



Department of  
Environmental  
Conservation

# GUIDELINES FOR CONDUCTING BIRD AND BAT STUDIES AT COMMERCIAL WIND ENERGY PROJECTS

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Prepared by New York State Department of Environmental Conservation  
Division of Fish and Wildlife

[www.dec.ny.gov](http://www.dec.ny.gov)

## Contents

Section 1: Purpose and Definitions.....	2
Section 2: Site and Project Description.....	3
Section 3: Study Objectives and Rationale.....	7
Section 4: Standard Pre-construction Studies.....	10
Section 5: Expanded Pre-construction Studies.....	13
Section 6: Standard Post-construction Studies.....	15
Section 7: Expanded Post-construction Studies.....	19
Section 8: Planning and Reporting.....	21
References and Sources of Information.....	29
Figure 1. Flow Chart of the General Process for Conducting Bird and Bat Studies at Wind Energy Projects in New York.....	34
Appendix A: Mortality Reduction Techniques and Bat Carcass Sampling.....	35

## **Guidelines for Conducting Bird and Bat Studies at Commercial Wind Energy Projects**

To help meet our increasing demand for electricity, the 2015 New York State Energy Plan places a priority on increased energy diversity and the use of renewable energy sources, with a goal of 50% of the state's energy generation coming from carbon-free renewable sources by 2030. While wind energy has significant emissions benefits when compared to energy produced from fossil fuel, the New York State Department of Environmental Conservation (DEC or Department) must also consider the potential negative environmental impacts of wind energy production when evaluating proposed projects. Currently, the nature and severity of both site-specific and cumulative impacts that commercial wind energy projects may have on birds and bats and their habitats in New York State is DEC's most pressing issue related to wind energy development. The Department's concern for and jurisdiction over these natural resources derives from the Environmental Conservation Law (ECL) which articulates the policies of the DEC (Article 1), the powers and duties of the Commissioner (Article 3), and the requirements for the protection of fish and wildlife and their habitats (Article 11).

This document sets forth DEC's guidance for commercial wind energy developers on how to characterize bird and bat resources at on-shore wind energy sites, estimate and document impacts resulting from the construction and operation of wind energy projects, and reduce mortality levels through turbine siting and operational modifications. These guidelines provide a general framework for the developer to propose site-specific studies needed to evaluate the potential and/or actual effects of a given wind energy project, and outline consistent and predictable methodologies, based on the latest scientific knowledge, to assist developers in the planning, development, and monitoring process. It should be recognized that the effort required to fully understand the movement of and impact to birds and bats at any given locale would be monumental and would take many years. Therefore, the studies described here are considered the minimum effort necessary to characterize bird and bat activity at a specific project location within a reasonable time frame relative to construction.

This guidance provides two tracks for pre-construction and post-construction studies: "standard" and "expanded." It is anticipated that all sites will warrant at least the standard studies. However, where site-specific conditions or other information suggest the potential for substantial adverse impacts to birds and/or bats, or their habitats, expanded studies and/or additional years of study designed to further evaluate the specific concerns may be necessary.

Along with providing essential data for evaluation of project operation, the protocols set forth herein are intended to allow for comparability of data collection among sites and between years such that the information from each site may contribute to a statewide understanding of the ecological effects of wind energy generation. A list

of web sites, published papers, and other references and information sources is included at the end of the document.

1. **Purpose and Definitions**

The purpose of this document is to set forth the protocols for conducting bird and bat studies at wind energy projects to provide information necessary for DEC to:

- a. assess and understand the ongoing or expected environmental impact of a specific wind energy project; and
- b. make a recommendation to the State Environmental Quality Review Act (SEQRA) lead agency or the Public Service Law Article 10 (PSL Article 10) New York State Board on Electric Generation Siting and the Environment (Siting Board), as appropriate, regarding the construction and operation of the project in order to avoid or minimize adverse environmental impact.
- c. determine the possible need for an incidental take permit for impacts to state listed species during construction and/or operation of the project, per 6 NYCRR Part 182.

These guidelines are not intended to cover survey recommendations for, or the evaluation of, potential impacts to species other than birds and bats. Developers should coordinate with DEC to determine if other wildlife resources may warrant investigation during the development, construction, and operation of a proposed project.

The following terms are used as defined here:

*Adverse impact* means 1) mortality of birds or bats due to collision or other possible effects such as barotrauma (sudden, potentially fatal, pressure changes that may rupture or otherwise injure ears, lungs, or other internal organs) caused by a wind turbine; 2) displacement of birds or bats from their habitat due to the presence and/or operation of a wind energy project; 3) a detectable reduction in bird or bat use of the site due to construction or operation of the project; or 4) repeated or continuous disruption of the natural feeding, roosting, breeding, wintering, or migratory behaviors of birds or bats as a result of the construction or operation of the project.

*Bird and bat resources* includes all species of native and protected birds (Class *Aves*) and bats (Order *Chiroptera*) that use or may use the site, as well as the habitats that support them.

*Site, project site, or project area* means not only the real property boundaries or outline of proposed turbine locations and other project-related infrastructure on the ground, but includes the air space over and surrounding the entire project.

*Study area or surrounding area* is defined as all land and air space within the project area and at least five miles outside of the edge of the project area. The study area may be extended out to fifteen miles, depending on the conditions and landscape of the project area, the proximity of the project to resources of concern and other proposed and existing wind energy projects, and which species are known or suspected to be present within or near the site.

*Project components* includes all proposed or existing turbines, overhead and underground collection lines and transmission lines, new or expanded public and private roads, substations and transfer areas, meteorological (met) towers, permanent and temporary staging, storage and laydown areas, operation and maintenance buildings, and any other building or infrastructure related to the construction and operation of the project.

As part of its environmental review, DEC must consider information pertaining to the presence and activity of birds and bats at the site and in the study area. One of the most effective means of reducing direct and indirect impacts to birds and bats is to site turbines in a location that will avoid disturbance to migrating, breeding, wintering, roosting, and feeding birds and bats. In addition to direct and indirect mortality caused by turbines, other negative effects from factors such as habitat loss or fragmentation, introduction or spread of invasive species, avoidance of otherwise potentially suitable habitat, increased human activity and development, and increased predator and parasite presence can result from the construction and operation of a wind energy project and should also be considered.

As wind energy development continues to expand throughout New York, more information is needed about the temporal and spatial use of habitats and the species composition of birds and bats using those habitats in order to relate wind energy production to its potential impacts. The studies described in these guidelines are based on DEC's current knowledge of the best procedures for conducting thorough and scientifically meaningful pre- and post-construction studies. As studies are conducted at more projects throughout the state, these guidelines may be fine-tuned to incorporate the most efficient, effective and accurate methodologies to fill data needs. When planning a project, developers should contact DEC as early as possible for the most current recommendations, which may differ from this document. Figure 1 (page 33) illustrates the steps described below for conducting pre- and post-construction studies.

## 2. **Site and Project Description**

A characterization of bird and bat resources includes documenting pertinent existing information, and collecting and analyzing additional field data on bird and bat use of the site and surrounding area. Several years of studies have been conducted to date gathering site-specific data on where, when, and how birds and bats use various habitats within the state. These guidelines are intended to provide a template for gathering further information and to aid DEC in assessing impacts and making recommendations to the lead agency, or Article 10 Siting Board, as necessary.

a. *Compile existing information on bird and bat resources*

Prior to expending significant effort in planning a wind energy project, the developer should compile existing information on bird and bat resources at the site and in the surrounding area, including available relevant information from other existing or proposed wind energy projects. The following sources should be consulted:

- i. The DEC Central Office Division of Environmental Permits (DEP) and Division of Fish, Wildlife and Marine Resources (DFWMR) should be the initial point of contact for information regarding the environmental review and assessment process for wind energy development;
- ii. The New York Natural Heritage Program (NYNHP) should be contacted for information on known state and federally listed endangered, threatened, and special concern species and sensitive ecological communities that may be located in or near the proposed project site and surrounding area;
- iii. Screen the project and surrounding area using New York's Environmental Resource Mapper, Nature Explorer, and Biodiversity and Wind Siting Mapping Tool
- iv. Biologists in the DEC Regional office(s), as applicable to the project location, should be contacted for available information on specific resources within the site and in the surrounding area;
- v. To the extent required by the US Fish and Wildlife Service (USFWS), information collected through the use of DEC's guidelines should be provided to the USFWS. The USFWS Ecological Services New York Field Office should also be contacted for information on federally listed species that may be present within or near a proposed project area;
- vi. Local ornithologists, Audubon Societies, birding clubs, hawk watches, and nature centers can provide specific information about bird and bat resources, as well as further information on data from the New York Breeding Bird Survey (BBS), Breeding Bird Atlas (BBA), eBird, and Christmas Bird Count (CBC);
- vii. Biologists in the Bureau of Wildlife's Wildlife Diversity Unit can provide site specific information regarding the proximity of bat hibernacula and summer roosting areas, as well as information on technical research being conducted within New York; and
- viii. Bat Conservation International (BCI) can provide general information about bats and bat biology.

