

**FOREST STEWARDSHIP-GREEN CERTIFICATION MANAGEMENT PLAN FOR THE PROPERTY OF THE  
CITY OF HOLYOKE WATER WORKS  
THE TIGHE CARMODY WATERSHED LAND  
c/o David Conti, Manager  
20 Commercial Street-Holyoke, MA 01040  
[contid@holyoke.org](mailto:contid@holyoke.org)**

**Forest lands located on Fomer Road in Southampton and Montgomery, Massachusetts  
TOTAL FORESTED AREA 2,384.9 ACRES**



**Submitted By: Wigmore Forest Resource Management 1637 West Road, Williamsburg, Ma 10196  
Foresters: Mary K. Wigmore (MFL 250) and John W. LeBlanc (CA RPF 2324)  
Technicians: Kurt P. Wigmore Richard Valcourt (MLF 277)**

**Invasive Plant Consultation: Chris Polatin**



# FOREST MANAGEMENT PLAN

Submitted to: Massachusetts Department of Conservation and Recreation  
For enrollment in CH61/61A/61B and/or Forest Stewardship Program



CHECK-OFFS					Administrative Box			
CH61 cert. <input type="checkbox"/>	CH61A cert. <input type="checkbox"/>	CH61B cert. <input type="checkbox"/>	STWSHP new <input checked="" type="checkbox"/>	C-S EEA <input checked="" type="checkbox"/>	Case No. _____	Orig. Case No. _____	Owner ID _____	Add. Case No. _____
recert. <input type="checkbox"/>	recert. <input type="checkbox"/>	recert. <input type="checkbox"/>	renew <input type="checkbox"/>	Other <input type="checkbox"/>	Date Rec'd _____	Ecoregion _____	Plan Period _____	Topo Name _____
amend <input type="checkbox"/>	amend <input type="checkbox"/>	amend <input type="checkbox"/>	Green Cert <input checked="" type="checkbox"/>	Conservation Rest. <input type="checkbox"/>	Rare Spp. Hab. _____	River Basin _____	CR Holder _____	
Plan Change: _____ to _____								

### OWNER, PROPERTY, and PREPARER INFORMATION

Property Owner(s) City of Holyoke – Holyoke Water Works  
 Mailing Address 20 Commercial Street, Holyoke, MA 01040 Phone 413.536.0442  
 Email Address \_\_\_\_\_

Property Location: Town(s) Southampton (S) / Montgomery (M) Road(s): Fomer Road

Plan Preparer Mary K. Wigmore Mass. Forester License # 250  
 Mailing Address 1637 West Road – Williamsburg, MA 01096 413.628.4594

### RECORDS

Assessor's Map No.	Lot/Parcel No.	Deed Book	Deed Page	Total Acres	Ch61/61A 61B Excluded Acres	Ch61/61A 61B Certified Acres	Stewshp Excluded Acres	Stewshp Acres
S-10	2	2329	137	230	0		106.1	123.9
S-17	10			115	0		0	115
S-16	2			314	0		0	314
TOTALS								

### Excluded Area Description(s) (if additional space needed, continue on separate paper)

Parcel 10 – 2 – 106.1 acres of this parcel fall within the White River watershed and are excluded from this plan.

Please see Page 1-a for the rest of the Assessor's Records and the excluded area description.

**HISTORY** Year acquired 1975 Year management began 1985

Are boundaries marked: Yes  blazed/painted/flagged/signs posted (circle all that apply)? No  Partially

What treatments have been prescribed, but not carried out (last 10 years if plan is a recert.)?

stand no. \_\_\_\_\_ treatment \_\_\_\_\_ reason \_\_\_\_\_  
 (if additional space needed, continue on separate page)

### Previous Management Practices (last 10 years)

Stand #	Cutting Plan #	Treatment	Yield	Acres	Date
_____	_____	_____	_____	_____	_____

### Remarks: (if additional space needed, continue on separate page)

Archive at City Hall missing-no deed copies in Holyoke and only one deed reference in Southampton tax records.

**RECORDS** (continued)

Assessor's Map No.	Lot/Parcel No.	Deed Book	Deed Page	Total Acres	Ch. 61/61A 61B <i>Excluded</i> Acres	Ch61/61A 61B <b>Certified</b> Acres	Stewshp <i>Excluded</i> Acres	Stewshp Acres
<u>S-9</u>	<u>2</u>	<u></u>	<u></u>	<u>39</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>39</u>
<u>S-9</u>	<u>5</u>	<u></u>	<u></u>	<u>100</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>100</u>
<u>S-16</u>	<u>3</u>	<u></u>	<u></u>	<u>1,774</u>	<u>0</u>	<u>0</u>	<u>372</u>	<u>1402</u>
<u>S-26</u>	<u>3</u>	<u>2329</u>	<u>137</u>	<u>16</u>	<u></u>	<u></u>	<u></u>	<u>16</u>
<u>S-26</u>	<u>9</u>	<u>2329</u>	<u>137</u>	<u>9</u>	<u></u>	<u></u>	<u></u>	<u>9</u>
<u>M-4</u>	<u>906</u>	<u></u>	<u></u>	<u>266</u>	<u></u>	<u></u>	<u></u>	<u>266</u>
<b>TOTALS</b>				<u>2,863</u>	<u></u>	<u></u>	<u>478.1</u>	<u>2,384.9</u>

**EXCLUDED AREA DESCRIPTION** (continued):

The 356.3-acre Tighe Carmody Reservoir is excluded from the Stewardship Program. The infrastructure zones below the dam (15.7 acres) are also excluded from the Stewardship Program inclusive of the spillway, the grass lower dam, and service access sites.

**HISTORY** (continued):

Owner(s) City of Holyoke-Holyoke Water Works Town(s) Southampton / Montgomery

**Landowner Goals**

Please **check** the column that best reflects the importance of the following goals:

Goal	Importance to Me			
	High	Medium	Low	Don't Know
Enhance the Quality/Quantity of Timber Products*	X			
Generate Immediate Income	X			
Generate Long Term Income	X			
Produce Firewood			X	
Defer or Defray Taxes				
Promote Biological Diversity	X			
Enhance Habitat for Birds	X			
Enhance Habitat for Small Animals	X			
Enhance Habitat for Large Animals	X			
Improve Access for Walking/Skiing/Recreation			X	
Maintain or Enhance Privacy	X			
Improve Hunting or Fishing			X	
Preserve or Improve Scenic Beauty	X			
Protect Water Quality	X			
Protect Unique/Special/ Cultural Areas	X			
Attain Green Certification	X			
Other:				

\*This goal must be checked "HIGH" if you are interested in classifying your land under Chapter 61/61A.

In your own words, describe your goals for the property:

**Stewardship Purpose**

By enrolling in the Forest Stewardship Program and following a Stewardship Plan, I understand that I will be joining with many other landowners across the state in a program that promotes ecologically responsible resource management through the following actions and values:

1. Managing sustainably for long-term forest health, productivity, diversity, and quality.
2. Conserving or enhancing water quality, wetlands, soil productivity, carbon sequestration, biodiversity, cultural, historical and aesthetic resources.
3. Following a strategy guided by well-founded silvicultural principles to improve timber quality and quantity when wood products are a goal.
4. Setting high standards for foresters, loggers and other operators as practices are implemented; and minimizing negative impacts.
5. Learning how woodlands benefit and affect surrounding communities, and cooperation with neighboring owners to accomplish mutual goals when practical.

Signature(s):  \_\_\_\_\_

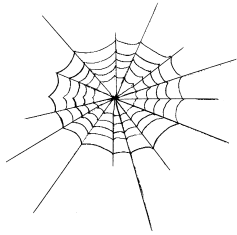
Date: 6/29/15

Owner(s) (print) City of Holyoke -Holyoke Water Works

Page 2 of \_\_\_\_\_

## Stewardship Issues

Massachusetts is a small state, but it contains a tremendous variety of ecosystems, plant and animal species, management challenges, and opportunities. This section of your plan will provide background information about the Massachusetts forest landscape as well as issues that might affect your land. **The Stand Descriptions and Management Practices sections of your plan will give more detailed property specific information** on these subjects tailored to your management goals.



**Biodiversity:** Biological diversity is, in part, a measure of the variety of plants and animals, the communities they form, and the ecological processes (such as water and nutrient cycling) that sustain them. With the recognition that each species has value, individually and as part of its natural community, maintaining biodiversity has become an important resource management goal.

While the biggest threat to biodiversity in Massachusetts is the loss of habitat to development, another threat is the introduction and spread of invasive non-native plants. Non-native invasive like European Buckthorn, Asiatic Bittersweet, and Japanese Honeysuckle spread quickly, crowding out or smothering native species and upsetting and dramatically altering ecosystem structure and function. Once established, invasive plants are difficult to control and even harder to eradicate. Therefore, vigilance and early intervention are paramount.

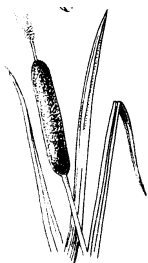
Another factor influencing biodiversity in Massachusetts concerns the amount and distribution of forest growth stages. Wildlife biologists have recommended that, for optimal wildlife habitat on a landscape scale, 5-15% of the forest should be in the seedling stage (less than 1" in diameter). Yet we currently have no more than 2-3% early successional stage seedling forest across the state. There is also a shortage of forest with large diameter trees (greater than 20"). See more about how you can manage your land with biodiversity in mind in the "Wildlife" section below. (Also, refer to *Managing Forests to Enhance Wildlife Diversity in Massachusetts* and *A Guide to Invasive Plants in Massachusetts* in the binder pockets.)



**Rare Species:** Rare species include those that are **threatened** (abundant in parts of its range but declining in total numbers, those of **special concern** (any species that has suffered a decline that could threaten the species if left unchecked), and **endangered** (at immediate risk of extinction and probably cannot survive without direct human intervention). Some species are threatened or endangered globally, while others are common globally but rare in Massachusetts.

Of the 2,040 plant and animal species (not including insects) in Massachusetts, 424 are considered rare. About 100 of these rare species are known to occur in woodlands. Most of these are found in wooded wetlands, especially vernal pools. These temporary shallow pools dry up by late summer, but provide crucial breeding habitat for rare salamanders and a host of other unusual forest dwelling invertebrates. Although many species in Massachusetts are adapted to and thrive in recently disturbed forests, rare species are often very sensitive to any changes in their habitat

Indispensable to rare species protection is a set of maps maintained by the Division of Fisheries and Wildlife's Natural Heritage & Endangered Species Program (NHESP) that show current and historic locations of rare species and their habitats. The maps of your property will be compared to these rare species maps and the result indicated on the upper right corner of the front page of the plan. Prior to any regulated timber harvest, if an occurrence does show on the map, the NHESP will recommend protective measures. Possible measures include restricting logging operations to frozen periods of the year, or keeping logging equipment out of sensitive areas. You might also use information from NHESP to consider implementing management activities to improve the habitat for these special species.



**Riparian and Wetlands Areas:** Riparian and wetland areas are transition areas between open water features (lakes, ponds, streams, and rivers) and the drier terrestrial ecosystems. More specifically, a **wetland** is an area that has hydric (wet) soils and a unique community of plants that are adapted to live in these wet soils. Wetlands may be adjacent to streams or ponds, or a wetland may be found isolated in an otherwise drier landscape. A **riparian area** is the transition zone between an open water feature and the uplands (see Figure 1). A riparian zone may contain wetlands, but also

includes areas with somewhat better drained soils. It is easiest to think of riparian areas as the places where land and water meet.

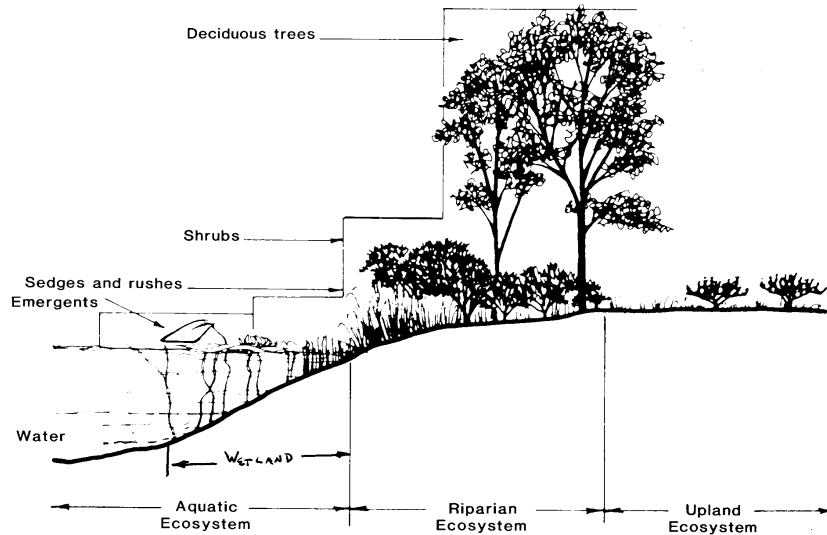


Figure 1: Example of a riparian zone.

The presence of water in riparian and wetland areas make these special places very important. Some of the functions and values that these areas provide are described below:

**Filtration:** Riparian zones capture and filter out sediment, chemicals, and debris before they reach streams, rivers, lakes, and drinking water supplies. This helps to keep our drinking water cleaner, and saves communities money by making the need for costly filtration much less likely.

**Flood control:** By storing water after rainstorms, these areas reduce downstream flooding. Like a sponge, wetland and riparian areas absorb storm water, and then release it slowly over time instead of in one flush.

**Critical wildlife habitat:** Many birds and mammals need riparian and wetland areas for all or part of their life cycles. These areas provide food and water, cover, and travel corridors. They are often the most important habitat feature in Massachusetts' forests.

**Recreational opportunities:** Our lakes, rivers, streams, and ponds are often focal points for recreation. We enjoy them when we boat, fish, swim, or just sit and enjoy the view.

In order to protect wetlands and riparian areas and to prevent soil erosion during timber harvesting activities, Massachusetts promotes the use of "Best Management Practices" or BMPs. Maintaining or reestablishing the protective vegetative layer and protecting critical areas are the two rules that underlie these common sense measures. DCR's Massachusetts Forestry Best Practices Manual (included with this plan) details both the legally required and voluntary specifications for log landings, skid trails, water bars, buffer strips, filter strips, harvest timing, and much more.

The two Massachusetts laws that regulate timber harvesting in and around wetlands and riparian areas are the Massachusetts Wetlands Protection Act (CH 131), and the Forest Cutting Practices Act (CH132). Among other things, CH132 requires the filing of a cutting plan and on-site inspection of a harvest operation by a DCR Service Forester to ensure that required BMPs are being followed when a commercial harvest exceeds 25,000 board feet or 50 cords (or combination thereof).



**Soil and Water Quality:** Forests provide a very effective natural buffer that holds soil in place and protects the purity of our water. The trees, understory vegetation, and the organic material on the forest floor reduce the impact of falling rain, and help to insure that soil will not be carried into our streams and waterways.

To maintain a supply of clean water, forests must be kept as healthy as possible. Forests with a diverse mixture of vigorous trees of different ages and species can better cope with periodic and unpredictable stress such as insect attacks or windstorms.



Timber harvesting must be conducted with the utmost care to ensure that erosion is minimized and that sediment does not enter streams or wetlands. Sediment causes turbidity, which degrades water quality and can harm fish and other aquatic life. As long as Best Management Practices (BMPs) are implemented correctly, it is possible to undertake active forest management without harming water quality.



**Forest Health:** Like individual organisms, forests vary in their overall health. The health of a forest is affected by many factors including weather, soil, insects, diseases, air quality, and human activity. Forest owners do not usually focus on the health of a single tree, but are concerned about catastrophic events such as insect or disease outbreaks that affect so many individual trees that the whole forest community is impacted.

Like our own health, it is easier to prevent forest health problems than to cure them. This preventative approach usually involves two steps. First, it is desirable to maintain or encourage a wide diversity of tree species and age classes within the forest. This diversity makes a forest less susceptible to a single devastating health threat. Second, by thinning out weaker and less desirable trees, well-spaced healthy individual trees are assured enough water and light to thrive. These two steps will result in a forest of vigorously growing trees that is more resistant to environmental stress.



**Fire:** Most forests in Massachusetts are relatively resistant to catastrophic fire. Historically, Native Americans commonly burned certain forests to improve hunting grounds. In modern times, fires most often result from careless human actions.

The risk of an unintentional and damaging fire in your woods could increase because of logging activity if the slash (treetops, branches, and debris) is not treated correctly. Adherence to the Massachusetts slash law minimizes this risk. Under the law, slash is to be removed from buffer areas near roads, boundaries, and critical areas and lopped close to the ground to speed decay. Well-maintained woods roads are always desirable to provide access should a fire occur.

Depending on the type of fire and the goals of the landowner, fire can also be considered as a management tool to favor certain species of plants and animals. Today the use of prescribed burning is largely restricted to the coast and islands, where it is used to maintain unique natural communities such as sand plain grasslands and pitch pine/scrub oak barrens. However, state land managers are also attempting to bring fire back to many of the fire-adapted communities found elsewhere around the state.



**Wildlife Management:** Enhancing the wildlife potential of a forested property is a common and important goal for many woodland owners. Sometimes actions can be taken to benefit a particular species of interest (e.g., put up Wood Duck nest boxes). In most cases, recommended management practices can benefit many species, and fall into one of three broad strategies. These are **managing for diversity, protecting existing habitat, and enhancing existing habitat.**

**Managing for Diversity** – Many species of wildlife need a variety of plant communities to meet their lifecycle requirements. In general, a property that contains a diversity of habitats will support a more varied wildlife population. A thick area of brush and young trees might provide food and cover for grouse and cedar waxwing; a mature stand of oaks provides acorns for foraging deer and turkey; while an open field provides the right food and cover for cottontail rabbits and red fox. It is often possible to create these different habitats on your property through active management. The appropriate mix of habitat types will primarily depend on the composition of the surrounding landscape and your objectives. It may be a good idea to create a brushy area where early successional habitats are rare, but the same practice may be inappropriate in the area’s last block of mature forest.

**Protecting Existing Habitat** – This strategy is commonly associated with managing for rare species or those species that require unique habitat features. These habitat features include vernal pools, springs and seeps, forested wetlands, rocky outcrops, snags, den trees, and large blocks of unbroken forest. Some of these features are rare, and they provide the right mix of food, water, and shelter for a particular species or specialized community of wildlife. It is important to recognize their value and protect their function. This usually means not altering the feature and buffering the resource area from potential impacts.

**Enhancing Existing Habitat** – This strategy falls somewhere between the previous two. One way the wildlife value of a forest can be enhanced is by modifying its structure (number of canopy layers, average tree size, and density). Thinning out undesirable trees from around large crowned mast (nut and fruit) trees will allow these trees to grow faster and produce more food. The faster growth will also accelerate the development of a more mature forest structure, which is important for some species. Creating small gaps or forest openings generates groups of seedlings and saplings that provide an additional layer of cover, food, and perch sites.

Each of these three strategies can be applied on a single property. For example, a landowner might want to increase the habitat diversity by reclaiming an old abandoned field. Elsewhere on the property, a stand of young hardwoods might be thinned to reduce competition, while a “no cut” buffer is set up around a vernal pool or other habitat feature. The overview, stand description and management practice sections of this plan will help you understand your woodland within the context of the surrounding landscape and the potential to diversify, protect or enhance wildlife habitat.



**Wood Products:** If managed wisely, forests can produce a periodic flow of wood products on a sustained basis. Stewardship encompasses finding ways to meet your current needs while protecting the forest’s ecological integrity. In this way, you can harvest timber and generate income without compromising the opportunities of future generations.

Massachusetts forests grow many highly valued species (white pine, red oak, sugar maple, white ash, and black cherry) whose lumber is sold throughout the world. Other lower valued species (hemlock, birch, beech, red maple) are marketed locally or regionally, and become products like pallets, pulpwood, firewood, and lumber. These products and their associated value-added industries contribute between 200 and 300 million dollars annually to the Massachusetts economy.

By growing and selling wood products in a responsible way, you are helping to our society's demand for these goods. Harvesting from sustainably managed woodlands – rather than from unmanaged or poorly managed forest – benefits the public in a multitude of ways. The sale of timber, pulpwood, and firewood also provides periodic income that you can reinvest in the property; increasing its value and helping you meet your long-term goals. Producing wood products helps defray the costs of owning woodland, and helps private landowners keep their forestland undeveloped.



**Cultural Resources:** Cultural resources are the places containing evidence of people who once lived in the area. Whether a Native American village from 1,700 years ago, or the remains of a farmstead from the 1800's, these features all tell important and interesting stories about the landscape, and should be protected from damage or loss.

Massachusetts has a long and diverse history of human habitation and use. Native American tribes first took advantage of the natural bounty of this area over 10,000 years ago. Many of these villages were located along the coasts and rivers of the state. The interior woodlands were also used for hunting, traveling, and temporary camps. Signs of these activities are difficult to find in today's forests. They were obscured by the dramatic landscape impacts brought by European settlers as they swept over the area in the 17<sup>th</sup> and 18<sup>th</sup> centuries.

By the middle 1800's, more than 70% of the forests of Massachusetts had been cleared for crops and pastureland. Houses, barns, wells, fences, mills, and roads were all constructed as woodlands were converted for agricultural production. However, when the Erie Canal connected the Midwest with the eastern cities, New England farms were abandoned for the more productive land in the Ohio River valley, and the landscape began to revert to forest. Many of the abandoned buildings were disassembled and moved, but the supporting stonework and other changes to the landscape can be easily seen today.

One particularly ubiquitous legacy of this period is stone walls. Most were constructed between 1810 and 1840 as stone fences (wooden fence rails had become scarce) to enclose sheep within pastures, or to exclude them from croplands and hayfields. Clues to their purpose are found in

their construction. Walls that surrounded pasture areas were comprised mostly of large stones, while walls abutting former cropland accumulated many small stones as farmers cleared rocks turned up by their plows. Other cultural features to look for include cellar holes, wells, old roads and even old trash dumps.



**Recreation and Aesthetic Considerations:** Recreational opportunities and aesthetic quality are the most important values for many forest landowners, and represent valid goals in and of them. Removing interfering vegetation can open a vista or highlight a beautiful tree, for example. When a landowner's goals include timber, thoughtful forest management can be used to accomplish silvicultural objectives while also reaching recreational and/or aesthetic objectives. For example, logging trails might be designed to provide a network of cross-country ski trails that lead through a variety of habitats and reveal points of interest.

If aesthetics is a concern and you are planning a timber harvest, obtain a copy of this excellent booklet: *A Guide to Logging Aesthetics: Practical Tips for Loggers, Foresters & Landowners*, by Geoffrey T. Jones, 1993. (Available from the Northeast Regional Agricultural Engineering Service, (607) 255-7654, for \$7). Work closely with your consultant to make sure the aesthetic standards you want are included in the contract and that the logger selected to do the job executes it properly. The time you take to plan ahead of the job will reward you and your family many times over with a fuller enjoyment of your forest, now and well into the future.



**Invasive Species Management:** Invasive species pose immediate and long-term threats to the woodlands of MA. Defined as a non-native species whose introduction does or is likely to cause economic or environmental harm or harm to human, animal, or plant health, invasive plants are well-adapted to a variety of environmental conditions, out-compete more desirable native species, and often create monocultures devoid of biological diversity. The websites of the Invasive Plant Atlas of New England, [www.nbii-](http://www.nbii-)

[nin.ciesin.columbia.edu/ipane](http://nin.ciesin.columbia.edu/ipane), and the New England Wildflower Society, [www.newfs.org](http://www.newfs.org) are excellent sources of information regarding the identification and management of invasive plants. Some of the common invasive plants found in MA are listed below.

- Oriental Bittersweet (*Celastrus orbiculata*)
- Glossy Buckthorn (*Frangula alnus*)
- Multiflora Rose (*Rosa multiflora*)
- Japanese Barberry (*Berberis thunbergii*)
- Japanese Knotweed (*Fallopia japonica*)
- Autumn Olive (*Eleaagnus umbellata*)

Early detection and the initiation of control methods soon after detection are critical to suppressing the spread of invasive species. Selective application of the proper herbicide is often the most effective control method. See the next section for information on the use of chemicals in forest management activities.



### **Pesticide Use**

Pesticides such as herbicides, insecticides, fungicides, and rodenticides are used to control “pests.” A pest is any mammal, bird, invertebrate, plant, fungi, bacteria, or virus deemed injurious to humans and/or other mammals, birds, plants, etc. The most common forest management use of a pesticide by woodland owners is the application of herbicide to combat invasive species. MA DCR suggests using a management system(s) that promotes the development and adoption of environmentally friendly no-chemical methods of pest management that strives to avoid the use of chemical pesticides. If chemicals are used, proper equipment and training should be utilized to minimize health and environmental risks. In Massachusetts, the application of pesticides is regulated by the MA Pesticide Control Board. For more information, contact MA Department of Agricultural Resources (MDAR), Pesticide Bureau at (617) 626-1776

**On MA Private Lands Group Certification member properties**, no chemicals listed in CHEMICAL PESTICIDES IN CERTIFIED FORESTS: INTERPRETATION OF THE FSC PRINCIPLES AND CRITERIA, Forest Stewardship Council, Revised, and Approved, July 2002, may be used.

**This is your Stewardship Plan.** It is based on the goals that you have identified. The final success of your Stewardship Plan will be determined first, by how well you are able to identify and define your goals, and second, by the support you find and the resources you commit to implement each step.

It can be helpful and enjoyable to visit other properties to sample the range of management activities and see the accomplishments of others. This may help you visualize the outcome of alternative management decisions and can either stimulate new ideas or confirm your own personal philosophies. Do not hesitate to express your thoughts, concerns, and ideas. Keep asking questions! Please be involved and enjoy the fact that you are the steward of a very special place.



## Overview of the Forest

The 2,384.9 acre forested watershed surrounds 356.3 acre Tighe Carmody Reservoir along Fomer Road in Southampton, Hampshire County with a 250-acre section on Montgomery. The 270-degree view from the dam at Tighe Carmody Reservoir encapsulates shape and function of the Tighe Carmody Reservoir. A series of twelve small mountaintops swings around the Manhan River drainage basin. Some of the prominent peaks in the series are Lizzie Mountain and Bungy Mountain to the west, Breakneck Hill to the north, and the Wolf Hill formation to the east. These uplands collect and move water into the Manhan River valley. The general relief across the watershed is moderate to gentle slopes sweeping from all directions to the reservoir.

These forests grow in the natural landscape feature know as the Berkshire Transition Forest. The vegetation here shifts between the true northern hardwood groves (beech, birches, ash, and maples) of north Berkshire and Franklin County and the oak and hickory forest of southern New England. The entire 2,384.9 tract is forested with a mix of six basic forest types, which are combinations of red oak, white pine, hemlock, red maple, black birch, and hickory. The minor associated species within each forest stand varies between the true northern hardwood crops such as white ash, yellow birch, black cheery, and basswood, and the more southern species such as tulip poplar, scarlet oak, black oak, white oak, chestnut oak, and sassafras. Some species are usually found in both ecotypes such as aspen and paper birch. The matrix of species in each stand depends on elevation, soil moisture, and past land use history.

The forest resource supports a distinctly two-aged structure with the maturing overstory oak, mixed hardwood, and hemlock trees of the main canopy ranging in age from 130 to 190 years and the immature, mid-canopy layer ranging in age from 30 to 65 years of age. Past timber harvest, work and natural decline opens gaps in the two upper layers for the development seedlings and saplings (less than 30 years). The forest structure is biased to the older age classes, and some small pockets or individual trees are older than 190 years. Scattered old farm relics (mostly sugar maple, white oak, red oak, and hickory) and small groves of surviving hemlock may even be older than 250 years. The core species in all of the types (but the pure pine groves) is the stately, ecologically and commercially valuable red oak.

These forests are generally healthy, vigorous, and productive with the exception of the hemlock, white ash, and paper birch crops. The hemlock component is under attack by the elongated hemlock scale and the hemlock wooly adelgid. These pathogens are systematically destroying the genetically ancient *Tsuga* species east of the Appalachian Mountains. The full ramifications of their loss from the watershed forest ecosystem are not understood. White ash suffers environmental decline, and paper birch is short-lived specie with many stems approaching their biological maturity across the watershed.



The Berkshire Transition ecotype has the most extensive areas of Supporting Natural landscape capable of supporting a wide array of wildlife species. This particular un-fragmented block of forest habitat teems with the large wide-ranging species such as moose and bear as well as many smaller mammals. Healthy vigorous forest ecosystem correspondingly support vibrant diverse habitat. The watershed is a unique local treasure of biodiversity.

- **Purpose of the Plan:**

The City of Holyoke Water Works (HWW) is charged with the delivery of clean, potable water to the City of Holyoke. One hundred percent of the drinking water for Holyoke comes from the Tighe Carmody Reservoir. HWW operates under a waiver from The Massachusetts department of Environmental Protection for the filtration requirements of the Surface Water Treatment Rules, which were established in 1986 in response to the Safe Drinking Water Act. Water quality protection is the highest priority with any activity on the watershed. HWW accepts the working hypothesis that healthy, resilient forests are the best natural filter for water. The basic premise of this hypothesis is that these ideal watershed forest ecosystems will be maintained into perpetuity for the protection of their filtration function. The maintenance of a healthy forest requires its continual replacement through natural regeneration of the trees. This document explains the silvicultural techniques that HWW will apply to maintain and regenerate the watershed filtration forest upon the Tighe Carmody Reservoir watershed lands. Silviculture requires the harvesting of trees from the watershed, and this document explains the strategies for the protection of water quality during the necessary silvicultural projects for the regeneration of the forest. .

## **2. Principles Guiding Forest Watershed Management**

The science of watershed management continues to evolve, although many basic principles are long established and are now widely accepted as the precedent for the stewardship of watershed lands. We present the following information with the permission of the Massachusetts Department of Conservation and Recreation, Division of Water Supply Protection, Office of Watershed Management. The discussion summarizes the current principles in watershed protection, water yields, water quality maintenance, the value of forest cover for water protection, the impact of disturbance on the delivery of high quality water from forested watersheds, and the role of active forest management in developing resistance and resilience in the water supply protected forest. This section is presented as the scientific defense for the City of Holyoke's watershed forest management program on the Tighe Carmody Reservoir watershed lands. The focus is on water quality, which can be directly impacted by active silviculture work. Although water yield is important to watershed management, the proposed silvicultural program restricts harvest levels below the 25% cover removal threshold for yield increases.

### **2.1 General Watershed Management Principles**

#### **2.1.1 Watershed Protection**

- Forested watersheds generally yield higher water quality than non-forested cover types.
- Maintaining vigorously growing forests across a vast majority of the watershed provides the best regulation of nutrients in a watershed.
- Watershed management activities depend upon an adequate, well-designed, and well-maintained watershed road system. Poorly designed or inadequately maintained roads represent the greatest potential source of sediment inputs into tributaries on undeveloped watersheds.

### 2.1.2 Water Quality

- Surface water collected from fully vegetated watersheds with minimal exposed soils generally carries low turbidity.
- In actively managed forests, Best Management Practices, correctly designed and applied effectively will protect water sources from sediment/nutrient losses otherwise associated with forest management work.
- The most common sources of water quality degradation by timber harvesting are intersections in harvesting roads and staging areas near water sources. Disconnecting roads/staging areas from water sources prevents this degradation.
- To prevent contamination of surface or ground waters, petroleum products on water supply watersheds must be tightly regulated.
- Maintaining a species and age/size diverse forest cover may increase the forest's resistance to natural disturbance. Active forest management can increase size and species diversity of forest cover.

### 2.1.3 Forests and Water Quality

- No land cover can be shown to protect the quality of drinking water better than forest cover.

### 2.1.4 The Value of Forests in Protecting Drinking Water Supplies

- No other watershed cover or land use exceeds the purifying role of forests for protecting drinking water supplies.
- Forested watersheds supply drinking water protection and deliver open space and its associated values, protect both rare and common species and their habitats, support rural economies with renewable, sustainable wood production, and reduce dependence on long distance transportation of natural resources.

### 2.1.5 The Effects of Management and Ecosystem Resilience: The Working Hypothesis

- The ideal watershed protection forest has the capacity to recover from natural disturbances with or without active forest management.
- The scientific literature demonstrates that there are opportunities to enhance these natural processes through active management.
- Good regeneration processes in the watershed forest is developed through frequent harvest disturbances, which mimic natural processes.
- Natural catastrophic disturbances occur on the watershed, such as fire.
- Healthy, well-distributed diverse age groups and size classes across the watershed increase the forest's ability to withstand these occurrences
- This natural resiliency of the forested watershed derives from the enhanced vigor of the individual trees on the watershed and the diversity of age, size, and species.

- Active silviculture for the maintenance of the ideal watershed filtration forest carries risks that might offset protection gains.

#### 2.1.6 Risk Management for the Implementation of the Working Hypothesis

- Current research on these risks indicates that by following a few rules, these risks can be controlled or eliminated.
- Research has shown that only harvesting up to 25% of the forested watershed in any given 5-10 year period can minimize the loss of nutrients or sediments, which may accompany increased water yield.
- Separation of the roads and staging areas from water resources is the first rule to protecting these resources from any negative impact due to logging.
- Roads should be designed to minimize stream crossings and storm water drainage structures need to be properly designed and managed.
- Staging areas must be remote from water resources.

- **Sub-watershed Focus**

While the focus of DWSP’s mission is the overall condition of the watershed and the quality of the water in the reservoir, those conditions reflect the collective conditions of a group of smaller drainages, or Sub-watersheds that comprise the whole. The planning process for the Tighe Carmody watershed forest management is most logically done on a Sub-watershed basis. The Tighe Carmody watershed was divided into eight Sub-watersheds.

#### 3.1: List of Tighe Carmody Sub-watersheds:

Sub-watershed Number	Sub-watershed Name	Area
#1	Blue Meadow Brook	238.9
#2	Breakneck Brook	100.0
#3	Manhan	353.0
#4	Montgomery	266.0
#5	Tucker Brook East	141.6
#6	Tucker Brook West	298.1
#7	West Shore	379.4
#8	Wolf Hill	607.9
	<b>Watershed Totals:</b>	<b>2,384.9</b>

- **HWW Forest Management Objectives for 2015 to 2025**

The research concepts are summarized as the following four basic working strategies for the active management of the Tighe-Carmody Reservoir watershed lands:

- To maintain the ability of the forest to regenerate itself;
- To encourage the development of the ideal all-aged, species diverse natural filtration forest structure on the forest stand suitable for silviculture treatment.
- To continually regenerate these portions of the forest, using The Selection Method (Combination of the Single Tree and Small Group Variants) and other silvicultural techniques in sites that are not ready for regeneration in order to maintain multi-age structure and diverse species composition;
- Strict adherence with Best Management Practices as stated the Department of Conservation and Recreation best Management Practices Manual (2103) with compliance with both the mandatory and suggested practices.
- To limit harvesting to no more than 25% of the total stocking on any given sub watershed during any given 10 year period.

- **HWW Water Quality Objectives for 2015 to 2025**

Silvicultural practices, as described in this management plan, are employed to bring about ideal filtration forest conditions. These practices require the cutting and removal of overstory trees to diversify structural and species compositions, and to maintain the vigor of the residual overstory. The process of removing trees disturbs the forest and the watershed soils, which are essential to protecting water quality. The areas of greatest concern are the hauling roads for timber products and log landings. Proper location of these in relation to streams, rivers, reservoirs, ponds, vernal pools, springs, and vegetated wetlands is important to prevent soil loss. Two basic objectives derived from this concern for water quality during the application of silviculture to these lands are:

- Prevent the movement of sediments into the water system and the Tighe Carmody Reservoir for the upland during any silvicultural work in the upland forest;
- The compliance with the best BMP's (Explicitly described in the Massachusetts Forestry best Management practices 2013 Manual) for harvest techniques in order to minimize the risks of sediment and nutrient loading into the water system.

- **History of Disturbance to the Forest**

The history of disturbance on this property from the 1830's is like that of the typical woodlot in Southern New England. The mid-19th century was the height of the forestland clearing for agriculture and pasturing. The community center of Southampton was along Fomer Road (known as Foamer at that time) district in the mid-to late 1800's. A thriving industrial center existed along Fomer Road with a sawmill, a brick factory, a button factory, the many homes of the settlement. The foundations of these enterprises and the home sites are strewn across the watershed. The availability of richer, more productive farmland in the Midwest resulted in the farm abandonment and subsequent regrowth of the forests. Industrial patterns and modes of production also shifted with the advent of the 20th century, and the factories were abandoned.

The forestland reverted to the dense white pine, hemlock, chestnut, and mixed hardwoods cover typical on old farms lands. These forests began the successional transition toward a more diverse species composition. Wood products industry surges in the early 20th century interrupted the development of these forests on portions of the Tighe Carmody watershed lands, yet many sections were not accessible and continue towards a more climax forest condition. This new upswing in land clearing for wood products and reversion to open land was cut short by the World War period. The forests have been maturing into their current condition since this time. More remote areas are farther along the succession continuum support maturing red oak and mixed hardwood crops.

More recent natural disturbance to the forests have been the Chestnut Blight in 1900 to 1908, the hurricane of 1938, the Gypsy Moth outbreak of 1980 to 1982, recent sever storm events, that are driven by climate change including the ice storm of 2008 and the October 2011 snow storm. Anthropogenic disturbance on the Tighe Carmody lands since the purchase and protection of the entire 2,384.9-acre watershed from 1912 to 1953 to 1912 have been less random than natural events. The City began purchased the old farms along the Foamer Road district, and left the forests grow for decades. The City planted areas of red pine and white pine for shoreline stability around the reservoir through the late 1950's. HWW began an active program of watershed management in the early 1970's. Unfortunately, no archive of their program exists in City hall. The past harvest regime is evident the forest condition.

Timber harvests for the improvement of the growing stock were completed through the 1980's before another less active period. Timber crop management began again in 2003 upon other HWW lands north of Tighe Carmody. The most recent timber harvest of the remote on the Tighe Carmody watershed was in 2005 (Harvest Cut Plan 276-1691-5) with the regeneration harvest in an oak stand on the Tucker Brook West sub-watershed. The red pine plantations were removed in 2006 because they were dying and presenting a water quality hazard.

- **The Role of The Forest in the Landscape Context and Local Economy:**

Surrounding the Tighe Carmody watershed are more than 8,500 acres of permanently protected open space lands. Most is in municipal or state ownership though 1,200 acres are in private hands. Much of the Protected Open Space lies within a matrix of forested vegetation that while unprotected is barely distinguishable from the adjacent protected spaces.

Protected open space is important in the maintenance of individual populations, species richness, and biological diversity. Population viability of many wildlife species within a regional context is reported to be dependent on large tracts of contiguous habitat that are minimally isolated from similar habitats. Often, area-sensitive species are not present or do not breed successfully in isolated, small, or fragmented tracts of land. The landscape context in relation to a given habitat can have an important effect on wildlife reproductive success and population health. Diversity of habitats and microhabitats within an area influences wildlife species richness and presence/absence of individual species.

Because species differ in home range or territory sizes, geographic distributions, microhabitat requirements, seasonal habitat uses, and responses to habitat alterations, the complex array of habitat

needs can be bewildering. Having large areas of protected open space within a reasonable distance of the property under management helps assure that those factors are satisfied. The extensive Tighe Carmody Reservoir Watersheds provides connectivity between these other protected lands. The Tighe Carmody watershed lands provide a large enough land base in the Southampton community to increase the ecological resiliency and biodiversity of the regional landscape.

The active silvicultural program on the Tighe Carmody watershed will produce large volumes of merchantable timber products each year. Local and regional forest products businesses will complete the physical management work on these lands. They rely on local small businesses for the necessary materials and tools for the production and processing of these timber products. The City of Holyoke relies on the timber revenues from their silvicultural program for the funding of special water related projects. Their use of the forest as a natural filtration system saves the City millions of dollars in the costs of construction and maintenance of a water filtration plant.

- Overview of the Forest
- 7.1. Overview of Forest Stands By Number, Forest Type, and Area

Sub-watershed Name	Sub-watershed Number	Stand Number	Stand Type	Acres
Blue Meadow Brook	1	1.01	RZ	58.5
Blue Meadow Brook	1	1.02	WH	12.9
Blue Meadow Brook	1	1.03	HH	6.1
Blue Meadow Brook	1	1.04	OH	12.7
Blue Meadow Brook	1	1.05	HH	7.5
Blue Meadow Brook	1	1.06	OHK	27.7
Blue Meadow Brook	1	1.07	OH	12.0
Blue Meadow Brook	1	1.08	WP	2.0
Blue Meadow Brook	1	1.09	WH	48.0
Blue Meadow Brook	1	1.10	WHK	13.0
Blue Meadow Brook	1	1.11	OH	14.0
Blue Meadow Brook	1	1.12	WA	24.5
			<b>Total:</b>	<b>238.9</b>
Breakneck Brook	2	2.01	WP	20.8
Breakneck Brook	2	2.02	OHK	15.0
Breakneck Brook	2	2.03	OH	47.6
Breakneck Brook	2	2.04	WH	7.1
Breakneck Brook	2	2.05	RZ	9.5
			<b>Total:</b>	<b>100.0</b>
Manhan	3	3.01	OH	35.2
Manhan	3	3.02	OH	75.3
Manhan	3	3.03	MO	17.3
Manhan	3	3.04	RP-OH	6.0
Manhan	3	3.05	OHK	30.0
Manhan	3	3.06	WH	14.5
Manhan	3	3.07	OH	14.8
Manhan	3	3.08	HH	64.1
Manhan	3	3.09	BM	10.8
Manhan	3	3.10	WH	10.4
Manhan	3	3.11	WHK	5.5
Manhan	3	3.12	OH	9.2
Manhan	3	3.13	WP	35.8
Manhan	3	3.14	HH	24.1
			<b>Total:</b>	<b>353.0</b>
Montgomery	4	4.01	OHK	213.0
Montgomery	4	4.02	WH	30.0
Montgomery	4	4.03	MO	23.0
			<b>Total:</b>	<b>266.0</b>
Tucker Brook East	5	5.01	WP	36.2
Tucker Brook East	5	5.02	WH	87.9
Tucker Brook East	5	5.03	WHK	8.5
Tucker Brook East	5	5.04	BM	9.0
			<b>Total:</b>	<b>141.6</b>



<b>Sub-watershed Name</b>	<b>Sub-watershed Number</b>	<b>Stand Number</b>	<b>Stand Type</b>	<b>Acres</b>
Tucker Brook West	6	6.01	HH	22.8
Tucker Brook West	6	6.02	OH	72.1
Tucker Brook West	6	6.03	OH	53.8
Tucker Brook West	6	6.04	HH	22.8
Tucker Brook West	6	6.05	BM	116.9
			<b>Total:</b>	<b>288.4</b>
West Shore	7	7.01	OHK	158.3
West Shore	7	7.02	BM	114.5
West Shore	7	7.03	WP	13.4
West Shore	7	7.04	OH	55.0
West Shore	7	7.05	BR-ESH	38.2
			<b>Total:</b>	<b>379.4</b>
Wolf Hill	8	8.01	OH	236.0
Wolf Hill	8	8.02	WH	79.5
Wolf Hill	8	8.03	HH	59.7
Wolf Hill	8	8.04	OH	12.9
Wolf Hill	8	8.05	RM	24.7
Wolf Hill	8	8.06	OH	26.0
Wolf Hill	8	8.07	BB	5.1
Wolf Hill	8	8.08	BB	5.0
Wolf Hill	8	8.09	HH	28.6
Wolf Hill	8	8.10	HH	49.0
Wolf Hill	8	8.11	BM	2.1
Wolf Hill	8	8.12	OH	59.9
Wolf Hill	8	8.13	WP	5.0
Wolf Hill	8	8.14	BR-ESH	11.4
			<b>Total:</b>	<b>607.9</b>
			<b>Grand Total:</b>	<b>2384.9</b>

- **The Role of Silviculture**

Applying ecological principles to a forest stand to enhance growth of desirable species or to promote regeneration is termed silviculture. Silvicultural treatments are generally divided into procedures designed to reproduce forest stands, and intermediate treatments that maintain vigor and desired composition and stand structure. The eight sub-watersheds were assessed for their suitability for silviculture. Suitability depends upon the ability of a given forest stand to support the main objectives for water quality of this management plan. Therefore, forest stands upon steep slopes with a high erosion factor were not deemed suitable, or forest stands that function solely for the filtration, collection, or transfer of water capacity. Other stands not deemed suitable include wetland, shrubs swamp, forest stands with insufficient stocking to protect the soils cover after any timber harvest removals, and areas that support other important values for ecological resiliency such as biodiversity or habitat value.

- **HWW Silvicultural Objectives for 2015 to 2025**

The three main silviculture objectives for the 2015 to 2025 operating period on the Tighe Carmody Reservoir watershed lands are:

- The development of the all-aged, species diverse, ecologically resilient ideal watershed forest capable of the natural filtration and purification of drinking water;
- The improvement of the quality and condition of the timber crops upon the silviculturally suitable forest stands; and
- The generation of immediate and long-term income from the timber resource.

- **Silvicultural Systems and Non-Harvest Techniques Employed:**

The following discussion addresses the harvest technique and other non-harvest techniques necessary for the maintenance and regeneration of the ideal watershed filtration forest.

### **9.1.1 Salvage Harvest**

Salvage Harvests along with sanitation cuttings are prescribed to remove trees infested with insects or disease. These infested or infected trees may pose a threat to the remaining stand. In general, losses to insects and disease can be minimized through a regular thinning program. Proper thinning maintains the trees in the best physiological condition making them less susceptible to attack.

Hemlock is currently under attack by the non-native woolly adelgid, and elongated hemlock scale. Most of the hemlock trees in the Tighe Carmody watershed are affected and are expected to die. The emerald ash borer, another non-native pest, threatens

white ash. The beech bark complex that includes both insect and fungal components heavily infects beech.

Removing infected trees allows potentially resistant in the stand to flourish and provide possibly resistant seed. A common characteristic of stressed trees is to seed heavily just before they die. Unfortunately, facing an uncontrollable threat, these are not the most desirable trees to reproduce.

### **9.1.2 Selection Method**

The Selection Method is a reproduction strategy, designed to establish a new cohort of trees, to replace the existing ones. Enough trees must be harvested so that the forest floor receives enough light for the species being reproduced to survive and thrive. The goal is to develop and maintain an all-aged, species diverse, resilient natural filtration and purification watershed forest. Usually stands are considered uneven-aged when they have three or more distinct age classes.

Frequent periodic cuttings occur to establish and maintain this structure. The residual stand must be considered when using this system. The possibility of residual trees being damaged from repeated harvesting operations makes careful logging crucial.

This plan proposes using two variants – Single-Tree Selection and Group Selection.

**9.1.2.1 Selection Method, Single Tree Variant:** In the Single Tree Selection variant, every tree in the stand is evaluated before harvest. Undesirable trees are removed, overly dense areas are thinned, and mature trees are harvested. Done carefully and correctly, enough light reaches the forest floor for all relevant species to regenerate. With Single Tree Selection, the forest continuously produces timber and constantly has new seedlings emerging to take the place of harvested trees. Singletree selection maintains a late succession forest that benefits many wildlife species such as squirrels and turkey.

**9.1.2.2 Selection Method, Group Selection Variant:** The Group Selection variant involves the harvest of small groups rather than individual trees. The openings resemble clear cuts, but since they are small, the edge trees still provide a protected environment for the developing regeneration in the group opening. This method is similar to Single Tree Selection in that harvests are frequent. Its main advantage is that it is easier for the logger to avoid damaging the residual stand. Usually with group selection, the surrounding matrix of trees is thinned, removing damaged or diseased trees and allowing crop trees sufficient room. The result is an all-aged, species diverse, resilient natural filtration and purification watershed forest.

**9.1.3 Irregular Shelterwood:** The Shelterwood System is generally an even-aged reproduction technique where mature trees are removed in two or three harvests over a period of 10 to 15 years. This method allows regeneration of medium to low shade-tolerant species because shelter is left to protect them. Many trees produce and maintain seedlings or sprouts in light shade under a partially cut stand; however, the young trees will not grow and develop fully until the remaining overstory trees are removed.

Irregular Shelterwood harvests are defined by timing of regeneration establishment not by spatial arrangement. The regeneration period for the stand is extended so long that the new stand is not even-aged. The stand does not have three or more age classes, as in an uneven-aged stand. Therefore, the stand structural objective is somewhere between the even-aged and uneven-aged structure.

Irregular refers to the subsequent variation in tree heights in the new stand. This system tends to draw on elements from other systems, notably Small Group and Single Tree Selection. Retained leave-trees can be scattered individually through a block, or group openings created. The groups are expanded slowly outward until they coalesce at the end of the regeneration period.

This Irregular Shelterwood system is used to promote structural diversity while maintaining the simplicity of even-aged management. Objectives for aesthetics, wildlife, biodiversity, or hydrological green-up may be compatible with this system. The Continuous Cover variant of the Irregular Shelterwood System allows the growth of native species with differing shade tolerance levels. A successful application of this system will keep a constant, superior genotype seed source on site and reduce the growth of undesirable lower strata tree species and shrubs. The trees reserved in the overstory have time and space to grow beyond their optimal size and quality.

**9.1.4 Scarification to Mineral Soil:** Many species need bare mineral soil exposed if their seeds are to germinate and become established. Often a consequence of timber harvest operations, the duff is pushed aside and mineral soil conducive to germination exposed. Careful supervision of logging and proper installation of erosion control measures during and after harvest, work reduces the problem of the exposed soil eroding. Red oak, sugar maple, black and yellow birch and white pine seed germination requirements require mineral soil scarification. Harvests Operations where feasible can be scheduled during dry and stable conditions to allow for seedbed preparation work. Some areas cannot be worked without frozen ground due to hydric soil, but whenever possible a combination of timing across a stand would allow for some scarification.

**9.1.5 Treatment of the Grape Vines:** Grape is native species. It responds quickly to sunlight and can overtop desirable regeneration. It can shade or even break stems. Grape vines provide an important food source for many wildlife species. The soft mast of the grapes and the leaves and shoots are important food sources. The dense thickets produced by the vines provide nesting habitat and escape cover. A balance between reproduction and wildlife value must be considered.

**9.1.6 Disturbance of the Dense Native Shrubs:** Witch-hazel in particular, along with other native shrubs can grow in thickets beneath the best seed producing trees. Removal of this understory shade is often more useful in procuring advance regeneration than altering the overstory stocking conditions. Their removal also frees water and soil resources for the crop trees. Some of these plants will be displaced with a timber harvest, but it may be necessary to enter the stand manually to reduce understory shrub stocking. Often it is too expensive to treat the entire stand pre or post harvest. In these instances, dense patches of native shrubs can be treated around just the future crop trees. Another benefit is that a greater diversity of forest floor herbaceous plants has access to sunlight, soil moisture, and nutrients, leading to greater diversity.

**9.1.7 Crop Tree Release:** Improvement cuttings are made to remove undesirable trees to favor desirable ones. In Crop Tree Release, specific trees are selected to grow into the future. Competing trees nearby are harvested, making sunlight, water, and soil nutrients available for the selected tree to use. Opening of the canopy around the selected tree also allows regeneration to thrive. Since selected crop trees are usually of superior form, these potentially superior seedlings are chosen for future crops.

**9.1.8 Invasive Plant Management:** Invasive plants, like Japanese barberry, Asiatic bittersweet, and multiflora rose can significantly inhibit regeneration and the future productivity of a forest stand. Usually escaped ornamentals, they have few natural enemies, and often have little to no wildlife value. In general preventing the spread of invasive plants is easier and less expensive than trying to control them. This plan often recommends treatment of existing invasive plants any timber harvest work and to use other practices to avoid their spread.

Annual monitoring inspections of the forest conditions post harvest for detection of spread into the regeneration zones will direct the use of resources for plant removals. Some of the removal work can be done manually with the removal of the plants from the soils. The areas may require treatment with the use of minimally toxic herbicides, mechanical methods, and manual treatments for successful stocking reduction.



## 10. Methodology

**10.1 Inventory Methodology:** A sampling system was devised that used probability parameters proportional to the size of the trees sampled and the relationship between basal area and volume. The “double point” sampling system relies on the measurement of the basal area in all trees with a 20 basal factor gauge and the measurement of the tree metrics (diameter, height, and condition class) of a sub-set of these trees with a 40 basal area factor gauge. Its core is the method, known as variable plot sampling work, assigns chance of measurement of trees on each sample plot based upon its relative size with larger trees, which have a greater chance of measurement. Four hundred and seventy five sample pints were taken in across the watershed on a systematic grid design that was executed with a GPS field system throughout all three compartments of the watershed. The placement on the plots on the grid was generated by a random plot function in QGIS. The DS Cruiser computer program calculated the stand volumes, basal areas, and stand structure metrics. The raw field data is stored in an electronic file, as well as the computed reports on each stand’s condition.

**10.2 Site Index Methodology:** Site index for each stand was estimated using data from Natural Resources Conservation Service, United States Department of Agriculture Web Soil Survey. This survey is available online at <http://websoilsurvey.nrcs.usda.gov/>. Site index by species was determined by weighted average based on the estimated percentage of the soil types within a stand.

**10.3 Soils Methodology:** Soils data were obtained from MassGIS, Office of Geographic Information, and Commonwealth of Massachusetts from the layer GISDATA\_SOILS\_POLY\_SV\_MUNAME. Stand maps were geo-referenced to the soils layer to delineate soil types.

**10.4 Mapping Methodology:** GIS data was obtained from MassGIS, Office of Geographic Information, and Commonwealth of Massachusetts. Layers included the following and the appropriate aerial imagery from the same source.

GISDATA\_L3\_TAXPAR\_POLY\_ASSESS

GISDATA\_EOTROADS\_ARC

GISDATA\_HYDRO25K\_ARC

GISDATA\_HYDRO25K\_POLY GISDATA\_SOILS\_POLY\_SV\_MUNAME

Stand maps, developed from aerial imagery and further refined during field investigation using GPS were geo-referenced to a base layer that covered the watershed. Forest Stands were numbered as a decimal (.01 – .15) within a watershed so

that they can be sorted correctly. For example, the Hemlock Hardwood stand in the Manhan sub-watershed is numbered 3.08 – stand # 8 in watershed # 3.

**10.5 Growth Rate Methodology:** Growth rates were determined using the method that the state determines Chapter 61 tax valuations using an expected volume increase of 162 board feet per acre per year calculated from state Forest Inventory Analysis (FIA) data. The total expected average volume increase was determined by multiplying the total acreage of the stand by 162 board feet per acre.

**10.6 Simple Regeneration Metric:** Regeneration is described at different points in the inventory data and the management plan in the following manner using a simple metric.

- A – High Very dense regeneration.
- B – Moderate – intermediate level of stocking.
- C – Low – low to negligible stocking.

**10.7 Simple Invasive Plant Metric:** The stocking level of invasive plants is described using a simple metric.

- A – High Very dense stocking of invasive plants.
- B – Moderate – intermediate level of stocking.
- C – Low – low to negligible stocking.

**11. Boundary Consideration:** The archives in the City of Holyoke –Holyoke water Works are not complete. Deeds and old property maps have been misplaced or lost. A boundary research and delineation project is underway for these lands with an anticipated completion date of December 2015. The Stand Boundary maps have been presented without the perimeter line bearings and distances. Revised maps will be submitted at the completion of the boundary project. Similarly, the record of the deed transfers is also incomplete. The City engineer is schedule to work with WFRM on the deed review. Revised Assessor records will be added to the management pan upon completion of this research.



## Forest Stands

For the purposes of this report, a forest stand is an easily defined area that is relatively uniform in composition, and structure.

### Summary of the Forest Stands:

Sub-watershed	Stand Number	Forest/Habitat Type	Approx. Size (acres)	Notes
Blue Meadow Brook	1.01(a)	RZa-HH	25.5	Two-aged stand with moderate stocking levels of small sawtimber and sapling/pole trees and dominance by hemlock in both size classes. Moderately dense understory. Riparian.
Blue Meadow Brook	1.01(b)	RZb-RM	2.0	Sparsely stocked immature red maple, elm, and yellow birch pole and small timber sized trees growing in wet soil.
Blue Meadow Brook	1.01(c)	RZ-HH-Rm	31.0	Two distinct shallow marsh areas surround four beaver ponds.
Blue Meadow Brook	1.02	WH	12.9	High quality white pine and declining hemlock with red oak, scarlet oak, chestnut oak, black oak, black birch, paper birch and poor quality red maple. Dense understory. Moist soil.
Blue Meadow Brook	1.03	HH	6.1	Poor to fair hemlock with large sized, high quality white pine and red oak. Densely stocked mixed hardwood understory.
Blue Meadow Brook	1.04	OH	12.7	Immature red oak, yellow, and black birch, red maple, paper birch, and beech pole and small sawtimber with good potential. Moderately stocked understory.
Blue Meadow Brook	1.05	HH	7.5	Small sized timber crop of declining hemlock with red maple, various oaks, and birches. Moderate mixed hardwood understory.
Blue Meadow Brook	1.06	OHK	27.7	Maturing good quality red oak with black birch, declining hemlock, and scattered large diameter white pine. Moderately stocked mixed hardwood understory
Blue Meadow Brook	1.07	OH	12.0	Remote stand with mature red oak, white ash, red maple, and declining hemlock. Well stocked mixed hardwood understory.
Blue Meadow Brook	1.08	WP	2.0	Small area of immature, healthy white pine with hemlock and red maple. Sparsely stocked mixed hardwood understory.
Blue Meadow Brook	1.09	WH2	48.0	Maturing, old-field white pine of fair quality. Understory gaps filled with black birch, red maple, beech, oak, aspen, cherry, and hemlock saplings and small pole trees ranging from 1 to 35 years of varying quality.
Blue Meadow Brook	1.10	WHK	13.0	Declining hemlock with red oak and good quality white pine near a beaver pond. Sparse hardwood and hemlock understory.
Blue Meadow Brook	1.11	OH	14.0	Maturing red oak, sugar maple, and marginal quality white pine and declining hemlock. Well developed mixed hardwood understory.
Blue Meadow Brook	1.12	WA	24.5	Blue Meadow Swamp plus three other beaver ponds.

