

## SECTION 10 BUFFERS

### A. Introduction

Vegetated buffer strips are an important means for maintaining the water quality of surface waterbodies by infiltrating stormwater runoff, and they can provide habitat and travel corridors for wildlife. Buffer strips may also provide a vegetated visual screen which can serve to lessen the visual impact of projects. The Hartland Solar Project benefits from the presence of extensive natural vegetated buffer areas surrounding the Project site.

### B. Project Siting and Design

The Project has been sited to minimize visual impacts and will be constructed to maintain vegetated setbacks from sensitive resource areas (i.e., wetlands, streams, vernal pools) to the maximum extent practicable. The solar arrays, substations, gen tie line and associated access roads have been sited and designed to minimize potential adverse visual impacts by utilizing surrounding natural vegetated buffers, existing topography, and forested land to conceal the Project from any adjacent residential properties and public roads. The nearest residential property to the Project is located 910 feet east of the interconnection substation and 5,070 miles east from the solar arrays. The nearest public road to the Project is Route 151 (5,050 miles to the north) and Mun Flat Road (1,570 miles to the west). Extensive woodlands lie between both the nearest residential property and public roads. Waterbodies and wetland areas within or adjacent to the development will be protected from potential sedimentation and surface runoff by the inclusion of vegetated buffer areas into the Project design. Due to the proposed use of the site as a solar facility, it is necessary to clear trees in select areas to reduce shading impacts to solar panels. These cleared areas at the perimeter of the facility will be maintained as vegetated meadow buffers that will provide stormwater infiltration and wildlife habitat. Vegetated buffers are an important tool to protect water quality and ensure a low-impact development profile for this Project.

To maintain natural buffers adjacent to the Project, all resource areas and clearing limits will be flagged in the field prior to the start of construction. The Engineering Procurement and Construction contractor selected for Project construction and the environmental monitor employed by the Applicant will be responsible for ensuring strict adherence to the protective measures identified in this application.

### C. Vegetation Management Plan

If construction activity requires work within an identified buffer area, disturbance will be minimized and all disturbed areas will be re-seeded immediately following completion of construction, or the following spring if construction ends during winter conditions.

The Applicant has prepared a VMP containing vegetation maintenance procedures related to Project operations. The VMP, provided in Exhibit 10-1, contains descriptions of the procedures and maintenance activities that apply to vegetation management throughout the Project Area, including within the following resource areas and associated buffers:

- Wetlands;
- Streams;
- Significant Vernal Pools and Potential Significant Vernal Pools;
- DWAs; and
- Potential Historic Sites.

The Applicant will implement the VMP following the start of Project operations and will continue to follow it during all subsequent vegetation maintenance actions.

## Hartland Solar Project

### MDEP Site Location of Development Application

#### D. Conclusion

Additional information regarding stream and stormwater buffers are provided in Section 7 (Wetlands, Watercourses, Wildlife and Fisheries) and Section 12 (Stormwater Management) respectively. Due to the remote location of the Project and limited scenic impacts from adjacent uses there are no visual buffers proposed for the Project.

The Applicant has made adequate provision for providing Project buffers.

#### Exhibits

- Exhibit 10-1 Post-Construction Vegetation Management Plan

**EXHIBIT 10-1      POST-CONSTRUCTION VEGETATION MANAGEMENT PLAN**

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# Post-Construction Vegetation Management Plan

Hartland Solar Project  
Somerset County, Maine



*Prepared For:*

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**TABLE OF CONTENTS**

	Page
1.0 Introduction	1
2.0 Vegetation Maintenance in Overhead Electrical Line Corridors	1
2.1 Mechanical Techniques .....	2
2.2 Herbicides .....	2
3.0 Vegetation Maintenance within Protected Waterbody Buffers	5
3.1 Additional Vegetative Maintenance Restrictions within Standard Waterbody Buffers	5
4.0 Vegetative Maintenance within Significant Vernal Pools	6
5.0 Vegetative Maintenance within Mapped Deer Wintering Areas	6
The following restrictions apply to vegetation maintenance within mapped DWAs:	6
6.0 Maintenance Procedures for Solar Arrays and Associated Shade Management Areas	7
6.1 Solar Array Area – Stormwater Meadow Buffers .....	7
6.2 Solar Array Area – Shade Management Areas.....	7
6.3 Solar Array Area – Historic Sites .....	7
7.0 Systems for Locating and Marking Restricted Areas	8
8.0 Training of Maintenance Personnel	8
8.1 Personnel and Schedule.....	8
8.2 Content of Training Sessions .....	8
9.0 Invasive Species	9
9.1 Existing Invasive Species in the Area .....	9
9.2 Invasive Species Monitoring Program .....	9
9.3 Invasive Species Control Strategies .....	10
10.0 References	13

**LIST OF FIGURES**

	Page
Figure 1. Diagram Illustrating Minimum Vegetation Maintained Between Vegetation and Conductors for the Hartland Solar Project; Somerset County, Maine, 2023. ....	3

**LIST OF APPENDICES**

- Appendix A. Map
- Appendix B. Representative Invasive Plant Photos
- Appendix C. Invasive Plant Fact Sheets

## 1.0 INTRODUCTION

Hartland Solar Facility, LLC (Owner) has prepared this Vegetation Management Plan (VMP) as a stand-alone document containing restrictive maintenance requirements that apply to vegetation management within the Project Area (Figure 1). During construction, construction techniques and mitigation measures and restrictions will be implemented to minimize potential adverse effects on natural resources as contained within the Construction Stormwater Pollution Prevention Plan (SWPPP) detailed in the Civil Site design and contained within the Project's Site Location of Development (Site Law) permit application within Section 14 (Basic Standards).

The requirements presented in this VMP apply to routine maintenance and are not intended to apply to emergency maintenance and repair actions. This VMP also includes the anticipated procedures for managing invasive plant species located within the solar arrays and associated shade management areas, along access roads, and within the electrical collector lines (Collector) and generation interconnection line (Gen-Tie) corridors.

The goal of this VMP is to supply the Applicant's maintenance personnel and contractors with a single, cohesive set of vegetation maintenance specifications for the facility during operations after the construction phase of development. The resources and buffer areas subject to restrictive maintenance requirements include:

- Stormwater buffers (Solar Array Area, Access Roads, and Substation Area)
- Wetlands (Solar Array Area, Collector, and Gen-Tie);
- Streams (Gen-Tie);
- Significant Vernal Pools (Solar Array Area);
- Deer Wintering Areas (Gen-Tie); and
- Potential Historic Sites (Solar Array Area).

There are no Inland Waterfowl and Wading Bird Habitats or Significant Sand & Gravel Aquifers located within the Project Area. In locations where individual restrictions or procedures overlap or multiple restrictions apply, the more stringent restrictions and all applicable procedures will be followed by the Applicant's maintenance personnel and contractors.

Throughout construction, numerous construction techniques, mitigation measures and restrictions will be implemented to minimize potential adverse effects on natural resources. To continue that effort, the goal of this VMP is to supply the Owner's maintenance personnel and contractors with a single, cohesive set of vegetation maintenance specifications for use during routine operation of the facility.

## 2.0 VEGETATION MAINTENANCE IN OVERHEAD ELECTRICAL LINE CORRIDORS

The primary functions of routine vegetation maintenance activities are to maintain the integrity and functionality of the Collector and Gen-Tie corridors, ensuring access for emergency repairs, and facilitating safety inspections. The key management objective along these corridors is to control large woody vegetation, which is crucial for the integrity and safe operation of the transmission conductors. To achieve this, integrated vegetation management practices will be adopted. These practices will involve hand-cutting and selective use of herbicide, particularly in and around sensitive natural resource such as wetlands, vernal pools and streams. Mechanical mowing may occur to regain control of vegetation when typical maintenance procedures are insufficient.

Vegetation will be maintained as much as practicable to minimize any negative environmental impacts. Large trees will be removed during the initial clearing of the Collector and Gen-Tie corridors. Subsequent

maintenance activities during the operation of these corridors include the selective removal of capable species and dead or hazardous trees. Capable species are defined as vegetation capable of growing to a height that could interfere with the clearance required between conductors and vegetation. Sound industry practice requires that a minimum separation be maintained between vegetation and the conductors. Due to the sag of electric transmission lines between poles, which may vary with the distance between poles, tension on the wire, electric load, air temperature and other variable conditions, the appropriate clearance is typically achieved by removing all capable species and topping other vegetation exceeding 8–10 feet in height (Figure 1).

Once the vegetation in an area is sufficiently controlled (usually within 3–4 years following construction), vegetation maintenance practices will generally be implemented on a 4- or 5-year cycle. The maintenance cycle is dependent upon growth, weather, geographic location, and corridor width. Substantial branches that overhang the line corridor and any dead or damaged trees outside the corridor with the potential to contact power lines or come within 15 feet of a conductor (“danger trees”) may be removed as soon as they are identified.

The following procedures will be implemented during all vegetation maintenance activities to ensure that sensitive natural resources are protected:

- All resources and associated buffers will be flagged or located with a Global Positioning System (GPS) prior to any maintenance operations;
- All areas of significant soil disturbance will be stabilized and reseeded immediately following the completion of maintenance activities in the area;
- Equipment access through wetlands or over waterbodies will be avoided as much as practicable by using existing public or private access roads, with landowner approval when required;
- Construction mats or the equivalent will be used for equipment support if saturated soils are present; and
- If rutting or significant damage to wetland or waterbody bank vegetation occurs, the site will be repaired immediately following completion of maintenance activities in the area.

