US Fish and Wildlife Service
Pacific Southwest Region

INTERIM GUIDELINES FOR THE DEVELOPMENT OF A PROJECT SPECIFIC AVIAN AND BAT PROTECTION PLAN FOR WIND ENERGY FACILITIES

I. Introduction and Purpose

Increased energy demands and the nationwide goal to increase energy production from renewable sources have intensified the development of energy facilities, including wind turbines. The U.S. Fish and Wildlife Service (Service) supports renewable energy development. However, the Service strongly encourages energy development that is wildlife- and habitat-friendly. Of concern is that the cumulative effects of renewable energy projects may initiate or contribute to the decline of some bird and bat populations as well as other affected species. In order to ensure that renewable energy projects avoid and minimize impacts to bird and bat populations, the Service's Pacific Southwest Region developed these *Interim Guidelines for the Development of a Project Specific Avian and Bat Protection Plan for Wind Energy Facilities* as a means to provide energy project developers a tool for assessing the risk of potential impacts, designing, and then operating a bird- and bat-friendly wind facility.

Migratory birds are a Federal trust resource managed and protected by the Service. The Service estimates that between 58,000 and 440,000 birds are killed each year by wind turbines in the U.S., with that number growing based on at least 23,000 commercially operating turbines today (Manville 2005, 2009). Impacts from wind energy developments result from both direct and indirect causes. Raptor, passerine, waterbird, and bat fatalities have been documented as a result of collision with rotating turbine blades and interactions with other infrastructure associated with wind energy facilities (Arnett et al. 2007, Kunz et al. 2007, Kuvlesky et al. 2007, Ontario Ministry of Natural Resources 2006). Barotrauma, an apparent effect of sudden air pressure changes from wind wake turbulence, also appears to cause direct mortality in some songbirds and is being documented in bats (Kunz et al. 2007, Manville 2009). In addition, indirect impacts from energy projects such as displacement, disturbance, and habitat fragmentation can have negative effects on birds and bats by preventing breeding, decreasing population vigor and/or viability, and altering behaviors and should be considered when evaluating project sites (Stewart et al. 2007).

Legal Drivers

The Endangered Species Act (16 U.S.C. § 1531 et seq.; ESA) prohibits the harassment, harm, pursuit, hunting, shooting, wounding, killing, trapping, capture, or collection of a listed species. ESA provides specific mechanisms to authorize "incidental" take that occurs as a result of an otherwise legal activity and does not jeopardize listed species or adversely modify habitat designated as critical. An ABPP does not authorize take of federally listed species.

The Migratory Bird Treaty Act (16 U.S.C. § 703 et seq.; MBTA) prohibits the taking, killing, possession, transportation and importation of migratory birds, their eggs, parts, and nests, except when authorized by the Department of Interior. Because MBTA does not provide a specific mechanism to permit "incidental" take, it is important for proponents to work proactively with

the Service to avoid and minimize take. While MBTA has no provision for allowing an "incidental" take, it must be recognized that some birds may be killed at renewable energy developments even if all reasonable measures to avoid it are implemented. The Service's Office of Law Enforcement carries out its mission to protect migratory birds not only through investigations and enforcement, but also through fostering relationships with individuals and industries that proactively seek to eliminate their impacts on migratory birds. While it is not possible under MBTA to absolve individuals, companies, or agencies from liability if they follow these recommended guidelines, the Department of Justice has used prosecutorial discretion in the past regarding individuals, companies, or agencies who have made good faith efforts to avoid the take of migratory birds.

The Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d; BGEPA) further protects eagles from "take", where take is defined as to pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, disturb individuals, their nests and eggs. "Disturb" was defined in 2007 (72 FR 31132) as "to agitate or bother a bald or golden eagle to a degree that causes…injury to an eagle, reduced productivity, or nest abandonment…" In 2009, two new permit rules were created for eagles. New 50 CFR 22.26 can authorize limited take of bald (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) when the take is associated with, but not the purpose of an otherwise lawful activity, and cannot practicably be avoided. New 50 CFR 22.27 can provide for the intentional take of eagle nests where necessary to alleviate a safety hazard to people or eagles, to ensure public health and safety, where nest prevents use of a human-engineered structure, and where the activity or mitigation for the activity will provide a net benefit to eagles. Only inactive nests are allowed to be taken except in cases of safety emergencies.

These new rules and regulations pertaining to take do not alter or increase in any way existing prohibitions against take in the statute, but do provide a mechanism where non-purposeful take of eagles can be legally authorized. However, BGEPA provides the Secretary of Interior with the authority to issue eagle take permits only if he is able to determine that the take is compatible with the preservation of the eagle. This must be "…consistent with the goal of increasing or stable breeding populations." For more information regarding the new eagle rules see the eagle rule and guidance listed in Appendix 1 of this document. The development of a protection plan does not guarantee qualification for a permit under BGEPA.

What is an Avian and Bat Protection Plan?

An Avian and Bat Protection Plan (ABPP) is a project-specific document that delineates a program designed to reduce the operational risks that result from bird and bat interactions with a specific wind energy facility. Although each project's ABPP will be different, the overall goal of any ABPP should be to reduce avian and bat mortality with the ultimate goal of eliminating take. The development and implementation of an ABPP is voluntary and is not intended nor shall it be construed to limit or preclude the Service from exercising its authority under any laws, statute, or regulation, and to take enforcement action against any individual, company, industry, or agency or to release any individual, company, industry, or agency of its obligation to comply with any applicable Federal, State, or local laws, statutes, or regulations. Ultimately, the ABPP can and should result in an agreement between the project proponent and the Service as a "good faith" effort to conserve migratory birds and bats while still allowing for the development of

wind energy projects and production of renewable electricity in the most environmentally friendly ways possible and practicable.

