U.S. Fish and Wildlife Service
Draft Land-Based Wind Energy Guidelines

Recommendations on measures
to avoid, minimize, and compensate for effects to fish, wildlife, and their habitats

Acknowledgements

The U.S. Fish and Wildlife Service (Service) would like to recognize and thank the Wind Turbine Guidelines Advisory Committee for its dedication and preparation of its Wind Turbine Recommendations. The Recommendations have served as the basis from which the Service's team worked to develop the Service's Draft Guidelines for Land-based Wind Energy Development. The Service also recognizes the tireless efforts of the Regional and Field Office staff that helped to review and update these draft Guidelines.

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Draft Land-based Wind Turbine Guidelines

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Acronyms:

ABPP – Avian and Bat Protection Plan
APLIC – Avian Power Line Interaction Committee
BACI – Before-After Control-Impact study design
BGEPA – Bald and Golden Eagle Protection Act
BMP – Best Management Practice
CFR – Code of Federal Regulations
EO – Executive Order
ESA – Endangered Species Act
FAA – Federal Aviation Administration
FOIA – Freedom of Information Act
FR – Federal Register
DOI – U.S. Department of the Interior
GIS – Geographic Information System
GPS – Global Positioning System
HEA – Habitat Equivalency Assessment
ITP – Incidental Take Permit
MBTA – Migratory Bird Treaty Act
MW – Megawatt
MWh – Megawatt hour

Executive Summary

The mission of the U.S. Fish and Wildlife Service is working with others to conserve, protect and enhance fish, wildlife, plants and their habitats for the continuing benefit of the American people. As part of this, we are charged with implementing statutes including Endangered Species Act, Migratory Bird Treaty Act, and Bald and Golden Eagle Protection Act. These draft Land-based Wind Energy Guidelines (draft Guidelines) are intended to promote compliance with these and other relevant wildlife laws and statutes. They call for scientifically rigorous surveys, "**monitoring**," assessment, and research designs proportionate to the "**risk**" to "**affected species.**" The Service encourages project proponents to use the process described in these voluntary draft Guidelines to address risks to fish and wildlife resources. The Service intends that these draft Guidelines, when used in concert with the appropriate regulatory tools, will be the best practical approach for conservation of species of "**Federal trust responsibility."**

In response to increasing wind energy development in the United States, the U.S. Fish and Wildlife Service (Service) in July 2003 released for public comment a set of voluntary, interim guidelines for reducing adverse effects to fish and wildlife resources from wind energy projects. After the Service reviewed the public comments, the Secretary of the Interior (Secretary) established a Federal Advisory Committee to provide recommendations to revise the guidelines related to land-based wind energy facilities. In March 2007, the Service announced in the Federal Register the establishment of the Wind Turbine Guidelines Advisory Committee (the Committee). The Committee submitted its final Recommended Guidelines (Recommendations) to the Secretary on March 4, 2010. The Service convened an internal working group to review the Recommendations and develop voluntary draft "**land-based"** wind energy guidelines that consider the Recommendations.

As the United States moves to expand wind energy production, it also must maintain and protect the Nation's fish, wildlife, and their habitats, which wind energy production can negatively affect. As with all responsible energy development, wind energy projects should adhere to high standards for environmental protection. With proper diligence paid to siting, operations, and management of projects, it is possible to mitigate for adverse effects to fish, wildlife, and their habitats. This is best accomplished when the developer coordinates as early as possible with the Service and other stakeholders. Such coordination should commence prior to any financial obligation or finalization of lease agreements to allow for the greatest range of development and mitigation options.

The Recommendations and U.S. Fish and Wildlife Service's Draft Guidelines for Land-based Wind Energy Development are founded upon a "tiered approach" for assessing potential adverse effects to fish and wildlife and their habitats. The tiered approach is an iterative decision making process for collecting information in increasing detail; quantifying the possible risks of proposed wind energy projects to fish, wildlife, and habitats; and evaluating those risks to make siting, construction, and operation decisions. Subsequent tiers refine and build upon issues raised and efforts undertaken in previous tiers. At each tier, a set of questions is provided to help the

developer evaluate the potential risk associated with developing a project at the given location. The tiered approach guides a developer's decision process as to whether or not the selected location is appropriate for wind development. This decision is related to site-specific conditions regarding potential species and habitat effects.

Briefly, the tiers address:

- Tier 1 – Preliminary evaluation or screening of potential sites (landscape-scale screening of possible project sites)

- Tier 2 – Site characterization (broad characterization of one or more potential project sites)

- Tier 3 – Pre-Construction monitoring and assessments (site-specific assessments at the proposed project site)

- Tier 4 – Post-construction monitoring of effects (to evaluate fatalities and other effects)

- Tier 5 – Research (to further evaluate direct and indirect effects, and assess how they may be addressed)

This framework allows the developer to determine whether sufficient information exists, whether and how to proceed with development of a project, or whether additional information gathered at a subsequent tier is necessary to make those decisions.

The Service urges voluntary adherence to the draft Guidelines and communication with the Service when planning and operating a facility. The Service will regard such voluntary adherence and communications as evidence of due care with respect to avoiding, minimizing, and mitigating adverse impacts to species protected under the MBTA and BGEPA, and will take such adherence and communication fully into account when exercising its discretion with respect to any potential referral for prosecution related to the death of or injury to any such species.

The draft Guidelines include best available methods and metrics to help answer the questions posed at each tier. Research on wind energy effects on fish, wildlife, and their habitats is ongoing and new information is made available on a regular basis. Substantial variability can exist among project sites and as such, methods and metrics should be applied with the flexibility to address the varied issues that may occur on a site-by-site basis, while maintaining consistency in the overall tiered process. As research expands and provides new information, these methods and metrics will be updated to reflect current science. The Service has created a website (http://www.fws.gov/windenergy) with the latest information on best management practices, policies, survey techniques, and other information to help support these draft Guidelines.

Introduction

A. OVERVIEW

The mission of the U.S. Fish and Wildlife Service is working with others to conserve, protect and enhance fish, wildlife, plants and their habitats for the continuing benefit of the American people. As part of this, we are charged with implementing statues including the Endangered Species Act, Migratory Bird Treaty Act, and Bald and Golden Eagle Protection Act. These statutes prohibit taking of federally listed species, migratory birds and eagles unless otherwise authorized. These draft Guidelines are intended to:

(1) Promote compliance with relevant wildlife laws and statutes;

(2) encourage scientifically rigorous survey, "**monitoring**" (see Glossary for bolded text definitions), assessment, and research designs proportionate to the "**risk**" to "**affected species**";

(3) produce potentially comparable data across the Nation;

(4) avoid, minimize, and/or compensate for potential adverse effects on fish, wildlife and their habitats; and,

(5) improve the ability to predict and resolve effects locally, regionally, and nationally.

The Service encourages project proponents to use the process described in these draft voluntary Land-based Wind Energy Guidelines (draft Guidelines) to address risks to fish and wildlife resources. The Service intends that these draft Guidelines, when used in concert with the appropriate regulatory tools, will be the best practical approach for conservation of species of "**Federal trust responsibility."**

1. History and Purpose

Climate change may be one of the greatest challenges the Service has ever faced in conserving "**fish, wildlife**," and their "**habitats**." Energy conservation, product recycling and reuse, and other ways of reducing our "footprint" on the land are necessary for the health of the planet's "**ecosystems.**" The Service believes exploring alternative energy sources (i.e., renewable vs. fossil fuel) will, in part, play an important role in addressing these complex conservation issues. However, a project's potential contribution to one aspect of ecosystem health (e.g., air quality) should not be at the expense of other aspects of the ecosystem. The Service supports the development of wind power as an alternative energy source; however, wind energy facilities can have negative "**effects**" on fish, wildlife, and their habitats. With proper diligence paid to siting, operations, and management of projects, it is possible to mitigate for some of the "**adverse"** effects to fish, wildlife, and their habitats. This is best accomplished through early coordination with the Service and other stakeholders. Such coordination should occur prior to any financial obligation or finalization of lease agreements to allow for the greatest range of development and "**mitigation**" options.

In July 2003, the Service released for public comment a set of voluntary, interim guidelines to assist developers in avoiding, minimizing, and/or compensating for effects to fish, wildlife, and their habitats related to land-based, wind energy facilities. Following an extended public comment period and review of public comments, the Secretary of the Interior (Secretary) established the Wind Turbine Guidelines Advisory Committee (Committee) under the Federal Advisory Committee Act. After more than two years of deliberations, the Committee submitted its final recommendations to the Secretary on March 4, 2010. The Service then convened an internal working group to review the Committee's recommendations. The working group decided to use the recommendations as a basis to develop the Service's draft wind energy Guidelines. These draft Guidelines describe the information needed to identify, assess, mitigate, and monitor the potential adverse effects of wind energy projects on fish, wildlife, and their habitats, using a consistent and predictable approach, while providing flexibility to accommodate the unique circumstances of each project.

Understanding how to "**avoid"** or "**minimize**" effects to certain species is important for compliance with a number of wildlife statutes including the Migratory Bird Treaty Act, the Bald and Golden Eagle Protection Act, and the Endangered Species Act. While adherence to these draft Guidelines demonstrates a good faith effort to develop and operate projects consistent with relevant wildlife laws, it does not provide authorization to "**take**" (see Glossary, Appendix A, for all definitions) fish and wildlife under any applicable statute. If take is expected to occur, and if appropriate authorization is available under the applicable statute, the developer should obtain that authorization; if appropriate authorization is not available, the developer should avoid take.

These draft Guidelines are intended to promote compliance with relevant wildlife laws and statutes; encourage scientifically rigorous survey, "**monitoring**," assessment, and research designs proportionate to the "**risk**" to "**affected species**"; produce potentially comparable data across the Nation; facilitate potential analyses of trends and patterns of effects at multiple sites; and ultimately improve the ability to predict and resolve effects locally, regionally, and nationally. The Service encourages project proponents to use the process described in these draft voluntary Guidelines to address risks to fish and wildlife resources.

Founded upon a "tiered approach," the draft Guidelines present an iterative decision making process for collecting information in increasing detail; analyzing the possible risks of proposed wind energy projects to fish, wildlife, and their habitats; and evaluating those risks to make siting, construction, and operation decisions. Subsequent tiers refine and build upon issues raised and efforts undertaken in previous tiers. At each tier, a set of questions is provided to help the developer identify potential problems associated with each phase of a project, and to guide its decision process. The tiered approach is designed to assess the risks of project development by formulating questions that relate to site-specific conditions regarding potential effects to species and habitat.

Additionally, these draft Guidelines provide "**best management practices**", best available technologies, and mitigation recommendations to address interactions between wind energy development and affected species. Following these draft Guidelines should result in greater certainty for wind energy developers, may expedite permitting by authorities, and may help demonstrate compliance to assure funding sources. Using the draft Guidelines may also result in

greater certainty for the public. The common metrics outlined in these draft Guidelines should also help ensure access to data, allowing for the development of a central repository that can be used to conduct regional- and landscape-scale analyses.

2. Scope

The draft Guidelines are designed to be used by all utility- and "**community-scale**" land-based wind energy projects to reduce potential impacts to fish and wildlife, regardless of whether they are proposed for private or public lands. While the Guidelines are designed to address wind energy projects at any scale, all wind project proponents, including those projects with anticipated very low levels of risk, are encouraged to coordinate early with the Service to determine the applicability of all tiers given site-specific conditions. The Service will work with "community-scale" wind turbine proponents to accommodate the application of the guidance for small proposals with anticipated very low levels of risk. Offshore wind energy projects may involve another suite of effects and analyses not addressed here.

The Service considers a "**project**" to include all phases of wind energy development, including, but not limited to, prospecting, site assessment, construction, operation, and decommissioning, as well as all associated infrastructure and interconnecting electrical lines. A "**project site**" is the land and airspace where development occurs or is proposed to occur, including the turbine pads, roads, power distribution and transmission lines on or immediately adjacent to the site; buildings and related infrastructure, ditches, grades, culverts; and any changes or modifications made to the original site before develop occurs. Airspace, including existing or proposed "**rotor-swept areas**," should be considered as part of the project site. This includes the space between the actual infrastructures. Project evaluations should consider all potential effects to fish, wildlife, and their habitats, collectively referred to as "**affected resources**."

Evaluations should also take into account measures to reduce adverse effects, such as those occurring from electrical lines as outlined in the Avian Power Line Interaction Committee Best Practices (1994, 2006, 2010 final draft) for collision and electrocution, and Service lighting guidance (Service Wind Energy website: http://www.fws.gov/windenergy). "**Mitigation**" includes actions to avoid, minimize, and/or compensate for adverse effects resulting from a project. "**Compensation,**" as part of mitigation, is the replacement or offsetting of project induced losses to fish and wildlife resources. The "**area of influence**" is a three dimensional area that includes the project site, and the area of potential "**direct"** and "**indirect effects"** of the project (See Figure 1). These draft Guidelines are not designed to address power transmission beyond the point of interconnection to the transmission system.

3. Implementation of draft Guidelines

The Service recommends the use of these draft Guidelines at the earliest planning stage of proposed projects to ensure early consideration of avoidance and minimization of effects to wildlife and to address requirements of the ESA, MBTA, and BGEPA. For projects already in the development or operational phase, implementation of all levels of the recommended tiered approach may not be applicable. The Service recommends that existing projects implement those portions of the draft Guidelines relevant to the continuing phases of the project in

coordination with the Service. Projects already in operation should adhere to recommendations in Tier 4 and Tier 5.

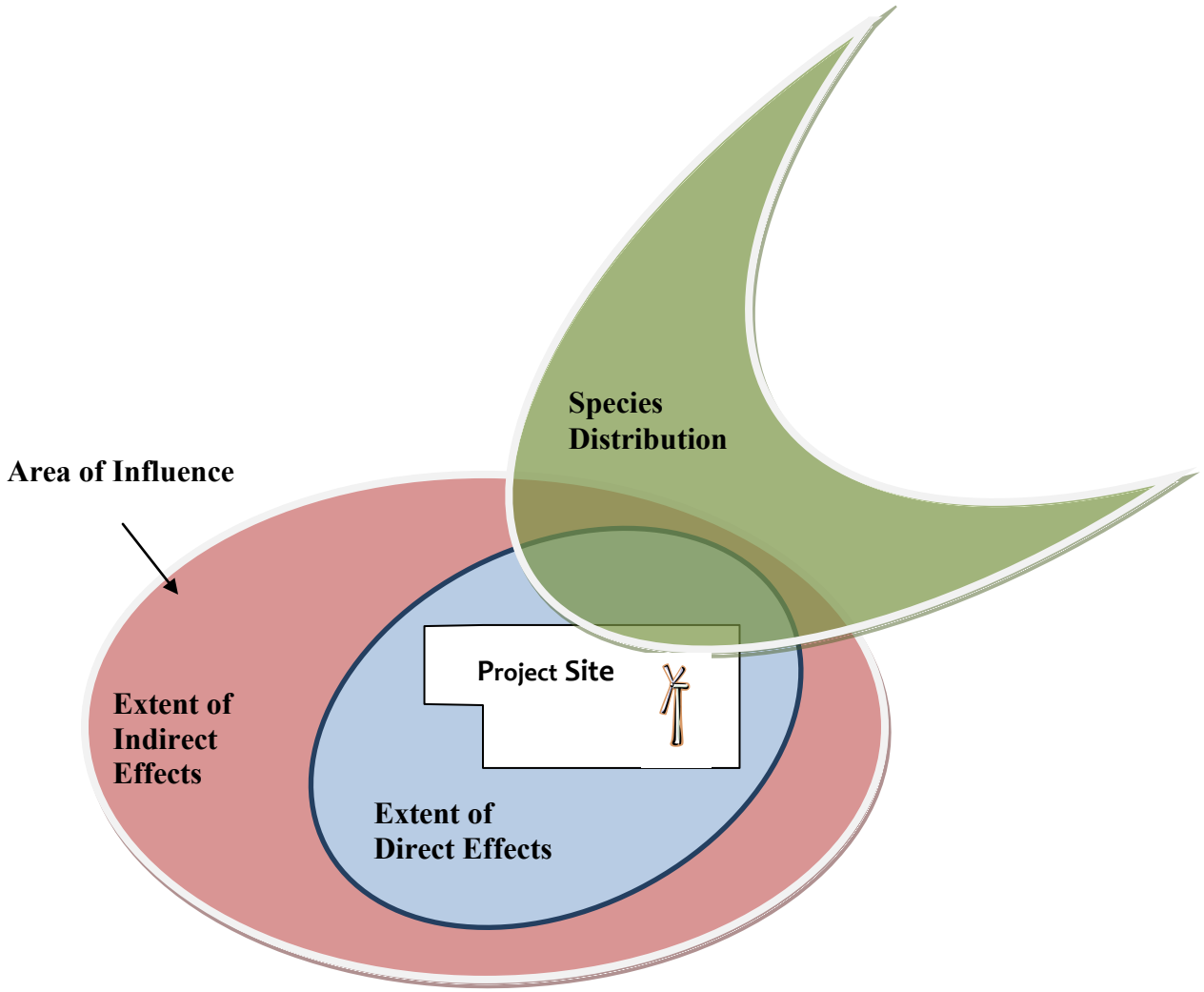
Questions that arise within each tier can be addressed though regular coordination among Service Field Office personnel, wildlife consultants, developers, conservation organizations, and other relevant jurisdictional entities. Implementation of these draft Guidelines may best be accomplished through development of Avian and Bat Protection Plans (ABPP) or similar plans that highlight an adaptive approach to reduce the operational risks resulting from bird and bat interactions with a wind energy facility.

A benefit of following the approach recommended in these draft Guidelines is that in the event of later adverse environmental effects, the developer will be able to demonstrate that it adhered to these draft Guidelines, communicated with Service, and considered the advice of the Service in project siting, construction and operation (see Authorities Under the Law below).

For future projects**,** voluntary adherence and communication means that the developer has applied these draft Guidelines, including the tiered approach, through site selection, design, construction, operation and post-operation phases of the project, and has communicated with Service and followed its advice to the maximum extent practicable.

For existing project or projects under development when the draft Guidelines are published, voluntary adherence and communication means that the developer has communicated with Service and can produce records that demonstrate that it has applied recommendations of the tiered approach relevant to remaining activities of the project and/or implemented "**adaptive management**" to incorporate recommendations of these draft Guidelines into the project. Such projects should have incorporated the best available guidance at the time (see Authorities Under the Law below).

Figure 1. Theoretical diagram showing areas and possible relationships between them.



B. POTENTIAL RISKS TO FISH, WILDLIFE, AND THEIR HABITATS

In order to understand and follow these draft Guidelines, it is important to have a basic understanding of the potential for species and habitats to be affected by wind energy development. For a discussion of such effects, please refer to the Service Wind website. There is no substitute for conferring with experts and resource agency staff with an understanding of the pertinent species, habitats, and literature on effects, surveying and monitoring techniques, and relevant conservation measures.

Siting of a wind energy project is the most important element in avoiding effects to species and their habitats. The Service recommends that developers carefully investigate sites at the landscape as well as local scale to determine whether there is a risk of direct or indirect effects to species and their habitats. Direct effects include blade strikes, barotrauma, loss of habitat, and "**displacement**". Indirect effects occur later in time and include introduction of invasive vegetation that result in alteration of fire cycles; increase in predators or predation pressure; decreased survival or reproduction of the species; and decreased use of the habitat that may result from effects of the project or resulting "**habitat fragmentation**."

1. Factors to Consider When Assessing Effects

Several factors should be considered to assess the potential effects to various species. First, the potential for presence of the species in the area of influence during the life of the project should be considered. Assessing species use from databases and site characteristics is a potential first step; however, it can be difficult to assess potential use by certain species from site characteristics alone. Various species in different locations may require developers to use specific survey protocols or make certain assumptions regarding presence. Seek local wildlife expertise, such as Service Field Office staff, in using the proper procedures and making assumptions.

