GUIDELINES FOR REDUCING IMPACTS TO WILDLIFE FROM WIND ENERGY DEVELOPMENT IN ARIZONA

Arizona Game and Fish Department

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ABSTRACT
These *Guidelines* provide information to help reduce impacts to wildlife from wind energy development in Arizona. They include recommendations on: 1) preliminary screening of proposed wind energy projects, 2) pre-construction study design and methods, 3) assessing direct, indirect, and cumulative impacts to wildlife in accordance with state and federal laws, 4) developing avoidance and minimization measures, 5) establishing appropriate mitigation, and 6) post-construction operations monitoring, analysis, and reporting methods.

ACKNOWLEDGEMENTS
These *Guidelines* are closely based on the guidelines: "California Energy Commission and California Fish and Game, 2007. California Guidelines for Reducing Impacts to Birds and Bats from Wind Energy Development. Commission Final Report. California Energy Commission, Renewables Committee, and Energy Facilities Siting Committee, and California Department of Fish and Game, Resources Management and Policy Division. CEC-700-2007-008-CMF". The authors would like to thank the California Energy Commission and California Department of Fish and Game for the approval to use their guidelines to create this document.

DISCLAIMER
The Arizona Game and Fish Department (AGFD), its employees, contractors, and subcontractors make no warrant, express or implied, and assume no legal liability for the information in this report; nor does any party represent that the use of this information will not infringe upon privately owned rights. This report has been reviewed and endorsed by AGFD as guidance. The recommendations and protocols discussed in this report are intended to be guidance for developers and local permitting agencies to avoid, minimize, or mitigate their impacts to Arizona's wildlife. These *Guidelines* are voluntary and are not intended to implement, replace, duplicate, interpret, amend, or supplement any current statute or regulation. Adherence to these *Guidelines* does not ensure compliance with any local, state, or federal statute or regulation, nor does failure to follow these *Guidelines* necessarily imply a violation of state laws.

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EXECUTIVE SUMMARY

These *Guidelines* are recommendations and protocols to be used by wind energy developers and local permitting agencies in Arizona, and as a resource for other parties involved in the permitting process. Local governments are encouraged to integrate the recommended study methods described herein with biological resource information and research unique to their region. The Arizona Game and Fish Department (AGFD), acting on behalf of the Arizona Game and Fish Commission, encourage the use of the *Guidelines* for the biological assessment, mitigation, and monitoring of wind energy projects in Arizona.

This document provides a science-based approach for assessing the potential impacts a wind energy project may have on wildlife species and includes suggested measures to avoid, minimize, and mitigate identified impacts. The focus is primarily on bat and bird species because they are most likely to be affected by wind energy development. However, wind energy development can also impact other wildlife; therefore, general guidance to avoid, minimize, and mitigate these impacts is covered in Chapter 4.

The document is organized around five basic project development steps:

1. Determine wildlife protection laws and the permitting process.
2. Gather preliminary information and conduct site screening.
3. Collect pre-construction data using standardized monitoring protocol.
4. Identify potential impacts to wildlife and mitigation.
5. Collect post-construction monitoring data using a standardized monitoring protocol.

Information in the *Guidelines* was specifically designed to employ adaptive management to address local and regional concerns and site-specific conditions. This information includes: frequency and type of bat and bird use, terrain, and the availability of scientifically accepted data from nearby sources. Decisions on the intensity of survey effort need to be made in consultation with AGFD.

The *Guidelines* do not duplicate or supersede any/or other legal requirements. This document does not mandate or limit the types of studies, mitigation, or alternatives an agency may decide to require.

INTRODUCTION

Arizona is a place of ecological extremes. Landscapes include a host of environments ranging from Alpine tundra conditions found on the San Francisco Peaks with an elevation exceeding 12,000 feet, and precipitation averaging 35 to 40 inches per year, to Sonoran Desertscrub where average rainfall can be as little as 3 inches a year and the lowest elevations are just above sea level. Between these extremes exists some of the most diverse habitat in North America. These climatic conditions have given rise to some of the most interesting and unique species as well as adaptations. Therefore, species in Arizona may respond differently to wind development than their counterparts in other states.

The same environmental conditions that produce such an interesting array of wildlife and habitat have made Arizona very popular with humans as well. Warm winter climates in the lower elevations of the state and cool summers in the high country, along with a myriad of outdoor recreational opportunities, have encouraged an ever increasing number of people to call Arizona home. This influx and increased outdoor activity has put tremendous pressure on land use and wildlife in the state. Environmental managers are studying the long-term effects of increased human demands on our environmental resources.

In order to make sound management decisions, resource managers and developers must understand and appreciate the biological ecosystems being impacted. Ecosystems are dynamic, so it is imperative the most current information is available for making decisions. Because humans now influence all ecosystems in Arizona, we need to plan responsibly to lessen impacts caused by continued development and economic growth.

The purpose of the *Guidelines for Reducing Impacts to Wildlife from Wind Energy Development in Arizona (Guidelines)* is to outline Arizona Game and Fish Department's (AGFD) recommendations to lessen the potential impacts on wildlife by: 1) describing methods to assess and evaluate wildlife activity at proposed wind projects, 2) design pre-construction and post-construction monitoring plans, and 3) develop avoidance and mitigation measures. Using these *Guidelines* will promote scientifically sound cost-effective study designs, produce comparable data among studies within Arizona, allow for analyses of trends and patterns of impacts at multiple sites, and improve the ability to estimate and resolve impacts to wildlife populations locally and regionally. Early and frequent communication related to potential impacts to wildlife is encouraged. AGFD recommends that developers work with us throughout the planning and implementation of a wind project.

This document focuses primarily on bat and bird species because those species have been highly impacted by wind energy development. However, wind energy development may impact other wildlife species as well. For example, pronghorn antelope are particularly sensitive to human-caused habitat modifications and fragmentation (e.g. roads, mechanical movement) and they are listed as an AGFD Species of Greatest Conservation Need. General guidance to avoid, minimize, or mitigate these impacts are covered in Chapter 4.

Organization of the Document

The *Guidelines* are split into five chapters:

- Chapter 1, "Wildlife Protection Laws and The Permitting Process," offers information on wildlife protection laws to facilitate completion of the permit process.

- Chapter 2, "Preliminary Site Screening," discusses the actions a developer should take to assess the biological resources of a potential wind energy project and to determine which studies would adequately evaluate the impacts on wildlife.

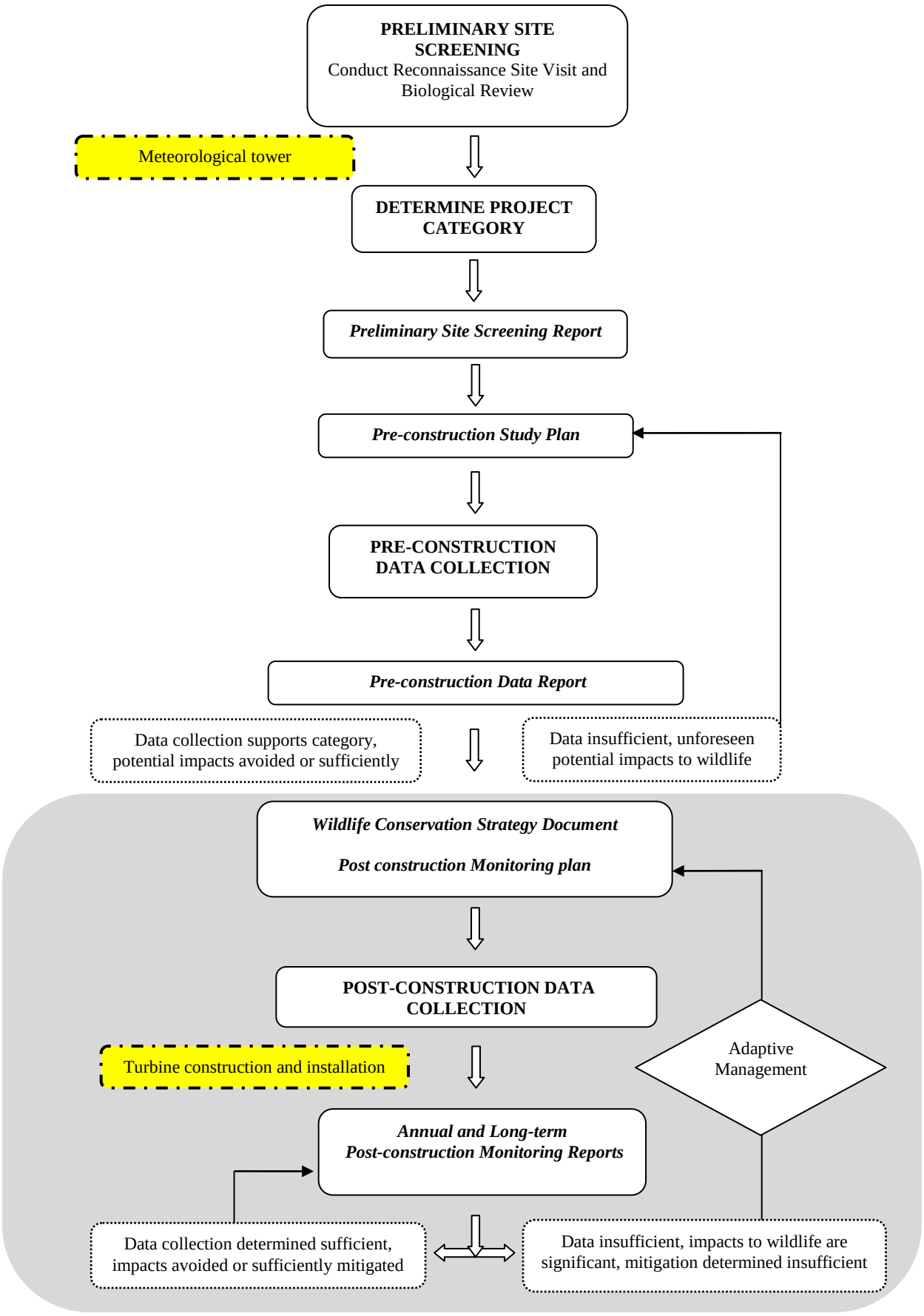
- Chapter 3, "Pre-construction Survey Protocols," offers standardized survey methods, protocols, and recommendations for conducting the studies identified by preliminary site screening.

- Chapter 4, "Impact Assessment and Mitigation," discusses how to assess impacts discovered during the pre-construction studies and suggests avoidance and mitigation measures to incorporate into the planning and construction of the wind energy project. This includes development of a wildlife conservation strategy (e.g. Bird and Bat Conservation Strategy).

- Chapter 5, "Post-construction Monitoring and Reporting," recommends standardized survey and monitoring techniques for collecting, interpreting, and reporting bat and bird fatalities and wildlife use data after construction. This chapter also discusses the formation of a Technical Advisory Committee (TAC) whose role is to provide advice and recommendations for developing and implementing effective and adaptive measures to monitor, avoid, minimize, and mitigate impacts to wildlife species and their habitats related to wind farm operations.

Within each Chapter is a reporting requirement. Reporting is crucial to assess if: 1) wind projects have undergone accurate methods of understanding the effects on biological resources in the area, 2) whether the impacts can be avoided and/or minimized, and 3) whether mitigation measures are appropriate. Monitoring reports are most useful when they follow a standard scientific reporting format and provide sufficient detail to allow agency and peer reviewers the ability to evaluate the methods used, understand the basis for conclusions, and independently assess conclusions. Thus, AGFD recommends permitting agencies and/or project proponents draft separate reports for each Chapter. This information can also be found in Appendix D. Below is a flowchart of the process.

WIND GUIDELINES FLOWCHART



Where to Submit Reports

All reports should be submitted to the AGFD's Project Evaluation Program (PEP) by email at pep@azgfd.gov, or mailed to:

Arizona Game and Fish Department
Project Evaluation Program - WMHB
5000 W. Carefree Highway
Phoenix, AZ 85086-5000

The Future of This Document

These *Guidelines* reflects the current state of knowledge about the impacts of wind energy development on wildlife. AGFD will continue to update and revise portions of the document as new research findings and user feedback suggests the current recommendations may need revision. For questions about this document or to contribute information to the current body of knowledge, please contact the PEP at (623) 236-7600.

CHAPTER 1: WILDLIFE PROTECTION LAWS AND THE PERMITTING PROCESS

Various federal, state, and local laws regulate the permitting requirements for wind energy development in Arizona. This chapter clarifies the permitting process and offers suggestions for completing the process by:

- Providing an understanding of the regulatory framework of environmental laws and processes governing siting and permitting.
- Providing an understanding of the agencies and other stakeholders who should be engaged in the process.
- Encouraging consistent use of pre-construction assessment methods to assess impacts and develop mitigation.

With the exception of wind energy development occurring on federal and state lands, compliance with these *Guidelines* is voluntary, but all native wildlife are protected under state law (see *State Laws*). AGFD strongly encourages adherence to these *Guidelines* to ensure impacts to wildlife populations are minimized from wind energy development and operations. Although it is not possible to absolve individuals and entities from liability for unlawfully taking wildlife under state law, AGFD will take compliance with these guidelines into consideration when considering law enforcement action. AGFD also encourages those involved in wind energy development to follow the recommendations set forth by the U.S. Fish and Wildlife Service (USFWS) in their *Land-Based Wind Energy Guidelines* (USFWS 2012) as they have similar prosecutorial discretion for species protected under federal laws.

Initiating the Permitting Process

Permitting decisions are made by the appropriate land management agency dependant on project location. We encourage all permitting authorities to adopt these *Guidelines* as part of the permit requirements. Examples of permitting requirements for wind development include the following:

- Private lands require a county or city land use permit. Permittees should contact the appropriate county/city early in the process to determine if there are standard conditions for addressing natural resource impacts. Compliance with these *Guidelines* during the permitting process is recommended, but is at the discretion of the county/city to require within their permit.
- Arizona State Trust Lands require a permit (e.g., commercial lease or right-of-way) from the Arizona State Land Department (ASLD) and a land use permit from the appropriate county. ASLD is required to consult with AGFD on all projects per an inter-agency Memorandum of Understanding. AGFD will recommend adherence to these *Guidelines*.
- Federal lands are governed by the federal land management agency where the development is being proposed. Each federal agency has its own permitting process which is subject to their laws, regulations, and policies, as well as the National

Environmental Policy Act (NEPA). Through NEPA, federal agencies must make diligent efforts to involve the public in preparing and implementing their NEPA procedures [40 CFR 1506.6(a)]. This includes coordination with the States and adherence to these *Guidelines* as well as the USFWS Land-Based Wind Energy Guidelines (USFWS 2012) will be recommended.

- Tribal lands fall under the jurisdiction of the tribal authority, and do not require AGFD consultation. However, AGFD encourages coordination where projects are adjacent to other federal, state, or private lands. Projects proposed on non-tribal lands owned or leased by tribes follow similar consultation procedures as projects proposed on private or state lands.

Permitting agencies and project proponents should consult with AGFD to identify any potential impacts to Special Status Species and other wildlife in the project area. AGFD consultations typically follow these steps:

1. The permitting agency or project proponent initiates a review of their project on HabiMap™ Arizona. This tool is a non-regulatory, online, publicly accessible tool to use for project planning and to assess general conservation value, see Chapter 2. .
2. The permitting agency or project proponent obtains a Special Status Species List from the Arizona On-line Review Tool or through the AGFD Project Evaluation Program (PEP).
3. The permitting agency or project proponent initiates an AGFD project review through PEP. PEP provides policy, technical and environmental law compliance guidance and oversight, and coordinates an internal review of land use projects affecting fish and wildlife resources in Arizona. PEP will advise the permitting agency or project proponent if coordination with the USFWS and/or AGFD is likely necessary to avoid, minimize, or mitigate wildlife impacts.
4. AGFD encourages permitting agencies and project proponents to continue coordination throughout the preliminary site screening, pre-construction assessment, impact analysis and mitigation, and operations monitoring and reporting phases.

Federal and state wildlife laws can influence project siting and operations. For example, wind energy projects which have the potential to "take" federally listed or protected species are subject to permitting requirements under the Endangered Species Act (ESA) and the Bald and Golden Eagle Protection Act (BGEPA). In addition, there are Arizona state laws protecting wildlife and their habitats (see below). Project proponents and permitting agencies should be familiar with these laws during the permitting process to ensure impacts to wildlife are minimized and/or mitigated for in order to avoid violating state and federal law.

The permitting agency and project proponent should coordinate frequently with AGFD and USFWS throughout the process, and particularly during development of permit conditions. Permitting agencies should structure permit conditions to clearly define the obligations of the developer and to establish triggers for mitigation beyond what is required upon project approval. Requirements for additional mitigation may include contributions to AGFD for research.

Involving and Communicating with Regulatory Agencies and Stakeholders

Project proponents should contact permitting agencies, landowners, AGFD, and USFWS early in the permitting process to obtain critical input on site development decisions, including any surveys that must be completed before permits may be issued and construction may begin. In addition, initiating pre-construction surveys early will help to avoid unnecessary delays during permitting (particularly in cases where NEPA compliance documentation is required).

Navigating Local, State, and Federal Laws

County Ordinances / Regulations

Some Arizona counties have adopted wind resource policies or ordinances as part of their general plans or zoning ordinances (e.g. Coconino, Navajo). The Department recommends checking local county policies as it relates to permitting policies. All counties currently permit wind development through a Conditional Use Permit. This county permit allows a wind energy project to operate under existing zoning ordinances so long as certain conditions (e.g. setbacks, height, noise, safety, aesthetics, wildlife protections) are met. Some county general plans include language, or direct planning staff to work with local, state, and federal agencies to ensure wind energy projects avoid, minimize, and mitigate direct impacts to fish, wildlife, and botanical resources wherever practicable. Some county general plans address assessment of impacts to wildlife and other natural resources, and some provide specific guidance on studies or programs necessary to quantify, mitigate, or monitor such impacts. The creation of these *Guidelines* is intended to fill this void in the planning/permitting process.

AGFD Policy

Although AGFD enforces Arizona's state wildlife laws, AGFD is not a permitting authority for wind energy development. Rather, AGFD makes recommendations to avoid, minimize and/or mitigate impacts to wildlife, and elects to support or oppose wind energy projects in consultation with the permitting agency. In making a decision to support or oppose a project, AGFD uses its *Wildlife and Wildlife Habitat Compensation Policy* (Commission Policy A2.16, Department Policy I2.3, authorized under A.R.S. 17-211) and its biological expertise to analyze impacts to wildlife from the proposed project activities. AGFD recommends project proponents follow this policy.