Sub-watershed	Stand Number	Forest/Habitat Type	Approx. Size (acres)	Notes
Breakneck Brook	2.01	WP	19.0	Dense stand of planted white pine of mixed quality and a small hardwood component. Gaps in the canopy are filled with pockets of mixed hardwoods of good form.
Breakneck Brook	2.02	OHK	11.8	High value red oak and white pine mixed with declining hemlock and paper birch. Sparse mixed hardwood understory.
Breakneck Brook	2.03	OH	28.3	Two-aged high quality red oak with smaller black birch and red maple. Some high value white pine. Moderate mixed hardwood understory in mostly good condition.
Breakneck Brook	2.04	WH	5.0	Tall white pine of good quality along with red oak and declining hemlock. Moderately well stocked mixed hardwood understory.
Breakneck Brook	2.05	(a) RZ HH and (b) Swamp	5.0	Narrow strip of mixed hemlock and hardwood providing riparian protection for Tucker Brook.
Manhan	3.01	OH	35.2	Mix of red oak, white pine, and hemlock large sized trees that provide excellent protective cover upon the steep slope sites.
Manhan	3.02	OH (BM)	64.2	Immature oak birch and maple of excellent form and potential.
Manhan	3.03	MO	17.3	Typical xeric, mountain top mixed oak stand.
Manhan	3.04	RP-OH	6.0	Dying red pine plantation, with mixed hardwoods in the understory.
Manhan	3.05	OHK	30.0	Mature high value red oak with dying hemlock.
Manhan	3.06	WH	14.5	Mature white pine and scattered red oak of good quality.
Manhan	3.07	OH	14.8	Mix of white pine, red pine, sugar and red maple, a few red and white oaks, black, yellow, and paper birch, aspen, tulip poplar, hickory, and hemlock. This area was the site of the old Southampton Town center.
Manhan	3.08	HH	64.1	Dense mature hemlock grove with good quality oaks.
Manhan	3.09	BM	10.8	Depleted abandoned agricultural field supporting scattered maturing sugar maple, red maple, and paper birch, black birch, aspen, and white ash.
Manhan	3.10	WH	10.4	Maturing good quality white pine with mixed hardwoods
Manhan	3.11	WHK	5.5	Dense, mature, and declining hemlock grove with good quality white pine.
Manhan	3.12	OH	9.2	Immature oak, birch, and maple of excellent form and potential.
Manhan	3.13	WP	35.8	Dense grove of maturing white pine of variable quality with scattered hemlock, red oak, and white ash timber trees.
Manhan	3.14	HH	24.1	Variable canopy composition with a hemlock grove on the level section, red oak and beech along the slopes, and hemlock by the river.
Montgomery	4.01	OHK	197.0	Declining hemlock mix with good to excellent quality red oak and a mix of hardwoods. Old farm field white pine of good to excellent. Moderate mixed hardwood understory.
Montgomery	4.02	WH	30.0	Steep slope to mountaintop with declining hemlock and good quality mixed hardwoods. Management entry is unlikely due

Sub-watershed	Stand Number	Forest/Habitat Type	Approx. Size (acres)	Notes
				to the slope and rockiness.
Montgomery	4.03	OM	23.0	Excellent quality red oak and associated hardwoods on gentle slope.
Tucker Brook East	5.01	WP	36.2	Pine timber growing above a somewhat sparse midstory of mixed hardwood in fair to good condition.
Tucker Brook East	5.02	WH	89.1	Mix of excellent quality white pine with northern red oak and black birch.
Tucker Brook East	5.03	WHK	8.5	Dense mature hemlock grove with white pine and northern red oak.
Tucker Brook East	5.04	BM	9.0	Immature grove of sugar maple, red maple, black locust, paper birch, black birch, cheery, and ash on abandoned agricultural site.
Tucker Brook West	6.01	HH	22.8	Maturing red oak, hemlock, and white pine.
Tucker Brook West	6.02	OH	81.8	Beech, black birch, red maple, hemlock, and northern red oak. The northern red oak and scattered eastern white pine is very good in form and condition.
Tucker Brook West	6.03	OH	53.8	Large good quality oak with declining hemlock.
Tucker Brook West	6.04	HH	22.8	Moderately stocked layer of hemlock, red maple, black birch, beech, and red oak saplings, and pole tees grow beneath the denser canopy.
Tucker Brook West	6.05	BM	108.4	Densely stocked Immature grove red oak, black birch, hemlock, beech, and red maple timber crops. The hemlock is in poor condition
West Shore	7.01	OHK	82.9	Fair to good mixed hardwoods.
West Shore	7.02	BM	91.7	High value red oak, red maple, and black birch timber crops with declining hemlock, sugar maple, white ash, beech, and hickory.
West Shore	7.03	WP	13.5	Maple, birch, ash, tulip poplar, and aspen sapling are growing in the small openings in the main canopy.
West Shore	7.04	OH	46.9	Northern red oak, black birch, along with red maple, and paper birch with scattered groves of the tall, statuesque tulip poplar
West Shore	7.05	BR-ESH	26.1	The overstory removal of a dying red pine plantation in 2010 opened this area. Scattered white pine timber and pole trees tower above the shrub and seedling layer.
Wolf Hill	8.01	OH	202.8	High value red oak, red maple, and black birch are the three consistent timber crops across the stand.
Wolf Hill	8.02	WH	66.9	Mature, large sized white pine with mixed hardwoods.
Wolf Hill	8.03	HH	56.4	A dense grove of declining hemlock with good quality red oak, and aspen sawtimber trees
Wolf Hill	8.04	OH	12.9	Short, maturing red oak, white oak, white oak, chestnut oak, and scarlet oak small sized timber crops cover the small hilltops.
Wolf Hill	8.05	RM	22.0	Dense red maple, white ash, aspen, elm, and yellow birch pole stand.

<b>Sub-watershed</b>	<b>Stand Number</b>	<b>Forest/Habitat Type</b>	<b>Approx. Size (acres)</b>	<b>Notes</b>
Wolf Hill	8.06	OH	29.0	Some of the oldest red oak crops were found in this special site. They have an average range age of 190 to 225 years.
Wolf Hill	8.07	BB	5.1	An uncommon, true northern hardwood grove of sugar maple, red maple, yellow birch, white ash, and beech, basswood, and black birch small sized timber crops.
Wolf Hill	8.08	BB	5.0	Immature northern hardwoods growing on a site featuring an old farmhouse foundation, barn foundation, root cellar foundation, and corral and roadside well built stonewalls.
Wolf Hill	8.09	HH	27.7	An immature grove of hemlock, red oak, black birch, sugar maple, and white ash small sawtimber crops.
Wolf Hill	8.10	HH	24.2	Small sized hemlock, red maple, hickory, red oak, red maple, and black birch timber crops due to timber trespass.
Wolf Hill	8.11	BM	2.1	Sapling and small pole red maple, white ash, sugar maple, and yellow birch above a dense wetland shrub, herbaceous plant, fern and grass ground cover.
Wolf Hill	8.12	OH	51.3	Short in stature and small in diameter, red oak, scarlet oak, chestnut oak, white oak, and birch stems.
Wolf Hill	8.13	WP	5.0	A 60 to 75 year old white pine plantation.
Wolf Hill	8.14	BR-ESH	11.4	Dense sapling and native shrub cover from overstory removal of a dying red pine plantation in 2010.

**SPECIFIC STAND DESCRIPTIONS**

**SUB-WATERSHED #1: BLUE MEADOW BROOK**

Objective	Stand Number	Forest Type	Stand Area	MSD or Size Class	Basal Area Per Acre	Volume Per Acre	Site Index	DCR/FIA Growth Rate
Stewardship Green Cert.	1.01	RZ (a) HH	<b>Total Stand Area: 58.5 acres</b>	13.6 inches	105 Sq. Ft.	1.844 MBF	50:WP	9.48  (a) 4.1  MBF per year
			(a): 25.5 acres			10 cords – 5 cords pulp  5 cords - firewood		

**Sub-Watershed:** Blue Meadow Brook

**Water Quality Concerns:** Primary. This stand drains westerly into an unnamed brook, which empties into the Manhan River. On its eastern, edge the waters of this riparian zone blend into a large swamp, which drains into Blue Meadow Brook. The Tighe Carmody reservoir is the main drinking water supply for the City of Holyoke. These sites function as a defense barrier and sediment sink for the reservoir.

**Silviculture Status:** Not suitable.

**Terrain/Topography:** The terrain dips below the general relief in this stand and broadens into a wide, level plain. Geologically, it is a classic example of an outwash plain along the Manhan River channel. Small boulders and stones cover the soil surface. The stand forms the western edge of a broader wetland/swamp system.

**Soils:** The Swansea Muck soils underlie this plain. These soils are deep, nearly level, and very poorly drained. They consist of black decomposed organic matter over rich, mineral sands. Water moves slowly through the organic matter, and the water table is at or near the surface for most of the year. Soil moisture restricts tree root development and causes seedling mortality except for water tolerant species. Trees grow very slowly on this moist plain.

- Timber Harvesting: Not applicable
- Water Quality: This low, wet plain holds water and slowly releases it into the Blue Meadow Brook. Sediments and impurities have time to settle into the deep mucks of the swampy grove.

**Overstory:** The stand has a two-aged structure with moderate stocking levels of small sawtimber and sapling/pole trees and dominance by hemlock in both size classes. The trees grow slowly upon hummocks within the moist soil. Other minor species include high quality white pine timber, white oak, and scarlet oak. A small portion (less than 30%) of the hemlock crowns suffer decline (grayish tint to crowns) from both the wooly adelgid and elongated hemlock scale.

**Understory:** The younger age class (10 to 30 years) supports a moderately dense stocking of poorly formed, suppressed hemlock saplings and pole trees, red maple poles of stump sprout origin, and well formed yellow birch sapling and pole stems.

- Regeneration: Reproductive stocking was sparse and limited to hemlock, yellow birch, and red maple seedlings.
- Native: A well-stocked shrub and herbaceous layer were noted. Shrubs species found include winterberry, highbush blueberry, witch-hazel, and mountain laurel. Bracken fern, sensitive fern, and cinnamon fern sprout up through the boulders.
- Non-native Invasive Growth: No threat exists from these plants as none was noted during the field inventory.
- Interfering native plants: All native plant communities were valuable components of a healthy wetland ecosystem without threat to regeneration.

**Habitat:** A local moose population uses this stand heavily as evidenced by scat, rubbings, and hoof prints. Birdsong was audible, and the sighting of a hawk hunting the area was noted. This low depression is surrounded by large oak crowns in the upland areas that provide excellent perching sites for predators. The coarse and fine woody debris was very heavy throughout this swamp. This provides nutrients and habitat to a wide array of organisms.

- NHESP: The BioMap2 Project defines this stand as a Wetland Core, Natural Critical Landscape, Core Habitat, and Forest Core.
- Habitat techniques: Not applicable.

**Fire Protection:** These moist soils do not pose a high hazard for fire occurrence. Access could be easily gained from Crooked Ledge Road if necessary for fire suppression.

**Desired Future Condition:** Preservation of this riparian forest ecosystem in its current condition will protect its function as a water quality filter with sediment deposition capacity and an excellent wetland habitat zone.

**Recommended Management Practices:** None in the next ten-year operating period.

Objective	Stand Number	Forest Type	Stand Area	MSD or Size Class	Basal Area Per Acre	Volume Per Acre	Site Index	DCR/FIA Growth Rate
Stewardship Green Cert.	1.01	RZ (b) RM	2 acres	7.5 Inches	45 Sq. Ft.	5 cords - firewood	50:RM	.6 cords per year

**Sub-Watershed:** Blue Meadow Brook

**Water Quality Concerns:** The water in this small depression drains northeasterly into a larger swamp complex. It fills from a subterranean flow from the larger swamp to the west. Red maple swamps collect sediments and toxins from water as it sits in these depressions.

**Silviculture Status:** Not suitable.

**Terrain/Topography:** This small depression lies at the eastern tip of the property upon a short, level plain.

**Soils:** The Ridgebury soils are very stony fine sandy loams with poor drainage, which usually form from glacial till. A seasonally high water table prevents deep root development and limits plant communities to shrubs and hydric tree species. Standing water fills the areas between the hummocks of tree growth.

- Timber Harvesting: Not applicable
- Water Quality: This small depression holds water over time and prevents sediment movement.

**Overstory:** A sparse stocking of immature red maple pole and small timber sized trees share this grove with elm and yellow birch. The wet soil stunts these tree heights and results in stubby boles.

**Understory:**



- **Regeneration:** Red maple seedlings and saplings poke up through a dense shrub layer in sufficient quantity for replacement of the red maple crop in the future.
- **Native:** Dense thickets of red alder, mountain laurel, blueberry, and ilex shrubs cover the moist ground. Reeds, sedges, bracken fern, and skunk cabbage were also noted.
- **Non-native Invasive Growth:** No threat exists from these plants at this time.
- **Interfering native plants:** All native plant communities were valuable components of a healthy wetland ecosystem without threat to regeneration.

**Habitat:** Shrub wetlands with a slight cover of hardwoods provide critical ecosystem functions such as flood control, pollutant filtration, erosion control, and wildlife habitat. Red alder produces a tasty catkin that lingers long into winter for bird feed. The laurel, blueberry, and reeds' lower brush offers suitable cover for wetland predators.

- **NHESP:** The BioMap2 Project defines this stand as a Natural Critical Landscape and Core Habitat.
- **Habitat techniques:** No special techniques would be employed in this area.

**Fire Protection:** These moist soils do not pose a high hazard for fire occurrence. Access could be easily gained from Crooked Ledge Road if necessary for fire suppression.

**Desired Future Condition:** Preservation of this riparian forest ecosystem in its current condition will protect its function as a water quality filter with sediment dumping capacity and an excellent wetland habitat zone.

**Recommended Management Practices:** None in the next ten-year operating period.

Objective	Stand Number	Forest Type	Stand Area	MSD or Size Class	Basal Area Per Acre	Volume Per Acre	Site Index	DCR/FIA Growth Rate
Stewardship Green Cert.	1.01	RZ: (c) MS	31 acres	NA	NA	NA	NA	NA

**Sub-Watershed:** Blue Meadow Brook

**Water Quality Concerns:** Water moves slowly through wetlands, and these wetlands trap sediments and phosphorus from the upland forests, which improves the quality of the water released into stream below the wetlands.

**Silviculture Status:** Not suitable.

**Terrain/Topography:** The terrain drops from the upland forest into level depressions, which surround the open water of the beaver ponds. Two distinct shallow marsh areas surround four beaver ponds. The largest pond lies in the southern section of this sub-watershed.

**Soils:** These swamps grow above the Swansea and Freetown Muck soils. These soils are deep, nearly level, and very poorly drained. They consist of black decomposed organic matter over rich, mineral sands. Water moves slowly through the organic matter, and the soil is saturated and often covered with up to six inches of water.

- Timber Harvesting: Not applicable
- Water Quality: These shallow marshes hold water and slowly release it into Blue Meadow Brook. Sediments and impurities have time to settle into the deep mucks of the swampy grove.

**Vegetation:** There is some open water, and the predominant vegetation is emergent including grasses, reeds, rushes, cattails, pickerelweed, and arrowhead.

**Habitat:** Fresh water shallow marshes provide habitat for many aquatic species of plants, fowl, and mammals. They also provide connectivity between the open water and the upland habitat.

- NHESP: The BioMap2 Project defines this stand as a Natural Critical Landscape and Core Habitat.
- Habitat techniques: No special techniques would be employed in this area.

**Fire Protection:** These moist soils do not pose a high hazard for fire occurrence. The open water may be used as a source of water for a pumper truck in the event of a fire.

**Desired Future Condition:** Preservation of these marshes in their current condition protects their function as a water quality filter with sediment dumping capacity and an excellent wetland habitat zone.

**Recommended Management Practices:** None in the next ten-year operating period.

Objective	Stand Number	Forest Type	Stand Area	MSD or Size Class	Basal Area Per Acre	Volume Per Acre	Site Index	DCR/FIA Growth Rate
Stewardship Green Cert.	1.02	WH	12.9 acres	14.3 Inches RO:16 in.	144 Sq. Ft.	7.619 MBF 4 cords – Pulp 3 cords - firewood	65 WP	2.088 MBF per year

**Sub-Watershed:** Blue Meadow Brook

**Water Quality Concerns:** Prevent any loss of sediment from these uplands into the Blue Meadow Brook.

Access into the northern portions of this stand requires use of an existing road along a narrow land bridge. Its proximity to the Blue Meadow Swamp and its main drainage into the larger system south of this point mandates careful road construction during management work and appropriate erosion control measures along the roadway post harvest. The southern portion of the stand has a higher water table, and frozen or dry and stable ground conditions scheduling will protect the soil structure.

**Silviculture Status:** Suitable.

**Terrain/Topography:** This terrain slopes very gently northwesterly into the drainage of the western portion of Blue Meadow Swamp before moderately ascending towards the north and east bound. An unusual narrow land bridge spans subterranean water flow out of the swamp to the west.

**Soils:** The southern portion of the stand along Crooked Ledge Road lies above the poorly drained, fine sandy Ridgebury loams. Their seasonally high water table prevents deep root development and stunts productive tree growth. Once the terrain climbs upslope to the north of the land bridge, the soil regime shifts to the deep, well drained Montauk loams. Water collects in these soils from both a perched water table and a series of spring seeps, which drain westerly into the swamp area. Excessive stones and boulders dot the soil surface. The available moisture and the rich, deep loam support productive tree growth.

- **Timber Harvesting:** Frozen ground is ideal for harvest work in some of the areas of this stand. The southern portion and some northern areas (less than 10% of area) will require frozen ground for timber harvest and management work in this stand. One main access road built across the land bridge and a series of spring seeps will be properly corduroyed for roadbed stability.
- **Water Quality:** The proximity of this area to the Blue meadow swamp will allow for the deposition of sediment before water leaves the swamp to enter the Manhan River system.

**Overstory:** High quality white pine and declining hemlock, which collectively contribute 27% to the total stocking, share the upper canopy of this stand with red oak, scarlet oak, chestnut oak, black oak, black birch, paper birch and red maple. The red maple timber has poor form and many stem defects. In the moist soil areas, the root systems of the tall white pine trees pull slightly up from the soil surface, creating a windfall threat. The hemlock crop is in serious decline from a combination of elongated hemlock scale and wooly adelgid damage, which manifests in discolored needles. Paper birch is a short-lived species, and the trees in this stand are in decline due to age. Nectria bacterium infects about 65% of the black birch crop. White ash pole and timber sized trees dot the canopy across this stand.

**Understory:** A dense stocking of sapling and small pole hemlock, which is the dominant species in this age class, red maple, yellow birch, black birch, mixed oak, and paper birch trees lies beneath the main canopy. These trees range in size from three to nine inches with heights less than 35 feet and ages less than 40 years. These immature trees, except for the hemlock and red maple, have good form and healthy crowns.

- **Regeneration:** Reproductive growth rates a C level on our simple metric with shade tolerant beech and hemlock most prevalent.
- **Native:** Mountain laurel grows in scattered dense thickets across the forest floor. Other native shrubs noted were witch-hazel, maple leaved viburnum, and beaked hazelnut.
- **Non-native Invasive Growth:** No threat exists from these plants at this time.
- **Interfering native plants:** All native plant communities were valuable components of a healthy wetland ecosystem without threat to regeneration.

**Habitat:** Cavities and holes riddle the large sized red maple trees in the upslope area of this stand, which offers ideal denning and nesting sites for cover and insect breeding sites for feed. The statuesque, tall white pine trees along the edge of the Blue Meadow Swamp West allow for large predator bird and small mammal nest and perching sites near a main water source. The vertical stratification with an upper canopy in excess of 70 feet, the dense mid- canopy layer, and the shrub cover supports songbird populations. Use of the site by moose, white tail deer, turkey, coyote, and black bear was observed during the field inventory.

- NHESP: The BioMap2 Project defines this stand as a Critical Natural Landscape and a Wetland Buffer Zone.
- Habitat techniques: Retention of the maturing white pine trees along the wetland edge preserves nesting and perching sites. Retention of a few of the large sized hemlock trees recruits future cavity stems.
- Risks: Not applicable.

**Fire Protection:** The sections with moist soils do not pose a high hazard for fire occurrence. A woods road parallels the eastern bound of this stand (also the property bound). Areas of the road are disappearing beneath the high water table, yet the road is suitable for fire suppression access.

**Desired Future Condition:** The further development of an all-aged, mixed species watershed forest ecosystem capable of natural filtration and purification function is desirable in this stand. This stand is deficient in suitable regeneration of white pine, red oak, yellow birch, and the other mixed oak overstory species. Stocking of immature and maturing high quality desirable stems is moderate. The release of their crowns allows for improved growth and development. The loss of hemlock and white ash stocking will open some growing space for these species.

**Recommended Management Practices:** 1. a combination approach of Single Tree and Small Group (.25 to 1.25 acres openings or gaps) Selection Harvest and Salvage Harvest will be used to encourage the complex forest structure necessary for biological water filtration. 2. Maintenance of the woods road along the eastern stand bound with placement and removal of geo-textile material over the wetland crossing area protects future access for management. 3. Treatment of the dense patches of mountain laurel scattered through this stand opens mineral soil for seed germination.

Objective	Stand Number	Forest Type	Stand Area	MSD or Size Class	Basal Area Per Acre	Volume Per Acre	Site Index	DCR/FIA Growth Rate
Stewardship Green Cert.	1.03	HH	6.1 acres	13.6 Inches WP: 18 inches	210 Sq. Ft.	9.919 MBF 10 cords – Pulp 6 cords - firewood	65 WP	.988 MBF per year

**Sub-Watershed:** Blue Meadow Brook

**Water Quality Concerns:** Prevent any loss of sediment from these uplands into the Blue Meadow Brook. Access into this stand requires the crossing of an existing road along a narrow land bridge. The proximity to the western portion of Blue Meadow Swamp and its main drainage south of this point mandates careful road construction during management work and appropriate erosion control measures along the roadway post-harvest. The water table in the western portion of the stand is rising annually from beaver activity in the swamp. Winter scheduling with frozen ground or snow cover is ideal for this site.

**Silviculture Status:** Suitable.

**Terrain/Topography:** This small stand sits along a level plain adjacent to Blue Meadow Swamp West and rises gently to the east. Small stones and boulders cover the ground here.

**Soils:** The soils are a weave of the Swansea Muck and the sandy Ridgebury loams. Both soils have a high water table and marginal productive capacity for tree growth. Trees grow in hummocks and clumps across the moist forest floor.

- **Timber Harvesting:** Frozen ground is necessary for timber harvest and management work in this stand. Access is gained from the south through Stand #3 with the use of a poled wetland/spring seep crossing.

- **Water Quality:** Frozen ground scheduling for any management work would minimize any sediment loss. The proximity of this area to the Blue Meadow Swamp West will allow for the deposition of any sediment before water leaves the swamp to enter the Manhan River system.

**Overstory:** Hemlock (43% of the stocking density) dominates the upper canopy in this stand. The quality of the hemlock crops ranges from poor to fair. The crowns present decline with a reddish tint due to either scale or water stress. Large sized, high quality white pine and red oak stems dot this layer.

**Understory:** Beneath the main canopy, a densely stocked sapling and pole layer of red maple, hemlock, white ash, yellow birch, and sugar maple grows well. The dominant immature red maple and hemlock trees have poor form and low quality.

- **Regeneration:** Reproductive growth rates a C level on our simple metric with shade tolerant hemlock most prevalent.
- **Native:** Mountain laurel, witch-hazel, and highbush blueberry compete heavily on the forest floor.
- **Non-native Invasive Growth:** No threat exists from these plants at this time.
- **Interfering native plants:** All native plant communities were valuable components of a healthy wetland ecosystem without threat to regeneration.

**Habitat:** Large sized black birch wolf trees provide denning and nesting trees close to the swamp area. The statuesque, tall white pine trees along the edge of the Blue Meadow Swamp West allow for large predatory bird and small mammal nesting and perching sites near a main water source. The local moose population heavily uses this site. Recent beaver signs included sapling and small pole red maple removals.

- **NHESP:** The BioMap2 Project defines this stand as a Critical Natural Landscape and a Wetland Buffer Zone.
- **Habitat techniques:** Retention of the maturing white pine trees along the wetland edge preserves nesting and perching sites. Retention of a few of the large sized hemlock trees recruits future cavity stems.
- **Risks:** Not applicable.

**Fire Protection:** The wet soils in this area do not pose any fire hazard. Access for fire protection can be gained from the old road along the eastern bound.



**Desired Future Condition:** The development of an all-aged, species diverse watershed forest ecosystem capable of natural filtration and purification is desirable here. Currently the stand structure lacks adequate reproductive growth. The salvage of the hemlock crops will open the main canopy and forest floor for seedling development.

**Recommended Management Practices:** 1. Application of a Salvage Harvest will remove the declining hemlock pole and timber sized trees from this area.

Objective	Stand Number	Forest Type	Stand Area	MSD or Size Class	Basal Area Per Acre	Volume Per Acre	Site Index	DCR/FIA Growth Rate
Stewardship Green Cert.	1.04	OH	12.7 acres	12.7 inches RO: 16 in.	110 Sq. Ft.	1.435 MBF 5 cords – Pulp 4 cords - firewood	65 RO	2.15 MBF per year

**Sub-Watershed:** Blue Meadow Brook

**Water Quality Concerns:** Prevent any loss of sediment from these uplands into the Blue Meadow Brook.

**Silviculture Status:** Suitable.

**Terrain/Topography:** The three narrow sections of this stand lay upslope of the main swamp upon a gentle north slope with frontage on Crooked Ledge Lane.

**Soils:** The stand grows above the deep, excessively well drained Gloucester soils. These fine, sandy loams move water through them quickly and allow for deep root penetration. Drought resistant trees such as white pine and red oak grow very well on these sites. Loss of new seedlings can be severe without removal of competing vegetation around them. One very small area of the central section lies above the moist, stony Ridgebury loams, and a spring seep drains across it.

- **Timber Harvesting:** Harvest work on these sites will not require any special scheduling since they drain quickly after storm events. Access from Crooked Ledge Road is feasible with a landing at the southern edge of the site near the intersection of Fomer Road. Sections of this old town road also hold moisture and require placement of sand and gravel along the bed for soil stability.
- **Water Quality:** Protection of the soil structure is important for the sustainability of aquifer recharge due to the fast percolation rates.

**Overstory:** This stand supports much younger trees than the surrounding communities do. Immature red oak, yellow, and black birch, red maple, paper birch, and beech pole and small sawtimber sized trees grow here. Most of these young trees have good form, vigorous crowns, and good potential for high quality lumber production with the exception of the multi-stem stump sprout origin red maple poles. These trees have defects on their main boles.

**Understory:** A moderate stocking of sapling and small pole stems (even younger in age with a range of 5 to 20 years) of the same overstory species fills the lower forest strata. Species include yellow birch, red oak, black birch, red maple, and black oak. The condition of this young crop is poor with the exception of well-formed yellow birch and red oak saplings.

- **Regeneration:** Shade from the two upper canopy layers limits the reproductive growth. Minimal seedlings grow per acre with dominance by beech and red maple.
- **Native:** Mountain laurel growth is limited, but witch-hazel and striped maple cover the forest floor. Other native shrubs cited include highbush blueberry, dogwood, and maple leaved viburnum. The herbaceous layer includes partridgeberry, Christmas fern, wood fern, trout lily, and Canada day lily.
- **Non-native Invasive Growth:** No threat exists from these plants at this time.
- **Interfering native plants:** The witch-hazel vegetation shades the forest floor and inhibits seed germination and seedling development of desirable hardwoods.
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**Habitat:** Witch-hazel plants are used as food by many species of moth and butterflies. Their presence here enhances biodiversity.

- **NHESP:** The BioMap2 Project defines this stand as a Critical Natural Landscape.
- **Habitat techniques:** Release of the red oak crowns through forest improvement work will increase acorn production for feed.
- **Risks:** Not applicable.

**Fire Protection:** These upland soils do not hold water as long as the wetland zones down slope near the swamp. Good fire protection access is gained from Crooked Ledge Road.

**Desired Future Condition:** The development of an all-aged, species diverse resilient watershed forest ecosystem capable of natural filtration and purification of water. Further development of this two-aged stand into the water filtration ecosystem will require many decades. Since the reproductive class is lacking here, the timber harvest work amongst the immature hardwood timber crop must open the oak crowns for seed production and tree improvement.

**Recommended Management Practices:** Application of the Selection Harvest System with intermediate improvement work in the younger age classes. One main objective is to promote oak seed germination and timber quality improvement.

Objective	Stand Number	Forest Type	Stand Area	MSD or Size Class	Basal Area Per Acre	Volume Per Acre	Site Index	DCR/FIA Growth Rate
Stewardship Green Cert.	1.05	HH	7.5 acres	12 inches 17 inches RO	193 Sq. Ft.	3.461 MBF 6 cords – Pulp 13 cords - firewood	60 RO	1.22 MBF per year

**Sub-Watershed:** Blue Meadow Brook

**Water Quality Concerns:** Prevent any loss of sediment from these uplands into the western portion of Blue Meadow Swamp through scheduling of the harvest work on stable ground conditions.

**Silviculture Status:** Suitable.

**Terrain/Topography:** The two sections of this stand rest upon a narrow level plateau along Crooked Ledge Road and descend moderately into the floodplain of the Blue Meadow Swamp West on its eastern edge.

**Soils:** The lower slope of the larger stand and the smaller strip of this stand lie above the moist, sandy Ridgebury loams. Their seasonally high water table prevents deep root development and stunts productive tree growth. Spring seeps effuse water across the soils in these two areas. The southern section of the larger strip of this stand grows above the well-drained, deep Gloucester loams that produce high yields of timber crops.

- **Timber Harvesting:** Some of the low depressions across this draughty Gloucester Soil require frozen ground for operability. Yet most of the area drains quickly, and open ground conditions for timber harvesting assure seedbed preparation in the mineral soil. Sections of the old Crooked Ledge Road roadbed /town road also hold moisture and require poled ford mitigation for soil stability.

- **Water Quality:** Some limited sections of this stand require frozen ground scheduling for harvest work with moist soils. No equipment may enter the spring field zones for the minimization of sediment loss and protection of the water percolation capacity of the soils. Sections of the old town access road hold moisture and will require placement of gravel and stone for soil stability.

**Overstory:** Small sized timber crops of hemlock (31% of stand stocking), red maple, black, scarlet, red, and white oak, and paper and black birch grow within this small area. Paper birch is a short-lived species, which is approaching the end of its lifespan and exhibiting serious decline and decay in its crowns. The hemlock crop is declining fast due to a combination of elongated hemlock scale and the wooly adelgid. High value red oak trees (greater than 18 inches in diameter) dot the upper canopy.

**Understory:** Red maple, hemlock, and yellow birch sapling and pole trees share the lower canopy. These trees range in size from two inches to eight inches. Their condition and quality is generally poor except for the yellow birch.

- **Regeneration:** Reproductive growth rates a C level on our simple metric with red maple and hemlock
- Most prevalent.
- **Native:** Mountain laurel (moderate stocking across the forest floor), high bush blueberry, dogwood, and witch-hazel populate a well-stocked shrub layer. The herbaceous layer is also sparse due to the shrub shade.
- **Non-native Invasive Growth:** No threat exists from these plants at this time.
- **Interfering native plants:** The lower strata plant community supports a healthy, vigorous forest ecosystem at this time with the potential for reproduction establishment.

**Habitat:** The large sized red oak crowns drop an ample volume of acorn mast each year for the deer and turkey populations. Beaver regularly enter the stand for seedling and small pole trees harvests.

- **NHESP:** The BioMap2 Project defines this stand as a Critical Natural Landscape.
- **Habitat techniques:** Retention of some of the dying hemlock timber sized trees (greater than 18 inches in diameter) will recruit future cavity stems close to a water source. Removal of the declining hemlock crop will open the forest floor for seedling development and increase the beaver feed source close to their lodge.

**Fire Protection:** These upland soils do not hold water as long as the wetland zones down slope near the swamp. Good fire protection access is gained from Crooked Ledge Road.

**Desired Future Condition:** The development of an all-aged, species diverse resilient watershed forest ecosystem capable of natural filtration and purification of water. The youngest age class is missing from

this stand. Removals of the declining hemlock and paper birch trees will open the forest floor for seedling development and release the crowns of the immature crop trees for improved growth.

**Recommended Management Practices:** 1. Application of a salvage harvest for the removal of declining hemlock and paper birch trees. 2. Mineral soils scarification during the snowless ground months for optimal seedbed preparation.

Objective	Stand Number	Forest Type	Stand Area	MSD or Size Class	Basal Area Per Acre	Volume Per Acre	Site Index	DCR/FIA Growth Rate
Stewardship Green Cert.	1.06	OHK	27.7 acres	15 inches 18 inches RO	100 Sq. Ft.	3.115 MBF <1 cord – Pulp 8.5 cords – firewood	65 RO	4.49 MBF per year

**Sub-Watershed:** Blue Meadow Brook

**Water Quality Concerns:** Prevent any loss of sediment from these uplands into the Blue Meadow Brook through scheduling of the harvest work to stable ground conditions either dry or frozen. The areas along the edge of the swamp must be harvested with frozen ground or snow cover conditions.

**Silviculture Status:** Suitable.

**Terrain/Topography:** The ground is level along crooked ledge Road and then gently slopes eastward into the moist depression of the mixed hemlock hardwood wetland zone.

**Soils:** This stand spreads across four different soil regimes all with a sandy loam base. A narrow strip along Crooked Ledge Road lies above a mix of Gloucester and Montauk well-drained, porous soils, which grow trees very well. Ridgebury soils lie beneath the central portion of the stand, and the eastern edge along the wetland rest above moist, stony Whitman soils. Both soils are stony and wet, yet the Whitman soils hold water for most of the year. Surprisingly, white pine and red oak grow very well in these sites.



- **Timber Harvesting:** Management work throughout the entire stand impacts the moist, poorly drained soils near the wetland. The areas along the edge of the swamp must be harvested with frozen ground or snow cover conditions
- **Water Quality:** Harvest work on these soils will not pose a threat to water quality.

**Overstory:** This stand supports a maturing grove of red oak (38% of the total stand stocking) mixed with hemlock, black birch, and scattered large diameter white pine trees. The large diameter red oak timber has good quality and high value. An estimated 20% of these trees exude a bacterial wet wood, which indicates merchantability may be decreasing in these trees. The hemlock crop is declining quickly from elongated hemlock scale and wooly adelgid damage. The scattered white pines have two distinct grades: some very high quality stems and large, branchy wolf trees, which provide habitat and seed. The paper birch trees here are also approaching their biological maturity. The red maple trees in the main canopy have many defects, small crowns, and low value. The stand was harvested over 30 years ago, when red oak timber crops were removed.

**Understory:** A moderate stocking of sapling and small pole stems (even younger in age with a range of 5 to 30 years) of the same overstory species fills the lower forest strata.

- **Regeneration:** Shade from the two upper canopy layers limits the reproductive growth. Minimal seedlings grow per acre with dominance by beech and red maple.
- **Native:** The three native shrubs mountain laurel, witch-hazel, and striped maple are dominant in this lower layer. Each species takes its turn covering the forest floor in different sections and prevents seedling development. Other native shrubs cited include highbush blueberry, dogwood, and maple leaved viburnum. The herbaceous layer included partridgeberry, Christmas fern, wood fern, trout lily, and Canada day lily.
- **Non-native Invasive Growth:** No threat exists from these plants at this time.
- **Interfering native plants:** The native shrubs shade the forest floor and inhibit seed germination and seedling development of desirable hardwoods.

**Habitat:** Although not beneficial to stand development, the numerous native shrubs produce annual fruit for a food source. The large sprawling red oak crowns are dropping massive volumes of acorns each fall, which are enjoyed by most species of wildlife.

- **NHESP:** The BioMap2 Project defines this stand as a Critical Natural Landscape.
- **Habitat techniques:** Release of the red oak crowns through forest improvement work will increase acorn production for feed.

**Fire Protection:** These upland soils do not hold water as long as the wetland zones down slope near the swamp. Good fire protection access is gained from Crooked Ledge Road.

**Desired Future Condition:** The ideal natural filtration watershed forest supports multiple age and size classes, species diversity, and a complex ecosystem structure. Conversion of this distinctly two-age stand to the ideal structure requires several decades. Use of the combination of the Selection System (Small Group and Single Tree Variants) and a Salvage Harvest in the hemlock and paper birch crops will introduce seedlings (preferably red oak) and improve the vigor and productivity of the best immature hardwood crop trees.

**Recommended Management Practices:** 1. Application of Small Group and Single Tree Selection Harvest combined with Salvage Harvests. 2. Removal of the shrub layer for preparation of an ideal seedbed with adequate solar exposure.

Objective	Stand Number	Forest Type	Stand Area	MSD or Size Class	Basal Area Per Acre	Volume Per Acre	Site Index	DCR/FIA Growth Rate
Stewardship Green Cert.	1.07	OH	12 acres	16 inches	100 Sq. Ft.	4.221 MBF 2 cord – Pulp 5 cords - firewood	65 RO	1.94 MBF per year

**Sub-Watershed:** Blue Meadow Brook

**Water Quality Concerns:** This stand lies on the eastern side of the beaver pond and shallow marsh section of the northern area of the Blue Meadow Brook Watershed. It is inaccessible from the Crooked Ledge Road side of the property. Water moves out of the spring seep field in this area down slope directly into the beaver pond. No sediment loss can occur from this stand since no harvest treatment is possible.

**Silviculture Status:** Suitable, but not applicable due to access.

**Terrain/Topography:** The stand lies upon a short slope (estimated 25% to 30%) to the east of the large beaver pond in the north section of this sub-watershed. Rocks and boulders clutter the soil surface, and a spring seep field effuses water into the beaver pond in the southern section of the stand.

**Soils:** This stand grows upon the well-drained, sandy Gloucester soils. These soils have large pore structures and percolate water rapidly. The deep sandy loams grow trees very well.

- Timber Harvesting: No management work is recommended in this area.
- Water Quality: The porous soils move water quickly out of the upland forest into the wetland zones. Without any management disturbance, the soil integrity will be maintained and no sediment loss into the riparian system will be incurred.

**Overstory:** This small remote stand grows maturing red oak, white ash, and red maple timber crops with some inclusions of large sized hemlock trees. The red oak timber has excellent quality, while the red maple has many defects on their boles. The white ash trees have defected free, tall boles with no evidence of the emerald ash borer yet. The hemlocks are declining rapidly in this stand; many stems have only 25% of their live needles left.

**Understory:** A well-stocked layer of black birch, red maple, paper birch, and hemlock sapling and small pole trees grow in the shade of the larger oak crowns. The immature black birch has good form and potential. The hemlock crop in this layer suffers the same afflictions as the older trees.

- **Regeneration:** Shade from the two upper canopy layers limits the reproductive growth. Minimal seedlings grow per acre with dominance by beech and red maple.
- **Native:** Mountain laurel clumps are scattered across the whole stand with some heavy concentrations in the northern section. Witch-hazel and striped maple also crowd this lower layer. Other native shrubs included highbush blueberry and maple leaved viburnum. The herbaceous layer included Christmas fern, wood fern, lycopodium (Christmas pine), and partridgeberry.
- **Non-native Invasive Growth:** No threat exists from these plants at this time.
- **Interfering native plants:** The native shrubs shade the forest floor, but the forest ecosystem appears in equilibrium at this time.

**Habitat:** Sign of use of this small stand by white tail deer, moose, beaver (marks on saplings and many saplings removed), raccoon, and fisher cat were noted during the inventory. The remote location provides safety for wildlife. The red oak and white oak trees produce ample annual mast crops.

- **NHESP:** The BioMap2 Project defines this stand as within a Critical Natural Landscape ( large blocks of forest minimally impacted by development and capable of providing habitat for a wide number of species), and over 75% of the stand as Wetland Buffer ( upland forest which acts as a filter and buffer for down slope wetlands).
- **Habitat techniques:** Preservation of this stand in its current condition protects this habitat. The dying hemlock trees provide cavity trees.

**Fire Protection:** These upland soils do not hold water as long as the wetland zones down slope near the swamp. Access could be gained from City of Holyoke lands to the north for fire management if necessary.

**Desired Future Condition:** The ideal natural filtration watershed forest supports multiple age and size classes, species diversity, and a complex ecosystem structure. This stand is distinctly two-aged, yet taken in a landscape perspective, it can be viewed as an older age group amongst the larger Tighe Carmody watershed.

**Recommended Management Practices:** No management work recommended in the 2015 to 2025 period.

Objective	Stand Number	Forest Type	Stand Area	MSD or Size Class	Basal Area Per Acre	Volume Per Acre	Site Index	DCR/FIA Growth Rate
Stewardship Green Cert.	1.08	WP	2 acres	13 inches	180 Sq. Ft.	17 MBF 5 cords pulp 2 cords firewood	65 RO	.32 MBF per year

**Sub-Watershed:** Blue Meadow Brook

**Water Quality Concerns:** Prevent any loss of sediment from these uplands into the Blue Meadow brook.

**Silviculture Status:** Not suitable.

**Terrain/Topography:** The ground is level along Fomer Road.

**Soils:** This stand grows above the well-drained, deep sandy Gloucester loams, which grows trees very well.

- Timber Harvesting: Management work is not recommended in this stand.
- Water Quality: This level plain joins the outflow from the hemlock swamp and the shallow marsh around the beaver pond. Water easily moves through these porous soils into the riparian zones.

**Overstory:** Immature white pine sawtimber crops dominate this small area with some inclusions of hemlock and red maple . The pine crop has healthy crowns and good quality stems.

**Understory:** A very sparse stocking of sapling and small pole stems (even younger in age with a range of 5 to 20 years) of red maple, beech, black birch, and paper birch dot the lower forest strata. These young

trees grow in thickets in small sunlit areas. Their tight stocking in these small niches keeps their boles straight and branch free.

- **Regeneration:** Shade from the two upper canopy layers limits the reproductive growth. Minimal seedlings grow per acre with dominance by beech and red maple.
- **Native:** A couple of dense mountain laurel patches were cited near Fomer Road. Other native shrubs cited include highbush blueberry, dogwood, and maple leaved viburnum. The herbaceous layer included partridgeberry, Christmas fern, wood fern, trout lily, and Canada day lily.
- **Non-native Invasive Growth:** No threat exists from these plants at this time.
- **Interfering native plants:** The overstory pine shade prevents shrub exploitation of the forest floor.

**Habitat:** These healthy young pine trees provide excellent roosting, perching, and denning opportunity for birds and small mammals.

- **NHESP:** The BioMap2 Project defines this stand as a Critical Natural Landscape, which provide habitat for many species, and enhance ecological resiliency.
- **Habitat techniques:** Preservation of habitat condition.

**Fire Protection:** Access for fire management is easy into this area from Fomer Road, and it is ideally located next to a water source for a four-wheel drive pumper truck.

**Desired Future Condition:** This small stand presents a pleasing aesthetic appearance from Fomer Road. The tall pine trees shade the roadside, and tower above the shrubs. The ideal natural filtration watershed forest supports multiple age and size classes, species diversity, and a complex ecosystem structure. A two-acre immature pine grove could be considered one small all-aged group amongst the larger Tighe Carmody watershed.

**Recommended Management Practices:** No management practices are recommended for this area in the 2015 to 2025 period.

Objective	Stand Number	Forest Type	Stand Area	MSD or Size Class	Basal Area Per Acre	Volume Per Acre	Site Index	DCR/FIA Growth Rate
Stewardship Green Cert.	1.09	WH	48 acres	17 inches	145 Sq. Ft.	10.745 MBF 2 cord – Pulp 4 cords - firewood	70 WP	7.78 MBF per year

**Sub-Watershed:** Blue Meadow Brook-southern portion

**Water Quality Concerns:** Prevent any loss of sediment from these uplands into the Blue Meadow Swamp and Blue Meadow Brook.

**Silviculture Status:** Suitable.

**Terrain/Topography:** The stand weaves itself across the southern portion of this sub-watershed. The largest section joins Crooked Ledge Road and Delisle Road. Three other smaller sections of the stand lie along Fomer Road on the southern edge of this stand. This terrain in the large section drops gradually across from Delisle Road southeast into the Blue Meadow Swamp. The other three sections slope moderately to the north into the swamp area from Fomer Road. Water moves out of the largest section of the stand from a large spring seep, which drains to the southwest.

**Soils:** This stand grows above the deep, well-drained, very stony Montauk soils. These soils have a perched water table in the late spring and fall, which holds water above the hardpan lower soil layer making it available for tree growth. The soils are well suited for the growth of white pine and oak timber crops.

- Timber Harvesting: These soils are easy to work for road construction due to their sandy base. The perched water table limits management work to dry (summer and early fall)



or frozen conditions. The hardpan layer restricts deep root penetration, therefore harvest levels should retain enough stocking to prevent any loss to wind throw.

- **Water Quality:** Harvest work on these soils directly impacts the water that moves into Blue Meadow Brook and Swamp. Although frozen ground conditions are ideal for management work in portions of this stand, the well-drained Montauk soils could be worked during open winter or dry ground conditions.

**Overstory:** The stand retained the appearance of an old-field type with maturing white pine (over 60% of the stocking density), which probably came in after pasture abandonment over 130 years ago, sharing the upper canopy with large red maple (contributes 19% of the stocking), red oak, and white oak. The quality of the white pine is fair. These trees have tall, statuesque boles, yet they retained abundant black knot defects. Pasturing practices pastures stripped soils of their nutrients for decades and the forest crop is still recovering.

**Understory:** The stand has been harvested several times throughout the past forty years. Each entry opened large patches of the forest floor. These gaps filled black birch, red maple, beech, oak, aspen, cherry, and hemlock saplings and now small pole trees with staggered age ranges from 1 to 35 years. The quality of this young crop is species dependent. The sugar maple, red oak, and black birch have the best form and potential.

- **Regeneration:** In the more open areas from recent blow down or tree death, seedlings still develop quickly. Overall, reproductive growth is limited by the overstory pine shade.
- **Native:** Native shrubs grow in two distinct ecotypes within this stand. Some of the hydric species that creep up into this area along the wetland edges include winterberry, serviceberry, shadbush, grey dogwood, and swamp pink. The majority of the stands support the upland shrubs species inclusive of mountain laurel, witch-hazel, highbush blueberry, and maple leaved viburnum. The herbaceous layer included partridgeberry, Christmas fern, wood fern, trout lily, and Canada day lily.
- **Non-native Invasive Growth:** Dense patches of Japanese barberry, privet, and Asiatic bittersweet are found in areas near Crooked Ledge Road and Fomer Road. The small old home site along Crooked Ledge Road is an invasive plant “hot spot,” which supports a dense stocking of many of these plants. These plants also spread through several areas near Fomer Road in the south of the stand. Their stocking levels are variable, yet overall still low to moderate.
- **Interfering native plants:** Native grapes climb into the crowns of many of the white pine trees, and witch-hazel could be a problem in the future after a new harvest project. Grapes left untreated will spread across the main canopy layer strangling trees.

**Habitat:** The main canopy height (over 85 feet) provides necessary sites for high nesters and roosters and excellent perching opportunity along the water and swamp edge. Ironwood, a small native tree, was quite abundant in the lower strata. This small tree hold sits catkin like fruit into late winter providing a

palatable food source. Several mature white oak and red oak “wolf” trees dot the overstory. These trees have cavity holes for nesting and denning, and they set ample mast crops.

- NHESP: The BioMap2 Project defines this stand as a Critical Natural Landscape (areas which provide habitat for many species, support intact ecological processes, maintain connectivity amongst habitats, and enhance ecological resilience), Core Habitat (areas which could support the long-term stability of rare and endangered species) along the edge of the shallow marsh and beaver pond, and valuable Wetland Buffer (upland forest which protects wetland down slope) also along the swamp and pond edges.
- Habitat techniques: Release of the red oak and white oak crowns through timber harvest work will increase acorn production for feed. Retention of some of the declining hemlock trees provides future cavity trees. Retention of the mature white pine along the swamp and pond edge protects denning, nesting, roosting, and perching sites adjacent to the water.

**Fire Protection:** These upland soils do not hold water as long as the wetland zones down slope near the swamp. Good fire protection access is gained from Crooked Ledge Road, Delisle Road, and Fomer Road.

**Desired Future Condition:** The ideal natural filtration watershed forest supports multiple age and size classes, species diversity, and a complex ecosystem structure. This stand is lacking in the younger age classes. Conversion of this stand to the ideal structure requires several decades and the development of this immature component. Use of the Selection System with a combination of the Single Tree and Small Group Variants will introduce seedlings and improve the vigor and productivity of the best residual crop trees.

**Recommended Management Practices:** 1. Treatment of the invasive plants before timber harvest work. 2. Treatment of the grape vines either before or during the timber harvest. 3. Application of Single Tree and Small Group Selection Harvest.

**Special Stewardship Considerations:** A large cellar hole for a house and barn are located close to Crooked Ledge Road. The stonework in these culturally important sites is fine workmanship. An elm tree grows near this settlement. Two small groves of maturing white pine and hemlock grow on the northern edge of the swamp. A very popular hiking trail loops through this stand from Crooked Ledge Road to Delisle Road. It meanders through the maturing pinewoods and brings the hiker to the pond edge.

Objective	Stand Number	Forest Type	Stand Area	MSD or Size Class	Basal Area Per Acre	Volume Per Acre	Site Index	DCR/FIA Growth Rate
Stewardship Green Cert.	1.10	WHK	13 acres	13 inches WP:22 inches	160 Sq. Ft.	7.903 MBF  2 cord – Pulp  9 cords - firewood	65  RO	2.11 MBF per year

**Sub-Watershed:** Blue Meadow Brook

**Water Quality Concerns:** Prevent any loss of sediment from these uplands into the Blue Meadow Brook and Swamp along its western edge.

**Silviculture Status:** Suitable.

**Terrain/Topography:** The stand is located in a “U” shaped strip along Fomer Road in the southern most section of the sub-watershed. The terrain slopes gently (less than 3% pitch) to the east into the Blue Meadow Swamp.

**Soils:** This stand grows above the deep, well-drained, very stony Montauk soils. These soils have a perched water table in the late spring and fall, which holds water above the hardpan lower soil layer making it available for tree growth. The soils are well suited for the growth of white pine and oak timber crops. The recent beaver activity is raising the water table on the eastern edge of this stand along the swamp.

- **Timber Harvesting:** These soils are easy to work for road construction due to their sandy base. The perched water table limits management work to dry (summer and early fall) or frozen ground conditions. The hardpan layer restricts deep root penetration,

therefore harvest levels should retain enough stocking to prevent any loss to wind throw.

- **Water Quality:** Harvest work on these soils directly affects the water that moves into Blue Meadow Brook and Swamp. Although frozen ground conditions are ideal for management work in portions of this stand, the well-drained Montauk soils could be worked during open winter or dry ground conditions.

**Overstory:** The stand has a matrix-like appearance that blends some open areas with sapling/pole tree growth and the dense conifer cover. The dominant species include hemlock (25% of stocking), red oak (23%), and white pine (19%). The hemlock crop is declining quickly from a combination of elongated hemlock scale and wooly adelgid damage; many trees have less than 50% live needles. The quality of the white pine is good. The red oak sprout many epicormic branches (lateral branch growth which lowers lumber grades) in the areas along the more open edges, yet one small section on the beaver pond grows high quality timber. Maturing hickory trees with their tall, statuesque form cap the upper canopy.

**Understory:** A sparse stocking of sapling and small pole stems of red maple, black birch, white ash, aspen, and hemlock grows beneath the main canopy. Except for the red maple, these young trees have good form and healthy crowns.

- **Regeneration:** Dense thickets of vigorous seedlings (all overstory species) developed in the more open areas, and beneath the main canopy, their stocking is sparse. The white pine seedlings have needle discoloration (reddish tint) across the stand.
- **Native:** Mountain laurel and witch-hazel shrubs grow prolifically across the forest floor. They prevent healthy seedling development in some areas. Other native shrubs cited include highbush blueberry and maple leaved viburnum upslope, and winterberry and red alder down slope near the beaver pond and swamp. The herbaceous layer includes partridgeberry, Christmas fern, lycopodium, trout lily, and Canada day lily.
- **Non-native Invasive Growth:** Japanese barberry shrubs cover about 10% of the forest floor along Fomer Road with individual shrubs scattered through the rest of the stand.
- **Interfering native plants:** The witch-hazel and mountain laurel shade the forest floor and inhibit seed germination and seedling development of desirable hardwoods.

**Habitat:** The juxtaposition of the maturing hemlock and white pine stems along the swamp and beaver pond edge creates vertical diversity and excellent perching, nesting, and roosting opportunities. The dying hemlock offer cavity stems for current and future use. Red oak and hickory set abundant mast crops for a food source. Recent beaver activity was cited with the removal of many saplings along the swamp edge. As the water table rises, it leaves behind many standing dead snag and cull stems, which provide insect breeding sites.

- **NHESP:** The BioMap2 Project defines this stand as a Critical Natural Landscape (areas which provide habitat for many species, support intact ecological processes, maintain

connectivity amongst habitats, and enhance ecological resilience), Core Habitat (areas which could support the long-term stability of rare and endangered species) along the edge of the shallow marsh and beaver pond, and valuable Wetland Buffer (upland forest which protects wetland down slope) also along the swamp and pond edges.

- **Habitat techniques:** Release of the red oak and hickory crowns through forest improvement work will increase acorn production for feed. Retention of the maturing hemlock and white pine trees along the pond and swamp edges is recommended for preservation of their habitat value.

**Fire Protection:** These upland soils do not hold water as long as the wetland zones down slope near the swamp. Good fire protection access is gained from Fomer Road.

**Desired Future Condition:** The ideal natural filtration watershed forest supports multiple age and size classes, species diversity, and a complex ecosystem structure. This stand has a surplus in the older age classes; introduction of more seedling growth will advance the stand's conversion to the ideal structure.

**Recommended Management Practices:** 1. Manual treatment of the invasive plant community before a timber harvest. 2. Application of a Combination Single Tree and Small Group Selection Harvest. 3. Salvage Harvest of the dying hemlock crops. 4. Disturbance of the of the dense witch-hazel and mountain laurel layer in certain sections of the stand for preparation of an ideal seedbed.

Objective	Stand Number	Forest Type	Stand Area	MSD or Size Class	Basal Area Per Acre	Volume Per Acre	Site Index	DCR/FIA Growth Rate
Stewardship Green Cert.	1.11	OH	14 acres	14.5 inches RO: 18 inches	140 Sq. Ft.	7.629 MBF 2 cord – Pulp 6.5 cords - firewood	65 RO	3. MBF per year

**Sub-Watershed:** Blue Meadow Brook

**Water Quality Concerns:** Prevent any loss of sediment from these uplands into the Blue Meadow Brook and Swamp and the small spring seep drainage through the center of the stand.

**Silviculture Status:** Suitable, but not applicable now.

**Terrain/Topography:** The stand lies in a shallow valley between the two slopes, which merge to form the Blue Meadow brook channel in the central portion of the property. The relief descends moderately from the eastern edge of this stand into a small depression along a spring seep run-off channel in the center of the stand.

**Soils:** This stand grows above the deep, well-drained, very stony Montauk soils. These soils have a perched water table in the late spring and fall, which holds water above the hardpan lower soil layer making it available for tree growth. The soils are well suited for the growth of white pine and oak timber crops. The spring seep system holds moisture in the soils along its course.

- **Timber Harvesting:** These soils hold a lot of moisture from the drainage channel through its center. If future harvesting work were recommended, scheduling during dry (open winter or dry summer and fall) and frozen ground conditions would protect the soil structure.

- **Water Quality:** Since no management work is recommended here, water quality protection measures are not a concern.

**Overstory:** The oldest trees in the main canopy are maturing red oak, sugar maple, and white pine with marginal timber quality. Many of the white pine trees, although large in size, suffer weevil damage from the past and have many stems and large black knots. The red oak trees are distributed evenly across the stand. The hemlock trees are declining quickly here from the scale and adelgid infestations. The upper canopy layer ranges in height from 65 to 90 (pine) feet and towers above the sapling and small pole layer beneath.

**Understory:** These younger trees contribute over 60% of the stand stocking density. They average less than four inches in diameter and less than 25 feet in height. Species include red maple, cherry, black oak, white ash, hickory, and black birch. These trees developed in open conditions, and they formed many branches along the main trunk. Their condition is poor to fair.

- **Regeneration:** Seedling stocking is moderate, yet the young trees are vigorous. Species cited include red maple, sugar maple, hemlock, white pine, red oak, white oak, black birch, and aspen.
- **Native:** Shrubs cited include high bush and low bush blueberry, maple leaved viburnum, dogwood, and swamp pink. The herbaceous layer included partridgeberry, Christmas fern, sensitive fern, cinnamon fern, interrupted fern, trout lily, and Canada day lily. Poison ivy grows prolifically through this stand, climbing up the maturing residual white pine trees.
- **Non-native Invasive Growth:** Japanese barberry shrubs appear on every acre through the stand. Their density is low, and the native plants are competing well with them for growing space.
- **Interfering native plants:** Grape vines climb into many of the white pine and larger oaks. These vines can suffocate a mature tree with their exploitive growth habits.

**Habitat:** The vertical stratification of the canopy layers provides habitat benefits for a wide variety of songbirds and small mammals for feeding and covers sites. The weevilled pine stems with their large crowns offer many denning and nesting sites. The red oak and hickory trees have large sprawling crowns, which shed large volumes of mast. The dense blueberry bushes also produce copious annual fruit. Native grapes do provide a palatable food source each fall.

- **NHESP:** The BioMap2 Project defines this stand as a Critical Natural Landscape (areas that provide habitat for many species, support intact ecological processes, maintain connectivity amongst habitats, and enhance ecological resilience).
- **Habitat techniques:** Preservation of this unique habitat niche increases the biodiversity of the local region and protects habitat values.

**Fire Protection:** These upland soils do not hold water as long as the wetland zones down slope near the swamp. Good fire protection access is gained from Delisle Road and Fomer Road.

**Desired Future Condition:** Preservation of this unique habitat niche amongst the mixed conifer cover increases the biodiversity of the site. Natural development of the sapling and pole class will be allowed during this cutting cycle. Retention of the overstory shade will prevent further advance of the Japanese barberry, Asiatic bittersweet, and privet across the forest floor.

**Recommended Management Practices:** 1. Treatment of the invasive plants for the protection of the native species communities. 2. Treatment of the native grapes for their removal from the main canopy.



Objective	Stand Number	Forest Type	Stand Area	MSD or Size Class	Basal Area Per Acre	Volume Per Acre	Site Index	DCR/FIA Growth Rate
Stewardship Green Cert.	1.12	WA	24.5 acres	NA	NA	NA	NA	NA

**Northern section:** Three small beaver ponds: 2.5 acres

**Southern section:** The large beaver pond known locally as Blue Meadow Swamp: 22 acres.

**SUB-WATERSHED #2: BREAKNECK BROOK**

<b>Objective</b>	<b>Stand #</b>	<b>Forest Type</b>	<b>Stand Area (acres)</b>	<b>MSD or Size Class (inches)</b>	<b>Basal Area (sq.ft./ac)</b>	<b>Volume Per Acre</b>	<b>Site Index</b>	<b>DCR/FIA Growth Rate (MBF/yr.)</b>
Stewardship Green Cert.	2.01	WP	20.80	13.7"	180 Sq. Ft.	12.3 MBF 15.9 Pulp cds 0.4 Firewd cds	Hk 55 WP 63 RO 59	3.08

**Sub-Watershed:** Breakneck Brook

**Water Quality Concerns:** The goal for water quality protection is the prevention of any movement of sediment or nutrients into Breakneck Brook and the reservoir during or after timber harvest work. The western edge of the northern portion of this stand lies along Breakneck Brook. The deep Hinckley sands move water downward quickly, which removes it from surface of the soils.

Frozen ground scheduling of the harvest work ideally prevents any soil displacement, but open ground with dry and stable earth allows for seedbed preparation work. Therefore, portions of the stand must be done when the ground is frozen, and others can be worked during stable ground conditions either open winter or dry summer or fall. Hinckley soils drain quickly.

**Silviculture Status:** Suitable.

**Terrain/Topography:** Two small sections lie along Fomer Road. The largest grows upon a broad plain with a slight tilt towards the west into the Breakneck Brook channel and crossing the brook. The terrain flattens further in this area near the north property bound near a most depression and a transition into a wetland. The smaller roadside section perches upslope on a level plain. The third small section lies west of Breakneck Brook upslope upon a small knoll.

**Soils:** Most of this stand grows above the Hinckley sandy loams, deep, excessively well drained soils on an upland terrace. The Hinckley soils are very porous, and water moves quickly through them. They are well suited to tree growth, yet their doughiness causes seedling mortality. The area, which straddles

Breakneck Brook in the north, lies above the Enosburg fine sandy loams. These deep, poorly drained soils have a seasonally high water table grow trees moderately well. They are considered highly erodible.

- **Timber Harvesting:** These Hinckley loamy sands have about 10% gravel composition. They are easily worked with equipment, and they will provide ideal road building medium for the harvest work. The Enosburg soils hold rendering unsuitable for silvicultural work. This area of the stand is not included in the timber harvest planning.
- **Water Quality:** The Hinckley soil's pore structure is small, which prevents the fast movement of sediments. Harvest scheduling during dry or frozen ground conditions will prevent any sediment loss and protect the soil structure.

**Overstory:** A dense stand of planted white pine timber crops grows in this area. These trees have an average age of 110 years. The main canopy layer is at 65 to 75 feet. These are immature, small timber sized pine with black knot defects. Black knots result when the limb has died and subsequent growth of the bole surrounds the dead limb. These knots are often black and may contain bark or pitch pockets separating the dead-limb wood from the living stem wood. They represent an undesirable defect in lumber. One small section of the stand near the wetland zone in along the north bound poor quality trees with multiple stems due to weevil damage and black knots. Scattered high value small timber red oak and small pockets of aspen trees break up the pine canopy.

**Understory:** Harvesting work in this stand over 45 years ago created gaps in the main canopy, which filled with black birch, white ash, black cherry, beech, and red oak poles trees. These trees have good form and high quality potential.

- **Regeneration:** recent blow down or tree loss to death opens small areas that fill quickly with hemlock, red maple, black birch, and pine seedlings, but these areas are spread through the stand. Overall, the pine shade prevents seedling development.
- **Native:** Shrub species scattered across the forest floor include striped maple, lambkill, and maple leaved viburnum. Grape vines climb up into the tall pine trees, but poison ivy was much more prolific on the forest floor and tree trunks. Other native herbaceous partridgeberry, dewberry, bracken fern, may flower, and false Solomon seal.
- **Non-native Invasive Growth:** Japanese barberry and multiflora rose advance from Fomer Road into the first 200 feet of the stand in both of the eastern sections. These individual stems and small clumps have been contained by the overstory shade, and only exploit small fully sunlit areas.
- **Interfering native plants:** The grape vines could easily spread through the canopy without treatment.

