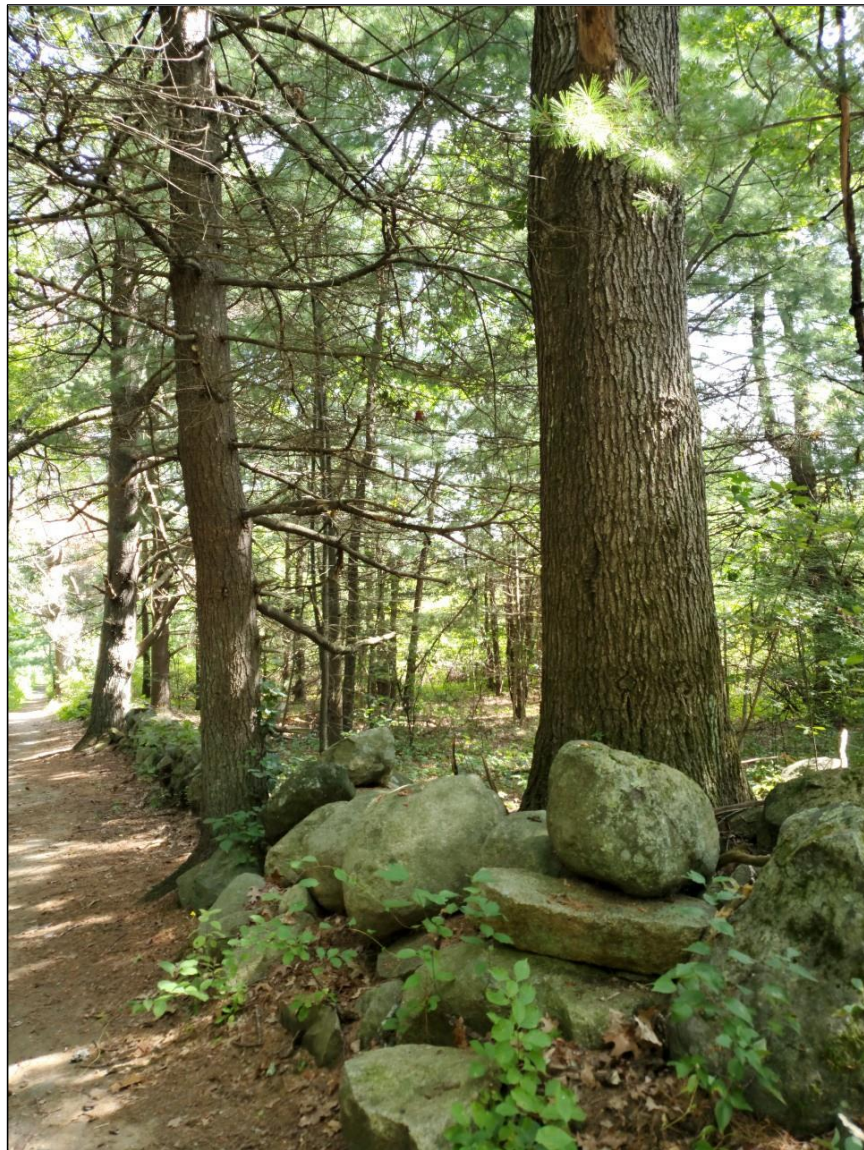


**Ecological LAND MANAGEMENT AND DESIGN PLAN FOR**

# **Willard's Woods**

**IN**

**LEXINGTON, MASSACHUSETTS**



*Jessica Applin*

*Land Stewardship Inc.*

*November 2021*

## Contents

Introduction .....	1
Site Description .....	1
Natural Communities .....	2
Invasive Plants .....	11
Infrastructure.....	18
Ecological Land Management & Design Plan.....	20
Site Goals and Challenges.....	21
Past management.....	21
Future management Recommendations.....	22
Short Term Goals.....	23
Long Term Goals.....	35
Schedule of management Activity.....	45
Priorities, Projects, Cost Estimates.....	45
Yearly Management Goals.....	47
Challenges.....	49
Additional Maps.....	51
Overview.....	52
Topographic.....	53
Soils.....	54
Other Management Areas.....	55
Prime Forest.....	56
Conclusion.....	57
Appendices.....	58
A. References.....	59
B. Resources.....	59
C. Invasive Plant Map Key.....	60
D. NRCS Soil Key.....	60
E. Photographs.....	61
F. Ecological Assessments.....	73
Forest Ecological Assessment.....	73
Wildlife Assessment.....	87
G. Universal Accessibility Trail Assessment.....	111

## Introduction

This Ecological Land Management and Design Plan for Willard's Woods was prepared for the Lexington Conservation Commission by Land Stewardship Incorporated. The recommendations and design included within this report take into consideration an existing drafted land management plan provided by the Town of Lexington Conservation Division (Kaufman 4/25/2019) as well as Lexington's drafted *Land Management Principles and Policies for Management of Lexington Conservation Land (2/23/2015)*. The purpose of this plan is to guide ecological management for the Willard's Woods property by providing recommendations that will help enhance the health and function of the landscape and will support passive recreational use in a balanced and safe way that is sustainable for the future. Management priorities for this site include field management and restoration, improving overall habitat health, supporting balanced recreational opportunities, and preserving some of Willard's Woods historic cultural highlights.

The initial effort in drafting this plan was to conduct a comprehensive inventory and assessment of the resources represented at the Willard's Woods property, both natural and those intended for public use. This work began in November 2019 and ran through July 2020. This work included natural resource classifications, invasive plant species inventories, field assessment, interpretation of site conditions, soils inventories, stone wall mapping, structural inventories, and an infrastructure and trail assessment. The results and interpretations of this effort are described and included in the *Site Description* section of this report.

Recommendations for future management and planning at Willard's Woods that evolved from this effort are included in the *Ecological Land Management and Design Plan* section under *Short-Term and Long-Term Goals*.

In addition, a more in-depth forest community assessment and wildlife community assessment were conducted in order to understand the natural resources at this site even further. As climate change and the loss of biodiversity continue to be two of our planet's most immediate stressors, it is more important than ever to understand the landscapes capacity/potential for carbon sequestration and to provide healthy intact habitats that will support as much diversity

as possible. These reports are included in the *Appendices* section and discuss these topics further as well as include their own set of management recommendations. Some of the recommendations that emerged from these two reports have been incorporated into the Ecological Land Management and Design Plan as well.

## Site Description

Willard's Woods is a unique expanse of protected land surrounded by an otherwise highly developed suburban landscape. Its 100 acres consists of fields, brooks, multiple wetlands, white pine forest, hardwood transitional oak forest, miles of stone walls, a historic mill pond and cottage chimney, public trails, bike trails, boardwalks, bridges, and areas where the public can come sit and enjoy the surroundings.

Once a family farm owned by the Willard family, now its fields, forests and wetlands provide a mosaic of habitat for wildlife that includes sightings of eastern coyote, red fox and a nesting pair of Great horned owls. Its structural remnants include the old mill pond that at one time provided waterpower and an old chimney from the cottage used by the Willard family. Then there are the miles of stone walls that wrap around its boundaries and crisscross through its interior, providing a snapshot of the historical landscape that once was and that continues to influence this landscape.

Now a popular area for the public to engage with and enjoy the outdoors, Willard's Woods hosts miles of foot and bike trails, as well as boardwalks and bridges, managed by the Town of Lexington. There are nine entrance points to the property. Two of these, North Street, and the Diamond Middle School both have accessible off-street parking (see *Additional Maps, Property Overview Map*, p.51). There is also a collection of informational kiosks and signage maintained by the town to help keep its visitors informed, educated, and aware. This access and information are provided as a way for the public to connect with the landscape and become invested in the land.

## Natural Communities

Natural Communities were assessed on the ground as well as by interpreting aerial ortho



imagery in ArcGIS. Combining these methods allowed us to map out these areas more efficiently and present an accurate overview of how these communities intertwine on the landscape. With the guidance of Mass Wildlife’s Natural Heritage and Endangered Species Program resources on the community types represented in the state of Massachusetts, we have classified each of these resource areas. These areas can be viewed on the following map and are described below. In addition, a more in-depth description and classification of forest types can be found in the *Forest Ecological Assessment Report (Morrison 2020)*, Appendix F.

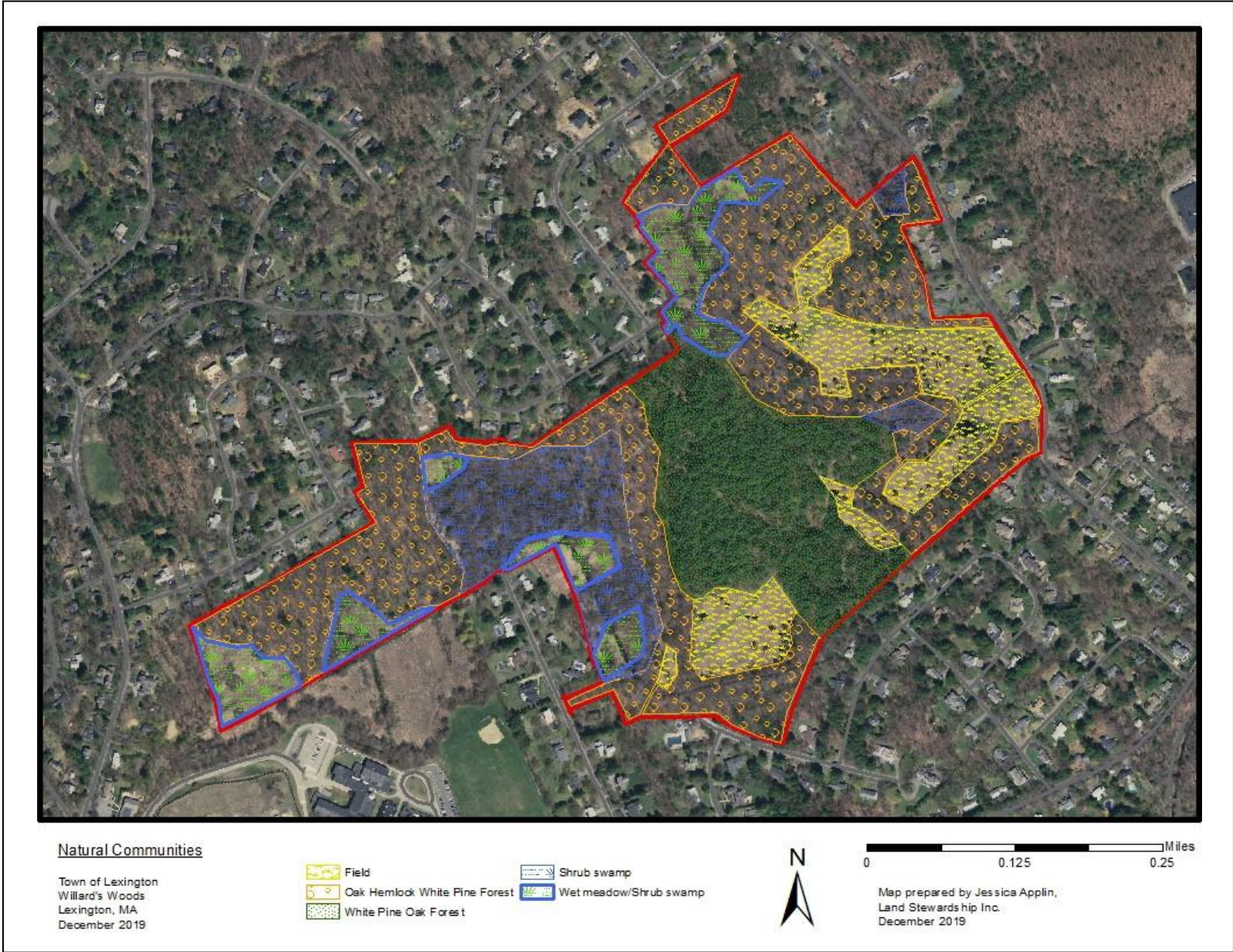


Figure 1. Map displaying Natural Communities classifications at Willard's Woods



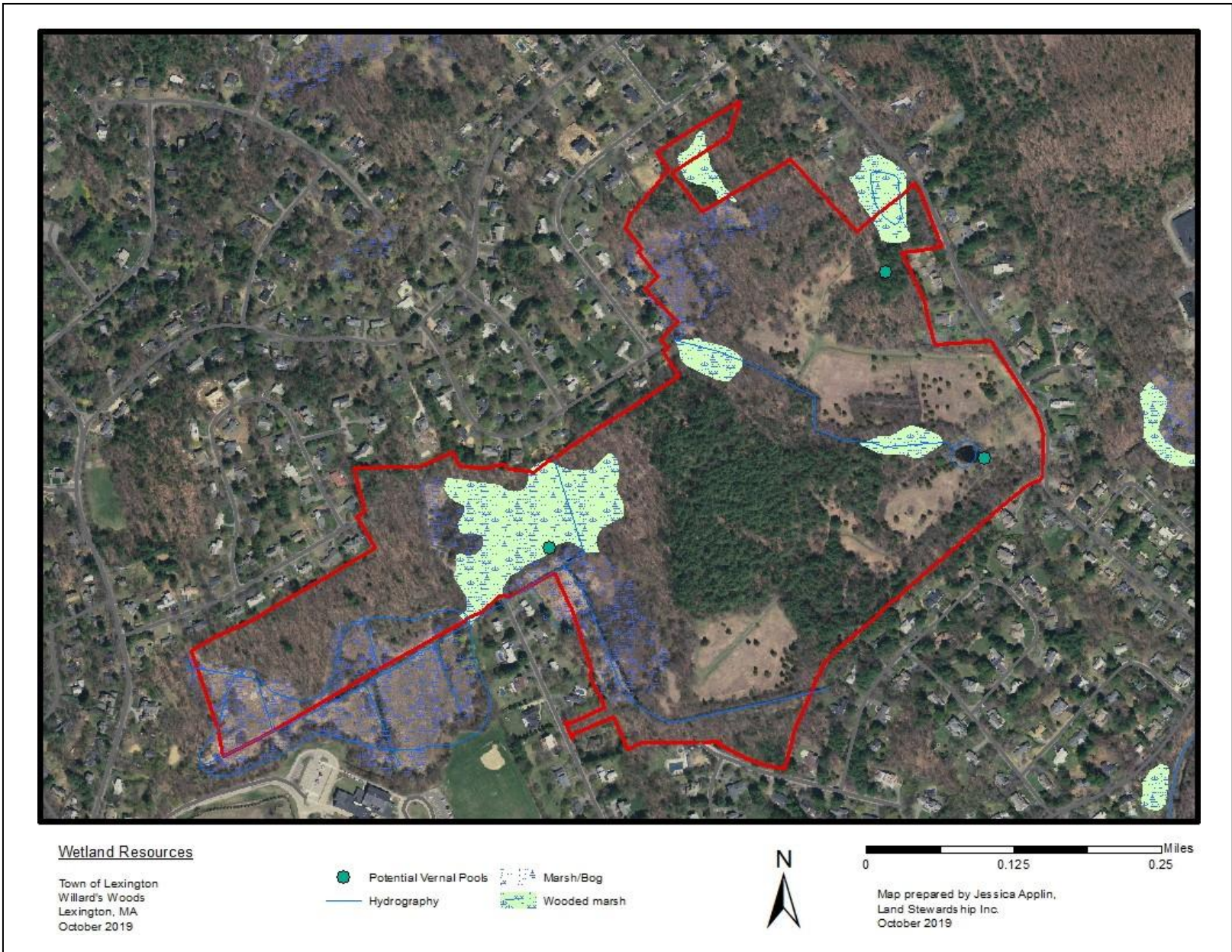


Figure 2. Map displaying DEP wetlands and water resources at Willard's Woods

## Wetland & Water Resources

The wetland and water resources at Willard's Woods represent a fourth of the property, covering approximately 26 acres. These resources are composed of a diverse mix of classifications including wet meadows, shrub swamps, red maple swamps, stream channels and the old mill pond. The overall health and functionality of these areas varies across the property due to invasive plant pressure (discussed further in the *Invasive Plants* section, p11.), pollution from outside development and storm water, and degradation from high levels of public use.

The wet meadow, shrub swamp complex located in the western most section of the property that is shared by the Diamond Middle school remains relatively clear of any major invasive plant infestation except for along the edges. Overall, this complex appears healthy and clear of any major disturbance or degradation.

The larger interior red maple shrub swamp complex, with scattered wet meadow areas has a more severe infestation of invasive glossy buckthorn and a high density of invasive woody shrubs along its western edge. However, the northeast area of this wetland has lower densities of glossy buckthorn and a higher diversity of native wetland shrubs. Overall, this northeastern red maple shrub swamp portion of this wetland is in better health than its interior or adjoining wet meadow areas.

The shrub swamp/wet meadow wetland area to the far north of the property, though also highly infested with glossy buckthorn, appears to be functioning as a relatively healthy system overall. An exception to this is the southwestern most area of this wetland where it connects to the stream channel and is choked out entirely by glossy buckthorn.

The shrub swamp wetland along North Street is also filled with glossy buckthorn, and most likely heavily influenced by runoff from the road and residential area abutting it. Much of this wetland also extends further north outside the Willard's Woods property. Though heavily impacted, there is still a decent mix of native wetland shrubs represented in this area.

To the east lies one last shrub swamp, which is entirely choked out by glossy buckhorn without much else growing in or around it.

Finally, there are the two stream channels and the old mill pond which are all partially man made/influenced. The stream channel in the north central section of the property is relatively open and clear except at its north and south ends where it connects with the heavily glossy buckthorn infested shrub swamps. The mill pond has been heavily influenced in the past by disturbance, pollution, and sediment input from the northern stream channel and by visiting dogs. It is currently fenced off in an effort to slow further bank erosion and degradation. The second stream channel in the south section of the property near Brent Rd. has heavier invasive plant pressure, though is not choked out and remains clear and free flowing. Both channels however are most likely highly influenced by the surrounding neighborhood runoff and storm water discharge. It is not likely that any of these three areas are functioning as particularly healthy habitat for fish or many other aquatic organisms, though it will depend on the overall chemical parameters and sediment deposit levels. They are all however a highly desirable drinking water resource for resident and visiting wildlife species.

In addition, there were three locations that the Natural Heritage and Endangered Species Program identified as potential vernal pool sites. We visited each of these locations and did not find current evidence that would indicate a functioning vernal pool. There was also an additional site brought to our attention in the white pine forest as having the potential to be a vernal pool. Upon inspection, this site is a significant upland depression and does indeed hold Spring melt and rainwater, though there was no evidence that it was functioning as such. The heavy layer of white pine needles and oak leaves most likely causes the soils here to be too acidic to function as a vernal pool.

### Fields

The open lands portion of Willards Woods was surveyed by Jess Applin and Chris Polatin on 7/10/2020 in order to broadly classify the existing site conditions of each field and to look for indicators as to which type of early-successional habitat each field may best support. Our survey notes are compiled in Table 1.

Early successional habitats include several categories of plant communities with vigorously growing grasses, forbs, shrubs, and trees which provide excellent food and cover for wildlife but need disturbance to be maintained. Examples of early successional habitats include weedy areas,



grasslands, old fields or pastures, shrub thickets (e.g. dogwood or alder), and young forest. If these habitats are not mowed, brush hogged, burned, cut, grazed or disturbed in some other fashion, they will eventually become forest over time. Grasslands will revert to old fields. Old fields will eventually grow into young forest. Young forest will grow into mature forest. As such, grasslands, meadows, shrubland, old fields, and young forests are often referred to as early successional habitats.

Four early-successional habitat types were observed at Willards Woods (Figure 8, p.40). It is important to note that the difference between these types is subtle and based on landscape patterns determined by soil moisture, sun aspect, soil nutrients, soil pH, soil texture, and sometimes, land use history. It is also important to note that many of the same generalist plant species are consistent within all the areas. Examples include cane species (*Rubus* spp.) such as raspberry, grey dogwood, poison ivy, and black-eyed susan. We specifically noted specific indicator species when present which are associated with more distinct habitats. These indicator species are discussed further below.

#### *Warm-Season Grassland (WSG)*

Warm-season grasslands were determined based on the presence of little bluestem (*Schizachyrium scoparium*) and purple love grass (*Eragrostis spectabilis*) where these co-associated species likely persist within areas containing nutrient-poor dry soils. We have widely delineated areas as WSG in cases where we observed even small quantities of these grasses based on the potential of the area to support more WSG grasses resulting from changing management timing and practices which is discussed in the long-term goals section of this report. WSG is an important and somewhat rare regional habitat type to support at Willards Woods.

#### *Meadow*

Observed upland meadow habitat at Willards Woods is quite similar to WSG without the presence of little bluestem and purple lovegrass. The meadow areas support cool season pasture grasses and classic forb wildflowers such as goldenrod (*Solidago canadensis*), black eyed susan (*Rudbeckia hirta*), milkweed (*Asclepias syriaca*), and various asters (*Aster* spp.).

### *Sedge Meadow*

The wet meadows observed at Willards Woods occur at topographically low areas within the open landscape which are closer to the water table. These areas support more wetland sedge and fern species (sensitive fern) rather than grass species and a different assortment of forb wildflowers than the upland meadows and WSG areas. Observed wildflower species include Joe Pye Weed (*Eupatorium fistulosum*), blue vervain (*Verbena hastata*), New England Aster (*Aster novae-angliae*), and boneset (*Eupatorium perfoliatum*).

### *Shrubland*

We classified only one area at Willards Woods as shrubland due to its dominance by native shrubs and briar species such as grey dogwood (*Cornus racemosa*) and raspberry (*Rubus spp.*). Invasive shrubs such as multiflora rose (*Rosa multiflora*) are also present and contribute to its overgrown thicket appearance.

**Table 1. Dominant species observed in Willards Woods early successional habitats/grasslands 7/10/2020 by field area.**

Name	Area (acres)	Dominant plant species	Notes/Invasive plants
Field 1: Orchard/Warm Season Grassland	1.25	Little bluestem Purple lovegrass	Relatively uninvaded
Field 2: Shrubland	0.5	Grey dogwood Round leaved dogwood Poison ivy Rubus spp. Black-eyed susan Joe Pye weed Queen Anne's Lace Milkweed	Ailanthus, bittersweet, multiflora rose, glossy buckthorn
Field 3: Meadow	3.75	Grey dogwood Milkweed Joe Pye weed Deer Tongue grass Sensitive fern Solidago spp. Canada goldenrod	Huge swaths grey dogwood. Ailanthus, bittersweet, glossy buckthorn
Field 4: Warm Season Grassland	1.5	Sumac Willows Sassafras	Lots of sumac Purple loosestrife

Field 5: Meadow	1	Little bluestem	
Field 6: Warm Season Grassland	1.8	Little bluestem Dogwood Rubus spp. Sedge	Overwhelmed with bittersweet
Field 7: Warm-Season Grassland/Sedge Meadow	0.5	Dogbane Rubus spp. Goldenrod Sedge	Bittersweet Glossy buckthorn
Field 8: Warm-Season Grassland	3.5	Little bluestem Clematis Poison Ivy Dogwood Poplar	Reed canary grass Glossy buckthorn and rose along trail edges
Field 9: Sedge Meadow	0.25	Rubus spp. Clematis	This area is very overgrown with woody vines

### Forested Land

There is a diverse mix of forested habitats covering the Willard’s Woods landscape that helps support a rich composition of plant and wildlife species. The most prominent forest community is the white pine stand located in the center of the property that covers approximately 21 acres and is the convergence zone of many of the Willard’s Woods trails. The other major forest types are the red oak and transitional forest communities that are interspersed throughout. Transitional oak forests are common throughout New England, having grown up in response to extensive land clearing and heavy use for agriculture as well as in response to other development and disturbance. In addition, there are also forested wetland habitats consisting of a large red maple swamp in the western half of the property, and several mixed shrub wetlands edges. Some of these forest communities are also classified as being Prime Forest areas or have significant local importance in terms of timber productivity (see *Additional Maps, Prime Forest*, p.55). Further description of the Willard’s Woods forests is included in the *Forest Ecological Assessment Report* (Morrison, 2020), Appendix F, p.72.