The *Wildlife and Wildlife Habitat Compensation Policy* guides the agency in evaluating habitat loss from development projects such as wind energy. This policy requires AGFD to work with developers and permitting agencies to develop adequate mitigation plans for habitat losses resulting from land and water projects. Criteria used to identify general mitigation goals fall into four categories (not to be confused with the Project Categories defined in Chapter 2):

- **Resource Category I**: Habitats in this category are of the highest value to Arizona Wildlife species and are irreplaceable on a statewide or regional basis.
  Goal: No loss of existing in-kind habitat value.
  Guideline: All potential losses of existing habitat values will be prevented. Insignificant changes may be acceptable provided they will have no significant cumulative impacts.

- **Resource Category II**: Habitats in this category are of high value for Arizona wildlife and are relatively scarce or becoming scarce on a statewide or regional basis.
  Goal: No net loss of existing habitat value, while minimizing loss of in-kind value.
  Guideline: Losses be avoided or minimized. If significant losses are likely to occur, AGFD will recommend alternatives to immediately rectify, reduce, or eliminate these losses over time.
- **Resource Category III**: Habitats in this category are of high to medium value for Arizona wildlife and are relatively abundant.
  Goal: No net loss of habitat value.
  Guideline: AGFD will recommend ways to minimize or avoid habitat losses. Anticipated losses will be compensated by replacement of habitat values in-kind, or by substitution of high value habitat types, or by increased management of replacement habitats, so no net loss occurs.
- **Resource Category IV:** Habitats in this category are of medium to low value for Arizona wildlife, due to proximity to urban development or low productivity associated with these sites.
  Goal: Minimize loss of habitat value.
  Guideline: AGFD will recommend ways to avoid or minimize habitat losses.

State Laws

Arizona State Statutes and AGFD Commission Policies have been established to maintain, protect, restore, and enhance fish and wildlife populations and their habitats. Project proponents should be familiar with these statutes and policies to ensure their projects are consistent with the intent of these laws and policies. Several Arizona state statutes and AGFD Commission policies, some of which are discussed below, are relevant to wind energy projects. Violation of these laws or other policies can result in criminal prosecution and/or civil liability.

- Pursuant to A.R.S. § 17-102, wildlife is the property of the state, and can be taken only as authorized by the Arizona Game and Fish Commission.
- "Wildlife" is defined in A.R.S. § 17-101(A)(22) as "all wild mammals, wild birds, and the nest or eggs thereof, reptiles, amphibians, mollusks, crustaceans, and fish, including their eggs or spawn."
- "Take" is defined in A.R.S. § 17-101(A)(18) as "pursuing, shooting, hunting, fishing, trapping, killing, capturing, snaring or netting wildlife or the placing or using of any net or other device or trap in a manner that may result in the capturing or killing of wildlife."
- It is unlawful to "take, possess, transport, buy, sell or offer or expose for sale wildlife except as expressly permitted" under A.R.S. § 17-309(A)(2)..
- A.R.S. § 17-235 authorizes the Arizona Game and Fish Commission to regulate the taking of migratory birds in accordance with the MBTA, described below.
- Under A.R.S. § 17-236(A), "it is unlawful to take or injure any bird or harass any bird upon its nest, or remove the nests or eggs of any bird, except as may occur in normal horticultural and agricultural practices and except as authorized by commission order",

- No state or federal lands can be closed to hunting or fishing without the consent of the Arizona Game and Fish Commission, and no person may lock a gate blocking access to state lands pursuant to A.R.S. § 17-304 and Arizona Administrative Code R12-4-110. Permittees should contact the AGFD Ombudsman at AGFD Headquarters for information regarding filing a petition with the Arizona Game and Fish Commission where a project requires the closure of state or federal lands to hunting or fishing.

Federal Laws

The following federal laws apply to protecting wildlife from the impacts of wind energy development. For more detailed information on federal laws and guidelines, refer to the USFWS *Land-Based Wind Energy Guidelines* (USFWS 2012).

- The National Environmental Policy Act and the regulations promulgated there under (42 U.S.C. § 4321, *et seq*., 40 CFR § 1500.1, *et seq*.) require the federal government to assess the environmental impacts of any "federal action," which includes actions undertaken (1) on federal land, (2) by a federal agency, (3) with federal funds, or (4) where the federal government will be issuing a permit. In some cases, federal agencies must prepare detailed Environmental Impact Statements or Environmental Assessments assessing the environmental impact of, and alternatives to, federal actions significantly affecting the environment. An example of a wind energy project falling under NEPA jurisdiction would be the proposed placement of wind turbines or associated transmission lines on U.S. Forest Service or Bureau of Land Management land. NEPA requires federal agencies to cooperate with state and local agencies in analyzing environmental impacts of proposed federal actions. More details on NEPA can be found at http://www.nepa.gov/nepa/regs/nepa/nepaeqia.htm
- The Endangered Species Act, 16 U.S.C. §1531, *et seq*., provides for the conservation of ecosystems upon which threatened and endangered species of fish, wildlife, and plants depend. The ESA, among many other things: 1) authorizes the determination and listing of species as endangered or threatened; 2) prohibits unauthorized taking, possession, sale, and transport of endangered species (including land-use activities that "harm" or "harass"); and 3) authorizes the assessment of civil and criminal penalties for violating the Act or regulations. ESA authorizes permits for the take of protected species if the permitted activity is for scientific purposes, is to establish experimental populations, or is incidental to an otherwise legal activity. Section 7 of the ESA requires federal agencies to insure that any action authorized, funded or carried out by them is not likely to jeopardize the continued existence of listed species or modify their critical habitat. More information on the ESA can be found at http://www.fws.gov/endangered/policy/index.html.
- Migratory Bird Treaty Act, 16 U.S.C. § 703, *et seq*., prohibits taking, killing, possessing, transporting, and importing of migratory birds, including their eggs, parts, and nests, except when specifically authorized by USFWS. Slightly more than 400 species of birds that are protected by the MBTA are either resident or at least occur annually in Arizona during certain seasons of the year (winter, summer, or during migration). The MBTA authorizes permits for some activities, including but not limited to scientific collecting, depredation, propagation, and falconry. No permit provisions are available for incidental take for any project-related incidental take, including take associated with wind energy

development. For more information on the MBTA, go to http://www.fws.gov/permits/mbpermits/regulations/mbta.html.

- Bald and Golden Eagle Protection Act, 16 U.S.C. §668, *et seq*., protects the bald eagle and the golden eagle by prohibiting, except under certain specified conditions, the take, possession, and commercial use of such birds. The BGEPA defines "take" of an eagle to include: "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, or molest or disturb." Take for bald and golden eagles can only be authorized under a permit provided such permits are "compatible with the preservation of the bald eagle or golden eagle." Forthcoming, guidance from the USFWS will provide information on creation of eagle conservation strategies and subsequent application for BGEPA take permits for projects that may result in "take" of bald and golden eagles. More information on the BGEPA can be found at http://www.fws.gov/midwest/eagle/guidelines/bgepa.html.

Federal wildlife protection laws prohibit most instances of take, although each law may provide for exceptions. Under these laws, unauthorized take may be penalized, even if the offender had no intent to harm a protected species. Direct consultation with the USFWS should occur early in the project development process to ensure each project is reviewed and permitted appropriately under these federal laws. When the project occurs on federal lands, the Federal land management agency is responsible for this consultation.

CHAPTER 2: PRELIMINARY SITE SCREENING

Wind energy developers need information to assess the biological sensitivity of the proposed project site early in the development process. This preliminary information gathering, or site screening, consists of a reconnaissance field survey and data collection from databases, federal and state agencies, and local experts. This information is used to identify species potentially at risk and the impact questions that must be addressed. Site screening is the first step in determining the kinds of studies developers will need to conduct and allows the project proponent the opportunity to seek a different site if significant, unavoidable impacts seem likely despite careful turbine siting.

This section is intended to provide guidance to wind energy developers to determine the biological significance of a site. It also includes recommendations on developing a scientific pre-construction study and assessing the level of effort required for such studies. For more information regarding the scope and nature of wildlife issues associated with wind energy projects, developers and project biologists should reference the Wildlife Society's Technical Review: *Impacts of Wind Energy Facilities on Wildlife and Wildlife Habitat* (Arnett et al. 2007).

Reconnaissance Site Visit, Meteorological Tower Construction, and Initial Biological Assessment

Once the landowner has granted permission to access the proposed wind energy site, the project proponent needs to arrange for a qualified wildlife biologist who is knowledgeable about the wildlife in the region to conduct a reconnaissance survey. The purpose is to obtain information on the vegetative communities and significant topographic features which will help determine the wildlife community using the project site. The biologist should prepare for the survey by securing recent aerial photography of the site (e.g. Google Earth imagery). In addition, the biologist should consult topographic maps to assess landscape level habitat features such as water or riparian features and/or significant geological features which may indicate high potential use of the area by wildlife. Surveys should be of sufficient duration and intensity to adequately address all habitat types in, and immediately adjacent to, the project area and provide a basis for predictions about species occurrence at the site throughout the year.

One of the first steps in determining whether a site has a wind resource sufficient for a wind development is to collect data through the installation of meteorological towers (met towers). AGFD requests project proponents recognize that the period of wind resource data collection (i.e. when met towers are operating) coincides with the pre-construction data collection period. Depending on the project timeline, AGFD requests project proponents consider initiating pre-construction monitoring (See Chapter 3, Pre-construction Survey Protocols) during the meteorological data collection phase.

Met towers usually collect wind data for a period of at least 1-2 years prior to wind tower construction. Many of these towers are considered temporary; however, a number of towers become permanent throughout the life of a wind project. Met towers (whether temporary or permanent) and their associated infrastructure have the potential to cause bat and bird mortalities

resulting from mid-flight strikes with the tower guy wires. Studies have shown guy-wired towers can cause four times more bird mortality than towers without guy wires (Young et al., 2003. http://www.west-inc.com/reports/fcr_final_mortality.pdf). While bats can also strike guy wires, the occurrence is much less frequent. In addition, the visibility of met towers is important for the safety of aircraft pilots at low flight elevations. To reduce the potential for bat and bird collisions, and to provide guidance for keeping pilots and personnel safe, AGFD has developed these recommendations. These guidelines can also be found in Appendix C.

- AGFD requests all *permanent* met towers be unguyed, free standing structures. If monopole are not practicable, then free standing lattice towers with perching deterrents may suffice. If possible, AGFD also requests temporary met towers be unguyed, monopole, free standing structures.
- When guy wires are present, AGFD recommends attaching Bird Flight Diverters (BFDs) at spaced intervals along the length of multiple wires. **At a minimum, four Aircraft Warning Markers (spherical or cylindrical, 36 inches in diameter) should be placed 10 meters below the apex and BFDs be placed at 10 meter intervals along the length of each outer wire**. Research shows the attachment of BFDs can reduce bird collisions by as much as 86-89% (Pope et al., 2006) (http://www.chelanpud.org/documents/Burch_Final_Report_V1.pdf). AWMs should be recognizable from a distance of at least 4,000 feet (1219m) in clear air and visible from all directions.
- AGFD recommends all temporary towers are only on site for the minimum amount of time needed to monitor the wind resource. If towers are on site for more than 1 year, AGFD recommends carcass searches be implemented, especially during the bird migration period (see Chapter 5, Post-construction Monitoring and Reporting).
- If a temporary tower is going to become a permanent structure for the life of the project, AGFD recommends the tower(s) be included as part of the longer term (pre-construction and post-construction) monitoring program.
- AGFD recommends the applicant place acoustic monitoring stations on met towers in the proposed project area (**Note:** This will help collect bat activity information needed for pre-construction analysis). An acoustic monitoring station is defined as two acoustic detectors, one at "ground level" (approximately 1.5 meters above ground) and the other with an elevated microphone, ideally within the future rotor swept zone, but not less than 30 meters high. Reynolds (2006) and Lausen (2006) provide detailed guidelines for detector deployment and operation. Rainey et al. (2006) provides an in depth discussion of acoustic monitoring systems. Acoustic data collection objectives should strive to evaluate bat species composition and bat use of the project area nightly and across seasons to assess potential impacts.
- Work with AGFD to determine the number of acoustic monitoring stations needed to adequately cover the project area. The number of acoustic stations will depend on project footprint and habitat complexity.
- When siting met towers, avoid habitat features that congregate wildlife such as water resources, habitat edges, ridgelines, etc. At a minimum, AGFD recommend 100m setbacks from these features. This varies site to site dependant on the combination geographic features and wildlife resources.

AGFD Personnel Safety

- Low-level aerial flights can occur outside routine wildlife survey routes. GPS locations of all towers need to be provided to AGFD prior to construction to allow survey aircraft to avoid the towers. In addition, AGFD requests project proponents notify the Department when met towers are removed.
- When guy wires are present, AGFD recommends attaching Bird Flight Diverters (BFDs) at spaced intervals along the length of multiple wires. **At a minimum, four Aircraft Warning Markers (spherical or cylindrical, 36 inches in diameter) should be placed 10 meters below the apex and BFDs be placed at 10 meter intervals along the length of each outer wire**. AWMs should be recognizable from a distance of at least 4,000 feet (1219m) in clear air and visible from all directions.
- For all monopole towers, paint the top 30 feet of the tower in alternate orange and white paint. This does not apply to lattice towers or lit towers, both of which are more visible than monopoles.

Data Resources for Biological Information

State Wildlife Action Plan (SWAP) & HabiMap™ Arizona

AGFD's State Wildlife Action Plan (SWAP) was accepted by the U.S. Fish and Wildlife Service's National Acceptance Advisory Team in 2006. It was the culmination of a 2-year effort during which AGFD solicited input from numerous experts, resource professionals, federal and state agencies, sportsmen groups, conservation organizations, Native American tribes, recreational groups, local governments, and private citizens and integrated those ideas and concerns into a single, comprehensive vision for managing Arizona's fish, wildlife, and wildlife habitats over the next ten years. It provides a framework and information to assist in setting conservation priorities for the state's wildlife and habitats. Data gathered for SWAP represents a myriad of sources and extensive public comment, and is used to support AGFD's efforts to develop proactive conservation goals and objectives. Much of that data (more than 300 data layers) is compiled into a single model of wildlife conservation potential, the Species and Habitat Conservation Guide (SHCG), and should be used in early project planning by wind developers. This document can be found at http://www.azgfd.gov/w_c/cwcs.shtml.

To ensure SWAP information is accessible and useful to everyone, AGFD developed HabiMap™ Arizona at http://www.habimap.org/. This user-friendly, web-based tool allows users to visually explore the distribution of Arizona's wildlife, potential stressors to wildlife, the Species and Habitat Conservation Guide, and other relevant data.

The Species and Habitat Conservation Guide provides non-regulatory information compiled from the best available data, and is meant to identify Arizona's wildlife conservation potential at a statewide scale, regardless of ownership. It does not replace or supersede consultation with the AGFD. HabiMap™ Arizona is intended to be used as an early planning tool for landscape-level analysis and should be used in concert with all available data and expertise to ensure project plans address wildlife and habitat conservation at all levels. Site-specific analysis will require additional wildlife information and on-the-ground expertise from AGFD biologists. For more information on environmental compliance issues and special status species (including plants), please use the Arizona Online Environmental Review Tool at http://www.azgfd.gov/hgis.

Heritage Data Management System (HDMS) & the Arizona Online Environmental Review Tool

AGFD Natural Heritage Program, Heritage Data Management System (HDMS) is an efficient and cost-effective source of biological information. HDMS is part of a global network of more than 80 Natural Heritage Programs and Conservation Data Centres. It identifies elements of concern in Arizona and consolidates information about their status and distribution throughout the state. Species lists are available by common name, scientific name, taxon, and county, and can be found at: http://www.azgfd.gov/w_c/edits/hdms_species_lists.shtml. Species abstracts are also available on the web at: http://www.azgfd.gov/w_c/edits/hdms_abstracts.shtml.

HDMS species data are element occurrence data generated from published and unpublished reports, data collected by cooperating agencies, museum and herbarium collections, the scientific and academic communities, and many other sources. A subset of these data, important for management and conservation decisions, are what populate the Arizona Online Environmental Review Tool (Online Tool) which generates a list of special status species buffered according to project type and location (Note: Obtaining a species list does not constitute a review of the project by AGFD). The Online Tool is updated quarterly based on new and better information. The Online Tool includes special status species at a federal or state level. Examples include T and E species, Forest Service and BLM sensitive species, and AGFD's Wildlife of Special Concern (WSC). WSC are species whose occurrence in Arizona is or may be in jeopardy, or with known or perceived threats or population declines, as described by the Arizona Game and Fish Department's listing of Wildlife of Special Concern in Arizona.

In addition, HDMS data does not include potential distribution of special status species. Be aware that occurrences are only recorded in HDMS if the site has been previously surveyed during the appropriate season, detection was made, and the observation was reported and entered into the database. As such, do not use the absence from the HDMS of an occurrence in a specific area to infer absence of special status species. It is also important to evaluate known occurrences of sensitive species and habitats near the site and in comparable adjacent areas.

Federal and State Agencies as Resources

Early consultation with both AGFD and USFWS will assist project proponents in determining the applicability of other state and federal laws, including the ESA, BGEPA, MBTA, and Arizona State Statutes and Arizona Game and Fish Commission Rules dealing with bat, bird, and raptor protection. Appendix A provides contact information for the six AGFD regional offices and headquarters. The USFWS has developed lists of federally Threatened, Endangered, and Candidate species arranged by county are available from the Ecological Services Offices at http://www.fws.gov/southwest/es/Arizona/Threatened.htm - CountyList. Information on birds which are high priorities for conservation action, and other general migratory bird information can be found at http://www.fws.gov/migratorybirds/. USFWS biologists can also offer information about listed species and designated critical habitat (see Appendix B for contact information). Early coordination with USFWS biologists will help identify potential impacts to federally listed and migratory species that are high priorities for conservation. The USFWS Arizona Ecological Services Field Office website is also a good source for guidance on the ESA,

species documents, county lists of Threatened and Endangered Species and Critical Habitat information (http://www.fws.gov/southwest/es/Arizona/).

Local Experts and Other Resources

Other helpful sources of information include contacts with biologists familiar with the area, including staff from universities, colleges, bird observatories, and Audubon chapters (http://www.audubon.org/states/index.php?state=AZ), as well as local bat experts and birders. National Audubon Society Christmas bird count data (http://www.audubon.org/bird/cbc) and North America Breeding Bird Survey data (http://www.mbr-pwrc.usgs.gov/bbs/) can provide useful information about species and abundance of birds during winter and spring in portions of Arizona. Audubon Arizona has mapped 30 officially identified areas in the state that they consider "Important Bird Areas" (http://www.aziba.org/). Additional information on raptor migration can be found at Hawk Watch International (http://www.hawkwatch.org/home/). Cities and counties may also have useful information on local wildlife populations.