**Habitat:** Signs of use by raccoon, white tail deer, moose, pileated woodpecker, grouse, and owl were noted. Many songbirds eat pine seeds, and pine needles appeal to porcupine and rodents for food and songbirds for nest material. Their high branches provide roosting sites to robins and turkeys.

- NHESP: The BioMap 2 project identified this stand as Aquatic Core Habitat, Critical Natural Landscape, Core habitat, and Forest Core habitat.
- Habitat techniques: Retention of the immature red oak and aspen timber crops will provide both acorns and grouse habitat. The proposed harvest will increase the vertical stratification within this stand and enhance biodiversity.

**Fire Protection:** The area is easily accessible to Fomer Road for fire management if necessary. These dry soils and the thick pine duff do pose a slight fire hazard.

**Desired Future Condition:** The development and maintenance of the all-aged, species diverse, resilient natural filtration and purification watershed forest is the desired objective in this stand. This stand is predominantly even aged (white pine less than 120 years) with some minor inclusions of younger hardwood. These soils are conducive to the productive growth of both white pine and red oak. Its conversion to the desirable structure will require several decades. The process begins with the introduction of the youngest age class. The goal is for prolific white pine seed germination will seed well to occur, and the future stand will be species diverse.

**Recommended Management Practices:** 1. Treatment of the invasive plant communities along Fomer Road before a timber harvest. 2. The application of an Irregular Shelterwood Harvest to encourage seedling development on the forest floor. 3. Treatment of the minor grape vine problem before or during the harvest work.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	2.02	OHK	15.00	12.2"	124	8.6 MBF 2.2 Pulp cds 5.9 Firewd cds	Hk 55 WP 63 RO 59	1.91

**Sub-Watershed:** Breakneck Brook

**Water Quality Concerns:** The goal for water quality protection is the prevention of any movement of sediment or nutrients into Breakneck Brook and the reservoir during or after timber harvest work. The deep Hinckley sands move water downward quickly, which removes it from surface movement. The moist soils near the brook require mitigation with either corduroy or geotextile material (If use geotextile, it must come out after the harvest work) and with gravel. Scheduling of the harvest during dry or frozen conditions will protect the soil stability.

The western edge of this stand lies along Breakneck Brook. The banks are about five to ten feet (rather steep pitch for banks) in height, and highly erodible. The eastern bridge abutments must be constructed in this stand, and the main access road to the brook for any management work will travel through this stand. Careful engineering and stabilization techniques before bridge installation and post harvest will prevent sediment loss this close to the reservoir.

**Silviculture Status:** Suitable in some sections.

**Terrain/Topography:** This stand lies upon a gentle slope (less than 2%) from Fomer Road to Breakneck Brook. The terrain is moist and hummocky on a level plain west of the brook.

**Soils:** The stand grows above Hinckley soils, deep, excessively well drained soils on upland terrace. The Hinckley soils are very porous, and water moves quickly through them. They are well suited to tree growth, yet their droughtiness causes seedling mortality.

- **Timber Harvesting:** These are loamy sands with about 10% gravel. They are easily worked with equipment, and they will provide ideal road building medium for the harvest work. They hold water near Breakneck Brook; this area will require corduroy or geotextile material (These materials must be removed post harvest work.) placement for protection of the soil integrity during the removal of all the timber products west of the brook.
- **Water Quality:** Post-harvest stabilization and emergency stabilization measures during storm events while the harvest is ongoing will be necessary to prevent any sedimentation into Breakneck Brook. These gravelly soils could be worked during open ground in winter or a dry summer or fall.

**Overstory:** The upper canopy is a mix of hemlock (32% of the stocking), large sized white pine, and high value red oak timber crops with minor contributions by black birch, paper birch, and red maple. The hemlock crop is declining quickly (elongated hemlock scale and wooly adelgid damage) with only about 50% of live needles across the stand. The paper birch crop approaches biological maturity, and the trees are in serious decline.

**Understory:** A sparsely stocked layer of red maple, black birch, yellow birch, red oak, beech, and hemlock sprang up over 30 years ago after a conservative harvest. The yellow birch, black birch, and red oak poles have good form and excellent potential for high quality. The red maple saplings and pole trees have stump sprout origin, poor form, and inferior quality. The young hemlock crop is also dying off. The young beech suffers from the beech bark disease complex, which results from a small aphid wound to the bark and the subsequent fatal infection of the cambium by necrotic bacteria.

- **Regeneration:** Reproductive stocking is very limited with dominance by hemlock and red maple.
- **Native:** Dense thickets of mountain, hobble bush, and witch-hazel shrubs cover the forest floor. The healthy herbaceous plant layer includes starflower, hay scented fern, sensitive and bracken fern (moist soils near brook), and partridgeberry.
- **Non-native Invasive Growth:** One area near the intersection of Fomer Road and the access road to the west of Breakneck brook supports dense thickets of Japanese barberry and multiflora rose. Overstory shade prevented their spread into the stand. Their density is still low enough for mechanical control with the removal of the shrubs.
- **Interfering native plants:** The native shrubs pose a minor threat to the reproductive stocking after a harvest without some reduction in their density.

**Habitat:** Several large diameter white pine trees died on the stump and their skulls provide excellent cavitations. Their collapse onto the forest floor provides high volume of coarse woody material for insects and invertebrates. Acorns rate a position at the top of the wildlife food chain; they are abundant in this stand.

- NHESP: The BioMap 2 Project defines this stand as Aquatic Core habitat, Aquatic Buffer, Forest Core, Critical Natural Landscape, and Core habitat, which indicates that this stand supports ecological resilience to climate change and other disturbances and increases local biodiversity.
- Habitat techniques: 1. The release of the red oak crowns will increase the annual acorn crop.
- 2. Protection of the white pine cull trees and retention of a few of the larger dying hemlock secures current and future cavity trees.
- Risks: Not applicable.

**Fire Protection:** The location close to breakneck brook provides a water source for a four-wheel drive pumper truck in the event of a crisis. The site is easily accessible from Fomer Road for fire management.

**Desired Future Condition:** The development and maintenance of the all-aged, species diverse, resilient natural filtration and purification watershed forest is the desired objective in this stand. The youngest age class in this stand is lacking. Silviculture work can introduce this age class on the forest floor and release the crowns of the residual red oak, yellow birch, and black birch crop trees for improved value and diameter growth.

**Recommended Management Practices:** 1. Treatment of the small area of invasive plants before any harvest work. 2. Application of the Selection Harvest System with a combination of the Single Tree and Small Group Variants. 3. Salvage Harvest for the removal of the declining hemlock (about 70%) and the paper birch. 4. Disturbance of the shrub layer during the timber harvest for full exposure of the mineral soils and seedbed preparation.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	2.03	OH	47.60	10.2"	129	7.8 MBF 2.6 Pulp cds 5.6 Firewd cds	Hk 55 WP 63 RO 59	4.58

**Sub-Watershed:** Breakneck Brook.

**Water Quality Concerns:** The goal for water quality protection is the prevention of any movement of sediment or nutrients into Breakneck Brook and the reservoir during or after timber harvest work. The lower slope of this stand meets the western bank of Breakneck Brook at a site with moderately steep banks, which are highly erodible. The establishment of a 75-foot no-entry filter strip on the banks of Tucker Brook and Breakneck Brook will prevent any sediment loss into the brook.

**Silviculture Status:** Suitable.

**Terrain/Topography:** The relief drops from the north bound of this stand (property bound also), which perches on the southern flank of a hilltop southeasterly onto a tilted plain on the banks of Breakneck Brook. The terrain sweeps westward across this same flank and slowly drops towards Tucker Brook with a break in the slope by a narrow drainage from upland spring seeps. The southernmost section supports two esker formations, which have steeply sloping sides.

**Soils:** The stand grows above the Hinckley soils, deep, excessively well drained soils on upland terrace. The Hinckley soils are very porous, and water moves quickly through them. They are well suited to tree growth, yet their doughtiness causes seedling mortality. The soils surface has many small boulders and stones.

- **Timber Harvesting:** These are loamy sands with about 10% gravel. They are easily worked with equipment, and they will provide ideal road building medium for the harvest work. The sloping terrain (ranging from 15 % to 40% slopes) presents an engineering challenge. Proper installation of erosion control measures during and post-harvest will prevent any sediment movement along the road surfaces.



- Access to the western portion of Stand 3 requires a bridge across Breakneck Brook. The approaches will be on a manageable grade perpendicular to the brook.
- Water Quality: Post-harvest stabilization and emergency stabilization measures during storm events while the harvest is ongoing will be necessary to prevent any sedimentation into Tucker brook or Breakneck brook. The establishment of a 75-foot no-entry zone around the spring seep drainage off the north bound will also protect soils stability and water quality in this drainage.

**Overstory:** This stand exists in a two-aged condition with an overstory of sawtimber sized; high quality red oak crops mixed with small sized black birch and red maple trees. Scattered white oak and black oak with large sized mature stems dot the upper canopy. Pockets (less than ½ acre in size) of large diameter (average 23 inches), high value white pine timber crops are scattered about the stand.

**Understory:** Red oak, yellow birch, black birch, paper birch, pine, beech, hemlock, and red maple large saplings and pole trees (less than 35 years old) grow beneath the large red oak crowns. All species are vigorous in this age class, but the immature red oak and yellow birch have the best form and quality. The young beech is very sick with the beech bark complex, and the hemlock is declining very fast.

- Regeneration: Reproductive growth is low across the stand with pockets of beech, red maple, and hemlock seedlings growing beneath the oak crown shade.
- Native: Witch-hazel shrubs are consistent across the forest floor in moderate density. Dense thickets of mountain laurel grow along the Breakneck Brook banks in the eastern portion of the stand and the upper slopes near the northern boundary. The only herbaceous plants visible during the inventory were trout lily, starflower, lycopodium, and partridgeberry.
- Non-native Invasive Growth: Small clumps of Japanese barberry and privet grow near the old home settlement along the access road. Their density is low, and they could be removed manually at this time. This small area will not be included in any harvest treatment, which could allow the shade to control their spread.
- Interfering native plants: The densest stocking of laurel grows in areas not suitable for silviculture such as the upper slopes and the riparian zones along the brook. Witch-hazel shrubs could interfere with seedling development if they spread out after a timber harvest. Their disturbance is recommended during the timber harvest.

**Habitat:** The mature red oak sets ample annual mast crops palatable to many wildlife species. The dense white pine thickets are good cover sites, and they provide roosting, denning, and perching opportunities. Moose sign was prolific through this stand with scat, rubbing on small pole trees, and hooves prints. A barred owl called extensively in this area during the inventory (daylight hours), which suggests protection of a nest.

- NHESP: The BioMap2 project defines this stand as Aquatic Core (near Tucker brook and Breakneck brook), Aquatic Buffer Zone (almost 80% of the stand), Critical Natural Landscape, Core Habitat, and Forest Core which indicates that this stand supports ecological resilience to climate change and other disturbances and increases local biodiversity.
- Habitat Techniques: 1. Release of the red oak crowns for increased mast production. 2. Retention of some upper canopy clumps of white pine for preservation of their roosting and denning value.
  3. Retention of any snags or cull pine and hemlock or hardwood stems for insect breeding sites for feed.
- Risks: The moose browse on the striped maple was heavy. Browsing maybe a problem with the new seedling growth.

**Fire Protection:** The dry, upland Hinckley soils do not hold moisture and could present a fire hazard. Access is possible to this area for fire management from the crossing point on Breakneck Brook. Post harvest protection of access road through proper erosion control measures and grading will allow a four-wheel drive pumper truck.

**Desired Future Condition:** The development and maintenance of the all-aged, species diverse, resilient natural filtration and purification watershed forest is the desired objective in this stand. The youngest age class in this stand is lacking. Use of the Selection Method with a combination of the Single Tree and Small Group variants will open the canopy for seedling development on the forest floor. The crowns of the best crop trees (red oak, yellow birch, and black birch) will also be released for improved vigor and value growth.

**Recommended Management Practices:** 1. Application of Selection Method. 2. Disturbance of the witch-hazel across the forest floor for seedbed preparation.

**Special Stewardship Considerations:** A series of waterfalls tumbles over Breakneck Brook along the eastern edge of the stand. An old quarry site lies beside brook near the waterfall.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	2.04	WH	7.10	11.7" 16 " RO and Hk	173 Sq. Ft.	15.8 MBF 7.2 Pulp cds 5.2 Firewd cds	Hk 55 WP 63 RO 59	0.81

**Sub-Watershed:** Breakneck Brook

**Water Quality Concerns:** It is important to prevent any movement of sediment or nutrients from this upslope site into Tucker Brook and Tighe Carmody Reservoir. This stand lies close to Tucker Brook with the slope of the land towards the brook system. An old well rests on the western tip of the northern section of the stand. Filter strips of 50 feet of non-entry status will be set around these areas during any harvest work for filtration and buffer function.

**Silviculture Status:** Suitable.

**Terrain/Topography:** The main access road through this tract separates the two small sections of this stand.

One section of the stand south of the main access trail rests on a gently sloping to level terrace with steep slopes to the north and close to Tucker Brook. The larger section to the north of this trail lies upon a knoll with steeply sloping sides.

**Soils:** The stand grows above the Hinckley soils. These are deep, excessively well drained soils on upland terrace. The Hinckley soils are very porous, and water moves quickly through them. They are well suited to tree growth, yet their doughiness causes seedling mortality.

- **Timber Harvesting:** These are loamy sands with about 10% gravel. They are easily worked with equipment, and they will provide ideal road building medium for the harvest work.

- **Water Quality:** Water moves quickly through these sands and gravels, yet the pore structure is small. Sediments will not move as quickly, and dry or frozen ground conditions scheduling will protect soil structure stability.
- Access to this stand requires a bridge on breakneck brook with proper crossing installation at a good grade and the perpendicular.

**Overstory:** Tall (over 80 feet) white pine trees with small, healthy crowns share the upper canopy with scattered red oak sawtimber, declining hemlock, and three or four over mature, “wolf” sugar maple trees. The quality of the white pine and red oak is very good. This layer ranges in age from 150 to 175 years of age. Timber harvest work was completed in this stand over 30 years ago. Many of the few hemlock trees have less than 50% live needles due to elongated hemlock scale and wooly adelgid damage.

**Understory:** A moderately well stocked layer of red maple, black birch, yellow birch, red maple, and beech sapling and pole trees grow beneath the towering main canopy. The immature yellow birch trees have exceptionally good form and quality. Most of the other species are in poor condition with life under the pine shade.

- **Regeneration:** Site dryness and the shade of the overstory white pine limit reproductive growth. Only the shade tolerant species (hemlock, beech, and red maple) seedlings were counted. The hemlock seedlings and saplings are dying quickly.
- **Native:** The herbaceous layer was not in full growth yet as the inventory was completed in early May. Native shrubs noted include hobblebush, striped maple, blueberry, and scattered short mountain laurel. Some herbaceous plants already out were star flower, mayflower,
- **Non-native Invasive Growth:** Not applicable.
- **Interfering native plants:** Not applicable.

**Habitat:** Sign of moose in this stand includes scat, hooves prints near the well, and heavy browsing of the hobblebush and striped maple plants. When the large diameter white pine trees blow over or dies, a high volume of coarse woody debris covers the forest floor. Tall, maturing pine provides excellent roosting sites for turkey or nesting and denning for small mammals.

- **NHESP:** The Natural heritage Endangered Species Program identifies to this stand as an Aquatic Core, an Aquatic buffer, Critical natural landscape, Core habitat, and Forest Core. These designations signify a strong capacity within this stand for ecological resiliency and the capacity to support wide array of wildlife species.
- **Habitat techniques:** 1. Retention of legacy, mature, tall white pine trees for nesting, denning, and perching. 2. Retention of the over mature sugar maple wolf trees for denning and cavity use.

- 3. Release of the largest and healthiest red oak crowns will increase mast production. 4. Harvest work opens the canopy to introduce vertical stratification, which supports songbird use.
- Risks: Seedling development is difficult here due to the soils, and moose browsing may further impact the ability to regenerate this site.

**Fire Protection:** The site lies close to Tucker Brook, which would serve as a natural firebreak. The dry soils and excessive pine needle layer are a fire risk. Access could be gained with some difficulty from the east off Fomer Road. Installation of the approaches to the bridge crossing can incorporate correct pitches for four-wheel drive access post-harvest.

**Desired Future Condition:** The development and maintenance of the all-aged, species diverse, resilient natural filtration and purification watershed forest is the desired objective in this stand. This small stand provides an inclusion of the mature age class within the larger watershed all-aged, species diverse landscape. The mature white pine is past its mid-life, and the replacement crop for this site is not started.

**Recommended Management Practices:** 1. Application of an Irregular Shelterwood System for the regeneration of white pine and red oak into this area.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	2.05	(a) RZ -HH (b) Swamp	9.50	(a) 12.1"	(a) 140	(a) 6.1 MBF 0.0 Pulp cds (a) 9.2 Firewd cds	(a) Hk 55 (a) WP 63 (a) RO 59	(a) 0.81

**Sub-Watershed:** Breakneck Brook

**Water Quality Concerns:** These two small areas provide green infrastructure for water quality protection with the dense cover on the steep slope and the shrub and wetland plants in the small riparian zone. Neither of these areas will be disturbed during any harvest work, and the soils structure and integrity will not be compromised. The narrow band of hemlock and hardwoods along Tucker Brook provides the last barrier to any sediment movement towards Tucker Brook during the timber harvest work.

**Silviculture Status:** Not suitable.

**Terrain/Topography:** The narrow strip of a mixed hemlock and hardwood grove along Tucker Brook slopes steeply to the west into the brook channel. The small hardwood sapling and pole swamp along the north west corner of the tract lies upon a wide, level, moist plain.

**Soils:** The steeply sloping mixed wood grove along Tucker brook grows above the deep, well-drained Hinckley soils. The small wetland lies above the Enosburg fine sandy loams. These deep, poorly drained soils have a seasonally high water table grow trees moderately well. They are considered highly erodible.

- Timber Harvesting: Not applicable.
- Water Quality: Discussed above.

**Overstory:** The steep slope site supports maturing hemlock (80% of the stocking), yellow birch, and red oak, black birch, and beech small sized timber trees. The hemlock crop is declining, yet many trees still have over 60% of their live needles.

**Understory:** In the hemlock grove, a well-stocked layer of red maple, hemlock and beech saplings, and seedlings develop beneath the main canopy. These trees have poor quality; yet function well as riparian zone cover. The pole hardwood swamp has one canopy height (35 to 45 feet) with dense stocking of white ash, red maple, yellow birch, aspen, and some elm.

- **Regeneration:** There is no appreciable reproductive stocking in either section of this stand.
- **Native:** Dense mountain laurel shrub growth covers the forest floor on the mixed hemlock slope area. Winterberry, red elder, serviceberry, and marsh marigold were cited beneath the pole swamp growing in standing water in some spots.
- **Non-native Invasive Growth:** Japanese barberry mixes with the herbaceous plants across the small wetland. No disturbance is recommended in this area, and the shade of the low canopy will prevent their spread.
- **Interfering native plants:** Not applicable.

**Habitat:** Hardwood pole swamps offer cover, food, and water for many wildlife species. These areas are rich in plants and invertebrates because of their shallow depths and warm temperatures. They provide beneficial food and breeding grounds for many species of wildlife including migratory birds, frogs, toads, and salamanders. The thick cover in the sloping, mixed hemlock site also provides cover and nesting sites for songbirds. The dying hemlock trees are current and future cavity stems. The recent extreme storm events threw a lot of coarse woody debris upslope into this grove, which is good invertebrate and insect habitat.

- **NHESP:** The BioMap2 project defines this stand as Aquatic Core, Aquatic Buffer Zone (almost 100% of both small sections), Critical Natural Landscape, Core Habitat, and Forest Core which indicates that this stand supports ecological resilience to climate change and other disturbances and increases local biodiversity
- **Habitat Techniques:** Preservation of this area in its current condition protects its habitat value.
- **Risks:** Not applicable.

**Fire Protection:** Access would be difficult into the steep slope zone, but Tucker Brook would stop the spread of fire westward. The moist Enosburg soils do not pose a fire hazard.

**Desired Future Condition:** These areas serve a valuable watershed protection function with steep slope cover and sediment deposition in the wetlands

**Recommended Management Practices:** Not applicable.



**SUB-WATERSHED #3: MANHAN RIVER**

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr.)
Stewardship Green Cert.	3.01	OH	32.2	9.4"	113	5.3 MBF 4.5 Pulp cds 0.0 Firewd cds	70:EWP 62:NRO 59:SM	5.26

**Sub-Watershed:** Manhan River

**Water Quality Concerns:** The primary objective of any management work on these lands is the prevention of the loss of sediment and nutrients into the Manhan River watershed basin and the Tigue Carmody Reservoir. This stand collects water out of the Blue Meadow Swamp and Brook system and moves directly downstream into the Manhan River and the drinking supply source. This green infrastructure functions as a collection and transfer area for the water out of Blue Meadow Swamp.

**Silviculture Status:** Not suitable.

**Terrain/Topography:** The terrain sweeps into a narrow stream valley in the north of the stand as water enters from the northern branch of Blue Meadow Brook. This valley widens as the second order stream joins a first order stream, which flows out of the Blue Meadow Swamp, and with a steep slopes along Blue Meadow Brook as it parallels Fomer Road in route to the intake area.

**Soils:** Ridgebury fine sandy loams along the stream channels and Montauk and Scituate fine sandy loams on the slopes and hillsides support this stand. The Ridgebury soils, derived from glacial till are mostly level and poorly drained. The high water table restricts root growth. The Montauk and Scituate soils, derived from granite and gneiss, are moderately well drained to well -drained and are moderately erodible. A perched water table develops in spring, restricting root growth.

- Timber Harvesting: Not applicable.
- Water Quality: The Ridgebury soils hold water in the valley, which allows it to move slower into the intake area for the reservoir.

**Overstory:** The main canopy is a mix of red oak, white pine, and hemlock large sized trees (average diameter >20 inches for all species). These trees provide excellent protective cover upon the steep slope sites. The quality of the red oak is very good, but more importantly these trees are healthy, wide, spreading crowns that reduce the impact of rainfall on the soils. Healthy tulip poplar trees and declining white ash line the moist low plain near the confluence of the two branches of Blue Meadow Brook. The overstory hemlock crop is dying, and many trees have only 50% of their live needles.

**Understory:** The middle canopy layer is sparse beneath the older crowns. The red maple, black birch, paper birch, and hemlock saplings, and pole trees have poor quality. Many of the black birch trees suffer damage from the necrotic bacterium.

- Regeneration: Reproductive growth is low (C on the simple metric discussed earlier in this report); the shade tolerant hemlock and red maple dominate this class.
- Non-native Invasive Growth: Japanese barberry and multiflora rose plants cling to the level lands along the edges of both Fomer Road and Delisle Road. These plants are not spreading into the interior forest yet, and the native plant community appears to be keeping their stocking contained.
- Native: Dense mountain laurel covers the northern stream valley and sweeps across the widening plain area. These shrubs provide excellent ground cover and anchor the soil along the steeper slopes. Area without laurel support thickets of witch-hazel, although not as useful as a cover crop, it also holds soil in place. Striped maple, maple leaved, viburnums, and dogwoods were noted. Only a few herbaceous plants were visible during the inventory inclusive of trout lily, teaberry, lycopodium, and Christmas fern.
- Interfering native plants: Not applicable.

**Habitat:** Sign of moose was prolific in the small level area near the confluence of the two brooks with heavy browse of the striped maple and red maple seedlings and tracks. The dying hemlock trees provide future and current cavity stems. The dense laurel and witch-hazel vegetation offers cover for nesting and foraging birds and small mammals.

- NHESP: The NHESP BioMap 2 Project defines this stand as critical natural landscape, which indicates its capacity to support wide-ranging wildlife species and enhance local biodiversity.
- Habitat techniques: No specific interventions. Preservation of the current condition also preserves habitat value.

**Fire Protection:** This stand is accessible from Delisle Road and Fomer Road for fire management. Water is readily available for use by a four-wheel drive pumper truck out of the Blue Meadow Brooks.

**Desired Future Condition:** This stand is an essential component in the water collection and transfer capabilities of these watershed lands. It lies within a hydrological sensitive area and will not be disturbed through any management work. Preservation of its current condition promotes the sustainability of its natural filtration function.

**Recommended Management Practices:** Not applicable.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	3.02	OH2 (BM)	75.30	9.0"	116	4.0 MBF 7.4 Pulp cds 0.0 Firewd cds	65:EWP 61:NRO 59:SM	10.4

**Sub-Watershed:** Manhan River

**Water Quality Concerns:** The primary objective of any management work on these lands is the prevention of the loss of sediment and nutrients into the Manhan River watershed basin and the Tighe Carmody Reservoir. Only the southeastern portion of this stand intersects with the spring seep fields, which drain into Blue Meadow Brook. Most of the area is remote from any direct impact upon water quality in the stream systems. These upland soils collect and move water quickly with limited storage.

**Silviculture Status:** Suitable in sections.

**Terrain/Topography:** This stand parallels the entire length of crooked Ledge Road. The terrain climbs a small hill in the northern tip, and descends across a broad southeastern slope towards Blue Meadow Brook. Several spring seep drainage channels along its southern edge intersect this slope.

**Soils:** Hinckley loamy sand, Montauk fine sandy loam, and Gloucester fine sandy loam, underlie the moderate slopes of this stand. These soils range from well drained to excessively drained and have rapid permeability and low available water capacity. They are moderately productive for tree crops. The deep, well drained to excessively drained Charlton-Hollis-Rock outcrop complex is found on the ridge tops. Their droughty nature makes these soils poorly to moderately productive for tree crops.

- **Timber Harvesting:** The soils have sand and gravel base, which facilitates use of the land with harvesting equipment. Harvest work could be done during a stable, dry summer or fall, an open frozen ground winter, or a frozen deep snow cover.
- **Water Quality:** Avoidance of the spring seeps in the southern edge and near Blue Meadow Brook through the establishment of a wide, no-entry filter strip will protect

these sites from sediment loss or erosion. Scheduling of the harvest projects during frozen or dry ground conditions further protects the soil integrity.

**Overstory:** The upper canopy supports an immature timber crop (less than 75 years) of red oak, scarlet oak, black oak, hickory, black birch, red maple, aspen, yellow birch, ash, and paper birch. The red oak and black birch tree have excellent form and potential. Red maple trees are from stump sprout origin with many defects. The aspen trees appear healthy and vigorous. Scattered pockets of mature white pine dot the upper canopy (heights near 85 feet); pockets are dying off in circular patterns with needle dieback and subsequent loss of the trees. The past agricultural use of the site is more apparent in the southern portion with poor quality, resulting from nutrient stripping in pastures. The stand is currently even aged with the average age of the main canopy ranging from 65 to 80 years.

**Understory:** A moderately stocked sapling and pole layer is found here with black birch, red maple, ash, and hickory dominating this class. This trees spring up in small natural openings, and they have fair quality. Gray birch and pin cheery were the most prevalent species amongst this younger age class.

- **Regeneration:** Reproductive growth is low (C level); red maple, hemlock, black birch
- **Native:** Many shrub species grow on the forest floor inclusive of striped maple, beaked hazelnut, and maple leaved viburnum, spicebush, and laurel. Dense thickets of witch-hazel are prolific across the stand. The forest floor supports a lush herbaceous layer with many of the typical xeric site plants such as lycopodium, high bush and low bush blueberry, and teaberry.
- **Non-native Invasive Growth:** Japanese barberry, multiflora rose, and Asiatic bittersweet are climbing into this stand from the old settlement area to the south (Stand 3.07). Their density is moderate (B+ on the simple metric), yet they are spreading along the run-off courses from bird flight paths.
- **Interfering native plants:** Not applicable, witch-hazel thickets are scattered still, and they will be disturbed during a timber harvest.

**Habitat:** Although their canopy is closed through much the stand, the dense shrub and sapling layer do provide vertical stratification for habitat diversity. Pileated woodpecker sounds resonated through this stand during the inventory. Blueberries are among the most important summer and early fall foods for grouse, which use aspen groves as cover and breeding sites. Several scattered large diameter white oak and sugar maple lie along the southern edge of the stand near Stand 3.07. They both set ample annual fruit and provide cavities for denning and nesting. Native grape vines climb into the tallest trees; this fruit is enjoyed by many species.

- **NHESP:** The NHESP BioMap 2 Project defines this stand as critical natural landscape, which indicates its capacity to support wide ranging wildlife species and enhance local biodiversity

- Habitat techniques: Retention of some of the dying hemlock and white pine and the over mature oak and sugar maple provide cavity trees for denning and mast.

**Fire Protection:** This area is accessible by four-wheel drive from Crooked Ledge Road. The dry upland soils and thick, dry duff layer could pose a fire hazard with the traffic along the discontinued town road.

**Desired Future Condition:** The long-term goal in this stand is the development of an all-aged, species diverse, resilient natural filtration, and purification watershed forest. This immature grove is not ready for regeneration yet. The intermediate work of Crop Tree Release will open the main canopy to improved stand vigor, tree quality, and timber value.

**Recommended Management Practices:** 1. Application of a Crop Tree Release. 2. Application of a Selection Method Harvest in 20 years in order to promote the youngest age class essential in the ideal watershed forest.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	3.03	MO	17.30	14.0"	140	6.3 MBF 6.3 Pulp cds 0.0 Firewd cds	63:EWP 63:NRO 55:SM	2.8

**Sub-Watershed:** Manhan River

**Water Quality Concerns:** The primary objective of any management work on these lands is the prevention of the loss of sediment and nutrients into the Manhan River watershed basin and the Tighe Carmody Reservoir. This stand is remote from any direct impact on water quality in the major drainage system to the south.

**Silviculture Status:** Not suitable.

**Terrain/Topography:** This stand rests upon the crest and steep sides of a small, unnamed hilltop near Crooked Ledge Road.

**Soils:** Gloucester fine sandy loams are moderately steep and excessively drained and stony soils derived from glacial till. With a rapid permeability and low available water capacity, these are moderately productive soils to grow tree crops. The deep, well drained to excessively drained Charlton-Hollis-Rock outcrop complex is found on the ridge tops. Their droughty nature makes these soils poorly to moderately productive for tree crops.

- Timber Harvesting: Not applicable.
- Water Quality: The dry soils have large pore structure, and they percolate water downwards into ground water reserves, which empty into the Manhan River system.

**Overstory:** This is a typical xeric, mountain top mixed oak stand. The main canopy supports small sawtimber sized red oak, chestnut oak, scarlet oak, black oak, and white oak trees with some scattered paper birch, black birch, and hemlock. The red oak trees have wide, spreading crowns and good quality,

and all of the oak crops are vigorous. The canopy height is restricted due to the mountain top location (less than 50 to 60 feet).

**Understory:** A dense layer of sapling and pole sized trees with a canopy height of 25 to 30 feet thrives beneath the main canopy. These young trees with the exception of the declining hemlock (many almost dead from needle drop and discoloration) and small pole sized red maple stump sprouts have good form and healthy crowns.

- **Regeneration:** Reproductive growth is low beneath the two main canopy stratum. Chestnut seedlings were prolific across the stand.
- **Native:** Mountain laurel grows prolifically through this stand, yet the shrub height is less than five feet and other species share the forest floor including witch-hazel, beaked hazelnut, sweetfern, low bush blueberry, lycopodium, and teaberry.
- **Non-native Invasive Growth:** None noted during the inventory.
- **Interfering native plants:** Not applicable.

**Habitat:** A variety of oak species assures a good annual acorn crop, as their peak production years would not be synchronized. The stand was filled with birdsong in early spring inventory; high-points offer a good advantage for perching. The dense shrub layer provides cover for feeding and nesting. The scarlet and chestnut oak stems were heavily used by pileated woodpecker.

- **NHESP:** The NHESP BioMap 2 Project defines this stand as critical natural landscape, which indicates its capacity to support wide-ranging wildlife species and enhance local biodiversity.
- **Habitat techniques:** This perched site inside the proposed harvest areas surrounding it will provide a retreat space for mammals and birds before the forest ground cover responds from the treatment. The release of the oak crowns along the edges of the treatment sites will increase mast production.

**Fire Protection:** This area is accessible by four-wheel drive from Crooked Ledge Road. The dry upland soils and thick, dry duff layer could pose a fire hazard with the traffic along the discontinued town road.

**Desired Future Condition:** This stand was not included in any past harvest on this tract. The oak crop, although small in stature are maturing (average age 125 to 150). They represent a small intact niche of middle-aged trees within the ideal all-aged, species diverse natural filtration and purification watershed forest.

**Recommended Management Practices:** None



Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	3.04	RP-OH	6.00	12.50"	120	12.9 MBF 0.0 Pulp cds 0.0 Firewd cds	63:EWP 57:NRO 52:SM	1.0

**Sub-Watershed:** Manhan River

**Water Quality Concerns:** The primary objective of any management work on these lands is the prevention of the loss of sediment and nutrients into the Manhan River watershed basin and the Tighe Carmody Reservoir. This stand lies adjacent to a spring seep, which drains southerly into the Blue Meadow Brook system.

**Silviculture Status:** Suitable.

**Terrain/Topography:** This small stand rests upon a knoll along the long, broad slope across Stand 2.02.

**Soils:** A deep, gravel and sand deposit lies beneath this knoll, which is very characteristic of the gravelly, sandy Gloucester loams. These sites grow oak and pine very well.

- Timber Harvesting: There are no equipment limitations on these soils for harvest equipment. They are easily workable for road construction.
- Water Quality: Water moves quickly down through the soils into the substratum for capture in the micro-drainage system and recharge of the springs.

**Overstory:** A dying red pine plantation perches on this knoll. Needle drop indicates an infestation of red pine scale in this area. These trees have clean, non-tapering boles.

**Understory:** As the canopy opens from red pine attrition, a dense layer of oak, birch, maple, ash, and aspen saplings and pole trees filled the available growing space. These young hardwood trees have good form and vigorous crowns. Two elm trees were found in this mix.

- **Native:** Native shrubs found on the forest floor include blueberry, striped maple, witch-hazel, and mountain laurel. The early spring inventory prevented full identification of the herbaceous plants here, but the last season debris was thick with the debris of ferns, partridgeberry, and trout lily.
- **Non-native Invasive Growth:** A few scattered Japanese barberry and multiflora rose were scattered across forest floor. They do not pose a threat to the native plant community at this time.
- **Interfering native plants:** Grape vines climb up into both the surviving and dead red pine trees. They could easily spread into Stand 2.02 after any harvest treatment.

**Habitat:** Pileated woodpeckers use this site as an insect farm. Several birds were seen during the short inventory window within the red pine crop. Although potentially harmful to healthy trees, the grape vines produce palatable fruit each season.

- **NHESP:** The NHESP BioMap 2 Project defines this stand as critical natural landscape, which indicates its capacity to support wide-ranging wildlife species and enhance local biodiversity.
- **Habitat techniques:** The salvage removal of the dying red pine trees will open the forest floor for the development of a lush seedling class and expand some of the native shrubs. This will increase vertical stratification, which supports songbird habitat.

**Fire Protection:** This area is accessible by four-wheel drive from Crooked Ledge Road. The dry upland soils and thick, dry duff layer could pose a fire hazard with the traffic along the discontinued town road.

**Desired Future Condition:** The long-term objective of management work on the silviculturally suitable lands across the watershed is the development of an all-aged, species diverse, resilient natural filtration and purification watershed forest. The youngest age class is lacking overall across the watershed. The salvage removal of the dying red pine crop will provide a small four-acre gap for seedling development.

**Recommended Management Practices:** 1. Application of a Salvage Harvest to remove the dying red pine timber crops, which will also release the young hardwood trees for improved growth and introduce a seedling layer to the stand. 2. Treatment for stocking reduction the potentially interfering grape vines in the stand either before or during the timber harvest work.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	3.05	OHK	32.2	12.0" Red oak: 22 inches	110	9.4 MBF 6.4 Pulp cds 0.0 Firewd cds	60:EWP 49:NRO 57:SM	5.38

**Sub-Watershed:** Manhan River

**Water Quality Concerns:** The primary objective of any management work on these lands is the prevention of the loss of sediment and nutrients into the Manhan River watershed basin and the Tighe Carmody Reservoir. Two major spring seep fields originate in this area at the base of a steep slope, which drain directly into the Manhan River.

**Silviculture Status:** Suitable.

**Terrain/Topography:** The relief scoops out a wide, sloping valley at the base of the hilltop of Stand 3.03.

**Soils:** Hinckley loamy sand mostly underlies the moderate slopes of this stand. This soils range from well drained to excessively drained and has rapid permeability and low available water capacity. It is moderately productive for tree crops. The soil surface is covered in stones and rocks here.

- **Timber Harvesting:** Although the Hinckley soils are easy to work for harvest equipment, the location of the spring seeps makes the engineering interesting in this area. Careful engineering will avoid these sites to protect soils structure. Some areas close to seeps or stream banks require frozen ground for work.
- **Water Quality:** Harvest scheduling during frozen or dry ground conditions will protect the quality of the water as it moves through the seep drainages. Clear delineation of their paths and the construction of pole crossings will maintain the integrity of the channels so water moves unimpeded southward and soil is not lost.

**Overstory:** Mature, high value red oak (average age near 200 years) share the upper canopy with scattered hemlock (dying quickly), large sized white pine, and declining mature paper birch. The area was harvested over 30 years ago. A few pockets of red pine timber were found south of the spring fields.

**Understory:** A sparse layer of red maple, black birch, and mixed oak saplings and seedlings grow beneath the mature oak. The immature red maple and hemlock trees are in poor condition. The young black birch has good form and potential.

- Regeneration: The sprawling oak crowns shade the forest floor prevent adequate reproductive growth, red oak seedlings were very scarce.
- Native: Fern growth was very dense, and witch-hazel thickets dot the forest floor.
- Non-native Invasive Growth: Not applicable.
- Interfering native plants: Not applicable.

**Habitat:** Mature red oak trees set large volumes of acorns each fall, which are enjoyed by most of the local wildlife species. The dying hemlocks provide cavity trees. Spring seeps offer a water source during dry periods and in the winter and early spring when other sources are still frozen. The hydric plants that cling to the water source also offer good browse. Moose tracks circled the spring seep area.

- NHESP: The NHESP BioMap 2 Project defines this stand as critical natural landscape, which indicates its capacity to support wide-ranging wildlife species and enhance local biodiversity.
- Habitat techniques: Retention of the declining hemlock trees provides future cavity trees. The proposed harvest work would create small gaps in the canopy, which will increase the vertical stratification of the stand structure and increase use of the site by interior forest songbirds.
- Risks: Not applicable.

**Fire Protection:** This stand will prove difficult to reach with a four-wheel drive pumper truck, but maintenance and improvement of the harvest roads will facilitate future access.

**Desired Future Condition:** The ideal watershed forest supports all age classes, a diversity of native plant species, and a resilient structure capable of the filtration of purification of water. The mature red oak has not replaced itself on this site. The Selection Harvest Method encourages the development of this ideal forest structure. Red oak is site demanding for seed germination. Scarification of the mineral soil will prepare an optimal seedbed for acorn drop.

**Recommended Management Practices:** 1. Application of the Selection Method of regeneration with use of a combination of the Single Tree and Small group (one to three trees) variants. 2. Scarification of the mineral soil by the equipment either during or before the next acorn drop.

**Special Stewardship Considerations:** The foundation of an old sawmill lies in a small pool of water along one of the drainages in the northern portion of the stand. This Millsite was used in the 1880's. The structure of the dam for the pond is still clearly visible.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	3.06	WH	14.50	14.8"	133	14.3 MBF 1.7 Pulp cds 0.0 Firewd cds	60:EWP 49:NRO 57:SM	2.3

**Sub-Watershed:** Manhan River

**Water Quality Concerns:** The primary objective of any management work on these lands is the prevention of the loss of sediment and nutrients into the Manhan River watershed basin and the Tighe Carmody Reservoir.

**Silviculture Status:** Suitable.

**Terrain/Topography:** The long slope from Crooked Ledge Road to the Manhan River is broken in this area by a gently tilted plain; this stand lies upon this plain.

**Soils:** Hinckley loamy sand mostly underlies the moderate slopes of this stand. This soils range from well drained to excessively drained and has rapid permeability and low available water capacity. It is moderately productive for tree crops.

- **Timber Harvesting:** An old roadbed traverses this stand, which has resisted any material loss through the last 30 years. The Hinckley soils provide an excellent road-building medium. Timber harvest work could be scheduled under dry or frozen ground conditions. Access into this stand may require solid or frozen ground along the main access route to the north.
- **Water Quality:** One large spring seep effuses water, which does not drain southward from this stand. Scheduling of the harvest work during dry or frozen conditions will prevent damage to the soil structure and its capacity to collect and move water.

**Overstory:** Mature white pine trees (estimated 150 to 180 years of age with diameters greater than 20 inches) share the upper canopy with scattered red oak timber. The pine trees have full, symmetrical crowns with a large live crown ration. The quality of the both the white pine and red oak is very good. A small pocket of dying red pine lies at the southeast corner of the stand.

**Understory:** The openings in the main canopy that were created 30 years ago recently filled with dense thickets of white pine, red maple, black birch, hemlock, and hickory, and aspen saplings with a canopy height of less than 30 feet. These young trees are vigorous, and with the exception of the hemlock well formed. They

- **Regeneration:** Reproductive growth is very limited beneath the pine shade, when openings occur, seedlings do grow quickly. Species cited included hemlock, white pine, hickory, beech, and red maple.
- **Native:** Herbaceous growth and fern growth were also limited in the thick pine duff.
- **Non-native Invasive Growth:** The eastern edge of this stand adjoins Stand 3.07 in which the invasive plant community is explosive. The plants are beginning to enter the pine grove.
- **Interfering native plants:** Not applicable.

**Habitat:** Mature white pine trees provide ideal roosting sites for robins, turkey, and small mammals. The scattered maturing red oak produce annual mast crops for turkey feed.

- **NHESP:** The NHESP BioMap 2 Project defines this stand as critical natural landscape, which indicates its capacity to support wide-ranging wildlife species and enhance local biodiversity.
- **Habitat techniques:** Once the stand is opened through the proposed harvest, the vertical stratification between the statuesque white pine and the seedling layer will increase vertical stratification and local biodiversity. Retention of the few large sized beech trees increases the diversity of the mast source.
- **Risks:** Not applicable.

**Fire Protection:** This stand will prove difficult to reach with a four-wheel drive pumper truck, but maintenance and improvement of the harvest roads will facilitate future access.

**Desired Future Condition:** The ideal watershed forest supports all age classes, a diversity of native plant species, and a resilient structure capable of the filtration of purification of water. The Selection Harvest Method encourages the development of this ideal forest structure. The maturing white pine crop did not successfully regenerate after the last harvest. Larger openings in the main canopy will encourage pine and all most other species seed germination.

**Recommended Management Practices:** 1. Application of a Group Selection Harvest.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	3.07	OH	14.80	9.8" 14" overstory	85	5.7 MBF 6.8 Pulp cds 0.0 Firewd cds	62:EWP 53:NRO 55:SM	2.4

**Sub-Watershed:** Manhan River

**Water Quality Concerns:** The primary objective of any management work on these lands is the prevention of the loss of sediment and nutrients into the Manhan River watershed basin and the Tighe Carmody Reservoir. This area drains to the east into the Blue Meadow Brook system. This area has a direct impact on the quality of water entering the Tighe Carmody reservoir.

**Silviculture Status:** Not suitable for conventional timber harvest work. Forest landscaping for aesthetics, cultural resource preservation, and invasive plant control are the silvicultural goals here.

**Terrain/Topography:** This area lies upon a wide plain with access along an old road off Fomer Road. It is a natural depression on the lower slope. Water collects in this area. Its eastern edge lies along Blue Meadow Brook.

**Soils:** Hinckley loamy sand mostly underlies the moderate slopes of this stand. This soils range from well drained to excessively drained and has rapid permeability and low available water capacity. It is moderately productive for tree crops. The Ridgebury soils lie beneath the areas adjacent to Blue Meadow Brook, derived from glacial till are mostly level and poorly drained. The high water table restricts root growth, slowing tree growth.



- **Timber Harvesting:** Not applicable. Invasive plant community work should be done with open ground and pliable soil condition. Access into some parts of the stand might require frozen ground conditions in winter.
- **Water Quality:** If invasive plant control is completed here, considerations must be made for the avoidance of containments entering the water system.
- **Mechanical methods, propane torch burning, or a combination of these, with minimally toxic herbicides is appropriate control techniques.**

**Overstory:** The main canopy through this area is a mix of white pine, red pine, sugar and red maple, a few red and white oaks, black, yellow, and paper birch, aspen, tulip poplar, hickory, and hemlock. This area was the site of the old Southampton Town center. Large foundations of manufacturing sites, home sites, a water cistern a kiln, corrals, and barns lie at the center of this stand. Through the years as the old settlement fell to ruin, the immature timber started growing here. Remnants of the mature sugar maple, white ash, white oak, and red oak (over 225 years of age) line the stonewalls along the main access road. These large trees have cavities and large crowns. The white ash and hemlock crops are declining quickly in this area. The small grove of red pine in the center of this stand is almost completely dead.

**Understory:** The lower canopy layers are densely stocked with seedlings, saplings, and pole trees of all the overstory species with dominance by red oak, yellow birch, black birch, red maple, and sugar maple. These young trees grow rapidly in the relatively open conditions.

- **Regeneration:** Reproductive growth is dense all across the stand; it is composed of vigorous seedlings of all the overstory species.
- **Native:** Most of the shrubs and herbaceous plants common to the oak transition forest grow within this area with a few dense thickets of hay-scented fern amongst the dying red pine.
- **Non-native Invasive Growth:** Birds come to this area for the water and the high food volume in shrubs and insects. Their droppings set the seed for a heavy invasive plant community including glossy buckthorn, Japanese barberry, Asiatic bittersweet, multiflora rose, and privet that was observed here. These plants are out-competing the native vegetation for growing space.
- **Interfering native plants:** Not applicable.

**Habitat:** The two-storied structure encourages use of this site by birds; birdsong was heard every time the stand was crossed in the inventory. The dense lower herbaceous, shrub, and seedling layer offer ideal cover for breeding and feeding of birds and small mammals. The proximity of the legacy maple, ash, and oak trees to open water and open cover provides denning, insect breeding, and nesting sites. Scattered tall white pine let perching birds sit close the brook. A few mature apple and crabapple trees still set annual crops. Aspen trees of all sizes and ages on site increase use of the site by grouse.

- NHESP: The NHESP BioMap 2 Project defines this stand as critical natural landscape, which indicates its capacity to support wide-ranging wildlife species and enhance local biodiversity.
- Habitat techniques: Preservation of this site in its current condition will protect the habitat benefits. Invasive plants do not have symbiotic relationship with insects and larvae, which build up in an ecosystem over long period. Therefore, they are not as useful for our native wildlife. It would be beneficial to the local biodiversity to remove these plants through the next operating decade. The research has yet to determine if their removal is essential for the health and functionality of this ecosystem. It may prove as useful to allow the two communities to develop over time, and only control the vegetation at the edges of the stand to prevent their spread into the silviculturally suitable sites.
- Risks: Not applicable.

**Fire Protection:** The installation of a portable bridge across Blue meadow Brook would provide access to this area for fire management. The moist Ridgebury soils do not present a fire hazard in the duff layer.

**Desired Future Condition:** This area is a cultural and historical treasure for the Town of Southampton. Preservation of the cellar holes and all stone and brickwork is important. The forest ecosystem is evolving and maturing naturally towards a more age and species diverse structure.

**Recommended Management Practices:** Monitor the invasive plant communities through the ten years, and control the edges of the stand to prevent their spread.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	3.08	HH	64.10	11.2"	145	6.6 MBF 2.1 Pulp cds 0.0 Firewd cds	60:EWP 49:NRO 57:SM	10.4

**Sub-Watershed:** Manhan River

**Water Quality Concerns:** The primary objective of any management work on these lands is the prevention of the loss of sediment and nutrients into the Manhan River watershed basin and the Tighe Carmody Reservoir. This stand lies along the Manhan River and holds three major ground water recharge systems, which drain directly into the Manhan River. Most of the water from the upper slopes crosses this plain in route to the Manhan River. Any activity in this area directly affects the water quality in Tighe Carmody Reservoir.

**Silviculture Status:** Small portion suitable, most not suitable. Only the far eastern edge of the stand, which grows above stony, rocky soil, is suitable for silviculture.

**Terrain/Topography:** This stand sprawls across the lower slope and the flood plain of the Manhan River. The soils are stone and boulder free. The northern strip of this site lies upon a steep slope (over 55% slope), and the southeastern portion ascends a steep esker above the intake reservoir.

**Soils:** Sudbury fine sandy loam and Windsor loamy sand underlie this stand. The Sudbury soil is nearly level to gently sloping soil and moderately well drained. Permeability and available water capacity are moderate; however, the high water table restricts root growth. The Windsor soil, derived from glacial outwash is moderately sloping deep and excessively drained. Roots grow deep but are restricted due to lack of moisture in this droughty soil.

- **Timber Harvesting:** Carefully done in some areas. The eastern edge of the stand can be accessed for a savage harvest within the hemlock crop. These lower slopes seep springs

heavily. Frozen ground conditions or stable, dry earth in summer or fall are best for scheduling the work.

- **Water Quality:** The heavy recreational foot, bike, and ATV activity in this area results in surface erosion and some gulleying along the paths. The area is posted for no trespassing, yet this policy is ignored locally. Permanent mitigation of one specific ATV crossing must be addressed at the southern edge of this stand.

**Overstory:** A dense grove of immature hemlock sawtimber (average size 12 to 17 inches) shares the upper canopy with red, scarlet, chestnut, black, and white oak, black birch, red maple, aspen, and white ash small sawtimber sized trees. The quality of the red oak is fair to good; the associate oak species have full crowns. Although the adelgid and elongated scale problems are prevalent in this stand, the trees only exhibit about 30% of needle discoloration and drop. The moist soils increase their productivity and resistance to these pathogens. All of the trees grow in hummock formations near the spring seep zones and the intake reservoir.

**Understory** A sparse stocking of oak, red maple, birch, and hickory shares the middle layer with hemlock saplings and pole tree s in poor condition.

- **Regeneration:** Reproductive growth is patchy across the stand and restricted to sunlit areas where an older tree dies and fell over. The cited include all of the oaks, hickory, red maple, black birch, and hemlock.
- **Native:** The overstory shade restricts fern and herbaceous plants to open areas. Some species cited include sensitive fern, cinnamon fern, Christmas fern bracken fern (in the small wetland near the intake reservoir), trillium, Solomon seal, and teaberry. Mountain laurel shrubs managed to sprawl throughout the stand with low height and marginal density. A small shrub swamp is located in this stand straddling the small intake reservoir. Hydric shrubs and plants growing here include illex, spicebush, swamp pinks, and marsh marigold.
- **Non-native Invasive Growth:** Japanese barberry is a persistent shrub along the river and amongst the spring seep zones. Individual plants and small clumps were noted. Some Asiatic bittersweet climbs the dead hemlock snags and the live trees along the river and near the intake reservoir.
- **Interfering native plants:** Not applicable.

**Habitat:** Use of this stand by moose, white tail deer, fisher cat, bobcat, raccoon, and skunk was observed during the field inventory. Dense groves of hemlock in the lowlands offer ideal white tail deer winter habitat. The low height of the laurel shrubs provides good cover for feeding and foraging by birds and small mammals. A large nest of owl or hawk was observed in one of the tall hemlock stems along the river. The variety of oak trees in this stand produces ample mast each fall. The dying hemlock and

hardwood trees, which have blown down from wind and storm, damaged litter the forest floor with large sized woody debris ideal for insects and invertebrates. Dead hemlock snag serve as cavity trees for many different wildlife species.

- **NHESP:** The NHESP BioMap 2 Project defines this stand as critical natural landscape, which indicates its capacity to support wide-ranging wildlife species and enhance local biodiversity.
- **Habitat techniques:** Preservation of the stand in its current condition protects the fragile riparian zone and the habitat values of this river floodplain.
- **Risks:** Not applicable.

**Fire Protection:** The soils hold moisture well and the duff and litter layer poses no threat of fire hazard. It is difficult to access the site for fire management even with a four-wheel drive pumper truck. The river provides a natural fire break.

**Desired Future Condition:** This site will evolve into the all-aged, species diverse, resilient filtration and purification forests ideal for watershed both naturally and with some help in the eastern edge area. This Continual decline (moderate) hemlock trees opens the forest floor for hardwood seed germination. The red oak, maple, and birch trees provide enough seed for adequate reproduction growth. The hemlock crop is dying quickly, and each new opening supports a different age sapling or pole tree now. This process will continue through the next two or three operating periods. The proposed harvest will start dense groves of seedlings.

**Recommended Management Practices:** Community program of education about water quality and trail use combined with a more active enforcement of the no trespass policy will help to protect these soils from erosion. This stand is the last barrier of filtration defense before water enters the Tighe Carmody intake reservoir on the Manhan River. Harvest work upslope on the eastern edge of the stand contains site disturbance outside the filter strip.

The remaining five stands are located upon the eastern side of the Manhan River Sub-watershed. This area borders Fomer Road. Stand 3.13, a dense stand of white pine, has sections on both sides of the Manhan River

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	3.09	BM	10.80	10.6"	60	4.7 MBF 5.5 Pulp cds 0.0 Firewd cds	59:EWP 49:NRO 55:SM	1.7

**Sub-Watershed:** Manhan River

**Water Quality Concerns:** The primary objective of any management work on these lands is the prevention of the loss of sediment and nutrients into the Manhan River watershed basin and the Tighe Carmody Reservoir. A large spring seep effuses water down slope towards the Manhan River on the eastern edge of the stand. Any activity in this area directly impacts water quality in the Tighe Carmody Reservoir.

**Silviculture Status:** Not suitable.

**Terrain/Topography:** The stand lies upon a gentle eastward slope.

**Soils:** Hinckley loamy sand mostly underlies the moderate slopes of this stand. This soils range from well drained to excessively drained and has rapid permeability and low available water capacity. It is moderately productive for tree crops.

- Timber Harvesting: Not applicable.
- Water Quality: Not applicable.

**Overstory:** The southern section of this stand along Fomer Road retains its old agricultural field appearance with scattered maturing sugar maple, red maple, and paper birch, black birch, aspen, and white ash. The soils were depleted, and the condition of these trees is poor. Scattered mature white pine trees tower above the hardwood canopy. These trees have large black knots defects all along their bole and wide, full crowns.

**Understory:** The open conditions in the lower strata encouraged a dense stocking of maple, birch, ash, and aspen saplings and seedlings. The immature black and yellow birches have good form and vigorous crowns.

- **Regeneration:** Reproductive growth is sparse due to the overstory shade and the dense invasive plants and shrub layer.
- **Native:** The herbaceous and shrub layer covers this gentle slope in a dense mat. Plants include trillium, wintergreen, partridgeberry, ferns, lycopodium, witch-hazel, mountain laurel, dogwood, and elderberry.
- **Non-native Invasive Growth:** This area is one of the invasive hotspots on the watershed. Tangles of Asiatic bittersweet compete with Asiatic grape to climb the large black and paper birch trees near an old entrance into the property on Fomer Road. Japanese barberry, multiflora rose, glossy buckthorn, winged euonymus, and some Japanese knotweed, and privet individual shrubs and clumps dot the rest of the forest floor. One area east of the parking site on Fomer Road is covered in Japanese knotweed.
- **Interfering native plants:** Not applicable.

**Habitat:** The mosaic of maturing hardwoods, dense shrubs, and sapling vegetation offers a unique habitat niche along Fomer Road. Despite their deterrent from the growth of our native shrubs, the invasive plants produce abundant fruit each season, which many birds enjoy. Pileated woodpeckers use the tall, mature pines for cavity sites; these trees also provide roosting and denning sites. The natural vertical stratification across the stand supports songbird habitat and increase local biodiversity. The aspen component encourages use of this brushy site by grouse.

- **NHESP:** The NHESP BioMap 2 Project defines this stand as critical natural landscape, which indicates its capacity to support wide-ranging wildlife species and enhance local biodiversity.
- **Habitat techniques:** Preservation of the stand in its current condition protects the fragile riparian zone and the habitat values of this river floodplain.
- **Risks:** Not applicable.

**Fire Protection:** Access into this area for fire management is easy from Fomer Road. The risk of fire hazard is low.

**Desired Future Condition:** This stand already exists in a rudimentary all-aged, species rich condition. The natural succession of this area into the ideal watershed forest will be allowed over the next two decades. The reformation of this hardwood grove to all native plant communities would be the ideal. A cost-benefit analysis by the City will determine the feasibility of this extensive work. The invasive plants do not have the symbiotic relationships with insects optimal for ecological efficiency. Therefore, they detract from biodiversity, yet they serve well as cover for the forest floor and the prevention of sediment loss due to erosion. .

**Recommended Management Practices:** 1. Study the cost benefits of extensive control of the invasive plants versus their functionality if retained in their current state for erosion control protection and slope stability. 2. If the City accepts a positive endorsement after the analysis, the use of a combination of low toxicity herbicides and mechanical means will be employed for the stocking reduction of these plants.



Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	3.10	WH	10.40	11.3"	145	7.850 MBF 9 Pulp cds 5 Firewd cds	60:EWP 49:NRO 57:SM	1.7

**Sub-Watershed:** Manhan River

**Water Quality Concerns:** The primary objective of any management work on these lands is the prevention of the loss of sediment and nutrients into the Manhan River watershed basin and the Tighe Carmody Reservoir. A large spring seep effuses water down slope towards the Manhan River on the eastern edge of the stand. Any activity in this area directly affects water quality in the Tighe Carmody Reservoir.

**Silviculture Status:** Suited.

**Terrain/Topography:** This small stand perches above the Manhan River on a broad slope with a steep drop in the northwest corner of the stand.

**Soils:** Hinckley loamy sand mostly underlies the moderate slopes of this stand. This soils range from well drained to excessively drained and has rapid permeability and low available water capacity. It is moderately productive for tree crops.

- **Timber Harvesting:** Although the Hinckley soils are easy to work for harvest equipment, the juxtaposition of this stand above the Manhan River requires careful engineering and site use. Road placement across the contour will prevent sediment loss. Installation of emergency erosion control measures during a harvest project and more permanent controls post harvest will protect the soil structure.

- **Water Quality:** Harvest scheduling during frozen ground conditions will protect the quality of the water as it moves through the seep drainages perched above the Manhan River.

**Overstory:** Maturing white pine (over 65% of the stocking), hemlock, black birch, red maple, and red oak share this upper canopy. The quality of the white pine is good with small black knots and long timber sections. Their crowns are small and asymmetrical. Many of the tree's root swells are heaving in the high winds. The immature red oak grows very well on this gentle slope. The black birch trees have necrotic bacteria infections. The hemlock trees in this stand are declining rapidly; some along the river fall into the riverbed.

**Understory:** Overstory shade allows sapling and pole growth into small canopy holes. The immature, suppressed hemlock and red maple have poor form and inferior quality. Yet the black and yellow birch trees are growing very well in the shade.

- **Regeneration:** Reproductive growth is limited in the shade of the overstory. Only beech, hemlock, and red maple seedlings were counted, and they are struggling for survival.
- **Native:** Shrub growth was restricted with the exception of some dense pockets of lambkill and blueberry along the riverbanks. Shade loving herbaceous plants (maidenhair fern, partridgeberry, Solomon seal, and jack-in-the-pulpit) developed on the forest floor.
- **Non-native Invasive Growth:** A few scattered Japanese barberry and glossy buckthorn shrubs dot the forest floor along the edges of the Stand 3.09. These plants do not pose a threat to the native community in the stand now, but their removal before any harvest along with a 100-foot strip into Stand 3.09 will prevent their spread into the open forest.
- **Interfering native plants:** Not applicable.

**Habitat:** A well-worn game path parallels the river in this stand with tracks from white tailed deer, moose, bear, and raccoon. Mature pine close to water offers perching, denning, and nesting opportunity to birds and mammals. Blueberry fruit is a common staple in most wildlife species. Mature birch catkins feed songbirds, squirrels, and chipmunks, while birch twigs attract hoofed browsers.

- **NHESP:** The NHESP BioMap 2 Project defines this stand as critical natural landscape, which indicates its capacity to support wide-ranging wildlife species and enhance local biodiversity.
- **Habitat techniques:** 1. Retention of the healthy pine trees along the riverbank. 2. Opening the blueberry patches with the harvest removals to increase their fruit production. 3. Retention of the scattered dying hemlock as future and current cavity trees.

**Fire Protection:** Access into this area for fire management is easy from Fomer Road. Water is available from the river for use in a four-wheel drive pumper truck in the event of a fire emergency. The risk of fire hazard is low.

