LAND STEWARDSHIP PLAN FOR BARE MEADOW CONSERVATION AREA

Prepared for the

Reading Conservation Commission

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Mass Audubon's Ecological Extension Service

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Mass Audubon

Protecting the nature *of Massachusetts*

Mass Audubon protects more than 40,000 acres of land throughout Massachusetts, saving birds and other wildlife, and making nature accessible to all. As Massachusetts' largest nature conservation nonprofit, we welcome more than a half million visitors a year to our wildlife sanctuaries and 20 nature centers. We believe in protecting our state's natural treasures for wildlife and for all people—a vision shared in 1896 by our founders, two extraordinary Boston women. Today, Mass Audubon is a nationally recognized environmental education leader, offering thousands of camp, school, and adult programs that get over 225,000 kids and adults outdoors every year. With more than 135,000 members and supporters, we advocate on Beacon Hill and beyond, and conduct conservation research to preserve the natural heritage of our beautiful state for today's and future generations.

Mass Audubon's Ecological Extension Service (EES) assists towns and cities, land trusts, state and federal agencies, and other conservation partners with natural resource inventories, habitat restoration and management planning, and conservation planning. Through EES we can share the experience we have gained in managing our own network of wildlife sanctuaries across the Commonwealth. .

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Introduction

The intent of this plan is to provide stewardship recommendations for the Bare Meadow Conservation Area that foster ecological values, passive recreational uses, and aesthetic qualities. The site includes areas of forest, wetlands, and significant areas of cultural grasslands. The plan will address stewardship of these habitats, efforts to control invasive species, other wildlife enhancement opportunities, and management of passive recreation uses.

Reading at a Glance

- Total Area: 6,393 acres (9.98 square miles)
- 12.3 sq. mi. land, 1.4 sq. mi water
- Human Population in 2020: 25,518
- Open space protected in perpetuity: 1,463 acres, or 23% percent of total area*
- Total developed land area: 3,356 acres, or 52%*

* Mass Audubon 2020 Losing Ground report

Land Acknowledgement

The land in Reading is part of the traditional, contemporary, and unceded territory of the Quannapowitt Tribe, 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.

Land that is well managed sustains us in many ways. 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,
- Health benefits from being in nature,
- The lumber we use to build our shelter,
- Filtration and decomposition of our wastes, and
- Habitats for a diversity of plants and animals.

This land helped sustain indigenous people 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.

Property Description

The town-owned Bare Meadow Conservation Area consists of 125 acres of diverse land (forests, fields, and wetlands). Bare Meadow was acquired from three major sources between 1972 and 1973. The largest parcel was a gift from Miriam Corey. Several additional parcels have been added. In 2007, the town purchased the abutting Mattera property, including a cabin. The Reading Open Land Trust has protected 27.8 adjacent acres between Bare Meadow and Main Street, known as Fairbanks Marsh.

At the western end of Bare Meadow there are two small open fields including remnants of an apple orchard. In the center there are beautiful, wooded areas and rocky hills with a network of trails that are enjoyed by visitors throughout the year. The trail system connects to Marion Woods (8.6 acres) that connects with the Ipswich River Greenway and its proposed trail system. Many stone walls mark earlier farming uses of this land. Bare Meadow Brook flows through red maple swamps and open marshes on the northeastern side and joins the Ipswich River at the northern end of the conservation area. There are six certified vernal pools in Bare Meadow. Many plant species can be found here including lady slippers, partridge berry, marsh marigold, prince's pine, trout lily, witch hazel, and others.

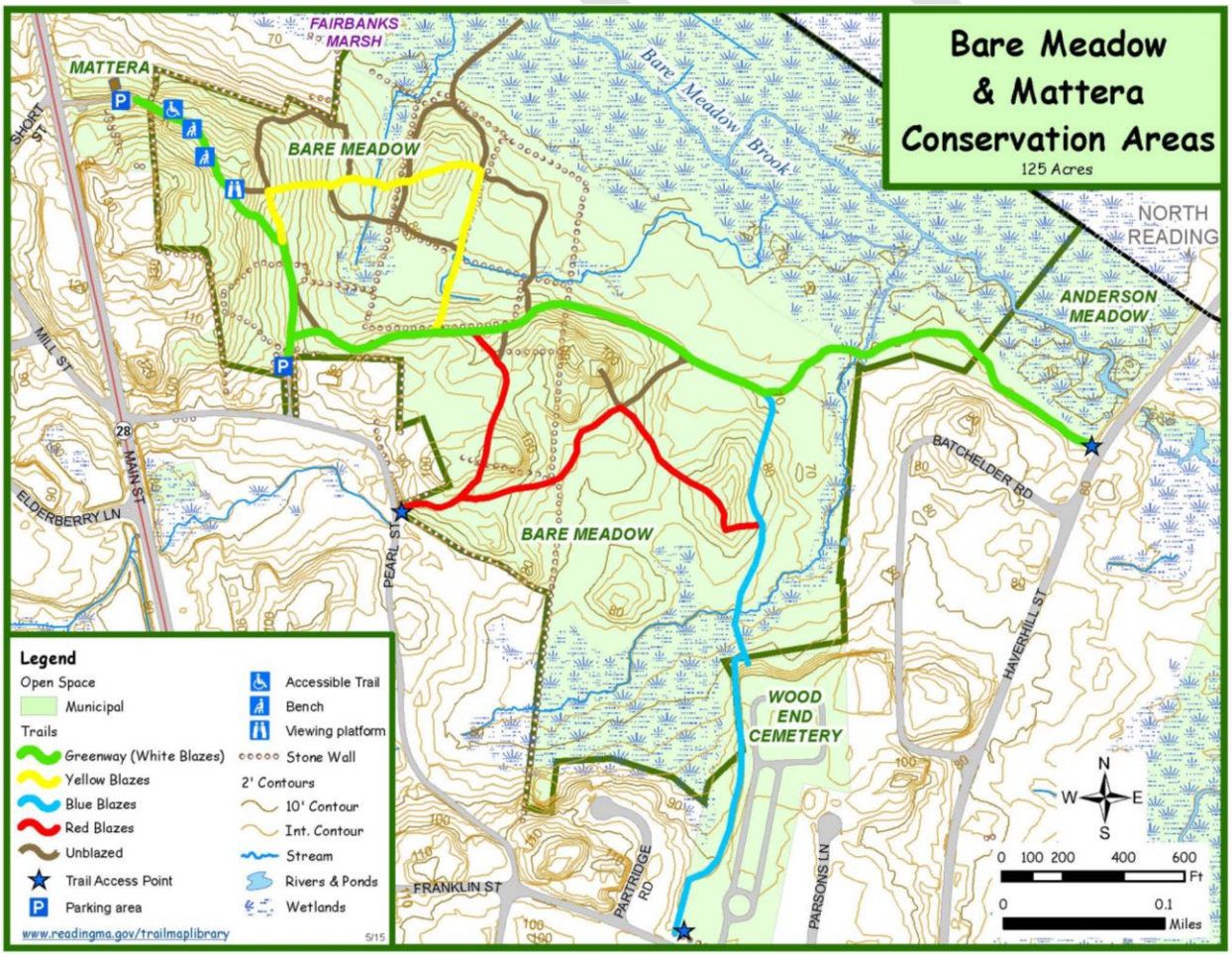

FIGURE 1 - BARE MEADOW AND SURROUNDING AREA

There are four entrances to Bare Meadow, all marked by large brown signs. The two primary entrances are off Pearl St. next to #717 and at the Mattera Cabin at 1481 North Main St. Both have ample off-street parking. The third is off Haverhill St. north of Batchelder Road. Parking is available on Batchelder Road. The fourth is off Franklin Street next to the Wood End Cemetery. Parking is available in the cemetery and on Partridge Road.

Site Setting and Context

Bare Meadow is bordered on the northeast by Bare Meadow Brook wetlands and the North Reading Chestnut Street Conservation Area. Much of the land to the west and south is mostly residential development and the Wood End Cemetery. Residential development also dominates the eastern edge of the property, but there is a narrow town-owned lot on the other side of Haverhill Street connecting Bare Meadow to the town-owned Cedar Swamp (424 acres). These connections to other protected lands contribute to the wildlife values for the site.

History

Reading's European settlers came from England in the 1630's. Many arrived through the ports of Lynn and Salem. The first settlement, called Lynn Village, was on the south shore of the Great Pond, what is now known as Lake Quannapowitt. On June 10th, 1644, the settlement was incorporated as the Town of Reading, taking its name from Reading, England.

The Bare Meadow area of Reading was settled before 1733 by the Emerson family. They had two houses on Pearl Street by 1765. The early Emersons were prosperous farmers and coopers. The extended family lived in adjoining houses. In 1875, Silas Emerson, four generations removed from the progenitor, had a shoe shop on Pearl Street like so many of his Reading peers, as Reading was a leading producer of women's and children's boots and shoes. The stone walls and remains of an apple orchard attest to the land’s agricultural uses.

Natural Assets Inventory and Assessment

The more than 2.3 miles of trails allow access to field, forest, and wetland habitats. The 125 acres, just minutes away from the center of town, are highly valued for the opportunities to experience nature they provide for the community. Any use for recreation needs to be balanced with preserving the diversity of habitats. Examples include maintaining mowed trails that hug the forest edge to minimize disturbance to habitat, as well as smart field management including late or early season mowing and leash law enforcement for dog walkers especially during the bird nesting season.

Ecological Features

The site includes a variety of significant ecological features, including physical features such as topography and soils, and natural habitats.

Topography

As seen in Figure 2, Bare Meadow Conservation Area has some moderate slopes (8 to 15%) running from a high point of 134 feet behind 1465 North Main Street and sloping down to the Bare Meadow Brook wetlands at 68 feet. Most of the site is below 100 feet. Areas below 70 feet are mostly wetlands. There

are a few steep slopes on the property, making most areas suitable for trails. Water drains from the high areas in the fields and forests toward Bare Meadow Brook.

Soils

Soil texture is classified by the relative composition of clay, silt, and sand particles. Sandy soils tend to be well-drained and nutrient poor. Silt laden soils are described as "dusty" and commonly found in floodplains. Clay soils are typically poorly drained and are often heavy, dense and sticky, conditions which limit root growth in some plants. Ideal agricultural soil, a "loam", is a combination of sand, silt and clay with moderate drainage and nutrient availability, and density conducive to root growth and microbial community colonization. Loamy soils can retain moisture but drain moderately well so the soil does not remain saturated for longer periods of time.

