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**GUIDELINES
for
CONDUCTING BIRD and BAT STUDIES
at
COMMERCIAL WIND ENERGY PROJECTS**

Prepared by

New York State Department of Environmental Conservation

**Division of Environmental Permits
and
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Figure 1. Flow Chart of Pre- and Post-construction Studies

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**Guidelines
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at
Commercial Wind Energy Projects**

The 2002 New York State Energy Plan placed a priority on increased energy diversity and use of renewable energy sources, and the New York Renewable Portfolio Standard promotes the research and development of alternative energy projects, particularly commercial wind energy (<http://www.nyserda.org/rps/default.asp>). While wind energy has significant environmental benefits when compared to energy produced from fossil fuel, the Department of Environmental Conservation (DEC) must also consider the potential 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 in New York State is DEC's most pressing issue related to wind energy development.

These guidelines outline DEC's recommendations to commercial wind energy developers on how to characterize bird and bat resources at on-shore wind energy sites, and how to estimate and document impacts resulting from the construction and operation of projects. *Bird and bat resources* includes all species of birds (Class *Aves*) and bats (Order *Chiroptera*) that use or may use the site, as well as the habitats that support them. The guidelines also 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. It should be recognized that the effort required to fully understand the movement of birds and bats at any given site would be monumental and would take many years. Therefore, the studies recommended here are considered the minimum effort necessary to characterize bird and bat activity at a site within a reasonable time frame relative to project construction. This guidance provides for two tracks for pre-construction and post-construction studies: "standard" and "expanded." Many sites will warrant the "standard" studies. However, where site-specific conditions or findings suggest exceptional risk to birds and/or bats, expanded protocols and/or additional years of study will be recommended. Also, the protocols outlined are intended to provide 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.

1. **Purpose** The purpose of this document is to outline the protocols for conducting bird and bat studies at wind energy projects to provide information necessary for DEC to:
 - a. assess ongoing or expected environmental impact; and
 - b. make a recommendation to the lead agency regarding the construction and operation of the project in order to avoid or minimize adverse environmental impact.

To perform such assessments and make a recommendation, DEC must consider information pertaining to the presence and activity of birds and bats at the site, or in the vicinity

of the site. In this context, *the site* means not only the real property boundaries or outline of proposed turbine locations on the ground, but includes the air space over and surrounding the project. 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 cause the least disturbance to migrating, breeding, wintering, roosting, and feeding birds and bats. In addition to direct mortality from blade strikes, other negative effects from factors such as habitat loss or fragmentation, increased human activity and development, and increased predator presence can all result from the construction of a wind farm.

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. In particular, the recommendations for post-construction studies described in these guidelines are based on DEC's current knowledge of the best procedures for conducting thorough and meaningful post-construction mortality surveys at operating wind projects in New York. As post-construction mortality studies are conducted at more projects throughout the state over the next several years, these guidelines will be fine tuned to incorporate the most efficient, effective and accurate methodologies to fill post-construction data needs. Figure 1 illustrates the process 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 data in the field on bird and bat use of the site. Few detailed studies have been conducted to date to gather site-specific data on where, when and how birds and bats use various habitats within the state. The study guidelines in this document are intended to provide a template for gathering such information and allowing for continued wind energy development that will not result in unacceptable impacts on the birds and bats of New York.

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, including available information from other existing or proposed wind energy projects. The following sources should be consulted:

- i. The DEC Central Office Division of Environmental Permits [<http://www.dec.ny.gov/about/642.html>] and Division of Fish, Wildlife and Marine Resources [<http://www.dec.ny.gov/about/634.html>] should be the initial point of contact for information regarding the permitting and assessment process for wind energy development;
- ii. The New York Natural Heritage Program (NYNHP) should be contacted for information on state and federally listed species and sensitive ecological communities that may be located on or near the proposed project site (<http://www.dec.state.ny.us/website/dfwmr/heritage/>);
- iii. Biologists in the DEC Regional office where the project is located should be contacted for available information on specific resources in the area of the proposed project site [<http://www.dec.ny.gov/about/255.html>];
- iv. Local ornithologists, Audubon Societies, birding clubs, hawk watches and

nature centers can provide specific information about bird and bat resources, as well as reference to data from Breeding Bird Surveys, Breeding Bird Atlases and Christmas Bird Counts (<http://www.audubon.org/states/index.php?state=NY>);

- v. DEC's mammal specialist in the Bureau of Wildlife Endangered Species Unit can provide site specific information regarding the proximity of major bat hibernacula and summer roosting areas, as well as information on technical research being conducted within New York (<http://www.dec.state.ny.us/website/dfwmr/wildlife/endspec/>); and,
- vi. Bat Conservation International can provide general information about bats and bat biology (<http://www.batcon.org/home/default.asp>).

