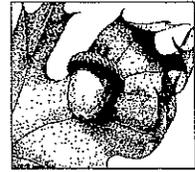


dcr

FOREST MANAGEMENT PLAN



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



(H) 127.9496

(WA) 337.9497

CHECK-OFFS						Case No. (WA) 340.9498	Orig. Case No. - new
CH61 cert. <input type="checkbox"/>	CH61A cert. <input type="checkbox"/>	CH61B cert. <input type="checkbox"/>	STWSHP new <input checked="" type="checkbox"/>	C-S EEA <input checked="" type="checkbox"/>	Owner ID 503169	Add. Case No.	
recert. <input type="checkbox"/>	recert. <input type="checkbox"/>	recert. <input type="checkbox"/>	renew <input type="checkbox"/>	Other <input type="checkbox"/>	Date Rec'd 6.25.12	Ecoregion 221 AF	
amend <input type="checkbox"/>	amend <input type="checkbox"/>	amend <input type="checkbox"/>	Green Cert <input checked="" type="checkbox"/>	Conservation Rest. <input type="checkbox"/>	Plan Period 2013-2022	Topo Name W-burg	
Plan Change: _____ to _____			CR Holder _____	Rare Sp. Hab. NO	River Basin I CT		

OWNER, PROPERTY, and PREPARER INFORMATION

Property Owner(s) The City of Northampton, Department of Public Works,* "MOUNTAIN STREET"
Mailing Address 125 Locust Street, Northampton, MA, 01060 Phone (413) 587-1376

Property Location: Town(s) Hatfield, Whately, Williamsburg Road(s) Mountain Street**

Plan Preparer Michael Mauri, Forester Mass. Forester License # 161
Mailing Address 20 West Street, South Deerfield, MA 01373 Phone (413) 665-6829

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
SEE	NEXT	PAGE	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
TOTALS				-	-	-	-	-

Excluded Area Description(s) (if additional space needed, continue on separate paper)
None

HISTORY Year acquired see records Year management began unknown

Are boundaries blazed/painted? Yes No Partially

What treatments have been prescribed, but not carried out (last 10 years if plan is a recert.)?
stand no. N/A treatment _____ reason _____
(if additional space needed, continue on separate page)

Previous Management Practices (last 10 years)

Stand #	Cutting Plan #	Treatment	Yield	Value	Acres	Date
N/A						

Remarks: (if additional space needed, continue on separate page)
*Attention Nicole Sanford, Senior Environmental Scientist; **Mountain Street in Williamsburg; Haydenville Rd., Laurel Mountain Rd. and Chestnut Mountain Rd. in Whately, and Rocks Road and Chestnut Mountain Roads in Hatfield

Property Records: Mountain Street Reservoir Watershed

TOWN	Assessor's Map	Lot/ Parcel	Deed Book	Deed Page	Year	Assessor-listed Acreage	CH 61/61A Excluded Acres	Ch 61/61A Certified Acres	Stwdshp/ Green-Cert Excluded Acres	Stwdshp/ Green-Cert Acres
Hatfield	209	10	562	239	1902	9.00	9.00	0	0.0	9.00
Hatfield	208	1	551	293	1901	22.00	22.00	0	22.0	0.00
Hatfield	208	1	562	383	1901					
Hatfield	208	1	551	273	1901					
Hatfield	208	1	551	441	1901					
Hatfield	208	1	551	149	1901					
Hatfield	208	7	848	477	1928	31.00	31.00	0	0.0	31.00
Whately	3	14	5771	199	2009	20.90	20.90	0	0.0	20.90
Whately	3	8	478	352	1901	2.11	2.11	0	0.0	2.11
Whately	3	7	478	352	1901	144.76	144.76	0	2.8	141.96
Whately	3	7	706	343	1925					
Whately	3	7	845	124	1940					
Whately	3	5	5996	33	2011	41.17	41.17	0	0.0	41.17
Whately	3	4	5996	33	2011	86.00	86.00	0	0.0	86.00
Whately	3	6	798	173	1925					
Whately	3	6	821	189	1923	47.68	47.68	0	0.0	47.68
Williamsburg	E	13	798	173	1925					
Williamsburg	E	13	821	189	1923	150.00	150.00	0	10.7	139.30
Williamsburg	E	11	562	383	1901	69.38	69.38	0	44.4	24.98
Williamsburg	E	11	551	149	1901					
Williamsburg	E	11	551	273	1901					
Williamsburg	E	11	551	293	1901					
Williamsburg	E	12	551	149	1901	7.05	7.05	0	0.0	7.05
Tax Acreage Totals						631.05	631.05	0.00	79.9	551.15
Acreage (GIS) Totals Used*						638.9	638.9	0.0	79.9	559.0

Excluded from Forest Stewardship and Green Certification:

The Mountain Street Reservoir (ca. 69.2 acres taken from Whately parcel 3-7, Hatfield parcel 208-1, and Williamsburg parcel E-11) and the Water Treatment Plant (ca. 10.7 acres taken from Williamsburg parcel E-13), totaling about 79.9 acres, are excluded. Note: for Williamsburg parcel E-11, the deeded acreage of 69.38 was substituted here for the tax acreage of 29.8. Apparently, the land under water was not counted in the tax acreage.

*The content of the Forest Stewardship Plan is based on the total GIS acreage.

2.8 GR Stnd
5
556.2 ac
8/10/12

STAND DESCRIPTIONS

Outreach Plan in Conjunction with Forest Stewardship
Planning: Northampton DPW
Ryan & West-Whately Reservoir Watershed
and Mountain Street Reservoir Watershed
6/6/2012

Purpose: Help develop public awareness of the role of forest management in sustaining the forested watersheds that supply water to most residents of the City of Northampton

Practice 1: create multiple-use/repeat-use educational brochure

Target audience: City residents and water users, abutters, general public; commissions of affected towns

Message: objectives and methods of forest management in a watershed setting

Advertising: include as bill stuffer to water customers; possible press release and posting on City website or other web-based platform; distribute at hikes (see below); possibly mail to abutters; possibly mail to Conservation Commissions and other commissions of Whately, Conway, Hatfield and Williamsburg and to libraries in affected towns.

Evaluation: (1) brochure is created and printed; (2) brochure has been mailed out to every water customer Conservation Commissions and other commissions of Whately, Conway, Hatfield and Williamsburg and to libraries in affected towns

STAND DESCRIPTIONS

Practice 2: offer educational hikes to show forest features (good and bad) and also before and after implementation of management practices

Target audience: City residents and water users, abutters, general public; commissions of affected towns; landowners

Message: concrete examples of forest management in a watershed setting (e.g. timber harvesting, invasive species control, etc.)

Advertising: include as bill stuffer to water customers; possible press release and posting on City website or other web-based platform; distribute at hikes (see below); possibly mail to abutters; possibly mail to Conservation Commissions and other commissions of Whately, Conway, Hatfield and Williamsburg

Evaluation: 10 hikes over a 10-year period

Deed Research/Clarification of Ownership Records

Some parcel record information could not be provided at this time. The City of Northampton Department of Public Works (DPW) is currently working with a title examiner and the City Solicitor to determine the correct book and page numbers for present day parcels owned by the City of Northampton. For purposes of the Forest Stewardship Plans and Green Certification, Northampton DPW requests that any outstanding deed research be included as a "Practice" in the Management Practices section of the Forest Stewardship Plans.

Status of Roads and Related Research

In some cases, the legal status (ownership and/or usage rights) of certain roads is uncertain. Northampton DPW will research and clarify these road issues as needed whenever these roads needed for timber harvesting activities.

Roads that fall into this category for the Ryan & West-Whately watershed are:

1. the Henhawk Trail in Williamsburg and Conway
2. Dry Hill Road in Williamsburg
3. Grass Hill Road in Whately

Roads that may fall into this category for the Mountain Street watershed are:

1. Chestnut Mountain Road in Hatfield
-

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			X	
Promote Biological Diversity	X			
Enhance Habitat for Birds		X		
Enhance Habitat for Small Animals		X		
Enhance Habitat for Large Animals		X		
Improve Access for Walking/Skiing/Recreation			X	
Maintain or Enhance Privacy			X	
Improve Hunting or Fishing			X	
Preserve or Improve Scenic Beauty			X	
Protect Water Quality	X			
Protect Unique/Special/ Cultural Areas	X			
Attain Green Certification	X			
Other:				

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

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

Promote and sustain a diverse, healthy and vigorous forest, and maintain associated infrastructure in good operating condition, so that the primary goal of water quality protection, and secondary goals of long-term timber revenue and habitat diversity are served.

Stewardship Purpose

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

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

Signature(s): Edward S. Huntley

Date: 6/25/12

Owner(s) (print) Edward S. Huntley
(This page will be included with the completed plan.)

Page _____ of _____

Combined Forest Stewardship Overview:
“Ryan Reservoir & West-Whatley Reservoir Watersheds”
and the “Mountain Street Reservoir” Watershed,
Land of the City of Northampton,
Department of Public Works,
Hatfield, Conway, Whately and Williamsburg, MA

Prepared by Michael Mauri, Licensed Forester

With

Bruce Spencer, Licensed Forester (private consultant);
Bob Bradbury, Licensed Forester (LandVest);
Molly Hale, M.S. Wildlife and Fisheries Conservation (private consultant);
and Chris Polatin, M.S. Conservation Biology (Polatin Ecological Services)

6/21/2012

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I. Introduction

The City of Northampton draws roughly 98% of its municipal water from a three-reservoir system formed by the Ryan, West-Whately and Mountain Street Reservoirs.

The total acreage of the watersheds cannot be exactly ascertained (with surveys lacking).

The estimated acreage of the Ryan & West-Whately watershed is 2,440 acres, more or less. Of this, about 94 acres is open water in the reservoirs, leaving about 2,346 acres of land to be covered in the Forest Stewardship Plan for the Ryan & West-Whately watershed.

The estimated acreage of the Mountain Street Reservoir watershed is 639 acres, more or less. Of this, about 69 acres is open water in the reservoir, leaving about 570 acres of land. Of this, the immediate grounds of the water treatment plant cover about 10.7 acres, leaving a total of about 559 acres to be covered in the Forest Stewardship Plan for the Mountain Street watershed.

The locations of these reservoirs and the approximate DPW property boundaries are shown on the attached Locus Maps.

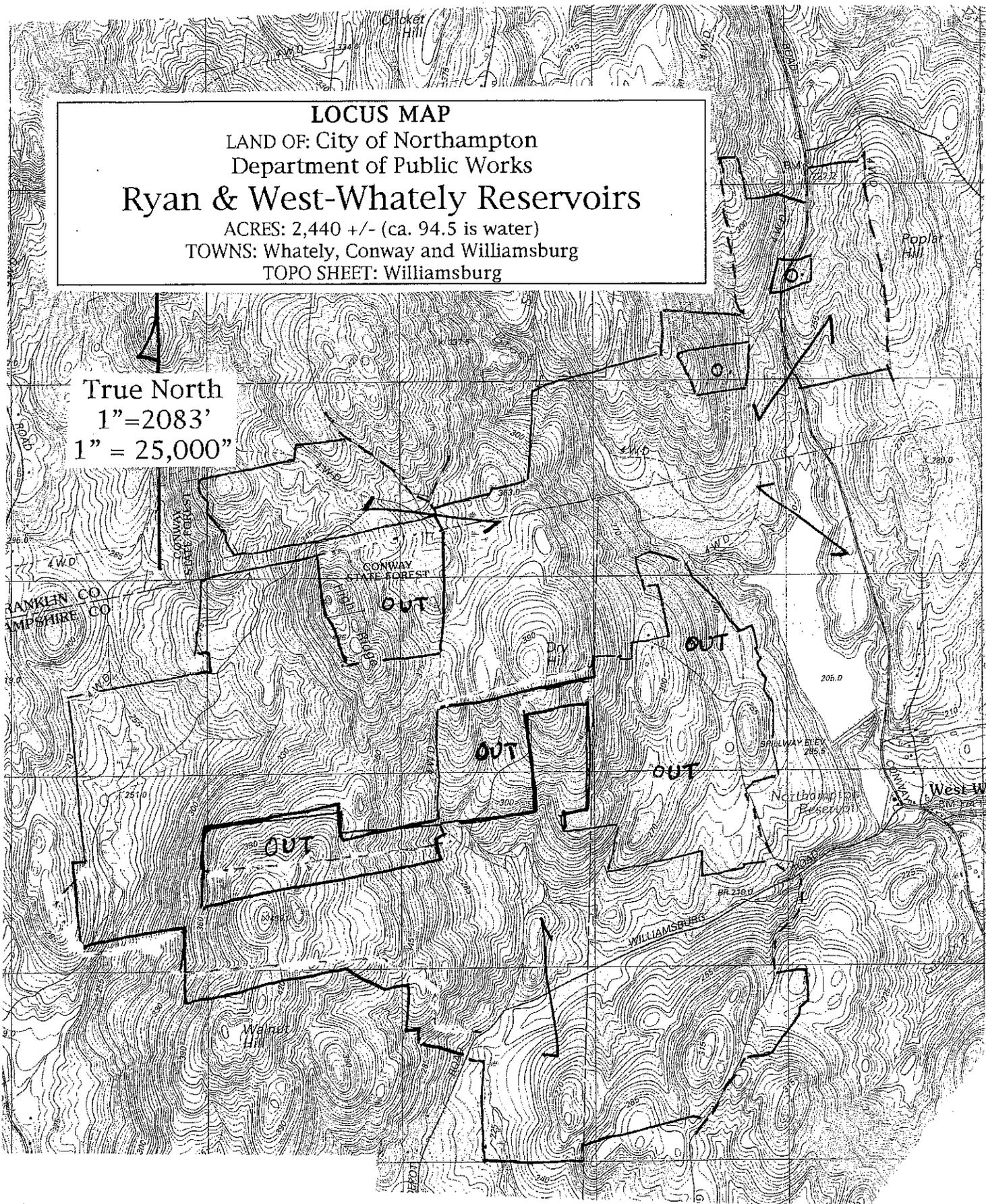
LOCUS MAP

LAND OF: City of Northampton
Department of Public Works

Ryan & West-Whately Reservoirs

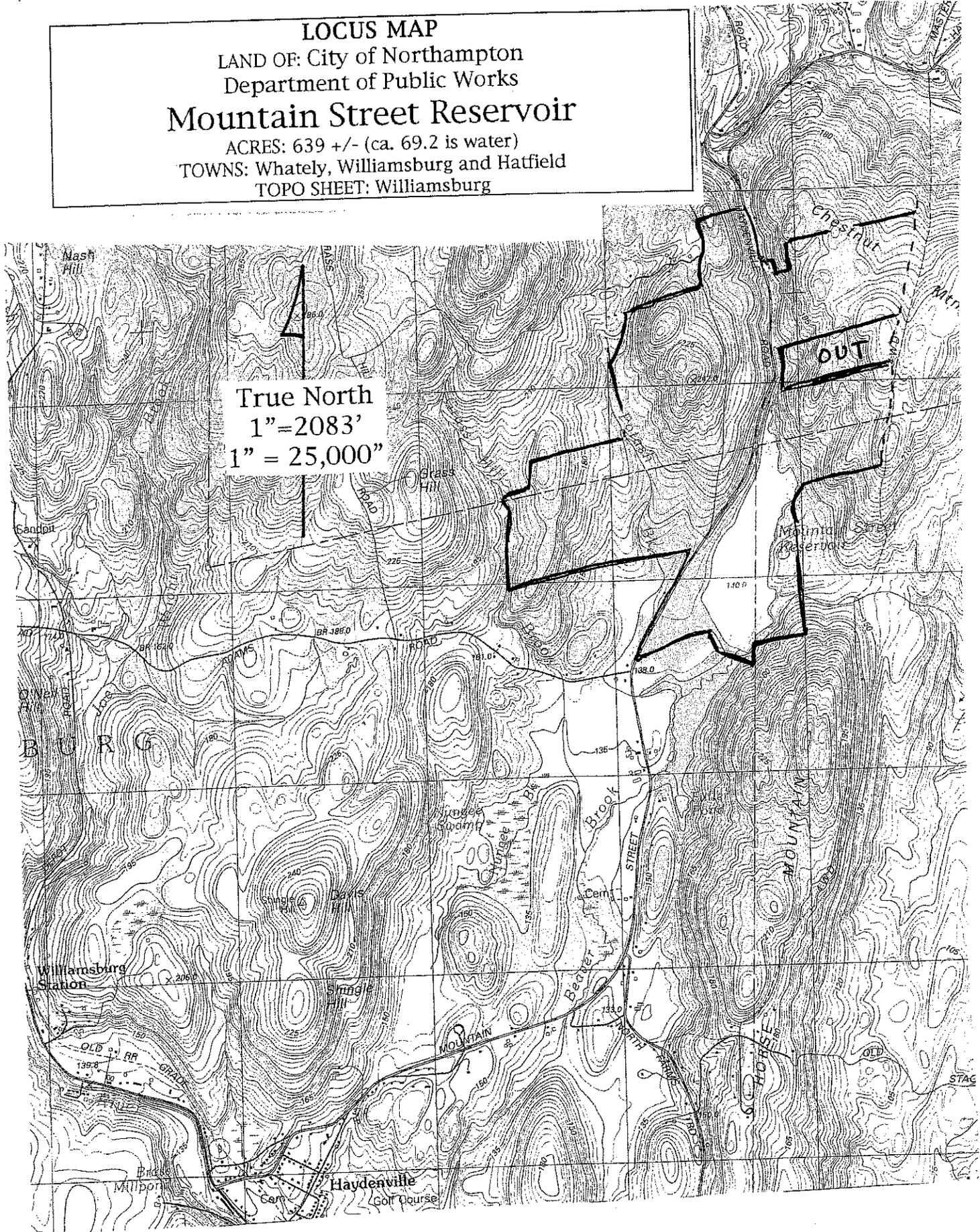
ACRES: 2,440 +/- (ca. 94.5 is water)
TOWNS: Whately, Conway and Williamsburg
TOPO SHEET: Williamsburg

True North
1" = 2083'
1" = 25,000"



LOCUS MAP
LAND OF: City of Northampton
Department of Public Works
Mountain Street Reservoir
ACRES: 639 +/- (ca. 69.2 is water)
TOWNS: Whately, Williamsburg and Hatfield
TOPO SHEET: Williamsburg

True North
1" = 2083'
1" = 25,000"



Acquisition of the land began in the late 1800's, and continues to this day

Raw water from Ryan Reservoir flows by gravity through approximately 16,000' of pipe (underneath Conway Road, Webber Road, Haydenville Road and Mountain Street) directly to the Water Treatment Plant. Raw water from the West-Whately Reservoir flows by gravity through approximately 10,000' of pipe before discharging into an open channel known as Borowski Brook, which flows (alongside Haydenville Road) into the Mountain Street Reservoir, where it mixes with water from the natural watershed of the Mountain Street Reservoir. From there, the water is pumped up to the Water Treatment Plant.

Ideal forest: The reservoirs are filled with water that drains out of the surrounding forested landscape. This land area, referred to as the "watershed", is largely covered with forest. The forested-land watershed plays an essential role in collecting, filtering, storing, and releasing water into the reservoirs through surface streams and subsurface flow. The condition of the forest affects the quality and amount of the water flowing into the reservoirs. For watershed purposes, the ideal forest condition is a diverse forest of vigorous, site-adapted native trees growing to mature size within a forest framework that is constantly regenerating with desirable new trees — in effect, a multi-aged forest of diverse, site-adapted species. This type of forest is considered to be the forest condition that will, over time, provide, sustainably, the highest-quality water. Accordingly, the objective of forest management on the watershed is to create and maintain this desired condition and, as necessary, identify threats to the desired condition and design effective responses to these threats.

The City of Northampton has been taking water from the three watersheds for over 100 years. Throughout this time, the forest, and the watershed land it occupies, have been effective in their function as suppliers of water to the reservoirs. Overall, the forest is still in a desirable condition, but exceptions exist and are expanding as, increasingly, a number of factors threaten to bring the forest into a less desirable condition. Chief among these factors are (1) an expected further decline and eventual loss of certain tree species (due to pests and disease), and (2) the accumulation of factors that aggressively interfere with the forest's ability to regenerate itself (e.g. aggressive growth of vines and over-browsing by herbivores). These factors are discussed in detail within the plan.

Purpose of this plan: This plan addresses the current condition of the watershed forest, and threats to this condition, and lists recommended management steps to maintain or work toward the ideal condition described above. Some of the forested land falls outside the physical watershed of the reservoirs. However, whether the land falls in or out of the watershed, all aspects of forest management described in this plan are intended to maintain, protect and enhance the watershed-protection functions of the forest.

Secondary goals of this plan include timber production and management of wildlife habitat.

The bulk of the work on this plan was carried out between May, 2011 and May, 2012.

Questions to be answered (“stewardship concerns”):

- (1) are there silvicultural treatments and other vegetation management treatments (e.g. invasive plant control) that can be implemented to maintain the watershed functions of the forest over time?
- (2) is road infrastructure maintained to provide ongoing access for monitoring and management while preventing sedimentation of waterways?
- (3) are there factors that threaten to compromise forest function (e.g. insect and plant pests) and, if so, how can these be addressed?
- 4) are boundaries adequately known and marked and posted with adequate signage at relevant access points to guide/restrict public access?
- (5) are prohibited or undesired uses of the watershed taking place, and, if so, how can these be resolved (e.g. unauthorized ATV riding)?
- (6) are outreach measures in place to facilitate public acceptance and cooperation as needed in order to be able to proceed with watershed management activity?

II. Watershed Focus

Water quality is the DPW's main concern in all areas part of the actual reservoir watersheds, with the key objective being the avoidance of any sediment inflow into the reservoirs or their tributaries and, secondarily, the maintenance of a healthy watershed forest that will contribute the best possible water to the reservoirs. The major question to be addressed in this plan is how to best maintain the watershed functions of the forest (mainly filtration and storage) over time, and how to best protect the reservoir and its tributaries from preventable pollution, primarily in the form of sediment from erosion and/or excessive flow. Acreage outside the actual watershed will be managed according to these same concepts.

The following list of principles, taken from the Quabbin Reservoir Land Management Plan 2007-2017* has been incorporated into the development this forest management plan:

- (1) maintain, or, develop and maintain a vigorous forest with strong regenerative capability by fostering, through silvicultural approaches, a variety of site-adapted tree and shrub species in a range of age classes;
- (2) identify sub-watersheds and manage these individually (see Tables 1A & 1B);
- (3) avoid increasing water-yield/increases in sediments and nutrients by keeping harvesting to < 25% of forest cover (i.e < 25% of basal area) within a 10-year period within any given sub-watershed;
- (4) pay special attention to roads and trails (e.g. town roads and trails, logging roads, snowmobile and ATV trails, etc.) so that these (through erosion, failure of stream crossings, etc.) do not become contamination sources;

(5) avoid or minimize any harmful impacts to watershed soil (e.g. due to compaction or overland flow or excessive removal of woody material);

(6) be mindful of, and where possible prevent or counter-act, trends and processes that could curtail the desired functioning of the watershed forest (e.g. decline and mortality of overstory trees and loss of canopy diversity as well as factors that interfere with the regenerative capacity of the forest such as non-native invasive plants (e.g. oriental bittersweet) as well as native interfering factors such as excessive browse by deer and moose and excessive growth of native vines, shrubs and ferns.); and,

(7) develop and implement an outreach component to give the public the means to appreciate the role of the watershed forest and its condition and to become aware of the rationale for watershed forest management.

*This section is based on the current 10-year forest management plan for nearby Quabbin Reservoir (Quabbin Reservoir Watershed System: Section 3: Principles Guiding Watershed Management, Land Management Plan 2007-2017, and conversations with the author, Thom Kyker-Snowman).

Table 1A: List of Ryan & West-Whately Subwatersheds

Subwatersheds	Acreage
Avery Brook West	362
East. Branch Mill River (OUT)	534
Sanderson Brook	858
Ryan/W. Whately Shore.	171
Avery Brook E / Ryan Shore	196
Finney Brook	225
Total	2,440

Table 1B: List of Mountain Street Subwatersheds

Subwatersheds	Acreage
Mountain Street East	195
Mountain Street West	180
Beaver Brook (OUT)	72
Potash & Grass Hill Brooks (OUT)	192
Total	639

III. Landscape Context

The local pattern of land use: By virtue of its large size, the forested-land surrounding the Ryan & West-Whately Reservoir is an important feature of the local landscape. To the north, the landscape is almost entirely forested, with uses such as hiking, snowmobiling, hunting, logging and water supply. Much of this land is public — Conway State Forest — though there are private woodlots as well. To the east, west, and south, the landscape is forested as well, but the forest is partially fragmented by residential development, much of which has occurred during recent decades, interspersed with older, grass-based farms.

Though smaller in area than the Ryan & West-Whately watershed, the forested land around the Mountain Street Reservoir watershed is also an important feature of the local landscape. To the west and east, the landscape is almost entirely forested, with uses such as hiking, snowmobiling,

hunting, and logging. This land is in private ownership. To the north and south, the landscape is partly forested, partly devoted to grassland farming, and otherwise is in low-density residential use.

Topography: the land surrounding the Ryan & West-Whately Reservoir is primarily glaciated upland that is generally sloping, sometimes steeply. The glacial till soils are generally stony and often shallow to bedrock. Exceptions include sandy glacial outwash terraces on the east and northwest side of Ryan Reservoir. Low areas in the landscape tend to be occupied by muck soils or wetlands and streams. The highest point within the Ryan & West-Whately watershed is High Ridge, with an elevation of approximately 1,550'. Other major named peaks around the Ryan & West-Whately Reservoirs include Dry Hill, Poplar Hill, and the northern tip of Walnut Hill. The lowest point, at the West-Whately spillway, is about 611' elevation, about 950' below High Ridge.

The land surrounding the Mountain Street Reservoir is also primarily glaciated upland that is generally sloping, sometimes steeply. The glacial till soils are generally stony and sometimes shallow to bedrock or shallow to a hard layer. Exceptions include sandy glacial outwash soils on the southwest side of Mountain Street Reservoir. Low areas in the landscape tend to be occupied by muck soils or wetlands and streams. The highest point in this watershed is Chestnut Mountain, with an elevation of approximately 831'. The other major peak is Laurel Mountain, with an elevation of about 762'. The Mountain Street spillway, is about 462' in elevation, about 370' below Chestnut Mountain.

Unique cultural and physical features surrounding the Ryan & West-Whately Reservoir include (1) the reservoirs themselves — two open-water reservoirs with major feeder brooks including Avery Brook and Sanderson Brook, as well as (2) a number of major forest roads (Poplar Hill Road, Old Phinney Road, Waterworks Road, Dry Hill Road, Williamsburg Road, Old Williamsburg Road, the Henhawk Trail, Grass Hill Road, and Judd Lane); (3) a significant block of contiguous forest within a larger forested context; (4) historical features such as the remains of both the Williamsburg Dam as well as a large mill site on Avery Brook.

Unique cultural and physical features at the Mountain Street Reservoir include (1) the reservoir itself — a, large, open water body fed by the surrounding landscape and by water supplied by the West-Whately Reservoir; as well as (2) a number of major forest roads (Chestnut Hill Road, Rocks Road, and Laurel Mountain Road); (3) a significant block of contiguous forest within a larger forested context; (4) historical features such as a number of cellar holes, stone walls, and other indicators of past land uses.

IV. The Forest: Species Forest Types, Timber, Habitat, History

Most areas of the three watersheds are covered by a tall, maturing, closed-canopy forest of mixed species between 70 and 110 years of age. Almost none of the forest is less than 40 years old, and there were very few areas with seedlings ("regeneration") that were free to grow. Scattered trees (mainly in old fence lines and in old pastures) may easily be 150-200 years old, but there are probably no trees that date from before European settlement of the area.

The overarching forest on the Ryan & West-Whately watershed is a mix of white pine, hemlock, red oak, and black and yellow birch. These 5 species make up about 74% of the total timber volume, with the following break down: white pine (33%), hemlock (18.6%), red oak (15.5%), and black and yellow birch (7%). Another 10% of the forest is a mix of red and sugar maple, beech, paper birch, white ash and black cherry, with small amounts of hickory (pignut and shagbark) and poplar (big-toothed aspen). Basswood, elm and red spruce occur as exceptions. White and black oaks, and black gum, were not found at all, though they may be present. The remaining 16% of the forest volume is made up of planted softwoods, almost all of which is red pine (14.6%), with small amounts of Norway spruce and Scots pine. Softwoods make up about 67.5% of the timber volume.

The forest surrounding the Mountain Street Reservoir watershed is dominated by the same species mix, with white pine, hemlock, red oak and other oaks, and black and yellow birch making up about 78% of the total timber volume. However, the distribution is more heavily weighted toward white pine, which makes up 62% of the total volume. All the other dominant species are not as abundant. Hemlock makes up only 5% of the total volume. Oaks make up only 7% of the volume, with 5% being red oak, and 2% including chestnut oak with a minor amount of white oak, black oak and scarlet oak. Black and yellow birch make up only 4% of the total. The balance is comprised of sugar maple (3%), black cherry (1%), white ash (2%) and pallet-grade hardwoods (4%) (red maple, hickory, beech, poplar, paper birch, etc.). As with the Ryan & West-Whately watershed there is a significant, and similar, inclusion of red pine (13%). Overall, the Mountain Street Reservoir watershed is more heavily weighted toward softwoods. Softwoods make up about 80% of the timber volume.

Most of the overstory trees (timber, firewood, pulp and non-commercial trees) were in the 8" to 20" diameter range. About 75% of the trees were between 8" and 14" in diameter, and another 20% of the trees were between 15" and 20" in diameter. Only about 5% of the trees were large, with 3% of the trees between 21" and 26", and only 2% of the trees ranged from 27" up to 50" or more.

Forest Products (timber, firewood and pulpwood): The forests of both watersheds are well-stocked with timber, firewood and pulpwood.

At the Ryan & West-Whately watershed, the timber volume on all acres is estimated at 13,437,000 board feet (about 3,000 truckloads), with an additional 23,276 cords of firewood and 20,657 cords of softwood pulp, with a total standing value of approximately \$2,070,000. Most of this value is concentrated in the white and red pine timber and in the red oak timber. For the entire watershed, the average value of the forest products was about \$882 per acre.

Most of the volume and value at the Ryan & West-Whately watershed was concentrated in the acreage (1,718.5 acres) that was suitable for silviculture. The timber volume on these acres was 10,937,496 board feet, with 18,344 cords of firewood and 18,942 cords of softwood pulp. The estimated total value was \$1,761,686, or about \$1,049 per acre. For practical purposes, this is the volume and value that could be considered potentially available for harvest if all trees were to be cut, but it is not a recommendation to actually go and harvest this volume and value.

At the Mountain Street watershed forest, the timber volume on all acres was estimated at 4,385,000 board feet (about 1,100 truckloads), with an additional 2,300 cords of firewood and 1,111 cords of softwood pulp, with a total standing value of approximately \$521,000. Most of this value (70%) is concentrated in the white and red pine timber. For the entire watershed, the average value of the forest products was about \$936 per acre.

At the Mountain Street watershed, only a small amount of the volume and value was concentrated in the acreage (24.6 acres) that was suitable for silviculture. The timber volume on these acres was 175,000 board feet, with 148 cords of firewood and 204 cords of softwood pulp. The estimated total value was \$20,254, or about \$823 per acre. For practical purposes, this is the volume and value that could be considered potentially available for harvest if all trees were to be cut, but it is not a recommendation to actually go and harvest this volume and value.

