Photo courtesy of Clearway Energy Group

National Utility-Scale Solar Wildlife Guidelines

AMERICAN CLEAN POWER

ASSOCIATION of FISH & WILDLIFE AGENCIES

EWAC® Energy and Wildlife Action Coalition

JUNE 2026

Foreword

The deployment of utility-scale solar energy is accelerating across the United States, driven by increasing electricity demand, national emissions reduction goals, and the continued maturation of solar technologies. As with all forms of infrastructure development, the construction and operation of solar energy facilities can affect the natural environment. Recognizing both the importance of expanding clean energy generation and the need to conserve wildlife and their habitats, the *National Utility-Scale Solar Wildlife Guidelines* were developed to provide a practical framework for identifying, avoiding, and reducing potential impacts while supporting responsible solar energy development.

These guidelines are intended to promote early engagement, informed decision-making, and collaborative problem-solving among solar developers and state fish and wildlife agencies. They reflect a shared commitment to improving outcomes for both energy development and wildlife conservation and to identifying solutions that avoid or minimize harm and, where possible, produce meaningful conservation benefits.

The guidelines are voluntary in nature and do not replace or preempt any existing federal, state, or local regulatory requirements. Instead, they are designed to complement existing processes and to provide a constructive framework for engagement in situations where formal wildlife permitting mechanisms may be absent, limited, or insufficient to address the full range of considerations associated with solar energy development. Their effectiveness depends on their thoughtful application and on the willingness of project proponents and wildlife agencies to engage in good faith, share information openly, and work collaboratively toward balanced outcomes.

The American Clean Power Association, the Energy and Wildlife Policy Committee of the Association of Fish & Wildlife Agencies, and the Energy and Wildlife Action Coalition jointly developed this document. Its development reflects a sustained collaborative effort among agency biologists, conservation professionals, developers, and industry experts who contributed their knowledge, experience, and perspectives throughout the process. Developing guidance intended to be applicable across diverse ecological, regulatory, and geographic contexts required careful deliberation and, at times, difficult conversations. While not every perspective could be fully incorporated, each contribution was carefully considered in the development of the final document.

The organizations responsible for this effort recognize that responsible solar development and wildlife conservation are complementary public interests. Achieving both requires ongoing communication, transparency, and a shared commitment to practical solutions. These guidelines are offered as a resource to support those efforts and as a foundation for continued collaboration among the energy and wildlife communities.

We extend our sincere appreciation to the many individuals and organizations whose expertise and dedication made this work possible. Their contributions reflect the type of cross-sector collaboration that will be essential to advancing both a clean energy future and the long-term conservation of the nation's wildlife resources.

ON BEHALF OF THE

Quintana Hayden
Senior Director,
Wildlife and Federal Lands

Clay Crowder
Chair,
Energy & Wildlife Policy Committee

John Anderson
Executive Director

Photo courtesy of Clearway Energy Group

Contents

Abbreviations

ACP	American Clean Power Association
AFWA	Association of Fish & Wildlife Agencies
AOI	Area of Interest
CFR	*Code of Federal Regulations*
ESA	Endangered Species Act
EWAC	Energy and Wildlife Action Coalition
NEC	*National Electrical Code*
NEPA	National Environmental Policy Act
NERC	North American Electric Reliability Corporation
NESC	*National Electrical Safety Code*
PV	Photovoltaic
SFWA	State Fish and Wildlife Agency
SGCN	Species of Greatest Conservation Need
SWAP	State Wildlife Action Plan
USC	*United States Code*
USFWS	US Fish & Wildlife Service
USGS	US Geological Survey
WOTUS	Waters of the United States

Photo courtesy of Clearway Energy Group

Introduction

The US National Power Demand Study from S&P Global Commodity Insights projects that electricity demand in the United States will increase by 35–50% between 2024 and 2040.[1] One key strategy to meet this anticipated growth is the deployment of utility-scale photovoltaic (PV) solar energy.

Utility-scale PV solar is among the most affordable and readily deployable energy technologies available.[2,3] It offers significant environmental advantages, producing no air pollutants during generation and maintaining one of the lowest life cycle carbon emissions profiles or any electricity source.[4] As a result of its cost-effectiveness and environmental benefits, deployment is accelerating in response to growing customer demand. The US Department of Energy's Solar Futures Study estimates that approximately 1,000 GW of solar energy capacity – about 900 GW of which is expected to be utility-scale solar – will be needed to meet emissions reduction and other energy goals by 2050.[5]

Achieving this scale of deployment will require land. It is estimated that approximately 6 acres are needed per megawatt of alternating current for utility-scale, ground-mounted PV solar, although this varies by site and typically ranges from 5 to 7 acres. In total, reaching 900 GWAC of utility-scale solar generation would require approximately 5.4 million acres – less than 0.5% of the land area of the United States and far less than the estimated 1.2 billion acres (about 53%) of land area occupied by agriculture alone.

While solar development supports national emissions reduction goals and can provide habitat benefits for certain species, changes in land use may also result in adverse impacts to wildlife and their habitats. This document has been developed as a voluntary tool to assist project proponents and state fish and wildlife agencies (SFWAs) in identifying, avoiding, and minimizing those impacts, while also highlighting opportunities to achieve positive conservation outcomes.

The Association of Fish & Wildlife Agencies (AFWA), the American Clean Power Association (ACP), and the Energy and Wildlife Action Coalition (EWAC) jointly developed this document to provide voluntary, national wildlife guidance for utility-scale, ground-mounted PV solar energy project development from project planning through operations.[1] AFWA represents the collective perspectives of SFWAs in all 50 states. These agencies hold primary statutory authority for managing fish and wildlife as public trust resources within their jurisdictions, unless preempted by federal law, and provide critical scientific expertise and technical guidance on the impacts of energy development on species and habitats. ACP and EWAC represent companies responsible for developing, permitting, constructing, owning, and operating the majority of utility-scale solar energy projects in the United States.

These guidelines are not intended to replace or preempt existing wildlife-related permitting requirements at the federal, state, or local level. Rather, they are designed to complement those processes and may help inform them. They are particularly intended to support site assessment, project development, construction, and operations in areas where formal wildlife-related permitting or review processes are absent or limited. The *National Utility-Scale Solar Wildlife Guidelines* provide a voluntary, structured, and repeatable framework for information collection and analysis to assess risks to species of interest[2] and their habitats throughout the life cycle of utility-scale, ground-mounted PV solar projects.

These guidelines provide a structured, communication-based process for science-based decision-making while allowing for flexibility regarding site-specific conditions. The guideline stages help identify information to collect and assess so that project proponents [3] (i.e., developers, owners, operators, or other project representatives such as biological consultants) can make informed decisions about whether to (i) proceed with development, (ii) collect additional information, or (iii) adjust project plans in response to potential adverse effects[4] on species of interest and their habitats. At any time, a project owner or operator may decide to delay or suspend further development on a project, which may happen for any number of reasons and can be a confidential part of a company strategy; this point is not further contemplated in these guidelines.

1 These guidelines discuss six stages. "Project development through operations" may be used in lieu of listing out the six individual stages. "Through operations" in this context is inclusive of decommissioning as addressed in the guidelines.

2 "Species of interest" is defined in Appendix C of this document and discussed in the General Approach and Applicability of These Guidelines section.

3 The term "project proponent" is used throughout these guidelines as the party that is responsible for implementing many of the tasks outlined in the guidelines. However, in certain circumstances, project owners or operators are identified as the ultimate decision-maker for the project.

4 While "adverse effects" is used throughout these guidelines, not every adverse effect necessitates action. Discussions about which effects to address will vary state to state and be an important part of discussions between SFWAs and project proponents.

General Approach and Applicability of These Guidelines

These guidelines provide a process for assessing and addressing potential adverse effects to species of interest and their habitats. Project proponents and SFWAs are encouraged to work collaboratively and in good faith to identify practicable solutions that address wildlife considerations, while recognizing that site conditions, technical constraints, and project objectives may limit implementation of recommendations. The guidelines are structured around six stages:

1. Relationship building
2. Preliminary area evaluation
3. Site characterization and design
4. Construction
5. Operations
6. Decommissioning

The stages are intended to broadly reflect a common sequence of activities solar project proponents normally undertake. These six stages were adopted from the Communications Framework for Solar Energy Project Proponents and SFWAs (included as Appendix D). At each stage, information is collected in increasing detail as needed to support project planning and risk assessment, and the information collected will guide the project owner or operator on the next steps for the project or help determine whether sufficient data have been gathered to adequately assess risk. The information will also contribute to project design and construction measures to reduce the potential for adverse effects to species of interest and their habitats identified during the process. The timing and duration of the stages will vary by project and are influenced by many factors, including landowner access limitations, iterative design changes, parallel permitting and interconnection processes, practical timelines for surveys, and state or local permitting requirements.

Throughout these guidelines, a summary of each stage is provided along with typical approaches to gather information, communication elements and suggested triggers, key considerations to assess at the stage, and an overview of how to use the information collected. As project proponents implement these guidelines, they are encouraged to document the approach and findings from each stage, as well as SFWA communications throughout the process. If a project is acquired during the development process, the purchaser is encouraged to make reasonable efforts to review the existing documentation and implement the remaining steps of these guidelines.

These guidelines are intended to apply to utility-scale, ground-mounted solar PV projects located within the United States. A project footprint includes the PV solar panels and their related facilities, such as substations, generation tie lines (commonly known as gen-tie lines), battery energy storage systems, access roads, and other infrastructure; see Appendix B for more information on the elements of a solar facility. Although this document was developed with discussions around utility-scale, ground-mounted PV solar energy projects, these guidelines and the incorporated tools can be utilized for any solar project types, regardless of size, especially when wildlife-related impacts may be expected.

Photo courtesy of EDP Renewables North America

The term "species of interest" (described further in Appendix C) refers to species that may not have the federal or state protection status but are recognized by SFWAs as important due to their conservation, ecological, or cultural significance. It encompasses several species groups with conservation status designations and may also include species recognized due to their value as game species, recreational significance, or economic role. SFWAs may identify additional species of interest because of limited or incomplete data on population status, distribution, or conservation needs. Further, species of interest may include those species where there is a potential for impact on a local or population-wide scale from solar energy project development and operations. Each state's identification of species of interest will be different, and early and frequent coordination with an SFWA is key to identifying and assessing the potential impacts on these species. The communication elements discussed throughout these guidelines outline the process and expectations to accomplish appropriate communication between SFWAs and project proponents. Specific discussions with SFWAs may vary based on the specific species designations outlined in Appendix C. These guidelines recognize that while actions for unregulated species are voluntary, meaning that a project owner or operator may or may not choose to implement them, collaboration with SFWAs can help identify and promote measures that support broader conservation goals.

Finally, these guidelines discuss opportunities to avoid and minimize impacts to species of interest and do not specifically address compensatory mitigation. Recognizing that mitigation requirements and discussion differ greatly among states and will be part of the communication between project proponents and SFWAs where applicable, this national-level guideline instead discusses voluntary conservation opportunities. These voluntary conservation opportunities are an important part of the engagement between project proponents and SFWAs and can lead to meaningful conservation outcomes.

Spotlight: Species of Interest

- Species of interest are recognized by SFWAs as important for considerations due to their conservation, ecological, or cultural significance and are identified through existing state processes and guidance; these species are limited to those reasonably relevant to potential project impacts.
- "Species of interest" is not a catchall term, nor does it assign or imply regulatory status (beyond that afforded to certain species that are federally or state listed).
- These guidelines and the Communications Framework intend that project proponents and SFWAs work in good faith to identify the species of interest that are relevant to each project based on best available science and SFWA guidance and discuss potential considerations for these species.
- Good faith conversations about species of interest include discussion of the practicability of considerations or SFWA recommendations for these species and are intended to support project-specific decision-making.
- These conversations may begin during the relationship-building stage and are a key component of the preliminary area evaluation; discussions should occur and ideally be resolved early in the project planning process to reduce uncertainty.
- Refer to Appendix C for a full description of species of interest.

