Forest Management Plan

for

The Wellesley Town Forest Longfellow Pond Section

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Antioch University New England

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INTRODUCTION

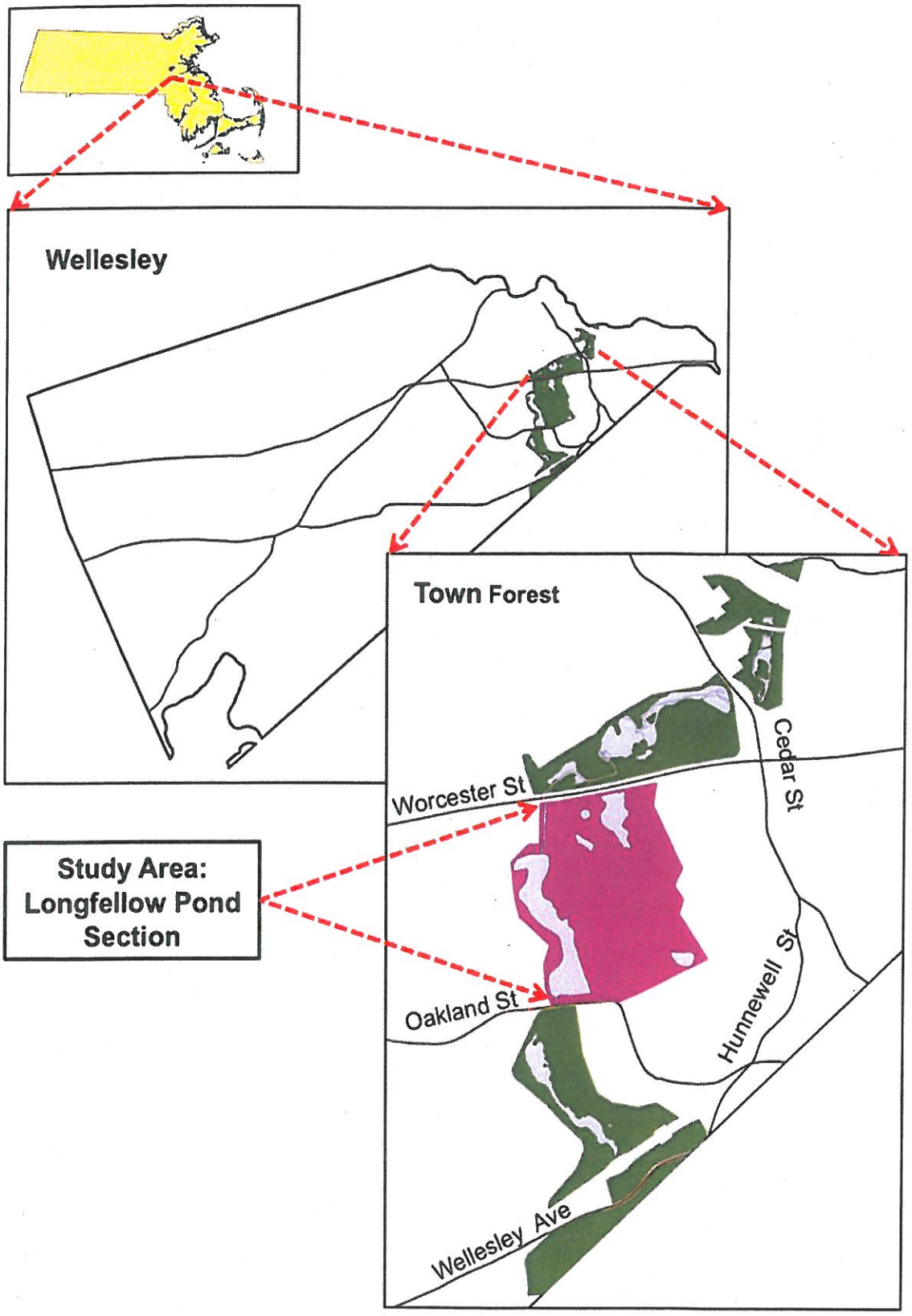
This plan was developed as a project for a graduate course, *ESS 568 Wildlife and Forest Management*, at Antioch University New England. While I have attempted to make the data gathering, data analysis, and report preparation adhere to professional standards, it should be noted that the author is a graduate student in environmental studies, not a professional forester.

I would like to thank Janet Hartke Bowser, Town of Wellesley Natural Resource Commission Executive Director; Brian DuPont, GIS Manager, Town of Wellesley Network and Information Systems; and Dr. Peter Palmiotto, Director of Conservation Biology, Antioch University New England, for their help and support on this project.

BACKGROUND

The Wellesley Town Forest consists of eight parcels lying along Rosemary Brook in the northeastern section of the town of Wellesley, Massachusetts (Map 1). The eight parcels total approximately 153 acres and extend from the Charles River at the northeast to the Needham town line at the south. The parcels are divided by Cedar Street, Worcester Street (Route 9), Oakland Street, and Wellesley Avenue.

One of the eight sections, the Longfellow Pond section, was chosen for study. This section will subsequently be referred to as TFLP for Town Forest – Longfellow Pond section. The TFLP lies between Worcester Street (Route 9) and Oakland Street, and at 68.3 acres is the largest single section of the Town Forest. Included in the 68.3 acres are Longfellow Pond (8.3 acres), wet areas (3.44 acres), a quarter-acre parking lot, a small meadow, and over an acre of cleared land adjacent to the Water Department building on Worcester St. Therefore, the total wooded area is closer to 55 acres.



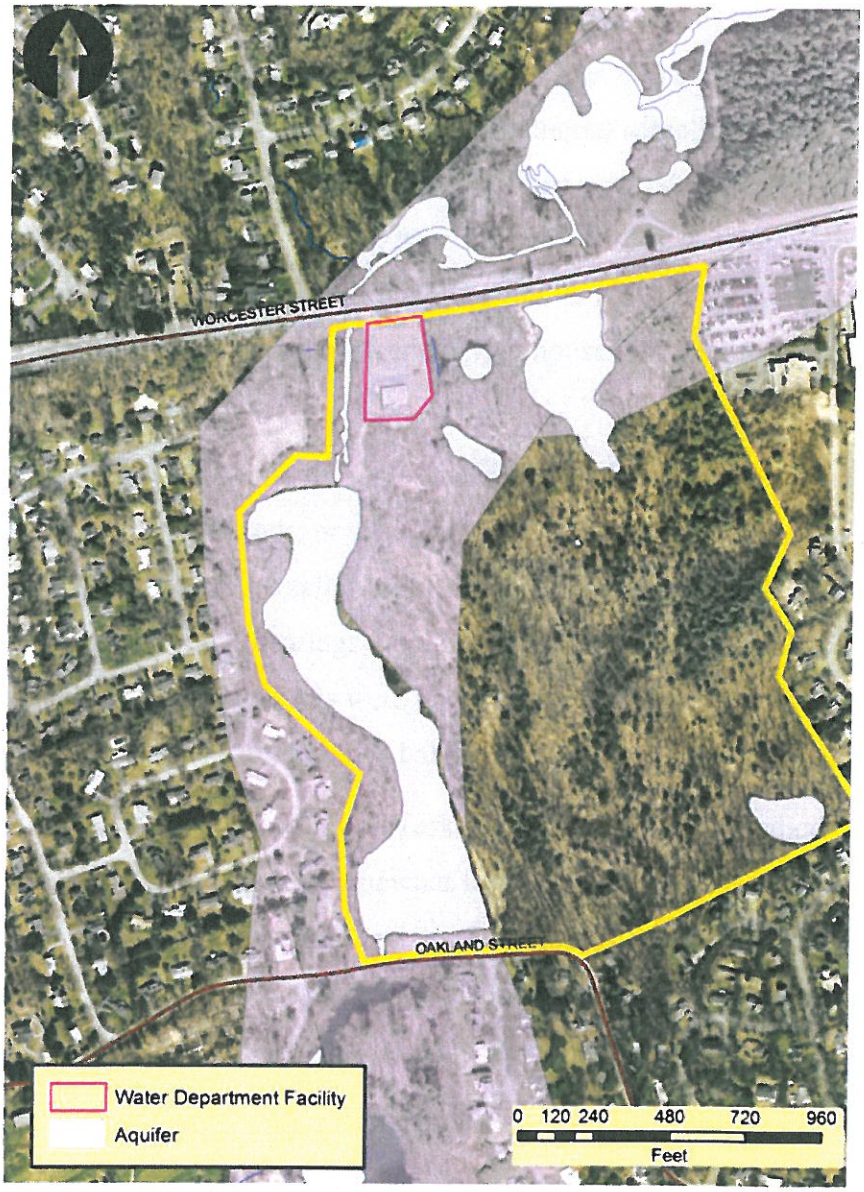
Map 1. Locus map of the Wellesley Town Forest in Wellesley, Massachusetts

TOWN OBJECTIVES

The town of Wellesley has four primary goals for the Town Forest:

1. **Healthy and diverse forest--water supply protection**. The town's overriding goal is to have a healthy and diverse forest that will provide protection for the town's water supply. The forest is in the middle of one of the town's water supply protection areas, and part of the study area lies over the Rosemary Brook alluvial aquifer. Six of the town's nine wells draw on this aquifer (Map 2).
2. **Wildlife habitat**. The forest should provide high-quality habitat for a variety of native wildlife species.
3. **Biodiversity**. The forest should include a variety of native plant species and avoid being a monoculture.
4. **Recreation**. The forest should continue to provide facilities for passive recreation such as walking, trail running, bird watching, nature study, and cross-country skiing. This use should be concentrated on the existing network of trails.

The town is **not** interested in timber harvest for its own sake. However, timber harvest might be considered if necessary for achieving one or more of the primary goals.



Map 2. Relation of study area to aquifer and pumping facilities.

METHODS

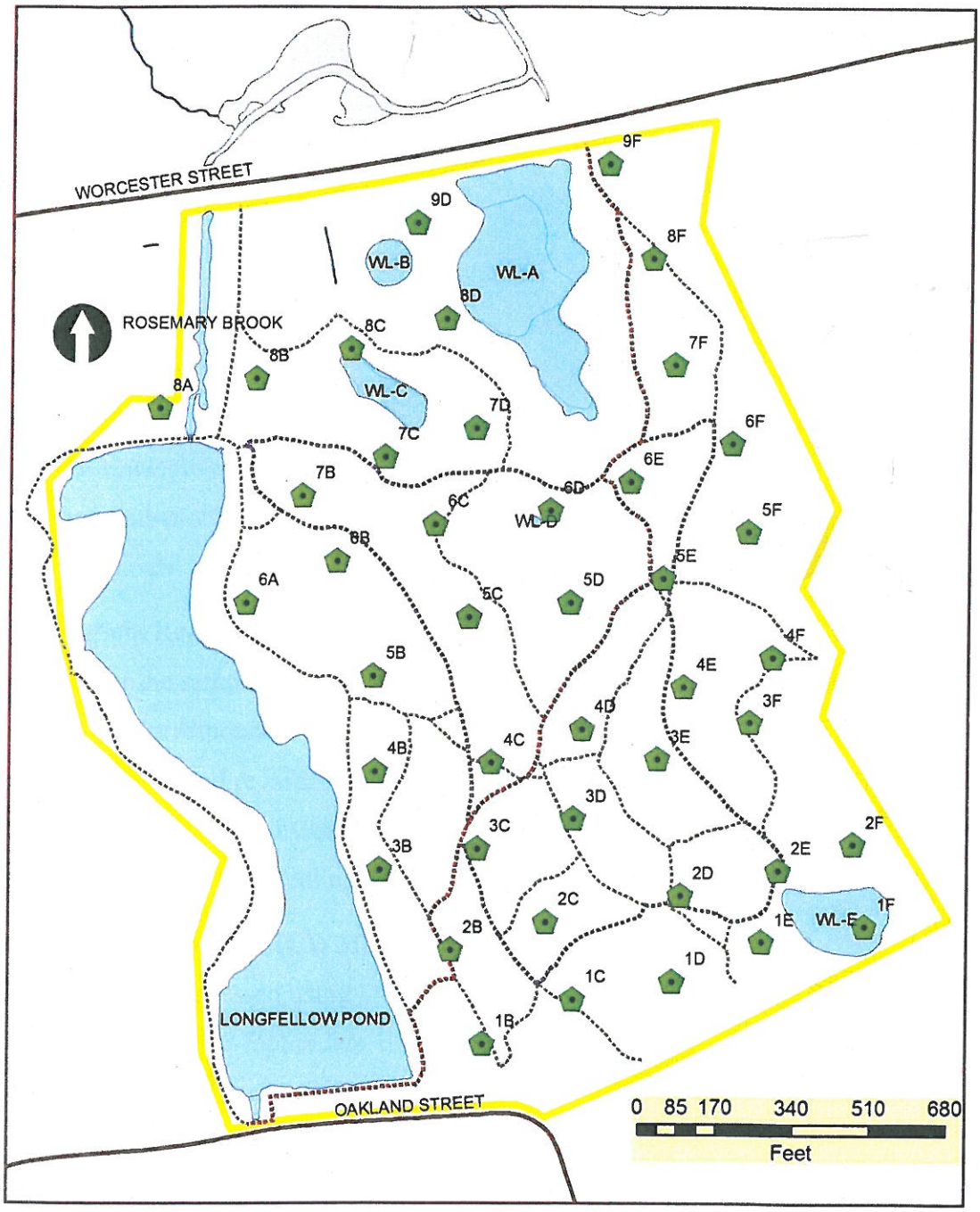
Study Area and Sampling Design

The study area, TFLP, is the largest section of the Town Forest and the one with the greatest amount of non-edge habitat. This section has greater potential for forest management than the other sections.