Species that are rare or cryptic; that migrate, conduct other daily movements, or use areas for short periods of time; that are small in size or nocturnal; or that have become extirpated in parts of their historical range will present particular challenges when trying to determine potential presence. One of these challenges is "**migration**," broadly defined as the act of moving from one spatial unit to another (Baker 1978), or as a periodic movement of animals from one location to another. Migration is species-specific, and for birds and bats occurs throughout the year. Such movements should be considered for all potentially affected species, including flying insects and species that migrate on the ground.

Developers should conduct monitoring of potential sites to determine the types of migratory species present, what type of spatial and temporal use these species make of the site (e.g., chronology of migration or other use), and the ecological function the site may provide in terms of the migration cycle of these species. Wind developers need to determine not only what species may migrate through a proposed development site and when, but also whether a site may function as a staging area or stopover habitat for wildlife on their migration pathway.

For some species, movements between foraging and breeding habitat, or between sheltering and feeding habitats, occur on a daily basis. Consideration of daily movements (morning and evening; coming and going) is a critical factor when considering project development.

Once likely presence has been determined or assumed, determine level of exposure regarding various risk factors, including abundance, frequency of use, habitat use patterns, and behavior. Finally, consider and/or determine the consequences to the "**populations**" and species. Below is a brief discussion of several types of risk factors that should be considered. This does not include all potential risk factors for all species, but addresses the most common ones.

a. Collision and Barotrauma

The Service is concerned about effects to birds and bats from collisions and barotrauma caused by moving blades and wind wake turbulence. Collision likelihood for individual birds and bats at a particular wind energy facility may be the result of complex interactions among species distribution, "**relative abundance**," behavior, visibility, weather conditions, and site characteristics. Collision likelihood for an individual may be low regardless of abundance if its behavior does not place it within the "**rotor-swept zone**." Individuals that frequently occupy the rotor-swept zone but effectively avoid collisions are also at low likelihood of collision with a turbine.

Alternatively, if the behavior of individuals frequently places them in the rotor-swept zone, and they do not actively avoid turbine blade strikes, they are at higher likelihood of collisions with turbines regardless of abundance. Some species, even at lower abundance, may have a higher collision rate than similar species due to subtle differences in their ecology and behavior. At many projects, the numbers of bat fatalities are higher than the numbers of bird fatalities, but the exposure risk of bats at these facilities is not fully understood. Researchers (Horn et al. 2008 and Cryan 2008) hypothesize that some bats may be attracted to turbines, which, if true, would further complicate estimation of exposure. A recent study (Long et al. 2010) found certain colors attracted significantly more insects, suggesting turbine color may play a role in potential effects to insect-eating birds and bats. Further research is required to determine whether bats are attracted to turbines and if so, whether this increased individual risk translates into higher population-scale effects.

Along with the observed direct fatalities from barotrauma, there may be lesser injuries, such as hearing impairment and other internal injuries that may allow the bats to fly or otherwise move away from the vicinity but would ultimately result in their death (Kozuka et al 1997). As a result, estimates of bat fatalities from carcass searches may underestimate total fatalities.

b. Barrier Effects

"Barrier effects" can occur when a species' avoidance of a wind facility results in decreased movement or an increase in energy use to circumvent the facility (Goodale and Divoll 2009). Avoidance of the area may also occur as the result of noise or habitat loss due to construction of roads and other structures associated with facility development (Fox et al. 2006). The level of barrier effect depends on species, turbine layout, size of wind facility, season, and the species'

ability to compensate for losses in energy due to avoidance, among other variables (Langston and Pullan 2003; Fox et al. 2006). Though population-scale effects currently have not been documented, scientists are concerned that "**barriers**" between breeding and feeding areas may have significant effects (Fox et al. 2006; Goodale and Divoll 2009; Drewitt and Langston 2006). The combined barrier effect of multiple wind facilities is also a concern as wind energy development becomes more prevalent (Drewitt and Langston 2006). The barrier effect has been documented fairly extensively in several offshore wind projects (Guarnaccia and Kerlinger 2007) where modified behaviors by various bird species have been recorded at distances of between 100 meters and 3 kilometers from turbine arrays (Drewitt and Langston 2006; Exo et al. 2003; Tulp et al. 1999; Christensen et al. 2004; Kahlert et al. 2005; and Pettersson et al. 2005; Desholm and Kahlert 2005; and Percival 2001).

Barrier effects are related to displacement (see section F). Displacement occurs when a species decreases or discontinues use of an area due to a human activity. For instance, on Kodiak Island, Alaska, eagles discontinued flying over a portion of a ridge once turbine towers had been constructed along that portion of the ridge (Sharp et al. 2010). Pre- and post-construction comparison study of Golden Eagle (*Aquila chrysaetos*) use for a wind facility in Argyll, Scotland, the findings showed that a pair of resident Golden Eagles altered their ranging behavior to avoid the entire wind facility area post-construction, except when intercepting intruding birds (Walker et al. 2005). Although not directly related to displacement resulting from wind projects, a study in Oklahoma (Pruett et al. 2009) found that individuals of greater and lesser prairie-chickens (*Tympanuchus pallidicinctus*) avoided power lines by at least 100 meters.

Movement corridors are important for a variety of reasons: to maintain genetic diversity, retain ecological processes, save populations from "**extirpation**", and possibly provide habitat for the movement of organisms affected by climate change (Chetkiewicz et al. 2006). "**Wind turbines**" and associated transmission lines are likely to be a barrier to movement for some species due to the avoidance of tall structures and human activity (Robel et al. 2004).

c. Habitat Loss and Degradation

Wind project development results in direct habitat loss and habitat modification, especially at sites previously undeveloped. Many of North America's native landscapes are greatly diminished or degraded from multiple causes unrelated to wind energy. Important remnants of these landscapes are identified and documented in various databases held by private conservation organizations, state wildlife agencies, and, in some cases, by the Service. Species that depend on these landscapes are susceptible to further loss of habitat, which will affect their ability to reproduce and survive. While habitat lost due to footprints of turbines, roads, and other infrastructure is obvious, less obvious is the potential reduction of habitat quality.

d. Habitat Fragmentation

Habitat fragmentation separates blocks of habitat for some species into segments, such that the individuals in the remaining habitat segments may suffer from effects such as decreased survival, reproduction, distribution, or use of the area. Site clearing, access roads, transmission lines, and arrays of turbine towers may displace some species or fragment continuous habitat areas into

smaller, isolated tracts. Habitat fragmentation is of particular concern when species require large expanses of habitat for activities such as breeding, foraging, and sheltering.

Habitat fragmentation can result in increases in "**edge"** resulting in direct effects of barriers and displacement as well as indirect effects of nest parasitism and predation. Sensitivity to fragmentation effects varies among species.

Habitat fragmentation and site modification are important issues that should be assessed at the landscape scale early in the siting process. Identify areas of high sensitivity due to the presence of blocks of native habitats, paying particular attention to known or suspected "**species sensitive to habitat fragmentation."**

e. Noise

Turbine blades at normal operating speeds can generate levels of noise beyond ambient background levels. Construction and maintenance activities can also contribute to noise levels by affecting communication distance, an animal's ability to detect calls or danger, or to forage. Noise associated with developments can also cause behavioral and/or physiological effects, damage to hearing from acoustic over-exposure, and masking of communication signals and other biologically relevant sounds (Dooling and Popper 2007). Some birds are able to shift their vocalizations to reduce the masking effects of noise. However, when shifts don't occur or are insignificant, masking may prove detrimental to the health and survival of wildlife (Barber et al. 2010). Data suggest noise increases of 3 dB to 10 dB correspond to 30 percent to 90 percent reductions in alerting distances for wildlife, respectively (Barber et al. 2010).

Noise effects to wildlife should be included as a factor in wind turbine siting and operation. This includes an understanding: of how wind facilities affect background noise levels and elevate noise levels above background; how and what masking, disturbance, and acoustical fragmentation occurs; turbine noise levels and construction and maintenance noise levels in all topographic areas; and, day and night ambient and turbine noise levels. Measurements should be **"frequency weighted"** for fish and wildlife species. Refer to the Service Wind Energy website for more information about effects of noise to wildlife.

f. Displacement and Behavioral Changes

Estimating displacement risk requires an understanding of animal behavior in response to a project and its infrastructure and activities, and a pre-construction estimate of presence/absence of species whose behavior would cause them to avoid or seek areas in proximity to turbines, roads, and other components of the project. Displacement is a function of the sensitivity of individuals to the project and activity levels associated with operations.

g. Indirect Effects

Wind development can also have indirect effects to wildlife and habitats. Indirect effects include reduced nesting and breeding densities and the social ramifications of those reductions; loss or modification of foraging habitat; loss of population vigor and overall population density;

increased isolation between habitat patches, loss of habitat refugia; attraction to modified habitats; effects on behavior, physiological disturbance, and habitat unsuitability. Indirect effects can result from introduction of invasive plants; increased predator populations or facilitated predation; alterations in the natural fire regime; or other effects, and can manifest themselves later in time than the causing action.

2. Considerations at the Population Scale

Mortality due to collisions may significantly contribute to the decline of a population that is already under stress, incurs high mortality, or has poor reproductive success. Assessing population-scale effects may not be as simple as assessing effects to individuals of a species. Population-scale significance of decreases in useable habitat (through habitat loss, degradation, fragmentation, or displacement) can be complicated and depend on the amount of habitat available to the affected population. If the loss of habitat results in habitat fragmentation, the risk to the demographic and genetic viability of the isolated animals is increased. The main causes of population change will likely come from effects to a species reproduction, survival, or distribution (e.g., reduced utilization of habitats).

3. Considerations for Monitoring and Assessment

The most current and appropriate protocols should be used to determine potential species presence, including use of the area of influence and the nature of that use (e.g., resident, "**migration stopover**," foraging). Various methods to avoid, minimize, and/or compensate for adverse effects will have different levels of certainty. Similarly, different sites, species, and habitats will have different levels of inherent risk. Monitoring may need to be developed or adapted on a site-specific and species-specific basis, but it should be as standardized as possible so that the data will be as comparable as possible for regional or continent-wide analyses. For instance, in order to truly understand the effects of multiple wind energy developments on fish, wildlife, and their habitats, a larger "**cumulative effects**" analysis may be necessary. Monitoring should be designed to support the adaptive management decision-making/assessment process.

4. Considerations for Mitigating

After assessing potential risk from exposure to various factors (e.g., collision, habitat loss, displacement) and portions of a project (e.g., turbines, roads), the developer should take appropriate steps to avoid or minimize effects. In some specific cases, compensation may be appropriate to consider in lieu of avoidance and minimization of effects; in other cases, avoidance is a statutory requirement and is typically the preference of the Service. When used, compensation must be commensurate with the effects anticipated. When substantial uncertainty exists, research and adaptive management may assist with mitigating project effects after development. The set of mitigation measures used (including various forms of avoidance, minimization, and/or compensation) should be appropriate for the affected resources and the anticipated level of effects and uncertainty.

C. RELATIONSHIP TO OTHER GUIDELINES

These draft Guidelines replace the Service's 2003 interim voluntary guidelines. The Service intends that these draft Guidelines, when used in concert with the appropriate regulatory tools, will be the best practical approach for conservation of species of "**Federal trust responsibility.**" Other federal, state, tribal and local governments may use these draft Guidelines to complement

their efforts to address wind energy development/fish and wildlife interactions. They are not intended to supplant existing regional or local guidance, or landscape-scale tools for conservation planning, but were developed to support efforts to provide a means of compliance with Service regulatory statutes. The Service will continue to work with states, tribes, and other local stakeholders on map-based tools, decision-support systems, and other products to help guide future development and conservation. Project proponents should utilize the appropriate jurisdictional entities' guidance, which will depend on the species and resources potentially affected by proposed developments.

1. Authorities under the Law

These draft Guidelines are not intended nor shall they be construed to limit or preclude the Service from exercising its authority under any law, statute, or regulation, or from conducting enforcement action against any individual, company, or agency. They are not meant to relieve any individual, company, or agency of its obligations to comply with any applicable federal, state, tribal, or local laws, statutes, or regulations.

Ultimately it is the responsibility of those involved with the planning, design, construction, operation, maintenance, and decommissioning of wind projects to conduct relevant fish, wildlife, and habitat evaluation (e.g., siting guidelines, risk assessment, etc.) and determine, which, if any, species may be affected. The results of these analyses will inform all efforts to achieve compliance with the appropriate jurisdictional statutes. Project proponents are responsible for complying with applicable state and local laws.

Consideration of the draft Guidelines in MBTA and BGEPA Enforcement

The Service urges voluntary adherence to the draft Guidelines and communication with Service when planning and operating a facility. Service will regard such voluntary adherence and communication as evidence of due care with respect to avoiding, minimizing, and mitigating adverse impacts to species protected under the MBTA and BGEPA, and will take such adherence and communication fully into account when exercising its discretion with respect to any potential referral for prosecution related to the death of or injury to any such species. Each developer will be responsible for maintaining internal records sufficient to demonstrate adherence to the draft Guidelines. Examples of these records could include: studies performed in the implementation of the tiered approach; an internal or external review or audit process; an Avian and Bat Protection Plan; or a wildlife management plan. Service retains its existing authority to inspect and assess the sufficiency of those records.

2. Avian and Bat Protection Plans

A project-specific Avian and Bat Protection Plan (ABPP) documents the steps a developer takes to avoid and minimize effects to birds and bats, and (if applicable) documents compensation measures taken and incorporates adaptive management. Typically, a project-specific ABPP will document the analyses, studies, and reasoning that support progressing from one tier to the next in the tiered approach described in these draft Guidelines. Often, an ABPP will be developed in stages, over time, as analysis and studies are undertaken for each tier. It will also address the

post-construction monitoring efforts for mortality and habitat effects, and may use many of the components suggested in the APLIC and Service Avian Protection Plan Guidelines.

3. Eagles

Because both bald eagles (*Haliaeetus leucocephalus*) and golden eagles are protected under BGEPA, the new permit regulations apply to golden eagles as well as bald eagles. 50 CFR 22.26 allows take of both species of eagles (including disturbance and limited "take resulting in mortality"), and 50 CFR 22.27 would allow the take of nests of both species for eagle and human health and safety reasons, and in other limited circumstances.

Under section 22.26, the take of an eagle refers to the non-purposeful disturbance, wounding or killing of eagles that are associated with but not the purpose of an activity, such as the construction and operation of a wind facility. Based on the overall goal of maintaining stable or increasing breeding populations of both species, "take" can only be authorized when it is compatible with the preservation of bald eagle and golden eagle populations.

Both regulations include provisions for "programmatic take," defined under 50 CFR 22.3 as "take that is recurring, is not caused solely by indirect effects, and that occurs over the long term or in a location or locations that cannot be specifically identified." Programmatic take permits under sections 22.26 and 22.27 may be issued only where take is unavoidable despite implementation of Advanced Conservation Practices developed in cooperation with the Service. ACPs are scientifically supportable measures that are approved by the Service and represent the best available techniques to reduce eagle disturbance and ongoing mortalities to a level where remaining take is unavoidable.

As of December 2010, the Service is only considering golden eagle take permits for safety emergencies, programmatic permits, and any other permits that will result in a reduction of ongoing take or a net take of zero because of concerns regarding population declines of golden eagles across the four large Bird Conservation Regions in the West. The same standards apply to the bald eagle in the Sonoran Desert, where the bald eagle continues to be listed under the ESA.

All permit applicants must provide documentation that they have included all practicable avoidance and minimization measures in their planning. "Practicable" is defined in the 50 CFR Part 22 as "capable of being done after taking into consideration, relative to the magnitude of the impacts to eagles, the following three things: the cost of remedy compared to proponent resources; existing technology; and logistics in light of overall project purposes." Additional information can be found in the 50 CFR Part 22 and Final Environmental Assessment, Proposal to Permit Take Provided Under the Bald and Golden Eagle Act.

The draft Eagle Conservation Plan Guidance was created to be compatible with the more general these draft Guidelines. However, because the draft Eagle Conservation Plan Guidance describes actions necessary or recommended to comply with the regulatory requirements in the BGEPA for an eagle take permit as described in 50 CFR 22.26, they are more specific in nature. The Eagle Conservation Plan Guidance is intended to provide a national framework for assessing and mitigating risk specific to eagles through development of Eagle Conservation Plans.

4. Federal Projects

Some projects may require federal authorization or funding to proceed with development. In these cases where the prospective developer requires federal authorization or funding to proceed, the "**lead federal agency"** may recommend the developer incorporate these draft Guidelines into the project design.

Federal agencies are bound by their own agency-specific statutes, as well as, by the MBTA, BGEPA, ESA, Executive Orders such as EO 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds", and the National Environmental Policy Act. These draft Guidelines should be viewed as complementary to other federal law and policy that may direct information collections and considerations in siting projects. The Service is available to assist other federal agencies and project proponents in integrating these draft Guidelines into the project design.

D. INTRODUCTION TO THE TIERED APPROACH

The draft Guidelines follow a tiered approach, an iterative process for evaluating the risks and minimizing the effects of a wind energy development project to fish, wildlife and their habitats. The tiered approach provides a framework for collecting information in increasing detail to evaluate risk and make siting and operational decisions. This approach allows efficient use of developer and wildlife agency resources with increasing levels of effort until sufficient information and the desired accuracy and precision are acquired for the risk assessment.

The tiered approach is designed to lead to the appropriate amount of evaluation in proportion to the anticipated level of risk. Duration and intensity of "**monitoring"** and assessment and research plans should be tailored to the unique characteristics of each site and the corresponding potential for adverse effects to resources as determined through the tiered approach. In particular, the risk of adverse effects to resources tends to be a function of site location as well as the size of the project. A small project in a sensitive location may pose greater risk to resources than a larger site in a less sensitive location, and would therefore require more pre- and post-construction surveys, monitoring, and research than the larger site. This is why the tiered approach begins with an examination of the potential location of the project, not the size of the project. In all cases, data collection plans and selection of appropriate methods and techniques should be tailored to the relative scale, location, and potential for adverse effects of the proposed site.