## Invasive Plants

Invasive plant species are characterized by several common attributes. They are generalist species that are not native to North America and can adapt to and thrive in a wide range of conditions, from full sun to shade, from dry to wet. Frequent colonizers of disturbed areas, they produce abundant fruits and seeds, and may have far-reaching root systems. They may reproduce sexually from seed, vegetatively (asexually) from rhizomes, or spread through the dispersal of rhizome fragments.

In our region, invasive plants leaf out earlier in the spring than native species and maintain photosynthetic capacity later in the fall. Some species are allelopathic – they can alter soil chemistry to their competitive advantage. Because species that are classified as invasive in our region are growing outside of their native range and away from the controlling influence of their co-evolved predators, there are no biological checks to control their growth.

The combination of these characteristics allows invasive plants to aggressively compete with and displace native plant communities. The resulting loss of biodiversity among native plant species threatens rare and endangered specimens. Reduction of native plants also results in reduction of associated insects, which in turn reduces food supplies critical to ensuring reproductive success of many bird populations.

The Willard's Woods property has several different species of invasive plants, both woody and herbaceous. Some of the species represented here are quite extensive throughout the property, such as glossy buckthorn (*Frangula alnus*). Other species like oriental bittersweet (*Celastrus orbiculatus*), shrub honeysuckles (*Lonicera L.*), multiflora rose (*Rosa multiflora*), Norway maple (*Acer platanoides*), and winged euonymus (*Euonymus alatus*) occur in specific areas at more manageable densities. Others still, such as common buckthorn (*Rhamnus cathartica L.*) and border privet (*Ligustrum obtusifolium*) occur at very low densities and are scattered. It should be noted that due to the time of year the majority of the assessments were done that the presence of some herbaceous invasive plants may have been missed, though black swallowwort (*Ciananchum louiseae*) and purple loosestrife (*Lythrum salicaria*) were identified during a final visit to assess field composition. Black swallowwort is considered a high priority early detection species in the state of MA and should be at the top of the list for

invasive plant management at Willard's Woods. Purple loosestrife, though not listed as a high priority species, is known to take over fields very quickly. At the time of the visit, these plants looked healthy, with no evidence of damage from the *Galerucella* biocontrol beetles. It is currently at low enough densities to be considered an early detection species and managing it now would take only a minimal effort and would prevent it from establishing. Though not previously identified at Willard's Woods, it will be important to keep a look out for other priority early detection species such as Japanese stilt grass (*Microstegium vimineum*) and mile-a-minute (*Polygonum perfoliatum*) in the years to come. These species are prevalent in the eastern part of the state and early detection is key to their successful management. Further, black walnut (*Juglans nigra*) was identified on site, both mature well-established trees as well as saplings starting to establish themselves in the field. This species is not currently listed as an invasive in the state of Massachusetts, but it can also take over fields quickly, and should be monitored closely as well as treated alongside other invasive plants in any field management activities. See Table 2 below for the full list of invasive plants identified at Willard's Woods during our 2019-2020 assessment. Invasive plant population maps are provided for reference below (Figures 3-6).

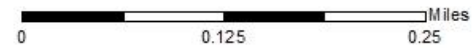
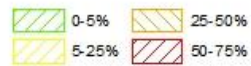




Glossy Buckthorn Populations

Town of Lexington  
 Willard's Woods  
 Lexington, MA  
 December 2019

Densities



Map prepared by Jessica Applin,  
 Land Stewardship Inc.  
 December 2019

Figure 3. Map displaying glossy buckthorn (*Frangula alnus*) densities at Willard's Woods






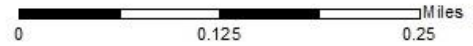


\*Does not include glossy buckthorn

High Density Woody Invasives

Town of Lexington  
 Willard's Woods  
 Lexington, MA  
 December 2019

-  Honeysuckle, Multiflora rose, 50-75%
-  Oriental bittersweet, 50-75%
-  Winged euonymus, 75-100%



Map prepared by Jessica Applin,  
 Land Stewardship Inc.  
 December 2019

Figure 4. Map displaying high density invasive areas at Willard's Woods



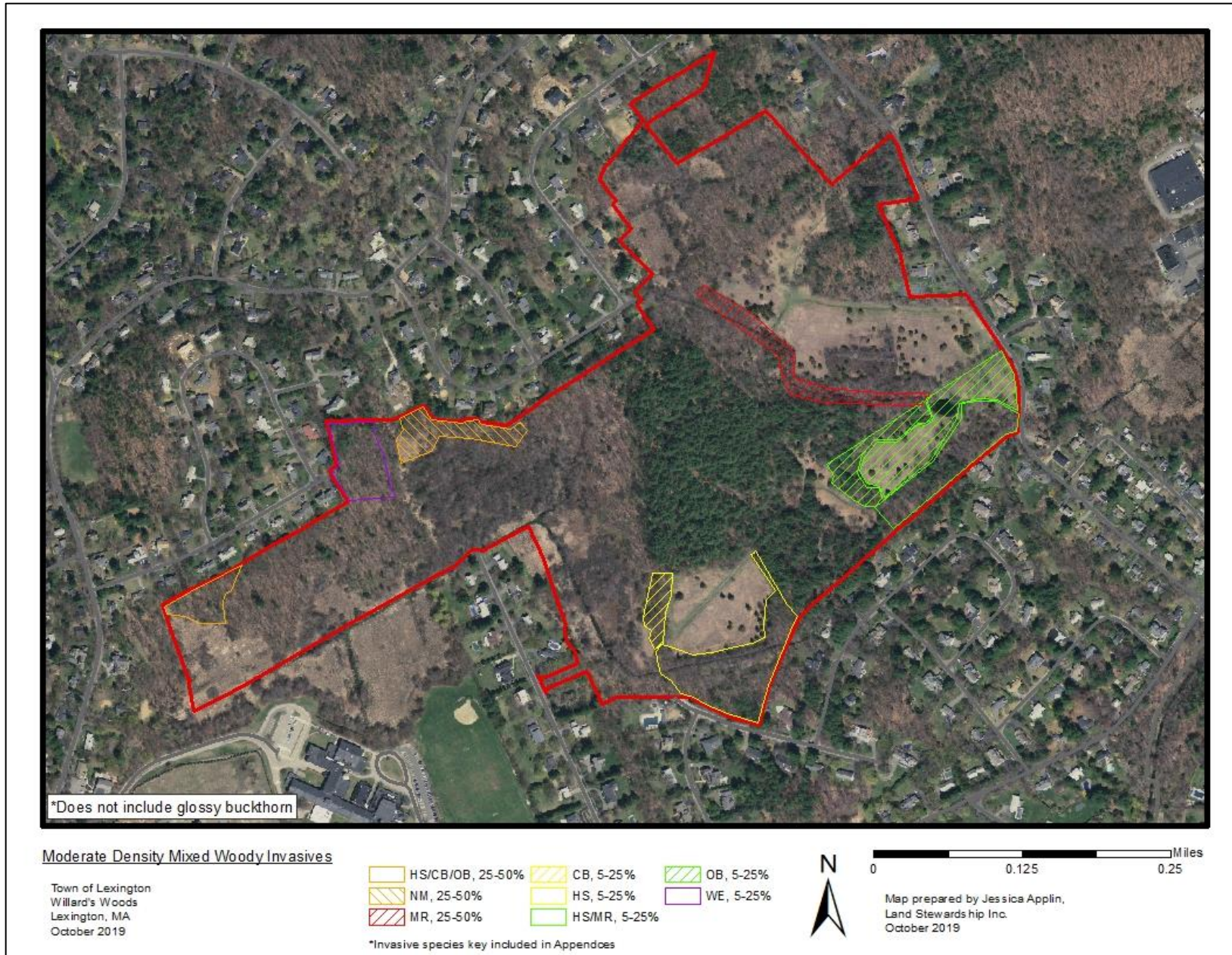
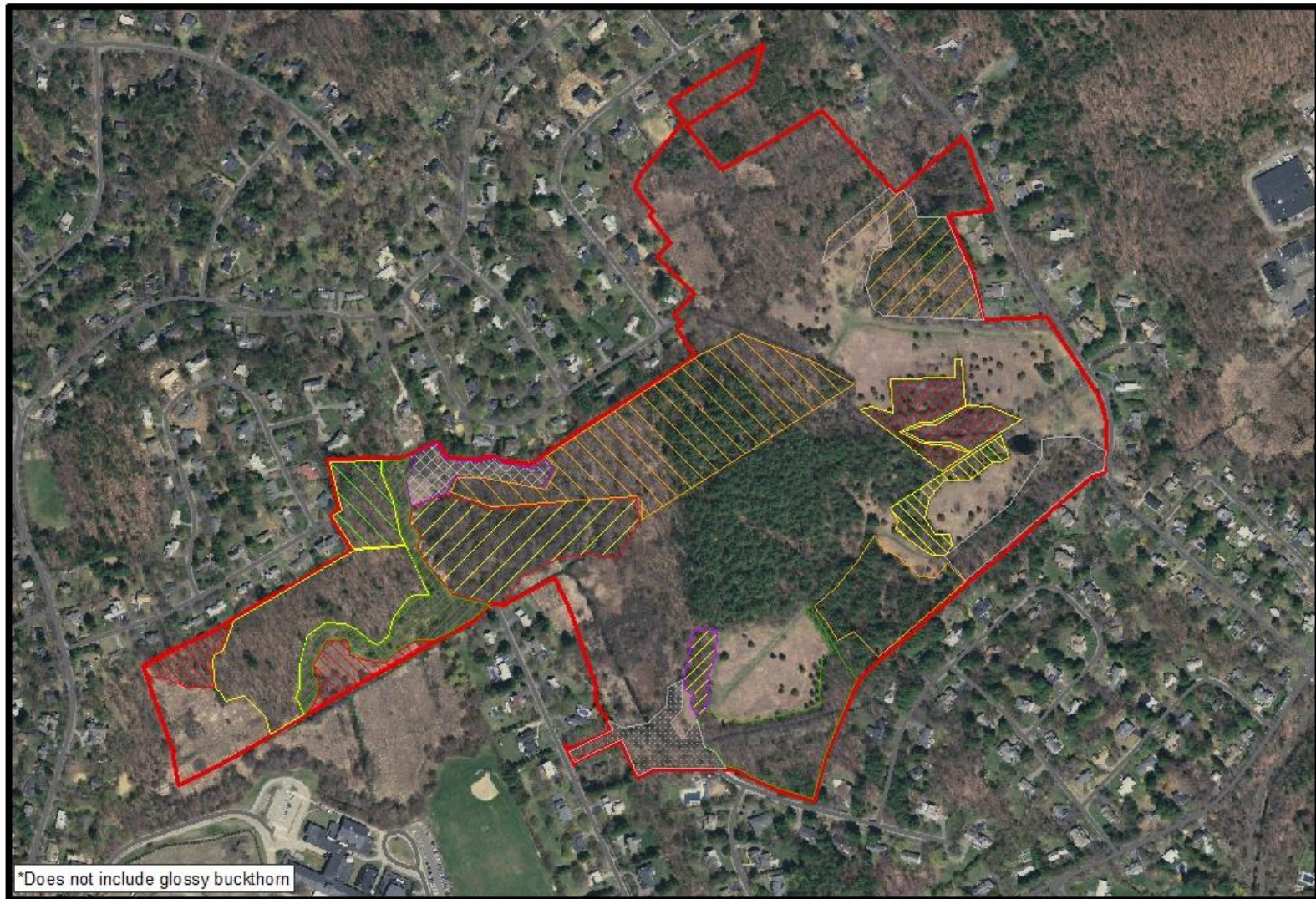


Figure 5. Map displaying moderate density invasive areas at Willard's Woods



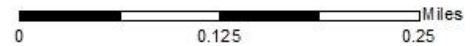


**Low Density Mixed Woody Invasives**

Town of Lexington  
 Willard's Woods  
 Lexington, MA  
 October 2019

AO, OB, MR, CB, 0-5%	HS/MR, 0-5%	HS/P/WE, 0-5%	NM, 0-5%
CB, 0-5%	HS/MR/OB, 0-5%	HS/WE/CB, 0-5%	OB, 0-5%
CB/WE, 0-5%	HS/OB, 0-5%	MR, 0-5%	WE, 0-5%
HS, 0-5%	HS/P, 0-5%	MR/HS, 0-5%	

\*Invasive species key included in Appendices



Map prepared by Jessica Applin,  
 Land Stewardship Inc.  
 October 2019

**Figure 6. Map displaying low density invasive areas at Willard's Woods**

**Table 2. Invasive species identified at Willard’s Woods**

<b>Scientific Name</b>	<b>National Common Name</b>
<i>Alliaria petiolata</i> (M. Bieb.) Cavara & Grande	Garlic mustard
<i>Berberis thunbergii</i> DC.	Japanese barberry
<i>Celastrus orbiculatus</i> Thunb., orth. var.	Oriental bittersweet
<i>Elaeagnus umbellata</i> Thunb.	Autumn olive
<i>Fallopia japonica</i> (Houtt.) Ronse Decr.	Japanese knotweed
<i>Frangula alnus</i> Mill.	Glossy buckthorn
<i>Lonicera</i> L. (shrub honeysuckles: <i>morrowii</i> , x <i>Bella</i> , etc.)	Honeysuckle
<i>Rhamnus cathartica</i> L.	Common buckthorn
<i>Rosa multiflora</i> Thunb	Multiflora rose
<i>Euonymous alatus</i> .	Winged euonymous
<i>Ligustrum obtusifolium</i>	Border Privet
<i>Ciananchum louiseae</i>	Black swallowwort
<i>Lythrum salicaria</i>	Purple loosestrife

*Massachusetts Invasive Plant Advisory Group (MIPAG)*

The Massachusetts Invasive Plant Advisory Group (MIPAG) has developed a classification system for invasive plant species based on numerous agreed-upon criteria. Those plants deemed to be invasive are listed as such for the Commonwealth. Other invasive plants are classified as Potentially Invasive, Likely Invasive, or Not Currently Meeting Criteria.

All invasive species identified at Willard’s Woods are considered as such, with the exception of Border Privet which is classified as a Likely Invasive.

Any population of target invasive species that occur at low densities or at isolated locations would be considered early detection species (ED). Managing ED populations that are at low levels will both prevent their spread and will also save time and money that would otherwise be needed to manage larger infestations. In addition to black swallowwort, a priority ED species found at Willard’s Woods, there are other populations with low enough densities, or that are isolated enough where prioritizing management could prevent more extensive infestations. These species and locations are included in our management recommendations.

Other species of invasive plants that are found at Willard’s Woods pose a threat to the specific habitats in which they are growing. This approach, also known as site-led invasive plant management, weighs the type of habitat threatened.



Species that are found in Willard's Woods fall within some of these classifications and are considered priority targets for management due to safety concerns, potential to invade intact forest, impacts to resource areas/potential resource areas, or are at low numbers where early management is key to success, include:

- Black Swallowwort
- Oriental bittersweet
- Japanese knotweed
- Winged euonymus
- Garlic mustard
- Purple loosestrife
- Glossy buckthorn \*select locations

Guidance on the prioritization for management of these species and where they are found throughout the property is discussed in the *Short-Term Goals* (p.23) and *Long-Term Goals* (p.35) sections of this report. A map displaying priority areas for invasive plant management is also included in the *Short-Term Goals* section for reference.

## Infrastructure

As the most popular conservation land in the Town of Lexington, Willard's Woods incorporates many different types of infrastructure features for public use and enjoyment. There are miles of walking and biking trails, parking and picnic locations, stone walls, bird boxes, and many kiosks and signs provided for visitor interaction (see *Additional Maps* section, *Overview*, p51.) However, many of these public resources are starting to age and are in some level of disrepair. Kiosks and signs are starting to break and are due for upgrades, boardwalk planks are starting to rot, the picnic area tables, and fire pits are in need of repair/replacement, and both the stone dust bike path/carriage road and trail network are showing signs of degradation and erosion from heavy use. The town is highly interested in upgrading and adding to some of these features in order to improve upon the overall enjoyment and safety of its guests. Some of the main priorities that are being focused on and considered include:

- Improvements to the parking area on North St.
- Bike path/carriage road repair and walking trail upgrades
- Handicap accessibility options
- Picnic area upgrades
- Kiosk and signage upgrades

-Viewing platform installations

To fully assess the conditions and feasibility of some of these priorities, Land Stewardship Inc. partnered with trails and infrastructure specialist Dick O'Brien from Conservation Works, LLC. This effort is discussed further in the *Ecological Land Management and Design Plan* under *Long-Term Goals* (p.35). The full Universal Accessibility Trail Assessment Report can be found as Appendix G.

## **Ecological Land Management and Design Plan**

## Ecological Land Management and Design Plan

The following plan is designed to provide a comprehensive look at how the Willard's Woods property has been managed in the past, and how it may be managed going into the future. The management recommendations presented come from numerous discussions with the town about their priorities and vision for the property, ideas, and feedback from the residents of Lexington that utilize and love the property, as well as from our expertise and experience guiding and managing land conservation efforts for the health, functionality, resiliency, sustainability, and balance of natural ecosystems. The goal of this plan is to offer an approachable set of management goals that will improve the Willard's Woods landscape for those that come to enjoy it, and that will strengthen its ecological integrity so that it can remain resilient in the face of future change.

### Site Goals and Challenges

#### *Past Management*

Historically Willard's Woods was managed by the Willard Family as a working farm and wood lot. A white pine stand, open grazing fields, apple orchard, and an active mill pond were all functioning components of farm operations.

More recently, under the management of the Town of Lexington, Willard's Woods undergoes routine maintenance and management through a combined effort provided by conservation staff, the town Department of Public Works, and stewardship volunteers. Maintenance and management activities include, but are not limited to:

- Bridges
- Boardwalk
- Trails
- Kiosks
- Signage
- Bike path/carriage road inspections
- General upkeep
- Scheduled yearly late fall field mowing
- Trail and edge mowing in June/July
- Periodic trail weed whacking
- Litter control
- Fallen tree removal

- Plowing/parking lot repair
- Culvert clearing
- Periodic general stewardship visits by conservation staff
- Mill pond daylighting restoration effort

In addition, between the time Willard’s Woods was actively managed as farmland and its transfer of status to conservation land, the Middlesex Mosquito Control Commission trenched some of the wetland swamp areas in an effort to control mosquito populations (Kaufman 2019). During this time, downed tree material was also actively cleared from the stream.

*Future Management Recommendations*

**Table 3. Management Goals for Willard’s Woods**

<b>Short Term Goals</b>	<b>Long Term Goals</b>
Invasive & nuisance plant management - safety (Roadsides/entrance)	Apple orchard replanting
Invasive plant management - priority areas (fields/mill pond/select wetland & stream edges/field edges)	Field restoration plantings- Pollinator Meadow
Mill pond area continued restoration	Field edge reclaiming
Wildlife Improvements - bird and bat boxes installation/maintenance/interpretive signs	Continued invasive plant management
Select stone wall vegetation clearing	Parking area improvements North Rd/Upgrade Brent Rd entrance
Cedar tree management	Trail head upgrades
Updated mowing schedule for field restoration	Handicap accessibility/UA trail
	Picnic area upgrades (fire pit, picnic tables, etc.)
	Bike path/carriage road upgrades and repair
	Accessible viewing platforms & benches



### **Short Term Goals:**

Short term goals are action items that can or should begin in the relatively near future. Most tasks can be executed with modest planning and preparation and many already have the support of the town and the public. The town is ultimately responsible for implementing these tasks, but a few of these recommended projects can be achieved through the help of volunteer efforts and educational outreach. Some of these goals are considered short term because they need to be implemented before other management goals can be attempted.

### **Invasive (and nuisance) plant management in priority areas**

Because of the large size of the property and the heavy representation of invasive plants throughout, we have focused our management recommendations to key areas of interest expressed by the town and the public, and to priority areas based on preserving natural resources, habitat restoration, and feasibility. That said, these recommendations are just a start and further invasive management and planning should be continued for the long term. This will be discussed, and further guidance provided, in *Long-Term Goals*. We have broken our recommendations down into management areas that can be viewed on the following *Invasive Plant Management Priority Areas* map, Figure 7, p24.

