

Invasive Plant Species and Habitat Management Plan for Minute Man National Historical Park

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Executive Summary

This management plan:

- 1) describes the process to prioritize habitat management zones and invasive species treatments in Minute Man National Historical Park,
- 2) determines park-specific priorities for invasive species management, and
- 3) provides detailed recommendations for the implementation of invasive species management in the park.

Invasive Plant Species and Habitat Management Plan for

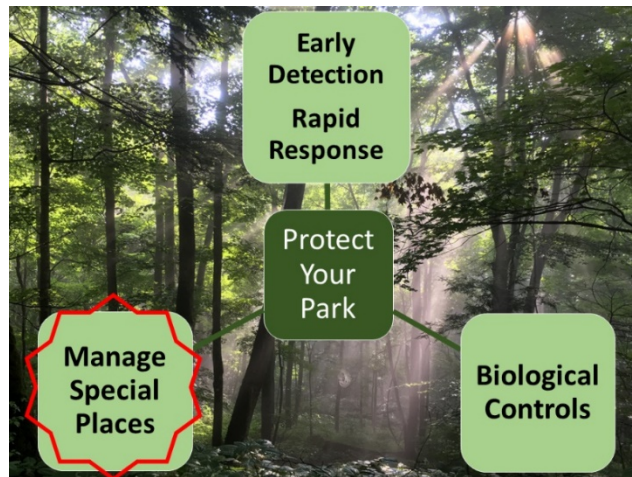
Minute Man National Historical Park

Invasive exotic plants threaten the natural and cultural resources of Minute Man National Historical Park (MIMA). These unwelcome invaders reduce native biodiversity, alter forest structure, suppress tree regeneration, degrade wildlife habitat, and pose significant threats to the long-term condition of parks' forest health and cultural resources. A recent analysis by NPS scientists of 12 years worth of data collected from over 1,400 forest plots in 39 eastern national parks showed that invasive plants are a large and, literally, growing problem for many national parks (Miller et al. 2020).

Recent forest health monitoring (2015-2018, Miller et al. 2020) in Minute Man National Historical Park showed at least one invasive species was detected in 100.0% of plots. The shrub guild was the most abundant guild in MIMA, and the most abundant invasive species was glossy buckthorn (*Rhamnus frangula*), followed by Oriental bittersweet (*Celastrus orbiculatus*), multiflora rose (*Rosa multiflora*), garlic mustard (*Alliaria petiolata*), and exotic bush honeysuckle (*Lonicera* sp.). Since invasive plants are inherently difficult to control, the effective management of these species is challenging.

Therefore, MIMA has adopted a three-pronged approach to managing invasive species:

- 1) early detection and rapid response,
- 2) strategically treating invasive species to protect the park's special places,
- 3) release of approved biological controls.



Early Detection and Rapid Response

The most cost-effective and ecologically viable method to control invasive species is to stop the spread of new and emerging invasive species before they become established in the park. In collaboration with the Northeast Temperate Inventory and Monitoring Network (NETN), MIMA maintains a target list of invasive species (Table 1) for early detection and rapid response. These species are not yet established in the park, but are likely to invade given their regional distribution. Each year, the early detection target list should be given to all NPS staff who will be working in the field, as well as partner agencies, volunteers, and outside researchers conducting field work in the park. Although early detection and rapid response will be implemented through the park, a 100 ft buffer inside the park boundary is the target zone for this effort (Figure 1). All observations of target invasive species in the park should be reported to Margie Brown, the Integrated Resource Program Manager who will coordinate the rapid response to treating the new invader.

Table 1. List of target invasive species for early detection and rapid response at Minute Man National Historical Park.

Common Name	Scientific Name
wine raspberry	<i>Rubus phoenicolasius</i>
princess tree	<i>Paulownia tomentosa</i>
Chinese yam	<i>Dioscorea oppositifolia</i>
giant hogweed	<i>Heracleum mantegazzianum</i>
Japanese stiltgrass	<i>Microstegium vimineum</i>
kudzu	<i>Pueraria montana</i>
mile-a-minute weed	<i>Persicaria perfoliata</i>

