RECOMMENDATIONS TO MINIMIZE ADVERSE IMPACTS OF WIND ENERGY DEVELOPMENT ON WILDLIFE 2012

A. INTRODUCTION

Wind-generated electrical energy is environmentally friendly in that it is renewable and does not create air-polluting and climate-modifying emissions. New Mexico has a Renewable Energy Portfolio Standard, requiring large investor-owned utilities to obtain 10% of their electricity from renewable sources by 2011, 15% by 2015, and 20% by 2020. Rural electric cooperatives will be required to include 10% renewables by 2020. However, wind turbines, particularly in the large arrays needed for commercial electricity generation, can have adverse impacts on wildlife and wildlife habitats (Edkins, undated; Erickson et al, 2001; Kunz et al, 2007b). As more facilities with larger turbines are built, the cumulative impact of this rapidly growing industry may initiate or contribute to the decline of some wildlife populations. Little or no data has been published regarding wind energy impacts on wildlife in Texas, the state with the greatest installed capacity in the US, or other southwestern states. Cumulative or landscape level effects are virtually unstudied.

The New Mexico Department of Game and Fish (NMDGF) does not have regulatory authority specific to wind power development, nor is there any other statewide permitting authority in New Mexico. The information in this guideline is intended for use by wind project developers, their consultants, local government and the general public. Developers are encouraged to contact NMDGF for project-specific comments and recommendations. Specific locations of listed species will be kept confidential, however other information shared with NMDGF may be accessible to the public through the NM Inspection of Public Records Act. NMDGF Guidelines referred to herein may be found in the Habitat Handbook, under the Conservation tab on the Department website.

Adverse wind energy impacts can be classified into three general categories:

1. Habitat fragmentation, loss and degradation.

Habitat loss refers to the direct conversion of surface area to uses not compatible with the needs of wildlife. Habitat loss occurs as a result of the direct footprint of wind farm facilities, roads and associated new transmission line. Degradation is the diminishment of habitat value or functionality. Degradation may occur through a number of mechanisms, such as pollution, or adverse changes in vegetation composition and structure or hydrologic regime. Habitat fragmentation is the division of contiguous or homogeneous blocks of wildlife habitat into smaller areas separated by physical or other barriers. Noise and visual disturbance can affect sensitive species such as the Lesser Prairie Chicken (LPC), which rely on auditory communication for reproductive efforts. Although the mechanism and population-level effects are not entirely clear, LPC also appear to avoid certain man-made elements on the landscape (Pitman et al, 2005; Pruett el at, 2009, but see Toepfer, 2009), presumably due to their potential use as perches by predators such as hawks. Grassland birds are a species group of concern, due to declining populations on a national basis. Some species of grassland birds may exhibit avoidance of wind turbines (Erickson et al, 2007; Mabey and Paul, 2007). Research has documented avoidance of man-made structures, roads and human activity by a variety of wildlife, large mammals in particular (Habitat Fragmentation and the Effects of Roads on Wildlife and Habitats, NMDGF Habitat Handbook). However, no specific information is available regarding avoidance of wind energy facilities by mammals.

2. Direct mortality to birds.

Direct killing can occur when birds are struck by moving blades. When birds approach spinning turbine blades, a phenomenon called "motion smear" occurs, which is caused by the inability of the bird's retina to process high speed motion stimulation (Hodos et al, 2001). This occurs primarily at the tips of the blades, making the blades deceptively transparent at high velocities. This increases the likelihood that a bird will fly through this arc, be struck by a blade and be killed. Efforts to decrease avian mortality by improving the visibility of turbine blades have not been successful to date.

The problem first surfaced in the late 1980s and early 1990s, at the Altamont Pass Wind Resource Area, a facility just east of San Francisco Bay, California. Several hundred raptors were killed each year due to turbine collisions, guy wire strikes, and electrocutions. The Altamont turbines are still estimated to kill 25 to109 Golden Eagles each year, as well as several hundred Red-tailed Hawks, American Kestrels and Burrowing Owls. In all, as of 2008, the turbines at Altamont were estimated to cause the death of over 1000 raptors per year (Smallwood and Thelander, 2008). The atypically high occurrence of raptor mortality at Altamont, compared to other wind facilities, can be attributed to poor site selection. An important purpose of conducting pre-construction wildlife surveys is to "avoid another Altamont".

In addition to protections for most native bird species under the Migratory Bird Treaty Act, Bald and Golden Eagles are afforded protection under the Bald and Golden Eagle Protection Act. Although the majority of documented turbine related mortalities have been passerine species, wind farms may disproportionately affect local populations of Golden Eagles and other raptors, whose breeding and recruitment rates are naturally low, and whose populations tend to have smaller numbers of breeding adults.