## 2.1 Mechanical Techniques

Mechanical methods of maintaining vegetation height along the Collector and Gen-Tie corridors post-construction will primarily consist of hand-cutting in and around sensitive natural resources such as wetlands, vernal pools and streams. Limited use of motorized equipment in areas directly accessible from public or private access roads also may occur. All capable species and any dead or danger trees will be cut at ground level, except in waterbody buffer zones. Large vegetation cut during routine maintenance will be removed, chipped, or flailed on site, or otherwise handled in accordance with the Maine Slash Law (Maine Forest Service 2017).

## 2.2 Herbicides

Herbicide application will be consistent with most New England utilities’ practices and will be used in conjunction with the mechanical methods of vegetation maintenance described above. Only herbicides registered and approved by the U.S. Environmental Protection Agency (EPA) and the Maine Board of Pesticides Control (BPC) will be utilized. The application will involve directional spraying of low-volume foliar treatments on targeted species along the Collector and Gen-Tie corridors. Herbicides may also be applied to cut stumps and surfaces of larger trees. This direct application to individual plant species, rather than a broadcast approach, ensures control only the targeted woody vegetation. As a result, low-growing plant communities consisting of grasses, forbs, and shrubs to remain unharmed. Selective herbicides also will be used to minimize the impacts to non-target species. Aerial application of herbicides will not be performed.

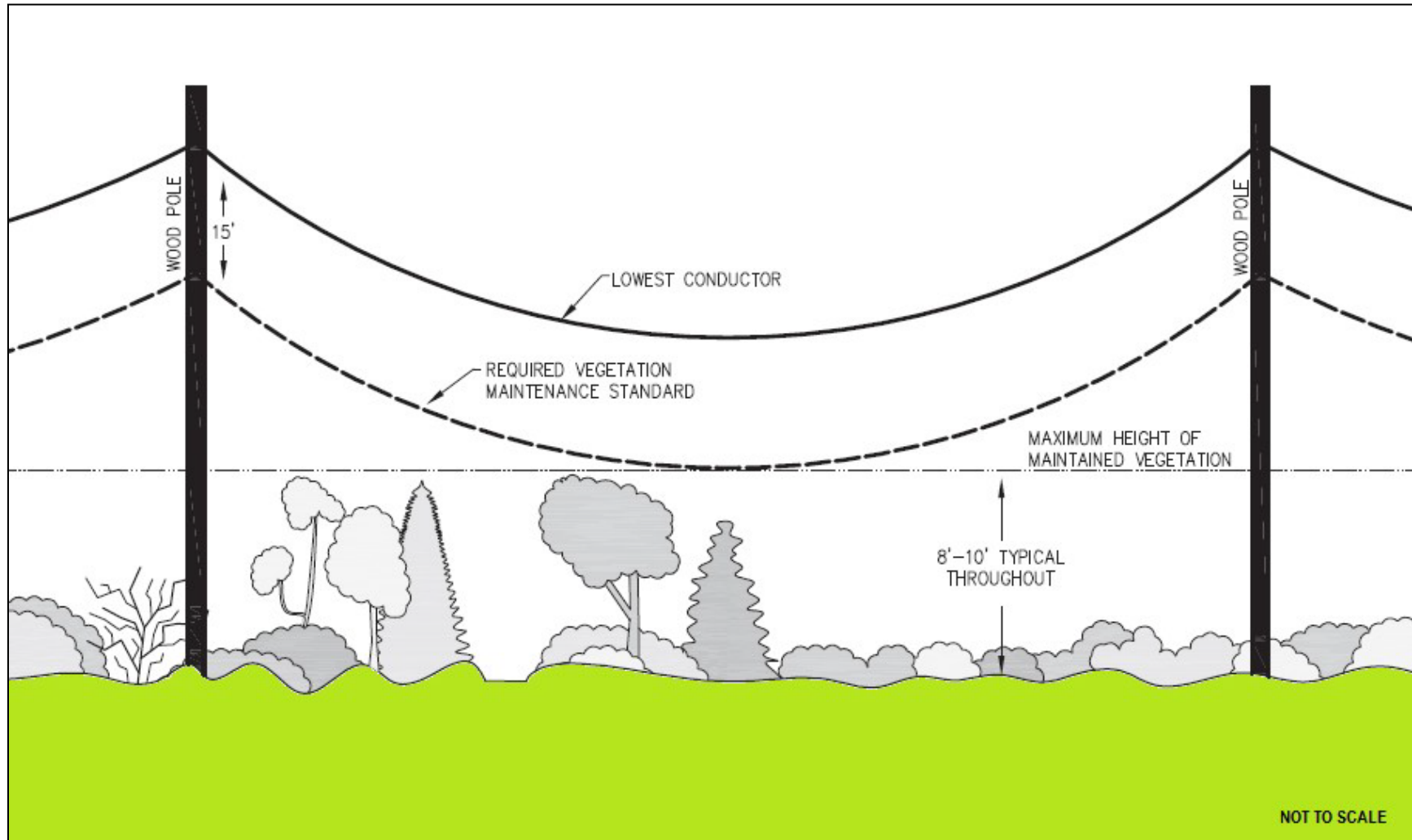


Figure 1. Diagram Illustrating Minimum Vegetation Maintained Between Vegetation and Conductors for the Hartland Solar Project; Somerset County, Maine, 2023.



The Collector and Gen-Tie corridors will likely receive herbicide treatment the year following construction and again 2 or 3 years after construction, to manage vegetation growth. When vegetation control is achieved, treatment will occur on a standard 4- or 5-year cycle or as needed. By using selective herbicide application methods, the line corridors will eventually consist of dense, low-growing plants and will impede woody vegetation from becoming established. Thus, fewer woody species will require treatment in future applications.

The following procedures will be implemented during vegetation maintenance activities involving herbicides:

- Herbicides will be used in accordance with the manufacturer's EPA-approved labeling and will not be applied directly to water or areas where surface water is present;
- Herbicides will not be applied, mixed, stored, or transferred between containers within any designated natural resource or stormwater buffer areas or applied within 25 feet of wetlands with standing water;
- Herbicides will not be applied, mixed, stored, or transferred between containers within 100 feet of vernal pool depressions;
- Herbicides will be used in strict accordance with the manufacturer's EPA-approved labeling and will not be applied directly to water or areas where surface water is present;
- Herbicides will not be applied, mixed, transferred or stored within designated buffers, or applied by broadcast application within 25 feet of wetlands with visible surface water or wetlands dominated by emergent or aquatic plants;
- Herbicides will only be applied, mixed, transferred, or stored near vernal pool basins or streams in accordance with BPC regulations;
- Herbicides will not be applied, mixed, transferred or stored within 100 feet of any known well or spring or within 100 feet of a home or other human dwelling. Please note that there are no known wells, springs or human dwellings identified within the Collector or Gen-Tie right-of-way (ROW);
- Herbicides will not be applied, mixed, transferred or stored within 100 feet of a dwelling or within 250 feet of any residences listed on the BPC's Pesticide Notification Registry;
- Herbicides with a low potential for mobility and low persistence in the environment will be used in sensitive areas such as wetlands;
- Herbicides will not be applied to any area when it is raining or when winds exceed 15 miles per hour, as measured on-site at the time of application;
- The foreman of every crew applying herbicides will be licensed by the BPC and will remain in eye contact and within earshot of all persons on his/her crew applying herbicides. At least one individual from any company applying herbicides must hold a Commercial Master License issued by the BPC and must be in Maine during any application. Application of pesticides will occur in accordance with the Maine Pesticides Control Act (Maine Forest Service 2020), including regulations to minimize drift, to maintain setbacks from sensitive areas during application, and to maintain setbacks from surface waters during the storing, mixing, or loading of herbicides;
- Chemicals will typically be mixed in a truck-mounted tank remaining on the access roads. Herbicides will be applied by spot-treating target species and will be performed by personnel with backpacks traveling along the ROW by foot or by all-terrain vehicle;

- Each target tree will be sprayed just enough to wet the foliage, while avoiding any dripping or run-off; and
- The location of all wetlands and vernal pools crossed by the Collector and Gen-Tie corridors will be shown on the final construction drawings. The presence of water on the surface will be determined prior to herbicide use in any wetland. The Owner will assure that all resources and buffers are located and properly delineated on the ground for clear identification by all herbicide applicators.

### 3.0 VEGETATION MAINTENANCE WITHIN PROTECTED WATERBODY BUFFERS

A minimum 100-foot maintenance buffer, measured from the top of bank on each side, will be established for all waterbodies crossed by the Gen-Tie. *Note: There are no waterbodies crossed by the Collector.* The streams crossed by the Gen-Tie are located within the Merrymeeting Bay Salmon Habitat Recovery Unit (National Oceanic and Atmospheric Administration 2020) necessitating additional precautions to protect water quality.

