

Forest Management Plan and Ecological Assessment

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**Horse Hill Nature Preserve
Horse Hill Nature Preserve
10-Year Forest Management Plan
and Ecological Assessment
Town of Merrimack, NH**

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Acknowledgements, Authors, and Format

This thorough forest management plan and ecological assessment is the result of the recommendation made by the Horse Hill Nature Preserve Master Plan Committee and has been made possible by the funding provided by the Merrimack Conservation Commission along with their full support at every step of the way. The Merrimack Board of Selectmen authorized spending the funds necessary to bring this plan to completion and are also to be thanked for their wisdom in seeing that such a plan be completed for such a large, valuable resource for the inhabitants of the Town of Merrimack.

As a forester who is charged with managing forest for clients who have a very diverse mix of objective, I am accustomed to wearing many different hats in both the natural resource field and multiple use/recreational fields. I must say that due in part to a fairly thorough analysis of this property by the Master Plan Committee, my parameters for this forestry and ecology plan were much broader than what is normally expected. This is a good thing in the sense that both myself and Ann Poole (who provided the ecological assessment) looked at this very valuable tract not only as a producer of forest products or as a place to recreate, but we also considered how wildlife and the sensitive habitats all fit into the broad scope of the Preserve.

Both Ann and I did read the Master Plan thoroughly to try to best understand what our report should project. Rewriting all the valuable information put forth in that plan in this management plan would be redundant and we encourage you to look at our product as an extension to the Master Plan and not as a replacement. There is more information presented in the Master Plan than we felt was in the scope of our work and in looking at the goals and objectives listed in section 8.1 of the Master Plan, we can only limit our involvement to the assessment of what we have found. This management plan should be the basis for action on the part of future work of the Master Plan Committee, and Conservation Commission, and/or other groups, clubs, and organizations.

Sincerely,
Dan Cyr, Consulting Forester

This report is split into a Forest Management Plan, written by Daniel J. Cyr and Brian E. Johnsen, and an Ecological Assessment, produced by E. Ann Poole and edited by Brian Johnsen. Mr. Cyr and Mr. Johnsen are licensed foresters in the State of New Hampshire with the private consulting forestry firm Bay State Forestry Service. Ann Poole is a consulting ecologist and environmental planner.

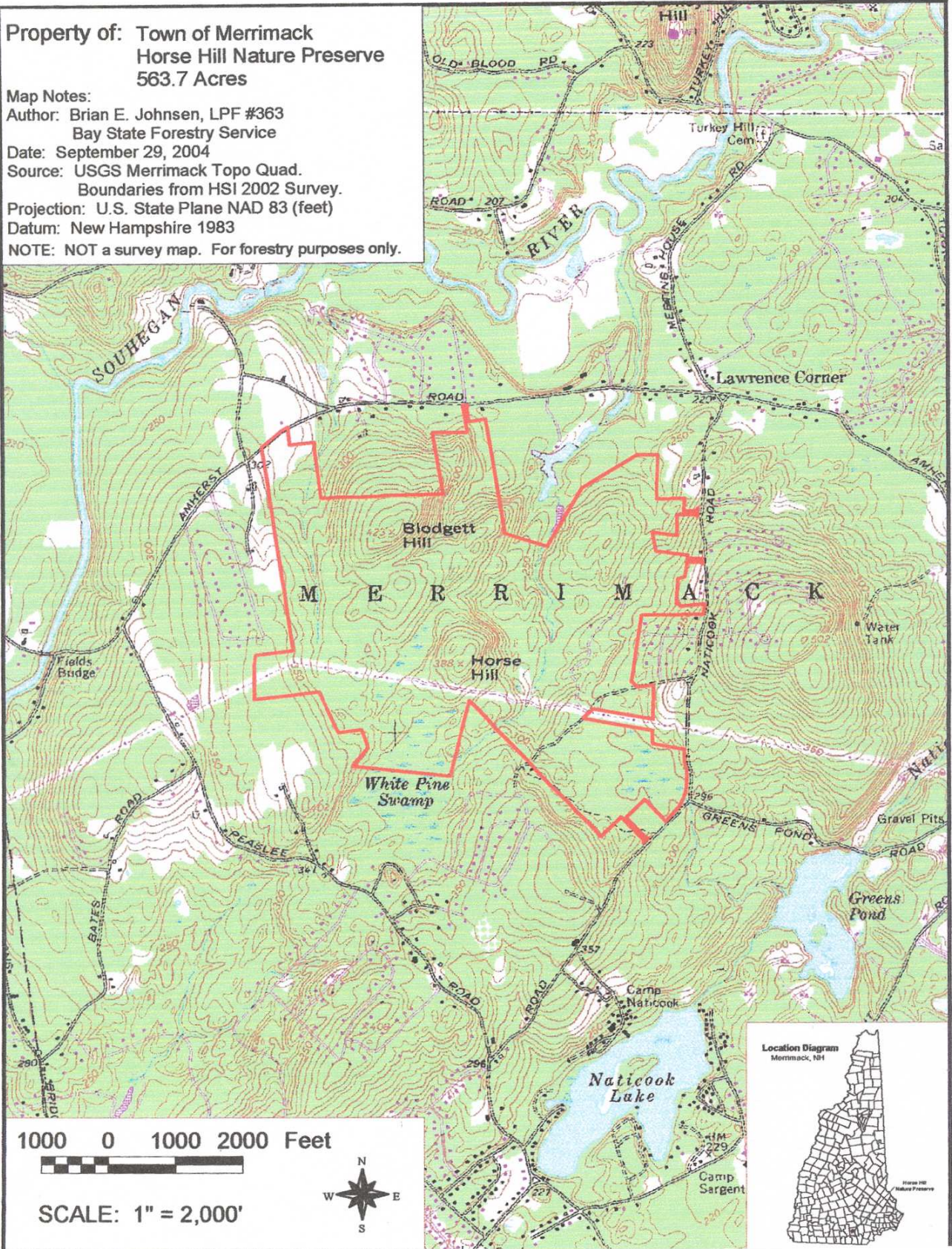
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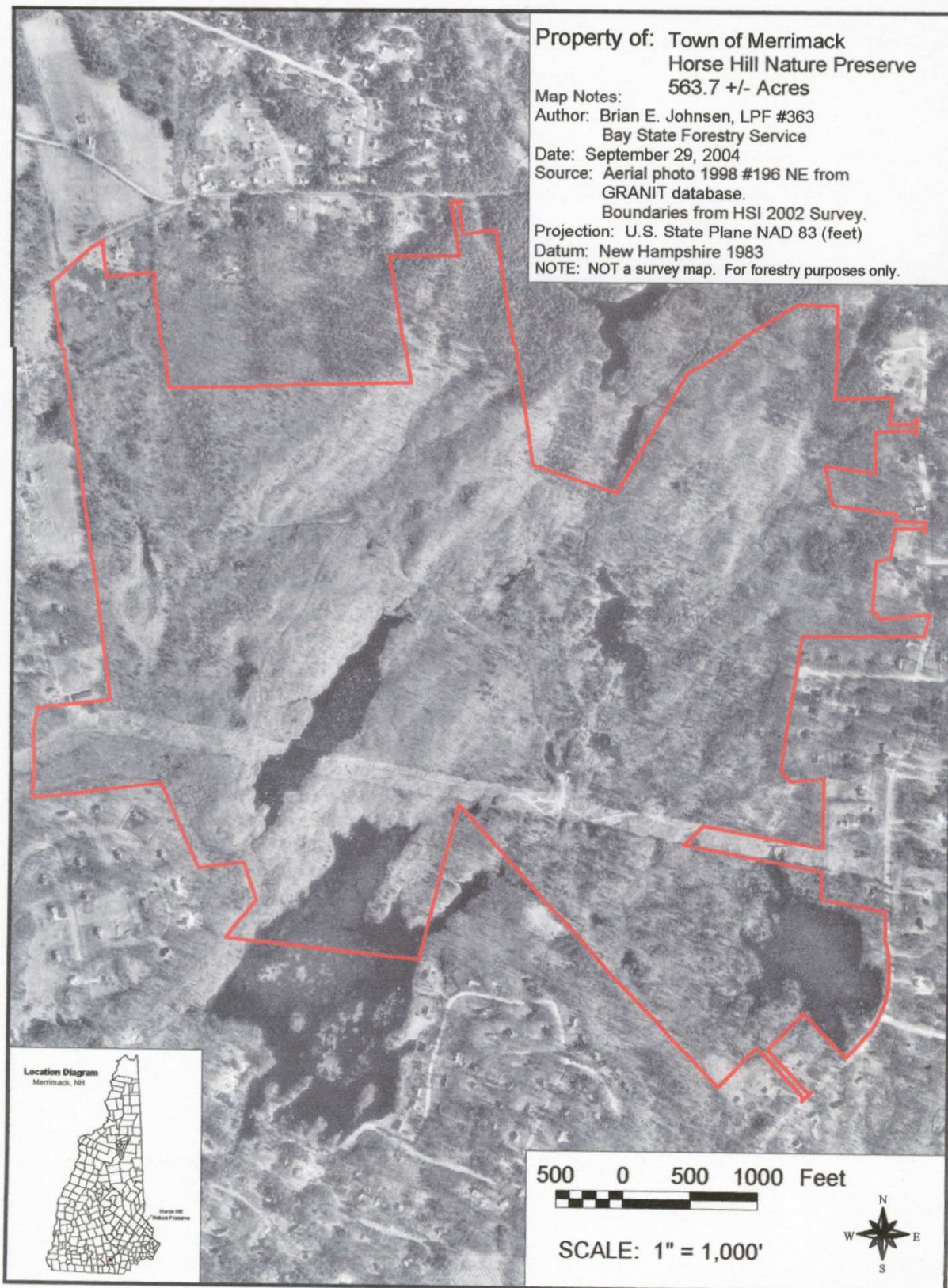
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Property of: Town of Merrimack
Horse Hill Nature Preserve
563.7 Acres

Map Notes:
Author: Brian E. Johnsen, LPF #363
Bay State Forestry Service
Date: September 29, 2004
Source: USGS Merrimack Topo Quad.
Boundaries from HSI 2002 Survey.
Projection: U.S. State Plane NAD 83 (feet)
Datum: New Hampshire 1983
NOTE: NOT a survey map. For forestry purposes only.





Horse Hill Nature Preserve, Merrimack, New Hampshire

Property Owner: Town of Merrimack, NH
Location: Naticook Road and Amherst Road, Merrimack, NH
Acreage: 563.7 Acres¹
Area Breakdown: Forested Area – 475.7 Acres
Open Water – 70.0 Acres
PSNH Right of Way – 18.0 Acres

General Description of Property:

In completing the timber cruise analysis of the property, this tract contains approximately 475 acres of forested land. The remaining acreage is comprised of about 18 acres of powerline right-of-way and about 70 acres of open water. Most of these ponds are present due to current or past beaver activity. An excellent survey map of the property complete by Hayner/Swanson, INC., provides compass bearings and distances, which aided in locating a good portion of the boundary lines. These lines were flagged with bright pink ribbons. These areas have been noted on the following Boundary Map. Although the remaining lines were approximated and flagged, Bay State Forestry Service does in no way claim to have a valid surveyor's license; establishment of boundaries did not take place for this management plan. Future licensed surveyor work will be needed to accurately locate lines that are not well-defined.

Most of this property is even-aged and was harvested 20-30 years ago, with most of the trees on the property falling between the 2" and 6" diameter classes. Much of the species composition is early-successional in nature, which means that there are a great number of white birch, gray birch, alder, and aspen trees growing here. These trees typically grow in following a very heavy cut, which was executed here by the past owners of this property. As part of that heavy harvest, an extensive network of roads was put in with bulldozers to create truck roads to access the forest products. In some cases, temporary culverts made out of logs (now rotted) or metal culverts (now mostly crushed) were used for drainage. Sections of this extensive network provide terrific access to some parts of this property. However, poor placement of some of these roads, coupled with the impact of failed culverts, beaver activity, and irresponsible vehicular use, has been a serious detriment to wetland areas across this property. This will be addressed further in the plan with some suggestions for remedial action.

This property does have a very rich history as outlined in the Master Plan and was mostly used as pasture by the Spaulding and Blodgett families in the early 1700's. Some of these old cellar holes can be found on the property long the Old Kings Highway and care will be taken to preserve these artifacts during any work prescribed in this plan. This rich asset to the property should be highlighted as part of the educational opportunities for the property. It was fascinating to find lilac bushes on both sides of the large threshold stone at the edge of one cellar hole after all these years since they were originally planted! It is always a treat as a natural resource manager to be able to show others the "hidden treasures" in the forest.

¹ The property was surveyed by Hayner/Swanson, INC. (HSI) in 2002 out to 559.6 acres. However, this survey did not account for a 4.1-acre corridor along Old Kings Highway, which is a Class 6 road belonging to the Town of Merrimack. Therefore, for the purposes of this plan, the acreage is considered to be 563.7 acres.

The wonderful beaver ponds are certainly the jewels that enrich the property to bring wildlife biodiversity to this property. Most of the ponds are occupied with fresh cutting and maintained dams. Some appear to be vacant with no beaver activity due in part to the loss of hardwood saplings needed for food close to the water's edge. In some cases, such as in White Pine Swamp, unique species such as the blue heron have chosen this area to nest in even with a backdrop of houses on the south and east sides of the swamp. The north and west sides of this bog are now part of the HHNP.

The powerline right-of-way maintained by Public Service of New Hampshire contains about 18 acres that is mowed every 4-6 years in order to prevent trees from growing into the powerlines. This provides a very rich habitat for wildlife that need or thrive on edge effects, early-successional habitat, or dense shrubbery. Thoughts on various management practices will be discussed later in this plan. Some of the worst off-highway recreational vehicle (OHRV) damage to the property is happening in this sensitive corridor.

A detailed timber cruise was completed on the property using a 300' by 300' spacing, which yielded 160 plots of tree data. This data was used to tabulate the current tree growth on the property and the field notes made during this cruise helped to create many of the maps in this management plan. A cruise is a statistical sample that is used to determine the volumes of various forest products growing on the property. This cruise generates volumes in terms of cords (for all trees 6-11" in diameter, or trees larger than 11" that are not suitable for sawtimber) and board feet (for trees 12" and greater in diameter that could be sold and sawn into boards). The diameter of a tree is measured at 4.5' above the ground, which is an industry standard referred to as diameter at breast height (DBH). From this intensive cruise, a total of nine stands are shown for this property. Stands are areas of trees with similar species composition, size, and frequency of occurrence. These stands will be the basis for the methodical analysis of the forest management plan, and are depicted on the following Stand Map. This 10-year evaluation does show some fairly large stands that are currently rather homogeneous in nature, but due to succession over time, inclusions (small stands) will become more evident. Stand modification caused by forestry activities (or other major factors like weather) will also help to create smaller stands, which will show up in the next 10-year inventory and plan of action.

The reader should note that this word "action" is associated with both the concepts of preservation (leaving a landscape untouched, allowing nature to take its course) and conservation, which can be described as maintaining a working forested landscape as open space. There are areas on this property where "action" will mean to purposely not manage the area for timber production, but instead to simply designate foot-paths with which humans may observe a natural habitat. There are many portions of this wonderful property where "action" will be more conservation-minded in which the natural resources can be modified for both tree growth and habitat enhancement.

Some of the forest management operations recommended in this plan will generate income, but only after access has been created or improved. Looking at harvesting timber in the short term to generate income off of which other priorities will be met is not necessarily the best way to proceed.

It will likely require a fair amount of time to digest the current forest conditions, management recommendations, and ecological assessment for this property. This plan is the correct first step to take to identify the sensitive areas and develop strategies for maintaining or enhancing these areas. Keep in mind that this is a working document, that forests change over time, and that this report should be updated every 10 years as the landscape changes.

Goals and Objectives:

The goals for the Horse Hill Nature Preserve, as outlined by the Committee in the Master Plan, are as follows:

- 1) Preserve and encourage the biological diversity of the property through the protection and careful management of existing, potential, and emergent plant and animal habitats and species.
- 2) Preserve and protect the property's surface and groundwater resources, including wetlands, vernal pools, and beaver ponds, to provide for wildlife habitat conservation, groundwater recharge, and watershed and aquifer protection.
- 3) Develop and maintain a network of trails.
- 4) Build upon the proximity of the property to other public and private open space through the establishment of wildlife corridors, access easements, and other means.
- 5) Preserve and protect the historic features of the property.
- 6) Balance competing community interests and uses of the property.
- 7) Provide adequate public access and parking.
- 8) Minimize impacts to the property between different users and surrounding properties with regards to safety issues, trash, noise, erosion, and other potential impacts.
- 9) Emphasize uses compatible with activities such as outdoor education, wildlife conservation, forestry, walking, hiking, biking, horseback riding, cross-country skiing, etc.

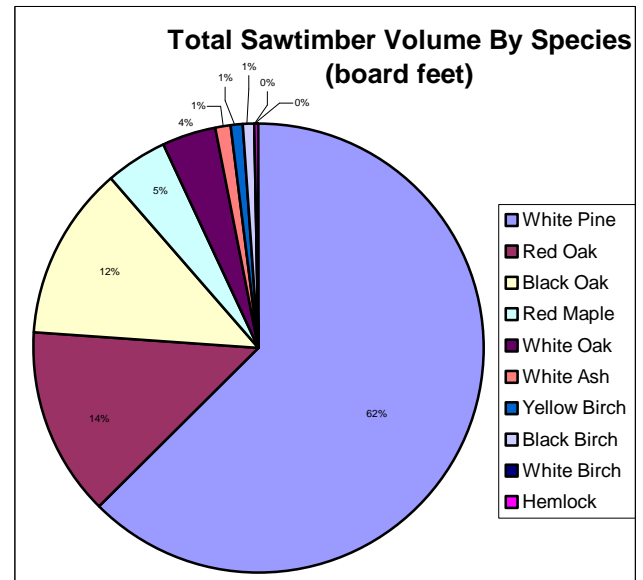
This body of land managers strongly encourages the Merrimack Conservation Commission to work closely with the HHNP Master Plan Committee or to form a separate Town Forest Committee responsible for the on-the-ground management of this property. Due to the increasing amount of acreage now owned by the Town of Merrimack, it would be ideal to have one group coordinate the multiple uses efforts on these tracts since this would require a fair amount of volunteer hours. The result would be better management and (hopefully) some continuity of membership.

Forest Products Summary Table for All Stands

Horse Hill Nature Preserve – Town of Merrimack, New Hampshire

Total Acreage: 563 +/- acres

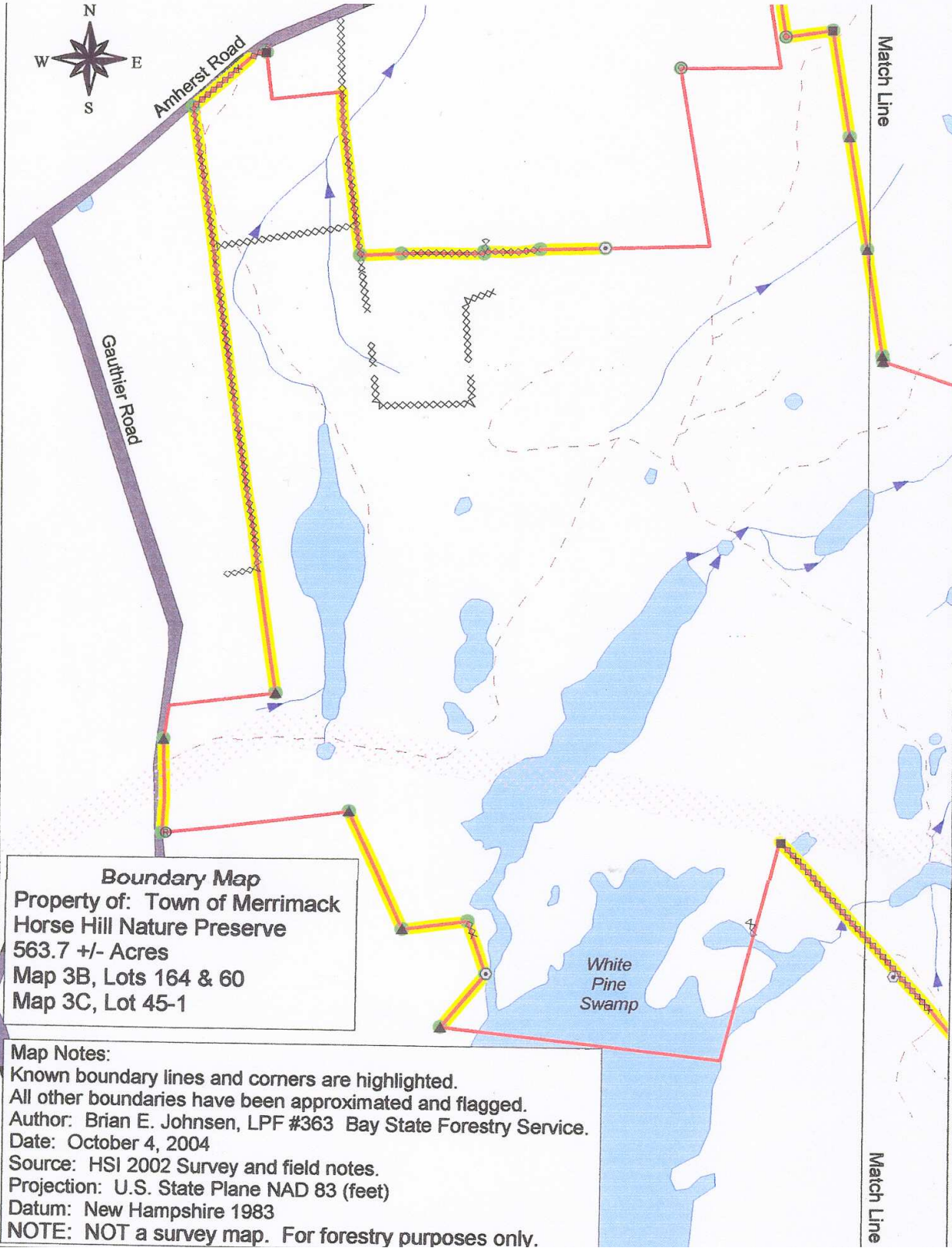
<u>Species</u>	<u>Board Feet</u>
White Pine	908,171
Red Oak	198,457
Black Oak	179,811
Red Maple	67,082
White Oak	55,918
White Ash	16,415
Yellow Birch	12,878
Black Birch	9,570
White Birch	3,078
Hemlock	2,277
Total Sawtimber	1,453,655 Board Feet²
Hardwood Cordwood	3,331 Cords
Softwood Pulpwood	1,476 Cords
Total Cordwood	4,808 Cords³

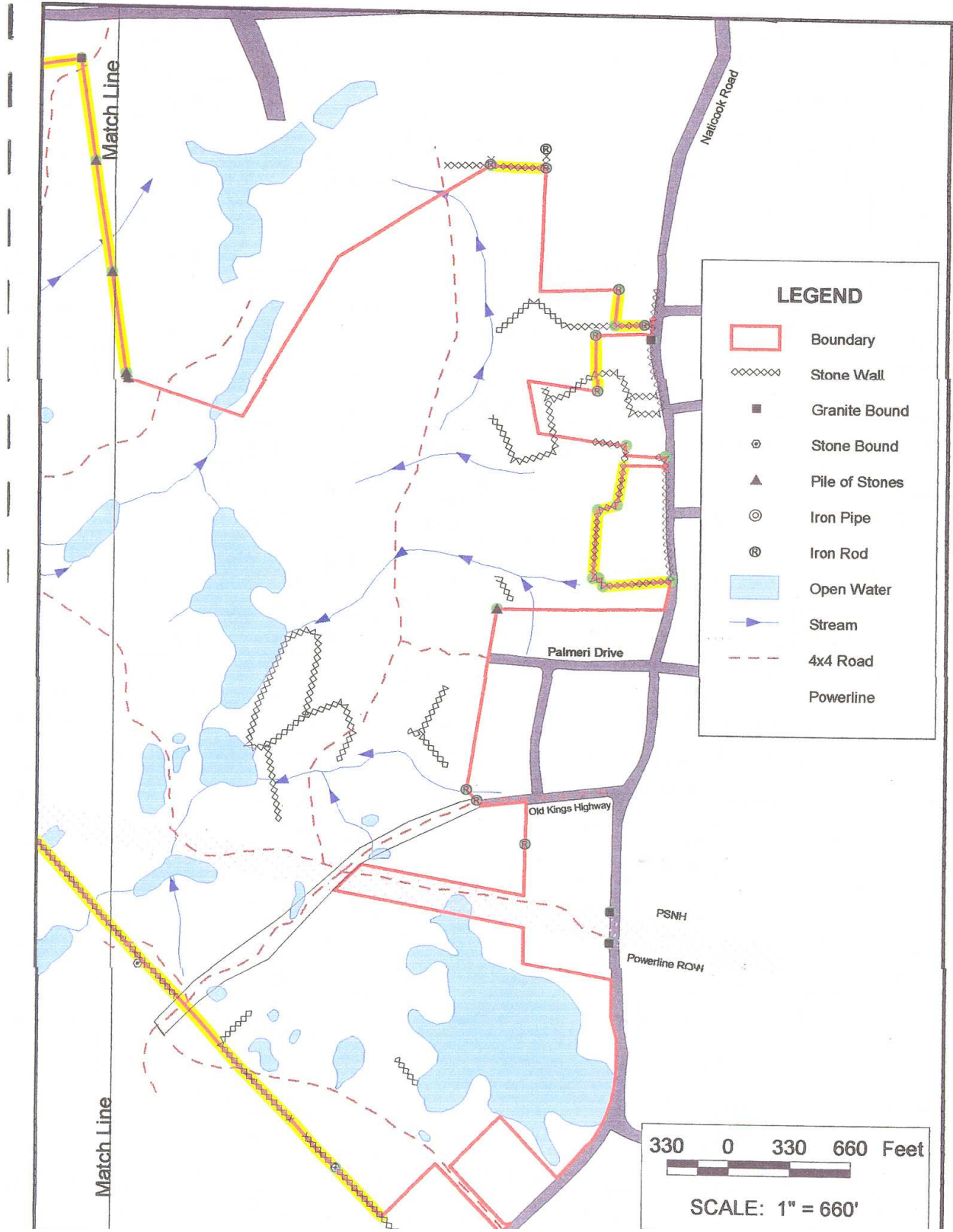


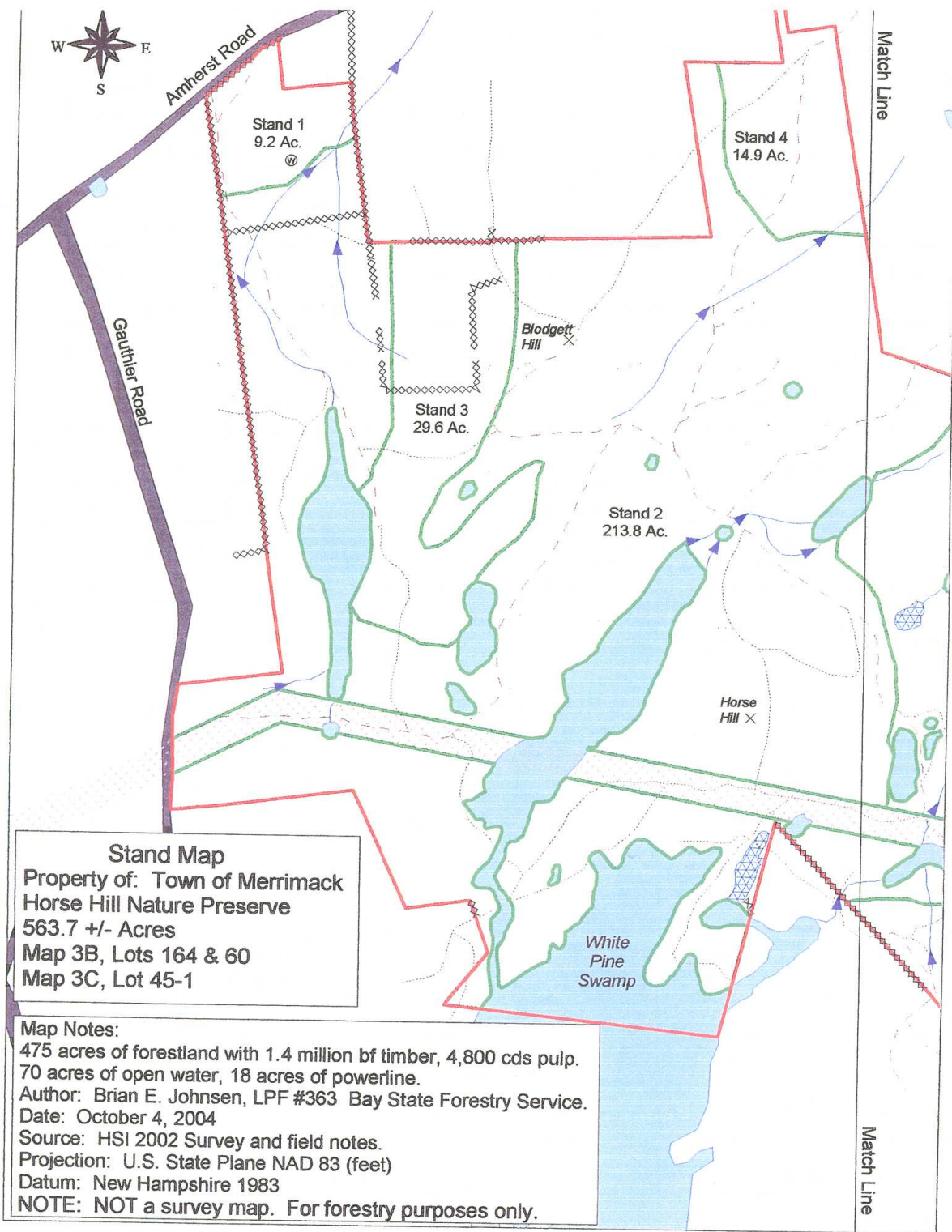
A basal area factor 10 prism was used to conduct the inventory sample. A total of 160 plots, distributed across each forested stand, were taken to arrive at this cruise summary.

