; an analysis of the environmental effects, if any, from the proposed amendment, including the effects on HCP species and an assessment of the amount of take of the species; an explanation of the reason(s) the effects of the proposed amendment conform to and are not different from those described in this HCP; and any other information required by law. When CWF proposes a minor amendment to the HCP, the USFWS may approve such amendment or recommend that the amendment be processed as a major amendment as provided below. The USFWS will provide CWF with a written explanation for its decision. When the USFWS proposes a minor amendment to the HCP, CWF may agree to adopt such amendment or choose not to adopt the amendment. CWF will provide the USFWS with a written explanation for its decision. The USFWS retains its authority to amend the ITP, however, consistent with 50 CFR § 13.23.

Provided a proposed amendment is consistent in all respects with the definition in the first paragraph of this sub-section, minor amendments include, but are not limited to, the following: adoption of new take avoidance measures; corrections of any text, maps or exhibits to reflect previously approved changes in the ITP or HCP; and minor changes to the survey, monitoring or reporting protocol.

8.1.3 Major Amendments

A major amendment is any proposed change or modification that does not satisfy the criteria for an administrative change or minor amendment. Major amendments to the HCP and ITP are required if CWF desires, among other things, to modify the Project and activities described in the HCP such that they may affect the take analysis or conservation strategy of the HCP, affect other environmental resources or other aspects of the human environment in a manner not already analyzed, or result in a change for which the public did not have opportunity to review during the original review period. Major amendments must comply with applicable permitting requirements, including the need to comply with NEPA, the NHPA, and Section 7 of the ESA.

In addition to the provisions of 50 CFR § 13.23(b), which authorize the USFWS to amend an ITP at any time for just cause and upon a finding of necessity during the permit term, the HCP and ITP may be modified by a major amendment upon CWF's submission of a formal permit amendment application and the required application fee to the USFWS, which shall be processed in the same manner as the original permit application. Such applications generally will require preparation of an amendment proposal and an environmental review document in accordance with NEPA. The specific document requirements for the amendment may vary, however, based on the substance of the amendment. For instance, if the amendment involves an action that was not addressed in the original HCP or NEPA analysis, the documents may need revision or new versions prepared addressing the proposed amendment. If circumstances necessitating the amendment were adequately addressed in the original documents, an amendment of the HCP or ITP might be all that would be required. Once the amendment documents have been prepared, they will be posted online along with the original HCP, NEPA, and any other documents referenced in the amendment, and the USFWS will publish a notice in the FR to initiate public review.

A major amendment may also be proposed by the USFWS through written notice to CWF. If CWF agrees to the amendment, the same process of amendment proposal and NEPA preparation and public review would be followed. When the USFWS proposes a major amendment to the HCP, CWF may agree to adopt such amendment or choose not to adopt the amendment. CWF will provide the USFWS with a written explanation for its decision.

Changes that would require a major amendment to the HCP or ITP include, but are not limited to: revisions to the Plan Area or activities that do not qualify as a minor amendment, increases in the amount of take allowed for covered activities, changes to the conservation strategy that do not qualify as minor amendments, and additional species listings.

8.2 Permit Renewal

CWF requests that the ITP associated with this HCP be renewable. If CWF decides to seek renewal of the ITP at the conclusion of the initial permit term, it shall submit an application which shall be processed by the USFWS pursuant to 50 CFR 13.22, as that regulation may be updated, revised or recodified at the time renewal is sought.

9 FUNDING

9.1 Costs for Implementing the HCP

The primary costs associated with the HCP include the costs of operational monitoring and reporting and the cost to implement the mitigation project. Other costs associated with HCP implementation include general administration and management of the HCP, summer presence monitoring, and contingencies for changed circumstances. Implementation of operational minimization measures will result in lost revenue, rather than out-of-pocket costs, to the Project. Table 9.1 sets forth the main categories and estimates of costs associated with HCP implementation and compliance.

Table 9.1 Estimated costs for implementing the Copenhagen Wind Farm Habitat Conservation Plan.

Budget Item	First Year Cost	Permit Term Total	Cost Basis and Assumptions
Recurring Costs			
General Administration, Management, and Overhead	$20,000	$729,185	CWF's costs for general administrative tasks implemented annually for duration of the ITP term additive to CWF's normal (non-HCP) operational budget, with 3% inflation over 25 years.