Special procedures and restricted activities will apply within these waterbody buffers during vegetation maintenance. Vegetation maintenance within waterbody buffers is typically conducted every 3 to 4 years, depending on growth rates and vegetation types. This section outlines the restrictions related to vegetation cutting and maintenance within all standard waterbody buffers. It is important to note that the vegetation maintenance procedures and restrictions applicable to typical ROW maintenance (Section 2.0) also apply within these buffers. The applicable procedures and restrictions include the BPC restrictions, restoring and stabilizing disturbed soils, disposition of slash in accordance with the Maine Slash Law, ROW access, the restrictions on waterbody crossings by equipment within the ROW, and the use of construction mats, low ground pressure equipment, and/or other procedures related to work in wetlands.

#### 3.1 Additional Vegetative Maintenance Restrictions within Standard Waterbody Buffers

The following additional restrictions apply to vegetation maintenance within standard waterbody buffers:

- Only capable species vegetation greater than 8 to 10 feet will be removed. No other vegetation, other than dead or danger trees, will be removed;
- Under most terrain conditions, removal of capable species and dead or danger trees will be accomplished by hand-cutting or by traveling into the buffer zone with low ground pressure tree harvesting equipment, and mats as necessary;
- No herbicides will be used, stored, mixed, or transferred between containers within the buffer areas;
- No refueling or maintenance of equipment, including chain saws, will occur within the buffer areas; and
- No accumulation of slash will be left within 50 feet of the edge of any waterbody.

The additional restrictions on vegetation maintenance within waterbody buffers will allow taller vegetation to provide additional shading of streams and reduce the warming effect of direct sunlight (insulation). Low ground cover will also remain to filter sediment in surface runoff. As a result, the buffers will continue to function in a similar manner as they did before construction. The restrictions are also intended to minimize ground disturbance and ensure that herbicides and petroleum products are not able to reach the waterbody via surface runoff or groundwater transport.

#### 4.0 VEGETATIVE MAINTENANCE WITHIN SIGNIFICANT VERNAL POOLS

One Significant Vernal Pool (SVP) and three potentially significant vernal pools (PSVP) were identified within or in close proximity to the solar array area and/ or Burrill Woods Road (VP01ML, ABA05EI, VP35EI, and VP08EI). The removal of vegetation is strictly prohibited within VP01ML, VP35EI, and VP08EI and their associated 250-foot Critical Terrestrial habitats (CTH). ABA05EI is located northwest of the western array cluster and all project development has been sited to avoid any direct impact to the pools CTH, however, selective tree removal may occur periodically within a designates area comprised of approximately 0.62 acres of the pools CTH. Trees greater than 6 meters in height may be removed periodically for shade management. Any removal of trees from within the CTH will be completed in accordance with the NRPA, Chapter 335 § 9(C) Habitat Management standards for Significant Vernal Pools in accordance with the following guidelines:

- (1) No disturbance or use of mechanized equipment will occur within 100 feet of the vernal pool depression;
- (2) No herbicide use will be allowed within the designated CTH area.
- (3) No vegetative maintenance will occur within any designated CTH area between April 1 and June 30 of any calendar year.
- (4) Removal of woody vegetation will be accomplished primarily by hand-cutting only, with limited use of motorized mowing equipment in areas that are directly accessible from within the developed area of the project.
- (5) Trees will be removed only the designated 0.62 acre area within the pools CTH;
- (6) The maintained portion of the CTH will remain as unfragmented forest with at least a partly closed canopy of overstory trees to provide shade, deep litter and woody debris.
- (7) The disturbance of the forest floor will be minimized during all tree removal activity;
- (8) Native understory vegetation and downed woody debris will be preserved during all tree removal activity.

#### 5.0 VEGETATIVE MAINTENANCE WITHIN MAPPED DEER WINTERING AREAS

The Gen-Tie corridor intersects an Indeterminant value mapped Deer Wintering Area (DWA). The mapped DWA has been altered by commercial logging activity in the past and does not provide contiguous adequate cover to support overwintering deer populations in the area of the proposed Gen-Tie corridor. Nevertheless, the Applicant will minimize impacts to the mapped DWA to the maximum extent allowed by ISO-NE standards.

The following restrictions apply to vegetation maintenance within mapped DWAs:

- Only those trees capable of growing to a height within 20 feet of a conductor within the next 3 to 4 years will be topped or removed. No other vegetation other than dead or danger trees will be removed;
- Tree topping is the preferred method of vegetation maintenance, unless the tree is dead or dying or unless topping will leave insufficient vegetation to sustain the tree;
- Within 50 feet on either side of each pole location in the DWA, focus will be given to retain coniferous species that will provide travel corridors across the cleared ROW. Deciduous, capable species will be selectively harvested, and coniferous species will be allowed to grow to the maximum allowable height as provided in the ISO-NE standards; and

- No herbicides use will be allowed within the mapped DWA.

## 6.0 MAINTENANCE PROCEDURES FOR SOLAR ARRAYS AND ASSOCIATED SHADE MANAGEMENT AREAS

During initial clearing activities prior to solar array construction, forested vegetation will be cleared within and around the proposed arrays to allow for construction and to prevent trees from shading solar panels. Clearing within the areas beyond the proposed solar arrays will generally involve cutting woody vegetation at ground level. Low growing herbaceous plants will generally remain uncut and/or the root systems will remain undisturbed during dormant season cutting. There are no streams within the Project solar array area. Vegetation clearing will be needed within wetlands to prevent trees from shading the panels (see Section 7.0 of the Site Law permit application for more information). The following practices will be implemented for vegetation clearing and management within delineated wetland boundaries:

- Removal of vegetation will be by hand-cutting or with low ground pressure tree harvesting equipment;
- Clearing will be done under dry or winter conditions to prevent wetland soil disturbance;
- No refueling or maintenance of equipment, including chain saws, will be performed within 100 feet of delineated wetlands, streams, or Significant Vernal Pools.
- Temporary erosion and sedimentation control measures (e.g., silt fencing) and/or erosion control berms will be implemented along the edges of areas proposed for clearing; and
- Ground disturbance caused by using harvesting equipment outside of the proposed grading limits will be repaired by returning the ground to its original contour, as needed, and seeding and mulching bare ground.

The following describes vegetation management procedures for areas within the fenced solar array area and shade management areas.

### 6.1 Solar Array Area – Stormwater Meadow Buffers

Stormwater buffers for the solar array area will consist of a meadow buffer underneath and throughout the fenced panel areas to provide for stormwater treatment. The meadow buffer shall be inspected for evidence of erosion resulting from panel drip. These conditions shall be corrected through soil reinforcements, if observed. Ground cover within the array area shall be mowed no more than twice per year.

### 6.2 Solar Array Area – Shade Management Areas

Shade management areas include Project areas outside the solar array fence line and cleared wetlands located within the solar array fence line that will not be impacted by solar array grading/installation. Maintenance inspections will occur twice each year and growth of trees or other vegetation that is shading the arrays will be trimmed as needed. Only trimming to maintain a vegetation height of approximately 6-8 feet is anticipated within the shade management areas following initial clearing.

### 6.3 Solar Array Area – Historic Sites

Three post contact historic archaeological sites were identified within the solar array area collectively known as the Burrill Homestead:

- a cellar hole with one intact wall and an associated depression and well on the north side of Burrill Woods Road east of the main north-south access road;

- a foundation stone and deflated stone wall on the north side of Burrill Woods Road west of the main north-south access road; and,
- a former barn area approximately 650 feet east of intersection of Burrill Woods Road and the main north-south access road.

The Burrill Homestead will be located 50 +/- feet outside the solar array fence line and will not be impacted directly by Project construction or maintenance clearing. Signs will be placed, at a minimum of 100-foot intervals, around the perimeter of the Burrill Homestead which identify it as a protected resource area and that maintenance clearing is prohibited during the lifetime of the Project.

## 7.0 SYSTEMS FOR LOCATING AND MARKING RESTRICTED AREAS

The Applicant will maintain a database of the sensitive areas and buffers listed above and located along the proposed ROWs and solar array areas. The database will include the locations and types of sensitive areas along the lines and their locations relative to the nearest numbered structure, road or array block. All structures along the Collector and Gen-Tie ROWs will be numbered at the time of construction. The structure numbers and array blocks will be included on the As-Built Plan and Profile drawings. Data will be provided to any maintenance contractor prior to the commencement of maintenance activities, which will enable contractors to locate and mark restricted areas in the field and facilitate compliance with the conditions of this VMP.

Prior to conducting maintenance activities along the Collector and Gen-Tie corridors, restricted areas such as stream, wetlands, vernal pools, deer wintering areas and historic sites will be identified with colored flagging. Alternatively, use of spatial data and global positioning equipment may be suitable to provide accurate location of resources and associated buffers during maintenance activities. If desired, maintenance personnel may permanently demarcate restricted habitats to aid in long-term maintenance activities. In some instances, signage may be attached to structures to facilitate identification of the sensitive resources. Maintenance contractors working on the ROWs will be given this VMP prior to receiving the required environmental training. Use of the VMP in conjunction with the As-Built Plan and Profile drawings will enable maintenance contractors to locate and mark restricted areas in the field.

## 8.0 TRAINING OF MAINTENANCE PERSONNEL

The owner will provide environmental training for personnel with maintenance responsibilities within the solar array areas, shading buffers, substations and Collector and Gen-Tie corridors.