**Desired Future Condition:** The ideal watershed forest for natural filtration and purification of water contains all-age and size classes, a diversity of species, healthy, resilient ecosystem function, and its replacement crop on site. This mixed white pine grove stand is not reproducing although it is half through its biological life span. Use of a conservative Selection Method technique with the combination of the Single Tree and Small Group variants will introduce the youngest age class and encourage the development of the desired ideal watershed forest condition.

**Recommended Management Practices:** 1. Application of the Selection Method with the combination of the Single Tree and Small Group variants. 2. Treatment of the invasive plant community along the edge of the stand prior to any harvest work.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	3.11	WHK	5.50	16.4"	140	10.2 MBF 2 Pulp cds 2 Firewd cds	60:EWP 49:NRO 57:SM	0.9

**Sub-Watershed:** Manhan River

**Water Quality Concerns:** The primary objective of any management work on these lands is the prevention of the loss of sediment and nutrients into the Manhan River watershed basin and the Tighe Carmody Reservoir. This stand perches on a steep slope directly above the intake reservoir for Tighe Carmody. The hemlock trees are dying quickly and falling into the river channel. Activity in this stand directly impacts water quality in the reservoir.

**Silviculture Status:** Suitable only for salvage purposes.

**Terrain/Topography:** The stand is placed above the intake reservoir on a steep slope with an eastern aspect.

**Soils:** Hinckley loamy sand mostly underlies the moderate slopes of this stand. This soils range from well drained to excessively drained and has rapid permeability and low available water capacity. It is moderately productive for tree crops.

- Timber Harvesting: Although these soils are easily worked with equipment and provide a good roadbed, this site is perched above the river demanding winter/frozen harvesting due to hydric soil conditions.
- Water Quality: A winter harvest schedule should prevent any sediment movement, and emergency placement of hay bales or erosion control blankets on any steep roads will hold the soils in place through the spring until more manner erosion control measures can be installed.

**Overstory:** A dense grove of hemlock timber crops with an average diameter of 20 inches shares the upper canopy with maturing white pine trees. The quality of both pine and hemlock is very good with minimal black knot defects. Sign of both the elongated hemlock scale and adelgid were blatant through the crowns of the hemlock, and the trees are declining rapidly.

**Understory:** There is not significant middle canopy layer. Although the stand was harvested about 30 years ago, seedlings and small saplings are just starting to fill these openings.

- Regeneration: Reproductive growth is patchy with hemlock seedlings filling the past gaps in the main canopy. These young trees are suffering the scale and adelgid infestations.
- Native: Thick lady fern, hay scented, and spinulose ferns cover the forest floor in the hemlock shade.
- Non-native Invasive Growth: Not applicable.
- Interfering native plants: Not applicable.

**Habitat:** The location of this stand so close to the edge of the steep riverbank precludes its valuable use as winter deeryard. Many of the declining hemlock timber trees exhibit pileated woodpecker and sapsucker use. The maturing white pine crop offers roosting and denning opportunity near a water source. Small mammals and birds use dense fern cover for feeding and breeding sites. Large volumes of coarse woody material from the declining hemlock downfalls provide habitat for insects and invertebrates.

- NHESP: The NHESP BioMap 2 Project defines this stand as critical natural landscape, which indicates its capacity to support wide-ranging wildlife species and enhance local biodiversity.
- Habitat techniques: 1. Retention of the healthy pine trees along the riverbank.
- Risks: Not applicable.

**Fire Protection:** Access into this area for fire management is easy from Fomer Road. Water is available from the river for use in a four-wheel drive pumper truck in the event of a fire emergency. The risk of fire hazard is low.

**Desired Future Condition:** The ideal watershed forest for natural filtration and purification of water contains all-age and size classes, a diversity of species, healthy, resilient ecosystem function, and its replacement crop on site. Although the aging and declining hemlock have been reproducing in the small canopy gaps, these young trees are not healthy and might be lost over the next two decades. Removal of the hemlock crops will create large openings in the canopy, which should accommodate seed germination of all the diverse species growing around this stand. Although usually useful for financial

reasons, the salvage harvest will introduce the youngest age and begin the site's conversion to the ideal watershed forest condition.

**Recommended Management Practices:** 1. Application of a Salvage Harvest treatment for the removal of the hemlock crop.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	3.12	OH	9.20	11.8"	85	3.250 MBF 1 Pulp cds 6 Firewd cds	60:EWP 49:NRO 57:SM	1.5

**Sub-Watershed:** Manhan River

**Water Quality Concerns:** The primary objective of any management work on these lands is the prevention of the loss of sediment and nutrients into the Manhan River watershed basin and the Tighe Carmody Reservoir.

**Silviculture Status:** Not suitable during the 2015 to 2025 operating period.

**Terrain/Topography:** This stand lies upon a level plain along Fomer Road.

**Soils:** Hinckley loamy sand mostly underlies the moderate slopes of this stand. This soils range from well drained to excessively drained and has rapid permeability and low available water capacity. It is moderately productive for tree crops.

- Timber Harvesting: Not applicable.
- Water Quality: Not applicable because forest cover will not be disturbed from 2015 to 2025

**Overstory:** An immature crop of red oak sawtimber (average diameter 13 to 17 inches) shares the overstory with paper birch, red maple, black birch, and yellow birch trees. An Improvement Harvest was conducted in this stand maybe ten years ago, which removed most of the low value hardwood stocking. The quality of the residual timber crops is very good. Scattered shagbark and pignut hickory trees tower above the main canopy level with their beautifully straight boles.

**Understory:** A sparse layer of red maple, beech, paper birch, and black birch trees grows beneath the timber crop. These young trees are in poor condition. A Nectria bacterium attacks the birch saplings and pole trees, and the red maple suffers common defects of stump-sprouted trees.

- **Regeneration:** Reproductive growth is very limited, only red maple, beech, and scattered thickets of tall black birch seedlings grow here.
- **Native:** Mountain laurel thickets dot the forest floor, which they share with dense ferns and some wildflowers.
- **Non-native Invasive Growth:** Individual Japanese barberry shrubs sprout up amongst the laurel. Their density is low (B level), and they do not pose any threat to the native plant community.
- **Interfering native plants:** Not applicable.

**Habitat:** Red oak and hickory produce the best mast for wildlife food. Almost all of the native wildlife species enjoy hickories nuts. Dense laurel thickets provide cover for feeding and nesting for songbirds. A game trail crosses the stand in route to the river.

- **NHESP:** The NHESP BioMap 2 Project defines this stand as critical natural landscape, which indicates its capacity to support wide-ranging wildlife species and enhance local biodiversity.
- **Habitat techniques:** Since the stand will not receive any silvicultural treatment this operating period, the mast trees will continue to shed annual crops.

**Fire Protection:** Access into this area for fire management is easy from Fomer Road. Water is available from the river for use in a four-wheel drive pumper truck in the event of a fire emergency. The risk of fire hazard is low.

**Desired Future Condition:** The Hinckley soils produce high yields of oak timber. The stocking level in this stand is ideal for optimal growth of the red oak timber. These young oak trees can increase in diameter and possibly double in value over the next ten years. Small areas like this can be viewed as one age class when taken in the perspective of the 2,115-acre watershed. The long-term management objective for this stand is the development of an all-aged, species, ecologically resilient ideal watershed forest that functions as a natural filter for water as it move through it. The application of the Selection Method will be considered in 2025.

**Recommended Management Practices:** Not applicable.



Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	3.13	WP	35.80	11.0"	150	9.750 MBF 3.8 Pulp cds 1 Firewd cds	60:EWP 49:NRO 57:SM	5.8

**Sub-Watershed:** Manhan River

**Water Quality Concerns:** The primary objective of any management work on these lands is the prevention of the loss of sediment and nutrients into the Manhan River watershed basin and the Tighe Carmody Reservoir. All the sections of this stand with the exception of the area closet to Crooked Ledge Road fall upon slopes near primary water sources such as streams spring seeps, or the river. Activity near these water sources could directly affect water quality in Tighe Carmody Reservoir.

**Silviculture Status:** Suitable.

**Terrain/Topography:** The sections of this stand along Fomer Road lie upon a level floodplain above the river. Both areas along Crooked Ledge Road both rest upon slopes. The larger area faces east on the flank of the mixed oak mountaintop. The smaller area south of this lie son a level plain crossed by a spring seep drainage, which spills into Blue Meadow Brook.

**Soils:** Hinckley loamy sand mostly underlies the moderate slopes of this stand. This soils range from well drained to excessively drained and has rapid permeability and low available water capacity. It is moderately productive for tree crops.

- **Timber Harvesting:** Hinckley soils drain water quickly and provide an ideal roadbed material. The level terrain to the west of the Manhan River will not erode easily, although its location on the floodplain mandates winter harvesting for the protection of the soils integrity. Installation of erosion control measures during the harvest for mitigation of emergency severe storm events flow and after the harvest will protect the site from sediment loss.

- **Water Quality:** Frozen or dry and stable ground conditions will protect the Manhan River from sediment movement across this stand during any timber harvest work.

**Overstory:** The main canopy is a dense grove of maturing white pine (average age 125 to 150 years) with scattered hemlock, red oak, and white ash timber trees. The quality of the pine is variable. Some high value stems tower above other sections of weevil damaged black knot riddled material the worst pine crop grows in a strip of the stand along Fomer Road. Some large diameter pine “wolf” trees were found here with several cavities along the main bole.

**Understory:** The overstory shade prevents the full development of younger age classes beneath the main canopy. A sparse layer of red maple, hemlock, and black birch fill small gaps. They have poor form and quality.

- **Regeneration:** Reproductive growth is low beneath the pine shade with scattered pockets of white pine, red oak, and black birch seedlings in small canopy gaps across the forest floor.
- **Native:** the thick pine duff does not encourage an herbaceous carpet, yet hay scented and spinulose fern grow in patches across the forest floor in many of the sections. Wildflowers were just beginning to emerge during the inventory, and mountain laurel exploits any available growing space.
- **Non-native Invasive Growth:** The section of this stand west of the Manhan River on Fomer Road support invasive plant “hot spots” with dense growth (B+ level) within 150 feet of the road. Species cited here were Japanese barberry, (most stocking), glossy buckthorn, and multiflora rose.
- **Interfering native plants:** Not applicable.

**Habitat:** Signs of use by white tailed deer for bedding in the early spring were observed across this stand. Some large nests of predator birds, turkey, or squirrels were noted in the upper branches. Pine needles are consumed by grouse and by some browsers. Porcupines will climb these trees to nibble on their twigs. Birds, squirrels, and chipmunks eat their small seed. Maturing pine is the favorite roosting place for robins and morning doves.

- **NHESP:** The NHESP BioMap 2 Project defines this stand as critical natural landscape, which indicates its capacity to support wide-ranging wildlife species and enhance local biodiversity.
- **Habitat techniques:** The retention of over half of the largest white pine trees will protect the roosting habitat. The release of the red oak and hickory trees scattered through these stand will increase mast production. Opening the stand for regeneration will increase the vertical stratification and use of the site by songbirds and enhance local biodiversity.

- Risks: Not applicable.

**Fire Protection:** All of the sections of this stand are easily accessed from a Town Road by a four-wheel drive pumper truck for fire management. The dry sites and the pine duff layer do present a fire hazard.

**Desired Future Condition:** The ideal watershed forest supports an all-aged structure with a diversity of species and ecological resiliency with the capacity for natural filtration and purification of water. These pine groves are lacking younger age classes. Although unconventional, the Selection method with a combination of Single Tree and Small group variants will be used to initiate the conversion of this stand to the ideal watershed forest condition.

**Recommended Management Practices:** 1. Application of the Selection Method and a combination of the Single Tree and Small group variants. 2. Treatment of the invasive plants in the sections along Fomer Road. Proximity to the Manhan River mandates the use of a combination of mechanical and low toxicity herbicides for this work.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	3.14	HH	24.10	11.4"	128	4.4 MBF 3.0 Pulp cds 0.0 Firewd cds	60:EWP 49:NRO 57:SM	3.9

**Sub-Watershed:** Manhan River

**Water Quality Concerns:** The primary objective of any management work on these lands is the prevention of the loss of sediment and nutrients into the Manhan River watershed basin and the Tighe Carmody Reservoir.

**Silviculture Status:** Not suitable.

**Terrain/Topography:** The relief across this stand resembles the crests and troughs of a sine wave. The terrain starts level near Fomer Road, drops into the wide valley of a 2<sup>nd</sup> order stream, rises quickly to a small knoll, and then plunges down into the Manhan River floodplain. Both banks form a slight gorge area here.

**Soils:** Hinckley loamy sand mostly underlies the moderate slopes of this stand. This soils range from well drained to excessively drained and has rapid permeability and low available water capacity. It is moderately productive for tree crops.

- Timber Harvesting: Not applicable.
- Water Quality: The eastern portion of this stand provides essential green infrastructure for the stability of the steep Manhan River banks. The forest cover anchors these large pored soils and prevents any sediment loss from severe storm events.

**Overstory:** The main canopy composition changes with the terrain across the stand. A dense hemlock grove with mixed red maple, red oak, yellow birch, and red oak timber trees grows along the level western section and follows the slope down into the stream basin. Red oak and beech dominate the slopes and crests of the small knoll, and the dense hemlock grove returns along the steep Manhan River bank. The quality of the hemlock is fair, although the combined threat of elongated hemlock scale and

wooly adelgid threatens this crop. Many trees have lost about 30% of their live needles. The small sized hardwood timber has good form and quality. Their crowns remained narrow amongst the dense hemlock. A pure beech grove covers the knoll top; these trees are heavily infected with the beech bark complex.

**Understory:** Openings in the upper canopy from a harvest 30 years ago filled slowly, and the red maple, beech, and ash saplings and pole shave poor condition. The immature yellow bark saplings and poles in the moist area around the stream are thriving.

- **Regeneration:** Reproductive growth is low beneath the main canopy with scattered pockets of red maple, beech, and hemlock.
- **Native:** The shade restricted the development of a healthy herbaceous and shrub layer in this stand. However, poison ivy covers the ground and climbs into the hemlock crop along the stream channel.
- **Non-native Invasive Growth:** Not applicable.
- **Interfering native plants:**

**Habitat:** Dense hemlock groves provide ideal winter habitat for white tailed deer. A well-worn game path crossed this stand in route to the river. Many mammals enjoy beechnuts, and some of the larger trees had bear marks along their trunks.

- **NHESP:** NHESP: The NHESP BioMap 2 Project defines this stand as critical natural landscape, which indicates its capacity to support wide-ranging wildlife species and enhance local biodiversity.
- **Habitat techniques:** The protection of this essential green infrastructure along the unnamed stream channel and the Manhan River preserves this small habitat niche.
- **Risks:** Not applicable.

**Fire Protection:** Access into this stand would be difficult with a four-wheel drive pumper truck, although available water is high and provides natural firebreaks. The fire hazard is low within this stand.

**Desired Future Condition:** Although the stand exists as an older grove of mixed hardwood and hemlock, taken in perspective of the entire 2,115-acre watershed, it represents one small all aged component within the all-aged, resilient, species diverse watershed forest structure with the capacity to filter and purify water.

**Recommended Management Practices:** None.

**SUB-WATERSHED #4: MONTGOMERY**

<b>Objective</b>	<b>Stand #</b>	<b>Forest Type</b>	<b>Stand Area (acres)</b>	<b>MSD or Size Class (inches)</b>	<b>Basal Area (sq.ft./ac)</b>	<b>Volume Per Acre</b>	<b>Site Index</b>	<b>DCR/FIA Growth Rate (MBF/yr.)</b>
Stewardship Green Cert.	4.01	OHK	213.0	12.0" RO: 16 "	124	6.1 MBF 6 Pulp cds 6 Firewd cds	55:EWP 59:NRO 61:SM	34.5

**Sub-Watershed:** Montgomery

**Water Quality Concerns:** The goal for water quality protection is the prevention of any movement of sediment or nutrients into the brook or reservoir during or after timber harvest work. The deep Chatfield soils move water downward quickly, removing it from surface movement. The moist soils near the brook require mitigation with either corduroy or geotextile material (These materials must be removed post harvest activity.). These lands font the headwaters of two major tributaries into tucker brook. The soils are low and most around these spring fields. The protection of these recharge sites is essential during any harvest work.

**Silviculture Status:** Suitable in some sections.

**Terrain/Topography:** The terrain sweeps eastward from the eastern flank of Bungy Mountain across a long, broad slope with steep pitches along the property bound in the western portion of the stand and a gently pitch to the east. This long slope terminates at the shoreline of the Tighe Carmody Reservoir. Three major stream channels break the plane of the slope. Although they are all first order streams, the slope descent and flow velocity after storm events carves small ravine like formations along their banks as they near the Reservoir. Two small shrub swamps upslope feed two of the streams. The North West corner of the tract supports a wide spring field amongst boulders and rocks, which feeds one stream here and several to the north in the Tucker Brook West watershed.

**Soils:** The soils in this stand are a mix of Chatfield and Hollis, with each holding different positions dependent on the slope grade. Both consist of well-drained and somewhat excessively drained soils formed in glacial till. They are nearly level through very steep soils on glaciated plains, hills, and ridges. Chatfield soils are moderately deep to bedrock, and are more productive than the Hollis series. The Hollis series is shallow to bedrock. Both are extremely stony.

- **Timber Harvesting:** The Chatfield soils in this association are loamy and relatively deep to bedrock. They are easily worked with equipment, though the extreme stoniness can be a challenge. The deep loam holds water after storm events and could be erodible. The Hollis soils in this association are shallower and often found near rock outcrops and the upper slopes. Sections of the Hollis sites are not operable for timber harvest work.
- **Water Quality:** Post-harvest stabilization and emergency stabilization measures during storm events while the harvest is ongoing will be necessary to prevent any sediment movement across the slope. Access onto the Montgomery subwatershed requires a bridge across Tucker brook. Proper approaches and abutments will protect the fragile brook banks. Post harvest stabilization of the bridge site and approaches with heavy seeding and hay mulching will prevent sediment movement.

**Overstory:** The upper canopy is a mix of hemlock (35% of the stocking), high value red oak, and a small amount of sugar maple, paper birch, and white ash timber crops with contributions by black birch, yellow birch, and red maple large sized pole trees. The hemlock crop is declining quickly (elongated hemlock scale and wooly adelgid damage) with only about 50% of live needles across the stand. Some paper birch sawtimber dots the upper canopy and these trees are also in decline, which is age related. The white ash crop is suffering environmental decline, and the emerald ash borer could develop in the stand within the next two years. Nectria bacterium infects over 30% of the overstory black birch, and the beech bark complex feeds on most of the overstory beeches.

**Understory:** The stocking of the sapling and small pole trees layer is patchy through the stand depending on the crown closure on the main canopy. Beech dominates the shady places, and red maple, black birch, yellow birch, and hemlock all grow consistently in this layer. The immature red maple has poor quality; many sprouted from stumps. Both the black and yellow birch trees have good form.

- **Regeneration:** Reproductive stocking is variable but largely limited due to both low and high canopy shade. Hemlock, beech, and red maple dominate this stocking, yet red oak “phantom” seedlings less than 6 inches in height dot the forest floor near some of the largest red oak seed bearers.
- **Native:** Dense thickets of mountain laurel and witch-hazel shrubs cover the forest floor. The healthy herbaceous plant layer includes starflower, Christmas fern, hay scented fern, interrupted fern, lady fern, maidenhair fern (two small sections mid-slope), Polypody fern (growing on the rocks and boulders of the upper slope), sensitive and bracken fern (moist soils near brook), and partridgeberry, Indian cucumber, sarsaparilla,

wintergreen, starflowers, and one small patch of black cohosh near a sugar maple grove. The large rocks and boulders across the stand are covered with the elephant ear lichen, which produces an eerie beauty to the stones.

- Non-native Invasive Growth: No significant occurrence of non-natives invasive plants was noted. A few areas on the higher slope with bird activity grow scattered clumps of Japanese barberry and multiflora rose, but their spread seems to be contained by the native brush layer.
- Interfering native plants: The native shrubs, especially witch-hazel pose a threat to the reproductive stocking after a harvest without some reduction in their density. Grapes were noted during the inventory. Grape is native species. It responds quickly to sunlight and can overtop desirable regeneration. It can shade or even break stems. Grape vines provide an important food source for many wildlife species. The soft mast of the grapes and the leaves and shoots are important food sources. The dense thickets produced by the vines provide nesting habitat and escape cover. A balance between reproduction and wildlife values must be considered

**Habitat:** Oak acorns provide mast for wildlife and are abundant in the stand. The declining hemlock will provide some snags for wildlife use and current and future cavity trees. Pileated woodpeckers were at work on these stems during the field inventory. These trees are beginning to fall down on the forest floor, which increases the woody material for insects and invertebrates. Moose browse upon hobblebush, stripe maple, and red maple seedlings were prolific across the stand. Tracks and scat cover almost every acre. The male moose population has marked countless red maple poles and the larger striped maple stems with antler rubbings for territorial establishment. The remote location of this stand on the western shore side of the reservoir and its connectivity with the larger Westfield Water Division lands to the west create a forest landscape capable of use by the wide-ranging species.

- NHESP: The BioMap 2 Project defines this stand as Forest Core, Critical Natural Landscape, and Core habitat, and having some Aquatic Core habitat and Aquatic Buffer. This indicates that this stand supports ecological resilience to climate change and other disturbances and increases local biodiversity.
- Habitat techniques: 1. the release of the red oak crowns will increase the annual acorn crop. 2. Protection of the white pine cull trees and retention of a few of the larger dying hemlock secures current and future cavity trees. 3. The salvage removals of large portions of the hemlock crop will open the main canopy and increase the vertical stratification useful to songbirds in this stand and other foragers and browsers.
- Risks: Moose browsing is very heavy across this stand. It may prove difficult to regenerate the more desirable hardwoods such as sugar maple, red oak, and yellow and black birch with this damage.

**Fire Protection:** The reservoir itself and the interior brooks provide a water source for a four-wheel drive pumper truck in the event of a crisis. Improvement of the woods access road network during and after a silvicultural treatment will improve the access into these remote zones. No fire hazard exists at this time.



**Desired Future Condition:** The development and maintenance of the all-aged, species diverse, resilient natural filtration and purification watershed forest is the desired objective in this stand. The youngest age class in this stand is lacking. Silviculture work can introduce this age class on the forest floor and release the crowns of the residual red oak, yellow birch, and black birch crop trees for improved value and diameter growth. The Selection Method-Single Tree variant will be used here to introduce the youngest age class. A Salvage Harvest System will be simultaneously applied for the recovery of the merchantable value in some of the hemlock crop and the declining white ash and paper birch timber. The hemlock removals will open larger gaps in the main canopy to accommodate the requirements for germination of a wide variety of seedling species.

**Recommended Management Practices:** 1. Application of the Selection Harvest System- Single Tree. 2. Salvage Harvest for the removal of the declining hemlock (about 80%), white ash, and the paper birch. 3. Disturbance of the witch-hazel shrub layer during the timber harvest and some additional brush cutting treatment post-harvest for full exposure of the mineral soils and seedbed preparation. 4. Treatment of the grape vines within the hardwood crowns post harvest.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	4.02	WH	30.0	10.5"	147	3.1 MBF 4 Pulp cds 3 Firewd cds	55:EWP 59:NRO 52:SM	4.86

**Sub-Watershed:** Montgomery

**Water Quality Concerns:** The goal for water quality protection is the prevention of any movement of sediment or nutrients into the brook and the reservoir during or after any management activity. This stand is remote from the hydrological function of the lower slope sin water transfer and storage.

**Silviculture Status:** Not suitable.

**Terrain/Topography:** This stand wraps itself around the full eastern flank of the lower crest of Bungy Mountain. The southwestern point of the hilltop drops off sharply to the east in a 180-degree arc across rock outcrops, boulder fields, and ledges.

**Soils:** The soils in this stand are a mix of Chatfield and Hollis varying but the proportion of the two and the steepness of the slope. Both the Chatfield and Hollis series consists of well drained and somewhat excessively drained soils formed in glacial till. They are nearly level through very steep soils on glaciated plains, hills, and ridges. Chatfield soils are moderately deep to bedrock, and are more productive than the Hollis series. The Hollis series is shallow to bedrock. Both are extremely stony.

- Timber Harvesting: Not suitable.
- Water Quality: Not applicable.

**Overstory:** The hilltop point supports a grove of mature white pine and hemlock, which tower above a sparse shrub and sapling /pole tree layer. These trees are reaching biological maturity (180 to 200 years of age), yet they are still healthy. Their crowns have been battered by the wind and weather. The hemlock trees still have over 75% of live needles. The side slopes are dominated by declining back birch and excellent quality northern red oak. Scarlett oak and white ash is significant components. Scattered

large hemlocks are declining rapidly and may be recruited for cavity trees. This pine/ hemlock mix stretches northward into a slightly lower slope position. The steep slope zones grow a low-density mix of red oak, birch, and maple timber crops. These trees are mature and slow growing on the shallow soils and rocks.

**Understory** A sparse stocking layer of red maple, aspen, black birch, and paper birch sapling and pole small pole trees struggle beneath the main canopy of these poor sites.

- **Regeneration:** Reproduction stocking is generally sparse with mixed hardwoods across the steep slopes and non-existent on the mountain top areas. Red oak, chestnut oak, and red maple are growing in patches.
- **Native:** Mountain laurel, sassafras, striped maple, and excessive witch-hazel were noted. A dense mat of our native herbaceous plants and ferns fill in any available growing niche along these slopes.
- **Non-native Invasive Growth:** No significant occurrence of non-natives invasive plants was noted.
- **Interfering native plants:** Dense witch-hazel and stands of mountain laurel inhibit regeneration, but the overstory cover and herbaceous layer hold the soils in place.

**Habitat:** Tall, maturing pine provides excellent roosting sites for turkey or nesting and denning for small mammals. When the large diameter white pine trees blow over or dies, a high volume of coarse woody debris covers the forest floor. The large declining hemlocks will become cavity trees. The numerous rock outcrops provide habitat niches for species that prefer these structures. Porcupine droppings were amassed beside several small niches in the rocks. Bobcat usually den in the high slope rock outcroppings. One small cave was observed beneath the mountain top area, which is ideal bobcat habitat. Moose scat was even piled on the mountaintop. The mature white pine and hemlock grove shave natural openings from attrition, which provide the vertical stratification useful to songbirds. Raptors like to fly around these high points and perch in the tall trees.

- **NHESP:** The Natural heritage Endangered Species Program identifies to this stand as Critical natural landscape, Core habitat, and Forest Core. These designations signify a strong capacity within this stand for ecological resiliency and the capacity to support wide array of wildlife species.
- **Habitat techniques:** Not applicable.
- **Risks:** Not applicable.

**Fire Protection:** Limited access and steep slopes make fire suppression activities challenging on this site. The moist soils beneath the pine groves could lessen nay fire hazard.

**Desired Future Condition:** Preservation of this area in its current condition protects its habitat value.

**Recommended Management Practices:** Not applicable.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	4.03	OM	23.0	13.6"	100	3.6 MBF 0.0 Pulp cds 6.6 Firewd cds	55:EWP 59:NRO 61:SM	3.73

**Sub-Watershed:** Montgomery

**Water Quality Concerns:** The goal for water quality protection is the prevention of any movement of sediment or nutrients into the shrub swamp, the brook, and the reservoir during or after timber harvest work. This stand abuts the small shrub swamp, which feeds the central stream through the property.

**Silviculture Status:** Suitable but not appropriate during 2015 to 2025.

**Terrain/Topography:** This small oak grove sits on a level plain between two steep slope zones. The plain is broad and slightly tilted into the shrub swamp area on its western edge. The discontinued portion of North Road from Montgomery Town center borders this swamp. This old road crosses the Montgomery parcel and enters the Tucker West Sub-watershed to the north.

**Soils:** The soils in this stand are a mix of Chatfield and Hollis varying but the proportion of the two and the steepness of the slope. Both the Chatfield and Hollis series consists of well drained and somewhat excessively drained soils formed in glacial till. They are nearly level through very steep soils on glaciated plains, hills, and ridges. Chatfield soils are moderately deep to bedrock, and are more productive than the Hollis series. The Hollis series is shallow to bedrock. Both are extremely stony.

- Timber Harvesting: Not applicable.
- Water Quality: These soils have very fine pore structure, and water moves slowly through them. They tend to compact, and they would not be easily dislodged during sever storm events.
- 

**Overstory:** The overstory consists of some excellent quality immature red oak, scarlet oak, white oak, aspen and black birch. The quality of these is very good. A few good quality eastern white pine trees are scattered through the stand.

**Understory:** A moderately stocked layer of black birch, red and scarlet oak, red maple, and aspen saplings and pole trees grow beneath the main canopy.

- **Regeneration:** Reproductive growth is low across the stand with pockets of beech, red maple, and hemlock seedlings growing beneath the oak crown shade.
- **Native:** Witch-hazel shrubs are consistent across the forest floor in moderate density. Dense thickets of mountain laurel grow in patches also grow here. Low bush blueberry plants share the forest floor with ferns and wildflowers. The shrub swamp vegetation includes illex, dogwood, spicebush, swamp pink azalea, sensitive fern, bracken fern, and wild blue flag iris.
- **Non-native Invasive Growth:** No significant occurrence of non-natives invasive plants was noted.
- **Interfering native plants:** Not applicable.

**Habitat:** Small swamp swamps in the interior of a large forest tract offer a unique habitat niche in which aquatic species thrive. A water source close to the dry upland oak sites would be appreciated by many species. The native blueberry plant is an important summer and early fall fruit to many wildlife species. They are enjoyed by the scarlet tanager, wood thrushes, bear, chipmunk, and white-footed mouse. Deer and rabbits browse the plants. Three species of oak would produce variable quantities of mast each year, but collectively they would yield a constant supply.

- **NHESP:** The Natural heritage Endangered Species Program identifies to this stand as Critical natural landscape, Core habitat, and Forest Core. These designations signify a strong capacity within this stand for ecological resiliency and the capacity to support wide array of wildlife species.
- **Habitat techniques: Risks:** Not applicable.

**Fire Protection:** The dry, upland soils do not hold moisture and could present a fire hazard. Access is possible to this area for fire management from the abandoned section of North Road. A water source is readily available from the swamp. No current fire hazard exists here.

**Desired Future Condition:** This small mixed oak grove is wedged between two steep sloping sites. The game trails suggest daily use by native populations. Preservation of the site in its current condition would increase local biodiversity. The stocking density supports optimal growth of the best red oak crop trees. A healthy forest condition correlates to a better habitat condition.

**Recommended Management Practices:** Not applicable.

**SUB-WATERSHED #5: TUCKER BROOK EAST**

<b>Objective</b>	<b>Stand #</b>	<b>Forest Type</b>	<b>Stand Area (acres)</b>	<b>MSD or Size Class (inches)</b>	<b>Basal Area (sq.ft./ac)</b>	<b>Volume Per Acre</b>	<b>Site Index</b>	<b>DCR/FIA Growth Rate (MBF/yr.)</b>
Stewardship Green Cert.	5.01	WP	36.20	12.3" WP: 16inches	220	17.1 MBF 8.9 Pulp cds 3.8 Firewd cds	Hk 55 WP 63 RO 59	5.8644

**Sub-Watershed:** Tucker Brook East

**Water Quality Concerns:** The goal for water quality protection is the prevention of any movement of sediment or nutrients into Tucker Brook and Tighe Carmody reservoir during or after timber harvest work. The deep Hinckley sands move water downward quickly, which removes it from surface movement. Frozen ground scheduling of the harvest work will prevent any over the ground sediment loss, and proper post-harvest installation of erosion control measures along the main hauling roads will prevent erosion.

**Silviculture Status:** Suitable.

**Terrain/Topography:** One section of this stand lies on the upper zone of a broad, gentle slope into Tucker Brook and the Tighe Carmody Reservoir. The terrain is nearly level to gently tilting towards the water. A second smaller section hugs the shoreline of the Tighe Carmody Reservoir at the inlet for the Manhan River. This terrain is a short, level plain with a sharp drop to the shoreline.

**Soils:** Hinckley loamy sand mostly underlies the moderate slopes of this stand. This soils range from well drained to excessively drained and has rapid permeability and low available water capacity. It is moderately productive for tree crops, yet its droughtiness causes seedling mortality. A small section in the southeastern corner of this stand grows above the deep, well-drained, very stony Montauk soils. These soils have a perched water table in the late spring and fall, which holds water above the hardpan

lower soil layer making it available for tree growth. The soils are well suited for the growth of white pine and oak timber crops.

- **Timber Harvesting:** These Hinckley loamy sands have about 10% gravel composition. They are easily worked with equipment, and they will provide ideal road building medium for the harvest work.
- **Water Quality:** The Hinckley soil's pore structure is small, which prevents the fast movement of sediments. Harvest scheduling during dry or frozen conditions will prevent any sediment loss and protect the soil structure.

**Overstory:** The main canopy supports healthy white pine of good quality and high value growing on a rich site. The associated hemlock (11% of the stocking density) crop is declining, but less so than in other parts of the watershed. The canopy height exceeds 85 to 90 feet.

**Understory:** The pine timber grows above a somewhat sparse midstory of mixed hardwood in fair to good condition. The tight stocking the pine and hemlock prevent the midstory from expansion. Yellow birch, black birch, and red oak contribute the best of the young crop trees. They have excellent form and vigorous crowns. These trees seeded into the openings from past harvest 25 to 30 years ago.

- **Regeneration:** The amount of regeneration is low due to competition from the overstory pines and hemlock. Where there are openings, there are dense seedling thickets of yellow birch, paper birch, red maple, black birch, and black cherry. Due to competition, a number of dead seedling and sapling white pine were noticed.
- **Native:** Shrub species scattered across the forest floor include witch-hazel and blueberry. Christmas and cinnamon ferns are found in the moister areas. Other native herbaceous plants include Christmas pine and false Solomon seal.
- **Non-native Invasive Growth:** Japanese barberry was noted near some of the moist areas, likely do to birds using these areas. A dense strip of Japanese barberry enters this stand for about 80 feet along the edge of Stand 5.04 to the south.
- **Interfering native plants:** Dense thickets of witch-hazel shrubs could interfere with seedling development if they spread out after a timber harvest. Their disturbance is recommended during the timber harvest. Native grape vines climb into some of the tallest white pine trees. They could spread into the residual trees after a harvest; they cover the crowns of tall, healthy trees and choke off their ability to photosynthesize.

**Habitat:** A large raptor next sits up about 80 feet in a pine trees. This stand lacks the vertical stratification attractive to songbirds and supportive of local biodiversity. Native blueberry fruit is enjoyed by many wildlife species. It is the most important summer and fall food for grouse. They are very important to wood thrushes, scarlet tanager, as well as mammals. There is a line of old sugar maples along Fomer Road, which offer excellent structure and cavities for species that desire these



conditions. A pileated woodpecker was working one of the large diameter white pine standing cull trees during the inventory.

- NHESP: The area around Tucker Brook is considered Aquatic Core and Aquatic core buffer. Much of the southwestern part of this stand is considered Forest Core. The entire stand is considered Core Habitat and Critical Natural Habitat. This indicates that this stand supports ecological resilience to climate change and other disturbances and increases local biodiversity.
- Habitat techniques: 1. Retention of some tallest (>85 feet), if they are wind sound, white pine for preservation of their roosting and denning value. 2. Open the stand to develop a multi-aged stand structure and allow regeneration to thrive. 3. Preserve the line of sugar maples for their aesthetic and habitat value.
- Risks: Not applicable.

**Fire Protection:** Access is excellent along Fomer road with water available from the reservoir and the Manhan River.

**Desired Future Condition:** The development and maintenance of the all-aged, species diverse, resilient natural filtration and purification watershed forest is the desired objective in this stand. This stand is predominantly even aged (white pine less than 125 years) with some minor inclusions of younger hardwood. These soils are conducive to the productive growth of both white pine and red oak. Its conversion to the desirable structure will require several decades. The process begins with the introduction of the youngest age class. White pine might seed well, and the future stand will be species diverse.

**Recommended Management Practices:** 1. Treatment of the invasive plant communities along Fomer Road on the edge of Stand 6.04 before a timber harvest. 2. The application of an Irregular Shelterwood Harvest to encourage seedling development on the forest floor. 3. Treatment of the minor grape vine problem before or during the harvest work.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	5.02	WH	87.90	13.2" RO: 18 inches WP:17 inches	119	8.2 MBF 3.2 Pulp cds 7.2 Firewd cds	Hk 55 WP 63 RO 60	14.2

**Sub-Watershed:** Tucker Brook East

**Water Quality Concerns:** The goal for water quality protection is the prevention of any movement of sediment or nutrients into Tucker Brook and Tighe Carmody reservoir during or after timber harvest work. This stand rests on the eastern shore of the Tighe Carmody Reservoir and the eastern bank of Tucker Brook. This stand slopes gently toward Tucker Brook. The deep Hinckley sands move water downward quickly, which removes it from surface movement. Frozen ground scheduling of the harvest work will prevent any over the ground sediment loss, and proper post-harvest installation of erosion control measures along the main hauling roads will prevent erosion.

**Silviculture Status:** Suitable.

**Terrain/Topography:** This majority of this stand sprawls across the entire broad, gentle slope into the reservoir. One small section drops sharply to the east bank of Tucker Brook at its confluence with the reservoir. The grade of the long slope is broken with two spring seep areas and their surrounding riparian zones. The larger spring seep field drains to the reservoir across a rocky, narrow channel. Illegal hiking trails traverse the terrain, and an illegal campsite sits on the reservoir shore.

**Soils:** Hinckley loamy sands underlie the northern portion of this stand across the moderate slopes, and in two small strips on the shoreline in the southeastern portion of the stand. These soils range from well drained to excessively drained and has rapid permeability and low available water capacity. It is moderately productive for tree crops. The remainder of the site grows above the Merrimac sandy loams on moderately sloping and rolling terrain. These soils are deep and somewhat excessively drained. Along

the reservoir boundary, the stand grows in Belgrade silt loam, which is nearly level, deep, and moderately well drained. A seasonal high water in some areas table limits root growth. These soils grow trees very well.

- **Timber Harvesting:** Both of these loamy sand soils have about a gravel composition (<20%). They are easily worked with equipment, and they will provide ideal road building medium for the harvest work. They are suitable for forest management operations.
- **Water Quality:** Fine sands compact well under the pressure of harvest equipment, and they do not dislodge easily. Harvest scheduling during dry or frozen conditions will prevent any sediment loss and protect the soil structure.

**Overstory:** A mixture of white pine (29% of overstory stocking), red oak (19%), and black birch (19%) dominate the overstory. The white pine is a mix of good to excellent quality sawtimber with a few scattered sections and weevil damaged, multi-leader stems. The red oak is of very good to excellent condition. Black birch, red maple, and sugar maple of generally good quality share the midstory. There are many declining hemlock saplings and poles in the midstory that they share with pockets of sapling sugar maple in good condition. Paper birches (greater than 16 inches in diameter) are in serious decline. The hemlock crop (12% of total stocking) is declining under attacks by the elongated scale and the wooly adelgid.

**Understory:** The midstory is well stocked with immature hardwoods including black birch, red maple, black cherry, yellow birch, and paper birch. Quality ranges from poor to excellent depending on species and location. These immature trees are growing fast on the rich soils. Hemlocks in this lower layer are declining quickly from wooly adelgid and elongated hemlock scale damage.

- **Regeneration:** A sparse layer (C and B- rating on the simple metric) of mixed hardwood regeneration is scattered throughout the stand. It is mostly in good quality with the exception of hemlock and paper birch poles and saplings.
- **Native:** Solomon's seal, false Solomon's seal cinnamon fern, partridgeberry, lycopodium, Christmas fern were some of the many species noted in the rich and vigorous herbaceous layer. Blueberry shrubs are prolific across the forest floor. The moist spring seep sites support hydric shrubs and plants such as blue flag iris, spicebush, illex, gray dogwood, sensitive fern, and royal fern.
- **Non-native Invasive Growth:** Japanese barberry and multiflora rose are a significant concern, mostly appearing along Fomer Road.
- **Interfering native plants:** Dense thickets of witch-hazel shrubs could interfere with seedling development if they spread out after a timber harvest. Their disturbance is recommended during the timber harvest. Grape is native species. It responds quickly to sunlight and can overtop desirable regeneration. It can shade or even break stems. Grape vines provide an important food source for many wildlife species. Treatment of

the grape vines after the harvest will reduce their spread into the crop trees, and simultaneous treatment with a brush saw after the harvest can remove the densest shrub clusters beneath the superior seeders.

**Habitat:** A spring seep included in this stand provides a number of shrub and herbaceous species that provide soft mast. The soft mast of the grapes and the leaves and shoots are important food sources. The dense thickets produced by the vines provide nesting habitat and escape cover. Fall downs and storm damaged top wood provide valuable coarse woody material on the forest floor.

- **NHESP:** The area around Tucker Brook is considered Aquatic Core and Aquatic core buffer. Much of the southwestern part of this stand is considered Forest Core. The entire stand is considered Core Habitat and Critical Natural Habitat. This indicates that this stand supports ecological resilience to climate change and other disturbances and increases local biodiversity.
- **Habitat techniques:** Retain the line of old maples along Fomer Road for both their aesthetic value and their habitat value for cavity nesters. Protect the wet areas from disturbance during management operations. Open the canopy to invigorate the midstory and understory to develop a multi-age stand structure with vertical stratification useful to songbirds.
- **Risks:** Fomer Road represents a continuous entry point for non-native invasive species from community dumping of these plants. Monitoring of the site long-term will allow for rapid detection and early removal of these plants.

**Fire Protection:** Access is excellent along Fomer road with water available from the reservoir and the Manhan River.

**Desired Future Condition:** The development and maintenance of the all-aged, species diverse, resilient natural filtration and purification watershed forest is the desired objective in this stand. The youngest age class in this stand is lacking. Use of the Selection Method with a combination of the Single Tree and Small Group variants will open the canopy for seedling development on the forest floor. The crowns of the best crop trees in both the main canopy and the middle layer (white pine, red oak, yellow birch, and black birch) will also be released for improved vigor and value growth.

**Recommended Management Practices:** 1. Application of Selection Method. 2. Disturbance of the witch-hazel across the forest floor for seedbed preparation post harvest. 3. Removal of the Japanese barberry, multi flora rose, and bittersweet along the edges of the invasive hotspots (zones with high stocking density) prior to operations to prevent their spread into the interior of the stand.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	5.03	WHK	8.50	14.3" White Pine: 20 inches	210	19.2 MBF 3.7 Pulp cds 10.5 Firewd cds	Hk 55 WP 63 RO 61	1.377

**Sub-Watershed:** Tucker Brook East

**Water Quality Concerns:** The goal for water quality protection is the prevention of any movement of sediment or nutrients into Tucker Brook and Tighe Carmody reservoir during or after timber harvest work. This stand perches on a moderate to steep slope on the eastern banks of Tucker brook close to its confluence with the Tighe Carmody Reservoir. Any disturbance in this stand could directly impacts water quality in the reservoir.

**Silviculture Status:** Suitable.

**Terrain/Topography:** This stand sits on a short slope tilting 20% to 30% towards the Tucker Brook with a sharper pitch along the banks.

**Soils:** Hinckley loamy sand mostly underlies the moderate slopes of this stand. This soils range from well drained to excessively drained and has rapid permeability and low available water capacity. It is moderately productive for tree crops.

- Timber Harvesting: These Hinckley loamy sands have about 10% gravel composition. They are easily worked with equipment, and they will provide an ideal road-building medium for the harvest work.
- Water Quality: The deep Hinckley sands move water downward quickly, which removes it from surface movement. Frozen ground scheduling of the harvest work will prevent

any over the ground sediment loss, and proper post-harvest installation of erosion control measures along the main hauling roads will prevent erosion.

**Overstory:** The main canopy supports a dense grove of hemlock timber crops, which shares this space with some white pine and red oak timber. The hemlock has clean lower boles and small black knots. This is usually considered high value hemlock, but the trees are declining due to the wooly adelgid and elongated hemlock scale. Their decline is much slower than other stands on the property. Overstory red oak and white pine are in good condition and very good quality. The white pine trees break the main canopy level and reach up to 85 feet or more. They have full, symmetrical crowns and clean, straight boles.

**Understory:** The sapling and pole layer is very sparse under the canopy shade. Scattered pockets of poor quality hemlock and red maple were noted.

- **Regeneration:** The hardwood regeneration minimal (beech) due to the shade and competition from witch-hazel and mountain laurel. Small, dense pockets of hemlock seedlings dot the forest floor.
- **Native:** Herbaceous vegetation is limited due to the overstory shade and shrub competition.
- **Non-native Invasive Growth:** No invasive species were noted at this time, but infection from the significant communities near Former Road is a possibility.
- **Interfering native plants:** Dense thickets of witch-hazel and mountain laurel shrubs could interfere with seedling development if they spread out after a timber harvest. Their disturbance is recommended during the timber harvest.

**Habitat:** Dense hemlock groves are often the favorite nesting places for veery; black throated blue warbler, black throated green warbler, and the Blackburnian warbler. Chickadee, rodents, and red squirrel enjoy their small, prolific seed. The vertical stratification important to these birds is lacking.

- **NHESP:** The area around Tucker Brook is considered Aquatic Core and Aquatic core buffer. Much of the southwestern part of this stand is considered Forest Core. The entire stand is considered Core Habitat and Critical Natural Habitat. This indicates that this stand supports ecological resilience to climate change and other disturbances and increases local biodiversity.
- **Habitat techniques:** 1. The retention of several of the dead or dying hemlock timber trees provides current and future cavity trees. 2. The Selection Method Harvest –Single Tree Variant opens small patches of the forest floor, which will attract some of the low nesters songbirds. 3. Retention of the dense hemlock cover will protect any deer yarding sites across the stand.
- **Risks:** Not applicable.

**Fire Protection:** Access is excellent along Fomer road with water available from the reservoir to the west and the Manhan River to the east.

**Desired Future Condition:** The development and maintenance of the all-aged, species diverse, resilient natural filtration and purification watershed forest is the desired objective in this stand. The youngest age class in this stand is lacking. Use of the Selection Method with a combination of the Single Tree and Small Group variants will open the canopy for seedling development on the forest floor. The crowns of the best white pine trees will also be released for improved vigor and value growth.

**Recommended Management Practices:** 1. Application of Selection Method-Single Tree Variant. 2. Disturbance of the witch-hazel across the forest floor for seedbed preparation.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	5.04	BM	9.00	11.2"	93	2.6 MBF 0.0 Pulp cds 17.0 Firewd cds	Hk 55 WP 63 RO 62	1.458

**Sub-Watershed:** Tucker Brook East

**Water Quality Concerns:** The goal for water quality protection is the prevention of any movement of sediment or nutrients into Tucker Brook and Tighe Carmody reservoir during or after timber harvest work. This stand lies along Fomer Road upslope from the reservoir. Any disturbance to this site would not directly affect water quality in Tighe Carmody Reservoir.

**Silviculture Status:** Not Suitable.

**Terrain/Topography:** This stand lies along a wide level plain in two small sections. The old landing site (created in 2010) is located in the northern section.

**Soils:** Hinckley loamy sand mostly underlies the moderate slopes of this stand. This soils range from well drained to excessively drained and has rapid permeability and low available water capacity. It is moderately productive for tree crops.

- Timber Harvesting: Not applicable.
- Water Quality: Not applicable.

**Overstory:** A large foundation along Fomer Road indicates a once active farm on this site. The stand has the appearance of more recently abandoned agricultural use. Large-sized (>25 inches) sugar maple trees wide spreading crowns and cavities, known as “wolf” trees dot the roadsides. They were probably retained or planted near the farmhouse in the late 1800’s. A few scattered white pine legacy (large sized pine retained in stand through their biological lifespan) tower above the hardwood canopy. An immature grove of sugar maple, red maple, black locust, paper birch, black birch, cheery, and ash crowd



into this small stand. The trees are healthy, with the exception of nectria bacterium infections in the black birch. Groups of aspen clones (maturing with diameters  $\geq 16$  inches) share the upper canopy.

**Understory:**

- Regeneration: The mixed hardwood regeneration is patchy and would benefit from openings in the canopy for release.
- Native: Cinnamon fern, Virginia creeper, and Christmas fern are found in this stand. Christmas fern blankets a small area near the cellar hole. Poison ivy climbs into many of the young hardwood trees.
- Non-native Invasive Growth: Japanese barberry, Glossy buckthorn, Asiatic bittersweet, Japanese knotweed, and multiflora rose plants radiate out from an epicenter on Fomer Road deep into this stand. They represent a significant source of infection for the rest of the watershed down slope of Fomer Road. Their stocking density rates an A level. The treatment of these plants might require more than a manual approach with the use of minimally toxic herbicides. While the City debates the cost-effectiveness of full treatment, the plants along the edges of Stand 5.02 and Stand 6.01 will be removed to prevent their rapid spread into the postharvest openings.
- Interfering native plants: Not applicable.

**Habitat:** There is a line of old sugar maples along Fomer Road, which offer excellent structure and cavities for species that desire these conditions. Poison ivy sets abundant palatable berries each fall, which are enjoyed by many songbirds. Despite their threats to our native plant communities with their lack of insect relationships and their exploitive growth habits, our local birds and small mammals take most of the invasive plant fruit. The juxtaposition of the tall white pine to the west of these two small areas provides vertical stratification for songbird habitat.

- NHESP: The area around Tucker Brook is considered Aquatic Core and Aquatic core buffer. This stand borders on habitat that is considered Forest Core and Critical Natural Habitat. The entire stand is considered Core Habitat. This indicates that this stand supports ecological resilience to climate change and other disturbances and increases local biodiversity.
- Habitat techniques: Treatment of the invasive plants protects local biodiversity.
- Risks: Not applicable.

**Fire Protection:** Access is excellent along Fomer road with water available from the reservoir and the Manhan River.

**Desired Future Condition:** This small stand is a unique rich, northern hardwood niche amongst a large white pine and mixed pine and oak ecotype. The young trees are growing well, dominant in the low canopy height, and contribute one small all-aged aggregate of true northern hardwood in the all-age, species diverse ideal watershed filtration forest. The preservation of this stand in its current condition will protect the cultural history artifact of the foundation, reduce the threat of the spread of the invasive plants into the interior of the surrounding stand, and allow the young hardwood crop to mature.

**Recommended Management Practices:** Not applicable.

**SUB-WATERSHED #6: TUCKER BROOK WEST**

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr.)
Stewardship Green Cert.	6.01	HH	22.80	15.2" Red Oak: 23 inches	227	22.7 MBF 8.9 Pulp cds 3.8 Firewd cds	Hk 55 WP 63 RO 59	3.69

**Sub-Watershed:** Tucker Brook West

**Water Quality Concerns:** The goal for water quality protection is the prevention of any movement of sediment or nutrients into Tucker Brook and Tighe Carmody reservoir during or after any future silvicultural treatment. This stand hugs the lower slope of abroad drop from two unmanned hilltops to the west. Many springs seeps effuse ground water across this stand directly into Tucker Brook. The recharge sites carve out some concave holes in the side of the slope. Any disturbance to this site would directly affect water quality in Tighe Carmody Reservoir.

**Silviculture Status:** Not suitable. The lower slope collects water near Tucker Brook.

**Terrain/Topography:** This stand hugs the west bank of Tucker brook on the extreme lower slope of the eastern flank of an unnamed twin peak mountain top formation.

**Soils:** Underlying this stand is the Charlton - Hollis - Rock Outcrop is a complex of undulating soils and rock outcrops on ridges and hills. About 40% of this soil is the deep well drained Charlton, 25% is shallow excessively drained Hollis, and 15% granite rock outcrops. The remaining 20% come from a variety of included soils. Productivity is variable based on the underlying soil, best on the Charlton soils and somewhat poor on the Hollis. Large stone and boulder fields dot this side hill.

- Timber Harvesting: Not applicable.

- **Water Quality:** Although the Charlton-Hollis soils have a low erosion K score, the moist low slope soils are fragile.

**Overstory:** Maturing red oak, hemlock, and white pine share the upper canopy layer. Hemlock contributes over 47% of the stocking. These trees are in decline from the wooly adelgid and elongated hemlock scale. One small grove in the northwestern corner of the stand is healthier. The quality of the white pine and minor amounts of yellow birch and red maple have fair to good quality. The red oak crop has excellent quality.

**Understory:** The density of the sapling and pole trees is variable with some dense pockets. Healthy young trees of black birch, yellow birch, and red maple share the lower canopy with poor condition hemlock.

- **Regeneration:** Regeneration is challenging in this dense dark stand. It is patchy occurring in open areas and rating about a C+ on the simple metric.
- **Native:** The moist rich soils support a dense mat of native shrubs, ferns, and herbaceous plants. Species include Christmas fern, Indian cucumber, partridgeberry, wild leeks, trillium, hay scented fern, maiden hair fern, hobblebush, witch-hazel, and mountain laurel (dense thickets with A rating level density. This ground cover plays a crucial role in soil stability so close to Tucker Brook.
- **Non-native Invasive Growth:** None noted.
- **Interfering native plants:** Not applicable.

**Habitat:** The large sized (>24 inches in diameter) red oak produces abundant mast t each fall. The dense herbaceous layer is useful for foraging and feeding by small mammals and songbirds. Some of the dying hemlock trees and a few red oaks have uprooted and dropped near the stream bank. This woody debris provides basking and perching places for reptiles and amphibians.

- **NHESP:** The BioMap 2 Project describes Tucker Brook as and its immediate surroundings as Aquatic Core habitat. The rest of the stand is classified as Aquatic Buffer, Forest Core, Critical Natural Landscape, and Core habitat, which indicates that this stand supports ecological resilience to climate change and other disturbances and increases local biodiversity.
- **Habitat techniques:** Preservation of this stream bank habitat area will protect local biodiversity.
- **Risks:**

**Fire Protection:** This stand is generally moist so fire here is unlikely. Access for four-wheel drive vehicles is available from an established ford on Tucker brook, which also is a fire management water source.

**Desired Future Condition:** This stand is a component of the green infrastructure that anchors erodible soils from displacement into the water system. The age of the red oak, (range 175 to 190 years) provides a small one older aggregate within the all-aged, species-diverse, ecologically resilient watershed filtration forest. This stand will be preserved in its current condition for the protection of water quality.

**Recommended Management Practices:** Not applicable.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	6.02	OH	81.80	10.7" Red oak: 20 inches	115	5.2 MBF 3.2 Pulp cds 7.2 Firewd cds	Hk 55 WP 63 RO 59	13.43

**Sub-Watershed:** Tucker Brook West

**Water Quality Concerns:** The goal for water quality protection is the prevention of any movement of sediment or nutrients into Tucker Brook and Tighe Carmody reservoir during or after timber harvest work. One section of the stand rests on the upper slopes, and the other smaller section is located on the western bank of Tucker Brook. Any disturbance to either site could directly affect water quality in Tucker Brook and the Tighe Carmody Reservoir.

**Silviculture Status:** Suitable in sections, but not appropriate in the 2015 to 2025 operating period.

**Terrain/Topography:** Tucker Brook borders the narrow strip in the northeastern part of this stand, with a general slope gently into the brook bed. A number of spring seeps flow through this stand towards Tucker Brook. One large seep sprouts beneath a boulder field. The second section of this stand lays high upslope along the north property bound. The relief in this area sweeps southerly across the north flank and peaks of twin unnamed mountain tops across the broad

**Soils:** Underlying both sections of this stand is the Charlton - Hollis - Rock Outcrop is a complex of undulating soils and rock outcrops on ridges and hills. About 40% of this soil is the deep well drained Charlton, 25% is shallow excessively drained Hollis, and 15% granite rock outcrops. The remaining 20% come from a variety of included soils. Productivity is variable based on the underlying soil, best on the Charlton soils and somewhat poor on the Hollis.

- Timber Harvesting: Not applicable.
- Water Quality: Not applicable.

**Overstory:** The overstory in this stand consists of beech, black birch, red maple, hemlock, and northern red oak. The northern red oak and scattered eastern white pine is very good in form and condition. Most of the overstory and midstory hemlocks are declining. Yellow birch in the midstory is in excellent form. Midstory red maple and black birch are in fair condition. Beech in the overstory and midstory is heavily infected with beech bark complex, and the black birch suffers necrotic bacterium infections on the drier sites. The twin peaks support typical higher slope mountain top oak hardwood with shorter trees.

**Understory:** The seedling class is somewhat lacking in this stand except in patches where a gap in the canopy has opened.

- **Regeneration:** Overall, it rates C on the simple metric with patchy contributions by yellow birch, black birch, red oak, red maple, and beech.
- **Native:** Despite the exposed ledge and rock on the higher slopes, a thick mat of herbaceous plants and ferns covered the ground here as well as along Tucker Brook. Species cited include foamflower, red trillium, daylily, and partridgeberry, hay scented fern, Christmas fern, striped maple, hobble bush, mountain laurel. Elephant ear lichen and Polypody fern were growing on the larger rocks and stones.
- **Non-native Invasive Growth:** None noted.
- **Interfering native plants:** Not applicable.

**Habitat:** Moose browse this stand heavily, shredding the hobblebush and striped maple. A screech owl was sighted during the inventory. The scattered, legacy eastern white pines provide tall branches for nesting. Pileated woodpeckers have been working the standing hemlock and hardwood snags and cull trees. Several large sized (>25 inches) red oak “wolf” trees were noted on the upper. These and the younger oaks set ample annual mast crops. A bear den was cited near a small vernal pool just east of the peak on the higher mountaintop. The dying hemlock trees provide a multitude of current and future cavity trees.

- **NHESP:** The BioMap 2 Project describes Tucker Brook as and its immediate surroundings as Aquatic Core habitat. The rest of the stand is classified as Aquatic Buffer, Forest Core, Critical Natural Landscape, and Core habitat, which indicates that this stand supports ecological resilience to climate change and other disturbances and increases local biodiversity.
- **Habitat techniques:** Let this stand develop naturally.
- **Risks:** Not applicable.

**Fire Protection:** The section of this stand on Tucker Brook is generally moist, so fire here is unlikely. Access for four-wheel drive vehicles is available at this point with a readily available water source in Tucker Brook. The higher slope oak sites are not accessible from the south for fire management

purposes; access could be gained from the Old Sate Line Road four-wheel drive (discontinued and in serious disrepair) entering the area from Montgomery.

**Desired Future Condition:** The lower section of this stand provides an important buffer to filter sediment from entering Tucker Brook. It is progressing slowly towards a mixed aged multi-species condition and should be allowed to do so. The areas of the upper slope section north of the twin peaks are also evolving into the – all-aged, species rich mixed hardwood grove with ecological resistance and a natural capacity for water filtration. The loss of the hemlock component in this stand creates sufficient canopy openings for the establishment of a seedling age class. Both of these sections could be operated for silviculture in the future. Re-assessment of stand conditions in 2025 might suggest the possibility of the use of the Selection Method for the further development of the ideal watershed forest condition in some areas. The mountaintops and steep slopes will be preserved in their current condition into perpetuity.

**Recommended Management Practices:** None.



Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	6.03	OH	53.80	13.3"	55	3.850 MBF 3.7 Pulp cds 4 Firewd cds	Hk 55 WP 63 RO 59	8.72

**Sub-Watershed:** Tucker Brook West

**Water Quality Concerns:** The goal for water quality protection is the prevention of any movement of sediment or nutrients into Tucker Brook and Tighe Carmody reservoir during or after timber harvest work. This stand slopes moderately towards Tucker Brook. ATV and dirt bike uses, though prohibited, are heavy here leading to significant gulleying and erosion along the recent harvest skid road to Tucker Brook.

**Silviculture Status:** Suitable.

**Terrain/Topography:** This stand stretches westerly along the moderate lower slopes of the twin peak mountain from a wide, gently sloping to level plain above Tucker Brook. A large drainage from an upslope spring seep drains eastward across this stand. Water pools in a depression area in the central portion of the stand along the main access road. This road was constructed in 2010 for an oak harvest. Many smaller spur hauling roads traverse the stand.

**Soils:** Underlying this stand is the Charlton - Hollis - Rock Outcrop is a complex of undulating soils and rock outcrops on ridges and hills. About 40% of this soil is the deep well drained Charlton, 25% is shallow excessively drained Hollis, and 15% granite rock outcrops. The remaining 20% come from a variety of included soils. Productivity is variable based on the underlying soil, best on the Charlton soils and somewhat poor on the Hollis.

- **Timber Harvesting:** The Charlton soils in this complex are deep sandy loams easily worked by equipment. The Hollis soils are shallow and often associated with rock outcrops and should be avoided. Erosion control measures were installed along the new skid road system. Illegal post harvest use of this road is degrading the water bars, and erosion is beginning along the surface.

