

Guidance for Developing a Vegetation Establishment and Management Plan for Solar Facilities



Minnesota Department of Commerce
Division of Energy Resources
Energy Environmental Review and Analysis

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This document is a collaboration between the Minnesota Department of Natural Resources, Minnesota Department of Agriculture, Commerce Department, and the Board of Soil and Water Resources. This document assists agencies in the review and approval of vegetation establishment and management plans for solar facilities. It also provides guidance for applicants and permittees seeking solar permits in Minnesota as they develop vegetation establishment and management plans for their projects.

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Developing a Vegetation Establishment and Management Plan

Section One: Introduction

Vegetation makes developed areas attractive, useful, and valuable. What is not seen, is the planning and management required for successful vegetation establishment. With the growth of solar projects in Minnesota, there is an opportunity to develop “stackable” benefits; that is additional benefits beyond the production of renewable energy. Using native plants that are pollinator friendly, suitable for grazing, and beneficial to the landscape can provide stackable benefits such as: improved soil health, water storage, water filtration, carbon sequestration, reduction in wind and surface water erosion, wildlife habitat, food production, and lower local energy costs. This guide provides the tools and information needed to develop, implement, and monitor long-range vegetation management plans.

What is a Vegetation Establishment and Management Plan and Why is it Needed?

Vegetation management plans (VMPs) detail how a site will be vegetated, maintained, and monitored over time. All utility scale solar sites permitted by the Minnesota Public Utilities Commission require a vegetation management plan and will require the information listed in this document. Other state agency resources such as the Board of Water and Soil Resources Habitat Friendly Solar, DNR’s Prairie Establishment & Maintenance Technical Guidance for Solar Projects, and the DNR’s Commercial Solar Siting Guidance all provide information that can help companies produce successful plans. A complete and approved vegetation management plan is required prior to submitting a site permit application.

Benefits of a Well Written and Organized Vegetation Establishment and Management Plan

The first step to a successful project is a thoughtful, well organized VMP! It will help you focus on management goals and objectives and develop a plan that will save time and resources in the long run. In addition to the operational benefits, a well-developed VMP using these guidelines ensures that you will have the necessary information in the VMP to begin agency review. Additional information may be required but following these guidelines creates a solid foundation.

Section Two: Vegetation Establishment and Management Plan Template

1. Executive Summary

This should be brief and include the following points:

- Introduction, including the name of the project, the project developer and owner.
- Location and size of the project. Include a locator map.
- Broad vegetation goals (for example restore the site with native grasses and forbs, provide pollinator habitat, etc).

2. Overview of the Vegetation Establishment and Management Plan

A description of the following is required:

- a. Vegetation establishment and management goals and objectives. This should be a broad overview of the project goals and objectives. More detailed information is required in section 4.
- b. Example goals include but are not limited to pollinator habitat, soil stabilization, water infiltration, carbon sequestration, panel cooling, songbird habitat, agricultural (haying, cropping, apiary, etc.). The goals should be clear and concise.
- c. Describe the management objective(s) required to meet each goal. Examples include but are not limited to management of woody vegetation, management of undesirable species, mowing, herbicide application, grazing, etc.

3. Site Description

An adequate site description provides agencies with the information needed to assess potential environmental concerns related to the proposed facility both at the site scale and, more broadly, at the scale of the adjoining region. This description will assist the applicant and agencies to identify both concerns and opportunities to maintain the ecological functions of the region.

- a. Describe the project location in terms of the major jurisdictional boundaries and physical features in or near the project area. At a minimum, these features should include counties, townships, cities, major roads, water features and natural environments in the local region. Provide a map showing all relevant features.
- b. Describe the size of the proposed project in terms of acres and boundary distances described in terms of feet. Provide a map at site scale showing the project boundary and features identified in 3a (above).
- c. Describe the general historic and current vegetation on the site, adjacent to the project, and within the local region.
- d. Describe land use types on the site, adjacent, and within the local region.
- e. Describe the soils on and adjacent to the site using the USDA-NRCS Soil survey. Include on-site investigations conducted to verify and adjust mapped soil locations as well as a discussion of soil types including hydric soils, drainage class, depth of topsoil, prime farmland designation, depth to water table, frequency of flooding, and any other soil characteristic relevant to vegetation establishment and management. Provide a map at site scale showing the project boundary and the identified soil types grouped by drainage class.
- f. Describe the topography within and adjacent to the site including the general landform and any specific high points, low points, and swales that will direct water on to or away from the site using 2' contours. Provide a map of the site and adjacent areas including a

contour interval of 2' and any areas that may be affected by grading or other site construction changes.