In an effort to reduce the impacts of wind energy projects to migratory birds and bats, the Service recommends that wind energy project proponents develop an ABPP that outlines the project development process and includes conservation measures that will be implemented to avoid and minimize impacts to birds and bats at each project they propose to develop. ABPPs could be similar or essentially the same for adjacent projects or may simply not be needed (see criteria below). The ABPP will aid project developers with 1) establishing project development in an adaptive management framework, 2) proper siting and project design strategies, 3) design and implementation of pre-construction surveys, 4) implementing appropriate conservation measures for each development phase, 5) design and implementation of appropriate post-construction monitoring strategies, 6) use of possible post-construction studies to better understand the dynamics of mortality reduction (e.g., changes in blade cut-in speed, assessments of blade "feathering" success, and studies on the effects of visual and acoustic deterrents) including efforts tied into Before-After/Control-Impact (BACI) analysis, and 7) conducting a thorough risk assessment and validation leading to adjustments in management and mitigation actions.

The template/recommendations set forth in this guidance were based upon the Avian Powerline Interaction Committee (APLIC) APP template (2005) developed for electric utilities and has been modified accordingly to address the unique concerns with wind energy facilities. These recommendations are consistent with the *2003 Service Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines* (USFWS 2003) and the March 4, 2010, *Wind Turbine Guidelines Advisory Committee Recommendations to the Secretary of Interior*. These ABPP guidelines follow the principles of the Advisory Committee guidelines, which strive to:

1. Provide a consistent methodology for conducting pre-construction risk assessments and post-construction impact assessments to guide siting decisions by developers and agencies.
2. Encourage communication and coordination between the developer and relevant state and federal agencies during all phases of wind energy project development.
3. Provide mechanisms to encourage the adoption and use of the Guidelines by all federal agencies, as well as the wind energy industry, while recognizing the primary role of the lead agency in coordinating specific project assessments.
4. Complement state and tribal efforts to address wind/wildlife interactions and provide a voluntary means for these entities to coordinate and standardize review of wind projects with the USFWS.
5. Provide a clear and consistent approach that increases predictability and reduces the risk of liability exposure under federal wildlife laws.
6. Provide sufficient flexibility to accommodate the diverse geographic and habitat features of different wind development sites.
7. Present mechanisms for determining compensatory mitigation, when appropriate, in the event of unforeseen impacts to wildlife during construction or operation of a wind energy project.
8. Define scientifically rigorous and cost-effective study designs that improve the ability to predict direct and indirect wildlife impacts locally and regionally.

9. Include a formal mechanism for revision in order to incorporate experience, technological improvements, and scientific advances that reduce uncertainty in the interactions between wind energy and wildlife.

II. Criteria for Developing an ABPP

Due to differences in wind energy projects, locations selected for development, and varying distribution of wildlife resources and their habitats, some wind energy projects may not need to develop an ABPP. The following criteria should be used to determine if a project should pursue the development of an ABPP. If a project does not fit within the decision key criteria below to develop an ABPP, coordination with the Service is encouraged prior to actual site selection and project construction to ensure that appropriate conservation measures that avoid and minimize bird and bat impacts are incorporated into the project design. Below is a decision key to determine whether an ABPP should be developed.

A. Are there bird or bats that are listed as federally threatened or endangered, state threatened or endangered, state species of special concern, state fully protected, or delineated on the federal Birds of Conservation Concern list (USFWS 2008) that use the project footprint for nesting, wintering, foraging, staging, roosting, breeding, or migrating?
    1. If yes – **DEVELOP ABPP**
    2. If no – Go to B
B. Is there one or more eagle territory within the project footprint or 16 km (10 miles) of the nearest project boundary?
    1. If yes – **DEVELOP ABPP**
    2. If no – Go to C
C. Is the project footprint (including transmission corridors) located within/or adjacent to a designated Important Bird Area (see http://www.audubon.org/bird/IBA/) or within a major bird and/or bat migratory corridor, pathway, staging area, breeding, roosting, wintering, or stopover site (e.g., Western Hemisphere Shorebird Reserve Network [WHSRN], or Ramsar Convention site)?
    1. If yes or unknown – **DEVELOP ABPP**
    2. If no - Go To D
D. Does the project consist of > 10 turbines each equal to or greater than 1.5 Megawatt (MW)?
    1. If yes – **DEVELOP ABPP**
    2. If no – Go to E

III. Recommended Elements of an ABPP

While the structure of an individual ABPP will be based upon the specifics of the project, it is recommended that every ABPP contain the following elements and address both birds and bats.

A. Introduction

1. A description of the purpose and goal of the plan
2. Legal drivers – MBTA, BGEPA, ESA, Section 404 of the Clean Water Act, National Environmental Protection Act (if there is a Federal nexus), state regulations, other regulations as appropriate

B. Corporate Policy - An ABPP typically includes a statement of company policy confirming the company's commitment to work cooperatively towards the protection of migratory birds and bats.