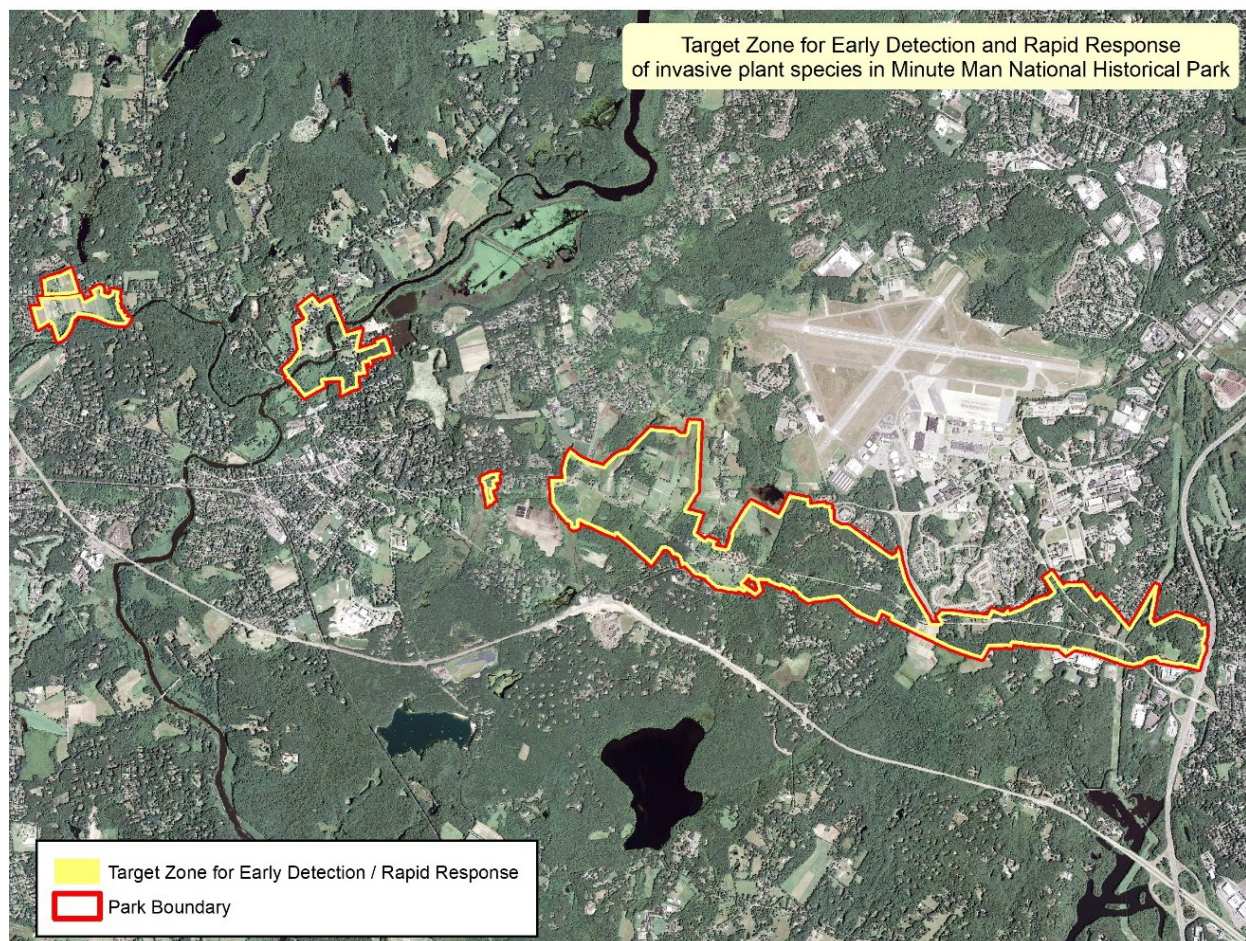


Figure 1. Target zone (100 foot buffer inside park boundary) for early detection and rapid response of invasive plants at Minute Man National Historical Park.

Strategically Manage MIMA's Special Places

Managing invasive plant species can seem like an endless and insurmountable challenge, so focusing limited time and resources where they can be most effective is key to successfully tackling the invasives problem. By strategically focusing treatments on their special places, parks can efficiently treat invasive plants in areas that are most important to preserve.

This management plan provides that strategic focus by identifying the places and invasive species within MIMA that are highest priority for invasive species treatment. This plan was created using the Invasive Plant Species and Habitat Management Planning Process developed by Art Gover at Penn State's Wildland Weed Management Unit (Gover 2016). This planning process is based on several important principles:

- Parks have finite resources that can only be directed to a small portion of potential natural resource needs.
- We can use park-specific data to make informed strategic decisions with limited resources. Strategic management is effective by protecting natural resources without wasted effort.
- Protecting the best sites within a park maximizes the benefit to park natural resources per person-hour expended on invasive species management.
- Inaction is more harmful than action. The decision NOT to manage invasive plant species has continued and increasingly negative impacts on the park's natural resources.

The Invasive Plant Species and Habitat Management Planning Process involves three steps: define habitat management zones, prioritization, and prescription.

Define Habitat Management Zones

To determine which areas of the park are more important to preserve, we assembled a team knowledgeable about MIMA's invasive species, including two park natural resources staff, the regional Invasive Plant Management Team (IPMT) Lead, and two vegetation monitoring specialists from NETN. This team met virtually to delineate Habitat Management zones within MIMA (Figure 2). Habitat management zones are discrete areas of the park that are ecologically or culturally valuable and where invasive species management is operationally feasible.

The Habitat Management Zones were delineated based on four criteria: 1) areas containing high priority invasive species, Japanese knotweed (*Reynoutria japonica*) and black swallowwort (*Vincetoxicum nigrum*); 2) location of rare species and plant communities; 3) location of vernal pools; 4) wetland and riparian areas. We identified 18 habitat management zones, ranging in size from 0.5 to 75 acres, and then we assigned a Stewardship Index based on the ecological value of the zone's resources, and an Outreach Index that captured the value of the zone to the park's interpretation and outreach goals (for further details see Gover 2016).