- **Water Quality:** Permeability of these soils is moderate to moderately rapid. The Charlton soils in this complex have a low runoff potential, while the Hollis soils component has a high runoff potential.

**Overstory:** The recent harvest reduced the upper canopy stocking to a sparse layer of maturing red oak, high quality timber crops, declining hemlock trees, and low value beech and red maple. The oaks are large with an average diameter over 22 inches. The quality of the red oak is very good, but more importantly these trees are healthy, wide, spreading crowns that reduce the impact of rainfall on the soils. The hemlock crops will be dead before the end of the ten-year operating period.

**Understory:** A sparse layer of poor quality red maple, black birch, yellow birch, and hemlock survive the intensive harvest operation.

- **Regeneration:** The reproductive response to the 2010 seed tree harvest was very successful. Over 2,000 seedlings per acre of red oak, (strong contribution), ash, black and yellow birch, red maple, aspen were counted in the inventory work. White oak, sugar maple, and hemlock cover the forest floor. These young trees range in height from six inches to six feet.
- **Native:** Full sunlight on the forest floor also encouraged a thick mat of ferns and herbaceous plants. Some of the species cited were Lycopodium, Solomon's seal, Indian cucumber, and sarsaparilla, Christmas fern, hay scented fern, spinulose fern, and sensitive and interrupted fern (in the moist depression). Thick native shrub clusters grow here also with witch-hazel, mountain laurel; striped maple, rubus, and dewberry are found here. Skunk cabbage and watercress in the moist areas were noted.
- **Non-native Invasive Growth:** None noted.
- **Interfering native plants:** Not applicable.

**Habitat:** A moose appears to be enjoying the hobblebush and striped maple in this stand. There was much evidence of moose browse throughout. Pileated and downy woodpeckers were seen, along with evidence of their residency in the holes in the dying hemlock trees. The dense seedling and shrub layer provides ideal habitat for nesting and breeding of interior forest songbirds and small mammals. A large volume of coarse and fine woody material (over 30% ground cover) supports insects and invertebrates. Many pockets of aspen seedling support grouse habitat, and they have the large downed logs for drumming. Red oak and beech produce mast crops each fall.

- **NHESP:** The BioMap 2 Project describes Tucker Brook as and its immediate surroundings as Aquatic Core habitat. The rest of the stand is classified partially as Aquatic Buffer, and completely as Forest Core, Critical Natural Landscape, and Core habitat, which indicates that this stand supports ecological resilience to climate change and other disturbances and increases local biodiversity.

- Habitat techniques: Not applicable.
- Risks: Not applicable.

**Fire Protection:** This stand is generally moist on the lower slopes o fire here is unlikely. Access for four-wheel drive vehicles is available by the harvest road system. Tucker Brook can provide water for fire suppression.

**Desired Future Condition:** The development of an all-aged, species rich, ecologically resilient watershed filtration forest is desirable in this stand. The previous forest manager for the watershed executed an even-aged method of regeneration, which was successful. The stand is deficient in the older age classes. Over time, the conversion to the ideal condition will naturally evolve here. This stand will be allowed to mature for three decades or more with the red oak timber crop on site. Monitoring of the stand periodically can assess the health of the older trees.

**Recommended Management Practices:** Not applicable.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	6.04	HH	22.80	9.4"	140	2.9 MBF 0.0 Pulp cds 17.0 Firewd cds	Hk 55 WP 63 RO 59	3.69

**Sub-Watershed:** Tucker Brook West

**Water Quality Concerns:** The goal for water quality protection is the prevention of any movement of sediment or nutrients into Tucker Brook and Tighe Carmody reservoir during or after timber harvest work. No silviculture treatment is suitable at any time in this area.

**Silviculture Status:** Not Suitable.

**Terrain/Topography:** The stand sits just below the highest of the twin peaks, and it stretches across a level spring seep field before dropping sharply to the east. The spring field bubbles through extensive small boulders and stones.

**Soils:** Underlying this stand is the Charlton - Hollis - Rock Outcrop is a complex of undulating soils and rock outcrops on ridges and hills. About 40% of this soil is the deep well drained Charlton, 25% is shallow excessively drained Hollis, and 15% granite rock outcrops. The remaining 20% come from a variety of included soils. Productivity is variable based on the underlying soil, best on the Charlton soils and somewhat poor on the Hollis.

- Timber Harvesting: Not applicable.
- Water Quality: The springs feed a major tributary of Tucker Brook. Water courses out of this rocky zone, and it cascades down the steep slope into the brook valley.

**Overstory:** A dense grove of immature hemlock (40% of the stocking), and black birch sawtimber (average size 12 to 17 inches) share the upper canopy with red oak, red maple, and beech small sawtimber sized trees. The quality of the red oak is fair to good. The adelgid and elongated scale

problems are prevalent in this stand; the trees exhibit more than 50% of needle discoloration and drop. Paper birch in the overstory and midstory is declining.

**Understory:** A moderately stocked layer of hemlock, red maple, black birch, beech, and red oak saplings and pole trees grow beneath the denser canopy. These trees are in poor condition with nectria in both the beech and black birch.

- **Regeneration:** Given the opportunity outside of the rock zone, northern red oak saplings and poles, yellow birch, black birch, and red maple will regenerate this stand. Scattered healthy seedlings were noted.
- **Native:** Ferns and moss were found in and around the rock and hummocks of the wetter areas of this stand inclusive of Christmas fern, lycopodium, daylily, and foamflower.
- **Non-native Invasive Growth:** None noted.
- **Interfering native plants:** Not applicable.

**Habitat:** Tracks of deer, moose, raccoon, and bear were observed around the spring seep and stream flow. This perennial discharge is a rare water source on the high slope. Thick blueberry shrubs produce a popular fruit with many wildlife species. Scattered large diameter, tall white pine trees offer roosting sites to raptors, which tend to fly along the higher slopes. The dense mountain laurel thickets provide nesting and breeding sites for songbirds and small mammals. Moose browsing in the striped maple and hobblebush was extensive.

- **NHESP:** The BioMap 2 Project describes Tucker Brook as and its immediate surroundings as Aquatic Core habitat. The rest of the stand is classified partially as Aquatic Buffer, and completely as Forest Core, Critical Natural Landscape, and Core habitat, which indicates that this stand supports ecological resilience to climate change and other disturbances and increases local biodiversity.
- **Habitat techniques:** Preservation of this stand in its current condition protects local biodiversity.
- **Risks:** Not applicable.

**Fire Protection:** Access into this area could be gained from an old four-wheel drive and cart road on the Montgomery side. Fire hazard was low now, and no evidence of recent fire was noted.

**Desired Future Condition:** This dense mixed wood cover protects the quality of the water from this rich upslope spring source. Protection of this important component within the water collection and transfer system on the Tighe Carmody Reservoir is recommended. The area is not accessible for silviculture work. The loss of the hemlock crops will impact its capacity to filter water, yet the hardwood seeding and saplings may replace the hemlock cover without any loss of functionality.

**Recommended Management Practices:** Not applicable.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	6.05	BM	116.9	10.9"	131	5.6 MBF 1.5 Pulp cds 12.1 Firewd cds	Hk 55 WP 63 RO 59	189.38

**Sub-watershed:** Tucker Brook West.

**Water Quality Concerns:** The goal for water quality protection is the prevention of any movement of sediment or nutrients into Tucker Brook and Tighe Carmody reservoir during or after timber harvest work. Several major streams collect and transfer water across this stand into Tucker Brook and the Tighe Carmody Reservoir. Disturbance to this site could directly affect the water quality downstream.

**Silviculture Status:** Suitable in sections.

**Terrain/Topography:** This stand stretches across a broad moderate slope with an eastern aspect. The terrain drops into the Tucker Brook basin, and the stand borders the brook at its eastern edge. Four spring fed stream drop quickly across this slope, and they cut ravine like channels with the velocity of their descent. Three of the streams converge before entering Tucker brook at its confluence with the reservoir.

**Soils:** Underlying this stand is the Charlton - Hollis - Rock Outcrop is a complex of undulating soils and rock outcrops on ridges and hills. About 40% of this soil is the deep well drained Charlton, 25% is shallow excessively drained Hollis, and 15% granite rock outcrops. The remaining 20% come from a variety of included soils. Productivity is variable based on the underlying soil, best on the Charlton soils and somewhat poor on the Hollis. The eastern edge of the stand lies above the Ridgebury soils derived from glacial till that are mostly level and poorly drained. A high water table restricts root growth, slowing tree growth. The moisture pools here from the stream flow.

- Timber Harvesting: Not applicable.
- Water Quality: Not applicable.

**Overstory:** The main canopy supports a densely stocked immature grove (14-18 inch diameter) red oak, black birch, and hemlock, beech, and red maple timber crops. The hemlock is in poor condition due to the woolly adelgid and elongate scale. The beech trees are severely infected with the beech bark complex. Some of the black birch and the red maple timber trees have good quality. The immature red oak has excellent quality and high value.

**Understory:**

- Regeneration: Regeneration is patchy across this stand (C rating on the metric) with all of the overstory species present.
- Native: The moist sites along the stream channels support dense herbaceous and fern growth inclusive of skunk cabbage, Christmas fern, maiden hair fern and a variety of wildflowers. The herbaceous layer is patchy through the rest of the stand. Native shrubs noted included striped maple, mountain laurel, witch-hazel, and hobblebush.
- Non-native Invasive Growth: None noted.
- Interfering native plants: Not applicable.

**Habitat:** Moose browse heavily on the hobblebush and striped maple on the lower slopes. Dead hemlock snag trees provide cavity trees, and the downfall dead hemlock litters the forest floor as woody debris habit for insects and invertebrates. Native grapes climb many of the dying hemlock and some of the tallest birch trees. Their annual fruit crops are enjoyed by birds and mammals.

- NHESP: The BioMap 2 Project describes Tucker Brook as and its immediate surroundings as Aquatic Core habitat. The rest of the stand is classified as Aquatic Buffer, Forest Core, Critical Natural Landscape, and Core habitat, which indicates that this stand supports ecological resilience to climate change and other disturbances and increases local biodiversity.
- Habitat techniques: Not applicable.
- Risks: Not applicable.

**Fire Protection:** This stand is generally moist so fire here is unlikely. Access would be difficult across the steep, rocky, and wet slopes for fire management. No evidence of recent fire was noted.

**Desired Future Condition:** The development of the all-aged, species-diverse, ecologically resilient watershed filtration and purification forest structure is desired in this stand. The stand exists in a two-aged condition now. The younger sage classes are not well developed, and the existing sapling and pole (with the exception of some black birch, yellow birch, and red oak) crops are of poor quality. The stocking densities of the hardwood overstory timber trees promote the optimal growth of these crops. Review of the site in 2025 will determine the feasibility of the application of a Selection Method Harvest for the further development of the ideal watershed forest conditions.



**Recommended Management Practices:** Not applicable.

**SUB-WATERSHED #7: WEST SHORE**

<b>Objective</b>	<b>Stand #</b>	<b>Forest Type</b>	<b>Stand Area (acres)</b>	<b>MSD or Size Class (inches)</b>	<b>Basal Area (sq.ft./ac)</b>	<b>Volume Per Acre</b>	<b>Site Index</b>	<b>DCR/FIA Growth Rate (MBF/yr.)</b>
Stewardship Green Cert.	7.01	OHK	158.30	12.5" Red Oak and Hk : 18 INCHES	100	4.4 MBF 0.5 Pulp cds 8 Firewd cds	61:EWP 60:NRO	25.64

**Sub-Watershed:** West Shore

**Water Quality Concerns:** The primary objective of any management work on these lands is the prevention of the loss of sediment and nutrients into the Tighe Carmody Reservoir and Manhan River watershed basin. Several spring seep fields originate in this area draining directly into the Tighe Carmody Reservoir. Any disturbance to this site will directly affect water quality in the watershed.

**Silviculture Status:** Suitable in very limited sections.

**Terrain/Topography:** The terrain in this stand is mostly moderate with intermittent level terraces. The land slopes toward Tighe Carmody Reservoir. The upper quarter of the stand is moderately steep and rocky.

**Soils:** The Charlton - Hollis - Rock Outcrop series supports the western portion of this stand. It is a complex of undulating soils and rock outcrops on ridges and hills. About 40% of this soil is the deep well drained Charlton, 25% is shallow excessively drained Hollis, and 15% granite rock outcrops. The remaining 20% come from a variety of included soils. Productivity is variable based on the underlying soil. Gloucester fine sandy loams support the lower elevation in the eastern portion, bordering the

reservoir. These are moderately steep and excessively drained and stony soils derived from glacial till. With a rapid permeability and low available water capacity, these are moderately productive soils to grow tree crops.

- **Timber Harvesting:** The variable nature and rocky outcrops of the Charlton - Hollis - Rock Outcrop series soils are a challenge to equipment. The Gloucester and Charlton soils are the deepest and easiest to work. The Hollis soils in this series are shallow and associated with the rocky outcrops. One main hauling road can cross the contour in the center of the stand, and it can avoid drainage crossings. Winter and its frozen ground logging is deal especially close to the drainage system, but the uplands and the major crossing could work dry and stable open ground.
- **Water Quality:** Overall, this is a moister site than the sandy nature of these soils suggests, with a number of spring seeps draining directly into Tighe Carmody Reservoir.

Corduroy pole installations along the spur roads will prevent damage to the moist depressions and protect the roadbed. Poled corduroy structures along the road prevent loss of the roadbed integrity.

**Overstory:** Black birch, red maple, dying hemlock, and sugar maple share the overstory. These hardwoods are in fair to good condition. Scattered individuals of northern red oak and basswood of good quality and condition share the overstory. White ash, paper birch, and hickory of good form and condition can be found in the midstory.

**Understory** A well-stocked layer of sapling and pole yellow birch, black birch, white ash, and red maple sapling and pole trees grow beneath the mature canopy. These trees are healthy with good form.

- **Regeneration:** Understory shrubs compete with potential regeneration leading to a B- on the simple metric. Red oak was not present in the seedling layer.
- **Native:** Dense thickets of mountain laurel and witch-hazel shrubs cover the forest floor. The healthy herbaceous plant layer includes starflower, Christmas fern, hay scented fern, interrupted fern, lady fern, maidenhair fern (two small sections mid-slope), Polypody fern (growing on the rocks and boulders of the upper slope), sensitive and bracken fern (moist soils near brook), and partridgeberry, Indian cucumber, sarsaparilla, wintergreen, starflowers, and one small patch of black cohosh near a sugar maple grove. The large rocks and boulders across the stand are covered with the elephant ear lichen, which produces an eerie beauty to the stones.
- **Non-native Invasive Growth:** No significant occurrence of non-natives invasive plants was noted. A few areas on the higher slope with bird activity grow scattered clumps or Japanese barberry and multiflora rose, but their spread seems to be contained by the native brush layer.
- **Interfering native plants:** The native shrubs, especially witch-hazel pose a threat to the reproductive stocking after a harvest without some reduction in their density. Grapes

were noted during the inventory. Grape is native species. It responds quickly to sunlight and can overtop desirable regeneration. It can shade or even break stems. Grape vines provide an important food source for many wildlife species. The soft mast of the grapes and the leaves and shoots are important food sources. The dense thickets produced by the vines provide nesting habitat and escape cover. A balance between reproduction and wildlife values must be considered.

**Habitat:** Oak acorns provide mast for wildlife and are abundant in the stand. The declining hemlock will provide some snags for wildlife use and current and future cavity trees. Pileated woodpeckers were at work on these stems during the field inventory. These trees are beginning to fall down on the forest floor, which increases the woody material for insects and invertebrates. Moose browse upon hobblebush, stripe maple, and red maple seedlings were prolific across the stand. Tracks and scat cover almost every acre. The male moose population has marked countless red maple poles and the larger striped maple stems with antler rubbings for territorial establishment. The remote location of this stand on the western shore side of the reservoir and its connectivity with the lands to the west create a forest landscape capable of use by the wide-ranging species.

- NHESP: The BioMap 2 Project defines this stand as Forest Core, Critical Natural Landscape, and Core habitat, and having some Aquatic Core habitat and Aquatic Buffer. This indicates that this stand supports ecological resilience to climate change and other disturbances and increases local biodiversity.
- Habitat techniques: 1. The release of the red oak crowns will increase the annual acorn crop. 2. Protection of the white pine cull trees and retention of a few of the larger dying hemlock secures current and future cavity trees. 3. The salvage removals of large portions of the hemlock crop will open the main canopy and increase the vertical stratification useful to songbirds in this stand and other foragers and browsers.
- Risks: Moose browsing is very heavy across this stand. It may prove difficult to regenerate the more desirable hardwoods such as sugar maple, red oak, and yellow and black birch with this damage.

**Fire Protection:** The reservoir itself and the interior brooks provide a water source for a four-wheel drive pumper truck in the event of a crisis. Improvement of the woods access road network during and after a silvicultural treatment will improve the access into these remote zones. No fire hazard exits at this time.

**Desired Future Condition:** The development and maintenance of the all-aged, species diverse, resilient natural filtration and purification watershed forest is the desired objective in this stand. The youngest age class in this stand is lacking. Silviculture work can introduce this age class on the forest floor and release the crowns of the residual red oak, yellow birch, and black birch crop trees for improved value and diameter growth. The Selection Method-Single Tree variant will be used here to introduce the youngest age class. A Salvage Harvest System will be simultaneously applied for the recovery of the

merchantable value in some of the hemlock crop and the declining white ash and paper birch timber. The hemlock removals will open larger gaps in the main canopy to accommodate the requirements for germination of a wide variety of seedling species.

**Recommended Management Practices:** 1. Application of the Selection Harvest System- Single Tree. 2. Salvage Harvest for the removal of the declining hemlock (about 80%), white ash, and the paper birch. 3. Disturbance of the witch-hazel shrub layer during the timber harvest and some additional brush cutting treatment post-harvest for full exposure of the mineral soils and seedbed preparation. 4. Treatment of the grape vines within the hardwood crowns post harvest.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	7.02	BM	114.50	12.7"	124	6.3 MBF 2.2 Pulp cds 9 Firewd cds	61:EWP 60:NRO	18.55

**Sub-Watershed:** West Shore

**Water Quality Concerns:** The primary objective of any management work on these lands is the prevention of the loss of sediment and nutrients into the Tighe Carmody Reservoir and Manhan River watershed basin. Any disturbance to the forest cover in this stand directly effects water quality in the Tighe Carmody Reservoir.

**Silviculture Status:** Suitable in sections.

**Terrain/Topography:** The terrain in this stand is mostly moderate with intermittent level terraces. The land slopes into Tighe Carmody Reservoir. Several spring seep fields originate in this area, and they drain directly into the Tighe Carmody Reservoir. These streams cut ravine like channels across the contour because of the vertical drop in the slope and the soils texture. The southwestern portion of this stand contains a shrub swamp that also drains directly into the Tighe Carmody Reservoir. Several old farm roads (the width of a cart) climb the slope away from the shoreline. More recent harvest roads (over 30 years ago) traverse the stand.

**Soils:** The Gloucester fine sandy loams support the northern two thirds of this stand. These are moderately steep and excessively drained and stony soils derived from glacial till. With a rapid permeability and low available water capacity, these are moderately productive soils to grow tree crops. The southern third is mostly Charlton - Hollis - Rock Outcrop series. It is a complex of undulating soils and rock outcrops on ridges and hills. About 40% of this soil is the deep well drained Charlton, 25% is shallow excessively drained Hollis, and 15% granite rock outcrops. The remaining 20% come from a variety of included soils. Productivity is variable based on the underlying soil.

- **Timber Harvesting:** The variable nature and rocky outcrops of the Charlton - Hollis - Rock Outcrop series soils are a challenge for harvesting equipment. The Gloucester and Charlton soils are the deepest and easiest to work. The Hollis soils in this series are shallow and associated with the rocky outcrops. The banks of the numerous stream channels are fragile and erodible due to the severe nature of recent storms and the velocity of run-off. One main hauling road can cross the contour in the center of the stand, and it can avoid drainage crossings. Winter and its frozen ground logging is ideal especially close to the drainage system, but the uplands and the major crossing could work dry and stable open ground.
- **Water Quality:** Overall, this is a moister site than the sandy nature of these soils suggests, with a number of spring seeps draining directly into Tighe Carmody Reservoir. Corduroy pole installations along the spur roads will prevent damage to the moist depressions and protect the roadbed. Poled corduroy structures along the road prevent loss of the roadbed integrity. Delineation of non-entry filter strips along each of these drainages and the demarcation of a 50'-filter along the western shore of the watershed will prevent any sediment movement into the reservoir. Erosion control measures will be implemented during and after any silviculture, work upslope of these filter zones.

**Overstory:** High value red oak, red maple, and black birch timber crops (diameter range 16 to 24 inches) share the upper canopy with declining hemlock, sugar maple, white ash, beech, and hickory. This stand is very similar to 7.01 without as much hemlock and the addition of the hickory crops. In fact, hemlock only contributes less than 9% of the total stocking versus 23% in Stand 7.01. The quality of this hardwood crop is very good. The hemlock component is dying quickly from the elongated scale and wooly adelgid attacks. Tall, majestic tulip poplar trees also dot the upper canopy.

**Understory:** A sparsely stocked layer of saplings and small pole trees grow beneath the main canopy. They have good form and vigorous crowns.

- **Regeneration:** Regeneration is limited by tangles of witch-hazel leading to a C rating on our metric.
- **Native:** The rich lower slope soils support a thick mat of ferns inclusive of Christmas fern, hay scented fern, spinulose, and cinnamon fern. Other native herbaceous plants here include starflower, Indian cucumber, and sarsaparilla.
- **Non-native Invasive Growth:** None noted.
- **Interfering native plants:** The dense tangles of witch-hazel impede regeneration. Native grapes climb in the tulip poplar, red maple, and declining hemlock in the southwestern section of the stand. They cover the host crown, and eventually kill these trees.

**Habitat:** A variety of bird species were seen and heard in this stand.

- NHESP: The NHESP BioMap 2 Project defines this stand as critical natural landscape, which indicates its capacity to support wide-ranging wildlife species and enhance local biodiversity. The western portion is considered Forest Core and Core Habitat.
- Habitat techniques: 1. Retention of some of the dying hemlock provide current and future cavity trees. 2. The application of the selection method will increase the vertical stratification across the stand, which attracts songbirds. 3. The release of the crowns of the red oak, beech, and hickory timber trees increases annual mast production. 4. The general improvement of the forest condition through silviculture correspondingly improves the quality of the habitat.
- Risks: Not applicable.

**Fire Protection:** There is acceptable four-wheel drive access from Southampton Road along the woods road and water available for the reservoir and river.

**Desired Future Condition:** The development and maintenance of the all-aged, species diverse, resilient natural filtration and purification watershed forest is the desired objective in this stand. The youngest age class in this stand is lacking. Silviculture work can introduce this age class on the forest floor and release the crowns of the residual red oak, yellow birch, and black birch crop trees for improved value and diameter growth. The Selection Method-Single Tree variant will be used here to introduce the youngest age class.

**Recommended Management Practices:** 1. Application of the Selection Method-Single Tree variant. 2. Disturbance during the harvest and possible post harvest treatment of the dense witch-hazel and ironwood layer of shade to open the forest floor and prepare an optimal seed bed.



Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	7.03	WP	13.4	13.0"	130	5.7 MBF 8 Firewd cds	55:EWP 60:NRO	2.17

**Sub-Watershed:** West Shore

**Water Quality Concerns:** The primary objective of any management work on these lands is the prevention of the loss of sediment and nutrients into the Tighe Carmody Reservoir and Manhan River watershed basin. Several spring seep fields originate in this area draining directly into the Tighe Carmody Reservoir.

**Silviculture Status:** Not suitable because of owner's objectives.

**Terrain/Topography:** The stand rests upon a gentle slope with an easterly aspect at the dam area on the western shore of the Tighe Carmody Reservoir.

**Soils:** The soils in this stand are a mix of Chatfield and Hollis varying but the proportion of the two and the steepness of the slope. Both the Chatfield and Hollis series consists of well-drained and somewhat excessively drained soils formed in glacial till. They are nearly level through very steep soils on glaciated plains, hills, and ridges. Chatfield soils are moderately deep to bedrock, and are more productive than the Hollis series. The Hollis series is shallow to bedrock. Both are extremely stony.

- Timber Harvesting: Not applicable.
- Water Quality: Preservation of this area as a unique pure pine habitat and forest ecotype prevents any disturbance to the forest soil.

**Overstory:** A fast-growing, vigorous, immature white pine grove grows upon this site. The quality of the timber crops is fair to good. The stems have small black knots and long timber section without defect on their main boles.

**Understory:** Maple, birch, ash, tulip poplar, and aspen sapling are growing in the small openings in the main canopy from downfall or attrition.

- **Regeneration:** Regeneration is sparse under the dense pine canopy.
- **Native:** There are some fern and saplings of maple leaver viburnum and sarsaparilla also growing in the small sunlit openings.
- **Non-native Invasive Growth:** Japanese barberry and multiflora rose are beginning to appear along the edges of this stand close to the end of Manhan Road and the dam. Their stocking level rates a B+ at this time. Retention of the dense overstory pine shade will prevent their spread into the interior of the pine grove.
- **Interfering native plants:** None noted.

**Habitat:** The dense cover of this pine grove adjacent to the wide pen landscape of the reservoir water and the brush site in Stand 7.05 provides perching, roosting, and feeding cover for small mammals, raptors, and several species of songbirds.

- **NHESP:** The NHESP BioMap 2 Project defines this stand as critical natural landscape, which indicates its capacity to support wide-ranging wildlife species and enhance local biodiversity.
- **Habitat techniques:** The preservation of this small pine grove in its current condition will protect its unique habitat value.
- **Risks:** Not applicable.

**Fire Protection:** no evidence of fire was noted in the inventory, nor did there seem to be fire hazard. There is acceptable four-wheel drive access from Manhan Road and the woods road into this area for fire control, and water is available from the reservoir and river.

**Desired Future Condition:** This small grove contributes one aggregate of the al-aged, species diverse, ecologically resilient watershed filtration forest. The small pine plantations that surround the reservoir are the last remnants of the pure pine ecotype. The HWW wishes to preserve this stand structure for the next ten-year operating period.

**Recommended Management Practices:** Not applicable.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	7.04	OH	55	11.1"	109	3.75 MBF 7.1 Pulp cds 7.8 Firewd cds	65:EWP 65:NRO	8.91

**Sub-Watershed:** West Shore

**Water Quality Concerns:** The primary objective of any management work on these lands is the prevention of the loss of sediment and nutrients into the Manhan River watershed basin. This stand is located below the dam and outlet flow for the Tighe Carmody Reservoir. Any disturbance to this site will not affect water quality in the reservoir.

**Silviculture Status:** Suitable.

**Terrain/Topography:** The terrain in this stand is moderate with intermittent level terraces. The land slopes toward the Manhan River. One small spring seep drains water into the outlet and Manhan River basin to the east. Access for management would be gained from the north along some old harvest roads with a landing location at Manhan Road near the dam.

**Soils:** The Charlton - Hollis - Rock Outcrop series and Chatfield-Hollis association supports the western portion of this stand. These are a complex of undulating soils and rock outcrops on ridges and hills. About 40% of this soil is the deep well drained Charlton, 25% is shallow excessively drained Hollis, and 15% granite rock outcrops. The remaining 20% come from a variety of included soils. Productivity is variable based on the underlying soil. Chatfield and Hollis soils occur in varying proportions related to the steepness of the slope. Both the Chatfield and Hollis series consists of well-drained and somewhat excessively drained soils formed in glacial till. They are nearly level through very steep soils on glaciated plains, hills, and ridges. Chatfield soils are moderately deep to bedrock, and are more productive than the Hollis series. The Hollis series is shallow to bedrock. Both are extremely stony. Hinckley loam sand supports the eastern most portion of the stand. This soils range from well drained to excessively drained and has rapid permeability and low available water capacity. It is moderately productive for tree crops.

- **Timber Harvesting:** The variable nature and rocky outcrops of the Charlton - Hollis - Rock Outcrop series soils are a challenge to equipment. The Charlton soils are the deepest and easiest to work. The Hollis soils in this series are shallow and associated with the rocky outcrops. Although the Hinckley soils are easy to work for harvest equipment, the location of the spring seep makes the engineering interesting in this area. Careful engineering will avoid these sites to protect soils structure
- **Water Quality:** Overall, this is a moister site than the sandy nature of these soils suggests, with a number of spring seeps draining into Tighe Carmody Reservoir. Harvest scheduling during frozen or very dry and stable ground conditions will protect the quality of the water as it moves through the seep drainages. Clear delineation of their paths and the construction of pole crossings will maintain the integrity of the channels so water moves unimpeded and soil is not lost.

**Overstory:** Northern red oak, black birch, along with red maple, and paper birch dominate the overstory. Scattered groves of the tall, statuesque tulip poplar trees dot the landscape. Other associated overstory hardwoods are white ash, hickory, and yellow birch are also found. There are two small pockets of hemlock timber trees in this stand; all of the hemlocks here are dying. The quality of the red oak timber crops (40% of the total stand stocking) is very good. Several (estimated one per acre) legacies, large sized, mature, high value white pine stems tower above the main canopy level.

**Understory:** A sparse layer of high quality black birch, yellow birch, ash, aspen, and paper birch (young enough to have good quality) grows beneath the main canopy.

- **Regeneration:** Regeneration is patchy, encouraged where light can reach the forest floor. There are a few northern red oak, yellow birch, and black birch saplings and poles in some locations. Chestnut seedlings were prolific.
- **Native:** This moist upland oak site supports a dense herbaceous and shrub layer. Species cited include witch-hazel, maple leaved viburnum, blueberry, hophornbeam, sarsaparilla, striped maple, hobblebush, and mountain laurel.
- **Non-native Invasive Growth:** The northeastern edge of the stand along the Manhan River basin is infiltrated with dense invasive plant growth. Species cited here include Japanese knotweed, Japanese barberry, glossy buckthorn, multiflora rose, and Asiatic bittersweet. The stocking density of these plants is an A level.
- **Interfering native plants:** A dense shrub layer of witch-hazel and mountain laurel inhibits seedling development.

**Habitat:** Red oak and hickory set abundant mast crops each fall. The seeds of the tulip trees (winged samaras) are eaten by several species of birds and squirrels. Some of their seed persist in their cones through the winter and are of special value for this reason.

- NHESP: The NHESP BioMap 2 Project defines this stand as critical natural landscape, which indicates its capacity to support wide-ranging wildlife species and enhance local biodiversity.
- Habitat techniques: 1. Retention of the large sized, over mature (>28 inches) red oak trees in the stand for denning and nesting sites. 2. Release of the crowns of the oak, hickory, and beech seed bearers will increase mast production. 3. Retention of the dying hemlock pockets provides cavity stems and future coarse woody debris.
- Risks: Not applicable.

**Fire Protection:** There is acceptable four-wheel drive access from Southampton Road along the woods road and water available from the reservoir and river.

**Desired Future Condition:** The development and maintenance of the all-aged, species diverse, resilient natural filtration and purification watershed forest is the desired objective in this stand. The youngest age class in this stand is lacking. Silviculture work can introduce this age class on the forest floor and release the crowns of the residual red oak, yellow birch, and black birch crop trees for improved value and diameter growth. The Selection Method-Single Tree variant will be used here to introduce the youngest age class. Salvage of the declining high value white ash stems is recommended for the recovery of their market value.

**Recommended Management Practices:** 1. Application of the Selection Method-Single Tree Variant. 2. Application of a Salvage Harvest for removal of the white ash timber crops. 3. Disturbance during the harvest and possible post harvest treatment of the dense witch-hazel and ironwood layer of shade to open the forest floor and prepare an optimal seed bed.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	7.05	BR-ESH	38.2	NA	NA	NA	NA	NA

**Sub-Watershed:** Wolf Hill

**Water Quality Concerns:** This stand lies below the dam site on Tighe Carmody Reservoir, and any disturbance in this area would not affect water quality in the reservoir.

**Silviculture Status:** Not suitable.

**Terrain/Topography:** The terrain drops sharply off the dam into a wide valley, which surrounds the old Manhan River bed. The current river channel runs narrow through a depression in eastern section of the stand. The river level ebbs and flows with storm events and the need to release water from the reservoir. Another stream seeps out of the base of the dam; the Manhan River converges with this drainage in a wide basing in the center of the stand. The terrain rises to the west out of this wide basin sweeping across a moderate slope to the western property bound.

**Soils:** Hinckley loamy sand mostly underlies the moderate slopes of this stand. This soils range from well drained to excessively drained and has rapid permeability and low available water capacity. It is moderately productive for tree crops.

- Timber Harvesting: Not applicable.
- Water Quality: Not applicable.

**Vegetation:** The overstory removal of a dying red pine plantation in 2010 opened this area. Scattered white pine timber and pole trees (less than six per acre) tower above the shrub and seedling layer. A dense cover of seedlings, saplings, and native shrubs quickly replaced the red pine. Native species cited here include witch-hazel, blueberry, dogwood, elderberry, sweet fern, steplebush, and mountain

laurel. A dense cover of herbaceous plants and ferns grows like a mat on the forest floor. Some of the species cited include cinnamon, sensitive, Christmas, interrupted, and a multitude of native wildflowers. The invasive non-native plants Japanese barberry, glossy buckthorn, multiflora rose, Japanese knotweed, and Asiatic bittersweet mix with the native plant community. Currently the balance between the two is in check, with the native plants containing their spread.

**Habitat:** Shrub and young forest habitats are important for shrubland birds; shrubland birds and game birds use shrub and young forest areas with or without open herbaceous areas. These habitats are also important for a variety of other wildlife such as butterflies and bees, black bear, deer, moose, rabbit, bobcat, frogs and others. Shrubland birds are important now because 22 of the 40 birds associated with shrubland habitats are undergoing significant population declines in eastern North America. Shrubland bird species locally found include warblers, ruffed grouse, and woodcock. Early-successional forest habitats are usually transitory or ephemeral because they change over time because of forest growth and succession. This means the community is dependent on repeated disturbances to create or maintain habitat. The current shrub like lower canopy layer once released and enhanced with a wider diversity of plant species and some section of herbaceous growth, might preclude the need for intensive maintenance of the habitat.

- NHESP: The NHESP BioMap 2 Project defines this stand as critical natural landscape, which indicates its capacity to support wide-ranging wildlife species and enhance local biodiversity.
- Habitat techniques: Preservation of this stand in its current condition will protect this valuable habitat niche.
- Risks: Not applicable.

**Fire Protection:** Access for fire management is easy into this stand from Manhan Road. The hazard of a fire emergency is low at this time, and no evidence of past fire was noted.

**Desired Future Condition:** The maintenance of an early successional habitat zone within the 2-115.2 acre forested watershed is desirable. The creation of new zones of this habitat refutes the argument for the development of an all aged, specie diverse, ecologically resilient ideal watershed filtration forest. This small are represents one aggregate of a forest stand less than ten years of age within the watershed forest.

**Recommended Management Practices:** Periodic maintenance of the early successional habit zone with brush cutting every seven to ten years.

**SUB-WATERSHED #8: WOLF HILL**

<b>Objective</b>	<b>Stand #</b>	<b>Forest Type</b>	<b>Stand Area (acres)</b>	<b>MSD or Size Class (inches)</b>	<b>Basal Area (sq.ft./ac)</b>	<b>Volume Per Acre</b>	<b>Site Index</b>	<b>DCR/FIA Growth Rate (MBF/yr.)</b>
Stewardship Green Cert.	8.01	OH	236.00	12.5"	120	4.850 MBF 2 Pulp cds 11.7 Firewd cds	60:EWP 56:NRO	38.23

**Sub-Watershed:** Wolf Hill

**Water Quality Concerns:** The goal for water quality protection on these watershed lands is the prevention of the movement of sediment and nutrients from the upland forests through the soils and streams into the Tighe Carmody Reservoir during or after any silviculture treatments in the forested watershed. This Sub-watershed perches upslope of the eastern shoreline of the reservoir.

**Silviculture Status:** Suitable.

**Terrain/Topography:** This stand weaves itself across the landscape in alignment with the Wolf Hill formation. The Wolf Hill formation is a series of five hills strung in a line with a north-south orientation, which parallels Fomer Road. Each small hilltop inches further away from Fomer Road, rises in elevation, and increases the pitch of their western slopes as the relief follows the north-south axis. The western slopes in the north are wide and broad with three low depressions that intersect with ground water breaking the slopes. Each of these low spots supports sapling, pole, or shrub wetlands.

The slopes in the sections of the stand south of the central swamp area (Stand 8.05) drop off the major Wolf Hill formation with pitches increasing from 15% to 45% with the southward progression. One unique peninsula-like land formation rests on the eastern shore. The inlet of the swamp (Stand 8.05) cuts this area off from the main stand. The lower slopes along the eastern shoreline are broken by numerous spring seeps that drain directly into the reservoir.



**Soils:** The soil regimes also weave themselves beneath this relief with a matrix of well-drained, sandy loams that decrease their fine material component and conversely increase their gravel and large sand content and surface stones with the southward progression. The whole matrix holds enough moisture for productive tree growth with the best growth rates upon the sites with the richer less fine loams. This discussion follows the north-south orientation. The Hinckley soils lie beneath the northern tip of the tract and hug the eastern shore southward to the edges of the interior swamp (Stand 8.05). These soils have the highest loam content with large sand granules. They percolate water downward quickly, and seedling mortality is a threat upon them. The northern section along Fomer Road grows above the Scituate very stony, fine sandy loams. Both of these soils surround a low depression underlain by the Ridgebury fine sandy loams. These soils have a hardpan layer, which restricts water movement into the deeper soils. They are saturated most of the year. A slice of Windsor fine sandy loams juts between the Scituate and Hinckley soils. These soils loose too much of their moisture, and their doughiness is not good for tree growth.

South of the central swamp (Stand 8.05), the soils shift to a complex of Charlton very stony, fine, sandy loams. These soils have larger gravel and sand composites mixed in their lower stratum. These soils hold water during the spring and early summer. This available water grows trees very well. Even as the slope pitch increases, enough loam sits above the rocks for productive tree growth. A small pocket of Sudbury fine, sandy loams sits on the edge of the reservoir. These soils do not have the stone component, and they grow trees very well. The stand grows timber crops well with possible high yields across a full rotation.

- **Timber Harvesting:** The soil matrix has minor limitations for road building and operability due to the stoniness in places, but it will provide a good foundation for access road building. The gravel and larger sands substratum transfers water efficiently from the upper slopes into the reservoir. The fine sands will compact with the pressure of equipment, which reduces available particles for displacement.
- **Water Quality:** Despite the soil's inherent ability to maintain its integrity through silviculture work, the entire stand lays immediately upslope of a primary drinking water supply. Harvest scheduling for frozen or dry and stable ground conditions will protect the soils structure and minimize sediment and nutrient loss. Installation of emergency erosion control measures during any timber harvest operations, and more permanent ones after the completion of a project are required for prevention of erosion.

**Overstory:** The composition of the overstory shifts along the north-south axis paralleling Fomer Road similar to the soil regimes. High value red oak, red maple, and black birch are the three consistent timber crops across the stand. These trees have good form, healthy crowns, and defect free lower boles. The associated species change with the southward progression. North of the central swamp, hickory shares the main canopy with minor contributions by paper birch, and other oaks. Minor contributions of

hemlock (less than 4% of total density) are more prevalent scattered through the upper canopy south of the central swamp.

White ash timber crops (average diameter 16 inches) are found in the northern tip and in the broad lower slope immediately southeast of the inlet and peninsula area. The white ash is experiencing environmental decline, while the paper birch is beginning to approach biological maturity and decline. Hemlock timber crops of all sizes and ages suffer attacks by the hemlock wooly adelgid and elongated hemlock scale. They are losing live needles quickly; many trees have only 30% live crown. Consistent small pockets of the mature white pine, which once grew prolifically through this old farm landscape, dot the upper strata in the central and southern sections of the stand.

**Understory:** The middle canopy supports a low to moderately stocked layer healthy, fast growing immature crop of black birch, yellow birch, sugar maple, red maple, and hickory sapling and pole trees. Scattered pockets of immature red oak and other mixed oak were also noted. Yet they were not common, in fact red oak is conspicuously missing from the younger age classes.

- **Regeneration:** Reproductive growth rates a B- or C grade along our simple metric. All of the overstory species were counted at certain location adjacent to the different parent trees. These seedlings look healthy. Hickory, white pine, and sugar maple seedlings were the most prolific nearby superior seed bearing stock. Chestnut seedlings were very consistent across the stand; they usually obtain a height of one foot before dying off.
- **Native:** These rich loams grow a high volume of biomass per acre. Lush mats of ferns and wildflowers cover the forest floor growing beneath a healthy shrub layer. Ferns noted include Christmas, hay scented (usually associated with the richer loams beneath sugar maple), interrupted, cinnamon, sensitive (near moist zones), spinulose, and maiden hair (mid-slope and moist). Blooming wildflowers include trillium, jack-in-the-pulpit, sarsaparilla, Solomon seal, golden Alexanders, wild columbine, starflower, foamflower, and Indian cucumber. Lycopodium also grew on the driest sites, which it shares with teaberry.

The native shrub layer is quite complex through this stand. Mountain laurel grows prolifically along the northern tip of the stand and in sections close to the northern shoreline. It pops back up in the lower layer of the peninsula formation. It is replaced through the majority of the stand by witch-hazel, which suppresses regeneration efforts with its umbrella like cover in various areas. Blueberry (high bush and low) is consistent across the stand with denser thickets on drier upslope areas. Other native shrubs follow the matrix behavior with dogwood, spicebush, and alder neat moist depressions and spring seeps, and in the drier sites beaked hazelnut, maple leaved viburnum, and musclewood. Poison ivy and grape were ubiquitous across the stand.

- **Non-native Invasive Growth:** The growth of these plants is concentrated in two areas: old settlement sites with sign of human activity and spring seep of wet depressions. Their densest begins at points on bird flight habits around water, dense native shrub thickets, and the edges of two vegetation tiers. The plants spread down the drainages moving with the water flows. One dense pocket is found in the low moist old farm site along the stonewall lined thoroughfare into from Fomer Road (close to the intersection of Delisle Road). The stocking density here is an A level on the simple metric. Plants here included Japanese barberry, multiflora rose, and glossy buckthorn. All of the other congregate around spring seep fed small wetland, which westward into the reservoir. The stocking densities rate B+ throughout these areas.
- **Interfering native plants:** Native grape vines climb into the main canopy in five major areas across the stand. These plants will strangle the tall trees in competition for sunlight. Witch-hazel thickets shade the forest floor beneath their dense thickets and prevent seed germination. These plants are prolific in all areas of the stand.

**Habitat:** Large tracts of forest ecosystems support a wide array of species from small mammals and songbirds to the larger wide-ranging species such as Moose. This discussion will focus on some of the obvious sign and habitat attributes unique in this stand. Moose sign was prolific through the stand with tracks, scat, and territorial markings. In the old settlement area along Fomer Road and in a small pocket close to the reservoir in the southern section, mature, large sized sugar maple trees with cavities and large sprawling crowns offer denning and nesting sites. The scattered white pine timber crops tower over the main canopy and provide perching and roosting opportunities for raptors, robins, morning doves, turkey, and small mammals. Many species (especially squirrels and chipmunks) relish the nuts of hickory. The seeds of ironwood and musclewood are eaten by songbirds and taken by small mammals. The dense herbaceous layer provides ground cover for foraging by of small mammals.

- **NHESP:** The NHESP BioMap2 project defines this stand as Critical Natural Landscape, which indicates its ability to support a variety of species inclusive of wide-ranging ones and its capacity for resilience to climate change other disturbances.
- **Habitat techniques:** The openings in the main canopy from the silviculture treatments will increase the vertical stratification useful to songbirds and enhance the local biodiversity. Retention of the hickory crop secures the steady mast supply. Release of the red oak crowns will increase acorn yields for feed each fall. Retention of at least one-half of the pine crops will protect the roosting sites in these tall trees. Retention of scattered pockets of pure aspen groves provide grouse habitat.
- **Risks:** Not applicable.

**Fire Protection:** This stand is accessible from Fomer road with a four-wheel drive pumper truck for fire management. Water is readily available in various sections. Fire hazard is not high with the upper soils moisture in some zones. No fire events have occurred across this area for decades.

**Desired Future Condition:** The development and maintenance of the all-aged, species diverse, resilient natural filtration and purification watershed forest is the desired objective in this stand. This stand has a two-aged structure now with the youngest age class deficient and stocking low in the middle age class. Red oak grows very well in these soils. It is desirable to attempt the introduction of the younger age classes inclusive of a high red oak seedling count through the application of the Selection Method and a combination of the Single Tree and Small Group (Upper size limit of 1/4<sup>th</sup> acre) variants. A Salvage Harvest System will be simultaneously applied for the recovery of the merchantable value in some of the hemlock crop and the declining white ash and paper birch timber.

**Recommended Management Practices:** 1. Application of the Selection Method Single Tree and Small Group Selection variants. 2. Simultaneous application of a Salvage Harvest to recover the possible financial loss of white ash and pep birch timber crops simultaneously. 3. Treatment of the invasive plants along the edges of the “hotspots.” 3. Treatment of the Grape vines in the productive timber growing sites. 4. Disturbance of the dense native witch-hazel thickets beneath the best seed producing red oak, red maple, white pine, black birch, and sugar maple.

**Special Stewardship Issues:** Some unique cultural historic sites were found in this stand. The thoroughfare off Fomer Road and its well preserve stonewall work was the site of a prosperous farm. Corral, foundations for a large house, a barn, and a root cellar, and an old well remain. This road runs west toward the reservoir and close to the shoreline, it parallels a spring fed stream. A foundation for both a sawmill with its wheelhouse for waterpower perch above this road on the stream. Several other cellar holes are scattered through the northern section of the stand. Fomer Road was once the center of Southampton and this evidence indicates its thriving industrial and agricultural community in the 1880’s.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	8.02	WH	79.50	11.9" WP: 21 inches	120	5.45 MBF 5 Pulp cds 4 Firewd cds	60:WP	12.88

**Sub-Watershed:** Wolf Hill

**Water Quality Concerns:** The goal for water quality protection on these watershed lands is the prevention of the movement of sediment and nutrients from the upland forests through the soils and streams into the Tighe Carmody Reservoir during or after any silviculture treatments in the forested watershed. All of the sections of this mixed pine hardwood stand perch along moderate to steep slopes directly on the eastern shore.

**Silviculture Status:** Suitable but not applicable from 2015 to 2025.

**Terrain/Topography:** Three smaller sections comprise this stand. The northern most section (8.02 a) wraps around the tip of the watershed on Fomer Road. The terrain is level in the south (extension of the old settlement area), and the land begins to slope to the west. The slopes are gradual initially close to Fomer Road, but the relief drops sharply as it drops closer to the reservoir. A first order stream, which originates in a upslope spring seep wetland, cuts bisects this section. The second section (8.02 b) lies along the narrow peninsula to the west of the central swamp. This area rests upon a knoll with moderate sloping sides. The third area (8.01 c) is at the southern point of the watershed adjacent to the dam and reservoir. The slope gently tapers into the reservoir here. A recently built harvest road cuts the contour in route to a log-landing site.

**Soils:** The northern section grows above Hinckley loamy sands. The Sudbury fine sandy loams lie beneath the peninsula. The stony Charlton soils support the southern area. All of these soils are fine sandy loams with increasingly more surface stone and gravel composition as the stand moves

southward. They range from well drained to excessively drain with rapid permeability and low available water capacity. They are moderately productive for tree crops

- Timber Harvesting: Not applicable.
- Water Quality: These soils have fine pore structure that moves water slowly and collects sediment and toxins before discharge to the ground water or stream flow. No silvicultural treatment will retain soil integrity on these fragile lower slopes.

**Overstory:** Mature, large sized white pine trees cap all of the sections with their statuesque crowns towering above the main canopy level to heights in excess of 80 feet. Brief summaries of the composition and condition of each subsection follow here. .8.02 a: The mature white pine trees (40% of stocking) shares the upper canopy with small diameter, high value red oak, black birch, white oak, and hemlock trees. Harvest work over 30 years created large gaps in the pine crowns. The quality of the pine timber crops is fair with many stems sprouting large black knots and small, asymmetrical crowns. Scattered large sized beech trees (disease resistant at this time) dot the main canopy.

8.02 b: The peninsula stand is naturally developing a rudimentary all-aged and species diverse structure. The maturing, large sized tall pine on this knoll suffers wind and storm damage, and many have blown down and opened gaps in the main canopy. High value red oak and declining hemlock grow just under the tall pine trees. They give a staggered upper canopy appearance to the stand.

8.02 c: The harvest in this area removed a large percentage of the older pine trees; the residual pine crops (less than 10% of the stocking) tower above a well-stocked mix of red oak, hemlock, black birch, and red maple small sawtimber crops. The red oak, red maple, and black birch have good form and quality. The hemlock trees are in serious decline.

**Understory:** All of the sub-sections of this stand support a sparsely stocked layer of black birch, yellow birch, red maple, red oak, ash, hemlock, and hickory sapling and pole trees. The immature birch and red oak trees consistently have good quality with the exception of the hemlocks.

- Regeneration: Dense patches of pine, red oak, black birch, and red maple seedlings filled the openings in sections 8.01 a and 8.02 b. Reproductive growth across the peninsula is limited. All of the overstory species are present in this healthy seedling class.
- Native: These xeric sites support the full mix of upland dry site herbaceous, fern, and shrub plants. Mountain laurel dominates the lower strata of the northern section, which provides excellent cover on the slope for soil stability. Chestnut seedlings sprout prolifically through all three areas, and they obtain heights of about one foot before dieback. Lady slipper orchards were found in the peninsula and the southern section.

Hay scented ferns grow in thick mats across the peninsula forest floor. Grapes climb into the tall white pine and dying hemlocks in the southern section, and witch-hazel shrub clusters are very dense in here.

- Non-native Invasive Growth: The small spring seep fed wetland straddling the northern tip off this stand and Stand 8.01 has filled with japans barberry and glossy buckthorn. These plants are contained to the wetland zone and the stream though section 8.02 a now. Retention of the full overstory shade should prevent their spread into the growing space. Only a few individual shrubs of Japanese barberry were noted in the peninsula. The invasive plants were not found in the southern area.
- Interfering native plants: Not applicable.

**Habitat:** The towering pine trees create a distinct vertical stratification in these areas conducive to use by songbirds. Turkeys, morning doves, robins, and small mammals roost and den in large pine trees. Several large “wolf” white pine trees line the swamp edge on the lower eastern slope of the peninsula. The provide excellent cavity trees; pileated woodpeckers use was already noted of these trees. Dense laurel cover is excellent feeding and breeding habitat for birds and small mammals. Low bush blueberry fruit, which is also present on the forest floor of the peninsula and southern sections, is enjoyed by many wildlife species. The oak and beech crops produce annul mast. The extensive shoreline provides an aquatic habitat.

- NHESP: The NHESP BioMap2 project defines this stand as Critical Natural Landscape, which indicates its ability to support a variety of species inclusive of wide-ranging ones and its capacity for resilience to climate change other disturbances.
- Habitat techniques: Preservation of this stand in its current condition will protect the habitat values.
- Risks: Not applicable.

**Fire Protection:** The reservoir provides a natural firebreak along the shoreline. Access for fire management is easy on both the southern and northern tips, but it will be difficult for the peninsula. The pine duff may pose a fire hazard, but no threat was noted at this time. Improvement of the post harvest woods roads into Stand 8.01 might allow four-wheel drive pumper access close to the stand.

**Desired Future Condition:** The long-term forest management objective for this stand is its conversion to a mature all-aged, species diverse, ecologically resilient watershed forest. The natural development of this condition is progressing slowly due to earlier harvest and attrition in the peninsula. The current stand stocking level across the stand supports optimal growth of the immature red oak, black birch, and yellow birch crop trees. The main canopy gaps open their crowns for full sunlight. Assessment of the

stand may indicate the need for the use of the Selection Method in the 2025 to 2035 operating period for the further development of the ideal watershed forest condition.

**Recommended Management Practices:** Not applicable.



Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	8.03	HH	59.70	12.0" Red oak: 17 inches WP: 22 inches	173	8.5 MBF 4.8 Pulp cds 8.9 Firewd cds	60:RO	9.67

**Sub-Watershed:** Wolf Hill

**Water Quality Concerns:** The goal for water quality protection on these watershed lands is the prevention of the movement of sediment and nutrients from the upland forests through the soils and streams into the Tighe Carmody Reservoir during or after any silviculture treatments in the forested watershed. The drainage system across this stand dumps water into the central swamp area, which holds water and pulls out sediment and nutrients before its water into the reservoir.

**Silviculture Status:** Suitable.

**Terrain/Topography:** This stand wraps itself around two small hilltop formations close to Fomer Road forming their western slopes before dropping into a wide natural depression adjacent to the central swamp. A spring field fills the soils in one section with water, which drains northwesterly across a moderate slope towards the swamp. A small shrub swamp perches on the eastern edge of the swamp in the northern tip of this stand.

**Soils:** Most of the stand grows above the deep well drained Charlton very stony, fine, sandy loams. These soils have a high moisture content and trees grow very well in them. Their surfaces are strewn with small stones and boulders. The soils in the depression and spring field have a perched seasonal water table in the spring, early summer, and fall.

- Timber Harvesting: The Charlton soils have very fine sand granules that do not dislodge easily under compaction of harvest equipment. The stones and boulders on the soil

surface make road construction difficult, and a deep snow cover would mitigate this issue. These lowland soils hold water from the upslope run-off on all sides.

- **Water Quality:** Their position of this stand upstream from the swamp area will reduce the risk of sediment transport into the reservoir. Over one-half work in the southern portion of Wolf Hill Subwatershed requires a wetland crossing in this stand for access. Pole structures and corduroying across this wetland area will protect the soil integrity. Winter harvest scheduling with its frozen ground conditions are necessary for successful harvesting. The pole corduroy must be placed into the roadbed before frozen ground conditions for successful hauling surface.

**Overstory:** A dense grove of hemlock, red oak, and aspen sawtimber trees share the upper canopy. The hemlock is suffering from both the elongated hemlock scale and the wooly adelgid, yet these trees are declining slower than the trees in other sections. The quality of the red oak and white pine timber crops is very good. Scattered overstory beech trees have severe nectria infections. Pignut hickory) less than 1% of the stocking poke their tall crowns into the highest canopy level with the white pine.

**Understory:** Hemlock saplings and pole trees dominate this lower strata with minor contributions by well-formed immature, vigorous black birch, yellow birch, and red oak trees. The young hemlock is in very poor condition.

- **Regeneration:** Reproductive growth is limited by the overstory shade; only hemlock and beech seedlings were noted.
- **Native:** The herbaceous plant layer is limited under the overstory shade. In small openings from a past trespass, harvest close to Fomer Road filled with dense thickets of witch-hazel. Dense mountain laurel grows along the steep slopes of the hilltops in the eastern portion of this stand. Some of the herbaceous plants and shrubs here include hobblebush, striped maple, starflower, teaberry, Christmas fern, wood fern, and lycopodium. Hydric shrubs such as illex, dogwood, and swamp pinks grow in the small wetland adjacent to the larger central swamp.
- **Non-native Invasive Growth:** Japanese barberry shrubs mix with the native shrubs in the swamp, and the line the narrow drainage channel exiting the spring seep field.
- **Interfering native plants:** The native grape vines climb into the white pine and the tallest hemlock in two small areas of this stand. The witch-hazel shrub clusters could exploit the open forest floor after a timber harvest.

**Habitat:** Dense hemlock groves offer ideal winter yards for resting and bedding for white tailed deer. The moose population uses this stand heavily; most striped maple and hobblebush stems were browsed just below the snow level this winter, and tracks cover every acre of the stand. Other tracks covering the stand included white tailed deer, raccoon, and fisher cat. The red oak and pignut hickory trees produce annual acorn crops. Aspen trees of all ages and sizes are very important to the grouse lifecycle.

- NHESP: The NHESP BioMap2 project defines this stand as Critical Natural Landscape, which indicates its ability to support a variety of species inclusive of wide-ranging ones and its capacity for resilience to climate change other disturbances.
- Habitat techniques: 1. Retention of aspen for preservation of the aspen habitat. 2. Retention of over 75% of the oak trees and all of the beeches and hickories will sustain the mast production. 3. The dying hemlock provides insect breeding sites and cavity trees. 4. Retention of 60% of the mature white pine trees across the stand preserves the perching and roosting sites for mammals, songbirds, and raptors.
- Risks: Not applicable
- .

**Fire Protection:** Access for fire management is easily gained into this stand along a series of illegal recreational trails off Fomer Road. The seasonally moist Charlton soils do not pose a fire hazard, and no evidence of fire damage was observed in the inventory.

**Desired Future Condition:** The long-term forest management objective for this stand is its conversion to a mature all-aged, species diverse, ecologically resilient watershed forest. This stand is missing the essential younger age classes necessary for the full development of the ideal watershed forest structure. The Single Tree selection harvest technique encourages the establishment seedlings of the shade tolerant species such as beech, yellow birch, hemlock, and red maple. The Salvage Harvest will recover some of the merchantable value in the dying hemlock crops.

**Recommended Management Practices:** 1. Application of the Selection Method Single Tree variant in combination with a Salvage Harvest of the hemlock crop. 2. Treatment of the grape vines after a timber harvest will remove their threat from the valuable white pine timber crop.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	8.04	OH	12.90	9.5"	120	1.0 MBF 1.6 Pulp cds 7.3 Firewd cds	60:RO	2.09

**Sub-Watershed:** Wolf Hill

**Water Quality Concerns:** The goal for water quality protection on these watershed lands is the prevention of the movement of sediment and nutrients from the upland forests through the soils and streams into the Tighe Carmody Reservoir during or after any silviculture treatments in the forested watershed. This stand sits upon twin knobs of stone and rock along Fomer Road near the bound. Water moves quickly off these slopes and collects in the hemlock grove (Stand 8.03) and swamp to the west.

**Silviculture Status:** Not suitable.

**Terrain/Topography:** This stand sits upon twin knobs of stone and rock along Fomer Road near the bound. The western slopes of these two hilltops drop sharply into the depression to the west. An illegal hiking trail passes between the two knobs with its origin on Fomer Road.

**Soils:** Charlton - Hollis - Rock Outcrop is a complex of undulating soils and rock outcrops on ridges and hills. About 40% of this soil is the deep well drained Charlton, 25% is shallow excessively drained Hollis, and 15% granite rock outcrops. The remaining 20% come from a variety of included soils. Productivity is variable based on the underlying soil.

- Timber Harvesting: Not applicable.
- Water Quality: Not applicable.

**Overstory:** Short, maturing red oak, white oak, white oak, chestnut oak, and scarlet oak small sized timber crops cover the small hilltops. These trees are older than the surrounding stand, as these knobs were not maintained as agriculture land as late as other sites. The trees have epicormic branches and many bole defects common in growth on these poor sites.

**Understory:** No true division of the middle and upper canopy exist, and the poor quality red maple, paper birch, and black birch saplings and pole trees hold almost the same canopy height.

- **Regeneration:** Reproductive growth is limited due to site conditions overstory shade and dense shrub competition. Seedlings of all of the oak species, red maple, and black birch seedlings managed to poke above the shrub layer in scattered patches.
- **Native:** Dense mountain laurel and low bush blueberry thickets cover these hilltops.
- **Non-native Invasive Growth:** A recreational trail runs the low spot between the two knolls. Japanese barberry plants are springing up along this trail. Their stocking density is low at this point (B- or C on the simple metric)
- **Interfering native plants:** Not applicable.

**Habitat:** The dense blueberry plants prolific in this small habitat niche provide one of the best fruit sources for many wildlife species. Songbirds nest in the lower branches of mountain laurel, which they use as cover for feeding and breeding. Both red oak and the white oak group assure a continual supply of acorns every year without the fluctuation consistent with red oak mast production. Despite the usual habitat demands of moose, sign of its use of this small niche was noted with brows, scat, and tracks.

- **NHESP:** The NHESP BioMap2 project defines this stand as Critical Natural Landscape, which indicates its ability to support a variety of species inclusive of wide-ranging ones and its capacity for resilience to climate change other disturbances.
- **Habitat techniques:** Preservation of this unique oak habitat in its current condition increases the local biodiversity and protects this valuable habitat value along Fomer Road.

**Fire Protection:** This stand is easily accessible from Fomer Road for fire management. No fire hazard was observed during the field inventory.