C. Adaptive Management and Habitat Compensation
   1. Adaptive Management Process – outline the adaptive management process, including key decision making steps to ensure each phase (e.g., siting, design, construction, operation, and post-operation) of project development is evaluated
      a. Establish goals for the project
      b. Establish biologically meaningful triggers for management actions such as:
         i. Additional Conservation Measures (CMs) – operational changes if appropriate (e.g., seasonal blade "feathering" protocol, changes in blade cut-in speed, turbine set-backs from ridges, elimination of "killer" turbine strings, and replacement of turbines in dips and end-of-row turbines with pylons).
         ii. Additional monitoring or research studies if appropriate
         iii. Additional compensation if appropriate (e.g., habitat compensation, other mitigation measures)
   2. Habitat Compensation – The Service recommends habitat compensation for the loss of high quality bird habitat
      a. Habitat Equivalency Analysis – HEA is a pre-construction analysis tool to guide upfront habitat compensation (see below for more information)

D. Site Suitability Assessment
   1. Pre-site Assessment
      a. Determine whether the site is designated as Critical Habitat under the Endangered Species Act, designated as an Important Bird Area, WHSRN or RAMSAR site, an area of critical environmental concern (ACEC), or other special designation as important for wildlife.
      b. Using an initial coarse site assessment (e.g., Potential Impact Index [PII], Rapid Assessment Method [RAM]) identify important habitats, sensitive species (e.g., Species of Conservation Concern, Threatened or Endangered Species, or eagles), and other environmental issues within the proposed footprint.
      c. Make a determination as to whether the proposed site can be developed for wind energy while concurrently avoiding or minimizing impacts to wildlife. An alternative site analysis may be required if significant adverse impacts cannot be minimized.
   2. Pre-construction Studies and Risk Assessment
      a. Bird Use Studies - Determine the temporal and spatial distribution of avian populations including special status species within the proposed

footprint, during the breeding, nesting, foraging, roosting, feeding, wintering, and migration seasons.

b. Bat Use Studies – Determine the presence and activity levels of bats at a temporal and spatial scale during the breeding, winter, and migration seasons within the proposed footprint.

c. Threats – Identify the current threats to wildlife within entire project footprint.

d. Risk Assessment – What are potential short and long-term impacts of project development on bird and bat populations, including the cumulative impacts from all threats (including compensatory and additive) and lethal "take"?

3. Reporting – All site surveys, rapid assessment methodologies, reconnaissance surveys, and risk assessments should be shared with appropriate agencies prior to final site selection and initial construction. To the extent allowable under the Freedom of Information Act (FOIA), this information would remain confidential between the Service and the proponent and be protected from the release to the public.

E. Project Design and Impact-Reducing Conservation Measures

1. A detailed description of the facility layout, including macro- and micro-siting CMs implemented (e.g., avoid fragmenting large contiguous blocks of high quality bird/bat habitat, creation of avoidance buffers, turbine set-backs from ridges; see below for additional siting CMs).
2. Construction Phase CMs to be implemented (e.g., avoid breeding season for vegetation removal and construction, minimize area disturbed to maximum practicable)
3. Operation Phase CMs to be implemented (e.g., minimize lighting, follow all APLIC guidelines; see below for additional operational CMs)

F. Post-Construction Monitoring and Risk Assessment Validation

1. A detailed description of the post-construction monitoring plan including the proposed duration and intensity of monitoring including a justification.
2. The monitoring plan should assess changes in baseline data.
   a. Changes in temporal and spatial distribution of wildlife populations
   b. Changes in migratory or resident species behavior (e.g., avoidance of the site, attraction to the site, abandonment of the site, attraction of nest predators, and noted reduction in population vigor).
3. Mortality Studies – must include detectability and scavenger studies based on the use of accepted scavenger and search efficiency studies (e.g., Erickson et al. 2004, Kunz et al. 2007).
4. Nest Management – identify actions that are proposed to be taken by the proponent and/or its consultant when nests are observed on facilities (e.g., power poles, infrastructure, or outbuildings).
5. Risk Assessment Validation – comparison of pre- and post-construction data to determine "actual" impacts to wildlife due to facility operation, ideally validating or negating the pre-construction risk assessment.

6. Reporting
    a. Facility Mortality Reporting System – develop an internal reporting system for the facility to report detected bird and bat mortalities. This system will include provisions to report bird/bat fatalities to the Service office of Law Enforcement's confidential, voluntary mortality reporting website.
    b. Agency Reports – annual monitoring reports (including documented mortalities) will be submitted to the appropriate federal, state, and/or county agencies. Annual reporting will be a condition of any migratory bird or eagle permit issued by the Regional Migratory Bird Permits Office.

G. Implementation
    1. Permit Compliance - An ABPP should identify which permits are required related to wildlife issues.
    2. Employee Training - Training is an important element of an ABPP. All appropriate facility personnel should be properly trained in avian and bat issues including basic avian and bat biology, ecology, behavior, presence, site use, monitoring protocols, and key issues that may result in significant impacts (e.g., presence of Federally listed species, critical habitat, adjacent hibernacula, and maternity colonies). This training should encompass the reasons, need, and method by which employees should report a bird or bat mortality, follow nest management protocols, dispose of carcasses, comply with applicable regulations, including the consequences of non-compliance, and the appropriate agencies that should be contacted after incidents.
    3. Quality Control - An ABPP should provide a mechanism to review existing practices, ensuring quality control and a project audit.
    4. Key Resources – key regulations, laws, contact information, forms, protocols, etc.
    5. Public Awareness –outreach and education materials for stakeholders, etc.

IV. Guidance on Specific Elements of ABPP

The following section is meant to provide project proponents useful information for planning each development phase of the facility. For each phase outlined below, conservation measures and guidance are recommended for inclusion in the development of any wind energy project.

Coordination

The most essential element to developing a successful project is the coordination between the project proponent and the appropriate agencies (e.g., federal, state, county agencies). Early coordination ensures that all parties and agencies understand the scope of the project and can highlight details that require special attention. Early coordination with agency personnel can ensure appropriate survey design is used, special status species are addressed, specific conservation measures are recommended, and inform the project proponent about any permit requirements and how to obtain those permits. Through early coordination, the project

proponent should understand agency expectations and have guidance on how to meet those expectations.