- g. Hydrology
 - i. Describe the general hydrologic conditions of the site and adjacent areas noting any significant features including public waters, water bodies, drainage ways, wetlands, farmed wetlands, restorable wetlands, sinks, hydric soils, and other features that affect water movement across the site and adjacent areas (check restorable wetlands layer and National Wetlands Inventory). Provide a map that locates all the identified features.
 - ii. Describe the known presence and likelihood for agricultural drainage features located on and adjacent to the site including drainage tile and inlets, private drainage ways, drainage outlets, and public drainage ditches. Provide a map that locates all the identified features.
- 4. Description of Management Areas or Units (include maps)
 - a. Define and describe the management area(s) or unit(s) addressed in the plan. Include a brief description of current and future management (such as current area is a harvested soybean field to be planted with natives in fall of 2021 and managed using sheep grazing). Be sure to include maps for each future management area and unit at an appropriate scale so management areas are visible. Large sites may require multiple maps.
 - b. Each area should include but is not limited to the following: areas between the arrays, perimeter plantings, and any other designated management areas within or adjacent to the site.
- 5. Description of Management Objectives for each Area/Unit (Objectives should be specific, measurable, attainable, realistic, time-bound)
 - a. Describe the long-term management objectives for each management area/unit (5 years after establishment to end of permit). For example: establish and maintain native prairie vegetation; develop a monitoring plan to evaluate target objectives such as percent of site dominated by native grass and forb cover will be a minimum of 65% with an ultimate goal of equal or greater than 80%. If a project nears 65%, describe how vegetation management will include targets for action such as supplemental seeding or other management.
 - b. Describe the short-term management objectives for each management area (site restoration and seed establishment 0-5 years). The emphasis will be on management strategies used during the vegetation establishment phase. For example: establish a cover crop for soil stabilization, reduce weeds and non-native species by spot-spraying, targeted re-seeding of areas with low germination (by year 5), etc.
- 6. Establishment and Management Prescriptions
 - a. Site Prep
 - i. Schedule/sequence of planned construction, planting, and management activities
Provide a table showing the planned sequence for construction, planting and management activities including the proposed month and summary of the activity.
 - ii. Soil and subsoil handling during grading and trenching
Summarize steps that will be taken to protect soil health during the construction and site preparation process including steps to avoid mixing soil layers and preserving the biological health of the upper soil layers. Please also describe any soil additions or enhancements needed.
 - iii. Eliminating soil compaction prior to seeding

Describe plans for preventing soil compaction across the site. Examples include loosening any compaction with soil rippers or tillers prior to final site preparation prior to seeding.

iv. Seedbed preparation

Summarize plans for seedbed preparation following construction activities including the management of weeds, the use of temporary covers, and equipment such as disks, tillers, harrows, or rollers, or other methods to prepare the seedbed for seeding.

v. Invasive species prevention

Describe how the project will prevent invasive species establishment and spread. Include equipment staging, transport, inspection, and cleaning. For more detailed guidance refer to the [Come Clean, Leave Clean website](#). Detail how the site will be inspected and managed for weeds and invasive plant species (see state list of [noxious weeds](#) and the DNR [terrestrial invasive plants website](#)) at the project site during the establishment phase.

vi. Cover crop planting and temporary covers (seed germination inhibitors, herbicide rotation restrictions)

Species such as oats, barley and other cereal grains are often used as temporary covers prior to seeding permanent seed mixes or are used as a nurse crop and seeded at the time of native seeding. Describe any planned use of cover species at the site.

b. Seeding and Planting

i. Seed Mixes (include scientific names, ounces/ac, seeds per sq ft., % of mix based on seeds per sq ft., and seed origin)

Provide a complete list of seed mixes for all areas of the project site in Excel format as well as a map denoting the seed mix areas overlaying solar operations (array, border, and detention areas). Seed mixes should be designed to meet site goals. A framework for establishing successful native seedings using regionally appropriate species is provided in the [DNR's Prairie Establishment & Maintenance Technical Guidance for Solar Projects](#), a portion of which is excerpted here for reference.