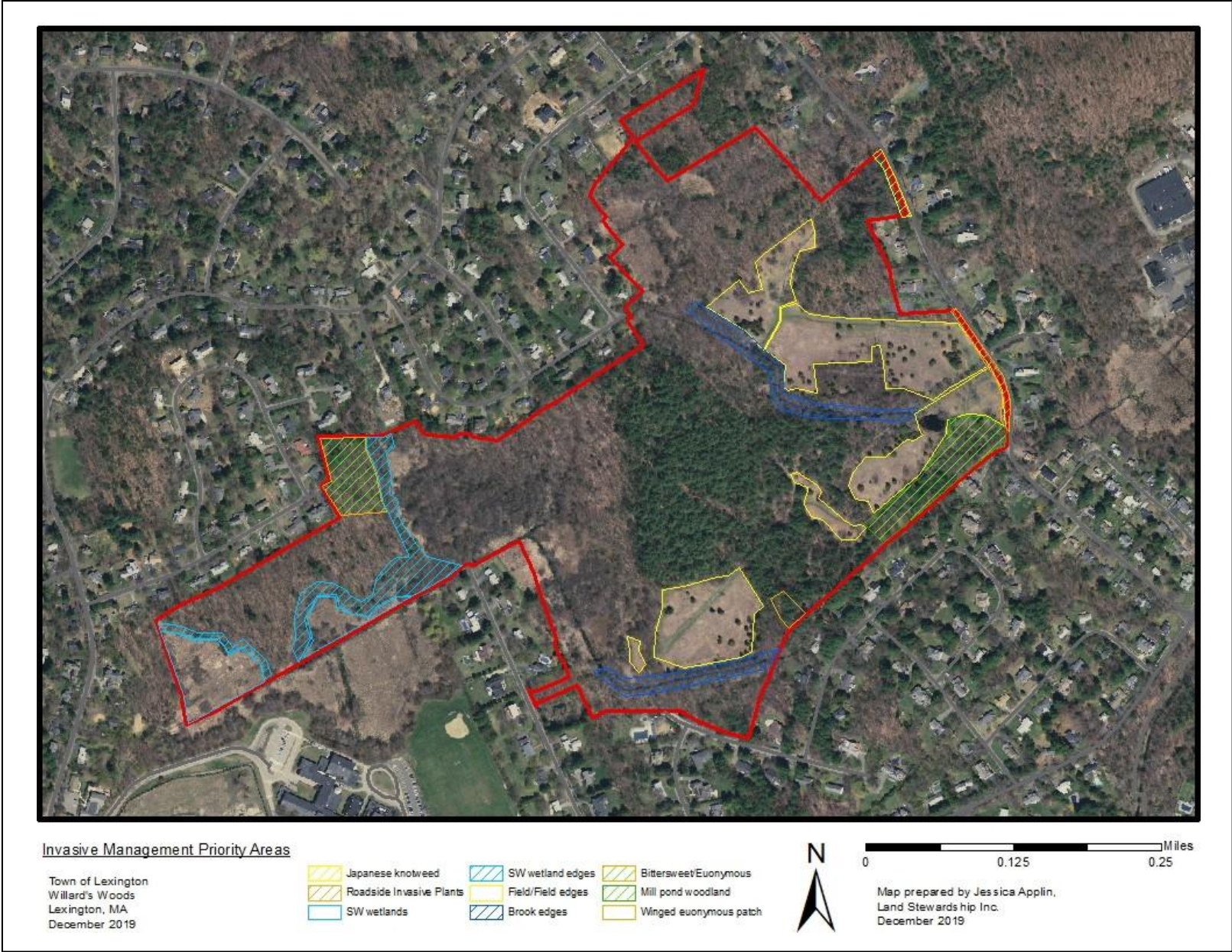


Figure 7. Map displaying recommended invasive plant areas prioritized for management.

### Management for safety

There are two areas along the property boundaries where invasive plants are a potential issue to public safety. Both areas are where the boundary meets the road, and the invasive plants are creating a visibility issue. These areas combined cover approximately 4,600 square feet of road frontage. The first location is on North Street on both sides of the main entrance to Willards Woods. There is Japanese knotweed along both sides of the entrance that blocks motorists from seeing oncoming vehicles as they are trying to pull out. As of now, it is being repeatedly cut back by the town when it becomes a problem. Japanese knotweed grows fast and continued cutting takes a lot of repeated effort. The second location is further south on North St. at the old carriage road/bike path trail entrance. Invasive plants cover the roadside stone wall on both sides of the trail here and need to be continually cut back from the road. It is recommended that these relatively small areas be managed more aggressively with the help of herbicides to knock these invasive plants back for a more effective level of maintenance.

Another safety concern expressed by the visitors of Willard's Woods is the extensive presence of poison ivy on site. Though poison ivy is considered a native plant in Massachusetts, it still poses a health issue for many people. For some, poison ivy exposure can lead to reactions that are quite severe and require medical attention or even hospitalization. Because of the extent of poison ivy on the property, it is not feasible to control all of it. However, it is recommended that it be managed along trail sides through cutting, mowing, and the help of herbicides in order to create a buffer and reduce the risk of exposure for the public. The trails at Willard's Woods span approximately 14,325 linear feet. Managing a five-foot buffer area on either side of the trails (where applicable) would help reduce unwanted contact with this plant and keep guests safe from its effects.

### West wetland interiors and edges:

The western portion of the property includes two wetland areas covering approximately four acres. Both of these wetland areas seem to be in a relatively healthy state, and their

interiors containing fairly low densities of invasive plants. As of now, there are also some scattered, larger glossy buckthorn established within the interior at a lower density. A large portion of these wetlands however falls outside of Willard's Woods boundaries and are part of the Diamond Middle School property. It would be beneficial if Willard's Woods could partner with the school to tackle the management of these shrubs/trees so that they do not establish themselves further. Though the interiors of these wetlands are mainly clear of woody invasive plants, the edges have a very high combined density of large, mature glossy buckthorn, multiflora rose, climbing oriental bittersweet, and shrub honeysuckle. This density gets higher as you move east along the wetland edge. Managing these edge areas as well as a bit of a buffer is recommended in order to reclaim part of the wetland and to keep the established invasive plants from continuing to spread inward. Since glossy buckthorn is still at a relatively low density in these two southwestern wetlands, but at a high density along its edges, it is also recommended that it be included in the species targeted for management in this area, where it is not recommended elsewhere.

As the edge of this wetland swings north, and the wetland itself opens to the east, the composition shifts, and the wetland becomes dominated by glossy buckthorn. It is recommended that the large multiflora rose, honeysuckle, and climbing oriental bittersweet are managed along this edge to keep them from spreading into the larger wetland complex, or in the case of the climbing bittersweet, creating a potential safety hazard. Since this larger wetland to the east already has a high density of glossy buckthorn, management of this plant along this edge does not make sense at this time and will need to be discussed as a much larger property wide, long term effort. Wetland edges and buffer areas in this southwestern section of the property add up to approximately 3.5 acres of recommended management.

#### Oriental bittersweet/winged euonymus west hot spots:

In the west section of Willard's Woods there are two areas where invasive plants have started to work their way in from the edges of the property. This is most likely due to development in the residential area abutting it. These pockets of woody invasive plants are a mix of shrub honeysuckle, common buckthorn, oriental bittersweet, winged euonymus,



multiflora rose and privet. Of these two areas, the one that is dominated by oriental bittersweet and winged euonymus is of higher concern and prioritized for management. This area covers approximately 1.7 acres. If left unmanaged the oriental bittersweet may move further into the property and damage/kill mature trees which also poses a risk to public safety. For the time being, it is recommended that winged euonymus only be monitored here. As of now, with the heavy infestation of glossy buckthorn in the surrounding forested upland area, it is unlikely to spread much further. However winged euonymus at Willard's Woods is currently found only in this hot spot, scattered at very low densities at the property's edges, and found as an isolated patch in the white pine stand that will be discussed later. This species is known for its ability to quickly take over forest understories and therefore should be managed to stop it from spreading further in these western and edge locations.

In addition, there is also a stand of Norway maple in this section along the north boundary near one of the boardwalks. The density of Norway maple throughout the rest of the property is very low and mostly scattered trees. Though not specifically called out for priority management, it may be of interest to manage this stand in the future and monitor the scattered Norway maple throughout the property in order to keep an eye on whether or not it is spreading or establishing further.

#### Fields:

There are approximately 14.5 acres of fields in the Willard's Woods property, all of which are of management and restoration interest. In order to move forward with any restoration plans for these fields (see *Field Restoration* p.35), the invasive plant populations need to be managed first. This will need to happen in conjunction with mowing efforts (see *Updated Mowing Schedule*, p.42). During our field assessment, two invasive species were identified that would benefit from immediate management efforts. The first, black swallowwort is a state listed priority/early detection species. At the time of the field visit, only one plant was identified, which indicates it is early in its establishment, but also most likely means there are several more. Committing to a structured mowing schedule in addition to successive herbicide applications will keep this plant from spreading further. Once black swallowwort has

established in an area it is extremely hard to manage, so moving forward with management quickly will be key to getting ahead of this species. The second species to note is purple loosestrife. Currently, this species is at very low densities scattered in small clusters near the wetter sections of the fields. There was no evidence of *Galerucella* beetle damage observed and these beetles most likely would not be an effective biocontrol unless the population was much larger, which ideally should be avoided. This plant can take over fields very quickly and becomes quite dense, forcing out other native plants. Managing for this plant as soon as possible would be a fairly easy effort and will prevent it from becoming an issue. This can be achieved by committing to a mowing schedule, spot herbicide applications, and even hand pulling efforts. Finally, there is also a mix of woody invasive plants scattered within the fields at low to moderate densities, with the exception of glossy buckthorn which can be found in higher density pockets. These woody invasive species can also be managed with a structured mowing regime combined with successive herbicide applications. In addition, several mature black walnut trees were also identified as well as many young saplings in and around the fields. Though black walnut is not listed as an invasive species in the state of Massachusetts, it grows quickly and can take over fields if not properly managed. It is recommended that these young saplings and any new growth seedlings be managed alongside the other woody invasive plants found in these fields. Usually after a consecutive three-year herbicide application effort paired with supportive mowing, woody invasive plants populations should be significantly knocked back and easier to control. After a three-year management period, continued stewardship through mowing, monitoring, spot foliar applications and/or hand pulling efforts should be all that is needed to keep these species from re-establishing.

#### Field Edges:

In order to successfully manage the fields for invasive plants, the edges of these fields will also need to be managed. There are approximately 9,270 linear feet of field edge at Willard's Woods. This includes interior stone walls along the old carriage road/bike path that are creating edges for invasive plants to establish. Invasive plant management of other stone walls along field edges would also be included in this effort. Managing these edges for invasive plants will be an important step to take prior to any field edge re-claiming or additional stone wall

vegetation clearing that may occur (see *Field Edge Reclaiming*, p.41) and *Stone Wall Vegetation Clearing*, p.33. It is recommended that all field edges be managed prior to, or in conjunction with any field management and before any field restoration begins.

Managing an invasive buffer of 10-15ft along these edges (where applicable) averages approximately 2-3 acres of recommended field edge management.

#### Mill Pond Area:

Management recommendations for invasive plants in the Mill Pond Area will also include the above recommendations for managing invasive plants in the fields and along field edges. This section, however, specifically focuses on managing invasive plants in the wooded areas surrounding the pond, some of which have already been captured under field edge management recommendations.

There is however, a larger wooded area to the south of the pond that extends to the south boundary of the property that covers an additional 2.75 acres. Overall invasive plant densities in this area are fairly high, particularly oriental bittersweet (which is again a priority due to safety concerns), but also multiflora rose and shrub honeysuckle with lower densities of common buckthorn, glossy buckthorn and privet. The high density of mature climbing bittersweet here is most likely fueling the higher density of low growing bittersweet observed in the fields around the pond. It is recommended that the entirety of this area be managed for invasive plants (not just the field edge) in order to keep them from continuing to re-seed, the fields and allow for a more successful restoration overall.

#### Stream edges:

There are two stream channels running through the Willard's Woods property that extend outside of the wetland areas. Both are priority resource areas and are recommended for invasive plant management. Combined, they span approximately 2,020 linear feet. The first is a small stream channel in the east/central portion of the property running north/south connecting wetland areas. The two wetlands at the north and south ends of the stream are being choked out with high density glossy buckthorn and will need to be part of a longer-term invasive management plan for the property. However, much of this stream edge has fairly low

densities of invasive plants, and the north section of this stream channel just above the foot bridge has an area of multiflora rose that would be beneficial to manage. The second is the small stream channel in the south/central portion of the property running east/west. This channel is surrounded on both sides by mixed woody invasive shrubs at varying densities. It is recommended that the edges of both these stream channels, as well as a buffer zone, be managed for invasive plants to restore these important resource areas. Combined, these areas add up to approximately .5 acre of management.

#### Isolated winged euonymus patch:

Along the south boundary in the eastern portion of the property there is an isolated high density winged euonymus patch with a few scattered large climbing oriental bittersweet vines. This area is approximately .4 acres. It is recommended that this population of winged euonymus, as well as the few mature bittersweet vines be managed in order to prevent these species from spreading further into the wooded areas or adjacent fields.

#### **Mill Pond area continued restoration**

The historic Mill Pond area, as mentioned previously, is a key area of management interest. It has already undergone an initial restoration and daylighting effort on the inlet and outlet of its stream channel in order to open the historic pond back up for public enjoyment. Since the completion of this effort, there has been difficulty finding a balance managing this area for the public. Willard's Woods as a whole is a popular place for the public to walk their dogs, and the pond has been a highly visited location within the property. This has caused continued degradation to the banks, the overall condition of the pond, and has potentially hindered the re-establishment of native plantings in the surrounding field area. To remediate this issue the town has put in temporary fencing to keep dogs out of the pond itself, but this does not solve the larger issue and was meant as only a temporary solution. It is recommended, (in addition to the suggested invasive management discussed in the previous section and the recommended meadow management that will be discussed in the next) to present this area more clearly as a restoration sight while simultaneously improving the area for public enjoyment. This can be achieved simply, by updating the fencing around the pond, adding in a



bench or two, installing educational signs to inform the public of the restoration effort, and requesting at the same time that dogs stay on trail through this area.

### **Bird, Duck, and bat boxes**

#### Bird boxes:

There are several bird boxes installed along field edges of the Willard's Woods property. With the goal of overall field restoration, a priority for this site, it would be beneficial to revitalize this initial effort. The first recommendation would be to investigate the specs, condition, and usage of the bird boxes that are currently standing. If they have evidence of being used, then the next step would be to observe them in the Spring and see who is using them to determine if they are being utilized by desirable species. If they do not seem to be used, consider moving them to locations that have a lower amount of pedestrian and dog traffic. As of now, these boxes are all located near trail junctions. It would be more ideal to place them deeper into the fields, away from active trails. Also take into account the direction they are facing, the height they are mounted, and whether or not there are overhanging branches nearby. All of these components factor into what species may decide to use the box. Another consideration is determining if they are already designed to attract a particular species. Check hole size and overall dimensions. Some species are not so specific in what they look for when it comes to a nesting box as long as they can fit.

While others, such as the eastern blue bird have set requirements.

Based on this information, it may be desirable to build/buy and place new boxes designed specifically for species of interest, or build/buy ones that are more general to encourage a diverse mix. This will be based on the decisions made from the field restoration recommendations discussed later (see *Field Restoration* p.35). Overall field restoration is set as a long-term goal, but starting to troubleshoot the bird boxes, investigating specifications for individual species, building, buying, and installing, can be accomplished as a short-term goal to get the process started. Resources for building blue bird boxes can be found in Appendix B.

### Duck boxes:

One duck box was found along the brook in the northeastern part of the property. Most likely this was installed for wood ducks, which was noted as a previously observed species at Willard's Woods. The placement of the box and habitat composition of the surrounding area should be desirable as a wood duck nesting site. Opening up and managing the brook it is placed on for invasive plants will also help make this location more attractive to potential nesters. It is recommended that the box be checked for signs of nesting and overall condition/repair needs. In the long term, once the brook area is fully restored it may be desirable to install a second box nearer to the southern wetland as well to further encourage wood duck nesting. This is not a necessary effort to attract wood ducks since the property already has the wetlands, streams and standing cavity trees that meet the needs of wood ducks, but the boxes will add to the overall resources available to them.

Resources for building wood duck boxes can be found in Appendix B.

### Bat boxes:

Bat boxes would be an excellent addition to the Willard's Woods property. There are nine species of bats in the state of Massachusetts, five of which are listed as endangered in the state. Of those five species, one is also listed as federally endangered, and one is listed as federally threatened. Installing bat boxes provides additional roosting sites for these animals and helps support their conservation. Having healthy bat populations is beneficial for the environment in many ways. For one, they would help manage the mosquito population, which is assumedly high with so many wetland areas on the property. It would also help reduce the threat of Eastern equine encephalitis (EEE) which has started to become more of a concern in the eastern parts of Massachusetts in recent years. Second, it is also an opportunity for wildlife education and active conservation on the property. Five of our nine bat species in Massachusetts are classified as endangered under the Massachusetts Endangered Species Act (MESA). There is currently one bat box located near the west trail entrance to Willard's Woods near the Diamond Middle School. Installing more bat boxes will help provide additional roosting sites for female bats to raise their young. They will also spark interest and conversation from the public. If handled correctly, there is an opportunity to engage further

support and investment to wildlife on site as well as to the property overall. One cautionary note here is that bats are considered controversial wildlife. Mainly it is because they are misunderstood. There is a lot of false information circulating that gives them a bad name or instills unnecessary fear. Providing the public with the right resources and information ahead of time will be very important in this effort it is of interest.

The main recommended area for installing bat houses would be in the main east fields along the brook corridor. This location provides nearness to a running water source, nearby wetlands, and fields with plenty of flying insects, enough space to allow for an east- southeast positioning, and an open flight path desirable to bats. Another area that may be a good location for a bat house would be next to the old mill pond. This location also has features desirable for bats and since it is already in the process of being a restoration highlight for Willard's Woods, it would be a great location to stage an educational component for this effort.

Resources for building/installing bat houses as well as helpful bat fact sheets can be found in Appendix B. Proposed locations for bat houses (approximate) are displayed on the *Other Management Areas* map in the *Additional Maps section* (p.54)

Bird and duck boxes as well as bat houses are excellent projects to engage the local community. Volunteers and local boy scout groups could easily become involved and help in these efforts. This would increase overall stewardship support and bring additional educational value to Willard's Woods.

### Select Stone wall vegetation clearing

Historic stone walls border and crisscross all over the Willard's Woods property. Clearing some of these stone walls for aesthetic value, and to reclaim a historic snapshot of the property as it once was, is of interest to the town and the public who come to enjoy it.

Though under studied, stone walls across New England have been observed functioning as an important habitat feature and corridor for several species of animals, from salamanders, frogs, and turtles to mice and chipmunks, to raccoon, fox, bobcat, coyote and even black bear. They are a man-made structure that has become a unique component to how wildlife survives and thrives in our landscape, especially in more highly developed areas. The walls of Willard's

woods most likely function as a crucial habitat feature for many species trying to navigate a landscape heavily used by the public, their dogs, cyclists, and that is fully surrounded by suburban development. The stone walls in Willard's Woods most likely won't be utilized by some of the species listed above, such as black bear, but will most definitely be utilized by many others, including several not mentioned. That said, the overall recommendation is to leave most of the walls on the property as they are, with a few possible exceptions where management and clearing may be beneficial as well as provide aesthetic value. These areas are displayed in the *Other Management Areas* map in the *Additional Maps section* (p.54).

The first location where stone wall vegetation clearing, and management may be beneficial is along the old carriage road/bike path leading in from North Street. This trail is bordered on both sides by stone walls and in sections, these walls are covered in invasive plants. There is also an intersecting stone wall that runs to the south at the west opening of this section (see *Additional Maps, Property Overview*, p.51). The recommendation here would be to manage invasive plants first, then clear back any of the remaining lower shrubby and immature vegetation leaving select mature trees along the road for cover and aesthetics. On the south side of the road between the wall and the field to the west side of the old mill pond, as well as section of wall running south from the west opening, it may make sense to clear the area further, expanding the field a bit (see *Field Edge Reclaiming* p.41). Overall, it is beneficial to leave some cover when clearing the stone walls. This can be achieved by leaving select mature trees along the length of it, and by leaving one side of the wall as wooded.

A second location where stone wall clearing may have aesthetic value, minimal impact on wildlife and some benefit, is around the westernmost field. A stone wall borders the north side of this field and is covered partially in invasive plants. Managing the invasive plants and clearing the wall would help create a buffer from the invasive glossy buckthorn north of the wall. The stone wall bordering the east side of the field does not have many invasive plants but is backed by white pine forest. Clearing the stone wall and pushing back the field edge to the wall here, and on the north side would provide a nice overall view of the stone wall field border and still preserve cover for wildlife.

A third possible location for clearing would be the stone wall that runs east/west along the



north edge of the northernmost field. There is also the potential for some field re-claiming here as well (see *Field Edge Reclaiming* p.41). This area is where the main access to the property is located and seems to be the most utilized. There is a picnic and fire pit area already in place here that is already on the priority list for improvements (Table 5, p.45).

There is also a possible apple orchard restoration for this field in the future (see *Apple Orchard Restoration*, p.37). Because this particular area is a high priority area for improvement already, also opening up the wall for aesthetics and public enjoyment makes sense in this location.

### **Cedar tree management**

The Eastern red cedar tree (*Juniperus virginiana*) is present in most of the fields at Willard's Woods at varying densities. The goal with managing this tree will depend on what is decided on for overall field restoration (see *Field Restoration* p.35). Ultimately, if left unchecked, the cedar trees will continue to establish themselves and take over the fields.

No matter what direction the restoration of the fields is taken, it is recommended that a large portion of the cedar trees be removed in most areas, leaving only a select few behind. Cedar trees provide an important food source for both birds and small mammals. They also provide cover, roosting areas, and nesting sites for several bird species. Leaving a tree or two in some of the field areas would provide an additional habitat resource for many species. Continued field management and mowing regimes will keep cedar trees from establishing and taking over the fields. See *Updated Mowing Schedule* (Table 4, p.42).

### **Long Term Goals:**

Long term goals are action items that may need a bit more planning, preparation, support, permission, and in some cases the acquisition of more extensive funding. Some of these goals are considered long term because they cannot be implemented until other goals are met beforehand. They can also be goals that may be able to start in the short term but will need to be executed over the long term to be successful or come to completion.

### **Field restoration**

The fields at Willard's Woods are broken down into seven discrete areas totaling approximately

14.5 acres. All of these fields have invasive plants at varying densities that will need to be managed prior to any restoration efforts as discussed previously. When initially assessing the layout of these fields, we considered two types of management approaches. The first possibility was to manage for grassland bird habitat, and the second was to manage for more of a diverse mosaic of field and shrub land habitat types. In investigating for grassland bird management, it became clear that the overall juxtaposition and acreage of fields would not be supportive of grassland bird species. Species, such as the eastern meadowlark, and upland sandpiper, require higher acreages than Willard's Woods can provide (60-100 acres minimum). Other grassland bird species like the bobolink and the vesper sparrow require smaller acreages preferring 10-15 at an absolute minimum (*Atwood, 2017*). These acreages could be achieved at Willard's Woods, though the layout of the fields would not be supportive of these birds. Minimum acreages need to maintain an open visibility to be desirable for these species. These conditions cannot be achieved on this property without significant tree removal and disruption to the landscape.

The ideal option would be to manage the fields in order to achieve a more diverse mosaic of habitats. This can be achieved at Willard's Woods, by managing them in a way that supports what they already want to be based on the characteristics and conditions already present (see Field descriptions p.7). A map displaying these field compositions and recommended management goals can be found at the end of this section (Figure 8, p.40). This approach is desirable for many reasons. Managing for habitat diversity supports a wider range of species in an area, increases biodiversity and leads to healthier, more resilient systems overall. With climate change one of the most significant threats to our planet, encouraging and supporting stronger, more complex systems is our best defense in order to adapt to the changes to come. It would also provide the opportunity to manage for more early successional habitats. In the state of Massachusetts, shrubland and young forest habitats are underrepresented (*NRCS, 2012*). Many of our forested areas have been allowed to fill back in since the height of our agricultural days, but have done so all together, creating a more even aged distribution, and ultimately a lower diversity of forest age classes. There are many species that require the use of these younger habitats to fulfill part, if not all their survival and reproduction needs. Because of this, we have seen a decline in the abundance and distribution of many species once common

throughout the state. Managing for these early successional habitats will help promote and support many of these species that are finding it hard to locate the resources they need to survive. The American woodcock, historically documented at Willard's Woods, is an example of a species who would benefit from a mosaic of habitat types (*Managing Forests for Trees and Birds in Massachusetts, Mass Audubon, 2016*). Others, like the White throated sparrow, also a historic visitor to this property, would benefit from more young forest representation.