² This sawtimber total represents all the trees of sawtimber quality 12 inches and greater in diameter found in this block. In order to capture this total volume, all trees of this specification would have to be harvested.

³ These cordwood totals, both softwood and hardwood, represent all the standing trees with diameters of 6-11 inches found in this block, as well as trees of larger diameters that do not meet sawtimber quality specifications. In order to capture this total volume, all trees of this specification would have to be harvested.

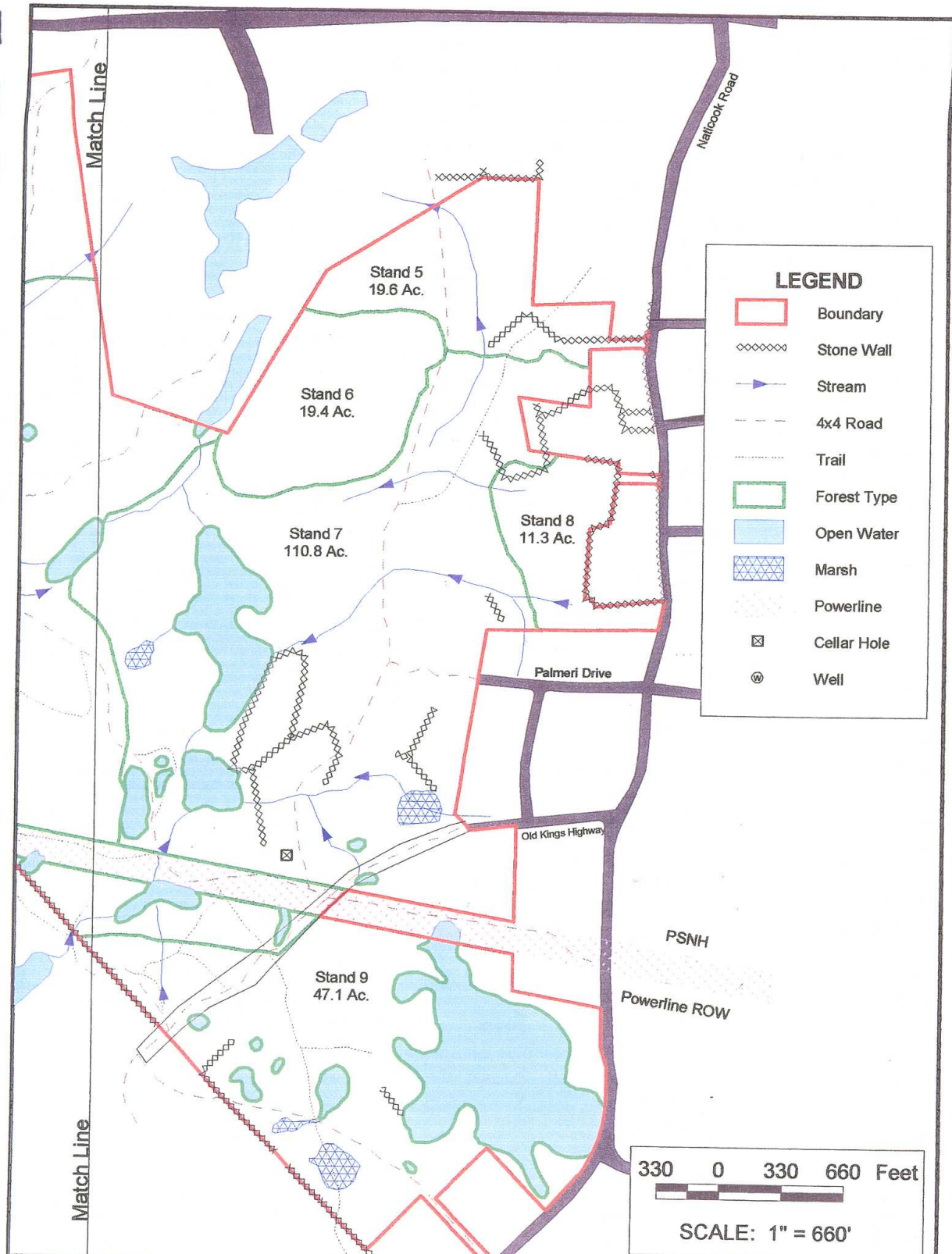






Stand Map
 Property of: Town of Merrimack
 Horse Hill Nature Preserve
 563.7 +/- Acres
 Map 3B, Lots 164 & 60
 Map 3C, Lot 45-1

Map Notes:
 475 acres of forestland with 1.4 million bf timber, 4,800 cds pulp.
 70 acres of open water, 18 acres of powerline.
 Author: Brian E. Johnsen, LPF #363 Bay State Forestry Service.
 Date: October 4, 2004
 Source: HSI 2002 Survey and field notes.
 Projection: U.S. State Plane NAD 83 (feet)
 Datum: New Hampshire 1983
NOTE: NOT a survey map. For forestry purposes only.



Stand 1 – White Pine – Mixed Hardwood Saplings/Poles

Standing Volumes -- Stand 1			9.2 Acres	
Species	Average BA/acre (sq. ft./ac.)	Average Height (16' sticks)	Volume per acre (bd. ft./ac.)	Total Volume (bd. ft.)
Sawtimber Total:	0.0	0.0	0.0	0
		8' sticks	Cords/ac.	Total Cords
Cordwood	30.0	2.0	4.3	39
Softwood Pulp	40.0	2.2	6.1	56
Total BA/acre	70.0			

Stand Description

This small stand is located along Amherst Road and is mostly an abandoned field that has reverted back to a stand of poor-quality, weeviled white pine along with red maples, birches, and alders in the 2-6” diameter classes. A few old apple trees can be found scattered through this stand along with some grape vines and some invasive multiflora rose bushes. The stand borders a small intermittent stream. The old logging road into the site originates here in this stand and the first 1,000 feet of this old road goes through some rather wet soils. This old road is currently being used by OHRV’s further into the stand.

Much of this stand is found on heavy soils with poorly-drained characteristics, except for a small section along Amherst Road where a small parking lot/trailhead area has been proposed.

The boundary lines in this area are stone walls to the west, which are well defined, and an unidentified line along the eastern side. There is an active water line in the ground in this stand, which would need to be located before any dirt work is done here for the parking area. This line comes from an old well on this property and services the Lastowka property on the north side of Amherst Road. One old well was found further into the property, which has been marked with orange flagging, but it is unclear as to whether or not this is the well in question. Numerous wetland plants and shrubs can be found in this stand, including a Jack-in-the-pulpit found by Lynne Wenz, a member of the HHNP Master Plan Committee.

Silvicultural Recommendations

The prime importance of this stand is certainly that of access into the property and the present use of the road. Have the road built into a graveled woods road with a ditch and cross-drainage culverts to make the trail into an access corridor for safety vehicles, forest fire control, and future harvesting equipment while maintaining the integrity of surrounding wetlands. The back of this stand should be managed as a white pine/hardwood stand for possible future sawtimber. This goal can be attained by cutting out the poor quality, weeviled pines in the 4-8” diameter classes and following the thinning with pruning work on best pines. Brush piles should be made out of the slash for wildlife by laying down large stems “log cabin” style, then covering the crossed sticks with large amounts of brush. This provides voids at the base of the brush pile for small mammals, ground birds, and reptiles to enter the pile for use as cover, shelter, and/or a nesting area. Brush should be kept at least 50 feet away from boundary lines to comply with State slash laws.

Consider mowing some of this area where the growth is mostly alders in order to enhance woodcock habitat. This should be done with a brontosaurus machine during dry or frozen

periods. While mowing this area, the machine could also be used to open up the main access road, since it is now only a narrow footpath through most of the stand and the dense multiflora rose makes walking very difficult.

Cut the competing trees around the old apple tree as well as fertilize and prune the better trees to increase soft mast production (apples).

When creating a parking area here, install a steel gate at the back end of the parking area and block off the entrance to the road that is currently being used. Place large rocks around the back of the parking area and gate to keep OHRV's from bypassing the gate. This would make controlling wheeled access more realistic. Making the parking area a trailhead area with a kiosk that includes trail maps and other educational material would serve to direct trail users.

Ecological Considerations

Ecologically speaking, the invasive species that are thriving here are of great importance because they are choking out the native species on which local wildlife populations depend. Invasives that were found include multiflora rose, oriental bittersweet, and autumn olive. Wild grapes were also found, and although they are not considered invasive, the vines have become completely intertwined with the bittersweet, making an impenetrable wall of vegetation that does not even allow foot travel. Mowing these invasives with a follow-up selective herbicide application is highly recommended.

Wetlands permits would have to be filed with the NH Department of Environmental Services (DES) before the road could be upgraded and a permanent culvert or stone ford installed on the intermittent stream.

Stand 2 – Mixed Oaks and Birch Saplings/Poles

Standing Volumes -- Stand 2		213.8 Acres		
Species	Average BA/acre (sq. ft./ac.)	Average Height (16' sticks)	Volume per acre (bd. ft./ac.)	Total Volume (bd. ft.)
White Pine	3.4	2.4	494.0	105,612
Red Maple	1.4	1.3	132.5	28,335
Red Oak	1.4	1.4	138.6	29,623
Black Oak	1.9	1.5	189.8	40,570
White Oak	0.7	1.3	63.3	13,523
Sawtimber Total:	8.9	1.6	1,018.1	217,664
		8' sticks	Cords/ac.	Total Cords
Cordwood	38.3	2.3	6.0	1,282
Softwood Pulp	9.5	2.5	1.6	340
Total BA/acre	56.7			

Stand Description

This is by far the largest stand found on the property with most of the trees being in the 2-6" diameter classes, or what a forester would call the sapling to pole stage of forest evolution. This stand is the result of a very heavy cut some 25-30 years ago and most of the trees here were established from stump sprouts, with very few trees being single stems that originated from seed.

In looking at the timber cruise, it can also be seen that there are some scattered white pines and mixed oaks in the 12-20" diameter classes spread lightly over the entire stand giving a total of about 217,000 board feet of sawtimber. This averages to just a little over 1 thousand board feet (MBF) per acre of sawtimber. In other words, this is very low stocking of big trees, and it would not be realistic to attempt to harvest at this time. Most of the stocking is in the firewood or pulpwood trees. This volume is almost 8 cords/acre of extremely dense young trees.

The terrain is quite variable across this stand, including ledge sections on Blodgett Hill, rolling hills, and low, wet areas near White Pine Swamp. Access into the stand is presently from numerous points, with very few of these points being very good at all. Entering from the powerline from the west would mean going through a steep hill down into a wet area due to beaver activity. Using Amherst Road will require upgrading the road and possibly relocating portions of the road to prevent the further degradation of wetlands. Entering from Old Kings Highway would require some major improvement to the Class 6 road, and because it is still and Town road, this way could not be gated to prevent misuse. There is an access point to the north, through Harold Watson's property, but this would require the construction of an access road to tie into the existing road network and possibly creating a parking area as part of this process.

There is a high number of trails found in this stand that have caused some major environmental impacts to this site, particularly erosion caused by the heavy OHRV traffic. Wheeled vehicles, which have degraded both the terrain in general and many habitats, are also heavily using the powerline corridor that bisects this stand.

The large beaver ponds found in this stand make this area very appealing for many species of wildlife including moose, deer, coyotes, bobcat, fisher, raccoons, porcupines, turkey, grouse, woodcock, chipmunks, squirrels, numerous bird species, blue herons, raptors, snakes, and numbers small wetland amphibians.

One unique area of this stand is a pocket of ironwood trees and a black gum tree that was found on the west shore of the westernmost beaver pond.

About half the boundaries along this stand are well defined; the other half will need some further survey work to establish a clear line of ownership.

The steep trail leading up to Blodgett Hill could provide some great views with a little bit of work, and offers a nice place for visitors to sit and relax.

There are some important ledges located just below a “party spot” on top of this hill that appear to possibly house small animals and/or snakes, which the ecological assessment will address later. A freshly-killed turkey was also found in this ledgy area, which may have been a bobcat’s meal.

The existence of blue heron rookeries in White Pine Swamp (just south of the HHNP boundary) prompted Ann Poole to contact Natural Heritage in Concord regarding the existence of this species in this unique dwarf heath shrub bog.

Silvicultural Recommendations

Some portions of this stand should not be specifically managed for timber production because the economic feasibility of harvesting is outweighed by the costs to access the timber and the ecological benefit of leaving the site intact. It would be a wise move to designate the portion of this stand south of the powerline right of way as an area strictly for wildlife habitat and human observation. Any management though the rest of this stand should certainly leave a healthy buffer around all the beaver ponds, particularly some of the sites that have sandier soils for turtle nesting. Maintaining no-cut buffers of at least 50 feet around the mapped vernal pools will help to maintain the water temperatures more evenly in the early summer months when there is still water in them.

Most of the forestry work that should be done here is in pockets where there are nice young oaks that would be worth thinning to improve growth. This action would actually cost money and would not generate revenue, but should be considered an investment of time and money that will greatly increase the growth rate of the residual future crop trees. This thinning, called timber stand improvement (TSI) involves hiring a forester to work through the woods with a chainsaw, identifying future crop trees and girdling and/or felling competing trees. Such an operation can be considered a “weeding and thinning” because it means the removal of poor quality trees as well as some crop species that growing too close together. Another possibility is to train volunteers to work with chainsaws and show them how to do this work. This would require the Town getting some form of liability coverage while volunteers perform this hazardous work. Making brush piles out of the cut trees would be great for wildlife as well.

Several pockets of young, poor quality aspen, maple, and birch could be mowed with a brush mower machine to bring these areas back to the early successional stage. These are very good food plots for game and non-game animals and new-tropical migrant bird species that need this brush phase for cover. At the same time, this action should leave the large, scattered oaks for hard mast production (acorns) for turkey, deer, and small mammals. It will not be economically feasible to attempt to harvest this scattered mature sawtimber at this time.

The access road should certainly be upgraded through this stand very soon, since the roads and trails are a major source of erosion and siltation in the streams and vernal pools. This will require re-routing some trails and shutting down other trails to keep the OHRV’s out of sensitive habitat areas.

Ecological Considerations

The improvement of a main access road seems to make the most sense here, especially since many of the existing roads and trails should not be where they are currently located. The greatest impact in this stand is being done to the wetlands by OHRV's causing erosion and sediment movement down the brooks. Impact of forest management would be negligible since most of the work in this first 10-year plan is precommercial in nature, which means mostly weeding and thinning young stands with a chainsaw and no logging equipment involved. Installing a gate in conjunction with boulders on the powerline would help limit the wheeled vehicle traffic.

Stand 3 – White Pine – Mixed Hardwood Saplings/Poles

Standing Volumes -- Stand 3				29.6 Acres
Species	Average BA/acre (sq. ft./ac.)	Average Height (16' sticks)	Volume per acre (bd. ft./ac.)	Total Volume (bd. ft.)
White Pine	23.8	1.9	2,807.7	83,108
Black Oak	0.8	1.0	57.7	1,708
Hemlock	0.8	1.5	76.9	2,277
Sawtimber Total:	25.4	1.5	2,942.3	87,092
		8' sticks	Cords/ac.	Total Cords
Cordwood	41.5	2.4	6.7	199
Softwood Pulp	44.6	2.5	7.5	223
Total BA/acre	111.5			

Stand Description

This stand is found on the northern and western slopes of Blodgett Hill and is growing some very nice white pine sawtimber in the 12-16” diameter classes. Most of the trees are in the 6-8” diameter range. The soils here are almost non-existent with bedrock showing throughout much of the stand. Some very dense pockets of hickory 2-4” in diameter can be found on the ledgy areas just west of Blodgett Hill. A small walled-in area with old barbed wire can be found in the northern portion of the stand and would have been used for pasture, perhaps during the sheep era of New England. Some grass is growing on some of the very shallow soils on the edge of Blodgett Hill.

A few trails can be found meandering through this stand, with a few of them going through wetlands and vernal pools and being heavily used by OHRV’s.

This area was harvested last about 20-30 years ago and has responded well since that time. It would be possible to harvest mature timber in this stand in the next 10-15 years.

The small amount of boundary line found along this stand is stone wall and well defined.

Silvicultural Recommendations

This stand has some great potential for white pine sawtimber and would greatly benefit from TSI work during this 10-year planning period. This TSI should include using the felled trees to create brush piles. Thinning the canopy would also increase the ground temperature, which is also beneficial for the snakes living in the adjacent ledge outcrops. The thinning work would also promote growth on the tiny white pine seedlings on the forest floor. Care should be taken not to drop brush in the hiking trails in this stand. Some of the larger, scattered oaks would also be left here to produce hard mast.

The main access route that has been proposed would run through this stand and might require a small amount of tree clearing to relocate a section of road to avoid wetlands.

Ecological Considerations

Some of the soils along the beaver pond that borders this stand are very sandy and may have turtle nesting potential. It would be wise to leave an undisturbed buffer of about 75' around this pond.

As mentioned, increasing the ground temperature should help snake populations feel freer to move about this stand. Moreover, brush piles should help provide snakes with cover as well as offer potential feeding sites, if the piles are frequented by very small mammals. Forestry activity would not occur on the ledge outcrops, so the sunning/denning sites would not be disturbed.

As mentioned, relocating the main road to avoid vernal pools is highly recommended.

Stand 4 – White Pine – Mixed Oak Sawtimber

Standing Volumes -- Stand 4			14.9 Acres	
Species	Average BA/acre (sq. ft./ac.)	Average Height (16' sticks)	Volume per acre (bd. ft./ac.)	Total Volume (bd. ft.)
White Pine	87.5	2.6	13,750.0	204,875
Red Oak	2.5	1.5	250.0	3,725
Black Oak	15.0	1.4	1,437.5	21,419
		8' sticks	Cords/ac.	Total Cords
Cordwood	70.0	3.4	15.2	226
Softwood Pulp	10.0	5.5	3.3	49
Total BA/acre	185.0			

Stand Description

This small stand is comprised mostly of white pine 12-24” in diameter along with some scattered oak in the 10-18” diameter range. A small amount of low quality red maple can be found here as well as a small pocket of hemlocks along the boundary line near a wet run. The stand has not been thinned in some 40-50 years and was certainly not cut in the last harvest which occurred 20-30 years ago.

Access to this areas is currently marginal and internal access would need to be upgraded. An alternative point of access would be to come from Amherst Road. There is a well-used hiking trail that currently ends up on the property of Harold Watson and access out to Amherst Road would have to be constructed on the frontage that is there. The boundary lines would also have to be clarified in this area.

Several old dumps can be found along the road as well as a few junk cars. Some of this refuse has already been cleaned up and sits on Mr. Watson’s property ready to be hauled away.

This area does have great wildlife potential because of the mast-producing oaks found here, as well as the dense cover afforded by the dense hemlock area.

The timber cruise for this stand shows that there is over 220 MBF of sawtimber growing on this 15-acre stand, as compared to 218 MBF growing on 214 acres of Stand 2. This is a vsat difference in stocking levels and is worth pointing out to the reader. Conducting periodic, sound silvicultural harvests here that would remove 50-75 MBF of sawtimber every 10-15 years would help guarantee sustainable tree growth here forever.

Silvicultural Recommendations

Conduct a sawtimber harvest here to remove some of the mature white pine and oak sawtimber along with some low quality hardwoods for firewood. This operation cannot take place until access to this stand is improved either from Amherst Road of internally from the main access route. The landing area could possibly then be used as a parking area with a gate to be installed on the road leading into the remainder of the woodlot. This operation would have to take care not to harvest in the wet areas along the brook and leave as much of the dense hemlock cover for deer as possible.

Ecological Considerations

Besides being suitable habitat for a deer wintering area, forestry activities should retain properly-shaped 3-pronged crowns for raptor nests. The riparian buffer along the brook will help maintain water temperature. The new young growth that comes up from the forest floor following a harvest will also provide browse for wildlife and shelter for small bird species that need this “layer” of diversity of forest cover.

Stand 5 – White Pine – Mixed Oak Sawtimber

Standing Volumes -- Stand 5			19.6 Acres	
Species	Average BA/acre (sq. ft./ac.)	Average Height (16' sticks)	Volume per acre (bd. ft./ac.)	Total Volume (bd. ft.)
White Pine	82.0	1.6	16,400.0	321,440
Red Oak	10.0	1.5	1,000.0	19,600
Black Oak	16.0	1.3	1,450.0	28,420
Yellow Birch	6.0	1.2	500.0	9,800
Black Birch	2.0	1.5	200.0	3,920
Red Maple	2.0	1.5	200.0	3,920
Sawtimber Total:	118.0	1.4	19,750.0	387,100
		8' sticks	Cords/ac.	Total Cords
Cordwood	30.0	2.7	5.4	105
Softwood Pulp	38.0	2.8	7.1	140
Total BA/acre	186.0			

Stand Description

This small, overstocked stand is mostly a white pine type with trees being mostly in the 12-20" diameter classes. A small amount of mature oaks, birches, and red maple in the 12-18" diameter classes can also be found here. The stand was not harvested in the last cut some 20-30 years ago and, in comparison to the neighboring stands, does have some very nice, larger timber trees. With a volume of 16.4 MBF per acre, this stand is growing even more volume per acre than Stand 4, without considering the immature hardwood and softwood component! Despite this terrific growth, however, comes a challenge because the soils in this stand are shallow and somewhat poorly drained. Managing this stand for timber production will present some challenges for a forester, primarily in scheduling harvests for an appropriate time of year that will avoid rutting. A second challenge will be to slowly bring the stocking down to optimal levels without opening up the stand too much and having the shallowly-rooted trees blow over. Access to this stand is limited and would need to be improved, presenting a further challenge for land managers. Some internal road work would be ideal to connect to a proposed access route from Palmeri Drive. This is an access point in this stand from Naticook Road, but many factors including poor soil type and excessive wetlands crossings makes other access from within this property much more feasible.

There is an invasive species called burning bush that is thriving in this stand and adjacent stands, as well as in neighbors' yards. This shrub has grown completely out of control and should be addressed soon, as well as educating neighbors as to why not to use this invasive plant for landscaping purposes.

Many snags and downed trees can be found her and are excellent for a myriad of wildlife species, including amphibians (on the low snags), birds, and small mammals.

The boundary lines need to be located along nearly the entire perimeter of this stand, since very few property corners could be located.

Silvicultural Recommendations

If access can be made into adjacent stands, conducting a light sawtimber/firewood harvest here would be extremely beneficial to the residual stand. The openings in the canopy will allow remaining crop trees to increase in diameter at a faster rate, and will also establish some regeneration on the forest floor. Removing about 100 MBF of sawtimber would not only yield some income for the Town, but would greatly enhance the existing wildlife habitat. This operation should be conducted with dry or frozen ground to prevent rutting the wet soils found here. Following the harvest, a mowing and/or herbicide application would be highly recommended to control the spread of burning bush from neighboring properties.

The main trail through this stand is presently receiving heavy OHRV use across a makeshift bridge on the stream that runs onto neighboring lands. This vehicular traffic needs to be controlled to protect the riparian areas.