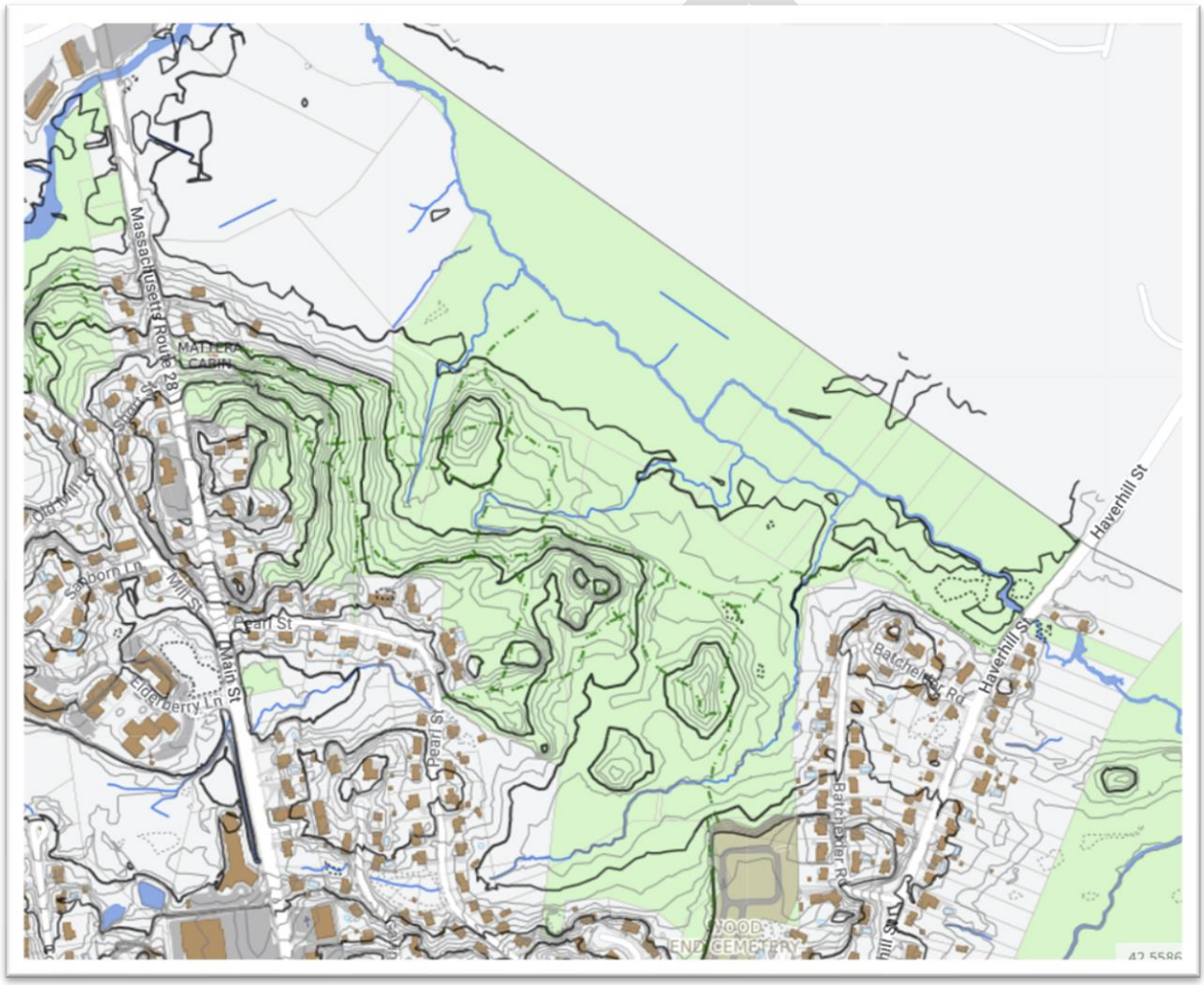

FIGURE 2 - TOPOGRAPHY (TOWN CONSERVATION AREAS IN GREEN)

Soils at Bare Meadow include both poorly drained mucks (along Bare Meadow Brook and other lower elevations of the site), rich in organic material from decaying wetland plants, and moderately drained sandy loam in the higher elevation areas. Some of the sandy loams (Windsor loamy sand) are listed as "Prime Agricultural Soils" and are considered as "farmland of statewide importance".

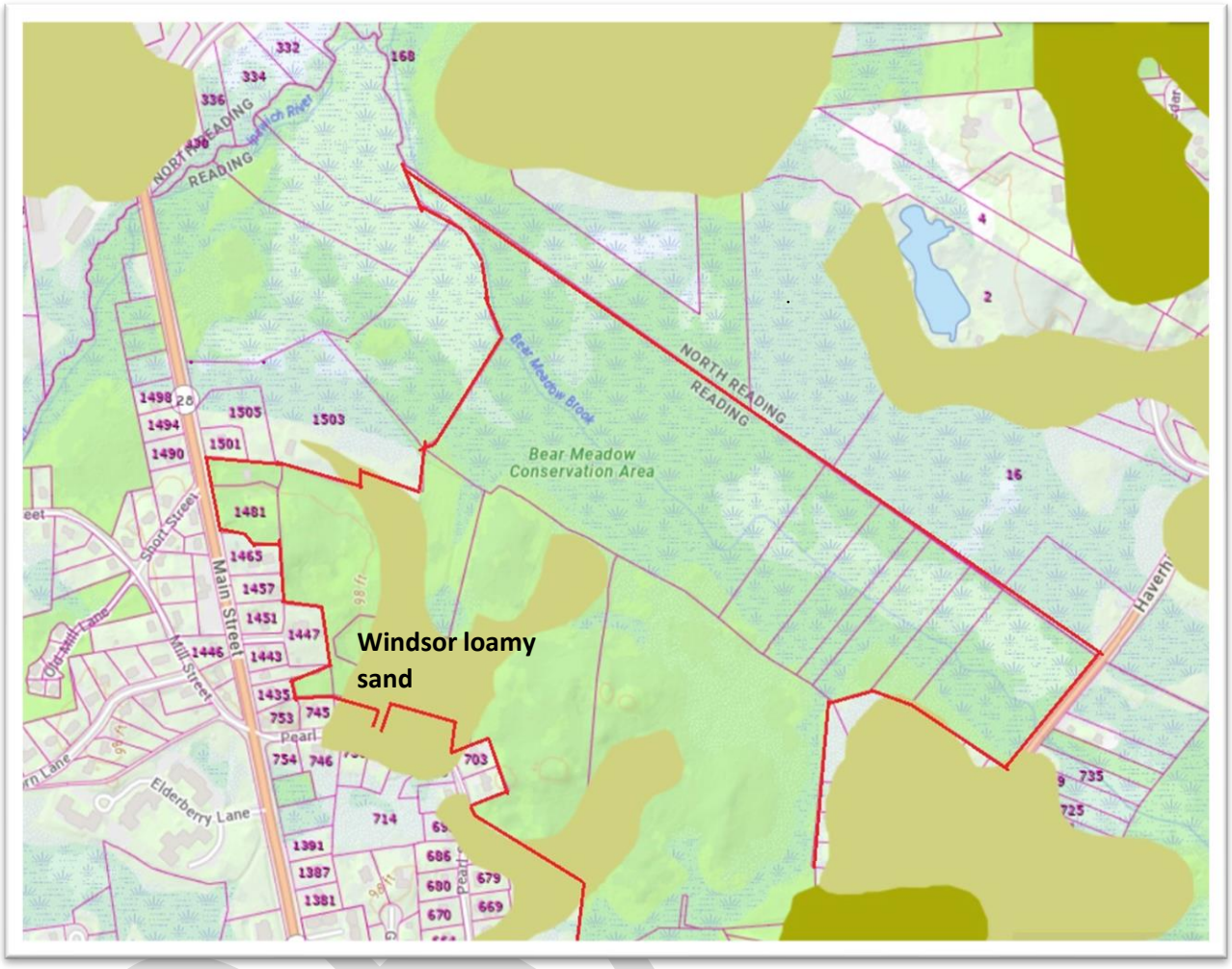

FIGURE 3 – PRIME AGRICULTURAL SOILS

Natural Communities

Natural communities are divisions in plant communities based on conditions determined by the entire landscape. Soil composition, slope, aspect, elevation, and land use history are all factors that determine the distribution of natural communities on a site.

According to the MassGIS Land Cover Land Use (2016) layer and DEP Wetlands layer, the natural communities at Bare Meadow are comprised of two small, mowed grasslands (about 2 acres total that have diminished over time because of edge encroachment), evergreen forest (about 17 acres), deciduous forest (about 18 acres), deep emergent (about 10 acres), and forested wetlands (about 70 acres). See Figure 4 for an aerial photo of fields and forest areas. There is also a parking area for 12 cars, community gardens, and the Mattera Cabin that serves as a community gathering place and site for small functions.

Cultural Grassland Community[1]

The area at Bare Meadow often referred to as meadow is called a cultural grassland community by the Massachusetts Natural Heritage and Endangered Species Program (NHESP) is maintained by frequent mowing and is primarily of conservation interest as habitat for the **woodcock** (**Bold** text indicates species that have been noted at Bare Meadow[2]) that have displayed and potentially nested there for several years and for pollinators – insects that are food for many species of birds and mammals.

FIGURE 4 - AERIAL PHOTO SHOWING HABITAT AREAS

These grassland areas include biennials and perennials. Perennials are those non-woody plants that grow back year after year. The grassland at Bare Meadow has a dense population of **little bluestem** and includes **goldenrod**, **asters**, and **milkweed**. Similar grassland communities often include daisy fleabane, other forbs, and many kinds of grasses and bush clovers. Biennials, those plants that grow one year and

[1] See Mass. NHESP factsheet https://www.mass.gov/doc/cultural-grassland-0/download

[2] The source of the observations are EBird, I Naturalist, and personal observations/site visits or reported by others.

flower the next year, often include sweet clover, mullein, curly dock, wild mustard (yellow rocket), shepherd's purse, black mustard, foxglove, and thistles. Small mammals such as mice, rabbits, and skunks use the habitat, along with foxes, **hawks**, and **owls**, an abundance of butterflies, and songbirds. **Multiflora rose, Oriental bittersweet, Autumn olive,** and **buckthorns** are also present especially along the edges of the fields at Bare Meadow.

Threats to these old field habitats include invasive non-native plant species and edge encroachment – the growth of shrubs and trees along the edges that reduce the size of the fields.

Upland Forest Communities

The upland forest communities include Oak-Hickory Forest and Successional White Pine Forest. Some areas of these forest communities have been classified as Prime Forest Land based on their potential for timber growth/harvest (an indication of their ecological vigor and importance).