In addition, there is also an opportunity at Willard's Woods to increase habitat diversity even further and establish areas as pollinator meadows. There will be the chance to incorporate many different species of native flowers in managing shrubland areas as well but designating set pollinator meadows will provide solid resource areas for insect species that are also facing a decline in quality habitat. Managing and protecting areas for pollinators is essential not only for the survival of countless species, but also to ensure our continued ability to grow crops for food, fiber and medicine. Insects are often a forgotten, yet integral part of how healthy ecosystems function.

#### Apple orchard replanting

The northeast field of Willard's Woods was historically an apple orchard (Figure 8, p.40). It is approximately 1.25 acres. The town Conservation Division is interested in once again establishing a small apple orchard at this location to bring back some of the features of this property's past, and for the enjoyment of the public. Restoring this field as an apple orchard would also be a benefit to local bird and wildlife species as it brings an additional food source, cover, perching and roosting sites to the property. It is also a low cost, low management addition that would be fairly easy to execute. The only reason this potential project is listed as a long-term goal is because management of the invasive plants should happen prior to any restoration efforts.

#### Warm season grasslands

The predominant potential habitat type that presents itself in the fields of Willard's Woods are warm season grasslands, which total approximately 8.5 acres. These areas are presented on the field management map as Areas 1, 4, 6, 7 and 8 (Figure 8, p.40). These fields with small

amounts of little bluestem are indicating their potential to be full-fledged warm season grassland habitat if they are managed accordingly. Managing these fields for invasive plants as is discussed earlier and supporting that effort with a committed mowing regime (see updated mowing schedule, Table 4, p.42), will give the native plant species the opportunity to thrive. By incorporating an early season mow (June) in addition to a late Fall mow, warm season grasses are encouraged, and the cool season species discouraged over time. Warm season grasses begin to germinate and grow when soil temperatures are reliably above 65 degrees Fahrenheit in the early-mid June timeframe. Mowing in June provides these grasses with a competitive advantage. Another technique which may be used to encourage warm season grasses is to broadcast sulfur as one would broadcast lime to increase soil pH or apply fertilizer to make land more productive for growing crops. Sulfur will do the opposite. It will bind up nutrients and render the area more nutrient poor which will support the desired grasses.

### Shrubland

Another desirable habitat type that is presenting itself at Willard's Woods are shrublands. Though any of these fields can be transitioned and managed as shrublands, there is a location already in transition that is also an ideal spot, to be managed as such. This area is defined as Area 2 on the Field Restoration map (Figure 8, p.40). At approximately half an acre, this location would provide enough of an area to be beneficial for wildlife, without taking over too much of the Willard's Woods overall field acreage. Once invasive plant management is underway, a Fall mowing on a three-to-five-year cycle will keep this area at the desirable age class to function as an early successional shrubland habitat.

### Native Meadow

In addition to the more clearly defined warm season grasslands presenting themselves at Willard's Woods, there are also native meadow and native wet meadow habitat types with even more of a mix of species represented. Totalling approximately 4.75 acres, these areas (Areas 3 and 5 on the Field Restoration Map, Figure 8, p.40) are an opportunity to encourage habitat diversity even further. In line with what is recommended above, consistent invasive plant management combined with a committed mowing regime will support a healthy native meadow



composition. Once invasive plants are under control, restoration can be taken even one step further with the additional introduction of more rare native plants historic to this area, such as New England blazing star (*Liatris novae-angliae*).

Groups such as Grassroots Wildlife Conservation Program and Native Plant Trust are both great resources if exploring this option is of interest.

### Pollinator/Sedge Meadow

Another opportunity for encouraging field habitat diversity is managing select spots as pollinator meadow. During our field assessment, we identified a small .25-acre field that would be an ideal location to work on such a project. Currently, this site is presenting itself partially as a sedge meadow, but with many other invasive and aggressive species mixed throughout. Located near the Brent Rd. and Hathaway Rd. entrances, it would be an excellent spot to welcome the public entering Willard's Woods. It is also a great opportunity to create a public outreach project and get the community involved and engaged with the property. Invasive plant management and mowing would also need to be part of this effort at the forefront, but with some additional planning and effort, this small forgotten field could be transitioned into an important habitat pocket for wildlife such as pollinators which is a very hot topic right now. If this is of interest, we recommend reaching out to Grassroots Wildlife Conservation Program and Native Plant Trust, both mentioned above, who can assist in designing a project that will work specifically with the needs of Willard's Woods.

### Mowing Alternatives

Another option that may be considered for the property as an alternative or supplement to mowing would be to utilize grazing animals such as goats and sheep in the form of conservation grazing. We recognize that goat grazing has previously been initiated within Lexington's conservation lands (Idylwilde Conservation Area and Chiesa Farm) and may be considered for Willard's Woods. Animals should be allowed to graze the months of April and May and taken off the land by mid-June to be effective tools for encouraging warm season grasses. Likewise, prescribed fire would be a great tool for these objectives, but we recognize that it will be very difficult for a fire program to gain traction for managing the conservation lands of Lexington.

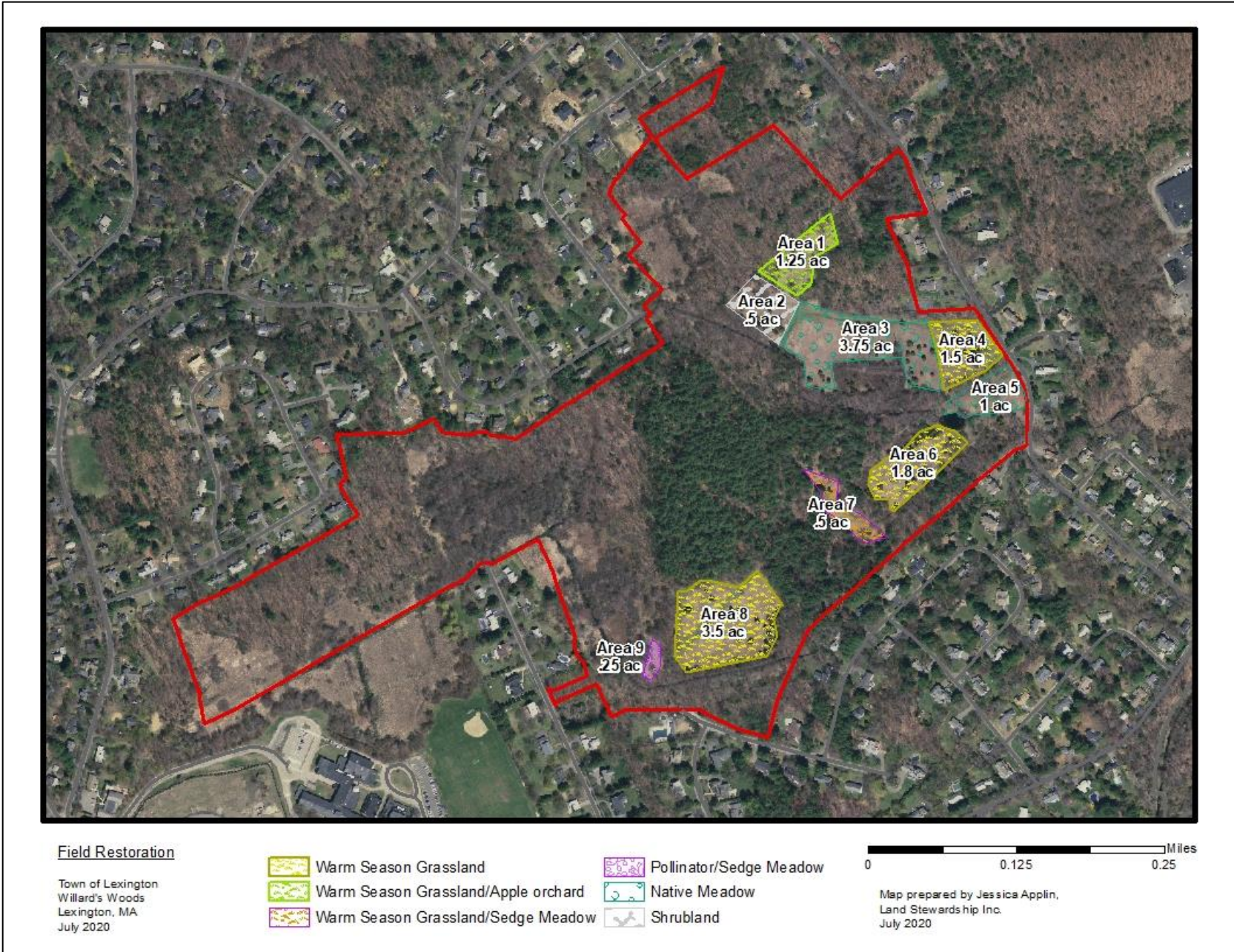


Figure 8. Map displaying field habitat types and acreages recommended for management.

## Field edge reclaiming

As mentioned in the *Field Edges* section, there are approximately 9,270 linear feet of field edge on the Willard's Woods property. All of the field edges at Willard's Woods have some degree of invasive plant pressure. Where field restoration is a priority for this property, management of invasive plants along these edge areas is recommended in order to prevent continued field encroachment. By doing so, many of the field edges will be reclaimed to some degree by default. After an initial invasive plant management effort in these areas, the town can then decide if opening up any additional field acreage is desirable or not. In some cases, there will be an added benefit of allowing parts of these areas to be managed as shrubland and early successional habitat as discussed in the previous section. In other instances, this effort can go hand in hand with other priority management activities, such as stone wall clearing, particularly in the Mill Pond restoration area and in the southwest field near Brent Rd. There are however a couple of field edge areas where reclaiming is not recommended. These areas include the south edge of the southwest field near Brent Rd. and the western edge of the large main eastern field. In both locations, there are small stream channels running in the woods behind the fields. Once invasive plants are managed in these areas, a wooded buffer should be maintained along the edges of these streams.

This may mean considering some future restoration plantings in areas where this zone is already very narrow such as in the large main east field. Maintaining a buffer along these streams will provide essential cover for several wildlife species, as well as keep water temperatures regulated for numerous insects and aquatic organisms. One exception to this may be in the northern section of this field, where more extensive invasive management is also recommended. Providing a small opening here along the east side of the channel, north of the trail and bridge, would allow better access to water for bat species if bat habitat restoration is of interest.

## Continued invasive plant management

Invasive plant management must always be considered a long-term stewardship effort. Invasive plants can be reintroduced to the area by wind, birds, and other animals. Seed banks can also

remain viable for years, re awakened by numerous environmental factors. To keep invasive plants out of the area for the long-term after short term management has been completed, it will be necessary to monitor the property by scouting for new patches and individual plants. Options for managing invasive plants after an initial management has been completed, usually include hand-pulling, spot herbicide spraying, and/or repeated cutting.

In the interest of glossy buckthorn management, where there is a large scale, property wide infestation, a long-term species-specific management plan should be discussed and considered for the future. Managing this plant over the entirety of the property is most likely not realistic, or financially feasible, but there are options to reduce the pressure this species inflicts on some of the properties more important resource areas.

Further guidance on how to prioritize and manage invasive plant infestations on a large scale can be acquired through the Invasive Plant Management Decision Analysis Tool, developed by the Nature Conservancy, [ipmdat.org](http://ipmdat.org).

### Updated mowing schedule

**Table 4. Mowing schedule**

Field ID	Management Goal		Winter	Spring	Summer	Fall
Area 1	Warm Season Grassland/Apple orchard			June		October
Area 2	Shrubland					October *Every 3-5 years
Area 3	Native Meadow			June *Until woody vegetation is controlled		October
Area 4	Warm Season Grassland			June		October
Area 5	Native Meadow			June *Until woody vegetation is controlled		October



Area 6	<i>Warm Season Grassland</i>			<i>June</i>		<i>October</i>
Area 7	<i>Warm Season Grassland/Sedge Meadow</i>			<i>June</i>		<i>October</i>
Area 8	<i>Warm Season Grassland</i>			<i>June</i>		<i>October</i>
Area 9	<i>Pollinator Meadow</i>			<i>June</i> <i>*Until woody vegetation is controlled</i>		<i>October</i>

*\*After this mowing regime and invasive plant management has been underway for a few years, the need for biannual mowing can be re-assessed. Once a balance has been restored in these field habitats, returning to an annual mowing regime may once again be sufficient to maintain desirable field composition.*

### **Infrastructure improvements**

One of the main topics of interest in developing an Ecological Design & Land Management Plan for the Willard’s Woods property was to assess how to incorporate a Universally Accessible Trail (UA) system for the public. To do this, Land Stewardship Inc. recruited the expertise of Dick O’Brien of Conservation Works LLC. to assess the feasibility and potential of such an upgrade to the existing trail network. During his assessment, Dick walked all trails to determine the best and most realistic location for the UA trail, what upgrades would be needed to make it happen, and the costs associated with it. He also assessed the parking area at North Street, the southwest entrance trail connection at Brent Road, all bridges/boardwalks, and signage/kiosks for upgrade potential. In addition, he looked at a possibility of enhancing the trail system even further with a viewing platform near the Diamond Middle School. The findings, recommendations, and costs associated with these assessments can be found in Dick O’Brien’s Universal Accessibility Trail Assessment Report as Appendix G. A more detailed task and cost breakdown can be found in Table 5. Priorities, Projects, Cost Estimates (p.47). Included below is a map of the proposed route for the UA trail upgrade (It is also included in the full UA trail assessment report).



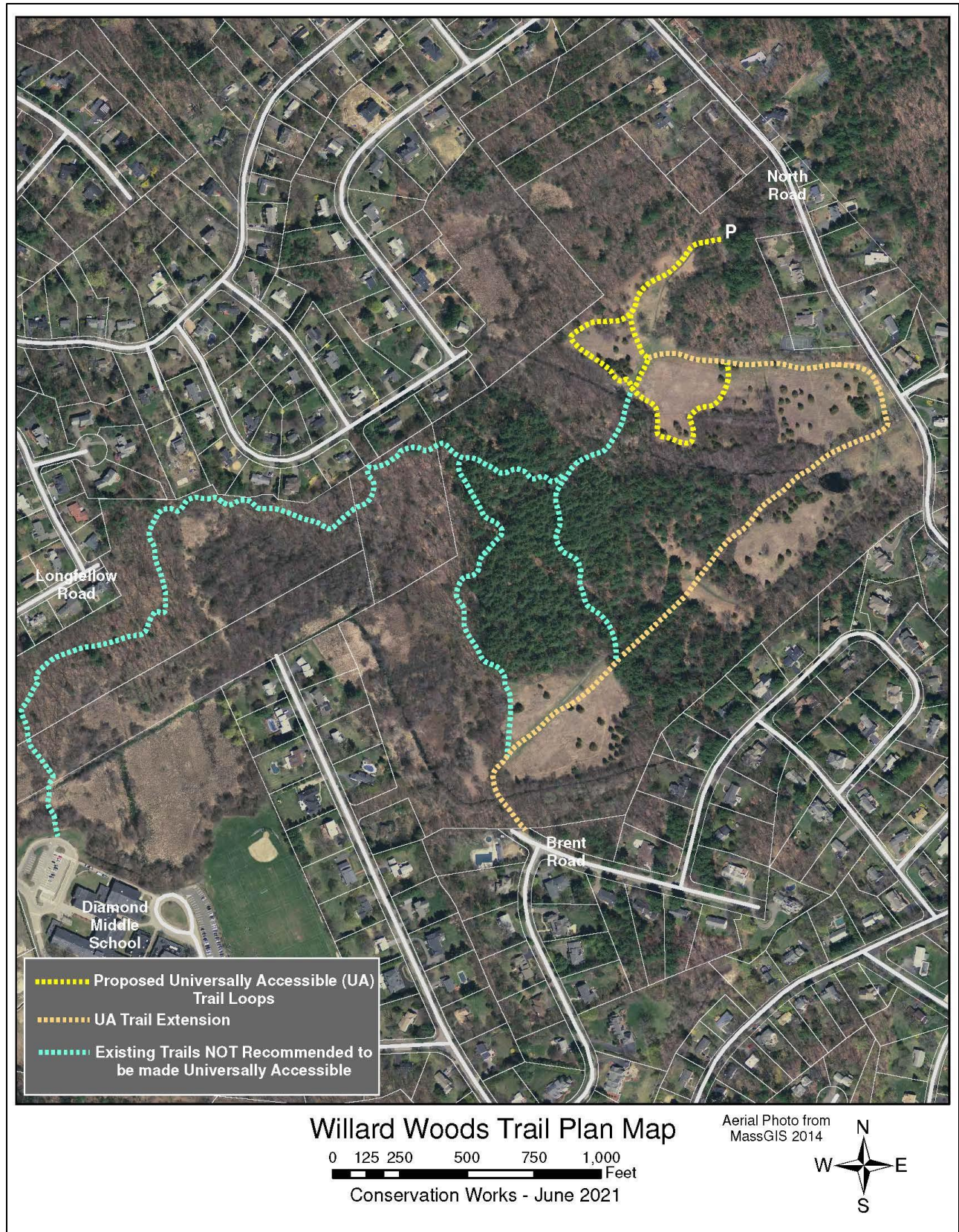


Figure 9. Map displaying proposed UA Trail.



## Schedule of Management Activity

**Table 5. Priorities, Projects, Cost Estimates**

Recommendation	Acreage	Priority Level	Cost Estimate (+/- 20%)	Variables
<b>Invasive &amp; Nuisance Plant Mgmt. - Safety</b>				
- North St. Japanese knotweed & roadside invasive plants	.12	High	\$1,250	Hazardous roadside work
- Trailside poison ivy	3.3	High	\$3,250	Possible trail closures during treatment.
<i>Invasive &amp; Nuisance Plant Mgmt. – Safety Total</i>			<i>\$4,500</i>	
<b>Invasive Plant Mgmt. – Priority Areas</b>				
- SW Wetlands	4	High	\$3,600	Permitting needed
- Wetland edges	3.5	High	\$4,350	Permitting needed
- Stream corridors	.5	High	\$1,250	Permitting needed
- Fields	14.5	High	\$25,000	
- Field edges/field edge reclaiming	2.5	High	\$3,750	
- Mill Pond woodland	2.75	Medium	\$4,250	
- Winged Euonymous patch	.5	Medium	\$1,100	
- West hot spot/climbing bittersweet	1.7	High	\$2,350	
<i>Invasive Plant Mgmt. – Priority Areas Total</i>			<i>\$45,650 (+/- 20%)</i>	
<i>Invasive Plant Mgmt. – Continued Stewardship</i>			<i>\$3,500</i>	Includes annual assessment/mgmt. prioritization and two days of follow up crew work
<b>Cedar Tree Management</b>			\$3,500	

<b>Select Stone Wall vegetation clearing</b>	1	Medium	\$1,650	
<b>Field Mowing</b>	14	High	\$6,000	Cost based on 2 annual mowing's.
<b>Field Restoration Plantings – Pollinator Meadow</b>	.25	High	\$7,500	
<b>Mill Pond Area Continued Restoration - Interpretive signs/protective fencing/benches</b>		High	\$6,500 \$6,000-\$8,000 \$2,000-\$4,000	Interpretive sign, sign lumber, installation hardware, 2 benches Wood post and rail fencing around pond Labor and installation
<i>Mill Pond Area Continued Restoration Total</i>			<i>\$14,500-\$18,500</i>	
<b>Apple Orchard Replanting</b>		Low	\$3,200	Cost based on 20 trees plus labor. Total will depend on how much of this area the town would like to plant for aesthetics.
<b>Infrastructure Improvements</b>				
Bike path/carriage road upgrades & repair			\$32,000	6' wide, compacted ¾" graded base surface, no geotextile, no finish layer, no loaming of the sides  Very basic upgrade, widens and raises trail to eliminate wetness issue through the field and crowding issues due to narrow conditions.
Handicap accessibility/UA Trail			\$165,000	<ul style="list-style-type: none"> <li>- 6" ¾"graded base layer, compacted</li> <li>- 4" bike path/carriage rd. finish layer, compacted</li> <li>- 6' wide geotextile separator between the layers</li> <li>- graded loam sides, out to 6' on either side</li> <li>- NE Conservation Mix</li> </ul> No excavation of treadway



Accessible viewing platforms/benches			\$1,600 to \$12,850	<ul style="list-style-type: none"> <li>- Material choice, wood, stone, steel, aluminum, recycled material</li> <li>- Quality level, base level to premium</li> <li>- Landscaping/ plantings included, plants, trees, mulch, etc.</li> <li>- Signage, interpretive panels, or other</li> <li>- Memorial features, brass plaques, stones, engraving, etc.</li> </ul>
Parking area improvements North Rd - Upgrade Brent Rd entrance			\$10,700-\$21,500	<ul style="list-style-type: none"> <li>- Size &amp; location of parking area, 4 cars or 8 cars or more at North Rd, and 2 cars at Brent Rd.</li> <li>- Landscaping around the parking area, guard rails, stones, handicap signage, etc.</li> <li>- Material used, assumes compacted gravel, could be bit. Concrete</li> <li>- Number of structures, kiosk, dog waste station, other signage, bench</li> </ul>
Trail head upgrades			\$5,350 - \$16,000 each	<ul style="list-style-type: none"> <li>- New kiosks, new mutt-mitt stations, new waste receptacles,</li> <li>- Benches, bike racks, new map/information panels</li> <li>- Design, materials and quality</li> <li>Handicap parking design and materials</li> </ul>
<i>Infrastructure Total</i>			<i>\$220,000-\$263,350</i>	
<b>Wildlife Improvements</b>				
Bird, Duck, Bat Boxes		Low	\$150-\$200	Cost for materials to build 3 each
Interpretive Signs (e.g. coyotes, bats)		Low	\$5,500 each	Cost for signs, lumber and installation hardware
<b>Picnic Area Upgrades</b>		High	\$0	Scout project permitted in 2021

**Table 6. Yearly Ongoing Management/Stewardship**

	Winter (Jan-March)	Spring (April-June)	Summer (July-Sept)	Fall (Oct-Dec)
Monthly Property Visits	x	x	x	x
Annual Work Plan with Staff and Stewards	x			
Safety Meeting with Staff, Stewards, Police and Fire Dept.	x			
Trail Walk/Clean Up (downed limbs, drainage issues, signage)		x		x
Building Projects (kiosks, signposts, etc.)		x		x
Invasive Plant Management		x	x	x
Mow Meadows		x		x
Clean out nest boxes				x
Boundary Walk (monitoring for encroachments, signage, etc)				x
Monthly Property Visits	x	x	x	x
Bat box checks	x			

## *Challenges*

The main challenges at Willard's Woods are those we face in any urban/suburban highly developed landscape. There will always be human impacts no matter how well the park is cared for by both staff and visitors alike. Some of these impacts are easier to mitigate than others, and all require public cooperation and stewardship to support the health of this landscape. Willard's Woods is highly loved by many of Lexington's residents, as well as many of its neighbors. This means there is an exceptionally high volume of visitors and heavy public use of the Willard's Woods foot trails, bike trails, picnic area, and parking access points. Heavy use leads to faster degradation and more frequent need for repair and replacement. It also means that there is increased pressure to the park resident and visiting wildlife species and increased human wildlife interactions. Further, there is an increasingly high level of dog walking activity at Willard's Woods due to a lack of other park systems or dog parks in the immediate area. The challenges here are safety, individual dog behavior and training issues, dog waste, increased wildlife pressure/interaction, and wildlife habitat disruption/degradation.