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

The presence of certain landscape features and/or ecological resources at a site can increase the likelihood that adverse impacts to bird and bat resources will result from a proposed wind energy project. The developer should identify whether any of these features or resources are present at the site of the proposed project. Such features or resources of concern include:

- i. Habitat of a listed bird or bat species per 6 NYCRR Part 182 (e.g., species of special concern, threatened or endangered) [<http://www.dec.ny.gov/animals/7494.html>];
- ii. Proximity of the project (approximately 5 miles) to the Atlantic coastline or the shoreline of one of the Great Lakes;
- iii. The presence of or proximity to concentration areas of raptors, waterfowl or other vulnerable species (approximately 2 miles) or a major bat hibernaculum (approximately 10 miles); and/or
- iv. The presence of a specifically identified habitat or landscape feature (e.g., a ridgeline) that functions to funnel or concentrate birds or bats during migration or for feeding, breeding, wintering, roosting activities.

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. To aid in project planning, the developer should prepare a complete description of the site, including:

- i. Description of the geographical, topographical and other physical features of the site and within 10 miles of the site;
- ii. Identification of state and federal wetlands, waterbodies, and drainage patterns;
- iii. Location of permanent meteorological (met) towers, a summary of local weather patterns (e.g., annual precipitation, prevailing winds), and a summary of the wind resource; and,
- iv. Maps with vegetation types, soils/bedrock, land use, and other information relevant to siting the project.

Prior to submitting the study work plan, additional information regarding the proposed project should be provided including:

- v. Maps of the proposed turbine layout;

- vi. Description of turbine type, size and rotor swept area;
- vii. Figures showing existing and proposed roads, transmission line routes, and substation location.

Data regarding proposed site development should be provided in the form of shapefiles, coverages, geodatabases, and/or geometric networks for use in Geographical Information Systems (GIS) software including:

- viii. Polygon coverages/shapefiles for the total project area as well as any concrete and building structures;
- ix. Line coverages/shapefiles/geometric networks for the transmission and interconnect lines as well as proposed temporary construction and maintenance roads;
- x. Polygons of the proposed temporary construction and maintenance roads for assessing the overall impact of the road footprints; and,
- xi. Point coverages/shapefiles for any tower locations and/or any other structures that would be best represented as a point.

d. *Prepare to implement standard or expanded study protocols.*

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 unacceptable adverse impact on bird and bat resources. Therefore, projects proposed for such sites will require expanded rather than standard pre- and post-construction studies to identify and quantify potential or actual impacts. In particular, a proposal to site a wind energy project in proximity (10 miles) to an Indiana bat hibernaculum, along a coastline, or on a prominent ridgeline will result in a recommendation to conduct 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 necessary licenses/permits for collection and possession of birds and bats [<http://www.dec.ny.gov/permits/28633.html>] or special license to handle endangered species [<http://www.dec.ny.gov/permits/25012.html>];
- ii. Contact the US Fish and Wildlife Service (USFWS) regarding Migratory Bird Treaty Act collection permits [<http://www.fws.gov/forms/3-200-7.pdf>];
- iii. Engage an accredited wildlife biologist or ecologist knowledgeable about New York state fauna, natural history and habitat requirements; and experienced in wildlife study and habitat assessment protocols.

3. Study Objectives and Rationale

The overall goal of the recommended studies 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 bird and bat species under a variety of environmental conditions throughout the year, and by estimating the mortality rate of birds and bats due to collisions with turbines. The effects of construction and operation on habitat changes and changes in wildlife use of the project site will also be studied to determine any displacement or loss of species related to project operation. Data collected prior to construction can be compared to information collected in a similar matter after construction to determine what impact, if any,

the project has on migrating and resident breeding and wintering birds and bats. Ultimately, information gained from pre- and post-construction studies will be used to identify mitigative measures that may be needed as part of an adaptive management plan to minimize direct and indirect impacts from project operation.

a. *Pre-construction studies*

The objective of the pre-construction studies is to determine to what extent the proposed project area is used by migrating, breeding, and wintering birds and bats, and how the physical and biological features of the proposed site may influence such use.

b. *Post-construction studies*

The objectives of the post-construction studies are:

- i. To estimate direct impacts of the operating project in terms of mortality rates of birds and bats caused by collisions with turbines; and,
- ii. To document any indirect impacts of construction and operation in the form of habituation/avoidance behavior of birds and bats in the area.