Framework for Determining Bat and Bird Study Effort (Categories)

With information from the preliminary site assessment, proposed project sites can be grouped into one of four categories to provide a general framework to assist in determining the duration and intensity of study needed for pre-construction and operations monitoring. Assigning projects to categories may not always be a clear-cut process, and projects may shift from one category to another as information from the pre-construction studies either reveals unanticipated issues or resolves expected concerns about potential impacts. Thus, AGFD recommends project proponents assess their project's category before, or at the time of, met tower construction. **Due to a paucity of data on effects of wind projects on wildlife resources, AGFD anticipates most proposed projects will be considered Category 3 or 4.**

For all categories of projects, recommendations to conduct more or less than one year of pre-construction surveys should be accompanied by a well-supported rationale and justification for the recommendation. The burden of proof rests with the party advocating the deviation from the standardized pre-construction survey effort. Caution is warranted in concluding a project will have low impacts to wildlife based on preliminary site screening data because currently little is known about the range and distribution of Arizona bat populations, their migratory routes, and population variation from year to year. Additionally regional raptor migration pathways are poorly understood and annual populations can vary with changes in climate and fluctuating prey bases (e.g. prairie dog colonies, rabbits). Consider the following questions when assessing the project category:

Note: "Near" refers to a distance within the area used by an animal in the course of its normal movements and activities.

1. Which species of wildlife use the project area and how do their numbers vary throughout the year?
    a. Are any of the following known, or likely to occur, on or near the proposed project site?

b. Species listed as federal "Threatened" or "Endangered" (or candidates for such listing)?
c. Special status species?
d. Bald or Golden eagles?

2. Is the site near a raptor nest, or are large numbers of raptors known or likely to occur at or near the site during portions of the year?

3. Is the site on or near important staging or wintering bird areas?

4. Are there prey species such as prairie dog colonies and high insect prey bases attracting wildlife populations to the area?
(Note: Species that may not appear to have a direct conflict with wind development may result in greater impacts to raptors due to the area's importance as a foraging site.)

5. Is the site likely to be used by birds whose behaviors include flight displays (e.g. common nighthawks, horned larks) or by species whose foraging tactics put them at risk of collision (e.g. contour hunting by golden eagles)?

6. Is the site near a known or potential bat roost, recognizing some species of bats will fly over 20 miles each way to forage?

7. Are there physical features such as ridgelines, cliff faces, caves (or cracks and fissures), unique vegetation communities, riparian areas, water or forage sources attracting and concentrating wildlife populations (e.g. foraging, roosting, breeding, or cover habitat)? Is the site near a known or likely migrant stopover site?

8. Is the site regularly characterized by seasonal weather conditions such as dense fog or low cloud cover which may increase collision risks to bats and birds, and do these events occur at times when birds may be concentrated?

9. If the site has characteristics which concentrate wildlife, what potential design and mitigation measures could reduce impacts?

Category 1 – Project Sites with Available Wildlife Data suggesting Low Potential Impacts to Wildlife

Most Category 1 projects will require one year of data collection. For those Category 1 projects which have at least one year of information regarding the use of a site by resident and migratory species, as well as credible mortality data, reduced pre-construction study effort may be appropriate. Category 1 may be appropriate for projects surrounded by or near existing wind energy projects which have been studied sufficiently and/or for which there is little uncertainty as to the level of impact. Factors to consider in determining whether or not data from an adjacent facility would allow a project to be considered for Category 1 include:

- Whether the field data were collected using a credible sample design.
- Where the data were collected in relation to the proposed site.

- Whether the existing data reflect comparable turbine type, layout, habitat, suitability for migratory species, physical features, and winds.
- Whether the data are scientifically defensible and still relevant.

Consultation with USFWS, AGFD, biologists with specific expertise, and other appropriate stakeholders (i.e. a conservation organization representative) is recommended when considering whether a project qualifies as Category 1. Caution is warranted in extrapolating existing data to unstudied nearby sites. Slight topographical or habitat variations can make substantial differences in wildlife use and potential impacts. In addition, technological changes including use of large turbines, variations in turbine design or layout, increased operating times, and use of different lighting may require new or additional data gathering. Pre-construction studies for Category 1 projects should focus on information gaps and particular species of concern, if any; and the cumulative impact analysis should address the effects of the proposed project combined with surrounding sites. These studies should build upon and expand existing data about those species from nearby wind resource areas.

Category 2 – Project Sites with Existing Information and No Indicators of High Potential Wildlife Impacts

If the preliminary site assessment for a project area indicates there are no potential issues (i.e. known occurrence of special status species, knowledge of significant raptor or bat migration through the project area, or high levels of fatalities at nearby wind projects) and information from nearby projects indicates low potential for wildlife impacts, the project area is likely to be categorized as Category 2. Pre-construction surveys should be conducted a minimum of one year. This will allow for an assessment of how wildlife use the site during spring, summer, fall, and winter, and may require additional years of survey if data from the first year is inconclusive.

Category 3 – Project Sites with High or Uncertain Potential for Wildlife Impacts

Project sites with high levels of bat and/or bird use or risk, presence of special status species, or considerable uncertainty regarding potential wildlife impacts will need a minimum of two years of study to help understand and formulate ways to reduce impacts. Characteristics which may put a proposed project site in Category 3 include: high prey abundance such as rodents or prairie dog colonies (current or historic) within, or immediately adjacent to, project areas that could attract resident and migratory raptors; known avian migration stopovers such as water bodies within or immediately adjacent to the project; high insect abundance that may increase potential as a bat foraging area; special status species occurring on or adjacent to a proposed site; or high concentrations of migrating, wintering, and/or breeding raptors. Projects for which little information is available on wildlife use and potential risk are also included in Category 3.

For most Category 3 projects, two years of data collection are recommended because one year will not adequately characterize bat and bird use due to high variability in seasonal populations from year to year. Additionally, in areas of seasonal importance (e.g. known or expected bat and raptor migration areas) the standard timing and frequency of surveys (e.g. weekly) may be inadequate to characterize overall use during these critical periods.

The number and size of turbines and the extent of the area covered by the project may also influence the need for more or less study because of a direct relationship between the number of turbines and the magnitude of the potential impact to wildlife populations. Development of numerous projects over large geographical areas, or those covering a heterogeneous mix of habitats and terrain, may need additional specialized or multi-year studies if these areas have never been surveyed. Such large-scale studies may be best addressed with a collaborative research approach encompassing a number of different projects within a region.

Category 4 – Project Sites with Significant Potential Impacts to Wildlife

Wind development proposed within designated wilderness areas, national parks or monuments, state parks, regional parks, and wildlife or nature preserves should be considered Category 4. Some projects for which preliminary information gathering or existing data indicates potential for unacceptable risk of bat or bird fatalities may also be appropriately classified as Category 4, particularly if no feasible avoidance or mitigation measures are available to reduce impacts. In Arizona, Category 4 areas include riparian corridors and areas of significant topographic relief. AGFD will not support Category 4 wind energy projects unless a minimum of three years of data indicate the suspected impacts to wildlife populations are not significant.

If a Category 4 project moves forward despite indications that high levels of bat or bird fatalities may occur, and operations avoidance and minimization options to reduce the impacts are limited, then the project may require costly, ongoing re-assessment of impacts and adjustment of mitigation including potential operational shutdown. The most critical component and progressive need in wind development planning today, and one which best addresses cumulative impacts, is the avoidance of areas where unacceptable risk to wildlife occurs. For those areas, mitigation is no substitute for poor site placement (e.g. Altamont Pass, CA).

Reporting

Report #1: Preliminary Site Screening

This report should include data from the initial reconnaissance visit as described in this Chapter. Include information on the assessment of the potential for wildlife to occur at the site and a preliminary evaluation of collision risk. This report should contain sufficient data to conclude with a data-driven framework the Category to which the potential project may be designated. Submit the report to AGFD for concurrence. This should be completed prior to the development and submittal of the pre-permitting study plan.

Information in this report should include but not be limited to:

- A description of the vegetation community and major topographical features.
- Information gathered from state and federal agencies on wildlife populations in the area including any Threatened and Endangered species, raptors, and significant bat populations (especially known migration and/or colonies).
- Any information on known or suspected migratory corridors for wildlife.
- Analysis of potential impact and mitigation to avoid impacts to wildlife (possible direct, indirect, and cumulative effects).

Where to Submit Wildlife Data and Reports

AGFD encourage data owners to share raw data and reports by submitting results to the PEP. Please e-mail a complete dataset with metadata and reports to pep@azgfd.gov or mail on a CD to the following address:

Arizona Game and Fish Department -WMHB
Project Evaluation Program
5000 W. Carefree Highway
Phoenix, AZ 85086

Please specify any viewing restrictions or applications required and any information which may be considered proprietary or confidential. AGFD requests the following necessary elements of data submittals: 1) electronic format, 2) geographic locations of biological observations including projected or geographic coordinate system and datum, 3) attributes defining observational data, 4) metadata and 5) monitoring reports (preferably in PDF format).

CHAPTER 3: PRE-CONSTRUCTION SURVEY PROTOCOLS

This chapter provides guidance to developers on collecting biological information to assess the potential direct and indirect impacts to wildlife at proposed wind energy sites. It also describes the study methods available for bat and bird field studies and recommended protocols for using the methods. These methods are a synthesis of other state and federal agency recommendations, wildlife literature, and recommendations based on local data from Arizona habitats and wildlife populations. While the techniques for quantifying effects to wildlife may by standardized, certain techniques may work better at some sites than others. Therefore, it is recommended each site develop a site-specific pre-construction study plan developed in coordination with AGFD and USFWS. Several good examples which can be used for assisting in developing a study plan can be found at West, Inc website, http://www.westinc.com/reports/. In the spirit of adaptive management, it is expected these *Guidelines* will undergo revisions and adjusted to remain current with the best available and accepted science that is pertinent to an individual site and/or region.

Developing a Pre-construction Study Plan

An important component in the development of a pre-construction study plan is early consultation with AGFD, USFWS, the Federal land management agency (if applicable), and other stakeholders with an expressed interest in the project. Project proponents and/or permitting agencies should consult with AGFD to evaluate pre-construction study designs, assess impacts, and establish permit conditions for operations monitoring protocol and mitigation. Many scientific questions generated by a wind energy project proposal can be addressed with input from this collaboration.

Developing a detailed pre-construction study plan involves asking questions about the potential for wildlife to occur at the site, how wildlife may use the site, and whether they may be at risk of colliding with wind turbines. Development begins with a clear identification of the impact questions which must be addressed, and then establishing a study design appropriate for answering those questions. The pre-construction study will provide the basis for an impact assessment and subsequent recommendations for micro-siting or other impact avoidance, minimization, or mitigation measures. Project proponents should base the duration and focus of pre-construction studies on the availability of site-specific baseline wildlife and habitat data needed to answer impact questions, the species potentially affected, and the magnitude of the anticipated effect. The questions used to determine the project's category (Chapter 2, Preliminary Site Screening) will aid in the development of the pre-construction study plan.

In addition, the National Wind Coordination Committee (NWCC) provides detailed information about the metrics and methods for designing pre-construction studies for diurnal birds (Anderson et al., 1999). Smallwood (2007) provides important information on quantifying bird mortality from wind turbines. Kunz et al. (2007) developed guidelines to address nocturnally active bat and bird species in relation to wind energy development. AGFD recommends the project

proponent consult each of these documents in the course of developing pre-construction and operations study design. While the above mentioned documents are current at the time these *Guidelines* are being written (2009), wind energy and the science evaluating wildlife impacts related to wind energy projects demand current literature searches be conducted.

Nocturnal Bat Survey Methods

Avian collisions with wind turbines have been a source of concern for almost two decades, but only recently have researchers turned their attention towards the impacts to bats. Compared to birds, much less is known about the life histories, habitat requirements, behavior, and geographic ranges of Arizona's 28 bat species, making an assessment of wind project impacts to bats a difficult subject to address in pre-construction studies. Bats are long-lived mammals with few predators and low reproductive rates (Kunz, 1982). Therefore, sustained, high fatality rates from collisions with wind turbines could have significant impacts to bat populations (Racey and Entwistle, 2000). Current and historic population figures for most species of bats remains elusive, but many populations are believed to be in sizeable decline (Arnett et al., 2007). Due to the levels of bat fatalities at some wind projects, and as population estimates for many species remain unknown, cumulative impacts must be considered for bat species (Kunz et al., 2007).

Bat mortality at wind developments in the U.S. was first reported in Minnesota (Johnson et al. 2003, Osborn et al. 1996), and fatalities have been documented at wind developments in at least 10 other states (Johnson 2004 and 2005). Of these fatalities, most have been migratory tree bats (i.e. hoary, red and silver-haired bats). In Arizona, the species at greatest risk of being impacted by wind development include: hoary bats (*Lasiurus cinereus*), silver-haired bats (*Lasionycteris noctivagans*), western red bats (*Lasiurus blossevillii*), Mexican free-tailed bats (*Tadarida brasiliensis*), and lesser long-nosed bats (*Leptonycteris yerbabuenae*). Other species which likely migrate, but whose migratory patterns are poorly understood in Arizona include: Western mastiff bats (*Eumops perotis*), pocketed free-tailed bats (*Nyctinomops femorosaccus),* and big free-tailed bats (*Nyctinomops macrotis*). Arizona has a different bat species assemblage than the Northeast where the most extensive bat fatality studies have been conducted. While north-south bat migration has been at least locally documented for several species, pathways of migration are poorly known. Given the diversity and complexity of bat movements within the state, and the uncertainty surrounding potential impacts of wind turbines on bat populations, pre-construction studies are necessary at all proposed wind energy sites to investigate the presence of migratory or resident bats and to assess collision risk. The primary methods used to assess bat activity/behavior and potential threats are provided below. For additional information, project proponents should consult *Assessing Impacts of Wind-Energy Development on Nocturnally Active Birds and Bats: A Guidance Document to design project and site-specific assessments* (Kunz et al., 2007).

Some of the methods provided below are not recommended for every project, but may be needed to answer particular questions about size, species composition, behavior, and activity patterns of roosts, or to further investigate habitat features which may attract bats. Table 1 summarizes each survey method and describes appropriate usage. Biologists with training in bat identification, equipment use, and data analysis and interpretation should design and conduct all studies

discussed below. Mist-netting and other activities involving capturing and handling bats require a special license (Scientific Collecting Permit) from AGFD (R12-4-418). The objectives of bat surveys during the pre-construction phase should be designed to determine: 1) species occurrence and diversity; 2) activity levels including relative abundance and daily/seasonal timing; and 3) potential migration corridors.

Acoustic Detection for Bats

All species of bats in North America emit vocalizations during flight that create echoes used for navigation and for detecting and pursuing prey (Kunz et al, 2007). These vocalizations, or echolocations, can be detected with acoustic devices and the collected information analyzed to help describe species composition and relative abundance, provide an index of activity level, or information on general activity patterns for an area. Understanding how bats move through or utilize an area generally requires some combination of appropriate methods, along with careful articulation of biases and assumptions and interpretation of results.

The objective of acoustic surveys is to determine relative abundance, activity patterns, and species or species group identification. Acoustic monitoring provides information about bat presence and activity, as well as seasonal changes in species composition, but does not measure the number of individual bats or population density. Acoustic monitoring only records detections, or bat passes, defined as a sequence of two or more echolocation calls, with each sequence or pass, separated by one second or more (Hayes, 1993). Furthermore, there is some question about how much bats use echolocation while migrating as opposed to during foraging or while navigating among obstacles; so caution is necessary when interpreting results of bat use of an area based only on acoustic monitoring data. Passive acoustic surveys can provide useful pre-construction information by establishing baseline patterns of seasonal bat activity at proposed wind energy sites. Researchers should be aware that with the current state of knowledge about bat-wind turbine interactions, a fundamental gap exists regarding links between pre-construction assessments and operations fatalities. There is evidence that bats might be attracted to newly created wind developments and their associated nacelles and blades (Kunz et al, 2007).

The goal of pre-construction surveys is to achieve a representative sampling of bat activity across a proposed wind development location. This will facilitate estimates of the relative risk to bats, but cannot guarantee that sites with low levels of activity will result in fewer deaths than sites with higher levels of activity. Surveys should aim to determine species occurrence and diversity; relative abundance, seasonal presence, daily timing; and whether the area serves as a migration corridor (Lausen et al, 2006). In terms of acoustic monitoring station placement, an even distribution over the project site to maximize coverage and sample varied topography and habitats is key. Lausen (2006) suggests a minimum number of monitoring stations at each north, east, south and west periphery of a proposed project area, with one station in the center; Kunz (2007) suggests additional stations be placed in the vicinity of any variations in terrain, especially those that may potentially serve as flyway.

Monitoring should cover a period of at least one annual cycle to account for potential variables and will ideally cover $\geq$ 3 years to assess both within-year and inter-annual variability (Kunz et al, 2007). Data on environmental variables such as temperature, precipitation, and wind speed

should be collected concurrent with the acoustic monitoring so these weather data can be correlated with bat activity levels. Project proponents should consult bat experts, AGFD, and USFWS to make a determination as to the credibility and applicability of any existing data

Bat mortality generally occurs in the rotor-swept area, therefore, acoustic microphones should be placed as high above the ground as possible, at least 30m to assess potential interactions of bats in this area. Existing met towers or temporary towers can be used to allow acoustic detector microphones to be hoisted high above the ground. All acoustic monitors at a site need to be at a consistent height so that data are comparable. Place two acoustic detectors at each met tower in the proposed project area, one at "ground level" and one elevated. Place the ground level detector approximately 5 feet (1.5 meters) above the ground to avoid acoustic interference from low-lying vegetation. Detectors placed at ground level cannot detect bats at the rotor-swept area, but will assist in assessing bat presence. Elevated detectors should be placed as high as possible on met towers without interfering with weather monitoring equipment, ideally at the future rotor-swept zone, but not less than 30m. Reynolds (2006) and Lausen (2006) provide detailed guidelines for detector deployment and operation. Rainey et al. (2006) provides an in-depth discussion of acoustic monitoring systems. Acoustic monitoring systems can be designed to run unattended for long periods of time using solar power and collect data passively by storing bat calls for later analysis.

