

PRINCIPLES AND POLICIES FOR STEWARDSHIP OF AMESBURY CONSERVATION LAND



Prepared for the
City of Amesbury

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Introduction

As of 2023, the City of Amesbury has over 1,000 acres of permanently protected open space (Article 97 land). Much of this land is under the care and custody of the Conservation Commission, with day-to-day maintenance (trail mowing, trash removal) undertaken by the Department of Public Works, and management assistance from volunteers including the Open Space, Natural Resources, and Trails Committee and Lake Gardner Improvement Association. Amesbury's preserved lands are critical to supporting clean air and water, wildlife habitat, and recreational amenities for the community.

In the past, land management activities have been undertaken on a case-by-case basis, without the benefit of a body of principles, policies, and plans to guide these decisions at both the individual property level and on the larger scale of all conservation lands in Amesbury. To manage and steward its conservation land more thoughtfully the City has created this guide to serve as a comprehensive, long-term set of land management principles and policies.

This document aims to provide overarching best practices, principles and strategies for land stewardship that can be applied to the conservation land found in Amesbury – parcels of varying sizes in a mostly suburban setting, many with high passive recreation usage (such as walking, painting, photography, birdwatching, and simply enjoying the view), protected either by fee simple ownership or conservation restrictions. The development of these guidelines and procedures for Amesbury conservation land is an acknowledgement of the critical need for cohesive stewardship and active management against an increasingly complex backdrop of climate change, land conversion and development, pollution, and the invasion of non-native species. This document is informed by input from the Conservation Commissioners; the Conservation Agent; Open Space, Natural Resources, and Trails Committee; and the Lakes and Waterways Commission. It can serve as a reference point for more detailed land stewardship plans written subsequently for individual conservation areas.

The Conservation Commission has ultimate decision-making authority over management activities over most of Amesbury's conservation lands owned in fee (some parcels are under the care and custody of the Mayor). Conservation Commission staff members are responsible for interpreting and implementing decisions of the Conservation Commission. Throughout this document, the phrase "Amesbury conservation land" will be used to refer to the properties that are held in the care and custody of the Amesbury Conservation Commission.

Amesbury at a Glance

- Total Area: 8,784 acres (13.7 square miles)
- 12.3 sq. mi. land, 1.4 sq. mi water
- Human Population in 2020: 17,366
- Open space protected in perpetuity: 1,125 acres, or 13% percent of total area*
- Conservation Commission managed land: 825 acres

* Calculated using MassGIS and City of Amesbury data

Land Acknowledgement

Land that is well managed sustains us in many ways – often referred to as ecosystem services. A few examples of what land provides when it is managed sustainably include:

- The air we breathe,
- The water we drink,
- The food we eat,
- Sequestration of carbon,
- Climate moderation,
- Protection from flooding,
- Recreation that renews our spirits,
- The lumber we use to build our shelters,
- Filtration and decomposition of our wastes, and
- Habitats for a diversity of plants and animals.

The land in Amesbury is part of the traditional, contemporary, and unceded territory of the Pentucket, a branch of the Pennacook-Abenaki people. These lands were taken from the Indigenous people, creating a legacy of trauma that persists to this day. Indigenous stewardship of the land kept its ecological communities vibrant, strong, and interconnected for thousands of years, but far from being relics of the past, Indigenous peoples, including 37,000 individuals who currently reside in Massachusetts, are still at the forefront of environmental protection, ecological stewardship, and climate mitigation. This land helped sustain them for thousands of years before its occupation by Europeans. How we care for the land will determine how well it will sustain us and our descendants.

General Character and Landscape Context of Conservation Land in Amesbury

Located along the boundary between Massachusetts and New Hampshire, Amesbury has protected more than 1,000 acres of

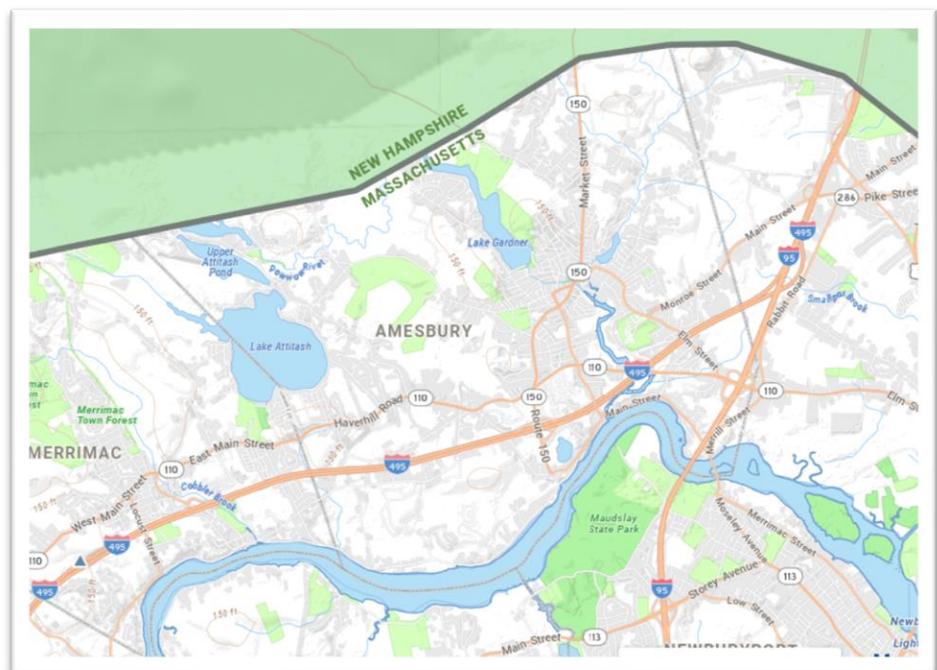


FIGURE 1 - AMESBURY

conservation land (under Article 97). Many of these conservation areas – spanning forests, fields, and wetlands – have trail networks that provide access for residents seeking to explore local open spaces. Amesbury’s conservation areas range from relatively large swaths of land connected to other open space, such as Woodsom Farm, to small parcels tucked away in neighborhoods.

While these parcels vary in size and in the natural and cultural resources they harbor, each contributes to the network of open spaces that define Amesbury as a community where residents have ready access to conservation land for renewal and enjoyment, where ecological assets are protected, and where beneficial ecosystem services contribute to the overall health of the community.

Amesbury lies at the boundary of the urban-suburban interface, between the denser development of parts of Haverhill or Newburyport and less developed areas. Its southern boundary is the Merrimack River and within the City’s boundary are several lakes, the Powow River, and the Back River – important water resources. Many of the housing developments of the last two decades have been clusters, where homes are concentrated in a compact area that saves surrounding open space, sometimes owned by the homeowners’ association, and more often deeded to the city as conservation land. Many of Amesbury’s conservation parcels are relatively small, and some of the larger properties are characterized by a high ratio of edge to area, meaning that the interior areas, less impacted by surrounding development, are generally small. As a result, the wildlife of Amesbury’s conservation lands are generally species that do well in suburban settings; common species that are well adapted to a human-shaped landscape. Despite this proximity to human development, the natural areas of Amesbury do provide stopover and foraging areas for a variety of migratory bird species and important habitats for a variety of other plant and animal species. Some like Woodsom Farm provide grasslands large enough for nesting grassland birds that are generally in decline.

eBird Hotspots in Amesbury

eBird is a project of the Cornell Lab of Ornithology that compiles bird sightings from volunteer birdwatchers. Amesbury has five hotspots including Deer Island (131 species), Lake Attitash (86 species), Battis Farm (85 species), Tuxbury Lake (57 species), and Woodsom Farm (129 species). See **Appendix B** for a listing of the species reported at each site.

Geology, Soils, Climate.

Much of Amesbury’s bedrock in the western part of the city is known as the Berwick Formation, a thin-to thick-bedded metamorphosed calcareous sandstone, siltstone, and minor muscovite schist. Granite predominates in the eastern half of the city. The metamorphic Berwick Formation is thought to have been formed 420 million years ago during the Silurian era when seas covered much of the planet and there was much active volcanism. The calcium contributes to the presence of prime agricultural land in Amesbury.

During the last Glacial Maximum, the Laurentide Ice Sheet constituted the largest ice mass on Earth, with an area of ~13,000,000 km² (~5,000,000 sq. mi.) that covered most of the northeastern United States with a layer of ice up to a mile thick. As this ice sheet advanced and retreated across the landscape, it scoured the earth and left behind distinct glacial features, such as erratics, moraines, drumlins (like Whittier Hill) and eskers. As a result of its glacial past, Amesbury is underlain with glacial drift deposited by the ice sheet or rivers of melted ice.

The topography of the city gently undulates, with seven prominent hills that were formed by the movement of the glacier on glacial till. The names and elevation of these hills are:

- Powow Hill; 331 feet
- Ring Hill: 265 feet
- Whittier Hill: 256 feet
- Lone Tree Hill, 239 feet
- Beech Hill: 217 feet
- Mundy Hill, 190 feet
- Powder House Hill, 179 feet

The soils of Amesbury are similarly glacial in nature; the most extensive soil types in the city were formed from glacial till, an unsorted mixture of sand, clay, and stones. The better drained soils in Amesbury, which are predominantly sandy in character, are related to glacial melt water and are typically found in valleys or flat areas in the region related to valleys. Poorly drained soils are associated with extensive wetlands and along the river valleys. Large areas of the city are “prime agricultural soils” of statewide importance.

Amesbury is in the Merrimack River Basin, which has a variable climate characterized by frequent but short periods of heavy precipitation averaging 41.73 inches according to a USGS station in nearby Lowell. In winter, the average annual snowfall is 55.7 inches. Amesbury lies in the path of the "prevailing westerlies," which bring hot dry weather that can lead to occasional summer droughts. The basin is also exposed to intense rainfall due to coastal storms of tropical origin that travel up the Atlantic seaboard, as well as to protracted storms during all seasons colloquially called "nor'easters". Amesbury and the rest of Massachusetts are also experiencing more extreme climate events due to climate change; for example, a severe drought was declared by the State of Massachusetts during the summer and fall of 2016 and again in 2022.

Water Assets

Amesbury has important water assets. The Merrimack River flows along the southern border of the city for 4.3 miles. The Powow River, the source of Amesbury’s drinking water, flows through the northwestern corner of the city before it briefly flows into New Hampshire and then re-enters the city and flows southeast to the Merrimack. The ponds and lakes include Tuxbury Pond (where Amesbury has drinking water wells), Meadowbrook Pond, Lake Attitash (a reserve water supply for the city), Lake Gardner, Clarks Pond, Park Pond, Pattens Pond, and Bailey Pond. These waterways have been recently assessed and the results and recommendations included in a report titled “An Assessment of Amesbury’s Lakes, Ponds, and Rivers”¹. The report notes that invasive aquatic plants (both native and non-native) threaten many of the town’s major lakes and ponds. Growth of these plants is usually associated with excess nutrients from the use of fertilizers.

¹ <https://www.amesburyma.gov/430/Lakes-Waterways>

Several waterbodies have organizations working to promote good stewardship including, The Amesbury Lakes and Waterways Commission, the Lake Attitash Association, Lake Gardner Improvement Association, Clark’s Pond Watershed Association, and the Merrimack River Watershed Council.

The Human History of Amesbury

Prior to European colonization, northeastern Massachusetts was inhabited by indigenous communities for thousands of years. It is estimated that there were between 70,000 and 100,000 Native Americans living in New England at the beginning of the 17th century². According to the Native Land Digital Website, the area that is now known as Amesbury was once occupied by four nations: the Wabanaki (Dawnland Confederacy), the Pennacook, the Pawtucket, and the N’dakina (Abenakki/Abenaquis). However, Native populations were drastically reduced in eastern Massachusetts to an estimated 5,000 individuals in 1616 as the result of disease brought to North America by early European explorers and traders, suspected to be leptospirosis carried by rodents.³

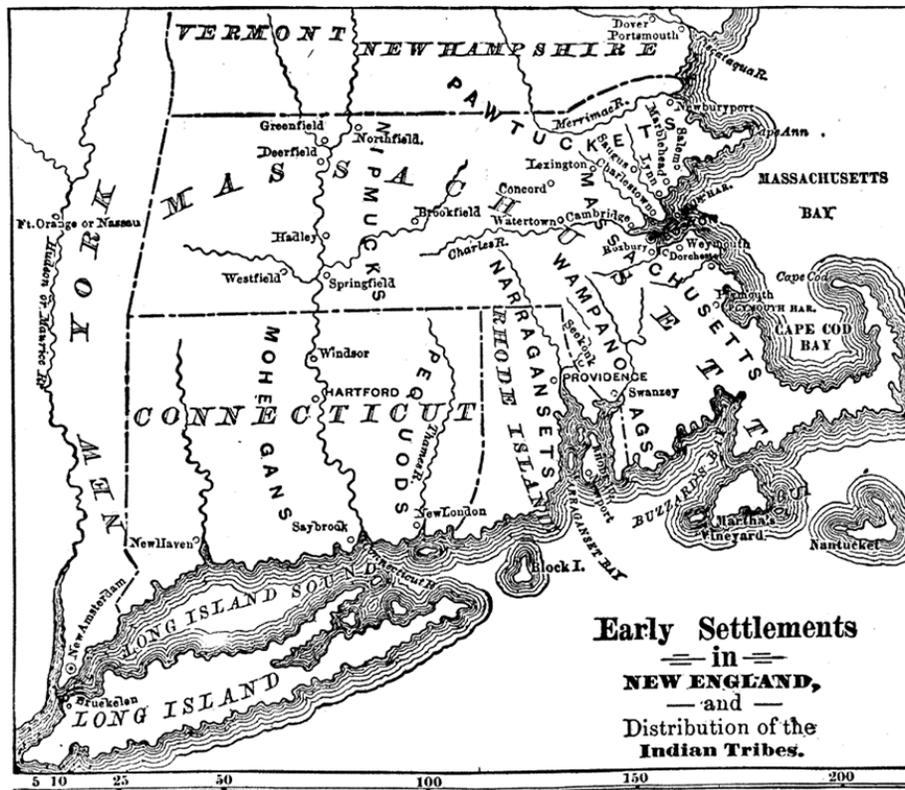


FIGURE 2 - EARLY SETTLEMENTS IN NEW ENGLAND AND DISTRIBUTION OF INDIGENOUS TRIBES, 1686.

² National Geographic Society (2020, April 30). New England Native Groups. Retrieved from <https://www.nationalgeographic.org/encyclopedia/new-england-native-american-groups/>

³ Marr, J.S., & Cathey, J.T. (2010). New Hypothesis for Cause of Epidemic among Native Americans, New England, 1616–1619. *Emerging Infectious Diseases*, 16(2), 281-286. <https://doi.org/10.3201/eid1602.090276> .

Most Indigenous villages in New England were semipermanent, with tribes moving to new areas because of seasonal changes or once the nearby agricultural land became depleted of nutrients. This resulted in fundamentally different perceptions of land ownership between Native people and European settlers who began encroaching on Indigenous lands in the 17th century after their arrival in 1620.⁴ The Indigenous people believed that they belonged to the land and were responsible for its good stewardship. European settlers reported “little resistance” from Native people when settling into the Merrimack Valley, likely due to the severely reduced population following the 1616 epidemic.⁵

Powow Hill (and Powow River) owes its name to the Algonquin word for group gatherings and celebrations held on the hill. The name “Merrimack” means “rapid waters.” Fishing stations were maintained at waterfalls and other sites along the river and its tributaries.

The origins of English settlement lie in the extreme pressure placed on Separatists for their defiance of the Church of England in the early decades of the 17th century and desires to exploit the resources of the recently discovered lands. In 1635, Newbury was settled, and in 1638 permission was granted by the General Court for a settlement north of the Merrimack River - Salisbury. Amesbury was settled in 1642 as part of Salisbury, it was named for Amesbury, England and became a separate precinct in 1654, and was incorporated as a township in 1668. In 1693 the town was a focus of witchcraft hysteria. After the early 17th century, English colonists vied with the Indigenous tribes for use of the Merrimack River. The English cleared the forests for farming, rafted logs downstream for construction purposes and engaged in shipbuilding along the shores of the Merrimack. The abundance of timber and easy river transport made colonial shipbuilding economically viable. Vessels were constructed and launched for European and American markets in the 17th and 18th centuries. During this early colonial period, shipyards were established downstream in Newbury near the river’s mouth and at the confluence of the Powow and Merrimack Rivers.

Early in the 18th century shipwrights looking for more room than they had available in Newbury, found that Salisbury Point had high ground well suited to the building of ships⁶, and began to move their operations there. Amesbury thrived as a shipbuilding port and was an early manufacturing center (iron, nails, hats, and carriages) deriving power from the drop in elevation of the Powow River. Textile production flourished after 1812 but declined in the 1920s. The city’s economy is now based on light manufacturing (electronics, computer components, furniture, and metalwork), although services are also important.

Protecting Natural Assets – An Ongoing Need

Over the past 50 years, the landscape of Massachusetts has been transformed by new residential and commercial developments. Eastern and southeastern Massachusetts have undergone the most change,

⁴ National Geographic Society (2020, April 30). New England Native Groups. Retrieved from <https://www.nationalgeographic.org/encyclopedia/new-england-native-american-groups/> .

⁵ Amesbury League of Woman Voters. (1994). The Amesbury City Handbook. Retrieved from <https://Amesburyma.gov/386/Amesbury-History> .

⁶ <http://lowellsboatshop.com/history/history/>

but virtually every community in the Commonwealth has experienced rapid growth driven by economic and demographic factors.

According to Mass Audubon's Losing Ground: Nature's Value in a Changing Climate (Sixth Edition)⁷, in 2017 Amesbury had 29% of its land area classified as developed and 54% classified as natural.⁸ It has 13% of its area permanently protected (1,119+ acres including land protected by Conservation Commission, Amesbury Water Department, Mass. Department of Agriculture, and Essex County Greenbelt, etc.). 30 by 30 (or 30x30) is a worldwide initiative for governments to designate 30% of Earth's land and ocean area as protected areas by 2030. The target was proposed by a 2019 article in Science Advances, "A Global Deal for Nature: Guiding Principles, Milestones, and Targets", highlighting the need for expanded nature conservation efforts to mitigate climate change. To achieve this goal Amesbury would need to more than double the area already protected. See **Appendix A** for a listing of permanently protected lands in Amesbury.

Natural Heritage Priority Habitats and BioMap3 Areas

The current (15th) edition of the Massachusetts Natural Heritage Atlas includes five Priority Habitat for Rare Species and three Estimated Habitats of Rare Wildlife in Amesbury. There are also 5 certified vernal pools. See **Appendix D** for a list of rare species that have been found in Amesbury.

The *BioMap Project* was developed by the Massachusetts Natural Heritage and Endangered Species Program (NHESP) and The Nature Conservancy as a guide for strategic biodiversity conservation in Massachusetts by focusing land protection and stewardship on the Core Habitats that are most critical for ensuring the long-term persistence of rare and other native species and their habitats, exemplary natural communities, and a diversity of ecosystems, and Critical Natural Landscapes, large landscapes minimally impacted by development and buffers to core habitats and coastal areas, both of which enhance connectivity and resilience.

