FOREST STEWARDSHIP-GREEN CERTIFICATION MANAGEMENT PLAN FOR THE PROPERTY OF CITY OF HOLYOKE WATER WORKS
THE ASHLEY PONDS RESERVOIR LANDS
Located on Westfield Road, Holyoke, Massachusetts
TOTAL FORESTED AREA 814.4 ACRES

Presented by Holyoke Water Works:
Our Mission: "Providing High Quality Water to our Customers at Competitive Rates"
Manager David Conti, 20 Commercial Street, Holyoke, Massachusetts

Prepared By: Wigmore Forest Resource Management,
Mary K. Wigmore (MLF 250),
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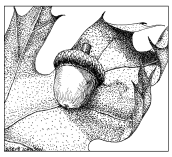
1637 West Road
Williamsburg, MA 010196
January 2016

dcr

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	CH61A	CH61B	STWSHP	C-S	Case No.		Orig. Case No.	
cert. ☐	cert. ☐	cert. ☐	new ☒	EEA ☒	Owner ID		Add. Case No.	
recert. ☐	recert. ☐	recert. ☐	renew ☐	Other ☐	Date Rec'd		Ecoregion	
amend ☐	amend ☐	amend ☐	Green Cert ☒		Plan Period		Topo Name	
			Conservation Rest. ☐		Rare Spp. Hab.		River Basin	
Plan Change: _____ to _____			CR Holder _____					

OWNER, PROPERTY, and PREPARER INFORMATION

Property Owner(s): **City of Holyoke –Holyoke Water Works-Ashley Ponds Reservoir Property**
Mailing Address: **20 Commercial Street, Holyoke, MA 01040** Phone: **413.536.0442**
Email Address: _____

Property Location: Town(s) **Holyoke** Road(s) **Highway #202-Westfield Road**

Plan Preparer**:** **Mary K. Wigmore** Mass. Forester License #: **250**
Mailing Address: **1637 West Road – Williamsburg, MA 01096** Phone: **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
177	**13**	**33475**	**174464**	**27.3**			**2.8**	**24.5**
193	**001**	**xx**	**xx**	**550.0**			**12.1**	**537.9**
176	**51**	**33475**	**174464**	**19**			**0**	**19**

Excluded Area Description(s) **(if additional space needed, continue on separate paper)**
The excluded area on all parcels except Map 177-lot 13 contains the water area of the alluvial outwash ponds. Please see page -2- for the continuation of the assessor's and legal records. Total Stewardship and Green Certification Area equals 815 acres.

HISTORY

Year acquired 1800's Year management began 1970

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.

(Form revised April 2010)

Front Page Overflow Form: CONTINUANCE OF ASSESSOR'S RECORDS AND EXCLUDED AREA DESCRIPTION FOR THE ASHLEY PONDS RESERVOIR LANDS

Assessor Map Number	Assessor Lot Number	Deed Book Reference	Deed Page Reference	Total Area-Acres	Stew/GC Exclusion Area-Acres	Stew/GC Certified Area-Acres
180	**01**	**XX**	**XX**	**903.8**	**670.8**	**233**
			Totals	**1,500.1**	**685.7**	**814.4**

Map 180-Lot 001: **Administrative Exclusion Areas from**

1. The water tank site: Located on the Wright Cut-off Road on the northern section of the lot near Route 202. Begin at a point on said road thence S4E for 159 feet; thence S24W for 253 feet; thence S79E for 455 feet; thence N45E for 300 feet; thence S88E for 105 feet; thence N4E for 145 feet to a point on the Wright Cut-Off Road, and thence along said access road for 400 feet to the point of beginning. Site contains **6.9 acres**.
2. The gravel bank site along the Ashley Ponds Cut Off access road along the narrow causeway. Begin at a point immediately south of the causeway thence S86E for 511 feet; thence S29E for 286 feet; thence S18E for 431 feet; thence N38W for 325 feet to a point on the Ashley Pond Cut Off causeway road, and thence north along said road for 510 feet to the point of beginning. Site contains **3.8 acres**.
3. Small triangular area south of the gravel bank. Begin at a point on the Ashley ponds cut-off causeway road, thence S23E to a point on the Lower Westfield Road, thence along Lower Westfield Road for 300 feet to a point on the Ashley Pond Cut-off Road, and along this road to the point of beginning. Site contains **1.8 acres**.
4. Small tank site at base of access road hill from Mclean Reservoir to the west. Begin at a appoint on the Mclean access road, thence N84E along this road for 217 feet; thence S13W for 225 feet; thence S37W for 182 feet to a point on the access road, thence north along the access point to the point of beginning. Site contains **1.6 acres**.
5. Ashley Ponds, Ashley Cut-Off, Wrights Pond, Wrights Cut-Off, Cedar Pond, Clear Pond, Connor reservoir ponds, and some other unnamed small kettle ponds strewn cross this outwash plain. Total area contains **347.7 acres**.
6. The entire **Mclean Reservoir –south parcel** (**309 acres**) is also excluded from this parcel.

Map 193-000-001: 1.5 acres for the storage tank, cell tower, and pump station, the balance of **10.6 acres** is water.

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 Other:	**X**			

*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.

Signatures _____ **Date** _____

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 invasives 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, invasives are difficult to control and even harder to eradicate. Therefore, vigilance and early intervention are paramount.

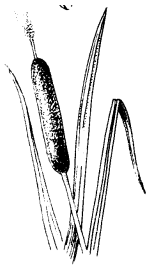
Another factor influencing biodiversity in Massachusetts concerns the amount and distribution of forest growth stages. Wildlife biologists have recommended that, for optimal wildlife habitat on a landscape scale, 5-15% of the forest should be in the seedling stage (less than 1" in diameter). Yet we currently 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.

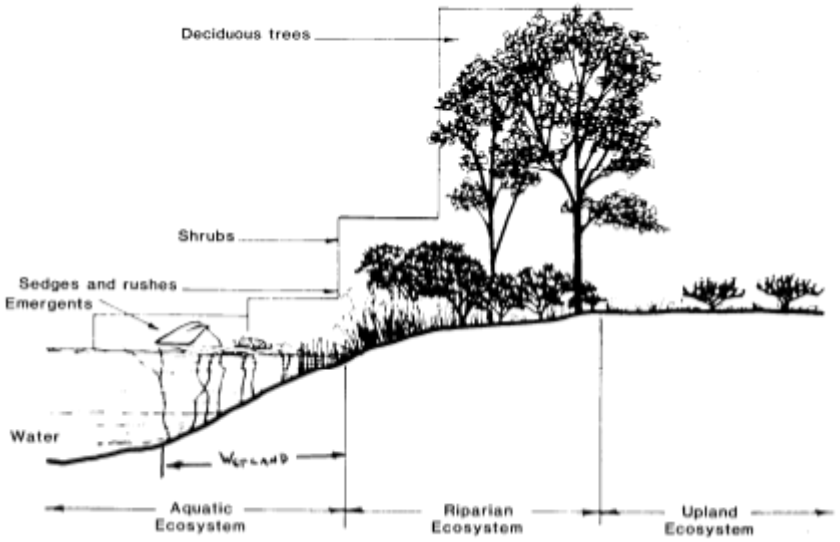


Figure 1: Example of a riparian zone.

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 keeps 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 stormwater, 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 then 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 as a result of logging activity if the slash (tree tops, 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 sandplain 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.

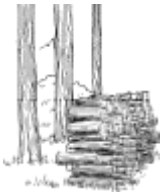
Wildlife Management: Enhancing the wildlife potential of a forested property is a common and important goal for many woodland owners. Sometimes actions can be taken to benefit a particular species of interest (e.g., put up Wood Duck nest boxes). In most cases, recommended management practices can benefit 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, rock 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, 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 17th and 18th 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. But 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.

History of Natural Disturbance:

As noted above, the mid 19th century was the height of forestland clearing for agriculture and pasturing. The availability of richer, more productive farmland in the Midwest resulted in farm abandonment and subsequent regrowth of white pine, chestnut, and mixed hardwoods including red oak. In the early 20th century these stands, particularly white pine, were cut to supply the wood container industry. Farm activity on the newly cleared land was truncated by World Wars I and II and brought about another wave of farm abandonment and regrowth. Natural disturbances since 1900 include the Chestnut blight of 1900-1908, the hurricane of 1938, the Gypsy Moth outbreak of 1980-1982, wind events, and ice damage, most notably in December 2008.

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 themselves. 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, invasives 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-nin.ciesin.columbia.edu/ipane, and the New England Wildflower Society, 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 (Berbis thunbergii)
- Japanese Knotweed (Fallopia japonica)
- Autumn Olive (Eleaeagnus 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.

Asian Longhorned Beetle

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

Please refer to FSC Pesticides Policy: Guidance on Implementation (FSC-GUI30-001 Version 2-0 EN, May 5, 2007) for information on chemicals banned from use on MA Private Lands Group Certification member properties.

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. Don't 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.

Purpose of the Plan

The 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. The three in-town reservoirs are off-line, reserve supplies. 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 model is that with maintenance an ideal watershed forest ecosystem offers the least expensive natural filter for drinking water. The maintenance of a healthy forest requires its continual replacement through natural regeneration of its trees. This first section (The Overview) of this document explains the silvicultural techniques that HWW will apply to maintain and regenerate the watershed filtration forest upon the McLean Reservoir, Ashley Ponds Reservoir, and Whiting Street 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.

The City owns a 1,350.8-acre forest ecosystem within these three watershed drainage systems. HWW plans to certify these lands under the Forest Stewardship Council Green Certification Program. Management plans are necessary for all certified acreage. HWW plans to make the management plan available in the public libraries with the expectation that community members and citizens and water rate payers of Holyoke will appreciate the valuable resource these lands bring to the City of Holyoke. Education raises awareness, which can motivate stewardship of a community's natural resources. These lands are often used unofficially for walking, hiking, nature study, and other benign activities. No official access is permitted onto these lands in order to protect water quality.

The In-Town Holyoke Reservoir System

Established in 1872, the Holyoke Board of Water Commissioners had the vision and foresight to design, plan and build one of the most reliable water systems known today. This network of reservoirs located within the City of Holyoke impounds billions of gallons of water, ensuring the City's water supply needs are met under all operating conditions. An energy efficient gravity based system conveys water from the reservoirs to a centralized treatment facility to meet all State and Federal water quality regulations. Treated water is then distributed to a series of storage tanks and pumping stations that service the five individual pressure zones within the City.

Holyoke Water Works
McLean Reservoir, Ashley Ponds, and Whiting Street Reservoir Watersheds
Locus Map

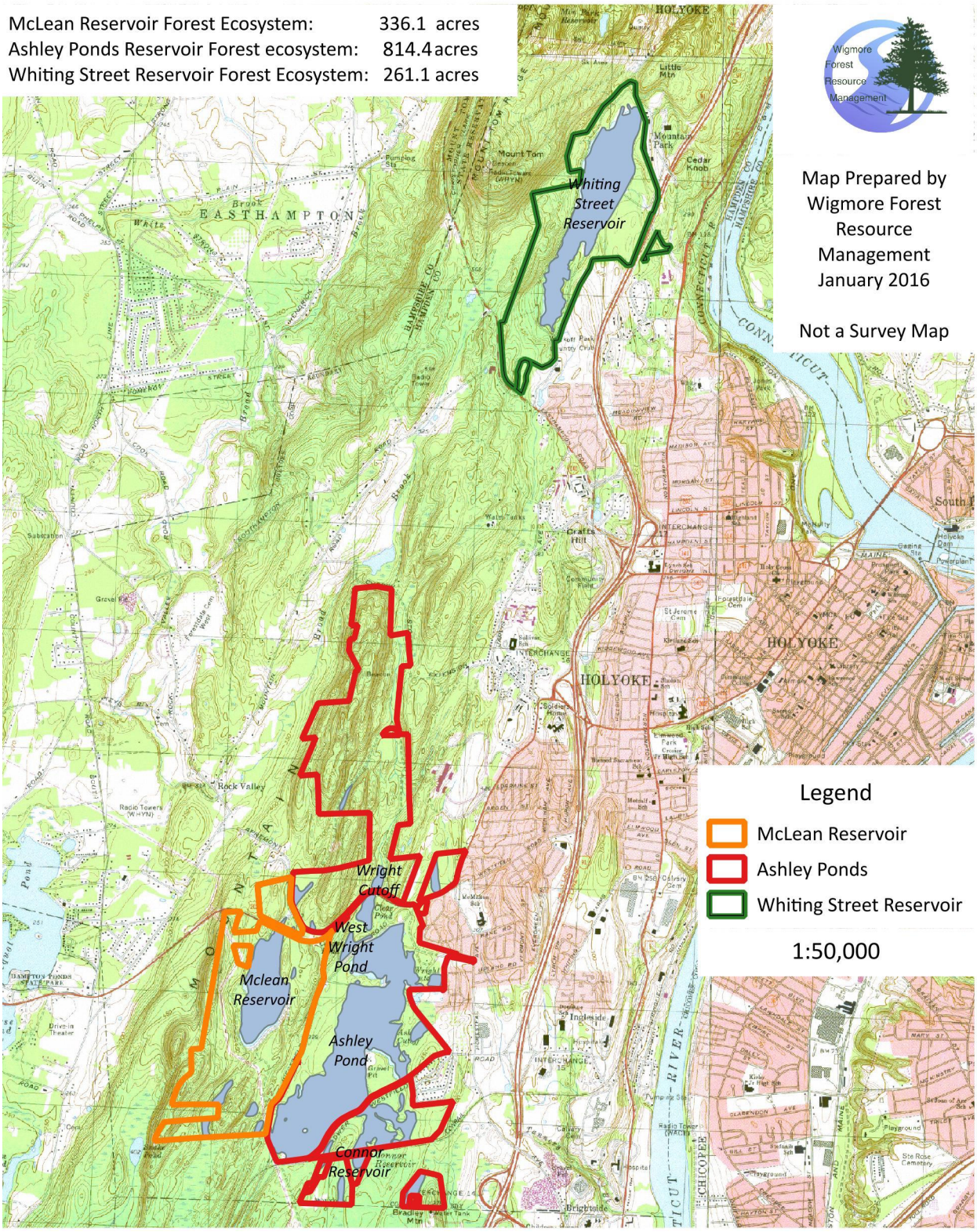


Figure #1: The 1,350.80 acre Three-Reservoir System Locus Map

The McLean Reservoir

The McLean Reservoir was constructed in 1903, and it has an impound capacity of 365 million gallons and a safe yield of 0.5 million gallons of water per day. The Reservoir drainage area is 319 acres, all of which is owned by the Holyoke Water Works. The McLean Reservoir dam is an earth fill dam with a total height of 35 feet and an approximate length of 700 feet. The Massachusetts Department of Conservation and Recreation (DCR) classifies the dam as a Large Size Structure and a Significant (Class II) Hazard Dam.