1. Application of the Tiered Approach and Possible Outcomes

Figure 2 illustrates the tiered approach, which consists of up to five iterative stages, or tiers:

Tier 1 – Preliminary evaluation or screening of potential sites
Tier 2 – Site characterization
Tier 3 – Pre-construction monitoring and assessments
Tier 4 – Post-construction monitoring of effects
Tier 5 – Research

At each tier, potential issues associated with developing or operating a project are identified and questions formulated to guide the decision process. This document outlines the questions to be

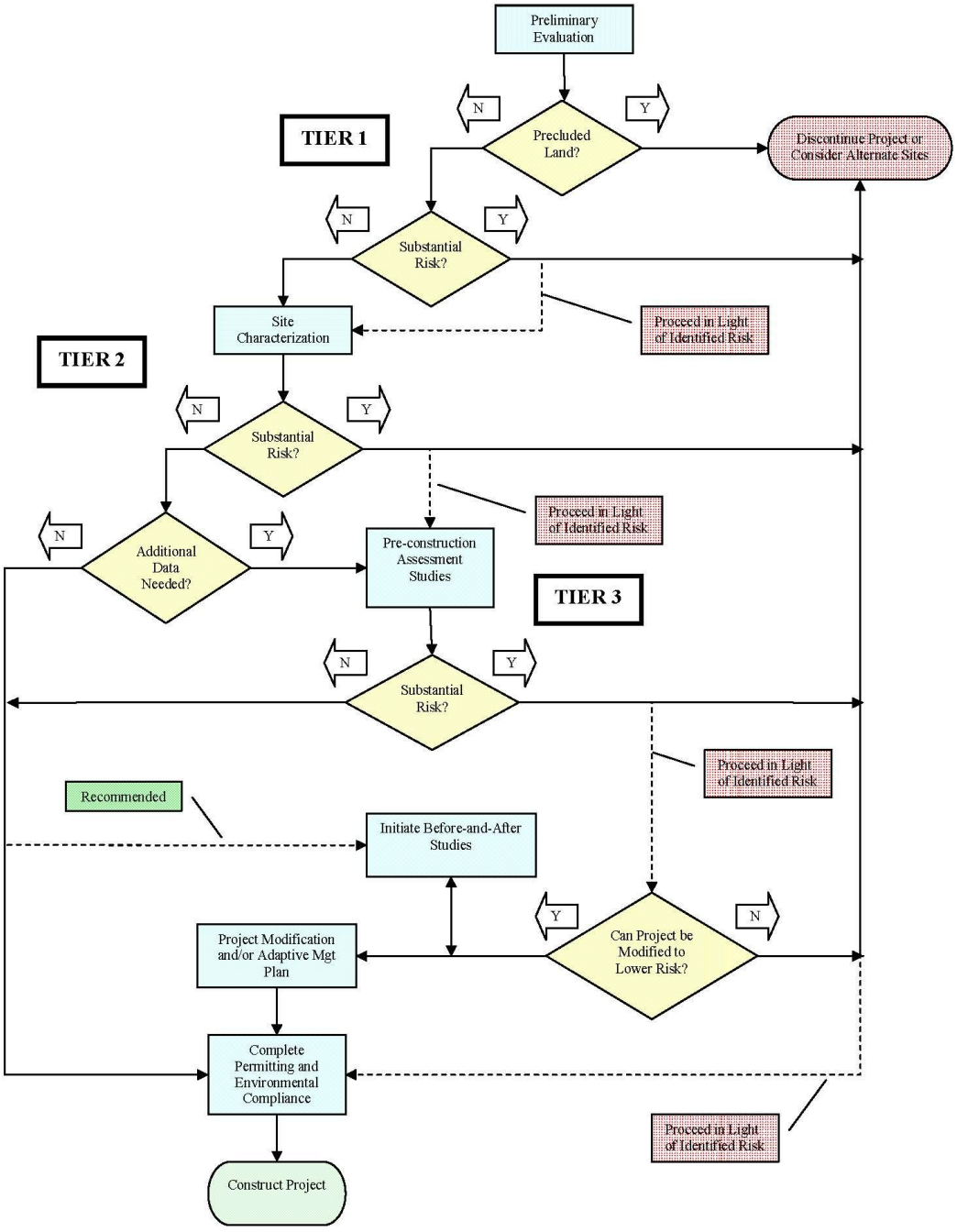
posed at each tier, and describes recommended methods and metrics for gathering the data needed to answer those questions.

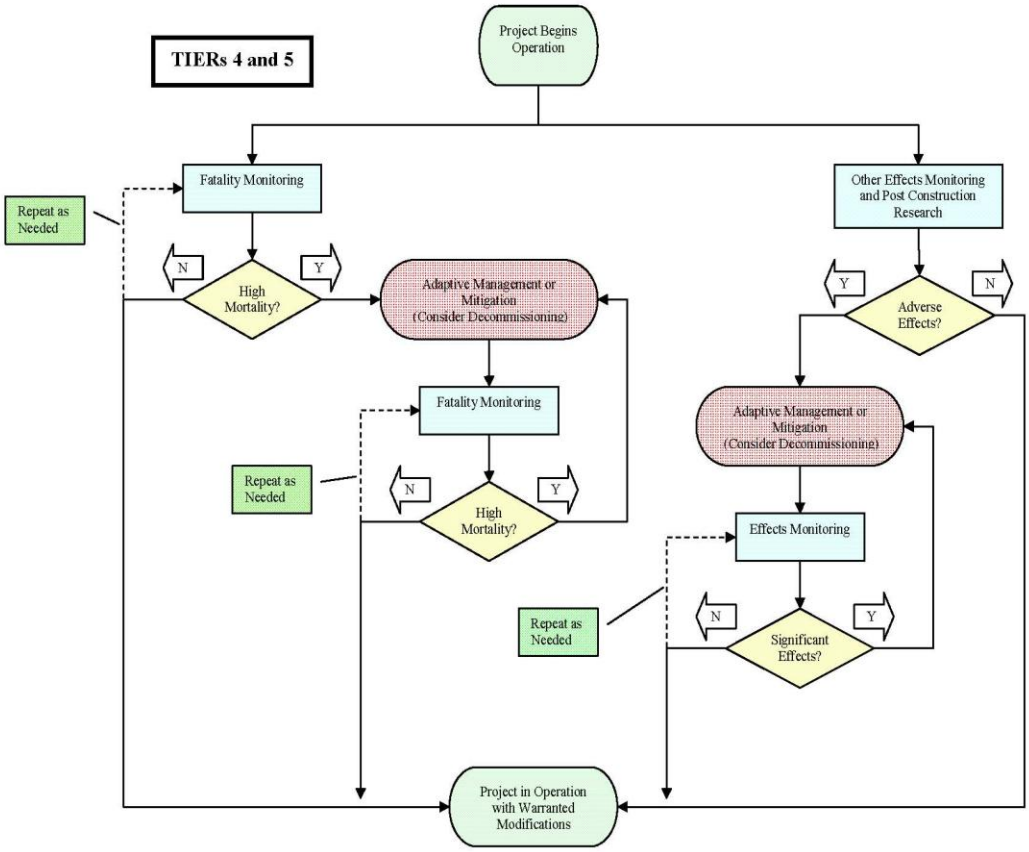
If sufficient data are available at a particular tier, the following outcomes are possible based on analysis of the information gathered:

1. The project is abandoned because the risk is considered unacceptable.
2. The project proceeds in the development process as designed without additional data collection.
3. The project proceeds with project modification and additional data collection.

If data are insufficient during pre-construction tier assessments, the project proponent should collect additional data before starting construction.
If, for example, adequate data are available from monitoring or assessments of the site being evaluated or from nearby sources, additional assessments may be unnecessary. A reduced level of survey effort may be warranted for certain projects, such as "**infill**" development, projects with low potential risk for adverse effects, some repowering projects, or projects contiguous to existing low-effect wind energy facilities – provided these projects have sufficient credible information regarding effects. In any case, existing data should be reviewed by interested federal, state, local, and tribal agencies to determine the adequacy of the information. After coordination with the relevant agencies, additional analyses may not be necessary if a species is unlikely to be present or is present but adverse effects are unlikely.

Figure 2. Decision Tree for Tier Approach




TIERs 4 and 5
Project Begins Operation
Fatality Monitoring
Repeat as Needed
N
High Mortality?
Y
Adaptive Management or Mitigation (Consider Decommissioning)
Fatality Monitoring
Repeat as Needed
N
High Mortality?
Y
Other Effects Monitoring and Post Construction Research
Y
Adverse Effects?
N
Adaptive Management or Mitigation (Consider Decommissioning)
Effects Monitoring
Repeat as Needed
N
Significant Effects?
Y
Project in Operation with Warranted Modifications

2. Application of the Tiered Approach and Risk Assessment

The Service is concerned about limited data being used to make long-term assumptions on effects. Limited data may not be representative of future years because data was collected during seasons with extremes in weather conditions, or due to changes brought about by global climate change or changes in species distribution. When uncertainty exists as to whether an action has risk of causing negative effects to species or habitats, the burden of proof that an action is not harmful falls on those taking the action. Planning, design, and operation decisions should be made considering such uncertainties and risk, and in a manner that strives to avoid or minimize the risk of adverse effects on resources, rather than delaying decisions until all necessary data are available. In cases of uncertainty regarding risks to wildlife, project planning and development should proceed with appropriate consideration for conservation of the species concerned, and implement measures commensurate to the potential risks to the species.

Risk can be defined by two factors. The first is the likelihood that adverse direct and indirect effects will occur to individuals or populations. The second is the consequences/severity of those adverse effects. Each project site varies in species composition, wind technology used, topographical setting, weather patterns, and other factors that make comparisons extremely difficult.

Risk assessment should incorporate sufficient data to estimate exposure and predict effects for individuals and their habitats for the potentially affected species, with what is known about the population status of these species. This should be accomplished in communication with the relevant wildlife agency and industry wildlife experts.

Predicting risk may help determine appropriate mitigation measures, if they are necessary. In the tiered approach, risk assessments conducted in Tiers 1 and 2 require less information to reach a risk-based decision than those conducted at subsequent tiers. In Tier 1, the assessments are coarse and are conducted at the landscape scale.

Assessing potential wind development sites at the landscape scale is important for various reasons. Performing a Tier 1 review may offer early guidance about the sensitivity of a site within its larger landscape context. A careful review of a landscape may help a developer avoid sites with a potential for high risk to species and habitat resulting in more intensive pre-construction assessments or increased mitigation requirements. Discussions with federal, state, tribal, and/or local agencies in a region being considered for development can facilitate better collection and interpretation of information and result in a better Tier 1 process, likely benefitting the project proponents. Where concerns about effects are discovered, specific high-risk sites or even high-risk landscapes should be avoided.

In Tier 2, assessments focus on one or more potential sites, including the possible areas of influence for those sites. Tier 2 should involve sufficient site visits to verify information found during Tier 1, on maps, and in databases. Tier 2 will help inform developers regarding the type of data to collect in Tier 3.

Tier 3 generally focuses on a specific prospective site and its area of influence, includes site-specific data collection to assess potential risk, and may also include data collection and assessment that will continue into and through Tiers 4 and 5. Any Before- After studies should be initiated during Tier 3.

The Service Wind Energy website has current information to help a developer understand which survey methods may be most appropriate for a given site and species or habitats, including whether permits are needed and other relevant information. Risk-assessment tools useful during the first three tiers include recognized methods for understanding migration patterns, passage rates, and local distribution of birds and bats. Methods may include visual or acoustic observation protocols that involve low or high levels of technology, handling individuals of the species, or other techniques. Each set of techniques has advantages and disadvantages that are important to understand.

Tiers 4 and 5 involve post-construction monitoring and research. Collecting information following construction will help verify assumptions and inform future projects and adjustments. For instance, in the event additional turbines are proposed for an existing project, results from Tier 4 and 5 data collection and the decision-making framework in the tiered approach can be used to determine whether the project should be expanded and whether additional information should be collected. It may also be necessary to evaluate whether additional measures are warranted to reduce adverse effects to species.

Research projects may occur at the same time as project-specific Tier 3 and 4 data collection. It is important during Tier 2 to anticipate the need for research in subsequent tiers, as certain research designs will require access to the site and initiation of work as early as Tier 3. Much uncertainty remains about predicting risk and estimating effects of wind energy development on wildlife. Additional research is needed to improve science-based decision making regarding siting wind energy facilities, evaluating effects on wildlife and habitats, and testing the efficacy of mitigation measures. More-extensive studies are needed to further determine patterns and test hypotheses regarding possible solutions to wildlife and wind energy effects.

Research may be undertaken collaboratively with appropriate stakeholders, and is generally not the sole or primary responsibility of any single developer. However, in some cases, project-specific research may be needed or recommended. Research partnerships involving diverse players will be helpful for generating common goals and objectives and adequate funding to conduct studies. Monitoring and research should be designed and conducted to ensure unbiased data collection.

It is in the interests of wind developers and wildlife agencies to improve research to better avoid, minimize, or compensate for the effects of wind energy development on wildlife and their habitats. Research to improve predictions and align pre-construction risk with estimates of post-construction effects is a high priority. Research can provide data on operational factors (e.g., wind speed, wind wake, blade tip vortices, and weather conditions) that are likely to result in fatalities. It could also include studies of "**cumulative effects**" of multiple wind energy projects, or comparisons of different methods for assessing avian and bat activity relevant to predicting

risk. It may also be necessary to evaluate whether additional measures are warranted to reduce adverse effects to species, or to inform the adaptive-management process.

3. Applicability of Adaptive Management

Adaptive management is an iterative learning process producing improved understanding and improved management over time (Williams et al 2007). The Department of the Interior determined that its resource agencies, and the natural resources they oversee, could benefit from adaptive management. Use of adaptive management in the DOI is guided by the DOI Policy on Adaptive Management. DOI adopted the National Research Council's 2004 definition of adaptive management, which states:

> Adaptive management [is a decision process that] promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a 'trial and error' process, but rather emphasizes learning while doing. Adaptive management does not represent an end in itself, but rather a means to more effective decisions and enhanced benefits. Its true measure is in how well it helps meet environmental, social, and economic goals, increases scientific knowledge, and reduces tensions among stakeholders.

This definition gives special emphasis to uncertainty about management effects, iterative learning to reduce uncertainty, and improved management as a result of learning.

When using adaptive management, project proponents will generally select several alternative management approaches to design, implement, and test. The alternatives are generally incorporated into sound experimental designs. Monitoring and evaluation of each alternative helps in deciding which alternative is more effective in meeting objectives, and informs adjustments to the next round of management decisions.

For adaptive management to be effective there must be agreement to adjust management and/or mitigation measures if monitoring indicates that goals are not being met. The agreement should include a timeline for periodic reviews and adjustments as well as a mechanism to consider and implement additional mitigation measures as necessary after the project is developed. The Service recommends use of adaptive management. The use of adaptive management should be discussed among the project proponent, Service field office, and the state wildlife agency. The DOI Adaptive Management Technical Guide is located on the web at: www.doi.gov/initiatives/AdaptiveManagement/index.html.

OTHER ELEMENTS OF THE DRAFT GUIDELINES

1. Use of Mitigation Policies and Principles

It is important to understand the development activities, species affected, applicable statutes, and opportunities available in order to ensure proper conservation measures are being applied. Several tools are available to determine appropriate mitigation, including the Service Mitigation Policy, which provides a common basis for determining how and when to use different mitigation strategies, and facilitates early consideration of fish and wildlife values in planning of wind energy projects. Chapter 6 in these draft Guidelines includes additional information regarding the use of mitigation and elements considered by the Service during mitigation development. Wind energy developers also should consult with appropriate state, tribal, and local agencies to ensure compliance with their mitigation requirements.

2. Confidentiality of Site Evaluation Process as Appropriate

Some aspects of the initial pre-construction risk assessment, including preliminary screening and site characterization, occur early in the development process, when land or other competitive issues limit developers' willingness to share information on projects with the public and competitors. Any consultation or coordination with agencies at this stage will be held in confidence to the extent allowed by federal law (e.g., Freedom of Information Act) and States may be limited by their respective public-disclosure laws. The Service will to the extent allowable by federal law, treat any information identified by the developer as "confidential business information" as potentially protected from FOIA under exemption 4.

3. Coordination for Issue Resolution

Unresolved concerns under the provisions of these draft Guidelines need to be expeditious and effective. The Service and developers should attempt to resolve any issues arising from use of these draft Guidelines at the Field Office level. Deliberations should be in the context of the intent of these draft Guidelines and be based on the site-specific conditions and the best available data. However, if there is an issue that cannot be resolved within a timely manner at the field level, the developer and Service staff will coordinate to bring the matter up the chain of command in a stepwise manner.

Chapter One

The Tiered Approach for Fish and Wildlife Assessment and Siting Decisions

The following chapters describe in detail the process for each stage of the tiered approach. Additional sections outlining BMPs during site construction, "**retrofitting,"** "**repowering**," and decommissioning phases of a project are included in Appendix D and on the Service's Wind Web site. The developer should communicate early in the tiered approach (e.g., prior to investment, power purchase and landowner agreements) with the Service and other relevant agencies and stakeholders.

The first three tiers correspond to the pre-construction evaluation phase of wind energy development. Tiers 4 and 5 refer to post-construction monitoring, assessments and research. At each of the tiers, these draft Guidelines provide a set of questions that the Service recommends developers attempt to answer, followed by recommended methods and metrics to use in answering the questions. Some questions are repeated at each tier, with successive tiers requiring a greater time and effort in data collection than previous tiers to answer certain questions. For example, while Tier 2 assessments may discover existing information on federal or state "**listed species**" and their use of the proposed development site, it may be necessary to collect empirical data in Tier 3 evaluations to determine the presence of federal or state listed species.

The decision to proceed to the next tier is made by the developer in coordination with the Service. The decision is based on whether all questions identified in the tier have been adequately answered and using methods appropriate for the site selected and the risk posed to affected species and their habitats. Answers indicating little or no risk for all questions in a tier may lead the developer to conclude that the tiered approach may end at a particular tier. Developers are encouraged to coordinate with the Service prior to the decision to end the process at that tier.

A. Tier 1: Preliminary Evaluation or Screening of Potential Sites

Tier 1

For developers taking a first look at a broad geographic area, a preliminary evaluation of the general ecological context of a potential site or sites can help prepare for coordination with federal, state, tribal, and/or local agencies. The first step for developers will likely be to identify and eliminate from consideration those areas that are precluded from development or are inappropriate for development based on high levels of risk to fish, wildlife, and/or their habitats. The Service is available to assist developers to identify potential fish, wildlife, and habitat issues and should be contacted as early as possible in the planning process and prior to any financial commitment or finalization of any lease agreements.

Development on some areas may be precluded or restricted by federal law or regulations (e.g., Congressionally-designated wilderness areas) or by state or local laws and ordinances. This designation is separate from a determination through the tiered approach that an area is not appropriate for development due to feasibility, ecological reasons, or other issues. Developers should consult publicly available databases or other available information during Tier 1 to see if a potential "**wind resource area"** is precluded from development by federal law.

Other areas may be inappropriate for large-scale wind energy development because of their high wildlife value (e.g. ecological rarity and intactness, etc.), based on best available information. For example, these areas include Audubon Important Bird Areas, The Nature Conservancy portfolio sites, priority habitats as identified in state wildlife action plans, areas identified as critical or important for listed species conservation, and areas identified in conservation initiatives or agreements. It is important to identify such areas through the Tier 1 assessments.

Developers should coordinate with private conservation organizations, state wildlife agencies, and the Service specifically about such areas in the vicinity of a prospective project site. Analysis of available sites in the region of interest will be based on a blend of the information available in published and unpublished reports, wildlife range distribution maps, and other such sources. The developer should check with the local Service Field Office about protected land status and biological information.

The Service may also have information on landscape-scale wildlife resources within a wind resource area that will be useful to developers at the conceptual stage of planning. After the initial contact with the Service, and preferably with the appropriate state natural resource agency, the developer should be at the first of several "continue/discontinue" decision points. Depending upon the response from the Service regarding potentially affected fish, wildlife and their habitats, the developer should seriously consider whether the areas being considered, or portions thereof, are appropriate for additional investigation or should be ruled out from further consideration. Part of this decision would include the intensity and duration of pre-construction surveys likely to be necessary, the likelihood that additional studies will support what is already known regarding the site, possible minimization or compensation, and the operational limitations that may be required in order to develop the site (e.g., shutdown or cut-in speeds, addition of avian radar to the facility, etc.) as more fully described in the paragraphs below.

Discussions with federal, state, tribal, and/or local agencies in a region being considered for development can facilitate better collection and interpretation of information and result in a Tier 1 process that will likely benefit the developer.

Assessing the potential effects to species and habitats at the landscape scale is important at Tier 1 because it:

- helps identify regions where wind energy development will pose substantial risk to affected species and/or their habitats, including fragmentation of large-scale habitats as well as threats to regional populations of affected species;

- helps to "screen" landscapes or proposed multiple sites for potential wind development to avoid sites with high habitat values;
- provides evidence that developing a potential site within a landscape may pose a serious risk to an affected species or its habitat.

1. Tier 1 Questions

The following questions help determine where wind development sites should not be constructed. Developers should attempt to answer these questions during Tier 1 assessments. Questions to be considered in Tier 1 include:

1. What fish and wildlife resources are known or potentially present in or near the geographic area under consideration)? Are any areas precluded from development by law or regulation or identified as high value to fish and wildlife and their habitats, according to best available information present in the geographic area under consideration?
2. Are there known or potential areas (within and beyond the geographic area under consideration) of wildlife congregation, including, but not limited to: maternity roosts, hibernacula, staging areas, winter ranges, nesting sites, migration stopovers or corridors, coastal migration drop-out zones, "**leks**" (male display area), or other areas of seasonal importance?
3. Are there areas of "**intact habitat**" in the geographic area under consideration where development would result in habitat degradation, loss or fragmentation, and are there species sensitive to habitat fragmentation?
4. Are there areas identified as critical for the recovery of a listed species, a core population area, or an expansion area of a recovering species within the geographic area under consideration?
5. Are there plant communities of concern present or likely to be present in the geographic area under consideration?
6. Have you contacted relevant agencies?