**Desired Future Condition:** Mixed oak habitats produce valuable mast crops for local wildlife population, and offer nesting sites for the scarlet tanager. The dense oak and shrub cover on these steep slopes anchor the soils directly above a small stream site. In the context of the 2,384.9-acre Tighe Carmody watershed, this site can be viewed as a single age group, thus the stand contributes to the all-aged, species diverse ecologically resilient ideal watershed filtration forest structure.

**Recommended Management Practices:** Not applicable.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	8.05	RM	24.7	9"	<45	<3 cords	50:RM	4.0

**Sub-Watershed:** Wolf Hill

**Water Quality Concerns:** Water moves slowly through this swamp from the upland forest regions. Impurities are pulled from the water in transit, and the slow passage allows particle matter to settle into the muck. This is an ideal barrier of defense for water collected upstream from the silviculturally suitable forest stands. Shallow standing water covered the ground during the early spring inventory.

**Silviculture Status:** Not suitable.

**Terrain/Topography:** The base of this stand sinks beneath the general relief into a depression filling with run-off and spring seep water.

**Soils:** The Scarboro Muck soils underlie this plain. These soils are deep, nearly level, and very poorly drained. They consist of black decomposed organic matter over rich, mineral sands. Water moves slowly through the organic matter, and the water table is at or near the surface for most of the year. Soil moisture restricts tree root development and causes seedling mortality except for water tolerant species. Trees grow very slowly on this moist plain.

- Timber Harvesting: Not applicable.
- Water Quality: Particle matter, sediments, nutrients, and toxins steel into the muck bottom of this swamp before the water enters Tighe Carmody Reservoir.

**Vegetation:** A dense red maple, white ash, aspen, elm, and yellow birch pole stand grows on the land portions of this swamp area. Beneath these trees dense sensitive fern, bracken fern, cinnamon fern, and royal fern, and maidenhair fern form a thick mat broken only be wetland herbaceous plants such as flag iris, marsh marigold, and arrowhead. Wetland shrubs inclusive of red alder, illex, and spicebush were

also present. A few scattered shrubs of Japanese barberry and multiflora rose were struggling to survive on this wet site. The small trees grew on moist hummocks with wetland grasses between them.

**Habitat:** These forested wetlands are home to an array of wildlife. The damp soils create rich insect and amphibian breeding habitat, and these species in turn become prey for birds such as wood duck and barred owl, and mammals such as raccoon and mink, or reptiles such as green frog and wood turtle. Research into the Connecticut River valley bird migration patterns found that spring flooding thaws these forest soils earlier than surrounding areas thus making insects available as food earlier to birds.

- NHESP: The NHESP BioMap2 project defines this stand as Critical Natural Landscape, which indicates its ability to support a variety of species inclusive of wide-ranging ones and its capacity for resilience to climate change other disturbances.
- Habitat techniques: Preservation of this forested wetland habitat in its current condition increases the local biodiversity.

**Fire Protection:** Fire hazard is negligible in this wet site. Access is not important for fire management.

**Desired Future Condition:** The local moose population uses this site for feeding and watering. These forested wetlands are important to migrating songbirds for water, feed, and early season breeding by some species like the Canada warbler and Eastern Pewee. Preservation of the stand in its current condition protects biodiversity and protects its crucial filtration and purification function of water in transit from the upper-forested slopes.

**Recommended Management Practices:** Not applicable

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	8.06	OH	29.00	13.6"	100	4.3 MBF 0.0 Pulp cds 5.6 Firewd cds	60:RO	4.70

**Sub-Watershed:** Wolf Hill

**Water Quality Concerns:** The goal for water quality protection on these watershed lands is the prevention of the movement of sediment and nutrients from the upland forests through the soils and streams into the Tighe Carmody Reservoir during or after any silviculture treatments in the forested watershed. This stand is remote from the waters that moves into Tighe Carmody Reservoir

**Silviculture Status:** Not suitable.

**Terrain/Topography:** This stand rests upon the broad southern slope and within the hilltop depression of the prominent peak of the Wolf Hill formation. A large spring fed shrub swamp lies at the southern edge of this stand due east of Stand 8.08.

**Soils:** The deep, well drained Charlton fine sandy loams lay beneath this hilltop. These soils have gravel composites and some variable layers of hardpan, which traps the water table near the surface in some areas. Large stones and boulders cover the soil surface in patches.

- Timber Harvesting: Not applicable.
- Water Quality: Water moves west down the broad slope into the forests, which provide a good natural filter for any sediment lost off the dry hilltop from severe storm events. The major spring seep fed drainage system drains to the east away from the reservoir out of this stand.

**Overstory:** Some of the oldest red oak crops were found in this special site. They have an average range age of 190 to 225 years. The stand was harvested over 30 years ago with other areas on the Wolf Hill



Sub-watershed. A very sparse mix shagbark hickory, red maple, black birch, scarlet oak and chestnut oak share the overstory. The quality of the red oak is very good; these mature stems have clean boles and wide, spreading crowns. The higher slope birch and maple do not grow so well on the Charlton soils.

**Understory:** No true canopy layer was noted beneath the main canopy height of about 50 to 60 feet.

- **Regeneration:** Reproductive growth was patchy across the stand. Nay red maple, black birch, and mixed oak seedlings thrive in the small openings. Seedlings in other areas could not break through the dense shrub layer.
- **Native:** The usual xeric site ferns and herbaceous plants common across the watershed were observed in this stand. A short species list includes Indian cucumber, Christmas fern, cinnamon fern, Polypody fern on the larger rocks, lycopodium (three varieties), teaberry, partridgeberry, starflower, sweet fern, hay scented fern, Solomon seal, mayflower, foamflower, and trillium. Dense shrub cover was prolific inclusive of high and low bush blueberry (20% of total cover), striped maple, and maple leaved viburnums, beaked hazelnut, and hobblebush. Mountains laurel thickets were scattered but very dense, almost impenetrable on foot. They surrounded the small shrub swamp on the southern edge. The shrub swamp supports illex, spicebush, a few alders, and gray dogwood.
- **Non-native Invasive Growth:** The area directly north of Stand 8.08 broadens out into a spring seep fed wetland and the shrub swamp. This area is inundated with all of the common invasive plans inclusive of glossy buckthorn, Japanese barberry, multi flora rose, winged euyonomous, Asiatic bittersweet, and Asiatic grape. Japanese barberry, glossy buckthorn, and multi flora rose had the highest stocking levels (A on the simple metric). These plants surround the small wetland and spread deeper into the main oak grove in all directions. Since the overstory shade will not be reduced, these plants will be contained in this hilltop niche without any threat to the productive timber growing sited down slope.
- **Interfering native plants:** Not applicable.

**Habitat:** This hilltop stand is a treasure trove of biodiversity and a valuable high slope habitat. Two small native low bush cranberry bogs rest deep within the depression. They are perennially filled with water. Native cranberry is so rare that many wildlife species are not used to it in their diet, but songbird activity was high around these bogs. Several small vernal pool is found in this area. The vernal pools serve as essential breeding habitat species of wildlife, including salamanders and frogs (amphibians). Juvenile and adult amphibians associated with vernal pools provide an important food source for small carnivores as well as large game species. The oak crops set annual mast crops for wildlife feed; and the host of fruiting shrubs produces palatable fruit each season. Scattered, tall white pine timber sized trees tower above this rich habitat area, and they provide roosting, perching, and denning sites.

- NHESP: The NHESP BioMap2 project defines this stand as Critical Natural Landscape, which indicates its ability to support a variety of species inclusive of wide-ranging ones and its capacity for resilience to climate change other disturbances.
- Habitat techniques: This small hilltop zone contributes an incredible rich biodiversity component. It will be preserved in its current condition for the protection of local biodiversity.
- Risks: Not applicable.

**Fire Protection:** Access into this area would be difficult for fire protection; it could be gained from an old logging, which enters the Wolf Hill Sanctuary to the north with a four-wheel drive pumper truck. The seasonally high water table across this stand does not pose a fire hazard at this time.

**Desired Future Condition:** This area will be preserved as a biodiversity and wildlife sanctuary zone.

**Recommended Management Practices:** Not applicable.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	8.07	BB	5.10	14.4"	160	12.8 MBF 0.0 Pulp cds 6.2 Firewd cds	60:WA 65:WP	0.8262

**Sub-Watershed:** Wolf Hill

**Water Quality Concerns:** The stream which drains east from the small shrub swamp and spring fed wetland in Stand 8.06 crosses this stand. This drainage does not empty into the Tighe Carmody Reservoir watershed. The stand is remote from the significant hydrological processes for the collection and filtration of water across the watershed.

**Silviculture Status:** Not suitable.

**Terrain/Topography:** This small stand sits on the lower slope of the prominent hilltop of the Wolf Hill formation. Water collects on this low area.

**Soils:** The deep, well drained Charlton fine sandy loams lay beneath this hilltop. These soils have gravel composites and some variable layers of hardpan, which traps the water table near the surface in some areas. Small stones dot the soil surface in patches. The ground is moist and spongy here. These soils grow timber crops fairly well.

- Timber Harvesting: Not applicable.
- Water Quality: The site is remote from the significant hydrological processes down slope on the Tighe Carmody watershed.

**Overstory:** The main canopy supports an uncommon, true northern hardwood grove of sugar maple, red maple, yellow birch, white ash, and beech, basswood, and black birch small sized timber crops. A few scattered red oak trees mix amongst this layer. The quality of the hardwood timber is very good. The white ash trees are in decline form environmental damage.

**Understory:** The middle canopy layer is sparse with pole sized red maple, sugar maple, black and yellow birch, and white ash. These immature trees have excellent form and quality.

- Regeneration: Reproductive growth is low due to overstory shade and the dense fern growth on the forest floor.
- Native: Hobblebush and striped maple are the common shrub species on the forest floor. Dense hay scented, Christmas, interrupted, cinnamon ferns covers the ground, and their roots mats prevent seed ling development.
- Non-native Invasive Growth: Japanese barberry is beginning to infiltrate the western edges of this stand along the watercourse.
- Interfering native plants: Not applicable.

**Habitat:** Rich northern hardwood sites like this offer a diversity of habitats for many animal species, from wide-ranging mammals such as moose, bobcat, black bear, and fisher to forest that is denizens that are more diminutive. Among the amphibians are eastern red-backed salamander, spotted salamander, eastern newt, wood frog, northern two-lined salamander, dusky salamander, and spring salamander. Breeding bird surveys have documented that more than 40 bird species use these forests for summer nesting habitat, including some spectacular long-distance migrants such as scarlet tanager, black and white warbler, and rose-breasted grosbeak. Some invertebrates – such as land snails and millipedes – may be especially abundant in these forests due to the calcium-rich soil.

- NHESP: The NHESP BioMap2 project defines this stand as Critical Natural Landscape, which indicates its ability to support a variety of species inclusive of wide-ranging ones and its capacity for resilience to climate change other disturbances.
- Habitat techniques: Preservation of the stand in its current condition will protect this unique ecotype amongst the oak transition woods.
- Risks: Not applicable.

**Fire Protection:** Access into this area would be difficult for fire protection; it could be gained from an old logging, which enters the Wolf Hill Sanctuary to the north with a four-wheel drive pumper truck. The seasonally high water table across this stand does not pose a fire hazard at this time.

**Desired Future Condition:** Preservation of the stand in its current condition will protect this unique ecotype amongst the oak transition woods. This area represents one small even aged aggregate of valuable northern hardwoods within the all-aged, species diverse, ecologically resilient ideal watershed filtration forest.

**Recommended Management Practices:** Not applicable.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	8.08	BB	5.00	11.3"	120	1.750 MBF 0.0 Pulp cds 11 Firewd cds	60:RO	0.81

**Sub-Watershed:** Wolf Hill

**Water Quality Concerns:** The goal for water quality protection on these watershed lands is the prevention of the movement of sediment and nutrients from the upland forests through the soils and streams into the Tighe Carmody Reservoir during or after any silviculture treatments in the forested watershed.

**Silviculture Status:** Not suitable.

**Terrain/Topography:** This stand rests within the wide depression (which also includes Stand 8.06 to the north) on the broad top plain of the prominent hilltop on the Wolf Hill formation. The terrain is gently sloping to the west.

**Soils:** The deep, well drained Charlton fine sandy loams lay beneath this hilltop. These soils have gravel composites and some variable layers of hardpan, which traps the water table near the surface in some areas. These soils grow timber crops fairly well. The stone throughout these soils were picked out in the 18800's and placed into the extensive stonewalls around the stand.

- Timber Harvesting: Not applicable.
- Water Quality: Although the water, collected and transported out of these soils, moves west down slope towards the Tighe Carmody Reservoir; the slope length and continuous forest cover filter any impurities that the water might carry.

**Overstory:** This area is another unique niche. An old farmhouse foundation (chimney stones still intact), barn foundation, root cellar foundation, and corral and roadside well built stonewalls indicate extensive agricultural use of the Wolf Hill area. The corrals and walls suggest overuse of the site and nutrient

stripping. It has taken decades for the forest to recover. The immature northern hardwood grove growing here has an average age of 55 to 70 years. The main canopy height ranges from 35 to 50 feet. Species growing here include black cherry, white ash, red maple, sugar maple, yellow birch, and black birch. These immature trees are healthy and well formed.

**Understory:** Discussed above.

- **Regeneration:** Red maple, sugar maple, and black birch seedlings were prolific along the edges of the stand where the sunlight is more intense.
- **Native:** The herbaceous and fern layer are sparse with dominance by Christmas fern and hay scented fern. Witch-hazel, maple leaved viburnums, and the small tree sassafras were common on the forest floor.
- **Non-native Invasive Growth:** Individual Japanese barberry shrubs grow amongst the ferns and shrubs across the stand. Their stocking level is a B+ on the simple metric. The cellar holes are inundated with Japanese barberry and multiflora rose (A rating). Their removal would restore the native natural heritage and plant communities to this old farm site. They are not interfering with the productive oak and hardwood timber production sites to the south. Retention of the overstory shade could contain them to this small niche. The City will conduct a cost analysis of treatment cost and the intrinsic values of native community restoration in this remote old settlement.
- **Interfering native plants:** Not applicable.

**Habitat:** The discussion about the habitat value of northern hardwood for Stand 8.07 applies within this group. A few large diameter sugar maple “wolf” trees offer cavities for nesting and denning. One tall white pine tree towered above the center of this stand. An owl called continuously during the inventory from this tree. Sign of the local moose population was not missing here. Moose browsing of the striped maple and maple leaved viburnum was prolific.

- **NHESP:** The NHESP BioMap2 project defines this stand as Critical Natural Landscape, which indicates its ability to support a variety of species inclusive of wide-ranging ones and its capacity for resilience to climate change other disturbances
- **Habitat techniques:** Preservation of this immature hardwood grove in its current condition will retain the overstory shade and minimize the spread of the non-native plants down slope into the more valuable native habitat sites.
- **Risks:** Not applicable.

**Fire Protection:** Access into this area would be difficult for fire protection; it could be gained from an old logging, which enters the Wolf Hill Sanctuary to the north with a four-wheel drive pumper truck. The seasonally high water table across this stand does not pose a fire hazard at this time.

**Desired Future Condition:** The immature hardwood grove represents a one aged (55 to70 years) aggregate within the all-aged, species diverse, ecologically resistant ideal watershed filtration forest. Regeneration in this area is not a concern at this time. The immature hardwoods will continue their development into a valuable hardwood timber crop.

**Recommended Management Practices:** Not applicable.

**Special Stewardship Issue:** The old farm settlement is an important cultural history artifact for the Town of Southampton. A popular hiking trail crosses through this area.



Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	8.09	HH	28.6	12.6"	124	7.4 MBF 0.0 Pulp cds 9.4 Firewd cds	65:WA 60:WP	4.63

**Sub-Watershed:** Wolf Hill

**Water Quality Concerns:** The goal for water quality protection on these watershed lands is the prevention of the movement of sediment and nutrients from the upland forests through the soils and streams into the Tighe Carmody Reservoir during or after any silviculture treatments in the forested watershed. This stand lies on the lower slope along the eastern shore of the reservoir.

**Silviculture Status:** Suitable.

**Terrain/Topography:** This stand spreads across the broad, gentle lower slopes of the Wolf Hill formation. A large spring seep source drains water into two drainage patterns along the northern edge of the stand. This stand is the northern extent of the zone of operability for access from the south along Manhan Road.

**Soils:** The Charlton series consists of very deep, well-drained loamy soils formed in till. They are nearly level to very steep soils on till plains and hills. Well drained, these soils are moderately productive for tree crops.

- **Timber Harvesting:** These loams collect water from the upper slope, and they discharge it slowly through the gravel substratum for collection in into the reservoir. This seasonally high water table and the extensive stone make it difficult to work on this soil. Some old harvest roads from over 50 years ago left deep ruts in the loams. These are erodible soils. A winter harvest schedule with frozen ground conditions is required for work in this stand.
- **Water Quality:** Perched on the eastern edge, management activity in the stand could impact water quality. Post-harvest stabilization and emergency stabilization measures

during storm events, even in the winter, while the harvest is ongoing will be necessary to prevent any sediment movement across the slope.

**Overstory:** An immature grove (average age range 90 to 120 years) of hemlock, red oak, black birch, sugar maple, and white ash small sawtimber crops fills the upper canopy. The quality of the oak, black birch and sugar maple trees is very good. The hemlock crop is in decline from elongated hemlock scale and wooly adelgid attack. The white ash crop suffers environmental damage, and most crowns have over 60% dead branches.

**Understory:** A sparse stocking of immature well-formed, potentially valuable black birch, sugar maple, and hickory large saplings and pole trees share this strata with red maple and hemlock of poor condition.

- **Regeneration:** reproductive growth is low due to the overstory shade; only beech and hemlock seedlings covered the whole stand. Dense thickets of sugar maple seedlings (less than 6 inches in height) surround each large diameter sugar maple trees. These young trees do not survive to reach the sapling stage.
- **Native:** Herbaceous growth was moderate with many of the same species ubiquitous across Wolf Hill. One species of note here was black cohosh, which usually grows on sugar maple sites. Dense Christmas fern pockets also were found on the forest floor.
- **Non-native Invasive Growth:** Japanese barberry and glossy buckthorn are spreading into the spring seep zone and its stream flow from the dense invasive hotspot to the north in Stand 8.01.
- **Interfering native plants:** The invasive plants could exploit the growing space after a timber harvest with more sunlit openings.

**Habitat:** One small dense pure hemlock grove in the center of this stand provides ideal winter yarding habitat for white tail deer. Sassafras trees and seedlings were thick in one small section. Flycatchers and turkey enjoy the small fruit of this tree, and the twigs are browsed by bear and deer. The large diameter sugar maple trees within a small sugar bush (arch stones still on the ground) has large cavities for denning and nesting.

- **NHESP:** The NHESP BioMap2 project defines this stand as Critical Natural Landscape, which indicates its ability to support a variety of species inclusive of wide-ranging ones and its capacity for resilience to climate change other disturbances.
- **Habitat techniques:** 1. The release of the red oak crowns will increase the annual acorn crop. 2. The salvage removals of portions of the hemlock crop will open the main canopy and increase the vertical stratification useful to songbirds in this stand and other foragers and browsers. 3. Retention of the mature sugar maple cavity trees.
- **Risks:** Not applicable.

**Fire Protection:** Access into this stand for fire management will be difficult from Manhan Road. The reservoir provides a natural firebreak to the west. The seasonally high table in the Charlton soils reduces the fire hazard. No threat from fire was evident during the inventory.

**Desired Future Condition:** The long-term forest management objective for this stand is its conversion to a mature all-aged, species diverse, ecologically resilient watershed forest. This stand is missing the essential younger age classes necessary for the full development of the ideal watershed forest structure. The Single Tree selection harvest technique encourages the establishment seedlings of the shade tolerant species such as beech, yellow birch, hemlock, and red maple. The Salvage Harvest will recover some of the merchantable value in the dying hemlock crops.

**Recommended Management Practices:** 1. Application of the Selection Method –Single Tree Variant and a Salvage Harvest. 2. Treatment of the invasive plants along the northern edge of the stand prior to any timber harvesting.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	8.10	HH	49.00	13.2"	95	1.6 MBF 1.7 Pulp cds 10.7 Firewd cds	60:RO 55:SM	7.94

**Sub-Watershed:** Wolf Hill

**Water Quality Concerns:** This stand grows on the eastern flank of the Wolf Hill formation upon a moderately steep slope. Water that moves across this stand drains eastward outside of the Tighe Carmody watershed.

**Silviculture Status:** Not suitable.

**Terrain/Topography:** This stand grows on the eastern flank of the Wolf Hill formation upon a moderately steep slope. The spring fed wetland, which drains from the small shrub swamp in Stand 8.06 drains southward across this stand in a wide, moist plain.

**Soils:** The Sudbury soils underlying this stand are nearly level to gently sloping soil and moderately well drained. Permeability and available water capacity are moderate; however, the high water table restricts root growth. The eastern lobe of this stand is supported by Charlton fine sandy loam. The Charlton series consists of very deep, well-drained loamy soils formed in till. They are nearly level to very steep soils on till plains and hills. Well drained these soils are moderately productive for tree crops.

- Timber Harvesting: Not applicable.
- Water Quality: The stand is remote from the significant hydrological processes on the western flank of Wolf Hill, and disturbance here is not capable of an impact on the Tighe Carmody watershed.

**Overstory:** One third of this area was harvested heavily within the last ten years. This work was an illegal trespass from the lands to the east, which is now owned by the Wolf Hill Wildlife Sanctuary. The largest hemlock crop trees were taken from this site. The main canopy throughout the rest of the stand supports small sized hemlock, red maple, hickory, red oak, red maple, and black birch timber crops. The quality of the hardwood timber trees is fair to good. The hemlock crop is declining rapidly in this area. Many trees have only 25% of their live needles.

**Understory:** The middle canopy layer is well stocked with immature red maple, black birch, hickory and hemlock saplings, and pole stems. The young hemlock is dying, and the hardwood trees have good form and vigorous crowns.

- **Regeneration:** Reproductive stocking is high in the new openings on the forest floor from both the illegal harvest and the dead hemlock. The maple, oak, birch, and hickory seedlings are healthy.
- **Native:** Shrubs growth is moderate overall with dominance by witch-hazel and dense thickets of mountain laurel (A level rating). Mountain laurel covers one small area on the northern property bound.
- **Non-native Invasive Growth:** Japanese barberry weaves itself through the lower strata, and exploits any available growing space. Dense shrub clusters follow the small stream flow. Individual glossy buckthorn and multiflora rose plants also dot the forest floor.
- **Interfering native plants:** Not applicable.

**Habitat:** Two large raptor nests were noted in the high hemlock canopy. Pileated woodpeckers are working on the declining and dead hemlock stems. Dense mountain laurel offers cover for nesting and breeding songbirds.

The oak and hickory trees set maple mast each season. The vertical stratification with the maturing residual hemlock and the low shrub layer provides useful cover for songbirds and increases local biodiversity.

- **NHESP:** The NHESP BioMap2 project defines this stand as Critical Natural Landscape, which indicates its ability to support a variety of species inclusive of wide-ranging ones and its capacity for resilience to climate change other disturbances
- **Habitat techniques:** This area is a part of the Wolf Hill habitat protection zone on the watershed. Preservation of the stand in its current condition protects the unique habitat zone.

**Fire Protection:** Access into this area would be difficult for fire protection; it could be gained from an old logging, which enters the Wolf Hill Sanctuary to the north with a four-wheel drive pumper truck. The seasonally high water table across this stand does not pose a fire hazard at this time.

**Desired Future Condition:** The dying hemlock crop is opening the forest floor for seed germination and seedling development. This natural process is promoting the development of the all-aged, species diverse, ecologically resilient ideal watershed filtration forest on this site.

**Recommended Management Practices:** Not applicable.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	8.11	BM	2.1	6"	40	<4 cords	65:WA 65:RM	<.4 cords

**Sub-Watershed:** Wolf Hill

**Water Quality Concerns:** This stand rests on the eastern shore of the Tighe Carmody Reservoir. Water pumps out of two narrow, spring seep fed streams in Stand 8.01 and 8.09 to the east of this site. The water pools in the moist soil beneath this area. This small hardwood grove filters this water as it transfers into the reservoir.

**Silviculture Status:** Not suitable.

**Terrain/Topography:** the stand lies upon a narrow, level plain on the shoreline.

**Soils:** The Sudbury soils underlying this stand are nearly level to gently sloping soil and moderately well drained. Permeability and available water capacity are moderate; however, the high water table restricts root growth. Surface water was over six inches deep during the inventory.

- Timber Harvesting: Not applicable.
- Water Quality: this small stand acts as the last filter for sediment that move in the stream flow from the spring seeps upslope.

**Vegetation:** Sapling and small pole red maple, white ash, sugar maple, and yellow birch tower above a dense wetland shrub, herbaceous plant, fern and grass ground cover. Royal fern was prominent here spreading its broad fronds above the moist soils.

**Habitat:** This tiny aquatic habitat supports amphibians (frogs and turtles) and small mammals that depend on the reservoir. The thick herbaceous plants and shrubs are useful to water-site nesting songbirds.

- NHESP: The NHESP BioMap2 project defines this stand as Critical Natural Landscape, which indicates its ability to support a variety of species inclusive of wide-ranging ones and its capacity for resilience to climate change other disturbances
- Habitat techniques: This area will be preserved as a small habitat niche.

**Fire Protection:** Access into this area would be difficult for fire protection; it could be gained from the south from the dam site and Manhan Road. The high water table across this stand and the natural firebreak of the reservoir to the west do not pose a fire hazard at this time.

**Desired Future Condition:** This area serves an essential last barrier of filtration function in the complex watershed ecosystem. The stand will be preserved in its current condition to protect its filtration function.

**Recommended Management Practices:** Not applicable



Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	8.12	OH	59.90	9.4"	88	2.3 MBF 2.2 Pulp cds 4.8 Firewd cds	55:RO 55:WP	9.70

**Sub-Watershed:** Wolf Hill

**Water Quality Concerns:** The goal for water quality protection on these watershed lands is the prevention of the movement of sediment and nutrients from the upland forests through the soils and streams into the Tighe Carmody Reservoir during or after any silviculture treatments in the forested watershed. This stand perches above the dam site on the Tighe Carmody Reservoir. Any disturbance to this stand would directly impact the water quality in the reservoir.

**Silviculture Status:** Not suitable.

**Terrain/Topography:** The relief climbs a series of narrow terraces over a steep slope from the dam to the peaks of the two small hilltops in the southern tip of the Wolf Hill formation. The ground is strewn with rock outcroppings.

**Soils:** This stand lies above the Charlton - Hollis - Rock Outcrop is a complex of undulating soils and rock outcrops on ridges and hills. About 40% of this soil is the deep well drained Charlton, 25% is shallow excessively drained Hollis, and 15% granite rock outcrops. The site is not conducive to productive tree growth.

- Timber Harvesting: Not applicable.
- Water Quality: The coarse structured soils could lose particle matter with severe storm activity if the vegetative cover were removed or disturbed.

**Overstory:** The rocky sites limit tree heights, and the main canopy height ranges from 25 to 40 feet with a few scattered white pine trees poking above this layer. Although short in stature and small in diameter, the red oak, scarlet oak, chestnut oak, white oak, and birch stems along this slope have an age

range of 125 to 175 years. They are growing slowly above rock and ledge. They exhibit many bole defects and epicormic branching habits.

**Understory:** Black birch and mixed oak pole share the lower canopy (height of 15 to 25 feet) with an older, suppressed layer of hemlock trees. These trees have an average diameter range of four to seven inches, yet they are probably over 70 years of age.

- **Regeneration:** Small patches of mineral soil fill quickly with oak seedlings, which continually replace the overstory crops.
- **Native:** Native shrubs dominate the ground cover. Species cited include blueberry, witchazel, maple leaf viburnum, and mountain laurel. Mountain laurel thickets were the most common. Elephant ear lichen covers many of the larger boulders and stones.
- **Non-native Invasive Growth:** Japanese barberry, glossy buckthorn, and multiflora rose shrubs mix with the native plants on the crests of each small terrace sites and the hilltops. Seed placement occurs from bird flight patterns.
- **Interfering native plants:** Not applicable.

**Habitat:** This is another unique habitat ecotype. A vernal pool sits upon one of the wider terraces. It was dry in later May, and filled with alder and illex. Dense shrub cover offers feeding and breeding cover to songbirds and small mammals. Moose sign was prolific even on this rocky steep slope. A timber rattler snake was observed retreating from a sunning location during the inventory. Birdsong was constant near the close of one afternoon across this stand.

- **NHESP:** The NHESP BioMap2 project defines this stand as Critical Natural Landscape, Habitat for Species of Conservation Concern, and Primary Habitat for Rare and Endangered Species, all of which indicates its ability to support a variety of species inclusive of wide-ranging ones and its capacity for resilience to climate change other disturbances.
- **Habitat techniques:** Preservation of this unique habitat ecotype will protect the rare species habitat.
- **Risks:** Not applicable.

**Fire Protection:** This area is not accessible for fire control management. Fire hazard was low now, and no sign of past fire was evident in the inventory.

**Desired Future Condition:** Mountaintop habitat is uncommon in the Southampton area; this stand will be preserved in its valuable habitat condition. The dense shrub and forest covers anchor the soils on this steep slope above the reservoir.

**Recommended Management Practices:** Not applicable.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	8.13	WP	5.00	11.8"	180	0.0 MBF 0.0 Pulp cds 14.9 Firewd cds	65:WP	0.81

**Sub-Watershed:** Wolf Hill

**Water Quality Concerns:** This stand lies below the dam site on Tighe Carmody Reservoir, and any disturbance in this area would not impact water quality in the reservoir.

**Silviculture Status:** Not suitable.

**Terrain/Topography:** The stand lays upon straddles the spillway canyon for the dam upon two sloping plains.

**Soils:** These maturing trees grow above coarse textured, Charlton sand and gravels. These well-drained soils are very conducive to white pine growth.

- Timber Harvesting: Not applicable.
- Water Quality: Not applicable.

**Overstory:** A 60 to 75 year old white pine plantation grows in this stand. The trees were not thinned in their earlier life, and they developed excessive black knot defects along the main bole. Their crowns are small and asymmetrical. They have poor quality, yet are growing well on this perch.

**Understory:** No significant sapling or pole layer grows beneath the pine shade.

- Regeneration: Reproductive growth is negligible.
- Native: Partridgeberry, poison ivy, native grape, and some scattered blueberry shrubs were growing on the forest floor and amongst the pine canopy.

- Non-native Invasive Growth: Japanese barberry shrubs have begun to move into this area from the early successional habitat/brush south to the south.
- Interfering native plants: Not applicable.

**Habitat:** Pine monocultures do not have a lot of vertical or horizontal diversity. Songbirds come into the stand to feed on the palatable poison ivy berries. Pileated woodpeckers have been working some of the standing dead trees.

- NHESP: The NHESP BioMap2 project defines this stand as Critical Natural Landscape, Habitat for Species of Conservation Concern, and Primary Habitat for Rare and Endangered Species, all of which indicates its ability to support a variety of species inclusive of wide-ranging ones and its capacity for resilience to climate change other disturbances.
- Habitat techniques: Preserve the current pine grove.
- Risks: Not applicable.

**Fire Protection:** Access to this stand for fire protection is easy from Manhan Road. Fire hazard is low in the area, and no evidence of past fire history was evident.

**Desired Future Condition:** Ideally, the replacement of this small grove would be desirable. Yet given the Species of Concern habitat designation by NHESP, removal of this plantation would only be possible if its presence presented a clear danger to water quality (DEP mandate). Since it does not at this time, the stand will continue to mature.

Objective	Stand #	Forest Type	Stand Area (acres)	MSD or Size Class (inches)	Basal Area (sq.ft./ac)	Volume Per Acre	Site Index	DCR/FIA Growth Rate (MBF/yr)
Stewardship Green Cert.	8.14	BR-ESH	11.4	NA	NA	NA	NA	NA

**Sub-Watershed:** Wolf Hill

**Water Quality Concerns:** This stand lies below the dam site on Tighe Carmody Reservoir, and any disturbance in this area would not impact water quality in the reservoir.

**Silviculture Status:** Not suitable.

**Terrain/Topography:** This stand rests on a gentle slope on Manhan Road. The timber harvest landing from the red pine plantation salvage work is found here.

**Soils:** Hinckley loamy sands mostly underlie the moderate slopes of this stand. This soils range from well drained to excessively drained and has rapid permeability and low available water capacity. It is moderately productive for tree crops.

- Timber Harvesting: The old landing site will be reopened for use during the silvicultural treatment in the southern portion of the Wolf Hill Sub-watershed. The disturbance of these soils will not impact upstream water quality
- Water Quality: Discussed above.

**Vegetation:** The overstory removal of a dying red pine plantation in 2010 opened this area. Dense sapling and native shrub cover quickly replaced the red pine. Native species cited here include witch-hazel, blueberry, dogwood, elderberry, sweet fern, steeplebush, and mountain laurel. A dense cover of herbaceous plants and ferns grows like a mat on the forest floor. Some of the species cited include cinnamon, sensitive, Christmas, interrupted, and a multitude of native wildflowers. Scattered white pine, red maple, and red oak trees (less than 2 or 3 we acre) offer ideal vertical stratification across the open type. The invasive non-native plants Japanese barberry, glossy buckthorn, multiflora rose, and Asiatic

bittersweet mix with the native plant community. Currently the balance between the two is in check, with the native plants containing their spread.

**Habitat:** Shrub and young forest habitats are important for shrubland birds; shrubland birds and game birds use shrub and young forest areas with or without open herbaceous areas. These habitats are also important for a variety of other wildlife such as butterflies and bees, black bear, deer, moose, rabbit, bobcat, frogs and others. Shrubland birds are important now because 22 of the 40 birds associated with shrubland habitats are undergoing significant population declines in eastern North America. Shrubland bird species locally found include warblers, ruffed grouse, and woodcock. Early-successional forest habitats are usually transitory or ephemeral because they change over time because of forest growth and succession. This means the community is dependent on repeated disturbances to create or maintain habitat. The current shrub like lower canopy layer once released and enhanced with a wider diversity of plant species and some section of herbaceous growth, might preclude the need for intensive maintenance of the habitat.

- NHESP: The NHESP BioMap 2 Project defines this stand as critical natural landscape, which indicates its capacity to support wide-ranging wildlife species and enhance local biodiversity.
- Habitat techniques: Periodic brush cutting to maintain the valuable early successional habitat zone.
- Risks: Not applicable.

**Fire Protection:** Access for fire management is easy into this stand from Manhan Road. The hazard of a fire emergency is low at this time, and no evidence of past fire was noted.

**Desired Future Condition:** The maintenance of an early successional habitat zone within the 2-115.2 acre forested watershed is desirable. The creation of new zones of this habitat refutes the argument for the development of an all aged, specie diverse, ecologically resilient ideal watershed filtration forest. This small are represents one aggregate of a forest stand less than ten years of age within the watershed forest.

**Recommended Management Practices:** Periodic maintenance of the early successional habit zone with brush cutting every seven to ten years.

<b>MANAGEMENT PRACTICES TO BE DONE WITHIN THE NEXT TEN YEARS</b>
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**Overview of Silviculture by Stand**

Stand	Type	Silviculture	Acres to Cut	BA to Cut	MBF to Cut	Cords Wood to Cut	Cords Pulp to Cut	Year
1.01	RZ	None	0	0	0	0	0	NA
1.02	WH	Selection	12.9	50	37	15	33	2015-16
1.03	HH	Salvage	6.1	70	28	13	26	2015-16
1.04	OH	None	0	0	0	0	0	NA
1.05	HH	Salvage	7.5	65	15	25	25	2015-16
1.06	OHK	Selection	25	70	70	70	25	2015-16
1.07	OH	None	0	0	0	0	0	NA
1.08	WP	None	0	0	0	0	0	NA
1.09	WH	Selection	40	50	145	40	30	2015-16
1.10	WHK	Selection	10	50	35	20	40	2015-16
1.11	OH	None	0	0	0	0	0	NA
1.12	WA	None	0	0	0	0	0	NA
2.01	WP	Irregular	19	63	92	NA	120	2020-21
2.02	OHK	Selection	11	50	40	20	20	2020-21
2.03	OH	Selection	23	50	115	25	10	2020-21
2.04	WH	Irregular	5	80	35	5	25	2020-21
2.05	RZ	None	0	0	0	0	0	NA
3.01	OH	None	0	0	0	0	0	NA



Stand	Type	Silviculture	Acres to Cut	BA to Cut	MBF to Cut	Cords Wood to Cut	Cords Pulp to Cut	Year
3.02	OH	Crop Tree	50	30	40	125	0	2015-16
3.03	MO	None	0	0	0	0	0	NA
3.04	RP-OH	Selection	4	100	40	0	20	2015-16
3.05	OHK	Selection	30	30	40	2	10	2015-16
3.06	WH	Selection	5	50	70	10	40	2015-16
3.07	OH	None	0	0	0	0	0	NA
3.08	HH	Selection/Salvage	10	30	20	10	20	2015-2016
3.09	BM	None	0	0	0	0	0	NA
3.10	WH	Selection	5	60	25	10	40	2015-16
3.11	WHK	Salvage	5	80	20	0	10	2015-16
3.12	OH	None	0	0	0	0	0	NA
3.13	WP	Selection	35	60	25	10	40	2015-16
3.14	HH	None	0	0	0	0	0	NA
4.01	OHK	Selection	197	30	275	100	200	2016-18
4.02	WH	None	0	0	0	0	0	NA
4.03	OM	None	0	0	0	0	0	NA
5.01	WP	Irregular	19	55	100	NA	30	2018-20
5.02	WH	Selection	72.1	30	180	100	20	2018-20
5.03	WHK	Selection	8.5	55	30	0	35	2018-20
5.04	BM	None	0	0	0	0	0	NA
6.01	HH	None	0	0	0	0	0	NA
6.02	OH	None	0	0	0	0	0	NA

Stand	Type	Silviculture	Acres to Cut	BA to Cut	MBF to Cut	Cords Wood to Cut	Cords Pulp to Cut	Year
6.03	OH	None	0	0	0	0	0	NA
6.04	HH	None	0	0	0	0	0	NA
6.05	BM	None	0	0	0	0	0	NA
7.01	OHK	Selection	89.2	30	60	40	20	2016-18
7.02	BM	Selection	91.7	30	70	75	20	2016-18
7.03	WP	None	0	0	0	0	0	NA
7.04	OH	Selection	46.9	30	70	75	20	2016-18
7.05	BR-ESH	None	0	0	0	0	0	NA
7.06	WP	None	0	0	0	0	0	NA
8.01	OH	Selection	202.8	35	230	240	75	2022-24
8.02	WH	None	0	0	0	0	0	NA
8.03	HH	Selection	56.4	60	90	20	50	2022-24
8.04	OH	None	0	0	0	0	0	NA
8.05	RM	None	0	0	0	0	0	NA
8.06	OH	None	0	0	0	0	0	NA
8.07	BB	None	0	0	0	0	0	NA
8.08	BB	None	0	0	0	0	0	NA
8.09	HH	Selection	27.7	60	90	20	50	2022-24
8.10	HH	None	0	0	0	0	0	NA
8.11	BM	None	0	0	0	0	0	NA
8.12	OH	None	0	0	0	0	0	NA
8.13	WP	None	0	0	0	0	0	NA

<b>Stand</b>	<b>Type</b>	<b>Silviculture</b>	<b>Acres to Cut</b>	<b>BA to Cut</b>	<b>MBF to Cut</b>	<b>Cords Wood to Cut</b>	<b>Cords Pulp to Cut</b>	<b>Year</b>
8.14	BR-ESH	None	0	0	0	0	0	NA

**SUB-WATERSHED #1: BLUE MEADOW BROOK**

<b>Stand Number</b>	<b>Forest Type</b>	<b>Silviculture Practice</b>	<b>Stand Area</b>	<b>Basal Area Removal</b>	<b>MBF Volume Removal</b>	<b>Cords Firewood Removal</b>	<b>Cords Pulpwood Removal</b>	<b>Timing</b>
1.02	WH	Selection-Single Tree and Small Group	12.9 acres	50 sq.ft.	37 MBF	15 cords	33 cords	2015 to 2016

**Sub-Watershed:** Blue Meadow Brook

**Management Practice Objective:** Application of the Selection Harvest System – Combination of Single Tree and Group Variants facilitates the development of a complex forest structure with mixed age classes, diverse species composition, healthy habitat conditions, and timber income.

**Trees to be Removed and Retained:** Removals will concentrate on dying and declining hemlock timber (75% of current stocking) and all of pole sized trees, pole and timber sized white ash trees, 30% of the white pine overstory (witch-hazel all stems with root pulling), 20% of the high value red oak timber crops, defected, inferior red maple poles, and diseased black birch pole and sawtimber sized stems. Crop trees include maturing pine, mixed oak, black and yellow birch stems with wide, full crowns, and seed bearing capacity as well as healthy, well-formed, vigorous immature stems.

**Regeneration Concerns:** Placement of the group openings near superior seed producing white pine, red oak, and other oak stems increases the possibility of a good seed catch of these desirable species. Scarification of the mineral soil post harvest during open ground improves the quality of the seedbed. The sandy Montauk loams are conducive to the seed germination of white pine. Disturbance of the mountain laurel thickets opens more forest floor for seed dispersal.

**Soil Concerns:** The landing site for this harvest project will be on the discontinued section of Crooked Ledge Road near the intersection with Fomer Road. Placement of gravel upon the old roadbed will be necessary for truck access in route south to the landing. Construction of a stable pole and corduroy base

for the main hauling road into the northern section of this stand stabilizes the soils. Frozen ground conditions are necessary for use of a road across the spring field zones into and within the northern sections of the stand. The sections above drier, more gravelly soils can be worked during open ground condition, when dry, for mineral soil scarification. Oak seedlings require good seedbed preparation for successful germination.

**Boundary Concerns:** The property bound in this area was maintained over 25 years ago with blazing and red paint. These old markings are fading and in some places impossible to discern. Maintenance of the bounds will be completed during the next two years.

**Invasive Plant Management Concerns:** Not applicable.

**Habitat Concerns:** 1. Retention of a few dying hemlock as future cavity trees (diameter greater than 18 inches). 2. Retention of mature, tall white pine stems along the wetland edges. 3. Opening the forest floor for seedling development increases the vertical stratification and biodiversity of the stand.

**Cultural Resource Concerns:** Preservation of the stonewalls along Crooked Ledge Road and the eastern bound access road.

Stand Number	Forest Type	Silviculture Practice	Stand Area	Basal Area Removal	MBF Volume Removal	Cords Firewood Removal	Cords Pulpwood Removal	Timing
1.03	HH	Salvage Harvest Single Tree Selection	6.1 acres	70 Sq.Ft.	28 MBF	13 cords	46 cords HK and WP pulpwood	2015 to 2016

**Sub-Watershed:** Blue Meadow Brook

**Management Practice Objective:** Application of a Salvage Harvest amongst the declining hemlock trees and Single Tree Selection Harvest stand-wide releases the immature hardwood for increased growth and productivity, releases the maturing oak and pine for seed dispersal, and facilitates the introduction of the youngest age class into the desired all-aged, species diverse watershed.

**Trees to be removed and retained:** Removals will concentrate on dying and declining hemlock timber and pole sized trees (more than 75%), pole and timber sized white ash trees and the defective, inferior red maple poles sized stems. Immature yellow birch, sugar maple, and red oak stems will be retained as crop trees along with maturing pine and red oak stems.

**Regeneration Concerns:** The salvage of large volumes of the hemlock crop will open big gaps on the forest floor for seedling development. Open ground harvest conditions disturb mineral soils for hardwood seedbed preparation.

**Soil Concerns:** The landing site for this harvest project will be on the discontinued section of Crooked Ledge Road near the intersection with Fomer Road. Placement of gravel upon the old roadbed will be necessary forwarder hauling access. Harvest work in this stand requires crossing the land bridge and equipment use near most soils. Frozen ground conditions and the placement of a suitable corduroy system along wet sections of the road are mandatory for the success of this project. This stand lies upon a moist, level depression. Matting of the harvest roads with top wood material will provide support for the equipment during the harvest.

**Boundary Concerns:** The boundary along the northern edge was delineated with blazes and paint over 25 years ago. A stone monument marks one corner of the stand. During the harvest preparation work, these lines will be clearly delineated.

**Invasive Plant Management Concerns:** Not applicable.

**Habitat Concerns:** 1. Retain a few dying hemlock as future cavity trees (diameter greater than 18 inches). 2. Retain mature, tall white pine stems along the wetland edges. 3. Open the forest floor for seedling development increases the vertical stratification and biodiversity of the stand.

Stand Number	Forest Type	Silviculture Practice	Stand Area	Basal Area Removal	MBF Volume Removal	Cords Firewood Removal	Cords Pulpwood Removal	Timing
1.04	OH	Selection Harvest Single Tree and Gaps/Groups	10 acres	35 Sq. Ft.	10 MBF	25 cords	25 cords	2015 to 2016

**Sub-Watershed:** Blue Meadow Brook

**Management Practice Objective:** Application of a Selection Harvest across this small stand with the removal of about 70% of the scattered hemlock crop and release of the best seed bearing oak and high quality immature timber crops will create large enough openings in the canopy and on the forest floor for the introduction of the seedling age class.

**Trees to be Removed and Retained:** Red oak, yellow birch, black birch, red, and sugar maple well-formed pole and sawtimber trees of all sizes will be selected as crop trees. The release of their crowns will remove beech and black birch pole firewood stems, dying and declining, scattered hemlock pole and sawtimber trees, and red oak high value sawtimber (>18 inches) when under wet wood conditions. Three small (under .5 acre) gap openings were placed throughout this stand adjacent to superior seed bearing red oak stem or natural openings.

**Regeneration Concerns:** The large canopy and forest floor openings should fill quickly with seedlings of all species. The yellow and black birch and red maple will easily establish themselves in the sunlit areas. Disturbance of the mineral soil during some portion of the timber harvest assures higher germination rates for acorns. Monitoring of these patches for oak and pine seedling development success is recommended within the first five years.



**Soil Concerns:** The excessive stones and boulders across the soil surface are a limitation with harvest equipment. All of the material will be hauled northward across the old town road. This roadbed has a well-compacted gravel base, but the roadbed requires the placement of gravel and stone in some of the moist areas to stabilize the soil. Harvest work on these stable soils can be conducted during either frozen or dry and stable ground conditions.

**Boundary Concerns:** Not applicable.

**Invasive Plant Management Concerns:** A few individual shrubs of Japanese barberry and multiflora rose were noted along the old Town road in this stand. Manual removal of these plants before the harvest will prevent their spread into the new open ground.

**Habitat Concerns:** 1. Retention of some of the dying hemlock timber sized trees (greater than 18 inches in diameter) will recruit future cavity stems close to a water source. 2. Removal of the declining hemlock crop will open the forest floor for seedling development and increase the beaver feed source close to their lodge. 3. Release of the mature red oak, white oak, and hickory trees scattered across the overstory will increase annual mast production.

**Recreational Concerns:** The local community enjoys hiking, Nordic skiing, and ATV use of the Town road Crooked Ledge Road. Excellent workmanship and contractual control of the post-harvest aesthetics will protect the pleasant forest view along this roadbed.

**Cultural Resource Concerns:** Preservation of the stonewall along Crooked Ledge Road at the access points into the stand will be facilitated by the use of one entry point along the roadbed. An old Town highway bound rests in the center of the stand. This is a piece of Southampton history and will not be disturbed during the harvest.

Stand Number	Forest Type	Silviculture Practice	Stand Area	Basal Area Removal	MBF Volume Removal	Cords Firewood Removal	Cords Pulpwood Removal	Timing
1.05	HH2	Salvage Harvest	7.5 acres	60 Sq. Ft.	15 MBF	25 cords	25 cords	2015 to 2016

**Sub-Watershed:** Blue Meadow Brook

**Management Practice Objective:** Application of a Salvage Harvest across this small stand with the removal of about 70% of the hemlock crop will create large enough openings in the canopy and on the forest floor for the introduction of the seedling age class.

**Trees to be Removed and Retained:** Hemlock pole and sawtimber trees of all sizes. These trees have very small live needles in their crowns. Some firewood trees may be removed in the mechanics of the hemlock harvest. Portions of the hemlock crop with greater than 40% of live crown will be retained as crop trees along with immature pine and red oak pole and small sawtimber stems, a few red maple pole and small sawtimber trees, and well-formed yellow birch pole trees.

**Regeneration Concerns:** The large canopy and forest floor openings should fill quickly with seedlings of all species. The yellow and black birch and red maple will easily establish themselves in the sunlit areas. Monitoring of these patches for oak and pine seedling development success is recommended within the first five years.

**Soil Concerns:** The excessive stones and boulders across the soil surface are a limitation with harvest equipment. All of the material will be hauled northward across the old town road. This roadbed has a well-compacted gravel base, but the roadbed requires the placement of gravel and stone in some of the moist areas to stabilize the soil. Harvest work can be conducted upon these soils during either frozen winter ground conditions or dry and stable late summer or fall ground conditions. One strip of the stand along Crooked Ledge Road will require winter scheduling and frozen ground for protection of the spring seep flows.

**Boundary Concerns:** Not applicable.

**Invasive Plant Management Concerns:** A few individual shrubs of Japanese barberry and multiflora rose were noted along the old Town road in this stand. Manual removal of these plants before the harvest will prevent their spread into the new open ground.

**Habitat Concerns:** 1. Retention of some of the dying hemlock timber sized trees (greater than 18 inches in diameter) will recruit future cavity stems close to a water source. 2. Removal of the declining hemlock crop will open the forest floor for seedling development and increase the beaver feed source close to their lodge. 3. Release of the mature red oak, white oak, and hickory trees scattered across the overstory will increase annual mast production.

**Recreational Concerns:** The local community enjoys hiking, Nordic skiing, and ATV use of the Town road Crooked Ledge Road. Excellent workmanship and contractual control of the post-harvest aesthetics will protect the pleasant forest view along this roadbed.

**Cultural Resource Concerns:** Preservation of the stonewall along Crooked Ledge Road at the access points into the stand will be facilitated by the use of one entry point along the roadbed. An old Town highway bound rests in the center of the stand. This is a piece of Southampton history and will not be disturbed during the harvest.

Stand Number	Forest Type	Silviculture Practice	Stand Area	Basal Area Removal	MBF Volume Removal	Cords Firewood Removal	Cords Pulpwood Removal	Timing
1.06	OHk	Selection Harvest - Single tree and Small Group Salvage Harvest	27.7 acres	40 Sq. Ft.	70 MBF	70 cords	25 cords	2015 to 2016

**Sub-Watershed:** Blue Meadow Brook

**Management Practice Objective:** 1. The application of Small Group (group openings range in size from .25 to 1.25 acres) and Single Tree Selection Harvest combined with a Salvage Harvest will introduce the youngest age and further develop the all-aged, species diverse, resilient watershed filtration ecosystem, release the crowns of the immature crop trees for improved growth and vigor, and create vertical stratification for an increase of habitat values and biodiversity. 2. Treatment of the grape vine prior to or during the harvest operation.

**Trees to be Removed and Retained:** Over 50% of the hemlock crop trees including pole sized pulpwood products, timber crops will be harvested along with the declining pole, and small sawtimber sized paper birch trees. High value red oak timber crops (about 35% of this crop), inferior, low value red maple pole trees and timber crops, black birch pole and small sawtimber stems with nectria infections. The red maple, red oak, black oak, and yellow and black birch stems of all ages and sizes will be retained as both crop and seed bearing trees. Several of the largest, superior red oak crop trees will be retained per care as the seed bearers.

**Regeneration Concerns:** Although some of chosen crop trees for retention are not acceptable growing stock, they will provide sufficient seed and shade to encourage a wide array of hardwood seedlings. The large openings from the salvage work provide excellent seedbeds.

**Soil Concerns:** Frozen ground conditions are recommended for this harvest work in the areas adjacent to the Blue meadow swamp headwaters at the lower slope upon moist soils. Given the matrix of Ridgebury and Gloucester soils and the high water table on the eastern edge of the stand along the Blue Meadow Swamp., frozen ground conditions would be best for harvest work in these areas. The wet soils with an under layer of clay along Crooked Ledge Road require the placement of gravel and stone for soil stability.

**Boundary Concerns:** Not applicable.

**Invasive Plant Management Concerns:** A few individual shrubs of Japanese barberry and multiflora rose were noted along the old Town road in this stand. Manual removal of these plants before the harvest will prevent their spread into the new open ground.

**Habitat Concerns:** 1. Retention of a few of the large sized declining hemlock timber trees (greater than 18 inches) provides future cavity trees. 2. Retention and protection of any of the native blueberry shrubs on the forest floor diversifies feed. Highbush blueberry and maple leaved viburnum growth within the openings will improve feed diversity. 3. The harvest will create a distinct vertical stratification useful to songbirds and small mammals for cover and feed.

**Cultural Resource Concerns:** Preservation of the stonewalls along Crooked Ledge Road at the access points into the stand will be facilitated by the use of one entry point along the roadbed. This stand touches onto Fomer Road at the landing location. A one and one half acre area will be opened here. This small area can be seeded to wild flowers and native grasses for a pleasant meadow at the road's edge post-harvest.

Stand Number	Forest Type	Silviculture Practice	Stand Area	Basal Area Removal	MBF Volume Removal	Cords Firewood Removal	Cords Pulpwood Removal	Timing
1.09	WH	Selection System	48 acres	50 Sq. Ft.	145 MBF	40 cords	30 cords	2015 to 2016

**Sub-Watershed:** Blue Meadow Brook

**Management Practice Objective:** 1. The application of Single Tree and Small Group Selection Harvest establishes reproductive stocking of site-suited white pine and hardwood trees, which further develops the all-aged, species rich resilient natural filtration forest ideal for watershed lands. 2. Treatment of the invasive plants before timber harvest work. 3. Treatment of the grape vines either before or during the timber harvest.

**Trees to be Removed and Retained:** Within the group openings, trees for harvest include high value and low value white pine timber crops, red maple, birch, mixed oak, and beech sapling and pole trees, and hemlock timber sized trees. The Single Tree Harvest work targets poorly formed and low quality red maple pole trees, nectria infected black birch pole trees, the declining paper birch pole, timber stems, and large diameter white pine trees with their root collars heaving into the air from the wind. Stand vigor will increase with the release of well-formed immature yellow and black birch and red oak stems and the best red oak timber stems. The residual stand consists of the superior white pine crop and seed bearing trees, maturing red oak, white oak, hickory, and sugar maple and well-formed vigorous black birch, red oak, yellow birch, white oak, and white ash trees.

**Regeneration Concerns:** Disturbance of the thick witch-hazel shrub layer universally across the stand and the small sections of dense mountain laurel will allow more sunlight directly on the forest floor for seed germination. Snowless ground conditions during the harvest would allow for mineral soil scarification and preparation of an ideal seedbed.

**Soil Concerns:** The well-drained Gloucester soils drain rapidly and require no equipment limitations. The establishment of a non-entry filter strip along the edges of the swamp and beaver pond will protect soil

stability here. Harvesting of the strip of land closest to the filter strips around the swamps and some of the spring seep areas require winter frozen ground conditions for harvest completion.

**Boundary Concerns:** Not applicable.

**Invasive Plant Management Concerns:** This stand has several invasive plant hot spots in which dense pockets of Japanese barberry, Asiatic bittersweet and multiflora rose, privet, and winged euyonomous dominate the forest floor. One large section in the old settlement site along Crooked Ledge Road presents a threat to the native plant community. This area could be treated manually with hand removal of the plants from the soil. Single shrubs of these species mingle amongst the main stand. The control work should be done before the timber harvest. This area will not be harvested with the rest of the stand. Consistent overstory shade prevents the spread of these plants.

**Habitat Concerns:** 1. Release of the crowns of the red oak crop trees will increase acorn mast production. 2. The harvest will create a distinct vertical stratification useful to songbirds and small mammals for cover and feed. 3. Retention of mature, tall (canopy height greater than 85 feet) white pine and hemlock trees along the swamp and beaver pond provides perching sites for predators and fishers and nesting and roosting opportunities.

**Recreational Concerns:** A lovely, narrow path loops from Crooked Ledge Road, to the pond shore, and back to Delisle Road. This trail is used daily by the community. It slowly traverses the pine grove with some very pleasing vistas. This trail will be re-opened post-harvest for the community's use. A pre-harvest community hike is planned for the education of the local users about the objectives and benefits of the timber harvest work.

**Cultural Resource Concerns:** Preservation of the stonewalls along Crooked Ledge Road and Fomer Road at the access points into the stand will be facilitated by the use of one entry point along the roadbed. A policy of non-disturbance of the extensive stonewalls and cellar holes on Crooked Ledge Road will preserve some of the cultural heritage of this old Southampton town center. This is a pretty site with the old foundations and some large diameter cull sugar maple and oak trees in the old farmyards.

Stand Number	Forest Type	Silviculture Practice	Stand Area	Basal Area Removal	MBF Volume Removal	Cords Firewood Removal	Cords Pulpwood Removal	Timing
1.10	WHk	Selection System	10 acres	50 Sq. Ft.	35 MBF	20 cords	40 cords	2015 to 2016

**Sub-Watershed:** Blue Meadow Brook

**Management Practice Objective:** 1. Manual treatment of the invasive plant community before a timber harvest. 2. Application of a Combination Single Tree and Small Group Selection Harvest. 3. Disturbance of the of the dense witch-hazel and mountain laurel layer in certain sections of the stand for preparation of an ideal seedbed.

**Trees to be Removed and Retained:** Within the group openings, trees for harvest include a few high value red oak timber, red maple, birch, mixed oak, and beech sapling and pole trees, white pine, and hemlock timber sized trees. The Single Tree Harvests between openings will target poorly formed red maple, nectria infected black birch, declining paper birch pole and timber stems, 20% of the high value red oak timber crops on site with diameters greater than 19 inches, and large diameter white pine trees with their root collars up heaving. Stand vigor will increase with the release of well-formed immature yellow and black birch and red oak stems and the best red oak timber stems.

**Regeneration Concerns:** Disturbance of the thick witch-hazel vegetation will allow more sunlight directly on the forest floor for seed germination. Snowless ground conditions during the harvest would allow for mineral soil scarification and preparation of an ideal seedbed.

**Soil Concerns:** The well-drained Gloucester soils drain rapidly and require no equipment limitations. The establishment of a non-entry filter strip along the edges of the swamp and beaver pond will protect soil stability here.

**Boundary Concerns:** Not applicable.



**Invasive Plant Management Concerns:** Dense thickets of Japanese barberry, multiflora rose, privet, and Asiatic bittersweet dot this area, and are especially concentrated near the pathway and the old corral on Fomer Road. These plant communities could still be controlled through manual removal of the plants from the soils. This work should be completed before the timber harvest work.

**Habitat Concerns:** 1. Release of the crowns of the red oak crop trees will increase acorn mast production. 2. The harvest will create a distinct vertical stratification useful to songbirds and small mammals for cover and feed. 3. Retention of mature, tall (canopy height greater than 85 feet) white pine and hemlock trees along the swamp and beaver pond provides perching sites for predators and fishers and nesting and roosting opportunities.

**Cultural Resource Concerns:** Preservation of the stonewalls along Fomer Road at the access points into the stand will be facilitated by the use of one entry point along the roadbed. A unique corral stonework area sits along Fomer Road. The integrity of this structure will be maintained through the timber harvest.

## SUB-WATERSHED #2: BREAKNECK BROOK

**Property Wide Breakneck Brook Sub-watershed Water Quality Concerns:** This sub-watershed lies within 800 feet of the drinking water source for the City of Holyoke. Over 75% of the Breakneck Brook sub-watershed lies to the west of Breakneck Brook. A hiking path/old four-wheel drive road accesses a major brook crossing from Fomer Road. Management activity on this property could affect the water quality of Breakneck Brook, which drains directly into the Tighe Carmody Reservoir. This property is well suited for silviculture work. Management access requires the installation of a bridge across Breakneck Brook. The boundary of the property parallels the existing woods road and stream-crossing site. A new crossing will be installed about 200 feet north of the current site.

The banks in this location are more suitable for the bridge installation. The approaches to the bridge crossing will be constructed in compliance with not only the Required Best Management Practices from the Department of Conservation and Recreation BMP Manual for Timber Harvesting, but also the suggested BMP's. Protection and preservation of the banks on both sides of the brook will prevent any sedimentation from entering the system. Protection and stabilization measures include hay bales along both banks at the bridge site during the operation and seeding and mulching post-harvest for stabilization. The moist ground conditions immediately west of the bridge site require frozen or dry conditions for scheduling a harvest.