The town has tried to manage these challenges in several ways. One solution was to create on and off leash times for dog owners. This was so that owners with timid dogs, or with dogs that have particular needs could also find a time to enjoy the park. This approach however depends on the participation of the public and is hard to enforce. There have been several complaints of people not adhering to these rules and creating issues for other dogs as well as their owners. It also doesn't require or ensure that dogs stay on marked trails. This leads to increased wildlife habitat disruption and degradation as well as undesirable interaction. As dogs run in and out of field areas, shrub thickets, streams, wetlands, and woodland areas, they are impacting these animals where they are trying to seek refuge from the public. Another solution was to temporarily fence off the Mill Pond. The Mill Pond area is an active habitat restoration site that was degrading quickly due to heavy public use. Though prohibited, and even with interpretive signs in place, the pond banks were eroding from both dog and human use. A more permanent fencing solution and additional educational signage to stress the importance of this restoration area are priorities of the town and are recommended/supported in this report. Further, the town is

trying to keep up with the repair and replacement needs of the Willard's Woods infrastructure due to the increased public use of this property. Part of the goal of this plan is to provide support and recommendations for these projects to help the town make decisions on how to move them forward.

Finally, climate change is now a universal challenge we all face in our changing global landscape. In terms of managing Willard's Woods in the years to come, prioritizing habitat health and function, managing for resiliency, and decreasing overall impacts and pressures will be essential in order to adapt to these changes. The more diverse, complex and healthy a system is, the stronger it will be in the face of adversity.

# Additional Maps

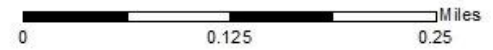




**Property Overview**

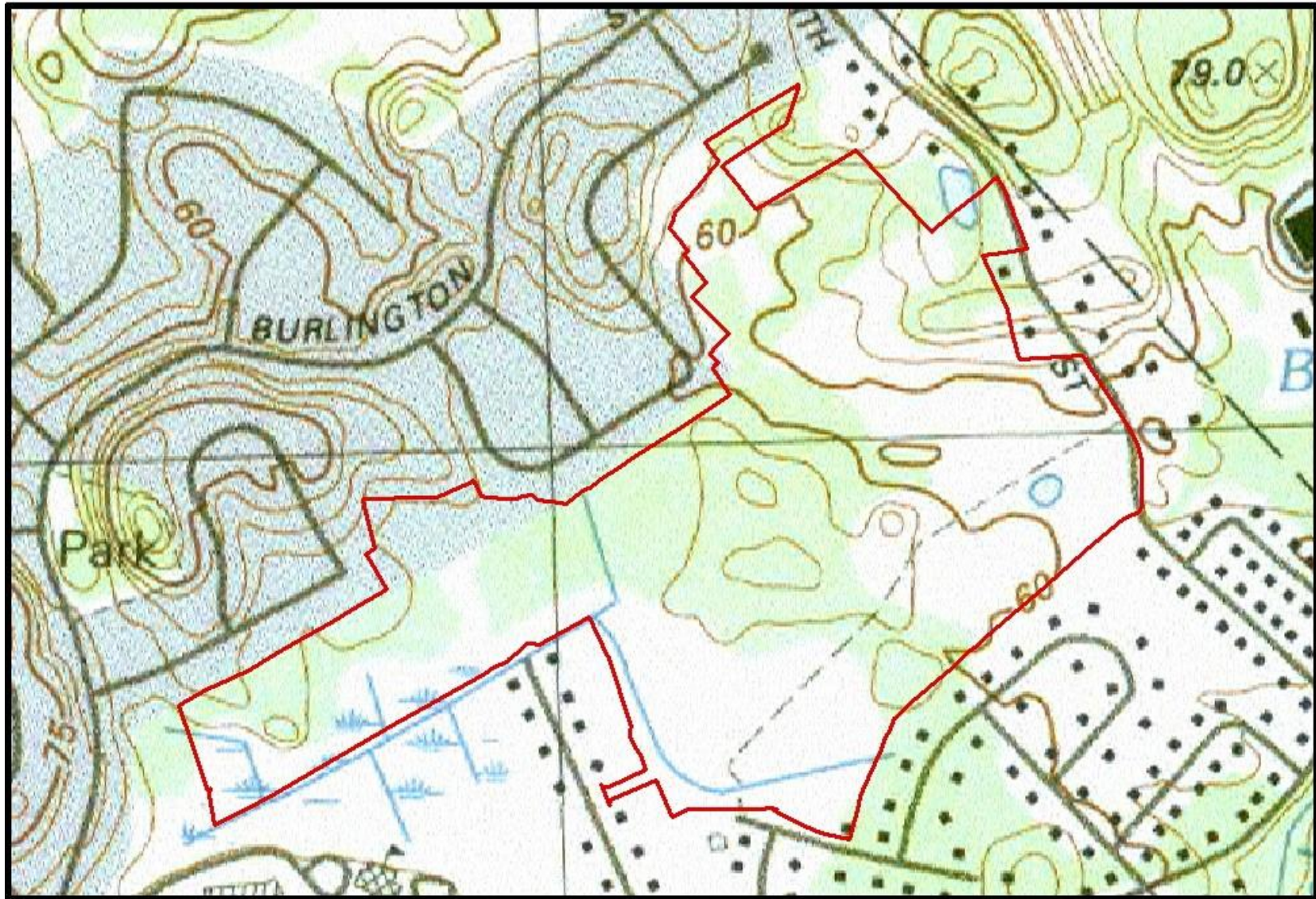
Town of Lexington  
 Willard's Woods  
 Lexington, MA  
 December 2019

- |              |          |            |         |
|--------------|----------|------------|---------|
| Entry points | Duck box | Boardwalk  | Parking |
| Bird box     | Kiosk    | Stone wall | Picnic  |
| Bridge       | Sign     | Trails     |         |




Map prepared by Jessica Applin,  
 Land Stewardship Inc.  
 December 2019

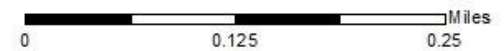




Topographic map

Town of Lexington  
 Willard's Woods  
 Lexington, MA  
 December 2019

 Property boundaries



Map prepared by Jessica Applin,  
 Land Stewardship Inc.  
 December 2019



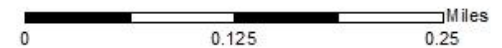


**NRCS Soils**

Town of Lexington  
 Willard's Woods  
 Lexington, MA  
 November 2019

1	253D	32B	626B	656
103B	255A	420B	629C	6A
253B	255B	51A	631C	
253C	260B	52A	655	

\*NRCS Soil classification legend included in the Appendices



Map prepared by Jessica Applin,  
 Land Stewardship Inc.  
 November 2019






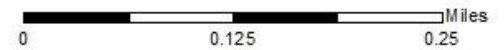


Other Management Areas

Town of Lexington  
 Willard's Woods  
 Lexington, MA  
 December 2019

Management Recommendations

-  Bat box
-  Field re-claiming
-  Stone wall clearing



Map prepared by Jessica Applin,  
 Land Stewardship Inc.  
 December 2019

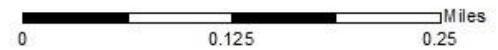




**Prime Forested Land**

Town of Lexington  
 Willard's Woods  
 Lexington, MA  
 November 2019

- |   |  |
|---|--|
|  Property boundaries |  Local Importance     |
|  Prime 2             |  Prime 3 Wet          |
|  Prime 3             |  Local Importance Wet |



Map prepared by Jessica Applin,  
 Land Stewardship Inc.  
 November 2019



## Conclusion

Willard's Woods is an invaluable piece of open space land in the greater Boston area. It is providing essential habitat for wildlife in an otherwise highly developed area and offers important recreational opportunities and enjoyment to many residents throughout the region. This property already hosts a variety of habitats and an impressive diversity of wildlife within its hundred plus acres. In helping to improve the quality of those habitats, and managing for their long-term health and resiliency, Willard's Woods will be able to support its resident wildlife, insect, and plant populations and will allow these systems to adapt and thrive in the face of climate change.

By making thoughtful management decisions that take into consideration the balance needed between nature and the public, there is the opportunity to improve the overall habitat conditions at Willard's Woods without the need for extreme measures. In working with the characteristics and features that are already presenting themselves throughout the property, it will ensure a successful management strategy that will be sustainable and easy to follow for the long term. The results of management are always better when you work with a system rather than against it.

The New England landscape has undergone a lot of change and disturbance throughout its history. Willard's Woods is no different. What is remarkable about these ecosystems and communities is that when given the opportunity, they almost always bounce back. They are resilient by nature. If we put in the effort to remedy some of the human created pressures put on these landscapes through supportive restoration, they will ultimately function the way they were meant to. The management recommendations, observations and guidance presented in this plan are intended to do just that.

# Appendices

## Appendix A. References

Atwood, J., J. Collins, L. Kidd, M. Servison and J. Walsh. 2017. Best Management Practices for Nesting Grassland Birds. Mass Audubon; Lincoln, Massachusetts. 10 pp.

Mass Audubon, Managing Forests for Trees. A guide to habitat assessments and silvicultural practices. Adapted from Vermont's Foresters for the Birds Program. 2016.

NRCS, Conservation Practices Benefit Shrubland Birds in New England. January 2012.

## Appendix B. Resources

### **Bats:**

Bats house building/installation guides and bat fact sheets

*\*From MassWildlife*

<https://www.mass.gov/guides/bat-houses>

<https://www.mass.gov/doc/living-with-bats-printable-fact-sheet/download>

<https://www.mass.gov/doc/build-a-four-chamber-bat-house/download>

### **Wood Duck Boxes:**

Wood duck box plans and installation guides

*\*From MassWildlife*

<https://www.mass.gov/files/documents/2016/08/wi/wood-duck-box-plans.pdf>

*\*From Ducks Unlimited*

<https://www.ducks.org/conservation/waterfowl-research-science/wood-duck-boxes>

### **Blue Bird Boxes:**

Blue bird box guides/installation/fact sheets

*\*From Norcross Wildlife Sanctuary*

<https://www.norcrosswildlife.org/wildlife-sanctuary/programs/bluebird-nestbox-programs/>

*\*From the North American Blue Bird Society*

<http://www.nabluebirdsociety.org/nestbox-plans/>

<http://www.nabluebirdsociety.org/PDF/NABS%20factsheet%20-%20Nestbox%20Recs.pdf>

## Appendix C. Invasive Plant Species Map Key

- GB – Glossy buckthorn
- CB – Common buckthorn
- HS – Shrub honey suckle
- MR – Multiflora rose
- WE – Winged euonymous
- OB – Oriental bittersweet
- AO – Autumn olive
- NM – Norway maple
- P – Privet

## Appendix D.

**NRCS Soils classification legend** \*Full NRCS Soils Report on file with the Town of Lexington

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
6A	Scarboro mucky fine sandy loam, 0 to 3 percent slopes	12.0	11.2%
32B	Wareham loamy fine sand, 0 to 5 percent slopes	12.2	11.4%
52A	Freetown muck, 0 to 1 percent slopes	22.1	20.7%
103B	Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes	7.3	6.8%
253B	Hinckley loamy sand, 3 to 8 percent slopes	7.9	7.4%
260B	Sudbury fine sandy loam, 3 to 8 percent slopes	12.4	11.5%
420B	Canton fine sandy loam, 3 to 8 percent slopes	28.1	26.2%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	2.4	2.2%
629C	Canton-Charlton-Urban land complex, 3 to 15 percent slopes	0.7	0.7%
631C	Charlton-Urban land-Hollis complex, 3 to 15 percent slopes, rocky	0.0	0.0%
655	Udorthents, wet substratum	1.9	1.8%
656	Udorthents-Urban land complex	0.0	0.0%
<b>Totals for Area of Interest</b>		<b>107.1</b>	<b>100.0%</b>



Appendix E. Photographs



Mixed herbaceous species found in much of the main Area 3 field



Milkweed in west section of Area 3 main field





Woody vegetation establishing along edges of Area 3 main field



Oriental bittersweet in Area 5 field northeast of Mill Pond.





Wet meadow characteristics in a south-central section of the main field, Area 3.



Black walnut and bittersweet in Area 5 field northeast of Mill Pond.





Glossy buckthorn establishing in Area 7 sedge meadow.



Warm season grassland characteristics presenting in Area 4.





View of freshly mowed Area 1 field looking towards North Street entrance.



View of understory at oak hemlock/shrub swamp transition zone.





Windstorm tree damage at edge of white pine stand.



View of glossy buckthorn saplings in the white pine understory.





View of glossy buckthorn saplings in the white pine understory.



View of Mill Pond in late Summer.





Fire pit and picnic area at west end of Area 1 field. North St. entrance.



View looking east along the trail on north side of Area 3 field.





Glossy buckthorn saplings in northeast wetland understory.

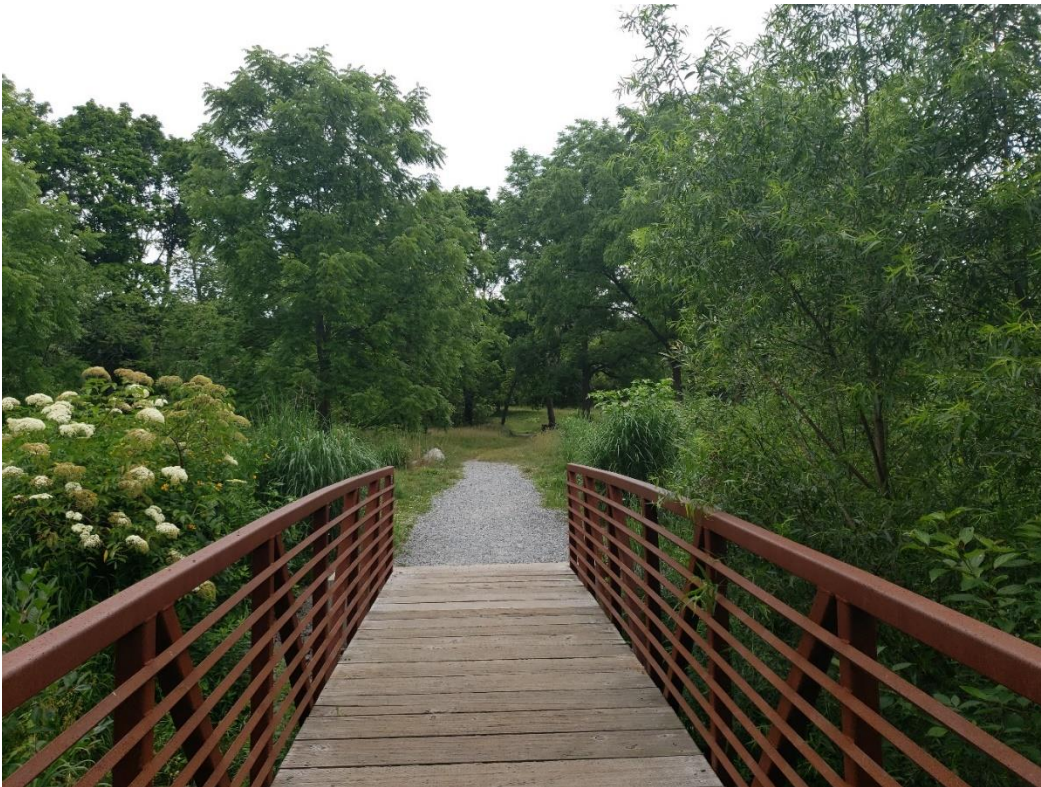


View looking northeast down main carriage road/bike path.





View looking northeast down main carriage road/bike path.



View of bridge crossing into Area 5 field near Mill Pond.





View looking northeast across footbridge towards North St. entrance.



View of boardwalk running along edge of wetland in north central section of the property.





View of Mill Pond in late Fall.



View of interior stone wall.

Town of Lexington

# Willard's Woods

Forest ecological assessment  
and management considerations

Prepared by  
Andrew Morrison  
Forest Ecologist  
3/10/2020



## Introduction

Willard's Woods is a conservation property owned and managed by the Town of Lexington. While not physically connected to other conservation areas it has connections to other town managed open spaces including the adjacent Diamond Middle School and is part of a small regional corridor for wildlife movement.

The property has a variety of habitat types, includes evergreen woodlands, deciduous woodlands, forested wetlands, shrub wetlands, a perennial brook, a small pond and a variety of open lands. This richness of habitat types is an incredible asset to the ecological function of the property. There are four dominant forest communities on the property. The most prominent communities are the white pine forest and midslope oak forest communities, while the property also has a transitional forest community, a red maple swamp and a small area of sand plain forest <sup>1</sup>.



### Natural Communities

Town of Lexington  
Willard's Woods  
Lexington, MA  
March 11, 2020

### Forest Community

midslope oak	transitional woodland
open field	wet meadow/open shrub wetland
red maple shrub swamp	white pine



0 0.1 0.2 Miles

Map prepared by Andrew Morrison

The forest communities at Willard's Woods are even aged. The dominant canopy trees in each stand all established at the same time as one another. While there is a spectrum of forest ages on the property ranging from roughly 35-120 years old (based on a rough sample of tree cores) the property does not contain what is considered either old forest or young forest. Old forest is generally a rare commodity within New England due to the history of land clearing and agriculture which boomed throughout the early 1800's. While pockets of forest that predate European settlement exist, even many of these have



been heavily influenced by human management. Old forest need not however be synonymous with old growth forest. Old forests can in some instances be defined by their structure as much as by their age. An old forest may mimic an old growth forest in structure by having a multitude of tree size and age classes, gaps in the canopy, dead standing trees and cavity trees and large dead wood material on the forest floor<sup>2</sup>. Other aspects of old growth forest are particular to age and may include shifts in bark chemistry that occur with tree age. In the contexts of Willard's Woods meaningful old forest would be difficult to manage for or achieve but some of the above stated structural features, including cavities, snag trees and large dead wood material on the forest floor, are achievable objectives. Young forests are forests which are just developing. These forests tend to be less than 15-20 years of age when the developing trees are still at very high densities. These forest types are far easier to create than old forests but also are an important part of the forested landscape and are the rearing grounds for a wide variety of species, especially several species of migratory songbird.

In addition to age diversity the forested habitats do not provide for strong interior forest conditions. Forests are impacted by what is referred to as the "edge effect" a set of ecological conditions driven by light levels and microclimate which makes the habitat of the forest different along its boundary with other habitat types than within its interior. The extent of the edge effect is situational but can be commonly thought of as extending roughly 300 feet from the forest edge. The forest interior is the areas of forest not impacted by this edge effect. Of the just over 100 acres at Willard's Woods roughly 75% of them are forested, this increases the edge effect on the forest and represents a trade-off between habitat diversity and forest integrity. Edge effect on the property is also in part due to the shape of the property, which is not a square but rather a more organic shape that is narrower north and south than it is east and west. The forest interior at Willard's Woods can be estimated at roughly 5.5 acres, a value so low that it is questionable whether it is ecologically significant. In addition to its small size this section of interior forest is the confluence of most of the properties trail system, increasing the amount of human interaction for wildlife seeking this type of habitat.

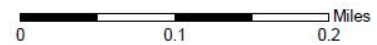


Interior Forested Lands

Town of Lexington  
Willard's Woods  
Lexington, MA  
March 11, 2020

**Interior Forest Area**

- 300 ft
- 325 ft
- Trails



Map prepared by Andrew Morrison

## Forest Ecological Communities

### White pine forest

This forest has a unique composition within the conservation lands in Lexington and forms the geographic and woodland core of the property. This forest is dominated by eastern white pine which forms the majority of the canopy. White pine is a fast growing species and is also capable of greater height growth than the other tree species common to New England, often forming a super canopy which rises above the maximum height of the surrounding trees. Many pure stands of white pine were established on abandoned agricultural fields. These communities were often susceptible to attack by an insect pest which would bore out and kill the leading green shoot of the tree. The damage induced by this weevil insect would require the pine to signal side branches to take up the torch and form a new leader. The resulting “weevilled” trees were of poor health and had multiple competing tree trunks. The pines at Willard’s Woods, while established after agriculture, show almost no signs of weevil damage and most cases are well spaced, large and healthy trees as demonstrated by their broad and deep tree crowns. Unfortunately these tall trees are vulnerable to storms and many of the pine in this stand have signs of some type of storm damage. In some cases storms have killed individual trees. The dead and storm damaged trees have increased the structural diversity of this stand by generating low densities of standing snags, some very large woody material on the forest floor and some light openings which have in places favored white pine or hardwood trees to regenerate.

Trees		Site	
Estimated Age*	90+	Course woody material	Moderate
White pine	75%		
Red maple	9%	Fine woody material	Moderate
Red oak	9%		
White oak	5%	Leaf litter	Adequate
Quaking aspen	2%		
Mean Diameter (quadratic)	15.5		
Total basal area	133 ft <sup>2</sup> /acre	Regeneration	Low to moderate, primarily with American beech or red maple in the midstory and low levels of pine in the understory
Canopy basal area	92 ft <sup>2</sup> /acre		
Suppressed basal area	42 ft <sup>2</sup> /acre	Health Notes	Wind damage present
Dead trees	15 ft <sup>2</sup> /acre		
Trees per acre	112	* based on tree cores	

White oak is a minor component of the stand and these wide crowned trees, which are now shorter than the surrounding pines, are likely older. White oak is not as fast growing a tree as its red oak cousin and the trees would not have established such wide crowns in the shade of the pines surrounding them. Some of these oak trees have died which has also increased the amount of snag material in the stand.



The midstory of the stand has some white pine as well as a small mix of hardwood species including red maple and the shade tolerant American beech.

The understory of the stand has low bush and high bush blueberry as well as a small component of American holly, a species found in excessively sandy soils. Glossy buckthorn is common throughout the understory. Some wintergreen, partridge berry and other herbaceous plants were present but most were hard to identify during the winter months.

