Wyoming Game and Fish Department Guidelines for Wind and Solar Energy Development

Approved by the Wyoming Game and Fish Commission
January 28, 2021

ABSTRACT These Guidelines provide information to help reduce impacts to fish and wildlife from utility-scale solar and wind energy development in Wyoming. They include recommendations on: 1) preliminary screening of proposed projects, 2) project siting, design, construction, and management, 3) collecting baseline data prior to construction to avoid or measure potential conflicts with fish and wildlife, 4) post-construction monitoring, and 5) mitigating impacts to affected fish and wildlife to the extent possible. This document provides guidance consistent with the "Wyoming Game and Fish Commission's Mitigation Policy" (WGFC 2016) and supports the Wyoming Game and Fish Department's Mission of "Conserving Wildlife – Serving People."

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A LIVING DOCUMENT The state of knowledge regarding the potential consequences of solar and wind development to fish and wildlife is limited, but continuously expanding. As such, we expect to modify these recommendations as new findings inform our understanding of the impacts of renewable energy development on fish and wildlife. We welcome new research and commit to maintaining these recommendations as a living document that reflects our current understanding. We encourage input that may improve future revisions. Please direct comments and questions to: Wyoming Game and Fish Department – Habitat Protection Program, 5400 Bishop Boulevard, Cheyenne, WY 82006; wgfd.hpp@wyo.gov.

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ACRONYMS

AIS	Aquatic Invasive Species
BACI	Before-After-Control-Impact
DDCT	Density and Disturbance Calculation Tool
DOE	U.S. Department of Energy
FAA	Federal Aviation Administration
GenEst	Generalized Mortality Estimator
GIS	Geographic Information System
GPS	Global Positioning System
HUC	Hydrologic Unit Code
IPaC	Information, Planning and Conservation System
MET	Meteorological Evaluation Towers
MOU	Memorandum of Understanding
MW	Megawatt
NABat	North American Bat Monitoring Program
NEPA	National Environmental Policy Act
NREX	Natural Resource and Energy Explorer Tool
PLA	Prediction Level Assessment
RLA	Reconnaissance Level Assessment
RRISSC	Rapid Resource Inventory for Sediment and Stability Consequence
SGCN	Species of Greatest Conservation Need
SWPPP	Storm Water Pollution Prevention Plan
TAC	Technical Advisory Committee
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WARSSS	Watershed Assessment of River Stability and Sediment Supply
WGFD	Wyoming Game and Fish Department
WOS	Wildlife Observation System
WyBIS	Wyoming Biodiversity Information System
WYBWG	Wyoming Bat Working Group
WYNDD	Wyoming Natural Diversity Database

INTRODUCTION

Wyoming's vast, untrammeled landscapes and abundant fish and wildlife are iconic of the American West and contribute to a quality of life and economic value that cannot be overstated. Solar and wind energy (referred to in this document in combination as renewable energy) provide environmental benefits to society, but local utility-scale developments can negatively impact fish and wildlife, the habitats on which they depend, and limit uses such as hunting, wildlife viewing, and other outdoor activities. Impacts to fish and wildlife can include mortality, as well as habitat loss, fragmentation, and degradation. These impacts should be considered and addressed at the individual project scale, but also within the greater context of cumulative effects at the landscape scale, in order to sustain species distributions, fish and wildlife populations, and ecosystem function.

This document describes the project review process provided by the Wyoming Game and Fish Department (Department) for renewable energy projects, and provides recommendations and methods for use by project proponents, permitting agencies, and other parties involved in utility-scale renewable energy, with a goal of ensuring a sustainable future for renewable energy and wildlife in Wyoming. This document replaces the Department's 2010 publication, "Wildlife Protection Recommendations for Wind Energy Development in Wyoming," and provides a science-based framework for assessing and quantifying the potential impacts of utility-scale renewable energy projects on wildlife. It also offers measures to mitigate those impacts consistent with the "Wyoming Game and Fish Commission Mitigation Policy" (2016). These recommendations can be applied to all lands within the state. These guidelines do not duplicate or supersede other legal or permitting requirements, and do not mandate or limit the types of studies, mitigation, or alternatives an agency or permitting authority may choose to recommend or require.

Not all recommendations listed within this document will be applicable to both solar and wind energy development or to all projects of those types, and recommendations may be applied that are not included below; **however, in all cases, appropriate project siting is paramount to mitigating impacts to fish, wildlife, and habitat.** Recommendations are intended to be applied based on site- and project-specific characteristics determined during pre-construction surveys and in on-going consultation with the Department. Early coordination with the Department is the best means for proponents to determine which recommendations are appropriate for their project area. Coordination with the Department early in project development will help to avoid delays in making specific recommendations to other agencies with regulatory and permitting authority. Because most pre-construction monitoring involves two years of data collection, it is recommended that proponents coordinate with the Department more than two years prior to anticipated initial construction, concurrently with other permitting agencies. Proponents should also consult with the Department in advance of major replacement, repair, or decommissioning to minimize impacts to fish and wildlife.

PROJECT COMMUNICATION

This table describes the flow of communications between a renewable energy project proponent and the Department. Not all projects will follow all steps described below. Note that planning for fish and wildlife considerations is an iterative process, and will recur at multiple stages as the proponent gathers information.

Step	Project Proponent Role	Department Role
Step 1: Preliminary Project Planning	• Assess fish and wildlife habitat and species of concern at a landscape-scale. • Consult with Department staff for guidance when choosing among multiple potential sites or a larger region.	• Provide Department contact information and list of resources for biological information. • Provide preliminary feedback for fish and wildlife concerns among potential sites or within a larger region.
Step 2: Submit Preliminary Project and Location Information to the Department	• Submit project description. • Submit shapefile of proposed project location(s) with infrastructure delineated. • Submit initial biological and watershed assessment, including the potential presence of species or habitats of concern at a project-scale.	• Receive and begin review of preliminary project and site characterization provided by the proponent. • Advise proponent on additional information needs.
Step 3: Proposal Review by the Department	• Incorporate avoidance and minimization measures to alleviate direct and indirect impacts to fish and wildlife into project planning. • Provide additional project-related information as requested by the Department.	• Conduct a Wildlife Environmental Review assessing the submitted project information and wildlife data. • Return written recommendations regarding project location, infrastructure micrositing, design, construction, and operations within 30-45 days of receipt of necessary project information. • Identify initial fish and wildlife concerns and monitoring needs to be addressed in a Monitoring Plan.

Step	Project Proponent Role	Department Role
Step 4: Fish, Wildlife, and Habitat Monitoring and Data Analyses	• Form and convene the Technical Advisory Committee (TAC). • Submit a draft Monitoring Plan addressing concerns and needs identified by the Department and the TAC. • Conduct pre-, during, and post-construction monitoring in accordance with the Monitoring Plan. • Maintain and submit appropriate records of data and data collection in accordance with the Monitoring Plan. • Communicate and discuss monitoring results with the Department and TAC. • Iteratively modify Monitoring Plan to address concerns as needed.	• Participate in TAC meetings. • Review and provide feedback on the Monitoring Plan iterations. • Advise on study design. • Review and discuss monitoring results with the proponent and TAC. • Advise on the need for and design of any additional studies or monitoring.
Step 5: Mitigation	• Discuss the need for adaptive management and/or other mitigation strategies with the TAC. • Identify and implement recommended adaptive management and/or other mitigation strategies. • Assess the efficacy of adaptive management and/or other mitigation strategies.	• Identify and advise on the need for and design of adaptive management and/or other mitigation strategies. • Discuss results of monitoring to assess the effectiveness of adaptive management and/or other mitigation strategies.

CONSTRUCTING UTILITY-SCALE RENEWABLE ENERGY PROJECTS IN WYOMING

The Department engages directly with proponents of renewable energy projects to guide project siting and to assess and mitigate potential fish and wildlife concerns. We encourage proponents to communicate with Department staff early and throughout the project planning process to effectively address fish and wildlife concerns. A five-step project review process is outlined in the main body of this document, and additional detail and guidance is contained in the appendices.

Various federal, state, county, and local laws regulate the permitting of renewable energy development in the State of Wyoming. For comprehensive information on project permitting in Wyoming, proponents can refer to the state permitting guides for wind energy and solar energy developed by the Wyoming Renewable Energy Coordination Committee located on the Wyoming Energy Authority website (https://www.wyoenergy.org/reports/).

The Department coordinates with state and federal agencies and local governments on permitting processes associated with renewable energy development to address project-specific fish and wildlife concerns. Wind energy project proponents should refer to the U.S. Fish and Wildlife Service's (USFWS) Land-based Wind Energy Guidelines and USFWS staff for direction relative to the federal process for addressing species under federal statutory authority. These species include listed, proposed, or candidate endangered and threatened species; bald and golden eagles; and migratory birds (https://www.fws.gov/ecological-services/es-library/pdfs/WEG_final.pdf). We provide review and recommendations as requested and in accordance with any agency-specific policies and Memorandums of Understanding (MOUs). For projects on public lands or with another federal nexus, we participate as a cooperating agency throughout the course of the National Environmental Policy Act (NEPA) process.

Adherence to these guidelines and the Department's recommendations is voluntary, unless otherwise stipulated by a permitting agency or entity; however, the State of Wyoming holds fish and wildlife in trust for the people, and all native fish and wildlife are protected under state law. The Department encourages adherence to these guidelines to mitigate impacts from renewable energy development and operations to fish and wildlife, and welcomes the opportunity to partner with proponents to achieve these goals.

THE PROJECT REVIEW PROCESS

To initiate the collaborative project review process, proponents should coordinate with the Department more than two years prior to initiating construction, during the conceptual design of the project and prior to the final site selection. This early collaboration is crucial for avoiding and minimizing negative impacts to fish and wildlife, as there can be limited opportunities for further mitigation, such as adaptive management, after a project is developed. Mitigation options will almost always be more costly once facilities are in place, and significant, unmitigated impacts may contribute to population declines of wildlife, alter species' distribution and community composition, and affect the Department's ability to meet species-specific population objectives.

Step 1. Preliminary Project Planning

Project Location

The selection of a project site is the most critical choice in avoiding impacts to fish and wildlife from renewable energy development. Proponents should seek to use previously disturbed areas or cultivated areas with lower wildlife habitat value when possible (see Fargione et al. 2012). Proponents should avoid high-value or sensitive wildlife and fisheries resources and large areas of unfragmented habitat, which can be identified through coordination with the Department and using geospatial data provided on the Department's website. When selecting a project location, the proponent should consider the potential impact of limiting public access or altering the character of the proposed project location. Additionally, consideration should be given to the surrounding landscape in which the project will be sited, and the potential for cumulative impacts to fish and wildlife resources. See Appendix A for more detail on considerations for project location.

Resources for Biological Information

- **Wyoming Game and Fish Department Biologists**

The Department is responsible for the management of all fish and wildlife within the State of Wyoming. The Department's fish, wildlife, and habitat managers have expertise regarding these resources that is specific to local geography, habitat, and species. Additionally, Department staff are knowledgeable about permitting processes and statewide policies and directives that may affect the development of renewable resources. The Department encourages proponents of renewable energy projects to contact our staff early in the project planning process when potential project locations are being considered. The Department can provide preliminary feedback on potential sites and project lease areas, as well as general information related to fish and wildlife resources that may either constrain or facilitate development at a prospective location. Project proponents may reach out to local Department staff (https://wgfd.wyo.gov/regional-offices), as well as the Department's Habitat Protection Program (https://wgfd.wyo.gov/Habitat/Habitat-Protection-Program).

Some Wyoming Game and Fish Department geospatial data can be directly accessed on our website at: https://wgfd.wyo.gov/Wildlife-in-Wyoming/Geospatial-Data and https://wyoming-wgfd.opendata.arcgis.com/

- **State Wildlife Action Plan**

The Department's State Wildlife Action Plan (https://wgfd.wyo.gov/Habitat/Habitat-Plans/Wyoming-State-Wildlife-Action-Plan) is a comprehensive strategy to maintain the health and diversity of fish and wildlife within the state. This document identifies species and habitats of conservation concern in Wyoming, including the current list of Wyoming Species of Greatest Conservation Need (SGCN), a diverse array of taxa, as well as the threats to their persistence and recommended actions to address those threats.

- **Statewide Habitat Plan**

The Department's Statewide Habitat Plan (https://wgfd.wyo.gov/Habitat/Habitat-Plans/Strategic-Habitat-Plan) identifies near-term habitat conservation and enhancement priorities, as well as goals for management actions and geographic areas, and sets forth strategies to address those priorities and goals. The Statewide Action Plan defines how Departmental personnel will work together internally and with external partners to accomplish those goals to conserve and protect habitat.

- **Natural Resource and Energy Explorer**

Proponents can generate site-specific fish, wildlife, and habitat information through the State of Wyoming's online Natural Resource and Energy Explorer Tool (NREX; https://nrex.wyo.gov/). Note that obtaining a species list from NREX does not constitute a review of the project by the Department. Permitting agencies may have their own lists of sensitive species and habitats, stipulations, or other resources that proponents may need to consider, as well. Among the many fish and wildlife data layers that can be accessed on NREX, an Ecological Impacts layer has been developed that represents a combination of important fish and wildlife data that can be specifically used to inform selection of a project location in order to avoid areas of important and overlapping habitats.

- **U.S. Fish and Wildlife Service**

Early consultation with the USFWS will assist proponents in determining the applicability of federal wildlife laws, including the Endangered Species Act, Bald and Golden Eagle Protection Act, and Migratory Bird Treaty Act. Wind energy project proponents should also refer to the USFWS Land-based Wind Energy Guidelines (https://www.fws.gov/ecological-services/es-library/pdfs/WEG_final.pdf).The USFWS Wyoming Ecological Services Field Office (https://www.fws.gov/wyominges/) can provide Wyoming-specific assessments of the potential effects of projects to migratory birds, raptors, endangered species, and other species under federal statutory authority. Proponents can identify federally Threatened, Endangered, Proposed, and Candidate species relevant to proposed project locations using the USFWS Information, Planning and Conservation System tool (IPaC; https://ecos.fws.gov/ipac/). Proponents should refer to the USFWS guidelines for federal timing and spatial stipulations for raptor nests, as well as guidelines for raptor habitat use, nest searching, and monitoring.

Step 2. Submit Preliminary Project and Location Information to the Department

What to Submit

The amount of preliminary project and site information initially requested by the Department is dependent upon the project's stage of development.

For projects in the earliest conceptual design phase with multiple alternative sites or a general region under consideration for development, the Department can provide an initial assessment of the project location(s). The Department will provide insight into the known potential scope of impacts for fish and wildlife, and whether there are areas of known greater or lesser potential conflict within or among proposed sites. In this case, proponents should submit:

1) A shapefile identifying the area or site(s) being considered.

2) A brief description of the project scope (e.g., acres, land ownership, potential timing of construction).

3) The type of energy generation components to be used (e.g., photovoltaic panels, 2.0 megawatt wind turbines).

