Wisconsin Department of Natural Resources (WDNR) Best Management Practices (BMPs) for Solar Energy Projects

The development of renewable solar energy in Wisconsin is an important component of energy policy in Wisconsin as solar energy plays an important role in meeting Wisconsin's future electrical needs. The Wisconsin Office of Sustainability & Clean Energy's Clean Energy Plan outlines how clean energy is being used today and will be developed in the future. The Wisconsin Department of Natural Resources (WDNR) advocates for the practical and environmentally responsible development of solar energy in the state. In 2023, WDNR's Office of Energy partnered with The RESET Collaborative as part of a grant received from the U.S. Department of Energy's Renewable Energy Siting through Technical Engagement and Planning Program. The collaborative aims to develop guidance and technical resources that enhance large-scale renewable energy planning, siting, and permitting processes which will help lead to positive outcomes for communities, local governments, and renewable energy developers.

The following BMPs and links to resources can assist solar energy developers (in addition to communities and local governments) with avoiding and/or minimizing potential direct and secondary impacts to wetlands, wildlife, and habitat. These BMPs will also address early coordination for siting, stormwater management, vegetation management, and end of life decommissioning. Ongoing monitoring and adaptive management may be appropriate to address these site-specific concerns.

Early Coordination

Solar installations that are designed and constructed following early and frequent coordination with local, state, and federal agencies will have a lasting positive impact on the landscape and regional energy production. The Association of Fish and Wildlife Agencies (AFWA), American Clean Power Association (ACP), and Energy and Wildlife Action Coalition (EWAC) have developed two useful documents. The Communications Framework for Solar Energy Project Proponents and State Fish and Wildlife Agencies is a document that outlines a framework for communication and coordination. The National Utility Scale Solar Wildlife Guidelines was developed to provide a practical framework for identifying, avoiding, and reducing potential impacts while supporting responsible solar energy development. Early site-specific coordination with agencies and interested parties, as well as adaptive management throughout the life of the project, is key to having a successful project.

Solar installations are often considered 'short-lived' infrastructure projects, as the initial property leases typically last for 25-30 years; however, such agreements commonly include options for renewal. It is important to consider both the short-term impacts from project construction and the long-term impacts during the solar production phase and decommissioning. Solar energy projects

are relatively new on the landscape and research relating to how wildlife interacts with solar facilities continues to evolve. The Renewable Energy Wildlife Institute (REWI) is an independent nonprofit that works to solve renewable energy, wildlife, and related natural resource challenges through sound science and collaboration. REWI published a summary of known research results (Solar Energy Interactions with Wildlife and Their Habitats) documenting adverse impacts and potential benefits of solar on wildlife. ACP developed the Wildlife and Solar Power document, which is a useful tool that describes how utility-scale solar projects can support wildlife habitats and conservation efforts while delivering clean energy.

Where feasible, sites should be chosen which make the best use of available land. Maps that can help accomplish this goal include:

- The Nature Conservancy's Site Renewables Right map identifies where renewable energy can be developed in the central U.S. while still conserving important wildlife habitats and natural areas, such as Important Bird Areas (IBAs) and Conservation Opportunity Areas (COAs).
- Ecological Landscapes of Wisconsin provides general management opportunities and considerations for property planning based on the ecological landscape present.
- The WDNR Managed Land Parcels Portal and the USFS National Forest Portal should be reviewed to avoid impacts to protected public lands. Buffers between project areas and state and federal lands should also be considered, as these areas tend to have a high concentration of rare species, high-quality habitats, and recreational use.
- Early coordination with local officials and review of community comprehensive management plans and adjacent land uses can help to lessen potential conflicts between adjacent incompatible uses.
- Another example includes siting solar arrays on marginal rather than prime farmland or on brownfields. Maps may be available through the National Resources Conservation Service / USDA, USDA Web Soil Survey, or the local Land Conservation Department.