Bat studies and research beyond those recommended in the *Guidelines* are needed to: 1) assess species composition and relative abundance of bats at proposed wind energy sites, 2) assess migration routes and the timing of migration, and to 3) help researchers understand temporal and spatial patterns of bat activity at facilities that encompass diverse landscapes (Kunz et al., 2007). The NWCC Wildlife Workgroup's publication, *Wind and Wildlife Key Research Topics* (May 2008, http://www.nationalwind.org/pdf/NWCC_ResearchPriorities.pdf) provides an overview of current issues and research needs. AGFD may request to include contributions toward this research as mitigation for proposed wind energy projects. These contributions would be in addition to the pre-construction monitoring recommended here. Wind developers are urged to participate in research to develop better bat risk assessment methodologies by making their project sites available to researchers, by collaborative funding of research efforts, and by releasing study results.

Mist-Netting for Bats

Mist-netting is the most common survey method for capturing bats. Mist netting provides valuable information about the species in an area, however, bat biologists and experts generally do not consider mist-netting for bats to be an effective method for assessing potential risk to bats at a proposed wind energy site (Kunz et al., 2007). Many bat species fly above mist-net heights, so captured bats may not represent all species using an area. In addition, not all wind energy sites contain features (e.g. water, flyways) that can easily be netted. Most mortalities occur in the rotor-swept area. Therefore, mist-netting alone is inappropriate for assessing bat activity at proposed wind energy installations and should be considered a low priority method for establishing the type of baseline data needed for pre-construction surveys (Lausen et al. 2006). With these limitations in mind, mist-netting does have a role among survey methods because this technique helps to establish a species list for an area, including species that are difficult to

identify or detect acoustically as well as age, sex, and reproductive status of local bat populations. Mist-netting must be conducted on no- or low-wind nights without precipitation because bats detect and avoid moving nets. Dark nights, closest to new moon, are best. Mist-netting should be conducted on multiple nights, July through October to account for natural fluctuations in activity. A survey is defined as a single night mist netting at a site. Surveyors should attempt to sample within different habitats at the site with the goal to maximize species captures. Surveys should begin at sunset and continue for a minimum of 3 hours, or until an hour after the last bat was captured, whichever is longer. A variety of factors influence capture success on any given night, so it is important to recognize mist net surveys may only provide a partial list of species in the area, and augment acoustic surveys.

Mist-netting and acoustic monitoring are complementary techniques that, when used together, can provide an effective means of inventorying the species of bats present at a site (O'Farrell et al. 1999). If mist-netting is to be used to augment acoustic monitoring data at a project site, trapping efforts should concentrate on potential commuting, foraging, drinking, and roosting sites. Methods for assessing colony size, demographics, and population status of bats can be found in O'Shea and Bogan (2003). Kunz et al. (1996) provide detailed guidelines on capture techniques for bats, including mist-nets and harp traps.

Roost Surveys for Bats

Pre-construction survey efforts should include an assessment to determine whether nearby mines, caves, bridges, buildings, or other potential bat roosts occur near proposed wind turbine sites. If active roosts are detected during this assessment, exit counts and roost searches can provide additional information about the size, species composition, and activity patterns for any bat-occupied features near project areas.

Roost searches at abandoned mines, caves, abandoned buildings or similar structures can document bat species that live within close range of a project area. In addition, many bat species are long-distance fliers and can forage in areas 50 miles or more from known roost and maternal sites. Therefore, it is important to assess significant regional roost sites and their relationships via foraging and movement patterns within a proposed wind development site. Roost searches are conducted by looking into or entering potential bat roosts (usually using artificial illumination) with the intent of finding roosting bats or bat "sign," including guano, culled insect parts, and urine staining. Conduct roost searches cautiously because roosting bats are sensitive to human disturbance (Kunz et al., 1996). Never conduct a roost search at known maternity roosts. Searches of abandoned mines or caves can be dangerous and should only be conducted by experienced researchers. For mine survey protocol and guidelines for protection of bat roosts, see the appendices in Pierson et al. (1999).

Exit counts may be conducted to provide additional information on colony size. They require a skilled observer, equipped with night vision equipment and supplemental infrared illumination, watching a bat roost exit at dusk when bats are leaving for their nightly foraging. Recording and later viewing of the exodus with one or more properly placed infrared video cameras (with supplemental infrared illumination) can allow a single biologist to cover large structures or

abandoned mines with several portals, and provides a permanent record of the emergence. Rainey (1995) provides a guide to options for exit counts.

Visual Monitoring of Bats

The tools and survey techniques available to help understand how, when, where and why bats collide with wind turbines each have their own strengths, limitations, and biases, making it critical to use a combination of survey methods to assess activity levels in a given area. Use of nocturnal visual survey equipment can aid researchers in determining bat activity level at a site. In general, the equipment used for recording or observing nocturnal activity include night-vision equipment, thermal infrared equipment, and Radio Detection and Ranging (Radar). Kunz (2004) and Kunz et al. (2007) provide detailed discussions of available and emerging technology for observing nocturnal behavior of bats and analyze the uses, advantages, and disadvantages of each.

Night-vision goggles, scopes, and cameras make it possible to follow and identify night flying bats and birds. Improvements in technology have increased the ability of researchers to detect and identify animals. Night-vision equipment is most useful for assessing general activity patterns, flight direction and altitude, and behavior.

Thermal infrared imaging cameras are designed to detect heat emitted from objects in a field of view without the need for artificial illumination (Kunz et al. 2007). Thermal imaging can be used to obtain information on the temporal aspects of bat or bird migration in addition to quantification of avian movements. The variability in the quantity of migration over a project area coupled with the occurrence of weather conditions that cause migrants to fly at low altitudes can be used to estimate the number of occasions per season when collision events could theoretically occur. Thermal imaging results are best compared with other methods like acoustic detection and radar.

Radio Detection and Ranging (Radar) surveys are useful for investigating nocturnal migrants passing through a proposed project area. Common types of Radar used to study bats and birds include large weather surveillance radars, tracking radar systems, and marine radar. Weather surveillance radars are tools that can determine general migratory pathways, migratory stopover habitat, roost sites, nightly dispersal patterns, and the effects of weather on migration (Gauthreaux and Belser, 2003; Kunz, 2004). They are not useful, however, for characterizing high resolution passage rates or altitude data over small spatial scales. Tracking radar systems can provide information on flight paths of individual insects, bats, and birds; however, it does not provide a broad view of migration over a given site and is not widely available. Horizontally mounted marine navigation radar allows accurate mapping of the trajectories of bats or birds, while vertically mounted scanning radar provides information on flight altitude. Mobile, low-power, high resolution marine surveillance radar has been used since 1979 to monitor collision risks of birds near power lines (Gauthreaux, 1985). Marine radar's advantage over weather surveillance radars and tracking radars is they are relatively inexpensive, available, dependable, easy to operate, and portable (Kunz et al. 2007). Radar surveys cannot identify bat or birds to the species level or reliably distinguish bats from birds, but can help identify use of a site by nocturnal migrants, making it suitable as an additional tool for site assessment.

Table 1. Nocturnal Bat Survey Techniques for Pre-Construction Studies

Technique	Purpose	When to Use	Seasons	Number of Years Recommended
Acoustic Detection	Acoustic monitoring provides information about bat presence and activity, as well as seasonal changes in species composition, but does not measure the number of individual bats or population density.	Conduct acoustic monitoring for bats at all proposed wind energy sites.	Year-round	Cat. 1: 1 year min Cat. 2: 1-2 years Cat. 3: 2 year min Cat. 4: 3 years
Mist-Netting	This capture technique can help to distinguish species that are difficult to identify or detect acoustically and to gather additional information such as species, age, sex, and reproductive status of local bat populations that no other source, short of collecting the bat, can provide. Such information may be relevant in pre-construction studies if the goal is to evaluate potential project impacts to a local bat population.	Use with acoustic monitoring to provide an inventory of the species of bats present at a site (O'Farrell et al., 1999).	April – October. See mist-netting section above for survey details.	As needed to supplement acoustic surveys and determine species composition for an area.
Roost Surveys	Include an assessment to determine whether known or likely bat roosts in mines, caves, bridges, buildings, or other potential roost sites could occur near proposed wind turbine sites. If active roosts are detected during this assessment, **exit counts** and **roost searches** can provide additional information about the size, species composition, and activity patterns for any bat-occupied features near project areas.	Use where potential roost sites occur near proposed wind turbine sites.	**Internal Roost Survey**: May – August. Use caution if the roost could be a hibernaculum or maternity colony; **External Roost Survey**: 1 survey each season. Recognize that absence of activity does not indicate absence of bats	As needed to supplement acoustic surveys and determine species composition for an area
Visual Monitoring	**Night-vision**, **thermal infrared imaging**, and **radar** can be used to augment the information from above survey methods.	Use when data from above survey methods are insufficient.	Should be conducted in conjunction with other surveys within a similar time frame	Should be conducted in conjunction with other surveys within a similar time frame

Diurnal Bird Survey Methods

Descriptions of avian survey techniques are provided below. Table 2 summarizes each and describes appropriate usage. All of the survey techniques require experienced surveyors who are skilled at identifying the birds that are likely to occur in the project area and who are proficient at accurately estimating vertical and horizontal distances. Kepler and Scott (1981) provide details on training observers to estimate distances and testing surveyors for their abilities to identify birds by sight and sound. Analysis of data from surveys should include suitable measures of precision of count data such as standard error, coefficient of variation, or confidence interval (Rosenstock et al., 2002).

Large Bird Use Counts

The large bird use count (LBUC) is a modified point count that involves an observer recording bird detections from a single vantage point for a specified time period. This survey technique provides information on bird species composition, relative abundance, and bird behavior that may enhance vulnerability to collisions with wind turbines. Bird use counts are especially useful to provide quantitative and seasonal data on larger birds like raptors, ravens, waterfowl, and other waterbirds. An individual should NOT conduct LBUC simultaneously with Small Bird Use Counts. LBUC locations should be placed a minimum of .25 miles from raptor nests and .5 miles from golden eagle nests to avoid disturbance during the breeding season.

Project proponents should select LBUC sample sites at vantage points that offer unobstructed views of the surrounding terrain and corresponding airspace. The number of selected observation points depends on: 1) the number and spacing of potential turbines or turbine strings, 2) the ability to observe several potential turbine locations from a single point (Morrison, 1998), 3) whether larger or smaller birds are the study focus, and 4) the heterogeneity of terrain and habitats. Establishing sufficient sample points to achieve an average minimum density of 1 to 1.5 sample points every one square mile (2.6 square kilometers) is normally adequate for large birds. Mark the observation points in the field with a labeled stake and geo-reference using global positioning system (GPS).

On large projects, a randomized sampling method, such as a systematic sample with a random start, is one way to help reduce bias and achieve independence of sample points. For example, if the proposed project consists of nine or fewer turbines, sample each turbine site; however, if the proposed project includes many turbines (e.g. 50 or more), a systematic sample selecting every third turbine may be used. The goal is to create enough sample points to meet analytical and statistical variance objectives and to completely cover the area occupied by the proposed turbine locations. On sites that support multiple habitat types, systematically stratify sampling among the habitats to ensure sufficient analysis of habitat variability. Particular emphasis should be given to unique habitat features that are known to attract a higher diversity of species and greater abundance of individuals. Categorize habitat according to the descriptions in ReGAP, http://fws-nmcfwru.nmsu.edu/swregap/pubs, and Arizona Partners in Flight Bird Conservation Plan, http://www.azgfd.gov/pdfs/w_c/partners_flight/APIF%20Conservation%20Plan.1999.Final.pdf.

Conduct LBUCs at each point location for 30 minutes once every week during spring migration, summer breeding, fall migration, and winter. Sequence observation times to cover most daylight

hours (for example, alternate each week with morning and afternoon surveys) and different weather conditions, such as windy days. Monitoring data collected at each LBUC point should include:

- Time
- Species
- Number
- Estimated distance from the observer to each bird
- Activity
- Habitat
- Flight direction
- Flight height estimated to the nearest meter

Weather and environmental data to record at each visit include:

- Temperature
- Wind speed and direction
- Visibility
- Barometric pressure
- Cloud cover
- Precipitation

For consistency in comparing bird use, report the results of bird use surveys as number of birds per a specified time period. The bird use per 30-minute metric allows for comparison with other past studies. This metric can be used to discuss bird use at the project site and in the rotor-swept area out to some distance, time spent in the area of interest, and bird use at some height above ground. This information can be broken down to groups of birds or individual species if desired.

Eagle Observation Surveys

For sites where LBUC document bald and golden eagle use within the proposed project area, dedicated Eagle Observation Surveys (EOS) may be recommended in order to fully assess potential impacts to eagle species, guide turbine siting, develop an Eagle Conservation Plan, and assess level of eagle mitigation likely required for a project to maintain compliance with the BGEPA and obtain a BGEPA take permit.

In general, EOS require selection of several observation points throughout a project area based on viewsheds, results of LBUCs, and a variety of project specific details (e.g. turbine siting, topography). The duration and frequency of observation at point locations is based on the desired level of certainty in eagle fatality estimates desired by the project proponent. For example, longer 4-hour observations at each point conducted weekly will provide more precise eagle fatality estimates than the same surveys conducted for 1 hour periods at each point every two weeks. As such, fatality estimates and corresponding compensatory mitigation will be higher for projects that expended minimal EOS effort.

Monitoring data collected during EOS should include:

- Time
- Species

- Mapped flight paths
- Estimated distance from the observer to each bird
- Minute by minute documentation of eagle use of the project area.
- Activity
- Habitat

Weather and environmental data to record at each visit include:

- Temperature
- Wind speed and direction
- Visibility
- Barometric pressure
- Cloud cover
- Precipitation

Raptor Nest Searches

AGFD recommends raptor nest searches be done at all proposed project sites to determine the number of nesting raptors that will be impacted. Raptor nest searches will provide baseline information to aid in micrositing decisions and disturbance buffers around raptor nesting territories. Surveys should be conducted during the breeding season within a radius of at least two miles of proposed turbine locations for raptors and within 10 miles for eagle nest searches. Surveys should document the number of nesting pairs, activity status, and their location. For any documented eagle nests, occupancy and productivity monitoring should be conducted annually. Search distances can vary depending on the target raptor species and vegetation community. Consult with AGFD, USFWS, and the Federal land management agency (if applicable) to establish the list of target raptor species for nest surveys.

Nest surveys can be conducted from the ground or air. If the area to be covered is large and/or inaccessible due to difficult terrain or private property considerations, helicopters are a useful way to survey for nests. Coordinate with landowners/land managers to ensure helicopter use would be permitted. Helicopters are also a particularly efficient means of surveying for nests in open country such as grassland or desert. For ground nest searches, researchers should avoid approaching the nest within 1000ft to minimize nest disturbance. When conducting foot surveys during the breeding season caution is warranted as site fidelity is weakest during the courtship and egg laying period. Therefore, if active nests are found, limit disturbance by remaining in the area for the shortest time possible to record the data. For aerial searches, 100-200 AGL (above ground level) should be maintained depending on wind speeds, terrain, and area power lines. Once a nest is detected, birds should not be flushed from the nest and a maximum distance possible maintained while determining species and nesting status. AGFD should be notified prior to conducting nest surveys as ongoing surveys and research in several areas of the state may be impacted by multiple surveyors. Also, contact AGFD, USFWS, and the Federal land management agency (if applicable) for species-specific protocols that may be available.

Migration Counts for Large Birds

Migration counts are recommended for all propose wind project sites and are especially important when there is evidence suggesting the site has potential for high rates of bird migration (e.g. within or near known migratory corridors, abundance of major prey (prairie dogs), or along prominent north-south topography and habitat features). Birds flying through or stopping over in the project site during migration are at risk of colliding with turbines. This may represent the greatest overall and cumulative threat to some taxa (e.g. raptors) in Arizona from wind energy development. Estimating risk to nocturnal migrants requires specialized techniques, which are discussed below, but daytime migration counts can help assess the number and flight height of diurnal birds flying through or over an area. Arizona is within the Pacific Flyway, one of four major north-south migratory corridors that cross the North American continent between Alaska and Central America. Every spring and fall millions of birds fly through this corridor on their way to and from their breeding and wintering grounds. Much of the state is in the Intermountain Flyway, a regional area of the Pacific Flyway delineated by Hoffman et al. (2002). The Intermountain flyway maintains one of the largest known concentrations of migrating raptors in the western U.S. and Canada (Smith and Neal, 2008). Annual totals range from 6,100 to 12,300 raptors of nineteen species.

Migration rates vary considerably from one day to the next, depending on weather conditions; therefore, the standard LBUCs are often ineffective for detecting large migration events. .For project sites with unknown large bird migration rates, it is recommended to conduct a "pilot" migration survey by conducting 10-12 consecutive days of migration counts from September 20th to October 5th (peak migration period). If the project site is within a likely migration routes or the "pilot" migration survey indicates significant numbers of migrants, more intensive migration counts throughout the fall migration period are recommended (September 1 to October 31).

Migration counts are a relatively simple technique to assess species composition, relative abundance, and to estimate flight height of migrants. To conduct a migration count, establish vantage point(s) (stations) along ridges or passes within the wind resource area that offer wide fields of view (360 degrees). Number and placement of observation points will be dependent on project location, size, and topography. For example, at some project sites it may be appropriate to place surveyors throughout the wind resource area approximately every one mile along an east-west axis extending one mile beyond the wind project footprint. Observations should start at 9:00A, extend for at least a six-hour period, four days per week (daily preferred) for eight weeks between September 1 and October 31 to assess large bird migrations. This will ensure good coverage and allow results to be compared with existing data. Data recorded for each bird observation should include:

- Time
- Species
- Number
- Activity
- Habitat
- Flight direction
- Estimated flight height

Small Bird Use Counts

Small bird use counts (SBUCs) should be conducted when one or more small birds of special status or species of concern are thought to breed in, or adjacent to, the project area. SBUCs are essentially LBUCs conducted at a greater density of smaller-radii point count circles. SBUC sampling sites can consist of LBUC sites but must apply a smaller radius, ranging from 160 to 330 feet (50 to 100 meters), depending on habitat type (Savard and Hooper 1995). Additionally, an individual should NOT conduct SBUC simultaneously with LBUC.

SBUC sampling points should be at least 820 feet (250 meters) apart to reduce the probability of double-counting individual birds (Ralph et al., 1995). If turbine locations are known, establish SBUC sites among turbines. If turbine locations are not known, but the general area where turbines will be placed is known, locate the SBUC sites in a grid pattern in the general area. The exact number of required sample sites depends on the size and extent of the project site, but sampling intensity should adequately estimate breeding small bird composition and abundance within the project area. Permanently mark the observation points in the field with a labeled stake and geo-referencing using GPS.