The Federal Aviation Administration (FAA) requires lighting on top of wind generator towers over 200 feet tall for aircraft avoidance. Lighted turbine towers can be assumed to have potentially the same effects on night-flying migratory birds as have been documented at tall communications towers. For a description of effects of tall towers with lights on night-flying migratory birds, with specific lighting recommendations for wind generators, refer to the Turbine Design and Operation Recommendations (below) and the NMDGF Communication Tower Guidelines. Raptors can be electrocuted on powerlines if raptor-safe technology (phase isolation) is not used. Powerlines located on concentrated migration routes, near migration stopover or winter concentration areas, or between known roosting and feeding areas, may also present a collision hazard for large birds, such as Sandhill Crane.

a) Direct Mortality to Bats

Documented mortalities show that bats are susceptible to being killed by wind turbines. Some studies have indicated that bats may to be attracted to the turbines, possibly mistaking them for the large trees which are favored for swarming and mating behavior (Cryan, 2008). One apparent mechanism of mortality, in addition to direct strike, is pulmonary trauma resulting from sudden pressure change caused by blade sweep movement (Baerwald, 2008). Adverse population-level effects are possible for migrating groups of bats or for local populations, due in part to their low reproductive rates. Most documented wind turbine bat mortalities in the US have affected migratory tree-roosting species such as Hoary Bat, Silver-Haired Bat and Eastern Red Bat. Mortalities have generally been concentrated in the late summer-fall migration season. Another potentially vulnerable bat species in NM is the Brazilian Free-tailed Bat, which occupies large communal roosts and feeds primarily over agricultural fields.

Bat fatalities increase exponentially at tower heights greater than 60 meters (Barclay et al, 2007). Most fatalities occur at wind speeds below 4 to 6 meters per second (mps) because bats are more active in those conditions (Arnett et al, 2008). To protect bats, tower height should be minimized. However virtually all modern commercial-scale turbines exceed 60 meter in height. One way to reduce mortality, at facilities with a high risk or high level of documented kills, is feathering the blades of turbines at wind speeds less than 6 mps (feathering is a change in the angle of blade which causes the turbine to cease from rotating, also known as curtailment). Data from pilot studies of low wind speed curtailment at sites in Pennsylvania (Arnett et al, 2011) and Alberta (Baerwald, et al 2009), showed significant nightly reduction in bat fatalities with less than 1% annual loss of generated power (Arnett et al, 2011). Efforts to develop an effective and economically feasible auditory or electromagnetic bat deterrent have not been successful to date.

B. SITE EVALUATION

1. Pre-Construction Studies.

Pre- development studies should be a part of any site development plan, in order to estimate to what extent mortality or avoidance may be expected, and to document potential effects on special status species. Studies should include collection of a minimum one year of baseline data, in order to include all seasons. Because bat migration can be highly variable from year to year, an optimal pre-construction survey schedule would include two late summer/fall bat migration periods. Field study schedules should leave enough time for additional investigation if indicated by initial results. Since migratory behavior of both birds and bats appears to be related to weather conditions, survey reports should correlate wildlife observations with available concurrent site meteorological data such as wind speed, precipitation and the passage of pressure fronts. The scope of the surveys should include the corridor that will be required for any new transmission to connect the project to the grid. The National Wind Coordinating Collaborative has published a detailed and thorough guide which provides a reference to methods, metrics and study design, and a framework for risk-based decision-making (Strickland et al 2011). The 2012 USFWS Land-Based Wind Energy Guideline includes similar content. Permits may be required from the USFWS and NMDGF to conduct surveys for certain species, particularly if these species are listed, or trapping, handling, and/or collecting of wildlife is necessary.

Please consider sharing the results of site surveys with NMDGF, to help us better evaluate the correlation of pre- and post-construction data, and the cumulative effect of multiple projects on the landscape.

Subjects that should be evaluated include:

1. **Habitat type stratification and spatial arrangement, and the presence of special habitat elements.** Examples of special elements might include prairie dog towns, water features or abrupt changes in elevation.
2. **General bird use is typically evaluated by periodic point counts conducted by a qualified observer.** Infrared or radar-based studies may be appropriate where high numbers of night migrants are expected. Suitable habitat within a one mile radius of any turbine should be surveyed for raptor nesting or winter aggregation. Distances to set back turbines from the edge of an escarpment can be guided by behavioral observations of spatial habitat use. If power generation is critical in areas with known high seasonal concentration of birds, an average of three years monitoring data (e.g., acoustic, radar, infrared, or observational) should be collected and used to determine peak use dates when shut-downs would be recommended.
3. **Bat use is typically evaluated using data-logging sonic detectors**. At least a portion of the detectors should be raised above ground level to detect animals flying at or near the rotor-swept zone. Detectors may be mounted on meteorological towers or on portable towers erected for the purpose. Bat studies may also include netting or trapping to document use of water features or known roost locations. Infrared or radar-based studies may be appropriate where available

information indicates the site may have particular significance for migratory or local bat populations.