Table 9.1 Estimated costs for implementing the Copenhagen Wind Farm Habitat Conservation Plan.

Budget Item	First Year Cost	Permit Term Total	Cost Basis and Assumptions
Research Phase Monitoring	$163,329	$331,558	Two years of Research Phase monitoring for estimating take and effectiveness of the turbine operational strategy; includes costs for monitoring implementation, with 3% inflation over 2 years.
Reporting for Research Phase Monitoring	$15,980	$32,439	Reporting for two years of Research Phase monitoring, with 3% inflation over 2 years.
Agency Meetings for Research Phase Monitoring	$12,260	$24,888	Agency meetings for two years of Research Phase monitoring, with 3% inflation over 2 years.
Crop Clearing for Research Phase Monitoring	$49,263	$101,500	Crop clearing for two years of Research Phase monitoring, with 3% inflation over 2 years.
Implementation Phase Monitoring	$66,398	$2,286,046	Annual Implementation Phase monitoring, beginning in Year 3, for estimating take and effectiveness of the turbine operational strategy, with 3% inflation over 23 years..
Reporting for Implementation Phase Monitoring	$13,560	$466,861	Reporting for 23 years of Implementation Phase monitoring, with 3% inflation over 23 years.
Agency Meetings for Implementation Phase Monitoring	$9,960	$342,915	Agency meetings for 23 years of Implementation Phase monitoring, with 3% inflation over 23 years.
Summer Presence Monitoring	$60,000	$151,748	Monitoring in Permit Year 1, Year 10, and Year 20 according to USFWS summer survey protocol at the time of monitoring, assuming double effort necessary for Year 1 monitoring where presence previously established, with 3% inflation applied over 20 years.
Adaptive Management Monitoring	$191,569	$191,569	Monitoring to confirm adaptive management response effectiveness, assuming one trigger is met over the permit term.
Crop Clearing for Adaptive Management Monitoring	$49,263	$49,263	Crop clearing for one year of Adaptive Management monitoring.
Total Recurring Costs		**$3,978,787**	**See above.**
Non-Recurring Costs			
Monitoring to evaluate the appropriate response to a changed circumstance	n/a	$50,583	Costs for an additional monitoring study and/or field studies; for example, to investigate the presence of Indiana bat maternity colonies.
Restoration of mitigation site in response to a changed circumstance	n/a	$10,000	Cost of restoration of the mitigation project (e.g., clearing debris from the entrance of the hibernaculum or remediating the collapse of mine sections near the cave gate).
Monitoring of changed circumstance response effectiveness	n/a	$191,569	Cost of monitoring to verify the effectiveness of changes to turbine operational protocols in response to a changed circumstance.

Table 9.1 Estimated costs for implementing the Copenhagen Wind Farm Habitat Conservation Plan.

Budget Item	First Year Cost	Permit Term Total	Cost Basis and Assumptions
Crop clearing for monitoring of changed circumstance response effectiveness	n/a	$49,263	Cost of crop clearing for monitoring to verify the effectiveness of changes to turbine operational protocols in response to a changed circumstance.
Changed Circumstances Fund Total	n/a	$301,415	See above.
Mitigation Project Cave Gating	n/a	$85,000	Proposal from qualified contractor.
Total Non-Recurring Costs		**$386,415**	**See above.**

General overhead and administrative costs were estimated to be $20,000 per year starting in 2017 and then escalated by 3% per year to account for inflation when calculating the total for the life of the ITP. These costs cover general administrative tasks, such as on-site coordination of monitoring studies, submitting reports, scheduling meetings, and coordinating O&M monitoring measures as necessary. It was assumed that one agency meeting would be held on an annual basis in the first quarter of each year, approximately 90 days after completion of the prior year's monitoring and before the start of the bat active season.

The cost estimates for Research Phase monitoring in permit years 1-2 and annual Implementation Phase monitoring thereafter for the life of the permit were estimated based on current monitoring costs, escalated by 3% per year to account for inflation.

