SCITUATE RESERVOIR WATERSHED PROPERTY

FOREST STEWARDSHIP PLAN

2011 - 2020

Providence Water Supply Board
Water Resources Division
552 Academy Avenue
Providence, RI 02908

(401) 521-6300

www.provwater.com

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Prepared in 2011 by:

Robert MacMillan, CF, Senior Forest Supervisor
(401) 521-6300, Ext. 7318
rmacmillan@provwater.com

Christopher Riely, CF, Forest Supervisor
(401) 521-6300, Ext. 7313
criely@provwater.com

Under the supervision of:

Richard Blodgett, CF, Environmental Resources Manager
(401) 521-6300, Ext. 7316
rblodgett@provwater.com

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552 Academy Avenue
Providence, RI 02908

401-521-6300

www.provwater.com

January 31, 2012

I am very pleased to provide to you our updated Forest Stewardship Plan. Providence Water values the forested buffer land surrounding our reservoirs. In fact, we consider these lands as the “first line of defense” in our water treatment process. Healthy forests yield or produce the cleanest water on the planet. An actively managed forest maintains clean water for our nearly 600,000 customers.

Our forest has been actively managed since it was re-established on former agricultural lands nearly 100 years ago. These activities have been overseen since the early 1950s by professional foresters and watershed managers.

The forestry program manages the Scituate Reservoir Watershed Property by promoting long-term ecosystem health to protect a high quality water supply and other natural resources.

Some of the current activities on our property include:

- Harvesting timber to create growing stands of trees of all ages
- Reducing deer impacts to protect native plants and animals
- Managing invasive plants and promoting native vegetation
- Creating or restoring habitat for less common wildlife species
- Protecting older forest areas and artifacts of past settlement & land use
- Providing appropriate opportunities for public visits and research

We feel that this plan will provide the reader with a clear understanding of our program, from our overall philosophy to detailed prescriptions for each of the management units.

Please feel free to contact us if you have any comments or questions about our plan, or anything else related to our forest management program.

Sincerely,

Boyce Spinelli

Boyce Spinelli
Acting General Manager

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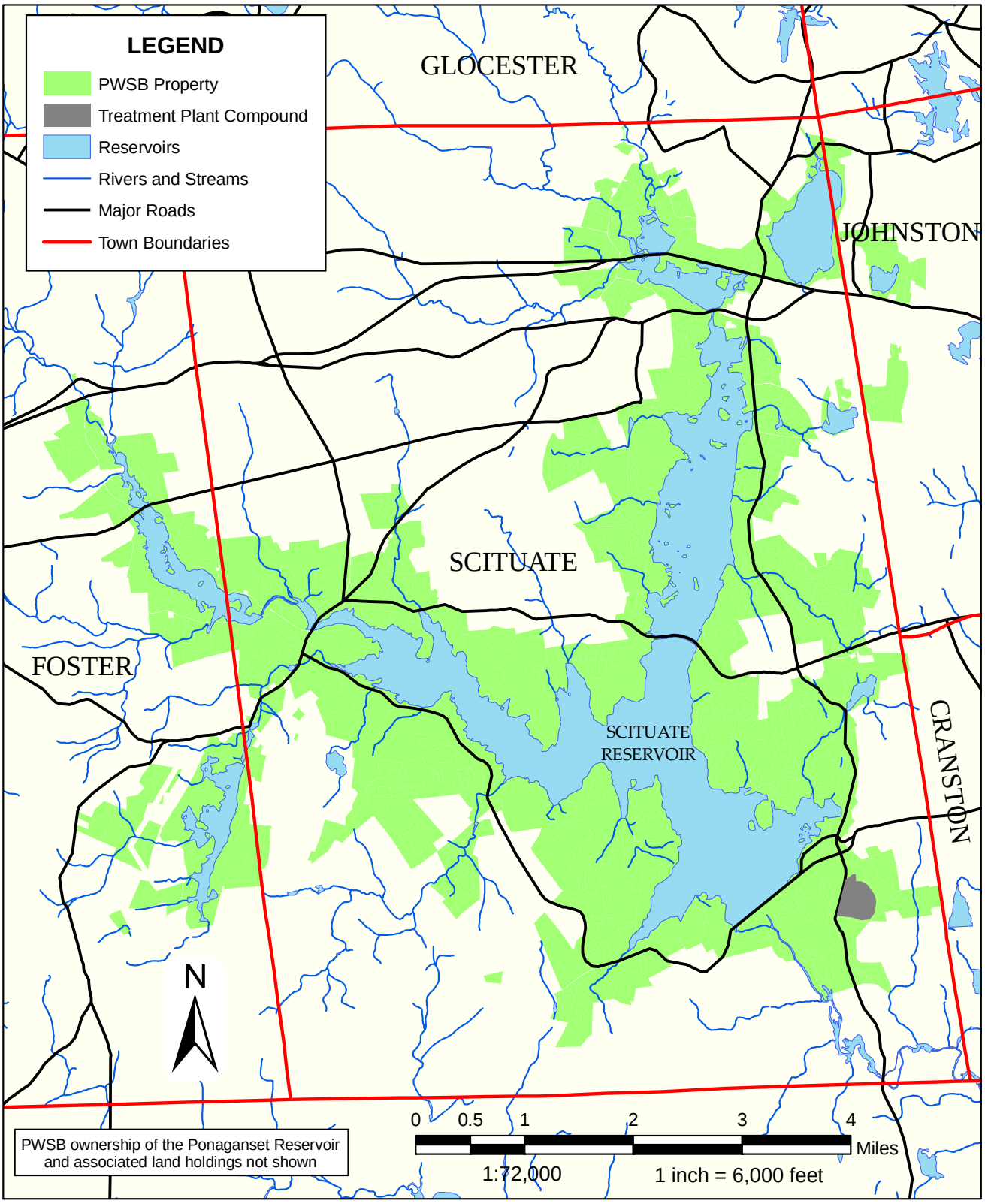


1. EXECUTIVE SUMMARY

Purpose and Overview

This forest management plan is intended to set forth management goals, objectives, and strategies and to guide Providence Water's Water Resources Division in managing approximately 12,500 acres of public watershed forestland surrounding the Scituate Reservoir and its smaller tributary reservoirs. The plan is based on a comprehensive forest inventory, an updated GIS database and maps, and applied knowledge of science-based forest and watershed management principles.

The first sections present organizational mission statements and guiding principles for watershed management. Second, the plan details broad goals and objectives and specific strategies to achieve them. A landscape overview of the larger watershed and historical background provide perspective on how the forest on the Providence Water property has arrived at its current condition. The next section describes the major forest cover types on the property and includes a related discussion of forest inventory methods and growth analysis. There are also sections dedicated to wildlife and property management. The plan establishes a framework for management activities planned for the 2011-2020 period and beyond to achieve the desired future condition of a resilient forest ecosystem supporting a high quality water supply.

To facilitate planning and execution of forestry and land management projects across the Providence Water forest ownership, the property has been divided into 25 administrative Management Units (MU) based on landscape features and roads and designed with practicality in mind. The size of these MUs varies widely, from as small as 100 to as large as 1,200 acres. The central part of this document is a collection of detailed sub-management plans to guide activities on each of the 25 individual MUs over the next 10 years. Following a standardized format, these detailed "management unit plans" include sections with specifics on (1) location, geography and access, (2) existing forest conditions, (3) soils, (4) past land use and forest management, (5) forest health and related management, (6) silviculture, and (6) cultural resources and other unique features. Included with the text component of each MU plan is a summary of forest stand inventory data, a management activity schedule, and a map of the unit.

Information from the management activity schedules for each MU have been combined for the entire property and sorted by the year the activity is planned. This comprehensive activity schedule is a working document as property management must be adaptive and based on current conditions and information. The exact acreages and types of timber harvests, invasive plant treatments, deer management and wildlife habitat projects, etc. may vary from the activity schedule as treatments will be based on current on-the-ground conditions as the project is implemented.

Providence Water Organizational Structure

In 1915, the Rhode Island General Assembly approved Chapter 1278 of the Public Laws to allow the creation of the Providence Water Supply Board (PWSB or WSB). The Act established a Water Supply Board of seven members to oversee the construction of the system. When the Water Supply Board had completed its work in 1929, all functions related to the operation and maintenance of the Scituate water supply system were assumed by the Providence Department of Public Works.

In 1941, the administration and operation of the Providence Water Works was transferred to a newly formed Water Supply Board. The Mayor was authorized to appoint four members to the Board, with their terms staggered so that a new member is appointed every year as another member's four-year term expires. The City Council authorizes two additional members and the City Treasurer is an ex-officio member of the Board. The Board is empowered to appoint a legal advisor and to hire a Chief Engineer and General Manager who serves as the director of operations. Together with the Chief Engineer, this seven-member Board oversees the administration and operation of Providence Water.

Providence Water's organizational structure includes 11 departments serving different functions within the utility. Two deputy general managers in charge of administration and operations work closely with the Chief Engineer, and each department has a director. The Water Supply Department oversees management of the Scituate Reservoir source watershed and operation of the water treatment plant in Scituate. This department is subdivided into three divisions: (1) Treatment Plant Operations, (2) Water Quality, and (3) Water Resources. The Water Resources Division is responsible for management of the surface reservoirs and surrounding forestland owned by Providence Water, land acquisition and watershed protection efforts on non-owned lands within the larger watershed, and also monitoring of dams and weather & climate data. The Water Resources Division currently has three staff members: a Manager of Environmental Resources, a Senior Forest Supervisor, and a Forest Supervisor.

Mission Statements

The mission of Providence Water is "To provide reliable, high-quality, safe, clean drinking water for our customers at a reasonable cost, supported by excellent customer service, within the context of a positive, fair, efficient and healthy workplace environment."

Within the larger organizational context, the forestry program "manages the Scituate Reservoir watershed property by promoting long-term ecosystem health to protect a high-quality water supply and other natural resources."

Broad Goals and Objectives

The following six goals have been identified for Providence Water to be successful in managing its forestland and fulfilling the forest management program's mission.

1. Optimize the collection of the highest quality and quantity of raw water
2. Ensure long-term forest productivity and health
3. Protect unique natural and cultural resources
4. Increase the long-term value of timber resources
5. Provide habitat for a variety of wildlife species
6. Provide support for public education and research

The forest management program's mission includes goals that can best be achieved through an active regime of forest protection and silviculture including timber harvesting. While promoting the growing and the sustainable harvesting of timber across the majority of the Providence Water property, the plan also identifies areas to be set aside to develop "older growth" forest characteristics. Riparian and wetland areas with fragile soils that may not support logging equipment have also been identified and excluded from timber management.

Strategies to Achieve Goals and Objectives

By implementing the plan, the current forest will continue to change into one that is stocked with a range of native tree species that are well matched to the soils on which they are growing. These healthier, more diverse woodlands will yield more water and higher value timber products while maintaining high water quality. The diversity of both tree species and age classes will improve the forest's resilience and ability to rebound from natural and anthropogenic disturbances and insect and disease infestations. A multi-layered forest structure including a greater variety of understory, shrub, and herb species will slowly develop as the native trees become established and grow. A critical component to achieving this level of forest health and diversity will be the continuation of a white-tailed deer management program that was begun in 2010. For the foreseeable future, all forest management projects on the Providence Water property must include consideration of deer impacts.

Through continued harvesting to diversify the overall age class structure across the forest landscape, forest stand stocking will be reduced to a level that will modestly increase water yields as a result of reduced evapotranspiration. By implementing best management practices (BMPs) during these activities, harvesting operations will have minimal or no adverse impact on water quality. Harvests will include protective measures such as retaining a certain amount of woody material onsite to protect soil function. By carefully planning and closely supervising timber harvests, trees chosen for retention will be primed to increase their rate of growth and crown expansion. Maximizing timber value over the long term will be balanced with goals of providing habitat for a variety of wildlife species and protecting natural and cultural resources.

Forest culture activities in young stands are an important component of an active forest management program. About 7 million tree seedlings have been planted on the Providence Water property over the years. While most of this planting activity was accomplished in the years following the initial watershed land acquisition, planting seedlings or sowing tree seed can still be important to restocking stands and species diversity can be increased through enrichment planting. No large-scale planting is planned for the time period covered by this plan, but planting may be necessary if a major disturbance such as a hurricane or fire impacts an area and creates water quality concerns. In recent years, culture practices in young stands such as pruning crop trees, timber stand improvement (TSI) to release desirable understory trees, and pre-commercial thinning have not been undertaken due to the overall maturing of the forest. With a number of overstory removal harvests intended to release established regeneration planned for the next ten years, however, these types of activities may once again become important on the property.

Providence Water only owns about one third of the land in the Scituate Reservoir watershed and relies heavily on local municipalities and private landowners as stewardship partners since it has no regulatory authority over non-owned lands. An important component of the utility's water supply protection strategy is educating and informing the public about the value and importance of watershed protection to public health and quality of life. Engaging residents, businesses, and

municipal officials in the watershed towns is especially important. Providence Water's support of public education programs helps provide this target audience with the necessary resources to act as stewards of their own land and in turn support Providence Water's protection efforts. In particular, Providence Water contracts with the Northern RI Conservation District to provide outreach and education services in the watershed area. Other good examples of these efforts are partnerships and staff involvement with organizations and programs such as the American Tree Farm System, RI Natural History Survey, and Society of American Foresters. The Water Resources Division also offers public field tours that visit project sites on the Providence Water property and are designed to give interested people a better understanding of forestry and land management issues.

Summary of Specific Management Activity Recommendations

The management plan identifies a number of actions that are necessary to continue sound management of Providence Water's forest property surrounding the surface reservoir system:

■ Many hardwood forest stands have insufficient native tree regeneration to sustain themselves and remain forested in the event of a large disturbance. The principal cause of this problem is an overabundant white-tailed deer population browsing on seedlings and saplings to the extent that natural forest regeneration processes are severely disrupted. Providence Water must continue and expand its efforts to reduce deer impacts on the forest through human-induced deer mortality. A managed hunting program such as the Tunk Hill Cooperative Deer Management Area is currently the preferred strategy to reduce deer impacts.

■ The majority of the forest on the Providence Water property was established around the same time as a result of both natural succession and human planting. Overall, its composition is relatively homogenous and lacking in age class diversity. Most of the forest stands are about 70-100 years old and in the sawtimber size class, with very little acreage in the seedling and sapling stages. To increase the acreage in seedling and sapling-sized woods and thus enhance overall diversity, the activity schedule calls for overstory removal harvests to release the established regeneration on about 35 acres per year over the next ten years. Most of these harvests are planned in stands dominated by white pine, a species that is not as susceptible to deer browse as hardwood species. If deer impacts are reduced, some hardwood stands scheduled for thinning will have regeneration included as a goal.

■ Non-native invasive plants have become a problem and impact how the forest can be managed, interfering with and limiting the use of traditional silviculture methods. The spread of these plants is attributed in part to white-tailed deer overbrowsing on native plants, which allows the invasive plants to grow with little competition. Reducing deer impacts should help to alleviate this problem, but areas heavily infested with invasive plants will need extra effort and measures to help reestablish native vegetation. The plan identifies a number of specific areas with high concentrations of invasive plants that may require treatment prior to harvesting activities.

■ With the maturing of the forest across southern New England, wildlife species dependent on young brushy habitats have decreased. These species include cottontail rabbits, American woodcock, and ruffed grouse. Eight sites have been identified for possibly receiving treatments to improve

habitat conditions for these animals. The plan for each area will be different based on site-specific conditions. In locations where deer impacts are not an issue, creating an opening large enough to meet habitat requirements and then allowing natural succession to occur may be sufficient. Other areas may need additional measures such as planting and fencing to increase the chances of success.

- Even with the maturing of the forest into stands of predominately sawtimber-size trees, there is very little true old-growth forest in southern New England. It takes long time periods for characteristics associated with old growth forest structure to develop. The first step is to recognize that these characteristics are important for wildlife and other natural processes. Approximately 300 acres of forest on the Providence water property have been identified and set aside from active management to develop "older growth" characteristics through natural processes. Many of these stands have unusual features such as large trees or rare species and have already developed some characteristics of older growth forest.

- Approximately 3,380 acres have been targeted for timber harvesting over the 2010-2019 period. This acreage is approximately 27% of the total forested land base, with many acres being thinned or prepped for regeneration harvests that will occur in the future. These harvests will have the effect of increasing long-term forest productivity and resiliency while maintaining water quality.

- Areas with unique natural or cultural resources will continue to be protected when planning and executing timber harvests and other management activities. Except for unusual circumstances, specific locations or stands with an abundance of historic features or known populations of rare species are managed as reserves excluded from timber harvesting.

- Tree planting, sowing of tree seed, pruning, and timber stand improvement (TSI) activities will be conducted on an as-needed basis for the purposes of watershed protection, increasing forest diversity and productivity, and increasing the value of future timber products.

- Periodic measurement of the existing the 44 Continuous Forest Inventory (CFI) plots will be continued and 18 more plots will be added to achieve a ratio of one plot per 200 acres of forest. New plots will be established in different forest cover types so that the overall number of plots in each type is representative of the acreage in each cover type on the property.

- Maintaining property boundary lines is important to protect the Providence Water property from trespass and encroachments. All property lines will be inspected, re-blazed and re-painted at least once during the 10-year period. To ensure that boundary line locations and access policies are clear to the public, an effort to post "No Trespassing" signs along wooded property lines will be initiated.

- Through continued participation in education and outreach efforts (especially in partnership with the Northern Rhode Island Conservation District), Providence Water will encourage private landowners in the watershed to maintain existing forest cover and consider active management on their properties. The Water Resources Division will continue to offer public field tours on the watershed property each year as long as there is sufficient interest. When possible, Providence Water will comply with requests to provide customized tours or participate in events that are consistent with watershed management goals. The property will continue to be available for legitimate research or experimental management activities supporting these goals.

Barden Dam Spillway

2. PURPOSE

This plan is intended to guide land management on Providence Water's Scituate Reservoir watershed property over the 2011-2020 time period by establishing and documenting specific resource management strategies to meet the objectives of the larger water utility. The majority of the plan focuses on the forest since about 98% of the PWSB ownership is forested, but it also considers non-forested areas such as open areas, grasslands, and wetlands. Since all elements of an ecosystem play a role in its overall health and function, the plan includes relevant information on topics such as non-native invasive plants and wildlife. For Providence Water, the most important part of the system is the water itself.

The plan summarizes the forest ecosystem resources on the watershed property and breaks the ownership into smaller Management Units (MUs). A comprehensive forest inventory was conducted to provide a quantitative and qualitative forest assessment and to inform the development of this plan. Detailed information on the forest inventory can be found in Section 11. An activity schedule is provided for each individual MU along with a summary for the entire property. The activity schedule is essentially the work plan for the next ten years and it includes measures such as improving access roads and gates, manipulating habitat for wildlife, and treating invasive species in addition to traditional forest management activities such as thinning and regeneration harvests. The activity summary will serve as a benchmark in evaluating Providence Water's progress in implementing the plan. The plan should be continuously updated as conditions change with major revisions in ten years. An updated forest inventory can be performed at this time to assess the success of the strategies and outcomes of the management activities that were implemented.

Watershed property management must take into account a wide range of changing external factors that are beyond the control of Providence Water. Adjustments to federal, state, and local laws and regulations concerning natural resources are usually phased in slowly and should thus allow for revisions to plans. As a public landowner, Providence Water must be responsive to the concerns of stakeholders from the local watershed area, the City of Providence, and elsewhere. Numerous natural factors including weather, fire, insects and pathogens, and animals and plants can also influence land management. Some unexpected natural disturbances occur quickly (hurricanes and fires), whereas other impacts are insidious and become evident only after significant impacts have occurred (invasive species, white-tailed deer herbivory).

While this plan will serve as a guide, actual management must remain responsive and adaptable to current needs and conditions. A wide range of external inputs, both human and natural, may change how the forest should be managed and may shift or create new priorities. For example, the invasive emerald ash borer insect was unknown to most professional land managers as recently as ten years ago, but now it is devastating ash trees and dramatically altering how many public forests in the eastern United States are being managed. The full range of ecosystem effects from losing ash trees will probably not be known for many years. Management will apply the most current scientific information available. We cannot fully plan and manage for the unknown, but we can respond and adapt management to new or changing conditions. As new techniques or methods are employed, they will be evaluated and, if necessary, modified.

Moswansicut Reservoir Outlet

3. PROVIDENCE WATER SUPPLY BOARD MISSION STATEMENT

"To provide reliable, high-quality, safe clean drinking water for our customers at a reasonable cost, supported by excellent customer service, within the context of a positive, fair, efficient and healthy workplace environment." (Approved August 2009)

3.1 WATER RESOURCES DIVISION MISSION STATEMENT

"To ensure the collection and protection of an adequate supply of high quality raw water for treatment and distribution to customers. Further, to plan, organize, lead, and control efforts to ensure that Providence Water's reservoirs, lands, and other watershed facilities are able to produce, store, and protect an adequate supply of high quality raw water."

3.2 FOREST MANAGEMENT PROGRAM MISSION STATEMENT

"The forestry program manages the Scituate Reservoir watershed property by promoting long-term ecosystem health to protect a high-quality water supply and other natural resources."

Jordan Pond below Westconnaug Dam

4. GUIDING PRINCIPLES FOR WATERSHED MANAGEMENT

4.1 GENERAL PRINCIPLES

- Providence Water will efficiently and effectively manage its natural resources based on current scientific principals, professional judgment, and experience.

- Providence Water will comply with all federal, state, and local laws, regulations, and ordinances. If at any time Providence Water is found to be out of compliance, the organization will take immediate steps to come into compliance.

4.2 WATER QUALITY

- The major water supply benefits of forests come from development of forest soils that promote infiltration and high quality water. Forest soils with a litter layer, high organic content, and large macropore fraction promote rapid infiltration and minimize erosive overland flow

- Forested watersheds generally yield higher quality water than non-forested cover types. Urban, suburban, and agricultural land uses all contribute in some way to lowered water quality.

- Uncontrolled human activities on unfiltered water supply watersheds represent a major source of potential contamination. Effective watershed protection must include adequate controls over human activity.

- Watershed cover types differ in their regulation of certain nutrients (especially nitrates); the best regulation is provided by forest stands that are growing vigorously and fully occupying sites.

- Deciduous tree species tend to have less nitrate in seepage water when compared to coniferous species.

4.3 WATER YIELDS

- Water yields are affected directly by evapotranspiration rates of the watershed cover. Therefore, management activities that result in decreased evapo-transpiration also result in increased water yield.

- Water yields usually decrease as young forests grow. As a forest becomes more open, water yields usually increase.

- Coniferous forests generally conduct greater amounts of groundwater to the atmosphere than do deciduous stands, yielding less runoff available to streams, ponds, and reservoirs.

- Water yields are influenced by precipitation amounts, site conditions such as slope, aspect, and soils, as well as intensity of management, with passively managed forests yielding the least water, intensive even-aged systems yielding the most, and uneven-aged systems yielding intermediate amounts.

- Due to interception loss and evapo-transpiration from deep-rooted trees and shrubs, forests may actually reduce annual runoff compared to other land uses, but the water coming from forests is generally of high quality and may be released in ways (i.e. timing) that increase its usability.

4.4 FOREST MANAGEMENT

- Diversity of species composition and forest age classes is an important part of a resilient ecosystem that can respond to destructive agents or changes in growing conditions.

- Fire protection, police surveillance, water sampling and other watershed management activities all depend upon an adequate watershed road system.

- With proper road location and maintenance and proper planning and supervision of silvicultural activities, tributary water quality impacts (including turbidity, nutrients, and stream water temperature) from forest management can be minimized.

- The proper management of riparian forests is a critical part of watershed protection.

- The long-term quality of water in tributaries that flow into a reservoir is a function of geology, soils, topography, vegetation, weather (especially infrequent major floods, hurricanes, and snow/ice storms), human impacts and wildlife. Humans and wildlife can also impact water quality over the short term. The importance of vegetation to water quality varies given physical basin characteristics and becomes an important factor in the long-term when the impacts of large, infrequent natural disturbances are considered.

4.5 SCITUATE RESERVOIR SYSTEM

- The Scituate Reservoir system was created solely to provide an adequate amount of the highest quality drinking water possible to its customers and to provide water for fire suppression.

- The land marginal to the reservoirs and riparian areas within the watershed, both owned and non-owned, serves as a buffer that can improve the quality of the water that ultimately reaches the reservoir.

- The water holding capacity of the Scituate Reservoir system is limited by the height of its dams and spillways. Manipulating the forest to increase water yield is of no consequence if the reservoir is unable to store additional water above that point.

4.6 SCITUATE RESERVOIR WATERSHED FOREST

■ Clean water is the most valuable and important product that comes from the watershed forest.

■ The Scituate Reservoir watershed forest provides an important area for natural resources including trees and plants, wildlife, insects, clean air, carbon storage, and visual aesthetics, all which are compatible with the primary mission of securing high quality drinking water.

■ From its creation, Providence Water has maintained and will continue to maintain a policy of no unauthorized access on its watershed property ownership. Access for authorized activities, research, and educational purposes has been and will continue to be granted when in the best interests of Providence Water.

■ Providence Water acknowledges that it is part of a larger ecosystem and has a responsibility to manage a portion of its land in a way smaller landowners may not be able to. This includes implementing management practices for wildlife that require particular habitat conditions and setting aside areas from active management indefinitely to develop older growth attributes. All land management activities must consider the role Providence Water lands play on a regional landscape scale.

■ While closed to unauthorized public access, the Providence Water property provides an important scenic backdrop for many public roads running through the watershed. Forest management activities in highly visible areas will be carefully planned to minimize negative visual impacts.

■ Forest management will focus on ecosystem health and integrity. Management includes manipulating the forest through silvicultural cutting activities to create desired conditions and distribution of age classes. When harvesting trees that contain merchantable products, Providence Water will strive to achieve the highest revenue possible for these products. A steady stream of timber products or revenue from the forest is not, however, a goal in managing the forest.

■ Opportunities to generate income from non-timber products such as maple sap collection, hay production, or witch-hazel will be evaluated on a case-by-case basis and implemented when they do not negatively impact water quality. These types of activities help to provide local products and additional local business opportunities.

The Barden Reservoir is one of five tributary reservoirs that flow into the main Scituate Reservoir.

5. BROAD GOALS AND OBJECTIVES

The following six (6) broad goals and objectives for managing watershed lands owned by Providence Water have been established. Maintaining high quality water is the primary mission of the Water Resources Division. All subsequent goals and objectives of the Division are intended to achieve this primary mission or support it in some way.

Not all goals and objectives apply equally to every acre of land and may be incompatible or impossible on the same "acre" in some cases. One example is that the goal of protecting soil function is a higher priority than maximizing timber revenue, so where soils are fragile, protecting the soils and water quality precludes harvesting timber. Similarly, a specific goal for a particular area may prevent others goals from being met in that area. Creating multiple age classes of forest cover is not a goal for an area being actively managed for wildlife where establishing and maintaining fields for warm season grasses has taken place or is planned. Goals are prioritized for each cover type in Section 10 along with an explanation of how the actions necessary to achieve these goals may affect other objectives. The goals are first described generally and then more specifically for the time period covered by the plan.

5.1 Optimize the collection of the highest quality and quantity of raw water.

Forests are the best land cover for producing high quality water. Forest soils trap nutrients and other water pollutants before they reach wetlands, streams or other water bodies and minimize soil erosion. Erosion decreases the water capacity of soil and usually reduces infiltration that can increase over-land flow. When water travels as subsurface instead of overland flow, nutrients and sediments are less prone to erosion. The type of forest cover (both type and number of trees) affects the amount of water available to migrate to waterways and eventual collection and storage in the main reservoir or one of its tributaries. Collection of the highest quality and quantity of water will be accomplished by adhering to the following principles:

a. During silvicultural operations, comply with or exceed environmental regulations for protecting water quality (BMPs). Maintaining a deep organic soil layer when possible will help in minimizing surface runoff.

b. Identify areas with fragile soils where water quality concerns outweigh the possible benefits of timber management and designate them as such. This designation does not limit the use of these areas for other activities that do not threaten water quality.

c. When possible, maintain stand densities at levels that optimize water yield, but do not increase sedimentation, soil degradation, or nutrient loading in waterways.

d. Convert high transpiration species (conifers) to low transpiration species (hardwoods) when feasible and soil types permit.

e. Retain organic litter (branches, leaves, needles, tree tops, etc.) during silvicultural operations to protect forest soils from erosion.

5.2 Ensure long term forest productivity and health

A healthy forest is critical to the primary mission of Providence Water to provide reliable, high-quality, safe clean drinking water for its customers. By maintaining a healthy and vigorously growing forest, continuous forest cover may be retained over a larger portion of the watershed. The most effective land use for reducing sediment is forest cover with its understory, surface litter, debris, and organically enriched soil. Leaves on understory plants and organic soil surface debris protect the soil

against the erosive force of rainfall. A multi-layered forest is more capable of protecting the soil and rebounding in the event of a disturbance. Seedlings and saplings are less affected by high winds than tall overstory trees and, if already established, will occupy openings shortly after a disturbance. Overall forest health and resiliency in a forest ecosystem subject to periodic disturbances will be maintained or improved by following the principles below:

a. Promote species diversity at all canopy levels and at the herbaceous level.

b. Promote tree regeneration.

c. Create multiple age classes across the forest and within stands.

d. Manipulate stand densities to increase individual tree and forest vigor.

e. Favor tree species on a particular site based on soil type.

f. Protect long-term soil productivity.

5.3 Protect unique natural and cultural resources

While protecting unique natural and cultural resources is not a direct contributor to the primary mission of Providence Water, locating and protecting these resources may be required by regulations. More importantly, it is the right thing to do. Protecting rare natural resources maintains biodiversity and supports ecosystem resiliency. Preserving cultural artifacts maintains tangible connections to historic human settlement and land use in the watershed area. Unique areas and cultural resources will be protected as described below:

a. Locate areas with unique or rare plants, document which species are present, and record them on maps and in the GIS database.

b. When silvicultural operations are conducted near cultural resources such as stone walls, foundations, and cemeteries, these physical features will be marked and avoided. Existing barways in stone walls will be utilized whenever possible.

5.4 Increase the long-term value of timber resources

While not a direct contributor to the primary mission of Providence Water, sound financial management of the property's timber resource assets is consistent with the organization's overall strategy. When conducting silvicultural operations to create the desired forest conditions, timber growth and revenue from harvested products will be maximized. This will be accomplished by following the guidelines below:

a. Secure adequate natural regeneration of commercial species whenever possible prior to removing the overstory. This will reduce the need for costly artificial regeneration (tree planting) efforts.

b. Limit the amount of pre-commercial thinning and release (i.e. non-revenue producing) work performed unless outside funds or cost share money becomes available or an outstanding opportunity presents itself.

c. When manipulating stand densities through thinning to increase tree vigor and growth, favor trees that will lead to higher quality/value products.

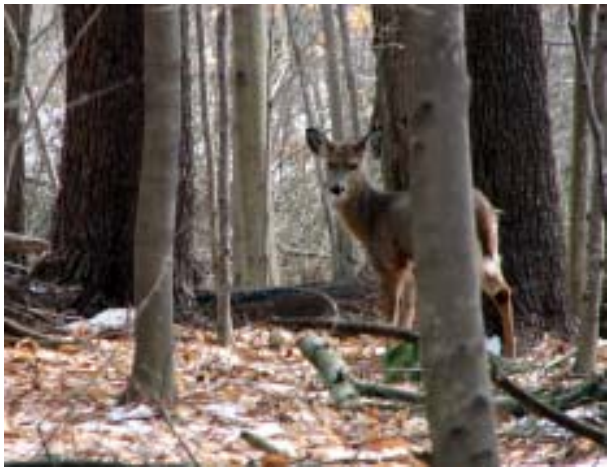
d. Favor tree species that will grow best on a particular site as they will grow to a larger size and should be more economically valuable when harvested.

e. Provide harvesting conditions that increase the value of the products without negatively impacting water quality by maintaining firelane roads and associated infrastructure.

f. Be open to new markets for both wood products and non-traditional wood products that may develop, provided that they do not contradict other objectives.

5.5 Provide habitat for a variety of wildlife species

When consistent with the primary mission of maintaining high water quality and other stated objectives, Providence Water will attempt to provide habitat conditions for a variety of wildlife species. When an animal species is negatively impacting forest ecosystem function or water quality (or has the potential to do so), appropriate actions will be taken to mitigate such impacts. Wildlife will be managed both passively and actively by implementing the following strategies:



a. Retain snags and coarse woody material when conducting silvicultural operations.

b. Retain and protect potential den trees and nesting sites when conducting silvicultural operations.

c. Create early successional habitat when appropriate on areas large enough to benefit species that require them.

d. Designate areas that will not be actively managed for timber production to allow trees to grow larger and begin to develop characteristics of older growth.

e. Manage and maintain current open areas and shrub communities and create additional areas when practical.

f. Monitor wildlife populations and their impacts on the forest and if necessary take steps to reduce negative impacts.

5.6 Provide support for public education and research

Providence Water will continue its traditional practice of making its watershed property ownership available for legitimate research, provided that the results are shared with Providence Water. Since Providence Water owns only 25% of the land area of the Scituate Reservoir watershed, public education and outreach is an important component of watershed protection.

A mechanized harvester thinning a white pine stand

6. SPECIFIC STRATEGIES TO ACHIEVE GOALS AND OBJECTIVES

6.1 Optimize the collection of the highest quality and quantity of raw water

Strategy 1: Collection of the highest quality and quantity of water will be enhanced by thinning approximately 2,000 acres of overstocked forest stands over the next ten years. By reducing stocking levels, evapotranspiration from the thinned stands will decrease and water available for storage will increase. At the same time, these thinnings will increase the vigor of residual trees by promoting crown expansion and bole diameter increase. If deer impacts are controlled, the increased light in these thinned areas will allow tree regeneration to become established and the shrub and herbaceous layer to flourish. These more vigorous growing plants will absorb and store nutrients.

Strategy 2: When silvicultural prescriptions are implemented, Providence Water will follow all guidelines detailed in the Forestry Best Management Practices for Water Quality Protection manual prepared by the Rhode Island Department of Environmental Management (Second edition, 2003).

Strategy 3: During silvicultural operations, active harvest sites will be inspected at least weekly and more often when ground or weather conditions warrant. By inspecting sites on a regular basis, potential problems can be identified and averted.

Strategy 4: Timber harvest planning and layout will minimize the number of stream and wetland crossings. When a stream crossing cannot be avoided, temporary bridges will be used.

6.2 Ensure long-term productivity and health of forestlands

Strategy 1: Long-term productivity and ecosystem health will be improved over the next ten years by promoting native plant diversity. Promoting native species in all canopy levels and at the herbaceous level will be accomplished by reducing overabundant deer impacts on vegetation. This will allow a variety of tree species to grow from seedlings into the understory and eventually advance into the canopy. Reducing deer impacts will be accomplished through a deer management program that focuses on ecosystem health. Information on implementing this program and monitoring its effectiveness can be found in records maintained by the Water Resources Division.

Strategy 2: Native plant diversity will be enhanced by limiting the spread and reducing the occurrence of non-native invasive plants. This will be accomplished by continuing to be vigilant in identifying new invasive plants and controlling them as soon as possible. Controlling non-native invasive plants in conjunction with reducing deer impacts will allow native plants to become established and flourish. The specific type of control (chemical, mechanical, fire) will depend on the extent of the infestation and the target plant(s). Controlling invasives will improve overall forest health and, if implemented correctly, will have no impact on water quality. This strategy will also promote timber growth by allowing native tree species to become established and improve wildlife habitat since fruits from non-native invasive plants are usually low in nutritional value. Controlling

non-native invasive plants should have no impact on cultural or historical sites. Further information on controlling specific plants can be found in records maintained by the Water Resources Division.

Strategy 3: By creating a robust forest with a diversity of species and age classes, water quality degradation from natural disturbances such as weather events, fire, insects, and disease will be minimized. This diverse forest cover will reduce the rebound time from a severe weather event by having adequate regeneration in place and ready to occupy the site if the overstory is significantly disturbed. Similarly, the presence of a variety of species will decrease the recovery time from a forest insect or disease outbreak that may affect a specific tree species or group of species. These conditions will improve the ability of the forest to recover quickly and with minimal intervention.

Increasing the range of age classes distributed across the forest will be accomplished by initiating regeneration cuts on 350 acres over the next ten-year period and managing 950 acres as uneven-aged forest. At present, the majority of the forest is in the same age class due to farm abandonment and land acquisition for the creation of the reservoir system. Currently less than 1% of the forest is in the seedling/sapling stage and most of these sites are former red pine plantations that have been harvested.

Manipulating stand densities to increase tree vigor will be accomplished by thinning 2,000 acres of overstocked stands over the ten-year period. This will be accomplished in all cover types (hardwood, softwood, and mixedwood). The more vigorous trees will be retained and allowed to more fully occupy the site. Specific information on when and where these silvicultural operations will be conducted is found in the management unit summaries and activity schedules.

Strategy 4: The tree species favored on a particular site will be based on the underlying soils. Growth and vigor of different tree species vary depending on the site characteristics such as soil depth and water holding capacity. While all tree species will grow better on the most productive sites, some species are less suited for the poorer sites than others. White pine and pitch pine grow more vigorously on droughty soils than does more site-demanding red oak. Oaks and other hardwoods can become established and survive on these sites, but they usually exhibit poor growth and other symptoms of stress. Over the long run, matching tree species to the site will increase the vigor of the forest and its ability to regenerate after disturbance.

Strategy 5: Soil productivity will be protected by ensuring that timber harvests leave a significant amount of coarse woody material onsite. This will be accomplished by including language in harvest specifications limiting woody material that can be removed from the site to logs greater than 4 inches in diameter. These specifications will be standard for all operations except for those in which the intent is to convert the area into grasslands. Limiting harvesting activities to locations and times of the year when compaction and rutting will be minimized will further protect soils.

6.3 Protect unique natural and cultural resources

Strategy 1: Over the 10-year management period, Providence Water will contract to conduct biological inventories on lands acquired since 1990, with an emphasis on identifying rare and endangered plants and animals. Information on populations of rare or threatened species will be recorded in a GIS database and on relevant maps. If necessary, silvicultural operations will be modified to protect these species. Any populations found will be monitored annually. If necessary to help in the protection of rare species, actions such as constructing fencing to prevent deer browsing may be accomplished.

Strategy 2: Approximately 50 cemeteries are located on the Providence Water property and many of them are classified by the state as historical. Most of these cemeteries have not been maintained on a regular basis. Some are bounded by stone walls or stone fence posts and are easily identifiable, while others are more difficult to locate and may have fieldstone markers with no inscriptions. During the land condemnation process, the cemeteries were photographed and their locations noted on record plans. Providence Water will continue locating these cemeteries and will obtain GPS coordinates for those that are not already in the GIS database. A maintenance program will include cutting and clearing brush and removing fallen trees from the cemeteries. Providence Water will strive to perform maintenance on at least five cemeteries per year so that all receive some attention over the 10-year management period. Headstones that have been damaged will not be repaired at this time. With Providence Water's authorization, other groups or individuals will be allowed to repair headstones or rebuild damaged stonewalls if they desire.

Strategy 3: Vernal pools and other small water bodies will be protected. Vernal pools are small depressions that fill with water during the spring and provide critical habitat for several amphibian and aquatic species that use them in their breeding cycle. They have no inlet or outlet and dry up completely during most summers, so fish cannot become established. When these features are located, they will be documented and their GPS coordinates will be recorded in a GIS database. This database will be consulted prior to any silvicultural activity, with planned activities modified if necessary. The relevant guidelines described in the Forestry Best Management Practices for Water Quality Protection manual will be followed when working in areas that contain vernal pools and related features.

6.4 Increase the long-term value of timber resources

Strategy 1: Providence Water will grow and harvest commercial timber products in a manner that does not contradict the primary mission of water quality or other stated objectives.

Strategy 2: Whenever possible, natural regeneration of commercial tree species will be secured prior to overstory removal when conducting a regeneration harvest. Silviculture relying primarily on natural regeneration will reduce the cost of stand establishment and ensure continuous forest cover. When creating openings to establish regeneration, the smallest opening to get the desired results should be employed. Adjacent openings will not be created until previously created ones are adequately stocked. When natural tree regeneration does not become established on its own, strategies such as planting, seeding, eliminating competing vegetation, or reducing browsing animals will be considered.

Strategy 3: Densities of overstocked stands will be reduced through thinnings to allow both individual residual trees and the stand as a whole to increase in timber volume and quality. Target densities will be set to allow the remaining trees to more fully occupy the site and to grow to a larger

size. Thinnings will generally not begin until the trees are large enough for the work to be accomplished commercially and at no cost to Providence Water.

Strategy 4: Good log landing areas and skid trails will be reused whenever possible to reduce both harvest setup costs and environmental impacts. Reduced costs will increase the value of products to the harvesting contractor. This value should be passed on to Providence Water in the form of an increased stumpage price for wood products harvested.

6.5 Provide habitat for a wide range of wildlife species

Strategy 1: Providence Water will maintain the warm and cool season grasslands established at the former Joslin Farm in 2009 through at least 2019. The land area in Rhode Island in this cover type has significantly diminished as the forest has reestablished itself in areas once cleared for agriculture. The loss of grassland habitat has led to a decrease in the populations of the animals that require these areas for part of their life cycle. The grasses in this area will be maintained by mowing or burning the site every 3-5 years to prevent the establishment of woody plants. Prescribed burning is the most effective management tool to maintain and rejuvenate native grasslands. Burning produces more succulent vegetation, increases forb diversity, and removes accumulated ground thatch that can be critical to ground nesting birds. If burning is not possible due to local restrictions, mowing outside primary bird nesting season will be substituted. Given the desired frequency of 3-5 years, this area will be treated 2-3 times over the 10-year management period. The Water Resources Division maintains additional information on the management of the Joslin Farm site.

Strategy 2: Providence Water will create or improve at least two areas at least 12 acres in size for early successional wildlife habitat. As with grasslands, larger areas of young shrubby growth have become less common in Rhode Island as forests have matured. The New England cottontail rabbit and birds such as woodcock and ruffed grouse need this habitat in patches of sufficient size to survive. Browsing by white-tailed deer can delay or prevent forest openings from becoming adequately stocked with young tree regeneration that provides dense, brushy cover. By implementing a deer management program, herbivory impacts should be reduced over time and the formation of these thickets may become more predictable. In the short term, additional measures such as fencing out deer and/or establishing preferred vegetation may be necessary. A number of potential early successional wildlife habitat areas have been identified in the Management Unit summaries and activity schedules. Since treated areas regrow and eventually lose their desirable habitat characteristics for these animals, not all of the identified areas will be established during this 10-year management period. Other early successional habitat areas for wildlife will need to be created in future planning periods.

Strategy 3: In 1990, Providence Water acquired land that included approximately 20 acres of hayfields. Over the past 20 years, these hayfields have been leased to a farmer with no restrictions on the timing of hay cutting or the height of the cut. The current lease expired on December 31, 2011. Providence Water will modify the use of these fields to improve habitat for birds and other wildlife species. These restrictions will decrease the attractiveness of this field for hay production and the amount of revenue produced from it. If the lease is renewed, the next agreement will restrict the time of cutting until after bird nesting season is over, usually accepted to be August 15. To allow the grass to recover quickly, mower blades will be restricted from cutting less than 6 inches from the ground. Alternatively, the lease may not be renewed and the fields may be considered for a wildlife habitat improvement project similar to that which has been undertaken on the former Joslin Farm fields.

Strategy 4: This plan identifies approximately 300 acres to be designated for "older growth" forest characteristics. These areas will be withdrawn from active management and allowed to grow and develop without planned human activities. The only permitted activities will be those that may be necessary for public safety. It has been shown that certain bird species occur more often in forests with old growth features such as large trees with cavities. Other characteristics of old growth include a diversity of tree sizes and ages, large standing dead trees and downed logs, and associated canopy gaps. With a "hands-off" management approach in these areas, developing true old growth structure will take many decades or longer.

Actively managed forested areas will include measures to increase "older growth" structure across the watershed forest. Leaving some large trees to become future snags and eventually large downed logs and making some larger gaps in the canopy will increase the development of "older growth" characteristics. These trees to be left (sometimes referred to "legacy trees") can be spaced throughout the area or in groups. Girdling trees can increase the number of snags in an area if none are present. These standing dead trees will provide habitat and eventually topple over to become coarse woody debris and benefit other wildlife species. The forest type and age/size of the trees in the stand being worked will in part determine the degree to which these practices will be implemented. Upland oak stands growing on relatively unproductive soils will never produce large diameter hardwoods and it may be too early to start thinking about specific legacy trees in a small-diameter white pine stand.

6.6 Provide support for public education and research

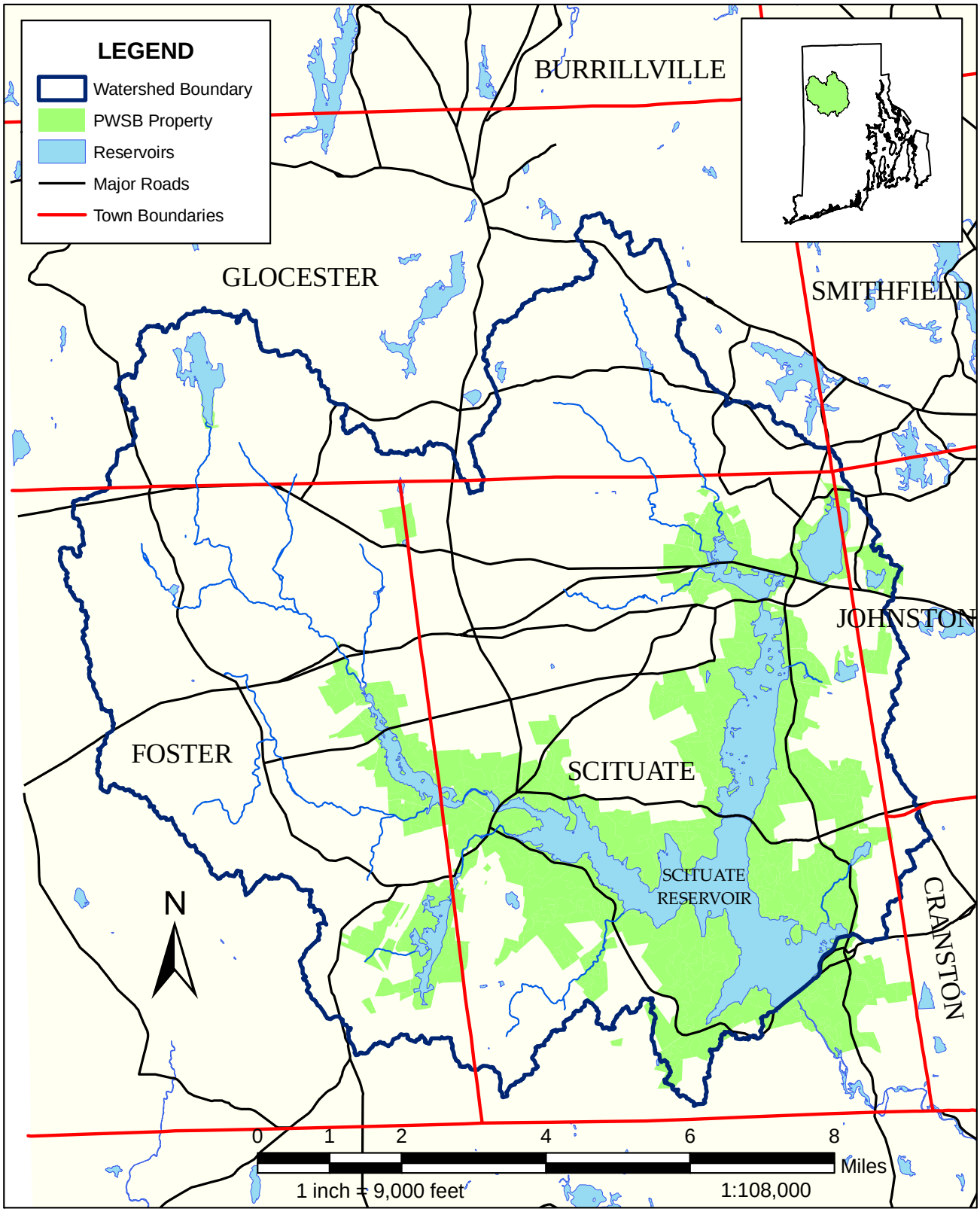
Strategy 1: Providence Water will continue its funding and support of the Scituate Reservoir Watershed Education Program administered by the Northern Rhode Island Conservation District.

Strategy 2: Research proposals from external agencies and academic institutions will be considered on a case-by-case basis. If requested, Providence Water personnel will assist with these studies if time permits.

Strategy 3: Providence Water will conduct free public tours on the watershed property each year. These field tours will be designed to educate the public on management issues so that interested people may gain a better understanding of the strategies used in an effort to achieve Providence Water's goals. If participation is low for these tours, the frequency will be modified.

Strategy 4: Providence Water periodically receives requests from external agencies, organizations, and groups to provide special property tours or to participate in events. When possible, Providence Water will comply with these requests when the theme is consistent with issues involving watershed management or goals and objectives described in this plan. Examples include Tree Farm and Society of American Foresters (SAF) tours, Conservation Commission events, historic site tours, and requests from State and Federal agencies.

SCITUATE RESERVOIR WATERSHED



7. SCITUATE RESERVOIR WATERSHED OVERVIEW

7.1 LAND USE AND OWNERSHIP

The Scituate Reservoir is the primary source of drinking water for approximately 60% of the state of Rhode Island's human population. The watershed area that drains into the reservoir is about 94 square miles and includes land in Foster, Glocester, Scituate, Cranston, and Johnston, Rhode Island. All watershed lands are within Providence County. The Philip J. Holton Treatment plant is located in Scituate, approximately 10 miles west of the City of Providence. The Scituate Reservoir watershed is part of the larger Pawtuxet River watershed. The outflow from the Scituate Reservoir feeds the north branch of the Pawtuxet River, which runs eastward and eventually empties into Narragansett Bay in Pawtuxet Village. Table 1 shows the acreage of land owned by Providence Water in each town within the watershed.

Table 1: Land Owned by Town

Town	Total Area (square miles)	Owned (acres)	Approximate Percent Owned
Scituate	54.8	14,511	41.4%
Foster	51.9	2,116	6.4%
Johnston	23.7	368	2.4%
Glocester	56.8	238	< 0.1%
Cranston	29.9	4	< 0.1%
TOTAL	217.1	17,238	

Within the 94 square mile watershed (±60,000 acres), Providence Water owns approximately 17,500 acres or about 29% of the watershed. This leaves about 42,500 acres of the Scituate Reservoir watershed owned by a variety of entities including private landowners, corporations, towns, and the state. The land use is mostly rural residential, but ranges from highways and light industrial use to unmanaged woodlots. Of the ±17,500 acres owned by Providence Water, approximately 5,000 acres are surface waters of the reservoir system, with the vast majority of the remainder (±12,500 acres) in some type of forest cover. About 1,000 acres of the Providence Water property (primarily the area surrounding the treatment plant downstream of the Gainer Dam) are located outside of the actual watershed boundaries. Table 2 shows land use within the Scituate Reservoir watershed.

Table 2: Land Use Within the Scituate Reservoir Watershed

Land Use Type	Owned (Acres)	Not Owned (Acres)	Total* (Acres)
Forest (non-wetland)	11,412	27,524	38,936
Wetlands (forested and open)	864	5,460	6,324
Surface Water (reservoirs, ponds, etc.)	4,596	191	4,787
Agricultural	20	2,066	2,086
Other Undeveloped (open, shrubland, etc.)	132	587	719
Residential	0	6,582	6,582
Recreation	0	280	280
Commercial, Industrial, and Institutional	214	299	513
TOTAL	17,238	42,989	60,227

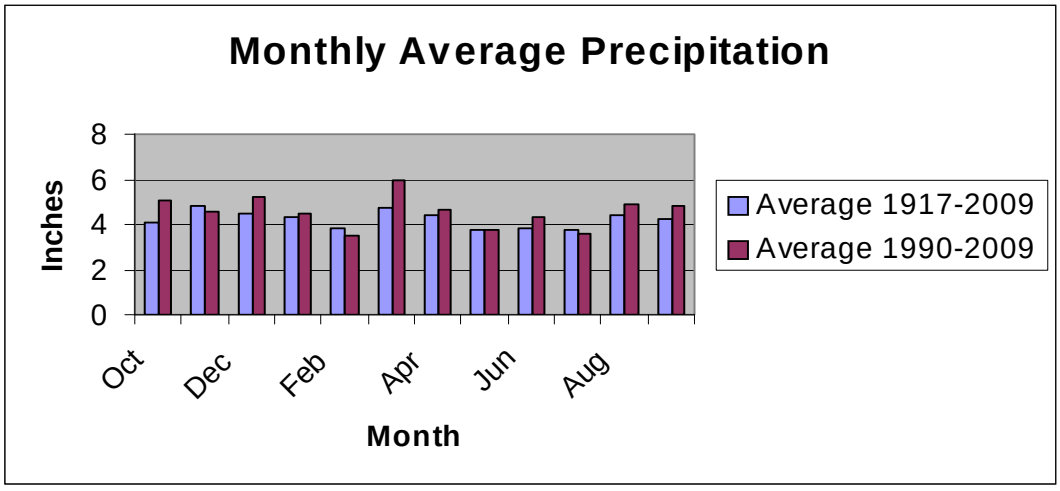
*Data from Scituate Reservoir Source Water Assessment, 2003

7.2 TOPOGRAPHY AND CLIMATE

Elevations in the Scituate Reservoir watershed range from the reservoir spillway elevation of 284 feet to the 812-foot summit of Jerimoth Hill in Foster near the Connecticut border (the highest point in Rhode Island, Jerimoth Hill also marks the northwestern watershed boundary). The topography of both the Providence Water property and larger watershed is generally flat to gently sloping with occasional steep slopes. There are many small streams and brooks, but few large rivers. The watershed contains many small dammed millponds or remnants that were originally created for milling grain and later to power industrial mills. Many of these dams have been intentionally breached to allow unimpeded stream flow, while others are still intact but receive little regular maintenance

The temperate climate is characterized by warm humid summers and cold winters. The Atlantic Ocean and Narragansett Bay influence the weather by moderating the extremes. Snow cover in the winter months can vary greatly from year to year depending on weather patterns, with average snowfall about 36 inches. During some winters there is almost continuous snow cover while in others there is very little. January is usually the coldest month and July the warmest. The growing season ranges from 130 to 180 days. Precipitation varies but there is usually adequate rainfall during the growing season for plants to be productive without regular irrigation. Providence Water has monitored precipitation on the watershed since 1917 at five rain gauges stations and precipitation averages about 50.5 inches per year over that time. Since 1917, the most precipitation recorded was 71.37” in fiscal year 2006 and the lowest was 33.43” in 1930. Precipitation is distributed fairly evenly throughout the year, but November is typically the wettest month with an average of 4.83” while July is usually the driest with an average of 3.72.” table 3 shows average precipitation by month for 1917 to 2009 and from 1990 to 2009 for the watershed.

Table 3: Monthly Average Precipitation



7.3 NATURAL DISTURBANCES

Southern New England juts out into the Atlantic Ocean and is often in the path of tropical storms and hurricanes as they move north. The cooler northern ocean waters usually weaken these storms before they reach land, but historic records show that intense storms periodically move inland. As these storms move northward, the east side of the storm center usually experiences higher winds and causes more wind-related damage. A hurricane is a large cyclonic storm with winds of 75 mph or greater that blow in a large spiral around a relatively calm center. The hurricane season in New

England is historically August through November, but changing climate patterns may cause the season to expand. Since 1900, 25 hurricanes and 14 storms have impacted New England. Nine of the 25 hurricanes made landfall on the southern New England coast and seven of these reached Category 2 or 3 in strength. Harvard Forest research has shown that there are strong gradients in storm intensity and frequency of storms of a given intensity moving from southeastern New England to the northwest. The highest values of both occur along the shore of eastern Connecticut, Rhode Island, and southeastern Massachusetts, while the lowest values are in northern New England near the Canadian border. In southern New England, historical records show that storms causing slight damage occur about every 5 years, those causing moderate damage including individual tree blowdowns occur about every 10-15 years, and that storms causing extensive damage occur about every 85-150 years. With the possible warming of the ocean and changing climate, both the intensity and frequency of these storms may increase.

The Hurricane of 1938 was the last intense hurricane of Category 3 or greater to make landfall in New England. Winds of over 120 mph were recorded and severe flooding occurred in some areas. Studies after this hurricane showed that damage increased with forest height, but that conifers (mostly white pine) sustained much greater damage than hardwoods of comparable height and exposure.

Other disturbances that have historically affected forests in southern New England and on the Providence Water property include insects and diseases, fire, and ice and snowstorms. Introduced forest insect pests have become an increasing concern in forests around the world. While the frequency of exotic species introductions may be increasing, the overall phenomenon is nothing new. Over the past century, the forests of southern New England have been impacted and shaped by a number of mortality-inducing insects and pathogens such as the chestnut blight (American chestnut), gypsy moth (oak and hardwood species), and red pine scale and adelgid (red pine). Relatively recent threats include the hemlock woolly adelgid (Eastern hemlock), Asian longhorned beetle (hardwoods including maples), and the emerald ash borer (ash).

Although fire may have historically played an important role in the southern New England and Rhode Island forest ecosystem, today it is not perceived to be a threat on the same scale that it is in the southern and western United States. Fires in Rhode Island and on the watershed are usually relatively small and quickly controlled. With the moist humid summer conditions preventing most ignitions during the warmest months, the typical fire season is the early spring from March until hardwood trees leaf out in May. Human fire suppression and exclusion in the eastern hardwood forest may in fact be influencing current and future forest composition, with fire-intolerant species becoming a more dominant component of the forest than in the past.

Heavy wet snow and freezing rain can cause extensive damage to the forest over large areas. In 1998 a large ice storm in eastern Canada and northern New England and New York damaged many trees by breaking branches and snapping trunks. Although Rhode Island has not experienced a devastating ice storm in recorded history, the threat is present. As in the case of tropical storms and hurricanes, climate change may increase the frequency and severity of these weather events.

Future disturbances may be unavoidable, but some actions to mitigate possible negative impacts are possible. Managing for a forest with a diversity of species, age classes, and stand structures may help to minimize damage and increase the forest's ability to rebound in the event of a large-scale disturbance. The acknowledgement that these unplanned disturbances may occur is important as it reinforces the need for adaptive and flexible management when working within a changing environment.

7.4 SOILS

Glacial ice sheets several thousand feet thick once covered the Scituate Reservoir watershed and the rest of New England. As the ice sheet expanded south from what is now Canada, it picked up and pushed along pre-glacial soil and scraped up chunks and boulders of bedrock and transported them in the ice. The glaciers scoured hills in the direction of ice movement and carved valleys. As temperatures warmed, the glaciers melted and retreated north 10,000 to 12,000 years ago, depositing unsorted glacial till and meltwater sorted sand, gravel, and silt. The most common of these materials deposited in Rhode Island was glacial till, an unsorted mixture of boulders, sand, and clay with large and small material mixed together. The glacial deposits in Rhode Island are divided into four types, with the Scituate Reservoir watershed located on the upland till plains. These upland till plains are composed primarily of granite, schist, and gneiss rock, with stones and boulders commonly scattered on the surface and bedrock outcrops present in some areas. This landscape of boulders and rocks is common across the watershed. On the Providence Water property, Indian Rock is an example of a large “glacial erratic” boulder that was dropped from the glacier where it sits on top of the ground today. Much of the till within the watershed is relatively loose and unconsolidated. Other areas are compacted, with deposits of dense material that is difficult to penetrate. Canton soils formed from the unconsolidated deposits while Paxton soils formed in the compacted deposits.

The 1981 Soil Survey of Rhode Island identified 41 different soil series that occur throughout the state. Of these 41 series, 19 are found on the Providence Water property. The most common soils on PWSB lands are examples of the Canton and Charlton series. The most productive growing sites are generally characterized by unsorted drift or till composed of heterogeneous materials ranging in size from large glacial erratics to clay. Conversely, the least productive sites are often characterized by water-transported material containing stratified outwash and fluvial deposits typically found in features such as kames, eskers, terraces, and outwash plains. The six most common soil series found on the Providence Water property are Canton, Charlton, Ridgebury, Paxton, Hinckley, and Woodbridge. A brief description of each of these soils follows:

Canton. Canton soils are well-drained soils formed in glacial till. They are coarse-loamy over sandy or sandy-skeletal soils, usually with a surface layer of fine sandy-loamy sand. They can be nearly level to moderately steep over short distances. Many stones and rocks are often present, along with scattered rock outcrops. Slopes range from 0-35% but most are within the 3-15% range. A well drained soil, there is only a slight risk of erosion and windthrow with few equipment limitations during most times of the year.

Charlton. Charlton soils are similar to Cantons and these two series are almost always mapped together as a complex. The Charltons differ in that they usually have a gravelly sandy loam substratum. Both Cantons and Charltons usually occur on upper slopes and higher positions on the landscape. They are well-drained soils with water draining from them readily, but not so quickly that it is unavailable to plants throughout most of the growing season. The Canton-Charltons are rated as moderate to low in productivity.

Ridgebury. Ridgebury soils are found on nearly level areas that are poorly to very poorly drained. They are coarse-loamy soils formed in glacial till. Water often drains from these soils so slowly that the soil is saturated periodically during the growing season in most years. Surface water during the growing season can limit the plants that grow in these soils. These soils are usually found in depressions, low-lying areas, and drainage ways. The water table is at a depth of about 6 inches during times of frequent rainfall or snowmelt. These soils rarely occur on slopes greater than 3% and most areas are stony.

Paxton. Paxton soils are well drained and formed in compact glacial till. Water is available to plants during most of the growing season while not inhibiting root growth. This series is a coarse-loamy soil with a surface that can be extremely stony or non-stony. They are usually found on middle to upper slopes ranging from 0-15% and are one of the more productive soils found on the watershed.

Hinckley. Hinckley soils are excessively drained, sandy-skeletal soils from which water drains very rapidly. The surface layer is usually gravelly sandy loam. Hinckley series are found on nearly level ground up to 35% slopes. Being excessively drained, Hinckley soils are not very productive especially for the more site-sensitive hardwoods such as red oak.

Woodbridge. Woodbridge soils are similar and sometimes mapped with Paxton soils. They are moderately well drained and usually have a surface layer of fine sandy loam. They are usually wet for only a short time during the growing season, but long enough that plants receive adequate moisture for good growth. These soils are often found on both lower slopes and upper crests of hills and drumlins. Slopes range from 0-8% and the water table is at about 20 inches during wet seasons. The Woodbridge series is one of the more productive soils found on the watershed.

Table 4 lists the major soil series found on the Providence Water property with relevant characteristics.

Table 4: Soils of the Scituate Reservoir Watershed

Soils	Characteristics	Description	Site Index
Adrian	Sandy or sandy-skeletal, mixed, euic, mesic	Very poorly drained wet mucky areas	RM: 51
Agawam	Coarse-loamy over sandy or sandy-skeletal, mixed mesic	Well drained productive soils	RO: 65; WP: 70
Canton	Coarse-loamy over sandy or sandy-skeletal, mixed mesic	Well drained less productive soils	RO: 52; WP: 58
Charlton	Coarse-loamy, mixed, mesic	Well drained moderately productive soils	RO: 65; WP: 65
Gloucester	Sandy-skeletal, mixed mesic	Somewhat excessively drained, moderately productive soils	RO: 60; WP 61
Hinckley	Sandy-skeletal, mixed mesic	Excessively drained less productive soils	RO: 49; WP: 60
Paxton	Coarse-loamy, mixed, mesic	Well drained productive soils	RO: 65; WP: 66
Ridgebury	Coarse-loamy, mixed, mesic	Poorly drained wet soils	RO: 57; WP: 63
Sutton	Coarse-loamy, mixed, mesic	Moderately well drained moderately productive soils	RO: 62; WP: 62
Woodbridge	Coarse-loamy, mixed, mesic	Moderately well drained productive soils	RO: 72; WP: 67

Site index is a measure of soil productivity for trees. The number is the average height in feet that dominant trees of a specific species should attain by age 50. Height growth is highly dependent on site and soils, while diameter growth is more subject to growing space. A site index of 65 for white pine on a particular soil type means that a dominant white pine should be about 65 feet tall in that soil when it is 50 years old.

7.5 RHODE ISLAND'S FORESTS

Over the last 300 years, forests have covered between 90 and 25 percent of the land in Rhode Island. Forestland now occupies 393,000 acres or 59% of the land in the state. The largest unfragmented core areas of forest are found along the western border with Connecticut, where there is a concentration of state-owned land. The areas around the city of Providence are predominately non-forested with smaller forest patches included within the landscape matrix. Seventy-five percent of forestland in Rhode Island is privately owned. The size of forest ownerships ranges from small house lots with tree canopy cover to properties totaling thousands of acres.

Oak-hickory is the most common forest type (61%) in Rhode Island. Other forest types are maple-ash (12%), maple-birch (11%), pine (6%), oak-pine (6%), and others (3%). Table 5 compares the total acreage of forest types in the state with those found on the Providence Water property. The oak-hickory forest type is more prevalent in the northern part of the state, with central Rhode Island having the largest areas of oak-pine and the pine type (mostly white and pitch) occurring in the southern part of the state. The oak-hickory forest type has been decreasing over the last few decades, while the maple-birch, oak-pine, and pine forest types have been increasing slightly.

Table 5: Forest Types in RI and on the Providence Water property

Forest Type	State Total (Acres)	Percent	Providence Water (Acres)	Percent
Oak-Hickory	239,730	61	5,617	46
Maple-Hardwood*	90,390	23	778	7
Oak-Pine	23,580	6	3,022	25
Pine	23,580	6	2,708	22
Other	15,720	4		
TOTAL	393,000	100	12,125	100

Providence Water's forest cover typing does not coincide exactly with statewide data. Providence Water does not have any forestland classified as oak-hickory, maple-ash or as maple-birch; these are included in the mixed oak-hardwood type.

On a statewide level, Rhode Island has seen a decline in seedling-sapling and pole-sized forest cover and an increase in the acreage of sawtimber-sized stands. From 1972 to 1998, the acreage in the seedling-sapling size classes decreased from 41% of the land considered forested to only 6%. Over the same time span, the acreage in sawtimber-sized trees increased from 22% to 54% of the total, while the poletimber size class has remained fairly constant, increasing from 34% in 1972 to 40% in 1998. The number of trees in the 2"–8" DBH classes decreased, while the number of trees greater than 8" DBH increased. In 1998, the oaks as a group accounted for 43% of the total volume on forested areas within the state, a drop from 50% in 1953. Meanwhile, white pine increased from 7% of the total volume in 1953 to 18% in 1998.

Rhode Island's forests are getting older. As a result of low harvesting levels and few disturbances, the average forest age class has increased so that as of 1998 more than half of the state's forests were in the 60-year age class. With forests concentrated in a few age classes, diversity is limited. This lack of diversity increases the forests' susceptibility to catastrophic damage and limits wildlife diversity. Even with more active management and harvesting, the situation is similar for the forest on the Providence Water property, with many pine stands having been planted between 1925 and 1940.

8. REGIONAL & LOCAL SETTLEMENT AND LAND USE HISTORY

The land area comprising the Scituate Reservoir watershed has seen significant human settlement and land use changes over the past 350 years that are largely representative of trends that have occurred across southern New England.

Before the first settlers of European origin arrived in the early 17th Century, the region's inhabitants were people belonging to the Algonquin family of Native American Indian nations. The Pawtuxet River served as the approximate northern edge of the area occupied by the powerful Narragansett tribe, whose territory extended southward along Narragansett Bay to the present towns of South Kingstown and Exeter. The comparatively weak Nipmuck tribe lived inland what is now the northwestern corner of Rhode Island and parts of adjacent states and maintained a distinct identity until around 1630, when the expanding Narragansetts absorbed them. These tribes subsisted on farming, fishing, and hunting, and the people lived in compact villages composed of related families. Early accounts written by European settlers document native tribes using fire to facilitate hunting and travel through the forest understory.

After the Plymouth and Massachusetts Bay Colonies were established by English settlers in 1620 and 1628 respectively, settlers from these outposts traveled south into the Narragansett region to trade with tribal groups and may have ventured inland. Rhode Island's first permanent settlement was founded at Providence in 1636 by English clergyman Roger Williams and his band of followers, who split from the repressive Massachusetts Bay Colony to pursue religious freedom. In 1638, Williams acquired a deed to land in the watershed from Indians who were living on the shores of Moswansicut Pond. The first real estate subdivisions followed in 1662, when a group of associates bought land known as the West Quanaug or Westconnaug Purchase and drew lots for their parcels. One of the first white settlers was a man named John Mathewson, who claimed 40 acres and lived in a rustic dwelling at the north end of the pond. Settlers from Scituate, Massachusetts, were claiming land by 1710 and reportedly brought the name "Satuit," or Scituate (meaning "cold brook or river"), with them.

The settlements of Scituate and Glocester were separated from Providence and organized as distinct towns in 1730 or 1731. The communities became known for their farms, sawmills, and gristmills. Most of the original "virgin" forest stands were cleared for agriculture or to provide wood or charcoal for the growing population during this era of settlement expansion. While the least productive acres were left as woodlots or served as poor pasture, the many stone walls built by farmers are testament to the rockiness of even the cultivated soil. Three entrepreneurial town fathers established a forge for making iron in the village of Hope in the southeastern corner of Scituate along the Pawtuxet River in 1765. One of Rhode Island's first industrial installations, the Hope Furnace was an early engine for economic development that produced, among other products, cannon castings used in the Revolutionary War effort. Scituate's western area of largely unsettled woodlands extending to the Connecticut border were split from the rest of the town in 1781 to create the new town of Foster.

With the arrival of the Industrial Revolution to the United States occurring in the nearby Blackstone River Valley, the availability of water power from the many ponds and streams brought manufacturing to the area in 1806 with the Hope Cotton Mill and moved upriver from there. The Ponaganset and Moswansicut Rivers, joining in Scituate to become the North Branch of the Pawtuxet, served as the main industrial arteries. The larger mills made cotton and woolen textiles, shoes, and similar products and encouraged the development of smaller supporting enterprises including machine, wheelwright, and blacksmith shops. Many of the watershed's villages developed

as small, somewhat self-sufficient settlements hugging the riverbank in the close proximity of a mill or mills owned by one company, often just downstream of a dam and millpond to create suitable head for increased water power. Of the original mill villages that dotted the landscape, only Clayville, Hope, Hopkins Mills, North Scituate and a few others remain. The Barden, Westconnaug, and Ponaganset Reservoirs were all originally created for industrial purposes, not for their later use as part of the Providence water supply system. By 1860 there were about 15 cotton mills in Scituate employing about 25% of the population of 4,500.

During the early-to-mid-1800s a boom in demand for merino wool led many regional farmers to convert remaining forests to pasture for raising these breeds of sheep, but the prosperity was short-lived. Other parts of the world soon outcompeted New England in the production of merino wool. The local farming economy undoubtedly continued to decline after the Civil War as the government encouraged the settlement of far more productive land south and west of New England. While increasing numbers of residents went to find work off the farm, the agricultural economy that remained transitioned to providing more perishable commodities such as dairy products and eggs to the growing industrial city of Providence and surrounding towns. The area remained surprisingly rural for its location in an urbanizing region: at the turn of the 20th Century, the state's last remaining stagecoach line traversed these river valleys from the western outskirts of Providence to Scituate, Foster, and Danielson, Connecticut. The Providence & Danielson Railway finally put this last line out of business when it opened in 1901 and provided the first mechanized transportation of goods and people between the watershed and Providence.

Barely more than a decade thereafter, the fortunes of this rural area took an abrupt change of course when the City of Providence pursued the creation of a new water supply system for the metropolitan area. The city's first major attempt at a public water supply system during the late 19th Century involved diverting water from the Pawtuxet further downstream, but the quality of the source became seriously compromised when water-powered mills moved into the area, discharged manufacturing waste into the river, and located their workers' privies along its banks. With this supply fouled, a civic planning coalition saw the critical need to secure a more sustainable water supply to ensure Providence's continued viability as a prominent city and set about finding a suitable location.

Using pragmatic political reasoning, the planning coalition determined the north branch of the Pawtuxet and its watershed to be the best location for creating a reservoir system because it was a rural area lying entirely within the state of Rhode Island. The location of the main dam was set at a location less than two miles below the confluence of the Moswansicut and Ponaganset Rivers. By this time, the landscape was mostly crop and grazing land with some remnant forested woodlots and the now quaint mill communities. With the assistance of the state legislature, the City of Providence used eminent domain to condemn and acquire nearly 24 square miles, or 15,000 acres, of land (including 38% of the land area of Scituate) in 1916 and created the Providence Water Supply Board to commence building the complex physical infrastructure and institutional capacity necessary for a large municipal water supply system. More

than 1,000 buildings occupying the site for the main Y-shaped Scituate Reservoir were dismantled, graveyards were moved, highways were rerouted, and the Scituate & Danielson Railway was put out of business. The creation of the reservoir system was one of the largest engineering projects ever undertaken in Rhode Island. In addition to the main reservoir, the new water supply system incorporated the three large former millpond reservoirs, natural Moswansicut Pond (which had also been harnessed for water power), and created the Regulating Reservoir. The first construction contract was awarded in 1917 and clearing of the thousands of trees and stumps along the future shoreline began in 1923 with work on the dams, aqueduct pipes, and treatment plant already in progress. After completion, the main Scituate Reservoir filled and the adjacent water treatment plant started operating in 1926.

