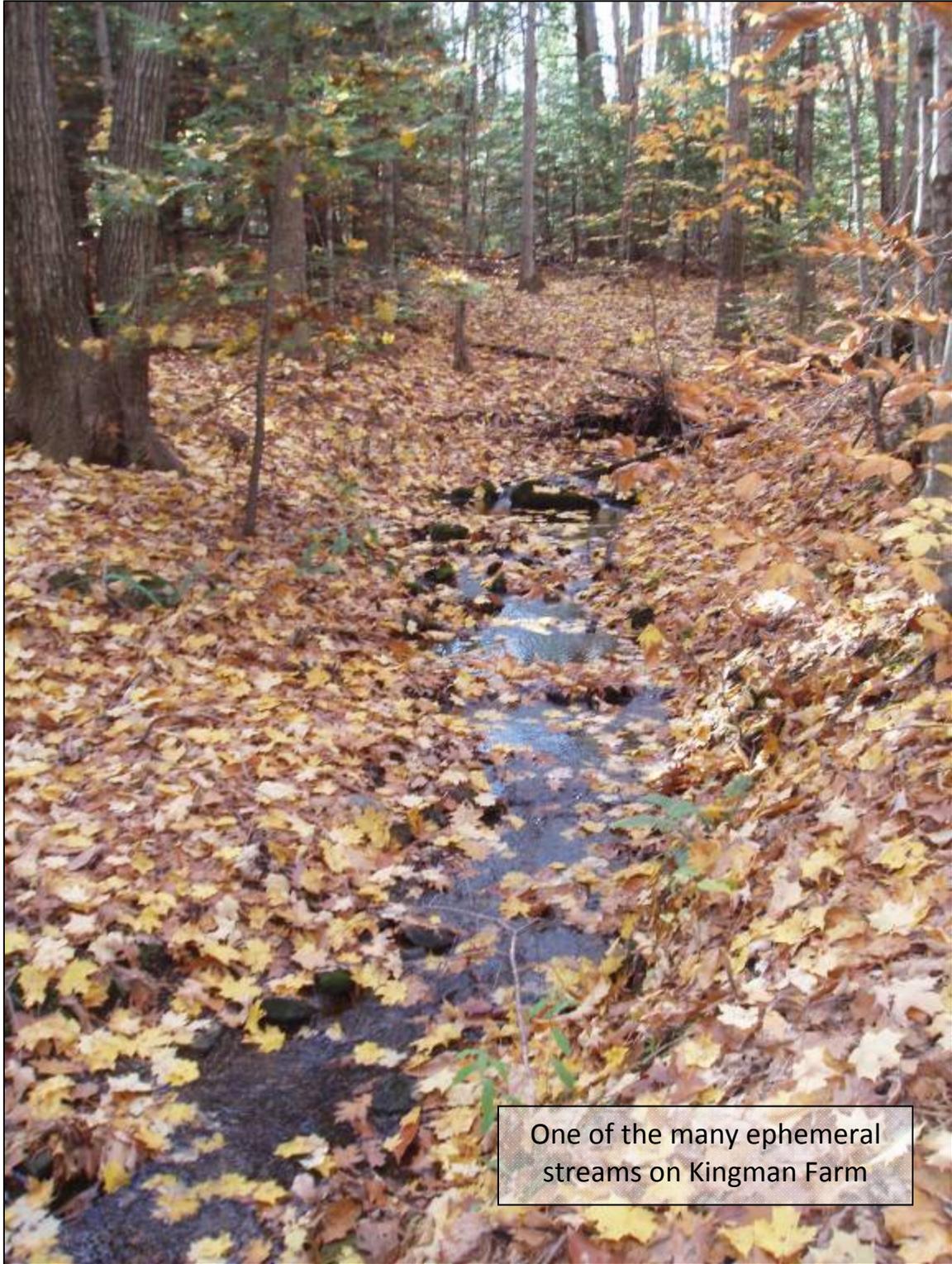


Kingman Farm Management and Operations Plan  
*UNH Office of Woodlands and Natural Areas*



One of the many ephemeral streams on Kingman Farm

<u>Table of Contents</u>		<u>Page</u>
I.	Introduction.....	4
	Ia. Management Objectives.....	4
II.	University Use.....	5
	IIa. Past Use.....	5
	IIb. Current Use.....	6
III.	Physical Attributes.....	7
	IIIa. Property Description.....	7
	IIIb. Soil Descriptions and site quality.....	8, 9
	IIIc. Wildlife.....	10, 11
	IIId. Vegetation.....	12,13
IV.	Stand level assessments and management suggestions.....	14
	IVa. Stand 1.....	14,15
	IVb. Stand 2.....	16
	IVc. Stand 3.....	17
	IVd. Stand 4.....	18
	IVe. Stand 5.....	19,20
	IVf. Stand 6.....	21
	IVg. Stand 7.....	22
	IVh. Stand 8.....	23
	IVi. Stand 9.....	24,25
	IVj. Stand 10.....	26
	IVk. Stand 11.....	27
	IVl. Stand 12.....	28,29
	IVm. Stand 13.....	30
V.	Operations Plan.....	31
	Va. Operations goals.....	31
	Vb. Management challenges.....	31,32
	Vc. Proposed Operations – Details and Timeline.....	33-36
 List of Maps		
	Map 1 Kingman Farm boundaries and aerial photo.....	39
	Map 2 Woodlands Office file map.....	40
	Map 3 Kingman Farm Recreational Map.....	41
	Map 4 Kingman Farm soils map.....	42
	Map 5 Stand Map.....	43
 List of Pictures		
	Picture 1 Stand 1 conditions.....	14
	Picture 2 Yellow birch.....	16
	Picture 3 White pine in Stand 4.....	18

Picture 4 Deer damage within a yarding area.....	19
Picture 5 Common damage to American beech.....	19
Picture 6 Our highest quality stand.....	22
Picture 7 A pretty big paper birch (20").....	24
Picture 8 THE BIG ELM.....	27
Picture 9 Red Spruce.....	28
Picture 10 Seed Orchard.....	28
Picture 11 Pitch Pine.....	28
 Appendix 1 Trees, shrubs and woody plants.....	 37,38

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## 1. Introduction

This document is written as both an overall resource assessment and descriptive strategy of specific management steps to be taken in the forested areas of Kingman farm.

Kingman Farm is a working forest that is managed to maximize educational and research opportunities. Minimization of ecological impact, maintenance of wildlife habitat and demonstration of good land stewardship are all overarching principles that drive decision making. Management strategies and timber harvesting operations are geared towards practicality, sustainability and applicability to contemporary and long-term research programs.

### 1a. Management Objectives for Kingman Farm

- Provide and maintain diversity in vegetation, age classes, and stand types for educational and research use.
- Maintain recreational access for UNH and local community.
- Manage stands at a level of intensity appropriate to the site potential for timber production.
- Design management operations in such a way as to increase the utility of the property by wildlife.

## 2. University Use

This plan addresses the forested areas of Kingman Farm. Multiple research programs utilize the non-wooded areas of Kingman area but will only be discussed where they interact with those programs/uses described within this plan.

### 2a. Past Use

#### Research

Former woodlands based research has included recent programs with the following foci:

- Utilization of sludge on forest and non-agricultural land (Bowden,Smith).
- Throughfall displacement (Aber).
- Molecular phylogenetics and reproductive ecology of the common garter snake (Kean)
- White Pine Growth plots (Barret, Ducey)
- Bacterial growth assessment on soil extract (Furnholm)
- Gypsy moth study (Johnson)
- Biomass harvesting (Earley)
- Flying Squirrel study (Litvaitis).
- White pine grafted seed orchard (Eckert)
- Red spruce provenance. (Eckert)
- Pitch pine plantation established for grafting program similar to white pine orchard. (Eckert)

#### Education

Thousands of University of New Hampshire students have used Kingman Farm as an outdoor classroom. The proximity of this area to the campus allows a quick trip for lab sessions.