Photo courtesy of EDP Renewables North America

COMMUNICATION

Establishing open lines of communication with SFWAs is an important component of the development process. Fish and wildlife authorities have expertise about local and regional wildlife and their habitats and can contribute to assessing potential sites. AFWA, ACP, and EWAC jointly developed and published the Communications Framework for Solar Energy Project Proponents and SFWAs in 2024.[6] The Communications Framework was developed collaboratively by AFWA, ACP, and EWAC members actively listening to each other's perspectives and concerns, engaging in candid discussions about communication challenges, and seeking to create a mutually beneficial and voluntary framework. SFWAs and project proponents recognize that a cornerstone of mutually beneficial communication is the reliance on best available science and/or local biological knowledge to inform suggestions, questions, recommendations, and decisions. The authors of these guidelines recognize that communication between project proponents and SFWAs is crucial to responsible site assessment; therefore, the Communications Framework is directly integrated into these guidelines through the inclusion of "Communication Elements" and "Communication Milestone Triggers."

- **Communication Elements** describe the objectives and expectations for how each party will communicate.
- **Communication Milestone Triggers** identify key moments when communication can occur. These are recommended discussion points, and parties may agree to add or adjust them based on their specific needs.

Photo courtesy of Lightsource BP

The previously published Communications Framework can be found in Appendix D.

Integrating the Communications Framework strengthens the goal of both documents: to establish national expectations for industry practices while providing the flexibility necessary for their application to be informed by site-specific conditions. Project proponents are encouraged to provide feedback to the SFWA regarding the implementation of recommendations; open communication can help inform discussions about which equivalent conservation measures could be more feasible for implementation than others. Notably, communication with the SFWA will provide additional information for consideration during all stages of these guidelines and is key to a thorough assessment. A review of available resources can help make communication more effective by guiding the timing and focus of communication between the SFWA and project proponents. However, some resources identified in the Preliminary Area Evaluation section may not always be available without SFWA communication, or the resources may not be as current as data directly available from the SFWA.

Although these guidelines (and the Communications Framework) focus on communication between SFWAs and project proponents, it is vital that all parties also communicate internally within their own teams. This internal alignment is key to avoiding misunderstandings and increasing efficiency and consistency across stages of solar project development through operations. Further, it is important to consider relevant communication with other stakeholders. When federally protected species may be involved, parties are encouraged to invite the US Fish & Wildlife Service (USFWS) (and/or other agencies, as appropriate) to participate in communications, maintain transparency, and avoid duplication of effort, consistent with confidentiality limitations of the parties.

Focal Wildlife Considerations for Solar Projects

For the heterogeneity of wildlife species and their associated habitats in the United States, there are many conservation considerations, concerns, and priorities for each SFWA. For project proponents, the breadth of ecological and wildlife considerations may be daunting, particularly when in concert with the myriad of other factors that determine the viability of an individual project. However, incorporating wildlife and habitat considerations early (and revisiting them throughout all stages of project development through operations) is critical to avoiding and minimizing unintended impacts, reducing project schedule delays and costs, building long-term project resilience, and protecting ecosystem health. It can also lead to streamlined permitting processes and foster stronger community support for a project. Through iterative discussions and consideration of conservation and wildlife concerns, SFWAs and project proponents can demonstrate how conservation and clean energy goals are inherently connected – solar energy reduces greenhouse gas emissions, helps slow global temperature rise, and ultimately supports the long-term health of ecosystems and biodiversity. These national guidelines do not attempt to define and interpret every wildlife consideration; those detailed discussions will occur during communication between the project proponent and the SFWA. However, four key ecological topics consistently emerge as nationally relevant to solar development through operations: habitat connectivity, fencing, vegetation management, and seasonality.

This section outlines the reason each of these key wildlife considerations matter on a national scale and provides a foundation for integrating them throughout these guidelines. By considering wildlife from the start, solar projects can achieve energy production goals and compatibility with conservation.

The following wildlife considerations represent common, nationally relevant points of discussion between SFWAs and project proponents; however, they may not be discussed in every instance. Given the unique nature of solar project development through operations and variety of environments that facilities will be constructed and operated in, wildlife considerations will differ from site to site, and therefore, the SFWA recommendations will vary accordingly. As a result, recommendations on approaches to minimizing wildlife impacts will be dependent on the specific details of the project design and location and in consideration of all other project constraints. SFWAs and project proponents should strive to communicate early and often to best address wildlife concerns while taking into consideration project siting, design, operations, and other project constraints.

Photo courtesy of EDP Renewables North America

HABITAT CONNECTIVITY

Habitat connectivity refers to the degree that wildlife can move across the landscape to access critical resources such as food, shelter, and breeding grounds. For many species, especially wide-ranging mammals, reptiles, and migratory birds, movement between habitat patches is essential for long-term survival.

Why it matters. Lack of habitat connectivity can lead to genetic isolation, reduced access to habitats, and increased wildlife–vehicle conflicts as animals seek alternate paths across developed areas. Solar infrastructure, access roads, and associated development may unintentionally disrupt wildlife movement by fragmenting otherwise connected landscapes.

National-scale relevance. Many state and federal agencies, and conservation organizations working in partnership with agencies, have identified ecological corridors that support game and nongame species alike. Ecological corridors function by reducing or eliminating movement barriers that would otherwise fragment habitats, and their effectiveness varies across different environmental contexts, spatial scales, and species requirements. From pronghorn and mule deer in the West to gopher tortoises and amphibians in the East, preserving connectivity across landscapes is a unifying priority across the United States. Project proponents can often access these data through SFWA websites or other online platforms – for example, US Geological Survey (USGS) migration Mapper[7] or state mappers such as Oregon's.[8] Efforts to identify ecological corridors are ongoing in many states; therefore, a lack of data should not be interpreted as an absence of a corridor. Early coordination with SFWAs can help identify potential concerns related to wildlife movement at a project site and includes discussion about known ecological corridors.

Thoughtful site alignments and layouts may be adjusted to leave corridors open, cluster infrastructure away from key migration paths, and co-locate fencing and other barriers in ways that minimize disruption of wildlife movement. Even in highly modified landscapes, connectivity-sensitive designs can preserve movement opportunities.

Photo courtesy of J.D. Willson – University of Arkansas

FENCING

Fencing design and placement can influence how wildlife interacts with the landscape, either by preserving movement or creating new barriers. All utility-scale solar facilities require fencing to comply with the North American Electric Reliability Corporation (NERC) critical infrastructure protection standards[9] and the *National Electrical Code* (NEC).[10]

Why it matters. Traditional security fencing can block access to food, water, and shelter; fragment habitats; increase stress or injury risks for wildlife; or unintentionally push wildlife onto roads or rights-of-way increasing the risk of wildlife–vehicle conflicts. With thoughtful, wildlife compatible design, fencing can protect the safety of wildlife and humans alike.

National-scale relevance. Across the country, agencies are increasingly recognizing the importance of wildlife-compatible fencing that balances safety, operational requirement, and ecological function. While in some settings this means allowing wildlife permeability (e.g., raised bottom wires, escape openings for desert tortoises, and smooth top wires for ungulates), in other cases exclusionary fencing may be necessary to prevent access to hazardous areas or to protect wildlife and equipment. The appropriate design varies by region, species, and site context. Project proponents are encouraged to consult with the SFWAs early in the planning process to identify relevant design protocols and integrate them into project plans.

VEGETATION MANAGEMENT

Native vegetation provides the foundation of local ecosystems, supports biodiversity, maintains soil structure, and contributes to ecological services. Clearing or grading a site in preparation for development, particularly in previously undisturbed areas, can remove native vegetation and alter soil composition and/or hydraulic conductivity. This, in turn, can affect wildlife species and habitats.

Solar development can provide a unique opportunity, in contrast to other development, to revegetate previously degraded habitat using native, regionally adapted, or appropriate naturalized species to improve the ecological function of the site. A site-specific vegetation and soil management plan that maintains or enhances native vegetation can lead to significant project and ecological benefits. These plans need to take into account state and local erosion and sedimentation control requirements, which may favor species that quickly establish at a site. Planting native species may require additional considerations, including that native vegetation may not establish quickly enough to meet state and local erosion and sedimentation control requirements or land use permit conditions, or may not be drought-resistant (see Table 1 for additional considerations).

Why it matters. Vegetation type and structure affect a site's ability to provide ecosystem services such as stormwater filtration, soil stability, and habitat provisioning. Regionally appropriate seed mixes that exclude invasive species provide effective erosion control and often require less maintenance once established. Revegetating disturbed areas with native species can provide habitat benefits, support pollinators, and allow for reduced mowing and other vegetation maintenance efforts. Where necessary to meet operational or regulatory requirements, regionally appropriate, noninvasive, naturalized species may be used in combination with native species to establish resilient vegetation communities that achieve stabilization objectives while providing ecological benefits. Further, a comprehensive topsoil management plan that prioritizes avoidance of unnecessary topsoil removal and promotes topsoil salvage will minimize long-term impacts to soil health and hydraulic conductivity.

National-scale relevance. Across the nation, SFWAs recognize the importance of native vegetation as a regional management tool. Implementing vegetation management plans at solar facilities can increase the ecological benefit of solar sites and help maintain surrounding vegetation communities and habitat important for species of interest. Because vegetation management plans should be site specific and implemented throughout the six stages of these electrical generation facilities, discussions about vegetation should occur early in the planning process. Early coordination may also allow SFWAs to provide local seed mix or other site-specific management recommendations.

Photo courtesy of J.D. Willson – University of Arkansas

SEASONALITY

Wildlife behaviors and life-history requirements vary throughout the year. Aligning project construction timelines with local seasonal patterns can reduce impacts and avoid conflicts with species of interest during critical periods such as migration, mating, and nesting.

Why it matters. Construction activities during nesting, breeding, or migration windows can impact species of interest. Seasonality also influences the detectability of species during surveys, making it an important consideration for effective data collection.

National-scale relevance. SFWAs often maintain seasonal timing windows to guide activity near species of interest or habitats. While not always regulatory, these timing windows are based on research and local biological knowledge. During project planning, project proponents may consider how timing of surveys, vegetation clearing, and site construction around seasonal wildlife activity patterns may help minimize potential impacts to wildlife while supporting construction goals.

BENEFICIAL EFFECTS OF SOLAR PROJECT DEVELOPMENT

The potential adverse effects of solar project development through operations should be weighed with the potential positive effects, which may be directly or indirectly related to wildlife. Positive effects of utility-scale solar projects include the intrinsic benefits of reduced carbon dioxide and other greenhouse gas emissions, reduced energy sector air pollution, and reduced energy sector water pollution. At many projects (whether these are available will depend on site specifics), positive effects may also include reduced long-term soil and water runoff, land conservation from other commercial uses, water conservation and improved water quality, soil restoration and carbon sequestration, and habitat for various species of wildlife. At certain projects (feasibility varies based on site and project details), additional measures may be taken to provide additive positive effects, including planting of native and naturalized vegetation, establishment of pollinator habitat, and dual-use development that may entail beehives, sheep grazing, or other activities co-located with the project. Although not prudent for all projects, in many cases decompaction and revegetation help prevent erosion and manage stormwater and may provide foraging and shelter opportunities for some species.

NATIONAL SFWA PRIORITIES AND ASSOCIATED PROJECT PLANNING CONSTRAINTS

This section outlines a set of SFWA priorities, along with associated project planning constraints for utility-scale, ground-mounted PV solar energy projects. These SFWA priorities reflect conservation strategies broadly shared across SFWAs and are intended to serve as a starting point for proactive dialogue between project proponents and SFWAs.

It is also important to communicate project factors that may affect how these items or other beneficial practices may be implemented. The project planning constraints highlight practical factors such as logistical, operational, and economic elements that project proponents often navigate during solar project development through operations. These constraints are included to provide context and enhance collaborative, good faith discussions between project proponents and SFWAs. Project proponents should be prepared to bring these constraints or any other project considerations to discussions with SFWAs so that both parties can openly discuss feasible outcomes.