### 8.1 Personnel and Schedule

The Owner's personnel and contractors who will be participating in vegetation maintenance activities on the Project site will receive appropriate environmental training before being allowed access the facility. The level of training will be commensurate with the type of duties of the personnel. The training will be given prior to the start of maintenance activities. Replacement or new employees that did not receive the initial training will receive similar training prior to performing any maintenance activities on the ROWs.

### 8.2 Content of Training Sessions

Prior to receiving maintenance training, each participant will be required to review this VMP. The training session will consist of a review of all protected resources and restricted areas, the respective maintenance requirements and restrictions for each, and a review of how restricted areas and resources can be located in the field (relative to the nearest numbered structure). Training will include familiarization with the contents of this VMP, as well as basic causes and preventive and remedial measures for contamination, erosion, and sedimentation of water resources. Training will also include a review of safety, clean-up, monitoring, and reporting requirements.

## 9.0 INVASIVE SPECIES

Invasive plants are non-native species that frequently cause environmental or economic harm following introduction to an area. Invasive plants often lack natural predators and can successfully colonize and thrive beyond the natural range of the species (MDACF 2019). Generally, these species have competitive adaptations, aggressive reproductive strategies, and efficient dispersal mechanisms, which often allow them to out-compete native plants. The spread of invasive plant species in both wetland and upland habitats is of concern for numerous reasons, such as reduced biological diversity, decreased quality of wildlife habitat, adverse aesthetic effects, and diminished recreational opportunities.

### 9.1 Existing Invasive Species in the Area

For the purposes of this VMP, the Project Area is defined as the developed portions of the Project site, including the access roads, solar array area, shading buffer areas, substations, maintenance building and collector and Gen-Tie corridors. Tetra Tech surveyed the Project Area for invasive plant species in 2021 and documented seven invasive plant species, one invasive plant group, and one potential invasive plant species: Asiatic bittersweet (*Celastrus orbiculatus*), Canada thistle (*Cirsium arvense*), shrubby honeysuckles (*Lonicera spp.*), multiflora rose (*Rosa multiflora*), reed canary grass (*Phalaris arundinacea*), purple loosestrife (*Lythrum salicaria*), yam-leaved virgin's bower (*Clematis terniflora*), coltsfoot (*Tussilago farfara*), and bull thistle (*Cirsium vulgare*). Reed canary grass (*Phalaris arundinacea*) and coltsfoot (*Tussilago farfara*) were determined to be widespread throughout roadsides, log landings, and other disturbed areas and were not individually mapped. Management recommendations for these species will be to follow construction best management practices (BMPs) for working near invasive plants (e.g., avoidance where possible and cleaning equipment before moving between sites). The remaining species were not widespread and have the potential to be successfully controlled. A map detailing locations of invasive plant species is provided in Appendix A, Appendix B provides representative photographs of invasive plants documented in the Project Area, and Appendix C includes fact sheets describing each invasive plant species and recommendations for control.

### 9.2 Invasive Species Monitoring Program

The Owner is committed to monitoring the status of invasive plant species within the Project Area and identifying areas where invasive species control measures may be required to maintain or enhance the functions and values of both wetlands and uplands. As noted above, and for the purpose of this VMP, the Project Area is defined as the developed portions of the Project, including the access roads, solar array area, shading buffer areas, substations, maintenance building and collector and Gen-Tie corridors. The monitoring program will target occurrences of invasive species identified above as well as any new occurrences that may be identified during the operation of the facility. The program also will provide recommendations that will be used to select and implement appropriate control strategies for each invasive species location.

The primary objectives of the invasive species monitoring program are to: (1) update the status of invasive species within the Project Area for the purpose of targeting areas requiring control measures, and (2) define the types of control measures most appropriate for each invasive species location.

The establishment of invasive plant species is a concern in any areas where soil is disturbed. Following Project construction, the Owner will retain a qualified, independent consultant to conduct the invasive species monitoring program, which will consist of completing field surveys of the Project Area to monitor the presence of invasive species and providing recommendations for control options. For each invasive species location, the consultant will complete invasive species monitoring forms, take photographs of the species and surrounding landscape, and record the location using a GPS receiver. Any site condition with

the potential to affect control methods also will be noted (e.g., wetlands, streams). Field surveys will be completed during the growing season when plant species are most easily identified. Monitoring will be scheduled to allow time for invasive species treatments to be implemented during the same growing season.

Invasive species monitoring within the Project Area will be initiated in the first full growing season following Project commercial operation. Monitoring will continue for a minimum of 5 years based on the results of initial surveys and agency consultations. It is possible that monitoring frequency may be reduced if invasive plant densities are determined to be low, within the first 5 years of monitoring.

Monitoring will locate invasive species to allow implementation of control measures as soon as practicable, particularly in areas where invasive species colonization is a direct result of Project activities. Monitoring and control schedules for invasive species may be adjusted to respond to site-specific issues (e.g., monitoring less frequently as densities decrease, instituting treatment in consecutive years to control an aggressive population).

The results of each year of invasive species monitoring will be detailed in an annual report that includes: a summary of the field survey methods and results, a table identifying invasive species in the Project Area, a map depicting GPS locations for all invasive species occurrences, completed monitoring forms, and representative photographs. The report will compare existing site conditions, as based on monitoring results compared to pre-construction data to determine invasive species trends within the Project Area. The monitoring report also will include recommendations regarding invasive species control measures, including locations requiring control, suggested control strategies, and the associated implementation schedule. Monitoring reports will be submitted to the Maine Department of Environmental Protection (MDEP) annually, with a deadline of March 31 following the year in which monitoring was conducted.

Implementation of invasive species control measures will be based on monitoring results and will not require approval from regulatory agencies. Control measures will be applied consistent with permit conditions and relevant safety requirements governing such activities.

### 9.3 Invasive Species Control Strategies

Effective invasive species control strategies for the Project must consider the following factors:

- Characteristics and functions/values of the wetlands and uplands in the Project Area;
- Invasive species present within the Project Area and associated densities;
- Sensitive areas within the Project Area, including wetlands, streams, vernal pools, wildlife habitat, sand and gravel aquifers, and visual buffers;
- Adjacent land use developments, which can affect the value of wetlands in the Project Area and influence the choice of control strategies; and
- Landowner cooperation and the potential lack of access, depending on the conditions of easements across private properties.

Based on the aforementioned factors, invasive species control measures may not be practicable or highly effective within all areas of the Project. Furthermore, once invasive species become established, complete eradication is unlikely given the aggressive nature of most invasive species.

In general, there are three types of invasive species control methods: mechanical, chemical, and biological. These control methods may be combined to enhance effectiveness.

Mechanical control measures such as digging, pulling, and cutting may be effective in controlling isolated invasive plants or small stands of plants. These methods are often necessary in sensitive natural resources areas where chemical treatment is not permitted, such as wetlands, streams, and wildlife habitat buffers. However, mechanical techniques are often labor intensive and may be impractical in areas with dense infestations of invasive species. This method also can be ineffective for certain invasive species.

Chemical control (i.e., herbicides) is the most common alternative used for managing invasive species along transmission line corridors and adjacent to roadways, and herbicide applications often provides the most cost-effective method for controlling dense infestations of invasive species. Herbicide application is an environmentally acceptable management practice, provided that treatment areas are carefully selected. For instance, herbicides should not be applied in wetlands with standing water, or adjacent to streams.

Biological controls can be administered to control certain invasive species. For instance, populations of purple loosestrife can be managed using beetles (*Galerucella* spp.). The beetles feed on bud, leaf, and stem tissue, causing defoliation and preventing flowering/seed production.

With all invasive species, the best method of control is to prevent the plant from becoming established. Once invasive species are present in an area, complete eradication is often difficult given the aggressive nature of these plants. In addition to attempts to eliminate invasive species populations, limiting further spread of these plants is critical.

Based on results of the post-construction monitoring program, annual invasive species treatment measures will be scheduled as soon as practicable upon receipt of field monitoring recommendations. The treatment schedule will depend on the types of control measures recommended and the species documented. For example, mechanical removal can occur throughout most of the year provided plants are identifiable. On the contrary, herbicide applications and biological controls are generally most effective when implemented during the growing season.

Depending on monitoring results, the Owner may contract a field biologist or wetland scientist to work with the invasive species management contractor to: (1) oversee the implementation of invasive species control measures, (2) recommend methods to maximize the potential re-establishment of native vegetation, and (3) suggest wetland plantings to enhance habitat value. Locations that receive treatment to control invasive species will be monitored in subsequent years to assess the effectiveness of such measures.

Although specific treatments will be refined based on the results of the monitoring program, it is anticipated that the most effective general approach for controlling invasive species within the Project Area will likely be a combination of mechanical removal and application of herbicides in selected locations during the growing season. During mechanical removal, plants that are cut or pulled will be treated as solid waste and disposed of off-site to limit the potential of further spread.