b. *Identify landscape features and resources of potential concern*

The relative proximity of certain landscape features and/or ecological resources to a site can increase the likelihood that substantial adverse impacts to bird and bat resources will result from a proposed wind energy project. The developer should identify any of the following features or resources within the proposed project site or surrounding area:

- i. Habitat of a listed bird or bat species per 6 NYCRR Part 182 (e.g., species of special concern, threatened or endangered). The project sponsor should be aware that if a threatened or endangered species, or habitat known to support those species, is present within or adjacent to the site and/or likely to be impacted by a project, the permit requirements of ECL Article 11-0535 may be applicable. Incidental take of a listed species is prohibited without a permit;
- ii. Proximity of the project (approximately 5 miles) to the Atlantic coastline, the shoreline of one of the Great Lakes, Lake Champlain, Oneida Lake, the Finger Lakes, or the corridor of large rivers (e.g. the Delaware, Hudson, St. Lawrence, Niagara);
- iii. The presence of, or proximity to, areas that concentrate raptors, waterfowl, or other specifically identified species of concern for the site (approximately 2 miles); or a major bat hibernaculum (approximately 40 miles); and
- iv. The presence of any specifically identified habitat or landscape feature that may function to funnel or concentrate birds or bats during migration or for feeding, breeding, wintering, or roosting activities, such as National Wildlife Refuges (NWR), Wildlife Management Areas (WMA), grassland focus areas (Morgan and Burger, 2008), core forest blocks (contiguous areas 150 acres or larger), high elevation mountaintops, prominent ridgelines, or other significant habitat areas.

c. *Provide project information to DEC*

Once existing information is compiled, the developer should meet with DEC to discuss an overview of the proposal, the bird and bat resources of potential concern, and the application of these guidelines to the environmental assessment of the project. DEC understands that some of the information requested below in part 2(c) i-xiii may be considered proprietary, or is likely to evolve as project planning progresses, and may need to be submitted as confidential information/business trade secrets, not subject to public disclosure under the Freedom of Information Law (FOIL) pursuant to Public Officer's Law § 87. To aid in project planning, the project sponsor should prepare a complete description of the project site and surrounding area prior to meeting with DEC, including:

- i. Description of the geographical, topographical and other physical features of the site and within 15 miles of the site, even if the proposed project is further than 5 miles from a shoreline, 2 miles from a wildlife concentration area, or 40 miles from a bat hibernaculum;
- ii. Identification of federal, state, or locally-regulated wetlands, streams, waterbodies, drainage patterns, and publicly-owned forests, parks, and wildlife or forest management areas;

- iii. Location of contiguous or core forest areas, expanses of grassland, large waterbodies, and wetland habitat located within the proposed project township(s) and surrounding study area;
- iv. Location of all meteorological (met) towers, a summary of local weather patterns (e.g., annual precipitation, prevailing winds, etc.), and a summary of the wind resource at the site and in the study area; and
- v. Maps with vegetation types, soils/bedrock, elevation, land use, and other information relevant to siting the project.

Prior to developing the pre-construction study work plan, additional information regarding the proposed project should be provided including:

- vi. Maps of the proposed preliminary turbine layout;
- vii. Description of turbine type, size and rotor swept area; and
- viii. Figures or maps showing existing and proposed roads, electric line routes, substation location(s), and other project components as defined in Section 1.

Data regarding proposed site development should be provided in the form of shapefiles, for use in Geographical Information Systems (GIS) software via ESRI's ArcGIS suite of software (e.g. ArcMap) including:

- ix. Polygon shapefile(s) showing the total project area;
- x. Line shapefile(s) for the transmission and interconnect lines, as well as all proposed temporary and permanent access and maintenance roads;
- xi. Polygon shapefile(s) of any proposed concrete and building structures, storage and lay down areas;
- xii. Point shapefile(s) for all turbine and met tower locations, and any other structures that would be best represented as a point; and
- xiii. Polygon shapefile(s) showing all areas proposed to be cleared around turbines, access roads, electric lines, and all other project components.

d. *Select and implement a standard or expanded pre-construction study protocol*

Sites that contain, are within, or are in close proximity to the features or resources of concern listed in 2(b) above have the potential to cause substantial adverse impacts to bird and bat resources. Therefore, for such sites, project sponsors should anticipate conducting expanded pre- and post-construction studies to identify and quantify potential or actual impacts associated with the specific features or resources of concern. In particular, a proposal to site a wind energy project in proximity to a bat hibernaculum (40 miles), wildlife concentration area (2 miles), along a coastline (5 miles), on a prominent ridgeline, or near a known location of a state or federally listed threatened or endangered species will likely justify a need for expanded pre-construction studies. In preparation for conducting either standard or expanded studies:



- i. Contact the DEC Bureau of Fish and Wildlife Services' Special Licenses Unit regarding any necessary licenses or permits for collection and possession of birds and bats, or special licenses to handle threatened and endangered species that may be needed;
- ii. Contact the USFWS regarding species covered by the Migratory Bird Treaty Act (MBTA), and Endangered Species Act (ESA) permits; and
- iii. Engage an individual or firm knowledgeable about New York state fauna, natural history, and sensitive species habitat requirements, with experience in wildlife biology, ecology, and habitat assessment methodologies, and who possesses the ability and means to conduct appropriate studies.

### 3. **Study Objectives and Rationale**

The overall goal of the studies described in this document is to determine the potential for a specific wind energy project to have an adverse impact on bird and bat resources by characterizing the use of the site and surrounding area by birds and bats under a variety of environmental conditions throughout the year, and by estimating the mortality rate of birds and bats due to collisions and other effects associated with the project. The effects of construction and operation on habitat, and changes in wildlife use of the site will also be studied to determine any displacement or loss of species related to project construction or operation. Data collected prior to construction can be compared to information collected in a similar manner after construction to determine what impact, if any, the project has on migrating and resident breeding and wintering birds and bats. With regard to migratory bats, the data collected as outlined in this document may assist DEC in quantifying the impact of wind power development on bat populations. DEC may also advise that separate studies be conducted to evaluate the presence of, and potential impacts to, species not covered by this document, including mammals other than bats, reptiles, turtles, amphibians, invertebrates, or aquatic organisms. Ultimately, information gained from pre- and post-construction studies will be used to identify appropriate locations to site a project, and measures that may be used to minimize direct and indirect impacts from project construction and operation. See Appendix A (page 34) for more information on potential methods to reduce bat mortality from turbines, and on-going efforts researching bat population size, distribution, and movement patterns across the landscape.

#### a. *Pre-construction studies*

The objectives of the pre-construction studies are to determine:

- i. To what extent the area of the proposed project is used by migrating, breeding, and wintering birds and bats and how the physical and biological features of the proposed site and surrounding area may influence such use;
- ii. The expected and potential direct impact to birds and bats as a result of using the site during operation of the project;

- iii. The expected and potential indirect impact to birds, bats, and their habitats as a result of construction and operation of the project;
- iv. The best possible siting of turbines and other project components with the least likelihood of adversely impacting birds and bats; and
- v. Areas to avoid siting any project components or facilities.

b. *Post-construction studies*

The objectives of the post-construction studies are:

- i. To estimate direct impacts of the operating project in terms of the species composition, seasonal timing, and mortality rates of birds and bats caused by collisions or other effects of the turbines;
- ii. To document any indirect impacts of construction and operation of the project in the form of habitat fragmentation and habituation/avoidance behavior of birds and bats in the area;
- iii. To determine how daily weather events and/or conditions may correlate with the number and species composition of dead or injured animals found beneath daily-searched turbines; and
- iv. To determine what types of operational regimes or technological designs would result in the lowest bird and bat mortality levels.

c. *Bird Studies*

Migrating birds, particularly neo-tropical migrants, are sensitive to changes occurring across the landscape that alter the amount and quality of habitat available to them during migration. Many aspects of the biology, population structure, and ecology of these birds are poorly understood. In a general sense, the following is known:

- i. Most songbirds, and many shorebirds and waterfowl migrate at night, while raptors, swallows, corvids, and some shorebirds and waterfowl move during the day;
- ii. The exact spatial and temporal distribution of this migration is affected by weather patterns, food availability, and geographic features;
- iii. Concentrations of species and individual birds vary with the habitat, season, and year;
- iv. Birds are much more physiologically vulnerable during migration than at other times of the year; and
- v. The effects of human-caused habitat and landscape alterations are persistent over time.