To determine which birds are breeding on the project site, conduct SBUCs three times at approximately two-week intervals during the appropriate time of year (April through August is the breeding season at higher elevations in Arizona, and February through May in lower [<2000 feet elevation] desert regions). Conduct surveys no earlier than a half-hour before and no later than four hours after sunrise. Time spent at each count station should be 10 minutes (Ralph et al., 1995). At each point, observers should record all birds detected by sight or sound during the survey period. Data recorded for each bird observation should include:

- Time
- Species
- Number
- Estimated distance from the observer to each bird
- Activity
- Habitat
- Flight direction
- Flight height estimated to the nearest meter

Area Searches for Birds

Area searches should be conducted only when secretive or difficult to detect special status or species of concern are thought to occur within or near the project area. For example, researchers may use an area search if they are concerned that a special status bird species may be present in the project area, but undetected by BUCs because the bird is secretive or the sampling sites do not include appropriate habitat. This would include riparian habitat which is infrequently represented in point counts since it constitutes a small, linear proportion of the project area. Standardize the area search by specifying the search duration and the size of the area being searched to quantify species numbers and abundance (Ralph et al., 1993; Watson, 2003). Standardized area searched should provide species richness data that can be compared between different project areas or for sites within a single large wind resource area.

Winter Bird Counts

Some species of birds concentrate in larger groups and flocks during the winter with the specific localities varying annually depending on the availability of vegetative cover, roosts, and/or food resources. Winter flocking species in Arizona include waterfowl, sandhill cranes (*Grus canadensis*), pinyon jays (*Gymnorhinus cyanocephalus*), common ravens (*Corvus corax*), American crows (*Corvus brachyrhynchos*), horned larks (*Eremophila alpestris*), American robin (*Turdus migratorius*), bluebirds (*Sialia spp.*), sparrows (*Ammodramus spp.*), longspurs (*Calcarius spp.*), meadowlarks (*Sturnella spp.*) and blackbirds (*Xanthocephalus* and *Agelaius spp.*). In areas with pinyon pine and juniper stands, periodic bumper crops of pine nuts and juniper berries will entice wintering flocks of American robins, bluebirds, and pinyon jays to congregate in flocks numbering in the 1000s. Therefore, wind energy sites in this habitat periodically have the potential of taking a heavy toll on local foraging bird populations. Similarly, when prey densities are high and weather favorable, raptors also frequently congregate in exceptional number in areas during the winter, particularly in grasslands and agricultural areas.

Winter bird counts are recommended in grasslands, agricultural areas, pinyon pine/juniper habitats where they are within a ½ mile of an open body of water (e.g. earthen tanks, ring tanks, and springs) from mid-November through mid-March to assess the potential impact of wind energy installations. See Small Bird Use Counts for methodology, except conduct surveys every two weeks between sunrise and four hours after sunrise.

Nocturnal Migratory Birds

Although there are currently no accurate survey methods for detecting nocturnal migratory birds, it is important to be aware of the potential for significant wind energy impacts on bird species with this behavior. Most songbirds, waterfowl, shorebirds, herons, and egrets migrate at night (Kerlinger and Moore, 1989) and radar studies have yielded some insight into general patterns of night flying behavior. Nocturnal migrants generally take off soon after sunset, ascend to their cruising altitude between 300 and 2,000 feet (90 to 610 meters) and land before sunrise (Kerlinger, 1995). Current turbine designs place rotor-swept areas within the "cruising altitude" of these nocturnal migrants. In general, studies show that the paths of high elevation nocturnal migrants are less affected by topography or habitat, but some studies suggest that landforms can have a significant guiding effect for birds flying below 3,300 feet (1000 meters) (Williams et al., 2001). Low cloud cover or head winds can reduce the above ground level altitude of migrants, bringing more birds within range of turbine blades (Richardson, 2000).

Once nocturnal migrants descend from their flying altitude and select a site for cover, foraging, and resting, local landforms and habitat conditions may play a role in determining where they alight (Mabey, 2004). Biologists knowledgeable about nocturnal bird migration and familiar with patterns of migratory stopovers in the region should assess the potential risks to nocturnal migrants at a proposed wind energy project site. Features that may strongly concentrate nocturnal migratory birds into an area, and thus should be avoided when selecting potential wind energy sites, include riparian areas (including heavily wooded washes in otherwise sparsely vegetated landscapes), open water bodies, and isolated homesteads with shade trees or agricultural windbreaks.

Table 2. Diurnal Bird Survey Techniques for Pre-construction Studies

Technique	Purpose	When to Use	Seasons	Number of Years Recommended
Large Bird Use Counts	To provide baseline data on bird species composition, occurrence, frequency, and behavior to compare with operations use and fatality data; to inform micrositing decisions; to provide estimate of potential collision risk based on time spent in rotor-swept area; to provide an estimate of spatial and temporal use of site by all diurnal birds, but primarily large birds (raptors, vultures, corvids, and waterfowl).	Use on all proposed wind energy projects.	Year round.	Cat. 1: 1 year min Cat. 2: 1-2 years Cat. 3: 2-3 years Cat. 4: 3 years
Eagle Observation Surveys	To provide baseline data on eagle occurrence, frequency, and spatial and temporal use within project area and provide data necessary to formulate eagle fatality estimates; to inform micrositing decisions; to provide estimate of potential collision risk based on time spend in rotor-swept area.	Use on all proposed wind energy projects where eagle use is documented during LBUC or suspected due to existing data.	Year round.	Cat. 1: NA Cat. 2: NA Cat. 3: 2 year min Cat. 4: 3 year min
Raptor Nest Searches	To provide baseline data on location and activity level of nesting raptors in relation to proposed wind turbine sites, microsite turbines to reduce potential impacts to nesting raptors, to develop appropriate buffer zones around breeding territories, and to develop mitigation measures for impacts to raptors.	Use on all proposed projects wind energy projects.	January – May below 4000 ft. elev. and April – July above 4000 ft. elev.	Cat. 1: 1 year min Cat. 2: 1-2 years Cat. 3: 2 year min Cat. 4: 2- 3 years
Migration Counts	To provide baseline data on species, abundance, and timing of annual fall migration routes in relation to proposed wind turbine sites: to microsite turbines to reduce potential impacts to migration birds, to develop appropriate buffer zones away from migration pathways, and to develop mitigation measures for impacts to migratory birds.	Use "pilot" survey on all proposed wind energy projects. Use more intensive migration counts dependent on "pilot" survey results or when a migratory corridor is thought to occur on or near the project site.	**Pilot:** September 20 – October 5 **Intensive:** September 1 – October 31	Cat. 1: 1 year min Cat. 2: 1 year min Cat. 3: 2 years min Cat. 4: 3 years
Small Bird Use Counts	To provide a relative density estimate of breeding songbirds, to determine whether a project poses a significant indirect impact to songbird populations, such as displacement, avoidance, or loss of special status or species of concern breeding habitat.	Use when one or more small birds of special status or species of concern is thought to occur on or near project site.	April – August (most of AZ); February – May at lower elevations (<2000 ft) in desert regions	Cat. 1: NA Cat. 2: 1 year Cat. 3: 2 years Cat. 4: 3 years
Area Searches	To sample the entire avifauna of a wind resource area, including small and local habitats.	Use when one or more secretive or otherwise difficult to detect special status or species of concern is thought to occur on or near the project site	April – July	Cat. 1: NA Cat. 2: 1 year Cat. 3: 2 years Cat. 4: 3 years
Winter Bird Counts	To sample the project area for birds known to concentrate in high numbers during the winter in Arizona.	Use at project sites in or near grasslands, agricultural areas, pinyon pine/juniper habitats, where open bodies of water occur within a ½ mile of the project footprint.	Mid-Nov – mid-March	Cat. 1: NA Cat. 2: 2 year Cat. 3: 3 year Cat. 4: 3 year

Minimum Pre-construction Bird Surveys by Project Category

Category 1:

Large Bird Use Counts	1 year
Eagle Observation Surveys	NA *(If eagles are thought to occur on or near the project, it is no longer a Category 1)*
Raptor Nest Searches	1 year
Migration Counts	1 year "pilot" survey *(If a migration route is documented within or near project (or topography indicates it may), it is no longer Category 1)*
Small Bird Use Counts	NA *(If special status or species of concern are thought to occur on or near project, it is no longer Category 1)*
Area Searches	NA *(If special status or species of concern are thought to occur on or near project, it is no longer Category 1)*
Winter Bird Counts	NA *(If your project occurs in or near grasslands, agricultural areas, pinyon pine/juniper habitats where open bodies of water occur within a ½ mile of the project footprint or open bodies of water, it is no longer Category 1)*

Category 2:

Large Bird Use Counts	1-2 years
Eagle Observation Surveys	NA *(If eagles are thought to occur on or near the project, it is no longer a Category 2)*
Raptor Nest Searches	1-2 years
Migration Counts	1 year "pilot" survey *(If a migration route is documented within or near project (or topography indicates it may), it is no longer Category 2)*
Small Bird Use Counts	1 year *(Only if special status or species of concern thought to occur or unexpectedly discovered during LBUC)*
Area Searches	1 year *(Only if secretive special status or species of concern are missed during LBUC or SBUC)*
Winter Bird Counts	2 year *(Only if your project occurs in or near grasslands, agricultural areas, pinyon pine/juniper habitats where open bodies of water occur within a ½ mile of the project footprint or open bodies of water)*

Category 3:

Large Bird Use Counts	2 years
Eagle Observation Surveys	2 years min
Raptor Nest Searches	2 years
Migration Counts	2 years *(Only if "pilot" survey documents a migration route or a migration route is thought to occur within or near project)*
Small Bird Use Counts	2 years *(Only if special status or species of concern thought to occur)*
Area Searches	2 years *(Only if secretive special status or species of concern are missed during LBUC or SBUC)*
Winter Bird Counts	3 years *(Only if your project occurs in or near grasslands, agricultural areas, pinyon pine/juniper habitats where open bodies of water occur within a ½ mile of the project footprint or open bodies of water)*

Category 4:

Large Bird Use Counts	3 years
Eagle Observation Surveys	3 years
Raptor Nest Searches	2 years raptors; 3 years for eagles
Migration Counts	3 years *(Only if "pilot" survey documents a migration route or a migration route is thought to occur within or near project)*
Small Bird Use Counts	3 years *(Only if special status or species of concern thought to occur)*
Area Searches	3 years *(Only if secretive special status or species of concern are missed during LBUC or SBUC)*
Winter Bird Counts	3 years *(Only if your project occurs in or near grasslands, agricultural areas, pinyon pine/juniper habitats where open bodies of water occur within a ½ mile of the project footprint or open bodies of water)*

Other Wildlife Observations

Economics and Wildlife
Arizona is a state rich in natural resources with wildlife being one of its most valuable assets. With more than 900 animal species and 30 million acres of public land, Arizona provides some of the best wildlife related recreational opportunities in the nation. The annual economic impact of fishing, hunting, and wildlife watching alone in Arizona is 2.1 billion. In 2006, 1.5 million Arizonans engaged in wildlife associated recreation, with a significant number (1.3 million) participating in wildlife watching activities (US Census Bureau, 2006). The economic return for investing in wildlife conservation is enormous. The promotion and incorporation of natural areas, wildlife, and native landscaping in community planning and development projects, can reap significant financial returns.

Development Impacts
Development impacts all wildlife. It can adversely affect wildlife by direct loss or degradation of habitat and, although less obvious but equally important, by disruption of movement patterns. Development can further exacerbate the issue due to the increased human disturbance in the area. Loss of habitat and habitat connectivity is not inevitable as long as the needs of wildlife are cooperatively addressed early in the development planning process.

Habitat fragmentation is the process by which previously intact areas of habitat are divided into smaller disconnected areas by roads, development, and other barriers. The disruption of animal movement by habitat fragmentation presents problems for Arizona's wildlife, ranging from direct mortality on roadways to the genetic isolation of fragmented populations. This disruption of animal movement patterns also negatively affects human welfare by increasing the risk of wildlife-vehicle collisions and the frequency of unwanted "close encounters" with wildlife. Effects of habitat fragmentation can often be mitigated by identifying and protecting areas that wildlife use for movement (Beier and Noss 1998, Bennett 1999, Haddad et al. 2003, Eggers et al. 2009, Gilbert-Norton et al. 2010). Ridgelines, canyons, riparian areas, cliffs, swaths of forest or grassland and other landscape or vegetation features can serve as wildlife linkages. Habitat blocks are areas large enough to sustain healthy wildlife populations and support essential biological processes into the future (Noss 1983, Noss and Harris 1986, Noss 1987, Noss et al. 1996). See Chapter 4 for more information on impact assessment and mitigation.

Identifying Wildlife Resources in your Planning Area
Wildlife species will vary on a site-by-site basis. The first step is to determine which species, including species of conservation concern are present in, or potentially migrate through the area, and what crucial habitat are required to sustain them. See *Data Sources for Biological Information* in Chapter 2 for tools to assist with the preliminary identification of the species and habitat in the project area. AGFD will work directly with project proponents to identify resources and incorporate conservation concepts into project documents and management plans.

AGFD recommends that surveys be conducted to determine which wildlife species are present on site and potentially impacted due to the project. Although only federally listed species and state species of concern are identified within the HDMS system, species protected by other federal and state laws are applicable and need to be considered in project planning. As

mentioned previously, all wildlife are impacted by development and potential project impacts will vary by site. It is up to the project proponent, in consultation with AGFD to determine all species that will be impacted by the project.

Prey species are of particular concern if they are present on a potential wind project site. Prairie dogs, cottontail rabbits, jackrabbits and other rodents are prey species for many raptors and high population/abundance levels will draw in more raptors thereby increasing the potential for direct raptor mortalities. Pre-construction surveys should include protocol to assess the level of prey species present at the project site. These can be accomplished in conjunction with other on-going surveys. AGFD will assist with any information it has on this aspect but again many areas of the state have not been surveyed and prey species populations and abundances will fluctuate over time.

AGFD recommends early and continuing coordination in order to assist the project proponents with ensuring proper and timely wildlife surveys for the project site. The Department has protocol for many different types of species surveys and will guide the project proponent in selecting the appropriate surveys for their site. In addition, all incidental sightings of wildlife should be recorded anytime project biologists are on site conducting surveys. These sightings should be included in the corresponding reports for that survey/period

Reporting

Report #2: Preliminary Site Screening

Once the project category has been designated and the *Preliminary Site Screening Report* has been completed and AGFD and other appropriate agencies have agreed to its conclusions, project proponents should draft a study plan for measuring pre-construction data on wildlife. The study plan should be drafted in coordination with, and submitted to, AGFD and appropriate federal agencies. Tables 1 and 2 in Chapter 3 should guide project proponents on types of data to collect and the duration the data needs to be collected, depending on which Category a project is deemed. Proponents should use the most current scientific data to determine methodologies for data collection as previously outlined in this chapter. Some of the data collected may include:

- *Bats:* acoustic detections, mist netting, roost surveys, and visual monitoring.
- *Birds:* bird use counts, migration counts, raptor nest searches, small bird counts, area searches, and/or winter bird counts.

Report #3- Annual reports of pre-construction data

Once a pre-construction study plan has been evaluated, AGFD recommends project proponents draft annual reports for ongoing pre-construction data collection and submit those within six months from the last season data collection occurred. Information in the annual reports should include but not be limited to:

- A yearly/seasonal synthesis of wildlife data separated out by technique used to measure these variables.
- A discussion of the effectiveness of the techniques and whether the study plan needs to be modified.
- A re-evaluation of the impact analysis, including fatality estimates.

- A discussion on mitigation measures should there be potential effects to wildlife.
- A discussion and/or justification of the Category chosen.

Where to Submit Wildlife Data and Reports

AGFD encourage data owners to share raw data and reports by submitting results to PEP. Please e-mail a complete dataset with metadata and reports to pep@azgfd.gov or mail on a CD to the following address:

Arizona Game and Fish Department -WMHB
Project Evaluation Program
5000 W. Carefree Highway
Phoenix, AZ 85086

Please specify any viewing restrictions or applications required and any information that may be considered proprietary or confidential. AGFD requests the following necessary elements of data submittals: 1) electronic format, 2) geographic locations of biological observations including projected or geographic coordinate system and datum, 3) attributes defining observational data, 4) metadata and 5) monitoring reports (preferably in PDF format).

CHAPTER 4: IMPACT ASSESSMENT AND MITIGATION

This chapter discusses approaches to assess impacts to wildlife that surveys revealed during the pre-construction phase of the wind energy project and to select the best measures for avoiding, minimizing, or mitigating those impacts. It also discusses the development of a wildlife conservation strategy (e.g. Bird and Bat Conservation Strategy). AGFD encourages project proponents to avoid impacts whenever possible. When not possible, minimization and mitigation are necessary conservation measures to counter the effects the project may have on wildlife and their habitats.

Evaluation and Determination of Impacts

This section provides a description of the types of impacts associated with wind energy development. Impacts can be categorized as "direct," "indirect," or "cumulative."

Direct Impacts

For purposes of these *Guidelines*, "direct" impacts refer to bat and bird collisions with wind turbine blades and met towers. Direct impacts are determined by reviewing all of the pre-construction data to evaluate which species may collide with turbines and which non-biological factors (e.g. topographic, weather, and turbine design features) may contribute to this risk. The presence of special status species may be enough to determine that there are potential impacts. Turbine design characteristics and proposed siting locations are two factors known during the impacts analysis and should be considered in assessing potential risk. Some factors are presented with the understanding that information is lacking about their contribution to fatality risk, so it is incumbent upon biologists making impact determinations to be up to date on the latest research. To learn of research advances, regularly consult the NWCC Wildlife Workgroup website (www.nationalwind.org/workgroups/wildlife/) and Bat and Wind Energy Cooperative website (http://www.batsandwind.org/).

Indirect Impacts

Indirect impacts to wildlife from wind energy projects can include disturbance of local populations, displacement or avoidance of the site, and disruption to migratory or movement patterns (NWCC, 2004). To date, displacement and site avoidance impacts have not been evaluated in Arizona, but have been in other areas. Several studies have been published on the displacement of grassland breeding songbirds and other birds (e.g. shorebirds, waterfowl) due to wind development. Some studies have documented decreased densities and avoidance by grassland songbirds, while others have looked at the relationship between nest occupancy and placement of turbines. Most of these studies do not conclusively establish that a reduction in use of an area is due to avoidance (indirect impact) versus the reduction in a local population due to collisions with turbines (direct impact). Whether it was a direct or indirect impact, studies have documented a reduction in nest occupancy near turbines.

In contrast to avoidance, indirect impacts may also result in the attraction of wildlife species due to construction and operations activities as well as changes in land use (e.g. changes in grazing practices, disturbance of soil, or introduction of weeds) attracting prey species such as insects and small mammals. These prey species may in turn attract bats, raptors, and insectivorous birds to the vicinity of wind turbines, putting them at increased risk of collision. Biologists should be aware of these potential impacts and recommend construction and management practices to minimize activities attracting prey and predators to the wind turbine site.