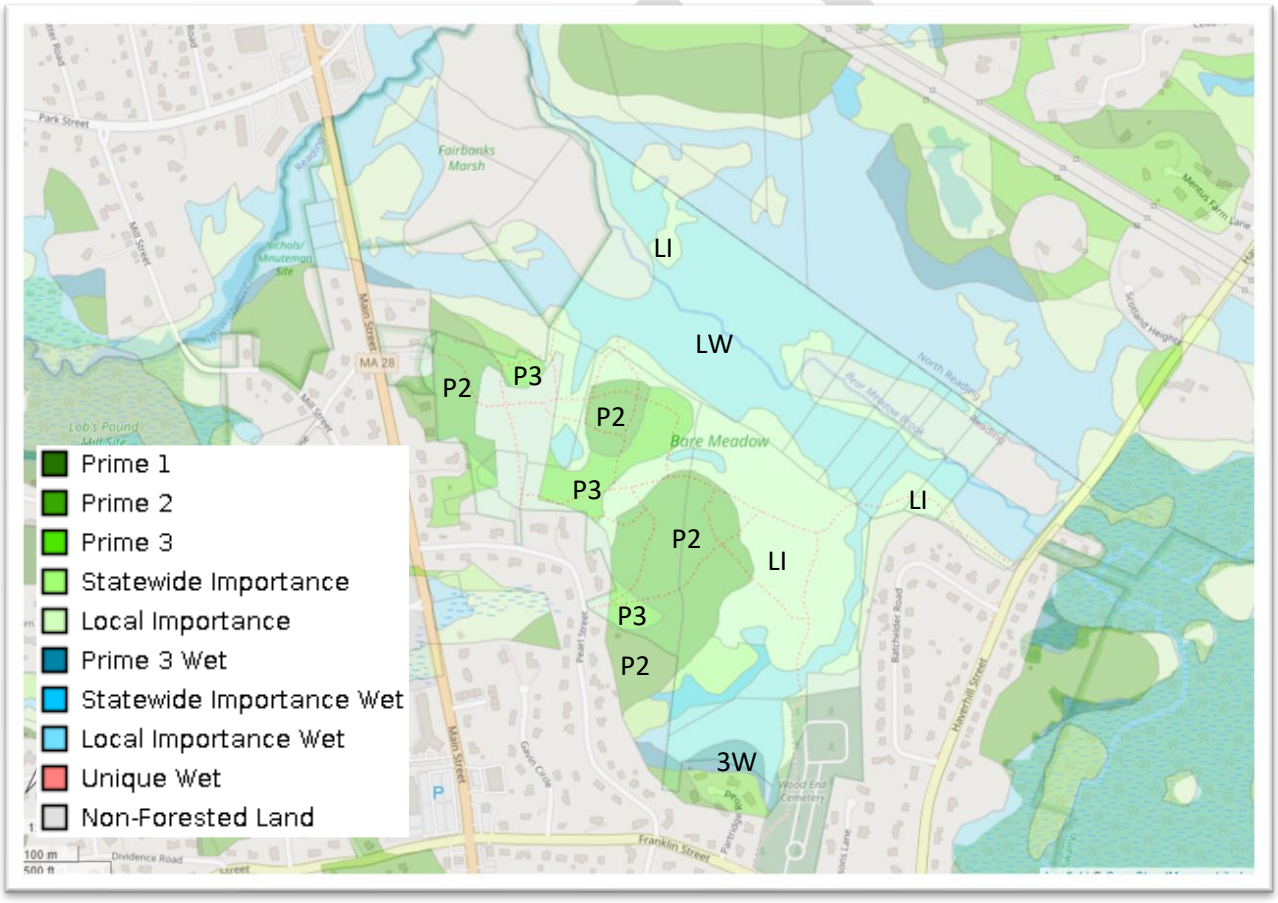

FIGURE 5 - PRIME UPLAND AND WETLAND FOREST LAND

OAK-HICKORY FOREST[3]

Most of the deciduous forest can be classified as Oak-Hickory Forest. The canopy is dominated by one or several **oaks**. Mixed in are lower densities of one or several **hickories**. The Bare Meadow oak-hickory forest also includes **white ash**, **red maple, white pine,** and **eastern hemlock.** Occasionally other trees in this community include black birch and sassafras. If present, conifers constitute <25% cover. The subcanopy/tall shrub layer (usually 25-50% cover) includes **witch-hazel,** other common shrubs may include hop hornbeam, flowering dogwood, downy shadbush, and American chestnut. Low shrubs included **blueberries.** This layer is often diverse and generally sparse but may have dense patches: maple-leaved viburnum, beaked and American hazelnut, and gray dogwood may be present. The herbaceous layer is often richer than in many oak forests. Plants typical of the herbaceous layer include silverrod, tick-trefoils, wild sarsaparilla, rattlesnake weed, false Solomon's seal, **pink lady's slipper**, and patches of long-beaked Pennsylvania sedge or Pennsylvania sedge.

Animals generally include wide-ranging species that would include this forest type as parts of their habitats, particularly when acorns are available. **Wild turkeys** are found in primarily oak areas. Dry oak forests support a smaller mix of animal species than are found in moister communities. Common species of dry sites include short-tailed shrew, white-footed mouse, and **chipmunks**. Snakes of dry forest sites include **garter snakes** and redbelly snakes. Birds that nest in oak forests include **Eastern wood-pewee**, **red-eyed vireo**, **scarlet tanager**, and **ovenbird**. Moths, butterflies, and other insects of Oak - Hickory Forests may include the orange sallow moth (a species listed of Special Concern).

The major threat to Oak-Hickory Forest is the proliferation of invasive non-native plant species such as **glossy buckthorn** and **Morrow's honeysuckle**.

SUCCESSIONAL WHITE PINE FOREST[4]

Most of the evergreen forest at Bare Meadow can be classified as Successional White Pine Forest. This forest type has a near monoculture of white pine (>75% cover) in the canopy, with scattered associates that vary with geography and prior land use, including **white oak**, **red oak**, **red maple**, and early successional trees such as **birches** and **aspens**. The shrub layer is variable, from sparse to thick, and may include black elderberry, **black cherry**, maple-leaved viburnum, and non-native species such as **glossy buckthorn**, **bush honeysuckles**, and/or **multiflora rose**. **Blackberry vines** may form thickets, and **poison ivy** often covers the ground near openings or in formerly open disturbed areas. **Lowbush blueberries** form patches mixed with black huckleberry on sites with less disturbed soil. **Bracken fern** may be in the shrub layer. The herbaceous layer is variable; large patches of **Canada mayflower** and **northern starflower**, with **clubmosses** (such as ground-pine, southern ground-cedar, and staghorn clubmoss), are particularly common on formerly plowed soil. **Partridgeberry**, fringed polygala, and **pink lady's-slipper** grow in many longer established sites.

Blackburnian warblers are probably the bird species most closely associated with dense white pine forests. Other birds of the community include **ovenbird**, **yellow warbler**, **Cooper's hawk**, and northern goshawk, as well as generalists such as the **black-capped chickadee**, and **white-breasted nuthatch**.

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[3] www.mass.gov/doc/oak-hickory-forest-0/download

[4] www.mass.gov/doc/successional-white-pine-forest/download

The major threat to Successional White Pine Forest is the proliferation of invasive non-native plant species such as **glossy buckthorn** and **Morrow's honeysuckle**.

Forested Wetlands[5]

Most of the Forested Wetlands at Bare Meadow can be classified as Red Maple Swamp. **Red maple** is strongly dominant in the overstory, and often provides more than 90% of the canopy cover. A variable mixture of tree species co-occurs with **red maple**, including **yellow birch**, black gum, white ash, **white pine**, **American elm**, **hemlock**, pin oak, and **swamp white oak**. **Atlantic white cedar** is a common associate in coastal areas and locally at sites in central Massachusetts and the lower Connecticut Valley. When **Atlantic white cedar** is dominant in the overstory, the community is classified as an Atlantic white cedar swamp. The shrub layer of Red Maple Swamps is often dense and well-developed, generally with >50% cover, but it can be variable. At Bare Meadow **sweet pepperbush** and **swamp azalea** are the dominant shrubs, often dense and bound together by **greenbriers**. Other common shrubs are **highbush blueberry** and common winterberry, which are often dominant, along with spicebush. In richer areas, northern arrow-wood, speckled alder, nannyberry, and poison sumac also occur. The herbaceous layer is often highly variable, but ferns are usually abundant. **Cinnamon fern** is common; other ferns include sensitive fern, **royal fern**, marsh fern, and **spinulose wood fern**. **Skunk cabbage** is one of the most common herbaceous species. Graminoids are common, mixed with a variety of herbaceous species.

Red Maple Swamps contribute variation to the habitats of many wide-ranging wildlife species. Songbirds of swamp forest are like the birds of structurally similar upland forests, but the dense shrub layers provide excellent nesting locations for birds of thickets. The amount of escape cover and water availability makes swamps important habitat for many species of small mammals. Ground-dwelling species, such as reptiles and amphibians, are affected by the presence of wet or moist soils in swamps and tend to use them for breeding and feeding. Parts of Red Maple Swamps that have two or three months of ponding and lack fish can function as vernal pools; these sections provide important amphibian breeding habitat.

The major threat to Red Maple Swamp is the proliferation of invasive non-native plant species such as **glossy buckthorn** and **Japanese barberry**.

Deep Emergent Marsh[6]

The Deep Emergent Marsh community is generally flooded with half a foot to 3 feet of water year-round, though water depth may vary not only during the growing season, but from year to year. Tall graminoids, like **broad-leaved cattail** and **phragmites**, form extensive dense stands. Narrow-leaved cattail often occurs in more alkaline sites or in saline areas along roads. Other characteristic graminoids may include wool-grass, common three-square, Canada bluejoint, reed canary-grass, rice cut-grass, and tussock-sedge. Herbaceous associates include arrow-leaf tearthumb, bulblet water-hemlock, swamp-candles, beggar-ticks, bedstraw, common arrowhead, slender-leaved goldenrod, and marsh-fern. Short shrubs including sweet-gale, meadowsweet, and hardhack may be scattered among tall graminoids. Tall

[5] www.mass.gov/doc/red-maple-swamp/download

[6] www.mass.gov/doc/deep-emergent-marsh/download

shrubs such as speckled and smooth alders, and **highbush blueberry** are generally sparse, totaling <25% cover. Invasive species often include purple loosestrife and **common reed (phragmites)**.

Emergent Marsh is the primary nesting habitat for a suite of secretive marsh birds (rails, bitterns, grebes, and moorhens). This habitat also provides an important nesting habitat for other birds of high conservation interest, such as marsh wren, **northern harrier**, and a variety of ducks. Emergent Marsh habitat supports many species of frogs and salamanders, especially leopard, pickerel, green, and bull frogs, and some vernal-pool obligate species, such as wood frogs and spotted salamanders, may use areas of Emergent Marsh for egg-laying if the areas are fish free.

Emergent Marshes are sometimes threatened by filling and dredging, impoundments that alter natural water-level fluctuations, and by nutrient inputs from adjacent roads, yards, or septic systems. Invasive species are a significant threat. Reed canary-grass can collect sediments that alter water depths and reduce habitat variability. **Common reed** can also form monocultural stands that out-compete native species. Purple loosestrife has a similar range of water depth requirements as cattails and will gradually invade and become abundant in such systems.

Climate change affects the structure and function of aquatic ecosystems both directly and indirectly. Direct effects include increases in water temperatures and changes to hydrology, while indirect effects may alter plant and animal communities, and accelerate the spread of invasive species. Aquatic habitats are particularly susceptible to these changes because habitat conditions like water temperature and the amount of water are climate-dependent, species that inhabit them are less able to disperse, and multiple stressors are already impacting them.

Conservation actions to protect or restore freshwater habitats can help address these threats. Landscape level planning can inform freshwater conservation at the site scale and can incorporate the link between freshwater and terrestrial systems across large landscapes. Dam removal, culvert upgrades, eradication of invasive species, daylighting of streams and floodplains, removal of channelization structures, and upslope revegetation are all examples of management actions that can be used to improve conditions in freshwater habitats.

BioMap Areas

Almost all Bare Meadow is designated as Critical Natural Landscape in BioMap, a joint program of MassWildlife and the Massachusetts Chapter of The Nature Conservancy (TNC) with the goal of protecting the diversity of species and natural ecosystems within the Commonwealth. BioMap is an important tool to guide strategic protection and stewardship of lands and waters that are most important for conserving biological diversity in Massachusetts. Designated areas are essential to safeguard the diversity of species and their habitats, intact ecosystems, and resilient natural landscapes.

Critical Natural Landscape identifies large landscapes minimally impacted by development and buffers to core habitats, both of which enhance connectivity and resilience. The wetland areas of Bare Meadow are designated as Core Habitat – an area critical for the long-term persistence of rare species, exemplary natural communities, and resilient ecosystems. Aquatic Core contains freshwater habitats (rivers, streams, lakes, and ponds) with the highest fish and freshwater mussel diversity, strongest anadromous (migratory) fish runs, aquatic rare species habitat, and habitats most resilient to a warming climate. These areas represent the most structurally and functionally intact freshwater ecosystems in the state.