Seed mixes should include:

- A minimum seeding rate of 40 seeds/sq. ft.²
- At least 40% of the total seeding rate should be composed of perennial forbs
- 7 or more native grass/sedge species with at least 2 species of bunchgrass
- 20 or more native forbs with at least 3 species in each bloom period: Early (April-May), Mid (June-August), and Late (August-October).
- Fulfill the guilds: cool season grasses; warm-season grasses; sedges/rushes; legume; and non-legume forbs
- Include species from different plant families to support the widest diversity of pollinator species

ii. Visual Screening and Maintenance

If visual screening is considered for the project site, provide a complete list of plants to be planted as well as the size of the plant material (container size or caliper size for ball and burlap or trees to be installed with a tree spade). Also summarize the planned planting methods for all trees and shrubs, including guidance for ensuring that trees and shrubs are planted using best practices (see the resources in Appendix B).

iii. Pesticide drift

Summarize steps that will be taken to ensure that any pesticides used at or near the project site will not drift and impact native vegetation, insects, or other organisms. Summarize plans for preventing the impact of pesticide drift from surrounding agricultural areas through the planting of evergreens or seeding areas without forbs to

prevent impacts to pollinators. See [Protecting Conservation Plantings from Pesticide Drift](#) for more information.

iv. Array Planting

Describe how planting will be conducted under solar arrays including the sequence of planting (which areas will be planted and when) planned month of planting, planting method (drilled, broadcast, bareroot or plugs), and equipment to be used.

v. Border Area Planting

Describe how plantings will be conducted in border areas including the planned month of planting, planting method (drilled, broadcast, bareroot or plugs), and equipment to be used.

vi. Stormwater Detention Area Planting

Describe how planting will be conducted for water detention areas including the planned month of planting, planting method (drilled, broadcast, bareroot or plugs), and equipment to be used.

c. Describe all that apply:

i. Establishment Mowing (first two years)

Summarize plans for mowing during the first two years after seeding to prevent weeds from producing seed and to decrease competition for native plants. Provide information about the frequency and height of mowing.

ii. Management Mowing (year three and beyond)

Summarize plans for mowing of vegetation to manage weeds and/or manage the height of vegetation at year three and beyond.

iii. Grazing

Describe plans for grazing with compatible livestock to manage vegetation. A grazing plan is needed and should summarize the goals of grazing, the type and number of animals to be used, plans for fencing, the time and duration of grazing, and the decision making process for ensuring that vegetation is not over-grazed. Adaptive management grazing should be used on solar sites and coupled with highly diverse plantings that include species from each functional group (cool-season grasses, warm-season grasses, sedges/rushes, legume forb, non-legume forb).

iv. Haying

Describe plans for haying vegetation at the site to manage weeds and/or manage the height of vegetation at year three and beyond. Haying/mowing should be done at a raised height of 4-6 inches once a season. Haying or mowing below the recommended height can damage the long-term health of the planting. Hayed/mowed vegetation should be bagged and removed off site to prevent smothering new growth. Haying/mowing equipment should be cleaned prior to use on site to prevent the spread of non-native and invasive species into the planting.

v. Tree and Shrub Control

Describe the steps that will be taken to control trees and shrubs at the project site including methods and timing of control.

vi. Spot Herbicide Application

Describe plans for the use of spot herbicide application to control undesirable vegetation. Include herbicide type, surfactant, rate, and frequency.

vii. Control and prevention of invasive species (please note this discussion focuses on invasive species control during seeding and planting as opposed to site preparation in 6a).

Describe steps that will be taken to inspect for and manage invasive plant species (see state list of [noxious weeds](#) and the DNR [terrestrial invasive plants website](#)) at the project site for the lifespan of the project. Summarize how practices will be combined to achieve control of species that are threats at the project site.