Habitat: large bodies of open water surrounded by contiguous, closed-canopy, maturing, tall conifer & oak-hardwood forest with limited but increasing rough-tree features, abundant oak mast, and scattered ledge exposures, with numerous vernal pools, various beaver ponds with affiliated marsh and shrub swamp, and numerous streams.

The general forested habitat on both watersheds is consistent with Western Massachusetts on the whole, and is distinguished mainly by consisting of a large, contiguous acreage that is not developed and presumably never will be. Like most of Massachusetts, this forest is re-growing from an earlier time when much of the forest was cleared — or at least clearcut — one or more times. The forest has grown into a medium age-range. What is lacking from a habitat perspective is both the very mature, and the very young ends of the age spectrum. These concerns can be addressed through management as follows:

- (1) provisions can be made for mature forest components (cavity trees, snags, downed woody debris, etc) to develop, both in silviculturally managed areas, and in set-aside/unmanaged areas.
- (2) Early successional (very young) habitat can be created either as a separate, dedicated practice, or incidentally in the course of normal silvicultural management.

A number of vernal pools were documented, some of which bore evidence of state-listed salamanders.

For each stand, habitat is discussed in greater detail in the Stand Descriptions section.

Major events shaping this forest: (forest-disturbance history): Like most of the forests of Southern New England, this forest has been shaped by both natural and human factors; these factors are intertwined to such a thorough extent that, in effect, they cannot be separated.

The possible uses of this land by native, pre-European people, and the uses of this land by these people after the onset of European fur trading and eventual trading-post and agricultural settlement, are not addressed in this plan. Direct European use of this land probably began with land clearing of the original (primary) forest by settlers, for purposes of farming, presumably in the late 18th/early 19th century (possibly beginning on Dry Hill). The better soils were cleared of stones as needed and tilled while the more rugged or wetter terrain was pastured with cattle and/or sheep, to a greater or lesser degree (all of which is evidenced by cellar holes, stone walls, barbed wire fence, and traces of narrow cart paths). Farming kept the natural tendency toward reforestation fully or partially at bay. In the mid 1800's much of this area was in pasture (or sometimes, on steep, fertile land, in sugar bushes) but beginning to see farm abandonment and an overall reduction in the intensity of farming use, which allowed the natural re-growth of forest to white pine (sometimes called old-field white pine). Some areas are still in old-field pine today. But others were cut off, usually by clearcutting, giving rise to oak-hardwood and hemlock forests. Sometimes these oak-hardwood and hemlock forests were cut off, giving rise to a new hardwood forest, often with less oak and hemlock and more birch, especially black birch. In a few instances, non-native softwoods were planted — by DPW — especially red pine, but also Norway spruce and Scots pine. Because all of this has occurred at various times in various places with varying degrees of intensity and consistency, the landscape-level forest is diverse.

The current trend seems to be a forest moving in a new direction, toward ever more black birch and beech (see discussion of forest health above).

Forestry has been practiced since the early days of the watershed. We do not have a detailed history of early forest management, but a 1988 report by Karl Davies, the previous forester for DPW, sheds some light. The softwood plantations in the early 1900's on old fields were intended to reduce soil erosion and reduce discoloration of the water from tannins in oak leaves. Chestnut, affected by the chestnut blight (an introduced pest) was cut heavily in the 1920's and 1930's, for fuelwood for the Water Department boiler. Later, other hardwoods were cut. This practice continued until about 1950, when the Water Department switched to oil. These early thinnings are credited with helping develop the large oaks in many places.

Most of the softwood plantations and some of the white pine was thinned (pulpwood) in the 1950's and early 1960's — interestingly, this practice faded when home freezers became popular and the need for barrel staves for salted meat evaporated (Fred Hunt, pers. Comm.). Some of the white pine was pruned at that time to develop clear (valuable) lumber, but thinnings were not carried out to take advantage of this.

The modern era of forest management began in 1981 on the Mountain Street watershed and in the mid 1980's at the Ryan watershed. By the late 1980's, an effort was underway to carry out improvement cuts, thinnings, and initial regeneration cuts across both watersheds. This work, consisting of numerous permitted harvests marked by Karl Davies and carried out by many different loggers under his supervision, continued until around 2000, when work was put on hold by DPW decision. Karl Davies passed away in 2003, and no further work has been carried out on the watershed. The general affect of this work was to reduce competition among overstory trees, refocus future growth on trees with good form and growth potential, and begin to develop understories of desirable seedlings.

Along with major changes caused by human activities, intentionally or not, a number of natural events have shaped and continue to shape the forest in a number of ways, including (1) the introduction of chestnut blight (described above), which effectively eliminated chestnut from the forest, and (2) various infestations of gypsy moths, most recently from 1979-1981, causing loss of vigor and mortality in hardwoods, and (3) the effects of storms, including the 1938 hurricane, but also including innumerable minor storms such as microbursts and ice storms. Another, more recent concern, is the Asian long-horned beetle: currently present only in the Worcester area — as far as we know — this insect is a major pest of red and sugar maple, and ash, but not oaks or hickories.

A number of other forest pests are discussed in the “Forest Health” section.

Stand Delineation: The forest was divided into numbered stands. For mapping and for tabular overviews, each stand is given a general type code, with more detailed discussion of forest composition provided in the individual Stand Descriptions. The main codes used are “WH” (white pine and mixed hardwoods), “WP” (nearly pure white pine), “HH” (hemlock and mixed hardwoods), “RP” (red pine plantation), “BB” (mixed hardwoods typically including red maple and sometimes sugar maple, black and yellow birch and sometimes paper birch, beech, and often white ash and black cherry and sometimes red oak), “OH” (red oak and mixed hardwoods), “RM” (red maple with yellow birch, white ash and elm, and sometimes with white pine and hemlock).

Sometimes there are notable inclusions of other forest types within a stand. These are sometimes shown on the map in brackets, and may include [WP] (white pine), [SM] sugar maple, [OR] (red oak), and [SS] (shrub swamp). The designation “GR” for the reservoir dam areas indicates a strong, but not exclusive, component of mowed grass.

The stands are listed in Tables 2A & 2B, with their approximate acreage. Each stand was given a name that is intended to help evoke a mental map of the stand's location and features. The subwatershed is also listed. The stands are also shown on the Stand Locator Map.

Table 2A: List of Stands by Name, Number, Acreage & Subwatershed: Ryan & West-Whately Reservoirs

Stand Name	Stand	Acres	Subwatershed
Conway State Forest East	1	58.9	Avery Brook W
Conway State Forest West	2	47.2	E. Branch Mill River (OUT)
Dry Hill North	3	166.4	Avery Brook W
High Ridge East	4	92.9	Sanderson Brook
Avery Brook West	5	137.0	Avery Brook W
High Ridge West	6	189.6	E. Branch Mill River (OUT)
Henhawk Trail Southwest	7	208.1	Sanderson Brook
Judd Lane	8	297.3	E. Branch Mill River (OUT)
Old Williamsburg Road	9	185.6	Sanderson Brook
Dry Hill South	10	52.4	Sanderson Brook
Grass Hill Road	11	277.4	Sanderson Brook
Nash Hill Road Swamp	12	41.3	Sanderson Brook
Dry Hill Road East	13	30.9	Ryan/W. Whately Shore.
Ryan & West-Whately West Shore	14	76.0	Ryan/W. Whately Shore.
Ryan North Red & White Pine	15	65.2	Avery Brook E / Ryan Shore
Ryan North Oak-Hemlock	16	130.3	Avery Brook E / Ryan Shore
Finney Brook	17	65.6	Finney Brook
Waterworks Road Northwest	18	50.9	Finney Brook
Conway Road Terrace	19	45.7	Ryan/W. Whately Shore.
Poplar Hill	20	108.3	Finney Brook
Ryan & West-Whately Dams	21	18.7	Ryan/W. Whately Shore.
Ryan & West-Whately Reservoirs		94.5	--
	Total	2440.3	

Table 2B: List of Stands by Name, Number, Acreage & Subwatershed: Mountain Street Reservoir

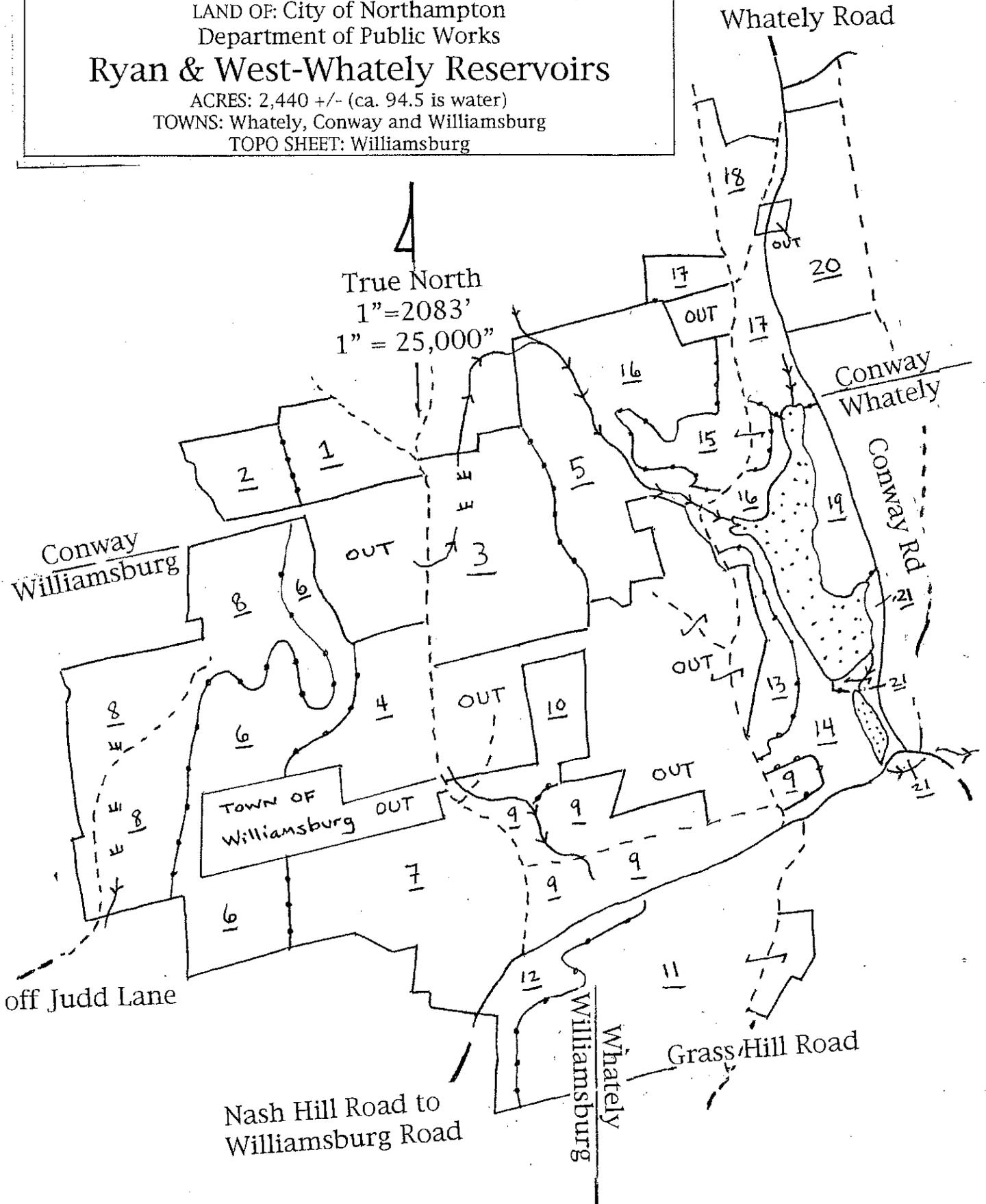
Stand Name	Stand	Acres	Subwatershed
Chestnut Mountain	1	151.3	Mountain Street East
Mountain Street East Shore	2	18.8	Mountain Street East
Rocks Road East	3	24.6	Mountain Street East
Mountain Street Reservoir Southwest	4	22.9	Mountain Street West
Mountain Street Dam	5	2.8	Beaver Brook (OUT)
Red Pine Plantation	6	15.3	Mountain Street West
Laurel Mountain Road	7	95.2	Mountain Street West
Old Orchard & Red Pine	8	33.7	Mountain Street West
Laurel Mountain West	9	47.7	Potash & Grass Hill Brooks (OUT)
Potash Brook	10	134.0	Potash & Grass Hill Brooks (OUT)
Mountain Street West Shore	11	12.7	Mountain Street West
Around Treatment Plant	12	10.7	Potash & Grass Hill Brooks (OUT)
Mountain Street Res.	13	69.2	Mountain Street Res.
	Total	638.9	

STAND LOCATOR MAP

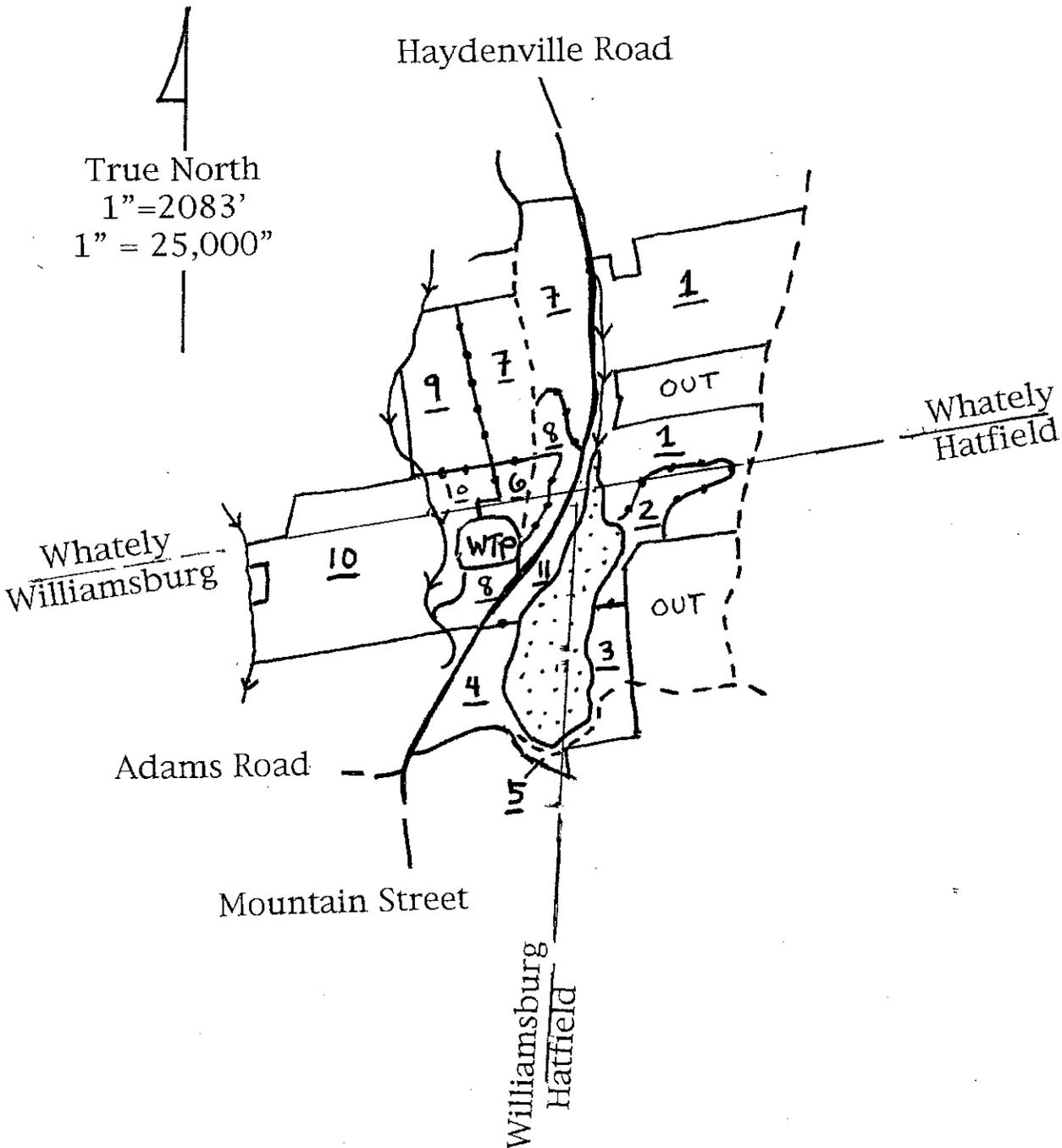
LAND OF: City of Northampton
Department of Public Works

Ryan & West-Whately Reservoirs

ACRES: 2,440 +/- (ca. 94.5 is water)
TOWNS: Whately, Conway and Williamsburg
TOPO SHEET: Williamsburg



STAND LOCATOR MAP
 LAND OF: City of Northampton
 Department of Public Works
Mountain Street Reservoir
 ACRES: 639 +/- (ca. 69.2 is water)
 TOWNS: Whately, Williamsburg and Hatfield
 TOPO SHEET: Williamsburg



V. Forest Health

The health of the forest in both the Ryan & West-Whately watershed and in the Mountain Street watershed is compromised by decline and mortality trends in some species on the one hand, but even more so by factors that are interfering with the forest's ability to regenerate itself to desirable species on the other hand. These are the major concerns raised by this plan.

Decline and mortality trends: Large numbers of red pine and hemlock are in declining health, a trend driven by introduced pests (such Diplodia tip blight/canker, with secondary infestations of bark beetles as well as armillaria root-rot fungus on red pine, and a combination of hemlock woolly adelgid and elongate hemlock scale on hemlock). This trend is likely to continue. And though not detected at this time, an arrival of red pine scale could cause a dramatic decline and dieback of red pine within a period of only a few years.

White ash, already in decline, may soon be infested by an introduced pest as well (emerald ash borer) and is expected to suffer significant decline and mortality. Beech is generally infested with beech-bark disease, a disease which also includes an introduced component. Though overstory beech tend to become sickly, and many ultimately die, the disease does not tend to kill the root systems, from which beech has the ability to vigorously resprout. The sprouts can readily outcompete desirable seedlings of other species. The effect is that beech, an ever-increasing component of the forest, is unlikely to ever form large, healthy trees.

Taken together, red pine, hemlock, ash and beech, all of which are in poor health, comprise 33.5% of the timber volume on the Ryan & West-Whately watershed (Scots pine belongs in this group as well, but is present only to a minor degree), and about 19% of the timber volume on the Mountain Street watershed. Though beech is not an appreciable part of the timber volume in either watershed, it is, as explained above, likely to increase over time.

Interfering factors (over-browsing, wild grape vines, oriental bittersweet vines, etc.):

As serious as the above-mentioned decline and mortality trends are, a much more serious issue is that the current forest, with its strong component of long-lived white pine, oaks and mixed hardwoods, cannot replace itself in the face of ongoing disturbances. This is true both for infrequent major disturbances (e.g. major hurricanes or other storms) as well as in the long, ongoing course of numerous, inevitable accumulated disturbances at smaller scales (e.g. microbursts, ice storms, lightning strikes, decline and mortality of certain canopy species due to pests, etc.). Throughout both watershed forests there is an almost total lack of viable, desirable regeneration (i.e. healthy seedlings and saplings of desirable trees that could be released and form part of the overstory someday). Despite its abundance throughout the forest, seedlings of red oak were almost entirely lacking. Among the desirable hardwoods, only black birch was present to any appreciable degree. Viable white pine regeneration was found only on a scattered and limited basis.

Certainly, overstory shade is a contributing factor, and, normally, a silvicultural approach could be used to address a lack of seedlings by carrying out timber harvests that adjust light conditions in the overstory and influence the forest floor. However, this conventional approach is not expected to work in some areas, due to a combination of interfering factors that includes (1) excessive herbivore feeding (deer and moose), (2) aggressive growth of certain native

vegetation (primarily wild grapes, thick carpets of hayscented fern, as well as thickets of beech sprouts and thick understories of shrubby striped maple and sometimes witch hazel as well), and (3) aggressive growth of non-native invasive plants (primarily oriental bittersweet – a vine). These problems are much worse, which is to say more advanced, at the Mountain Street Reservoir, and this serves as a useful warning for the Ryan & West-Whately watersheds.

The aggregate effect of this set of interfering factors is that the forest is headed on a transitional course away from its strong mix of white pine, hemlock and red oak, along with maples, cherry, and certain other hardwoods, towards a very different forest that will be dominated by, at best, black birch, which is a desirable species, with abundant beech in some areas and large areas overrun with vines — native and non-native — and ferns. At worst, the black birch component will be minimal, and vines and ferns will dominate everywhere. This condition is not desirable from any perspective, whether it be water quality, timber, or habitat. The progressive decline of shade from hemlock and red pine will probably exacerbate these trends.

The major conclusion of this plan is that great care needs to be taken to steer away from this direction. A combination of passive and active steps outlined throughout this Stewardship Plan is designed to accomplish this.

Why? The essential feature of forest as a watershed cover is its ability to capture, slow, store, filter and gradually release rainfall and snowfall into the reservoir. This is best done by a vigorous forest of site-adapted trees with a tall canopy. Over time, as disturbances occur (e.g. microbursts, ice storms, tornadoes, hurricanes, but also pest and fire), the established trees will shed seed and young trees will become established. These young trees quickly take up any new growing space that is created. A general aim of watershed management is to have a significant reserve of young trees to act as a sort of insurance policy in the face of inevitable disturbance.

The current watershed forest finds itself in a condition lacking this essential reserve of young trees, and it may not be able to develop this reserve and, therefore, the forest is not as healthy as it may seem. If the forest could be frozen in time right now, everything would be fine. But, inevitably, over time, disturbances will tend to steer the forest away from this desirable condition, toward a less desirable condition that will be more difficult, and more expensive, to correct. Therefore, from a forest health perspective, a key objective embedded in this plan is to preserve the desirable attributes of this forest while trying to anticipate and counteract the negative trends. The resulting plan will necessarily try to limit any cutting of white pine or red oak (cutting these species should only occur where these pines or oaks are overcrowding each other). The plan will be very cautious in how and where new openings are made, trying to ensure that these areas can regenerate to desirable species. And the plan will be pro-active in identifying and curtailing the influence of interfering factors.

Non-native invasive plant species: To assess the extent and severity of non-native invasive vegetation, all stands were ranked using the following scheme (see below). Stands ranked 3, 4 or 5 were considered “not suitable” for silviculture. Non-native invasive plants detract from desirable watershed forest conditions by aggressively competing with desirable native vegetation, including tree seedlings. This is particularly true for oriental (i.e. asiatic) bittersweet, a vine that was commonly found across the watershed. This is also particularly

true for buckthorn (both European and glossy buckthorns, which, fortunately, were not widespread at all).

(1) ESSENTIALLY ABSENT (none observed or, if any, then extremely sparse; no, or minimal, invasive plant seed bank expected).

(2) MINOR AND READILY TREATABLE. Minor and readily treatable, and therefore still available for silviculture if treated; possible presence of localized invasive plant seed bank, but widespread invasive plant seed bank not expected).

— (stands ranked 3 or higher were considered not suitable for silviculture) —

(3) MODERATE TO SEVERE. Moderate to severe, and therefore cannot be considered available for silviculture within a 5-10 year period/until 5-10 years after receiving treatment and, under monitoring with follow-up treatment as needed until plants and seedbank are controlled, and being downgraded to (2) or (1).

(4) SEVERE. Severe infestation with no expectation of silviculture within 10 years even if treated.

(5) CANDIDATE FOR RESTORATION: the area no longer meets any criteria of a desirable watershed forest — the site is no longer dominated by desirable forest vegetation and/or there is no expectation that the site will be, or will continue to be, dominated by desirable forest vegetation within any foreseeable timeframe without complete intervention/restoration.

On the Ryan & West-Whately Reservoir watershed, non-native invasive plants were found in many, but not all, areas. In two isolated cases (in Stands 7 & 9) there were relatively small infestations needing restoration included within a larger stand with an overall lower ranking.

On the Mountain Street Reservoir watershed, non-native invasive plants were found in most areas. In one isolated case (Stand 1) there was a relatively small infestation needing restoration. However, all of Stand 8 was ranked as a candidate for restoration, and abutting Stands 6 & 11 were ranked “severe”. This combination of Stands 6, 8 & 11 is the largest contiguous area of severe, or worse, infestation on either watershed.

The results of the ranking of non-native invasive plant infestations are shown in Tables 3A & 3B. These results are also shown on the maps titled “MAP Showing Invasive Species Ranking” (one map for each watershed).

Table 3A: Ranking of Invasives by Stand: Ryan & West-Whately Reservoirs

Stand	Overall Invasives Rank 1 - 5	Acres Ranked 1	Acres Ranked 2	Acres Ranked 3	Acres Ranked 4	Acres Ranked 5
1	1	58.9	0.0	0.0	0.0	

2	1	47.2	0.0	0.0	0.0	
3	1	166.4	0.0	0.0	0.0	
4	1	92.9	0.0	0.0	0.0	
5	2	0.0	137.0	0.0	0.0	
6	1	189.6	0.0	0.0	0.0	
7	2	0.0	205.1	0.0	0.0	3
8	2	0.0	297.3	0.0	0.0	
9	2	0.0	176.9	0.0	0.0	8.7
10	2	0.0	52.4	0.0	0.0	
11	2	0.0	277.4	0.0	0.0	
12	2	0.0	41.3	0.0	0.0	
13	1	30.9	0.0	0.0	0.0	
14	3	0.0	0.0	76.0	0.0	
15	2	0.0	65.2	0.0	0.0	
16	1	130.3	0.0	0.0	0.0	
17	2	0.0	65.6	0.0	0.0	
18	1	50.9	0.0	0.0	0.0	
19	2	0.0	45.7	0.0	0.0	
20	1	108.3	0.0	0.0	0.0	
21	4	0.0	0.0	0.0	9.7	9
	Total	875.4	1363.9	76.0	9.7	20.7
	% of Total	37.3%	58.1%	3.2%	0.4%	0.9%

Overall, 37.3% of Ryan & West-Whately watershed acreage was ranked 1, and 58.1% was ranked 2, for a combined 95.5% considered to have no infestation or a scattered infestation. As explained above, stands ranked 1 or 2 could be considered for silvicultural operations.

3.6% of the Ryan & West-Whately watershed had a ranking of 3 or 4. A ranking of 5, indicating a need for restoration, occurred in two separate sections within larger stands, and covered the remaining 0.9% of the total acreage (about 20.7 acres).

Table 3A: Ranking of Invasives by Stand: Mountain Street Reservoir

Stand	Overall Invasives Rank 1 - 5	Acres Ranked 1	Acres Ranked 2	Acres Ranked 3	Acres Ranked 4	Acres Ranked 5
1	3	0.0	0.0	150.8	0.0	0.5
2	3	0.0	0.0	18.8	0.0	0
3	1	24.6	0.0	0.0	0.0	0
4	3	0.0	0.0	22.9	0.0	0
5	2	0.0	2.8	0.0	0.0	0
6	4	0.0	0.0	0.0	15.3	0
7	3	0.0	0.0	95.2	0.0	0
8	5	0.0	0.0	0.0	0.0	33.7
9	1	47.7	0.0	0.0	0.0	0
10	3	0.0	0.0	134.0	0.0	0
11	4	0.0	0.0	0.0	12.7	0
	Total	72.3	2.8	421.7	28.0	34.2
	% of total	12.9%	0.5%	75.4%	5.0%	6.1%

Overall, 12.9% of the Mountain Street watershed acreage was ranked 1, and 0.5% was ranked 2, for a combined 13.4% considered to have no infestation or a scattered infestation. As explained above, stands ranked 1 or 2 could be considered for silvicultural operations.

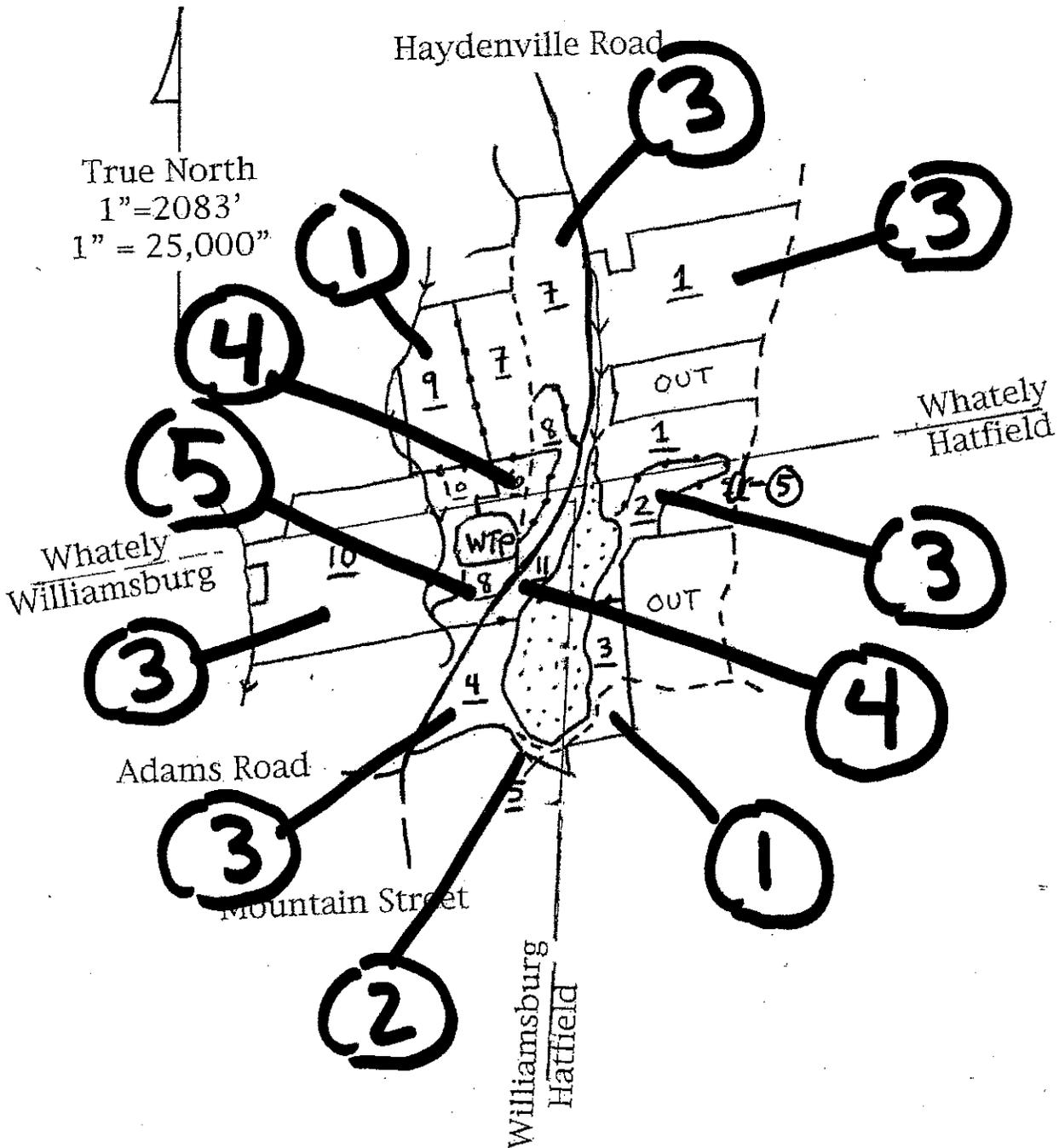
Most of the Mountain Street watershed (80.4%, or about 449.7 acres) had a ranking of 3 or 4. A ranking of 5, indicating a need for restoration occurred throughout most of Stand 8, as well as in a 0.5-acre section of Stand 1, meaning that about 6.1% of the total acreage (about 34.2 acres) was in need of restoration.