#### Forest management

A 1983 Biomass harvest was done to thin stands in what this plan calls Stand 9 and create what is the current compost field.

740 Tons biomass chips.

16 cords firewood.

16mbf White Pine sawlogs

1mbf Eastern Hemlock sawlogs.

Woodlands office records provide anecdotal evidence of a high-grading operation in 1951 previous to UNH acquiring the property in 1961. The condition of some of the stands at Kingman would support this.

## 2b. Current Uses

### Research

USDA Forest Service Foliar Sampling Training Site

White Pine Growth plots (Barret, Ducey)

Assessment of amphibian growth performance (Babbitt)

Continuous Forest Inventory sample plots

### Education

NR 745/845 Forest management

NR 652 Forest Resource Assessment

NR 636 Vertebrate Biology

SOIL 601 Field Descriptions of soils

FORT 263 Forest Ecology

FORT 266 Forest surveying

FORT 272 Mensuration

FORT 273 Forest Management

### Recreation

Cycling club cyclecross series (6 times yearly)

Thousands of University and local community members recreate at Kingman farm yearly.

### 3. Physical attributes

#### 3a. Property description

*Please see the map section of this document*

Located entirely in the town of Madbury NH, Kingman farm is 2 miles from UNH's Durham campus and is located at 333 Knox Marsh Road (RT 155). It is bordered on the northeast by the Bellamy river and to the north and west by other private ownership. The town of Madbury owns a parcel close to the southeastern boundary and there is a large piece of property to the north that will potentially be in conservation easement in the near future.

The property covers roughly 340 acres and sits on fairly high ground in relation to the surrounding area. There is very little topographical change (elevation varies only between 120 and 140 ft above sea level) within the property boundaries. The highest point in the immediate area, Hicks Hill sits beyond the southeastern boundary and rises to 331ft above sea level.

Approximately 100 acres of Kingman farm is devoted to agricultural fields and buildings related to the University's Plant Biology and Sea Grant research facilities. The remaining 240 acres is covered by a wide variety of natural features including forested wetlands, streams, meadows, plantation areas and substantial natural growth woodland. This management plan prescribes management actions specific to this portion of the property.

Several small streams meander through the property, most originating from the Hicks Hill area. These streams supply two substantial red maple swamps in the interior of the property before finally finding their way to the lowest spot, the Bellamy River to the Northeast. Many other small streams crisscross the property and provide for a diversity of habitats and related natural communities.

A well established woods road and trail system crisscrosses the property providing excellent access for recreation and management. These are accessed by trailheads on RT 155 and behind the Madbury town hall. Several easements exist allowing for water supply from the Bellamy reservoir to the Portsmouth water supply and a PSNH easement to run a pump station supplying a Town of Madbury water supply on Hicks Hill. Parties interested in the maintenance of these utilities commonly use these access roads.

Some uncommon characteristics found on Kingman farm include several exceptionally large trees. In stand 11 was found a 40"+ American elm and in stand nine a vigorous 20" white birch. Spicebush was found in several wet locations on Kingman farm.

### 3b. Soil Descriptions and site quality:

See map 4 for a layout of the soils on the Kingman Farm property. The soils on this property have high relative value in their ability to produce woodland crops. All soils are rated either fair or good for growth of grasses and wild herbaceous plants for wildlife use. Other than those areas dominated by either scantic soils or intermittent streams and other wetland micro-sites, soil types do not restrict activities that require heavy equipment. In limited areas where this is a potential concern, work could be accomplished while the ground is frozen to reduce the risk of soil disruption.

Average Site Index ratings are listed following each species designation within the specific soil descriptions (e.g. White pine[79] would be a site index of 79 for this species). For a breakdown of treatment and stand areas see the map section and operations section of this document.

#### Buxton silt loam (BzB):

Seasonal wetness and low permeability can limit access in these locations. These sites are rated good in their productivity for both white pine[65]<sup>1</sup>, upland oaks[59] and northern hardwoods[55]; current site conditions support this.

These soils are found in the southern half of stand 13

#### Charlton fine sandy loam CfB, CfC, CsB

These sites are rated good in their productivity for white pine[65], upland oaks[59] and northern hardwoods[55]; current site conditions support this.

The most predominant soil on the property it covers most of stands 1, 2, 4, 5, 7 and 11. It is also found in the northeastern block and a portion in the center stand 3, a portion of stand 6 bordering the agricultural fields on the south and the portions of stand 8 that border upland sections of surrounding stands.

#### Hinckley HbE, HaA, HaC

These soils are rated fair for pine[55] upland oaks[50] and northern hardwoods[50]. There is a chance of equipment limitation on these soils(MORE)

This soil occupies a small portion of stand 3, and a large area that makes up the compost field

#### Hollis-Charlton Soils(HcB, HcC HdB)

These soils are rated fair for pine[55] and upland oaks[50] and good for northern hardwoods[55]; current site conditions support this. Limitations on operability range from moderate to severe while windthrow risk in general is moderate. Limitations with this soil are generally related to rockiness; this can be mitigated through careful skid road and harvest unit layout. Windthrow risk can be lessened through appropriate harvesting methods.

Western edge of stand 9

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<sup>1</sup> Average Site Index ratings are listed following each species designation within the specific soil descriptions (e.g. White pine[79] would be a site index of 79 for this species).

All of stand 12, the western edge of stand 9 and the center of stand 13 have Hollis-Charlton soil.

#### Leicester Lea, LeB

These sites are rated good in their productivity for white pine[65] and upland oaks[59] and fair for northern hardwoods[50].

Although not a predominant soil, Leicester soils cover a swath through the center of stand 2, a small strip of 4, a block at the center of stand 8 and the northern section of stand 9.

#### Paxton, PdB, PdD

These sites are rated good in their productivity for white pine[65], and excellent for upland oaks[65] and northern hardwoods[59].

Paxton soils can be found at the southeastern corner of stand 1.

#### Scantic Silt Loam(Sca, ScB):

Scantic soils are not well drained and therefore limit management due to susceptibility to windthrow and poor support for woods roads and equipment use. In general, these areas have been removed from consideration in terms of operability; in places where this is not the case, work areas are kept up and out of areas susceptible to pooling water.

These soils are rated fair in their productivity for both white pine[55] and northern hardwoods[50] and poor for upland oaks[44]; current site conditions support this.

Scantic soils are often associated with wet sites, this is true at Kingman in a small block in the center of stand 7, at the southernmost edge of stand 9 the northern tip of stand 13 and over the entirety of stand ten (which is mostly a red maple swamp).

#### Sutton (SnB, SuB)

These sites are rated good in their productivity for white pine[65], upland oaks[59] and northern hardwoods[55]; current site conditions support this

Sutton soil runs as a substantial north to south band through the center of stand five and through portions of stands three and six.

#### Windsor loamy sand and loamy fine sand (WfB,WdA)

These soils are rated fair for pine[55] and upland oaks[50] and good for northern hardwoods[55]. The qualities of this soil type do not limit use of equipment.

Windsor is found in large sections centered in and running along the northeastern boundary of stand 9.

### 3c. Wildlife

#### Current Wildlife Habitat Assets on Kingman Farm

Kingman Farm forest areas are mostly homogenous in age and therefore represent several hundred acres of middle aged forest. This cover type supports a number of mammal and bird species that use these forest types for cover, food and range. Personal observation during the timber inventory and associated field visits provided direct evidence of the following species:

Moose  
Raccoon  
Porcupine  
White tailed deer  
Red Squirrel  
Gray Squirrel  
Barred Owl  
Fisher  
Coyote  
Red fox  
Crow  
Pileated Woodpecker  
Ladderback woodpecker  
American Woodcock  
Numerous unidentified raptors and songbirds

Large scale wildlife resources include the dense thermal cover that is represented by substantial areas of hemlock and white pine in stands 1, 4, 5 and 9. The mature oak overstory in Stand 7 represents an excellent hard mast source that is accessible from adjacent stands and central to many streamside travel corridors, such as the one that bisects the red maple swamp in stand 8. Year round open water can be found both in the seeps originating from the agricultural fields and in wet areas found within or easily accessed from all areas of the property.