Types of bird surveys include habitat surveys for sensitive and listed species, breeding bird surveys, nest searches and monitoring, migration surveys, eagle use surveys, wintering raptor surveys, waterfowl surveys, and marine radar surveys. The radar surveys provide information on target passage rate, flight altitude, and flight direction. Acoustic monitoring of migratory birds can also be used to identify some species that vocalize in flight, and may provide a rough estimate of flight height for these species. DEC will recommend one or more of these methods based on the

specifics of the site, as each provides a different type and scope of information about the bird species utilizing the area.

d. *Bat studies*

Nine species of bats are known to occur in New York. At this time, the greatest concern at wind energy projects is for the state and federally endangered Indiana bat (*Myotis sodalis*), state and federally threatened northern long-eared bat (*Myotis septentrionalis*), and the species that typically migrate: eastern red (*Lasiurus borealis*), hoary (*Lasiurus cinereus*), and silver-haired bats (*Lasionycteris noctivagans*), collectively “tree bats” or “migratory tree bats”. The populations of cave bats, including Indiana bat, northern long-eared bat, little brown bat (*Myotis lucifugus*), small-footed bat (*Myotis leibii*), tri-colored bat (*Perimyotis subflavus*), and big brown bat (*Eptesicus fuscus*) have experienced drastic declines since the appearance of the fungus *Pseudogymnoascus destructans*, which causes white-nose syndrome (WNS). Hibernacula in New York have lost between 75% and 100% of wintering bats since 2007. During the time WNS was spreading across the state, from 2006 to 2009, cave bats made up 24.9% of identified bat carcasses found at New York wind energy projects. Between 2009 and 2014, after WNS was prevalent statewide, that number dropped to 4%. Now, with such reduced numbers on the landscape, even a single fatality of a *Myotis* bat comprises a proportionately larger percentage of the total cave bat population in a given area. Acoustic monitoring to determine presence or probable absence of cave bats, particularly Indiana and northern long-eared bats, can help DEC and USFWS guide project developers in the best siting, construction, monitoring and mitigation actions. As various studies continue, and improvements are made to the science informing our understanding of bat biology and the status of listed species, project developers should coordinate with DEC and USFWS for the latest recommendations on conducting bat surveys for state and federally listed species.

Little is known about the breeding behavior and ecology of migratory tree bats, though they occupy the landscape in New York from April until the end of October, and potentially later, particularly in coastal areas. Based largely on post-construction mortality monitoring at wind projects in the northeast and across the continent, it is known that the majority of turbine-caused bat fatalities occur during the late summer and fall period. The peak of migratory movements and group social behaviors occurs from mid-July until early October, with a smaller peak from mid-April until June.

It is not well known whether tree bats migrate across a broad front, if they use migratory corridors, what their typical flight height is, or if their migration is influenced by geographic features. If bats are reluctant to cross large bodies of water, then the shores of the Great Lakes, and possibly Long Island, are more likely to have concentrations of migrating bats at lower altitudes than other regions of the state. Eastern red bats and tri-colored bats are known to utilize islands in Lakes Erie and Ontario during fall migration (Thorne 2014), and there is evidence that at least some silver-haired bats cross directly over the Great Lakes during fall migration (McGuire et al 2012). While tree bat behavior during migration is largely under-studied, it is suspected they are attracted to turbines, possibly from great distances (Cryan and Barclay 2009).

#### 4. **Standard Pre-construction Studies**

After compiling the site and project description and before commencing field studies, the developer should consult with DEC regarding the scope and specifics of pre-construction field studies. A minimum of one year of pre-construction studies is needed for all proposed wind energy projects. Additional years or a wider breadth of study will likely be undertaken if warranted by the results of initial on-site studies, if the initial studies took place under abnormal environmental conditions that may have skewed results, or as information is learned through post-construction studies from other projects in the state.

##### a. *Weather conditions*

For all studies described in these guidelines (standard, expanded, pre- and post-construction) standardized daily weather observations should be recorded any time field studies are being conducted. Weather information such as temperature, cloud cover, ceiling height, precipitation, wind speed and direction, and the timing of any cold or warm fronts passing through the area should be recorded on an hourly basis. In general, surveys should not take place when weather conditions limit the potential to detect birds or bats. Any additional weather information relevant to specific studies is identified in the individual study descriptions that follow.

##### b. *Habitat surveys*

Surveys should be undertaken at all proposed projects to identify existing habitat for state or federally listed threatened or endangered species, New York State species of special concern (SC), or species of greatest conservation need (SGCN). If such habitat exists on site or in the surrounding area, additional surveys should be undertaken to determine if any listed or sensitive species are actually present on or near the site. Developers should consult with DEC to determine the methodology, scope and timing of habitat surveys for a given species. Surveys should be seasonally appropriate for each of the target species, and their potential use of the area (e.g., summer for upland sandpiper, fall and spring for migrating golden eagles, and winter for short-eared owls).

Pre-construction habitat surveys should include an evaluation of existing areas of wetland, grassland, and interior forest habitat, and the species known or expected to occur on the site and in the surrounding area. Habitat fragmentation often occurs as a result of the construction of many types of projects, which has the potential to impact local populations of many species. A discussion of the existing habitats should include a calculation of the direct and indirect impacts to habitats expected to occur as a result of the project, particularly for interior forests and grasslands. Direct loss caused by tree clearing, wetland filling, and other construction activities reduces the amount of habitat available to wildlife. Direct impact calculations for habitat should include potential impacts from all project components, as well as expanded roads, rights-of-way (ROW), and other changes to existing infrastructure.

Indirect impacts as a result of construction and operation of a wind energy project are more difficult to quantify, though a number of studies have shown measureable impacts are found up to at least 300 feet (91 meters) from the boundary of a disturbance in forested areas, sometimes 984 to 1969 feet (300 to 600 meters),

depending on the species (Rich et al, 1994; Robinson and Wilcove, 1994). As these studies did not include the presence of a turbine, indirect impacts may extend further into the forest than reported. Therefore, *minimally*, all forested habitat within 300 feet from the edge of a cleared area is considered to suffer indirect impacts, as pertaining to interior forest breeding birds. Larger distances may be needed for some projects, depending on the species present, forest quality, and surrounding habitat.

Indirect impacts in forests and grasslands are likely species-specific and habitat dependent, and include: avoidance of novel tall structures (Shaffer and Buhl, 2015; Stevens et al, 2013; Leddy et al, 1999); increased presence of predators (Keyser et al, 1998), and nest parasites such as brown-headed cowbirds (Howell et al, 2007); the introduction or spread of invasive species; and human disturbance. These, as well as changes in temperature, light penetration, humidity, soil moisture, plant composition, noise levels, prey availability, and other factors may cause birds to avoid forest edges and grasslands during nesting, feeding, and migration periods. This can then lead to increased intra-and inter-species competition for preferred undisturbed habitat, changes in food availability, decreased fledging rates, and increased energy expenditure during foraging and territory defense in sub-par habitat (Wilcove et al, 1986). Every project that impacts interior forest habitat and core grassland areas across the landscape puts cumulative stress on bird and bat populations in New York and across the northeast, which may cause a gradual decline in the overall number and diversity of interior forest- and grassland-dependent species.

c. *Raptor migration surveys*

Raptor migration surveys should be conducted from one or more prominent locations with a clear view of the entire project area during spring and fall migration periods (March 1 to May 31; August 15 to December 15). The size, location, and topography of the proposed project will influence the total number of, and distance between, survey points that DEC recommends. Observations should take place starting at 8:00 a.m. and last until two hours prior to sunset, or later if birds are continuing to move through the area. Surveys should be done at least once every seven days during each season, on days without heavy rain, snow, fog or excessive cloud cover that would limit visibility. Information on the species, number of individuals, sex and age class (if possible), behavior, flight height and direction, time of sighting, and location of each bird relative to the project area should be recorded. Project developers should coordinate with the USFWS for the latest recommendations on conducting eagle use surveys in the project site and surrounding area.