To determine forest composition, sampling at a set of points within the TFLP was planned. A six-by-nine point grid with 220-foot interstices was drawn manually over a map of the TFLP. Each intersection represented a potential sampling point. To get the best coverage of the area, the grid was oriented with the vertical axis running from 343° to 163° and the horizontal access running from 253° to 73°. The starting anchor point was located in the southeast corner of the TFLP, at a point that would allow rows and columns to be close to, but clear of, adjacent private house lots. The total area included in the sampling zone was 47.6 acres (Map 3).

While the grid would theoretically provide 54 sampling points, some of these points fell within Longfellow Pond, wetlands, or an area of lawn maintained by the water department, so 42 points were actually sampled. Starting at the southeast anchor point and proceeding north by rows, bearings were initially taken by hand-held compass, and the 220-foot distances between points were paced. Once a sampling point was established, its location was captured by a hand-held Garmin 60CSx GPS device.

Since the TFLP includes a number of hills (eskers) and valleys, this method created actual sampling points that departed somewhat from the planned grid intersections (Map 3). However, these errors were random and not the result of biased site selection. For rows 7 through 9, waypoint projection using the Garmin GPS was substituted for compass and pacing, and resulted in closer adherence to the original grid intersections.



Map 3. Actual Data Collection Points with Contours

Data Collection

At each sampling point, three categories were sampled: mature trees, regeneration, and coarse woody material (CWM).

Trees. Variable Radius Plot Sampling. From the plot center, trees were visually selected using a CRUZ-ALL-type angle gauge at 20 BAF. Trees were counted as "in" if they measured ≥ 4 inches *diameter at breast height (DBH).* Breast height was defined as a point 4.5 feet from the ground on the uphill side of the tree. For each "in" tree, DBH was measured using a DBH tape, and the tree's DBH and *status* (Acceptable Growing Stock [AGS], Unacceptable Growing Stock [UGS], or Dead) were recorded. Of these trees, those recorded as AGS and ≥10 inches DBH were further measured to determine number of 16-foot *sawlogs* to the nearest log. For AGS trees ≥ 4 inches DBH and < 10 inches DBH, the number of 8-foot pulpwood *bolts* were estimated using the Biltmore stick and recorded as notes.

Regeneration. Regeneration was measured by using a 3.72-foot measuring dowel centered over the sampling point center and rotated through 360 degrees. The area of the circle created corresponds to 1/1000 acre. Each tree stem falling within the length of the stick was counted and recorded by species and size class (*pole, sapling,* or *seedling*). Poles were defined as ≥ 1 inches DBH and < 4 inches DBH, saplings as ≤ 1 inch DBH and > 4.5 feet high), and seedlings as ≤ 1 inch DBH and < 4.5 feet high.

Coarse Woody Material (CWM). The volume of coarse woody material, that is, downed logs, was assessed using Diameter-Limited Perpendicular Distance Sampling (DLPDS). Within a 66-foot radius, downed logs were counted if they were perpendicular to the plot center, ≥ 4 inches in diameter at the point of perpendicularity, and within the limiting distance for a volume factor (VF) of 300 as specified by Roberge (n.d.). For each qualifying downed tree, the following were recorded: species, diameter, and *decay class* (I–V). (Table 1 provides definitions of the decay classes.)

Table 1. Definitions of CWM decay classes

Decay Class				
I	II	III	IV	V
Fresh wood, bark intact	Bark loose, wood firm	Bark absent, wood hard	Wood soft, not mushy	Wood soft, mushy or powdery

Data Analysis

Data collected by field sampling was entered into an Excel workbook. Each of the 42 data collection points was assigned to one of three stands as explained under the topic "Parcel and Stand Descriptions" later in this document. Using Excel pivot table reports and charts, data was analyzed for the entire TFLP parcel and for the individual stands. Data analysis addressed eight topics: "basal area," "density," "stocking" "sawlog volume," "pulpwood volume," "regeneration," " dead trees," and "coarse woody material (CWM)."

Basal area. By summing the basal area factor (20) of all individual AGS and UGS trees, and averaging across plots within stands for species, AGS and UGS, basal area in square feet per acre was calculated by stand, species, and plot. These results were graphed for the TFLP parcel and for individual stands.

Density. Density in trees per acre was calculated by stand, species, and plot using a formula based on DBH of AGS and UGS trees. It was then graphed for the TFLP parcel and for individual stands.

Stocking. Stocking was determined by comparing average basal area in square feet per acre, against a stocking guide value for that general type of tree, average diameter, and average number of trees per acre using stocking guides presented in (Bennett, 2010).

Sawlog Volume. Sawlog volume in board feet per acre was calculated for AGS trees ≥10 inches DBH by using DBH for each tree (rounded down to the nearest even number), number of sawlogs for each tree, and the tables for "Southern Conifers and Eastern Hardwoods" and "Northern Conifers" as presented in Bickford (1951). Results by species were graphed for the TFLP parcel and for individual stands.

Pulpwood Volume. Pulpwood volume was calculated for AGS trees ≥ 6 inches DBH and < 10 inches DBH, by using DBH for each tree (rounded down to the nearest even number), number of 8-foot bolts for each tree, and the pulpwood table found in the University of New Hampshire Cooperative Extension's paper "Tree and Stand Measurement"(2002). Results by species were graphed for the TFLP parcel and for individual stands.

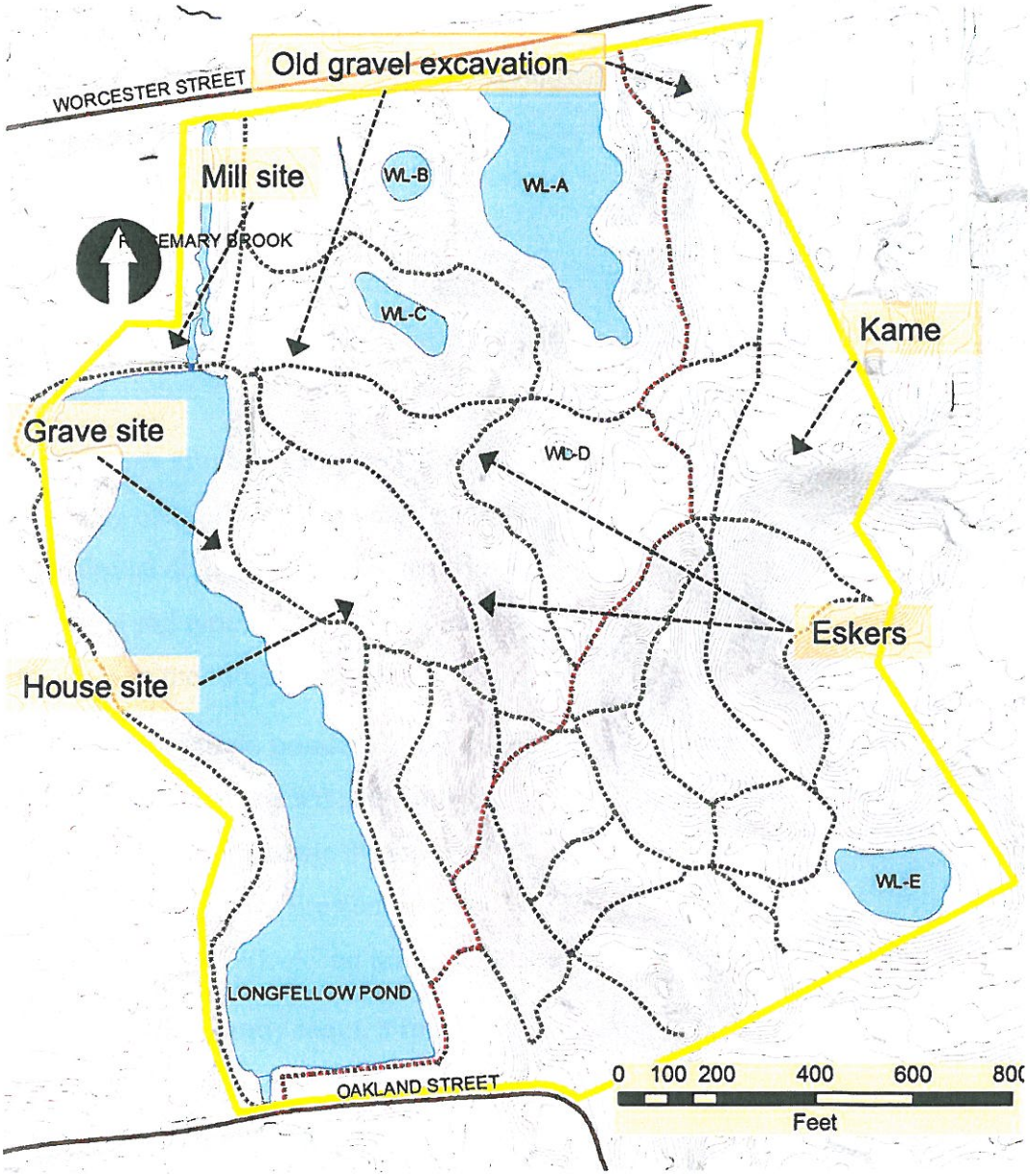
Regeneration. Counts of poles, saplings, and seedlings were summarized by plot, stand, and species, and graphed for individual stands and for the TFLP as a whole.

Dead trees. Considering only trees recorded as having a status of "dead," estimate of number of dead trees per acre were calculated for individual stands, and for the TFLP as a whole.

Coarse woody material (CWM). Volume factors (300) of all CWM instances were totaled and summarized by species and decay class.

LANDSCAPE ANALYSIS

Landscape in the vicinity of the Town Forest is almost entirely glacial in origin, with little or no exposed bedrock. Glacial features characterize the Longfellow Pond study area (Map 4). Anyone walking in the forest will immediately be struck by the tall, narrow and sinuous hills that wind through the forest. These are *eskers*, created as meltwater flowed beneath the ice of the retreating glaciers. The meltwater created inverted rivers, laying down sand and gravel deposits on the bottom as they cut upward into the ice. East of the eskers are *kames*, that is, hills created when glacier-born sand and gravel were deposited in gaps within the ice (Fowler-Billings, 1971). The eskers and kames left a landscape characterized by brief but steep ascents and descents. The many steep slopes made most of the study area unsuitable for farming, but the eskers and kames proved an easy source of sand and gravel. Before the town prohibited further exploitation, gravel pits were cut into the northern end of the eskers.



Map 4. Eskers and kames create a landscape of concentrated hills and valleys.

SOIL TYPES

The Natural Resources Conservation Service of the U.S. Department of Agriculture (NRCS) lists eight soil types within in the Town Forest study area, but coverage is by no means equally distributed among the soil types (Map 5). Soil types are listed below in numerical order.

5–Saco silt loam, 0 to 3 percent slopes. The NRCS indicates that this soil type is found on alluvial flats, consists of soft coarse-silty alluvium, is poorly drained, and is frequently flooded. In all months but July and August the zone of saturation is at 3 inches below the surface. Erosion hazard is slight. This soil type is shown as occurring primarily on the west side of Longfellow Pond away from the areas sampled. In this case, I think the NRCS designation is inaccurate, since inspection of the ground and review of the contour map shows that this land is **not** flat and is mostly located well above the level of possible flooding.

51–Swansea muck, 0 to 1 percent slopes. The NRCS describes this hydric soil as consisting of "highly-decomposed herbaceous organic material over loose sandy glaciofluvial deposits." It is frequently ponded and fully saturated in all months of the year. This soil type occupies only one small patch adjacent to the parking lot, and does not figure in the forest assessment.

53–Freetown muck, ponded, 0 to 1 percent slopes. The NRCS describes this hydric soil as very poorly drained and consisting of "highly-decomposed, ponded herbaceous organic material." Like the Swansea muck, it is frequently ponded and fully saturated in all months of the year. Erosion hazard is slight. In the study area, this soil is found in the largest wetland, ("WL-A" on Map 4). No trees grow here.