MAP Showing Invasive Species Ranking

LAND OF: City of Northampton
Department of Public Works

Mountain Street Reservoir

ACRES: 639 +/- (ca. 69.2 is water)
TOWNS: Whately, Williamsburg and Hatfield
TOPO SHEET: Williamsburg



VI. Silviculture and Timber Harvesting

Role of Silviculture: One of the key goals of watershed forest management is to have an abundance of large, healthy, dominant trees that can provide a tall, relatively stable forest canopy within which openings can be made and in which younger trees can flourish. At this writing, the trees that are most likely to fill this role over time are white pine and red oak, mixed with other hardwoods, which, together, can grow to very large size and reach advanced ages. Due to their declining health, hemlock, red pine, beech and white ash cannot be expected to provide this function. Red maple and black birch, which, along with the pines, hemlock, and red oak, are the most abundant trees, are second best to white pine and red oak (in terms of size, longevity and dominance). Sugar maple and yellow birch do play an important role, but typically only on the richest sites. Although Norway spruce, a non-native, has done very well here in small plantations, it would be risky to try to greatly expand the area covered by any planted tree. The upshot is that red oak and white pine are, at this writing, critical to the functioning of the watershed forest. Therefore, a top priority of the silviculture will be to develop and promote these species.

As noted above, there is little or no established regeneration of white pine or red oak throughout the watershed. The known interfering factors (including vines, ferns and herbivore browsing) are likely to make it very difficult to regenerate these species. This suggests very strongly that the best way to promote and develop white pine and red oak is to preserve the trees that are already established, in particular those that are well-formed and healthy. The silvicultural tool used to promote existing, well-established trees is thinning, which works by reducing competition for sunlight around the crowns of desired trees.

As a practical matter, since the timber value on the watershed is concentrated in the white pine and the red oak, it turns out that much of the timber value is in trees that we do not want to cut.

A parallel aim of watershed forest management is to have a diverse forest structure including areas of vigorously growing young trees. Due to the limiting effects of shade from overstory trees, in order to establish and grow tree seedlings it is usually necessary to make openings in the forest canopy to let in light to the forest floor. Sometimes this is best done in stages (using a shelterwood approach) and sometimes this is best done all at once (using a selection system to make openings, which can range from ¼ or less up to several acres). Both of these approaches can be used in creative ways, interspersed with small or large no-cut areas, to foster a structurally diverse, multi-aged forest.

Though an effort will almost always be made to regenerate white pine and red oak, or sugar maple or black cherry, the likelihood is that black and yellow birch and red maple will dominate these new regeneration layers, and the reality is that this will be entirely preferable to seeing these areas fill up with vines, ferns, beech or striped maple.

Overall, the value to be generated by recommended harvesting is incidental to the objectives of the cut, and is derived from the trees that are inherently less well-suited to maintaining a desirable watershed forest.

Suitability for Silviculture: Each stand was evaluated as to whether the goals of the plan could be furthered using silvicultural practices (e.g. logging/harvesting) to shape the forest in a beneficial way. Stands were assigned a “no” if they had excessive invasive species infestations (a ranking of 3 or greater, see below) or if the practical risk of soil damage and erosion was deemed significant enough such that no net benefit would occur with silvicultural practices (e.g. on steep, seepy ground and in the more remote locations).

About 1,718.5 acres (73.2%) of the Ryan & West-Whately watershed was considered suitable for silviculture. About 629.5 acres (26.8%) was not considered suitable.

About 24.6 acres (4%) of the Mountain Street watershed was considered suitable for silviculture. About 532.7 acres (96%) was not considered suitable.

Stands are shown in Tables 4A & 4B with a yes/no value indicating whether the stand was considered suitable for silvicultural activity at this time. The suitability for silviculture is shown in the maps entitled “MAP Showing Suitability for Silviculture”

Table 4A: Suitability of Stands for Silviculture: Ryan & West-Whately Reservoirs

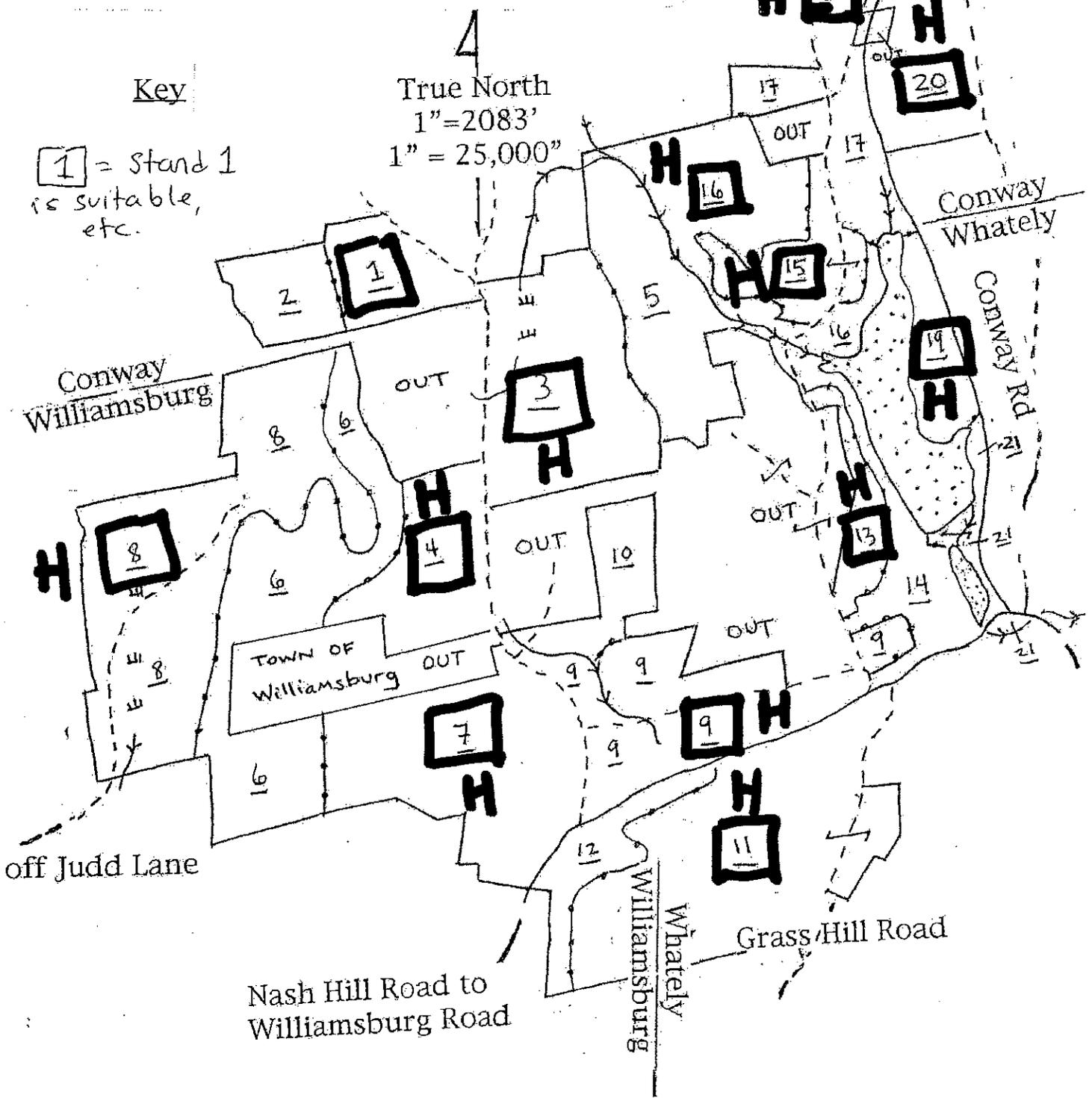
Stand Name	Stand	Type	Acres	Suitable for silviculture? (Yes/No)	Total Yes	Total NO
Conway State Forest East	1	BB	58.9	YES	58.9	0.0
Conway State Forest West	2	BB	47.2	NO	0.0	47.2
Dry Hill North	3	WH	166.4	YES	166.4	0.0
High Ridge East	4	WH	92.9	YES	92.9	0.0
Avery Brook West	5	BB	137.0	NO	0.0	137.0
High Ridge West	6	HH	189.6	NO	0.0	189.6
Henhawk Trail Southwest	7	OH	208.1	YES	208.1	0.0
Judd Lane	8	HH	297.3	YES	297.3	0.0
Old Williamsburg Road	9	WH	185.6	YES	185.6	0.0
Dry Hill South	10	BB	52.4	NO	0.0	52.4
Grass Hill Road	11	WH	277.4	YES	277.4	0.0
Nash Hill Road Swamp	12	RM	41.3	NO	0.0	41.3
Dry Hill Road East	13	WH	30.9	YES	30.9	0.0
Ryan & West-Whately West Shore	14	BB	76.0	NO	0.0	76.0
Ryan North Red & White Pine	15	RP	65.2	YES	65.2	0.0
Ryan North Oak-Hemlock	16	HH	130.3	YES	130.3	0.0
Finney Brook	17	BB	65.6	NO	0.0	65.6
Waterworks Road Northwest	18	WH	50.9	YES	50.9	0.0
Conway Road Terrace	19	HH	45.7	YES	45.7	0.0
Poplar Hill	20	WH	108.3	YES	108.3	0.0
Ryan & West-Whately Dams	21	GR	18.7	NO	0.0	18.7
Ryan & West-Whately Reservoirs	23	WA	94.5	NO	0.0	94.5
	Total		2440.3		1,718.0	627.8
	Land		2345.8	% of forest	73%	27%

Table 4B: Suitability of Stands for Silviculture: Mountain Street Reservoir

Stand Name	Stand	Type	Acres	Suitable for silviculture? (Yes/No)	Total Yes	Total NO
Chestnut Mountain	1	WH	151.3	NO	0.0	151.3
Mountain Street East Shore	2	WH	18.8	NO	0.0	18.8
Rocks Road East	3	OH	24.6	YES	24.6	0.0
Mountain Street Reservoir Southwest	4	WP	22.9	NO	0.0	22.9
Mountain Street Dam	5	GR	2.8	NO	0.0	2.8
Red Pine Plantation	6	RP	15.3	NO	0.0	15.3
Laurel Mountain Road	7	WH	95.2	NO	0.0	95.2
Old Orchard & Red Pine	8	AO	33.7	NO	0.0	33.7
Laurel Mountain West	9	WH	47.7	NO	0.0	47.7
Potash Brook	10	WH	134.0	NO	0.0	134.0
Mountain Street West Shore	11	RP	12.7	NO	0.0	12.7
Around Treatment Plant	12	Non	10.7	NO		
Mountain Street Res.	13	WA	69.2	NO		
	Total		638.9		24.6	534.4
	Forest		559.0	% of forest	4%	96%

MAP Showing Suitability for Silviculture*
 LAND OF: City of Northampton
 Department of Public Works
Ryan & West-Whately Reservoirs
 ACRES: 2,440 +/- (ca. 94.5 is water)
 TOWNS: Whately, Conway and Williamsburg
 TOPO SHEET: Williamsburg

*Stands with a recommended harvest are indicated by "H".



Key

[1] = Stand 1
 is suitable,
 etc.

True North
 1" = 2083'
 1" = 25,000"

Conway
 Williamsburg

TOWN OF
 Williamsburg

Conway
 Whately

CONWAY
 Rd

off Judd Lane

Nash Hill Road to
 Williamsburg Road

Williamsburg
 Whately

Grass Hill Road

Whately Road

MAP Showing Suitability for Silviculture*

LAND OF: City of Northampton

Department of Public Works

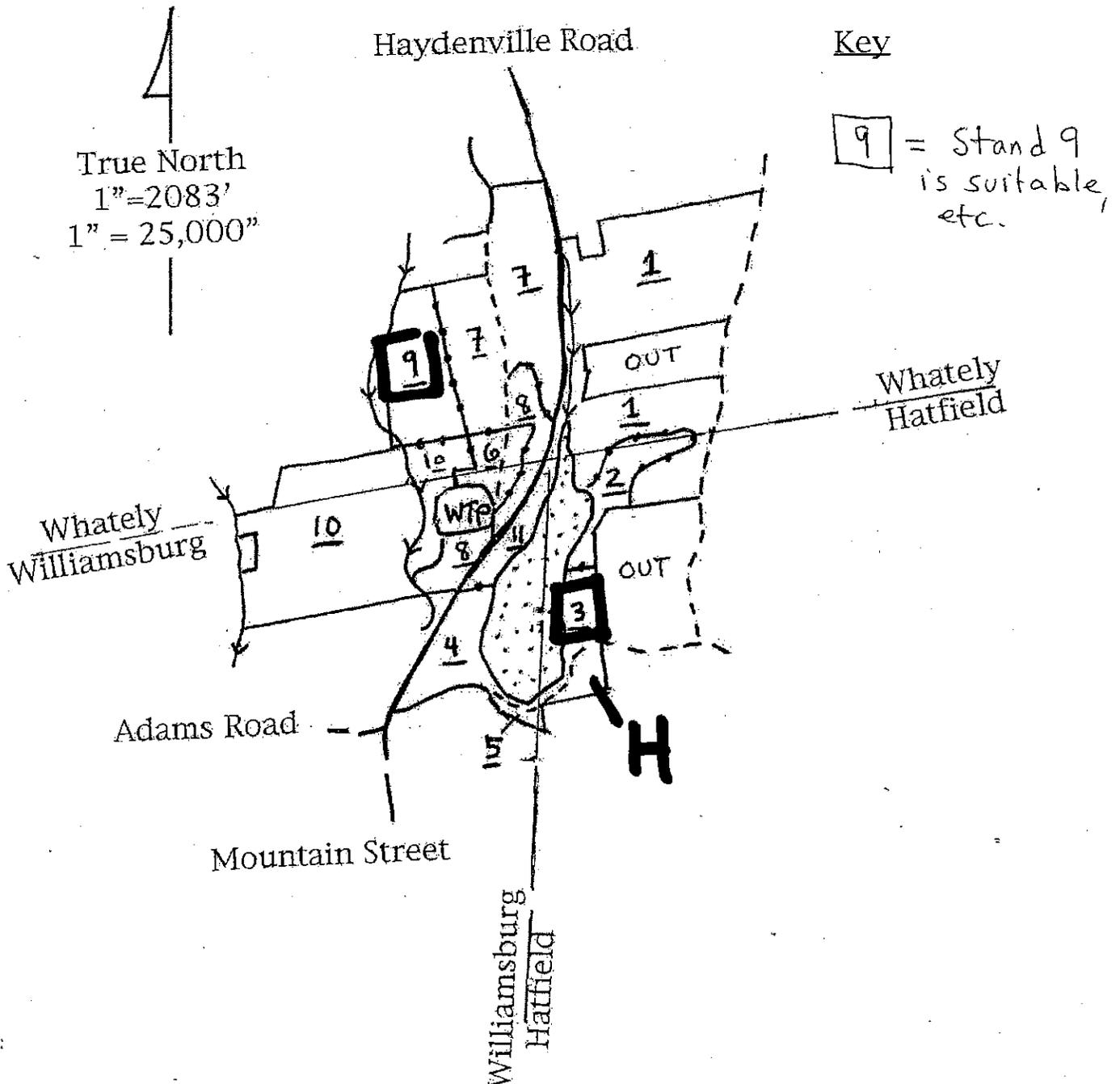
Mountain Street Reservoir

ACRES: 639 +/- (ca. 69.2 is water)

TOWNS: Whately, Williamsburg and Hatfield

TOPO SHEET: Williamsburg

*Stands with a recommended harvest are indicated by "H".



Silvicultural Approach: The silvicultural approach used in this plan is designed to enhance the strengths of the current forest while avoiding an incremental degradation of future prospects for the forest, and therefore is necessarily conservative.

For the Ryan & West-Whately watershed, the actual harvest recommendations (presented in the Management Practices section) call for harvesting about 10% of the timber, 9% of the firewood and 9% of the pulpwood, which would be accomplished on about 33% of the acreage (782 acres). The estimated gross value of this harvesting is approximately \$140,000, which represents about 8% of the total forest products value in stands suitable for silviculture, or about 7% of the total value in all stands at the Ryan & West-Whately watershed. The work would be carried out in approximately 8 or more separately-permitted harvests.

Actual harvest recommendations at the Mountain Street watershed call for harvesting in only one stand. In this stand, on about 4% of the total DPW watershed acreage, about 1% of the total timber, 1% of the total firewood and 13% of the total pulpwood would be harvested. The estimated gross value of this harvesting is \$2,429, which represents about 0.5% of the total forest products value for the entire Mountain Street Reservoir watershed acreage. The work would be carried out in a single, DCR-permitted harvest.

Tables 5A & 5B lists all recommended harvesting for the period 2012-2022 at the Ryan & West-Whately and Mountain Street watersheds. This list shows *anticipated* harvests based on 2012 conditions. Actual harvesting recommendations may change if conditions change. Dollar amounts are not shown in this table.

Table 5A: Overview of Silviculture by Stand: Ryan & West-Whately Reservoirs

Stand	Forest Type	Silviculture (harvesting)	Acres to Cut	BA to Cut	Mbf to Cut	Cords Wood to Cut	Cords Pulp to Cut	Year
1	BB	None	0	0	0	0	0	N/A
2	BB	None	0	0	0	0	0	N/A
3	WH	selection	133	36	134	476	263	2012
4	WH	selection	46	28	34	142	50	2012
5	BB	None	0	0	0	0	0	N/A
6	HH	None	0	0	0	0	0	N/A
7	[RP]	Shelterwood	4	80	50	4	4	2017
7	OH	Selection	5	120	20	75	21	2017
8	HH	Shelterwood	30	50	50	30	90	2012
8	[BB]	Thinning	120	30	20	300	0	2017
9	[RP]	Shelterwood	8	80	100	8	8	2017
9	[WP]	Thinning	18	30	50	5	20	2012
10	BB	None	0	0	0	0	0	N/A
11	WH	selection	83	33	120	263	179	2012
12	RM	None	0	0	0	0	0	N/A
13	WH	selection	12	20	18	7	20	2012
14	BB	None	0	0	0	0	0	N/A
15	RP	selection	59	41	291	54	324	2012
16	HH	selection	98	32	162	264	232	2012
17	BB	None	0	0	0	0	0	N/A
18	WH	selection	41	40	46	156	43	2012
19	HH	shelterwood	27	65	75	147	149	2012
20	WH	shelterwood	97	32	177	248	397	2012
21	GR	N/A	N/A	N/A	N/A	N/A	N/A	N/A
0	WA	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Totals 782 1,347 2,180 1,802

*Indicates earliest recommended timing. However, harvesting may be done at a subsequent time.

Table 5B: Overview of Silviculture by Stand: Mountain Street Reservoir

Stand	Forest Type	Silviculture (harvesting)	Acres to Cut	BA to Cut	Mbf to Cut	Cords Wood to Cut	Cords Pulp to Cut	Year*
1	WH	None	0	0	0	0	0	N/A
2	WH	None	0	0	0	0	0	N/A
3	OH	selection	20	35	46	30	139	2012
4	WP	None	0	0	0	0	0	N/A
5	GR	None	0	0	0	0	0	N/A
6	RP	None	0	0	0	0	0	N/A
7	WH	None	0	0	0	0	0	N/A
8	AO	None	0	0	0	0	0	N/A
9	WH	None	0	0	0	0	0	N/A
10	WH	None	0	0	0	0	0	N/A
11	RP	None	0	0	0	0	0	N/A
12	Non	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	WA	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	0		20		46	30	139	

*Indicates earliest recommended timing. However, harvesting may be done at a subsequent time.

Overview of Proposed Harvests: The silvicultural recommendations for the Ryan & West-Whately watershed listed in Table 5A would be implemented through 8 or more separate operations under separate permits to be obtained from DCR. These harvests can be done independently of each other, and may be done by separate logging operators or with different mixes of equipment. Details of each harvest are discussed in the relevant Management Practices sections. These harvests are listed in Table 5C.

The sole silvicultural recommendations for the Mountain Street watershed listed in Table 5B is discussed in the Management Practices section for Stand 3 (i.e. there is no Table SD).

Table 5C: Proposed Harvests at the Ryan & West-Whately Watershed:

Stand	Forest Type	Silviculture (harvesting)	Acres to Cut	BA to Cut	Mbf to Cut	Cords Wood to Cut	Cords Pulp to Cut	Year
3	WH	selection	133	36	134	476	263	2012
4	WH	selection	46	28	34	142	50	2012

8	HH	Shelterwood	30	50	50	30	90	2012
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9	[WP]	Thinning	18	30	50	5	20	2012
13	WH	selection	12	20	18	7	20	2012

11	WH	selection	83	33	120	263	179	2012
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15	RP	selection	59	41	291	54	324	2012
16	HH	selection	98	32	162	264	232	2012
18	WH	selection	41	40	46	156	43	2012

19	HH	shelterwood	27	65	75	147	149	2012
20	WH	shelterwood	97	32	177	248	397	2012

7	[RP]	Shelterwood	4	80	50	4	4	2017
7	OH	Selection	5	120	20	75	21	2017
9	[RP]	Shelterwood	8	80	100	8	8	2017

8	[BB]	Thinning	120	30	20	300	0	2017
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Totals 782 1,347 2,180 1,802

VII. Treatments to Limit Interfering Factors: Interfering factors to be treated are divided into (1) treatments of interfering vegetation and (2) treatments of interfering wildlife activity (i.e. reduction of over-browsing).

Treatment of Interfering Vegetation: It is hard to imagine that interfering vegetation can be successfully controlled on a broad scale without the use of chemical herbicides. While mechanical methods (such as cutting, mowing, and hand-pulling) would be an important part of an overall approach (e.g. cutting large grape vines in a stand with good overstory shade), there is no good way, currently, to control the vegetation in question without the use of herbicides to some degree. The thought of using herbicides in a forested watershed raises, understandably, concerns about risks these may pose.

Discussion: Herbicide Use in a Forested Watershed Context: Healthy, diverse forests are an essential component of the natural system that collects, filters, stores, releases, and protects the water that enters the reservoirs of the Northampton DPW surface water supply system. Such highly functioning forest stands are considered to be the best possible watershed condition. Conversely, forests in poor condition cannot provide this same level of service. The objective of forest management on the watersheds is to maintain desirable forest conditions in all areas. As part of the overarching effort to maintain desirable forest conditions in these watersheds, it is necessary to limit (i.e. “control”) the negative impacts of undesirable vegetation. Throughout much of the Mountain Street watershed, and in parts of the Ryan & West-Whately watersheds, undesirable vegetation is significantly compromising the condition of the forest. In worst-case scenarios — of which there are several instances in the watersheds — the undesirable vegetation prevents DPW from having any tall forest overstory at all. These areas have been reduced to stands of dead or dying broken trees smothered by mats of bittersweet vine. Over time, these very negative worst-case impacts are expected to cover more land area as the undesirable vegetation continues to thrive.

The term “undesirable vegetation” can refer to either non-native invasive plants (e.g., oriental bittersweet vines) or interfering native vegetation (e.g., wild grape vines). Control measures can be passive (e.g., avoiding disturbance of the soil or the forest canopy, or maintaining shade) or active (e.g., cutting or crushing undesirable vegetation). These approaches, where applicable, are built into the Stewardship Plan on a stand-by-stand basis. However, these approaches alone may not be sufficient in many areas to achieve the desired level of reduction or control. In cases where these approaches are inadequate on their own, it may be necessary to add the use of chemical (e.g., herbicide) controls to the overall effort to limit the negative impacts of the undesirable vegetation.

Herbicide use for control of invasive and/or interfering vegetation in wetland resource areas is regulated under the Wetlands Protection Act, but unfortunately there is no single set of clear guidelines for herbicide use in upland watershed areas of surface water supplies in Massachusetts.

The Watershed Protection Act (WsPA) regulates land use and activities within critical areas of the Quabbin Reservoir, Ware River and Wachusett Reservoir watersheds for the purpose of protecting the quality of drinking water. However, this Act pertains only to locations within

these three watersheds. There are no guidelines for herbicide use in other public drinking water supply watersheds in the Commonwealth of Massachusetts

Regulations promulgated under the WsPA preclude "...the use or storage of pesticides or herbicides which carry a mobility rating as provided for by the United States Environmental Protection Agency or which have been determined by the Commonwealth using United States Environmental Protection Agency standards to pose a threat or potential threat to ground water." The WsPA does not prohibit the use of herbicides that are not shown to pose a threat or potential threat to ground water, and it also includes provisions for herbicide use by utilities and railroads conducting Right of Way maintenance activities to control undesirable vegetation.

These entities must follow Right of Way regulations, and are obliged to write a Vegetation Management Plan (VMP) and a Yearly Operational Plan (YOP) detailing their activities and the materials they will use, under the provisions of 333 CMR 11.00, which are administered by the Massachusetts Department of Agriculture (MDAR). Only those herbicides included on the Sensitive Area Materials List, all of which have low mobility ratings, may be used for ROW maintenance. Included on the list are glyphosate, triclopyr, Imazapyr and metsulfuron methyl, which have been widely used to control non-native invasive plants including those found in these watersheds.

In addition, model ROW plans developed by utility companies such as National Grid include setback distances from public surface water sources that preclude and/or restrict use of Sensitive Area-approved herbicides. The ROW plan prohibits herbicide use within 100' of reservoirs, while allowing use of only those herbicides for the Sensitive Area Materials List noted in the preceding paragraph. Of the stands currently under consideration for control of invasive and/or undesirable vegetation, only the shoreline portions of Stand 8 in the Mountain St. watershed would fall within 100' of the reservoir. Under the ROW protocol, only mechanical control methods would be use. Vegetation control in the other stands in both watersheds will occur either in upland areas, or in the vicinity of wetland resource areas, where they would be subject to the provisions of the Wetland Protection Act. Permits would need to be secured from the conservation commissions with jurisdiction in the respective towns where those stands are located.

With the exception of ROW operations, herbicides are not currently in use in the watersheds of the Quabbin/Ware River/Wachusett Reservoirs to manage non-native invasive vegetation. Apparently, this decision is based more on sensitivity to negative public perceptions about herbicide use in public water supply watersheds than on science-based assessments of risk.

In situations where there are no effective alternatives for controlling interfering vegetation (non-native invasive species such as oriental bittersweet or multiflora rose, and/or interfering native species such as wild grapes and hay-scented fern), we recommend that Northampton DPW allow the use of herbicides as part of a program to manage these species. In this manner, desirable vegetation that serves the overarching goal of watershed protection may be allowed to reestablish itself and to flourish.

As a framework to guide the usage of herbicides in Northampton DPW watershed forests, we recommend preparing and implementing a VMP in accordance with ROW standards. This VMP would meet the same standards as ROW maintenance VMP's developed for use within the watersheds of the Quabbin/Ware River/Wachusett Reservoirs. The VMP will be submitted with

Notice of Intent applications related to management activities and will stipulate use of only those herbicides on the Sensitive Area Materials List. We recommend using the setback protocol used by National Grid VMP (e.g. no herbicide use within 100' of the bank or a reservoir or tributary, and limited use in the area 100'-400' from the reservoir or tributary). Herbicide-based control will be recommended in situations where mechanical control (e.g. cutting), or mechanical control alone, is not expected to achieve the desired control. Actual treatments will be prescribed in detail, applied, and documented only by Licensed Pesticide Applicators working in conjunction with Northampton DPW, and will observe all recommended Best Management Practices.

There are separate challenges for each watershed. Because the infestation of undesirable vegetation is so advanced at the Mountain Street reservoir watershed, most of the needed effort will focus on "winning back", or restoring, the forest so that conventional management activities can resume eventually. In the Ryan & West-Whately watersheds, only a few areas are in need of restoration; the main challenge will be to work in ways that allow conventional forest management to proceed while simultaneously controlling any undesirable vegetation.

Treatment Recommendations based on Stand Ranking: treatments of interfering vegetation will be designed according to the degree of infestation. For each stand and situation, a specific prescription would be developed. The general approach to treatments is discussed below. Tables 6A & 6B indicate which stands are recommended for treatment within the next 10 years..

In Stands ranked 1, there is typically no need to treat interfering vegetation.

In Stands ranked 2 and scheduled for silvicultural activity, control of interfering vegetation is typically recommended as a condition of the harvest (i.e. recommended to occur, as a separate step to be done by separate contractors before, during, or right after the harvesting.) Without treatment of interfering vegetation, these harvests should not be pursued (because it would merely spur new growth in the interfering vegetation). A typical treatment for stands ranked 2 would be as follows:

- Winter, Year 1 (dormant season): cut-stump herbicide application to invasive plants and interfering vegetation. Garlon 4 Ultra in basal oil would be used. Various saws and clippers used as needed.
- Summer, Year 1: foliar herbicide application of triclopyr-based herbicide on low and resurgent vegetation (e.g. horizontal vines, resprouts, etc.). Use backpack sprayer.
- Summer, Year 2: follow-up foliar spray application.

For some Stands ranked 3 (none of these are slated for silvicultural treatment), especially where there is significant timber, treatments are recommended that would seek to reduce the Stand ranking to 2 so that harvesting could occur in the future (though probably beyond the 10-year time frame of this plan). A typical treatment for stands ranked 3 would be as follows:

- Winter, Year 1 (dormant season): cut-stump herbicide application to invasive plants and interfering vegetation. Various saws and clippers used as needed.

- Summer, Year 1: foliar herbicide application of triclopyr-based herbicide on low vegetation (e.g. horizontal vines). Mistblower and/or backpack sprayer would be used.
- Late Summer, Year 1: foliar herbicide application of glyphosate-based herbicide and imazapyr-based herbicide on low vegetation (e.g. horizontal vines) on low-growing vegetation.
- Summer, Year 2: follow-up foliar spray application.
- Summer, Year 3 follow-up foliar spray application.

For some Stands ranked 4 or 5, no active treatment is recommended at this time, unless the DPW wishes to be very ambitious and regain the ability to manage all DPW lands with normal silvicultural methods. The exceptions would be for included areas ranked 5 (i.e. in Ryan & West-Whately Stands 7 & 9, and in Mountain Street Stand 1). Control is recommended in these focused areas in order to prevent these areas from enlarging over time and from serving as a seed source to surrounding areas. A typical treatment for stands ranked 4 or 5 would be as follows:

- Winter, Year 1 (dormant season): cut-stump herbicide application to invasive plants and interfering vegetation. Various saws and clippers used as needed.
- Winter, Year 1 (6 weeks after previous treatment): if needed, using equipment as needed, create walkable access routes into the treatment area
- Summer, Year 1: foliar herbicide application of triclopyr-based herbicide on low vegetation (e.g. horizontal vines). Mistblower and/or backpack sprayer would be used.
- Late Summer, Year 1: foliar herbicide application of glyphosate-based herbicide and imazapyr-based herbicide on low vegetation (e.g. horizontal vines) on low-growing vegetation.
- Fall, Year 1 or early spring, Year 2: in Stands ranked 5, possible planting of new vegetation (e.g. Norway spruce to cast dense shade) to grow in combination with native vegetation.
- Summer, Year 2: follow-up foliar spray application.
- Summer, Year 3 follow-up foliar spray application.