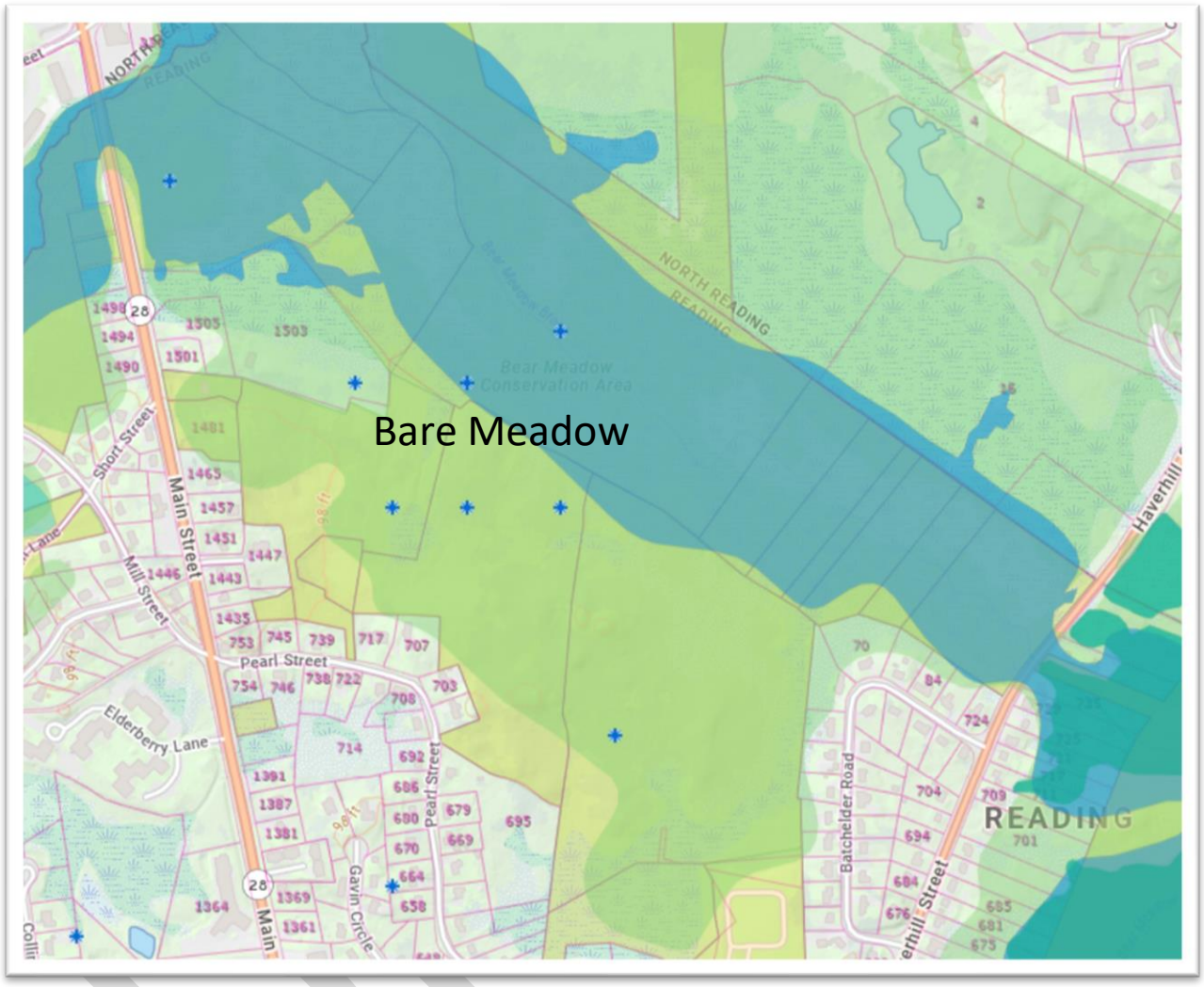

FIGURE 6 - BIOMAP CRITICAL NATURAL LANDSCAPE AREA (IN GREEN) AND AQUATIC CORE HABITAT (IN BLUE) – AND CERTIFIED VERNAL POOLS (IN BLUE CROSSES)

Wildlife

Bare Meadow is a haven for wildlife including birds, amphibians, reptiles, mammals, and insects. Its natural communities contribute to the diversity of wildlife at the site and in the surrounding areas.

Birds

Bare Meadow Conservation Area is a Cornell University/eBird "hotspot" and birdwatchers have reported more than 102 species of birds from the site (see Appendix A for the entire list). Forty-two species have been observed during the breeding season and are likely to breed at Bare Meadow, nearby or are non-breeders.

Migratory bird species use a mix of forest, edge, and field habitats that are available within the site and surrounding habitats. The loss of natural habitats through conversion to other land uses, residential

development or through succession, is resulting in the decline and disappearance of some wildlife. See Mass Audubon's report on the State of The Birds for more details on these declines.[7]

Amphibians and Reptiles

There are six certified vernal pools located in the forested areas of the site. A vernal pool is a natural depression that temporarily fills with water in the spring. Due to its periodic drying, vernal pools do not support fish populations. Organisms that have evolved to vernal pools are called obligate species because they rely on the pools for various parts of their life cycle. Common obligate species are fairy shrimp, **mole salamanders**, and **wood frogs** which form a significant base of the food chain.

FIGURE 7 - SPOTTED SALAMANDER

The vernal pools, wetlands, and forests provide good habitats for a variety of amphibians and reptiles. The Massachusetts Herpetological Atlas Project[8], a seven-year effort, running from 1992 through 1998, reported 21 species of amphibians and reptiles in the vicinity of Reading. Likely species at Bare Meadow include northern leopard frog, American toad, bullfrog, common snapping turtle, **eastern garter snake**, eastern milk snake, gray treefrog, **green frog**, northern water snake, **spotted salamander**, **Eastern red-backed salamander**, painted turtle, and possibly spotted turtle and blue spotted salamander. An inventory of amphibians and reptiles would be a good citizen science project.

Mammals

The site also provides habitat for generalist species. Common habitat generalist mammals that are likely to occur within the Bare Meadow Conservation area include: Virginia opossum, **eastern gray squirrel**, **red squirrel**, **eastern chipmunk**, meadow vole, **white-footed deer mouse,** eastern cottontail, **coyote**, red fox, long-tailed weasel, striped skunk, and **white-tailed deer**.

FIGURE 8 - MONARCH BUTTERFLY

Insects

Butterflies, bees, and other insects help pollinate the wildflowers and are food for many of the small mammals and birds that use the habitats. Eleven

[7] https://www.massaudubon.org/content/download/21633/304821/file/mass-audubon_state-of-the-birds-2017-report.pdf

[8] Jackson, S.D., R.M. Richmond, T.F. Tyning and C.W. Leahy (eds). 2010. Massachusetts Herpetological Atlas 1992-1998, Massachusetts Audubon Society & University of Massachusetts (massherpatlas.org).

species of insects have been reported by I-Naturalist including three species of wasps and one hornet. **Painted skimmer**, **pine tree spur-throat grasshopper**, **swamp milkweed leaf beetle,** and **winter firefly**, are among the others reported. Declines in the health and population of pollinators pose what could be a significant threat to the integrity of biodiversity, to global food webs, and to human health. At least 80% of our world's crop species require pollination to set seed. A 2021 study estimated that without pollinators, fertility would be reduced by 80% in half of all wild plant species and one-third of all wild plant species would fail to produce any seeds at all.

Trails

A well-designed, comfortable, and safe trail network facilitates enjoyment of an area and protects the conservation values of the site. The existing trail network is an integral part of the site's passive recreational value, providing visitors with a means for exploring and enjoying the site. Trails should be located to minimize redundancy and enhance the visitor experience by not exceeding the capacity of the site to accommodate trails. To the greatest extent possible, all trails should be located outside of sensitive natural resource areas, such as habitat for sensitive wildlife, steep slopes, or soils that are too wet or prone to erosion.

Sustainable Trails

Climate change is having a big impact on trails because of more intense 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 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.

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

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

Trail Assessment

Periodic assessment of the trails is recommended. Trail assessments provide a detailed evaluation of tread conditions that can be used for planning and budgeting purposes. They provide detailed information of each section 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 that 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. Any structures on trails such as benches, guardrails, and viewpoints will deteriorate over time and will 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 evaluates the existing trail network, section by section. Problem areas are identified and alternatives for solving those problems are presented for discussion. Based on that discussion each solution can be described in detail (i.e., width, linear feet of trail, materials, permitting requirements, and costs, etc.).

Design, construction, and maintenance of the trail network should be guided by the standards and guidelines in *Trail Solutions: IMBA's Guide to Building Sweet Singletrack*[9] and the *U.S. Forest Service Trail Construction and Maintenance Notebook.* The particulars of trail design will vary based on site conditions and use. Nevertheless, the staff and volunteers should pursue the following principles in trail design.

Trail width – Major trails should be 4-6 feet wide in areas of heavy use and other favorite destinations so that visitors can walk side by side or pass. Lesser used trails should be 3-4 feet wide to minimize impacts to natural resources and to encourage a closer experience with nature, with the expectation that some width expansion may be inevitable with use. Dense vegetation along the edge of trails should be regularly clipped back (or mowed with a Weed Wacker) 2 feet beyond the tread width to accommodate use so that it does not grow into the trail and present an opportunity for ticks to attach to visitors. Selected trails through rapidly encroaching vegetation may need to be trimmed wider or more frequently.

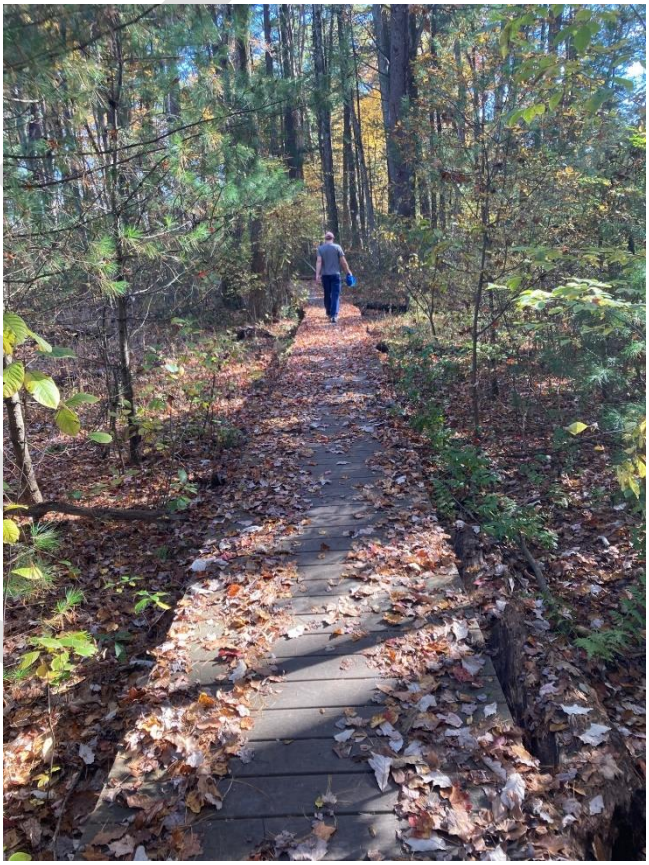

FIGURE 9 - EXISTING BOARDWALK AT BARE MEADOW

Trail Layout – avoid trails running perpendicular to the contours. These "fall line" trails almost guarantee erosion if they are more than 10% grade. Trails should cross contours at an angle and have "out-slope" and "grade reversals" to move water off the trail treadway. "Trail anchors", and "corralling" should be used to help keep users on the trails.

Trail surface – trails should normally retain a natural soil surface. Trails through grasslands should 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,

[9] 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=

supplemental surfacing material may be used. Accessible trails, if any, should meet standards set by the *U.S. Forest Accessibility Guidelines Service*[10].