McLean Reservoir's fill system is quite simple. A small wetland adjacent to the east side of Apremont Way pumps ground water out of springs into a small intake reservoir directly north of Route #202. System complexity manifests at its exit point. Water seeps under the dam into a web of ponds, forested wetlands, and swamps, and drains directly out of the sluiceway into a high velocity stream. This water joins the feeder system for Paucutuck Brook after working its way through the Ashley Ponds Reservoir pond matrix.

The Ashley Ponds Reservoir

The Ashley Ponds Reservoir was constructed in 1897, and it has an impound capacity of 795 million gallons and a safe yield of 2.1 million gallons of water per day. The Reservoir drainage area is 1,261 acres, 86% of which Holyoke Water Works owns. The Ashley Reservoir dam is an earthen fill dam with a total height of 12 feet and an approximate length of 640 feet. The dam is classified by the Massachusetts Department of Conservation and Recreation (DCR) as an Intermediate Size Structure and a Significant (Class II) Hazard Dam.

An aquifer recharge zone north of Cherry Street at the northern tip of the Ashley Ponds Reservoir north section drains its waters both east and west. The western flow funnels into the Broad Brook watershed, and the eastern flow drains a saddle formation into a long narrow wetland paralleling the west side of Cherry Street. This wetland surrounds a spring field through which the aquifer pumps out the headwaters of Paucutuck Brook. After about two thirds of its track through the northern Ashley Ponds watershed, it is joined by two small tributaries with origins in upslope springs. All of this water collects in a small pond that functions as an intake reservoir to Clear Pond and the Ashley Ponds matrix. Water slowly makes its way through these ponds, flowing down gradient until exiting Ashley Pond and flowing downstream to the Bearhole Watershed.

Whiting Street Reservoir

The Whiting Street Reservoir was constructed in 1888, and it has an impound capacity of 479 million gallons and a safe yield of 1.5 million gallons of water per day. The Reservoir drainage area is 897 acres, of which 42% is owned by the Holyoke Water Works. The Whiting Street Reservoir dam is a stone masonry and earthen embankment dam with a height of 19 feet and an approximate length of 1,900 feet. The dam is classified by the Massachusetts Department of Conservation and Recreation (DCR) as a Large Size Structure and a High (Class I) Hazard Dam.

Whiting Street reservoir fills with stream flow from the north and south. Water collects from the run-off on upper Mount Tom slopes and gushes down into Whiting. Spring seep flow augments this volume along the down gradient. Whiting Brook originates in a wetland near the HWW water tanks on Homestead Avenue. Here, water is pulled from the aquifer and pumped north into Whiting Street Reservoir across a series of wetlands and small ponds.

Geology

Over 200 million years ago in the Triassic Period, the North American, Eurasian, and African plates drifted towards each other and eventually collided. The collision force shoved the northern Appalachian Mountains upwards along the spine of New England. These rifts were also the sites of lava bursts onto the earth, cooling in thick slabs. This volcanic rock, basalt, is orientated in narrow

north-south columns. Erosion wore down many of these ridge tops, leaving behind the curving spur of the East Mountain formation. As time passed, the new land formation also split, which began the split of the Connecticut River peneplain.

Less than 2 million years ago, the Wisconsin Ice Sheet covered the Connecticut River valley. Its slow, grinding flow scoured the earth. Its melt water collected behind a massive dam of sand and gravel and formed a giant lake that stretched to the Canadian border. Less than 12,000 years ago, this sand dam burst and Lake Hitchcock drained, leaving the matrix of terraced floodplains above deep sands and gravels and the kettle ponds formation found today.

Terrain

East Mountain Ridge, which is part of the long, narrow spur of Metacomet Ridge, lies to the west of the Connecticut River Valley. The ridge tops stretch through the western edges of both the McLean Reservoirs and Whiting Street Reservoir lands and the central core of the northern Ashley Ponds lands. The basalt rock juts up into cliffs and exposed bedrock on the crests and upper slopes and crumbles into the richer talus lower slopes. The landscape transitions to the deep, stratified sands and gravels of the alluvial outwash plains. Another common feature is the north south orientated small hills of gravel and sands (drumlins or drumloidal hills), which alternate with the stream and run-off terraces across the Ashley Ponds area. The kettle ponds were scoured out the glacial force, and the site is water rich.

History

The level alluvial terraces and floodplains of the valley were frequented by native peoples, as evidenced in fishing sites and in tools found in the uplands made from basalt. The current forest structures, the dry site oak transition forest ecosystem, developed about 15,000 years ago as proven by tree pollen and seed found in the sands. European influence began on the native peoples and ecosystems around 1600. Europeans walked the trail systems of the Nashawannuck and Pascounmuck. Springfield plantation was established in 1627. It included all of West Holyoke, both ridges and floodplains. Most of the land was too wet for agriculture across the Ashley Pond area and too steep up the ridges and upper slopes. In the mid-1800's, a group of financiers planned the industrial city of Holyoke. The population grew by 400% from 1870 to 1920, primarily because of workers in the mills. Timber harvesting stretched up into the ridges and higher slopes in search of lumber and fuel for the growing valley. People moved into the urban core of the city, and the uplands to the west were reverted to forest.

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 availability of richer, more productive farmland in the Midwest resulted in 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 mixed oak, white pine, hemlock, chestnut, and mixed hardwood cover typical on old farmlands. 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. 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 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, and recent severe storm events driven by climate change, including the ice storm of 2008 and the October 2011 snow storm.

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. Timber harvests for the improvement of the growing stock were completed through the 1980's and late 1990's. Timber crop management began again in 2003 upon the reservoir lands. The forestry program renewal started on Ashley Ponds Reservoir lands in 2007 with a red pine plantation salvage operation.

Forest Soils

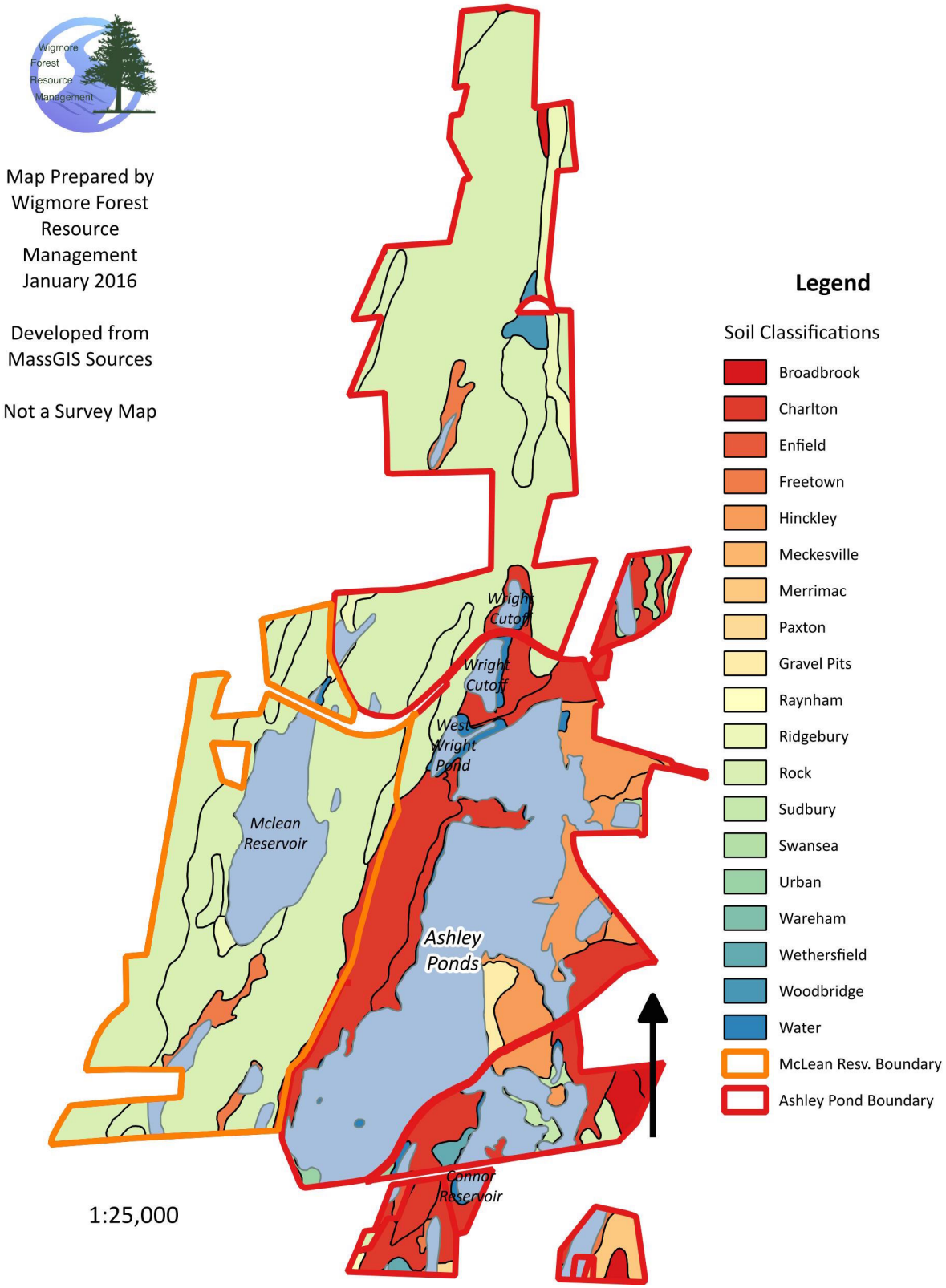
Time and weather eroded the once jagged, stately ridge tops into exposed basalt rocks and the crumbling talus lower slopes. The movement of water across the alluvial outwash plains and terraces constantly alters these soils. The United States Department of Agriculture – Soil Conservation Service classified all of the soils within the three watersheds into categories dependent upon their texture, depth, topography, and productivity. Many areas are designated as Highly Erodible in the soils survey. Protection measures are essential during any forest management work. Continual use of the trails and roads by illegal recreationists causes massive loss of sediment along the road and trail system.

The Rock Outcroppings - Holyoke Complex soils cover most of the three reservoir system lands. These shallow, upland soils do not grow trees very well. These soils are characterized by the talus slope formations that arise from the crumbling basalt due to erosion. The coarse texture loams lose their water quickly through evaporation and percolation. This droughtiness can kill off seedlings and discourage tree vigor. Young trees are easily carried away with rainwater and wind forces. Use of these upper slopes for road construction for any management purposes is difficult, as they tend to gulley quickly without proper erosion control installations. Descending the terrain across the lower slopes and into the alluvial outwash plains, the soils deepen and sequester more fertile organic material in some areas mixed with the silts, sands and gravels. Exposed basalt rock is less common here. Tree productivity varies with the averages from poor/fair on the rocky slopes to moderately high across the outwash terraces and plains.

Table 1.: Soil Classifications and Descriptions for the Three Reservoir In-Town System

Terrain/ Topography	USDA Classification	Soil Name	Soil Description	Forest Productivity
Upper slopes, ridgeline tops, and rock outcroppings	RHD	Rock Outcroppings and Holyoke Complex	Coarse textured, shallow soils in uplands formed in a thin layer of glacial till or simply exposed bedrock. Holyoke component is excessively well-drained.	Poor to very poor for productive tree growth.
Lower slopes, and drumlin hills.	CkB, CkC, CmB, CnB, CnC, CnB, CnC	Charlton Close minor associates: Meckesville and Woodbridge.	Coarse textured, fine, stony, sandy loams, which are deep and well-drained. Tend to seepage and they are useful for earthen dams for reservoirs.	High- very productive for tree growth.
	PaB	Paxton	These soils lie along the side hills of drumlins. They have a seasonal perched water table.	High- well suited to productive tree growth.
	WgF, WgC, WgB	Wethersfield	Deep, well-drained sandy loams that formed on drumloidal hills and ridges.	High- well suited to productive tree growth.
Outwash Plains, stream terraces, and alluvial terraces.- lowlands of the system and surrounding the ponds.	En	Enfield Minor associate Freetown and Broadbrook	Nearly level, deep, well-drained silt loams.	High- well suited to productive tree growth.
	SeA	Swansea	Nearly level fine sandy loam found on the alluvial terrace formations of the central Ashley Ponds section. They are very well-drained.	Moderate to low productivity for oak and white pine.
	SrB	Sudbury	Nearly level, fine, sandy loams found on the alluvial terrace formations in the central Ashley Ponds section. They are very well-drained.	Moderate to low productivity for oak and white pine.
	HgB, HgC, HgD	Hinckley	Deep, excessively, well-drained sands that formed on the glacial outwash plains. Too dry for good tree growth.	Poor/Low Productivity.
Alluvial floodplain depressions, old lake bed deposits, and depressions on upper slopes.	Ra	Raynham	Silts and loams that formed in the glacio-lacustrine deposits of the old Lake Hitchcock bed. Water sits at surface for most of the year.	Moderate tree productivity.
	RgA, RgB	Ridgebury	A stony, moderately deep sandy loam found in the low depressions across the landscape.	Fair to Moderate tree productivity.

Figure #2. Soil Classification Map for the McLean and Ashley Ponds Reservoir Lands



Overview of Forest Ecosystem on the Ashley Ponds Reservoir Watershed Lands

This discussion will first examine the broad forested landscape of the three-reservoir system, and it will finish with an overview of the specific reservoir forest ecosystem. The HWW lands are nestled within a vast, continuous green band along the north-south axis of the East Mountain Ridge formation. This emerald spine offers a valuable habitat refuge deep within the urban Connecticut River valley landscape. 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 forest is predominantly deciduous. Dominant trees in the upland forests are red oak, white oak, paper birch, and hickory, with some American beech, white pine, black birch, yellow birch, Eastern hemlock, sugar maple, and red maple. Along the mountaintops, chestnut oak and scarlet oak are common. Forested wetlands and lowlands consist predominantly of red maple in association with American elm, white ash, silver maple, swamp oak, yellow birch, and tulip poplar. Common understory shrubs include spicebush, highbush and low-bush blueberry, speckled alder, mountain laurel, maple-leaved viburnum, beaked hazelnut, and witch-hazel.

The forest exists in a rudimentary all-aged structure with the exception of the white pine and red pine plantation stocking. This complex, vast forest ecosystem functions as an ideal natural filter. The maturing overstory oak, mixed hardwood, white pine and hemlock trees of the main canopy range in age from 85 to 145 years and the immature, mid-canopy layer range in age from 30 to 65 years of age. Past timber harvests and natural decline opened gaps in the two upper layers for the development of seedlings and saplings (less than 30 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 200 years.