Repeated spot herbicide applications may be required in subsequent growing seasons to achieve effective control. Based on the number of invasive species documented in the Project Area prior to construction, large-scale control is not anticipated. The need for, and types of chemical control of invasive species will be carefully evaluated, particularly in sensitive areas such as wetlands, streams, and vernal pools; and areas not owned or controlled by the Owner. Additionally, invasive species may be present in wetland and upland areas that are outside of the defined boundaries of the Project Area. The Owner does not have authority to attempt to control invasive species that may occur in areas adjacent to the Project.

Herbicide applications will be performed in accordance with applicable laws and regulations put forth by the MDEP, the BPC, and the EPA. The type of herbicide(s) to be used, method of application, and schedule



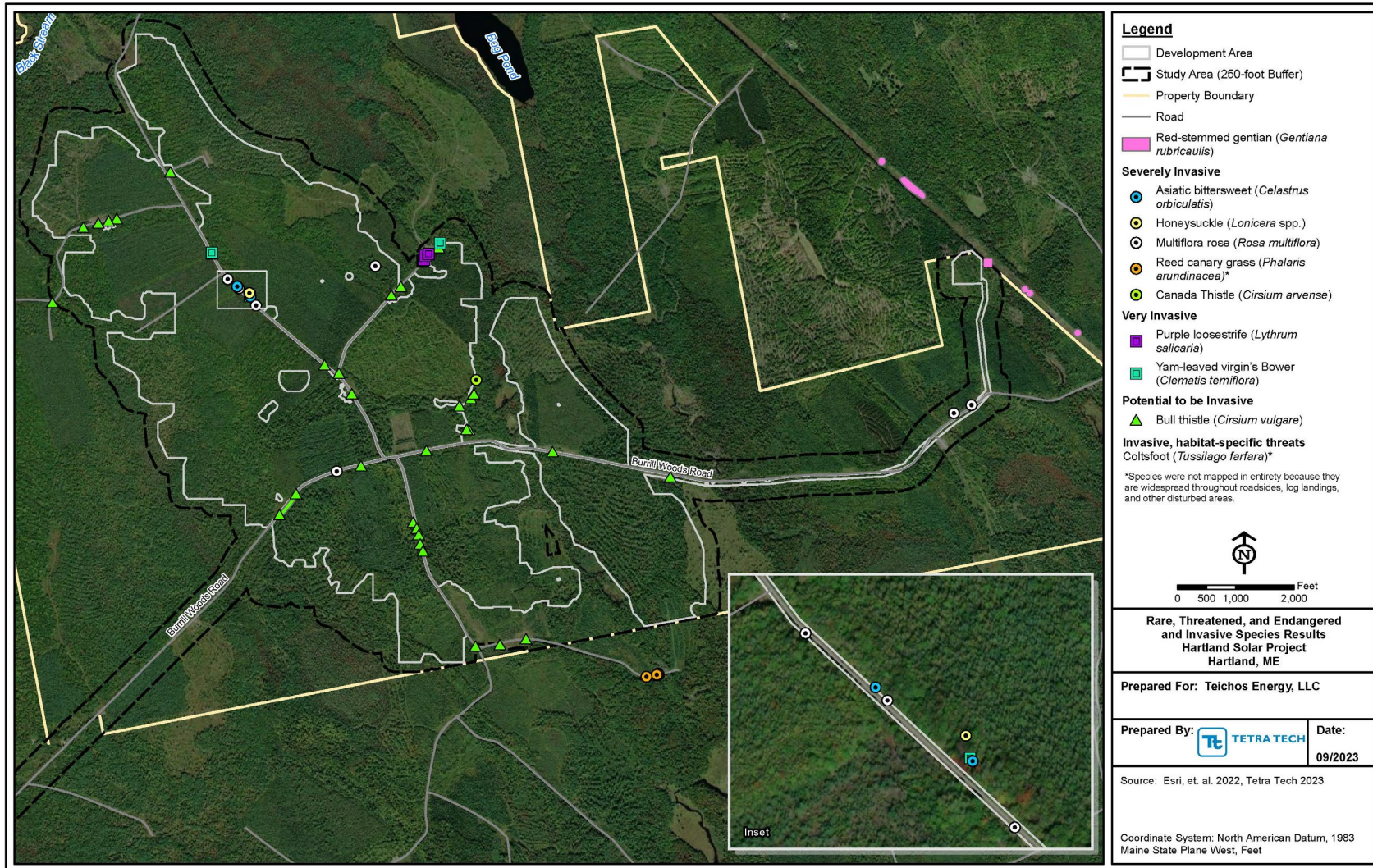
for application will be determined based on the locations of the targeted areas and the particular invasive species to be controlled.

Similarly, the use of any biological control measures will be coordinated with the MDEP. The species used for biological control will be obtained from approved sources and released pursuant to specifications.

## 10.0 REFERENCES

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## APPENDIX A. MAP



## **APPENDIX B. REPRESENTATIVE INVASIVE PLANT PHOTOS**



**Photo No.:** 1

**Common Name:**  
Asiatic bittersweet

**Scientific Name:**  
*Celastrus orbiculatus*

**Maine Natural Areas  
Program Ranking:**  
Severely invasive



**Photo No.:** 2

**Common Name:**  
Canada thistle

**Scientific Name:**  
*Cirsium arvense*

**Maine Natural Areas  
Program Ranking:**  
Severely invasive



**Photo No.:** 3

**Common Name:**  
Shrubby honeysuckle

**Scientific Name:**  
*Lonicera spp.*

**Maine Natural Areas  
Program Ranking:**  
Severely invasive



**Photo No.:** 4

**Common Name:**  
Multiflora rose

**Scientific Name:**  
*Rosa multiflora*

**Maine Natural Areas  
Program Ranking:**  
Severely invasive



**Photo No.:** 5

**Common Name:**  
Reed canary grass

**Scientific Name:**  
*Phalaris arundinacea*

**Maine Natural Areas  
Program Ranking:**  
Severely invasive



**Photo No.:** 6

**Common Name:**  
Purple loosestrife

**Scientific Name:**  
*Lythrum salicaria*

**Maine Natural Areas  
Program Ranking:**  
Very invasive





**Photo No.:** 7

**Common Name:**  
Yam-leaved virgin's  
bower

**Scientific Name:**  
*Clematis sterniflora*

**Maine Natural Areas  
Program Ranking:**  
Very invasive



**Photo No.:** 8

**Common Name:**  
Coltsfoot

**Scientific Name:**  
*Tussilago farfara*

**Maine Natural Areas  
Program Ranking:**  
Invasive, habitat-specific  
threats



**Photo No.:** 9

**Common Name:**  
Bull thistle

**Scientific Name:**  
*Cirsium vulgare*

**Maine Natural Areas**

**Program Ranking:**  
Potential to be invasive,  
monitor

## APPENDIX C. INVASIVE PLANT FACT SHEETS

# ASIATIC BITTERSWEET

(Oriental bittersweet)

*Celastrus orbiculatus*

Status in Maine: widespread



**Description:** Perennial, deciduous, woody vine. Twines around mature trees and climbs high into the canopy, or sprawls over low-growing vegetation. **Leaves:** Simple, alternate, round to somewhat elliptical, 2-4" long, with wavy or weakly toothed edges, turning yellow in fall. Leaves abruptly pointed at tips or in sun more tapering toward pointed tip. **Flowers:** Green-yellow, 5-petaled, small, clustered in leaf axils, ~June. **Fruits:** Distinctive yellow aril covers orange-red seed. Fruits mature in fall and persist into winter. **Bark:** Light brown with raised tan lenticels. **Roots:** Bright orange.

**Native range:** Japan, China, Korea. **How arrived in U.S.:** As an ornamental.

**Reproduction:** By seed and vegetatively. Plants are usually dioecious; males do not produce fruit. Fruits are eaten and dispersed by birds and small mammals, or by careless disposal of bittersweet wreaths. Seeds are viable for about one year. New shoots may sprout from the root crown, and root fragments may also regenerate.

**Habitat:** Forests, forest edges, woodlands, old fields, beaches, and dunes. Moderately shade-tolerant; more productive in sun. Tolerates dry to moist soils.

**Similar native species:** American bittersweet (*C. scandens*), uncommon in Maine, is very similar but only has flowers and fruit at vine tips, and usually has leaves twice as long as wide. Grape (*Vitis* spp.) will also grow into tree canopies. Grape bark has a peeling, shredded appearance and leaves



# ASIATIC BITTERSWEET

are larger and palmately lobed.

**Similar non-native species:** None in our area.

**Control methods:** Very small plants and seedlings may be pulled up by the roots when soil is moist; larger vines can be cut, but aggressive re-sprouting will occur. Cut larger vines at chest height and also at ankle height to prevent new vines climbing up old ones (you can also treat the rooted part of the vine with cut-stem herbicide if desired). Persistent cutting alone, multiple times during the growing season over several years, may kill the plant, but diligence is required (at least 6x/yr for 3 yrs is suggested). Vines can be left to die in the canopy; pulling the vines from the trees can cause additional damage. Mowing can prevent seedlings from establishing. Herbicides are effective as foliar applications (triclopyr solution, foliar glyphosate not as effective on this species), cut-stump applications (glyphosate or triclopyr solution applied immediately after cutting except during early spring), or basal bark application any time of year (for stems <6" diameter, triclopyr in bark oil). For dense thicket-type growth and very large infestations, cut or bush-hog all vines at mid-summer, then foliar spray triclopyr solution the following summer before flowering when plant height is lower and less herbicide is needed.