Trails and Wildlife – layout should preserve large areas of habitat without trails, avoid habitat fragmentation, and protect wetlands and sensitive areas. Consider reducing or eliminating trails especially in sensitive areas.

Non-native Invasive Plants

Like many open spaces Bare Meadow has become infested with non-native invasive plants. Non-native plants are species introduced since the Colonial Period. More than 2,200 plant species have been documented in Massachusetts, and some 725 of them are non-natives that are considered naturalized (established). Of those, 72 plant species have been categorized by the Massachusetts Invasive Plant Advisory Committee (MIPAG) as "Invasive," "Likely Invasive," or "Potentially Invasive."

Why Are Non-native Invasive Plants a Problem?

Non-native invasive species cause or are likely to cause economic harm, environmental harm, or harm to human health. The term "invasive" is used for the most aggressive species. These species grow and reproduce rapidly, causing major disturbance to the areas in which they occur.

- Invasive plants are one of the greatest threats to the nature of Massachusetts (Mass Audubon)
- These non-native plants can out-compete, displace, and kill our native species.
- They grow fast and produce a lot of seeds.
- They're often the first plants to leaf out in the spring, and the last to lose their leaves in the fall.
- They often grow in dense patches and use up moisture and nutrients that are then not available for more desirable plants.
- They also lack the insects or diseases of their place of origin that might keep them in check.

Why Does It Matter?

Invasives compete with native plants and wildlife for resources, disrupt beneficial relationships, spread disease, cause direct mortality, and can significantly alter ecosystem function. We may lose some of the things we love about our natural places, such as:

- Native forest types,
- Rare plants – think of New England wildflowers,
- Wildlife that depends on native species – think of Monarch butterflies that depend on native milkweed plants.

It's been shown that our native bird species that evolved over thousands of years eating the insects that feed on our native plants (and their seeds) do not obtain the same nourishment from non-natives. Many insects are only able to feed on native plants and the presence of the invasive non-natives reduces the abundance of food sources for our birds[11].

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[10] https://www.fs.usda.gov/sites/default/files/FSORAG-2013-Update.1.pdf

[11] Tallamy, Douglas w., Nature's Best Hope, Timber Press, Portland, Oregon, 2019 pp. 110-117

Non-native Invasive Plants at Bare Meadow

As noted in the natural communities' descriptions invasive species are everywhere at Bare Meadow. Some of the worst actors are **Oriental bittersweet**, **Autumn olive**, **winged euonymus**, **garlic mustard**, **Japanese knotweed**, **multi-flora rose**, **honeysuckles**, and **buckthorns**. Recommendations on the control of invasives will be covered in the section on land stewardship.

Land Stewardship Plan

There are many choices concerning how we steward our common land – land held for the benefit of us all. Some of those choices are determined by the nature of the land itself. For example, the Cedar Swamp is entirely wetland and inappropriate for trails and recreation, but it is an important source of groundwater retention for the town as well as a large headwater for the Ipswich River. Most parks are managed for their scenic beauty and/or for active recreation. Some forests are managed primarily for timber harvest. Aldo Leopold[12], sometimes referred to as the father of wildlife ecology, was an advocate for the conservation of land to preserve its natural assets as wildlife habitat and recommended that some land be designated as "wilderness". In short, not every site is the same. There are competing uses for public land and it is in the interest of everyone to maintain a variety of stewardship. Bare Meadow Conservation Area is managed as an important natural area to benefit wildlife and provide an area to be enjoyed for less organized passive activities. Passive recreation means leisure activities commonly practiced by an individual or small group that are usually unorganized and noncompetitive, including, but not limited to, picnicking, birdwatching, cross-country skiing, snowshoeing, nature observation, and walking. These activities have minimal impact on the site's natural assets.

Bare Meadow Conservation Area Goals and Objectives

The main stewardship goal for Bare Meadow is to maintain and improve the wildlife habitat values of the site while allowing it to be enjoyed for passive activities.

Objectives for the site are to:

- Protect and enhance habitat values for wildlife,
- Maintain or improve grassland and forest habitats,
- Evaluate designated access / trails and restrict unofficial access,
- Protect scenic assets,
- Protect surface water and groundwater assets,
- Protect cultural assets,
- Develop a stewardship activities schedule / timetable,
- Suggest how to mitigate the negative effects of dogs (waste, wildlife disturbance, erosion, etc.)
- Suggest how to manage invasive species, in fields and along the edges and in forested habitats.

Recommendations for addressing these objectives are detailed below.

Rules and Regulations for Use of Town of Reading Conservation Lands

Bare Meadow Conservation Area is open for the public to enjoy multiple passive use opportunities including walking, hiking, cross-country skiing, snowshoeing, and wildlife watching. The following are the official rules and regulations for use of the town's conservation area as adopted on August 16, 2008

1. Everyone is welcome to enjoy the Reading Conservation Lands at no charge from dawn to dusk.

[12] https://en.wikipedia.org/wiki/Aldo_Leopold

2. Hours of use may be extended for a specific event or use if written permission has been obtained from the Conservation Commission for the specific extended time. Applications for the extended time must be made at least 21 days in advance of the event or use. The written permission shall be carried by the person in charge of the event at all times during the event.
3. Organized commercial or group activities on Conservation Land require prior written permission by the Conservation Commission. Applications for the activity must be made at least 21 days in advance of the activity. The written permission shall be carried by the person in charge of the activity at all times during the activity.
4. No work of any type shall be carried out on Conservation Land without prior written permission from the Conservation Commission. "Work" includes but is not limited to trail clearing, trail maintenance, excavation, filling, building structures, and posting signs.
5. Smoking is prohibited. Fires and camp stoves are prohibited.
6. No person shall cut, break, remove, deface, defile, or ill-use any structure, fence, or sign, or have possession of any part thereof. No plants (including trees, bushes, grasses, or flowers) shall be defaced or cut. This prohibition applies to dead as well as living vegetation.
7. Discharge of firearms is prohibited in the Town of Reading, including Conservation Land. Discharge or carrying of BB guns, pellet guns, paintball guns, airsoft guns, and similar non-lethal weapons is prohibited in Conservation Land.
8. Hunting of deer with bow and arrow by persons licensed by the Massachusetts Division of Fisheries and Wildlife is allowed only during deer hunting season (except Sundays) and only in the following Reading Conservation Lands: North and South Cedar Swamp and the northern parts of Bare Meadow Conservation Land as shown on the attached map. Hunting as allowed above must also comply with the following:
    a. Hunting shall be conducted in compliance with Massachusetts law.
    b. No hunting is allowed within 500 feet of any structure or within 150 feet of any road (per Massachusetts law).
    c. Only deer hunting is allowed.
    d. Hunting is allowed during deer hunting seasons only.
    e. No hunting is allowed on Sundays (per Massachusetts law).
    f. Portable tree stands may be used under the following conditions:
        i. No tree stand may be attached to any Atlantic White Cedar tree;
        ii. Trees stands and steps shall be installed in a manner to avoid or minimize damage to tree bark and limbs;
        iii. Tree stands shall be secured to trees with no more than one locking tee-nut;
        iv. Tree stands and steps shall be removed at the end of deer hunting season; and
        v. The Conservation Commission and the Town of Reading are not responsible for use of tree stands or steps, or for their loss or damage, or for any injuries resulting from their use.
9. Conservation Land is closed to any type of motor-powered vehicle except in prepared driveways and parking areas, or vehicles necessary for emergency response by the Reading Police and Fire Departments, or with prior written permission of the Conservation Commission.

10. Use of bicycles is prohibited on Conservation Land, except in prepared driveways and parking areas, or bicycles necessary for emergency response by the Reading Police and Fire Departments, or with prior written permission of the Conservation Commission.
11. Alcoholic beverages are prohibited on Town property, including Conservation Land. Glass containers for any purpose are prohibited on Conservation Land.
12. Dumping, littering, filling or any other deposition of imported materials, including but not limited to garbage, debris, earth, leaves or brush is prohibited in Conservation Land. (Please use the town compost area for yard wastes. Call the Public Works Department for information.) Users must carry out everything that they carry in.
13. Dogs may enter Town Conservation Land provided that they are accompanied by and under the effective control of some person. The person accompanying the dog shall promptly remove feces deposited by the dog on Town Conservation Land.
14. Violations of these rules and regulations may be punished by fines up to $100 per violation under Massachusetts General Laws, Chapter 40, Section 8C, which is administered by the Reading Conservation Commission or its agents, including the Reading Police and Fire Departments.

Safety Concerns

There are few concerns about public safety relating to the condition of the property. The open fields could host stinging insects and ticks. Some poison ivy was observed both in the forest understory and along the edges. Given the trails are along the field edges and within the forest, special efforts should be made after high wind events to survey the trails for fallen trees and hanging branches overhead and remove any hazards identified.

Concerns have been raised about aggressive or uncontrolled dogs. The Town of Weston in cooperation with the Sudbury Valley Trustees recruited volunteer "Bark Rangers" to walk some of the town's trails and spread the message about the negative impacts dogs can have on wildlife, water quality, and other visitors. Bark Rangers encouraged trail walkers to keep dogs under their command and on the trails and to "scoop the poop".

Trail walkers should take care and wear orange during the hunting season, especially near the areas open to hunting. The main entrance should have a sigh warning visitors during the hunting season.

Threats and Opportunities

Invasive species pose one of the main threats to ecological integrity of the Bare Meadow Conservation Area. **Glossy buckthorn**, **common buckthorn**, **Oriental bittersweet**, **bush honeysuckle**, and **multiflora rose** edge the forest and grassland interface and some of the hedgerows separating fields. **Glossy buckthorn** is the main invasive growing in the forest understory. **Multiflora rose, Oriental bittersweet**, and **buckthorns** are also present in some small areas of the fields. There is an area of **Japanese knotweed** at the parking area/entrance on Pearl Street and **winged euonymus** is scattered in some areas.

Woody species like **buckthorns**, **Oriental bittersweet**, and **multiflora rose** are found along the edges of the fields. All these invasive, non-native species benefit from a late cutting of the fields because they

have had the opportunity to produce seeds and store energy for the next season. Measures to maintain the fields will be addressed in the section on management.

Enforcing the regulations on dogs is another challenge. It is important to ensure that dogs are kept on leash during the bird breeding season. Measures to improve enforcement will be addressed in the section on management.

The Bare Meadow Conservation Area is a moderately popular site for passive recreation in all seasons. This is an important opportunity to engage the public.

Stewardship Recommendations

The following recommendations will address management with regard for climate change, past management efforts, management of the fields, recommendation on forest management, efforts to control invasive species, other wildlife enhancement opportunities, and management of passive recreation uses.

Management of Natural Areas with Regard for Changing Climate

The management of natural resources has largely assumed a stable climatic background. Now there is widespread agreement among scientists and the public that the climate is changing because of 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, from hotter summers with more periods of drought, warmer winters with less snow cover but more precipitation, rising sea levels, more frequent severe weather events, and inland flooding in winter and spring.

Climate impacts that may affect conservation land are predicted to:

- Increase the number of extremely hot days and degraded air quality,
- Compromise infrastructure like trails (e.g., more erosion, blowdowns, and flooding),
- Increase the risks from storm events,
- Changes in the composition of species,
- 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 public open space in complex ways. Manomet Center for Conservation Science and the Massachusetts Division of Fisheries and Wildlife have published a study[13] 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 four principles for increasing the resilience of conservation land.

1. **Reduce non-climate stressors** – for example, controlling invasive plants and pests.

