

Conservation Considerations for Solar Farms

NRCS Fact Sheet



Introduction

Ground-based, utility-scale solar panel installations used for electricity generation of 1 MW or greater are commonly referred to as 'solar farms' (US Energy Information Administration, 2020). The purpose of the solar farm is to generate and sell electricity, therefore it is key that the collection, generation, and distribution of energy is not hampered by factors that reduce capacity. Management of natural resources on a facility's footprint is beneficial to enable it to maintain capacity. Natural resource concerns, such as soil erosion, dust, runoff, and damage from wildlife or livestock, frequently occur during construction and operation of solar farms.

The Natural Resources Conservation Service (NRCS) and its partners provide financial and technical assistance for producers and landowners to restore, enhance, and preserve the Nation's productive landscapes and natural resources. Producers, landowners and developers should consider the following natural resource conservation concerns regarding solar farms.

Soil Conservation

Healthy soils are critical for proper function of the water cycle and for providing habitat for a diversity of organisms. Soil conservation concerns include soil erosion by water and wind, compaction, water ponding, pollutants, and loss of organic matter. Four principles that guide land management to support healthy soil are: (1) maximize soil cover, (2) minimize soil disturbance, (3) maximize living roots, and (4) maximize biodiversity. These principles can apply to solar farms during planning, construction, operation, and even decommissioning activities.

Soil erosion, by water or wind, is a key resource concern that is often a consequence of construction and infrastructure projects.

Erosion generally occurs where soils have been heavily disturbed or left uncovered as bare ground. With solar farms, wind erosion can cause problems when wind-blown soil ends up on the surface of panels, reducing their electricity output and possibly leading to permanent damage. Water erosion from runoff and concentrated flows can damage infrastructure, equipment, and facilities, leading to increased maintenance and repair costs. It can also lead to detrimental offsite environmental effects including gullies and the transport of sediment.

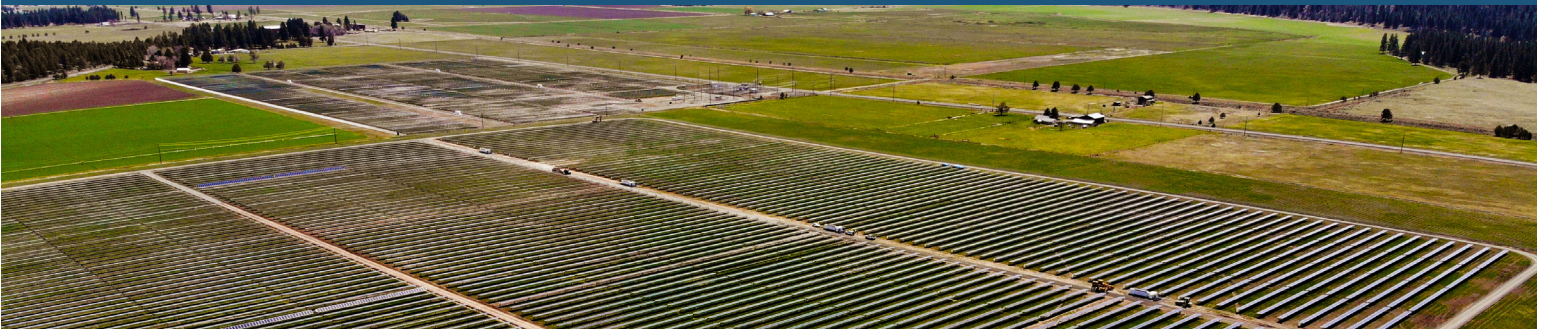
Steps to take during the construction and operation to conserve soil include:

- Limiting disturbance and compaction from heavy machinery to only the most necessary areas such as access roads and other areas with frequent or intense use.
- Preserving on-site topsoil; covering and preventing soil movement by applying mulches and erosion control mats or socks.
- Designing sites for optimal runoff flow with diversions, terraces, basins, and other earthworks.
- Maintaining a healthy perennial vegetative cover on the soil under and between solar panel rows to encourage infiltration and prevent erosion. Ideally, the vegetated distance between the rows of panels should be no less than the maximum horizontal width of the panel rows.
- Planting windbreaks perpendicular to the prevailing wind direction to reduce wind erosion.
- Utilizing dust control measures on unpaved roads and surfaces.

More Information

This fact sheet provides conservation considerations regarding solar farms for a general audience. For producers and landowners, there may be program-specific rules or requirements that could affect potential participation in USDA programs which are not included in this document. NRCS encourages producers and landowners to utilize the complete NRCS conservation planning process to address natural resource concerns through the implementation of conservation practices.





The Farmland Protection Policy Act is intended to minimize the impact Federal programs have on the unnecessary and irreversible conversion of farmland to nonagricultural uses. If agricultural farmland (cropland, forest, pasture, or other land) will be converted to a non-agricultural use, producers, landowners, and developers should make every effort to minimize the impact and maintain the possibility for the land to be converted back to agricultural use. Limiting use of concrete and cement footing or pads; and if ground-mounted, considering use of driven-post structures to minimize use of concrete footings; will protect future agricultural suitability. Consider solar development using existing buildings, structures, idle or marginal lands, or water bodies such as irrigation ditches.