Cumulative Impacts

A cumulative impact analysis considers a project's incremental impacts combined with the impacts of other land use projects. If the lead permitting agency finds a particular project's incremental impacts to be significant, then the project proponent should mitigate for its portion of the cumulative effect. The findings of the analysis should be reported to the AGFD and USFWS so appropriate mitigation and avoidance measures can be identified. AGFD will review the report for identification of avoidance measures.

Assessing cumulative impacts to wildlife is difficult because population viability data are not available for most species. Furthermore, it is difficult to establish an appropriate geographic scope for a cumulative impact analysis, to secure comprehensive information on existing and planned projects, and to gauge the relative contribution of a project's impacts compared to past, present, and future projects. Cumulative impact analyses for wind energy projects should focus on potential impacts to wildlife populations over the entire estimated operational life of the project. The level of detail in a cumulative analysis does not need to be as great as the project's direct impact analysis, but should reflect the severity and likelihood of occurrence of the potential impacts. Standards of practicality and rationality should guide the cumulative impact discussion. While the cumulative impacts of a project may be difficult to determine, do not discount the impacts of a project based on relative size. The addition of one small wind energy project in an existing wind resource area may seem trivial, but requires evaluation of the potential cumulative impacts of an increasing number of projects, regardless of project size. An adequate analysis of cumulative impacts on special status species should include the following steps:

1. Identify the species warranting a cumulative impact analysis, including any species which a determination of potentially significant impacts exists. Assess the baseline population of the relevant species, as well as whether the population is resident, seasonally breeding, migratory, or wintering and whether it is stable, increasing, or decreasing. The assessment should include a discussion of natural and anthropogenic factors contributing to population trends.
2. Establish an appropriate geographic scope for the analysis and provide a reasonable explanation for the geographic limitations used. The geographic scope of the analysis will generally include a larger area than the project site. Cumulative impacts could apply to the wildlife within and immediately adjacent to the wind project, migratory pathways or in populations or subpopulations some distance away due to changes in immigration and emigration.
3. Compile a summary list of past, present, and future projects within the specified geographical range that could impact the species, including construction of transmission

lines and other related wind energy infrastructure. The list of projects should include other wind projects as well as other projects which may involve habitat loss, collision fatalities, or blockage of migratory routes that could impact species under consideration. The project summary should describe the environmental impacts of each individual project on the species and provide references for information about other projects.

4. Assess the impacts to the relevant wildlife species from past, present, and future projects. The analysis should use population trend information and regional analyses available for the species.
5. Identify impact avoidance, minimization, or mitigation measures to the species, and make a determination regarding the significance of the project's contributions to cumulative impacts. The determination should include an evaluation of the cumulative impacts the project and neighboring projects may have on the local or regional species population or the species as a whole. For some projects, the only feasible mitigation for cumulative impacts may involve the adoption of ordinances or regulations or implementation of a regional mitigation plan, rather than the imposition of conditions on a project-by-project basis.

Impact Assessment Approaches

The goal of collision risk assessment is to determine whether overall bat and bird fatality rates are low, moderate, or high relative to other projects, and to provide measures of overall bat and bird casualties attributable to collisions with wind turbines. Information on wildlife use from the pre-construction studies can be used to perform a qualitative assessment of risks. A qualitative risk assessment determines whether high wildlife use may represent a fatal flaw of a proposed project and helps to develop studies to better evaluate risk. The next level of a risk analysis is to make the assessment more quantitative by collecting data on the abundance, spatial, and temporal distribution and behavior of bats and birds in areas where they may be at risk of collision. This information is then compared to existing data on fatalities at wind resource areas. For all quantification of risk and fatality estimates, apply a uniform metric of bat or bird fatalities per megawatt (MW) of installed capacity per year.

Avoiding or Minimizing Impacts

Wind development has the potential to directly and indirectly affect wildlife species. Examples of these effects are: small and large scale habitat fragmentation, displacement, introductions of invasive plant species, behavior modifications, and direct loss of habitat. Avoidance criteria are best applied during pre-construction site selection (macrositing) and during micrositing. Good macrositing decisions are essential for choosing an acceptable site or portion of a site.

Once a site is selected, micrositing efforts, such as appropriate placement of turbines, roads, power lines, and other infrastructure can avoid or reduce potential impacts to bats, birds, and other biological resources. Each wind energy project site is unique, and no one recommendation will apply to all pre-construction site selection and layout planning. However, consideration of the following elements in site selection, turbine layout, and development of infrastructure for the facility can be helpful to avoid and minimize impacts. In addition to the recommendations described below, consult the NWCC's *Mitigation Toolbox,*

www.nationalwind.org/publications/wildlife/Mitigation_Toolbox.pdf, for a compilation of mitigation measures which can be used to minimize or eliminate impacts to wildlife resulting from the design, construction, and operation of the wind project (NWCC, 2007).

Draft a Wildlife Conservation Strategy

Wildlife conservations strategies (WCS) are voluntary plans put forth by developers as good-faith efforts in order to proactively address potential impacts to wildlife resulting from the construction, maintenance, and operation of a wind facility. They are developed prior to construction to help ensure the project is designed, constructed and operated to avoid and/or minimize potential impacts to wildlife and their habitats, and to ensure compliance with applicable state and federal laws. WCS's include specific design features, avoidance, minimization, and mitigation features for those species that may be affected by wind energy development.

Types of WCS's include Bird and Bat Conservations Strategies (BBCS), Eagle Conservation Plans (ECP's) or other taxa specific plans meeting the intent of protecting wildlife affected by energy development. More specifically, the goal of BBCS's are to meet the intent of the Migratory Bird Treaty Act (MBTA, as amended), the Bald and Golden Eagle Protection Act (BGEPA, as amended), and state wildlife guidelines (AGFD 2012) by reducing risk to bat and bird species and mitigation of unavoidable risks. The BBCS framework is to identify the operational risks associated with bat and bird interactions with the project, identify measures to avoid and minimize risks through site planning and resource protection measures, describe the adaptive management, monitoring, and reporting plans for the project, and voluntarily develop measures to address wind/wildlife impacts in coordination with federal and state wildlife agencies.

A wildlife conservation strategy represents a specific agreed-upon understanding and commitment between the wind developer, the US Fish & Wildlife Service (USFWS), and the Arizona Game & Fish Department (AGFD), to minimize impacts to bat and bird species (and in some cases other wildlife) and provide a framework to address impacts that may occur as a result of the project.

Specific agreements and commitments put forth by developers may include initial thresholds for species of concern, whereby exceeding thresholds triggers operational (e.g. turbine curtailment or shut downs), and non-operational (e.g. mitigation dollars for on or offsite-direct habitat loss compensation, and/or research) mitgation. These thresholds do not permit take under any legal protections, but are developed to ensure any potential impacts to identified species are addressed, and to assess cumulative impacts of wind projects across a broader geographical region. In addition, it is recommended that WCS's include earmarked wildlife funds to be used as appropriate for research, or biologically appropriate avoidance or mitigation purposes.

Map Baseline Information

Pre-construction studies must be sufficiently detailed in order to create maps of special status species habitats (e.g. wetlands or riparian habitat, oak woodlands, large, contiguous tracts of undisturbed wildlife habitat, raptor nest sites) as well as other local species movement corridors

(e.g. bats, birds, deer, elk, pronghorn, prairie dogs, badgers, gray/kit fox den sites) that are used daily, seasonally, or year-round, and winter bird concentrations. Use these maps, as well as others, to show the location of sensitive resources, to establish the layout of roads, fences, and other infrastructure to minimize habitat fragmentation and disturbance. Listed below are Best Management Practices for avoiding, minimizing, and mitigating impacts to wildlife:

Minimize Habitat Disturbance and Fragmentation

- Avoid using or degrading high value or large intact habitat areas. Use agriculture lands or other disturbed areas when possible.
- When disturbed areas are not an option, high quality wildlife habitat should be avoided (e.g. wetlands or riparian habitat, oak woodlands, large, contiguous tracts of undisturbed wildlife habitat, raptor nest sites). Disturbed areas should be returned to the original grade and revegetated following construction.
- Staging areas and construction sites should be located in previously disturbed areas and revegetated when construction is completed.
- Use existing roads for met tower and/or turbine access when possible.
- When new roads or two-tracks must be constructed, minimize habitat fragmentation by:
    i. creating the road through cross-country travel versus blading (check local land management agency for cross-country travel regulations);
    ii. constructing the minimum footprint (road width) and number of roads needed to maintain the facility.
- Close, obliterate and revegetate any roads constructed for the project which are not necessary for facility maintenance after tower construction.
- Roads will be located, designed, constructed, reconstructed, used, maintained and reclaimed so as to:
    i. control or prevent erosion, siltation, and air pollution by vegetating or otherwise stabilizing all exposed surfaces;
    ii. control or prevent damage to fish, wildlife, or their habitat and related environmental values;
    iii. prevent or control damage to public or private property.
- Any new road access or restriction (year-round or seasonal) should be coordinated with AGFD, especially where disturbance to wildlife and their habitat may occur as a result of public use of the road, or when hunting season is occurring.

Vegetation Removal and Reclamation

- Coordinate plant salvage efforts with the Arizona Department of Agriculture, in accordance with the Arizona Native Plant Law.
- Do not plant aggressive, non-native grasses (e.g. intermediate wheatgrass, pubescent wheatgrass, crested wheatgrass, smooth brome) in seed mixes. Use native species which approximate the pre-disturbance plant community composition.
- Contact the applicable land management agency regarding guidelines for revegetation efforts.
- Fence livestock out of newly reclaimed areas until proper vegetation cover is achieved (consult AGFD for wildlife friendly fencing standards).

Noxious Weed Management

- Develop an Adaptive Weed Management Plan.
- Assume immediate responsibility for the control of all noxious weeds resulting from surface disturbances.
- Sanitize undercarriages of vehicles to remove weed seeds, and limit weed transport to other sites.

Establish Buffer Zones to Minimize Collision Hazards

If pre-construction studies show the proposed facility could pose a bat or bird collision hazard, establish non-disturbance buffer zones to protect raptor nests, bat roosts, areas of high bat or bird use, special status species habitat, or wintering bird concentrations. For example, proposed wind energy project sites near water and/or riparian habitat in an otherwise dry area could increase the number of bat and bird collisions; therefore, projects should not be placed in these types of areas. Determine the extent of the buffer zone in consultation with AGFD, USFWS, the Federal land management agency (if applicable), and biologists with specific knowledge of the affected species.

Seasonal Timing Limitations

Construction of wind development infrastructure could temporarily or permanently displace breeding and/or wintering wildlife species. Due to the difference in elevation across Arizona, wildlife species breed and/or winter at different times across the state. Therefore, project proponents should work with AGFD for site-specific breeding and wintering seasonal timing limitations for species such as mule deer, pronghorn, and elk.

Reduce Impacts with Appropriate Turbine Layout

Pre-construction studies must be sufficiently detailed to establish normal movement patterns of wildlife in order to make micrositing decisions about turbine configuration. Turbine alignments separating bats or birds from their daily roosting, feeding, or nesting sites, or those located in high bat or bird use areas can pose a collision threat.

Assessing the impacts of turbine siting and determining appropriate turbine placement requires a thorough understanding of the distribution and abundance of wildlife at the proposed site, as well as site specific knowledge of how wildlife interacts with landscape features. Wind turbine siting along certain topographic features contributes substantially to bat and bird fatalities (e.g., ridgelines, mountain saddles, ridge summits, valleys, rivers, canyons, cliffs, fissures). Careful siting of new wind turbines which incorporate this knowledge could substantially reduce fatalities (Orloff and Flannery,1992 and 1996; Smallwood and Thelander, 2004 and 2005; and Smallwood and Neher, 2004). Locating wind turbines away from the these features may lower bat and bird fatality rates (Richardson, 2000, Williams et al., 2001, McCrary et al. 1983).

- Maximize use of flat land and gentle slopes.
- When ridges, canyons, cliffs, and fissures are within the project vicinity, offset the turbines away from the geologic features.
- Avoid placing strings or clusters of towers close to prairie dog colonies.

- Use cluster and/or string designs to reduce gaps. Towers in groups or strings cause fewer mortalities than lone towers. Perhaps due to the visual disturbance causing raptors and birds to fly around the wind farm as opposed to flying through it.
- Minimize or eliminate single towers or cluster designs less than 4 towers.
- Add non-bladed pylons at the ends of large cluster strings. Increased mortality occurs at string ends. By placing less lethal structures at the ends, birds are more likely to fly around the strings without incident.

Minimize Ground Disturbance near Turbines

Areas around turbines and along roads disturbed by construction and operations activities may provide habitat for prey species such as insects and small mammals. Increases in prey availability may in turn attract bats, raptors, and insectivorous birds, putting them at increased risk of collision. Project proponents should be aware of these potential impacts when reviewing the site design and recommend construction and management practices to minimize ground-disturbance activities that may attract prey and predators.

- Avoid riprap around towers. Debris piles invite a variety of prey species into an area, which attract raptors.
- Coordinate with AGFD on any plans that involve the elimination or reduction of burrowing animals in the project area.

Avoid Lighting that Attracts Bats and Birds

How bats and birds respond to lighting is poorly understood. Night migrating songbirds are apparently attracted to steady-burning lights at communications towers and other structures, increasing the potential for large scale fatality events (Kerlinger, 2004). Research by Evans et al. (2007) indicates that the color of light and whether it is steady or flashing makes a significant difference in whether night migrating birds aggregate around tall, lit structures.

While red lights have been blamed for bird fatalities at tall TV towers, the Evans et al. (2007) study indicates that for birds migrating within cloud cover, blue, green, or white light would be more likely to induce bird aggregation and associated fatality. Evans et al. concluded that while white flashing lights are relatively safe, red flashing lights with a long dark interval and short flash on-time would likely be the safest lighting configuration for night flying birds. Bats and nighthawks are known to feed on concentrations of insects at lights (Fenton, 1997). Thus, any source of lighting that attracts insects may also attract bats at a wind development. No studies have found differences in bat fatalities between turbines equipped with red, flashing Federal Aviation Administration (FAA) lights and those that were unlighted (Arnett, 2007). Under current FAA guidelines (FAA, 2007; http://oeaaa.faa.gov), anyone proposing construction of structures above a certain height must notify the FAA 30 days prior to construction and in that notification should specify the type of lighting desired at the proposed structure. Plans for lighting should balance FAA requirements with protection of bats and birds.

- Use only red or dual red and white flashing lights with the minimum “on” period for turbines instead of steady burning lights.
- Keep lighting at both operation and maintenance facilities and substations to the minimum required to meet safety and security needs.

i. Use white lights with sensors and switches that keep the lights off when they are not required.
ii. These lights should be hooded and directed to minimize backscatter, reflection, skyward illumination, and illumination of areas outside of the facility or substation.

Minimize Power Line Impacts

To prevent avian collisions and electrocutions, place all connecting power lines associated with the wind energy development underground, unless burial of the lines would result in greater impacts to biological or archeological resources.

- Follow existing disturbed areas during installation to minimize habitat alterations. In low areas where the power line crosses drainages, the soil should be compacted to reduce the potential for erosion.
- Trenching and backfilling crews should be close together to minimize the amount of open trenches at any given time.
- Trenching should occur during the cooler months (October – March) when wildlife is less active. However, there may be exceptions (e.g. critical wintering areas) that need to be assessed on a site-specific basis.
- Avoid leaving trenches open overnight.
- Where trenches cannot be back-filled immediately, escape ramps should be constructed at least every 45 meters. Escape ramps can be short lateral trenches or wooden planks sloping to the surface. The slope should be less than 45 degrees (1:1). Trenches that have been left open overnight should be inspected and animals removed prior to backfilling.

All above-ground lines, transformers, or conductors should fully comply with the Avian Power Line Interaction Committee (APLIC) 2006 standards to prevent avian fatality, including use of various bird deterrents and avian protection devices.

Avoid Guy Wires

Guyed structures are known to pose a hazard to birds, especially if lighted for aviation safety or other reasons. Communication towers and permanent met towers should not be guyed at turbine sites. If guy wires are necessary, then use bird deterrents as previously addressed.

Mitigation

Project proponents and permitting agencies should ensure that appropriate measures are incorporated into the planning and construction of the project to avoid or minimize impacts as much as possible. If these measures are insufficient to avoid estimated impacts to wildlife, mitigation can be used to offset such impacts, including cumulative impacts. The following potential mitigation options are known to protect and enhance wildlife populations at biologically appropriate locations when properly designed and implemented:

- Funding wildlife research

  - → Studies of displacement
  - → Population impacts
  - → Wildlife movement and behavior
- Offsite conservation and protection of essential habitat
  - → Nesting and breeding areas
  - → Foraging habitat
  - → Roosting or wintering areas
  - → Migratory rest areas
  - → Habitat corridors and linkages
- Offsite conservation and habitat restoration
  - → Restored habitat function
  - → Increased carrying capacity
- Offsite habitat enhancement
  - → Predator control program(s)
  - → Exotic/invasive species removal

Although impacts may occur, the ability to mitigate for them can determine whether a project is supported by AGFD. Feasible mitigation is recommended by AGFD if it will serve to minimize a project's effect on wildlife populations and their habitat. Mitigation is site- and species-specific, and must be formulated for each individual project. Mitigation should have a biological basis for ensuring protection or enhancement of the species affected by the project.

Mitigation can involve the purchase of land through fee title, or purchase of conservation easements, or other land conveyances for the permanent protection of the biological resources on these lands. The purchased land or easements should have biological value equal to or higher than the land lost for the target species affected by the wind energy project. Please refer to AGFD's Conservation Easements Fact Sheet for more information at http://www.azgfd.gov/hgis/pdfs/LandsConservationEasement.pdf.

Development of effective mitigation measures should involve the AGFD, permitting agencies, project proponents, USFWS, and the affected public stakeholders. Since a project's operational fatalities cannot be forecast with precision, AGFD and/or the lead permitting agency may be unable to make some mitigation decisions until fatality data have been collected. However, the general terms for future mitigation, the triggers or thresholds for implementing such mitigation, and the study designs to monitor for those triggers should be developed prior to issuing final permits. If operational impacts exceed the threshold specified in the permit, additional mitigation would be necessary. Any additional mitigation should be well defined and feasible to implement, so the permittee will have an understanding of any potential future mitigation requirements.