For proponents who contact the Department for the first time with known boundaries of leased lands or who have less flexibility in project location, we request the following:

- **Proposed project location.** Provide the legal description, a shapefile, and maps identifying the proposed project location. Delineation of the project area should include associated infrastructure, such as proposed power line corridors and access roads. Proponents should describe any considerations that were implemented in the selection of the project location to reduce impacts to fish and wildlife resources (see Appendix A).

- **Project description.** Describe the acreage of the project; nameplate energy generation capacity; infrastructure including energy generation components, roads, fencing, power lines, lighting; seasonal timing and duration of construction; plans for reclamation; invasive plant species management; proposed fish and wildlife protections (see Appendix A, B, and C).

- **Initial biological assessment.** The proponent should arrange for a qualified biologist who is knowledgeable about fish and wildlife in the region to conduct an initial desktop biological assessment of the proposed project location. This assessment should include:

- A description of the current land use, zoning, and the project site in relation to the larger landscape (e.g., proximity to high-priority fish and wildlife habitats or hotspots, existing disturbed areas, areas of industrial land use).

- A habitat map delineating landcover, including major vegetation communities, existing surface disturbance, significant topographic or biological features (e.g., rock outcroppings, prairie dog colonies), and ephemeral and perennial waterbodies. This preliminary habitat map can be created using best available aerial imagery and remotely sensed datasets, such as the USFWS National Wetland Inventory and the U.S. Geological Survey (USGS) National Landcover Dataset. Any heads-up digitization of features using aerial imagery should occur at a scale no coarser than 1:4,000.

- A list of potential or known sensitive species or habitats within the project area and a 1-mile buffer surrounding the project area. Greater sage-grouse habitat (including leks) should be assessed within a 2-mile buffer of the project area. For wind energy projects, eagle nest sites should be assessed within a buffer of the project area consistent with USFWS requirements. The species list can be generated using the State of Wyoming's online NREX (described in Step 1).

- **Initial watershed assessment.** The proponent should arrange for a qualified biologist or hydrologist to prepare a Reconnaissance Level Assessment (RLA; Level 1), using the Watershed Assessment of River Stability and Sediment Supply (WARSSS) methodology (Rosgen 2006; see Appendix D). This assessment will identify existing and potential project sediment sources and channel stability concerns. The assessment may require the preparer to have completed the Wildland Hydrology Level 1 course.

Where to Submit

Wyoming Game and Fish Department Habitat Protection Program
5400 Bishop Blvd., Cheyenne, WY 82006
307-777-4506
wgfd.hpp@wyo.gov
https://wgfd.wyo.gov/Habitat/Habitat-Protection-Program

Step 3. Proposal Review by the Department

After receiving preliminary project and site information from the proponent (Step 1 and 2), the Department will:

1) Assess the biological values of the proposed site(s).

2) Identify potential or known impacts to fish and wildlife resources.

3) Identify the types of fish, wildlife, and habitat monitoring needed to assess the potential for impacts and to quantify potential or known impacts.

4) Provide preliminary recommendations for project location, micrositing of infrastructure, as well as applicable design, construction, and operations best practices (see Appendix A and C).

Design, Construction, and Operations

Project design features; timing of construction, major maintenance work, and decommissioning; minimization of human activity during operations; and appropriate reclamation can help alleviate impacts to fish and wildlife during the life of a renewable energy development project. Infrastructure micrositing efforts, such as appropriate placement of roads, power lines, and turbines, will further reduce impacts to fish, wildlife, and habitat. Infrastructure micrositing may be informed by investigations and recommendations during preliminary project planning and further refined during pre- and post-construction monitoring. See Appendix A and C for more detailed information on project location and infrastructure micrositing considerations, as well as recommendations for design, construction, and operations.

Department Recommendations

The Department will provide the proponent and/or permitting entity with formal, written recommendations for a proponent's plan of development within approximately 30 to 45 days of receiving all the needed project documentation. **Proponents should use this information to guide the selection of a project location and for infrastructure micrositing, as well as design, construction, and operations in order to mitigate impacts to fish and wildlife.**

Step 4. Fish, Wildlife, and Habitat Monitoring and Data Analyses

Monitoring and Reporting

The Department will recommend developing a Monitoring Plan (see Appendix E) as needed, typically consisting of two years of pre-construction monitoring, monitoring during construction (on a case-by-case basis), and three years of post-construction monitoring. In some cases, existing data and information may be used to assess potential impacts of renewable energy development to fish and wildlife (e.g., the known impacts of wind turbines on birds and bats). The Department may consider adjustments to pre- and post-construction monitoring recommendations for projects that have effective mitigation measures proactively incorporated into siting, design, or operations. Similarly, adjustments to monitoring recommendations may be considered depending on initial monitoring findings, and with the implementation of effective adaptive management measures.

The goals of the Monitoring Plan are to evaluate impacts to fish and wildlife, and ultimately, mitigate impacts to species of concern and important habitats. The Monitoring Plan is an agreement between the proponent, affected landowners, and the Department. A signed Monitoring Plan may become a condition of the proponent's permit application at the discretion of the permitting agency or authority. The objectives of the plan are to:

- Identify species of concern and important fish and wildlife habitats.
- Estimate the scale and scope of impacts to fish, wildlife, and habitat.
- Inform project location, infrastructure micrositing, design, and management actions.
- Assess whether adaptive management or other mitigation efforts are warranted.
- Evaluate the effectiveness of adaptive management or other mitigation efforts.

It is an expectation of the Department that proven mitigation measures to the known impacts of wind and solar energy development on fish and wildlife resources will be built into the project on the front-end, and that impacts detected in post-construction monitoring will be addressed through adaptive management.

The Monitoring Plan is intended to be updated over time, based on site-specific information and conditions, and at different stages of project development, including when the project is submitted for permitting. A Monitoring Plan generally consists of the following:

- Pre-construction baseline surveys (Appendix E).
- WARSSS Rapid Resource Inventory (Level 2) and Prediction Level Assessment (Level 3) analysis and actions, if indicated by the RLA (Appendix D).

- During-construction monitoring, if warranted (Appendix D and E).
- Post-construction monitoring surveys (Appendix E).
- Seasonal or annual reporting, summarizing pre- and post-construction monitoring data (Appendix G).
- Annual submission of geospatially referenced data to the Department (Appendix G).
- Meeting of a project-specific Technical Advisory Committee (TAC) after each year of pre-, during-, and post-construction monitoring data is reported, or as needed (Appendix F).

The development of the Monitoring Plan occurs in several iterative phases. Once potential high-value or sensitive fish and wildlife resources have been identified for a given project location (Steps 1, 2, and 3), the next phase consists of identifying survey methods to assess, map, and quantify those resources; formalizing permission by the landowner(s) to conduct monitoring; and inviting all cosigners to the table to discuss monitoring and plans to alleviate impacts. The scope and spatial extent (i.e., project area + buffer) of monitoring will depend on the fish and wildlife resources identified. The duration of monitoring may depend on availability of existing data to inform mitigation measures, initial monitoring findings, or anticipated impacts from unmitigated project location, infrastructure micrositing, design, or operations. Based on the results of initial monitoring, the Monitoring Plan should be updated to reflect measures developed to alleviate potential impacts to species and habitats of concern. The updated Monitoring Plan should again be signed by all parties, and should be included with the proponent's permit application to the Industrial Siting Division of the Wyoming Department of Environmental Quality.

Technical Advisory Committee

The Department recommends that a Technical Advisory Committee (TAC; Appendix F) be organized and facilitated by the proponent as a component of the Monitoring Plan. The purpose of the TAC is to support a collaborative effort to assess and address fish and wildlife-related considerations. At a minimum, the TAC should review monitoring data, identify pre-construction issues and alternatives to address issues, and recommend post-construction mitigation measures to address identified project impacts.

Step 5. Mitigation

The "Wyoming Game and Fish Commission Mitigation Policy No. VII H" (WGFC Mitigation Policy VII H-2016) supports and adopts the definition of the term mitigation as defined by the President's Council on Environmental Quality in the National Environmental Policy Act regulations to include: "(a) avoiding the impact altogether by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and (e) compensating for the impact by replacing or providing substitute resources or environments." [40 CFR Part 1508.20 (a-e)].

Mitigation approaches are placed into two broad classes, namely resource maintenance and resource compensation. Resource maintenance includes avoiding, minimizing, rectifying, or reducing impacts through project planning. The Department supports and prioritizes maintaining fish and wildlife resources rather than compensating for adverse impacts. **Avoiding impacts is critical to maintaining functioning ecosystems and healthy fish and wildlife populations.** It is important to note that although mitigation oriented towards resource maintenance can play a key role in reducing and offsetting impacts to fish and wildlife, once a project is constructed and/or operational, not all impacts can be redressed. The Department encourages proponents of renewable energy projects to contact our staff early in the project planning process when potential project locations are being considered (Step 1). Project locations that avoid high-value or sensitive wildlife and fisheries resources are likely to require less monitoring and further mitigation.

Adaptive Management

Adaptive management is an important component of a resource maintenance mitigation approach. It is difficult to modify the design or operation of a renewable energy facility once constructed and in-service. When choices for adaptive management are so limited, developing contingency plans to moderate impacts becomes important. To avoid open-ended conditions, which are difficult for proponents to include when planning for project costs and timing, proponents should work together with the Department to establish a toolbox of mitigation measures that could be used for anticipated and unanticipated impacts.

The Department may recommend operational and facility changes in cases with high levels of impacts. The adaptive management process recognizes the uncertainty in forecasting impacts to fish and wildlife and allows testing of options to achieve a goal and determine the effectiveness of impact mitigation measures. Management options to reduce impacts could include maintenance activities or the modification of infrastructure or habitat. For example, removal of problem solar or wind project components (e.g., turbines, fences), use of acoustic or visual deterrents, or seasonal changes such as turbine curtailment. In cases with impacts to species subject to federal oversight, conservation measures may be required by and should be coordinated with the USFWS.

Resource Compensation

Proponents and permitting agencies should ensure that appropriate measures are incorporated into the planning, construction, and operation of the project to mitigate impacts to fish and wildlife through resource maintenance. If these measures are determined by the Department to be insufficient, mitigation oriented towards resource compensation may be used to offset some impacts. Mitigation measures should target the affected species and habitat, and should consider both direct and indirect impacts in estimating the appropriate scale of the response (e.g., acres of habitat loss due to conversion and avoidance). Offsite conservation or restoration may conserve and enhance fish and wildlife populations at biologically appropriate locations when properly designed and implemented. For example:

- Nesting and breeding areas
- Foraging habitat
- Roosting or wintering areas
- Migratory rest areas (e.g., stopover habitat)
- Habitat corridors and linkages
- Aquatic wildlife passage and connectivity
- Habitat restoration and enhancement (e.g., revegetation, invasive species removal)
- Wildlife mortality reduction initiatives

Resource compensation can also involve the purchase of land through fee title, purchase of conservation easements, conservation credits from an established bank (e.g., in accordance with the State of Wyoming Greater Sage-Grouse Mitigation Framework) or other land conveyances for the permanent protection of the biological resources. The purchased land or easements should have biological value equal to or higher than the land lost for the target species, or community of species, affected by the project, and should be located within Wyoming and ideally, within the region where the impacts to fish and wildlife have occurred.

Although impacts may occur, the ability to mitigate them can influence whether a project is supported or not by the Department. Practical and feasible mitigation is recommended when it will serve to minimize a project's effect on fish and 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 and its habitat affected by the project.

Research

Funding fish and wildlife research focused on key data gaps is an option with potential long-term benefits that may be recommended or otherwise supported by the Department. Such research will aid in the development of more effective and targeted recommendations to mitigate impacts to fish and wildlife. When considering research as an option, consult with the Department to help design and conduct investigations. Research should be conducted with scientific rigor. Note, research is not a replacement for effective mitigation. Research to assess impacts to fish and wildlife from renewable energy development may include investigating:

- Displacement
- Population impacts
- Movement corridors and stopover habitats
- Techniques/technologies for minimizing renewable energy impacts
- Effectiveness of mitigation
- Localized or statewide cumulative effects

APPENDIX A. PROJECT LOCATION AND INFRASTRUCTURE SITING CONSIDERATIONS

The selection of a project location and siting of infrastructure within the project area are the most critical choices in avoiding impacts to fish and wildlife from renewable energy development. Proponents should avoid high-value or sensitive fisheries and wildlife resources and large areas of unfragmented habitat, which can be identified through coordination with the Department and using geospatial data provided on the Department's website: https://wgfd.wyo.gov/Wildlife-in-Wyoming/Geospatial-Data. Projects that are placed in areas with fewer fish and wildlife concerns and that adopt best practices in layout, design, construction, and operations will result in reduced conflict with fish and wildlife values, and consequently will have reduced need for monitoring and further mitigation.

The following are factors the Department considers when assessing biological values of a site. Symbols are used to denote factors specific to either wind energy development () or solar energy development (). Factors with no annotation apply to both wind and solar energy development.

Aquatic Resources

- Will soil disturbance occur in areas sensitive to trail, wind, and water erosion?
- Will water or sediment from the proposed project area flow into a Blue or Red Ribbon trout stream, an important cool and warm water fishery, or waters that contain a Species of Greatest Conservation Need (SGCN)?
- Does the site and/or infrastructure have the potential to act as a fish migration barrier?

Birds, Bats, and Species of Greatest Conservation Need

- Are the following known or likely to occur on or near the proposed project site?
    - Species federally listed as "Threatened" or "Endangered" or candidates for such listing or their habitats.
    - Federally designated Critical Habitat components.
    - Bald or golden eagles.
    - Wyoming SGCN.
- Are any raptor nests within one mile of the site?

- Are any golden eagle nests within two miles of proposed wind turbine locations?
- Is the site on or near important areas for seasonal movement, staging, wintering, foraging, roosting, nesting, resting, raptor flight paths, orographic uplift or thermal updrafts for birds or other special status species?
- Where will aerial migrants intersect zones of risk with potential turbine blades?
- Would new roads or increased traffic occur in proximity to habitat that supports high numbers of SGCN herpetofauna (e.g., perennial/ephemeral water, rocky outcrops), thereby increasing rates of road mortality?

Greater Sage-Grouse and Sharp-Tailed Grouse

- Where is the site in relation to greater sage-grouse core population areas, connectivity areas, winter concentration areas, occupied leks, and other seasonal habitats?
- Is the project compliant with the current State of Wyoming Greater Sage-Grouse Core Area Protection Executive Order and its stipulations for development?
- Is the project area located in suitable habitat for greater sage-grouse? Proponents should note that suitable habitat in northeast Wyoming can occur in smaller, patchier tracts in contrast to western Wyoming's larger, more contiguous expanses.
- Where is the site in relation to sharp-tailed grouse leks and associated nesting habitat?

Big Game

- Is the site within important big game habitats, such as seasonal movement areas or crucial ranges?
- Is the project compliant with the current State of Wyoming Mule Deer and Antelope Migration Corridor Protection Executive Order and its conditions for development?
- Does the surrounding landscape and project design, including fencing, allow for big game movement, as determined by data or expert knowledge?
- If the site is developed will the project impact any aspect of big game ecology or life history (e.g., will the project sever a migration corridor or otherwise subject wildlife to increased risks, such as highway/vehicle collisions)?