The original land purchased or condemned by the City of Providence comprised about a quarter of the 93-square mile Scituate Reservoir watershed. Subsequent land acquisitions – mostly since 1990 – have brought the percentage of land owned by Providence Water to about a third of the total watershed area, with most of the rest in private ownership. Past forest management on the Providence Water property is discussed in Section 9 of this plan. Many acres of private land once used for agriculture have returned to forest. Improved roads built during the middle decades of the 20th Century facilitated automobile travel and have dramatically increased the watershed's relative proximity to Providence and other population centers, although public transportation may have not served the area since the railway. Meanwhile, the post-industrial decline of Providence and other manufacturing centers in the decades after World War II encouraged more people to live outside the city. Waves of housing development during the 1960s and 80s brought new residents to the watershed while the last vestiges of the former agricultural and manufacturing economy vanished: the watershed towns became bedroom communities and most adult residents must now leave the area to work.

Parts of the eastern edge of the watershed are now the outer fringe of suburban sprawl, but the Scituate Reservoir itself serves as a buffer to development that helps maintain the rural character of the land to the west. Along with the three main towns, Providence Water is increasingly engaged in planning initiatives and land use monitoring across the entire watershed, including an active conservation land acquisition program to protect water quality. While most of the private land in the watershed remains forested, there is relatively little active forest management on these properties.

Workers transplating seedlings from the former tree nursery on the Providence Water property in April of 1939.

9. PAST FOREST MANAGEMENT ON THE PROVIDENCE WATER PROPERTY

After the construction of the Kent (now Gainer) Dam and the filling of the Scituate Reservoir, the first forest management activities on the Providence Water property focused on reforesting former agricultural fields.

Beginning in 1925, City engineers and maintenance workers began an aggressive tree-planting program that continued until about 1943. About seven million coniferous seedlings (mostly red and white pine) were planted during this 18-year period. Seedlings were planted on open land to stabilize the soil and around the reservoir shorelines to provide "leaf screens" limiting the number of deciduous tree leaves entering the reservoirs. During the later part of this period, seedlings were also planted under mature hardwood trees on poorer sites. The full rationale for this practice is now unknown, but at the time pine timber was more valuable than that of hardwood species. In any event, the conifer underplanting proved to be a sensible practice as many of these sites are better suited to species such as white pine.

Reforestation efforts were slow for the first several years because of a limited labor force to perform the work. Starting in 1934, hardwoods and brush were cleared from the perimeter of the Scituate Reservoir to allow the shoreline to be planted with conifers. Tree nurseries from around New England and Canada initially supplied the planting stock, but this strategy resulted in a high rate of seedling mortality due to excess handling and roots drying out. With the need for a large number of seedlings to be planted along the reservoir shoreline, managers decided to establish a nursery on the property instead of continuing to rely on outside suppliers. About two acres of seedbeds and ten acres of transplant beds were established below the Kent Dam near where the settling lagoons are now located. Seedlings germinated and remained in the seedbeds for two years and were then transferred to the transplant beds for another year or two before outplanting.

Between 1935 and 1942, about five million seedlings were grown in the Providence Water nursery and planted on the watershed property. With much of this work occurring during the Great Depression, labor for the nursery and reforestation program was provided by the Civil Works Administration and then by the Federal Emergency Relief Administration. Later, operations were handed off to workers in the State Unemployment Relief program. As of 2008, Providence Water had recorded planting a total of 7,138,562 seedlings. White pine was the most commonly planted species (41% of the total), closely followed by red pine (37%). Other species planted included Norway and white spruce, Austrian, jack, and Scotch pine, hemlock, and several others in lesser quantities. 85% of these trees were planted between 1926 and 1940.

During World War II, work related to the war effort was a priority and little work was done on the watershed property. After the war ended, limited forest culture work such as pruning and thinning was conducted from about 1947 to 1950. The first professional forester was hired to manage the property (then totaling about 11,000 acres) in 1951. During the 1950s, major projects included improving roadside aesthetics and pruning the planted conifers. Much of the pruned wood was chipped or piled and burned. Thinning of the conifer plantations to maintain a robust growth rate and prevent stagnation also began during this decade. These early thinnings removed about a third of the volume in a given stand, reducing the density to between 400 and 450 trees per acre. Many of the initial plantings were established at 6' x 6' spacing (1,210 trees/acre) and in some cases as close as 4' x 4' (2,722 trees/acre). Crews of City workers often performed work that did not produce a merchantable product, while private loggers bid to cut standing marked timber and sold the pulpwood to local mills.

After 1959, silviculture shifted to releasing conifers that were planted under hardwoods of poor timber quality. Most of these areas were upland oak stands with gravelly or sandy soils better suited to growing pines than hardwoods. White pine thrived on these sites, while other conifers such as red pine and spruce (while surviving) did not grow well. Release treatments consisted of frilling or girdling. When frilled with an axe, chemicals were sprayed into the frill to ensure that the tree died. A watershed maintenance crew of up to 14 men was employed to perform these tasks and other work on the watershed and distribution system.

As the energy crisis developed in the late 1970s, hardwood trees that were being girdled became commercially valuable as firewood for the first time. Logging contractors took over these pine release harvests, with one of the first forwarders in Rhode Island used on the property in an effort to

protect the residual stand during these operations. Since the white pine was planted under an existing hardwood overstory, growth was slow but white pine weevil damage was often minimized. With demand for home firewood remaining strong, release harvests continued into the 1980s. The planting and cultural work to promote white pine over the decades has resulted in this species dominating the current sawtimber volume on the property, with white pine accounting for 41.5 million board feet or 50% of the total.

During the 1980s, the size of the watershed maintenance crew was reduced and work priorities shifted to landscaping the grounds surrounding the water treatment plant and along the distribution aqueducts. The crew was able to maintain existing fire access roads by clearing fallen trees and repair roadside fencing damaged in vehicle accidents, but did not have the manpower to devote much time to other work on the watershed. During this decade, development and home construction on private land in the watershed increased dramatically and much of the forestry staff's time was dedicated to providing input at public meetings in the watershed municipalities to ensure that water quality concerns were addressed. By the mid-1980s, harvesting activity was limited to cleanup after windstorms and Hurricane Gloria.

During the 1990s emphasis was placed on reducing the acreage of red pine on the Providence Water property. This species was planted extensively during the initial reforestation efforts between 1925 and 1940. Although not native to Rhode Island, red pine was planted for its fast growth and (at the time) lack of susceptibility to insects and pathogens. Planting both red and white pine helped reduce legitimate concerns about the white pine weevil and white pine blister rust. Unexpectedly, red pine developed its own set of problems several decades later with the arrival of the red pine scale (*Matsucoccus resinosae*) and red pine adelgid (*Pineus boerneri*) insects. First reported in Connecticut in 1946, the red pine scale is an introduced invasive species to North America that attacks only red pine and has no natural controls. The insect spread slowly, but it was only a matter of time before it reached Rhode Island.

Many of Providence Water's red pine plantation stands had closed canopies and very little understory development since it had been many years since they were last thinned. To establish native regeneration, the forestry staff prioritized both pure red pine stands and mixed conifer stands including red pine for thinning. Once adequate regeneration was established, overstory removal was planned to release the understory in one or two operations. The presence of the red pine scale on the Providence Water property was confirmed in 1998. With the insect on the watershed

property, the pace of red pine harvesting increased. Since the insect was initially found on the western part of the property near the Westconnaug Reservoir, work began in this area and moved east in an attempt to stay ahead of the insect. This meant that some unthinned stands with little or no regeneration established were intentionally cut more heavily than originally planned.

In stands that were thinned before cutting the remaining red pine, the final harvest often released the established regeneration (usually white pine). In other stands that were cut heavily without prior thinning, the lack of regeneration left the ground in an open condition. Many of these sites still do not have adequate regeneration, with both white-tailed deer browsing and invasive plant colonization inhibiting native hardwood regeneration. Invasive plants are especially problematic near old house sites, many of which were surrounded by fields reforested with red and white pine when the reservoir system was created. The harvesting stayed ahead of the red pine scale and very few accessible and merchantable stands of red pine died. The red pine harvesting strategy did, however, leave some areas occupied by invasive plants (in particular Japanese barberry, Oriental bittersweet, and buckthorn) with little to no desirable tree regeneration present.

While staff maintained records of forest management activities (including planting and stand records, maps, and work logs) over Providence Water's first half-century, the first written management plan was not drafted until 1979. Prepared by Watershed Manager Hans Bergey and Forester Jon Beekman, this plan was general in nature and did not include a forest inventory. This first plan was revised and updated in 1990 by Watershed Manager Marc Tremblay to include proposals for salvaging oaks killed by gypsy moth defoliation, converting upland oak sites to more suitable species, and reducing the acreage of red pine plantations before they succumbed to the red pine scale and red pine adelgid.

In 1996, the Water Resources Department drafted a new and more comprehensive plan that included detailed sections on guiding principles for watershed management, research on water yield and forest management, management options, and management objectives and strategies. It included a ten-year general operational plan to be updated annually and proposed establishing a number of operating procedures. Specific forest stands to be treated in a given year would be established at the beginning of each fiscal year, with those activities carried out included in an annual (fiscal year) report summarizing the Water Resources Division's accomplishments. These annual work plans and summary reports would help the Division monitor its progress towards meeting established goals, while still allowing the flexibility to respond to changing forest conditions. The plan called for drafting treatment proposals documenting current conditions, specific objectives, and desired outcomes before any on-the-ground operations. Senior management would be given the opportunity to review and modify these proposals before the work took place. Despite the Water Resources Division's efforts towards preparing this plan, the Providence Water Supply Board never formally accepted it as the document guiding management of the watershed property.

Instead, Providence Water's managing directors pursued an alternate strategy during the late 1990s. Under the direction of the Chief Engineer and Providence Water Supply Board members, the consulting firm Wagner Forest Management of Lyme, New Hampshire, was contracted to assess Providence Water's forest management practices compared to other utilities and private enterprises. This project encompassed developing a forest management plan accompanied by a harvesting schedule designed to maximize annual financial returns. Development of this plan included establishing Providence Water's first GIS database and conducting an on-the-ground forest inventory of the watershed property. The inventory included 487 plots, with tree growth data recorded from increment core samples at every 10th plot. This data was intended for estimating forest stocking over

the 20-year plan period if the harvest schedule was implemented. The harvest schedule was subdivided into five-year periods based forest type and acreage to be worked each year. The plan established general management strategies, but did not include stand-specific prescriptions or a work schedule. The plan focused on timber management and called for the following levels of harvesting in different stand types:

Table 6: Timber Harvest Levels Called For in Previous Management Plan

Period	Stratum	Acres/Year	Harvest Volume/acre
Years 1-5 (1999-2003)	RP3	85	9.81 MBF & 16.01 cords
	MR3	64	6.46 MBF & 10.49 cords
	MR2	15	3.52 MBF & 6.61 cords
	S3	86	5.92 MBF & 10.95 cords
Years 6-10 (2004-2008)	S3	86	5.92 MBF & 10.95 cords
	M2	176	2.10 MBF & 8.05 cords
	M3	206	2.21 MBF & 8.07 cords
Years 11-15 (2009-2013)	H3	469	1.38 MBF & 6.51 cords
	S2	42	2.19 MBF & 6.24 cords
	UO3	94	0.63 MBF & 6.09 cords
Years 16-20 (2014-2018)	H2	442	1.23 MBF & 6.08 cords
	S2	42	2.19 MBF & 6.24 cords
	UO2	114	0.69 MBF & 3.53 cords

Wagner's harvesting schedule was generally followed for the first two five-year periods. Stands containing red pine and sawtimber-sized white pine stands were the focus of silvicultural work during the first five-year period. In the second period, work continued in red and white pine stands along with some work in mixed sawtimber-size stands. During the early 2000s, repeated insect defoliations and a summer drought resulted in mortality and crown dieback in oak stands on poor soils in the P and Q Blocks. Although not designated for entry until later in the 20-year plan, harvests were conducted in some of these impacted stands to salvage the dead and dying oaks and to scarify the ground in an effort to establish pine and hardwood regeneration. Following harvesting, white pine and pitch pine seed were sowed in some areas. Invasive species are not a problem in most of these stands, but white-tailed deer continually browse back hardwood seedlings or stump sprouts that become established. Deer impacts on regeneration were believed to be so severe that a consultant was hired in 2008 to evaluate the conditions where much of this salvage harvesting was performed (in the P Block or Tunk Hill Management Unit). The deer management consultant's report is on file with the Water Resources Division.

Around 2008, small-diameter white pine became marketable both as sawtimber and pulpwood. Small-diameter pine had previously been difficult to market due to long trucking distances to mills. With this development, thinning dense white pine stands with a high proportion of pulpwood became feasible. As of 2011, several larger areas of this forest type have recently been and or are currently being thinned. While the revenue from these thinnings is insignificant, the accelerated diameter growth and vigor of the residual trees (as in any early thinning) is the real benefit.

The Scituate Reservoir is buffered by forestland on all sides.

10. FOREST COVER TYPES ON THE PROVIDENCE WATER PROPERTY

The basic unit of management on the Providence Water forest and across southern New England is the forest stand. A stand is defined as a group of trees occupying a given area sufficiently uniform in species composition, age, structure, site quality, and condition so as to be distinguishable from the forest on adjoining areas. On the Providence Water property, there are more than 800 recognizable stands ranging from 1 to 155 acres in size. Although there are many individual stands, they are spread across a limited number of forest cover types. A forest cover type is expressed as a tree species or group of species having the greatest presence (i.e. in terms of volume for older stands or number of trees for younger stands) in a stand. Forest cover type in its simplest form can be broken down into hardwood, softwood, and mixedwood. In further describing the forest for management purposes, size class and density designations are included. More details are provided in the forest inventory section.

The forest on the Providence Water property is comprised of four main cover types: (1) mixed oak-hardwood, (2) upland oak, (3) pine-hardwood, (4) white pine-softwood. Three additional types are designated for management purposes: (5) forested wetlands, (6) “older growth” stands, and (7) open areas. While each stand can have unique attributes, on a large forest it is necessary to classify stands into cover type strata to create useful “big picture” inventory data and to create a practical management plan. Different stands within a cover type can have great variation when considering features such as understory composition and herbaceous plants. If a stand feature or inclusion within a larger stand is rare on the Providence Water property or has special value, it is noted in the relevant management unit plan and may be designated as a reserve. This section provides a general description of the main cover types and discusses primary management objectives, silvicultural approaches to achieve these objectives, and information on how these practices will impact the forest. This section also includes information on secondary cover types found on the property including forested wetlands, open areas, and “older growth” forest stands.

Since the mission of Providence Water is to provide clean drinking water to its customers, water quality and to a much lesser extent water quantity is the primary objective for all management activities on the watershed property. Secondary objectives include (1) ensuring long-term forest productivity and health; (2) protecting unique areas and cultural resources, (3) optimizing the long-term value of timber resources, (4) providing habitat for a variety of wildlife species, and (5) providing support for public education and research. Providence Water believes that actively managing its forestland will allow it to meet these secondary objectives, which contribute to the overall mission. The secondary objectives are broad and how they are met will vary among forest cover types and the particular sites. Not all secondary objectives will be applicable to each cover type or individual stand. Specifics on proposed activities during the 10-year management period can be found in the Management Unit summaries and activity schedules.

10.1 MIXED OAK-HARDWOOD COVER TYPE

This type occurs on about 4,387 acres across the watershed property with the majority of stands in the small sawtimber and sawtimber size classes with complete crown closure. Table 4 in the Forest Inventory section provides information on the acreage of this type in different size and density classes. The primary tree species found in this type are black, Northern red, scarlet, and white oak, with other species such as hickory, red maple, white ash, sugar maple, black birch and white pine present as a minor component. Chestnut oak is also sometimes found in this type. This type is usually found on the more fertile, moist, moderately well drained sites, often adjacent to watercourses, where the hardwood tree species grow best. The soils that best support this type are the Woodbridge and Paxton series, with red oak site indices of 72 and 65, respectively. As the soils become more xeric, black, scarlet and white oaks become more common and red oak less common. A tall shrub layer of witch-hazel (*Hammamelis virginiana*) is sometimes present along with sassafras (*Sassafras albidum*) to a lesser extent. Other shrub species found include lowbush blueberries (*Vaccinium pallidum* and *V. angustifolium*) and sheep laurel (*Kalmia angustifolia*). Seedlings and saplings are often sparse due to the dense canopy cover and deer browse. The ground layer is typically a mix of ferns, grasses, and sedges where repeated browsing has limited the abundance and diversity of species.

The mixed oak-hardwood forest type is the most common forest type on the property and represents more than a third (36%) of the woodland acreage. Almost all the hardwood stands developed naturally and their distribution is a result of past land use – as an overall pattern, they tend to be located away from the reservoirs and toward the edges of the property. Also, a higher proportion of hardwoods are found on the west side of the property. Including the upland oak type, the hardwood small sawtimber (H2/3A) and sawtimber (H3A) size and density classes are the largest inventory strata, together comprising 4,401 acres (89% of hardwood stands and 36% of the total forest). Timber volume in mature stands averages about 7 MBF/acre. Only 1.5% of the hardwood acreage is in an early successional stage of development. Regeneration is poor since oaks and other hardwoods are preferred deer browse species. Red maple and black birch, somewhat less preferred by deer, are regenerating better than most other hardwood species.

Continuous Forest Inventory (CFI) plot measurements indicate that this type has been growing at a rate of approximately 0.66 cords/acre/year over the last 10-year period. More information on Providence Water's CFI system can be found in Section 12.2.

After maintaining water quality, primary objectives for the mixed oak-hardwood cover type are to ensure long-term productivity and forest health, manage for a variety of wildlife species, protect unique features found within these stands, and optimize the long-term value of the timber resources.

Silviculture

Traditional even-aged management of oak stands using the shelterwood regeneration method ultimately requires removing the overstory, or at least a majority of the canopy, after securing

advance regeneration through a series of intermediate treatments. When conducted over large areas, the final shelterwood removal cut that allows full sunlight to reach the seedlings is often disliked by a significant percentage of the public. The negative perception of these overstory removals has curtailed their use in southern New England. Over the past 20 years or so, the impacts of increasingly overabundant deer browsing on oak and other hardwood seedlings have further complicated managing this forest type. Fire suppression in oak forests in the eastern United States may also be leading to an increase in thin-barked species such as red maple and black birch that were killed more often during fires than the oaks (black birch is not a preferred deer browse species). This combination of factors can make it difficult to regenerate mixed oak-hardwood stands, as securing the number of seedlings needed to replace the overstory may be problematic.

Since many of the H3A mixed oak and hardwood stands are approaching maturity, beginning the regeneration process in some of these stands would normally be planned to increase the acreage in the seedling/sapling size class. Given the current level of deer impacts, however, regenerating oak-hardwood stands may be difficult until deer numbers are reduced. Silvicultural work in these stands over the next ten years will focus on improvement thinnings to increase tree vigor. If deer impacts are reduced, regeneration treatments in the form of patch cuts or shelterwoods can be started. Group selection or patch cuts should begin to convert these even-aged stands to an uneven-aged structure and increase species diversity as a mix of species with differing light requirements become established. Patch size should be the smallest area possible that will meet regeneration goals. Employing the group selection method will maintain forest cover over a higher portion of the stand and diminish possible water quality impacts. If shelterwood harvests are implemented, the final overstory removal cut will not be conducted until adequate regeneration is present. Irregular shelterwoods (leaving a portion of the overstory) will be preferred to moderately harsh visual impacts, especially along public roads.

Impacts from Proposed Activities

Improvement thinnings in the mixed oak-hardwood and mixed oak types will improve overstory health by favoring the most vigorous trees. Following BMPs will minimize any possible impacts on water quality. Vernal pools and wetlands will be protected by marking a no-harvest buffer 50 feet from the edge of these features. These thinnings will increase timber growth as the more vigorous residual trees will increase their growth rate and more fully occupy the site. Wildlife habitat for some species may be improved, as logging slash will provide more downed coarse woody material, while snags and den trees will be retained when they do not pose a logging hazard. In areas where there are few white oaks with large healthy crowns, these trees will be favored for retention because of the value of their acorns to wildlife.

Soil conservation will be maintained by limiting operations to times of the year when the ground is dry or frozen and limiting the size of material which can be removed from the site to logs greater than 4” in diameter. Over time, finer woody material will be incorporated back into the soil as it decomposes. Cultural and archeological resources will not be significantly impacted by these operations. Cemeteries and foundations will be identified in advance and logging contractors will made aware of their location and importance prior to commencing operations. The impact to stone walls will be minimized by using existing barways or, if none are present, selecting a section of wall in disrepair to establish a new access point. Many problems associated with timber harvesting can be avoided by maintaining good relations with the logging contractor, making them aware of any special sites within the harvest area, and making frequent site inspections.

10.2 UPLAND OAK COVER TYPE

This type occurs on approximately 1,230 acres across the watershed property. Table 4 provides information on the acreage of this type in different size and density classes. The primary tree species found in this type are scarlet and white oak with lesser amounts of black, chestnut, and red oak, and red maple. White pine occurs to varying degrees depending on the available seed source. Pitch pine can also be found on some of these sites and it is becoming a dominant tree in some areas. Prior to the chestnut blight, American chestnut was common in these areas and stump sprouts are still found today. The upland oak cover type is found on some of the less productive sites on the property and it is strongly associated with Canton and Charlton soils, which are well to excessively drained and very acidic. According to the Soil Survey of Rhode Island, these soils generally have a site index of 58 for white pine and 52 for red oak. The hardwoods found on these sites are of poor vigor with low growth rates. CFI plot measurements show that stands in this type have grown at the rate of about 0.27 cords/acre/year over the last 10-year period, compared to 0.66 cords/ac/year for the mixed oak-hardwood type on better sites. Many of these upland oak stands have been severely impacted by repeated defoliation from gypsy moth (*Lymantria dispar*), orange striped oakworm (*Anisota senatoria*), and, more recently, forest tent caterpillar (*Malacosoma disstria*). Drought, the two-lined chestnut borer (*Agrilus bilineatus)*, and shoestring root rot (*Armillariella mellea*) have also contributed to the stresses affecting many of these stands, where there is up to 75% oak mortality on some individual sites.

The upland oak type makes up 10% of the total forest. Although they comprise only 20% of the stratum acreage, the upland oak stands were treated as a subset of the larger hardwood cover type during the watershed forest inventory. Scattered around the higher, droughtier, and rockier parts of the property, the upland oak areas were generally never cleared for agriculture because of the unproductive soils. Most of the upland oak stands are in the small sawtimber or polewood size classes, having smaller trees, less dense stocking, and lower merchantable wood volumes than mixed oak-hardwood stands. The smaller diameters reflect the poorer growing conditions rather than a young age.

Black huckleberry (*Gaylussacia baccata*), low bush blueberry (*Vaccinium pallidum*), and sweet fern (*Comptonia peregrina*) often form a dense shrub layer limiting tree regeneration and growth. Some of these areas are starting to look like heathlands with the huckleberry and stunted or nonexistent tree regeneration under a sparse canopy of oak. The huckleberry is becoming more prominent as browsing deer prefer the blueberry.

The primary objective for the upland oak type is to ensure long-term forest productivity and health. Other objectives include managing for wildlife and protecting unique features found within these stands. Timber is a lower objective due to the poor growing conditions. As pine becomes a larger overstory component in this type, timber may become more important but it will probably never be a primary objective.

Silviculture

The types of silviculture that can be successfully implemented in this type are limited by the relatively unproductive soils. White pine and pitch pine will be favored species in this type and will be released from poor-quality overtopping oaks when possible. Release harvesting on these sites will be very light and focus on specific trees. It will be important to emphasize the need to protect the trees being released to logging contractors working in these stands. White pine and pitch pine seed can be sown on disturbed areas after harvesting to increase the likelihood of these species becoming established. Harvesting small patches of poor-growing oak will create disturbed areas that can then be seeded. Operations in these stands should be done with low or no snow cover to increase the soil scarification. Planting pine on these sites is difficult as the soils are typically very rocky and survival rates are usually low, and deer will browse the pines if other more desirable species are not readily available. The areas with high oak mortality will be salvaged if the dead trees are a hazard or if it will promote pine on these sites. Optimizing revenue from timber products on these sites is not a priority.

Impacts from Proposed Activities

Proposed silvicultural activities should benefit the upland oak cover type by increasing the pine component and allowing existing pine to more fully occupy these sites. BMPs will be followed during all harvesting operations to minimize any impacts to water quality. Streams and other water bodies will be avoided and excluded from timber harvests. By promoting pine in these areas, the long-term productivity and health of these stands will improve along with the potential for more valuable timber products. Species diversity will increase as existing upland oak stands transition to a mixedwood composition. These areas should benefit greatly from deer hunting as reduced deer impact will allow tree regeneration to become more readily established and advance into the understory. Other wildlife and bird species will benefit as more soft and hard mast will become available to them and birds will be able to nest in the shrub and intermediate layers of the forest. Due to light levels of past land use, these upland oak areas do not have a high incidence of foundations, cemeteries, or other cultural resources. When artifacts are encountered during timber harvest planning and layout, these resources will be protected by marking and avoiding them and using existing stone wall barways whenever possible.

10.3 PINE-HARDWOOD COVER TYPE

This mixedwood type occurs on about 3,022 acres across the watershed and the primary species are white pine and black, red, scarlet, and white oak. Other species that are frequently present include red maple, black birch, and black cherry. The shrub layer includes black huckleberry, blueberries, and sweet fern, but not at the height or densities found in upland oak stands. The herbaceous layer is usually sparse with little diversity. Table 4 provides information on the acreage of this type in different size and density classes. The pine-hardwood type is found on many different soils across the watershed and growth and vigor varies with the soils. This type is limited on the most productive soils, as hardwoods tend to outcompete the white pine over time on the best growing sites. Mixedwood stands are most prevalent on sandy soils that are not excessively drained where pine grows well and hardwoods can find small areas that are moderately drained to be more competitive.

These soils include Hinckley gravelly sandy loams and the better Canton-Charlton soils, which have site indices ranging from 60-65 for white pine and 50-65 for northern red oak.

After hardwoods, the mixedwood cover type is the second most common, representing 25% of the total forest. Two thirds of the mixedwood acreage is closed-canopy woods. This type is scattered around all parts of the property and, not surprisingly, often occurs between areas of hardwoods and softwoods. Fully 57% of these stands are in the small sawtimber size class, in part because the mature conifers are typically larger than their hardwood counterparts. Timber volume in the sawtimber-sized stands runs about 7-10 MBF/acre. 5% of mixedwood stands are in an early successional stage, which is a slightly higher percentage than any other cover type, and 3% are considered uneven-aged. Overall, the amount of understory regeneration is moderate, and it is dominated by white pine with lesser but significant hardwood components black birch and red maple.

CFI plot data indicate that these stands have been growing at the rate of about 1 cord/acre/year over the last 10-year period, which is greater than the average for the forest as a whole. This productivity is due to both the better quality growing sites where these stands are found and the presence of white pine, which is one of the faster-growing trees on the watershed when it receives adequate sunlight.

The primary objectives for the mixedwood type are ensuring long-term forest productivity and health, optimizing the long-term value of timber resources, protecting unique features found within these stands, and managing for wildlife.

Silviculture

A range of silvicultural approaches can be applied in these pine-hardwood stands depending on species composition and specific site conditions and objectives. Many of the mixedwood stands were once classified as hardwood, with the softwood component growing to become a significant percentage of the stocking relatively recently. In many of these stands, the hardwood species are those comprising the upland oak type described above. In these areas, activities over the next 10 years will focus on improving timber quality and releasing white pine from competing poor hardwoods. In sawtimber-size stands on better soils, even-aged regeneration methods such as a series of shelterwood cuts could be employed. This method typically requires a final overstory removal to release the established regeneration. Even if individual trees or groups of legacy trees are retained, the majority of the canopy is removed during one harvest. The disturbance in conducting these operations over a large area may have water quality implications and the appearance may be unsightly until the younger age class is well established. An alternative strategy is uneven-aged management. This approach would employ group selection harvests or patch cuts to create gaps just large enough to have favorable light conditions for moderately shade-tolerant species. The number of patches to cut in a stand can be calculated when the desired time between entries, rotation length, and patch size are determined. The patches can be spaced throughout the stand to create new age classes during each entry. For planning future entries and establishing a cutting cycle, it will be important to document which stands are selected for uneven-aged management.

Impacts from Proposed Activities

Silvicultural activities in this cover type will improve long-term forest health and productivity as new age classes are created through group selection or shelterwood harvests. By establishing the next generation of trees in some areas, this multi-aged forest will be more resilient and capable of rebounding from natural disturbances that may affect the overstory. The success of these regeneration efforts will depend on controlling impacts from overabundant white tailed deer through hunting or

other strategies such as fencing. Although the patches created in group selection harvests will be too small to meet the needs of wildlife species requiring large early successional thickets, they will undoubtedly provide cover, nesting sites, and food sources for certain birds. If shelterwood cuts are employed, the final overstory removal cut will for a time create larger areas of early successional thickets that are used by a different group of birds and animals. Planning these operations as commercial timber harvests (in which Providence Water receives income instead of paying for contractor services) will achieve the goal of optimizing value from timber resources. To attract bids from logging contractors, commercial harvests need to be packaged as economically viable projects that involve cutting a sufficient volume of standing timber. This may require combining work in adjacent or nearby stands in one area or including stands in more than one location. The mix of wood products will depend on the type of harvest. In a series of patch cuts, both cordwood and sawtimber will be harvested during each entry. In shelterwood harvests, early entries remove lower-quality growing stock while leaving the dominant canopy trees to shelter the regeneration. The final harvest removes the majority of the largest and most robust overstory trees remaining in the stand.

On sites transitioning from upland oak to mixedwood, long-term forest health, productivity, and timber quality will improve, as the pine being released is better suited to the soils on these sites. Growth of pine has been shown to outpace that of hardwoods on these sites. Silvicultural activities on these transitioning sites should have little effect on wildlife. As the pine component increases, hardwoods will still occur in numbers large enough to provide plentiful hard mast.

Regardless of the type of timber harvest, cultural resources and unique areas will be protected by identifying them in the field and conveying their importance to contractors working on the site. Limiting the size of material that can be removed from the site will protect soil productivity. Tree tops, branches, and coarse woody material under 4 inches in diameter will be required to remain onsite to help protect the soil and eventually decompose.

10.4 WHITE PINE-SOFTWOOD COVER TYPE

The dominant conifer species found in the Providence Water forest is white pine and this type occurs on approximately 2,708 acres across the watershed property. Table 4 provides information on the acreage of this type in different size and density classes. White pine was planted extensively along with red pine after the Scituate Reservoir was created. Secondary softwood species also included in this type are pitch and red pine, Norway and white spruce, and Eastern hemlock. Hardwoods are present as a minor component (less than 25% of the stand) or not at all. As many of these stands were established through open planting or underplanting and subsequent release, they can be found on a wide variety of soils. White pine typically grows best on moist sandy loams such as Woodbridge and Paxton, but it is unable to compete with hardwoods on these sites without human intervention. Many good white pine stands are found on these soils because they were planted and the pine was favored in past thinnings. As these areas are regenerated, it is expected that hardwoods will also become established. Where deer impacts are more severe, hardwood establishment will probably be very limited since these species are preferred browse over white pine. The result is that these sites will remain dominated by white pine unless deer numbers are reduced so that they can support a mixed species composition. The understory

layer in these stands can range from nonexistent (where the closed canopy and heavy needle layer have excluded other plants) to dense white pine regeneration (in thinned stands with more open canopies). These densely stocked white pine understories may at first appear healthy, but they lack diversity as a result of deer browsing and a more varied species composition would be preferable for forest health. In some stands, a thick layer of hay-scented fern has become established in part due to deer impacts and the ferns will make regenerating these stands more difficult.

The white pine-softwood cover type comprises 22% of the total forest. Most, but not all, of these stands resulted from planting conifers on former farmlands or under an oak canopy. Softwoods tend to be concentrated around the reservoirs because these species were considered to be desirable to have in close proximity to the water when the water supply system was developed. Due to recent thinnings and regeneration harvests, the softwood type has a greater diversity of stand structures and densities than others – only 48% of this type is closed-canopy woodland. Softwoods notably have the greatest volume per acre, with 70% of these stands sawtimber-sized and averaging about 13-15 MBF/acre with significant cordwood in addition. About 3% of these stands are in an early successional phase of development and 5% are under uneven-aged management. Since conifers are less preferred by white deer, the softwood stands have abundant understory regeneration dominated by white pine.

CFI plot growth estimates indicate that these stands have grown at a rate of about 1.6 cords/acre/year over the last 10-year period, or more than twice the average for the forest as a whole. Many of the white pine stands have been thinned over the past 15 years and are making good use of the additional growing space.

The primary objective for the white pine-softwood type is to maintain long-term forest productivity and health. Other objectives include optimizing the long-term value of timber resources and protecting unique features that occurring in these stands. Historically, managing for wildlife has been a secondary concern in these stands since establishment, with early and intermediate treatments intended to promote the softwoods and discriminate against hardwoods. Large areas of a single coniferous species are often viewed as poor wildlife habitat due to the lack of species diversity and low hardwood mast production.

Silviculture

The white pine-softwood type offers some of the best opportunities to manage for traditional wood products (sawlogs and pulpwood) on the Providence Water property. Specific management strategies depend on the conditions present in individual stands. Polewood and small sawtimber-size stands will be thinned to increase the growth rate and live crown ratio of the remaining trees. Hardwoods will generally be retained at a higher rate than in the past to increase species diversity and hard mast for wildlife (in previous decades, hardwoods were cut or girdled in place to favor the softwoods). Larger areas of pure softwoods are often viewed as having low wildlife value, but white pine provides seeds, needles, buds, and bark and hosts insects for a variety of bird species. The relatively small individual size of Providence Water's softwood stands (few are more than 50 acres) and hardwood retention will help make them more attractive habitat for a range of wildlife species.

Regenerating these even-aged stands can be accomplished through a series of shelterwood cuts where the next generation of trees is established under partial sun and then released through subsequent harvests. The last harvest will remove the majority of trees in the overstory, exposing the younger age class that has already been established to full sunlight. Groups of overstory trees or individual trees can be left as "legacy trees" that are never cut, a practice often described as an

irregular shelterwood or green tree retention. These trees are left to grow larger, die, and eventually fall to the ground and are beneficial different to wildlife species at each stage in the process. Trees selected for retention should have the potential to develop some attribute(s) such as size, cavities, or possible dens that set it apart from other trees in the stand. Some trees could also be girdled, creating snags providing valuable habitat structure for certain bird species. Uneven-aged management using group selection harvests as described in mixedwood type section above is also possible in white-pine dominated stands.

Impacts from Proposed Activities

The silvicultural activities proposed for softwood stands during the 10-year management period should help to improve the health of the remaining canopy trees by increasing their growth and vigor. Considering the property as a whole, forest resilience will also be improved as regeneration harvests create new age classes. Water quality and soil conservation will be maintained by following BMPs and inspecting harvesting activities on a regular basis and more frequently during times when soils may be more susceptible to rutting and erosion. Most tops, branches, and other coarse woody material will remain onsite to stabilize and become incorporated into the soil over time. Over time, these activities will improve both the quantity and quality of timber grown. During thinnings, trees in less favorable canopy positions are usually cut to increase the growing space available for the most vigorous dominant trees. Most of these residual trees will be eventually harvested when they reach a larger size. Thinnings should improve wildlife habitat over the long term by increasing the amount of light reaching the forest floor and stimulating the growth of the herbaceous layer. Many of the existing closed-canopy softwood stands have very few plants in the lower layers. By retaining hardwoods in these stands, mast that is used by a variety of wildlife species will be maintained or increased as the hardwood crowns expand. Where they do not pose safety hazards, standing dead trees (both hardwood and softwood) will be retained. These snags provide habitat for cavity-dwelling animals and are important for a variety of insects and the birds that feed on them.

10.5 FORESTED WETLAND COVER TYPE

This type includes seasonally flooded forest areas dominated by red maple. Due to their fragile soils, these stands are not candidates for silvicultural activities that promote the growth of traditional wood products. Many small seasonal streams and areas of standing water are usually present in the early spring and after heavy rains. The most common soils associated with this type are the Ridgebury, Whitman, and Leicester series. Other soil types underlying forested wetlands include Paxton and occasionally Woodbridge soils. After red maple, other trees found in this type include white pine, hemlock, white ash, green ash, black gum, and yellow birch. Common shrub species are winterberry (*Ilex verticillata*), spicebush (*Lindera benzoin*), highbush blueberry (*Vaccinium corymbosum*), swamp azalea (*Rhododendron viscosum*), and sweet pepperbush (*Clethra alnifolia*). These wetland areas often have a diverse ground layer, with skunk cabbage (*Symplocarpus foetidus*), jewelweed (*Impatiens capensis*), sensitive fern (*Onoclea sensibilis*), and cinnamon fern (*Osmunda cinnamomea*) occurring frequently. The invasive shrub Japanese barberry (*Berbis thunbergii*) is also often found in these areas.

Representing 6% of the total forest, the Providence Water property includes about 778 acres of forested wetlands that can largely be characterized as “red maple swamps,” as is typical in the Northeast. While this type is found in low areas across the property, the two largest forested wetlands are located along Quonopaug and Swamp Brooks. Overall, trees in wetland areas are densely stocked, smaller than those in the other types (except for upland oak), and distributed evenly between the pole and sawtimber size classes (26% poletimber, 39% mixed, 25% sawtimber). As a result, sawtimber volumes are generally lower than those across the rest of the forest while cordwood volumes are relatively high. With open wetlands excluded from this type, only 1% of these stands are in an early successional stage. Regeneration in these hardwood-dominated stands is poor and mostly red maple.

Forested wetlands are important areas for capturing nutrients and sediments before reaching streams and buffering the effects of heavy rain and snowmelt. Stands in this type should be excluded from timber harvesting because of the potential for negative impacts on water quality.

The primary management objectives for these forested wetlands are maintaining long-term forest health and protecting unique plants that may occur within them.

Silviculture

Due to the fragile soils, no timber harvesting will be carried out in forested wetlands. Given the high red maple component in most of these stands, maple sap production may become a viable product with the tapping and processing technologies. Limiting factors will be the number of tap trees, accessibility, and the amount of standing water during the tapping season. To increase crown

size and sap production, crop trees may be individually released with cut trees left on the ground. Even this type of operation may have negative impacts on the shrub and ground layers due to foot traffic, trees falling on other plants, and increased sunlight. Japanese barberry is found in some of these stands and where this invasive shrub is widespread it limits the growing space available to native shrubs and ground plants. Some of these stands will be targeted for Japanese barberry control during the 10-year management period.

Impacts from Proposed Activities

Since no timber harvests are planned for these areas, there will be no impacts. If efforts are undertaken to control Japanese barberry, methods must be appropriate for use in a wetland setting. By law, any herbicides used in these areas must be approved for wetland use. Other methods such as flame weeding or mechanical cutting/pulling will protect water quality.

10.6 "OLDER GROWTH" COVER TYPE

During the forest inventory, a number of forest stands were noted as having the potential to develop characteristics of old growth forest. True "virgin" stands that have never seen timber harvesting are exceptionally rare in southern New England as most of the undeveloped land has either been cleared for agriculture or logged at least once. Characteristics of old growth structure include a wide range of tree sizes, less common species, large living trees, big standing snags and fallen logs, and gaps in the canopy where large trees have fallen. Except for a few areas included in this type because active silviculture is impractical, the stands identified as "older growth" have some of these characteristics. Moreover, management records confirm or strongly suggest that logging has not occurred in these areas during Providence Water's tenure of ownership. Providence Water has designated about 300 acres for passive management where nature will take its course and the forest may slowly develop further attributes of old growth structure over a long time period. Documentation of these areas in plans and maps is important so that future land managers know that these areas were left alone for specific reasons and not by chance. While the sizes of these individual areas are too small to attract larger mammals that once inhabited the area, many bird species are known to prefer the attributes found in these "older growth" stands.

Impacts from Proposed Activities

By designating areas for no active management, Providence Water has made a decision to value the benefits that older growth characteristics may provide over the current and future timber value on these areas. Wildlife habitat diversity and long-term forest health will be increased as natural processes are allowed to take place.

10.7 OPEN AREA COVER TYPE

Open areas can either be maintained for the long-term or may exist for a relatively short time period, such as when an area is being regenerated using an even-aged silvicultural method. This type is limited to long-term open areas that are being managed to remain grasslands or shrublands to benefit wildlife species that require them for all or part of their life cycle. Creating and maintaining open areas can be expensive. Repeated treatments are required to keep them open; otherwise they will eventually revert back to forest in a normally functioning ecosystem.

Providence Water recognizes the value of these habitats and converted approximately 65 acres of the former Joslin Farm hilltop acreage to warm season grassland in 2009. This area will be maintained as grassland through periodic mowing or burning to prevent it from reverting to shrubland, young forest, and eventually closed-canopy forest. Along Route 116 north of the North Scituate village, another 20 acres are currently being maintained as hayfields that provide some habitat benefits to wildlife. Open areas under passive management at the time of plan preparation include former agricultural fields on several relatively recent land acquisitions. Over the 10-year management period, Providence Water will continue to maintain and manage these long-term open areas and will also create new ones.

In addition to grasslands, Providence Water will also create and manage transitional brushy thickets for other wildlife species that require these vegetation conditions, such as cottontail rabbits and woodcock. To create the required conditions, additional steps such as fencing out deer and planting or sowing seed after cutting the overstory may be necessary. Areas that have already been cut and not regenerated to tree species can be enlarged and, if necessary, fenced and seeded or planted. To provide contiguous patches of brushy vegetation large enough to meet these species' habitat requirements, these areas will be at least 12 acres in size and larger when possible.

While these openings represent only about 150 acres or 1% of the total land area of the Providence Water property, they are important to many wildlife species and contribute to habitat diversity.

Impacts from Proposed Activities

The major impact of these wildlife habitat manipulation activities will be to greatly increase the availability of early successional habitat on a small percentage of the total land area of the Providence Water property. Overall forest health will benefit from the diversified structure, while population numbers of the declining wildlife species that require these habitats will likely increase. Timber management is not an objective for these areas and the total acreage available for commercial harvesting will decrease slightly as these sites are taken out of production. Soil conservation will be maintained or improved. On some former red pine plantation sites that have not regenerated with tree species, measures will be taken to secure early successional species that will stabilize the soil. If contractors are hired to create and/or maintain these habitat areas, contracts will include provisions to protect cultural resources.

11. FOREST INVENTORY: SAMPLING DESIGN, METHODS, AND DATA

PWSB forestry staff performed a field inventory of the Scituate Reservoir Watershed Forest between July 2009 and January 2011. This inventory intended to include all stands on the property larger than 5 acres, with a sampling intensity of one plot per five acres (e.g. five plots in a 28-acre stand). The complete data set included 1,868 sampling plots. One goal of the project was to obtain inventory data specific to individual stands across the forest, since this information had previously been unavailable. Where practical within individual stands, a systematic sampling grid (usually 500 x 500 feet, measured by pacing) was employed to determine the location of the plots. Plot locations were estimated and hand-recorded on paper maps, but their precise locations were not recorded using GPS.

At each sampling point, both live and dead trees greater than 3.5 inches in diameter were selected using variable-radius plots and a 10 basal area factor angle gauge or prism. Using this method, the probability of individual trees being sampled is determined by their size (diameter). At each plot, the species, diameter at breast height (DBH; 4.5 feet) to the nearest inch, and tree classification (sawtimber, cordwood, cull, wildlife tree, dead) were recorded. Sawtimber volume was estimated by measuring the number of 16-foot sawlogs, to the nearest half-log, in merchantable hardwood trees greater than 12 inches DBH and softwood trees greater than 10 inches DBH. Cordwood volume was estimated by measuring the number of 16-foot logs, to the nearest half-log, in merchantable hardwoods 6 to 11 inches DBH, softwoods 6 to 9 inches DBH, and also in larger trees not of sawlog quality. Thus, different sections of a single merchantable tree could be assigned different product classifications (sawtimber, cordwood, cull).

Using the same overstory variable-radius plot center established at each sampling point, tree regeneration abundance was estimated using fixed-radius understory plots. Saplings greater than 4.5 feet in height but less than 3.5 inches DBH were individually counted within 1/100 acre plots. The total number of saplings was estimated in “doghair” stands where stocking was very dense. Seedlings greater than 1 foot but less than 4.5 feet in height were individually counted within 1/1,000 acre plots. The regeneration statistics in the management unit plans are the combined estimated number of seedlings and saplings per acre of all tree species.

The presence of understory or non-canopy tree species was recorded when they were found within the 1/100 acre fixed radius plot. One exception was made for huckleberry and blueberry: given the dense ground layer of these species throughout much of the forest, huckleberry and blueberry were not recorded at plots where they had only a very minor presence. Meanwhile, the presence of invasive plant species was recorded when recognized species were found within sight of the plot center.

In each stand, qualitative data was also noted for documentation in the appropriate management unit plan. Qualitative data included information on species abundance and distribution, timber quality, wildlife, cultural resources, and management possibilities and limitations.

Quantitative inventory data was collected, stored, and processed using the TwoDog 2.6 forest inventory software suite developed by Foresters Incorporated, Inc., and now owned by Fountains America, Inc. Field inventory data was initially recorded using handheld computers and the PocketDog mobile software application and later transferred to the companion OfficeDog desktop software program. All forest inventory statistics were calculated using OfficeDog and Microsoft Access. Stand acreages were estimated using ESRI ArcGIS software.

Individual forest stands were assigned to one of 55 strata based on cover type, size class, and

density criteria as detailed below. Stands were characterized in further detail by primary and secondary tree species composition. A summary of the statistical data for each inventory stratum is listed in Table 8 below.

Section 12.2 (Successive Forest Inventories) provides interpretation of the inventory data at the property level and comparison with the previous inventory.

Data provided for individual stands greater than 15 acres (with at least three inventory points) is based on the measurements gathered in those stands. Data provided for stands less than 15 acres is based on the pooled small stand inventory points and data for the relevant stratum.

Table 7: Forest Inventory Codes

Cover Type:

Stand Type Code	Criteria
H - Hardwood	Greater than 75% of volume in hardwood species
M - Mixedwood	Between 26-75% of volume in hardwood species
S – Softwood	Greater than 75% of volume in softwood species

Size/Age:

Size Class Code	Criteria
1	Seedlings and saplings
2	Pole-to-cordwood sized
3	Sawtimber sized
U	Uneven-aged

Stocking:

Density Class Code	Criteria
A	80-100% crown closure
B	50-79% crown closure
C	20-49% crown closure
D	Less than 20% crown closure
U	Uneven-aged

Trees:

Code	Species/Group
MO	Mixed oaks: red, white, black, & scarlet. Usually on better sites
UO	Upland oaks: scarlet, white, black. Usually on poorer sites
MH	Mixed hardwoods: no dominant species. Usually on better sites
PH	Pine (usually white) and hardwoods
WP	White pine
MS	Mixed softwoods: white pine, red pine, pitch pine, spruce (none dominant)
TH	Tolerant hardwoods: sugar maple, yellow birch, beech (none dominant)
IH	Intolerant hardwoods: aspen, black cherry (none dominant)
RM	Red maple
RP	Red pine

HK	Hemlock
SP	Spruce
PP	Pitch pine
SM	Sugar maple
PA	Aspen
BE	Beech
RO	Red oak
HI	Hickory
YB	Yellow birch
BB	Black birch
BC	Black cherry

Table 8: Forest Inventory Strata Statistical Data

Stratum	# Plots	Acres	Trees/ac	Basal Area/ac	Mean Stand Diameter	MBF/ac	Cords/ac	Regen Stems/ac
H1A	0	15	-	-	-	-	-	-
H1C	0	3	-	-	-	-	-	-
H1D	2*	37	5	5	8.9	N/A	0.2	±300
H1/2A	3	11	104	33	7.8	1.7	3.5	±4,700
H1/2B	1*	5	80	40	9.6	0.7	2.7	±4,100
H1/2C	1*	13	211	50	6.6	2.0	1.8	±100
H2A	12	159	246	84	7.9	1.5	9.8	±550
H2B	18	130	161	59	8.1	1.3	6.6	±406
H2C	40	213	99	37	8.2	1.0	3.5	±508
H2D	0	24	-	-	-	-	-	-
H2/3A	405	2,349	190	105	10.0	4.8	9.3	±650
H2/3B	73	372	187	80	8.6	3.1	7.0	±807
H2/3C	4	30	130	60	9.1	1.3	7.7	±400
H3A	362	2,052	184	116	10.6	7.2	8.6	±463
H3B	18	132	107	72	10.7	3.6	10.0	±1,522
H3C	12	46	100	64	10.9	4.0	6.5	±1,047
HU	6	24	89	67	11.7	3.5	4.3	±833
M1A	3	15	158	30	5.9	0.2	0.7	±1,000
M1B	0	3	-	-	-	-	-	-
M1D	3	44	13.5	10	11.7	1.6	0.5	±1,100
M1/2A	3	4	222	43	6.1	0.3	2.5	±733
M1/2B	0	34	-	-	-	-	-	-
M1/2C	12	85	142	28	6.2	0.6	1.3	±525
M2A	5	30	257	96	8.5	3.0	13.8	±880
M2B	13	74	225	88	8.5	3.0	11.0	±692
M2C	6	29	157	65	8.7	2.5	6.8	±317

M2/3A	166	1,235	284	122	8.8	5.9	12.2	±889
M2/3B	71	444	161	79	9.4	4.3	8.0	±700
M2/3C	9	43	169	68	8.6	2.6	6.7	±722
M3A	103	623	235	137	10.0	10.7	10.5	±1,444
M3B	41	209	153	98	10.8	8.3	6.7	±954
M3C	5	38	152	74	9.2	3.8	9.7	±1,180
MU	21	103	206	96	9.2	5.8	5.3	±995
S1A	3	11	0	0	N/A	N/A	N/A	±1,933
S1B	0	11	-	-	-	-	-	-
S1C	1*	12	115	10	4.0	N/A	N/A	±500
S1D	0	4	-	-	-	-	-	-
S1/2A	2*	15	725	80	4.6	N/A	1.2	±3,500
S1/2B	2*	14	401	70	5.7	N/A	5.1	±1,400
S1/2C	2*	18	55	20	8.2	1.4	0.4	±1,200
S2A	2*	39	358	140	8.5	3.8	20.9	N/A
S2B	5	41	134	56	8.8	1.3	6.2	±420
S2C	2*	19	109	35	7.7	0.6	7.4	±2,350
S2/3A	61	465	282	136	9.2	9.0	14.9	±730
S2/3B	20	161	247	115	9.2	7.5	15.3	±3,235
S2/3C	2*	10	252	75	7.4	2.6	8.5	±2,850
S3A	101	779	159	136	11.4	14.8	11.2	±6,196
S3B	141	890	130	110	12.5	13.7	10.5	±2,340
S3C	12	92	80	82	13.1	13.0	5.5	±4,192
SU	24	127	156	100	10.7	8.4	5.7	±1,183
W1/2A	0	9	-	-	-	-	-	-
W2A	2*	201	496	160	7.7	2.4	25.9	±50
W2/3A	44	302	186	117	10.7	5.5	11.9	±127
W2/3B	4	65	227	143	10.6	5.9	24.6	±125
W3A	13	197	183	130	11.3	5.4	19.4	±523

* Inventory data is not statistically valid for strata with fewer than three plots

12. FOREST GROWTH

Ensuring the long term productivity and health of the forest is a primary objective for Providence Water. One way to monitor progress in meeting this objective is by examining forest growth and harvesting to ensure that operations are sustainable over the long term. A forest that maintains or increases stocking while timber is harvested at a planned rate set out in a plan is one indicator of a healthy managed ecosystem. The most common way to track forest growth is by estimating the amount of woody material that is added (grown) over a defined time period while accounting for natural mortality and harvested trees. Units of measurements are the same as for a traditional forest inventory – trees/acre; basal area/acre; board feet/acre; cords/acre; and cubic feet/acre. The last three measurements estimate merchantable aboveground woody material excluding branches. Estimating net growth is also important to ensure that harvesting timber to manipulate forest stand densities and structures is sustainable over time. While growing and harvesting a steady stream of wood products is not a primary objective of Providence Water, it is important to verify that harvesting practices used to achieve management objectives are sustainable.

12.1 HISTORICAL GROWTH STUDY

In 1999, a growth study was conducted as a component of a forest inventory performed by Wagner Forest Management. Increment coring was used to measure tree radial growth for the prior ten-year period. Over 475 separate measurements were distributed across all species and diameter classes. Individual species growth curves were calculated through standard regression analysis for the seven most common species found on watershed lands: white pine, red maple, scarlet oak, red oak, black oak, white oak, and white ash. Forest-wide annual net growth for the 1999-2009 period was estimated to be 2.19% of 1999 volume or 0.63 cords/acre/year. Based on this data and the approximately 11,536 acres of land available for growing and harvesting wood products, annual growth is estimated at approximately 7,268 cords/year (0.63 cords/acre/year x 11,536 acres).

From this study, the projected 2009 stocking per forested acre (accounting for growth and harvesting) is estimated to be 28.29 cords/acre. Projected estimates assume that previous growth rates will continue over time. While these numbers include estimates of expected mortality, they cannot predict unforeseen losses that may occur during the time between measurements. A large-scale loss from insects, disease, or a weather event at the beginning or in the middle of a measurement cycle can make 10-year projections worthless.

Individual tree growth of a specific species will vary substantially from broad averages depending on age, diameter, soils, stand density, and insect and disease conditions. Net growth for the seven main species was found to range from 3.12% for white pine to 1.27% for white ash. Net growth accounts for a certain number of trees naturally dying each year, with estimated mortality ranging from 15-30% of annual growth depending on the species.

12.2 CONTINUOUS FOREST INVENTORY (CFI) SYSTEM

In 1991, Providence Water began establishing a series of fixed radius plots to be remeasured on a regular basis for the purpose of establishing continuous forest inventory (CFI) data. All trees greater than 3.5 inches in diameter at 4.5 feet above ground (DBH) are measured on these circular plots 1/5 acre in size. Individual trees are numbered so that they can be remeasured and tracked over time as they develop and/or die. As of 2010, repeated measurements have been made on more than 2,100 trees on these plots, with some trees having been measured four times. Information recorded for each tree within the plot includes species, DBH, products that could be harvested from the tree, and merchantable length of the product in 8-foot sections. These measurements can be used to calculate

basal area/acre, trees/acre, average tree diameter, and product volumes/acre. Some regeneration data is also collected. The method of collecting regeneration data has been revised to provide more detailed information on species abundance and seedling/sapling size.

The plots were not placed randomly, but were installed so that each main forest cover type is represented in the same percentage that type occurs on the property. Currently 44 CFI plots are distributed across the property, with plans to increase the number of plots so that data is more reliable. From these repeated measurements, both individual tree growth and cover type or forest-wide growth can be estimated in terms of diameter and merchantable volume. When silvicultural treatments are conducted in a stand containing a plot, the trees in the plot are treated the same as those in the rest of the stand.

These plots were established in different years so that the 10-year measurement period differs among plots, but all plots have been measured within the current measurement interval of five years. Volumes were converted to total cords using a factor of 2 cords/MBF to estimate growth and to facilitate comparison with the Wagner growth and inventory data. The plots are stratified into five general cover types: mixed oak (MO), mixed hardwood (MH), upland oak (UO), softwood (WP), and pine-hardwood (PH). A description of each of these cover types is provided in Section 10 of this plan. The growth data from these plots is as expected. Softwoods (mostly white pine) are growing the fastest, followed by pine-hardwood, mixed oak, and mixed hardwood. The poorer upland oak stands are adding the least growth and in one plot volume has decreased due to high mortality. The estimated average annual growth for all plots for the 10-year period was 1.01 cords/acre/year. This number is significantly higher than the value calculated in the 1999 increment coring study and is due in large part to the number of CFI plots (16) that are in the relatively fast-growing softwood type. Many of the stands where these plots are located have been thinned within the last 15 years and are at densities that result in good growth. In many of the pine-hardwood plots, the percentage of white pine has been increasing and boosting growth in individual plots. It is noteworthy that some of the plots originally typed as mixed oak, mixed hardwood, or upland oak have transitioned to pine-hardwood as the white pine has started to become merchantable or moved from polewood to sawtimber size. The growth on the mixed oak and mixed hardwood plots is about the same as that which was calculated for the forest as a whole during the 1999 study (0.66 cords/acre/year), while the upland oak plots are experiencing the poorest growth with less than a third of a cord/acre/year.

Table 9: CFI Plot Data from Last Two Measurements

Mixed Oak – Hardwood

CFI Plot Number	Previous Measurement			Most Recent Measurement			Volume Harvested (Cds/ac)	Annual Growth (Cds/ac)
	MBF/ac	Cds/ac	Total Cds/ac	MBF/ac	Cds/ac	Total Cds/ac		
6	3.68	10.6	18.0	6.519	9.9	22.9	0.0	0.49
10	1.196	10.1	12.5	2.453	16.1	21.0	0.0	0.85
13	6.571	5.8	18.9	6.758	17.1	30.6	0.0	1.17
15	2.637	6.0	11.3	5.311	11.0	21.6	0.0	1.03
16	0.887	11.5	13.3	1.736	12.9	16.4	0.0	0.31
20	1.351	9.3	12.0	2.463	16.1	21.0	0.0	0.90
25	3.454	3.4	13.6	4.280	10.8	23.3	0.0	0.97
30	4.641	10.4	19.7	8.453	11.4	28.3	0.0	0.86
35	9.213	9.6	28.0	10.496	10.2	31.2	0.0	0.32

36	2.884	9.5	15.3	4.927	11.5	21.3	0.0	0.60
38	8.229	7.0	23.5	9.361	9.7	28.4	0.0	0.49
39	2.179	6.9	11.3	4.308	8.3	16.9	0.0	0.56
45	1.993	9.6	13.6	6.374	9.7	22.4	0.0	0.80
47	1.653	10.6	13.9	3.811	9.2	16.8	0.0	0.29
48	4.072	12.4	20.5	5.942	11.9	23.8	0.0	0.33
Average	**3.643**	**8.8**	**16.4**	**5.546**	**11.7**	**23.1**		**0.66**

Upland Oak

CFI Plot Number	Previous Measurement			Most Recent Measurement			Volume Harvested (Cds/ac)	Annual Growth (Cds/ac)
	MBF/ac	Cds/ac	Total Cds/ac	MBF/ac	Cds/ac	Total Cds/ac		
4	0	9.6	9.6	0.238	11.8	12.2	0.0	0.26
9*	0.164	8.4	8.6	0	3.2	3.2	9.6	0.42
12	0	10.3	10.3	0.175	5.4	5.8	0.0	-0.45
14	0	7.4	7.4	1.491	10.7	13.7	0.0	0.63
43	0.788	8.4	10.0	2.629	7.8	13.1	0.0	0.31
46	0.121	14.5	14.7	2.848	13.2	18.9	0.0	0.42
Average	**0.179**	**9.8**	**10.1**	**1.230**	**8.7**	**11.2**		**0.27**

Softwood

CFI Plot Number	Previous Measurement			Most Recent Measurement			Volume Harvested (Cds/ac)	Annual Growth (Cds/ac)
	MBF/ac	Cds/ac	Total Cds/ac	MBF/ac	Cds/ac	Total Cds/ac		
1	0.910	14.0	15.8	7.854	19.0	34.7	0.0	1.89
3	0.170	7.9	8.2	1.962	17.4	21.3	0.0	1.31
17*	23.770	3.0	50.5	17.141	5.6	39.9	27.2	1.66
18*	19.279	18.5	57.1	18.476	11.4	48.4	15.9	0.71
19*	14.479	14.8	43.8	15.441	7.5	38.4	22.8	1.74
21*	9.967	16.3	36.2	10.630	9.1	30.4	33.1	2.73
24	4.135	17.1	23.0	10.441	21.0	41.9	0.0	1.89
26*	22.111	3.5	47.7	15.328	4.5	55.2	21.1	2.86
28	9.889	7.8	27.6	15.634	10.7	42.0	0.0	1.44
29*	14.550	15.2	44.3	10.531	8.8	29.9	39.7	2.53
31	3.371	12.7	19.4	7.783	12.9	28.5	0.0	0.91
32	8.000	12.9	28.9	10.423	18.9	39.7	0.0	1.08
33	5.885	14.5	26.3	7.537	20.6	35.4	0.0	0.91
34	7.312	13.5	28.1	11.615	13.3	36.5	0.0	0.84
37*	19.998	16.7	56.7	16.987	13.1	47.1	29.0	1.93
42	6.117	9.2	21.4	10.559	14.7	35.8	0.0	1.44
Average	**10.621**	**12.4**	**33.4**	**12.396**	**13.0**	**37.8**		**1.62**

Pine-Hardwood

CFI Plot Number	Previous Measurement			Most Recent Measurement			Volume Harvested (Cds/ac)	Annual Growth (Cds/ac)
	MBF/ac	Cds/ac	Total Cds/ac	MBF/ac	Cds/ac	Total Cds/ac		
2*	8.243	8	24.5	4.438	6.5	15.4	20.4	1.12
8*	2.066	17.8	21.9	3.669	13.6	20.9	16.8	1.58
22	3.156	8.7	15.0	9.026	10.9	28.9	0.0	1.39
23	0.700	19.0	20.4	2.581	21.4	26.6	0.0	0.62
27	4.137	6.6	14.9	7.602	11.2	26.4	0.0	1.15
41	0.224	5.3	5.7	1.337	8.4	11.1	0.0	0.54
44	1.594	10.4	12.0	3.260	10.7	17.2	0.0	0.52
Average	**2.874**	**10.8**	**16.3**	**4.559**	**11.8**	**20.9**		**0.99**
ALL TYPES Average	**5.586**	**10.6**	**21.7**	**7.292**	**11.8**	**26.5**		**1.01**

*Harvesting activity occurred on plot sometime between measurements
**Harvested volume was added back into total cord estimate to estimate growth

For each main cover type, multiplying the estimated net growth by the total acreage yields an estimate of total annual growth:

Mixed oak hardwood - 5,450 acres x 0.66 cds/ac/yr = 3,597 cords/year

Upland oak – 970 acres x 0.27 cds/ac/yr = 262 cords/year

Softwood (white pine) 2,334 acres x 1.62 cds/ac/yr = 3,781 cords/year

Pine-Hardwood 2,782 acres x 0.99 cds/ac/yr = 2,754 cords/year

Total estimated growth = 10,394 cords/year

12.3 SUCCESSIVE FOREST INVENTORIES

Comparing successive forest inventories can be another useful method to determine forest growth. The two most recent inventories were performed by Wagner Forest Management in 1999 and by PWSB forestry staff in 2009-10. While these inventories provide two similar datasets for comparison, there were a number of significant differences in the sampling methods that are discussed in the notes following the inventory numbers.

Table 10: 1999 Inventory-Total Volume Estimates by Species (11,536 forested acres)

SOFTWOODS

Species	Sawlogs (MBF)	Pulpwood (cds)	Growing Stock (cds)	Total (cds)
White pine	25,996	28,769	16,390	92,534
Red pine	8,443	9,106	3,911	30,084
Pitch pine	1,338	2,962	550	6,032
Spruce	895	361	148	2,420
Hemlock	218	330	284	1.011
Total Softwoods	**36,860**	**41,529**	**21,284**	**132,081**

HARDWOODS

Species	Sawlogs (MBF)	Pulpwood (cds)	Growing Stock (cds)	Total (Cds)
Red maple	3,354	34,789	3,882	45,181
Scarlet oak	5,821	24,430	5,363	41,013
Red oak	7,247	10,922	4,609	29,186
Black oak	4,634	13,312	3,208	25,466
White oak	2,624	11,569	2,348	19,034
White ash	1,956	5,762	3,085	12,650
Yellow birch	347	3,265	2,547	6,503
Aspen	438	1,651	646	3,167
Chestnut oak	499	1,764	299	3,042
Sugar maple	100	542	395	1,135
Black cherry	27	482	18	554
Basswood	0	37	0	37
Other	1,200	3,741	2,194	8,281
Total Hardwoods	**28,246**	**112,266**	**28,593**	**195,248**
Total Volume	**65,107**	**153,794**	**49,877**	**327,329**
Average Volume/Acre	**5.7**	**13.5**	**4.4**	**28.7**

Table 11: 2009-10 Inventory-Total Volume Estimates by Species (12,125 forested acres)

SOFTWOODS

Species	Sawlogs (MBF)	Cordwood (cds)	Total (cds)
White pine	41,460	40,590	111,899
Red pine	1,320	1,952	4,193
Spruce	1,556	986	3,890
Pitch pine	1,086	1,255	3,061

Hemlock	209	375	857
Larch	213	195	571
Other softwood	0	19	19
Total Softwoods	**45,844**	**45,911**	**124,922**

HARDWOODS

Species	Sawlogs (MBF)	Cordwood (cds)	Total (Cds)
Scarlet oak	12,724	18,921	40,114
Red maple	5,878	23,332	32,826
Scarlet oak	12,724	18,921	40,114
Black oak	6,371	7,963	18,392
White oak	4,036	8,641	15,196
Red oak	4,653	5,029	12,660
Hickory	950	1,866	3,502
Black birch	482	2,696	3,501
White ash	664	1,665	2,778
Chestnut oak	512	1,063	1,925
Yellow birch	116	1,465	1,655
Sugar maple	294	828	1,302
Aspen	214	266	636
Beech	103	464	634
Other hardwood	39	514	576
Black gum	44	296	367
Black cherry	35	106	163
White birch	0	58	58
Basswood	9	31	47
Hornbeam	0	5	5
Total Hardwoods	**37,125**	**75,207**	**136,335**
Total Volume	**82,969**	**121,118**	**261,257**
Average Volume/Acre	**6.9**	**10.0**	**21.7**

A number of patterns and conclusions can be drawn from the 1999 and 2009-10 inventory data:

Comparison between inventories and determination of forest measurement procedures and typing criteria are not the same. During the 1999 inventory, forest stands were stratified by main type and size but not by stocking density, while diruing the most recent inventory, density was included. For example, the 1999 inventory included an H2 stratum that was divided into three different strata (H2A, H2B and H2C) during the 2010 inventory. The plot data from the recent inventory would need to be compbined into similar strata and statistics recalculated in order to compare attributres such as basal area per acre, trees per acre, and average stand diameter.

Instead, some general changes can be observed based on timber total volumes for the entire property. Volumes on a per acre basis are also necessary for comparison since the total property acreage has increased with the addition of several tracts. The volume harvested over the time period must also be taken into account:

Table 12: Comparison of 1999 to 2009-10 Inventory Data

Species	1999 Volume (MBF)	Harvested Volume 1999 - 2010 (MBF)	2009-10 Volume (MBF)
Softwoods	36,860	13,386	45,844
Hardwoods	28,246	826	37,125
Total	**65,107**	**14,212**	**82,969**
Species	**1999 Volume (cords)**	**Harvested Volume 1999 - 2010 (cords)**	**2009-10 Volume (cords)**
Softwoods	62,813	4,244	45,911
Hardwoods	140,859	5,198	75,207
Total	**203,672**	**9,442**	**121,118**

The above tables show that the sawtimber volume has increased while harvesting over 14 million board feet during the same time period. At the same time, cordwood volume has decreased significantly even when taking into account the cordwood harvested. These changes may be in part due in part to different inventory procedures, conversion factors, cordwood trees growing to sawtimber size, and the recent hardwood mortality from repeated insect defoliations on certain areas of the property.

Among the coniferous species, white pine has become even more dominant. The percentage of softwood sawtimber volume in white pine increased from about 70% in 1999 to 90% in 2010. This increase is due in part to the harvest of nearly all the red pine on the property over the same time period. Red pine accounted for 23% of the softwood sawtimber in 1999, decreased to less than 3% in 2010, and will probably drop to near zero as the remaining trees are cut or die from insect and disease issues. Thinning of white pine stands is also contributing to the increase in white pine both as a percentage of softwood sawtimber and average board feet per acre (2,253 BF/acre in 1999 to 3,419 BF/acre in 2010). As a result of these thinnings that focus on removing trees of lower timber quality, better-formed trees continue to grow at an accelerated rate with additional space.

Oaks (scarlet, black, red, white, and chestnut) as a group continue to be the primary hardwood species on the property, combining to make up 63% of the hardwood volume in 2010. This percentage is a small increase from 1999, when oaks made up about 60% of the hardwood volume. Over the decade-long time period, scarlet oak increased from 21% to 29% of hardwood volume while red oak decreased from 15% to 9%. On a per acre basis, scarlet oak volume grew from approximately 500 to 1,050 BF/acre while red oak dropped from 630 to 380 BF/acre. These changes are probably due to higher quality scarlet oak being tallied as red oak during the 1999 inventory and then being recorded as scarlet oak during the 2010 inventory. The remaining hardwood species remain at about the same percentage of hardwood volume, but the volume per acre for all species decreased slightly.

Total sawtimber volume including both softwoods and hardwoods increased from about 5,700 BF/acre in 1999 to 6,900 BF/acre in 2010, while cordwood volume decreased from 17.9 cords/acre to 10.0 cords/acre. The overall increase in sawtimber is due both to the growth of the large white pine

component and to many trees moving from cordwood to sawtimber size. The thinning regimes implemented in the past favored better trees of all species and allowed them to grow faster and into higher value products (cordwood to sawtimber). The different inventory methods may also be contributing to the decrease in cordwood volume between the two inventories. The total finalcial value of the forest resource was a primary concern during the 1999 inventory, but it was not in 2010. cordwood and topwood may have been tallied more aggressively in 1999. Another contricuting factor may be the recent loss of hardwoods from repeated insect defoliation over a large portion of the property.

13. WILDLIFE MANAGEMENT

The approximately 12,500 acres of land and 5,000 acres of surface reservoirs managed by Providence Water are home to many species of animals, birds, and insects. In an increasingly suburbanizing area, these 17,500 acres effectively serve as a wildlife refuge and offer an opportunity to actively provide and create habitat conditions that smaller landowners may not have. These larger-landscape habitats include areas of grasslands, early successional shrublands and thickets, forest stands to be managed for older growth characteristics, and sizeable expanses of contiguous forest.

13.1 RARE, THREATENED, AND ENDANGERED WILDLIFE SPECIES

As of 2006, there were 148 species listed by the Rhode Island Natural Heritage Program on its list of Rare Native Animals of Rhode Island. Of these 148 species, seven are listed as Federally Endangered (FE) and two are listed as Federally Threatened (FT). The remainder are either State Endangered (SE), State Threatened (ST), State Species of Concern (C), cannot be possessed without a RI Fish and Wildlife permit (P), or have been documented to occur in the State but are currently not known to occur {State Historical (SH)}. When Providence Water becomes aware of any species on this list or other uncommon or rare species inhabiting the watershed forest, steps will be taken to protect it and its habitat.

The only Federally listed animal known to currently occur on Providence Water land is the Bald Eagle (*Haliaectus leucocephalus)*. One of the mammal species of concern is the New England cottontail rabbit *(Sylvilagus transitionalis),* which is under consideration for Federal Listing and is listed as State Endangered in New Hampshire.

13.2 “HIGH PROFILE” WILDLIFE SPECIES

The following information pertains to high profile animals that are presently found on the Providence Water property or for which habitat improvement attempts may be undertaken during the 2011-2020 planning period.

13.2.1 Bald Eagle *(Haliaectus leucocephalus)*

By the 1960s, the bald eagle had fallen from a common species in the United States to one in decline and possible extinction. The pesticide DDT is widely accepted as the major cause of the population decline of the bald eagle and other raptors. Other factors contributing to their decline included illegal hunting and ingesting lead shotgun pellets from dead waterfowl. DDT (Dichloro-Diphenyl-Trichoroethane) was sprayed extensively on cropland beginning in the 1940s until it was banned for most uses in the

United States in 1972. Residual spray entered streams in runoff and eventually made its way to large rivers and lakes. The chemical was absorbed by aquatic plants that were eaten by fish and other small animals that eagles prey on. Eggs laid by eagles had thin shells that often cracked as the birds incubated them. In 2007, after extensive recovery and reintroduction efforts, the bald eagle was removed from the Federal Endangered Species list. It remains on State Endangered list in Connecticut and Rhode Island.

Since 2003, a pair of bald eagles has successfully nested on a small island in the Scituate Reservoir located near the north end of the east arm. The eagle nest is visible from Route 116. Personnel from the U.S. Fish and Wildlife Service have installed metal flashing on the nest tree to prevent predators from disturbing and preying on the eggs or eaglets. The eaglets are banded to aid in tracking their continued recovery and dispersal. During the winter of 2008-09 the original nest was dislodged and fell from the white pine tree in which it was built. A replacement nest has since been built in a neighboring tree and the eagles successfully produced two more chicks during the spring of 2009.