Ecological Considerations

The main issues from an ecological point of view would be to attempt to control the spread of the invasive burning bush through chemical and/or mechanical means. This extremely dense bush has now choked out most of the understory vegetation and is marching south through to the rest of HHNP. The way to work such control is to apply integrated pest management, or IPM. Leaving the bush alone will only allow the spread to get worse. Constantly mowing the bush will only allow it to resprout off the intact root system. Digging up the whole bush, roots and all, will be a very costly and difficult operation, and will not necessarily guarantee eradication of the invasive plant. Roots may end up left in the soil, the disturbed soil will be a ripe planting bed for some other invasive, the soil will be very susceptible to erosion, and neighboring plants will invade again.

The ideal scenario would be to have the timber harvest flatten and crush the invasive plant to the ground during a winter operation on frozen ground. If the ideal does not happen, a follow-up mowing/chainsaw operation the following summer could cut down the remaining bushes. This mechanical operation should be followed with a selective herbicide application on the new invasive root-sprouts that pop up over the summer. The ground could then be seeded with an appropriate mix of grasses and shrubs that actually have wildlife habitat value, based on the ecologist's recommendations. During this whole procedure, representatives from the HHNP or the Town should approach the neighbors and ask them to consider using some other plant for landscaping. The site should be evaluated the following summer to ensure that the invasive has been satisfactorily controlled. Using the multi-pronged approach of IPM, invasive species can be controlled in a cost-effective, safe manner.

It is also recommended that a solid footbridge be installed on the brook with OHRV barriers along either side. The steep hill next to the brook is already showing signs of erosion with the danger of sediment reaching the stream.

Stand 6 – Mixed Oak Saplings/Poles

Standing Volumes -- Stand 6			19.4 Acres	
Species	Average BA/acre (sq. ft./ac.)	Average Height (16' sticks)	Volume per acre (bd. ft./ac.)	Total Volume (bd. ft.)
Red Oak	8.0	1.4	750.0	14,550
Black Oak	10.0	1.1	800.0	15,520
White Oak	2.0	1.0	150.0	2,910
Sawtimber Total:	20.0	1.2	1,700.0	32,980
		8' sticks	Cords/ac.	Total Cords
Cordwood	68.0	2.5	11.4	222
Softwood Pulp	12.0	3.0	2.4	46
Total BA/acre	100.0			

Stand Description

This very nice stand of quality oaks can be found on well-drained hill overlooking the beaver ponds on Mr. Watson's property. The mature sawtimber was removed from this area 20-30 years ago, but the stand has responded very well with a fairly high stocking of oaks 2-6" in diameter. A few larger black, red, and white oaks in the 12-16" diameter classes can be found scattered throughout the stand. There is also one isolated pocked of young white pine saplings and poles located in this stand. This stand provides a rich supply of hard mast for wildlife, and abundant deer and turkey sign was found here.

A heavily-used OHRV trail can be found at the base of this stand with a brook that is now flowing down the trail because of the excessive use and lack of attention to drainage. This is hopefully the trail that could be upgraded for access to Stand 5.

The boundary line was only approximated along the edge of this stand, and further boundary work should be done to locate or establish the corner markers and lines.

Silvicultural Recommendations

This stand should be managed for future oak sawtimber. A TSI operation is highly recommended for this stand, since future return on the investment would be exceptional. As with other areas, brush piles should be made with the poles that are cut during the TSI operation. This forestry work will yield a high quality stand that will continue to produce sawtimber income in the future as well as provide excellent wildlife feeding grounds. Leaving some properly-shaped trees for hawk nests is recommended as well.

Ecological Considerations

As in all wooded portions of this property, wood turtles should be kept in mind during harvest operations. Therefore, it is recommended that a good portion of the canopy remain after any harvest to maintain cover. Improving the main trail into a woods road with appropriate ditches and culverts would minimize the environmental mess that is currently occurring with the OHRV traffic. Gating access points and installing large rocks to prevent bypassing the gates is highly recommended. No negative impacts can be foreseen from timber harvest operations here.

Stand 7 – Mixed Oaks – Birches – White Pine Saplings/Poles

Standing Volumes -- Stand 7			110.8 Acres	
Species	Average BA/acre (sq. ft./ac.)	Average Height (16' sticks)	Volume per acre (bd. ft./ac.)	Total Volume (bd. ft.)
White Pine	8.1	2.2	1,083.3	120,033
Red Oak	7.4	1.4	713.0	78,996
Black Oak	4.8	1.4	463.0	51,296
White Oak	3.3	1.1	268.5	29,752
Red Maple	2.6	1.2	222.2	24,622
White Birch	0.4	1.0	27.8	3,078
Yellow Birch	0.4	1.0	27.8	3,078
White Ash	1.5	1.5	148.1	16,415
Sawtimber Total:	28.5	1.4	2,953.7	327,270
		8' sticks	Cords/ac.	Total Cords
Cordwood	47.8	2.5	8.0	888
Softwood Pulp	23.0	2.6	4.1	451
Total BA/acre	99.3			

Stand Description

This stand is very large and for the most part, the stand is a mixture of black, red and white oak, black, gray, yellow, and white birch, red maple, and white pine 2-6" in diameter. Some scattered white pine and mixed hardwoods of the above-listed species in the 12-18" diameter classes can be found scattered through this stand. What distinguishes this stand from Stand 2 is basically the higher amount of young white pine growth, whereas Stand 2 has more young oak growth. The timber cruise shows more than 325 MBF and more than 1,300 cords of firewood and softwood pulp growing here, which are fairly good numbers for a stand that was heavily cut 20-30 years ago. With some TSI work done over this next 10-year planning period, this stand will have the potential to yield income through sound forest management strategies during the next 10-year management period.

This stand is a major corridor for wetland wildlife species because of the series of beaver ponds starting at the powerline corridor and heading north into the property. Most of these beaver ponds are abandoned gravel pits that now have filled with runoff and ground water, with some help from the beavers' skilled dam work. The section of powerline that bisects this stand has some of the best turtle habitat on the property, and many nests raided by predators were found here.

Unfortunately, the best habitat is also the area that is being the most adversely impacted by OHRV's. In just the few weeks of field work associated with this project several new "mud holes" began to spring up in vernal pools and wetlands as riders in wheeled vehicles sought new areas to make a mess.

Access to this stand is actually quite poor despite the major OHRV activity. Old Kings Highway, a Class 6 road, is actually very eroded and has huge puddles that would require substantial amounts of gravel to allow this road to be adequate for safety vehicles or harvesting equipment. The other two access points on Naticook Road are quite bad and would require much capital improvement to even make it passable as a woods road. The most feasible access to this stand and adjacent stands is from the end of Palmeri Drive. The hiking trail could be

upgraded into a woods road, with a parking area, kiosk, and appropriate gates placed at the entrance.

In the same general area as the parking area, there is a small patch of invasive Japanese bamboo that should be addressed with IPM measures before it gets out of hand. The northern corner of this stand also has some of the invasive burning bush, and should be addressed as mentioned in Stand 5.

Silvicultural Recommendations

Many areas of this stand have beaver ponds with intersecting associated wetlands that simply are not economical or feasible for timber production. These areas are the very same areas that are critical for some wildlife species, and therefore these portions of this stand will receive much management for timber products. Through this entire stand, it is difficult to find more than 3-4 acres of high ground without having the area crossed by an intermittent stream or wetlands. Due in part to this hydrology and forest structure, the management of the forest here will be in small pockets of TSI that have potential to produce quality oaks and pines, much like the management recommended in Stand 2. Similarly, there are also several areas in this stand that would make wonderful wildlife habitat if mowed and retained in the early successional stage.

It will be very important to gain the support of the neighborhood on Palmeri Drive to try to open up an access point at the end of this cul-de-sac. This will not only connect the internal access route, but should also include a small public parking area, in keeping with the objectives listed in the Master Plan. Installing a gate at the back of the parking areas would help deter unwanted wheeled vehicles in the property. Much like the parking lot proposed in Stand 1, it would probably be appropriate to install a kiosk with trail maps and other information. A suitable landing area could then be constructed inside the property and would provide a central location for stands 5, 8, and eventually, Stand 6. It will also be very important to install a gate and boulders on the powerline access road where it meets Old Kings Highway to curb wheeled traffic on the powerline corridor without actually blocking of this Class 6 road.

There are some pockets of gravel that would be suitable for use in improving some of the access roads and fixing some of the OHRV damage that has been done. The gravel could be removed from these areas with little impact to wildlife species, and the area could then be allowed to regrow back to vegetation or used as landing areas for future harvests.

Ecological Considerations

In evaluating this stand with respect to the entire property, it became evident that the section of proposed safety route that would run along the powerline corridor and between 2 vernal pools is some of the best habitat for turtles and many other wetland species. This being the case, it might make the most sense to not have an access route that connects from Amherst Road to Palmeri Road, but instead to simply have two distinct access networks that do not connect to each other. The other option to look into would be to see if the section of road that is built in this habitat could have wildlife travel culverts built under the road bed to allow animals to pass under the road instead of on the surface.

Leaving good buffers around the sensitive wetlands will help maintain the current populations of both flora and fauna.

Stand 8 – White Pine – Mixed Oak Sawtimber

Standing Volumes -- Stand 8			11.3 Acres	
Species	Average BA/acre (sq. ft./ac.)	Average Height (16' sticks)	Volume per acre (bd. ft./ac.)	Total Volume (bd. ft.)
White Pine	40.0	2.7	6,375.0	72,038
Red Oak	10.0	1.8	1,125.0	12,713
Black Oak	10.0	1.3	875.0	9,888
Black Birch	5.0	1.5	500.0	5,650
White Oak	5.0	1.0	375.0	4,238
Sawtimber Total:	70.0	1.6	9,250.0	104,525
		8' sticks	Cords/ac.	Total Cords
Cordwood	45.0	2.9	8.6	97
Softwood Pulp	35.0	3.3	7.4	84
Total BA/acre	150.0			

Stand Description

The dominant species in this stand is white pine with fairly large diameters ranging from 10-24 inches. Also found here is a very nice mature component of mixed oaks, red maple, and black birch 12-20" in diameter. The timber cruise shows 104 MBF, a little less than 10 MBF per acre. The total basal area, including pulpwood and cordwood, is about 150 square feet of basal area per acre, which (in forester's terms) is an overstocked stand. This stand was not harvested in the cut that occurred 20-30 years ago. A very dense understory of invasive burning bush is found throughout most of this stand, with almost no other regeneration growing here.

The soils are varied, but range from well-drained sandy soils to very deep, loamy soils that are quite moist. There are also pockets of ponded soils with large surface rocks as well.

The forest floor of this stand has very little wildlife value because the ground is devoid of almost any other vegetation other than burning bush. Some mast is being produced here from cluster of large oaks behind the homes on Palmeri Drive.

Despite the dense burning bush, some of the boundary lines (particularly stone walls) were identifiable and some corners were found in the thick of the brush. However, more survey work should be done to establish some of the lines and corners.

Access to this stand would most likely be best from an internal network of roads coming off of Palmeri Drive. Although the boundary map does show road frontage on Naticook Road, the slope and soil types would not be very conducive to such access.

Silvicultural Recommendations

This stand would be greatly enhanced by conducting a sawtimber/firewood harvest to remove some of the mature white pine and oaks along with some low quality hardwoods for firewood. Part of the intent of this harvest would be to have the harvesting equipment run over most of the burning bush shrubs to be able to avoid the mowing costs. Like Stand 5, this stand should probably be harvested under frozen conditions. The invasive could then be controlled using IPM as described in Stand 5.

Ecological Considerations

Controlling the major invasive infestation is certainly a priority for this stand and will have benefits for the whole property. It is possible that income from the timber sale in this stand could help to fund the invasive management. A few small intermittent streams originate in this stand and wooded buffers should be maintained to protect these riparian zones.

Stand 9 – White Pine – Mixed Oaks – Mixed Birch Saplings/Poles

Standing Volumes -- Stand 9		47.1 Acres		
Species	Average BA/acre (sq. ft./ac.)	Average Height (16' sticks)	Volume per acre (bd. ft./ac.)	Total Volume (bd. ft.)
White Pine	74.7	1.5	2,816.7	132,665
Red Oak	8.7	1.4	833.3	39,250
Black Oak	2.7	1.3	233.3	10,990
Red Maple	2.7	1.1	216.7	10,205
White Oak	1.3	1.3	116.7	5,495
Sawtimber Total:	90.0	1.3	4,216.7	198,605
		8' sticks	Cords/ac.	Total Cords
Cordwood	38.0	2.2	5.8	274
Softwood Pulp	12.0	2.3	1.9	89
Total BA/acre	140.0			

Stand Description

The dominant species in this stand is white pine with more than 130 MBF of volume along with a mature component of scattered oaks and maple comprising another 65 MBF of sawtimber. The total basal area per acre of this stand is around 140 square feet, which means that this stand is not far away from being able to produce income from sound management of the forest resource with little negative impact to sensitive habitat. Most trees are in the 4-16” diameter classes.

The soils in this stand are quite varied with well-drained gravelly soils to ponded soils around the large beaver pond as well as along Old Kings Highway.

The last harvest that took place here was 20-30 years ago, but it does not appear to have been as heavy a cut here as other areas of this property.

The property borders the Watonic Bowman’s Club woodlot, which actually makes for a wonderful neighbor to this tract. The access from Old Kings Highway from the Club’s end of the property is showing some severe OHRV impact. A series of hiking trails are now all being used by OHRVs and a large amount of erosion is occurring. The Bowman’s Club does appear to be using part of this stand for target practice and shooting matches with no obvious detriment to the environment. Some of their trails connect to HHNP trails, which creates a good network of footpaths through that area of this stand. The new Wasserman trail that originates from Wasserman Park across Naticook road is a great link between Town properties. However, a portion of this trail on the HHNP is going through the middle of a wetland area and should be rerouted. Professional advice should be sought before any more trail location and/or construction is done.

The boundary map shows road frontage on Naticook Road, but this access will need to be more distinctly defined by a surveyor. The western property boundary line along this stand is stone wall and is fairly well defined, but the lines behind the houselots along Naticook Road require a surveyor to establish corner points.

Silvicultural Recommendations

Based on the stocking levels shown in the cruise, this stand appears to be ready for some type of thinning. Although there are a few small pockets of sawtimber that could possibly be harvest now, they are so scattered and remote that it just would not make economical sense to attempt a serious timber harvest at this time. Much of the sawtimber that is currently growing in this stand right now ranges from 12-18” in diameter, and could still use some more time to grow into large sawlogs. The best approach would be to do some TSI work to reduce the number of trees per acre and leave the desirable crop trees of oak and pine for long term sustainable forest management. The oaks and white pines are the climax species for this area (as well as hemlock) and managing for birch in terms of timber production is usually an exercise in futility since most of these species die before reaching maturity. Pruning some of the better quality white pines with a pole saw would also greatly improve the future value of the pines, and also makes the forest look much better.

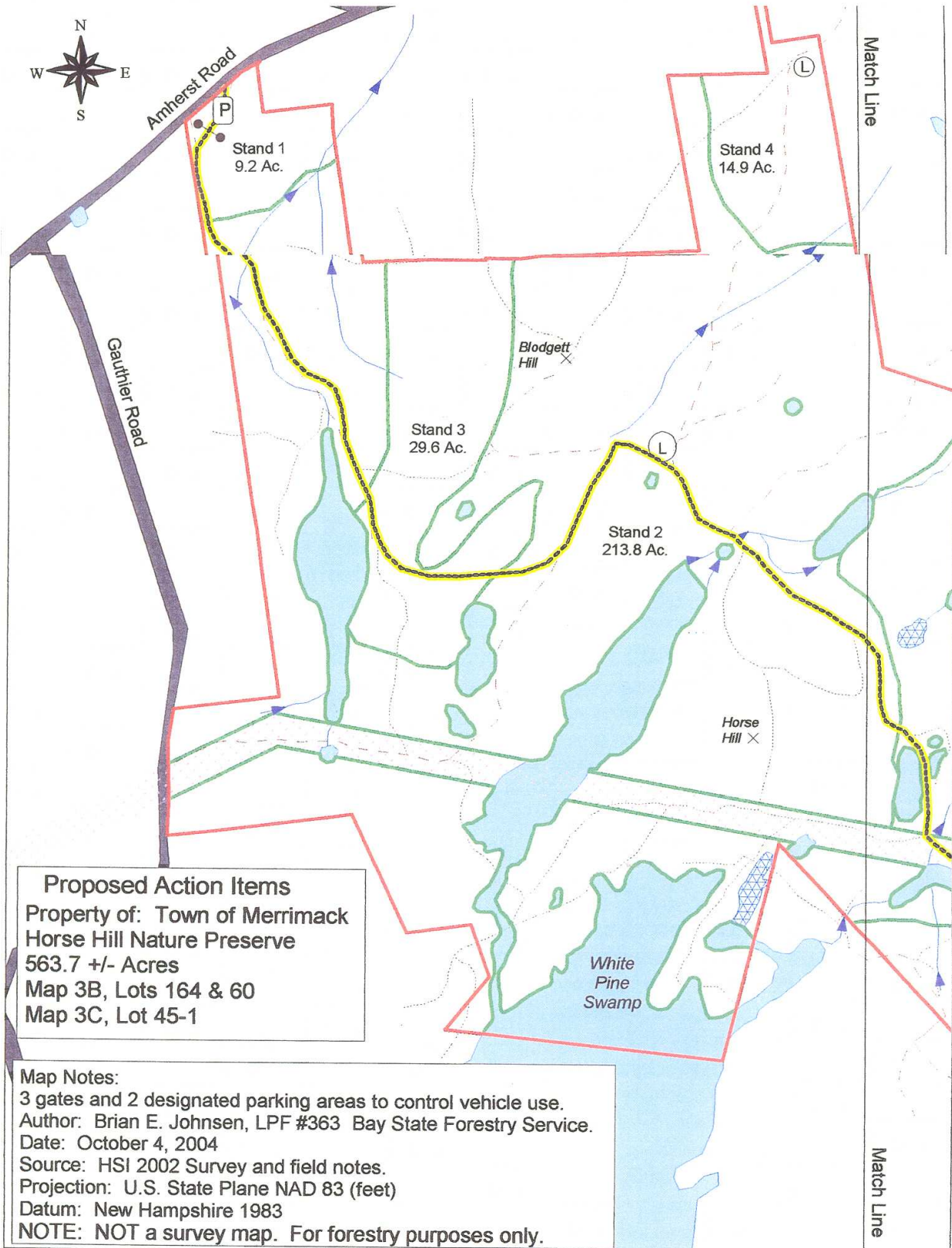
A few wildlife openings should be made in this stand for birds species, small mammals, and browse for large animals. Mowing these areas at 5-year intervals is highly recommended.

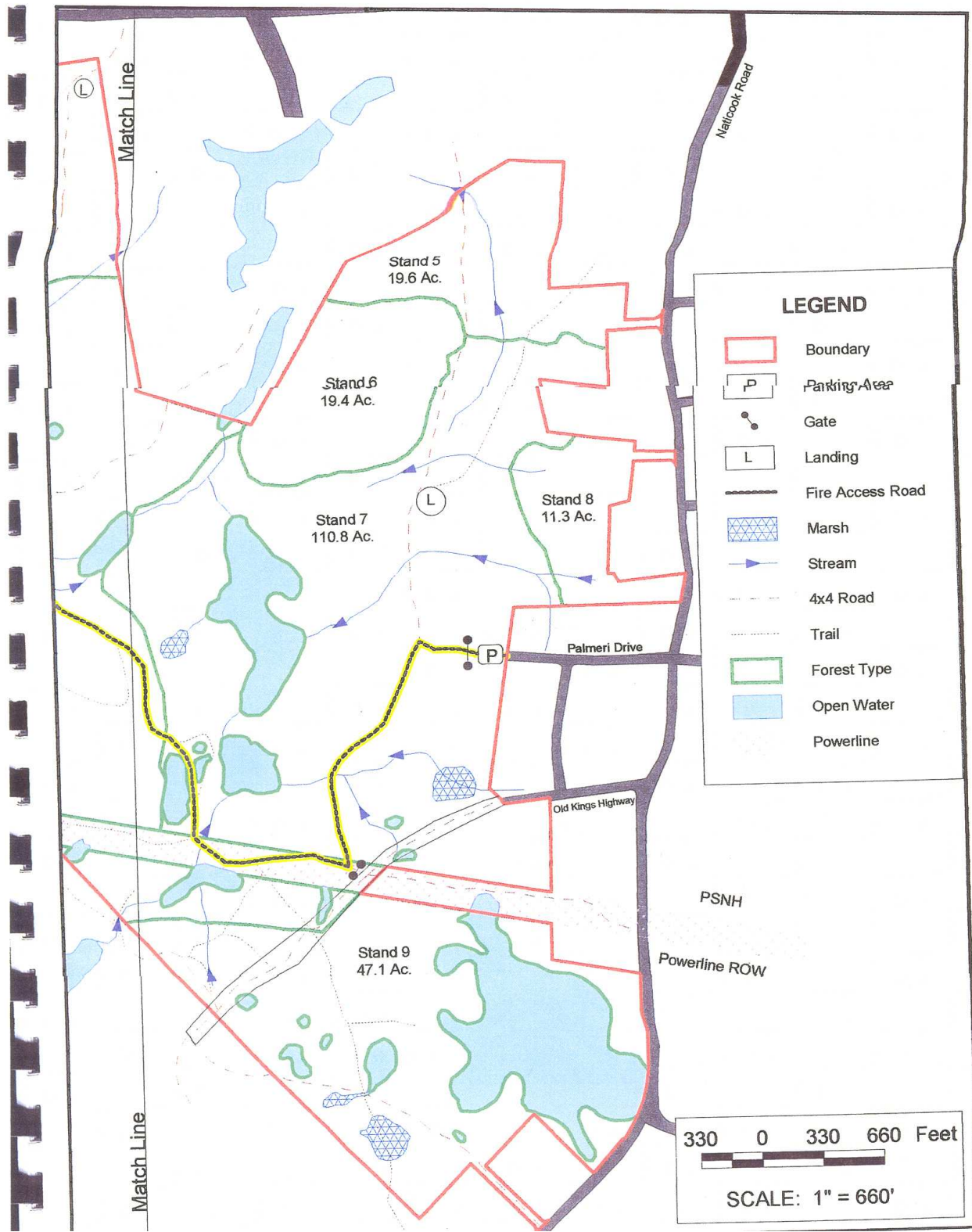
Working with the Watonic Bowmen’s Club is certain encouraged to manage both their tract and the HHNP tract in conjunction with each other to get the “biggest bang for the buck” as far as enhancing both the forest production and wildlife habitat.

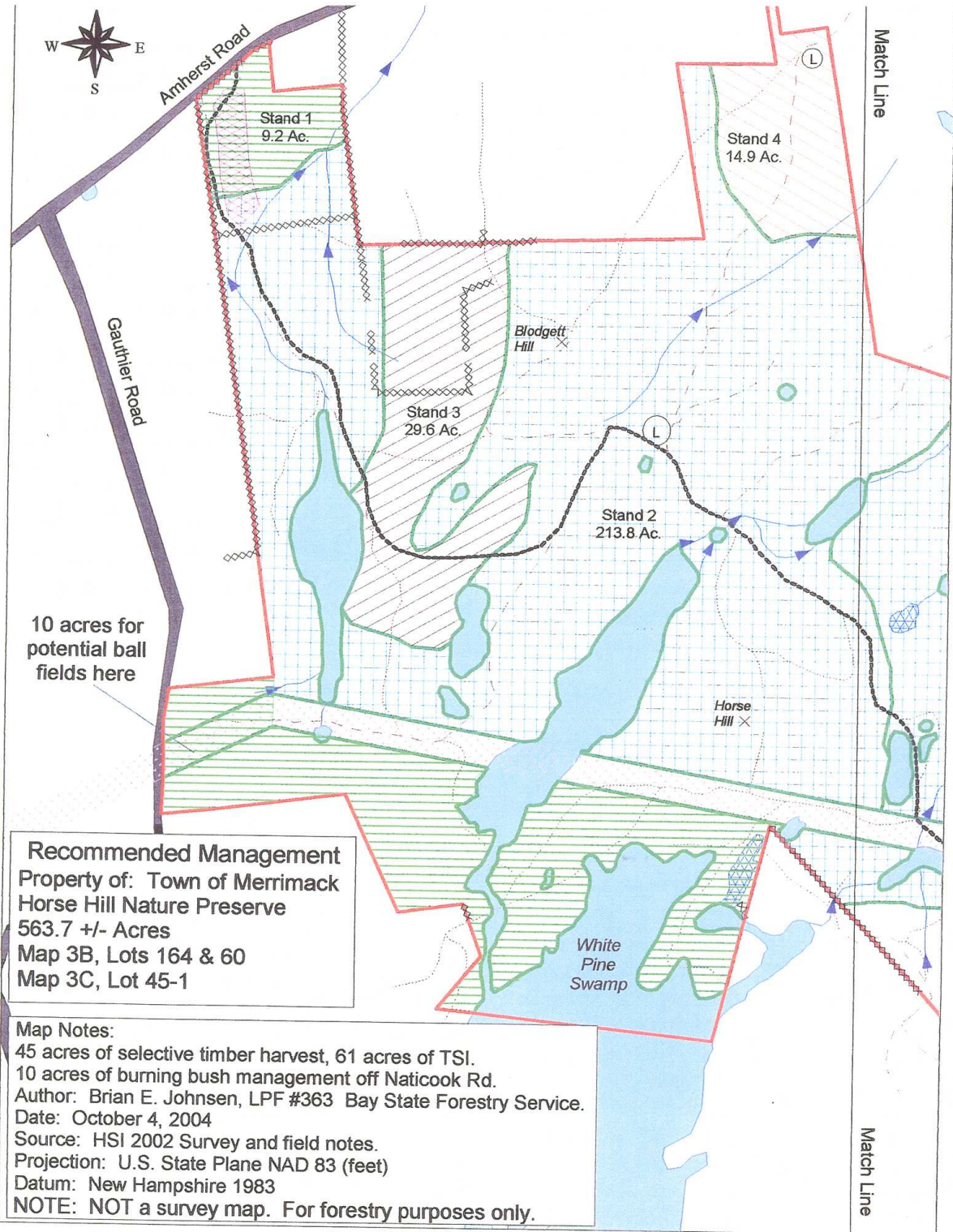
Ecological Considerations

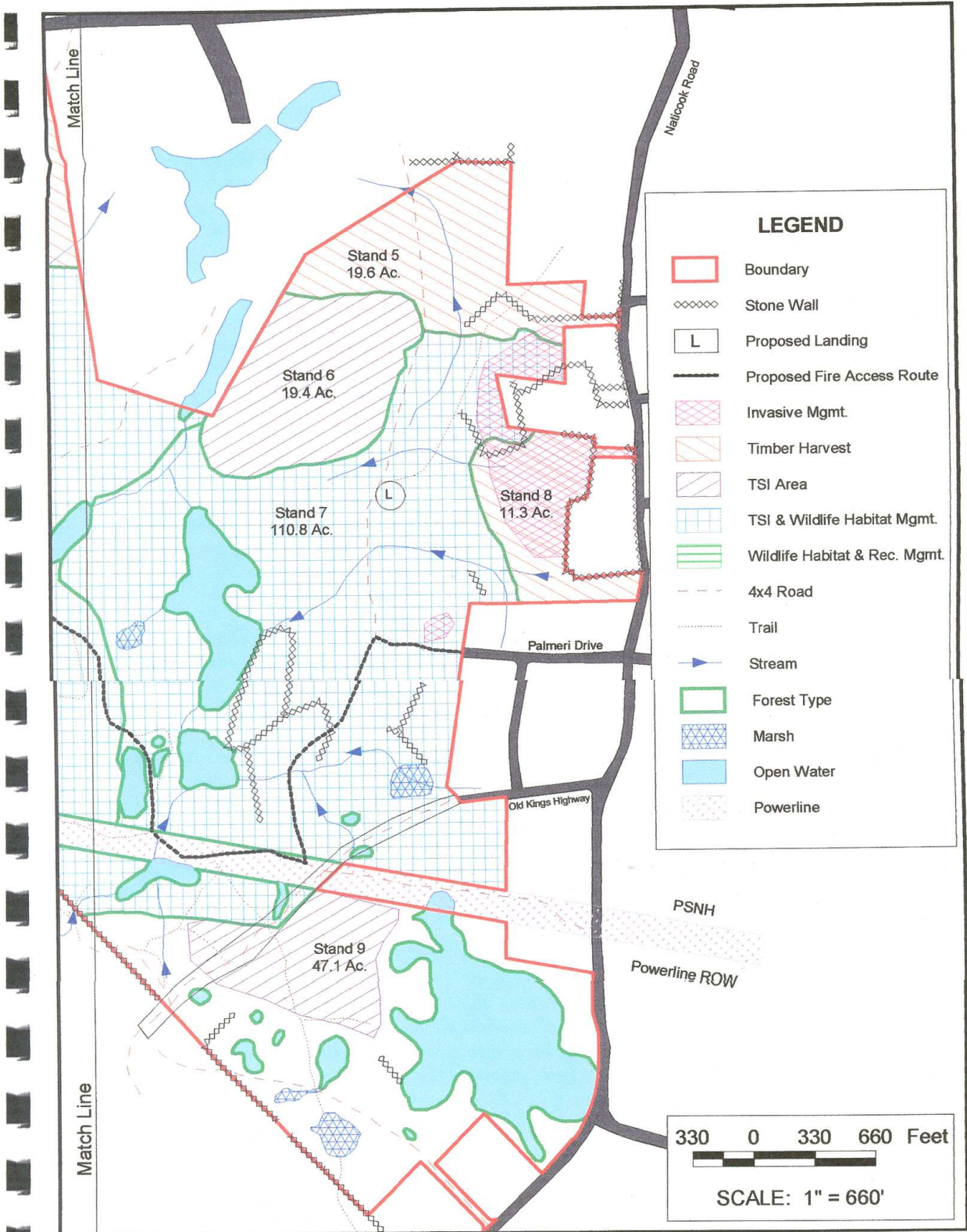
There are a large number of small- and medium-sized vernal pools dotted throughout this stand. Some sections of this stand will make harvesting a headache of setback zones, and these areas (where the buffer of one vernal pool meets and overlaps the buffer of the next pool) should probably be left untouched so as not to disturb amphibians and other wildlife traveling from one pool to the next. The HHNP Planning Committee should meet with other Town officials to determine how best to handle the heavy traffic on Old Kings Highway that is negatively impacting many of these sensitive areas.