245C–Hinckley sandy loam, 8 to 15 percent slopes. This is one of two Hinckley soils differentiated primarily by their slopes. The NRCS describes these soils as consisting of loose "sandy and gravelly glaciofluvial deposits." It is neither flooded nor ponded. Water movement is high, available water to a depth of 60 inches is low, and the zone of saturation lies below 72 inches. Erosion hazard is slight. This soil type is found in the relatively flat areas in the southeast corner of the study area.

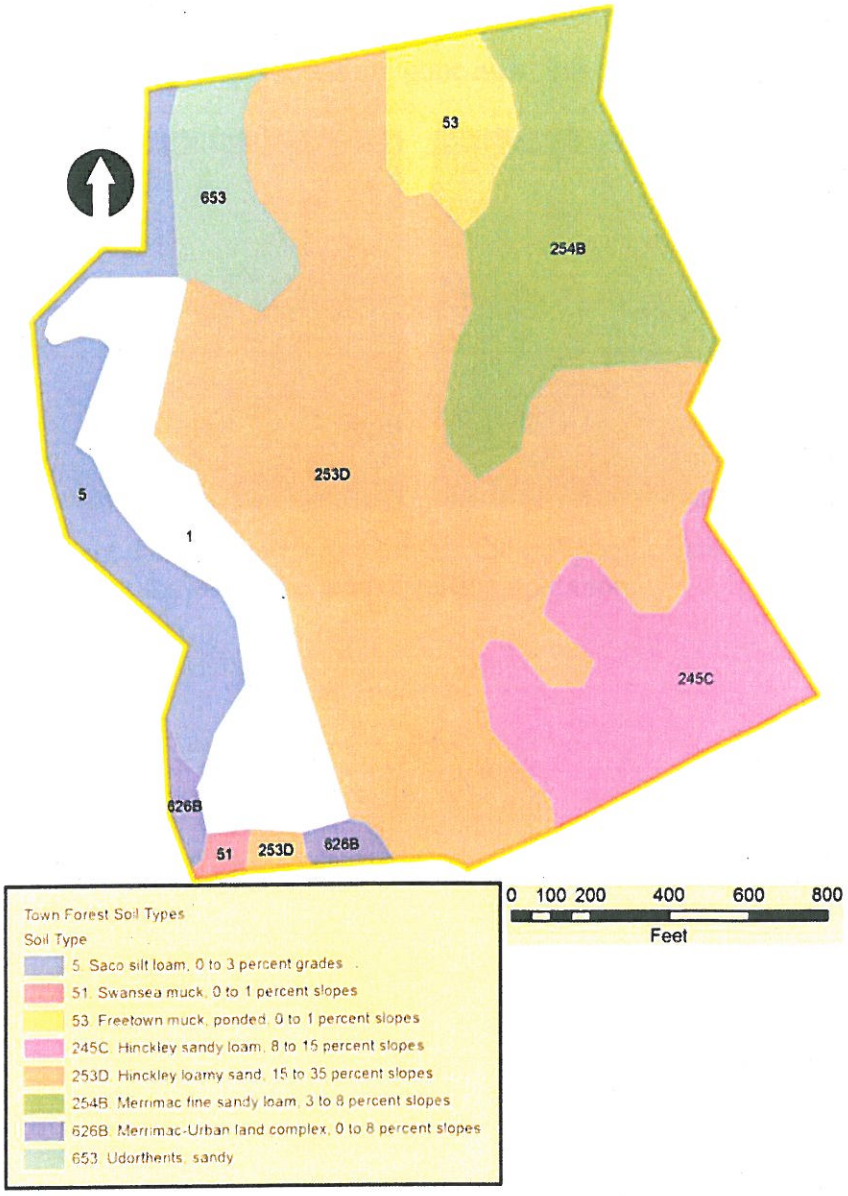
253D–Hinckley loamy sand, 15 to 35 percent slopes. This is the second Hinckley soil. It shares all characteristics of number 245C except for slope. Erosion hazard is moderate. This soil type covers the largest section of the study area and includes the eskers.

254B–Merrimac fine sandy loam, 3 to 8 percent slopes. This soil has some characteristics similar to the Hinckley soils. The NRCS describes these soils as consisting of "friable coarse-loamy eolian deposits over loose sandy glaciofluvial deposits,"

somewhat excessively drained. It is neither flooded nor ponded. Water movement is high, available water to a depth of 60 inches is low, and the zone of saturation lies below 72 inches. Erosion hazard is slight. Within the study area, this soil occupies the northeast corner. It appears to be associated with higher occurrence of white pine.

626B–Merrimac-Urban land complex, 0 to 8 percent slopes. This soil has some characteristics similar to 254B–Merrimac fine sandy loam. Erosion hazard is slight. Within the study area it is found only in two small patches in the parking lot and on the southwest bank of Longfellow Pond.

653–Udorthents, sandy. According to the NRCS this soil type is found "on fills, leveled land, railroad beds, sanitary landfills" and "consists of excavated and filled sandy glaciofluvial deposits." Water movement is moderately low, available water to a depth of 60 inches is very low, and the zone of saturation lies below 72 inches. There is little organic matter in the surface horizon. This soil is found only where the land has been significantly disturbed. In the study area it corresponds to the section in the northwest corner where the esker had been excavated for gravel and to the cleared, level land surrounding the Water Department building.



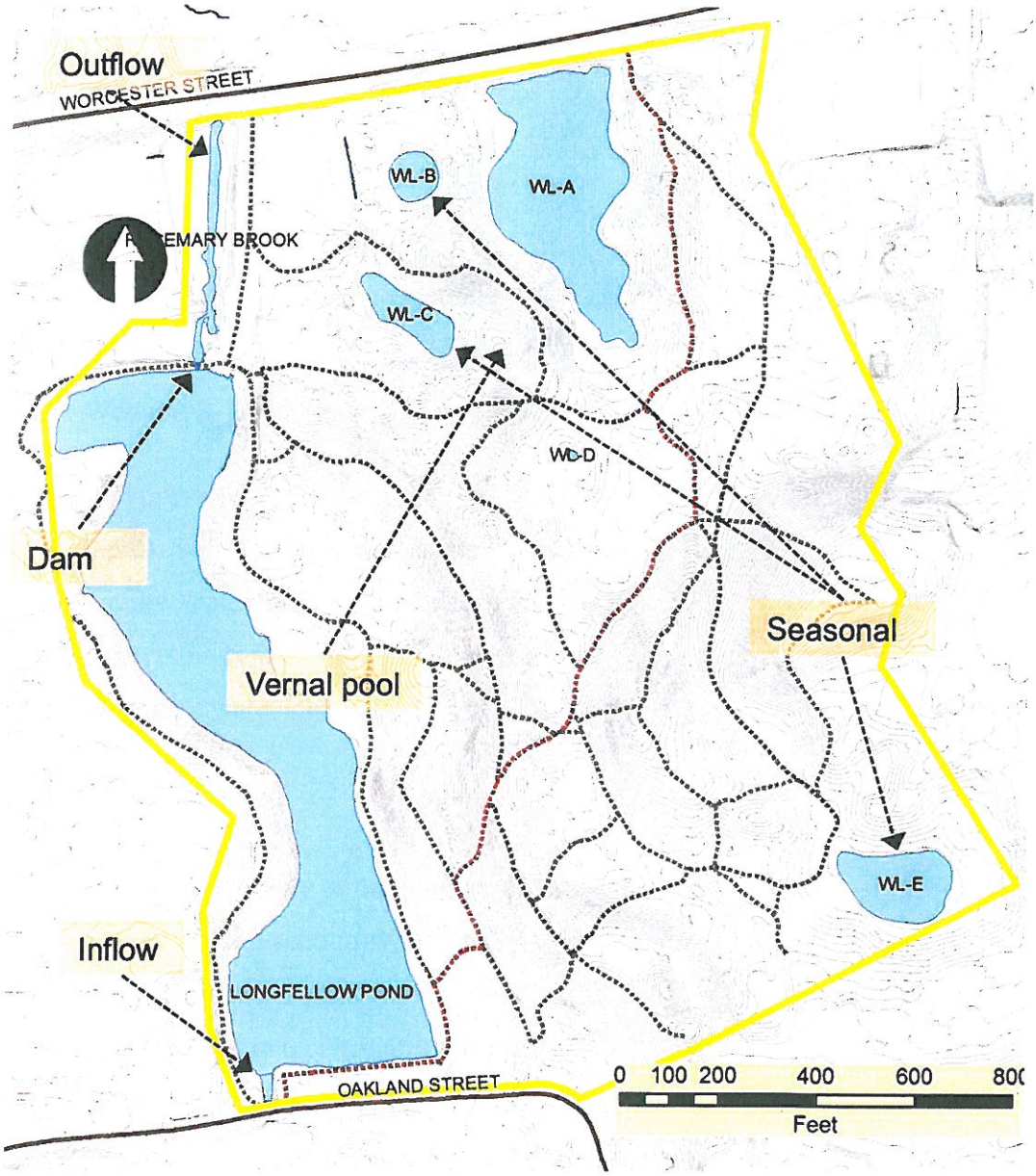
Map 5. Soil Types in Wellesley Town Forest Study Area

Water Sources

The Town Forest area has abundant water resources including Longfellow Pond itself, Rosemary Brook, four wetlands, and a vernal pool. In 1815, Rosemary Brook was dammed to create a head of water to power a nail factory and the result was Longfellow Pond (Figure 1). In 1836, a paper mill joined the nail factory behind the dam. Sometime

in the 1870's an ice-harvesting operation began, and continued to the 1930's (Morrison, 1994). All these commercial operations are gone now, but the dam remains.

Figure 1. The current dam continues to maintain the millpond created in 1815, but only a few pieces of concrete are left of the ice-harvesting operation.



Map 6. Water and wetlands

Several wetlands are found on the property, and some are important as recharge areas for the town's water supply (Map 6). One, shown as "WL-A," was flooded during surveying, and supports permanent wetland vegetation such as cattails. This wetland drains into Rosemary Brook by means of a culvert under Route 9. The other three wetlands were in the process of drying out at the time of the surveying. None of these had cattails (Figure 2).

Figure 2. Wetland A is permanent, while the other wetlands are seasonal.

As mentioned previously, part of the Town Forest lies over the Rosemary Brook alluvial aquifer (Map 2). Six of the town's nine wells draw on this aquifer, and several of these are located at the Water Department facility within the study area. Longfellow Pond itself, and the wetlands at the northern end of the study area are important as recharge areas for the town's water supply.

Timber Resources

The TFLP consists primarily of oak–hickory forest, which shades into white pine–oak forest in the northeastern section. White pines are present throughout the oak–hickory community, and oaks are present throughout the white pine–oak section, so the distinction between the two communities is one of degree rather than type. Three oak species, red oak, white oak, and black oak are present. Both in basal area and in trees-per-acre, red oak leads all other species by a substantial margin. Species mix, both as a whole and by individual stands, will be presented in more detail later in this report.

Size and age

The average red oak is 18.6 inches DBH, with a number of individual trees well over 20 inches (Figure 3). This indicates that oaks in the forest are about 70 - 80 years old. This age class is typical for New England forests, which were devastated 73 years ago by the Hurricane of 1938 and subsequent salvage logging.