Adaptive Management and Habitat Compensation

The Service recommends that proponents take an Adaptive Management (AM) approach to project development and operation. Adaptive Management promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions become better understood (Williams et al. 2009). The AM process is a decision making process that has six key principles: Problem Assessment, Design, Implementation, Monitoring, Evaluation, and Adjustment. The AM process should establish clear, biologically appropriate goals and triggers tied to mitigation measures. Based on the validation of risk assessment through post-construction monitoring a series of adaptive management actions should be identified as possible solutions to identified sources of wildlife impacts. The AM process should develop triggers based on available data and perceived risk that signal the level of adaptive action that is required. Through the AM process, management decisions can be made in response to post-construction assessments. Adapative Management decisions could include (but are not limited to) changes in facility operation, use of additional conservation measures, further impact research or monitoring, and/or additional resource compensation. For a complete discussion of AM, please see Williams et al. (2009).

In order to compensate for the loss of high quality wildlife habitat, the Service strongly encourages project proponents to conduct a Habitat Equivalency Analysis (HEA) and determine compensation for both temporary and permanently lost habitat at the start of the project. HEA is a method of quantifying interim and permanent habitat injuries, measured as a loss of habitat services from pre-disturbance conditions, and scaling compensatory habitat requirements to those injuries (Dunford et al. 2004, National Oceanic and Atmospheric Administration 2006, 2009). Habitat services are generally defined by a metric that represents the functionality of that habitat (i.e., the ability of that habitat to provide "services" such as nest sites, prey populations, cover from predators, protected loafing areas, protected roosting areas, and reliable feeding sites). Interim habitat injuries are those habitat services that are absent during disturbance and during vegetation restoration that would have been available if that disturbance had not occurred. Permanent habitat injuries are habitat injuries remaining after vegetation recovery is complete (e.g., permanent habitat loss). The objective of an HEA is to replace lost services with like services, providing a replacement ratio for interim and permanent injury (see literature in Appendix 1 for more information on HEA).

Pre-siting Data Collection

Due to local differences in wildlife concentrations and movement patterns, habitats, area topography, facility design, and weather; each proposed development site is unique and requires detailed and individual evaluation (USFWS 2003). In addition, renewable energy projects are rapidly expanding into habitats and regions that have not been well studied and where animal population data are scarce. Thus, in an effort to place projects in locations that will yield the least risk of population impacts, a rigorous siting evaluation process should be completed.

Pre-siting analyses should consist of 1) a coarse site assessment (e.g., PII, RAM), 2) a HEA, 3) site specific wildlife use surveys, and 4) a wildlife-facility interaction risk assessment. Data collection methods will vary between projects due to differences mentioned previously, however the Service recommends the following considerations when conducting pre-siting assessments.

A. Coarse Site Assessment – Each pre-siting assessment should start with a coarse site assessment of the potential environmental issues that might preclude the site from development based on its perceived or validated level of risk. At a minimum, every wind project should conduct either a PII (USFWS 2003 – Appendix 1) or use a more detailed and consistent RAM that will include a checklist for temporal and spatial air space components lacking in the PII (the RAM is still in development). Factors that should be considered during any coarse assessment include:
    1. Is the site designated as Critical Habitat for any federally listed species?
    2. Is the site designated as an Important Bird Area (see http://www.audubon.org/bird/IBA/), or a WHSRN or RAMSAR site?
    3. Does the site provide suitable habitat for any federal or state listed species, or sensitive species (e.g., ACEC)?
    4. What is the type and quality of bird/bat habitat within and surrounding the footprint?

B. Habitat Equivalency Analysis – The Service encourages the wind industry to look for opportunities to promote bird, bat, and other wildlife conservation when planning renewable energy facilities. These opportunities may come in the form of voluntary habitat acquisition or conservation easements. In order to quantify the appropriate compensation acreage, the use of an HEA can be used to identify high quality habitat and calculate compensation for the development of high quality habitats for both permanent and temporary losses. See HEA resources in Appendix 1 of this document.

C. Site Specific Wildlife Surveys
    1. Development of appropriate survey question – It is important to develop the appropriate survey questions as they dictate the sampling design and protocols to be used. An inappropriate study design and/or insufficient duration of data collection may result in unreliable data inferences with resultant biases and skewed results (Kunz et al. 2007). Pre-siting survey data will become the baseline for project impacts to bird and bat populations. Thus, most survey designs should be established as BACI studies, when possible. Well designed BACI studies that test the response of birds and bats to certain operational conditions are needed to fully evaluate options for mitigating fatalities to birds and bats at wind-energy projects (Kunz et al. 2007). Examples of possible survey questions include (but are not limited to):
        a. Which species of birds and bats use the project area and how do their numbers vary temporally (i.e., daily, monthly, annually)?
        b. How much time do birds/bats spend in the risk zone (rotor swept area) and does this behavior vary by season?
        c. What is the estimated range of bird/bat mortalities from the project?

d. Are there nesting raptors within the project footprint (all species), within 5 km (3 miles) of footprint (all species), within 16 km (10 miles) of footprint (eagles)?
e. Is there a preponderance of inclement weather events that coincide with avian and/or bat presence that would put these species at especially high risk?