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 a short-lived species, with many stems approaching their biological maturity across the watershed. The black birch crop suffers from minor infestation of the nectria bacteria.

Ashley Ponds Reservoir

The Ashley Ponds Reservoir is located on Westfield Road in two large sections north and south of the highway. The outwash plains drain water through thick sand and gravel sediment out of a healthy forest ecosystem. Once the water supply was running smoothly, the City engineers turned their attention to the improvement of the watershed lands. Roads were built for access to all areas of the shoreline. In the 1930's, over one eighty hundred acres of predominantly white pine plantations were set along the shores of the reservoir in abandoned farmland. Red pine, scotch pine, and Norway spruce seedlings were mixed with the plantings. Although aesthetically pleasing, no one tended these stately groves, and the trees are stagnating.

The upland mixed oak and northern hardwood forests sweep up from the gentle slopes north of Route #202 into a unique ridge top oak forest. The average age range of the oldest age class is 140 to 180 years of age. A few outlier red oak trees with massive trunks and crowns are close to 225 years old. Beneath this maturing overstory, a sparse layer of black birch, sugar maple, red maple,

white oak, and black oak pole and small timber sized trees has filled any canopy openings. The xeric uplands support a very dense native shrub layer with dominance in this group by eastern hophornbeam (ironwood).

The Holyoke Water Works allows public use for hiking, walking, jogging, bird watching, and geo-caching. Public access into this forest restricts use to foot and bike traffic. It is a very popular destination for the local community. On any given day, one will find many people enjoying the gentle the miles of trails besides the shimmering ponds. The extensive white pine plantations support large volumes of white pine timber, which should be improved with harvesting.

These stagnating groves are beginning to show signs of suppression and decline. Many of the trees have small, asymmetrical crowns and spindly bole shapes. Eventually these trees will begin to fall down and possibly pose a threat with the high use recreation zone. The HWW begin a program of regeneration to native species inclusive of white pine, black birch, sugar maple, and mixed oak from seed. The actual harvest may not happen for three years or more. A program of education and outreach will educate the stakeholders in the local community about the need for attention to these groves. Public hikes and talks will continually present the scientific data about the life cycle of white pine and the eventual condition of these declining groves.

Table #2: Forest Stand Summary By Number, Forest Type, and Area:

Reservoir Name	Stand Number	Forest Type	Stand Description	Area
Ashley Ponds	1	OH	Mountain top and ridge line maturing red oak with black and white oak, pine, hemlock, black birch, and red maple. .	221 acres
Ashley Ponds	2	OH	Maturing stand of red oak, white oak, black birch, red maple, sugar maple, wash, paper birch, chestnut oak, with scattered large sized pine capping the upper canopy. The quality of the red oak timber crops is very good.	131 acres
Ashley Ponds	3	RZ-RM	All of the low areas on the land where the run-off and streams drain towards the reservoir collect moisture and support a matrix of wetland shrubs, swamps, spring seep fonts, red maple, aspen, ash, elm, and scattered white pine trees. Invasive plants exploit the open conditions of the forest floor within the riparian zone.	190.3 acres
Ashley Ponds	4	WP	Maturing white pine plantations with dense native shrub and hardwood sapling growth. Invasive species growth is dense in this stand. Inclusive of patches of Red Pine, Scotch Pine, Jack Pine, Austrian Pine, and Norway Spruce.	116acres
Ashley Ponds	5	SM	Small all-aged grove of sugar maple with a shady forest floor.	8 acres
Ashley Ponds	6	WH	Mixed hardwood component to this old plantation is pronounced with the maturing pine timber and immature valuable hardwood poles and small timber. Invasive species growth is dense in this stand.	105 acres
Ashley Ponds	7	OH	Lowland, outwash plain mixed oak and pine. Filters water through the lower strata. Healthy pine, red oak, swamp white oak, and other hardwoods.	43.1 acres
			Subtotals Stewardship and Green Certified Area	**814.4 acres**

Invasive Plant Communities and Their Management

Invasive plants threaten local biodiversity with their aggressive displacement of native species. They can significantly inhibit regeneration and the future productivity of a forest stand. Invasive plants 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 before any timber harvest work and the use of non-toxic practices to avoid their spread. Manual removal, stem cutting, application of vinegars and borax, brush cutting, and mowing in cycles reduce invasive plant stocking and prevent their spread. Retention of high crown closure uses shade as a deterrent of their spread. Scheduling and planning efforts for the treatment with natural correctives will be coordinated with income production.

These plants are found in dense volumes along all Ashley Ponds Reservoir Road system and waterways and edges, the reservoir shore, and within the riparian zones and red maple wetland forests with their lower canopy cover. Brushing maintenance along the road edges has prevented

full exploitation of the road edge and movement of the plants up slope into the valuable oak groves. A 200-foot band of individual stems of the most common plants extends into the forest all along the access road. Monitoring of the white pine plantations after the proposed harvest will provide early detection and rapid response opportunity in these stands.

HWW operates on a very tight budget, and they cannot commit their financial resources to this control program. Some monies will be invested for assurance of reproduction. During the public outreach campaign for the pine plantation education, the invasive species problem will be discussed. HWW hopes to motivate the site users to participate in a volunteer program for simple manual removals of some of the plants. Only natural corrective measures will be considered as their program develops, so as to protect water quality.

Table #3: Invasive species plants observed across the Three-Reservoir System from a 2012 Williams College Study

Autumn Olive	Winged Euyonomous	Coltsfoot	Common Buckthorn
Japanese barberry	Glossy Buckthorn	Swallow-wort	Common Reed
Asiatic bittersweet	Bush Honeysuckle	Privet	Multiflora rose
Purple loosestrife	Climbing nightshade	Spotted nightshade	Norway Maple

Wildlife

Many groups through the years have done extensive studies of the East Mountain Ridge and reservoir plains habitat including Massachusetts Audubon, Massachusetts Division of Fisheries and Wildlife, Trustees of Reservations, The Nature Conservancy, and the Sierra Club. A summary of the most recent data is summarized in this section of the management plan. This is a rich natural heritage, and this list does not include all of the many invertebrates in the City. Because of the richness of undisturbed habitats on the East Mountain Ridge and the expansive ponds, the three-reservoir system has many more species of both plants and animals than most people realize.

Birds

Data on the bird populations is the best for the three-reservoir system land base. The Connecticut River valley is a major pathway for migratory birds. Their movement attracts a lot of enthusiasm, with special attention to hawks and birds of prey. Hawk watching is common on East Mountain Ridge during their fall migration. The large tracts of forest provide important breeding habitat for interior forest birds.

Massachusetts Audubon (2012 Count) defines these forests as a historic nesting site for Peregrine Falcons on rocky cliffs, with the potential for future nesting there. It is also an important nesting habitat for the Whip-poor-will; worm-eating, Black-and-White, Blackburnian, Black-throated Blue and Cerulean Warblers; Louisiana Water thrush; Eastern Towhee; Eastern Wood-Pewee; Hairy Woodpecker; Baltimore Oriole; Rose-breasted Grosbeak; Scarlet Tanager; Wood Thrush; and other priority species by Partners In Flight for southern New England.

The ranges are a migration route for large concentrations of Broad-winged, Sharp-shinned and Cooper's Hawks and American kestrel, as well as several other species including the Northern Goshawk, Red-shouldered Hawk, Peregrine Falcon, Merlin, Osprey, and Bald Eagle. They are also a significant stopover for numerous migrant songbirds including 22 warbler species, as well as good numbers of breeding interior forest birds. Important habitat for birds includes the mixed oak habitat of the ridge tops and large continuous tracts of mature mixed oak and hardwood forests. A full list from the Massachusetts Audubon 2014 Christmas Count includes over 110 species.

Mammals, Reptiles, and Amphibians

The diversity of habitat supports a wide number of wildlife species. No conclusive species lists were found for the East Mountain Ridge and ponds area. The extensive three-reservoir system provides a corridor for large mammals and other wildlife. The Department of Conservation and Recreation (Cardoza and Mirick (2009)) conducted the most recent survey and noted the species in Table #4 as common to the three-reservoir system watershed lands.

Vernal Pools

Vernal pools are temporary bodies of fresh water that provide critical breeding habitat for many vertebrate and invertebrate wildlife species. They are defined as "basin depressions where water is confined and persists for at least two months during the spring and early summer of most years, and where reproducing populations of fish do not survive." Vernal pools may be very shallow, holding only five or six inches of water, or they may be quite deep. They range in size from fewer than 100 square feet to several acres (Natural Heritage & Endangered Species Program, Massachusetts Division of Fisheries & Wildlife, Massachusetts Aerial Photo Survey of Potential Vernal Pools, Spring 2001).

Three pools are found in the oak hardwood grove in small woodland depressions, swales, or kettle holes, which collect spring runoff or intercept seasonal high groundwater. Many species of amphibians and vertebrates are completely dependent on vernal pools to reproduce. Loss of vernal pools can endanger entire populations of these species. According to NHESP, clusters indicate particularly good habitat for species. Also, with clusters, there are alternate habitats if something happens to one pool, and slightly different conditions in each may provide different habitats for species dependent upon the pools.

Table #4: 2009 DCR Wildlife Species Lists

Reptiles:			
Snapping Turtle	Northern painted Turtle	Milk Snake	Common Garter Snake
American Mud Turtle	Eastern Race Turtle	Brown Snake	Copperhead
Pond Turtle	Ring Necked Snake	Northern Water Snake	Timber Rattler Snake
Wood Turtle	Eastern Rat Snake	Red Bellied Snake	
Eastern Box Turtle	Eastern Hog Nosed Snake	Eastern Ribbon Snake	

Amphibians:			
Mudpuppy	Marble Salamander	Spring Salamander	Fowler's Toad
Jefferson Salamander	Eastern Newt	Northern Two Lined Salamander	Green Frog
			Bullfrog
Blue Spotted Salamander	Redbacked Salamander	Spadefoot Salamander	Wood Frog
Spotted Salamander	Four Toed Salamander	American Toad	Pickerel Frog

Mammals:				
Feral Cat	Mink	Beaver	Northern Shrew	Porcupine
Bobcat	Striped Skunk	Jumping Mouse	Smoky Shrew	Snowshoe Hare
Coyote	Raccoon	Meadow Vole	American water Shrew	Eastern Cottontail
Mountain Lion	Moose	Woodlands Vole	Mole	New England Cottontail
Gray Fox	White Tailed Deer	Common Muskrat	Red Squirrel	
Red Fox	Virginia Opossum	Deer Mouse	Woodchuck	Woodchuck
American Black Bear	Gray Squirrel	Rat	Northern Flying Squirrel	Fisher
North American Otter	Ermine	Northern Flying Squirrel	Chipmunk	Longtailed Weasel
Brown Bat	Eastern Red Bat	Tri-Color Bat	Silver Bat	Myotis

Biodiversity:

The Massachusetts Division of Fish and Game through its Natural Heritage and Endangered Species Program designates these lands as Priority Habitat and Core Habitat, which is essential for the long-term health of native communities. Priority Habitat is land desirable for habitat use by the rare and special concern plant and animal species in western Massachusetts. The ecosystem provides high quality wetlands, vernal pools, habitat, and range for rare and vulnerable or uncommon animals, birds, reptiles, amphibians, invertebrates, and plants. Much of the area is also designated as Critical Natural Landscape, which provides good habitat for wide ranging species, nurtures intact ecosystems, and protects habitat integrity. The protection of both Priority Core Habitat and Critical Natural Landscapes (especially their overlap zones) assures healthy ecosystem functioning and rich biodiversity. The continuous acreage provides connectivity for species to cross the landscape.

Massachusetts Audubon designated this area as an Important Bird Area (IBA), which provide essential habitat to migrating birds for mating and roosting. Twenty-seven state-listed birds whose population is decreasing were noted here. Habitat is variable across the three-reservoir system from the upland oak talus slopes, rocky outcrops, and the alluvial floodplains. Peregrine falcons have been seen soaring above East Mountain, and many documented wood turtle observations exist. A few rare plants grow on the ridge tops and rocky outcroppings. Massachusetts DFG, The Nature Conservancy, and Massachusetts Audubon support the use of this area for the protection of many habitats of species of greatest need of conservation. The entire three-reservoir system provides both resiliency (the capacity of an ecosystem to recover from stress) and resistance (the ability of an ecosystem to stay stable) to the climate crisis.

Biodiversity Protection:

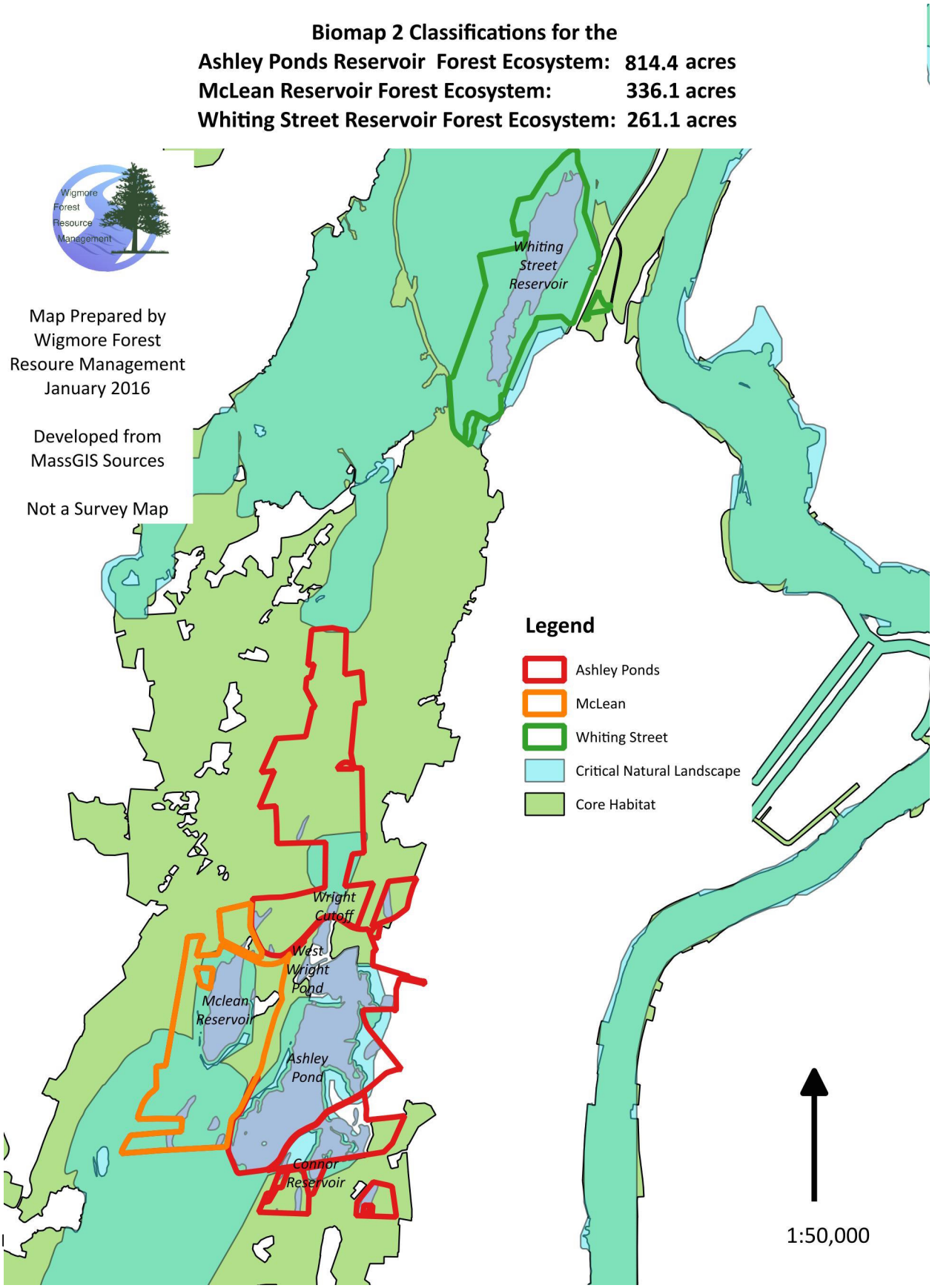
Holyoke is remarkably rich in rare plant and animal species. The East Mountain Ridge and glacial ponds are cited by the Massachusetts Natural Heritage and Endangered Species Program (NHESP) as one of the most important and ecologically significant rare species localities within the Commonwealth. It is a high priority Special Focus Area for protection given the rare species habitat, the extent of contiguous habitat types, and the habitat for migratory land birds available.