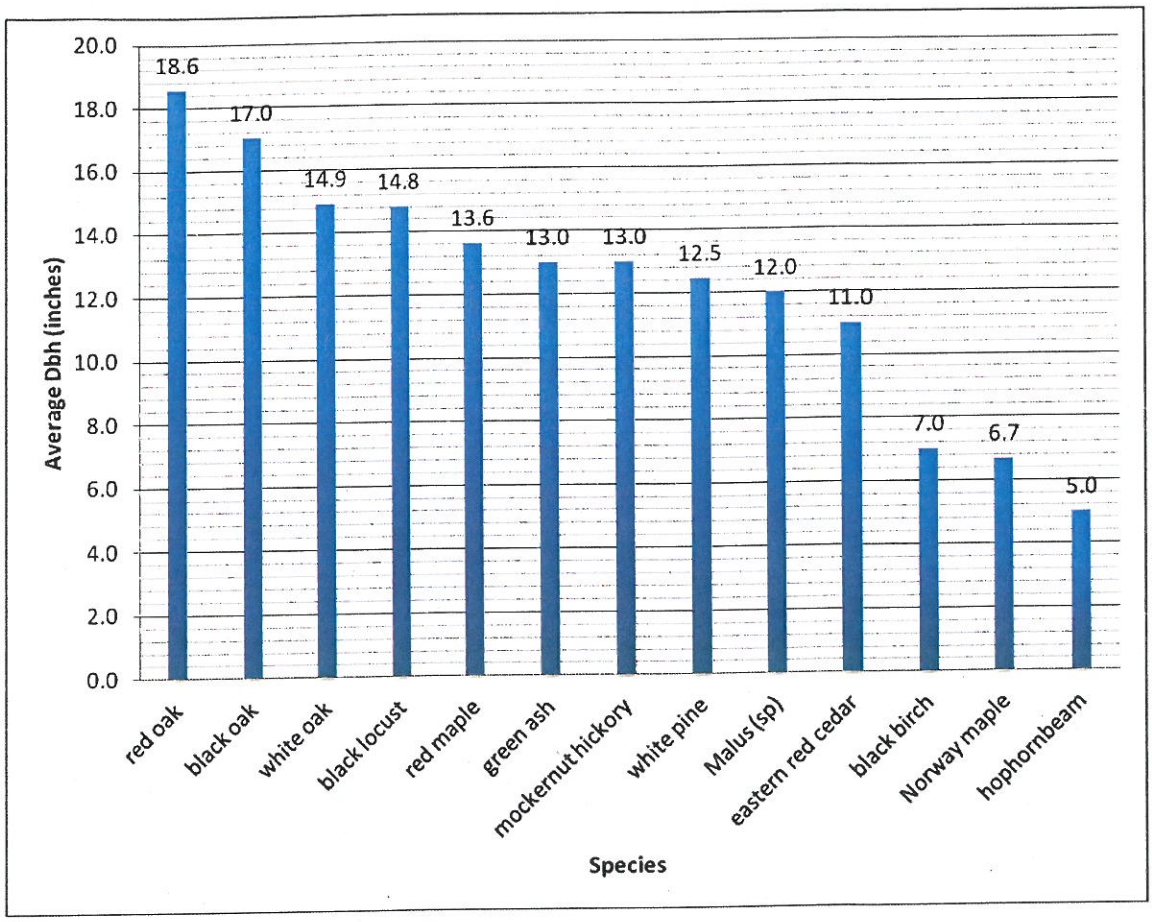


Figure 3. Average diameter—all stands.

Logging History

The daunting up-and-down terrain would have made most of the forest completely unsuitable for farming, but it would have permitted logging by traditional methods, and the Town Forest does show the effects of having been aggressively logged in the past. While no stumps remain, a sizeable proportion of oaks are multi-trunked, indicating that they grew by sprouting from the stumps of trees whose roots were intact (Figure 4). Based on the size of the stump-sprouted trunks, this logging would have taken place about 70-80 years ago. Since most multi-trunked trees are of the same age, the logging must have been comprehensive.

Figure 4. Frequent multi-trunked trees indicate the forest was heavily logged.

Two massive oaks found near the Hastings homesite give an indication of what the previous forest might have looked like. These trees have trunks at least three feet in diameter and are probably more the 150 years old (Figure 5).

Figure 5. One of two massive sun-grown oaks near the old Hastings homesite.

Wildlife Habitat

Although it is surrounded by suburban development and flanked by a major east-west road (Route 9), the Wellesley Town Forest, and particularly the Longfellow Pond section, provides an uncommon and much needed area of contiguous forest habitat.

Forest Edge/ Pond Shores

The edges of the forest, especially along the path to the east of Longfellow Pond, have been overwhelmed by invasive species such as oriental bittersweet, common buckthorn, glossy buckthorn, autumn olive, winged euonymus and multiflora rose (Figure 6).

Figure 6. Invasives dominate the edges of the forest.

While the negative aspects of these invasives outweigh their wildlife benefits, they do create a dense shrub layer and provide soft mast and cover for birds. However, the value of such invasive species for birdlife is the subject of some controversy, and the nutritional value of their berries may be questionable (Bennett, 2010).

Very little native early-successional habitat exists here, since appropriate sites have been co-opted by invasive species, but some gray birch and pin cherry are found in the southwest corner near the parking lot. Unfortunately, this habitat has survived by invading the already small butterfly meadow, which is the only meadow in the study area (Figure 7).

No attempt was made to inventory birds as part of this study, since most migratory species had left before fieldwork started. Based on prior Wellesley bird records and habitat preferences, we would expect to find these birds among those using the brushy areas near the pond for breeding, as a stop on migration, or as year-round habitat: song sparrows, white-throated sparrows, northern mockingbirds, gray catbirds, palm warblers, common yellowthroats (Ewer, 1988).

Figure 7. Some early-successional habitat survives by invading the butterfly meadow.

Mature forest

The majority of the TFLP is mature oak – hickory and white pine – oak forest (Figure 8). In most of the mature forest, the canopy is partially closed. It was difficult to assess the degree of closure since fieldwork was performed when many of the leaves were off the trees. At some spots, particularly under the largest pines and on the sides of the eskers, the understory is sparse and there is little forest regeneration or shrub layer. In such places, wildlife habitat is somewhat limited (Figure 9).

Figure 8. At the center, mature oak and pine stands dominate.

Figure 9. Under the biggest pines and on the esker sides, the understory is sparse.

In the moister valleys between eskers, or where a canopy opening has allowed more light to reach the forest floor, regeneration and a shrub layer are present. Witch hazel and mapleleaf viburnum are prevalent on both hills and valleys. At least two different *malus* species—apparently a type of crab apple—grow in all but the driest locations (Figure 10).

Figure 10. In the moist valleys between eskers or where some opening has occurred, the understory is thicker.

We would expect to find a number of birds using the forest seasonally, on migration, or year round. These include eastern wood pewees, red-eyed vireos, white-breasted nuthatches, scarlet tanagers, and ovenbirds all of which might nest in the oak-hickory forest (Swain & Kearsley, 2001). Other birds of this forest include downy and hairy woodpeckers, Baltimore orioles, and cuckoos. Based on prior Wellesley bird records and habitat preferences, several species of warblers might be expected to stop on migration or possibly nest in the forest: northern parula, magnolia, yellow-rumped, and black-and-white warblers, as well as blackpolls and American redstarts (Ewer, 1988). Broad-winged hawks and red-tailed hawks may nest in the forest, and red-tailed hawk calls were frequently heard during surveying. Other animals found in this type of habitat include short-tailed shrews, red-backed voles, and garter snakes (Swain & Kearsley, 2001).

Mast. All three species of oak present (red, white, and black oak) produce hard mast, as do the less-common hickories. Hard mast provides food for wild turkeys, white-footed mice, chipmunks, gray squirrels, and blue jays (DeGraaf, 2005). Acorns should also support white-tailed deer, but curiously, only one deer sign (a freshly-barked sapling) was observed during surveying. This is unusual, since white-tailed deer are frequent visitors to suburban yards elsewhere in town.

Snags and Cavity Trees. *Snags* are standing dead trees. *Cavity trees* may or may not be dead, but have natural or bird-excavated holes. Both snags and cavity trees are extremely important in providing den sites for a number of mammals and birds. Various species of

woodpecker, along with black-capped chickadees and red-breasted nuthatches, are the primary initial excavators of cavities, but once a tree's bark is breached through loss of a top or large limb, natural decomposition plays a major role in creating openings. Habitat value increases with tree diameter since larger trees can provide dens for a wider variety of animals. All species of woodpeckers, screech owls, bats, fishers, and raccoons use tree cavities, as do several species of cavity-nesting ducks including wood ducks, common mergansers, and hooded mergansers. Additionally, high and exposed dead limbs can provide hunting perches for red-tailed hawks and other raptors. Our sampling indicated that there was an average of 6.1 dead trees per acre across the TFLP, which is in line with the recommended management goal of six trees per acre (Bennett, 2010) (Table 2).

Coarse Woody Material (CWM). CWM refers to downed trees. In all states of decay, downed trees provide cover and/or food for a variety of animals. About half of amphibian and reptile species use CWM in some form, as do many mammal species. Some larger mammals use hollow logs as den sites, and a number of smaller mammals including rodents and shrews, feed and/or shelter around downed logs. Some ground-nesting birds use upturned tree-roots as nesting sites. Decomposing wood provides a substrate for fungi and for regenerating tree seedlings, as well as habitat for many insect species (Bennett, 2010).

Table 2. Summary of dead trees and coarse woody material for TFLP as a whole.

Stand	Number of Dead Trees/Acre		Volume of Coarse Woody material (cubic feet per acre)
	Goal	Actual	
All	6	6.1	442.9

Pond, brook and wetlands

Rosemary Brook, Longfellow Pond, and the wetlands are important as water sources for terrestrial animals and provide habitat for aquatic life including catfish, frogs, sunfish, and painted turtles (Morrison, 1994). Mallard ducks and Canada geese are ubiquitous when the pond is not frozen. Wetland A should provide good habitat for nesting red-winged blackbirds. During surveying, a belted kingfisher, a great blue heron, a pair of hooded mergansers, and even an osprey were observed.

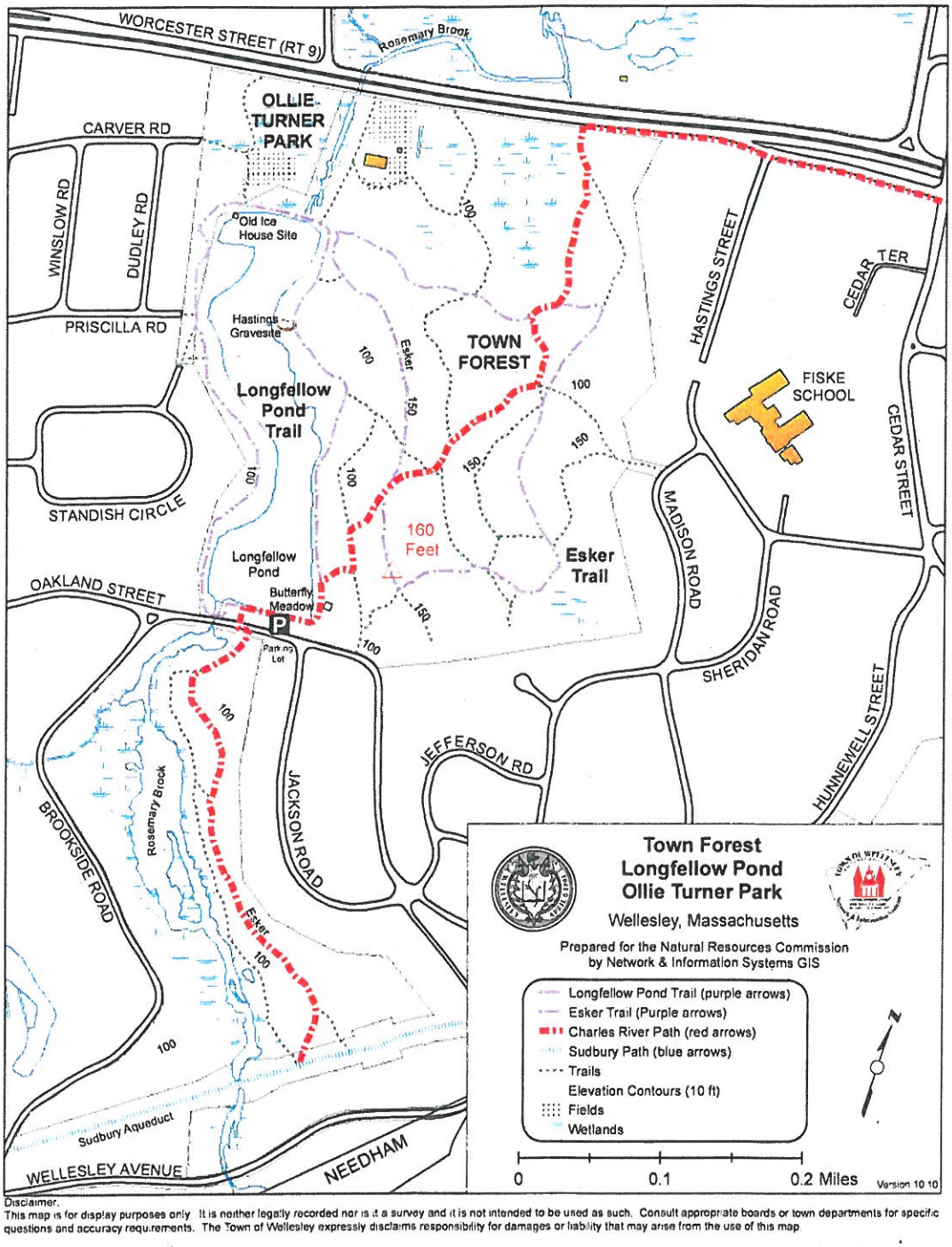
Vernal Pools. One certified vernal pool exists (Map 5), and another is suspected. Due to the absence of fish predators, such pools provide crucial spawning areas for wood frogs and for the spotted salamanders that will live the rest of their lives within a few hundred yards of the pool (Figure 11).

Figure 11. One vernal pool in the forest is certified, and another is suspected.