- What effects will habitat removal and fragmentation, as well as indirect disturbance from vehicles, human presence, and noise have on big game?

Habitat

- Are there high-value fish and wildlife habitat features present, such as rock outcroppings, cliffs, caves, unique vegetation communities, riparian areas, springs, wetlands, water, nearby fish spawning locations, migration stopover habitat, or food resources?

- Would the facility irreparably alter a fish or wildlife habitat not able to be mitigated? For example, there is no current evidence demonstrating that migration corridors can be re-created or replicated.

- What potential impacts would the development have on the biological values and hydrology of the site?

- Will changes in management impact fish, wildlife, and habitat?

- How will development alter the distribution of invasive species, including invasive annual grasses?

Land Use

- What is the current land use of the site? Zoning? What is the land use of the larger landscape surrounding the site? How intact is the landscape?

-  For wind projects, how intact is the air space (up to ~250 meters of altitude, which represents potential aerial migration pathways) of the project location and surrounding landscape?

- Which species of fish and wildlife use the project area and how do their numbers vary throughout the year?

- Does existing law, regulation, or policy preclude development at the site?

Access

- What are the fish and wildlife-related recreational values of the site, such as public access for hunting, fishing, birding?

- Will construction of the project at this site impede or restrict fish and wildlife-related recreation access to public lands? What are the potential fish, wildlife, and habitat consequences if alternative travel routes are constructed to facilitate access?

- Will any increase in public access (e.g., through road construction) negatively affect fish, wildlife, or habitat?

Cumulative Impacts

- Are there existing or predicted localized or statewide cumulative impacts to fish, wildlife, or habitat?

APPENDIX B. FISH AND WILDLIFE RECOMMENDATIONS

This appendix provides recommendations for siting, design, construction, operations, and reclamation. Not all recommendations will apply to all projects, and recommendations will be made on a project-specific basis determined by the biological values of a particular site. These recommendations may be modified as new scientific findings become available. Projects that are placed in areas with fewer fish and wildlife concerns and that adopt recommendations and best practices in layout, design, construction, and operations will result in reduced conflict with fish and wildlife values, and consequently will have reduced need for monitoring or further mitigation. Symbols are used to denote recommendations specific to either wind energy development () or solar energy development (). Recommendations with no annotation apply to both wind and solar energy development.

Aquatic Resources

- Avoid construction and staging, including servicing and fueling of equipment, within 500 feet of aquatic and riparian habitats.

- Avoid instream construction during the spring and fall to minimize impacts to spawning. Spawning dates vary based on elevation and species.

- Ensure all sediments and other pollutants are contained within the boundaries of the work area. Disturbed areas that are contributing sediment to surface waters as a result of project activities should be promptly re-vegetated to maintain water quality.

- Avoid obstructing fish passage and aquatic species movement.

- Prevent the spread of aquatic invasive species (AIS) from one body of water to another. The following is required:

    - Equipment that was in contact with a water positive for zebra/quagga mussels within the last 30 days is required to undergo inspection by an authorized inspector prior to contacting a Wyoming water.

    - From March through November, all water hauling equipment and watercraft entering the state by land must be inspected before contacting a water of the state.

    - Equipment used in any Wyoming water that contains AIS, must be Cleaned, Drained and Dried before use in another water.

- When equipment that has been in contact with any Wyoming water is moved from one 4th level watershed (8-digit Hydrological Unit Code) to another within Wyoming, it must be Cleaned, Drained and Dried.

- More guidance is available at: https://wgfd.wyo.gov/Fishing-and-Boating/Aquatic-Invasive-Species-Prevention.

Birds

- Implement appropriate turbine setbacks from ridges, bluffs, or other features to mitigate collision risk to migrating neotropical birds, migratory birds, or raptors.

- Follow the Avian Power Line Interaction Committee's (APLIC) guidelines for mitigating electrocution and collision risk for birds (aplic.org; APLIC 2006, APLIC 2012).

- Minimize surface occupancy during the general bird breeding season (April-July).

- Minimize surface occupancy within known breeding concentrations of long-billed curlew, mountain plover, and upland sandpiper. Construction activities within 0.25 mi of known habitat should be minimized during the general breeding season (April - July) to mitigate impacts to be breeding individuals.

- Construction should be suspended within raptor nest buffers and during the dates specified around raptor nests as provided in Table 1 and in coordination with the U.S. Fish and Wildlife Service (USFWS).

- Consult the USFWS for buffers associated with eagle winter roosts, concentrated prey resources, and high-use areas.

- Avoid high-value golden eagle habitats (e.g., areas of high nest site density, winter use, or movement) identified by the USFWS Western Golden Eagle Team (https://www.fws.gov/mountain-prairie/migbirds/species/birds/golden_eagle/distributionandmovement.php).

- Minimize project traffic after dusk to reduce disturbance and collision risk for night roosting birds.

- Locate turbines to avoid separating species of concern from their daily roosting, feeding, or nesting sites.

- Follow USFWS Land-Based Wind Energy Guidelines (2012) Best Management Practices.

Table 1. Disturbance-free dates and buffers for raptor nests in Wyoming. Dates cover territory establishment through fledging.

SPECIES	DISTURBANCE-FREE BUFFER	DISTURBANCE-FREE DATES
Golden eagle	0.50 mile	January 15 – July 31
Ferruginous hawk	1.0 mile	March 15 – July 31
Swainson's hawk	0.25 mile	April 1 – August 31
Bald eagle	0.50 mile	February 1 – August 15
Prairie falcon	0.50 mile	March 1 – August 15
Peregrine falcon	0.50 mile	March 1 – August 15
Short-eared owl	0.25 mile	March 15 – August 1
Burrowing owl	0.25 mile	April 1 – September 15
Northern goshawk	0.50 mile	April 1 – August 15
Osprey	0.25 mile	April 1 – August 31
Cooper's hawk	0.25 mile	March 15 – August 31
Sharp-shinned hawk	0.25 mile	March 15 – August 31
Red-tailed hawk	0.25 mile	February 1 – August 15
Rough-legged hawk	Winter resident	----
Northern harrier	0.25 mile	April 1 – August 15
Merlin	0.50 mile	April 1 – August 15
American kestrel	0.125 mile	April 1 – August 15
Common barn owl	0.125 mile	February 1 – September 15
Northern saw-whet owl	0.25 mile	March 1 – August 31
Boreal owl	0.25 mile	February 1 – July 31
Long-eared owl	0.25 mile	February 1 – August 15
Great horned owl	0.125 mile	December 1 – September 30
Northern pygmy owl	0.25 mile	April 1 – August 1
Eastern screech owl	0.125 mile	March 1 – August 15
Western screech owl	0.125 mile	March 1 – August 15
Great gray owl	0.25 mile	March 15 – August 31

Bats

- Avoid placement of infrastructure within 0.25 mile of known bat roosts (WDOW 1994).
- Avoid disturbance around known maternity colonies from April 1 to October 1.
- Avoid placement of infrastructure in proximity to water features used as foraging habitat.
- Use turbine control (e.g., curtailment, cut-in speeds, blade orientation), including the temporary shut-down of turbines, adjustment of cut-in speeds, and low-speed idling with pitched and feathered blades (Kunz 2004, Arnett et al. 2013, Hayes et al. 2019) to reduce bat mortality at operational wind facilities (Arnett and May 2016).
- Locate turbines to avoid separating species of concern from their daily roosting and feeding sites.

Species of Greatest Conservation Need

- Avoid placement of infrastructure within:
    - Active prairie dog colony boundaries.
    - 0.25 mile of pygmy rabbit habitat, and minimize surface occupancy or disturbance of tall, dense stands of Wyoming big sagebrush (*Artemisia tridentata wyomingensis*).
    - 0.25 miles of known, active swift fox den sites.
    - Dry upslope areas where pocket gopher mounds or diggings are present, and within 0.25 miles of areas occupied by pocket gopher in Wyoming pocket gopher distribution.
    - Streams with SGCN fish
- Avoid activities that compact soils within prairie dog towns, occupied pygmy rabbit habitat, around swift fox dens, and in Wyoming pocket gopher range, which may limit burrow development and maintenance.
- Avoid disturbance of amphibian and reptile habitats, such as fallen trees, prairie dog colonies, and rock outcrops.

- Avoid siting renewable energy facilities within 500 meters of identified habitat used by SGCN amphibians and reptiles. This buffer was designed to reflect amphibian and reptile SGCN average home range and migration distances (Baxter and Stone 1985, Hammerson 1999, Lannoo 2005, Werner et al. 2004, Ernst and Ernst 2003, Parker and Anderson 2007).

Greater Sage-Grouse and Sharp-Tailed Grouse

- Commercial wind and solar energy development is not recommended in greater sage-grouse core areas (State of Wyoming Greater Sage-Grouse Core Area Protection Executive Order 2019-3). Any wind or solar energy project that is constructed in core area should comply with the permitting process and stipulations for development outlined in the Executive Order 2019-3.

- Above-ground infrastructure, including roads, should not be located within 0.25 mile (no surface occupancy) from the perimeter of occupied greater sage-grouse leks in non-core habitat.

- Avoid construction or development activities within two miles of the perimeter of an occupied non-core greater sage-grouse lek between March 15 and June 30.

- In northeast Wyoming, suitable greater sage-grouse habitat includes areas of sagebrush canopy cover that rarely exceeds 15%. Developments should avoid intact sagebrush stands to the extent possible in northeast Wyoming.

- Sound levels at leks due to new project noise, individually or cumulatively from anthropogenic sources should not exceed 10 decibels above baseline sound levels at the perimeter of the lek during the breeding season (March 1 to May 15 from 6pm to 8am). Baseline sound levels should be determined prior to project initiation. Sound level measurement and monitoring protocols available from the Department should be used to measure and report sound levels.

- Above-ground infrastructure, including roads, should not be located within 0.25 mile (no surface occupancy) from the perimeter of plains sharp-tailed grouse leks.

- Above-ground infrastructure, including roads, should not be located within 0.6 mile (no surface occupancy) from the perimeter of Columbian sharp-tailed grouse leks.

- Avoid construction or development activities within two miles of the perimeter of an occupied plains or Columbian sharp-tailed grouse lek between March 15 and June 30.

Big Game

- Avoid siting renewable energy facilities within important big game habitat, such as crucial winter range, identified parturition areas, and seasonal movement areas.

- Avoid siting renewable energy facilities within migration corridors, as designated by the State of Wyoming Mule Deer and Antelope Migration Corridor Protection Executive Order 2020-1. Any wind or solar energy project that is constructed in a designated migration corridor should comply with the development conditions outlined in Executive Order 2020-1.

- Avoid construction or development activities within big game crucial winter range between November 15 and April 30.

- Avoid construction or development activities within big game parturition areas between May 1 and June 15.

Access

- Minimize public travel on new access and maintenance roads within the project area, as applicable for management purposes.

- Access for hunting should be allowed to continue within project lease areas on public lands and on private land with landowner permission. We encourage renewable energy project developers to work with landowners who are willing to provide public access for hunting and fishing.

APPENDIX C. BEST PRACTICES FOR DESIGN, CONSTRUCTION, AND OPERATIONS

This appendix provides recommendations and best practices for siting, design, construction, operations, and reclamation. These are recommendations and may be modified or added as new practices and technologies emerge. These recommendations do not supersede regulatory agency requirements and/or landowner agreements or preferences. Projects that are placed in areas with fewer fish and wildlife concerns and that adopt recommendations and best practices in layout, design, construction, and operations will result in reduced conflict with fish and wildlife values, and consequently will have reduced need for monitoring or further mitigation. Proponents should also refer to and apply the Best Management Practices described in the U.S. Fish and Wildlife Service (USFWS) Land-Based Wind Energy Guidelines (2012). Symbols are used to denote practices specific to either wind energy development ( ) or solar energy development ( ). Practices with no annotation apply to both wind and solar energy development.

Solar Energy Generation Components and Facilities

Energy Generation Technology. Given the available body of research on direct mortality for wildlife, the Department recommends photovoltaic or trough technologies over the solar tower, which initial studies find to have higher rates of mortality for birds and bats (Kagan et al. 2014, Smith and Dwyer 2016).

Evaporation Ponds. For technologies that use evaporation or other open water holding ponds, wildlife are attracted to open water, which can lead to accidental drowning or inadvertent poisoning due to poor water quality, including concentrated salts. To mitigate impacts to wildlife:

- Escape ramps for wildlife should be placed to prevent entrapped wildlife from drowning. Additional information on escape ramps can be found at: https://www.fs.fed.us/pnw/lwm/aem/docs/olson/bciwaterforwildlife.pdf

- Monitor ponds for wildlife mortality and have a contingency plan for wildlife entrapment or mortality incidents (i.e., if a waterfowl or amphibian die-off is observed contact the Department and USFWS immediately).

- Monitor the toxicity of the ponds over time, and develop a mitigation plan to exclude wildlife from the water, as needed.

- Construct ponds in areas undesirable to wildlife, such as those with high human use or with high levels of disturbance.

For water ponds or holding tanks with poor water quality, including concentrated salts:

- Use closed containment systems.
- Exclude wildlife from contacting or entering the water using netting. To be effective, netting must be a suitable mesh size to exclude bats and migratory birds. Netting must be maintained regularly so as not to entangle or trap bats, birds, and other wildlife. Netting should be properly installed to prevent ground entry and to withstand snow-loading. Flagging is not an acceptable substitute for netting. Additional information on net installation can be found at: https://www.fws.gov/mountain-prairie/contaminants/oilPits.php
    - If netting is not feasible, create steep pond sides to minimize shallow areas that would be used by wading birds. Construct ponds in locations undesirable to wildlife, such as areas with high human use. Place and maintain escape ramps for wildlife.

Wind Energy Generation Components

Mitigate bat and bird fatality by using the best available turbine design, control, and collision-deterrent strategies and technologies (U.S. Fish and Wildlife Service 2003; DOI Wind Turbine Guideline Advisory Committee Recommendations 2010; Marques et al. 2014; Gartman et al. 2016).

- Turbine control (e.g., curtailment, cut-in speeds, blade orientation) includes the temporary shut-down of turbines, adjustment of cut-in speeds, and low-speed idling with pitched and feathered blades (Kunz 2004, Arnett et al. 2013, Hayes et al. 2019). These approaches are the best supported for reducing bat mortality at operational wind facilities (Arnett and May 2016). Turbine control can be tailored to minimize cost to proponents and maximize benefits to wildlife by incorporating data on:
    - Presence of at-risk wildlife (e.g., human observer, radar, or video-assisted)
    - Occurrence of high-risk conditions (e.g., weather, low wind speed [<6 meters/second], season)
- Deterrence strategies to minimize the numbers of bats and birds entering the rotor-swept zone are primarily in experimental testing at present. Proponents may propose testing strategies, such as:
    - Visual – Lighting, paint/color of blades and turbine base (Duerr 2010, May et al. 2020)

  - Acoustic
  - Electromagnetic fields
  - Carcass removal to avoid luring scavenging raptors

- Mitigate disruptions to wildlife and decrease collision risk by using best turbine lighting practices, such as an Aircraft Detection Lighting System (ADLS), which triggers tower lighting to illuminate when aircraft are in range.
  - If an ADLS system is not feasible, use synchronous red flashing lights at night, with the minimum number of lights, minimum intensity (< 2,000 candela), and minimum number of flashes per minute as would be necessary to comply with Federal Aviation Administration (FAA) regulations.
- Minimize habitat fragmentation by using fewer, larger turbines, where appropriate, to reduce the overall project footprint.