Habitat improvement for this stand, and others, and particularly the powerline corridor, should include planting berry-producing shrubs and trees, since these species are significantly lacking across much of this property. These types of plants are available through the State Nursery in Boscawen, and can be planted by scouting groups, members of the HHNP Master Plan Committee, or other interested parties. Funding for this and other wildlife habitat improvement work can be sought under the Wildlife Habitat Improvement Program (WHIP) by contacting the natural Resource Conservation Service (NRCS) in Hillsborough County.









10-Year Planning Guide

Explanation of Management Priorities

In writing a conventional forest management plan that is aimed more at simply the management of trees, a forester will typically set up a schedule of events on an annual basis where portions of the forest can be harvested as they mature or to fit the landowners objective of income generation. In writing this comprehensive plan that focuses on so much more than just silviculture, it seems that setting up a list of priorities for action and identifying which silvicultural practices could be implemented will best serve whomever is charged with the authority to manage this large tract.

There are some immediate concerns that must be addressed that focus primarily on preventing further degradation of the natural resources on HHNP. While some of these priority actions may be worked out in conjunction with forest management activities and not necessarily completed prior to any other work done on this property, these issues (notably, Priorities 1-10) should be addressed as soon as possible, within the next year if at all possible.

Obviously, the OHRV issue is of great importance because of all the damage currently being done to sensitive wetland areas on the HHNP. However, of even greater importance is protecting this property for the long term. It simply does no good to protect the land from wheeled vehicle damage for the next 10 years and then see the land paved for a parking lot of developed into buildings. Therefore, the issue of greatest importance is to protect this property forever through the use of a conservation easement to allows management actions that have been described in this plan but does not allow development of the property in years to come.

With the future security of the land taken care of, there are some very pressing needs that should be addressed soon before too much is lost. To make the citizens of Merrimack aware of this magnificent nature experience right in their back yards (instead of 3 hours north in the White Mountains), some sort of press coverage should be sought for any facets of the work that is done on site, including the completion of this report, trail head parking, habitat creation, closed trails, and forestry work. Education will go a long way towards having others join the Master Plan Committee and Conservation Commission efforts to make this property into what it will become.

Thirdly, before access routes, trails, and forestry efforts can begin, it is essential for whatever group is charged with the authority to manage this property (HHNPMPC, MCC, or a Town Forest committee) to address the OHRV issue directly, decisively, and productively. Gates and boulders will make some progress, enforcement will go a little further, education will go further still, but working with recreationists to understand the damage they are doing and to receive their input about how to solve the problem will sometimes go a very long way. Not only that, it might behoove the Town to locate areas that can be used for OHRV recreation and directing those wheeled vehicles to that area and away from the more sensitive areas on this property. Perhaps one trail on this property could be upgraded and routed away from sensitive areas to keep the damage from continuing. This is not an issue of hating people that ride ATVs, but rather an issue of allowing humans to enjoy recreation without making it at the expense of delicate wild communities.

This opening statement is not meant as a rambling of thoughts, but to ensure that communication and a team approach will be sought when attempting to manage this property. The focus should be on the long-term outlook and making sure that quality of life is maintained or enhanced, using the goals and objectives laid out in the Master Plan as a guide.

Priority Actions

- 1) Determine which group will ultimately be responsible for the management of this parcel, whether it is the Horse Hill Nature Preserve Master Plan Committee, the Merrimack Conservation Committee, or a Town Forest Committee set up by the Board of Selectmen.
- 2) Look into placing a conservation easement on most of the property that should remain as open space forever, and determine which areas of this property could be set aside of other Town uses (such as a ball field). This may require a much more thorough evaluation of soils and costs of road and site construction before this can be determined, but the process should begin as soon as possible. One potential area for ball fields (about 10 acres under the powerlines on the western edge of the property) has been identified on the Recommended Management map based on the existing soils map.
- 3) Get press coverage for any facets of the work that is done on the site, including completion of this plan, trail head public parking, trail closings, wildlife habitat work, and forestry activity.
- 4) Install gates, boulders, and logs at all the main access points into this site to prevent any more OHRV damage on this property until (if and when) a suitable trail can be agreed upon for this type of recreation. A policy on education (see Priority 7), enforcement (see Priority 10), and public communication (see Priority 2) should be established along with this step.
- 5) Construct access points and parking areas with gates at the two proposed sites on Amherst Road and Palmeri Road.
- 6) Hire a surveyor to finish locating the property lines, then have the forester blaze and paint the boundary lines and install small conservation signs along boundaries. One recommendation would be to have the same crew from HSI do the work, since they are no doubt already somewhat familiar with this property.
- 7) Install kiosks and signs at the access points to show that this is the Town-owned Horse Hill Nature Preserve.
- 8) Conduct a thorough, on-the-ground review of all the trails with a newly-formed subcommittee called the Trails Committee to determine the condition of all the trails and determine which trails need to be closed, repaired, or re-routed. From this assessment, determine what uses will be allowed on these trails.
- 9) Conduct educational seminars in the field with interested parties to look at all the critical habitats and point out the location of new, re-routed, and closed trails. This includes re-routing the Wasserman Trail, which is an excellent link to further expand the use of open space in the Town of Merrimack.
- 10) Set up policy with the Conservation Commission, the Board of Selectmen, and the Merrimack Police Department on which types of uses will be allowed on this site and where.

- 11) Look at constructing a main access/safety route through the property and where gravel deposits on the property could be use to upgrade this road. Consider the impacts to the habitat surrounding this road and determine the level of upgrade needed based on the approved uses on the HHNP.
- 12) Conduct wildlife surveys over the winter to determine where major wildlife corridors are to further help determine where trails for snowmobiles and/or wheeled vehicles amy be feasible with no impact to wildlife or the baitat. Consult State Firsh and Game officials as well as the UNH Wildlife Biologists for their assistance. Don't overlook the potential use of the HHNP to UNH students that need class projects, which could provide valuable information at no cost.
- 13) Begin construction of the internal main access road from both the Amherst Road parking area and Palmeri Drive parking area. File all necessary wetlands permits to be able to upgrade this road for fire, safety, and forest management.
- 14) Conduct timber sales in Stands 4, 5, and 8 as access is improved. Access to Stand 4 may be gained through Mr. Watson's adjacent property instead of building all the way around from the parking area on Amherst Road.
- 15) Begin a program to control the invasive species found on the property, particularly the tangled mess in Stand 1, the burning bush understory in Stands 5, 7, and 8, and the Japanese bamboo in Stand 7.
- 16) Apply for cost-sharing funds to make some of the wildlife habitat projects occur. Contact the NRCS office in Milford, NH at (603) 673-2409 Ext. 4 to apply for the funds. Apply for the Small Grants program from NH Fish and Game to do further wildlife habitat work.
- 17) Look into areas over the entire forest that TSI could be done as discussed in this plan. Hire a forester to do the work, or hold training sessions for volunteers to train interested parties how to do this work with chainsaws. Determine if the Town has insurance coverage for such tasks with volunteers.
- 18) Prune appropriately-sized pine trees with pole saws to improve their quality as future sawtimber.
- 19) Have an Eagle Scout make an interpretive nature trail and brochure that can be used by local schools on field trips. Hold a teaching seminar with science teachers in the field to show them where the nature trail is located and point out interesting features along the way. Contact Project Learning Tree (PLT) to let them know that there is a large tract of managed forestland to help with public education.
- 20) Certify this property as a Certified Tree Farm with the American Tree Farm Association.
- 21) Retain the current forester throughout this process to help with these priorities and update the management plan in 2014

ECOLOGICAL FINDINGS & RECOMMENDATIONS

In May, 2004, Daniel Cyr, Bay State Forestry and forestry consultant to the Town of Merrimack (NH), retained E. Ann Poole, Ecologist and Environmental Planner, to conduct an informal ecological assessment at the Horse Hill Nature Preserve, Merrimack, NH. Objectives of the project were to:

- ◆ Gather background information (existing reports, maps and other documentation, as available) regarding wetlands, soils, rare/threatened/endangered wildlife, and exemplary vegetative communities
- ◆ Identify and evaluate wildlife habitat suitability and condition
- ◆ Determine potential for presence of rare, threatened, endangered or declining species habitat and plant communities
- ◆ Identify ecologically sensitive areas in order to avoid encroachment and minimize potential impacts
- ◆ Identify areas that could benefit from habitat management, and
- ◆ Analyze existing conditions and provide information to support and guide recommended forest management practices

This report presents information regarding existing site conditions (i.e. wetlands, rare species, and related natural resources); field observations made on 13 July, 17 September and 21 September, 2004; and analyses to inform and support conservation and recreation land use planning by the Town of Merrimack. The Ecologically Sensitive Areas (ESA) map was prepared by Brian Johnsen, Bay State Forestry.

General ecological findings and recommendations in the following topic areas are offered to assist the Town of Merrimack Board of Selectmen, land use planners, and engineers in integrating habitat conservation and human use objectives as expressed by the Merrimack Conservation Commission and other stakeholders:

- A. Ponds, Pools & Bottomlands
- B. Upland Forests & Powerline Corridor
- C. Public Access & Trails



Fig. 1.2 Beaver pond in Stand 2.



Fig. 1.1 White Pine Swamp is an example of a dwarf heath shrub bog. Off the photo are half a dozen great blue heron rookeries.

A. Ponds, Pools and Bottomlands

Ponds, pools and poorly-drained bottomlands provide critical habitat for a diverse array of wildlife at the HHNP. While many species rely on permanent wetlands for all of their life cycle, others utilize these areas in combination with surrounding habitats. Wetland buffers protect water quality and provide upland habitat for wildlife such as *Ambystomid* salamanders, which come to ponds only to breed, and pond turtles, which lay their eggs on land. Bottomlands act as transition zones between wetlands and surrounding upland habitats and benefit many semi-aquatic species by providing cover for safe passage and aiding dispersal and migration.

Wetlands and forested bottomlands [ESA Map Area 11] within the HHNP provide several ecological functions. These areas are diverse in vegetation and structure, are interconnected, and provide continuous wildlife habitat and travel corridors, including:

- Shallow marsh habitat for pond turtles (e.g., Blanding's and spotted turtles)
- Spawning habitat for *Ambystomid* or mole salamanders (blue-spotted and spotted salamander) [ESA Map Areas 3, 4, 5, 9 & 10]
- Waterfowl nesting habitat [Beaver ponds and ESA Map Area 6]
- Foraging habitat for insect and amphibian predators, such as herons and small mammals
- Breeding grounds for rare insects, such as noctuid moths, dragonflies and damselflies, and
- Food and cover for resident and migratory birds (e.g., red-shouldered hawk)

Bottomland forests at the HHNP have moderate to high vertical diversity consisting of a canopy of relatively large hardwood overstory trees with dense, wide-spreading crowns that are interspersed with occasional evergreens grading downward into understory trees. The sub-canopy consists of a variety of woody shrubs having a relatively deep foliage layer. Forested edges have dense ground and low shrub layers interspersed with occasional brambles.

The principal threat to ponds, pools and bottomlands at the HHNP and the species they support is off-highway recreational vehicle (OHRV) use. OHRVs have a wide range of damaging effects on many species of wildlife. Some are direct and highly visible ranging from chasing and harassment to mortality. Others are indirect and less obvious, but no less serious, including behavioral changes and habitat fragmentation. OHRVs contribute to soil erosion and compaction, the destruction of plants, sedimentation of streams, and the potential spread of invasive weeds. Taken together, these impacts threaten the well-being and survival of wildlife in areas where OHRVs operate. *OHRVs should be restricted from operating in ecologically sensitive areas where wildlife could be impacted directly by roads and trails or indirectly through increased disturbance to the area.*



Fig. 1.3 OHRV trail through wetlands in powerline corridor.

- ***Existing emergent wetlands at White Pine Swamp and other areas of open water provide habitat for American bittern, green heron, great blue heron rookeries, Ambystomid salamanders and pond turtles.*** American bittern nests are often difficult to detect and may be abandoned if disturbed; suspected nest sites should be protected from human disturbance during the breeding season. Vegetated wetland buffers and no-cut zones in the vicinity of White Pine Swamp and other areas of open water provide feeding habitat for wetland birds and a variety of migratory birds.
 - ***Natural water level fluctuations of wetlands should be maintained.*** Allowing natural flow regulation by beaver creates a spatial and temporal diversity of plant species. Where road and trail crossings through wetlands are unavoidable, use technical designs that do not alter seasonal water level fluctuations.
 - ***Avoid clearing native vegetation along the wetland edges.*** Establishing vegetated wetland buffers and no-cut zones will protect principal wetland functions and values. A minimum of 100 feet is recommended; more would be beneficial in particularly sensitive areas. In addition to the wetland buffer, protect travel corridors and adjacent upland habitat required by many wetland species (e.g. *Ambystomid* salamanders and nesting turtles).
-

B. Upland Forests and Powerline Corridor

Relatively large, contiguous tracts of upland forest exist throughout the HHNP. These areas consist primarily of dry woodlands, but also include moist thickets and brushy openings (e.g., powerline corridor).

Upland forest at the HHNP supports a diversity of wildlife species and could potentially support several rare species (e.g., wood turtle and northern black racer). Potentially suitable habitat and ecologically sensitive areas include:

- Potential turtle nesting areas (i.e., sparsely-vegetated, south-facing slopes with uncompacted or well-drained mineral soils within 500 feet of ponds or wetlands) [ESA Map Area 7]
- Bedrock outcrops, rock heaps and debris piles on south facing slopes (critical habitat for northern black racer (*Coluber c. constrictor*)) [ESA Map Areas 1 & 2]
- Herbaceous and brushy openings (critical habitats for New England cottontail rabbit (*Sylvilagus transitionalis*) and Cooper's hawk (*Accipiter cooperii*)) [ESA Map Area 12]
- Wildlife and mast/seed-producing trees, and
- Riparian borders

Scattered forest openings create diversity and can support a wide variety of wildlife. Openings provide food, cover and nesting habitat for insects, birds, turtles and herbivores all of which support snakes, raptors, and predatory mammals.



Fig. 1.4 Powerline corridors offer valuable shrubby cover for ground dwellers and structural diversity in the forest canopy.

Irregularly shaped openings arranged to receive maximum sunlight are best. Different types of openings will further increase habitat diversity.

Herbaceous, or grassy, openings support tender plants and grasses that do not develop a woody stem. *Few herbaceous openings exist at the HHNP.* Brushy openings, such as the powerline corridor, can further increase habitat diversity by supporting fruit-bearing vines, shrubs and saplings [ESA Map Area 8].

Wildlife trees are standing dead or live trees that provide food (insects attracted to decaying trees), and living quarters for a wide variety of birds and mammals. Snags (upright dead trees) contain insects and provide potential sites for cavities. Cavity trees (live trees with internal cavities) provide nesting and denning cover. A mix of large-diameter hardwood and softwood wildlife trees is desirable because they decompose at different rates. Different animals will use a tree at different stages of decomposition. For example, an owl might build a nest in the cavity of an old oak tree. The owl will leave this tree if it dies and falls down, but a fallen tree

provides excellent cover for salamanders and snakes. Mast trees produce food and seeds for regeneration.

Maintaining large patches of upland forest in a relatively natural state is important to sustaining animal populations. Riparian areas in particular are sensitive to human impacts, soil disturbance and alterations in surface runoff. That said, forest management activities have the potential to significantly enhance upland habitats.

Thinning certain trees from a stand is a valuable practice used to create grassy openings and maintain a healthy forest. Thinning can enhance an area for wildlife by:

- Allowing greater sunlight penetration, permitting an increase in understory development, which will, in turn, increase browse and cover for wildlife.
- Allowing the remaining trees to receive more nutrients (water, sunlight), so in turn they will increase their mast (acorn, nut) production. Mast is an important food source for many animals, including deer, wild turkey, squirrel and chipmunk.

A slower but certain threat to the native forest community is the progressive spread of invasive plant species. On the north and east sides of the property, invasive plants have clearly begun to overtake the native shrub understory. As these plants spread toward the south and west, both forest and wetland plant and animal communities will gradually be impacted.

- *Snags, logs, masts, overhangs, thickets, dens, cavities, woody debris and old pilings should be retained to the greatest extent possible.* In particular, large trees and snags adjacent to White Pine Swamp and other areas of open water should be retained to provide attractive feeding perches and roosting sites for transient raptors such as Cooper's hawk.
- The relative mobility of wildlife makes it is possible that suitable habitats could be occupied by rare species in future years. While not observed in the course of this investigation, *field surveys for rare and sensitive wildlife at the HHNP would be beneficial to developing long-term land management practices.*
- Large expanses of even-aged, closed canopy monocultures will support a handful of highly adaptable generalists, but will fail to sustain many species, some of which are imperiled or declining at alarming rates. On timber stands, *maintain a diversity of age classes, density, and structure either within the same stand or among adjacent stands; consider a mosaic of smaller, adjacent patches of varying management regimes.* Maintain habitat diversity by encouraging the forest understory to remain complex. When possible leave large trees and forested patches that can serve as refugia for forest-dwelling animals from which they can more easily disperse and repopulate harvested areas as they mature.
- *Avoid fragmenting woodlands through careful placement of roads and other barriers to wildlife movement.* Upland forest stands that are separated from wetlands and bottomlands by roads or unfavorable habitat may limit the dispersal and migration of amphibians and

reptiles. When possible, forested blocks should be planned to help maintain transition zones between adjacent complementary habitat types. Where wildlife corridor crossings are unavoidable, a combination of directional fencing and underpasses or overpasses (ecopassages) can be used to funnel wildlife safely from one side of a roadway to the other. Ecopassages should be located in existing migration routes, such as between breeding (e.g., wetland) and non-breeding (e.g., upland) habitats.

- Many wildlife species nest, forage, or shelter inside or underneath brush piles and rotten logs. Root balls and stump holes are critical hibernation habitats for most forest amphibians and reptiles. Forest value is enhanced for wildlife when tree butts, branches, and other fallen woody debris are left in place to decay rather than “cleaned up.” *Because dead wood and snags are a primary source of food and shelter for many animals, they should only be removed where they block trails, represent a safety hazard to pedestrians, or pose disease threat to healthy trees.*
 - Mast trees provide for regeneration and pockets of shade until the surrounding harvest area re-grows. *E ven harvesting timber, leave large mast and seed-producing trees or patches of trees on harvested sites.*
 - Many wildlife species are specifically adapted to forage, bask, hibernate, nest, etc. exclusively in native vegetative communities. *In Stands 7 and 8, native plants are gradually losing out to invasive non-natives, such as burning bush and Japanese bamboo.* In areas where non-native species are already established, the safest and most effective means of controlling invasives should be used (i.e., mechanical removal). Where necessary, apply herbicides selectively. Improper or excessive use of chemicals can poison wildlife. Make sure that sensitive habitats, especially aquatic systems, are adequately buffered to minimize impacts of chemicals beyond the target area.
-

C. Public Access & Trails

Access to and recreational use of the HHNP by pedestrians is limited by a lack of road frontage, parking, controlled entry points and emergency access. To direct appropriate uses, access and signage will need to be improved. For example:

- Parking, passenger and gear loading zones should be readily accessible and adequate to accommodate year-round use
- Trails, trailheads, and parking areas should be appropriately signed using the International Symbols of Access
- Trails should be accessible from parking areas
- Interpretive signage describing the trails and points of interest should be posted at the trailhead

Several factors need to be considered when laying out a trail, including the types of users that will take advantage of the trail(s) and environmental constraints. Trails should be routed and designed so as to minimize direct (e.g., erosion, soil compaction, damage to vegetation) and indirect (i.e., human disturbance of wildlife) impacts. Recommended minimum design standards can be found in the State of NH's Department of Resources and Economic Development *Nonmotorized Trails Manual* (Spoerl & Hersch 1996).

- *The use of existing roads and trails should be explored before clearing new trails.* Old logging roads and skid trails can make good trails and usually lead to a potential public access point. Some remnant roads and logging tracks that traverse the HHNP can be made suitable for trails and pathways.
- *Soil erosion and compaction, recreational killing, and noise-related disruptions of natural behaviors are potential side effects of increased recreational use.* Trails, roads, landings, and recreational facilities should be located away from sensitive habitats (e.g. nesting breeding and denning areas), migration corridors, and transitional zones between complementary habitats. Seasonal restrictions on access during particularly sensitive time, such as during turtle nesting (May-July) and amphibian migration periods (early spring), should be considered. Prohibit the harming or taking wildlife; prevent HHNP users from altering or damaging habitats. Minimize publicity of biologically significant areas to prevent collection or indiscriminate killing.



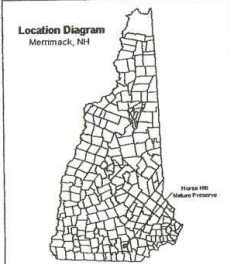
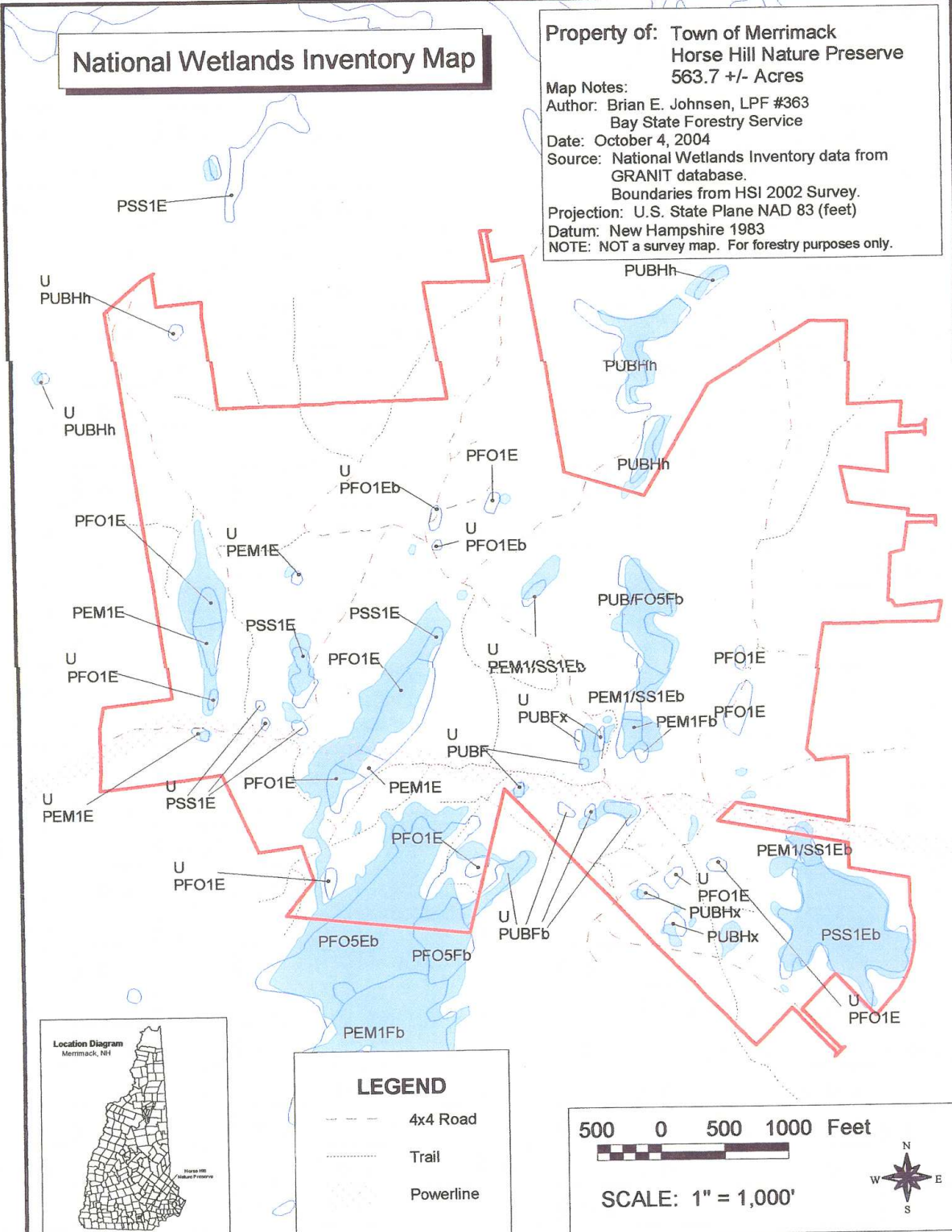
Fig. 1.5 Raided turtle nest at edge of OHRV trail.