Regardless of the form of mitigation, the permitting agency should establish a nexus between the level of impact and the amount of mitigation. Unlike habitat impacts in which an acre of habitat loss can be compensated with an appropriate number of acres of habitat protected or restored, bat and bird collisions with wind turbines are cumulative impacts that do not suggest an obvious mitigation ratio. These impacts can extend well beyond the local environment because the

affected bats and birds are often migratory and far ranging, sometimes coming from out of state or out of country. Finally, fatalities can vary greatly between project sites and from year to year. Under these circumstances, it is difficult to identify acreage of land that offers mitigation value for some quantity of bat or bird fatalities. Consult with AGFD and USFWS in development of the ratios and fees to be used in establishing these compensation formulas, because all of these methods require some forecasting of impacts over the life of the project based on pre-construction studies.

Funding wildlife research is one potential mitigation option with long-term benefits. The more knowledge about wildlife response to wind energy development in Arizona, the more effective recommendations can be made to avoid/minimize/mitigate impacts. When considering research as a mitigation option, consult with AGFD to help design and conduct investigations. AGFD has identified the following top wind-wildlife research needs in Arizona:

- Monitor the movement patterns of resident raptors (e.g. nesting golden eagles, red-tailed hawks) prior to the wind project's construction in order to aid in tower placement.
- Identify and map the major migratory pathways of raptors and bats in Arizona.
- Determine patterns of migration (e.g. time of year, time of day) by wildlife in Arizona.
- Identify the temporal and spatial patterns of bat activity at proposed wind energy sites.
- Determine the effect of wind turbine size and configuration on bat and bird mortality.
- Evaluate the movement and behavior patterns of select wildlife species (e.g. ungulates, grassland passerines, raptors) pre- and post-construction.
- Evaluate the efficacy of bird strike diverters used on guyed wire towers.
- Develop standardized before-after/control-impact study protocols for bat and bird mortality studies in Arizona.
- Identify the impacts of wind development infrastructure (e.g. roadways, high voltage wires, electrical substations) on wildlife connectivity.
- Develop and evaluate predictive models that forecast wildlife fatalities prior to wind energy development at the project site.
- Determine the potential effects of a proposed wind project on the demographics of select wildlife species.
- Identify the causes of bat and bird mortalities at wind project sites; develop and evaluate potential mitigation procedures and/or devices.

Operations Impact Mitigation and Adaptive Management

Operations impact mitigation and adaptive management generally occur only if the level of fatalities at a project site was unanticipated when the project was permitted, and therefore, measures included in the permit are inadequate to avoid, minimize, or compensate for bat or bird fatalities. Once a project is operating, it is difficult to modify turbine site layout. Developing contingency plans to mitigate high levels of unanticipated fatalities become important when choices for operational impact avoidance or minimization are so limited. To avoid open-ended conditions which are difficult for developers to include when planning for project costs and timing, establish minimization measures and mitigation that could be used for unexpected impacts as well as the thresholds which will trigger these actions.

Determine these measures and mitigation early in the process. In extreme cases, the compensation specified in the permit may not be adequate for high levels of unanticipated impacts, and project operators may need to consider operational and facility changes. For example, if a Category 3 site is developed without resolving uncertainties about potential risk to wildlife through pre-construction and operations monitoring studies, adaptive management may be a necessary tool to reduce impacts to the level described in permit conditions. The adaptive management process recognizes the uncertainty in forecasting impacts to wildlife and allows testing of options as experiments to achieve a goal and determine impact avoidance, minimization, and mitigation effectiveness. These options include maintenance activities or habitat modification to make the site less attractive to at-risk species and seasonal changes to cut-in speed. During the bat migratory period, limited and periodic feathering of wind turbines during low wind nights may help avoid impacts to bats. If multi-year monitoring documents high levels of fatalities, removal of problem turbines or seasonal shutdowns of turbines may be options if other minimization measures are ineffective in reducing fatalities.

CHAPTER 5: POST-CONSTRUCTION MONITORING AND REPORTING

This section of the *Guidelines* describes the standardized techniques recommended for collecting, interpreting, and reporting post construction monitoring data. After data from initial pre-construction surveys is collected, laws and permitting requirements are met, and impact and mitigation measures are in place, it becomes necessary to evaluate the potential long-term effects of met towers and wind turbines on wildlife, specifically to bat and bird species. It is necessary to collect this information in order to estimate the direct and indirect impacts and how these may change over time.

It is important to collect post-construction data at wind turbine and met tower sites in order to assess and compare:

- Wildlife use data and impact estimates from the pre-construction studies,
- Cumulative impacts from other wind energy projects,
- Avoidance, minimization, and mitigation measures implemented in the pre-construction phase, and
- Overall bat and bird fatality rates and how these rates relate to other projects.

In general, post-construction monitoring consists of ongoing wildlife use surveys and counts of bat and bird carcasses in the vicinity of wind turbine bases. In order to best measure effects, post-construction monitoring should be directly comparable to pre-construction, therefore the same techniques should be used in both the pre and post-construction monitoring (see Tables 3 (birds) and 4 (bats) for exceptions). Post-construction monitoring should also include carcass searches and the associated searcher bias estimation.

Post-construction Monitoring and Adaptive Management

Technical Advisory Committee

AGFD recommends that a science-based Technical Advisory Committee (TAC) be created as a component of any wildlife conservation strategy to help ensure that impacts to wildlife species can be monitored and mitigated as necessary due to routine operations of a wind project. The primary purpose of the TAC is to evaluate information on the operational impacts of the wind project on wildlife, make comments and recommendations based on the best available science regarding specific issues, and work within an adaptive management framework to address emerging and changing wildlife management needs. The specific duties and responsibilities of the TAC would include:

- Develop and approve TAC Charter and MOU.
- Convene annually, and/or when wildlife adaptive management needs arise.
- Make recommendations based on best available science to address specific issues resulting from the project.
- Review protocols used in the post-construction monitoring plan.
- Review annual reports prepared as part of the post-construction monitoring plan and

provide comments and recommendations.

- Review mortality thresholds identified for the wildlife conservation strategy and provide comments and recommendations to the project developer regarding necessary threshold adjustments.
- Review significance levels of impacts to wildlife at the project, state, and regional scales as defined in the annual post-construction monitoring reports.
- Provide comments and recommendations for a wildlife conservation strategy, including avoidance, minimization and mitigation measures.
- Recommend funding recipients and specific projects for funds allocated within the compensatory mitigation framework.

AGFD recommends that at a minimum TAC membership consist of: AGFD wildlife resource specialists, USFWS wildlife resource specialists, the project developer, project biologist, and County or other permitting representatives. Other entities could be added as necessary to improve the functionality of the TAC. The TAC would adopt a charter and be formed no later than six months following initial-phase facility operation. As necessary, the TAC would remain in place throughout the life of the wind facility's permit and beyond should the facility be re-powered. A Memorandum of Understanding (MOU) would be developed by the project developer in consultation with the agencies, and signed by each party to ensure participation in the TAC.

Where should monitoring occur?

Wind development can occur within a variety of wildlife habitats, at varying scales of production; therefore, it is recommended post-construction monitoring occur at all wind projects. In addition, there may be areas requiring more intensive monitoring due to the absence of existing information or significant biodiversity. This would include those projects classified as Category 3 or 4 in Chapter 2, or projects adjacent to significant areas such as Important Bird Areas (http://www.aziba.org), AGFD Wildlife Areas, (http://www.azgfd.gov/outdoor_recreation/WildlifeViewingAreas.shtml), or National Wildlife Refuges (http://www.fws.gov/southwest/refuges/arizona/azrefuges.html). Refer to Tables 3 and 4 for information about type and duration of operations monitoring techniques relative to Project Category.

When should monitoring begin?

Post-construction monitoring should begin immediately after met towers (see Met tower guidance, Appendix C) and/or wind turbines are constructed in order to evaluate initial effects. While some local wildlife species may adjust to the presence of wind-related structures over time, they may be initially affected by new structures within their home range. As a result, some fatalities or injuries may occur immediately after construction and should be captured by post-construction monitoring.

When rare species are not present and/or post-construction monitoring is not plausible (e.g., bad weather), AGFD recommends data collection begin the next season or period in which pre-construction data was collected. For example, if wind structures were constructed in winter, data collection would need to start the following spring breeding season.

For consistency, these monitoring periods should be the same as those in the pre-construction data collection period in order to make direct comparisons (See Chapter 3: Pre-construction Survey Protocols). Monitoring should be emphasized during wildlife breeding seasons and spring/fall migration periods. Winter sampling should also be included since wintering grounds in Arizona are important for some wildlife locally and nationwide. The duration of monitoring should be sufficient to determine if pre-construction estimates of impacts were accurate. See Table 3 & 4 for a summary of post-construction monitoring recommendations.

How should monitoring occur?

It is recommended that post-construction monitoring consist of a combination of estimating presence and activity of wildlife species at wind structures, assessment of fatalities, and quantifying displacement due to wind structures. Kunz et al. (2007) recommends post-construction monitoring for bats and birds address two objectives:

1. Search protocols be conducted in such a way that they can be compared across different landscapes and habitats, and
2. Protocols be implemented to measure and establish patterns of fatalities relative to several variables such as weather, turbine characteristics, and other environmental variables in the post-construction monitoring.

Determining Bat and Bird Abundance and Behavior During Operations

Estimating Presence and Activity Post-construction (Bats and Nocturnal Birds)

The purpose of post-construction monitoring is to obtain data that can be compared with pre-construction survey data, evaluate the effectiveness of mitigation measures, and assess fatalities at wind turbines (Kunz et al. 2007). The guidance document entitled *Assessing Impacts of Wind-Energy Development on Nocturnally Active Birds and Bats* provides methods to assess impacts of wind energy on nocturnal bats and birds. Kunz's methods include:

1. Visual methods such as night vision imaging, thermal infrared imaging, and radar,
2. Acoustic monitoring of migrating and non-migrating bats and birds using sophisticated microphones and bat detectors, and
3. Radio telemetry techniques.

Carcass Searches

Estimating Fatalities of Bats and Birds:

Carcass surveys are an important tool for assessing mortality in the turbine area. It is recommended that carcass searches be done at no less than 30% of turbines and met towers at large sites, and at smaller sites, every tower-base should be searched. Turbines sampled should represent a variety of the habitat features and be located throughout the project footprint. The search area should have a width equal to the maximum rotor tip height (e.g. a turbine that is 400 feet tall, the search radius should be 200 feet from the base of the turbine). Kerns et al. (2005) found bats were located >80% of the time within half the maximum distance from the top of the

rotor to the ground. In addition, searches should begin at sunrise to minimize carcass loss by early morning scavengers. Although there are multiple approaches to doing carcass searches (e.g. line transects, circular plots), they can all be scientifically reliable as long as the sampling bias is quantified (Kunz et al.2007). It is recommended that developers and consultants work directly with AGFD and USFWS to develop a monitoring design appropriate for a given site.

Collecting Carcass Data

Collecting bats and birds during carcass counts can provide data about the geographical source and abundance of resident and migratory populations (Note: Scientific Collecting License is required by AGFD to handle native animals). Record the species information, which turbine they were collected beneath (e.g. mid-row or end row), and if possible, photograph the specimen. Since AZ and CA have some overlap in raptor species, it may be helpful for searchers to use the Energy Commission's *2005 Guide to Raptor Remains: A photographic guide for identifying the remains of selected species of California raptors* available at www.energy.ca.gov/2005publications/CAC-500-2005-001/CEC-500-2005-001.PDF.

Frequency of Carcass Searches

Since bat and bird carcasses are readily scavenged and easily overlooked, at least 30% of turbines at a given site should be searched daily during seasons when bats are most active (April to October) to identify potential problem areas. If it is not possible to survey all turbines each day, then a staggered pattern search should be conducted to ensure some turbines are searched each day over a longer period (Arnett 2005). If it is not possible to search on a daily basis, then searches should be conducted on a systematic schedule of days (e.g. every 3rd, 7th, or 14th day), with an effort to conduct more intensive daily searches during spring and autumn migratory periods (Kunz et al. 2007).

With respect to fatality estimates, it should be noted that important sources of field sampling bias must be taken into account (Wobeser and Wobeser 1992, Philibert et al. 1993, Anderson et al 1999, Morrison 2002, Kunz et al. 2007). The following section defines these biases and offers methods in which to minimize them.

Bias #1: Fatalities occur on a periodic, clustered basis instead of more evenly distributed. This may happen due to weather events, flushes of migratory movement, and/or habitat use patterns.

Correction*:* In order to account for fatalities occurring on a periodic (clustered) basis, or to determine a specific goal, such as the effect of weather on fatalities during the bat migratory period (July to August-October), search plots should be done on a nightly basis during a portion of the survey period and well-distributed throughout the site. If nightly surveys are not reasonable throughout the entire survey period due to site location, bad weather, etc, clustering a sub-period of nightly surveys will help address this problem.

Bias #2*:* Carcasses are removed by scavengers prior to search effort. All wind energy sites will be inhabited by a variety of species of scavengers; therefore, it is important to determine site-specific scavenging rates.

Correction: Conducting carcass removal trials will determine scavenging rates and assist in estimating more accurate fatality estimates in a given area (Smallwood 2007, CA

guidelines, others). It should be noted scavenging will vary temporally and spatially from site to site, therefore estimating scavenging rates between sites is discouraged. Several wind sites have conducted scavenging trials and found using small birds as surrogates for bats may not be recommended (Erickson et al. 2003, Johnson et al. 2003). However, if bat carcasses are not available, small birds may be used. It is important to conduct multiple scavenger trials, as one is not typically representative. Lastly, if scavenging trials indicate high levels of carcass removal, it may become necessary to conduct more frequent carcass searches.

Bias #3: Differences in searcher detection. Depending on individual searcher variation and site conditions (e.g., vegetation characteristics), detection of carcasses will vary.

Correction: Incorporate estimates of searcher detection from previous studies (Smallwood 2007) in order to more accurately estimate fatality. In addition, the use of trained dogs for increased detection is recommended (Arnett 2006).

Bias #4: Fatalities or injured bats or birds may move outside of search plots.

1. ***Correction:*** Although there is little relevant data per unit time to measure crippling bias (CA guidelines), AGFD recommends searchers conduct stratified random searches outside of the "regular" search zone in order to determine if there are towers that may be higher risk.

Table 3. Bat Survey Techniques for Post-Construction Monitoring

Technique	Purpose	When to Use	Seasons	Number of Years Recommended
Carcass Searches	To assess mortality in the turbine area.	Daily during high activity seasons or systematically (every 3rd, 7th, 14th day, etc.) during migratory periods.	In general, April – October (higher elevations); lower elevations may warrant year round surveys	Cat. 1: 1 year min Cat. 2: 1-2 years Cat. 3: 2 year min Cat. 4: 3 years
Acoustic Detection	Acoustic monitoring provides information about bat presence and activity, as well as seasonal changes in species composition, but does not measure the number of individual bats or population density.	Conduct acoustic monitoring for bats at all proposed wind energy sites.	Samples should be robust during migration (August 16 – October 31); Year-round surveys will yield additional information.	Cat. 1: 1 year min Cat. 2: 1-2 years Cat. 3: 2 year min Cat. 4: 3 years
Mist-Netting	This capture technique can help to distinguish species that are difficult to identify or detect acoustically and to gather additional information such as species, age, sex, and reproductive status of local bat populations in which no other source, short of collecting the bat, can provide. Such information may be relevant in pre-construction studies if the goal is to evaluate potential project impacts to a local bat population.	Use with acoustic monitoring to provide an inventory of the species of bats present at a site (O'Farrell and Gannon 1999).	In general, April – October (higher elevations); lower elevations may warrant year round surveys	Cat. 1: 3 survey min Cat. 2: 5 surveys min Cat. 3: 7 surveys annual Cat. 4: 9 surveys annual
Roost Surveys	Include an assessment to determine whether known or likely bat roosts in mines, caves, bridges, buildings, or other potential roost sites could occur near proposed wind turbine sites. If active roosts are detected during this assessment, exit counts and roost searches can provide additional information about the size, species composition, and activity patterns for any bat-occupied features near project areas.	Use where potential roost sites occur near proposed wind turbine sites.	**Internal Roost Survey**: anytime, use caution in winter if the roost could be a hibernaculum; **External Roost Survey**: Conduct a minimum of 1 survey each season – recognize that absence of activity does not indicate absence of bats	For each category: surveys should be conducted until such time the roost use can be described
Visual Monitoring	**Night-vision**, **thermal infrared imaging**, and **radar** can be used to augment the information from above survey methods.	Use when the information from acoustic monitoring needs to be augmented.	Should be conducted in conjunction with other surveys with a similar time frame	Should be conducted in conjunction with other surveys with a similar time frame

Table 4. Diurnal Bird Survey Techniques for Post-Construction Monitoring

Technique	Purpose	When to Use	Seasons	Number of Years Recommended
Carcass Searches	To assess direct impacts to birds from wind turbines and met towers; to determine patterns and rates of fatality within resident migratory populations; and to assess the effectiveness of micrositing design for turbine locations and other mitigation measures designed for birds.	Use on all constructed wind energy projects. Daily during high activity seasons or systematically (every 3rd, 7th, 14th day, etc.) during migratory periods.	Immediately after turbine construction for site with rare species, April – July otherwise	For the first 2 years, then throughout the life of the project at 3- year intervals.
Bird Use Counts	To assess small and large bird species composition, displacement, occurrence, frequency, and behavior in relation to wind development operations. Also used to assess the effectiveness of mitigation measures designed for birds.	Use on all constructed wind energy projects. Design surveys with points of unlimited radius and at the small bird use count density (see pre-permitting section).	April – July	For the first 2 years, then throughout the life of the project at 3- year intervals.
Raptor Nest Searches	To provide data on location and activity level of nesting raptors in relation to wind turbine sites, and to assess the effectiveness of mitigation measures designed for raptors.	Use on all constructed wind energy projects because ground disturbance associated with construction can increase prey populations for raptors.	January – May below 4000 ft. elev. and April – July above 4000 ft. elev.	After 5 years then throughout the life of the project at 5-year intervals

Minimum Post-construction Monitoring for Birds by Project Category

Note: *Post construction eagle surveys will be determined on a site by site basis and outlined within the project's Eagle Conservation Plan (or equivalent) and be incorporated as permit requirements within the project's BGEPA permit.*

Category 1:
Carcass Searches — *Immediately after operations begin for 2 consecutive years; long-term monitoring TBD*
Bird Use Counts — *2 consecutive years; then once every 3 years*
Raptor Nest Searches — *Once every 5 years*

Category 2:
Carcass Searches — *Immediately after operations begin for 2 consecutive years; long-term monitoring TBD*
Bird Use Counts — *2 consecutive years; then once every 3 years*
Raptor Nest Searches — *Once every 5 years*

Category 3:
Carcass Searches — *Immediately after operations begin for 2 consecutive years; long-term monitoring TBD*
Bird Use Counts — *2 consecutive years; then once every 3 years*
Raptor Nest Searches — 2 *consecutive years; then once every 5 years*

Category 4:
Carcass Searches — *Immediately after operations begin for 3 consecutive years; long-term monitoring TBD*
Bird Use Counts — *3 consecutive years; then once every 2 years*
Raptor Nest Searches — *3 consecutive years; then once every 5 years*

Reporting

Report #4- Post Construction Monitoring plan:

Once permits are acquired for a wind project and sufficient information has been collected in the pre-construction phase, AGFD recommends project proponents develop a post-construction monitoring study plan. This monitoring plan should be developed in coordination with appropriate state and federal agencies. Table's 3 and 4 provide guidance on bat and bird survey techniques depending on project site category. Post-construction data should be directly comparable to pre-construction. Types of information needed in this monitoring plan may include:

- Methods to assess the effects of wind turbines on wildlife populations and how those coincide with monitoring for the established triggers.
- *Bats:* carcass searches (with searcher efficiency trials), acoustic detections, mist-netting, roost surveys, visual monitoring (Table 3).
- *Birds:* carcass searches (with searcher efficiency trials), bird use counts, migration counts, raptor nest searches, small bird counts, area searches, winter bird counts (Table 4).