Forest lands support a host of ecosystem services and values including aesthetics, recreation, wildlife habitat, forest products, and water and air quality. Where possible, proposed solar development should avoid siting projects on forests of high ecological or habitat value and minimize conversion of isolated forest patches in fragmented landscapes. If the site is forested, site developers should consider siting on non-Managed Forest Law (MFL) or Forest Crop Law (FCL) land as solar is not compatible with these programs and the landowner would be required to withdraw these lands to continue with solar development.

Public Service Commission

Many utility-scale solar projects are required to be reviewed by the Public Service Commission (PSC) and must follow the solar application filing requirements when applying. There are generally two types of projects that come before the PSC:

- 100 Megawatts or larger in size require a Certificate of Public Convenience and Necessity (CPCN). These projects are often submitted by independent companies or developers of solar projects. These large projects require an Environmental Assessment (EA) or Environmental Impact Statement (EIS), technical and public hearings, and rounds of testimony from the applicant, intervenors (if any), and technical staff.

- Smaller utility scale projects less than 100 Megawatts in size and submitted by regulated public utilities require a Certificates of Authority (CA). These applications still require an EA but typically do not require a technical hearing.

Both types of solar applications to the PSC have opportunities for the public to get involved by either providing comments or becoming an intervenor.

WDNR Office of Energy

The DNR's Office of Energy (OE) is responsible for coordinating the review and natural resource permitting of energy projects in Wisconsin. OE provides project management within the DNR and serves as the main point of contact for project applicants, the PSC, and other DNR programs and stakeholders. Developers are highly encouraged to coordinate early with the WDNR Office of Energy on proposals for new solar projects.

Endangered Resources

All projects must avoid impacts to state and federally protected species. To ensure the project is complying with these laws, applicants should request a review through WDNR's Endangered Resources (ER) Review page. The review will provide specific requirements and recommendations to avoid and/or minimize impacts to endangered and threatened resources, if a possibility for impacts in the project area is identified. The ER Review will also include information regarding other areas of potential concern, such as Important Bird Areas or high-quality habitat. Coordination with the U.S. Fish and Wildlife Service (USFWS) is also encouraged. Using available data from the ER Review, pre-application coordination meetings, and species surveys, applicants may then consider layout of panels, roads, power lines, fences, and other infrastructure that avoids directly or indirectly impacting important habitat areas. Any projects that are not designed to avoid impacts to state-protected species will be required to apply for an Incidental Take Permit/Authorization per Wisconsin State Statute 29.604.

Wetland and Waterway Permitting

The WDNR's Surface Water Data Viewer (SWDV) can be used as a starting point to determine if wetlands are potentially present within the project area. Activities in wetlands may require authorizations from WDNR through Wisconsin State Statute 281.36. When conducting this desktop

review, the Wisconsin Wetland Inventory Layer and Mapped Indicator Soils layer can be considered to conservatively represent assumed wetland locations. A wetland field delineation is required in all project areas where project infrastructure is proposed (i.e., arrays, fence lines, driveways, substation, etc.) and may be required in areas where land will be disturbed. Projects should be designed to avoid and minimize impacts to wetlands.

The WDNR's SWDV can also be used as a starting point to determine if waterways are present within the project area. Surface waters mapped in the SWDV should be assumed navigable. Activities in and adjacent to navigable waterways may require authorization from the WDNR through Wisconsin State Statute Chapter 30. Activities that may trigger Chapter 30 permit coverage include, but are not limited to, culvert and bridge crossings for permanent access roads and driveways, temporary clear span bridges for temporary access roads, storm water pond construction within 500-feet of a waterway, open cut trenching a collection line to cross a waterway, etc. Applicants should attempt to site project components to avoid and minimize impacts to waterways and obtain applicable permits if necessary.

All solar facility developers should visit the WDNR Water Permitting Application Page for more information and specific application requirements. More helpful information can be found in the guidance document on Wetland and Waterway Permitting.