2. Selection of appropriate survey methodology – Based on the project and questions being asked, there are many suitable methods to survey birds and bats and establish baseline data. Generally, it is recommended to employ multiple survey techniques to ensure adequate data collection. A good summary of survey methods can be found in Kunz et al (2007) for night-migrating birds and bats and Ontario Ministry of Natural Resources (2006) for bats. Efforts are currently underway to update the Anderson et al. 1999 methods for monitoring diurnally active birds. In addition, follow Service survey and monitoring guidelines (e.g., the Interim National Golden Eagle Inventory and Monitoring Guidelines; Pagel et al. 2010). Examples of survey methods that might be appropriate for wind projects include acoustic, radar, infrared, radio telemetry, mist netting, harp trapping, and a variety of observational surveys. Specific survey methods should include:
    a. Diurnal bird use counts
    b. Nocturnal bird use counts
    c. Raptor nest searches (see Pagel et al. 2010 for golden eagle protocols)
    d. Small bird counts (CEC 2007, EC/CWS 2006a and 2006b)
    e. Migration counts
    f. Acoustic bat monitoring
    g. Bat roost exit counts – if applicable
3. Duration and timing of surveys – To collect data under variable climatic conditions and accumulate sufficient samples for data analysis, pre-construction surveys should be conducted to assess the potential risk of the proposed project to wildlife. Multi-year surveys, up to three years pre-construction, may be warranted. This can vary depending on the project specifics, known or perceived level of risk, the variability in use of habitat by avian species, environmental stochasticity, and species present. Surveys should be designed to ensure adequate data are collected on breeding, staging, migration, and winter bird/bat use of the project site, taking into account peak use of the site temporally and spatially. Bird surveys should include diurnal and nocturnal use studies for the project footprint. Bat surveys should also include year-round acoustic monitoring to detect presence and activity (e.g., mean number of passes/detector/night), as little information is typically known about the ecology of resident, wintering, and migrating bats. Coordinate with the wildlife agencies when selecting locations for bird and bat data collection.
4. Use of additional data – Other sources of data may be available for specific project sites. When available and appropriate, these data should also be included in the site evaluation. Other good sources of bird data include (but are not limited to) Audubon Christmas Bird Count data, USGS Breeding Bird Survey data, Cornell Lab of Ornithology eBird data, California Natural Diversity Database, and Audubon Important Bird Area data. These data have utility limitations (i.e., what

the data can be used for) and these limitations should be considered prior to inclusion in the assessments.

5. Special status species – When evaluating a project site, special status species should be identified. Special status species include all federal and state species listed as endangered or threatened, state species of concern and fully protected species, and those listed on the Fish and Wildlife Service's Birds of Conservation Concern 2008 (http://library.fws.gov/Bird_Publications/BCC2008.pdf)
    a. Eagles – The ABPP should address whether bald or golden eagles use the project site for foraging, roosting, nesting, wintering, migration, or as a migration stop-over site. The project assessment should address whether there are nesting bald or golden eagles within 16 km (10 miles) of the project site and include whether the project development impacts eagle foraging habitat, roost sites, wintering habitat, migratory stop-over sites, migratory corridors, defended eagle territories, or displaces eagles during either the breeding and/or the winter seasons.

D. Risk Assessment – The risk assessment should identify potential short and long-term impacts of the project development on bird and bat populations, including lethal "take" (as defined by all applicable regulations).
    1. Site specific threats – Based on the results of the site specific wildlife surveys, the site specific risk assessment should address what the potential for take is based on:
        a. Turbine collision and other turbine interactions (e.g., barotrauma, crippling loss or injury from wind wake turbulence and blade-tip vortices)
        b. Transmission line, power tower, met tower, or guy line collision
        c. Electrocution potential
        d. Displacement issues
        e. Nest and roost site disturbances
        f. Habitat loss
        g. Habitat fragmentation
        h. Additional human presence disturbances
    2. Cumulative Impacts – Effects that are likely to result from the project in combination with other projects or activities that have or will be carried out should be analyzed. We recommend that the cumulative effects assessment, where practicable and reasonable, should include the impacts from all threats and lethal "take".
        a. Evaluate the cumulative effects of all new or existing renewable energy projects within 16 km (10 miles) of the project footprint
        b. Evaluate the cumulative effects of all new or existing utility structures within 16 km (10 miles) of the project footprint
        c. Evaluate the cumulative impacts of all other human disturbances within 16 km (10 miles) of the project footprint (e.g., urbanization, agriculture, off-road recreation areas, other recreation areas)
        d. For eagle cumulative effects, we recommend the analysis should include the area within 69 km (43 miles) of the project site for bald eagles and 225 km (140 miles) for golden eagles (USFWS *in prep*)

E. Reporting – After all appropriate pre-siting survey work is completed; the resulting information and risk assessment should be provided to all appropriate agencies for review and discussion.

Project Design Conservation Measures

Based on the information gathered in the pre-siting data collection and risk assessment phase, the project design should be tailored so that wildlife mortality risks are avoided and minimized. The primary question to be asked during project design is what design features and/or considerations can potentially reduce the hazard of wind turbines to wildlife populations? Consideration for the following aspects is strongly recommended:

A. Project siting – After all pre-siting survey data have been collected and analyzed, it is important to select the site that will have the least impacts to bird and bat populations. The ultimate goal is to avoid any take of migratory birds and bats and/or minimize the loss, destruction, or degradation of migratory bird or bat habitat by placing projects in disturbed and degraded areas to the maximum extent practicable. Siting conservation measures should include both the macro- and micro-site scales.
    1. Macro-siting – Consideration should be made to avoid:
        a. Locations with federally or state listed, or otherwise designated sensitive species, and areas managed for the conservation of listed species (i.e., ACECs)
        b. Areas frequently used for daily bird and bat movements (i.e., areas between roosting and feeding sites)
        c. Breeding and wintering eagle use areas
        d. Known migration flyways for birds and bats
        e. Areas near known bat hibernacula, breeding, and maternity/nursery colonies
        f. Areas with high incidence of fog, mist, low cloud ceilings, and low visibility, or where other risk factors may come into play
        g. Fragmentation of large, contiguous tracts of wildlife habitat (see ES/CWS 2006a and 2006b)
    2. Micro-siting – Once a footprint has been selected, there may be opportunities for finer scale micro-siting of the project components. Component siting considerations include:
        a. Avoid placing turbines near landscape features that attract raptors
        b. Avoid placing turbines near landscape features that attract migrant birds (e.g., water sources, riparian vegetation)
        c. Set turbines back at least 200 meters (~650 feet) from cliff tops where raptors nest (Richardson and Miller 1997)
        d. Minimize the potential for creating habitats suitable for rodents such as rock piles and eroded turbine pads with openings underneath that will additionally attract raptors, especially golden eagles