The recently updated BioMap incorporates enhanced knowledge of biodiversity and habitats, improved information on the threats to biodiversity, and new understandings of how to ensure that natural systems are more resilient in the face of climate change. The earlier

- *BioMap3* Core Habitat: 1,591 acres (18% of City area)
- *BioMap2* Critical Natural Landscape: 2,132.47 acres (24% of City area)

BioMap3 Components

Core Habitat

- 1 Priority Natural Community
- 5 Core Habitats
- 3 Aquatic Cores
- 7 Rare species Cores
- 7 Species of Conservation Concern Cores*
 - 1 bird, 2 amphibians, 2 fishes, 1 mussel, 1 plant

Critical Natural Landscape

- 6 Aquatic Core Buffers
- 5 Aquatic Core Buffer
- 1 Coastal Adaptation Area

* See the Appendix C for a summary of the BioMap2 City Report.

⁷ See <https://www.massaudubon.org/our-conservation-work/policy-advocacy/local-climate-resilient-communities/losing-ground>

⁸ This classification is based on interpretation of air photo images where the forested area on a private lot will be classified as "natural", roads buildings and lawns, etc. will be classified as "developed".

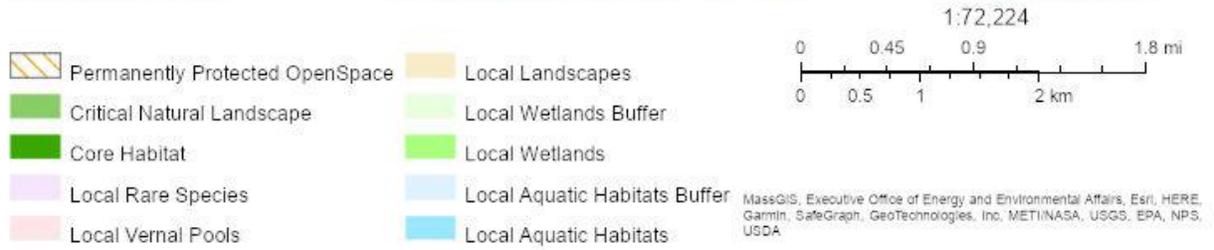
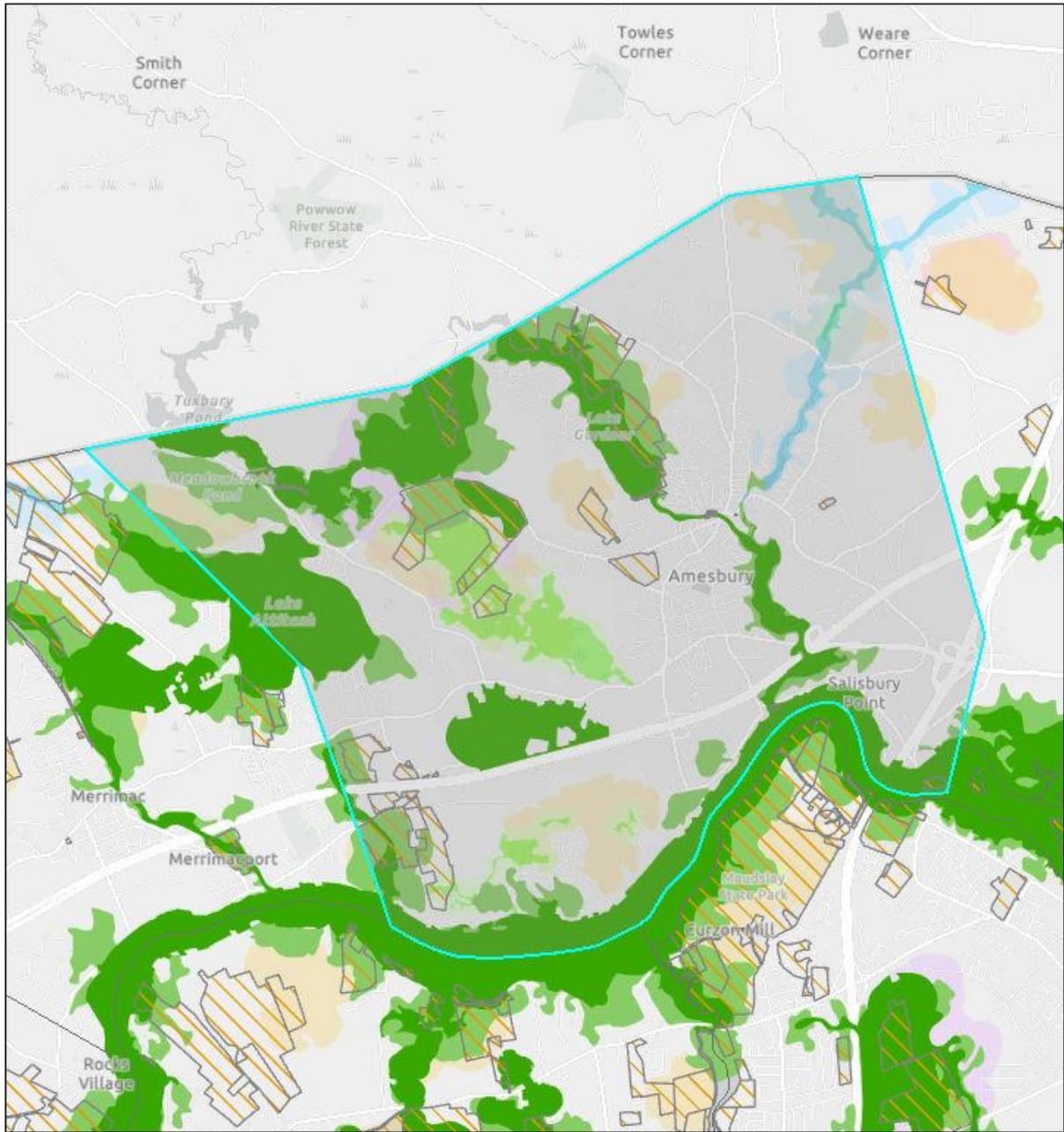


FIGURE 3 – BIOMAP3 AREAS

versions focused on areas of statewide importance. The current BioMap3 includes new areas that are of more local importance as indicated in Figure 3.

The Heritage Program's *BioMap3* Amesbury city report lists areas along the Merrimack River, areas along the Powow River, an area including Lake Attitash, and a large, unprotected area between Middle Road and Haverhill Road that includes a cluster of vernal pools. Such unprotected, high ecological resource areas are critical to Amesbury's climate resilience and should be a priority for protection. Any access improvements should include a high level of sensitivity to the uncommon natural features. See the map on the previous page and **Appendix C** for a summary of the BioMap3 Report for Amesbury.

Stewardship of Amesbury's Conservation Land

Conservation land provides opportunities to walk, jog, bicycle, cross-country ski, and observe the wild plants and animals that share our natural surroundings with us. By protecting open space from development, conservation land also protects many beneficial functions that nature performs for us. These so-called ecosystem services include flood protection, nutrient cycling, and the purification of air and water. And because all of Amesbury was once farmland, forest, or wetland, conservation land helps to preserve the historic and cultural character of our city.

Stewardship Goals

Stewardship goals for Amesbury's conservation lands reflect the following:

The mission of the Conservation Commission is:

- to protect Amesbury's natural resources in accordance with the state law and the City's Wetlands Protection Ordinance and
- to act as trustees in perpetuity of the City's conservation land

The 2020 – 2027 Amesbury Open Space & Recreation Plan goals:

1. Preserve, restore, enhance, and acquire natural resources that increase Amesbury's resilience to the effects of climate change, protect Amesbury's drinking water supply, and expand opportunities for passive and active recreation.
2. Maintain, enhance, and create recreational facilities for the enjoyment of Amesbury residents and visitors of all ages, abilities, and interests.
3. Improve care, management and awareness of existing protected land, natural resources, and recreational facilities.
4. Improve access to and connectivity among open spaces, recreational facilities, and other important city resources for all members of the Amesbury community, including low-income neighborhoods, English language learners (ELL), persons with disabilities, and older residents ("socially vulnerable populations").
5. Improve coordination and collaboration among departments, committees, and local organizations working toward common goals for open.

available maps, and other information disseminated on the City’s website, social media, and available at trailheads.

6. Build local and regional partnerships to help accomplish these goals.
7. Create property use regulations consistent with these goals and objectives and identify monitoring and enforcement entity(-ies).

Achieving Stewardship Goals Through Collaboration

Amesbury conservation land abuts parcels with a wide variety of ownerships, including private residences, commercial and industrial businesses, statewide organizations, and land trusts such as the Essex County Greenbelt and the Amesbury Improvement Association. To achieve land stewardship goals and maximize positive impacts, stewardship efforts and initiatives should be coordinated with adjacent property owners and local conservation groups when possible. Certain stewardship activities, such as invasive species control, are more effective when they extend across property boundaries, and/or when abutting owners are involved and supportive. Collaborations can be particularly impactful for contiguous swaths of protected properties that are managed by different entities. In such cases, the City of Amesbury and its partners may benefit by pooling resources, expertise, and volunteers. Examples of projects that may benefit from organizational collaboration include:

- Invasive species management,
- Habitat restoration, particularly for rare species,
- Trail connectivity,
- Deer management/hunting policies,
- Climate resiliency,
- Training programs for volunteers and staff,
- Educational programs.

Integrating Land Stewardship Guidelines and Procedures with Other Relevant Plans

There are several existing policies, plans, and procedures that directly relate to or impact the stewardship of Amesbury conservation land. This information has been integrated into this document where applicable and should be considered when setting priorities or executing action items. Plans or other documents that are relevant to the management of Amesbury conservation land include:

- The City of Amesbury Open Space and Recreation Plan 2020-2027
- I AMesbury 2030
- Amesbury Municipal Vulnerability Preparedness: Summary of Findings Report
- City of Amesbury Massachusetts 2004 Master Plan
- Watershed and Waterways Management Plan⁹
- Massachusetts State Wildlife Action Plan (MassSWAP)

⁹ <https://www.amesburyma.gov/DocumentCenter/View/1903/Watershed--Waterways-Management-Plan-PDF>

Informing, Educating, and Engaging the Public

Public support and engagement are crucial to ensuring the long-term preservation of Amesbury's conservation land. To inform, educate and engage the public, the city should:

- Provide information about the natural, cultural, and historic resources and features found on city properties.
- Provide information about human impacts that threaten natural habitats and species.
- Educate the public about actions that help protect and preserve natural resources at home and in their everyday lives.
- Provide opportunities for the public to participate in land management activities when appropriate.
- Maintain partnerships with community groups, businesses, and others who are interested in participating in land management projects.

Means used to inform, educate, and engage the public may include:

- The City of Amesbury website
- Email news and updates
- Social media
- Signage at trailheads
- Guided walks
- Lectures or workshops
- Volunteer events

Allowable and Prohibited Uses (DRAFT)

Land protection requires a careful balance of economic, social, and ecological values and goals. The allowable and prohibited uses of conservation land, which should be adopted by Conservation Commission (and reflected in City ordinance if necessary), are centered on protecting Amesbury's natural assets, conservation values, and visitor safety. Visitors are welcome to use conservation properties for passive recreation during daylight hours, with permission required for evening picnics, overnight camping, or large group activities (see Parks and Recreation Commission's Park and Facilities Rules and Regulations available online as a PDF).

Allowable uses of conservation land are as follows:

- Walking, hiking, trail running, and the like,
- Non-commercial dog-walking (dogs shall be on-leash only in certain areas during grassland-bird nesting season); all off-leash dogs shall be voice-controlled,
- Non-motorized boating,
- Picnicking,
- Birdwatching and other nature observation,
- Skiing and snowshoeing,
- Fishing,
- Bicycling on designated trails,

- Equestrian use on designated trails,
- Authorized community gardening activity as permitted by the Commission,
- Parking on designated roads, parking areas, or trails,
- Authorized maintenance or construction work.

Prohibited uses of conservation land in Amesbury are as follows:

- Possession of alcoholic beverages,
- Hunting or discharging of firearms,
- Trapping, except as authorized for the purpose of habitat conservation or invasive species removal,
- Cutting, defacing, removal of trees, bushes, plants, flora, or deadwood, except as part of an approved habitat management project,
- Dumping of any material, including yard waste such as leaves and brush,
- Littering or trash disposal,
- All motorized vehicle types, except as authorized. Permits for motorized vehicle use may be granted to visitors with qualified disabilities who show appropriate documentation.
- Fires and campfires, except as authorized,
- Paintball or “war” games,
- Construction of off-road bicycle BMX-style trails and jumps,
- Additional trail construction except by specific authorization of the Conservation Commission and/or Mayor and City Council.

Best Practices for Addressing Primary Land Stewardship Issues

Principles for Managing Natural Areas in a Time of Changing Climate

The management of natural resources has largely assumed a stable climatic background. Now there is widespread agreement among scientists and most of the public that the climate is changing due to human activities – largely attributed to the burning of fossil fuels resulting in the production of carbon dioxide. Massachusetts is already experiencing the effects of climate change, such as hotter summers, warmer winters with less snow cover, rising sea levels, more frequent severe weather events, and inland flooding.

Climate impacts that may affect open spaces are predicted to:

- increase the number of extremely hot days and degraded air quality,
- increased flooding from higher intensity storms,
- compromise infrastructure like trails (e.g., more erosion, blowdowns, and flooding),
- increase non-native plants and pests,
- increase vector-borne illnesses (like West Nile and Lyme disease).

Some of these impacts are likely to affect the future management of conservation lands in complex ways. Manomet Center for Conservation Science and the Massachusetts Division of Fisheries and

Wildlife have published a study¹⁰ promoting two primary objectives for the management of sites and habitats – managing resilience and managing change.

Management for Resilience and Managing Change

Mass Audubon generally pursues and recommends four principles for increasing the resilience of conservation land.

1. **Reduce Non-climate Stressors** – for example, controlling invasive plants and pests.
2. **Restore Form and Function** – for example, removing a dam to promote spawning of diadromous fishes.
3. **Increase Complexity** – for example, increasing natural diversity and microclimates.
4. **Create Linkages** – for example connecting to adjacent land and creating corridors.

The previously mentioned Manomet report does make recommendations for forests and freshwater wetlands that are relevant Amesbury.

Forested Habitats

- **Diversifying the age structure and species composition** of the forested landscape in advance of climate change could increase resilience of forested ecosystems and overall resistance to the impacts of a changing climate.
- **Control of white-tailed deer densities.** High levels of browsing by white-tailed deer have adversely affected the structure, composition, and functioning of Massachusetts forested ecosystems, particularly through the elimination of preferred food species such as Red Oak, and thereby reduced their diversity and resilience. Also, overgrazing by deer has opened the way for increased rates of infestation by non-native plants.
- **Control invasive species and pests.** Damage caused by non-native plants and insect pests will become more serious under climate change. Forest managers will need to:
 - detect and track infestations and outbreaks in their early stages, and
 - take aggressive actions to eliminate these problems before they escape control.
- **Manage change with adaptive management.** Past management has been primarily guided by the concept of preserving natural habitats and associated species. Adaptive management is recognizing that preserving the status quo may not always be possible. When preservation of a habitat or species is no longer feasible, we will need to adapt management practices to guide change. For example, one strategy may be to plant more southern species that will help maintain diversity or other ecological values within the context of climate change.

Freshwater Wetlands

The main threats to freshwater wetlands in Amesbury are likely to be impaired hydrology and habitat loss, and ecological injuries caused by non-native pest species, the same threats that currently affect wetland quality and function. The regulations that currently protect wetlands have been extraordinarily

¹⁰ Manomet Center for Conservation Sciences & Massachusetts Division of Fisheries and Wildlife, Habitat Management, April 2010 (<https://www.manomet.org/wp-content/uploads/old-files/Climate%20Change%20and%20Massachusetts%20Fisheries%20and%20Wildlife%20Reports,%20Vol.%203%20April%202010.pdf>)

successful. However, the Manomet report notes that climate change may require us to rethink how these regulations are applied. It goes on to say that active management of wetlands may be an important tool under climate change. For example, it may become beneficial to alter wetland hydrology, or expand their boundaries. If such management is impeded by the way some regulations are currently applied, they may have to be modified to reflect changing circumstances.

Control of Invasives. It is likely that the problems that are currently posed by invasive plant species to wetlands will be exacerbated by the higher levels of environmental stress introduced by climate change (droughts, extreme storm and heat events, etc.). To continue to protect valued wetlands will require three things:

- **More active monitoring.** It will be essential to detect pest outbreaks in their earlier stages, rather than later when they have secured a foothold. This can only be accomplished if active detection and monitoring schemes are implemented.
- **Aggressive control activities.** More resources will be needed to eliminate or control outbreaks of pests in their early stages.
- **Education on and enforcement of best management practices.** Many pests are transported from site to site by humans. To reduce this hazard, it will be necessary to educate users of wetland resources (e.g., anglers, hunters, nature viewers) about the dangers posed by invasives and to provide them with guidance and facilities to reduce off-site transport.

Watershed Protection. Wetlands are impacted by what happens within the entire watershed. The nexus of expanding human populations, land-use change, and climate change requires that we adopt a watershed focus when considering how to protect wetlands and other water assets. Land protection within the watershed is also watershed protection.

Conservation Land Stewardship Activities

Amesbury's conservation land stewardship activities fall into four categories: monitoring and inventories, active management, infrastructure maintenance, and special projects.

1. **Annual Monitoring** of conservation land is important to assessing the health of natural resources, the presence and extent of any human impacts, and the condition of infrastructure. As resources allow, conservation land is also inventoried to compile information about the natural and cultural assets and environmentally significant features of each property.
2. **Active Management** includes ongoing activities such as invasive species removal, forestry, native plantings, habitat restoration, grassland mowing, and erosion control.
3. **Infrastructure Maintenance** is performed on an ongoing, as-needed basis for the protection and enhancement of natural and cultural assets, and to maintain recreational amenities such as trails, boardwalks, kiosks, picnic tables, benches, etc. for the benefit of the broader community.
4. **Special Projects** are carried out on an as-needed basis to provide improvements to conservation properties. Such projects may include the construction of bird blinds, trailhead kiosks, new trail development, public art installations, educational tree ID tags, etc.

A schedule of annual management activities will be presented at the end of this section.

Historically, Amesbury conservation land has been managed passively with some monitoring and little active management other than mowing contracted to a farmer. However, the need for more active

management is needed to address escalating stressors like climate change, non-native species invasion, and human impacts on the land. Amesbury's leading management priorities can be grouped into the following three categories: **Habitat Conservation and Preservation, Recreation, and Management of Human Impacts.**

Habitat Conservation and Preservation

Habitat conservation and preservation priorities should be established based on the presence (or absence) of priority habitats and state-listed species and other species of conservation concern. MassWildlife's Natural Heritage and Endangered Species Program (NHESP) maintains a list of all documented Massachusetts Endangered Species Act (MESA)-listed species observations and has delineated Priority and Estimated Habitats throughout the state to help protect rare species¹¹. Amesbury is home to several MESA-listed species, including vascular plants, amphibians, reptiles, and a variety of invertebrates. Furthermore, Lake Gardner (PH2155), Tuxbury Pond (PH2152), a portion of Woodsom Farm (PH2151), an area along the Powow River (PH2150), and the Merrimac River (PH2154) are considered Priority Habitat for Rare Species.