### Midslope Oak Forest

This community is the major deciduous component of the forest. The canopy dominant in this stand is red oak, which is a fast growing species, but is joined by red maple and at times American beech, white pine, bitternut hickory, quaking aspen and white ash. This stand has a fairly regular ecological gradient from what is considered a midslope oak community to a low slope oak community. In the strongly upland sections of the stand red oak is the dominant tree with red maple, as a minor canopy component and occasional hickory, primarily shagbark hickory, or white pine. Closer to the wetland edges at the toe of the slope or where the ground appears to be seasonally less upland in nature, red maple is a stronger component of the stand composition, sometimes more dominant a component than the oak. This stand has low to moderate levels of woody material on the forest floor. Competition between trees is present and has led to the death of some, mostly midsized trees. Many of the oak are beginning to shed larger low branches because of competition which will help to form more tree cavities over time. Epicormic branching is common on the oaks and is often a sign of stress. Gypsy moth damage has been common throughout the southern range of Massachusetts over the past several seasons and may be the root cause. Red maple is prone to rot as it ages and cavities are more common in these trees and will likely continue to develop over time.

The midstory of the stand has red maple, shagbark hickory and some American beech throughout with occasional pockets of white pine.

The understory has high and low bush blueberry present as well as some signs of herbaceous plants including ground raspberries, Lycopodia such as princess pine and some fern species. Invasive plants are common throughout this forest type. The primary species is glossy buckthorn pockets of winged euonymus and Asiatic bittersweet are also present as are other species at lower densities.

Within the northeast corner of this community is a small pocket of pitch pine. Pitch pine is a fire adapted tree species which is considered an important ecological indicator of the sand plain forest community.

Trees		Site	
Estimated Age*	60+	Course woody material	Moderate
Red oak	46%		
Red maple	27%	Fine woody material	Moderate
White Pine	15%		
Pitch Pine	4%	Leaf litter	Generally Adequate
American beech	3%		
Shagbark hickory	2%		
Hardwoods (5 species)	4%		
Mean Diameter (quadratic)	11.6		

Total basal area	101 ft <sup>2</sup> /acre	Regeneration	Low to moderate, understory and midstory regeneration of red maple and white pine with other species as well
Canopy basal area	72 ft <sup>2</sup> /acre	Health Notes	Oak have lots of epicormic branching. Some red maple have heart rot
Suppressed basal area	29 ft <sup>2</sup> /acre		
Dead trees	9 ft <sup>2</sup> /acre	* based on tree cores	
Trees per acre	150		

While this section of woodland is too small to be considered a sand plain forest, the pitch pine is an indicator, like the American holly, of the sandy well drained nature of the higher points of land at Willard's Woods.

### Transitional Forest

This is the youngest forest type on the property. This forest stand likely only developed within the past 30 years, having previously been open land. The canopy is primarily red maple and quaking aspen with some white pine and black cherry present. This stand has a lower canopy height than the surrounding forest and smaller average tree size due to its young age. Old pasture remnants are still present in the midstory such as red cedar and crab apple. Other midstory species include white pine and red maple. This stand has very few cavities and almost no large woody material on the forest floor, neither of which would be anticipated in a stand this young. This stand seems to have a higher overall density of invasive plants. The primary species is glossy buckthorn but Asiatic bittersweet and bush honeysuckle are also present. While the quaking aspen in this stand are still in good health, this is a short lived species and will begin to die back and deteriorate in the coming years.

Trees		Site	
Estimated Age*	35	Course woody material	Moderate-Abundant
Red maple	36%	Fine woody material	Moderate-Abundant
White Pine	24%		
Quaking Aspen	19%	Leaf litter	Somewhat Adequate
Bigtooth Aspen	12%		
Paper Birch	2%		
Hardwoods (3 species)	7%		
Mean Diameter (quadratic)	8.4		
Total basal area	105 ft <sup>2</sup> /acre	Regeneration	Moderate to high midstory regeneration of red maple with some white pine and other species as well
Canopy basal area	60 ft <sup>2</sup> /acre		

Suppressed basal area	45 ft <sup>2</sup> /acre	Health Notes	Red cedar are declining or dead, aspen will begin to decline in the future
Dead trees	9 ft <sup>2</sup> /acre		
Trees per acre	270	* based on tree cores	

Red maple swamp

This is a forested wetland area, primarily dominated by red maple of a variety of sizes, including multi-stemmed trees. As is common in these wetland communities the trees are much smaller than their age would suggest, averaging well below 12 inches in diameter after greater than 50 years of growth.

**Management Considerations**

Willard’s Woods has numerous management pressures. An attempt is made here to identify some of the current and future management considerations and the inherent trade-offs which need to be considered.

Current considerations

**Old Forest:** The white pine forest at Willard’s Woods is best positioned to provide old forest characteristics as several of these characteristics already exist. This stand, because of the quick growing nature of white pine, has large trees present already. Past storm events have snapped the tops out of some of these pines and created dead standing snags, larger woody material on the forest floor and small canopy gaps. Storm damage to the remaining pines is inevitable so additional management actions will generally involve timely public outreach and management vision to prevent salvaging and woods cleanup from occurring following these storms.

**Young Forest:** The transitional forest areas are best positioned to provide rotational young forest. These forest areas are not yet well established, don’t occupy the core of the property and in several cases contain species of trees that grow rapidly from root sprouts such as aspen. Willard’s Woods has 3 distinct patches of transitional forest that could be managed as 4 young forest blocks with the southeastern block of forest managed as two pieces of forest divided by the open field. Having 4 forest blocks would allow for canopy clearing on one of them every 5 years. This scheme would allow for a rotation that would keep some acreage of young forest always present on the property. Cutting would not necessitate tree harvesting and cut trees could be left in place with larger trees girdled if desired. The primary obstacle to implementing the establishment of young forest is the control of invasive plants. Many of the transitional forest zones on the property are around the property edges, areas that already have high invasive plant pressure. The perpetuation of disturbance in these areas will continue to provide establishment opportunities for invasive plants. The investment in both the creation of these forests and the invasive plant control can be thought of in terms of its investment in nesting habitat for song birds such as the golden-winged warbler, chestnut-sided warbler and indigo bunting and dozens of other migrating birds that are in decline because of the lack of this critical habitat throughout New England<sup>3</sup>.



**Hazardous trees and Wildlife habitat:** Dead standing trees and trees with interior rot are important habitat features in an unmanaged forest. These trees are not just a critical part of old forest, but provide habitat for a host of insect and fungus species which form the backbone of the forest food web as well as providing physical structures for bird and mammal species to inhabit. In order to continue to promote cavity tree habitat it is important to retain dead trees whenever possible. Although dead trees can sometimes pose a hazard to visitors they should be kept in place whenever they occur in a location where it is unlikely that they could cause any harm. If trees must be removed then leaving the dead material in place on the forest floor will provide a different type of habitat for a suite of amphibian and mammal species to utilize. While the Massachusetts manual on Best Management Practices does not give specific guidance for snag retention or forested lands they do require snag retention in the context of some biomass harvesting operations in which they require that 5 snags greater than 10" in diameter be retained per acre <sup>4</sup>.

**Gypsy moth:** Over the past several years Massachusetts has had severe gypsy moth outbreaks <sup>5</sup>. Gypsy moths are a non-native insect pest whose caterpillar larva can appear in devastating numbers and eat the entirety of leaves from both canopy and midstory trees and shrub species. While plants are often capable of responding from the loss of their leaf crop in any particular season, multiple years of defoliation or the combination of defoliation with drought or other stressors can kill even mature trees. In a forest area as small as Willard's Woods the loss of a large area of tree cover would be a severe disturbance that should trigger emergency management actions. Control strategies could include such actions as insecticide applications and a plan should be established ahead of time to prevent the need for a reactive management strategy in the event that severe outbreaks occur. A strategy should be developed with the input of a licensed Arborist which establishes a monitoring system and threshold for management in order to determine when the Town of Lexington should take action to protect Willard's Woods from a severe moth outbreak.

**Invasive plant species:** Invasive plant species are pervasive throughout the forests and other natural areas at Willard's Woods. These plants are given special consideration elsewhere and so it will suffice to say here only that they degrade the ecological integrity of the forests where they occur, can reduce the recruitment of new tree growth and are capable in some cases of killing established trees. Management of invasive plant species will be a critical step in attaining any of the management goals laid out in this document.

**Carbon sequestration:** In this age of climate changes many communities are looking for methods for offsetting their carbon footprint. As Carbon Markets increase town managers may also think to look to Willard's Woods for revenue. Managing forests for carbon sequestration can be a complex task to evaluate and often requires trade-offs with other management objectives. The clearest information regarding carbon sequestration is that forests store carbon, and they store it well. Forests in the northeast are storing nearly twice as much carbon as grassland communities and 6 times that which is stored in developed areas. New England forests, and the oak dominated woodlands in particular, sequester greater quantities of CO<sub>2</sub> than the other woodlands types across the whole of the United States because of the forests' structure and species adaptations <sup>6</sup>. A forest has a variety of "carbon pools", such as living tree material or soil organic material, where carbon is stored. Carbon can shift between these pools due to human or natural processes and each pool of carbon has different capacities and durations for storage. Research into maximizing carbon storage through management is difficult to perform because of the complexities of the lifecycle analysis involved. It is known that carbon stored in wood which is used for durable projects such as furniture or housing can remain locked up for over 100 years. Management that focuses on rapidly growing trees for these end uses could

theoretically increase carbon sequestration over other forest uses but is complicated by the emissions outputs involved in the harvesting, processing and transportation of these materials as well as the carbon releases from the impact on forest soils<sup>6</sup>. Unmanaged forests, in contrast, do not facilitate the fastest tree growth rates but do have higher plant densities than managed forests. In addition, unmanaged forests can eventually lead to the death of trees and accumulation of woody material which continues to store carbon on the forest floor and within forest soils.

## Future vulnerability assessment and planning

What the future holds has a great deal of uncertainty but that does not preclude exploring the predicted changes, assessing the vulnerabilities at Willard's Woods and developing plans and strategies to meet or pre-empt future challenges.

Many changes face New England in the coming decades but in particular increased pressure from development, the arrival of insect pests and changes in climate are the most striking. Each of these challenges is unique in its own way and likewise the level of threat which each possess to Willard's Woods is unique.

**Development pressure:** Willard's Woods, as described in the introduction, is already embedded in a matrix of heavy human development. Future development of the property itself could be considered non-existent but the development of the neighboring landscape can't be entirely ignored. In their analysis of the Town of Lexington open spaces updated in 2015 the civil engineering firm VHB identified Willard's Woods as part of a local corridor for wildlife<sup>7</sup>. While Willard's Woods does not have continuous connecting woodlands surrounding it, neighborhood tree cover and open spaces such as William Diamond Middle School help to connect the woodland to other woodland areas including Chiesa Farm, Parker Meadow Conservation Area and the Ada Govan Bird Sanctuary. While the woodland areas mentioned above are not at risk, changes in the tree cover in surrounding neighborhoods could have an outsized impact on the utilization of this connecting corridor system by wildlife.

**Insect Pests:** Non-native insects are not unknown to New England. Within the oak dominated woodlands of Massachusetts many are familiar with the gypsy moth caterpillar. This non-native insect pest can reach incredibly high population levels which are capable of defoliating the canopy of a mature forest. Regionally there are several other insect pests of great concern which include the emerald ash borer and Asian longhorn beetle. Each of these species has a preferred host profile and their impact on Willard's Woods can be predicted based upon the current forest composition. Emerald ash borer is a recent arrival to Lexington<sup>8</sup>. This insect pest has been spreading throughout New England with saddening effect. As the name of this species implies its target host plants are all members of the ash genus. White ash is present on the property but at very low levels. The loss of ash at Willard's Woods, while not inconsequential for the regional forest community, would not have a dramatic effect on the forest cover or species composition of the property due to the minor number of trees present. If community support existed there are system insecticide products which can be used to prevent infestation of a particular tree. Such an application should be done by an Arborist and is a way that Willard's Woods could provide a small refuge during this period of ash devastation. Asian longhorn beetle has been identified at a site in Worcester, Massachusetts, one of only 3 infestations nationwide. This infestation has been managed through a Federal eradication effort which has had an overwhelming positive impact but has been a costly decade long endeavor<sup>9</sup>. The impact of an infestation of Asian longhorn beetle would be severe. The beetle has a wide range of host species which include the maples, ash species, birches, sycamores, willows, poplars and elm species in Massachusetts. These trees

comprise a significant portion of the hardwood species on the property. Despite the severity of the threat the likelihood of infestation is very low and any infestation would be managed with a Federally orchestrated response. Generally the best strategy for the prevention of insect infestations is to educate residents and local industries about the movement of wood products. Asian longhorn beetle was introduced to the Worcester area in pallet stock, while gypsy moth caterpillar and emerald ash borer are both easily transported within firewood. People can move these insects orders of magnitude further than they are capable of flying on their own so the responsibility is in our hands to slow their spread.

**Climate:** Climate change is a global threat with yet unknown implications. Research has provided some regionally scaled modeling for anticipated changes based on global modeling predictions that have some utility in understanding the impact of climate change on eastern Massachusetts. Generally speaking, under all of the climate models New England is likely to experience increases in average temperature and precipitation <sup>10</sup>. Changes in both of these climate phenomenon have some level of variability in the level of change expected but models of precipitation have more variability than those for temperature. Likewise, while research points to the theoretical potential for an increase in extreme weather events, such as high intensity rain fall, high wind events or hurricanes, these uncommon occurrences are difficult to establish a historic baseline for and therefore models are a poor indicator of what to expect in the future. These broad shifts in climate will effect each of New England's forest ecosystems differently. The central hardwood-pine ecosystem which covers much of eastern Massachusetts including Willard's Woods is not a particularly vulnerable ecosystem. Our oak and pine woodlands are at the northern range of a similar ecosystem type that stretches into regions of the country that already experience the type of climate predicted to occur under warming models. It is expected that this forest type will fare better than many of the other regional forest types because of the abundance of drought and warm weather adapted species which are present including the oaks and hickories <sup>10</sup>. Other associated changes from climate change include increases in ice storm damage, moisture stress and drought, high wind events and heavy rainfall events. These associated events may have a greater impact upon Willard's Woods than the general shifts in precipitation and temperature norms predicted under climate change scenarios. Unlike the shifts in climate that can be easily modeled it is hard to predict the likelihood or severity of these associated changes. The best management protocol in the face of such uncertainty is to manage the forest for greater adaptive capacity to better assist it in weathering whatever the future may bring.

## Managing for Adaptive Capacity

In addition to the aforementioned shifts in climate patterns and associated changes, climate change is likely to have an impact on existing stressors including invasive plant species, insect pests and others. While there is no silver bullet for managing a forest in these changing times any efforts that can be made to reduce existing stressors on forests will increase their adaptive capacity. The following management goals have been selected from those identified by the USFS Northern Research Station as opportunities to restore or increase forests' adaptive capacity <sup>11</sup>.

**Maintain or restore hydrology:** Willard's Woods has several areas of open and forested wetlands. As precipitation regimes change, either with alterations of the seasonal timing and type of rainfall or the severity of rain events, the capacity of wetland areas to absorb large amounts of surface water and restore ground water supplies will be important. Efforts that restore wetland areas through invasive plant removal or the mitigation of any existing drainage modifications that may exist from the agricultural legacy of the land would increase the capacity of these wetlands to play their part.



**Maintain or improve capacity to resist pests:** Insect tree pests, both native and non-native, are attracted to stressed trees. Likewise, trees under stress are more likely to die from insect damage. Reducing other stress factors on a tree, specifically competition with neighboring trees, can be a mechanism for reducing a tree's chemical stress signals and increasing a tree's capacity to weather a season insect outbreak such as defoliation by gypsy moth caterpillars.

**Remove or manage existing invasive plant species:** Invasive plant species have numerous impacts on a forest ecosystem including competing with newly established trees for growing space, altering soil nutrient regimes and even competing with mature trees for resources. Invasive plant management is addressed more specifically elsewhere but all of these impacts can harm the existing forest (eg. Asiatic bittersweet vines girdling mature trees) and future forest (eg. glossy buckthorn outcompeting the establishment of climate adapted shagbark hickory seedlings).

**Manage for the threat of wind or storm events:** If the severity of storm events increases or shifts in temperature regimes result in heavy icing events while trees still have leaves it could result in devastating damage to the trees at Willard's Woods. Managing for wind can be difficult but often focuses upon avoiding harsh woodland edges on the face of a mature forest that faces prevailing or winter storm winds and not drastically thinning mature trees which are in an exposed location. In particular, the white pines at Willard's Woods are likely the most susceptible trees on the property to wind and storm events because of their large healthy crowns and height above the surrounding tree cover. While thinning some of the white pine may be necessary in the future to ensure that the remaining trees continue to have enough growing space any cutting should be careful to ensure that the remaining trees are not left exposed on more than 2 sides. In addition, storm damaged trees can increase important old forest characteristics and storm damage should not trigger salvaging activities.

**Promote a diversity of age classes:** While it has been noted earlier in this document that forests of varying age classes are important in providing a variety of habitat conditions it can also be an important factor in increasing adaptive capacity. Just like any "all your eggs in one basket" style recommendation, forests and trees have different characteristics and structures at different points in their development. For simple example, you may recall from Robert Frost's poem *Birches* that the ice storm of the tale has bent over the birch trees "They are dragged to the withered bracken by the load; And they seem not to break"<sup>12</sup> yet research presented at the Monadnock Natural History Conference in 2019 by Peter Palmiotto found that on Mount Monadnock in New Hampshire it was birch trees that suffered worst from the 2008 ice storm which damaged trees throughout the region<sup>13</sup>. The difference between the flexible trees of Frost's playtime forest and the brittle trees on Monadnock was simply age. While young birch trees and other saplings can be bent low under a load without damage, the older paper birch on Monadnock was over-mature and no longer able to respond to the ice loading.

## Conclusion

Willard's Woods is an important part of the forested and open lands in the Town of Lexington. At present the property is providing a wide variety of forest and wetland cover types as well as some variation in forest maturity. It is also a cornerstone of a regional wildlife corridor and is providing habitat types for a variety of wildlife species documented elsewhere in this report. In addition to the current conditions, the property offers management opportunities that can enhance the overall value and adaptive capacity of the woodland, expanding its value to the Town of Lexington now and into the future.

- Old forest structure through snag tree and coarse wood material retention
- Improved woodland habitat value through invasive plant control
- Increased age diversity and young forest habitat creation
- Plan for thresholds and reactions to insect pest outbreaks
- Protect and restore the hydrology of wetland areas
- Act as a part of broader public messaging campaign about timely subjects such as the need to not move firewood

Along with these opportunities the woodlands also face challenges. While the forest is poised to weather some of the clearest changes in climate which are predicted there are still challenges to come for which the forest will need management and support. Steps taken to mitigate the current stressors and to prepare for future adaptive capacity will only increase the forests value to the Town's human and wild communities.

#### End Notes:

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- 5** (pg. 9 ) Gypsy Moth in Massachusetts. <https://www.mass.gov/guides/gypsy-moth-in-massachusetts#-history-of-gypsy-moth-in-ma->. Accessed 3/4/20.
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- 7** (pg. 10) Vanasse Hangen Brustlin, Inc. (VHB). 2015. Town of Lexington Open Space and Recreation Plan 2015 update.
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12 Frost, R. 1949. The Complete Poems of Robert Frost. Henry Holt and Co. New York.

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**Ongoing Management/Stewardship**

	Annually	Every 5 years	Every 10 years
Property visits	x		
Cut young forest habitat		x	
Assess hazard trees for retention or removal	x		
Monitor for insect pest threats	x		
Invasive plant species control projects	x		x
Update to survey and Recommendations			x

**Priorities, Projects, Cost Estimates**

Recommendation	Priority Level	Cost estimate	Variables
Old-Forest retention	High	Low	Requires inaction following storm events and visitor education
Young forest creation	Moderate	High	Invasive plant control required
Insect Pest Preparedness	Low	Moderate	Gypsy moth preparedness is a higher priority than E. Ash Borer preparedness
Invasive plan control projects	High	High	See planning document for priority locations
Restore Hydrology	Low	High	Restoration efforts may not be necessary given the age of the farm drainage structures
Thinning for tree health	Low	Moderate-High	Thinning trees can promote health and reduce risk of disease and insect damage, but is at odds with management for carbon sequestration



Town of Lexington

# Willard's Woods Wildlife Assessment



*Observations, Interpretation and Management  
Recommendations*

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March 2020

## **Introduction**

When it comes to wildlife, Willard's Woods is an important tract of open space land nestled within a highly developed urban/suburban landscape. The town of Lexington itself sits just to the northeast of what quickly becomes the concrete jungle of the inner Boston area. Willard's Woods, along with a few other scattered areas of greenspace throughout the town, create an essential network of habitat resources utilized by many wildlife species. It is within these core areas, with the help of residential backyards, small stream corridors, rail trails, bike trails, and powerlines, that the wildlife in this area are able to move around in order to piecemeal together the resources they need to survive.

## **Assessment Methods**

The Willard's Woods wildlife assessment was conducted over the course of four and a half months, running from mid-November 2019 through the end of March 2020. Because of the time of year this survey was executed, the focus of the assessment was on small-medium and large mammals, with a few exceptions. The methods utilized included: Track identification, wildlife camera trapping, sign and spoor observation, and visual/auditory confirmation. These methods can be used to collect data quantitatively, qualitatively, or both, depending on the purpose and scope of the study. The goals for the Willard's Woods wildlife assessment were to identify as many of its wildlife residents as was feasible during the winter months, get a sense of activity levels of its key members, and to observe where and how they are utilizing the property. For this assessment, all data and observations collected was done on a qualitative level for the purpose of educating the town and its residents about the wildlife they are sharing Willard's Woods with.

### Track Identification

Winter snow tracking in the northeast is an effective way to determine species presence/absence, activity levels, frequency of occurrence, and movement patterns within an area of interest, or across a larger landscape. This method can be used on a quantitative level by running line transects and collecting data on only those species who cross the lines, or, qualitatively by exploring a property more holistically and collecting observational data as you encounter it. Either approach, when taking tracking data for a set purpose, requires specific snow conditions in order to collect quality data, and to get a more accurate sense of activity levels of the animals

moving through the landscape. The recommended protocol is for tracking to occur 24-48hrs after a significant snowfall event, usually at a minimum of 3 inches to ensure a more even snow cover. This re-sets the canvas so to speak. You can track animals at any time but may not get an accurate representation of activity levels or number of individuals unless you follow a protocol. For example, you may come across an area that is covered with coyote tracks and assume that there is a high number of these animals living there. But, if it has been several weeks since the last snowfall, what you might be seeing is one or two individuals moving through or utilizing the same area every day. Animals are creatures of habit.

Ideally, the winter snow tracking method would have been utilized over the course of the entire four-and-a-half-month assessment. However, the 2019-2020 winter season in Massachusetts did not produce any significant snowfall aside from one early season storm. This meant shifting to more mud and leaf litter tracking/trailing and putting more of a focus on wildlife camera data collection.

### Wildlife Camera Trapping

The use of wildlife cameras on a property is an excellent way to collect data on wildlife with minimal disturbance or disruption to the animals. Not only can it be used to confirm track observations, it can also be used to investigate areas of interest, habitat types, resource features or areas of concern. There are also many species that are difficult to track, especially if they are small, lightweight, or moving through leaf litter conditions, or across hard substrate. Wildlife cameras provide a way to explore other options for data collection.