When conducting forest management activities near known or future bald eagle nest sites, Providence Water will follow guidelines put forth in the National Bald Eagle Management Guidelines published in May 2007 by the U.S. Fish and Wildlife Service. To avoid disturbing nesting bald eagles, this document recommends establishing both distance and landscape buffers and limiting activities during the breeding season.

Specifically, clearcutting or overstory removal will be altogether avoided within 330 feet of a known nest site. Timber harvest activities including road construction will not take place within 660 feet of a known nest site during the breeding season. Operations such as thinning and selection harvests will be undertaken outside of the breeding season and log landing areas will not be constructed within 330 feet of a known nest site.

No habitat improvements are planned for bald eagles during this planning period.

13.2.2 Bobcat *(Lynx rufus)*

More common in northern New England, bobcats are State listed as Threatened in Rhode Island. Bobcats are solitary animals and primarily nocturnal, doing most of their hunting during the night. Their diet consists of smaller mammals such as cottontail rabbits, squirrels, woodchucks, raccoons, and birds. They will also prey on small, weak, or injured deer. Bobcats are somewhat adaptable and can live in a wide range of habitats including interior forest and open areas, but they favor swamps, bogs, thick understories, and rocky areas. Dens are created in rock crevices and hollow logs and beneath wind-felled trees.

The bobcat population in Rhode Island probably declined as land clearing for agriculture increased through the late 1800s. As agriculture moved west in the early 1900s, the forest reestablished itself following widespread farm abandonment. Habitat suitable for bobcat and a staple of its diet, the cottontail rabbit, increased as thickets of early successional forests became common. As a result of the maturing forest and land development over the last half-century, the amount of suitable habitat has decreased and therefore bobcat are uncommon in Rhode Island today. If hardwood stands are managed using even-aged methods including a final overstory removal harvest, one type of suitable bobcat habitat and habitat for prey will be increased. Regenerating these mixed oak forests will depend in part on managing the white-tailed deer population and controlling invasive plants. Based on the number of car strikes over the last several years, the Rhode Island Department of Environmental Management believes that the bobcat population in the state is increasing. This animal may have been sighted on the Providence Water property as recently as 2009.

Several habitat improvements for animals requiring early successional thickets are planned for this period. These activities consist of increasing the size of existing openings to at least twelve acres or creating openings and installing fence if deer are suspected to be limiting regeneration. Projects may

occur in the Cork Brook, Ashland, and Trimtown Management Units. Further information can be found in the management unit summaries.

13.2.3 New England Cottontail Rabbit *(Sylvilagus transitionalis)*

The New England cottontail requires a habitat of dense thickets for habitat, often provided by early successional forest. The lack of such thickets is believed to be the primary reason for the current scarcity of this species. After many farms were abandoned in New England in the late 1800s and early 1900s, a great deal of these early successional habitats developed and cottontails thrived. As the forest developed and the protection the thickets provided disappeared, the cottontail population also declined. Habitat competition from the much more common Eastern cottontail rabbit is recognized as a significant stressor for the New England cottontail.

Other factors in the decline of suitable habitat could include exotic invasive species and white-tailed deer. When forest openings are created either through harvesting or natural disturbances such as fire or wind, exotic invasive species now often colonize the site. These plants may not provide the food or habitat that the cottontails require. White-tailed deer consume many of the same plants as cottontails and also affect the forest by overbrowsing and not allowing thickets to develop. The New England cottontail feeds on grasses and plant leaves during the growing season and subsists on bark and sprout twigs during the winter months. High deer densities can have a large impact on these food sources, essentially eliminating ground layer vegetation on some sites. With a home range usually less than 10 acres in size, these rabbits have a limited ability to move to new areas when food sources are scarce. If hardwood stands are managed using even-aged methods and regenerated with a final overstory removal harvest, suitable cottontail habitat will develop. Regenerating these mixed oak forests will depend in part on managing the deer population and controlling invasive plants.

Several habitat improvements for animals requiring early successional thickets are planned for this period. These activities consist of increasing the size of existing openings to at least twelve acres or creating openings and installing fence if deer are suspected to be limiting regeneration. As mentioned above, projects may occur in the Cork Brook, Ashland, and Trimtown Management Units. Further information can be found in the Management Unit summaries.

13.2.4 White-Tailed Deer *(Odocoileus virginianus)*

In Rhode Island, as throughout most of the Northeast, white-tailed deer are not threatened or endangered. Conversely, the deer population has become overabundant and is contributing to the decline of other species of mammals, forest birds, and forest vegetation. Deer have probably been impacting forests in Rhode Island for so long that a “naturally balanced” forest only occurs in areas where aggressive and consistent hunting has been taking place for many years. Deer eat nearly all native plants in the herbaceous layer and overabundant populations severely limit new native plants from becoming established. These plants include native wildflowers, shrubs, and tree seedlings, saplings, grasses, and sedges. Without these plants and the cover they provide, populations of other animals and birds that depend on them for some part of their life cycle are diminished. In the

absence of groundcover, ground-nesting forest birds have fewer opportunities to nest. Deer eat both the flowers and fruit of the spring wildflower trillium and these flowers can disappear in areas with high deer impacts. When tree seedlings are absent, secondary canopy layers and the understory cannot develop and populations of mid-canopy nesting birds such as the eastern wood pewee and indigo bunting are affected. When silvicultural prescriptions such as group selection patch harvests or clearcuts for early successional wildlife habitat are implemented, deer browsing on stump sprouts and newly germinated seedlings prevents the desired outcomes. Without being able to create these dense thickets, animals such as woodcock and ruffed grouse become less common. Other animals that are affected by white-tailed deer inhibiting tree regeneration include cottontail rabbits and the animals that prey upon them.

Deer generally do not browse on exotic invasive species or hay-scented fern, a native species with some invasive characteristics. With native tree seedlings and understory herbs continually overbrowsed, invasives and ferns can flourish and prevent desirable regeneration from becoming established. These invasives can be controlled at a cost using chemicals or mechanical methods, but as long as native plants are unable to become established invasives will eventually reoccupy most sites.

In 2008, Providence Water contracted with a wildlife consulting firm specializing in conflicts between deer and humans to conduct a deer impact study and provide management recommendations. The major recommendation from the firm's report was to initiate human-induced deer mortality through hunting. The report also outlined procedures to establish and measure vegetation in paired deer exclosures to determine the effectiveness of the program. More information on deer management can be found in the report and files maintained by the Water Resources Division.

13.2.5 Grassland Birds

This group of birds includes (but is not limited to) the grasshopper sparrow, upland sandpiper, horned lark, vesper sparrow, Savannah sparrow, and bobolink. The habitat for these birds follows the same path as the early successional thickets required by the New England cottontail rabbit, ruffed grouse, and American woodcock. Prior to European settlement, the extent and variety of early successional habitats that existed in much of the Northeast is not well known. Disturbance due to fire, hurricanes, floods, Native American burning and agriculture, and beaver, as well as native prairies, barrens, and oak openings imparted an open character to much of southern New England and the Mid-Atlantic region, and created patches of early successional and young forest habitats. European settlers cleared much of the area for agriculture and created an open countryside that included grasslands. During the late 1800s and early 1900s, grassland habitat declined as farms were abandoned. The settlers also introduced non-native cool season grasses that met their needs but were less suitable for this class of birds. As farms were abandoned, the grasslands and fields started to revert back to forest. The grasslands transitioned to shrublands and early successional thickets and eventually to forest.

Providence Water recognizes the value of this type of habitat and in 2008 initiated a project in cooperation with the Natural Resource Conservation Services (NRCS) to re-establish about 65 acres of warm season grasslands on the former Joslin Farm site atop Field Hill. Future management of this area will include periodically burning or mowing the fields, limiting the establishment of woody species, and treating invasive species. More information on this project can be found in files maintained by the Water Resources Division.

13.2.6 Beaver *(Castor canadensis)*

Beavers are native to New England, but by the late 1800s they had disappeared from Rhode Island and much of New England due to over-trapping for pelts and widespread land use change as native forests were cleared for agriculture. In 1976, the Rhode Island Division of Fish and Wildlife confirmed the first beaver colony in the state since the 1800s. Since 1976, the population of beavers in Rhode Island has continued to grow due to the reversion of cleared areas to suitable forest habitat and the lack of natural predators (including mountain lions and wolves). The largest North American rodent, the beaver can weigh up to 65 pounds and grow to a length of 40 inches. Beavers are herbivores that feed on non-woody aquatic plants during the growing season, eat woody shoots, twigs, and leaves in the late summer, and stockpile woody vegetation near their lodge or den for during the winter.

Beavers are well known for their ability to modify their environment by damming running water to create ponds and wetlands. This trait can benefit wetland-dependent species, but may have negative impacts on human property and infrastructure by causing water to back up into areas where it usually does not occur. Damming culverts under roads can divert water that may overtop the road at another location where it causes erosion and damage. Beavers have also been known to create dams atop old millpond spillways. These beaver augmentations can weaken the old stone dams by retaining more water than usual or cause damage if water overtops the dam crest.

In creating dams, beavers alter the hydrology of an area and can have impacts on water quality. In some instances, beaver ponds can act like natural detention basins that reduce sediment and nutrient transportation downstream. This function may be pronounced if the stream bank prior to damming was prone to erosion. Damming may also cause changes in the water's chemical and physical properties. Given the large size of the reservoir system and the small number of beaver sites on main tributaries to the reservoir, these impacts are probably insignificant.

Beaver are potential carriers of a parasite that causes Giardiasis, an intestinal disease that can cause illness in healthy people and be debilitating to those who have stressed immune systems. The parasite can be transmitted to humans through drinking water with *Giardia lamblia* cysts in it. Other animals and humans can also spread cysts by shedding them in water that infects other individuals.

A 2004 survey conducted by the Rhode Island DEM's Division Fish and Wildlife located 22 active beaver sites within the Scituate Reservoir watershed, with the majority occurring off the Providence Water property. When necessary, Providence Water will protect human health and infrastructure from beaver impacts using the most cost-effective and practical methods available.

13.2.7 Great Blue Heron *(Arden herodias)*

Great Blue Herons are large wading birds that nest in colonies of several to many pairs. These nesting colonies are called rookeries. Migrating herons arrive in New England as early as the end of March and return southward in August or September. Some birds overwinter in coastal areas and where fresh water remains open during the winter. Nesting colonies may be located miles from wetland and shoreline feeding areas. Herons typically use the same nesting area year after year and usually nest high up in trees, but sometimes they nest on the ground. They eat fish, frogs, small mammals, and reptiles. The number of great blue herons in New England has increased significantly in recent years. One known heron rookery is located on the Providence Water property on an island in the Regulating Reservoir near the village of North Scituate. The same precautions and buffer zones that the U.S. Fish & Wildlife Service has established for working around eagle nests will also be used for heron rookeries. No active habitat improvement activities for herons are planned for the time period covered by this plan.

14. BIODIVERSITY AND HIGH CONSERVATION VALUE AREAS

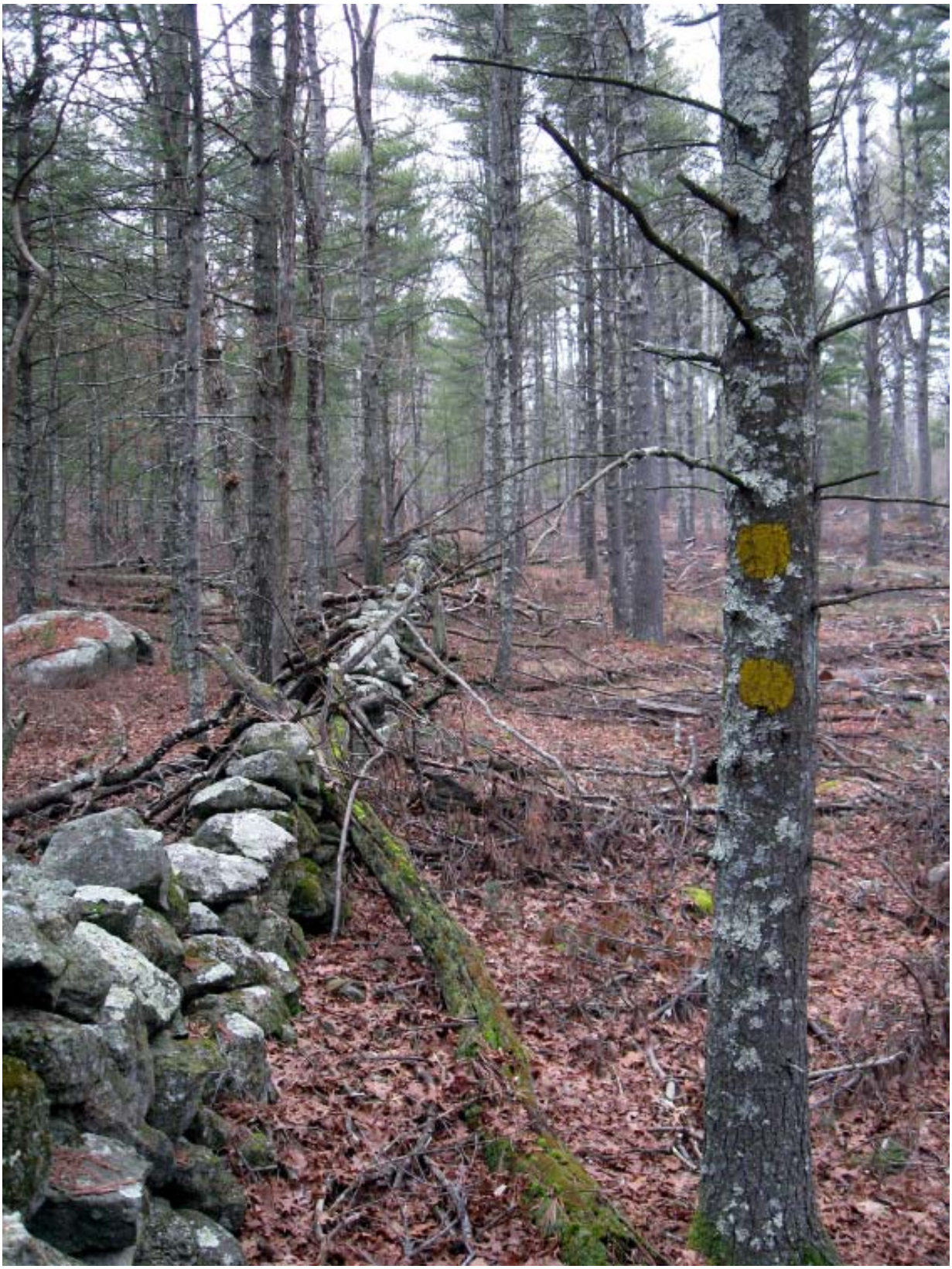
Consistent with its mission of providing a high quality drinking water supply, Providence Water intends to conserve biodiversity and "high conservation value" areas on the watershed property. Maintenance of biodiversity is generally regarded as an indicator of overall forest and ecosystem health. Specific strategies for conserving biodiversity are addressed broadly in Section 6 and more specifically in the individual management unit (MU) plans.

Under certain definitions, the entire Providence Water property has high conservation value because of its essential role and function in protecting the watershed of a major public drinking water supply. For example, the Forest Stewardship Council (FSC), an international organization established to promote responsible management of the world's forests, includes in its definition of high conservation value forests those that "provide basic services of nature in critical situations" and are "fundamental to meeting basic needs of local communities." Following the FSC's detailed forest management standard for the United States, active management is consistent with these high conservation value attributes.

The property contains at least two rare natural communities (see below) that have been removed from active timber management and designated reserves by Providence Water. These two areas are included in the approximately 300 acres of forest on the property that have been identified and set aside from active management to develop "older growth" characteristics through natural processes. When Providence Water becomes aware of other unusual or rare natural communities located on its watershed property, steps will be taken to protect and maintain them. Organizations dedicated to conserving rare native biota such as the Rhode Island Natural History Survey and the New England Wildflower Society may assist with the location and stewardship of these areas or communities and related recordkeeping.

Data available from the Rhode Island Natural History Survey currently identifies two locations overlapping the Providence Water property that have been known to support clustered populations of a number of rare plant species. In both places, the rare plants are spring ephemerals that have been found on the adjacent private land on several occasions since 1971. In addition, a small number of isolated rare plant populations have been observed in the past or are currently known to occur elsewhere on the property.

One of the rare plant "hot spots" is the lower Huntinghouse Brook corridor in the Elmdale MU. The current GIS map polygon of this area includes entire area surrounding Huntinghouse Brook that is bounded by Elmdale, Rocky Hill, and Gleaner Chapel Roads and Quaker Lane. Much of this area is on private property. The other location is the area between the Barden Reservoir and Round Hill, which includes both public and private land and where the current GIS map polygon overlaps approximately the northeastern third of the Round Hill MU.



Double yellow blazes mark Providence Water's wooded property boundaries.

15. PROPERTY MANAGEMENT

Maintenance and periodic improvement of infrastructure and physical features related to owning forestland is critical to Providence Water for forest management, forest fire protection, forest health monitoring, security patrols, and reservoir protection. While some of these may not be directly related to managing the forest, the Water Resources Division has traditionally been involved in their maintenance.

15.1 ACCESS ROADS (FIRELANES)

A quality internal road system providing access to different parts of a large forest property improves management efficiency by getting people and materials to otherwise remote sites with less effort. A good access road system can also increase the value of wood products by reducing the skidding or forwarding distances to log landings accessible to road trucks. While these roads are important for management, they can be a source of erosion and sedimentation if not constructed or maintained properly. Providence Water currently has more than 61 miles of recorded private access roads on the various parcels comprising the watershed property. Many of these are former town roads that were acquired during the original land condemnation process. Other roads were constructed during the establishment of the reservoir system or built later for management purposes. No new access roads have been constructed on the original ownership since the 1980s. Some of the original access roads have become overgrown with vegetation or are in such poor condition that maintenance has been discontinued.

On newly acquired properties, existing access roads are incorporated into the system if they are in good repair and at low risk for causing negative impacts to water quality. Roads unnecessary for management or likely to create sources of erosion are abandoned and removed from maps. If only minor repairs are required, these improvements are made before putting the roads into service.

Internal roads are identified by the management block (A through Q) in which they are located, followed by a number distinguishing each road from others within a given block (e.g. A-1). These numbers are recorded in the GIS database and on maps. On the ground, many roads are marked with their number at intersections with public roads and other firelanes. This identification system facilitates navigation and communication for anyone traveling or working on the property. The roads are classified into two categories (improved and unimproved) based on construction and serviceability. As the two names suggest, improved roads have had culverts and stone fords installed or have had gravel or stone added and receive routine maintenance. Unimproved roads are only sporadically maintained and may not be suitable for driving during certain times of the year of with low ground clearance vehicles.

The access roads shown on the maps included in this plan contain the most recently updated information possible. Roads that have been abandoned are not included on the maps.

15.2 PROPERTY BOUNDARIES

Well-established and clearly marked property boundary lines are important not only for protection from trespass and encroachment, but also for monitoring and land management. Water Supply Board property acquired by the City of Providence was surveyed and bounded during the original condemnation process. The A and EX Sheets identify the original condemnation line and the individual parcels acquired. The Record Plan Sheets contain survey data including the location and type of established boundary markers and the azimuth and length of exterior property lines.

Early land management efforts included fencing much of the property along public road frontage. This practice was carried over to some boundary lines not along roads. The reasons why some of these lines away from roads were selected for fencing while others were not is unknown, but the fences provide evidence (similar to old stone walls) of how the land has changed over time. These boundary lines were located in the open when the fences were constructed, but the forest has since grown up around them.

Boundary lines that are not fenced or located along public roads are marked in the field by axe-blazing trees with two blazes on each side to permit sighting along the property line. The blazes are painted with high-visibility yellow boundary marking paint for easy identification. The distance between marked trees varies, but ideally several marked trees should be visible in either direction when walking along a given property line. Witness trees are established at each corner or angle point and marked with three vertically aligned blazes pointing to the corner or point. The axe blazes eventually heal over, leaving marks that are identifiable after the paint has faded to those who are familiar with locating and marking wooded property boundaries. Lines are inspected and repainted on a rotating basis about every 8-10 years. Lines are checked or painted more frequently in areas where there are recurring trespass or encroachment problems or where a timber harvest is planned.

When trespass and encroachment infringements on Providence Water property are discovered, resolution is sought through personal contact, standard letter notification, and if necessary, legal action. If necessary, boundaries can be resurveyed by professional surveyors with the lines marked and encroachments documented. Rhode Island General Law 11-44-4 addresses trespass and vandalism and makes it unlawful to enter upon the land of another without the owner’s permission for shooting, trapping, or fishing when the land is conspicuously posted with clear and legible signs stating that these activities are prohibited. General Law 46-14-1, entitled “Contamination of Drinking Water,” prohibits activities that may pollute, corrupt, or impair the purity or quality of a public drinking water supply or activities that pose a potential significant risk to public health. Chapter 701 of the Public Laws of 1925 provides protection to Providence Water from adverse possession, so the land remains in public ownership regardless of the length or extent of the encroachment.

Yellow “No Trespassing” signs citing the prohibition of all unauthorized activities in RI General Law are attached to fence posts along public roads. These signs are also often found along wooded boundary lines attached to the fences that were constructed long ago. The boundary lines that are blazed and painted are not posted with the standard “No Trespassing” signs, making them invisible to people who are unfamiliar with the methods Providence Water uses to marks its property boundaries. Without clearly posting these lines, it may be difficult to prove that trespassers and encroachers knowingly entered onto Providence Water land. With plans to continue white-tailed deer population management through controlled hunting, it will become more important to make abutting landowners and willful trespassers aware of boundary line locations. In the event of an incident, signage would help show Providence Water’s attempt to make others aware that they are breaking the law by trespassing. During the 10-year management period covered by this plan, posting these wooded back lines will begin. At the very least, areas to be included in the deer management program will have exterior boundary lines posted with “No Trespassing” signs.

15.3 CULTURAL RESOURCES

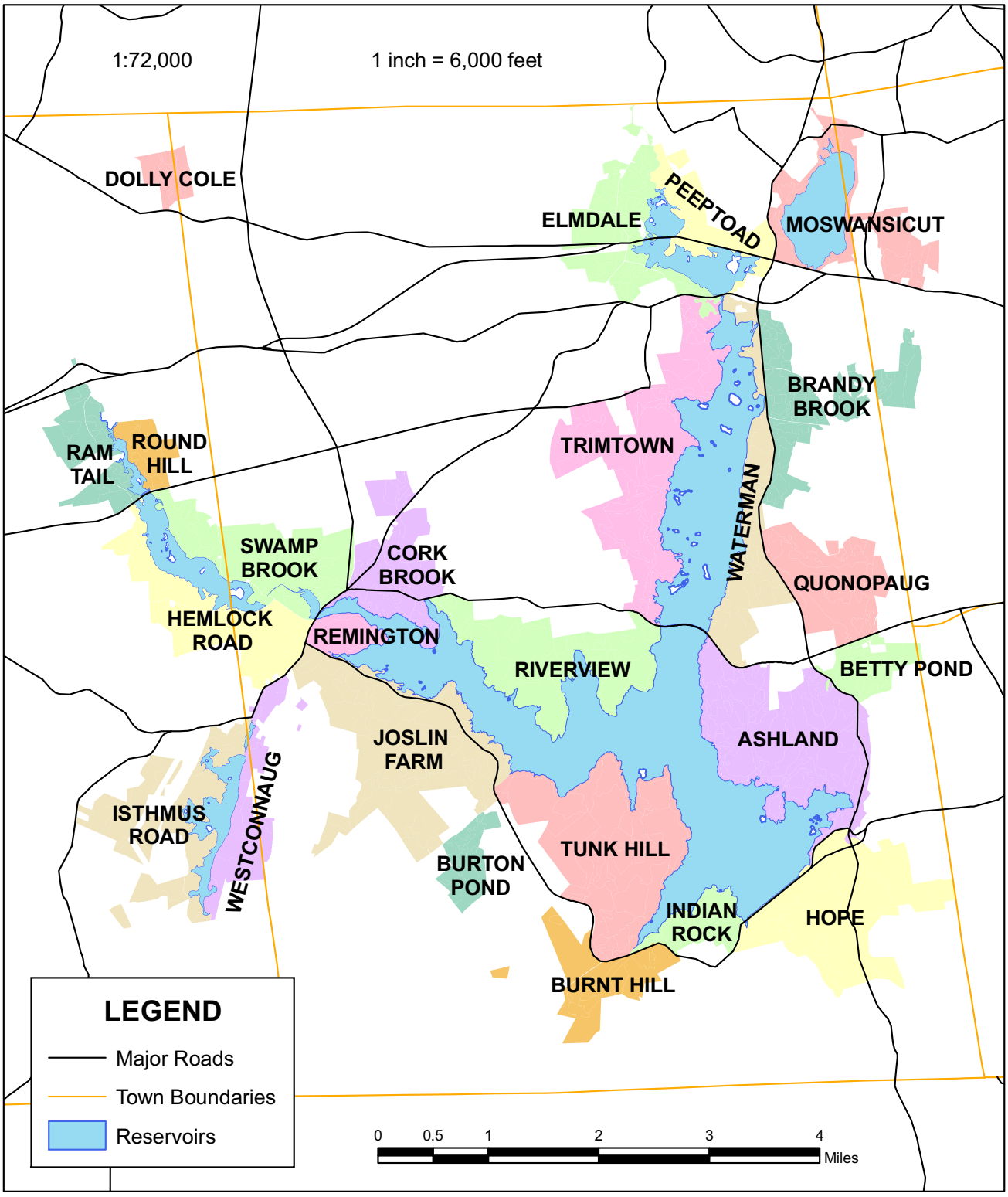
The Providence Water property contains about 50 historic cemeteries that were not relocated since they were outside the area flooded to create the Scituate and Regulating Reservoirs. Around the time of watershed land acquisition, these cemeteries (along with those in locations now underwater that were relocated to the Rockland Cemetery) were well documented in photographs and on property maps so their locations are still known. Most of them are designated and included in the state of Rhode Island’s historic cemetery program. Cemetery size and type varies from plots with a few unmarked fieldstones to graveyards including many headstones with inscriptions and enclosed by stone walls or stone fence posts. Over time, vegetation has grown up within most of these cemeteries, as they have not been maintained on a regular basis. Families or descendents maintain several others. When labor is available, minor maintenance (mostly cutting brush and small trees) has been performed by temporary summer employees or included with work performed during a commercial timber harvest nearby. Efforts will be made to continue light maintenance of these cemeteries when manpower allows.

The property also contains many stone walls and stone foundations. Like the cemeteries, structures, buildings, barns, mills, etc. were well documented in photographs and on property maps. While the structures themselves were removed, the stone foundations remained in place. Research in Providence Water’s archives can usually locate the photograph of a structure before it was removed. Stone walls were not documented, but there are many miles of them all across the property as there are throughout New England. The condition of these walls ranges from relatively intact to almost indiscernible and disappearing into the surrounding landscape. No active improvement or maintenance of stonewalls has been undertaken over the years.

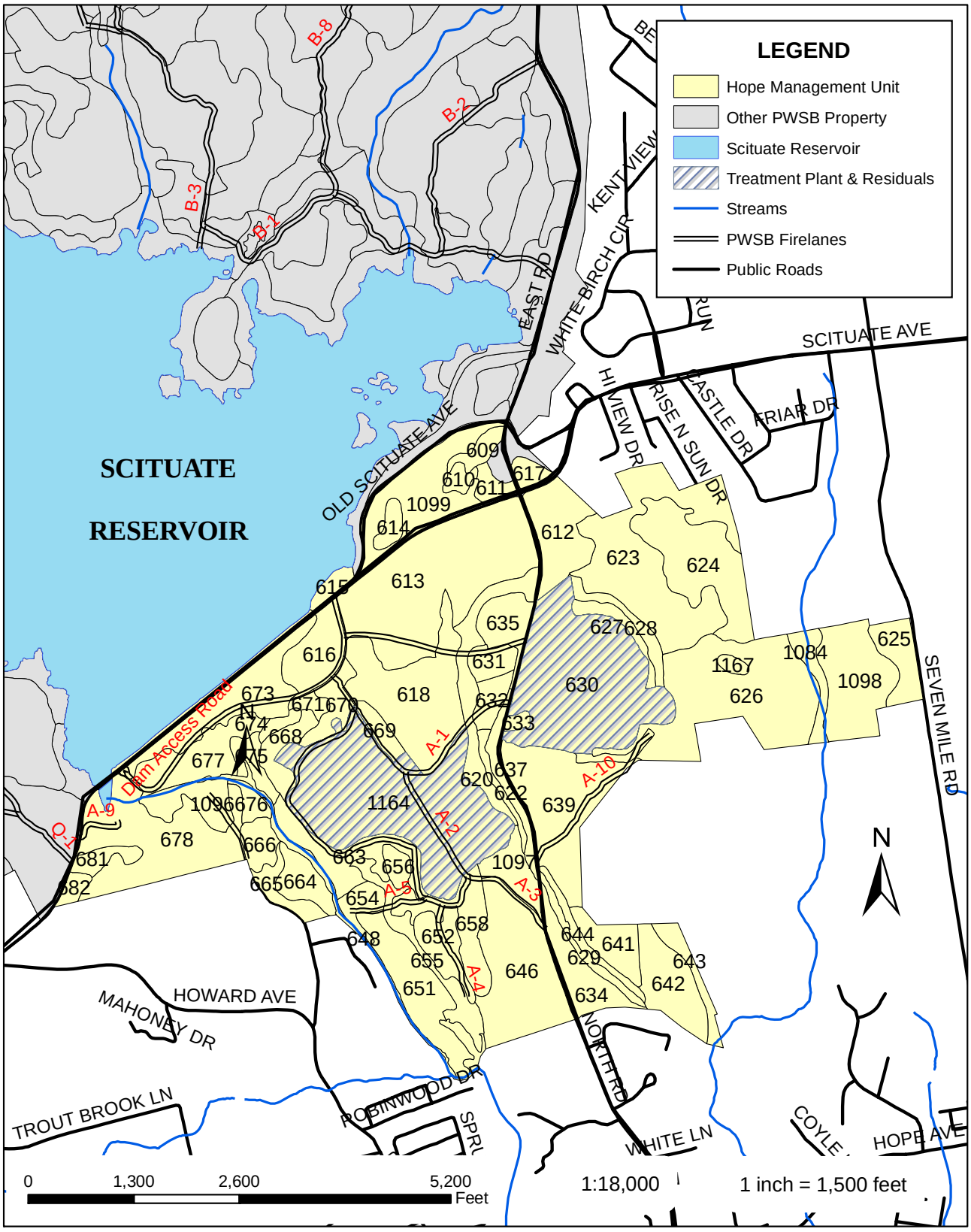
Providence Water recognizes the importance these historic cultural resources and takes steps to protect them when timber harvests are planned nearby. Before a harvest, the Water Resources Division staff consults records to determine if any known cemeteries are located within the harvest area. Where necessary, cultural resources are clearly marked during the course of harvest preparation (e.g. old foundation cellar holes). Contractors are made aware of the location of these historic artifacts and informed that they are to be protected during timber harvesting activities.

The property also contains three sites that are believed to have been used by Native American Indian tribal inhabitants. These sites are Indian Rock in the MU of the same name, the Council Bowl in the Moswansicut MU, and the Elmdale rock shelter in the Elmdale MU. More details about each landmark are provided in the Cultural Resources section of the respective MU plans. Each of these features has been a source of local interest, but a professional archaeological analysis has never been performed. The surrounding forest areas in which these special sites are located have been designated cultural resource reserves and set aside from timber harvesting. All three sites are unsuitable for timber management in any event due to their terrain and location.

SCITUATE RESERVOIR WATERSHED PROPERTY
Management Units



HOPE MANAGEMENT UNIT



HOPE MANAGEMENT UNIT

Location, Geography and Access

The Hope MU consists of about 820 acres south of the Gainer Dam and old Scituate Avenue (located a short distance north of current Route 12 on the east side of the dam). Since it is located below the dam, this southernmost area of the Providence Water property is not part of the Scituate Reservoir watershed. This MU is also the most heavily modified part of the property as it contains the water treatment plant compound, associated grounds, and settling lagoons used in separating residuals during the water treatment process. Most of the terrain is relatively flat to rolling, with a hilly area in the northeast corner between Scituate Avenue and the treatment plant compound. The North Branch of the Pawtuxet River begins immediately downstream of the dam spillway. This MU is noteworthy for the PWSB property in that only 80% of the land area is forested and fully 20% (about 170 acres) is in other cover types, including 87 acres of grounds, 60 acres of wetlands, and 23 acres of open water. All of the areas not managed by the Water Resources Division are excluded from this plan.

Road access within this MU is good, although some of the firelanes in the wooded sections are poorly maintained as these roads receive infrequent use. Most of the land is situated close to a public road, PWSB firelane, or cleared transmission right-of-way. At the northern edge of the MU, the old section of Scituate Avenue located east of the Gainer Dam has been closed to public access for security reasons since September 11, 2001.

Existing Forest Description

Divided into two sections by Route 116, the forest in this MU is predominately hardwood of varying timber quality. About 410 acres (63%) of the forested area is in the hardwood cover type, followed by 186 acres (28%) of pine-hardwood, and only 55 acres (9%) of softwoods.

On the east side of Route 116, the area east of the treatment plant is a relatively large (165 acres) tract of hardwoods. This area contains a higher proportion of American beech than other hardwood stands found on the Providence Water property. Although beech has traditionally been a low-value timber species, it does have significant wildlife value as its beechnuts are consumed by a variety of animals. Beech sprouts prolifically, with new shoots developing from cut stumps and roots, and it is also one of the most shade-tolerant hardwoods in the Northeast. In 1996, a 50-75’ wide strip around the settling basins was cleared of all trees for a proposed security fence. The fence was ultimately constructed along the edge of the access road at the perimeter of the basins rather than in the cleared area set further back. This cleared area was left to regenerate naturally and has developed into a hardwood thicket. The area south of the treatment plant is a diverse mix with healthy stands of white pine-hardwood (639), white pine (641), and younger white pine-hardwood (642) that transition to upland oak and then mixed oak (643).

On the west side of Route 116, much of the area across the road from the treatment plant has changed over the last 10 years due to expansion and modification of the settling lagoons. Some of

these areas have been reclassified as grounds, more accurately reflecting their use. The upland oak stand towards the village of Hope (646) has a high incidence of oak mortality as a result of repeated insect defoliations. The white pine in the understory is being released naturally and should grow better than the oaks did on these thin soils. A large red maple-hardwood stand (651) borders the Pawtuxet River. While timber management is possible in this riparian area, water quality and wildlife values are more important. Ducks and other animals use the river and its associated wetlands. North of the settling lagoons and the Gainer Dam access road, site quality improves as the forest cover type transitions from pine-hardwood to mixed oak-hardwoods.

Soils

This MU contains a variety of soils, with small and intermingled occurrences of different series forming a mosaic pattern on the western side. Some of these series are uncommon in Scituate and on the PWSB property, including Lippitt, Narragansett, Raypol, and Scio sandy and silt loams. Most of these locally uncommon soils are found in the Pawtuxet River floodplain and may have also occurred along the former Ponaganset and Moswansicut riverbanks that are now underwater in the Scituate Reservoir. The Lippitts are found on side slopes and bedrock crests east of the settling basins behind the treatment plant. These soils are somewhat excessively drained and relatively unproductive, with a site index of 55 for white pine and 47 for red oak.

The soils underlying the majority of the acreage in this MU are the more common Canton-Charlton, Paxton, and Woodbridge rocky sandy loams. The intermingled Canton-Charlton series are the most prevalent, with site indices ranging from 58 to 65 for white pine and 52 to 65 for red oak. Red maple-hardwood wetlands are found on hydric Ridgebury soils; these areas will be excluded from future timber harvests. Significant areas of the original soils in this MU have been severely disturbed and excavated to construct the Gainer Dam, treatment plant compound, and settling lagoons. Most of these areas are not included in the forest management plan.

Past Land Use and Forest Management

At the time of the creation of the reservoir system in 1915, the PWSB land use survey recorded almost all of the land in this MU as woodland, with the exception of two small patches of arable land along Scituate Avenue at the far western edge and a small pond nearby.

Since acquisition, management in this somewhat unusual section of the PWSB property has been quite varied. Early on, the area near the settling lagoons west side of what is now Route 116 was cleared and used as a nursery for growing tree seedlings for outplanting all parts of the watershed property. During the initial round of planting, however, only about 25 acres of this MU were planted in red and white pine between 1926 and 1929 because most of the acreage was already forested.

Silviculture from the 1950s through the 1970s emphasized intermediate treatments in the established stands, while also including a second round of planting. Beginning with pruning in the 1950s, almost all the plantation stands and some natural ones were thinned or released during this period and some prescriptions included weevil control and cull treatment. Significant parts of this MU saw land use changes associated with the construction of the new water treatment plant and modification of the surrounding grounds. In addition to harvest sites, plantings between 1960 and 1973 occurred along roadsides and around the treatment plant and employed a wide range of conifers, including Austrian, red, and white pine, hemlock, larch, Norway and white spruce, balsam fir, and Douglas-fir. “Aesthetic improvement” treatments along roadsides continued into the early 1980s. Several chainsaw trainings were conducted in the stands adjacent to the Gainer Dam access road during the 1990s. Trainees gained experience by felling poor quality hardwoods, helping release

the understory white pine in these stands.

Timber harvesting in this MU in recent years has been limited to two entries. Prompted by the threat of mortality from the red pine scale and red pine adelgid, the 2007 Waterman harvest on about 37 acres removed the red pine component from two neighboring red and white pine stands (616 and 677) just south of the Gainer Dam. The stands south of the treatment plant were worked once again in 2010. A shelterwood prep cut was conducted in 639, while the white pine in stand 641 was thinned and white pine released in stand 642. Like many other parts of the watershed forest, this area is transitioning from hardwood to pine. The high white-tailed deer herbivory and past cutting practices that favored the better growing pine over hardwoods on these soils are contributing to this species shift.

Forest Health and Related Management

Repeated insect defoliation during the late 1990s has led to high mortality in oak stands situated on unproductive soils. Fortunately, white pine was already established in the understory in many of these stands either through planting or natural regeneration. The death of some of the canopy trees has allowed increased sunlight to reach the understory and naturally release the pine. White pine is on its way to becoming the dominant species in these upland areas, particularly stand 646. Although the dead hardwoods could be salvaged, the value of the established pine outweighs the income that could be realized from harvesting cordwood in these stands.

As in the rest of the oak-hardwood forest across the PWSB ownership, the issue of deer herbivory and lack of oak regeneration is common in the hardwood and mixedwood stands. Generally more abundant, white pine regeneration is prevalent in the stands and it becoming the dominant species.

Heavy infestations of buckthorn occur at several locations in this MU. Most notable are the ones below the Gainer Dam in mixed conifer stands from which the red pine component was removed several years ago. Established populations are also found near the settling lagoons and in a stand of mixed softwoods (652) where no harvesting has occurred. Given the amount of disturbance that accompanies managing the water treatment residuals in the settlings lagoons, other invasive plants are most likely present as well. *Phragmites* reeds are found in some locations along the edges of the lagoons, but the species identification of these plants (invasive *Phragmites australis* or the native variety) has not been confirmed.

Silviculture

Except for the few conifer stands, most areas of this MU have seen little silvicultural activity during Providence Water's ownership tenure. This low level of active forest management is probably due in part to the MU's location near the treatment plant and other water supply facilities. Planned activities for the 2010-2020 management period will focus on preparing hardwood stands on moderate to good growing sites for regeneration and improvement thinnings. These stands are not scheduled for harvesting until the later part of the current planning cycle and may be delayed if deer herbivory is still an issue. At the same time (2018), there may be opportunities to expand the brushy area that was created when land was cleared for the security fence that was later constructed closer to the settling basins. There is also an area of turf that could possibly be included to increase the overall early-successional forest acreage by leaving all or a portion of it unmowed and allowed to grow.

Some areas south of the treatment plant that were treated in 2010 are scheduled for another entry in 2022. The white pine stand (641) should be ready for another thinning, with another group or single-tree selection harvest planned for stand 639. The timing and intensity of this harvest will depend on how the stand responds after the most recent cut. Salvage operations are not planned for the upland

oak stand south of the treatment plant (646) even though there is high oak mortality. At this time, the understory white pine will be allowed to develop and be naturally released as more sunlight reaches this regeneration through the thinning oak canopy.

Cultural Resources

Located at the base of the Scituate Reservoir and at the northwestern edge of the Hope MU, the largest manmade feature on the Providence Water property is the huge Gainer Dam and its spillway. Created to impound water for the Scituate Reservoir, this earthen dam with a clay center is the largest in Rhode Island and it is a defining landmark in the watershed. Although not as old as the Industrial Revolution-era dams elsewhere on the property, the Gainer Dam has historic significance while continuing to serve as a critical infrastructure component of the water supply system. A comprehensive history of the dam's construction (1921-25) and related facts and figures can be found in other documents and plans maintained by Providence Water.

Also located within this MU are the aqueducts and water transmission lines that transport raw water into the treatment plant, and then carry treated water from the plant to distribution reservoirs. Other features include electrical power transmission lines and the "settling lagoons" where residuals from the water treatment process naturally settle out, with the excess water discharged into the Pawtuxet River. For many years, the Gainer Dam access road was open to the general public for pedestrian access, but it was closed in 2001 due to security concerns.

More traditional cultural resources in the Hope MU include stone walls and the occasional stone foundation. Scituate Historic Cemetery 149, also known as the Daniel Fiske Lot, is located between the settling lagoons and the Pawtuxet River. Remnant abutments from a bridge used before the Gainer Dam was constructed are visible on the riverbanks just south of the dam access road where water is released near the meter chamber.

Hope MU Inventory Summary:

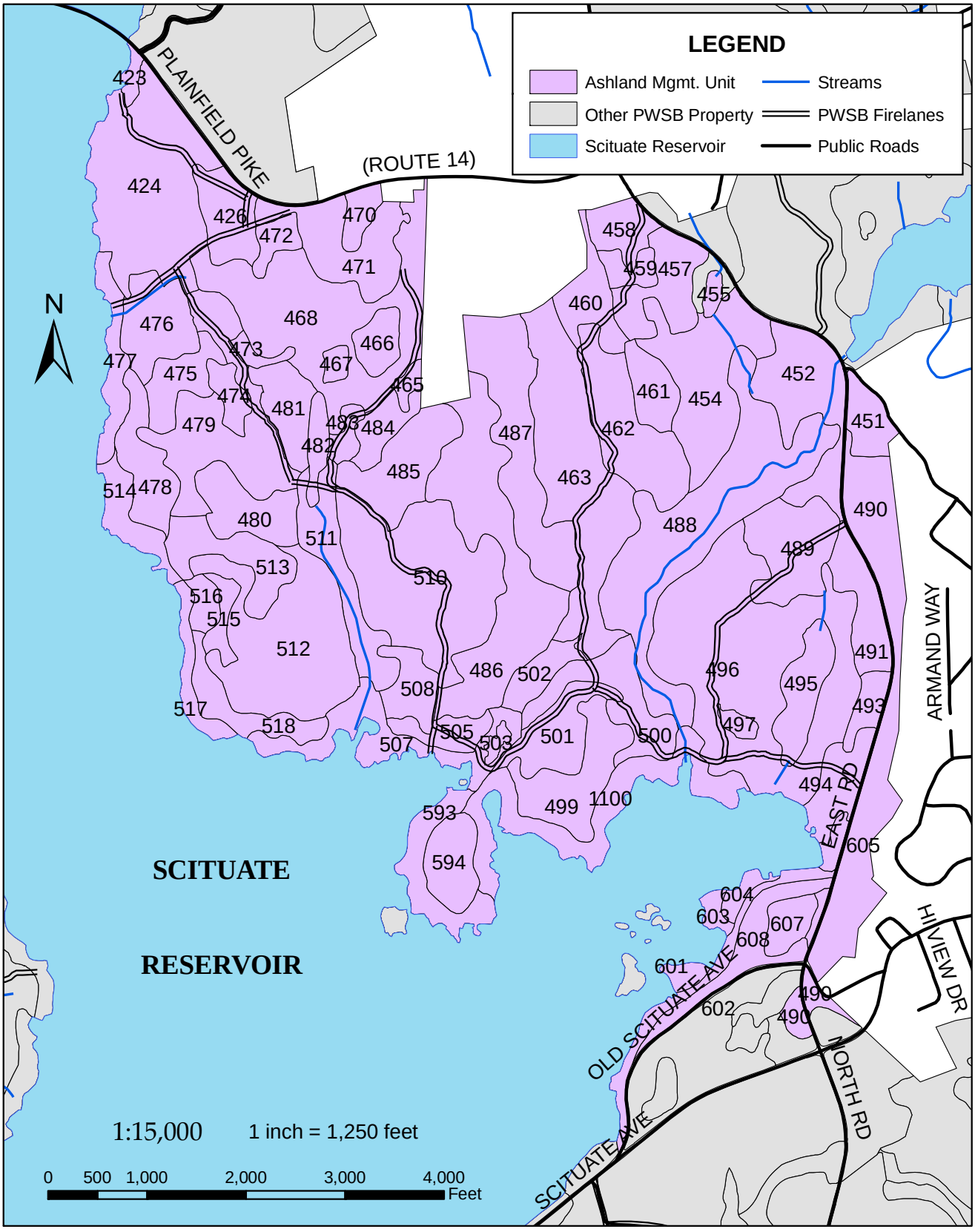
Stand	Acres	Type	Species	TPA	BA/ac	MSD	MBF/ac	Cds/ac	Regen/ac
602	9	Grounds	Gainer Dike						
609	4	W1/2A	RM/MH			No	Data		
610	2	W2A	RM/MH	496	160	7.7	2.4	25.9	±50
611	3	M3A	MO/WP	235	137	10.0	10.7	10.5	±1,444
612	17	H3A	MO	130	117	12.8	10.2	12.6	±233
613	61	H3A	MO	175	107	10.6	6.7	12.8	±318
614	3	Wetland							
615	3	S3A	MS	159	136	11.4	14.8	11.2	±6,196
616	12	S3B	WP/MH	130	110	12.5	13.7	10.5	±2,340
618	35	M2/3A	MO/WP	224	120	9.9	6.1	15.7	±133
620	15	W2/3A	RM/MH	186	117	10.7	5.5	11.9	±127
622	6	Open	Pipeline						
623	48	H2/3A	MO/-/BE	140	87	10.4	3.6	13.8	±945
624	29	H2/3A	MO/-/BE	240	115	9.4	3.2	17.8	±300
625	9	M2B	MH/MS	225	88	8.5	3.0	11.0	±692
626	51	H2/3A	MO/-/WP	161	108	10.7	7.2	14.6	±544
627	4	S2/3A	MS	247	115	9.2	7.5	15.3	±3,235
628	7	H1A	MH			No	Data		
629	4	Open	Pipeline						
630	62	Grounds							
631	5	S2/3A	MS	282	136	9.2	9.0	14.9	±730
632	5	M3A	MO/WP	235	137	10.0	10.7	10.5	±1,444
633	1	M2/3A	WP/MH	284	122	8.8	5.9	1.2.2	±889
634	9	M3A	WP/MH/MS	235	137	10.0	10.7	10.5	±1,444
637	3	S2/3A	WP	282	136	9.2	9.0	14.9	±730
639	33	M3B	WP/MO	80	74	12.7	8.0	7.8	±20
641	9	S3B	WP	130	110	12.5	13.7	10.5	±2,340
642	16	M2/3B	WP/UO	161	79	9.4	4.3	8.0	±700
643	5	H3A	MO	137	97	11.4	7.3	10.7	±100
644	4	S2/3A	WP	282	136	9.2	9.0	14.9	±730
645	3	S2/3A	WP	282	136	9.2	9.0	14.9	±730
646	35	M2/3B	UO/WP	189	76	8.6	2.0	12.0	±329
648	9	Water	Pawtuxet R.						
651	20	W2/3A	RM/MH	118	72	10.8	1.8	12.5	±100
652	9	S3A	WP/MS	159	136	11.4	14.8	11.2	±6,196
654	5	S2/3A	PP/MS	282	136	9.2	9.0	14.9	±730
655	10	Wetland							
656	3	W2C	White Cedar			No	Data		
658	14	M2/3B	WP/MO	161	79	9.4	4.3	8.0	±700
663	16	H3A	MO	184	116	10.6	7.2	8.6	±463
664	8	M2/3A	MH/WP	284	122	8.8	5.9	12.2	±889

665	5	H2/3A	MO/WP	190	105	10.0	4.8	9.3	±650
666	5	M2/3A	WP/-/MH	284	122	8.8	5.9	12.2	±889
668	7	M3B	MO/WP	153	98	10.8	8.3	6.7	±954
669	4	M2/3A	WP/MO	284	122	8.8	5.9	12.2	±889
670	7	S3A	WP/MS	159	136	11.4	14.8	11.2	±6,196
671	2	M3A	MH/WP	235	137	10.0	10.7	10.5	±1,444
673	25	Grounds	Gainer Dam						
674	2	W2/3A	MH/RM	186	117	10.7	5.5	11.9	±127
675	5	H2/3A	MH	190	105	10.0	4.9	9.3	±650
676	3	M2/3A	MH	284	122	8.8	5.9	12.2	±889
677	16	M3A	WP/MH/MS	235	137	10.0	10.7	10.5	±1,444
678	39	H2/3A	MO/WP	138	96	11.0	5.4	12.6	±1,786
681	4	H2A	RM/MH	246	84	7.9	1.5	9.8	±550
682	2	S2/3A	WP/PP/MS	282	136	9.2	9.0	14.9	±730
1084	6	W3A	RM/MH	183	130	11.3	5.4	19.4	±523
1096	10	M3A	WP/MH	143	117	11.9	14.2	13.7	±367
1097	8	M2/3B	WP/MH/MS	161	79	9.4	4.3	8.0	±700
1098	24	H2/3A	MH	142	94	11.0	3.8	13.2	-
1099	24	H3A	MO	184	116	10.6	7.2	8.6	±463
1164	75	Grounds	Residuals Treatment						
1167	2	Wetland							

Hope MU Management Activity Schedule:

Stand	Type & Species	Activity	Acreage	Timeframe
612	H3A-MO/MH	Shelterwood thinning/group selection	18	2018
613	H3A-MO/MH	Shelterwood thinning/group selection	56	2018
623	H2/3A-MO	Enlarge early-successional area with stand 630	5	2018
626	H2/3A-MO	Enlarge early-successional area with 630	5	2018
623	H2/3A-MO	Improvement thinning	42	2018
626	H2/3A-MO	Improvement thinning	77	2018
624	H2/3A-MO	Improvement thinning	28	2018
639	M3B-WP/MO	Group selection harvest	31	2022
641	S3B-WP	Thinning	6	2022

ASHLAND MANAGEMENT UNIT



ASHLAND MANAGEMENT UNIT

Location, Geography, and Access

The Ashland MU covers about 1,180 acres on the east shore of the Scituate Reservoir, directly north of the Gainer Dam. This large area is almost entirely PWSB property. Containing most of the land in the B Block, it is bounded to the north by Plainfield Pike (Route 14) and to the south by the old section of Scituate Avenue east of the dam. The eastern boundary between Plainfield Pike and Betty Pond Road is Route 116 (North Road); between Betty Pond Road and Tunk Hill Road it is a forested property line just east of and roughly parallel to the same public highway. The name of the MU is derived from the former mill village of Ashland, which was located along the Moswansicut River where the Route 14 causeway now crosses the east arm of the reservoir. This MU is dominated by undulating upland terrain with a significant length of reservoir shoreline along its southern and western edges. Markedly different from the surrounding bony upland ground, the swampy Kent Brook corridor is a defining feature of the eastern interior area and the wetlands here have grown larger over the past several years as beaver have attempted to dam the flow. A second unnamed stream also flows south into the reservoir. The southernmost stands are separated from the majority of the land in the MU by a small bay that extends eastward just north of the Gainer Dam.

Road access into this MU is generally poor. Three gates along Route 116 and one along Plainfield Pike provide access to the interior, but only the B-8 firelane gate can accommodate a log truck or tractor-trailer. Rocky and winding, the interior firelanes were not built to accommodate modern log trucks and have gone without maintenance for some time (once public roads, the short B-6 and B-7 firelanes are exceptions). The lack of good road access into to the main part of the MU means long hauling or skidding distances with logging equipment for any commercial harvest. A goal during this management period should be to improve access from the public roads. At the southern edge of the MU, the old section of Scituate Avenue located east of the Gainer Dam and roughly parallel to the dike has been closed to public access for security reasons since September 11, 2001.

Existing Forest Description

This MU has a large acreage of interior forest isolated from public roads and the majority is comprised of hardwood stands of varying densities and timber quality (approximately 659 acres of hardwoods; 198 of conifers; and 321 acres classified as mixedwood). In 1999, most of the area was classified as one large block of upland oaks. As a result of mortality from defoliating insects in the 1980s and some salvage cuttings in the 1990s that helped establish and release white pine, the area is now a mosaic of stands with different degrees of crown closure and pine occurrence. Over time, the pine component of these lower-density oak stands is increasing and some of them will transition to

mixedwood and eventually softwood-dominated stands. The small acreage currently in conifers relates to past land use and poor soils; only about 11% of the land area was planted in evergreen species after the creation of the reservoir. A secondary pitch pine component is present especially in the southern part of the MU, where this species is well suited to the dry, rocky soils.

Soils

This MU is characterized by very rocky and unproductive soils. Including significant rock outcrop areas with slopes up to 35%, Canton and Charlton very stony fine sandy loams are the most common soil series, especially in the central and southern part of the MU. These soils are well drained and moderately productive where they are not very rocky, with a site index of 58 for white pine and 52 for red oak. The somewhat more productive Paxton and Woodbridge series (white pine site index 66 and 67 respectively) are found in the northern section of the MU, where white pine is emerging as the dominant species. Carlisle and Adrian muck and Ridgebury soils surround Kent Brook and a few other wet areas. Future timber harvesting will be limited on these hydric soils and excluded from the Kent Brook corridor, with decisions informed by on-the-ground assessment at specific locations. Other soil series found in this MU include a significant presence of Sutton soils west of Route 116 in the vicinity of the B-1 and B-2 firelanes, and an area of Ninigret and Agawam soils near the B-1/B-3 firelane intersection.

Past Land Use and Forest Management

A large gap exists in the records from the 1915 PWSB land use survey for much of the area that now comprises this MU, so the previous land cover in what are now the interior and shoreline areas is not definitively known. Land along the northern and eastern edges was largely woodland (or "swamp woodland" in the vicinity of Kent Brook) with some small patches of arable land and reforested areas, so it is probable that most of the remaining acreage was wooded as well.

Early management during the PWSB era focused on planting red and white pine and other conifers on formerly cultivated land and enrichment planting of white pine under a hardwood overstory in some stands in the northern part of this MU. The interior stands were planted in or around 1940, and while documented planting dates for the thin shoreline leaf screen stands are unavailable they were presumably planted around the same time. Silvicultural treatments in the following decades included thinning the pine plantations and releasing the underplanted white pine. In general, the plantations located near public roads and firelanes were thinned while those adjacent to the reservoir or with long hauling distances to public roads were left untended. Since past silviculture focused on the plantations, it is not surprising that the natural mixed upland oak forest (including some pitch pine and redcedar) on most of the land in this MU received little or no active management during this era.

Timber harvests since 1990 have mainly focused on responding to forest health threats while also accomplishing other silvicultural goals. A large 1993-95 salvage harvest on about 220 acres on both sides of the B-3 firelane removed a significant amount of both live and dead hardwood cordwood from these upland oak stands, which suffered heavy mortality from repeated defoliation by gypsy moth *(Lymantria dispar)* and orange striped oakworm *(Anisota sentoris)* caterpillars. Following the harvest, white pine and pitch pine seed were broadcast by helicopter in 1995 and many of the seeded areas are now in the process of transitioning from upland oak to a mix of oak and pine.

Prompted by the threat of mortality from the red pine scale and red pine adelgid, the 2000 Ashland harvest removed red pine and spruce from scattered conifer stands around this MU while also accomplishing white pine thinning. Many of these stands had never been thinned, and in some pure

red pine stands (such as 465, 473, and 483) the harvest released an established white pine understory. Smaller harvests in 2002 and 2005 removed red pine from the perimeter of the seasonally accessible egg-shaped peninsula extending from the southern shore and nearby shoreline areas. Almost all the live red pine still remaining in this MU is located along the reservoir shoreline.

Forest Health and Related Management

Given the large acreage and high percentage of oak forest, the issue of deer herbivory and lack of oak regeneration common to hardwood stands across the PWSB ownership is very evident in this MU in areas with both open and closed canopies. In the upland oak stands, regeneration is often severely challenged by the tall, dense shrub layer of huckleberry and blueberry, although some white pine saplings are making their way through.

The majority of this MU will be the second area included in the managed deer hunt if the process is successful in the Tunk Hill MU. With the large acreage in PWSB ownership and only a few adjacent landowners, the Ashland block is an ideal candidate for deer management. The canopy openings and seed source in many areas should allow desirable tree regeneration to become established when deer impacts are reduced. Once established, the regeneration may take some time to grow through the heavy huckleberry layer, but when reaches it understory the available sunlight should allow for rapid growth. Most of the open-canopy stands are on the dry upland sites that were salvaged in 1993-95. White pine and pitch pine will be encouraged on these upland sites while hardwoods will be favored on the more mesic sites.

Likely due to the large acreage of interior forest and low density of previous human settlement, invasive plants are not yet widespread here but scattered Japanese barberry and *Ailanthus* (Tree of Heaven) were encountered during the field inventory. Along Plainfield Pike, a small population of highly invasive Japanese knotweed was found growing in a drainage structure constructed by RIDOT and should be treated as soon as possible. Two larger concentrated populations are discussed below.

In the northeast corner of the MU near the intersection of Route 116 and Plainfield Pike, stands 457 and 458 were planted with red and pine and, through a series of thinnings, have developed into large white pine. A goal of the last thinning in 2000 was to promote the establishment of white pine regeneration, but instead the forest floor is now covered with native hay-scented ferns that share some invasive characteristics and are inhibiting the desired regeneration.

Near the intersection of the B-1 and B-3 firelanes, stand 508 is located on the site of a former farm or settlement where several buildings were located. This stand was once dominated by planted white spruce with a secondary component of red and white pine, but the spruce suffered significant windthrow and most of the spruce and white pine was harvested in 2000. Glossy buckthorn has overtaken these eight acres and the infestation may be a source for further spread of this invasive plant. Controlling and monitoring this buckthorn population is an important management goal.

Early conifer planting in the eastern part of the MU included some hemlock in stands 493 (adjacent to Route 116) and 495 mixed with other conifers. Since the mid-1990s, the hemlock has been in a state of decline due to the exotic hemlock woolly adelgid insect *(Adelges tsugae)* and many of the smaller trees here have already died. The hemlocks will not be salvaged because these stands are situated on wet soils and already dominated by other species. If larger hemlocks near the road die and pose a safety hazard, they will be felled and left in place.

Silviculture

The fully stocked hardwood stands growing on the better soils in this MU should be thinned during the 2010 – 2020 management period. The residual trees will be left to grow larger until these areas are ready to be regenerated. If the deer population is reduced, hardwood regeneration should start to become established after thinning. The overstocked white pine in stands 476 and 479 will be thinned as soon as possible, as these trees have small live crowns and little annual diameter growth is occurring.

The hay-scented fern cover and invasive *Ailanthus* will be an obstacle to regenerating the white pine in stands 457, 458, and 459. Large, mature white pines dominate most parts of these stands with many trees greater than 24" DBH. Deer control and herbicide treatment of the ferns and invasives will increase the likelihood of establishing regeneration in these stands. If the invasives are controlled and regeneration fails to become established, a light thinning or site preparation to scarify the soil will be executed during a good white pine seed year.

The opening created by harvesting the red pine in stand 497 will be expanded to create habitat for animals and birds requiring early-successional thickets. The expansion will be accomplished by cutting in adjacent stand 496 to enlarge the opening to about 12 acres, which is the minimum recommended size for the New England cottontail rabbit. With a forested wetland (stand 495) nearby to the east and the reservoir to the south, this area will likely be used by many species if the thicket can develop. Reducing the deer population will be necessary for the thicket to grow.

The narrow and very rocky strip of forest in this MU on the east side of Route 116 contains some relatively large red oaks. This 38-acre strip probably has limited value in providing late-successional forest structure for wildlife, but it will be designated a reserve because active management is impractical. The only management will be to prevent or remove hazard trees along Route 116.

Since they contain the most significant stream corridor and wetlands in this MU, stands 452, 453 and 488 along Kent Brook will be designated a riparian reserve set aside from timber management.

Cultural Resources

This MU contains some cultural resources in the form of remnants of past land use. Historical building sites along Plainfield Pike are located adjacent to the reservoir in stands 476 and 477 and up the hill in stand 426. A few structures were also located in the southern part of the MU on the west side of the B-3 firelane in the vicinity in stands 508 and 510. The site of the former village of Ashland is now underwater in the reservoir just south of the Route 14 causeway.

Ashland MU Inventory Summary:

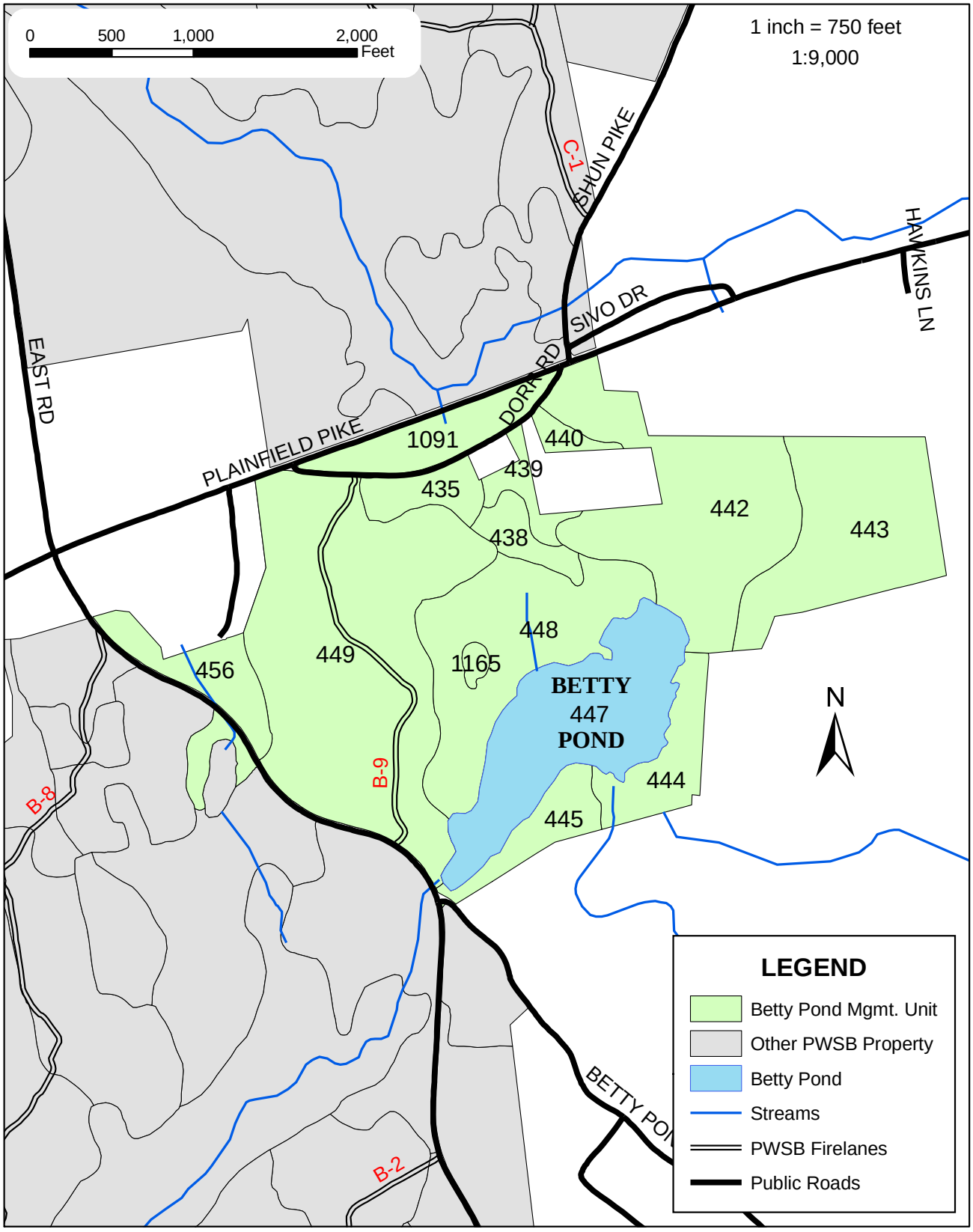
Stand	Acres	Type	Species	TPA	BA/ac	MSD	MBF/ac	Cds/ac	Regen/ac
423	2	S3A	SP/WP/RP	159	136	11.4	14.8	11.2	±6,196
424	45	M2/3A	MO/WP	243	133	8.9	9.4	19.5	±2,790
426	11	M3C	WP/MH/RP	72	80	10.6	7.9	8.1	±845
451	7	S3A	WP	298	230	11.6	26.0	30.3	±2,800
452	22	M3A	WP/MO	233	205	12.8	20.6	25	-
454	28	H3A	MO	172	105	10.3	6.3	12.7	±470
455	2	Water							
457	14	S3B	WP/MS/MH	100	95	10.1	16.3	9.7	±195
458	7	M3B	WP/MS	153	98	10.8	8.3	6.7	±954
459	4	M2/3B	WP/MH	161	79	9.4	4.3	8.0	±700
460	10	H2/3A	MO/WP	147	83	10.6	3.5	11.3	±500
461	7	S2/3A	PP/WP	282	136	9.2	9.0	14.9	±730
462	22	H2/3C	MO	162	70	8.8	1.4	10	±533
463	44	H3A	MO/-/MH	128	95	8.9	6.1	11.9	±475
465	2	S2A	WP	358	140	8.5	3.8	20.9	-
466	6	W2/3A	RM	186	117	10.7	5.5	11.9	±127
467	2	Water							
468	47	H2/3A	MO/RM	113	93	10.5	6.8	10.2	±235
470	4	S2/3B	WP	247	115	9.2	7.5	15.3	±3,235
471	18	M2/3B	MO/WP	104	80	12.2	5.8	10.4	±265
472	4	S3B	WP	130	110	12.5	13.7	10.5	±2,340
473	2	S1/2B	WP/MH	401	70	5.7	N/A	5.1	±1,400
474	4	S2/3B	RP/WP/PP	247	115	9.2	7.5	15.3	±3,235
475	9	M2/3A	MO/WP	284	122	8.8	5.9	12.2	±889
476	14	S2/3A	WP	282	136	9.2	9.0	14.9	±730
477	9	S3C	MS	157	117	11.3	14.2	11.8	±500
478	12	M2/3B	WP/UO	201	90	7.6	4.2	11.4	±315
479	29	S2/3A	WP/UO	215	152	10.1	14.9	20.1	±280
480	12	M2/3B	WP/UO	161	79	9.4	4.3	8.0	±700
481	10	M2/3B	WP/UO	148	75	8	3.9	8.8	±4,444
482	4	W2A	RM	496	160	7.7	2.4	25.9	±50
483	3	S1/2B	WP	401	70	5.7	N/A	5.1	±1,400
484	6	M2B	WP/MH	225	88	8.5	3.0	11.0	±692
485	17	M2B	UO/WP	204	90	8.2	2.9	10.4	±300
486	43	H2C	UO/WP	105	55	8.5	0.9	7.4	±525
487	30	M2C	UO/WP	121	60	8.6	2.2	7.7	±420
488	53	W2/3B	RM	198	140	10.6	5.9	24.6	±155
489	18	S3B	WP/SP	159	107	9.1	8.9	13.1	±3,575
490	43	H3A	MO	180	125	10.9	6.8	16.9	±350
491	11	W2/3A	RM	186	117	10.7	5.5	11.9	±127

493	4	S3B	WP/HE	130	110	12.5	13.7	10.5	±3,235
494	9	W2/3A	RM/MH	186	117	10.7	5.5	11.9	±127
495	11	W2/3A	RM/MH	186	117	10.7	5.5	11.9	±127
496	73	H2/3A	MO/UO	111	79	9.8	3	20.3	±486
497	2	Open							
499	17	H2B	UO/WP	160	75	9.2	1.1	9.7	±750
500	15	H2B	MO	102	85	10.8	3.7	12.8	±287
501	12	M2/3A	UO/WP	147	65	7.7	1.0	10.5	±2,265
502	6	H3A	MO/RM	90	90	12.6	7.9	9.2	±550
503	1	Water							
505	6	S1B	WP/SP			No	Data		
507	17	M3A	MS/MH	235	137	10.0	10.7	10.5	±1,444
508	8	M3D	SP/MH			No	Data		
510	47	H2/3A	UO	170	83	9.4	2.7	10.9	±267
511	16	H3A	MO/MH	108	97	11.8	6.0	11	±525
512	41	M2/3C	UO/WP	115	61	8.6	2.6	6.7	±775
513	13	H3A	MO/MH	50	75	16.2	7.5	5.3	±250
514	8	M1/2B	UO/-/WP			No	Data		
515	4	S2B	WP/UO	134	56	8.8	1.3	6.2	±420
516	3	M2/3A	WP/-/UO	284	122	8.8	5.9	12.2	±889
517	6	S2A	MS	358	140	8.5	3.8	20.9	-
518	9	M2B	MO/WP	159	80	9.6	3.4	11.2	±200
593	11	S2/3B	SP/WP	247	115	9.2	7.5	15.3	±3,235
594	10	M2B	UO/WP	130	85	10	4.0	10.2	±850
601	2	H3B	MH	107	72	10.7	3.6	10.0	±1,522
603	2	H3A	MO	184	116	10.6	7.2	8.6	±463
604	3	S3B	WP	130	110	12.5	13.7	10.5	±2,340
605	2	S3A	WP/SP/MH	159	136	11.4	14.8	11.2	±6,196
607	5	W2A	RM/MH/MS	496	160	7.7	2.4	25.9	±50
608	11	S3C	WP/MS	80	82	13.1	13.0	5.5	±4,192
612	3	H3A	MO/RM/WP	184	116	10.6	7.2	8.6	±463
617	3	H3A	MO	184	116	10.6	7.2	8.6	±463
1100	24	H2D	UO/WP			No	Data		

Ashland MU Management Activity Schedule:

Stand	Type & Species	Activity	Acreage	Year
425, 473, 474, 475, 476, 479, 480, 481	WP, MO, UO	Thinning	130	2011
497	Open	Manage for early-successional wildlife thicket	2	2011
452, 454, 463, 489, 496, 501	MO, UO, WP	Thinning	TBD	2012
496	H2/3A-MO	Clearcut to enlarge 497 opening for early-successional wildlife thicket	10	2012
457	S3B-WP	Treat hay-scented fern and invasive *Ailanthus*	25	2014
458	M3B-WP/MS			
459	M2C-MH/WP			
457	S3B-WP	Light thinning and/or scarify soil to promote regeneration	25	2016
458	M3B-WP/MS			
459	M2C-MH/WP			

BETTY POND MANAGEMENT UNIT



BETTY POND MANAGEMENT UNIT

Location, Geography, and Access

The small Betty Pond MU comprises about 200 acres in the B Block located east of Route 116 and Betty Pond Road and south of Plainfield Pike (Route 14). The western 145 acres including the namesake pond and a narrow strip of land surrounding it have been PWSB property since the creation of the reservoir system, while the acreage northeast of the pond was acquired when Providence Water purchased the 56-acre former Paquette property in 1989. Most of this MU is located in Scituate, but the newer land includes four acres in Cranston. The terrain is generally rolling to hilly and most of the land drains into Betty Pond, a former millpond which is part of the larger Kent Brook watershed. Short Dorr Road runs roughly parallel to Plainfield Pike where the MU abuts this public highway. Interior road access is provided by the B-9 firelane extending between Dorr Road and Route 116.

Existing Forest Description

The forest in this MU is characterized by mixed oak and white pine. Scarlet oak is the most common species on the rocky upland soils found across most of the area, but some red oak is present on the more mesic sites adjacent to Betty Pond. The overstory white pine component is greater in the mixedwood stands occupying the western half of the MU, while pine is currently found mostly in the understory of the eastern stands. Wetlands dominated by red maple are found adjacent to the northeast end of the pond in parts of stands 438, 444, and 448. Almost all the stands are pole-to-sawtimber sized, with the only area of early-successional forest (stand 1091) occupying the flattish strip of land between Dorr Road and Plainfield Pike. Without catastrophic disturbance, white pine eventually will grow to dominate or become a larger part of the species composition in the upland stands of this MU in the future.

Soils

This MU is generally characterized by rocky upland soils. Canton and Charlton very stony fine sandy loams are the most common soil series. These soils are well drained and moderately productive where they are not very rocky, with a site index of 58 for white pine and 52 for red oak. The hydric Ridgebury, Whitman, and Leicester series are found in the low areas adjacent to Betty Pond and also along the stream between Route 116 and Pinecrest Road; no harvesting is recommended where these hydric soils occur. Small areas of more productive Sutton and Woodbridge soils are found at the eastern end of the former Paquette property, on both sides of Dorr Road, and – along with the uncommon Lippitt series – at the westernmost edge of the MU along Route 116.