Vegetation Management

Establishment and maintenance of perennial vegetation is paramount for ensuring the health and function of both the land and the solar farm. Sites are typically cleared of all vegetation and subjected to substantial land manipulation during construction. The bare, disturbed soil creates an environment favorable for undesirable species, including noxious and invasive species. Perennial herbaceous vegetation should be reestablished immediately following initial site preparation. Also, many tree and brush species will resprout from the base following top removal. Unmanaged vegetation can grow over and into electrical equipment and infrastructure, potentially causing damage, reducing performance and efficiency, and increasing maintenance costs. Select plants that are adapted to the area and require minimal maintenance. An ideal species will be low-growing (short stature) or which can easily be maintained by mowing or grazing. Sod-forming or rhizomatous grasses (such as those found in a typical yard) are preferred, as is a mix of warm and cool-season plants, if the site and climate allow. When practical, include native forbs that attract pollinators, promote soil health, and offer aesthetic value.

Vegetation management plans should:

- Identify commercially available, locally adapted species. Consider using plants with drought, moisture, and shade tolerance. Solar panels can significantly affect ecohydrology by redistributing moisture from precipitation and casting a significant amount of shade.
- Account for potential threats from noxious and invasive species, prioritize the prevention of their establishment, and ensure effective treatment if discovered.
- Anticipate encroachment from woody species common to the area and include treatment thresholds and plans for treating both resprouting and emerging plants.
- Where vegetation isn't growing, and the ground is covered instead by a community of bacteria, lichens, or mosses (collectively referred to as a microbiotic soil crust), minimize disturbance to the crust as much as possible since these beneficial communities take much longer to establish than vegetation.
- Identify target minimum and maximum vegetation heights and prescribe regular mowing, grazing, or other similar maintenance treatments to manage vegetation height and prevent vegetation from growing into the equipment, casting shade or dropping pollen, leaves, limbs, mast, or other debris onto the solar panels or causing other damage to equipment and facilities.

Wildlife Considerations

Wildlife can interfere with solar farm operations by causing damage to equipment or injuring themselves. Identify management strategies to reduce the attractiveness of the site for nuisance species. Establishing food, water, and favorable habitat in alternative locations can draw troublesome species away from the solar farm and maintain the current level of wildlife habitat. Physical deterrents can also be used to discourage nesting by birds and to otherwise dissuade unwanted wildlife from using the site. Some wildlife, like aquatic habitat birds, may perceive the reflected light from solar panels as bodies of water and be drawn to the facility. Consider selecting panels that have a white outline or white grid lines to reduce this effect. Ensure perimeter fencing is constructed to exclude problem wildlife species. When practical, design fences to facilitate the movement of migrating animals around facilities. Nuisance wildlife species will vary by site. Two common examples of invasive species include feral swine and the European Starling (*Sturnus vulgaris*). Both can greatly reduce the efficiency and/or destroy equipment.

Other types of wildlife, including many pollinator species, are relatively low-impact and can coexist on solar farms without conflict. Incorporating locally adapted, pollinator-friendly forbs into seed mixes is an effective strategy for creating habitat for pollinators and promoting the environmental benefits provided by these species.



NRCS Conservation Practice Standards to consider when planning on solar farms: Critical Area Planting (Code 342), Conservation Cover (Code 327), Herbaceous Weed Management (Code 315), Range Planting (Code 550), Brush Management (Code 314), Windbreak-Shelterbelt Establishment and Renovation (Code 380), Diversion (Code 362), Terrace (Code 600), Heavy Use Area Protection (Code 561), Access Road (Code 560), Water and Sediment Control Basin (Code 638), Fence (Code 382), Prescribed Grazing (Code 528).

Contingency Planning

Anticipating and planning for unexpected disturbances, such as severe weather, vandalism, and wildfire, is crucial for maintaining equipment and ensuring the continuity of operations. Access to the site should be controlled with secure perimeter fencing to provide critical security and protection of assets and prevent unauthorized human access. Plan roads to provide dedicated travel ways for heavy equipment and vehicles and to allow easy access to facilities and infrastructure for maintenance and repairs. Regularly mowing or grazing can reduce the risk of fire. Firebreaks constructed both along the perimeter and inside the facility can help contain potential internal fires and protect the facility from external wildfires. Plan heavy use area protection for sites frequently used by vehicles, equipment, and machinery and for stockpiling supplies and spare parts, or discarded components.

To learn more about NRCS recommendations for conservation on solar farms and vegetation for a specific area, contact the local USDA Service Center at farmers.gov/working-with-us/USDA-service-centers.

Additional Resources:

1. Information on vegetation planting and establishment: <https://efotg.sc.egov.usda.gov/#/>
2. Controlling Soil Erosion: [Small Scale Solutions for your Farm](#)
3. [Introduction to Microbiotic Crusts](#)
4. [Web Soil Survey](#) soil interpretations are available for fencing and solar panels: <https://websoilsurvey.nrcs.usda.gov/app/>



*Note the toxic African Rue (*Peganum harmala*) plants in the foreground.*

Photo left. Side-view of an array of Photo-voltaic panels at a solar energy electricity generating station.

Photo right. Front-view of an array of Photo-voltaic panels at a solar energy electricity generating station.

These photos show sparse herbaceous vegetation under and around the photo-voltaic panels. This is not an ideal situation. A healthy cover of short-stature herbaceous grasses and forbs is preferred from both ecological and operational perspectives.