BEST MANAGEMENT PRACTICES
FOR SOLAR ENERGY DEVELOPMENT ON FARMLAND
A Guide for Solar Energy Developers

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ACRONYMS AND ABBREVIATIONS

DACF	Maine Department of Agriculture, Conservation and Forestry
HVAL	high-value agricultural land
IPM	Integrated Pest Management
M.R.S.	Maine Revised Statutes
PVC	polyvinyl chloride
sq ft	square feet

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PRE-CONSTRUCTION, SITING, & DESIGN

Conduct a Site Walk & Discuss Plans with the Landowner. Walk the property with the landowner to identify important features of the site, such as seasonally wet areas, steep slopes, invasive plants, poorly drained soils, and property boundaries. With the landowner, discuss plans for the property after the solar energy development is decommissioned and identify expectations for post-construction conditions of the land.

Conduct a Soil Survey & Map the Location(s) of HVAL. Documenting the soil profile, texture, compaction, structure, consistency, drainage, and health will be useful in land restoration after the solar energy development is decommissioned, especially if heavy soil disturbance is planned. Reconfigure the project layout to avoid and minimize impact to HVAL and ensure the project is located on the least agriculturally productive portions of the parcel to the extent practicable.

Please Note: Soil surveys must be conducted by a Maine-licensed soil scientist. No person may practice or offer to practice soil science in Maine without a current license (32 M.R.S. §4903). Find a licensed soil scientist here: https://www.pfr.maine.gov/ALMSOnline/ALMSQuery/SearchIndividual.aspx

Though not required, **soil testing** can be a useful tool for measuring organic matter and nutrient content. Soil test kits may be obtained through the University of Maine Cooperative Extension: https://umaine.edu/soiltestinglab/home/kit-request/

Conduct a Geotechnical Survey. Though not required, a geotechnical survey of the ground conditions will help determine which anchoring method may be best suited to a particular site.

- Consider opportunities to limit subsurface anchoring structures or foundations where possible. For more information, please refer to DACF's Fact Sheet on Foundation and Installation Types: https://www.maine.gov/dacf/ard/resources/docs/solar-installation-applications-factsheet.pdf

Consider Neighboring Farms. Consider the timing of construction and how it may interfere with current activities on the property or neighboring properties. Will it impact crop production and harvest activities? Will it limit access to other land or equipment?

Removal of Invasive Plants. If the area is heavily infested with invasive plants, create an Integrated Pest Management Plan to determine the best treatment, or combination of treatment methods, to address the infestation. It is advisable to address any significant infestations of invasive plants before the start of construction. See "Responsible Pest Management" on page 8 for more information.

Utility Connection. During the planning of project designs for interconnection, ensure that the height of overhead powerlines and the placement of utility power poles will not interfere with the landowner's or adjacent landowner's ability to access the land with harvest equipment.

Consider the Climate. Choose equipment with a proven track record in the Northeast. Climatic conditions such as temperature, wind, and snow load can impact the equipment's output.

DURING CONSTRUCTION

Prevent Soil Compaction. Because all solar farm construction projects result in some degree of soil disturbance, consider the following practices during construction and decommissioning *to the extent practicable*:

- Use tracked vehicles to reduce the pounds per square inch of pressure on soil.
- Use timber mats or similar measures to provide bearing strength when soils are soft.
- Limit vehicle or equipment axle loads of over 12,000 pounds when soils experience higher than average rainfall for a trailing 30-day period based on local rainfall data.

Minimize Soil Disturbance

- Excavation, grading, cutting, or clearing of trees, stumping, and using heavy mechanized equipment should be limited to the extent practicable.
- When possible, avoid stumping, grubbing, and removal of sod. Leaving stumps and sod in place will provide soil stability, bearing strength, and prevent erosion.
- Construction techniques that eliminate or minimize soil disturbance, such as directional drilling, are preferred over excavating and trenching.

Grading

- If excavation activities occur, stockpile the soil by horizon type and place it back in the order in which it was removed to restore the soil to as close to its original conditions as possible.
- Where excess topsoil or subsoil has been removed from permanently impacted areas (e.g., roads), it should be stockpiled to reclaim the area from which it came or spread on other areas of the project site with insufficient topsoil.
- Where fill is required, use native excess topsoil or subsoil stockpiled from the property. If no native excess soil is available to use for fill, import soil free of invasive species consistent with the quality of the existing site conditions to approximate soil conditions from before alteration.
- Avoid stockpiling soil on slopes greater than 15%.
- Remove rock excavated during construction from areas intended to return to agricultural use.