Concurrent with the information described above, observations of the movements of any other large flocks or individual birds (waterfowl, waders, corvids, icterids, swallows, etc.) should be recorded in a similar manner. However, preference should be given to observing and recording data on raptors. The presence and movement of groups or large numbers of individuals of non-raptor species could indicate the area is an important staging, feeding or migratory area.

d. *Breeding and migrating bird surveys*

Breeding bird surveys should be conducted a minimum of once per week from approximately May 15 until June 30 or July 20, depending on the habitat and expected

species. Migrating bird surveys should be conducted a minimum of once per week throughout the spring and fall (March 15 to May 15; August 15 to October 31). These surveys should be done from first light until no later than 10:00 a.m. Weather conditions should be conducive to hearing birdsong and contact calls, and seeing birds move about in vegetation and in flight. Excessively windy, rainy, foggy, or cold days should not be surveyed, as birds are not as detectable under these conditions.

Transects beginning at proposed turbine locations and extending out at least 300 meters into the targeted habitats should be placed throughout the project area. One or more transects should also be placed along proposed transmission line corridors, as needed, to provide adequate coverage of the impacted habitat. Observation points every 50 meters along each transect should be marked with GPS coordinates and surveyed for five to ten minutes for all species seen and heard. Survey duration will vary with project size and total number of transects. A smaller number of control transects should be placed in similar habitat at least 800 meters from potential turbine locations, and surveyed in the same manner. If possible, control transects should be located in the surrounding area outside of the project site, and may be further than 800 meters from potential turbine locations. All transects and observation points will be used for both breeding and migratory surveys, and re-surveyed during post-construction surveys. This before-after-control-impact (BACI) design is intended to evaluate bird presence and use of the site prior to turbines and electric lines being constructed, and compare that information with data gathered after turbines are operational.

All birds identified by sight or sound at each transect survey point should be recorded, though the focus should be on songbirds. Other species, including soaring raptors, waterfowl, and other fly-overs, should also be counted and recorded. These surveys are intended to provide an estimate of the type and number of each species moving through the area in the spring and fall, and using habitat in the project area during nesting time.

Conducting these surveys separately from the raptor migration surveys in the spring and fall will allow for more time and attention to be given to detecting songbird species that move through the project area but may not nest or winter there, and would therefore likely be missed during other types of migration surveys. The location, length, and total number of transects, and number of surveys to be conducted at each transect should be determined in consultation with DEC, may vary among projects, and will depend on the size and layout of the project, dominant habitat types, and the known or suspected presence of listed and sensitive species on site or in the surrounding area.

e. *Bat acoustic monitoring*

Summer bat acoustic surveys should be conducted to determine possible use of the site by state-endangered Indiana bat, state-threatened northern long-eared bat, and other *Myotis* species during the maternity season. Winter and summer locations of Indiana bats are well documented, and are restricted to certain parts of the state. Though less is known about the migration and breeding behavior of northern long-eared bats, they occur in small numbers statewide, and could potentially breed in or migrate through almost any area of the state. The number and placement of detectors will be dependent on the size and layout of the proposed project, and should follow the latest USFWS Indiana Bat Summer Survey Guidelines. Surveys during spring migration, fall

migration, and fall swarming times may also be recommended. Analysis of the data and call identification by software and experienced personnel should focus on determining the presence and species of any *Myotis* bats detected. At least two different software packages should be utilized to filter recorded calls, with a person(s) experienced in distinguishing and identifying bat calls conducting a visual inspection of all *Myotis* or other suspect calls flagged by software.

## 5. **Expanded Pre-construction Studies**

If a developer proposes to construct a wind energy project in or near one of the features or resources of concern identified in Section 2(b), then at least two years of pre-construction study may be needed, incorporating one or more expanded pre-construction studies to provide in-depth information on the bird and bat resources of the site. Similarly, if post-construction study results from a wind energy project in a locale with similar physiographic or ecological features to the proposed project have shown that pre-construction predictions under-estimated the actual post-construction impacts, expanded pre-construction studies may be warranted. Following are examples of the type of expanded studies that DEC may recommend based on site-specific conditions.

### a. *Radar studies*

Radar studies include the use of remote sensing marine radar to determine the use of the project and surrounding area by nocturnally migrating birds and bats. The radar should sample concurrently in both horizontal and vertical modes to collect information on target passage rate, flight height, direction, and speed. Radar units should be operated from at least one hour prior to sunset to one hour after sunrise, minimally during the migration periods of March 1 to May 31 and August 1 to October 31. Different date ranges and/or daily sampling times may be recommended, depending on the goal of the study and resources of concern at a particular site. Data should be recorded in digital format, and include weather information, airspace not sampled due to ground clutter or other interference, and all information on targets corrected for the volume of airspace actually sampled and the density of targets detected at various altitudes. Nocturnal visual observations may be undertaken for a minimum of ten minutes each hour during radar operation to estimate the proportion of birds and bats using the airspace immediately over or adjacent to the radar unit. Moon watching, spotlighting, and/or thermal imaging are the most commonly used methods. Project sponsors should consult with DEC biologists to determine an appropriate location, duration, intensity, and time frame for these surveys, as well as the latest data analysis and reporting methods.

An analysis of archived and current Next-Generation Radar (NEXRAD) data from one of the six radar stations that cover land in New York may provide information on mass movements of migrants relative to major nightly weather patterns. Due to limitations in NEXRAD coverage, only projects near the cities of Buffalo (BUF), Binghamton (BGM), Montague (TYX), Burlington, Vermont (CXX), Albany (ENX), or New York City (OKX) are able to utilize this type of information. As NEXRAD largely samples a portion of the airspace far above the highest turbine height, this method does

not generally provide any kind of estimate for number of targets within the rotor swept zone or a likelihood of collision.

b. *Raptor migration surveys*

Expanded raptor migration surveys may be justified for projects proposed to be sited on a ridgeline, in a known or suspected raptor migration route (e.g. close to the shores of Lakes Erie and Ontario), or near an established spring or fall hawk watch. In addition, if observations during a standard study detected migrating raptor species listed by the state or federal government as threatened or endangered, expanded raptor surveys may be recommended. Even in areas known to concentrate raptors during migration, site-specific information on species' flight height, direction, and timing of movement is important in understanding and evaluating the potential risk to birds at a proposed wind project. Surveys should be conducted from one or more prominent locations within the project area during spring and fall migration periods (March 1 to May 31; August 15 to December 31). If standard surveys have already been conducted, expanded surveys should be done from the same observation point(s). Every favorable weather day should be surveyed during the migration periods. All other data and information collected should be the same as for standard raptor migration surveys. Project sponsors should consult with DEC biologists to determine an appropriate survey time frame and frequency for specific target species, which may differ from the above dates.

c. *Waterfowl surveys*

Waterfowl surveys may be recommended if the project is in close proximity to a recognized major waterfowl concentration area, National Wildlife Refuge, or State Wildlife Management Area used for feeding, roosting, wintering, breeding, or migration staging. Surveys should include both driving and static observations in a variety of seasons and weather conditions. Driving surveys consist of slowly driving roads throughout the project site and surrounding area at various times during the day to observe and record the species, numbers, and behavior of birds in wetlands, rivers, fields and other habitats. For static surveys, an observer is stationed for a designated period of time at a given location and recording the same observations as driving surveys. Project sponsors should consult with DEC biologists to determine appropriate location(s), duration, intensity, and time frame for these surveys.