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: most songbirds and many shorebirds and waterfowl migrate at night, while raptors move during the day; the exact spatial and temporal distribution of this migration is affected by weather patterns, food availability, and geographic features; concentrations of species and individual birds vary with the habitat, season, and year; birds are much more physiologically vulnerable during migration than at other times of the year; and the effects of human-caused habitat and landscape alterations are persistent over time.

Study methods for bird surveys include mist netting, reconnaissance surveys, habitat surveys for sensitive/listed species, and radar. The radar surveys provide information on target density, flight altitude, and flight direction. Acoustical monitoring of migratory birds can also be used to identify some species that vocalize in flight, and provide an estimate of flight height for these species. A combination of some or all of these methods will be recommended 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*

At this time, the greatest concern is for the Indiana bat and other bat species that typically migrate (red, hoary, silver-haired bats), as they are likely to be exposed to multiple wind facilities across much of their migration routes, and thus face the largest potential mortality. There is some evidence to suggest that pipistrelles are migratory as well. The timing of the fall migration extends into the end of October and the spring migration is underway by mid April. At this time, it is not known if these bats migrate across a broad front, if they use migratory corridors, or if their migration is affected by geographic features. However, it is assumed that the shores of the Great Lakes are more likely to have concentrations of migrating bats at lower altitudes than other regions of the state. Current methods for determining passage rates of bats

and estimating the likelihood of collisions with turbines include mist netting, radar, thermal and/or light amplification imaging and acoustical monitoring. None of these methods provides definitive information and all have some drawbacks, although acoustical monitoring appears to hold the greatest promise because of the relatively low cost, low commitment of staff time, the ability to distinguish between birds and bats, and the ability to identify most individual calls to species.

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 at the project site. A minimum of one year of pre-construction studies is recommended at all proposed wind energy projects. Additional years of study will be recommended if warranted by the results of initial studies.

a. Weather conditions

For all studies described in these guidelines (standard, expanded, pre- and post-construction) standard daily weather observations should be recorded any time field studies are being conducted. Weather information such as temperature, cloud cover, 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. Any additional weather information required for specific studies is identified in the individual study descriptions that follow.

b. Breeding bird surveys

Breeding bird surveys should be conducted in accordance with USGS methods during morning hours in June [<http://www.pwrc.usgs.gov/bbs/participate/instructions.html>]. The USGS method should be modified to include five-minute rather than three-minute counts to provide more thorough coverage. The number of survey points in each habitat type found within the project area should be representative of the number and location of turbines proposed in each habitat type. Each point should be surveyed by a single observer at least twice during the breeding season, with a minimum of seven days between surveys. All birds identified by sight or sound at each survey point should be recorded. Weather conditions should be conducive to hearing birdsong and seeing birds move about in vegetation and in flight. Excessively windy, rainy, or cold days should not be surveyed, as birds are not as active under these conditions. Observation points should be as close to proposed turbine locations as possible, and marked with GPS coordinates for future reference.

c. Habitat surveys

Surveys should be undertaken at all project sites to identify existing habitat for New York State or federally listed rare, threatened or endangered species or State species of special concern. If such habitat exists on or adjacent to the project area, additional surveys should be undertaken to determine if any such species are actually present on or near the project site. Developers should consult with DEC to determine the scope and timing of habitat surveys for a given species. Surveys should be seasonally appropriate for each of the listed 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).

d. Raptor migration surveys

Raptor migration surveys should be conducted from one or more prominent locations within the project area during spring and fall migration periods [April 1 to end of May; August 15 to November 1]. Observations should take place between the hours of 9:00am and 4:00pm on at least 10 days during the predicted peak migration times for targeted species [see <http://hawkcount.org/index.php>], under the most favorable weather conditions (winds from the south during spring, winds from the north or northwest during fall). At a minimum, observations should include the peak two-week migration period for red-tailed, sharp-shinned and broad-winged hawks, and turkey vultures. It may be important to evaluate the migratory passage of other raptor species at site-specific locations as determined during consultation with DEC. 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.