- ***Avoid crossing wildlife travel corridors and wetlands.*** Wildlife corridors or ‘traces’ are created when animals travel from one place to another, for example from a water supply to a feeding area. Any disruption to these corridors can confuse wildlife and even cause them to relocate. Plan not to interrupt these corridors but choose a route to travel with or away from traces. Travel corridors are most easily identified when scouting trail routes on the ground. Any necessary crossing of wetland areas should be done at the narrowest point possible to minimize impacts on the environment.
 - ***Motorized vehicle access should be limited to official conservation-related traffic.*** The use of OHRVs has left significant scars in the form of mud holes, blow-outs, denuded roads and clearings. These open areas leave the land more susceptible to erosion and wildlife disruption. The construction of new roads and ATV trails should be minimized and existing roads should be gated.
 - ***Hunting should be explicitly prohibited at the HHNP*** due to the proximity of dwellings and roadways, and use by pedestrians.
-

National Wetlands Inventory Map

Property of: Town of Merrimack
 Horse Hill Nature Preserve
 563.7 +/- Acres

Map Notes:
 Author: Brian E. Johnsen, LPF #363
 Bay State Forestry Service
 Date: October 4, 2004
 Source: National Wetlands Inventory data from GRANIT database.
 Boundaries from HSI 2002 Survey.
 Projection: U.S. State Plane NAD 83 (feet)
 Datum: New Hampshire 1983
 NOTE: NOT a survey map. For forestry purposes only.



LEGEND

- - - 4x4 Road
- Trail
- x--- Powerline

500 0 500 1000 Feet

SCALE: 1" = 1,000'

The scale bar shows increments of 500 feet up to 1000 feet. A north arrow is located to the right of the scale bar.

National Wetlands Inventory Key

National Wetlands Inventory 1990

The codes found on NWI maps can be broken down into system, subsystem, class, and subclass. Some wetlands may be further classified using modifiers.

Example: P -- Palustrine
SS -- scrub-shrub
1 -- broad-leafed deciduous
F -- semi-permanently flooded
b -- beaver

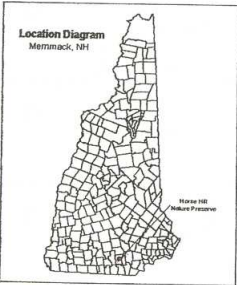
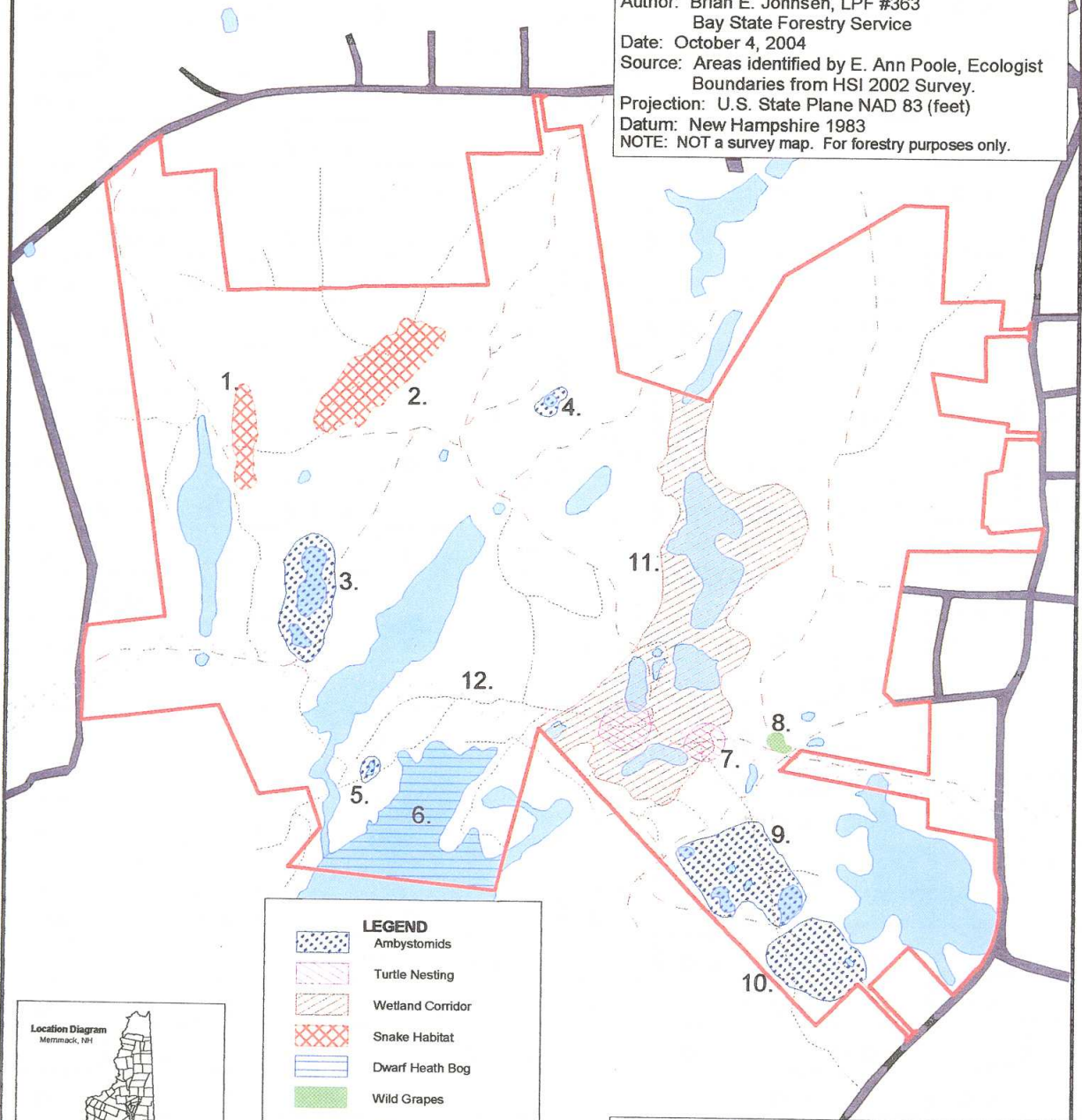
Note: The letter "U" preceding the code primarily represents upland areas, but may include unclassified wetland such as man-modified areas, non photo-identifiable areas, and/or unintentional omissions.

PEM1 -- Palustrine emergent persistent
PEM1E -- Palustrine emergent persistent seasonally flooded/saturated
PEM1Fb -- Palustrine emergent persistent semi-permanently flooded beaver
PFO1E -- Palustrine forested broad-leafed deciduous seasonally flooded/saturated
PFO1Eb -- Palustrine forested broad-leafed deciduous seasonally flooded/saturated beaver
PFO5Eb -- Palustrine forested dead seasonally flooded/saturated beaver
PFO5Fb -- Palustrine forested dead semi-permanently flooded beaver
PSS1E -- Palustrine scrub-shrub broad-leafed deciduous seasonally flooded/saturated
PSS1Eb -- Palustrine scrub-shrub broad-leafed deciduous seasonally flooded/saturated beaver
PUB -- Palustrine unconsolidated bottom
PUBF -- Palustrine unconsolidated bottom semi-permanently flooded
PUBFb -- Palustrine unconsolidated bottom semi-permanently flooded beaver
PUBFx -- Palustrine unconsolidated bottom semi-permanently flooded excavated
PUBHh -- Palustrine unconsolidated bottom permanently flooded diked/impounded
PUBHx -- Palustrine unconsolidated bottom permanently flooded excavated

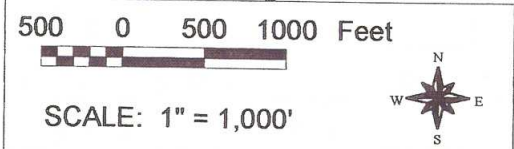
Ecologically Sensitive Areas

Property of: Town of Merrimack
 Horse Hill Nature Preserve
 563.7 +/- Acres

Map Notes:
 Author: Brian E. Johnsen, LPF #363
 Bay State Forestry Service
 Date: October 4, 2004
 Source: Areas identified by E. Ann Poole, Ecologist
 Boundaries from HSI 2002 Survey.
 Projection: U.S. State Plane NAD 83 (feet)
 Datum: New Hampshire 1983
 NOTE: NOT a survey map. For forestry purposes only.



LEGEND	
	Ambystomids
	Turtle Nesting
	Wetland Corridor
	Snake Habitat
	Dwarf Heath Bog
	Wild Grapes
	Powerline Corridor
	Open Water
	4x4 Road
	Trail



Appendix A.
Individual Species Accounts
Property of the Town of Merrimack
Horse Hill Nature Preserve
Merrimack, NH

Swamp Azalea
Rhododendron viscosum

Status: Federal - none;
State - Threatened; Rare / uncommon.

Range: Eastern United States.

Local Distribution:

Unknown. The state Natural Heritage Program reports documented occurrences in the local region.

Habitat: Usually in wet areas (swamps, bogs, marshy forest edge, pine barrens swamp, cedar swamp, and lake and stream edges) and occasionally in dry areas (sandy woods, sandy barrens, pine woods, and oak-hickory woods). The species is indicative of mineral soils and tolerant of flooding. It grows on acidic wet sphagnum peat and occasionally dry upland peat at swamp margin.

Survey Method:

Incidental visual observation.

Confirmed locations:

None.

Potentially suitable habitat areas:

White Pine Swamp and beaver impoundments in Stands 2, 7, and 9 [ESA Map Area 6].

Management Considerations & Recommendations:

Primarily threatened by habitat fragmentation, diminished water quality and altered flow regimes.

Projects possibly affecting water levels in swamp azalea habitat areas must be carefully considered. Unpolluted water is critical for the species' survival in natural bogs and marshes, so wetland ecosystems should be preserved in a healthy state.

Blue-spotted Salamander
Ambystoma laterale

Status: Federal - none;
State - Nongame.

Range: Southeastern Quebec and n. shore of the Gulf of St. Lawrence w. to James Bay and the s. end of Lake Winnipeg, s. to n. Illinois and Indiana, n. New York and New England. Disjunct colonies in New Jersey, Long Island, Iowa, and Labrador.

Local Distribution:

Widely distributed, but uncommon in local sites. This species is not tracked by the state Natural Heritage Program.

Habitat: Found in a variety of habitats, the blue-spotted salamander occurs primarily in deciduous forests with loamy soils and wooded swamps where they can be found beneath logs, rocks, leaf litter, or in burrows of small woodland animals. Ponds and pools that retain water into midsummer are vital for breeding, and the salamanders will migrate there to reproduce.

Survey Method:

Incidental visual observation.

Confirmed locations:

None.

Potentially suitable habitat areas:

White Pine Swamp, beaver impoundments and vernal pools (breeding habitat) and adjacent moist woodlands in Stands 2, 3, 7, and 9 [ESA Map Areas 3, 4, 5, 9 & 10].

Management Considerations & Recommendations:

Logging operations, especially the clear cutting of woodlands, are one of the greatest threats to this forest floor inhabitant. The construction, and presence, of roads that intersect the migration route to breeding ponds also threaten the persistence of this species.

Spotted Salamander
Ambystoma maculatum

Status: Federal - none;
State – Nongame.

Range: Nova Scotia and the Gaspé Peninsula w. to s. Ontario, s. through Wisconsin, s. to s. Illinois (excluding prairie regions), e. Kansas and Texas, and throughout the eastern United States except Florida, the Delmarva Peninsula, and s. New Jersey.

Local Distribution:
Common; declining. This species is not tracked by the state Natural Heritage Program.

Habitat: Occur primarily in moist deciduous or mixed woods with sandy loam soils in or adjoining floodplains, on rocky hillsides and shallow woodland ponds or marshy pools that hold water through the summer for breeding. In summer often wanders far from breeding ponds. Adults are fossorial. Terrestrial hibernator.

Survey Method:
Incidental visual observation.

Confirmed locations:
None.

Potentially suitable habitat areas:
White Pine Swamp, beaver impoundments and vernal pools (breeding habitat) and adjacent moist woodlands in Stands 2, 3, 7, and 9 [ESA Map Areas 3, 4, 5, 9 & 10].

Management Considerations & Recommendations:

Logging operations, especially the clear cutting of woodlands, are one of the greatest threats to this forest floor inhabitant. The construction, and presence, of roads that intersect the migration route to breeding ponds also threaten the persistence of this species.

Northern Leopard Frog
Rana pipiens

Status: Federal - none;
State - Nongame; Rare / Uncommon.

Range: Nova Scotia, Labrador w. to se. British Columbia, Washington and California, n. Arizona and New Mexico, Ohio, n. New York and New England.

Local Distribution:

Widespread, spotty distribution. Extirpated from some formerly occupied areas. The state Natural Heritage Program reports no documented occurrences in the local region.

Habitat: Wet meadows and fields. Breeds in temporary and permanent ponds, marshes, weedy lake shores, and slow shallow streams with muddy banks and profuse vegetation. Usually hibernates from October or November to March; hibernates in under water pits or burrows. Sometimes emerges in early February and during warm days in winter.

Survey Method:

Incidental visual observation.

Confirmed locations:

None.

Potentially suitable habitat areas:

Aside from the narrow grassy wetland margins around White Pine Swamp and beaver impoundments, no significant areas of potentially suitable habitat for northern leopard frog were observed at the Horse Hill Nature Preserve. Open grassy meadows, pastures and fields which are their preferred habitat are extremely limited within the Preserve.

Management Considerations & Recommendations:

Primarily threatened by habitat loss, fragmentation and diminished water quality. Also threatened by vehicular traffic during the breeding season.

Unpolluted water is critical for the species' survival in natural bogs and marshes, so wetland ecosystems should be preserved in a healthy state.

The construction of roads in the vicinity of breeding areas should be avoided.

Blanding's Turtle
Emydoidea blandingii

Status: Federal - none;
State - Nongame; Rare / Uncommon.

Range: Great Lakes region and west to Nebraska. Separate population in s. New Hampshire, Massachusetts, and e. New York.

Local Distribution:

The state Natural Heritage Program reports several documented occurrences in the Town of Merrimack and adjacent towns.

Habitat: Lake shallows, ponds, marshes, and brooks with soft bottoms and dense aquatic vegetation. Prefers shallow to deep marshes dominated by moderate to dense submergent vegetation and often co-dominated by emergent vegetation (usually cattails) along the shorelines. May also be found in almost every other wetland type excluding northern bogs and oligotrophic lakes. Strongly prefers lentic water although individuals will use riverine corridors for travel and hibernation. Basks on logs, stumps, or beaver lodges.

Survey Method:

Incidental visual observation.

Confirmed locations:

None.

Potentially suitable habitat areas:

White Pine Swamp and beaver impoundments in Stands 2, 7, and 9 [ESA Map Area 6].

Management Considerations & Recommendations:

Primarily threatened by habitat loss and fragmentation. Also threatened by collection for pet trade.

Blanding's turtles disappear in an area when the muddy substrate and associated flora are replaced by hardwood trees such as red maples. The result of this natural succession suggests habitat management by harvesting of some of these trees to keep an open canopy.

Projects possibly affecting water levels in Blanding's turtle habitat areas must be carefully considered. Unpolluted water is critical for the species' survival in natural bogs and marshes, so wetland ecosystems should be preserved in a healthy state. Because the turtle's habitat is so dependent upon a naturally succeeding environment, normal distribution corridors in and along streams must be kept open rather than blocked by road crossings and other construction.

As a semi-terrestrial species, Blanding's turtle often forage in wet prairies, sedge meadows or shrub-carrs adjacent to aquatic habitats. Blanding's turtles do not nest communally. Many herpetologists have observed nest-site fidelity they believe is associated with the turtle's natal hatching site, although

this has not been documented. Nesting occurs from along the shoreline to > 1.5 miles from aquatic habitat. They have a strong preference for nesting in sandy soils, which may partially explain why they travel so far from water to nest.

Spotted turtle
Clemmys guttata

Status: Federal - none;
State - Nongame; Rare / Uncommon.

Range: Southern Maine south along the Atlantic coastal plain to n. Florida, west through Maryland, Pennsylvania, and s. New York into n. Ohio and Indiana, extreme ne. Illinois and adjacent se. Wisconsin, s. Michigan, and Ontario.

Local Distribution:

Generally uncommon; common in some localized areas. The State Natural Heritage Program reports two documented occurrences in the local region.

Habitat: Unpolluted shallow waterbodies surrounded by vegetation, marshy meadows, wet woodlands, boggy areas, beaver ponds, marshes, and shallow, muddy-bottomed streams. Requires well-drained loamy or sandy soils within 1600 feet for nesting. Frequently hides in mud and detritus at bottom. Most often seen basking at water's edge on brush piles in water, logs or clumps of vegetation in early spring. Hibernates in water under tree root balls in vernal pools and in forested, scrub-shrub, and emergent wetlands, or in the muddy bottoms of shallow, freshwater wetlands.

Survey Method:

Incidental visual observation.

Confirmed locations:

None.

Potentially suitable habitat areas:

White Pine Swamp and beaver impoundments in Stands 2, 7, and 9 [ESA Map Area 6].

Management Considerations & Recommendations:

Primarily threatened by contaminants, road mortality, habitat loss and fragmentation. Also threatened by collection for pet trade.

Projects possibly affecting water levels in spotted turtle habitat areas must be carefully considered. Unpolluted water is critical for the species' survival in natural bogs and marshes, so wetland ecosystems should be preserved in a healthy state. Because the turtle's habitat is so dependent upon a naturally succeeding environment, normal distribution corridors along effluent streams must be kept open rather than blocked by roads and other construction.

Wood turtle
Clemmys insculpta

Status: Federal - none;
State - Nongame; Rare / Uncommon.

Range: Nova Scotia south to n. Virginia and discontinuously west through s. Quebec and the Great Lakes region to e. Minnesota and ne. Iowa.

Local Distribution:

Unknown. The State Natural Heritage Program reports one documented occurrence in the local region.

Habitat: Cool streams and associated banks in deciduous woodlands, red maple swamps, marshy meadows. This species is highly terrestrial, spending days to months away from water in late spring and summer in lowland hardwood forests, some upland forests and in a variety of wetland habitats adjacent to riverine corridors. Overwinter on gravelly bottoms of small streams.

Survey Method:

Incidental visual observation.

Confirmed locations:

None.

Potentially suitable habitat areas:

All forested areas and wetland margins within the Horse Hill Nature Preserve are potentially suitable wood turtle habitat.

Management Considerations & Recommendations:

Primarily threatened by road mortality, loss of nest sites, habitat loss and fragmentation. Also threatened by collection for pet trade.

These turtles need clean streams running through or near wooded banks of sandy-bottomed streams with adjacent wet meadows or fields. These brooks or streams are probably necessary for courtship. They live in large groups or colonies, usually returning to the same stream each year and often using its muddy substrate or soft banks in the winter for hibernation. Because these turtles do show a tendency to return to the same stream each year the water quality of those known and potential streams must be protected. Suggested habitat management techniques include vegetative buffers >200-m wide along streams and, where mowing occurs, mow to 8 to 12-inches high in late-summer when temperatures are below 70 degrees F on more than three consecutive days.

Wood turtles tend to nest close to rivers and streams in south exposed sandy banks but may occasionally cross land to access disturbed soils or loose sand (i.e. sand roads adjacent to streams, gravel pits near rivers). Nesting usually occurs at an elevation of 4 or more feet above normal river

stage. Light to moderately sloughing southerly exposed sandy banks with scattered vegetation are preferred.

This species requires large roadless preserves of preferred habitat in order to maintain viability, provided that collecting is eliminated. This species seems to favor easy access to shady areas to avoid over heating, so management should allow for scattered small trees and brush as opposed to clear-cutting.

Eastern box turtle
Terrapene c. carolina

Status: Federal - none;
State - Nongame; Rare / Uncommon.

Range: Southwestern Maine w. through the Thousand Islands region of New York to the Mississippi River, central Illinois and s. to n. Florida.

Local Distribution:

Widespread but uncommon. Most common in low-lying coastal areas. The State Natural Heritage Program reports one documented occurrence in the area, though the accuracy of that record is in question.

Habitat: Woodlands, field edges, thickets, marshes, bogs, stream banks; typically found in well-drained forest bottomland. Found chiefly in open deciduous forests. Ecotones with sandy soils are favored. During hot weather, may rest in mud or water or burrow under logs or decaying vegetation for extended periods. When not active, rests in brush piles and thickets. Hibernates on land from depth of several inches to 2 feet below surface in loose soil, decaying vegetation, mud, or in stream banks from late fall to April.

Survey Method:

Incidental visual observation.

Confirmed locations:

None.

Potentially suitable habitat areas:

No significant areas of potentially suitable habitat for eastern box turtle were observed at the Horse Hill Nature Preserve. Expanses of well-drained relatively level sandy soils which typify their preferred habitat do not exist within the Preserve.

Management Considerations & Recommendations:

Although they are still common in many areas, box turtles have declined over much of their range, probably due largely to habitat destruction by man. Many box turtles are killed as they cross our highways. Dogs sometimes catch box turtles and chew their shells, resulting in injury and eventual death to the turtle. Many are also hit by lawn mowers as the turtles hide in tall grass and weeds. Box turtles are popular as pets and over collecting for the pet trade can also seriously reduce their numbers. In spite of these threats, box turtles can often survive close to man if suitable pockets of habitat exist.

Eastern Hognose Snake
Heterodon platirhinos

Status: Federal - none;
State - Nongame; Rare / Uncommon.

Range: Eastern-central Minnesota to extreme s. New Hampshire south to s. Florida, west to e. Texas and w. Kansas.

Local Distribution:

Unknown. Anecdotal evidence suggests that eastern hognose snake may inhabit areas adjacent to the Horse Hill Nature Preserve. The state Natural Heritage Program reports several documented occurrences in the Town of Merrimack and adjacent towns.

Habitat: Prefers open sandy-soiled areas; thinly wooded upland hillsides, cultivated fields, woodland meadows. Dry open pine and deciduous woods. Hibernates under forest floor debris, stumps, and trash piles. Diet consists primarily of amphibians, especially American toad (*Bufo americanus*).

Survey Method:

Incidental visual observation.

Confirmed locations:

None.

Potentially suitable habitat areas:

No significant areas of potentially suitable habitat for eastern hognose snake were observed at the Horse Hill Nature Preserve. The sandy soils and dry open woodlands which typify their preferred habitat are severely limited within the Horse Hill Nature Preserve.

Management Considerations & Recommendations:

Eastern hognose snake benefits from habitat management techniques such as clear cutting small portions of pine-oak woods and building 3- to 4-foot mounds with stumps, logs, brush, and sand.

This species hibernates and nests in subterranean rodent burrows and stump holes. Potential den and nest sites should be protected and left undisturbed.

Northern Black Racer
Coluber c. constrictor

Status: Federal - none;
State - Nongame; Rare / Uncommon.

Range: S. British Columbia and extreme s. Ontario; every state in continental United States, except Alaska; scattered populations through e. Mexico to n. Guatemala.

Local Distribution:

Unknown. The state Natural Heritage Program reports no documented occurrences in the area.

Habitat: Overgrown fields, meadows, sparse brushy areas along open woodland, wooded hillsides, grassy-bordered streams, and pine flatlands. Partially arboreal. Will use ledges for sunning. Racers thrive in areas that are periodically cleared or mowed. Hibernates in large congregations using rock crevices or abandoned woodchuck holes.

Survey Method:

Incidental visual observation.

Confirmed locations:

None.

Potentially suitable habitat areas:

All forested areas within the Horse Hill Nature Preserve are potentially suitable racer habitat, most notably Stands 2 and 3 where ledges and rock outcrops exist.

Management Considerations & Recommendations:

The northern black racer benefits from habitat management techniques such as clear cutting small portions of pine-oak woods and building 3- to 4-foot mounds with stumps, logs, brush, and sand. This provides good hiding places and will help to attract small mammals, the main diet of the racer. Ledges and rock outcrops should not be disturbed.

American Bittern
Botaurus lentiginosus

Status: Federal – none;
State – Nongame; Rare / Uncommon breeder.

Range: British Columbia, Manitoba, and Newfoundland to Maryland, Kansas, and southern California; also in Texas, Louisiana, and Florida. Winters north to British Columbia, Ohio, and Delaware, occasionally farther north.

Local Distribution:

Unknown but believed to be declining due to loss of freshwater wetlands. The state Natural Heritage Program reports no documented occurrences of breeding in the area.

Habitat: Large marshes and emergent wetlands where tall dense emergent vegetation such as cattails, bulrushes, sedges, and reeds are present. Also marshy lake shores, scrub-shrub swamps with abundant amphibian populations.

Survey Method:

Incidental visual observation.

Confirmed locations:

None.

Potentially suitable habitat areas:

White Pine Swamp and beaver impoundments in Stands 2, 7, and 9 [ESA Map Area 6].

Management Considerations & Recommendations:

The principal cause of the apparent decline of American bittern has been loss of habitat. No specific habitat management techniques are practiced specifically for this species. Research suggests that habitat protection is critical for their survival.