Ironically, beech bark disease has been a benefit in that it is a great contributor to dead and down material (especially in stand 5); this element is often missing in stands of this age and stage of development. The poor quality of the standing beech has led to a high number of dead (or weakened, rotting and in the course of dying) and standing snags that are of great use to mammals and birds that use them to den, perch, and feed.

Agricultural operations and fields immediately adjacent to wooded areas are of great use by wildlife for forage. The composting area is used extensively by a large group of crows; it is unknown whether this food source is of overall benefit or has the associated negative effects found with artificially feeding natural populations of wildlife.

The number of red maple swamps and similar swampy areas provide great habitat from wetland associated overstory tree species and a number of shrubby species not found in other areas (speckled alder, spicebush, dogwoods, winterberry holly, highbush blueberry); representing a significant source of soft mast. In addition to this, these areas contribute what are the only naturally occurring/relevant (albeit small and scattered) grassy openings that can be found on the property. Additionally we find here the greatest numbers of standing snags

(other than in stand 5) that are associated with wetlands that change in size and composition almost yearly.

There are also two small (<1/2 acre) stock ponds on the property that represent the only open still water habitat on the property. The Bellamy river corridor running along the northeastern edge of the property offers a migration and travel corridor as well as many unique habitat elements for both terrestrial and aquatic wildlife.

*Wildlife assets adjacent/related to Kingman Farm*

The ownership immediately to the north of the property is mostly hayfield/old field habitat and serves to compliment the wooded areas UNH owns immediately adjacent to it. Substantial open and maintained (non-cropped) fields are also found south of and on the other side of route 155 surrounding the Madbury public safety complex.

The Bellamy River runs north away from Kingman farm for roughly a mile before reaching the Bellamy reservoir. This reservoir is the largest area of open water habitat type within the local vicinity of Kingman Farm and may be paired with agricultural field use by migrating waterfowl as a stopover site. A railroad line crosses at the southern edge of the agricultural fields; these have been found to act as migration corridors for wildlife that depend upon the scrubby growth that often occurs at these roughly maintained margins.

### 3d. Vegetation

Please see Appendix 1 for a list of all trees and woody plants found during recent inventory.

#### Invasive plants

Although not widely invaded, Kingman Farm has representative communities of the laundry list of non-native invasive plants that are often found in this region:

- European(*Berberis vulgaris*) and Japanese barberry(*Berberis thunbergii*)
- Common(*Rhamnus cathartica*) and glossy buckthorn (*Rhamnus frangula*)
- Oriental bittersweet(*Celastrus orbiculata*)
- Morrow's honeysuckle (*Lonicera morrowii*)
- Multiflora rose (*Rosa multiflora*)
- Winged burning bush (*Euonymus alata*)
- Norway Maple(*Acer platanoides*)

Areas of highest invasive stem density include Stand 10 and the margins where this stand meets upland areas, Stand 12 (especially in the white pine seed orchard), and stand 13. It appears (observation only) that those areas that have experienced the greatest and most recent level of human activity also have the greatest related populations of these plants. Additionally, areas that are associated with wet soils and/or may serve as a congregating point for birds appear to also suffer greatest invasion.

From the Woodlands Office perspective there are two main concerns regarding invasive species:

1. It is generally accepted that invasion by foreign species is a detriment to normal ecosystem function.
2. Any shrub monoculture that persists indefinitely in an understory limits the ability to regenerate favorable tree species; this interrupts timber production.

Although we do not currently have a set policy on invasive control, operations proposed within this plan will address any known or anticipated problems as part of projections of stand development.

Timber inventory  
Methods and Findings

*Please see the map section of this document*

The inventory data used here was acquired during the implementation of Kingman Farm's portion of our continuous forest inventory (CFI) program during the summer of 2007.

Sampling Method: Big BAF Variable plot (1 every 2.5 acres) for overstory trees. Count trees were identified using a prism with a BAF of 20; measure trees are determined using a prism with a BAF of 75. To count regeneration a cluster of ten mil-acre fixed area plots were established using the permanently established plot center. Saplings and seedlings were differentiated and invasive species are included in the tally.

Property Wide

*Please see the map section of this document*

BA/Acre:	152 sqft (0% SE)
Trees Per Acre:	203 (10% SE )
Mean DBH:	12.8" (4% SE )

Stand age is estimated by using site index and height measurements. Barring areas of stand 5 (which appear to be 30-40 years old), a portion of stand 7 (which may be over 100 years old) portions of stand 12 (which were planted over the last 30 years), and most areas of stand 13 (which appear to be 30-40 years old), the majority of dominant trees in other stands are between 55 and 75 years old; this is supported by the anecdotal evidence that the farm was high-graded around the middle of the last century. Additionally, coring of several dominant trees in stands one and seven showed that:

- Dominant pine appears to be older in mixed stands than the hardwoods that are present. It is probable that prior stand composition was pine dominant with the current pine we see now already established in the understory.
- Dominant oak in stand 7 is roughly 75 years of age.

#### 4. Stand level assessments and management suggestions

*Please see the map section of this document*

##### 4a. Stand 1

BA/Acre: 136 sqft (SE 9% )  
Trees Per Acre: 229 (SE 0%)  
Mean DBH: 11.2" (SE 14% )

Dominant tree species in order of prevalence (basal area ft/ac): Black Birch(28) , N. Red Oak(22), Eastern hemlock(22), red maple(22), American beech(13), paper birch white pine, sugar maple, yellow birch (<10 sqft/ac).

Dominant regeneration and woody shrubs(>100 stems per acre):. Eastern Hemlock, American Beech, Blue Beech.

Invasive shrub species (>100 stems per acre): None found at sample points.

Stand 1 occupies the southwestern most corner of the property and is approximately 17 acres; site index is rated "good" for timber production. This area abuts town property land on the southern edge and the trails that crisscross it are joined with those on town land. The stand transitions quickly when you cross onto town land to a higher softwood component; on UNH property mixed hardwoods (red oak, beech, black birch, red maple) are dominant although there are considerable inclusions of larger



diameter white pine and hemlock, especially along and near the riparian zones of the brook (Hick's brook from here on) that runs from south to north (downhill from the height of Hick Hill). Hick's brook initially bisects the stand as it enters the property and eventually turns eastward to serve as a rough stand boundary on the northeast side. The transition from stand one to two is marked by a gentle switch from a mixed wood stand to one dominated by red maple.

Timber quality is good through most of stand 1 with red oak stems representing the greatest future value while black birch(high canker infection) and American beech(a number with beech bark disease) representing the lowest value. The larger white pine are currently of age to serve as a potential seed source but not quite frequent enough to represent a pine focused commercial sale. Hemlock occurrence is high enough so as to represent a great potential for wildlife cover even though it represents low commercial value. Regeneration consists mostly of shade tolerant species (American beech, hemlock).

##### Management Suggestions:

Aggressively thin around the higher quality pole sized and larger hardwood stems using single tree and small group selection methods; it has been shown that single tree selection can reduce the spread of both nectria canker and beech bark disease while concurrently reducing competition with higher quality stems. This will work especially well in the northern sections of the stand where there is some beech of excellent quality (unusual for this property).

Coring of both dominant white pine and oak shows that growth has slowed considerably and that these trees should be released (Rings in last two inches = 28 in oak and 18 in white pine) Patch cuts of up to ½ acre could be made to introduce more diversity to the stand by establishing a new age group of sun loving regeneration. These openings should be placed near to vigorous mature white pine of seed-bearing age and centered upon areas where 50% or more of current growing stock is of less than good quality; this mostly means large groups of poor beech and red maple. Aesthetic objectives may make it difficult to locate these patches given the proximity of this stand to the farm and many recreational trails.