All projects within Priority Habitats undergo a review by DFG NHESP. Most of the watershed area is designated as a sensitive resource not suitable for timber harvest or silviculture work. Access into the vernal pool zones on the southern watershed is discouraged. Holyoke Water Works supports the diligent use of Forest Conservation Management Practices. All CMPs published by the DFG NHESP will be followed during the one proposed timber harvest project within the white pine plantations.

Conservation Management Practices (CMPs) are specific, science-based guidelines for conservation of rare species during forest harvesting. CMPs are somewhat analogous to Forestry Best Management Practices (BMPs), except whereas BMPs focus mainly on protection of water resources, CMPs specialize in protection of rare wildlife. The primary objective of CMPs is to guide harvesting activities such that rare species listed under the Massachusetts Endangered Species Act (MESA) are not impacted in a way that jeopardizes long-term viability of local populations. CMPs first identify and describe potential impacts of forest harvesting to state-listed species, whether impacts may be direct (e.g., physical injury or death of individual animals) or indirect (e.g., alteration of habitat in a way that reduces overall reproductive success of a local population). Then, CMPs provide specific guidelines to avoid or minimize impacts that would be considered negative or potentially detrimental to a local population. The guidelines are based on scientific knowledge of the habitat requirements, reproductive strategy, dispersal ability, survivorship, and other ecological factors that influence population dynamics of the species.

CMPs aim to maintain adequate opportunity for sustainable management of timber products in Massachusetts. To this end, CMPs tend to focus forest harvesting restrictions on the critical areas

Figure #4: Priority habitat and natural Critical Landscape Map from the BioMap2 Project for the McLean Reservoir, Ashley Ponds Reservoir, and Whiting Street Reservoir lands



within known habitat of state-listed species, thereby allowing timber management to proceed with fewer restrictions over as large an area as possible. This strategy is based, in part, on the recognition that forest harvesting typically results in temporary habitat change or sometimes even habitat improvement rather than permanent habitat loss. Thus, the CMP strategy is designed to help maximize the protection of state-listed species and the ability of Massachusetts landowners to manage their forests for timber and other wood products.

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. This section is presented as the scientific defense synopsis for the City of Holyoke's watershed forest management program. 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 to a less than 20% threshold, which is not significant enough to impact yield.

Watershed Protection

- Forested watersheds generally yield higher water quality than non-forested cover types.
- Maintaining vigorously growing forests across a 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.

Water Quality

- Surface water collected from fully forested watersheds with minimal exposed soils generally carries low turbidity.
- In actively managed forests, correctly designed and effectively applied Best Management Practices 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.

The Water Protection Forest: A Working Hypothesis

- The ideal watershed protection forest has the capacity to recover from natural disturbances with or without active forest management.
- Healthy, well-distributed diverse age groups and size classes across the watershed increase the forest's ability to withstand environmental stress and disturbance.
- Research has shown that harvesting less than 25% of the forested watershed in any given ten year period can minimize the loss of nutrients or sediments.

- 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.

Forest Management Objectives/Strategies:

- 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 lands 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 20% of the total stocking on any given forest stand over a 15 to 20 year cutting cycle; and
- Delineation and marking of the boundaries of the entire reservoir lands with documentation of all monumentation for archive purposes.

Water Quality Objectives/Strategies for 2016 to 2026

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.

1) Prevent the movement of sediments into the water system and the reservoirs from the silviculture work in the white pine plantations.

2) The compliance with the best BMP's (Explicitly described in the Massachusetts Forestry best Management Practices2013 Manual) for harvest techniques in order to minimize the risks of sediment and nutrient loading into the water system. The timber harvest work would be conducted during frozen ground conditions.

3) Establish a program of public outreach to the local community users about erosion prevention and trail use.

4) Conduct a detailed survey of the trail and road system condition and record and document high erosion concern areas.

5) Establish a community partnership for volunteer maintenance projects on erosion control and site monitoring and a forum for discussion about adaptive watershed management.

Biodiversity Objectives/Strategies for 2016 to 2026

1) Protect and encourage native plant communities through the study and control of the invasive plant infestations across the reservoir lands.
2) Seek grant funding for analysis and control measures against the invasive plants.
3) Establish non-disturbance preservation areas within each reservoir property for the conservation and development of intact natural communities and the diverse species within each area.
4) Monitoring for forest health, which poses a threat to biodiversity if a species is threatened by a pathogen.
5) Strict adherence to all CMP's as published by Massachusetts NHESP during any silviculture work.

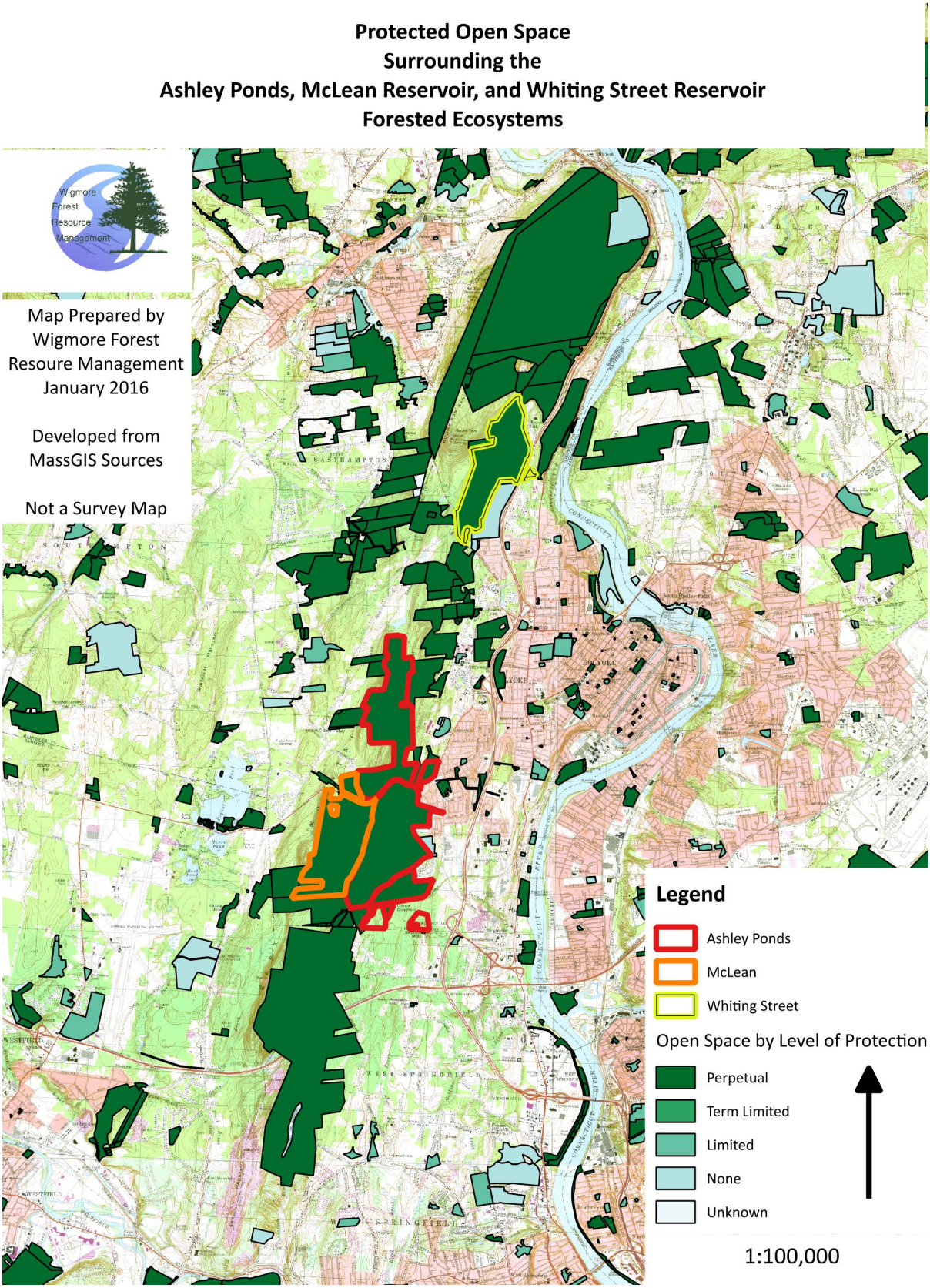
The Role of the Forest in the Landscape and Local Economy

The three-reservoir system stretches on a north-south axis over more than three miles of the East Mountain Ridge. It provides a unifying corridor for a vast habitat and forest core. Most is in municipal or state ownership, though 800 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 properties include the Mount Tom Reservation State lands, the Trustees of Reservations Little Mount Tom Reservation, Division of Fish and Game lands, and the Bearhole watershed lands owned by the City of West Springfield to the south.

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. The three-reservoir watershed increases the ecological resiliency and biodiversity of the regional landscape.

The active silvicultural program on these three watershed areas will produce moderate volumes of merchantable timber products over ten years. 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 and maintenance needs. 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.

Figure #5: Protected Open Space in and around the McLean Reservoir, Ashley Ponds Reservoir, and Whiting Street Reservoir lands



The Role of Silviculture

Applying ecological principles to a forest stand to enhance growth of desirable species or native plant communities 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. All of the tree species growing within the three-reservoir properties are biologically immature. The oak species might approach senescence near 275 years. However, some red oak can live for over 400 years, and some white pine have been recorded at well over 300 years. The average age range of trees across these properties is 85 to 180 years, with anomalies in all species. These trees are mid-way through their life cycles. If a tree is not under stress from a pathogen or environmental hardships, it is likely to continue growing.

The forest stands upon the three reservoir properties 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 and biodiversity of this management plan. Therefore, forest stands upon steep slopes with a high erosion factor were not deemed suitable, nor were forest stands that function solely for the filtration, collection, or transfer of water (wetlands, swamps, or stream banks). Some areas were deemed not suitable for silviculture because of their support function for habitat and their important values for ecological resiliency, such as biodiversity or habitat value.

The 248- acre white pine plantations and mixed pine woods (28% of the total reservoir holding) and one area of the red oak and northern hardwood eastern stands are suitable for silviculture during the 2016 to 2026 period upon the Ashley Ponds Reservoir forest. This stand is at its mid-point in the lifecycle. Regeneration of the site is the long-term goal of the silviculture work, yet full site occupation by over 2,000 seedlings per acre of all native species is not mandatory for several decades. The silvicultural system appropriate for this objective is the Irregular Shelterwood Harvest System, Crop Tree Management techniques, and Salvage Harvests for hemlock and white ash.

Shelterwood Harvests reproduce a new forest beneath the cover and shelter of the maturing crops. The Irregular Shelterwood System retains portions of the overstory crop, called legacy trees, for their lifespan. This approach is executed over several decades in a stand of trees. The first phase of this system, known as the Preparatory Harvest, removes an estimated 25% to 30% of the stocking with the objective of removing the worst stems, releasing the best trees for improved growth and increased seed production. The retention of over 66% of the growing stock will minimize the disturbance to this stand, and introduce the aesthetic changes in the stand gradually.

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 recommends treatment of existing invasive plants with natural correctives prior to the proposed timber harvest and after the work. Treatment will be necessary along the reservoir shoreline, along the Whiting Street Reservoir Road, and into the interior of the plantations. Throughout the rest of the forest ecosystem without any reduction in crown closure, shade should prevent the spread of these plants.

Annual monitoring inspections of the pine plantation conditions post harvest for detection of spread of the plants into the regeneration areas can motivate future control work. Some of the removal work can be done manually with the removal of the plants from the soils. Brush cutting and mowing along the Whiting Reservoir Road by the HWW will continue to reduce their spread. Toxic methods and the use of chemicals will not be permitted on the Whiting Street Reservoir lands. HWW's management philosophy subscribes to the opinion that invasive plants, although a threat to the native ecosystem, should not introduce a more dangerous threat to water quality in their treatment. Other natural corrections include propane torch application, stem cutting and vinegar and borax application, and direct plant removal by tool or hand.

Hazard Tree Removals

Whiting Street Reservoir Road is lined with stately, tall hardwoods and conifers. Recent severe storm events damage trees and create hazardous circumstances for the public users. Adaptive watershed management encourages dynamic changes in management decisions as new information and situations arise. In the case of hazardous tree events, HWW may need to prioritize public safety over other planned management events. Amendments would be made to the management plan after review by all stakeholders, which would include the development of a prudent plan for hazard tree removal.

Adaptive Watershed Management

Adaptive resource management (ARM) is a structured, iterative process of robust decision making in the face of uncertainty, with an aim to reducing uncertainty over time via system monitoring. In this way, decision making about the use and management of the forest resources on the Whiting Street Reservoir simultaneously meets one or more resource management objectives and, either passively or actively, accrues information needed to improve future management. Adaptive management is a tool that will be used not only to change the watershed management system, but also to learn about the system.