Past Land Use and Forest Management

The 1915 PWSB land use survey is only available for the original land in this MU (roughly the western two thirds). Of this acreage, the survey recorded most of the land as woodland with significant patches of arable land and brush (the latter presumably former agricultural land reverting to forest) on both sides of Dorr Road and along what is now Route 116. The wetland area comprising parts of stands 438 and 448 on the north side of Betty Pond is recorded as a swamp.

PWSB forestry records show the first active management in 1930, when four acres of existing hardwood forest between Betty Pond and the B-9 firelane were underplanted with white pine and later released in 1951. The former farmland on both sides of Dorr Road (modern stand 435) was planted in red pine in 1938 and these stands were pruned and received several thinnings between 1950 and 1970. The arable land along Route 116 may have naturally returned to forest without planting, as no management is recorded for this stand described as “mixed hardwood, pine, cedar” until a cedar post harvest in 1967.

Two harvests during the past decade have included most of the operable stands on the original land in this MU. The stand 1091 red pine plantation was completely harvested during the 2000 Shun Pike harvest prior to mortality due to the red pine scale and red pine adelgid. The 2008-09 Betty Pond harvest included thinning in stand 449 with a shelterwood/group selection prescription in stand 448 to create gaps promoting the development of new age classes of trees.

Without further research, little detailed information on past land use and management history of the former Paquette parcel is readily available. Aerial photos dating back to 1939 show that the land cover has been relatively stable over the past several decades. The 1939 photo appears to show part of the wooded land being used for cattle grazing under a more open canopy. Since the exclusion of grazing, the canopy has closed and the oak-hardwood forest has matured. No active forest management has taken place former Paquette property since it was acquired by PWSB.

Forest Health and Related Management

As in the rest of the oak-hardwood forest across the PWSB ownership, the issue of deer herbivory and lack of oak regeneration is common in the hardwood stands in this MU. White pine is the most prevalent understory tree species and very little hardwood regeneration other than red maple is present. Huckleberry and lowbush blueberry are also common, most notably in upland oak stand 442.

Despite its location bordering two heavily traveled public roads, this MU is relatively free if invasive plants and no significant infestations were encountered during the field inventory except for a significant population of buckthorn on the site of the harvested red pine stand between Dorr Road and Plainfield Pike. The buckthorn must be treated before any further management in this roadside “island” stand (1091), but among all the invasive plant populations on the property this one is a relatively low priority due to its location. Preventing the buckthorn from spreading into the stands on the south side of Dorr Road thinned in 2008-09 is an important management goal and the buckthorn population should be monitored.

Silviculture

Since much of the operable acreage has been worked in recent years, this MU is a relatively low priority for silvicultural activity during the coming decade. The regeneration conditions in the gaps created in stand 448 during the 2008-09 harvest should be monitored and will inform future timber management. If or when it becomes possible to secure oak regeneration, the stands in this MU will

benefit from silvicultural prescriptions that continue to diversify the current homogeneous age class structure. Where possible, harvests should still favor and promote white pine, as the soils here are well suited to this species. Regeneration harvesting in the hardwood-dominated stands where there is little understory pine is less desirable if insufficient oak seedling development due to deer herbivory continues to be a problem.

The mixedwood western stands included in the Betty Pond harvests should be evaluated for another treatment in some or all of the stands in 2019. In addition to the regeneration issue, viable logging access needs to be considered before planning any harvesting in the maturing oak-dominated stands on the former Paquette property. The wetlands in the north-central section of the MU may prevent using a landing site on Dorr Road, but alternate access may be available from Plainfield Pike into the eastern end of the MU.

Cultural Resources

Compared to the rest of the PWSB ownership, the Betty Pond MU contains few cultural resources or artifacts of past land use. The most significant remaining physical feature is the Industrial Revolution-era Betty Pond dam located immediately adjacent to the intersection of Route 116 and Betty Pond Road. Like several other old dams on the property, this dam was constructed using large boulders and other native stone and is still used in a secondary capacity by Providence Water today.

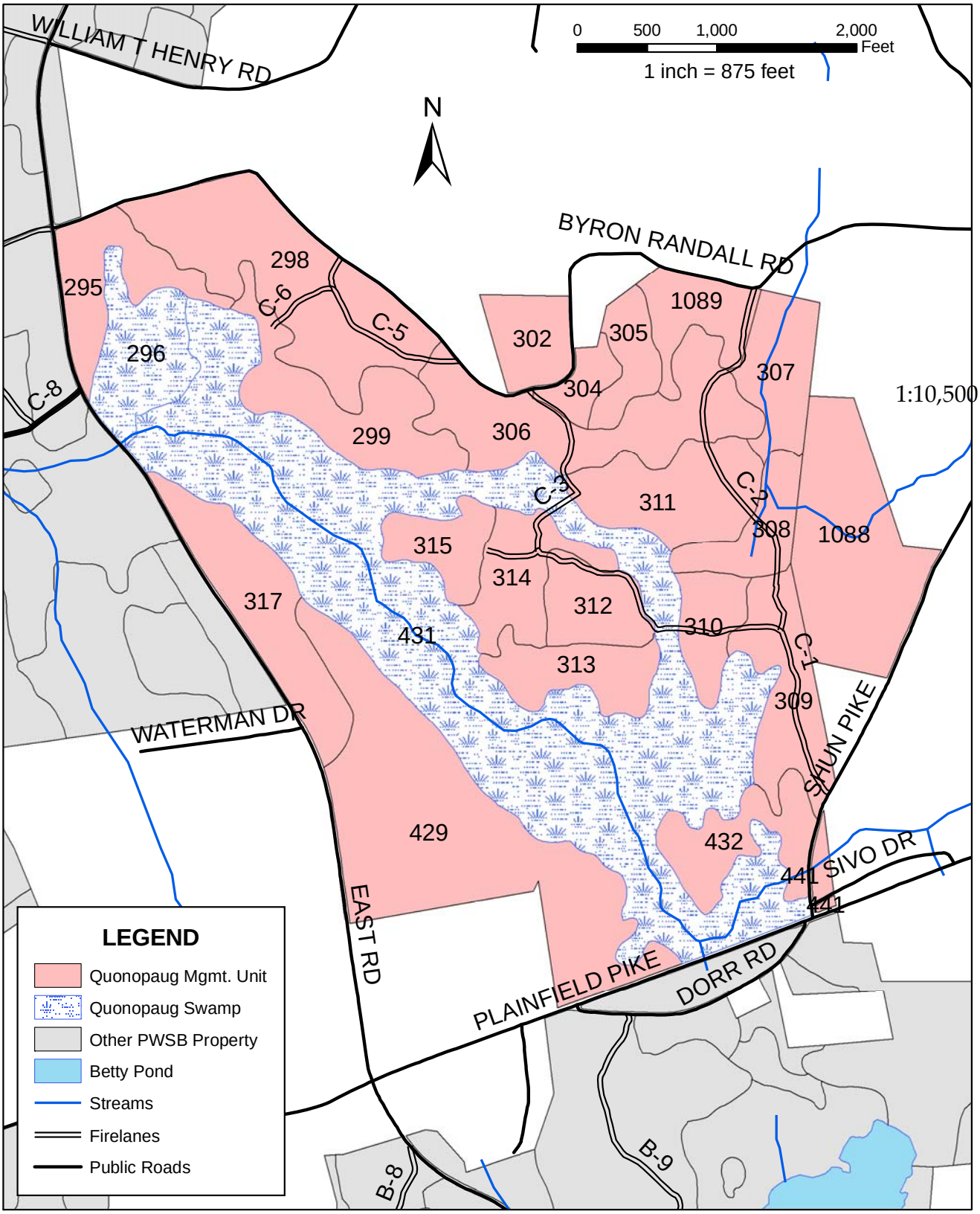
Betty Pond MU Inventory Summary:

Stand	Acres	Type	Species	TPA	BA/ac	MSD	MBF/ac	Cds/ac	Regen/ac
435	5	M1/2B	WP/MH			No	Data		
438	4	W3A	RM/MO	183	130	11.3	5.4	19.4	±523
439	3	H3A	MH	184	116	10.6	7.2	8.6	±463
440	2	Easement							
442	30	H2/3A	MO/UO	141	94	9.9	3.7	13.2	±565
443	22	H3A	MO	86	90	12.8	4.8	13.3	±215
444	8	H2/3A	MH	190	105	10.0	4.8	9.3	±650
445	6	H2/3A	MO	190	105	10.0	4.8	9.3	±650
447	24	Water							
448	24	H3B	MO/-/WP	96	78	12.2	5.2	9.5	300
449	53	M2/3B	WP/MO	173	96	9.6	5.1	13.8	550
456	6	H2/3A	RM/MO	190	105	10.0	4.8	9.3	±650
1091	8	H1A	MH			No	Data		
1165	1	Wetland							

Betty Pond MU Management Activity Schedule:

Stand	Type & Species	Activity	Acreage	Year
Part 442, 443	MO/UO	If both oak regeneration and logging access can be secured, evaluate for group selection/patch cut harvest	TBD	2019
448, 449	MO/WP	Evaluate for harvest which could include individual/group selection and additional thinning	up to 75	2019

QUONOPAUG MANAGEMENT UNIT



QUONOPAUG MANAGEMENT UNIT

Location, Geography, and Access

The Quonopaug MU covers about 480 acres and includes all the land in the C Block east of Route 116. Byron Randall Road and Plainfield Pike (Route 14) serve as the northern and southern boundaries respectively. The eastern boundary is an irregular and mostly wooded property line that includes two separate sections along Shun Pike. All of this land has been PWSB property since the creation of the reservoir system except for the 30-acre former Relahan property bordering the Shun Pike purchased by Providence Water in 2004. The distinguishing geographic feature of this MU is the broad, low-lying Quonopaug Brook corridor and surrounding forested wetland. The 150-acre central "Quonopaug swamp" occupies nearly a third of the land area and divides the operable uplands of the MU into two distinct sections. Served by the C-1 to C-6 network of firelanes in varying conditions, the 255-acre northeastern upland section transitions from rolling terrain in its eastern areas to relatively flat ground approaching the swamp. The much smaller southwestern upland area (about 75 acres) has no interior road access and is situated on a gentle northeast-facing slope between the public highways and the edge of the swamp.

Existing Forest Description

The forest in this MU is characterized by distinctly different species types in the upland sections and Quonopaug swamp.

As evidenced by the many tall, relatively large-diameter white pines, the upland soils are well suited to this species and this MU has some of the better white pine sites on the PWSB property. Some of the stands in the northeastern section have a significant mixed oak component, while the southwestern section is overwhelmingly dominated by pine except for large early-successional openings created in stand 317 where nearly pure red pine groves were harvested. Most stands are sawtimber-sized, with only a small acreage in the sapling and seedling size classes. Timber harvests between 2000 and 2010 have reduced stocking levels in many stands to improve growing conditions for the remaining trees and to enhance the development of regeneration.

The densely wooded Quonopaug Brook corridor is dominated by red maple and associated hardwoods suited to growing in hydric soils. Occasional white pine (including some large individual trees) is also present on drier microsites within the swamp. Inoperable for timber harvesting and challenging for human travel, the swamp contains a varying level of standing water over the course of the year and was not included in the on-the-ground forest stand inventory. Historic forest stand records list "scattered black spruce" in the swamp, but the continued presence of this rare species has not been confirmed.

Soils

Somewhat unusual for the PWSB property, this MU has large areas of significantly different soils due to its varied terrain and geomorphology. Very rocky Canton and Charlton soils are the most common series in the hillier eastern part of the northeastern uplands, including some rock outcrops along Byron Randall Road. These soils are well drained and moderately productive where they are not very rocky, with a site index of 58 for white pine and 52 for red oak. The flatter operable stands in the northwest corner transition to more mesic Woodbridge soils along with occurrences of the Gloucester-Hinckley and Paxton series; the seasonable high water table here must be taken into account when planning timber harvesting operations. Stony Paxton soils are prevalent on the high ground adjacent to Route 116 in the southwestern uplands, while the Canton, Charlton, and Woodbridge series are found north of Plainfield Pike. The well drained Paxton soils have a site index of 66 for white pine and 65 for red oak.

Underlying the main part of Quonopaug swamp are Adrian and Carlisle mucks, elsewhere uncommon on the watershed property. The Ridgebury and Tisbury series are associated with the edges of the swamp or the narrow stream corridors in the northeastern uplands. These hydric soils pose operational limitations and the swamp in particular will continue to be excluded from timber harvesting activity. Near the center of the MU, adjacent areas of Enfield, Sudbury, and Walpole soils are located near a flat, operable “island” with an elevation slightly above the surrounding wetlands.

Past Land Use and Forest Management

At the time of the creation of the reservoir system, the 1915 PWSB land use survey recorded the majority of this MU as woodland or, in the Quonopaug Brook corridor, “swamp wooded.” The patches of arable land at this time closely coincide with the boundaries of modern stands 304 and 312 and also comprised a small roadside part of 298. “Reforested” areas presumably returning to forest from agricultural use were recorded along what is now Route 116 (in the location modern stand 317 and the western edge of 295), Plainfield Pike (the southern part of 429), and Shun Pike (309 and 432).

Silviculture has been very active in the upland forest stands of the Quonopaug MU since Providence Water acquired the land. The roadside areas already classified as reforested in the 1915 survey were among the first on the watershed property to be planted in red and white pine in 1925, with the most recently cultivated farmland planted in 1938 and 1940. Small areas of white and Norway spruce were also planted along Route 116. Natural stands made up the northeast corner of the MU and stands 298 and 429 were also existing forest when PWSB started managing the land. Hardwoods may have dominated the natural stands overall, but species composition varied by stand and several of them had a strong natural white pine and pitch pine component (along with redcedar in stand 298). The Hurricane of 1938 caused catastrophic windthrow in part of stand 314 and led to the natural regeneration of white pine on this site.

Management from the mid-1940s and through the 1970s emphasized intermediate treatments. Beginning with pruning in the 1940s, many stands of both plantation and natural origin were released or thinned during this period and some prescriptions included weevil control, cull treatment, pitch pine removal, and cedar post harvesting. Many of the old field plantation stands received several thinnings. White pine was planted under a hardwood canopy in stand 429 in 1961 and released over the course of the next decade. Records for several stands in the northeast list natural hardwood over white pine without a planting date, but it is unclear whether the white pine was natural regeneration or underplanted. Three acres at the western edge of stand 298 were planted in

white pine, hemlock, and larch in 1967. In plantation stand 312, five acres were enrichment planted with black cherry and white ash in 1972 after two thinnings, but this experiment ultimately failed.

More recent harvests between 2000 and 2010 have focused on responding to forest health threats and promoting greater diversity in stand structure and age classes represented across the MU landscape. Almost all the upland stands in this MU have been worked over the past decade. Prompted by the threat of mortality from the red pine scale and the red pine adelgid, the 2000 Shun Pike and 2001 Quonopaug harvests combined red pine removal with thinning and other stand-specific prescriptions. The 2009-10 Byron Randall harvest included a large number of both white pine and mixedwood stands in the northeastern upland section (returning to some stands entered nine years earlier), with a variety prescriptions intended to both improve overstory crop tree growth and health and encourage the development of regeneration.

No silviculture or active forest management has been undertaken in the Quonopaug swamp or its tributary wetlands since Providence Water has owned the property.

Without further research, little detailed information on past land use and management history of the former Relahan parcel (stand 1088) is readily available. Aerial photos dating back to 1939 show that the property has been forested for the past several decades.

Forest Health and Related Management

As in the rest of the oak-hardwood forest across the PWSB ownership, the issue of deer herbivory and lack of oak regeneration is common in the hardwood and mixedwood stands. In general, however, regeneration in the upland sections of this MU is healthier than many other areas of the watershed forest because so many of the stands are dominated by white pine. Timber harvests that have created canopy openings while leaving many seed trees have done much to promote abundant pine regeneration, which is less by preferred by deer to hardwood seedlings.

Adjacent to Route 116, the areas of stand 317 formerly dominated by red pine have not regenerated naturally to desirable native species. Along with scattered overstory white pines, these areas are presently dominated by shrubby vegetation, invasive species (Oriental bittersweet, multiflora rose, probably others), and undesirable vines that share some invasive characteristics (notably greenbrier). Rehabilitating these areas is a priority, but accomplishing this goal may be difficult without controlling deer herbivory. Some additional white pine regeneration from seed trees in the surrounding areas of the stand will probably develop here. Possible treatments would likely include some combination of herbicide application, mechanical mowing, deer exclosure establishment, and/or tree planting. Around the corner along Plainfield Pike, a small population of buckthorn is currently present at the southern edge of stand 429 bordering the public highway. The buckthorn plants may have spread across the road from the significant infestation in the “island” stand between Plainfield Pike and Dorr Road in the Betty Pond MU. These invasives should be treated before the harvest in stand 429 described in the silviculture section and their populations monitored after the harvest.

A limited amount of Japanese barberry is present in the Byron Randall timber harvest stands that were cut in 2009. With the new canopy openings dramatically increasing the amount of sunlight reaching the understory, the barberry population should be monitored and treated if it spreads.

Silviculture

Since much of the operable acreage has been worked in recent years, this MU is a relatively low priority for silvicultural activity until the end of the next decade, with the notable exception of one stand. Understory response to the 2001 thinning in the well-stocked white pine stand at the

southwest corner of the MU (429) has been spectacular, and this stand currently has some of the most dense white pine regeneration on the entire watershed forest (±25,000 stems/acre in places). This stand is ready for a harvest in 2011 that will maintain roadside aesthetics since two edges of the stand are highly visible along Route 116 and Plainfield Pike. As conditions vary within the stand, a prescription combining thinning and release where appropriate will provide more growing space for the remaining trees and allowing the regeneration to develop further.

The stands which were thinned received an initial or intermediate regeneration cut the as part of the Shun Pike and/or Byron Randall harvests and should be evaluated for another treatment at the end of the 2010-2020 management period. Some kind of intermediate treatment (possibly non-commercial) may be viable for young stands 304 and 312 within the surrounding matrix of older forest.

Cultural Resources

Compared to many other areas of the PWSB ownership, the Quonopaug MU contains relatively few cultural resources or artifacts of past land use. The large Quonopaug swamp wetland has discouraged settlement, agricultural use, and logging throughout the modern history of human land use in the watershed. A small historic cemetery surrounded by stone walls is located on the east side of Route 116 a short distance south of the location where Quonopaug Brook flows under the highway. Several stone walls now run through the forest in the uplands south of Byron Randall Road.

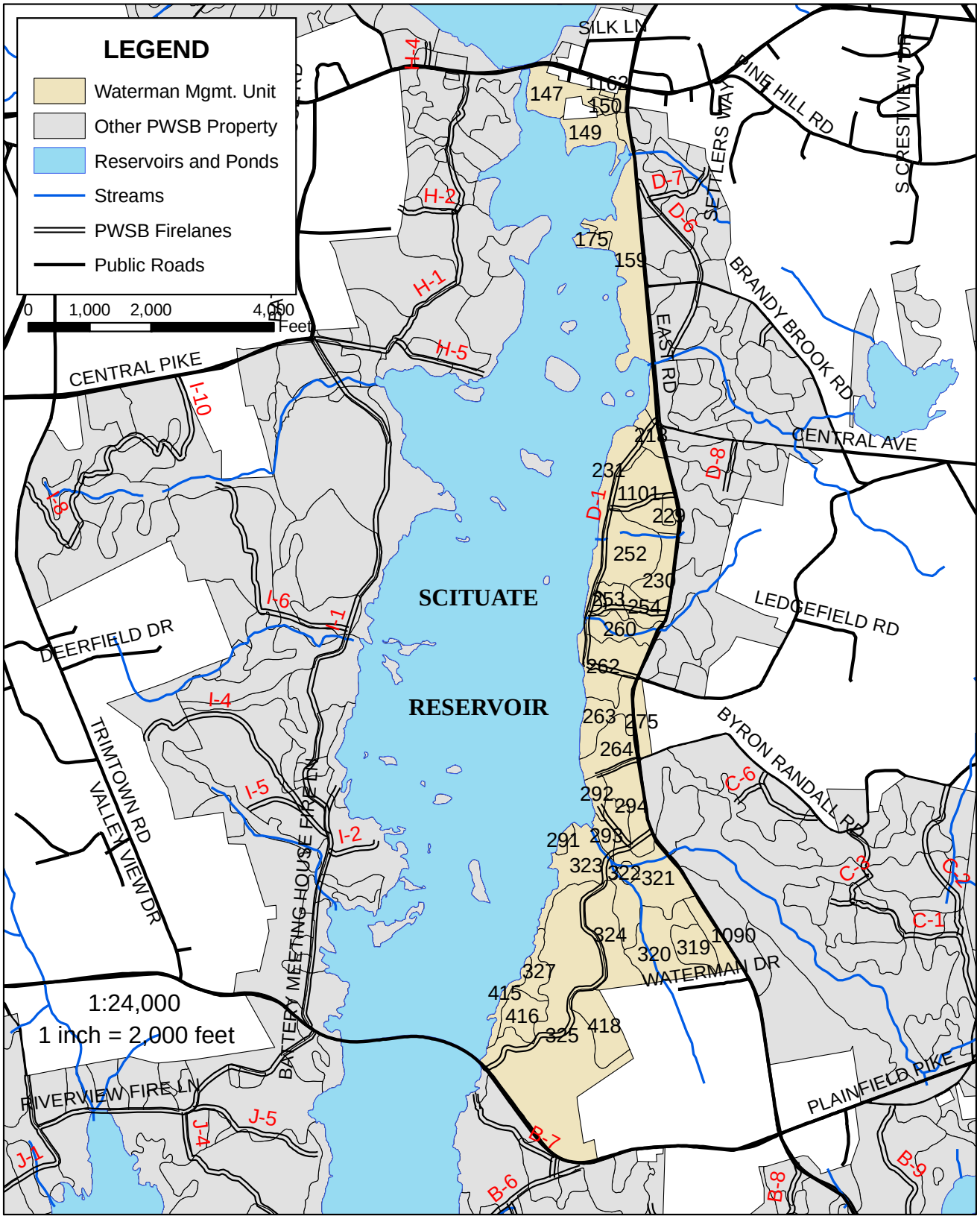
Quonopaug MU Inventory Summary:

Stand	Acres	Type	Species	TPA	BA/ac	MSD	MBF/ac	Cds/ac	Regen/ac
295	13	M3A	MO/WP	102	90	12.7	9.1	3.5	±50
296	14	W2/3A	RM	186	117	10.7	5.5	11.9	±127
298	35	S3A	WP/-/MO	76	95	15.0	12.7	4.3	-
299	19	W2/3A	MO/WP	107	60	11.6	6.9	5.7	-
302	8	S3B	WP	130	110	12.5	13.7	10.5	±2,340
304	4	M1/2C	RM/WP	142	28	6.2	0.6	1.3	±525
305	7	W2/3A	RM	186	117	10.7	5.5	11.9	±127
306	27	S3B	WP	32	68	19.0	11.2	3.2	±1,000
307	11	H3A	MO/MH	70	75	13.3	5.0	2.5	±150
308	9	H2/3A	MH	190	105	10.0	4.8	9.3	±650
309	16	M3B	MO/WP	169	107	10.8	7.4	4.1	±167
310	8	S3B	WP	130	110	12.5	13.7	10.5	±2,340
311	17	S3B	WP	52	83	17.1	12.1	4.5	±1,567
312	9	S1/2A	WP	725	80	4.6	N/A	1.2	±3,500
313	11	M3B	WP/MO	153	98	10.8	8.3	6.7	±954
314	12	S3B	WP	130	110	12.5	13.7	10.5	±2,340
315	8	M2/3A	RM/WP	284	122	8.8	5.9	12.2	±889
317	20	S3B	WP/-/MS	17	40	20.9	7.5	1.0	±1,867
429	57	S3A	WP	134	108	11.8	13.1	5.9	±23,600
431	140	W2A	RM/MH	496	160	7.7	2.4	25.9	±50
432	13	M3B	WP/MO	160	105	11.2	13.2	3.8	±500
441	1	H2/3A	MH	190	105	10.0	4.8	9.3	±650
1088	30	H3A	MO	136	103	11.7	6.6	5.7	±800
1089	9	H3C	MO/WP	60	70	14.6	5.6	3.2	±50

Quonopaug MU Management Activity Schedule:

Stand	Type & Species	Activity	Acreage	Year
317, 429	N/A	Treat invasives species before harvest in stand 429 to prevent spread and improve conditions for regeneration in stand 317	~5	2010
429	S3A-WP	Thinning/first release harvest	~50	2011-12
295, 298, 302, 307, 309, 310, 313, 314	WP/MO	Evaluate for harvest in some or all of these stands to follow up on previous silvicultural treatments	TBD	2019
304, 312	WP/MO	Evaluate for intermediate treatment to improve growth of white pine and other desired species	15	2019

WATERMAN MANAGEMENT UNIT



WATERMAN MANAGEMENT UNIT

Location, Geography, and Access

The long, narrow Waterman MU covers approximately 450 acres in the C and D Blocks on the east shore of the Scituate Reservoir's east arm. Bounded to the east by Route 116, this area includes a 4½ miles of shoreline and stretches from Plainfield Pike north to the village of North Scituate and Danielson Pike. For the northern two-thirds of this MU, Route 116 is located within 1,500 feet of the reservoir and in many locations the highway is much closer. The terrain is generally flat to gently westward-sloping, with several small streams and associated wetlands emptying into the reservoir. The land slopes more steeply down to the reservoir's edge at the southern end. The MU is named after the old Waterman homestead that was located near the current intersection of Route 116 and Route 14 (locally known as Waterman Four Corners). This area of the PWSB property is currently home to the only known bald eagle nesting site in Rhode Island. Since 2003, a nesting pair has used a white pine tree on a small island that can be observed from Route 116, just north of the intersection with Central Avenue.

The D-1 firelane running parallel to the reservoir was formerly part of the North Scituate-Kent Road that served as the main north-south transportation route along the east side of Moswansicut River. Portions of other old town roads that are now used as firelanes in this MU include Byron Randall Road (C-10) and William Henry Road (D-1). Some of the firelanes (D-3, D-5, and D-2) in the area of the former Hall Estate will be abandoned as they are in poor condition and unnecessary for management activities.

Existing Forest Description

The stands in this MU are fairly evenly divided among cover types: 169 acres in softwoods (37%); 123 acres in hardwoods (27%), and 161 acres classified as mixedwood (36%). As in other parts of the watershed forest, much of the mixedwood acreage is transitioning to white pine as a result of both silviculture and hardwood mortality (especially scarlet oak). White-tailed deer are also contributing to the shift, as they prefer to browse on hardwood seedlings rather than white pine. The majority of stands in this MU are pole-to-sawtimber sized and smaller size classes are absent. The age class distribution will begin to change over the course of the next 20 years as release harvests are planned for some stands with good white pine regeneration. At the northern edge of the MU adjacent to the Glenford Cemetery and the village of North Scituate is the property's only large stand of sugar maple (147, 13 acres). Some locally rare black walnut trees are also found in this stand behind the houses on the north side of the cemetery.

Soils

The soils in this MU consist mostly of fine sandy loams belonging to the Paxton, Agawam and the Canton and Charlton series. These well drained soils are able to support a wide range of tree species, with site indices ranging from 58 to 70 for white pine and from 52 to 65 for red oak. Agawam soils are most prevalent at the flat northern end of the MU, with the Paxton series underlying most of the central section and Canton and Charlton soils on the rocky slopes at the southern end. Hydric Ridgebury soils are found along two neighboring stream corridors in the central section and in a wetland along Plainfield Pike; these areas are dominated by red maple and should be excluded from future timber harvests. Areas of moderately well drained Woodbridge soils that usually provide good growing sites for hardwoods are present in the uplands between the C-8 firelane and Route 116.

Past Land Use and Forest Management

Around the time of the creation of the reservoir system, the PWSB land use survey recorded the majority of the land in this MU as woodland. A patchwork of different cover types and conditions was present in the northern and central sections, particularly around the former Hall Estate. “Brush” and “reforested” areas presumably returning to forest from agricultural use were intermingled with still arable land.

Approximately a third of the acreage has seen some type of tree planting, and past management has significantly influenced species composition across the MU. About 95 acres of plantation stands were established in two phases. Most of the old fields and open areas adjacent to the reservoir were planted to red and white pine and Norway and white spruce between 1925 and 1930. A second round of open planting took place over 1951-67 in the area of the former Hall Estate, and species used here included Douglas-fir, larch, and Austrian, jack, and pitch pine. In addition to plantation establishment, another 92 acres of hardwood forest were underplanted with white pine in 1941-42. The underplanted pine was partially released by hardwood girdling in 1961-62, but some of the girdling was unsuccessful and some trees have healed-over wounds that are still visible. Many of these survivors have apparent butt rot or other health problems, but make good wildlife trees. Most of the plantation stands were thinned at least once between the 1950s and 70s.

Timber management has been very active in this MU over the past fifteen years, with harvesting activity on about 255 acres (about 56% of the land area) targeted at reducing forest health threats while accomplishing other silvicultural goals. Five separate harvests between 1998 and 2008 (Quonopaug Hardwood, Shun Pike, Brandy Brook, Waterman, and Saundersville) have primarily focused on removing red pine, thinning conifers, and continuing the release of the underplanted white pine. Stand-specific prescriptions employed a mix of thinning and strategies to secure regeneration, depending on species composition. The shoreline and roadside red pine in this MU is now mostly gone (while many declining or dead trees remain in buffers along the reservoir’s edge), and silvicultural activities have shifted many stands towards white pine.

Forest Health and Related Management

The overall health of the MU appears to be good, as white pine has emerged into the overstory. Abundant regeneration of this species has developed where past thinnings have allowed increased light to reach the forest floor. Several white pine stands that were very recently thinned already have numerous new pine seedlings under an inch tall. The success of white pine, however, has been somewhat disguising the lack of hardwood regeneration and deer impacts in this MU as in the rest of the forest across the PWSB ownership. In addition, many scarlet oaks have died over the last few years from insect defoliation but the presence of the unaffected conifers lessens the visual impact.

Given this area's land use history, location along heavily traveled roads, and proximity to the village of North Scituate, it is not surprising that invasive plants are common. In particular, there is a high occurrence of Japanese Barberry, Tree of Heaven, and Oriental bittersweet in the central and northern sections of the MU. The heaviest concentrations of these invasives are located near the old building locations, suggesting that they may have been planted. Planting these species was a common practice before they were known to be undesirable. An infestation of Japanese barberry in stand 260 was treated in 2010 along with the roadside area along the D-1 firelane. Future timber harvest project planning in the central and northern sections will incorporate invasive assessment and treatment, as an important management goal is to try to prevent these populations from spreading.

Silviculture

Management will continue during to be very active in this MU during the 2010-2020 timeframe. Although not a silvicultural practice, the sugar maple in the 13-acre stand 147 will be tapped for sap production beginning in 2011. The sugarbush lease is an existing agreement.

In the southern end between Plainfield Pike and the C-10 firelane, activities will focus on the white pine and white pine-hardwood stands (264, 294, 317, 319, 321, 324, and 325). Stand-specific thinning, group selection, and shelterwood prep cut prescriptions will improve growing conditions for the remaining overstory trees while releasing or promoting further development of the abundant white pine regeneration. Most of these stands were last worked during the 1996-97 Quonopaug harvest and will be combined into one harvest scheduled for 2014.

At the far northern end, good white pine regeneration has similarly become established in stands 160 and 175 since they were last worked in 2004. These stands form a narrow strip between heavily traveled Route 116 and the reservoir shoreline. In stand 160, the removal cut of an irregular shelterwood will release the regeneration secured by previous establishment cuts, while leaving groups of trees intact for vertical diversity. All the remaining spruce will be harvested as it has proven to be less windfirm than white pine on these soils. Areas close to the road should be cut heavily or not at all to decrease the chance of trees blowing down into the road. Stand 175 is located on a small peninsula and has a mixed oak-conifer composition; a group selection prescription will be applied here. This harvest on up to 36 acres in these northern stands is scheduled for 2017 and planning should include interpretive signage given the high visibility location and proximity to the village of North Scituate

In the central section, stand 253 is composed of heavily weeviled white pine of poor timber quality while adjacent stand 254 is mixed hardwood with spruce. Both stands occupy wet sites and standing water is present during certain times of the year. These stands will be converted to early successional growth for wildlife by clearcutting during dry or frozen ground conditions, followed by planting or sowing seed. This project will be accomplished later in the long-term planning cycle when nearby stand 262 is thinned unless outside funding becomes available.

Cultural Resources

This MU contains some notable remnants of past land use, especially in the central section. As the main north-south transportation route in the local area, the former North Scituate-Kent Road was used for transporting materials from Cranston to the iron furnaces in Smithfield and Glocester. The D-1 firelane was once a section of this road. The Hall Estate was the main cluster of settlement in this area and the property included a small dam that is still present. Some of the structures were not demolished until the 1960s and their foundations and other remnants are easy to recognize. Evidence of other buildings can also be found elsewhere along the length of the D-1 firelane. PWSB's general

policy of protecting and preserving historic sites applies to these locations, but – like similar sites across the PWSB property – it is not formally designated a special management area at present. At the northern end of the MU, a few structures were located along the public roadway at the outlet of Pine Swamp Brook but few artifacts remain.

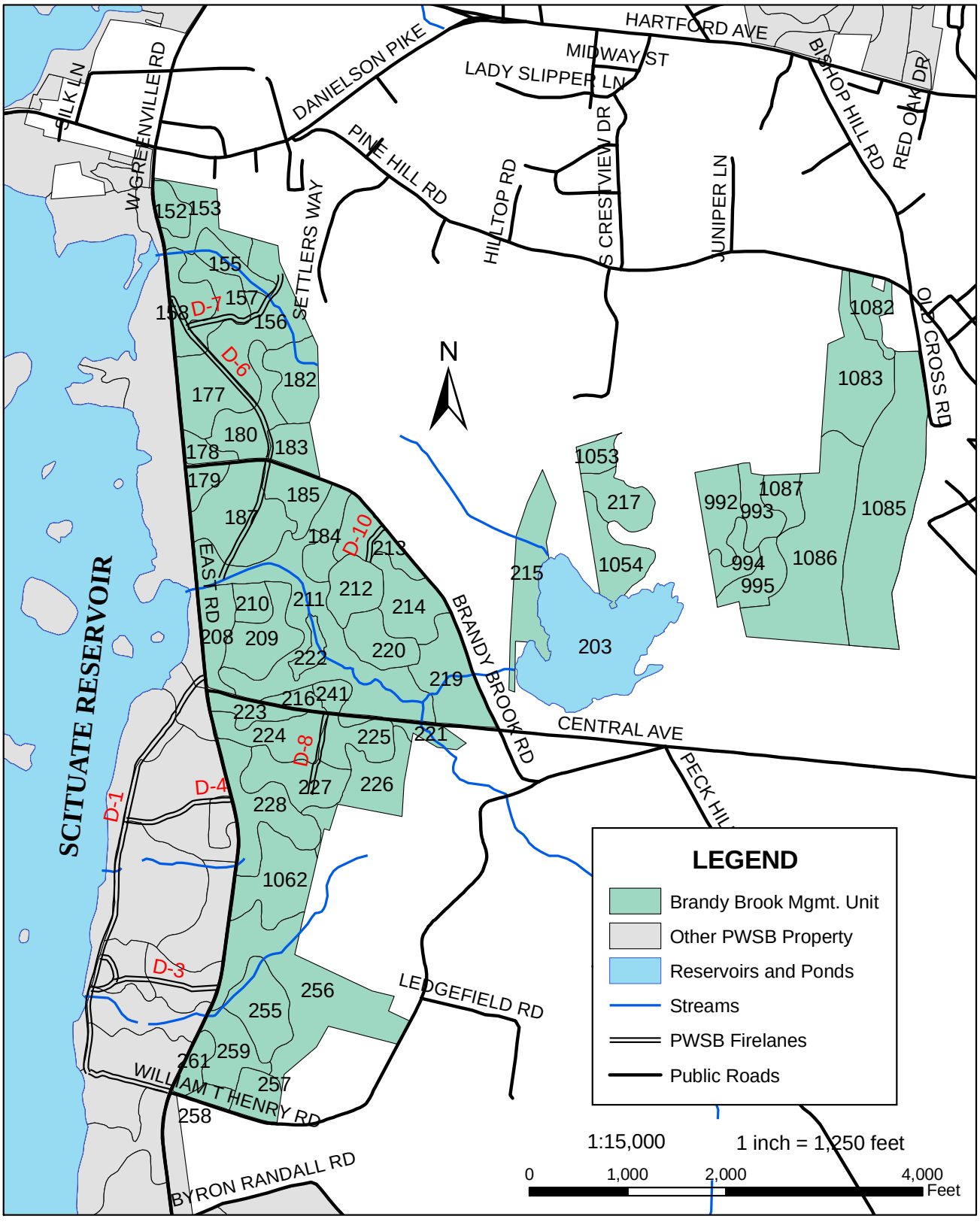
Waterman MU Inventory Summary:

Stand	Acres	Type	Species	TPA	BA/ac	MSD	MBF/ac	Cds/ac	Regen/ac
147	15	H2/3A	SM/-/WP	190	105	10.0	4.8	9.3	±650
149	11	M2/3B	WP/MH	161	79	9.4	4.3	8.0	±700
150	2	Water							
159	39	S3B	WP/MS	150	118	12.0	17.2	9.2	±5,180
175	4	M2/3B	MO/WP	161	79	9.4	4.3	8.0	±700
224	2	W3A	RM/MH	183	130	11.3	5.4	19.4	±523
229	3	S3B	WP/SP	130	110	12.5	13.7	10.5	±2,340
230	10	M3A	MO/WP	235	137	10.0	10.7	10.5	±1,444
231	18	S3B	WP/MS	118	113	13.3	18.4	9.1	±2,167
252	21	H3A	MO/WP	190	98	10.3	3.6	15.2	±175
253	6	S3B	WP/LX	130	110	12.5	13.7	10.5	±2,340
254	7	M2/3A	MH/SP	284	122	8.8	5.9	12.2	±889
260	10	W3A	RM/MH/WP	183	130	11.3	5.4	19.4	±523
262	18	S3B	WP/MS	153	130	12.1	14.1	17.5	±667
263	13	H3A	MO	184	116	10.6	7.2	8.6	±463
264	12	M3A	WP/MO	178	147	12.4	14.8	18.3	±2,433
275	5	M3A	WP/MO	178	147	12.4	14.8	18.3	±2,433
291	1	S3B	MS/MH	130	110	12.5	13.7	10.5	±2,340
292	3	M3C	MS/MH	152	74	9.2	3.8	9.7	±1,180
293	3	H2/3A	MO/RM	190	105	10.0	4.8	9.3	±650
294	15	S3A	WP/-/SP	159	136	11.4	14.8	11.2	±6,196
319	9	M3B	WP/MO	153	98	10.8	8.3	6.7	±954
320	22	W3A	RM/MH	200	133	11.0	3.5	23.0	±75
321	32	M3A	MO/WP	223	144	10.9	9.8	17.5	±460
322	2	W2/3B	RM	227	143	10.6	5.9	24.6	±125
323	18	H2/3A	MO/WP	190	105	10.0	4.8	9.3	±650
324	18	M2/3A	WP/MO/MH	177	103	10.4	7.0	14.6	±467
325	101	S3B	WP/-/MH	203	134	10.6	13.2	17.4	±4,572
327	6	H2/3A	MO/WP	190	105	10.0	4.8	9.3	±650
415	4	S3C	WP	80	82	13.1	13.0	5.5	±4,192
416	10	M2/3A	MO/WP	284	122	8.8	5.9	12.2	±889
418	14	M2B	WP/UO	147	70	9.4	2.0	10.7	±900
1090	7	S3A	WP	159	136	11.4	14.8	11.2	±6,196
1101	22	M3B	MO/WP	45	57	15.0	6.9	5.0	±100

Waterman MU Management Activity Schedule:

Stand	Type & Species	Activity	Acreage	Year
325	S3B-WP/-/MO	Thinning	100	2014
327	H2/3A-MO/WP		6	2014
159	S3B-WP/SP/RP	Shelterwood overstory removal	39	2017
175	M2/3B-MO/WP	Group selection harvest	4	2017
252	H3A-MO/WP	Shelterwood thinning/group selection	21	2018
263	H3A-MO		13	2018
253	S2/3A-WP	Wildlife clearcut with planting for early successional habitat	6	2018
254	M2/3A-MH/SP		7	2018
264	M3A-WP/MO	Group selection harvest	~65	2018
319	M3C-MO/WP			
321	M3B-MO/WP			
324	M2/3A-WP/MO			
262	S3B-WP	Shelterwood thinning	18	2018
294	S3A-WP		15	2018
1090	S3A-WP		7	2018
292	M3C-MH/MS	Shelterwood overstory removal	3	2018

BRANDY BROOK MANAGEMENT UNIT



BRANDY BROOK MANAGEMENT UNIT

Location, Geography, and Access

The Brandy Brook MU includes about 450 acres in the D Block on the east side of Route 116. Danielson Pike and William Henry Road serve as the northern and southern boundaries respectively, nearly bisected by Central Avenue. The eastern boundary of the main section of the MU (about 315 acres) is an irregular property line that includes a long section along Brandy Brook Road. Almost all of this land has been PWSB property since the creation of the reservoir system except for the 47-acre former Merchant property at the southern end purchased by Providence Water in 1991. The terrain slopes gently towards the Scituate Reservoir to the west. Brandy Brook runs through the central acreage, while Pine Swamp Brook passes near the northern edge and the southern area drains directly into the reservoir. The public roads bordering and passing through the main section of the MU give it a large amount of road frontage. The short D-6 and D-8 firelanes provide access to the interior, while the D-7 firelane has not been actively maintained and is inaccessible to standard 4WD vehicles.

This MU also includes four parcels that are not contiguous with the main section and are located to the east in the vicinity of Pine Swamp Reservoir and its large area of associated wetlands. The former Langlais (14 acres; acquired 1990) and Mansolillo (15 acres; 2007) tracts in Scituate include frontage along the west and north sides of this small secondary reservoir. The two other parcels are located in Johnston on the eastern edge of the wetlands: one of these tracts is an outlying 17-acre fragment of PWSB's historical ownership, while the adjacent 82-acre former Baldwin tract was acquired in 2008. These properties were purchased with the intention of conserving land to protect water quality in areas where suburban residential development has been occurring at a rapid pace.

Existing Forest Description

The forest composition in this MU is notable for its mosaic of many small but distinct stands, especially towards the northern end, that are the legacy of both past land use and silviculture during more recent decades. Only four stands in this section cover more than 10 acres. The white pine, mixed oak, and red maple and associated hardwood forest types are all well represented, and the MU still contains inclusions of now less common conifers including natural pitch pine and planted red pine, Norway spruce, and larch. Small forested wetlands are found along the streams draining this area and an artificial millpond remains in the Brandy Brook corridor. Most stands are pole-to-sawtimber sawtimber sized, but several thinned open-canopy and early-successional stands (largely the result of red pine harvesting) are present within the matrix of maturing even-aged forest.

Considered together, the hodgepodge eastern parcels have a high proportion of forested wetlands given their proximity to Pine Swamp but they also contain uplands stands of mixed oak and hardwoods with a growing white pine component. Stand 994 on the historic ownership parcel is a

remnant late-successional stand with large trees that has not been cut for a long time because its isolated location surrounded by wetlands has served to deter logging. Most of the former Baldwin property on the west side of private, unmaintained Cross Road is currently an overgrown field being overtaken by invasive plants. On the east side of the road, parts of the forested slope have been used for gravel extraction, degrading the soil and impacting forest growth in these areas.

Soils

Influencing the forest stand pattern in this area of the watershed forest, this MU contains small and intermingled occurrences of many different soil series. The main section does not have a dominant soil type although rocky Canton and Charlton soils underlie a greater area than any other series. These soils are well drained and moderately productive where they are not very rocky, with a site index of 58 for white pine and 52 for red oak. Other soils present in the uplands include Agawam, Gloucester-Hinckley, Paxton, Sutton, Woodbridge, and Walpole. The hydric Ridgebury, Sudbury, and Scarboro series are found in the stream corridors and associated wetlands; these areas will be excluded from harvesting.

On the eastern parcels, wetlands and adjacent low-lying areas are characterized by hydric Carlisle, Merrimac, and Ridgebury soils. Extremely stony Canton and Charlton soils are found on the upland portions of the former Langlais and Mansolillo tracts. On the former Baldwin property, Enfield silt loam underlies the field along Cross Road with the gravel pits on the east side of the road.

Past Land Use and Forest Management

When the reservoir was created, the 1915 PWSB land use survey recorded the original land in the main section of this MU as a patchwork of different cover types and conditions. The areas west of Brandy Brook Road and south of Central Avenue remained mostly woodland, but most of the land near the village of North Scituate and along the major roads was heavily disturbed. Fields under cultivation were clustered along Central Avenue and the modern D-6 and D-8 firelanes. Significant "brush" and "reforested" areas presumably returning to forest from agricultural use were intermingled with the arable land and generally concentrated towards the village and along what is now Route 116. The former impounded water source for the Saundersville mill was recorded as a dry pond, with both open and wooded swamp noted along the lower Pine Swamp Brook corridor.

Providence Water has intensively managed the Brandy Brook MU since acquiring the land. The former farmlands and brushy areas were mostly planted in red and white pine between 1925 and 1940. Smaller amounts of Norway and white spruce, Scotch pine, and Douglas-fir were also planted in several stands. In addition to the hardwood forest generally located on soils poorly suited to agriculture, scattered natural conifer stands containing varying amounts white and pitch pine and redcedar were also present when PWSB started managing the land.

Silviculture from the mid-1940s through the 1970s emphasized intermediate treatments, although red pine and larch were planted in stands 156 (following a fire), 177, 183, and 210 during the 1950s. Beginning with pruning in the 1940s, many stands of both plantation and natural origin were thinned or released during this period and some prescriptions included white pine weevil control and cedar post harvesting. A number of the old field plantation stands received several thinnings. Probably because of the limited acreage of hardwood forest on upland sites, the widespread practice of enrichment planting white pine under an oak canopy does not appear to have occurred in this MU.

Timber management has been very active in this MU over the past fifteen years, responding to forest health threats while accomplishing other silvicultural goals. Prompted by threat of the red pine

scale and red pine adelgid, four different harvests between 1995 and 2008 (Brandy Brook 1995-96, Pine Swamp, Brandy Brook 2004, and Saundersville) combined red pine removal with thinning of other conifers, shelterwood prep cuts, and work in mixedwood stands. Stand-specific prescriptions employed a mix of thinning and strategies to secure regeneration, depending on species composition. The percentage of red pine that once characterized the northern two-thirds of this MU is now all but gone, and recent silvicultural activities have shifted many upland stands towards white pine.

Without further research, little detailed information on past land use and management history of the former Merchant property and the four eastern parcels is readily available. Aerial photos dating back to 1939 show that the southern part of the former Merchant land along William Henry Road was farmed during the first half of the 20th Century, but the area that now comprises stands 258 and 261 was already reverting to forest by 1952. Present land cover on the eastern parcels is remarkably similar to 80 years ago. In agricultural use until fairly recently, the large field on the former Baldwin tract has not changed appreciably in size over this time period.

Forest Health and Related Management

As in the rest of the oak-hardwood forest across the PWSB ownership, the issue of deer herbivory and lack of oak regeneration is common in the hardwood and mixedwood stands. The varied mosaic of small stands and high percentage of conifers in the northern two-thirds of the MU, however, make the problem less stark than in areas of the property dominated by hardwood forest. Except on the poorest sites such as stands 214 and the eastern portion of 256, a shrub layer of blueberry and huckleberry generally does not impede desirable tree regeneration. White pine regeneration is healthy where there are seed trees and canopy openings; the recent timber harvests are leading to the establishment of more white pine seedlings in many stands.

Given this MU's land use history, location along heavily traveled public roads, and proximity to the village of North Scituate, it is not surprising that invasive plants are common. Oriental bittersweet in particular has probably been established for a long time. Along with lesser amounts of Japanese barberry and Tree of Heaven, this species is a problem in the stands formerly dominated by red pine along Route 116 and Central Avenue that have not regenerated naturally to desirable species. Rehabilitating these areas is a priority, but accomplishing this will be difficult without controlling deer herbivory. The infestation in stands 208, 209, and 210 (including nine acres with little to no tree cover) was treated with herbicides in 2009 and afterwards three fenced deer exclosures and a roadside interpretive sign were placed in stand 208. A short distance to the east, additional bittersweet and barberry are located on both sides of Central Avenue in stand 223. Another large, concentrated population of bittersweet is found in the stands at the northern end of the MU (152, 157, 158, 177) and the well-established vines are climbing the trees in stand 158. Finally, bittersweet is also starting to overrun mostly open stand 183 on the north side of Brandy Brook Road where the remaining red pine was harvested in 2004. The invasive populations must be treated before any further harvesting in these areas; specific prescriptions could include some combination of herbicide application, mechanical mowing, deer exclosure establishment, and/or tree planning.

Invasives also have a presence on the former Baldwin property. Without mowing, the large field is slowly but steadily being overtaken by shrubs that are currently waist high. Multiflora rose appears to be the most common shrub species and other invasives may be present as well. Some autumn olive is present at the edges of the forest. With its large field and outlying location, this tract differs from most of the watershed ownership but has similarities with a few other acquisitions. PWSB should establish a management strategy for the property that includes controlling the invasives. This could involve leasing the field to a farmer for haying or working in partnership with another organization.

Silviculture

Although much of the operable acreage has been worked in recent years, this MU will see a modest level of silvicultural activity during the coming decade. Several small stands clustered along Bandy Brook Road will benefit from a management entry scheduled for 2014 that can be combined into one timber harvest on about 30 acres. The mature white pine in stand 212 received a shelterwood prep cut as part of the 2002 Pine Swamp harvest and regeneration is developing nicely; this stand is ready for the seed cut to further enhance regeneration development. Adjacent mixedwood stands 214 and 220 are gradually transitioning from mixed and upland oak to pine dominance. The oaks are showing signs of heath stress and there is some mortality, especially among the upland oaks in stand 214. The rocky, well drained soils underlying these sites are better suited to pine. A thinning from above favoring pine and removing primarily oaks will improve growing conditions in these stands. Further north, the densely stocked white pine in plantation stand 185 should also respond well to a thinning.

The stands which were thinned or received an initial or intermediate regeneration cut as part of the Saundersville harvest (187, 213, 225) should be evaluated for another treatment at the end of the ten-year management period in 2020. At this time, some kind of intermediate treatment may be viable for young stands 177 and 227 within the surrounding matrix of older forest.

Timber management on the eastern parcels is inappropriate in many places and impractical overall. The “landlocked” former Langlais and Mansolillo tracts have no road access and all four properties have a significant acreage in forested wetlands. Stand 994 on the historic ownership parcel is a noteworthy 4-acre “older growth” stand of very large white pine, hemlock, and mixed oak trees. Large hemlocks are somewhat rare locally. This small, isolated fragment of late-successional forest apparently escaped logging because it is surrounded by wetlands on three sides and historically abutted two different ownerships to the east and west. The four eastern parcels will be designated reserves set aside from timber harvesting and passively managed for old growth forest structure through natural processes. Trees will not be salvaged in the event of natural disturbances including mortality from insects or disease and weather events. The only forest management will be to prevent or remove hazards along the boundaries with abutting landowners and along Cross Road on the former Baldwin property

Cultural Resources

This MU contains significant cultural resources in the form of remnants of past land use, especially around the location of the former mill village of Saundersville along Central Avenue just east of the intersection with Route 116. A standing stone ruin of one secondary mill building can be seen in stand 223 from the public road and the foundation and turbine pits of the main mill are still present in stand 208 very close to that intersection. The steep earth-covered dam creating the mill pond along Brandy Brook is located a short distance northeast of the mill site and evidence of other structures related to the mill’s water power system is present elsewhere in the stands immediately north of Central Avenue. PWSB’s general policy of protecting and preserving historic sites applies to the former mill location, but – like similar sites across the watershed ownership – it is not formally designated a special management area at present. Near the northern edge of the MU, a few structures were located along the public roadway on the north side of Pine Swamp Brook but no artifacts remain at this site.

Brandy Brook MU Inventory Summary:

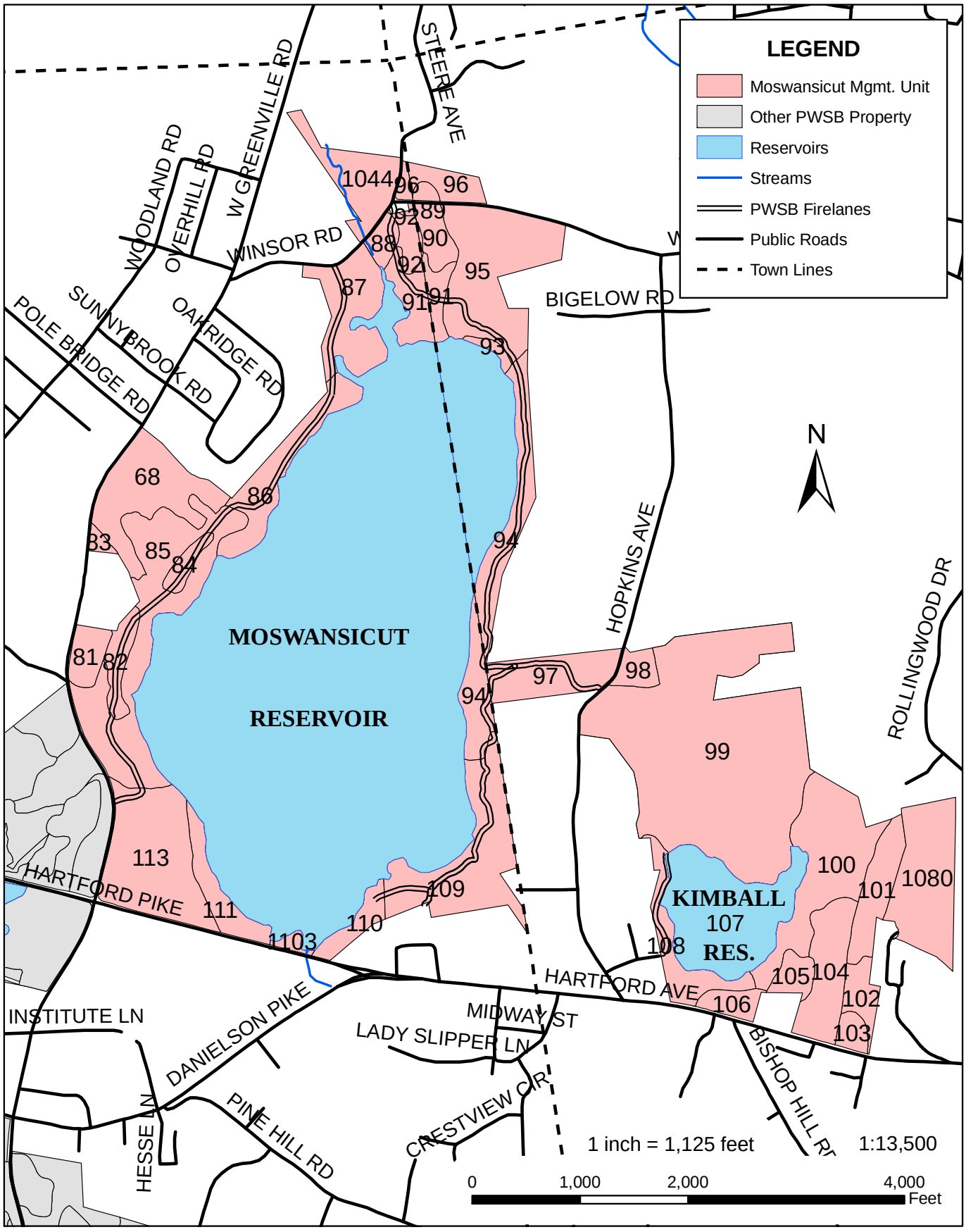
Stand	Acres	Type	Species	TPA	BA/ac	MSD	MBF/ac	Cds/ac	Regen/ac
152	3	M1D	MH	14	10	11.7	1.6	0.5	±1,100
153	7	M2/3B	MS	161	79	9.4	4.3	8.0	±700
155	5	W2A	RM/-/MO	496	160	7.7	2.4	25.9	±50
156	15	M2/3B	WP/MO/PP	150	97	10.9	10.0	5.1	±67
157	6	S3B	WP	130	110	12.5	13.7	10.5	±2,340
158	6	S3B	SP/-/WP	130	110	12.5	13.7	10.5	±2,340
177	9	S1/2C	WP	55	20	8.2	1.4	0.4	±1,200
178	2	H2/3A	RM/MH/WP	190	105	10.0	4.8	9.3	±650
179	3	H2/3A	RM/MH/WP	190	105	10.0	4.8	9.3	±650
180	9	W2/3A	RM	186	117	10.7	5.5	11.9	±127
182	9	H3B	MO/-/WP	107	72	10.7	3.6	10.0	±1,522
183	5	S1/2C	WP	55	20	8.2	1.4	0.4	±1,200
184	6	M2/3A	WP/MO	284	122	8.8	5.9	12.2	±889
185	9	S3A	WP	159	136	11.4	14.8	11.2	±6,196
187	16	S2/3A	WP/MO	110	77	11.3	6.5	4.1	±5,167
208	6	M1D	MS/MH	14	10	11.7	1.6	0.5	±1,100
209	12	M2/3B	WP/MH	161	79	9.4	4.3	8.0	±700
210	3	S3B	LA	130	110	12.5	13.7	10.5	±2,340
211	31	H2/3A	RM/-/MO	162	120	11.5	5.2	6.0	±167
212	7	S3A	WP	159	136	11.4	14.8	11.2	±6,196
213	7	S3A	WP	159	136	11.4	14.8	11.2	±6,196
214	8	M2/3A	UO/WP	284	122	8.8	5.9	12.2	±889
215	8	H2A	MO	246	84	7.9	1.5	9.8	±550
217	7	W2/3A	RM/MO	186	117	10.7	5.5	11.9	±127
219	12	H3A	MO	184	116	10.6	7.2	8.6	±463
220	7	M3A	MO/WP	235	137	10.0	10.7	10.5	±1,444
221	2	H2/3A	RM/-/MO	190	105	10.0	4.8	9.3	±650
222	2	Water							
223	6	M3B	WP/MO	153	98	10.8	8.3	6.7	±954
224	8	H3A	MO	184	116	10.6	7.2	8.6	±463
225	9	S3A	WP	159	136	11.4	14.8	11.2	±6,196
226	10	H2/3A	MO/WP	190	105	10.0	4.8	9.3	±650
227	9	S2C	WP/MO/MS	109	35	7.7	0.6	7.4	±2,350
228	12	W2/3A	RM	186	117	10.7	5.5	11.9	±127
255	10	W2/3A	MH/-/WP	186	117	10.7	5.5	11.9	±127
256	28	H2/3A	MO/-/WP	209	120	10.0	5.5	7.9	±120
257	5	M1/2C	MH/WP	142	28	6.2	0.6	1.3	±525
258	2	M2A	MH/WP	257	96	8.5	3.0	13.8	±880
259	7	M3A	MH/WP	235	137	10.0	10.7	10.5	±1,444
261	3	M3A	WP/MH	235	137	10.0	10.7	10.5	±1,444
992	8	W2A	RM/MH	496	160	7.7	2.4	25.9	±50

993	5	H2A	MH/MS	246	84	7.9	1.5	9.8	±550
994	4	M3A	MS/MO	235	137	10.0	10.7	10.5	±1,444
995	5	W2A	RM	496	160	7.7	2.4	25.9	±50
1053	3	H2/3A	MO/-/WP	190	105	10.0	4.8	9.3	±650
1054	8	H3A	MO/MH	184	116	10.6	7.2	8.6	±463
1062	12	M3A	WP/MO	235	137	10.0	10.7	10.5	±1,444
1082	5	Open							
1083	16	W2/3A	RM/MH	186	117	10.7	5.5	11.9	±127
1085	36	H3A	MO/MH	139	73	9.8	3.2	3.8	±500
1086	31	Open							
1087	4	M3A	WP/MH	184	116	10.6	7.2	8.6	±1,444

Brandy Brook MU Management Activity Schedule:

Stand	Type & Species	Activity	Acreage	Year
212	S3A-WP	Shelterwood seed cut	7	2014
214, 220	M2/3-UO/WP, M3A-MO/WP	Thinning from above favoring white pine	15	2014
185	S3A-WP	Crown thinning	9	2014
152, 157, 158, 177, 183, 223	N/A	Treatment(s) of Oriental bittersweet and other invasives prior to next harvest near these areas	TBD	2018
187, 213, 225	S2/3A-WP/MO, S3A-WP	Evaluate for harvest in some of these stands to follow up on previous silvicultural treatments	up to 32	2020
177, 227	WP, WP/MO	Evaluate for intermediate treatment to improve growth of white pine and other desired species	TBD	2020

MOSWANSICUT MANAGEMENT UNIT



MOSWANSICUT MANAGEMENT UNIT

Location, Geography, and Access

The Moswansicut MU encompasses about 340 acres of land surrounding the Moswansicut and Kimball Reservoirs (285 and 25 acres respectively) at the northeastern corner of the PWSB watershed property. It has the same geographic boundaries as the E Block and is roughly bounded to the west by Route 116 and to the south by Route 6 (Hartford Pike); the northern and eastern boundaries are more irregular. This MU is divided into two distinct but connected sections around each of the reservoirs, with the private land along Route 6 and Hopkins Avenue in between largely developed except for the Tasca and Verde conservation easements held by PWSB. The reservoir basins dominate the local topography, but away from the Kimball Reservoir the eastern section includes rolling and hilly upland terrain.

Most of the land surrounding the Moswansicut Reservoir has been PWSB property since the creation of the system and six gates provide access to the E-1 to E-4 network of firelanes traversing the reservoir's perimeter. The three firelanes on the east side of the reservoir are in reasonably good condition, but the E-1 firelane on the west side suffers from periodic flooding at its northern end while the southern end is currently blocked to vehicular traffic to prevent damage to the Moswansicut Dam. In contrast, the majority of its property in the vicinity of the Kimball Reservoir has been acquired since 1990 and there are no interior firelanes in this section.

Straddling the Scituate-Johnston town line, this MU is noteworthy for its location adjacent to the village of North Scituate and two busy public highway corridors in the most urbanized corner of the Scituate Reservoir watershed. The rapid pace of land development and related threats to water quality here have prompted Providence Water to make this area a focus of its land conservation efforts, with about ten separate land transactions since 1990.

Existing Forest Description

The forest in this MU is largely composed of the fragmented stands that remain in an area of the watershed that has seen extensive land use change over the past century. While the land in the western section (the thin strip around the Moswansicut Reservoir) was set aside as a reservoir buffer early on, much of the land in the eastern section has remained forested because the local topography and hydrology made it less attractive for agriculture and later development. Overall, hardwoods dominate the species composition although pines are present as a secondary or minor component in all the natural stands. Almost all the stands are pole-to-sawtimber sized, with less than five acres in the seedling and sapling age classes. Red maple and mixed hardwoods are prevalent in the low-lying stands and associated wetlands around the edges of both reservoirs.

Around the Moswansicut Reservoir, some large trees are found in the mixed oak stands on higher ground (86, 94, 95, 109) where no management has occurred during PWSB's tenure. The limited acreage in conifers (about 10% of the land area) is concentrated in the pine plantations on the west shore north and south ends of this reservoir. Two recent land acquisitions between the historic ownership and Route 116 include two fields, which are currently leased for haying.

The eastern section contains a significant area of upland oak forest, including the MU's only true stretch of unbroken woodland (stand 99) north of the Kimball Reservoir. The stands in the southeast corner (102, 103, and the southern part of 104) have been heavily disturbed by gravel extraction, dumping, and other activities, with the current forest cover in a degraded condition.

Soils

The western section of the MU immediately surrounding the Moswansicut Reservoir has a surprising variety of soil types. Hinckley gravelly sandy loams are the most common series at the southern end, underlying the old conifer plantations (82, 84, 110, 113) and also some natural hardwood stands (109). These glacial outwash soils are well suited to pines, with a site index of 60 for white pine and 49 for red oak. The pattern elsewhere is one of small occurrences of many different soil types, including Agawam, Canton and Charlton, Enfield, Merrimac, Ninigret, Sudbury, Sutton, Walpole, and (in the wetlands) Ridgebury and Scarboro and Carlisle mucks.

The rocky uplands of the eastern section Hopkins Avenue are overwhelmingly dominated by Canton and Charlton series, with significant rock outcrop areas although slopes exceed 15% only for short distances. These soils are well drained and moderately productive where they are not very rocky, with a site index of 58 for white pine and 52 for red oak. Locally uncommon Adrian muck underlies the large wetland on the east side of the Kimball Reservoir and there are small occurrences of Ridgebury soils on the western side.

Past Land Use and Forest Management

Around the time of the creation of the reservoir system, the PWSB land use survey recorded the original land in this MU in a variety of different cover types and conditions. The east shore of the Moswansicut Reservoir was mostly woodland, with brush recorded on the upland parcels on both sides of Hopkins Avenue along with a small patch of arable roadside land. Land along the west shore and at the north and south ends was more heavily disturbed as it was easily accessible and the flatter terrain provided better farmland. Only two small areas along the west shore remained woodland (parts of modern stands 86 and 111). The majority was farmland still under cultivation or recently reforested. Stand 95 and the southern part of 85 were recorded as "swamp wooded"

Providence Water has very actively managed the former agricultural lands adjacent to the reservoir while passively maintaining the natural forest concentrated on the east shore. Modern stands 88, 110, and 113 were planted in red and white pine in 1930 and 1934. A second round of conifer planting occurred between 1961 and 1974, when stands 82, 84, 87, and part of 113 were planted with various combinations of white pine, hemlock, larch, Norway spruce, and Douglas-fir. White pine by far the most successful of these species. Silviculture from the mid-1940s through the mid-1970s included many intermediate treatments. Beginning with pruning in the 1940s, many of the plantation stands were thinned or released during this period and some prescriptions included hardwood cull removal. Probably because of the very limited acreage of hardwood forest on upland sites, the widespread practice of enrichment planting white pine under an oak canopy does not appear to have occurred in this MU.

Timber harvesting in recent years has been limited to two stands. Prompted by the threat of mortality from the red pine scale and red pine adelgid, the 2005-06 Moswansicut harvest removed red pine from stands 88 and 113. This harvest also accomplished white pine thinning in stand 113 and included a second entry into stand 88 to cut more dying red pine in 2008.

Without further research, little detailed information is readily available on past land use and management history of the parcels in the vicinity of the Kimball Reservoir, which together comprise the majority of the MU's eastern section. Aerial photos dating back to 1939 show that land cover has been relatively stable over the past several decades, with most of the area remaining forested. The 1939 photo shows the land at both the western edge of the Kimball Reservoir and the southeast corner of the modern ownership along Route 6 mostly being used as an orchard, with some structures along Route 6. Parcelization and residential development on adjacent land began during the 1950s and the agricultural era on the property now owned by PWSB appears to have by ended by 1961, with a large disturbance appearing at the southeast corner. No active forest management has taken place on any of these parcels since they were acquired by PWSB.

Forest Health and Related Management

As in the rest of the oak-hardwood forest across the PWSB ownership, the issue of deer herbivory and lack of oak regeneration is common in the hardwood stands. Oak regeneration in the upland stands of the eastern section is better than on many other parts of the property, however, with some understory seedlings more than 3 feet tall (particularly white oak) in stand 99 and on the former Ronci property despite a competing blueberry and huckleberry shrub layer. Deer impact here may be lower than on other parts of the forest because of the area's proximity to development and related human activity, with deer spending less time here because they feel less comfortable.

Given this MU's land use history, location along heavily traveled roads, and proximity to the village of North Scituate, it is not surprising that invasives are common especially in the western section. In the pine plantation at the corner of Route 6 and Route 116 (stand 113), Oriental bittersweet and one of the property's larger concentrations of Tree of Heaven have overrun much of the understory and are partially inhibiting white pine regeneration. Although these species were undoubtedly already present in the stand, they appear to have spread following the 2005-06 red pine removal harvest. Oriental bittersweet and other invasives are also present in stands 82, 84, 98, and 109. At the northern end of the MU in stand 87, a large patch of multiflora rose has become established along the E-1 firelane just south of the Windsor Avenue gate. The invasive infestations in these stands need to be treated before further harvesting, and the multiflora rose should be addressed in any event as this aggressive species it is not yet widespread on this part of the PWSB property. Poison ivy, an undesirable native vine that shares some invasive characteristics, is widespread in parts of this MU (most notably stands 82, 84, 85, 87, 102, and 113) and efforts to control it should focus on areas where it is growing with true invasives in stands where harvesting is planned.

Silviculture

With its high percentage of both shoreline reservoir buffer stands and hardwood forest, overall this MU is a low priority for silvicultural activity during the coming decade. The two small white pine stands on the west shore of the Moswansicut Reservoir that were planted in 1962 (stands 82 and 84, together comprising 6 acres) have suffered heavy white pine weevil damage but will benefit from a thinning in 2011 along with understory invasive treatment. This harvest will have very low economic value and it may need to be packaged together with other marked timber stands to attract commercial bids, or if necessary the harvest could be structured as a non-commercial project.

The stands that were included in the Moswansicut harvest should be evaluated for another treatment in 2016. When the invasives are under control, the long-term goal for stand 113 will be to regenerate white pine while maintaining roadside aesthetics next to the PWSB property's busiest public road intersection. This process will probably include more than one additional harvest, combining additional thinning with group selection or small patch cuts and significant retention of large, healthy legacy trees along the roadsides and reservoir shoreline. In small stand 92 at the opposite end of Moswansicut Pond, the focus will be on regeneration and a combination of planting and deer fencing may be considered if deer prevent sufficient natural regeneration from developing.

If or when deer browse impacts are reduced and it becomes possible to secure oak regeneration with more confidence, stand 99 in the eastern section of the MU could benefit from an improvement thinning to favor white pine which is better suited to this unproductive upland site. This contingent harvest is proposed for a future date beyond the 2010-2020 management period.

Since they contain the most significant wetlands in this MU, stands 90, 96, 100, 104, and part of 85 will be classified as reserves set aside from timber management. Several long-uncut shoreline stands adjacent to the reservoirs (86, 94, 106, 108, and 109) will also be set aside from commercial harvesting and managed for old growth forest structure through natural processes. Because of their importance as reservoir buffers and location adjacent to property boundaries and (in the case of 106 and 108) Route 6, these stands may require hazard tree removal, invasive plant control, or a larger management entry in the event of natural disturbances. The firelanes passing through the stands next to the Moswansicut Reservoir will continue to be actively used and maintained.

Cultural Resources

Located in stand 109 near the firelane gate behind the shopping center and Tasca Field, the feature known as the Council Bowl is a well-known local natural and cultural landmark in the Moswansicut MU. Previous local Native American Indian tribal inhabitants are believed to have used this location as a gathering place. The Council Bowl is a regular destination of Scituate elementary school class field trips guided by PWSB forestry staff. At present, few details of how tribal inhabitants previously used the Bowl are known without further research. Since the Council Bowl is a special site on the PWSB property, stand 109 will be designated a cultural resource reserve in addition to being set aside from timber management for its value as a reservoir buffer. The firelane passing through this stand will continue to be actively used and maintained.

This MU also contains several cultural artifacts of more recent past land use. Although it has been extensively rebuilt by Providence Water, the largest remaining physical feature is the Moswansicut Reservoir dam located on the southwest side of the reservoir in the southern part of stand 85. This dam was originally built during the Industrial Revolution to enlarge Moswansicut Pond and thus create a more reliable water source for the North Scituate Cotton Mill located a short distance below the dam. Providence Water actively maintains the current dam as an integral part of the modern water supply system. Four historic cemeteries are located in this MU. The fenced roadside cemetery located adjacent to stand 92 has received periodic maintenance and the one within stand 97 is easily recognizable, but the small plots with only a few gravestones in stands 109 and 113 are hard to find and rapidly returning to forest.