[13] www.manomet.org/wp-content/uploads/old-files/Climate%20Change%20and%20Massachusetts%20Fisheries%20and%20Wildlife%20Reports,%20Vol.%203%20April%202010.pdf

2. **Restore form and function** – for example, removing a dam to promote spawning of diadromous fishes.
3. **Increase complexity** – for example, increasing diversity and microclimates.
4. **Create linkages** – for example connecting to adjacent land and creating corridors.

FORESTED HABITATS

The maps show recent and projected forest types. Major changes are projected for many regions. For example, in the Northeast, under a lower emissions scenario, the currently dominant maple-beech-birch forest type (red shading) is projected to be completely displaced by the oak-hickory forest type in a warmer future. Source: USGCRP (2009). To respond to climate change:

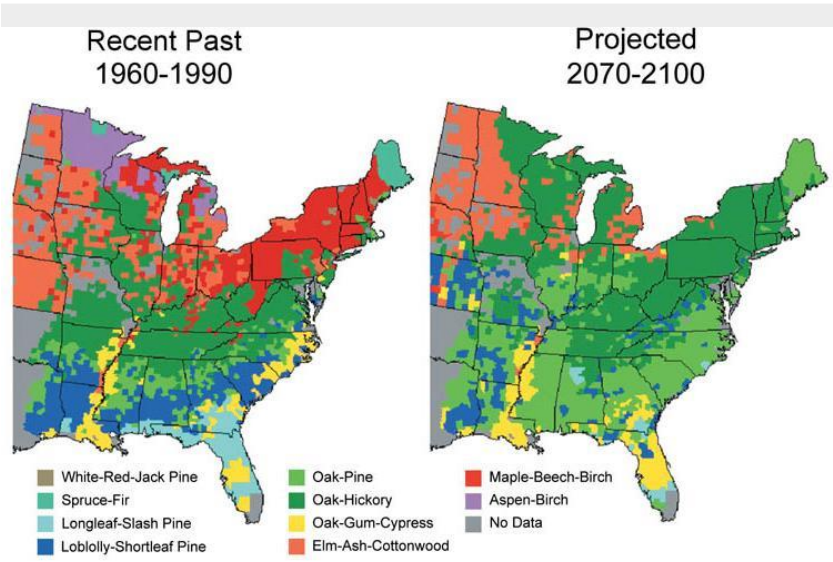

FIGURE 10 - PROJECTED CHANGE IN FOREST TYPES

- **Diversify the age structure and species composition** of the forested landscape in advance of climate change, this 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**. In the 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. One strategy may be to plant more southern species that will help maintain diversity or other ecological values.

FRESHWATER WETLANDS

The main threats to freshwater wetlands in Massachusetts 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 successful. However, climate change may require us to rethink how these regulations are applied. Active management of wetlands may be an important tool under climate change. 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 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.

Description of Past Management Efforts

In recent years management has consisted of mostly volunteer-led efforts to control invasives. Trails have been maintained by the Reading Trail Committee and the Department of Public Works has mowed the two small fields in the late fall each year.

Recommendations for Future Management

Recommendations for each natural community; cultural grassland, oak hickory forest, successional white pine forest, forested wetlands, and shrub swamp will follow.

Cultural Grassland Community

Periodic mowing of the vegetation is necessary to maintain open fields. Grasslands can range from grass-dominated, frequently mown hayfields to infrequently mown, wildflower-dominated fields like those at Bare Meadow. Each type provides habitat for a different suite of species based on plant composition, size, moisture, and other factors. 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. 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. Fields as small as 10 acres may host breeding bobolinks and other ground nesting species and should be managed for bird habitat. While Bare Meadow's small fields (total of 2 acres) provide habitat for occasional use of some more common species of birds, it should be managed for

plants and invertebrates, both of which provide cover and food for a variety of birds and small mammals.

Challenges to grassland management include succession, encroachment by shrubs, impacts to wildlife, and invasive species. 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. 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 field year-by-year. This encroachment has been noted at Bare Meadow. Historical photos show a much larger area of field. In 1995 the fields were more connected and totaled 3 acres. We would urge regaining some of the size of the fields by pushing back the encroaching edges and joining the two together by removing some of the shrubs and small trees that have grown between them.

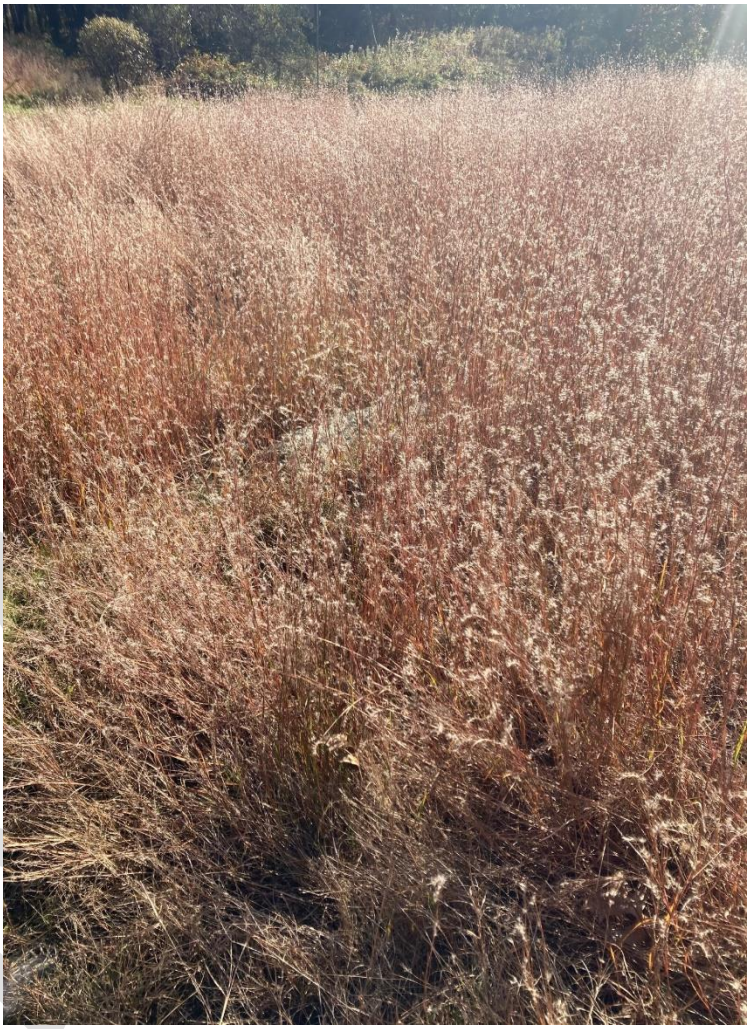

FIGURE 11 - WARM SEASON GRASSES AT BARE MEADOW

Grassland management is generally limited to 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 the animals. A field being actively grazed would be inaccessible to the general user, and conflicts between livestock and dogs may arise. For these reasons, mowing will be the more appropriate grassland management technique at Bare Meadow.

There are two types of grasses.

Cool-season grasses—grow best in spring and fall when cool nights follow warm days. Kentucky bluegrass, fescue, timothy, and orchard grass, all introduced species, are commonly grown, and are often planted with cool season legumes like alfalfa and clover. June grass, bluejoint and Canada wildrye are native cool-season grasses. These grasses form a dense cover that provides poorer habitat for some ground-nesting birds.

Warm-season grasses—develop most rapidly during the warm summer months. They include native prairie and Northeast species such as big bluestem, little bluestem, Indiangrass and switchgrass and are often planted with native wildflowers such as aster, black-eyed Susan, and blazing star to increase diversity and to provide additional food and cover. They grow in summer when cool season grasses are inactive, and they can be harvested (or mowed) later in the year providing a long period of time for ground-nesting birds to fledge.

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 cool season grasses. This more frequent mowing regime is appropriate for more park-like areas for recreational or event uses and is not recommended for conservation areas.
- A field mown once every two or even three years and later in the fall or early spring will tend to have a higher component of warm season grasses and wildflowers. Thus, the fields can be mown in late fall or early spring to provide nectaring plants for invertebrates.
- Mass Audubon and others are now recommending not mowing until early spring (March or April) as the dry stems of grasses and wildflowers provide wintering habitat for a variety of insects. See the Massachusetts Butterfly Club website for more details (https://www.naba.org/chapters/nabambc/butterfly-conservation.asp#mowing). Warm season grasses tend to require less frequent mowing.

Type of equipment – Fields can be mown with a rotary deck mower or a sickle bar mower. A rotary mower tends to leave clumped material which can inhibit re-sprouting in the spring and may smother some insect larvae.

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.

Another measure to assure the maximum area for the ground nesting birds is to keep pushing back the field edges and/or removing tree lines and trails that fragment, separate, or reduce the fields. Trees and shrubs along the interface between the fields and the forests are always seeking more sun by trying to grow out into or overhang the field edges. It is important to keep this from happening by trimming back the branches of the trees and shrubs.

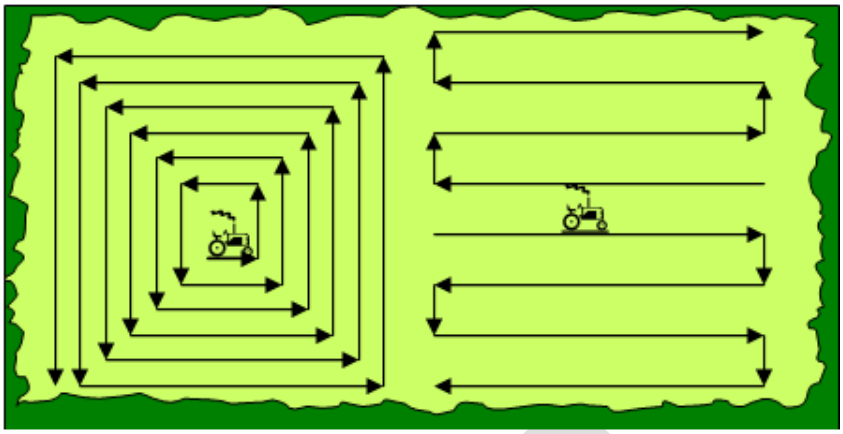

FIGURE 12 - WHEN MOWING START IN THE MIDDLE AND WORK OUTWARD.

Another means to improve the fields for pollinators and to benefit wildlife in general is to eliminate trails that fragment the fields. Relocating the trails that cross the fields at Bare Meadow to the edges of the enlarged area would help control encroachment and result in less disturbance of the critters that use the grassland habitat.

Forest Communities

Forest management activities are constantly changing to accommodate new challenges, and it is becoming increasingly important that forest and land management planning intentionally consider a changing and uncertain climate. The major threats for the three types of forested communities, Oak-Hickory Forest, Successional White Pine Forest, and Forested Wetlands, are the proliferation of invasive species, especially **glossy buckthorn**, deer browse, and the effects of climate change.

The section on Management of Natural Areas with Regard for Changing Climate (page 21) 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, recreational opportunities, and carbon absorption and sequestration. In addition to forest protection, there are various ways to steward/manage forests to retain or at times 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 Management of Forests

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.

- Sequestering carbon forest growth plays a significant role in combatting climate change. Currently, carbon sequestration in our forests offsets about 14% of annual emissions in New England.
- As forest managers and scientists study the various benefits and implications of active forest management, it is important to have untouched sites for comparison.

Active Forest Management

The thoughtful application of forest management practices can help restore habitat conditions found within young and old growth forests. Most of Reading was cleared for agriculture in the middle of the 19th century, and woodlands were regularly 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 few acres of young forests (0-20 years) or old growth forests (200+ years). Any active forest management should begin with a consultation with a Forester.

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 resources. Removing older trees from small areas of the forest is an effective way to recreate this type of habitat for wildlife species that depend on young forest habitat, including several warblers and white-throated sparrows.