For wildlife, groups of hemlock that are larger than 10 stems and >8" diameter should be retained; smaller groups or individual stems may be removed to satisfy other goals. The riparian zone surrounding Hick's brook should remain mostly intact, although access to different parts of the stand may require some small scale impingement.

#### 4b. Stand 2

BA/Acre: 110 sqft(SE 27%)  
Trees Per Acre: 133.2 (SE 0%)  
Quad Mean DBH: 14.9" (SE 31%)

Dominant tree species in order of prevalence (basal area ranking): Red Maple (70). White Pine (30), Shagbark Hickory (10).



Dominant regeneration and woody shrubs in order of prevalence (>100 stems per acre): Highbush Blueberry (>2000spa), white pine (>2000spa), spiraea, black birch, arrowwood, shagbark hickory, eastern hemlock, red maple, yellow birch.

Invasive shrub species (>100 stems per acre): (other species are present but in smaller numbers). None found at sample points.

Stand two is a healthy red maple swamp of approximately 12 acres in size. It is supplied

by Hick's Brook and by another stream (Town Hall brook from here on) that originates in wetlands at the Northwest base of Hick's Hill. Town Hall Brook runs through Stand 2 and finally forms a rough boundary between stands two and three. This boundary provides a marked change in species, from red maple to upland types, in some cases a homogenous mix of high quality red oak stems on the boundary to stands 3 and 4. Understory plants consist of a wide range of wetland herbaceous cover and woodland shrubs including an extremely high density of high bush blueberry. Surprisingly there are a large number of white pine seedlings per acre. This can be attributed to the fact that red maple swamps generally have an open canopy and there is more than enough seed coming in from stand 4 to the north.

#### Management suggestions:

This stand represents an excellent and somewhat uncommon stand type that should be left alone for what it offers to the property in both diversity and wildlife habitat benefit. It should, however, be monitored closely for the presence of invasive plants. Other areas on Kingman farm similar in composition are experiencing a tremendous onslaught of this type and attempts should be made to nip the problem in the bud should it rear its ugly head here.

#### 4c. Stand 3

BA/Acre: 160 sqft(SE 21%)  
Trees Per Acre: 247 (SE 0%)  
Quad Mean DBH: 10.4" (SE 25% )

Dominant tree species in order of prevalence (basal area ranking): White Pine (28) Quaking Aspen (28), Northern Red Oak (24), Red Maple (20), White Ash (20), Sugar Maple (12), Black Birch (8), Eastern hemlock (8), Paper Birch (4).

Dominant regeneration and woody shrubs (>100 stems per acre): White ash, sugar maple, red oak, quaking aspen, highbush blueberry, American beech. Witch hazel.

Invasive shrub species (>100 stems per acre): Japanese barberry.

Stand 3 (17 total acres) is a catch-all designation given to three different areas of mixed hardwoods (aspen, red oak, black oak, red maple, black birch, white ash, paper birch). There are also some large diameter white pines scattered about these areas. The commonality of the three areas is basic species composition and the structural characteristics that come from substantial edge where upland meets wetlands. (e.g. High diversity of tree and shrub species).

Northwestern most area: This area is a mixed hardwood stand of pole-sized stems with occasional scattered small-sawtimber sized trees that are generally of low merchantable value (either because of species or form) There are some notable softwood inclusions of larger diameter hemlock and white pine. Occasional large diameter beech can be found and some individuals still maintain large productive appearing crowns; bole quality varies based upon level of beech bark infection.

Southern areas of stand three: These are areas of mixed hardwood stand of pole-sized stems with occasional scattered small/large sawtimber sized trees that are generally of fair to good quality. There are also scattered small clumps of softwoods that range in sizes.

#### Management suggestions

Free thin across the stand to remove poorly formed stems competing with future crop trees. Crop tree designation should be based upon form and not species (i.e. current market value). Large patch cuts of up to ½ acre located could be made to introduce more diversity to the stand by establishing a new age group of sun loving regeneration. These openings should be placed near to vigorous mature white pine of seed-bearing age and centered upon areas where 50% or more of current growing stock is of less than good quality. Large diameter beech and other hardwood species (such as the occasional shagbark hickory) should be retained for diversity in vertical structure and other benefit to wildlife. Streamside riparian zones (50-100 foot buffer zone) should be left intact when possible and disrupted only when other access to portions of the stand are infeasible.

#### 4d. Stand 4

BA/Acre: 145.7 sqft(SE 17%)

Trees Per Acre: 124.8(SE 0%)

Mean DBH: 15.5"(SE 12% )

Dominant tree species in order of prevalence (basal area ranking): White Pine(60), Eastern Hemlock(34.3), Red Maple(14.3), N.Red Oak(8.6), Sugar Maple(8.6), Black Birch, Shagbark Hickory, Yellow Birch (all less than 3sqft.)

Dominant regeneration and woody shrubs (>100 stems per acre):American beech, Witch Hazel, White Pine, maple-leaved viburnum, black birch.

Invasive shrub species (>100 stems per acre): No significant numbers found.

This stand is 13 acres and consists of an overstory of large diameter white pine and hemlock towering over a younger age class of mixed hardwoods. It appears that earlier operations removed a number of larger white pines in the area. This mostly resulted in areas of poorly formed shade tolerant regeneration (now pole sized and aged 30-40 yrs old) although occasional areas exist where this cutting resulted in white pine and red oak of good form; these represent the greatest potential for future value within this stand. Young regeneration (seedlings) consists mostly of shade tolerant species (American beech, hemlock) although there are pockets of white pine to be found.

#### Management Suggestions:

Steps should be taken to perpetuate this stand as pine dominated. Using an approach emulating a two step shelterwood system an initial cut should be performed to favor final crop trees (current quad mean diameter of white pine is 15.6"); by removing overtopped or poorly formed co-dominant stems we strengthen the stand for a final release cut at financial maturity (18"+). The first cut should occur within the next few years and timed with a good cone year.

The final removal cut should be performed 10-20 years following the seed cut; this will allow the highest valued stems within the stand to reach their highest commercial value and the regeneration to progress to a point where it can be released. During any (or even all) of these operations efforts should be made to continue to nurture the smaller second age class of hardwoods by continuing to use crop tree thinning methodology. Where patches of 4 or greater large diameter hemlock exist these should be kept for wildlife.



Picture 3 White pine in Stand 4

#### 4e.Stand 5

BA/Acre: 166.3 sqft(SE 13%)

Trees Per Acre: 316.7 (SE 0%)

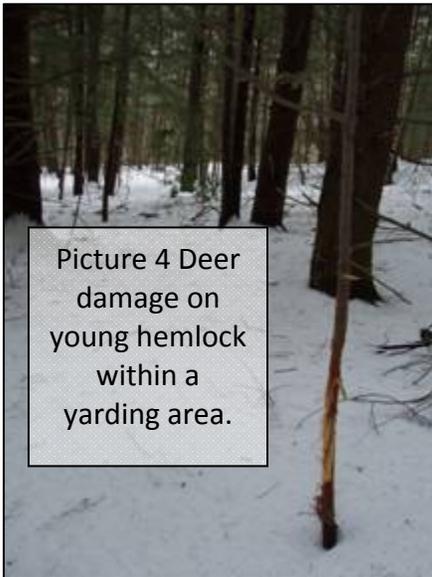
Mean DBH: 10.8" (SE 10% )

Dominant tree species in order of prevalence (basal area ranking): Eastern hemlock(60), American beech (22), white pine (20), red maple (11), bigtooth aspen, black birch, n red oak, sugar maple, paper birch, shagbark hickory, white ash, yellow birch, American elm (Range 1-8 sqft per acre)

Dominant regeneration and woody shrubs (>100 stems per acre):. American Beech, Eastern Hemlock.