Because adaptive management is based on a learning process, it improves long-run management outcomes. The challenge in using the adaptive management approach lies in finding the correct balance between gaining knowledge to improve management in the future, and achieving the best short-term outcome based on current knowledge. The use of these lands as a primary biodiversity protection area is a new direction for HWW. The reproduction of the forest tree species is essential to the maintenance of the forest's filtration function. Diligent monitoring, documentation, and analysis will inform the watershed manager and all stakeholders about the effectiveness of this approach for the achievement of HWW stated Forest Stewardship and Green Certification Goals. This approach allows for the flexibility to evaluate the forest when a new threat to forest health, ecosystem function, or habitat condition develops in the future, and to change direction when necessary.

Methodology

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, which 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. 136 points were taken 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.

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.

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.

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.

Growth Rate Methodology: Growth rates were determined using the method by which the state determines Chapter 61 tax valuations, using an expected volume increase of 162 board feet per acre per year as 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.

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.

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.

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. Some of the old surveys of the Whiting Street lands were found and used during the management plan project. A boundary research and delineation project is underway for these lands with an anticipated completion date of December 2016. The record of the deed transfers is also incomplete. The City engineer is working with WFRM on the deed review. Revised Assessor records will be added to the management pan upon completion of this research.

Combination Forest Stand Descriptions and Management Practices for 2016 to 2026 by Stand

For the purposes of this report, a forest stand is an easily defined area that is relatively uniform in composition and structure. If a stand is suitable for silviculture, the management data was presented directly after the stand descriptions. Specific stand attributes that support the value of its habitat are mentioned in the stand description narratives.

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.	4.01	MO	221.0	12	75	2.675 MBF 6 cords	WP:55 RO:55	35.755

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 Paucutuck Brook watershed or Wright Pond. The trail network through this large stand offers potential sediment movement and soil loss events due to the steep slopes pitches. Installation of subtle erosion control measures along the steep sections of the trail will minimize the risk of sediment movement.

Silviculture Status: Not Suitable.

Terrain/Topography: This stand clings to the upper talus rock slope in the northern section of the watershed. This stand stretches the western bound of the northern section across the remnants of East Mountain Ridge. Steep slopes, rock outcroppings, cliffs, and raised terraces and valleys mark the ridgeline. There is a unique high valley, some cinder cone eskers, and cliff and cave sites. The dramatic terrain provides some excellent views that sweep in all directions.

Soils: The coarse textured, very shallow Holyoke Rock Complex soils lie beneath this narrow band of oak and hardwoods. Exposed bedrock and cliffs are common, and trees grow slowly in these thin loams.

Timber Harvesting: No harvest work is recommended except for hazard tree and high-risk tree removals.

Overstory: Main canopy height is 50 feet or less with dominance by red oak, sugar maple, white ash, black oak, scarlet oak, and chestnut oak, and hickory. The trees are growing slow on a stressful site, and they have marginal quality. Large sized white pine trees dot the upper canopy. A few sapling and small pole red maple (dominant species with poor quality), beech, sugar maple, and hemlock fill the middle canopy layer. A beech bark complex attacks the beech trees of all ages marking its trunk with cankers and eventually killing the tree. Most of the hemlock crop is under attack from the wooly adelgid with over 55% of needles in dieback. The maturing paper birch trees are in serious decline.

Understory

Regeneration (B-/C): Whenever an opening occurs in the canopy, black birch, red maple, sugar maple and hemlock seed heavy into the spots. These young trees are less than two inches in diameter and less than ten feet in height. If an opening s near a white pine seed tree, pine seedlings are very dense.

Shrub and Herbaceous Cover: Despite the overstory shade a healthy herbaceous and shrub layer grows in clusters and patches beneath the pine crop. Plants cited include wintergreen, Christmas fern, tree club moss, Christmas fern, partridgeberry, running cedar, and hay scented fern. A moderate stocking of native shrubs were also found here. Most prominent shrubs include witch-hazel, low bush blueberry, and maple leaved

viburnum. Two small native trees, ironwood and musclewood, grow prolifically in this stand. Native grape attacks the most dominant trees in a stand climbing their crowns and pulling them down.

Invasive Plants: The edges of the stand along Cherry Street extension have been infiltrated with invasive plants. The plants grow in thickets on the road edge, and they are consistently found in individual stems for a distance of 200 feet from the road. Species include Japanese barberry, common buckthorn, winged euyonomous, and Asiatic bittersweet. Their density rating is variable with an average of B-. They are positioned to migrate into the more productive oak hardwood stands to the east especially in the northern tip.

Habitat: Six varieties of oak produce a continual supply of mast. The dense herbaceous and fern carpet provides feeding and nesting sites for songbirds. The Massachusetts Natural Heritage and Endangered Species program designated three areas along the western bound of this stand as Priority Habitat. Recent storm events deposited high volumes of both coarse and fine woody material for feed production for songbirds and small mammals. Large white pine stems usually > 18 inches in diameter having a decaying central core are very valuable habitat elements to large-bodied cavity excavators such as pileated woodpecker and other cavity dwellers such as the barred owl, woodpeckers, and red-breasted nuthatches. In the north west section of the stand, several vernal pools support amphibian habitat.

Fire Protection: This stand is accessible from Cherry Street and Route 202 with a four-wheel drive pumper truck for fire management. Water is readily available from Paucutuck Brook to the east. No fire events have occurred across this area for decades.

Desired Future Condition: This ridge top oak grove supports an all aged, all sized ecosystem with each component essential to the whole. Hiking the ridge line trail offers a wonderful panorama of the valley glacial history. Retention of dense crown cover will prevent spread of the invasive plaints. The stand will be protected as a habitat and aesthetic reserve. Tree removal of hazard reduction or prevention are allowed along ten extensive trail network.

Recommended Management Practices: 1. Seasonal and annual monitoring schedules for prevention of hazardous conditions. 2. Delineation and mapping of the invasive plant communities, and the initiation of a control program. 3. Seasonal and annul maintenance program executed daily. 4. Trail maintenance and improvement program facilitated by HWW, accepting of volunteers, and open for research grants.

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	OH	131	16 RO: 22	110	5.750 MBF 7 cords	WP: 65 RO: 65	28.951

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 drain water across the upper slopes into Paucutuck Brook and the wetland drainage basin. Retention of full canopy within a 50-foot filter strip along the brook edge protects the soil structure and precludes any sediment loss. Installation of proper erosion control measures and full compliance with Massachusetts General Law Chapter 132 conditions specific along harvest access roads is mandatory during timber harvest activity. Water moves east off the slopes and seeps up from ground reserves into the Paucutuck Brook channel. A healthy forest ecosystem filters the water of minerals and sediments.

Silviculture Status: Suitable.

Terrain/Topography: In the northern section, this stand lines the lower slopes along the Paucutuck Brook drainage system. Water backs upslope slightly west of the bordering sapling and shrub swamp. This narrow band follows a natural swale along the east bound. In the narrow neck zone, the stand lines steep banks before broadening across short cliffs, rocks and boulders, and a very fertile plain near Route #202.

Soils: Bedrock outcroppings and exposed basalt are common amongst the Rock Outcropping Holyoke Complex soils along the upper slopes. Small boulder and rock fields dot the mid-slopes in the far northern and southern sections of the stand. The swale collects upslope sediment, so the rock sands are slightly deeper on the eastern bound.

Timber Harvesting: Application of a conservative small group selection and individual tree selection would promote red oak seed germination and the improvement of the timber asset. Access to the northern section either requires a right-of-way from a neighbor or a well-engineered stream and wetland crossing with geotextile material, stone, and bridges. The merchantable hardwood crop is valuable.

Overstory: The stand has a two-storied structure with medium sized (<=19inches) red oak trees sharing the upper canopy with sugar maple, chestnut oak, black oak, and scattered white pine trees, and a moderate stocking level of slightly younger, well-formed, vigorous 2 to 7 inches black birch, white pine, red oak, yellow birch, cherry, ash, sugar maple, and elm trees beneath them. Big tooth aspen copses are present throughout the stand with all ages. The immature red oak (average age 150 years), cherry, and sugar maple crops have excellent quality. Immature red maple pole and sapling stump sprout trees have poor form, low vigor, and no future value. The hemlock crop declined and died out of these stands over the last decade, and in the dense immature groves, most trees have over 60% needle dieback. The oak crowns suffered damage from the recent storm events, yet the stand was in general healthy with the exception of declining paper birch and white ash trees. The stand was harvested over 25 years ago with harvest access from the south along Route #202.

Understory

Regeneration: The vigorous upper crowns spread wide and prevent full sunlight into the lower layers for seed germination and seedling development. The shade tolerant species such as beech, hemlock, black birch and sugar maple are seeding into the stand, and white pine prolifically seeds along the edges of the pine plantation or adjacent to the scattered legacy white pine stems. The hemlock seedlings show serious needle dieback.

Shrub and Herbaceous Cover: These lower slope acidic rock cliff communities collect runoffs, and they are the most diverse of local habitats. They support blueberry, lycopodium, Virginia creeper, trout lily, Christmas fern, cinnamon fern, interrupted fern, and prolific horsetail (dense thickets along Paucutuck Brook). Common native shrubs include witchhazel, blueberry, musclewood, beaked hazelnut, elderberry, spice bush, mountain laurel, and maple leaved viburnum. Ironwood, a small native tree, exploits any available growing space. These shade tolerant plants contribute over 65% of the shrub cover. Their stocking levels prevent vigorous seedling development.

Invasive Plants: Invasive plants are present in this entire stand with various levels of density. The northern section eastern bound supports “A” rating stocking density of Japanese barberry, Asiatic bittersweet, buckthorn, multiflora rose, and winged euyonomous within the wetlands, stream banks, and upland boundary area. The plant communities follow the watercourse and spread out in the southern edge of the north section with extremely dense patches of all these plants along Route #202 and access roads into the watershed. These patches are difficult to navigate and attain heights less than eight feet. These are designated as “hotspot zones” in need of stocking reduction strategies inclusive of shade retention, plant removal from site, and promotion of native seedlings.

Habitat: Red oak mast is enjoyed by over 200 species of brads and mammals. The prolific ironwood tree produces large volumes of a very sweet nutlet each year, which hold on in the twigs until late winter as a food source. Dense thickets of mountain laurels scattered in the stand offers a well-protected low nest for songbirds. The sheer number of shrubs on the forest floor attests to the high biodiversity within this ecosystem. Several large diameter sugar maples with large branches and cavities dot the upper canopy, and they provide denning, and perching sites for birds and small mammals. Two large nests were recorded at an estimated 85-foot height in white pine trees. Small niches of beech trees provide diversity with the mast crop. Pileated woodpecker damage was noted in most of the white ash trees. Many vernal pools lie scattered about the forest floor. Abundant fine and coarse woody material clutters the forest floor from the storm damage. This material supports the lifecycle of invertebrates and fungi and provides burrowing and nesting sites form small mammals.

Fire Protection: This stand is accessible in most sections with a four-wheel drive pumper truck for fire management. Water is readily available from the vernal pools, the bordering wetland to the brook, and Paucutuck Brook. No evidence of a recent fire event was noted.

Desired Future Condition: The long-term objective for this stand is its development into a mature all-aged species diverse forest community. The reproductive class is deficient at this time, and even though the dense shrub and saplings cover provides soil stability, it restricts seed germination with its shade. A combination Small Group and Individual Tree Selection Harvest techniques will promote hardwood reproduction and improve the quality of the immature hardwood crop. Selection harvest systems encourage all-aged, species rich, and high value hardwood stands. Retention of a closed canopy along the Paucutuck brook wetland corridor protects stream quality.

Special Stewardship Considerations: The elm trees along Paucutuck Brook are a rare plant community. A small wooden bridge crosses Paucutuck Brook in the wide floodplain stretch. A popular hiking trail straddles the brook as it winds towards Holyoke Community College. This area moves water slowly towards the ponds, and the green terrace is a beautiful eco-niche.

Recommended Management Practices: 1. Initiation of a public outreach campaign within the local community to prepare the site users and stakeholders for the preservation of the East Mountain ridge about the necessity of this harvest work amongst the overstocked native ecosystem. 2. Delineation and mapping of the invasive plant communities, and the initiation of a control program before any harvest work and its continuance after any harvest. 3. Application of the Selection Harvest System-combination of Small Group and Individual Tree variants with the objectives of red oak, sugar maple, cherry, and black and yellow birch regeneration over thirty years or more, improvement of the vigor and growth of the hardwood seed bearing trees and immature timber crops, and the removal of any potential hazard trees along the trails and harvest roads through the stand.

Stand Number	Forest Type	Silviculture Practice	Stand Area (acres)	Basal Area Removal (sq.ft/ac)	Volume Removal (MBF)	Firewood Removal (Cords)	Pulpwood Removal (Cords)	Timing
4.02	OH	Crop Tree Management	95	<=27	200	200	60	2018-2020

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 in native oak, maple, and birch seedlings. Crown openings result from a carefully planned Crop Tree Management harvest encourage the development of the desired optimal watershed forest condition. The release of the crowns of the crop trees improves their growth and quality. Harvest levels will not exceed 27% of stocking, and crown closure will be maintained at 70% or greater. The purpose of crop tree release is to maintain survival and growth on the best trees. Crop trees should be good, healthy trees of desirable species. The trees can be good timber species, desirable for wildlife values, or for aesthetics. Crop trees should be uniformly spaced throughout the stand where practical. Do not select crop trees on poor sites, or where no good candidates exist. 50-75 crop trees per acre should suffice in immature stands. Release the young crop trees by eliminating adjacent trees whose crowns are touching that of the crop tree. Also, cut or kill climbing vines on or near the crop tree. Competing trees are usually cut with chainsaws. Released trees should be exposed to full sunlight and free-to-grow overhead and at least three sides (hopefully four). Remember not to cut non-crop trees if they are not competing with the best trees. Use of Massachusetts Best Management Practices for timber harvesting will protect water quality.

Trees to be removed and retained: Crop trees in this stand will be selected for improving timber value, seed dispersal, and retaining habitat value. Desirable crop trees are red oak, black cherry, black and yellow birch, and sugar maple trees larger than 16 inches in diameter with full, vigorous crowns and large sized white pine and sugar maple "wolf" trees. An estimate of 30 or more crop trees will be retained per acre, all in the dominant and co-dominant crown position. These trees will be released on all four sides. Space will be made on the forest floor for seedling development, so trees in all canopy layers will be removed from all four sides of these crop trees. Trees for harvest include sapling and small pole beech (most of the harvest stems), black birch, red maple, and white ash, scattered high value mature white pine overstory remnants, a small portion of the high value red oak sawtimber, and pallet birch, hickory and oak timber sized trees.