2. Tier 1 Methods and Metrics

When conducting Tier 1 investigations, developers should be able to use existing public or other readily available landscape-scale maps and databases from sources such as federal, state, local, or tribal wildlife or natural heritage programs, the academic community, conservation organizations, or the developer's or consultant's own information. Analysis of available sites in the area of interest will be based on a blend of the information available in published and unpublished reports, wildlife range distribution maps, and other such sources. Currently available data sources useful for this analysis are listed on Service Wind website. It is recommended that the developer check with the Service Field Office for data specific to the geographic area under consideration.

3. Tier 1 Decision Process

The objective of the Tier 1 process is to help a developer identify areas within the geographic area under consideration where wind energy development would be inappropriate. That is, if high risk sites or high risk landscapes are identified, they should be avoided. We recommend the proponent use the following decision key to determine if development at the landscape scale (and a specific site(s) within that landscape) is appropriate.

If answers to all of the first five questions of the Tier 1 questions are "no" for the sites within the geographic area under consideration, this indicates a low probability of adverse effects to wildlife. Proceed to Tier 2 site characterization and answer the Tier 2 questions with site-specific data to confirm the validity of the preliminary indications of low potential for adverse effect.

If the answer to any of the first five questions is "yes," this indicates a higher probability of adverse effects to fish and wildlife and their habitats. Consider discontinuing the project at the area/site, or identify possible means by which the project can be modified to avoid, minimize, and/or compensate for adverse effects. If the area/site(s) is not abandoned, go to Tier 2, answer the Tier 2 questions with site-specific data, and assess the proposed measures to avoid, minimize, and/or compensate for adverse effects.

If available data are insufficient to answer one or more of the Tier 1 questions above, proceed to Tier 2 with the intent of collecting the data necessary to answer the Tier 2 questions, which include those asked at Tier 1.

Chapter Two
Tier 2

A. Tier 2 Site Characterization

Tier 2

At this stage, the developer should narrow consideration to specific sites. Additional data may be necessary to systematically and comprehensively characterize a potential site in terms of the risk wind energy development would pose to affected species and their habitats. In the case where a site or sites have been selected without the Tier 1 preliminary evaluation of the general ecological context, the developer will address the questions asked in Tier 1 at this stage. To begin this process, the developer should answer the following questions, to help determine where wind development sites should not be constructed. The Service is available to assist developers to identify potential wildlife and habitat issues and should be contacted as early as possible in the developers planning process and prior to any financial commitment or finalization of any lease agreements, if this has not been done already in Tier 1.

A distinguishing feature of Tier 2 assessments is that they focus on site-specific information and should include at least one reconnaissance level site visit to each of the prospective site(s). Tier 2 assessments should include enough site visits during appropriate times of the year to adequately account for varying conditions and/or seasons and to adequately ground-truth available information.

1. Tier 2 Questions

Questions to be considered in Tier 2 include:

1. What fish and wildlife resources are known or potentially present in the area(s) of influence? Are there areas precluded from development by law or regulation or areas identified as high value to fish and wildlife and their habitats according to best available information present in the area of influence?

2. Are there known or suspected areas where potentially affected species congregate in the area of influence, including, but not limited to: maternity roosts, hibernacula, staging areas, winter ranges, nesting sites, migration stopovers or corridors, coastal migration drop-out zones, leks, or other areas of seasonal importance?

3. Are there areas of intact habitat in the area of influence where development would result in habitat degradation, loss or fragmentation and are there species sensitive to habitat fragmentation?

4. Are there areas identified as critical for the recovery of a listed species, a core population area, or an expansion area of a recovering species within the area of influence?

5. Are there plant communities of concern present or likely to be present in the area of influence?
6. Do the site visits validate the answers to the Tier 1 questions?
7. Have you contacted relevant agencies?

2. Tier 2 Methods and Metrics

When conducting Tier 2 investigations, developers should be able to use existing public or other readily available landscape-scale maps and databases from sources such as federal, state, local, or tribal wildlife or natural heritage programs, the academic community, conservation organizations, or the developers' or consultants' own information.

Similar to Tier 1, the analysis of available sites in the area of influence will be based on a blend of the information available in published and unpublished reports, wildlife range distribution maps, and other such sources. Currently available data sources useful for this analysis are listed on Service Wind Guideline website. Obtaining answers to Tier 2 questions will involve a more thorough review of the existing site-specific information than in Tier 1. Tier 2 site-characterizations assessments will generally contain four elements:

a) A review of existing information, including existing published or available literature, databases, and maps of topography, land use and land cover, potential wetlands, wildlife, habitat, and sensitive plant distribution. If agencies have documented potential habitat for species sensitive to habitat fragmentation, this information can help with the analysis. Risk assessment tools appropriate for use during Tier 2 assessment tend to utilize landscape-specific, spatial analyses. Examples of these types of risk assessment tools can be found on the Service Web site.

b) The developer should contact federal, state, tribal, and local agencies that have jurisdiction or management authority over the project or relevant scientific information about the potentially affected resources. In addition, because conservation organizations and local groups are often valuable sources of relevant local environmental information, it is recommended that developers contact conservation organizations, even if confidentiality concerns preclude the developer from identifying specific project location information at this stage. These contacts also provide an opportunity to identify other potential issues and data not already known.

c) One or more reconnaissance-level site visits by a wildlife biologist and botanist to evaluate current vegetation/habitat coverage and land management/use will help determine the baseline against which potential effects from the project would be evaluated. Vegetation types or habitats will be evaluated against available information such as land use/land cover mapping. Natural Resource Conservation Service ecological site classification system and United States Geological Survey National Land Cover data maps can be used to determine site characterization.

Vegetation/habitat information will be used to identify fish and wildlife resources occurring at the site and the presence of affected species or their habitats. Affected resources located during the site visit should be noted and mapped or digital location data recorded for future reference. Any individuals or signs of affected species observed during the site visit should be noted. The developer should work with the local Service Field Office if there are access issues.

The results of the site visit(s) should:

- identify landscape features, habitats, or use areas that could be seasonally important to raptors, prairie grouse, other birds that may be at risk of adverse effects, and bats, including nesting and brood-rearing habitats, areas of high prey density, movement corridors and features such as ridges that may concentrate "**protected species**;"
- characterize and evaluate vegetation relative to surrounding areas;
- evaluate the topography and physiographic features in relation to the surrounding region; and
- assess the potential for the project area to concentrate resident or migratory fish or wildlife, to the extent practicable.

d) Consideration of whether there are areas of intact habitat in the area of influence where development would result in habitat degradation, loss or fragmentation. This should include an analysis and assessment of the current habitat quality and spatial configuration of the area of influence with respect to the potential species sensitive to habitat fragmentation. This will include:

- reviewing the most recent aerial and remote sensing imagery of the area of influence to determine distinct habitat patches, boundaries, and the extent of existing habitat fragmenting features and lack of habitat integrity (e.g., highways, transmission lines, and other infrastructure)
- assessing of the level of habitat fragmentation within existing habitat for species sensitive to habitat fragmentation
- determining whether potential changes in quality and spatial configuration of the habitat and any changes in the temporal use by species sensitive to habitat fragmentation could occur if development were to proceed as proposed.

A variety of resources are available to help characterize a potential site in terms of the risk wind energy development would pose to affected species and their habitats. The Service Wind Energy website has the most recent information.

3. Tier 2 Decision Process

The objective of the Tier 2 process is to help a developer identify potential sites within the geographic area under consideration where wind energy development would be appropriate. We recommend the proponent use the following decision key to determine if additional information is needed, or if a proposed project site(s) should be abandoned.

If answers to the first six questions of the Tier 2 questions are "no" for the area of influence under consideration, this indicates a low probability of adverse effects to fish and wildlife and their habitat. Proceed to Tier 3 pre-construction monitoring and assessments and answer the Tier 3 questions with site-specific data to confirm the validity of the preliminary indications of low potential for adverse effect.

If the answer to any of the first six questions is "yes," this indicates a higher probability of adverse effects to fish and wildlife and their habitats. Consider discontinuing the project at site, or identify means by which the project can be modified to avoid, minimize, and/or compensate for adverse effects. If the site(s) is not abandoned, go to Tier 3, and answer the Tier 3 questions with site-specific data. The developer should consider the Service's input when making this decision, particularly if the Service is concerned about adverse effects to listed species and/or a high level of adverse effects to fish and wildlife and their habitats at the site. Tools to assist with this decision are available on the Service Wind Energy website.

If available data are insufficient to answer one or more of the Tier 2 questions above, the developer may proceed to Tier 3, with the intent of collecting the data necessary to answer the Tier 3 questions, and formulating questions, methods, and mitigation measures based on the issues identified in the Tier 2 results.

Before proceeding to Tier 3 the developer should thoroughly consider whether to proceed with or discontinue the project based on the information collected in the first two tiers. If information to this point indicates a high or reasonable probability of adverse effects to fish and wildlife resources and/or there is opposition to development at the proposed site by the Service, state, local or tribal resource agencies, the developer should strongly consider whether it is reasonable to proceed to Tier 3 in terms of commitments and resources. If the likelihood of adverse effects to fish and wildlife resources is high, the developer should understand that proceeding with project development would likely lead to pre-construction and post-construction (should development occur) studies of greater duration and intensity, possible "**operational modifications**," and additional minimization and compensation measures to offset adverse effects.

Chapter Three
Tier 3

A. Tier 3: Pre-Construction Monitoring and Assessments

Tier 3

Tier 3 is the first tier in which quantitative and scientifically rigorous monitoring and assessments are conducted to assess the potential risk of the proposed project. These studies provide pre-construction information to:

- Further evaluate a site for determining whether the wind energy project should be developed or abandoned.
- Design, construct, and operate a site to avoid, minimize and/or compensate for adverse effects if a decision is made to develop.
- Design compensation measures if adverse habitat effects cannot acceptably be avoided or minimized.
- Determine duration and intensity of post-construction studies.
- If warranted, comprise the pre-construction component of Tier 5 research necessary to estimate effects.

The decision to conduct a Tier 3 monitoring and assessments depends on whether additional data are necessary to answer the questions below. The duration, seasonality, and level of effort required to answer each Tier 3 question depends on several factors, including but not limited to: the question being addressed; site sensitivity; amount and quality of existing data from nearby comparable sites with similar species and their habitats; seasons of occupancy; variability within and between seasons and years where such variability is likely to substantially affect answers to the Tier 3 questions and affected species. This draft Guidance recognizes it is possible to design assessments and surveys commensurate with anticipated risk associated with the size and location of the project, thus balancing the expected impacts with the costs of assessments and surveys.

If adequate data are available from nearby sources or from studies of the site being evaluated, then additional studies may be unnecessary. A reduced level of survey effort may be warranted for certain projects, such as infill development, projects with low potential risk for adverse effects, some repowering projects, or projects contiguous to existing low impact wind energy facilities provided sufficient credible information regarding effects is available. Increased effort and duration of monitoring and assessment may be needed for uncommon or rare species when there is little existing information, or when deviation from normal environmental conditions or variability in the metric(s) of interest is considered so high that it is not otherwise possible to categorize risk as high, moderate, or low. The developer should share the data with interested federal, state, local, and tribal agencies to determine the adequacy of the information.

Tier 3 will include an assessment of which species identified in Tier 1 and/or Tier 2 will be studied further. This determination is based on analysis of existing data from Tier 1 and existing site-specific data and project site visit(s) in Tier 2, and on the likelihood of presence and the degree of adverse effect to species or their habitat.

If the habitat is suitable for a species needing further study and the site occurs within the historical range of the species, or is near the existing range of the species but presence has not been documented, additional field studies may be appropriate. For example, if the answer to Tier 2, Question 3, was "yes", but existing information did not allow for a complete analysis of potential effects, additional studies and analyses should take place in Tier 3. Additional analyses may not be necessary if a species is unlikely to be present, or is present but adverse effect is unlikely or insignificant, based on coordination with relevant agencies.

1. Tier 3 Questions

Tier 3 assessments address many of the questions in Tiers 1 and 2, but Tier 3 assessments differ because they attempt to quantify the distribution, relative abundance, behavior, and site use of affected species. Tier 3 data also attempt to estimate the extent that these factors expose these species to risk from the proposed wind energy facility. In answering Tier 3 questions 1-3, developers should collect data sufficient to analyze and answer Tier 3 questions 4-6.

Tier 3 monitoring and assessments should be designed to answer the following questions:

1. Are individuals or "**local populations**" of affected species present on or likely to use the proposed site?

2. Is there a potenti**al for adverse eff**ects to individuals and local populations of the affected species?

3. What is the chronology, distribution, relative abundance, behavior, and site use of species identified in Tiers 1 or 2, and to what extent do these factors expose these species to risk from the proposed project?

4. What are the potential risks? For example, are there species known to be sensitive to: acoustical fragmentation, noise masking, adverse behavioral or physiological effects, hearing impairment, habitat degradation, loss or fragmentation? What are the possible adverse effects to local populations, as well as to the entire population and habitats?

5. If adverse effects are predicted to affected species, can these effects be mitigated? If so, how? Will a permit, such as an incidental take permit, be required/advisable?

6. Should monitoring and assessment be initiated at this stage that would be continued in either Tier 4 or Tier 5?

7. Have relevant agencies reviewed and commented on proposed monitoring and assessments?

2. Tier 3 Methods and Metrics

The Service encourages the use of common methods and metrics in Tier 3 assessments for measuring wildlife activity and habitat features. Common methods and metrics provide benefit

over the long term, allowing for comparisons among projects and greater certainty regarding what will be asked of the developer for a specific project. Deviation from commonly used methods should be carefully considered, scientifically justifiable and discussed with federal, tribal, or state natural resource agencies, or other experts, as appropriate. It may be useful to consult other scientifically credible information sources. It is the developer's responsibility to obtain the most current and relevant information on study methodology.

In some instances, a single method will not adequately assess potential collision risk or habitat effect. For example, when there are moderate to high levels of concern about risk to nocturnally active species, such as migrating passerines and local and migrating bats, a combination of remote-sensing tools such as radar, acoustic monitoring for bats, and indirect inference from diurnal bird surveys during the migration period, may be necessary. Answering questions about habitat use by songbirds may be accomplished by relatively small-scale observational studies, while answering the same question related to wide ranging species such as prairie grouse and sage grouse may require more time consuming surveys, including telemetry.

Many methods for assessing risk are components of active research involving collaborative efforts of public-private research partnerships with federal, state, local, and tribal agencies, wind energy developers, and conservation organizations interested in wind energy development/wildlife interactions (e.g., Bats and Wind Energy Cooperative and the Grassland Shrub Steppe Species Cooperative). While there is merit in using common study methodologies at most wind energy projects, it is recognized that new techniques may be appropriate and contribute to furthering our knowledge of wind energy development/wildlife interactions.

a. General Recommendations for Pre-construction Monitoring

A variety of monitoring and assessment tools are available for evaluating presence and potential effects to fish and wildlife. This is not an inclusive or priority list. The Service Wind Energy website has the most recent information, including whether permits are needed and other relevant information.

- Preferably at Tier 2 but no later than Tier 3, a detailed literature search and assessment of available site information should be conducted. Such information includes GIS overlays, maps, aerial photographs, soil and vegetation surveys, and any other pertinent information that can be obtained about the project site. Using the suggested Rapid Assessment Methodology, once it is completed, should help expedite this process.

- Baseline surveys and assessments are conducted where appropriate, using accepted and validated methods such as: point counts, ground and aerial transects, raptor nest and hawk watch surveys, lek counts, radio telemetry assessments (using, for example, satellite tracking in a GIS mode, perhaps with mortality monitoring hardware), radar surveys , thermal imagery tracking (e.g., using night vision scopes or thermal imagery camera equipment), acoustic monitoring for both birds and bats, mist netting and harp trapping, bat cave exit counts, stable isotope feather and fur analyses, vegetative cover mapping, and other methods. Some of these "tools" not only help delineate presence but help estimate abundance, or lack thereof.

- Risk should be modeled based on the potential for future collision and for possible avoidance using suggested modeling approaches referenced in the literature (see the Service Wind Energy website).

- It is during Tier 3 that a risk assessment is conducted. The methodology should include the problem formulation of likely risk from developing a site, a determination of risk exposure, an assessment of possible effects if the project goes forward, and a characterization of risk based on the overall review.

The remainder of this section outlines methods and metrics that may be appropriate for gathering data to answer Tier 3 questions.

b. Assessing Effects to Species

Federal, state, local, and tribal agencies often require specific protocols be followed when protected species may be present in an area of influence. It should be noted, however, that for many protected species, there are no specific survey protocols, or only assumptions that the generalized protocols are sufficient. When such established protocols are not available, or not applicable, the developer will communicate with federal or state natural resource agencies or other credible experts on project-specific conditions, and design studies that collect sufficient data to answer Tier 3 questions. In general, surveys should sample the potential sites and applicable area of influence during seasons when species are most likely present. Often, methods and protocols will include an estimate of relative abundance. Most presence/absence surveys should be done following a probabilistic sampling protocol to allow statistical extrapolation to the area and time of interest.

The level of effort normally contemplated for Tier 3 studies should detect common species and species that are relatively rare, but which visit a site regularly (e.g., multiple times every year) or that remain for sufficient periods of time. In the event an affected species is very rare and only occasionally visits a site, it may be determined that the species is likely to occur based on the habitat at the area of influence and historical records of occurrence on or near the site. However, assuming presence does not necessarily mean that appropriate studies will or will not be recommended. Developers should coordinate with agencies when species are presumed present but risks are low, and further studies are not being considered.

Methods for estimating risk will vary with the affected species. Factors to consider include collision/barotrauma, displacement, habitat loss, and behavioral modification. For those affected species considered at risk of collisions or habitat effects, the questions to be answered in Tier 3 include: where and when are they likely to occur (i.e., where is their habitat) within a "**study area**," and in what abundance. The spatial and temporal distribution of affected species, including the airspace for flying species in relation to the rotor-swept zone, can influence how a site is developed. The abundance of a species and the spatial distribution of its habitat can be used to determine the relative risk of adverse effects to species using the sites, and the absolute risk when compared to existing projects where similar information exists. Species abundance and habitat distribution can also be used in modeling risk factors.

Collision risk to individual birds and bats at a particular wind energy facility may be the result of complex interactions among species distribution, relative abundance, behavior, weather conditions (e.g., wind, temperature, inclement weather events), and site characteristics. If collision models are used, they may provide an additional tool for estimating fatalities. Models have been used in Australia (Organ and Meredith 2004), Europe (Chamberlin et al. 2006), and the United States (Madders and Whitfield 2006). As with other prediction tools, model predictions should be evaluated and compared with post-construction fatality data to validate the models. Models should be used as a subcomponent of a risk assessment based on the best available empirical data. For example, estimating potential bird fatalities in Tier 3 may be accomplished by comparing exposure estimates at the proposed site with exposure estimates and fatalities at existing projects with similar characteristics (e.g., similar technology, landscape, and weather conditions)

Based on information gathered in Tiers 1 and 2, developers may need to conduct Tier 3 assessments on noise effects to wildlife. Such assessments should consider the following two aspects: 1) determine the acoustic regime and acoustic "footprint" of the proposed wind facility, including from its design and operation, and from its construction; and 2) perform pre-construction acoustic monitoring using appropriate frequency weighting to establish ambient baseline sound levels. Sampling should occur over a sufficient number of days to account for variations and to optimize the statistical power analysis. Since wildlife presence and activity will vary greatly within and between seasons, sampling should be conducted during all four seasons.

c. Assessing Effects to Habitat

Assessing adverse effects to habitat in Tier 3 will depend on how habitat integrity, patch, block size, and fragmentation affect the life cycles of the affected species; the likelihood that the project will adversely affect a local population of the affected species; and the potential effects to reproduction, survival, or distribution of individuals within populations. Estimating displacement risk requires an understanding of animal behavior in response to a project and its infrastructure, and a pre-construction estimate of presence/absence of species whose behavior would cause them to avoid areas near turbines, roads and other project components. The amount of habitat lost to indirect effects will depend on the sensitivity of individuals to the project and the activity levels associated with the project's operations. The population-scale significance of this habitat loss will depend on the amount of habitat available to the affected population. If the loss of habitat also results in habitat fragmentation, the risk to the viability of the isolated animals is further increased.