Moswansicut MU Inventory Summary:

Stand	Acres	Type	Species	TPA	BA/ac	MSD	MBF/ac	Cds/ac	Regen/ac
68	16	Open							
81	4	Open							
82	3	S2/3A	WP	282	136	9.2	9.0	14.9	±730
83	1	H2/3A	MH	190	105	10.0	4.8	9.3	±650
84	2	S2/3A	WP	282	136	9.2	9.0	14.9	±730
85	28	H2/3A	MH	156	124	12.1	5.2	8.2	±640
86	11	H3A	MO	184	116	10.6	7.2	8.6	±463
87	13	W2/3A	RM/WP	186	117	10.7	5.5	11.9	±127
88	2	S3B	MS	130	110	12.5	13.7	10.5	±2,340
89	<1	Water							
90	4	W2A	RM/-/MH	496	160	7.7	2.4	25.9	±50
92	2	H1/2C	MO	211	50	6.6	2.0	1.8	±100
90	4	W2/3A	RM/-/MH	186	117	10.7	5.5	11.9	±127
91	8	M3A	MO/MS	235	137	10.0	10.7	10.5	±1,444
93	1	Wetland							
96	4	W3A	RM/-/MH	183	130	11.3	5.4	19.4	±523
95	23	H3A	MO	214	120	10.1	6.9	4.5	±640
94	17	H2/3A	MO/RM	220	123	10.3	4.6	8.5	±1,600
96	4	W3A	RM/-/MH	183	130	11.3	5.4	19.4	±523
97	10	H2/3A	MO/-/WP	190	105	10.0	4.8	9.3	±650
98	3	H2B	UO/MH	161	59	8.1	1.3	6.6	±406
99	72	H2/3A	UO	168	90	9.9	3.4	5.3	±164
100	20	W2/3A	RM/MH	147	90	10.5	4.1	4.7	-
101	8	H3A	MO	184	116	10.6	7.2	8.6	±463
102	4	H2A	MO/MH	246	84	7.9	1.5	9.8	±550
103	2	H2A	MH	246	84	7.9	1.5	9.8	±550
104	10	W2/3B	RM	227	143	10.6	5.9	24.6	±125
105	3	H2/3A	MO/WP	190	105	10.0	4.8	9.3	±650
106	3	M2/3A	WP/MO	284	122	8.8	5.9	12.2	±889
108	7	H3A	MO/RM	184	116	10.6	7.2	8.6	±463
109	21	H3A	MO	184	116	10.6	7.2	8.6	±463
110	4	M2/3B	MS/MO	161	79	9.4	4.3	8.0	±700
111	6	M3A	MO/WP	235	137	10.0	10.7	10.5	±1,444
113	22	S3B	WP	110	128	14.6	17.1	6.7	±2,925
1044	9	H2/3A	MO	190	105	10.0	4.8	9.3	±650
1080	18	H2A	UO	295	87	7.5	0.6	6.4	±200
1103	1	M2A	MH/WP	257	96	8.5	3.0	13.8	±880

Moswansicut MU Management Activity Schedule:

Stand	Type & Species	Activity	Acreage	Year
82, 84	S2/3A-WP	Improvement thinning	6	2011
82, 84	S2/3A-WP	Treat invasive plants and perform follow-up monitoring	6	2011
113	S3B	Treat invasive plants before timber harvest and perform follow-up monitoring	20	2016
113	S3B	Evaluate for initial regeneration cut while maintaining roadside aesthetics	~ 20	2016
92	H1/2C	Monitor regeneration development and consider intervention if natural regen is not developing	3	2015-20

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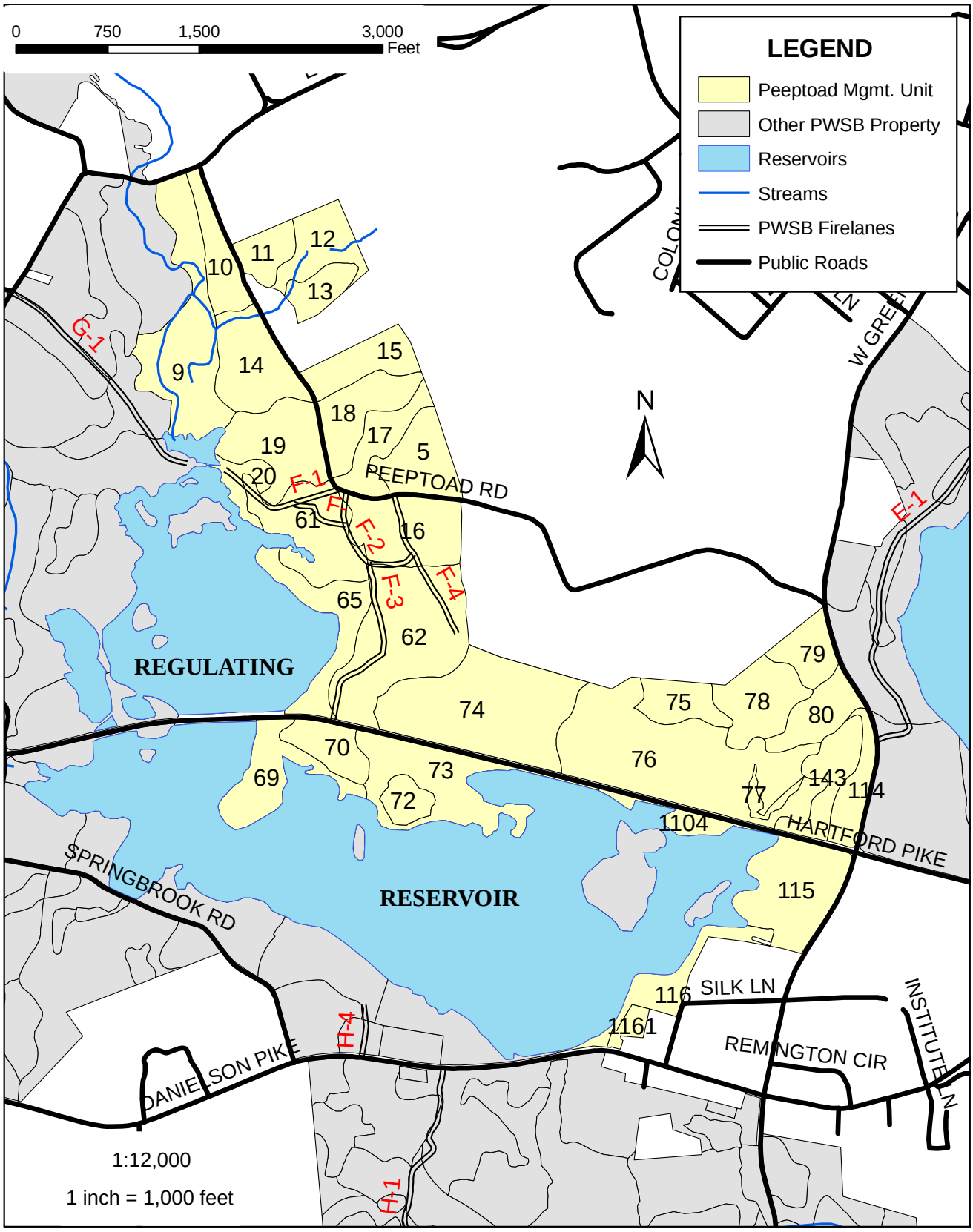
PEEPTOAD MANAGEMENT UNIT



PEEPTOAD MANAGEMENT UNIT

Location, Geography, and Access

The Peeptoad MU encompasses about 260 acres on the east shore of the Regulating Reservoir at the northern edge of the watershed property. It includes all the F Block and small part of the H Block. Located entirely within Scituate, it is bounded to the west by Peeptoad Brook, to the east by Route 116, and to the south by Danielson Pike. The northern/northeastern boundary is irregular. Peeptoad Road runs through the northwestern part of the MU and also serves as its boundary for two short sections. All of the land has been PWSB property since the creation of the reservoir system. Overall, the terrain is rolling to hilly and slopes towards the Regulating Reservoir, with fair amount of variation in microtopography. This small MU is noteworthy for its location adjacent to the village of North Scituate and for its proportionally large amount of public road frontage, including two busy highways. Near the sharp bend in Peeptoad Road, several short firelanes provide access to the interior.

Existing Forest Description

Like adjacent areas of the PWSB property in close proximity to the village of North Scituate, the forest in this MU is notable for its mosaic of many small but distinct stands that are the legacy of past land use and silviculture during more recent decades. Excluding the forested wetlands along Peeptoad Brook, only two upland stands in this section (74 and 76) cover more than 15 acres. Overall, the acreage is evenly divided among softwood, mixedwood, and hardwood stand types. Partly as a result of past planting and more recent red pine harvesting, the conifer stands (now almost entirely white pine) are largely concentrated both in the central part of the MU near the sharp bend in Peeptoad Road and at the eastern end. Mixed oaks dominate among hardwood species and red maple and other species requiring moist soil conditions are mostly confined to the stream corridors and forested wetlands. Most stands are pole-to-sawtimber sized, with about 40 acres of former red pine stands now in the seedling-to-large sapling age classes scattered within the matrix of maturing, mostly even-aged forest (approximately 15% of the total area).

Soils

The soils in the upland areas that comprise the majority of this MU are droughty. Hinckley gravelly sandy loams are the most common series and have a site index of 60 for white pine and 49 for red oak despite being characterized as excessively drained. Small areas of Agawam, Canton and Charlton, Merrimac, and Woodbridge soils are also found in the uplands. Hydric soils are limited to the vicinity of Peeptoad and Moswansicut Brook and two smaller stream corridors. Series occurring in the low-lying areas include Ridgebury, Sudbury, Sutton, and Walpole. These areas will be excluded from timber harvesting and Peeptoad Brook (where there is also Adrian muck) requires wider buffer than the others as it is the most significant stream.

Past Land Use and Forest Management

Around the time of the creation of the reservoir system, the PWSB land use survey recorded the land in this MU in a variety of different cover types and conditions. About half the total acreage had been converted to agriculture, especially the easily accessible land along the town roads (including Peeptoad Road and what is now Route 116). While much of this acreage was still cultivated, an equal area was already reverting to forest naturally or through planting. Most of the remaining original upland forest was concentrated in the center along Hartford Pike, but also found in modern stands 14 and 61 along Peeptoad Road. A pitch pine component was present in some of the natural conifer stands in the southern section. The wetlands in stands 12, 17, and 80 were recorded as "wooded swamp," and the fact that stand 9 was described only as "swamp" suggests that it may have been more open at the time.

Since acquisition, Providence Water has very actively managed the former agricultural lands while work in the natural stands has been much less intensive. Most of the old farmlands were planted in red and white pine between 1930 and 1940. Smaller amounts of Austrian pine (16, 18, and 62) and spruce (19) were also planted in several stands. Underplanting of white pine under an oak canopy was performed in stand 73 adjacent to the reservoir.

Silviculture from the mid-1940s through the 1970s emphasized intermediate treatments. Beginning with pruning in the 1940s and 50s, many stands of both plantation and natural origin were thinned or released during this period. Several of the old field plantation stands were thinned twice or even three times. Considered undesirable at the time, the natural pitch pine component was reduced in the 1950s through harvests targeting this low-value species. In 1959, a two-acre fire on the small peninsula occupied by stands 61 and 65 in part led to a minor second round of conifer planting in the early 1960s. The burn site was replanted in 1960 with an experimental combination of red, white, and Austrian pine, larch, white spruce, and Douglas-fir. Some seedlings suffered severe Pales weevil damage, prompting reinforcement with hemlock and larch two years later. Around the same time, enrichment planting was also performed in the roadside stands at the urban eastern edge of the MU (hemlock in 114, white pine in 115, and white spruce in 116).

Timber management has been very active in this MU over the past fifteen years, responding to forest health threats while accomplishing other silvicultural goals. Prompted by the threat of the red pine scale and the red pine adelgid, five different harvests between 1997 and 2007 combined removal of red pine and other exotic conifers with white pine thinning. The significant red pine component in this MU is now mostly gone and recent silvicultural activities have generally shifted many of these stands towards white pine. The 2009-10 Hartford Pike harvest included a white pine overstory release first cut in stand 16 with group selection patch cuts in stands 74 and 76 to create gaps promoting the development of new age classes of trees.

Forest Health and Related Management

As in the rest of the oak-hardwood forest across the PWSB ownership, the issue of deer herbivory and lack of oak regeneration is common in the hardwood and mixedwood stands. The shrub layer of blueberry and huckleberry present is fairly thick in some upland areas of the southern section and may contribute to impeding regeneration. Nonetheless, the varied mosaic of small adjacent stands of different types makes the problem less stark than in areas of the property dominated by hardwood forest. White pine regeneration is generally healthy where there are seed trees and canopy openings; the recent timber harvests have led to the establishment of abundant seedlings and saplings in stands such as 16 and 18.

Given this MU's land use history, location along heavily traveled roads, and proximity to the village of North Scituate, it is not surprising that invasive plants are common especially in the eastern end and have probably been established for a long time. The stands on the west side of Route 116 between Moswansicut Brook and Danielson Pike (114, 115, 116, and 143) are the site of one of the worst Oriental bittersweet infestations on the entire property. Other invasives including Japanese barberry, Tree of Heaven, and winged euonymus are also common here. All of these stands are current or former conifer plantations with a heavy red pine component. In the stands where salvage harvesting has taken place, native tree species have not regenerated naturally and the invasives have spread. Rehabilitating these stands is highly desirable, but accomplishing this goal will be difficult and controlling deer herbivory may be necessary (see silviculture section below)

Invasives have a significant presence in a few other parts of this MU heavily impacted by past human settlement and land use. In stand 10, dense Japanese barberry is found along Peeptoad Road surrounding the site of an old mill and scattered through much rest of this red and white pine plantation. Following the harvest of senescent red pine and other conifers, Oriental bittersweet has spread within stand 62 and is also present in the adjacent southern part of 16. The infestations in stands 10 and 16 were treated with herbicides in 2010. The invasive populations in these two stands in particular should be closely monitored as timber harvests have/will open the canopy in these stands. Follow-up treatments may be necessary. The level of success in controlling the invasives here can be used to inform silviculture and timber management in similarly infested stands elsewhere. Nearby white pine stand 19 was thinned in 2005 in part to promote the establishment of new regeneration, but the forest floor is now covered with hay-scented ferns that share some invasive characteristics and are inhibiting the desired regeneration.

Silviculture

Although much of the acreage has been worked in recent years, this MU will see a modest level of silvicultural activity during the coming decade. Last thinned in 1972 and now experiencing some overstory mortality, stand 10 is one of the last two densely stocked red and white pine plantations in this MU. Following treatment of the understory Japanese barberry, the remaining merchantable red pine will be harvested and the white pine thinned in 2010 or 2011 to send this stand on a white pine trajectory.

At few stands near the sharp bend in Peeptoad Road will benefit from another management entry around 2020 to follow up on previous treatments and can be combined into one timber harvest. With continued growth of the abundant regeneration, the white pine in stand 18 will be due for a first shelterwood release cut and that in 16 will be ready for a final release harvest retaining some large, healthy legacy trees. On the west side of the road, the white pine in stand 19 will be ready for shelterwood prep or seed cut, although the dense understory hay-scented fern will almost certainly need to be treated beforehand in order for regeneration to develop. This regeneration harvest should not be performed without controlling the fern. To the south, stand 61 can be evaluated for a possible selection harvest at the same time as its neighbor stands. Parts of this mixed pine-oak stand have a near-uneven-aged structure. Work in this stand is not imperative and it may more appropriate to leave it alone at this time.

Located between the Regulating Reservoir and the village of North Scituate, stands 115 and 116 in their current condition pose a difficult management problem that will eventually require careful intervention. Both were established as mixed conifer plantations dominated by red pine. The white spruce and scale-afflicted red pine in stand 116 have been cut but new regeneration has not become established, leaving a ragged-looking patch immediately behind the Scituate Town Hall. Just to the

north, many if not most of the overstory red pines in stand 115 are senescent, dead, or being overtaken by Oriental bittersweet. Harvesting in this stand has been deferred in part because of the difficult site conditions and location adjacent to the PWSB property's busiest public road intersection. Some trees are potential roadside hazards. Silvicultural choices are complicated by of the extent of the invasive plants here (see above) and the importance of trying to maintain roadside aesthetics in an area of such high public visibility. A restoration plan for these stands would likely include treating the invasives (probably more than once), harvesting a certain amount of the red pine, possibly establishing deer exclosure fencing, and tree planting. Between 2010 and 2015, Providence Water should work with representatives from the Town of Scituate (e.g. the conservation commission) to develop and communicate an action plan for this problematic site.

No harvesting will occur in stands 74 and 76 during the 2010-2020 management period, but the group selection patch cuts executed in 2009-10 were planned with a 25-year cutting cycle in mind. The regeneration conditions in the gaps should be monitored and will inform future timber management here and in other oak-dominated stands similar to 74. It is hoped that a second round of large openings will be created in these stands around 2035 when an established new age cohort of trees will be competing for canopy dominance in those already implemented. Forest managers then will doubtless have new information about local deer populations and oak regeneration conditions.

Cultural Resources

This MU contains significant cultural resources in the form of remnants of past land use, particularly those related to the small textile mills that were established in the local area before the creation of the reservoir system. Two still-standing stone ruins of buildings that belonged to North Scituate Cotton Mills can be seen from public roads. One is located in stand 10 on the west side of Peeptoad Road where a tributary stream to Peeptoad Brook crosses under the road, and the other is in stand 80 on the south side of Moswansicut Brook. A related noteworthy feature is the remains of a very long millrace that extended from Peeptoad Pond to the former Moswansicut River. Resembling a trench and crossing both private and PWSB property, the millrace is particularly apparent in stands 74 and 76. Apparently unrelated to the mills, another prominent foundation remnant is located in the northeast corner of stand 115 immediately adjacent to the Route 6/Route 116 intersection. PWSB's general policy of protecting and preserving historic sites applies to these textile mill era artifacts, but – like similar sites across the watershed ownership – these are not formally designated special management areas at present. This MU also contains stone walls running through the forest and a historic cemetery located in stand 16 just southeast of the intersection of Peeptoad Road and the F-2 firelane.

Peeptoad MU Inventory Summary:

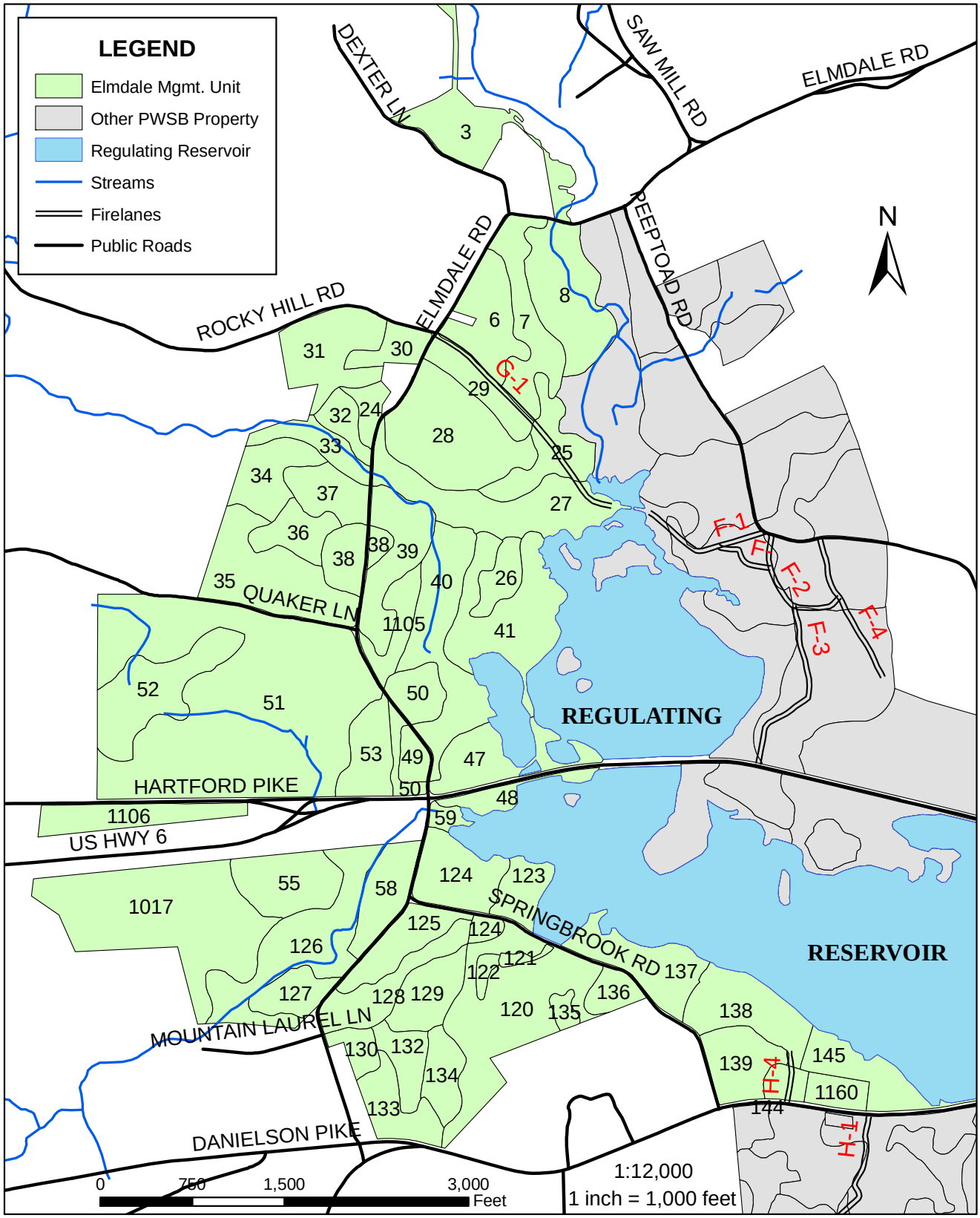
Stand	Acres	Type	Species	TPA	BA/ac	MSD	MBF/ac	Cds/ac	Regen/ac
9	19	W2/3A	MH/WP	141	107	11.2	10.7	6.5	±433
10	6	S3A	WP/-/RP	159	136	11.4	14.8	11.2	±6,196
11	4	S1D	WP			No	Data		
12	7	M3A	MH/WP	235	137	10.0	10.7	10.5	±1,444
13	4	M1D	MH/WP	14	10	11.7	1.6	0.5	±1,100
14	17	H3A	MO/-/WP	177	140	12.1	11.6	5.1	±233
16	19	S3C	WP	80	82	13.1	13.0	5.5	±4,192
17	6	M2/3A	MH/MS	284	122	8.8	5.9	12.2	±889

18	8	S3B	WP	130	110	12.5	13.7	10.5	±2,340
19	11	S3B	WP	130	110	12.5	13.7	10.5	±2,340
20	3	H2A	RM/-/WP	246	84	7.9	1.5	9.8	±550
61	12	M3B	WP/MO	153	98	10.8	8.3	6.7	±954
62	22	M1/2B	WP/MO	222	43	6.1	0.3	2.5	±733
65	9	M2/3A	WP/MH	284	122	8.8	5.9	12.2	±889
69	9	M3A	MS/MO/RM	235	137	10.0	10.7	10.5	±1,444
70	5	M1A	MS/MO	158	30	5.9	0.2	0.7	±1,000
72	3	Water							
73	13	H2/3A	MO/-/WP	190	105	10.0	4.8	9.3	±650
74	24	HU	MO	89	67	11.7	3.4	4.3	±833
75	5	M2A	MH/WP	257	96	8.5	3.0	13.8	±880
76	31	SU	WP/-/MO	103	108	14.0	10.7	6.9	±540
77	1	Water							
78	8	H3A	MH/-/WP	184	116	10.6	7.2	8.6	±463
79	5	S3A	WP/-/MO	159	136	11.4	14.8	11.2	±6,196
80	6	H2/3A	MH	190	105	10.0	4.8	9.3	±650
143	6	S3C	WP	80	82	13.1	13.0	5.5	±4,192
115	13	S3A	RP/-/WP	159	136	11.4	14.8	11.2	±6,196
114	5	M1D	MH/MS	14	10	11.7	1.6	0.5	±1,100
116	6	M1/2C	MH	142	28	6.2	0.6	1.3	±525
1104	2	M3A	WP/MO	235	137	10.0	10.7	10.5	±1,444
1161	1	Lease							

Peeptoad MU Management Activity Schedule:

Stand	Type & Species	Activity	Acreage	Year
10	S3A-WP/-/RP	Red pine removal and white pine thinning; monitor invasive Japanese barberry and perform follow-up treatments if necessary	6	2010-2011
115,116	S3A-RP/-/WP, M1/2C-MH	Work with Town of Scituate to develop an action plan for this problematic site	20	2010-2015
16	S3C-WP	Shelterwood final release cut; monitor invasive Oriental bittersweet and perform follow-up treatments if necessary	19	2020
18	S3B-WP	Shelterwood prep/seed cut	8	2020
19	S3B-WP	White pine shelterwood prep cut	11	2020
61	M3B-WP/MO	Evaluate for possible selection harvest	12	2020

ELMDALE MANAGEMENT UNIT



ELMDALE MANAGEMENT UNIT

Location, Geography, and Access

The Elmdale MU covers about 485 acres on the west side of the Regulating Reservoir and Peeptoad Brook at the northern edge of the watershed property. It includes all of the G Block and the northern part of the H Block. Located entirely within Scituate, it is bounded to the south by Danielson Pike and to the north mostly (but not entirely) by Elmdale Road, while the western boundary is irregular. All of the land has been PWSB property since the creation of the reservoir system except for the 6-acre former Ash property at the northern end purchased by Providence Water in 1990. Overall the terrain generally slopes eastward towards the shore of the Regulating Reservoir, but there is a large amount of topographic variation within the MU and it contains a number of short but relatively steep slopes for the local area. The public roads bordering and passing through the MU give it a large amount of road frontage. Elmdale Road is a defining feature that provides a central transportation corridor, taking the shape of an upside-down Y when Springbrook Road is included at the southern end. The Route 6 highway corridor effectively divides the MU into northern and southern sections for operational purposes. The G-1 and H-4 firelanes provide access to the interior on the reservoir side of Elmdale Road.

Existing Forest Description

Like adjacent areas of the PWSB property in close proximity to the village of North Scituate, the forest composition in this MU is notable for its mosaic of many small but distinct stands — especially those along the roads and reservoir shoreline — that are the legacy of past land use and silviculture during more recent decades. The white pine, mixed oak, and red maple and associated hardwood forest types are all represented in different parts of the MU. Interspersed with oak in both relatively pure and mixedwood stands, white pine is concentrated in the planted stands along the roads and is especially dominant along Springbrook Road. A red pine component is still present in the shoreline stands at the southeast corner of the MU. The larger natural upland hardwood stands along the western boundary provide a contrast to the central and eastern areas. Red maple is mostly confined to the four stream corridors and forested wetlands near the reservoir's edge. Most stands are pole-to-sawtimber sized, but due to red pine harvesting this MU contains a comparatively large area (about 50 acres) of heavily thinned open-canopy and early successional stands present within the matrix of maturing even-aged forest.

Including both public and private land, the lower Huntinghouse Brook corridor is one of two locations overlapping the PWSB property that the Rhode Island Natural History Survey has identified as likely hosting rare species. The rare species here are spring ephemeral plants, which have been found on the adjacent private land on several occasions between 1971 and 2007. The current RINHS map polygon includes the entire area surrounding Huntinghouse Brook that is bounded by Elmdale, Rocky Hill, and Gleaner Chapel Roads and Quaker Lane.

Soils

This MU contains a variety of soil types, generally transitioning from very rocky soils on the uplands west of Elmdale Road to sandier soils in the stream corridors and towards the reservoir shoreline. Gloucester-Hinckley and Hinckley gravelly to stony sandy loams are the most common series overall, especially on the east side of Elmdale Road. These shallow glacial outwash soils are somewhat excessively drained and classified as relatively unproductive despite a site index of 60 for white pine and 49 to 60 for red oak. Canton and Charlton soils are found on the boniest upland areas near the western boundary. Agawam, Walpole, and Sudbury series occur together in the lowlands, especially near the reservoir shoreline in the southeastern part of the MU. These soils are more mesic and productive, with a site index of up to 70 for white pine and 75 for red maple. The Huntinghouse and Rush Brook corridors should be excluded from future timber harvesting activity as the hydric Ridgebury, Rumney, and Scarboro series are found in these areas. Adrian muck underlies the stand 26 wetland. Small occurrences of Paxton, Rumney, Sudbury, and Sutton soils are also present within the MU.

Past Land Use and Forest Management

At the time of the creation of the reservoir system, the 1915 PWSB land use survey recorded the majority of the overall acreage in this MU as woodland. The land on both sides of Elmdale and Springbrook Roads, however, was dominated by cultivated land and former farmland reverting to forest naturally or through planting. The wetland areas comprising stands 122, 132, and part of 120 in the southern part of the MU are recorded as swamp.

Since acquisition, Providence Water has intensively managed the land along the road corridors while generally leaving the upland hardwood stands along the western edge alone. The former farmlands and brushy areas were mostly planted in red and white pine between 1925 and 1940. Smaller amounts of Norway and white spruce and Austrian and Scotch pine were also planted in several stands. During the late 1930s, some underplanting was performed in the upland oak stands south of what is now Route 6, but these efforts were abandoned when the plantings failed. In addition to the hardwood forest generally located on soils poorly suited to agriculture, scattered natural stands containing varying amounts white and pitch pine and aspen were also present when PWSB started managing the land.

Silviculture from the mid-1940s through the 1970s emphasized intermediate treatments. Beginning with pruning in the 1940s and 50s, many stands of both plantation and natural origin were thinned or released during this period. A number of the old field plantation stands were thinned twice. In 1964, the Austrian pine in modern stands 5 and 6 was harvested and the ground replanted in white pine. Limited underplanting of hemlock, white pine, white spruce, and larch in three stands in the southern part of the MU (146 and parts of 47 and 126) followed later in the same decade. Presumably following a weather event, a salvage harvest occurred in two small pine stands on opposite sides of Elmdale Road (30 and part of 38) in 1973.

Timber management has been very active in this MU over the past fifteen years, responding to forest health threats while accomplishing other silvicultural goals. Prompted by threat of the red pine scale and red pine adelgid, four different harvests between 1997 and 2009 (Springbrook, Elmdale, Rush Brook, and Rocky Hill) combined red pine removal with white pine thinning and work in a few mixedwood stands. The spruce in stand 139 was salvaged after windthrow and experimental hardwood replanting on this site ultimately failed. Other stand-specific prescriptions employed a mix of thinning and strategies to secure regeneration, depending on species composition. The large

amount of red pine that once characterized the central part of this MU along Elmdale Road is now all but gone, and recent silvicultural activities have generally shifted many of these stands towards white pine. Ongoing spring plantings seek to establish white pine and larch in former red pine stands where natural regeneration has not developed.

Forest Health and Related Management

As in the rest of the oak-hardwood forest across the PWSB ownership, the issue of deer herbivory and lack of oak regeneration is common in the hardwood stands. Oak regeneration in the upland stands (particularly 51 and 1017) is better than on many other parts of the property, however, despite a competing blueberry and huckleberry shrub layer. Deer impact here may be lower than on other parts of the forest because of the area's proximity to the heavily traveled and noisy Route 6 and Route 101 transportation corridors, with deer spending less time here because they feel less comfortable.

Populations of the invasive plants common across PWSB property are mostly confined to the roadside areas of this MU and are not significantly impacting the interior forest. Oriental bittersweet has become well established in the shoreline conifer stands adjacent to Springbrook Road and Danielson Pike (137, 145, and 146), while buckthorn has taken hold in stand 47 near the intersection of Route 6 and Elmdale Road. These infestations need to be treated before any further harvesting in these areas and trying to prevent the spread of these invasives into the interior forest is an important management goal.

Japanese stiltgrass, an "early detection" invasive plant in Rhode Island, was confirmed to be present in stand 6 in 2009 and the irregular patch growing over parts of a 3.5 acre area in this stand is the largest known population in the state at the time of writing. This species is considered to be a highly aggressive invader because it can grow under a forest canopy (unlike most other grasses) and spread rapidly. With the stiltgrass mostly growing in the skid trails used in the 2002-03 red pine harvest in this stand, it is likely that the species was transported to the site on logging equipment used during this operation. In the summer of 2010, deer exclosure fencing was erected around the main part of the stiltgrass population as an experimental management strategy, along with hand pulling of outlying patches mostly in the G-1 firelane. The goal is to provide native tree seedlings and other plants an opportunity to naturally outcompete the stiltgrass while being protected from deer browse. The results of this strategy will be closely monitored as preventing the spread of Japanese stiltgrass is one of the highest invasive management priorities on the entire PWSB property. Any new stiltgrass patches found growing outside the deer exclosure fencing must be treated or hand-pulled, and it is possible that a pre-emergent herbicide may need to be applied to prevent the stiltgrass from growing back where it had become established in the G-1 firelane.

Silviculture

With a high percentage of the acreage in the central and eastern sections having seen harvesting in recent years, this MU is a relatively low priority for silvicultural activity during the coming decade. Red pine harvesting and associated visual impacts have been concentrated along the public roads.

PWSB's limited planting efforts have recently focused on restocking some of the former red pine plantations in this MU that have experienced regeneration failure due to deer browse. In 2010, white pine and European larch were planted in stands 38, 58, and part of 55. Replanting stand 55 should continue in subsequent years until the entire 9-acre area is reforested.

At the corner of Danielson Pike and Springbrook Road, stand 139 is in a brushy early successional phase of stand development following the windthrow and salvage harvest of the red pine and spruce formerly occupying this stand. This is now primarily a mixed hardwood stand with an increasing amount of white pine towards its inner edges. The stand offers good potential habitat for the increasingly rare New England cottontail rabbit, which is being considered for protection under the federal Endangered Species Act, and thus may be selected as a site for a cooperative habitat management project.

Three small white pine stands along Elmdale Road that were thinned in 2003 will benefit from follow-up entries that can be combined into one timber harvest on about 18 acres, possibly in a contract including other work in nearby MUs. Stands 29 and 125 are still densely stocked and a second thinning will promote the continued growth of healthy remaining trees while providing more light to establish more abundant understory regeneration. Stand 125 is located at a public road intersection where two adjacent stands were the site of heavy red pine harvests in 2003 and 2007, so maintaining roadside aesthetics is important. Immediately south of 125, more heavily thinned stand 128 has developed abundant white pine regeneration that is ready to be released. A shelterwood prep cut, possibly including some spatial irregularity, is appropriate for this long, thin stand with frontage along Elmdale Road at its western edge.

Due to its significance as a rare plant species "hot spot," the section of the Huntinghouse Brook corridor on PWSB property located west of Elmdale Road and between Rocky Hill Road and Quaker Lane will be designated a reserve set aside from timber management and passively managed for old growth forest structure through natural processes. Invasive plant management may, however, may be necessary or desirable if these species are found since they may be considered a threat to the rare plant populations. Except in the case of catastrophic disturbance or other unusual circumstances, management of the trees in this area will be limited to preventing or removing hazards along the boundaries with abutting landowners and the public roads.

Cultural Resources

This MU contains an archaeological site known as the Elmdale rock shelter in stand 51. The small but recognizable south-facing cave-like shelter is located at the base of a large rock formation on the north side of Old Bank Brook, near where this ephemeral stream bends southward before passing under the Routes 6 and 101. Most of the limited information PWSB currently has on this site is contained in a report prepared by a college student in 1983. According to the report, the Elmdale rock shelter was rediscovered at some time during the 20th Century by a group of local amateur archaeologists who performed a limited excavation of the site and removed a variety of artifacts that were ultimately donated to Rhode Island College. Previous Native American tribal inhabitants are believed to have used the shelter as a fall-winter seasonal settlement. A professional archaeological analysis of the site has apparently never been performed.

Since the Elmdale rock shelter is a special site on the PWSB property, the section of Stand 51 along the Old Bank brook corridor will be designated a cultural resource reserve. The very rocky terrain in this area, including both exposed bedrock ledges and large boulders, and the ephemeral stream corridor make this site unsuitable for timber management in any event.

This MU also contains several historic cemeteries and the some remaining foundations of the old town road bridge across Peeptoad Brook at the end of the G-1 firelane.

Elmdale MU Inventory Summary:

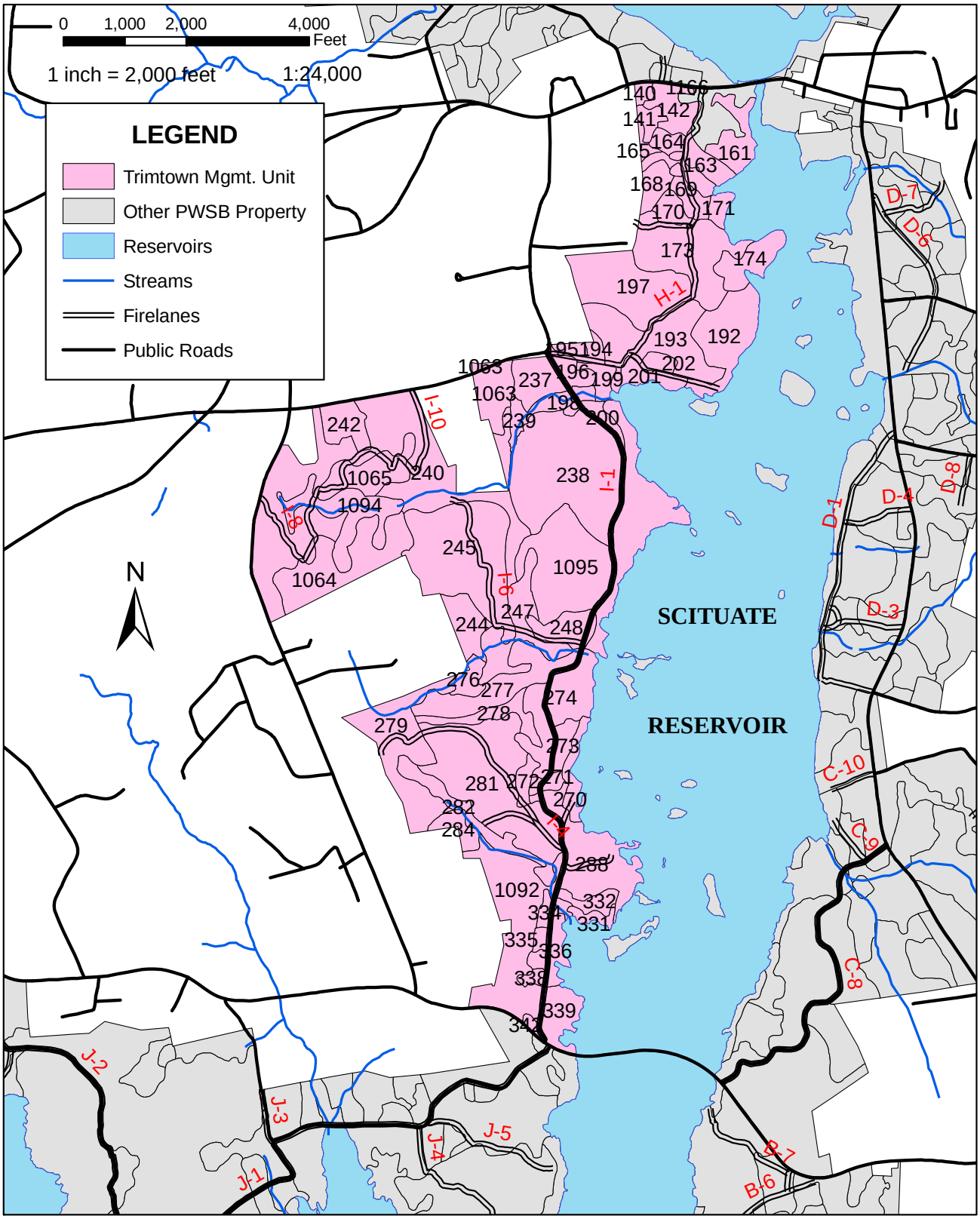
Stand	Acres	Type	Species	TPA	BA/ac	MSD	MBF/ac	Cds/ac	Regen/ac
3	11	H3A	MO	184	116	10.6	7.2	8.6	±463
6	9	M2/3B	WP/MH	161	79	9.4	4.3	8.0	±700
7	10	S3A	WP	159	136	11.4	14.8	11.2	±6,196
8	13	H3A	MO/-/MH	184	116	10.6	7.2	8.6	±463
25	8	H2/3A	MO	190	105	10.0	4.8	9.3	±650
26	3	W2A	RM	496	160	7.7	2.4	25.9	±50
27	17	H2/3A	MO/-/WP	247	120	9.5	6.1	3.6	±567
28	18	H2/3A	UO	184	93	9.6	5.2	3.8	±600
29	5	S2/3A	WP	282	136	9.2	9.0	14.9	±730
30	3	S3B	WP/-/MH	130	110	12.5	13.7	10.5	±2,340
31	11	H3A	MO	184	116	10.6	7.2	8.6	±463
32	3	M1/2C	MH/WP	142	28	6.2	0.6	1.3	±525
33	4	H2A	RM/-/MH	246	84	7.9	1.5	9.8	±550
34	7	H3A	MO	184	116	10.6	7.2	8.6	±463
35	15	H2/3A	MO	190	105	10.0	4.8	9.3	±650
36	5	M3A	MO/WP	235	137	10.0	10.7	10.5	±1,444
37	6	S3B	WP	130	110	12.5	13.7	10.5	±2,340
38	5	H2C	MH	99	37	8.2	1.0	3.5	±508
39	9	S3B	WP	130	110	12.5	13.7	10.5	±2,340
40	15	H2/3B	MO/MH/WP	127	63	9.5	2.9	3.0	±133
41	15	H2/3A	MO	240	110	9.3	3.7	6.3	±633
44	6	Water							
47	8	H2B	MH/-/MS	161	59	8.1	1.3	6.6	±406
48	2	M2/3B	MH/MS	161	79	9.4	4.3	8.0	±700
49	2	H2A	MO/MH	246	84	7.9	1.5	9.8	±550
50	6	H2/3B	MH/-/WP	187	80	8.6	3.1	7.0	±807
51	63	H2/3A	UO	210	110	9.7	4.3	7.7	±3,345
52	12	H3A	MO/-/MH	167	93	9.0	4.3	5.2	-
53	3	S3A	SP	159	136	11.4	14.8	11.2	±6,196
55	9	M1D	WP/MH	14	10	11.7	1.6	0.5	±1,100
58	6	M1D	MH/MS	14	10	11.7	1.6	0.5	±1,100
59	1	Wetland							
120	22	M2/3A	WP/MO/MH	234	120	9.2	6.9	6.5	±660
121	1	Water							
122	1	Wetland							
123	6	S3B	WP	130	110	12.5	13.7	10.5	±2,340
124	9	S1C	WP	115	10	4.0	N/A	N/A	±500
125	6	S3A	WP	159	136	11.4	14.8	11.2	±6,196
126	16	H3A	MH	202	110	10.0	5.8	6.0	±400
127	4	M3B	MO	153	98	10.8	8.3	6.7	±954
128	7	S3A	WP	159	136	11.4	14.8	11.2	±6,196

129	6	M2/3A	MO	284	122	8.8	5.9	12.2	±889
130	3	H2/3A	MO/-/MH/WP	190	105	10.0	4.8	9.3	±650
132	4	W2A	RM/-/MO/WP	496	160	7.7	2.4	25.9	±50
133	5	H2/3C	MH	130	60	9.1	1.3	7.7	±400
134	5	M2/3B	MH/WP	161	79	9.4	4.3	8.0	±700
135	1	S3A	WP	159	136	11.4	14.8	11.2	±6,196
136	3	S3A	WP	159	136	11.4	14.8	11.2	±6,196
137	9	M2/3A	MO/WP	284	122	8.8	5.9	12.2	±889
138	10	S3A	WP	159	136	11.4	14.8	11.2	±6,196
139	7	M1A	MH/WP	158	30	5.9	0.2	0.7	±1,000
144	2	M2/3B	MS/MH	161	79	9.4	4.3	8.0	±700
146	8	M2/3A	WP/RP/SM	284	122	8.8	5.9	12.2	±889
1017	29	H2/3A	MO	161	110	10.7	4.5	8.6	±4,500
1105	5	H2/3A	MO	190	105	10.0	4.8	9.3	±650
1106	7	H2/3A	UO	190	105	10.0	4.8	9.3	±650
1160	3	Lease							

Elmdale MU Management Activity Schedule:

Stand	Type & Species	Activity	Acreage	Year
6	M2/3B-WP/MH	Monitor invasive Japanese stiltgrass infestation and growth of native vegetation inside deer exclosure fencing. Monitor for stiltgrass growing outside exclosure and treat as necessary.	4	2010-20
55	M1D-WP/MH	Continue with spring conifer planting until all areas with regeneration failure are restocked	9	2010-15
139	M1A-MH/WP	Possible cooperative habitat improvement project to favor New England cottontail rabbit	7	2012-20
29, 125	S2/3A-WP, S3A-WP	Crown thinning	11	2013
128	S3A-WP	Shelterwood prep cut	7	2013

TRIMTOWN MANAGEMENT UNIT



TRIMTOWN MANAGEMENT UNIT

Location, Geography, and Access

The Trimtown MU covers about 1,050 acres in the H and I Blocks on the west shore of the Scituate Reservoir's east arm. It is bounded to the north by Danielson Pike and to the south by Plainfield Pike (Route 14). The long and irregular western/northern boundary includes sections along Trimtown Road, Central Pike, and Battey Meeting House Road and wooded property lines contained by these roads. This large land area includes about five miles of reservoir shoreline and a powerboat launch site. While there is considerable variation in local microtopography, overall the terrain is generally flat to gently eastward-sloping towards the reservoir with occasional rocky slopes and outcroppings. The Providence Police firing range is located along the I-1 firelane near the southern end. Most of the land has been PWSB property since the creation of the reservoir system, but some acreage has been added along the western edge since 1990 with the purchase of the former Gorham/Fenner property (153 acres) and, further south, the neighboring Battey (13 acres) and Fiske (11 acres) parcels.

Road access in this MU is good. Formerly part of the old Battey Meeting House Road, the long I-1 firelane parallels the reservoir shoreline from the modern Battey Meeting House Road/Central Pike intersection to Plainfield Pike. The H-1 firelane is the main access road in the northern section of the MU and connects the same intersection with Danielson Pike; the east-west portion of this road was once part of the old Saundersville Pike. Several short spur roads on the east side of the main backbone (I-2, I-7, H-5) are drivable but reach a dead end at the reservoir. Two long unimproved dead-end spur firelanes (I-4 and I-6) accessing stands on the western upland side of the MU are currently in poor condition. Several unnumbered firelanes or extensions that were widened in 1998-99 need excavation work to restore 4WD vehicle access. Once these roads are repaired, they should be included in the normal maintenance cycle.

Existing Forest Description

Hardwoods currently dominate the forest in this MU with about 50% of the acreage in this cover type, followed by 35% in softwoods and 15% classified as mixedwood. Many of the hardwood stands are unproductive upland oak sites characterized by scarlet, black, and white oak. Some of these upland oak areas have a secondary softwood component of either natural white pine or underplanted spruce. The spruce has grown poorly on the droughty soils in these areas and is slowly dying. Most of the areas that were underplanted with white pine and subsequently released have transitioned into conifer stands.

The stands at the far northern end of the MU adjacent to Danielson Pike (especially 161) are unusual for the PWSB watershed property due to the combination of mesic soils and local land use

history. Several large old sugar maple trees that once shaded houses or lined streets are present here. These old trees are dying, but their offspring are healthy and have matured enough to be tapped for sap production for the first time in spring of 2010. These sugar maples have grown up in the shade of the red and white pine that was planted in this area. Since sugar maple is often associated with richer sites, 13-acre stand 161 could be expected to support a variety of understory plant but the current species diversity is probably limited by deer herbivory.

All but 18 acres of the MU are classified as forestland, with the remainder in wetlands, small water bodies, and other cleared areas. The largest is an 11-acre patch of old field and brushy vegetation adjacent to Central Pike on the former Gorham-Fenner property that has not yet reverted to forest.

Soils

Variations of Canton-Charlton soil complexes dominate this MU. These soils are well drained with differing amounts of Canton, Charlton, and other soils with variations in slope and percents of boulders and rock outcrops so intermingled that it is not practical to separate them. Other series found in this MU include moderately drained Agawam, Hinckley, Paxton, and Woodbridge soils, with an even smaller amount very poorly drained Scarboro and Adrian mucks. The mucks are often found within areas of hydric Ridgebury soils. These areas cannot support logging equipment and are usually included as forested wetlands; future timber harvests will be excluded from these areas. The Canton soils are lowest in productivity with a site index of 58 for white pine and 52 for red oak, while the somewhat more productive Charltons have site indices of 65 for both species. The less frequently occurring Paxtons, Agawams, and Woodbridges are still more mesic with site indices ranging from 65 to 67 for white pine and 65 to 72 for red oak. The poorly drained soils are less productive for forest growth, but they are used by a large number of wildlife species.

Past Land Use and Forest Management

Around the time of the creation of the reservoir system, the PWSB land use survey recorded the majority of the original land in this MU as woodland. Other cover types and conditions were also present, largely concentrated in a patchwork area south of Danielson Pike and along the length of the I-1 firelane. “Brush” and “reforested” areas presumably returning to forest from agricultural use were intermingled with still arable land.

Early management during the PWSB era focused on old field plantation establishment and enrichment planting. About 125 acres of formerly cultivated land (12% of the total acreage) were planted with conifers, predominately red and white pine, between 1925 and 1935. In 1940-41, conifers were planted under a hardwood overstory on another 425 acres (40%). Most of the plantation stands were thinned more than once between the 1950s and 70s. Some of these stands are now ready to be regenerated or have the existing regeneration released. Some stands with underplanted white pine such as 281 were released during the 1960s, although another large area (stands 238) was not released from the hardwood overstory until 2003.

Timber management has been very active in this MU over the past fifteen years, with harvesting activity occurring on the majority of the original acreage and targeted at reducing forest health threats while accomplishing other silvicultural goals. Five separate harvests between 1997 and 2010 (Springbrook, Trimtown, Battey Meeting House, Saundersville Crossing, and Remington) have primarily focused on removing red pine, thinning white pine and some hardwoods, and continuing the release of the underplanted white pine. Stand-specific prescriptions employed a mix of thinning and strategies to secure regeneration, depending on species composition. Overall, the Trimtown area never contained a high percentage of red pine relative to some nearby MUs, but the red pine

component that was once present here is now mostly gone.

Without further research, little detailed information on past land use and management history of the former Battey, Fiske, and Gorham-Fenner properties is readily available. Aerial photos from 1939 to 1962 show the northwest corner of the Gorham-Fenner parcel cleared for 10 acres of farm pasture with two adjacent fields separated by a narrow buffer of trees. The western field was abandoned for pasture sometime before the eastern one, but both were starting to revert to forest before Providence Water acquired the land in 1990. In 2000, the eastern field was mowed and planted with red oak seedlings (except for a roadside buffer), but this planting suffered near-total mortality due to deer browsing and possibly other factors. The brushier western field was mowed around 2001 but apparently never planted. The eastern field remains in an early-successional condition with tall grasses and herbaceous plants, while western has developed into a young coppice stand of alder and gray birch with occasional white pine.

On the former Battey and Fiske parcels, no agriculture or clearing was present in 1939 and these properties remained forested throughout the rest of the 20th Century. No active management has taken place here since the land was acquired by PWSB.

Forest Health and Related Management

Several interconnected forest health issues are impacting the hardwood stands in this MU. As in other areas of the PWSB property, the upland oaks stands are suffering high mortality due to a combination of factors including the poor soils and repeated defoliation from insects such as the forest tent caterpillar and orange striped oakworm. Meanwhile, oak and hardwood regeneration is severely compromised due to heavy deer herbivory and, to a lesser extent, the dense layer of blueberry and huckleberry that is present in most of the upland stands. Where some natural white pine is present in the understory, these areas are transitioning to mixedwood stands. The areas without white pine will be low-density upland oak stands until deer pressure is reduced and hardwood seedlings can make it past browse height. While the oaks that may become established in these areas will not produce high quality timber, they will help to protect the site for water quality. As time passes, more white pine that is better suited to these sites will become established as the scattered sapling and pole sized trees start to bear cones and disperse seed.

The deer herbivory and regeneration problem can contribute to the establishment of invasive plants, which deer generally avoid and can become established in open areas or in the forest understory where native tree regeneration has not taken hold. Considering the deer pressure in this area, the extent of invasives could be worse. With the I Block relatively isolated from public roads and having low levels of previous human settlement, most of these plants on the historic ownership in this MU are found in the H Block and especially towards the northern end. Scattered patches of Japanese barberry are well established in the understory of the stands south of Danielson Pike. A few thickets of Oriental bittersweet are present along the northern part of the H-1 firelane, including one occupying a tiny dead red pine stand with one of the property's largest patches of winged *Euonymus.* At the southern end of the same road, Japanese barberry and *Euonymus* growing along the old Saundersville Pike section were treated with a herbicide application in 2010 in an effort to prevent their spread into the recently thinned stands on the north side of the road. Future timber harvest project planning will incorporate similar invasive assessment and possible treatment.

Oriental bittersweet is also widespread in and around the 10 acres of old fields and surrounding forest edges on the former Gorham-Fenner property. Any management of this possible early successional wildlife habitat site needs to consider invasives control.

Silviculture

Several entries into this MU are planned during the 2010-2020 management period, with others projected further out based on recently completed work. The first operations will be improvement thinnings as the first step in beginning the regeneration process in mixed and hardwood stands. The success of the subsequent regeneration harvests will be dependent on controlling deer impacts on the hardwood seedlings. To increase the likelihood of success, this MU will be included in the RI DEM Deer Management Cooperative Area with hunting of white-tailed deer to begin during the 2011-12 season. The initial hardwood thinning will include maintaining and expanding an area devoted to early successional wildlife habitat. The edges of the old fields on the former Gorham-Fenner property (stand 242) will be cut back to increase the total area from 11 to 15 acres or more.

The second treatment in this MU will occur a few years later and involve removing the overstory on areas with good white pine regeneration and establishing white pine regeneration in other stands. The stands without regeneration have been thinned within the last 10 years with little regeneration becoming established. Ferns that now dominate the ground layer that will be an impediment to seedling establishment will be treated prior to the operation if still necessary. The harvest should be conducted during periods when the ground is not frozen or covered with snow to scarify the soil with a skidder being favored for this type of operation.

The third treatment in this MU will be a continuation of the thinning/regeneration regime in areas of white pine that has recently been completed (2009-2010). Approximately 120 acres of white pine were thinned during two separate operations. These areas will be allowed to grow for at least ten years during which time the live crown ratios and bole diameters will increase. Around 2020, the regeneration process will be started through a shelterwood thinning looking to continue growth on the better trees and establish regeneration. Any regeneration that becomes established after the 2010 thinning will be protected if possible even though it was not an objective of the 2010 operation.

The fourth operation in this MU will not occur for approximately 15 years when regenerating white pine that was released from upland oaks in 2003 will begin. While this would be a relatively long period (20+ years) between treatments in a white pine stand, the current tree density is less than in other areas due to stand history and terrain. The long time between underplanting and releasing (62 years, 1941 to 2003) resulted in some white pine mortality from shading and misshapen crowns as they grew up into the hardwoods. Many of the trees with poor crowns or poor form were cut during the 2003 operation. Subsequent repeated insect defoliation of the oaks that were retained during the 2003 release further reduced overall stocking as some of these trees died. This stand (238) is on a rocky, slightly sloped area that probably made planting difficult with impacts on seedling survival rates. These same factors made protecting the white pine more difficult during the harvest. The prescribed long growth period and wider tree spacing will allow crown expansion and tree bole diameter growth. The next treatment in 2025 will be aimed at establishing regeneration and thinning sections that were not included in the 2003 operation. As in all operations, the conditions at the time of the harvest will dictate the intensity and extent of the treatment. If the regeneration is insufficient, a light thinning will be conducted to scarify the soil to help in establishing new seedlings. If enough seedlings have survived and developed, the operation's objectives may include their release.

The north end of this MU along the H-1 access road near Danielson Pike is leased for maple sap collection. The current lease runs through the 2014 season with an option to extend the agreement for an additional five years to 2019. There is also flexibility to expand operations into other areas if feasible. This venture has proven to be positive with the contractor employing the most current technology and showing good stewardship. The operation has also generated some good publicity.

With a continued good relationship with the contractor, the five year extension will be granted.

Cultural Resources

At the far northeastern corner of the MU in stands 146 and 161, many remnants of past land use remain from the textile mill era when this area was part of the village of Scituate. A short distance below the current Horseshoe Dam and just east of the current shoreline, the Moswansicut River was dammed to create a millpond to provide water power to the large North Scituate Cotton Mill. The mill foundation is now underwater in the reservoir, but the paths of Mill Street (which once led to the factory) and Hoxie Lane are evident along with foundations of houses that were once located along these streets. With the help of old photographs and a little imagination, it is not hard to imagine how this area looked before the establishment of the reservoir system. PWSB's general policy of protecting and preserving historic sites applies to the Mill Street/Hoxie Lane area, but – like similar sites across the watershed ownership – it is not designated a special management area at present. Further south, a stone structure that is believed to have used for storing coffins in the winter months until they could be buried in the spring is located on the south side of the H-5 firelane. This MU also contains several historic cemeteries and stone walls running through the forest.

Trimtown MU Inventory Summary:

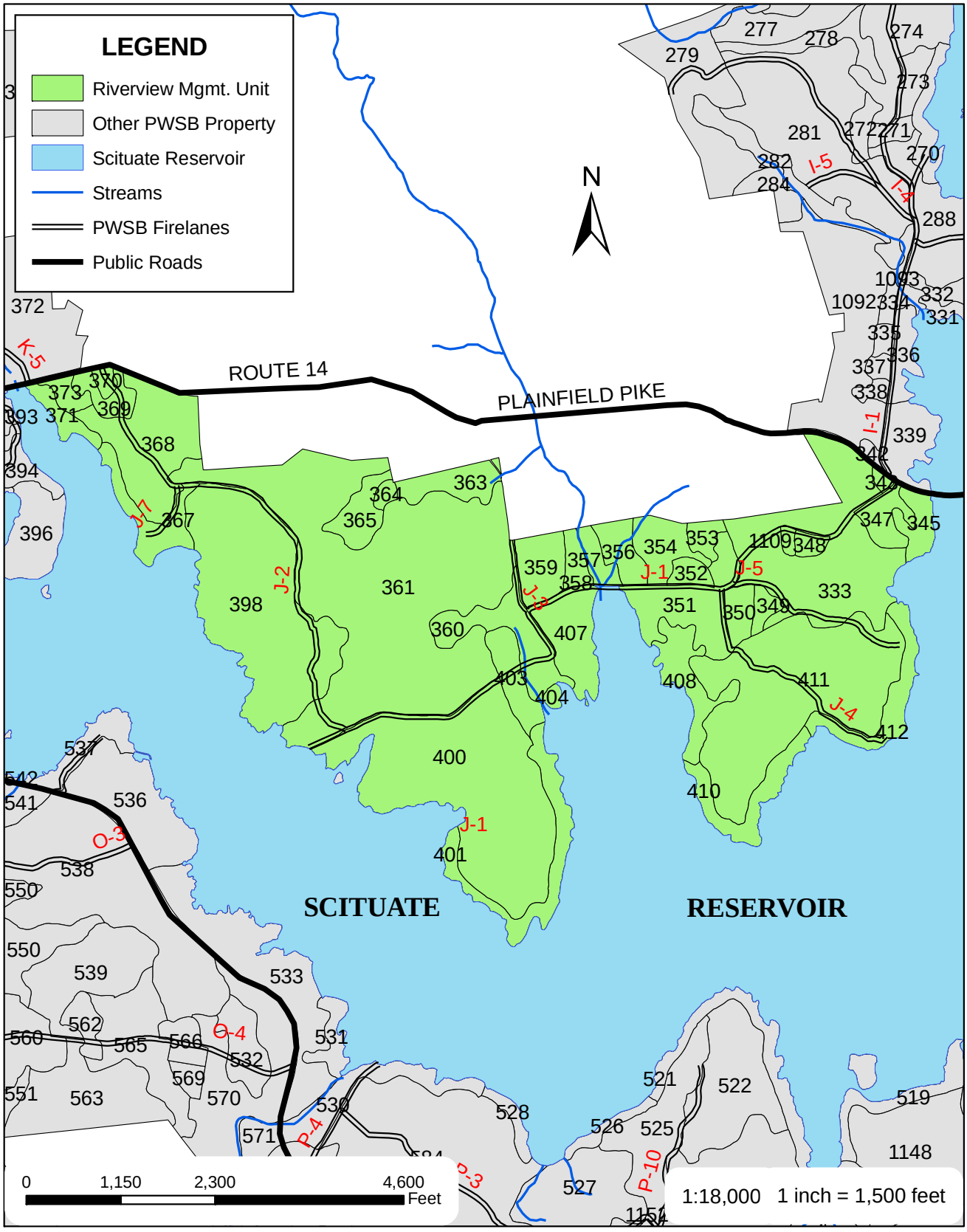
Stand	Acres	Type	Species	TPA	BA	MSD	MBF	Cds	Regen
140	2	H2A	MO/MH	246	84	7.9	1.5	9.8	±1,167
141	4	S2B	WP/MH	134	56	8.8	1.3	6.2	±420
142	10	S3B	WP	130	110	12.5	13.7	10.5	±2,340
146	14	M3A	WP/SM/MH	235	137	10.0	10.7	10.5	±1,444
161	13	H3A	SM/WP	184	116	10.6	7.2	8.6	±463
163	7	S3C	WP	80	82	13.1	13.0	5.5	±4,192
164	4	M3A	MO/WP	235	137	10.0	10.7	10.5	±1,444
165	2	H2/3A	MO	190	105	10.0	4.8	9.3	±650
166	1	Water							
167	1	S1B	WP			No	Data		
168	7	H2/3A	MO/MH	190	105	10.0	4.8	9.3	±650
169	8	H3A	MH/RM	184	116	10.6	7.2	8.6	±463
170	5	M2/3A	MO/MS	284	122	8.8	5.9	12.2	±889
171	4	S3C	WP	80	82	13.1	13.0	5.5	±4,192
173	36	S3B	WP	59	80	15.8	12.8	6.8	±200
174	13	M3B	WP/MO	153	98	10.8	8.3	6.7	±954
192	26	H3C	UO/WP	83	50	10.5	2.0	6.9	±1,572
193	35	M2/3B	MO/WP	111	67	10.6	2.9	10.1	±1,367
194	4	M2/3A	MO/MH	284	122	8.8	5.9	12.2	±889
195	2	S3A	WP	159	136	11.4	14.8	11.2	±6,196
196	5	H1/2A	MH/IH	104	33	7.8	1.7	3.5	±4,700
197	36	H3B	MO	92	75	12.3	5.2	9.6	±2,100
198	6	H2/3A	MO	255	127	9.6	7.5	16.2	±100
199	5	H3A	MH	184	116	10.6	7.2	8.6	±463
200	5	H1/2A	MH/WP/SP	104	33	7.8	1.7	3.5	±4,700

201	8	S2B	WP	134	56	8.8	1.3	6.2	±420
202	4	S3B	WP	130	110	12.5	13.7	10.5	±2,340
237	12	M2/3A	UO/WP	284	122	8.8	5.9	12.2	±889
238	106	S2/3B	WP/MO	235	102	9.0	4.8	15.2	±3,323
239	4	Water							
240	107	H2/3A	MO/MH	206	102	9.5	4.3	14.3	±537
242	11	Open							
244	11	H2/3A	UO/MH/WP	190	105	10.0	4.8	9.3	±650
245	59	M2/3A	WP/MO	334	163	9.4	8.8	23.2	±1,375
247	22	H3A	MO/RM	184	116	10.6	7.2	8.6	±463
248	11	S3A	WP	159	136	11.4	14.8	12.2	±6,196
270	7	S2/3C	RP/-/WP	252	75	7.4	2.6	8.5	±2,850
271	3	S2A	SP/WP	358	140	8.5	3.8	20.9	-
272	4	S1A	WP	0	0	N/A	N/A		±1,933
273	5	M2/3A	WP/UO	284	122	8.8	5.9	12.2	±889
274	28	H2A	UO	142	52	8.2	0.4	8.6	±1,040
276	5	M3A	WP/MH	235	137	10.0	10.7	10.5	±1,444
277	25	S3B	WP/-/MH	151	110	11.2	10.0	15.5	±2,000
278	10	S2C	RP/UO/WP	109	35	7.7	0.6	7.4	±2,350
279	37	H2/3A	UO/MO	143	90	10.6	3.7	13.7	±980
281	65	S3B	WP/MO	178	116	10.9	11.2	14.6	±9
282	13	W3A	MH/RM	183	130	11.3	5.4	19.4	±523
284	6	S3B	WP	130	110	12.5	13.7	10.5	±2,340
288	34	M2/3A	UO/MS	315	95	7.4	1.3	12.7	±1,575
331	3	S3A	MS	159	136	11.4	14.8	12.2	±6,196
332	6	S2/3A	WP/SP	282	136	9.2	9.0	14.9	±730
334	2	S3A	WP	159	136	11.4	14.8	12.2	±6,196
335	2	Grounds							
336	7	S3A	WP/MS	159	136	11.4	14.8	12.2	±6,196
337	2	S3A	WP	159	136	11.4	14.8	12.2	±6,196
338	2	M2/3A	WP/MO	284	122	8.8	5.9	12.2	±889
339	12	S3A	WP/SP/MH	159	136	11.4	14.8	12.2	±6,196
342	1	S3A	WP/SP	159	136	11.4	14.8	12.2	±6,196
1063	13	M2A	UO/WP	262	110	9.1	3.3	17.8	±1,167
1064	33	H3B	UO	120	56	9.2	1.0	10.5	±2,720
1065	17	H3B	UO	107	72	10.7	3.6	10.0	±1,522
1092	47	H2/3A	MO/UO/WP	182	94	9.9	3.5	13.7	±1,150
1093	2	H2/3A	MO/UO/WP	182	94	9.9	3.5	13.7	±1,150
1094	23	W2/3A	RM/MH	179	114	10.9	5.2	18.4	±100
1095	44	M2/3A	WP/MO	327	128	7.9	3.1	19.8	±100
1107	4	W3A	RM	183	130	11.3	5.4	19.4	±523

Trimtown MU Management Activity Schedule:

Stand	Type & Species	Activity	Acreage	Year
240	H2/3A-MO/MH	Shelterwood/improvement thinning & enlarge area of early successional type w/242	70	2011
242	Open	Early successional habitat improvements	11	2011
1065	H3B-UO/MO	Enlarge area of early successional type w/242	TBD	2011
245	M2/3A-MO/WP	Shelterwood/improvement thinning	59	2011
244	H2/3A-MO/MH	Shelterwood/improvement thinning	11	2011
142	S3B-WP	Treat invasive plants	TBD	2013
140	H2A-MO/MH	Treat invasive plants	TBD	2013
202	S3B-WP	Treat invasive plants	TBD	2013
248	S3A-WP	Treat invasive plants	TBD	2014
142	S3B-WP	Shelterwood thinning	10	2015
140	H2A-MO/MH	Improvement thinning	2	2015
163	S3C-WP	Shelterwood overstory removal	7	2015
164	M3A-MO/WP	Thinning	4	2015
171	S3C-SP/WP	Shelterwood overstory removal	4	2015
202	S3B-WP	Shelterwood thinning	4	2015
195	S3A-WP	Shelterwood thinning	2	2015
248	S3A-WP	Shelterwood thinning	15	2015
334	S3B-WP	Shelterwood thinning	3	2015
337	S3B-WP	Shelterwood thinning	2	2015
336	S3A-WP/MS	Shelterwood thinning	6	2015
333	M2/3A-MO/WP	Thinning	50	2015
173	S3B-WP	Shelterwood thinning	29	2021
174	M3B-WP/MO	Shelterwood thinning/group selection	13	2021
281	S3B-WP	Shelterwood thinning	71	2021
277	S3B-WP	Shelterwood thinning	17	2021
238	S3B-WP	Shelterwood thinning	±145	2025

RIVERVIEW MANAGEMENT UNIT



RIVERVIEW MANAGEMENT UNIT

Location, Geography, and Access

The Riverview MU encompasses approximately 725 acres on a broad double peninsula, which is almost entirely PWSB property, located between the two arms of the Scituate Reservoir and south of Plainfield Pike (Route 14). It has the same geographic boundaries as the J Block. The area derives its name from the old River View Cross Road that is now part of the J-1 firelane. This MU is dominated by rocky upland terrain with relatively steep slopes down to the reservoir around the perimeter. Spruce Brook empties into a bay of the main reservoir between the two peninsulas and several seasonal streams and forested wetlands are also present. Two gates along Plainfield Pike at opposite ends of the MU and a third in between at the end of Wilbur Hollow Road provide access to a network of interior firelanes, which are mostly in good condition except for the J-2 firelane. Tractor-trailers can use the J-1 firelane gate near the Ashland causeway without difficulty, but the J-2 firelane gate is problematic and should be replaced.

Existing Forest Description

Considering the overall species composition of the PWSB watershed forest, the most noteworthy feature of the forest in this large MU is that it is dominated by conifers rather than hardwoods (323 acres of conifers; 246 of hardwoods; and 154 acres classified as mixedwood). The current species composition results from 90% of the land (660 acres) having seen some type of planting after the establishment of the reservoir, with more than 100 open acres directly planted in pines and other conifers and 550 acres of hardwood underplanted with white pine. Many of the underplanted stands now resemble plantations as the hardwoods have been cut over time to release the white pine. Past silvicultural activities have created a range of forest types, conditions, and size classes.

The stands classified as mixedwood in the 1999 inventory are transitioning from mixed oak with white pine to predominately white pine with scattered oaks. Much of the pine that is beginning to emerge into the overstory in these mixedwood stands was underplanted but never released through silvicultural cutting in past decades. Instead, natural release is occurring as repeated attacks of defoliating insects kill the oaks (especially scarlet oak), which are already stressed by the dry, rocky soils. The standing dead hardwoods make good cavity trees and the insects in the trees are a food source for birds. When these trees fall, they'll provide habitat and benefits to another set of animals.

Soils

Canton and Charlton sandy loams are the dominant soil type in this MU, generally very stony and including significant rock outcrop areas with slopes up to 35%. Well drained and moderately productive where they are not very rocky, these soils are suited to growing pine and a mix of pine and hardwoods, with a site index of 58 for white pine and 52 for red oak. Interspersed with these

series are smaller areas of other soil types including Sutton, Woodbridge, Wapping, where some better quality and more vigorous hardwoods can be found.

Past Land Use and Forest Management

At the time the reservoir system was created, the 1915 PWSB land use survey recorded the majority of this MU as woodland and only about 95 acres were under some type of cultivation. The stone walls in woodland areas indicate that these locations were probably being used as pasture, since the rocky slopes in these areas would have made them more suitable for pasture rather than crops.

Providence Water has intensively managed the Riverview MU since acquiring the land. Fully 90% of the acreage has been planted with conifers, either direct planting of various species on former arable land or enrichment planting of white pine under a sparse hardwood canopy. PWSB established some of the first plantations on the new watershed property here in 1925 and many of them have since been thinned three or four times.

Harvesting since 1990 has largely focused on responding to forest health threats while also accomplishing other silvicultural goals. Prompted by the threat of the red pine scale and red pine adelgid, harvests in 1993-94 and 2000 combined red pine removal with white pine thinning, and most of the small amount of remaining mature red pine was cut in 2009. Stand-specific prescriptions employed a mix of thinning and strategies to secure regeneration, depending on species composition. Silvicultural activities have generally shifted these stands to white pine and regeneration is abundant.

Silviculture in the stands underplanted with white pine has pursued a parallel but different course. Two large stands (411 and 361) that were enrichment planted in 1940 had the hardwoods removed in 1965 and during the 1980s, respectively. During the 1965 entry the trees were girdled and left to die in place, while during the 1980s, the trees were harvested for marketable fuelwood. The 2009-10 Spruce Brook harvest thinned the white pine in these stands the first time. Many suppressed and small sawlog-size trees that would have died from competition were captured during this entry, with the work accomplished commercially due to new markets for pulpwood and landscaping mulch.

Forest Health and Related Management

As in the rest of the oak-hardwood forest across the PWSB ownership, the issue of deer herbivory and lack of oak regeneration is common in the hardwood stands in this MU. White pine is the most prevalent understory tree species and very little, if any, oak or hardwoods other than red maple are present. Huckleberry and low bush blueberry are also common, as deer prefer to browse other species. Deer browsing was evident on stump sprouts of recently cut hardwoods.

About 27 acres of former red pine plantations in this MU have been successfully regenerated through a series of cuttings and are currently in the seedling/sapling stage. For the most part, white pine has naturally seeded in from nearby seed sources. Red pine has also regenerated in these areas but is now beginning to die, and the only hardwood found in any numbers is stump sprout red maple. Stand 351 is a good example of successful white pine shelterwood regeneration, with more than 4,700 stems per acre growing under a low-density overstory.

This MU is relatively free of invasive plants, probably in part due to the limited settlement and land disturbance at the time of land condemnation. Some Japanese barberry is present near wetland areas close to where houses or other structures once stood at the J-1/J-4 firelane intersection. There is also a thicket of Oriental bittersweet in a mature white pine stand (369) adjacent to the J-2 firelane gate and Plainfield Pike. Before the next harvest in this stand, the bittersweet will be treated to prevent its spread and to help in securing regeneration.

Silviculture

Future management in this MU will be as varied as the forest types and size classes present. The recently regenerated stands have entered a long growth period. Stands such as 352 can be left to grow until a commercial thinning is viable. It may take 25-30 years or more for the trees to reach merchantable size as their diameters will increase very slowly while they compete for dominance. Since they are receiving full sunlight, height growth should remain strong. As the dominant individuals emerge during the stem exclusion phase, slower-growing trees will become suppressed and die. These densely-stocked stands may currently provide suitable habitat for certain wildlife species including grouse, woodcock, and the New England cottontail rabbit. A more management-intensive option in these stands would be to conduct a pre-commercial release in which the dominant saplings are released by felling and leaving the competing trees around them. Any quality hardwoods would also be retained and freed from competition. Pre-commercial release work is costly and should only be considered if cost-share money from other sources is available or if Providence Water maintenance personnel can perform the work. These stands should be monitored over time, as it may be desirable to release the white pine from the red maple sprouts that may ultimately overtop them.