These practices are not binding, prescriptive, or intended as regulatory thresholds. Rather, they serve as a shared starting point for informed conversations and joint problem-solving between SFWAs and project proponents and provide a foundation for collaborative discussions about how best to balance wildlife conservation with solar energy development goals. Early coordination with the appropriate SFWA(s) remains essential. Importantly, site-specific factors, state guidance, and permitting frameworks may suggest alternative or refined approaches. State-specific beneficial practices are available on SFWA websites[5] and in the AFWA Solar Beneficial Management Practice Database.[11]

Table 1: National SFWA Priorities and Associated Project Planning Constraints to Guide SFWA and Project Proponent Discussions

Category	SFWA Priorities	Associated Project Planning Constraints
Habitat connectivity	**Consider:** ▪ Avoiding and minimizing impacts to known ecological corridors. ▪ Using design elements such as clustered infrastructure or unfenced gaps to support species movement through or around facility. ▪ Using available tools such as state corridor maps or national platforms for siting decisions.	**Consider:** ▪ Land availability, parcel layout, and landowner agreements. ▪ Tradeoffs between minimizing gen-tie length or limited flexibility on gen-tie route and ability to avoid ecological corridors. ▪ Variability in the recency and precision of wildlife data informing ecological corridors.
Fencing	**Consider:** ▪ Using fencing that accommodates species-specific needs for either exclusion or permeability. ▪ Limiting fencing to the greatest extent possible to minimize facility footprint. ▪ Designing fencing that avoids entrapment and injury and/or includes escape routes for wildlife (e.g., amphibians, reptiles, small mammals, and ungulates).	**Consider:** ▪ Compliance with federal, state, and local regulatory requirements. ▪ Project cost implications and viability. ▪ County requests to use list of county-approved contractors and vendors. ▪ Balance between multiple species of interest. ▪ Tradeoffs between minimizing project footprint and dispersed arrays to support species movement.

5 A comprehensive list of SFWA resources can be found in the AFWA State Fish and Wildlife Agency Energy Resources Catalogue.[12]

Table 1: National SFWA Priorities and Associated Project Planning Constraints to Guide SFWA and Project Proponent Discussions (continued)

Category	SFWA Priorities	Associated Project Planning Constraints
Vegetation management	**Consider:** ▪ Avoiding and minimizing impacts to existing native vegetation. ▪ Creating vegetation management plans that are compatible with local ecosystems and their functions. ▪ Using regionally appropriate seed mixes that exclude invasive species and support appropriate wildlife habitat goals (e.g., native pollinators and ground-nesting birds). These mixes should enhance biodiversity, require minimal maintenance, and align with project site soil and moisture conditions, processes, and functions. ▪ Implementing an invasive species management plan that includes site monitoring, early detection, and sanitation of equipment and vehicles arriving to and leaving from a site to prevent the introduction and spread of invasive species.	**Consider:** ▪ Required operations and maintenance vegetation management scheduling. ▪ Landowner agreements or restrictions. ▪ Balancing mowing requirements to manage impacts on panel shading and site safety (i.e., fire risk) with seasonal wildlife considerations. ▪ Cost, availability, local requirements, and functionality (i.e., grazing, ground cover, etc.) associated with seed mixes. ▪ Vegetation management planning to comply with Stormwater Management Plans and minimize site erosion, and to satisfy insurance requirements and ensure safe and reliable operations of the facility. ▪ The need for a stabilized working surface for construction activities.
Seasonality	**Consider:** ▪ Avoiding commencing ground disturbance (e.g., mowing, land clearing, grading, and site access) and seasonal habitat impacts during species of interest sensitive life-history stages (e.g., local breeding, migration, nesting, and hibernation), in consultation with the SFWA. ▪ Using species data (e.g., habitat maps, occurrences, and life-history information) to identify periods of avoidance and minimization of disturbance, especially near aquatic habitats or sensitive breeding areas, in consultation with the SFWA. ▪ Where avoidance is not feasible or timing constraints limit avoidance, monitoring should be considered to evaluate effects, identify conservation opportunities, and inform measures to minimize impacts during construction.	**Consider:** ▪ Construction schedules driven by permits, site conditions, equipment and contractor logistics, or other requirements that may unavoidably overlap species of interest sensitive life-history stages. ▪ Mowing schedules necessary to comply with safety and insurance requirements, including for wildlife risk management. ▪ Mowing schedules necessary to ensure solar panel performance due to potential vegetation shading issues. ▪ Other scheduled maintenance required for safe and reliable power production. ▪ Complex ecological tradeoffs created by multiple species with overlapping timing needs options or permit requirements to use clearance surveys or biological monitors.

Relationship Building

Common to all stages of project development through operations is a constructive relationship with SFWAs. Therefore, relationship building, the first stage and a key theme of the Communications Framework, is focused on establishing and maintaining relationships between SFWAs and project proponents. Relationship building should be an ongoing and continual process that occurs from the time a project proponent considers development in a state and continues throughout the prospecting, siting, development, construction, operations, and decommissioning of the solar project. The extent of relationship building may vary depending on existing relationships, local knowledge, and experience in a given state, but early and iterative communication is key.

While the Communications Framework sets the foundation for effective communication, it is important to recognize that each project will be unique in that interactions between the project proponent and the SFWA will vary in cadence and duration and are established during relationship building. The cadence of communication should be discussed to balance both parties being informed without feeling overburdened with changes that require follow-up. SFWAs and project proponents may elect to communicate on a regular time interval, upon major project milestones, if extended periods of time have passed or if the project is delayed. Additionally, some repeat conversations between project proponents and SFWAs on parts of these guidelines may be warranted; for example, while SFWAs may not need to see all iterations of a site design, if an external circumstance warrants a modification to the site design that changes impacts to species of interest or their habitats, SFWAs may wish to have a check-in on the changes. Similarly, project proponents are encouraged to discuss future plans for the area (e.g., additional phases of the project) with SFWAs when known. Both parties share a responsibility to proactively communicate and remain responsive to each other.

Importantly, while this section focuses on the relationship building, the expectations and triggers outlined are intended to guide communication throughout the entire relationship between the project proponent and the SFWA. They are intended to be used in addition to the communication items listed under each of the other stages. One key trigger with application across all stages is a change in the project ownership, which should prompt SFWA communication to be revisited regardless of the current stage.

Suggested Communication Milestone Triggers

- Initiation of interest in assessing solar project development in a state
- Communication begins with relationship building and becomes an ongoing effort. It is recommended to incorporate communication elements from relationship building in all stages.
- Project ownership change

Communication Elements

- It is recommended that project proponents contact the SFWA for an introductory discussion to provide affiliation, contact information, and nature of the potential development activity. It is further recommended that SFWAs provide accurate renewable energy contact information and that project proponents and SFWAs communicate any changes in points of contact within their respective organizations to maintain lines of communication.
- In establishing a line of communication, project proponents and SFWAs are encouraged to exchange respective expectations for how often to check in with each other (e.g., based on project milestones or a time frame) and the preferred method of communications (e.g., verbal, meeting notes, email exchange, official correspondence, etc.). Project status updates, including information about delays or lack of meaningful activity, will be welcomed by SFWAs.
- To develop a viable project and address conservation concerns, it is important for the SFWA and project proponents to communicate while the siting and design may still be flexible. In addition, the SFWA and project proponents are encouraged to maintain communication as new data or information relevant to the project's design becomes available. It is important for the SFWA to share new data and science with the project proponent to facilitate educated development decisions.
- Project proponents and SFWAs are encouraged to discuss confidentiality concerns relating to data and information sharing between parties. Communicating the sensitivity or proprietary nature of the project proponent or SFWA's data and information will establish distribution parameters between the parties.

- Project proponents are encouraged to invite both SFWAs and local USFWS contacts (if federally protected species or their habitat may be impacted) to participate in communications to maintain transparency and avoid duplicating efforts. A project proponent is encouraged to utilize any publicly available tools as early coordination resources to identify whether federally protected species may be present and to inform a decision on any communication needs with USFWS.
- Be generous with assumptions; respect the words, intentions, and actions of each party.
- Be respectful of time frames and capacity. Parties are encouraged to respond to each other's inquiries in a timely manner by acknowledging inquiry receipt and, for inquiries that necessitate time to compile a response, to provide an estimated time to respond fully.
- SFWAs and project proponents should discuss any species of interest based on state-specific priorities, which may include more than legally protected species. All parties should recognize that there may not be a regulatory obligation regarding these species and that some recommended actions are voluntary for the project owner or operator.

Solar Project Development Through Operations

PRELIMINARY AREA EVALUATION

Preliminary area evaluation refers to the "big box" evaluation stage when project proponents assess potential development locations over broad geographic areas to generate a general ecological context of a potential area of interest (AOI). Initial desktop screening commences during the AOI development or once an AOI is identified. This screening provides an early view of the potential wildlife sensitivity and effects of developing the solar project in an AOI and identifying any additional site assessment work necessary to further evaluate and address potential effects. The screening may also discover regulatory limitations on development (i.e., federal, state, or local siting rules, such as setbacks from residences, roadways or other community features, federally designated critical habitat, etc.). Overall, the objective for the preliminary area evaluation is to ascertain whether species of interest and/or their habitat may be present and, if so, determine what additional due diligence may be necessary if a project owner or operator elects to continue to evaluate the AOI.

Approach

For preliminary area evaluations, project proponents may use publicly available geospatial data sources such as landscape-level maps, databases, and publications from sources such as federal, state, or tribal wildlife or natural heritage programs, or information collected by the project proponent through communication with the SFWAs.[6]

Suggested Communication Milestone Triggers

- Requests for wildlife and habitat information and data
- Significant changes in AOI or project area after preliminary site evaluation studies are complete

Communication Elements

- The SFWA has publicly available tools, data, and information to assist project proponents with preliminary site evaluations. Project proponents and SFWAs can discuss the availability of additional (including nonpublic) or more current information and data and request additional information, as applicable.
- SFWAs are encouraged to provide information about SFWA websites related to coordination and renewable energy to AFWA to facilitate an inventory of website resources that may assist project proponents during preliminary area evaluations.
- Project proponents may review prospective development areas or assess other information or priorities from prior discussions with the SFWA. To the extent information is not confidential, SFWAs will provide the project proponents with any specific regional wildlife and/or species of interest considerations.
- Project proponents will share preliminary information on project plans (i.e., area under consideration, planned schedule, potential megawatt capacity, and siting constraints) that impact design flexibility (i.e., wetlands, setbacks, or other state and local requirements, etc.).

6 Some examples of these publicly available resources include USFWS National Wetlands Inventory and various state-managed databases. Additionally, the Renewable Energy Wildlife Institute and AFWA have compilations of additional resources on their websites, including state-by-state resources.

Key Considerations During Preliminary Area Evaluations

The following includes, but is not limited to, a list of key items to consider during this preliminary area evaluation stage:

- The location of legally protected areas, where development is precluded by law, relative to the AOI
- Landscape context (i.e., current land use surrounding the AOI)
- AOI overlap with documented current range of species of interest
- Presence of potential habitat (including federally designated critical habitat) or vegetation types, wetlands, or riparian areas that may be suitable for species of interest within the AOI
- Opportunities to maintain intact habitat connectivity via ecological corridors that may overlap the AOI based on publicly available spatial datasets or coordination with SFWAs
- Federal or state permitting that includes relevant wildlife-related analyses that may be triggered by site development and/or operations of utility-scale solar energy generation within the AOI

This preliminary area evaluation assesses the above key considerations to inform siting decisions and preliminary design. The preliminary area evaluation also identifies the scope and intensity of additional site assessment work, if any, to be conducted during the site characterization and design stage that may further inform site design and determine the need for avoidance and minimization measures or permitting. If the preliminary area evaluation indicates that a project is located on disturbed lands, project owners or operators should document this determination and coordinate with the appropriate SFWA to confirm whether any additional wildlife assessment is recommended before proceeding with development. In many cases, these sites may be appropriate for a streamlined process, depending on state-specific guidance and site conditions.

Photo courtesy of Ben Stratton – University of Arkansas

SITE CHARACTERIZATION AND DESIGN

The site characterization and design stage includes further analysis into desktop information, initial site visits, and the progression of facility design from a fluid state through to final design. During this stage, identification of additional field work or studies, if any, may occur and be implemented. This stage may also include federal, state, or local permitting.

Following desktop due diligence, a site reconnaissance is generally conducted to field verify the desktop information. This step can help confirm whether the potential species of interest and/or their habitats identified in the previous preliminary area evaluation stage have the potential to be present within the AOI and whether species-specific surveys should occur. If species of interest and/or their habitats are present, this step informs on how potential adverse effects can be best avoided or minimized through site design or addressed through mitigation, whether required by permit or undertaken voluntarily. The site characterization and design stage equips a project proponent with information to assess whether to pursue wildlife-related permits based on survey results and the feasibility of site design adjustments to avoid and minimize potential effects.

This site characterization and design stage is typically the first stage to include site visits. However, site visits can be completed only when site access is available from the landowner(s), and access limitations may drive timing of surveys.