To assess habitat fragmentation in the project vicinity, developers should evaluate landscape characteristics of the proposed site prior to construction and determine the degree to which habitat for species sensitive to habitat fragmentation will be altered by the presence of a wind energy facility. A general framework for evaluating habitat fragmentation at a project site, following that described in Tier 2, is outlined below.

This framework should be used when the Service, or a relevant federal, state, tribal, and/or other local agency, demonstrates the potential presence of a population of a species sensitive to habitat fragmentation that may be adversely affected by the project. In some cases, a population of species sensitive to habitat fragmentation may not be present at the time of project proposal, but

may depend on that type of habitat for recovery. In other cases, the habitat is rare and it has been established that species rely on contiguous habitat. In such cases, habitat fragmentation may be assessed based upon habitat characteristics rather than species presence. This method for analysis of habitat fragmentation at project sites should be adapted to the local resources potentially affected by the proposed development and documented using GIS.

The developer should:

1) Define the area for pre-construction assessments. The area of influence for the site should include the project site for the proposed facility plus the area surrounding that may experience direct and indirect effects (Figure 1). The extent of the study area should be based on the area where there is potential for adverse effects to habitat, including displacement and site avoidance, within the distribution of habitat for the affected species.

2) Determine the potential for occupancy of the study area based on the information collected or assessed for the species sensitive to habitat fragmentation in Question 1.

3) Analyze current quality and spatial configuration of habitat in the study area for the species sensitive to habitat fragmentation.

    a. Use recent aerial or remote imagery to determine distinct habitat patches or boundaries within the study area, and the extent of existing habitat fragmenting features.

        i. Assess the level of fragmentation of the existing habitat for the species sensitive to habitat fragmentation and categorize into three classes based on the integrity of the habitat:

            - High quality: little or no apparent fragmentation of intact habitat
            - Medium quality: intact habitat exhibiting some recent disturbance activity (e.g., off-road vehicle trails, roadways, transmission corridors, some soil erosion, other apparent disturbance)
            - Low quality: extensive fragmentation of habitat (e.g., row-cropped agricultural lands, active surface mining areas, off-road vehicle trails, Superfund sites, degraded and heavily developed commercial areas)

        ii. Determine edge and interior habitat metrics of the study area:

            - Identify habitat, non-habitat landscape features to determine whether they represent barriers/fragmentation

- Identify existing fragmenting features relative to the species sensitive to habitat fragmentation, to estimate existing edge
- Calculate amount of edge (e.g., perimeter to area ratio)
- Calculate area of intact patches of habitat and compare to needs of the subject species

b. Determine potential changes in quality and spatial configuration of the habitat in the study area if development proceeds as proposed using existing site information and the best available temporal and spatial data regarding placement of wind turbines and ancillary infrastructure:

   i. Identify, delineate and classify all additional features added by the development that potentially fragment habitat (e.g., roads, transmission and distribution lines, maintenance structures, fences, communication structures, turbine pads, etc.).

   ii. Assess the expected future size and quality of habitat patches for the species sensitive to habitat fragmentation and the additional fragmenting features, and categorize into three classes as described above

   iii. Determine expected future acreage of edge and interior habitats

   iv. Calculate the anticipated rotor-swept areas for each of the proposed turbines for the entire project site to anticipate airspace effects.

c. Compare pre-construction and expected post-construction fragmentation metrics:

   i. Determine the area of intact habitat lost (to the displacement footprint or by alteration due to the due to effects from edge).

   ii. Identify habitat patches expected to be moved to a lower habitat quality classification as a result of the development.

Assess the likelihood of adverse effects to individuals and population of the species sensitive to habitat fragmentation (reproduction, survival, distribution) using the habitat-fragmentation information collected under item 3 above and any other currently available data regarding habitat quality, amount, and juxtaposition. The developer and relevant agencies share information and discuss if adverse effects are a concern and whether the developer should consider the items below:

a. While communicating with species experts, consider alternative locations and development configurations to minimize fragmentation of habitat for all species sensitive to habitat fragmentation in the study area.

b. Identify high quality habitat parcels for species that may be protected as part of a plan to limit future loss of habitat.

c. Identify areas of medium or low quality habitat within the range of the species that may be restored or improved, and identify opportunities for other conservation actions or areas of potential habitat that could be recruited, to compensate for losses of habitat that result from the project.

d. Monitoring and Assessment Duration and Intensity

Where pre-construction assessments are warranted to help assess risk to wildlife, the studies should be of sufficient duration and intensity to ensure adequate data are collected to accurately characterize wildlife use of the area. In ecological systems, resource quality and quantity can fluctuate rapidly. These fluctuations occur naturally, but human actions can significantly affect (i.e., increase or decrease) natural oscillations. Pre-construction monitoring and assessment of proposed wind energy sites are "snapshots in time," showing occurrence or no occurrence of a species or habitat at the specific time surveyed. Often due to prohibitive costs, assessments and surveys are conducted for very low percentages (e.g., less than 5 percent) of the available sample time in a given year, however, these data are used to support risk analyses over the projected life of a project (e.g., 30 years of operations).

In order to establish a trend in site use and conditions that incorporates annual and seasonal variation in meteorological conditions, biological factors, and other variables, pre-construction studies need to occur over multiple years. To address this need, and in light of development timelines, three years of pre-construction studies may be appropriate in many circumstances. However, the level of risk and the question of data requirements will be based on site sensitivity, affected species, and the availability of data from other sources. Accordingly, decisions regarding the studies required should consider information gathered during the previous tiers, variability within and between seasons, and years where variability is likely to substantially affect answers to the Tier 3 questions. These studies should also be designed to collect data during relevant breeding, feeding, sheltering, staging, or migration periods for each species being studied. Additionally, consideration for the frequency and intensity of pre-construction monitoring should be site-specific and determined through consultation with an expert authority based on their knowledge of the specific species, level of risk and other variables present at each individual site. Some tools have been developed for existing guidance to evaluate sites based on risk criteria. See Service Wind Energy website for additional information and examples.

Because pre-construction surveys and risk assessments are conducted before wind turbines and other infrastructure are built, post-construction fatality studies in Tier 4 should always be conducted to confirm earlier findings and predictions and allow for the implementation of minimization measures, if necessary. This is especially important in areas where project

development modifies existing habitat and where the effects of projects have not been well studied.

As with pre-construction studies, post-construction fatality studies should be conducted for no less than three years and collect data during appropriate seasons for species of interest. It should be noted that even three years of post-construction fatality monitoring may fail to detect large-scale but infrequent episodic mortality events. Therefore, additional years of post-construction monitoring may be warranted when negative effects are expected to occur intermittently and/or over long time periods. The three-year recommendation could be re-evaluated to a minimum of 2 years in situations where the level of risk is considered to be low.

Tier 5 research may require post-construction monitoring of durations longer than the minimum three years recommended for fatality monitoring. Tier 5 research duration depends on the research question and study design identified during earlier tiers. Project proponents should consider the type of studies to be conducted (e.g., "**Before-After Control-Impact"** studies), and thus, the applicable study duration for both pre- and post-construction studies/monitoring that are necessary to draw meaningful results under the BACI design. See the Tier 5 section for more information on BACI studies.

e. Additional Considerations

It is necessary to identify the assessments needed to address the Tier 3 questions. The Service also recommends considering how the resulting data may be used in conjunction with post-construction Tier 4 monitoring and assessments and potential Tier 5 research. The design of post-construction monitoring or mitigation assessment studies will depend on the specific questions being addressed. Tier 3 predictions of fatalities will be evaluated using data from Tier 4 studies designed to estimate fatalities. Tier 3 assessments may demonstrate the need for compensation of adverse habitat effects or for measures to avoid or minimize fatalities. Where adverse habitat effects are of concern, Tier 4 and/or Tier 5 studies will provide data that evaluate the predicted effects and the effectiveness of avoidance, minimization and compensation measures.

The results of Tier 3 assessments should provide a basis for identifying measures to mitigate adverse effects predicted. Information on wildlife use of the proposed area is most useful when designing a project to avoid, minimize, and/or compensate for adverse effects. In cases of uncertainty, additional studies may be necessary to quantify adverse effects and determine the need for mitigation of those effects.

When adverse effects cannot be fully avoided or adequately minimized, some form of compensation may be appropriate to address loss of habitat. For example, it may be possible to mitigate habitat loss or degradation by enhancing or restoring comparable nearby habitat. See the Mitigation Chapter for more details on mitigation and deterrent methods and metrics.

3. Tier 3 Decision Process

At the end of Tier 3, the developer, after coordinating with the relevant agencies, will again make a decision regarding whether and how to develop the project. The decision point at the end of Tier 3 involves multiple potential outcomes:

1. Development of the site has a low probability of adverse effects to fish and wildlife and their habitats. There is little uncertainty regarding when and how development should proceed, and adequate information exists to satisfy any required permitting. The decision process proceeds to permitting, when required, and/or development, and pre-construction surveys are terminated.

2. Development of the site has a relatively high probability of adverse effects unless proper measures are taken to mitigate those effects. This outcome may be subdivided into several possible scenarios:

    a. There is certainty regarding how to develop the site to adequately mitigate adverse effects. A decision to develop the site is made, conditional on adopting the proper minimization and compensation measures, with appropriate follow-up fatality and habitat monitoring.

    b. There is uncertainty regarding how to develop the site to adequately mitigate adverse effects, or a permitting process requires additional information on potential adverse wildlife effects before permitting future phases of the project.

        i. A decision to develop the site is made through coordination with the Service and state natural resource agency, conditional on the proper mitigation measures being taken and with appropriate follow up post-construction monitoring and research (Tier 4 and 5). The decision would likely include consideration of minimization, compensation, monitoring and adaptive management and the time and effort needed to accomplish those elements.

        ii. The developer disagrees with the Service and/or state natural resource agency regarding the likely adverse wildlife effects resulting from development and operation of the proposed facility. There is not agreement between the developer and interested resource agencies regarding appropriate minimization and compensation for the site or on an appropriate adaptive management process. The Service may document the concerns of the adverse effects on wildlife and will share the concerns with the developer. At this point, the decision to discontinue or continue development at the proposed site rests with the developer.

3. Development of the site has a high probability of adverse effects to fish and wildlife and their habitats that cannot be satisfactorily mitigated.

i. Site development is delayed until plans can be developed that satisfactorily avoid, minimize, and/or provide compensation for the adverse effects.

ii. Alternatively, the site is abandoned in favor of known sites with less potential for adverse environmental effects, or the developer begins an evaluation of other sites or landscapes for more acceptable sites to develop.

Chapter Four
Tier 4

Tier 4: Post-Construction Monitoring of Effects

Tier 4

Following the tiered decision process, the outcome of Tier 1 to Tier 3 monitoring and assessments will determine the type, duration, and intensity of Tier 4 monitoring. Tier 4 monitoring occurs following construction and falls into two categories: fatality monitoring (4a) and monitoring of other effects (4b). It is likely that both 4a and 4b monitoring will be necessary for most projects to accurately assess post-construction and operational effects. Fatality monitoring is essential for validating risk estimates made prior to construction whereas other efforts (4b) evaluate other effects of the project development. Wind project operators and the relevant agencies should discuss the results from Tier 4 monitoring to determine whether results indicate that fatalities or other direct and indirect effects are a concern. Based on these results, the project operator and relevant agencies can develop a plan to mitigate any additional effects.

A. Tier 4a: Fatality Monitoring

Fatality monitoring should be conducted at all wind energy facilities and should include a rigorous monitoring design that can accurately detect mortality events resulting from all aspects of the facility operation (e.g., turbine collision, barotrauma, electrocution, collision with utility lines, etc.). Fatality-monitoring efforts involve searching for wildlife carcasses beneath turbines and other facilities to estimate the number and species composition of fatalities. The primary objectives of these efforts are to estimate fatality rates for wildlife and evaluate the risk assessments made prior to construction. These data should be used to determine whether mortality events occur at rates lower, higher, or as predicted during the risk assessment based on analyses made during Tiers 1 to 3.

Other questions that can be answered with fatality monitoring include the relationship of mortality to specific site characteristics and comparison of fatalities among facilities in similar ecological settings. If designed properly, fatality monitoring can be used to determine whether individual turbines or "**strings**" of turbines are responsible for a disproportionate number of bird and bat mortalities at a wind facility or if fatality rates may be related to site characteristics such as proximity to water, forest edge, staging and roosting sites, known stopover sites, or other key resources. This information is particularly useful for evaluating micro-siting options when planning a future facility or expansion and on a broader scale, determining the location of the entire project. These data also can inform decisions on operational adjustments (including changes in minimization measures, if deemed necessary through adaptive decision framework), and can evaluate cumulative effects across a broader scale.

It is important to determine overall fatality rates for a wind facility but it is also important to look for fatality patterns. The observed overall "**fatality rate"** for a facility may be relatively low, but if one or a few turbines are responsible for most of the fatalities, or if one or a few turbines are responsible for multiple fatalities of affected species, this indicates a need to focus on these turbines and apply methods or techniques to reduce or eliminate such fatalities. Accurately

estimating fatality rates and identifying possible patterns of mortality may assist operators in developing and evaluating effective avoidance and minimization measures.

1. Tier 4a Questions

Post-construction fatality monitoring should be designed to answer the following questions as appropriate for the individual project. Answering the questions below can provide the information necessary for risk model validation and make modifications to the facility operation to reduce documented effects.

1. What are the fatality rates for affected species, including migrating and resident wildlife?
2. How do the estimated fatality rates compare to the predicted fatality rates?
3. Do wildlife fatalities vary within the project site and/or in relation to site characteristics, in relation to weather patterns, or across seasons?
4. Do fatality data suggest the need for a modification in minimization measures to further reduce adverse effects?

2. Tier 4a Methods and Metrics

Fatality monitoring results should be of sufficient statistical validity to answer Tier 4a questions, allow comparisons with pre-construction predictions of effects and comparisons with other sites, and provide a basis to determine whether corrective management and/or additional mitigation are appropriate.

The basic method of measuring fatality rates is the carcass search. All fatality monitoring should include estimates of carcass removal and carcass detection bias likely to influence those rates, using the most current accepted methods. Fatality and bias correction efforts should also occur across all seasons to assess potential variation. Search protocols should be standardized to the greatest extent possible, especially for common objectives and affected species, and should include methods for adequately accounting for sampling biases (searcher efficiency and scavenger removal). However, some situations warrant exceptions to standardized protocol. Any modifications (increasing or decreasing the duration and/or intensity of monitoring) to a standardized protocol should be appropriate to the specific site, based on the best available science, and defensible.

Below is some general guidance about the following design issues relative to protocols for fatality monitoring:

- Duration and frequency of carcass searches
- Number of turbines to monitor
- Delineation of carcass search plots, transects, and habitat mapping
- General search protocol guidance
- Field bias and error assessment
- Estimators of fatality

More detailed descriptions and methods of fatality search protocols can be found on the Service Wind Energy website.

a. Duration and frequency of carcass searches

The duration of fatality monitoring is a critical issue that must be carefully considered. The carcass searching protocol should be adequate to answer applicable Tier 4a questions at an appropriate level of precision to make general conclusions about the project. Developers may need to get a federal and/or state permit to possess carcasses. The Service recommends multiple years of fatality monitoring to adequately evaluate all sources of variation. Multiple years of surveys will be needed to properly characterize species use of a proposed site and its area of influence as part of Tier 3, but also will be important to characterize fatalities and other information collected in Tier 4a and 4b.

In some cases, a species may have had its range reduced from historical levels and may require some areas for recovery; therefore any current surveys might not detect its presence or would underestimate effects. In other cases, the probability of current use of an area may be greatly reduced due to low population levels and reduced distribution. Global climate change may manifest itself in local and regional ways that disrupt species abundance and distribution. Episodic events may disrupt a species distribution and use of an area for years. Extreme seasonal weather variation may disrupt a survey's efficiency; result in lower species abundance; and/or alter species behavior. Episodic events such as inclement weather during migration may result in pulses of mortality not commonly observed during other years. Therefore, monitoring efforts should account for these variances to accurately assess how these factors influence wildlife interactions with wind facilities.

Many factors should go into deciding the duration of fatality monitoring at each facility. Results from Tier 1 and Tier 2 landscape, habitat and site assessments can provide information to assess anticipated fatality risk. In addition, data collected during Tier 3 can further elucidate site-specific and species-specific fatality risks. Post-construction mortality information is also important for cumulative effects analyses, operational adjustments, assessments of future projects, and a number of other reasons.

The Survey Decision Support Matrix below may be used by developers and Service field staff as a tool to guide appropriate decisions on the duration and intensity of such monitoring. Other things to consider are whether the years will be consecutive, the number or proportion of sites monitored, frequency of monitoring within the year, and the information obtained from pre-construction surveys. The species involved and the level of risk are also important factors. Service staff can help guide a developer through such decisions. Based on the initial results of post-construction mortality monitoring, there may be opportunities for alterations of the duration and timing.

Frequency of carcass searches (search interval) may vary for different wildlife taxa, and will vary depending on the questions to be answered, the affected species, and their seasonal abundance at the project site. Therefore, fatality monitoring should occur across all seasons to assess variation in mortality due to migration patterns and the use of the site by resident wildlife.

The number of seasons and total length of the monitoring effort may be determined separately for the various affected species, depending on the pre-construction risk assessment and the results of previous and on-going fatality monitoring.

It may be appropriate to conduct monitoring using different durations and intervals depending on the affected species. For example, if raptors occupy an area year-round, it may be appropriate to monitor for raptors throughout the year, while it may be warranted to monitor for bats only when they are active in the project area. It may be appropriate to increase the search frequency during the months bats are active and decrease the frequency during periods of inactivity. It may be appropriate to continue monitoring for a single or few affected species after general fatality monitoring has confirmed the predicted pre-construction risk assessment.

Unless the developer intends to conduct multiple searches to cover different taxa, the Service recommends basing search intervals on whatever resource has the shortest acceptable interval between searches. Except during low use times (e.g., winter months in northern states), protocols should be designed such that carcass searches occur at some turbines within the project area most days each week of the monitoring effort.

The search interval is the interval between carcass searches at individual turbines. This interval may be lengthened or shortened depending on the carcass removal and decomposition rates and results of field bias and error trials. If the primary focus is on fatalities of large raptors, where carcass removal is typically low, a longer interval between searches may be sufficient. However, if the focus is on fatalities of bats and small birds and carcass removal is high, then a shorter search interval is necessary. In some situations, higher intensity of monitoring (e.g., daily searches at individual turbines within the sample) may be appropriate. When assessing effects of previous day's/night's weather, searches will need to occur daily.

In general, the timing, duration, and intensity of fatality monitoring should consider the question being asked and can be modified based on preliminary results of these efforts. There may be tradeoffs between intensity and duration; design strategies should be discussed with relevant agency personnel. As data are collected, modifications to the fatality monitoring program can be made as appropriate.

Table 1. Survey Decision Support Matrix Tool for Post-construction Tier 4 Fatality Monitoring. Ensure that survey protocols, and searcher efficiency and scavenger removal bias correction factors are the most reliable, robust, and up to date (after Huso 2009).