Wildlife cameras were deployed starting in mid-November and were rotated to different locations in Willard's Woods until the end of March. In total, there were six separate locations where cameras were set up throughout the property. Locations were chosen to represent different habitat types, resource areas, and points of interest based on field observations. All were set back away from trails and the bulk of human traffic. These areas covered the northeast shrub wetland, northeast oak upland, a northeast den site, the southwest oak upland, a southeast wet meadow, and the white pine forest.

### Sign & Spoor

Sign and spoor observation and identification go hand in hand with tracking. Sign and spoor



cover all the other pieces of evidence left behind by wildlife. This evidence includes things like scat, deer antler rubs/incisor scrapes on trees, midden piles, scent scrapes, browsed foliage, bedding sites, dens, game trails, holes/tunnels, kill/feeding sites, bones, etc. Basically, anything that gives proof an animal was there. These observations help to flesh out the story of who is living on or using a property, and what behavior they are engaging in while they are there.

### Visual/Auditory

Finally, there are the wildlife observations and identifications made directly through sight and sound. Wildlife professionals and enthusiasts are not often rewarded with actual encounters, and if acting responsibly, do not seek them out except at safe distances where the animals can be observed but not influenced. When sightings do occur, such as coyote pups at the edge of a field, a red fox skirting the edge of a shrubland, or a black bear turning to run deeper into the forest, it is a true gift. Of course, in the greater Boston area, we are more likely to see the wildlife exceptions such as the grey squirrel or chipmunk that are habituated to human presence, but it doesn't mean a rarer sighting won't occur from time to time, or that certain species aren't living on the landscape. Auditory identification is also possible, particularly for bird species if you are familiar with their songs. Mammals can also be identified this way, though for certain species, if you can hear them and know who it is, like a black bear grunt/huff for instance, you are too close and do not want to catch them unaware. Some, you may hear from a distance, like coyote howls, red fox barks/screams or chipmunk chirping.

## **Results & Interpretation**

### Present Day Species List

This list represents only species that were positively identified during the assessment period. There are many other species that live on and utilize the Willard's Woods property, but they cannot be added to the list without observational confirmation. Because of the time of year and brief period that this survey was conducted, this list shows only a snapshot of the creatures that represented, and as mentioned prior, is mainly focused on small/medium to large sized mammals with a few exceptions. It is recommended that the list continue to be added to by wildlife professionals and that the public continue to share their own observations and sightings for confirmation. Including future surveys of birds, reptiles and amphibians would also be of great

benefit in order to truly understand the health and functioning of the habitat mosaic and ecosystem that is Willard's Woods.

### Winter 2019-2020 Species observations

#### **Birds**

Red-tailed Hawk	American Crow	Turkey
Robin	Tufted Titmouse	
Mourning Dove	Great Horned Owl	
Blue Jay	Black Capped Chickadee	

#### **Mammals**

Coyote	Deer mouse	Chipmunk	Skunk
Eastern Cottontail	Red Squirrel	Raccoon	
White-tailed deer	Grey Squirrel	Opossum	

A full historic species list was provided by conservation steward David L. Kaufman and can be viewed in Appendix B.

### Cameras Tracks, Sign & Observations

As described in the methods section, there were six separate locations at Willard's Woods where cameras were set up over the course of a four-and-a-half-month period from mid-November 2019 through the end of March 2020. Photos and video footage captured on these cameras revealed a significant amount of wildlife activity, even over the more dormant winter months. Not surprisingly, grey squirrel was the number one Willard's Woods celebrity caught on camera, with white tailed deer coming in a close second. Species such as raccoon, Eastern cottontail and Eastern coyote also made significant appearances. Others include red squirrel, chipmunk, opossum, skunk, deer mouse, blue jay, tufted titmouse, crow, red tailed hawk and domestic dog. See Appendix A for camera capture highlights.

Tracks were found and identified more randomly because of the lack of snow this season. Tracking data was collected as they were observed over multiple days during other data collection visits. Species identified through their tracks included opossum, raccoon and white-tailed deer. Other tracks were also noted, but because of substrate conditions and age, identification to species was not possible. Physical sign also helped to flesh out and confirm the list of species and level of activity found at Willard's Woods. Midden piles were found all over

the property, most likely left by chipmunks based on the pile location and characteristics. Scat was also noted in several places identified as raccoon, coyote, deer and cottontail. Well-worn game trails were noted in a few areas, most likely utilized by several different species, as well as older antler rubs/incisor scrapings, and two potential kill sites/feeding locations were observed. Further, a den site was located on the property. Though there was no evidence over the winter of it being actively used, by the end of March it had been excavated out and seemed to be active. Based on the size and location relative to activity observed, it is possible that it is an active coyote den site being prepared for pup rearing starting this April. Finally, Great horned owl was identified through auditory confirmation. Though many visitors to Willard's Woods shared their sightings of these birds with me, I did not get to observe one during my time on the property. However, after a long field day, racing the sun as it started to set for the day, I was rewarded by the pleasant sound of their hoots as I made my way back to the car. Further auditory confirmations partnered with visual observations were from red tailed hawk, black-capped chickadee, mourning dove, and crow.

The species documented are those I would expect to be living and utilizing the Willard's Woods property. Most of them, are what I would classify as urban wildlife. Those species that have adapted and thrived living in and around human development, activity and civilization. I would like to describe and comment on a few of these observations a bit further.

Raccoon – This species was observed in multiple camera locations and were highly active throughout the property. There are a couple public health and safety issues to note with a high level of raccoon activity. The first, is that raccoons are the primary host of the intestinal roundworm (*Baylisascaris procyonis*) which can be found in their feces. It is transmissible to both humans and dogs and can cause serious infection leading to major neurological impacts. Visitors with dogs should be extra cautious and remain on trail to prevent them from picking up this dangerous roundworm. The second issue to be aware of is that raccoons are one of the primary carriers of the rabies virus. Though it is not uncommon for racoons to be out and about during the day, be cautious and stay away from the animal, and keep pets close. Infected raccoons will display abnormal and erratic behavior such as staggering, wandering aimlessly, have discharge around the eyes and mouth, or show other distress. If you see a raccoon (or any other animal) that seems



distressed at all, leave the area, and contact town animal control immediately.

Coyote - The presence of coyote at Willard's Woods is not at all surprising. This species is highly adapted to living in developed landscapes and has gotten used to human activity out of necessity. This property provides a nice refuge for these animals and a bit of a break from navigating backyards, crossing roads/dodging traffic, being chased and barked at, or in some cases shot at, poisoned and trapped. Though visitors may see these animals from time to time at Willard's Woods, they would prefer to go about their business without interacting with humans at all. Tucking themselves into the woods and wetlands of this property allows them that reprieve. Camera captures revealed exactly that type of behavior.

Coyote activity does indeed seem to be high at Willard's Woods based on camera footage. In addition to the potential denning site mentioned previously, other areas were identified as sites where these animals are periodically bedding down for the evening. There are also areas where they seem to just be moving through. In the areas where coyotes were observed settling down for the night, up to four individuals were seen together at the same time on a few occasions. What is most likely being captured on camera in these cases is a mating pair accompanied by members from a previous litter of pups. This means that there is a family group of coyotes utilizing and living in Willard's Woods at least part of the time, and that sightings are not just only individuals travelling through. More resources on coyotes is provided in the Recommendations section and in Appendix E.

Additional information – Since Willard's Woods has such a high level of wildlife activity and is also a highly popular location for the public to walk their dogs, dog owners should make sure to talk to their veterinarians about preventative vaccine options. Many dog owners already know the importance of having their dogs vaccinated for Lyme disease, but some may not be aware of a second vaccine for Leptospirosis. Leptospirosis is caused by bacteria that can be carried by raccoon, opossum, mice, rats, skunks and white-tailed deer. It can be contracted through animal urine or contaminated water and soil. Leptospirosis can also infect humans. Though rarer, when infected, symptoms can be

mistaken for other ailments. If untreated, there can be major impacts to the organs, spine and respiratory system.

## **Further Discussion**

### Connectivity

The overall suburban landscape of the town of Lexington does not provide much connectivity of habitat for wildlife movement or include enough open space land to support any significant functioning wildlife corridors. The University of Massachusetts has assessed the ecological integrity of all the state's land and water through the Conservation Assessment Prioritization System (CAPS) ecosystem-based model. There are only small, scattered areas in Lexington that are highlighted on this index and they are all highly fragmented from each other. One of these areas is Willard's Woods. This index is included in Appendix C. There are however some potential locally functioning corridors in the Willard's Woods area that may be helping facilitate wildlife movement. Although these locations are not classified as having ecological importance, they are still providing some level of cover for these animals. One possible local corridor of movement may be between Willard's Woods, the Diamond Middle School, and Chiesa Farm. Though still highly developed, these areas show enough tree cover and green space to potentially support some level of wildlife movement. There is also the possibility that some species, like the coyote, may incorporate the Ada Govan Bird Sanctuary and Lower Vine Brook area, though Adams Street and Grant Street seem significant enough barriers to deter many species. Finally, there are areas of greenspace and wetlands north and east of North St. that are most likely being utilized along with Willard's Woods by larger species like coyote and deer, though again, the traffic on this road is most likely influencing the behavior of smaller species. It would be interesting to collect roadkill and crossing data at these locations to see if animals are attempting to connect these areas and if so, what species. There may be opportunities at one or both crossings to help facilitate movement, especially near the Fiske School.

### Urban Wildlife Behavior

As mentioned previously, Willard's Woods is home to mainly what are considered urban wildlife species. Those who have been able to adapt to living in and among highly developed areas and high levels of human activity. These species, however, are also found in the more rural and

wilder parts of Massachusetts. There is an important distinction to consider here. Though similar in many ways, these animals may display differences in behavior depending on what type of environment they are living in. That is because each is facing a different set of stressors and pressures in order to survive. For instance, coyotes living in a suburban landscape have far less land to utilize for resources, and more territorial pressure from other coyotes because they are forced to live in a much more concentrated scenario. That means that territories and home ranges tend to be smaller and much more fragmented than would normally be seen in a more open landscape. It may also mean that overlapping territories between individuals, or between different species are more common. You also start to see differences in how and when the animal uses the landscape. You may notice wildlife out more frequently during the day or poking in and out of residential neighborhoods and yards more often. Further, species that prefer to be out hunting during dawn and dusk normally, may need to shift that behavior in order to avoid human interference or interaction and pressure from other animals. This is all because these animals are trying to find a way to utilize their landscapes opportunistically and partition resources with other individuals and other species. They are trying to get the resources they need while navigating around a high level of human activity, and higher densities of other individuals and other species. Finally, wildlife living in more developed areas are much more habituated to human activity. A normally fearful or shy animal may display indifference, or even boldness around humans in an urban/suburban setting. Overall, when trying to understand and manage wildlife in these developed landscapes, it is important to realize that the known natural history and behavioral information on a species may not accurately represent what is happening with these animals on the ground.

## **Recommendations**

The Human Wildlife Interface – Considering the high activity and diversity of wildlife residing in and moving through Willard’s Woods, as well as the high level of public activity on the property, it should be no surprise that the human wildlife interface is of concern. The wildlife that utilize this landscape are already under extreme stress and pressure from surrounding development and varying types of human disturbance. They are finding a way to piecemeal together the resources they need in order to survive, and Willard’s Woods acts an oasis of sorts for many of these animals. The human visitors to this property are also utilizing Willard’s



Woods in a very similar way. It becomes a natural refuge from the stressors and pressures of the urban landscape outside its boundaries. Part of the reason why this is the case for so many is because of the natural landscape it provides and the connection to nature. A major part of that is the wildlife that live here. That said, it is up to the public that use this property, as well as its managers, to be the stewards of the land and the wildlife within. There will always be varying levels of stress at this interface. Light, noise and physical pollution, edge effects, habitat degradation, wildlife/human interactions/concerns, and worries for dog walkers. But there are ways that everyone can help maintain a balance so that wildlife, humans and dogs alike can coexist safely and continue to enjoy this property in a healthy way.

The main recommendation to keep the peace at this interface is to keep dogs on trails. The Town of Lexington allows dog owners the privilege of off leash hours for their beloved pets to stretch their legs, but this comes with a price when dogs are allowed free rein through its woods and wetlands. Keeping dogs on trails still allows plenty of room to run and get exercise. It also helps keep dogs safe from unwanted wildlife interaction and possible disease transmission as well as gives wildlife a safe place to be on the property. Every time I visited Willard's Woods, I observed at least one dog being allowed to charge full tilt in and out of these resource areas. I also observed, in some of the properties more remote sections, dogs running up to, and past the wildlife cameras. Some of these locations were near active den and bedding sites. Allowing this sort of behavior not only puts the wildlife at risk, it puts the dogs at risk of having an unwanted, potentially dangerous encounter, or picking up a dangerous disease/infection. Further, it poses potential issues with other dogs that may not be as outgoing, energetic, or friendly. If a dog is well trained enough to be considered safe/have proper behavior and etiquette for off leash adventures, then keeping them on trail and close by should not be a problem. If a healthy balance is to be maintained between wildlife and the public at Willard's Woods, then wildlife need to have safe places to nest, feed, forage, rest and sleep, away from as much human influence as possible. The trail network on this property is quite extensive and already allows plenty of places for people and dogs to roam, play and enjoy the land.

A second recommendation to maintain a healthy balance at Willard's Woods is to establish an interpretive program for the public so that they can be educated and informed about how to safely share the space with wildlife. Kiosk bulletins, trail signs, information on the town

website, brochures, and even small informational workshops on site, can help build understanding and guide behaviors to maintain a healthy interface. For instance, many visitors to the Willard's Woods property expressed concern over the presence and high activity levels of coyote on site. This was particularly true for dog owners. Coyotes are not considered to be aggressive animals, and very rarely attack humans or most dogs unless under extreme stress. An exception to this would be for small dogs off leash (which can trigger predator prey behavior) or large dogs that get too close to dens or encroach into coyote territories. Coyotes, like most wildlife, would much rather prefer to avoid confrontation and be left alone. That said, they are still a larger wild animal, and there are things visitors can do to keep their dogs and themselves safe from an interaction. Mainly, as mentioned previously, keeping dogs close by or on leash, not allowing them to run into wildlife resource areas, maintaining safe distances, and if off leash making sure dogs have good recall training. If you observe a coyote on the property, walk the other way. If you have a large dog with you, call them to you and leash them if they aren't already. If you have a small dog with you, pick them up. These suggestions hold true for almost all significant wildlife observations: coyote, raccoon, skunk, opossum, deer. Even with squirrel, chipmunk, rabbit and bird sightings. Though these smaller residents do not necessarily pose a threat themselves, dogs should not be allowed to chase or harass them. More resources on living safely with coyotes are included in Appendix E.

Concern was also expressed from the public that the Great horned owl nesting site may need further protection. It was observed that due to storm damage that the nest is now much closer to the ground. If these birds do decide to continue using this location to raise their chicks, it is recommended that the area be roped off in some way during this time. Incorporating educational signage to this restriction will help visitors understand its importance in protecting these birds from disturbance or harm.

A final recommendation is to consider and implement as much invasive plant management and habitat restoration on the property time and budget will allow. These management recommendations are found in the main Ecological Land Management Report. Establishing healthy habitats and supporting functioning ecological systems will lead to a more stable, diverse and robust set of species. It will also help build resiliency to environmental impacts, human

impacts, and to continued shifts due to climate change.

## **Conclusion**

In conclusion, Willard's Woods is a very special place for the wildlife that call it home, and for its human visitors. In an area that does not have a lot of open space left, it is a critical landscape that provides essential resources for the survival of local wildlife and the wellbeing of its human visitors. Understanding the animals that live here and the pressures that they face is necessary to create a healthy balance for everyone. If the town and the public embrace education and stewardship of this landscape it will be possible to conserve its resources, maintain and provide healthy habitats, and support and encourage a diverse set of species on the Willard's Woods property for years to come.



## Appendix A. Wildlife Camera Captures













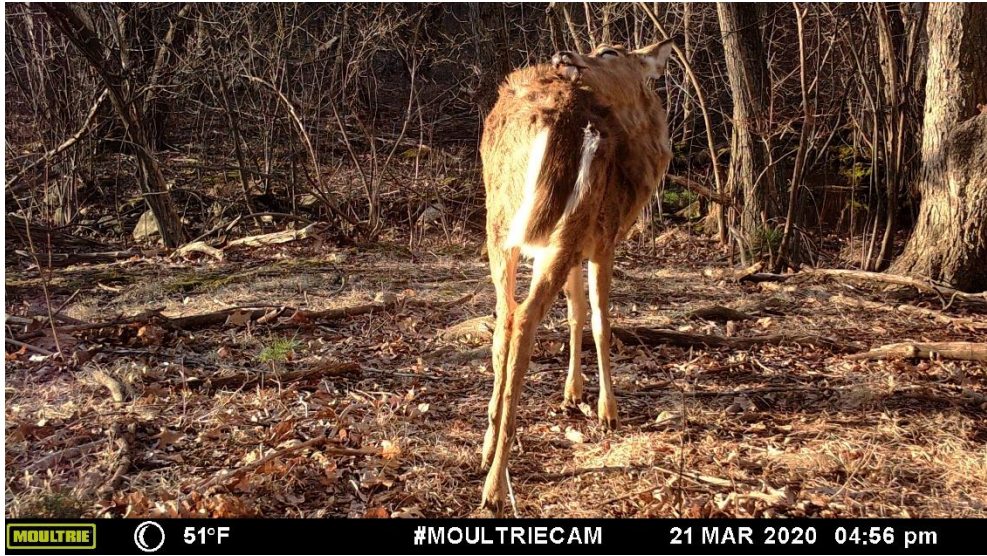




















## **Appendix B. Historic Species List**

The following species list was provided by David L. Kaufman, conservation steward for the town of Lexington. This list is based on observations made on the property over the last 40 years. Some of these species are full time residents, while others were most likely just passing through. Abundance, diversity, and frequency of visitation have also shifted over time. Not all species represented on this list continue to use the property or live in the surrounding Lexington area due to environmental changes, land use shifts, landscape fragmentation, and habitat quality degradation.

### **Birds**

Red-tailed Hawk	Red-breasted Nuthatch	Starling	Eastern Kingbird
Ring-necked Pheasant	Brown Creeper	Northern Oriole	Chimney Swift
Rock Dove	Carolina Wren	House Finch	Wood Thrush
Robin	Gray Catbird	Purple Finch	Hermit Thrush
Mourning Dove	Mockingbird	American Goldfinch	Yellow Warbler
Downy Woodpecker	Brown Thrasher	Rose-Breasted Grosbeak	American Redstart
Hairy Woodpecker	Cedar Waxwing	Great Horned Owl	Yellow-rumped Warbler
Common Flicker	Tennessee Warbler	Mallard	Black-throated Green Warbler
Eastern Phoebe	Black Throated Blue Warbler	Wood Duck	Ovenbird
Tree Swallow	Common Yellowthroat	Canada Goose	House Wren
Barn Swallow	Indigo Bunting	Wild Turkey	Song Sparrow
Blue Jay	Northern Cardinal	American Woodcock	White-throated Sparrow
American Crow	Tree Sparrow	Barred Owl	Swamp Sparrow
Black-capped Chickadee	Dark-eyed Junco	Eastern Screech Owl	Great Blue Heron
Tufted Titmouse	Red-winged Blackbird	Red-bellied Woodpecker	Eastern Bluebird
White-breasted Nuthatch	Common Grackle	Great-crested Flycatcher	

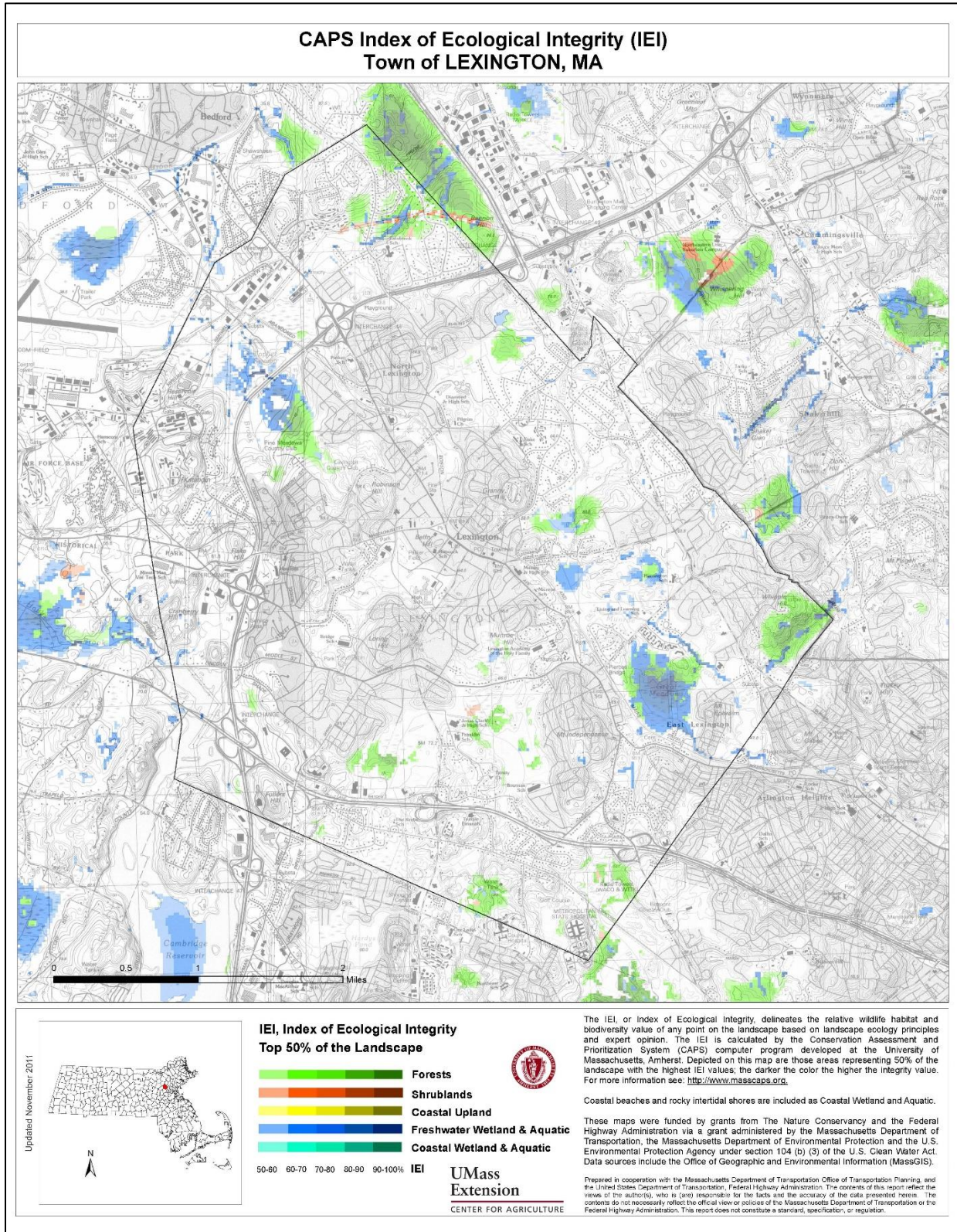
### **Mammals**

Coyote	Vole and field mice	Red and gray squirrel
Red Fox	Bat (sp?)	Chipmunk
Skunk	Opossum	White tailed deer
Rabbit	Fisher	Raccoon
Muskrat	Weasel	

### **Reptiles & Amphibians**

Garter snake	Leopard Frog
Turtles	Spring Peeper
Bull Frog	Toad

# Appendix C. UMass Conservation Assessment Prioritization System



## Appendix D.

### References:

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## Appendix E.