Recreation

The Longfellow Pond section of the town forest is an important recreation resource for the town. Several points provide access to people from adjacent neighborhoods, and an ample parking lot provides for those who need to drive to get there. The pond provides fishing opportunities and pleasant vistas.

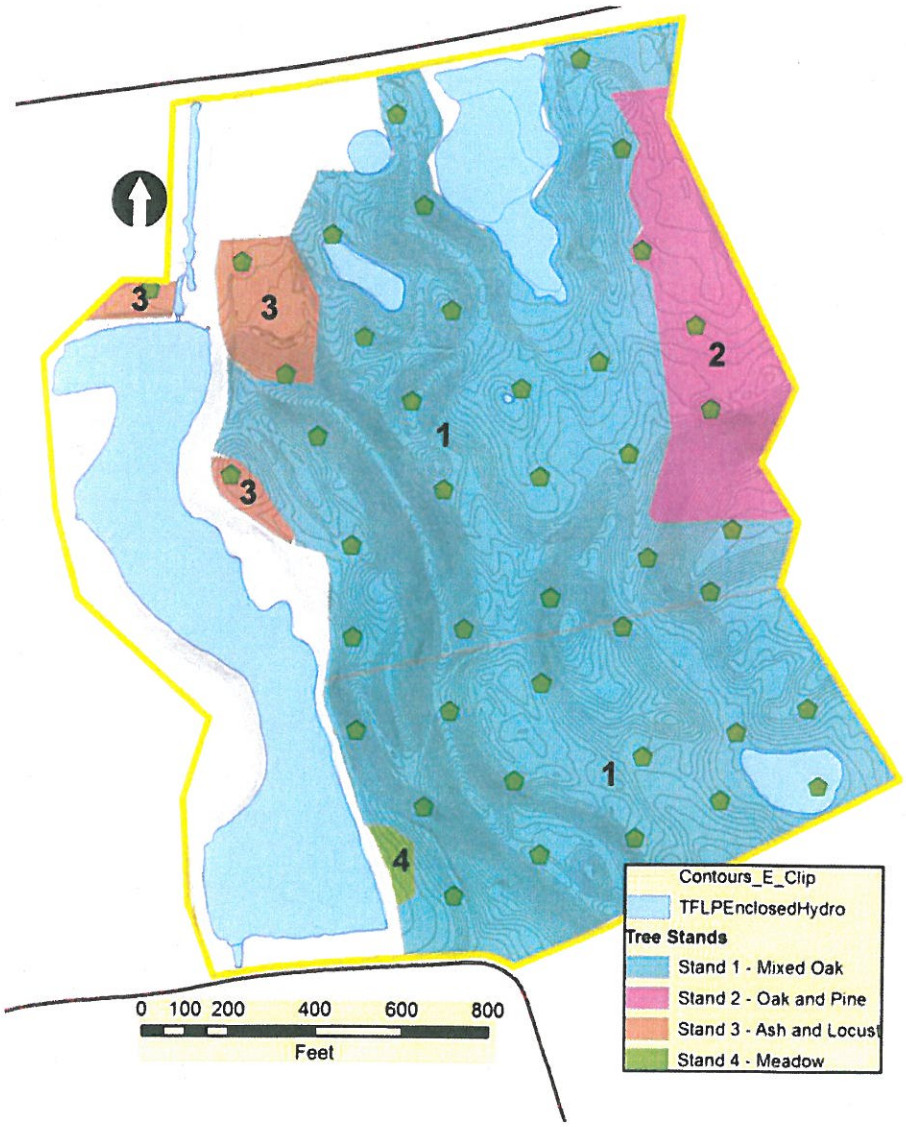
A network of trails laces the forest and includes a section of the multi-town Charles River Link Trail (Map 7). These trails are used for casual walking, dog walking, hiking, and trail running. They provide access for birdwatchers, wildflower and geology enthusiasts, school nature-study groups, as well as those neighborhood children who refuse to be left inside. The trail that circles the pond includes lookout points and benches for enjoying a view of the pond.



Map 7. Town Forest Trails. Map courtesy of the Town of Wellesley GIS department

PARCEL AND STAND DESCRIPTIONS

The study area was divided into three stands (Map 8). The largest stand, stand 1, corresponds to the oak—hickory component of the forest. Stand 2 is a section where white pine shares canopy dominance with oak. Stand 3 corresponds to places where extensive disturbance has left a mixture of green ash, black locust, and invasive plants.



Map 8. Stands with Sampling Points.

Stand 1

Stand 1 is by far the largest of the three stands, occupying 40.3 acres of the 47.6-acre study area. This is an *oak—hickory forest community* as defined by the Natural Heritage and Endangered Species Program of the Massachusetts Division of Fisheries and Wildlife (Swain & Kearsley, 2001).

Species Mix, Basal Area, and Density: Stand 1

Three oak species, red, black and white oak, are present with red oak dominant both in terms of basal area and trees per acre (Figures 12 and 13). Mockernut and shagbark hickory are both present as sub-canopy trees but have only a modest presence in terms of basal area and trees per acre. Hophornbeam is ubiquitous but seldom reaches large stature, and accounts for only a small proportion of stand basal area.

White pine is a major player in this stand and ranks second in trees per acre. The pine is unevenly distributed. It has taken hold along esker ridges and at the margins of stand 2.

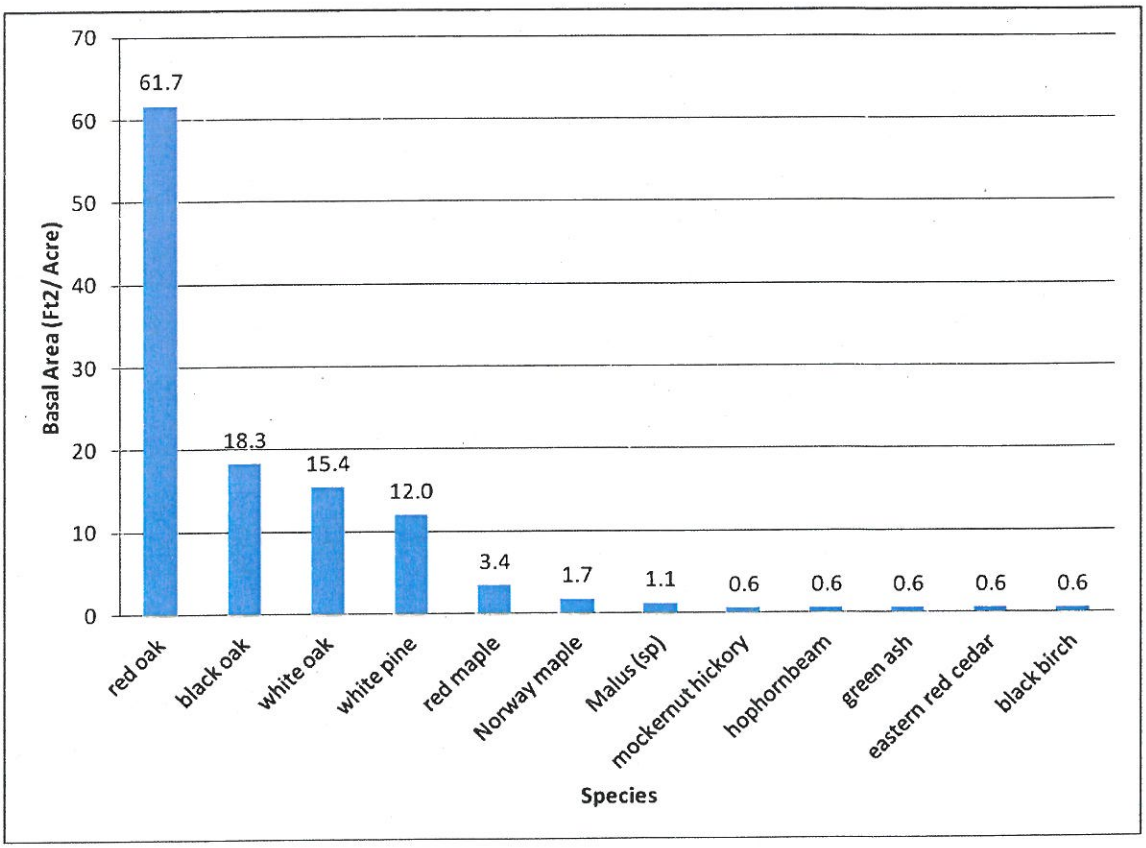


Figure 12. Basal area in square feet per acre for stand 1.

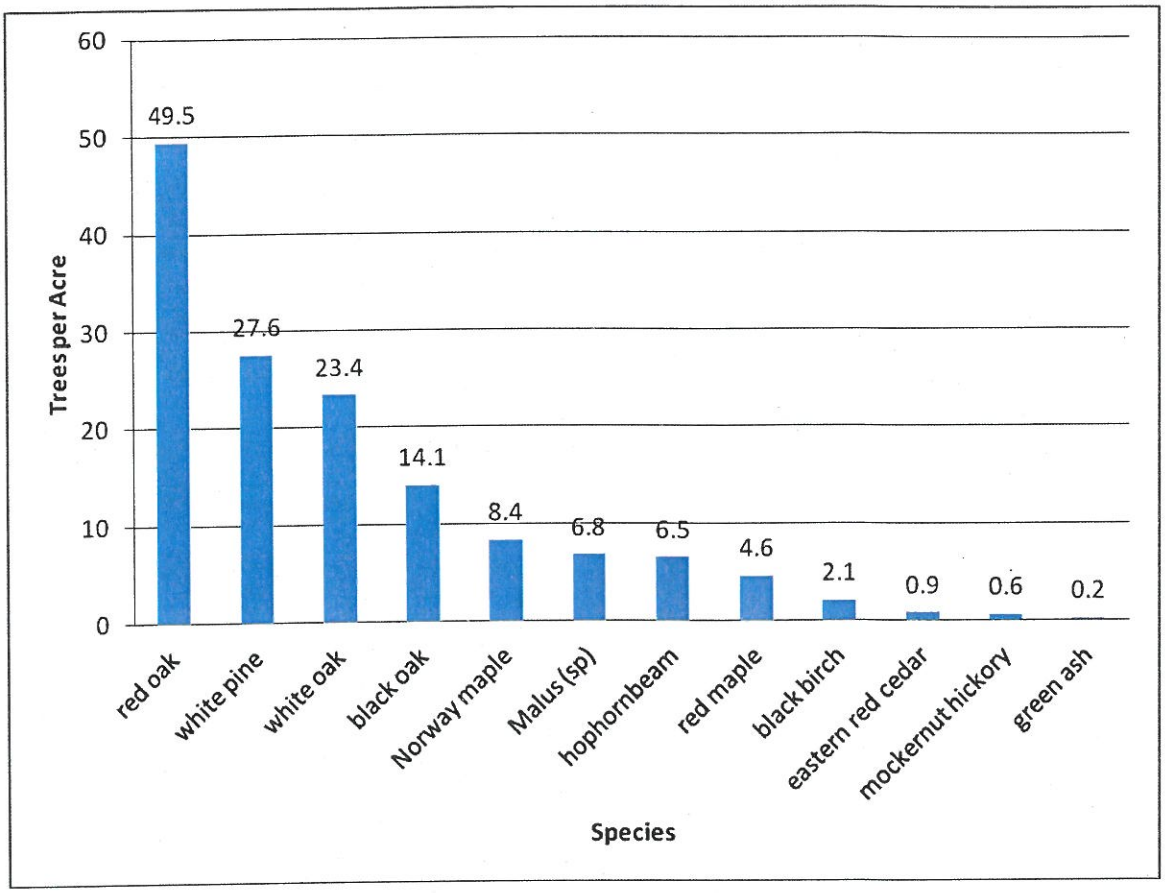


Figure 13. Density in trees per acre for stand 1.

Stocking: Stand 1

Stocking is a term used in evaluating the density of a forest stand for optimum timber growth. Stocking guides are often presented graphically and establish at least two reference lines based on general forest type: average diameter and average trees per acre. The A-line represents the density at which the growth of forest of a given type will be suppressed, while the B-line represents the density at which growing space is used efficiently and timber growth will be highest. If a stand exceeds the A-line in square feet of basal area per acre it is considered *over stocked.* If it falls below the B-line it is considered *under stocked,* and if falls between the A and B lines it is considered *fully stocked.*

At the current density, Stand 1 is somewhat above the B-line and well below the A-line, so it is considered fully stocked (Table 3).

Table 3. Stocking level for stand 1

Stand	Average DBH	Trees / Acre	Basal Area (ft^2 / acre)	A-line (ft^2 / acre)	B-line (ft^2 / acre)	Stocking Level
1	16.6	144	117	180	108	Fully Stocked

Saw Timber: Stand 1

The three oak species, and especially red oak, provide the most potential saw timber with 445,584 estimated board feet in total (Figure 14). These oaks clearly would have the greatest market value were the Town of Wellesley ever to want to harvest timber in the Town Forest.