d. *Breeding bird surveys*

Targeted breeding bird surveys for state or federally listed threatened or endangered species, species of concern, or SGCN may be recommended if the project is in close proximity to a wetland, grassland, forest or other habitat area that may harbor marsh birds, nightjars, forest raptors, owls, or other birds that would not easily be detected during a morning survey, either because they are not active during the morning, or are not typically vocal. These surveys may incorporate playback of species-specific songs and calls and/or mobbing calls, and take place in the very early morning and/or in the evening hours until after sunset, depending on the target species. A number of points should be designated in appropriate habitat, where an observer should listen for calling birds before broadcasting a recording and listening again for a



response. The number of individuals estimated to be present, the number of times and length of time each bird called during the survey period, the approximate distance from the observer, the habitat the bird is likely located in while calling, and other relevant information should be recorded. The details of specific timing, duration, and method of detection for these surveys would be site-specific and dependent on the habitat and species involved. A draft survey protocol is currently being developed specifically for breeding grassland birds (NYSDEC 2014a), and may be appropriate for use at some sites. If forest raptors are potentially present on site, nest searches may be recommended. Project sponsors should consult with DEC biologists to determine an appropriate location, duration, intensity, and time frame for these surveys.

e. *Wintering bird surveys*

Wintering bird surveys are applicable for projects that contain or are near a location known to harbor significant numbers of wintering birds, primarily focusing on but not limited to grassland-dependent raptors. Particular attention should be paid to the presence of short-eared owls, snowy owls, northern harriers, bald eagles, golden eagles, rough-legged hawks, and American kestrels. Weather information collected should include snow depth, temperature, cloud cover, and wind speed and direction. Project sponsors should consult with DEC biologists to determine the appropriate location(s), duration, intensity, and time frame for these surveys, based on the latest version of the wintering grassland bird survey protocols (NYSDEC 2014b).

f. *Expanded studies for Indiana bats and northern long-eared bats*

Additional bat surveys may be warranted if the project site: contains habitat known or likely to harbor Indiana bats or northern long-eared bats; is within 40 miles of an Indiana bat hibernaculum; is within 5 miles of a northern long-eared bat hibernaculum; is within a known summer range area; or if there is other information to suggest that Indiana bats or northern long-eared bats may be present. In addition to acoustic monitoring, the number of bats in the project area and the locations they are utilizing may be estimated through the use of such techniques as mist netting, radio tracking, and roost counts. Methods should follow the USFWS Indiana Bat Summer Survey Guidelines, and DEC recommendations.

6. **Standard Post-construction Studies**

Post-construction studies will be conducted to evaluate actual impacts to birds and bats at the project site during turbine operation. Standard post-construction studies include mortality surveys and bird habituation/avoidance studies. DEC will review the data from the first year of study to determine any protocol changes that may be necessary to refine future surveys.

a. *Ground searches*

Ground searches for bird and bat carcasses should be conducted under turbines at operating wind projects for an initial two years, at a minimum. After the first year of post-construction surveys, data will be reviewed to determine the appropriate protocols for the second and, if warranted, third year. Post-construction monitoring protocols for

projects that have applied for an Incidental Take Permit (ITP) for state or federally listed threatened or endangered species may differ from those described here, per conditions of the permit and agency requirements. All collection and possession permits must be obtained at the state and federal level prior to the commencement of searches. Should a state or federally listed species be found dead or injured anywhere in the project area by any person, either during a regular survey period or incidentally at any time during the life of the project, DEC and USFWS, respectively, are to be notified as soon as possible but no later than 24 hours after the discovery, for direction on how to proceed with handling the animal.

- i. Turbine searches – A standardized turbine-search regime should be designed such that one third of the total number of turbines in the project are searched daily, and one third of the total number of turbines in the project are searched weekly, from April 15 to November 15 during the first year of study. At any project with 10 or fewer total turbines, all turbines must be searched daily. At any project with between 11 and 29 turbines, at least 10 turbines must be searched daily, and one third of the remaining number searched weekly. Whether the second and third year of study are done in sequence or postponed to later years (e.g., the fifth or sixth year of operation) will be determined following analysis of data from the first year. Should the project expand to include more turbines, the number and location of turbines in the search pattern will be altered accordingly.
- ii. Area to be searched – The area to be searched beneath each turbine should be no less than 1.5 times the rotor diameter. Although plot size will be dependent on specific turbine height and rotor diameter, 120 meters by 120 meters should be adequate for most modern turbines currently being used in New York. Transects should be five (5) meters apart, allowing for a visual search area of approximately 2.5 meters on either side of the centerline. These distances may vary slightly from one site to another, due to varying ground conditions. Full plots are necessary for at least the first study year to produce the most accurate mortality estimate possible. After the first year of study, DEC may discuss with the developer the possibility of a portion of the study turbines being searched only on the cleared gravel road and pad area. If so, the number of carcasses found on the road and pad may be used to estimate fatality rates when compared with full plot searched turbines during the same year.
- iii. Ground cover – The type and amount of ground cover under each turbine should be recorded every day that searches occur. Vegetation growth, crop harvesting and other changes in the substrate could greatly alter the efficiency of carcass recovery.

Mowing and/or brush-hogging some or all of the search plots, each in their entirety, is recommended to increase searcher efficiency and provide a relatively consistent ground cover throughout the study area and between projects. Mowing should take place as often as necessary to maintain vegetation height suitable for seeing small, dark, potentially wet or decomposing carcasses at a distance of 2.5 meters. Early notification to and coordination with landowners holding study turbines is essential to ensure an agreement can be made that will be satisfactory to all parties.

- iv. Search conditions – Searches should begin as close to sunrise as possible. Overnight weather conditions greatly affect the number of animals that will fly and how they are distributed in the airspace, and thus their exposure to turbine blades. The standard weather data collection noted in Section 4(a) need only be collected on a daily basis for ground searches.
- v. Photographs – Digital photographs should be taken of each carcass found. At least one picture of each carcass should include a ruler or other standard item used for scale. These photos, along with all field data information described in 6(a)i-vi, should be sent with the final report to DEC. The file name or folder for each photo or set of photos should be clearly marked with the date and turbine number. At a minimum, documentation for each carcass should include photos showing:
  - (1) the position in which it was found;
  - (2) the dorsal and ventral sides;
  - (3) photos that indicate the gender and reproductive condition of bats (if possible); and
  - (4) any identifying characteristics such as bill, foot, wing or tail shape, and plumage coloration for birds.
- vi. Data collection – The following data should be recorded for each carcass found during standard searches or incidentally:
  - (1) date, time, project name, and turbine number;
  - (2) location on plot marked with GPS coordinates;
  - (3) distance and cardinal direction from turbine;
  - (4) distance and bearing from transect from which it was first spotted;
  - (5) condition of carcass (whole or partial, extent of injury and some measure of decomposition and/or scavenging to estimate time of death);
  - (6) position of carcass (face-up/down, sprawled, balled up, etc.);
  - (7) species, age and sex, if determinable;
  - (8) substrate conditions when found (gravel, short/long grass, crows, brush, etc.);

- (9) identification of searcher/collector; and
- (10) for all carcasses found incidentally (associated with a turbine outside of the study area, under a study turbine during non-survey times, or by someone other than a trained searcher), as much information as possible from 1-9 above should be recorded, and the carcasses labeled and stored in the same manner as a study carcass, with a marker identifying it as an incidental find.

b. *Searcher efficiency and carcass removal trials*

To accurately estimate mortality rates, searcher efficiency tests, and scavenger removal tests should be conducted throughout the study period for each year of post-construction monitoring, using carcasses of various sizes and species that breed and migrate through the project area. Factors such as ground topography, vegetation cover, current weather conditions, searcher experience and fatigue level, and scavenging rates all affect the overall efficiency of carcass detection for a given project area. Searcher efficiency trials should be conducted to estimate search accuracy, and should take place unbeknownst to the searcher(s). Recovery rates should be calculated separately for bats and small, medium, large and all birds combined. Methodologies for this type of study may evolve as new information is gathered. The following is a standard process for conducting the trials:

- i. Carcass placement – A person not performing searches that day should place bird and bat carcasses throughout the search areas under various turbines representing different types of ground cover early in the morning that a trial is to occur. This person should record the location of each carcass within the study area, and any not found by the searchers should be removed at the completion of the day's trial. Carcasses should be discreetly marked with a non-reflective material to identify them as test animals. If enough bat carcasses are not readily available, fresh brown mice may be used as a surrogate for searcher efficiency trials.
- ii. Carcass recovery – Information collected on trial carcasses should be identical to all non-test carcasses as outlined in section 6(a)(vi). The number of test carcasses recovered and the accuracy of data recorded will be determined for each searcher, and an efficiency rate calculated for each trial conducted throughout the course of the study.
- iii. Carcass removal trials – Most mammalian and avian scavengers quickly recognize easy food sources, can readily incorporate wind projects in their daily routes, and are often active at pre-dawn hours. Insect scavengers are active mostly in warmer months, and in some cases can drastically deteriorate a carcass in a matter hours. Carcass removal trials should continue throughout post-

construction monitoring, as scavenging rates change in response to a steady source of food.