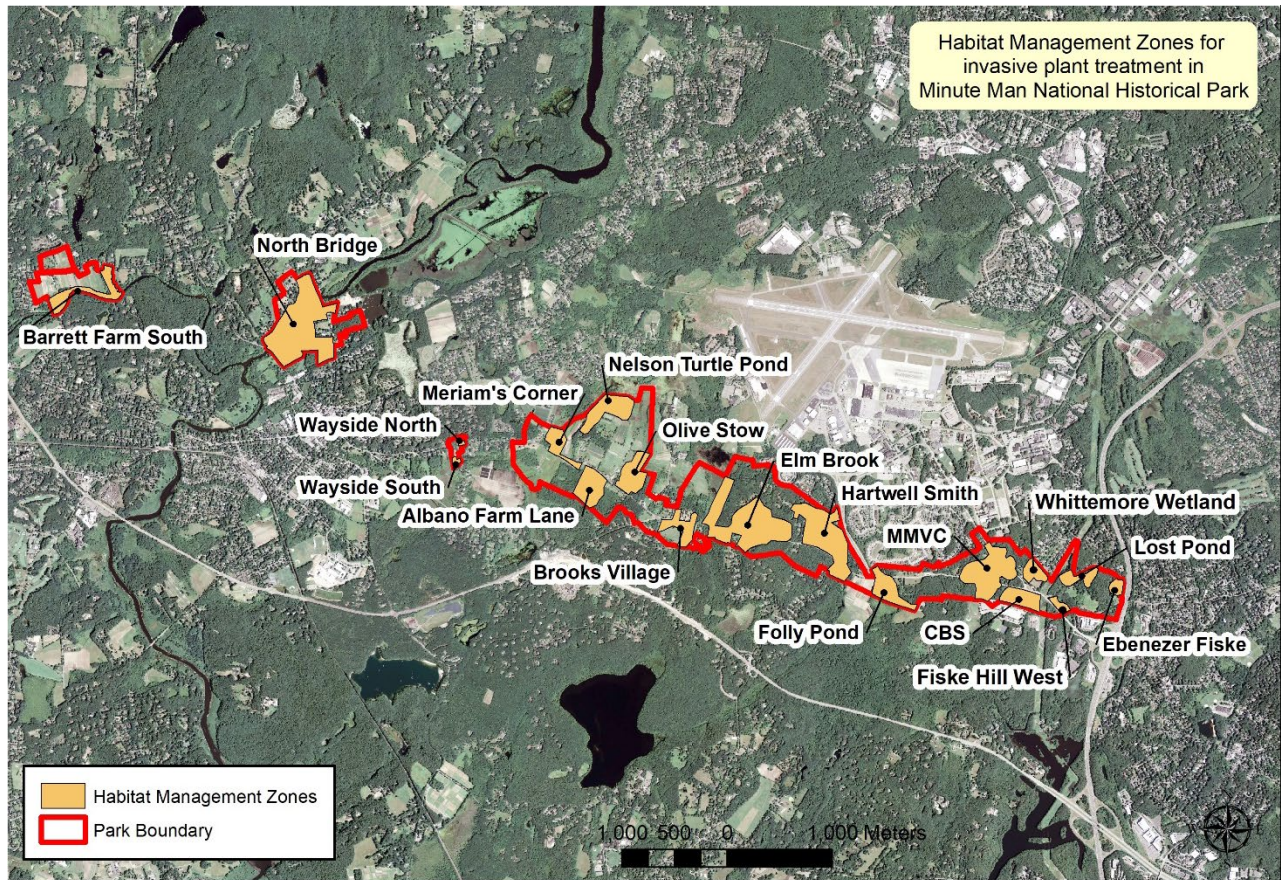


Figure 2. Habitat Management Zones for the treatment of invasive plants at Minute Man National Historical Park.

Prioritization

We then used a prioritization tool (Gover 2016) housed in an excel workbook to prioritize which habitat management zones and which invasive species should be managed in order to maximize the benefit to park natural resources. First, data on invasive species were collected from:

- park-wide invasive species surveys conducted by park interns from 2017 - 2020,
- the Great Walden BioBlitz in 2019,
- IPMT invasive treatment data from 2016 – 2019,
- vegetation classification plots (2005) and accuracy assessment points (2006) collected for the park's vegetation classification and mapping project (Gawler et al. 2017),
- long-term forest health monitoring data collected in 2016 and 2018 as part of NETN Forest Health Monitoring (Tierney et al. 2014),
- publicly available data from iNaturalist (2016 – 2021) and EDDMaps (2002 – 2009).

From those data, we identified the invasive species known to occur in the 18 habitat management zones, and then categorized the species into three groups:

- 1) Weedy non-native species (e.g., hoary alyssum (*Berteroa incana*), European lily of the valley (*Convallaria majalis*), common star of Bethlehem (*Ornithogalum umbellatum*) and others) that can act invasively, but do not cause as much ecological harm, relative to other invasive species which are known to be problematic in the park. These species were excluded from the prioritization tool.
- 2) “Super Bad” invasive species that cause significantly greater negative impact to park resources (e.g., Japanese knotweed, Japanese stiltgrass (*Microstegium vimineum*), lesser celandine (*Ficaria verna*), and others). These species were given higher priority by the tool.
- 3) The remaining invasive species known to occur in the habitat management zones were included in the prioritization tool as “regular” invasive species (see Gover 2016 for more details).

Next, we evaluated the level of infestation of each known invasive plant species in each zone, the potential impacts of those invasive species on the habitats, the difficulty of managing those invasives, and the restoration effort required in each habitat. The prioritization tool ranks and weights all of these inputs and creates a prioritization matrix (Table 2) that provides strategic direction for managers to protect the best sites within the park.

Nelson Turtle Pond, North Bridge, Cattail and Blueberry Swamp (CBS), and Albano Farm Lane are the highest priority zones for invasive species management, specifically the species highlighted in red, orange, and yellow in Table 2. The next tier of zones includes Elm Brook, Minute Man Visitor Center (MMVC), Folly Pond, Lost Pond, and Whittemore Wetland; followed in the next lowest tier by Hartwell Smith, Brooks Village, Meriam’s Corner, Olive Stow, Wayside North, and Fiske Hill West. Ebenezer Fiske and Wayside North are the lowest priority zones.

Table 2. Priority habitat management zones (darker green indicates higher priority) and priority invasive species (high number indicates higher priority) for Minute Man National Historical Park.