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# CANADA THISTLE

*Cirsium arvense*

Status in Maine: widespread



**Description:** A creeping perennial herb, 2-5' tall, and member of the aster family. **Leaves:** Alternate, oblong, to 8", base sessile to stem clasping; margins variable, entire to deeply lobed, often wavy or crinkled looking, and very spiny. **Flowers:** Each "flower" is a compound head of ~50 flowers. Plant is mostly dioecious. Flower heads are ~½" diameter, ~1" long, and flask shaped. Several pale lilac to pinkish-purple flower heads per branching stem. Flower bracts are not spiny. **Fruit/seeds:** Each tiny, tan-colored achene has a long feathery pappus with branched hairs. **Stem:** Hollow, subtly ribbed, with few hairs. Freely branching toward top. **Root:** Has both a deep taproot (~3'), and spreading horizontal rhizomes.

**Native range:** Eurasia. **How arrived in U.S.:** Introduced to Canada in the 1600s as a contaminant in crop seeds.

**Reproduction:** Formidable capacity by both rhizomatous spread and seed production. With ~40 flower heads per plant, each plant can produce roughly 1,500 seeds. Its plumose pappus aids long distance seed dispersal. Seeds can remain viable for decades in the soil. Horizontal roots produce numerous shoots and can spread several meters in a season. Small fragments of stem or root can generate new plants.

**Habitat:** Disturbed sites, roadsides, agricultural areas, stream banks, floodplains, logging roads and landings. Shade intolerant.

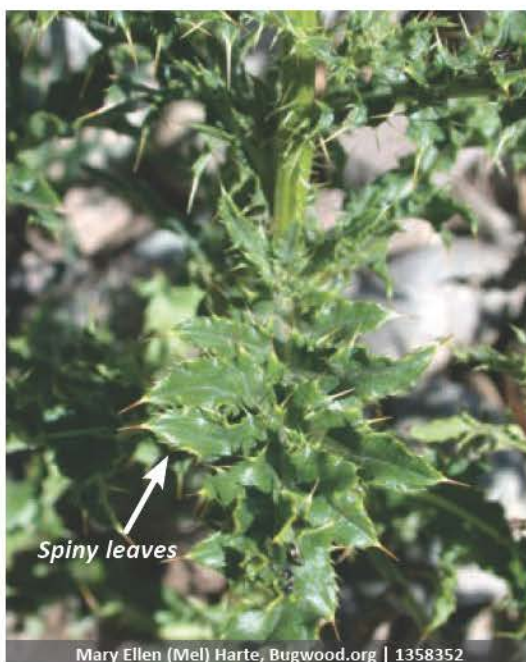
**Similar native species:** Swamp thistle (*Cirsium discolor*) has larger flower heads. Leaves are more deeply lobed than Canada thistle, and not as spiny.



# CANADA THISTLE

**Similar non-native species:** Bull thistle (*Cirsium vulgare*) is typically a larger, more robust plant, with spiny stem and a long spine on leaf midrib. Flower heads are ~2".

**Control methods:** Suppression can be achieved by repeated mowing (several times per season for several years), pulling, and/or cutting that exhausts the plant and eliminates seed production. Wear protective gear since the spines are sharp! Mechanical actions that result in fragmented shoots and roots are not recommended as these can create new plants if conditions are favorable. Sheep and goats are said to graze it when plants are young. Different ecotypes of Canada thistle have differing responses to herbicides, and the plants substantial below-ground biomass means that more than one application may be needed per growing season. One study found good control when the plant was cut in late July and then treated with glyphosate about a month later when in a rosette stage. Late summer or fall herbicide treatments seem to be the most effective. **Consult a professional for large infestations.**



# SHRUBBY HONEYSUCKLES

*Lonicera* spp. (*L. morrowii*, *L. tatarica*, *L. x bella*)

Status in Maine: widespread



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**Description:** Perennial, deciduous shrub, up to ~10' tall and wide, usually very branched. **Leaves:** Simple, opposite, oval to egg-shaped, with blunt to pointed tip, 1-2" long, edges entire, may be hairy underneath. Leaves emerge early and are held late. **Flowers:** ~1" wide, paired in leaf axils, fragrant, tubular, creamy white, yellow, or pink. Bilaterally symmetrical, ½" long petals like "arms" extend in several directions. Paired in leaf axils. Appear in May in Maine. **Fruit:** Red, globular, juicy berry, to ~½" wide. Ripen by late summer. **Stems:** Larger plants have shaggy bark on lower stem. Larger twigs have hollow pith (tube in twig center, cut with sharp blade to see).

**Native range:** Asia. **How arrived in U.S.:** As an ornamental and for windbreaks.

**Reproduction:** By seed. Birds and mammals consume fruits and disperse seed. Seed longevity is not known but likely modest.

**Habitat:** Reaches largest size in sun but highly shade-tolerant and capable of invading intact forest understory. Grows in forests, edges, old fields, and roadsides. Tolerant of dry to wet, nutrient-poor soils.

**Similar native species:** Fly-honeysuckle (*Lonicera canadensis*) and mountain honeysuckle (*Lonicera villosa*) both have similar oval, paired leaves, but have solid pith and tubular flowers with short triangular petals, and are much shorter in height. Bush-honeysuckle (*Diervilla lonicera*) has solid pith and leaves with fine teeth which are long-pointed at the tip. All native honeysuckles (*Lonicera* spp.) have solid pith.





# SHRUBBY HONEYSUCKLES

**Similar non-native species:** The invasive shrubby honeysuckles can be distinguished as follows: *L. morrowii* (white or yellow flowers) is finely hairy on leaf bottoms, *L. tatarica* (pink flowers) mostly lacks leaf hairs, and their hybrid *L. x bella* (light pink to white flowers) is somewhat hairy. Common snowberry (*Symphoricarpos albus*), another opposite-leaved shrub, has clusters of small pink flowers and forms large white berries.

**Control methods:** Small plants and seedlings may be pulled up by the roots when soil is moist; larger plants can be cut, but re-sprouting will occur. Persistent cutting or burning the root crown multiple times during the growing season over several years may kill the plant, but diligence is required. Mowing can prevent seedlings from establishing. Goats and sheep will browse it but repeated, heavy damage over multiple years is required to kill established shrubs. Glyphosate is the most effective herbicide for honeysuckles. They will hold on to their leaves into the fall which makes them susceptible to a foliar glyphosate application after many native species have dropped their leaves. For cut-stump applications use glyphosate applied immediately after cutting except in early spring. Basal bark application is less effective on these species.



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# MULTIFLORA ROSE

(Rambler rose)

*Rosa multiflora*

Status in Maine: widespread



**Description:** Perennial, deciduous shrub, up to 20' tall, usually very branched, with arching canes that can grow up over other plants and into low tree branches. Canes have stout recurved thorns. Thornless varieties exist, but they are uncommon. **Leaves:** Pinnately compound, 5-11 leaflets, each ~1" long, with teeth. Petiole is fringed at the base (stipule) where it attaches to twig; no other rose in Maine has this character. **Flowers:** 5-parted, white to pale pink, ~1" wide, clustered at twig tips, blooms in June in Maine. **Fruit:** ~¼" round to oblong, red, rose "hips" clustered at twig tips.

**Native range:** Japan and Asia. **How arrived in U.S.:** Rootstock for ornamental roses; also promoted for erosion control and living fences.

**Reproduction:** By seed and rooting from twig tips. Birds and mammals eat fruits and disperse seed. Seeds viable in soil for up to 20 years.

**Habitat:** Reaches largest size and fruiting capacity in full sun but is somewhat shade-tolerant. Found in forest edges, old fields, as well as disturbed sites. Can occur in forest interior after disturbance such as timber harvest. Tolerant of dry to moist soils.

**Similar native species:** Native roses, but none of our native roses have a fringed base on the leaf petiole. Also, all native roses have pink flowers.

**Similar non-native species:** Rugosa rose has pink flowers to 2" wide and stems with straight prickles all around. Other horticultural roses escape infrequently and have fewer



# MULTIFLORA ROSE

flowers, as well as other prickly arrangements.

**Control methods:** Small plants and seedlings may be pulled up by the roots when soil is moist (wear gloves!); larger plants can be cut, but re-sprouting will occur. Persistent cutting or mowing multiple times during the growing season over several years may kill the plant, but diligence is required. Mowing can prevent seedlings from establishing. Goats will browse it but repeated, heavy damage over multiple years is required to kill established shrubs. Herbicides are effective as foliar applications (glyphosate or triclopyr solution), cut-stump application (glyphosate or triclopyr solution applied immediately after cutting except in early spring), or basal bark application any time of year (glyphosate or triclopyr ester in bark oil).



# REED CANARY GRASS

*Phalaris arundinacea*

**Status in Maine:** widespread



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**Description:** Robust, perennial grass, 2-6' tall, commonly to 4'. **Leaves:** Alternate,  $\frac{1}{3}$ - $\frac{3}{4}$ " wide, and 4-8" long, gradually tapering to a point. Leaves are flat, with a rough texture, and come off the stem at a 45-degree angle. Transparent,  $\sim\frac{1}{4}$ " ligule occurs where the leaf sheath meets the stem. **Flowers/seeds:** 3-8" long inflorescences are formed high above the leaves. They begin as slender spikes in early summer, and become somewhat open-spreading when flowering. Color changes from green to purplish to tan as seeds mature. **Stem:** Hairless, sometimes hollow,  $\sim\frac{1}{3}$ " diameter. **Root:** Sturdy, creeping rhizomes.