Stand Number	Forest Type	Silviculture Practice	Stand Area (acres)	Basal Area Removal (sq.ft)	Volume Removal (MBF)	Firewood Removal (Cords)	Pulpwood Removal (Cords)	Timing
2.01	WP	Irregular Shelterwood	20.8 ac	63 Sq. Ft.	92 MBF	NA	120 cords white pine	2020-2021

**Sub-Watershed:** Breakneck Brook

**Management Practice Objective:** Initiation of the conversion of this stand to the all-aged, species diverse natural purification and filtration watershed forest. The Preparatory Cut of the Irregular Shelterwood Harvest System will be applied here in order to open the canopy for seed germination of pine and hardwood. They set the stage for later regeneration by strengthening and improving the vigor of both the seed bearing and legacy pine trees. The Preparatory Cut retains a moderately high stocking density, which will preserve the aesthetic appeal of this level pine grove along Fomer Road.

**Trees to be Removed and Retained:** Trees for harvest include the suppressed co-dominant pine and the damaged or high-risk large, dominant white pine trees with bole defects or root collar upheavals. Any pine tree with white pitch oozing from the black knots will be harvested. The best pine trees to reserve are the dominant crowns class white pines that have deep, wide crowns, large live crown ratios, and strong, tapering boles. Twenty five percent (25%) of the mature red oak trees will be harvested, while the remainder of the oak, aspen, and immature poles will be reserved as crop trees.

**Regeneration Concerns:** The Preparatory Cut sets the stage for a future harvest, which will encourage regeneration that is more extensive across the stand. Large enough openings need to be made in this harvest so that species other than the shade tolerant beech and hemlock spread into the growing space.

**Soil Concerns:** The moist soils on the western edge of this stand require frozen or dry and stable ground conditions for harvest.

**Boundary Concerns:** The north boundary is clearly defined with a barbed wire fence and a stonewall along the proposed harvest edge. The northern property bound along the edge of this stand needs to be painted prior to the commencement of any harvest work.

**Invasive Plant Management Concerns** The Japanese barberry, multiflora rose, and privet plants amongst this stand should be removed prior to commencement of the harvest in order to avoid their exploitation of the growing space. Their density is low enough now for manual treatment with plant removal from the soils.

**Habitat Concerns:** Retention of the immature red oak and aspen timber crops will provide both acorns and grouse habitat. The proposed harvest will increase the vertical stratification within this stand and enhance biodiversity.

Stand Number	Forest Type	Silviculture Practice	Stand Area (acres)	Basal Area Removal (sq.ft)	Volume Removal (MBF)	Firewood Removal (Cords)	Pulpwood Removal (Cords)	Timing
2.02	OHk	Selection Method Single Tree and Small Group Salvage Harvest	15 ac	50 Sq. Ft.	40 MBF	20 cords	20 cords hemlock	2020-2021

**Sub-Watershed:** Breakneck Brook

**Management Practice Objective:** The Selection Method encourages the development of the all-aged, species diverse, resilient natural purification and filtration forest. Conversion from the current two-aged structure with bias towards the oldest age class to the desired structure will start with the introduction of a dense seedling class. The red oak crop is valuable and not yet financially mature. The opening in the canopy will release the crop trees for improved vigor and value growth.

**Trees to be Removed and Retained:** Trees for harvest include the dying hemlock trees of all sizes, 50% of the scattered white pine crop, 30% of the large diameter red oak crop inclusive of all stems with bacterial wet wood ooze on their lower boles, declining paper birch sawtimber crops, inferior red maple pole trees, black pole and sawtimber trees with nectria infections, and all sick beech trees. Crop trees include superior red oak trees with wide spreading crowns and clear lower boles, vigorous yellow and black birch pole trees.

**Regeneration Concerns:** Use of the Small Group variant will create large enough openings to encourage most site suitable seedlings. I hope that dry site species like white pine and red oak will seed heavily on these droughty Hinckley soils.

**Soil Concerns:** The moist and hummocky soils around the spring seeps on the western edge of this stand require frozen or dry ground conditions for successful harvest work. The log-landing zone will be placed along Fomer Road on the eastern edge of this stand. A gravel apron and pad will be required for truck access from the dirt town road into the stand. A bridge over Breakneck Brook for the harvest work

will be built on the stream approaches in Stand 2. The placement of hay bales downstream of the bridge crossing will prevent sediment movement below the bridge. Stabilization of the approaches during and after any timber harvest is essential for erosion prevention at this sensitive point.

**Boundary Concerns:** Not applicable.

**Invasive Plant Management Concerns:** The Japanese barberry and multiflora rose along Fomer Road should be removed prior to the commencement of the harvest to avoid their exploitation of the growing space. Their density is low enough now for manual treatment with plant removal from the soils.

**Habitat Concerns:** The proposed harvest will increase the vertical stratification within this stand and enhance biodiversity. The release of the best red oak crowns increases annual mast production. Retention of the large, tall white pine trees dotting the upper canopy provides roosting and denning sites.

Stand Number	Forest Type	Silviculture Practice	Stand Area (acres)	Basal Area Removal (sq.ft)	Volume Removal (MBF)	Firewood Removal (Cords)	Pulpwood Removal (Cords)	Timing
2.03	OH	Selection Method Single Tree and Small Group Salvage Harvest	47.6 ac	50 Sq. Ft.	115 MBF	25 cords	10 cords hemlock	2020-2021

**Sub-Watershed:** Breakneck Brook

**Management Practice Objective:** The Selection Method encourages the development of the all-aged, species diverse, resilient natural purification and filtration forest. Conversion from the current two-aged structure with bias towards the oldest age class to the desired structure is the introduction of a dense seedling class. The opening in the canopy will release the crop trees for improved vigor and value growth.

**Trees to be Removed and Retained:** Trees for harvest include the dying hemlock trees of all sizes, 50% of the scattered white pine crop, 30% of the large diameter red oak crop inclusive of all stems with bacterial wet wood ooze on their lower boles, declining paper birch sawtimber crops, inferior red maple pole trees, black pole and sawtimber trees with nectria infections, and all sick beech trees. Crop trees include superior red oak trees with wide spreading crowns and clear lower boles, 50% of the scattered white pine crop, vigorous yellow and black birch pole trees.

**Regeneration Concerns:** Use of the Small Group variant will create large enough openings to encourage most site suitable seedlings. We hope that the dry site species like white pine and red oak will seed heavily on these droughty Hinckley soils.

**Soil Concerns:** These slopes and eskers are highly erodible; careful engineering of harvest access road across the stand can avoid any direct climbs down the steeper slopes. Erosion control measure installations during storm events when the harvest is ongoing and post-harvest will stabilize the soils on

the roadbeds. Dry or frozen ground conditions during any harvest will also protect soil stability and prevent sediment loss.

**Boundary Concerns:** The northern boundary has no physical evidence except some corner markers. Clear delineation will be completed prior to any harvest work.

**Invasive Plant Management Concerns:** The Japanese barberry and multiflora rose plants near the old settlement site should be removed prior to any harvest work. Although they are contained within this small area, they may spread into the main stand when the canopy is opened.

**Habitat Concerns:** The proposed harvest will increase the vertical stratification within this stand and enhance biodiversity. The release of the best red oak crowns will increase annual mast production. Retention of the large, tall white pine trees dotting the upper canopy will provide roosting and denning sites.

**Cultural Resource Concerns:** An old home settlement is found along the main access road in the western portion of this stand. A cellar hole, corral stonewalls, and old well still mark the home site. These areas are a part of the history of Southampton, and they will be protected from any disturbance.

Stand Number	Forest Type	Silviculture Practice	Stand Area (acres)	Basal Area Removal (sq.ft)	Volume Removal (MBF)	Firewood Removal (Cords)	Pulpwood Removal (Cords)	Timing
2.4	WHK	Irregular Shelterwood	7.1	80 sq. ft.	35	5	25	2020-2021

**Sub-Watershed:** Breakneck Brook

**Management Practice Objective:** The Irregular Shelterwood Harvest introduces natural reproduction into white pine groves under the shade and protection of the mature crop. Mature pine trees would be retained through their biological maturity for habitat benefit, aesthetic appeal, and mature forest component. The introduction of younger age classes will direct this stand towards the ideal structure for watershed function.



**Trees to be Removed and Retained:** High value, large diameter white pine trees, a few high value red oak sawtimber trees, large sapling, and pole sized hemlock trees with serious needle discoloration or drop, and some red maple pole trees. The crop trees include high value white pine and red oak timber trees, large diameter, “rough” white pine trees for habitat, and immature yellow birch, black birch, and red oak pole and small sawtimber sized trees.

**Regeneration Concerns:** Use of the Irregular Shelterwood will retain enough shade, hopefully, to keep moisture on the forest floor for seed germination and seedling development. Monitoring of the area for five years post harvest to assess the success of the harvest goals is recommended.

**Soil Concerns:** These deep sands will support the use of equipment very well. The proximity to Tucker Brook and the slight pitch in the southern section requires dry or frozen ground conditions for harvest work.

**Boundary Concerns:** Not applicable.

**Invasive Plant Management Concerns:** Not applicable.

**Habitat Concerns:** The Irregular Shelterwood by design retains sufficient mature pine for roosting and perching use. Vertical stratification after a harvest in the main canopy provides habitat value to songbirds and mammals and increases the local biodiversity.

**Cultural Resource Concerns:** The old well site is not covered. Trespassers regularly hike through this area; it is recommended to set a cover over the well for safety. The well site will not be disturbed.

### SUB-WATERSHED #3: MANHAN RIVER

**Property Wide Manhan River Sub-watershed Water Quality Concerns:** This sub-watershed lies within 800 feet of the drinking water source for the City of Holyoke. The terrain throughout this land slopes to the south into the Manhan River watershed basin. The lower slopes effuse water through numerous spring seep flows, which carve channels through the sand and gravel based soils. The harvest engineering system will use hauling roads that bring the wood northward to Crooked Ledge Road. Road placement and construction will be easy in these soils, which are not highly erodible. They tend to pack and adhere together with pressure, which will provide a stable roadbed. Avoidance of the spring seeps and their drainage channels can be arranged through intelligent road design. Since all of the harvest hauling activity draws the timber crops uphill, the installation of erosion control measures during the harvest (in the event of severe storm events) and after the close of the harvest are essential for the protection of the soil structure.

Successful silviculture for the stand in this subwatershed involves red oak, birch, and pine seedling development. These species require open, disturbed mineral soils for germination. This prescription presents a dilemma and challenge to the harvest program. Whenever possible and weather conditions are favorable, open ground harvest work will prepare these sites for seed germination. Yet several zones require frozen ground for soil and water purification capacity protection. Good timing and supervision will weave these two demands together into the contractual capacity of the forest ecosystem timber harvest work.

Stand Number	Forest Type	Silviculture Practice	Stand Area (acres)	Basal Area Removal (sq.ft)	Volume Removal (MBF)	Firewood Removal (Cords)	Pulpwood Removal (Cords)	Timing
3.02	OH	Crop Tree Release	75.3 ac	30 Sq. Ft.	40 MBF	125	0	2015-2017

**Sub-Watershed:** Manhan River

**Management Practice Objective:** A conservative Crop Tree Release Treatment in this stand will open the crowns of the best red oak, black birch, yellow birch, and mixed oak trees for improved vigor and value growth. The stand is too young to be concerned with regeneration at this time, yet canopy opening allows for seed germination.

**Trees to be Removed and Retained:** Crop Tree Release treatments select the best main canopy trees in this stand with a bias towards the commercially valuable red oak crop, and remove trees in direct competition with them on two to three sides. Trees for removal include inferior, co-dominant red maple, black birch, paper birch, hemlock, and mixed oak pole and small sawtimber sized trees. This method will also remove about 25% of the red oak small sawtimber crop.

**Regeneration Concerns:** Seedling survival on the dry soils is difficult, but the nature of the treatment is not focused on seed germination at this time.

**Soil Concerns:** The dry sands and gravels are easy to work with harvest equipment. Their open pore structure can erode, so careful attention to erosion control measures during and after the harvest work is recommended.

**Boundary Concerns:** Not applicable.

**Invasive Plant Management Concerns:** The Japanese barberry, multiflora rose, and Asiatic bittersweet growth along the southern bound should be treated for stocking reduction prior to or soon after the proposed harvest to prevent their spread onto the newly open forest floor.

**Habitat Concerns:** Retention of the scattered mature red oak and aspen timber crops will provide both acorns and grouse habitat. The proposed harvest will increase the vertical stratification within this stand and enhance biodiversity. Retention of all aspen trees will promote their reproduction, which enhances grouse habitat.

**Cultural Concerns:** Crooked Ledge Road was once a busy thoroughfare in the Southampton community center. The old road is lined with impressive stonewalls, which are a part of Southampton's cultural history. They will be protected during the proposed harvest work

Stand Number	Forest Type	Silviculture Practice	Stand Area (acres)	Basal Area Removal (sq.ft)	Volume Removal (MBF)	Firewood Removal (Cords)	Pulpwood Removal (Cords)	Timing
3.04	RP-OH	Selection Method Single Tree and Small Group Salvage Harvest	6.0 ac	100 Sq. Ft.	40 MBF	0	20 cords pine	2015-2017

**Sub-Watershed:** Manhan River

**Management Practice Objective:** Salvage Harvests are usually intermediate treatments that remove badly damaged or dying trees to prevent their financial loss. They address economic concerns more than ecological ones. The subsequent introduction of a dense seedling class will further develop the all-aged, species diverse, resilient natural filtration and purification watershed forest.

**Trees to be Removed and Retained:** Trees for harvest include the red pine crop trees.

**Regeneration Concerns:** The opening on the forest floor will be large enough to accommodate most of the species growing in the surrounding stands.

**Soil Concerns:** Proper maintenance during and after the harvest will prevent any sediment loss along the access road into this area. This small knoll is remote from any direct impact on water quality.

**Boundary Concerns:** Not applicable.

**Invasive Plant Management Concerns** The vigorous new hardwood seedlings should contain the spread of the spotty Japanese barberry and multiflora on the forest floor.

**Habitat Concerns:** Large young forests of seedlings and sapling increase vertical stratification useful to songbirds and provide cover for feeding and foraging of small mammals.

Stand Number	Forest Type	Silviculture Practice	Stand Area (acres)	Basal Area Removal (sq.ft)	Volume Removal (MBF)	Firewood Removal (Cords)	Pulpwood Removal (Cords)	Timing
3.05	OH	Selection Method Single Tree and Small Group Salvage Harvest	30 ac	30 Sq. Ft.	40 MBF	2ocords	10 cords hemlock	2015-2017

**Sub-Watershed:** Manhan River.

**Management Practice Objective:** The Selection Method encourages the development of the all-aged, species diverse, resilient natural purification and filtration forest. Conversion from the two-aged structure with the dominant mature crop and the sparse sapling and pole classes will require several decades. Red oak regeneration is missing from the stand. The small group openings should be placed near the best red oak seed bearers. The release of the oak crowns will also improve their growth and value.

**Trees to be Removed and Retained:** Trees for harvest include some of the dying hemlock trees of sawtimber size (greater than 16 inches with merchantable timber volume), 50% of the scattered white pine crop, 30% of the large diameter red oak crop including all stems with bacterial wet wood ooze on their lower boles, declining paper birch sawtimber crops, inferior red maple pole trees, and black birch pole and sawtimber trees with nectria infections. Crop trees include superior red oak trees (diameter range 18 to 24 inches) with wide spreading crowns and clear lower boles, 50% of the scattered white pine crop, and the vigorous yellow and black birch pole trees.

**Regeneration Concerns:** Use of the Small Group variant will create large enough openings to encourage most site suitable seedlings. I hope that dry site species like white pine and red oak will seed heavily on these droughty Hinckley soils. Disturbance of the mineral soil during open ground conditions will assure higher seed germination rates. Acorns germinate best in mineral soil free of a duff/litter layer. Scarification of the soil surface will create these conditions. Monitoring of the site for the first five years is recommended to assess the oak seed germination success, and planting may be a future consideration.

**Soil Concerns:** The spring seep zones provide an engineering challenge for this project. Road placement must avoid their source and cross at narrow points with a rocky base. Erosion control measure installations during storm events when the harvest is ongoing and post-harvest will stabilize the soils on the roadbeds. Dry or frozen ground conditions during any harvest will also protect soil stability and prevent sediment loss.

**Boundary Concerns:** Not applicable.

**Invasive Plant Management Concerns** Not applicable.

**Habitat Concerns:** The proposed harvest will increase the vertical stratification within this stand and enhance biodiversity. The release of the best red oak crowns increases annual mast production. Retention of a few large, tall white pine trees dotting the upper canopy provides roosting and denning sites.

**Cultural Resource Concerns:** The old sawmill foundation and pond dam will not be disturbed during any proposed management work. These areas are a part of the cultural history of Southampton.



Stand Number	Forest Type	Silviculture Practice	Stand Area (acres)	Basal Area Removal (sq.ft)	Volume Removal (MBF)	Firewood Removal (Cords)	Pulpwood Removal (Cords)	Timing
3.06	WH	Group Selection	14.5	50 sq. ft.	70	10	40 white pine	2015-2017

**Sub-Watershed:** Manhan River

**Management Practice Objective:** The Selection Method encourages the development of the all-aged, species diverse, resilient natural purification and filtration forest. Although unconventional for pine groves, which are usually managed as even aged aggregates, reproductive stocking is missing here. The Selection Method will encourage a diversity of seedling species beneath the residual pine crop. About 50% of the pine crop will remain on site as legacy trees, some of which will live out their biological lifespan. The introduction of younger age classes will direct this stand towards the ideal structure for watershed function.

**Trees to be Removed and Retained:** About 50% of the high value, large diameter white pine trees, 75% of the high value red oak sawtimber trees scattered across the main canopy and large sapling, pole sized black, and yellow birch will be retained as crop trees. The other half of the pine crop and about 25% of the large sized red oak trees will be removed in the proposed work. Pine trees with large black knots, damaged or small crowns, and root swell heaving, as well as red oak with bacterial wet wood ooze at their base will be removed. Some of the red maple and hemlock pole stems will be harvested in the mechanics of felling these large pine stems.

**Regeneration Concerns:** Pine seed requires open mineral soil for germination. Disturbance of the thick duff during the harvest work will prepare this seedbed. The larger openings should accommodate the germination of a wide variety of species.

**Soil Concerns:** These deep sands will support the use of equipment very well. The main hauling road climbs upslope from this area and the timing of the harvest should be set for dry or frozen conditions for protection of the soil structure.

**Boundary Concerns:** Not applicable.

**Invasive Plant Management Concerns** Japanese barberry, multiflora rose, and Asiatic bittersweet are beginning to invade the southern edge of this stand. Their stocking density is still marginally low (B- on the simple A, B, C metric) and treatment should be completed before any harvest work to prevent their spread. Eradication can be accomplished by manual removal of the plants (digging them up by hand and letting them dry out).

**Habitat Concerns:** Vertical stratification after a harvest in the main canopy provides habitat value to songbirds and mammals and increases the local biodiversity.

Stand Number	Forest Type	Silviculture Practice	Stand Area (acres)	Basal Area Removal (sq.ft)	Volume Removal (MBF)	Firewood Removal (Cords)	Pulpwood Removal (Cords)	Timing
3.08	HH	Salvage Harvest Selection harvest System Single Tree	10	50 sq. ft.	25	10	20 hemlock	2015-2017

**Sub-Watershed:** Manhan River

**Management Practice Objective:** The Selection Method encourages the development of the all-aged, species diverse, resilient natural purification and filtration forest. Although unconventional for pine groves, which are usually managed as even aged aggregates, reproductive stocking is missing here. The Selection Method will encourage a diversity of seedling species beneath the residual pine crop. About 50% of the pine crop will remain on site as legacy trees, some of which will live out their biological lifespan. The introduction of younger age classes will direct this stand towards the ideal structure for watershed function.

**Trees to be Removed and Retained:** About 50% of the declining and dying hemlock pole and sawtimber sized trees, 35% of the high value red oak sawtimber trees scattered across the main canopy, and inferior red maple and black birch pole firewood products. Crop trees to be grown for both timber quality improvement and seed bearing purposes include over 60% of the mature red oak sawtimber crops on site, large sapling, pole sized black, and yellow birch and the healthiest hemlock crops will be retained as crop trees. Scattered White Pine trees with large black knots, damaged or small crowns, and root swell heaving, as well as red oak with bacterial wet wood ooze at their base will be removed. Some of the red maple and hemlock pole stems will be harvested in the mechanics of felling these large pine stems.

**Regeneration Concerns:** Pine seed requires open mineral soil for germination. Disturbance of the thick duff during the harvest work will prepare this seedbed. The larger openings should accommodate the germination of a wide variety of species.

**Soil Concerns:** Only a narrow strip of this forest is suitable for timber harvest work. This small strip lies east of the drainage channel from a large spring seep field upon sloping and rocky land. The main hauling road climbs upslope from this area and the timing of the harvest should be set for dry or frozen conditions for protection of the soil structure.

**Boundary Concerns:** Not applicable.

**Invasive Plant Management Concerns** Japanese barberry, multiflora rose, and Asiatic bittersweet are beginning to invade the southern edge of this stand. Their stocking density is still marginally low (B- on the simple A, B, C metric) and treatment should be completed before any harvest work to prevent their spread. Eradication can be accomplished by manual removal of the plants (digging them up by hand and letting them dry out).

**Habitat Concerns:** Vertical stratification after a harvest in the main canopy provides habitat value to songbirds and mammals and increases the local biodiversity.

Stand Number	Forest Type	Silviculture Practice	Stand Area (acres)	Basal Area Removal (sq.ft)	Volume Removal (MBF)	Firewood Removal (Cords)	Pulpwood Removal (Cords)	Timing
3.10	WH	Selection Method with Single Tree and Group Variants	10.4	60 sq. ft.	25	10	40 white pine	2015-2017

**Sub-Watershed:** Manhan River

**Management Practice Objective:** The Selection Method encourages the development of the all-aged, species diverse, resilient natural purification and filtration forest. The Selection Method will encourage a diversity of seedling species beneath the main canopy. About 60% of the healthiest pine crop will remain on site as legacy trees and a seed source. The introduction of younger age classes will direct this stand towards the ideal structure for watershed function. Group size will be limited to less than .5 acres due to the stand’s proximity to the Manhan River. The gaps should be placed next to the best quality hardwood and pine seed bearers.

**Trees to be Removed and Retained:** Pine trees with large black knots, damaged or small crowns, and root swell heaving, some of the live hemlock with less than 50% of live needles, a few high value red oak trees with bacterial wet wood ooze at their bases, poor condition red maple and white ash, black birch pole trees will be removed. The crop trees include high-value red oak and black birch timber crops, 40% of the white pine crop, and the best yellow birch, black birch, red oak, and red maple pole trees.

**Regeneration Concerns:** Pine seed and acorns require open mineral soil for germination. Disturbance of the thick duff during the harvest work will prepare this seedbed for the success of a wide variety of species. The larger openings should accommodate the germination of a wide variety of species.

**Soil Concerns:** The Hinckley soils have large pore structures in the gravel components; they will be highly erodible on the riverbank. Harvest scheduling with frozen or dry ground conditions will protect

the soil structure and prevent erosion. Installation of erosion control methods during the work and after the harvest will prevent any sediment transfer so close to the Manhan River.

**Boundary Concerns:** The northern boundary along this stand is clearly marked with a barbed wire fence and a stone monument. There is some encroachment from the neighbor with debris and compost location. These boundaries will be researched and delineated before any harvest work.

**Invasive Plant Management Concerns** Japanese barberry, glossy buckthorn, and multiflora rose are invading along the western and southern edge of this stand. Their stocking density is still marginally low (B- on the simple A, B, C metric) and treatment should be completed before any harvest work to prevent their spread. Eradication can be accomplished by manual removal of the plants (digging them up by hand and letting them dry out).

**Habitat Concerns:** Vertical stratification after a harvest in the main canopy provides habitat value to songbirds and mammals and increases the local biodiversity. Retention of 60% of the maturing pine component will enhance this stratification.

Stand Number	Forest Type	Silviculture Practice	Stand Area (acres)	Basal Area Removal (sq.ft)	Volume Removal (MBF)	Firewood Removal (Cords)	Pulpwood Removal (Cords)	Timing
3.11	WHK	Salvage	5.5	80 sq. ft.	20	0	10 hemlock	2015-2017

**Sub-Watershed:** Manhan River

**Management Practice Objective:** Salvage Harvest techniques usually address financial concerns, but in this stand, the ecological function of the filtration and purification function of the watershed forest is at risk. If these hemlock crops continue to die without adequate regeneration, soil cover may be lost. The trees are also falling down slope near the intake reservoir for Tighe Carmody and causing debris in the channel near the small dam. The objectives of the harvest are the removal of the hemlock and the introduction of a new age class into this one aged pine and hemlock grove. Sufficient seed is available from the pine trees in the stand and the surrounding hardwood stands.

**Trees to be Removed and Retained:** Over 75% of the overstory hemlock will be harvested in this stand. All of the other growing stock will be retained as forest cover and a seed source.

**Regeneration Concerns:** Some disturbance of the fern layer post-harvest during open ground conditions might be necessary to break up their dense root mats and allow seedling development.

**Soil Concerns:** These deep sands will support the use of equipment very well. The main hauling road climbs upslope from this area and the timing of the harvest should be set for dry or frozen conditions for protection of the soil structure.

**Boundary Concerns:** Not applicable.

**Invasive Plant Management Concerns** Monitoring the site post harvest for the encroachment of these plants from the stands along Fomer Road is recommended.

**Habitat Concerns:** Vertical stratification after a harvest in the main canopy provides habitat value to songbirds and mammals and increases the local biodiversity.



Stand Number	Forest Type	Silviculture Practice	Stand Area (acres)	Basal Area Removal (sq.ft)	Volume Removal (MBF)	Firewood Removal (Cords)	Pulpwood Removal (Cords)	Timing
3.13	WP	Selection Method with Single Tree and Group Variants	35.8	60 sq. ft.	25	10	40 white pine	2015-2017

**Sub-Watershed:** Manhan River

**Management Practice Objective:** The Selection Method encourages the development of the all-aged, species diverse, resilient natural purification and filtration forest. The Selection Method will encourage a diversity of seedling species beneath the main canopy. About 60% of the healthiest pine crop will remain on site as legacy trees and a seed source. The introduction of younger age classes will direct this stand towards the ideal structure for watershed function. Group size will be limited to less than .5 acres due to the stand’s proximity to the Manhan River. The gaps should be placed next to the best quality hardwood and pine seed bearers.

**Trees to be Removed and Retained:** Pine trees with large black knots, damaged or small crowns, and root swell heaving, some of the live hemlock with less than 50% of live needles, a few high value red oak trees with bacterial wet wood ooze at their base, poor condition red maple and white ash, black birch pole trees will be removed. The crop trees include high-value red oak and black birch timber crops, 40% of the white pine crop, and the best yellow birch, black birch, red oak, and red maple pole trees.

**Regeneration Concerns:** Pine seeds and acorns require open mineral soil for germination. Disturbance of the thick duff during the harvest work will prepare this seedbed for the success of a wide variety of species. The larger openings should accommodate the germination of a wide variety of species.

**Soil Concerns:** The Hinckley soils have large pore structures in the gravel components; they will be highly erodible on the riverbank. Harvest scheduling with frozen or dry ground conditions will protect

the soil structure and prevent erosion. Installation of erosion control methods during the work and after the harvest will prevent any sediment transfer so close to the Manhan River.

**Boundary Concerns:** The northern boundary along this stand is clearly marked with a barbed wire fence and a stone monument. There is some encroachment from the neighbor with debris and compost location. These boundaries will be researched and delineated before any harvest work.

**Invasive Plant Management Concerns** Japanese barberry, glossy buckthorn, and multiflora rose are spreading into the stand along the western edge of this stand. Their stocking density is still marginally low (B- on the simple A, B, C metric) and treatment should be completed before any harvest work to prevent their spread. Eradication can be accomplished by manual removal of the plants (digging them up by hand and letting them dry out).

**Habitat Concerns:** Vertical stratification after a harvest in the main canopy provides habitat value to songbirds and mammals and increases the local biodiversity. Retention of 60% of the maturing pine protects the roosting sites for raptors and small mammals.

## SUB-WATERSHED #4: MONTGOMERY

**Property Wide Montgomery Sub-watershed Water Quality Concerns:** This Sub-watershed lies within five hundred feet of the primary drinking supply for the City of Holyoke (Tighe Carmody reservoir). The continuous slope across the Chatfield-Hollis Association soils carries water down slope. These soils have evenly fine sand grains, which allow them to pack well when the pressure of equipment is placed upon them. They will not wash away easily along the roadbeds. All of the merchantable timber across the silviculturally suitable areas must be drawn down slope to an access road, which begins out to the dam area. Some of the old roadbeds, especially the old Town and farm roads across the lot, have eroded below their original grade, and they cross moist areas, spring seeps, and stream channels in inappropriate places or with unsustainable strategies. These roads are not useful for any future harvest work.

Management access into this stand requires the mitigation of several 1<sup>st</sup> order streams. Although their flow is not perennial, portable bridges will be used for these crossings in order to protect their banks. The largest stream (origin small shrub swamp upslope) cuts through the lower slope in a ravine-like formation. This stream will not be crossed, nor will any entry be made into this lower slope zone. It is mandatory that the new roads avoid any moist, low depression, which effuse ground water and feed these streams. Intelligent road design, layout, and diligent harvest supervision will assure the protection of the soil structure during any active management work.

The roads and stream crossings will be constructed in compliance with not only the Required Best Management Practices from the Department of Conservation and Recreation BMP Manual for Timber Harvesting, but also the suggested BMP's. Protection and preservation of the stream banks will prevent any sediment loss into the stream flow. Protection and stabilization measures include hay bales along both banks during the operation and seeding and mulching post-harvest for stabilization and sediment catchment. The harvest will be scheduled for frozen or dry and stable ground conditions. This scheduling reduces the probability of soil displacement. Access for the proposed timber harvests in this area depends upon the harvest road network and a bridge across Tucker brook. The long hauling distance from the forest stands to the landing site mandates some harvest work in the summer with the open ground and no need for plowing.

Stand Number	Forest Type	Silviculture Practice	Stand Area (acres)	Basal Area Removal (sq.ft)	Volume Removal (MBF)	Firewood Removal (Cords)	Pulpwood Removal (Cords)	Timing
4.01	OHK	Selection Method-Single Tree Variant Salvage Harvest	21.3 ac	30 Sq. Ft. Stand Wide 60 Sq. Ft. within Hk sections.	275 MBF	100 cords	200 cords hemlock	2016 to 2018

**Sub-Watershed:** Montgomery

**Management Practice Objective:** The long-term objective for this stand is the mature development of the all-aged, species diverse, ecologically resilient watershed forest capable of natural water filtration and purification. These stands exist in a rudimentary all-aged condition with serious deficiencies in the youngest age classes. The Selection Method encourages the development of the desired optimal watershed forest condition. The Salvage Harvest in the hemlock portions of this stand will create larger openings, which will encourage wide species seed germination.

**Trees to be removed and retained:** Trees for harvest include 25% of the maturing red oak timber crops with emphasis on trees with crown damage, bacterial wet wood ooze at their lower boles, and juxtaposed to a superior seed producing red oak. The salvage work will remove about 80% of the hemlock trees greater than 6 inches in diameter. Hemlocks with less than 50% of their needles living will be harvested. Paper birch timber trees (less than 6% of the total stocking in the stand) greater than 16 inches seem to be in the worst condition; they will be harvested. All of the declining white ash timber crops will be removed. The suppressed co-dominant pine and the damaged or high-risk large, dominant white pine trees with bole defects or root collar upheavals and any pine trees with white pitch oozing from the black knots will be harvested. This criterion includes about 40% of the white pine crop. The crop trees of all species for reserve are the dominant class with deep, wide crowns, large live crown ratios, and strong, tapering boles. Some of the lower strata pole class will be harvested through the mechanics of felling large or because they compete with better immature black or yellow birch and red oak.

**Regeneration Concerns:** Recently many scientists have become alarmed about the failure of oak types to regenerate. Despite a high stocking removal of all overstory competition to the maturing oak crop over twenty years ago, the establishment of red oak replacement crop failed on these sites. The seedling development goal with this work would be to provide at least 150 to 385 established red oak stems per acre. Since red oak seeds germinate in relatively low light levels (average 65% to 86%), the Single tree Selection Method is suitable for this attempt at reproduction.

Actually, the dense lower strata in some sections with beech and hemlock saplings and the witch-hazel shrubs and ironwood saplings provide intense low canopy shade conditions. Removal of this understory shade is more useful in procuring advance red oak regeneration than altering the overstory stocking conditions. Some of these plants will be displaced with a timber harvest, but it will be necessary to enter the stand post-harvest and manually remove more of this stocking. Monitoring the site to determine success with the seedling count per acre for the first five years after harvest is recommended. If the threshold is not met, mineral scarification and planting of red oak seedlings or acorns will be done.

**Soil Concerns:** These soils are loams that hold moisture and move it slowly down slope to the reservoir. Frozen ground in winter or dry and stable late summer and fall ground conditions will protect water quality in the reservoir.

**Boundary Concerns:** The boundaries on the Montgomery parcel are in very poor condition. Two sets of boundary flagging and painting from the past contradict each set's position. No deed information was found yet in the City records. Research and delineation will be completed in 2015.

**Invasive Plant Management Concerns:** Not applicable.

**Habitat Concerns:** The proposed harvest will increase the vertical stratification within this stand and enhance biodiversity. Retention of 20% of the hemlock crop, which is dying, and some of the near dead standing trees provide future cavity trees.

**Cultural Resource Concerns:** The discontinued portion of North Road, which has fallen into total disrepair, crosses the center of this stand. Stonewalls line the roadside at various points, and a few cellar

holes are located along it. Two well-built stone pillars on the Southampton-Montgomery town line sit on the eastern edge of the stand. These are important cultural history artifacts, and they will not be disturbed during a harvest.

## SUB-WATERSHED #5: TUCKER BROOK EAST

**Property Wide Tucker Brook Sub-watershed Water Quality Concerns:** This sub-watershed lies within 800 feet of the drinking water source for the City of Holyoke. The wide, long slope from Fomer Road to Tucker brook (northern section) and the Tighe Carmody reservoir descends across a gentle pitch (less than 5% grade) with the exceptions of a steep cliff like drops at the northern tip of the stand and the inlet from the Manhan River and a 20%+ slope within the dense, maturing hemlock grove. The Merrimac and Hinckley soils have a fine sandy composition with elements of gravel. These soils will compact well during road building and machine use. The 2010-landing site (used for Tucker Brook West oak timber harvest project) will be re-opened for the proposed future work. The main access road to Tucker Brook and the secondary hauling roads through each stand will require the installation of erosion control measures during (in anticipation of severe storm vents) and after the timber harvest work. Delineation of a 100-foot filter strip around the spring seep riparian zones will prevent disturbance to these sensitive sites. All roads will be constructed in compliance with not only the Required Best Management Practices from the Department of Conservation and Recreation BMP Manual for Timber harvesting, but also the suggested BMP's. Protection and preservation of the banks on both sides of the brook will prevent any sedimentation from entering the system. Sections of these dry soils could be worked during dry, open ground conditions, which would be ideal for pine seedbed preparation and seed germination.

Stand Number	Forest Type	Silviculture Practice	Stand Area (acres)	Basal Area Removal (sq.ft)	Volume Removal (MBF)	Firewood Removal (Cords)	Pulpwood Removal (Cords)	Timing
5.01	WP	Irregular Shelterwood	36.2 ac	55 Sq. Ft.	100 MBF	NA	30 cords white pine	2018-2020

**Sub-Watershed:** Tucker Brook East

**Management Practice Objective:** Initiation of the conversion of this stand to the all-aged, species diverse natural purification and filtration watershed forest. The Preparatory Cut of the Irregular Shelterwood Harvest System will be applied here in order to open the canopy for seed germination of pine and hardwood. They set the stage for later regeneration by strengthening and improving the vigor of both the seed bearing and legacy pine trees. The Preparatory Cut retains a moderately high stocking density, which will preserve the aesthetic appeal of this level pine grove along Fomer Road.

**Trees to be Removed and Retained:** Trees for harvest include the suppressed co-dominant pine and the damaged or high-risk large, dominant white pine trees with bole defects or root collar upheavals. Any pine tree with white pitch oozing from the black knots will be harvested. The best pine trees to reserve are the dominant crowns class white pines that have deep, wide crowns, large live crown ratios, and strong, tapering boles. The high quality immature yellow birch, black birch, cheery, and red oak pole trees will be retained for improved growth. Some of the younger hardwood must be removed for the felling and harvesting of the larger pine trees and the work will direct these removals to red maple and beech.

**Regeneration Concerns:** The Preparatory Cut sets the stage for a future harvest, which will encourage regeneration that is more extensive across the stand. Large enough openings need to be made in this harvest so that species, other than the shade tolerant beech and hemlock, spread into the growing space.

**Soil Considerations:** The Hinckley soils are easily worked for road construction; use of the old road system (built over 30 years ago) will minimize soils disturbance. Erosion control measure installations



during storm events' when the harvest is ongoing and post-harvest will stabilize the soils on the roadbeds. Dry or frozen ground conditions during any harvest will also protect soils stability and prevent sediment loss.

**Boundary Concerns:** The north boundary is clearly defined with a barbed wire fence and a stonewall along the proposed harvest edge.

**Invasive Plant Management:** The Japanese barberry and multiflora rose plants along the edge of this stand should be removed prior to the commencement of the harvest to avoid their exploitation of the growing space. Their density is low enough now for manual treatment with plant removal from the soils.

**Habitat Considerations:** The proposed harvest will increase the vertical stratification within this stand and enhance biodiversity. Preparatory harvest for the Irregular Shelterwood System retains about 75% of the stand stocking. Despite this high residual stocking, the vertical stratification will be enhanced greatly due to the pine tree heights. Identification of any nest or roost trees prior to the harvest and their retention during the harvest work is recommended.

Stand Number	Forest Type	Silviculture Practice	Stand Area (acres)	Basal Area Removal (sq.ft)	Volume Removal (MBF)	Firewood Removal (Cords)	Pulpwood Removal (Cords)	Timing
5.02	WH	Selection Method Single Tree and Small Group Salvage Harvest	87.9 ac	30 Sq. Ft.	180 MBF	100 cords	20 cords hemlock 25 cords pine	2018-2020

**Sub-Watershed:** Tucker Brook East

**Management Practice Objective:** The Selection Method encourages the development of the all-aged, species diverse, resilient natural purification and filtration forest. Conversion from the current two-aged structure (with bias towards the oldest age classes) will require several decades on this site. The first phase of this conversion is the establishment of a dense, mixed species seedling class. The use of both the Single Tee and Small group variants accommodates the seed germination requirements white pine and red oak as well as birches and maples. Placement of the small group openings next to the superior red oak and white pine seed bearing tress increases the chances of a good seed catch and seedling development. The openings in the canopy will release the crop trees for improved vigor and value growth.

**Trees to be Removed and Retained:** Trees for harvest include the dying and severely declining hemlock trees of all sizes, which includes trees with over 50% of their live needles gone. White pine crop timber trees (range in diameter from 16 to 24 inches), 25% of the large diameter red oak crop inclusive of all stems with bacterial wet wood ooze on their lower boles, declining paper birch sawtimber crops, inferior red maple pole trees, and black birch pole and sawtimber trees with nectria infections. Crop trees include superior red oak trees with wide spreading crowns and clear lower boles, vigorous yellow and black birch pole tree.

**Regeneration Concerns:** Use of the Small Group variant will create large enough openings to encourage most site-suitable seedlings. I hope that dry site species like white pine and red oak will seed heavy on these sandy loam soils.

**Soil Considerations:** The fine sand and gravel particles compact well under the equipment weight and soil displacement should not be drastic along the main hauling roads. The moist and hummocky soils close to the spring seeps in the center of this stand require frozen or dry and stable ground conditions for harvest. 100-foot filter strips will be delineated around these areas. In the areas closer to the reservoir, emergency erosion control measures must be installed during the harvest in severe storm events.

**Boundary Concerns:** Not applicable.

**Invasive Plant Management:** The Japanese barberry and multiflora rose along Fomer Road and along the edges of Stand 6.04 should be removed prior to the commencement of the harvest to avoid their exploitation of the growing space. Their density is low enough now for manual treatment with plant removal from the soils.

**Habitat Considerations:** The proposed harvest will increase the vertical stratification within this stand and enhance biodiversity. The release of the best red oak crowns increases annual mast production. Retention of the large, tall white pine trees dotting the upper canopy provides roosting and denning sites.

Stand Number	Forest Type	Silviculture Practice	Stand Area (acres)	Basal Area Removal (sq.ft)	Volume Removal (MBF)	Firewood Removal (Cords)	Pulpwood Removal (Cords)	Timing
5.03	WHK	Selection Method Single Tree and	8.50 ac	55 Sq. Ft.	30 MBF	0 cords	35 cords hemlock	2018-2020

**Sub-Watershed:** Tucker Brook East

**Management Practice Objective:** The Selection Method – Single Tree Variant encourages the development of the all-aged, species diverse, resilient natural purification and filtration forest. The sloping land demands the retention of a dense forest cover. The conversion to the ideal watershed filtration forest condition will require three decades or more with the gradual introduction of the younger age classes. The small openings created with this approach should fill with birch, red maple, and possibly some oak and pine on the roadside and adjacent stand edges.

**Trees to be Removed and Retained:** Trees for harvest include the most severely declining hemlock timber crops (diameters greater than 16 inches). These include trees with less than 25% of their live needles. Large white pine trees that exhibit wet wood ooze from their base or sap leaks from the black knots or root swell rising will also be removed. All of the hardwood crops (all sizes and all species) will be retained onsite for seed production, as the hardwood crop will have to replace the dying hemlocks through the next 40 years. Some of the immature, low value hardwood will be harvest in the mechanics or felling and removing the more mature hemlock and pine trees.

**Regeneration Concerns:** Use of the Selection Method Single Tree variant creates small openings across the forest. Fortunately, yellow birch, beech, and red maple pole trees grow here. These shade tolerant trees should set maple seed to start the reproductive process beneath the declining hemlock grove.

**Soil Considerations:** The timber products will be hauled across the slope and eastwards on the existing main access road. Cross contour roads do not encourage as much soil disturbance as a direct climb out of this pocket. As discussed earlier, erosion control measures will be installed during and after any harvest work for site stability and the prevention of sedimentation. Frozen ground in winter or dry and stable open summer ground conditions are required for successful timber harvesting in this stand.

**Boundary Concerns:** The northern boundary along the edge of this stand needs delineation and marking. Illegal hiking paths from the neighbors weave along this area. No clear demarcation of the bound was found near Tucker Brook.

**Invasive Plant Management:** Not applicable.

**Habitat Considerations:** The proposed harvest will minimally increase the vertical stratification within this stand and encourage the low nesters of the interior hemlock forest. Retention of the large, tall white pine trees dotting the upper canopy provides roosting and denning sites.

## SUB-WATERSHED #7: WEST SHORE

**Property Wide West Shore Sub-watershed Water Quality Concerns:** This Sub-watershed lies along the western shore of the primary drinking supply for the City of Holyoke (Tighe Carmody reservoir). These soils across the watershed have very fine sand grains, which allow them to pack well when the pressure of equipment is placed upon them. They will not wash away easily along the roadbeds. All of the merchantable timber across the silviculturally suitable areas must be drawn across the gentle upper slope contour to an access road, which begins out to the dam area. Some of the old roadbeds (Especially the old Town and farm roads across the lot) have eroded below their original grade, and they cross the moist areas, spring seeps, and stream channels in unacceptable places or manners. These roads will be abandoned for any future harvest.

Management access into this stand requires the mitigation of several first order streams. Although their flow is not perennial, portable bridges will be used for these crossings in order to protect their banks. The largest stream (origin small shrub swamp upslope) cuts through the lower slope in a ravine-like formation. This stream will not be crossed, nor will any entry be made into this lower slope zone. It is mandatory that the new roads avoid any moist, low depression, which effuse ground water and feed these streams. Intelligent road design, layout, and diligent harvest supervision will assure the protection of the soil structure during any active management work.

The roads and stream crossings will be constructed in compliance with not only the Required Best Management Practices from the Department of Conservation and Recreation BMP Manual for Timber harvesting, but also the suggested BMP's. Protection and preservation of the stream banks will prevent any sediment loss into the stream flow. Protection and stabilization measures include hay bales along the both banks during the operation and seeding and mulching post harvest for stabilization and sediment catchment. The harvest work should be ideally scheduled for frozen ground in the winter or stable and dry ground conditions condition in the summer or fall months. This scheduling reduces the probability of soil displacement. One main access road will cross the western portions of these stands on the upper slopes. Avoidance of any crossings of the spring seep drainages channels is possible with a network of diagonal side roads.

Stand Number	Forest Type	Silviculture Practice	Stand Area (acres)	Basal Area Removal (sq.ft)	Volume Removal (MBF)	Firewood Removal (Cords)	Pulpwood Removal (Cords)	Timing
7.01	OHK	Selection Method-Single Tree Variant Salvage Harvest	158.3 ac	30 Sq. Ft.	60 MBF	40 cords	20 cords hemlock	2016 to 2018

**Sub-Watershed:** West Shore

**Management Practice Objective:** The long-term objective for this stand is the development of the all-aged, species diverse, ecologically resilient watershed forest capable of natural water filtration and purification. These stands exist in a rudimentary all-aged condition with serious deficiencies in the youngest age classes. The Selection Method encourages the development of the desired optimal watershed forest condition. The Single Tree variant limits the size of the openings on the forest floor, and reduces exposure of the forest soils. Salvage harvests will recover the financial value in the declining white ash and hemlock timber crops. The larger openings from these trees will accommodate the seed germination requirements of a host of species.

**Trees to be removed and retained:** Trees for harvest include 25% of the maturing red oak timber crops with emphasis on trees with crown damage, bacterial wet wood ooze at their lower boles, or juxtaposed to a superior seed producing red oak. Black birch and red maple sawtimber and pole trees will be harvested when they compete with the crowns of the superior crop trees. Most of the white ash timber trees greater than 16 inches in diameter will be harvested to recover their financial value before attacks by the emerald ash borer. About 65% of the largest hemlock timber trees with greater than 75% of their live needles lost will be harvested. The crop trees of all species for reserve are the dominant class with deep, wide crowns, large live crown ratios, and strong, tapering boles. Some of the lower strata pole class will be harvested through the mechanics of felling larger trees.

**Regeneration Concerns**: Recently many scientists have become alarmed about the failure of oak types to regenerate. Despite a high stocking removal of all overstory competition to the maturing oak crop over twenty years ago, the establishment of red oak replacement crop failed on these sites. The seedling development goal with this work would be to provide at least 150 to 385 established red oak stems per acre. Since red oak seeds germinate in relatively low light levels (average 65% to 86%), the Single tree Selection Method is suitable for this attempt at reproduction.

Actually, the dense lower strata in some sections with beech and hemlock saplings and the witchazel shrubs and ironwood saplings provide intense low canopy shade conditions. Removal of this understory shade is more useful in procuring advance red oak regeneration than altering the overstory stocking conditions. Some of these plants will be displaced with a timber harvest, but it will be necessary to enter the stand post-harvest and manually remove more of this stocking. Monitoring the site to determine success with the seedling count per acre for the first five years after harvest is recommended. If the threshold is not met, mineral scarification and planting of red oak seedlings or acorns will be done.

**Soil Considerations**: These soils are loams that hold moisture and move it slowly down slope to the reservoir. Winter harvesting with frozen or dry and stable ground conditions will protect water quality in the reservoir. The harvest work should be ideally scheduled for frozen ground in the winter or stable and dry ground conditions condition in the summer or fall months. This scheduling reduces the probability of soil displacement. One main access road will cross the western portions of this stand on the upper slopes. Avoidance of any crossings of the spring seep drainages channels is possible with a network of diagonal side roads.

**Boundary Concerns**: The boundaries on the southern section of the watershed are in very poor condition. No deed information was found yet in the City records. Research and delineation will be completed in 2015 prior to any timber harvesting.

**Invasive Plant Management**: Not applicable.

**Habitat Concerns**: The proposed harvest will increase the vertical stratification within this stand and enhance biodiversity. Retention of 20% of the hemlock crop, which is dying, and some of the near dead standing trees provide future cavity trees.



Stand Number	Forest Type	Silviculture Practice	Stand Area (acres)	Basal Area Removal (sq.ft)	Volume Removal (MBF)	Firewood Removal (Cords)	Pulpwood Removal (Cords)	Timing
7.02	BM	Selection Method-Single Tree Variant	79.5 ac	30 Sq. Ft.	70 MBF	75 cords	20 cords hemlock	2016 to 2018

**Sub-Watershed:** West Shore

**Management Practice Objective:** The long-term objective for this stand is the mature development of the all-aged, species diverse, ecologically resilient watershed forest capable of natural water filtration and purification. These stands exist in a rudimentary all-aged condition with serious deficiencies in the youngest age classes. The Selection Method encourages the development of the desired optimal watershed forest condition. The Single Tree variant limits the size of the openings on the forest floor, and reduces exposure of the forest soils.

**Trees to be removed and retained:** Trees for harvest include 25% of the maturing red oak timber crops with emphasis on trees with crown damage, bacterial wet wood ooze at their lower boles, juxtaposed to a superior seed producing red oak. Black birch and red maple sawtimber and pole tress will be harvested when they compete with the crowns of the superior crop trees. The crop trees of all species for reserve are the dominant class with deep, wide crowns, large live crown ratios, and strong, tapering boles. Some of the lower strata pole class will be harvested through the mechanics of felling larger trees

**Regeneration Concerns:** Recently many scientists have become alarmed about the failure of oak types to regenerate. Despite a high stocking removal of all overstory competition to the maturing oak crop over twenty years ago, the establishment of red oak replacement crop failed on these sites. The seedling development goal with this work would be to provide at least 150 to 385 established red oak stems per acre. Since red oak seeds germinate in relatively low light levels (average 65% to 86%), the Single tree Selection Method is suitable for this attempt at reproduction.

Actually, the dense lower strata in some sections with beech and hemlock saplings and the witchazel shrubs and ironwood saplings provide intense low canopy shade conditions. Removal of this understory shade is more useful in procuring advance red oak regeneration than altering the overstory stocking conditions. Some of these plants will be displaced with a timber harvest, but it will be necessary to enter the stand post-harvest and manually remove more of this stocking. Monitoring the site to determine success with the seedling count per acre for the first five years after harvest is recommended. If the threshold is not met, mineral scarification and planting of red oak seedlings or acorns will be done.

**Soil Concerns:** These deep rich loams hold water and the engineering of the road system must avoid the main spring seep site. The installation of emergency erosion control measures during the harvest and immediate after snowmelt the next spring post harvest will reduce the risk of sediment loss. The harvest work should be ideally scheduled for frozen ground in the winter or stable and dry ground conditions condition in the summer or fall months. This scheduling reduces the probability of soil displacement. One main access road will cross the western portions of this stand on the upper slopes. Avoidance of any crossings of the spring seep drainages channels is possible with a network of diagonal side roads.

**Boundary Concerns:** The boundaries on the southern section of the watershed are in very poor condition. No deed information was found yet in the City records. Research and delineation will be completed in 2015 prior to any timber harvesting.

**Invasive Plant Management:** Not applicable.

**Habitat Considerations:** The proposed harvest will increase the vertical stratification within this stand and enhance biodiversity. Retention of 20% of the hemlock crop, which is dying, and some of the near dead standing trees provide future cavity trees.

Stand Number	Forest Type	Silviculture Practice	Stand Area (acres)	Basal Area Removal (sq.ft)	Volume Removal (MBF)	Firewood Removal (Cords)	Pulpwood Removal (Cords)	Timing
7.04	OH	Selection Method-Single Tree Variant	55.0	30 Sq. Ft.	70 MBF	75 cords	20 cords hemlock	2016 to 2018

**Sub-Watershed:** West Shore

**Management Practice Objective:** The long-term objective for this stand is the mature development of the all-aged, species diverse, ecologically resilient watershed forest capable of natural water filtration and purification. These stands exist in a rudimentary all-aged condition with serious deficiencies in the youngest age classes. The Selection Method encourages the development of the desired optimal watershed forest condition. The Single Tree variant limits the size of the openings on the forest floor, and reduces exposure of the forest soils.

**Trees to be removed and retained:** Trees for harvest include 25% of the maturing red oak timber crops with emphasis on trees with crown damage, bacterial wet wood ooze at their lower boles, juxtaposed to a superior seed producing red oak. Black birch and red maple sawtimber and pole tress will be harvested when they compete with the crowns of the superior oak crop trees. The crop trees of all species for reserve are the dominant class with deep, wide crowns, large live crown ratios, and strong, tapering boles. Some of the lower strata pole class will be harvested through the mechanics of felling larger trees or because they compete with better immature black or yellow birch and red oak.

**Regeneration Concerns:** Recently many scientists have become alarmed about the failure of oak types to regenerate. Despite a high stocking removal of all overstory competition to the maturing oak crop over twenty years ago, the establishment of red oak replacement crop failed on these sites. The seedling development goal with this work would be to provide at least 150 to 385 established red oak stems per acre. Since red oak seeds germinate in relatively low light levels (average 65% to 86%), the Single tree Selection Method is suitable for this attempt at reproduction.

Actually, the dense lower strata in some sections with beech and hemlock saplings and the witch-hazel shrubs and ironwood saplings provide intense low canopy shade conditions. Removal of this understory shade is more useful in procuring advance red oak regeneration than altering the overstory stocking conditions. Some of these plants will be displaced with a timber harvest, but it will be necessary to enter the stand post-harvest and manually remove more of this stocking. Monitoring the site to determine success with the seedling count per acre for the first five years after harvest is recommended. If the threshold is not met, mineral scarification and planting of red oak seedlings or acorns will be done.

**Soil Concerns:** These deep rich loams hold water and the engineering of the road system must avoid the main spring seep site. The installation of emergency erosion control measures during the harvest and immediate after snowmelt the next spring post harvest will reduce the risk of sediment loss. The harvest work should be ideally scheduled for frozen ground in the winter or stable and dry ground conditions condition in the summer or fall months. This scheduling reduces the probability of soil displacement. One main access road will cross the western portions of this stand on the upper slopes. Avoidance of any crossings of the spring seep drainages channels is possible with a network of diagonal side roads.

**Boundary Concerns:** The boundaries on the southern section of the watershed are in very poor condition. No deed information was found yet in the City records. Research and delineation will be completed in 2015 prior to any timber harvesting.

**Invasive Plant Management:** Not applicable.

**Habitat Concerns:** The proposed harvest will increase the vertical stratification within this stand and enhance biodiversity. Retention of 20% of the hemlock crop, which is dying, and some of the near dead standing trees provide future cavity trees.

**SUB-WATERSHED #8: WOLF HILL**

**Property Wide Wolf Hill Sub-watershed Water Quality Concerns:** The terrain follows a continuous slope to the eastern shore of the Tighe Carmody Reservoir. These soils have evenly fine sand grains, which allow them to pack well with the pressure of equipment upon them. They will not wash away easily along the roadbeds. Over 75% of the merchantable timber across the silviculturally suitable areas must be drawn upslope to landing spots along Fomer Road. Work in the northern portion requires one crossing of a wetland area that feeds a drainage system into the central swamp. This small swamp area holds water and releases it slowly into the reservoir after the depositing of sediments and nutrients into the swamp muck. Extensive pole placement along this road across the wetland will hold soil in place during the timber harvest. Access into the southern portion will travel to an existing landing location along Manhan Road immediately north of the main water line grass strip. The road network can avoid contact with any major seep drainage or stream flow with careful design. This material will be hauled across the contour reducing the risk of soil loss.

The roads and stream or wetland crossings will be constructed in compliance with not only the Required Best Management Practices from the Department of Conservation and Recreation BMP Manual for Timber Harvesting, but also the suggested BMP's. Portable bridges and mats will be used for any run-off or 1<sup>st</sup> order stream crossing. Protection and preservation of the stream banks will prevent any sediment loss into the stream flow. Protection and stabilization measures include hay bales along any stream or run-off banks during the operation and seeding and mulching post harvest for stabilization and sediment catchment. The silvicultural dilemma of seedbed preparation versus stable site conditions raises its head again in this area. If possible, some open ground harvest work is necessary for good seedbed preparation and mineral soil disturbance. Yet the proximity of the western edges to the reservoir merits prudence in scheduling. The harvest will be scheduled for frozen or dry and stable conditions.

Stand Number	Forest Type	Silviculture Practice	Stand Area (acres)	Basal Area Removal (sq.ft)	Volume Removal (MBF)	Firewood Removal (Cords)	Pulpwood Removal (Cords)	Timing
8.01	OH	Selection Method-Single Tree Variant Salvage Harvest	236.0	30 to 40	230	240	75 cords hemlock and pine	2022-2024

**Sub-Watershed:** Wolf Hill

**Management Practice Objective:** The long-term objective for this stand is the mature development of the all-aged, species diverse, ecologically resilient watershed forest capable of natural water filtration and purification. These stands exist in a rudimentary all-aged condition with serious deficiencies in the youngest age classes. The Selection Method encourages the development of the desired optimal watershed forest condition. The Salvage Harvest of the minor components of hemlock, white ash, and paper birch across this stand address financial issues. Release of crop trees crowns improves their growth and quality.

**Trees to be removed and retained:** Trees for harvest include 25% of the maturing red oak timber crops with emphasis on trees with crown damage, bacterial wet wood ooze at their lower boles, and juxtaposition to a superior seed producing red oak. The salvage work will remove about 65% of the hemlock trees greater than 6 inches in diameter. Trees with more than 50% needle death will be harvested. Paper birch timber trees (less than 6% of the total stocking in the stand) greater than 16 inches seem to be in the worst condition; they will be harvested. All of the declining white ash timber crops will be removed. Large diameter white pine with bole defects or root collar upheavals and any pine trees with white pitch oozing from the black knots will be harvested. This criterion includes about 40% of the white pine crop. Some of the lower strata pole class will be harvested through the mechanics of felling large or because they compete with superior red maple, hickory, cherry, black or yellow birch and red oak pole and small sawtimber sized stems. The crop trees of all species for reserve are the dominant class with deep, wide crowns, large live crown ratios, and strong, tapering boles. Crop trees chosen for habitat benefit are described below.

**Regeneration Concerns:** Recently many scientists have become alarmed about the failure of oak types to regenerate. Despite a high stocking removal of all overstory competition to the

maturing oak crop over twenty years ago, the establishment of red oak replacement crop failed on these sites. The seedling development goal with this work would be to provide at least 150 to 385 established red oak stems per acre. Since red oak seeds germinate in relatively low light levels (average 65% to 86%), the Single tree Selection Method is suitable for this attempt at reproduction.

Actually, the dense lower strata in some sections with the witch-hazel shrubs and ironwood saplings provide intense low canopy shade conditions. Removal of this understory shade is more useful in procuring advance red oak regeneration than altering the overstory stocking conditions. Some of these plants will be displaced with a timber harvest, but it will be necessary to enter the stand post-harvest and manually remove more of this stocking. Monitoring the site to determine success with the seedling count per acre for the first five years after harvest is recommended. If the threshold is not met, mineral scarification and planting of red oak seedlings or acorns will be done.

**Soil Considerations:** These soils are loams that hold moisture and move it slowly down slope to the reservoir. The harvest work should be ideally scheduled for frozen ground in the winter or stable and dry ground conditions condition in the summer or fall months. This scheduling reduces the probability of soil displacement. One main access road will cross the western portions of this stand on the upper slopes. Avoidance of any crossings of the spring seep drainages channels is possible with a network of diagonal side roads.

**Boundary Concerns:** Not applicable.

**Invasive Plant Management:** Several of the invasive hotspots that surround or grow within the spring seep sources, their adjacent wetlands, and the flow channels are found in this large stand. Treatment of the plants on the edges of these spots is recommended before any timber harvest work. It may not be necessary to fully treat the entire hotspot and incur those costs, but the edge treatment will prevent the spread of these plants onto the new open forest floor conditions. No work will be done in or within 100-feet of the old settlement site on Fomer Road for the protection of this cultural resource. Edge removals are still necessary around the stonewalls and foundations.

Annual monitoring inspections of the forest conditions post harvest for detection of spread into the regeneration zones will direct the use of resources for plant removals. Some of the removal work can be

done manually with the removal of the plants from the soils. The areas with a B+ or higher stocking level rating (consistent at edges also) may require treatment in the hot spots with the use of minimally toxic herbicides, mechanical methods, and manual treatments for successful stocking reduction.