Floodplain and Shoreland Zoning

Floodplain and shoreland zoning setbacks and requirements are another important factor to consider for solar siting. Electrical components should generally be placed above the Flood Protection Elevation (FPE). Hydrologic and Hydraulic (H&H) studies may be required, depending on the proposed location of above ground infrastructure (i.e., fencing, arrays, and electrical components) in relation to the floodway and flood fringe. Projects need to be designed to comply with local floodplain and shoreland zoning ordinances. Please connect with your local zoning administrator to determine specific requirements in your area, if applicable.

Stormwater Permitting

If a solar project has more than 1 acre of total land disturbance planned during construction activities, then WDNR storm water permit coverage is needed. Results of initial reviews will need to be submitted with an electronic Notice of Intent (NOI) application by uploading the ER Review and wetland concurrence on the WDNR Construction Site Storm Water Permits website. Also see WDNR Storm water construction technical standards, models and BMPs.

Post-construction storm water management practices must satisfy the performance standards in ss. NR 151, specifically, 151.121 to 151.128, Wis. Adm. Code. The WDNR has developed post-construction guidance specifically for solar facilities to assist in the design of practices that meet those performance standards.

Minimization Measures

Erosion and Sediment Control Planning Before and During Construction

Solar construction often involves the disturbance of large land areas and therefore carries with it the potential for environmental impacts due to erosion occurring during construction activities and after the site is in service, if post construction stabilization is not successful. The following items should be considered during development of an erosion and sediment control plan for solar projects:

- **Cover crop:** Establishing a cover crop of oats, alfalfa or other grasses prior to the start of construction can help reduce the potential for erosion during the early phases of construction. Land stabilization and initial vegetation management are appropriate as construction may extend beyond a full year for large scale projects. Leave existing vegetative buffers in place. Do not use seed mixes with restricted or prohibited invasive species.
- **Construction sequencing:** Phase construction to minimize the bare soil and open disturbed area at any one time. Understand that local jurisdictions may have different requirements for how disturbed areas must be temporarily stabilized. For multi-block sites, work should be staged so that land disturbing activities progress sequentially with crews following to stabilize areas.
- **Soil health:** Manage ground cover to prevent erosion and maintain healthy soil structure to increase rainwater infiltration. Follow the four core principles of soil health: *Minimize soil disturbance – Maximize biodiversity – Maximize soil cover – Maximize living roots.* This will reduce the likelihood of flooding and maintain the viability of the soil resource into the future, especially after decommissioning. Minimize use of concrete footings where feasible to reduce soil disturbance and disruptive repairs/equipment removal.
- **Soil handling:** Crop production often relies on thick layers of topsoil. When excavating trenches or stripping topsoil in preparation for grading, care should be taken to separate topsoil from subsoil and then replace the material with the topsoil at the surface.
- **Soil compaction:** Minimize soil compaction to the extent practicable. Construction traffic should travel on designated access roads to prevent compaction or utilize tracked equipment. Soil compaction prevents vegetation establishment and can degrade soil health long-term.
- **Drain Tile:** Many solar projects are developed in areas that are served by drain tile. Damaged drain tile can result in sediment discharge or flooding in unexpected locations. Locating and showing the drain tile locations on the erosion control map can help the contractor avoid damage to existing drain tile. Where grading or excavation is proposed, drain tile may need to be replaced if there is insufficient cover over the tile. A plan for repairing damaged drain tile should be included in the construction documents. Drain tile outlets should be checked for appropriate vegetative filtration especially during construction phases when the potential for water loss is higher.