Regeneration Concerns: Despite full canopy closure, seedlings of black birch, sugar maple, and red oak sprouted across the forest floor. Seedling establishment will be easy, yet the shrub layer may also thrive with the increased sunlight. Seedbed preparation techniques cull the shrub and ironwood layers and provide more direct sunlight on the forest floor. Clearings of shrubs and dense spelling thickets beneath superior oak, maple, and birch seed bearing trees increase germination opportunities.

Soil Considerations: These fine-grained sand and gravel soils drain directly into Paucutuck Brook drainage system restricting the natural filtration process to a short period. Scheduling of all harvest work during stable ground conditions in the winter months or dry late summer months prevents un-due disturbance to the roads and soils. The mains access route originates on Route #202, the hauling distance is long, and planning for ideal soils conditions through the entire project will be difficult. Flexibility with operating windows is encouraged.

Invasive Plant Management: Treatment of the plants scattered through the stand interior, along the roadside, and on the edges of the stand within the riparian zones is recommended to prevent their spread prior to the harvest work. Annual monitoring inspections of the forest conditions post harvest for detection of spread into the regeneration zones will direct the use of resources directly to high priority plant removals.

The removal work can be done manually with the removal of the plants from the soils and with mowing and brushing along the road.

Habitat Considerations: The proposed harvest will increase the vertical stratification within this stand and enhance biodiversity. The silviculture practices will incorporate the guidelines of existing Conservation Management Practices from Massachusetts Division of Fish and Game NHESP publications.

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	RZ-RM	190.3	**RO and WP: 17 RM, WA, Aspen, BB, Yb, Elm and Ironwood in swamps: 9.5**	**Forested Portions Only**: 120	**Forested Portions Only**: 4.218 MBF 11cords	WP: 55 RO: 55	**Forested Portions Only**: 9.575

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 spring seep fields, wetlands, shrub and sapling swamps, streamsides, or Paucutuck brook and its drainage system across the Ponds. These sites are the last barrier for filtration of sediment and toxins. Retention of full canopy and shrub cover will protect the forest ecosystem soils from displacement.

Silviculture Status: Not suitable.

Terrain/Topography: This stand lies in the depression and swales across the landscape. A long narrow band follows Paucutuck Brook along its entire channel with a large, orb shaped wetland in the central zone of the northern section in the narrow neck and north of this site. The water table is at the surface in the lowlands, spring seeps effuse water in the floodplain and outwash terraces, and dense shrub and sapling swamps and shallow marsh cover some areas.

Soils: The small patches of this type grow above a matrix of the fine sandy Broadbrook loams and the hydric Swansea and Raynham soils. Water collects in these soils from run-off and spring effusion.

Timber Harvesting: Not applicable.

Narrative: Riparian areas are lands that occur along watercourses and water bodies. On this property they include forested wetlands, red maple sapling and pole swamps, native shrub swamps in many coves along the Ponds shoreline. The pattern of vegetation placement expands from the core of each small area of the riparian zone with a stream or watercourse (spring seep flow or stream flow) in the center, red maple sapling and small pole and shrub swamp habitat directly adjacent to the water, and the forested wetlands more removed from the water and perched in broad terraces.

A saturated red maple sapling and pole wetland (with scattered red oak timber trees) lies through the north central core and into the narrow neck. In the southern tip areas the forested wetland spreads across w level plain. Associated hardwood trees in these wetlands include aspen, elm, white ash, and paper birch. The water table is rising and flooding sections of these groves. In a small area south of the railroad bed swamp white oak was noted thriving.

Species in the shrub swamps include illex, spice bush, speckled alder, blueberry, musclewood, witchhazel, and ironwood. This dense shrub layer provides vertical stratification and low nesting and breeding sites. Horsetail plants were prolific along Paucutuck Brook and in the wetlands. Dense shrub cover provides

forage and breeding sites for woodcock, ruffed grouse, and wetland songbirds such as the Canadian warbler. Sign of use of these areas by raccoon, white tailed deer, pileated woodpecker, and coyote were noted during the field inventory. Migrating birds use red maple swamps as they pass the Connecticut River valley. All of the native shrubs produce palatable fruit crops each year. One unique site is the narrow isthmus that extends from the railroad bed northward in the southern section. This two-sized shoreline habitat supports songbirds and waterfowl.

Invasive Plants: The invasive plant community spread extensively into these small niches. Their stocking rating is a B+ to A throughout each of the sites. They expanded into the edges of the pine plantation an oak hardwood stand and along all watercourses. The filtration function of the riparian areas would be threatened if chemical control were used for these plants. A monitoring program within stand can initiate an early detection and rapid response program for protection of the regeneration beds. Natural corrective measures would be used for plant removal on the edges of the silviculturally suitable stands. Retention of a denser canopy and some retained shrub cover throughout the riparian zones will prevent further growing site exploitation.

Habitat: **Fire Protection**: This stand is accessible from the Cherry Street and Route #202 with a four-wheel drive pumper truck for fire management. Water is readily available from Paucutuck Brook, the wetlands, and the Ponds for protection in the event of a fire. No fire events have occurred across this area for decades.

Desired Future Condition: These sites function as core habitat and water filtration strips across the landscape. No disturbance is recommended in these sites.

Function: Because these riparian zones occupy low areas in the landscape, ground water is generally nearer to the surface and available for plants. The fine-textured sediments in flood plains hold large amounts of water. These two conditions promote productive and diverse plant communities. Nutrients for plant growth in riparian ecosystems depend on sedimentation of nutrient-rich organic matter and on the dissolved nutrients in the water. Riparian zones are often nutrient-rich ecosystems. Because flooding occurs periodically, and ground water moves through flood plain soils, the surface layers of soils are wetted and dried seasonally. The presence and movement of the surface and ground water enhance the recycling of nutrients and other chemical reactions beneficial to plant growth within the riparian zone.

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.	4.04	WP	116.0	16	197	25.500 MBF 3 cords firewood 9 cords Wp pulp	WP: 65 RO: 65	25.636

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 Paucutuck Brook basin, wetlands, or any of the Ponds. Shelterwood harvest limits retain over 60% of the forest stocking, which minimizes rainfall impact on soils. Use of Best Management Practices as defined in the Massachusetts MGL-Ch132 Manual 2013 reduces threats from erosion or high storm event flow.

Silviculture Status: Suitable.

Terrain/Topography: This stand lies upon a gentle, level outwash plains and terraces adjoining the Ponds. Sands depth can reach 25 feet in these stratified sand and gravel beds. These are the most productive sites in the Ashley ponds complex ecosystem. Easy, gentle land sweeps uphill from the ponds.

Soils: The productive deep Broadbrook sandy loams support this stand.

Timber Harvesting: Harvest work on the gentle terrain will not cause sediment loss if scheduling of the proposed harvest during the winter with frozen ground conditions or dry late summer months protects the soils' integrity. Open ground harvesting would prepare the pine seedbed for optimal germination with scarification. Application of the Best Management Practices (MGL Ch132 Manual 2013) suitable for timber harvest work on principal watershed lands protects water quality and soil integrity during any of the proposed harvest projects.

Overstory: The overstocked white pine plantations (with minor stocking of balsam fir, red pine, scotch pine, and Norway spruce) have an average age of 120 years. The trees have small, asymmetrical crowns, excessive sap flow from the knots on the main boles, and sign of weevil damage. Many roots heaved upward from high winds, and the trees appear ready to blow over. An estimated 40% of the stems have good form and potential high value. These trees have been growing too closely for decades. They are stagnant with many suppressed stems. Immature red oak, sugar maple, black birch, red maple (poorly formed and low value), ash, and aspen pole trees grew well in any past opening in the canopy. Thinning for quality improvement will release the best trees for future growth.

Understory

Regeneration: Whenever an opening occurred in the canopy, black birch, red maple, sugar maple and hemlock seeded into the spots. These young trees are less than two inches in diameter and less than ten feet in height.

Shrub and Herbaceous Cover: The rich soils support a dense mat of ferns, herbaceous plants, and shrubs. Common species include lycopodium, spinulose fern, spicebush, Christmas fern, partridgeberry, hay scented fern, witchhazel, blueberry, beaked hazelnut, maple leaved viburnum, and musclewood. Mountain laurel covers about 30% of the forest floor. Poison ivy grows prolifically throughout this stand, often-climbing 80 feet or more into the maturing pine trees. Virginia creeper and native grape shared this vine layer.

Invasive Plants: Many individual stems and clumps of Japanese barberry, multiflora rose, winged euyonomous, buckthorn, and Asiatic bittersweet row in the stand's interior with stocking level ratings of B+ and An ear the property bounds, the shoreline of the Ponds, wetland edges, the gravel pit zone, and all road edges and ditch sites. These plants pose a threat to the native plant community if the forest cover is reduced with a harvest. Their stocking reduction might allow for more successful native tree reproduction. .

Habitat: White pine provides terrestrial habitat elements across the New England landscape in ways that other large conifer species are unable to duplicate. As a food source, white pine provides seeds, needles and buds, bark, and the insects that can be gleaned from white pine substrates. White pine seed provides a food source for bird species such as red-breasted nuthatch, pine warbler, common grackle, and evening grosbeak. The black-capped chickadee and the pine warbler glean insects from pine needles and bark. White pine seed is an important food for chipmunk, gray squirrel, voles, and an emergency food for white tailed deer. Porcupines will also forage in pine groves looking for carpenter ants. Large white pine stems usually > 18 inches in diameter having a decaying central core are very valuable habitat elements to large-bodied cavity excavators such as pileated woodpecker and other cavity dwellers such as the barred owl, woodpeckers, and red-breasted nuthatches.

Fire Protection: This stand is accessible with a four-wheel drive pumper truck for fire management. Water is readily available from the Ponds. No evidence of a recent fire event was noted.

Desired Future Condition: The white pine crop is aging and suffering from stagnation. The development of an all-aged grove of mixed species with a proportion of mature white pine towering above the hardwoods in the upper canopy will provide the best long-term protection to water quality in the reservoir.

Recommended Management Practices: 1. Initiation of a public outreach campaign within the local community to prepare the site users and stakeholders for the preservation of the alluvial outwash terraces and ponds native ecosystems and about the necessity of this harvest work amongst the overstocked pine groves. 2. Delineation and mapping of the invasive plant communities, and the initiation of a control program before any harvest work and its continuance after any harvest. 3. Application of the Preparatory Harvest within a Shelterwood Harvest System with the objectives of stand regeneration over thirty years or more, improvement of the vigor and growth of the legacy pine and seed bearing pine trees, and the removal of any potential hazard trees along the edges of the stands.

Stand Number	Forest Type	Silviculture Practice	Stand Area (acres)	Basal Area Removal (sq.ft/ac)	Volume Removal (MBF)	Firewood Removal (Cords)	Pulpwood Removal (Cords)	Timing
4.04	WP	Irregular Shelterwood Harvest-Preparatory Harvest	116	<=80	550 MBF	55 cords	200 cords	2017-2020

Management Practice Objective: The long-term objective for this stand is the conversion of the declining plantation to a species diverse, un-even aged forest capable of resistance to pathogens, disease and climate change and natural water filtration and purification. The Preparatory Harvest of a Shelterwood System removes an estimated one third of the growing stock in the stand. This approach retains another one third of the growing stock through its biological lifespan for seed production, aesthetic appeal, and the habitat benefit of the mature pine.

Trees to be removed and retained: The application of the complete regeneration of this stagnant pine grove will require several decades, therefore the criteria for designated crop trees include the largest live crown ratio, secure rooting systems, minimal sap streaking, and crack free lower boles. It is advisable to retain small groups or rings of these superior genotype trees for wind firmness. These trees have grown closely for almost a century, and their release might leave even the best trees prone to windfall or snapping. The crop trees will be expected to produce seed for regeneration and support the stand for another thirty years with many surviving another one hundred years. Once the crop and legacy trees have been chosen, the trees for harvest will be the smaller diameter stems with tiny, asymmetrical crowns, excessive black knot defects along the main bole, and fissures on the base of the trunk.

Regeneration Concerns: Despite full canopy closure, seedlings of black birch, sugar maple, and red oak sprouted across the forest floor. Seedling establishment will be easy, yet the shrub layer may also thrive with the increased sunlight. Treatment of the shrub and red maple spelling layer with conservative removals will encourage seedling growth.

Soil Considerations: These fine-grained sand and gravel soils drain directly into Whiting Street reservoir restricting the natural filtration process to a short period. Scheduling of all harvest work during stale ground conditions in the winter months prevents undue disturbance to the roads and soils. Priority habitat zones require frozen ground scheduling of all management work under Massachusetts Endangered Species regulations.

Invasive Plant Management: Treatment of the plants scattered through the stand interior, along the roadside, and on the edges of the stand with the riparian zones is recommended to prevent 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. The removal work can be done manually with the removal of the plants from the soils and with mowing and brushing along the road. Poison ivy will prove difficult during the harvest work in this stand. Severing the stems at the root collar kills the plant. Future treatment of any re-sprouts will prevent wild grapes from dominating the upper canopy post harvest.

Habitat Considerations: The proposed harvest will increase the vertical stratification within this stand and enhance biodiversity. The legacy pine trees will provide excellent perching and roosting opportunities near the water. The silviculture practices will incorporate the guidelines of existing Conservation Management Practices from Massachusetts Division of Fish and Game NHESP publications.

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.	4.05	SM	8	16	110	4.000 MBF-SM 6 cords firewood 9 cords Wp pulp	WP: 65 RO: 65	2.225

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 Paucutuck Brook basin, wetlands, or any of the Ponds. Preservation of the current condition reduces threats from erosion or high storm event flow.

Silviculture Status: Not Suitable.

Terrain/Topography: A short, gentle slope that drains into a wetland on Route #2902 and Doyle Road near a pumping station.

Soils: The productive deep Broadbrook sandy loams support this stand.

Timber Harvesting: Not applicable.

Overstory: A small grove of all aged sugar maple grows here. These well-formed trees are vigorous. White pine legacy trees seed heavily into larger openings. This pleasant grove provides a beautiful aesthetic niche close to the piping infrastructure.

Understory

Regeneration: Whenever an opening occurred in the canopy, black birch, red maple, sugar maple and hemlock seeded into the spots. These young trees are less than two inches in diameter and less than eight feet in height.

Shrub and Herbaceous Cover: Deep leave litter during the inventory only exposed native grape, maple leaved viburnum, Lady fern, Christmas fern, hay-scented fern, and ironwood.

Invasive Plants: Many individual stems and clumps of Japanese barberry, multiflora rose, winged euyonomous, buckthorn, and Asiatic bittersweet row in the stand's interior with stocking level ratings of B+ and A near the property bounds, the shoreline of the Ponds, wetland edges, all road edges and ditch sites. These plants pose a threat to the native plant community if the forest cover is reduced with a harvest. Their stocking reduction might allow for more successful native tree reproduction. .