Summer presence for the Covered Species is expected to occur in permit years 1, 10, and 20. The actual level of effort required by the USFWS summer survey protocol in place in permit years 10 and 20 may vary from the level of effort currently required, depending upon such factors as the continued effects of WNS on Covered Species populations and the development of new technologies or survey techniques. However, because such changes cannot be predicted, the cost for summer presence monitoring was estimated based on the current cost to implement the USFWS summer survey protocol, escalated by 3% per year to account for inflation for future years.

The estimated cost for an adaptive management response was based on the cost of one year of Re-evaluation Phase monitoring and crop clearing implemented at any point during the permit term. Because the study period for Re-evaluation Phase monitoring will be determined based on the situation triggering the monitoring (per Section 6.5.1.3) and is anticipated to be shorter in duration than the Evaluation Phase monitoring as it would be targeted to specific seasonal adjustments, the year one cost of Evaluation Phase monitoring ($191,569) was used as a generous cost basis for Re-evaluation Phase monitoring occurring at any point in the permit term. Similarly, the year one cost of crop clearing for Evaluation Phase monitoring ($49,263) was used as a generous cost basis for crop clearing for Re-evaluation Phase monitoring occurring at any point in the permit term. The total cost ($240,832) was based on the assumption that adaptive management will be triggered no more than once during the permit term, as it will be CWF's objective to implement an adaptive management response that is expected (based on best available science) to most effectively maintain take at or below the ITP limit over the permit term (per Section 6.6.1) and therefore avoid the need for repeated adaptive management actions. Adaptive management monitoring would be necessary following any year after which it is determined that the estimated rate of take of Covered Species would exceed the permitted incidental take, as described in Section 6.6.1. The costs resulting from an adjustment to the turbine operational measures as an adaptive management response would necessarily be reflected and accounted for in the revised operating budgets for the Project (i.e., any reductions in revenue or increases in expenses would be reflected in CWF's net income, and if the Project could not operate profitably as a result then operations would be discontinued and no further take would occur).

The estimated cost to respond to changed circumstances was based on a number of components, including (i) the cost of an additional monitoring study and/or field studies, for example, to investigate the presence of Indiana bat and/or northern long-eared bat maternity colony(ies) (estimated at no more than $50,583 at any point in the permit term; Table 9.1), (ii) the estimated cost of restoration of the mitigation project (e.g., clearing debris from the entrance of the hibernaculum or remediating the collapse of mine sections near the cave gate) (estimated at no more than $10,000 at any point in the permit term), and (iii) the costs of monitoring to verify the effectiveness of changes to turbine operational protocols in response to the occurrence of a changed circumstance (estimated at $240,832, the cost of a year of Re-evaluation Phase monitoring and crop clearing as explained above). CWF cannot predict the specific operational adjustments or permit modifications that might become necessary in response to some of the changed circumstances (for example, a change in fall migration dates, additional species listing, new technology, etc.); however, as is the case with adaptive management, the costs associated with such adjustments or modifications would represent a reduction in revenue generated by the Project, rather than an out-of-pocket expense. Based on the above components, the total costs reasonably anticipated to respond to changed circumstances are estimated to be $305,778.

The cost to implement the mitigation project is estimated at $85,000, based on a proposal obtained from a qualified contractor. That amount would cover the cost of construction and installation of a gate at the cave entrance. The hibernaculum itself is located on land owned by the State of New York and included in the Walter Williams Preserve, so there is no cost to acquire or place a conservation easement on the property. Further, while New York state law (Environmental Conservation Law of New York § 3-0301) permits CWF to fund the construction and installation of the gate, it requires NYSDEC to monitor and manage the hibernaculum as a state resource on a permanent basis and precludes it from accepting funding from CWF for that purpose. Accordingly, there will be no ongoing costs to CWF for management and maintenance of the mitigation project although those activities are legally assured by NYSDEC.

9.2 Funding Assurances

ESA Section 10(a)(2)(B)(iii) provides that the USFWS shall issue an ITP if, among other things, it finds that "the applicant will ensure that adequate funding for the plan will be provided." Measures requiring funding in an HCP typically include on-site measures during Project construction or operation (e.g., monitoring surveys), and off-site measures required for mitigation (e.g., acquisition of mitigation lands). CWF will ensure that adequate funding for this HCP will be provided using two financing mechanisms: CWF's annual budget/operating revenue and a surety.