Table 6A: Proposed Treatment of Interfering vegetation at the Ryan & West-Whately Watershed:

Stand	Stand Acres	Overall Invasives Rank 1 - 5	Acres Ranked 5	Treatment Recommended?	Acres to treat
1	58.9	1	0	NO	
2	47.2	1	0	NO	
3	166.4	1	0	NO	
4	92.9	1	0	NO	
5	137.0	2	0	NO	
6	189.6	1	0	NO	
7	208.1	2	3	YES	5
8	297.3	2	0	NO	
9	185.6	2	8.7	YES	10
10	52.4	2	0	NO	
11	277.4	2	0	NO	
12	41.3	2	0	NO	
13	30.9	1	0	NO	
14	76.0	3	0	NO	
15	65.2	2	0	YES	50.0
16	130.3	1	0	NO	
17	65.6	2	0	NO	
18	50.9	1	0	NO	
19	45.7	2	0	YES	2
20	108.3	1	0	NO	
21	18.7	4	9	YES	9
Total	2345.8		20.7		76.0

Table 6A: Proposed Treatment of Interfering vegetation at the Mountain Street Watershed:

Stand	Stand Acres	Overall Invasives Rank 1 - 5	Acres Ranked 5	Treatment Recommended?	Acres to treat
1	151.3	3	0.5	YES	1.0
2	18.8	3	0	NO	0.0
3	24.6	1	0	NO	0.0
4	22.9	3	0	YES	22.9
5	2.8	2	0	NO	0.0
6	15.3	4	0	YES	15.3
7	95.2	3	0	YES	95.2
8	33.7	5	33.7	NO	0.0
9	47.7	1	0	NO	0.0
10	134.0	3	0	YES	134.0
11	12.7	4	0	YES	12.7
Total	559.0		34.2		281.1

Reducing Over-Browsing: Browsing of deer and moose is contributing to an overall lack of desirable hardwood regeneration, including oaks, maples and black cherry. Moose hunting is prohibited by statute in Massachusetts. Allowing deer hunting would help reduce the browsing pressure exerted by deer on the desirable regeneration. This was tried, with success, at the Quabbin Reservoir. Specific recommendations about how to do this go beyond the scope of this plan. But, presumably, there would be sort of registry of hunters and some sort of supervision of the hunt, including parking and the use of off-road vehicles, and measures to protect public safety, perhaps in coordination with the Environmental Police. If, ever, hunting of moose became legal in Massachusetts, the hunt would be expanded to include these.

VIII. Impact on Nearby Protected Land and Local Economy

Role/Impact wrt. nearby Protected Lands: these include abutting MA Division of Fish & Wildlife land and abutting MA DCR state forest.

Water supply: The intention of this plan is to maintain and enhance the watershed benefits of this forest. No other drinking water supplies will be affected. No negative impact to any water supply is expected from following this plan.

Wildlife habitat: The anticipated uses should sustain or enhance a component of the current mature-forest habitats while adding a younger-growth dimension. There should be no near-term net effect on habitat on nearby protected land. Any success in controlling non-native invasive plant species will benefit abutting lands as well.

Recreation: Recreation is not permitted, other than authorized snowmobile trail use (for the Ryan & West-Whately watershed, on Waterworks and Old Phinney Roads, Old Williamsburg Road, the Henhawk Trail, and for the Mountain Street watershed on the west side of Laurel Mountain and on Chestnut Mountain Road). Residents of Williamsburg are specifically (by agreement between the City of Northampton and the Town of Williamsburg) allowed to walk on the Henhawk Trail. At the Ryan & West-Whately watershed, Williamsburg Road is a public highway, but with the bridge out at the eastern end of the road, this road is mainly used for recreation. At the Mountain Street watershed, Chestnut Mountain Road and Rocks Road are public ways and are used for recreation. No current or anticipated use of these roads is expected to affect water quality.

The between-property impact of any forest management: is expected to be essentially non-existent.

Role/Impact wrt. the local economy: The most important economic role of this forest is to supply water to the reservoirs. The value of the water produced by the water supply is much more significant than the value of any forest products. Income from forest products plays a secondary role, and harvesting is designed to shape watershed forest conditions rather than to meet economic goals. From a “woodlot perspective”, this parcel is relatively large by Massachusetts standards, and can contribute positively to the local economy, providing work for foresters, loggers, truckers, and possibly local sawmills, firewood operations, and wood-chip-burning facilities (e.g. Cooley Dickinson Hospital). There has been no harvesting of timber on these lands over the last 10 years. Over the next ten years, the economic role played by timber will increase. Much of the volume that might be harvested is low-grade material, including firewood, softwood pulp, and potential chipwood.

Additionally, there are opportunities for specialists in invasive plant control to assist in regaining the ability to use this woodlot to produce forest products, and there may be opportunities for wildlife biologists to shape management.

IX. Summary of Management Recommendations

The City of Northampton DPW's primary goal for the forest is to ensure the forest's proper function as a watershed protection forest. Secondary goals include growing and harvesting timber for the purpose of revenue generation, and providing a diversity of wildlife habitat. The property's potential to achieve the landowner's goals is good, but the significant health concerns caused by the interfering factors identified in this plan will require DPW to maintain considerable attention and effort, over a long period of time, to ensure that this situation does not worsen.

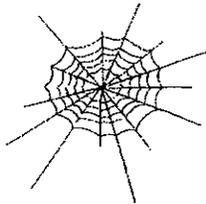
Working towards these goals, the main recommendations include:

1. Develop and follow a forest management plan approved by the MA Department of Conservation and Recreation (DCR) that incorporates the following elements:
 - a. A Forest Stewardship Plan (a comprehensive assessment and set of forest management considerations).
 - b. Green Certification: (involving third party verification by Smartwood, in conjunction with DCR, and ongoing monitoring of forest conditions by the landowner or its agent)
 - c. An outreach component to facilitate public awareness.
2. Continue to clarify parcel deeds and status of roads.
3. Locate, mark (as needed) or re-mark boundaries with abutters and inspect these periodically.
4. Continue efforts to acquire or otherwise protect land within the watersheds.
5. Maintain roads and logging access in a condition that protects water bodies from sediment inflows and allows them to be re-used over the long term.
6. Use passive and active approaches to limit the spread of, and push back the negative effects of, interfering factors such as non-native invasive vines and shrubs, native plants such as wild grapes, beech, and hayscented fern, and overbrowsing by herbivores.
7. Conduct a limited set of silviculturally-based harvests designed to promote and maintain a diverse, mixed-age forest that is well suited to watershed protection (described above). By limiting cutting within each subwatershed to less than 25% of basal area within any 10-year period, these harvests will not increase run off into the reservoirs. (Exceptions to the anticipated course of harvesting could occur in response to events, such as severe storms or pest outbreaks, but this could be determined as needed.)
8. Continue to ensure that unwanted uses (e.g. ATV use) within the watershed are minimized.

9. Monitor watershed-forest conditions. This can be done as an ongoing, integrated effort involving the DPW Ranger (monitoring road conditions and any occurrence of prohibited uses) and forestry or ecological staff (monitoring general forest conditions on a periodic basis — possibly on a rolling, walk-through basis so that all areas are casually inspected within any 5-year period — and monitoring specific forest conditions in areas that have undergone Silvicultural or interfering vegetation control treatments). Irregular inspections could occur in the event of any major storms or pest outbreaks or other notable disturbances. One particular focus of monitoring should be the condition of red pine to detect as early as possible any sign of the red pine scale so that an accelerated response can be developed.
10. Consider developing a framework that allows for hunting of deer to help reduce over-browsing of desirable seedlings.
11. Design and implement a series of outreach products and/or efforts to help facilitate public awareness of watershed management activities.
12. Review this plan and the entire forest in 10 years (2022), evaluate successes and failures, new developments, etc., and use updated information to prepare a plan for the next 10 years of forest management.

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.

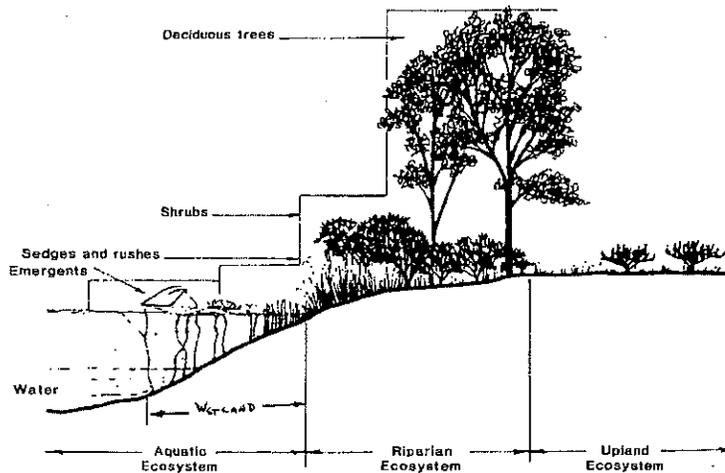


Figure 1: Example of a riparian zone.

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 keep our drinking water cleaner, and saves communities money by making the need for costly filtration much less likely.

Flood control: By storing water after rainstorms, these areas reduce downstream flooding. Like a sponge, wetland and riparian areas absorb 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 than to cure them. This preventative approach usually involves two steps. First, it is desirable to maintain or encourage a wide diversity of tree species and age classes within the forest. This diversity makes a forest less susceptible to a single devastating health threat. Second, by thinning out weaker and less desirable trees, well-spaced healthy individual trees are assured enough water and light to thrive. These two steps will result in a forest of vigorously growing trees that is more resistant to environmental stress.



Fire: Most forests in Massachusetts are relatively resistant to catastrophic fire. Historically, Native Americans commonly burned certain forests to improve hunting grounds. In modern times, fires most often result from careless human actions. The risk of an unintentional and damaging fire in your woods could increase 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.

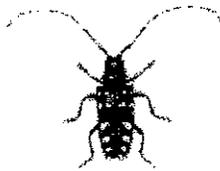


Invasive Species Management: Invasive species pose immediate and long-term threats to the woodlands of MA. Defined as a non-native species whose introduction does or is likely to cause economic or environmental harm or harm to human, animal, or plant health, invasives are well-adapted to a variety of 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.nbi-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 (*Berberis thunbergii*)
- Japanese Knotweed (*Fallopia japonica*)
- Autumn Olive (*Eleaegnus 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.



STAND DESCRIPTIONS

Notes Applying to All Stands

Stand Objectives: For all stands, the objectives are Forest Stewardship & Green Certification

Volume Growth Rate: For all stands, stewardship-plan growth rates were based on the DCR/USFS Forest-Inventory-and-Analysis published average rate of 162 board feet per acre per year. If any adjustments were made to this figure, it was discussed in the specific stand description.

Are there slopes greater than 30%? No.

Is this soil highly erodible? No.

Protection from fire: No evidence of wildfire. The main threat of wildfire is careless, unauthorized recreational use. In case of a fire, the well-established road network will provide essential access, and can also serve as a firebreak.

Field method for volume per acre: for all stands except Stand 5, a nested point-sampling cruise was conducted using a BAF-10 prism for "count trees" and a BAF-40 prism for volume trees (diameter and height) (see "Using a large-angle gauge to select trees for measurement in variable plot sampling", Marshall, Lles and Bell, Canadian Journal of Forest Research 34: 840-845 (2004)). See also: "Is BAF 10 a Good Choice for Point Sampling, Wiant, Yandle and Andreas, Journal of Forestry, pp. 23 & 24, June, 1984. Product volumes are calculated in an Excel spreadsheet using formulas published in Mawson and Rivers. No timber was measured in Stand 5.

Field method for site index: Published Soil Survey data for Franklin and Hampshire Counties interpreted with qualitative adjustments for tree vigor and in-stand features. These are discussed for each stand under the "Soils" heading.

STAND DESCRIPTIONS

Standard Procedure for Invasive Inspections: *stand-level recommendations may refer to "standard procedure" for invasive inspections. These procedures are listed below:*

Standard procedure for invasive inspections for stands ranked 1 or 2: If vehicle entry or gaps caused by logging, wind, or grape pulldown occurs in this stand it should be inspected within 2 years and any invasive plants should be pulled. If they are seed-bearing they should be bagged and removed to a landfill. If logging or major blowdowns occur on adjacent stands but not on this one, the inspection should occur within 5 years. If on any inspection, invasives are found, then repeat inspections should occur every year or two thereafter until no invasives are found, at which point the inspections can be less frequent.

Standard procedure for invasive treatments for stands ranked 3: In addition to the procedure for stands ranked 1 or 2, efforts to remove invasives should be made even before the canopy is opened. After the initial removal treatment, the treated areas and areas surrounding them should be inspected every year for at least 5 years.

For Stands ranked 4 or 5: avoid any further disturbance or vehicle entry; develop a specific plan to regain control/use of the site.

STAND DESCRIPTIONS

Overview of Stand Descriptions:

Stand	Type	Acres	Size (MSD")	Basal Area (ft ² /ac)	Mbf per acre	Cords per acre (wood)	Cords per acre (pulp)	Site Index	Volume growth rate (Mbf/yr)
1	WH	151.3	12.7	84	6.1	3.3	2.1	65 WP	24.5
2	WH	18.8	14.1	90	10.7	3.3	1.7	70 WP	3.0
3	OH	24.6	11.3	141	7.1	6.0	8.3	60 OR	4.0
4	WP	22.9	16.4	133	21.5	0.5	2.7	66 WP	7.4
5	GR	2.8	N/A	N/A	N/A	N/A	N/A	N/A	0.0
6	RP	15.3	12.7	104	13.5	4.6	0.2	65 WP	2.5
7	WH	95.2	15.4	115	7.3	7.0	2.8	65 WP	15.4
8	AO	33.7	N/A	N/A	N/A	N/A	N/A	70 WP	0.0
9	WH	47.7	12.3	127	6.3	7.8	3.6	60 WP	7.7
10	WH	134.0	12.9	84	10.4	3.3	0.3	70 WP	21.7
11	RP	12.7	12.4	134	10.4	0.0	6.5	60 WP	2.1
12	Non	10.7	N/A	N/A	N/A	N/A	N/A	N/A	0.0
13	WA	69.2							
Total		638.9							88
Forest		559.0							

Reservoir Mountain Street Town(s) Whately, Williamsburg & Hatfield

Owner(s) City of Northampton DPW

STAND DESCRIPTIONS

Stand	Type	Acres	Size (MSD")	Basal Area (ft ² /ac)	Mbf per acre	Cords per acre (wood)	Cords per acre (pulp)	Site Index	Volume growth rate (Mbf/yr)
1	WH	151.3	12.7	84	6.1	3.3	2.1	65 WP	24.5

Stand Name: Chestnut Mountain

Watershed / Sub-watershed: Mountain Street / Mountain Street East

Special water quality concerns (for stands within a reservoir watershed):

Avoid any inputs of sediments into Borowski Brook, any small feeder streams, or to the reservoir itself. No logging is planned, and there are no particular risks of sediment inputs from this stand in the near term. However, over the long-term, the continued spread of oriental bittersweet vines and grapes will compromise DPW's ability to maintain a functioning forest canopy.

Silvicultural Status (options are "suitable" or "not suitable"): Not suitable due to the current extent and potential spread of oriental bittersweet and other invasive plants.

Overstory: Forest Type and Condition: This stand stretches from Borowski Brook and the northeast shore of Mountain Street Reservoir all the way up to Chestnut Mountain Road. The stand is divided into a northern and southern half by a woodlot owned by WD Cows, and consists of a variable mix of white-pine & hardwood, oak-hardwood, northern hardwood and hemlock-hardwood types, with scattered, sometimes "unexpected" small plantations of planted red pine. Red maple and black birch are the most widespread hardwoods, with sugar maple occurring in many places as well. Red oak is also scattered throughout, but black oak is more common. In the northwest part of the northern half there is even hickory — mostly bitternut, but also shagbark and pignut. Most species seem to occur in at least one dense species-specific concentration, with no predictable pattern (e.g. in one area, black birch seems to dominate, but then in the next area, pine is dominant, and in the next area, sugar maple is dominant, etc.). Black cherry is scattered throughout. Paper birch is scattered throughout. There was very little white ash. Yellow birch and big-tooth poplar occur in the northwest area. One sassafras was noted. Beech was not common.

Though there are well-formed, valuable individual trees of most of the species present, the general quality of the timber is average in size and quality. Hardwood quality often suffered due to epicormic sprouts that formed on trunks after the last, relatively heavy cutting. Many trees were damaged by the logging itself (butt scars). The white pine and hemlock often have a rough appearance, with large branches or knots of large branches from long ago. The hemlock is in a general state of decline, with thin tops. The red pine often has rough stems, and many of the trees are pulp-sized. Black birch, sugar maple, and red & black oak seem, to the whole, to have the best timber quality.

Reservoir Mountain Street Town(s) Whately, Williamsburg & Hatfield

Owner(s) City of Northampton DPW

STAND DESCRIPTIONS

Exceptions to the general size range are found in the area along Borowski Brook. Here there are a number of very large, tall white pines (heights well over 100', diameters to 45") and with tall, timber-sized hemlocks. And in the northeast area, within the stone-wall enclosure (along the western wall) there are a number of extremely large, rough, old red oaks, some of which are breaking apart due to age and storms.

As mentioned, this stand is divided into a northern and southern half by the WD Cows woodlot. Both areas had fairly heavy cutting in the recent past (1990 in the southern half, 1998 in the northern half). The cutting removed enough of the overstory shade so that many areas have successfully regenerated (to a mix of red maple and black birch, sometimes with sugar maple). The regeneration, some of which is free to grow, is discussed below. The result of this cutting is that the stand is now in a desirable two-aged condition. Note: some areas of regeneration have failed due to the growth of oriental bittersweet and grapes or sometimes witch hazel (this is also discussed below). This two-aged structure is desirable for watershed purposes, and can be further developed into a multi-aged structure over time.

Though the red pine is generally in poor vigor, similar to other areas of red pine across both watersheds. One section of red pine seems to have gone through a heavy phase of mortality (the forest floor is littered with dead stems) but the overstory seems to have stabilized (to a poor condition). Though no harvesting is recommended for this 10-year cycle, in the future, the red pine should be cut off and replaced with native vegetation. Regeneration (in the form of stringy hardwood saplings) is already in place, but would need to be flush cut in order to be able to vigorously resprout.

One specific problem involving red pine is worth special mention. All along Borowski Brook, on the east side, there is tall red pine, usually in small but dense plantations (groves, really), but sometimes mixed in with hemlock and white pine. The red pine groves are broken up by dense areas of hemlock, with white pine, and sometimes yellow birch and other hardwoods. The site, which is at times ledgy and at times rich and seepy, is comprised both of a steep slope and the wet toe of the slope, and is bounded by Borowski Brook and by Haydenville Road. The site is very difficult to access. The problem is that both the red pine and the hemlock are in states of decline, and may die at about the same time (some years from now), or stay "nearly dead" for many years. This will not pose a problem for water quality, but it may look bad. The only feasible way to address this is to come in from the east (from Chestnut Mountain Road) and cut the trees. However, with the risk of spreading invasives at this point, this is not recommended.

Understory:

Desirable Tree Regeneration (species and distribution) for future overstory: Spread throughout, in many areas, there is abundant hardwood regeneration, consisting primarily of saplings of red maple and black birch, often with sugar maple. The saplings tend to occur in one of two height classes, either roughly 10'-20' (diameters 1"-2") or roughly 30'-40' (diameters 3"-6"), and seem to occur as same-height groups (i.e. there will either be a group of 10' tall saplings, or a group of 40' tall saplings). In many places

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Reservoir Mountain Street Town(s) Whately, Williamsburg & Hatfield

Owner(s) City of Northampton DPW

STAND DESCRIPTIONS

the overstory is shading the saplings and will ultimately inhibit their growth, but, throughout, there are groups of saplings that are actually free-to-grow (i.e. there is no overstory shade to prevent them from ultimately growing into a tall canopy). The free-to-grow condition usually applies to small groups of saplings, rather than to individual saplings, so there will still be aggressive competition among these saplings for survival and growth into a tall canopy. This process should produce many well-formed trees.

Where regeneration is established but not free to grow, or where it did not establish at all, this may be due to overstory shade (as mentioned above), or due to the aggressive competition of witch hazel, or to the growth of vines (bittersweet and/or grapes) that have pulled these down. The effects of witch hazel are more prevalent in the western 2/3 of the stand, though not in areas where hemlock or red pine was dense before the last cut (witch hazel doesn't develop well under these overstories). The effect of vines is greater in the eastern third, but few areas seem totally free of grapes. In two locations, the bittersweet infestation is very extreme, such that no new trees can grow at all.

It is fair to say that the past cutting benefitted both the regeneration and the interfering vegetation. Subsequent cutting, if it does not address the interfering vegetation, would be likely to see interfering vegetation increase markedly.

In addition to these inhibiting effects, hayscented fern and deer/moose browse would pose additional challenges to any effort to establish new seedlings in the future.

In areas with enough hemlock shade so that the understory is primarily a thick duff layer, there are a surprising number of red oak seedlings, usually less than 1' tall. If the risk of spreading invasives were not so great, it would be good to try to work with this situation to try to help these become well-established.

Interfering native vegetation: When there is any problematic native vegetation, it is typically hay-scented fern or witch hazel. Hay-scented fern is very dense in some large canopy gaps in the north section of the stand. Witch hazel is dominant in some areas but not throughout.

Other native understory vegetation (species and distribution): Most of the upland ground vegetation is sparse with common species of acid soils such as evergreen woodfern, Canada mayflower, poison ivy and starflower. An exception is a small ravine just south of the Cows boundary. See Special Habitat, below.

Non-native invasive vegetation (species, distribution/severity) (see "Notes applying to all stands" above): Severity level 3 overall, but varying between 1 and 5. There are two complete infestations (level = 5), in locations along Chestnut Mountain Road.

The first is a long, total patch of dense bittersweet (level = 5) right next to the road, along the crest of the hill just south of the Whately-Hatfield line. Otherwise, in the south half of the stand most of the upland area is a 2 overall with only occasional seedlings of bittersweet and some small shrubs of barberry. Seepy areas scattered throughout

Stand Descriptions Page 6

Reservoir Mountain Street Town(s) Whately, Williamsburg & Hatfield

Owner(s) City of Northampton DPW

STAND DESCRIPTIONS

invariably have a greater population of bittersweet and other invasives, and even the upland areas have some small gaps (200-5000 sf) moderately dense with bittersweet and multiflora rose. In general the invasives are less concentrated as one moves east except along the southernmost part of Chestnut Mountain Road where there is a larger concentrated area of bittersweet and barberry.

The second serious infestation is north of the WD Cows parcel, and goes deeper into the stand where the 1998 log landing was located, following the main skid roads in part ways. In the north half of the stand, along Chestnut Mountain Road, there is an extensive dense patch of several acres containing large vines of bittersweet and small shrubs of multiflora rose. Small barberry shrubs are also present in smaller amounts. These 3 species are also dispersed at a moderate density in the forest surrounding the dense patch, but there are other concentrated hotspots in this general vicinity.

The western half of the north section is at severity level 2, with only occasional seedlings of bittersweet and multiflora rose present, except within the small canopy gaps where the % cover of these species is 6-25%.

Overall, the population of invasives becomes minimal toward the west. One area — the section just south of the WD Cows parcel, but north of the town line, had hardly any invasives at all. Invasives do increase, though, around the edge of Stand 2.

Along Borowski Brook, down to the northern tip of the reservoir there are very few invasives. Only one small dense patch of bittersweet was observed and there were 2 small bittersweet vines at the northern tip of the reservoir. Both these sites were where there was a sunny gap. It is likely that dense shade from the overstory pine and hemlock, plus the mountain laurel in the northern section, prevent invasives from germinating. However, this stand is also in close proximity to invasives seed sources from the western side of Borowski Brook and the western side of Mountain Street (Stand 8).

Overall, throughout this stand, invasives in this stand are at a level such that, if left untreated, any further cutting would trigger a widespread and damaging release of invasives, particularly bittersweet. Though there are areas with few invasives, it seems risky to try to work just with this — it would not be possible to access these areas without stirring up infested areas in the process.

Soils (type, moisture, drainage and productivity): Westminster extremely rocky loam. This "droughty", "shallow" soil formed in layers of glacial material derived from gray-mica schist containing impure limestone, with dark-gray schist bedrock at a depth of about 18". The water table is high 7 - 9 months of the year, and this soil is subject to erosion. Overall, trees in this soil cannot develop deep root systems (due to high water tables and shallow depths to bedrock) and are often not windfirm. These soils are considered to produce "poor yields" of timber.

However, there is variability within this broad categorization, and trees can grow well in some areas. Black birch seems to do quite well. Perhaps it is the shallow depths to the

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water table that seem to favor the growth of grapes and invasive plants (esp. bittersweet). According to the Soil Survey, "the growth of miscellaneous hardwoods and shrubs has to be controlled to prevent the overtopping of young conifers". If written today (50 years later), grapes and bittersweet should be included in this list.

Site index for northern hardwoods: 46-51, site index for upland oaks: 55-64, site index for white pine: 60-69. My own measurements (on this soil, but in other locations) indicate a site index of 70-75 for black birch and poplar.

For tree **growth purposes**: despite problems (see above), growing timber is still a viable option for this soil.

For **logging purposes**: extreme care must be used to minimize rutting and erosion; very frozen or very dry conditions must prevail. Skid roads must be properly drained off (water bars, etc.) and should be closed to unofficial vehicle use.

Habitat:

General Habitat: This is a mixed hardwood-white pine stand with various small inclusions of red pine. Red maple, black birch, and red and black oak are present throughout with old field white pines more abundant in the south than the north section. There is some chestnut oak. The midstory is light with patchy dense areas. It consists of black birch, hemlock, sugar maple and red maple. In the shrub layer striped maple, along with red maple is widespread but not dominant, and the ground layer is mostly sparse, except where ferns are dominant.

Especially in the north section and in the vicinity of Chestnut Mountain Road there are canopy gaps now filled with dense bittersweet and some multiflora rose. Because of past logging there is a relatively high amount of well-rotted coarse woody debris on the ground (large, rough logs from old-field pine stems). The importance of this feature was clear because nearly every dead log or stump in this stand had been torn apart by black bears in search of ants or other insects.

Borowski Brook is a permanent, shaded shallow stream along Mountain Street, feeding Mountain Street Reservoir from the north. This is a man-made feeder brook taking discharge from the West-Whately Reservoir. The stream is home to dusky and 2-lined salamanders and could be suitable habitat for wood turtles. This low area contains many large hemlocks and white pines with a sugar maple midstory. The riparian area is a likely north-south wildlife travel corridor. Overall, the midstory, shrub, and ground layers are light, but the shrub layer is dense with laurel on the west-facing oak slope.

There are ledge outcrops both along Borowski Brook and set back from the shoreline in places.

At the tip of the prominent peninsula into the reservoir there is a small colony of Allegheny mound ants. These were not observed anywhere else on either watershed. These ants are not cause for any special concern.

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Do wetlands occupy more than 10% of this stand?: No, but a drainage flowing southwest through the south section contains several intermittent streams and the soils are moist and seepy.

Were vernal pools identified/mapped for this stand? (if "yes", how many): Yes, vernal pool 30 is very significant because it is used for breeding (in spring) by Jefferson salamanders (confirmed by Molly Hale, May, 2012), which are listed as Special Concern in Massachusetts, and may also be used for breeding (in fall) by marbled salamanders, a species listed as Threatened in MA. It is located along the north boundary of the stand. Vernal pool 36 is on abutting property west of Chestnut Mountain Road but is 160 ft. from the stand.

Are NHESP layers indicated for this stand? (if "yes", describe) No, but, if reported to NHESP, the Jefferson (and possibly marbled) salamander occurrences would presumably trigger the creation of a new polygon in the Estimated Habitat and Priority Habitat layers if it is reported to NHESP.

Other Special Habitat (elements to preserve) (e.g. tall ledge outcrops, etc.): At the ravine/quarry area just south of the Cows boundary, (wpt 87-01) is a slightly rich mesic area. Plants present are ebony spleenwort fern (*Asplenium platyneuron*), rattlesnake fern (*Botrychium virginianum*), ginseng (5 plants) (*Panax quinquefolius*, currant, possibly bristly black (*Ribes*), broad-leafed woodland sedge (*Carex platyphyllum*), slippery elm, basswood, lots of Christmas fern (*Polystichum acrostichoides*), spicebush, ash, sugar maple, black birch. This mix is uncommon throughout the two watersheds.

At the northern tip of the reservoir is an area of especially big white pines and hemlocks. This area is also actively used as an otter roll. The large size of the pines and hemlocks in this section combined with its remoteness from human activity make this a potential nesting area for owls, hawks and American crows.

Special risks to habitat: The possibility of invasive plants spreading after canopy gaps are created by microbursts or other storms, or by silviculture. This is a particular concern for the rich mesic community mentioned above (due to good soil fertility that is favorable for invasive plants).

Desired habitat modifications (options will vary, including "none"): Treatment of invasives to knock down their potential as seed sources.

Historical/archaeological/contemporary: Cellar hole (see map); quarry (see map); various stone walls (see map).

Management history: Southern section last logged ca. 1990. Northern section last logged ca. 1998. Both cuts were under the direction of previous DPW forester Karl Davies.

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Desired future condition: A multi-aged, mixed-species forest free of the influence of non-native invasive plants and other interfering factors.

Recommended Management for the next 10 years: Ideally, it would be nice to re-enter the stand and carry out a selection system cut that would further thin around selected overstory trees while releasing as much of the well-established regeneration as possible. In view of the serious bittersweet infestation and its likelihood of spreading vegetatively and by seed (with other non-native invasive plants), a key goal should be to eradicate bittersweet from the eastern third of the stand, as well as from any scattered locations in the western third. If successful, then ideas about Silvicultural activity can be revisited after 10 years.

Growth Rate Method and Volume (see "Notes applying to all stands" above):
DCR/Green-cert.

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Stand	Type	Acres	Size (MSD")	Basal Area (ft ² /ac)	Mbf per acre	Cords per acre (wood)	Cords per acre (pulp)	Site Index	Volume growth rate (Mbf/yr)
2	WH	18.8	14.1	90	10.7	3.3	1.7	70 WP	3.0

Stand Name: Mountain Street Reservoir Central Shore (East)

Watershed / Sub-watershed: Mountain Street / Mountain Street East

Special water quality concerns (for stands within a reservoir watershed):

Avoid any inputs of sediments into the small feeder streams, or to the reservoir itself. No logging is planned, and there are no particular risks of sediment inputs from this stand in the near term. However, as in Stand 1, the continued spread of oriental bittersweet vines and grapes will compromise DPW's ability to maintain a functioning forest canopy.

Silvicultural Status (options are "suitable" or "not suitable"): Not suitable due to current extent and potential spread of oriental bittersweet and other invasive plants and due to the difficult, wet access.

Overstory: Forest Type and Condition: This stand was delineated to include an area of land that, due to limitations caused by streams and wetlands, will probably never be suitable for logging.