7. Vegetation Monitoring and Adaptive Management

- a. Describe monitoring protocols (this should be reflective of management objectives) to be used on site.
- b. For compliance with the PUC permit and the Agricultural Impact Mitigation Plan, site monitors are required during construction to ensure soil health is maintained and during operation for ongoing vegetation monitoring. Construction monitoring focuses on reducing impacts related to construction, such as soil compaction, soil erosion, stormwater run-off, and soil separation and storage. After construction, the site monitoring focuses on meeting vegetation establishment and management plans set forth in this document.
- c. Vegetation monitoring should occur annually during the establishment phase (first 5 years) and continue through the management phase (years 5 through the end of the permit).

Monitoring methods should provide an unbiased assessment of each management unit within the overall site. Quantitative measures may be supplemented by qualitative measures to assess how well the project's management objectives are being achieved.

- *Quantitative* – Quantitative techniques allow for comparisons of subsequent reporting to understand the progression of vegetation establishment over time. Vegetation should be sampled using standardized techniques with fixed sample locations and photo points. Include percent vegetation cover and estimated species richness. Report the seed mix planted and assess estimated success rates for each species.
- *Qualitative* – Include systematic monitoring of location-specific management issues, including noxious weed/invasive species populations, localized surface erosion issues or other disruption of established vegetation, including impacts related to operations.

Monitoring should address and reflect stated project goals. It should evaluate seed mixes and associated planting areas for establishment, including species present and percent cover; presence of invasive species and subsequent management activities needed—this includes both species on site and early detection of new invasions. A timeline of monitoring activities should be included in this section.

d. Monitoring Team/Consultant

A qualified third party independent agency monitor (e.g., the project's agricultural monitor and environmental inspector), with sufficient botanical experience identifying native plants, native plant communities, invasive species, and non-native species typical of Minnesota, should complete the vegetation monitoring to ensure an unbiased reporting of vegetation establishment.

e. Projected Outcomes

Provide an assessment of anticipated outcomes. For example, if a goal is to meet the pollinator habitat friendly standard, is the project on track to do so? Include a timeline for projected outcomes.

f. Adaptive Management

An adaptive management approach will use the results of the annual report and other site visits throughout the year to determine vegetation management measures necessary to achieve project objectives. Explain how the adaptive measures will aid in meeting project objectives. Describe thresholds for implementing adaptive management as well as the type of management, frequency, and duration of management activities to meet project goals. After adaptive management measures are implemented, provide an updated timeline of activities.

8. Annual Reporting

Submit an annual report for the project in e-dockets (if applicable). Vegetation monitoring results shall be submitted as an annual monitoring report for each growing season, to be submitted by January 31 of the following year. If the project is committed to achieving “[Habitat Friendly Solar](#)” status, specific reporting requirements are necessary to maintain project compliance. At the end of the third year of vegetation establishment (by December 31) for the project, and every three years afterwards, a qualified natural resource professional with sufficient botanical experience identifying native plants, native plant communities, invasive species, and non-native species typical of Minnesota, must complete the [Established Project Assessment Form](#) (updated 05-2020). Submit the form, along with at least three photo-point records (site images showing the current vegetation taken at fixed points and revisited throughout the duration of the project), to local government staff who have approval responsibilities for the project or other BWSR-designated representatives. Submitting these materials keeps the permittee on the list of projects meeting standards and enables the permittee to promote the array as a MN Board of Water and Soil Resources “Habitat Friendly Solar” project. In addition to completing a full assessment every three years, yearly site inspections are important to identify issues with weeds, erosion, or other problems that need to be addressed. If projects have significant problems, additional discussion about potential solutions may be needed among project managers, local government staff and BWSR to ensure that projects can remain on the list of projects meeting standards.

- a. Include a summary of site conditions and management activities to meet management objectives by management area/unit.
- b. Description of adaptive management actions implemented to meet management objectives (see Section 6.4).
- c. Description of management challenges (unanticipated weather events, staffing, etc). Discuss specific management challenges faced by the project during the reporting year. Describe how these management challenges hindered the establishment of the species in the seed mix for the site. For example, include details regarding seed availability, weather events, invasive species, staffing, or other constraints.
- d. If the project is committed to achieving and maintaining “Habitat Friendly Solar” status, describe any barriers or challenges that may influence success.