Habitat conservation and preservation comes in many forms, from annual maintenance to reactive restoration. For properties that provide habitat for MESA-listed species or other species of conservation concern, management activities should factor in the specific needs of these diminishing populations. Close collaboration with the NHESP and affiliated organizations, such as Mass Audubon, can help to guide management actions to ensure maximum ecological benefit. See Appendix D for a listing of all the MESA species in Amesbury.

Habitat Stewardship

The following sections will discuss management of the variety of habitats included on Amesbury conservation land.

Early Successional Habitat Management

To support biodiversity in Amesbury and in the region, it is critical to maintain a variety of different habitat types. Certain existing habitat types that occur on permanently protected conservation land such as upland forests, rivers and streams, forested swamps, ponds, marshes, and rocky areas require

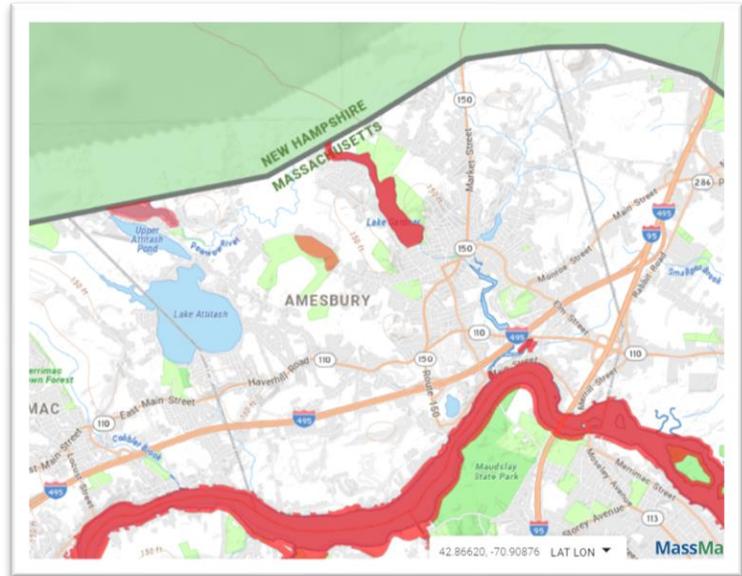


FIGURE 5 - NHESP PRIORITY HABITAT FOR RARE SPECIES & ESTIMATED HABITAT FOR RARE WILDLIFE

¹¹ For important areas to protect in Amesbury see the section on BioMap3.

little active management. However, early successional habitats are rapidly dwindling due to a disrupted disturbance regime in the northeast. Grasslands, shrublands, and young forests were once maintained through frequent, variable-intensity natural events like windstorms and wildfires, and by management by Native Americans. As these disturbances created gaps of varying sizes across the landscape, the resulting early successional growth created habitat for species like the New England cottontail, American woodcock, and the chestnut-sided warbler. However, European colonization of the area marks the disruption of these processes –fire suppression has prevented most wildfires for years, and the changing climate has altered the pattern and intensity of historic windthrow events. As a result, early successional species are rapidly declining across Massachusetts.

Disturbance dependent, early successional habitat can be created and supported through a variety of management techniques depending on the desired management goal. For example, clearcutting of forested areas can promote the growth of young forest and grassland habitats. Strategic small patch cuts in mature stands can also support biodiversity by providing discrete open, shrubby patches that support young forest and shrubland species alongside mature forest species. Early successional habitat is ephemeral and disappears in 10-20 years in New England as the regenerating trees mature, so ongoing management is required to maintain this habitat type.

Grassland Management

In the absence of some form of disturbance, most New England grasslands will naturally transition to an ‘old field’, a young forest, and eventually a mature forest. This process is termed *succession*. Periodic mowing of the vegetation is necessary to maintain open fields. This open habitat type has become less common in Massachusetts as agricultural land has grown into forest or been developed for housing or commercial use. As a result, remaining grasslands are valuable habitat for a range of plants and animals that are also becoming less common.

Grasslands can range from grass-dominated, frequently mown hayfields to infrequently mown, wildflower-dominated fields. Different mowing frequencies provide habitat for a different suite of species by influencing plant composition, size, moisture, and other factors. Several rare birds make use of grassland for nesting however they prefer very large fields, generally 50 acres or larger

with the most uncommon grassland birds found only in sites over 100 acres. Woodsom Farm is a hot spot for three declining grassland nesting bird species – bobolink, Savannah sparrow, and meadowlark. Fields as small as 10 acres will host breeding bobolinks and should be managed for bird habitat. Amesbury’s smaller fields provide supplemental habitat for some birds and should generally be managed for plant and invertebrate (pollinator) habitat, and cultural and aesthetic values.



FIGURE 5 – FIELD MOWING

Encroachment is a more insidious form of succession where even well-tended fields slowly shrink as shrubby vegetation on the field edge grows further into the grasslands year by year.

All fields need to be *disturbed* on a regular basis to avoid succession and encroachment. The ultimate tension in grassland management is that disturbance is required to maintain the habitat, yet the disturbance may result in an impact to wildlife making use of the field. **The goal of management is to plan the disturbance in a way that minimizes impacts to grassland-dependent species.**

The most common forms of disturbance are mowing, grazing, and burning. Since burning is logistically complex and expensive, grassland management on Amesbury conservation land will generally be limited to grazing and/or mowing. Grazing can be an appropriate method for grassland management; however, it requires a dedicated farmer willing to take on all aspects of animal husbandry including erecting and maintaining fencing and providing water for livestock. A field being actively grazed may be inaccessible to the general user, and conflicts between livestock and dogs may arise. For these reasons, mowing will be the more likely grassland management technique.

Mowing variables include timing, frequency, type of equipment, blade height, and fate of the mown material.

- **Timing and Frequency** – A field that is mown earlier in the season and more frequently in a season will tend to be dominated by grasses. A field mown once per year and later in the fall or early spring will tend to have a higher component of wildflowers (pollinator habitat). Mowing should be prohibited during bird nesting season, mid-May to the end of July or middle of August¹². **Thus, any fields smaller than 10 acres can be mown in September or October or in March to provide nectaring plants for invertebrates.** Mowing in March has an added benefit of providing more wintering habitat for invertebrate eggs and overwintering larvae. Parts of some large fields may be mowed to discourage nesting by being mowed every 3 or 4 weeks – providing the farmer with better quality hay. Smaller fields being maintained for pollinator habitat can be mowed less frequently – every other year to prevent woody growth.
- **Type of equipment** – Fields can be mowed with a rotary deck mower or a sickle bar mower. A sickle bar, or hay mower, is preferred for larger fields to be managed as grasslands. A rotary mower tends to leave clumped material which can inhibit re-sprouting in the spring and smother insect larvae.
- **Blade height** – Any mowing should leave roughly 6 inches of standing material to provide habitat for invertebrate larvae.



FIGURE 6 - NESTING TIME FOR GRASSLAND BIRDS

¹² www.massaudubon.org/content/download/19413/274073/file/Best-Management-Practices_Grasslands.pdf

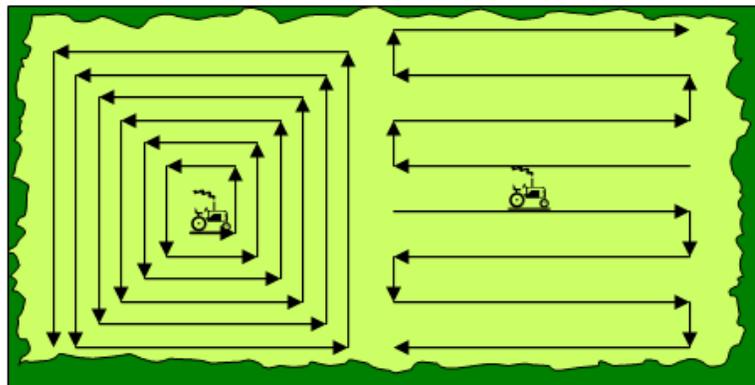
- Treatment of mown material – Small wildflower fields, like those on some of Amesbury’s conservation lands, can be managed for invertebrate habitat and the clippings left in place.

Battis Farm (36 acres of mowed grassland in three separated fields) and Woodsom Farm (154 acres of mowed grassland) are major grassland areas in the city and region. The annual mowing of these fields is currently administered by the DPW under contracts with two local farmers. Any application of fertilizers should be carefully controlled to prevent run-off into adjacent waterways. The Massachusetts Department of Agricultural Resources has developed specific rules for fertilizing on agricultural land that should be observed (see 330 C.M.R. § 31.03).

Beyond protected areas that are actively managed for grassland habitat, early successional habitat is maintained in transmission line corridors, where utility companies periodically cut vegetation in the right-of-way. Although this practice creates early successional habitat, vegetation management may occur in early or mid-summer and can present a danger for ground-nesting species. Clear communication with utility companies and support from the NHESP can help address potential conflicts that can arise in transmission line corridors and other utility rights-of-way.

Mowing should include removal of woody shrubs growing on the field edge to resist their natural expansion into the field. If necessary, a heavy mower should be used to clear back shrubs along field edges. Management should include removing any shrubs and trees growing along stone walls that divide adjacent fields to maximize the size of contiguous fields. Single trees standing in a field can be maintained if they offer significant aesthetic appeal, but generally should be removed to maximize size of the field and to eliminate refugia for woody invasive species.

How the mowing is done also influences wildlife. Mowing from the outside toward the center has the potential to trap small mammals, fledgling birds, reptiles, and amphibians in the center. Mowing from the middle and working outward allows more wildlife to have a chance to escape.



Regular mowing should prevent colonization by woody invasive species; although once established, invasive shrubs and vines can persist even in a mowed field. Once woody species such as glossy buckthorn are established throughout a field, the most effective approach for their control is use of a broad-leaf herbicide which targets the shrubs but does not impact grasses.

Vines such as oriental bittersweet and black swallowwort can be pernicious grassland invaders. These species can be removed by hand and kept at bay with regular work parties dedicated to their removal. It is particularly important to control black swallowwort as soon as it is discovered since this species, related to milkweeds, spreads its wind-dispersed seeds far and wide, expanding in a field relatively quickly and reducing habitat quality for butterflies. In fact, the plant is toxic to some butterflies. If manual control is not successful, herbicides may be necessary.

Characteristics of each field and the intended management routine should be identified in a detailed ecological management plan for each property. Property stewards should meet annually to review the condition of fields, identify threats that are not being addressed by the current management approach, and formulate adjustments to management to reduce those threats. **Efforts should be made to survey each field for breeding bird activity and use by butterflies, with volunteer efforts such as local birders, the annual Xerces Society butterfly count, or the Massachusetts Butterfly Club.**

Forest Management

The section on Management of Natural Areas in a Time of Changing Climate (page 13 – 15) recommended **four strategies for forest management**: Diversifying the forest’s age structure and species composition, control of white-tailed deer densities, control invasive species and pests, and managing change.

Forests provide many ecological services including wildlife habitat, flood and erosion control, public health benefits (clean air, water, and fostering well-being), recreational opportunities, and carbon sequestration. In addition to forest protection, there are various ways to steward forests to retain or enhance their benefits to the community. This includes passive management, a mostly hands-off approach, and active management to create a particular habitat type or benefit a species of conservation need.

Passive Forest Management

A passive approach to forest management lets forests continue to mature. Allowing forests to naturally mature has inherent values, including:

- Encouraging old growth forests – one of the rarest habitats in Massachusetts. These forests have a unique multi-layered structure of vegetation and provide particularly high-quality habitat for some wildlife species. Old growth conditions can only develop with time, usually after 200–300 years.
- By sequestering carbon, forest growth plays an important role in combatting climate change. Currently, carbon sequestration in our forests offsets about 14% of annual emissions in Massachusetts.
- As forest managers and scientists study the various benefits and implications of active forest management, it is important to have untouched sites for comparison.

Amesbury has no forest management plans for its forested conservation land and is currently following a passive management approach.

Active Forest Management

The thoughtful application of more active forest management practices can help restore habitat conditions found within young and old growth forests. Most of Amesbury was once cleared for agriculture or the wood was harvested for various purposes. As farmers moved west for better land, forests began to regrow about 80–120 years ago and are now considered “middle-aged.” This means we have very little young forests (0-20 years) or old growth forests (200+ years).

Young forests occur in relatively open conditions and are dominated by dense growth of shrubs and sapling trees. This type of habitat used to occur naturally due to large-scale disturbances such as beaver activity and fires. These disturbances are now less frequent and are controlled to protect human lives

and infrastructure. Selectively removing white pine stands that grew up in abandoned fields from small areas of the broader forest can create patches of young forest that recreate this type of early successional habitat for wildlife species that depend on such areas, including several warblers and white-throated sparrows.

Middle-aged forests often have a less complex structure than **old growth forests** and provide poorer habitat for some species. Habitat management can be used to mimic the unique features of old growth forest, and bolster wildlife species of conservation concern. This may include the creation of standing deadwood, or snags, for cavity nesting wildlife species by girdling lower-value trees.

CLIMATE SMART FORESTRY (CSF)

Forests in Massachusetts are already affected by climate change—more extreme weather events damage trees, and the warmer climate makes forests vulnerable to invasive pests. CSF practices promote healthy forests and support carbon sequestration under changing conditions, allowing forests to be part of the climate change solution. For more information see

<https://www.massaudubon.org/our-conservation-work/ecological-management/habitat-management/climate-smart-forestry> .

FORESTERS FOR THE BIRDS PROGRAM

Mass Audubon has partnered with the Massachusetts Department of Conservation and Recreation (DCR) and the Mass Woodlands Institute to bring the Foresters for the Birds program to Massachusetts. The program provides technical assistance for landowners to manage their forests for bird habitat. Carefully planned and sustainable forestry practices can create young forest habitat and enhance the structure within our maturing forests. For more information see <https://www.massaudubon.org/our-conservation-work/wildlife-research-conservation/bird-conservation-monitoring/forest-birds> . Note that cities and non-profits are not eligible for any financial incentives offered to private landowners for the Forestry for the Birds Program. Still using a forester trained in this program can be beneficial to cities or towns wishing to develop forestry plans.

It is recommended that the city develop forest management plans for its larger forested areas.

DEER MANAGEMENT

As a direct result of the removal of predators from the food chain, white-tailed deer have rapidly increased in abundance throughout the state of Massachusetts. These large deer populations are likely to have significant ramifications for Amesbury's natural assets; heavy deer browse prevents the regeneration of trees and vegetation in the understory and shrub layer of forests, affecting the natural processes of forest ecology. Deer overabundance also causes a reduction in wildflowers, diminishes water quality, increases motor vehicle accidents, and increases in Lyme disease infections and other tick-borne diseases.

In response to this issue, some towns have begun archery hunting programs on conservation land. All hunters must pass a shooting test before their admittance into the program. Furthermore, all participating hunters must follow the laws outlined by MassWildlife and are only permitted to hunt by bow and arrow. The Conservation Commission should monitor the impacts of deer and consider a hunting program if warranted. MassWildlife has also begun a program to contribute venison from hunters to food pantries.

Wetlands, Stream, and Water Body Protection/Improvement

Amesbury's watershed resources play an important role in the community: draining storm run-off, purifying ground and drinking water, harboring wildlife, and providing aesthetically pleasing places to visit. Protection of these aquatic resources, and the functions they perform, is a fundamental objective of the Conservation Commission. Therefore, all land management will comply with current local, state, and federal rules and regulations, including:

- Wetland Protection Code administered by the Amesbury Conservation Commission,
- Wetlands Protection Act administered by the Massachusetts Department of Environmental Protection, and
- Federal Clean Water Act administered by the Environmental Protection Agency.

Any regulated activities considered within jurisdictional areas on conservation land will be fully reviewed by the Conservation Commission through the normal processes laid out in the Wetlands Protection Act and the Amesbury Code. Current and future management activities will strive to minimize real and potential impacts to wetland resources. Projects on conservation properties should serve as showcases for low-impact land use regarding wetlands and buffer areas. For example, run-off from city-owned areas used for agriculture should be minimized.

The northeast is predicted to receive more frequent intense storms in coming decades as one result of climate change. Storm water storage is one of the most valuable ecosystem services already performed by wetlands and thus will become even more important in the future. Restoration and improvement of wetland habitats should focus on building connectivity and increasing flood-storage capacity. Connectivity for aquatic wildlife can be increased by ensuring that any wetland and stream crossings incorporate culverts or bridges of adequate size and design to ensure that wildlife can move through the passage unhindered. Stream culverts must ensure that water does not move through the passage at high speed, lead to a drop at the downstream end, or scour the riverbank below the crossing. Staff and commissioners should engage with the Engineering Division of the DPW to review opportunities for improving culverts and other stream crossings to ensure that they are adequately sized for wildlife passage and in-stream habitat. Cost may be eligible for grants under the Municipal Vulnerability Program.

Areas of Special Concern

Areas of special concern include those areas recognized by the state as ecologically significant and exemplary natural features within the city that may not have statewide importance but still hold great conservation value in the local landscape. Areas of special concern include:

- Rare species habitat identified by the Massachusetts Natural Heritage & Endangered Species Program (NHESP) in the most current Natural Heritage Atlas.
- Core Habitat and Critical Natural Landscapes identified by NHESP in their BioMap project (see section on page 7 and Appendix C).
- Locations of exemplary local natural features (see BioMap "local" areas on page 8 and in Appendix C) or that might be identified in site-specific management plans.
- Areas where it is impractical to provide environmentally sustainable human access.

If at any time the recreational use of a conservation property has the potential to conflict with these ecological values, the natural resources should take precedence and recreational use of an area may be limited.

Mosquito Spraying

According to the Massachusetts Department of Public Health¹³:

“In communities that belong to a Mosquito Control District, truck-mounted ground spraying occurs when virus is found in mosquitoes. In situations where there is a high risk of human disease over a large geographic area – and the risk is not effectively being reduced by use of personal protection and truck-based spraying -- the response may include an aerial pesticide sprayed in the evening and overnight hours to reduce the number of infected, adult mosquitoes in areas of high risk. This allows for the rapid treatment of large areas of high concern that are not accessible by truck-mounted ground sprayers.

Please note: although aerial spraying may sometimes be necessary to reduce human risk, it will not eliminate risk. It is critical that residents protect themselves from mosquito bites by applying insect repellent when outdoors, draining standing water where mosquitoes breed, repairing screens, and – when risk is greatest-- avoiding outdoor activity during peak mosquito hours. You can also take steps to protect animals and pets.”

The pesticides used, Anvil 10+10 and other similar pesticides, are toxic to land-dwelling and water-dwelling invertebrates (e.g., dragonflies, beetles) and fish. For this reason, conservation land should be excluded from such spraying except in a declared public health emergency. It is necessary to annually request that areas not be sprayed.