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 on a similar, separate data sheet.

e. *Songbird migration surveys*

Songbird migration surveys should be conducted for a minimum of once per week during the months of May and September. These surveys should be done from first light until no later than 11:00am on different days from the raptor surveys. The focus should be on songbirds, though other species, including soaring raptors and other fly-overs, should also be counted. Depending on the size and habitat distribution of the project area, one or more transects should be walked, with stops every 50 meters to record all species seen and heard during a 5 minute session. 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. Conducting this survey separately from the raptor migration survey will allow for more time and attention to be given to detecting songbird species that move through the project area but do not nest or winter there, and would therefore likely be missed during other types of surveys. The location, length, and number of transects may vary for each project, and should be determined in consultation with DEC staff.

f. *Bat acoustical monitoring*

Movements of bats feeding at or passing through the site should be characterized using acoustical detectors. Detectors should be situated to sample no less than the rotor swept area, and to capture calls from as high an altitude as possible or at least 150 feet above ground surface. Wherever possible, detectors should be attached to existing meteorological (met) towers. As it is unlikely that there will be an adequate number of met towers to provide meaningful results, additional detector infrastructure will need to be installed. Two detectors sampling in a horizontal plane should be installed at each sampling location, one at roughly 22 meters above the ground and another at the top of the tower. Horizontal detectors should be oriented in the likely direction of arriving migrants (south in the spring, north in the fall). A vertical sampling detector should also be installed at the top of the tower. Recording should continue from 0.5 hrs prior to sunset until 0.5 hrs after sunrise daily between April 15 and October 15. Summer surveys should also include active acoustical sampling to determine which species are present on the site i.e., a field investigator with a detector walking across the study area in a variety of habitats that are likely to contain bats, and recording what is present. Active sampling should be conducted on at least nine warm (>55 deg F), dry, and calm evenings between June 1 and July 10, starting at dusk and ending no earlier than midnight. Analysis of calls should include the

criteria used for species identification and should be verified by an independent authority.

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), two to three years of pre-construction study will be recommended incorporating one or more of the following expanded pre-construction studies to provide in-depth information on the bird and bat resources of the site.

a. Radar studies

DEC will request the use of remote sensing marine radar to determine the use of the project area by nocturnally migrating birds and bats. The radar should sample in both horizontal and vertical modes to collect information on target density, flight height, direction, and speed. Radar units should be operated from sunset to sunrise April 15 to May 31 and August 15 to October 15. Data should be recorded in digital format. Nocturnal visual observations should be undertaken hourly 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. Consultation with DEC biologists is recommended to determine an appropriate location, duration, intensity, and time frame for these surveys.

b. Raptor migration surveys

For projects proposed to be sited on a ridgeline or in a known raptor migration route, expanded raptor migration surveys will be recommended. 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 will be recommended. Surveys should be conducted from one or more prominent locations within the project area during spring and fall migration periods [April 1 to end of May; August 15 to November 1]. If golden eagles are observed migrating through the project area, the fall observation period should extend through mid-December. Observations should take place between the hours of 9:00am and 4:00pm on as many days as possible during these predicted peak migration times for any targeted species, under the most favorable weather conditions (winds from the south during spring, winds from the north or northwest during fall). 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. Consultation with DEC biologists is recommended to determine an appropriate survey time frame for target species.

c. Waterfowl surveys

Waterfowl surveys should be conducted if the project is in close proximity to a recognized major waterfowl concentration area. 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 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 making the same observations as driving surveys. Multiple static survey points should be located throughout the project area. Consultation with DEC biologists is recommended to determine an appropriate location, duration, intensity, and time frame for these surveys.

d. *Breeding bird surveys*

Targeted breeding bird surveys for species of concern should be conducted if the project is in close proximity to a wetland, grassland, forest or other habitat area that may harbor marshbirds, nightjars, owls, or other birds that would not easily be detected during a morning breeding bird survey, either because they are not active during the morning or are not typically vocal. The timing, duration, and method of detection for these surveys would be site-specific and dependant on the species involved. Consultation with DEC biologists is recommended to determine an appropriate location, duration, intensity, and time frame for these surveys.

e. *Wintering bird surveys*

Wintering bird surveys are recommended for projects that contains or are near a location known to harbor significant numbers of wintering birds, primarily focusing on but not limited to raptors. Particular attention should be paid to the presence of short-eared owls, snowy owls, northern harriers, bald eagles, and rough-legged hawks. Consultation with DEC biologists is recommended to determine appropriate location, duration, intensity, and time frame for these surveys.