Report #5- Annual and Long Term Monitoring reports:

Once a post construction monitoring study plan has been developed, AGFD recommends project proponents draft an annual report for ongoing post-construction data collection. Annual reports should be yearly at first, then at intervals determined by the category to which the project belongs (see Tables 3 and 4). AGFD requests annual reports be submitted within six months from the last season's data collection. AGFD recommends project proponents submit an annual report of ongoing post-construction data. Annual reports should cover the full calendar year and include the following:

- Synthesis of bat and bird fatality and carcass search data.
- Comparison of these results to other areas.
- A discussion of the effectiveness of the techniques and whether aspects of monitoring need to be modified.
- A discussion on mitigation measures and whether they are sufficient to mitigate effects.

Where to Submit Wildlife Data and Reports

AGFD encourage data owners to share raw data and reports by submitting results to the PEP. Please e-mail a complete dataset with metadata and reports to pep@azgfd.gov or mail on a CD to the following address:

Arizona Game and Fish Department -WMHB
Project Evaluation Program
5000 W. Carefree Highway
Phoenix, AZ 85086

Please specify any viewing restrictions or applications required and any information that may be considered proprietary or confidential. AGFD requests the following necessary elements of data submittals: 1) electronic format, 2) geographic locations of biological observations including projected or geographic coordinate system and datum, 3) attributes defining observational data, 4) metadata and 5) monitoring reports (preferably in PDF format).

Self-Reporting of Incidental Findings

Field personnel at wind energy sites can augment information from operations monitoring programs by reporting incidental findings of dead or injured bats and birds. Orloff and Flannery (1992) provide guidance and template data sheets for self-reporting monitoring programs, which are typically implemented in collaboration with USFWS. The Avian Powerline Interaction Committee (APLIC, 2006) also offers suggestions on developing avian fatality reporting programs by trained field personnel. While not part of a systematic data collection effort, incidental observation data from trained workers who record and report bat and bird carcasses discovered in the project area can supplement fatality data from the standard operations monitoring studies. If such incidental observations are to be included in the data analysis and monitoring reports, researchers should coordinate closely with field personnel collecting the data, establish criteria for which self-reported data are appropriate for inclusion, and fully describe the criteria and protocol for incidental observation data collection in the monitoring reports.

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Wobeser, G., and A. G. Wobeser, *Disappearance and Estimation of Mortality in a Simulated Die-off of Small Birds*, Journal of Wildlife Diseases, 28:548-554, 1992.

APPENDIX A: Contact Information for the Arizona Game and Fish Department Headquarters and Regions

Arizona Game and Fish Department Headquarters
5000 W. Carefree Hwy
Phoenix, AZ 85086
(602) 942-3000

Project Evaluation Program
5000 W. Carefree Hwy
Phoenix, AZ 85086
(623) 236-7600
pep@azgfd.gov

Region 1
2878 E. White Mountain Blvd.
Pinetop, AZ 85935
(928) 367-4281

Region 2
3500 S. Lake Mary Rd.
Flagstaff, AZ 86001
(928) 774-5045

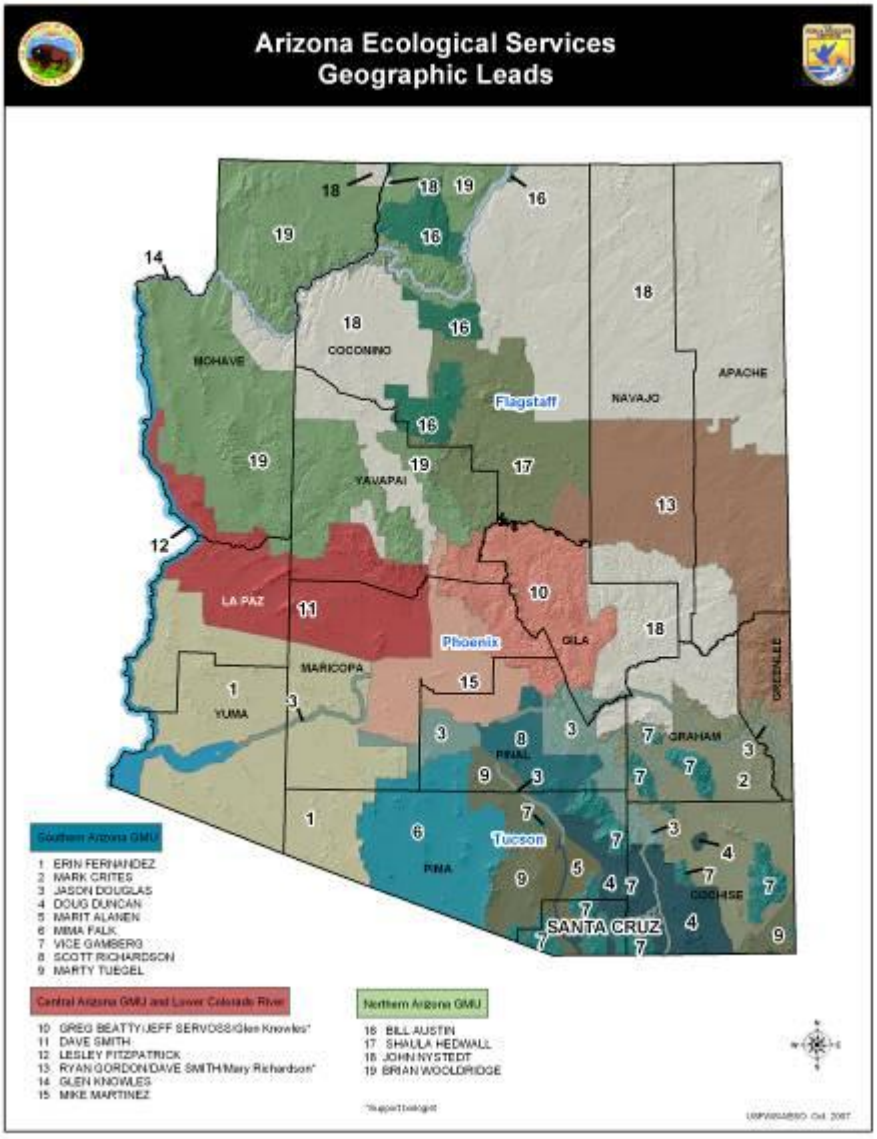
Region 3
5325 N. Stockton Hill Rd.
Kingman, AZ 86409
(928) 692-7700

Region 4
9140 E. 28th St.
Yuma, AZ 85635
(928) 342-0091

Region 5
555 N. Greasewood Rd.
Tucson, AZ 85745
(520) 628-5376

Region 6
7200 E. University Dr.
Mesa, AZ 85207
(480) 981-9400

APPENDIX B: Contact Information for United States Fish and Wildlife Service Ecological Services Offices with Jurisdiction in Arizona



Phoenix Main Office
2321 W. Royal Palm Rd.
Suite 103
Phoenix, AZ 85021
Phone: (602) 242-0210
Fax: (602) 242-2513

Tucson Sub-Office
201 N. Bonita
Suite 141
Tucson, AZ 85745
Phone: (520) 670-6144
Fax: (520) 670-6155

Flagstaff Sub-Office
323 N. Leroux St.
Suite 201
Flagstaff, AZ 86001
Phone: (928) 226-0614
Fax: (928) 226-1099

APPENDIX C: Guidelines for Installation and Monitoring of Meteorological Towers and their Associated Infrastructure

Met towers (whether temporary or permanent) and their associated infrastructure have the potential to cause avian and bat mortalities resulting from mid-flight strikes with the tower guy wires. Studies have shown guy-wired towers can cause four times more bird mortality than towers without guy wires (Young et al., 2003) (http://www.west-inc.com/reports/fcr_final_mortality.pdf). While bats can also strike guy wires, the occurrence is much less frequent. In addition, the visibility of met towers is important for the safety of aircraft pilots at low flight elevations. To reduce the potential for bat and bird collisions, and to provide guidance for keeping pilots and personnel safe, AGFD has developed these recommendations:

- AGFD requests all *permanent* met towers be unguyed, free standing structures. If monopole are not practicable, then free standing lattice towers with perching deterrents may suffice. If possible, AGFD also requests temporary met towers be unguyed, monopole, free standing structures.
- When guy wires are present, AGFD recommends attaching Bird Flight Diverters (BFDs) at spaced intervals along the length of multiple wires. **At a minimum, four Aircraft Warning Markers (spherical or cylindrical, 36 inches in diameter) should be placed 10 meters below the apex and BFDs be placed at 10 meter intervals along the length of each outer wire**. Research shows the attachment of BFDs can reduce bird collisions by as much as 86-89% (Pope et al., 2006) (http://www.chelanpud.org/documents/Burch_Final_Report_V1.pdf). AWMs should be recognizable from a distance of at least 4,000 feet (1219m) in clear air and visible from all directions.
- AGFD recommends all temporary towers are only on site for the minimum amount of time needed to monitor the wind resource. If towers are on site for more than 1 year, AGFD recommends carcass searches be implemented, especially during the bird migration period (see Chapter 5, Post-construction Monitoring and Reporting).
- If a temporary tower is going to become a permanent structure for the life of the project, AGFD recommends the tower(s) be included as part of the longer term (pre-construction and post-construction) monitoring program.
- AGFD recommends the applicant place acoustic monitoring stations on met towers in the proposed project area (**Note:** This will help collect bat activity information needed for pre-construction analysis). An acoustic monitoring station is defined as two acoustic detectors, one at "ground level" (approximately 1.5 meters above ground) and the other with an elevated microphone, ideally within the future rotor swept zone, but not less than 30 meters high. Reynolds (2006) and Lausen (2006) provide detailed guidelines for detector deployment and operation. Rainey et al. (2006) provides an in depth discussion of acoustic monitoring systems. Acoustic data collection objectives should strive to evaluate bat species composition and bat use of the project area nightly and across seasons to assess potential impacts. .

- Work with AGFD to determine the number of acoustic monitoring stations needed to adequately cover the project area. The number of acoustic stations will depend on project footprint and habitat complexity.
- When siting met towers, avoid habitat features that congregate wildlife such as water resources, habitat edges, ridgelines, etc. At a minimum, AGFD recommend 100m setbacks from these features. This varies site to site dependant on the combination geographic features and wildlife resources.

AGFD Personnel Safety

- Low-level aerial flights can occur outside routine wildlife survey routes. GPS locations of all towers need to be provided to AGFD prior to construction to allow survey aircraft to avoid the towers. In addition, AGFD requests project proponents notify the Department when met towers are removed.
- When guy wires are present, AGFD recommends attaching Bird Flight Diverters (BFDs) at spaced intervals along the length of multiple wires. **At a minimum, four Aircraft Warning Markers (spherical or cylindrical, 36 inches in diameter) should be placed 10 meters below the apex and BFDs be placed at 10 meter intervals along the length of each outer wire**. AWMs should be recognizable from a distance of at least 4,000 feet (1219m) in clear air and visible from all directions.
- For all monopole towers, paint the top 30 feet of the tower in alternate orange and white paint. This does not apply to lattice towers or lit towers, both of which are more visible than monopoles.

APPENDIX D: Reporting Monitoring Data

Reporting is crucial in determining if wind projects have undergone accurate methods of understanding possible effects on biological resources in the area, whether impacts can be avoided and/or minimized, and whether mitigation measures were appropriate. Reports are most informative and comparable when they follow standard scientific reporting format and provide sufficient detail to allow agency and peer reviewers to evaluate the methods used, understand the basis for conclusions, and independently check conclusions. To that end, AGFD recommends that permitting agencies or project proponents report on the following, and in this order:

Report #1: Preliminary Site Screening

This report should include data from the initial reconnaissance visit as described in Chapter 2. Include information on the assessment of the potential for wildlife to occur at the site and a preliminary evaluation of collision risk. This report should contain sufficient data to conclude with a data-driven framework the Category to which the potential project may be designated. Submit the report to AGFD for concurrence. This should be completed prior to the development and submittal of the pre-permitting study plan.

Information in this report should include but not be limited to:

- A description of the vegetation community and major topographical features.
- Information gathered from state and federal agencies on wildlife populations in the area including any Threatened and Endangered species, raptors, and significant bat populations (especially known migration and/or colonies).
- Any information on known or suspected migratory corridors for wildlife.
- Analysis of potential impact and mitigation to avoid impacts to wildlife (possible direct, indirect, and cumulative effects).

Report #2: Preliminary Site Screening

Once the project category has been designated and the *Preliminary Site Screening Report* has been completed and AGFD and other appropriate agencies have agreed to its conclusions, project proponents should draft a study plan for measuring pre-construction data on wildlife. The study plan should be drafted in coordination with, and submitted to, AGFD and appropriate federal agencies. Tables 1 and 2 in Chapter 3 should guide project proponents on types of data to collect and the duration the data needs to be collected, depending on which Category a project is deemed. Proponents should use the most current scientific data to determine methodologies for data collection as previously outlined in this chapter. Some of the data collected may include:

- *Bats:* acoustic detections, mist netting, roost surveys, and visual monitoring.
- *Birds:* bird use counts, migration counts, raptor nest searches, small bird counts, area searches, and/or winter bird counts.

Report #3- Annual reports of pre-construction data

Once a pre-construction study plan has been evaluated, AGFD recommends project proponents draft annual reports for ongoing pre-construction data collection and submit those within six months from the last season data collection occurred. Information in the annual reports should include but not be limited to:

- A yearly/seasonal synthesis of wildlife data separated out by technique used to measure these variables.
- A discussion of the effectiveness of the techniques and whether the study plan needs to be modified.
- A re-evaluation of the impact analysis, including fatality estimates.
- A discussion on mitigation measures should there be potential effects to wildlife.
- A discussion and/or justification of the Category chosen.

Report #4- Post Construction Monitoring plan:

Once permits are acquired for a wind project and sufficient information has been collected in the pre-construction phase, AGFD recommends project proponents develop a post-construction monitoring study plan. This monitoring plan should be developed in coordination with appropriate state and federal agencies. Table's 3 and 4 provide guidance on bat and bird survey techniques depending on project site category. Post-construction data should be directly comparable to pre-construction. Types of information needed in this monitoring plan may include:

- Methods to assess the effects of wind turbines on wildlife populations and how those coincide with monitoring for the established triggers.
- *Bats:* carcass searches (with searcher efficiency trials), acoustic detections, mist-netting, roost surveys, visual monitoring (Table 3).
- *Birds:* carcass searches (with searcher efficiency trials), bird use counts, migration counts, raptor nest searches, small bird counts, area searches, winter bird counts (Table 4).

Report #5- Annual and Long Term Monitoring reports:

Once a post construction monitoring study plan has been developed, AGFD recommends project proponents draft an annual report for ongoing post-construction data collection. Annual reports should be yearly at first, then at intervals determined by the category to which the project belongs (see Tables 3 and 4). AGFD requests annual reports be submitted within six months from the last season's data collection. AGFD recommends project proponents submit an annual report of ongoing post-construction data. Annual reports should cover the full calendar year and include the following:

- Synthesis of bat and bird fatality and carcass search data.
- Comparison of these results to other areas.
- A discussion of the effectiveness of the techniques and whether aspects of monitoring need to be modified.
- A discussion on mitigation measures and whether they are sufficient to mitigate effects.

AGFD encourages project proponents make wildlife data publicly available. Making pre-permitting and operations wildlife data publicly available serves several important functions and would be a useful permit condition of all wind energy projects. Aside from facilitating maximum utility of results from wildlife surveys, sharing the data may foster collaboration among individuals working on similar projects in various parts of the state. Operations monitoring reports and raw data have value as public documents because they facilitate the

learning process for application on subsequent projects and can supplement baseline data for nearby new projects. Making raw data available to the public is useful in cumulative impact analyses and potentially provides an overview of trends. Additional study results from impact avoidance, minimization, and mitigation monitoring and adaptive management programs would similarly be useful to the public.

Where to Submit Wildlife Data and Reports

AGFD encourage data owners to share raw data and reports by submitting results to the Project Evaluation Program. Please e-mail a complete dataset with metadata and reports to pep@azgfd.gov or mail on a CD to the following address:

Arizona Game and Fish Department -WMHB
Project Evaluation Program
5000 W. Carefree Highway
Phoenix, AZ 85086

Please specify any viewing restrictions or applications required and any information that may be considered proprietary or confidential. AGFD requests the following necessary elements of data submittals: 1) electronic format, 2) geographic locations of biological observations including projected or geographic coordinate system and datum, 3) attributes defining observational data, 4) metadata and 5) monitoring reports (preferably in PDF format).

Self-Reporting of Incidental Findings

Field personnel at wind energy developments can augment information from operations monitoring programs by reporting incidental findings of dead or injured bats and birds. Orloff and Flannery (1992) provide guidance and template data sheets for self-reporting monitoring programs, which are typically implemented in collaboration with USFWS. The Avian Powerline Interaction Committee (APLIC, 2006) also offers suggestions on developing avian fatality reporting programs by trained field personnel. While not part of a systematic data collection effort, incidental observation data from trained workers who record and report bat and bird carcasses discovered in the project area can supplement fatality data from the standard operations monitoring studies. If such incidental observations are to be included in the data analysis and monitoring reports, researchers should coordinate closely with field personnel collecting the data, establish criteria for which self-reported data are appropriate for inclusion, and fully describe the criteria and protocol for incidental observation data collection in the monitoring reports.