Section Three: Figures and Maps

Maps and their associated data are a critical component of a vegetation establishment and management plan. This section provides general guidance for preparing figures and maps. Additionally, the maps listed below should be included in the appropriate section within the VMP. Oversized maps, drawings, or figures can be included in an appendix.

When aerial photos are used as a base layer a scale of at least 1:4800 is necessary. The extent of the aerial photography must be inclusive enough to show the landscape context within which the proposed facilities would be placed and will require the map extent to go beyond the project boundary. Rectified orthophotos using GIS are preferred (reduced size aerial photos are not adequate). The most current version of the ESRI ArcGIS platform is preferred (unless other data forms have been agreed upon). All data (shapefiles are preferred) used to create the following maps must be submitted to EERA upon filing the VMP.

In some cases, providing all the layers requested on a single map is not practical. Maps should provide cartographic clarity as well as providing the necessary geographic information below.

Obtaining Data Layers

Data layers and shapefiles for use with ArcGIS can be obtained from several sources, including but not limited to:

Minnesota Geospatial Commons

Provides and maintains certain statewide geographic data, including aerial photographs.

<https://gisdata.mn.gov/>

Natural Resource Conservation Service (NRCS)

<http://www.mn.nrcs.usda.gov/technical/soils/digi.html><https://www.nrcs.usda.gov/wps/portal/nrcs/site/soils/home/>

Minnesota State Geological Survey

<http://www.geo.umn.edu/mgs/><https://www.mngeo.umn.edu/>

US Geological Survey

<http://www.usgs.gov/>

State Historic Preservation Office

<https://mn.gov/admin/shpo/>

List of Maps

Please include maps in the relevant section of the plan. It is quite likely that in addition to including maps(s) in the relevant section, an appendix or map book will still be necessary.

1. Site Location Map

Include county and municipal boundaries, cities, villages, lakes and rivers, and all major roads and highways delineated. Include a state locator map. Extent should be at least 3-5 miles from the project boundary. Include the nearest city or town to the site.

2. Provide a project area map with a recent (within the last 3 years) aerial photograph as a base. Include:
 - a. Boundaries of the project area,
 - b. Location of all proposed arrays
 - c. Location of any new substation facilities or existing substation expansion
 - d. Location of collector circuits, access roads
 - e. Fencing
 - f. Seeding zones and specific seeding plans
 - g. Detention ponds
 - h. Overlay onto existing contour map
 - i. Border plantings within and adjacent to the site boundary

3. Preliminary Site Plan including the project area and facilities. Provide an overview map of the site and a site plan for each array. Include enough detail to sufficiently evaluate vegetation establishment and management activities following this section. Plans should be drawn to scale.
 - a. Detailed layout and plan dimensions of all proposed construction elements
 - b. Detailed site grading plan including location of any relocated topsoil/subsoil.
 - c. Provide a map that locates all the identified features that could affect vegetation establishment and management.
 - j. Profile and detail drawing(s) of all proposed construction elements (solar infrastructure, detention ponds, drainage, fencing, roads etc.) including dimensions, elevations, and grades as applicable.
 - k. Construction notes on plans (as needed) to ensure accurate interpretation of drawings and to supplement construction specifications, methods, and materials specification. C

4. Cut and Fill map showing existing and proposed contours.

5. Land Use Map of Project Site and Surrounding Properties
 - a. Include existing topography at 2' contours.

6. Soil Survey Map (or other soil information if Web Soil Survey not available for the area). Within each drainage classification provide the types of soils.
 - a. Drainage classification
 - b. Location of hydric soils

7. Existing Wetlands Map (approved delineation or estimate based on best available data) and restorable wetlands
 - a. Wetland Maps
 - b. MN Wetland Inventory (MNWI) Maps up to ¼ mile from the project boundary). Provide maps showing NWI wetlands within and around the project area boundary. Include solar arrays and all connecting facilities (roads, collector circuits etc.) without obscuring map details. Identify public water wetlands.
 - c. Delineated Wetlands Maps (within the project boundary)
 - d. Wetland Type
 - e. Flood Insurance Rate Maps (if project is in a floodplain).