f. *Expanded studies for Indiana bats*

If the project site is within 10 miles of an Indiana bat hibernaculum or known summer range, or if there is other information to suggest that Indiana bats are present, DEC will recommend an expanded version of the standard acoustical monitoring to include an inventory of the actual number of Indiana bats in the project area. The likelihood of bats from a maternity colony encountering a turbine diminishes as distance from the hibernaculum increases, with little chance of summering bats encountering a turbine more than 10 miles away. The Indiana bat inventory requires extensive mist netting with banding and radio tagging of captured bats as follows:

- i. Bats should be captured in standard net sets, tagged and tracked to the roost;
- ii. At each roost, bats leaving the roost should be captured, banded and radio tagged;
- iii. This sequential tracking and netting process at each roost tree should be used to identify all of the maternity colonies in the project area;
- iv. Concurrent exit counts of all bats leaving the identified roosts should be conducted to provide an estimate the number of individuals bats in the project area; and,
- v. Exit counts of radio-tagged bats from each roost should be conducted on nights with sunset temperatures greater than 55 degrees F° over the duration of the transmitter's life (generally less than 20 days).

Wing punches and hair samples should be collected from all animals captured (regardless of species) and provided to DEC with appropriate chain of custody documentation. All bats captured should be fitted with a band provided by DEC. Any Indiana bat or silver-haired bat that is captured should be radio tagged and tracked to roost on a daily basis. DEC should be notified within 24 hrs of any captures of these two species. All information on capture [date, time, location etc.] and all radio tracking data for banded bats should be provided in a DEC specified database format.

g. *Expanded studies for migratory bats*

The primary concern for migratory bats (red, hoary and silver-haired) is the mortality of migrants, especially migrants passing over waterbodies, because the potential for mortality is compounded as bats move seasonally through the many proposed turbine fields in eastern North America. In order to assess the potential mortality of migratory bats at a project proposed along a lakeshore, a network of acoustical sampling stations should be provided extending from the lakeshore to the portions of the proposed project area farthest from the lake such that variations in acoustical activity may be observed at the different sampling stations. The sampling should be conducted throughout the spring and fall migratory period from April 15 to October 15 and should include sampling at least to maximum turbine height. Consultation with DEC biologists is recommended to determine an appropriate location, duration, intensity, and time frame for these surveys.

In addition, to address the biases associated with acoustical sampling and validate the results of that sampling, a telemetry project should be conducted to locate the path of migrants through the project area. The recommended protocol is to:

- i. Establish a line of automated receivers perpendicular to the assumed migration line, extending from the shoreline inland to the far periphery of the project;
- ii. Based on receiver resolution, space receivers at intervals to ensure detection by at least two units for any migrating animal; and,
- iii. Capture migrating bats at some distance (at least 25 miles) from the monitoring zone and attach transmitters.

Analysis of the telemetry data should assume that the movement patterns of a transmitting individual is representative of the species in terms of where they cross the monitoring zone.

6. Standard Post-construction Studies

The developer should conduct post-construction studies to evaluate actual impacts to birds and bats at the project site during turbine operation. Standard post-construction studies include mortality surveys, bird habituation and avoidance studies, and bat acoustical monitoring. DEC will evaluate the data from the first year of study to determine any changes to protocols that may become necessary after analysis and review of the initial data. The developer must ensure DEC staff and its agents full access to the site over the life of the project.

a. *Ground Searches*

Ground searches for bird and bat carcasses should be conducted under turbines at operating wind projects for a minimum of three years. For small projects (10 or fewer turbines), all the turbines should be searched. At larger projects (more than 10 turbines) at least 30% of the total number of turbines should be included in the ground searches.