Middle-aged forests often have a less complex structure than common 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.

The two upland habitats, Oak-Hickory Forest and Successional White Pine Forest would benefit from a forest stewardship plan following the principles of two programs developed by Mass Audubon in partnership with the Massachusetts Department of Conservation and Recreation (DCR) and others – Foresters for the Birds and Climate Smart Forestry.

Foresters for the Birds[14]

The Foresters for the Birds program is the result of a partnership between Mass Audubon, the Massachusetts Department of Conservation and Recreation (DCR), and the Massachusetts Woodlands Institute. Based on a similar initiative by Audubon Vermont, the program provides education, expertise, and limited funding to private landowners to enable them to manage their woodlands in a way that meets their own land management goals while also supporting forest bird species and other wildlife.

The program connects landowners with licensed foresters trained and certified in conducting Bird Habitat assessments. Together, they evaluate the land to determine what types of habitats are present and which species likely utilize the habitats already. The forester also makes recommendations for

[14] https://www.massaudubon.org/news/latest/foresters-for-the-birds-managing-forests-for-trees-and-birds-alike

improving or creating new bird habitats. If a forest management plan is to be done for Bare Meadow (as is recommended) it should be done by a forester that has been certified by the program.

Climate Smart Forestry[15]

Management actions that promote climate adaptation and mitigation are sometimes referred to as climate-smart forestry. The Forest Climate Resilience Program has identified four climate-smart forestry strategies that will promote both forest adaptation and mitigation that are appropriate for the forest habitats a Bare Meadow. Tactics that fall within one of these four practices may be eligible for funding. Practice manuals are available for each practice.

- **Plant Trees to Increase Forest Stocking**
  Some forested areas may be stressed and are not adequately growing or "stocked." This practice involves planting tree species that can cope with climate change and requires that stressors, like deer browse and invasive plants, be addressed.
- **Protect Seedlings and Saplings from Deer Browse**
  Forests with high deer populations often lack healthy young trees. Measures like temporary tree tubes and fencing can protect young trees, allowing the forest to better respond to climate change in the long-term.
- **Climate-Informed Forest Access and Forestry Operations**
  Harvests, including those for wildlife habitat and forest resilience, often use heavy machinery and can have negative impacts on soil and water. Forestry best management practices are already used to reduce those impacts. However, climate change is causing more extreme storms and shortened winters, creating the need for additional protections such as the use of additional water bars and bridge mats that protect soil and water quality.
- **Remove Invasive Vegetation**
  Invasive species can prevent young trees from becoming established and can impact water quality. They can also threaten the success of other management efforts. Treating invasive species where they are preventing new generations of trees from growing can help ensure the success of other forest management actions and can build resilience to climate change.

DCR's Forest Stewardship Program has funds available to municipalities for preparing new stewardship plans and upgrading existing plans. We would recommend that the town engage a forester to do a forest stewardship plan with improving wildlife habitat as a goal.

Invasive Species Management

Invasive plants are non-native species that have spread into native plant communities. Invasive species pose one of the greatest threats to biodiversity, natural landscapes, agricultural interests, recreational activities, and scenic beauty of conservation properties. Invasives have left behind the herbivores and diseases that control their populations in their native habitats. These plants cause economic or environmental harm by developing self-sustaining populations that dominate and/or disrupt native ecosystems.

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[15] https://www.massaudubon.org/our-work/resilient-lands/climate-smart-forestry-resources

There are many ways to deal with this threat including initial prevention, early detection, and control through manual removal, mechanical treatment, pesticide application, biological control, grazing and fire. Invasive species are difficult to eradicate and without multiple seasons of dedicated management, infestations will rebound despite one's best efforts. Prioritization of targeted management is essential to successfully managing an area for invasive species. Any effort to control invasives in regulated areas subject to the Wetlands Protection Act requires submitting a Request for Determination of Applicability or Notice of Intent to the Conservation Commission. Some Conservation Commission will provide "Administrative Approval" for invasives removal in regulated areas.

The goals for invasive species management at Bare Meadow should be:

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

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.

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. The spread of existing invasives will be reduced by limiting soil disturbance and implementing restoration when soils are disturbed 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 the very least with larger areas restored with 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 will 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

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

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

and mile-a-minute vine. The stewards should be prepared to collaborate on planning and implementing the rapid response element to eliminate new invasions as quickly as possible.

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.

Table 2. Particularly aggressive invasive species. (Bold indicates species noted at Bare Meado.)

Common name	Latin Name
Black swallowwort	*Cynanchum louiseae*
Common reed	***Phragmites autralis***
Garlic mustard	***Alliaria petiolata***
Japanese knotweed	***Fallopia japonica***
Japanese stiltgrass	*Microstegium vimineum*
Purple loosestrife	***Lythrum salicaria***
Tree of heaven	*Ailanthus altissima*
Water chestnut	*Trapa natans*
Porcelain-berry	*Ampelopsis brevipedunculata*

CONTROL INVASIVE SPECIES WITH RECENT OR LIMITED PRESENCE

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

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 conservation stewards to prevent encroachment of invasives in cleaner areas without getting overwhelmed or tackling a project that is too big for the available resources.

If highly noxious species are present in the densely invaded area extra measures may need to be taken to really prevent 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 by mechanical means (whole plant removal) or chemically.

Treatment Methods

Different invasive species respond to different management techniques, several of which are summarized here and detailed in Appendix F (page 73). Manual control, pulling plants by hand or with light tools such as loppers or weed wrenches, is preferred and may be effective for small infestations and where volunteer capacity permits repeated effort. Large infestations and certain problematic species may require more intensive management, sometimes involving the use of herbicides as a last resort. Herbicides can only be applied by an individual duly licensed by the Department of Agricultural Resources. Because licensure requires liability insurance coverage, while volunteers could obtain this license, it is more likely that herbicide will be applied by a contracted professional. Management plans should identify infestations and recommend approaches for control. The property managers should plan and budget for the involvement of professionals as necessary. Table 3 provides information on species that can be managed at various times of year.

FIGURE 13 - WEED WRENCH

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 and phragmites can sprout from any stray plant part).

Restoration

Many of the invasive species are adapted to pioneer disturbed soils. For this reason, all control efforts and general site work that results in exposed 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 from on-site. Non-forested sites such as fields, should be seeded with a grass mix including annual rye (*Lolium perenne*) which can provide a quick cover to open soils and allow non-invasives time to self-germinate (see https://newp.com/product/new-england-erosion-control-restoration-mix-for-dry-sites/ for a recommended seed mix) .

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 (Phagmites)			**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**	
Asiatic Bittersweet	**manual**		**chemical**
Purple loosestrife		**biological**	
Porcelain-berry	manual	manual	
Spotted knapweed		chemical/manual	
Tree-of-Heaven	manual		chemical

Record-Keeping

All invasive plant species management actions (contractor, or volunteers) should be documented with a field datasheet and records kept in a central file (a shared Google drive). Information collected should include the location, date, species targeted, phenology of plant (vegetative, flowering, fruiting), type of management used (manual, mechanical, chemical), the size of the infestation and an estimate of what percent of the area was managed (See Appendix F, page 73 for a sample field sheet). Recording these data allows Town staff and volunteer stewards to track progress in management efforts, adapt tactics in future years if needed, and have a sense of the expanse of targeted invasive species.

Wildlife Enhancement Management Recommendations

There are several actions that can enhance wildlife habitat quality and make the conservation area a more interesting destination.

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. Also, 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.

Snags
Leaving dead or partially dead standing trees provide several important benefits to a variety of wildlife. Snags provide 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. 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 for outdoor activities.

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 shttps://www.massaudubon.org/learn/nature-wildlife/birds/birdhouses for instruction for building and placing nest boxes.

Vernal pools
According to MassGIS there are six vernal pools at Bare Meadow Conservation Area. These areas may be critical for several species of amphibians and invertebrates.

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 flowers can help, as it adds 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. Explore establishing a pollinator garden in the vicinity of the old orchard.

Shrubland
There are several small areas of shrubland, areas that were once fields and are now filling in with saplings and shrubs. These areas are important for a variety of birds and small mammals as they provide food and cover. Unless they are periodically maintained they will grow up into forest. We recommend periodic (every five years) mowing or selective cutting areas on the western boundary and

other edges not used for hay to maintain them as shrubland. Cut and paint application of herbicide may also be used to reduce small trees. These actions can be taken during the off-season.

Passive Recreation Management Recommendations

Bare Meadow Conservation Area is a popular destination for birders, walkers, and just folks looking for a break without distractions. For the most part these activities and the conservation area's values for wildlife are in harmony. The exception is dogs, especially off-leash.

Dogs

It is a town-wide policy that dogs be kept on lease during the nesting season, from May 1 until the fields are mowed in late July or August. Not all visitors observe this regulation and person-power for enforcement is limited. Mass Audubon has long had a "no pets" policy because of the detrimental impact on wildlife and other conservation goals.

How do dogs affect Wildlife? The scientific community and conservation land managers generally agree that dogs negatively affect some species of wildlife. This happens through the direct effects of dogs chasing and harming or killing wildlife, or indirect effects from flushing a bird from its nest, scaring it from an area that it needs to gather food or from protecting its young, or wildlife avoiding areas that have been scent-marked by dogs (thus reducing available habitat). There have been reports of dogs being bitten by mother coyotes defending their young. As our population grows, and there are more dogs using trails, wild animals have fewer places to live safely. People also see more wildlife in places where dogs are not allowed.

Dog waste has another negative impact on the environment. There are many health and environmental issues associated with dog waste. Nitrogen from dog waste can cause significant changes to soil chemistry, killing native plants and encouraging noxious weed growth. Dogs have a wide variety of intestinal bacteria that may harbor parasites including roundworms, whipworms, hookworms, tapeworms, parvovirus, giardia, salmonella, and *E. coli.* Roundworms are one of the most common parasites and can remain in soils for years. Dog waste carried in storm runoff can also contribute to water pollution. Dog waste is also unpleasant, smells bad, and detracts from the positive experience of enjoying conservation lands.

Bare Meadow is the town's premier conservation area and the one place where dogs should be banned. Other areas are available for people to walk their dogs in accordance with the town'

Trails and Program Uses

The trail should be mown every two weeks and woody vegetation should be clipped back annually. Trails should be walked regularly but particularly after large storm events to remove down trees and make necessary repairs.

Any programs or recreational opportunities open to the public will need to follow ADA regulations. Every recreational opportunity does not need to be ADA accessible. However, the town needs to provide people with disabilities equal opportunities to participate in programs and recreational opportunities in the town. This means, the town of Reading should look at all of its trails and conservation areas and have an equal representation for the type of experience offered for that activiy that is accessible to people of all abilities. Not every trail has to be accessible nor can or should be made accessible if it would fundamentally alter the experience of that activity. The Conservation Commission

will need to communicate with the designated ADA Coordinator in Reading (Town Administrator) for official guidance on providing equal opportunities to the public.

Schedule of Management Activity

The following matrix is proposed for yearly management activities. Quantities and estimated costs will be shown in Appendix B.