Habitat Management Zone		Nelson Turtle Pond	North Bridge	Cattail - Blueberry Swamp	Albano Farm Lane	Elm Brook	MMVC	Folly Pond	Lost Pond	Whittemore Wetland	Hartwell Smith	Brooks Village	Meriam's Corner	Olive Stow	Wayside South	Fiske Hill West	Ebenezer Fiske	Wayside North
Stewardship Index		2	2	2	2	2	1	1	1	1	0	0	1	1	1	1	0	0
Outreach Index		2	2	2	2	1	2	2	2	2	2	2	1	1	1	1	1	1
Scientific Name	Common Name																	
<i>Microstegium vimineum</i>	Japanese stiltgrass	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cirsium vulgare</i>	bull thistle	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0
<i>Hesperis matronalis</i>	dames rocket	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0
<i>Alliaria petiolata</i>	garlic mustard	8	6	8	8	5	5	7	0	5	4	6	6	6	6	0	5	5
<i>Centaurea stoebe</i>	spotted knapweed	0	0	8	0	0	5	7	0	0	6	0	6	0	0	0	5	0
<i>Anthriscus sylvestris</i>	wild chervil	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Pastinaca sativa</i>	wild parsnip	0	0	0	0	0	7	0	0	0	6	0	6	0	0	0	0	0
<i>Phragmites australis</i>	common reed	7	0	0	0	0	5	6	5	0	0	0	0	4	0	0	0	0
<i>Securigera varia</i>	crownvetch	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0
<i>Fallopia japonica</i>	Japanese knotweed	10	10	10	0	9	9	9	9	0	8	8	8	0	8	8	0	0
<i>Vincetoxicum</i> spp.	swallow-worts	0	10	0	0	9	9	9	0	9	8	8	8	0	0	0	7	7
<i>Lythrum salicaria</i>	purple loosestrife	7	7	7	7	6	6	0	7	0	5	5	5	5	5	6	0	0
<i>Elaeagnus umbellata</i>	autumn olive	8	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rhamnus cathartica</i>	common buckthorn	10	8	10	8	7	7	7	7	7	6	6	6	6	6	6	5	5
<i>Frangula alnus</i>	glossy buckthorn	8	8	8	8	7	7	7	7	7	6	6	6	6	6	6	5	5
<i>Berberis thunbergii</i>	Japanese barberry	10	0	0	0	8	8	0	0	0	8	0	0	0	0	8	0	7
<i>Acer platanoides</i>	Norway maple	9	7	7	7	6	6	6	6	0	5	5	5	5	0	5	4	4
<i>Ligustrum</i> spp.	privet	10	0	0	0	0	0	0	8	0	8	0	8	0	0	0	0	0
<i>Lonicera</i> spp.	shrub honeysuckle	8	8	10	8	7	7	7	7	6	6	6	6	6	6	6	5	5
<i>Euonymus</i> spp.	euonymus	10	10	0	0	8	8	0	8	0	8	0	0	0	0	6	7	0
<i>Ailanthus altissima</i>	tree-of-heaven	0	0	0	0	0	6	8	0	0	0	0	0	0	0	0	0	0
<i>Lonicera japonica</i>	Japanese honeysuckle	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0
<i>Celastrus orbiculatus</i>	Oriental bittersweet	7	7	7	7	6	6	6	6	8	5	5	5	7	7	7	4	6
<i>Ampelopsis glandulosa</i>	porcelainberry	9	9	0	9	8	8	0	8	0	0	0	0	0	0	0	0	0
<i>Trapa natans</i>	European water chesnut	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Arctium minus</i>	lesser burdock	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0
<i>Cardamine impatiens</i>	narrowleaf bittercress	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0
<i>Artemisia vulgaris</i>	mugwort	0	8	8	0	7	0	0	0	0	0	0	0	0	0	0	0	0
<i>Iris pseudacorus</i>	yellow flag iris	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Robinia pseudoacacia</i>	black locust	0	9	0	0	8	8	0	0	8	5	0	7	7	0	0	0	0
<i>Rosa multiflora</i>	multiflora rose	8	8	8	8	7	7	7	7	7	6	6	6	6	6	6	5	0
<i>Wisteria</i> spp.	wisteria	0	0	0	0	7	0	0	0	0	6	6	0	0	0	4	0	0
<i>Ranunculus ficaria</i>	lesser celandine	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Euonymus fortunei</i>	winter creeper	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0

The Barrett Farm habitat management zone could not be included in the prioritization tool because no invasive species data exist for this zone. Surveying for and collecting data on the distribution and abundance of invasive species in the Barrett Farm habitat management zone is a high priority for the 2021 field season, since the Barrett Farm zone received the high stewardship (2) and outreach (2) ranks. Japanese knotweed is known to occur in this zone, but information on other invasive species is currently lacking.

Prescription

Last, we described how strategic invasive species management will be implemented in the park. The prescription specifies: **who** will be doing the work, **how** the invasives will be managed, and **when** the management should be conducted for only the habitat management zones that were identified as priorities and for only those invasive species that were identified as priorities in Table 2.

Other invasive species not specified by this plan may be treated while crews are in the habitat management zones targeting priority species. Thus, species with lower ranks (e.g., 4, 5, 6) in Table 2 can also be treated when operationally efficient. For example, all invasive shrubs should be treated at the same time within a priority zone, even if the various shrub species received different priority rankings.

Appendix A contains the invasive species management prescriptions for the high priority zones and species. There are many opportunities for volunteers and park partners to play an important role in invasive species management in MIMA. Also, many invasive management prescriptions require a Certified Applicator, someone who has completed the required trainings to use herbicides. In addition to conducting the treatments themselves, Certified Applicators can supervise non-credentialed applicators as long as they are in direct contact at the work site. Certified Applicators can be park staff, NPS Invasive Plant Team members, or contractors.

Restoration

Planting native plants in areas where invasive species have been removed will help restore forests dominated by native species. Tables 3 and 4 below provide native species that should be used for restoration, along with their habitat preferences.

Table 3. Native woody species recommended for restoration in Minute Man National Historical Park.

Layer	Species	Wetland Edge	Upland
Canopy	<i>Acer rubrum</i> (red maple)	X	X
	<i>Acer saccharum</i> (sugar maple)	X	X
	<i>Acer saccharinum</i> (silver maple)	X	X
	<i>Betula alleghaniensis</i> (yellow birch)	X	X
	<i>Betula lenta</i> (sweet birch)	X	X
	<i>Betula papyrifera</i> (white birch)	X	X
	<i>Betula populifolia</i> (gray birch)	X	X
	<i>Carya ovata</i> (shagbark hickory)		X
	<i>Carya glabra</i> (pignut hickory)		X
	<i>Liriodendron tulipifera</i> (tulip tree)		X
	<i>Pinus strobus</i> (white pine)		X
	<i>Quercus alba</i> (white oak)	X	
	<i>Quercus coccinea</i> (scarlet oak)		X
	<i>Quercus palustris</i> (pin oak)	X	
	<i>Quercus prinus</i> (chestnut oak)		X
	<i>Quercus rubra</i> (red oak)	X	X
	<i>Quercus velutina</i> (black oak)		X
	<i>Tilia Americana</i> (basswood)	X	X
Subcanopy	<i>Carpinus caroliniana</i> (American hornbeam/ musclewood)	X	X
	<i>Cornus florida</i> (flowering dogwood)	X	X
	<i>Crataegus mollis</i> (downy hawthorn)		X
	<i>Juniperus virginiana</i> (Eastern redcedar) in sunny areas		X
	<i>Nyssa sylvatica</i> (swamp tupelo)	X	X

Subcanopy	Species	Wetland Edge	Upland
	<i>Salix nigra</i> (black willow)	X	
	<i>Sassafras albidum</i> (sassafras)		X
Shrub	<i>Alnus incana</i> (speckled alder)	X	
	<i>Cephalanthus occidentalis</i> (buttonbush)	X	
	<i>Clethra alnifolia</i> (sweet pepper bush)	X	
	<i>Cornus amomum</i> (silky dogwood)	X	
	<i>Cornus racemose</i> (gray dogwood)		X
	<i>Hamamelis virginiana</i> (witch hazel)	X	
	<i>Ilex verticillata</i> (winterberry)	X	X
	<i>Kalmia latifolia</i> (mountain laurel)	X	X
	<i>Rhus typhina</i> (staghorn sumac)		X
	<i>Rubus allegheniensis</i> (common blackberry)		X
	<i>Rubus occidentalis</i> (black raspberry)		X
	<i>Sambucus nigra</i> (black elderberry)	X	
	<i>Spiraea alba</i> (white meadowsweet)	X	X
	<i>Vaccinium corymbosum</i> (highbush blueberry)	X	X

Table 4. Native herbaceous and graminoid species recommended for restoration in Minute Man National Historical Park.