Invasive Species Management

Invasive species pose one of the greatest threats to the biodiversity, natural landscapes, agricultural interests, recreational activities, and scenic beauty of conservation properties. Since European colonization, humans have been intentionally and accidentally introducing non-native species to New England from around the world. Because introduced species did not evolve in their new environment, they often lack predators or competitors for resources, and are not affected by native invertebrates or pathogens that help to keep populations balanced. As a result, many introduced species rapidly spread and can overwhelm an area, causing substantial harm to native ecosystems. Therefore, non-native species are considered “invasive” when their introduction causes, or is likely to cause, economic or environmental harm or harm to human health (National Invasive Species Information Center, 2021). By threatening specialized native habitats and the unique species assemblages they support, invasive species can contribute to a phenomenon known as “biotic homogenization”¹⁴.

¹³ <https://www.mass.gov/service-details/mosquito-control-and-spraying>

¹⁴ Olden J.D., Poff, N.L., Douglas, M.R., Douglas, M.E., & Fausch, K.D. (2004). *Ecological and evolutionary consequences of biotic homogenization*. Trends in Ecology and Evolution. 19(1):18-24.

The Massachusetts Invasive Plant Advisory Group (MIPAG) defines invasive plants as “non-native species that have spread into native or minimally managed plant systems in Massachusetts, causing economic or environmental harm by developing self-sustaining populations and becoming dominant and/or disruptive to these systems.” Many organisms develop specialized associations with plants, so the invasion of non-native species can cause adverse effects that radiate throughout the food web. In addition to reducing biodiversity, invasive plants can alter soil chemistry, affect biogeochemical cycles, clog waterways, impact water quality, and degrade wildlife habitat. Some invasive plants alter habitats in ways that encourage pest species, such as ticks and mosquitoes, and potentially increase the transmission of certain diseases to humans¹⁵. According to MIPAG, 72 plant species are currently considered invasive or likely invasive in Massachusetts, with many others considered a potential threat. Unfortunately, globalization makes it increasingly difficult to prevent the spread of additional non-native species to the area.

Essex County has the second highest total number of invasive species reports of all Massachusetts counties (based on the University of Georgia Early Detection and Distribution Mapping System [EDDMapS] invasive species status report by state). The reality of this statistic is reflected in the severe non-native plant invasions that are widespread in some Amesbury conservation lands. Invasive plant species commonly found in Amesbury include Oriental bittersweet, glossy buckthorn, winged euonymus (burning bush), non-native bush honeysuckles, multiflora rose, Japanese knotweed, Japanese barberry, tree of heaven, Norway maple, autumn olive, purple loosestrife, and garlic mustard.

Massachusetts Invasive Plant Advisory Group Principles

The Massachusetts Invasive Plant Advisory Group (MIPAG) advocates the following as guidelines for addressing invasive plant species¹⁶.

1. The first principle of invasive plant management is to manage for specific outcomes. Thereafter, a meaningful strategy of invasives management must first define what natural or cultural values should have priority for protection from established or incipient invasion to ensure their conservation. This mirrors the colloquial “save the best, leave the rest” philosophy that is often cited.
2. Next, the invasive species that pose the greatest threat to natural resources should be identified for targeted removal. This requires an inventory and possibly a map of the area(s) in question. When budget allows, expertise from outside groups may be helpful or necessary. When

¹⁵ Stone, C.M., Witt, A.B.R., Walsh, G.C, Foster, W.A., & Murphy S.T. (2018). *Would the control of invasive alien plants reduce malaria transmission? A review*. Parasites and Vectors. 11, 76. <https://doi.org/10.1186/s13071-018-2644-8>. and

Williams, S.C., Linske, M.A., & Ward, J.S. (2017). Long-term effects of *Berberis thunbergii* (Ranunculales:Berberidaceae) management on *Ixodes scapularis* (Acari:Ixodidae) abundance and *Borrelia burgdorferi* (Spirochaetales: Spirochaetaceae) prevalence in Connecticut, USA. *Environmental Entomology*. 46(6):1329-1338. <https://doi.org/10.1093/ee/nvx146>

¹⁶ Massachusetts Invasive Plant Advisory Group (MIPAG). (2012, December). *Guidance for the Effective Management of Invasive Plants: Version 2*. Retrieved from <https://www.lexingtonma.gov/sites/g/files/vyhlf7101/f/uploads/guidanceinvplantmgmtmipag.pdf>

applicable, wetlands, state-listed species, or Priority or Estimated habitats should be noted and factored into all decision making to ensure minimal or no damage is inflicted.

3. After identifying the target invasive species, research should be conducted to determine the best management method – options include mechanical/manual (hand pulling), chemical (herbicide application), prescribed fire, and even biological control (i.e., the use of pests like beetles or weevils). Table 3 outlines season-specific management strategies that are recommended for common invasive plant species.
4. A realistic management goal should then be developed based on the extent of the invasion and other threats in the area. Goals may include eradication, suppression, or containment.
5. Available resources should then be evaluated relative to the selected goal to establish a timeline and ensure adequate resources are available to see the project to fruition. If inadequate resources are available, the goals may need to be reevaluated.
6. Once these details have been established, it is time to implement the selected management strategy. Smallest or satellite infestations should be treated first, while working towards larger or core infestations.
7. The final step is monitoring and documenting outcomes to determine the success of the project. This may include photographs of the management area, written descriptions, or a specific scientific protocol.
8. For all succeeding projects, the relative successes and failures of past invasive species management efforts should serve to inform and improve future invasive species management efforts. This embodies the spirit of adaptive management – a structured, iterative process of decision making in the face of uncertainty.

Invasive Species Management Methods

There are many ways to deal with this threat, including initial prevention, early detection, and control through manual removal (i.e., pulling, digging, cutting) mechanical treatment (i.e., mowing, smothering with black plastic), or use of biological control agents (i.e., species-specific predators, pathogens, or parasites), pesticide application, grazing, and fire. Invasive species are difficult to eradicate and without multiple seasons of dedicated management, and infestations will rebound despite one's best efforts. Prioritization of targeted management is essential to successfully managing an area for invasive species. Land managers and scientists are constantly working to find the best control methods for individual species. The best way to keep up with this on-going research is to search for control methods for the targeted species.

Invasive species control efforts can be divided into two categories: species-based and location-based. The species-based approach will focus on individual species no matter where they occur on conservation properties. The five elements of the species-based approach are:

- Preventing invasion by new species,
- Early detection of new invasions,
- Eliminating or effectively controlling species with recent or limited presence,
- Limiting the spread of highly noxious invaders,
- Directing effort at species which are particularly susceptible to control.

Location based efforts focus efforts on all invasive species within specific areas of the conservation property. The three elements are:

- Protecting sensitive habitats,
- Establishing invasives-free zones,
- Restricting the spread and reducing the extent of heavily invaded zones.

For areas that are particularly sensitive habitat, contain species of concern, or hold high aesthetic value, location-based methods, which prioritize certain areas and take a systematic approach to large infestations, will direct control efforts.

The approaches will overlap at times and when taken together will define a comprehensive approach to reducing the presence of invasives across the conservation properties.

Management of invasives species should follow an adaptive approach – a continuous process that allows for flexibility in management based on the inclusion of the most recent management options. As new information becomes available on plant biology and treatment methods, it will be incorporated into future management decisions. An adaptive approach will also allow property managers to learn from the efficacy of current treatment methods and adjust future management actions.

SPECIES-BASED EFFORTS

PREVENT SPREAD OF EXISTING INVASIVES AND INTRODUCTION OF NEW INVASIONS

The primary element of a proactive prevention plan is limiting the introduction of new invasive species to individual conservation properties. The spread of existing invasives will be reduced by limiting soil disturbance and implementing restoration when soils are disturbed, by washing equipment that has been used in heavily invaded areas before moving to an un-invaded area, and by implementing practices to reduce likelihood of seed spread by individuals working on invasives control projects. Soil disturbance from plowing, tree removal, trail building, etc., should be limited and all disturbed soil should be covered with leaf litter at minimum with larger disturbed areas restored using a fast-growing native seed mix. All equipment used for maintenance operations in heavily invaded areas should be cleaned (e.g., with a leaf blower) before moving to non-invaded areas; and staff and volunteers should take special care to pat down, wipe, and/or rinse clothes and shoes after working with invasive plants.

EARLY DETECTION/RAPID RESPONSE

Any comprehensive invasive species control program must also include early detection (ED) of new invaders and rapid response (RR) to eliminate new invasions before they become well-established. ED efforts should be directed at the list of early detection species identified by the Massachusetts Invasive Plants Advisory Group (MIPAG). MIPAG's current ED list is presented in Table 1, and updates can be found on the MIPAG website: <http://www.massnrc.org/mipag/>. Land Stewards should be trained to identify the ED species which are not yet well-known in this part of the state, such as Japanese stiltgrass and mile-a-minute vine. The Conservation Commission, Conservation Division staff, and volunteer stewards should be prepared to collaborate on planning and implementing the rapid response element to eliminate new invasions as quickly as possible.

Once an infestation reaches a certain point, the only remaining management option becomes localized control (e.g., to protect species of conservation concern). However, if caught at an early stage it is feasible to eliminate invasions at low effort and cost.

Table 1. Early Detection (ED) invasive plants as identified by the Massachusetts Invasive Plant Advisory Group (MIPAG).

Common name(s)	Species	Comments
Flowering Rush	<i>Butomus umbellatus</i>	Aquatic perennial herb
Brazilian waterweed	<i>Egeria densa</i>	Submerged aquatic
Tall mannagrass, Reed mannagrass	<i>Glyceria maxima</i>	Perennial grass
Giant Hogweed	<i>Heracleum mantegazzianum</i>	Biennial or short-lived perennial herb
Hydrilla	<i>Hydrilla verticillata</i>	Submerged aquatic
Parrotfeather	<i>Myriophyllum aquaticum</i>	Submerged aquatic
Yellow floating heart	<i>Nymphoides peltata</i>	Floating-leaved perennial aquatic herb
Mile-a-minute	<i>Persicaria perfoliate</i> , <i>Polygonum perfoliatum</i>	Once established this species spreads rapidly; annual herbaceous vine
Kudzu	<i>Pueraria montana ssp. lobata</i>	Woody vine
Tansy ragwort, Stinking willie, Stinking Billy	<i>Senecio jacobaea</i>	injurious to livestock; biennial herb
Pale swallowwort	<i>Cynanchum rossicum</i>	Kills Monarch Butterfly caterpillars; Perennial herbaceous vine
Tall pepperweed, Broadleaved pepperweed	<i>Lepidium latifolium</i>	Perennial herb
Japanese stiltgrass	<i>Microstegium vimineum</i>	Annual grass

LIMIT SPREAD OF HIGHLY NOXIOUS INVADERS

Special attention should be paid to particularly aggressive invaders, such as those species with wind-dispersed seeds, aggressive root suckering, allelopathic characteristics, rapid growth, and high resistance to control. Species in this category are shown in Table 2.

CONTROL SPECIES WITH RECENT OR LIMITED PRESENCE

Early invasions are much more easily eradicated than well-established stands of any species. Removing young woody plants before they reach a fruiting size prevents further spread, and it is critical to remove aggressively rooting species before they establish a dense underground network. Vining species are more easily removed before they tangle with native shrubs and trees.

CONTROL RELATIVELY EASILY MANAGED SPECIES

Japanese barberry and garlic mustard are examples of species that can be controlled with dedicated manual effort. Such species should be the focus of eradication efforts before they spread.

Table 2. Particularly aggressive invasive species.

Black swallowwort	<i>Cynanchum louiseae</i>
Common reed	<i>Phragmites australis</i>
Garlic mustard	<i>Alliaria petiolata</i>
Japanese knotweed	<i>Fallopia japonica</i>
Japanese stiltgrass	<i>Microstegium vimineum</i>
Purple loosestrife*	<i>Lythrum salicaria</i>

Tree of heaven
Water chestnut
Oriental bittersweet
Common buckthorn
Glossy buckthorn

Ailanthus altissima
Trapa natans
Celastrus orbiculatus
Rhamnus cathartica
Frangula alnus

* Now less of a problem because of prevalence of biocontrol beetles

PROTECT AND RESTORE RARE SPECIES HABITAT AND UNCOMMON OR EXEMPLARY NATURAL COMMUNITIES

Invasives control should be a priority at any sites within the City’s conservation properties that support state listed species or other species of conservation concern. Invasive control activities that occur near these populations should be conducted in a manner that does not have a negative effect on these populations.

INVASIVES FREE ZONES

Larger parcels of conservation land will typically have some sections that do not contain invasive plant species. These resilient parcels should be identified and monitored on an annual basis in the late summer to determine if these areas have remained pristine or if new invasions have started to become established. If a new infestation is found, efforts should be made to eradicate those plants and keep the “clean” areas “clean”.

LIMIT EXPANSION OF HEAVILY INVADED AREAS

An area that is completely covered in invasive species or has several species of invasive plants growing in the same location should be contained to prevent further spread of the infestation. This can be done by identifying the boundary of the heavily invaded area(s) and creating a treatment area buffer zone (e.g., 50 feet around the perimeter of infestation) for targeting management efforts. This allows stewards to prevent the encroachment of invasives in cleaner areas without getting overwhelmed or tackling a project that exceeds available resources.

If highly noxious species are present in the densely invaded area extra measures may need to be taken to truly prevent the further spread of the infestation. Some options include increasing the treatment area to a 100-foot buffer zone or hiring outside contractors to treat the infestation chemically.

However, many invasive species have berries with seeds that are eaten by birds and excreted far from the source, so for these fruiting species, a buffer will not be effective.



Weed Wrench in Action

Treatment Methods

Different invasive species respond to different management techniques, several of which are summarized here and detailed in Appendix C. **Manual control**, pulling plants by hand or with light tools such as loppers or weed wrenches, may be effective for small infestations and where volunteer capacity permits repeated effort. Large infestations and certain problematic species will require more intensive management, often involving the use of herbicides. **Herbicides** can only be applied by an individual duly licensed by the Department of Agricultural Resources. Because licensure requires liability insurance coverage, it is more likely that herbicide will be applied by a contracted professional or city employees than by volunteers. Property-specific management plans should identify infestations and recommend approaches for control. The Conservation Commission, Conservation Division staff, and stewards should plan and budget for involvement of professionals as necessary. Table 3 provides information on species that can be managed at various times of year.

DISPOSAL OF REMOVED INVASIVES

Invasive plants that have been hand pulled or cut can be piled on site to decompose or bagged and brought to an area for invasive plant containment. The site(s) used to dump invasives should be monitored to ensure that invasive plants are not establishing themselves from the materials deposited there. Staff and volunteers should take extreme care to avoid spreading seed or other material from which plants can resprout, (e.g., Japanese knotweed can sprout from any stray plant part).

Restoration

Many of our invasive species are adapted to pioneer disturbed soils. For this reason, all control efforts and general site work that results in exposed mineral soil should incorporate restoration with fast-growing native species. Small patches of exposed soil, for example from root wrenching a shrub, should be tamped down by foot and covered with leaf litter sourced on-site. Non-forested sites such as fields, should be seeded with a native grass mix including annual rye (*Lolium perenne*) which can provide a quick cover to open soils, prevent erosion, and allow non-invasives time to self-germinate. While annual rye is not a native, it will only last one year giving time for more desirable species to germinate.

RECORD-KEEPING

All invasive plant species management actions should be documented with a field datasheet and records kept in a central file. (See **Appendix C** for a sample field sheet). Recording these data allows conservation staff to track the progress of management efforts, adapt tactics in future years if needed, and have a sense of the expanse of targeted invasive species.

Table 3: Season-specific Management for Commonly Found Invasive Plant Species.

Common Name	Spring	Summer	Fall
Autumn Olive	manual		chemical
Black swallowwort		chemical/manual	
Burning Bush	manual		chemical
Bush honeysuckle	manual	chemical	
Common reed			chemical
Garlic mustard	chemical/manual		
Glossy Buckthorn	manual		chemical
Japanese Barberry	manual		chemical
Japanese knotweed		chemical	
Japanese stiltgrass		chemical/manual	chemical
Multiflora rose	manual	chemical	
Oriental Bittersweet	manual		chemical
Purple loosestrife		biological	
Spotted knapweed		chemical/manual	
Tree-of-Heaven	manual		chemical
Water chestnut		manual	

Invasive Insects

Like invasive plants, non-native insects and pathogens can pose a significant threat to native tree species and forest ecosystems due to the lack of coevolved natural predators and the reduced resistance of host plants to invasion. Once introduced, invasive insects and pathogens can quickly spread and degrade water quality, forest health, and wildlife habitat. The impacts of invasive insects and pathogens can be exacerbated by factors such as climate change and weather events, adding additional complexity to the management of these invasions.

The leading invasive insects that are present in Amesbury’s ecosystems include the following species:

1. Emerald Ash Borer (*Agrilus planipennis*) – commonly called “EAB”
2. Spotted (previously Gypsy) Moth (*Lymantria dispar*)
3. Hemlock Woolly Adelgid (*Adelges tsugae*)

The emerald ash borer was first detected in Massachusetts in 2012 but has not yet been detected in Amesbury. These wood-boring beetles feed on the inner bark of ash trees, which disrupts the tree’s ability to transport nutrients and water. This species has damaged hundreds of millions of ash trees across the United States, therein affecting the habitat of the many organisms that have specialized associations with ash trees¹⁷. Three species of wasps have been introduced in Massachusetts for biocontrol (Massachusetts Department of Conservation & Recreation, n.d.-a), but the success of these introductions is yet to be determined.

¹⁷ Wagner, D.L. & Todd, K.J. (2016). New ecological assessment for the emerald ash borer. A cautionary tale about unvetted host-plant literature. *American Entomologist*. 62(1): 26-35.

The spongy moth was introduced to Massachusetts in 1869 and has been a persistent problem since¹⁸. During its life stage as a caterpillar, this species can cause extensive defoliation of numerous deciduous trees and some conifers. These defoliation events occur cyclically and are currently passively managed by state agencies. Fortunately, spongy moth outbreaks may be prevented or controlled, at least in part, by an introduced soil-borne fungus (*Entomophaga maimaiga*), and by the nucleopolyhedrosis virus. Both require ample moisture early in the season to proliferate¹⁹, so these agents may be ineffective in controlling spongy moths during years with unusually dry springs and summers²⁰.

The hemlock woolly adelgid was introduced to Massachusetts in 1988 and has since caused significant damage to the state's native eastern hemlock trees. This insect feeds on sap from the twigs of the host plant and can be easily seen with the naked eye as small, white, woolly clusters on the underside of hemlock needles. Trees growing in suboptimal habitats (e.g., in drought-prone or compacted soils) may die within 3 to 5 years of infestation, while trees growing under favorable conditions may tolerate the adelgid for 7-10 years before showing signs of decline²¹. The significant damage to hemlock trees in turn affects the many organisms that rely on these trees for cover and food²², including several bird species that are considered hemlock specialists²³. Two beetle species have been released in Massachusetts for biocontrol of hemlock woolly adelgid (*Sasajiscymnus tsugae* and *Laricobius nigrinus*) but they have not yet been successfully established²⁴.

Recent reports of Asian longhorned beetles (*Anoplophora glabripennis*) and spotted lanternflies (*Lycorma delicatula*) in Massachusetts present possible future issues with these damaging invasive insects as well.