- i. Turbine searches - A standard turbine-searching pattern should be designed such that each turbine included in the study is searched either daily, weekly, or every three days from April 15 to November 15 during the first and second year after the entire project becomes operational. Whether the third year of study is done in sequence or postponed to a later

year (e.g., the fifth) will be determined following analysis of data from the first and second years. Should the wind project expand to include more turbines, the number 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. Transects should be approximately five (5) meters apart, allowing for a visual search area of 2.5 meters on either side of the centerline. These distances may vary slightly from one site to another, due to varying ground conditions.
- iii. Ground cover - The type and amount of ground cover under each turbine should be recorded at regular intervals a minimum of once per week. Vegetation growth, crop harvesting and other changes in the substrate could greatly alter the efficiency of carcass recovery.
- 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 above, should be sent to DEC for species identification verification on a pre-arranged schedule. Photo documentation of each carcass should include:
 - (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);
 - (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:
 - (1) date, time, 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 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, crops,

brush, etc), and identification of collector.

b. *Searcher efficiency and carcass removal trials*

To more accurately estimate mortality rates, searcher efficiency tests and scavenger removal tests should be conducted throughout the study period using carcasses of various sizes and species. Factors such as ground topography, vegetation cover, current weather conditions, searcher experience and fatigue level, scavenging rates, and the use of dogs all affect the overall efficiency of carcass detection for a given project area. Methodologies for this type of study will evolve as new information is gathered, and specifics on data-gathering techniques will be updated and posted on the NYSDEC website. Searcher efficiency trials should be conducted to estimate search accuracy, and should take place unbeknownst to the searcher. The following process for conducting the trials is recommended:

- i. Carcass placement - A project manager should place carcasses throughout the search areas under various turbines representing different types of ground cover early in the morning that a trial is to occur. The project manager 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 trial. Carcasses should be discreetly marked to identify them as test animals.
- 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. The efficiency of any dogs used should be calculated separately from that of humans.
- iii. Carcass removal trials - Carcass removal trials should take place periodically throughout the duration of the mortality study. Most mammalian and avian scavengers quickly recognize easy food sources, can readily incorporate wind farms 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 of 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 - Carcasses should be as fresh as possible, since long-frozen carcasses are much more difficult to find and are far 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. Scavenging rates for each season and habitat type in the project area will be calculated.

c. *Bird habituation and avoidance studies*

The pre-construction Breeding Bird Survey should be repeated during the first and

second years of operation. A third year of study should be conducted on the third, fourth or fifth year of project operation as determined by DEC. Post-construction survey points should be as close as possible to the location of pre-construction survey points. At pre-construction sample locations that become actual turbine sites, to the greatest extent possible, surveys should take place during a period when turbine noise does not interfere with the observer's ability to hear birds. Information from the post-construction BBS survey will examine whether the wind project is having any effect on resident/breeding bird use of the site, and whether habituation or avoidance is occurring.

d. *Raptor migration surveys*

The standard pre-construction raptor surveys should be repeated during the first year of operation. If dead or injured raptors are found under turbines during the first year of post-construction ground searches, then the expanded raptor surveys described below should be conducted in conjunction with subsequent years of mortality studies.

e. *Bat Acoustical sampling*

Conduct standard bat acoustical monitoring following the same methods used for summer resident and migratory bat surveys during pre-construction, or per DEC recommendations. Detectors should be added to those wind turbines that will be monitored for kills on a daily basis. These detectors should be sampling the airspace above, below and perpendicular to the turbine hub.

f. *Bat specimen collection*

Entire bat carcasses should be collected and sent to DEC for species identification on a pre-arranged schedule. Should the developer decide not to provide the entire carcass, DEC will require a substantial (>1 cubic cm) sample of hair plucked from between the scapula, a full frame photograph of both the dorsal and ventral surface, and photographs that clearly indicate the sex and reproductive condition of both males and females. A complete wing and the head should also be collected and sent to DEC. All samples should be frozen immediately upon collection.

7. **Expanded Post-construction Studies**

For wind energy projects constructed in or near one of the identified features or resources of concern, expanded post-construction monitoring studies will be recommended to provide in-depth information on the impacts to bird and bat resources of the site.

a. *Radar surveys*

If radar studies during pre-construction surveys showed high passage rates, low flight altitudes, or other unanticipated conditions were observed, then a radar survey will 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, the use of radar will be recommended for the following year of study regardless of whether radar studies were conducted during pre-construction studies.

b. *Raptor migration surveys*

Raptor surveys should be repeated during the first year of post-construction operation if expanded raptor surveys were conducted during pre-construction surveys. Raptor migration surveys should be done using the methods described under the expanded pre-construction survey

section, or as recommended by DEC staff.