- iv. Number and condition of carcasses – Trial carcasses should be as fresh as possible, since long-frozen carcasses may be much more difficult to find and are possibly less attractive to scavengers. The number of carcasses used should not cause an excessive attraction to bring scavengers into the area. Carcasses should be placed in a variety of habitats and checked daily for the first week, and every two days thereafter until the carcass disappears (due to scavenging or decomposition). On each check, the location and condition of the carcass should be recorded to determine if any scavenging has occurred. Any tracks, scat, marks, or other signs that may indicate the type of scavenger should be noted. Scavenging rates for each season, animal taxa, and habitat type in the project area will be calculated.

*c. Bird habituation and avoidance studies*

The pre-construction breeding and migrating bird surveys described in sections 4(d) and 5(d) should be repeated during the first and second years of mortality monitoring. Additional years of study may be recommended for the third, fourth, or fifth year of project operation as determined through consultation with DEC. Post-construction survey transects, points, and methods should be as close as possible to those used during pre-construction surveys. At pre-construction sample locations that become actual turbine sites, surveys should, to the greatest extent possible, take place during a period when turbine noise does not interfere with the observer's ability to hear, see, and record birds. If expanded pre-construction breeding bird surveys were conducted, developers should consult with DEC to determine the scope, methods, and focus species post-construction breeding bird surveys will have. Any land use or habitat changes that may have occurred since pre-construction or the previous post-construction survey was conducted should be noted, as this could potentially alter the bird species composition, density, and distribution within the project area. Information from this post-construction survey is intended to be comparable to pre-construction surveys, and will examine whether the wind project is having any effect on bird use of the site during breeding and migration periods, and whether habituation or avoidance is occurring.

**7. Expanded Post-construction Studies**

For wind energy projects constructed in or near one of the features or resources of concern identified in section 2(b), and for projects that DEC determines may adversely affect a state or federally listed species, expanded post-construction monitoring studies may be needed to provide additional in-depth information to further understand the specific impacts to bird and bat resources of the site. Exact details of these components of post-construction monitoring will be determined on a site-specific basis through discussions between DEC and the project developer.

a. *Radar surveys*

If radar studies during pre-construction surveys showed high passage rates, low flight altitudes, or if other unanticipated conditions that may affect the results and conclusions of the study were observed, then a radar survey may be recommended during the first year of post-construction mortality surveys. The use of radar during subsequent years of post-construction surveys will be contingent on the results of the first year of post-construction study. For any project where post-construction monitoring reveals a higher than expected level of mortality based on pre-construction data and analysis, the use of radar may be recommended for the second year of post-construction study regardless of whether radar surveys were conducted during pre-construction studies. The timing and duration of post-construction radar studies should be determined in consultation with DEC staff.

b. *Raptor migration surveys*

Raptor migration surveys should be repeated during at least the first year of post-construction monitoring if: expanded raptor surveys were conducted during pre-construction surveys; the results of post-construction studies from other projects estimate impacts to raptors that are not consistent with pre-construction expectations; or as recommended by DEC. Raptor migration surveys should be done using the methods described under the expanded pre-construction survey section 5(b), or as recommended by DEC staff.

c. *Waterfowl surveys*

Waterfowl surveys should be repeated during at least the first year of post-construction monitoring if: they were conducted during pre-construction surveys; results of post-construction studies estimate impacts to waterfowl are not consistent with pre-construction expectations; or as recommended by DEC. Waterfowl surveys should be done using the methods described under the expanded pre-construction survey section 5(c), or as recommended by DEC staff.

d. *Wintering bird surveys*

Wintering bird surveys should be repeated during at least the first year of post-construction monitoring if: they were conducted during pre-construction surveys; the results of post-construction studies estimate impacts to wintering birds that are not consistent with pre-construction expectations; or as recommended by DEC. Wintering bird surveys should be done using the methods described under the expanded pre-construction survey section 5(e), or as recommended by DEC staff.

e. *Bat acoustic monitoring*

Bat acoustic monitoring may be recommended on a site-specific basis. If pre-existing data, information collected on site during pre-construction surveys, current conditions, or agency determination indicate a potential for undue impact to *Myotis* species, post-construction acoustic monitoring may be warranted. Consultation with DEC staff is recommended to determine the most appropriate methods for each site.

## 8. **Planning and Reporting**

### a. *Work plans*

After discussions with DEC staff regarding the application of these guidelines to a particular site, the developer should submit a draft work plan incorporating the necessary elements for study at the site. The work plan should include the site description and maps of the most up to date project layout, as well as shapefiles indicating the locations of all project components, points, and transects used for bird and bat surveys. This information will assist DEC in reviewing the data and evaluating potential impacts to sensitive species and their habitats using GIS software. Pre-construction work plans and shapefiles should be submitted to DEC with enough lead time for all parties to discuss and agree upon the details of the plan before implementation of the proposed field work. A comprehensive post-construction study plan should be developed and submitted to DEC for review prior to completion of project construction, and all work should be conducted in consultation with DEC. Project sponsors should work closely with DEC to provide a work plan detailing the search regime, bias corrections, bat acoustic monitoring, bird displacement/habituation surveys, reporting techniques, and other aspects of a project's post-construction mortality study.

### b. *Reports*

After completion of the agreed-upon studies, the developer should prepare a report presenting the results. A description of the proposed project should be provided including maps of the proposed or existing turbine layout and other project components, topography, state and federal wetlands, and any other relevant information and environmental features on or near the site. A composite map containing all project and study information (turbine locations, raptor observations points, breeding and migratory bird transects with observation points, radar unit location (if applicable), wintering bird and waterfowl survey points/routes, acoustic detector locations, and habitat types) should be provided. The preferred format for reporting is described below.

- i. **Habitat surveys**: The habitat survey report should minimally include the following:
  - (1) a description of the habitat types found on site, including the location and identity of any invasive species;
  - (2) a description of what state and/or federally listed species are associated with each habitat type and may occur in the area;
  - (3) a layout map of ground cover (grassland, forest interior/edge, old field, shrub/scrub, young forest, wetland, agricultural/grazing land, developed areas, etc.), and their respective proportions on the landscape within the project site and surrounding area;
  - (4) one or more map, as needed, showing the locations of habitat suitable for any listed, special concern or SGCN species, as well as the locations of any actual observations made of listed or sensitive species; and

- (5) a detailed discussion of the methods, results, and recommendations, including a description of the listed species presence/absence survey results.
- ii. Breeding and migrating bird surveys: The breeding and migrating bird survey report should minimally include the following:
- (1) the number, location and length of each turbine, electric line, and control transect;
  - (2) the overall survey period, and date, time, and duration of surveys conducted at each point;
  - (3) a description of the habitat surrounding each transect;
  - (4) the number of species observed overall;
  - (5) the total number of individuals of each species observed overall;
  - (6) the number of individuals of each species observed at each transect point;
  - (7) a summary of the number and behavior of birds seen (e.g. individual, moving in a small flock, feeding, resting, carrying nesting material, food, or fecal sac, etc.), and whether any active nests or recently fledged young were observed;
  - (8) which birds were identified visually or via vocalizations;
  - (9) the point(s) and transect(s) with the highest and lowest: number of species, species diversity, frequency, and abundance;
  - (10) the habitat type(s) with the highest and lowest: number of species, species diversity, frequency, and abundance;
  - (11) a description of the weather conditions during and immediately prior to survey days;
  - (12) a list of all species with the dates and points where they were observed;
  - (13) the number and identification of the observer(s) conducting each survey;
  - (14) a description of any disruptions and/or distractions that occurred during each sampling period that may have precluded an adequate survey;
  - (15) a detailed discussion of all methods, results, and recommendations;
  - (16) one or more table and graph, as needed, depicting the above information, as well as all species with the dates and points where they were observed, the location proposed or existing turbines and other project components;
  - (17) one or more map, as needed, which displays all observations of all individuals of state and federally listed species, species of concern, SGCN, and any other species targeted at the site. Detailed information on the location, method of detection, behavior, flight paths, and all other



- relevant data should be clearly shown on the map, or otherwise made available in the report; and
- (18) shapefiles depicting the date, location and behavior of each individual of all state and federally listed species observed on site, and shapefiles of all transects and point locations.