Lighting

Artificial lighting can have negative impacts to wildlife, including changing behavior and land use, disorienting wildlife, and potential increases in risk of mortality (Bird et al. 2004, Coehlo et al. 2012, Kociolek et al. 2010, McGuire and Fenton 2010, Miles et al. 2010, Stone et al. 2009, Stone et al. 2012, Wiese et al. 2001). The best approach to mitigate impacts from artificial lighting is to avoid its use whenever possible (Pawson and Bader 2014, Davies et al. 2017). Facilities should minimize light pollution whenever feasible and use the best available technologies.

- Use only fully shielded, dark-sky friendly fixtures, so lights shine down towards the ground.
- Use only the amount of light needed.
- Install timers, motion sensors, or dimmer switches. Turn off lights when not in use.
- Limit the use of artificial lighting during peak migration periods.
- For facility lighting, use warmer-colored lights (<2200 Kelvin) versus cooler-colored light on the white-blue end of the spectrum (≥2200 Kelvin; Longcore et al. 2018).
- As noted previously, for wind turbines and Meteorological Evaluation Towers (MET), use the least-disruptive lighting possible, such as radar-activated, aircraft detection lighting systems or synchronous, red flashing aviation lighting, with the minimum

number of lights, minimum intensity (< 2,000 candela), and minimum number of flashes per minute as would be necessary to comply with FAA regulations.

Fencing

Wildlife-Friendly Fence Design. The construction of new fences should be avoided if possible to reduce collision risk and facilitate wildlife movement on the landscape.

- New fences, other than those intended to exclude wildlife, should be built to wildlife-friendly specifications.
- Fence design should include movement options around and through projects that maintain sufficient corridors and prevent winter loss of big game.
- Consultation with local Department personnel is critical to ensure fences are appropriately sited considering snow deposition and slope.
- Information is available at: https://wgfd.wyo.gov/getattachment/Habitat/Habitat-Protection-Program/Resources-for-Development-Planning/A-Wyoming-Landowner-s-Handbook-to-Fences-and-Wildlife_2nd-Edition_-lo-res.pdf?lang=en-US

Fence Markers. Many species of birds, including greater sage-grouse, raptors, and waterfowl, are at risk of death by collision with fences. For locations or fencing types that pose a higher concern of collision risk, bird diverter fence markers are low-cost but effective approach to make fences more visible to birds and thereby reduce deaths.

- Three-inch vinyl markers should be placed along the top wire at 3-foot intervals, with fence posts serving as markers.
- Additional information is available through the Sage Grouse Initiative at: http://www.sagegrouseinitiative.com/wp-content/uploads/2014/08/FENCEMARKER-FAQ.pdf.

Gates for Egress. Big game can become entrapped inside exclusionary fencing that may be required at some renewable energy facilities. In such cases, having gates on multiple sides of the fenced perimeter can allow for easier egress.

- Include an adequate number of gates along the perimeter to facilitate big game egress (e.g., consider gates on opposite sides of facilities).
- See information on stranded or injured wildlife provided below.

Hydrologic Resources

To mitigate impacts to aquatic resources, we recommend design and construction practices that conserve unpolluted water on the landscape, prevent erosion, avoid sediment from reaching waterways, and sustain proper stream form and function. Use a Reconnaissance Level Assessment (RLA) to develop a design that reduces risks to aquatic habitats (Appendix D). If RLA determines high impacts due to roads, erosive soils, and/or development on steep slopes, further Watershed Assessment of River Stability and Sediment Supply (WARSSS) analysis may be necessary.

- Water Quality - Develop a Stormwater Pollution Prevention Plan (SWPPP) in coordination with the Wyoming Department of Environmental Quality: http://deq.wyoming.gov/wqd/storm-water-permitting/.

- Water Use - Water conservation measures should be a priority for any development in Wyoming. For solar development, the Department encourages the use of technologies that minimize the amount of water used for operation, such as photovoltaic applications. If cooling is required, refer to the U.S. Department of Energy (DOE) report entitled, "Concentrating Solar Power Commercial Application Study: Reducing Water Consumption of Concentrating Solar Power Electricity Generation" available at: http://www.nrel.gov/csp/publications.html.

- Surface Water - Maintain water infiltration into soil, water table connections, and ephemeral flows, while reducing soil erosion to the maximum extent possible.
    - Do not alter or restrict existing drainage systems.
    - Avoid removal of xeroriparian washes and recontouring of the site.
    - Avoid streams, wetlands, and drainages.
    - Time construction activities to protect fisheries and water quality.

- Water Table - Groundwater withdrawal affects springs and riparian areas through lowering of the ground water table, and alteration of subsurface groundwater flow, resulting in unwanted dewatering of any of these water resources.
    - Identify sustainable yields of groundwater and nearby surface water bodies.
    - Limit the withdrawal of water at the facility so it does not exceed the sustainable yield.

- Avoid soil compaction near or within natural springs and riparian areas.

Meteorological Evaluation Towers

Many species of birds, particularly migrating birds, are at risk of death by collision with MET. Risk of death for birds can be substantially reduced by using towers without guy wires, without steady burning lights, and under 199 feet in height.

- All temporary and permanent MET should be self-supporting structures without guy wires.

- When siting MET, avoid habitat features that congregate wildlife such as water resources, habitat edges, and high-use movement areas.

- Use best lighting practices, such as an ADLS, which triggers tower lighting to illuminate when aircraft are in range.

    - If an ADLS system is not feasible, use red flashing lights at night, with the minimum number of lights, minimum intensity (< 2,000 candela), and minimum number of flashes per minute as would be necessary to comply with FAA regulations.

- If guy wires must be used, bird diverter markers or other proven deterrents should be attached at 3-foot intervals along the length of all guy wires.

- Guyed towers should only remain on site for the minimum amount of time needed to collect data. If towers are on site long-term, then carcass searches should be implemented to determine whether mortality rates indicate a need for mitigation.

- Wyoming State Law requires all new and existing MET to be mapped within the Wyoming Department of Transportation information system and marked to be visible from 2000 feet during daylight hours. This information is available to the aviation community on the Wyoming Department of Transportation website: http://www.dot.state.wy.us/home/aeronautics.html.

- Additional guidance applicable to MET is available at: https://www.fws.gov/migratorybirds/pdf/management/usfwscommtowerguidance.pdf

Power Lines

Many species of birds are at risk of death by collision with or electrocution by power lines.

- Site projects in close proximity to substations or other points of tie-in to the energy grid to reduce the construction of new power lines.

- Burying transmission lines between facilities and substations will further reduce these risks.

- If burying is not feasible, proponents should follow the Avian Power Line Interaction Committee's (APLIC) guidelines for mitigating electrocution and collision risk for birds, which simultaneously minimizes power outages and fire risk associated with bird use (aplic.org; APLIC 2006, APLIC 2012).

    - Avoid crossing naturally occurring perennial streams, lakes, reservoirs, riparian corridors, and large (>5 acres) wetlands with overhead power lines.

    - Mark overhead lines using bird flight diverters per APLIC guidelines to mitigate collision risk (APLIC 2006, APLIC 2012).

Reclamation

Reclamation Plan. Construction of renewable energy facilities will create soil disturbance and may lead to soil erosion and growth of non-native, invasive plants. Reclamation following construction should contour soils to match the original topography as much as possible. Reclamation should re-establish native grasses, forbs, and shrubs to achieve cover, species composition, and life form diversity commensurate with the ecological site potential. Where possible, use seed from local sources. The Department can provide consultation on desirable plant seed mixes. Landowners should be consulted on a desired plant mix on private lands. Proponents should control noxious and invasive plant species and adopt the best management practices for topsoil handling.

Soils. Identify the soils on the site. Basic information can be obtained from the Natural Resource Conservation Service (NRCS) Soil Survey. Soil pits and testing properties on the site may be necessary to determine stability, pH, electrical conductivity, texture, calcium, carbonate, and gravel content. Properly preserved topsoil is critical for reclamation.

- Remove topsoil from the site before facility construction activities, and salvage while at a low moisture content.

- Store topsoil stockpiles where:

    - Not disturbed by facility construction activities.

    - Not contaminated by foreign or spilled materials.

    - Movement of stockpiles would be minimal.

  - Exposure to erosional forces is minimal.
  - Pristine soils are not present.

- Avoid mixing A horizon and B horizon soil layers.
- Re-spread topsoil on the disturbed site to approximate original conditions from March 14 - July 1.
- As an alternative to large-scale topsoil removal, skim surface vegetation with heavy equipment.
  - Best implemented between July 1 and March 14.
  - Applicable where operational plans are uncertain or where there is a desire to "live-spread" soils.
  - Leave as much root intact as possible.

Vegetation. Identify native plant communities prior to disturbance. Refer to Ecological Site Descriptions where available, to determine site potential post-disturbance: https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/ecoscience/desc/.

- Leave vegetative biomass in wind-rows to reduce wind and water erosion.
- Soil testing should be completed prior to re-establishment of native plants.
- Appropriate soil amendments should be added prior to planting if necessary to establish native plant community.
- Reestablish on the replaced topsoil as quickly as possible to stabilize the site and prevent erosion.
- Commercial fertilizer is not recommended for native rangeland reestablishment due to the possibility of increased annual weeds.
- Regular monitoring should be conducted and adaptive management implemented as needed to ensure no site degradation.

Invasive Weed Management Plan. The proponent should develop and implement a plan to control noxious weeds, as well as invasive, non-native plant species (including invasive annual grasses), with an expectation that invasive plants will be controlled for the life of the renewable energy facility and until final reclamation is complete.

- Thoroughly wash all surfaces and undercarriages of vehicles and equipment before moving to the project site and after leaving the site to remove any noxious or non-native plant seeds. This will reduce the possibility of transporting noxious or non-native plants from one site to another.

- All disturbed soils that will not be landscaped or otherwise permanently stabilized by construction should be seeded using species native to the project vicinity.

- Proponents should coordinate with the County Weed and Pest District Offices for guidance at (https://wyoweed.org/).

Road Construction

Use existing roads for construction and access when possible. When new roads must be constructed, mitigate impacts by:

- Construct the minimum number, type, and footprint of roads needed to maintain the facility (e.g., two-track vs. crown-and-ditch roads).

- Reclaim any roads created for project construction that are not needed for operation.

- Locate, design, construct, reconstruct, use, maintain, and/or reclaim roads so as to:

    - Avoid sensitive or important fish and wildlife habitat.

    - Control or prevent erosion, siltation, and air pollution by vegetating or otherwise stabilizing all exposed surfaces.

    - Control or prevent damage to fish, wildlife, or their habitat and related environmental values.

    - Control invasive species including invasive annual grasses.

    - Accommodate fish passage and wildlife movement

In areas of steep slopes and erodible soils, locate temporary construction bypass roads where they will have minimal impact on streams.

- Stabilize the side banks of a road during construction:

    - Planting and/or seeding and other structural measures may be required.

    - Mesh or other stabilizing material may be necessary.

- Construct drainage ditches only where necessary.
- When the slope increases, additional diversion ditches should be constructed.
- Avoid streams, wetlands, and drainages.
- Locate access roads to minimize stream and dry wash crossings.
    - Adjust the road grade to avoid the concentration of road drainage.
    - Direct drainage flows away from the stream or into an adequate filter.
    - Mitigate impacts where stream and dry wash crossings cannot be avoided.
- Stream crossings should:
    - Accommodate fish passage and wildlife movement.
    - Accommodate flood stage.
    - Provide a bankfull bench to maintain stream form and function.
    - Not concentrate velocities.
- Dry wash crossings should:
    - Accommodate wildlife movement.
    - Accommodate typical flash flood events.
- Crossing types in order of minimal aquatic impacts are:
    - Bridge spans with abutments on banks with natural stream bed.
    - Bridge spans with center support.
    - Open bottomed box culverts with natural stream bed.
    - Open bottomed arch culvert with natural stream bed.
    - Round culverts with bottom no less than one foot below the existing stream grade, and appropriate structures at outlet to prevent erosion.

Rodent Control

Rodents may be attracted to infrastructure and cause damage. However, some control methods pose a risk to non-target wildlife species, for example, the use of anti-coagulant rodenticides can result in wildlife deaths through the consumption of poisoned rodents or the rodenticide bait.

- Mechanical control methods or use of baited traps that do not allow rodents to exit the trap are preferred.

- Rodent control should be coordinated with the relevant County Weed and Pest District office.

Stranded or Injured Wildlife

Wildlife including big game, raptors, and waterbirds can become stranded or injured within renewable energy facilities or while navigating renewable energy infrastructure.

- Facility operators should immediately notify and coordinate with the Department's regional staff for assistance with and removal of stranded or injured wildlife.

- Wind energy project facility maintenance activities should include the removal of large animal carcasses from turbine areas to reduce potential collision risk to scavenging raptors.

Seasonal Timing Limitations

Activity associated with the construction, decommissioning, or repowering of utility-scale renewable developments may impact wildlife, temporarily or permanently displacing them. For some species, impacts can be mitigated by observing seasonal or time-of-day timing stipulations.

- Recommended timing stipulations will vary based on initial biological assessments and pre-construction field surveys.

- Proponents should take into consideration site-specific seasonal timing limitations for species such as migratory birds, big game, nongame, aquatic, and special status species.

Travel Management

Travel Management Plan. Develop and implement a comprehensive travel management plan for construction and operations, including road and travel mitigation measures to reduce impacts to fish and wildlife. Include provisions in subcontractor agreements limiting traffic to the same standards applied to company operations.

Speed Limits. Mitigate wildlife-vehicle collisions and reduce dust by limiting vehicle speeds within the project area and on access roads to the project area. Post speed limits on these roads where feasible.

Temporal Observances. Limit traffic during high wildlife use hours (i.e., within 3 hours of sunrise and sunset), especially during the winter months.

Waste Management

Litter Control. All project-related trash and food waste should be disposed of properly, as anthropogenic food sources may attract scavengers that can also act as opportunistic predators.

Hazardous Materials Management Plan. Large-scale construction projects, such as solar energy plants, have the potential to generate or spill hazardous materials during construction, operation, and/or decommissioning, which could affect fish, wildlife, habitat, and surrounding water sources. Potential hazardous materials associated with solar energy include heat transfer fluids (i.e., oils), molten salts, hydraulic fluids, coolants, lubricants, wastewater, and the heavy metals found in photovoltaic panels.

- Proponents should coordinate with the Wyoming Department of Environmental Quality for hazardous waste management and spill prevention planning at: http://deq.wyoming.gov/shwd/.