B. Buffer zones – It might be appropriate and necessary to establish biologically meaningful buffer zones to protect raptor and other bird nests, areas of high bird and bat use, and known bat roosts. These buffers should be established up-front and be part of the siting process. The Service recommends that the following avoidance buffers are considered:

1. Passerines – Avoid disturbance activities (e.g., construction actions, noise) within established buffers for active nests of any protected bird species or any high quality nesting habitat (e.g., riparian areas). Buffer distances should consider species, terrain, habitat type, and activity level as these features relate to the bird alert distance and bird flight initiation distance (Whitfield et al. 2008). Buffer size should be coordinated with the Service biologists prior to activities.
2. Raptors (including eagles) – Avoid siting wind turbines, minimize human access, and avoid disturbance activities (e.g., construction actions, noise) within 1.6 km (1 mile) of an active raptor/eagle nest, unless specific features (e.g., terrain, barriers) dictate reduced buffers (Richardson and Miller 1997). Reduced buffers should be coordinated with the Service.
3. "Prairie" and Sage Grouse – Avoid construction of wind facilities within 8 km (5 miles) of all grouse lekking sites (Manville 2004)

C. Appropriate facility design – There are many conservation measures that can be incorporated into the facility design that might reduce the potential effects of a project on bird populations. Some include:
   1. Use tubular supports with pointed nacelle tops rather than lattice supports to minimize bird perching and nesting opportunities.
   2. Avoid placing external ladders and platforms on tubular towers to minimize perching and nesting.
   3. Consider using fewer larger turbines compared to a larger number of smaller turbines.
   4. Avoid the use of guy wires for all meteorological towers and do not light them unless the Federal Aviation Administration (FAA) requires them to be lit, which is generally >60 meters (>199 ft) AGL in height. Any necessary guy wires should be marked with recommended bird deterrent devices (APLIC 1994, USFWS 2000)
   5. If taller turbines (top of rotor swept area is >60 meters [>199 ft] AGL) require lights for aviation safety, the minimum amount of pilot warning and obstruction avoidance lighting specified by the FAA should be used (FAA 2007), approximately 1 in every 5 turbines should be lit, and all lights within the facility should illuminate synchronously. Lighting of the boundary of the facility is most important as an aviation safety warning. Unless otherwise requested by the FAA, use only the minimum number of strobed, strobe-like or blinking red incandescent lights, with minimum intensity, duel strobe lights preferred per lit nacelle. No steady burning lights should be used on turbines or facility infrastructures.
   6. Facility lights should be focused downward to reduce skyward illumination. Lights should be equipped with motion detectors to reduce continuous illumination.
   7. Where feasible, place electric power lines underground or on the surface as insulated, shielded wire to avoid electrocution of birds. Use recommendations of APLIC (1994, 2006) for any required above-ground lines, transformers, or conductors. When transmission lines must be above-ground, avoid placing lines within wetlands and over canyons.
   8. The creation of roads leads to further loss and fragmentation of migratory bird habitat. The Service recommends that the number of roads be minimized for all phases of a project.

D. Appropriate turbine layout – A well thought out turbine layout can substantially reduce the potential for bird strikes. Some examples of better turbine layouts include grouping turbines versus spreading them widely across the project area and orienting rows of turbines parallel to known bird movements. In addition, placing large, turbine sized pylons at the end of turbine rows and in ridge dips can re-direct birds and bats away from the danger areas.

Construction Phase Conservation Measures

During the construction of energy facilities, standard construction conservation measures should be established. Conservation measures (CMs) that specifically relate to bird conservation include (but are not limited to):

A. Minimize area disturbed to extent practicable, including access road construction – In an effort to minimize the amount of habitat disturbance and fragmentation, construction plans should emphasize the minimization and placement of habitat disturbance whenever possible, and where possible, avoid construction during the breeding, nesting, and maternity-colony seasons. Construction roads that are not required for long-term operation and maintenance of the facility should be closed and restored to the pre-construction habitat type present.

B. Vegetation clearing – Over 1,000 bird species and their eggs and nests are protected from take by the MBTA. Thus, the Service recommends that all vegetation within the project footprint that will be disturbed be cleared outside of the bird breeding season to the maximum extent practicable (Note: the bird breeding season will vary from location to location, by habitat type, and by species, please consult the Service for breeding seasons in the specific project area). If the proposed project includes potential for take of migratory birds and/or the loss or degradation of migratory bird habitat and vegetation removal cannot occur outside the bird breeding season, project proponents should provide the Service an explanation for why work must occur during the bird breeding season. Further, in these cases, project proponents should demonstrate that all reasonable and practicable efforts to complete work outside the bird breeding season were attempted, and that reason for work to be completed during the breeding season were beyond the proponent's control.
    1. When vegetation removal cannot take place outside of the breeding season and a reasonable explanation was provided to the Service, the Service recommends having a qualified, on-site biologist during construction activities to locate active nests, establish avoidance buffers around active nests, watch for new nesting activity, and if necessary stop construction when noise and general activity threaten to disturb an active nest. All active nests of protected birds (e.g., MBTA, ESA, state regulations) should not be disturbed until after nest outcome is complete.