¹⁸ Massachusetts Department of Conservation & Recreation. (n.d.-b). *Lymantria dispar* (gypsy moth) in Massachusetts. Retrieved from <https://www.mass.gov/guides/lymantria-dispar-gypsy-moth-in-massachusetts#:~:text=The%20Lymantria%20dispar%20has%20been,in%20the%20caterpillar%20life%20stage>.

¹⁹ Childs, R. (Revised by Simisky, T.). (2016). Gypsy Moth (*Lymantria dispar*). Retrieved from https://ag.umass.edu/sites/ag.umass.edu/files/pdf%2Cdoc%2Cppt/final_gypsy_moth_fact_sheet_1_column.pdf

²⁰ Harrington S. (2017, September 26). A very hungry caterpillar is killing trees in New England. Retrieved from <https://yaleclimateconnections.org/2017/09/a-very-hungry-caterpillar-is-killing-trees-in-new-england/>

²¹ Childs, R. (Revised by Simisky, T.). (n.d.). Hemlock Woolly Adelgid. Retrieved from <https://ag.umass.edu/print/9557>.

²² Quimby, J.W., Salom, S.M., Tigner, T.C., & Reardon, R.C. (1995). Value and importance of hemlock ecosystems in the eastern United States. *Environmental Science*.

²³ Toenies, M.J., Miller, D.A.W., Marshall, M.R., & Stauffer, G.E.. (2018). Shifts in vegetation and avian community structure following the decline of a foundational forest species, the eastern hemlock. *The Condor*. 120(3):489-506. <https://doi.org/10.1650/CONDOR-17-204.1>.

²⁴ Massachusetts Department of Conservation & Recreation. (n.d.-b). Current Forest Health Threats. Retrieved from <https://www.mass.gov/service-details/current-forest-health-threats>

Other Invasive Organisms

Amesbury is affected by other invasive macroorganisms, such as the Asian carp (*Cyprinus carpio*), Asian jumping worm (*Amyntas agrestis*), European starling (*Sturnus vulgaris*), and the house sparrow (*Passer domesticus*). Despite their larger size, these species are similarly difficult to manage and cause serious disruptions to Amesbury’s native organisms. There are very few options for control available to land managers, but invasive birds can be deterred by using specific nesting boxes or choosing birdseed preferred by native species.

Although invisible to the naked eye, pathogens are an important category of invasive species. Invasive pathogens are those pathogenic microorganisms such as bacteria, fungi and viruses that spread to new habitats and pose the risk of disease to native plants and/or animals²⁵. Invasive pathogens may produce disease in a single species or a closely related group for species, such as the lethal fungal pathogen that causes Dutch elm disease in American elms and other elm trees²⁶. Pathogens of high concern that are current affecting forests in Massachusetts include the following:

- White pine needle disease, caused by four fungal pathogens: *Lecanosticta acicola* *Septorioides strobi*, *Bifusella linearis* and *Lophophacidium dooksii*
- Beech bark disease, caused by *Xylococcus betulae* and the beech scale insect, *Cryptococcus fagisuga*.

Wildlife Enhancement/Management Recommendations

There are several actions that land managers can take to enhance the quality of wildlife habitat within a conservation area. In addition to benefiting native species populations, improved habitat can help make conservation areas a more interesting destination for visitors interested in wildlife observation.

Brush piles

Strategically place piles of brush in the forested areas or at the edges of the fields can be assembled to provide resting/escape cover and den sites for wildlife. Brush piles are used for cover by Eastern cottontails and other small mammals. Songbirds may use brush piles for perch sites, especially if the piles are located near feeding or nest sites. If brush piles are adjacent to a water source, amphibians and reptiles may use them for breeding, feeding, or resting. See

<https://extension.psu.edu/management-practices-for-enhancing-wildlife-habitat> for more information on steps for enhancing wildlife habitat.



FIGURE 7 – PURPLE MARTIN NEST BOX

²⁵ USGS Leecity Science Center. (n.d.). Invasive Pathogens. Retrieved from <https://www.usgs.gov/science/science-topics/invasive-pathogens>

²⁶ Ibid

Snags

Leaving dead or partially dead standing trees provides several important benefits to a variety of wildlife. Snags support cavities for nesting and resting, perches for hunting and displaying, and an abundant supply of food for insect eaters. There are numerous species of birds and mammals that use snags at some point in their life cycles, such as pileated woodpeckers and barred owls. The best method to provide snags for wildlife is to retain existing snags in places where they will not create a dangerous situation for people using the nearby area. Snags can also be created by girdling low quality trees, such as white pines in a generalist stand.

Nest boxes

Nest boxes, platforms, and other types of nesting structures provide nest sites for wildlife in areas where natural nest sites (particularly cavities) are absent or available only in low numbers. They are also used to attract wildlife to specific areas even when nest sites are not limited. Nest boxes can be used to provide nest sites for birds such as bluebirds, tree swallows, wrens, and wood ducks. Nest boxes also provide nest sites for mammals like squirrels and bats. Platforms and other structures are used to provide nest sites for species like the ospreys, eastern phoebe, barn swallow, and some waterfowl. Special colonial nest boxes can be erected for purple martins. Bat boxes can also be erected along the field edges. See Mass Audubon's website <https://www.massaudubon.org/learn/nature-wildlife/birds/birdhouses> for instruction on building and placing nest boxes.

Nest boxes that are put out in a field can be monitored by volunteers, and the results shared with the Cornell Lab of Ornithology.

Pollinator Plantings

Pollinator-friendly plantings support numerous kinds of native bees, as well as honeybees, butterflies, hummingbirds, and other pollinators. Planting a diverse mix of flowering plants that provides a sequence of blooms from early spring to late fall will have the most impact. Even a small patch of the right native flowers can help, as this contributes to the larger landscape mosaic in which the pollinators live and search for food. For a list of plants and guidelines for planting see https://extension.unh.edu/resources/files/Resource005973_Rep8387.pdf and for a plant list that supports native declining pollinators, visit the MCA Native Pollinator Task Force at <https://www.svtweb.org/mca-native-pollinator-task-force> .

Prevention and Remediation of Human Impacts

As a densely settled suburban city, Amesbury's conservation land is highly impacted by both allowable and prohibited human uses. Having a cadre of volunteer stewards who look after conservation areas is a great help for the Conservation Commission.

Prohibited and Illegal Use

Once established, illegal and prohibited uses of conservation properties can be very difficult to discontinue. ATVs, paintballs, forts and firepits are examples of prohibited activities that should be 'nipped in the bud'. Individuals will often engage in these types of prohibited uses on a whim; however, if there is no sign of a reaction, such as closing informal access points, posting signage, engaging neighbors, or cleaning up litter, the use may continue and intensify.

Stewards should regularly inspect each property, including areas off trail with an eye for unpermitted uses. Such use should be reported immediately to Conservation Division staff, no matter how minor. Staff and stewards should then develop an appropriate response focused on:

- Repair of impacts, including cleaning litter, removing structures, etc., which demonstrates that the site is being cared for.
- Education about permitted uses through temporary signage at secondary or informal entrances.
- Outreach to these users, e.g., through letters to neighbors or information distributed in local media or through the school system.

More problematic illegal and offensive uses such as drinking parties, drug use, and casual assignations should lead to involvement of Amesbury police and a specific plan to add patrols until the activities are driven out.

Dumping/Pollution

Once discovered, dumped materials should be cleaned up as soon as possible. Delayed cleanup gives the impression that a property is not well-monitored and well-cared for, which is discouraging to visitors and invites further misuse. Stewards should monitor parking areas and all road frontage of conservation parcels at least monthly and immediately inform staff of new dumping. Each report should include a photograph, some indication of location, and an assessment of what materials have been dumped. Small piles of innocuous materials such as paper or household trash should be removed as soon as possible by the steward. Removal of larger piles or anything including potentially hazardous material should be coordinated by staff with DPW or another appropriate partner. Locations experiencing repeated dumping should be posted with signs reading “No Dumping Including Yard Waste”. If dumping continues, it will be reported to Amesbury police with a request for more frequent patrol of the site.

Encroachment

While vandalism and dumping in commonly used areas of conservation land is easily detected, encroachment along the boundaries is more difficult to monitor, yet critically important. Common forms of encroachment include dumping yard waste across a boundary, extending a lawn into conservation land, and clearing vegetation across the boundary. Other cases may involve fence building, placement of a shed or swing-set, or intensive landscaping extending onto conservation land. Failure to identify, pursue, and resolve encroachments reduces the value of conservation land and may jeopardize the ability to obtain an appropriate resolution. Accordingly, the Commission will take timely action to resolve encroachments in the defense of lands entrusted in their care. Resolution should take place as soon as practical, and encroachments should be treated consistently.

Different levels of encroachment will likely require different responses. A critical step is mutual agreement with the offending neighbor that an encroachment has occurred. Potential outcomes include passive restoration where nature restores the disturbance; active restoration; remediation of conservation land elsewhere within the city; or monetary compensation.

Boundary Maintenance

Clearly marking boundaries and maintaining open communication with abutters will help to minimize the risk of encroachment. Small, weather-resistant markers, such as plastic markers nailed to trees, should be placed along boundary lines at regular intervals – especially those boundaries adjacent to residential development. Boundaries should be inspected a minimum of once per year, and an annual

report with a summary of any encroachments, including documentary photographs and maps, should be prepared, and kept on file by conservation staff.

Travel off Official Trails

Traveling off official trails will be discouraged by clearly stating on all signs and kiosks that visitors should remain on trails. In those areas where unofficial trails become apparent, large sticks and branches will be placed on the trail to indicate that travel is not allowed. Where needed, “*Trail Closed*” or “*Ecological Restoration Area. Do Not Enter*” signs will be posted.

Property stewards should endeavor to understand the use of each site for geocaching or other informal activities that specifically involve leaving official trails. Stewards should engage these user groups to understand the use and make a recommendation to staff regarding potential impacts of off-trail use. If any such use is determined to have a specific impact on a known resource, action should be taken in cooperation with the specific user group to minimize impact, or if deemed necessary, to alter or discontinue this use.

Off-leash Dogs and Pet Waste

Amesbury’s conservation lands are popular destinations for birders, nature lovers, walkers, dog-walkers, and visitors seeking a quiet escape. For the most part these activities are in harmony with a conservation area’s role as a wildlife refuge. However, one distinct exception is dogs being walked off-leash. Off-leash dogs are a particular threat for ground-nesting birds and other wildlife during the wildlife nesting season, when dogs can fatally disrupt these nests without the owner’s knowledge. Off-leash dogs are also at greater risk of defecating in the woods unseen, which poses a significant threat to the health of Amesbury’s drinking water and wildlife habitat.

Amesbury’s By Laws require dogs outside the premises of the owner to be held firmly on a leash no greater than six feet in length by a person who shall have control of such a dog. Unrestrained dogs may be taken by police or the animal control officer and impounded in an animal shelter. Not all visitors observe this regulation and person-power for enforcement is limited. Most people will obey the regulation if they have enough information to understand the harm that their pets may cause. Education is the key.

Several elements of a program to encourage keeping dogs on leash are recommended:

1. Install interpretive signs on the precarious state of ground nesting wildlife and the adverse impacts of loose dogs at the informational kiosk and trailheads.
2. Signs can also mention how other visitors may fear off-leash dogs or have an unfriendly dog that may not wish to be approached by another animal.
3. Recruit volunteer docents during busy weekends to educate visitors about the site’s wildlife and remind them of the importance of keeping their pets on-leash.
4. Consider a volunteer program like the “Bark Ranger” initiative that began in Weston with the Sudbury Valley Trustees.
5. Create areas away from sensitive wildlife that can be designated off-leash dog areas year-round.

Signs should also be posted at popular dog walking spots to encourage owners to clean up after their pets. Some towns have information for dog owners. The Dogs of Andover website includes the following:

“Dog waste left on the ground is more than smelly and unsightly....it pollutes our water and poses a health risk for pets and people, especially children! During rainfall, pet waste left on lawns, trails, and sidewalks washes into storm drains where it ends up flowing, untreated, directly into streams and local water bodies. Pet waste carries bacteria (twice as much as human waste), viruses, and parasites that threaten the health of humans and wildlife. Decaying pet waste consumes oxygen and sometimes releases ammonia. Low oxygen levels and ammonia can damage the health of fish and other aquatic life.

Unlike wildlife, who consume resources and nutrients from the same ecosystem they're a part of, dogs eat pet food rich in nutrients to provide them with a complete and healthy diet. Those pet foods lead to excess nutrients like nitrogen and phosphorus in the environment when dog poop isn't picked up. A buildup of those nutrients can create unstable conditions in many ecosystems.

Please be sure to not only pick up after your dog but also dispose of the waste in a receptacle. If no receptacle is available, please be prepared to bring the waste back home to dispose of in your trash. Never throw dog poop bags down a storm drain.

Scooping the poop is not only the right thing to do, in Andover, it's also the law!

A culture of picking up dog waste often evolves based on the behaviors of others: when a dog owner sees others picking up, s/he will adopt this as standard behavior; when a dog owner observes uncollected dog waste, s/he often assumes that this is the local practice and follows suit. Stewards should work to identify local, dog-owning 'ambassadors' who would be willing to speak with other dog walkers about the importance of picking up their dog's waste. In addition, stewards should endeavor to clean up uncollected dog waste on a regular basis to avoid giving the impression that it is ok to leave behind a dog's waste.

Passive Recreational Uses

A vital role of the Commission is to provide all citizens with ample opportunity to engage in a wide range of passive recreational uses. At the same time, the Commission is obligated to protect the natural resources found within its lands. Therefore, the Commission may restrict the use of certain properties, either partially or in entirety, to help ensure that natural resources are not impacted and to enhance visitor enjoyment. Furthermore, the Commission recognizes that some properties contain inherent limitations, such as extensive wetlands, steep terrain, or lack of adequate parking, and thus certain activities and uses may not be suitable at all properties.

Trails

Trails are one of the most important means of gaining support for conservation by providing access to a site. A well-designed, comfortable, and safe trail facilitates enjoyment of an area and protects the conservation values of the site, while a poorly designed and maintained trail can be a barrier, making return visits and support less likely. The existing trail network is an integral part of Amesbury's recreational open space, providing citizens with a means for exploring and enjoying the city's conservation lands. Trail networks should utilize appropriate existing trails and add trails as necessary to create loop walks of varying distance and character. Trails should also link conservation properties with

other conservation land, open space, and greenway corridors. Trails should be located to minimize redundancy and enhance the visitor experience by not exceeding the capacity of the conservation property to accommodate trails. To the greatest extent possible, all trails should be located outside of sensitive natural resource areas, such as habitat for rare wildlife, wetlands, steep slopes, or soils that are too wet or prone to erosion. Appropriate mitigating measures should be taken when this goal is not attainable, such as installation of boardwalks or bog bridges.

The number of or total length of trails in a property or part of a property may be reduced or limited to enhance the visitor experience or for reasons including, but not limited to: redundancy; presence of rare or vulnerable resources; lack of external access points; the capacity of the property to sustain trails; property deed, conservation restriction, or conservation easement restrictions that preclude human access; or the impracticality of relocating trails or building structures to mitigate erosion, wetland damage, or other resource damage. Redundant trails or trails that are causing damage to natural resources should be closed or rerouted. Closed trails and trail sections should be blocked with brush or, if use continues, with a small sign indicating that the trail is closed.

The Commission and staff should work with volunteer conservation stewards to systematically monitor trails and maintain an updated inventory of trail conditions as part of the annual property inspection process. Volunteer stewards should identify priority trail maintenance issues such as boardwalk repairs, trail erosion, and trail obstructions. Monitoring should also be used to catalogue areas where improvements such as benches and signs would enhance the visitor's experience. Volunteer stewards should also monitor for adequate signage, including trail blazes, directional arrows, route connectors, and points of interest.

Easements and road frontage granting access to conservation land should be identified as soon as practical, for example, clearly marked with one or more signs identifying the easement or frontage as conservation land access.

Staff or volunteers should maintain spatial data on the location of trails on conservation land. Trail location data should be available for display and analysis in a geographic information system (GIS).

SUSTAINABLE TRAIL DESIGN²⁷

Climate change is significantly impacting trails due to more intense and frequent weather events. Northeastern U.S. saw a 55% increase in the amount of rain or snow falling in the heaviest 1% of storms between 1958 and 2016. Some climate models project that monthly precipitation between December and April will increase 1 inch by the end of this century. Both the Appalachian Mountain Club and the Long Trail Club have noted the impacts on trails of extreme weather events. Trail managers have noted more erosion, more frequent blowdowns, and more wet trail areas that stay wet longer. These factors can all have a big impact on the visitor experience and on maintenance. Some of the trails on Amesbury's conservation land do not meet standards of sustainability, which can impair a pleasant visitor experience.

The US Forest Service defines a sustainable trail as one that will:

²⁷ See also <https://www.mass.gov/doc/dcr-trails-guidelines-and-best-practices-manual/download>

- withstand the impacts of normal use and natural elements,
- cause negligible soil loss,
- encourage users to stay on trail,
- not adversely affect area's natural or cultural resources, and
- require minimal maintenance.

An assessment of the trails on Amesbury conservation land is recommended. Trail assessments provide a detailed segment-by-segment evaluation of tread conditions that can be used for planning and budgeting purposes. They provide detailed information of each segment of trail which is useful in developing trail restoration plans as well as seeking funds for the restoration of trails. They can help managers see the larger picture so sound restoration or maintenance priorities can be developed. Like buildings, trails should be viewed as assets which depreciate and thus need periodic refurbishment or structural upgrading. Larger structures on trails such as bridges, boardwalks, observation platforms, and any other elevated structures will deteriorate over time and need regular inspection to ensure that they are sound. Comprehensive trail assessments are usually done every 5 to 10 years to evaluate conditions.

A trail assessment would evaluate the existing trail network, section by section. Problem areas would be identified and alternatives for solving those problems would be presented and discussed. Based on that discussion each solution would be described in detail (i.e., width, linear feet of boardwalk, materials, permitting requirements, and costs, etc.). Design, construction, and maintenance of the trail network shall be guided by the standards and guidelines in *Trail Solutions: IMBA's Guide to Building Sweet Singletrack*²⁸ and the *U.S. Forest Service Trail Construction and Maintenance Notebook*. The particulars of trail design will vary across the Amesbury conservation properties based on site conditions and use. Nevertheless, the Commission, staff, and volunteers will pursue the following principles in trail design.

Trail width – Trails will be 4-6 feet wide in areas of heavy use and close to parking areas so that pedestrians can walk side by side or pass and so that cyclists can safely pass on multi-use trails. Lesser used trails and those further from parking areas will be 2-4 feet wide to minimize impacts to natural resources and to encourage a closer experience with nature, with the expectation that some width expansion is inevitable with use. Woods roads and other double-track trails should be maintained at their existing width to accommodate the full suite of uses and to maintain their historic character. Vegetation should be regularly clipped back to 2 feet beyond the tread width and up to a height of 8 feet to accommodate winter use so that it does not grow into the trail. Selected trails through rapidly encroaching vegetation may need to be trimmed wider. Trails intended for cross-country skiing should be trimmed up to 12 feet to prevent snow-burdened limbs from bending onto the trail corridor.