A preliminary site design is typically developed during this stage. Preliminary designs in this step are often highly subject to change based on the outcome of considerations identified in this or other processes, including both wildlife and non-wildlife permitting processes, as well as through other development factors such as equipment changes, construction schedule, final land control, etc. A preliminary site design typically accounts for information and constraints identified during the preliminary area evaluation stage and this site characterization and design stage and allows a project owner or operator to identify whether the project's requirements can be met while avoiding and minimizing effects. Changes to site design, regardless of their origin, may warrant a follow-up with the SFWA, specifically if the impact to species of interest or their habitat has changed (including if the impact has decreased).

Approach

This stage can include a more detailed desktop evaluation and may include an on-site field habitat assessment conducted by a qualified biologist using common methods and available suitable technologies for the task.[7] A habitat assessment can establish the presence and quality of potential suitable habitat for species of interest to inform preliminary project design, and consideration of species-specific surveys. Thus, conducting habitat assessments in areas where development is most likely to occur may suffice for project planning, and there is not a need for habitat assessments to cover the entire AOI. When there is a need to cover larger areas, remote technology such as drones, LiDAR, or other imaging technology could be utilized. Absent publicly available guidance, project proponents are encouraged to discuss field study designs related to species of interest with SFWAs prior to data collection.

Species-Specific Surveys and Planning

Project proponents may determine during either of the prior stages that additional surveys would inform site design or permitting decisions for species of interest. Survey methods should be science based and follow existing protocols or survey guidelines if possible. Depending on the availability of public guidance from and the communication preferences of the SFWA, coordination with the SFWA may be necessary to determine the appropriate sampling methods, timing of activities that reduce impacts to species of interest (e.g., breeding, nesting, migration, etc.), and detectability of species. The project proponent may use the results of the focused surveys to inform the need for wildlife clearance surveys in the construction stage, a decision on whether to seek a permit, and the final site design and beneficial practices to implement.

Suggested Communication Milestone Triggers

- Change in project area or schedule
- Completion of habitat and wildlife-related site characterization studies
- Modifications or updates to SFWA data, maps, or other planning-related information
- Survey methodology development
- Interim or final results of field surveys
- Project design changes with wildlife or habitat implications
- State and local permitting recommendations

Communication Elements

- Project proponents and SFWAs may want to review information discussed during the preliminary area evaluation stage to determine whether the project proponent has access to the most comprehensive and current resources needed to develop a viable project that also evaluates and considers conservation concerns. Either party may request or provide additional information, as applicable.
- When responding to requests for information, the SFWA will provide current fact- and/or science-based information, local biological knowledge, or data that support its cautions, concerns, or suggestions.
- Commensurate with the scale of development activity, it is recommended that project proponents update SFWAs of changes in project(s) status as a result of on-site evaluations or other knowledge gained relevant to SFWAs' purview or as previously agreed upon.
- Project proponents and SFWAs are encouraged to discuss SFWA beneficial practices or feedback and to collaborate on the planning, design, and/or survey efforts of a project, recognizing that there may be equivalent conservation measures and understanding that other land uses and constraints impact project planning (e.g., state and local siting requirements, NEC and NERC reliability and safety requirements, etc.).
- Prior to submission, project proponents and SFWAs are encouraged to discuss SFWA recommendations that may be submitted to a formal federal, state, and/or local permitting process, where required or relevant.
- If a decision to conduct field surveys is made, project proponents or their biological consultants are encouraged to review field survey approaches and methodologies with SFWAs prior to data collection, including when to conduct the survey, for which species of interest and their habitat(s), and for how long surveys are valid. When federally protected species are involved and a decision is made to conduct field surveys, communication about survey approaches with USFWS is also encouraged.
- SFWAs and project proponents are encouraged to structure site surveys based on best available science, federal or SFWA published guidance (if available), and/or generally accepted practices. Should a generally accepted practice be referenced, it is encouraged to be shared with the SFWA.

7 Habitat assessment information may be collected at the same time as or as part of other field assessments, such as wetland delineations.

- As project development proceeds, it is recommended that a project proponent notify the SFWA of material changes to project design that may have potential wildlife or habitat implications. Communication triggers, which can be temporal or milestone based, should be mutually agreed upon early in the development effort (see the relationship building and preliminary area evaluation stages).
- Survey results and SFWA responses to those results will be shared in the manner mutually agreed upon.

Key Considerations During Site Characterization and Design

The following includes, but is not limited to, a list of key items to consider during this site characterization and design stage:

- The confirmed presence of, or suitable habitat for, species of interest that could be adversely affected by solar energy development
- The confirmed presence of riparian areas, wetlands, or waters present within the site that could be habitat for species of interest and affected by solar energy development
- Whether focused surveys (sometimes referred to as field studies) are necessary to inform avoidance and minimization measures for species of interest, as well as the decision on whether or how to proceed with the construction stage
- Consideration of state and/or federal permits given on-site verification of resources present
- Opportunities to maintain habitat connectivity and wildlife movement, particularly where the project area intersects known ecological corridors, including the use of strategic fencing design as practicable or placement options afforded by site engineering, land control, or other constraints (see the National SFWA Priorities and Associated Project Planning Constraints section)
- Opportunities to minimize impacts to native vegetation or revegetate disturbed areas with native and/or site appropriate vegetation, excluding invasive species, to support soil health and species of interest, while aligning with project maintenance goals

This evaluation helps identify the next steps for the site, if any, regarding wildlife resources. If the information gathered is inconclusive or indicates that adverse effects are likely, the project proponent should consider whether additional surveys would provide meaningful data for the site (see the Species-Specific Surveys and Planning section). The project proponent may also consider coordinating with SFWAs and/or federal agencies to seek additional information depending on the resource(s) of potential concern. If the information gathered indicates a low probability of adverse effects, the project owner or operator may elect to proceed to the construction stage. During this stage, project proponent should determine whether the information gathered (considered together with the site design and any planned avoidance and minimization measures) indicates a need for state and/or federal permits and, if so, engage with the relevant permitting agency.

Photo courtesy of LightSource BP

CONSTRUCTION (FINAL SITE DESIGN, PREPARATION FOR CONSTRUCTION, AND WILDLIFE CLEARANCE SURVEYS, IF NECESSARY)

The construction stage includes preparation for construction, typically when the design is near final and activities move to execution of the design. In addition, this stage includes ground disturbance activities (e.g., clearing and grading), installation of the piles, solar arrays, inverters and ancillary facilities (including gen-tie), and the initiation of reclamation activities of temporary disturbances to restore drainage and vegetation.

At this stage, the information gathered during prior stages informs:

- Final site design
- Identification of any on-site wildlife clearance surveys needed prior to certain construction activities and development of policies and procedures if certain species of interest and related habitat are found, such as for nests and/or burrows (including procedures for obtaining disturbance, relocation, or other permits, if the need for such a permit is identified during clearing surveys)
- Identification of any seasonal considerations for certain activities, if necessary, depending on the specific species of interest and their habitat that may be present

At this construction stage, a project proponent will also finalize beneficial practices that may be utilized to further avoid and minimize adverse effects.

Where required by permit, this construction stage also includes finalization of potential compensatory mitigation measures.

Approach

Site design software and accepted engineering methods are used in generating site design layouts. To the extent practical, detailed advanced designs should include the footprint within which all relevant facilities, including but not limited to external access roads, gen-tie lines, substations, and battery energy storage systems, would be located.

If the preliminary site design is reassessed due to non-wildlife commercial and development factors, project proponents should consider maintaining a similar level of avoidance and minimization of adverse effects on species of interest and their habitats to the extent practicable, if not precluded by the non-wildlife factors necessitating the change in site design.

As discussed in the Relationship Building section, project proponents and SFWAs should agree upon the cadence and timing of meetings and communication early in the process; this decision is made on a case-by-case basis depending on the project and may include project milestones. The construction stage includes particularly important project milestones that SFWAs and project proponents may identify as communication triggers, such as notice to proceed given to construction contractors, or commencement of construction activities.

Suggested Communication Milestone Triggers

- Project milestones
- Changes in project schedule
- Unanticipated presence of or unexpected impact to species
- Final design changes
- Survey initiation and milestones

Communication Elements

- Project proponents will notify the SFWA once reaching agreed upon project milestones.
- If final design changes are made that could impact species of interest or their habitat differently than what was discussed with the SFWA during an earlier stage, project proponent will reach out to the SFWA in the manner previously agreed upon.
- If preconstruction surveys are warranted as discussed with the SFWA during the site characterization and design stage, the project proponent and SFWA will discuss and review the survey timing, any related permits or conditions, data and results, and next steps based on the results, if necessary.
- If there is an unanticipated presence of species of interest for the project or an unexpected impact to species of interest or their habitat during any phase of construction, the project proponent will communicate with the SFWA about how to proceed.

Key Considerations During Construction

The following includes, but is not limited to, a list of key items to consider during this construction stage:

- Avoidance and minimization of adverse effects to species of interest and their habitat through revisions to the preliminary site design based on the results of any focused surveys (if necessary) and communication with relevant agencies, while also considering other factors that influence site design
- The presence of species of interest or their habitat for which on-site surveys are recommended immediately prior to certain construction activities and seasonal timing of construction activity to avoid or minimize adverse effects to species of interest
- Beneficial practices that are relevant for the specific site, required by a permit, and/or are workable for project economics, including but not limited to native vegetation management and wildlife compatible fencing

The project owner or operator may determine, based on this evaluation, that no additional planning or revisions are necessary and proceed with construction. Conversely, the project owner or operator may, through this evaluation, identify additional revisions to the site design compatible with engineering, permitting (where relevant), and/or commercial constraints that would further avoid and minimize adverse effects to species of interest or their habitats. During this evaluation, the project owner or operator may also identify the need to develop policies and procedures for implementing any planned avoidance and minimization measures, train appropriate staff on the measures, and incorporate the measures into relevant contractual documents. Actions taken during this stage under a permit should be communicated with the relevant authority, as required.

Photo courtesy of Lightsource BP

OPERATIONS

The operations stage refers to when the site is energized, is producing and delivering power, and the construction team has departed the site and includes maintenance activities to ensure that the facility is in compliance with laws, permit requirements, and/or operator commitments. It may also include completion of reclamation activities, if warranted. This stage covers the long-term and flexible lifespan of a facility. Recognizing that numerous conditions (e.g., regulatory environment, species presence, facility repowering, etc.) may change over the life of a facility, the inclusion of this stage in these guidelines is not intended to be comprehensive. Instead, this stage underscores the importance of ongoing communication between the SFWA and facility operator during operations and identifies key considerations relevant to wildlife responsible management and potential adaptive management over the facility's lifespan.

Suggested Communication Milestone Triggers

- Ongoing effort
- Unanticipated presence of or unexpected impact to species
- Plans to repower or significantly change a facility

Communication Elements

- The SFWA and operator will continue to communicate as mutually agreed upon (e.g., additional research or surveys).
- If there is an unanticipated presence of species of interest for the project or an unexpected beneficial or negative impact to species of interest or their habitat during facility operations, it is recommended that the operator communicate the event with the SFWA and discuss how to proceed.
- If an operator is planning to repower a facility with upgraded technology or related changes that could impact species of interest and/or associated habitats, it is recommended that the operator communicate with the SFWA regarding the plans.

Key Considerations During Operations

The following includes, but is not limited to, a list of key items to consider during this operations stage:

- Operations and maintenance activities to manage potential impacts to previously identified species of interest and/or their habitats
- Management of wildlife species that cause damage or safety concerns
- Previously agreed upon operational surveys or discussed monitoring efforts (e.g., invasive species, wildlife corridors, etc.)
- Situations that may warrant adaptive management actions (e.g., vegetation management outcomes prompting an adjustment in protocols, a new federal or state listing of a species of interest that has been documented at the facility, proposed repower, etc.)
- Supporting native or regionally appropriate vegetation, excluding invasive species, that align with project maintenance goals
- Scheduling maintenance activities to accommodate wildlife seasonality patterns, as needed

DECOMMISSIONING

At the end of a facility's operational life, operators plan the removal of equipment and the transition of the land to its post-power land use. Similar to the operations stage, because the timing of this activity is flexible and subject to change but generally anticipated to be a long-term future activity, numerous conditions (e.g., regulatory environment, species presence, facility repowering, etc.) may change before the operator decides to decommission a facility. Decommissioning plans are driven by a facility's leases or other landowner agreements and must abide by their unique terms. Based on decommissioning's site-specific nature, these guidelines do not include key considerations for this stage. Instead, as a project approaches facility decommissioning, the operator should communicate with the SFWA about species of interest and their habitats that may, based on best available information, be present at that time and considerations that are relevant to the project's specific decommissioning plan. Parties recognize that this information may not be available until much closer to the date of decommissioning.