APPENDIX D. MONITORING RESOURCES

This appendix provides guidance for survey methods, data sheets, and templates for data reporting. These methods are a synthesis of other state and federal agency recommendations, the fish and wildlife scientific literature, and are based on local information from Wyoming habitats and fish and wildlife populations. The Department's Handbook of Biological Techniques can provide details for some methods (https://wgfd.wyo.gov/Wildlife-in-Wyoming/More-Wildlife/Handbook-Bio-Techniques). Methods and technologies are continuously evolving. Proponents can use the resources provided below to aid in the development of the Monitoring Plan, but should seek to use current best practices in selecting a methodology. Methods should be tailored to assess the site-specific fish and wildlife resources of concern identified by the Department. The proponent should arrange for a qualified biologist who is knowledgeable about fish and wildlife in the region to develop a Monitoring Plan (in coordination with the Department as described in Appendix E) and to conduct the monitoring.

Recommendations for species-specific monitoring are primarily based upon species distribution and suitable habitat within the project area. Although the specific monitoring recommendations will vary by project, proponents should plan for the typical survey durations. In most cases, surveys and monitoring efforts should be conducted for a minimum of two years prior to construction and three years post-construction for species or habitats of interest located within the project area. Additional efforts may be recommended if pre-construction monitoring ended more than three years prior to the start of construction. Monitoring during construction may be recommended on a case-by-case basis. Proponents should use best practices as applicable (see Conkling et al. 2020), including:

- Use consistent, standardized protocols to allow for comparison both pre- and post-construction and to facilitate comparison among projects.
- Account for probability of detection.
- Implement sampling effort to adequately estimate the metric of interest with sufficient precision to detect biologically relevant changes, and to inform the need for mitigation efforts and evaluate their efficacy when implemented.
- Use an appropriate sampling design to allow inference to be made to the entire project area.
- Incorporate an off-site reference or control area(s) with similar biophysical characteristics (e.g., vegetation types, slope, soils).
- Assess wildlife responses related to relevant measures of infrastructure (e.g., density and proximity of turbines, above-ground electrical lines, fencing, roads)

Until a sufficient body of scientific knowledge is developed to understand and quantify the project-level and cumulative impacts of renewable energy development to fish and wildlife, project proponents are expected to implement appropriate monitoring to help answer this question on a case-by-case basis in Wyoming.

Aquatic Resources

Disturbance on the landscape resulting from the construction and operation of renewable energy facilities has the potential to adversely affect aquatic resources, including fish, macroinvertebrates, reptiles, and amphibians, through changes in the sediment supply and channel stability. Impact potential depends on elevation, aspect, slope, acres of disturbance, soil type, vegetative cover, drainage size, ephemeral and perennial stream miles, road density, distance from ephemeral and perennial waters, and existing soil disturbances in the watershed. Appropriate assessment and monitoring will aid proponents of renewable energy projects in mitigating impacts to aquatic resources through project layout, implementation of best practices, and design features that reduce sediment movement. This assessment will identify existing and potential project sediment sources and channel stability concerns.

Monitoring recommendations may be reduced if the project is proposed within an:

- Existing heavily developed area (e.g., an existing oil or gas field).
- A closed basin (i.e., water cannot reach a perennial water body).
- If sediment catchments exist on the ephemeral drainage(s) such that sediment could never reach a perennial watercourse.
- The Department determines the area of impact has no fisheries, Species of Greatest Conservation Need (SGCN), or herpetofauna affected.

Watershed Assessment of River Stability and Sediment Supply Methodology

The Department recommends the Watershed Assessment of River Stability and Sediment Supply (WARSSS) methodology outlined in Rosgen (2006; Figure 3). Geomorphological monitoring of the hydrology, stream crossings, dry wash crossings, and roads with 5% or greater slope will determine the presence, absence, and extent of impacts. The following descriptions of the WARSSS methodology are quotes from Rosgen (2006) and are provided here as background information.

Level I. The Reconnaissance Level Assessment (RLA) provides an initial screening. The results 1) identify obvious sediment sources or channel stability problems as influenced by current and the proposed land use; 2) exclude sub-watersheds, areas, or reaches from further assessment; and 3) locate potential problem areas for the next higher level of assessment. If the RLA indicates

potential hydrologic instability or degradation, the Department may recommend the next monitoring level.

Level II. The Rapid Resource Inventory for Sediment and Stability Consequence (RRISSC) is the intermediate assessment level. The three objectives of this assessment are to 1) exclude low-risk areas; 2) provide management and/or mitigation recommendations for moderate-risk sites with monitoring; and 3) identify high-risk sites, sub-watersheds and/or river reaches requiring a more detailed assessment. High-risk sites or those affecting a blue or red ribbon trout stream, an important warm or cold water fishery, or contains SGCN will prompt the third level of monitoring.

Level III. Prediction Level Assessment (PLA) quantifies sediment (tons/year) from sources, such as roads, streambanks, surface erosion, and mass erosion. This monitoring entails 1) establishing a monitoring station with repeated measures, 2) a monitoring station plus a reference station with repeated measures, or 3) multiple monitoring stations. The hydrology monitoring metrics recommended will be site-specific.

Hydrology Monitoring Metrics

When assessing RLA, RRISSC, and/or PLA monitoring, sediment contributions are most likely to come from steep roads, natural channel geomorphology, stream crossings, and dry wash crossings.

At these sites, RRISSC and/or PLA monitoring reports should include:

1) Global Positioning System (GPS) coordinates for each monitoring point
2) Fish passage barrier assessment at road stream crossings
3) Macroinvertebrate sampling
4) Summary worksheets associated with the Rosgen Level II
5) Longitudinal profiles, cross-sections, stream bank erosion, and vertical and lateral stability that are outlined in: Harrelson, C.C., C.L. Rawlins and J.P. Potyondy (1994); in Chapter 2 of Rosgen (2008); and in Chapter 5 of Rosgen (1996).
6) Pre and post-construction photographs of each monitoring site, upslope/upstream and downslope/downstream.
7) A contingency plan if monitoring shows that impacts are occurring

Monitoring reports should be submitted to the Department within 45 days of completion of the surveys.

Amphibians and Reptiles

Renewable energy projects have the potential to directly and indirectly impact amphibians and reptiles at a local scale through mortality, habitat loss, and habitat alteration. Construction and traffic associated with renewable developments can result in increased mortality for herpetofauna. Solar energy development results in large-scale changes to landcover and habitat, and may alter patterns in water infiltration, soil permeability, temperature, basking habitat, and predation risk. These changes could result in displacement of herpetofauna and changes in community composition. Wind turbines cause ground-level vibrations that could negatively affect herpetofauna.

The level of monitoring recommended by the Department will depend on the SGCN predicted to occur within or near the project site, and the proactive actions taken by the proponent to mitigate impacts to herpetofauna at the site. All amphibians and reptiles encountered incidentally during wildlife surveys should be documented with the following data elements: species, geographic coordinates (preferably decimal degrees or UTM), date, age class (adult, juvenile, larval, or egg), general vegetation type, name of the observer, and general comments.

For SGCN amphibians and reptiles with known occurrence or that are predicted to occur within or near the project site, delineate habitat for the project area. In conjunction with mapping terrestrial habitats including potential hibernacula, water features should also be mapped including ephemeral drainages, perennial waters, vernal pools, and playas.

- If SGCN amphibian or reptile habitat or hibernacula is not found during mapping, no additional monitoring recommendations will be made.

- If suitable SGCN amphibian or reptile habitat occurs within the project site, the Department will work with the proponent to determine the type and level of additional monitoring or mitigation needed. Monitoring may include timed visual encounter surveys in specific habitat, roadkill/basking surveys on roads, or acoustic surveys at waterbodies. Mitigation may include avoidance (with adequate buffer) of identified habitat features. Avoiding habitat features can mitigate the need for additional monitoring.

If a project is located in habitat that is known to have the following species or if one or more of these species have the potential to occur within or near the project, additional monitoring is recommended.

Midget Faded Rattlesnake, Great Basin Gophersnake, and Desert Striped Whipsnake

1) The Department recommends that before a survey is conducted, that the survey team consult with Departmental personnel to ensure that the survey method will be used correctly.

2) Delineate rock outcroppings with southern aspects (SE, S, SW or 120º - 240º) using aerial photography, Google Earth, or other available geographic information system (GIS) data layers within the proposed project area. Any rock outcropping above 7,500 feet or with a northern aspect may be excluded from the survey design. Although hibernacula for these species have been historically observed below 7,000 feet, the Department recommends that searches occur at slightly higher elevations to ensure the absence of midget faded rattlesnake, Great Basin gophersnake, or desert striped whipsnake populations.

3) Two surveys should be performed from May 1 – May 30 on delineated rock outcroppings. Surveys should only be performed after one week of sequential nights above freezing (32ºF) AND one week or more of daytime temperatures exceeding 55ºF. Surveys must be spaced at least one week apart. Surveys may be performed any time during the day; however, if daytime temperatures exceed 85ºF, surveys should be limited to morning and early afternoon time periods (8:30AM to 1:00PM).

4) Each delineated rock outcropping should be surveyed for a total of one person-hour per km^2 of suitable habitat (i.e., one person should survey suitable habitat for one hour, while two people could survey the same area for 30 minutes). If a snake is found, a separate, more intensive survey must be completed within a 100-m radius of the snake and any additional snakes should be recorded. Intensive surveys should be repeated around all snakes found in order to map any congregations of snakes, thus narrowing the search to likely locations of a potential den. Surveyors should inspect crevices, fissures, and overhangs under rocks and within rock outcrops. Effort should be made to avoid flipping rocks as this activity could alter reptile habitat. All herpetofauna found during the course of a survey should be noted on observational data sheets and photographed. If more than two snakes of the same species are found during a den survey, please contact a Department herpetologist.

5) For midget faded rattlesnakes, it is recommended that surveyors wear protective gear or clothing while conducting surveys to maintain safety. This could include any of the following items: snake boots, snake gaiters, or snake chaps. When climbing rocks, surveyors should also verify that all handholds are snake free. Observers should listen for snakes rattling while conducting surveys; however, all surveyors should be aware that midget faded rattlesnakes very often DO NOT RATTLE. Thus, visual detection is often more common than auditory detection of this rattlesnake species.

Bats

Renewable energy development alters habitat and has the potential to negatively impact bats, for example, through direct mortality from collisions with or barotrauma from turbine blades, the loss of roosting habitat, or large-scale changes in foraging habitat or migration routes.

The following are general recommendations aimed at standardizing surveys to improve our understanding of the bat community and use at a particular site, and to provide guidance on the collection of baseline data related to bat issues (e.g., causal factors, species susceptibility,

distribution, abundance, behavior, and changes over time). These methods help provide a comprehensive picture of use and species composition, so targeted recommendations can be made and cumulative impacts can be assessed across projects over time. These recommendations were developed by the Department and the Wyoming Bat Working Group (WYBWG) specifically to address survey standardization in Wyoming. If additional information on broader objectives is required, consult survey recommendations in Hester and Grenier (2005).

These recommendations are intended to provide specific details (e.g., timing, duration, equipment), yet remain flexible enough to provide managers with the ability to prescribe appropriate surveys (e.g., pre- and post-construction) across a broad range of project sites. The level of monitoring recommended by the Department will depend on the biological values of the project site, and on the proactive actions taken by the proponent to mitigate impacts to bats at the site. At a minimum, passive acoustic surveys and North American Bat Monitoring Program (NABat) monitoring protocols should be implemented during the pre-construction phase and continue through post-construction, and carcass searches should be conducted during the post-construction phase (Kunz et al. 2007a, Kunz et al. 2007b, USFWS 2012, Loeb et al. 2015). Please refer to the Survey Matrix (Table 1) for additional guidance. As bat survey methods advance, the Department and WYBWG will evaluate new techniques and equipment for potential application in the state and revise these recommendations if new methods are appropriate.

Habitat Evaluation

1) Objective – Identify and quantify existing bat habitats within a project site.

2) Rationale – The results can be used to identify potential roosting and foraging areas for bats within project sites to prioritize surveys and improve siting. The analysis can also be used to quantify changes in habitat.

3) Equipment – No specialized equipment is required; however, analysis is most easily completed using remote sensing techniques (e.g., aerial or satellite imagery) and GIS.

4) Application – A pre-construction evaluation should be completed by identifying potential foraging areas (i.e., forest and woodlands, grasslands and shrub-steppe, riparian corridors, and water features) and roosting areas (i.e., rock shelters, forest and woodlands, riparian corridors) within the project boundary. Refer to "A Conservation Plan for Bats in Wyoming" (Hester and Grenier 2005) for additional information on habitats and associated bat species. Habitat can be evaluated either remotely (e.g., GIS) or using ground surveys. If the pre-construction evaluation is done using remote sensing, then field verification is also recommended. Delineate foraging and roosting habitats within the project site. Compare proposed project siting plans with the results of the habitat evaluation to identify potential conflict areas.

5) Analysis of Data – Total area and the percentage of each foraging and roosting habitat type present within the project area prior to construction should be reported.

Passive Acoustic Surveys

1) Objective – Identify and quantify species and activity of both resident and migrant bats. For wind energy development, target the rotor sweep zone. For solar energy development, target the solar project footprint and project-specific infrastructure.

2) Rationale – Results can be used to identify bat species presence and describe bat behavior (e.g., spatial and temporal use) likely to occur near rotor sweep zone or within the project footprint. Season-long surveys will allow for an assessment of the entire bat community, including residents and migrants.

3) Equipment – There are many systems available for acoustic monitoring of bats. Currently, the recommended bat detectors are full-spectrum, SonoBat-compatible units. Please consult Chapter 4 of A Plan for the North American Bat Monitoring Program (Loeb et al. 2015) for details regarding hardware, software, and setup configuration. If other systems are to be used please consult the Department prior to data collection to ensure that survey equipment is compatible with survey objectives.

4) Application – Passive acoustic survey stations should be designed to collect bat calls at ≥ 50 m whenever possible to identify activity within the rotor sweep zone or within the project footprint. Meteorological Evaluation Towers (MET) can provide an appropriate structure for this type of data collection. At least one acoustic unit, aimed away from the prevailing wind direction, per MET should be utilized. A second unit, placed near the ground (e.g., < 5 m), can be used to quantify bat activity below the rotor sweep zone in areas that concentrate bat use (e.g., roosting or foraging areas).

   Units should be deployed between April 15 and October 15 and be programmed to begin data collection ½ hour prior to sunset and end data collection ½ hour after sunrise. Equipment should be calibrated annually and checked bi-monthly to ensure that units are properly functioning. Non-functioning equipment should be replaced immediately. Storage cards should be rotated bi-monthly for data analysis.

   The number of acoustic survey stations needed for a project will vary depending on the available bat habitat in the area. If few (e.g., ≤ 2) survey stations are used during the pre-construction survey period, then the data collection period may need to extend past two years to ensure that the data accurately reflect conditions (e.g., species diversity, temporal and spatial use) within the project area.

   Results from previous studies have demonstrated a high correlation between data collected using the above recommendations (e.g., species diversity, temporal and spatial use) and project site characteristics despite constraints that each unit samples a small amount of area (Weller 2007, Collins and Jones 2009). Please refer to Weller (2007) for additional specifics regarding the deployment of passive units on METs.