Access Roads

- Temporary access roads may be constructed with erosion control mulch, the thickness of which depends on the wetness of the soils (6 inches for dry soils and 12 inches for wet soils).
- Ensure access roads are constructed so they do not shed water onto active agricultural fields and that the finished grade does not interfere with normal drainage patterns. This may require the installation of waterbars or culverts.

POST-CONSTRUCTION & RESTORATION

Timing. Restorative practices should occur under favorable conditions when the land is workable and relatively dry.

Site Cleanup. Make all best efforts to remove all construction debris (wire, bolts, metals, plastics, etc.) to avoid mixing with soil or being consumed by grazing livestock. Do not bury excess concrete or leave it on site.

Revegetation & Soil Restoration

- When regrading, establish contours that support the area's natural hydrology. Rehabilitation efforts should restore the natural soil and hydrology to the extent practicable.
- Select a seed mix that meets the maintenance agreement. The mix may include pollinator habitat, livestock grazing pasture, cover crops, row crops, grass, or another cover type. Prioritize native species over non-native or invasive species.
- Prepare the seedbed by removing debris, regrading the topsoil, and scarifying the soil surface. Amend the soil based on soil tests, crop or livestock needs, or the seed supplier's recommendations.
- Apply the seed mix immediately after preparing the bed at the supplier's recommended rate. If the site cannot be seeded shortly after the seedbed has been prepared, use temporary erosion control measures until seeding takes place, such as erosion control blankets or hydro-seeding.
- If revegetation efforts occur during the summer, hydroseed or mulch with enough straw to cover the soil completely to prevent erosion, keep the seed moist, and prevent weed establishment. Typically, 90 pounds of mulch will cover 1,000 sq ft. (or two square bales for a 30-foot x 30-foot area).
- If revegetation efforts occur after October 1st, use winter seeding rates and reseed any bare areas in the spring. Use temporary measures to divert surface water runoff away from the newly seeded area(s) until they are permanently stabilized.

Erosion Controls

- Any surface or subsurface drainage structures to be left in place should be in good working order, be repaired if needed, and should maintain or improve pre-existing conditions.
- Stormwater from the drip edge of solar panels can cause soil erosion, particularly when the soil below it has been disturbed and is bare. To prevent soil erosion under the drip edge of solar panels, install controls such as erosion control blankets, hay mulch, or other appropriate measures until ground cover conditions are permanently stabilized.
- Employ measures to maintain runoff as sheet flow from the solar panels onto and across vegetated areas. Proper design, construction, and maintenance techniques of swales, berms, level spreaders, etc. may be needed if concentrated flows are necessary.

Buried Utilities. Consult the National Electrical Code for the standards for buried electrical lines, which can vary depending on the voltage and length of the run. The Code allows for direct buried lines, although they are typically installed in PVC conduits for solar projects to avoid damage. The Code requires anywhere from 18 to 30 inches of minimum coverage, but a minimum of 30 inches is typical for solar installations. For buried conduit, 30+ inches of soil cover is recommended to allow for adequate root growth for desired plant growth.

Stockpiled Soil. Seed agricultural stockpiled soils with a conservation or perennial mix. Hydro-seed or mulch with straw for long-term storage. Utilize silt fencing, hay bales, or erosion control mulch to prevent sediment from leaving the stockpile site until stabilized with vegetation.

DURING OPERATION, MAINTENANCE, & MONITORING

Operations and Maintenance Plan. Solar Developers should provide landowners entering a solar contract with an operations and maintenance plan. At a minimum, the plan should address the following:

- ***Responsible Party*.** All monitoring, remediation, and maintenance work should be the sole responsibility of the solar developer unless there are site conditions and/or potential damage attributable to any agricultural land use practices undertaken by the landowner.
- ***Revegetation Monitoring*.** In the two years following project completion, revegetation efforts should be monitored three times during the growing season (Spring, Summer, and Fall) and whenever new soil is brought in and applied to the site. Observations should include, but are not limited to, erosion, bare soil, soil compaction, tree growth, and invasive plants. Reseed bare areas according to the seed supplier's recommendations.
- ***Maintenance*.** Maintain vegetative growth within the project area throughout the growing season. Do not undertake maintenance of ground cover using mechanical methods such as lawnmowing, bush hogging, and weed whacking when soils are saturated, as this will cause rutting and soil compaction. Clippings should be left in place as mulch to maintain nutrients on-site and reduce erosion risk.
- ***Invasive Plant Monitoring*.** If the project area was treated for invasive plants before or during construction, monitor the project area for invasive plant regrowth for at least one full growing season after removal/treatment. Remove any invasive plants found within the project. See "Responsible Pest Management" under "Additional Information" on page 8 for more information.