**Native range:** There are native ecotypes of this grass in North America, but the invasive strain is of Eurasian origin.

**How arrived in U.S.:** Planted for forage and erosion control on wet pastures and fields. There are also ornamental varieties including one with white-stiped leaves which occasionally naturalizes.

**Reproduction:** Spreads by seed and vegetatively by rhizomes. Seeds are likely spread via movement of water.

**Habitat:** Stream and river banks, lakeshores, marshes, ditches, and roadsides. Found in wet soils but not usually in standing water. Only moderately shade tolerant; prefers full sun.

**Similar native species:** It is not possible to separate the native and non-native strains of reed canary grass without



# REED CANARY GRASS

molecular techniques, however the invasive strain grows aggressively in areas with a history of human disturbance, forming large stands. Canada bluejoint (*Calamagrostis canadensis*) is similar and often grows in dense stands in wetland habitats. It has narrower inflorescences, leaves, and stems than reed canary grass.

**Similar non-native species:** Orchard grass (*Dactylis glomerata*) has narrower leaves ( $\frac{1}{8}$ - $\frac{1}{3}$ " wide) and grows in tufts or small clusters as opposed to the spreading habit of reed canary grass.

**Control methods:** Hand pulling or digging is only practical for small patches. For larger infestations, mowing, if possible, can reduce or eliminate seed production and perhaps lower density over time. Prolonged flooding can kill reed canary grass, but may also kill desirable vegetation if present. Fire can be successfully used to remove the dense reed canary grass litter/thatch build-up. Litter build-up can prevent native species from establishing in areas previously dominated by reed canary grass, so even if treatments to kill the grass are successful, additional work may be needed to achieve a desired condition. Aquatic formulations of glyphosate are somewhat effective, but follow-up will be required, including repeat applications in many cases. ***Special rules apply to herbicide use in or near wetlands and waterbodies - see the section in the back of this guide titled "Use of Herbicides to Control Invasive Plants in or Near Wetlands and Waterbodies."***



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# PURPLE LOOSESTRIFE

*Lythrum salicaria*

Status in Maine: widespread



**Description:** Robust, perennial herb 4-6', base of mature plant feels woody. **Leaves:** Simple, opposite or whorled, lanceolate to oblong, entire, sessile. **Flowers:** In long, crowded spikes, deep pink-purple, 5-7 petals, ½-¾" wide, mid to late summer in Maine. Asynchronous flowering - bottom of spikes open first. **Fruit:** Brown, dry capsules persist on stem. **Stem:** Four-angled.

**Native range:** Europe and Asia. **How arrived in U.S.:** As an ornamental, and as contaminant in ballast, livestock bedding, and possibly wool.

**Reproduction:** By seeds, which are viable for several years. Seeds are readily transported by water and can float for up to three days, or they may hitchhike on wildlife or in soil or fill.

**Habitat:** Wetlands, rivershores, lakeshores, and wet open areas such as roadsides, agricultural swales, and powerline corridors. Tolerates saturated conditions (organic/peat) and damp mineral soils. Most prolific in full sun, will survive in partial shade.

**Similar native species:** Fireweed (*Chamerion angustifolium*) also has spikes of pink-purple flowers, but the flowers are large (~1") and 4-petaled. Fireweed has alternate leaves and tends to grow in uplands. Blue vervain



# PURPLE LOOSESTRIFE

(*Verbena hastata*) has spikes of blue-purple flowers and opposite leaves, but the leaves are toothed and the flowers are very small (<math>\frac{1}{3}</math>") and consistently have 5 petals.

**Similar non-native species:** None in our area.

**Control methods:** Small plants or isolated individuals may be dug up by the roots when the soil is moist, but re-sprouting may occur. Persistent cutting or pulling multiple times during the growing season over several years (before flowering) may kill the plant, but diligence is required (at least 3x/year for 3 years is recommended). Herbicides are effective as foliar applications (aquatic glyphosate solution) or cut-drip applications (aquatic glyphosate applied immediately after cutting). Foliar applications of aquatic triclopyr can control loosestrife while avoiding harm to grasses and sedges. Cut-drip applications report less success than foliar applications and are extremely tedious and time-consuming. Regardless of the method chosen, cutting and bagging any flower heads is suggested since this is a prolific seed-producer. ***Special rules apply to herbicide use in or near wetlands and waterbodies - see the section in the back of this guide titled "Use of Herbicides to Control Invasive Plants in or Near Wetlands and Waterbodies."***



## Japanese clematis, *Clematis terniflora* (D.C.) Ranunculaceae<sup>1</sup>

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Michael Meisenburg, Ken Langeland, and Kurt Vollmer<sup>2</sup>



**Figure 1.** A Japanese clematis has smothered a Southern magnolia in a natural, wooded area of Gainesville, FL.

### Introduction

Japanese clematis (*Clematis terniflora*) is a vigorous woody vine that has been used for landscaping in the southeastern United States since 1877. The plant is recommended for landscape use in cold-hardy zones and is sometimes grown on trellises.

Some other frequently used common names for Japanese clematis include the following: sweet autumn virginsbower (http://www.plantatlas.usf.edu), autumn virginsbower (Wunderlin and Hansen 2003), sweet autumn clematis and autumn clematis.

Although native to Asia, Japanese clematis has naturalized and is considered invasive in many areas of the country, including in Florida. Japanese clematis is currently classified by the Florida Exotic Plant Pest Council as a Category II Invasive Species. This designation indicates the plant has increased in abundance and frequency in natural areas, but has not altered native plant communities to the extent caused by a Category I species.

In natural areas, Japanese clematis typically invades along roadsides and thickets, as well as along the edges of woods near creeks. It also grows well in the well shaded understory of forests.

### Description

Dark green, glossy leaves are opposite in arrangement with 3 - 5 leaflets ranging from 2 - 3 inches long (Figure 2). The leaves of mature Japanese

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  2. Michael Meisenburg, biological scientist; Ken Langeland, professor; and Kurt Vollmer, graduate student assistant, Department of Agronomy, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL.

The Institute of Food and Agricultural Sciences (IFAS) is an Equal Opportunity Institution authorized to provide research, educational information and other services only to individuals and institutions that function with non-discrimination with respect to race, creed, color, religion, age, disability, sex, sexual orientation, marital status, national origin, political opinions or affiliations. U.S. Department of Agriculture, Cooperative Extension Service, University of Florida, IFAS, Florida A. & M. University Cooperative Extension Program, and Boards of County Commissioners Cooperating. Millie Ferrer-Chancy, Interim Dean



clematis are entirely smooth, without teeth. However, leaves of the small plants may have teeth, which are sometimes rounded (Figure 3). Leaves on small plants are often variegated (Figure 3).

Vines usually grow to about 1/2-inch in diameter (rarely to 4 inches). The vine can climb up to 30 feet with the aid leaf petioles twisting around supports (Figure 4). The bark is light brown with long splits and long shredding strips. Like other *Clematis* species, nodes persist on stems every 6 - 8 inches from where the leaves attach (Figure 5). Sporadic flowering takes place year-round, but occurs primarily in the late summer and early fall. Densely pubescent, star-shaped flowers are white with four sepals about 1 1/4 inch in length (Figure 6). Seeds are small and brown with a white, feathery plume (Figure 7). Mature seeds can germinate anywhere between one and nine months after maturity. Vines trailing along the surface of the ground rarely take root.

Two native species of similar-looking *Clematis* also occur throughout northern and central Florida: virginsbower (*C. virginiana*) and satincurls (*C. catesbyana*). Toothed leaves distinguish each of these native species from Japanese clematis (Figure 8).



**Figure 2.** Leaves of the invasive Japanese clematis usually have entire margins (smooth edges with no serrations).



**Figure 3.** Japanese clematis leaves can have some teeth along the margins and light green down the middle.



**Figure 4.** Leaf petioles wrap around vegetation to support climbing vines.



**Figure 5.** Clematis stems are distinctive with their swelled nodes every 6-8 inches.

## Impacts

Populations of Japanese clematis have been occurring with increased frequency in northern Florida. This invasive plant is a prolific seed producer, and the short-winged appendages and fairly large seed mean most seeds are probably not dispersed far. While this method of dispersal may limit the speed at which the population expands, the



**Figure 6.** Flowers of Japanese clematis.



**Figure 7.** A cluster of Japanese clematis seeds. These seeds are not quite mature as evidenced by their light color.



**Figure 8.** The toothed leaves of native *Clematis* (such as these *C. catesbyana*) aid in distinguishing them from the invasive *C. terniflora*.

plant occurs at high densities within infested areas. In natural wooded areas, Japanese clematis commonly overgrows saplings and small trees, killing some. (See Figure 1.) As the Japanese clematis vine climbs, it has the potential to smother fully grown trees. In a review of Japanese clematis by UF/IFAS' Assessment of Non-native Plants in Florida's Natural Areas (<http://plants.ifas.ufl.edu/assessment/>), a lack of sufficient evidence for the invasiveness of the plant in northern and central Florida resulted in Japanese clematis being listed as "OK" for planting throughout Florida.