5) Analysis of Data –Analysis of bat calls should only be performed by experienced personnel. Species identification should be made whenever possible; however, calls should at a minimum be identified to a frequency grouping (e.g., 25 kHz, 40 kHz).

   For each unit deployed report the total number of calls, number of identifiable calls, total number of survey nights, number of species detected, scientific name of species detected, and number and identity of frequency groups detected (e.g., 25 kHz, 40 kHz). The index of activity should be reported as the total number of calls per species (or frequency group) per survey night per unit. The geographic coordinates (preferably decimal degrees or UTM), equipment aspect, microphone height, surveyor, and name of call analyst should also be reported.

   A voucher call (i.e., representative call sequence) should be submitted for each species and frequency groups detected with the final report. The following supporting information should be supplied for each voucher call: geographic coordinates (preferably decimal degrees or UTM), date, time, scientific name of species detected, detector height and aspect, and name of call analyst.

North American Bat Monitoring Program

1) Objective – Identify species presence and occupancy of resident bats in the project area allowing for analyses of trend and community composition.

2) Rationale – NABat is a continent-wide effort to monitor and assess trends of bat species (Loeb et al. 2015). NABat protocols can be continued throughout the life of the project to better assess cumulative impacts across projects to resident bats.

3) Equipment – The same equipment used for passive acoustic monitoring should be used for NABat surveys. If equipment is limited, acoustic detectors can be reallocated from passive acoustic surveys to NABat monitoring and then returned to passive acoustic surveys once NABat surveys are completed.

4) Application – Follow methods outlined in Chapter 3 – The NABat Sampling Design and Chapter 4 – Stationary Point Acoustic Survey Protocols in Loeb et al. (2015). Conduct as many grids in the project area as is feasible within the sampling time-frame. The goal of NABat is to target resident populations before juveniles enter the population. In general, this is between May 15 and July 10 in Wyoming, although specific timing will depend on location and elevation of the site.

5) 5. Analysis of Data – Refer to Chapter 6 – Species Identification of Acoustic Recordings and Chapter 9 – Analysis in Loeb et al. (2015).

Mortality Estimation

1) Objective – Identify and quantify bat species mortality attributable to the renewable energy facility.

2) Rationale – The results of pre- and post-construction carcass searches are used to estimate mortality rates of bats at renewable energy development sites.

3) Equipment – The WYBWG recommends searchers have their rabies prophylactic vaccination prior to conducting carcass searches to minimize risk associated with handling dead or wounded bats. A Wyoming Game and Fish Department Chapter 33 Scientific Collection Permit is also required for all personnel planning to collect bat carcasses. Carcasses should be stored in a freezer on-site and should be submitted to the Department on a regular basis. Appropriate state and federal permits are required for carcass salvage and are required to handle carcasses of species protected under the Endangered Species Act.

4) Application – Baseline mortality levels should be estimated at the project site pre-construction for comparison with post-construction levels. For projects with no pre-construction mortality monitoring, the Department will assume the baseline mortality rate to be zero. If proponents propose an alternate baseline rate, the Department will review the evidence provided in support of that rate. Carcass searches should be conducted weekly during two periods: April 15 – June 15 and August 1 – September 30. More intensive carcass searches may be conducted if necessary. All carcasses should be collected and frozen, with carcass disposition conducted as directed by the Department. A subset of carcasses (that likely remain attractive to scavengers) should be used to determine searcher efficiency and disappearance rates (Kerns 2005, Arnett et al. 2008). Carcass searches should be conducted using a robust methodology, and mortality estimates should correct for searcher efficiency, disappearance rates, carcasses that fall outside of the sampled area, and fatalities that occur outside of the monitoring period (i.e., detection probability; Arnett et al. 2009, Baerwald et al. 2009, Simonis et al. 2018). In locations and seasons with low detection rates, best practices, such as detection dogs should be used to provide greater accuracy and precision in parameter estimation (Smallwood et al. 2020).

5) Analysis of Data – Report age, sex, species, total number of killed and wounded bats found, infrastructure associated with killed and wounded bats (e.g., turbine name or number), and an estimate of bat mortality (Arnett et al. 2009, Baerwald et al. 2009). To allow for comparison across sites, bat mortality should be estimated using the U.S. Geological Survey (USGS) Generalized Mortality Estimator (GenEst) suite of statistical models and software tools (Dalthorp et al. 2018). Include information on climate conditions leading up to the search data, including nightly average temperature, average wind speed, and change in barometric pressure. Reporting procedures for the Department's Chapter 33 Scientific Collection Permit must be followed. Proponents should note that mortality rates within the ranges reported at other facilities do not imply

that impact levels are acceptable, particularly for species such as the hoary bat, where the body of scientific knowledge indicates that continued, accumulating impacts have resulted in on-going population declines and risk of extinction (Frick et al. 2017, Rodhouse et al. 2019).

Stable Isotope Analysis

Stable isotope ratios vary in a predictable spatial pattern across the continent, and are incorporated into animal tissues through consumption of food and water. These variations can be used to identify the geographic origin of wildlife mortalities at a renewable energy facility. Identifying the area from which an animal has been removed will support efforts to assess whether the numbers of bird and bat mortalities associated with renewable energy projects may cause population-level impacts (see Katzner et al. 2020 for details on this approach).

The Department requests that proponents collect a sample from all bird and bat carcasses found on renewable energy project sites for use in longer-term stable isotope analyses. Collection of samples requires a Department Chapter 33 Scientific Collection Permit and a U.S. Fish and Wildlife Service (USFWS) Migratory Bird or Eagle Scientific Collecting Permit. Proponents should consult with the USFWS to ensure compliance with federal permit requirements. Specimen collection and handling methods will be provided to the proponent by the Department.

Table 1. The following matrix was developed by the WYBWG to facilitate survey selection for bats within proposed wind project sites. The matrix recommends survey methods for use during both pre- and post-construction, and identifies relevant actions (e.g., timing) for conducting surveys in Wyoming.

Recommended Survey Methods for Bats				
Survey Type	**Objectives**	**Timing**	**Training**	**Comments**
Habitat Evaluation	Quantify existing habitat	Anytime	Habitat Evaluation	Desktop or field-based
Passive Acoustic	Quantify bat activity in the rotor sweep area or within the project footprint	Apr 15 - Oct 15	Call interpretation	Provide copies of calls to WGFD
NABat	Identify species presence and occupancy in the project area; determine trends	May 15 - Jul 10	Call interpretation	Provide copies of calls and occupancy results to WGFD. Upload all data into the online NABat database.
Carcass Search	Quantify bat species that are being impacted	Apr 15 - Jun 15 & Aug 1 - Sep 30	Species identification	Collect all carcasses not used to evaluate detection probability. Coordinate with WGFD for carcass disposition. Requires a WGFD Chapter 33 permit.

Birds

Renewable energy development has the potential to negatively impact birds both directly and indirectly. For example, renewable energy infrastructure such as above-ground electrical lines, fencing, solar panels, and turbines present a risk of increased mortality rates. Both types of development also result in changes to and loss of habitat which may result in displacement of birds, changes in community composition, and changes in productivity and other vital rates.

Bird surveys should only be performed by experienced personnel who are trained in the applied methodology and capable of identifying the birds of Wyoming by sight and, as needed, by sound.

Mortality Estimation

Mortality monitoring should estimate the number and species composition of fatalities occurring at a facility over time, in order to evaluate which species or taxonomic groups are at risk and to determine the need for mitigation. These monitoring data should inform whether adaptive management actions are needed, and facilitate their application and evaluation. Proponents should consult the USGS report: Mortality Monitoring Design for Utility-Scale Solar Power Facilities (2016), the USFWS publication: Land-based Wind Energy Guidelines (2012), and the USGS webpage: GenEst – A Generalized Estimator of Mortality (https://www.usgs.gov/software/genest-a-generalized-estimator-mortality) for guidance on study design and mortality estimation.

Proponents should conduct carcass collection surveys to generate estimates of mortality rates. Baseline mortality levels should be estimated at the project site pre-construction. For projects with no pre-construction mortality monitoring, the Department will assume the baseline mortality rate to be zero. If proponents propose an alternate baseline rate, the Department will review the evidence provided in support of that rate.

The extent (e.g., sub-sample versus complete census of infrastructure), frequency (e.g., daily, weekly, biweekly), and seasonality (e.g., migration, breeding season) should be determined prior to the initiation of the surveys, and will be influenced by site-specific characteristics such as terrain and vegetation cover, bird population size, community composition, size of the development, and the level of impact the development may have on birds in the area. Sampling should include all relevant infrastructure, including but not limited to: solar components/wind turbines, meteorological towers, fencing, above-ground power lines including generation tie-in and collector lines, and project-associated ponds or other open water-holding facilities.

All carcasses should be collected and identified to species when possible. A Wyoming Game and Fish Department Chapter 33 Scientific Collection Permit is required for all personnel collecting bird carcasses. Specimens should be stored in an appropriate manner and submitted to the Department on a regular basis. Appropriate federal permits are required for carcass salvage and are required to handle carcasses of species protected under the Migratory Bird Treaty Act and the

Endangered Species Act. Eagles should be reported to USFWS law enforcement within 24 hours of discovery.

Using current and scientifically accepted methods, mortality rates should be adjusted for imperfect detection by at least these factors: 1) carcass removal by scavengers, 2) searcher efficiency rates, 3) the unsampled area, and 4) the unsampled time period. In locations and seasons with low detection rates, best practices, such as increased effort or detection dogs, should be considered to provide greater accuracy and precision in parameter estimation (Smallwood et al. 2020). Carcass persistence and searcher efficiency trials should use carcasses of species that are scavenged at similar rates to the native species of interest. Trials should be conducted at each site to account for site- and project-specific variation, such as scavenger distribution, vegetation, and observer. Searcher efficiency trials should be conducted as a blind trial with a naïve observer, such that searchers do not know when or where trials are occurring.

Bird mortality should be estimated using the GenEst suite of statistical models and software tools (Dalthorp et al. 2018). If other approaches are to be used, the Department should be consulted prior to data collection to ensure that the approach is compatible with survey objectives. Proponents should report adjusted seasonal and annual mortality rates per species or relevant grouping at the site level, as well as per turbine and/or per megawatt.

Stable Isotope Analysis

Stable isotope ratios vary in a predictable spatial pattern across the continent, and are incorporated into animal tissues through consumption of food and water. These variations can be used to identify the geographic origin of wildlife mortalities at a renewable energy facility. Identifying the area from which an animal has been removed will support efforts to assess whether the numbers of bird and bat mortalities associated with renewable energy projects may cause population-level impacts (see Katzner et al. 2020 for details on this approach).

The Department requests that proponents collect a sample from all bird and bat carcasses found on renewable energy project sites for use in longer-term stable isotope analyses. Collection of samples requires a Department Chapter 33 Scientific Collection Permit and a USFWS Migratory Bird or Eagle Scientific Collecting Permit. Proponents should consult with the USFWS to ensure compliance with federal permit requirements. Specimen collection and handling methods will be provided to the proponent by the Department.

Point Count and Transect Surveys

Conduct point count or transect surveys to estimate community composition; density or occupancy rate (where sample size does not permit density estimation); areas of high use; and distribution of passage migrant, locally breeding, and overwintering birds; and, for wind energy projects, to identify areas of potential for collision risk for raptors.

Species or taxa-specific surveys may be recommended for SGCN that are not reliably detected or quantified using the following general point or line-transect count methodologies. These surveys may be recommended by the Department on a site-specific basis based on the presence of potentially suitable habitat.

Surveys should be randomly distributed across the proposal area or strategically placed to assess bird metrics relative to habitats or proposed or existing infrastructure (e.g., turbine locations), depending on the site-specific design and objectives. Survey duration and effort should be tailored to the project-specific objectives and taxa. Sufficient distance between survey points or transects is necessary to avoid duplication of counts (Alldredge et al. 2006, Buckland et al. 2009).

Reporting for migrating, breeding, and wintering bird surveys should include: detailed survey methodology, geographic coordinates of survey site locations (preferably decimal degrees or UTM), survey effort, proofed observation data, and a summary of results. Post-construction reports should provide an assessment of changes in the metric of interest (e.g., community composition and species-specific density or occupancy rate) between pre- and post-construction phases of development, as well as in relation to relevant measures of post-construction infrastructure (e.g., turbine proximity, turbine density), and in comparison to undisturbed reference sites, when used (see Shaffer and Buhl 2016 for an example sampling design).

For sampling plans designed to assess potential displacement of birds by turbines or other project infrastructure, surveys should be placed in areas of relatively homogenous habitat and should avoid confounding features such as other infrastructure, including fences. The best available research indicates displacement of open-land birds from wind turbines can occur at a fairly fine spatial scale (summarized by Shaffer and Buhl 2016). Sampling to evaluate displacement of Wyoming's open-land birds from renewable energy development should be designed with this spatial scale in mind.

- Migration – Point count or transect surveys with adjustment for detection probability should be conducted weekly over a 12-week period in spring, and again in fall in order to detect early, mid, and late-season migrants (Buckland et al. 2001, 2004, Farnsworth et al. 2002).

- Breeding – Point count or transect surveys with adjustment for detection probability should be conducted at least twice per survey location between mid-April to late June (depending on location and elevation) to detect the majority of breeding landbirds. Surveys should begin 30 minutes prior to official sunrise and end approximately four to five hours after official sunrise, subject to field conditions and bird activity. Surveys should be limited to times with no precipitation and wind speeds less than 18 mph. For example survey methods, see Shaffer and Buhl 2016, or the Bird Conservancy of the Rockies' Integrated Monitoring in Bird Conservation Regions Field Protocol (http://rmbo.org/v3/avian/DataCollection.aspx).

- Winter – Line-transect surveys with distance sampling techniques are recommended to detect overwintering birds (Buckland et al. 2001, 2004). A minimum of two surveys should be conducted per season: early winter from December 1 – January 15 and late winter from January 16 – February 28. Since birds remain active throughout the day in the nonbreeding season, overwintering surveys can be conducted throughout daylight hours, but should be limited to times with no precipitation and wind speeds less than 18 mph. For reference survey protocols, see Thompson et al. (2015).

Raptors

Raptor-specific surveys and analyses should be used to identify: high-use areas, nest location and status, and areas that could present an increased risk of mortality given project-specific components and plans. The latter will apply primarily to wind energy development. Proponents should consult with the USFWS for eagle survey and monitoring methods and recommendations. These survey methods may be well-suited to other raptor species of concern, as well.

- Migration – Surveys conducted during migration should seek to document areas of high use in order to mitigate loss of important habitat features, such as stopover foraging sites, and should also identify areas where use could result in increased risk of mortality, such as topographic features (e.g., major wind currents, linear landscape features, summits and steep slopes) that concentrate raptors at altitudes that place them within the rotor-swept zone for wind turbines (see Schuster et al. 2015 for a summary).