The group of low-density white pine stands with abundant regeneration established has also entered a long growth period. Partial shade from the overstory should not significantly decrease the growth of the understory white pine. These stands will be allowed to grow until the dominant understory trees are 8 or 9 inches in diameter. At this time, the majority of the overstory will be removed while retaining a few scattered trees or groups of trees as legacies. These large legacy trees will never be harvested and will be left to grow larger and eventually die, eventually providing standing dead snags and then large downed logs for wildlife. Any trees which already have attributes that benefit wildlife (such as cavities or dens) will be selected for retention.

White pine stands 411 and 361 were thinned in 2009-2010 in a relatively light entry intended to minimize the threat of windthrow in these previously unthinned stands. These stands will receive a second thinning after growing for another 10 years or more. During this future harvest, hardwoods — especially hard mast producing species such as white oaks and hickories — should be retained for wildlife value and species diversity. Groups of trees covering up to a quarter acre will be selected and cut in some areas, whereas no trees will be cut in other areas. The remaining matrix between these “gaps and skips” will receive a crown thinning where the better growing trees are left to increase in size.

Cultural Resources

The land in this MU retains many signs of past land use, especially where prior settlement and agriculture were concentrated along the eastern shoreline and near the head of the bay separating the two peninsulas. A number of stone walls now run through the forest. Still, most of the previous settlement in this area was located a short distance south of the present reservoir shoreline, closer to the Ponaganset River and the old Plainfield Pike. A significant number of buildings once clustered around the hamlet of Wilbur Hollow, but this location is now underwater in the reservoir and only the northern portion of the road leading to it remains.

Scituate Historical Cemetery Number 51, also known as the Page Cemetery, is located adjacent to the J-4 firelane. The stone walls surrounding this cemetery are in good condition and the vegetation growing within was once cut every few years, but this practice has been discontinued in recent years and the cemetery is currently becoming overgrown.

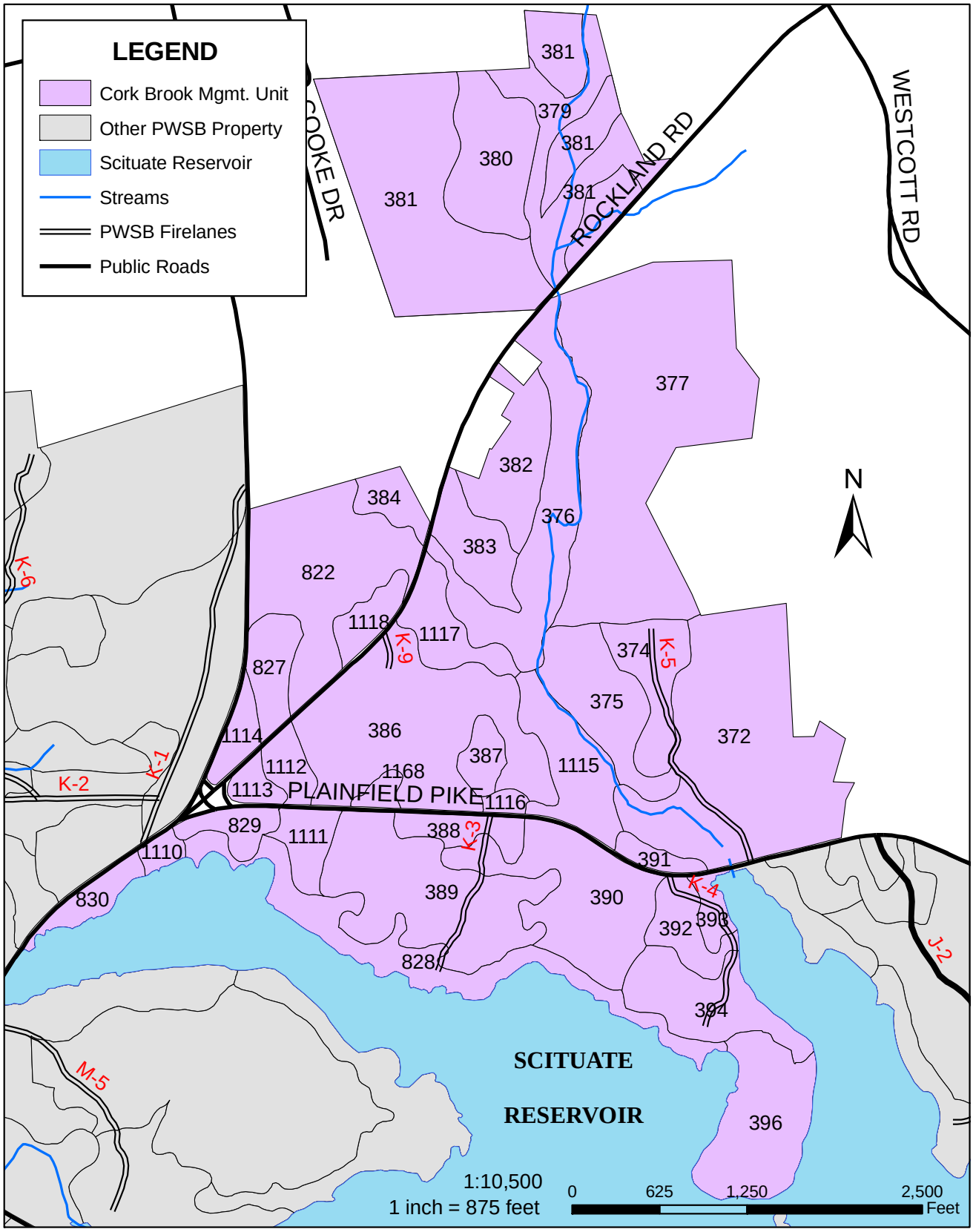
Riverview MU Inventory Summary:

Stand	Acres	Type	Species	TPA	BA	MSD	MBF	Cds	Regen
333	60	H2/3A	MO/-/WP	195	115	10.4	5.5	17.7	±450
343	1	M1A	WP/RP/MH	158	30	<3.5	0.2	0.7	±1,400
345	7	M3C	MH/MS	152	74	9.2	3.8	9.7	±1,180
347	7	M2/3A	MO/WP	284	122	8.8	5.9	12.2	±889
348	2	M1A	WP/MH	158	30	<3.5	0.2	0.7	±1,200
349	3	S1C	WP	115	10	<3.5	N/A	N/A	±500
350	5	S1/2A	WP	492	60	4.7	0	1.6	±3,100
351	21	S3C	WP/-/MH	68	92	15.8	18.9	3.5	±4,750
352	4	S1A	WP/RP	0	0	<3.5	N/A	N/A	±1,300
353	4	S1A	WP/RP	0	0	<3.5	N/A	N/A	±2,600
354	10	H2/3A	MO/RM/WP	190	105	10.0	4.8	9.3	±650
356	7	S3B	WP	130	110	12.5	13.7	10.5	±2,340
357	5	W2A	RM	496	160	7.7	2.4	25.9	±50
358	4	S2B	MS/MH	134	56	8.8	1.3	6.2	±420
359	11	S3C	WP/MS	80-	82	13.1	13.0	5.5	±4,192
360	12	W3A	MO/RM	154	130	12.5	7.7	18.9	±500
361	155	S2/3A	WP	314	153	9.5	9.8	20.9	±139
363	10	W2/3A	MO	186	117	10.7	5.5	11.9	±127
364	2	W2B	RM	496	160	7.7	2.4	25.9	±50
365	8	H3A	MO	308	137	9.0	6.6	17.7	±300
367	11	M2/3A	WP/MO/MS	284	122	8.8	5.9	12.2	±889
368	32	H3A	MO	183	140	11.9	11.7	18.1	±175
369	6	S3B	WP	130	110	12.5	13.7	10.5	±2,340
370	2	H3A	MH	184	116	10.6	7.2	8.6	±463
371	5	S3A	WP/SP	159	136	11.4	14.8	11.2	±6,196
373	4	H2/3A	MO/WP/MH	190	105	10.0	4.8	9.3	±650
398	78	H2/3A	MO/WP/MH	233	108	9.6	5.2	16.3	±177
400	109	M2/3A	MO/WP	216	106	9.6	5.5	16.9	±1,864
401	18	S3B	WP/MS	150	100	10.8	10.6	13.5	±4,600
403	9	S1/2B	WP/MS/MH	401	70	5.7	N/A	5.1	±1,400
404	1	S3A	WP	159	136	11.4	14.8	11.2	±6,196
407	17	S3B	WP	49	93	18.7	18.7	7.3	±11,000
408	12	H2/3A	MO/-/WP	190	105	10.0	4.8	9.3	±650
410	12	M2/3B	MO/WP	161	79	9.4	4.3	8.0	±700
411	81	S3B	WP	151	117	11.9	12.3	15.9	±154
412	13	S3B	SP/WP	130	110	12.5	13.7	10.5	±2,340
1109	1	S2/3A	WP	282	136	9.2	9.0	14.9	±730

Riverview MU Management Activity Schedule:

Stand	Type & Species	Activity	Acreage	Year
350/351	N/A	Treat invasive Japanese barberry at J-1/J-4 firelane intersection; monitor to prevent spread	1	2013
333	H2/3A-MO/WP	Improvement thinning/white pine release	60	2013
368	H3A-MO	Oak shelterwood thinning	32	2013
369	S3B-WP	Treat Oriental bittersweet & monitor; white pine shelterwood seed cut after invasives are controlled	6	2013
398	H2/3A-MO/WP	Improvement thinning/white pine release	78	2013
400	M2/3A-MO/WP	Improvement thinning/white pine release	92	2015
401	S3B-WP	White pine shelterwood partial overstory removal	18	2015
411	S3B-WP	White pine thinning	81	2022
412	S3B-SP/WP	White pine shelterwood partial overstory removal	13	2022
361	S3B-WP	White pine thinning	155	2023

CORK BROOK MANAGEMENT UNIT



CORK BROOK MANAGEMENT UNIT

Location, Geography, and Access

The Cork Brook MU includes about 450 acres in the K Block located north of the Scituate Reservoir's west arm. Route 102 serves as its western boundary, while the irregular northern and eastern boundaries are property lines in the woods. The southern and central sections comprising 60% of the land area in this MU have been PWSB property since the creation of the reservoir system, but the northern acreage is comprised of two later land acquisitions along the brook. Providence Water purchased an 80-acre parcel north of Rockland Road in 1956; the acquisition of the 100-acre former Saute property in 1998 connected the 1956 purchase to the main watershed property and put more than a mile of the lower Cork Brook corridor in PWSB ownership.

Subdivided by three public roads (Chopmist Hill Road, Rockland Road, and Plainfield Pike) converging at the intersection known locally as Crazy Corners, this MU is parcelized into four sub-units for management purposes. The Cork Brook corridor is the dominant landscape feature and this MU includes almost all the southern portion of this subwatershed on PWSB property. Although the brook is now considered a major stream emptying into the Scituate Reservoir, before the creation of the water supply system it was a small tributary of the lower Ponaganset River. Public roads give this MU a large amount road frontage. The short K-3, K-4, K-5, and K-9 firelanes provide access to the interior of the original southern acreage, but the northern parcels lack formal interior roads.

Existing Forest Description

The forest in this MU is quite varied due to its past ownership and land use history. Hardwoods dominate the species composition, although conifer and mixedwood stands are more prevalent in the original southern section (about 300 acres of hardwood stands; 64 of conifers; and 76 acres classified as mixedwood). Most of the hardwood stands are pole-to-sawtimber sized, with little in the sapling and seedling size classes. Species composition shifts from mixed oak in the west towards mixed oak/red maple in the Cork Brook corridor, where tributary streams and forested wetlands are common. The operable eastern acreage of the former Saute property (stand 377) was heavily cut before the land was sold to Providence Water. Little or no management has taken place during PWSB's tenure on both of the sections north of Rockland Road, and the forest on the parcel acquired in 1956 has "older growth" characteristics including hardwood overstory trees larger than many on the watershed. The stands in the southern section near Plainfield Pike are the legacy of past human land uses and intensive tree planting and silviculture in these areas. Many of these stands are of plantation

origin, with a large volume of red pine having been cut from them over the past 20 years.

Soils

The southern/western and northern/eastern parts of this MU are characterized by very different soil types and strongly influence the varied forest cover and species composition. Very rocky Canton and Charlton sandy loams are the dominant soil type in the sections this MU near Crazy Corners and south of Plainfield Pike, with small areas of Gloucester-Hinckley soils and rock outcrops interspersed. Well drained and moderately productive where they are not very rocky, these soils are suited to growing pine and a mix of pine and hardwoods, with a site index of 58 for white pine and 52 for red oak. Moving north and east towards Cork Brook, soils change to the more mesic but still very stony Paxton and Woodbridge fine sandy loams, which have higher site indices for all species and are better suited to hardwoods. Hydric Ridgebury, Whitman, and Leicester series are found along the inner stream corridor.

Past Land Use and Forest Management

The 1915 PWSB land use survey is only available for the original land in this MU (the southern 270 acres). Of this acreage, the survey recorded most of the land as woodland with less than 35 acres in cultivation and a few additional cleared areas used as pasture with some tree cover or reverting to forest. The current firelanes are now located in the areas where the cleared land used to be. Settlement in this MU was limited to a few buildings along Plainfield Pike and in a small cluster just east of the current K-5 firelane.

With most of its acreage in natural forest stands when the reservoir system was created, this MU has seen limited active management during the PWSB era and most of it has been concentrated in the southern and central sections. The former agricultural land was planted with predominately red pine in 1938. Around the same, time about 45 acres of hardwood stands (modern stands 389, 396, and 390) were enrichment planted with white pine and released in later decades with varying results. Some of these underplanted stands now resemble white pine plantations, while enough hardwoods still remain in others for them to be classified as mixedwood stands.

Since around 1990, harvesting in the plantation stands has focused on responding to forest health threats while also accomplishing other silvicultural goals. Prompted by the threat of the red pine scale and red pine adelgid, harvests in 2001-02 and 2007 combined red pine removal with white pine thinning. The remaining red pine has either died (stand 373) or will not be cut due to its proximity to the reservoir or inaccessibility (stands 828 and 830). Moving away from focusing solely on the conifer stands, the 2007 harvest included various other stand-prescriptions including hardwood thinning (stands 826 and 827), individual/group selection in a mixedwood stand (386), and an oak shelterwood seed cut (stand 1115).

Just before Providence Water purchased the former Saute parcel in 1998, the eastern part of the property (stand 377) was heavily cut in a non-silvicultural “highgrade” harvest and some rutting incurred during this logging operation remains.

Forest Health and Related Management

As in the rest of the oak-hardwood forest across the PWSB ownership, the issue of deer herbivory and lack of oak regeneration is common in the hardwood stands in this MU. Little hardwood regeneration is found in these stands even where cutting has created canopy gaps, such as the shelterwood seed cut in stand 1115. This can be attributed at least in part to deer herbivory pressure on seedlings and stump sprouts.

Regeneration following the removal of red pine in the southern section of the MU varies. Shoreline stand 828 has good white pine and some hardwood (mostly red maple stump sprouts) regeneration present. Stands 388 and 391 are also starting to fill in with white pine, but stand 374 has very little new regeneration and the deer impact is obvious. A small area of white spruce is present in the vicinity of the K-4 firelane, and spruce regeneration has become established in the areas where it was planted in a mixture with red and white pine. Suppressed spruce is also growing in the understory of the stands between Rockland Road and Chopmist Hill Road; these trees were evidently planted at some time although no records are available. Blueberry and huckleberry dominate the ground layer in this area.

Invasive plants in this MU are concentrated in the Cork Brook corridor and two significant infestations were found here during the field inventory. Japanese barberry is present throughout stand 372; while this infestation is not as concentrated as some others on the PWSB property it is found consistently over the 40 acres. This stand is located near the former cluster of buildings east of the K-5 firelane and there is no record of harvesting here, as the stand is seasonally extremely wet with standing water. Japanese stiltgrass, a relatively new species to this area that is highly invasive in forest environments, was found along Cork Brook and some of its tributary streams. Monitoring and treatment of the stiltgrass and especially trying to prevent its spread beyond this section of the MU is an important management goal.

Silviculture

For practicality in operational planning, silviculture and related management activities will be addressed in the context of the four sub-units into which this MU is divided.

A number of stands in the section south of Plainfield Pike were last cut in 2001-02 and the next harvest in this area will be scheduled for 2014. The white pine in stands 389 and 390 will continue to be thinned and treated as even-aged. Larger hardwoods present when this area was underplanted will be retained to add diversity and hard mast for wildlife. This harvest will include small patch cuts in stand 394 and part of stand 391 to create canopy gaps and start regenerating the areas that were not cut in 2001. To help reduce the threat of windthrow, the spruce between the cut patches will not be thinned. If the roadside red pine in stand 830 dies and becomes a safety hazard, these trees will be cut and left in place.

Most of the central section of the MU (between Rockland Road and Plainfield Pike) east of Cork Brook will not have any active timber management during the 2010-2020 management period. The area of the former Saute property cut heavily prior to PWSB acquisition (Stand 377) will be left to naturally rehabilitate itself. Most of stand 372 is too wet to support logging equipment, but its high percentage of red maple and some sugar maple may make this stand a good sugarbush for maple sap production. Stand 374, a former red pine plantation with poor regeneration, will have wildlife value if deer browsing can be controlled enough to allow a thicket to develop. Hardwood trees along the stone walls within the stand were retained when the red pine was harvested from this site. A future harvest will combine removal of these “wall” trees with a 4-acre clearcut in stand 375 to create about 12 acres of early successional wildlife habitat for species including the New England cottontail rabbit, ruffed grouse, and American woodcock. If deer impacts prevent the thicket from developing, a 10-foot deer fence will be constructed around the harvest area as described in Natural Resource Conservation Service (NRCS) Connecticut practice 382.

With the exception of the former Saute property, most of the stands in the central section west of Cork Brook were included in the 2007 harvest. This harvest included a shelterwood seed cut in

mature red oak stand 1115. To date, the regeneration has not developed as hoped because of deer herbivory. Before overstory removal, both deer control and a second light seed cut may be needed in this stand for the necessary regeneration to become established. The overstory removal cut should be timed so that nearby stands 386 and 826 can be entered at the same time. These stands will continue to be managed under an uneven-aged silvicultural regime using single-tree selection, group selection, and patch cuts.

The 77-acre parcel north of Rockland Road acquired in 1956 appears to have seen little human disturbance during the 20th Century. The forest has many "older growth" characteristics: a significant number of large-diameter hardwoods (average DBH greater than 17" and some red oaks nearing 30"); individual tree and group canopy gaps from blowdowns with large coarse woody material remaining; and some larger standing snags. The attribute currently missing from these stands is the presence of multiple age classes, which have not developed in part due to deer herbivory. This site has a higher percentage of more productive soils than most parts of the watershed forest. Given the high conservation value forest, productive soils, and limited operability in the Cork Brook corridor, this parcel will be designated a reserve set aside from timber harvesting and passively managed for old growth structure through natural processes. The only active management on this parcel will be for public safety purposes. Trees will not be salvaged in the event of a natural disturbances including mortality from insects or disease and weather events.

Cultural Resources

One of the largest white oak trees in the state was formerly located in this MU on the north side of Plainfield Pike. The original plans for relocating Plainfield Pike after the creation of the reservoir system called for cutting this local landmark known as "The Big Oak," but the roadway's location was ultimately changed to save the tree. Over the course of the 20th Century, the tree's health slowly deteriorated until it finally died. The 20-30 foot standing dead trunk remained until 1996, when a fire was started in the hollow base and the trunk was shortly thereafter cut and removed from the site.

Cork Brook MU Inventory Summary:

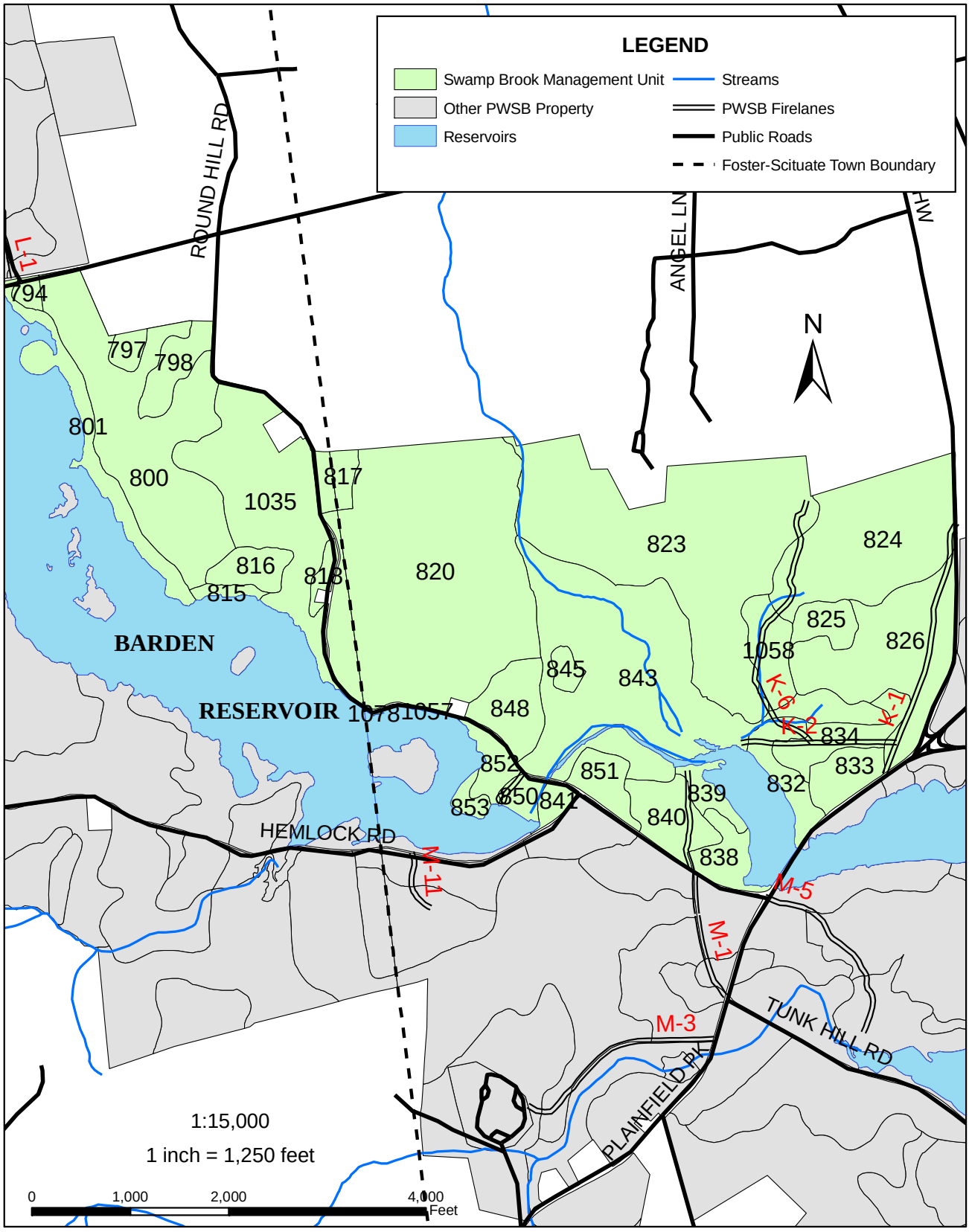
Stand	Acres	Type	Species	TPA	BA	MSD	MBF	Cds	Regen
372	43	H2/3A	RM/MH	179	140	10.4	5.4	21.8	±200
374	9	H1D	MH	5	5	8.9	N/A	0.2	±300
375	13	H3A	MO	165	93	10.2	7.6	8.1	±467
376	21	H3A	MH/RM	184	116	10.6	7.2	8.6	±463
377	55	H2/3B	MO	168	81	9.5	1.0	13.3	±2,270
379	15	W2/3A	RM	186	117	10.7	5.5	11.9	±127
380	14	H3A	MO/RM	183	132	11.5	8.1	15.3	±475
381	49	H3A	MO	154	109	11.5	7.1	12.3	±144
382	11	H3A	MO/WP	184	116	10.6	7.2	8.6	±463
383	7	H2/3A	MH	190	105	10.0	4.8	9.3	±650
384	4	W2/3A	RM	258	130	9.5			±200
386	33	M3B	WP/MO	127	82	10.9	7.6	9.1	±180
387	3	W3A	RM	183	130	11.3	5.4	19.4	±523
388	3	S1B	WP			No	Data		
389	25	S2/3A	WP	289	180	10.7	13.8	28.2	±67

390	20	S2/3B	WP	266	160	10.0	16.3	21.5	±400
391	2	H1C	MH			No	Data		
392	5	M2A	WP/MH	257	96	8.5	3.0	13.8	±880
393	2	S2/3C	SP/-/WP	252	75	7.4	2.6	8.5	±2,850
394	12	S3B	SP/WP	188	160	12.5	22.3	15.5	±1,050
396	16	M2/3A	WP/MO/MS	238	165	10.0	15.0	20.5	±1,000
822	24	H3A	MO/-/WP	147	120	12.2	9.1	13.2	±475
827	6	W2/3A	MO/RM	186	117	10.7	5.5	11.9	±127
828	17	M3C	MO/MH/MS	141	57	8.1	1.1	11.2	±1,450
829	4	S3A	WP	159	136	11.4	14.8	11.2	±6,196
830	4	M2/3A	RP/MO/WP	284	122	8.8	5.9	12.2	±889
1110	2	H3A	MO	184	116	10.6	7.2	8.6	±463
1111	4	H3B	MO	107	72	10.7	3.6	10.0	±1,522
1112	3	H3A	MO/RM	184	116	10.6	7.2	8.6	±463
1113	2	H3A	MH	184	116	10.6	7.2	8.6	±463
1114	3	H3A	MH	184	116	10.6	7.2	8.6	±463
1115	11	H3C	MO	54	55	13.7	4.3	5.0	±467
1116	1	H1C	MH			No	Data		
1117	7	H3B	MO	107	72	10.7	3.6	10.0	±1,522
1118	4	M3A	WP/MO	235	137	10.0	10.7	10.5	±1,444
1168	1	W3A	RM/MH	183	130	11.3	5.4	19.4	±523

Cork Brook MU Management Activity Schedule:

Stand	Type & Species	Activity	Acreage	Year
374, 375	H1D-MH, H3A-MO	Clearcut and manage for wildlife dependent on early successional habitat	12	2014
389	S3A-WP	Thinning	15	2014
390	S3B-WP	Thinning	16	2014
392	M2A-WP/MH	Thinning	6	2014
394	S3B-WP/SP	Irregular shelterwood	13	2014
396	M2/3A-WP/MO/MS	Improvement thinning	16	2014
822	H3A-MO/-/WP	Shelterwood seed thinning	24	2014
1111	H3B-MO	Shelterwood thinning/group selection	4	2014
1115	H3C-MO	Light shelterwood seed cut	11	2014
N/A	N/A	Install wider gate at K-3 firelane entrance	N/A	2014
386	M3B-WP/MO	Group/single tree/ patch cuts for multi-aged management	26	2020
1112	H3B-MO	Shelterwood thinning/group selection	3	2020
1115	H3C-MO	Overstory removal if deer impacts are controlled	11	2020

SWAMP BROOK MANAGEMENT UNIT



SWAMP BROOK MANAGEMENT UNIT

Location, Geography, and Access

The Swamp Brook MU comprises about 575 acres between the east shore of the Barden Reservoir and Route 102. It contains significant parts of K and L Blocks and a small area of M Block, and is bounded to the north by Central Pike and to the south by Plainfield Pike and the section of Ponaganset Road southeast of the intersection with Hemlock Road. This MU includes almost all of the southern portion of the Swamp Brook watershed that lies on PWSB property, and also a significant acreage draining into the Barden Reservoir. Ponaganset Road passes through the western half of this MU and several gates and short firelanes provide access beyond the main roads, although the aptly named Swamp Brook corridor is somewhat isolated.

Existing Forest Description

This MU is generally characterized by mixed oak-hardwood forests and moderately productive growing sites, at least compared to the rest of the PWSB ownership. The secluded area encompassing the Swamp Brook watershed outlet is somewhat geographically distinct from the gentle southwest-facing slopes above the Barden Reservoir to the west. Individual stands vary widely in size and composition, but the larger stands where little or no management has taken place since PWSB acquisition are generally located towards the northern end or “back” of the MU. Beech is well represented in the understory of these stands because the deer prefer to browse other species, indicating that regeneration of the dominant oak canopy species is probably being browsed heavily. The many smaller stands in the southern and western parts of the MU near the reservoirs and roads are the legacy of past human land uses and intensive tree planting and silviculture in these areas. Many of these stands are of plantation origin, with a large volume of red pine having been cut from them over the last 20 years.

Soils

Canton-Charlton sandy loams are the most common soil type in this MU, ranging from fine to very stony and occurring on slopes from 3-25%. These soils are well drained and moderately productive in locations where they are not very rocky, with a site index of 58 for white pine. Hydric Ridgebury soils are found in the broad lower part of the Swamp Brook corridor and three smaller stream drainage areas. No harvesting is recommended where these Ridgebury soils occur. A significant area of Woodbridge very stony fine sandy loam underlies the northwestern corner of the MU. Other soil series present are small-to-moderate occurrences of stony Gloucester, Hinckley, Paxton, and Sutton soils.

Past Land Use and Forest Management

At the time of the creation of the reservoir system, the 1915 PWSB land use survey recorded most of this MU as woodland, presumably the current oak forest in an earlier stage of stand development and being used as a woodlot. Significant areas of arable land and brush were also recorded, in addition to reforested land. The land in much the southern part of the MU was heavily disturbed, as it had been the site of the small mill village of Ponaganset. The land use classification appears to have been performed after the buildings were razed.

Forest management during the PWSB era came to this MU with intensive planting of red & white pine and white spruce between 1925 and 1940 to return open land to forest. Natural pitch pine existed in some stands at this time, although little of it appears to remain. As the planted stands grew, management from the early 1950s through the mid-70s emphasized intermediate treatments. Many stands were thinned during this period, and some stand prescriptions included pruning, cull treatment, and cedar and locust post harvests. A salvage harvest was conducted in stand 838 in 1968, although records indicating why the salvage harvest was necessary are no longer available.

Harvests since 1990 have continued to focus on the conifer stands, responding to forest health threats while also accomplishing other silvicultural goals. Prompted by the threat of mortality from the red pine scale and red pine adelgid, four different multiple-stand harvests spread over this time period have combined red pine and white spruce removal with white pine thinning. Individual stand prescriptions ranged from light thinning to overstory removal depending on species composition and the severity of the red pine infestation.

Forest Health and Related Management

In addition to the issue of deer herbivory and lack of oak regeneration common to hardwood stands across the PWSB ownership, the related major forest health concern in this MU is the extent of invasive plant populations here.

Many of the small former red pine stands, especially those near Ponaganset Road, have not regenerated naturally to desirable native species. At present, these areas are largely dominated by shrubby vegetation, invasives (Japanese barberry, Oriental bittersweet) and undesirable native vines that share some invasive characteristics (catbrier and grape vines). Rehabilitating these stands should be a priority, but accomplishing this goal will be impossible without controlling deer herbivory. Stand-specific treatments would likely include some combination of herbicide application, mechanical mowing, deer exclosure establishment, and/or tree planting.

The stands west of Ponaganset Road are the site of one of the worst Japanese barberry infestations on the entire property, with its epicenter in stands 798 and 800 near the sharp turn in Ponaganset Road. Eradicating the barberry during this management period is unrealistic, but trying to prevent its spread beyond this section of the MU (especially across Ponaganset Road and Central Pike) is an important management goal. Alternatively, this dense infestation could be a candidate for some kind of aggressive large-scale experimental control treatment in partnership with another organization.

Another invasive species found in this MU is a very small, isolated colony of *Phragmites* or common reed growing next to stream below the Barden dam outlet. *Phragmites* thrives in wetlands and there are few suitable growing sites near where it is has become established, but since this species can be highly invasive the small patch of reeds should be treated as soon as possible with a wetland-approved herbicide and the location monitored afterwards.

Silviculture

This MU is a relatively low priority for silvicultural activity during the coming decade both due to the generally stable overstory conditions and the threats posed by invasive plants and deer herbivory.

The broad, flat area surrounding the lower part of Swamp Brook before it empties into the Scituate Reservoir (stand 843) is a largely a forested wetland and a good candidate for a sugarbush. The hydric soils make timber management impractical and this stand will be essentially be treated as a reserve. Although red maple is the dominant species, a significant component of sugar maple is also present. If the current maple tapping lease including stands in H and L Blocks is considered successful, a similar arrangement could be considered for this large stand. One limitation to sugarbush productivity here is that limited vehicular access to low-lying collection points in this stand could make removing the sap difficult.

With the serious Japanese barberry infestation spreading into almost all the stands west of Ponaganset Road, any disturbance opening the canopy and disturbing the soil would probably make the problem worse. Therefore, the barberry will need to be treated here before any further harvesting is conducted. The thin mixedwood stand along the reservoir shoreline (801) would benefit from a thinning from below, but given its isolated and sensitive location a harvest in this 14-acre stand will not be a priority during this management period.

The large acreage in mixed oak stands between Ponaganset Road and Route 102 towards the north end of the MU (namely 820 and 823) is a good representative core area of older hardwood forest where there is currently no pressing need for active management. Timber harvesting here would increase the risk of invasive plant infestation similar to that in the stands on the other side of Ponaganset Road, and the large amount of beech in the understory suggests that desirable oak regeneration would be heavily browsed by deer after a harvest. Other than the usual hardwood regeneration problem, these stands are relatively healthy.

In addition to the main goal of red pine removal, the 1999 RP-99-A harvest included a white pine thinning in small stand 833 on the north side of Rockland road, just west of Crazy Corners. Tall white pine regeneration is well established in this even-aged stand and its is ready for a release harvest or initial shelterwood cut to allow the younger age cohort to start to grow into the overstory. An irregular prescription could increase structural variety within this stand. The adjacent smaller-diameter mixedwood stand (834) would benefit from an improvement thinning. Combining the work in these two stands would create a small but viable 17-acre harvest.

Behind the inholding on the west side of Ponaganset Road, stand 1035 includes a small grove of “older growth” hardwoods with some exceptionally large oak trees (25-30+ inches DBH) for second-growth forest in this area. This area will be designated a reserve and set aside from timber management.

Cultural Resources

Given its proximity to the Barden Reservoir and two old roadside cemeteries, scenic Ponaganset Road attracts a significant amount of recreational pedestrian traffic in addition to local vehicular use. In addition to nearby residents living within walking distance, people from further away drive and park here to exercise, walk dogs, or go for a walk in an appealing natural setting. The community of people who use Ponaganset Road for recreation surely values the opportunities that it affords.

From a watershed security perspective, the recreational use of public roads adjacent to the Barden Reservoir presents a limited potential vulnerability. At the same time, maintaining this public access

important to those who use it and has strong community relations value for Providence Water. Recreational use is currently unmanaged beyond the usual watershed inspector patrols. Both watershed security and the quality of the recreational experience could be improved by creating a designated parking area along Ponaganset Road and/or (through an agreement with the Towns of Foster and Scituate) closing the southern part of the road to vehicular traffic. Alternate vehicular travel routes between Central Pike and Plainfield Pike are provided by nearby Chopmist Hill Road to the east and Kate Randall and King Roads to the west.

This MU contains many cultural resources in the form of remnants of past land use, especially around the location of the former mill village of Ponaganset below the Barden Reservoir dam. Building foundations, remains of the mill's water power system (millraces and penstocks), and other cultural artifacts are found throughout the forest stands in this area. PWSB's general policy of protecting and preserving historic sites applies to Ponaganset village, but – like similar sites across the watershed ownership – it is not formally designated a special management area at present.

Swamp Brook MU Inventory Summary:

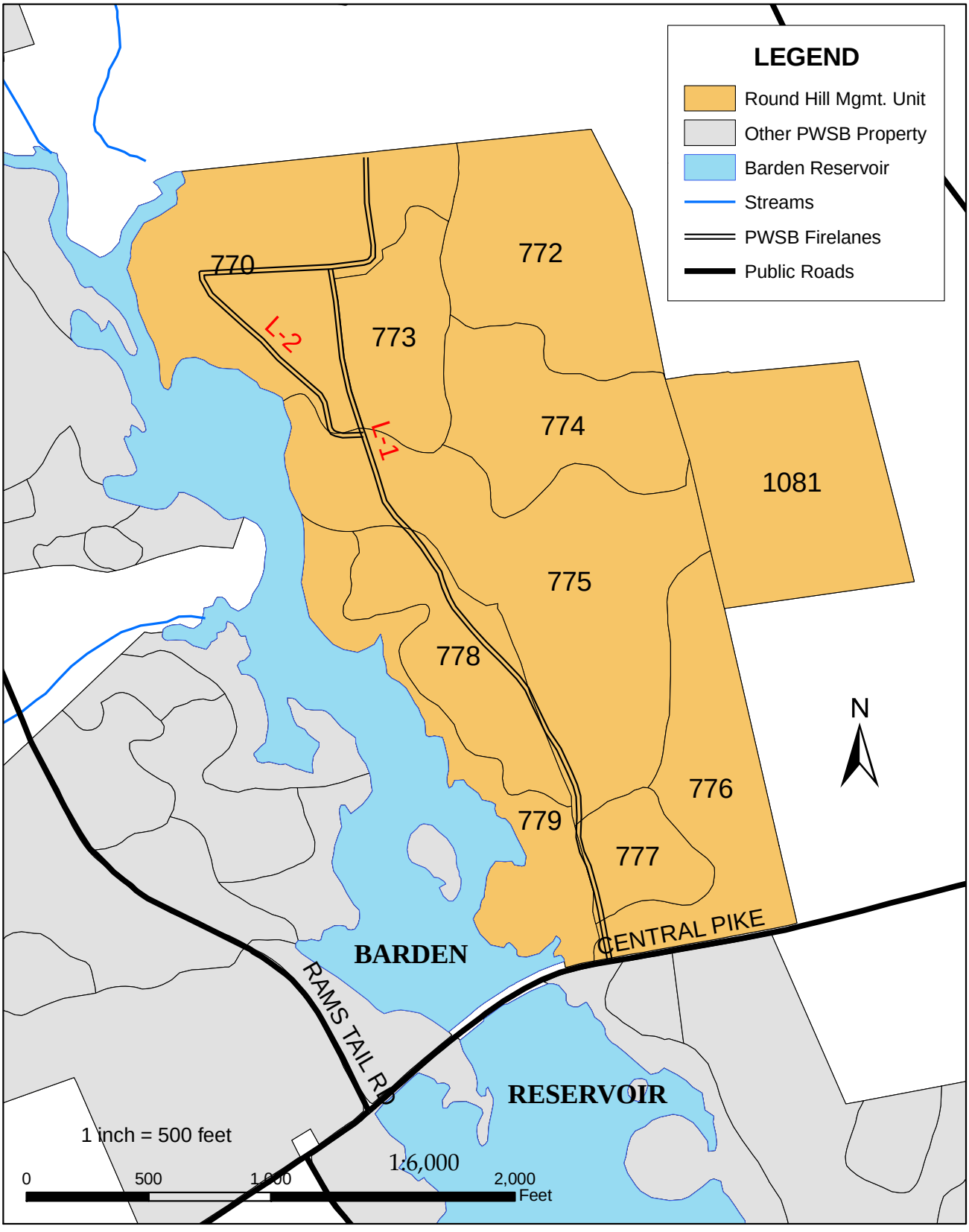
Stand	Acres	Type	Species	TPA	BA/ac	MSD	MBF/ac	Cds/ac	Regen/ac
794	2	M1D	MH/MS	14	10	11.7	1.6	0.5	±1,000
797	3	H2C	MH	99	37	8.2	1.0	3.5	±508
798	8	H2C	MH	99	37	8.2	1.0	3.5	±508
800	47	H3A	MH	210	143	10.9	8.8	10.5	±440
801	14	M3A	MO/MS	235	137	10.0	10.7	10.5	±1,444
815	2	M2/3A	MS/MH	284	122	8.8	5.9	12.2	±889
816	7	H1D	MH	5	5	8.9	N/A	0.2	±300
817	5	H2/3B	MH	187	80	8.6	3.1	7.0	±807
818	2	M2/3A	MO/WP	284	122	8.8	5.9	12.2	±889
820	56	H3A	MO	200	114	10.2	6.6	6.4	±1,081
823	113	H3A	MO	213	119	10.1	6.5	6.6	±460
824	28	H2/3A	MH	218	120	10.0	5.0	8.4	±317
825	6	S2/3A	WP/-/MH	282	136	9.2	9.0	14.9	±730
826	48	H3A	MO/-/WP	257	125	8.8	6.7	5.8	±400
832	8	M2/3A	MH/RP	284	122	8.8	5.9	12.2	±889
833	7	S3A	WP	159	136	11.4	14.8	11.2	±6,196
834	10	M2/3A	MH/WP	284	122	8.8	5.9	12.2	±889
838	6	S3A	WP	159	136	11.4	14.8	11.2	±6,196
839	4	M2/3B	WP/MH	161	79	9.4	4.3	8.0	±700
840	10	M3A	MO/WP	235	137	10.0	10.7	10.5	±1,444
841	3	S3A	MS/-/MO	159	136	11.4	14.8	11.2	±6,196
843	76	W3A	MH	193	136	11.4	8.9	8.5	±407
845	2	M3A	MH/SP	235	137	10.0	10.7	10.5	±1,444
848	12	H2/3B	MH/-/WP	187	80	8.6	3.1	7.0	±807

851	11	M3B	MS/MH	153	98	10.8	8.3	6.7	±954
852	6	H1D	MH	5	5	8.9	N/A	0.2	±300
853	2	M3A	WP/MO	235	137	10.0	10.7	10.5	±1,444
1035	53	H3A	MO	210	117	9.7	7.6	6.7	±167
1057	<1	H2A	MO	246	84	7.9	1.5	9.8	±550
1058	9	W2/3A	RM	186	117	10.7	5.5	11.9	±127
1078	<1	H2A	MO	246	84	7.9	1.5	9.8	±550

Swamp Brook MU Management Activity Schedule:

Stand	Type & Species	Activity	Acreage	Timeframe
Barden Dam outlet	N/A	Treat invasive *Phragmites* and perform follow-up monitoring in subsequent years	< 1	2010
833, 834	WP, WP/MH	Release harvest or shelterwood prep cut; improvement thinning	17	2013
843	H3A-MH	If established maple tapping lease is successful and market remains available, evaluate for possible sugarbush lease here	?	2010-20
Stands along and west of Ponaganset Rd	N/A	Monitor and prevent spread of invasive plants (especially Japanese barberry); possible invasive treatments	?	2010-20

ROUND HILL MANAGEMENT UNIT



ROUND HILL MANAGEMENT UNIT

Location, Geography, and Access

The small Round Hill MU includes about 130 acres on the east shore of the upper section of the Barden Reservoir, north of Central Pike. It is contained entirely within L Block, and its northern and eastern boundaries are property lines in the woods. This MU is actually located on the west-facing lower slope of its namesake hill (the crest of which lies on private property to the east) adjacent to the reservoir. The main L-1 firelane provides access to four short secondary roads in varying conditions, but none of these connect to any other interior roads on the PWSB property.

Existing Forest Description

This MU is divided into two main forest types. The western stands bordering the reservoir and most readily visible from the main L-1 firelane are largely, but not exclusively, the legacy of past land uses and subsequent conifer plantations. The gentle slopes comprising the eastern two-thirds of the land area are dominated by natural mixed-oak hardwood stands with a secondary component of white pine. The area in the northeast corner (stand 772 and part of 774) has not been cut or actively managed for a long time because it is an extremely rocky forested wetland that has served to deter logging. The square DiColo parcel (stand 1081) adds 17 acres on the uphill side of the traditional eastern boundary. This property was gifted to Providence Water in 2007, apparently following a relatively heavy harvest to capture most of the timber value.

Including both public and private land, the area between the Barden Reservoir and Round Hill Road contains one of two locations overlapping the PWSB property that the Rhode Island Natural History Survey has identified as likely hosting rare species. The rare species here are spring ephemeral plants which have been found on the adjacent private land on several occasions between 1971 and 2007. The current RINHS map polygon includes approximately the northeastern third of the Round Hill MU.

Soils

Roughly delineated by the route of the L-1 firelane, this MU has somewhat different soils on the eastern slopes and flatter lowlands immediately adjacent to the Barden Reservoir. Rising no more steeply than 8%, the very rocky eastern slopes are characterized by Canton, Charlton, Paxton, Gloucester-Hinckley, and Woodbridge soils. Woodbridge is the most dominant series and these soils are moderately well drained and moderately productive where they are not very rocky, with a site index of 72 for red oak and 67 for white pine. The more sandy and gravelly Hinckley, Merrimac, Sudbury, Sutton, and Walpole series underlie the areas adjacent to the reservoir. Hydric Ridgebury, Whitman, and Leicester soils are found in two small riparian corridors. Future timber harvesting will be limited or excluded on these hydric soils, with decisions informed by on-the-ground assessment at specific locations.

Past Land Use and Forest Management

At the time of the creation of the reservoir system, the 1915 PWSB land use survey recorded the great majority of this MU as woodland. One large area of arable land almost exactly coinciding with modern stand 778 was also recorded, in addition to brush on the site of stand 779 along with a second, much smaller arable patch immediately adjacent to present location of the L-1 firelane gate.

PWSB forestry records show the first active management in 1940, when the former farmland was planted in red pine and white spruce. The lowland area to the north, comprising modern stand 770, was later planted at two different dates (1963 and 1974) with an apparently experimental mix of conifers: white pine, larch, hemlock, Norway spruce, and Douglas-fir. The 14 acres planted in 1963 received mechanical release and (unsuccessful) weevil control treatments within the same decade. The slopes east of the L-1 firelane are listed as natural stands of mixed hardwood, white pine, and redcedar. The southern two-thirds of this uphill acreage were entered on multiple occasions for cedar post harvests, cordwood thinning, and cull treatment between 1960 and 1970.

Two harvests during the past decade have included most of the operable stands in this small MU. Prompted in part by the threat of mortality from the red pine scale and red pine adelgid, the 2000-01 Ram Tail harvest combined red pine removal with white spruce thinning in stand 778. The 2007-08 L Block East harvest thinned the mixed conifer plantation and surrounding pine and hardwood stands.

Forest Health and Related Management

As in the rest of the oak-hardwood forest across the PWSB ownership, the issue of deer herbivory and lack of oak regeneration is evident, especially in the hardwood-dominated stands east of the L-1 firelane and on the regenerating site of the former red pine-white spruce plantation (stand 778).

This MU is relatively free of invasive plants and no significant infestations were encountered during the field inventory. Trying to prevent the spread of invasive plants into the Round Hill area is an important management goal.

Silviculture

Since the majority of the operable acreage has been worked in recent years, this MU is not a priority for silvicultural activity during the current management period. Within a few years, the tightly spaced mixed conifer plantation in the northwest corner (stand 770) will be ready for a second thinning, but there may not be enough wood to justify a stand-alone harvest here.

In the northeast corner, the rocky, forested wetland comprising stand 772 and the northern part of 774 will be designated a reserve set aside from timber management. This area is probably the most likely location for the rare spring ephemerals. Moreover, the ground conditions explain why the there has been no logging or active management here for a long time.

Cultural Resources

The land in this MU retains many signs of past land use, especially where settlement and agriculture were concentrated in the flatter area near the current reservoir shoreline. The Foster Woolen Manufactory or “Ramtail Mill,” which actually manufactured cotton cloth for most of its industrial life, operated from the early-to-mid 1800s on a site on the east bank of the Ponaganset River half a mile below Hopkins Mills. The mill was the central structure in a small village that included several buildings. A large stone building foundation at the modern L-1/L-5 firelane intersection may be the remains of the mill, and another significant foundation is located in stand 775 just north of the L-1/L-3 intersection. Several stone walls now run through the forest.

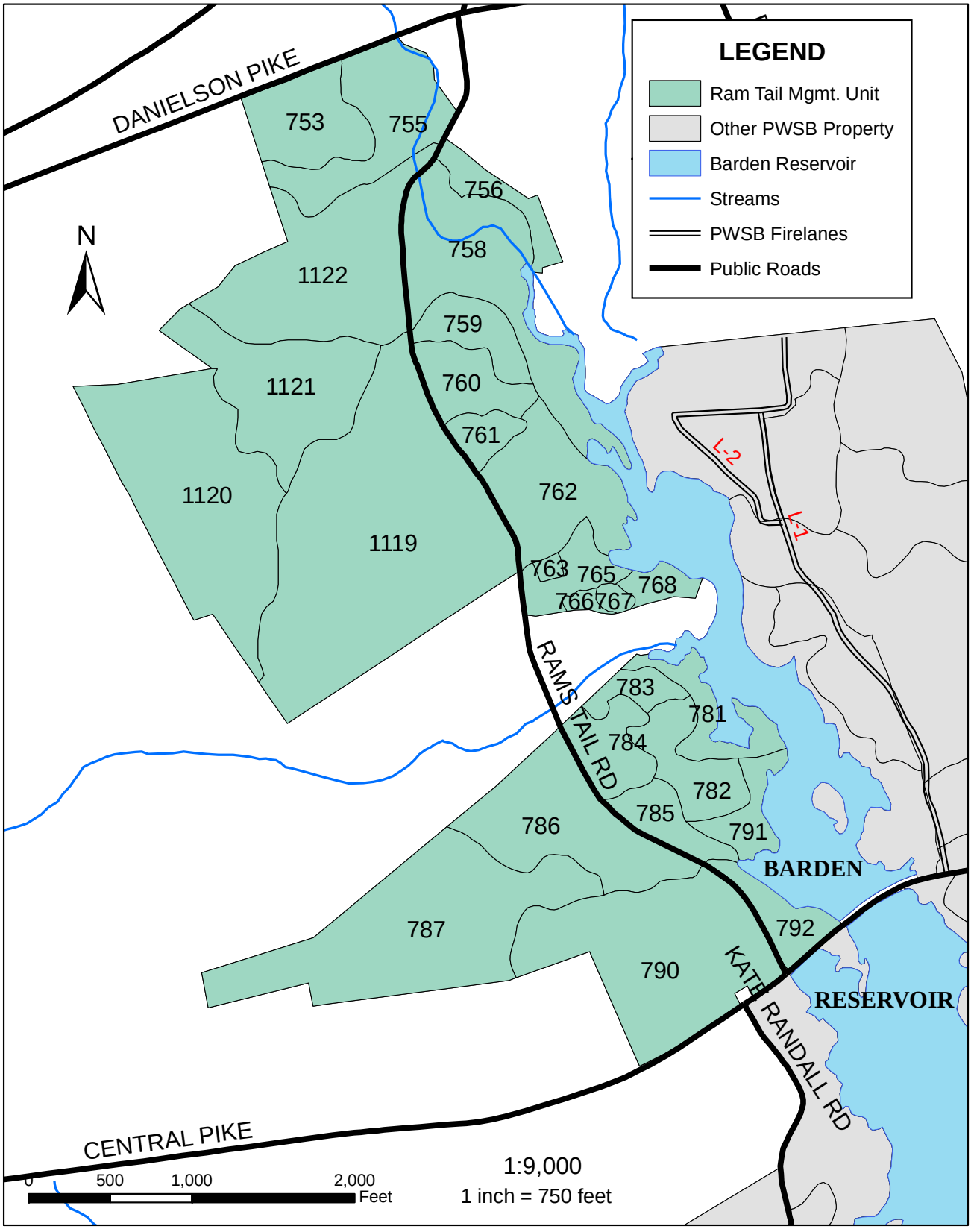
Round Hill MU Inventory Summary:

Stand	Acres	Type	Species	TPA	BA/ac	MSD	MBF/ac	Cds/ac	Regen/ac
770	21	S3A	MS	149	110	11.6	8.4	6.6	±33
772	15	H3A	MH	143	127	12.6	10.9	5.1	±700
773	8	S3B	WP	130	110	12.5	13.7	10.5	±2,340
774	12	H2/3B	MH	187	80	8.6	3.1	7.0	±807
775	27	M2/3B	MO/WP	114	92	12.1	6.4	5.5	±20
776	13	M2/3A	MO/MH	284	122	8.8	5.9	12.2	±889
777	4	W3A	RM/MH	183	130	11.3	5.4	19.4	±523
778	10	M1/2C	MH/MS	296	35	4.7	0	0.8	±523
779	10	S2/3A	SP	282	136	9.2	9.0	14.9	±730
1081	17	H2/3B	MO	73	47	9.3	2.1	3.8	±3,400

Round Hill MU Management Activity Schedule:

Stand	Type & Species	Activity	Acreage	Timeframe
770	S3A-MS	Second thinning (if economically/logistically feasible)	21	2015-20

RAM TAIL MANAGEMENT UNIT



RAM TAIL MANAGEMENT UNIT

Location, Geography, and Access

The Ram Tail MU covers about 285 acres on the west shore of the upper section of the Barden Reservoir, between Central Pike and the Danielson Pike (Route 6). It is contained entirely within the L Block and the western property boundary is irregular. The land in the southern third of this MU has been PWSB property since the creation of the reservoir system, while the northern two-thirds is comprised of several parcels that have been purchased since 1990. The northern and southern sections are currently separated by a small private inholding. Ram Tail Road passes through the center of the MU, but – largely because much of the property is relatively new to PWSB – there are no formal interior firelanes. An unimproved woods road runs roughly parallel to the shoreline of the reservoir's upper reaches.

Existing Forest Description

This forest in this MU is markedly different on the east and west sides of Ram Tail Road, the result of both terrain and land use history. The small eastern stands adjacent to the reservoir are a mosaic of low-lying stands of red maple, conifer plantations established on former agricultural lands, and some old fields naturally returned to white pine. West of the road, the gently sloping uplands comprising most of the MU are dominated by natural mixed oak-hardwood stands with a secondary white pine component. The former Church property west of the road contains a large forested wetland.

Soils

Roughly delineated by the route of Ram Tail Road, the upland and lowland areas of this MU have somewhat different soils. The upland areas west of the road are characterized by Canton, Charlton, Paxton, Sutton, and Woodbridge very stony fine sandy loams. Woodbridge is the most dominant series on the flatter terrain and these soils are moderately well drained and moderately productive where they are not very rocky, with a site index of 72 for red oak and 67 for white pine. Somewhat less productive Canton, Charlton, and Paxton soils are found on the hillier ground, where slopes are generally less than 15% but range up to 25% in a few places. East of the road and adjacent to the reservoir, soils are generally more sandy and gravelly (Agawam, Hinckley, Sudbury, Walpole) with smaller areas of individual series. Hydric Ridgebury, Whitman, and Leicester soils are found in the riparian corridors and the large wetland in the middle of the former Church parcel. Future timber harvesting will be limited or excluded on these hydric soils, with decisions informed by on-the-ground assessment at specific locations.

Past Land Use and Forest Management

The 1915 PWSB land use survey is only available for the original land in this MU (the southern

third). Of this acreage, the survey recorded almost all the land west of Ram Tail Road as woodland and most of the flat area east of the road as arable land.

The original land in the MU has seen relatively little active management during the PWSB era. Forestry records show that the former farmland was planted in red pine and white spruce in 1940. These plantation stands apparently never received mid-rotation thinning or other intermediate treatments, but clearly gained a significant white pine component from unrecorded planting or natural seed sources. Documented as containing red maple and native spruce, the “swampy” forested lowlands around the perimeter of the farmland were excluded from planting. The area west of Ram Tail Road is listed as natural mixed hardwood forest including some white pine, with no recorded management.

The only harvests in this MU in recent years have been two entries into the conifer plantation stands dominated by red pine (784 and 786) during the 1990s to remove trees threatened by the red pine scale and red pine adelgid. These harvests also accomplished white pine thinning as a secondary goal.

Without further research, little specific information on past land use and management history of the properties comprising the northern two-thirds of the MU is readily available. Most of this acreage was forested in 1939 and throughout the rest of the 20th Century. On the east side of Ram Tail Road, 1939 aerial photos show a field on the former Church parcel which was apparently later abandoned to develop into the poor quality old field white pine stands (759 and 760) which exist on this site today. The hodgepodge early-successional forest which now exists on the Emmons parcel was also a field in 1939.

Forest Health and Related Management

As in the rest of the oak-hardwood forest across the PWSB ownership, the issue of deer herbivory and lack of oak regeneration is evident, especially in the hardwood-dominated stands west of Ram Tail Road and on the regenerating site of the former red pine-white spruce plantation (stand 784).

Probably due to its secluded location and light history of human settlement, this MU is relatively free of invasive plants and no significant infestations were encountered during the field inventory except for a modest colony of Japanese barberry near the Ponaganset River on the west side of Ram Tail Road. This barberry infestation should be treated before it grows larger, and trying to prevent the spread of invasive plants further into the area is an important management goal.

Near the reservoir shoreline in the southern third of this MU, stands 782 and 792 are planted stands of white spruce which contain irregular patches of dead trees fallen in different directions. These downed logs appear to have been from suppressed and intermediate trees that were in poor health and eventually succumbed to windthrow. This mortality has had the effect of adding structural diversity and wildlife habitat value to stagnating homogeneous stands, and silvicultural intervention is not required.

Silviculture

Old-field white pine stands 759 and 760 are densely stocked and 760 in particular contains many branchy or poorly-formed trees resulting from the original open growing conditions and white pine weevil damage. Stand 762 has a significant oak component in addition to white pine, but may have similar origins. Hardwoods dominate 758 and 761. Located close together on the east side of Ram Tail Road, these five stands comprising about 40 acres will benefit from a harvest in 2012.

Prescriptions will be tailored to the individual stands and will likely combine crown thinning in stands 758, 761, and 762 with a shelterwood prep cut or group selection in the pine stands.

The hardwood-dominated stands west of Ram Tail Road have seen little or no active management in recent decades. Some of these stands would benefit from a silvicultural entry to promote greater age class diversity, but any harvest must carefully consider the current difficulty in securing oak regeneration. The stands at the northern end of the MU (753, 755, 1122) have a greater white pine component and will be evaluated between 2010 and 2020 for a thinning or group selection harvest to favor the pine, with a buffer adjacent to the Ponaganset River

The large forested wetland on the west side of Ram Tail Road (stand 1121) will be designated a reserve set aside from timber management.

Cultural Resources

Other than several stone walls running through the woods, this MU appears to contain relatively few cultural resources in the form of remnants of past land use. A stone cellar hole foundation is located on the east side of the road in one of the stands (760) that was a field in 1939.

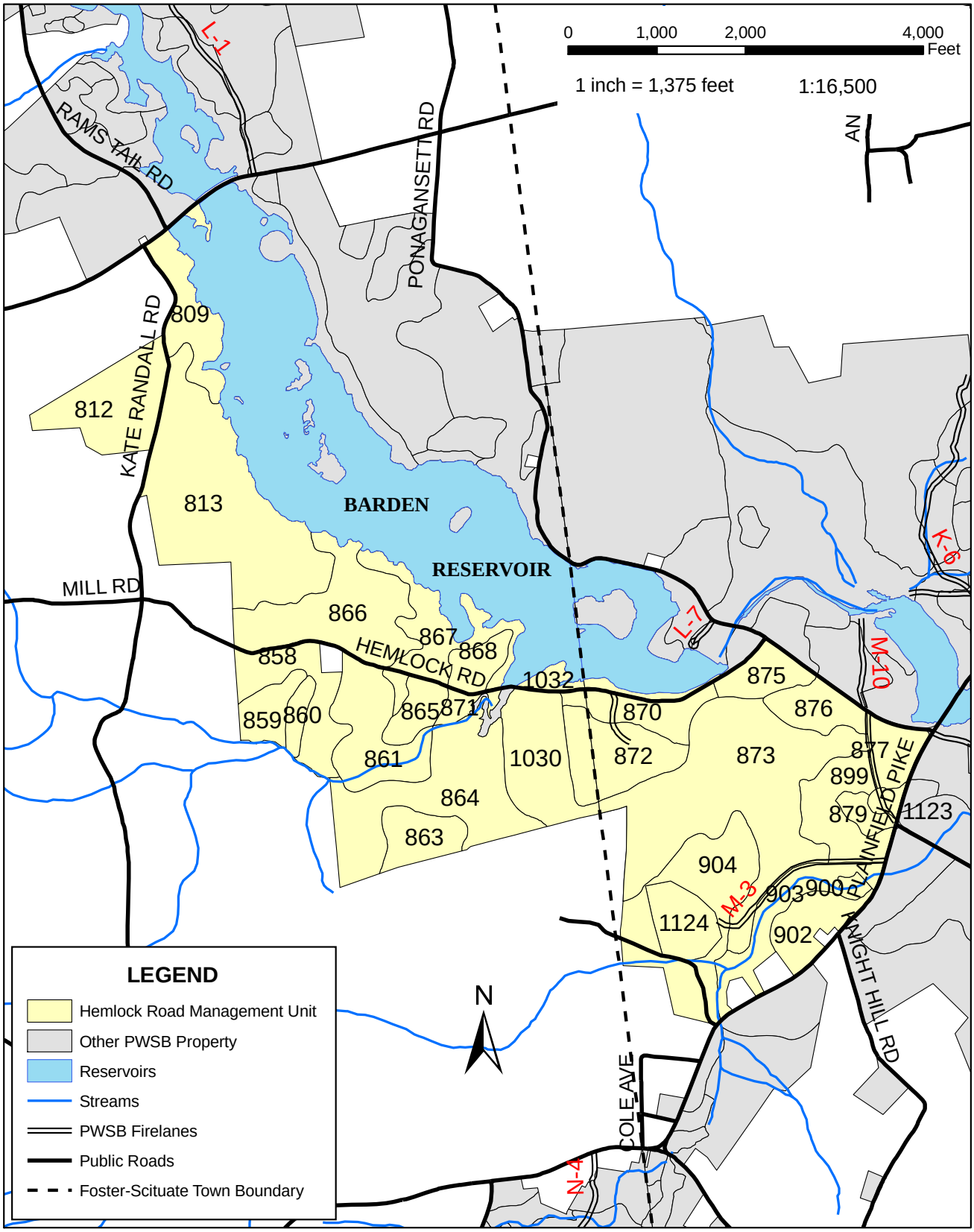
Ram Tail MU Inventory Summary:

Stand	Acres	Type	Species	TPA	BA/ac	MSD	MBF/ac	Cds/ac	Regen/ac
753	8	M3A	MO/WP	235	137	10.0	10.7	10.5	±1,444
755	12	H3A	MO/RM	184	116	10.6	7.2	8.6	±463
756	3	WP/Open							
758	17	H2/3A	RM/MO	200	120	10.6	5.5	5.8	±1,933
759	5	S3A	WP	159	136	11.4	14.8	11.2	±6,196
760	5	S3A	WP	159	136	11.4	14.8	11.2	±6,196
761	2	H2/3A	MO	190	105	10.0	4.8	9.3	±650
762	6	M3B	WP/MO	153	98	10.8	8.3	6.7	±954
763	<1	Open							
765	4	H2A	RM/MH	246	84	7.9	1.5	9.8	±550
766	<1	Open							
768	1	M2B	MH/WP	225	88	8.5	3.0	11.0	±692
781	5	H2/3A	MO	190	105	10.0	4.8	9.3	±650
782	6	S3B	WS	130	110	12.5	13.7	10.5	±2,340
783	2	S3A	WP	159	136	11.4	14.8	11.2	±6,196
784	5	M1D	MH/WP	14	10	11.7	1.6	0.5	±1,100
785	4	W2A	RM	496	160	7.7	2.4	25.9	±50
786	15	H2/3A	MH	179	103	10.9	4.9	5.2	±200
787	28	H3A	MO	158	120	11.9	9.6	4.6	±280
790	28	H3A	MO	228	143	10.6	11.3	3.8	±200
791	4	M2A	MS/MH	257	96	8.5	3.0	13.8	±880
1119	46	H2/3A	MO	183	106	10.2	6.6	4.4	±500
1120	28	H2/3A	MH	177	86	9.4	5.0	4.4	±180
1121	15	H3A	MO/RM	97	103	13.9	8.2	3.0	±333
1122	21	M3A	MH/WP	141	105	11.7	7.8	5.3	±300

Ram Tail MU Management Activity Schedule:

Stand	Type & Species	Activity	Acreage	Timeframe
758, 761, 762	MO/RM WP/MO	Crown thinning	~30	2012
759, 760	WP	Shelterwood prep cut/ group selection	10	2012
753, 755, 1122	MH/WP	Evaluate for thinning/ group selection harvest	Up to 35	2018

HEMLOCK ROAD MANAGEMENT UNIT



HEMLOCK ROAD MANAGEMENT UNIT

Location, Geography, and Access

Straddling the Foster-Scituate town line, the Hemlock Road MU includes about 550 acres south and west of the Barden Reservoir. It contains part of L and the majority of M Block and is bounded to the north by Central Pike and to the east and south by Ponaganset Road and Route 102; the western property boundary is irregular. This area contains the lower section of Hemlock Brook and also part of Westconnaug Stream, which transports water from the Westconnaug to the Scituate Reservoir. Hemlock Road passes through the central part of the MU and several gates and firelanes provide interior access to the southern portion. The slim northern part of the MU has no firelanes, with access available from Kate Randall Road and Central Pike.

Existing Forest Description

This irregular L-shaped MU is characterized by mostly natural forest evenly distributed between hardwoods and conifers. Mixed oak and white pine are the dominant species, while the percentage of the volume in white pine has grown significantly since the 1999 inventory. Site quality varies widely, from upland oaks and stands with a significant pitch pine component in the southwest part of the MU to relatively mesic slopes with large trees closer to the Barden Reservoir. The smaller stands in the eastern and northernmost parts of the MU near the roads are the legacy of past land uses and subsequent tree planting and silviculture concentrated in these areas. In part because of this history, the small portion of the area in the Bear Tree Brook subwatershed is somewhat distinct from the larger stands on the north- and east-facing slopes adjacent to the Barden Reservoir.

Soils

Except for riparian corridors, stony sandy loams dominate this MU although a greater variety of soil series are found here than on most parts of the PWSB ownership. Canton and Charlton fine sandy loams are the most common series, occurring on 3 to 25% slopes. These soils are well drained and moderately productive where they are not very rocky, with a site index of 58 for white pine and 52 for red oak. Very significant areas of other soils are found throughout this MU, including Gloucester, Hinckley, Merrimac, Sudbury, Sutton, and Woodbridge. Hydric Ridgebury, Whitman, and Leicester soils are found in the riparian corridors, along with somewhat unusual Walpole sandy loams along the lower section of Hemlock Brook before it drains into the Barden Reservoir. Future timber harvesting will be limited on these hydric soils and excluded from particularly sensitive areas, with decisions informed by on-the-ground assessment at specific locations.

Past Land Use and Forest Management

At the time of the creation of the reservoir system, the 1915 PWSB land use survey recorded the vast majority of this MU as woodland. A few areas of arable land, brush, and reforested land were recorded, mostly along Ponaganset Road and the route of present-day Route 102, and also along Kate Randall Road near Central Pike. The land on the eastern edges of the MU was heavily disturbed due to its location immediately adjacent to the former Ponaganset and Rockland mill villages. The land use classification appears to have been performed after the buildings were razed.

With PWSB forestry records listing many natural stands of oak, mixed hardwoods, and white and pitch pine in this MU, other areas were a higher priority for planting during the early part of the PWSB era and thus active management commenced here relatively late. The records suggest that the forest had a higher pitch pine component than still exists today. Except for a one-acre stand planted in 1930, the small areas of remaining old farmland were not planted in red pine and white spruce until 1940. Management from the early 1950s through the mid-70s emphasized intermediate treatments. All of the planted stands and many natural pine and mixedwood stands were thinned during this period, and some stand prescriptions included pruning and cull treatment.

The 2004-05 Hemlock Road timber sale has been the only harvest in this MU in recent years. Prompted in part by the threat of mortality from the red pine scale and red pine adelgid, this harvest combined red pine removal with other silvicultural objectives in white pine and mixedwood stands. Individual stand prescriptions included white pine and mixed species thinnings and shelterwood seed cuts, helping promote the abundant white pine regeneration that currently exists in these stands.

Forest Health and Related Management

As in the rest of the oak-hardwood forest across the PWSB ownership, the issue of deer herbivory and lack of oak regeneration is evident in the hardwood stands in this MU.

Probably due to its secluded location and light history of human settlement, this MU is relatively free of invasive plants and no significant infestations were encountered during the field inventory except for limited populations along the edges of Route 102 and Ponaganset Road. Trying to prevent the spread of invasive plants further into the Hemlock Road area is an important management goal.

Along the reservoir shoreline a short distance south of Central Pike, stand 809 is a planted stand of white spruce with a composition that is slowly shifting towards natural hardwoods and white pine. This stand contains a patch of dead, fallen white spruce that appear to have been in poor health and eventually succumbed to windthrow. Natural regeneration and succession will ultimately close this blowdown gap and silvicultural intervention is not required.

Silviculture

At the eastern end of the MU, stand 899 is an 18-acre oak-pine mixedwood stand with a strong pitch pine component that will benefit from an improvement thinning to favor the pines which are better suited to this site. Pitch pine will be retained as much as possible because it is especially well-suited to the rocky soils, and also in an effort to restore a portion of this area to more closely resemble its likely pre-agricultural era species composition. The Oriental bittersweet patch near the south gate of the M-1 firelane should be treated prior to this harvest, especially because this site is the best situated location for the log landing during the harvest. The area adjacent to the north gate of the same short firelane provides an invasive-free alternate landing location slightly further from stand 899. Maintaining good roadside aesthetics will also be an important part of this timber harvest since part of this stand is located next to Route 102.

The stands in the central part of the MU will continue to be managed for white pine. On the north side of Hemlock Road, stands 866 and 867 are acquiring good white pine regeneration following the 2004-05 thinning. These stands will be ready for a second entry in 2017 to promote further regeneration development using a shelterwood and/or group selection prescription. An improvement thinning to favor white pine in at least part of stand 858 on the south side of Hemlock Road can be performed at the same time.

The hardwood stands in this area have to date seen little active management during PWSB's tenure. Some of these stands would benefit from a silvicultural entry to promote greater age class diversity, but any harvest must carefully consider the current difficulty in securing oak regeneration. Excluding the red maple wetland in its northern corner, stand 812 on the west side of Kate Randall Road is a good candidate to evaluate for an uneven-aged selection harvest.

Hemlock and Bear Tree Brooks are significant streams which are large enough that it would be impractical to attempt crossing them during timber harvest. These two riparian corridors and associated wetlands (stands 900, 903, 906, and parts of 861 and 864) will be designated reserves set aside from timber management.

Cultural Resources

Most of the cultural resources in this MU are concentrated in the eastern end near Route 102 and Ponaganset Road. Remnants of past land use are most obvious in the Bear Tree Brook corridor, which was heavily modified when the brook provided water power for the Rockland textile mill. Visible to the public from Route 102, the most striking remaining physical feature is the Industrial Revolution-era Peabody Pond dam, which was constructed using huge boulders and other native stone and is still used in a secondary capacity by Providence Water today. Further north, the edges of the MU are immediately adjacent to the former Rockland and Ponaganset mill village sites and one might expect these areas to contain more cultural artifacts than are readily apparent.

Also just north of Route 102 is the large Rockland cemetery, which was established by Providence Water in 1918 as a new burial ground to accept the remains from the small, scattered river valley cemetery sites that were flooded during the creation of the Scituate Reservoir. PWSB does not own the cemetery, but has the responsibility to maintain it. The cemetery is accessed by a town road and is open to the public.