Species Name	Common Name	Light Tolerance			Habitat Value	Estimated Cost
		Sun	Semi Shade	Shade		
<i>Agrostis perennans</i>	Autumn bentgrass	X	X		Bird, Mammal	\$14.00/lb seed (Ernst Seed)
<i>Andropogon gerardii</i> 'Niagara'	Big Bluestem 'Niagara'	X			Bird, Mammal, Pollinator habitat	\$14.00/lb seed (Ernst Seed)
<i>Andropogon glomeratus</i>	Bushy Bluestem	X			Bird, Insect, Pollinator habitat	\$100.00/lb seed (Ernst Seed)

Species Name	Common Name	Light Tolerance			Habitat Value	Estimated Cost
		Sun	Semi Shade	Shade		
<i>Asclepias syriaca</i>	Common Milkweed	X			Insect, Pollinator food	~\$5.00/plant (Prairie Nursery)
<i>Asclepias tuberosa</i>	Butterfly Milkweed	X			Insect, Pollinator food	\$7.00/plant (American Meadows)
<i>Aster laevis</i>	Smooth Blue Aster	X			Mammal, Pollinator food	\$5.00/plant (Prairie Nursery)
<i>Baptisia australis</i>	Wild Blue Indigo	X			Bird, Mammal, Pollinator food	\$4.00/seed packer (American Meadows)
<i>Bouteloua curtipendula</i> 'Butte'	Side-oats Grama 'Butte'	X			Bird, Mammal	\$12.00/lb seed (Ernst Seed)
<i>Carex appalachica</i>	Appalachian Sedge					
<i>Carex crinita</i>	Fringed Sedge					
<i>Carex eburnea</i>	Bristle-leaved Tickseed	X	X	X	Insect, Pollinator food	
<i>Chamaecrista fasciculata</i>	Partridge Pea	X	X		Bird, Mammal, Pollinator food	\$29.95/lb seed (American Meadows)
<i>Chelone glabra</i>	White Turtlehead		X	X	Pollinator food	\$4.25/pkt (wildseedproject.net)
<i>Comptonia peregrina</i>	Sweet Fern	X	X		Bird, Insect, Pollinator habitat	~\$8.00/plant (Prairie Nursery)
<i>Coreopsis verticillata</i>	Thread-leaved Tickseed					
<i>Echinacea purpurea</i>	Eastern Purple	X	X		Pollinator food	
<i>Elymus virginicus</i>	Virginia Wildrye		X		Bird, Mammal, Pollinator habitat	
<i>Eragrostis spectabilis</i>	Purple Lovegrass	X			Insect	
<i>Eryngium yuccifolium</i>	Rattlesnake-master	X			Insect	
<i>Eupatorium hyssopifolium</i>	Hyssop-leaved Boneset	X			Bird	
<i>Eupatorium perfoliatum</i>	Boneset Thoroughwort		X		Bird, Insect, Pollinator food	
<i>Eurybia divaricata</i>	White Wood Aster			X	Insect, Pollinator food	
<i>Eutrochium maculatum/</i> <i>Eupatorium maculatum</i>	Spotted Joe-Pye Weed	X			Insect, Pollinator food	~\$5.00/plant (Prairie Nursery)
<i>Festuca rubra</i>	Red fescue	X				
<i>Helianthus divaricatus</i>	Woodland Sunflower	X	X	X	Bird	~\$5.00/plant (Pra Nurs)

Species Name	Common Name	Light Tolerance			Habitat Value	Estimated Cost
		Sun	Semi Shade	Shade		
<i>Heliopsis helianthoides</i>	Sunflower Everlasting, Smooth Oxeye	X			Pollinator food	
<i>Ionactis linariifolius</i>	Stiff Aster	X	X	X	Mammal, Pollinator food	
<i>Liatris novae-angliae</i>	Northern Blazing Star	X			Insect, Pollinator food	
<i>Liatris spicata</i>	Marsh Blazing Star	X			Pollinator food	\$210.00/lb seed (Ernst Seed); ~\$5.00/plant (Prairie Nursery)
<i>Monarda fistulosa</i>	Wild Bee-balm	X	X		Bird, Pollinator food	\$3.95/seed packet (American Meadows)
<i>Monarda virgatum</i>	Spotted Bee-balm	X			Insect, Pollinator food	\$3.95/seed packet (American Meadows)
<i>Panicum virgatum</i>	Switchgrass	X	X		Bird, Insect, Pollinator habitat	
<i>Penstemon digitalis</i>	Foxglove Beardtongue, Tall White Beardtongue			X	Pollinator food	\$160.00/lb seed (Ernst Seed)
<i>Pycnanthemum incanum</i>	Hoary Mountainmint	X	X		Pollinator food	
<i>Pycnanthemum tenuifolium</i>	Narrow Leaf Mountainmint	X	X		Bird, Insect, Pollinator food	\$140.00/lb seed (Ernst Seed)
<i>Rudbeckia fulgida</i>	Showy Coneflower	X			Bird	
<i>Rudbeckia hirta</i>	Black-eyed Susan	X			Bird, Mammal, Pollinator food	
<i>Rudbeckia triloba</i>	Brown-eyed Susan	X			Bird	~\$5.00/plant (Prairie Nursery)
<i>Schizachyrium scoparium</i>	Little Bluestem	X	X		Bird, Mammal, Pollinator habitat	\$37.95/lb seed (American Meadows)
<i>Senna hebecarpa</i>	Wild Senna	X			Bird, Mammal, Pollinator food	~\$5.00/plant (Prairie Nursery)
<i>Senna marilandica</i>	Maryland Senna	X			Bird, Mammal, Pollinator food	\$24.00/lb seed (Ernst Seed)
<i>Solidago caesia</i>	Blue-stemmed Goldenrod	X	X		Bird, Insect, Pollinator food	~\$5.00/plant (Prairie Nursery)
<i>Solidago juncea</i>	Early Goldenrod	X	X	X	Pollinator food	\$280.00/lb seed (Ernst Seed)
<i>Solidago nemoralis</i>	Gray Goldenrod	X	X	X	Bird, Insect, Pollinator food	\$360.00/lb seed (Ernst Seed)