C. Minimize wildfire potential – Wildfire is a potential threat that could impact bird and bat habitat. The Service recommends that construction activities are conducted in a manner that avoids and/or minimizes the ignition of a wildfire.

D. Minimize activities that attract prey and predators – During construction, garbage should be removed promptly and properly to avoid creating attractive nuisances for birds and bats.

E. Control of non-native plants – The introduction of non-native, invasive plant species can impact bird habitat quality. The Service recommends that all appropriate control measures be implemented to prevent the introduction and spread of invasive plant species with and surrounding the project area. Use only plants native to the area for seeding or planting during habitat revegetation or restoration efforts.

Operational Phase Conservation Measures

Once a facility is built, appropriate CMs should be in place to reduce the attractiveness of the facility to breeding, migrating, and wintering birds and bats to ensure mortality is minimized. The following Operational CMs should be considered:

A. Do not create or maintain attraction features for birds/bats – Through appropriate habitat maintenance, facilities should seek to reduce features that attract birds and bats to the facility. Simple measures could include removal of carrion that attracts raptors and other scavengers to the site, maintain vegetation heights around turbines to reduce raptor foraging (habitat maintenance to reduce prey availability), and minimizing water sources (especially in desert habitats) that birds and other wildlife seek, and avoid creating situations where rodent prey bases will increase (i.e., through creating new habitats for them, disturbance, and cattle grazing) thus drawing in raptors. These measures should be implemented only after completely evaluating each specific project site and implementation of these measures will not have deleterious effects on other special status wildlife species.

B. Reduce "Motion Smear" – When an object moves across the retina with increasing speed, it becomes progressively blurred, termed "motion smear" (Hodos 2003). This blurring of turbines blades lessen a bird's ability to detect and avoid rotating turbine blades. Using blades with staggered stripes or incorporating a black blade with two white blades could reduce motion smear and thus potential bird turbine collisions (Hodos 2003), although this needs more research.

C. Turbine feathering and cut-in speed - Data suggest that most bird fatalities at wind projects occurred at times of low wind speed (typically <6m/sec), conditions under which rotor blades are moving, but the amount of electricity generated is minimal (Kunz et al. 2007). Turbine feathering, electronically pitching the blades parallel to the wind, could significantly reduce bird impacts by making the blades stationary at low wind speeds (Kunz et al. 2007, Manville 2009). In addition, changing the blade cut-in speed and reducing operation hours in periods of low wind (e.g., from cut-in at 3.0mps to 5.0mps) has been shown to reduce bat mortality by up to 92% with minimal power loss (Arnett et al. 2009). The Service recommends setting a maximum rpm rate for each nameplate turbine that allows for sufficient energy production but reduces the potential for avian and bat collisions. In addition, the Service recommends reducing operation hours during periods of low wind.

D. Lock rotors during daytime and at night during peak migration periods and peak presence – In areas with high concentrations of migrating raptors, passerines, and bats, and high concentrations of overwintering raptors, it may be appropriate to turn the turbines off during peak migration periods or peak use of an area (Manville 2009).

E. Follow APLIC guidelines for overhead utilities – If overhead transmission lines are necessary, facilities should follow all APLIC (1994 and 2006) guidelines.

F. Minimize lighting – Research indicates that lights can both attract and confuse migrating birds (Gehring et al. 2009, Manville 2005, 2009) and bats are known to feed on concentrations of insects at lights (Fenton 1997). The goal of every facility should be to minimize operational lighting to the maximum extent practicable.
    1. To avoid disorienting or attracting birds and bats, FAA visibility lighting of wind turbines should employ only strobed, strobe-like or blinking incandescent lights, preferably with all lights illuminating simultaneously. Minimum intensity, maximum "off-phased" duel strobes are preferred by the Service. No steady burning lights (e.g., L-810s) should be used. See also Project Design recommendations for additional lighting guidance.
    2. Keep lighting at both operation and maintenance facilities and substations located within ½ mile of the turbines to the minimum level for safety and security needs by using motion or infrared light sensors and switches to keep lights off when not required, shielding operational lights downward to minimize skyward illumination, and do not use high intensity, steady burning, bright lights such as sodium vapor or spotlights.

G. Decommission Non-operational Turbines – All turbines that are non-operational should be decommissioned to reduce collision threats and ideally the blades removed immediately.

Post-construction Monitoring

An essential element to understanding the actual impacts of each wind energy facility is post-construction monitoring. The goal of the post-construction monitoring program is to validate the pre-construction risk assessment and allow the facility to implement adjustments based on identified problems and triggers (see Adaptive management section above). Every post-construction monitoring program should be comprised of 1) clear monitoring objectives, 2) a sound monitoring design including an appropriate duration and intensity of study, 3) nest management protocols, 4) a risk assessment validation, and 5) reporting.