Infrastructure Checks.

- Inspect project area fencing, gates, panels, and other infrastructure on a seasonal basis and repair as needed.
- See "Reporting Practices for Solar Developers" under "Additional Information" on page 8 for more information on keeping the landowner informed of seasonal inspections.

DECOMMISSIONING

Currently, decommissioning plans are required for solar energy developments with ground-mounted solar panels occupying three acres or more per 35-A M.R.S. §3491. However, it is recommended that the solar developer provide a decommissioning plan for all projects, regardless of size, that includes measures to restore the property to its original status as part of the solar contract. In addition to the requirements detailed in 35-A M.R.S. §3491, the decommissioning plan should address the following:

Responsible Party. The solar developer should be solely responsible for decommissioning and restoration work. The decommissioning plan should identify who is responsible for the costs and how this work will be funded (e.g., trusts, escrow accounts, surety bonds, or letters of credit).

Abandonment. The plan should identify when a project is considered abandoned and a timeframe for completion of decommissioning activities, typically 120 days. Examples of abandonment include decommissioning after a specified amount of time in which:

- construction has not been undertaken,
- the system has not been operational,
- a land lease has expired, or
- with prior written notification.

Prevent Soil Compaction. See "Prevent Soil Compaction" in the "During Construction" section on page 4.

Equipment Disposal. All equipment removed above or below ground should be disposed of off-site. When possible, equipment should be recycled by a facility authorized to accept such materials for recycling. All non-recyclable equipment or waste should be disposed of at a facility authorized to accept such materials for disposal. Equipment includes but is not limited to, panels, racking systems, signage, fencing, equipment pads, storage buildings, underground utilities, concrete piers, footers, electrical conduit, concrete, etc.

Below-grade Equipment. Any abandoned conduit should be sealed or capped to avoid the potential of unwanted drainage onto adjacent property. Repair or replace any surface or subsurface drainage structures to remain.

Access Roads. Unless otherwise specified by the landowner, remove access roads and restore this land back to its predeveloped grade and soil conditions.

Regrading & Restoration

- Establish contours that support the natural hydrology of the area and its next intended use.
- Where fill is required, use native excess topsoil stockpiled from the property or imported topsoil free of invasive species consistent with the quality of the existing site conditions.
- Restorative practices should occur under favorable conditions when the land is workable and relatively dry.

Revegetation. See "Revegetation" in the "Post-Construction" section above on page 5.

Property Owner Notification. The solar developer should notify the landowner prior to undertaking any decommissioning steps or if there is any need to update the decommissioning plan. Verify whether or not a decommissioning plan can be recorded with the Registry of Deeds. Before the final electrical inspection, the solar developer should provide the landowner with evidence that the decommissioning plan was recorded with the Registry of Deeds.

ADDITIONAL TOPICS

Responsible Pest Management. Invasive plants are diverse, and no "one size fits all" removal plan exists. Effective approaches vary by plant species, infestation size, and whether a seed bank is present. Exhaust all efforts and means for controlling pests before implementing pesticides or herbicides. Pesticides can leach into the soil, drift in the air, or run into water, resulting in more widespread effects than intended. Some herbicides leave behind residues or are slow to break down in the environment. However, many invasive species can regrow from their roots, so removing the above-ground vegetation may not kill them. In these situations, herbicides may be helpful in accordance with an integrated pest management plan.

- Follow an Integrated Pest Management Plan. Integrated Pest Management (IPM) is an environmentally sound approach to managing pests such as weeds. IPM relies on proper pest identification, monitoring, and combinations of pest avoidance and management strategies to protect people, crops, and the environment while minimizing reliance on pesticides.
- If the landowner is Certified Organic, additional consultation with the landowner and certifying agent is strongly advised if any herbicide use is contemplated.
- If you determine that herbicides are required to manage an invasive plant population, evaluate what other mechanical methods could be combined with herbicide treatment to ensure the least amount of pesticide is used.
- If the area treated with herbicide is extensive and bare soil is present, reseed with non-invasive plant species.
- Dispose of invasive plant material with care so as not to spread seeds or viable plant fragments.
    - For more information regarding the proper disposal of invasive plants, please refer to the University of New Hampshire guidance document "Methods for Disposing Non-Native Invasive Plants" found here:

      https://extension.unh.edu/resource/methods-disposing-non-native-invasive-plants
- Determine appropriate weed control strategies for the access road.