8. Existing land cover within ¼ mile of the project boundary (current dominant vegetative cover of site and surrounding area). Include additional information regarding grasslands (e.g. previous pasture, conservation easement, remnant prairie, or restored prairie).
9. Land Ownership (natural resources and public ownership)
 - a. Public waters
 - b. State, federal, and county land ownership
 - c. Conservation easements
 - d. Unique natural resources (MBS sites, natural plant and aquatic communities)
10. Seeding/Planting Zone Map – map clearly showing labeled zones where various planting/seeding will be conducted and specific seed mixes to be used. Use air photo or topographic map as a base.
11. Monitoring Plan Map showing proposed monitoring locations.
12. Site Photographs

Appendices:

- A. Maps and Figures
- B. Resources for Applicants, Developers, and Permittees

Minnesota DNR (MDNR)

- [Commercial Solar Siting Guidance](#)
- [Prairie Establishment & Maintenance Technical Guidance for Solar Projects](#)
- [Considerations for Siting Solar Power Facilities near Lakes and Rivers](#)

Minnesota Board of Soil and Water Resources (BWSR)

- [Habitat Friendly Solar Program](#)
- [Habitat Friendly Solar Program](#)
- [Project Planning Assessment Form \(updated 05-2020\) \(pdf\)](#)
- [Established Project Assessment Form \(updated 05-2020\) \(pdf\)](#)
- [Monitoring Form & Meander Survey Guide \(updated 02-2021\) \(pdf\)](#)
- [Fact Sheet on Protecting Conservation Plantings from Pesticides \(pdf\)](#)
- [Sample Habitat Friendly Solar Planting Plan Specifications \(pdf\)](#)
- [Template Pesticide Letter Word Document \(docx\)](#)
- [Local Government Solar Toolkits](#): The Great Plains Institute has developed toolkits for planning, zoning, and permitting of solar projects for Minnesota and other Midwest states

Minnesota Department of Agriculture (MDA)

Resources for surface and subsurface drainage systems:

<https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17551.wba>

<https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=18364.wba>

<https://extension.umn.edu/agricultural-drainage/designing-subsurface-drainage-system>

<https://extension.umn.edu/crop-production/agricultural-drainage>

Resources for soil compaction mitigation:

[https://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/agdex13331/\\$file/510-1.pdf?OpenElement](https://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex13331/$file/510-1.pdf?OpenElement)

<https://extension.umn.edu/soil-management-and-health/soil-compaction>

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwiqVJfF_5TvAhUDK80KHYY0WArEQFjAPegQIIBAD&url=https%3A%2F%2Fwww.researchgate.net%2Fprofile%2FMohammad_Mehdizadeh%2Fpost%2FArticle-Research-to-evaluate-the-compaction-of-soils-under-2-years-test%2Fattachment%2F5b73a3fdcf4a7f7ca5a5ee4%2FAS%253A659738303922187%25401534305277812%2Fdownload%2FA3367.pdf&usq=AOVaw2Gby3A0hIHq3SEdiKEhfOw

<https://fyi.extension.wisc.edu/forage/identifying-and-managing-soil-compaction-in-field-crop-production/>

Minnesota Pollution Control Agency (MPCA)

- [Stormwater Management for Solar Projects](#)
- [MN Stormwater Manual](#)

Tree Planting Guidelines:

- DNR Planting Specifications
<http://files.dnr.state.mn.us/assistance/backyard/treecare/howtoPlantTree.pdf>
- MNDOT Plant Specifications
<http://www.dot.state.mn.us/pre-letting/spec/2000/sp3861.pdf>
<https://www.dot.state.mn.us/pre-letting/prov/order/2571.pdf>
- Minnesota Stormwater Manual (PCA) - Design guidelines for tree quality and planting
https://stormwater.pca.state.mn.us/index.php/Design_guidelines_for_tree_quality_and_planting_-_tree_trenches_and_tree_boxes
- USDA NRCS Minnesota – Tree/Shrub Establishment
https://efotg.sc.egov.usda.gov/references/public/MN/612mn_Tree-Shrub-Establishment_Specifications_12-2016.pdf
- UMN Extension - Recommended Trees for Minnesota <https://extension.umn.edu/tree-selection-and-care/recommended-trees-minnesota>