Photo courtesy of EDP Renewables North America

Incorporating Avoidance, Minimization, and Voluntary Conservation Opportunities

As project proponents work through the communication and assessment processes outlined in these guidelines, and as discussed in several key considerations, there may be opportunities to discuss:

- Prioritizing avoidance of species of interest and their habitat through strategic site selection, facility layout, and design features
- Emphasizing minimization of unavoidable impacts through implementation of wildlife-compatible design features, seasonal timing restrictions, and other protective measures
- Exploring conservation opportunities where impacts cannot be avoided or minimized, allowing SFWAs and project proponents to discuss additional voluntary conservation measures that could provide broader ecological benefits

While these voluntary conservation opportunity discussions are supplemental to the structured process established in these guidelines, many project proponents already implement the above conservation opportunities in their development process. The authors of these guidelines encourage this approach as it supports solar project development through operations alongside meaningful conservation outcomes.

SFWAs have the statutory responsibility of managing wildlife and habitat within their jurisdiction, which requires a landscape-scale approach (see Appendix C). Understanding and accounting for the cumulative effects of all development on the landscape is essential as SFWAs work toward establishing and maintaining long-term conservation outcomes. This is why SFWAs may consider cumulative effects during discussions with project proponents. If cumulative effects are a concern, SFWAs may prioritize voluntary conservation opportunities that help alleviate landscape-level pressures.

DISCUSSING VOLUNTARY CONSERVATION OPPORTUNITIES

When the project proponent and SFWA identify situations where impacts to wildlife or habitat cannot be avoided or minimized, both parties may agree to discuss types of conservation opportunities that are either project specific or more broad reaching. To facilitate these discussions, project proponents and SFWAs may review the following questions and examples to start a conversation around what conservation opportunities could look like. However, it is important to acknowledge that such additional measures are not regulatory obligations and may not be feasible for project proponents to implement. This limitation should be openly addressed during discussions.

Voluntary Conservation Case Study

The following case study is provided as an example of communication between a project proponent and the SFWA leading to voluntary conservation. A project proponent, in coordination with the project landowner, began coordinating with the Arizona Game and Fish Department (SFWA) during the early planning stages of a solar project to identify design features that would minimize the project's potential impacts to wildlife movement. The Arizona Game and Fish Department's telemetry data indicated that the project area served as a movement pathway for mule deer and pronghorn. Using these data, the facility was designed to include wildlife corridors ranging from several hundred feet wide to half a mile wide with the intent that their effectiveness would be evaluated through a research project. The Arizona Game and Fish Department is currently coordinating with both the project proponent and the landowner to assess the movement of mule deer and pronghorn before, during, and after the construction of the solar facility.

- Are there opportunities specific to this project that may address local ecological concerns?
  - *Examples of potential conservation outcomes include research studies that address activity of a species of interest within project bounds and implementation of a vegetation management plan that encourages or incorporates native species revegetation and habitat.*
- When looking across a project proponent's portfolio or at broad state initiatives, are there landscape-scale conservation opportunities that may benefit ecological corridors, habitat connectivity, and state-identified conservation needs (e.g., local pollinator programs)?
  - *Examples of potential conservation outcomes include establishing conservation easements or land trusts on property owned by project proponents or local partners (e.g., local development authorities) and incorporating State Wildlife Action Plan initiatives in site design, such as wildlife crossings or pollinator habitat.*
- Are there opportunities to collect additional data to be shared with SFWAs that contribute to filling knowledge gaps and supporting broader conservation goals?
  - *Examples of potential conservation outcomes include data-sharing agreements for wildlife surveys at or near a project site and monitoring of relocated populations or altered habitats.*
- Are there opportunities for research partnerships that advance understanding of solar–wildlife interactions?
  - *Examples of potential conservation outcomes include collaborative research that addresses topics such as species occupancy and biodiversity pre- and post-construction, wildlife movement, native vegetation restoration, or wildlife fatality risk, at solar facilities.*

Some Considerations for Voluntary Data Sharing

- Until the project is built, project-specific information and data may be considered intellectual property.
- Landowner agreements may have confidentiality or data-sharing conditions that either prohibit sharing or require landowner permission. SFWAs may have the ability to legally shield collected data from the public, which may satisfy these conditions.
- To share data, the project proponents and the SFWA may consider signing a data-sharing agreement.

DATA SHARING AS A CONSERVATION OPPORTUNITY

Coordination between SFWAs and project proponents throughout the life of a project provides opportunities to collaborate on filling data gaps or collect other useful information that will help with SFWA's broader conservation goals. This collaboration may occur directly between the SFWA and project proponents or through data contributions to publicly available resources.[8] SFWAs recognize that there may be concerns with data confidentiality, proprietary information, and so on and that different project proponents may not be able to share more detailed data. In some states, SFWA databases are isolated from state-level Open Records Act or similar programs, which may help resolve confidentiality concerns.

Conclusion

The *National Utility-Scale Solar Wildlife Guidelines* are intended to support science-based decision-making for PV solar energy development. By emphasizing early engagement, transparent communication, and thoughtful application of scientific and technical expertise, the guidelines provide a framework for constructive collaboration between solar developers and SFWAs. Although voluntary in nature and not intended to replace existing regulatory requirements, the approaches outlined in this document are designed to help identify practical solutions that address potential adverse impacts to wildlife and their habitats while highlighting opportunities for positive conservation outcomes.

The application of these guidelines should be understood as an iterative process. As experience is gained through their use, scientific understanding evolves, and solar technologies continue to advance, the practices described in this document may be refined and improved. Flexibility and good faith communication of lessons learned will be essential to ensuring that these guidelines remain effective and relevant over time. Through sustained engagement and a shared commitment to balanced outcomes, the energy and wildlife communities can work together to advance both a clean energy future and the long-term conservation of the nation's wildlife resources.

8 For example, the Renewable Energy Wildlife Institute's Solar Wildlife & Ecosystem Database. The Solar Wildlife & Ecosystem Database was created through a US Department of Energy funding program to be a community resource of solar-biodiversity data enabling its users to find and share data collected at solar facilities. More information and the database access are available at https://rewi.org/about-us/our-work/solar-database.

References

[1] S&P Global Commodity Insights. 2025. "US National Power Demand Study." S&P Global. https://cleanpower.org/resources/us-national-power-demand-study.

[2] Lazard. 2023. *Levelized Cost of Energy+ (LCOE+)*. Lazard. https://www.lazard.com/media/2ozoovyg/lazards-lcoeplus-april-2023.pdf.

[3] American Clean Power Association. 2022. Clean Power Annual Market Report 2022. American Clean Power Association. https://cleanpower.org/resources/clean-power-annual-market-report-2022.

[4] National Renewable Energy Laboratory. 2021. "Life Cycle Greenhouse Gas Emissions from Electricity Generation: Update." National Renewable Energy Laboratory, US Department of Energy. https://www.nrel.gov/docs/fy21osti/80580.pdf.

[5] US Department of Energy. 2021. "Solar Futures Study." US Department of Energy. https://www.energy.gov/cmei/systems/solar-futures-study-multimedia.

[6] Association of Fish & Wildlife Agencies, American Clean Power Association, and Energy and Wildlife Action Coalition. 2024. "Communications Framework for Solar Energy Project Proponents and State Fish and Wildlife Agencies." Association of Fish & Wildlife Agencies, American Clean Power Association, and Energy and Wildlife Action Coalition. https://cleanpower.org/resources/afwa-acp-communication-framework-for-solar-energy.

[7] US Geological Survey. 2026. "Western Migrations." US Geological Survey, US Department of the Interior. https://apps.usgs.gov/western-migrations/.

[8] Oregon Conservation Strategy. n.d. "Priority Wildlife Connectivity Areas (PWCAs)." Oregon Department of Fish and Wildlife. https://www.oregonconservationstrategy.org/success-story/priority-wildlife-connectivity-areas-pwcas.

[9] North American Electric Reliability Corporation. 2026. "Reliability Standards." North American Electric Reliability Corporation. https://www.nerc.com/standards/reliability-standards.

[10] NFPA 70. *National Electrical Code* (NEC). National Fire Protection Association. https://www.nfpa.org/codes-and-standards/nfpa-70-standard-development/70.

[11] Association of Fish & Wildlife Agencies. n.d. "Solar Beneficial Management Practice Database." Association of Fish & Wildlife Agencies. https://www.fishwildlife.org/solar-beneficial-management-practice-database#home.

[12] Association of Fish & Wildlife Agencies. n.d. "State Fish and Wildlife Agency Resources Catalogue." Association of Fish & Wildlife Agencies. https://docs.google.com/spreadsheets/d/1ezMPIHQdb6LIAhE7Vw_6y95sgU9FzJNQfFDBZ91-WoY/edit?gid=0#gid=0.

Appendix A. Definitions

Area of interest (AOI) – The area that a project proponent has identified as potentially suitable for a solar project and in which the physical footprint of the project may be located.

Critical habitat – For listed species under the Endangered Species Act (ESA), it consists of the specific areas designated by rule pursuant to 16 *United States Code* (USC) § 1532. The term "critical habitat" for a threatened or endangered species means (i) the specific areas within the geographic area occupied by the species, at the time it is listed (under the ESA), on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection, and (ii) specific areas outside the geographic area occupied by the species at the time it is listed upon a determination by the Secretary that such areas are essential for the conservation of the species.

Disturbed lands – Lands already converted from their natural state, such as agriculture lands, industrial sites, and brownfield sites designated pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act at 42 USC § 9601(39)(A)–(B).

Ecological corridor – A specific geographic area that facilitates the ability of plants and wildlife to move among larger habitat patches.[1] Efforts to identify ecological corridors are ongoing in many states; therefore, a lack of data should not be interpreted as an absence of a corridor. Early coordination with state fish and wildlife agencies can help identify known ecological corridors.

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

Intact landscape – Undisturbed or relatively undisturbed areas characterized by maintenance of most original ecological processes and by communities with most of their original native species still present.

Legally protected area – Includes the following lands where the development of solar is not allowed, although in some circumstances, transmission, roads, and related facilities may be allowed in some of these areas. This is intended to include legally protected areas at the time the project is initiated. The identified areas may change over time through statutory or regulatory changes, with additional lands excluded from, or made available for, development:

- Wilderness areas as defined and designated pursuant to 16 USC § 1131 – § 1136.
- National parks as defined and designated pursuant to 16 USC § 123 and § 124.
- Wildlife refuges as defined and designated pursuant to 16 USC § 668dd.
- Federal lands withdrawn from development under the Antiquities Act as defined and designated pursuant to 54 USC § 320301 – § 320303.
- Wild river areas under the Wild and Scenic Rivers Act as defined pursuant to 16 USC § 1271 – § 1287.
- Lands closed to renewable energy development through statute or regulation by federal, state, or tribal jurisdictions.

Riparian areas – As defined pursuant to 36 *Code of Federal Regulations* (CFR) § 219.19.

Terrestrial migration corridor – Terrestrial migration routes and/or corridors are the known and relatively predictable pathways that species travel between seasonal ranges, usually breeding and nonbreeding grounds.

Waters of the United States (WOTUS) – 33 CFR § 328.3.]

Wetlands – As defined by WOTUS (33 CFR § 328.3) or applicable state definition.

[1] Gregory A., Spence E., Beier P., Garding E. 2021. "Toward Best Management Practices for Ecological Corridors." *Land* 10 (2): 140. https://doi.org/10.3390/land10020140.

Appendix B. Solar Photovoltaic Energy Development Background

In general, while there are a variety of factors that influence site selection for utility-scale photovoltaic (PV) solar development, the primary factor is where there is either (i) transmission access with sufficient capacity to add power generation that can be economically delivered to an electricity market or (ii) an industrial load that requires a large amount of renewable electricity that does not need to be tied to the grid. The primacy of transmission access is driven by the fact that the cost to connect to the grid from further away makes such sites uneconomic to build due to vigorous competition in the electrical power industry that is lowering prices generators receive.

As such, locations suitable for development generally occur only around existing transmission facilities or near-term planned transmission lines and substations with sufficient transmission injection capacity,[1] or near industrial loads. Considerations – such as landowner willingness to lease necessary acreage, local zoning and community support, presence of historic or Native American cultural resources, presence of other infrastructure (e.g., easements, roads, and rights-of-way), solar resource, terrain (e.g., steep slopes), geological features (e.g., bedrock outcrops), geotechnical conditions, site hydrology, local and state ordinances, taxes, land prices, political boundaries, and effects to wildlife and habitat, among others – further limit the availability of suitable sites.