For more information regarding **invasive pest management**, please go to www.gotpests.org

For a **list of licensed companies** offering services for the control of invasive terrestrial plants, please go to https://www.maine.gov/dacf/php/gotpests/solutions/terrestrial-invasive-companies.shtml

For tips on **hiring a licensed pesticide applicator**, please go to https://www.maine.gov/dacf/php/pesticides/public/index.shtml#hiring

Dual-Use Solar Energy Development & Agriculture

- ***Livestock Grazing***
    - Grazing Plan**.** Create a rotational grazing plan with the farmer to prevent overgrazing, avoid soil compaction, and allow rest periods for each paddock. Plan flock sizes based on the amount of forage available.
    - Design the solar facility equipment, layout, panel height, panel spacing, and overall design to be compatible with the chosen livestock. Consider the following elements to determine what would work best for the project in conjunction with livestock grazing:
        - Fixed-tilt vs. tracking panels
        - Bi-facial vertical panels vs. horizontal panels
    - Forage**.** Plant vegetation that is compatible forage for the grazing livestock and avoid any plants that might be toxic to them.
    - Water**.** Plan how a water source will be provided to livestock. Will there be a water source on site, or will water be brought in via a truck or trailer?
    - Safety**.** Secure any exposed electrical wires to the solar equipment and protect against damage from grazing animals and other wildlife with meshing or other pest guards. This equipment must be inspected regularly and repaired as necessary.
    - Rehabilitation of Disturbed Soils**.** Avoid using areas affected by livestock compaction until vegetation is reestablished.
    - Fencing. Ensure the security fence around the solar facility is restrictive enough to prevent predators from entering or livestock from escaping. Use temporary fencing as necessary to create paddocks for rotational grazing.
- ***Pollinator Habitat with Apiary***
    - Management Plan**.** Create a management plan with an apiarist to ensure solar and pollinator habitat integration.
        - Prioritize planting native seed mixes with diverse species well-suited for the site-specific conditions (i.e., upland vs. wetland species).
        - Choose seed mixes that can provide both a food source and overwintering habitat.
        - Plan how many hives would be suitable for the amount of pollinator habitat being created.

        - To provide a pollinator habitat, mowing should be done infrequently to allow plants to flower. Establish a mowing schedule and identify mowing methods (i.e., weed whacking vs. lawnmower). Determine how short vegetation should be cut.
        - For more information regarding beekeeping, please refer to DACF's Apiary Program webpage: https://www.maine.gov/dacf/php/apiary/index.shtml
    - Design the solar facility equipment, layout, panel height, panel spacing, and overall design to be compatible with the chosen pollinator plants to be planted and apiary location.
        - Ensure panel height is suitable for the chosen plant seed mix to ensure panels will

not be shaded by vegetation.

        - Consider enclosing the apiary within a fenced area to prevent bears from accessing the hive. However, if the apiary is fenced, ensure that it provides ease of access for the beekeeper.

    - Safety**.** Secure any exposed electrical wires to the solar equipment and design the project with the safety of beekeepers in mind.

    - Pesticides**.** Avoid using pesticides or herbicides on-site or using seed mixes pre-treated with pesticides. If neighboring farms use pesticides and herbicides, determine if an apiary would be suitable for the site or if another location should be chosen.

    - Safety**.** Secure any exposed electrical wires to the solar equipment and design the project with the safety of beekeepers in mind.

- ***Crop Production***

    - Agricultural Plan**.** Create an agricultural plan with the farmer to ensure the successful integration of solar and crop production. Identify what crops have historically grown successfully at the site or in the region. Choose crops that would be most suitable for site-specific conditions.

    - Design the solar facility equipment, layout, panel height, panel spacing, and overall design to be compatible with the chosen crop(s) to be planted and farming equipment to be used. Consider the following elements to determine what would work best for the project in conjunction with crop production:

        - Fixed-tilt vs. tracking panels
        - Bi-facial vertical panels vs. horizontal panels
        - Microclimate between panels vs. under panels

    - Water**.** Plan how a water source will be provided for the crops. Will there be a water source on site, or will water be brought in via a truck or trailer?

    - Safety**.** Secure any exposed electrical wires to the solar equipment and design the project with the safety of farmers in mind.

    - Minimize Soil Disturbance During Construction**.** See "Prevent Soil Compaction" and "Minimize Soil Disturbance" in the "During Construction" section above on page 4.

Reporting Practices for Solar Developers

- **Ongoing Reporting.** The solar developer should immediately report to the landowner any need for remediation work identified during seasonal inspections. The solar developer should determine with the landowner what remediation actions to undertake before work commences unless otherwise agreed.
- **Annual Report.** The solar developer should consolidate their annual observations about the project area into an annual report for the landowner. The report should i) include images of any adverse impacts to the land and document the remediation process and results, and ii) identify any long-term projects or changes in maintenance going forward and what additional permits or approvals may be needed.