Invasive shrub species (>100 stems per acre): None found at sample points.

Stand 5 is 55 acres of mixed wood dominated by larger diameter eastern hemlock. Occasionally



Picture 4 Deer damage on young hemlock within a yarding area.

there are groups of up to ¼ ac in size of pole to small sawtimber sized quaking aspen of high to very high quality and vigor. Smaller groups of similar age class can be found of paper birch, black birch and American beech. American beech is of poor quality and in a state of potential perpetuation; as it reaches a certain age it becomes heavily infected with beech bark disease and dies, only to release the next younger age class of the same species resulting in small thickets of American beech. There are scattered larger diameter individual red oak and white pine stems, but these are mostly found on the transitional edges of other stands. Along the

intermittent streams in this stand are interesting alleys of species that imply enrichment-sugar maple, white ash, and basswood.

#### Management suggestions:

Large groups of hemlock are important cover for wildlife and should be maintained, especially along stream banks and in low wet areas. Single tree selection should be used to remove afflicted American beech stems where other healthy vigorous trees of good form will benefit. Where this is not true aggressive patch cuts should be used to interrupt the perpetuation of beech over beech. These should be followed by mechanical mowing, brush saw treatments or other control means of the smaller age class of beech. Operations should be performed in the summer with hopes that scarification during overstory harvest will introduce regeneration of other species into the mix. Fortunately, beech is abundant enough that discrimination against it should not reduce its contribution towards diversity on this property.



Picture 5 Common damage to American beech.

Other operations in this stand could include large group selection harvests of aspen to benefit wildlife as well as patch cuts to induce regeneration for increased overall diversity and stand value.

#### 4f. Stand 6

BA/Acre: 150 sqft(SE 33%)  
Trees Per Acre: 172.6 (SE 0%)  
Quad Mean DBH: 14.0" (SE 38%)

Dominant tree species in order of prevalence (basal area ranking): White Pine (90), Eastern hemlock (30) , Black Birch, Sugar Maple, White Ash (10 each).

Dominant regeneration and woody shrubs (>100 stems per acre): Eastern Hemlock, Northern Red Oak, sugar maple, quaking aspen.

Invasive shrub species (>100 stems per acre): None found at sample points.

Stand 6 is 6 acres of high quality large diameter white pine stems with some large diameter hemlock mixed in. Regeneration is hemlock, red oak, sugar maple and quaking aspen.

Management suggestions: Perpetuate this stand towards pine using a two step shelterwood. This will vary from usual shelterwood methods in that final removal cut should remove only so much of the canopy that the newer age class will flourish, this should be done so as to maintain the aesthetic quality of this area because of its high visual exposure.

#### 4g. Stand 7

BA/Acre: 166 sqft(SE 9%)

Trees Per Acre: 159.6 (SE 0%)

Mean DBH: 14.2" (SE 7%)

Dominant tree species in order of prevalence (basal area ranking): N Red Oak (80 sq ft/ac), red Maple(25), White Ash (10), American Beech, Basswood, Aspen, Black Ash, Black Birch, Black Oak, eastern hemlock, shagbark hickory, sugar maple, white pine, yellow birch(range between 1-9 sqft per acre).

Dominant regeneration and woody shrubs (>100 stems per acre):Maple leaved viburnum, sugar maple, American beech, red oak, hobblebush, hazelnut, eastern hemlock.

Invasive shrub species (>100 stems per acre): (other species are present but in smaller numbers).

This stand is 35 acres and is composed primarily of small to large sawtimber red oak of good to high quality (mean diameter is 17"). Although soils at the northern portion of this stand are more favorable to the growth of red oak, areas to the south (especially bordering the agricultural fields) have pockets of veneer quality stems exhibiting excellent growth. These small higher quality areas (especially those nearest rt155) are as much as 30 years older than the remainder of the stand. The only detriment to quality that recurs throughout the stand is that most stems appear to have originated from stump sprouts and therefore have bit of sweep. Coring of two dominant trees showed that growth has been limited from 1/15<sup>th</sup> to 1/20<sup>th</sup> of an inch per year.



#### Management suggestions:

Some small scale attempts at crown and low thinning should be made although great care should be taken during any operations to limit damage to this residual (and very high quality) stand. In areas where the risk of damage is too great thinning attempts should be abandoned and the stand should be left as is. Unfortunately, growth rates as assessed above would show that financial maturity for veneer quality logs will only be reached in 45 years. A vigorous reassessment should be made in 5 years across the stand to find whether predicted rates are true. Market conditions may also be more favorable for small scale oak harvest at that time.

Based upon the apparent ability of this stand to produce high quality vigorous oak steps should be painstakingly undertaken to regenerate this stand to that species. These stands offer great potential to test many possible experiments regarding the association of fire, scarification and mowing/cutting of hardwood regeneration within stands that are already established. At least one area of substantial acreage should be left as is to be used for educational purposes

#### 4h. Stand 8

BA/Acre: 145 (SE18%)  
Trees Per Acre: 92.9 (SE 0% )  
Mean DBH: 16.2" (SE 7% )

Dominant tree species in order of prevalence (basal area ranking): Red maple (65), Shagbark Hickory (30), American Beech, Eastern hemlock, N. Red Oak, White ash (all 10 sqft each), sugar maple (5).

Dominant regeneration and woody shrubs (>100 stems per acre):. White ash, American beech, eastern hemlock, American elm.

Invasive shrub species (>100 stems per acre): (other species are present but in smaller numbers).

Stand eight is a five acre red maple swamp that acts as a collection point for Hick's brook and the many seeps that drain from below the agricultural fields to the south. Although red maple as a species predominates here there are fairly large pockets of other hardwoods as the stand transitions to upland. Most notably there is a large area of white ash to the north at the border of stand 3.

Management suggestions: As with stand two: *This stand represents an excellent and somewhat uncommon stand type that should be left alone for what it offers to the property in both diversity and wildlife habitat benefit. It should, however, be monitored closely for the presence of invasive plants. Other areas on Kingman farm similar in composition are experiencing a tremendous onslaught of this type and attempts should be made to nip the problem in the bud should it rear its ugly head here.*

#### 4i. Stand 9

BA/Acre: 160 (SE 12%)  
Trees Per Acre: 139.9 (SE 0%)  
Mean DBH: 15.3 (SE 8%)

Dominant tree species in order of prevalence (basal area ranking): White pine (91), eastern hemlock (47.5), American elm, aspen, black birch, n.red oak, Norway maple, paper birch, red maple (all in the range of 1-6 sqft/ac).

Dominant regeneration and woody shrubs (>100 stems per acre): Eastern hemlock, gray birch, lowbush blueberry, American beech, American elm, black birch, white ash.

Invasive shrub species (>100 stems per acre): (other species are present but in smaller numbers): European barberry, common buckthorn, Norway maple,

This stand is 48 acres in size. The overstory is comprised primarily of large diameter white pine and hemlock. Individual stem quality varies greatly, but in general quality drops as you move from north to south. This can be attributed to the fact that the lower sections are wet in the transition to stand 10 and therefore less likely to produce trees of good form. Additionally, some northern sections were thinned in 1983 and it is likely that the higher quality stems were left and benefited from the additional growing space. The understory consists primarily of pole sized black birch and smaller hemlock. There are also some small pockets of sapling sized black birch that are just transitioning from thicket stage, these are likely a result of the 1983 thinning as well. Where this stand borders the Bellamy river, especially on the northeast side (and boundary) hemlock becomes quite thick and regeneration is expectedly limited to that species.