Species Name	Common Name	Light Tolerance			Habitat Value	Estimated Cost
		Sun	Semi Shade	Shade		
<i>Solidago odora</i>	Licorice Goldenrod		X	X	Bird, Pollinator food	\$320.00/lb seed (Ernst Seed); \$5.00/plant (Prairie Nursery)
<i>Sorghastrum nutans</i>	Indian Grass				Bird, Mammal, Pollinator habitat	
<i>Symphotrichum laeve</i>	Smooth American Aster	X			Insect, Pollinator food	\$3.95/seed packet (American Meadows)
<i>Symphotrichum novae-angliae</i> , <i>Aster novae-angliae</i>	New England Aster	X	X		Bird, Mammal, Pollinator food	~\$5.00/plant (Prairie Nursery)
<i>Symphotrichum novi-belgii</i>	New York American Aster	X			Insect, Pollinator food	
<i>Tradescantia ohiensis</i>	Ohio Spiderwort		X		Pollinator food	~\$5.00/plant (Prairie Nursery)
<i>Verbena hastata</i>	Blue Vervain	X	X		Pollinator food, Bird seed	\$4.25/pkt (Wildseedproject.net) \$1.10 /plug (NEWP)
<i>Vernonia noveboracensis</i>	New York Ironweed	X			Pollinator	\$4.25/pkt (Wildseedproject.net) \$1.45 /plug (NEWP)
<i>Veronicastrum virginicum</i>	Culver's Root	X	X		Insect, Pollinator food	~\$5.00/plant (Prairie Nursery)

Biological Controls

For invasive plants that are widespread, biological controls (also known as biocontrols) are often the only realistic management options. Biocontrols are host-specific insects or pathogens that feed only on one particular invasive plant. The biocontrols weaken the target invasive plant, limiting its spread and its ability to displace nearby native plants. The use of biocontrols is strictly regulated and guided by federal and state laws, an International Code of Best Practices, and specific protocols that are all designed to ensure the safety and effectiveness of biocontrol programs.

The biological control of purple loosestrife (*Lythrum salicaria*) illustrates how biocontrols can successfully reduce the abundance of highly invasive species to a tolerable level at which they co-exist within native plant communities. From the mid-1990s until the mid-2010s, the Massachusetts Division of Ecological Restoration (DER), Massachusetts Audubon, and partner organizations in the Sudbury-Assabet-Concord Cooperative Invasive Species Management Area released two loosestrife beetles (*Galerucella californiensis* and *Galerucella pusilla*) that have controlled the spread and abundance of purple loosestrife. These beetles have likely colonized MIMA wetlands on their own and are likely helping keep purple loosestrife in check within the park. Additional purple loosestrife

beetles may be available from the Phillip Alampi Beneficial Insect Laboratory in Treton, NJ. Contact Rhonda Strubel (rhonda.strubel@ag.state.nj.us) for more information.

Psyllid insects to control Japanese knotweed are Another biocontrol that would be beneficial to MIMA. These insects are currently being released at many field sites in the northeastern US, including in national park units. MIMA can work with the US Forest Service Morgantown Field Office (specifically, Yun Wu <yun.wu@usda.gov> and Heather Smith <heather.c.smith@usda.gov>) to determine if MIMA can be a release site.

Strategic Management Protects Park Resources

Invasive species management is crucial to protecting the park's important natural and cultural resources. Inaction will result in declines in the park's forests, biodiversity, and the integrity of key cultural resources. The strategic prescriptions presented in this report direct scarce resources to the areas of the park where invasive species management will most benefit the park's cultural and natural resources.

This plan can be updated every 4 – 5 years, to determine progress on containing priority species in habitat management zones and re-evaluate park priorities in light of staffing and funding levels. The latest monitoring data and new observations from the Invasive Species Early Detection / Rapid Response Program will be incorporated into the updated plan. However, the excel workbook prioritization tool can be updated at any time (e.g., new invasive species found, land parcel newly acquired by the park, etc), in order to evaluate evolving management priorities.

Literature Cited

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Tierney, G., B. Mitchell, K. Miller, J. Comiskey, A. Kozlowski, and D. Faber-Langendoen. 2014. Northeast Temperate Network long-term forest monitoring protocol: 2014 revision. Natural Resource Report NPS/NETN/NRR—2014/805. National Park Service, Fort Collins, Colorado

APPENDIX A

Treatment Prescriptions for Nelson Turtle Pond

[illegible]

Treatment Prescriptions for North Bridge

[illegible]

Treatment Prescriptions for Cattail - Blueberry Swamp

[illegible]

Treatment Prescriptions for Albano Farm Lane

[illegible]