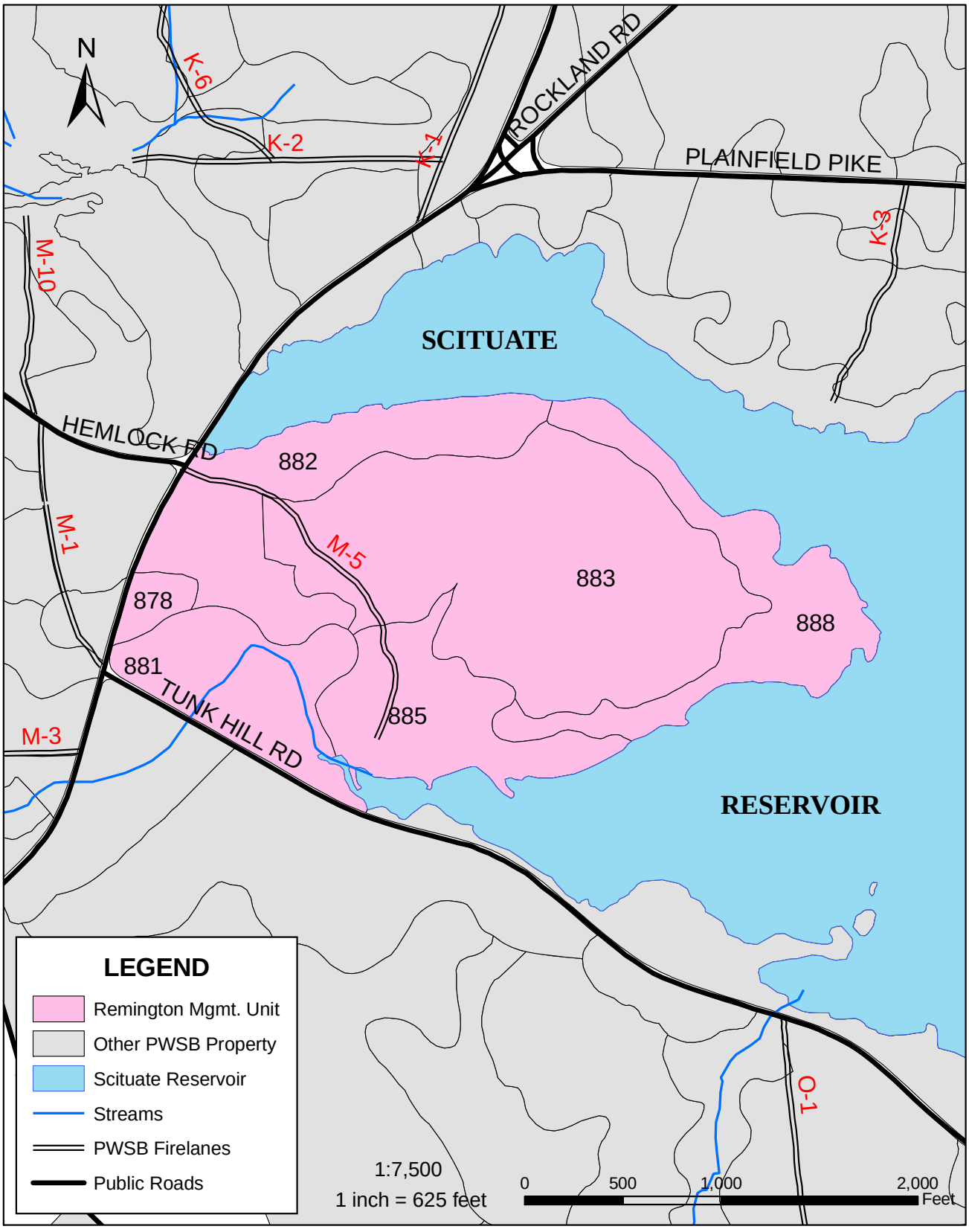
Hemlock Road MU Inventory Summary:

Stand	Acres	Type	Species	TPA	BA/ac	MSD	MBF/ac	Cds/ac	Regen/ac
809	17	M2/3A	MS/MH	136	110	11.2	6.9	5.1	N/A
812	26	H2/3A	RM/MO	191	116	10.5	6.3	5.8	±300
813	69	H3A	MO	200	124	10.7	8.6	5.8	±300
859	8	H2A	RM/MH	246	84	7.9	1.5	9.8	±550
858	18	M3A	MO/WP	134	120	12.8	10.7	4.1	±300
860	4	S2/3A	WP	282	136	9.2	9.0	14.9	±730
861	24	M3A	WP/MH	166	113	10.5	11.1	4.3	±6,150
863	11	H2/3A	UO	190	105	10.0	4.8	9.3	±650
864	43	M2/3A	MO/MS	221	105	9.3	5.4	5.4	±113
865	7	S3B	WP	130	110	12.5	13.7	10.5	±2,340
866	35	S3A	WP	126	117	12.5	12.8	6.7	±24,050
867	21	M3A	WP/MH	320	127	7.8	8.9	5.2	±4,033
868	10	H2/3A	MO	190	105	10.0	4.8	9.3	±650
869	2	Water							
870	12	M2/3A	WP/MH	375	150	8.1	8.0	9.7	±2,033
872	22	M3A	MS/MO	174	103	9.6	9.0	4.5	±8,133
873	77	H2/3A	MO	186	100	9.8	4.3	7.2	±133
875	11	M2/3A	MH/WP	284	122	8.8	5.9	12.2	±889
876	11	H2/3A	MH	190	105	10.0	4.8	9.3	±650
877	9	S3B	WP	130	110	12.5	13.7	10.5	±2,340
879	4	S3A	WP	159	136	11.4	14.8	11.2	±6,196
979	4	S3A	WP	159	136	11.4	14.8	11.2	±6,196
899	18	M2/3A	MH/MS	248	130	9.3	6.2	9.4	±167
900	2	Water							
902	12	M3A	MS/MO	235	137	10.0	10.7	10.5	±1,444
903	16	M2/3A	MH/WP	284	122	8.8	5.9	12.2	±889
904	35	M3A	WP/MO	263	140	9.7	9.6	7.4	±1,171
1123	1	S2/3A	SP	282	136	9.2	9.0	14.9	±730
1124	12	Cemetery							
1030	24	H2/3A	MO	272	118	8.8	4.8	6.8	±280
1032	3	M2/3A	MH/WP	284	122	8.8	5.9	12.2	±889

Hemlock Road MU Management Activity Schedule:

Stand	Type & Species	Activity	Acreage	Timeframe
899	M2/3A-MH/MS	Improvement thinning to favor pitch and white pine	18	2016
812	H2/3A-RM/MO	Evaluate for uneven-aged selection harvest	~20	2016
866, 867	WP, WP/MH	Shelterwood prep cut/group selection	56	2017
858	M3A-MO/WP	Improvement thinning to favor white pine	18	2017

REMINGTON MANAGEMENT UNIT



REMINGTON MANAGEMENT UNIT

Location, Geography, and Access

The small Remington MU includes about 120 acres in the M Block located on an isolated peninsula at the end of Scituate Reservoir's west arm. Route 102 and Tunk Hill Road (Route 12) serve as its western and southern boundaries. The terrain is relatively hilly for the local area, with the highest elevation atop a central hill with modest slopes down to the reservoir shoreline on three sides. A significant wetland is located at the southwest corner of the MU where Westconnaug Stream flows into the reservoir. The gated M-5 firelane leads to the M-7 and these two interior roads provide limited 4WD vehicular access to the south and north sides of the peninsula respectively. The short M-6 and M-8 spur firelanes have not been actively maintained for some time and are reverting to forest. Due to the peninsular geography, these interior firelanes do not connect with any others on the PWSB ownership.

Existing Forest Description

Except for the southwest corner, the forest in this MU is dominated by white pine (approximately 90 of the 120 acres). As evidenced by the many tall, relatively large-diameter white pines, the soils here are well suited to this species and this MU has some of the better white pine sites on the PWSB property. Other forest types found within the MU include a 1-acre stand (878) of Norway and white spruce, 18 acres of mixed oak and mixed softwoods, and the 10-acre wetland which includes forested, shrub, and open marsh areas (stand 881). Several vernal pool sites are located in stand 888 near the eastern point of the peninsula.

Soils

Covering roughly two-thirds of the area, Canton and Charlton rocky fine sandy loams on 3 - 15% slopes are the dominant soil type. These soils are well drained and moderately productive where they are not very rocky, with a site index of 58 for white pine. Similar Gloucester-Hinckley soils underlie the upland areas of the southwest acreage, and other soils include Agawam, Walpole, and the Ridgebury, Whitman, and Leicester association. All of these soils are well drained except for the Ridgebury association, which are poorly drained and found in the areas of the Westconnaug Stream corridor and surrounding wetland. Soils in the upland areas pose no limitations to forest harvesting operations. The wetland area is normally too wet to operate in and will be excluded from future timber harvests as the threat to water quality outweighs the value of potential benefits from active silviculture.

Past Land Use and Forest Management

At the time of the creation of the reservoir system, the 1915 PWSB land use survey recorded the majority of this MU as woodland. The eastern section was almost entirely forested, while about half of the western acreage was classified as arable, brush, or reforested.

Providence Water has actively managed the Remington peninsula for conifers since intensive planting between 1925 and 1939. Red and white pine and some other conifers (Norway and white spruce, jack pine) were open planted in the formerly cultivated areas, while a larger acreage of semi-forested pasture and hardwood forest was enrichment planted with white pine. Early silvicultural activities included pruning, several thinnings in the mixed conifer plantations, and release of the white pine planted under hardwoods in the old pastures and wooded areas.

More recent harvests have continued to focus on the conifer stands, responding to forest health threats while continuing to promote the growth and development of the white pine stands. Prompted by the threat of mortality from the red pine scale and red pine adelgid, a 1998-99 harvest included many stands and combined red pine removal with white pine thinning. Another harvest in 2009 thinned 45 acres of maturing white pine in the stands that originated from underplanting.

Forest Health and Related Management

Although not as stark as in the areas of the PWSB property dominated by hardwood forest, the issue of deer herbivory and lack of regeneration is evident in this MU. Regeneration in most areas is poor, with lowbush blueberry and huckleberry forming a largely continuous shrub layer in stand 888. The shrub layer is lighter in the recently harvested stands and the thinning should promote the establishment of some white pine regeneration. Existing white pine and spruce regeneration is more robust in stand 885. Deer browse on white pine seedlings was observed during the field inventory, and deer are most likely inhibiting tree regeneration and contributing to fern and invasive groundcover by preventing tree seedlings from becoming established. Above the forest floor, fresh woodpecker cavities in some white pine poles were also observed.

This MU has a significant invasive plant infestation near the location where former human activity and settlement were concentrated. The southern area of stand 885 near the reservoir has heavy Oriental bittersweet cover (ground thickets and vines climbing into the trees) that must be treated before any further harvesting in this area. Other invasive species include scattered Japanese barberry and glossy buckthorn mostly concentrated near the M-5 firelane gate and adjacent landing. Native fern cover is also impeding regeneration in some areas of this MU.

Silviculture

This MU will continue to be managed as even-aged white pine with hardwoods retained to add species diversity and hard mast for wildlife. The hardwoods will also serve as wildlife snags as they die. The white pine stands will be evaluated for a first shelterwood cut in 2019 when up to 50% of the white pine basal area may be removed to open the canopy for regeneration. Invasive species in this area should be treated before the next harvest to limit their spread and give tree regeneration a chance to become established. When the final shelterwood cut is ultimately made, some of the larger trees or groups of trees will be retained as legacy trees. Also in 2019, stand 888 will be evaluated for a thinning to promote the conifer species present. Encircling the eastern half of the MU, the entire length of this wishbone-shaped stand is adjacent to the reservoir and keeping it in conifers may have some benefit as a leaf screen promoting good water quality.

The vernal pools in stand 888 will be protected during any harvesting by marking a no-cut buffer around these well-defined depressions of less than a quarter-acre each. As further information on how to manage vernal pool sites becomes available, these measures will be incorporated into management planning.

The small plantation spruce stand (878) adjacent to Route 102 will be maintained as it offers some wildlife benefits: its dense canopy affords protection during winter and the seeds of these trees are a favorite of squirrels and other small mammals.

Cultural Resources

This MU contains significant cultural resources in the form of remnants of past land use as this area was immediately adjacent to a hub of human activity before the creation of the reservoir system. Stone walls and foundations are found throughout the forest stands, especially near the water's edge on the lower southern slopes of the modest hill that is now a peninsula. The Ponaganset River previously flowed past the north side of the hill, while the village of Rockland and the Remington textile mill were located on the south side near the present Route 102/Tunk Hill Road intersection. PWSB's general policy of protecting and preserving historic sites applies to the Rockland village and mill area, but – like similar sites across the watershed ownership – it is not formally designated a special management area at present.

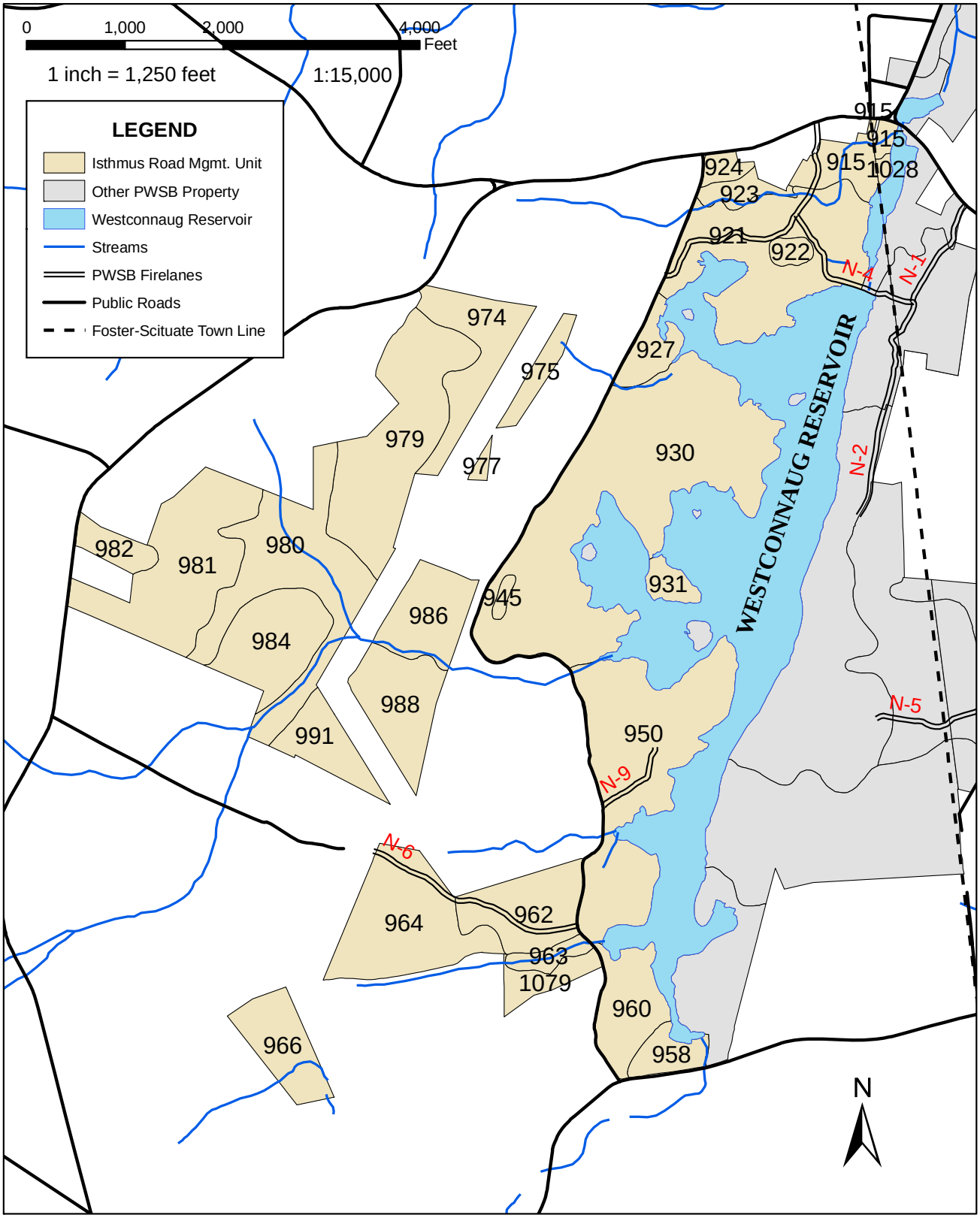
Remington MU Inventory Summary:

Stand	Acres	Type	Species	TPA	BA/ac	MSD	MBF/ac	Cds/ac	Regen/ac
878	2	S2/3A	SP	282	136	9.2	9.0	14.9	±730
881	10	Wetland						N/A	
882	22	S3A	WP/RP	247	158	10.8	20.8	15.7	not
883	53	S3B	WP	145	101	11.3	10.1	11.2	
885	16	S3B	WP/RP/NS	93	105	14.4	18.4	6.3	recorded
888	18	M2/3A	UO/MS	284	122	8.8	5.9	12.2	±889
898	6	M2/3A	MS/MH	284	122	8.8	5.9	12.2	±889

Remington MU Management Activity Schedule:

Stand	Type & Species	Activity	Acreage	Year
883, 885	S3B-WP S3B-WP/RP/NS	Treat invasive species prior to next harvest	TBD	2017
882, 883, 885	WP, WP/RP/NS	Evaluate for shelterwood harvest – prescription may vary between stands	90	2019
888	M2/3A-UO/MS	Evaluate for thinning	18	2019

ISTHMUS ROAD MANAGEMENT UNIT



ISTHMUS ROAD MANAGEMENT UNIT

Location, Geography, and Access

The Isthmus Road MU covers about 540 acres in the N Block along the west shore of the Westconnaug Reservoir and the upper section of Westconnaug Stream. Located at the western edge of the PWSB property and almost entirely in Foster, it is roughly bounded to the north and west by Route 102 (Plainfield Pike) and to the south by Old Plainfield Pike. The land ownership history of this MU is such that it is divided into two separate but nearby sections, with mostly undeveloped private land in between. Connecting Route 102 and Old Plainfield Pike, unpaved Isthmus Road is a defining feature that provides a central north-south transportation corridor and passes between the two sections. All the land drains into the Westconnaug Reservoir, but there is considerable variation in local aspect and microtopography.

All of the land east of Isthmus Road along the shore of the Westconnaug Reservoir has been PWSB property since the creation of the reservoir system. Several firelanes provide limited interior access to this area, with most becoming logging trails after a short distance. The original PWSB ownership also includes 57 acres on the west side of Isthmus Road along Tray Hollow Brook and an isolated 14-acre parcel with no road access located a short distance to the southwest. The unpaved and unmaintained eastern end of Tray Hollow Road passes through this area north of the brook and connects with Isthmus Road, but it is not accessible to standard vehicles.

PWSB purchased the 219-acre former DEPCO property located between Route 102 and Isthmus Road in 1994. Prior to acquisition, a utility right-of-way ownership passing through this area divided the original contiguous property into four separate, irregularly-shaped parcels. The main 178-acre parcel has frontage along Route 102 in three locations and the next-largest 41-acre parcel is accessible from Isthmus Road, but there are no interior firelanes.

Existing Forest Description

The forest composition in this MU is strongly influenced by the underlying soils and terrain. Mixed and upland oak stands comprise half the overall acreage and softwood and mixedwood stands currently represent about 20% and 30% of the land area, respectively. While there are no pure softwood stands, the large stands in the northern two-thirds of the historic property on the west shore of the reservoir are shifting towards white pine dominance and will have increased softwood volumes in the future. Here, the difference in classification between mixedwood and softwood is small. These stands contain some heterogeneity and were previously broken out into smaller stands, but they are now starting to develop an overall uneven-aged structure and have been combined for management practicality. The upland oak component is more prevalent in the Tray Hollow area at the southern end of the original acreage and stand 964 contains a high concentration of locally uncommon chestnut oak. The former DEPCO property

is dominated by less densely stocked oak-hardwood forest with a few pockets of white pine near the roads. Red maple is found in the riparian and low-lying areas, most notably along Westconnaug Brook and the large associated forested wetland in the middle of the main DEPCO parcel (stand 980). Almost all of the even-aged stands in this MU are large pole-to-sawtimber sized and only about 1% of this acreage is in an even-aged early successional condition. Many small gaps are spread over about 140 acres in stands 921 and 930, which are gradually being converted to an uneven-aged structure.

Soils

This MU is characterized by rocky and well-to-excessively drained soils. Hinckley gravelly sandy loams underlie most of the rolling and hilly terrain comprising the northern two-thirds of the original acreage on the west shore of the reservoir. Hinckley soils retain little water and are thus more favorable for pines than hardwoods, with a site index of 60 for white pine and 49 for red oak. Rocky Canton and Charlton series are found in the Tray Hollow area at the southern end of the original acreage and on the uplands of the former DEPCO property. These soils are well drained and moderately productive where they are not very stony, with a site index of 58 for white pine and 52 for red oak. A significant area of hydric Ridgebury soils is located in the large forested wetland in the middle of the main DEPCO parcel (stand 980). Only small areas of Ridgebury series are found elsewhere, most notably in stand 927 and the southern end of 966. Future timber harvesting should be excluded from these locations. Small occurrences of Merrimac, Scarboro, Sutton, Walpole, and Woodbridge soils are also present within the MU.

Past Land Use and Forest Management

Around the time of the creation of the reservoir system, the PWSB land use survey recorded the majority of the original land in this MU as woodland. A number of patches of arable land were recorded along the public roads along with a small area of “brushy” formerly cultivated land reverting to forest.

Since Providence Water acquired the land, forest management activities in this MU have largely occurred in pulses concentrated during particular time periods. The old farmlands on the east side of Isthmus Road were planted with red and white pine in 1938 and this effort also included enrichment planting of these species in at least one area of natural pitch pine. No planting or silviculture took place in the upland oak stands along Tray Hollow Brook on the west side of Isthmus Road.

Following the establishment of these small plantation stands, active management was essentially absent from this MU for the next three decades. The next entry cycle occurred between 1966 and 1972, when almost all the plantations and some natural stands with a strong white pine component were thinned. A few stands received two closely spaced thinnings. A two-acre area of shoreline forest that burned in a fire (part of modern stand 950) was replanted with white pine and hemlock in 1976.

Timber management has been very active on the original acreage of this MU in recent years, first responding to forest health threats and then accomplishing other silvicultural goals. Prompted by the threat of the red pine scale and red pine adelgid, the 1994 Westconnaug Red Pine and 1998-99 RP-99-A harvests removed most of the red pine in this area of the watershed property over two entries. The 2006 Clayville harvest also included some remaining red pine, but primarily focused on thinning and shelterwood thinning prescriptions in the stands in the northern and central sections. This harvest included the creation of many small gaps and helped set the stage for future uneven-aged management in these stands.

Without further research, little detailed information on past land use and management history of the

former DEPCO property is readily available. Aerial photos dating back to 1939 show that land cover has been very stable. No agriculture or clearing was present in 1939 and the property has remained forested throughout the rest of the 20th Century. No active forest management has taken place on the DEPCO parcels since the land was acquired by PWSB.

Forest Health and Related Management

As in the rest of the oak-hardwood forest across the PWSB ownership, the issue of deer herbivory and lack of oak regeneration is common in the hardwood stands. The thick shrub layer of blueberry and huckleberry in some of the upland areas with poorer soils such as stands 979 and 984 contributes to impeding regeneration. White pine regeneration is healthy in the stands where this species dominates or shares the canopy.

Likely due to its relatively isolated location and low density of previous human settlement, this MU is relatively free of invasive plants. Those invasives that are present are mostly limited to modest populations around the edges. Buckthorn has become established on the former red pine harvest landing location in stand 958 and needs to be treated before this site can be used again. Trying to prevent the spread of invasives into the interior of this MU is an important management goal.

Silviculture

The pine-oak stands on the west shore of the reservoir (921, 930, and 950) provide some of the best opportunities for uneven-aged management on the PWSB property. These stands already contain some structural diversity based on their composition and management history. Along the central and southern part of the shoreline, stand 950 has not seen silvicultural activity other than red pine removal since the early 1970s. A harvest in 2013 combining thinning and small gap creation where appropriate will improve growing conditions for the best canopy trees and start to promote new age classes as the Clayville harvest did in the stands to the north. Twelve years after the last entry, a true selection harvest in stands 921 and 930 (both individual trees and groups) in 2018 will continue to diversify the age class structure of these stands. Good record keeping is critical to the implementation of the selection system and managers may want to establish a cutting cycle at this time. These harvests on the east side of Isthmus Road do not need to work every acre and they should exclude patches of younger forest, steep slopes, and uncommon areas such as natural pitch pine inclusions.

The hardwood-dominated stands in this MU will be left to grow during the 2010-2020 management period as there is no pressing need for silvicultural intervention on these relatively unproductive growing sites, especially where oak regeneration is sparse.

The isolated and “landlocked” parcel of the historic PWSB ownership located south of the Tray Hollow Brook corridor (stand 966) will be designated a reserve because active management is impractical. The small-diameter upland oak stand and rocky red maple swamp here will slowly develop older forest structure through natural processes. For the same reasons, the two smallest parcels of the former DEPCO property (1 and 5 acres) will similarly be considered reserves.

Cultural Resources

The northern end of the MU is located adjacent to the village of Clayville, which had a larger population and physical footprint before the Providence Water era. Archival photos show that the area below (i.e. north of) the Westconnaug Dam was heavily modified when the City acquired the land. The community was largely built around two textile mills along Westconnaug Stream. The most obvious remaining physical feature is the large Westconnaug Dam, which was originally built

to provide water power for one of the two mills and has been upgraded to meet modern standards as Providence Water still uses it as a primary reservoir dam.

Away from Clayville, the rest of the property in the Isthmus Road area contains fewer artifacts of past land use as previous settlement was sparse. Elaborate stonework where Isthmus Road crosses Westconnaug Brook may be evidence of a former small mill at this location. Tray Hollow Road was once used as a cart path providing an east-to-west transportation route connecting Isthmus Road with Plainfield Pike (now Route 102). In addition to a few stone walls running through the woods, old stone foundations are present in the southwest corner of 960 near Isthmus Road and in the eastern part of stand 930.

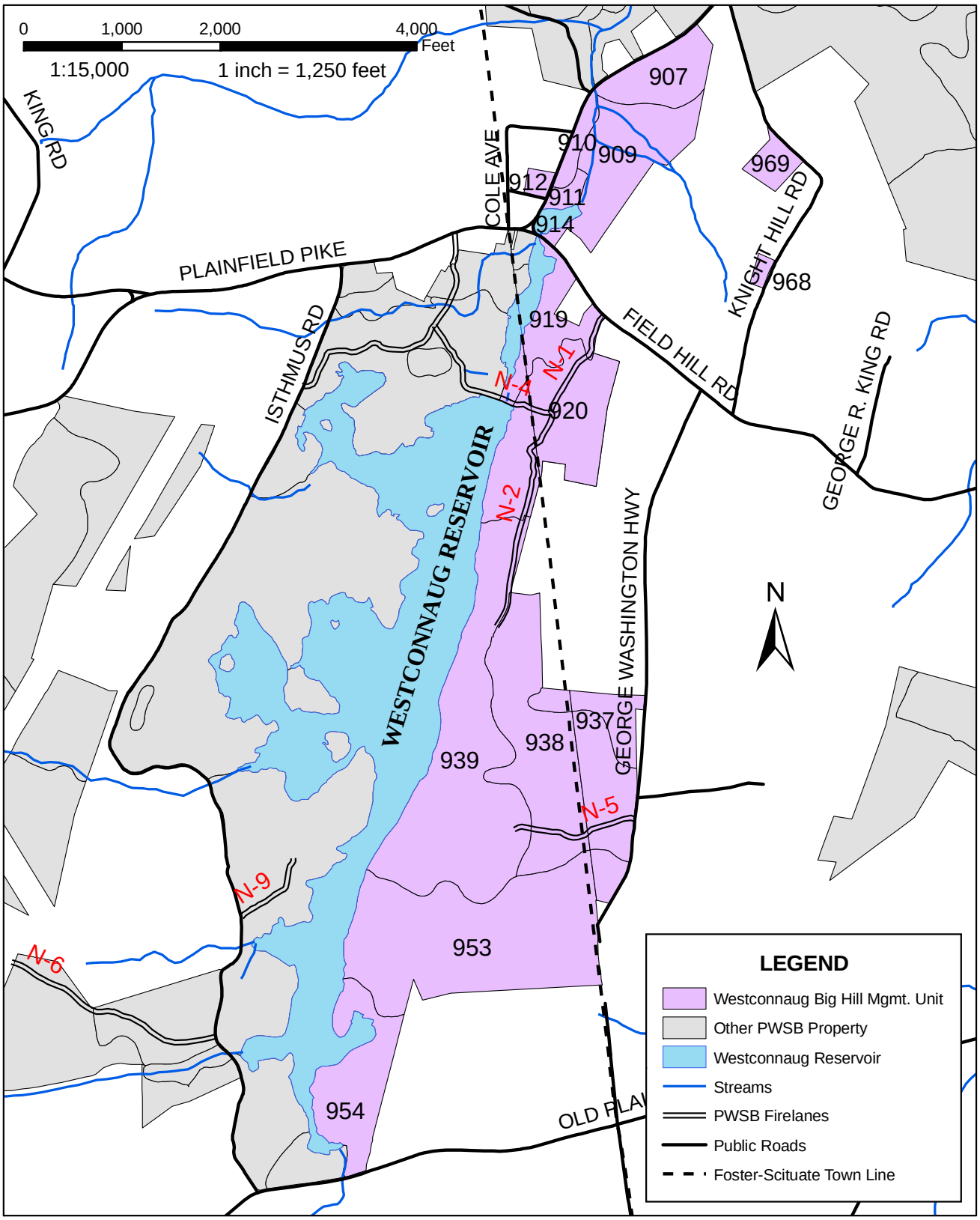
Isthmus Road MU Inventory Summary:

Stand	Acres	Type	Species	TPA	BA/ac	MSD	MBF/ac	Cds/ac	Regen/ac
915	10	M2/3A	MO/MS	284	122	8.8	5.9	12.2	±889
921	46	MU	WP/MO/MH	146	89	10.4	5.7	4.9	±300
922	3	W2/3A	MH/-/WP	186	117	10.7	5.5	11.9	±127
923	4	Open							
924	3	M1B	MH			No	Data		
927	7	H2/3A	RM/MH	190	105	10.0	4.8	9.3	±650
930	94	SU	WP/-/MO	169	97	10.1	7.7	5.4	±1,353
931	4	M2/3A	WP/MO	284	122	8.8	5.9	12.2	±889
945	1	W2/3A	RM/-/MH/WP	186	117	10.7	5.5	11.9	±127
950	57	MU	WP/MO	260	102	8.5	5.8	5.6	±1,627
958	6	M2/3A	WP/RM	284	122	8.8	5.9	12.2	±889
960	15	H2/3A	UO/-/WP	190	105	10.0	4.8	9.3	±650
962	19	M2/3A	UO/WP	310	135	8.8	5.3	8.1	±850
963	4	W2A	RM	496	160	7.7	2.4	25.9	±50
964	32	H2/3A	UO/-/WP	266	107	8.4	3.5	6.5	±1,367
966	14	H2/3B	UO/-/RM	187	89	8.6	3.1	7.0	±807
974	19	M2/3A	MO/WP	209	113	10.1	5.8	7.2	±1,067
975	5	H2/3A	MH/-/WP	190	105	10.0	4.8	9.3	±650
977	1	H2/3A	MH/-/WP	190	105	10.0	4.8	9.3	±650
979	42	H2/4B	UO	135	83	10.1	4.2	4.6	±378
980	41	H2/3A	MH	190	109	10.2	4.9	6.8	±338
981	38	H2/3A	MO/-/WP	183	97	10.0	4.8	4.6	±143
982	6	M3A	MO/WP/MH	235	137	10.0	10.7	10.5	±1,444
984	21	H2/3A	UO/-/WP	154	83	10.2	4.7	2.8	±575
986	16	M2/3A	MO/WP	183	103	9.8	6.1	6.3	±967
988	19	H2/3A	MO/WP	208	93	9.2	3.7	6.5	±667
991	11	H2/3A	MH/-/WP	190	105	10.0	4.8	9.3	±650
1028	1	Water							
1079	5	M2/3A	UO/WP	284	122	8.8	5.9	12.2	±889

Isthmus Road MU Management Activity Schedule:

Stand	Type & Species	Activity	Acreage	Year
950	MU-WP/MO	Thinning/group selection harvest	up to 55	2013
921, 930	M/SU-WP/MO	Individual/group selection harvest	up to 140	2018

WESTCONNAUG BIG HILL MANAGEMENT UNIT



WESTCONNAUG BIG HILL MANAGEMENT UNIT

Location, Geography, and Access

Straddling the Foster-Scituate town line, the oblong Westconnaug Big Hill MU comprises about 300 acres in the M and N Blocks on the east shore of the Westconnaug Reservoir and along the upper section of Westconnaug Stream. It is bounded to the north by Route 102, to the east by Knight Hill Road and the George Washington Highway, and to the south by Old Plainfield Pike. Irregular wooded property lines largely define the long eastern boundary. All of the land has been PWSB property since the creation of the reservoir system except for the 3-acre former Keebler parcel acquired in 1997. Almost all the terrain has a western aspect, and the MU derives its name from a steep drop down to the reservoir's edge in the southern section that may be the steepest extended slope on the entire PWSB property. The N-1 and N-2 firelanes provide access to the Westconnaug Dam and the northern end of the MU, while the much more lightly used N-5 firelane provides an entrance to the large, unbroken forest stands towards the southern end.

Existing Forest Description

The forest in this MU is quite different in the northern and southern sections. The large, long-unmanaged natural stands in the southern section stand out as some of the most noteworthy on the entire PWSB property. Few areas of comparable acreage in the local landscape have gone undisturbed for so long. Some of the largest hardwood trees on the watershed are found here, particularly the red oaks in stand 939. On the steep and rocky slope above the reservoir, stand 953 contains a large concentration of locally uncommon chestnut oak. White pine is a secondary component in these hardwood stands although it shares the canopy in stand 954 at the very southern end. In contrast, the northern section is composed of smaller natural and planted stands where conifers are a much more significant component. White pine is the main conifer although some natural pitch pine and planted larches remain. This MU contains few low-lying areas, but there is a significant amount of red maple where a tributary to Westconnaug Stream passes through stand 909. Almost all of the stands in this MU are sawtimber-sized and only about 1% of the acreage is in an early successional condition.

Soils

This MU has very productive forest soils for the local area in its central portion, with rockier and otherwise less productive growing sites at the north and south end. Woodbridge and Paxton soils underlie most of the area where the large-diameter oaks and tall pines are found between Field Hill Road and the steep slope of Big Hill. Woodbridge very stony fine sandy loams are moderately well drained and favorable for hardwoods, with a site index of 72 for red oak and 67 for white pine. Very rocky Canton and Charlton series are found on the Big Hill slope south to Old Plainfield Pike, and then on the uplands above Westconnaug Stream. These soils are well drained and relatively less

productive than neighboring series, with a site index of 58 for white pine and 52 for red oak. The only hydric soils (Ridgebury) are in the forested wetland areas of stands 909 and 937. Future timber harvesting should be excluded from these locations. Small occurrences of Hinckley soils are also present within the MU.

Past Land Use and Forest Management

Around the time of the creation of the reservoir system, the PWSB land use survey recorded the vast majority of this MU as woodland. Adjacent to the village of Clayville, a few acres of arable land were recorded immediately south of Field Hill Road (modern stand 919) and east of what is now Route 102, mostly on the west side of Westconnaug Stream (910, 911). A small area of "brushy" cultivated land naturally reverting to forest was identified along the eastern property boundary in stand 920.

With PWSB forestry records listing natural pine and hardwood stands in all but the roadside areas around Clayville, most of the acreage in this MU has simply been left alone and unmanaged since acquisition. At least a couple of old fields were by design allowed to seed naturally to white pine, and the early planting era only involved one small stand in this MU (the northern part of stand 919 was planted to spruce and white pine in 1938).

Silviculture from the mid-1950s through the 1970s emphasized intermediate treatments. Many of the pine stands, especially those near the Westconnaug Dam, were pruned or thinned during this period. These conifer stands once contained a significant pitch pine component that was intentionally reduced in the 1950s and 60s through harvests targeting this low-value species. Apparently not planted earlier, three small remaining open areas near the Route 102/Field Hill Road intersection were reforested in 1964 and 1973 with a semi-experimental mix of white pine, larch, hemlock, Norway spruce, and even tulip poplar. The two planted areas on the east side of Route 102 each received subsequent mechanical release treatments.

Active management in this MU in recent years has been limited to one entry, in part because there were hardly any dying red pine concerns to be addressed. The few planted red pines that remained were cut in 2005-06 as part of the Moswansicut harvest. The work in this MU, however, primarily focused on thinning the large, mature white pine in stands 919 and 920.

Forest Health and Related Management

As in the rest of the oak-hardwood forest across the PWSB ownership, the issue of deer herbivory and lack of oak regeneration is common in the hardwood stands. The thick shrub layer of blueberry and huckleberry in the upland areas with poorer soils such as stand 953 contributes to impeding regeneration. The problem is less stark, however, than in some other areas of the property with a high percentage of hardwood forest. White pine regeneration is abundant and healthy in stands where this species dominates or shares the canopy (907, 920, 954).

Likely due to the large acreage of interior forest undisturbed by previous human settlement, the main part of the MU between Field Hill Road and Old Plainfield Pike is relatively free of invasive plants. Trying to prevent the spread of invasives into this area on the east shore of the Westconnaug Reservoir is an important management goal.

One invasive population that has become established in this area is a patch of Japanese knotweed just inside N-1 firelane gate, between the dirt road and the stone wall shared with the abutting landowner. The knotweed was treated in 2010 by mechanical cutting and application of a herbicide solution directly into the bases of the stems. Subsequent communication revealed that the knotweed

patch is located near the abutter's well and that this landowner is very uncomfortable with the use of herbicides. Japanese knotweed is an aggressively invasive plant and trying to prevent its re-establishment and spread is a management priority. To prevent potential problems with the abutting landowner, however, future knotweed treatments at this site should avoid the use of herbicides if possible.

The roadside portion of stand 910 is the former location of two house lots that Providence Water acquired in 1990. The buildings were subsequently razed and the former yards are naturally reverting to forest. A hodgepodge of tree and understory species is currently growing here, including patches of invasive Oriental bittersweet (extending to Westconnaug Stream) and a couple of Norway maples. More bittersweet and a patch of Japanese knotweed are found across the road in tiny stand 911, in close proximity to an occupied house lot. The health of the crowded planted conifers in stands 911 is slowly declining and these trees will probably require eventual thinning or complete removal. Management of this site is potentially difficult due to its roadside location and the proximity of residential neighbors. A goal for the 2010-2020 management period is to monitor and try to prevent these populations from spreading, while developing a control strategy to be implemented before or at the same time as intervention in the conifer patches.

Silviculture

The majority of the stands in this MU will continue to be left to grow during the 2010-2020 management period as there is no pressing need for silvicultural intervention, especially in the hardwood stands where oak regeneration is relatively sparse. Any timber harvest entries must be carefully planned to try to avoid spreading invasive plants into the interior forest and building additional roads is not recommended.

East of the Westconnaug Dam, the tall white pine in stand 920 will benefit from another entry to follow up on the 2005-06 thinning. With regeneration developing nicely, this stand will be ready for a shelterwood prep cut in 2017. At the far south end of the MU, the structure and composition of mixed oak-pine stand 954 makes it a good candidate for management, but its location is very impractical from an operational perspective. There is no good landing site or access to this stand from Old Plainfield Pike, while transporting logs to a landing near the N-5 firelane gate is undesirable due to the distance, slope, and disturbance involved.

With its large-diameter red oaks, stand 939 has some "older growth" characteristics, although significant canopy gaps and downed coarse woody debris have not yet developed. No logging has occurred on this site for a long time and it has more productive soils than most parts of the watershed forest. Due to its high conservation value, stand 939 will be designated a reserve set aside from timber harvesting and passively managed for old growth structure through natural processes. Given its location along the reservoir's edge, however, a change of management strategy could be necessary in the future if natural disturbances (including mortality from insects and disease and weather events) are determined to have a negative impact on water quality.

Cultural Resources

While the area south of the Westconnaug Dam is one of the least disturbed parts of the PWSB ownership, the northern part of this MU contains significant cultural resources in the form of remnants of past land use around the village of Clayville. This village had a larger population and physical footprint before the Providence Water era and archival photos show that the area below (i.e. north of) the Westconnaug Dam was heavily modified when the City acquired the land. The Clayville community was largely built around two textile miles along Westconnaug Stream, one located above

and one below the Jordan Pond Dam. The most obvious remaining physical features are the structures related to water control and power for the mills. The large Westconnaug Dam has been upgraded to meet modern standards as Providence Water still uses it as a primary reservoir dam. A short distance downstream, the Jordan Pond Dam remains closer to its original construction as it is only used in a secondary capacity. Below the Jordan Pond Dam, Westconnaug Stream is confined within a stone millrace for its entire length within this MU. The relatively well-preserved skeleton of a building belonging to the lower mill which was constructed late enough to feature a large amount of concrete is located along the west bank of the stream in stand 909, just east of Route 102.

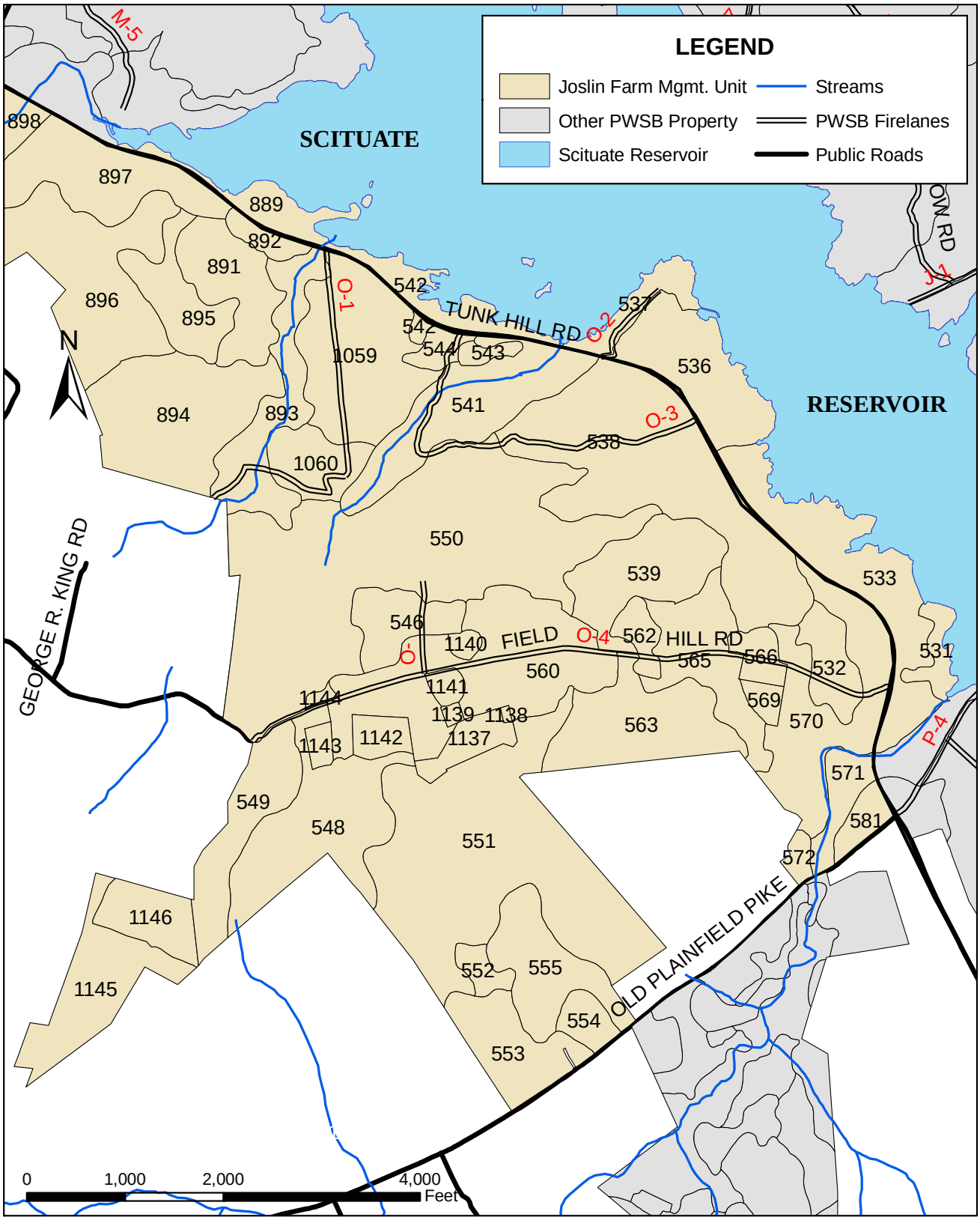
Westconnaug Big Hill MU Inventory Summary:

Stand	Acres	Type	Species	TPA	BA/ac	MSD	MBF	Cds/ac	Regen/ac
907	13	S3A	WP/-/MO	159	136	11.4	14.8	11.2	±6,196
909	24	H3A	MO/RM/MS	112	103	12.8	6.4	7.7	±125
910	4	H1/2C	MH/-/MS	211	50	6.6	2.0	1.8	±100
911	4	S2/3A	WP/-/LA	282	136	9.2	9.0	14.9	±730
919	12	H2/3A	MO/MH/WP	190	105	10.0	4.8	9.3	±650
920	33	S3B	WP	102	90	12.5	13.6	3.3	±7,080
937	9	W2/3A	RM/-/MO	186	117	10.7	5.5	11.9	±127
938	52	H3A	MO/-/MH/WP	171	120	11.3	8.9	6.0	±120
939	64	H3A	RO	165	124	11.8	9.5	6.0	±723
953	69	H3A	UO/-/WP	220	117	9.8	6.0	6.2	±792
954	22	M3A	MO/WP	240	118	9.2	6.1	7.1	±2,825
968	1	M2/3A	MH/WP	284	122	8.8	5.9	12.2	±889
969	4	S3A	WP/-/MO	159	136	11.4	14.8	11.2	±6,196

Westconnaug Big Hill MU Management Activity Schedule:

Stand	Type & Species	Activity	Acreage	Year
919	N/A	Monitor Japanese knotweed inside N-1 firelane gate and perform non-herbicide follow-up treatment(s) as necessary	< 1	2010-20
910, 911	N/A	Monitor Oriental bittersweet and Japanese knotweed and try to prevent these populations from spreading	< 1	2015
920	S3B-WP	White pine shelterwood prep cut	33	2017

JOSLIN FARM MANAGEMENT UNIT



JOSLIN FARM MANAGEMENT UNIT

Location, Geography, and Access

Located along the west shore of the Scituate Reservoir's west arm, the Joslin Farm MU covers about 1,100 acres and includes most of the land in the O Block. Route 102 serves as its northern boundary and the irregular southern and western boundary lines are contained by Old Plainfield Pike and Knight Hill Road. The northern half of this MU has been PWSB property since the creation of the reservoir system, but the southern half is comprised of two relatively new land acquisitions. PWSB purchased the 540-acre former Joslin Farm property in 1991 and the much smaller adjacent Hull parcels in 1998.

The landscape of the southern two-thirds of this MU is dominated by the broad crown of Field Hill (the highest point on the PWSB ownership) and significant slopes down to the Scituate Reservoir and Wilbur Hollow on three sides. Relative to the rest of the property, this MU has a large acreage of roadless interior forest. Gated at both ends and no longer a public road where it crosses PWSB property, Field Hill Road traverses the crest of the hill and is in good condition. The less frequently used O-1, O-2, and O-3 firelanes (the latter two only partially accessible to standard vehicles) provide limited access to the northern stands from Tunk Hill Road.

The 85 acres of former cleared and agricultural lands atop Field Hill and along Field Hill Road are not included in the forest management plan for this MU. This acreage is dedicated to the Joslin Farm Wildlife Habitat Improvement Project (WHIP), which is broadly addressed in the open areas section of this plan and more specifically in separate documents.

Existing Forest Description

This MU is dominated by mixed oak-hardwood forest on growing sites of widely varying productivity. The comparatively small acreage of mixedwood and conifer stands is concentrated in the shoreline strip on the reservoir side of Tunk Hill Road, and also along Old Plainfield Pike. Perhaps the most noteworthy feature of many of the hardwood stands is that they have not been cut or actively managed for a long time. The forest contains some groves of large oak and other hardwood trees, particularly on productive soils in stands 500 and 551 and in riparian corridors. Stand 550 is a catchall mixed oak stand that includes a wide variety of terrain and local site conditions. Rocky, unproductive soils cause the forest composition to shift towards upland oak in stand 538 and adjacent stands to the south, along the middle and southern portions of the MU's eastern boundary along Tunk Hill Road. Ash decline has recently affected this area of the forest, which once contained a significant component of white ash trees that are now mostly dead.

Since they were only recently acquired, the Joslin Farm and Hull parcels have a different 20th Century land management history from the majority of the PWSB property.

Soils

Often very stony, Canton and Charlton fine sandy loams are the most common soil type in this MU, occurring on 3 to 25% slopes. These soils are well drained and moderately productive where they are not very rocky, with a site index of 58 for white pine and 52 for red oak. Significant areas of other soils are found especially on the south and east sides of Field Hill. Similar in texture and rockiness, these secondary soils are predominately Sutton, Woodbridge, Ridgebury, Whitman, and Leicester. The hydric Ridgebury, Whitman, and Leicester soils are located in the riparian corridors throughout the MU and in the wetland areas north of Old Plainfield Pike. Future timber harvesting will be limited on these hydric soils and excluded from particularly sensitive areas, with decisions informed by on-the-ground assessment at specific locations. A very small area of Gloucester-Hinckley soils is also present along Tunk Hill Road near the intersection with Route 102.

Past Land Use and Forest Management

At the time of the creation of the reservoir system, the 1915 PWSB land use survey recorded most of the original land in this MU as woodland. Significant areas of arable land and a few adjacent lots in brush were also recorded, mostly along Tunk Hill Road and Old Plainfield Pike near the former villages of Rockland and Potterville. The land in the northernmost part of the MU was heavily disturbed as it had been at the center of the Rockland mill village. The land use classification appears to have been performed after the buildings were razed.

The original land in this MU has seen relatively little active management during the PWSB era, presumably because most of the land was already forested and for most of the 20th Century poor local markets for hardwood products did not encourage silviculture in oak-hardwood timber types except for conifer enrichment planting. The former agricultural fields naturally returned to old field white pine or were planted with red and white pine and spruce in the 1930s, although one stand near the Tunk Hill Road/Old Plainfield Pike intersection was planted as late as 1959. As the young stands grew, management from the late 1950s through early 1970s emphasized intermediate treatments. The plantations and a few adjacent areas of hardwood forest were thinned during this period, and stand prescriptions often included pruning and cull treatment.

Small harvests in recent years have continued to focus on the conifer stands, responding to forest health threats and accomplishing other silvicultural goals. Prompted by the threat of mortality from the red pine scale and red pine adelgid, the separate RP-99-A and Tunk Hill harvests in 1998-99 removed red pine from four small stands along Tunk Hill Road. The 2004 Old Plainfield Pike harvest focused on white pine thinning in stand 555.

Without further research, little specific information on past land use and management history of the former Joslin and Hull parcels is readily available. Aerial photos dating back to 1939 show that during the 20th Century a greater portion of the Joslin property was used for agriculture than the remaining open land atop Field Hill. A larger acreage of fields and formerly cleared land reverting to forest are evident both around the hilltop and extending up the south slope from Old Plainfield Pike. The Hull parcels appear to have been forested in 1939 and throughout the rest of the 20th Century.

Forest Health and Related Management

Given the large acreage and high percentage of oak forest, the issue of deer herbivory and lack of oak regeneration common to hardwood stands is very much in evidence in this MU. Regeneration competition from a dense shrub layer of blueberry and huckleberry is limited to the upland oak sites with the poorest soils. Likely due to the large acreage of roadless interior forest and areas

undisturbed by previous human settlement, invasive plants are not yet widespread here but existing populations are concentrated in the three distinct locations discussed below.

The edges of the stands surrounding the former agricultural lands and Joslin house site along Field Hill Road contain several of the most common local invasive species, which have presumably spread from the open areas into the forest. Parts of stands 550 and 551 also have noteworthy tangles of greenbrier, an undesirable native vine that shares some invasive characteristics. The forest edges surrounding the new grasslands and early-successional habitat areas will be monitored as part of the Joslin Farm WHIP. Herbicide or other treatments to help prevent the spread of invasives will be performed using the NRCS budget for as long as this funding remains available.

Adjacent to Old Plainfield Pike near the intersection with Tunk Hill Road, a former red pine plantation (stand 581) which has not regenerated naturally to desired vegetation and part of the adjacent riparian stand (571) are the site of one of the worst Japanese barberry infestations on the entire property. Eradicating the barberry during this management period is unrealistic, but trying to prevent its spread beyond this section of the MU (especially into neighboring early-successional stand 572) is an important management goal. Two paired experimental propane treatment plots established as part of a larger Connecticut Agricultural Experiment Station project are currently located in the less dense area of the infestation on the west side of Wilbur Brook, and this research will continue into the early part of this management period.

A significant buckthorn infestation occupies the former landing site behind the roadside gate along Old Plainfield Pike in stand 553 and has spread into stand 554 and the roadside portion of stand 555. The buckthorn will be treated as soon as is feasible to help prevent its spread and to promote the establishment of native white pine regeneration in these stands.

Silviculture

This MU is a relatively low priority for silvicultural activity during the coming decade until the deer herbivory problem is addressed because timber harvesting in the oak and mixed hardwood stands risks being unsustainable if there is not sufficient regeneration development. If or when it becomes possible to secure oak regeneration, the stands in the northern two-thirds of the MU (north of Field Hill Road) will benefit from silvicultural prescriptions that diversify the current homogeneous age class structure. Any timber harvest entries must be planned to avoid spreading invasive plants into the interior forest and building additional roads is not recommended.

The 13 acres of upland oak underplanted with white pine on the northernmost of the former Hull parcels (stand 1146) are ready for a release harvest that will allow the pine to grow into the overstory and take over this site better suited to conifers than hardwoods. It may be most practical to structure this project as a non-commercial harvest in which the small-diameter overstory upland oaks are simply felled and left on the forest floor (as in timber stand improvement) because the low-value wood in this small, remote stand may not be able to support a stand-alone commercial harvest. A harvest in this area would usually be combined with work in the surrounding stands, but even though regeneration is not a focus at present any harvesting in these upland oak stands not suffering heavy mortality may be unwise without confidence in securing regeneration.

Some areas of the areas in stands 550 or 551 with larger trees could be candidates for a thinning designed to enhance growing conditions for these trees and to accelerate the development of late-successional stand structure. Sometimes referred to “slot harvesting,” this type of prescription removes a defined range of intermediate diameter classes while retaining the smallest and largest. The idea is for large trees to remain in the stand until smaller ones can begin replacing them, so the

diameter range of trees that are removed is typically fairly narrow. Harvesting in these stands is not recommended, however, until regeneration conditions improve, so these stands will be evaluated in 2015 for a possible silvicultual entry.

Located on a relatively steep north-facing slope above Tunk Hill Road near the west gate of the O-3 firelane, small stand 543 (2.5 acres) is noteworthy in that it is listed in the management records as a somewhat rare natural stand of pitch pine and redcedar. Since the pitch pine component has been retained and it appears to be a representative sample of what more of the forest used to be like in this area, this high conservation value stand will be designated as such with any management dedicated to maintaining or enhancing these conditions. Stand 543 also provides an example of what more of PWSB's upland stands might be like if the pitch pine component of the forest were restored to more closely resemble the likely pre-agricultural era species composition.

Since they contain the most significant stream corridors and wetlands in this MU, stands 541, 571, 893, and parts of stands 550, 553, and 895 will be designated reserves set aside from timber management. The southeastern portion of stand 551 includes a high conservation value grove of large "older growth" hardwood trees located on hydric soils. This area will be delineated as a separate stand and similarly set aside from timber management.

Cultural Resources

This MU contains many cultural resources in the form of remnants of past land use, especially around the location of the former mill village of Rockland near the present Route 102/Tunk Hill Road intersection. Stone foundations, remains of the mill's water power system (millraces and penstocks), and other cultural artifacts are found throughout the forest stands in this area. PWSB's general policy of protecting and preserving historic sites applies to Rockland village, but – like similar sites across the watershed ownership – it is not formally designated a special management area at present. The MU also contains several historic cemeteries and many stone walls .

The acreage dedicated to the Joslin Farm WHIP also contains significant cultural resources, which are addressed in documents relating to this part of the property.

Joslin Farm MU Inventory Summary:

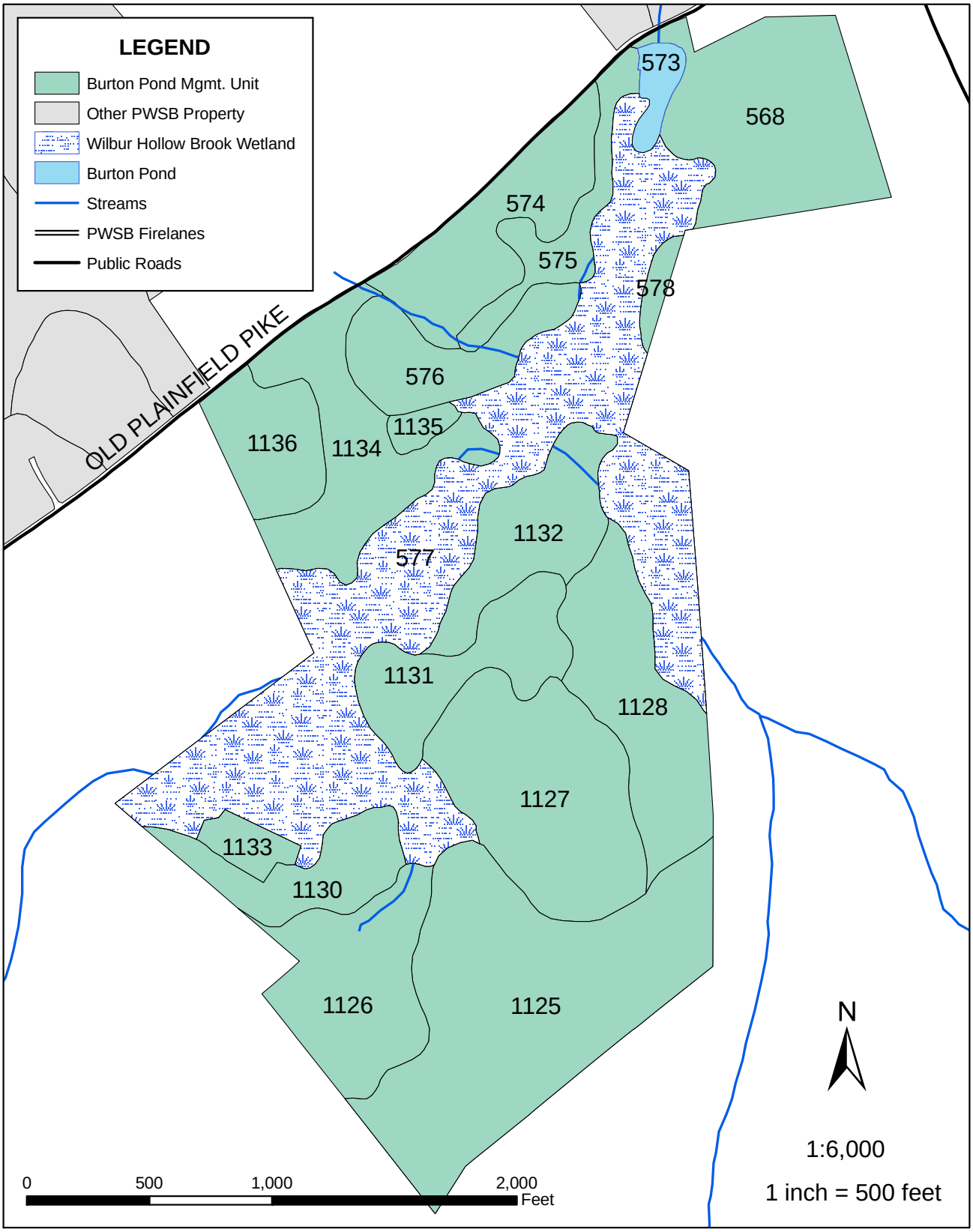
Stand	Acres	Type	Species	TPA	BA/ac	MSD	MBF/ac	Cds/ac	Regen/ac
531	6	S3A	WP	159	136	11.4	14.8	11.2	±6,196
532	11	M2/3A	WP/MO	284	122	8.8	5.9	12.2	±889
533	39	M2/3A	MO/WP	163	97	10.1	6.4	4.8	±450
536	28	S2/3A	WP	182	125	8.6	7.4	5.8	±300
537	9	S3A	WP	159	136	11.4	14.8	11.2	±6,196
538	77	H2/3A	UO	237	111	8.9	4.5	8.5	±507
539	27	H2/3A	MH	106	90	11.1	5.9	6.4	±40
541	35	H2/3A	MO	203	113	9.9	7.5	7.0	±117
542	12	S3B	WP/MS/RM	130	110	12.5	13.7	10.5	±2,340
543	2	S2/3A	PP/-/MH/RC	282	136	9.2	9.0	14.9	±730
544	4	W2/3A	RM	186	117	10.7	5.5	11.9	±127
546	14	S2A	MS	358	140	8.5	3.8	20.9	-
548	39	H2/3A	MO	237	123	9.8	5.0	8.5	±144
549	23	H2/3A	UO	215	120	10.1	5.8	9.9	±225
550	131	H3A	MO	188	120	10.6	8.0	7.3	±217
551	98	H3A	MH	145	116	12.1	6.6	7.3	±363
552	4	W2A	RM	496	160	7.7	2.4	25.9	±50
553	20	M3A	WP/MH	184	135	11.2	6.0	11.8	±75
554	6	S3B	WP	130	110	12.5	13.7	10.5	±2,340
555	23	S3A	WP	83	115	15.9	11.6	8.3	±9,775
560	56	Open							
562	5	S2D	MS			No	Data		
563	31	H2/3A	MH	135	110	12.1	5.4	6.3	±60
565	24	H2/3A	MH	240	125	9.8	3.7	11.3	±25
566	6	Open							
569	3	Open							
570	38	H2/3A	MO/WP	256	110	9.1	5.1	7.7	±214
571	9	H3A	MH	184	116	10.6	7.2	8.6	±463
572	3	H2/3C	MO/-/WP	130	60	9.1	1.3	7.7	±400
581	5	H1/2B	MH	80	40	9.6	0.7	2.7	±4,100
889	9	S3B	WP/-/MS	130	110	12.5	13.7	10.5	±2,340
891	22	H2/3A	MO	186	118	10.8	5.4	7.9	±225
892	4	H2/3B	MO/-/MS	187	80	8.6	3.1	7.0	±807
893	27	H2/3A	MH	189	112	10.6	6.2	8.3	±320
894	44	M2/3A	MO/WP	157	123	11.5	6.7	9.1	±300
895	17	H2/3A	MH	153	113	11.5	7.8	4.7	±233
896	56	H3A	MO	151	118	11.7	8.4	7.2	±173
897	34	H3A	MH	211	108	10.2	5.1	8.2	±50
898	13	M2/3A	NS/MH	284	122	8.8	5.9	12.2	±889

1137	7	Open							
1140	2	M1/2A	MH/MS	222	43	6.1	0.3	2.5	±733
1141	3	M1/2A	MH/MS	222	43	6.1	0.3	2.5	±733
1142	5	Open							
1143	2	Open							
1059	41	H2/3A	MO	197	98	9.6	4.9	6.2	±250
1060	13	H2/3B	MO	187	80	8.6	3.1	7.0	±807
1145	26	H2/3A	UO	280	93	7.8	2.5	7.2	±50
1146	13	H2A	UO/WP	246	84	7.9	1.5	9.8	±550

Joslin Farm MU Management Activity Schedule:

Stand	Type & Species	Activity	Acreage	Timeframe
571, 581	N/A	Experimental Japanese barberry treatment; prevent spread of barberry	< 5	2013
1146	H2A-UO/WP	Harvest or TSI to release underplanted white pine	13	2015
553, 554, 555	WP/MH	Treat invasive buckthorn, monitor, and perform follow-up treatments as necessary	< 5	2015 or earlier
Stands surrounding Joslin Farm WHIP	MO/MH	Monitor invasive plants and perform treatments as necessary	TBD	2010-20
550, 551	H3A-MO	Where appropriate, evaluate for possible “slot thinning” to enhance late-successional stand structure	TBD	2015

BURTON POND MANAGEMENT UNIT



BURTON POND MANAGEMENT UNIT

Location, Geography, and Access

The small Burton Pond MU includes about 165 acres in the O Block located south of Old Plainfield Pike and west of Tunk Hill Road. The bow tie-shaped parcel comprising the northeastern 38 acres has been PWSB property since the creation of the reservoir system, but the majority of the land is part of the 127-acre former Foglia property purchased by Providence Water in 1999. The defining geographic feature of this MU is the wide, low-lying Wilbur Hollow Brook corridor that extends upstream from Burton Pond, an old millpond created during the Industrial Revolution era. The southern acreage is slightly higher in elevation, culminating in steep ledges along the southern property boundary line.

Access limitations and challenges are a major issue for this MU. Although Old Plainfield Pike provides about half a mile of road frontage along the northern edge, the majority of the property lies on the opposite side of the wide marsh and beaver dams along Wilbur Hollow Brook. The only vehicular (or dry) access to the main part of the former Foglia property is via a narrow earthen causeway built across the wetland. This causeway has not been maintained for some time and is in poor condition. In addition, the northeast corner of the MU east of Burton Pond lacks viable road access altogether. Implications for timber harvesting operations are discussed in greater detail in the silviculture section.

Existing Forest Description

With variations determined by geography and underlying soils, the forest in this MU is characterized by stands of white pine, mixed oak, and red maple and other hardwoods. Surrounding the open areas with marsh grasses and dead trees in standing water, the forested portion of the brook corridor and surrounding wetlands contains a very high percentage of red maple and associated species such as yellow birch. The acreage south and east of the brook has some stands of relatively pure white pine, but the majority of the acreage is currently in mixedwood composition where the pine component is gradually increasing. Except for the wettest areas, white pine will eventually grow to dominate these stands. The original PWSB acreage includes a roadside Norway spruce plantation on former agricultural lands (stand 574), while the former Foglia property still has three open fields in different locations.

Soils

Atypical for the PWSB property, this low-lying MU is dominated by hydric soil series that underlie about 50% of the land area. Scarboro, Ridgebury, and Walpole soils are found along Wilbur Hollow Brook and its tributaries; these soils are poorly drained and relatively low in site productivity. The wetland soils pose serious operational limitations and therefore the brook corridor will be excluded

from future timber harvesting activity. Care must also be taken to prevent erosion in the event of logging equipment crossing this corridor, which would be likely in any timber harvest in this MU.

The stony Canton and Charlton soils that predominate in the upland southern section of the MU are similar to those on much of the rest of the watershed forest: well drained and moderately productive where they are not very rocky, with a site index of 58 for white pine and 52 for red oak. Sudbury and Sutton soils are found in the limited upland areas of the original northern acreage. All of these soils are well drained and have no operational limitations.

Past Land Use and Forest Management

At the time of the creation of the reservoir system, the 1915 PWSB land use survey recorded the original land in this MU as swamp in the Wilbur Hollow Brook lowland, woodland to the east, and arable land with a small patch of brush along what is now Old Plainfield Pike. The old fields were not planted in red pine and spruce until 1959 and land use at this location over the first 40 years of PWSB's tenure is unknown. Prompted by the threat of mortality from the red pine scale and red pine adelgid, the 1998-99 Tunk Hill harvest included an entry into this stand (574) to remove red pine and thin the spruce and white pine that had developed here. No active management is recorded in the vicinity of the brook or in the upland forest stand to the east.

Without further research, little detailed information on past land use and management history of the former Foglia parcel is readily available. Aerial photos dating back to 1939 show that land cover has not changed significantly over the past several decades although the upland forest has matured. According to the previous owner, a significant volume of white pine timber was salvaged after hurricane of 1938. Similar to many other areas of the PWSB property, the relative percentage and volume of white pine appear to have increased since this time. The field at the northwest corner of the property was previously the hub of small livestock and poultry farm; PWSB razed the barn and chicken coops after acquiring the property. The parcel contains two smaller old fields on opposite sides of the brook that are now in the early stages of reverting to forest; these appear to be all that remain of areas that were once used for grazing and/or haying.

Forest Health and Related Management

Although not as stark as in the areas of the PWSB property dominated by hardwood forest, the issue of deer herbivory and lack of oak regeneration is evident in this MU. Generally more abundant, white pine regeneration is plentiful in the stands dominated by this species, especially 1127 and 1130.

Probably due to the secluded location and light history of human settlement on the majority of the property south of the brook, this MU is relatively free of invasive plants except for a significant infestation of glossy buckthorn in the roadside Norway spruce plantation that developed or spread after the 1998-99 thinning and red pine removal in this stand (574). The tall buckthorn must be treated if desirable tree regeneration is to develop in this stand and before any further harvesting in this area. With the lowland terrain providing favorable growing conditions, the large amount of greenbrier in this MU is also noteworthy. Although it is a native species, this thorny vine shares some invasive characteristics.

Silviculture

Except for the stands along Old Plainfield Pike, commercial timber harvesting in the majority of this MU is contingent upon maintaining the causeway across the Wilbur Hollow Brook wetland so that it can support logging equipment. Rebuilding the causeway will also improve access for fire

control and other purposes. Improvements should include clearing the existing culverts under the roadway to enhance wetland drainage and hydrologic function. Even with these improvements, future timber harvests should be timed to coincide with dry summer or frozen winter conditions as much as possible to minimize erosion. Since dragging logs across the causeway will cause damage, harvesting operations should use a forwarder and not a skidder to remove logs. Work on the causeway is scheduled for 2020 prior to the next harvest.

The next harvest in this MU will focus on the white pine stands on the former Foglia property (1127 and 1130, and the non-wetland portions of 1132) where white pine regeneration is abundant. This irregular harvest on about 20 acres will combine thinning and group selection in these even-aged stands to both focus growth on remaining trees and create gaps to encourage the development of new age cohorts. The regeneration is currently ready for release but the harvest is tentatively scheduled for 2022 pending completion of the causeway improvement project.

The mixedwood stands will be left to grow during the 2010-2020 management period. Without natural disturbance, the size and stocking of the trees in these stands will increase as the species composition shifts towards pine. Future silviculture in these somewhat remote stands will depend on the desired level of management intensity and may be influenced by the condition of local wood markets.

The three old fields on the former Foglia property will be assessed for their potential to provide additional value to wildlife through plantings or other cultural activities. The fields are good candidates for a cooperative project between Providence Water and a public or private organization with wildlife expertise to supplement PWSB's experience in forestry and land management. A more specific sub-plan may be developed to guide a project of this type.

A significant percentage of the land area in this MU will be set aside from active management. The open and forested wetlands along the Wilbur Hollow Brook corridor (576 and 577) will be designated a riparian reserve. The mixed species composition and white pine regeneration present in the upland portion of stand 568 would make it a good candidate for uneven-aged silviculture, but there is no viable logging access to the PWSB property east of Burton Pond. Therefore, this area will be passively managed for late-successional forest stand development through natural processes. Except for safety concerns along the boundaries with abutting landowners, trees will not be salvaged in the event of natural disturbances including mortality from insects or disease and weather events.

Cultural Resources

Most of the cultural resources in this MU are located where human settlement was concentrated along Old Plainfield Pike. Immediately adjacent to the public road, the most significant remaining physical feature is the Industrial Revolution-era Burton Pond dam, which was constructing using large boulders and other native stone and is still used in a secondary capacity by Providence Water today. Some foundations of the razed farm buildings are still located in the field at the northwest corner of the former Foglia property. A few of the property boundaries are marked by stone walls.