- **Module installation:** During module installation the traffic between the rows of piles can damage the vegetation and compact the soil. Best practices for this stage include installation from every other row to preserve vegetation in the alternative rows, use of tracked equipment, routing traffic around damaged areas, and limiting vehicle access during wet conditions.
- **Off-site drainage:** One way to limit the potential for erosion and sediment discharge is to limit the flow of stormwater draining onto the construction site from areas outside the limits of construction. Where feasible, diversion swales or berms can be used to route this water around, rather than through, the construction site.
- **Concentrated flow:** Sheet flow is generally limited to a maximum distance of 300 feet in ideal conditions, after which it begins to channelize. Soils with low infiltration capacity (i.e. clay) are especially susceptible to concentrated flow patterns. For long flow lengths, it is recommended that cues be taken from existing topography on the location of swales, and grading should be considered accordingly. Ditch checks, sediment traps, and sediment basins are appropriate sediment control practices for concentrated flow areas.
- **Winter construction:** Many projects continue construction through the winter months. While the ground is frozen at times, there are generally several thaw cycles during the winter. Erosion and sediment control inspections must continue through the winter months so that erosion and sediment controls are maintained in functional condition prior to snowmelt events. It is important to plan for spring as the ground is often soft and saturated, making access more challenging. Plowing of snow in vegetated areas is not recommended, as it often results in damage or removal of vegetation. Instead of plowing, lightly compacting or grooming the snow may facilitate access without damaging vegetation.

Vegetation Management

Project proponents should survey construction areas and inventory invasive species present in the project area prior to construction, and plan construction activities in a manner which will avoid and/or minimize spreading them more broadly throughout the construction site. Check out the WDNR's Invasives web page for other ways to avoid spreading invasive species. Invasive species, groundcover height, and weeds should be managed intentionally with a goal of minimizing the use of pesticides. It is recommended that any seed mixes used are not treated with neonicotinoids.

If tree clearing is necessary, explore beneficial uses for woody material where practical. Look for local opportunities to sell available merchantable timber or repurpose chipped or ground material through composting facilities, park or community improvement projects, or woody biomass facilities.

It is highly recommended that a native seed mix with flowering species be planted along with a cover crop as soon as possible after construction and be used not only around the perimeter of the solar facility but within and under the panel arrays as well. This native mix will benefit the state's pollinators which include butterflies and bumble bees - many of which have been in steady decline in recent years. Threats such as climate change, pesticide use, and habitat loss are having a

devastating impact on their populations. Efforts are being made at the state and federal levels to increase the number of milkweed stems, and other species that flower throughout the growing season, for the benefit of monarch butterflies and other pollinators. Long term, native prairie plants at solar facilities will improve soil health in anticipation of facility decommissioning and when the land is returned back to the landowner.

Seed mixes which include non-native, aggressive species such as red fescue or Kentucky bluegrass, may be able to reach quicker ground stabilization; however, these species typically form dense mats of vegetation that do not allow for most native species to become established. Warm season prairie species are slower to grow above ground and instead spend their first year or two developing roots. Over time, those roots can extend to 10 feet or more below ground. While these plants take longer to fill in and obtain a look of above ground stabilization, their roots are feet deeper than red fescue and other cool season grasses: thereby stabilizing the ground below. By mixing these species with warm season prairie plants, even at a low seed rate, there is concern that they could quickly outcompete the prairie plants and not allow them to survive long-term. For better long-term ground stabilization, it is beneficial to not include these species in the seed mix from the beginning when feasible.

There are many useful websites for planning and creating pollinator friendly habitats:

> The Center for Pollinators in Energy - Fresh Energy is a national clearinghouse for pollinator-friendly solar information, standards, and best practices.
>
> Clean Energy Resources Teams web site contains examples from Minnesota which can be applied to Wisconsin projects.
>
> Rights-of-Way as Habitat Working Group has created a forum to collaborate, share ideas, and identify best management practices for habitat conservation within rights-of-ways and contains resources and tools to achieve that goal.

Long term vegetation maintenance planning should seek to utilize multi-use opportunities wherever community partnerships make it feasible on solar field sites. If the site will be grazed by livestock, coordinate with experienced grazers on appropriate seed mixes. Seed mixes will be different based on the effect of livestock movement on plant resiliency. Work with local partners and landowners early in the process to consider appropriate panel height for activities like livestock grazing and angle adjustable mounting systems to allow for equipment access for agrivoltaics farming or vegetation management.