8. Bat Mortality and Genetic Isotope Analysis Project

As a means of assessing cumulative impacts to bat species from wind energy development in New York and along the Atlantic Coast, a regional bat mortality and genetic isotope analysis project is being implemented by a consortium of bat experts and resource agencies. The study will initially focus on the three New York bat species that appear most vulnerable to wind mortalities. These are the red (*Lasiurus borealis*) hoary (*Lasiurus cinereus*) and silver-haired (*Lasionycteris noctivagans*). The project will also determine if there are unique geographic population segments that should be of regional conservation concern. Bat mortality and genetic isotope studies should be conducted at each proposed and operating wind energy facility as follows:

- a. Collect a minimum of 10 bat carcasses for genetic analysis over the duration of fall and spring migration and provide to DEC for collection of hair and tissue samples;
- b. Provide funding for costs associated with the collection, field processing and analysis of specimens at approximately \$250-\$300 per animal; and
- c. Repeat collection at a future date after build out of the wind resource in New York, to be coordinated with other regional collections.

9. Planning and Reporting

a. Work Plans

After discussions with DEC staff regarding application of these guidelines to a particular site, the developer should submit a draft work plan incorporating the recommended elements for study at the site. The work plan should include the site description and project layout provided for the initial consultation with staff. Pre-construction work plans should be discussed with and accepted by DEC before implementation of the proposed work. A comprehensive post-construction study plan should be developed and submitted to DEC for review and acceptance prior to project completion, and all work should be conducted in close consultation with DEC. Developers should work closely with DEC to provide a work plan detailing the search regime, bias corrections, reporting techniques, and other aspects of a project's post-construction mortality study.

b. Reports

After completion of the recommended studies, the developer should prepare a report presenting the results. A description of the proposed project should be provided including maps of the proposed turbine layout, existing and proposed roads, transmission line routes, substation location, topography, and state and federal wetlands. Maps with vegetation types, soils/bedrock, land use, significant archeological sites, and other relevant information should also be included. A composite map containing all project and study information (turbine locations, raptor observation points, BBS points, radar unit location (if applicable), wintering bird and waterfowl survey points/routes, and habitat types) should be provided. The preferred format for reporting is as follows:

- i. Breeding bird surveys: The breeding bird survey report should identify the number of survey points, survey dates, the time and duration of surveys at each point, and the number of species identified at each point.

A summary should include the number of species observed overall, species seen or heard most frequently throughout the study, point(s) with the greatest number of species, and habitat type(s) with the highest and lowest species diversity and abundance. The report should also include maps, tables and graphs reporting the location of each survey point and its relation to the proposed/existing turbine locations, and GPS coordinates of each point. Weather conditions during and immediately prior to survey days, a list of all species with the dates and points where they were observed, and the number and identification of observer(s) conducting each survey should also be provided.

- ii. Raptor migration survey: The report should identify the number of observation point(s), the dates and times surveys were conducted, the number of species observed overall, species seen most frequently during the survey, the average and median flight height and direction of each species, and any notable behavior. The following information should also be included in the main report or as an appendix: the duration of each survey, the number and identification of observer(s) conducting each survey, a table containing an hourly breakdown of each survey day with information on weather conditions, the species composition, flight height and direction of each bird, a map with the observation point location(s) and overall mean flight paths over and adjacent to the project area.
- iii. Songbird migration surveys: The report should identify the location and length of each transect, the number and location of survey points, survey dates, the time and duration of surveys at each point, and the number of species identified along each transect. Observations should be described as to number and behavior of birds seen e.g., solitary individual, moving in a small flock etc. The report should also include maps, tables and graphs reporting the location of each transect and its relation to the proposed/existing turbine locations, and GPS coordinates of each survey point along the transect(s). Weather conditions during and immediately prior to survey days, a list of all species with the dates and points where they were observed, and the number and identification of observer(s) conducting each survey should also be provided.
- iv. Habitat surveys: The habitat survey report should describe the types of habitat found on site, and whether there are potentially any state and/or federally listed species that could be associated with each habitat type. The report should also include the results of listed species presence/absence surveys. A map of habitat locations (grassland, forest, shrub, wetland, etc.) within and near the project area should be provided, including the locations of habitat suitable for any listed species, as well as the locations of any actual observations made of listed species.
- v. Radar studies: For each migration season, report the dates and total number of days that surveys took place; the radar unit location, elevation

and surrounding vegetation/topography; and mean and median target flight height, direction, density (passage rate in targets/km/hr), and percentage of targets detected below the maximum height of the proposed turbines. The report should also include tables and graphs reporting the times and number of hours actually sampled each night, hourly weather information (particularly wind speed and direction, percent cloud cover, and the presence of fog and/or precipitation), mean and median hourly flight heights, direction, density and percentage of birds and bats below proposed turbine height. The evaluation of results should also report the amount of down time, failures, or suspected malfunctions. All performance data of equipment used should be reported to better assess the efficiency and accuracy of the units being used at each location.