CWF will fund recurring costs associated with implementation of this HCP through operating revenues generated by the Project. These recurring costs, which are identified in Table 9.1 above, will be built into the Project's annual operating budget. Prior to the beginning of each year of monitoring, CWF will provide written confirmation to USFWS that it has entered into a contract for the performance of monitoring activities and included those costs in its operating budget. The Project has secured a power purchase agreement with an investment-grade utility that guarantees the Project will be paid for each MW-hour of energy produced, ensuring that adequate revenue will be generated and funds will be available for the required activities. The only situation in which the Project would not earn revenue would be if the Project were to not operate or generate energy. In that situation, CWF would lock the Project's turbines and no take of the Covered Species would occur. Therefore, the recurring costs in Table 9.1 would cease to be incurred.

Non-recurring costs of plan implementation are identified separately in Table 9.1, and include the cost to implement the mitigation project and the costs of responding to changed circumstances. CWF will fully fund implementation of the mitigation project within 90 days after issuance of the ITP. To ensure that funding is available to cover the potential costs of changed circumstances that may occur, CWF will provide financial assurance in the form of a surety acceptable to the USFWS (e.g., a corporate guarantee from CWF's direct or indirect parent or affiliate, a performance bond or a letter of credit to be maintained by an independent, rated financial institution). The financial assurance instrument will be provided within 90 days after permit issuance. As indicated in Section 9.1, CWF has estimated the foreseeable costs associated with the specified responses to those changed circumstances identified in Sections 7.1.1 through 7.1.5 at $291,415. The changed circumstances surety will include an additional amount of $10,000 to account for a changed circumstance impacting the viability of the mitigation project (as specified in Section 7.1.6). This additional amount reflects the estimated cost of reasonably foreseeable restoration of the mitigation project.

Based on the foregoing, and in light of the inherent imprecision of the future cost estimates involved, the total value of the surety for all changed circumstances will be $300,000. The surety may be drawn upon only in the event that CWF fails to fund its obligations under the ITP for any reason. However, in the event the Project permanently ceases operation and the USFWS' analysis indicates that the impact of the take that has occurred to that date has been adequately mitigated, the surety will not be drawn upon and any unspent funds will be released or returned to CWF. If the impacts of the taking have not been adequately mitigated, the surety may be drawn upon to complete the necessary mitigation.

10 ALTERNATIVES TO THE TAKING

ESA implementing regulations and USFWS guidance for developing HCPs require that an HCP submitted in an application for an ITP detail among other things, "alternative actions the applicant considered that would not result in take, and the reasons why such alternatives are not being utilized" (USFWS and NMFS 1996, p. 3-1). To meet this requirement, CWF evaluated two alternatives that would avoid take of Covered Species against the proposed conservation plan (Chapter 6 *Conservation Program*) to determine the option that best addressed the purpose and need for the Project and conservation of the Covered Species. The two alternatives evaluated by CWF were:

1. long-term operation of the Project with turbine operational adjustments recommended by the USFWS for avoiding take of Indiana bats and northern long-eared bats; and
2. an alternative Project location.

10.1 Long-term Operation of the Project with Turbine Operational Adjustment for Avoiding Take of Indiana Bats and Northern Long-eared Bats

The USFWS New York Field Office issued a technical assistance letter for the Project, dated October 26, 2015, concurring with CWF's proposed operational measures to reduce the likelihood of take through collision or barotrauma to a point where it is highly unlikely. Under this alternative, take of Indiana bats and northern long-eared bats would be avoided through the following measures:

- April 1 to May 15 (spring migration season): feather all turbines within three miles of the northern long-eared bat capture site at wind speeds below 5.0 m/s and feather all other turbines at wind speeds below 3.0 m/s from 0.5 hour before sunset to 0.5 hour after sunrise.
- May 16 to July 31 (summer maternity season until overlapped by fall migration): feather all turbines within three miles of the northern long-eared bat capture site at wind speeds below 6.9 m/s and feather all other turbines at wind speeds below 3.0 m/s from 0.5 hour before sunset to 0.5 hour after sunrise.
- August 1 to September 30 (fall migration season): feather all turbines at wind speeds below 6.9 m/s from 0.5 hour before sunset to 0.5 hour after sunrise.
- April 1 to September 30 (spring, summer, and fall seasons): tree removal only as necessary for emergency and hazard tree removal, according to the avoidance protocol defined in the technical assistance letter.