#### Management Suggestions:

Maintain 100 foot buffer to Bellamy river and arms of thick hemlock growth that reach out from this buffer into the surrounding stand. Similarly retain at least 50% of the current hemlock where it occurs in groups of ten stems or greater or is associated with other riparian zones. Large diameter white pine stems that are of financial maturity and competing with stems of greater quality should be removed. This harvest should essentially be the first of a two step shelterwood system except that the removal cut should retain up to 1/3 of the basal area represented by mature white pine for both vertical stand diversity and wildlife utility.



Picture 7 A pretty big paper birch (20")

In areas that form a transition zone to stand 10 and timber quality is poor, several large patch openings (of up to ¼ acre in size) should be created for use by wildlife. These patches should also try to incorporate any available mature clumps of aspen. These patches will allow us to maintain important thicket habitat next to the wetland for use by small mammals, grouse and

other birds and allow us access to alder patches (in stand 10) for future maintenance for woodcock.

#### 4j. Stand 10

BA/Acre: 80 (SE 21%)  
Trees Per Acre: 152.7 (SE 0%)  
Mean DBH: 12.1" (SE 25%)

Dominant tree species in order of prevalence (basal area ranking): Red maple(44), American elm(12), white pine (8) n.red oak, shagbark hickory(both 4 sqft/ac).

Dominant regeneration and woody shrubs (>100 stems per acre):.Spiraea, black cherry, white ash, blue beech, silky dogwood, red maple, basswood, arrowwood.

Invasive shrub species (>100 stems per acre): (other species are present but in smaller numbers).European Barberry, Japanese barberry, common buckthorn, multiflora rose.

At 9 acres in size stand 10 at its core is a red maple swamp. Other wetland associated species occur including a large number of American elm and blue beech. Shrub species include spiraea, silky dogwood and arrowwood are scattered about the area and where the stand transitions to upland stand 9 we find many large clumps of speckled alder and rhubarb. Several interesting "islands" of mature white pine and hemlock of less than ¼ acre in size are scattered about the swamp, forming an unusual juxtaposition of cover types. The understory of this stand has been profoundly invaded by both species of barberry that at times it is so thick you cannot walk through it. Other invasive species found here include glossy and common buckthorn, multi-flora rose, honeysuckle and bittersweet, (albeit at lower densities than barberry).

#### Management Suggestions

In approximately 5 years the alder present in this stand should be mowed back to maintain its use for feeding habitat by woodcock. The agricultural fields are likely used by woodcock as singing grounds and these feeding areas could help to supplement the number of habitat elements that this species requires.

This stand also should undergo some form of treatment for invasive plants. It undoubtedly now serves as a seed source to aid dispersal to other areas of the property. Since it is in a wetland herbicides should be avoided and some sort of large scale (and aggressive) mechanical intervention will be required.

#### 4k. Stand 11

BA/Acre: 140 (se% na)  
Trees Per Acre: 212 (se% na)  
Mean DBH: 8.9 (se% na)

Dominant tree species in order of prevalence (basal area ranking): White pine, white ash, red maple.  
Dominant regeneration and woody shrubs (>100 stems per acre): Black birch.  
Invasive shrub species (>100 stems per acre): European barberry, Norway maple.

Stand 11 is a mix of large diameter white pine of fair quality and a number of large diameter hardwoods (white ash, red oak, black cherry) that are of good quality. The variety of tree species and the quality of Individual trees implies that this is an enriched micro-site. This stand is mostly isolated from the rest of the property by stand 10 and by the stream (and associated riparian zone) that drains this wetland. At the northern edge of this stand stands an impressive 40+” American Elm of good vigor and quality.



Picture 8 THE BIG ELM

#### Management Suggestions

This stand should remain untouched due to its important contributions to structural age and species diversity that it contributes to the property as a whole. It also acts as a buffer to the adjacent landowner to the East.

#### 4I. Stand 12

BA/Acre: NA  
Trees Per Acre: NA  
Mean DBH: NA

Dominant tree species in order of prevalence (basal area ranking): White pine, red oak, black birch, red spruce, pitch pine, paper birch.



Dominant regeneration and woody shrubs (>100 stems per acre): Yellow birch, alternate-leaved dogwood, white pine, black cherry, grey birch, red maple, northern red oak.  
Invasive shrub species (>100 stems per acre): (other species are present but in smaller numbers). Japanese barberry.

The composition of this stand is originated primarily of planted stock. These plantings occur in areas roughly an acre in size and include:

-Pitch pine approximately 20 years old that was originally planted as stock to be used to develop a grafted seed orchard. The experiment was never completed and the pitch pine has grown to the point of stasis; although the stems look fairly vigorous crown development is now limited by constricted growing space. There is no current or planned use for this plantation.

-Red Spruce approximately 20 years of age that was planted from seed found across the natural range of red spruce. These were planted to maintain this source of genetic variation and as a source of material for experimentation. Although utilized for research in the past there is no current or planned use for this plantation.



-A white pine seed orchard that was grafted on seedling stock to maintain genetic source material from across the state. This seed orchard is a sister to one maintained by the state nursery in Boscawen. Although utilized heavily for research in the past there is no current or planned use for this plantation.

Along the unmaintained edges of these plantings brushy areas of natural regeneration have sprung up.



This has manifested itself mostly poorly formed stems in a varied mix of species and shrubby growth including several clumps of sumac. Some grassy openings still remain where forest has not successfully reinvaded.

Where this stand edges to the road to the south a small stand of naturally developed good quality larger diameter white pine is found (in the diameter range of 14 to 22 inches.)

Management Suggestions:

Although not in current use, the obvious potential for future research and educational reference exists for all three planted areas (where else is there red spruce around here?). The white pine seed orchard should remain as is, although the understory should be mowed just to halt invasive plant takeover and allow easy access for classes and research projects. The pitch pine plantation should be thinned to allow the better stems to develop to their full potential. A recent request for pitch pine seedlings for pine barren recovery shows that this may at some point serve as a useful seed source. The red spruce plantings should be thinned as well, less for development and more just for access as the lower crowns prevent any movement at all between rows. The margins of this field that surround these plantings should be mowed back to allow for future planting area if needed and to increase the aesthetics of what is currently a jumbled mess of vegetation. The patch of large diameter pine at the bottom of this stand near the access road may be thinned and maintained as an aesthetically pleasing stand.

#### 4m. Stand 13

BA/Acre: 166 (SE 26%)

Trees Per Acre: 250 (SE 39%)

Quad Mean DBH: 8.4" (SE 17%)

Dominant tree species in order of prevalence (basal area ranking): Black birch (46) quaking aspen(40), red maple (20), white pine (13) white ash, bigtooth aspen, yellow birch (all 6.7)

Dominant regeneration and woody shrubs (>100 stems per acre):.White ash, silky dogwood, sugar maple, American elm, black cherry, highbush cranberry, bigtooth aspen, spiraea, , hawthorn, arrowwood, alternate leaved dogwood, Virginia creeper.

Invasive shrub species (>100 stems per acre): (other species are present but in smaller numbers).

European barberry (>4700 spa), common buckthorn, multiflora rose, Norway maple.

This stand is a brushy swampy area that may have existed as a pasture and just let go approximately 20 years ago (some woodlands maps comically refer to this stand type as "brush"). In lower areas red maple is dominant while in drier sections large clumps of mature quaking aspen occur here mixing in with and shifting over to predominantly pole-sized black birch as the stand nears its edge with stand 7. The black birch is of very poor quality as most of it is succumbing to nectria canker. Where shrubby invasives (multiflora, barberry, etc.) are not dominant the most common regeneration is sugar maple.

#### Management Suggestions:

This stand offers another excellent opportunity for testing invasive control procedures. Since this area is highly visible to recreational users, care should be taken during operations to consistently produce results that are both silviculturally sound and visually pleasing (at least not "train-wreckish").