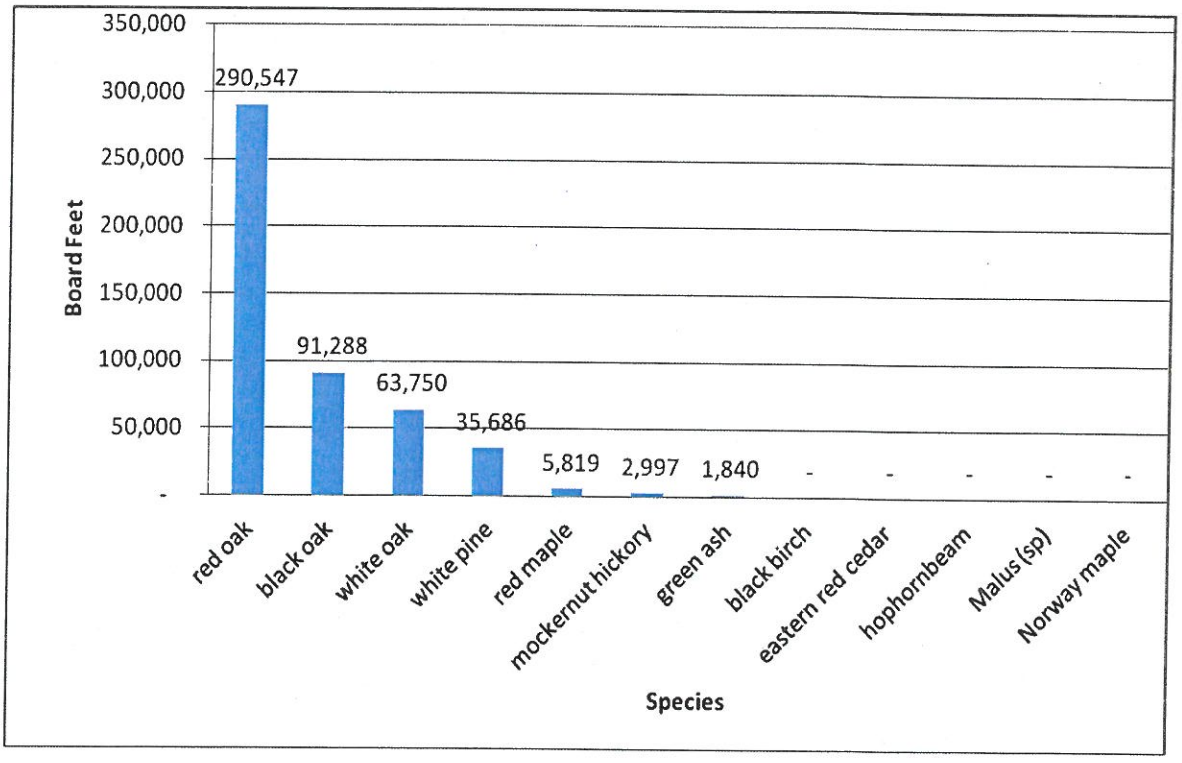


Figure 14. Volume of saw timber in board feet for stand 1.

Pulpwood: Stand 1

Pulpwood available from trees ≥ 6 inches and < 10 inches DBH is not large (Table 4).

Table 4. Volume of pulpwood for stand 1.

Species	Cords per acre	Acres	Cords
black birch	0.09	42.8	3.9
Norway maple	0.24	42.8	10.4
red maple	0.09	42.8	3.9
red oak	0.28	42.8	11.8
white pine	1.10	42.8	47.3

Regeneration: Stand 1

Regeneration is described by the number of *poles* (≥ 1 inch DBH and < 4 inches DBH), *saplings* (< inch DBH and ≥ 4.5 feet high) and *seedlings* (< 4.5 feet high). Hophornbeam and witch hazel are well represented at all sizes, and white oak shows an unusually high number of seedlings relative to other species. Results might be different if these measurements were done in spring or summer and more seedlings were apparent (Figure 15).

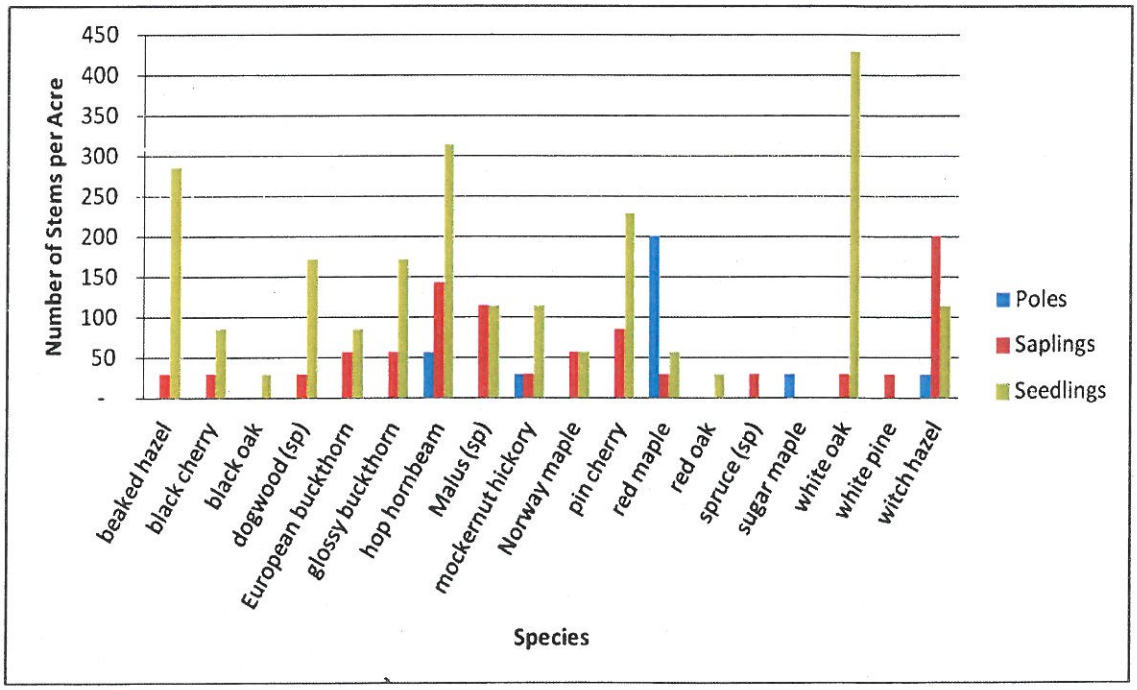


Figure 15. Regeneration for stand 1

Cavity Trees, Snags and CWM: Stand 1

As mentioned earlier, overall, the number of dead trees per acre is approximately at the recommended level. Coarse woody material (CWM) consists of logs in various states of decay. The number of dead trees per acre is almost at target level for stand 1 (Table 5).

Table 5. Summary number of dead trees and volume of CWM for 1.

Stand	Number of Dead Trees/Acre		Volume of Coarse Woody material (cubic feet per acre)
	Goal	Actual	
1	6	5.7	480

Stand 2

Stand 2 is small, occupying only 5 acres of the 47.6-acre study area. This is a *white pine—oak community* as defined by the Natural Heritage and Endangered Species Program (Swain & Kearsley, 2001).

Species Mix, Basal Area, and Density: Stand 2

The definition for the white pine – oak forest is similar to that for the oak – hickory forest of stand 1. It includes one section where mature white pines are dominant canopy trees with oaks co-dominant. In other parts of this stand a few canopy pines tower over younger pines. The area where white pines are biggest and most dominant is a rare small flat area that was probably farmed and then abandoned. (White pines are particularly adept at establishing themselves in abandoned fields). This section shows no regeneration of any kind. This may be due to dense shade, but it may also have been brought about by an abutter's lawn mower.

Even in this heavy pine area, red oak remains dominant in basal area (Figure 16), but, due to enthusiastic regeneration by mixed ages, white pine leads in number of trees per acre (Figure 17).

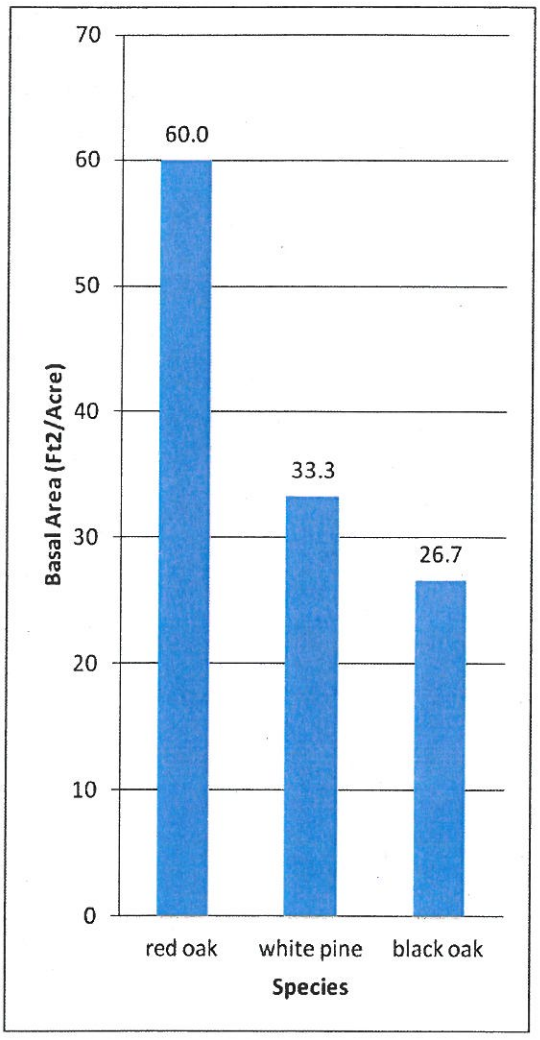


Figure 16. Basal area in square feet per acre for stand 2.

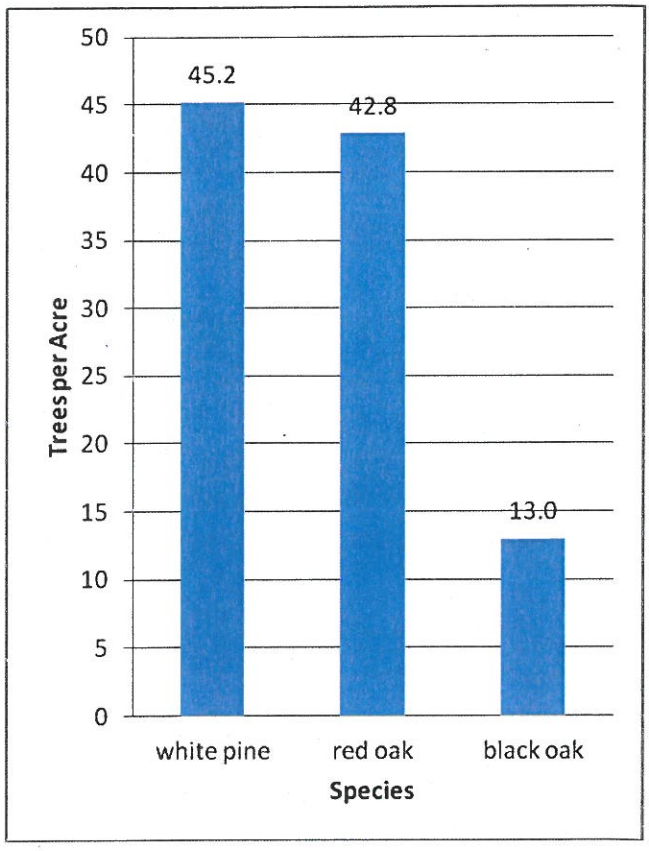


Figure 17. Density in trees per acre for stand 2.

Stocking: Stand 2

Stocking for stand 2 is somewhat above B-line but well below A-line indicating that this stand is on the lower level of fully stocked (Table 6).

Table 6. Stocking level for stand 2

Stand	Average DBH	Trees / Acre	Basal Area (ft^2 / acre)	A-line[1] (ft^2 / acre)	B-line (ft^2 / acre)	Stocking Level
2	19.4	101	120	180	108	Fully Stocked

[1] A and B-line value for 16 inch Dbh was used here since the stocking table did not go as high as 19 inches.

Saw Timber: Stand 2

Even here in the pine stand, red oak has almost twice the saw timber potential of white pine. The same ratio holds for pulpwood. But regeneration in this stand is exclusively in white pine poles.