The utility-scale PV solar development process may take anywhere from 2 to 10 years. Development through operations typically includes the following project stages, each of which is explained in the body of these guidelines:

1. Preliminary area evaluation
2. Site characterization and design
3. Construction
4. Operations
5. Decommissioning

During these stages, there are many development activities going on in parallel to wildlife-related assessments and permitting activities. For example, companies are identifying and negotiating with potential customers to purchase the power, talking to landowners and negotiating agreements, engaging in community outreach, developing a project budget, creating a schedule and economic profile, and filing for grid interconnection studies, among others.

The development process is often guided by federal, state, and local permitting processes, some of which consider potential effects to wildlife and wildlife habitat. For example, projects with a federal nexus (i.e., projects sited on federal lands or projects requiring permits, approval, or funding from a federal agency) are subject to review under the National Environmental Policy Act (NEPA). The NEPA process requires a comprehensive evaluation of a project's potential impacts on a range of environmental resources before development can proceed. Projects with a federal nexus that may affect federally listed species will also trigger consultation with the US Fish & Wildlife Service under Section 7 of the Endangered Species Act. The consultation process assesses whether species or their critical habitats are likely to be adversely affected by a project and, if so, typically results in recommended measures to avoid, minimize, and mitigate direct, indirect, and cumulative effects to wildlife and their habitats.[2]

Many states also have permitting processes for utility-scale PV solar siting and development that require evaluation of potential effects to wildlife and wildlife habitat. For example, states may require approval of utility-scale solar facilities by a Public Utility Commission or Corporation Commission during which consultation with all relevant agencies is conducted. Finally, in some cases, local authorities maintain their own environmental permitting or development standards that include wildlife and habitat effect analysis or measures.

1 The transmission injection capacity at a given point on the electrical system defines how much power can be injected at that point without triggering transmission upgrades. Project proponents may elect to pay for transmission upgrades to secure room on the grid for their proposed project, but the cost of doing so must be economically feasible for the project.

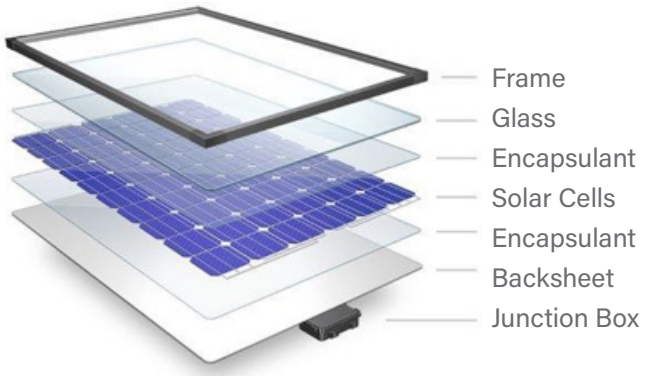
2 See, for example, *50 Code of Federal Regulations Part 402*.[1]

Elements of a Utility-Scale Solar PV Facility

SOLAR PANELS, ARRAYS, AND RACKING SYSTEMS

Solar panels consist of glass, aluminum, copper, and semiconductor materials. Solar cells are made of either connected silicon atoms or thin layers of PV material that have been placed onto glass or metal and convert energy from sunlight into electricity. The thin layer of solar cells is sealed on both sides and covered with glass and an aluminum frame. There are different types of solar modules, such as bifacial panels able to generate from both sides of the panel and fixed tilt (which remain stationary) versus tracking (which pivot as the sun moves across the sky), which may influence vegetation management strategies among other project decisions.

Strings of PV panels, known as an array when combined, are strung together on aboveground mounting systems (also known as racking systems) and connected via low-voltage wiring. Racking systems are secured to the ground via steel piles (e.g., cylindrical pipes, H-beams, helical screws, or similar structures), which would be driven into the soil. More than 90% of new utility-scale projects are equipped with trackers that follow the path of the sun over the course of the day.[2] Trackers can help address stormwater management issues by allowing the panels to tilt and minimize rainwater concentration.



INVERTERS

Wires move the direct current generated by the panels to central inverter stations, which change the direct current to alternating current. Low-voltage collector lines then aggregate the alternating current.

SUBSTATION AND GENERATION INTERCONNECTION TIE LINES

A project substation yard includes one or multiple transformers, depending on the size of the solar PV facility, which would transform or "step up" the voltage from 34.5kV to 500 kV or whatever voltage of the line or substation to which the project is interconnecting. Substations are constructed based on applicable electrical safety codes. The substation area is graded and compacted to an approximately level grade. Each substation would include fencing. Substation equipment is placed on concrete pads or equivalent engineered substrate per engineering specifications. The remaining areas within the substation fence will be covered in aggregate, road base, or other appropriate materials to minimize dust and disturbance.

Generation interconnection tie lines (commonly known as gen-tie lines) are higher-voltage electrical wires and associated equipment that deliver the electricity from the generator to the electrical grid. Gen-tie lines begin at the project substation and typically are strung overhead to an offsite substation or switchyard that will connect the project to the bulk power system for distribution to local grids. The design of gen-tie lines is limited by electrical code requirements to ensure operational safety and security.

BATTERY ENERGY STORAGE SYSTEMS

Many utility-scale PV solar projects include a battery energy storage system (also referred to as BESS) to supplement the solar electricity generated by the solar panels. Such systems are typically housed in electrical enclosures and are designed and operated in compliance with electrical codes and other safety codes.[3]

ROADS

Project-related roads within the solar facility will include the access road around portions of the development areas, and solar field internal access roads, using existing facilities, rights-of-way, roads, and other existing infrastructure, where practicable.

Most access roads will be constructed using only recompacted native materials. If required, the existing surface area of the access roads will be cleared and compacted using on-site materials and may be covered in aggregate, where needed (either due to high usage or necessary based on the need to facilitate drainage and minimize dust or erosion).

FENCING

Pursuant to the *National Electrical Code* (NEC)[10] and/or the *National Electrical Safety Code* (NESC)[11] (which code applies varies depending on the ownership, purpose, and location of the electrical equipment at issue), all utility-scale solar projects require external fencing to keep people safely away from energized equipment. Code adherence may be required for local permit approvals and may also impact the ability to secure financing and insurance for solar facilities.

For example, NEC Section 691.4 Special Requirements for Large-Scale PV Electric Supply Stations states, "Large-scale PV electric supply stations shall be accessible only to authorized personnel and comply with the following: (1) Electrical circuits and equipment shall be maintained and operated only by qualified persons. (2) Access to PV electric supply stations shall be restricted by fencing or other adequate means in accordance with 110.31."

Per NEC 110.31, "…a wall, screen, or fence shall be used to enclose an electrical installation to deter access by persons who are not qualified. A fence shall not be less than 2.1 m (7 ft) in height or a combination of 1.8 m (6 ft) or more of fence fabric and a 300 mm (1 ft) or more extension utilized three of more strands of barbed wire or equivalent."

Similarly, per NESC Section 11, Rule 110A, "metal fences, when used to enclose electricity supply stations having energized electrical conductors or requirement shall have a height not less than 2.13 m (7 ft) overall and shall be grounded in accordance with Section 9."

CONSTRUCTING A UTILITY-SCALE PV SOLAR FACILITY

Before starting construction, project owners or operators and their contractors will secure necessary local and/or state authorizations, develop plans as needed for erosion and sediment control, stormwater management, noise and dust abatement, vegetation management, etc.

In general, construction lasting 12 months or longer is typical, but construction duration depends on the size of the project, geography, site conditions and topography, weather, supply chain, etc.

Typical construction equipment includes backhoes, pile drivers, scrapers, bulldozers, dump trucks, watering trucks, forklifts, bucket or concrete trucks, compactors, and other common construction equipment.

Site preparation

All sites will require some degree of site preparation and earth moving activities to create a safe work environment, bury cabling, and compact soils for safe access roads.

Pile driving

Pile drivers are used to place steel posts into the ground that support the solar panel racking system. Piles go into the ground at a depth necessary (which can vary by site) to ensure the stability of the array during inclement weather and continued functioning of the tracker.

Racking, panels, and conduit

Panels are attached to the racking system. Wiring connecting panels to electrical equipment may be above ground or buried via a trench. Most construction activities are limited to less than 6 ft in depth; however, some excavations, such as those undertaken for the installation of collector poles and gen-tie dead-end structures, may reach depths of 40 ft or more.

POSTCONSTRUCTION RESTORATION

As a project nears completion, areas of temporary disturbance are generally decompacted and revegetated based on local site conditions to reestablish ground cover.

3 For more information on storage safety, see these ACP documents: "NFPA 855: Improving Energy Storage System Safety,"[3] "Claims vs. Facts: Energy Storage Leading on Safety,"[4] "Battery Energy Storage Safety: Frequently Asked Questions (FAQs),"[5] and "Energy Storage & Safety."[6]

References

[1] Office of the Federal Register. 2024. *Code of Federal Regulations: Title 50 – Wildlife and Fisheries, Chapter IV – Joint Regulations (United States Fish and Wildlife Service, Department of the Interior and National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Department of Commerce); Endangered Species Committee Regulations, Part 402 – Interagency Cooperation – Endangered Species Act of 1973, as Amended.* US National Archives and Records Administration.

[2] Bolinger M., Seel J., Mulvaney Kemp J., Warner C., Katta A., Robson D. 2023. *Utility-Scale Solar, 2023 Edition: Empirical Trends in Deployment, Technology, Cost, Performance, PPA Pricing, and Value in the United States.* Lawrence Berkeley National Laboratory. https://emp.lbl.gov/sites/default/files/emp-files/utility_scale_solar_2023_edition_slides.pdf.

[3] American Clean Power Association. 2025. "NFPA 855: Improving Energy Storage System Safety." American Clean Power Association. https://cleanpower.org/wp-content/uploads/gateway/2024/01/NFPA855_Safety_240111.pdf.

[4] American Clean Power Association. 2023. "Claims vs. Facts: Energy Storage Leading on Safety." American Clean Power Association. https://cleanpower.org/wp-content/uploads/gateway/2023/12/ACP_Energy-Storage-Leading-on-Safety_FactSheet.pdf.

[5] American Clean Power Association. 2023. "Battery Energy Storage Safety: Frequently Asked Questions (FAQs)." American Clean Power Association. https://cleanpower.org/wp-content/uploads/2023/07/ACP-ES-Product-4-BESS-Safety-FAQs-230724.pdf.

[6] American Clean Power Association. 2022. "Energy Storage & Safety." American Clean Power Association. https://cleanpower.org/resources/energy-storage-safety.

[7] NFPA 70. *National Electrical Code (NEC)*. National Fire Protection Association. https://www.nfpa.org/codes-and-standards/7/0/nfpa-70.

[8] IEEE Standards Association. 2023. *National Electrical Safety Code (NESC)*. IEEE Standards Association. https://standards.ieee.org/products-programs/nesc.

Appendix C. Species of Interest

The species designations and definitions discussed in this appendix are the most common species state fish and wildlife agencies (SFWAs) consider and are most relevant to solar energy project development through operations. Importantly, the term "species of interest" used throughout these *National Utility-Scale Solar Wildlife Guidelines* refers to a flexible category of species that may not have federal or state protection status but are recognized by SFWAs as important for considerations due to their conservation, ecological, or cultural significance. The term can include any of the below-defined species groups with conservation status designations and also may include species recognized due to their value as game species, recreational significance, or economic role. SFWAs may identify additional species of interest because of limited or incomplete data on population status, distribution, or conservation needs. Further, species of interest may include those species where there is a potential for impact on a local or population-wide scale from solar energy development and operations. Each state's identification of species of interest will be different, and early and frequent coordination with an SFWA is key to identifying and assessing the potential impacts on these species. The Communications Framework for Solar Energy Project Proponents and SFWAs (see Appendix D) outlines the process and expectations for early and frequent communication between SFWAs and the solar energy industry, including discussing any species of interest. Specific discussions with SFWAs may vary based on the species designations described below. These guidelines acknowledge that while actions for unregulated species are voluntary, meaning that a project owner or operator may or may not choose to implement them, collaboration with SFWAs can help identify and promote measures that support boarder conservation goals.

In summary, species of interest is a flexible category of species that may not have formal federal or state conservation status but are still considered valuable by SFWAs. Project proponents are encouraged to work with SFWAs to identify these species of interest and reduce adverse effects on these species and their habitats.