Yearly ongoing Activities

	Winter	Spring	Summer	Fall
	Dec-Feb	Mar-May	Jun-Aug	Sep-Nov
Permitting for Planned Projects	■			
Monthly Property Visits	■	■	■	■
Annual Work Plan with Staff and Stewards		■		
Safety Meeting with Staff, Stewards, Police and Fire Dept.		■		
Trail Walk/Clean Up (downed limbs, drainage issues, signage needs)		■		
Repair Equipment and tools	■	■		
Building Projects (kiosks, signposts, etc.)	■	■		
Invasive Plant Management		■	■	■
Mowing of Grassland (After August 15th or March/April)		■		■
Boundary Walk (monitoring for encroachments, signage, etc.)				■

Short term Projects

Field Management

- Continue mowing fields after mid-July or even better in March or April

Invasive plant management recommendations:

- Obtain an herbicide applicator's license by staff if use of herbicides is considered

Wildlife enhancement management recommendations:

- Dependent on volunteer and staff resources

Passive recreation management recommendations:

- Adopt and implement a “no dogs” policy
- Prepare and install interpretive signs at parking lot and trail heads to educate visitors about rationale for the “no dogs” policy

Long Term Projects

Field Management

- Continue mowing fields after mid-August or in March/April

Invasive plant management recommendations:

- Maintain an herbicide applicator’s license by staff
- Strategically treat invasive plants within the property:
    - Treat invasive plants along the trail system
    - Treat invasive plants along the edges of the fields
    - Treat invasive plants within the forested areas of the property working from the trail system towards the interior of the property.

Wildlife enhancement management recommendations:

- Actions dependent on volunteer and staff resources

Passive recreation management recommendations:

- Mow trails on perimeter of fields to 6ft in width
- Walk trails after storm events to clear tree hazards and make repairs to boardwalks

Appendix A – Bare Meadow Birds

The following list of 102 species was generated using eBird (ebird.org). It includes birds seen in the fields, forests, wetlands, and flying over the area. Underlined species (42) have been observed during the breeding season and are likely to breed at Bare Meadow, or nearby.

Waterfowl
- Canada Goose
- Wood Duck
- Mallard

Grouse, Quail, and Allies
- Wild Turkey
- Ruffed Grouse

Pigeons and Doves
- Rock Pigeon
- Mourning Dove

Swifts
- Chimney Swift

Hummingbirds
- Ruby-throated Hummingbird

Shorebirds
- American Woodcock

Gulls, Terns, and Skimmers
- Ring-billed Gull
- Herring Gull

Cormorants and Anhingas
- Double-crested Cormorant

Herons, Ibis, and Allies
- Great Blue Heron
- Black-crowned Night-Heron

Vultures, Hawks, and Allies
- Turkey Vulture
- Sharp-shinned Hawk
- Cooper's Hawk
- Sharp-shinned/Cooper's Hawk
- Red-shouldered Hawk
- Broad-winged Hawk
- Red-tailed Hawk

Owls
- Great Horned Owl
- Barred Owl

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

Falcons and Caracaras
- Peregrine Falcon

Tyrant Flycatchers: Pewees, Kingbirds, and Allies
- Eastern Wood-Pewee
- Least Flycatcher
- Eastern Phoebe
- Great Crested Flycatcher
- Eastern Kingbird

Vireos
- Yellow-throated Vireo
- 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
- Tree Swallow

Kinglets
- Ruby-crowned Kinglet
- Golden-crowned Kinglet

Nuthatches
- Red-breasted Nuthatch
- White-breasted Nuthatch

Treecreepers
- Brown Creeper

Gnatcatchers
- Blue-gray Gnatcatcher

Wrens
- House Wren
- Winter Wren
- Carolina Wren

Starlings and Mynas
- European Starling

Catbirds, Mockingbirds, and Thrashers
- Gray Catbird
- Northern Mockingbird

Thrushes
- Eastern Bluebird
- Veery
- Swainson's Thrush
- 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
- American Tree Sparrow
- Dark-eyed Junco
- White-throated Sparrow
- Song Sparrow
- Swamp Sparrow
- Eastern Towhee

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

Wood-Warblers
- Ovenbird
- Blue-winged Warbler
- Black-and-white Warbler
- Nashville Warbler
- Common Yellowthroat
- American Redstart
- Northern Parula
- Magnolia Warbler
- Blackburnian Warbler
- Yellow Warbler
- Chestnut-sided Warbler
- Blackpoll Warbler
- Black-throated Blue Warbler
- Palm Warbler
- Pine Warbler
- Yellow-rumped Warbler
- Black-throated Green Warbler

Cardinals, Grosbeaks, and Allies
- Scarlet Tanager
- Northern Cardinal
- Rose-breasted Grosbeak
- Indigo Bunting

Appendix B – Control of Invasive Plants

Several species of invasive plants are currently found within the Bare Meadow Conservation Area and we have described their management as it pertains to specific goals and objectives outlined in this plan. In general, we recommend that the stewards assess threats from invasive species during annual monitoring and implement treatment according to specifications outlined by the town.

If herbicide is used, the exact concentration, chemical, and type of application should be decided by the applicator and approved by the town. The applicator should develop an Invasive Plant Management plan for the area and make recommendations to the town that are best suited for the site.

Glossy and Common Buckthorn

Manual, mechanical, and chemical means are effective in controlling glossy buckthorn and is most effectively controlled by recognizing its appearance early and removing isolated plants before they begin to produce seed. With large infestations, remove the largest seed-producing plants first. Currently no means of biological control is available for controlling buckthorn. Hand pulling is effective in small infestations. Remove the entire root section or re-sprouting will occur. Weed wrenches can be very effective in uprooting buckthorn.

Chemical treatment is also an option. The type of herbicide determines the best time of year to apply based on how the chemicals disrupt the biological process of the plant. Triclopyr herbicides are much more effective early in the growing season. Glossy buckthorn retains its leaves late into the fall, so you can apply herbicide fairly late in the season. However, the application should not be too late, or the leaves will no longer be photosynthetically active (or minimally so) and will easily fall from the twigs without affecting the roots. During the growing season, cut the stems near ground level and apply a 20%-25% herbicide mixture to the stumps. Re-sprouts should be cut and treated again or sprayed with a hand sprayer of 1.5%. Foliar applications over non-water sites can also be used. Foliar application of herbicides using a backpack sprayer is effective, but less selective.

Common Reed – Phragmites

Control with herbicides is effective for controlling areas with large, established, populations of phragmites. Other options include mowing and prescribed burning. New stands of phragmites commonly occur when new wetlands are created, or the soil is disturbed. Minimizing land disturbances and water pollution helps deter this invasive species. Land management practices that guard against erosion, sedimentation, fluctuating water levels, and nutrient loading in wetlands are the best long-term solution.

Control of phragmites is difficult. Repeated cutting can slow its growth and possibly hinder its spread but will not eliminate it altogether. The best method to eliminate phragmites is the foliar application of a systemic herbicide when the plants are actively growing. Currently no means of biological control is available for treating phragmites infestations. Manual or mechanical cutting or pulling has been used successfully to control phragmites. Treatments usually need to be repeated annually. The best time to cut phragmites is at the end of July. Cutting at other times may increase stand density. Phragmites

stems should be cut below the lowest leaf, leaving a 6" or shorter stump. Hand-pulling is an effective technique for controlling phragmites in small areas with sandy soils.

Repeated mowing is effective at slowing the spread of established stands but is unlikely to kill the plant. Excavation of sediments may also be effective, but root fragments left in the soil may lead to reestablishment. Prescribed burning after the plant has flowered, either alone or in combination with herbicide treatment, is also effective. Burning after herbicide treatment also reduces standing dead stem and litter biomass which may help to encourage germination of native plants in the following growing season. Do not burn plants in the spring or summer before flowering as this may stimulate growth. Chemical treatments are effective in controlling established populations. If a population can be controlled soon after it has established the chances of eliminating the infestation are much higher because the below-ground rhizome network will not be as extensive. Herbicides are best applied in late summer/early fall after the plant has flowered either as a cut stem treatment or as a foliar spray. Repeat treatments are required for several years to prevent any surviving rhizomes from re-sprouting.

Multiflora Rose

Mechanical and chemical methods are effective methods for managing multiflora rose but may need to be combined with chemical treatment in large or persistent infestations. The most important steps to controlling multiflora rose are to destroy existing plants and begin a yearly program to control seedlings as they appear. Biological control is not yet available for management of multiflora rose. However, researchers are investigating several options, including a native viral pathogen (rose-rosette disease), which is spread by a tiny native mite, and a seed-infesting wasp, the European rose chalcid.

Manual and mechanical control consisting of frequent, repeated cutting or mowing three to six times per growing season for two to four years is effective in achieving high mortality of multiflora rose. In high quality natural communities, cut the individual plants to minimize habitat disturbance. Herbicides are successful in controlling multiflora rose, but follow-up treatments are required because of the long-lived stores of seed in the soil. Apply systemic herbicides (such as glyphosate) late in the growing season to freshly cut stumps or to regrowth. In wetlands, where multiflora rose may occur, make sure to use a wetland-formulated concentrate. Use an active ingredient concentration of 25-35% when you apply herbicide to the cut stem. Plant growth regulators control the spread of multiflora rose by preventing fruit set.

Oriental Bittersweet

A combination of cutting followed by application of concentrated systemic herbicide to rooted, living cut surfaces is an effective approach for removing Oriental bittersweet. For large infestations spanning extensive areas of ground, a foliar herbicide is recommended over manual or mechanical methods, which would create soil disturbance to minimize soil disturbance. Manual, mechanical and chemical control methods are effective in removing and killing Oriental bittersweet. A combination of methods often yields the best results and may reduce potential impacts to native plants, animals and people. The method selected depends on the extent and type of infestation, the amount of native vegetation on the site, and the time, labor and available resources. No biological controls are currently available for this plant.

Manual Control of small infestations can be achieved by hand-pulling, but the entire plant should be removed including all the root portions. If fruits are present, collect, bag, and dispose of them in heavy garbage bags. Always wear gloves and long sleeves to protect your skin from poison ivy and barbed or spiny plants. Plants can also be controlled by cutting climbing vines near the ground at a comfortable height to kill upper portions and to relieve the tree canopy. Vines can be cut using pruning snips or a pruning saw for smaller stems, or a hand axe or chain saw for larger vines. Minimize the damage to the bark of the host tree. Rooted portions will remain alive and should be repeatedly cut to the ground or treated with herbicide. Cutting without herbicide treatment requires vigilance and repeated cutting because plants will re-sprout from the base. Begin treatment early in the growing season and repeat the treatment every two weeks until autumn.

Systemic herbicides are absorbed into plant tissues and carried to the roots, killing the entire plant within about a week. This method is most effective if the stems are first cut and herbicide is applied immediately to the cut stem tissue.

Fall and winter applications will avoid or minimize impacts to native plants and animals. Repeated treatments will be required. Any herbicide applications should be carefully targeted to avoid damage to native, non-target species. If native grasses are intermingled with the bittersweet, triclopyr is better to use than glyphosate because it is selective for broad-leaved plants and will not harm grasses. Follow-up monitoring is required to ensure effective control.

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

Method	Good for Volunteers?	Timing	General guidelines	Target Species
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
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	Purple loosestrife (preferred) Spotted knapweed (needs research)

Method	Good for Volunteers?	Timing	General guidelines	Target Species
			infestation size this could be a good way to treat spotted knapweed.	
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 invasive species. Foliar spray is likely to kill all species (including native species) in the area sprayed.
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 then 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 or25% triclopyr. A 2% foliar spray can be used while there are leaves. Remove dead stems, if possible, by mowing or lopping. Use care with foliar spray to not kill native species.	7 years Seeds remain viable for 5-7 years.

Species	Biology	Control Recommendations		Monitoring Period
		Manual	Chemical	
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.
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.

Species	Biology	Control Recommendations		Monitoring Period
		Manual	Chemical	
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.
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.

Species	Biology	Control Recommendations		Monitoring Period
		Manual	Chemical	
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.
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.