A. Monitoring Objectives (should include but are not limited too)
    1. Estimate bird/bat fatality rate due to all aspects of facility operation
    2. Assess changes in bird/bat behavior due to all aspects of facility operation
    3. Assess changes in population status within and adjacent to the project footprint
    4. Assess displacement and avoidance of birds/bats from within the project footprint
    5. Determine whether avoidance and minimization measures implemented for the project were adequate to reduce mortality

B. Monitoring Design - The degree and intensity of a monitoring program is determined by a combination of factors including size of the facility, presence of special status species as determined by pre-construction data, and perceived/known risks at the site, as well as additional permit conditions. Similar to pre-siting surveys, the design of post-construction monitoring programs is critical to generate meaningful results. Using BACI study designs pre- and post-construction data, where possible, will be comparable and achieve monitoring objectives. Coordinate with wildlife agencies when designing any monitoring programs. Important aspects of a post-construction monitoring plan include:
    1. Duration and Timing - Post-construction monitoring programs should be done for a minimum of three years after operation of the facility begins (see Pagel et al. 2010 for duration of eagle monitoring). Where risk is determined to be high, at least five years of assessment and monitoring is recommended (Stewart et al. 2007). This time period ensures data capture differences in parameters due to seasonal and annual variability. Monitoring programs should be extended, as appropriate, if mortality level triggers are reached or the project results in the mortality of a listed species or eagle. It is important to ensure that monitoring includes data collection during breeding, wintering, and migration periods as bird/bat use of areas will vary across season.
    2. Study Components – All studies should be based on the objectives of the monitoring program and should follow accepted scavenger and search efficiency studies (e.g., Erickson et al. 2003).
        a. Mortality Studies should cover both turbine collisions and mortalities associated with other aspects of the facility (e.g., electrocutions, transmission line collisions, displacement, wind wake and blade-tip vortices)
            i. The Service recommends that mortality surveys be completed on a weekly basis for at least one year post monitoring. The survey frequency could be adjusted, if appropriate, depending on the results of the detectability and scavenger studies
        b. Assessment of search efficiency (observer bias studies)
        c. Assessment of carcass scavenger rates
        d. Ensure monitoring plan is representative of the entire footprint
    3. Eagle Monitoring Plan – In addition to project-specific mortality monitoring studies, the Service recommends developing an eagle monitoring plan separately to ensure that bald and golden eagle mortality is adequately assessed (2007 National Bald Eagle Management Guidelines).

C. Nest Management – Each facility should have protocols in place on how to manage nests established on any part of the facility (see APLIC 2006). Eagle nests should be covered separately according to the new rules and included in the Eagle Monitoring Plan (see above).

D. Risk Assessment Validation – Using pre-and post-construction data, the proponent should validate the identified risks of the project. The validation process should consider:

1. Whether the documented mortality rate is higher, lower, or expected as determined in the pre-construction risk assessment
2. Are CMs adequate to meet expected levels of mortality?
3. Would additional CMs reduce mortality rates?
4. Do documented mortality rates trigger additional management or mitigation actions?

E. Reporting – All post-construction monitoring results and risk assessment validation should be reviewed by the appropriate agencies annually. Additional reporting may be a condition of permits issued. Confidentiality should be maintained between the proponent and the agency (ies) reviewing the project reports. For Service reviews, to the extent allowable under FOIA, project-specific information would remain confidential between the Service and the proponent and be protected from release to the public.

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Appendix 1. Key Resources for Avian and Bat Protection Plan Development

Adaptive Management

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Avian and Bat Protection Plan Guidelines

- Avian Power Line Interaction Committee and U.S. Fish and Wildlife Service. 2005. Avian protection plan (APP) guidelines. http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/APP/AVIAN%20PROTECTION%20PLAN%20FINAL%204%2019%2005.pdf
- Avian Power Line Interaction Committee. 2006. Suggested practices for avian protection on power lines, the state of the art in 2006. http://www.aplic.org/
- Avian Power Line Interaction Committee. 1994. Suggested practices for avoiding avian collisions on power lines: state of the art in 1994. Edison Electric Institute and APLIC, Washington, DC.

Birds of Conservation Concern

- U.S. Fish and Wildlife Service, Division of Migratory Birds. 2008. Birds of Conservation Concern. Arlington, VA. http://library.fws.gov/Bird_Publications/BCC2008.pdf

Eagle Rule and Guidance

- For a general overview of the new eagle permits final rule, review the Service's *Migratory Bird Management Information: Eagle Rule Questions and Answers*; located at http://www.fws.gov/migratorybirds/CurrentBirdIssues/Management/BaldEagle/QAs%20for%20Eagle%20Rule.final.10.6.09.pdf
- Review the Service's 2009 *Final Environmental Assessment, Proposal to Permit Take as Provided Under the Bald and Golden Eagle Protection Act*; located at http://www.fws.gov/migratorybirds/CurrentBirdIssues/BaldEagle/FEA_EagleTakePermit_Final.pdf
- Review the Service's 2009 *Eagle Permits; Take Necessary to Protect Interests in Particular Localities; Final Rules*; located at http://www.fws.gov/migratorybirds/CurrentBirdIssues/BaldEagle/Final%20Disturbance%20Rule%209%20Sept%202009.pdf
- Minimize impacts to bald eagles by implementing recommendations provided in the Service's 2007 *National Bald Eagle Management Guidelines*; located at http://www.fws.gov/migratorybirds/CurrentBirdIssues/Management/BaldEagle/NationalBaldEagleManagementGuidelines.pdf
- Pagel, J.E., D.M. Whittington, and G.T. Allen. 2010. Interim golden eagle inventory and monitoring protocols; and other recommendations. Division of Migratory Birds, Arlington, VA

Habitat Equivalency Analysis

- National Oceanic and Atmospheric Administration. 2006. Habitat equivalency analysis: an overview. http://www.darrp.noaa.gov/library/pdf/heaoverv.pdf
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Wind Project Development Guidance

California Energy Commission and California Department of Fish and Game. 2007. California Guidelines for Reducing Impacts to Birds and Bats from Wind Energy Development Commission Final Report. http://www.energy.ca.gov/windguidelines/index.html

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- National Wind Coordinating Collaborative. 2007. Mitigation Toolbox. http://www.nationalwind.org/assets/publications/Mitigation_Toolbox.pdf
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