- Adaptive management: feather all turbines within three miles of northern long-eared bat capture under 6.9 m/s April 1 to May 15 from 0.5 hour before sunset to 0.5 hour after sunrise in response to a northern long-eared bat carcass found in spring; feather all turbines according to the protocol for the turbines within three miles of the northern long-eared bat capture in response to a northern long-eared bat carcass found at any turbine outside of the 3-mile buffer in any season.

This type of nightly curtailment of the wind turbines (i.e., turbines feathered and non-operational) during the periods when Indiana bats and northern long-eared bats could be active in various parts of the Permit Area is expected to eliminate the risk of take for the two species in the Permit Area. That is, this measure essentially stops the turbine blades from turning when wind speeds are low and bat activity is potentially high. Because no take would be expected, no HCP would be developed and no application for an ITP submitted.

This alternative was not chosen for the following reasons:

- The purpose of the Project is to maximize renewable energy production using reliable sources of wind energy and address renewable portfolio requirements for New York. Renewable energy production in turn advances state and national renewable energy production objectives while minimizing short- and long-term environmental impacts associated with carbon output and greenhouse gas emissions. Curtailing the turbines during night time hours for the period April 1 through October 31 would result in the Project not being economically viable and limit the contribution of the Project to meeting New York State's renewable goals.

10.2 Alternative Project Location

Under this alternative, the Project would be sited at a different location in the region (i.e., the northeastern US) to minimize potential for take of listed species. This alternative was not chosen for the following reasons:

- The purpose of the Project is to maximize renewable energy production using reliable sources of wind energy and address renewable portfolio requirements for New York. Renewable energy production in turn advances state and national renewable energy production objectives while minimizing short- and long-term environmental impacts associated with carbon output and greenhouse gas emissions. The site was selected based on a number of constraints and concerns, but ultimately had the wind resource needed to support the Project's energy production goals. The ability of alternative sites to meet the purpose and need of the Project is unknown and they may not have a sufficient wind resource to meet the Project's goals.

- Siting the Project at an alternative location appears much less adequate than the proposed HCP, because during the Project development and siting process, CWF took into consideration environmental concerns, including listed species. CWF conducted due diligence studies and determined that the site selected as the Project location would have minimal potential for impacting listed species. Based on literature regarding Indiana bat maternity colony elevations, post-construction monitoring data from Maple Ridge and other wind energy facilities, the agencies' positions in the public record for the nearby Maple Ridge project, and mist-netting studies that were negative for Indiana bats, risk to the species was considered minimal. The northern long-eared bat had not been proposed for listing at the time the Project site selection was made; however, the species has a widespread and common distribution on the landscape and an extensive geographic range, indicating that a site in the region with less potential to take northern long-eared bats cannot be identified based on the best scientific data currently available. Alternative sites for the Project in the region would therefore be unlikely to reduce the potential for impacts to listed species more than the selected site.
- The proposed site location was selected to minimize potential take of listed species, as described above. Based on the current lack of data from which to evaluate fall migration risk for Indiana bats and northern long-eared bats and the limited understanding of northern long-eared bat habitat use, selection of an alternative site in the region would likely do no more to minimize the potential take of listed species, and lower elevation sites may increase the potential for take of the listed species.

Accordingly, CWF proposes to utilize the proposed site location rather than an alternative, based on the site's minimal potential to take listed species relative to alternative sites and its ability to support the Project's energy production goals.

11 PLAN IMPLEMENTATION AND SUCH OTHER MEASURES THAT THE SECRETARY MAY REQUIRE

As a mandatory condition of the permit, CWF will implement this HCP for the duration of the permit term. CWF will be responsible for implementing or contracting for the implementation of the measures described in this HCP and meeting the terms and conditions of the ITP. CWF will allocate sufficient personnel and resources to ensure effective implementation of the HCP, and coordination with the USFWS during the permit term.

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