SFWA WILDLIFE MANAGEMENT RESPONSIBILITIES

In the United States, fish and wildlife are public trust resources managed by governmental agencies. Ownership of land does not convey ownership of wildlife.[1] Under the US federal system of government, the 50 US SFWAs and their counterparts in the US territories and the District of Columbia have the primary legal authority and management responsibility for much of the nation's fish and wildlife resources. Under the Tenth Amendment to the US Constitution, powers not specifically delegated by the Constitution to the federal government are reserved to the states or to the people, and this includes the responsibility for the management of most of the nation's fish and wildlife species, with certain well-defined exceptions for those species where Congress has created joint management authorities for certain species, such as under the federal Endangered Species Act (ESA) or the Migratory Bird Treaty Act. To administer these authorities, each state and territory and the District of Columbia have created an agency or department whose responsibility includes the management of the state or territory's fish and wildlife resources. Most SFWAs also have significant habitat management responsibilities, which often include managing certain state lands, such as wildlife management areas and parks, and administering partnership programs that conduct conservation activities on lands outside state ownership.[2] Further, the majority of these agencies were originally founded to conserve those species of fish and wildlife that are actively hunted, fished, trapped, or otherwise harvested – a mission that drives and shapes the actions of the agencies today.

The conservation and management of game species and their habitats are supported through excise taxes on hunting and fishing equipment collected under the authority of the federal Pittman–Robertson (1937) and Dingell–Johnson (1950) Acts.[3] Sales of hunting and fishing licenses to the general public also contribute significant financial support for state agencies' conservation efforts. Funding from these excise taxes and licenses is directed primarily, but not exclusively, to the conservation of game species and their habitats.[2]

STATE WILDLIFE ACTION PLANS

It has long been recognized that the traditional focus of SFWAs has been on the conservation of game species and that more attention and funding should be directed toward the conservation of nongame species. This need has been the impetus for the development of the State Wildlife Action Plans (SWAPs). SWAPs are developed in collaboration with federal, state, and private partners, including participation from the public, and lay out a vision for sustaining fish and wildlife for future generations.[4] The first iteration of SWAPs was drafted in 2005 and mandated by Congress to be revised every 10 years in order for states to be eligible for federal funding through the State and Tribal Wildlife Grants Program.[5] Each state and territorial SWAP identifies the Species of Greatest Conservation Need (SGCN; discussed below) in the state, describes the key habitats needed to conserve SGCN in the state, provides information on threats to SGCN and priority research and surveys needed to conserve SGCN, outlines the actions needed to conserve SGCN, and defines the provisions for monitoring SGCN and their habitats and measuring the effectiveness of conservation actions.[1] Refer to the US Geological Survey (USGS) database of SWAPs or the Association of Fish & Wildlife Agencies (AFWA) website to find all SWAPs.[4]

In the following sections, we provide additional context on SGCN, including definitions of species designations and/or categories commonly used by SFWAs. Ultimately, this information offers the background and context for these guidelines and the term used in these guidelines, "species of interest."

SPECIES DESIGNATIONS

Species of Greatest Conservation Need

SGCN are species that, through a combination of low and/or declining populations, vulnerability to threats (anthropogenic, disease, habitat loss, etc.), or data deficiency, require conservation action and attention.[6] SGCN can include terrestrial, freshwater, and marine birds, mammals, reptiles, amphibians, invertebrates, fishes, and plants and plant communities. SGCN are identified in SWAPs and are designated through rigorous selection criteria and ranked based on relative conservation need and/or status. The rank determinations vary by state and can be based on a number of factors including, but not limited to, conservation need, conservation feasibility, and economic feasibility. Further, rankings are determined using a variety of methods or criteria including the NatureServe ranking system[7] or expert consensus processes such as the Delphi technique or the Millsap process.[8] Each SWAP describes its process for SGCN ranking. Refer to the USGS database of SWAPs or the AFWA website to find all SWAPs.

The term "Species of Greatest Conservation Need" is not a statutory designation and therefore differs from terms "endangered" or "threatened," which are codified by federal and state ESAs. Some SGCN have official protection status (e.g., threatened or endangered), whereas others may be in decline but are not currently listed as part of either the federal or state endangered species programs. Some of the species on the list may be relatively common, including some game species, but nonetheless require attention and continued conservation action. It is the SFWA's goal to keep common species common.[9]

Game Species

Game species are designated as such by a relevant authority and are species that are hunted, fished, or trapped. They generally have historical importance as a sustainable food source and can range from large species, such as elk, to small bird species, such as pheasants. To be classified as legal game, the animals must (i) be useful, primarily for food; (ii) be abundant with population levels that can be sustained; and (iii) offer a unique or traditional challenge for hunters.[10] Due to the historical significance of game species and the traditional funding model of state SFWA, which is primarily supported by revenue from the Pittman–Robertson and Dingell–Johnson Acts, much of the available data and agency focus is centered on game species.

Nongame Species

Nongame species include any indigenous species that are neither hunted, trapped, nor fished, including aquatic and terrestrial invertebrates and plants.

State Threatened or Endangered

State ESAs can reflect more specific, regional concerns and can address many of the gaps that exist because of the limitations of federal protections. Species may be listed as state threatened or endangered and not federally listed under the ESA.[11]

Federally Threatened or Endangered

The ESA defines an endangered species as "any species which is in danger of extinction throughout all or a significant portion of its range." Endangered species are automatically protected by prohibitions of several types of "take," including harming, harassing, collecting, or killing, under Section 9 of the ESA. The ESA defines threatened species as "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." Threatened species receive protections through separate regulations issued under Section 4(d) of the ESA. These regulations occur separately from the listing and detail what take prohibitions are in effect. Also called 4(d) rules, they can include the same prohibitions under Section 9.[12]

Invasive Species

Invasive species are species that are (i) nonnative (or alien) to the ecosystem under consideration and (ii) whose introduction causes or is likely to cause economic or environmental harm or harm to human health.[13]

Tracked Species

Tracked species are species that an SFWA biologist is interested in tracking due to concern of some kind. Tracked species often rely on local biological knowledge and can be referred to in a number of ways depending on the state. "Tracked species" is our catchall term. Herein, we define local biological knowledge as knowledge and practices of the local SFWA biologists regarding ecological relationships that are gained through extensive personal empirical observations of and interactions with local ecosystems and shared among local resource users.[14]

References

[1] Association of Fish & Wildlife Agencies. 2015. "Association of Fish and Wildlife Agencies Core Concepts." Association of Fish & Wildlife Agencies. https://www.fishwildlife.org/application/files/2015/1373/0546/Comprehensive_Conservation_Core-Concepts.pdf.

[2] Association of Fish & Wildlife Agencies. 2017. *State Fish and Wildlife Agency Approaches to Landscape-Scale Conservation. Association of Fish & Wildlife Agencies*. https://www.fishwildlife.org/application/files/9815/1855/4798/State_F_and_W_Agency_Perspectives.pdf.

[3] Association of Fish & Wildlife Agencies. n.d. "The American System of Conservation Funding." Association of Fish & Wildlife Agencies. https://www.fishwildlife.org/afwa-informs/resources/american-system-conservation-funding.

[4] US Geological Survey. 2022. "Climate-Informed State Wildlife Action Plans." US Geological Survey. https://www.usgs.gov/programs/climate-adaptation-science-centers/science/climate-informed-state-wildlife-action-plans#overview.

[5] US Fish & Wildlife Service. n.d. "State Wildlife Grants." US Fish & Wildlife Service. https://www.fws.gov/program/state-wildlife-grants.

[6] US Geological Survey. 2025. "Species of Greatest Conservation Need (SGCN) National Database Dashboard." US Geological Survey. https://www.usgs.gov/tools/species-greatest-conservation-need-sgcn-national-database-dashboard.

[7] NatureServe. n.d. "Statuses: Conservation Status Categories." NatureServe. https://www.natureserve.org/nsexplorer/about-the-data/statuses/conservation-status-categories.

[8] Department of Energy and Environment. 2015. *District of Columbia Wildlife Action Plan: Chapter 2 – Species of Greatest Conservation Need.* Department of Energy and Environment. https://doee.dc.gov/sites/default/files/dc/sites/ddoe/service_content/attachments/03%202015%20WildlifeActionPlan%20%20Ch2%20SGCN.pdf.

[9] Vermont Fish & Wildlife Department. 2015. *Vermont's Wildlife Action Plan 2015: Chapter 5 – Species of Greatest Conservation Need.* Vermont Fish & Wildlife Department. https://vtfishandwildlife.com/sites/fishandwildlife/files/documents/About%20Us/Budget%20and%20Planning/WAP2015/5.-SGCN-Lists-Taxa-Summaries-%282015%29.pdf.

[10] Hunter-Ed. n.d. "Wildlife Categories." Kalkomey Enterprises. https://www.hunter-ed.com/national/studyGuide/Wildlife-Categories/201099_93182.

[11] National Caucus of Environmental Legislators. 2020. "State Protections for Endangered Species." NCEL Blog, September 30. https://www.ncelenviro.org/articles/state-protections-for-endangered-species.

[12] US Fish & Wildlife Service. n.d. "Endangered Species Act." US Fish & Wildlife Service. https://www.fws.gov/law/endangered-species-act.

[13] National Invasive Species Information Center. n.d. "What Are Invasive Species?" US Department of Agriculture. https://www.invasivespeciesinfo.gov/what-are-invasive-species.

[14] Charnley S., Fischer A.P., Jones E.T. 2007. "Integrating Traditional and Local Ecological Knowledge into Forest Biodiversity Conservation in the Pacific Northwest." *For Ecol Manag* 246 (1): 14–28. https://doi.org/10.1016/j.foreco.2007.03.047.

Appendix D. Communications Framework for Solar Energy Project Proponents and State Fish and Wildlife Agencies

Included in the following pages

COMMUNICATION FRAMEWORK

FOR SOLAR ENERGY PROJECT PROPONENTS AND STATE FISH AND WILDLIFE AGENCIES

The Association of Fish and Wildlife Agencies (AFWA), American Clean Power Association (ACP), and the Energy and Wildlife Action Coalition (EWAC) recognize the practical value and mutual interest of opening and maintaining lines of communication between large-scale, ground-mounted photovoltaic (PV) solar energy project proponents (i.e., developers, owners, operators, or other project representatives such as biological consultants) and state fish and wildlife agencies. AFWA represents the collective perspectives of state fish and wildlife agencies (SFWAs) in all 50 states. These agencies exercise primary statutory authority for management of fish and wildlife as public trust resources within their borders, unless specifically preempted by a federal statute, and provide critical scientific expertise and technical guidance on the effects of energy development on species and their habitats. ACP and EWAC collectively represent companies who develop, permit, construct, own, and operate the vast majority of the large-scale, ground-mounted PV solar energy in the United States. Communication between project proponents and SFWAs during PV solar energy siting and development, construction, operations, and decommissioning is a crucial step towards evaluating and addressing the potential impacts to species that are of interest (which includes those based on state-specific priorities, and which may include more than legally protected species) and their associated habitats. Although this document was developed with discussions around these large-scale, ground-mounted PV solar energy projects, the framework provided in this document can be utilized for other solar projects, regardless of size, especially when direct or indirect wildlife-related impacts may be present.

In 2023, ACP and AFWA collaboratively developed and published the Communications Framework for Wind Energy Project Proponents and SFWAs, which is specific to wind energy. Although many communication components are shared between the Wind Energy Communications Framework and this Solar Communications Framework, there are key differences in the technology, siting and development process, and wildlife and habitat impacts associated with large-scale, ground-mounted PV solar development and operations that result in variations between the two documents. The stages of development – relationship building, preliminary area assessment, site characterization and design, construction, operations, and decommissioning – are different than those in the Wind Communications Framework because that document was based on the tiers defined in the U.S. Fish and Wildlife Service's Land-based Wind Energy Guidelines (2012). The stages of development in this Solar Communications Framework are intended to broadly reflect a common sequence of activities project proponents normally undertake and are defined below.