A breeding census of favorable nesting areas should be undertaken. Areas supporting only one pair could be made attractive by enlargement.

Great Blue Heron (rookery)

Ardea herodias

Status: Federal - none;
State - Nongame; Rare / Uncommon breeder, species does not over-winter in New Hampshire.

Range: Breeds from Alaska and Newfoundland s. to Florida and the Gulf Coast. Winters regularly from the Gulf Coast and California s. to Argentina. Also breeds in Eurasia, n. Africa, the East Indies, and Australia.

Local Distribution:

Fairly common and increasing breeder. The state Natural Heritage Program reports no documented occurrences in the local region.

Habitat: Lakes, ponds, rivers, and marshes with abundant amphibian populations. Breeds in rookeries located in trees or forested wetlands near open water, preferably free from human disturbance.

Survey Method:

Incidental visual observation.

Confirmed locations:

White Pine Swamp (portion outside Horse Hill Nature Preserve). Report filed with the state Natural Heritage Program (Appendix B).

Potentially suitable habitat areas:

White Pine Swamp and beaver impoundments in Stands 2, 7, and 9 [ESA Map Area 6].

Management Considerations & Recommendations:

Avoid disturbing potential nest sites during the early part of the nesting cycle, especially from the pre-laying and egg-laying stages (mid-March to late June) up to hatching (late July). Human activity at or near colony sites should be strictly prohibited as this species is sensitive to disturbance and will desert previously active heronries if disturbed. Active lumbering in the vicinity during the breeding season and removal of nest trees through timber harvest should also be prevented at known colony sites. Retain snags and standing dead trees in secluded areas near open water.

Efforts to locate and census additional sites are needed. Winter censuses should be compiled and areas of important wintering habitat delineated. Historically active heronries should be checked for recent nesting activity.

Cooper's Hawk
Accipiter cooperii

Status: Federal - none;
State - Nongame; Threatened, imperiled breeder, species does not over-winter in New Hampshire.

Range: British Columbia, Ontario, and Nova Scotia south to Florida and Costa Rica. Winters north to southern New England and British Columbia.

Local Distribution:

A rare and local breeder. The state Natural Heritage Program reports no documented occurrences of breeding in the area.

Habitat: Mature semi-open deciduous and, less often, coniferous forests, especially where these are interrupted by meadows and clearings, such as woodlots. Tolerant of forest fragmentation.

Survey Method:

Incidental visual observation.

Confirmed locations:

None.

Potentially suitable habitat areas:

Forested uplands in Stands 2, 3, 4, 5, 6 and 7.

Management Considerations & Recommendations:

Once one of the most abundant birds of prey in the 1800s, Cooper's hawks have declined in New England since the late 1800s when they were persecuted. The major factor affecting Cooper's hawk today is the destruction of nesting habitat.

This species would benefit from clearing for timber stand improvement to remove low quality wood and release mast trees in uplands.

Red-Shouldered Hawk

Buteo lineatus

Status: Federal – none;
State – Nongame; Rare / uncommon, special concern.

Range: Temperate forested regions of North America.

Local Distribution:

Uncommon breeder and migrant. The state Natural Heritage Program reports no documented occurrences in the area.

Habitat: Mature riparian deciduous woodlands with tall trees for nesting. Wooded river swamps, bottomlands and wooded margins of marshes and beaver ponds, often near openings or fields for foraging.

Survey Method:

Incidental visual observation.

Confirmed locations:

None.

Potentially suitable habitat areas:

Moist woodlands in Stands 2, 3, 7 and 9 [ESA Map Area 11].

Management Considerations & Recommendations:

Red-shouldered hawk have declined greatly in abundance since 1900-1920 in southern New England as the wet woods they prefer have been drained or filled for development. The major factor affecting red-shouldered hawk today is the destruction of nesting habitat.

This species would benefit from clearing forest openings in uplands.

New England Cottontail
Sylvilagus transitionalis

Status: Federal - none;
State – Game (closed season); Rare / uncommon.

Range: Breeds from Aleutian Islands, Alaska, and northern Canada south to New Hampshire, Montana, and California. Winters south to the Gulf Coast. Also breeds in Iceland.

Local Distribution:

Unknown. Suburbanization and forest maturation have restricted populations to small patches of early successional habitat. The state Natural Heritage Program reports several documented occurrences in the Town of Merrimack and adjacent towns.

Habitat: Brushy areas, open woodlands, scrub-shrub swamps, young forests, powerline corridors. Closely spaced patches of dense cover and conifers are frequent components of habitats used by this species.

Survey Method:

Incidental visual observation.

Confirmed locations:

None.

Potentially suitable habitat areas:

Powerline corridor, scrub-shrub wetlands and patchy openings throughout the Horse Hill Nature Preserve.

Management Considerations & Recommendations:

The New England cottontail benefits from habitat management techniques to improve food sources (native warm season grasses and herbs, maple and oak seedlings) and cover (3/4 to 10-acre patches of dense woody understory vegetation).

This species would benefit from clearing forest openings in uplands.

Appendix B.
Natural Heritage Notification Form
Property of the Town of Merrimack
Horse Hill Nature Preserve
Merrimack, NH

Rare Species Occurrence Record

Please fill out this form to report the location of a rare plant or animal species to the New Hampshire Natural Heritage Inventory. Required information is indicated by an asterisk; other items are desirable but not required. Lists of tracked species are available at: www.nhdfi.org/formgt/nhiweb/lists_&_reports_online.htm
Call (603) 271-3623 with any questions. Thank you!

What and When

* Scientific Name:
Common Name: HERON ROOKERY
* Date(s) Observed: 21 SEPT 2004
* Who Observed It: E. Ann Poole, Ecologist, and Danl. Cyr, LPF

Location

Town Name: MERRIMACK
* Map Please attach a copy of a map with the location marked (use an "X" for the probable exact location, and indicate the degree of uncertainty by drawing a line around the entire area that <i>could</i> include the actual site). Ideally, use a USGS topographic map. If you have to hand-sketch the map, be sure to include a north arrow, the scale, and landmarks such as a nearby town, roads, and major water bodies. If you provide GPS coordinates (preferably as latitude & longitude), please tell us the make and model of the unit.
Directions. Write this as if you are telling someone how to get back to the exact site: Everett Turnpike, Exit 11, to Continental Blvd (south). Right on Camp Sargent Rd. Right on Tinker Rd. Straight to Naticook Rd.-Peaslee Rd. From Peaslee Rd., right on to Spaulding Drive. Wetland and heron rookery is straight ahead (nne) approximately 0.2 mile.

Taxonomy

* How did you identify the species? What traits helped you decide that you had seen this species? What similar species did you consider and how did you exclude them? Photos showing key characteristics are welcome. A specimen is usually required to document a new plant population, however, an entire plant should never be collected if there are < 20 plants present. Several very large loosely-constructed nests 25-30 feet off the ground on an island of white pine trees in a 50+ acre wetland.
* Certainty of ID (1=dubious, 5=absolutely positive): 5
If a specimen was collected, collector, collection number, and where the specimen is stored:

Biology

* How many? If there are a few, count them. If there are a lot, estimate (e.g. 50-100)

Five to eight. Possibly more. Hard to determine the exact number from a distance and through foliage.

Plants: how are they distributed, in how large an area? For example: "In a tight clump about 2 feet square" or "Scattered over a 30 x 60 foot area"

Evidence of reproduction? Plants: flowers/fruit/seed. Animals: nests/youngsters... etc.

Nests.

Local surroundings: what do you see when you look around the area? Is it a steep slope or the middle of a swamp? What are the most common plants?

On a small island in a dwarf heath shrub bog variant (Type 5) with a pond-border fen (Type 10b).

Conservation Status (if known):

* Land ownership: name of owner (private) or area (if public). **Unknown**

Phone number of owner (if known):

Does the landowner know that you were on their land and are reporting this finding to NH Heritage? (If not, we will only be able to consider this a "lead" until we can contact the landowner.) **No**

Factors that indicate how secure the occurrence is (e.g. evidence of disturbance / owner is interested in protecting it...)

No evidence of disturbance. Protected by surrounding waterbody. Within view of several nearby homes.

Exemplary Natural Community Reporting Form

Please provide the following information when reporting the location of a natural community to the New Hampshire Natural Heritage Bureau (NHNHB). *Particularly important information is indicated by an asterisk; other items are desirable but not required.* Call (603) 271-3623 with any questions. Thank you!

Location

*Town: MERRIMACK County: HILLSBOROUGH
*Site Name: WHITE PINE SWAMP
*Directions: Everett Turnpike, Exit 11, to Continental Blvd (south). Right on Camp Sargent Rd. Right on Tinker Rd. Straight to Naticook Rd.-Peaslee Rd. From Peaslee Rd., right on to Spaulding Drive. Wetland and heron rookery is straight ahead (nne) approximately 0.2 mile.
*Please attach a map. USGS Quad Name: SOUTH MERRIMACK

Note: A xeroxed portion of a USGS topographic map is **required**, with an outline of the area you actually visited. Optional: add another outline of what you believe to be the full extent of the natural community, beyond the area actually visited.

Identification

*Your ad hoc name (e.g., *Typha* emergent marsh): WHITE PINE SWAMP
NHNHB Community Name: Dwarf heath shrub bog variant with Pond-border fen.
Classification document used (name, date): _____
Other classification (NWI, SAF, etc) : _____
*Broad ecological group (e.g., riparian forest and woodland; coastal marsh):
USFWS National Wetland Inventory - PEM1Fb

*Community Structure

_____ Forest (canopy cover >60%) _____ Herbaceous (herb dom; < 25% woody)
_____ Woodland (canopy cover 25-60%) _____ Nonvascular (lichen, bryophyte, or algae dom.)
_____ Shrubland (<25% trees; >25% shrubs or shrubs the dom. life form) _____ Sparse vege. (substrate-dominated; < 25% vege.)

Cover type: _____ Generally coniferous-dominated
(of upper or dominant stratum) _____ Generally mixed (ca. 25-75% each)
_____ Generally deciduous-dominated

Cover class or %: closed (>75%); high (50-75%); moderate (25-50%); low (5-25); sparse (1-5%); scattered (<1%); absent (0%); if uncertain, use a range (e.g., "moderate to high").

Canopy cover: 0%
Shrub layer cover: 10%
Herb layer cover: 40%
Nonvascular cover: 20%
Bare substrate cover: 0% Substrate type (outcrop, boulder, cobble etc): _____

Open water: 30%

Community Composition

*Dominant canopy species: None

Other common canopy species: _____

Dominant understory species: _____

Dominant shrub layer species: _____

Dominant herb layer species: *Chamaedaphne calyculata* (Leatherleaf)

*Other characteristic species (indicators of distinctive conditions, e.g., high pH soil, elevation, geographic region, other particularly abundant species): _____

Environment

*Topographic position (e.g., ridge crest, toe slope): Broad intervals between bedrock ridges

Geology/rock type: _____

Soil texture or type (peat, muck, sand, silt etc or NRCS name): _____

*Moisture regime

*Flood regime

Hydric _____

Inundated _____

Wet-mesic _____

Seasonally flooded _____

Mesic _____

Temporarily flooded _____

Dry-mesic _____

Saturated _____

Dry (xeric) _____

Other important environmental factors (e.g., steep slope, wind exposure): _____

Quality

*Estimated size of community (contiguous or close together in natural landscape): 50+A

*Confidence in size estimate: High _____ Medium _____ Low _____

Size of surrounding natural landscape (total natural area): 75-100A

*Quality of surrounding landscape (e.g., natural high quality; natural low quality, residential)

Within ¼ mile: Some residential development nearby

Within 1 mile: Moderate residential and commercial development

*Maturity (for forests/woodlands: age &/or DBH of canopy trees; density of large snags/acre; time since last major disturbance): Not applicable

*Evidence or knowledge of human disturbance (logging, old roads, ditches, foot trails):

Residential development along southeast perimeter. Recreational/ATV trails along western edge.

How much has human disturbance impacted the integrity of the natural community?: _____

Exotic species (species, abundance, ecological effect): _____

*Disruption of natural disturbance regime (e.g., fire suppression, flood alteration):

Unknown. Septic systems and human disturbance of sensitive wildlife species are possible.

Other Site Information

Other natural community types present: Heron rookery, beaver dam

Rare species present: Unknown. Evidence of turtles nesting in vicinity.

*Owner/manager of site: Unknown

Current protective designation? (TNC Preserve, State Park, etc.): _____

Documentation

*Name of contributor: E. Ann Poole, Ecologist & Environmental Planner

Describe any additional information or documentation you have for this occurrence/site:

Digital photographs

Others knowledgeable about the community or site: Danl. Cyr, LPF

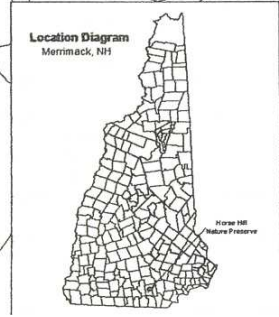
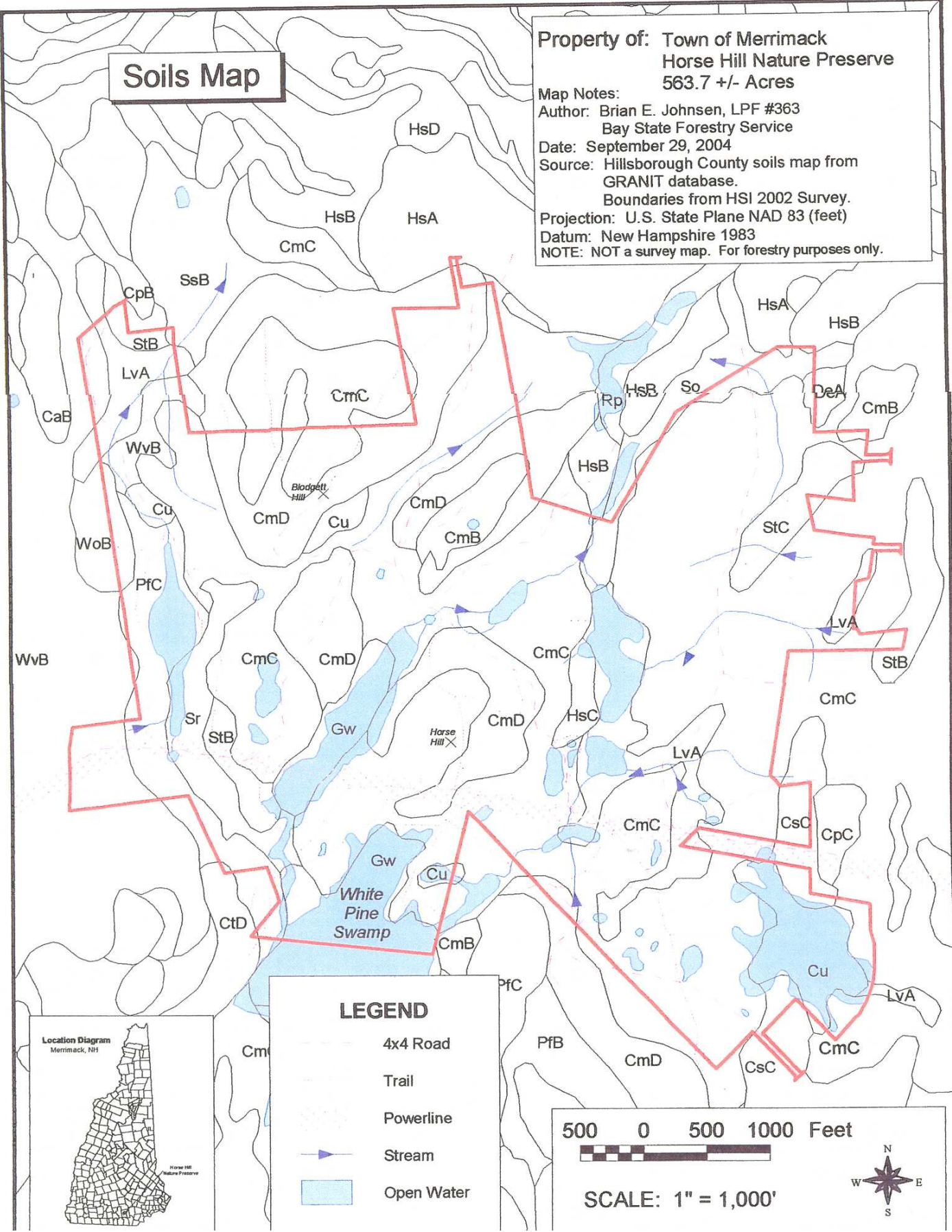
*Date natural community last observed: 21 Sept. 2004

Appendix C.
Soils Map and Descriptions
Property of the Town of Merrimack
Horse Hill Nature Preserve
Merrimack, NH

Soils Map

Property of: Town of Merrimack
 Horse Hill Nature Preserve
 563.7 +/- Acres

Map Notes:
 Author: Brian E. Johnsen, LPF #363
 Bay State Forestry Service
 Date: September 29, 2004
 Source: Hillsborough County soils map from GRANIT database.
 Boundaries from HSI 2002 Survey.
 Projection: U.S. State Plane NAD 83 (feet)
 Datum: New Hampshire 1983
 NOTE: NOT a survey map. For forestry purposes only.



LEGEND

- 4x4 Road
- Trail
- Powerline
- Stream
- Open Water

500 0 500 1000 Feet

SCALE: 1" = 1,000'

Included with this soil in mapping are areas of nearly level and gently sloping Scituate soils, stony Canton soils, and other well drained soils. Included soils make up 15 to 20 percent of the unit.

The permeability of this Canton soil is moderately rapid in the surface layer and subsoil and rapid in the substratum. Available water capacity is moderate. The depth to bedrock is more than 5 feet. The frost-action potential of the soil is low.

Most areas of this soil are used for hay or pasture. A few areas are used for cultivated crops or orchards, and some areas in the cities and suburbs are used for residential development.

This soil is well suited to silage corn, grasses and legumes, and hay and pasture. The soil can be used for row crops continuously if it is tilled on the contour or stripcropped to control erosion and if cover crops and grasses and legumes are used in the cropping system. Droughtiness during the growing season is a limitation for hay and pasture in some years.

This soil is poorly suited to most tree species, and productivity is low.

The soil has few limitations for most types of community development and recreational use, but subsurface stones in some areas interfere with the construction of playgrounds.

The capability subclass is IIe.

CaC—Canton fine sandy loam, 8 to 15 percent slopes. This soil is sloping and well drained. It is on side slopes of hilly uplands. The areas are irregularly shaped and range from 5 to 25 acres.

Typically, the surface layer is dark brown fine sandy loam about 7 inches thick. The subsoil is yellowish brown fine sandy loam 12 inches thick. The substratum is pale brown and light brownish gray gravelly loamy sand to a depth of 60 inches or more.

Included with this soil in mapping are areas of Scituate soils, Chatfield soils, stony Canton soils, and soils with a weak hardpan below a depth of 40 inches. Included soils make up 10 to 15 percent of the unit.

The permeability of this Canton soil is moderately rapid in the surface layer and subsoil and rapid in the substratum. Available water capacity is moderate. The depth to bedrock is more than 5 feet. The frost-action potential of the soil is low.

Most areas of this soil are used for pasture or hay. A few areas are used for cultivated crops or orchards, and areas in the cities and suburbs are used for residential development.

An erosion hazard limits this soil for row crops. Using grasses and legumes in the cropping system, contour farming, stripcropping, and using diversions will help to control erosion in cultivated areas. Adding manure and mixing crop residue into the soil provide additional organic matter to help maintain tilth and conserve moisture. A few stones and cobblestones in some areas interfere with tillage.

This soil is poorly suited to most tree species; productivity is low. Constructing logging roads on the contour helps to control erosion.

Slope is the main limitation of this soil for most types of community development and recreational use.

The capability subclass is IIIe.

CaD—Canton fine sandy loam, 15 to 25 percent slopes. This soil is moderately steep and well drained. It is on side slopes of hilly uplands. The areas are long a narrow and range from 5 to 10 acres.

Typically, the surface layer is dark brown fine sandy loam about 5 inches thick. The subsoil is yellowish brown fine sandy loam 14 inches thick. The substratum is pale brown and light brownish gray gravelly loamy sand to a depth of 60 inches or more.

Included with this soil in mapping are areas of sloping Chatfield soils, Canton soils that have slopes of more than 25 percent or less than 15 percent, stony Canton soils, and other well drained soils. Included soils make up 10 to 15 percent of the unit.

The permeability of this Canton soil is moderately rapid in the surface layer and subsoil and rapid in the substratum. Available water capacity is moderate. The depth to bedrock is more than 5 feet. The frost-action potential of the soil is low.

Most areas of this soil are used for pasture, hay, or apple orchards. Some areas are wooded.

Slope and an erosion hazard limit this soil for row crops, but the soil is suited to hay and pasture. The hazard of erosion makes the use of grasses and legumes necessary in the crop rotation in cultivated areas. Reseeding of hay crops in strips also helps to control erosion. If sodded, the soil is suited to apple orchards, but spot drainage is necessary in places. Subsurface stones in some areas of this soil interfere with tillage.

This soil is poorly suited to most tree species; productivity is low. Slope limits the use of equipment, and the use of logging equipment during wet periods increases the hazard of erosion. Constructing logging roads on the contour helps to control this hazard.

Slope is the main limitation of this soil for most types of community development and recreational use.

The capability subclass is IVe.

CmB—Canton stony fine sandy loam, 3 to 8 percent slopes. This soil is gently sloping and well drained. It is on hilltops and side slopes of wooded uplands. The areas are irregularly shaped and range from 5 to 15 acres. Stones that are 1 to 1-1/2 feet in diameter and 5 to 30 feet apart cover the surface.

Typically, the surface layer is dark brown fine sandy loam about 4 inches thick. The subsoil is yellowish brown fine sandy loam 15 inches thick. The substratum is pale brown and light brownish gray gravelly loamy sand to a depth of 60 inches or more.

Included with this soil in mapping are areas of Scituate soils, Chatfield and Hinckley soils, and other well

drained, stony soils. Included soils make up 10 to 20 percent of the unit.

The permeability of this Canton soil is moderately rapid in the surface layer and subsoil and rapid in the substratum. Available water capacity is moderate. The depth to bedrock is more than 5 feet. The frost-action potential of the soil is low.

Most areas of this soil are wooded. A few areas are used for unimproved pasture. Some areas in the cities and suburbs are used for residential development.

The stones on the surface make this soil unsuited to row crops and limit use for pasture or hay. Areas that are cleared of stones and trees have fair potential for hay and pasture and for apple orchards.

This soil is poorly suited to most tree species; productivity is low.

The stones on the surface are the main limitation of the soil for most types of community development and recreational use.

The capability subclass is VI_s.

CmC—Canton stony fine sandy loam, 8 to 15 percent slopes. This soil is sloping and well drained. It is on side slopes and hills of wooded uplands. The areas are irregularly shaped and range from 5 to 150 acres. Stones that are 1 to 1-1/2 feet in diameter and 5 to 30 feet apart cover the surface.

Typically, the surface layer is dark brown fine sandy loam about 4 inches thick. The subsoil is yellowish brown fine sandy loam 15 inches thick. The substratum is pale brown and light brownish gray gravelly loamy sand to a depth of 60 inches or more.

Included with this soil in mapping are areas of gently sloping Scituate soils, areas of Chatfield soils, and areas of soils with a weak hardpan at a depth of more than 40 inches. Included soils make up 10 to 15 percent of the unit.

The permeability of this Canton soil is moderately rapid in the surface layer and subsoil and rapid in the substratum. Available water capacity is moderate. The depth to bedrock is more than 5 feet. The frost-action potential of the soil is low.

Most areas of this soil are wooded (fig. 3). A few areas are used for unimproved pasture. Some areas in the cities and suburbs are used for residential development.

The stones on the surface make this soil unsuited to row crops and limited for hay or pasture. Areas that are cleared of stones and trees have fair potential for hay and pasture and for apple orchards.

This soil is poorly suited to most tree species; productivity is low.

The stones on the surface and slope are the main limitations of the soil for most types of community development and recreational use.

The capability subclass is VI_s.

CmD—Canton stony fine sandy loam, 15 to 25 percent slopes. This soil is moderately steep and well



Figure 3.—Northern hardwoods on Canton stony fine sandy loam, 8 to 15 percent slopes.

drained. It is on hillsides of wooded uplands. The areas are long and narrow and range from 5 to 35 acres. Stones that are 1 to 1-1/2 feet in diameter and 5 to 30 feet apart cover the surface.

Typically, the surface layer is dark brown fine sandy loam about 4 inches thick. The subsoil is yellowish brown fine sandy loam 15 inches thick. The substratum is pale brown and light brownish gray gravelly loamy sand to a depth of 60 inches or more.

Included with this soil in mapping are areas of Chatfield soils and small areas of sloping and steep stony Canton soils. Included soils make up 10 to 15 percent of the unit.

The permeability of this Canton soil is moderately rapid in the surface layer and subsoil and rapid in the substratum. Available water capacity is moderate. The depth to bedrock is more than 5 feet. The frost-action potential of the soil is low.

Most of the acreage of this soil is wooded. A few areas are used for unimproved pasture.

Slope and the stones on the surface make this soil unsuited to row crops and limited for hay or pasture.

The soil is poorly suited to most tree species; productivity is low. Slope limits equipment operation. Erosion is a hazard if logging equipment is used on

wet periods, but this hazard can be controlled by constructing logging roads on the contour.

Slope is the main limitation of the soil for most types of community development and recreational uses.

The capability subclass is VIs.

CmE—Canton stony fine sandy loam, 25 to 35 percent slopes. This soil is steep and well drained. It is on hillsides of wooded uplands. The areas are long and narrow and range from 5 to 35 acres. Stones that are 1 to 1-1/2 feet in diameter and 5 to 30 feet apart cover the surface.

Typically, the surface layer is dark brown fine sandy loam about 4 inches thick. The subsoil is yellowish brown fine sandy loam 15 inches thick. The substratum is pale brown and light brownish gray gravelly loamy sand to a depth of 60 inches or more.

Included with this soil in mapping are areas of Chatfield soils and small areas of moderately steep, very stony Canton soils. Included soils make up 10 to 15 percent of the unit.

The permeability of this Canton soil is moderately rapid in the surface layer and subsoil and rapid in the substratum. Available water capacity is moderate. The depth to bedrock is more than 5 feet. The frost-action potential of the soil is low.