There are two distinct forest types in this stand. The western end, along the reservoir shore, on a nearly flat, somewhat deep, cobbly, well-drained knoll, is a remarkable stand of large, tall old-field white pine, with hemlocks, red and black oak, sugar maple, and other hardwoods which tend to occur as large poles. The pine is well over 100' tall, and some trees are as large as 50" diameter. Trees 25" or more are common. The quality is variable, ranging from straight, very well-formed trees with 4 or more 16-foot logs, to twisted, rough-branched, multi-stemmed trees with short, rough logs. A significant number of tall trees have blown down or broken off (snapped off) in a storm wind from the west (probably the same wind that affected Stand 4). Grape vines, as large as 5" diameter, have contributed to this process. The result is that this stand has a remarkable amount of very large, coarse woody debris, and has somewhat of an "old-growth" feel. With the tall overstory and the large poles as a second canopy, this stand has a desirable, two-aged structure. Oak trees range from 10" to 28". Both grapes and bittersweet are present in storm gaps, and bittersweet is scattered in shadier areas wherever moisture is better.

To the north and northeast, the soil becomes much wetter, darker, and richer, and takes in a number of small drainages. Roughly 50% of the pines have blown down on the fringe of this area. Most of this area, though, as it follows the drainages back up into upland areas, is a mix of timber-sized white pine, small-timber-sized sugar maple, and other hardwoods, with red maple, white ash, elm, yellow birch, and poplar in the wettest

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parts. The storm effects (blow down) are limited mostly to the flatter area along the reservoir, and disappear further up the drainage.

Understory:

Desirable Tree Regeneration (species and distribution) for future overstory: On the drier soil, beech and hemlock seedlings are scattered. Sugar maple seedlings are scattered on the richer soil, though not where it is very wet.

Interfering native vegetation: Grapes are present, often as large vines.

Other native understory vegetation (species and distribution): The muck wetland in the central section has very dense poison ivy, plus foam flower, smaller enchanter's nightshade, spicebush, silvery spleenwort (a fern), sensitive fern, and doll's eye. The upland knoll in the south end of the stand (just north of vernal pool 32) has sparse vegetation consisting of poison ivy, Virginia creeper, evergreen woodfern, partridgeberry, and pinesap, though maple leafed viburnum is somewhat abundant.

Non-native invasive vegetation (species, distribution/severity) (see "Notes applying to all stands" above): Severity level is 3 overall.

In the drainage of intermittent streams through the center of the stand there is a widespread, moderately dense distribution of barberry, multiflora rose, and bittersweet, with the former being small to large shrubs and the latter two being seedlings to small plants.

In the blowdown area (see General Habitat below) one finds the heaviest growth of invasives. Here there is perhaps ½ acre covered 1-5% with bittersweet vines up to 25 ft long. This area also has a moderate density of small to medium sized bush honeysuckle, as well as scattered glossy buckthorn and barberry.

The dispersed current distribution of invasives and the moist soils in parts of this stand, as well as seed sources from non-NDPW property to the southeast will probably keep invasives a stubborn presence here even if treated.

Soils (type, moisture, drainage and productivity): The soil is listed as Westminster (as is Stand 1, see above), but this small area does not include the drier aspects of Westminster. Rather, there is an elevated level of fertility in the areas that are not excessively wet. These very wet areas appear to be a transition from Westminster to muck. The southern part seems to be a different soil type altogether, presumably a Sudbury fine sandy loam (cf. Stand 3 just south of this) with good access to the water table and there, also, not exhibiting the droughtier characteristics of that soil.

For tree growth purposes: Excellent, with elevated fertility, but increased risk of windthrow (in part due to shallow water table and, possibly, in part due to winds off the reservoir).

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For logging purposes: Although the southern section has well-drained soil on an upland knoll, it is a sort of island surrounded by much wetter soil (that is not suitable for logging), a vernal pool, or open water. Unless there were particular, extenuating circumstances, there is no good reason to try to log on this soil or access the upland knoll. It is not worth the difficulty that would be incurred.

Habitat:

General Habitat: Large white pine is predominant in the canopy along with sugar maple, oak, and black birch. There's a dense mixed midstory, a light, mostly hemlock shrub layer, and sparse ground vegetation. Numerous large trees have blown over, leaving a tangle of large downed trunks and several upturned root mats. This wetland is the accumulation of drainage from intermittent streams flowing from the east that is now prevented from entering the reservoir by a constructed berm. The berm has redirected the flowage to the south onto abutting private property.

Do wetlands occupy more than 10% of this stand?: Yes

Were vernal pools identified/mapped for this stand? (if "yes", how many):
Vernal pool 32 marks the south boundary of the stand. It is a man-made long, narrow pool oriented east-west. It is separated from the reservoir by a berm and intermittently drains to the east and ultimately into a culvert that — apparently — goes under the reservoir and empties downstream of the reservoir. No vernal pool obligates were observed in 2011, but Molly Hale reported spotted salamander eggs and wood frog tadpoles in this pool in 2001. Vernal pool 33, located south of the blowdown area and north of VP 32, is a 20 x 20 ft basin 6" deep in July 2011. No obligates were observed in it at this time, but metamorphosed amphibians could have left the pool by this time.

Are NHESP layers indicated for this stand? (if "yes", describe) No.

Other Special Habitat (elements to preserve) (e.g. tall ledge outcrops, etc.):
Keep large woody structure from blowdowns.

Special risks to habitat: Even if invasives are removed from this stand, there is a risk that they will easily become re-established.

Desired habitat modifications (options will vary, including "none"): none.

Historical/archaeological/contemporary: A few stretches of stone wall and wire fence; the southern vernal pool is (we assume) man-made, and drainage has been altered (as described above).

Management history: Parts of this stand were logged in 1990 as part of Stand 1; the southern area has not been logged in recent times, but the patches of pole-sized hardwoods indicate logging at some past time.

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Desired future condition: Maintain as is and allow natural processes to diversify forest structure but, ideally limit the role of grapes and eliminate non-native invasives.

Recommended Management for the next 10 years: None.

Growth Rate Method and Volume (see "Notes applying to all stands" above):
DCR/Green-cert.

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Stand	Type	Acres	Size (MSD")	Basal Area (ft ² /ac)	Mbf per acre	Cords per acre (wood)	Cords per acre (pulp)	Site Index	Volume growth rate (Mbf/yr)
3	OH	24.6	11.3	141	7.1	6.0	8.3	60 OR	4.0

Stand Name: Rocks Road East

Watershed / Sub-watershed: Mountain Street / Mountain Street East

Special water quality concerns (for stands within a reservoir watershed): avoid introduction of sediment directly into the reservoir by maintaining good drainage on Rocks Road. The greater risk of run off is from Rocks Road itself rather than from the forest.

Silvicultural Status (options are "suitable" or "not suitable"): suitable

Overstory: Forest Type and Condition: This is a remarkably diverse stand considering its small size, with a variety of oak-hemlock and oak-hardwood groupings, with areas of very mature hemlock, a small pocket of very mature white pine, a red maple riparian wetland, and a number of red pine plantings.

The red pine takes up about 4 acres, mostly in the narrow band between Rocks Road and the reservoir (south of the dike). The remainder is found north of the red maple swamp. The red pine is generally in very poor health. Some, planted north of the red maple swale, is in even worse health, with significant mortality, and many downed trees. Most of the red pines are pulpwood size and quality, though there is some timber. The longer-term survival of the red pine is very questionable, but even if it does "survive", it is very unlikely to ever thrive. Sometimes there is hemlock mixed in with the red pine. The hemlock, too, has very thin crowns. It would be a good idea to begin thinking about using silvicultural techniques to convert the red pine and hemlock to other, native species, perhaps with an enrichment planting of (non-native) Norway spruce to ensure that there is a softwood component in the future forest.

On the east side of Rocks Road, on about 10 acres, the land is very rugged and steep as it rises a short way up the northwest shoulder of Horse Mountain. There are numerous ledge outcrops. Here, the forest varies continuously, with very large red oaks (up to 35") in the southern part. These grew from sprouts, from cutting long ago, and would be considered "overmature" from a timber-quality and timber-value standpoint (i.e. their quality and value is likely to diminish over time). However, these large, large-crowned trees are still vigorous and are well-suited to watershed forest function. Sugar maple forms a scraggly subcanopy in some places, hinting at what, sometimes, seems to be an elevated fertility in the soil. Higher up on the slope, chestnut oak becomes common, with sizes ranging up to 24", which is large for chestnut oak. Throughout this southern section are numerous downed hardwoods that were killed by gypsy moths (presumably)

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in the 1979-1981 outbreak — the last significant gypsy moth outbreak in this area. These red and chestnut oaks may date back to the 1880's.

To the north, a younger area of red oak is mostly 10"-14" and seems to originate after the 1938 hurricane. Many of these trees are well-formed and vigorous and would benefit from thinning.

There is also a grove of very mature ("overmature") tall hemlock, with trees as large as 30". Many, though not all, of these hemlocks appear to have substantial defect. A number of trees have died and sometimes snapped off, leaving tall snags. With the arrival of hemlock pests, the long-term survival of these hemlocks is questionable.

The red maple swale (with poplar) runs alongside a slow-flowing, sedgy stream with marsh marigolds that flows toward the reservoir (but is actually piped underneath the reservoir). The stream and swamp is about one acre.

North of this stream, a gentle knoll takes up the remaining acreage (ca. 10 ac.). Here there are, again, areas of very mature hemlock, some of which is decrepit, with many stems snapped-off due to stem rot. And there are areas of vigorously-growing oaks — red and black, with a tiny amount of white oak — and other hardwoods (sometimes in timber-sized groups, and sometimes as tall poles). The different sizes of these poles reflect cutting that took place at various times. And, in the northwest corner, there are many large old pines (again "overmature"), with impressive sizes ranging up to 45" or more, and with mixed quality. Older trees in the western third of the stand sometimes have a pronounced lean to the east or southeast, hinting at a microburst or some other strong wind from that direction. Trees that have been "tilted" by the wind often have internal timber defects. And there is a small area of red pine with substantial mortality (mentioned above).

Overall this is a diverse stand with many desirable features, though lacking any component of young forest. In dealing with the red pine and hemlock declines, there is an opportunity to create areas of young forest while promoting the continued growth of oaks and white pine.

Understory:

Desirable Tree Regeneration (species and distribution) for future overstory: Essentially lacking. Rarely, in the thick hemlock duff, there are small red oak seedlings, and a small area with hemlock and black birch saplings.

Interfering native vegetation: Only a light amount of witch hazel and mountain laurel but not to a degree to be interfering except, to a limited extent, on the east side of Rocks Road.

Other native understory vegetation (species and distribution): In the areas with dense conifer overstory, the understory layers are very light, with red maple, hemlock and black birch in the midstory, hemlock and laurel common in the shrub layer,

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and the ground layer absent except in a moist gap where cinnamon fern is moderately dense. South of the access road, where there is more deciduous canopy mountain laurel is moderately dense in patches.

Non-native invasive vegetation (species, distribution/severity) (see "Notes applying to all stands" above): Severity level 1. Surprisingly, though it is bisected by Rocks Road, this stand is mostly free of invasives. However, along the berm west of vernal pool 32 is a small but fairly dense patch of glossy buckthorn ranging from seedlings to a medium shrub in size. Along Rocks Road, near the curve by the northern gate, were 3 small shrubs of multiflora rose. Only a single bittersweet plant (1-5 ft long) was observed in this stand, just north of the wetland north of Rocks Road. The lack of invasives may be a result of the shady overstory, but there is likely to be a seed bank that could be activated when gaps are created naturally or through silviculture.

Soils (type, moisture, drainage and productivity): There are three main soil types. The southern part of the stand is listed as "Charlton Rock outcrop Hollis complex, steep" (cf. Ryan & West-Whately Stand 7). The central riparian soil (ca. 1 ac.) is muck. And the northern knoll is shown as "Sudbury fine-sandy loam" as well as the Charlton.

"Charlton Rock outcrop Hollis complex, steep" is a variable glacial till soil including both deeper, well-drained pockets, and shallow, poorly drained pockets, as well as shallow, droughty pockets, with about 10% of the surface in ledge outcrops. As such, tree growth is variable. Moisture-holding capacity is moderate, and trees can be subject to windthrow. Site index for red oak is 65, for white pine also 65, 60 for shagbark hickory, and 55 for red maple. In swales, and sometimes below ledges, there seem to be noticeable increases in moisture and fertility, with more sugar maple and richer-site herbaceous species such as doll's eyes.

For tree growth purposes: With the Charlton, in most places, moisture is adequate, good or excellent for tree growth, but growth and vigor will be reduced on droughtier knobs

For logging purposes: On the Charlton, most areas of the stand can be worked, but sometimes the ledge and slope make this tricky. Logging should only happen when conditions are quite dry or frozen. An old woods trail of some sort provides access off Rocks Road onto Horse Mountain.

The Sudbury is a deep, somewhat excessively drained soil formed in glacial outwash deposits. With few stones, gentle slopes, and good drainage, this soil is well suited to management, though overall fertility can be compromised by limitations on moisture availability. Site indices are listed as 60 for white pine but only 45 for red oak. In actuality, the oaks on this site look better than a "45" would indicate, so there may be some blending of Charlton and Sudbury. Overall, a site index of 60 for red oak will be used.

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Habitat:

General Habitat: This stand, which borders the reservoir, is diverse. It contains a stand of 8-14" diameter red pines with small, weak, crowns, a stand of large white pine and hemlock, and a red and chestnut oak-dominated hardwood component, especially southeast of Rocks Road. The canopy is uniformly closed, so the midstory, shrub, and ground layers are mostly light. The exception is a portion of the area east of Rocks Road, where there is a fairly dense deciduous midstory and laurel shrub layer. Coarse woody debris is generally sparse, except at waypoint 01-01 where there is a 100 x 100 ft area of broken-off red pine snags and the CWD cover is 26-50%. Rocky ledges along the reservoir could serve as basking sites for turtles and water snakes.

Do wetlands occupy more than 10% of this stand?: No

Were vernal pools identified/mapped for this stand? (if "yes", how many): No. A vernal pool identified by Molly Hale in 2001 is on the abutting property to the south

Are NHESP layers indicated for this stand? (if "yes", describe) No.

Other Special Habitat (elements to preserve) (e.g. tall ledge outcrops, etc.): As in Stand 2, the large size of the pines and hemlocks in this stand, combined with its remoteness from human activity make this a potential nesting area for owls, hawks and American crows. The berm west of vernal pool 32 had signs of otter activity and also is a possible turtle nesting site, due to the bare patches of sandy soil. A painted turtle was seen on the berm during nesting season (May, 2011).

Special risks to habitat: There is potential for access by the public via Rocks Road. Minor dumping of beer cans in one area and a bag of sand in another area, indicate the potential for more serious dumping as well as introduction of invasive species.

Desired habitat modifications (options will vary, including "none"): none

Historical/archaeological/contemporary: Rocks Road is a public highway. The stream that drains toward the reservoir is actually piped underneath the reservoir. The remains of an AT&T underground cable line cross the southern part of the stand.

Management history: No evidence of recent cutting. Cutting in patches after the 1938 hurricane, and perhaps about 40 years ago, gave rise to various groupings of pole-sized trees.

Desired future condition: a diverse stand with multiple age-groups of oaks, and without excessive standing or down dead trees.

Recommended Management for the next 10 years: A selection system that will accomplish a number of objectives:

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1. reduce the stocking of mature hemlock in several hemlock groves down to a level that can be tolerated if and when the residual hemlock continue to decline and die. The cut would remove about 2/3 of the hemlock in these areas and would regenerate presumably black birch, creating a 2-age structure.

2. cut all or most of the red pine in one or two stages and allow this to grow into a mix of native hardwoods. If there is a desire by DPW to have conifer cover in the shoreline area, consider planting Norway spruce.

3. In areas of red oak and other hardwoods, thin around well-formed trees to promote their longer-term vigor.

Growth Rate Method and Volume (see "Notes applying to all stands" above):
DCR/Green-cert.

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Stand	Type	Acres	Size (MSD")	Basal Area (ft ² /ac)	Mbf per acre	Cords per acre (wood)	Cords per acre (pulp)	Site Index	Volume growth rate (Mbf/yr)
4	WP	22.9	16.4	133	21.9	0.5	2.7	66 WP	7.4

Stand Name (location): Mountain Street Reservoir Southwest (Corner of Rocks Road & Mountain Street)

Watershed / Sub-watershed: Mountain Street / Mountain Street West

Special water quality concerns (for stands within a reservoir watershed):

Limit any potential sediment inputs (erosion) along the shoreline of the reservoir (currently there is no threat of erosion); prevent vines (native and invasive) from taking over the stand and precluding tall-forest growth.

Silvicultural Status (options are "suitable" or "not suitable"): not currently suitable due to invasives (but otherwise suitable)

Overstory: Forest Type and Condition: A mix of 4 discrete forest types, with minor inclusions of non-forest grass and forbs. This stand is comprised primarily of tall white pine timber occupying a central knoll as well as most of the Rocks Road frontage. Other areas are a small pocket of tall red pine timber (at the foot of the dam), tall oak-poplar pole timber (in an area of stripped soil along Mountain Street), and very small area of mixed northern-hardwood saplings (visible from Mountain Street). The non-forest areas are an area of forbs next to Mountain Street (possibly an old log landing), and a stretch of mowed grass over a water main running from the Water Treatment Plant down toward the foot of the dam.

The white pine undoubtedly forms an impressive stand of timber with, normally, significant economic value.

There is variability within the white pine itself, with the bulk of the area south of the mowed water main being as follows: vigorous white pine (based on healthy crowns) of large diameter (16"-25") and good height (3.5 - 4 16-ft logs), sometimes more, of above-average timber form. It is hard to tell whether this is a plantation or not; however, at least two thinnings over time have helped shape this impressive and valuable stand of timber.

Along, and to the north of, the water main, the pine quality is less impressive (due mainly to larger limbs and a greater tendency for trees to be forked, but also due to past wind storms (at least two) out of the west, which have bent, snapped, or uprooted trees); these diameters are not as large (perhaps due to one cycle of thinning being skipped, but also partly attributable to shallower rooting depths — see soil below), however, this is a good stand of timber in its own right. Most of the softwood pulp is concentrated here. Some of these trees are marked with faded blue paint, indicating

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that they were slated to be logged (i.e. thinned out), but were not (for an unknown reason).

In both areas, north and south, the white pine is vigorous, and, barring destructive storm effects or new pests, could and should continue to grow for many decades.

The red pine — a nearly pure plantation — is south of the dam, at the foot of the white pine knoll. Due to past thinnings (probably two or more), all the red pine is of timber size (typically 14" — 17") with good height (3+ logs) and form, but vigor is very poor (as evidenced by thin crowns and standing-dead trees that were free to grow and thus did not die as a result of competition). Like some of the other areas of red pine on DPW lands, these trees appear to be stuck in a complex downward cycle of decline (see discussion of red pine health in Ryan/West-Whately Stand 15), and are likely to die.

The hardwood poles are tall and well-formed but are already overcrowded and would normally be ideal candidates for thinning. Red oak is a significant but not dominant presence; poplar is more abundant and dominant than red oak. Other hardwoods include black birch and red maple. Because top layers of soil were apparently stripped off in this area (perhaps as part of the dam construction), soil fertility may have been reduced, which may affect oak timber quality.

The hardwood saplings (2"-4") are vigorous, and include a mix of sugar maple, red oak, hickory, red maple, black cherry, pin cherry, striped maple and witch hazel. Grape vines (up to 1" diameter) are already climbing many of these trees (but bittersweet and poison ivy are not).

The forb area (e.g. golden rods) and mowed grass have no forest overstory and are seen as minor components of the stand.

Understory:

Desirable Tree Regeneration (species and distribution) for future overstory: generally lacking altogether or sparse. Occasionally there is sparse sugar maple. Suppressed midstory red maple, black birch (and, in a few cases, sugar maple) would, if flush-cut (i.e. if cut back close to the ground), resprout vigorously.

Interfering native vegetation: Dense ferns in red pine section. Grape vines are present throughout. Thick poison ivy in some areas (vines 3" or greater).

Other native understory vegetation (species and distribution): Poison ivy is dense in the southern part of the stand and moderate everywhere else. Other ground vegetation is wild sarsaparilla, honeysuckle, blackberry and ferns.

Non-native invasive vegetation (species, distribution/severity) (see "Notes applying to all stands" above): Level of severity: 3. The ferny red pine plantation just south of the dike and the narrow north part of this stand are mostly free of invasives. However, in the central and southern section of the stand, where soils are

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moist and dense fern cover is lacking there are some small to large gaps (up to 3000 sf) with relatively dense patches of bittersweet. Scattered throughout this section are bittersweet vines 1-5 ft long with a few longer vines climbing trees along with poison ivy and Virginia creeper. Also in this section is a dispersal of small shrubs of invasive non-native shrub honeysuckle (*Lonicera* sp.) and Japanese barberry. Even if the dense patches of bittersweet are treated, small dispersed vines spread over a large area would have to be removed to prevent a jump to level 4 following creation of gaps. One gap illustrates this — located just east of the hardwood pole section, in a place where several trees were cut in a group, the understory is essentially a thick mat of bittersweet.

Soils (type, moisture, drainage and productivity): There are three similar fine sandy-loam soil types here. The bulk of the soil (the entire northern knoll) is Paxton fine sandy loam. The frontage along Rocks Road is Merrimac fine sandy loam. The stripped area (pole hardwoods) is Sudbury fine sandy loam. The first two soils are well-suited for both tree growth and tree harvesting, whereas the stripped soil is somewhat reduced in suitability in both categories.

The Paxton series consists of deep, well-drained soils on glaciated uplands. The soils formed in glacial till, with a drainage- and root-restricting fragipan typically ranging from 20" to 38" in depth.

The Merrimac series consists of deep, somewhat excessively drained soils formed in glacial outwash deposits. Lacking a fragipan, rooting depth can be as deep as 60". The pines growing on this soil in this stand are especially tall.

The Sudbury series consists of deep, moderately well-drained soils on glacial outwash plains and terraces, and are formed in glacial outwash deposits, with rooting depths of 18"-30".

For tree growth purposes: very good, with site indices of 66, 64 (and 60) for white pine; 65, 51 (and 45) for red oak; and 75, 58 (and none given) for sugar maple. Both pine and hardwoods grow well here.

For logging purposes: good — much of this stand is on sandy, well-drained soil that is sited for logging at most times of year.

Habitat:

General Habitat: The majority of the stand has a closed canopy of timber sized white pine over a dense deciduous midstory, sparse shrub and variable ground layers. One area of white pine near the shore has a lot of blowdown which left broken trunks and abundant CWD (coarse woody debris) on the ground. Just west of the dam is a stand of red pine over an extremely dense fern layer including lady, NY, cinnamon, interrupted and hay-scented ferns. A band of deciduous forest near the south end is dominated by aspen, with black birch but also oak, also present in the canopy. A mowed grassy swath, attractive to flycatchers, goes the length of the stand from the Mountain Street pull-in

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area to the dam. South of the grassy swath, dead trees and live cavity trees are few in number, causing a habitat deficiency. Coarse woody debris on the ground is likewise very sparse, though there are a few blowdowns.

Do wetlands occupy more than 10% of this stand?: No

Were vernal pools identified/mapped for this stand? (if "yes", how many): No.

Are NHESP layers indicated for this stand? (if "yes", describe) No.

Other Special Habitat (elements to preserve) (e.g. tall ledge outcrops, etc.):
none

Special risks to habitat: Mountain St., Rocks Road, and ATV trail (ATV use is prohibited on the snowmobile trail): as with Stand 2, these create the potential for the dumping of trash and spread of invasive species

Desired habitat modifications (options will vary, including "none"): Sever (i.e. cut) tree-climbing vines; control invasives (non-native vegetation can outcompete native vegetation, thereby reducing native biodiversity). Create a few dead snags, especially in tall-canopy pines

Historical/archaeological/contemporary: (1) short length of stone wall, possibly constructed as a by-product of soil-stripping; (2) two course of a snowmobile trail; (3) a significant sand/gravel pit just northwest of the dam (perhaps used to construct the dam) and also a stripped/surface-mined area alongside Mountain Street; (4) underground water main running right through the stand.

Management history: The red pine was planted (probably circa 1920) and perhaps the white pine was planted then as well, though it may be of old-field origin. Both have been thinned (probably two times, if not three), most recently in 1999 (Conkey), allowing large, well-formed trees to develop. The hardwood poles and the hardwood saplings sections were created where patches were cut in the forest (and in one case, when soil was stripped); these areas regenerated naturally to a mix of hardwoods from sprouts and seed.

Desired future condition: Vigorous, multi-aged, mixed-species stand that is free of the unwanted influence of non-native and native interfering vegetation so that timber can be grown and harvested over time, thereby creating a healthy, resilient forest that is able to provide periodic revenue while maintaining water quality. It is within reach to bring this stand back to an invasives ranking of 2 or 1, and it is possible that timber proceeds generated within the stand could pay for this. Apparently, sugar maple wants to grow here as well and could be part of the future forest overstory.

Recommended Management for the next 10 years: Begin a process of bringing this stand back to a more tolerable invasives ranking of 2, or even 1. Techniques would

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include cutting vines from trees, and herbicide-treating bittersweet (both climbing and understory/creeping vines).

This treatment would be followed, after allowing a period of time to elapse in order to reduce seedbanks (of grapes and bittersweet) and to monitor and, where necessary, follow up on invasives control, by flush-cutting existing hardwoods in the understory and midstory to induce re-sprouting. The overall task would be to develop a vigorous understory of mixed hardwoods, including sugar maple, and ideally white pine as well, to take up the growing space and help keep invasives and grapes at bay.

Toward the end of the 10 year period, if the above steps succeed, it may be possible to begin diversifying stand structure using silvicultural harvesting (logging).

Once — if — it is determined that a new understory is well established and the threat of invasives has abated to a tolerable degree, then the next step would be a shelterwood prep harvest (logging) to continue the process of establishing a widespread and vigorous hardwood seedling/sapling layer (presumably co-occurring with continued monitoring and control on grapes and bittersweet). This harvest would look much like a thinning, with the purpose of increasing the amount of light reaching the regeneration.

Beyond that, the next step would be to begin diversifying forest structure by making small openings (up to ½-acre, or possible larger) in which seedlings can be released. Some thinning would occur in adjacent areas as well.

Over time, this process can be continued until the stand reaches a desirable balance of age-classes / range of canopy heights and a more-balanced species mix.

The oak-hardwood area would follow a different path. This area would be thinned (firewood and poplar-pulp would be removed after undergoing invasives and grapes control) to promote the longer-lived hardwoods that are already established, especially the oaks.

The red pine area may need an accelerated program of interfering vegetation treatment since the rate of decline/dieback of the overstory is expected to be faster than the slower restoration process described above, and the shade of the red pine overstory is diminishing. The direct result of this is that invasives, and grapes, in the understory will get more sunlight and thrive. The red pine section might be a good candidate for accelerated invasives/grapes control and flush-cutting of suppressed hardwoods. The red pine area is out of the watershed, and thus concerns about herbicide use affecting drinking water are reduced. This would be followed by a complete removal of the overstory. If hardwood re-growth is not adequate, it might be a good idea to replant this area to dense Norway spruce, which will provide deep shade.

Growth Rate Method and Volume (see "Notes applying to all stands" above):
200% of DCR/Green-cert rate to reflect above-average incremental growth potential of timber volume in well-formed, nearly pure white pine stands.

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Stand	Type	Acres	Size (MSD")	Basal Area (ft ² /ac)	Mbf per acre	Cords per acre (wood)	Cords per acre (pulp)	Site Index	Volume growth rate (Mbf/yr)
5	GR	2.8	N/A	N/A	N/A	N/A	N/A	N/A	0.0

Stand Name: Mountain Street Reservoir Dam

Watershed / Sub-watershed: Mountain Street / Beaver Brook (Out of watershed)

Special water quality concerns (for stands within a reservoir watershed):
N/A

Silvicultural Status (options are "suitable" or "not suitable"): suitable

Overstory: Forest Type and Condition: There is no forest overstory. See below for description of vegetation.

Understory:

Desirable Tree Regeneration (species and distribution) for future overstory:
N/A

Interfering native vegetation: Growing on the guardrail posts west of the road are vines of poison ivy, Virginia creeper, and grapevine, but these are not causing problems, mostly because there is nothing to grow up onto.

Other native understory vegetation (species and distribution): See General Habitat description below.

Non-native invasive vegetation (species, distribution/severity) (see "Notes applying to all stands" above): Severity level 2. No invasive plants were observed on the dam itself, but on the steep slope west of Rocks Road there is a strong presence of garlic mustard. The habitat value of the dam is so minimal that garlic mustard would not cause significant ecological harm there. While garlic mustard thrives less in coniferous forests than in deciduous, it could become established in Stands 3 and 4 and this should be prevented. A bigger threat is the possibility of the garlic mustard spreading downhill to the wetland and lowland areas. These kinds of habitats are ideal for garlic mustard and this species could cause significant displacement of native wetland species.

Soils (type, moisture, drainage and productivity): The dam, roadway, and spillway berm are man-made soils and are not intended for tree growth. Below the roadway, the soil is listed as Scarborough muck. Like other mucks, this soil is saturated throughout much, or all, of the year, and is composed of decomposed organic matter.

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For tree growth purposes: not well suited for most trees, though red maple can tolerate this soil. This soil is well-suited to its current, sedgy-marshy vegetation.

For logging purposes: not suited.

Habitat:

General Habitat: This stand essentially consists of the grassy dam along the south end of the Mountain St. Reservoir. The dam is about 20 ft. high, and 20 ft. deep, with about a 45 degree slope. There is a flat area about 6 ft. wide on top of the dam. A concrete spillway breaches the south end of the dam and is crossed by Rocks Road. Rocks Road runs along the base of the dam and is separated from the dam by an uninterrupted snow fence. The grassy slope and top of the dam is maintained by mowing and consists of grasses, along with forbs including English plantain, sheep sorrel, curly dock, evening primrose, a mustard (not garlic) cinquefoil, yarrow, daisy, and cleavers.

Because the exact property boundary was not delineated on the ground at the time of the field work, it was not possible to say how much, if any, of the adjoining land to the west of Rocks Road is included within the property, and thus within this stand. On the west side there is a steep slope that bottoms out at a wetland fed by the water from the spillway. The upper part of this slope is similar to the grassy dam, but is steeper, with patches of bare dirt and pebbles. The grass here is mixed with garlic mustard and wild strawberries. At the base there is a tangle of blackberry, pokeweed, goldenrod, asters, and milkweed. The wetland itself is a mixture of scattered trees, abundant shrubs, cattails, and other emergent wetland plants.

The top of the dam and the riprap edge toward the water are probably used for basking by turtles and water snakes, even though the lack of cover makes these areas less than optimal.

Do wetlands occupy more than 10% of this stand?: No.

Were vernal pools identified/mapped for this stand? (if "yes", how many): No.

Are NHESP layers indicated for this stand? (if "yes", describe) No..

Other Special Habitat (elements to preserve) (e.g. tall ledge outcrops, etc.):
None.

Special risks to habitat: Possibly the spread of garlic mustard.

Desired habitat modifications (options will vary, including "none"): control invasives.

Historical/archaeological/contemporary: the dam is significant public works infrastructure

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Management history: none apparent.

Desired future condition: maintain this area free of the influence of non-native invasive plants.

Recommended Management for the next 10 years: control garlic mustard

Growth Rate Method and Volume (see "Notes applying to all stands" above):
no appreciable growth assumed.