Perceived Risk identified in Tier 3	Recommended Duration and Intensity	Possible outcomes of monitoring results
LOW	**Duration**: Minimum of two years where low risk can be justified. Field assessments must be sufficient to validate effects to birds and bats. Compare findings to Tier 3 risk assessment determinations for both birds and bats to ensure that the perceived level of risk was indeed "low" based on documented levels of mortality. **Intensity**: Field studies must be of sufficient intensity to reliably validate effects to birds and bats. Monitoring must be conducted at least during all seasons in which a species may be present and during all times of a species' daily cycle and in conditions within which a bird and/or bat may fly.	1) Risk level validated – documented fatalities are equal to or lower than predicted risk. A decision is required on future levels of monitoring. Operator can discontinue monitoring after two years with no fatalities. 2) Increased mortality documented – mortality greater than predicted is documented. Adaptive management actions are required. Renegotiate future monitoring duration and intensity with the Service.
MODERATE	**Duration**: Minimum three years Field assessments must be sufficient to validate with a statistically significant degree of certainty that risk to birds and/or bats was indeed "moderate." Closely compare validated effects to species to those determined from the risk assessment protocol(s). Specifically, were field assessments conducted at the appropriate time of the year, during at least four to six seasons, including breeding bird use of the area (i.e., May-June), migration use (March-May and August-November), and in some moderate risk areas, were winter surveys (November-April) conducted?	1) Risk level validated – documented fatalities are equal to or lower than predicted risk. A decision is required on future levels of monitoring. Operator can discontinue monitoring after two years with no mortalities. 2) Increased mortality documented – mortality greater than predicted is documented. Adaptive management actions are required. Renegotiate future monitoring duration and intensity with the Service.

	Intensity: Monitoring must be conducted at least during all seasons in which a species may be present and during all times of a species' daily cycle and in conditions within which a bird and/or bat may fly.	
HIGH	**Duration**: Minimum of five years Where the risks to species are determined to be "high," this determination must be quantified in regard to the status, vulnerability, chronology, and adverse effects to each affected species. Field assessments must be sufficient to validate with a statistically significant degree of certainty that risk to birds and/or bats was indeed high. Were strong correlations reached between the high level of risk hypothesized in Tier 3 and the actual level of risk determined in Tier 4? **Intensity**: Monitoring must be conducted at least during all seasons in which a species may be present and during all times of a species' daily cycle and in conditions within which a bird and/or bat may fly.	1) Risk level validated – documented fatalities are equal to or lower than predicted risk. A decision is required on future levels of monitoring after first three years. 2) Increased mortality documented – mortality greater than predicted is documented. Adaptive management actions are required. Renegotiate future monitoring duration and intensity with the Service, consider moving to Tier 5.

b. Number of turbines to monitor

The Service can assist project developers develop a monitoring plan that includes a sufficient number of turbines to produce statistically valid result. Sampling plans can be varied to increase efficiency as long as a probabilistic sampling approach is used.. If the project contains fewer than 10 turbines, all turbines in the area of interest should be monitored unless otherwise agreed to by the permitting or wildlife resource agencies. Stratification among different habitat types also is recommended to account for differences in fatality rates among different habitats (e.g., grass versus cropland or forest); a sufficient number of turbines should be sampled in each strata.

c. Delineation of carcass search plots, transects, and habitat mapping

It is important to accurately delineate and map the area searched for each turbine to adjust fatality estimates based on the actual area searched. It may be advisable to establish habitat visibility classes in each plot to account for differential detectability, and to develop visibility classes for different habitats (e.g., rocks, vegetation) within each search plot.

The use of visibility classes requires that detection and removal biases be estimated for each class. Fatality estimates should be made for each class and summed for the total area sampled. Global positioning systems (GPS) are useful for accurately mapping the total area searched and the area searched in each habitat visibility class, which can be used to adjust fatality estimates. The width of the belt or subplot searched may vary depending on the habitat and affected species; the key is to determine actual searched area and area searched in each visibility class regardless of transect width. An adjustment may also be needed to take into account the density of fatalities as a function of the width of the search plot.

Subplots should be smaller when vegetation makes it difficult to detect carcasses; subplots can be wider in open terrain. Subplot width also can vary depending on the size of the species. For example, small species such as bats may require smaller subplots than larger species such as raptors. Each search plot should be divided into oblong subplots or belt transects and that each subplot should be searched. The objective is to find as many carcasses as possible so the width of the belt will vary depending on the ground cover and its influence on carcass visibility. In most situations, a search width of six meters should be adequate, but this may vary from three to 10 meters depending on ground cover.

Three similar studies in Wisconsin looked at the distance from turbines where carcasses where found (BHE Environmental, Inc. 2010; Drake et al. 2010; and Gruver et al. 2009). They found that the large majority of bat carcasses were located within about 60 meters of the turbine while bird carcasses continued to be found at least100 meters from the turbines. Decisions regarding search plot size should be made in discussions with the Service, state wildlife agency, local permitting agency, and/or tribes.

d. General search protocol guidance

Personnel trained in search techniques should record and collect all carcasses along transects or subplots within each plot. A complete search of the area should be accomplished and subplot

size (e.g., transect width) should be adjusted to compensate for detectability differences in the search area. Some locations and circumstances may best be searched using alternative methods such as human and dog teams (Arnett 2005. Using search dogs could greatly improve the efficiency of carcass searches, particularly in dense vegetation, (Homan et al. 2001) but this presents unique challenges and should be considered on a case-by-case basis. Other alternative approaches include the rope method as described by Baerwald et al (2009).

Data to be recorded include date, start time, end time, interval since last search, observer, which turbine area was searched (including GPS coordinates) and weather data for each search, including the weather for the interval prior to the search. When a dead animal is found, the searcher should place a flag near the carcass and continue the search.

After searching the entire plot, the searcher returns to each carcass and records information on a fatality data sheet, including date, species, sex and age (when possible), observer name, turbine number, distance from turbine, azimuth from turbine (including GPS coordinates), habitat surrounding carcass, condition of carcass (entire, partial, scavenged), and estimated time of death (e.g., $\leq$1 day, 2 days). A digital photograph of the carcass should be taken. Rubber gloves should be used to handle all carcasses to eliminate possible transmission of rabies or other diseases and to reduce possible human-scent bias for carcasses later used in scavenger removal trials.

e. Field bias and error assessment

It has long been recognized that during searches conducted at wind turbines, actual fatalities are not completely observed and that therefore carcass counts must be adjusted by some factor that accounts for imperfect detectability. Important sources of bias and error include: 1) fatalities that occur on a highly periodic basis; 2) carcass removal by scavengers; 3) differences in searcher efficiency; 4) failure to account for the influence of site (e.g., vegetative) conditions in relation to carcass removal and searcher efficiency; and 5) fatalities or injured birds and bats that may land or move outside search plots.

Some fatalities may occur on a highly periodic basis creating a potential sampling error (number 1 above). It is recommended that sampling be scheduled so that some turbines are searched most days and episodic events are more likely detected, regardless of the search interval. To address bias sources 2-4 above, it is strongly recommend that all fatality monitoring efforts conduct carcass removal and searcher efficiency trials using accepted methods. More information about accepted methods can be found on the Service's Wind Energy website. Bias trials should be conducted throughout the entire monitoring period and searchers should be unaware of which turbines are to be used or the number of carcasses placed beneath those turbines during trials. It is uncertain how many carcasses or injured individuals may land or move outside the search plots that may require more attention in the future (Manville 2009) (number 5 above).

Prior to a trial's inception, a list of random turbine numbers and random azimuths and distances (in meters) from turbines should be generated for placement of each bat or bird used in bias trials. Data recorded for each trial carcass prior to placement should include date of placement, species, turbine number, distance and direction from turbine, and visibility class surrounding the

carcass. Trial carcasses should be distributed as equally as possible among the different visibility classes throughout the monitoring period and area. Developers should attempt to avoid "over-seeding" any one turbine with trial carcasses by placing no more than one or two carcasses at any one time at a given turbine. Before placement, each carcass must be uniquely marked in a manner that does not cause additional attraction, and its location should be recorded. There is no agreed upon sample size for bias trials, though some state guidelines recommend from 50 to 200 carcasses).

f. Estimators of fatality

If there were a direct relationship between the number of carcasses observed and the number killed, there would be no need to develop a complex estimator that adjusts observed counts for detectability, and observed counts could be used as a simple index of fatality. But the relationship is not direct and raw carcass counts recorded using different search intervals and under different carcass removal rates and searcher efficiency rates are not directly comparable.

There are a several ways that fatality predictions can be assigned and later evaluated. During the planning stages in Tier 2, predicted fatalities may be based on existing data at facilities with similar ecological settings. In this case, the assumption is that use is similar, and therefore fatalities may be similar at the proposed facility. Alternatively, results from pre-construction assessments could be used in conjunction with use and fatality estimates from existing projects to develop a model for predicting fatalities at the proposed project site. Finally, physical models can be used to predict the probability of a bird of a particular size striking a turbine. This probability, in conjunction with estimates of use and avoidance behavior, can be used to predict fatalities.

It is strongly recommended that only the most contemporary equations for estimating fatality be used, as some original versions are now known to be extremely biased under many commonly encountered field conditions. See Service Wind Energy website.

Fatality rates are traditionally reported on a "per turbine," "per megawatt," or in some cases "per rotor-swept area" basis. Because wind turbines with different physical and operational characteristics can have the same MW rating (nameplate capacity) and because none of these metrics provide any indication of the wind or operational conditions during a given time period, fatality rates should also be reported on a "per megawatt-hour" basis. This metric provides a direct, albeit imperfect, measure of turbine operation (e.g., the amount of time blades were actually in motion) during a given time period. Reporting "**mortality rates**" on a per turbine, per MW, per rotor swept area, and per MWh basis will facilitate meaningful comparisons across a broader landscape, will help standardize fatality monitoring results between facilities and time periods, and may provide insight into other factors affecting wildlife mortality at wind facilities.

B. Tier 4b: Post-construction Monitoring for Other Effects

In addition to mortality caused by turbine operation, wildlife populations could experience other negative effects resulting from project construction and operation. Identification of these potential effects should occur in Tiers 1-3 and should be evaluated in Tier 4b.

Assessing effects should include two important components: 1) effects on wildlife resulting from displacement, disturbance, and other behavioral response, as well as habitat loss, alteration, and fragmentation; and 2) demographic effects that may occur at the local, regional, or population-wide scales. These factors can individually or cumulatively affect wildlife, although some species may be able to habituate to some habitat changes. Indirect effects may be difficult to quantify but their effects may be significant.

1. Tier 4b Questions

Post-construction monitoring should produce statistically valid results that answer the following questions as appropriate for the individual project. Answering the questions below can provide the information necessary to validate risk models and make modifications to facility operation to reduce documented effects.

1. What are the effects of habitat loss, modification, and fragmentation on affected species?
2. Were any behavioral modifications, displacement, or barrier effects noted in regard to affected species?
3. What are the effects of construction and operational noise on fish and wildlife? Are noise effects comparable to those determined from Tier 3 ambient noise assessments?

2. Tier 4b Methods and Metrics

Specific questions related to effects will vary from project to project. Methods and metrics will therefore depend upon the questions being posed. The type, design, duration, and intensity of monitoring should depend on prior monitoring and assessments conducted in Tiers 1-3 and discussions with appropriate agencies. The most common practical considerations include the area being monitored, time period of interest, affected species, potentially confounding variables, time available to conduct monitoring, project budget, and the magnitude of the anticipated effects.

There are many considerations when designing monitoring efforts assessing effects. A clearly defined question is the most important step to designing appropriate monitoring programs, including what are the variables of interest and trends to be observed?

a. <u>Habitat Loss and Modification</u>

To assess the effects of habitat loss or modification, habitat assessments within the area of influence begun in Tier 3 should continue. Habitat types should be mapped and assessments of habitat quality should be conducted and recorded. Habitat data should be maintained consistent with other geo-spatial data.

Key indications of habitat quality should be the focus of such monitoring. Depending on the affected species within the area of influence, specific components of habitat should be identified and measured to determine if habitat loss and degradation are occurring beyond what was anticipated. Other indicators of habitat quality include aspects of the aquatic environment, including shade, pool frequency and depth, and freedom from excessive sedimentation. It is important to remember that wind development projects include road construction and maintenance, and other earth-moving activities that can have an effect on the aquatic community if not properly planned and conducted. For instance, a road parallel to a stream will disrupt the natural recruitment of trees into the stream and may result in less large pool-forming wood as well as excessive road-generated sediment.

b. Habitat Fragmentation

To assess the effects of habitat fragmentation on wildlife, monitoring programs must target variables that infer a change due to the construction of the wind facility. Appropriate effects to monitor include changes in species composition, reduced survival, reduced productivity, and altered use of the project site (both increased and decreased use). If monitoring indicates that changes from pre-construction assessments have occurred, further evaluation of habitat fragmentation should be considered in Tier 5 research.

c. Barriers

Barrier effects can occur when a species does not pass through a wind project, or expends greater energy in avoiding the wind project or its individual towers and infrastructure. Observations of individuals and their tendency to pass through or circumvent a wind project can be obtained from visual observations, telemetry, acoustical monitoring, as well as radar and other technologies. Some issues associated with barrier effects can be clarified with simple monitoring; other issues may require more complex research efforts. Whether barriers are affecting a species' energetic balance would be a matter more suited to a research project. Displacement from the project site and adjacent areas may also indicate that barrier effects may be occurring.

d. Displacement

Displacement is considered a potentially adverse effect to species and can result from a species' avoidance of noise, structures, and/or human presence. Monitoring may be necessary to determine the extent of these effects and the need for mitigation. The Service recognizes that monitoring of displacement may not be appropriate for all individual projects.

Monitoring for displacement of affected species caused by project development requires the comparison of baseline conditions (i.e., Tier 3 information) to data collected after construction and operation begins. Factors that might increase displacement include noise, increase in human activity, and presence of structures. By conducting pre- and post-construction local population surveys, such information should become available indicating whether disturbance and other factors are affecting fish and wildlife within the project site. Where displacement is suspected, the developer should attempt to assess the effects, if any, during Tier 4. Such verification that

displacement is occurring, and determining its causative factors, should follow during Tier 5 research.

e. Noise

To assess the potential effects of noise on wildlife, developers should compare baseline (ambient) noise levels determined at the site during Tier 2 and/or 3 assessments to noise levels determined at the site from operating turbines and infrastructure (e.g., gear boxes, generators, and blade whirring). Measurements should be made in the frequency weighting (see Delaney et al. 1999 for more information) that is most similar to the species that may be affected and should be done consistent with ambient noise determination in Tier 3. In particular, developers should record elevated levels of noise caused by large turbines ($\geq$ 1.5 MW), especially in those topographic features where turbines will likely significantly increase sound levels. To limit measurement uncertainty and improve statistical power, sample a sufficient number of days during each season for noise. Since wildlife presence and activity will vary greatly within and between seasons, ideally sample during all seasons. Noise can contribute to fatalities; additional research is needed to fully understand this situation (Baerwald et al. 2009, Acoustical Society of America 2009). Evidence of effects from noise may lead to Tier 5 research.

Chapter Five
Tier 5

Tier 5

A. Tier 5: Research

Early coordination with the Service together with following the tiered approach should help steer projects away from sites where Tier 5 research might be necessary. Research will not be required in all circumstances but should be used when there is a need to address risk and uncertainty. Research may also be pursued by the developer to address gaps in knowledge, evaluate the effectiveness of BMPs, address questions that exist across multiple projects, and as a key component of an adaptive management program.

Research should be conducted when: (1) Tier 3 assessment indicates a high risk to affected resources at the local, regional, or entire population scale, and adequate measures are taken to mitigate those effects and the developer chooses to initiate research; (2) Tier 3 assessment shows a high level of risk and there is uncertainty in how to mitigate; or (3) Tier 4 monitoring shows higher than anticipated levels of mortalities or adverse effects.

Project developers are encouraged to discuss research opportunities with the Service, relevant agencies, as well as industry and cooperative organizations. Research partnerships (e.g., Bats and Wind Energy Cooperative, Grassland and Shrub Steppe Species Collaborative) involving diverse players will be helpful for generating common goals and objectives and adequate funding to conduct studies.

1. Tier 5 Questions

Tier 5 research is intended to answer questions in several major categories; answering "yes" to any of these questions might indicate research is needed:

1. Are post-construction levels higher than pre-construction estimates for direct and indirect effects on affected species and/or their habitat?

2. Has monitoring failed to indicate that mitigation measures for affected species or habitat (e.g., deterrence, restoration) have been effective?

3. Are the effects (estimated or known; direct or indirect) of the proposed project expected to reduce the reproduction, survival, and/or distribution of a species at the local, regional, or entire population scale?

4. Is there uncertainty about which methods to use, or the effectiveness of methods, to reduce or avoid adverse effects to the species and/or habitats?

5. Is this project an appropriate candidate to participate in regional-scale research in cooperation with other projects and organizations?

Tier 5 research likely will not be conducted at all projects, and the specific Tier 5 questions, and methods for addressing these questions, may depend on the individual project and the concerns raised prior to construction and during operational phases.

2. Potential Application of Research

More intensive, post-construction fatality research may be used to determine relationships between fatalities and weather, wind speed, or other factors, which usually require frequent and intensive carcass searches. For example, fatalities determined to have occurred the previous night can be correlated with that night's weather or turbine characteristics to establish important relationships that can then be used to evaluate the most effective times and conditions to implement collision-reduction measures.

Research on the efficacy of certain operational modifications (e.g., changing turbine cut-in speed or "**feathering**") to reduce collisions is currently limited and evaluation of such techniques has generally been initiated only recently. Many such operational modifications may be effective at avoiding and/or minimizing adverse effects to species, and may in fact be necessary in some situations. Operational modifications and other measures should be applied at sites where collisions are predicted or demonstrated to be high.

Research is lacking for a number of factors that can affect the rate of collisions, such as color of turbines, marking of blades, turbine juxtaposition, feathering, and ultrasonic and laser deterrents. For many such factors, research will be needed in multiple locations and should be coordinated across the industry. Continued testing and application at appropriate sites will contribute to the breadth of knowledge regarding the efficacy of such measures in addressing collision fatalities. Research remains needed on poorly understood effects such as displacement, noise, and other behavioral changes. There is also little information to address indirect effects that may occur "later in time" but nevertheless may be substantial in terms of severity. Research involving multiple sites and academic researchers can provide results that are more robust.

3. Designing a Research Project

In the past, wildlife managers often used observations and associations on the basics of species life history and habitat use patterns to inform management decisions. This approach is generally no longer deemed sufficient to make important resource decisions. Research in the field of wildlife management is encumbered with tremendous natural variation and numerous uncontrollable factors that are not present in the laboratory. Therefore, wildlife research often lacks the replication needed or the control of extrinsic factors to definitively answer questions. It must therefore be approached with attention to proper design.

Components of true experiments generally include control and treatments, randomization, and replication (Fisher 1935). While true experiments may not be possible in a field situation, "quasi-experiments" may still be preferable to mere observational data collection. Quasi-experiments have some but not all of the requirements of a true experiment (Campbell and Stanley 1963). A discussion on research design, as well as additional information on contemporary research design resources are on the Service Wind Energy website.

Chapter Six
Mitigation

A. Overview

In its Mitigation Policy (501 FW 2 of the Service Manual), the Service defines "**mitigation**" as avoiding and minimizing adverse effects, and when appropriate, compensating for adverse effects. When used in this document, the priority of mitigation activities is to avoid and minimize adverse effects before resorting to compensation. Because avoidance is the first step in achieving mitigation, the importance of early consultation with the Service cannot be overstated. The amount of compensation will depend on the effectiveness of any avoidance and minimization measures undertaken. If a proposed wind development is poorly sited with regard to wildlife effects, the most important mitigation opportunity is largely lost and the remaining options can be expensive, with substantially greater environmental effects. The Service will work with developers to report on the success of industry's mitigation efforts.