Slope and the stones on the surface make this soil unsuited to farming. Most areas are wooded, but the soil is poorly suited to most tree species and productivity is low. Slope limits equipment operation. Erosion is a hazard if logging equipment is used during wet periods, but this hazard can be reduced by constructing logging roads on the contour and using diversions and grass cover.

Slope is the major limitation of the soil for most types of community development and recreational use.

The capability subclass is VIIs.

CnC—Canton very stony fine sandy loam, 8 to 15 percent slopes. This soil is sloping and well drained. It is on hills and low mountains. The areas are irregularly shaped and range from 25 to 150 acres. Stones and boulders less than 5 feet apart cover the surface.

Typically, the surface layer is dark brown fine sandy loam about 4 inches thick. The subsoil is yellowish brown fine sandy loam 15 inches thick. The substratum is pale brown and light brownish gray gravelly loamy sand to a depth of 60 inches or more.

Included with this soil in mapping are areas of very stony soils with slopes of 3 to 8 percent and areas of stony Scituate soils in slight depressions and sloping Chatfield soils. Included soils make up 10 to 20 percent of the unit.

The permeability of this Canton soil is moderately rapid in the surface layer and subsoil and rapid in the substratum. Available water capacity is moderate. The depth to bedrock is more than 5 feet. The frost-action potential is low.

Most of the acreage of this soil is wooded. A few areas are used for unimproved pasture.

The stones and boulders on the surface make this soil unsuited to farming. The soil is poorly suited to most tree species, and productivity is low. The stones and boulders limit logging operations. Erosion is a hazard if logging equipment is used during wet periods, but this hazard can be controlled by constructing logging roads on the contour.

The stones and boulders on the surface limit the soil for most types of community development and recreational use.

The capability subclass is VIIs.

CnD—Canton very stony fine sandy loam, 15 to 35 percent slopes. This soil is moderately steep to steep and is well drained. It is on hills and low mountains. The areas are irregularly shaped and range from 25 to 150 acres. Stones and boulders are less than 5 feet apart on the surface.

Typically, the surface layer is dark brown fine sandy loam about 4 inches thick. The subsoil is yellowish brown fine sandy loam 15 inches thick. The substratum is pale brown and light brownish gray gravelly loamy sand to a depth of 60 inches or more.

Included with this soil in mapping are areas of sloping Scituate soils, moderately steep Chatfield soils, and soils with slopes of more than 35 percent. Included soils make up 10 to 20 percent of the unit.

The permeability of this Canton soil is moderately rapid in the surface layer and subsoil and rapid in the substratum. Available water capacity is moderate. The depth to bedrock is more than 5 feet. The frost-action potential of the soil is low.

The stones and boulders on the surface and the slope make this soil unsuitable for farming. Most areas are wooded, but the soil is poorly suited to most tree species and productivity is low. The stones and boulders and slope are limitations for logging operations. Erosion is a hazard if logging equipment is used during wet periods, but this hazard can be reduced by constructing logging roads on the contour.

The stones and boulders and slope also limit the soil for most types of community development and recreational use.

The capability subclass is VIIs.

CoC—Canton-Urban land complex, 3 to 15 percent slopes. This complex consists of gently sloping to sloping Canton soils and urbanized areas. It is in upland areas on the west side of Nashua and on both sides of the Merrimack River valley in Manchester and Goffstown. The areas are irregularly shaped and range from 25 to 300 acres. They are about 50 percent Canton soils, 35 percent urbanized, and 15 percent included soils. The Canton soils and urbanized areas are so intermingled that it was not practical to map them separately.

The depth to bedrock makes the soils in this complex better suited to grasses and legumes than to row crops. Irrigation helps to increase the suitability for crops. The hazard of erosion can be lessened by using diversions and by controlling runoff with stripcropping or contour farming.

This complex is suitable for a variety of trees, and productivity is moderate. There are few limitations for most types of forest management or logging operations. Constructing logging roads on the contour helps to control erosion.

The depth to bedrock in the Chatfield and Hollis soils and the slope are the main limitations of the complex for most types of community development and for some recreational uses.

The capability subclass is IVe.

CpD—Chatfield-Hollis-Canton complex, 15 to 25 percent slopes. This complex consists of moderately steep soils in such an intricate pattern that it was not practical to map them separately. The complex is about 35 percent well drained, moderately deep Chatfield soils; 30 percent somewhat excessively drained, shallow Hollis soils; 25 percent well drained, deep Canton soils; and 10 percent other soils. The complex is generally on the sides of hills and ridges. The areas are irregularly shaped and range from 10 to 50 acres.

Typically, the surface layer of the Chatfield soils is dominantly very dark grayish brown fine sandy loam 4 inches thick. The subsoil is yellowish brown sandy loam 20 inches thick. Slightly weathered granite bedrock is at a depth of 24 inches.

Typically, the surface layer of the Hollis soils is dark brown fine sandy loam 4 inches thick. The subsoil is yellowish brown fine sandy loam 15 inches thick. Unweathered granite bedrock is at a depth of 19 inches.

Typically, the surface layer of the Canton soils is dark brown fine sandy loam about 4 inches thick. The subsoil is yellowish brown fine sandy loam 15 inches thick. The substratum is pale brown and light brownish gray gravelly loamy sand to a depth of 60 inches or more.

Included with this complex in mapping are small areas of moderately steep Paxton soils; exposed bedrock; and moderately steep, very shallow soils.

These Chatfield soils have moderate or moderately rapid permeability and low available water capacity. The depth to bedrock is 20 to 40 inches.

The Hollis soils have moderate or moderately rapid permeability and very low available water capacity. The depth to bedrock is 10 to 20 inches.

The Canton soils have moderately rapid permeability in the surface layer and subsoil and rapid permeability in the substratum. Available water capacity is moderate. The depth to bedrock is generally more than 5 feet.

Slope and the depth to bedrock make the soils of this complex unsuitable for cultivated crops and limited for hay and pasture.

Most areas are wooded, and the complex is suitable for a variety of trees. Productivity is moderate. Slope

limits equipment operation. Constructing logging roads on the contour helps to control erosion.

The depth to bedrock in the Chatfield and Hollis soils and slope limit this complex for most types of community development and some recreational uses.

The capability subclass is VIe.

CsB—Chatfield-Hollis complex, 3 to 8 percent slopes. This complex consists of gently sloping soils in such an intricate pattern that it was not practical to map them separately. The complex is about 45 percent well drained, moderately deep Chatfield soils; 40 percent somewhat excessively drained, shallow Hollis soils; and 15 percent other soils. The complex is generally on the tops of hills and ridges. The areas are irregularly shaped and range from 10 to 50 acres.

Typically, the surface layer of the Chatfield soils is dominantly very dark grayish brown fine sandy loam 4 inches thick. The subsoil is yellowish brown sandy loam 20 inches thick. Slightly weathered granite bedrock is at a depth of 24 inches.

Typically, the surface layer of the Hollis soils is dark brown fine sandy loam 4 inches thick. The subsoil is yellowish brown fine sandy loam 15 inches thick. Unweathered granite bedrock is at a depth of 19 inches.

Included with this complex in mapping are small areas of gently sloping Canton and Paxton soils, isolated spots of wet soils in depressions, spots of exposed bedrock, and small areas of soils that are very shallow to bedrock.

These Chatfield and Hollis soils have moderate or moderately rapid permeability. Available water capacity is low in the Chatfield soils and very low in the Hollis soils. The depth to bedrock is 20 to 40 inches in the Chatfield soils and 10 to 20 inches in the Hollis soils.

The depth to bedrock and low available water capacity make these soils unsuitable for farming. Most areas are wooded, and the complex is suitable for a variety of trees. Productivity is moderate. A high rate of seedling mortality and a hazard of uprooting during windy periods are the main woodland management concerns.

The depth to bedrock is the main limitation of these soils for most types of community development.

The capability subclass is IIIe.

CsC—Chatfield-Hollis complex, 8 to 15 percent slopes. This complex consists of sloping soils in such an intricate pattern that it was not practical to map them separately. The complex is about 45 percent well drained, moderately deep Chatfield soils; 40 percent somewhat excessively drained, shallow Hollis soils; and 15 percent other soils. The complex is generally on the tops and sides of hills and ridges. The areas are irregularly shaped and range from 10 to 50 acres.

Typically, the surface layer of the Chatfield soils is dominantly very dark grayish brown fine sandy loam 4 inches thick. The subsoil is yellowish brown sandy loam 20 inches thick. Slightly weathered granite bedrock is at a depth of 24 inches.

Typically, the surface layer of the Hollis soils is dark brown fine sandy loam 4 inches thick. The subsoil is yellowish brown fine sandy loam 15 inches thick. Unweathered granite bedrock is at a depth of 19 inches. Included with this complex in mapping are small areas of gently sloping Canton and Paxton soils, isolated spots of wet soils in depressions, spots of exposed bedrock, and small areas of very shallow soils.

These Chatfield and Hollis soils have moderate or moderately rapid permeability. Available water capacity is low in the Chatfield soils and very low in the Hollis soils. The depth to bedrock is 20 to 40 inches in the Chatfield soils and 10 to 20 inches in the Hollis soils.

The depth to bedrock and low available water capacity make these soils unsuitable for farming. Most areas are wooded, and the soils are suitable for a variety of trees. Productivity is moderate. Constructing logging roads on the contour helps to control erosion. A high rate of seedling mortality and a hazard of uprooting during windy periods are the main woodland management concerns.

The depth to bedrock and the slope limit these soils for most types of community development and recreational use.

The capability subclass is IVE.

CtD—Chatfield-Hollis-Rock outcrop complex, 15 to 35 percent slopes. This complex consists of moderately steep to steep soils and areas of exposed bedrock in such an intricate pattern that it was not practical to map them separately. The complex is about 35 percent well drained, moderately deep Chatfield soils; 30 percent somewhat excessively drained, shallow Hollis soils; 20 percent exposed bedrock; and 15 percent other soils. The complex is generally on the sides of hills and ridges. The areas are irregularly shaped and range from 10 to 50 acres.

Typically, the surface layer of the Chatfield soils is dominantly very dark grayish brown fine sandy loam 4 inches thick. The subsoil is yellowish brown sandy loam 20 inches thick. Slightly weathered granite bedrock is at a depth of 24 inches.

Typically, the surface layer of the Hollis soils is dark brown fine sandy loam 4 inches thick. The subsoil is yellowish brown fine sandy loam 15 inches thick. Unweathered granite bedrock is at a depth of 19 inches.

Included with this complex in mapping are small areas of moderately steep Canton and Paxton soils, isolated spots of wet soils in depressions, and areas of very shallow soils.

These Chatfield and Hollis soils have moderate or moderately rapid permeability. Available water capacity is low in the Chatfield soils and very low in the Hollis soils. The depth to bedrock is 20 to 40 inches in the Chatfield soils and 10 to 20 inches in the Hollis soils.

The areas of exposed rock and the slope make this complex unsuitable for farming. Most areas are wooded, but the complex is poorly suited to most tree species. Productivity is low. Slope and the areas of exposed rock limit the use of equipment.

Slope, the depth to bedrock, and the areas of exposed bedrock limit the complex for most types of community development and recreational use.

The capability subclass is VIIc.

Cu—Chocorua mucky peat. This soil is nearly level and very poorly drained. It is in depressions on terraces, plains, uplands, and flood plains. The areas are irregularly shaped and range from 10 to 50 acres.

Typically, this soil consists of black, partly decayed organic material to a depth of 22 inches. Between depths of 22 and 33 inches, the soil is dark yellowish brown and olive gray gravelly loamy sand and gravelly sandy loam. From 33 inches to a depth of 60 inches or more, the soil is light brownish gray coarse sand and loamy sand.

Included with this soil in mapping are areas of very poorly drained Scarboro and Greenwood soils and areas of Borochemists, nearly level, and Borochemists, ponded. Also included are a few areas where the soil underlying the organic deposits is loam or sandy loam. Included soils make up 10 to 15 percent of the unit.

The permeability of this Chocorua soil is moderate in the organic material and rapid in the mineral layers. Available water capacity is high. The depth to bedrock is more than 5 feet. The water table is between the surface and a depth of 6 inches year-around, and water is ponded on the surface of some areas. The frost-action potential of the soil is high.

Most areas of this soil are in open bogs or are wooded. Red maple and small shrubs such as highbush blueberries are the common types of vegetation. The water table and poor stability make the soil unsuitable for most uses other than as wetland wildlife habitat.

The capability subclass is VIIIw.

DeA—Deerfield loamy fine sand, 0 to 3 percent slopes. This soil is nearly level and moderately well drained. It is in slight depressions on terraces and outwash plains. The areas are irregularly shaped and range from 10 to 100 acres.

Typically, the surface layer is very dark grayish brown loamy fine sand 9 inches thick. The subsoil is yellowish brown loamy fine sand 11 inches thick. The substratum is mottled and extends to a depth of 60 inches or more. The upper part of the subsoil is yellowish brown loamy sand, and the lower part is pale brown and light brownish gray sand.

Included with this soil in mapping are areas of soil with gravel in the substratum and small areas of Pipestone and Saugatuck soils in depressions. Included soils make up 10 to 15 percent of the unit.

The permeability of this Deerfield soil is rapid in the surface layer and subsoil and very rapid in the substratum. Available water capacity is low. The depth to bedrock is more than 5 feet. A seasonal high water table is at a depth of 1-1/2 to 3 feet from December to April. The frost-action potential of the soil is moderate.

Most areas of this soil are in woodland. A few areas are used for hay or residential development.

Seasonal wetness in undrained areas restricts the choice of crops on this soil and delays cultivation in the spring. Drained areas can be used for row crops continuously, but irrigation is needed during dry periods. Adding manure and mixing crop residue into the soil help to maintain the organic matter content.

This soil is suited to some tree species, and productivity is moderate. There are few limitations for most types of forest management and logging operations.

The seasonal high water table is the main limitation of the soil for community development and recreational use.

The capability subclass is IIIw.

DeB—Deerfield loamy fine sand, 3 to 8 percent slopes. This soil is gently sloping and moderately well drained. It is in slight depressions on terraces and outwash plains. The areas are irregularly shaped and range from 10 to 30 acres.

Typically, the surface layer is very dark grayish brown loamy fine sand 9 inches thick. The subsoil is yellowish brown loamy fine sand 11 inches thick. The substratum is mottled and extends to a depth of 60 inches or more. The upper part of the substratum is yellowish brown loamy sand, and the lower part is pale brown and light brownish gray sand.

Included with this soil in mapping are areas of soil with gravel in the substratum and small areas of Pipestone and Saugatuck soils in depressions. Included soils make up 10 to 15 percent of the unit.

The permeability of this Deerfield soil is rapid in the surface layer and subsoil and very rapid in the substratum. Available water capacity is low. The depth to bedrock is more than 5 feet. A seasonal high water table is at a depth of 1-1/2 to 3 feet from December to April. The frost-action potential of the soil is moderate.

Most of the acreage of this soil is in woodland. A few areas are used for hay or residential development.

Seasonal wetness in undrained areas restricts the choice of crops on this soil and delays cultivation in the spring. Drained areas can be used for row crops continuously, but irrigation is needed during dry periods. Adding manure and mixing crop residue into the soil help to maintain the organic matter content.

This soil is suited to some tree species, and productivity is moderate. There are few limitations for most types of forest management or logging operations.

The seasonal high water table is the main limitation of this soil for community development and recreational use.

The capability subclass is IIIw.

Dp—Dumps. These areas are or have been used for residential and industrial waste disposal. The areas are irregular in shape and range from 3 to 35 acres.

Included with this unit in mapping are small areas of Udipsamments, nearly level, and Hinckley and Windsor soils. Also included are small gravel pits. Included areas make up 5 to 10 percent of the unit.

Some areas of this unit have been reclaimed and used for parks, playgrounds, or building sites. However, the variable properties of the unit make onsite investigation necessary to determine the potentials and limitations of these areas for most uses.

This unit is not assigned to a capability subclass.

Gw—Greenwood mucky peat. This soil is nearly level and very poorly drained. It is in depressions on outwash terraces, outwash plains, and uplands. The areas are irregularly shaped and range from 10 to 400 acres.

Typically, this soil is very dusky red or dark reddish brown, partly decayed organic material to a depth of 60 inches or more.

Included with this soil in mapping are areas of very poorly drained Chocorua soils; Borohemists, ponded; and Borohemists, nearly level. Included soils make up 5 to 10 percent of the unit.

The permeability of this Greenwood soil is moderate, and available water capacity is high. The depth to bedrock is more than 5 feet. A high water table is between the surface and a depth of 1 foot most of the time between September and June, and water is ponded on some areas during that period. The frost-action potential of the soil is high.

Most of the acreage of this soil is wooded. Some areas are in open bogs. Unless fill material is used, the high water table and instability make the soil unsuitable for most uses other than as wetland wildlife habitat.

The capability subclass is VIIIw.

HsA—Hinckley loamy sand, 0 to 3 percent slopes. This soil is nearly level and excessively drained. It is on terraces and outwash plains. The areas are irregularly shaped and range from 10 to 150 acres.

Typically, the surface layer is very dark brown loamy sand 3 inches thick. The subsoil is yellowish brown gravelly loamy sand 18 inches thick. The substratum extends to a depth of 60 inches or more. The upper part of the substratum is pale brown gravelly coarse sand, and the lower part is brownish yellow very gravelly coarse sand.

Included with this soil in mapping are areas of Deerfield soils, Windsor soils, and soils with stones 1 to 1-1/2 feet in diameter and 5 to 30 feet apart on the surface. Included soils make up 10 to 15 percent of the unit.

The permeability of this Hinckley soil is rapid in the surface layer and subsoil and very rapid in the substratum. Available water capacity is very low. The depth to bedrock is more than 5 feet.

Most areas of this soil are wooded. Some areas in the cities and suburbs are used for residential and industrial development.

This soil has limited suitability for farming; irrigation and heavy applications of fertilizer are needed for most crops. Adding manure and mixing crop residue into the soil help to maintain the organic matter content.

This soil is suited to drought-tolerant tree species, but productivity is low. Droughtiness causes a high rate of seedling mortality.

The rapid permeability is the main limitation of the soil for community development. It causes a hazard of ground-water contamination in areas used for septic tank absorption fields. Droughtiness limits the soil as a site for lawns. Some areas of this Hinckley soil are a good source of gravel.

The capability subclass is IIIs.

HsB—Hinckley loamy sand, 3 to 8 percent slopes.

This soil is gently sloping and excessively drained. It is on terraces and outwash plains. The areas are irregularly shaped and range from 10 to 150 acres.

Typically, the surface layer is very dark brown loamy sand 3 inches thick. The subsoil is yellowish brown gravelly loamy sand 18 inches thick. The substratum extends to a depth of 60 inches or more. The upper part of the substratum is pale brown gravelly coarse sand, and the lower part is brownish yellow very gravelly coarse sand.

Included with this soil in mapping are areas of Deerfield soils, Windsor soils, and soils with stones 1 to 1-1/2 feet in diameter and 5 to 30 feet apart on the surface. Included soils make up 10 to 15 percent of the unit.

The permeability of this Hinckley soil is rapid in the surface layer and subsoil and very rapid in the substratum. Available water capacity is very low. The depth to bedrock is more than 5 feet.

Most areas of this soil are wooded. Some areas in the cities and suburbs are used for residential or industrial development.

This soil has limited suitability for farming; irrigation and heavy applications of fertilizer are needed for most crops. Adding manure and mixing crop residue into the soil help to maintain the organic matter content.

This soil is suited to drought-tolerant tree species, but productivity is low. Droughtiness causes a high rate of seedling mortality.

The rapid permeability is the main limitation of the soil for community development. It causes a hazard of ground-water contamination in areas used for septic tank absorption fields. Droughtiness limits the soil as a site for lawns. Some areas of this Hinckley soil are a good source of gravel.

The capability subclass is IIIs.

HsC—Hinckley loamy sand, 8 to 15 percent slopes.

This soil is sloping and excessively drained. It is on terraces and outwash plains. The areas are irregularly shaped and range from 5 to 75 acres.

Typically, the surface layer is very dark brown loamy sand 3 inches thick. The subsoil is yellowish brown

gravelly loamy sand 18 inches thick. The substratum extends to a depth of 60 inches or more. The upper part of the substratum is pale brown gravelly coarse sand, and the lower part is brownish yellow very gravelly coarse sand.

Included with this soil in mapping are areas of sloping Windsor soils and small areas with stones on the surface. Included soils make up 10 to 15 percent of the unit.

The permeability of this Hinckley soil is rapid in the surface layer and subsoil and very rapid in the substratum. Available water capacity is very low. The depth to bedrock is more than 5 feet.

Most areas of this soil are wooded. Some areas in the cities and suburbs are used for residential development.

This soil is better suited to drought-resistant grasses and legumes than to row crops. Irrigation is needed for most row crops and for the establishment and maintenance of a grass cover. The hazard of erosion is moderate. Using grasses and legumes, stripcropping, and using cover crops keep soil losses to a minimum. Fertilizer is quickly leached through this soil and needs to be reapplied frequently.

This soil is best suited to drought-tolerant tree species, but productivity is low; droughtiness causes a high rate of seedling mortality. There are few limitations for most types of forest management or logging operations.

Slope limits this soil for some types of community development and recreational use. The rapid permeability causes a hazard of ground-water contamination in areas used for septic tank absorption fields. Establishing lawn grasses is difficult because of droughtiness. This soil is a good source of gravel.

Slope is a limitation for most recreational uses.

Capability class IVs.

HsD—Hinckley loamy sand, 15 to 35 percent slopes.

This soil is moderately steep to steep and is excessively drained. It is on terrace escarpments, eskers, and kames. The areas are long and narrow or irregularly shaped and range from 10 to 40 acres.

Typically, the surface layer is very dark brown loamy sand 3 inches thick. The subsoil is yellowish brown gravelly loamy sand 18 inches thick. The substratum extends to a depth of 60 inches or more. The upper part of the substratum is pale brown gravelly coarse sand, and the lower part is brownish yellow very gravelly coarse sand.

Included with this soil in mapping are areas of moderately steep to steep Windsor soils and small areas that have stones on the surface. Included soils make up 10 to 15 percent of the unit.

The permeability of this Hinckley soil is rapid in the surface layer and subsoil and very rapid in the substratum. Available water capacity is very low. The depth to bedrock is more than 5 feet.

Droughtiness and slope make this soil unsuitable for farming. Nearly all areas of this soil are wooded, and the

These Walpole soils have moderately rapid permeability in the surface layer and subsoil and rapid permeability in the substratum. Available water capacity is moderate. The depth to bedrock is more than 5 feet. A seasonal high water table is between the surface and a depth of 1 foot from November to April. The frost-action potential of the Walpole soils is high.

Most areas of this complex are used for pasture. The seasonal high water table in the soils makes them unsuitable for row crops; the choice of crops is restricted, and cultivation is delayed in the spring. Using tile drains or open ditches makes the soils suitable for moisture-tolerant varieties of grasses and legumes.

The soils are suited to a variety of trees, mainly water-tolerant species such as red maple. Productivity is moderate. The seasonal high water table limits some forest management practices and logging operations.

The high water table and frost-action potential limit these soils for community development and recreational use.

The capability subclass is IVw.

LtB—Leicester-Walpole complex, 3 to 8 percent slopes. This complex consists of gently sloping, poorly drained soils in such an intricate pattern that it was not practical to map them separately. The complex is about 40 percent Leicester soils, 35 percent Walpole soils, and 25 percent other soils. The complex is generally in depressions in hilly uplands. The areas are irregularly shaped or long and narrow and range from 3 to 10 acres.

Typically, the surface layer of the Leicester soils is very dark grayish brown loam about 9 inches thick. The subsoil is mottled, grayish brown fine sandy loam 13 inches thick. The substratum extends to a depth of 60 inches or more. It is mottled, light brownish gray sandy loam in the upper part and light gray gravelly sandy loam in the lower part.

Typically, the surface layer of the Walpole soils is very dark gray sandy loam about 5 inches thick. The subsoil is mottled, dark grayish brown sandy loam 13 inches thick. The substratum is mottled and extends to a depth of 60 inches or more. The upper part of the substratum is pale brown sand, and the lower part is light yellowish brown gravelly sand.

Included with this complex in the mapping are areas of Ridgebury, Pipestone, and Saugatuck soils and stony Scarboro soils.

These Leicester soils have moderate or moderately rapid permeability and moderate available water capacity. The depth to bedrock is more than 5 feet. A seasonal high water table is between the surface and a depth of 1-1/2 feet from November to May. The frost-action potential of the Leicester soils is high.

These Walpole soils have moderately rapid permeability in the surface layer and subsoil and rapid permeability in the substratum. Available water capacity is moderate. The depth to bedrock is more than 5 feet. A

seasonal high water table is between the surface and a depth of 1 foot from November to April. The frost-action potential of the Walpole soils is high.

Most of this complex is used for pasture. The seasonal high water table in the soils makes them unsuitable for row crops; the choice of crops is restricted, and cultivation is delayed in the spring. Tile drains or open ditches make the soils suitable for moisture-tolerant varieties of grasses and legumes.

The soils are suited to a variety of trees, mainly water-tolerant species such as red maple. Productivity is moderate. The high water table limits some forest management practices and logging operations.

The high water table and frost-action potential limit the soils for community development and recreational use.

The capability subclass is IVw.

LvA—Leicester-Walpole complex stony, 0 to 3 percent slopes. This complex consists of nearly level, poorly drained soils in such an intricate pattern that it was not practical to map them separately. The complex is about 40 percent Leicester soils, 35 percent Walpole soils, and 25 percent other soils. The complex is generally in depressions in hilly uplands. The areas are irregularly shaped or long and narrow and range from 3 to 10 acres. Stones 1 to 1-1/2 feet in diameter and 5 to 30 feet apart cover the surface.

Typically, the surface layer of the Leicester soils is very dark grayish brown loam about 6 inches thick. The subsoil is mottled, grayish brown fine sandy loam 16 inches thick. The substratum extends to a depth of 60 inches or more. It is mottled, light brownish gray sandy loam in the upper part and light gray gravelly sandy loam in the lower part.

Typically, the surface of the Walpole soils is very dark gray sandy loam about 5 inches thick. The subsoil is mottled, dark grayish brown sandy loam 13 inches thick. The substratum is mottled and extends to a depth of 60 inches or more. The upper part of the substratum is pale brown sand, and the lower part is light yellowish brown gravelly sand.

Included with this complex in mapping are areas of Ridgebury, Pipestone, and Saugatuck soils and stony Scarboro soils.

These Leicester soils have moderate or moderately rapid permeability and moderate available water capacity. The depth to bedrock is more than 5 feet. A seasonal high water table is between the surface and a depth of 1-1/2 feet from November to May. The frost-action potential of the Leicester soils is high.