### Coyote Resources:

Mass Wildlife:

<https://www.mass.gov/service-details/learn-about-coyotes>

*\*Many links and informational pdf's available here.*

Urban Coyote Initiative:

<https://urbancoyoteinitiative.com/10-fascinating-facts-about-urban-coyotes/>

*\*Comprehensive look at the coyote human interface in urban areas.*



## WILLARD'S WOODS UNIVERSAL ACCESSIBILITY TRAIL ASSESSMENT

By Conservation Works, LLC  
December 28, 2019  
**REVISED: 3/23/2020**  
**REVISED: 6/14/2021**

**Introduction:** Conservation Works, LLC (CW) was contracted by Land Stewardship, Inc. to conduct a feasibility study on the potential of a trail route at Lexington's 100-acre Willard's Woods Conservation Area for upgrading to a universally accessible (UA) trail. This report contains CW's findings and recommendations.

**Findings and Recommendations:** The Willard Woods Trail Plan Map included in the file depicts the route CW staff hiked during our initial field reconnaissance (November 21, 2019) with Jessica Applin from Land Stewardship, Inc and Jordan McCarron of the Lexington Conservation Department. It is the same route for which CW staff later completed a detailed trail assessment (December 23, 2019). During the initial field reconnaissance, Dick O'Brien, CW's lead trail designer visit, indicated that he saw no conditions that would preclude that route from being upgraded to a UA trail, **but upon completion of a detailed assessment (feasibility analysis), CW is of the opinion that the route we hiked and evaluated is not the best alternative for a UA trail on the property. On March 20, 2020, CW staff staked out, flagged, and mapped an alternative route for a UA trail loop in the large meadow just south of the North Road trailhead. This proposed UA trail has been re-staked and flagged on June 11, 2021 per request of the Conservation Department.** Included with this report are the two maps relevant to this report: the Willard Woods Trail Plan Map that depicts the initial route taken by CW and others and the Willard Woods UA Trail Map depicting the UA trail route being proposed by CW. Below are our reasons supporting this conclusion:

**The Trail Configuration and Length are Not Conducive to Handicap Use:** The initially designated route follows an "out and back" trail configuration - the user hikes out to a destination or location and then returns to the starting point by retracing their route. For this proposed trail, the user would travel over a mile to get to the Diamond Middle School trailhead and then return to the North Road trailhead by the same route – a total distance of approximately 2-1/2+ miles. Most wheelchair users are not looking for that extensive a trail experience. Additionally, the more user-friendly trail configuration is a trail loop. One that begins at one spot and loops around to the beginning without having doubled back on itself. Trail loops of ½ mil to 1 mile are more user-friendly and used more often than longer loops or out and back trails.

**The Existing Trail Grades Would Require Several Trail Reroutes and significant new disturbance to the wooded habitat on the knoll.** At 7 different locations along the existing proposed route, CW found running grade conditions on the existing trail that exceeded the recommended standards for UA trails. In 5 out of the 7 situations, running grades exceeded 12%. While none of these is sufficient to seek an exemption or preclude re-routing the trail to provide running grades that comply with the national accessible trail guidelines, the required trail re-routes

are lengthy (with some as long as 400'), would add thousands of dollars to the construction cost of the trail, and significantly increase the overall disturbance and impact of the trail through this wooded knoll area between the North Street entrance and the Brent Road entrance. For these reasons we recommend using the proposed route that connects from the proposed UA loop trails over to Brent Road trail entrance.

**The Existing Boardwalks and Bridges Need Renovation:** referring to the 2 bridges and 3 boardwalks on the route in question; all of them fail to meet current UA trail standards for bridge and boardwalk structures. While the bridges require minimal corrections to achieve compliance, the boardwalks will require extensive work to meet the guidelines and preferences of Lexington officials. The top decking and framework for the deck will have to be removed from the existing boardwalks and redone to provide a minimum 3' wide travel surface with required edging to keep wheelchair-bound users from falling off the structure. To minimize the impact of the boardwalks being low to the ground so as not to trigger the need for railings, CW would propose using molded PVC mesh grating with an imbedded grit surface for traction. This decking allows 70% light through the grate to minimize the impact to the native vegetation beneath the boardwalk. All this work can be done, but the material and labor costs would be relatively high.

**A Better Alternative Exists on the Property:** CW believes that a UA Loop Trail can be constructed in the meadow just off North Road that would be used more frequently by the intended user groups, would cost considerably less to build, and would impact the property less!

CW Proposes an Alternative UA Trail Loop in the shape of a figure 8 trail loop. This UA trail that would begin and end at the North Road Trailhead and be roughly .42 miles. See the included map (Willards Woods Proposed UA Trail Route) for this proposed trail layout and the resting/viewing areas along the trail. One of the features of this configuration is that it actually consists of 3 loops; Loop 1 (the shortest' loop at .22 miles) that loops around to the west from the main trail, Loop 2 (the next longest at .33 miles) that flows to the east from the main trail and Loop 3 (the longest at .42 miles) the includes both the outer segments of both Loop 1 and Loop 2. This layout gives the user multiple choices for their outdoor experience on any given day. CW is proposing this because the initial route was:

- **it provides 3 distance options for handicap users.**
- **it will be less than ½ the cost to construct compared to the initial proposed trail route**
- **does not include traveling over the same trail on the same trip**
- **should cause minimal impact to the flora and fauna on the property**
- **much simpler and quicker to install**

CW recommends that this UA trail consist of a 6' compacted gravel trail built on top of the existing grade with a base layer of coarse gravel (4"-6" of 3/4" graded base), a geotextile fabric (4 oz, non-woven type), and a finish layer of 4"-6" of 3/8" crusher fines (P.J. Keating "Cart Path" mix). The Town of South Hadley recently completed a UA trail built to these specifications right along the banks of the Connecticut River. The "River to Range" UA trail has been well received and is getting lots of use. This base layer and finish layer would be compacted separately using a vibratory roller. The edges of the trail would transition down to the existing grade using screened loam, lightly compacted, and seeded with a NE Conservation Mix grass seed. In addition to the basic UA trail, CW is also recommending creating 6 new seating/resting/viewing areas along these loop trails as well as upgrading the existing picnic table/firepit area. These areas will either be right along the UA trail or accessed by means of short spur trails – all of

which are handicapped accessible. While the options for what these areas look like and what materials are used are numerous, they should all be designed and built to be handicapped accessible as well! These could be great opportunities for public donations for potential “memorial” seating/resting areas. Benches of powder-coated cast iron, granite, or heavy wooden structures that are anchored into the ground resist degradation from the elements, both natural and manmade! The settings for these benches/viewing areas have been carefully selected to already be “anchored” by some natural feature like a large, mature tree, a grove of trees, a stream, or a rock outcrop, but additions to these sites if sensitively done, could add to the user’s enjoyment of the trail and their experience on it. In addition to the creation of a UA trail loop, CW recommends the following improvements to existing trail features and amenities:

**Existing Conditions at Trailhead Areas:** Whether the initial route or the alternative route is developed, users will continue to access the property using three trailhead areas. CW found each of these lacking with the structures dated and in poor repair, with poor overall layout and placement of features. CW recommends upgrading all three of the trailheads on this property. They are; the main parking area and trailhead off North Road, the secondary trailhead off of Brent Road, and the third trailhead at the Diamond Middle School. Below are our detailed findings relative to these three trailheads:

The North Street Trailhead:

- The trailhead and parking area off North Road are easy to find and access down the gravel driveway is safe and clear
- Gravel surface of parking area is dry, firm, and level, but surfacing material is not to accessible trail standards
- The entrance sign on North Road is acceptable for users to find their way to this property, even those from out-of-town
- The size of the parking lot is more than adequate for the volume of traffic we encountered on the two times we visited the property and there was room for several more cars (capacity: 20 vehicles)
- No identified “handicap parking” spaces or signs to indicate where they would be (Photo 3)
- Large hazardous White pine on the right corner of the driveway just as one enters the parking area. the lean of the tree indicates in will fall towards the parking area. Should be removed before it causes injury or damage.
- Trash can is the first thing users see as they enter the trail
- Aging dog regulation sign is the next structure visible to users
- Unimpressive trailhead kiosk with unappealing map and trail information

The Brent Road Trailhead:

- Limited roadside parking
- Entrance easy to find
- Trail is level and firm but does not meet UA standards
- Signage is adequate but not visually appealing, not well-designed or well laid out at entrance
- Trash receptacle the first item users see at this entrance



#### The Diamond Middle School Trailhead:

- Trail surface material from the parking area to the beginning of the boardwalk does not meet UA standards
- Directional and enforcement signage is present, but the trailhead lacks a formal kiosk
- The running grade of the trail is 14% from the school parking area down to the beginning of the boardwalk

**Recommendations for Trailhead Areas:** While the three trailhead areas on this property are adequate, CW recommends enhancing the look and amenities at all three trailheads. This includes more stylish and more informational kiosks, better visual and practical layout of the entrance signs, kiosks, dog walking signs and ancillary structures and to make all of this UA compliant. As an example, TimberHomes LLC ([www.timberhomesllc.com](http://www.timberhomesllc.com)) produces custom made post and beam wooden kiosks that would add to the aesthetics and functionality of this structure. Additionally, they produce smaller kiosks for interpretive and regulatory signage that would provide a consistent look throughout the property.

With regard to handicap parking areas, CW recommends outlining on the ground two spaces for handicap vans; one on either side of the trail entrance at North Road and two side-by-side at the Brent Road parking area. The outlining can consist of 8'x20' rectangles created by installing granite curb stone flush with the ground for both parking spots (The Old Manse, Concord has done this in their visitor parking area). Appropriate handicap parking signage should be posted at the front of the parking spot. Within and around these two areas, the surfacing should meet accessibility guidelines and not have particles larger than 1/2" in diameter. This surfacing should connect directly to the start of the trail. Access to the trailhead kiosk and the "mutt-mit" station should be made handicap accessible as well. The kiosk should be the first thing users see and with which they interact. Any Rules and Regs signs, trash receptacles and dog-walking amenities should be placed further in from the entrance. All should be accessible from the trail for wheelchair-bound users.

**Existing Conditions at Bridges:** The two bridges on this property are not in bad shape. Since only the Excel Bridge will be experiencing handicapped traffic, that will be the focus of this assessment.

#### Bridge 1 (PT lumber, 6" width, 25' length, 42" railings)

- Good, sturdy PT wood bridge, but does not meet the technical standards for a UA trail
- The gaps in the deck boards are > 1/2" standard allowing for the possibility of the front wheels of a wheelchair to get stuck in the gap between two decking boards
- The spacing between the side rails on the railings are too wide allowing for a young child to slip or slide through them down into the stream below.
- The lip at both ends of the bridge creates a potential barrier to wheelchair users

#### Excel Bridge (Steel and concrete bridge, 10' wide, 25' long, concrete abutments)

- Designed to accommodate vehicle crossings as well as pedestrian traffic
- Railings meet UA standards for height and openings
- Concrete surface is solid, firm and smooth for wheelchair users
- The gap between the bridge deck and the bridge abutment on both ends of the bridge are wider than allowed by the UA trail guidelines

**Recommendations for the Bridges:** CW recommends the following work for the Excel Bridge near the Brent Street Trailhead.

- The Excel metal/concrete bridge is in fine condition as it is relatively new. The one area of concern is the gap between the deck of the bridge and the concrete abutments. The gap is greater than the ½” allowed by code. CW recommends that a flat metal 4” strip could be welded to one side of the bridge to cover the gap and eliminate the possibility of wheels getting caught in this gap. This would still allow the bridge structure to shrink or expand due to the temperature and would not impact travel over the flange. The railings on this bridge meet the guidelines and the concrete decking is great!

**Recommendations for the Boardwalks:** Since the UA trail will not be following this section of trail with the boardwalks, CW did not see the necessity of including an assessment or recommendations on these structures

**Trail Grades:** While running trail grades would be an issue on the initially designated trail, running grades will not be an issue on the alternative trail route.

**Viewing Platform** - As a part of this trail enhancement project, Lexington officials expressed a desire for a viewing platform on the boardwalk closest to Diamond Middle School. CW recommends a platform large enough to handle a classroom of children (approximately 25-30). It should also have benches around the outer edge of the platform so the students can sit and listen to teachers or naturalists presenting information. The location of benches on the outer edge of the platform suggests the need for railings that would prohibit younger children from climbing up on the benches and falling over them into the marsh. The railings should be no higher than 42” so that future wheelchair users would have a line of sight over the railing. CW would propose a 6’-sided octagon that is split down the middle by the 6’ boardwalk. The benches would facilitate educational use of the trail while also providing benefits to other users. The existing boardwalk from the access at Diamond Middle Scholl to the viewing platform would have to be redone to meet UA code.

**Trail Signage:** CW recommends greater use of the metal trail signs shown in the photo to the left. They should be installed on posts at each trail intersection at a minimum.



The image below shows another example of an effective, easy to maintain signage system used in the City of Leominster’s trail network. It uses metal signs and PT posts & provides a mini-map attached to the angled top of the post. This map shows the trails and all the numbered trail intersections on the trails. Below the mini-map is the trail Intersection # and below that are directional arrows and distances to the next closest trail intersection or feature. This system has worked very well for the City and has all but eliminated lost hikers in its 2,000-acre watershed area. The signs are made of aluminum and attached to 6x6 PT posts with vandal-resistant stainless-steel screws and an epoxy adhesive. The posts are set 3-4’ in the ground using a traditional “deadman” anchor to keep the posts from being removed from the ground.

**Brent Rd. Trail Connection:** Connecting from the side of LOOP 2 over to Brent Road is possible using the same trail construction approach as is recommended for the accessible trail loops. A layer of compacted graded base, covered with a 6' wide sheet of geotextile, capped with a compacted layer of Cart Path (3/8" crusher fines) would produce a compliant, accessible trail that could flow to the Excel Bridge and then to the Brent Road trailhead. The sides of this upgraded trail would need to be sloped down to meet the original grade with loam and then seeded with a NE conservation mix of grasses. Given the intended user group and the length of this trail, CW recommends that 2 or 3 benches be placed along this trail to give users a chance to rest and enjoy the property.

**Approximate Costs:** Given the length of trail proposed for upgrading to accessible standards and the length of newly constructed accessible trail, the upgrading of the three trailhead areas with new amenities, the creation of a new accessible parking area off of Brent Road, the accessible viewing areas/benches; CW estimates that the cost of this work would be approximately \$150,000 to \$200,000.



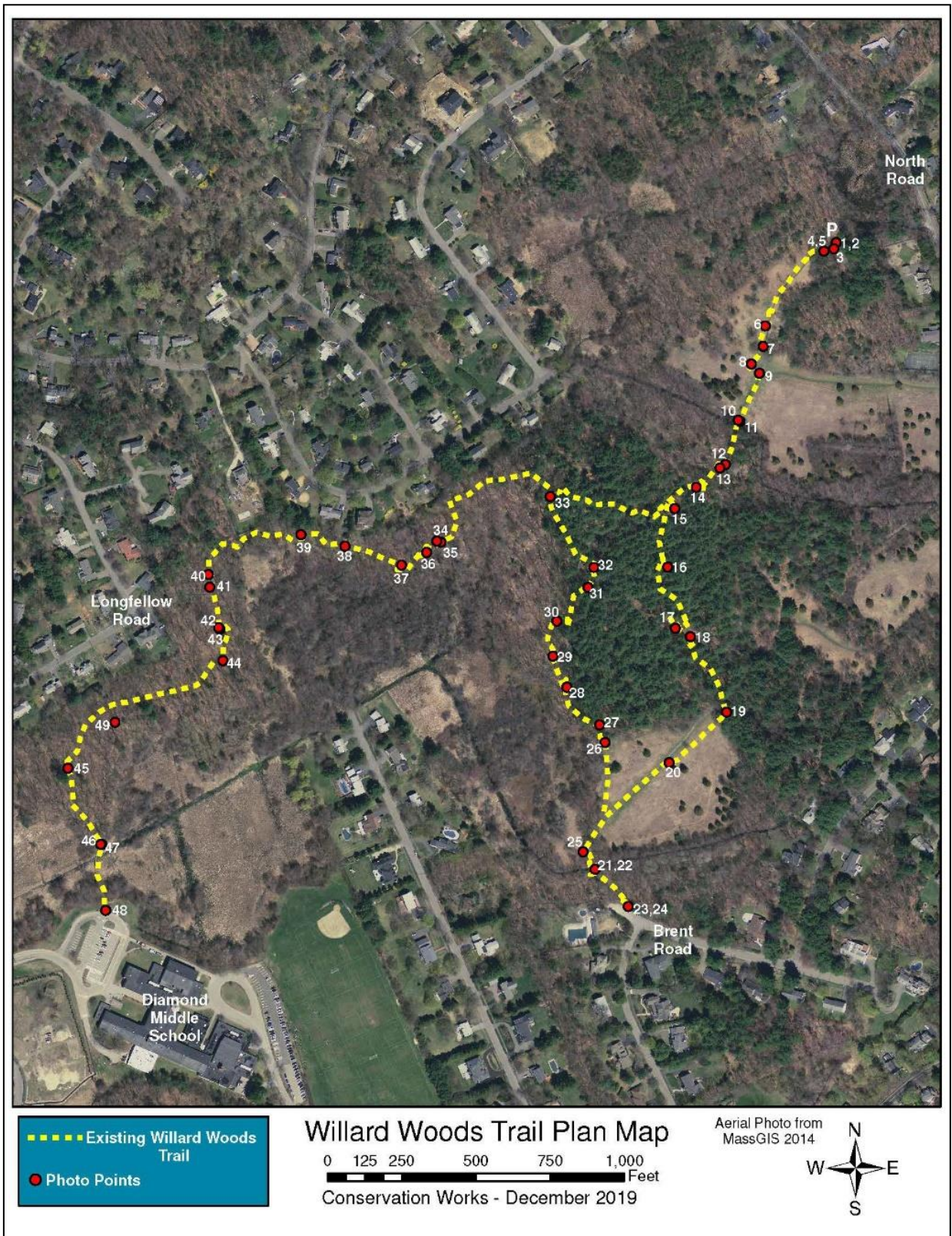


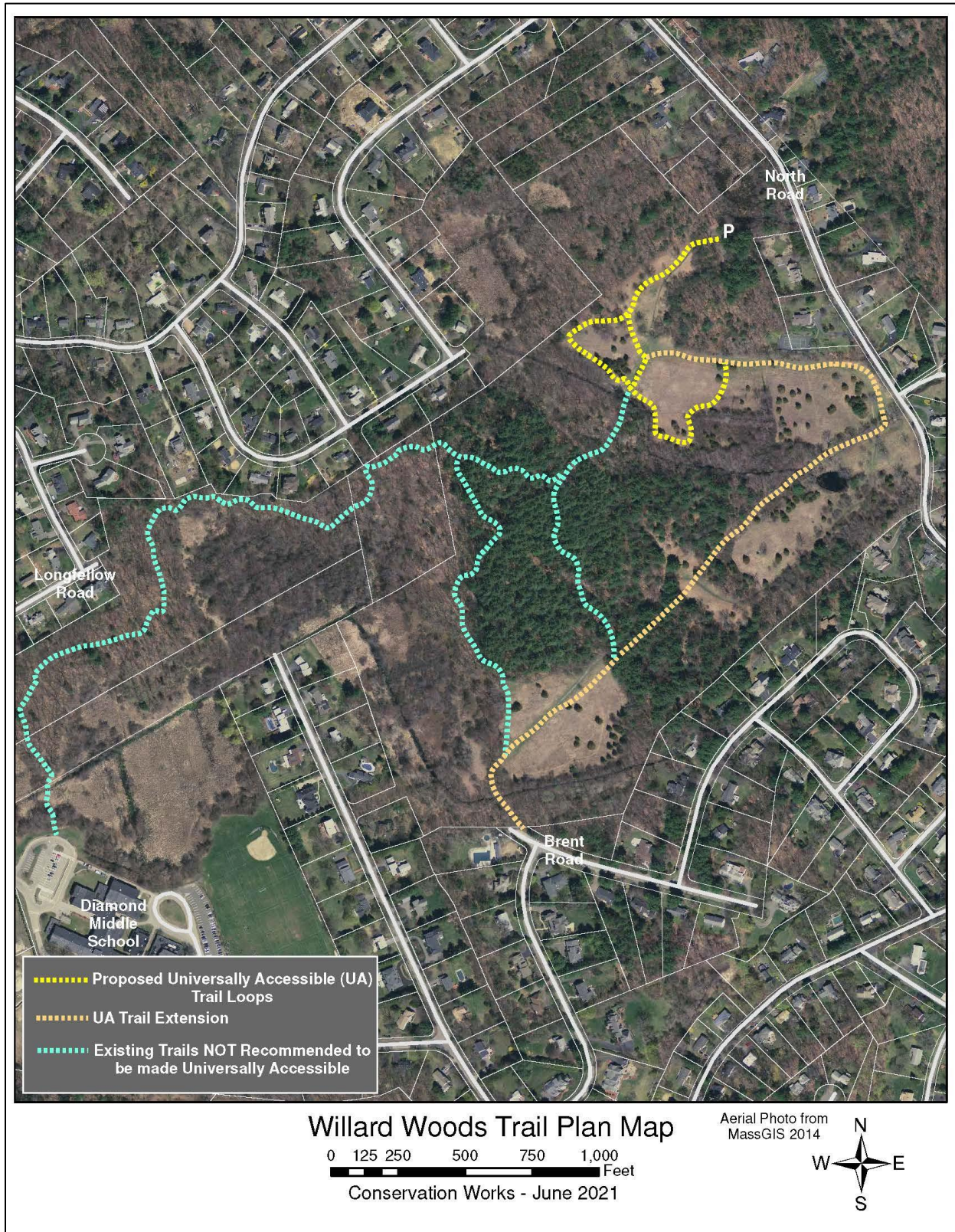
Figure 9. Willard's Woods Trail Plan Assessment Points





Figure 10. Willard's Woods UA Trail Plan Map





**Figure 11. Willard's Woods Trail Plan Map**