Where the black birch is profoundly damaged by canker it should be removed; since this is the predominant condition for black birch in this stand it offers us a unique opportunity to open up some growing space for the sugar maple regeneration that is already present. The sugar maple is prevalent enough in the understory to realistically become a small stand mixed with black birch in the upland areas.

Where the stand becomes low and wet invasive control measures should be implemented. The overstory should be allowed to progress naturally; aggressive vegetative manipulation seems unproductive commercially but may at some future point present some opportunity for research or wildlife habitat benefit. In regards to wildlife, it may be desirable to target some of the clumps to produce vegetative sprouts. These areas should be cut in groups of 5 trees or greater and placed so as to supplement earlier work and produce an aesthetically pleasing result.

## 5. Operations Plan

### 5a. Operations goals

Although this plan in its essence seeks to alter the current vegetative makeup, it is assumed that the overall productivity of the property for use in education will be heightened. This can only be stated assuredly knowing that:

- there are currently no known long-term research sites in place that require a moratorium on management.
- the site conditions are not so unique that classes that use this area for its present structure cannot easily find those conditions within this property or other local university properties.

Most operations will be centered on the goal of improving both the value and diversity of our timber resource. The Woodlands office should produce additional documentation for harvest strategies as needed. It should be noted that factors outside of Kingman farm will play a role in implementation of harvesting. Specifically, timing of other harvests and how these effect our sustainable cut guidelines may change the years in which we implement the treatments prescribed here. Other goals include:

Resample CFI plots on a ten year cycle-

- :Take action on newly established invasive plant communities.
- :Modify management and operations plan based upon growth, signs of decline or widespread disease, changes in local land use and/or changes in University policy towards land use and research.

Maintain plantations and make space available in anticipation of needed future planting space.

Maintain recreational and management access through yearly road and trail work.

Nurture management relationships with town conservation commission and other abutting landowners.

Maximize wildlife habitat goals.

- Where appropriate, implement (1) ½ acre early successional opening per stand during other operations (as few as 5, as many as 9)

Implement research based vegetative manipulations based upon newly established or anticipated need.

### 5b. Management challenges

One clear challenge is the difficult coexistence of recreational access and management of (especially the agricultural portion) the property. Hundreds of users can frequent the farm on a single day, many of them dog-walkers. This situation is a difficult one for the farm manager in that the introduction of dog waste can seriously alter the science of growing crops related to research programs. This necessarily requires that dog walkers be barred from the fields; when people follow this rule then all is well, when they do not this creates a situation where it seems that the next step to be taken

is to bar recreation from the property. Not only would this be incredibly unfortunate it would be extremely politically unpopular and destroy the important outreach tool that Kingman Farm is.

The other challenge is that people sometimes have issue when we manage through timber harvest. In past operations we have found that if the event is well publicized and site visits are provided, it turns into an important outreach and education opportunity instead of a potential public relations problem. Each major operation will have a well publicized walk through and related meeting with the Madbury Conservation commission.

### 5c. Proposed Operations – Details and Timeline

Stand 1: Timeline: 2010-2014 implement single ½ ac or larger patch cut to benefit wildlife.  
Thin appropriate areas over multiple year low grade harvest.  
Estimate: 100-125cds total volume, 25cds per year over 4 years.

This represents 1/5 of the total volume of this stand and assumes that several acres in riparian zones will not be thinned. This means that although total basal area is reduced by ¼, areas that are more intensely managed will have basal area reduced by sometimes over 1/3. One half of all volume of black birch, red maple and American beech will be removed; 1/6 of all red oak volume will be removed.

Current basal area: 136 sqft/ac  
Residual Basal Area Goal: 90-100 sqft/ac

Stand 2: 2018 monitor as part of CFI resample.

Stand 3 Timeline: 2010-2014 implement single ½ ac or larger patch cut to benefit wildlife.  
Thin appropriate areas over multiple year low grade harvest.  
Estimate: 100cds total volume, 25cds per year over 4 years.

This represents 1/4 of the total volume of this stand and assumes that several acres in riparian zones will not be thinned. This means that although total basal area is reduced by ¼, areas that are more intensely managed will have basal area reduce by sometimes over 1/3. One third of all volume of red oak, red maple and black birch will be removed; 1/4 of all white pine volume will be removed and ½ all aspen will be removed in the form of a patch cut.

Current basal area: 160 sqft/ac  
Residual Basal Area Goal: 90-100 sqft/ac

Stand 4 Timeline: One harvest in the years 2013-2108  
Seed cut removing half of all material timed with good white pine cone year, this will include poor quality co-dominant white pine stems, dominant stems that have reached financial maturity and low value pole and small timber sized hardwood.

Estimate: 160cds total volume, 40 cds per year over 4 years.

This represents 1/5 of the total volume of this stand and assumes that several acres in riparian zones will not be thinned. This means that although total basal area is reduced by ¼, areas that are more intensely managed will have basal area reduce by sometimes over 1/3. One half of all volume of red maple will be removed. One third of all volume of American beech and white pine and mixed hardwoods will be removed. ¼ all volume of eastern hemlock will be removed.

Current basal area: 146 sqft/ac  
Residual Basal Area Goal: 90-100 sqft/ac

Stand 5 Timeline: 2010-2014 implement multiple 1/4 ac or larger patch cuts to benefit wildlife.

Thin appropriate areas over multiple year low grade harvest.  
440cds total volume, 110 cds per year over 4 years.

This represents 1/4 of the total volume of this stand and assumes that several acres in riparian zones will not be thinned. This means that although total basal area is reduced by ¼, areas that are more intensely managed will have basal area reduce by sometimes over 1/3. The goal is to roughly remove equal fractions of volume for each species.

Current basal area: 166 sqft/ac  
Residual Basal Area Goal: 110-120 sqft/ac

Stand 6 Timeline: One harvest in the years 2013-2108

2 step shelterwood. Reduce basal area by 40%.  
85 cds total volume.

Current basal area: 150sqft/ac  
Residual Basal Area Goal: 90-100 sqft/ac

Stand 7 2008 Establish red oak growth plots  
2013 resample/harvest within 10 years based upon findings.

Stand 8 2018 Monitor as part of CFI resample

Stand 9 Timeline: One harvest in the years 2013-2018

Remove 1/3 volume focusing on co-dominant or poor dominant white pine stems. 740 cds total volume.

Current basal area: 160sqft/ac  
Residual Basal Area Goal: 90-100 sqft/ac

Stand 10 Implement invasive control plots based upon acquisition of funding. Regenerate alder where possible to benefit woodcock.

As with operations on MacDonald Lot, funding will be sought to:

- Establish a proven invasive control strategy that can be used for other areas of University property.
- Manipulate these areas in a way that our researchers can use (i.e. sound experimental design).
- Serve as a demonstration site for other agencies/landowners.

Stand 11 2018 Monitor as part of CFI resample  
Leave for diversity along wetland and as a forested buffer to adjacent landholdings.

Stand 12 Summer 2009  
Thin Plantations  
Keep understory of plantations controlled with mowing.  
Reclaim/maintain field openings.  
10cds total volume.

Stand 13 Timeline: Project area "fill in" for summer crew.  
Thin out poor quality black birch to promote sugar maple regeneration.  
Cut aspen to benefit wildlife.  
Use various mechanical controls to contain invasive species (include/supplement to those measures in stand 10)  
2 cds total removal volume.

General  
Recreation

Timeline 2009-2011  
Redevelop main trailhead parking area to accommodate parking needs.