- iii. Raptor migration surveys: The raptor migration report should minimally include the following:
  - (1) the number and location of observation point(s);
  - (2) the overall survey period, and date, time, and duration of surveys conducted at each point;
  - (3) a general description of the viewshed from each point, including any area with limited or no visibility of the horizon and sky;
  - (4) the number of species observed overall;
  - (5) the total number of individuals of each species observed overall;
  - (6) the number of individuals of each species observed on each survey;
  - (7) the flight height and direction of each raptor and vulture, including any changes observed;
  - (8) the average and median flight height and direction of each raptor and vulture species, and any notable behavior observed;
  - (9) a description of the weather conditions during each hour of and immediately prior to survey days;
  - (10) the number and identification of the observer(s) conducting each survey;
  - (11) a description of any disruptions and/or distractions that occurred during each hour that may have precluded an adequate survey;
  - (12) a detailed discussion of all methods, results, and recommendations;
  - (13) one or more table or graph, as needed, depicting the above information;
  - (14) one or more map, as needed, depicting survey location(s), viewshed(s), the overall mean raptor and vulture flight paths, and locations of any listed species observations; and
  - (15) shapefiles depicting the date, location and behavior of each individual of all state and federally listed species observed on site, and shapefiles of all observation point locations.
- iv. Radar studies: The radar report should minimally include the following:
  - (1) the radar unit location, elevation, and characteristics of the surrounding vegetation and topography;

- (2) the total number of days surveyed overall, and in each season;
- (3) the date, time, and number of hours per night and day that surveys took place each season;
- (4) the mean, median, minimum and maximum values recorded each hour and overall each season for: target flight height, direction, passage rate in targets/km/hour, and percentage of targets detected below the maximum height of the proposed turbines, all corrected for the volume of airspace actually sampled and density of targets within that space;
- (5) the elevation and total height of the proposed turbines;
- (6) a detailed discussion of all methods, results, and recommendations;
- (7) a discussion and evaluation of results describing the type of equipment used, including capabilities, limitations, and settings used for all equipment, as well as the amount of down time, failures, or suspected malfunctions that may have occurred during the survey periods. All equipment performance data should be reported to better assess the efficiency and accuracy of the units being used at each location;
- (8) one or more picture from both the horizontal and vertical screen views indicating the location and amount of ground clutter surrounding the radar unit; and
- (9) one or more table or graph, as needed, depicting the above information, as well as times and number of hours actually sampled each night and day in both horizontal and vertical modes, and hourly weather information (particularly wind speed and direction, percent cloud cover, ceiling height, and the presence of fog and/or precipitation).

- v. Wintering bird surveys: The wintering bird survey report should minimally include the following:
- (1) the number, location and length of all observation points and routes surveyed;
  - (2) the overall survey period, and date, time, and duration of surveys conducted at each point and driving route;
  - (3) a general description of the viewshed from each observation point, including areas with limited or no visibility of the targeted habitat;
  - (4) the number of species observed overall;
  - (5) the total number of individuals of each species observed overall;
  - (6) the number of individuals of each species observed on each survey, and at each point;

- (7) a description of the behavior (feeding, perching, soaring, flocking, etc.) of the birds observed and the habitat they occupied;
- (8) which birds were identified visually or via vocalizations;
- (9) the point(s)/route(s) with the highest and lowest: number of species, species diversity, frequency, and abundance;
- (10) a description of the weather conditions during an immediately prior to survey days;
- (11) any disruptions and/or distractions that occurred during each survey that may have precluded an adequate collection of data;
- (12) the number and identification of the observer(s) conducting each survey;
- (13) a detailed discussion of all methods, results, and recommendations;
- (14) one or more table or graph, as needed, depicting the above information, as well as all species and individuals with the dates and points where they were observed;
- (15) one or more map, as needed, showing the locations of the sightings relative to proposed or existing turbine locations and from the survey point/driving route;
- (16) any other information as requested by NYSDEC 2014(b); and
- (17) shapefiles depicting all survey locations, the viewshed from each, and the date, location, flight direction, and behavior of each individual of all state and federally listed species observed.

- vi. Waterfowl surveys: The waterfowl survey report should minimally include the following:
- (1) the number, location and length of all observation points and routes surveyed;
  - (2) the overall survey period, and date, time, and duration of surveys conducted at each point and driving route;
  - (3) a description of the habitat surrounding each observation point and along routes surveyed;
  - (4) the number of species observed overall;
  - (5) the number of individuals of each species observed overall;
  - (6) the number of individuals of each species observed on each survey and at each point;
  - (7) a description of the behavior (feeding, resting, flying, flocking, etc.) of birds observed, the habitat they occupied, and any movements of birds within or across the project area;
  - (8) detailed descriptions of the location and behavior of all state or federally listed species observed;

- (9) which birds were identified visually or via vocalizations;
- (10) the point(s)/route(s) with the highest and lowest: number of species, species diversity, frequency, and abundance;
- (11) the habitat type (open water, river, marsh, agricultural field, etc.) with the highest and lowest: number of species; species diversity, frequency, and abundance;
- (12) a description of the weather conditions during and immediately prior to survey days;
- (13) any disruptions and/or distractions that occurred during each survey that may have precluded an adequate collection of data;
- (14) the number and identification of the observer(s) conducting each survey;
- (15) one or more table or graph, as needed, depicting the above information, and all species observed with the dates and points/areas where they were observed; and
- (16) one or more map, as needed, showing the locations of the sightings relative to proposed or existing turbines, and from the survey point/driving route.

vii. Indiana bat, northern long-eared bat, and bat acoustic surveys: The bat survey report should minimally include the following:

- (1) a table depicting calls from each detector, organized by species (including any unidentified calls), indicating the number of calls by date and hour;
- (2) all acoustic data should be recorded and archived for quality control and to later verify the identification of calls;
- (3) the total number of calls per detector night for the spring, summer, and fall seasons, as appropriate;
- (4) a description and pictures of the habitat in the immediate area of the detectors and the broader landscape;
- (5) a description of the type of detectors, settings used, and performance data for each detector throughout the course of the study, including a description of the performance of each piece of equipment as it is configured for field data collection (sensitivity setting, housing, etc.);
- (6) identification of the software program(s), all individual(s) and/or company/organization(s) conducting the identification of bat call sequences;
- (7) a description of the hours and/or days that any detector is non-functional during the study period, along with the suspected reason for the malfunction should be identified;
- (8) one or more map, as needed, showing the location of all detectors; and
- (9) all information as described by USFWSa-e.

viii. Mortality studies: An interim progress report should be submitted to DEC no later than mid-July summarizing the post-construction survey results from spring of that year. The interim report is not intended to be an exhaustive analysis of methods, results and estimates. At a minimum, this report should include:

- (1) the number and species of all dead or injured birds and bats found to date during standardized searches and incidentally, including any state or federally listed species found anywhere on site;
- (2) the turbine number at which each animal was found;
- (3) the date each animal was found;
- (4) an overview of the searcher efficiency and carcass removal trials conducted to date;
- (5) one or more map, as needed, identifying each turbine number and location; and
- (6) any other notable bird or bat observations made on site.

A draft final report, to be submitted by January 31 following the end of the fall study period, should minimally include the following:

- (7) the results of the daily and weekly ground searches;
- (8) a description of the habitat type and ground cover height surrounding each turbine, including details of any vegetation management that was done at each turbine;
- (9) the cardinal direction and distance from the turbine, in 10 meter increments, each carcass was found during standardized searches and incidentally;
- (10) the size class of each carcass (small or large bat, small, medium or large bird);
- (11) the condition of each carcass found;
- (12) the date each carcass was found;
- (13) photographs of all carcasses found;
- (14) the age and sex of each carcass, if determinable;
- (15) the total area beneath each turbine actually searched;
- (16) a description of daily weather conditions prior to and during each search;
- (17) the number and identification of people conducting each survey;
- (18) the results of the searcher efficiency tests and scavenger removal study. The estimated searcher efficiency should be reported by carcass size, ground cover type, and season for each searcher. Estimated scavenging rate should be reported for each carcass size, habitat type, and season. This should include the types of scavengers present on site (avian, mammalian, insect) and the frequency at which each occurs;
- (19) a discussion of all methods, results, and recommendations;

- (20) one or more table or graph, as needed, depicting all the above information, as well as showing the number and identification of birds and bats found, and at which turbine, during standardized searches and incidentally; and
- (21) one or more map, as needed, identifying each turbine number and location, and the area searched beneath each turbine.