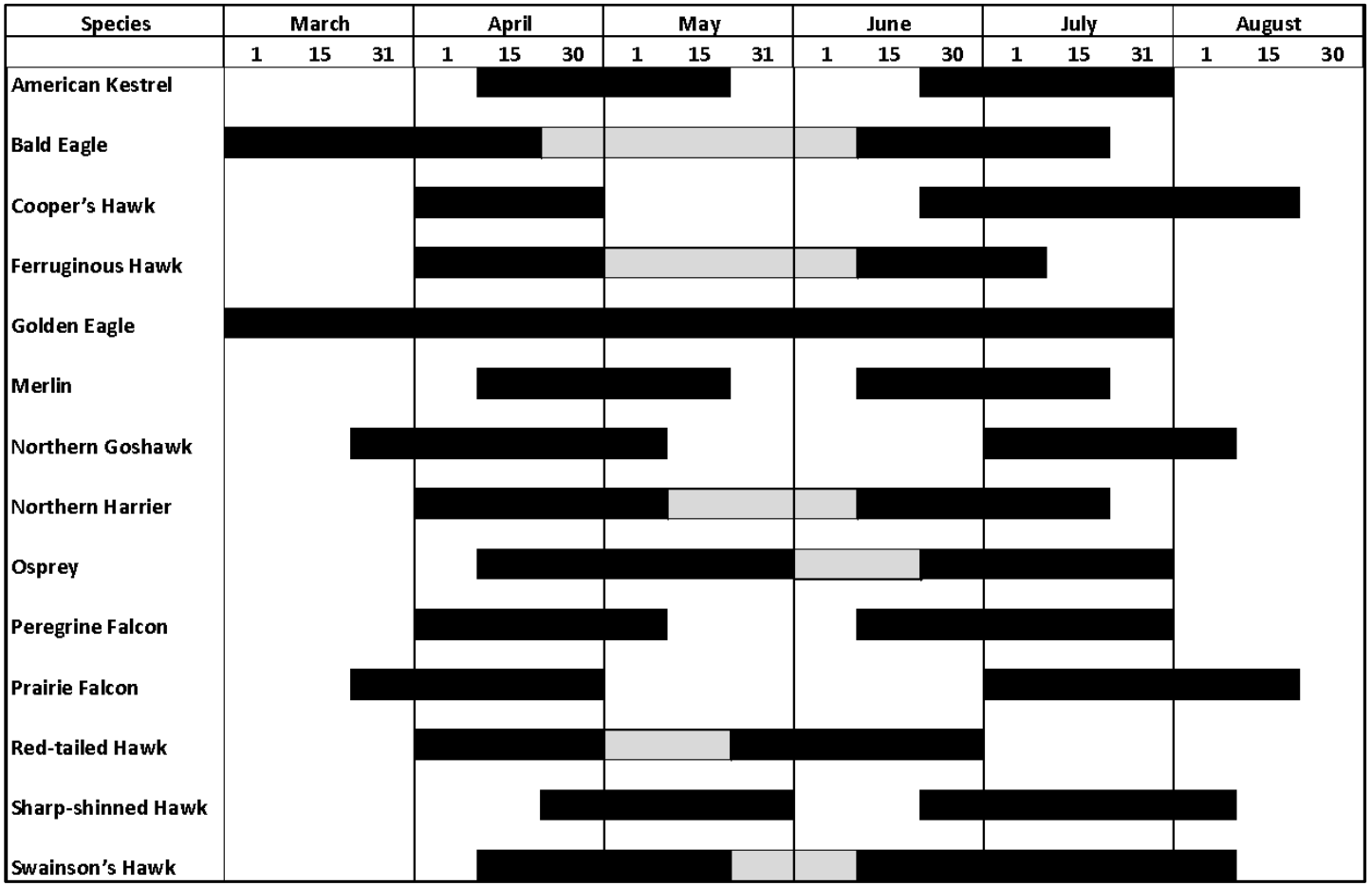
    - Suitable survey methods will vary with the identified objectives, but to document stopover use within the project area survey locations should be distributed across the site, and include features that may be suitable for stopover use, such as concentrations of burrowing mammals like prairie dogs.

    - To document areas of uplift and travel, proponents should conduct weekly, day-long count surveys during both the spring and fall 12-week migration periods. Survey sites should include features that can concentrate migrating raptors, such as areas that provide uplift for soaring raptors. Surveyors should consider the survey plot cylinder approach recommended by the USFWS for eagles, and should record relevant information to identify high-use areas by migrating raptors, including geographic coordinates (preferably decimal degrees or UTM) of the count site, species, number of birds detected, sex and age class (if possible), time, time spent within the survey plot cylinder (or a given area), behavior, altitude (particularly relative to the rotor-swept zone for wind energy projects), weather, flight direction, and primary habitat. Any observations of large flocks of non-raptors (e.g., waterfowl, shorebirds, swallows, etc.) and their estimated altitude should also be recorded.

- Nests - To locate raptor nests, conduct area search surveys during the breeding season. Surveys to locate nests within suitable habitat (e.g., trees, rock outcrops, hillsides) can be conducted either by ground-based surveys along transects that are no more than ½ mile apart (depending on topography and physical features) or aerially in a low-flying fixed-wing aircraft or helicopter. In general, the method used will depend on the size and accessibility of the proposed project site. If ground surveys cannot provide comprehensive coverage and accurate locations of nests within the project area, aerial surveys should be implemented. Surveyors should record nest data, including location, nest condition, status, using the standardized "Raptor Nest Survey Datasheet" (April 2020; available by request from the Department's Statewide Nongame Bird and Mammal Program). Surveyors should also provide information on survey effort (e.g., flight tracks, polygons of areas searched, number of visits). See Table 2 for species-specific survey dates.

- High-Use Areas – Areas of concentrated raptor prey resources (e.g., prairie dog colonies), eagle roosts, and other high-activity areas should be identified. Proponents should consult with the USFWS for guidance on eagle surveys, such as for eagle roosts.

Table 2. Diurnal Raptor Survey Dates



Black blocks indicate the best times to detect birds in courtship (early dates) or with young in the nest when adults will be conspicuous (later dates). For accipiters, merlins, and peregrine falcons, detectability during courtship is variable, with some pairs almost impossible to detect.
Grey blocks indicate periods for species with conspicuous nests during which surveys can also be conducted effectively.
Note: Dates may vary slightly by latitude, altitude, or other factors affecting phenology and should be adjusted depending on field conditions.

Greater Sage-Grouse and Sharp-Tailed Grouse

Greater sage-grouse and sharp-tailed grouse are two species that attend leks, or communal dancing grounds, each spring. Monitoring leks is important because these camouflaged birds are reliably visible at a known place and time each year. Lek data are used as a primary means to assess population trends for these species over time. Proponents should consult with regional Department biologists to coordinate lek monitoring. Coordination should occur annually, prior to March 15, and data should be submitted to the appropriate Department biologist annually by May 31. For projects that will occur in occupied greater sage-grouse or sharp-tailed grouse range the following monitoring protocol should be used:

- Map habitat within a two-mile buffer of the project boundary. Habitat mapping should document dominant vegetation types and habitat suitability to ensure lek surveys and other monitoring activities are occurring in the appropriate areas.
    - In northeast Wyoming, map sagebrush where canopy coverage is greater than or equal to 5% (desktop mapping of sagebrush should be ground-truthed to differentiate between other common shrub species). In this region, suitable greater sage-grouse habitat occurs in a mosaic across the landscape. The Department typically recommends avoiding disturbance of sagebrush stands to the extent possible in this part of the state.
- Conduct lek counts and surveys for previously undiscovered leks within a two-mile buffer of the proposed project area boundary using Department protocols as described in the Handbook of Biological Techniques: https://wgfd.wyo.gov/Wildlife-in-Wyoming/More-Wildlife/Handbook-Bio-Techniques.
- Compare lek counts with a suitable nearby reference area to assess potential changes in attendance attributable to a renewable energy project.

Big Game

Renewable energy development alters habitat and has the potential to negatively impact big game mammals through both direct and indirect effects. For example, fencing associated with solar energy development can exclude big game animals from project areas resulting in direct habitat loss, while both solar and wind facilities may displace animals from otherwise intact landscapes, reducing available habitat, disrupting landscape connectivity and animal movements. Responses to human presence and infrastructure may also lead to stress-induced changes in vital rates.

If the project occurs on or may otherwise affect lands designated as crucial winter range, identified parturition areas, or areas of seasonal movement, the following may be recommended to provide pre- and post-construction data that will help identify impacts and potential mitigation options for affected big game species:

- Observational survey data.
- GPS collar a representative sample of the affected herd(s).
- Collect GPS collar data for two years prior to construction and three years post-construction to determine habitat use, identify areas of seasonal movement, and identify changes in habitat use and population demographics.
- Collect and compare these parameters with a suitable, nearby reference area.

The methods used for gathering these data should be determined in coordination with the Department, and these data should be collected, analyzed, and provided in an annual report to the Department (see Appendix G for Reporting Guidelines). For GPS collar data associated with movement studies, the proponent should submit a cleaned version of the data, as well as an "Animal ID" spreadsheet. This spreadsheet should include a unique identifier for every animal in the study, along with the deploy date and retrieve date for the associated collar or tag. A template is available from the Department upon request.

If the Department determines that significant avoidance of important habitats is occurring or populations are being negatively affected by the renewable energy development, a mitigation plan should be developed in collaboration with the Department to compensate for that impact. Projects within or affecting designated migration corridors, bottlenecks, or stopover sites should be developed in accordance with the State of Wyoming Mule Deer and Antelope Migration Corridor Protection Executive Order 2020-1.

Nongame Mammals

Renewable energy development alters habitat and has the potential to negatively impact nongame mammals. Solar energy development can result in large-scale changes to landcover, and may result in displacement of nongame mammals and changes in nongame mammal community composition. Wind energy development and associated infrastructure compact soils and also causes ground-level vibrations that could affect burrowing nongame mammals. Colonial burrowing nongame mammals such as prairie dogs or ground squirrels are keystone species that create habitat conditions that support a wide diversity of wildlife. Consequently, the Department may recommend additional species-specific surveys be conducted for identified nongame mammal SGCN to inform project siting and design, improve our understanding of nongame mammal responses to renewable energy development, as well as potential mitigation efforts. The proponent should use Department survey methods as described in the Handbook of Biological Techniques: https://wgfd.wyo.gov/Wildlife-in-Wyoming/More-Wildlife/Handbook-Bio-Techniques.

APPENDIX E. MONITORING PLAN

The goal of the Monitoring Plan is to evaluate potential impacts to terrestrial and aquatic wildlife, and ultimately mitigate potential impacts to species of concern and important fish and wildlife habitats.

The Monitoring Plan is an agreement between the proponent, affected landowners and the Department to conduct monitoring to identify species or taxa of concern and important fish and wildlife habitats, and to address identified potential or documented impacts. Collected data will be used to develop plans, siting proposals, and further mitigation actions to alleviate potential or documented impacts. As cosigners of the Monitoring Plan, landowners will be invited to participate in discussions between the Department and proponent, and should be included in the Technical Advisory Committee (TAC, Appendix F). The Monitoring Plan is intended to be updated as needed based on site-specific information, conditions, or data, and different stages of project development, including when the project is submitted for permitting. Two years of pre-construction monitoring, monitoring during construction, and three years of post-construction monitoring is expected.

Development of the Monitoring Plan occurs in several phases. Initially, prior to project development, the Monitoring Plan consists of identifying and monitoring species or taxa of concern, important fish and wildlife habitats, formalizing permission by the landowner(s) to conduct monitoring, and inviting all cosigners to the table to discuss monitoring and plans to alleviate impacts. Based on the results of initial monitoring, an updated Monitoring Plan that includes measures to alleviate potential or documented impacts to species and/or habitats of concern should be developed. The updated Monitoring Plan should again be signed by all parties, and should be included with the proponent's permit application to the Industrial Siting Division of the Wyoming Department of Environmental Quality.

Coordination with Landowners

Affected private landowners are an integral part of project-specific consultations, and project developers are expected to be inclusive of these landowners in project-related discussions. "Affected landowners" are defined as any person, or their designated representative, holding record title to land on which any portion of a commercial facility generating electricity from renewable sources is proposed to be constructed. The coordination process outlined below includes all renewable energy generation facilities located on private lands including that portion of any collector system located on those same lands.

As cosigners of the Monitoring Plan, landowners are invited to participate in discussions between the Department and proponent. Prior to entering into any agreement with a renewable energy proponent to undertake studies or monitoring activities on private lands that precede efforts to develop a Monitoring Plan, the Department requests from the proponent a written statement certifying that all affected landowners have been notified of the proposed studies or monitoring activities and have granted all necessary access for the purpose of such studies or

monitoring. The proponent should provide contact information for all affected landowners to the Department.

Federal and state land management agencies may require permits for performing surveys on lands within their jurisdiction. Proponents should coordinate with the appropriate agencies to assure regulatory compliance.

Affected landowners or their representative are entitled to participate in all discussions between the proponent and the Department, including TAC meetings. The proponent is responsible for notifying affected landowners of all meetings between the Department and the proponent, including TAC meetings.

Pre-Construction Monitoring

The goal of pre-construction baseline monitoring is to map species habitats, identify existing and potential project sediment sources and channel stability concerns, map areas of high use or movement routes, and to estimate baselines of relevant metrics for high-priority fish and wildlife (e.g., occupancy rate, density, mortality rate, relative use) for the proposed project location. These data are used to 1) assess the relative risk of development for fish and wildlife, 2) inform infrastructure siting to mitigate impacts, and 3) to estimate and compare impacts pre- and post-construction within the site and relative to other sites (i.e., cumulative impacts).

Sampling methodologies should be consistent between pre- and post-construction monitoring, and the sampling plan should provide the statistical rigor needed to compare pre- and post-construction monitoring data, as well as to estimate the relevant fish and wildlife metrics of interest for a given project. Proponents can refer to monitoring best practices in Appendix D for further guidance.

Pre-construction mapping efforts should be of a sufficient scale to detail special status species habitats (e.g., wetlands or riparian habitat, ephemeral water sources, rocky outcrops, prairie dog colonies, contiguous tracts of undisturbed wildlife habitat, raptor nest sites, swift fox den sites), as well as local areas of high use or routes for movement (e.g., for bats, birds, and big game). Pre-construction survey design should consider daily, seasonal, or year-round variation in use, as is relevant to the biology of the target species, and should be of a suitable duration (typically two years) to account for variability in the natural system. Recommended methods and additional monitoring resources can be found in Appendix D. The use of these methods is encouraged to allow for comparison across projects. Project proponents should develop a site-specific Monitoring Plan in coordination with the Department. Proponents should also consult with the U.S. Fish and Wildlife Service (USFWS) for planning related to migratory birds, raptors, and threatened or endangered species.

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

- A yearly/seasonal synthesis of fish and wildlife data separated out by technique used to measure these variables.

- A discussion of the effectiveness of the techniques and whether the monitoring plan needs to be modified.

- A re-evaluation of the impact analysis, including mortality estimates.

- A discussion on mitigation measures should there be potential effects to fish and wildlife.