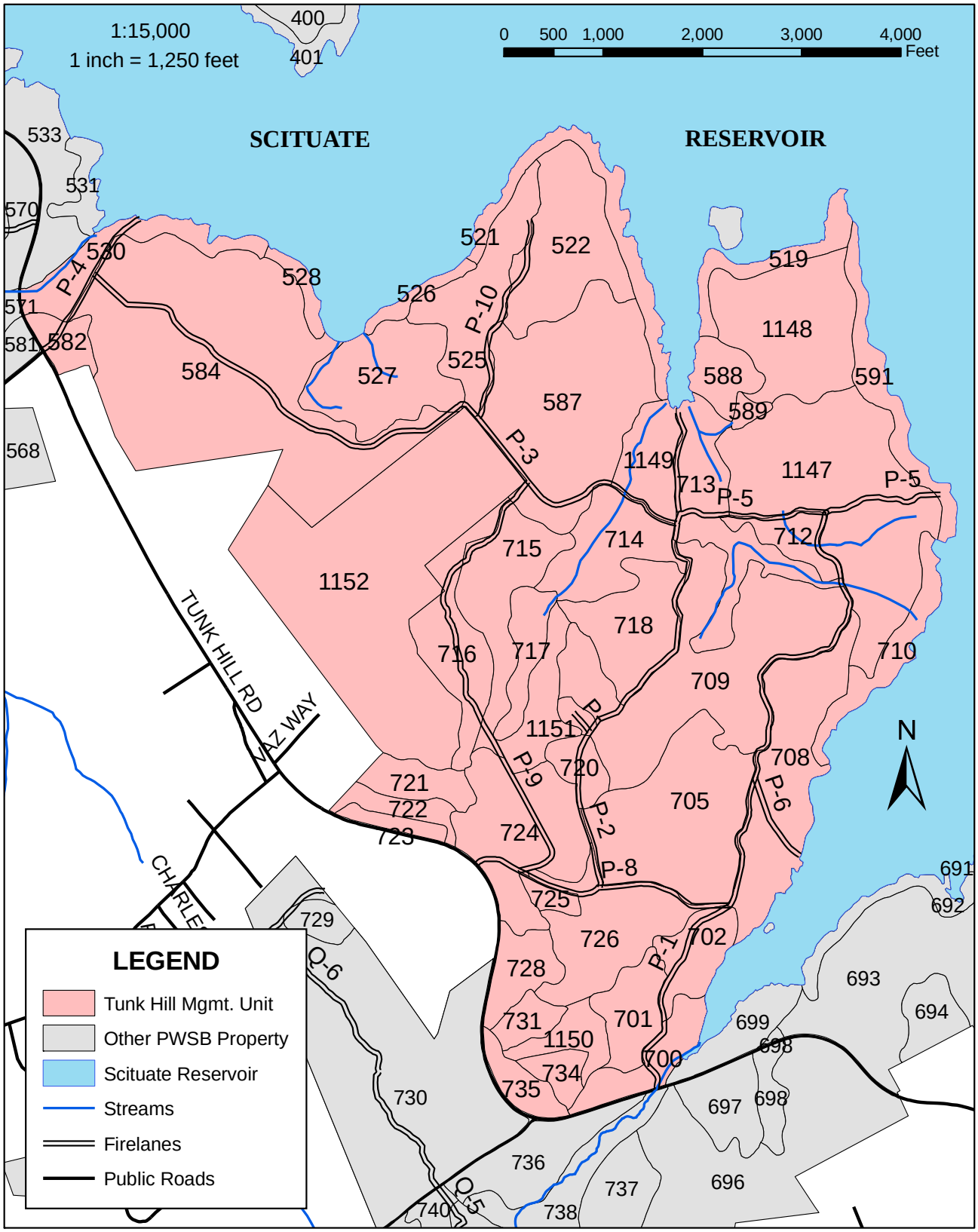
Burton Pond MU Inventory Summary:

Stand	Acres	Type	Species	TPA	BA/ac	MSD	MBF/ac	Cds/ac	Regen/ac
568	13	M3A	MH/WP	274	155	10.3	11.4	7.7	±500
573	1	Water							
574	8	S3B	NS	130	110	12.5	13.7	10.5	±2,340
575	4	H2/3A	MO	190	105	10.0	4.8	9.3	±650
576	6	W1/2A	RM			No	Data		
577	40	Wetland							
578	1	M3A	MH/WP	235	137	10.0	10.7	10.5	±1,444
1126	9	M2/3A	MO/WP	284	122	8.8	5.9	12.2	±889
1127	11	S3A	WP	334	160	9.0	14.2	11.7	±4,750
1128	13	M2/3A	MH/WP	284	155	10.0	7.9	10.3	±150
1125	25	H2/3A	MH	224	115	9.8	5.1	7.3	±275
1130	5	S3A	WP	159	136	11.4	14.8	11.2	±6,196
1131	7	M2/3A	MH/WP	284	122	8.8	5.9	12.2	±889
1132	7	S2/3A	WP/RM	282	136	9.2	9.0	14.9	±730
1133	2	Field							
1134	10	H2/3A	MH	228	125	10.0	2.9	6.9	±200
1135	1	Field							
1136	5	Field							

Burton Pond MU Management Activity Schedule:

Stand	Type & Species	Activity	Acreage	Year
1133, 1135, 1136	Old fields	Engage partners and assess for cooperative wildlife habitat improvement project	up to 8	2015
577	Wetland	Causeway improvement/rebuilding	N/A	2020
1127, 1130, 1133	S3A, S2/3A	Irregular harvest combining thinning and group selection	~20	2022

TUNK HILL MANAGEMENT UNIT



TUNK HILL MANAGEMENT UNIT

Location, Geography, and Access

The Tunk Hill MU covers about 1,060 acres on a broad peninsula which is almost entirely PWSB property, located between the Scituate Reservoir and Tunk Hill Road (Route 12). It has the same geographic boundaries as the P Block and is bounded by Wilbur and Coventry/Knight Brooks to the north and south, respectively. The low, broad crown of Tunk Hill dominates the western and central area of this MU, while much of the northern and eastern acreage is in close proximity to the reservoir shoreline. Three gates in different locations along Tunk Hill Road provide access to a well-developed network of firelanes so that despite the large acreage of interior forest few stands are far from a woods road. In 2000, the purchase of three significant parcels surrounded by PWSB land on three sides added about a hundred acres of upland terrain to this MU.

Existing Forest Description

This MU is characterized by a significant acreage of both upland oak forest and a mosaic of mixed oak and pine stands closer to the reservoir. Individual stands vary widely in size and composition. The terrain is nearly flat to gently sloping near the top of Tunk Hill, where a combination of factors are contributing to forest health problems in the upland oak stands here. Growing conditions improve away from the poor hilltop soils, and the best growing sites are on the moderate southeast-facing slopes that descend from the P-1 firelane towards the reservoir. The largely homogeneous oak-pine acreage in the northwest was somewhat separated from the rest of the MU until PWSB's acquisition of the Scituate Light & Power and Wilbur Land parcels. Thin coniferous stands planted as leaf screens are located along sections of the reservoir shoreline. The reservoir buffer stands with a significant red pine component suffered heavy mortality while those dominated by white pine have been less impacted.

Soils

Canton-Charlton sandy loams are by far the dominant soil type in this MU, ranging from fine to extremely stony and occurring on slopes from 3-25%, with some additional rock outcrop areas with slopes up to 35%. These soils are well drained and moderately productive in locations where they are not very rocky, with a site index of 58 for white pine. Most of the soils in this area are rocky and unproductive, however, especially in the western half of the MU where growing conditions are poor and upland oak mortality is high. Soils are generally more productive on the gently sloping terrain near the reservoir shoreline, away from the crest of Tunk Hill. Other soil series present are limited to small occurrences of very stony Bridgehampton, Narragansett, Sutton, and Wapping soils. Only a small acreage of Ridgebury soils pose operational constraints, and no harvesting is recommended in the few narrow stream corridors and wetlands where these soils occur.

Past Land Use and Forest Management

At the time of the creation of the reservoir system, the 1915 PWSB land use survey recorded the western area of this MU as woodland and the eastern acreage as brush and woodland. The woodland was presumably oak forest used as a woodlot. The survey also denoted five patches of arable land, four in the southern part of the MU and one in the northwest corner at the intersection of Tunk Hill Road and (now Old) Plainfield Pike.

Silviculture has been very active in the forest stands on the Tunk Hill peninsula since intensive planting of white and red pine between 1926 and 1939. Managers also experimented with planting limited amounts Scotch, Austrian, and jack pine, Norway spruce, hemlock, and Douglas-fir in particular stands, although not all of these species remain today. Conifers were underplanted in many areas with an existing oak and hardwood overstory and plantations were established in former agricultural fields. In addition to the coniferous species, black locust was also “open planted” in a small area of what is now stand 724.

As the planted forest grew, management between the late 1950s through the early 1970s emphasized intermediate treatments. Many stands were released or thinned during this period, and some stand prescriptions included pruning, weevil control, cull treatment, and frill release. A fire in the hardwood forest near the intersection of Tunk Hill and Matteson Roads resulted in a small burn area that was salvaged and replanted in mixed conifers in 1965 (now stand 731). Stand 720 along the P-2 firelane was planted with black walnut, tulip poplar, and white ash in 1973 after two previous red pine thinnings, but this experiment suffered heavy mortality.

More recent harvests have largely focused on responding to forest health threats while also accomplishing other silvicultural goals. Prompted by the threat of mortality from the red pine scale and red pine adelgid, the 1998-99 Tunk Hill and 2006 Richmond harvests both included a large number of stands – mostly in the southern half of the MU – and combined red pine removal with white pine thinning. Individual stand prescriptions ranged from light thinning to overstory removal depending on species composition and the severity of the red pine infestation. The Young’s Road harvest in 2005 was a salvage and thinning of the upland oak acreage near the eastern tip of the peninsula (stand 590) and on the former Scituate Light & Power and Wilbur Land parcels (collectively stand 1152). Both of these areas had been experiencing heavy oak mortality.

Forest Health and Related Management

The Tunk Hill area is currently affected by several interconnected forest health issues that are heavily impacting a significant part of the MU. Although not as widespread as in the neighboring Burnt Hill MU, the upland oaks in the stands near the top of Tunk Hill are experiencing moderate to severe mortality due to a combination of factors including the poor soils and repeated defoliations from insects such as the forest tent caterpillar and orange striped oakworm.

Although white pine regeneration is very good in stands where thinnings have created canopy openings, healthy oak and hardwood regeneration (except for some red maple) is almost nonexistent due to very heavy deer herbivory and, to a lesser extent, the dense layer of blueberry and huckleberry that is present in most of the upland stands. Deer were very frequently sighted while inventory fieldwork was being conducted. This MU has been a focal area for both formal and informal deer impact monitoring and regeneration studies. Desirable hardwood regeneration will remain sparse until hunting or exclosure fencing reduces seedling browsing.

The deer herbivory and regeneration problem can contribute to the establishment of invasive plants,

which deer exhibit a distaste for and can become established in disturbed open areas or in the forest understory where native tree regeneration has not taken hold. Considering the deer pressure in this area, the extent of invasives could be worse. At present, this MU has three known significant but fairly concentrated invasive infestations. The buckthorn in former red pine stand 724 has been treated once before in the fall of 2007 and was generally considered successful, but the population is now rebounding and spreading. Successfully regenerating white pine in stand 700 will be impossible without controlling the well-developed buckthorn in the understory here, which is spreading along the road into stand 702. Stand 726 appears to be the site of one of the farms noted in the 1915 land use survey and there is a large Japanese barberry thicket amidst a grove of white ash trees in the interior of the stand, likely resulting from planting by former settlers at a house site. Each of these infestations should be treated with a species- and site-specific prescription before any further management activities are undertaken in these areas.

Silviculture

Several white pine and mixedwood stands in this MU have seen little or no management activity since conifer planting or release and these stands are due for thinning, as they are at risk for stagnation and mortality without management. Although a portion of nearly pure white pine stand 709 was thinned in 1998-99, there is little understory development in the unthinned acreage that comprises the majority of this 70-acre stand where the underplanted pines were released in the 1950s and 60s. Present conditions call for a crown thinning, and the acreage and volume is significant enough for a stand-alone harvest focusing on this one stand.

Some of the large area of homogeneous oak-pine forest in the northwestern part of the MU along the P-3 firelane was thinned around 1970, but no management information is available for a significant portion of this acreage. The crowded growing conditions and poor underlying Canton-Charlton soils are probably a reason for the oak mortality here, although not as severe here as atop Tunk Hill to the south. Stands 525 and 584 will benefit from an improvement thinning in 2014 favoring white pine, and this harvest can also include crown thinning in those reservoir buffer stands that remain well-stocked (such as 530) and work in 582 along the P-4 firelane.

In addition to working in stands where no management has occurred for some time, other harvests should follow up on previous silviculture over the past 15 years that has contributed to the development of abundant white pine regeneration in some stands. In the white pine stands along the P-1 firelane in particular, the established regeneration is becoming ready for release. Stand-specific prescriptions could include additional thinning, shelterwood prep cuts, or group selection. The stands to the east of the P-1 firelane that were included in the 2006 Richmond harvest should be evaluated for a second entry between 2015 and 2020, and this harvest could also include upland oak salvage and thinning to favor white pine in the adjacent southern portion of stand 1147 not treated in 2005.

Further south along the P-1 firelane, stands 700 and 702 would normally be ready for a second entry to follow their 1998-99 thinning, but no additional harvesting can be done here until the invasive buckthorn in this area is controlled as it would make this large infestation worse. A harvest in stands 700 and 702 should enter adjacent stand 699 in the Indian Rock MU at the same time, and this job could also include improvement thinning in small, coniferous stands 731 and 735 to the west.

Further silviculture in the stands near the broad crown of Tunk Hill should be postponed until deer impacts are reduced. Additional declining or dead upland oak cordwood could be salvaged from some of these stands, but its economic value is low and – along with the adjacent Burnt Hill MU –

this area of the forest has already experienced much harvesting driven by tree mortality and forest health concerns. Leaving the dead trees for a time does pose some fire risk, but they offer some wildlife and structural value and these stands will not recover until the regeneration problem is resolved. Coniferous seedlings are subject to herbivory and hardwood seedlings stand little chance of developing. If the controlled hunt is successful in reducing the deer impact, an aggressive planting program should be considered in this area of the MU.

Since they contain the most significant stream corridor and wetlands in this rocky upland MU, stands 527, 713, 714, 717, and 1149 will be designated reserves set aside from timber management.

Cultural Resources

Although it is now hard to see from public roads, the tall Tunk Hill fire tower in stand 1151 occupies a prominent high point in Scituate and has been on the National Historic Lookout Register since 1992. The tower's lookout cabin and open stairs offer panoramic views of the Scituate Reservoir watershed that are otherwise difficult to obtain in a relatively flat, heavily forested landscape. Due to security and liability concerns, the tower receives almost no authorized use at present beyond occasional visits from a few PWSB watershed staff members.

No longer in functional use, the metal fire tower structure is aging and will eventually require upkeep to prevent it from becoming a hazard. Forestry activities will not physically impact the tower and a special management area is unnecessary, but the tower could be vulnerable to a hurricane or especially strong winds. PWSB should make an active decision to determine the future of this fire tower instead of letting it become neglected. Since the tower has strong historic and scenic value, it could be restored and shared with the public on periodic, closely supervised occasions (perhaps in partnership with a community or non-profit organization). Conversely, if PWSB considers the tower's maintenance costs/liability concerns to outweigh other values, the tower could be removed.

Tunk Hill MU Inventory Summary:

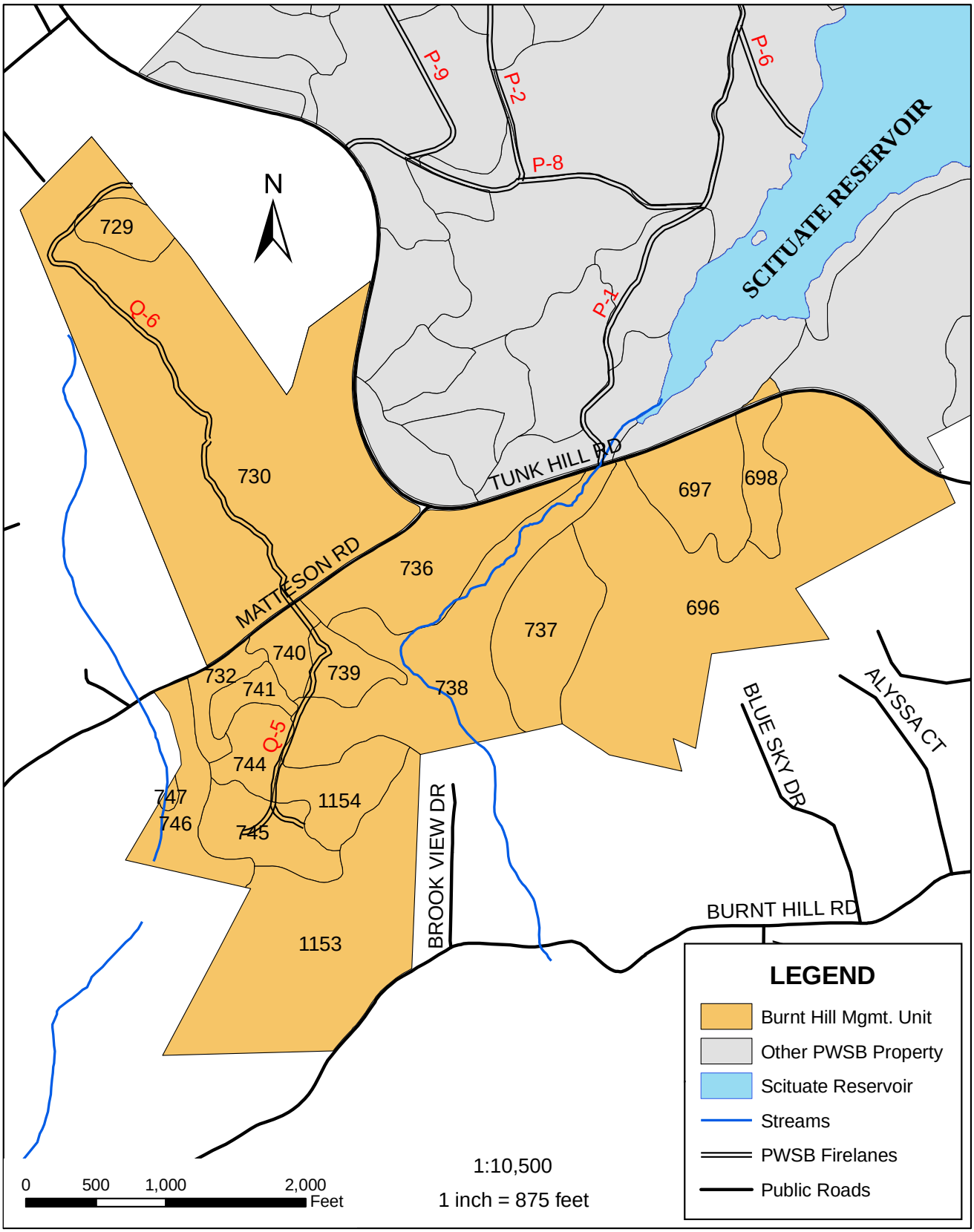
Stand	Acres	Type	Species	TPA	BA/ac	MSD	MBF/ac	Cds/ac	Regen/ac
519	10	S2/3A	WP/-/MO	282	136	9.2	9.0	14.9	±730
521	16	M1/2C	MS/MH	142	28	6.2	0.6	1.3	±525
522	33	S3A	WP	314	148	8.5	9.8	14.1	±283
525	26	M2/3A	MO/WP	478	145	7.5	6.1	13.1	±175
526	4	H1/2C	MH	211	50	6.6	2.0	1.8	±100
527	29	H3A	MO/MH	248	110	9.1	4.7	10.1	±300
528	4	H1/2C	MH	211	50	6.6	2.0	1.8	±100
530	15	S3A	WP	159	136	11.4	14.8	11.2	±6,196
582	7	S3A	WP/-/MH	159	136	11.4	14.8	11.2	±6,196
584	125	M2/3A	MO/WP	377	120	7.8	4.3	9.6	±300
587	65	M3A	MO/WP	419	139	7.8	6.5	11.7	±200
588	9	M2/3B	MO/RP	161	79	9.4	4.3	8.0	±700
589	2	Wetland							
591	14	S3A	WP	159	136	11.4	14.8	11.2	±6,196
700	12	S3A	WP	159	136	11.4	14.8	11.2	±6,196
701	13	M2/3A	MO/MS	284	122	8.8	5.9	12.2	±889
702	12	S3A	WP	159	136	11.4	14.8	11.2	±6,196
705	48	H3A	MO	186	108	10.2	6.9	9.0	±275

708	40	S2/3A	WP	304	139	8.9	8.1	13.4	±757
709	69	S3A	WP	332	165	9.4	12.2	14.7	±308
710	12	S3A	WP	159	136	11.4	14.8	11.2	±6,196
712	8	S3A	WP	159	136	11.4	14.8	11.2	±6,196
713	27	H3A	MO	266	94	8.0	4.8	7.3	±100
714	22	H3A	MO/MH	280	118	8.9	7.0	9.6	±367
715	37	H2/3B	MO/UO	280	114	8.7	4.2	9.8	±75
716	22	S2B	WP/HK/UO	99	45	9.0	1.0	3.7	±75
717	10	W3A	RM	183	130	11.3	5.4	19.4	±523
718	22	H2/3B	UO	143	48	8.0	2.1	2.5	±140
720	7	M2B	WP/MO	225	88	8.5	3.0	11.0	±692
721	9	S2A	RP	358	140	8.5	3.8	20.9	N/A
722	6	H2B	UO/-/RP	161	59	8.1	1.3	6.6	±406
723	4	M1D	MS/MH	14	10	11.7	1.6	0.5	±1,100
724	35	M1/2C	WP/MO	49	18	8.1	0.6	1.3	±67
725	3	H2/3A	MH	190	105	10.0	4.8	9.3	±650
726	29	H3A	MO/MH	208	140	10.8	11.6	13.3	±175
728	11	M3A	WP/MO	235	137	10.0	10.7	10.5	±1,444
731	6	S2A	MS	358	140	8.5	3.8	20.9	N/A
734	5	S3A	WP/-/MH	159	136	11.4	14.8	11.2	±6,196
735	7	M2/3A	MO/WP	284	122	8.8	5.9	12.2	±889
1147	72	H2/3B	UO	164	63	8.1	3.2	3.8	±620
1148	38	S2/3A	WP/-/UO	228	80	8.0	2.7	7.6	N/A
1149	13	M2/3A	MO	284	122	8.8	5.9	12.2	±889
1150	8	H2/3B	MO/-/WP	187	80	8.6	3.1	7.0	±807
1151	2	Open	Fire Tower						
1152	110	H2C	UO	98	35	8.2	1.2	2.3	±320

Tunk Hill MU Management Activity Schedule:

Stand	Type & Species	Activity	Acreage	Timeframe
Roadside	N/A	Treat roadside invasive Japanese stiltgrass patch	< 1	2010
724	M1/2C-WP/MO	Second treatment of invasive buckthorn	TBD	2011-12
709	S3A-WP	Crown thinning	~50	2014
525, 584, and buffer stands	MO/WP	Improvement thinning; crown thinning in buffer stands	up to 150	2014
700, 702	S3A-WP	Treat invasive buckthorn & monitor; shelterwood prep cut/group selection harvest after invasives are controlled	25	2017
731, 735	MS, WP/MO	Improvement thinning included with harvest in adjacent stands 700 & 702	12	2017
708, 710	WP	Evaluate for second entry with stand-specific prescriptions	up to 50	2017
1147	H3A-UO	Upland oak salvage/firewood thinning	~30	2017
726	H3A-MO/MH	Monitor concentrated infestation of invasive Japanese barberry	< 5	2010-20

BURNT HILL MANAGEMENT UNIT



BURNT HILL MANAGEMENT UNIT

Location, Geography, and Access

The Burnt Hill Management Unit covers about 350 acres in the Q Block located between Tunk Hill Road (Route 12) and Burnt Hill Road. The northern, southern, and eastern portions of this MU contain some of the poorest growing sites on the entire PWSB ownership, but the central cluster of small stands south of Matteson Road provides a diverse range of forest habitat types in one area. Coventry/Knight Brook runs through the middle of this MU before draining into the Scituate Reservoir. The Q-5 and Q-6 firelanes provide access to the stands on either side of Matteson Road, but only the first half of the gated Q-5 is accessible to standard vehicles because this is the only section that has been maintained. Logging and off-road access is also available from Burnt Hill Road and from an abandoned, overgrown historic woods road extending from Tunk Hill Road next to an old gravel borrow pit a short distance east of the P-1 firelane gate.

Existing Forest Description

The distinguishing feature of this roughly triangular MU is its large acreage of upland oak forest, especially in stands 696 and 1153 at its eastern and southern ends. Due to a combination of factors including the poor soils and exacerbating factors such as insect defoliation, these stands have been experiencing severe oak mortality. A recent salvage harvest on the upland oak acreage north of Matteson Road will accelerate the conversion of the previously underplanted areas to white pine. Mixedwood stands that are also increasingly dominated by pine abut the upland oak areas. The riparian stream corridor and surrounding forested wetlands (stand 738) are located squarely in the middle of the MU and may dictate that management entries into stands on opposite sides use different approaches. A significant component of pitch pine is also present as a secondary species in the portion of the MU south of Matteson Road. Despite the rocky terrain and associated upland oak forest health problems, rural residential land parcelization and development is currently very active on the private land abutting this part of the PWSB property and is significantly reducing unbroken forest cover at the local landscape level.

Soils

Underlying the vast majority of the forest in this area, Canton and Charlton very stony fine sandy loams on 3-25% slopes are the dominant soils. These soils are well drained and moderately productive in locations where they are not very rocky, with a site index of 58 for white pine and 52 for red oak. The only other soils found on a significant acreage of this MU are Narragansett very stony silt loams in the vicinity of Matteson Road and Ridgebury, Whitman, and Leicester extremely stony fine sandy loams in the Coventry/Knight Brook riparian corridor and wetland areas. Very small areas of Raypol and Sutton soils are also present. Only the Ridgebury, Whitman, and Leicester soils

pose operational constraints, and no harvesting is recommended in the stand 738 stream corridor and wetlands where these soils occur.

Past Land Use and Forest Management

At the time of the creation of the reservoir system, the 1915 PWSB land use survey recorded the entire portion of the MU north of Matteson Road as woodland, but the condition of most of the acreage south of the road was not recorded. Forest management records suggest that all the upland oak and "swamp hardwood" stands in the Burnt Hill area were existing forest at the time of PWSB acquisition and no management activities were recorded for these stands until the 2007-08 oak shelterwood prep cut in stand 1153. In 2008-09, a similar harvest was conducted under the same contract in stand 730, with the prescription ranging from oak salvage in the northern two-thirds of the stand that experienced heavy mortality to small-diameter thinning where the soils provide somewhat better growing conditions closer to Matteson Road.

The hodgepodge of small stands immediately south of Matteson Road probably results from former use as a farm. The 1915 survey denotes two modest patches of arable land on either side of the small pond. Stands of red and jack pine were planted on these two open sites in 1938, thinned in 1970, and then almost completely harvested in 1999 prior to mortality due to the red pine scale and red pine adelgid. The present stands are mostly comprised of white pine and mixed hardwoods now that the former red pine plantations have been cut. In the 1960s and early 70s, the stand immediately south of the Tunk Hill Road/Matteson Road intersection (736) was thinned, underplanted with conifers and hardwoods, and subsequently released. Also during this period, white pine was planted within remaining open areas in stand 746 along the western property boundary to supplement existing natural pine regeneration and then followed by two release harvests.

Forest Health and Related Management

Like the rest of the Q Block and adjacent P Block, the Burnt Hill area is currently affected by several interconnected forest health issues that are heavily impacting this MU. The upland oak stands (696, 730, and 1153) are experiencing severe mortality due to a combination of factors including the poor soils and repeated defoliations from insects such as the forest tent caterpillar and the orange striped oakworm.

Regeneration is severely challenged in the upland oak stands due to the tall, dense shrub layer of blueberry and huckleberry in most places. Deer browsing is also evident, especially on oaks and other hardwood species. Regeneration – in particular white pine – is better in the stands near Matteson Road where it is not impeded by dense blueberry.

Stands 740 and 744 are in an early successional phase of stand development following the harvesting of the red pine. Brushy stand 744 in particular may offer good habitat for the increasingly rare New England cottontail rabbit, which is being considered for protection under the federal Endangered Species Act. This same stand has a dense infestation of invasive buckthorn that is spreading into adjacent stands, including 740, and the buckthorn will be treated (probably using herbicide application and/or mechanical mowing) to help prevent its spread before any further management activities are undertaken in this area.

Silviculture

The sizeable upland acreage of this MU has limited management options, but the serious forest health problems should continue to be addressed and silvicultural intervention can promote white and pitch pine which are better suited to these sites than the upland oaks which have dominated the

overstory until being decimated by mortality. Where ground conditions are operable, rocky stand 696 will benefit from an oak salvage and firewood thinning in 2011. This harvest will resemble recent ones which have taken place in stands 730 and 1153.

The stands south of Matteson Road off the Q-5 firelane will continue to be managed for white pine and mixed hardwoods. With all the nearby recent harvesting driven by tree mortality and forest health concerns, these stands should be set aside from timber harvests for a few years but appropriately stocked stands will be evaluated for an improvement or crown thinning in 2016.

With its potential for providing suitable New England cottontail habitat, stand 744 is a good candidate for evaluation as a possible cooperative habitat improvement project with the NRCS or U.S. Fish & Wildlife Service. More detailed management planning in this area will need to weigh and consider the interrelationships between possible rabbit habitat, invasive buckthorn control, and active forest management.

Located on a north-facing slope adjacent to Tunk Hill Road in the eastern part of the MU, stand 697 is noteworthy in that it is listed in the management records as a (somewhat rare) natural stand of pitch and white pine. Since it does appear to be an “older growth” stand of pitch and white pine and a representative sample of what more of the forest used to be like in the Burnt Hill area, stand 697 will be designated a reserve set aside from timber management. This stand also provides an example of what more of PWSB’s upland stands might be like if the pitch pine component of the forest were restored to more closely resemble the likely pre-agricultural era species composition.

Cultural Resources

Compared to the rest of the PWSB ownership, the Burnt Hill MU contains relatively few cultural resources or artifacts of past land use. A fairly well preserved historic cemetery is located in stand 740 just west of the Q-5 firelane, possibly visible from the firelane gate on Matteson Road. This cemetery is managed according to the same policies as other historic cemeteries across the watershed forest, and unless trespassing or vandalism becomes a problem here there is no need establish a different approach for this cemetery.

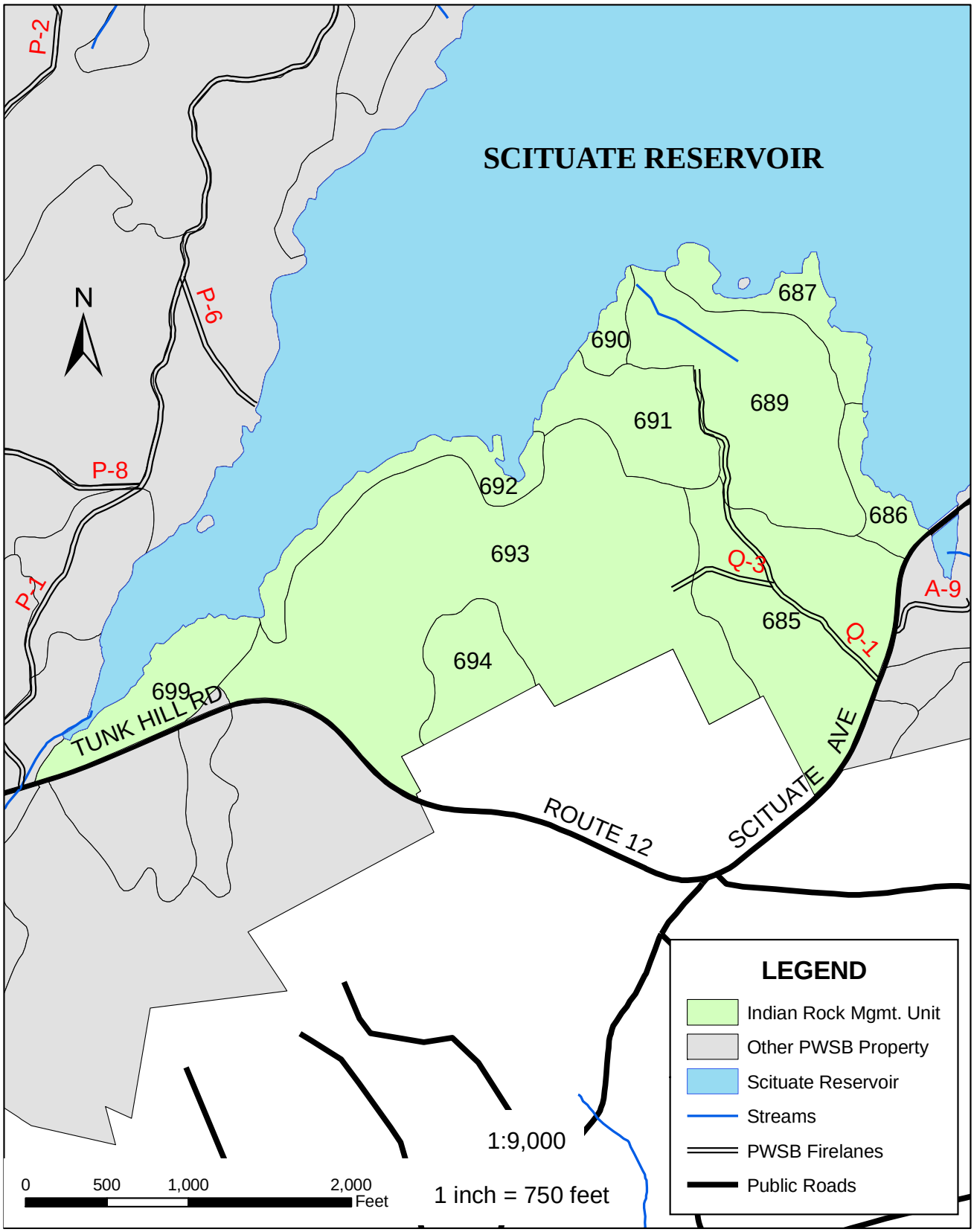
Burnt Hill MU Inventory Summary:

Stand	Acres	Type	Species	TPA	BA/ac	MSD	MBF/ac	Cds/ac	Regen/ac
696	72	H2B	UO	148	47	7.7	1.0	4.9	±417
697	13	M3A	WP/MO	235	137	10.0	10.7	10.5	±1,444
698	6	H2/3A	MH	190	105	10.0	4.8	9.3	±650
729	5	S2/3A	WP/-/UO	282	136	9.2	9.0	14.9	±730
730	106	M2/3B	UO/WP	135	58	8.8	2.4	3.8	±225
736	19	M2/3A	MO/WP	461	147	7.5	4.1	14.5	±900
737	17	M3A	WP/UO	235	137	10.0	10.7	10.5	±1,444
738	33	M2/3A	MH/WP	322	127	8.7	4.6	11.7	±550
740	5	S1/2C	WP/-/JP	55	20	8.2	1.4	0.4	±1,200
741	3	Water							
744	6	M1/2C	WP/MH	142	28	6.2	0.6	1.3	±525
745	9	M3B	MO/MS	153	98	10.8	8.3	6.7	±954
746	10	M2/3A	WP/MH	284	122	8.8	5.9	12.2	±889
747	<1	Water							
1153	45	H2C	UO	71	29	8.4	0.9	3.8	±573
1154	9	S2/3A	WP/-/MO	282	136	9.2	9.0	14.9	±730

Burnt Hill MU Management Activity Schedule:

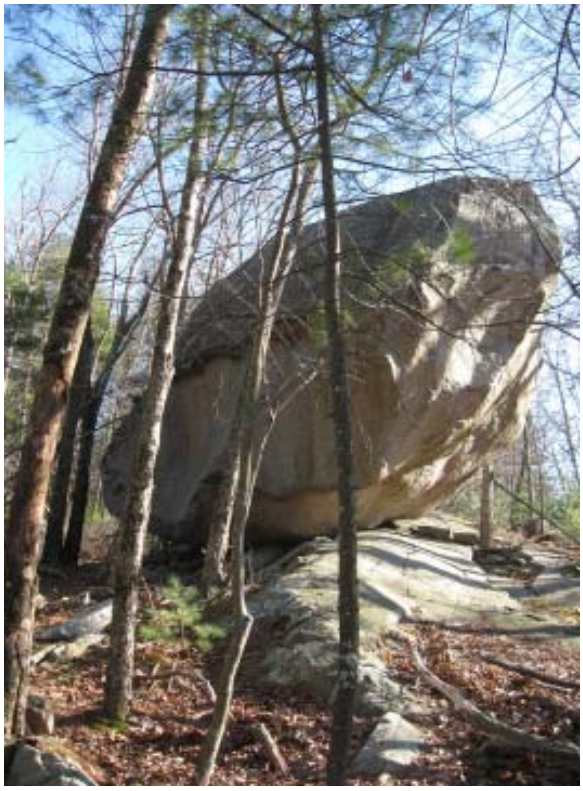
Stand	Type & Species	Activity	Acreage	Timeframe
696	H2B-UO	Oak salvage/firewood thinning	~50	2011
744	M1/2C-WP/MH	Evaluate for N.E. cottontail rabbit habitat improvement; invasive buckthorn treatment	6	2012-13
736, 745, 746, etc.	M2/3A MH, WP	Evaluate for improvement or crown thinning	TBD	2016

INDIAN ROCK MANAGEMENT UNIT



INDIAN ROCK MANAGEMENT UNIT

Location, Geography, and Access



The small Indian Rock Management Unit comprises about 190 acres in the eastern Q Block on the north side of Tunk Hill Road (Route 12) between the Gainer Dam and the small bay to the west where Coventry/ Knight Brook empties into the reservoir. This MU is essentially two contrasting halves, roughly equivalent in area, resulting from differences in terrain, past land use, and forest management history. Despite these differences, the two areas will be managed as one unit because of their contiguous geographic location on a peninsula and the limited vehicular access provided by the Q-1 through Q-4 firelanes, which do not connect with any other interior roads on the PWSB ownership. Located entirely in the eastern half MU, these woods roads have not been actively maintained for some time and only the first part Q-1 firelane is accessible to standard 4WD vehicles.

Existing Forest Description

Divided among several stands now dominated by white pine, the eastern half of the MU generally has a northeastern aspect and slopes from a low, flat ridge down to the Scituate Reservoir. Most of the western half is upland oak forest with the bulk of the acreage in one stand (693), and this area of jumbled topography contains some of the rockiest terrain and poorest growing sites on the entire PWSB property. A combination of factors is contributing to forest health problems in the upland oak stands here. Thin coniferous stands planted as leaf screens fringe most of the reservoir shoreline, and the white pine stand (699) adjacent to Knight/Coventry Brook at the far western end of the MU is more similar to the other stands in the eastern half.

Soils

Covering roughly two-thirds of the area, Canton and Charlton fine sandy loams on 3 - 25 % slopes are the dominant soil type, with varying degrees of rockiness. These soils are well drained and moderately productive with a site index of 58 for white pine and 52 for red oak. Other soils found in this MU include Bridgehampton, Gloucester-Hinckley, Narragansett, Sutton, and Ridgebury. All of these soils are well drained except for Ridgebury, which is poorly drained and is found along two small stream drainage areas, at least one of which is ephemeral. All but the Ridgebury soils have no operational limitations as they are well drained and typically do not hold water. The areas in Ridgebury may be too wet and will be excluded from future harvests if on-the-ground assessment determines that the threat to water quality outweighs the value of silviculture.

Past Land Use and Forest Management

At the time of the creation of the reservoir system, the 1915 PWSB land use survey recorded the highest percentage of this MU as woodland, but a large part of the central area furthest from the reservoir shoreline as brush. The only arable land was a small area in what is now the eastern part of stand 699.

Much of this MU has been managed for pine since planting of white and red pine (also some pitch pine) between 1930 and 1938. In some of the eastern areas, the pines were planted in open old fields, and elsewhere under an existing overstory of mixed oak and other hardwoods. Early silvicultural work focused on pruning. In the eastern area, a significant acreage of the planted mixed pine stands were thinned in 1956 and a stand of pure red pine (691) was released in 1957. During the 1960s, two thinnings occurred in the white pine stand east of the Coventry Brook. More recent harvests in 1998-99 and 2002-03 (in different stands) focused on removing the red pine prior to mortality from the red pine scale and red pine adelgid, with additional thinning of white pine and other species.

Forest Health and Related Management

Like the rest of the Q Block and adjacent P Block, the Indian Rock area is currently affected by several interconnected forest health issues that are heavily impacting a significant part of this MU. The upland oak stands (primarily 693, but also mixedwood stand 694) are experiencing severe mortality due to a combination of factors including the poor soils and repeated defoliations from insects such as the forest tent caterpillar and orange striped oakworm.

White pine regeneration is generally very good across much of this MU, encouraged by the recent thinnings despite ample lowbush blueberry on the drier sites. Deer browsing is evident, although not as severe as in other parts of the forest such as nearby P Block. Large stand 693 is a notable exception with its difficult growing conditions and a dense blueberry and huckleberry shrub layer providing little growing space for quality regeneration.

A dense infestation of buckthorn and Oriental bittersweet occupies an old landing site behind the roadside gate in stand 685 and these plants are spreading further into the stand. These invasives will be treated before the next harvest (probably using a combination of herbicide application and/or mechanical mowing) to help prevent their spread and to promote the establishment of native tree regeneration. Other than this location, the MU appears to be relatively free of invasives.

Silviculture

The eastern half of the Indian Rock MU will continue to be managed primarily for white pine, while maintaining the secondary hardwood component to retain species diversity and hard mast for wildlife. In 2012, these stands will be evaluated for a harvest that could combine a combination of thinning, shelterwood prep cut, group selection, and uneven-aged management prescriptions tailored to particular stands and sites. Some larger trees and groups of trees should be targeted for retention as legacy trees. The stands adjacent to the reservoir will be managed, but except for remaining dying red pine they will be harvested lightly due to their location and function as natural filter strips.

The rocky terrain and poor growing conditions offer limited options for Stand 693, but the serious forest health problems should be addressed. Silvicultural intervention can promote white and pitch pine which are best suited to this site. Where ground conditions are operable - and assuming that the wood remains merchantable and a logging contractor can be found - Stand 693 will benefit from an oak salvage and firewood thinning. This harvest will resemble recent ones that have taken place in nearby, similarly afflicted upland oak stands in the Q Block.

Stand 699 has very good established white pine regeneration and is ready for a second entry to follow the 1998-99 red pine harvest and white pine thinning. Due to its location, it makes sense to combine 699 in a harvest including adjacent stands 700 and 702 in the Tunk Hill MU (just as in the previous entry) and possibly others as well. The harvest in stands 700 and 702, however, cannot until be performed until the invasive buckthorn infestation in those nearby stands is controlled.

Cultural Resources

Located directly on top of a property corner in the southeast corner of stand 693 and accessed by the rough Q-4 firelane, the huge glacial erratic boulder known as Indian Rock is a well-known natural and cultural landmark in this MU. Indian Rock is a regular destination of Scituate elementary school class field trips guided by PWSB forestry staff. At present, the rock's true previous significance to tribal inhabitants is unknown although this has been a popular topic of local speculation. Although Indian Rock is undoubtedly a special site on the PWSB ownership, potential management activities will not physically impact the boulder so a special management area surrounding it is unnecessary. It makes sense to maintain appealing forest aesthetics in the vicinity of Indian Rock since it is a feature of interest to visitors, and if it is ever found to be of tribal significance additional measures may be considered in consultation with tribal members. Although none are as spectacular as Indian Rock, Stand 693 contains many other large glacial erratic boulders that, along with the varied topography, make for an interesting landscape.

At present, visitors to Indian Rock must walk there from Route 12 because the most of the standard route via sections of the old Q-1, Q-3, and Q-4 firelanes is impassable to vehicles. The trip through the woods to the boulder takes some time, especially for the school groups who are probably the most frequent visitors. PWSB could improve the woods roads leading to Indian Rock so that it is possible to drive to or near the boulder, making it more easily accessible. A different perspective is that keeping Indian Rock only accessible by foot maintains the special quality of the visitor experience and helps protect the site. A compromise would be to upgrade the Q-1 firelane (useful for fire control and timber harvest access) but not the spur roads. Away from Indian Rock, the spur roads in this small MU should no longer be designated "firelanes" or vehicle roads as they are not functioning as such and upgrading them is a relatively low priority.

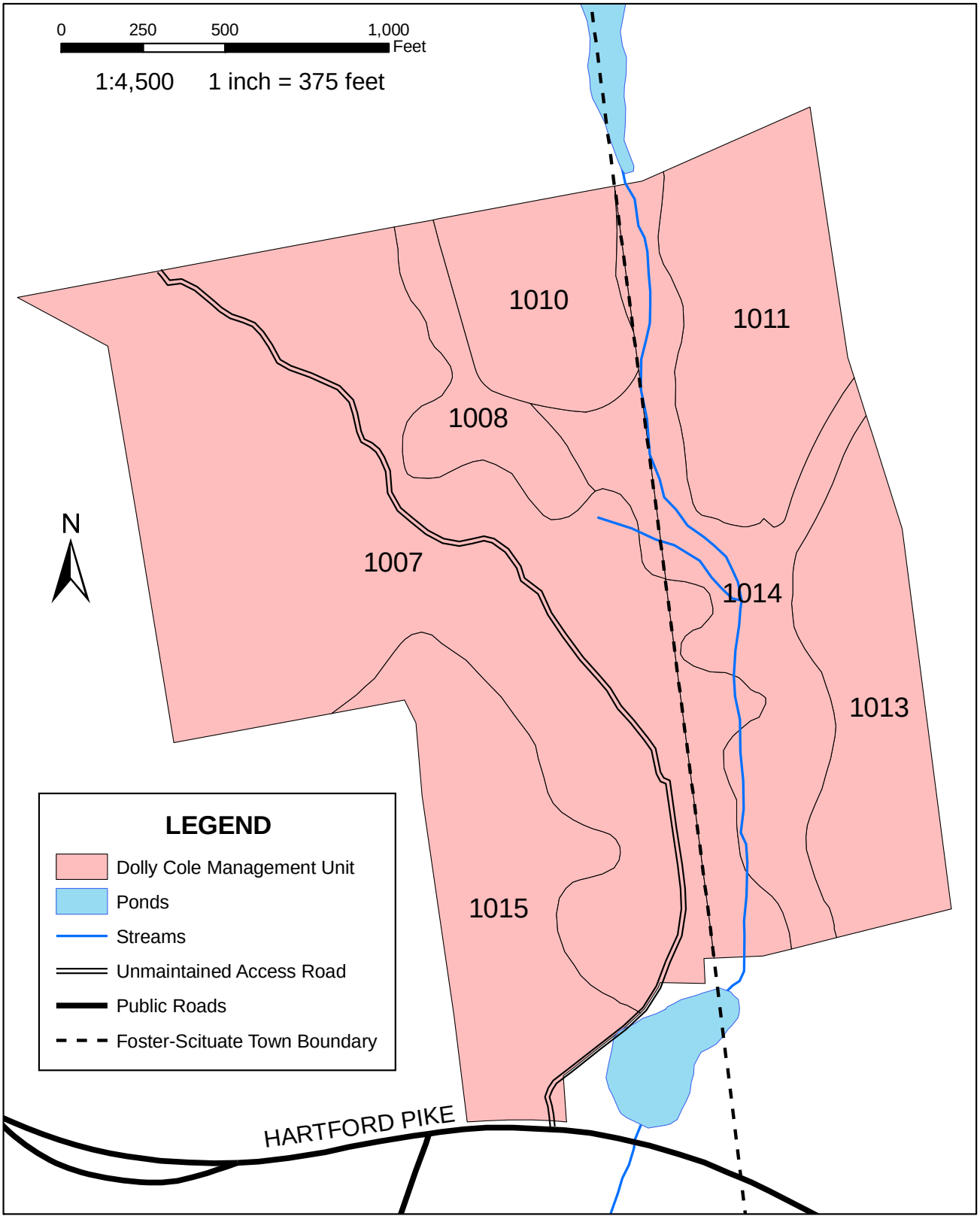
Indian Rock MU Inventory Summary:

Stand	Acres	Type	Species	TPA	BA/ac	MSD	MBF/ac	Cds/ac	Regen/ac
685	32	S3A	WP/-/MO	150	84	10.3	5.5	8.5	±11,760
686	4	S3A	WP	159	136	11.4	14.8	11.2	±6,196
687	8	S2/3B	RP/WP	247	115	9.2	7.5	15.3	±3,235
689	29	M2/3A	WP/MO	309	98	7.7	3.1	14.1	±840
690	3	S3A	WP	159	136	11.4	14.8	11.2	±6,196
691	13	S3A	WP/PP	203	110	9.7	8.3	12.8	±7,500
692	8	S3A	WP	159	136	11.4	14.8	11.2	±6,196
693	79	H2/3B	MO/WP	220	76	7.9	2.8	8.8	±1,093
694	8	S2/3B	WP	247	115	9.2	7.5	15.3	±3,235
699	11	S3A	WP/MH	153	120	12.0	12.7	10.4	±8,800

Indian Rock MU Management Activity Schedule:

Stand	Type & Species	Activity	Acreage	Timeframe
699	S3A-WP/MH	Shelterwood seed cut/group selection	11	2012
693	H2/3B-MO/WP	Oak salvage/firewood thinning	77	2012
Eastern stands	S3A WP, MO	Evaluate for harvest	TBD	2012

DOLLY COLE MANAGEMENT UNIT



DOLLY COLE MANAGEMENT UNIT

Location and Access

The small, isolated Dolly Cole MU encompasses 112 acres straddling the Foster-Scituate town line a short distance south of the Glocester border. Also known as the former D & M Concepts property, it is located on the north side of Hartford Pike (Route 101) and includes about 300 feet of road frontage next to an old mill pond. The other property lines are wooded. Purchased by Providence Water in 1991, this squarish parcel is an outlier since it is not contiguous to any of the historic PWSB ownership or other parcels targeted for acquisition. Just north of the property boundary are Brush Meadow Pond and Swamp, both created by a dam on private land. The outflow from the pond is the source of Dolly Cole Brook, which flows north-to-south through this MU and ultimately empties into the Barden Reservoir. Away from the brook and associated wetlands, the terrain is rolling with moderate slopes east and west of the pond outflow.

From the gate on Hartford Pike, a dirt road provides limited access to the interior of the MU on the west side of the brook. This road leads to an area that appears to have been used for gravel extraction in the past. The road and the old borrow pit are both becoming overgrown. For much of its length, the road is not currently accessible to vehicles other than ATVs. An adjacent landowner holds a right-of-way easement on this road to gain access to his property to the north.

Existing Forest Description

The forest within this MU is predominately mixed hardwood with a small mixedwood stand in the north-central part of the property. West of the Dolly Cole Brook corridor, stands 1007 and 1015 are predominately low-quality upland oaks (scarlet, black, and white) with an understory of huckleberry and blueberry that is typical for these sites. East of the stream and wetlands, the forest changes to mixed oak and hardwoods of higher timber quality. These stands include those species requiring richer sites such as Northern red oak, sugar maple, yellow birch, and white ash along with the other oaks, black birch, and hickory. Here, the understory includes witch-hazel, hornbeam, and hop hornbeam. The forested wetlands along the brook mainly support red maple, yellow birch, and green ash, with red oak in areas where hydric soils do not exclude its establishment and growth. A minor white pine component is present in all of these hardwood-dominated areas. True mixedwood composition is limited to a 7-acre white pine-hardwood stand (1010) on the west side of the brook near the northern boundary, where the pine is of sawlog size and of good form.

Soils

The forest types in this MU strongly mirror the underlying soils. The upland oak stands are found on rocky and well drained Canton and Charlton soils, which are relatively unproductive and have a site index of 58 for white pine and 52 for red oak. The white pine-hardwood stand is probably on the more productive Charlton portion of this soil complex. Moderately drained and more mesic Sutton

and Woodbridge series occupy the sites where the better hardwood stands are growing, with site indices of 62 to 67 for white pine, 62 to 72 for red oak, and 54 to 65 for sugar maple. Hydric Ridgebury soils are found along Dolly Cole Brook and in the forested wetlands. These soils cannot support logging equipment and the forested wetlands will be excluded from future timber harvests.

Past Land Use and Forest Management

Since the former D & M Concepts parcel was not acquired until 1991, Providence Water has no records concerning past land use and forest management activities on this property. Several stone walls are present and some of them delineate current property boundaries. Given the rocky soils, slopes, and wetlands, most of the acreage in this MU would have been considered undesirable farmland. There is no evidence of past plowing for crop agriculture, but some areas may have been used as unimproved pasture. Stone foundations of what was presumably once a small mill are located near the remains of an old breached dam along Dolly Cole Brook.

As for more recent land use, there are signs of gravel extraction along the edges of the access road. Larger rocks have been pushed to the edge of the main borrow pit and the slopes created when the gravel mining stopped are still apparent. No active forest management has taken place on this property since Providence Water purchased it and no recent logging activity (stumps, old tops, or basal scars) was noted at the time of acquisition.

Forest Health and Related Management

The upland oak stands in this MU have not been impacted by insects as heavily as similar areas elsewhere on the PWSB property. While these stands may not be overly productive or valuable, the majority of trees are alive and healthy. Since this MU is only 112 acres, hunting on adjacent lands or illegal hunting on this property may be keeping the deer impacts under control. During the field inventory, hardwood regeneration was observed on the better hardwood sites although its continued development remains uncertain. Witch hazel and other shrubs shade the forest floor on most of these sites and no openings were found where larger numbers of seedling and saplings would be expected. The access road and old borrow pit have filled in with white pine and some black birch.

Likely due to its secluded location and light human land use, invasive plants are absent from most of this MU. A notable exception is the access road and old borrow pit. Some autumn olive is present in these more open areas and other invasives may be found on the disturbed soils. Trying to prevent the spread of invasives into the adjacent forest is an important management goal. Although the light requirements of autumn olive should prevent it from becoming established in the closed-canopy forest, this population should be monitored. The access road should also be scanned for new invasives during property visits.

Silviculture

Relatively unproductive upland oak sites and forested wetlands occur on about 65 of the 112 acres of this MU (58% of the total area). About 30 acres could benefit from improvement thinning within the next 10 years, but harvesting in these areas will be delayed for 15-20 years to allow the white pine seedlings and saplings in the upland oak stands time to develop. This strategy will concentrate silvicultural treatments in one management entry. Between 2025 and 2030, the white pine in stand 1007 will be released from the overtopping oaks. Due to the irregular distribution of the natural pine (compared to stands that were underplanted), the release prescription will not be uniform but will provide additional growing space to individual trees. The growth rate of the white pine in the mixedwood stand (1010) will suffer from this delay and the ratio of live crown to tree height will

decrease. Thinning in this stand should be light to minimize the chance of windthrow and to allow the crowns of the residual trees to expand. At this time, the more productive hardwood stands (1011 and 1013) east of the brook corridor should be ready to begin being regenerated through a series of shelterwood cuts.

When planning future management activities in an ever-changing environment, the likelihood that they will be implemented as envisioned decreases as time from the planning date increases. With harvesting operations in this MU not scheduled until 15-20 years from the time of management plan preparation, many things could change. These areas will continue to be monitored and management modified if appropriate.

Cultural Resources

South of the current dam that impounds water to create Brush Meadow Pond, an old trail with several stone culverts leads to what appears to have been the site of a small mill along Dolly Cole Brook. Several stone foundations are located near the remains of an old breached dam which still restricts stream flow enough to form a small pool and wetlands. A number of large boulders make this an interesting spot with some sheltered growing sites. Elsewhere, this MU contains a number of stone walls now running through the woods.

Dolly Cole MU Inventory Summary:

Stand	Acres	Type	Species	TPA	BA/ac	MSD	MBF/ac	Cds/ac	Regen/ac
1007	51	H2A	UO/MO/MH	284	90	7.6	0.6	15.0	±933
1008	4	W2A	MH/RM	496	160	7.7	2.4	25.9	±50
1010	7	M3A	WP/MO	235	137	10.0	10.7	10.5	±1,444
1011	12	H3A	MO	184	116	10.6	7.2	8.6	±463
1013	11	H3A	MH/MO	184	116	10.6	7.2	8.6	±463
1014	14	W3A	RM/MH	183	130	11.3	5.4	19.4	±523
1015	13	H2/3A	MH/MO	190	105	10.0	4.8	9.3	±650

Dolly Cole MU Management Activity Schedule:

Stand	Type & Species	Activity	Acreage	Year
1007	H2A-UO/MH	White pine release harvest	46	2025
1010	M3A-WP/MO	Thinning	6	2025
1011	H3A-MO	Shelterwood seed thinning	11	2025
1013	H3A-MH/MO	Shelterwood seed thinning	9	2025

ACTIVITY SCHEDULE SUMMARY

Management Unit (MU)	Stand	Type & Species	Activity	Acres	Year
Ashland	424	M2/3A-MO/WP	Thinning	35	2011
Ashland	473	S1/2B-WP/MH	Thinning	2	2011
Ashland	474	S2/3B-RP/WP/PP	Thinning	4	2011
Ashland	475	M2/3A-MO/WP	Thinning	9	2011
Ashland	476	S2/3A-WP	Thinning	14	2011
Ashland	479	S2/3A-WP/UO	Thinning	28	2011
Ashland	480	M2/3B-WP/UO	Thinning	12	2011
Ashland	481	M2/3B-WP/UO	Thinning	10	2011
2012					
Ashland	452	M3A-WP/MO	Thinning	22	2012
Ashland	454	H3A-MO	Thinning	28	2012
Ashland	463	H3A-MO/-/MH	Thinning	44	2012
Ashland	489	S3B-WP/SP	Thinning	18	2012
Ashland	496	H2/3A-MO	Thinning & clearcut to enlarge early successional area with 497	61	2012
Ashland	497	Open	Manage for early successional growth	2	2012
Ashland	501	M2/3A-UO/WP	Thinning	12	2012
Burnt Hill	744	M1/2C-WP/MH	Treat invasive plants	6	2012
Elmdale	6	M2/3B-WP/MH	Monitor Japanese stiltgrass infestation	4	2012
Elmdale	55	M1D-WP/MH	Continue with conifer planting until all areas are restocked	9	2012
Indian Rock	699	S3A-WP/MH	Shelterwood/group selection	11	2012
Indian Rock	693	H2/3B-MO/WP	Oak salvage & thinning	77	2012
Peeptoad	115	S3A-RP/-/WP	Work with Town of Scituate to develop an action plan for this site	13	2012
Peeptoad	116	M1/2C-MH	Work with Town of Scituate to develop an action plan for this site	6	2012
Ram Tail	758	H2/3A-RM/MO	Thinning	17	2012
Ram Tail	759	S3A-WP	Shelterwood prep	5	2012
Ram Tail	760	S3A-WP	Shelterwood prep	5	2012
Ram Tail	761	H2/3A-MO	Thinning	2	2012
Ram Tail	762	M3B-WP/MO	Crown thinning	6	2012
Riverview	369	S3B-WP	Treat invasive plants	6	2012
Trimtown	240	H2/3A-MO/MH	Shelterwood/thinning & enlarge early successional area with 242	70	2012
Trimtown	242	Open	Enlarge early successional area	11	2012
Trimtown	244	H2/3A-UO/MO/WP	Shelterwood/improvement thinning	11	2012
Trimtown	245	M2/3A-MO/WP	Shelterwood/improvement thinning	21	2012
Trimtown	1064	H3B-UO	Improvement thinning	34	2012
Trimtown	1065	H3B-UO/MO	Enlarge early successional area w/ 242	17	2012

Management Unit (MU)	Stand	Type & Species	Activity	Acres	Year
2013					
Burnt Hill	744	M1/2C-WP/MH	Early successional habitat improvements	6	2013
Elmdale	6	M2/3B-WP/MH	Monitor Japanese stiltgrass infestation	4	2013
Elmdale	29	S2/3A-WP	Crown thinning	5	2013
Elmdale	125	S3A-WP	Crown thinning	6	2013
Elmdale	128	S3A-WP	Shelterwood prep cut	7	2013
Isthmus	950	MU-WP/MO	Thinning/group selection harvest	55	2013
Riverview	333	H2/3A-MO/WP	Improvement thinning/release white pine	60	2013
Riverview	368	H3A-MO	Shelterwood thinning	32	2013
Riverview	369	S3B-WP	Shelterwood seed cut	6	2013
Riverview	398	H2/3A-MO/WP	Improvement thinning/release white pine	78	2013
Swamp Brook	833	S3A-WP	Shelterwood release	8	2013
Swamp Brook	834	M2/3A-MH/WP	Improvement thinning	10	2013
2014					
Ashland	457	S3B-WP/MS/MH	Treat ferns and invasive plants	14	2014
Ashland	458	M3B-WP/MS	Treat ferns and invasive plants	7	2014
Ashland	459	M2/3B-WP/MH	Treat ferns and invasive plants	4	2014
Brandy Brook	185	S3A-WP	Crown thinning	7	2014
Brandy Brook	212	S3A-WP	Shelterwood seed cut	7	2014
Brandy Brook	214	M2/3A-UO/WP	Thinning	9	2014
Brandy Brook	220	M3A-MO/WP	Thinning	7	2014
Cork Brook	374	H1D-MH	Clearcut and manage for wildlife requiring early successional habitat	8	2014
Cork Brook	375	H3A-MO	Clearcut & manage for wildlife requiring early successional habitat w/ 374	4	2014
Cork Brook	389	S2/3A-WP	Thinning	25	2014
Cork Brook	390	S2/3B-WP	Thinning	20	2014
Cork Brook	392	M2A-WP/MH	Thinning	6	2014
Cork Brook	394	S3B-SP/WP	Irregular shelterwood	12	2014
Cork Brook	396	M2/3A-WP/MO/MS	Improvement thinning	16	2014
Cork Brook	822	H3A-MO/-/WP	Shelterwood seed thinning	24	2014
Cork Brook	1111	H3B-MO	Shelterwood thinning/group selection	4	2014
Cork Brook	1115	H3B-MO	Light shelterwood seed cut	11	2014
Cork Brook	1118	M3A-WP/MO	Shelterwood seed thinning	4	2014
Elmdale	6	M2/3B-WP/MH	Monitor Japanese stiltgrass infestation	4	2014
Elmdale	55	M1D-WP/MH	Continue with conifer planting until all areas are restocked	9	2014
Trimtown	140	H2A-MO/MH	Treat invasive plants	2	2014
Trimtown	142	S3B-WP	Treat invasive plants	10	2014

Management Unit (MU)	Stand	Type & Species	Activity	Acres	Year
Trimtown	202	S3B-WP	Treat ferns	4	2014
Trimtown	248	S3A-WP	Treat ferns	11	2014
Tunk Hill	709	S3A-WP	Thinning	70	2014
Tunk Hill	525	M2/3A-MO/WP	Improvement thinning	26	2014
Tunk Hill	584	M2/3A-MO/WP	Improvement thinning	125	2014
Tunk Hill	530	S3A-WP	Shelterwood thinning	15	2014
Waterman	325	S3B-WP/-/MH	Thinning	100	2014
Waterman	327	H2/3A-MO/WP	Thinning	6	2014
2015					
Burton Pond	1133	Open	Wildlife habitat improvement	2	2015
Burton Pond	1135	Open	Wildlife habitat improvement	1	2015
Burton Pond	1136	Open	Wildlife habitat improvement	5	2015
Elmdale	6	M2/3B-WP/MH	Monitor Japanese stiltgrass infestation	4	2015
Elmdale	55	M1D-WP/MH	Continue with conifer planting until all areas are restocked	9	2015
Joslin Farm	553	M3A-WP/MH	Treat invasive plants	20	2015
Joslin Farm	554	S3B-WP	Treat invasive plants	6	2015
Joslin Farm	555	S3A-WP	Treat invasive plants	<23	2015
Joslin Farm	550	H3A-MO	Slot thinning	131	2015
Joslin Farm	551	H3A-MO	Slot thinning	98	2015
Joslin Farm	1146	H2A-UO/WP	Release white pine	13	2015
Moswansicut	113	S3B-WP	Treat invasive plants	22	2015
Riverview	400	M2/3A-MO/WP	Improvement thinning/release white pine	92	2015
Riverview	401	S3B-WP	Shelterwood partial release	18	2015
Trimtown	140	H2A- MO/MH	Improvement thinning	2	2015
Trimtown	142	S3B -WP	Shelterwood thinning	10	2015
Trimtown	163	S3C-WP	Shelterwood overstory removal	7	2015
Trimtown	171	S3C-SP/WP	Shelterwood overstory removal	4	2015
Trimtown	195	S3A-WP	Shelterwood thinning	2	2015
Trimtown	202	S3B-WP	Shelterwood thinning	4	2015
Trimtown	248	S3A-WP	Shelterwood thinning	11	2015
Westconnaug	910	N/A	Treat invasive plants	<1	2015
Westconnaug	919	N/A	Treat invasive plants	<1	2015
2016					
Ashland	457	S3B-WP/MS/MH	Shelterwood seed cut	14	2016
Ashland	458	M3B-WP/MS	Shelterwood seed cut	7	2016
Ashland	459	M2/3B-WP/MH	Shelterwood seed cut	4	2016
Burnt Hill	736	M2/3A-MH/WP	Crown thinning	19	2016

Management Unit (MU)	Stand	Type & Species	Activity	Acres	Year
Burnt Hill	746	M22/3A-WP/MH	Crown thinning	10	2016
Hemlock Road	812	H2/3A-RM/MO	Selection harvest	20	2016
Hemlock Road	899	M2/3A-MH/MS	Improvement thinning	18	2016
Moswansicut	113	S3B-WP	Shelterwood overstory removal	22	2016
2017					
Hemlock Road	858	M3A-MO/WP	Improvement thinning	18	2017
Hemlock Road	866	S3A-WP	Shelterwood/group selection	35	2017
Hemlock Road	867	M3A-WP/MH	Shelterwood/group selection	21	2017
Remington	885	S3B-WP/RP/SP	Control invasives	16	2017
Tunk Hill	700	S3A-WP	Shelterwood/group selection	12	2017
Tunk Hill	702	S3A-WP	Shelterwood/group selection	12	2017
Tunk Hill	731	S2A-MS	Improvement Thinning	6	2017
Tunk Hill	735	M2/3A-MO/WP	Improvement Thinning	7	2017
Tunk Hill	1147	M2/3A-WP/UO	Thinning	72	2017
Waterman	159	S3B-WP/SP/RP	Irregular shelterwood overstory removal	39	2017
Waterman	175	M2/3B-MO/WP	Group selection	4	2017
Westconnaug	920	S3B-WP	Shelterwood prep cut	29	2017
2018					
Brandy Brook	152	M1D-MH	Treat invasive plants	3	2018
Brandy Brook	157	S3B-WP	Treat invasive plants	6	2018
Brandy Brook	158	S3B-SP/-/WP	Treat invasive plants	7	2018
Brandy Brook	177	S1/2C-WP	Treat invasive plants	10	2018
Brandy Brook	183	S1/2C-WP	Treat invasive plants	4	2018
Brandy Brook	223	M3B-WP/MO	Treat invasive plants	6	2018
Isthmus	921	MU-WP/MO/MH	Individual/group selection harvest	46	2018
Isthmus	930	SU-WP/-/MO	Individual/group selection harvest	94	2018
Ram Tail	753	M3A-MO/WP	Group selection/thinning	8	2018
Ram Tail	755	H3A-MO/RM	Group selection/thinning	11	2018
Ram Tail	1122	M3A-MH/WP	Group selection/thinning	21	2018
Waterman	252	H3A-MO/WP	Shelterwoood thinning/group selection	21	2018
Waterman	253	S2/3A-WP	Wildlife clearcut with planting for early successional habitat	6	2018
Waterman	254	M2/3A-MH/SP	Wildlife clearcut with planting for early successional habitat	7	2018
Waterman	262	S3B-WP/MS	Shelterwood thinning	18	2018
Waterman	263	H3A-MO	Shelterwoood thinning/group selection	13	2018
Waterman	264	M3A-WP/MO	Group selection	12	2018
Waterman	319	M3C-MO/WP	Group selection	9	2018

Management Unit (MU)	Stand	Type & Species	Activity	Acres	Year
Waterman	321	M3B-MO/WP	Group selection	32	2018
Waterman	324	M2/3A-WP/MO/MH	Group selection	18	2018
Waterman	1090	S3A-WP	Shelterwood thinning	7	2018
2019					
Betty Pond	442	H2/3A-MO/UO	Group selection	30	2019
Betty Pond	443	H3A-MO	Group selection	22	2019
Betty Pond	448	H3B-MO/-/WP	Selection harvest	24	2019
Betty Pond	449	M2/3B-WP/MO	Selection harvest	53	2019
Quonopaug	295	M3A-MO/WP	Overstory removal	13	2019
Quonopaug	298	S3A-WP	Overstory removal	35	2019
Quonopaug	302	S3B-WP	Overstory removal	8	2019
Quonopaug	307	H3A-MO/MH	Overstory removal	12	2019
Quonopaug	309	M3B-MO/WP	Overstory removal	16	2019
Quonopaug	310	S3B-WP	Overstory removal	8	2019
Quonopaug	313	M3B-WP/MO	Overstory removal	11	2019
Quonopaug	314	S3B-WP	Overstory removal	12	2019
Quonopaug	304	M1/2C-RM/WP	Thinning	4	2019
Quonopaug	312	S1/2A-WP	Thinning	9	2019
Remington	882	S3A-WP/RP	Shelterwood	22	2019
Remington	883	S3B-WP	Shelterwood	53	2019
Remington	888	M2/3A-UO/MS	Improvement thinning	18	2019
2020					
Brandy Brook	187	S2/3A-WP/MO	Shelterwood seed cut	17	2020
Brandy Brook	213	S3A-WP	Shelterwood seed cut	7	2020
Brandy Brook	225	S3A-WP	Shelterwood seed cut	7	2020
Brandy Brook	241	S3A-WP	Shelterwood seed cut	2	2020
Brandy Brook	177	S1/2C-WP	Thinning	9	2020
Brandy Brook	227	S2C-WP/MO/MS	Thinning	9	2020
Cork Brook	386	M3B-WP/MO	Group/single tree/ patch cuts for multi-aged management	26	2020
Cork Brook	1112	H3B-MO/RM	Shelterwood thinning/group selection	3	2020
Cork Brook	1115	H3B-MO	Overstory removal	11	2020
Peeptoad	5	S3C-WP	Shelterwood overstory removal	7	2020
Peeptoad	16	S3C-WP	Shelterwood overstory removal	11	2020
Peeptoad	18	S3B-WP	Shelterwood seed thinning	8	2020
Peeptoad	19	S3B-WP	Shelterwood seed thinning	11	2020
Peeptoad	61	M3B-WP/MO	Selection harvest	12	2020

Management Unit (MU)	Stand	Type & Species	Activity	Acres	Year
2022					
Burton Pond	1127	S3A-WP	Thinning & group selection	14	2022
Burton Pond	1130	S3A-WP	Thinning & group selection	5	2022
Burton Pond	1132	S2/3A-WP/RM	Thinning & group selection	7	2022
Riverview	411	S3B-WP	Thinning	81	2022
Riverview	412	S3B-SP/WP	Shelterwood partial release	13	2022
2023					
Riverview	361	S3B-WP	Thinning	155	2023
2025					
Dolly Cole	1007	H2A-UO/MH	Release white pine	46	2025
Dolly Cole	1010	M3A-WP/MO	Thinning	6	2025
Dolly Cole	1011	H3A-MO	Shelterwood seed thinning	11	2025
Dolly Cole	1013	H3A-MH/MO	Shelterwood seed thinning	9	2025

REFERENCES

Barrett, J.W. 1995. *Regional Silviculture of the United States*. John Wiley & Sons, New York.

Bergey, H.T. and J.M. Beekman. 1979. *Management Plan for City of Providence Water Supply Board Watershed and Surrounding Lands*.

Butler, B.J. and E.H. Wharton. 2003. *The Forests of Rhode Island*. USDA Forest Service, Northeastern Research Station. NE-INF-155-02. In cooperation with Rhode Island Department of Environmental Management, Division of Forest Environment.

D'Amato, A. and P. Catanzaro. 2007. *Restoring Old-Growth Characteristics*. University of Massachusetts Extension publication.

Duffany, M., Milone, K., Sobetzer, J. and Super, K. 1999. *Forest Management Plan for the Providence Water Supply Board Scituate Reservoir Watershed Forest.*

Enser, R.W. and Lundgren J.A. 2006. *Natural Communities of Rhode Island*. A joint project of the RI DEM Natural Heritage Program and The Nature Conservancy of RI.

Foster, D.R. and J.D. Aber. 2004. *Forests in Time: The Environmental Consequences of 1,000 Years of Change in New England*. Yale University Press, New Haven, CT.

Town of Glocester, Rhode Island, municipal website. "Our Town." Retrieved May 15, 2009, from http://www.glocesterri.og/ourtown.htm

Heritage Room Committee. 1998. *Scituate, Rhode Island* (Images of America series). Arcadia Publishing, Dover, NH.

Ice, G.G. 2009. Comments on "Using Forestry to Secure America's Water Supply." *Journal of Forestry.* 107(3):150.

Molloy, D.S. "Mass Transit in Rhode Island." *Quahog.org.* Retrieved May 18, 2009, from http://www.quahog.org/factsfolklore/index.php?id=73

Northeast States Emergency Consortium (NESEC) website. Retrieved October 28, 2010 from http://www.nesec.org/hazards/hurricanes.cfm.

Oehler, J.D. et al. 2006. *Managing Grasslands, Shrublands, and Young Forest Habitats for Wildlife: A Guide for the Northeast.* Massachusetts Division of Fisheries & Wildlife, Northeast Upland Technical Committee.

Providence Water website. "History of Providence Water and the Scituate Reservoir." Retrieved May 19, 2009, from http://www.provwater.com/history.htm

Quinn, A.W. 1976. *Rhode Island Geology for the Non-Geologist*. Rhode Island Department of Natural Resources publication.

Rector, D.D, 1981. *Soil Survey of Rhode Island*. USDA Soil Conservation Service. In cooperation with Rhode Island Agricultural Experiment Station.

State of Rhode Island General Assembly website. Rhode Island History. Retrieved May 15, 2009, from http://www.rilin.state.ri.us/studteaguide/RhodeislandHistory/rodehist.html

Town of Scituate, Rhode Island, municipal website. “History of Scituate.” Retrieved May 15, 2009, from http://www.scituateri.org

Tremblay, M.J. 1997. *Forest Management Plan for the Providence Water Supply Board Scituate Reservoir Watershed Forests.*

Widmann, R.H. 2002. *Trends in Rhode Island Forest: A Half-Century of Change*. USDA Forest Service report. In cooperation with Rhode Island Department of Environmental Management, Division of Forest Environment.

Wright W.R. and E.H. Sautter. 1988. *Soils of Rhode Island Landscapes*. University of Rhode Island Agricultural Experiment Station and USDA Soil Conservation Service. Bulletin No. 492.

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