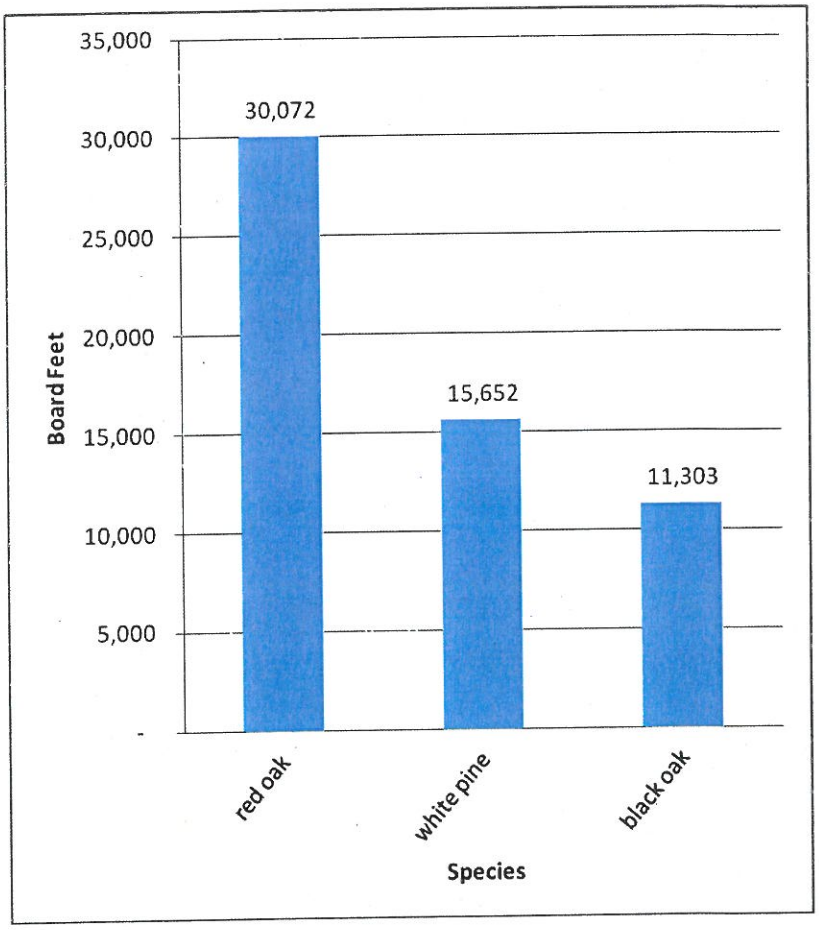


Figure 18. Volume of saw timber in board feet for stand 2.

Pulpwood: Stand 2

Estimated pulpwood availability for stand 2 is very low (Table 7).

Table 7. Volume of pulpwood from trees ≥ 6 inches and < 10 inches DBH for stand 2.

Species	Cords per acre	Acres	Cords
red oak	1.76	5.01	8.8
white pine	1.07	5.01	5.4

Regeneration: Stand 2

Regeneration is entirely in pole-sized white pine. Many of these pines are about 25 years old (Figure 19).

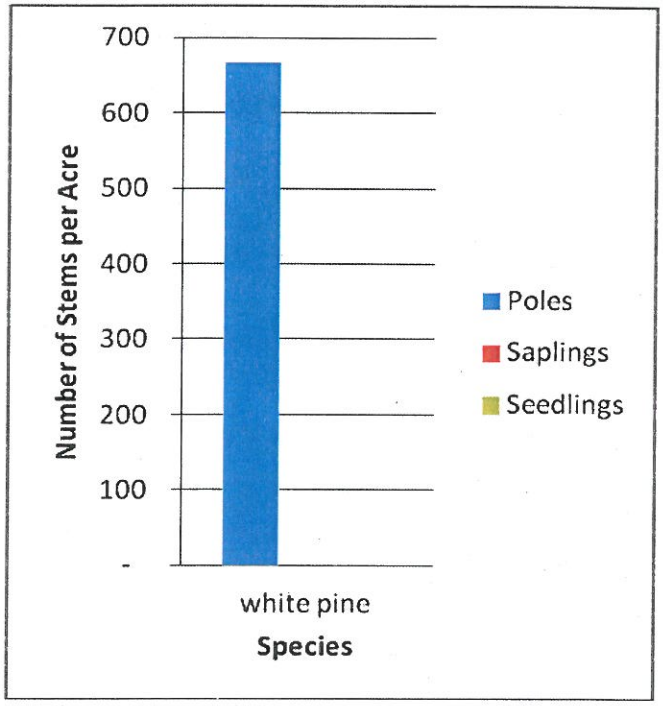


Figure 19. Regeneration for stand 2.

Cavity Trees, Snags and CWM: Stand 2

No dead trees were recorded in the three sampling sites within stand 2 (Table 8). This resulted in a value of zero for dead trees per acre, which is almost certainly not true for the stand as a whole. However, the combination of a few large white pines with a number of much smaller stems, has resulted in situation where the young pines are still vigorously growing and have not entered the phase where intense competition will result in the death of a number of less competitive stems.

Table 8. Summary number of dead trees and volume of CWM for all stands.

Stand	Number of Dead Trees/Acre		Volume of Coarse Woody material (cubic feet per acre)
	Goal	Actual	
All	6	0	200

Stand 3

Stand 3 is the smallest of the three stands, occupying only 2.3 acres of the 47.6-acre study area. This stand is a somewhat arbitrary collection of three separate parcels that share a history of extreme disturbance. One parcel is located at the former paper mill site, a second parcel covers an area where the esker was ripped apart for gravel, and the third parcel includes the old Hastings homesite. All are flat, and, to a greater or lesser extent, damp.

Species Mix, Basal Area, and Density: Stand 3

All these areas have some green ash, black locust, and red maple (Figure 20). And all are overrun with invasives, particularly with oriental bittersweet. In Massachusetts, black locust itself is considered an invasive tree species because of its tendency to invade fields and open woods. It fixes nitrogen, enriches the soil, and so excludes native plants adapted to nutrient poor soil (Mass Audubon, 2011).

Despite the prevalence of these invasive species, red oak remains a presence. Green ash leads in both basal area and trees per acre. In basal area, red oak is second and black locust is third, but in trees-per-acre, red maple is second and black locust is fifth (Figures 21 and 22).

Figure 20. Some large, old black locust trees are found in stand 3, but invasive vines are everywhere.

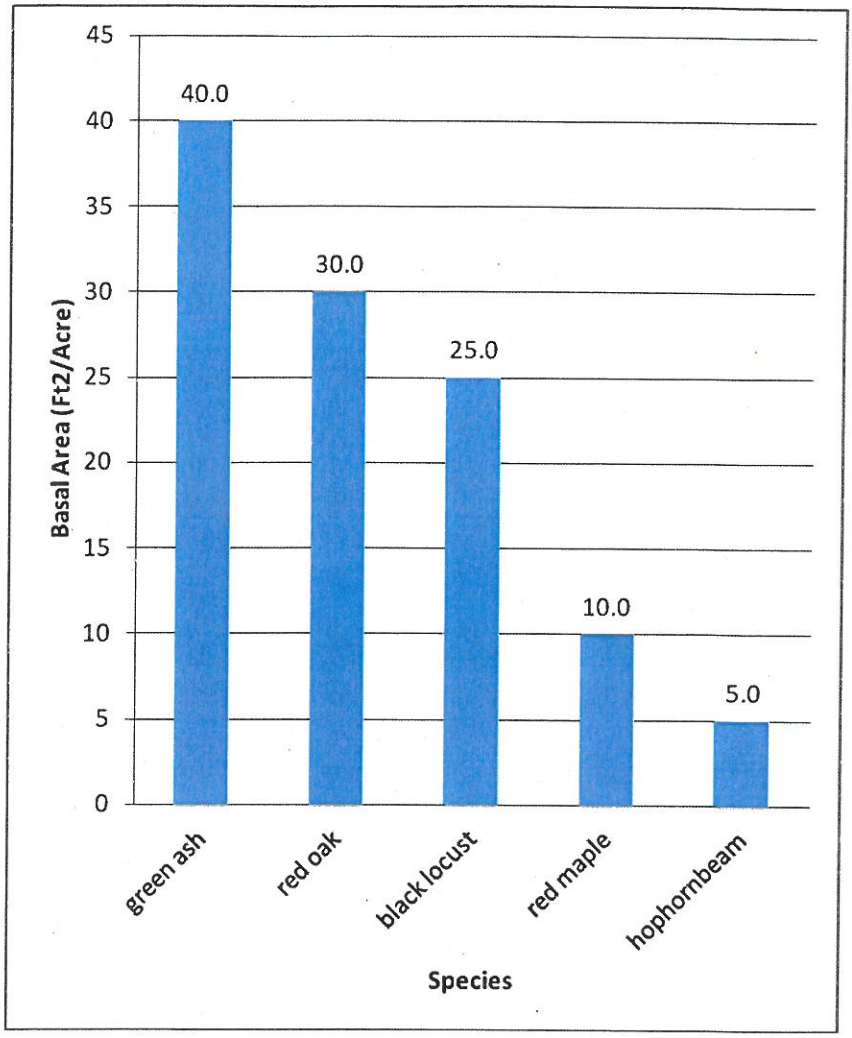


Figure 21. Basal area in square feet per acre for stand 3.

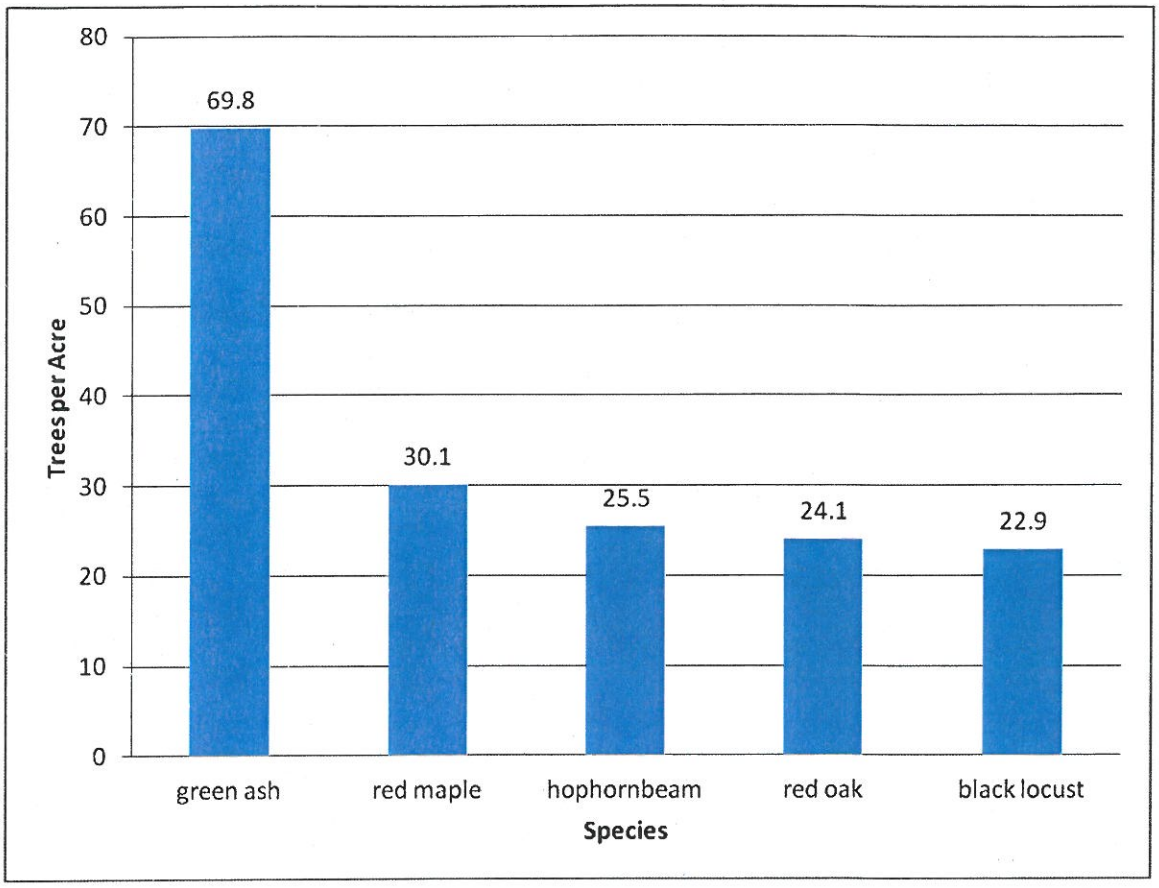


Figure 22. Density in trees per acre for stand 3.

Stocking: Stand 3

At 110 square feet per acre, basal area for all tree species is just above the B-line, so this stand would be considered fully stocked (Table 9). However, the basal area total includes the invasive black locust.

Table 9. Stocking level for stand 3.