If operational curtailment of all or a portion of the turbines occurred at any time during the survey period, the final report should include detailed information on the following:

- (22) which turbines were feathered;
- (23) the wind speed at which curtailment took place, and whether that varied between turbines;
- (24) the dates and times of curtailment events, as well as total time of curtailment;
- (25) a detailed discussion on how the curtailment effort impacted the estimated bird and bat mortality rates; and
- (26) any other information relevant to changes in operational cut-in speeds.

All statistical methodologies should be fully explained and justified, and the most appropriate and accurate model used for estimating mortality rates. Project developers should consult with DEC and USFWS to determine the statistical model(s) to be used. Mortality rates should be calculated using at least a 95% confidence interval. Estimates should be made of overall mortality during the study period on a per turbine, per megawatt rated, per megawatt produced, and per rotor swept area for bats and birds (including small, medium and large birds, and all birds together). A separate estimate of bat mortality during the late summer/fall period (approximately mid-July through September) should also be provided, to allow for comparison of results with studies that only evaluated this time frame. All of these estimates should take into account:

- (27) searcher efficiency rate;
- (28) scavenger removal rate;
- (29) the overall search plot size under each turbine;
- (30) the amount of area actually searched under each turbine and throughout the project;
- (31) the frequency of searches;
- (32) operational curtailment, if any;
- (33) the number of birds and bats estimated to have fallen outside of the search plot; and
- (34) a discussion of any other factor that may have influenced the search regime and results.

- ix. Other post-construction surveys: Either inclusive with the mortality report, or as a separate document, information on the post-construction bat surveys, bird habituation/avoidance studies, bird and raptor migration surveys, and/or radar surveys should be reported as described above in 8(b) i-vii, with the following additions: specific avoidance behavior of flying birds and/or bats observed in the project area; and any other information relevant to how birds and bats are using or avoiding the operating project area, especially with respect to the level of habitat restoration that has occurred at the time.

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USFWSb Indiana Bat Information

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USFWSc Federally Listed Bat Summer Survey Guidance

<https://www.fws.gov/midwest/endangered/mammals/inba/inbasummersurveyguidance.html>

USFWSd Land-based Wind Energy Guidelines

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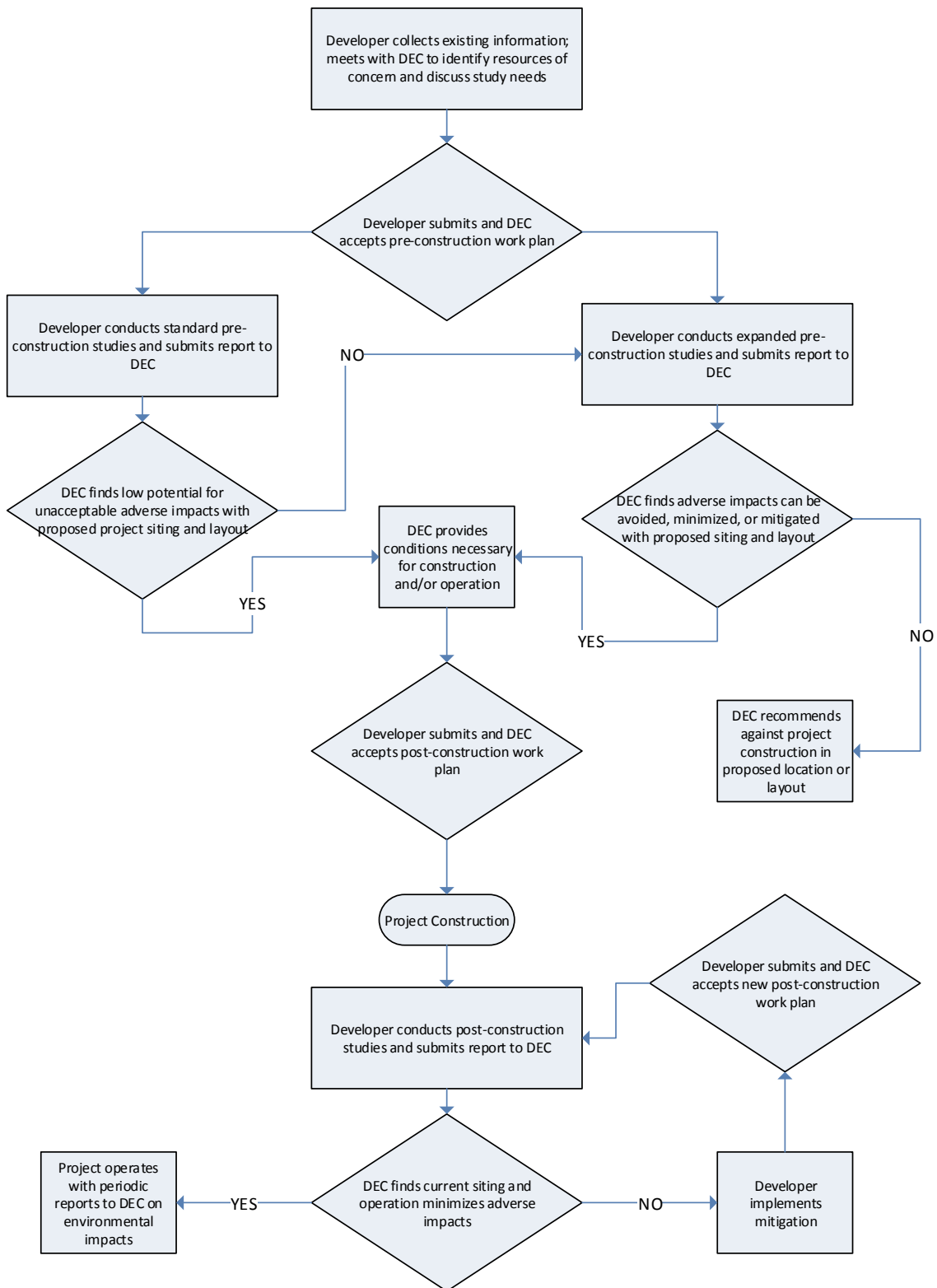
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Figure 1. General Process for Conducting Bird and Bat Studies at Wind Energy Projects in New York



## APPENDIX A

### Mortality Reduction Techniques and Bat Carcass Sampling

#### Mortality Reduction

Bats are known to fly more frequently on nights with lower wind speeds and higher temperatures, and will approach and investigate turbines, especially in the late summer and fall (Cryan et al 2014). The precise reasons why bats congregate at turbines during this time period are unknown, but are suspected to be related to mating behavior, and possibly searching for food and roosting sites (Cryan, 2008). Research has shown that higher turbine cut-in speeds are less likely to kill bats than turbines that operate at lower wind speeds (Arnett et al 2011). The benefits of curtailment are particularly noticeable for larger-bodied species such as hoary, silver-haired and eastern red bats (Baerwald et al. 2009).

DEC recommends that all projects follow a curtailment regime by feathering blades during certain time periods and under certain conditions, particularly if listed species are known or suspected to be present in the area. Current research is ongoing to determine the most beneficial operational schedule, and developers should refer to the latest information available and consult with DEC before committing to dates, times, and weather conditions during which to feather turbine blades. Curtailment may be required at sites likely to impact Indiana bats or northern long-eared bats. The effect of turbine curtailment on bird mortality levels has not been studied in detail.

DEC encourages project developers to promote research on bat and bird strike deterrents and detectors at their projects, and will provide support and assistance in this endeavor to reduce the impacts wind energy development has on New York's birds and bats.

#### Bat Carcass Sampling

There are also on-going research projects throughout the country that utilize bat carcasses found at wind energy projects to investigate questions analyzing DNA and stable isotopes. DEC encourages project developers to consider collecting tissue and hair samples to contribute to such research. Though sampling methods may differ for each project, often a one square centimeter wing clip and hair snip from each animal provide enough material. Developers can coordinate with DEC to determine what recipients may be in need of the material, and for further details on proper collection, storage, and transfer of samples.