During the early communication process the Service, the developer, and other relevant agencies will identify affected species and their habitats that may occur in the area that might be affected by project development. The objective is to avoid, minimize, and/or compensate for adverse effects to affected species, and when appropriate, to provide compensation for unavoidable adverse effects. Avoidance, minimization, and compensation may be required elements of other efforts including conservation plans, regulations, or conditions of permit compliance. It is expected that the developer will work with the Service and other appropriate entities and subject experts to agree on mitigation strategies. It is in the best interest of all parties to cooperate early in the project siting and design process to identify up front where mitigation may be appropriate and feasible. This will avoid unnecessary project delays and allows for incorporation of the mitigation into the project design. Early coordination can help avoid substantial investment costs in projects that may have poor chances of successful permitting or may come with high mitigation expenses, and instead facilitate investment in projects with a high probability of success.

Ideally, project impact assessment is a cooperative effort involving the developer, the Service, tribes, local authorities, and state resource agencies. The Service does not expect developers to provide compensation for the same habitat loss more than once. But the Service, state resource agencies, tribe, local authorities, state and federal land management agencies may have different species or habitats of concern, according to their responsibilities and statutory authorities. Hence, one entity may seek mitigation for a different group of species or habitat than does another. Compensation is most often appropriate for habitat loss and only under limited circumstances or for direct take of wildlife (e.g., Habitat Conservation Plans). In certain limited situations, compensation may be more desirable; developers should consult with the Service and state agency prior to initiating such an approach.

More typically, avoidance and minimization is utilized to offset direct take. EO 13186, which addresses responsibilities of federal agencies to protect migratory birds, includes a directive to federal agencies to restore and enhance the habitat of migratory birds as practicable. So for any

wind projects with a federal nexus, EO 13186 provides a basis and a rationale for mitigating for the loss of migratory bird habitat that result from developing the project.

Regulations concerning eagle take permits in 50 CFR 22.26 and 50 CFR 22.27 may both allow for compensation as part of permit issuance. Compensation may be a condition of permit issuance in cases of nest removal, disturbance or take resulting in mortality that will likely occur over several seasons, result in permanent abandonment of more than a single breeding territory, have large scale impacts, occur at multiple locations, or otherwise contribute to cumulative negative effects. The draft Eagle Conservation Plan Guidance has additional information on the use of compensation for programmatic permits.

ESA also has provisions that allow for compensation through the issuance of an Incidental Take Permit. Under ESA, mitigation measures are determined on a case by case basis, and are based on the needs of the species and the types of effects anticipated. If a federal nexus exists, or if a developer chooses to seek an ITP under ESA, then effects to listed species need to be evaluated through the Section 7 and/or Section10 processes. If an ITP is requested, it and the associated HCP must provide for minimization and mitigation to the maximum extent practicable, in addition to meeting other necessary criteria for permit issuance. For further information about compensation under federal laws administered by the Service, see the Service's Habitat and Resource Conservation website http//www.fws.gov/habitatconservation.

When adverse effects to important habitats cannot be avoided, developers should pursue opportunities to minimize adverse effects to the fullest extent practicable. For example, it may not be possible to avoid removing some forested habitat for a turbine string, but it may be possible to reduce the total amount of forest habitat removed through alternative placement of other structures and to provide compensation for the habitat loss.

In cases where adverse effects cannot be avoided or minimized, it may be possible to offset all, or a portion, of these effects through compensation. One approach for compensation is the Service Mitigation Policy, which describes steps for addressing habitat loss in detail and includes information on Resource Categories to assist in considering type and amount of compensation to offset losses of habitat.

The Mitigation Policy applies to all activities of the Service with three specific exceptions:

A. "**Threatened** or **Endangered species"**
B. Service recommendations for completed federal projects or projects permitted or licensed prior to enactment of Service authorities, or
C. Service recommendations related to the enhancement of fish and wildlife resources.

For example, the resource goals for the following habitat resource categories are:

Resource Category 1: Avoid habitat loss
Resource Category 2: No net loss of in-kind habitat value
Resource Category 3: No net loss of out-of-kind habitat value
Resource Category 4: Minimize loss of habitat value

Under the Service Mitigation Policy, the highest priority is for mitigation to occur on-site within the project planning area. The secondary priority is for the mitigation to occur off-site. Off-site mitigation should first occur in proximity to the planning area within the same ecological region and secondarily elsewhere within the same ecological region. Generally, the Service prefers on-site mitigation over off-site mitigation because this approach most directly addresses project impacts at the location where they actually occur. However, there may be individual cases where off-site mitigation could result in greater net benefits to affected species and habitats. Developers should work with the Service in comparing benefits among multiple alternatives.

Recommended measures may include on- or off-site habitat improvement, and may consist of "**in-kind**" or "**out-of-kind compensation**." Compensatory measures may be project-specific, species-specific, or may be part of a mitigation banking approach. It is recommended that the method for implementing compensation (e.g., fee-title acquisition, in-lieu fee, conservation easement, etc.) be determined as early in the process as possible.

If it cannot be determined that adverse effects have been adequately addressed by existing mitigation measures, additional mitigation for adverse effects from operations may need to be implemented. In some cases, a project's effects cannot be forecast with precision and the developer and the agencies may be unable to make some mitigation decisions until post-construction data have been collected.

Mitigation measures implemented post-construction, whether in addition to those implemented pre-construction or whether they are new, are appropriate elements of the tiered approach. The general terms and funding commitments for future mitigation and the triggers or thresholds for implementing such compensation should be developed at the earliest possible stage in project development. Any mitigation implemented after a project is operational should be well defined, bounded, technically feasible, and commensurate with the project effects.

Some industries, such as the electric utilities, have developed operational and deterrent measures that when properly used can avoid or minimize "take" of migratory birds. Many of these measures to avoid collision and electrocution have been scientifically tested with publication in peer-reviewed, scientific journals. We strongly encourage the wind industry to use these measures in siting, placing, and operating all power lines, including their distribution and grid-connecting transmission lines. While the Service has worked cooperatively with the electric utility industry since the early 1970s, our partnership with the commercial wind industry is a much more recent one and the state of the art regarding operation and deterrence with this industry is only evolving. At present, the primary tool available to the wind industry involves site selection. The Service strongly recommends proponents select sites with the least likelihood of encountering protected species. We acknowledge, however, that even some heavily developed, exploited sites, such as extensive areas of intensive agricultural production remain a concern relative to bat collisions and barotrauma, among others.

B. Operational Measures: Some operational measures have proven effective or are showing promise. Promising measures need further field testing, replication, validation, and

publication in scientific journals to demonstrate their effectiveness. The following are operation measures to be considered as opportunities to reduce adverse effects:

- Changes in blade cut-in speeds have been shown in some cases to reduce bat collision and/or barotrauma by up to approximately 90 percent (Baerwald et al. 2009, Arnett et al. 2010). How this may benefit migratory birds, especially night migrating songbirds, remains unknown. Refining this operational tool for reducing bat mortality is ongoing.
- Blade "feathering" or idling has been suggested as an operational tool and several companies are using it as their primary operational deterrent to avoid or minimize bird take. It will likely also work to avoid or minimize take of bats. Use of the tool may be tied into a profiling Supervisory Control and Data Acquisition radar detection system, operating in both the vertical and horizontal modes, which is designed to detect a certain number of approaching "targets" and send a signal to all operating turbines within a facility to "feather" their blades. There may be a delay of several minutes before the blades pitch into the wind and stop moving. Once the radar determines that the risk has passed, a signal is sent to the turbines to change their blade pitch and begin operating once again. This measure needs further refinement, testing and validation.
- Seasonal shutdowns of turbines either as "rolling shutdowns" or as shutdowns of an entire facility have recently been used at the Altamont Wind Energy Facility in California, but only with limited success. The tool needs to be tested at other facilities and the protocol refined. It has been suggested, for example, as a tool to use at operating turbines in the whooping crane (*Grus americana*) corridor during their spring and fall migrations, and on Appalachian Mountain ridge lines where operating turbines could impact migrating golden eagles and peregrine falcons (*Falco peregrinus*), both of which may fly within rotor swept zones of risk.
- Using published best practices by the APLIC can avoid or minimize take of migratory birds. All distribution and grid-connecting transmission lines, power infrastructure, and any outbuildings and related infrastructure should use electrocution and collision avoidance best practices.
- Steady-burning night lights, especially bright lights, have been well documented to attract and kill a variety of night-migrating bird species especially during inclement weather events (Gehring et al. 2009, Gehring et al. 2010 in press). Turbines should have the minimal amount of lighting required for pilot warning as recommended by the Federal Aviation Administration and the Service (Manville 2005). Lighting on other project infrastructure for security purposes should also be minimized. Security lighting should be motion or heat activated, thereby operating only when needed.
- Where certain turbines within a "string", especially those located at the end of a row, or turbines located in a ridge dip or depression have been shown to kill disproportionate numbers of birds (Smallwood and Thelander 2004), efforts to replace these turbines with pylons show promise. However, further testing should be conducted to validate their efficacy.
- Turbine setbacks from cliff, rim, and ridge edges where raptors frequently soar have provided promising results.

- Minimizing habitats that attract rodents (e.g., brush and rock piles), result in insect attraction (e.g., animal waste from grazing livestock) that may further attract burrowing owls and American kestrels (*Falco sparverius*), among others, and other similar management best practices should be used (Smallwood and Thelander 2004). Further field testing is suggested.
- Where options exist for testing vertical helix turbines compared to the alternative industry standard, 3-bladed turbines, those investigations need to continue in efforts to determine the most bird and bat compatible turbines.

C. Deterrent Devices: Efforts to develop deterrents that effectively warn or frighten birds and bats from operating turbines continue and some methods may prove effective. However, deterrent devices still need further development, refinement, and project application to evaluate their effectiveness. Some of these efforts include:

- Improved blade marking with further testing of variations in paint color and color patterns (e.g., black versus white, white versus yellow, and black versus white phosphorescence), modification of blade design (e.g., to produce bird warning "whistles" without upsetting blade balance and integrity), or other promising or related blade marking devices should continue to be tested to address bird blade "smear" issues (Hodos 2000) and alert birds to moving blades. While color marking has not to date been effective, further testing is suggested.
- Development of ultrasonic devices designed to infuse the entire rotor-swept area of a turbine with high frequency sound intended to alert and frighten bats from within the operating area are currently being tested. Preliminary results are promising.
- **"Infrasound"** has been shown to deter homing pigeon flights (Hagstrum 2000) and may have promise as a bird-alerting warning device at wind facilities. Logistic issues remain challenging but further testing, development, and validation are suggested.
- Laser bird-alerting lights used on double-crested cormorants (*Phalacrocorax auritus*), Canada geese (*Branta canadensis*), and American crows (*Corvus brachyrhynchos*) as airport bird deterrents and for other purposes may provide promising alerting "tools" and turbine deterrent devices. Further testing is recommended.
- Facility lighting should be down-shielded to minimize light emission into the atmosphere where it may attract night-migrating birds, especially during inclement weather.
- Power line collision avoidance "tools" (e.g., swan flight and bird flight diverters, spinners, flappers, and other marking devices should be used where facility wires may result in collision impacts.

Chapter Seven

State and Tribal Coordination

A. Service-State Coordination and Cooperation

These draft Guidelines are intended to complement and not supplant State and Regional guidelines. The Service will work with states and local governments wishing to increase compatibility between state guidelines and these draft Guidelines, protocols, data-collection methods, and recommendations relating to wildlife and wind-energy development. These draft Guidelines contain recommendations that can be used at the Federal, state, tribal, and local levels across the country. The Service will coordinate and share its expertise when requested by a state. The Service will also use states' technical resources as much as possible and as appropriate. The Service and interested states and local governments are encouraged to reach agreements to foster consistency in review of projects.

B. Service-Tribal Coordination and Cooperation

The Federal government maintains a special trust relationship with Tribes pursuant to treaties, statutes, Executive Orders, regulations, and judicial decisions. Many tribal traditional lands and tribal rights extend outside federal lands onto state regulated lands. In addition, tribal interests are impacted in even private land developments. A discussion of tribal input to all projects is important.

Authorities for Federal-Tribal Coordination

Indian tribes have a special status under American law as sovereign nations. Tribes also possess certain rights that are different from the rights of other Americans. Some of the special rights of tribes are based on treaties, acts of Congress, actions taken by the executive branch of the federal government, and by federal court rulings. So the Service will consult with tribes on a government to government basis as described under Executive Order 13175 "Consultation and Coordination with Indian Tribal Governments," and Presidential Memorandum "Government-to-Government Relations with Native American Tribal Governments" (April 29, 1994), Joint DOI/DOC Secretarial Order 3206 "American Indian Tribal Rights, Federal Tribal Trust Responsibilities, and the Endangered Species Act" (updated January 16, 2008), and the USFWS Native American Policy (June 28, 1994).

Tribal Coordination

The Service will, where appropriate, to the extent practicable and permissible by law engage with tribes in open and meaningful communication during coordination. Accordingly, the Service shall seek to establish and maintain effective government-to-government working relationships with Tribes to achieve the common goal of promoting and protecting the fish, wildlife, and their habitats. Whenever the Service is aware that its actions and activities may impact tribal resources or the exercise of tribal rights, or Indian lands (both lands held in trust for tribes and individual Indians, and lands owned by tribes or individual Indians subject to restrictions on alienation), the Service shall consult and coordinate with, and seek the

participation of, the affected Tribes to the maximum extent practicable. This shall include providing affected Tribes adequate opportunities to participate in data collection, consensus seeking, comment, and associated processes. To facilitate the government-to-government relationship, the Service may coordinate its discussions with a representative from an intertribal organization, if so designated by the affected Tribe(s).

Jurisdiction on Tribal Lands

The Service recognizes that Tribes value and take responsibility for the management of their lands and resources. Indian lands, whether held in trust by the United States for the use and benefit of Indians or owned exclusively by a Tribe, are not subject to the controls or restrictions set forth in federal public land laws. Indian lands are not federal public lands or part of the public domain, but are rather retained by Tribes or set aside for tribal use pursuant to treaties, statutes, court orders, executive orders, judicial decisions, or agreements. Accordingly, Tribes manage Indian lands in accordance with tribal goals and objectives, within the framework of applicable laws.

Except when determined necessary for investigative or prosecutorial law enforcement activities, or when otherwise provided in a federal/tribal agreement, the Service, to the maximum extent practicable, shall obtain permission from Tribes before knowingly entering Indian reservations and tribally-owned fee lands and shall communicate as necessary with the appropriate tribal officials. If a Tribe believes this section has been violated, such Tribe may file a complaint with the Secretary, who shall promptly investigate and respond to the Tribe.

Tribal Conservation and Management Plans

The Service acknowledges that Tribes value, and exercise responsibilities for, management of Indian lands and tribal trust resources. As such, the Service shall give deference to tribal conservation and management plans for tribal resources that: 1) govern activities on Indian lands and 2) address the conservation needs of tribal resources. The Service shall conduct government-to-government consultations to discuss the extent to which tribal resource management plans for tribal trust resources outside Indian lands can be incorporated into actions to address the conservation needs of tribal resources.

Communication with other Agencies

The Service will encourage and facilitate communication and cooperation among tribal governments, states, federal agencies and others to identify and delineate respective roles and responsibilities and to ensure that issues of common interest and concern are discussed. This may include such activities as taking the initiative, as lead federal agency in this process, to provide the biological or managerial expertise necessary for resolution of conflicts about fish and wildlife resource issues. This may include, but is not limited to, coordination and cooperation with other fish and wildlife management agencies, such as the National Marine Fisheries Service.

Intergovernmental Agreements for Sensitive Species

The Service shall, when appropriate and at the request of a Tribe, pursue intergovernmental agreements to formalize arrangements for federal candidate, proposed, and listed species such as, but not limited to, land and resource management, multi-jurisdictional partnerships, cooperative

law enforcement, and guidelines to accommodate Indian access to, and traditional uses of, natural products. Such agreements shall strive to establish partnerships that harmonize the Service's mission with the Tribe's own ecosystem management objectives.

Coordination on Cultural Resources Issues

Tribes and the Service both recognize the relationship between habitat resources and cultural and historical resources. The Service and its Cultural Resources Program manage the array of cultural resources under its jurisdiction. Therefore, the Service shall consult with appropriate Tribe(s) to identify the cultural or religious interests, the traditional practices, aboriginal use areas, historic and sacred sites, artifacts, archeological sites, and treaty rights that could be affected by Service actions on Indian lands held in trust by the federal government. The Service will be guided in this respect by such legislation as the National Historic Preservation Act, Native American Graves Protection and Repatriation Act, Archaeological Resources Protection Act, the American Indian Religious Freedom Act, and the Religious Freedom Restoration Act.

The Service will work with Tribes with the goal to promote compatibility between tribal and federally recommended wildlife protocols, data collection methods, and requirements relating to wildlife and wind energy. These wind energy Guidelines contain recommendations that may be generally applicable at the federal, state, tribal and local levels across the country, as well as policies, measures and incentives that are focused on Service policies, procedures, goals and regulations, and those of other federal agencies. Some of the specific recommendations may not be applicable at the tribal government level. Those Tribes that desire to or that have formally adopted wind energy siting, permitting or environmental review regulations or guidelines may contact the Service for technical assistance (including consultation, as necessary, with the Office of the Solicitor) in order to minimize conflicting or unnecessary requirements resulting from different tribal versus federal practices. In addition, the Service will confer, coordinate and share its expertise with interested Tribes when a Tribe lacks its own guidance or program to address wind and wildlife interactions.

Formal agreements between the Service and Tribes may be explored. Cooperation between Tribes and the Service may include the following elements:

- Strengthening a cooperative approach to the management of fish and wildlife habitat on Indian lands through potential mutually cooperative agreements, memoranda of understanding, or memoranda of agreement with interested tribal governments to promote coordinated, consistent review of projects for compliance with applicable Federal wildlife laws.

- Provision for voluntary joint agency reviews and other appropriate measures to reduce duplication and increase coordination between tribal governments and the Service in reviewing projects.

- Fostering of communication between Tribes and Service to ensure that the party first obtaining the information about a prospective project will notify the other party to enable joint planning on how to coordinate review of the project, when consistent with confidentiality agreements.

- Identification of representatives of a Tribe who are authorized to work an applicable Service Regional Office to coordinate review of proposed wind activities under applicable wildlife laws.

- Establishment of consistent and predictable joint protocols, data-collection methodology, and study requirements that can be used by the Service and Tribes to satisfy project permitting and environmental review requirements.

- Designation of a Service contact within each Field Office who is available as a resource to work with Tribes to resolve wildlife-related issues that may arise at projects.

- Establishment of cooperative tribal/Federal/industry research agreements relating to wind-energy development / wildlife interactions.

- Tribes should have confidence that developers are considering tribal resources that may be at risk and are ensuring that tribal regulatory processes or mitigation requirements are being addressed in project development.

- In administering such a tribal/Federal partnership program, the Service and the Tribes may provide differing but complementary services.

Appendices

Appendix A:
Glossary

Adaptive management –A decision process that promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a 'trial and error' process, but rather emphasizes learning while doing. Adaptive management does not represent an end in itself, but rather a means to more effective decisions and enhanced benefits. Its true measure is in how well it helps meet environmental, social, and economic goals; increases scientific knowledge; and reduces tensions among stakeholders.

Adverse- Causing harm or harmful

Affected Resources – Fish, wildlife and their habitats

Affected Species -- Any species of fish, wildlife, or plant which 1) is listed as an endangered, threatened, or candidate species under the Endangered Species Act; 2) is subject to the Migratory Bird Treaty Act or Bald Eagle Protection Act; 3) is designated by law, regulation, or other formal process for protection and/or management by the relevant agency or other authority; or 4) has been shown to have potential to be adversely affected by wind energy development.

Area of influence – A three dimensional area that includes the project site, and the area of potential direct and indirect effects.

Avoid – To forego taking an action or parts of an action, or to change the manner in which or location/timing within which an action is taken, to avert all the potential effects of the action.

Barrier – A structure, impediment or factor that can obstruct, separate, or restrict the free movement, mingling or interbreeding of individuals, a local population or even the entire population of a plant and/or animal species (after Webster's). A commercial wind facility may present a barrier to the free movement of birds, such as migrating Northern Sage-grouse and Common Eiders.