Operations timeline

Stand	2009-2011	2010-14	2013-2018	2018	2024
1		THIN-LOW GRADE <b>50MBF</b>		CFI RESAMPLE	
3		THIN-LOW GRADE <b>50MBF</b>		CFI RESAMPLE	
5		THIN-LOW GRADE <b>50MBF</b>		CFI RESAMPLE	
4			HARVEST SEEDCUT <b>80MBF</b>	CFI RESAMPLE	
6			HARVEST SEEDCUT <b>45MBF</b>	CFI RESAMPLE	
9			HARVEST THIN <b>370MBF</b>	CFI RESAMPLE	
12	Recover plantations			CFI RESAMPLE	
13	Invasive control/Wil dlife habitat work			CFI RESAMPLE	
2				CFI RESAMPLE	
7	Resample for growth estimates			CFI RESAMPLE	HARVEST
8				CFI RESAMPLE	
10	Invasive control			CFI RESAMPLE	
11				CFI RESAMPLE	
Recreation	Develop main Trailhead parking				

Appendix 1 Trees, shrubs and woody plants observed at Kingman Farm.

Indigenous tree species

American Beech	<i>Fagus grandifolia</i>
American Elm	<i>Ulmus americana</i>
Bigtooth aspen	<i>Populus grandidentata</i>
Blue Beech	<i>Carpinus caroliniana</i>
Basswood	<i>Tillia americana</i>
Black Cherry	<i>Prunus serotina</i>
Black Oak	<i>Quercus velutina</i>
Black Birch	<i>Betula lenta</i>
Eastern Hemlock	<i>Tsuga canadensis</i>
Gray birch	<i>Betula populifolia</i>
Hophornbeam	<i>Ostrya virginiana</i>
Pitch Pine	<i>Pinus rigida</i>
Quaking aspen	<i>Populus tremuloides</i>
Red Oak	<i>Quercus rubra</i>
Red Maple	<i>Acer rubrum</i>
Red Spruce	<i>Picea rubens</i>
Shagbark Hickory	<i>Carya ovata</i>
Sugar Maple	<i>Acer saccharum</i>
Yellow birch	<i>Betula lutea</i>
White ash	<i>Fraxinus americana</i>
White birch	<i>Betula papyrifera</i>
White oak	<i>Quercus alba</i>
White pine	<i>Pinus strobus</i>

Indigenous woody plants and shrubs

Alternate Leaved Dogwood	<i>Cornus alternifolia</i>
Arrowwood	<i>Viburnum recognitum</i>
Gray dogwood	<i>Cornus racemosa</i>
Hawthorn	<i>Crateagus</i>
Highbush cranberry	<i>Viburnum trilobum</i>
Highbush blueberry	<i>Vaccinium corymbosum</i>
Lowbush blueberry	<i>Vaccinium angustifolium</i>
Maple Leaved Viburnum	<i>Viburnum acerifolium</i>
Partridgeberry	<i>Mitchella repens</i>
Poison Ivy	<i>Toxicodendron radicans</i>
Silky dogwood	<i>Cornus amomum</i>
Spicebush	<i>Lindera benzoin</i>
Spiraea	<i>Spiraea</i>
Virginia creeper	<i>Parthenocissus quinquefolia</i>
Wintergreen	<i>Gaultheria</i>
Winterberry holly	<i>Ilex verticellata</i>

Non-native trees, woody plants and shrubs

Common buckthorn	<i>Rhamnus cathartica</i>
European barberry	<i>Berberis vulgaris</i>
Glossy buckthorn	<i>Rhamnus frangula</i>
Japanese barberry	<i>Berberis thunbergii</i>
Morrow's honeysuckle	<i>Lonicera morrowii</i>

Multiflora rose  
Norway Maple  
Oriental bittersweet  
Winged burning bush

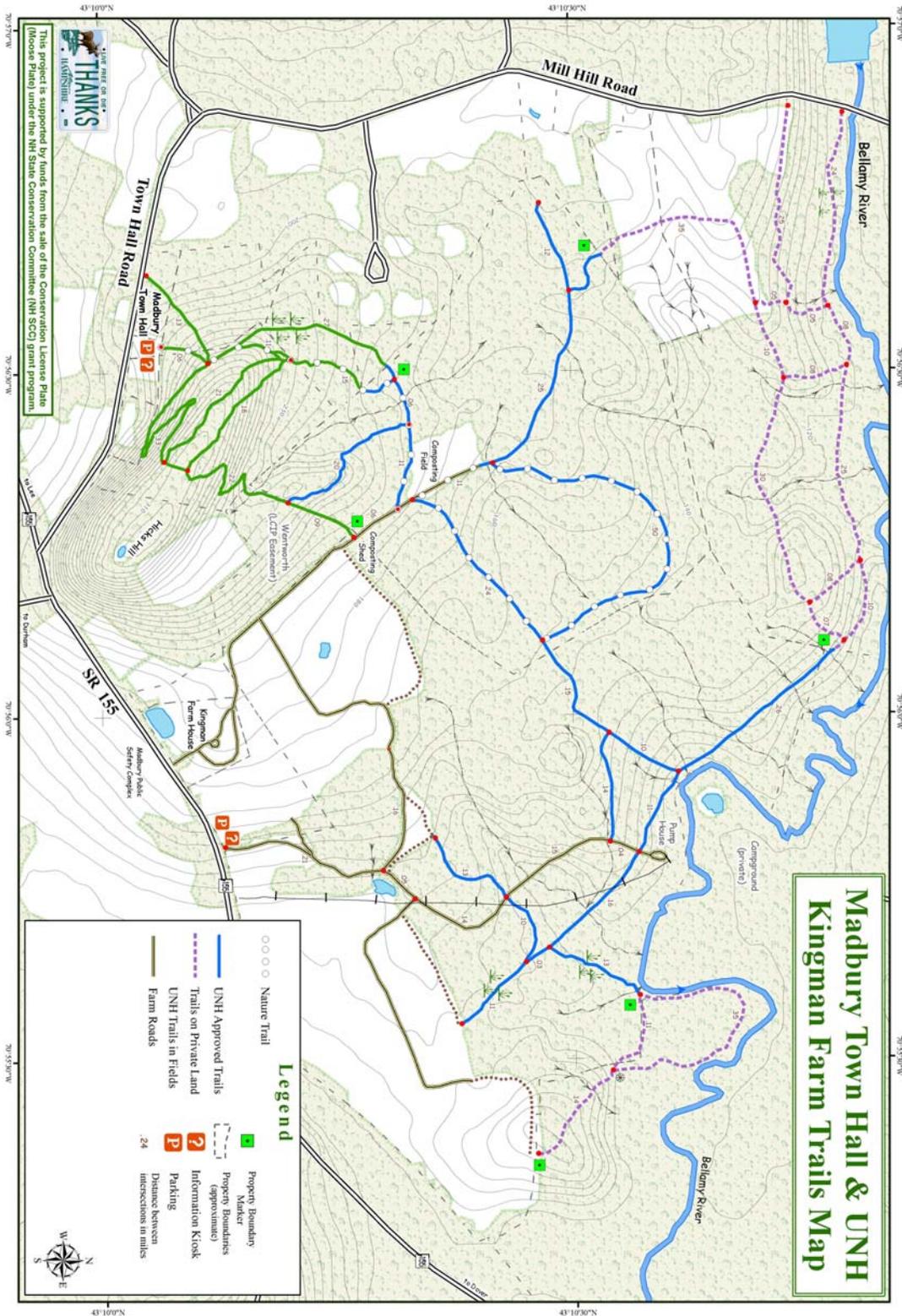
*Rosa multiflora*  
*Acer platanoides*  
*Celastrus orbiculata*  
*Euonymus alata*

Map 1 Kingman Farm boundaries and aerial photo





Map 3 Kingman Farm Recreational Map



Map 4 Kingman Farm soils map



BzB	BUXTON
Cfb, Cfc, CsB, Csc	CHARLTON
HaA, HaC, HbE	HINCKLEY
HcB, HcC, HdB	HOLLIS-CHARLTON
LeA, LeB, LrA	LEICESTER
PdB, PdD	PAXTON
ScA, ScB	SCANTIC
SnB, SuB	SUTTON
WdA, WfB	WINDSOR

Map 5 Kingman Farm Stand Map