**Habitat Considerations:** The proposed harvest will increase the vertical stratification within this stand and enhance biodiversity. Retention of 20% of the hemlock crop, which is dying, and some of the near dead standing trees provides future cavity trees. Scattered pockets of aspen sapling, pole, and timber crops provide ideal grouse habitat conditions. All of these small groves will be retained across the stand. Delineation of a 75-foot filter strip around all spring seep and their associated wetland spots will protect these important sources of water in winter and the feed value of their dense shrub cover.

**Cultural Resource Concerns:** The old settlement area along Fomer Road and its extensive stonewall network are the artifacts of a once prosperous farm in the community center of 1880's Southampton. The condition of the sawmill and wheelhouse foundations on the stream inlet to the reservoir is very good. These areas are pieces of Southampton's cultural history, and they will be preserved through any management work. Wide buffer strips will be delineated around them to prevent any disturbance.



Stand Number	Forest Type	Silviculture Practice	Stand Area (acres)	Basal Area Removal (sq.ft)	Volume Removal (MBF)	Firewood Removal (Cords)	Pulpwood Removal (Cords)	Timing
8.03	HH	Selection Method- Single Tree Variant  Salvage Harvest	59.7	55 to 65	90	20	50 cords hemlock	2022- 2024

**Sub-Watershed:** Wolf Hill

**Management Practice Objective:** The long-term objective for this stand is the mature development of the all-aged, species diverse, ecologically resilient watershed forest capable of natural water filtration and purification. These stands are lacking the youngest age classes. The Selection Method Single-Tree variant encourages the development of the desired optimal watershed forest condition. The Salvage Harvest of the minor components of hemlock across this stand addresses financial issues. The release of the crowns of the red oak, aspen, hickory, and black birch (in both upper and lower strata) crop trees improves their growth and quality.

**Trees to be removed and retained:** Trees for harvest include 25% of the maturing red oak timber crops with emphasis on trees with crown damage, bacterial wet wood ooze at their lower boles, and juxtaposition to a superior seed producing red oak. The salvage work will remove about 65% of the hemlock trees greater than 6 inches in diameter. Trees with greater than 50% needle death will be harvested. Large diameter white pine with bole defects or root collar upheavals and any pine trees with white pitch oozing from the black knots will be harvested. This criterion includes about 40% of the white pine crop. Pole sized beech; red maple and black birch (average diameter range 6 to 9 inches) will be harvested in the mechanics of the overstory removals. Some of the lower strata pole class will be harvested because they compete with superior red maple, hickory, black or yellow birch and red oak pole and small sawtimber sized stems. The crop trees of red oak, aspen, hickory, and black birch species for reserve are the dominant class with deep, wide crowns, large live crown ratios, and strong, tapering boles.

**Regeneration Concerns:** The forest floor is free of any significant reproductive growth. The salvage work will make bigger gaps in the main canopy, which should accommodate the seed germination requirements of many species. The timber harvest work should disturb the witch-

hazel growth (covers 20% of the forest floor in some areas) sufficiently for seedling development.

**Soil Considerations:** These soils drain water into the central swamp area, which filters sediment and nutrients before its transfer to the reservoir. The main harvest road for the central portion of the harvest project has to cross the small stream exiting the spring seep field. This road must climb the slope into Stand 8.01. Hauling timber products uphill requires careful engineering on these soils. Installation of emergency erosion control measures at the necessary stream and wetland crossing will minimize sediment loss into the stream flow.

The harvest work should be ideally scheduled for frozen ground in the winter or stable and dry ground conditions condition in the summer or fall months. This scheduling reduces the probability of soil displacement. One main access road will cross the western portions of this stand on the upper slopes. Avoidance of any crossings of the spring seep drainages channels is possible with a network of diagonal side roads.

**Boundary Concerns:** The boundaries in this area are not delineated. Trespass issues are common with some illegal timber harvesting. Research of the deeds and boundary delineation is necessary before the preparation of a harvest project.

**Invasive Plant Management:** The two invasive hotspots in the small shrub swamp and spring field (and along the stream course) will require some treatment before the proposed timber harvest. Treatment of the plants on the edges of these spots is recommended to prevent their spread into the interior hemlock grove. Annual monitoring inspections of the forest conditions post harvest for detection of spread into the regeneration zones will direct the use of resources for plant removals. The removal work can be done manually with the removal of the plants from the soils.

**Habitat Considerations:** The proposed harvest will increase the vertical stratification within this stand and enhance biodiversity. Retention of some of the dying hemlock crop provides future cavity trees. Scattered pockets of aspen sapling, pole, and timber crops provide ideal grouse habitat conditions. All of these small groves will be retained across the stand. Delineation of a 75-foot filter strip around all spring seep and their associated wetland spots will protect these important sources of water in winter and the feed value of their dense shrub cover.

Stand Number	Forest Type	Silviculture Practice	Stand Area (acres)	Basal Area Removal (sq.ft)	Volume Removal (MBF)	Firewood Removal (Cords)	Pulpwood Removal (Cords)	Timing
8.09	HH	Selection Method-Single Tree Variant Salvage Harvest	28.6	55 to 65.	90	20	50 cords hemlock	2022-2024

**Sub-Watershed:** Wolf Hill

**Management Practice Objective:** The long-term objective for this stand is the mature development of the all-aged, species diverse, ecologically resilient watershed forest capable of natural water filtration and purification. These stands are lacking the youngest age classes. The Selection Method Single-Tree variant encourages the development of the desired optimal watershed forest condition. The Salvage Harvest of the minor components of hemlock and white ash across this stand addresses financial issues. The release of the crowns of the red oak, red maple, sugar maple and black birch (in both upper and lower strata) crop trees improves their growth and quality.

**Trees to be removed and retained:** Trees for harvest include 25% of the maturing red oak timber crops with emphasis on trees with crown damage, bacterial wet wood ooze at their lower boles, and juxtaposition to a superior seed producing red oak. The salvage work will remove about 40% of the hemlock trees greater than 6 inches in diameter. Trees with greater than 75% needle death will be harvested. Although many more trees could be taken, the proximity of this site to the reservoir requires a conservative approach. White ash timber crops (most greater than 17 inches) will be harvested. Some of the lower strata pole class will be harvested because they compete with superior red maple, hickory, black or yellow birch and red oak pole and small sawtimber sized stems. The crop trees of red oak, aspen, hickory, and black birch species for reserve are the dominant class with deep, wide crowns, large live crown ratios, and strong, tapering boles.

**Regeneration Concerns:** The forest floor is free of any significant reproductive growth. The salvage work will make bigger gaps in the main canopy, which should accommodate the seed germination requirements of many species. The goal for regeneration in this stand is the development of at least 1,000 seedlings per acre within five years of all the present overstory species. Replacement of the cover on this lower slope is essential for water quality protection.

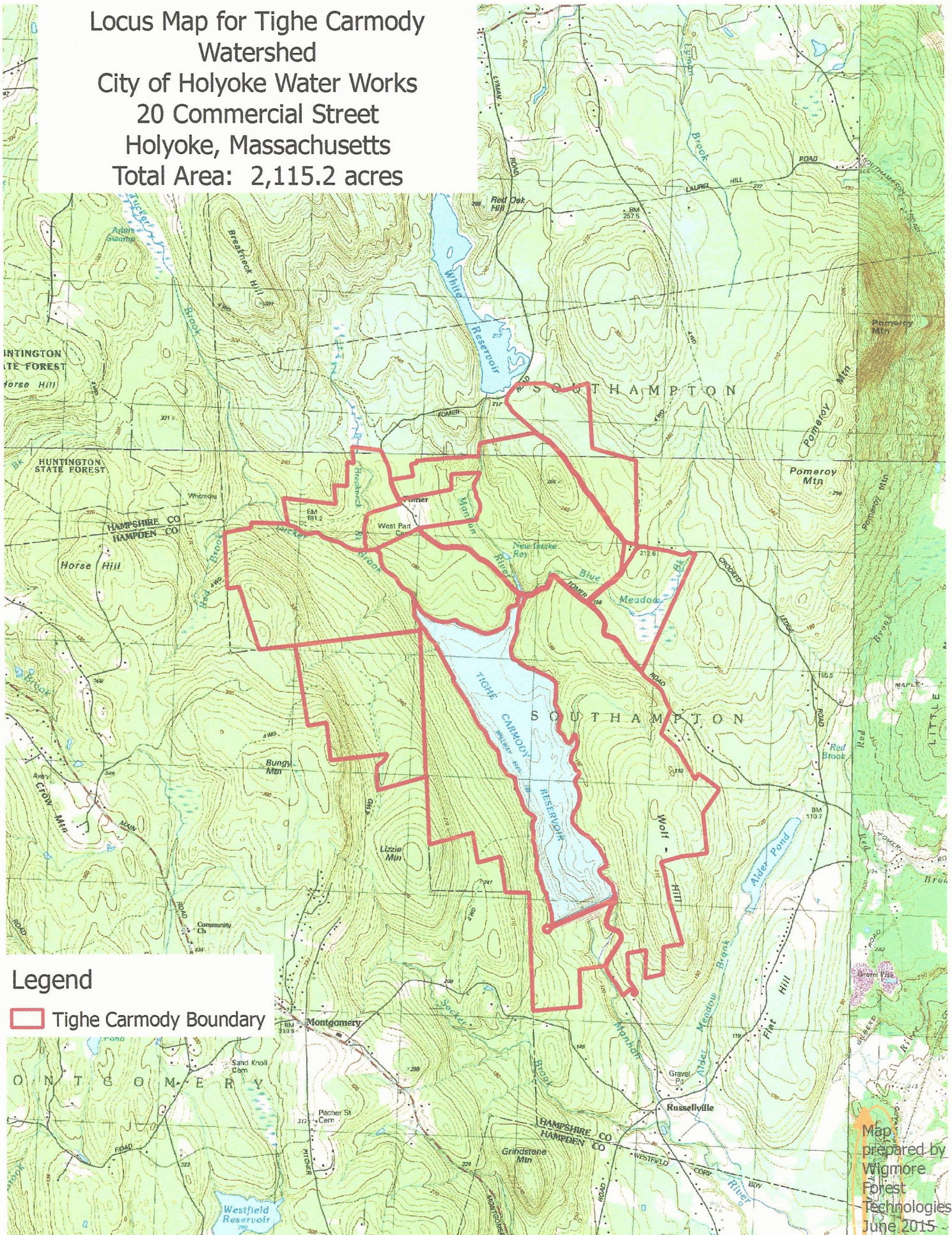
**Soil Considerations:** These soils drain water directly into Tighe Carmody Reservoir. The conservative application of the harvest would minimize the risk of sediment loss. The harvest work should be ideally scheduled for frozen ground in the winter or stable and dry ground conditions condition in the summer or fall months. This scheduling reduces the probability of soil displacement. One main access road will cross the western portions of this stand on the upper slopes. Avoidance of any crossings of the spring seep drainages channels is possible with a network of diagonal side roads.

**Boundary Concerns:** Not applicable.

**Invasive Plant Management:** The invasive plants along the northern edge of the stand will require some treatment before the proposed timber harvest to prevent their spread into the interior hemlock grove. Annual monitoring inspections of the forest conditions post harvest for detection of spread into the regeneration zones will direct the use of resources for plant removals. The removal work can be done manually with the removal of the plants from the soils.

**Habitat Considerations:** The proposed harvest will increase the vertical stratification within this stand and enhance biodiversity. Retention of some of the dying hemlock crop provides future cavity trees. Retention of the dying hemlock for site cover will also retain cavity trees.

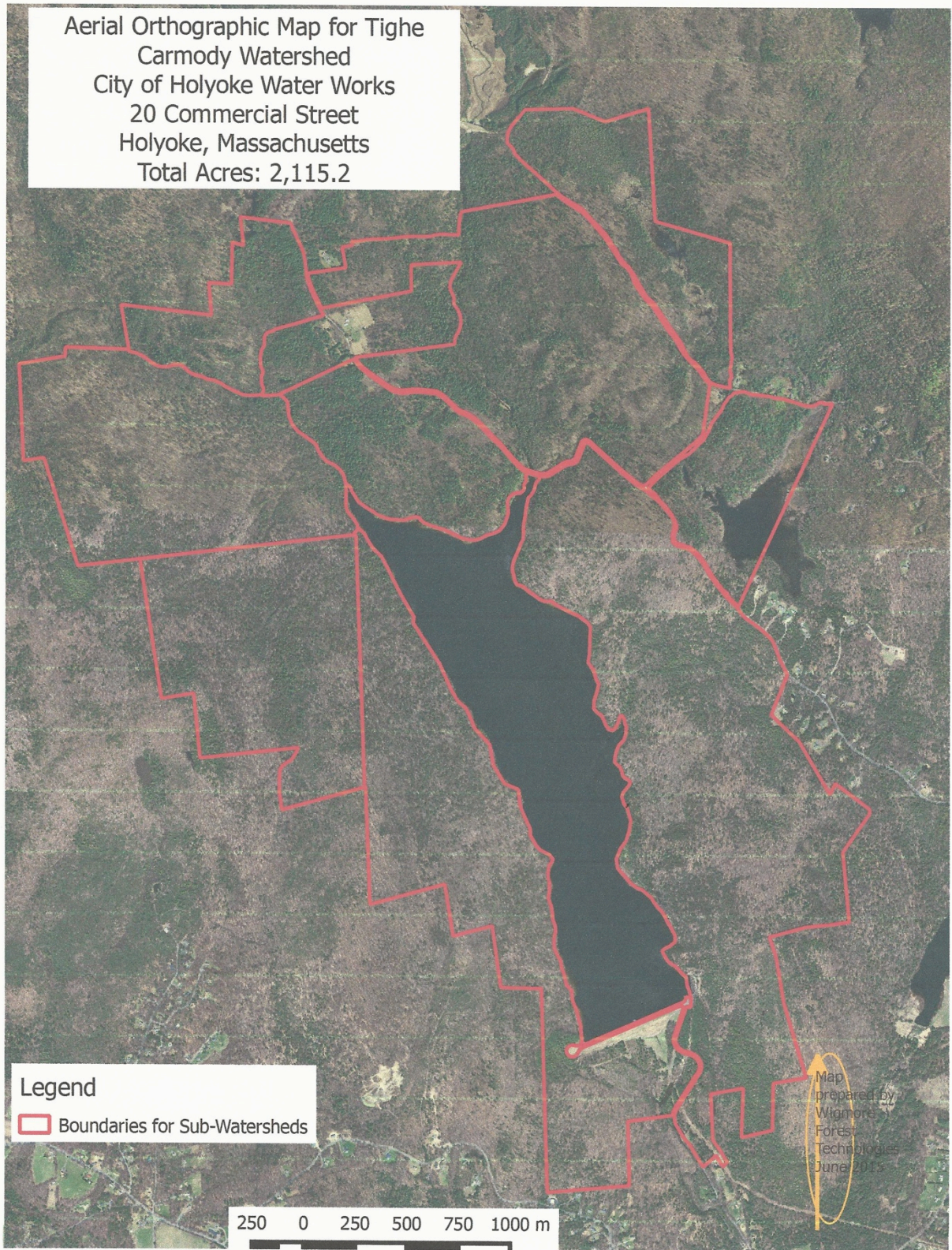
Locus Map for Tighe Carmody  
Watershed  
City of Holyoke Water Works  
20 Commercial Street  
Holyoke, Massachusetts  
Total Area: 2,115.2 acres



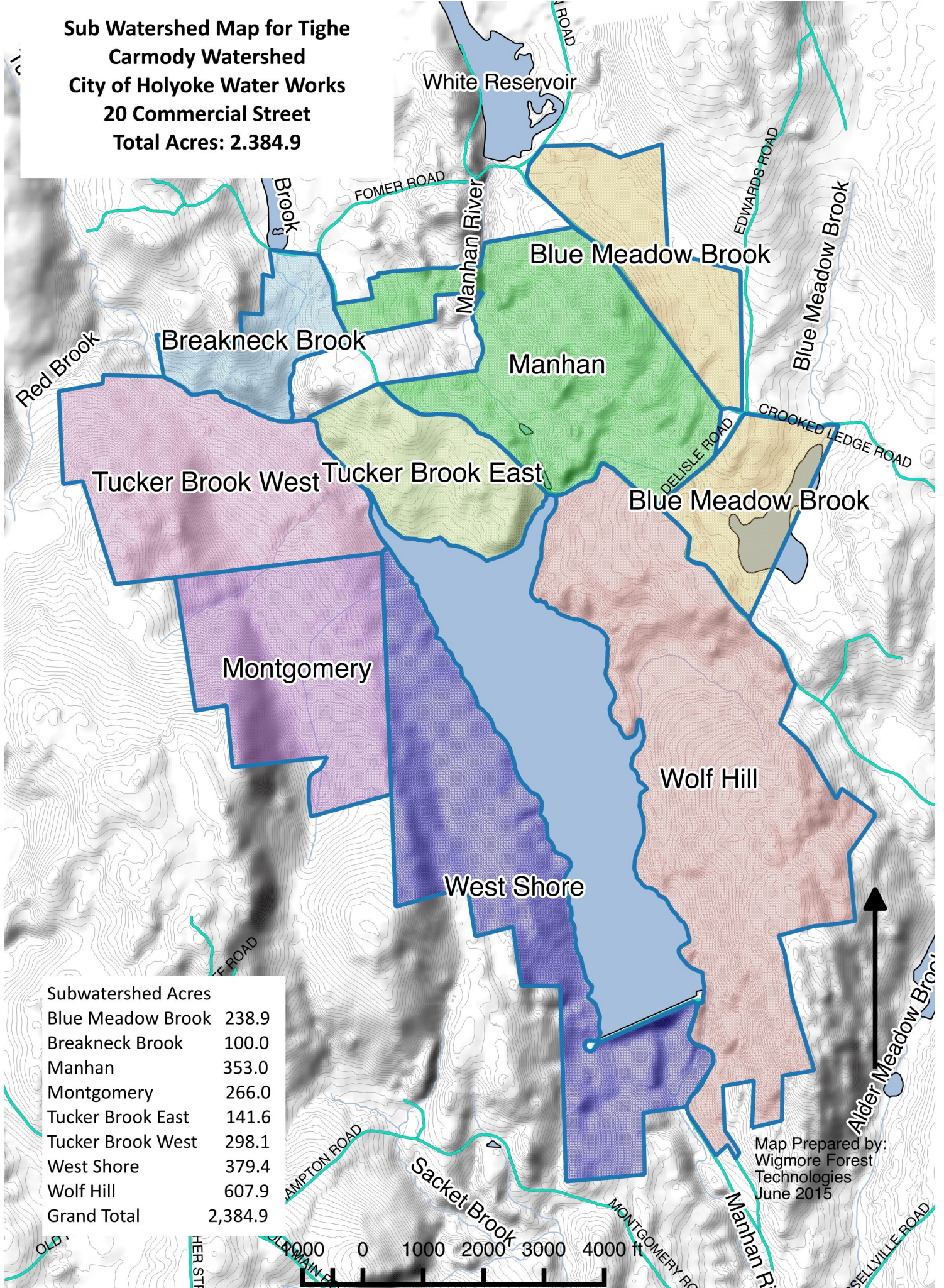
**Legend**

 Tighe Carmody Boundary

Map prepared by  
Wigmore  
Forest  
Technologies  
June 2015

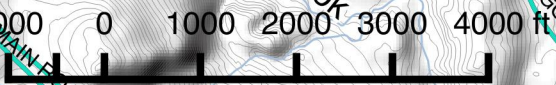


**Sub Watershed Map for Tighe Carmody Watershed  
City of Holyoke Water Works  
20 Commercial Street  
Total Acres: 2,384.9**



Subwatershed Acres	
Blue Meadow Brook	238.9
Breakneck Brook	100.0
Manhan	353.0
Montgomery	266.0
Tucker Brook East	141.6
Tucker Brook West	298.1
West Shore	379.4
Wolf Hill	607.9
<b>Grand Total</b>	<b>2,384.9</b>

Map Prepared by:  
Wigmore Forest  
Technologies  
June 2015











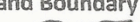




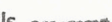



Sub watershed  
# 2

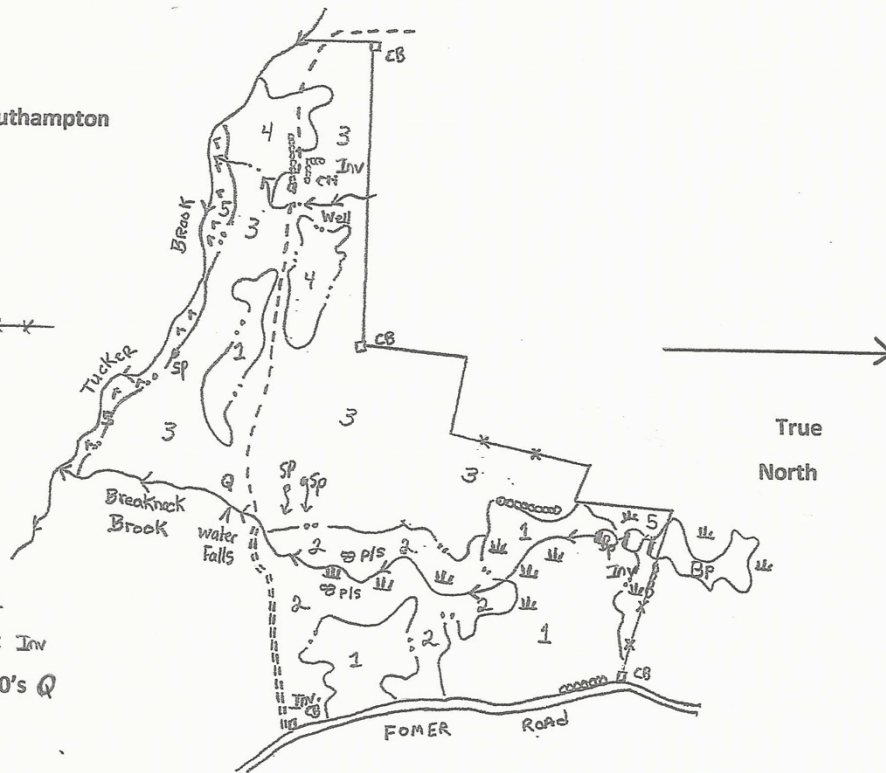
**Forest Stand Map for the Property of  
The City of Holyoke Water Works  
20 Commercial Street  
Holyoke, Massachusetts 01040  
The Breakneck Brook Sub-watershed  
69.1 acres**

Map Scale:  
660 feet

Assessors Records:  
Map 9 Lot 5  
No deed reference in Southamptton  
Assessor's Office.

Physical Feature Legend

- Barbed Wire fence 
- Beaver Pond 
- Cellar Hole CH 
- Cement Bound 
- Forest Stand Number 1
- Forest Stand Boundary 
- Hydric Soils/Wetland 
- Invasive Species Hotspot 
- Old quarry site from 1880's 
- Spring Seep 
- Stonewalls 
- Stream 
- Town Road 
- Woods Road 



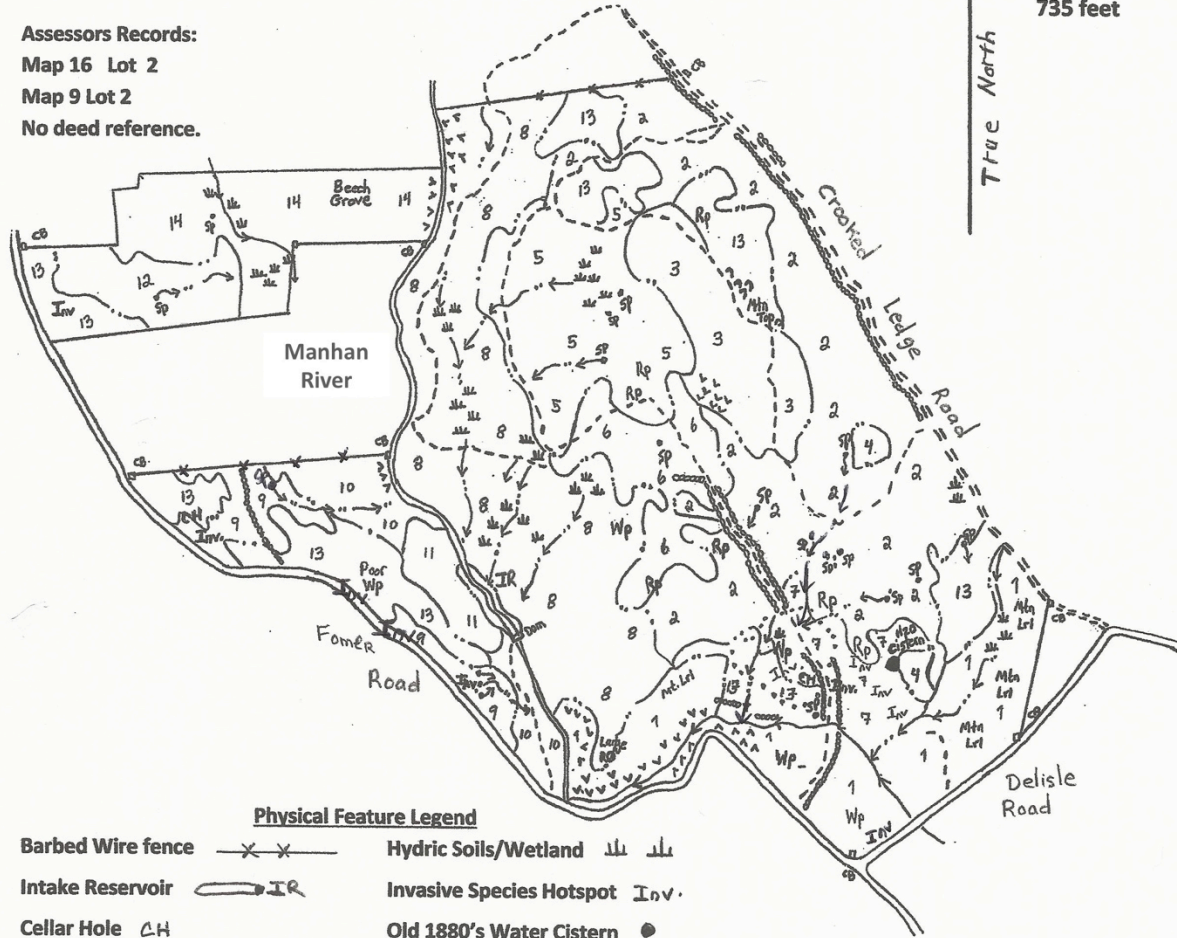
This map was prepared by Wigmore Forest Resource Management  
In June 2015 from Southamptton tax maps, GPS survey in October to  
December 2014 and old HWW records. This is not a survey map.

**Forest Stand Map for the Property of  
The City of Holyoke Water Works  
20 Commercial Street  
Holyoke, Massachusetts 01040  
The Manhan River Sub-Watershed  
341.90 acres**

Sub-watershed #3

**Map Scale:  
735 feet**

**Assessors Records:  
Map 16 Lot 2  
Map 9 Lot 2  
No deed reference.**



**Physical Feature Legend**

Barbed Wire fence	— x x —	Hydric Soils/Wetland	ll ll
Intake Reservoir	— IR —	Invasive Species Hotspot	Inv.
Cellar Hole	△H	Old 1880's Water Cistern	●
Cement Bound	□ CB	Town Road	==
Forest Stand Number	1	Spring Seep	~
Forest Stand Boundary	- · - · -	Stonewalls	o o o o o o o o
Grove of White Pine	ST WP	Steep Slopes	v v v v
Grove of RP Timber	RP	Stream	→ or → · · →
		Woods Road	- - - - -

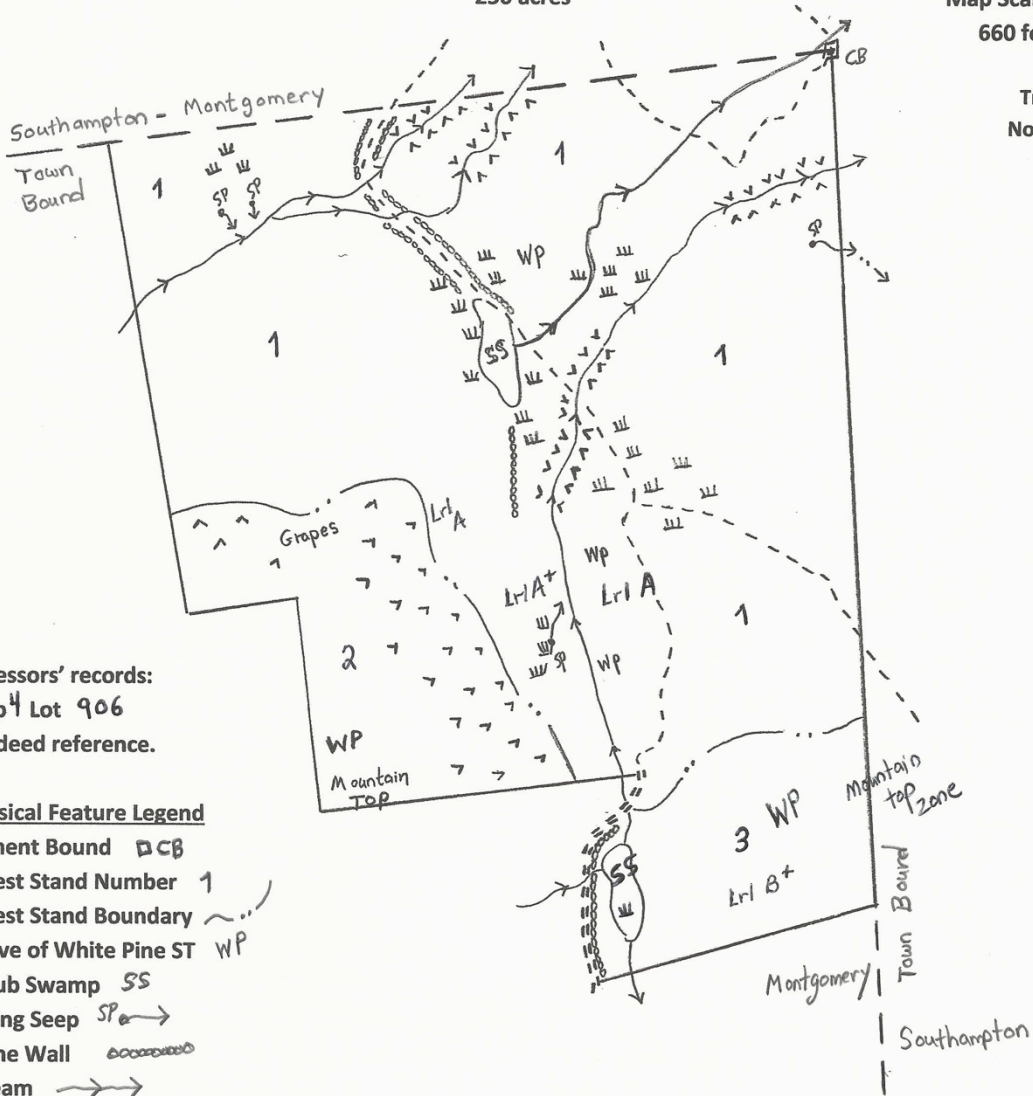
This map was prepared by Wigmore Forest Resource Management in June 2015 from Southampton tax maps, GPS survey in October to December 2014 and old HWW records. This is not a survey map.

Forest Stand Map for the Property of  
 The City of Holyoke Water Works  
 20 Commercial Street  
 Holyoke, Massachusetts 01040  
The Montgomery Sub-watershed  
 250 acres

Sub watershed  
 # 4

Map Scale:  
 660 feet

True  
 North



Assessors' records:  
 Map 4 Lot 906  
 No deed reference.

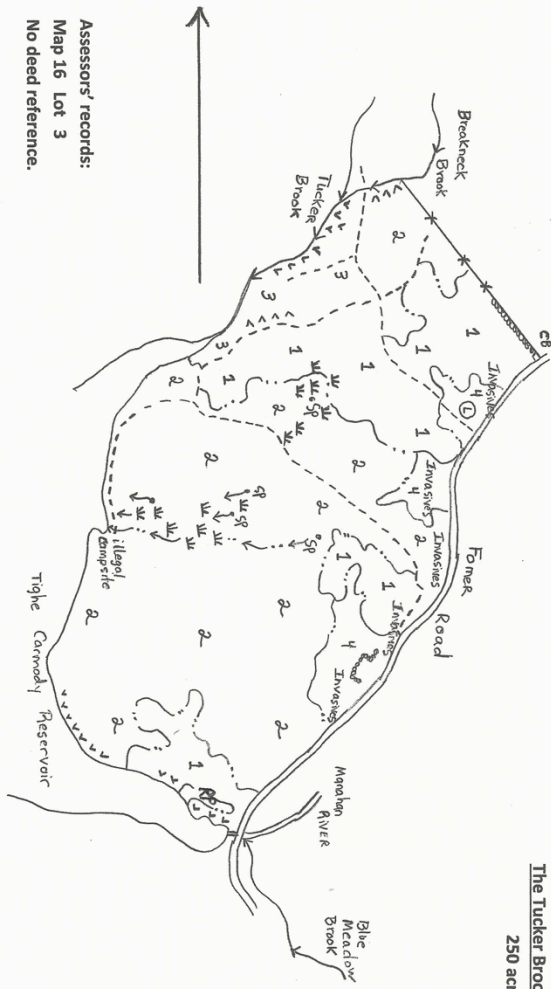
Physical Feature Legend

- Cement Bound □ CB
- Forest Stand Number 1
- Forest Stand Boundary ~~~~
- Grove of White Pine ST WP
- Shrub Swamp SS
- Spring Seep SP →
- Stone Wall ○○○○○○○
- Stream →→→
- Steep Slope √√√√
- Hydric Soils/Wetland ≡

This map was prepared by Wigmore Forest Resource Management In June 2015 from Montgomery tax maps, GPS survey in October to December 2014 and old HWW records. This is not a survey map.

Subwatershed # 5

Forest Stand Map for the Property of  
The City of Holyoke Water Works  
20 Commercial Street  
Holyoke, Massachusetts 01040  
The Tucker Brook East Sub-watershed  
250 acres



Assessors' records:  
Map 16 Lot 3  
No deed reference.

**Physical Feature Legend**

- Cement Bound □ CB
- Forest Stand Number 1
- Forest Stand Boundary

- Invasive Species Hotspot Inv.
- Spring Seep sp
- Stream

- Stonewall
- Steep Slope
- Town Road
- Woods Road

This map was prepared by Wigmore Forest Resource Management in June 2015 from Southampton tax maps, GPS survey in October to December 2014 and old HWW records. This is not a survey map.

Subwatershed # 5

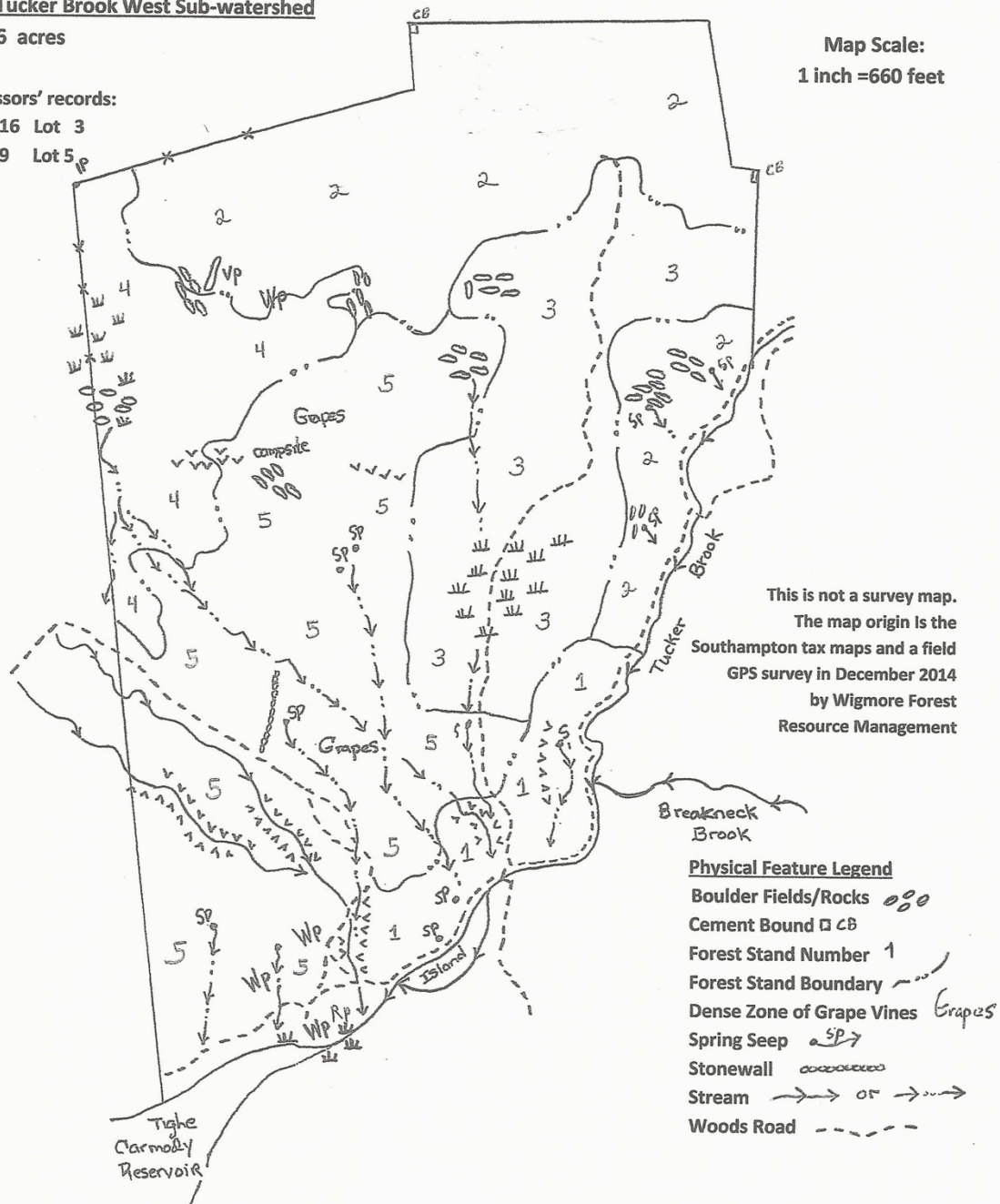
Subwatershed # 6.

Forest Stand Map for the Property of  
The City of Holyoke Water Works  
20 Commercial Street  
Holyoke, Massachusetts 01040  
The Tucker Brook West Sub-watershed  
289.6 acres

Assessors' records:  
Map 16 Lot 3  
Map 9 Lot 5

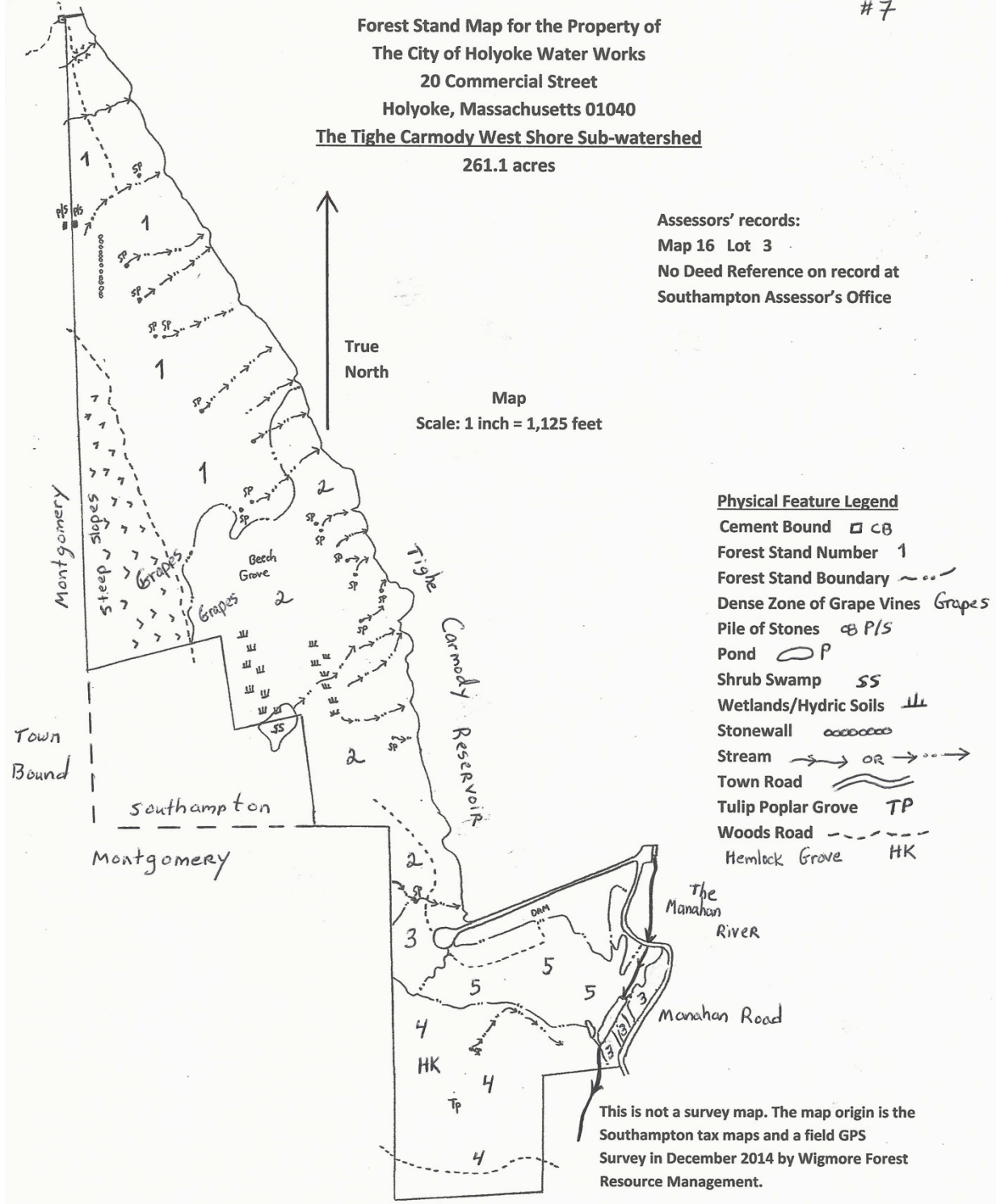
True North

Map Scale:  
1 inch = 660 feet



Subwatershed #7

Forest Stand Map for the Property of  
The City of Holyoke Water Works  
20 Commercial Street  
Holyoke, Massachusetts 01040  
The Tighe Carmody West Shore Sub-watershed  
261.1 acres



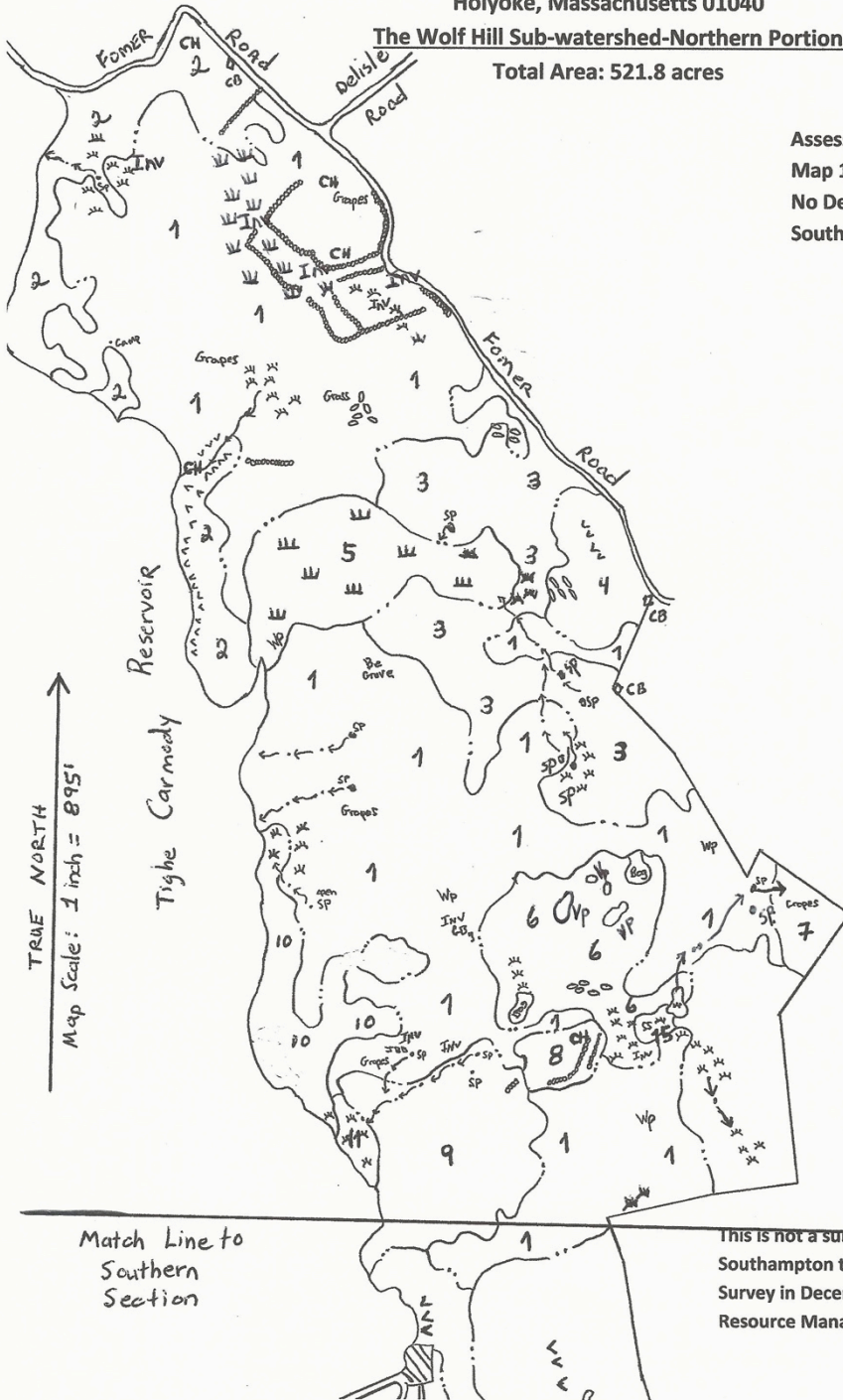
Sub watershed  
# 8 (a)

Forest Stand Map for the Property of  
The City of Holyoke Water Works  
20 Commercial Street  
Holyoke, Massachusetts 01040

The Wolf Hill Sub-watershed-Northern Portion

Total Area: 521.8 acres

Assessors' records:  
Map 16 Lot 3  
No Deed Reference on record at  
Southampton Assessor's Office



- Physical Feature Legend
- Bog
  - Cellar Hole
  - Cement Bound
  - Forest Stand Number
  - Forest Stand Boundary
  - Dense Zone of Grape Vines
  - Groves of White Pine ST
  - Invasive Plant Hotspot
  - Pond
  - Shrub Swamp
  - Wetlands/Hydric Soils
  - Stonewall
  - Stream
  - Town Road
  - Tulip Poplar Grove
  - Woods Road
  - Vernal pool

TRUE NORTH  
Map Scale: 1 inch = 895'

Match Line to  
Southern  
Section

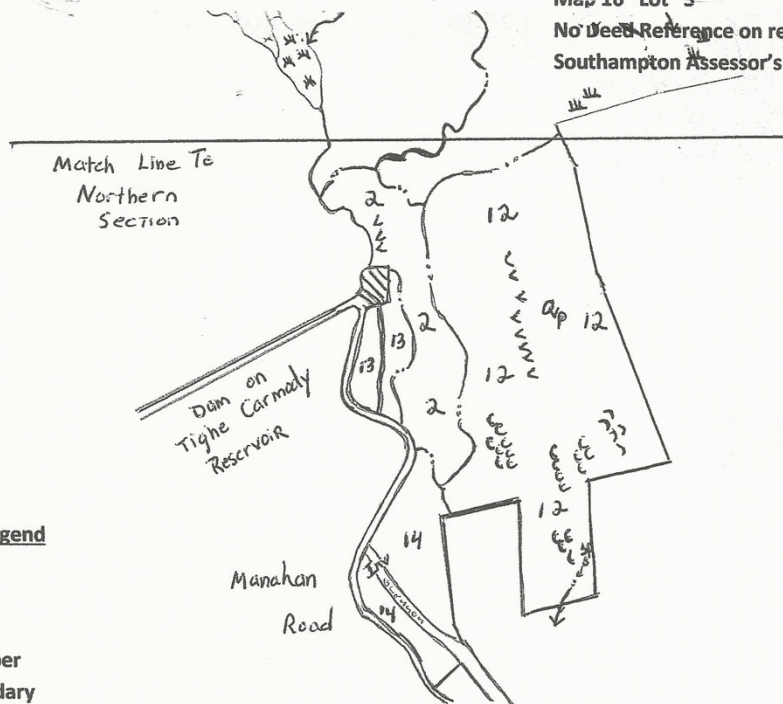
This is not a survey map. The map origin is the  
Southampton tax maps and a field GPS  
Survey in December 2014 by Wigmore Forest  
Resource Management.

Sub watershed  
# 8(b)

Forest Stand Map for the Property of  
The City of Holyoke Water Works  
20 Commercial Street  
Holyoke, Massachusetts 01040  
The Wolf Hill Sub-watershed-Southern Portion  
Total Area: 521.8 acres

True North  
Map Scale: 1 inch = 895 Feet

Assessors' records:  
Map 16 Lot 3  
No Deed Reference on record at  
Southampton Assessor's Office



**Physical Feature Legend**

- Bog
- Cellar Hole
- Cement Bound
- Forest Stand Number
- Forest Stand Boundary
- Dense Zone of Grape Vines
- Groves of White Pine ST
- Invasive Plant Hotspot
- Pond
- Shrub Swamp
- Wetlands/Hydric Soils
- Stonewall
- Stream
- Town Road
- Tulip Poplar Grove
- Woods Road
- Vernal Pool

This is not a survey map. The map origin is the Southampton tax maps and a field GPS Survey in December 2014 by Wigmore Forest Resource Management.



**APPENDIX A**

**City of Holyoke-Holyoke Water Works**

**Forest Stewardship Outreach Plan**

Wigmore Forest Resource Management

Massachusetts Licensed Forester #250

July 2015

**EXECUTIVE SUMMARY**

This Forest Stewardship Outreach Plan was prepared concurrently with the Green Certification and Forest Stewardship Plan for the City of Holyoke-Holyoke Water Works for the 2,384.9 -acre Tighe Carmody Reservoir watershed lands. The Natural Heritage and Endangered Species Program BioMap2 Project rate this extensive forested ecosystem as an ecologically resilient landscape. This rating indicates the site's ability to accommodate a wide array of wildlife species inclusive of the wide-ranging species such as moose or bobcat, adapt well to climate change, and integrate landscape disturbance easily. The City of Holyoke manages a working Tree Farm upon the larger watershed. In over thirty years, millions of board feet of sawtimber products and thousands of cords of both firewood and pulpwood have left these woods during the course of the routine maintenance of a natural water quality purification and filtration forest. The City hopes to begin a more active forest management program in 2015 with the support and participation of the local community.

The preparation of the FSC Green Certification and Forest Stewardship Plan for the Tighe Carmody Watershed Forest was funded by a grant from the Massachusetts Department of Conservation and Recreation (DCR). The City of Holyoke and HWW have a responsibility to the community for the inclusion of an education and outreach program to the public on issues of forest stewardship, the use of a forest as a natural filter for water quality filtration, and general forest ecology issues. The following Forest Stewardship Outreach Plan summarizes the planned stewardship activities. This Forest Stewardship Outreach Plan was prepared with the assistance of Butch Seidel, HWW Operations Director.

The Forest Stewardship Outreach Plan discusses the planned activities in chronological order. The City of Holyoke sets out two major goals for their community outreach program which are as follows:

- 1. To educate the public about the importance of the care, maintenance and perpetuation of a healthy, resilient, multi-age, species rich natural water filtration and purification forest ecosystem upon the Tighe Carmody Watershed lands;**
- 2. To engage the citizens of Holyoke and the neighboring community, with emphasis to Southampton for Tighe-Carmody, in the stewardship of the forest ecosystem at Tighe-Carmody.**

The main ideas and management philosophy within the FSC Green certification and Forest Stewardship Management Plan 2015 will be presented at a public forum in both Holyoke and Southampton. These educational forums promote an understanding of the mechanics of the natural filtration forested watershed. The Southampton Board of Selectmen has requested a special meeting for the presentation of the management plan basic ideas and our proposals for silviculture projects in the 2015 to 2020 period.

Other measures for the fulfillment of this goal will bring the community into the forest. A series of twilight and weekend hiking tours of the watershed lands will demonstrate the concepts of the natural water purification and filtration forest ecosystem to community participants. Field tours during all phases of the forest management work on the silviculture treatment sites will demonstrate the mechanics and benefits of a forest harvest operation.

Work towards the fulfillment of the public engagement goals include the organization and facilitation of a volunteer non-chemical Invasive Species' Control Program within the community for the watershed lands, a historic tour of the foundations for the old Southampton community center inclusive house and barn foundations, sawmill and wheelhouse foundations on the reservoir, and manufacturing sites.

**Goal #1:** To educate the public about the importance of the care, maintenance, and perpetuation of a healthy, resilient, multi-age, species rich, natural water filtration and purification forest ecosystem upon the Tighe Carmody Reservoir Watershed lands.

**Target Audience:**

- The un-invited recreationists on the watershed for camping, hiking, ATV riding, and mountain biking.
- Elected Public officials in the Town of Southampton and the City of Holyoke.
- Members of local environmental activist organization.
- Members of the Southampton, Westhampton, and Holyoke Conservation Commissions.
- Property owners in the Fomer Road and crooked Ledge Road neighborhoods.

**Basic Message:**

- Forested ecosystems filter and purify drinking water as it moves through this natural system.
- Harvesting forest crops is a vital part of the regeneration, maintenance, and stewardship of a natural water filter.
- Maintenance of the watershed forest does not negatively influence the other valuable services such as wildlife habitat, carbon sequestration, aesthetic appeal, and biodiversity provided by a watershed forest ecosystem.

**Possible Partners in Delivery of the Message:**

- Massachusetts Department of Conservation and Recreation
- Massachusetts Forest Alliance
- American Tree Farm Council
- Holyoke Water Works
- Massachusetts Division of Fish and Game, and Massachusetts
- Several community members with expertise in botany, plant identification, and natural history.
- Holyoke Water Works Manager, David Conti
- Department of Conservation and Recreation
- Several community members with expertise in botany, plant identification (Randall Stone-Retired DCR Water Resources Division Forester and fern expert), and natural history (Molly Hale-Natural Historian)

## Activities and Implementation Schedule:

### **Year 1: September 2015:**

Public Presentation of a PowerPoint Summary of the Forest Stewardship Plan for the Southampton and Holyoke Communities and the Concepts of the Natural Water Filtration and Purification Forested Ecosystem and its care and stewardship.

- 
- **Responsible Parties:** HWW and Field Watershed Manager.  
**Advertisement:**
  - **Notice on the Southampton and Holyoke websites.**
  - **Posters on the notice board at the Southampton Town Hall, Holyoke City hall, and both libraries.**
  - **Notice in the Hampshire Gazette, the Holyoke Sun, and the Westfield Record.**
  - **Notice mailed to the server list of Massachusetts Forest Alliance**
  - **Notice sent through the server list for the Southampton and Holyoke Conservation Commission**
  - **Invitation to elected town officials.**
  - **Notice to DCR District service Forester.**
  - **Notice to Massachusetts Woodland Institute web events board.**

**Evaluation and Documentation:** A survey will be administered to the participants of the public forums, which will be analyzed into a report for an archive with the City and delivery to the Massachusetts Forest Stewardship Program. The City and HWW hopes to measure an increased level of awareness and knowledge about the forested watershed ecosystem management and a community-wide acceptance of the working forest model.

### **Year 1 to Year 5: A series of three field tours through each silviculture treatment site with a Pre-harvest, During-harvest, and Post-harvest tour at each proposed harvest site:**

Weekend or twilight walks through the silvicultural treatment/timber harvest sites to demonstrate each phase of the silvicultural operation/timber harvest project for the encouragement regeneration of the forest.

**Responsible Parties:** DPW Water Division and Field Watershed Manager.

### **Advertisement:**

- **Notice on the Southampton and Holyoke websites.**

- Posters on the notice board at the Southampton Town Hall, Holyoke City hall, and both libraries.
- Notice in the Hampshire Gazette, the Holyoke Sun, and the Westfield Record.
- Notice mailed to the server list of Massachusetts Forest Alliance
- Notice sent through the server list for the Southampton and Holyoke Conservation Commission
- Invitation to elected town officials.
- Notice to DCR District service Forester.
- Notice to Massachusetts Woodland Institute web events board.
- Notice to Massachusetts Woodland Institute web events board.

**Evaluation and Documentation:** A survey will be administered to the participants of the public forums, which will be analyzed into a report for an archive with the Town and delivery to the Massachusetts Forest Stewardship Program. The Town hopes to measure an increased level of awareness and knowledge about the forested watershed ecosystem management and an acceptance of the working forest model.

**Goal #2:** To engage the citizens of the City of Holyoke and the neighboring community in the active management of the natural water filtration and purification forest ecosystem at the Tighe Carmody Reservoir Watershed

**Target Audience:**

- Voting citizens and water users of the City of Holyoke.
- Students in the Holyoke Public School System, Environmental Science and nature teachers within the City of Holyoke Public School System
- Local Boy Scout troops and Eagle Scout candidates
- Members of the Holyoke, Southampton, and Westhampton Conservation Commission
- Notice sent to the Massachusetts Forest Alliance server list

**Basic Message:**

- This is your working forest, which produces clean water for the City of Holyoke’s primary drinking water system.
- It takes a lot of time and commitment to care and steward a forest ecosystem.
- Local wood products needs can be met from a working forest without any loss of the other valuable benefits of a forested watershed ecosystem.

**Possible partners in the delivery of the message:**

- **Massachusetts Department of Conservation and Recreation**
- **Massachusetts Forest Alliance**
- **American Tree Farm Council**
- **Holyoke Water Works**
- **Massachusetts Division of Fish and Game, and Massachusetts**
- **Several community members with expertise in botany, plant identification, and natural history.**
- **Holyoke Water Works Manager, David Conti**
- **Department of Conservation and Recreation**
- **Several community members with expertise in botany, plant identification (Randall Stone-Retired DCR Water Resources Division Forester and fern expert), and natural history (Molly Hale-Natural Historian)**

**Activities and Implementation Schedule:**

**Year 1 to Year 5:** Twilight and or weekend walks through culturally significant zones on the watershed for a discussion the general natural history and cultural history of the Southampton community and to promote an n appreciation for this cultural treasure.

**Responsible Parties:** DPW Water Division and Field Watershed Manager.

**Advertisement:**

- **Notice on the Southampton and Holyoke websites.**
- **Posters on the notice board at the Southampton Town Hall, Holyoke City hall, and both libraries.**
- **Notice in the Hampshire Gazette, the Holyoke Sun, and the Westfield Record.**
- **Notice mailed to the server list of Massachusetts Forest Alliance**
- **Notice sent through the server list for the Southampton and Holyoke Conservation Commission**
- **Invitation to elected town officials.**
- **Notice to DCR District service Forester.**
- **Notice to Massachusetts Woodland Institute web events board.**

**Evaluation and Documentation:** A survey will be administered to the participants of the public forums, which will be analyzed into a report for an archive with the City and delivery to the Massachusetts Forest Stewardship Program. The Town hopes to measure an increased level of awareness and knowledge about the forested watershed ecosystem management and an acceptance of the working forest model.

**Year 1 to Year 5:** Initiation of a volunteer work effort for the removal of Invasive Plant Species on the Tighe Carmody Watershed around the foundations of the old Southampton community center along Blue Meadow Brook on Fomer Road. Year #1- Late summer and fall work dates.

**Responsible Parties:** HWW, Attorneys for the City of Holyoke, and Field Watershed Manager.

**Advertisement:**

- **Notice on the Southampton and Holyoke websites.**
- **Public notice at the Southampton and Holyoke libraries and Town/City Halls.**
- **Public notice in Daily Hampshire Gazette, Westfield Record, and Holyoke Sun.**
- **Invitations to Local Boy Scout troops and Eagle Scout candidates.**
- **Invitations to the Southampton and Holyoke Conservation Commissions.**

**Evaluation and Documentation:** The Participants in the Invasive Species Control Project will complete a survey upon completion of one years' service as volunteers to measure their awareness of the important of their efforts and the reasons for invasive removal. A summary of the participant surveys will be documented for use by the to