The framework was developed collaboratively by AFWA, ACP, and EWAC members who actively listened to each other's perspectives and concerns, engaged in candid discussions about communication challenges, and sought to create a mutually beneficial and voluntary framework. Importantly, this framework does not prescribe a set of rigid steps or instructions. There is substantial variation at the state and/or regional level among SFWAs, project proponents, and wildlife and habitat concerns and, as such, the framework is intentionally flexible and relevant to all large-scale, ground mounted PV solar projects. This framework is nationally focused and establishes a set of communication objectives and milestones that are flexible enough to address state and/or project-specific concerns. It serves as a guide for early and iterative communication in good faith between project proponents (or their representatives) and SFWAs that establishes expectations for the frequency of engagement and the suggested communication triggers. SFWAs and project proponents recognize that a cornerstone of mutually beneficial communication is the reliance on best available science and/or local biological knowledge to inform suggestions, questions, recommendations, and decisions. These open communications can also help inform discussions about equivalent conservation measures that could be more feasible for a project to implement and/or research opportunities the parties may elect to collaboratively pursue.

CONTACT US
info@fishwildlife.org

PRODUCT OF THE AFWA ENERGY AND WILDLIFE POLICY COMMITTEE – SOLAR WILDLIFE WORKING GROUP IN PARTNERSHIP WITH AMERICAN CLEAN POWER ASSOCIATION AND ENERGY AND WILDLIFE ACTION COALITION

COMMUNICATIONS FRAMEWORK FOR SOLAR ENERGY PROJECT PROPONENTS AND STATE FISH AND WILDLIFE AGENCIES

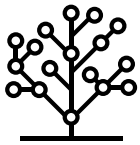
Although this framework focuses on communications between SFWA and project proponents, it is vital that all parties also communicate internally within their own teams. This internal alignment is key to avoiding misunderstandings and increasing efficiency and consistency across stages of development and construction of the facility. Further, it is important to consider relevant communication with other stakeholders. When federally protected species may be involved, parties are encouraged to invite the U.S. Fish and Wildlife Service (and/or other agencies, as appropriate) to participate in communications as well to maintain transparency and avoid duplication of effort, consistent with confidentiality limitations of the parties.

AFWA, ACP, and EWAC recognize that maintaining effective communication can be difficult due to various factors, both within and beyond the control of project proponent and SFWA representatives. Every project is unique, and the communications between project proponents and SFWA will vary in duration and cadence; therefore, both parties share a responsibility to proactively communicate and remain responsive to each other. It is crucial to understand that this framework is a tool for facilitating better communication and building collaborative relationships while allowing flexibility in adoption and implementation by all parties involved.

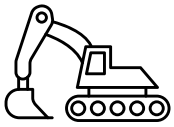
STAGE DEFINITIONS

Relationship Building – This stage is focused on establishing and maintaining relationships between state fish and wildlife agencies and solar project proponents. This should be an ongoing and continual process that occurs from the time a project proponent considers development in a state and throughout the prospecting, siting, development, construction, operations, and decommissioning of the solar project. The extent of this stage may vary depending on existing relationships, local knowledge, and experience in a given state, but early and iterative communication is key.

Preliminary Area Evaluation – This stage refers to 'big box' evaluation stage when project proponents are prospecting and taking a first look at a broad geographic scale for a preliminary evaluation of the general ecological context of a potential area of interest.



Site Characterization and Design – This stage includes further analysis into desktop information, initial site visits, and deciding what the project proponent might need to do further on site. This stage begins when site design is still fluid and continues through final design. During this stage, identification of additional field work or studies, if any, may occur and be implemented. This stage may also include federal, state, or local permitting.



Construction – This stage includes preparation for construction, typically when the design is near final and activities move to execution of the design. In addition, this stage includes ground disturbance activities (e.g. clearing and grading), installation of the piles, solar arrays, inverters and ancillary facilities (including the generation tie-line), and the initiation of reclamation activities of temporary disturbances to restore drainage and vegetation.

Operations – This stage refers to when the site is energized and producing and delivering power and includes maintenance activities to ensure the facility is in compliance with laws, permit requirements, and/or operator commitments. It may also include completion of reclamation activities, if warranted.

Facility Decommissioning – This stage occurs when the facility reaches the end of its operational life and the operator plans to remove equipment and transition the land to its post-power land use.

CONTACT US
info@fishwildlife.org

PRODUCT OF THE AFWA ENERGY AND WILDLIFE POLICY COMMITTEE – SOLAR WILDLIFE WORKING GROUP IN PARTNERSHIP WITH AMERICAN CLEAN POWER ASSOCIATION AND ENERGY AND WILDLIFE ACTION COALITION

COMMUNICATIONS FRAMEWORK FOR SOLAR ENERGY PROJECT PROPONENTS AND STATE FISH AND WILDLIFE AGENCIES

Stage	Communication Framework Elements	Communication Milestone Triggers
Relationship Building	• It is recommended that project proponents contact the SFWA for an introductory discussion to provide affiliation, contact info, and nature of the potential development activity. It is further recommended that SFWAs provide accurate renewable energy contact information and for project proponents and SFWAs to communicate any changes in points of contact within their respective organizations to maintain lines of communication. • In establishing a line of communication, project proponents and SFWAs are encouraged to exchange respective expectations for how often to check in with each other (e.g., based on project milestones or a timeframe) and the preferred method of communications (e.g., verbal, meeting notes, email exchange, official correspondence, etc.). Project status updates, including information about delays or lack of meaningful activity, will be welcomed by SFWAs. • To develop a viable project and address conservation concerns, it is important for the SFWA and project proponent to communicate while the siting and design may still be flexible. In addition, the SWFA and project proponents are encouraged to maintain communication as new data or information relevant to the project's design becomes available. It is important for the SFWA to share new data and science with the project proponent to facilitate educated development decisions. • Project proponents and SFWAs are encouraged to discuss confidentiality concerns relating to data and information sharing between parties. Communicating the sensitivity or proprietary nature of the project proponent or SFWA's data and information will establish distribution parameters between the parties. • Project proponents are encouraged to invite both SFWAs and local U.S. Fish and Wildlife Service (USFWS) contacts (if federally protected species or their habitat may be impacted) to participate in communications to maintain transparency and to avoid duplicating efforts. A project proponent is encouraged to utilize the Information for Planning and Consultation (IPaC) tool as an early coordination resource to identify whether federally protected species may be present and to inform a decision on any communication needs with USFWS. • SFWAs and project proponents should discuss any species that are of interest based on state-specific priorities, which may include more than legally protected species. All parties should recognize there may not be a regulatory obligation regarding these species and that some recommended actions are voluntary for the project proponent/operator. • Be generous with assumptions; respect the words, intentions, and actions of each party. • Be respectful of timeframes and capacity. Parties are encouraged to respond to each other's inquiries in a timely manner by acknowledging inquiry receipt and, for inquiries that necessitate time to compile a response, an estimated time to respond fully.	On-going effort; it is recommended to incorporate these elements in all stages of communication and project development and construction; communication related to operations and decommissioning relevant in certain circumstances addressed below.
Preliminary Area Evaluation	• The SFWA has publicly available tools, data, and information to assist project proponents with preliminary site evaluations. Project proponents and SFWAs can discuss the availability of additional (including non-public) or more current information and data and request additional information, as applicable. • SFWAs are encouraged to provide information about SFWA websites related to coordination and renewable energy to AFWA to facilitate an inventory of website resources that may assist project proponents during preliminary area evaluations. • Project proponents may review prospective development areas or review other information or priorities from prior discussions with the SFWA. To the extent information is not privileged, SFWAs will provide the project proponent any specific regional wildlife and/or species that are of interest considerations. • Project proponents will share preliminary information on project plans (i.e., area under consideration, planned schedule, potential MWs, and siting constraints) that impact design flexibility (i.e., wetlands, setbacks, or other state/local requirements, etc.)	Requests for wildlife and habitat information and data; changes in project ownership; significant changes in project area after preliminary site evaluation studies are complete.

CONTACT US
info@fishwildlife.org

PRODUCT OF THE AFWA ENERGY AND WILDLIFE POLICY COMMITTEE – SOLAR WILDLIFE WORKING GROUP IN PARTNERSHIP WITH AMERICAN CLEAN POWER ASSOCIATION AND ENERGY AND WILDLIFE ACTION COALITION

COMMUNICATIONS FRAMEWORK FOR SOLAR ENERGY PROJECT PROPONENTS AND STATE FISH AND WILDLIFE AGENCIES

Stage	Communication Framework Elements	Communication Milestone Triggers
Site Characterization and Design	• Project proponents and SFWAs may want to review information discussed in Preliminary Area Evaluation stage to determine if the project proponent has access to the most comprehensive and current resources needed to develop a viable project that also evaluates and considers conservation concerns. Either party may request or provide additional information, as applicable. • When responding to requests for information, SFWA will provide current fact- and/or science-based information, local biological knowledge, or data that supports its cautions, concerns, or suggestions. • Commensurate with the scale of development activity, it is recommended that project proponents update SFWAs of changes in project(s) status as a result of on-site evaluations or other knowledge gained relevant to SFWA's purview or as previously agreed upon. • Project proponents and SFWAs are encouraged to discuss SFWA beneficial practices or feedback and to collaborate on the planning, design, and/or survey efforts of a project, recognizing there may be equivalent conservation measures and understanding that other land uses and constraints impact project planning (e.g. state/local siting requirements, FERC/NERC reliability and safety requirements, etc.). • Prior to submission, project proponents and SFWAs are encouraged to discuss SFWA recommendations that may be submitted to a formal federal, state, and/or local permitting process, where required or relevant. • If a decision to conduct field surveys is made, project proponents or their biological consultants are encouraged to review field survey approaches and methodologies with SFWAs prior to data collection, including when to conduct the survey, for which species that are of interest and their habitat(s), and for how long surveys are valid. When federally protected species are involved and a decision is made to conduct field surveys, communication about survey approaches with USFWS is also encouraged. • SFWAs and project proponents are encouraged to structure site surveys based on best available science, federal or SFWA published guidance (if available), and/or generally accepted practices. Should a generally accepted practice be referenced, it is encouraged to be shared with the SFWA. • As project development proceeds, it is recommended that a project proponent notify the SFWA of material changes to project design that may have potential wildlife or habitat implications. Communication triggers, which can be temporal- or milestone-based, should be mutually agreed upon early in the development effort (see Relationship Building and Preliminary Area Evaluation stages). • Survey results and SFWA responses to those results will be shared in the manners mutually agreed upon.	Change in project ownership, project area, project schedule; completion of habitat and wildlife-related site characterization studies; modifications or updates to SFWA's data, maps, or other planning related information; survey methodology development; interim or final results of field surveys; project design changes with wildlife or habitat implications; or state/local permitting recommendations.
Construction	• Project proponents will notify the SFWA upon reaching agreed upon project milestones. • If final design changes are made that could impact species that are of interest or their habitat differently than what was discussed with SFWA in an earlier stage, project proponent will reach out to the SFWA in the manner previously agreed upon. • If pre-construction surveys are warranted as discussed with SFWA during site characterization and design stage, the project proponent and SFWA will discuss and review the survey timing, any related permits or conditions, data and results, and next steps based on the results, if necessary. • If there is an unanticipated presence of any species that are of interest or an unexpected impact to species that are of interest or their habitat during any phase of construction, the project proponent will communicate with the SFWA about how to proceed.	Project milestones; unanticipated presence of or unexpected impact to species; final design changes; survey initiation and milestones.

COMMUNICATIONS FRAMEWORK FOR SOLAR ENERGY PROJECT PROPONENTS AND STATE FISH AND WILDLIFE AGENCIES

Stage	Communication Framework Elements	Communication Milestone Triggers
Operations	• SFWA and operator will continue to communicate as mutually agreed upon (e.g., additional research or surveys). • If there is an unanticipated presence of any species that are of interest or an unexpected beneficial or negative impact to species that are of interest or their habitat during facility operations, it is recommended that the operator communicate the event with the SFWA and discuss how to proceed. • If an operator is planning to repower a facility with upgraded technology or related changes that could impact species that are of interest and/or associated habitats, it is recommended the operator communicate with the SFWA regarding the plans.	On-going effort; unanticipated presence of or unexpected impact to species; plans to repower or significantly change a facility.
Facility Decommissioning	• As a project approaches facility decommissioning, the operator will communicate with the SFWA about wildlife considerations present at that time. Parties recognize that this information may not be available until much closer to when this activity is expected to occur.	Upon consideration of or planning for facility decommissioning.

CONTACT US
info@fishwildlife.org

PRODUCT OF THE AFWA ENERGY AND WILDLIFE POLICY COMMITTEE – SOLAR WILDLIFE WORKING GROUP IN PARTNERSHIP WITH AMERICAN CLEAN POWER ASSOCIATION AND ENERGY AND WILDLIFE ACTION COALITION