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Stand	Type	Acres	Size (MSD")	Basal Area (ft ² /ac)	Mbf per acre	Cords per acre (wood)	Cords per acre (pulp)	Site Index	Volume growth rate (Mbf/yr)
6	RP	15.3	12.8	86	10.9	0.5	1.5	65 WP	2.5

Stand Name: Red Pine Plantation

Watershed / Sub-watershed: Mountain Street / Mountain Street West

Special water quality concerns (for stands within a reservoir watershed):

Limit any potential sediment inputs into (minor) tributaries of the reservoir (currently there is no threat of this); prevent vines (native and invasive) from taking over the stand and precluding tall-forest growth; return to conditions that allow for ongoing establishment of regeneration (young, desirable forest growth) before decline of red pine progresses, allowing undesirable vegetation to become further established.

Silvicultural Status (options are "suitable" or "not suitable"): not suitable due to invasives and grapes

Overstory: Forest Type and Condition: This stand has a planted red pine overstory with well-spaced trees that is a remnant of a larger red pine plantation that was thinned or heavily cut at various times and is now plagued by vines (these areas are now lumped in with Stand 8; but also, some of this plantation was cleared for the Water Treatment Plant). The red pine is of small to medium timber size (12"-16") and tall, reflecting good fertility. Co-occurring with the red pine is a small amount of tall, well-formed black cherry and, on the west side of Laurel Mtn Road there are scattered, tall white pines. Mixed in with this overstory is a subcanopy of tall, well-formed hardwoods (mostly black birch, 9"-11" diameter) that became established with thinning long ago and thrived.

This stand provides as good an illustration as any of the risk of pitfalls of cutting the overstory when bittersweet and grapes are present in the understory. At the southern end of the stand, where all the red pine was cut as part of clearing for the treatment plant, the forest consists of a few tall black cherry that were left (probably for seed) and, otherwise, a thick, climbing mat of grapes and bittersweet overtopping every other plant.

Understory: This is a small residual pocket of what was once a larger red pine plantation (now included in Stand 8) which, due in part to the denser shade attributable to lighter cutting that took place here, has not become infested with bittersweet or grapes, though this certainly could happen if light conditions changed (via logging, storm damage, or decline due to pests).

Desirable Tree Regeneration (species and distribution) for future overstory: completely lacking.

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Interfering native vegetation: Grape vine and, presumably, a robust grape vine seedbank throughout. If natural disturbance such as ice storms or microbursts create gaps, grapevines could get established. Striped maple is present typically as small seedlings throughout, and sometimes as stouter saplings, though these are often bent over from ice and/or vines.

Other native understory vegetation (species and distribution): The ground layer is generally thick with evergreen woodfern, NY fern, hayscented fern and blackberry as well as poison ivy.

Non-native invasive vegetation (species, distribution/severity) (see "Notes applying to all stands" above): Severity level 4. East of Laurel Mtn Road, bittersweet is widespread as seedlings, and as small vines climbing understory trees, with a few large vines. But wherever there has been any type of windfall or ice damage, the bittersweet proliferates, along with grapes. In effect, the bittersweet and grapes are the regeneration (see comments above about cutting around the WTP). West of Laurel Mtn Road, there are also pulldowns of bittersweet and grapes, but the bittersweet does not seem as prevalent in the understory. The designation of 4 is used here because, though there is an overstory in place now, if anything happens to the overstory it is highly likely that bittersweet and grapes will proliferate.

Soils (type, moisture, drainage and productivity): Soils are a mixture of Paxton stony or very stony fine sandy loam (on the Williamsburg side) and Shelburne extremely stony sandy loam (on the Whately side).

Paxton is a deep, well-drained soil formed in glacial till, having a drainage- and root-restricting fragipan typically ranging from 20" to 38" in depth, and also occurs in Stands 4, 8 and 10. These are good all-around soils for timber management.

Shelburne is a well-drained, deep loam with partly decomposed limestone in a substratum layer. Soil depth is good – typically 24" or more – before a hard, water-restricting layer is reached.

For tree growth purposes: good. Drainage and depth are good and moisture is adequate for average or better growth. Site indices range from 65 or more for white pine, and 55 or more for red oak.

For logging purposes: normal care must be used to minimize rutting and erosion; frozen or dry conditions must prevail. Slopes are mild and the risk of erosion is minimal, but root and soil can be damaged if the ground is not stable.

Habitat:

General Habitat: Tall red pine with a closed canopy and thin, tall understory of striped maple.

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Do wetlands occupy more than 10% of this stand?: No.

Were vernal pools identified/mapped for this stand? (if "yes", how many): No.

Are NHESP layers indicated for this stand? (if "yes", describe) No.

Other Special Habitat (elements to preserve) (e.g. tall ledge outcrops, etc.):
None.

Other Special Habitat (elements to preserve) (e.g. tall ledge outcrops, etc.):
Large black cherry trees (important soft mast producers).

Special risks to habitat: Complete replacement of tall forest habitat by vine mats.

Desired habitat modifications (options will vary, including "none"): Control
invasives (especially bittersweet) and grape vines.

Historical/archaeological/contemporary: The red pine plantation itself is a cultural
artifact.

Management history: Presumed thinning in the 1950's/early 1960's. One or more
thinnings dating back to the early 1980's.

Desired future condition: a young forest of site-adapted hardwoods free of
interfering vines.

Recommended Management for the next 10 years: Cut large grape vines. control
bittersweet. If at some future point, bittersweet is brought under control, use a
sequence (one or more) of shelterwood cuts to establish regeneration leading up to an
overstory-replacing release cut.

Growth Rate Method and Volume (see "Notes applying to all stands" above):
DCR/Green-Cert.

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Stand	Type	Acres	Size (MSD")	Basal Area (ft ² /ac)	Mbf per acre	Cords per acre (wood)	Cords per acre (pulp)	Site Index	Volume growth rate (Mbf/yr)
7	WH	95.2	15.4	115	7.3	7.0	2.8	65 WP	15.4

Stand Name: Laurel Mountain Road

Watershed / Sub-watershed: Mountain Street / Mountain Street West

Special water quality concerns (for stands within a reservoir watershed):

Limit any potential sediment inputs into (minor) tributaries of the reservoir (currently there is no threat of this); prevent vines (mainly grapes at this time) from taking over the stand and thereby precluding tall-forest growth; return to conditions that allow for ongoing establishment of regeneration (young, desirable forest growth) before any deterioration of old field white pine occurs, allowing undesirable vegetation to become further established.

Silvicultural Status (options are "suitable" or "not suitable"): not suitable

Overstory: Forest Type and Condition: This is a patchwork of old-field areas that were abandoned at various times and have grown mainly into tall, mostly rough-quality, mostly timber-sized white pine, with pines ranging in size from 8" up to 30" diameter or more. On the east side of Laurel Mountain Road, this is a pine-dominated stand, with hardwoods mixed in (mostly black birch, red oak, red maple and sugar maple, but also white ash, yellow birch, black cherry, bigtooth poplar, and a very limited amount of beech and pignut hickory. On the west side, just the opposite is true, with pines being just part of a hardwood-dominated mix, which includes the same hardwoods as the east side, but also includes chestnut oak, and limited amounts of black oak, scarlet oak, white oak, and midstory hemlock, as well as a concentration of paper birch (along the northern property boundary).

The dominance of hardwoods on the west side is attributable to heavier past logging of old-field white pine. On the east side, past logging was generally partial, which tended to preserve a dominant white pine overstory while allowing for the establishment of a hardwood midstory. Some of these hardwoods were classified as growing stock, i.e. desirable trees that could be released. Of the 7 cords of "firewood" in this stand, 3 cords are actually growing stock (which, if management were possible here, would be trees to favor). The growing stock was mostly black birch, but included a range of species, including red oak and sugar maple, and also yellow birch, red maple, white ash, hickory and chestnut oak.

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Most of the sugar maple growing stock occurred to the east and north of the orchard in Stand 8, where the soil appeared to be quite rich and there were several very large old sugar maples (as seed sources). Apparently, there was a small area here used as a sugarbush.

The pines, especially on the east side, are often very tall and large, and very rough, with large branches and lots of crooks (and sometimes multi-stemmed trunks). Sometimes these trees have surprisingly thin crowns (relative to their height and size). Some of the pines are well-formed, however, with tall, straight trunks and small knots.

The oak is often somewhat rough, with past branch scarring, and sometimes very rough bark. A few well-established oaks have died for no obvious reason.

Grapes are abundant, growing in large vines, wherever soil moisture is elevated.

Hemlocks are mostly absent, though there is a pocket of tall, timber-sized hemlock in a small pocket around the bottom of a road that comes out of the old orchard in Stand 8 (see map). The hemlocks are nearly dead, due to hemlock elongate scale (and possibly hemlock woolly adelgid, though this was not detected). The hemlocks occur on a steep face of land that runs in a thin strip along Haydenville Road, with very rich soil, which has few pines but tends, instead, to have a northern hardwood mix of yellow birch, sugar maple, red oak, beech, black birch and black cherry.

Understory:

Desirable Tree Regeneration (species and distribution) for future overstory: often lacking (other than established "growing stock"), though there are areas with somewhat abundant red oak seedlings mixed with red maple, white ash and black cherry, and sometimes with white pines 5'-10' tall. This occurs most notably in the very northern part of this stand, east of Laurel Mountain Road. If bittersweet and grapes were not such a problem, then these would be candidates for encouragement and ultimate release.

Interfering native vegetation: Hay-scented fern is a definite presence in this stand. It is densest, at 50% to over 75%+ density, along the top of the ridge in the west section of the stand. Selective avoidance of this plant by deer is likely a contributing factor to its propagation, because other signs of deer browsing were evident here. Hay-scented fern is present but somewhat less dense in much of the rest of the southern part of the stand. It is mostly absent north of the junction of Laurel Mountain and Grass Hill Roads.

There are numerous treetop grapevines ranging from 1-5" diameter in many parts of the stand. Grapevines are widespread, though not uniformly, in the western part of the stand. There are some huge grapevines along the east-west wall that bisects the stand, and at least one small pulldown in the north part of the stand. The eastern part of the

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stand, where the land comes down to Mountain Street, is seepier and especially prone to grape vines, of which there are many.

Other native understory vegetation (species and distribution): Besides hay-scented fern, ground vegetation is light. It includes Canada mayflower, lowbush blueberry, princess pine, wild sarsaparilla, sassafrass, maple leaf viburnum, Virginia creeper and NY, lady and evergreen wood ferns. Poison ivy is abundant in the eastern part of the stand and wherever moisture is elevated.

Non-native invasive vegetation (species, distribution/severity) (see "Notes applying to all stands" above): Severity is 3. This stand, probably related to its history as an old pasture, has a significant amount of Japanese barberry. It is especially abundant in one section east of Laurel Mountain Road and north of stand 8 where for several acres there is a continuous 26-50% cover of barberry in the medium to large shrub size. From here the barberry gradually becomes less abundant and smaller as you go north to where there is barely any in the northernmost section. Barberry is for the most part absent on the western side of Laurel Mountain Road.

Also, bittersweet is a lurking presence, though mostly absent on most of the acreage, there are scattered seedlings throughout, and small patches ranging from 6-50% density, and an abundant nearby seed source (Stand 8). An exception—where bittersweet was abundant as seedlings on the forest floor-- was just west of Laurel Mountain Road along the north boundary. This spot is a continuous patch of at least ½ acre of about 15-50% cover of bittersweet multiflora rose in the seedling to small shrub size. Along the Laurel Hill Road corridor, multiflora rose, barberry, and bittersweet are common. Bittersweet occurs in a thick growth along the edge of Laurel Mountain Road (along the east side of the road where it is still maintained), and, to the east of this, bittersweet occurs in small disturbance gaps within the forest. Overall, looking at what has become of Stand 8 (i.e. proliferation of undesirable vegetation following harvesting, cf. Stand 8 Description), there is a real concern that the same thing could happen to Stand 7 if disturbances (intentional or nature-driven) occurs before the bittersweet and grapes can be controlled.

Soils (type, moisture, drainage and productivity): Soils are a mixture of Shelburne extremely stony sandy loam (on the east side of Laurel Mountain Road and Westminster extremely rocky loam, on the west side of Laurel Mountain Road.

The Westminster is a "droughty", "shallow" soil formed in layers of glacial material derived from gray-mica schist containing impure limestone, with dark-gray schist bedrock at a depth of about 18"; the steep slope from the top of the land seems to create greater moisture deficiency, as evidenced by the noticeably shorter hardwoods, and as suggested by the presence of chestnut oak. As the slope drops toward Laurel Mountain Road, moisture increases.

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Shelburne is a well-drained, deep loam with partly decomposed limestone in a substratum layer. Soil depth is good – typically 24" or more – before a hard, water-restricting layer is reached.

For tree growth purposes: Productivity varies with soil depth and moisture, with diminished productivity at the western, ridgetop area, and markedly elevated fertility in much of the eastern-most part of the stand. White pine site indices will range, accordingly, from 50 to 70.

For logging purposes: this is a fragile soil; extreme care must be used to minimize rutting and erosion; very frozen or very dry conditions must prevail. Skid roads must be properly drained off (water bars, etc.) and should be closed to unofficial vehicle use.

Habitat:

General Habitat: This stand is an old pasture. Multiple-trunked white pine, mostly over 22" dbh, is the dominant tree in most of the stand. It typically grows accompanied by black birch, red maple and black oak. One area, along the north boundary west of Laurel Mountain Road, probably reverted more recently to forest, with pole-sized aspen, white birch, ash, red maple, black birch and black cherry now the main tree species. Along the top of the ridge on the west side of the stand are some patches of hemlock midstory that are used as deer yards, but at least some of the hemlock foliage is thinning due to either adelgid or scale. The midstory is light and deciduous. The shrub layer is absent or light with striped maple, witch hazel, black birch and red maple. Several seeps are present, including one that is the site of an old well. The number of dead trees ≤ 12 " dbh is abundant but the number of large dead trees and live cavity trees of any size is very low.

Do wetlands occupy more than 10% of this stand?: No. North of the interior stone wall is a ¼ acre wetland opening completely filled with sensitive fern. In the past, some of the natural seeps were dug out a developed as watering holes; these are now small wetlands.

Were vernal pools identified/mapped for this stand? (if "yes", how many): Yes. Two dry basins were found in the fall that are likely vernal pools. They are vernal pools 34 and 35 and are located in the north part of the stand just east of Laurel Mountain Road. Both are small and shallow and should be re-checked in the spring to assess their biology.

Are NHESP layers indicated for this stand? (if "yes", describe) No.

Other Special Habitat (elements to preserve) (e.g. tall ledge outcrops, etc.):
There is a large seep at point 08-01. It has some bittersweet seedlings in it that should be removed.

Special risks to habitat: Potential for extensive grape pulldowns and further spread of bittersweet and barberry.

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Desired habitat modifications (options will vary, including "none"): After action is taken to control invasives, it would be desirable to encourage more oaks for mast production. This could be done by cutting or girdling pines near healthy oaks or by doing patch clearcuts after a good acorn year. Fencing around oak regeneration areas may be necessary to exclude deer.

Historical/archaeological/contemporary: (1) The old road is a discontinued, two-rod-wide county highway whose history was studied and documented in conjunction with the construction of the treatment plant; (2) there is an old road cut connecting the northeast corner of the apple orchard in Stand 8 with Haydenville Road; this road is built up in one place and a culvert was installed to let seasonal flows pass under; (3) various seepy "holes" were apparently dug out and used as watering holes for cattle; (4) various sections of stone wall, including what appear to be both sidelines of the discontinued road along parts of its course, and wire fence; (5) next to Haydenville Road there is a gurgling outflow pipe, the outflow of which is water from the West Whately Reservoir. This water flows next to Haydenville Road for a short stretch before passing under the road and becoming "Borowski Brook".

Management history: Small patches of old-field pine were cut 40 years ago or more; no recent cutting.

Desired future condition: mixed -age pine & hardwood forest free of interfering vines.

Recommended Management for the next 10 years: Begin control of grapes; control bittersweet. If at some future point, these are brought under control, a combination of a small-group selection system and a shelterwood system could be used to begin to establish a new age class.

Growth Rate Method and Volume (see "Notes applying to all stands" above):
DCR/Green-Cert.

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Stand	Type	Acres	Size (MSD")	Basal Area (ft ² /ac)	Mbf per acre	Cords per acre (wood)	Cords per acre (pulp)	Site Index	Volume growth rate (Mbf/yr)
8	AO	33.7	N/A	N/A	N/A	N/A	N/A	70 WP	0.0

Stand Name: Old Orchard & Red Pine

Watershed / Sub-watershed: Mountain Street / Mountain Street West

Special water quality concerns (for stands within a reservoir watershed):
Bringing land back to forested condition.

Silvicultural Status (options are "suitable" or "not suitable"): not suitable

Overstory: Forest Type and Condition: This stand is comprised of two distinct areas which have in common an excessive growth of oriental bittersweet and native grapes. The first area is an abandoned orchard along the discontinued part of Laurel Mountain Road. This area has few tall trees and is almost entirely overgrown with vines. The overgrown vines project northward into the old-field pines of Stand 7 (see map). The second area is a residual red pine plantation that has been largely cut off in some places, and thinned in others. Throughout this area, bittersweet and grapes are overtopping all other vegetation, or, where tall red pines remain, threaten to quickly do this if the pines decline, die, blow over or are cut. In the southern part of the stand there is a small, shrubby wetland.

Understory:

Desirable Tree Regeneration (species and distribution) for future overstory: completely lacking.

Interfering native vegetation: grapevine is present in this entire stand. Between Mountain Street and Laurel Mountain Road, grapevines have created 2 huge gaps (2 acres and 5 acres) where there are virtually no standing trees, and those that remain are covered with grape and bittersweet. The forest between these gaps also has many grapevines climbing into the canopy and grapevines up to 20 ft long growing at ground level.

Other native understory vegetation (species and distribution): in the areas with standing trees, the typical ground vegetation is sparse or patchy and includes evergreen woodfern, bittersweet, raspberry, and Christmas fern. Poison ivy is present throughout the stand, with an especially dense carpet (50-75% cover) in a ½ acre area just north of the old orchard area.

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Non-native invasive vegetation (species, distribution/severity) (see "Notes applying to all stands" above): Severity level 5.

Between Mountain Street and Laurel Mountain Road, bittersweet and multiflora rose are a constant presence. Bittersweet is consistently present on the ground at a 1-5% cover and forms a dense canopy in the treetops in some areas. Where gaps have been created, bittersweet forms dense patches, mostly growing horizontally rather than vertically. Small shrubs of multiflora rose range from 1-5% cover in some areas to 6-25% cover in others. A small number of scattered small shrubs of barberry and honeysuckle are also present.

Once you move 50 feet west of Laurel Mountain Road, this corner of the stand is refreshingly free of invasives. Even a gap with 2 upturned blowdowns had no invasives. This could be due to less disturbance here or to drier soils, or a combination of the two factors.

In the southern part of the stand, where past cutting was not as heavy as along, the severity is level 4 (but the overall stand ranking is 5). Throughout this area there is a 1-5% cover of bittersweet on the ground, in addition to scattered patches of perhaps 500 sq ft each of very dense bittersweet. The bittersweet vines in the shaded areas are mostly less than 5 ft long, but in the sunny gaps they range from 5 to over 25 feet long. The large number of small dispersed plants will make them a challenge to control, and is what caused this stand to be rated 4 rather than 3. A few large shrubs of multiflora rose occupy the north end of the sphagnum wetland, and along the western access road there is a 6-25% cover of small multiflora rose bushes. A few small barberry bushes are in some of the low moist areas along Potash Brook. One small shrub of glossy buckthorn was seen along the access road, but surprisingly this plant was not observed in the forested wetland area. The extensive amount of bittersweet east of this stand provides an abundant seed source.

Soils (type, moisture, drainage and productivity): Soils are a mixture of Paxton stony or very stony fine sandy loam (in most of the areas planted to red pine) and Shelburne loam (the old orchard) or Shelburne extremely stony sandy loam (around the orchard). The wetter areas in the southern part of the stand are classified as Ridgebury (a poorly-drained glacial till) and Walpole (a poorly-drained glacial outwash).

Paxton is a deep, well-drained soil formed in glacial till, having a drainage- and root-restricting fragipan typically ranging from 20" to 38" in depth, and also occurs in Stands 4, 6 and 10.

Shelburne is a well-drained, deep loam with partly decomposed limestone in a substratum layer. Soil depth is good - typically 24" or more - before a hard, water-restricting layer is reached. The depth, relative lack of stones, and flat topography were what made the orchard site suitable for that purpose.

For tree growth purposes: soil depth and moisture are generally good or excellent, with good fertility. The exception is the flat area next to the reservoir, which seems

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deeper and perhaps excessively-drained, so that moisture may be somewhat limited. With the exception of the Walpole, which is too wet for productive tree growth, site indices range from 55-69 or more for white pine, and 55 or more for red oak.

For logging purposes: the old orchard is more stable than much of the remaining red pine plantation, especially along Haydenville Road, where extreme care must be used to minimize rutting and erosion, and very frozen or very dry conditions must prevail. The shoreline area of the reservoir has both flatter ground with less fragile soil, where erosion risk is minimal, and normal precautions (dry or frozen ground) should be followed. However, heading north the land becomes steeper and extreme care must be used to prevent surface run off right into the reservoir.

Habitat:

General Habitat: This stand is characterized by large gaps completely covered by dense grape, bittersweet, and other vegetation and containing few standing trees. While the grapes certainly provide fruit for wildlife, this benefit is far outweighed by the apparent lack of forest regeneration due to overtopping by these vines. The areas between the gaps are still forested but have abundant grapevines up to 20 ft, multiflora rose and bittersweet seedlings waiting to take off if/whenever the canopy is opened.

An old apple orchard is one of the areas now covered with vines. Not many apples are being produced, maybe because of the age and lack of pruning and partly because of being overtopped by vines.

Hummingbirds, red-eyed vireos, American redstarts and catbirds were observed during this survey, and, according to the Massachusetts Breeding Bird Atlas II in 2010, a pair of ravens was nesting in the pines between Mountain Street and the reservoir, about 200 yards north of the treatment plant entrance.

Birds such as the catbird, brown thrasher and common yellowthroat are known to prefer dense thickets, but whether they would use such a dense vine covered area would have to be determined in nesting season.

This stand has 30-70% canopy closure of red pine in the south and east sections and white pine in the northwest section. A moderate to heavy deciduous midstory consists of red maple, black birch, with minor elements of sugar maple, yellow birch, and black oak. Coarse woody debris is scant, at less than 1% cover except at one point where several red pines had blown down to create a dense bittersweet gap.

Do wetlands occupy more than 10% of this stand?: No. However, it is worth mentioning the shrubby, sphagnum wetland that divides the southern part of the stand and extends off the property much farther south. North of the sphagnum the wetland is continuous wet forest up to the access road. Much of the forest east of this main wetland is seepy. The sphagnum wetland could be suitable habitat for the 4-toed salamander due to the tall fluffy sphagnum hummocks above open water. This wetland

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could also meet the needs of the southern bog lemming, masked shrew, smoky shrew, and star-nosed mole in addition to forest generalists. Other plants observed in the sphagnum area were horsetail, winterberry, alder, poison sumac, highbush blueberry, sensitive fern, jewelweed and turtlehead.

Were vernal pools identified/mapped for this stand? (if "yes", how many): No.

Are NHESP layers indicated for this stand? (if "yes", describe) No.

Other Special Habitat (elements to preserve) (e.g. tall ledge outcrops, etc.): The sphagnum wetland is important (because it provides habitat for wildlife mentioned above).

Special risks to habitat: Grape and bittersweet stand poised to overtop and take down even more forest than has already been toppled. The density of the thickets prevents regeneration of new trees, so unless significant action is taken, much of this stand could become blanketed with these species. Although only a little glossy buckthorn was seen in this stand, the wetlands are the kind of habitat where glossy buckthorn could easily become established. Glossy buckthorn is difficult to control once it becomes widespread.

Desired habitat modifications (options will vary, including "none"): Control invasives so tree regeneration and native understory vegetation do not become impeded.

Desired habitat modifications (options will vary, including "none"): Restore a balanced vegetation mix to the stand.

Historical/archaeological/contemporary: (1) the old orchard and the red pine plantation are cultural artifacts reflecting what was, at the time of their creation, viewed as a beneficial use of the land; (2) furthermore, the non-native invasive plants are also the result of human activity (which never intended this outcome). In many respects, this area is completely artificial.

Management history: the red pine was cut at various times, with heavier cutting to remove or partially remove the overstory beginning in the 1980's.

Desired future condition: Any type of native forest that is free of the influence of bittersweet vines (and any other non-native invasive plants) and grapes will be acceptable.

Recommended Management for the next 10 years: A substantial effort to control bittersweet vines (and other non-native invasive) and grapes so that normal forest processes can resume.

Growth Rate Method and Volume (see "Notes applying to all stands" above): DCR/Green-Cert.

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Stand	Type	Acres	Size (MSD")	Basal Area (ft ² /ac)	Mbf per acre	Cords per acre (wood)	Cords per acre (pulp)	Site Index	Volume growth rate (Mbf/yr)
9	WH	47.7	12.3	127	6.3	7.8	3.6	60 WP	7.7

Stand Name: Laurel Mountain West

Watershed / Sub-watershed: Mountain Street / Potash Brook & Grass Hill Brook (Out of watershed)

Special water quality concerns (for stands within a reservoir watershed):
N/A

Silvicultural Status (options are "suitable" or "not suitable"): not suitable (due to access)

Overstory: Forest Type and Condition: There are two main forest types. The first occupies the west-facing, sometimes steep and ledgy, slope down toward Potash Brook, and the second occupies a relatively flat terrace that abuts Potash Brook; this band is quite narrow at the northern end, but widens at the southern end.

The sloped portion is a variable mix of oaks — red oak and, notably, chestnut oak, which is not common across the watersheds (there is some in Mountain Street Stand 3) — with a minor amount of white oak. There is also pignut hickory (generally slender, though as large as 22"), which was not noted in any other stands across the watershed except in abutting Stand 7. Black birch is more abundant lower down on the slope (sometimes with yellow birch, paper birch, red maple, and minor amounts of sugar maple, white ash and bigtooth poplar. Mixed with the oaks there are white pine, which occur sometimes as scattered trees, and sometimes are in denser arrangements. Hemlock, as either a bushy midstory tree or as a slender overstory tree, occurs on a scattered basis. In general, the timber quality appears poorer on the upper half of the slope (presumably attributable to droughtier, less fertile conditions); there was more evidence of past gypsy moth mortality on the upper half of the slope. Timber quality improved notably on the lower slope, with red oak, back birch, and white pines showing good timber form. Many of the hardwoods, especially the oaks, are growing as multiple trees from stumps that were cut a long time ago.

Conditions on the terrace are quite different, with rolling micro-topography, and with moisture abundant, and with the water table sometimes right at the surface forming mini-wetlands in the low swales of the micro-topography. Hemlock, yellow birch and sugar maple, with red oak, and, in the southern half, large white pine, were the dominant species. The hemlock and hardwood timber trees tended to be in the 12"-18" range, of average quality, whereas the well-formed white pine ranged from 16"-24", and the rough

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white pines were as large as 32". One beech tree (on the western boundary) was 31" in diameter, well-formed, and apparently free of beech-bark disease.

Understory:

Desirable Tree Regeneration (species and distribution) for future overstory: altogether lacking, with the exception small groupings of white pine seedlings, 3'-6' tall, in the southern half.

Interfering native vegetation: Mountain laurel occurs in dense patchworks of thickets on steeper parts of the stand, and hay-scented fern sometimes occurs in thickets along the eastern boundary of the stand. Witch hazel is sometimes thick on the lower slope.

Other native understory vegetation (species and distribution): Often, the understory is bare oak leaves and evergreen needles. Maple-leaved viburnum is abundant along Potash Brook, in the northern half of the stand. Huckleberries and lowbush blueberries occur in thick patches near the top of the slope. Ironwood occurs in a thin distribution on the slope.

Non-native invasive vegetation (species, distribution/severity) (see "Notes applying to all stands" above): Severity level 1. No invasives were noted (despite abundant nearby seed sources).

Soils (type, moisture, drainage and productivity): Primarily Westminster extremely rocky loam, except on the flatter land in the southwest corner, which is Buckland extremely stony fine sandy loam. The Westminster is a "droughty", "shallow" soil formed in layers of glacial material derived from gray-mica schist containing impure limestone, with dark-gray schist bedrock at a depth of about 18"; the steep slope from the top of the land seems to create greater moisture deficiency, as evidenced by the noticeably shorter hardwoods, and as suggested by the presence of chestnut oak. Lower down on the slope, however, moisture availability appears to be more typical. Overall, trees in this soil cannot develop deep root systems (due to high water tables and shallow depths to bedrock) and are often not windfirm. These soils are considered to produce "poor yields" of timber.

The Buckland soil is formed from the same parent material as the Westminster, but is slightly deeper, with a hard layer typically at around 20" depth. Fertility in this moderately well-drained soil is better than in the adjacent Westminster (as seems to be evidenced by the tall pines).

For tree growth purposes: Productivity is below average on the dry, shallow face of the long slope (however, this condition favors the growth of Chestnut Oak, which is not common across the watersheds). On the flatter riparian area, moisture, and fertility are good or above average. Overall site index for upland oaks: 50-55, site index for white pine: 55-69.

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For logging purposes: normal care must be used to minimize rutting and erosion; frozen or dry conditions should prevail. The steep slope poses a considerable erosion risk (though this will not effect the reservoir because this area is not within the watershed). Skid roads must be properly drained off (by water bars, etc.).

Habitat:

General Habitat: Mast-producing oaks (red, black, white and chestnut) along with hickory (apparently bitternut and also pignut) are mixed with tall pines across the broad, steep slope and interspersed with occasional ledge outcrops and sometimes thick mountain laurel or huckleberry.

The lower section, where the ground has hummocky soil that is mostly upland but is interspersed with tiny wetlands in low spots, sometimes with a thick overstory of hemlock.

Around Potash Brook there are small inclusions of wetlands with yellow birch.

Do wetlands occupy more than 10% of this stand?: No but Potash Brook has moist soils.

Were vernal pools identified/mapped for this stand? (if "yes", how many): No.

Are NHESP layers indicated for this stand? (if "yes", describe) No.

Other Special Habitat (elements to preserve) (e.g. tall ledge outcrops, etc.): Maintain chestnut oak and other oaks.

Special risks to habitat: The spread of invasive species from surrounding stands.

Desired habitat modifications (options will vary, including "none"): None.

Historical/archaeological/contemporary: (1) various stretches of stone wall and wire fence; (2) old woods roads, some of which are part of an overlapping snowmobile trail

Management history: as evidenced by stumps, there was some logging of old-field white pine a long time ago (40+ years) and apparently some firewood cutting of gypsy-moth killed trees around 1980.

Desired future condition: A multi-aged, mixed-species forest continuing to be free of the influence of non-native invasive plants and other interfering factors.

Recommended Management for the next 10 years: Because this stand cannot be accessed without crossing (and disturbing) other stands, and because the potential productivity of much of the acreage is low (on the long, dry slope), and because there is

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no water-quality benefit to managing this stand (it is outside the watershed), no management is recommended.

Growth Rate Method and Volume (see "Notes applying to all stands" above):
DCR/Green-Cert.