By contrast, Japanese clematis is considered invasive by exotic/invasive plant councils in Alabama, Georgia, Tennessee, South Carolina, and the Mid-Atlantic, as well as in Florida. Given the invasive designation these councils have assigned to Japanese clematis, and considering, as well, the plant's tendency to escape cultivation and invade intact natural areas, it would be prudent not to cultivate this plant in Florida

## Management

**Preventative.** Japanese clematis is still at the stage where it can be effectively managed by preventing its introduction into new areas. Homeowners should not introduce this plant to their lawns or gardens, but instead plant the native *C. virginiana* or *catesbyana* if so desired. Identification of Japanese clematis is important to distinguish it from the native *Clematis*. Homeowners wishing to remove Japanese clematis vines from their property should properly dispose of cuttings and seeds, leaving them out of mulch and yard waste. Japanese clematis will probably continue to spread in natural areas throughout the Southeast. Natural-area managers should be proficient in identifying the species and be vigilant for its occurrence.

**Mechanical.** Seedlings may be hand-pulled or mowed. Mature plants can be cut by hand or mowed. Plants must be cut back enough and dug up to ensure complete removal.

**Biological.** To date no biological control exists for this species. However, leaf damage is occasionally observed (Figure 2) perhaps because Japanese clematis shares its range with several native *Clematis*.

**Chemical.** Current chemical-control methods include foliar applications of triclopyr amine (e.g. 2-3% Garlon 3A) and triclopyr ester (e.g. 15% Garlon 4 oil) for basal-bark applications. Either formulation, applied to cut stump, is effective in controlling the plant. Foliar application of glyphosate (e.g. 3% Roundup ) provides good, but short-term control. For basal-bark applications, be sure to locate where the vine is rooted. Clematis vines will sometimes grow up one tree, trail back down to the ground, and climb up another tree. Applying

herbicide to a trailing vine will only kill the distal part; another treatment will later be required.

## References and Useful Links

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*Clematis terniflora* Fact Sheet.  
<http://www.cnr.vt.edu/dendro/dendrology/syllabus2/factsheet.cfm?ID=494>

*Clematis terniflora*: *Sweet Autumn Clematis*  
<http://www.plantoftheweek.org/week273.shtml>

*Clematis terniflora*. Global Invasive Species Database.  
<http://www.invasivespecies.net/database/species/ecology.asp?si=1224&fr=1&sts>

*Floridata*:  
[http://www.floridata.com/ref/c/clem\\_ter.cfm](http://www.floridata.com/ref/c/clem_ter.cfm)

*Invasive Plant List: Planting for a Livable Delaware*.  
[http://dda.delaware.gov/publications/plant\\_industries/DEInvasPlntBklt.pdf](http://dda.delaware.gov/publications/plant_industries/DEInvasPlntBklt.pdf)



# Coltsfoot *Tussilago farfara L.*

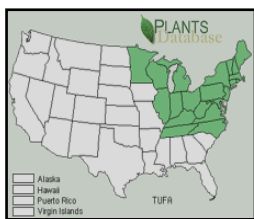
**Common Names:** coughwort, assfoot, horsefoot, foalfoot, bull's-foot, horsehoof, colt-herb, clayweed, cleats, dove-dock, dummyweed, ginger, gingerroot, hoofs, sowfoot, British tobacco, gowan

**Native Origin:** A native of Europe, this plant is believed to be brought to this country by early settlers for its medicinal properties.

**Description:** Coltsfoot is a perennial herb in the Aster family (Asteraceae). Solitary flowers are dandelion-like and bright yellow in color. There are several scaly white flower stalks per plant. Flowers emerge before the leaves in early spring through June growing 3 to 12 inches in height. Brown nutlets are attached to a pappus resembling the white fluffy seed heads of common dandelion. The heart-shaped (cordate) leaves appear after flowers have matured. Leaves are 3 to 7 inches wide, slightly toothed, upright and the underside is whitish. They arise directly from the root with no main stem present. Coltsfoot reproduces both vegetatively and sexually. The roots can remain dormant underground for long periods of time.



**Habitat:** Coltsfoot thrives in low-lying mesic areas including stream banks, moist field or pastures, roadsides, and disturbed areas. It can also be found in drier sites and in poor soils. It is intolerant of shade and is not commonly found in wooded areas, though it has been documented invading forests following fire.



**Distribution:** This species is reported from states shaded on Plants Database map. It is reported invasive in CT, ME, NC, NJ, and TN.

**Ecological Impacts:** Plant can be very competitive and may have the capacity to invade natural communities along disturbance corridors, or to spread from stands in disturbed sites into undisturbed areas.

**Control and Management:**

- **Manual-** Initial infestations may be controlled by hand pulling to remove the entire plant.
- **Chemical-** It can be effectively controlled using any of several readily available general use herbicides such as glyphosate. Treat in summer when the leaves of coltsfoot are fully developed. Follow label and state requirements.

**References:** [www.invasive.org](http://www.invasive.org), [www.hort.purdue.edu](http://www.hort.purdue.edu), [www.weedmapper.org/tufa.html](http://www.weedmapper.org/tufa.html)  
[www.forestryimages.org/search/action.cfm?q=coltsfoot](http://www.forestryimages.org/search/action.cfm?q=coltsfoot)

# Invasive Plants in Pennsylvania

## Bull Thistle

*Cirsium vulgare* (Savi) Ten.



Photo: Western New Mexico University, Dept. of Nat. Sci. & Dale A. Zimmerman Herbarium

### Description:

Stems grow up to seven feet tall and have lance shaped, hairy leaves that are three to 12 inches long. There are lobes on each leaf, and they are tipped with stout spines. Flower heads are purple and one to two inches across. They appear from June to September.

### Biology and Spread:

Bull thistle reproduces and spreads exclusively by seed. Plants produce 100 to 300 seeds per flower head, with up to 400 flower heads per plant. Seeds exhibit features that are suited for wind dispersal. Roughly 90 percent of seeds land within a distance of 1.5 times the height of the parent plant, however up to 10 percent of seeds produced do travel over 80 feet.

### Background:

Thought to have been introduced to eastern North America during colonial times and western North America during late 1800s.

### Range:

This plant is native to Europe, western Asia and northern Africa. It can now be found on every continent except Antarctica, and it is present in all 50 states in the U.S., although it is not as common in the southern states as it is in the north.



Photo: Steve Dewey, Utah State U., [www.invasive.org](http://www.invasive.org)

### Ecological Threat:

Bull thistle has the potential to form dense thickets that displace and prevent native vegetation from establishing. The spiny features of the plant also make it unpalatable to wildlife and livestock, reducing forage land available.

### Habitat:

This plant has the ability to become established in a wide variety of areas, especially ones that have been disturbed, like clearcuts, riparian areas and pastures.



Photo: Steve Dewey, Utah State U., [www.invasive.org](http://www.invasive.org)

## How to Control this Species:

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### Prevention

Prevention should be the first goal in any control efforts for this plant. Equipment and gear need to be extensively cleaned after use in an infested area, to prevent seed transport. Use of weed-free seed should also be conducted.

### Manual and Mechanical

Manual removal of plants via hand pulling, tilling and hoeing can be effective, but care should be taken to conduct these measures before flowering, in order to prevent seed production and spread. Slicing off the root crown has proven to be very effective at controlling this plant.

### Chemical

Herbicides are most effective at controlling infestations when incorporated as part of a long-term, multifaceted control effort. Herbicide applications should be optimally timed in order to have the greatest effect.

Regardless of the control measures taken, reestablishing competitive, desirable vegetation to the site is critical.

## Look-A-Likes:

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Native species of thistle (*Cirsium* sp.), some of which are rare, could be confused with bull thistle. Before control is attempted, the thistle species in question should be accurately identified.

## References:

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Zouhar, Kris. 2002. *Cirsium vulgare*. In: *Fire Effects Information System*. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory:

<http://www.fs.fed.us/database/feis>

Center of Invasive Species and Ecosystem Health: [www.invasive.org](http://www.invasive.org)

Field Thistle



Chris Evans, River to River CWMA  
[www.forestryimages.org](http://www.forestryimages.org)

## For More Information:

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DCNR Invasive Species Site: <http://www.dcnr.state.pa.us/conservation/science/invasivespecies/index.htm>

DCNR Invasive Exotic Plant Tutorial for Natural Lands Managers: [http://www.dcnr.state.pa.us/forestry/invasivetutorial/canada\\_thistle.htm](http://www.dcnr.state.pa.us/forestry/invasivetutorial/canada_thistle.htm)

*Plant Invaders of Mid-Atlantic Natural Areas*, National Park Service, <http://www.nps.gov/plants/alien/pubs/midatlantic/midatlantic.pdf>

*Invasive Plants Field and Reference Guide*, U.S. Forest Service: [http://na.fs.fed.us/pubs/misc/ip/ip\\_field\\_guide.pdf](http://na.fs.fed.us/pubs/misc/ip/ip_field_guide.pdf)