Stand	Average DBH	Trees / Acre	Basal Area (ft^2 / acre)	A-line (ft^2 / acre)	B-line (ft^2 / acre)	Stocking Level
3	13.6	172	110	173	106	Fully Stocked

Saw Timber: Stand 3

The total volume of saw timber is small in stand 3, with the majority provided by green ash and black locust (Figure 23).

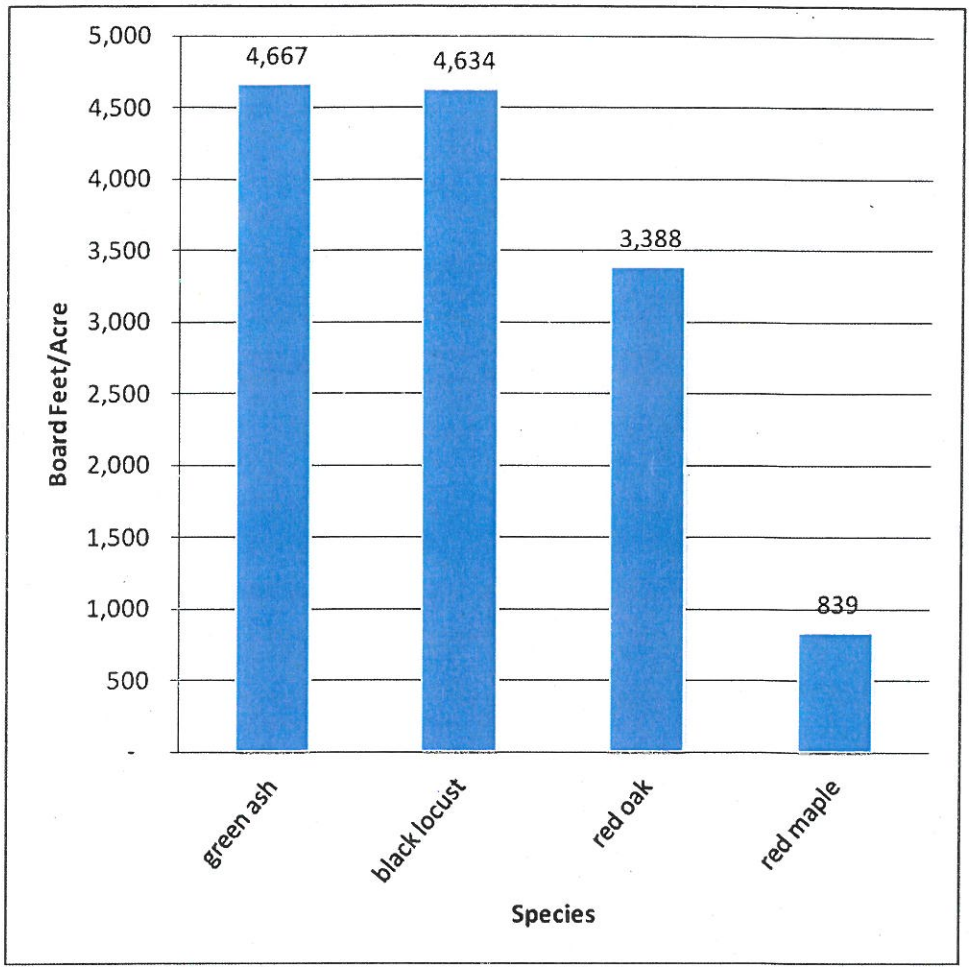


Figure 23. Volume of saw timber in board feet for stand 3.

Cavity Trees, Snags and CWM: Stand 3

In stand 3, the number of dead trees per acre is well above target value (Table 10):

Table 10. Summary number of dead trees and volume of CWM for all stands.

Stand	Number of Dead Trees/Acre		Volume of Coarse Woody material (cubic feet per acre)
	Goal	Actual	
All	6	14.3	300

"Stand 4"

Stand 4 is shown on the stand map. It is not really a stand but rather a small area of meadow that is maintained as a butterfly garden. However, early successional trees are pushing into this area (Figure 7).

MANAGEMENT SUGGESTIONS

Stand 1

Healthy Forest / Water Protection

Except at some of its edges, stand 1, which accounts for most of the forest acreage, is a healthy and mature oak-hickory forest. It plays an important role in minimizing runoff, stabilizing esker margins and some wetland banks. From this perspective, no cutting is indicated.

Biodiversity

Considerations here are similar to those for wildlife habitat, but some additional points deserve attention.

Norway maples. Norway maples are invading the forest from the east and west side. While they are beautiful, they leaf out earlier in spring than other species and create dense shade. This inhibits native species including regenerating hardwoods, understory shrubs and spring ephemeral wildflowers. The town should take overt action to restrict Norway maple incursions. This should include girdling of large and medium Norway maple trees, and lopping smaller stems. The southwest section of the TFLP should be the first priority, and the southeast section the second.

Encroachment. Some abutters on Madison and Sheridan Roads have encroached on the forest to varying degrees. Most abutters dump leaves and branches in the forest behind their homes. This is unlikely to change. Beyond this, at least one homeowner on Madison Road periodically mows the forest floor behind his house, thus eliminating any chance of seedling establishment.

The encroachments of some landowners on Sheridan road have been more egregious (Figure 24). In two cases, the abutters have greatly extended their lawns into the forest–something that can readily be seen by using GIS to lay lot boundaries over an orthophoto layer of the southeast corner of the forest. These practices work against biodiversity and should be stopped. Marking the forest boundaries would be a good first step.

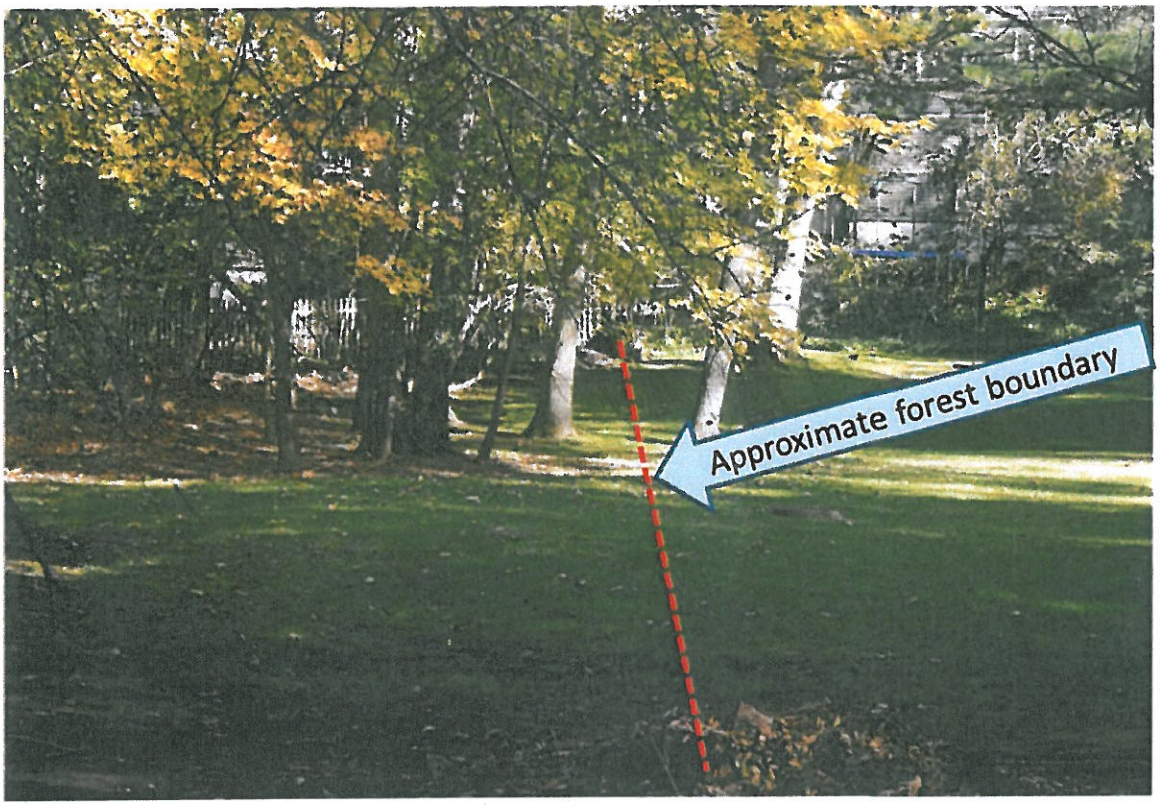


Figure 24. Some abutters have extended their lawns into the forest

Recreation

The current trail maintenance appears to be excellent, with little sign of trail erosion. Trails blocked by fallen trees from the October snowstorm were quickly reopened. This high level of service should continue. In some valley locations, poison ivy has become well established. Whether this is enough to impede recreational walking in the area is not clear.

Stand 2

Healthy Forest / Water Protection

Considerations for stand 2 under this heading are similar to those for stand 1.

Wildlife Habitat

Considerations are somewhat similar to those for stand 1. While pines do not produce the same hard mast as oaks, this is mitigated by the continuing heavy presence of oak in this forest community.

While the white pine areas feel darker than stand 1, the canopy appears to have many openings. Dead trees are around target levels, but CWM is less than half that of stand 1. No action is indicated, however.

Biodiversity

Considerations are somewhat similar to stand 1. In one case, a Madison Road resident may be occasionally mowing the forest floor.

Recreation

This is less of a concern since almost all trails lie in stand 1.

Stand 3

While the vegetation in stand 3 may protect the water supply, the density of invasive plants here and all along the eastern pond-side trail is a concern. One prominent tree species of stand 3, black locust, is an invasive species.

Complete elimination of invasive species in this area is almost certainly impossible. Reducing the amount of invasive species would probably require a concerted and extended volunteer effort not just in stand 3 but all along the trail on the east side of Longfellow Pond. Because of the size of the task and the number of different species involved, a separate invasive species survey and prioritization should occur for the extended area.

While eradicating invasives in stand 3 and along the pond-side trail is worthwhile in itself, the most important goal should be preserving the integrity of stand 1 and stand 2. Viewed from that perspective, the priority targets for eradication would be those most likely to spread into and do the most damage in stands 2 and 3. This determination would be influenced by several factors:

- The mechanism of dispersion, for example, through bird droppings, through wind dispersal of light-weight seeds, or through clonal root extension
- The ability of the species to thrive in the shade of the oak-hickory and pine-oak forests
- The anticipated degree of damage to native plants if the species becomes established in stands 2 or 3.

Two immediate and high-value projects might be cutting large bittersweet vines that are overwhelming existing trees, and releasing remnant native apple trees from vines and from their adjacent competitors.

Reducing invasives would in many cases improve the experience of those who walk the lakeside trails. However, some invasives, such as winged euonymus and oriental bittersweet, are also esthetically pleasing, and attempting their elimination might trigger some resistance from those who use the area for recreation.

"Stand 4"

Stand 4 is not really a stand but it does provide an opportunity to increase biodiversity and wildlife habitat. This could be done be expanding the meadow area to what was apparently its earlier extent. This would correspond to the area shown as stand 4 (Map 8). Un-mowed open land is becoming scarce everywhere, and it provides necessary habitat to a number of bird and insect species.

CONCLUSION

The Longfellow Pond section of the Town Forest is a wonderful natural asset that protects the town water supply, provides wildlife habitat and offers passive recreation for many people with different interests. Viewed from the perspective of the town's four objectives, some actions are implied:

Healthy and diverse forest--water supply protection. Stand 1, the core of oak-hickory forest, and stand 2, the small white pine–oak section, both remain intact and functional.

The canopy is partially open and timber harvest is not a goal, so no cutting of oaks, hickories, or pines is indicated in these stands.

Wildlife habitat. Stands 1 and 2 are good sources of hard mast, especially acorns and hickory nuts, and the canopy is sufficiently open to support a variety of bird species. While creation of additional early successional habitat might provide habitat for some additional species, any cutting to achieve this might just result in additional invasive species rather than native vegetation. Protecting the existing and suspected vernal pools, leaving coarse woody material intact, leaving dead standing trees in place, and creating some additional snags by girdling Norway Maples would maintain or improve habitat for a number of animals.

Biodiversity. The previously disturbed areas found near the dam and at the Hastings house site, as well as much of the trail along the east side of Longfellow Pond have been overrun by a variety of invasive plants. A long-term volunteer-supported project will be necessary to deal with the invasives. An invasives inventory should be conducted, and prioritization should be driven by the goal of keeping invasives out of stands 2 and 3. Attacking the Norway maples that have been invading from the west could help biodiversity, as would reclaiming some small segments of forest converted to lawn by adjacent homeowners. An expansion of the present butterfly meadow could provide additional and highly valuable un-mowed grassland

Recreation. The forest and pond already provide a variety of recreational options. Here, continuation of existing excellent trail maintenance, together with possible treatment of the worst areas of trailside poison ivy are called for.

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