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Stand	Type	Acres	Size (MSD")	Basal Area (ft ² /ac)	Mbf per acre	Cords per acre (wood)	Cords per acre (pulp)	Site Index	Volume growth rate (Mbf/yr)
10	WH	134.0	12.9	84	10.4	3.3	0.3	70 WP	21.7

Stand Name: Potash Brook

Watershed / Sub-watershed: Mountain Street / Potash Brook & Grass Hill Brook (Out of watershed)

Special water quality concerns (for stands within a reservoir watershed):
N/A

Silvicultural Status (options are "suitable" or "not suitable"): not suitable

Overstory: Forest Type and Condition: Much of this stand has an overstory of tall, large, well-formed, mature white pine timber, with good crowns and overall good vigor. This is one of the nicest timber stands across both watersheds. Mixed in with the pine are northern hardwoods — primarily black birch, sugar maple, white ash and red oak, with less black cherry. The hardwoods are both timber-size and smaller, with sugar maple occurring as viable, well-established midstory trees in sizes as small as 6". There is almost no hemlock.

Inclusions are a small plantation of well-formed red pine timber (in the southeastern section, on the east side of Potash Brook) (this abuts red pine in Stand 8; the red pine in Stand 10 is intended to include only the area where bittersweet is not already prevalent and taking control of the stand). To the north of the treatment plant, in a small area bounded to the north and east by a stone wall, there is a mixture of red pine and white pine timber.

West of Potash Brook, in a large, wet, central area, tall northern hardwoods, especially white ash, dominate in an open overstory with thick shrubs and ferns. The ash appears vigorous. This is probably the best white ash anywhere across both watersheds.

On the flat ridgetop, mostly in the northern half, overstory red pine and white pine was cut heavily enough to secure good mixed-hardwood regeneration which had grown to stout sapling size but became overrun with grapes. These areas did not hold up well in recent ice storms (presumably the storm of 12/2008) and are mostly bent over with no hope of recovery. Bittersweet is present in these areas as well, and now the bent-over saplings are merely serving as trellises for vines, with little expectation that trees can grow out of this mix.

At the western edge of the stand the land drops down steeply to Grass Hill Brook. This is a hemlock hardwood mix, with small hemlock, red oak and black birch timber and large

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poles of these species. In patches where cutting took place, there are sometimes well-established black birch seedlings, and otherwise witch hazel and mountain laurel thickets.

Understory:

Desirable Tree Regeneration (species and distribution) for future overstory: scattered throughout, in an uneven distribution, are large hardwood seedlings — especially sugar maple and black birch — sometimes occurring in sizes up to 3-6" as stout midstory trees. At the top of the slope, what would have been large areas of viable hardwood saplings have mostly been bent over by ice in conjunction with being pulled over by, and overgrown by, grapes and bittersweet.

Interfering native vegetation: Grapevines and bittersweet along the top of the ridge have caused extensive pulldowns, which in turn have led to dense bittersweet growth. However grapevines are not rampant throughout the stand. Parts of the west-facing slope east of Potash Brook have a dense cover of mountain laurel. Hay-scented fern was present in a healthy balance with many other native species. Witch hazel is a common component of the midstory in the southern half of the stand, but is not dominant.

Other native understory vegetation (species and distribution): Ground vegetation ranged from dense to sparse. Ferns were especially dense in moist, more open areas and included cinnamon, NY, lady, hay-scented, sensitive, Christmas and silvery glade fern. Other plants, all typical of an acidic mixed forest included wild sarsaparilla, partridgeberry, starflower, Canada mayflower, poison ivy, raspberry, brambles, maple-leaf viburnum, awned woodgrass and various sedges. Clubmosses were noticeably absent except for one area near the property boundary along Potash Brook where 3 species were present. There were cattered sassafrass seedlings.

Non-native invasive vegetation (species, distribution/severity) (see "Notes applying to all stands" above): Severity level 3 overall. The distribution of invasive plants within this stand is quite variable. The invasive distribution can be broken down into 4 zones. The worst infestation is along the top of the north-south ridge between Potash and Grass Hill brooks. On top of the ridge over 50% of the area is grapevine pulldowns that have bittersweet cover ranging from 6% to over 50% in density. These pulldowns occur where there are many saplings bent over, perhaps by an ice storm that opened the canopy and allowed the grapevine and bittersweet to take over.

Along the west slope of the ridge is another zone, where small plants of bittersweet, multiflora rose and barberry are sprinkled lightly throughout, and one area about 1 acre in size along the boundary where there is a 1-5% cover of bittersweet and multiflora rose. There are also a small number of gaps, generally smaller than 600 square feet, with somewhat denser growth of these 3 species.

The 3rd zone is east of the ridge and west of Potash Brook. Here the number of invasives in shaded areas is minimal (between 0-15 small individual plants counted per 500 ft transect), but there are numerous openings between 400 and 6000 square feet in area that have a density of invasives ranging from 1-75% cover. Bittersweet is the most common invasive, with multiflora rose and barberry also present. These openings

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tend to occur in seepy areas. Barberry is generally restricted to the moist areas along drainages.

The 4th zone is the section east of Potash Brook. This area occupies the west slope of a hill. Invasives were nearly absent in this zone. Here only a 400 square foot patch of bittersweet and a 200 sf patch of multiflora rose were encountered. However, the southern section of this stand (east of Potash Brook) is bounded by a severe infestation of bittersweet, and it is fair to assume that there is a heavy seedbank of bittersweet in this area (which would be triggered by any cutting or blowdown or dieback of the red pine).

Soils (type, moisture, drainage and productivity): Primarily Paxton fine sandy loam (cf. Stand 4). Paxton is a deep, well-drained soil formed in glacial till, having a drainage- and root-restricting fragipan typically ranging from 20" to 38" in depth.

For tree growth purposes: Productivity is generally good or excellent, with elevated fertility along Potash Brook. On the wetter soils there is a somewhat increased risk of windthrow. Overall site index is 66 or more for white pine, 65 for red oak, and 75 for sugar maple.

For logging purposes: on upper and top-slope positions, Paxton is suited for logging at most times of year, but on mid- and lower slopes, logging should be seasonally restricted. West of Potash Brook, on a long, gradual slope, large areas have wet, fragile soil, and extreme care must be used to minimize rutting and erosion; very frozen or very dry conditions must prevail. Skid roads must be properly drained off (water bars, etc.). Both approaches to the Potash Brook crossing are seepy and unstable, and it would be wise to either build these up with stone or choose an alternate crossing (if one can be found) with more stable ground. On the east side of Potash Brook, the soil is generally more well-drained and stable, with the exception being the area directly west of the treatment plant.

Habitat:

General Habitat: The forest type is variable in zones running north-south. The western zone, along Grass Hill Brook and also the area in the north half of the stand east of Potash Brook is a mix of hemlock, white pine (including some >36" dbh) and hardwoods. Along the top of the ridge and along the lower areas west of Potash Brook white pines >22" dbh are predominant, with hardwoods interspersed in some sections. The remains of a red pine plantation are at the north end of the ridgetop. Several of the red pines have blown over. Along the seepy east-facing slope of the ridge is a deciduous band containing mostly ash, yellow birch, sugar maple, red oak and red maple.

The midstory in the south half of the stand is generally dense and either deciduous or mixed, containing black birch, red maple, beech, sugar maple, hemlock and witch hazel. In the north half of the stand the midstory ranges from dense to sparse and is mostly hemlock with some black birch and beech in some parts. The shrub layer, deciduous with laurel in some places, was generally too light to provide significant habitat value.

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Potash Brook is a permanent stream about 8 ft across bank to bank. Its maximum depth in spring is 1 ft, but runs less than 3" deep and 1-2 ft wide in dry seasons. It has flat rocks, sandy areas, and low undercut banks. It provides habitat for 2-lined and dusky salamanders, but is probably too small to support wood turtles.

Do wetlands occupy more than 10% of this stand?: No but Potash Brook and a parallel drainage to the west have moist soils and there are several seeps on the east side of the ridge.

Were vernal pools identified/mapped for this stand? (if "yes", how many): No.

Are NHESP layers indicated for this stand? (if "yes", describe) No.

Other Special Habitat (elements to preserve) (e.g. tall ledge outcrops, etc.): A few ledgy areas are contained in the stand, but do not provide significant wildlife value.

Special risks to habitat: The spread of invasive species from the gaps they now occupy is a threat to forest regeneration.

Desired habitat modifications (options will vary, including "none"): Control invasives, increase coarse woody debris, and leave defective live trees to create future live cavity trees.

Historical/archaeological/contemporary: (1) various stretches of stone wall and wire fence; (2) snowmobile trail

Management history: various Silvicultural cuttings dating to the early 1980's.

Desired future condition: A multi-aged, mixed-species forest free of the influence of non-native invasive plants and other interfering factors, in which normal silvicultural techniques can be used to continue to grow high-value timber (pine and hardwood).

Recommended Management for the next 10 years: In view of the serious bittersweet and grape infestation in hotspots and scattered throughout most of the western part of the stand (west of Potash Brook) and bordering the stand to the southeast, and the likelihood of this spreading vegetatively and by seed (with other non-native invasive plants), a key goal should be to eradicate bittersweet and grapes from the western part of the stand, as well as from any scattered locations in the eastern third. If successful, then ideas about Silvicultural activity can be revisited after 10 years.

Growth Rate Method and Volume (see "Notes applying to all stands" above): DCR/Green-cert.

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Stand	Type	Acres	Size (MSD")	Basal Area (ft ² /ac)	Mbf per acre	Cords per acre (wood)	Cords per acre (pulp)	Site Index	Volume growth rate (Mbf/yr)
11	RP	12.7	12.4	134	10.4	0.0	6.5	60 WP	2.1

Stand Name: Mountain Street West Shore

Watershed / Sub-watershed: Mountain Street / Mountain Street West

Special water quality concerns (for stands within a reservoir watershed):
Bringing land back to forested condition.

Silvicultural Status (options are "suitable" or "not suitable"): not suitable
(due to invasives)

Overstory: Forest Type and Condition: This stand is characterized by a well-spaced red pine overstory, with a dense, herbaceous understory, in the southern end, and a dense white pine and mixed softwood hardwood canopy in the north, with a sparse understory. The red pine is of small-timber size (typically 12"-15"), typically with 2 log heights. Like the red pine in general across both watersheds, the red pine does not appear to be of good vigor. Though green (at this writing: 5/29/2012), the tops (but not the needles) have a stunted or compressed look. Past thinnings have created good spacing between most of the trees (except along the shoreline, which has been maintained at greater density). All things being equal, trees with this spacing should be growing well.

The northern part of the stand is a thin strip between the Mountain Street & Haydenville Road guardrail and the reservoir (or, in the northern part, Borowski Brook). This overstory is closed (and was apparently not thinned in the past — presumably due to nearly impossible access) and is dominated by large, rough-grown white pine mixed with a smattering of planted red pine and a thin mixture of native hardwoods (e.g. red maple, black cherry).

Understory:

Desirable Tree Regeneration (species and distribution) for future overstory: scattered red oak, red maple, black cherry, white ash in the brush-mowed understory. These bear signs of deer browse. Over time, continued brush mowing should serve to strengthen the red oak seedlings.

Interfering native vegetation: Grapevine is present in this entire stand. Many of the red pines are festooned with grapevine, together with poison ivy, Virginia creeper, and bittersweet, reaching the canopy. In this section these plants, together with, multiflora rose, sumac, goldenrod, blackberry, jewelweed, raspberry and cinnamon fern, form a practically 100% cover carpet at knee to chest level. Here there is some regeneration

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of black cherry and ash, but it is doomed to be overtaken by bittersweet and grape. In the northern (white pine) part of the area east of Mountain Street the overtopping vines of bittersweet and grape are at a higher height and not as dense, allowing patchy regeneration of sugar maple, red maple, red oak, elm and basswood. But the future for these saplings is not good, as they will very likely be topped by bittersweet and grape.

Other native understory vegetation (species and distribution): See above.

Non-native invasive vegetation (species, distribution/severity) (see "Notes applying to all stands" above): Severity level 4. Between Mountain Street and the reservoir, well established bittersweet vines are rampant, with a cover of 6-25%. They are mostly growing horizontally on top of shrubs and other vegetation 3-10 feet or so from the ground, rather than up the trees, which are already covered with native vines. The bittersweet was able to get established because of the gaps created by tree loss from wind, past cutting and grapevine pull-down. Multiflora rose of medium size is also abundant, but not dense, in the stand. In addition there are at least two dense patches of Japanese knotweed, each about 2000 sf. The designation of 4 is used here because, though there is an overstory in place now, if anything happens to the overstory it is most likely that bittersweet and grapes will proliferate, especially in the southern (red pine) part..

Soils (type, moisture, drainage and productivity): Paxton stony or very stony fine sandy loam.

Paxton is a deep, well-drained soil formed in glacial till, having a drainage- and root-restricting fragipan typically ranging from 20" to 38" in depth, and also occurs in Stands 4, 6 and 10.

For tree growth purposes: this soil is deep but perhaps excessively-drained, so that moisture is limited. The red pines reflect this with their somewhat stunted, flat tops.

For logging purposes: The shoreline area of the reservoir has both flatter ground with less fragile soil, where erosion risk is minimal, in the southern, red-pine-dominated area, and much steeper, and therefore more erosion-prone soil in the northern end. Normal precautions (dry or frozen ground) should be followed in the red pine area. However, heading north the land becomes steeper and extreme care must be used to prevent surface run off right into the reservoir.

Habitat:

General Habitat: This stand is characterized by a widely-spaced red pine overstory, with a dense, herbaceous understory, in the southern end, and a dense white pine and mixed softwood hardwood canopy in the north, with a sparse understory.

Do wetlands occupy more than 10% of this stand?: No.

Stand Descriptions Page 50

Reservoir Mountain Street Town(s) Whately, Williamsburg & Hatfield

Owner(s) City of Northampton DPW

STAND DESCRIPTIONS

Were vernal pools identified/mapped for this stand? (if "yes", how many): No.

Are NHESP layers indicated for this stand? (if "yes", describe) No.

Other Special Habitat (elements to preserve) (e.g. tall ledge outcrops, etc.): No. Normally, tree-fall into a water-body would be a welcome addition to habitat (e.g. for basking), however, for purposes of reservoir management, such trees falls are not welcomed and are often cleaned up.

Special risks to habitat: Grape and bittersweet stand poised to overtop any regeneration if and when the red pine overstory is cut, taken down by storms, or succumbs to pests.

Desired habitat modifications (options will vary, including "none"): Control invasives so tree regeneration and native understory vegetation do not become impeded.

Historical/archaeological/contemporary: a bark-mulch-covered pipeline down to the reservoir is referred to as "the boat ramp".

Management history: the red pine was thinned at various times; the festooning vines have been cut back at least once (as evidenced by axe marks in the red pine bark).

Desired future condition: Any type of native vegetation that is free of the influence of bittersweet vines (and any other non-native invasive) and grapes will be acceptable.

Recommended Management for the next 10 years: Control tree-climbing vines (and other non-native invasive) and brush-mow the red pine understory to keep bittersweet and grape from going to seed.

Growth Rate Method and Volume (see "Notes applying to all stands" above): DCR/Green-Cert.

MANAGEMENT PRACTICES
to be done within next 10 years

Explanation of Silvicultural Methods

“Silviculture” is the body of ideas and practices used by foresters to shape the forest. Ideally, the forester will mark the silviculture (by painting trees to be cut). A crucial aspect of success is to find a logger who is willing and able to carry out the marked cutting as the forester intends.

To the landowner: recommended silvicultural methods for your particular forest stands are referred to in Stand-level management practices on subsequent pages and are drawn from the following list, which is based on (proposed) Chapter 132 (Forest Cutting Practices Act) regulations. Silvicultural methods are broadly divided into two groups, **intermediate cuts** and **regeneration cuts**. Intermediate cuts focus on improving growth existing overstory trees. Regeneration cuts focus on establishing and promoting new stands of trees. Please note that in considering or implementing any of the methods described below there are numerous factors that must be contemplated and addressed, such as competing vegetation, browse, optimal logging systems, woodlot access (roads, landings, etc.), time of year and ground conditions, and measures to protect state-listed species, watercourses and wetlands, etc.

Intermediate Cuts

Thinnings & Improvement Cuts: these reduce the density of trees to enhance the vigor of residual trees. An improvement cut is usually an initial treatment that removes trees of low quality or undesirable species. Thinnings are subsequent adjustments to continue focusing growth on selected trees. Intermediate cuts that are overly “heavy” (i.e. cuts that let in a lot of light) are classified as regeneration cuts: *proposed* (pending as of this writing) basal area thresholds are as follows: BA = 100 for conifer stands, BA = 60 for hardwood stands, BA = 80 for conifer-hardwood stands.

Regeneration Cuts

Regeneration cuts use existing stands of trees to create future stands of trees. The future stands of trees can be of a single age (known as “even-aged”), two ages (two-aged) or of three or more ages (uneven-aged). In regeneration cuts, particular attention is paid to seed sources and/or existing seedlings/saplings for the future stand, light conditions in the understory, and interfering factors (e.g. native or non-native competitor plants in the understory, browsing by deer or moose, etc.). A regeneration cut can be sudden and decisive (clearcutting, seed-tree, coppice, single-cut shelterwood), or a regeneration cut can be staggered (multiple cut shelterwood), or ongoing (uneven-aged, i.e. “selection system” or “irregular shelterwood”).

MANAGEMENT PRACTICES
to be done within next 10 years

Even-aged Regeneration Methods

Clearcut: All established trees are removed to allow new trees to grow from seed in full sun. Clearcutting is especially appropriate for early-successional species (e.g. paper birch, poplar and black cherry plus gray birch and pin cherry) and may grow with mixes of hemlock, red maple and other birches. Seeding is assumed to occur from edge trees or from seed stored in the soil (cherry). Clearcuts may be up to 5 acres, or, if artificial seeding or planting is used, up to 10 acres. Larger clearcuts require special permission. Clearcuts separated by more than 100 feet are considered separate. Clearcutting is sometimes confused with the final cut ("overstory removal cut") in a shelterwood system (see below), but the difference is that clearcutting is done to grow new trees from seed, whereas the overstory removal cut in a shelterwood system is done to release existing seedlings or saplings. Clearcutting is also sometimes confused with patch selection (see below); in fact, the distinction between two practices falls into a gray area.

Seed-Tree Cut: Similar to a clearcut except that seed trees are retained to provide seed (and either cut later or leave) and except that any species may be grown. There is no acreage limitation. At least 4 seed trees (20-inch diameter or greater (BA = 10)) or 12 seed trees (14-20 inches diameter) (BA 20) must be retained per acre.

Shelterwood/ Shelterwood System: usually a multi-step approach to establish desirable trees in the understory in medium-light conditions before the overstory is eventually removed to release the seedlings. The final step in the shelterwood system is the overstory removal, which is done to release the established young trees. Used especially for oak, sugar maple (giving these species years to establish well-developed root systems) white pine and hemlock (giving these species years to establish competitive height). Black birch typically becomes abundant as well. Regeneration that is adequate for release must typically be 2 feet tall, well-distributed and abundant. Interfering vegetation must be identified and (ideally) controlled.

Coppice: a complete "cutting off" of small or medium-sized hardwoods, especially oaks, hickory, red maple) to cause these to re-sprout and form a new stand from the same root systems. This is an old system that sometimes occurs inadvertently, and is useful for reliably producing firewood or whips.

Two-aged Regeneration Methods

Clearcut, Seed-tree, Shelterwood with "reserves": Same as methods described above but with retention of trees (12 inches diameter or larger) (possibly for timber, seed source, habitat or aesthetic reasons, but not for the purpose of managing understory light conditions).

MANAGEMENT PRACTICES
to be done within next 10 years

Uneven-aged Regeneration Methods (Selection/Irregular Shelterwood)

In an uneven-aged stand there will always be trees in a range of size and age classes that are *free to grow*. Often current conditions will be an approximation of this, but over time a true multi-aged stand can be created and maintained. A selection cut is a mix of thinning and creating or enlarging openings. Openings are defined either as groups or patches; new openings generally do not cover more than 50% of the stand area.

Group Selection: openings may range from single-tree-size up to 1/4 acre (e.g. equivalent to a circle about 120 feet in diameter in size, which is about 1.5 times the mature height of many trees (80'-100')). No special provisions are needed to prepare the understory for this more conservative opening size, though, to achieve the ideal outcome, it may be necessary to control competing vegetation (native vegetation such as beech or striped maple, or non-native invasive vegetation such as bittersweet, buckthorn, etc.).

Patch Selection: openings may range up to 2 acres (e.g. equivalent to a circle about 333 feet in diameter). Interfering vegetation (if present) should be identified and ideally controlled so that seedlings can be established/released. Please note: in Massachusetts, patch cuts will appear identical (to the public) as clearcutting.

Continuous-Cover Irregular Shelterwood: (see "The Irregular Shelterwood System", Journal of Forestry, December, 2009) is used to "create and maintain an unbalanced, multi-aged stand for a long and indefinite period of time by successive regeneration fellings." This system is perhaps the most complex, but is the most versatile or creating or maintaining complex forests. In this system, elements of thinning, shelterwood, and group selection are combined and applied in ways that reflect the current conditions and ultimate potential of specific woodlot areas, and strongly reflect the judgement and vision of the forester. A forest managed in this way will not have an "industrial" feel and should be rewarding for people with a wide range of interests ranging from on-going timber production to contemplative enjoyment of nature. This system is not used when the landowner wants to maximize short-term income or dramatically alter the landscape (for this see "Even-Age Regeneration Methods" above).

MANAGEMENT PRACTICES
to be done within next 10 years

Overview of harvesting

Stand	Forest Type	Silviculture (harvesting)	Acres to Cut	BA to Cut	Mbf to Cut	Cords Wood to Cut	Cords Pulp to Cut	Year
1	WH	None	0	0	0	0	0	N/A
2	WH	None	0	0	0	0	0	N/A
3	OH	selection	20	35	46	30	139	2012
4	WP	None	0	0	0	0	0	N/A
5	GR	None	0	0	0	0	0	N/A
6	RP	None	0	0	0	0	0	N/A
7	WH	None	0	0	0	0	0	N/A
8	AO	None	0	0	0	0	0	N/A
9	WH	None	0	0	0	0	0	N/A
10	WH	None	0	0	0	0	0	N/A
11	RP	None	0	0	0	0	0	N/A
12	Non	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	WA	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	0		20		46	30	139	

MANAGEMENT PRACTICES
to be done within next 10 years

Stand	Forest Type	Silviculture (harvesting)	Acres to Cut	BA to Cut	Mbf to Cut	Cords Wood to Cut	Cords Pulp to Cut	Year
1	WH	None*	0	0	0	0	0	N/A

Stand Name (location): Stand Name: Chestnut Mountain

Watershed / Sub-watershed: Mountain Street / Mountain Street West

Note: Due to the invasives ranking, this stand is not currently suitable for silviculture. However, if the invasives ranking is, through treatment, lowered to 2 or 1, then this stand would become suitable.

***Practice purpose (how it helps create desired future condition)**

No silviculture is recommended at this time. However, control of invasive plants (esp. oriental bittersweet) as well as native grapes is recommended. The purpose is to adequately reduce the impact of this interfering vegetation (native and non-native) so that normal Silvicultural processes may resume, to continue the management of this multi-aged, mixed-species forest so that it can provide watershed protection as well as a range of other benefits including periodic timber income.

Control efforts would be concentrated around two major hotspots off Chestnut Mountain Road, both of which are primarily infested with oriental bittersweet and secondarily as well as with a number of other non-native invasives and with wild grapes. The infestation weakens markedly as you move away from these hotspots, though there are scattered, smaller hotspots here and there. A specific prescription would be prepared for this treatment, which normally would involve herbicide use. The treatment period might last three growing seasons, with ongoing monitoring and spot treatment of recurring problem plants. At some point, the stand could be re-evaluated to determine whether a designation of "2" or, less likely "1", was warranted. If the new designation is either 2 or 1, then the stand could be re-evaluated and a Silvicultural prescription developed.

Trees to be removed & retained (types, conditions, sizes): None. Harvesting would not occur until after successful completion of efforts to control interfering vegetation. At such a time, a harvesting plan can be created to reflect prevailing conditions. See Stand Descriptions for a description of techniques to be used at such a time.

Special regeneration considerations (seed source, seed bed preparation, interfering vegetation, browse, etc.): N/A.

Special invasive species considerations: Please re-confirm severity ranking for this stand (cf. Stand Descriptions section). Stand must be ranked 1 or 2. If ranked 1, no treatment required. If ranked 2, treatment must fall

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Mountain Street Reservoir Town(s) Whately, Williamsburg & Hatfield

Owner(s) City of Northampton DPW

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MANAGEMENT PRACTICES
to be done within next 10 years

within the same 12-month period as any harvesting. Stands ranked 3 or 4 are not eligible for harvesting.

Current level = 3.

Special soil considerations (erosion, seasonal timing, cultural, etc.): Ground must be adequately dry or frozen so that rutting/compaction are avoided. These conditions will be met at most times of year on this soil.

Special access considerations (erosion, access, timing, cultural, etc.): Access is straightforward, with two or three landings off Chestnut Mountain Road. Chestnut Mountain Road is unmaintained, though an abutter has recently installed waterbars with a back hoe. The road would probably need some upgrading to make it useable to log trucks again, especially in one perpetual muck hole on the Hatfield — Whately town line.

Special equipment/logging-system considerations: Any system that can adequately protect the ground/soil and residual stand is acceptable.

Special boundary considerations: Boundaries should be blazed/re-blazed and painted.

Special invasive species considerations: Follow standard procedure for inspections of stands ranked 3. Particular attention should be paid to the ravine/quarry area to protect the unique plants there, and to areas of elevated fertility along drainages.

Special habitat improvements (anything particular to accomplish Treatment, possibly over successive years, of invasive plants, especially the dense thickets in eastern half of stand

Special habitat protection considerations (anything particular to protect): Protection of the habitat of marbled salamanders should be the highest priority for this stand. According to the *Massachusetts Forestry Conservation Management Plan for MESA-listed Mole Salamanders*, if there is to be any cutting, the following forest management would probably be required: a 50 ft. no-cut zone around each vernal pool; retention of a 75% canopy cover within the 50 to 450 ft. zone; within the 450 ft. zone any areas that are cut should not be concentrated disproportionately close to the pool; new landings and skid roads must be located at least 100 ft. from any vernal pool; use of machinery in the protected zones should be limited to the period starting March 1 and ending May 14.

The average migration distance for marbled salamanders ranges from 100 to 900 feet depending on the study, with the maximum known distance 4,024 ft. Clearly the 450 ft. requirement above only covers a small portion of the potential upland habitat for this species. According to the NHESP fact sheet for marbled salamanders the minimum recommended distance to protect is 500-1,000 meters (1,640-3,280 ft.). All of the north half of the stand is within 1,640 ft and half of the south part of the stand is within 3,280 ft.

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Mountain Street Reservoir Town(s) Whately, Williamsburg & Hatfield

Owner(s) City of Northampton DPW

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MANAGEMENT PRACTICES
to be done within next 10 years

The actual area used by a population of marbled salamanders (which is as yet not confirmed here) is often concentrated in a specific area within the radial distances above, but until this population's movements have been documented, the assumption must be used that they are equally distributed over the entire radial area east of Mountain Street. Mountain Street and the stream that parallels it are likely to be migration barriers.

Similar considerations apply to Jefferson salamanders.

The following guidelines are also recommended (in case of any logging); coarse woody debris should be left in place and at least 2 snags or dying or old trees per acre should be left to provide future woody debris; harvesting should only occur when the ground is frozen in order to reduce soil compaction and prevent rut formation.

Special trail/recreational considerations (anything particular to accomplish or avoid/protect): None.

Special cultural resource considerations: None.

MANAGEMENT PRACTICES
to be done within next 10 years

Stand	Forest Type	Silviculture (harvesting)	Acres to Cut	BA to Cut	Mbf to Cut	Cords Wood to Cut	Cords Pulp to Cut	Year
2	CC	None	0	0	0	0	0	N/A

Stand Name: Mountain Street Reservoir Central Shore (East)

Watershed / Sub-watershed: Mountain Street / Mountain Street East

Stand Name (location): Stand Name: Chestnut Mountain

Watershed / Sub-watershed: Mountain Street / Mountain Street West

Practice purpose (how it helps create desired future condition)
No silviculture is recommended for this stand.

Trees to be removed & retained (types, conditions, sizes): None.

Special regeneration considerations (seed source, seed bed preparation, interfering vegetation, browse, etc.): N/A.

Special invasive species considerations: Please re-confirm severity ranking for this stand (cf. Stand Descriptions section). Stand must be ranked 1 or 2. If ranked 1, no treatment required. If ranked 2, treatment must fall within the same 12-month period as any harvesting. Stands ranked 3 or 4 are not eligible for harvesting.

Current level = 3.

Special soil considerations (erosion, seasonal timing, cultural, etc.): N/A.

Special access considerations (erosion, access, timing, cultural, etc.): N/A.

Special equipment/logging-system considerations: N/A.

Special boundary considerations: Boundaries should be blazed/re-bazed and painted.

Special invasive species considerations: Follow the Standard procedure for invasive inspections for stands ranked 3.

Special habitat improvements (anything particular to accomplish): None.

MANAGEMENT PRACTICES
to be done within next 10 years

Special habitat protection considerations (anything particular to protect):

Follow BMPs for vernal pools 32 and 40 and their surrounding uplands. VP 30 in stand 1 is within 1600 ft of the north part of stand 2. Since this vernal pool contains a MESA listed species the BMPs described under stand 1 should be followed in the north portion of this stand too. Shady overstory should be maintained throughout this stand to maintain moist ground area for amphibians.

Special trail/recreational considerations (anything particular to accomplish or avoid/protect): None.

Special cultural resource considerations: None.

MANAGEMENT PRACTICES
to be done within next 10 years

Stand	Forest Type	Silviculture (harvesting)	Acres to Cut	BA to Cut	Mbf to Cut	Cords Wood to Cut	Cords Pulp to Cut	Year
3	OH	selection	20	35	46	30	139	2012

Stand Name: Rocks Road East

Watershed / Sub-watershed: Mountain Street / Mountain Street East

Practice purpose (how it helps create desired future condition)

The purpose is to replace declining softwoods (hemlock and red pine) with vigorously-growing native hardwoods while also preserving the white pine component and promoting the growth of well-established oaks and other hardwoods.

Trees to be removed & retained (types, conditions, sizes):

1. reduce the stocking of mature hemlock in several hemlock groves down to a level that can be tolerated if and when the residual hemlock continue to decline and die. The cut would remove about 2/3 of the hemlock in these areas and would regenerate presumably black birch, creating a 2-age structure. Most white pine and hardwood would be retained, except for firewood-quality hardwood.
2. cut all or most of the red pine in one or two stages and allow this to grow into a mix of native hardwoods. Also cut hemlock within these red pine areas. If there is a desire by DPW to have conifer cover in the shoreline area, consider planting Norway spruce. Ideally, the understory hardwoods and witch hazel will be flush cut prior to or during the cut so that these can grow vigorously from sprouts.
3. In areas of red oak and other hardwoods, thin around well-formed trees to promote their longer-term vigor. Most trees removed will be hardwood firewood.

Because Rocks Road is a town road, DPW should check with the Town of Hatfield to see whether any public shade tree rules apply. Typically, an initial site visit with the town Road Boss and Tree Warden is a good way to begin identifying how to proceed.