- vi. Wintering bird surveys: The report should include the number of survey points and/or routes surveyed, dates surveys were conducted, the duration and time of surveys at each point/location, the number of species observed overall, the species seen most frequently throughout the study, the point(s) with the greatest number of species, and the survey locations with the highest and lowest species diversity and abundance. Also included in the main report or as an appendix should be a description of the behavior (feeding, perching, soaring, flocking, etc.) of the birds observed and the habitat they occupied, along with a map showing the locations of the sightings relative to proposed/existing turbine locations, weather conditions during and immediately prior to survey days, a list of all species with the dates and points where they were observed, and the number and identification of observer(s) conducting each survey.
- vii. Waterfowl surveys: The static survey report should include the number of survey points, dates surveys were conducted, the duration and time of surveys at each point, the number of species observed overall, the species seen most frequently throughout the study, the point(s) with the greatest number of species, and the locations/habitat type (open water, river, marsh, agricultural field, etc.) with the highest and lowest species diversity and abundance. The driving survey report should include the same information provided for the static surveys, as well as the roads/areas that were driven/surveyed, and the type and number of species observed and their approximate location on the route. Behavior of individual birds and flocks seen should be noted (feeding, resting, flying, etc.), as well as any movements of birds within or across the project area. Also included in the main report or as an appendix should be maps, tables and/or graphs reporting the location of each survey point/route in relation to proposed/existing turbine locations, weather conditions during and immediately prior to survey days, a list of all species with the dates and points where they were observed, and the number and identification of observer(s) conducting each survey.
- viii. Bat acoustical surveys: Acoustical data should be recorded and archived

for quality control and to verify the identification of calls. Calls should be organized by species indicating the number of calls by date and by hour of the day. The report should identify the type of detectors in use, the performance data for each detector, its height above the ground, and its orientation. Include a description of the performance of each piece of equipment as it is configured for field data collection (sensitivity setting, housing, etc.) in order to determine the variability in detection based on species, and the distance from the target. Determine the reception range of all equipment used so as to identify variations between units and the variation between sensitivity settings used during the study. This should be described using a common metric (maximum detection range of each unit of a signal generated at a fixed DB at 20, 30 and 40 khz).

- ix. Mortality studies: Details of the post construction mortality studies should be presented in a report consisting of the results of the ground searches with: the number of turbines searched and the frequency of searches (daily, weekly etc.), habitat type surrounding each turbine, table of how many birds and bats were found beneath each turbine, size class of carcass (small or large bat, small, medium or large bird), the dates found and condition of each carcass, daily weather conditions prior to and during each search, and the number of people and dogs, if applicable, conducting each survey. Results of the searcher efficiency tests and scavenger removal study should also be presented. The estimated searcher efficiency should be reported by carcass size and ground cover type 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.

10. Sources of Information

Audubon of New York Christmas Bird Counts
<http://www.audubon.org/chapter/ny/ny/christmas.html>

Audubon of New York Important Bird Areas
http://www.audubon.org/chapter/ny/ny/IBA_new.htm

Audubon of New York Local Chapters <http://www.audubon.org/states/index.php?state=NY>

Bat Conservation International <http://www.batcon.org/home/default.asp>

DEC Breeding Bird Atlas <http://www.dec.state.ny.us/website/dfwmr/wildlife/bba/>

Hawk Migration Association of North America <http://hawkcount.org/index.php>

Indiana Bat Recovery Plan <http://ecos.fws.gov/speciesProfile/SpeciesReport.do?spcode=A000>

New York Natural Heritage Program <http://www.dec.state.ny.us/website/dfwmr/heritage/>

NYSDEC Endangered Species Unit: contact Alan Hicks (bats) and Peter Nye (eagles)
<http://www.dec.state.ny.us/website/dfwmr/wildlife/endspec/>

USFWS Migratory Bird Treaty Act Collection Permit <http://www.fws.gov/forms/3-200-7.pdf>

USGS Breeding Bird Survey <http://www.pwrc.usgs.gov/bbs/participate/instructions.html>

Figure 1. Flow Chart of Pre- and Post-Construction Studies