Trail surface – Trails will normally retain a natural soil surface except where boardwalks cross wetlands or where trails are designed to meet accessibility standards. Trails through fields will

²⁸ For an on-line version of much of the same information see <http://www.crgov.com/DocumentCenter/View/1430/Sustainable-Trail-Development-Guidelines-PDF?bidId=>

be maintained with periodic mowing and need not be cleared down to mineral soil. In rare circumstances where the existing substrate cannot be made into a sustainable surface, supplemental surfacing material may be used. Accessible trails will meet standards set by the *U.S. Forest Accessibility Guidelines Service*.

Signage Design Standards

The Commission should develop standardized signage for properties. Signage should have a consistent look at all conservation properties and include, at minimum:

- Roadside sign – A highly visible sign identifying the property by name and as an Amesbury conservation property. Signs should be located close to the road, be oriented perpendicular to the road, include very little text, and be designed with contrasting text and background to enhance legibility from a passing car.
- Boundary markers – All conservation land exterior boundaries should be indicated in the field with small plastic markers, ideally custom ordered with text identifying the land as owned by the Amesbury Conservation Commission.
- Trail signs – Blazes or weather-resistant markers mounted to trees that correspond to colored trails on publicly available maps.

Parking areas at more heavily used properties should have a weatherproof structure such as a capped wooden kiosk or metal or composite sign including the site name, ownership, a trail map, and a list of approved uses. Such a kiosk could include a plexiglass- or Lexan-covered bulletin board or a chalk board for recording wildlife sightings, but materials must be regularly updated. Information boards should include a reminder to check for ticks in all seasons. Volunteer efforts to build kiosks and other signage will be encouraged; however, volunteers will work closely with volunteer stewards and staff to ensure that the design of any structures is consistent with other trailheads in the city.

Entryway Design and Maintenance

A well-designed and maintained entryway sets the tone of the use and care of a conservation area. A hidden driveway and parking lot, confusing parking, outdated or faded signage, and litter give the impression of neglect and questionable safety. A clearly visible entrance will provide: well-marked, level, and logical parking that is visible from the road; informative signage; and appearance of frequent maintenance draw in a wide variety of users and immediately set the tone of respectful enjoyment of the property. Most of Amesbury's conservation areas have little or no parking so ways to improve access and parking should be considered.

Entryways should be visited on a regular basis by volunteer stewards and monitored for dumping and other litter, damage to signage and other infrastructure, condition of the parking lot, and parking lot capacity and use. Stewards should make note of potential incipient issues and hazards such as potholes, erosion, and dead tree limbs. Stewards should collect any small litter and report to Conservation staff larger piles of dumped materials and other issues requiring immediate attention.

Where appropriate, entryways will provide adequate parking for typical visitor use. Stewards will monitor parking and update Conservation staff if parking capacity is inadequate, as indicated by cars parked informally at times of heavy use.

Connectivity Between Conservation Areas

Connecting open spaces benefits both people and wildlife providing habitat connectivity through the less developed parts of our landscape and potentially creating an extended trail network. The Conservation Commission should refer to goals and priorities identified in the Amesbury Open Space and Recreation Plan when considering acquisition of new conservation parcels. The Conservation Commission should continue to work closely with groups like Amesbury Trails, Lake Gardner Improvement Association, and the Coastal Trails Coalition and to develop and extend the Amesbury trail system and other city-wide trail connections.

Accessibility

The Commission aims to provide passive recreational opportunities for users of all physical abilities. The Commission, staff, and volunteers will identify opportunities for creating accessible trails according to the standards laid out in the *U.S. Forest Service Accessibility Guidelines*²⁹.

The Commission and Conservation staff are also working to improve recreational amenities for individuals with disabilities, such as updated trailhead signage that incorporates accessible design, and accessible boat and kayak launches. Future opportunities for accessible paths and accessible community garden design are also currently being explored.

User Conflicts

If conflicts between user groups arise, the Commission and staff should make reasonable efforts to engage the involved parties and reach a resolution that accommodates the users while adhering to Commission principles and policies.

Safety/Education

Emergency Vehicle Access

The Commission strives to provide a safe experience for all its visitors, yet visitors must assume a certain degree of risk when visiting conservation properties. Risks inherent in use of conservation land include, but are not limited to, uneven ground, falling tree limbs, wildlife encounters, and limited emergency vehicle access in certain parts of the properties. Conservation properties will be managed to offer access for emergency vehicles if such access has existed in the past, such as along a woods road, but the properties will generally not be managed to create new roads to permit more extensive emergency vehicle access.

To facilitate emergency response, the Commission will schedule annual meetings with the Amesbury Fire and Police Departments to discuss emergency vehicle access issues, including protocols for accessing any properties that are gated.

The Commission should also work with the city to periodically maintain existing fire roads, as determined necessary, such as clearing brush, or improvement of surfaces and drainage. Fire roads should be kept gated and locked to discourage unintended use.

²⁹ <https://www.fs.usda.gov/sites/default/files/FSTAG-2013-Update.pdf>

Other Safety Concerns

Informational kiosks should include signs regarding health issues such as ticks and mosquitoes. Volunteer stewards should place temporary flagging and signage where a bee or wasp nest is found close to a trail. Staff and volunteers should aim to keep trails cleared of downed trees and poison ivy encroaching on edges when feasible. All safety concerns identified by stewards should be noted and logged with the Conservation Commission.

Outreach and Education

The Conservation Commission may coordinate with others to offer walks and educational activities to engage the citizens of Amesbury about the natural resources contained within conservation land and the many benefits they provide the city, including passive recreation, mitigation of climate change, wildlife habitat, and a variety of ecosystem services. The Commission should publish informational materials on Amesbury’s conservation lands using outlets such as their trail guide and the City’s website, social media, and the Amesbury Public Library. It is suggested that the Commission foster connections with other groups within the city, such as Scouts, the Amesbury Youth and Recreation Department, and local school environmental groups to engage more residents in responsibly managing and using Amesbury’s open space.

Complying with Applicable Laws, Regulations, and Guidelines

When planning management activities, care should be taken to make sure all projects are carried out in accordance with applicable laws and regulations. Activities on Amesbury conservation land that may be regulated under local, state, and federal laws are listed in the table below. Projects involving more than one type of activity must comply with laws/rules for all applicable activities.

Table 4 Activities regulated under local, state, and federal laws, regulations, and rules

Activities	Applicable Laws/Regulations/Rules
Any activity or workplace condition that could result in a potentially unsafe situation for a City employee	1. Massachusetts General Law Chapter 149, Section 6-1/2 (requires public sector employers to comply with OSHA standards)
Work within a state- or city-protected wetland resource area or buffer zone	2. City of Amesbury Wetlands Protection Ordinance 3. Massachusetts Wetlands Protection Act and associated regulations (310 CMR 10.00)
Work within an area mapped as Estimated Habitat for Rare Wildlife and/or Priority Habitat for Rare Species	Massachusetts Endangered Species Act and associated regulations (321 CMR 10.00)
Work involving the application of pesticides	Massachusetts Pesticide Control Act and associated regulations (333 CMR)
Archery deer hunting	1. Massachusetts General Law Chapter 131 2. City of Amesbury Deer Hunting Permit and other requirements listed on the City of Amesbury’s website (https://ecode360.com/13328756) 3. Regulations listed in MassWildlife’s Massachusetts Fishing & Hunting Guide (https://www.mass.gov/doc/2021-massachusetts-fishing-and-hunting-guide/download)
Projects to create walkways, trails, sites, etc. that are accessible to people with disabilities	1. Americans with Disabilities Act (28 CFR part 35) 2. Americans with Disabilities Act Accessibility Guidelines (36 CFR part 1191, appendices B and D)
Timber harvesting/Forest cutting	Massachusetts Forest Cutting Practices Act (Massachusetts General Law Chapter 132)

Activities	Applicable Laws/Regulations/Rules
<p>Projects involving the construction of any structure in, over or under any navigable water of the United States³⁰, the excavation or dredging from or depositing of material in such waters, or other work affecting the course, location, condition, or capacity of such waters</p> <p>Projects involving the discharge of dredged or fill material and discharges associated with excavation into waters of the U.S.³¹</p> <p>Certain projects requiring a federal license or permit that involve the discharge of dredge or fill material, dredging, and dredged material disposal activities, or discharge of a pollutant into waters of the U.S. within Massachusetts</p> <p>Certain projects involving the placement, construction, alteration, demolition or removal of structures, addition of fill, dredging, and certain other activities in tidelands, Great Ponds, and navigable non-tidal rivers and streams.³²</p>	<ol style="list-style-type: none"> 1. Section 10 of the Rivers and Harbors Act of 1899 (33 CFR 322) 2. Section 404 of the Clean Water Act (33 CFR 323) 3. 401 Water Quality Certification (314 CMR 9.00); Section 401 of the Clean Water Act (33 U.S.C. 1251; 33 USC 1341) 4. Massachusetts General Law Chapter 91 (Waterways) (310 CMR 9.00)
<p>Prescribed fire³³</p>	<ol style="list-style-type: none"> 1. Massachusetts Comprehensive Fire Safety Code (527 CMR 1.00) 2. Massachusetts Department of Environmental Protection Air Pollution Control Regulations for Open Burning (310 CMR 7.07)
<p>Survey, excavation, or construction activities on municipal lands potentially affecting archeological, paleontological, or historical sites or objects</p>	<ol style="list-style-type: none"> 1. State Register Review (Massachusetts General Law Chapter 9, Section 27C) 2. Massachusetts Unmarked Burial Law (Massachusetts General Law Chapter 38 Section 6) 3. Massachusetts Environmental Policy Act (301 CMR 11.00: if destruction of a listed archaeological site) 3. 18. Section 106 of the National Preservation Act of 1966 (16 USC 470 et seq)

Resources for Stewardship of Conservation Land

Stewardship of conservation land requires resources. As noted in the introduction to this document the Conservation Commission, with day-to-day maintenance (trail mowing, trash removal) undertaken by the Department of Public Works, and stewardship assistance from volunteers including the Open Space,

³⁰ The entire section of the Merrimack River within Massachusetts is a navigable water (USACE 2012).

³¹ Waters of the United States include (a) navigable waters of the United States (b) wetlands (c) tributaries to navigable waters of the United States, including adjacent wetlands and lakes and ponds (d) interstate waters and their tributaries, including adjacent wetlands, and (e) all other waters of the United States not identified above, such as isolated wetlands, intermittent streams, and other waters that are not part of a tributary system to interstate waters or to navigable waters of the United States, where the use, degradation or destruction of these waters could affect interstate or foreign commerce (USACE 2012).

³² Navigable non-tidal rivers and streams relevant to Amesbury include (1) the non-tidal portion of the Merrimack River and (2) any non-tidal river or stream on which public funds have been expended for stream clearance, channel improvement, or any form of flood control or prevention work, either upstream or downstream within the river basin, except for any portion of any such river or stream which is not normally navigable during any season, by any vessel including canoe, kayak, raft, or rowboat (MADEP 2021).

³³ Assuming impacted area is below Massachusetts Environmental Policy Act (MEPA) thresholds

Natural Resources, and Trails Committee, and Lake Gardner Improvement Association are currently overburdened with efforts to be good stewards of Amesbury's wonderful conservation areas.

In Massachusetts, local Conservation Commissions were created to work on the protection of important ecological resources. For many decades the focus has been to protect important areas by acquisition. Amesbury has protected more than 1,000 acres. Since its passage Conservation Commissions have become the administrators of the Massachusetts Wetlands Protection Act and are saddled with regulatory duties that require much time and effort. In much of Massachusetts the focus has shifted from acquisition of land to stewardship. This document has provided principles and policies for how Amesbury should be stewarding the ecological assets on its conservation lands. Having the resources to carry out the document's recommendations will require increasing the resources currently available to the Conservation Commission.

Conservation Commissions have been responding to the shift from acquisition to stewardship in different ways. Some have put stewardship of their conservation lands at the top of their monthly agenda. While that step is important and keeps the stewardship needs and the volunteer resources (or the lack thereof) in the limelight, it doesn't always get the work done. Other Commissions (Andover, Lincoln, Weston, Lexington, Ipswich, etc.) have hired staff that work under the Conservation Agent who have land stewardship as part, if not all, of their job description.

The City of Amesbury needs to address this lack of resources, or this document will do little more than collect dust.

Recommended Schedule of Annual Maintenance Activities

	Winter Dec- Feb	Spring Mar- May	Summer Jun - Aug	Fall Sep- Nov
Monthly Property Visits	X	X	X	X
Permitting (trails, boardwalks, invasive control, etc. in wetlands and buffer areas)	X			
Annual Work Plan Review Meeting with Staff and Stewards	X			
Safety Meeting with Staff, Stewards, Police and Fire Dept.		X		
Trail Walk/Clean Up (downed limbs, drainage issues, signage needs, plow damage)		X		
Invasive Plant Management	X		X	X
Building Projects (kiosks, signposts, trails, boardwalks, etc.)		X	X	X
Mowing for Manicured Areas			X	
Mowing for Grassland Fields		March	mid-late August	X
Mowing for Wildflower Fields		March		late Sep-Oct
Boundary monitoring for encroachments, signage, etc.	X			X
Year-in-review meeting with Staff and Stewards	X			

Appendix A – List of Permanently Protected Properties Conservation Commission Properties

ACRES	MAP ID	LOCATION	LEVEL OF PROTECTION
4.7	101-9	DEER ISLAND	P
0.55	108-3	130 PLEASANT VALLEY RD	L
0.51	109-10	122 PLEASANT VALLEY RD	P
1.69	109-9	120 PLEASANT VALLEY RD	P
19.72	110-4	71 PLEASANT VALLEY RD	P
53.34	110-4A	RIVERFRONT DR #RR	P
27.92	110-4B	RIVERFRONT DR #RR	P
0.8142	110-4C	RIVERFRONT DR #RR	P
0.5885	110-4D	RIVERFRONT DR #RR	P
0.1602	111-7	62 PLEASANT VALLEY RD	P
0.1678	111-8	64 PLEASANT VALLEY RD	P
85.28	12-3	76 S HAMPTON RD	P
0.0645	26-35	17 HILL ST	P
1.1	27-19	23 CLINTON ST #R	P
4.09	27-45F	83 CEDAR ST	P
1.4	32-4	TUXBURY POND ISLAND	P
7.72	38-1	116 WHITEHALL RD	P
0.92	38-1A	110 WHITEHALL RD	P
27.21	39-1	POWOW HILL	P
4.3	46-45	135 KIMBALL RD	P
11.23	47-28	10.5 HARRISON EATON LN #RR	P
24.61	48-14	270 LIONS MOUTH RD #RR	P
4.23	60-1	70 KIMBALL RD #RR	P
41.01	60-5	54 KIMBALL RD #RR	P
14.38	61-7	36 KIMBALL RD	P
15.01	62-1	24 KIMBALL RD #R	P
3.61	62-2	26 KIMBALL RD #RR	P
6.8	62-3	85 HAVERHILL RD #RR	P
2.47	63-5	18 BAKER ST	P
3.51	66-16	51 RIVER ST	P
0.7212	66-50	45 LAFAYETTE ST EXT	P
0.5595	66-51	42 LAFAYETTE ST EXT	P
0.3142	66-53	40 LAFAYETTE ST EXT #R	P
0.382	66-7	17 R RIVER ST	P
0.3848	66-9	21 RIVER ST #R	P
8.11	72-22	SPINDLETREE RD	P
5.29	72-71	8 CHAPMAN WAY	P

3.48	72-72	28 SPINDLETREE RD	P
13.42	74-2	79 HAVERHILL RD #RR	P
1.32	78-13	49 MACY ST #R	P
0.8949	92-2B	52 MERRILL ST	P
1.92	97-12	10 S HUNT RD	P

Other City-Owned Properties with Permanent Protection

ACRES	MAP ID	LOCATION	LEVEL OF PROTECTION
0.8173	10-4	178 WHITEHALL RD	P
2.24	11-36	41 UNICORN CR	P
3.08	22-1	176 WHITEHALL RD	P
1.68	22-2	174 WHITEHALL RD	P
1.74	22-3	172 WHITEHALL RD	P
2.19	22-4	170 WHITEHALL RD	P
0.6887	22-5	168 WHITEHALL RD	P
0.4867	22-6	166 WHITEHALL RD	P
1.6	25-22	92 POWOW ST	P
4.09	25-7	44 S HAMPTON RD #R	P
13.24	25-7B	ATLANTIC VIEW #REAR	P
2.96	32-13	137 KIMBALL RD #A	P
29.1	32-14	145 KIMBALL RD #R	P
1.4	33-11	34 NEWTON RD	P
8.31	33-14	28 NEWTON RD	P
4.66	33-15	30 NEWTON RD	P
2.21	33-30	45 NEWTON RD	P
4.1	33-4	140 KIMBALL RD	P
0.3	33-8	130 KIMBALL RD	P
5.35	34-11	22 NEWTON RD #R	P
9.41	34-18	11 NEWTON RD	P
5.73	34-19	13 NEWTON RD	P
55.91	35-3	254 LIONS MOUTH RD	P
6.49	35-4	9 NEWTON RD #R	P
32.2	35-5	249 LIONS MOUTH RD	P
49.8	36-10	222 LIONS MOUTH RD	P
80	36-11	235 LIONS MOUTH RD #RR	P
20.76	36-7	235 LIONS MOUTH RD #RR	P
79.1	37-4	219 LIONS MOUTH RD #RR	P
2.75	37-6	130 WHITEHALL RD #R	P
0.0041	39-146A	70 PROSPECT ST	P
0.7438	39-43A	14 ORCHARD ST #R	P
14.73	50-22Y	206 RR LIONS MOUTH RD	P

ACRES	MAP ID	LOCATION	LEVEL OF PROTECTION
0.1331	52-37	79 HIGH ST	P
0.0813	52-38	79 HIGH ST	P
1.45	53-110	25 WATER ST	P
0.1771	53-278	10 MILLYARD	P
0.6028	54-220	39A WATER ST	P
1.59	54-75	COLLINS AVE	P
0.1818	54-75A	37 COLLINS AVE	P
4.28	55-106	38 MONROE ST	P
2.65	55-50H	69.5 MADISON ST	P
0.5432	55-58A	34 MONROE ST	P
0.5522	55-58B	36 MONROE ST	P
0.1508	55-60A	40 MONROE ST #R	P
0.6872	55-81	9.5 ASH ST	P
2.01	56-25	57 MONROE ST	P
15.5	61-3	214 LIONS MOUTH RD #RR	P
6.37	62-27	27 ELIZABETH ST #R	P
2.86	63-16	166 LIONS MOUTH RD #RR	P
7.98	79-62	28.5 ROCKY HILL RD	P
0.4676	81-3	RABBIT RD REAR	P

Appendix B – eBird Hot Spots in Amesbury

Woodsom Farm

The following list of 135 species was generated using eBird (ebird.org). It includes birds seen in the fields, forests, wetlands, and flying over the area. Underlined species (93) have been observed during the breeding season and are likely to breed nearby or are non-breeders.