These Walpole soils have moderately rapid permeability in the surface layer and subsoil and rapid permeability in the substratum. Available water capacity is moderate. The depth to bedrock is more than 5 feet. A seasonal high water table is between the surface and a depth of 1 foot from November to April. The frost-action potential of the Walpole soils is high.

Most areas of these soils are in woodland. A few areas are used for unimproved pasture.

The permeability of this Paxton soil is moderate in the surface layer and subsoil and slow in the hardpan. Available water capacity is moderate. The dense hardpan is at a depth of 15 to 36 inches and limits the rooting depth of plants. A seasonal high water table is perched on the hardpan from February to March, and some areas have seep spots. The depth to bedrock is generally more than 5 feet. The frost-action potential of the soil is moderate.

Most of the acreage of this soil is used for pasture or hay. Some areas are in woodland.

Slope and a severe erosion hazard make this soil poorly suited to row crops and limited for hay and pasture. Stripcropping and using grasses and legumes in the cropping system help to control erosion.

This soil is well suited to most tree species, and productivity is high, but slope limits equipment operation. Operating logging equipment during wet periods increases the hazard of erosion. Constructing logging roads on the contour helps to control erosion.

Slope is the major limitation of the soil for community development and recreational use.

The capability subclass is IVE.

PfB—Paxton stony fine sandy loam, 3 to 8 percent slopes. This soil is gently sloping and well drained. It is on hillcrests and at the base of slopes of hilly uplands. Many of the hills, called drumlins, are smooth sided and oval. The areas of the soil are long and narrow and range from 5 to 50 acres. Stones 1 to 1-1/2 feet in diameter and 5 to 30 feet apart cover the surface.

Typically, the surface layer is dark brown fine sandy loam about 5 inches thick. The subsoil is yellowish brown and light yellowish brown fine sandy loam 19 inches thick. The substratum is a dense hardpan of olive fine sandy loam that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of nearly level to gently sloping Woodbridge and Ridgebury soils and gently sloping Chatfield soils. Also included are areas of very stony soils. Included soils make up 20 to 25 percent of the unit.

The permeability of this Paxton soil is moderate in the surface layer and subsoil and slow in the hardpan. Available water capacity is moderate. The dense hardpan is at a depth of 15 to 36 inches and limits the rooting depth of plants. A seasonal high water table is perched on the hardpan from February to March, and some areas have seep spots. The depth to bedrock is more than 5 feet. The frost-action potential of the soil is moderate.

Most of the acreage of this soil is in woodland. A few areas are used as unimproved pasture, and some areas near Manchester and Nashua are used for residential development.

The stones on the surface make this soil unsuitable for row crops and limited for hay and pasture. The stones especially interfere with cultivation.

This soil is well suited to most tree species, and productivity is moderately high. The hazard of erosion is increased if logging equipment is used during wet periods, but erosion can be controlled by constructing logging roads on the contour.

The stones on the surface, the moderate frost-action potential, and seasonal wetness limit the soil for most types of community development. The slow permeability of the hardpan is an additional limitation for septic tank absorption fields. The stones and slow permeability also limit most types of recreational use.

The capability subclass is VIs.

PfC—Paxton stony fine sandy loam, 8 to 15 percent slopes. This soil is sloping and well drained. It is on hilltops and side slopes of uplands. Many of the hills, called drumlins, are smooth sided and oval. The areas of the soil are long and narrow and range from 5 to 30 acres. Stones 1 to 1-1/2 feet in diameter and 5 to 30 feet apart cover the surface.

Typically, the surface layer is dark brown fine sandy loam about 5 inches thick. The subsoil is yellowish brown and light yellowish brown fine sandy loam 19 inches thick. The substratum is a dense hardpan of olive fine sandy loam that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Woodbridge, Montauk, and Chatfield soils. Also included are small areas of very stony Paxton soils. Included soils make up 20 to 25 percent of the unit.

The permeability of this Paxton soil is moderate in the surface layer and subsoil and slow in the hardpan. Available water capacity is moderate. The dense hardpan is at a depth of 15 to 36 inches and limits the rooting depth of plants. A seasonal high water table is perched on the hardpan from February to March, and some areas have seep spots. The depth to bedrock is greater than 5 feet. The frost-action potential of the soil is moderate.

Most of the acreage of this soil is in woodland. A few areas are used as unimproved pasture, and some areas near Manchester and Nashua are used for residential development.

The stones on the surface make this soil unsuitable for row crops and limited for pasture and hay. The stones especially interfere with cultivation.

This soil is well suited to most tree species, and productivity is moderately high. The hazard of erosion is increased if logging equipment is used during wet periods, but erosion can be controlled by constructing logging roads on the contour.

The stones on the surface, the moderate frost-action potential, slope, and seasonal wetness limit the soil for most types of community development. The slow permeability of the hardpan is an additional limitation for septic tank absorption fields. The stones and slope limit most types of recreational use.

The capability subclass is VIs.

Most areas of this soil are wooded, and the soil is suited to trees, mostly water-tolerant species such as red maple. Productivity is moderate. The seasonal high water table limits forest management and logging operations.

The seasonal high water table, the slow permeability in the hardpan, and the high frost-action potential limit this soil for most types of community development and recreational use.

The capability subclass is VIIc.

Rp—Rippowam fine sandy loam. This soil is nearly level and poorly drained. It is in depressions on flood plains. The areas are long and narrow and range from 5 to 10 acres.

Typically, the surface layer is very dark grayish brown fine sandy loam 6 inches thick. The subsoil is mottled, dark grayish brown and grayish brown fine sandy loam 27 inches thick. The substratum extends to a depth of 60 inches or more. It is mottled, olive gray sand in the upper part and dark gray sand in the lower part.

Included with this soil in mapping are small areas of Pootatuck and Saco Variant soils that make up about 10 percent of the unit.

The permeability of this Rippowam soil is moderate or moderately rapid in the surface layer and subsoil and rapid in the substratum. Available water capacity is moderate. The depth to bedrock is more than 5 feet. This soil is subject to frequent flooding from November to April and has a high water table between the surface and a depth of 18 inches during the same period. The frost-action potential of the soil is high.

Most areas of this soil are in woodland. A few areas are used for hay or pasture.

The seasonal high water table and frequent flooding make this soil unsuitable for truck crops or row crops. If adequately drained, the soil is suitable for some varieties of hay and pasture; open ditches are commonly used. A permanent strip of sod or trees along streams reduces the hazard of streambank erosion.

This soil is suited to water-tolerant tree species, and productivity is moderate. The seasonal high water table limits most types of forest management and logging operations.

The seasonal high water table and frequent flooding limit this soil for community development and recreational use.

The capability subclass is IIIw.

Sm—Saco Variant silt loam. This soil is nearly level and very poorly drained. It is on flood plains in depressions and old oxbows. The areas are long and narrow and range from 3 to 15 acres.

Typically, the surface layer is mottled, very dark gray silt loam about 10 inches thick. The substratum extends to a depth of 60 inches or more. It is dark gray and gray silt loam in the upper part and dark gray sand in the lower part.

Included with this soil in mapping are small areas of Rippowam and Pootatuck soils on the higher parts of the landscape. Included soils make up about 10 percent of the unit.

The permeability of this Saco Variant soil is moderate in the surface layer and rapid in the substratum. Available water capacity is high. The depth to bedrock is more than 5 feet. This soil is subject to frequent flooding from November to May and has a high water table between the surface and a depth of 6 inches from October to May. The frost-action potential of the soil is high.

Some areas of this soil are wooded, but the frequent flooding and seasonal high water table limit the soil for most uses other than wetland wildlife habitat.

The capability subclass is VIw.

Sn—Saugatuck loamy sand. This soil is nearly level and poorly drained. It is in depressions on terraces and outwash plains. The areas are irregularly shaped and range from 5 to 150 acres.

Typically, the surface layer is grayish brown loamy sand about 7 inches thick. The subsoil is 30 inches thick. The upper part of the subsoil is mottled, dark reddish gray loamy sand, and the lower part is strongly cemented, very dark grayish brown and yellowish red gravelly sand. The substratum is yellowish brown gravel coarse sand to a depth of 60 inches or more.

Included with this soil in mapping are areas of Pipestone and Scarboro soils that make up 10 to 15 percent of the unit.

The permeability of this Saugatuck soil mainly is rapid but is slow in the strongly cemented part of the subsoil. Available water capacity is very low. The depth to bedrock is more than 5 feet. A perched high water table is between the surface and a depth of 2 feet from December to June, and some areas have water on the surface during that period. The frost-action potential of the soil is moderate.

The seasonal high water table makes this soil generally unsuited to row crops. Using tile drains or open ditches makes the soil suitable for moisture-tolerant grasses and legumes.

Most areas of this soil are wooded, but the soil is poorly suited to most tree species and productivity is low. The seasonal high water table limits forest management and logging operations.

The high water table also limits the soil for community development and recreational use.

The capability subclass is Vw.

So—Scarboro mucky loamy sand. This soil is nearly level and very poorly drained. It is in depressions on terraces and outwash plains. The areas are irregularly shaped and range from 3 to 35 acres.

Typically, the surface layer is black mucky loamy sand 9 inches thick. The substratum is mottled, gray and olive gray sand to a depth of 60 inches or more. It has layers of coarse sand in the lower part.

Included with this soil in mapping are areas of very poorly drained Chocorua soils and poorly drained Pipestone and Saugatuck soils. Included soils make up about 10 percent of the unit.

The permeability of this Scarboro soil is rapid, and available water capacity is low. The depth to bedrock is more than 5 feet. A year-round high water table is between the surface and a depth of 1 foot, and some areas have water in the surface. The frost-action potential of the soil is high.

The high water table makes this soil generally unsuited to farming. The use of tile drains or open ditches makes the soil suitable for moisture-tolerant grasses and legumes.

Most areas of this soil are wooded, but the soil is poorly suited to most tree species and productivity is low. The high water table limits forest management and logging operations.

The high water table also limits the soil for community development and recreational use.

The capability subclass is Vw.

Sr—Scarboro stony mucky loamy sand. This soil is nearly level and very poorly drained. It mainly is in depressions on uplands. The areas are long and narrow and range from 3 to 15 acres. Stones 1 to 1-1/2 feet in diameter and 5 to 30 feet apart cover the surface.

Typically, the surface layer is black mucky loamy sand about 5 inches thick. The substratum is mottled, gray and olive gray sand to a depth of 60 inches or more.

Included with this soil in mapping are areas of poorly drained Ridgebury soils, areas of very poorly drained Chocorua soils, and areas of Leicester and Walpole stony soils. Included soils make up 10 to 15 percent of the unit.

The permeability of this Scarboro soil is rapid, and available water capacity is low. The depth to bedrock is more than 5 feet. A year-round high water table is between the surface and a depth of 1 foot, and some areas have water on the surface. The frost-action potential of the soil is high.

The high water table and stones on the surface make this soil unsuited to farming. Most areas are wooded, but the soil is poorly suited to most tree species and productivity is low. The high water table limits forest management and logging operations and is the main limitation for community development and recreational use.

The capability subclass is Vlls.

SsA—Scituate fine sandy loam, 0 to 3 percent slopes. This soil is nearly level and moderately well drained. It is in slight depressions on hilly uplands. The areas are long and narrow or irregular in shape and range from 5 to 15 acres.

Typically, the surface layer is very dark grayish brown fine sandy loam about 9 inches thick. The subsoil is mottled and 13 inches thick. The upper part of the

subsoil is yellowish brown fine sandy loam, and the lower part is strong brown gravelly sandy loam. The substratum is a hardpan of mottled, pale olive gravelly loamy sand that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of poorly drained Leicester and Walpole soils in depressions. Included soils make up 15 to 20 percent of the unit.

The permeability of this Scituate soil is moderately rapid in the surface layer and subsoil and slow in the hardpan. Available water capacity is moderate. The hardpan is at a depth of 19 to 29 inches and limits the rooting depth of plants. A seasonal high water table is perched at a depth of 1-1/2 to 3 feet from November to May, and some areas have seep spots. The depth to bedrock is more than 5 feet. The frost-action potential of the soil is high.

Most areas of this soil are used for hay or pasture, but some areas near Manchester and Nashua are used for residential development.

The seasonal high water table limits this soil for farming. Wetness restricts the choice of crops and delays cultivation in the spring. Using tile drains or open ditches makes the soil suitable for row crops. Grasses and legumes on this soil must be species that tolerate seasonal wetness. Mixing crop residues and manure into the plow layer improves tith and the organic matter content.

This soil is suited to most tree species, and productivity is moderate. There are few or no limitations for most types of forest management or logging operations.

The seasonal high water table and slow permeability in the hardpan limit some types of community development and recreational use. The high frost-action potential is an additional limitation for community development.

The capability subclass is llw.

SsB—Scituate fine sandy loam, 3 to 8 percent slopes. This soil is gently sloping and moderately well drained. It is in slight depressions on hilly uplands. The areas are long and narrow or irregular in shape and range from 3 to 10 acres.

Typically, the surface layer is very dark grayish brown fine sandy loam about 9 inches thick. The subsoil is mottled and 13 inches thick. The upper part of the subsoil is yellowish brown fine sandy loam, and the lower part is strong brown gravelly sandy loam. The substratum is a hardpan of mottled, pale olive gravelly loamy sand that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of gently sloping, well drained Montauk soils and areas of Scituate soils that have slopes of 8 to 15 percent. Included soils make up 15 to 20 percent of the unit.

The permeability of this Scituate soil is moderately rapid in the surface layer and subsoil and slow in the hardpan. Available water capacity is moderate. The

hardpan is at a depth of 19 to 29 inches and limits the rooting depth of plants. A seasonal high water table is perched at a depth of 1-1/2 to 3 feet from November to May, and some areas have seep spots. The depth to bedrock is more than 5 feet. The frost-action potential of the soil is high.

Most areas of this soil are used for hay or pasture, but some areas near Manchester and Nashua are used for residential development.

The seasonal high water table limits this soil for farming. Wetness restricts the choice of crops and delays cultivation in the spring. Using tile drains or open ditches makes the soil suitable for row crops. Stripcropping, contour farming, and using moisture-tolerant grasses and legumes in the cropping system help to control erosion. Mixing crop residue and manure into the plow layer improves tilth and the organic matter content.

This soil is suited to most tree species, and productivity is moderate. There are few limitations for most types of forest management or logging operations. Operating logging equipment during wet periods increases the hazard of erosion; constructing the roads on the contour helps to control this erosion.

The seasonal high water table and the slow permeability in the hardpan limit some types of community development and recreational use. The high frost-action potential is an additional limitation for community development.

The capability subclass is IIw.

SsC—Scituate fine sandy loam, 8 to 15 percent slopes. This soil is sloping and moderately well drained. It is in slight depressions on hilly uplands. The areas are irregular in shape and range from 5 to 10 acres.

Typically, the surface layer is very dark grayish brown fine sandy loam about 7 inches thick. The subsoil is mottled and 15 inches thick. The upper part of the subsoil is yellowish brown fine sandy loam, and the lower part is strong brown gravelly sandy loam. The substratum is a hardpan of mottled, pale olive gravelly loamy sand that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of well drained Montauk soils on the higher parts of the landscape and areas of Scituate soils that have slopes of 3 to 8 percent. Included soils make up 15 to 20 percent of the unit.

The permeability of this Scituate soil is moderately rapid in the surface layer and subsoil and slow in the hardpan. Available water capacity is moderate. The hardpan is at a depth of 19 to 29 inches and limits the rooting depth of plants. A seasonal high water table is perched at a depth of 1-1/2 to 3 feet from November to May, and some areas have seep spots. The depth to bedrock is more than 5 feet. The frost-action potential of the soil is high.

Most areas of this soil are used for hay, pasture, or woodland. Some areas near Manchester and Nashua are used for residential development.

Slope, an erosion hazard, and the seasonal high water table make this soil poorly suited to row crops. Using tile drains or open ditches and protecting the soil from erosion help to improve suitability for row crops. Stripcropping, contour farming, and using moisture-tolerant grasses and legumes in the cropping system help to control erosion. Adding manure and mixing crop residue into the soil provide additional organic matter to help maintain tilth and conserve moisture.

This soil is suited to most tree species, and productivity is moderate. There are few limitations for most types of forest management or logging operations. Operating logging equipment during wet periods increases the hazard of erosion; constructing the roads on the contour helps to control this hazard.

The seasonal high water table, slope, and the slow permeability in the hardpan limit this soil for some types of community development and recreational use. The high frost-action potential is an additional limitation for community development.

The capability subclass is IIIe.

StA—Scituate stony fine sandy loam, 0 to 3 percent slopes. This soil is nearly level and moderately well drained. It is in slight depressions in hilly uplands. The areas are irregularly shaped and range from 3 to 20 acres. Stones 1 to 1-1/2 feet in diameter and 5 to 30 feet apart cover the surface.

Typically, the surface layer is very dark grayish brown fine sandy loam about 7 inches thick. The subsoil is mottled and 15 inches thick. The upper part of the subsoil is yellowish brown fine sandy loam, and the lower part is strong brown gravelly sandy loam. The substratum is a hardpan of mottled, pale olive gravelly loamy sand that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of stony Leicester and Walpole soils in depressions and areas of Woodbridge soils. Also included are areas of very stony soils. Included soils make up 15 to 20 percent of the unit.

The permeability of this Scituate soil is moderately rapid in the surface layer and subsoil and slow in the hardpan. Available water capacity is moderate. The hardpan is at a depth of 19 to 29 inches and limits the rooting depth of plants. A seasonal high water table is perched at a depth of 1-1/2 to 3 feet from November to May, and some areas have seep spots. The depth to bedrock is more than 5 feet. The frost-action potential of the soil is high.

Most areas of this soil are in woodland, but a few areas are used for pasture.

The stony surface interferes with cultivation and makes the soil unsuitable for row crops and limited for pasture and hay.

This soil is suited to most tree species, and productivity is moderate. There are few limitations for most types of forest management or logging operations.

The seasonal high water table and slow permeability of the hardpan limit this soil for some types of community development and recreational use. The high frost-action potential is an additional limitation for community development, and the stones on the surface for recreational use.

The capability subclass is Vs.

StB—Scituate stony fine sandy loam, 3 to 8 percent slopes. This soil is gently sloping and moderately well drained. It is in slight depressions on hilly uplands. The areas are irregularly shaped and range from 5 to 25 acres. Stones 1 to 1-1/2 feet in diameter and 5 to 30 feet apart cover the surface.

Typically, the surface layer is very dark grayish brown fine sandy loam about 7 inches thick. The subsoil is mottled and 15 inches thick. The upper part of the subsoil is yellowish brown fine sandy loam, and the lower part is strong brown gravelly sandy loam. The substratum is a hardpan of mottled, pale olive gravelly loamy sand that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of stony Leicester and Walpole soils in depressions and areas of Woodbridge soils. Also included are small areas of very stony soils. Included soils make up 15 to 20 percent of the unit.

The permeability of this Scituate soil is moderately rapid in the surface layer and subsoil and slow in the hardpan. Available water capacity is moderate. The hardpan is at a depth of 19 to 29 inches and limits the rooting depth of plants. A seasonal high water table is perched at a depth of 1-1/2 to 3 feet from November to May, and some areas have seep spots. The depth to bedrock is generally more than 5 feet. The frost-action potential of the soil is high.

Most areas of this soil are in woodland, but a few areas are used for pasture.

The stony surface interferes with cultivation and makes the soil unsuitable for row crops and limited for pasture and hay.

This soil is suited to most tree species, and productivity is moderate. There are few limitations for most types of forest management or logging operations. Operating logging equipment during wet periods increases the hazard of erosion; constructing logging roads on the contour helps to control this erosion.

The seasonal high water table and the slow permeability in the hardpan limit this soil for some types of community development and recreational use. The high frost-action potential is an additional limitation for community development, and the stony surface for recreational use.

The capability subclass is VIs.

StC—Scituate stony fine sandy loam, 8 to 15 percent slopes. This soil is sloping and moderately well drained. It is in slight depressions and on side slopes of hills on uplands. The areas are irregularly shaped and range from 5 to 15 acres. Stones 1 to 1-1/2 feet in diameter and 5 to 30 feet apart cover the surface.

Typically, the surface layer is very dark grayish brown fine sandy loam about 7 inches thick. The subsoil is mottled and 15 inches thick. The upper part of the subsoil is yellowish brown fine sandy loam, and the lower part is strong brown gravelly sandy loam. The substratum is a hardpan of mottled, pale olive gravelly loamy sand that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of gently sloping, stony Leicester and Walpole soils in depressions and areas of very stony soils. Included soils make up 15 to 20 percent of the unit.

The permeability of this Scituate soil is moderately rapid in the surface layer and subsoil and slow in the hardpan. Available water capacity is moderate. The hardpan is at a depth of 19 to 29 inches and limits the rooting depth of plants. A seasonal high water table is perched at a depth of 1-1/2 to 3 feet from November to May, and some areas have seep spots. The depth to bedrock is more than 5 feet. The frost-action potential of the soil is high.

Most areas of this soil are in woodland, but a few areas are used for pasture.

The stony surface interferes with cultivation and makes the soil unsuitable for row crops and limited for pasture and hay.

This soil is suited to most tree species, and productivity is moderate. There are few limitations for most types of forest management or logging operations. Operating logging equipment during wet periods increases the hazard of erosion; constructing logging roads on the contour helps to control this erosion.

The seasonal high water table and slope limit this soil for some types of community development and recreational use. The high frost-action potential is an additional limitation for community development, and the stony surface for recreational use.

The capability subclass is VIs.

Su—Suncook loamy fine sand. This soil is excessively drained and nearly level. It is on the highest parts of flood plains. The areas are long and narrow and range from 3 to 15 acres.

Typically, the surface layer is very dark grayish brown loamy fine sand 2 inches thick. The underlying layers extend to a depth of 60 inches or more and consist of light olive brown and light yellowish brown loamy fine sand and fine sand and very dark grayish brown loamy fine sand.

Included with this soil in mapping are small areas of soils that are gravelly in the substratum. Also included are spots of Occum soils. Included soils make up about 10 percent of the unit.

The capability subclass is IIw.

WoB—Woodbridge loam, 3 to 8 percent slopes.

This soil is gently sloping and moderately well drained. It mainly is in slight depressions on hilly uplands. Some areas are on smooth-sided, oval hills called drumlins. The areas of this soil are long and narrow and range from 5 to 25 acres.

Typically, the surface layer is very dark grayish brown loam about 7 inches thick. The subsoil is mottled, light olive brown and olive fine sandy loam 18 inches thick. The substratum is a dense hardpan of mottled, light olive brown fine sandy loam that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Scituate soils in depressions and Paxton soils on the higher parts of the landscape. Included soils make up 15 to 20 percent of the unit.

The permeability of this Woodbridge soil is moderate in the surface layer and subsoil and slow in the hardpan. Available water capacity is moderate. The hardpan is at a depth of 24 to 33 inches and limits the rooting depth of plants. A seasonal high water table is perched at a depth of 1-1/2 to 3 feet from November to May, and some areas have seep spots. The depth to bedrock is more than 5 feet. The frost-action potential of the soil is high.

Most areas of this soil are used for hay or pasture. Some areas are in woodland.

The seasonal high water table makes this soil poorly suited to row crops. Wetness restricts the choice of crops and delays cultivation in the spring. Using tile drains or open ditches makes the soil suitable for crops. Grasses and legumes on this soil must be species that tolerate seasonal wetness. Mixing crop residue and manure into the plow layer improves tilth and the organic matter content.

This soil is well suited to most tree species, and productivity is moderately high. Operating logging equipment during wet periods increases the hazard of erosion; constructing logging roads on the contour helps to control this erosion.

The seasonal high water table, the high frost-action potential, and the slow permeability in the hardpan limit this soil for community development and recreational use.

The capability subclass is IIw.

WvB—Woodbridge stony loam, 3 to 8 percent

slopes. This soil is gently sloping and moderately well drained. It mainly is in slight depressions on hilly uplands. Some areas are on smooth-sided, oval hills called drumlins. The areas of this soil are long and narrow and range from 5 to 75 acres. Stones 1 to 1-1/2 feet in diameter and 5 to 30 feet apart cover the surface.

Typically, the surface layer is very dark grayish brown loam about 5 inches thick. The subsoil is mottled, light olive brown and olive fine sandy loam 20 inches thick.

The substratum is a dense hardpan of mottled, light olive brown fine sandy loam that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Paxton, Scituate, and Ridgebury soils. Also included are areas of very stony, nearly level Woodbridge soils. Included soils make up 15 to 20 percent of the unit.

The permeability of this Woodbridge soil is moderate in the surface layer and subsoil and slow in the hardpan. Available water capacity is moderate. The hardpan is at a depth of 24 to 33 inches and limits the rooting depth of plants. A seasonal high water table is perched at a depth of 1-1/2 to 3 feet from November to May, and some areas have seep spots. The depth to bedrock is more than 5 feet. The frost-action potential of the soil is high.

Most areas of this soil are wooded, but a few areas are used for pasture.

The stony surface and the seasonal high water table make this soil unsuitable for row crops and limited for pasture and hay. The surface stones especially interfere with cultivation.

The soil is well suited to tree species. Operating logging equipment during wet periods increases the hazard of erosion. Constructing logging roads on the contour helps to control this erosion.

The seasonal high water table, the high frost-action potential, the stony surface, and the slow permeability in the hardpan limit this soil for community development and recreational use.

The capability subclass is VIi.

WvC—Woodbridge stony loam, 8 to 15 percent

slopes. This soil is sloping and moderately well drained. It mainly is in slight depressions on hilly uplands. Some areas are on smooth-sided, oval hills called drumlins. The areas of this soil are long and narrow and range from 5 to 30 acres. Stones 1 to 1-1/2 feet in diameter and 5 to 30 feet apart cover the surface.

Typically, the surface layer is very dark grayish brown loam about 5 inches thick. The subsoil is mottled, light olive brown and olive fine sandy loam 20 inches thick. The substratum is a dense hardpan of mottled, light olive brown fine sandy loam that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Paxton and Scituate soils and very stony Woodbridge soils. Included soils make up 10 to 15 percent of the unit.

The permeability of this Woodbridge soil is moderate in the surface layer and subsoil and slow in the hardpan. Available water capacity is moderate. The hardpan is at a depth of about 25 inches and limits the rooting depth of plants. A seasonal high water table is perched at a depth of 1-1/2 to 3 feet from November to May, and some areas have seep spots. The depth to bedrock is more than 5 feet. The frost-action potential of the soil is high.

Most areas of this soil are wooded, but a few areas are used for pasture.