Barrier Effect – The phenomenon that results in a bird's (or other wildlife species) avoidance of, for example, a wind facility, resulting in additional energy use to circumvent the facility. The effect will vary depending on species, turbine layout, size of the development, season, weather, topographic features and other variables. While population level effects from barriers have yet to be documented at offshore wind facilities, there are concerns that blockage between breeding, feeding, loafing, staging, and rafting areas may have significant effects (Fox et al. 2006; Goodale and Divoll 2009; Drewitt and Langston 2006). Similar concerns have been raised for land-based facilities that may impact the movement and dispersal of various species of "prairie" and "sage

grouse," other avifauna, and other terrestrial wildlife (Pruett et al 2009). Cumulative effects are also of concern (Drewitt and Langston 2006).

Before-After Control-impact (BACI) – A study design that involves comparisons of observational data, such as bird counts, before and after an environmental disturbance in both treated and untreated sites. This study design allows a researcher to assess the effects of constructing and operating a wind turbine by comparing data from the "control" sites with the "treatment" sites, and to look at both time periods (before and after management) in all sites.

Best management practices (BMPs) – Methods that have been determined by the stakeholders to be the most effective, practicable means of avoiding or minimizing adverse effects to individual species, their habitats or an ecosystem, based on the best available information.

Community-scale wind energy project – Wind energy projects greater than 100 kW where the electricity is sold rather than used on-site. This category can include large arrays of 100 or more turbines owned by large corporations, a single locally-owned wind turbine greater than 100 kW in size, or anything in between. Wind Energy Glossary at http://www.windustry.org/glossary

Compensation – Replacement of project-induced losses to fish and wildlife resources often through providing funds that will be used to enhance fish and wildlife resources. Substitution or offsetting of fish and wildlife resource losses with resources considered to be of equivalent biological value.

- **In-kind –** Providing or managing substitute resources to replace the habitat value of the resources lost, where such substitute resources are physically and biologically the same or closely approximate to those lost.
- **Out-of-kind –** Providing or managing substitute resources to replace the habitat value of the resources lost, where such substitute resources are physically or biologically different from those lost. This may include conservation or mitigation banking, research, or other options.

Cumulative effects – *See* **effect**.

Displacement – The lack or decrease in use of habitat as result of an animal's behavioral avoidance of otherwise suitable habitat. Displacement may be short-term (during the construction phase of a project), temporary (returning to normal use as a result of habituation), or long-term (for the life of the project and possibly beyond).

Ecosystem – A system formed by the interaction of a community of organisms with their physical and chemical environment. All of the biotic elements (i.e., species, populations, and communities) and abiotic elements (i.e., land, air, water, energy) interacting in a given geographic area so that a flow of energy leads to a clearly defined trophic structure, biotic diversity, and material cycles. Service Mitigation Policy adopted definition from E. P. Odum 1971 *Fundamentals of Ecology.*

Edge – Habitat that is adjacent to a different type of habitat or non-habitat. Land that is deep in the middle of a patch of a given habitat type is often different than habitat on the periphery of that patch, especially if the adjacent area is not a similar habitat type.

Effects – A change or changes to natural resources and the components, structures, and functioning of affected ecosystems.

- **Cumulative –** Changes in the environment caused by the aggregate of past, present and reasonably foreseeable future actions on a given resource or ecosystem.
- **Direct –** Effects on individual species and their habitats caused by the action, and occur at the same time and place.
- **Indirect –** Effects caused by the action and are later in time or farther removed in distance, or occur as a result of a consequence of an action, but are still reasonably foreseeable.

Endangered species – *See* **listed species**.

Extirpation – The species ceases to exist in a given location; the species still exists elsewhere.

Fatality rate – The ratio of the number of individual deaths to some parameter of interest such as megawatts of energy produced, the number of turbines in a wind project, the rotor-swept area, the number of individuals exposed, etc, within a specified unit of time.

Feathering – A form of curtailment for wind turbines that involves either: 1) reducing the angle of individual blades into the wind, thereby reducing rotor speed, or 2) turning the whole unit out of the wind. When rotors are feathered, they are pitched parallel to the wind, essentially making them stationary.

Federal Trust Responsibility – The federal government, through U.S. Fish and Wildlife Service and National Marine Fisheries Service, has responsibilities for anadromous fish which are shared with the states, and also has responsibilities for migratory birds, endangered and threatened species, and marine mammals.

Fish and wildlife –All classes of wild animals including, but not limited to, any mammal, fish, bird, amphibian, reptile, mollusk, crustacean, arthropod, or other invertebrate and any part, product, egg or offspring thereof.

Frequency weighting – In the measurement of sound loudness, a weighting filter is commonly used to mimic the responses of the human hearing. Such a weighting filter will emphasize frequencies for which the human ear is most sensitive, while lessening very high and very low frequencies to which the ear is insensitive. A commonly used weighting is the A-weighting curve, which results in units of dBA sound-pressure level. With this filter, the sound level meter is thus less sensitive to very high and very low frequencies. A-weighting is only really valid for human hearing and relatively quiet sounds. Alternative weighting filters are available including G-weighting to deal with infrasound and "level weighting".

Habitat – The area which provides direct support for a given species, including adequate food, water, space (i.e., air space), cover, and arrangement necessary for survival and completion of life-history processes.

Habitat fragmentation – A process in which a specific habitat is progressively sub-divided into smaller, geometrically altered, and more isolated fragments as a result of both natural and human activities. Habitat fragmentation occurs when the creation of discontinuity in the spatial distribution of resources affects occupancy, reproduction, or survival in a particular species. It is often confused with or complicated by associated habitat loss.

Infill – Add an additional phase to the existing project, or build a new project adjacent to existing projects.

Infrasound - Sound with a frequency below the threshold of human hearing, about 20 Hz. Infrasonic sound with sufficiently large amplitude can be perceived, and is both heard and felt as vibration.

In-kind compensation – See **compensation.**

Intact habitat – An expanse of habitat for a species or landscape-scale feature, unbroken with respect to its value for the species or for society.

Land-based – Wind turbines that are on land.

Lead federal agency – Agency that is responsible for federal regulatory or environmental assessment actions.

Lek – A traditional site commonly used year-after-year by males of certain species of birds (e.g., greater and lesser prairie-chickens, sage and sharp-tailed grouse, and buff-breasted sandpiper), within which the males display communally to attract and compete for female mates, and where breeding occurs.

Listed species – As defined in 50 CFR §402.02, any species of fish, wildlife, or plant that has been determined to be endangered or threatened under section 4 of the Endangered Species Act. Names of listed species are found in 50 CFR 17.11 – 17.12. For purposes of these draft Guidelines, it also includes species similarly designated by state law or rule.

Local population – A subdivision of a population of animals or plants of a particular species that is in relative proximity to a project.

Migration – An evolutionary strategy developed by myriad species and various suites of avifauna, some microchiroptera, some insects, and some land mammals in North America (and elsewhere) to generally move from northerly breeding grounds to southerly wintering habitats – with the exception of some seabirds where the reverse is true (Zimmerman 1998). For birds, staging or congregation gatherings are frequently noted, often in well defined sites where birds gather in large numbers before proceeding with migration. For "flying vertebrates" – consisting

in North America of birds and bats – something is always migrating throughout the year, either staging, resting, feeding, or moving from breeding to wintering sites and vice versa (Zimmerman 1998, Shieldcastle 2006, Carlisle et al. 2009, Popa-Lisseanu and Voigt 2009, Gauthreaux 2010, and Fleming 2010). Therefore, when conducting pre- and post-construction site monitoring, it is important to consider what is moving through an area at any particular time. While, for example, songbirds may have broad-front migratory concentrations during late spring and early fall (Gauthreaux 2010), some marshbirds, many raptors (e.g., September to November and February to May in the Great Lakes [Shieldcastle 2006]) and other species are moving or breeding during periods when site monitoring is not occurring. This could result in a misrepresentation of what species are actually using a site.

Migratory bird – An individual of more than 1,000 species protected by the MBTA, found at 50 CFR 10.13 or http://www.fws.gov/migratorybirds/.

Migration stopovers – Areas where congregations of birds or other fish and wildlife assemble during migration. Such areas (e.g., wetlands and associated habitats) often supply high densities of food.

Minimize – To reduce effects to the smallest practicable amount or degree.

Mitigation – includes actions to avoid, minimize, and/or compensate for adverse effects resulting from a project.

Monitoring – (1) A process of project oversight such as checking to see if activities were conducted as agreed or required; (2) making measurements of uncontrolled events at one or more points in space or time with space and time being the only experimental variable or treatment; (3) making measurements and evaluations through time that are done for a specific purpose, such as to check status and/or trends or the progress toward a management objective.

The objective of monitoring is not to determine cause-and-effect; that is better determined through a research study

Mortality rate – Population death rate, typically expressed as the proportion of individuals in the population that die per year (or some other time period).

Operational modification – Deliberate changes to operating protocols for a project or facility, with the objective of reducing adverse effects to fish and wildlife and their habitats.

Population – A group of interbreeding animals and/or plants of a particular species, that live in the same area at the same time.

Project site - the land and the airspace that is included in the project where development occurs or is proposed to occur including the turbine pads, roads, power distribution and transmission lines on or immediately adjacent to the site, any out-buildings and related infrastructure, ditches, grades, culverts and any changes or modification to the original site before develop occurs.

Airspace including existing or proposed rotor swept areas should be considered as parts of the project site. This includes the space between the development.

Protected Species – Any species of fish, wildlife, or plant that is protected by a federal, state, or other jurisdiction. This includes species protected by the Endangered Species Act**,** Migratory Bird Treaty Act, Bald Eagle Protection Act, as well as those species protected as game or nongame animals by state, tribal, or local authorities.

Relative abundance – The number of organisms of a particular kind in comparison to the total number of organisms within a given area or community.

Retrofitting - Replacing portions of existing wind turbines or project facilities so that at least part of the original turbine, tower, electrical infrastructure, or foundation is being utilized.

Repowering - Removal and replacement of turbines and associated infrastructure

Risk – The likelihood that adverse effects may occur to individual animals or populations, as a result of development and operation of a wind energy project.

Rotor – The part of a wind turbine that interacts with wind to produce energy. Consists of the turbine's blades and the hub to which the blades attach.

Rotor-swept area – The area of the circle (or volume of the sphere) swept by the turbine blades.

Rotor-swept zone – The altitude within a wind energy project which is bounded by the upper and lower limits of the rotor-swept area and the spatial extent of the project.

Species sensitive to habitat fragmentation – Species whose occupancy, breeding, feeding, sheltering, or survival is known or suspected to be reduced by separation of their habitats into smaller blocks

String – A number of wind turbines oriented in close proximity to one another that are usually sited in a line, such as along a ridgeline.

Study area - the area used to answer a particular question under one of the tiers, and part of research, monitoring or assessment. This area could include project site, area of influence, and/or other areas.

Take- As defined by the:

- The Migratory Bird Treaty Act (MBTA) (16 U.S.C. 703-712), prohibits the taking of any migratory bird or any part, nest, or egg, except as permitted by regulation. In 1972, the scope of the Act was expanded to cover bald eagles and other raptors. Implementing regulations define "take" under the MBTA as "pursue, hunt, shoot, wound, kill, trap, capture, possess, or collect." The migratory bird species protected by the Act are listed in 50 CFR 10.13.

- The Bald Eagle Protection Act, commonly known as the Bald and Golden Eagle Protection Act (BGEPA) (16 U.S.C. 668-668c), prohibits anyone, without a permit issued by the Secretary of the Interior, from "taking" bald eagles, including their parts, nests, or eggs. The Act provides criminal and civil penalties for persons who "take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald eagle ... [or any golden eagle], alive or dead, or any part, nest, or egg thereof." The Act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb." "Disturb'' means: "Disturb means to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior." In addition to immediate impacts, this definition also covers impacts that result from human-induced alterations initiated around a previously used nest site during a time when eagles are not present, if, upon the eagle=s return, such alterations agitate or bother an eagle to a degree that injures an eagle or substantially interferes with normal breeding, feeding, or sheltering habits and causes, or is likely to cause, a loss of productivity or nest abandonment.

- The Endangered Species Act (ESA) makes it unlawful for a person to "take" a listed animal without a permit. Take is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct." Through regulations, the term "harm" is defined as "an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering." Listed plants are not protected from take, although it is illegal to collect or maliciously harm them on federal land. Protection from commercial trade and the effects of federal actions do apply for plants. In addition, states may have their own laws restricting activity involving listed species.

Threatened species – *See* **listed species**.

Wind Resource Area - (WRAs): Areas where wind energy is available for use based on historical wind data, topographic features, and other parameters.

Wind turbine – A machine for converting the kinetic energy in wind into mechanical energy, which is then converted to electricity.

Appendix B:
Best Management Practices (BMPs) for Wind Energy Development

Site Planning, Construction, Operation, Retrofitting and Repowering

During project site planning for wind energy projects, developers should avoid and minimize adverse effects to fish and wildlife resources through careful site selection and facility design. The following BMPs can assist a developer in the planning process, including retrofitting and repowering, to help reduce potential effects to fish and wildlife resources. At some project sites, implementation of these BMPs alone may not fully address adverse effects to fish and wildlife resources. For these projects, additional compensation may be needed to address site-specific concerns. Not all of these BMPs will apply to every project site.

These BMPs will evolve over time as additional experience, learning, monitoring, and research becomes available for wind energy. The Service will work with the wind industry, states, and other stakeholders to evaluate and revise these BMPs on a periodic basis, and make the updated information publicly available.

1. Minimize, to the maximum extent practicable, the area disturbed by pre-construction site monitoring, testing activities, and installations.
2. Avoid active construction of wind facilities during key times in the life history of fish and wildlife, such as the nesting season for migratory birds.
3. Use all available data from state and federal agencies, and other sources, such as maps, databases, reports, that show the location of fish and wildlife resources and the results of Tier 2 and/or 3 studies to establish the layout of roads, power lines, fences, and other infrastructure.
4. Minimize, to the maximum extent practicable, the extent of roads, power lines, fences, and all other infrastructure associated with a wind development project. When fencing is necessary, construction should use wildlife compatible design standards.
5. Use native plant seed sources to the maximum extent possible when seeding or planting during restoration. Consult with appropriate state and federal agencies regarding native species to use for restoration.
6. To reduce avian collisions, place low and medium voltage connecting power lines associated with the development underground to the maximum extent practicable, unless it can be demonstrated that doing so would result in greater adverse effects to fish and wildlife resources.
7. For any overhead power lines constructed to support a wind energy project all applicable guidelines from the APLIC 2006 (Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006) and 1994 (Mitigating Bird Collisions With Power Lines: The State of The Art in 1994) guidance documents should be implemented to minimize wildlife electrocutions and collisions.

8. Avoid guyed communication towers and permanent meteorological towers at project sites. If guy wires are necessary, use bird flight diverters or high visibility marking devices to increase their visibility. Where permanent meteorological towers must be maintained on a project site, use the minimum number necessary.
9. Use only red, or dual red and white strobe, strobe-like, or flashing lights, not steady-burning lights, to meet FAA requirements for visibility lighting of wind turbines, permanent met towers, and communication towers. Wind facilities should be lit with the minimum number of lights required on the turbines to meet FAA requirements. All pilot warning lights should fire synchronously.
10. Keep lighting at both operation and maintenance facilities and substations to the minimum required. Use lights with motion or heat sensors and switches to keep lights off when not required. Lights should be hooded downward and directed to minimize horizontal and skyward illumination. Minimize use of high intensity lighting, steady-burning, or bright lights such as sodium vapor, quartz, halogen, or other bright spotlights.
11. Establish non-disturbance buffer zones in areas of high risk for affected species identified in pre-construction studies. Determine the extent of the buffer zone in consultation with the Service, state, local, and tribal wildlife biologists, and land management agencies as appropriate.
12. Locate turbines to avoid separating wildlife species from their daily roosting, feeding, sheltering, or nesting sites if documented that the turbines' presence poses a risk to species.
13. Avoid effects to hydrology and stream morphology, especially where federal or state-listed aquatic or riparian species may be involved. Use all appropriate erosion control measures in construction and operation to eliminate or minimize runoff into water bodies.
14. Although it is unclear whether tubular or lattice towers reduce risk of collision, when practical, use tubular towers or best available technology to reduce ability of birds to perch.
15. After project construction, close any roads not needed for site operations and restore these roadbeds to native vegetation.
16. Minimize effects to wetlands and water resources by following all applicable provisions of the Clean Water Act and the Rivers and Harbors Act; for instance, by developing and implementing a storm water management plan and taking measures to reduce erosion and avoid delivery of road-generated sediment into streams and waters.
17. Establish a training program for staff and contractors working on construction, operation, and maintenance of projects with respect to implementation of BMPs. This should include instructing employees, contractors, and site visitors to avoid harassing or disturbing wildlife, particularly during reproductive seasons or other sensitive times, and driving at appropriate speeds.
18. Take precautions to avoid wildfires on project sites. Reduce fire hazard from vehicles and human activities. For example, employees should use spark arrestors on power equipment, ensure that no metal parts are dragging from vehicles, and use caution with open flames, cigarettes, etc. Site development and operation plans should specifically address the risk of wildfire and provide appropriate cautions and measures to be taken in the event of a wildfire.

19. Follow federal and state measures for handling toxic substances to minimize danger to water and wildlife resources from spills. Facility operators should maintain Hazardous Materials Spill Kits on site and train personnel in the use of these.
20. Reduce the introduction and spread of invasive species by following applicable local policies for noxious weed control; cleaning vehicles and equipment arriving from areas with known invasive species issues; using locally sourced topsoil; and monitoring for and rapidly removing noxious weeds at least annually.
21. Use pest and weed control measures as specified by county or state requirements, or by applicable federal agency requirements (such as Integrated Pest Management) when federal policies apply.
22. Properly manage garbage and waste disposal on project sites to avoid creating attractive nuisances for wildlife by providing them with supplemental food. In some circumstances removing large animal carcasses (e.g., big game, domestic livestock, or feral animal) should also be considered.
23. Remove wind turbines when they are no longer cost effective to retrofit or repower.

Decommissioning Best Management Practices:

Decommissioning is the cessation of wind energy operations and removal of all associated equipment, roads, and other infrastructure. The site is then dedicated to a new type of land use. During decommissioning, contractors and facility operators should apply BMPs for road grading and plant re-establishment to ensure that erosion and overland flows are managed to restore pre-construction landscape conditions. The facility operator, in conjunction with the landowner and state and federal wildlife agencies, should restore the natural hydrology and plant community to the greatest extent practical.

1. Methods should minimize new site disturbance and removal of native vegetation, to the greatest extent practicable.
2. Foundations should be removed and covered with soil to allow adequate root penetration for native plants, and so that subsurface structures do not substantially disrupt groundwater movements.
3. If topsoils are removed during decommissioning, they should be stockpiled and used as topsoil when restoring plant communities. Once decommissioning activity is complete, topsoils should be restored to assist in establishing and maintaining pre-construction native plant communities to the extent possible, consistent with landowner objectives.
4. Soil should be stabilized and re-vegetated with plants appropriate for the soil conditions and adjacent habitat using agency approved sources, and of local seed sources where feasible, consistent with landowner objectives.
5. Surface water flows should be restored to pre-disturbance conditions, including removal of stream crossings, roads, and pads, consistent with stormwater management objectives and requirements.

6. Surveys should be conducted by qualified experts to detect invasive plants, and comprehensive approaches to controlling invasive plant species should be implemented and maintained as long as necessary.
7. All facilities and infrastructure that are no longer needed should be removed.
8. After decommissioning, erosion control measures should be installed in all disturbance areas where potential for erosion exists, consistent with stormwater management objectives and requirements.
9. Fencing should be removed unless the landowner requires such fence, and the retained fence meets requirements outlined for regional conservation of fish and wildlife resources.
10. Petroleum product leaks and chemical releases should be remediated prior to completion of decommissioning.

Appendix C:
Literature Cited

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