Waterfowl

Canada Goose
Mute Swan
Wood Duck
Blue-winged Teal
Mallard
American Black Duck
Green-winged Teal
Ring-necked Duck
Hooded Merganser

Grouse, Quail, and Allies

Wild Turkey
Ruffed Grouse
Ring-necked Pheasant

Pigeons and Doves

Rock Pigeon
Mourning Dove

Cuckoos

Yellow-billed Cuckoo
Black-billed Cuckoo

Swifts

Chimney Swift

Hummingbirds

Ruby-throated Hummingbird

Rails, Gallinules, and Allies

Sora
American Coot

Shorebirds

Killdeer
American Woodcock
Wilson's Snipe
Greater Yellowlegs

Gulls, Terns, and Skimmers

Ring-billed Gull
Herring Gull

Cormorants and Anhingas

Double-crested Cormorant

Hérons, Ibis, and Allies

Great Blue Heron
Great Egret
Green Heron

Black-crowned Night-Hero Vultures, Hawks, and Allies

Black Vulture
Turkey Vulture
Osprey
Northern Harrier
Sharp-shinned Hawk
Cooper's Hawk
Bald Eagle
Red-shouldered Hawk
Broad-winged Hawk
Red-tailed Hawk

Owls

Barred Owl

Woodpeckers

Yellow-bellied Sapsucker
Red-bellied Woodpecker
Downy Woodpecker
Hairy Woodpecker
Pileated Woodpecker
Northern Flicker

Caracaras and Falcons

Crested Caracara
American Kestrel
Merlin
Peregrine Falcon

Flycatchers

Eastern Wood Peewee
Willow Flycatcher
Least Flycatcher
Eastern Phoebe
Great-crested Flycatcher
Eastern Kingbird

Vireos

Blue-headed Vireo
Warbling Vireo
Red-eyed Vireo

Crows and Jays

Blue Jay
American Crow
Fish Crow

Common Raven

Tits, Chickadees, and Titmice

Black-capped Chickadee
Tufted Titmouse

Martins and Swallows

Northern Rough-winged Swallow
Tree Swallow
Bank Swallow
Barn Swallow
Cliff Swallow

Kinglets

Ruby-crowned Kinglet
Golden-crowned Kinglet

Nuthatches

Red-breasted Nuthatch
White-breasted Nuthatch

Gnatcatchers

Blue-gray Gnatcatcher

Wrens

House Wren
Winter Wren
Marsh Wren
Carolina Wren

Starlings and Mynas

European Starling

Catbirds, Mockingbirds, and

Thrashers

Gray Catbird
Brown Thrasher
Northern Mockingbird

Thrushes

Eastern Bluebird
Veery
Hermit Thrush
Wood Thrush
American Robin

Waxwings

Cedar Waxwing

Old World Sparrows

House Sparrow

Finches, Euphonias, and Allies

House Finch
Purple Finch
American Goldfinch

New World Sparrows

Chipping Sparrow
Field Sparrow
 American Tree Sparrow
 Dark-eyed Junco
 White-crowned Sparrow
 White-throated Sparrow
 Vesper Sparrow
Savannah Sparrow
Song Sparrow
Swamp Sparrow
Eastern Towhee

Blackbirds

Bobolink
Eastern Meadowlark
Orchard Oriole
Baltimore Oriole
Red-winged Blackbird
Brown-headed Cowbird
Common Grackle

Wood-Warblers

Ovenbird
 Northern Waterthrush
Blue-winged Warbler
Black-and-white Warbler
 Nashville Warbler
Common Yellowthroat
American Redstart
 Northern Parula

Magnolia Warbler
Yellow Warbler
 Chestnut-sided Warbler
 Blackpoll Warbler
 Palm Warbler
Pine Warbler
 Yellow-rumped Warbler
 Prairie Warbler
 Black-throated Green Warbler
 Wilson's Warbler

Cardinals, Grosbeaks, and**Allies**

Scarlet Tanager
Northern Cardinal
Rose-breasted Grosbeak
Indigo Buntin

Deer Island

The following list of 136 species was generated using eBird (ebird.org). It includes birds seen in the fields, forests, wetlands, and flying over the area. Underlined species (60) have been observed during the breeding season and are likely to breed nearby or are non-breeders.

Waterfowl

Brant
Canada Goose
Mute Swan
 Wood Duck
 Gadwall
 American Wigeon
Mallard
 American Black Duck
 Mallard x American Black Duck (hybrid)
 Northern Pintail
Green-winged Teal
 Ring-necked Duck
 Tufted Duck
 Greater Scaup
 Lesser Scaup
 Greater/Lesser Scaup
 Common Eider
 Surf Scoter
 White-winged Scoter
 Black Scoter
 Long-tailed Duck
 Bufflehead

Common Goldeneye
 Barrow's Goldeneye
 Hooded Merganser
Common Merganser
 Red-breasted Merganser

Grouse, Quail, and Allies

Wild Turkey

Grebes

Pied-billed Grebe
 Horned Grebe
 Red-necked Grebe

Pigeons and Doves

Rock Pigeon
Mourning Dove

Swifts

Chimney Swift

Shorebirds

American Oystercatcher
 Semipalmated Plover
 Killdeer
 Semipalmated Sandpiper
 Wilson's Snipe
Spotted Sandpiper
 Solitary Sandpiper

Alcids

Thick-billed Murre

Gulls, Terns, and Skimmers

Black-headed Gull
 Laughing Gull
Ring-billed Gull
Herring Gull
 Iceland Gull
Great Black-backed Gull
 Least Tern
 Black Tern
Common Tern

Loons

Red-throated Loon
 Common Loon

Cormorants and Anhingas

Great Cormorant
Double-crested Cormorant

Hérons, Ibis, and Allies

Great Blue Heron
Great Egret
Green Heron
 Glossy Ibis

Vultures, Hawks, and Allies

Black Vulture
Turkey Vulture
Osprey
Golden Eagle
Northern Harrier
Sharp-shinned Hawk
Cooper's Hawk
Bald Eagle
Red-shouldered Hawk
Broad-winged Hawk
Red-tailed Hawk
Rough-legged Hawk

Kingfishers

Belted Kingfisher

Woodpeckers

Red-bellied Woodpecker
Downy Woodpecker
Hairy Woodpecker
Pileated Woodpecker
Northern Flicker

Falcons and Caracaras

Merlin
Peregrine Falcon

Tyrant Flycatchers: Pewees,

Kingbirds, and Allies

Eastern Wood-Pewee
Willow Flycatcher
Eastern Phoebe
Great Crested Flycatcher
Eastern Kingbird

Vireos

Blue-headed Vireo
Warbling Vireo
Red-eyed Vireo

Jays, Magpies, Crows, and

Ravens

Blue Jay
American Crow
Fish Crow
Common Raven

Tits, Chickadees, and Titmice

Black-capped Chickadee
Tufted Titmouse

Martins and Swallows

Northern Rough-winged Swallow
Tree Swallow
Bank Swallow
Barn Swallow
Cliff Swallow

Kinglets

Golden-crowned Kinglet

Nuthatches

Red-breasted Nuthatch
White-breasted Nuthatch

Treecreepers

Brown Creeper

Wrens

House Wren
Carolina Wren

Starlings and Mynas

European Starling

Catbirds, Mockingbirds, and

Thrashers

Gray Catbird
Northern Mockingbird

Thrushes

Eastern Bluebird
American Robin

Waxwings

Cedar Waxwing

Old World Sparrows

House Sparrow

Finches, Euphonias, and Allies

House Finch
Common Redpoll
American Goldfinch

New World Sparrows

Chipping Sparrow
American Tree Sparrow
Dark-eyed Junco
White-throated Sparrow
Saltmarsh Sparrow
Song Sparrow
Swamp Sparrow

Blackbirds

Baltimore Oriole
Red-winged Blackbird
Brown-headed Cowbird
Common Grackle

Wood-Warblers

Black-and-white Warbler
Nashville Warbler
Common Yellowthroat
American Redstart
Northern Parula
Yellow Warbler
Palm Warbler
Pine Warbler
Yellow-rumped Warbler

Cardinals, Grosbeaks, and Allies

Scarlet Tanager
Northern Cardinal
Rose-breasted Grosbeak

Lake Attitash

The following list of 86 species was generated using eBird (ebird.org). It includes birds seen in the fields, forests, wetlands, and flying over the area. No species have been observed during the breeding season (this is likely the result of few or no observations during the breeding season).

Waterfowl

Snow Goose
Canada Goose
Mute Swan

Tundra Swan
swan sp.
Wood Duck
American Wigeon

Mallard
American Black Duck
Green-winged Teal
Ring-necked Duck

Greater Scaup
 Lesser Scaup
 Greater/Lesser Scaup
 Black Scoter
 Bufflehead
 Common Goldeneye
 Hooded Merganser
 Common Merganser
 Red-breasted Merganser
 Ruddy Duck
Grouse, Quail, and Allies
 Wild Turkey
Grebes
 Pied-billed Grebe
 Horned Grebe
 Red-necked Grebe
Pigeons and Doves
 Rock Pigeon
 Mourning Dove
Rails, Gallinules, and Allies
 American Coot
Shorebirds
 Killdeer
Gulls, Terns, and Skimmers
 Ring-billed Gull
 Herring Gull
 Great Black-backed Gull
Loons
 Red-throated Loon
 Common Loon
Cormorants and Anhingas
 Double-crested Cormorant
Hérons, Ibis, and Allies
 Great Blue Heron
Vultures, Hawks, and Allies
 Turkey Vulture
 Osprey
 Cooper's Hawk
 Sharp-shinned Hawk

Bald Eagle
 Red-tailed Hawk
Owls
 Eastern Screech-Owl
Kingfishers
 Belted Kingfisher
Woodpeckers
 Red-bellied Woodpecker
 Downy Woodpecker
 Hairy Woodpecker
 Downy/Hairy Woodpecker
 Pileated Woodpecker
 Northern Flicker
Tyrant Flycatchers: Pewees, Kingbirds, and Allies
 Eastern Phoebe
Jays, Magpies, Crows, and Ravens
 Blue Jay
 American Crow
 Common Raven
Tits, Chickadees, and Titmice
 Black-capped Chickadee
 Tufted Titmouse
Martins and Swallows
 Tree Swallow
 Barn Swallow
Kinglets
 Ruby-crowned Kinglet
 Golden-crowned Kinglet
Nuthatches
 Red-breasted Nuthatch
 White-breasted Nuthatch
Treecreepers
 Brown Creeper
Wrens
 Winter Wren
 Carolina Wren
Starlings and Mynas

European Starling
Catbirds, Mockingbirds, and Thrashers
 Gray Catbird
 Northern Mockingbird
Thrushes
 Eastern Bluebird
 Hermit Thrush
 American Robin
Waxwings
 Cedar Waxwing
Old World Sparrows
 House Sparrow
Finches, Euphonias, and Allies
 Evening Grosbeak
 House Finch
 Pine Siskin
 American Goldfinch
New World Sparrows
 Chipping Sparrow
 Field Sparrow
 American Tree Sparrow
 Dark-eyed Junco
 White-throated Sparrow
 Song Sparrow
 Eastern Towhee
 Yellow-breasted Chat
 Yellow-breasted Chat
Blackbirds
 Red-winged Blackbird
 Rusty Blackbird
 Common Grackle
Wood-Warblers
 Yellow-rumped Warbler
Cardinals, Grosbeaks, and Allies
 Northern Cardinal

Battis Farm

The following list of 94 species was generated using eBird (ebird.org). It includes birds seen in the fields, forests, wetlands, and flying over the area. Underlined species (43) have been observed during the breeding season and are likely to breed nearby or are non-breeders.

Waterfowl

Canada Goose
Mute Swan
Mallard
Ring-necked Duck
Lesser Scaup
Bufflehead
Common Merganser
Red-breasted Merganser

Grouse, Quail, and Allies

Wild Turkey

Grebes

Pied-billed Grebe

Pigeons and Doves

Rock Pigeon
Mourning Dove

Nightjars

Common Nighthawk

Swifts

Chimney Swift

Hummingbirds

Ruby-throated Hummingbird

Shorebirds

American Woodcock

Gulls, Terns, and Skimmers

Ring-billed Gull
Herring Gull

Hérons, Ibis, and Allies

Great Blue Heron

Vultures, Hawks, & Allies

Turkey Vulture
Osprey
Golden Eagle
Northern Harrier
Sharp-shinned Hawk
Coopers Hawk
Bald Eagle
Red-shouldered Hawk
Red-tailed Hawk
Barred Owl

Woodpeckers

Red-bellied Woodpecker
Downy Woodpecker
Hairy Woodpecker

Pileated Woodpecker

Northern Flicker

Falcons

American Kestrel

Flycatchers

Eastern Wood Pewee
Eastern Phoebe
Great-crested Flycatcher
Eastern Kingbird

Vireos

Warbling Vireo
Red-eyed Vireo

Jays, Crows, & Ravens

Blue Jay
American Crow
Common Raven

Tits, Chickadees, and Titmice

Black-capped Chickadee
Tufted Titmouse

Martins and Swallows

Purple Martin
Tree Swallow
Barn Swallow

Nuthatches

Red-breasted Nuthatch
White-breasted Nuthatch

Kinglets

Ruby-crowned Kinglet

Treecreepers

Brown Creeper

Gnatcatchers

Blue-gray Gnatcatcher

Wrens

House Wren
Carolina Wren

Starlings and Mynas

European Starling

Catbirds, Mockingbirds, and**Thrashers**

Gray Catbird
Brown Thrasher
Northern Mockingbird

Thrushes

Eastern Bluebird
Hermit Thrush
Wood Thrush
American Robin

Waxwings

Cedar Waxwing

Old World Sparrows

House Sparrow

Finches, Euphonias, and Allies

House Finch
American Goldfinch

New World Sparrows

Chipping Sparrow
American Tree Sparrow
Dark-eyed Junco
White-crowned Sparrow
White-throated Sparrow
Savannah Sparrow
Song Sparrow
Swamp Sparrow
Eastern Towhee

Blackbirds

Bobolink
Baltimore Oriole
Red-winged Blackbird
Brown-headed Cowbird
Common Grackle

Wood-Warblers

Ovenbird
Common Yellowthroat
Northern Parula
Yellow Warbler
Pine Warbler
Yellow-rumped Warbler

Cardinals, Grosbeaks, and**Allies**

Scarlet Tanager
Northern Cardinal
Rose-breasted Grosbeak
Indigo Bunting
Dickcissel

Tuxbury Pond

The following list of 57 species was generated using eBird (ebird.org). It includes birds seen in the fields, forests, wetlands, and flying over the area. Underlined species (1 – this low number is likely the result of few observations during the breeding season) have been observed during the breeding season and are likely to breed nearby or are non-breeders.

Waterfowl

Canada Goose
Mute Swan
Wood Duck
Mallard
Ring-necked Duck
Bufflehead
Hooded Merganser
Common Merganser

Grebes

Pied-billed Grebe

Pigeons and Doves

Mourning Dove

Shorebirds

Killdeer

Hérons, Ibis, and Allies

Great Blue Heron

Vultures, Hawks, and Allies

Osprey
Sharp-shinned Hawk
Bald Eagle
Red-tailed Hawk

Woodpeckers

Yellow-bellied Sapsucker
Red-bellied Woodpecker
Downy Woodpecker
Hairy Woodpecker
Pileated Woodpecker
Northern Flicker

Tyrant Flycatchers: Pewees, Kingbirds, and Allies

Eastern Phoebe
Eastern Kingbird

Jays, Magpies, Crows, and

Ravens

Blue Jay
American Crow

Tits, Chickadees, and Titmice

Black-capped Chickadee
Tufted Titmouse

Martins and Swallows

Tree Swallow

Kinglets

Ruby-crowned Kinglet
Golden-crowned Kinglet

Nuthatches

Red-breasted Nuthatch
White-breasted Nuthatch

Treecreepers

Brown Creeper

Gnatcatchers

Blue-gray Gnatcatcher

Wrens

Carolina Wren

Catbirds, Mockingbirds, and

Thrashers

Gray Catbird

Thrushes

Eastern Bluebird
Veery
American Robin

Old World Sparrows

House Sparrow

Finches, Euphonias, and Allies

Evening Grosbeak
American Goldfinch

New World Sparrows

Chipping Sparrow
Dark-eyed Junco
White-throated Sparrow
Song Sparrow

Blackbirds

Baltimore Oriole
Red-winged Blackbird
Common Grackle

Wood-Warblers

Black-and-white Warbler
Common Yellowthroat
Yellow Warbler
Blackpoll Warbler
Palm Warbler
Yellow-rumped Warbler

Cardinals, Grosbeaks, and

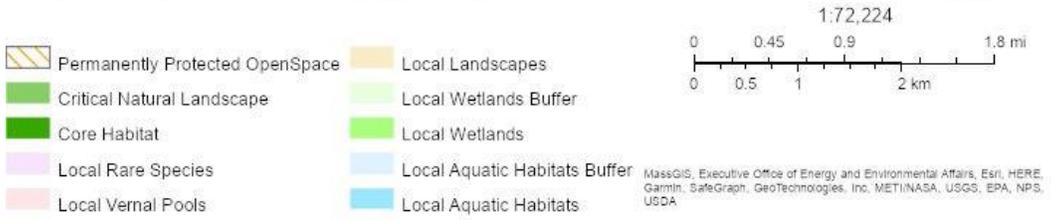
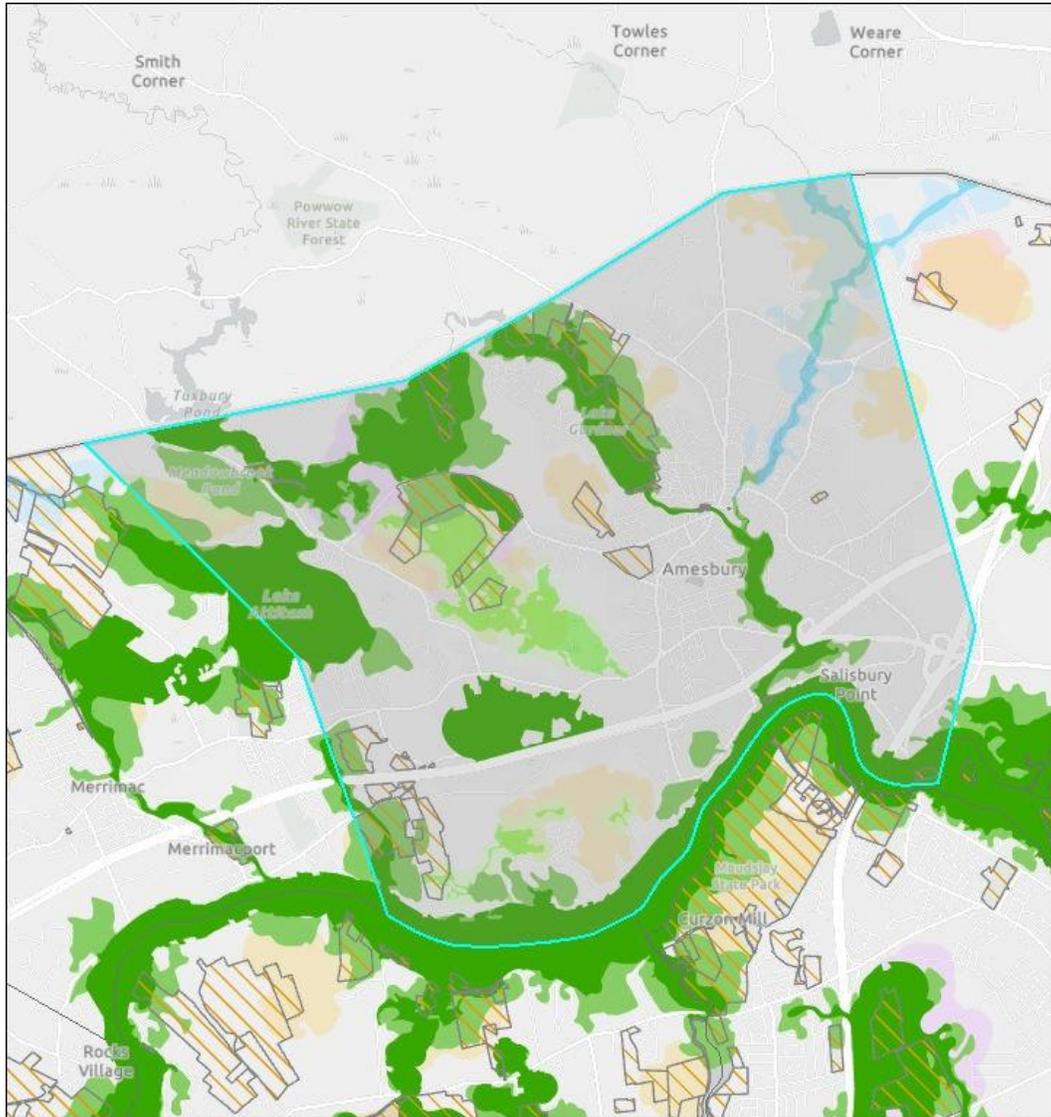
Allies