Wildlife Movement and Fencing

When not sited well, large scale solar projects can inhibit the movement of large mammals such as deer, elk, wolves, and bears. The fenced arrays act as a barrier which could cause habitat fragmentation and disruption to daily movement and migratory patterns. For example, where a solar facility fence line runs parallel to a road, especially when the fence line is on both sides of the road, large mammals may follow the fence line due to the restricted corridor which may result in an

increase in large mammal-vehicle collisions. It is also possible that once agricultural lands become fenced solar arrays, deer may congregate into the remaining agricultural lands for foraging purposes, resulting in increased agricultural damage.

To facilitate small and large wildlife movement, the following should be considered:

- Break up array fencing where known wildlife corridors are already present such as along waterways, wetlands, or other natural habitats.
- Modify array fence height to be as low as possible while adhering to safety standards.
- Avoid using barbed wire on top of the fences except when surrounding substations.
- Provide ramps along the inside of the fence at regular intervals for larger wildlife if frequent entrapment is occurring.
- Increase fence visibility by using appropriate markers or fencing tapes to avoid bird collisions.
- Utilize small wildlife permeable fencing around the solar arrays especially when adjacent to wetlands, waterways, and/or natural areas. Options include:
    - Raise the fence a minimum of 6-8" off the ground (preferred)
    - Install 1' x 1' openings every 50-100'
    - Ensure that the openings at the bottom of the fence are a minimum 12” wide by 8” tall
- Incorporate habitat enhancement practices like bird houses, diverse native plantings and reduced light at night for nocturnal insects.

American Kestrel

Once common across North America, American Kestrels are now declining in many areas. Solar farms can provide the kind of open habitat these falcons prefer. The areas around solar panels often attract small mammals—perfect prey for kestrels. By installing nest boxes near solar arrays, facilities can help kestrel populations recover while benefiting from natural rodent control that protects solar equipment.

Ongoing Maintenance and Monitoring

It is important to observe how birds, bats, pollinator species, large and small mammals, and herp species interact with solar arrays throughout the life of the facility. Monitoring facilities with trail cameras or conducting wildlife mortality surveys can help determine what species are using or attempting to use the area. It is important to determine what species continue to populate the area after construction and adapt the management of the property (e.g. fencing or vegetation management) to benefit those species. Allowing academic or non-profit research at the facility may also provide new and useful information which can help to measure outcome success and inform future projects.

The vegetation plan for the solar facility will specify the initial planting for the site. Revegetation may be needed in areas where the initial plants did not thrive which will help to prevent erosion,

manage stormwater, and provide shelter and foraging for local species. Plant surveys throughout the life of the project can help inform future management plans. Management should include removal of non-native and invasive species. Timing of management should be planned in a manner which will have the greatest impact on unwanted species and the least impact on pollinators, nesting birds, herps, and wildlife movement. Grazing has also been an important tool on solar facilities, though it is important that the vegetation plan is suitable for the type of grazing animals that will be used.

All projects must continue to avoid impacts to state and federally protected species throughout their service life. To ensure the solar energy facility continues to comply with these laws, facility managers should consider completing an Endangered Resources Review for vegetation management and complete renewals annually. Contact the Office of Energy ER Team to begin annual ER Renewals.

Decommissioning

Solar panels typically have a lifespan of more than 25 years before they need to be replaced or decommissioned. At the end of their lifecycle, they become a waste stream and must be managed safely. WDNR has information related to managing this waste stream at - Managing Used Solar Panels and Components [PDF]. The U.S. Environmental Protection Agency (USEPA) also provides information about different types of solar panels and how they are regulated at end of life - Regulation and management of solar panel waste. For more information please see Solar panel recycling and Frequent questions on solar panel waste.