Post-Construction Monitoring

After data from initial pre-construction monitoring are collected, and impact and mitigation measures are in place, it is necessary to evaluate the potential long-term effects of the renewable energy facility on fish, wildlife, and habitat. This information should be collected using methods that enable the estimation of direct and indirect impacts between pre- and post-construction. Once a post-construction monitoring plan has been implemented, proponents should draft annual reports for ongoing post-construction data collection and submit those within six months from the last season data collection occurred (Appendix G).

In general, post-construction monitoring consists of mortality estimation for birds and/or bats in relation to project infrastructure, fish and wildlife use, and changes in habitat. Depending upon the site-specific concerns of a particular project, it is important to collect data to assess:

- Mortality rates and how these rates relate to the relevant population size.

- Changes in wildlife habitats and landcover.

- Relevant metrics for comparison with pre-construction studies (e.g., use, occupancy rate, density).

- Drainage and/or channel alterations causing erosion and/or deposition.

- Reclamation and invasive plant presence and distribution.

- Mitigation needs.

- Efficacy of implemented mitigation measures including adaptive management.

- Localized and/or statewide cumulative impacts from other renewable energy projects, surface disturbance, human activity, or infrastructure.

Post-construction monitoring should be directly comparable to pre-construction monitoring in order to measure effects. Therefore, the same techniques should be used in both the pre- and post-construction monitoring, including rigorous approaches for estimating detection probability, and adjusting mortality rates for carcass persistence and searcher efficiency. Proponents can refer to the 2016 U.S. Geological Survey (USGS) Open-File Report 2016-1087, "Mortality monitoring design for utility-scale solar power facilities." for guidance available at: https://pubs.er.usgs.gov/publication/ofr20161087.

Where Should Post-Construction Monitoring Occur?

- Development can occur within a variety of habitats, at varying scales of production; therefore, it is recommended post-construction monitoring occur at all project sites. 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 adjacent to Important Bird Areas, Department Wildlife Habitat Management Areas, or USFWS National Wildlife Refuges. Projects that are placed in areas with fewer fish and wildlife concerns and that adopt best practices in layout, design, construction, and operations will result in reduced conflict with fish and wildlife values, and consequently will have reduced need for monitoring.

When Should Post-Construction Monitoring Begin?

- The commencement of post-construction monitoring will be project-specific, but may begin immediately after infrastructure is constructed or once operational in order to evaluate initial effects. While some species may adjust to the presence of structures over time, they may initially be affected by new structures within their home range. As a result, some mortalities or injuries may occur immediately after construction and should be captured by post-construction monitoring.

- When focal species are not present and/or post-construction monitoring is not plausible (e.g., inclement weather), data collection should begin the next season or period in which pre-construction data were collected (e.g., if structures were constructed in winter, data collection should start the following spring breeding and/or spawning seasons).

- For consistency, these monitoring periods should be the same as those in the pre-construction data collection period in order to make direct comparisons. Post-construction monitoring strategies (e.g., duration, intensity, timing, and specific surveys) should be tailored based on site-specific project concerns.

How Should Post-Construction Monitoring Occur?

- Post-construction monitoring should consist of a combination of quantifying presence and activity of wildlife species at facilities, mortalities, and displacement due to

infrastructure and activity. As described in Kunz et al. (2007a and 2007b), post-construction monitoring should address two objectives:

1) Using consistent methods to allow for comparison of data across different landscapes, watersheds, and habitats.

2) Protocols implemented to measure and establish patterns of mortalities relative to several variables such as weather, infrastructure characteristics, and other environmental variables in the post-construction monitoring.

It is important for project proponents to acknowledge that if post-construction monitoring demonstrates a significant impact is occurring as a result of the renewable energy project, it is expected the proponent/operator will develop and implement appropriate mitigation in coordination with the Department.

Monitoring Plan Components

The following components should be included in the Monitoring Plan for fish and wildlife resources identified within and/or adjacent to the project area, as applicable. Given the site-specific nature of the Monitoring Plan, additional items not listed below may be warranted.

Summary of Fish, Wildlife, and Habitat Resources

- Delineation/description of landcover, species-specific habitats, information regarding current land use, and description of the project site in relation to the larger landscape (e.g., proximity to high priority fish and wildlife habitats or hotspots, existing disturbed areas, areas of industrial land use).
- Aquatics
- Amphibian and reptiles
- Bats
- Migratory birds and raptors
- Greater sage-grouse
- Big game
- Nongame mammals

- Other project-specific species or habitat of concern

Landowner Agreement(s) Allowing Access for Monitoring

- Written statement certifying that all affected landowners have been notified of the proposed studies or monitoring activities and have granted all necessary access for the purpose of such studies or monitoring.

Monitoring Pre- and Post- Construction

Pre- and post-construction monitoring may include, but is not limited to the following:

- Watershed assessment
- Amphibians and reptiles
- Bats
- Migratory birds and raptors
- Greater sage-grouse
- Big game
- Nongame mammals
- Wildlife mortality
- Post-construction reclamation and invasive plant species management
- Other project-specific species or habitat monitoring

Mitigation

Mitigation may include, but is not limited to the following:

- Explanation of adaptive management measures or actions will be taken to alleviate identified impacts
- Habitat restoration or enhancement
- Species-specific seasonal stipulations and spatial buffers

- Offsite conservation of important/crucial/valuable habitat
- Techniques/technologies for minimizing renewable energy impacts
- Other project-specific species or habitat

Data Reporting

- Annual or seasonal monitoring summary
- Geospatial data
- TAC expectations and commitments

Signature Page

- Affected landowner(s)
- Proponent(s)
- Wyoming Game and Fish Department

APPENDIX F. TECHNICAL ADVISORY COMMITTEE

A Technical Advisory Committee (TAC) should be created and facilitated by the proponent as a component of the Monitoring Plan (Appendix E). The purpose of the TAC is to support a collaborative effort assessing and addressing fish and wildlife-related considerations. At a minimum, the TAC should review monitoring data, identify pre-construction issues and alternatives to address issues, and recommend post-construction mitigation measures to address identified project impacts.

TAC Membership

- Wyoming Game and Fish Department resource specialists
- U.S. Fish and Wildlife Service resource specialists
- Project proponent(s)
- Project biologist
- Landowners (federal, state, and/or private)
- Permitting and/or local government agency representatives (if applicable)

Other entities can be included as needed. The TAC should remain in place for the duration of the Monitoring Plan and could be reconvened at any point during the life of the wind or solar facility as needed to address fish and wildlife concerns.

TAC Meetings

The TAC should be implemented once the proponent has contacted the Department regarding the development of their project in the State of Wyoming. It will be the responsibility of the proponent in coordination with the Department to ensure all parties are invited to participate in TAC meetings both pre- and post-construction. TAC meetings should take place as needed pre-construction to review baseline survey data and should continue through construction and post-construction to review post-construction monitoring data. The TAC should meet at a minimum annually and should include an annual site visit (additional site visits may be requested) to the proposed or constructed facility. If at any time affected parties (i.e., those who have signed the Monitoring Plan) want to convene a meeting of the TAC they may request to do so.

TAC Responsibilities

- Develop and approve a Monitoring Plan.
- Convene annually to review pre-construction and post-construction data reports, and/or when mitigation needs arise or protocols require review.
- Make recommendations based on best available science to address specific issues resulting from the project.
- Review monitoring findings and provide comments and recommendations to the proponent regarding necessary mitigation options.

The TAC should operate in good-faith, and attempt to resolve any issues arising from the use these guidelines, as well as any fish or wildlife-related issues identified as a result of the proposed or constructed/operational wind or solar energy facility. Recommendations should be based on site-specific conditions and best available science. If resolution or agreement cannot be reached, the project proponent and Department staff should coordinate to elevate the matter for further discussion.

APPENDIX G. REPORTING GUIDELINES

Where to Submit Wildlife Data and Reports

Wyoming Game and Fish Department Habitat Protection Program
5400 Bishop Blvd., Cheyenne, WY 82006
307-777-4506
wgfd.hpp@wyo.gov
https://wgfd.wyo.gov/Habitat/Habitat-Protection-Program

Necessary Elements of Data Submittals

The Department requests the following data submittals:

1) A complete dataset that describes geographic location of survey sites/transects, survey effort, fish and wildlife observations or relevant metrics, statistically adjusted estimates of fish and wildlife, associated metrics of renewable energy development, and any additional information that may be needed to review findings and compare across sites and years.

    - Electronic format.

    - Geospatially referenced (preferably using decimal degrees or UTM), including coordinates, datum, and UTM Zone if needed.

    - Attributes defining observational data.

    - Relevant metadata.

    - Specifics on viewing restrictions or applications required and any information that may be considered proprietary or confidential. The Department encourages that datasets documenting mortality and displacement monitoring be made publicly available to allow for the assessment of cumulative effects. **These data can be anonymized to protect dates and locations, such that data will not be identifiable to a particular year, project, or landowner, but instead will represent time relative to construction and spatial location relative to infrastructure**.

- Note that for some monitoring, external databases are used in place of or in addition to submission to the Department. These data should be submitted in accordance with the Monitoring Plan and relevant state and federal permits. External databases include:

    - North American Bat Monitoring Program (NABat) - a free, online database systematically documenting bat populations should be used for acoustic monitoring conducted using NABat standardized protocols.

    - Movebank - a free, online database of animal location data should be used for data obtained from Global Positioning System (GPS)/satellite collar/receiver units. Note that proponents should also submit an "Animal ID" spreadsheet to the Department. This spreadsheet should include a unique identifier for every animal in the study, along with the deploy date and retrieve date for the associated collar or tag. A template is available from the Department upon request.

    - Wyoming Natural Diversity Database (WYNDD) – an online biodiversity database that also provides a centralized and standardized repository for raptor nest data in Wyoming. Developed in partnership with the Wyoming Raptor Working Group, WYNDD provides a data submission template that was developed in tandem with the standardized "Raptor Nest Survey Datasheet") at: http://www.uwyo.edu/wyndd/collect/standard-protocols-and-templates/raptor-nest-surveys.html. The database has rigorous data sensitivity policies that allows proponents to restrict data sharing as needed. Proponents should observe data restrictions set forth by private landowners.

2) A subset of the dataset that describes all fish and wildlife observations formatted for inclusion in the Wildlife Observation System (WOS). Project proponents should use the excel Observation Data Template available at: https://wyndd.org/chapter_33. This template is used for multiple reporting purposes and not all fields in this template are required. Note the following:

    - Observation data will ultimately be entered into the Wyoming Biodiversity Information System (WyBIS), a database system housed at WYNDD, and managed in conjunction with the Department. WYNDD provides species and habitat data contained within WyBIS to state and federal agencies, non-profits, private consultants and industry, and other researchers. **Proponents who wish to restrict access to their data must do so by selecting the appropriate values in the Record Sensitivity column of the template.** See the Record Sensitivity tab for more information. Proponents should observe data restrictions set forth by private landowners.

    - The required fields are:

        - Observer

        - Date

- Species
- Data Type
- A count of >0 for at least one sex/life stage combination
- Coordinates (either Lat/Long or UTM Northing and Easting)
- Datum
- UTM Zone (if UTM coordinates provided)

- Species should be reported by scientific name, not a common name or code. To reduce taxonomic discrepancies, scientific names used in the spreadsheet must exactly match those provided at: https://wyndd.org/species_list/.

- If there are no Tag Numbers, Tag Colors, Collar Frequency, or Animal ID, leave these columns blank.

- Failing to populate columns correctly and completely could result in your spreadsheet being returned to you for modification.

3) Preserved bird and bat carcasses, feathers, or tissue samples should be submitted to the Department annually, in accordance with the Monitoring Plan and relevant state and federal permits.

Recommended Reports

Report 1. Preliminary Project and Site Information

Information in this report should reflect preliminary planning discussions between the proponent and the Department and should document potential or known conflicts with fish and wildlife resources, as described in Step 1 and 2 of this document. It will also provide the information needed for the Department to conduct the more detailed assessment of the biological values of the proposed potential site(s) associated with a project question.

Report 2. Planning for Fish and Wildlife Considerations

This report should detail the siting, design and construction specifications, management actions for mitigating impacts, and Monitoring Plan that the proponent has adopted in consultation with and following the receipt of the Department's assessment of biological values, which will also provide targeted recommendations for these topics, as described in Step 3, 4, and 5 of this document.

Report 3. Pre-Construction Baseline Monitoring (Seasonal or Annual)

These reports should document and summarize the survey methods, effort, and findings. In addition to data summaries, the proponent should submit geospatially referenced datasets of survey locations with associated detections, and all additional relevant data describing effort (e.g., date, time, number of visits, weather conditions) The proponent should also submit frozen carcasses of birds and bats as directed by the Department and agreed to in the Monitoring Plan. Data summaries should address:

1) Does monitoring indicate the potential for direct, indirect, or cumulative adverse impacts to fish and wildlife species or habitat?

    - Does pre-construction monitoring indicate that project-specific focal species are present on or likely to use the proposed site?

    - What are the pre-construction estimates for species-specific occupancy rates, use of important or sensitive habitats, density, mortality, community composition, and other metrics of interest within the project site and at a reference site, if applicable?

    - Does pre-construction monitoring identify existing and potential project sediment sources and channel stability concerns?

    - Does pre-construction monitoring indicate noxious weeds or invasive plants exist within the project area?

2) If adverse impacts are predicted to a species or habitat, how can these impacts be avoided (preferable), minimized, or further mitigated?

3) Is continued monitoring needed during and/or after construction?

Report 4. Post-Construction Monitoring (Seasonal or Annual)

These reports should document and summarize the survey methods, effort, analyses, and findings. In addition to data summaries, the proponent should submit geospatially referenced datasets of survey locations with associated detections, and all additional relevant data describing effort (e.g., date, time, number of visits, weather conditions). The proponent should also submit frozen carcasses of birds and bats as directed by the Department and agreed to in the Monitoring Plan. Data summaries should address:

1) Does monitoring document adverse impacts on fish and wildlife species or habitat?

    - What are the post-construction estimates for species-specific occupancy rates, use of important or sensitive habitats, density, mortality, community composition, and other metrics of interest within the project site and at a reference site, if applicable?

- How do estimates compare to the pre-construction and/or reference site rates?
    - Is there evidence of displacement of focal species? If so, at what scale?
    - What are the species-specific bird and bat mortality rates for the project and reference site, if applicable? Is that rate biologically significant to the relevant populations from which the losses are occurring?
    - Have greater sage-grouse lek counts changed?
    - Has raptor nesting and production been affected?
    - Have big game distributions or population parameters (e.g., recruitment rates) changed?
    - How do metrics of interest (e.g., use, density) vary in relation to relevant measures of post-construction infrastructure (e.g., turbine proximity, turbine density)?
- Does post-construction monitoring identify impacts to aquatic resources because of project sediment sources and channel stability concerns?
- Does post-construction monitoring indicate control or treatment of noxious or invasive weeds is needed?

2) What adaptive management actions or further mitigation efforts are needed to reduce or offset impacts to fish and wildlife or habitat?

3) Is continued monitoring needed?

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