Habitat: This two-aged canopy provides foraging and breeding sites with the protection of deep cover and escape heights for songbird use. Moose and deer sign were common. .

Fire Protection: This stand is accessible with a four-wheel drive pumper truck for fire management. Water is readily available from the Ponds. No evidence of a recent fire event was noted.

Desired Future Condition: Preservation of this healthy immature mixed oak forest will protect water quality throughout the Ashley ponds system.

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.	4.06	WH	105	**16-18 inches** WP and RO **6 to 9 inches:** Pole	157 SF	12.885 MBF 11 cords	WP:65 RO:65	23.305

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 Ashley Ponds reservoir system, Paucutuck Brook, and its basin during or after any silviculture treatments in the forested watershed. Retention of the current full crown closure (85%) in riparian or sensitive zones in the stand will protect the forest soils from displacement (also useful as an invasive plant constraint).

Silviculture Status: Suitable.

Terrain/Topography: This stand covers the raised terraces adjacent to the alluvial outwash plains across the central core of the Ponds. The terrain is gently sloping into the Ponds with level areas cut with drainage and seeps.

Soils: The productive deep Broadbrook sandy loams support this stand.

Timber Harvesting: Harvest work on the gentle terrain will not cause sediment loss if scheduling of the proposed harvest during the winter with frozen ground conditions or dry late summer months protects the soils' integrity. Open ground harvesting would prepare the pine seedbed for optimal germination with scarification

Overstory: A past harvest over 40 years ago opened the main canopy of the more than 120 year old white pine plantation for the development of red oak, scarlet oak, white oak, white pine, red maple, yellow birch, black birch, and paper birch spilling and pole trees. The immature hardwood trees range in size from 6 to 11d Norway spruce dot the main pine layer. The pine crop has weevil damage, extensive black knot, and small crowns. The quality of the red oak timber crop is very good. The hemlock trees are dying quickly in this area from the scale and wooly adelgid dual attack. Hazard tree removals will be necessary along the main gravel access roads.

Understory:
Regeneration: Overstory shade prevents prolific seedling development. Seedlings of chestnut, birch, maple, all the oaks, and white pine grow vigorously when sunlight hits the forest floor. The stocking rating is a C here with dominance by white pine, white oak, red maple, and birch.

Shrub and Herbaceous Cover: Although deep sands usually record low fertility, the ground is covered with a of wintergreen, Christmas fern, tree club moss, broad leaved beech fern, running cedar, hay scented fern, whorled loosestrife, and lamb's quarter. Dense thickets of native shrubs were found in this area. Most prominent shrubs include witchhazel, sheep laurel, mountain laurel, low bush blueberry, maple leaved viburnum, and beaked hazelnut. Low bush blueberry mats some sections of the forest.

Invasive Plants: Invasive plants were found along the gravel access road, the Ponds edge, and vey dense thickets were found along the edge of the forested wetland on the east bound. Their simple metric rating is B+ to A in narrow strips and bands with a consistent density cross the whole stand. The most common plants were Japanese barberry, winged euyonomous, bush honeysuckle, glossy buckthorn, and Asiatic bittersweet. Stocking reduction work prior to any timber harvesting will reduce their spread. Retention of full crown shade in strips adjacent to their densest clusters wisely contains them in these patches.

Habitat: High nutrition hard and soft mast is set each year by the musclewood, hophornbeam, hazelnut, viburnum, and dogwood shrubs and oak, hickory, and birch trees. The proximity of sections of the stand to Route #202 seem like a deterrent for wildlife, yet during the field inventory use of the site by fisher cat, fox, coyote, moose, and deer was observed. Pileated woodpeckers use the dying lower strata hemlock for insect feed. Nests were recorded over 80 feet up in white pine trees. Dense white pine attracts robins, scarlet tanagers, and some of the interior forest warblers. Small mammals nest and breed in the dense pine bowers.

Fire Protection: This stand is easily accessible with a four-wheel drive pumper truck for fire management. Available water is also close at hand for prevention. No fire events have occurred across this area for decades.

Special Stewardship Considerations: This grove parallels the gravel access road providing a peaceful appearance to the hikers and runners. A recreational trail runs along the western shore of the main Ashley Pond and straddles a canal back to the gravel access road. This small corridor is a beautiful stretch of trail with the expanse of the ponds to the east and deep pinewoods.

Desired Future Condition: The development an all-aged, species diverse, resilient watershed filtration structure is recommended in this stand. The youngest age class is missing here. Conservative openings around the crowns of the superior white pine and young hardwood crop trees allow more sunlight on the forest floor and introduce a new age class. Release of the immature timber crop's crowns improves value and volume productivity.

Recommended Management Practices: 1. Initiation of a public outreach campaign with the possibility of some closed hiking times for harvest safety. Tours of the overgrown pine plantations would begin in the summer of 2016 to educate the community about pine plantation health and condition, watershed forest management concepts, and the objectives of the proposed timber harvest. Gradual preparation with demonstrations throughout the engineering process will be necessary for public trust building and acceptance of the work. 2. Application of a Crop Tree Release and Salvage Harvest. 3. Assessment of the invasive plant community, delineation of perimeter with GPS, and the initiation of a control program before the harvest operation with designated zones of full cover retention for cost efficiencies.

Stand Number	Forest Type	Silviculture Practice	Stand Area (acres)	Basal Area Removal (sq.ft)	Volume Removal (MBF)	Firewood Removal (Cords)	Pulpwood Removal (Cords)	Timing
4.06	WH	Crop Tree Management and Salvage Harvest in hemlock crop	105	<=55 Sq. Ft.	275 MBF	85 cords	250 cords pine	2017 to 2020

Management Practice Objective: The long-term objective for this stand is the further 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. Conservative removals of trees in competition with the crop trees will open the forest floor for shade tolerant hardwood (cherry, yellow, and black birch, oaks, and sugar maple) seedling and sapling development. Harvest levels will not exceed 25% of stocking, and crown closure will be maintained at 70% or greater. Use of the Massachusetts Best Management Practices for timber harvesting protects water quality.

Trees to be removed and retained: Hemlock trees of all sizes and ages will be removed in this proposed harvest. Trees with more than 75% of their crown in dieback will be harvested. Crop trees in this stand will be selected for timber value improvement, seed dispersal, and habitat value retention. Desirable crop trees are white pine (and a small portion of red oak) trees larger than 18 inches in diameter with full, vigorous crowns, and small branch defects or no defects. The other crop trees include the immature sugar maple, cherry, yellow, and black birch, hickory, and red oak saplings and poles, and large sized white pine and sugar maple "wolf" trees. An estimate of 45 or more crop trees will be retained per acre, all in the dominant and co-dominant crown positions. These trees will be released on all four sides. Space will be made on the forest floor for seedling development, so trees in all canopy layers will be removed. Trees for harvest include sapling and small pole red maple, paper birch, white pine and hemlock, scattered high value mature white pine overstory remnants trees, and a small portion of the high value red oak sawtimber, pallet birch, hickory and oak timber sized trees

Regeneration Concerns: Intentional disturbance to the native shrub layer during the harvest work should allow for seedling development.

Soil Considerations: Careful engineering and the installation of emergency erosion control measures along the road system will minimize sediment loss during any proposed timber harvest. Scheduling of the harvest work during the winter months or the very small late summer dry period will prevent undue disturbance to the rods and soils. Stabilization with seed and hay of all slopes or sensitive areas on the hauling road network will prevent sheet erosion.

Habitat Considerations: The proposed harvest will increase the vertical stratification within this stand and enhance biodiversity. Retention of some of the dying hemlock tree provides future cavity trees. Release of the oak crop trees will also increase available mast for feed. Retention of over 70% crown closure assures upland habitat integrity. Many songbirds prefer dense interior forests.

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.	4.07	OH	43.1	12.5 inches	126 SF	3.535 MBF 11 cords	RO:60	9.525

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 Ashley Ponds reservoir system or Paucutuck Brook and its basin during or after any silviculture treatments in the forested watershed. Retention of the current full crown closure (>90%) in these mixed oak and hardwood stand with pine inclusions protects the forest soils from displacement. These stands collect water as it seeps from the edges of all the ponds in the Ashley Ponds System. Water sits and deposits any impurities in these low areas before movement south.

Silviculture Status: Not Suitable.

Terrain/Topography: Four sections (a-d) of this stand lie on the alluvial outwash plains beside or surrounding the glacial kettle ponds south of Route #202 in the Ashley Ponds Reservoir South.

(a): The land slope south from the water tanks on Whitney Avenue across undulating rock outcroppings and eskers. Vernal pools and small ponds dot the ground. A hiking trail crosses the esker formations. The lowest points have a high water table.

(b): This section joins an urban neighborhood along the Pioneer Valley Railroad bed. An inclusion of some very, healthy Scotch pine joins the eastern bound near the houses. Pitch pine and scarlet oak are common species in the stand dynamic. The hemlock crop is dying quickly in this moist grove. Water table is high through this entire section with some hummock growth. Dense hazelnut, illex, blueberry, and ironwood cover the lower canopy.

(c) : This is the largest section and it rests upon a broad undulating outwash plain with water bisecting the section from pond drainage. Isolated clumps of white pine dot the upper canopy. They provide small habitat niches for high nesting songbirds and small mammals. Swamp white oak trees grow in this area. This is a unique species in such abundance for Hampden County. A beautiful hiking trail cuts through this moist area with a small wooden bridge across the drainage.

(d): This small stand lies at the southeastern corner of the property along the West Springfield Town bound. Swamp white oak trees grow in this area. This is a unique species in such abundance for Hampden County. The terrain gently slopes into a wetland area on the western edge of the site.

Soils: The productive deep Broadbrook sandy loams support this stand. These soils were formed from vast layers of sand and gravel sediments. Years of pasturing and agriculture use depleted these soils. The site is beginning to rebuild its fertility as evidenced with the immature hardwood crop on site.

Timber Harvesting: These areas act as filtration and purification last barriers of defense as water leaves the Ashley Ponds system. No disturbance would ever be appropriates in these four sections.

Overstory: These areas have the appearance of an old-field successional pattern with the scattered overstory, large sized white pine and dense immature hardwood small timber, which grow above dense hardwood (red maple, sugar maple, scarlet oak, red oak, and black birch) pole, and sapling trees. The red oak crop has good form and potential high value. All of red maple stems have many defects as characteristic of the old-field maple products. They are from common stump sprout origin. Swamp white oak trees grow in two sections of this area. This is a unique species in such abundance for Hampden County.

Understory:
Regeneration: Overstory shade prevents prolific seedling development. Seedlings of chestnut, birch, maple, all the oaks, and white pine grow vigorously when sunlight hits the forest floor. The stocking rating is a C here.

Shrub and Herbaceous Cover: Although deep sands, the ground is covered with a of wintergreen, Christmas fern, tree club moss, broad leaved beech fern, running cedar, spinulose fern, Lady fern, maiden hair fern, hay scented fern, whorled loosestrife, and lamb's quarter. Dense thickets of native shrubs were found in this area. Most prominent shrubs include witchhazel, sheep laurel, mountain laurel, low bush blueberry, maple leaved viburnum, lamb's quarter, elderberry, spicebush, and beaked hazelnut. Hundreds of ironwood seedlings and saplings also grow in these forests. Illex dominates the cover at the edges of the ponds and riparian zones. Grape vines aggressively climb and strangle larger pine, and hardwood stems.

Invasive Plants: Invasive plants consistently through these stands with highest densities near the water/pond edges and railroad and road edges with the sunlight were found along the gravel access road. Their simple metric rating is B+. The most common plants were Japanese barberry, winged euyonomous, bush honeysuckle, glossy buckthorn, and Asiatic bittersweet. Retention of full crown shade contains them in these plant communities. The geography here does not support migration of these plants into more productive ecosystems.

Habitat: Pitch pine growing amongst the oak groves provides a high nest opportunity. Five oak species produce ample mast each season for feed. These dense maturing stands suffer storm damage annually, and the forest floor holds high volumes of woody material for invertebrates. Moose rubbings were common on red maple sapling and pole trees. These remote stands provide deep, interior forest for use by Black throated blue warbler, black-throated green, Canada warbler, and Woodthrush. Woodpeckers freely use the mature sugar maple, pine, hemlock, and white oak for insect feed.

Fire Protection: This stand is easily accessible with a four-wheel drive pumper truck for fire management. Available water is also accessible for prevention. No fire events have occurred across this area for decades.

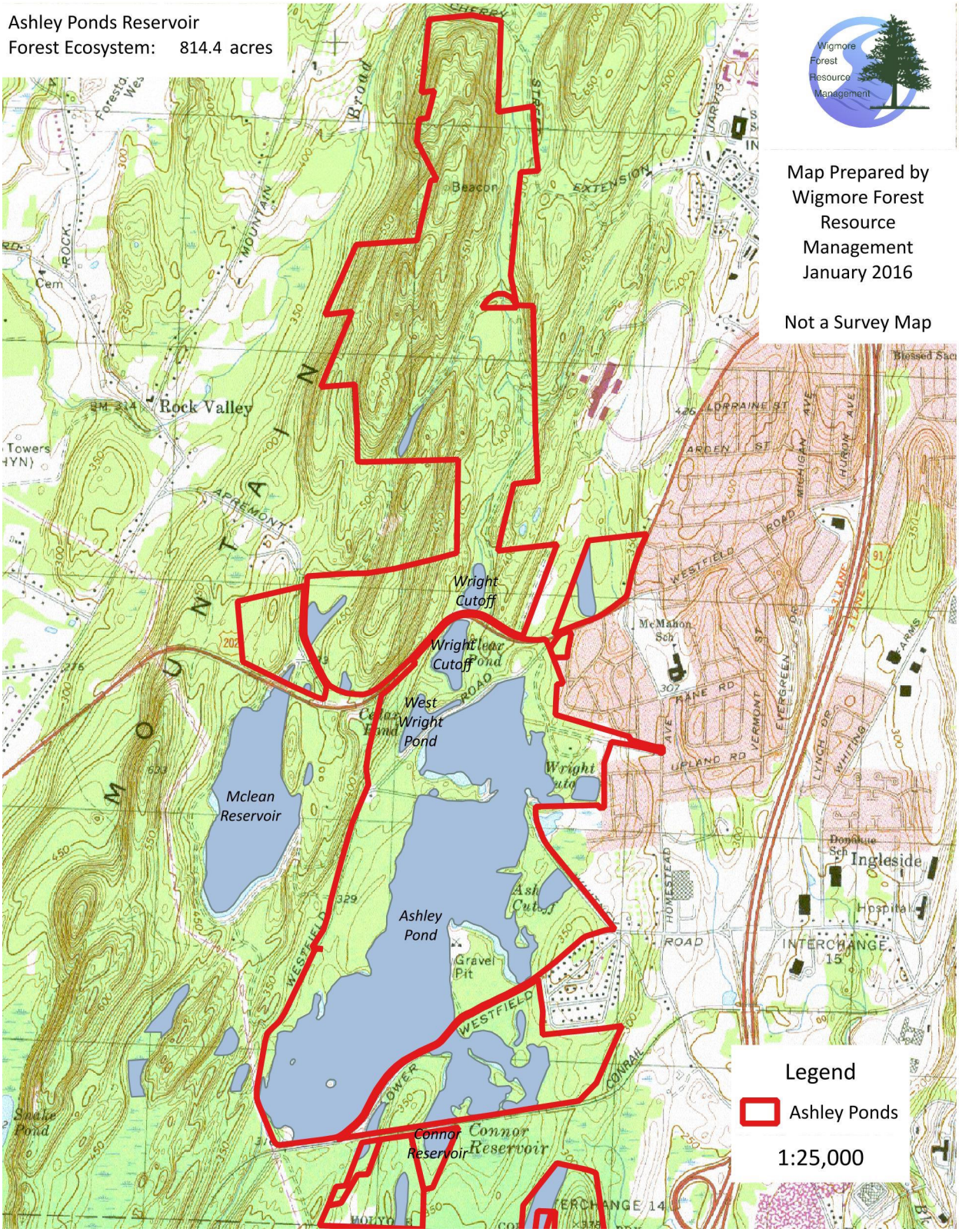
Special Stewardship Considerations: A recreational trial runs through the center of this stand. The water drains out of these small sections into the vast swamp and wetland complex on the West Springfield Town lines to the south. This is an essential support habitat for the blue Herron rookery to the south.