Treatment Prescriptions for Elm Brook

Priority Rank	Habitat Management Zone	Species	Lead Worker	Method	Comments	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
9	Elm Brook	Japanese knotweed	Certified Applicator	Foliar-AirStrike	Preferred Treatment: Use an aquatic Glyphosate at maximum low volume foliar rate (usually ~4-5% for concentrates)												
9	Elm Brook	Japanese knotweed	Volunteer	Cut	Optional early season cutting to reduce biomass, foliar treatments can then be conducted later in the season due to delayed flowering												
9	Elm Brook	Japanese knotweed	Certified Applicator	Stump-aqueous	Not usually as effective as foliar: use an aquatic Glyphosate at 33 to 50% strength												
9	Elm Brook	swallow-worts	Certified Applicator	Foliar-Broadleaf	3-5% Triclopyr Amine (Garlon 3A), Triclopyr Amine has better performance than Triclopyr Ester (Garlon 4 Ultra), could use non-selective 3% Glyphosate or 1 qt per acre of Imazapyr, some applicators recommend a mix of Triclopyr Amine and Escort XP												
8	Elm Brook	Japanese barberry	Volunteer	Cut	Not best for volunteers due to prickles, couple with herbicide application ideally (water based products within 5 mins, oil based can be anytime)												
8	Elm Brook	Japanese barberry	Certified Applicator	Stump-aqueous	33-50% water-based herbicides, could use 20-25% oil-based herbicides as well in dry areas												
8	Elm Brook	Japanese barberry	Certified Applicator	Foliar-Broadleaf	For example 3% Triclopyr Amine (Garlon 3A), if this is the only plant being treated can switch to 2%, could use foliar non-selective (for example Glyphosate) as well												
8	Elm Brook	euonymus	Volunteer	Cut	Couple with herbicide stump application ideally (water based products within 5 mins, oil based can be anytime), or follow up foliar on regrowth												
8	Elm Brook	euonymus	Certified Applicator	Stump-aqueous	33-50% water-based herbicides, could use 20-25% oil-based herbicides as well in dry areas												
8	Elm Brook	euonymus	Certified Applicator	Foliar-Broadleaf	For example 3% Triclopyr Amine (Garlon 3A), could use foliar non-selective (for example Glyphosate) as well												
8	Elm Brook	porcelainberry	Volunteer	Cut	Couple with herbicide stump application ideally (water based products within 5 mins, oil based can be anytime), or follow up foliar on regrowth												
8	Elm Brook	porcelainberry	Certified Applicator	Stump-aqueous	33-50% water-based herbicides, could use 20-25% oil-based herbicides as well in dry areas; lower effectiveness during times of heavy sap flow (early spring) particularly for water based mixes												
8	Elm Brook	porcelainberry	Certified Applicator	Foliar-Broadleaf	For example 3% Triclopyr Amine (Garlon 3A), could use foliar non-selective (for example Glyphosate) as well												
8	Elm Brook	black locust	Volunteer	Cut	Cut only (chainsaws required for larger trees) and foliar treat respouts/suckers; can cut stump treat with herbicide, but it won't stop root suckering												
8	Elm Brook	black locust	Certified Applicator	Stem-basal	Oil based Triclopyr 20-25% in basal oil, standing dead trees a consideration												
8	Elm Brook	black locust	Certified Applicator	Foliar-Broadleaf	3% Triclopyr Amine (Garlon 3A), some applicators combine it with a tiny amount of Aminopyralid (Milestone)												
7	Elm Brook	common buckthorn	Volunteer	Cut	Couple with herbicide stump application ideally (water based products within 5 mins, oil based can be anytime), or follow up foliar on regrowth												
7	Elm Brook	common buckthorn	Certified Applicator	Stump-aqueous	33-50% water-based herbicides, could use 20-25% oil-based herbicides as well in dry areas												
7	Elm Brook	common buckthorn	Certified Applicator	Foliar-Broadleaf	For example 3% Triclopyr Amine (Garlon 3A), could use foliar non-selective (for example Glyphosate) as well												
7	Elm Brook	glossy buckthorn	Volunteer	Cut	Couple with herbicide stump application ideally (water based products within 5 mins, oil based can be anytime), or follow up foliar on regrowth												
7	Elm Brook	glossy buckthorn	Certified Applicator	Stump-aqueous	33-50% water-based herbicides, could use 20-25% oil-based herbicides as well in dry areas												
7	Elm Brook	glossy buckthorn	Certified Applicator	Foliar-Broadleaf	For example 3% Triclopyr Amine (Garlon 3A), could use foliar non-selective (for example Glyphosate) as well												
7	Elm Brook	shrub honeysuckle	Volunteer	Cut	Couple with herbicide stump application ideally (water based products within 5 mins, oil based can be anytime), or follow up foliar on regrowth												
7	Elm Brook	shrub honeysuckle	Certified Applicator	Stump-aqueous	33-50% water-based herbicides, could use 20-25% oil-based herbicides as well in dry areas												
7	Elm Brook	shrub honeysuckle	Certified Applicator	Foliar-Broadleaf	For example 3% Triclopyr Amine (Garlon 3A), could use foliar non-selective (for example Glyphosate) as well												
7	Elm Brook	mugwort	Certified Applicator	Foliar-Specialized	Milestone herbicide at approximately 0.25%, may want to run a calibration and calculate amount per acre since that is how the label is set up, especially for dense patches that will be a broadcast type treatment												
7	Elm Brook	multiflora rose	Volunteer	Cut	Not best for volunteers due to prickles, couple with herbicide application ideally (water based products within 5 mins, oil based can be anytime)												
7	Elm Brook	multiflora rose	Certified Applicator	Stump-aqueous	33-50% water-based herbicides, could use 20-25% oil-based herbicides as well in dry areas												
7	Elm Brook	multiflora rose	Certified Applicator	Foliar-Broadleaf	For example 3% Triclopyr Amine (Garlon 3A), if this is the only plant being treated can switch to 2%, could use foliar non-selective (for example Glyphosate) as well												
7	Elm Brook	wisteria	Volunteer	Cut	Couple with herbicide stump application ideally (water based products within 5 mins, oil based can be anytime), or follow up foliar on regrowth												
7	Elm Brook	wisteria	Certified Applicator	Stump-aqueous	33-50% water-based herbicides, could use 20-25% oil-based herbicides as well in dry areas; lower effectiveness during times of heavy sap flow (early spring) particularly for water based mixes												
7	Elm Brook	wisteria	Certified Applicator	Foliar-Broadleaf	For example 3% Triclopyr Amine (Garlon 3A), could use foliar non-selective (for example Glyphosate) as well												

Treatment Prescriptions for MMVC (Minute Man Visitor Center)