Northern Cardinal
Evening Grosbeak

Appendix C – BioMap Summary Report for Amesbury



BioMap Summary Report Amesbury, Massachusetts



Summary

Name	Count	Area(acres)	Length(ft)
Core Habitat	9	1,591.30	N/A
Critical Natural Landscape	11	2,132.47	N/A
Aquatic Core	8	1,331.13	N/A
Aquatic Core Buffer	6	152.20	N/A
Priority Natural Communities Core	1	1.18	N/A
Rare Species Core	8	848.24	N/A
Coastal Adaptation Areas	2	9.93	N/A
Local Aquatic Habitats	4	104.46	N/A
Local Aquatic Habitats Buffer	3	251.10	N/A
Local Wetlands	11	607.51	N/A
Local Wetlands Buffer	63	597.93	N/A
Local Landscapes	10	1,615.18	N/A
Local Rare Species	3	705.99	N/A
Local Vernal Pools	1	78.65	N/A
Regional Rare Species	5	388.78	N/A
Regional Connectivity	0	0	N/A

Appendix D – Massachusetts Endangered Species Act Species in Amesbury

Status: E = Endangered, T = Threatened, SC = Special Concern

Category	Common Name	Scientific Name	Status	Date Last Observed
Amphibian	Blue-spotted Salamander	<i>Ambystoma laterale</i>	SC	2018
Beetle	Twelve-spotted Tiger Beetle	<i>Cicindela duodecimguttata</i>	SC	2015
Bird	Bald Eagle	<i>Haliaeetus leucocephalus</i>	T	2019
	Eastern Meadowlark	<i>Sturnella magna</i>	SC	2017
Fish	Atlantic Sturgeon	<i>Acipenser oxyrinchus</i>	E	2016
	Shortnose Sturgeon	<i>Acipenser brevirostrum</i>	E	2016
Mussel	Eastern Pondmussel	<i>Ligumia nasuta</i>	SC	2000
Reptile	Wood Turtle	<i>Glyptemys insculpta</i>	SC	1992
Vascular Plant	Dwarf Scouring Rush	<i>Equisetum scirpoides</i>	SC	1903
	Eaton's Beggar-ticks	<i>Bidens eatonii</i>	E	1928
	Vasey's Pondweed	<i>Potamogeton vaseyi</i>	E	2002

Appendix E – Invasive Plant Management Options

As noted in the section on Invasives, the best way to keep up with the ongoing research on the best methods to control an individual species is to search control methods for the targeted species. Many invasive species and relatively small infestations can be managed manually or mechanically (hand pulling, weed wrench, shovel, etc.), others are best managed with targeted, careful use of herbicides applied by a licensed herbicide applicator.

Foliar spray- This method is usually applied with a type of sprayer (backpack, mist blower, or tank). The percentage of solution depends on the target species, the time of year, and type of sprayer. Glyphosate will target all species while Triclopyr will only target broadleaf plants and will have minimal impact if any on grasses.

Bloody glove- A more intensive method of herbicide application often used in place of foliar spray when impacts to non-target species is a concern. Herbicide is applied directly to leaves and stems of target species from a soaked cotton glove worn over a rubber glove.

Cut and paint- The stem of the plant is cut so a cross section is showing. The outer edge of the stem is then painted in herbicide; if the stem is hollow herbicide can be injected into the hollow stem. Triclopyr or Glyphosate can be used for treatment.

Girdling- This method used for trees involves making a shallow cut through the bark and outer cambium tissue; the plant is slowly killed due to the inability to transport water and nutrients up the trunk. Girdling is particularly effective for species that sprout aggressively from root suckers, particularly black locust, since it seems to bypass the signal to respond to a dead main stem by sprouting from root suckers. Care must be taken not to cut too deeply into the trunk as too deep a cut can sever all phloem tissue which transports nutrients down into the roots of the plant and is necessary to transport herbicide into the roots. If the phloem is all cut, downward transport will cease, and black locust will respond by sprouting aggressively from root suckers.

Basal bark- Herbicide is applied to the outer surface of the stem. Triclopyr is used because glyphosate will not penetrate the stem. There should not be any standing water present or moisture on the stem. The application can be made with a paint brush or backpack sprayer from the base of the stem to about 1 foot up the stem.

Recommended herbicides:

Triclopyr- Triclopyr is a selective herbicide that will affect broad leaf plants and will have minimal to no impact on monocots. This is since it stimulates cell growth elongation. Since monocots grow naturally by elongating their cells it will have little to no effect where since dicots grow laterally, they burst their cell walls and cause damage to the plant when they are stimulated for cell elongation. Since this herbicide can be mixed with water or oil it can be used for foliar sprays, cut and paint, or basal bark applications. It is recommended to use this herbicide when there is a dense native grass understory surrounding a target plant.

Glyphosate- Glyphosate is a broad-spectrum herbicide meaning it will kill most plants it is applied to. It is an amino acid inhibitor, so it inhibits the growth of plants. Foliar sprays should be applied while the plant is actively growing but cut and paint applications can be done during the fall/winter months. This

herbicide can be used for foliar sprays and cut and paint applications. Since water is used as the base of the solution it cannot be used for basal bark treatments because water-based solutions will not penetrate the bark layer. During cut and paint treatments the herbicide will need to be applied before the cambium layer seals for it to be effective.

Table B-1. General Management Options.

Method	Good for Volunteers?	Timing	General guidelines	Target Species
Cut and paint	Yes	Late August to November	Preferably done in the fall when woody plants are translocating energy towards roots. Can be done to all trees/ shrubs except black locust (signals root suckering). Preferred treatment for multiflora rose. If berries are present, take extra precaution to not spread seed. Best when left in local area and burned in brush pile. Good for volunteers working together with staff: have volunteers cut and haul brush while licensed applicator paints herbicide.	Common Reed (stem injection) Japanese knotweed (stem injection) Burning Bush Oriental bittersweet Multiflora rose (preferred) Bush Honeysuckle (fall) Glossy buckthorn Autumn olive
Hand pull	Yes	Spring and Summer	Great for herbaceous plants with taproot and shallow root system. Best for small infestations. All trees/ shrubs can be hand-pulled when in seedling stage. Garlic mustard should be hand-pulled when second year plants start sending up seed stalk and all plant parts should be bagged and kept out of the sun (seeds can still develop if sunlight is available).	Spotted knapweed Garlic mustard All seedlings for trees and shrubs

Method	Good for Volunteers?	Timing	General guidelines	Target Species
Mechanical (weed wrench/ shovel)	Yes	Spring through Fall, although better before seed set.	Great for small shrubs/ trees. Best when done in early spring when leaves start coming out but before berries develop. Shovels can be used to dig up herbaceous plants with fibrous root systems (black swallowwort) care needs to be taken to make sure all root system is dug up. Soil should be tamped down after removal or native species planted soon after disturbance to keep additional invasives from re-colonizing area.	Japanese knotweed Burning Bush Japanese barberry Black swallowwort Autumn olive Tree of heaven
Basal bark herbicide	No	August through October	This method is best when done in late summer mid fall (Aug- Oct) when flow is towards roots. Can be performed on all trees/ shrubs.	Burning Bush Autumn olive
Biological	Yes	Dependent on insect.	This method of treatment works well for purple loosestrife. It is the least disruptive method of treatment currently available. Usually agents are released in July/ August. The affect the biological agent will have on the environment should be taken into consideration and the relative easiness of other forms of treatment. Depending on infestation size this could be a good way to treat spotted knapweed.	Purple loosestrife (preferred) Spotted knapweed (needs research)
Foliar spray herbicide	No	When leaves are out.	For trees/ shrubs best when done in the fall when flow is towards roots. Can be done any time for herbaceous plants. When spraying the least amount of herbicide at the smallest effective percentage should be used. The surrounding habitat (wetland vs upland), nesting/ breeding animals, and whether it is a necessary treatment should be considered.	All species

Method	Good for Volunteers?	Timing	General guidelines	Target Species
Girdling	If certified in chainsaw safety	Fall	A chainsaw is used to create a ~2" wide cut all around the tree between knee and waist height taking care to remove only the outer layer of cambium, then the fresh cut is painted with herbicide.	Larger trees
Bloody glove	No	When leaves are out.	A rubber glove is worn on the hand with an absorbent cotton glove over it. The cotton glove is dipped in a glyphosate solution (strength depending on target species) then used to directly apply herbicide to leaves, stems, and inflorescences of target plants. Herbicide is absorbed directly into the plant via the stem and leaves, however, breaking the stem aids in more rapid absorption.	Small patches of common reed, seedlings, etc. particularly in wetlands where impacts to non-target species is a concern.

Table B-2. Species Specific Management Options.

Species	Biology	Control Recommendations		Monitoring Period
		Manual	Chemical	
Autumn Olive	Autumn Olive flowers in May-July (plants must be at least 3 years old to flower). Seeds are produced August – November and nuts usually ripen in September. Adults produce less seed in the shade than the sun. Autumn Olive reproduces primarily by seed.	Seedlings can be hand-pulled. Bigger plants can be removed with weed wrenches. Care should be taken to get entire root system. Plants re-sprout vigorously when cut without the use of herbicide. Resprouting may also be stopped by use of “Buckthorn Baggie”.	A foliar treatment with at 2% solution of Triclopyr or Glyphosate can be used when leaves are present. A 25% solution of Triclopyr or Glyphosate can be used for cut-and-paint. A 20% solution of Triclopyr is recommended for basal bark treatments.	3 years No information available on seed viability.
Black Swallowwort	Black swallowwort spreads vegetatively and by seed. It flowers in June-August. The seeds are released from August to October;	Plants can be dug up with a shovel. The entire root system would need to be removed and this method is very time consuming.	A 2% foliar spray of Glyphosate or Triclopyr is recommended before mid- July. Chemical treatment is recommended from May- June, this would be before the plants flower so there would not be a possibility of spreading seed.	6 years Seeds remain viable up to five years
Winged Euonymus (Burning Bush)	Burning Bush reproduces by seed and vegetatively.	Small plants can be hand pulled while a weed wrench will need to be used for larger plants. Care should be taken to remove entire root system.	A 2% foliar solution of glyphosate is recommended when leaves are present. A 20% solution of glyphosate or triclopyr is recommended for cut and paint and a 20% solution of triclopyr should be used for basal bark application.	5 years No information on seed banking,

Species	Biology	Control Recommendations		Monitoring Period
		Manual	Chemical	
Bush Honeysuckles (Tartarian and Morrow' s)	The berries are mildly poisonous if eaten.	small plants can be hand pulled or removed with a weed wrench. Care should be taken to remove all roots and not to spread berries.	Foliar spraying can be done if there are leaves present a 2% solution of triclopyr or glyphosate is recommended. A 25% solution for cut and paint treatments can be used, put the solution right into the hollow stem and around the stem edge. This is best during the fall when all the plant fluids are headed towards the root system.	3 years Few seeds viable for more than one year.
Common Reed	Common Reed reproduces by seed and vegetatively. Inflorescences develop in late June.	Plants can be cut. The shoots should be removed to prevent re sprouting.	A 2% solution of Glyphosate is recommended. Since Phragmites is an aquatic species, an aquatic safe herbicide must be used. The best results are when the herbicide is applied in the late summer or early fall when Phragmites is actively growing and in full bloom. Remove dead stems, if possible, by mowing or clipping.	2 years Seed viability is typically low, although it may vary year to year.
Garlic Mustard	Garlic mustard is a biennial plant and is allelopathic.	Basal rosettes and second year plants can be hand pulled. Plants should be pulled at base near ground to ensure that the root is removed.	A 2% glyphosate solution can be sprayed in April/ May before the basal rosettes go to seed and in September/ October when other plants are dormant.	6 years The seed bank is viable for 5 or more years.
Glossy Buckthorn	Reproduces by seed.	Seedlings can be hand-pulled and larger plants can be removed with a weed wrench. "Buckthorn Baggies" can be used to prevent resprouting.	Cut and paint with a 20% solution of glyphosate or 25% triclopyr. A 2% foliar spray can be used while there are leaves. Remove dead stems, if possible, by mowing or lopping.	7 years Seeds remain viable for 5-7 years.
Japanese Barberry	Japanese Barberry spreads by seeds and vegetatively. The seeds have a 90% germination rate.	Small plants can be removed by hand pulling or using a weed wrench.	A 2% foliar spray can be used when leaves are present (April). Both glyphosate or a triclopyr solution can be used. A 25% cut and paint solution of glyphosate or triclopyr can be used, it is most effective in the fall when sap flow is towards the root system.	2 years Do not persist in seed bank.

Species	Biology	Control Recommendations		Monitoring Period
		Manual	Chemical	
Japanese Knotweed	Most of the literature recommends spraying after flowering; this makes it harder for the plant to have enough reserves to re-sprout that year. When the plant is in flower (August) there are a lot of bees around this species; care should be taken to avoid spraying bees when present and if possible, efforts should be made to spray multiple times a year before flowering.	Due to its extensive root system hand pulling Japanese Knotweed is not recommended as an efficient form of control.	A 2% solution of Triclopyr or Glyphosate is recommended for foliar spraying and is recommended to be done soon after flowering. For cut and paint techniques a 25% solution of glyphosate or triclopyr is recommended.	4 years Seeds do not remain viable beyond one year, but rhizomes and other plant parts can sprout up to three years after treatment.
Japanese Stiltgrass	Japanese stiltgrass emerges in late August.	Small patches can be hand pulled and bagged. Be sure to remove entire root system.	A 2% glyphosate or triclopyr solution can be used for foliar spray in August/September.	7 years Seeds remain viable for 5-7 years.
Multiflora Rose	It flowers from April to June and fruits seeds July-Dec. It reproduces by seed and vegetatively.	Hand-pulling small plants are recommended as long as all the roots are removed. It is not recommended for established plants.	Foliar application is best when near flowering time. A 2% of triclopyr or glyphosate can be used. Cut and paint or basal bark applications can also be applied in the fall. A 25% solution of triclopyr or glyphosate is recommended for cut and paint and 20% of triclopyr can be used for basal bark treatments.	20 years Seeds of multiflora rose are viable for up to 20 years.

Species	Biology	Control Recommendations		Monitoring Period
		Manual	Chemical	
Oriental Bittersweet	The seeds are viable for several years but can sprout from roots and runners.	Seedlings are easy to hand-pull. Bigger vines can be removed by unwinding them from their host and using a weed wrench to uproot them. This can be done year-round, but use caution when berries are present.	You can foliar spray with a 2% solution of Glyphosate or Triclopyr. A 20% solution can be used for basal bark treatment. A 25% solution is recommended for cut and paint treatments, both Glyphosate and Triclopyr can be used.	5 years Seeds do not remain viable, but resprouts from roots.
Purple Loosestrife	Galerucella spp. beetles are recommended for bio control agents.	Plants can be removed by hand pulling. All roots should be removed.	An aquatic safe herbicide (Rodeo) should be used. A 2 % foliar spray is recommended in late August early September.	Ongoing Produces nearly inexhaustible seed bank. Bio-control will not eliminate plant.
Spotted Knapweed	Plants may contain carcinogenic compounds and skin irritation can also occur; gloves should be worn when handling	Plants can be hand pulled and bagged. Care should be taken to get entire root system and not to distribute seeds if present.	A 2% Glyphosate foliar spray can be used. Plants are most susceptible if sprayed in the late stages of flower buds (late June).	10 years Seeds can survive for 8 or more years.
Tree-of-Heaven	Tree-of-heaven flowers in May-June, and fruits starting in July. It reproduces by seed and vegetatively. Plants need to be 2 or 3 years old to produce viable seed. It re-sprouts vigorously when cut without herbicide.	Small plants can be removed by hand-pulling or using a weed wrench. Care should be taken to remove entire root system.	A 2% solution is recommended for foliar spray. Either Triclopyr or Glyphosate can be used. Triclopyr is recommended for cut and paint (30% solution) and basal bark (20% solution) treatments.	2 years Few seeds remain viable after one year.

Species	Biology	Control Recommendations		Monitoring Period
		Manual	Chemical	
Water Chestnut	Water chestnut emerges in June and sets seed in August	Small patches can be hand pulled in canoes and kayaks. Vegetation can be used as compost.	An aquatic specific herbicide would be used. Also required NPDES permits would have to be in place before control.	15 years Seeds remain viable for 12 or more years.

Appendix F: Invasive Species Treatment Record Datasheet

Invasive Species Treatment Record

Property:

Date:

Location:

UTM (WGS84/NAD83):

Weather (include 24 hours before and after for chemical treatment)

	Current	24 hours before	24 hours after
Temp.			
Wind speed/direction			
Cloud Cover			
Precipitation			

Method: Chemical Manual Mechanical Biological

Chemical

Chemical used: % Solution Used: Amount of solution used:

Amount of herbicide used: Mix date:

Adjuvants/Carriers etc.:

Method of Application:

Name of applicators:

Biological

Biological control agent: # Released: Stage:

Mechanical/ Manual

Equipment used:

Acres/number of plants treated:

% of infested area treated:

Growth stage of target:

Target Species:

Comments:

Date current treatment mapped w/ GPS:

Efficacy notes:

Date/type of last treatment:

ATTACH MAP OF TREATMENT AREA

or hand draw on back of this sheet