4. **Protocol surveys for any special status species (state or federal Endangered, Threatened or sensitive) which may occur on the location and habitat occupied by the project.** Special status species lists by county for NM can be generated using the Bison-M database (www.bison-m.org), or by request from NMDGF. For information on state-listed plants, contact the NM Energy, Minerals and Natural Resources Department, Division of Forestry, or go to the NM Rare Plants website at http://nmrareplants.unm.edu/. Recommended survey methodology for many sensitive species is available by contacting the NMDGF Conservation Services Department.
5. **Other surveys as indicated**. These might include avoidance studies for areas important to nesting grassland birds or evaluation of wildlife use of special habitat elements. To the extent feasible, avoidance should be evaluated using a before-after control-impact study design.

2. Post-Construction Studies.

The current state of knowledge allows for some degree of confidence in the correlation of pre-construction avian occurrence with expected impact. The same cannot be said of bats. In addition, there is very little available information of any kind documenting wind-wildlife interactions in Texas or the southwestern states. Therefore, post-construction follow-up is necessary to confirm the accuracy of the pre-construction predictions of risk. Since the pressure for timely site development ceases to be a consideration once the facility is operational, NMDGF recommends that formal post-construction studies should have a minimum duration of two years to incorporate natural year-to-year variability. Please consider sharing the results of site surveys with NMDGF. Subjects that should be evaluated include:

1. **Bird and bat mortality.** To produce useful data, all mortality studies should include correction procedures for searcher efficiency and scavenger removal biases. Study design should also evaluate statistical sufficiency of the selected search duration and interval.
2. **Other surveys as needed to document avoidance or to monitor the effects of mitigation efforts.** Additional information may be desirable in order to follow up on potential concerns identified by the initial site-specific studies.

RECOMMENDATIONS FOR WIND ENERGY FACILITIES. (Adapted from USFWS 2003 Interim Guidance on Avoiding and Minimizing Wildlife Impacts from Wind Turbines)

1. Site Development

1. Review preliminary screening-level wildlife information about locations under consideration for wind energy development, which may be available from NMDGF, the US Fish & Wildlife

Service, NM Natural Heritage Program, the Audubon Society, Playa Lakes Joint Venture, land managing agencies and other public sources. A lack of published information, however, does not necessarily imply the absence of sensitive resources.

2. Avoid placing turbines in documented locations of any species of wildlife, fish or plant protected under the Federal Endangered Species Act, the NM Wildlife Conservation Act, or NM Administrative Code, 19.21.2. (Endangered Plants).
3. Avoid locating turbines in concentrated migration routes, unless mortality risk is low (e.g., birds present rarely enter the rotor-swept area). Examples of high concentration areas for birds are wetlands, playa lakes or playa lake complexes, State or Federal refuges, private duck clubs, staging areas, rookeries, leks, roosts, riparian areas along streams, and landfills.
4. Avoid daily movement flyways (e.g., between roosting and feeding areas) and areas with a high incidence of fog, mist, low cloud ceilings, and low visibility.
5. Avoid placing turbines near bat hibernation, breeding, and maternity/nursery colonies, in concentrated migration routes, or in flight paths between colonies and feeding areas.
6. Configure turbine locations to avoid areas or features of the landscape known to attract raptors. For example, Golden Eagles, hawks, and falcons use cliff/rim edges extensively; setbacks from these edges may reduce mortality if monitoring documents this type of use. Other examples include not locating turbines in a saddle or pass in a ridge, or in or near prairie dog colonies (prairie dogs are a favored prey item for raptors).
7. Avoid placing turbines in proximity to raptor nests. Buffer distances for direct mortality prevention should be established based on behavioral observations. Buffer distances for avoiding disturbance effects can be determined in consultation with NMDGF, based on species and topography.
8. Configure turbine arrays to avoid potential avian mortality where feasible. For example, group turbines instead of using a wide-spread spatial arrangement, and orient rows of turbines parallel to known bird movements, thereby decreasing the potential for bird strikes. Implement appropriate storm water management practices that do not create attractions for birds, and maintain contiguous habitat for area-sensitive species.
9. Avoid fragmenting large, contiguous tracts of wildlife habitat. Where practical, place turbines on lands already altered or cultivated (such as row-crop agriculture or developed oilfields), and away from areas of intact and healthy native habitats. Select fragmented or degraded habitats over relatively intact areas. Where it is necessary to build on large contiguous tracts of intact habitat, place the development at the edge of the habitat block.
10. To prevent degradation of aquatic habitat, leave buffers separating surface disturbance from water bodies, including intermittent and ephemeral streams. The setback distance should be measured from the edge of the riparian zone, if any, and determined using the Natural Resources Conservation Service Revised Universal Soil Loss Equation or similar method which considers topography, soil type and composition of the natural vegetation. Habitat value of the water body may also be a factor.
11. Please consult with NMDGF at an early stage of planning for any facility within historic LPC range. To the extent feasible, avoid placing turbines within 3 miles of any lek (communal pair formation ground) which has been active within the past 5 years. In places where there has not been adequate recent survey coverage, it will be necessary to conduct auditory lek surveys during the appropriate season (mid March to mid April) using NMDGF survey protocols (available by contacting the Conservation Services Department).
12. Minimize roads, fences, and other infrastructure. Minimize traffic volume, control vehicle speed, control access where feasible, and prohibit off-road travel. Construct fences so as to allow wildlife movement and minimize the risk of injury (see NMDGF Fencing Guideline).
13. Conduct pre-construction clearance surveys for active raptor nests and other sensitive species at locations of surface disturbance. Observe appropriate spatial and temporal construction buffer zones, as determined in consultation with NMDGF.
14. Incorporate native plant species into interim and long-term habitat restoration plans for proposed sites. Avoid or minimize negative impacts on vulnerable wildlife while maintaining or enhancing habitat values for other species. For example, avoid attracting high densities of prey animals (rodents, rabbits, etc.) used by raptors.