Priority Rank	Habitat Management Zone	Species	Lead Worker	Method	Comments	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
9	MMVC	Japanese knotweed	Volunteer	Cut	Optional early season cutting to reduce biomass, foliar treatments can then be conducted later in the season due to delayed flowering												
9	MMVC	Japanese knotweed	Certified Applicator	Foliar-AirStrike	Preferred Treatment: Use an aquatic Glyphosate at maximum low volume foliar rate (usually ~4-5% for concentrates)												
9	MMVC	Japanese knotweed	Certified Applicator	Stump-aqueous	Not usually as effective as foliar: use an aquatic Glyphosate at 33 to 50% strength												
9	MMVC	swallow-worts	Certified Applicator	Foliar-Broadleaf	3-5% Triclopyr Amine (Garlon 3A), Triclopyr Amine has better performance than Triclopyr Ester (Garlon 4 Ultra), could use non-selective 3% Glyphosate or 1 qt per acre of Imazapyr, some applicators recommend a mix of Triclopyr Amine and Escort XP												
8	MMVC	Japanese barberry	Volunteer	Cut	Not best for volunteers due to prickles, couple with herbicide application ideally (water based products within 5 mins, oil based can be anytime)												
8	MMVC	Japanese barberry	Certified Applicator	Stump-aqueous	33-50% water-based herbicides, could use 20-25% oil-based herbicides as well in dry areas												
8	MMVC	Japanese barberry	Certified Applicator	Foliar-Broadleaf	For example 3% Triclopyr Amine (Garlon 3A), if this is the only plant being treated can switch to 2%, could use foliar non-selective (for example Glyphosate) as well												
8	MMVC	euonymus	Volunteer	Cut	Couple with herbicide stump application ideally (water based products within 5 mins, oil based can be anytime), or follow up foliar on regrowth												
8	MMVC	euonymus	Certified Applicator	Stump-aqueous	33-50% water-based herbicides, could use 20-25% oil-based herbicides as well in dry areas												
8	MMVC	euonymus	Certified Applicator	Foliar-Broadleaf	For example 3% Triclopyr Amine (Garlon 3A), could use foliar non-selective (for example Glyphosate) as well												
8	MMVC	porcelainberry	Volunteer	Cut	Couple with herbicide stump application ideally (water based products within 5 mins, oil based can be anytime), or follow up foliar on regrowth												
8	MMVC	porcelainberry	Certified Applicator	Stump-aqueous	33-50% water-based herbicides, could use 20-25% oil-based herbicides as well in dry areas; lower effectiveness during times of heavy sap flow (early spring) particularly for water based mixes												
8	MMVC	porcelainberry	Certified Applicator	Foliar-Broadleaf	For example 3% Triclopyr Amine (Garlon 3A), could use foliar non-selective (for example Glyphosate) as well												
8	MMVC	narrowleaf bittercress	Volunteer	Pull	Bag reproductive plants												
8	MMVC	narrowleaf bittercress	Certified Applicator	Foliar-AirStrike	1.5 - 2% Glyphosate												
8	MMVC	black locust	Volunteer	Cut	Cut only (chainsaws required for larger trees) and foliar treat resprouts/suckers; can cut stump treat with herbicide, but it won't stop root suckering												
8	MMVC	black locust	Certified Applicator	Stem-basal	Oil based Triclopyr 20-25% in basal oil, standing dead trees a consideration												
8	MMVC	black locust	Certified Applicator	Foliar-Broadleaf	3% Triclopyr Amine (Garlon 3A), some applicators combine it with a tiny amount of Aminopyralid (Milestone)												
7	MMVC	wild parsnip	Certified Applicator	Foliar-AirStrike	Can be controlled by mowing or digging, however sap is toxic												
7	MMVC	common buckthorn	Volunteer	Cut	Couple with herbicide stump application ideally (water based products within 5 mins, oil based can be anytime), or follow up foliar on regrowth												
7	MMVC	common buckthorn	Certified Applicator	Stump-aqueous	33-50% water-based herbicides, could use 20-25% oil-based herbicides as well in dry areas												
7	MMVC	common buckthorn	Certified Applicator	Foliar-Broadleaf	For example 3% Triclopyr Amine (Garlon 3A), could use foliar non-selective (for example Glyphosate) as well												
7	MMVC	glossy buckthorn	Volunteer	Cut	Couple with herbicide stump application ideally (water based products within 5 mins, oil based can be anytime), or follow up foliar on regrowth												
7	MMVC	glossy buckthorn	Certified Applicator	Stump-aqueous	33-50% water-based herbicides, could use 20-25% oil-based herbicides as well in dry areas												
7	MMVC	glossy buckthorn	Certified Applicator	Foliar-Broadleaf	For example 3% Triclopyr Amine (Garlon 3A), could use foliar non-selective (for example Glyphosate) as well												
7	MMVC	shrub honeysuckle	Volunteer	Cut	Couple with herbicide stump application ideally (water based products within 5 mins, oil based can be anytime), or follow up foliar on regrowth												
7	MMVC	shrub honeysuckle	Certified Applicator	Stump-aqueous	33-50% water-based herbicides, could use 20-25% oil-based herbicides as well in dry areas												
7	MMVC	shrub honeysuckle	Certified Applicator	Foliar-Broadleaf	For example 3% Triclopyr Amine (Garlon 3A), could use foliar non-selective (for example Glyphosate) as well												
7	MMVC	multiflora rose	Volunteer	Cut	Not best for volunteers due to prickles, couple with herbicide application ideally (water based products within 5 mins, oil based can be anytime)												
7	MMVC	multiflora rose	Certified Applicator	Stump-aqueous	33-50% water-based herbicides, could use 20-25% oil-based herbicides as well in dry areas												
7	MMVC	multiflora rose	Certified Applicator	Foliar-Broadleaf	For example 3% Triclopyr Amine (Garlon 3A), if this is the only plant being treated can switch to 2%, could use foliar non-selective (for example Glyphosate) as well												

Treatment Prescriptions for Folly Pond

[illegible]

Treatment Prescriptions for Lost Pond

[illegible]

Treatment Prescriptions for Whittemore Wetland

[illegible]

Treatment Prescriptions for Hartwell Smith and Brooks Village

[illegible]

Treatment Prescriptions for Meriam's Corner and Olive Stow

[illegible]

Treatment Prescriptions for Wayside South and Fiske Hill West

[illegible]

Treatment Prescriptions for Ebenezer Fiske and Wayside North

[illegible]