Desired Future Condition: This stands lies on the lowland alluvial plains where water collects from the entire Ashley ponds system. These soils and the forest ecosystem act as a filter and purifier for the slow moving water. They naturally stratified into a two-aged stand with mature pine scattered in the upper canopy. The dense shrub layer protects the forest floor. Preservation of the forest ecosystem protects water quality downstream in the Bearhole watershed and Reservoir.

Management Program Summary by Stand and Practice for 2016 to 2026:

Stand Number	Forest Type	Area Acres	Silvicultural practice/ Management Technique	Yield Revenue/ Costs	Volume Yields	Timing
2	OH	95	1. Public outreach and Community Building 2. Crop Tree Management 3. Invasive Plant Reduction Treatment	1. Costs 2. Revenue 3. Costs	1. 160 MBF 200 cords firewood 60 cords hk pulp	
4	WP		1. Public outreach and Community Building 2. Irregular Shelterwood Harvest 3. Invasive Plant Reduction Treatment	1. Costs 2. Revenue 3. Costs	1. 550 MBF, 45 cords firewood, and 250 cords plup	1. 2016 to 2020 2. 2017 to 2020 3. 2016 to 2026
6	WH		1. Public outreach and Community Building 2. Crop Tree Management 3. Invasive Plant Reduction Treatment	1. Costs 2. Revenue 3. Costs	1. 275 MBF, 80 cords firewood, and 160 cords of pulp	1. 2016 to 2020 2. 2017 to 2020 3. 2016 to 2026
All	All		Boundary delineation, research, and monumentation.	Costs		2016 to 2019

Holyoke Water Works
Ashley Ponds Watershed
Locus Map



FOREST STEWARDHSIP STAND AND BOUNDARY MAP
FOR THE PROPERTY OF THE HOLYOKE WATER WORKS
THE ASHLEY PONDS WORKING FOREST-NORTHERN SECTION
WESTFIELD ROAD-HOLYOKE, MASSACHUSETTS
STEWARDSHIP/GREEN CERTIFICATION AREA: 537.9 ACRES

Map Scale
1 inch = 1,155 feet

True North

Physical Feature Legend

Bridge BRD

Cement bound CB

Forest Stand Boundary

Forest Stand Number 1

Gravel Road

Groves of White Pine (WP) and Beech (Be) WP BE

Excluded sites

Invasive Plant "Hotspot" Inv.

Hydric Soils/Wetland Site

Hiking Trail

Priority Habitat Zone-NHESP

Pond P

Steep Slopes

Shrub swamp SS

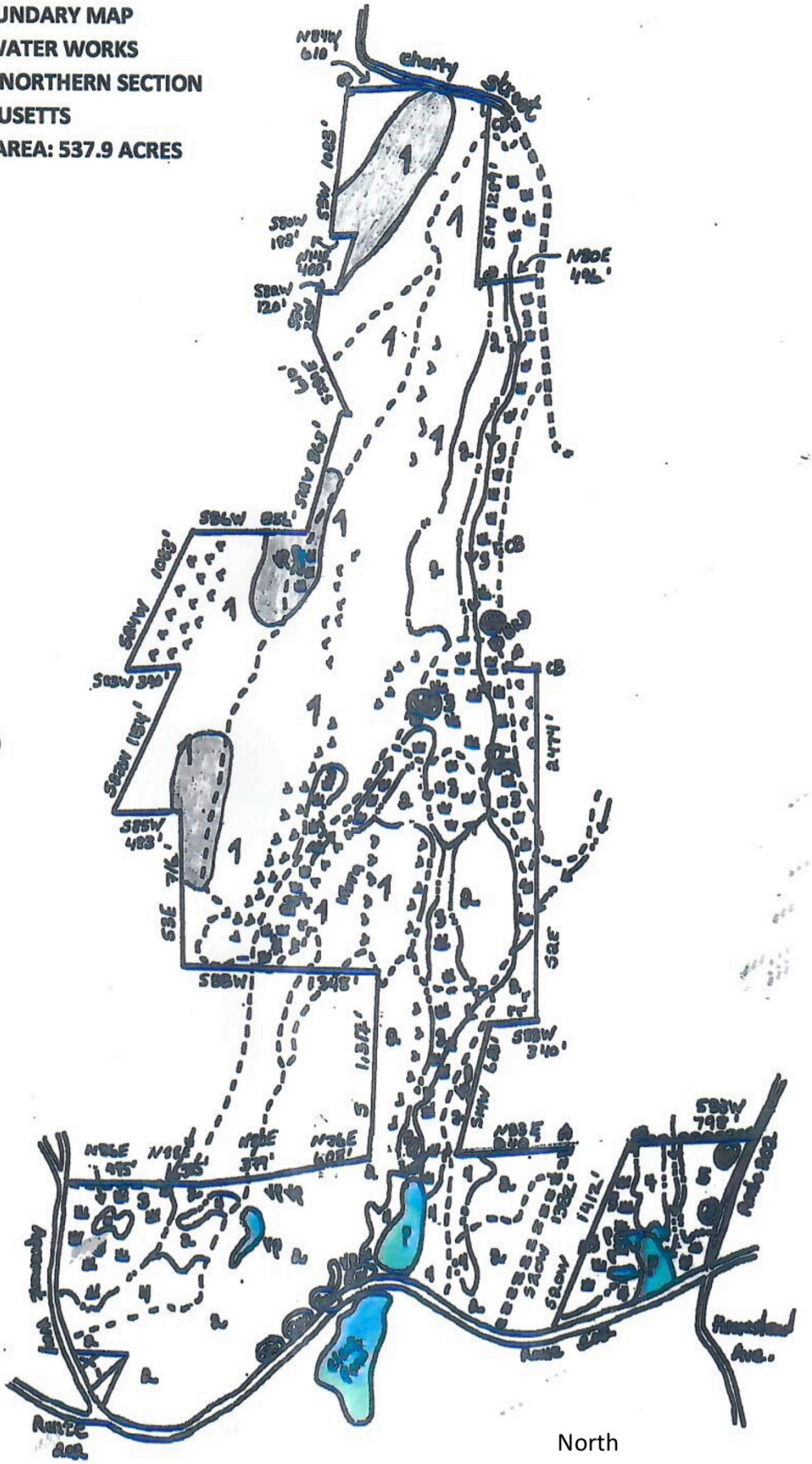
Spring Seep SP

Stream

Stonewall

Vernal Pool VP

Map prepared by Wigmore Forest Resource Mgt in January 2016. Map source tax maps, neighboring survey maps, GPS field data collection, and MassGIS tax layer. This is not a survey map.



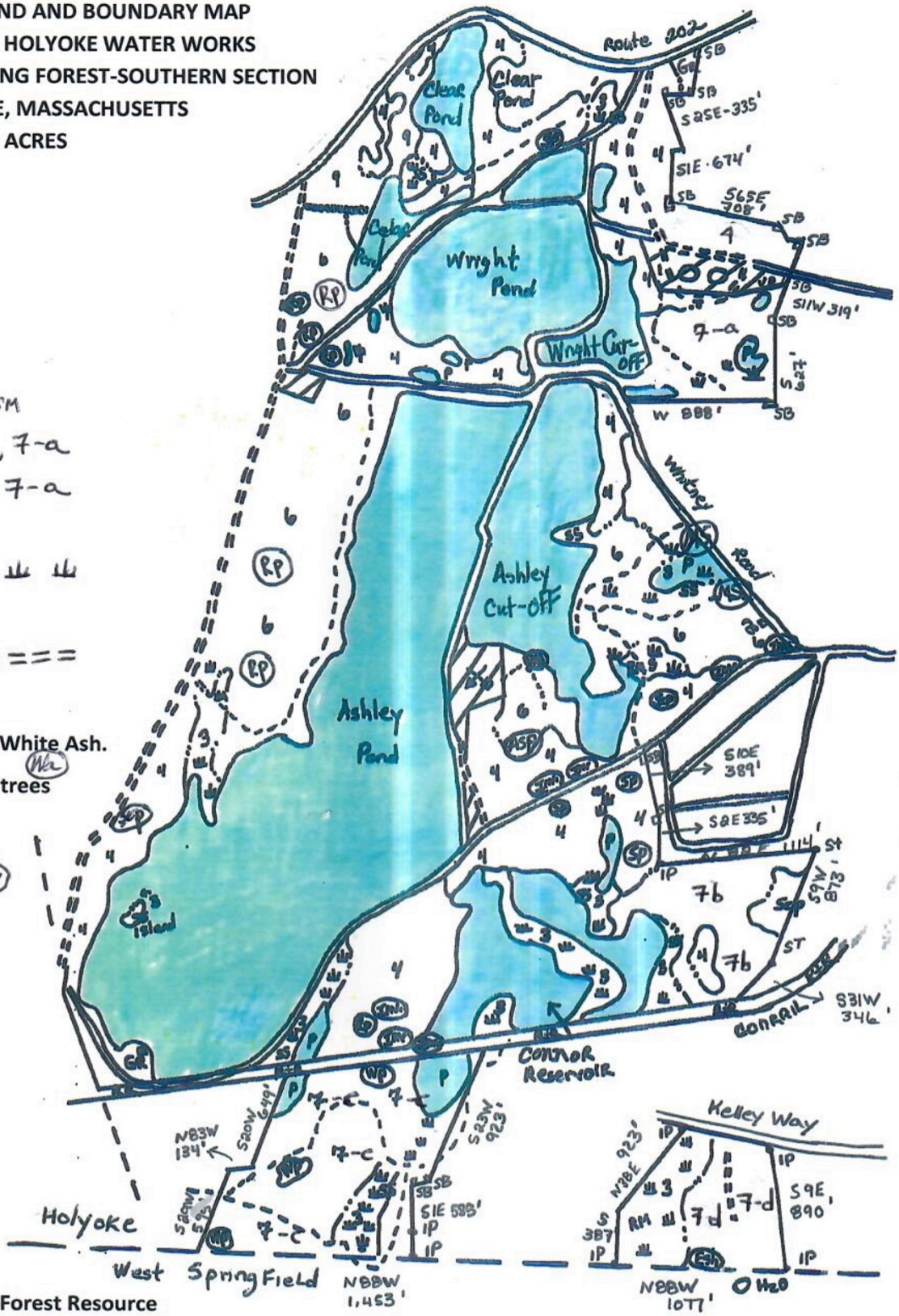
FOREST STEWARDHSIP STAND AND BOUNDARY MAP
FOR THE PROPERTY OF THE HOLYOKE WATER WORKS
THE ASHLEY PONDS WORKING FOREST-SOUTHERN SECTION
WESTFIELD ROAD-HOLYOKE, MASSACHUSETTS
STEWARDSHIP AREA: 276.5 ACRES

Map Scale
1 inch = 1,012 feet

True North

Physical Feature Legend

- **Cement bound** CB or SM
- **Forest Stand Boundary** 1, 7-a
- **Forest Stand Number** 1, 7-a
- **Iron Pipe** IP
- **Hydric Soils/Wetland Site**
- **Excluded sites**
- **Gravel Road**
- **Gravel Bank**
- **Groves of Red Pine, Aspen, White Ash.** RP, Asp, Wa
- **White Pine and Spruce trees** WP, SP
- **Hiking Trail**
- **Invasive Plant Hotspot** Inv
- **Pond** P
- **Shrub swamp** SS
- **Stream**
- **Stonewall**
- **Vernal Pool** Vp



Map prepared by Wigmore Forest Resource Mgt in January 2016. Map source tax maps, neighboring survey maps, GPS field data collection and MassGIS tax layer. This is not a survey map.

South

Signature Page **Please check each box that applies.**

☐ **CH. 61/61A Management Plan I attest that I am familiar with and will be bound by all applicable Federal, State, and Local environmental laws and /or rules and regulations of the Department of Conservation and Recreation. I further understand that in the event that**

I convey all or any portion of this land during the period of classification, I am under obligation to notify the grantee(s) of all obligations of this plan which become his/hers to perform and will notify the Department of Conservation and Recreation of said change of ownership.

☒ **Forest Stewardship Plan. When undertaking management activities, I pledge to abide by the management provisions of this Stewardship Management Plan during the ten year period following approval. I understand that in the event that I convey all or a portion**

of the land described in this plan during the period of the plan, I will notify the Department of Conservation and Recreation of this change in ownership.

☒ **Green Certification. I pledge to abide by the FSC Northeast Regional Standards and MA private lands group certification for a period of five years. To be eligible for Green Certification you must also check the box below.**

☐ **Tax considerations. I attest that I am the registered owner of this property and have paid any and all applicable taxes, including outstanding balances, on this property.**

Signed under the pains of perjury:

Owner(s)_____**Date**_____

Owner(s)_____**Date**_____

I attest that I have prepared this plan in good faith to reflect the landowner's interest.

Plan Preparer_____**Date**_____

I attest that the plan satisfactorily meets the requirements of CH61/61A and/or the Forest Stewardship Program.

Approved, Service Forester_____**Date**_____

Approved, Regional Supervisor_____**Date**_____