15. Encourage landowners/lessees to reduce availability of carrion by practicing responsible animal husbandry (removing carcasses, fencing out cattle, etc.) to avoid attracting Golden Eagles and other raptors.
16. Where habitat loss or degradation is unavoidable, compensate for the impacts using off-site mitigation. Mitigation might take the form of research projects or the purchase, lease or other arrangement for conservation of off-site habitat. Off-site mitigation projects should replace habitat of similar kind, and equal to or greater than the value of the habitat which will be lost.

2. Turbine Design and Operation

1. In areas with known high seasonal concentration of birds, use radar systems to detect bird movements and/or weather patterns, so that turbines can be shut down during periods when birds are highly concentrated at rotor height.
2. Avoid using guy wires to support turbines or permanent meteorological towers. All existing guy wires should be marked with bird deterrent devices.
3. If taller turbines (top of the rotor-swept area is >199 feet above ground level)) require lights for aviation safety, the minimum amount of pilot warning and obstruction avoidance lighting specified by the FAA should be used. Unless otherwise requested by the FAA, only strobe or blinking lights should be used at night, and these should be the minimum number, minimum intensity, and minimum number of flashes per minute (longest duration between flashes) allowable by the FAA. Lighting other than airplane safety should be the minimum necessary, and shielded downward.
4. Where the height of the rotor-swept area produces a high risk for wildlife, adjust tower height where feasible to reduce the risk of strikes.
5. Where feasible, place electric power lines underground (see NMDGF Trenching Guideline) or on the surface as insulated, shielded wire to avoid electrocution of birds. To avoid bird electrocution or collisions associated with on- or off-site above-ground lines, transformers or conductors, refer to the NMDGF Powerline Guideline, and follow the published recommendations of the Avian Power Line Interaction Committee (1994, 2006).
6. Where post-construction studies show a high rate of bat mortality, or mortality to special status bat species, turbines operation should be curtailed at wind speeds below 4-6 mps, at the relevant time of day and season of the year.
7. Post-construction studies may show disproportionate mortality at certain towers, for example those located on the end of a tower string, or closest to the edge of a cliff; in these cases, curtailment, retrofitting or relocating is highly recommended.
8. Use a project-specific Technical Advisory Committee to review monitoring results and make suggestions to mitigate unanticipated impacts.
9. Promptly remove towers which are no longer in operation.

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U.S. Fish and Wildlife Service, 2012. Land-based wind energy guidelines. OMB Control No. 1018-0148. http://www.fws.gov/windenergy/

Additional Sources of Information

Bats and Wind Energy Cooperative. http://www.batsandwind.org/default.asp
Bureau of Land Management Wind Energy Development Programmatic EIS. http://windeis.anl.gov/

National Wind Coordinating Collaborative. http://www.nationalwind.org/

Playa Lakes Joint Venture. http://www.pljv.org/cms/wind-energy