Special regeneration considerations (seed source, seed bed preparation, interfering vegetation, browse, etc.): In red pine areas, the understory hardwoods and witch hazel should be flush cut prior to or during the cut so that these can grow vigorously from sprouts.

Special invasive species considerations: Please re-confirm severity ranking for this stand (cf. Stand Descriptions section). Stand must be ranked 1 or 2. If ranked 1, no treatment required. If ranked 2, treatment must fall

MANAGEMENT PRACTICES
to be done within next 10 years

within the same 12-month period as any harvesting. Stands ranked 3 or 4 are not eligible for harvesting.

Current level = 1.

Special soil considerations (erosion, seasonal timing, cultural, etc.): Ground must be adequately dry or frozen so that rutting/compaction are avoided.

Special access considerations (erosion, access, timing, cultural, etc.): Access is off Rocks Road. Because Rocks Road is a town road, we'll want to confer with the Hatfield road boss about locating log landings, etc. There are a number of existing woods roadways off of Rocks Road that will be helpful in keeping log landings off the town road, but some of the red pine may need to be accessed right off of Rocks Road.

Special equipment/logging-system considerations: Any system that can adequately protect the ground/soil and residual stand is acceptable, but a cut-to-length system with a high degree of pulpwood utilization would be best suited. The operator should be able to ensure that tops will be kept a set distance away from Rocks Road (to be determined). Some chipping of tops may be helpful.

Special boundary considerations: Locate and mark the southeastern boundary area (this is partially done).

Special invasive species considerations: Follow the Standard procedure for invasive inspections for stands ranked 1 or 2.

Special habitat improvements (anything particular to accomplish None.

Special habitat protection considerations (anything particular to protect): Any trees with large nests which could be used by hawks or owls should be flagged and not cut if any logging takes place in this stand.

Special trail/recreational considerations (anything particular to accomplish or avoid/protect): Keep roadside area looking neat.

Special cultural resource considerations: None.

MANAGEMENT PRACTICES
to be done within next 10 years

Stand	Forest Type	Silviculture (harvesting)	Acres to Cut	BA to Cut	Mbf to Cut	Cords Wood to Cut	Cords Pulp to Cut	Year
4	WP	None	0	0	0	0	0	N/A

Stand Name (location): Mountain Street Reservoir Southwest (Corner of Rocks Road & Mountain Street)

Watershed / Sub-watershed: Mountain Street / Mountain Street West

Note: Due to the invasives ranking, this stand is not currently suitable for silviculture. However, if the invasives ranking is lowered to 2 or 1, then this stand would become suitable. The potential harvesting described is a guide to what could be prescribed following successful control of invasive and interfering vegetation.

Practice purpose (how it helps create desired future condition)

The purpose is to adequately reduce the impact of interfering vegetation (native and non-native) so that normal silvicultural processes may resume, to effect a successful transition to a multi-aged, mixed-species forest that can provide watershed protection as well as a range of other benefits including periodic timber income.

Trees to be removed & retained (types, conditions, sizes): No trees to be harvested. Harvesting would not occur until after completion of initial control of interfering vegetation. At such a time, a harvesting plan can be created to reflect prevailing conditions. See Stand Descriptions for a description of techniques to be used at such a time.

Special regeneration considerations (seed source, seed bed preparation, interfering vegetation, browse, etc.): N/A.

Special invasive species considerations: Please re-confirm severity ranking for this stand (cf. Stand Descriptions section). Stand must be ranked 1 or 2. If ranked 1, no treatment required. If ranked 2, treatment must fall within the same 12-month period as any harvesting. Stands ranked 3 or 4 are not eligible for harvesting.

Current level = 3.

Special soil considerations (erosion, seasonal timing, cultural, etc.): Ground must be adequately dry or frozen so that rutting/compaction are avoided. These conditions will be met at most times of year on this soil.

Special access considerations (erosion, access, timing, cultural, etc.): Access is straightforward, with options from Mountain Street or Rocks Road.

MANAGEMENT PRACTICES
to be done within next 10 years

Special equipment/logging-system considerations: Any system that can adequately protect the ground/soil and residual stand is acceptable.

Special boundary considerations: None.

Special invasive species considerations: After treatment, follow Standard procedure for invasive inspections for stands ranked 3.

Special habitat improvements (anything particular to accomplish): Cut tree-climbing vines, treat invasives.

Special habitat protection considerations (anything particular to protect):
none

Special trail/recreational considerations (anything particular to accomplish or avoid/protect): Keep established snowmobile trails free of logging debris.

Special cultural resource considerations: None. This is a prominent stand along a well-traveled road, and the public will respond to what does or does not happen here. A successful course of management, ultimately with silvicultural harvesting (logging) would be an opportunity to help instill public confidence in the forest management activities on DPW lands.

MANAGEMENT PRACTICES
to be done within next 10 years

Stand	Forest Type	Silviculture (harvesting)	Acres to Cut	BA to Cut	Mbf to Cut	Cords Wood to Cut	Cords Pulp to Cut	Year
5	GR	None	0	0	0	0	0	N/A

Stand Name: Mountain Street Reservoir Dam

Watershed / Sub-watershed: Mountain Street / Beaver Brook (Out of watershed)

See Stand Descriptions for discussion of possible control of garlic mustard.

Special invasive species considerations: This stand is ranked 2 because the garlic mustard west of Rocks Road is a seed source that could spread this plant into nearby forested stands, where it can prevent native ground plants from growing.

Special habitat improvements (anything particular to accomplish) Hand-pull the garlic mustard or flame it with a torch. This should be fairly easy since the area is small and easily accessible. Seed can remain viable in the soil for 5 years, so follow-up inspections and removal should occur each year for this time period.

The snow fence cuts off potential access for turtles leaving the reservoir to seek nesting sites each year. Painted and snapping turtles are sure to inhabit the reservoir, and each June females seek sites where they can dig the ground to lay eggs. Typical sites are grassy lawns or fields, or along roadsides. Because the field to the west of Rocks Road could be a nesting area, it would be beneficial and easy to improve access to potential nesting areas by creating gaps in the snow fencing. To accommodate large snappers, 4 adjacent wood slats should be cut off just below the 2nd strand of wire. Two or three of these gaps should be created along the length of the fence. One already exists, probably created by accident.

Special habitat protection considerations (anything particular to protect):
None.

MANAGEMENT PRACTICES
to be done within next 10 years

Stand	Forest Type	Silviculture (harvesting)	Acres to Cut	BA to Cut	Mbf to Cut	Cords Wood to Cut	Cords Pulp to Cut	Year
6	RP	None	0	0	0	0	0	N/A

Stand Name (location): Red Pine Plantation

Watershed / Sub-watershed: Mountain Street / Mountain Street West

Note: Due to the invasives ranking, this stand is not currently suitable for silviculture. However, if the invasives ranking is lowered to 2 or 1, then this stand would become suitable.

Practice purpose (how it helps create desired future condition)

The purpose is to adequately reduce the impact of interfering vegetation (native and non-native) so that normal Silvicultural processes may resume, to effect a successful transition to a multi-aged, mixed-species forest that can provide watershed protection as well as a range of other benefits including periodic timber income. The recommended practice is: cutting mature grape vines. Cutting mature grapes reduce the likelihood of grapes damaging existing trees and of creating still more pull-downs, which tend to create gaps that fill with bittersweet and more grapes.

Trees to be removed & retained (types, conditions, sizes): None. Cut any grapevines that are climbing trees, including along the edge of existing pull-downs. In small pull-down gaps, try to sever all vines, but in larger pull-downs (pull-downs that are not partially shaded by surrounding forest) do not bother to cut vines.

Special regeneration considerations (seed source, seed bed preparation, interfering vegetation, browse, etc.): N/A.

Special invasive species considerations: Please re-confirm severity ranking for this stand (cf. Stand Descriptions section). Stand must be ranked 1 or 2. If ranked 1, no treatment required. If ranked 2, treatment must fall within the same 12-month period as any harvesting. Stands ranked 3 or 4 are not eligible for harvesting.

Current level = 4.

Special soil considerations (erosion, seasonal timing, cultural, etc.): Ground must be adequately dry or frozen so that rutting/compaction are avoided.

Special access considerations (erosion, access, timing, cultural, etc.): Access from Laurel Mountain Road is straightforward.

MANAGEMENT PRACTICES
to be done within next 10 years

Special equipment/logging-system considerations: Any system that can adequately protect the ground/soil and residual stand is acceptable.

Special boundary considerations: None.

Special invasive species considerations: See standard treatment for stands ranked 4.

Special habitat improvements (anything particular to accomplish): None.

Special habitat protection considerations (anything particular to protect): None.

Special trail/recreational considerations (anything particular to accomplish or avoid/protect): None.

Special cultural resource considerations: None.

MANAGEMENT PRACTICES
to be done within next 10 years

Stand	Forest Type	Silviculture (harvesting)	Acres to Cut	BA to Cut	Mbf to Cut	Cords Wood to Cut	Cords Pulp to Cut	Year
7	WH	None	0	0	0	0	0	N/A

Stand Name (location): Laurel Mountain Road

Watershed / Sub-watershed: Mountain Street / Mountain Street West

Note: Due to the invasives ranking, and the risk of grapes, this stand is not currently suitable for silviculture. However, if the invasives ranking is lowered to 2 or 1, and the grapes are controlled, then this stand would become suitable.

Practice purpose (how it helps create desired future condition)

The purpose is to adequately reduce the impact of interfering vegetation (native and non-native) so that normal Silvicultural processes may resume, to effect a successful transition to a multi-aged, mixed-species forest that can provide watershed protection as well as a range of other benefits including periodic timber income. The recommended practice is: cutting mature grape vines. Cutting mature grapes will reduce the likelihood of grapes damaging existing trees and of creating still more pull-downs, which tend to create gaps that fill with bittersweet and more grapes.

Trees to be removed & retained (types, conditions, sizes): None. Cut any grapevines that are climbing trees, including along the edge of existing pulldowns. In small pulldown gaps, try to sever all vines, but in larger pulldowns (pulldowns that are not partially shaded by surrounding forest) do not bother to cut vines.

Special regeneration considerations (seed source, seed bed preparation, interfering vegetation, browse, etc.): N/A.

Special invasive species considerations: Please re-confirm severity ranking for this stand (cf. Stand Descriptions section). Stand must be ranked 1 or 2. If ranked 1, no treatment required. If ranked 2, treatment must fall within the same 12-month period as any harvesting. Stands ranked 3 or 4 are not eligible for harvesting.

Current level = 3.

Special soil considerations (erosion, seasonal timing, cultural, etc.): Ground must be adequately dry or frozen so that rutting/compaction are avoided.

Special access considerations (erosion, access, timing, cultural, etc.): Access from Laurel Mountain Road is straightforward.

MANAGEMENT PRACTICES
to be done within next 10 years

Special equipment/logging-system considerations: Any system that can adequately protect the ground/soil and residual stand is acceptable.

Special boundary considerations: Blaze and paint northern boundaries.

Special invasive species considerations: See standard treatment for stands ranked 3. Search for and hand pull or otherwise control bittersweet seedlings and barberry seedlings in the northern part of the stand. Remove bigger barberry plants to the south by either using a weed wrench or applying herbicide.

Special habitat improvements (anything particular to accomplish Control invasive or interfering species. Some suggestions as to approaches to take follow:

It would be highly beneficial to control the grapevines in this stand now before they create more pulldowns, as occurred in stand 8 to the south. Simply going through and cutting the vines should suffice, as there is adequate shade to prevent re-sprouting. Even though grapes are an important wildlife food, there is more than enough grapevine in the pulldowns in stand 8 to provide this function.

To re-establish tree regeneration the dense patches of hay-scented fern should be reduced (by chemical control and/or by repeated mowing), and reduction of the deer population should be attempted, perhaps by allowing hunting on the property.

After initial efforts to control invasives have happened, future harvests should call for some of the large multi-trunked pines to be felled and left on the ground to create coarse woody debris. Many of these trees have little or no economical value anyway.

Special habitat protection considerations (anything particular to protect): Protect vernal pools (limit cutting within 500 ft and protect basin from disturbance). Maintain closed canopy to provide shade for amphibians.

Special trail/recreational considerations (anything particular to accomplish or avoid/protect): None.

Special cultural resource considerations: None.

MANAGEMENT PRACTICES
to be done within next 10 years

Stand	Forest Type	Silviculture (harvesting)	Acres to Cut	BA to Cut	Mbf to Cut	Cords Wood to Cut	Cords Pulp to Cut	Year
8	AO	None	0	0	0	0	0	N/A

Stand Name (location): Old orchard and red pine

Watershed / Sub-watershed: Mountain Street / Mountain Street West

Note: Due to the invasives ranking, and the risk of grapes, this stand is not currently suitable for silviculture. However, if, following substantial effort, the invasives ranking is lowered to 2 or 1, and the grapes are controlled, then this stand would become suitable.

Practice purpose (how it helps create desired future condition)

The purpose is to restore forested conditions to this stand.

Trees to be removed & retained (types, conditions, sizes): None. This stand needs a full restoration. This would be an intensive, expensive, multi-year process that would eliminate invasive species and grapes and allow native forest vegetation, or planted vegetation (e.g. Norway spruce), to occupy this site.

Special regeneration considerations (seed source, seed bed preparation, interfering vegetation, browse, etc.): N/A.

Special invasive species considerations: Please re-confirm severity ranking for this stand (cf. Stand Descriptions section). Stand must be ranked 1 or 2. If ranked 1, no treatment required. If ranked 2, treatment must fall within the same 12-month period as any harvesting. Stands ranked 3 or 4 are not eligible for harvesting.

Current level = 5.

Special soil considerations (erosion, seasonal timing, cultural, etc.): Ground must be adequately dry or frozen so that rutting/compaction are avoided.

Special access considerations (erosion, access, timing, cultural, etc.): Access from Laurel Mountain Road and from the southern road to the back of the treatment plant is straightforward.

Special equipment/logging-system considerations: Any system that can adequately protect the ground/soil and residual stand is acceptable.

Special boundary considerations: Blaze and paint southern property boundary.

MANAGEMENT PRACTICES
to be done within next 10 years

Special invasive species considerations: The exceptionally high density and extent of invasives here, combined with the grapevines, is a foreshadowing of what could occur in other stands ranked 3 or 4 as gaps are created. This stand should serve as a warning of what to avoid but may have also provide an opportunity to determine how successful restoration measures can be.

To begin bringing this stand into a condition where silviculture can occur, the top priority is controlling bittersweet and grapes. It is doubtful that hand pulling, even of the widely dispersed bittersweet seedlings, could have much overall effect. Chemical control of bittersweet and grapes will probably be necessary. In order to gain access to do the treatment, pathways will need to be forged through the overtopping thickets with some sort of heavy equipment. At the same time, shrubs of barberry, multiflora rose, and any buckthorn, if found, should be treated as well. At least 5 years of follow-up to monitor and remove seedlings of all of these species will be necessary. It is unknown how long it will take to deplete the seedbank, but (for grapes at least) this could take up to 15 years.

Special habitat improvements (anything particular to accomplish): None.

Special habitat protection considerations (anything particular to protect): Do not allow equipment to move from Laurel Mountain Road into the "clean" area to the west. To prevent its spreading remove bittersweet, multiflora rose, and barberry by hand-pulling or selective herbiciding on the west side of Laurel Mountain Road. In the southern section, standard BMPs should protect the sphagnum and other wetlands from runoff and pollution. In addition, monitoring and removal of any invasives in these areas is of special importance to protect the unique habitat qualities of the wetland.

Special trail/recreational considerations (anything particular to accomplish or avoid/protect): None.

Special cultural resource considerations: None.

MANAGEMENT PRACTICES
to be done within next 10 years

Stand	Forest Type	Silviculture (harvesting)	Acres to Cut	BA to Cut	Mbf to Cut	Cords Wood to Cut	Cords Pulp to Cut	Year
9	WH	None	0	0	0	0	0	N/A

Stand Name (location): Laurel Mountain West

Watershed / Sub-watershed: Mountain Street / Potash Brook & Grass Hill Brook (Out of watershed)

Note: Although the invasives ranking for this stand is low enough for Silvicultural purposes, there is little incentive to pursue management here at this time (management will not serve the landowner's primary goal of protecting water quality, and will do little to serve the secondary goals of timber revenue and habitat improvement). Furthermore, the access is somewhat difficult (on the steep slope and wet flat) and there is a risk that the disturbance created by logging will introduce non-native invasives to the more fertile parts of the stand (i.e. the wetter flat) and, furthermore, that crossing other stands to get to this stand will inflame infestations of invasives there.

Practice purpose (how it helps create desired future condition)

The purpose is to maintain forested conditions to this stand, which will limit the spread of interfering vegetation.

Trees to be removed & retained (types, conditions, sizes): None.

Special regeneration considerations (seed source, seed bed preparation, interfering vegetation, browse, etc.): N/A.

Special invasive species considerations: Please re-confirm severity ranking for this stand (cf. Stand Descriptions section). Stand must be ranked 1 or 2. If ranked 1, no treatment required. If ranked 2, treatment must fall within the same 12-month period as any harvesting. Stands ranked 3 or 4 are not eligible for harvesting.

Current level = 1.

Special soil considerations (erosion, seasonal timing, cultural, etc.): Ground must be adequately dry or frozen so that rutting/compaction are avoided.

Special access considerations (erosion, access, timing, cultural, etc.): Access from Laurel Mountain Road and from the southern road to the back of the treatment plant is straightforward.

MANAGEMENT PRACTICES
to be done within next 10 years

Special equipment/logging-system considerations: Any system that can adequately protect the ground/soil and residual stand is acceptable.

Special boundary considerations: Blaze and paint northern and western property boundary.

Special invasive species considerations: Avoid introduction of invasives by avoiding logging disturbance at this time.

Special habitat improvements (anything particular to accomplish): None.

Special habitat protection considerations (anything particular to protect): maintain large-crowned oaks (including chestnut oaks).

Special trail/recreational considerations (anything particular to accomplish or avoid/protect): None.

Special cultural resource considerations: None.

MANAGEMENT PRACTICES
to be done within next 10 years

Stand	Forest Type	Silviculture (harvesting)	Acres to Cut	BA to Cut	Mbf to Cut	Cords Wood to Cut	Cords Pulp to Cut	Year
10	WH	None	0	0	0	0	0	N/A

Stand Name (location): Potash Brook

Watershed / Sub-watershed: Mountain Street / Potash Brook & Grass Hill Brook (Out of watershed)

Note: Due to the invasives ranking, this stand is not currently suitable for silviculture. However, if the invasives ranking is lowered to 2 or 1, and the grapes are controlled, then this stand would become suitable.

Practice purpose (how it helps create desired future condition)

The purpose is to adequately reduce the impact of interfering vegetation (native and non-native) so that normal Silvicultural processes may resume, to resume a successful transition to a multi-aged, mixed-species forest that can provide a range of benefits including periodic timber income. The recommended practice is: cutting grape vines and controlling non-native invasive plants, especially oriental bittersweet, then allowing a considerable amount of time to pass during which monitoring can confirm (or not) that invasives and grapes have been reduced to a tolerable level.

Trees to be removed & retained (types, conditions, sizes): None. Cut any grape vines that are climbing trees. Herbicide-treat bittersweet and other invasives.

Special regeneration considerations (seed source, seed bed preparation, interfering vegetation, browse, etc.): N/A.

Special invasive species considerations: Please re-confirm severity ranking for this stand (cf. Stand Descriptions section). Stand must be ranked 1 or 2. If ranked 1, no treatment required. If ranked 2, treatment must fall within the same 12-month period as any harvesting. Stands ranked 3 or 4 are not eligible for harvesting.

Current level = 3.

Special soil considerations (erosion, seasonal timing, cultural, etc.): Ground must be adequately dry or frozen so that rutting/compaction are avoided.

Special access considerations (erosion, access, timing, cultural, etc.): Access from Laurel Mountain Road is straightforward.

MANAGEMENT PRACTICES
to be done within next 10 years

Special equipment/logging-system considerations: Any system that can adequately protect the ground/soil and residual stand is acceptable.

Special boundary considerations: Re-blaze and re-paint southern, western and northern boundary.

Special invasive species considerations: In the section west of Potash Brook, efforts to remove invasives are necessary before silviculture can occur. See the standard procedure for stands ranked 3. East of Potash Brook, the standard procedure for stands ranked 1 or 2 can be followed.

Special habitat improvements (anything particular to accomplish Control invasives, increase coarse woody debris, especially in northern half of stand, and leave defective live trees to create future live cavity trees.

Special habitat protection considerations (anything particular to protect): The cherry trees and healthy beeches described above should not be cut and could be encouraged to grow bigger and produce more seeds by lightly thinning around them. Both these trees are important sources of food for wildlife, and are species that are under-represented in the Mountain Street watershed. Any grapevines growing near them should be cut.

Special trail/recreational considerations (anything particular to accomplish or avoid/protect): None.

Special cultural resource considerations: None.

MANAGEMENT PRACTICES
to be done within next 10 years

Stand	Forest Type	Silviculture (harvesting)	Acres to Cut	BA to Cut	Mbf to Cut	Cords Wood to Cut	Cords Pulp to Cut	Year
11	RP	None	0	0	0	0	0	N/A

Stand Name (location): Mountain Street West Shore

Watershed / Sub-watershed: Mountain Street / Mountain Street West

Note: Due to the invasives ranking, this stand is not currently suitable for silviculture. However, if the invasives ranking is lowered to 2 or 1, then this stand would become suitable.

Practice purpose (how it helps create desired future condition)

The purpose is to adequately reduce the impact of interfering vegetation (native and non-native) so that normal Silvicultural processes may resume, to effect a successful transition to a multi-aged, mixed-species forest that can provide watershed protection as well as a range of other benefits including periodic timber income. The recommended practice is: cutting vines, and preventing vine growth in the understory by brushmowing. These combined practices will reduce the likelihood of vines damaging existing trees and of creating pull-downs, which tend to create gaps that fill with bittersweet and more grapes, and will reduce their ability to serve as seed sources.

Trees to be removed & retained (types, conditions, sizes): No trees to be cut. Cut any vines that are climbing trees. Continue brush-mowing in between red pines in order to keep vines from forming thick mats and producing seed.

Special regeneration considerations (seed source, seed bed preparation, interfering vegetation, browse, etc.): N/A.

Special invasive species considerations: Please re-confirm severity ranking for this stand (cf. Stand Descriptions section). Stand must be ranked 1 or 2. If ranked 1, no treatment required. If ranked 2, treatment must fall within the same 12-month period as any harvesting. Stands ranked 3 or 4 are not eligible for harvesting.

Current level = 4.

Special soil considerations (erosion, seasonal timing, cultural, etc.): Ground must be adequately dry or frozen so that rutting/compaction are avoided.

Special access considerations (erosion, access, timing, cultural, etc.): Access from the Haydenville Road turnout is straightforward.

Management Practices Page 25

Mountain Street Reservoir Town(s) Whately, Williamsburg & Hatfield

Owner(s) City of Northampton DPW

Page of

MANAGEMENT PRACTICES
to be done within next 10 years

Special equipment/logging-system considerations: Any system that can adequately protect the ground/soil and residual stand is acceptable.

Special boundary considerations: None.

Special invasive species considerations: Do not allow invasives (and grapes) to pull down existing overstory trees.

Special habitat improvements (anything particular to accomplish: See above.

Special habitat protection considerations (anything particular to protect):
None.

Special trail/recreational considerations (anything particular to accomplish or avoid/protect): None.

Special cultural resource considerations: None.

List of Locus, Stand Locator, and Stand Maps
(7 maps)
for the Mountain Street Reservoir Watershed

Locus Map

Stand Locator Map

Stands 1 & 2

Stands 3 & 5

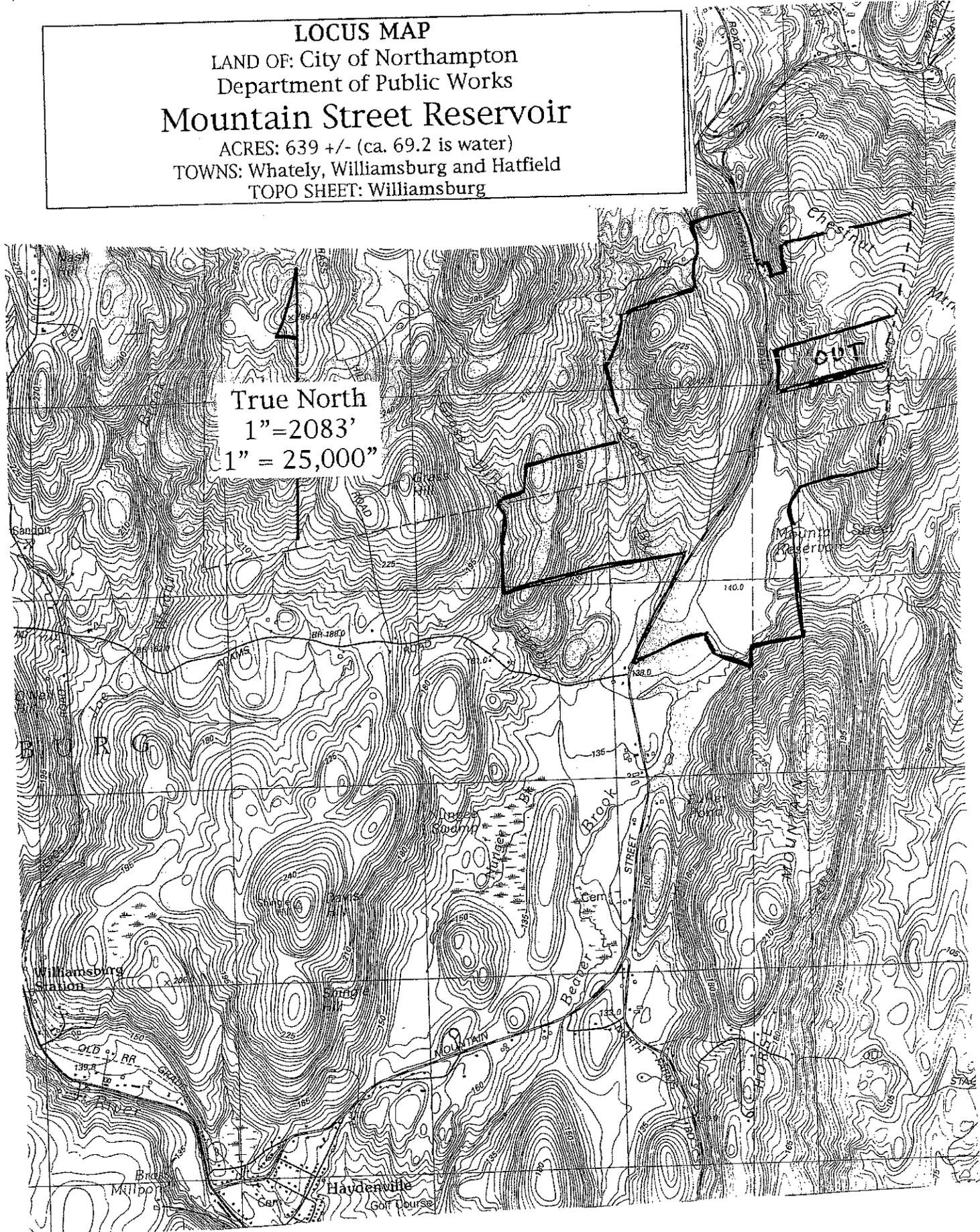
Stand 4

Stands 6 & 7 & 8 & 11

Stand 10

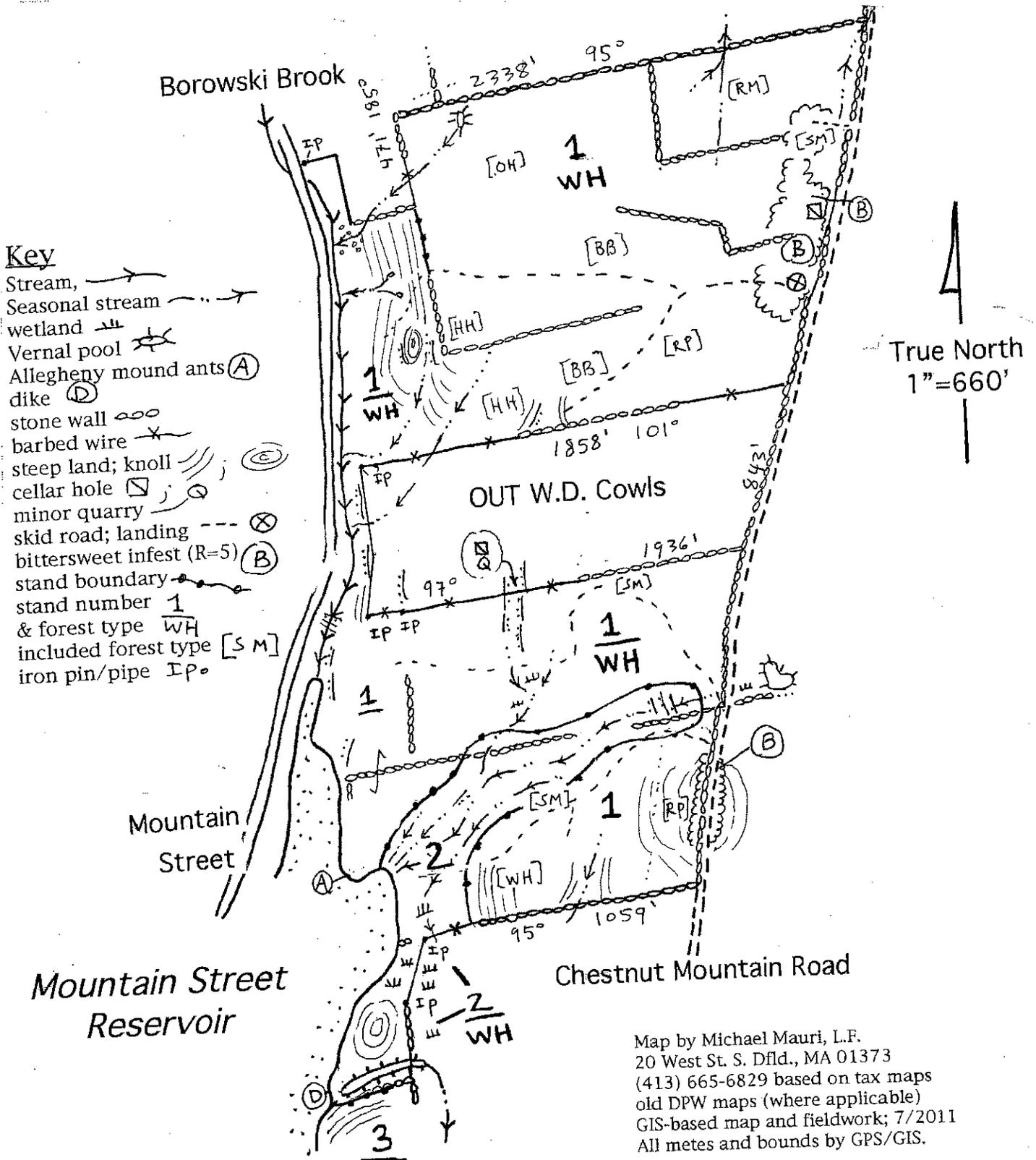
LOCUS MAP
LAND OF: City of Northampton
Department of Public Works
Mountain Street Reservoir
ACRES: 639 +/- (ca. 69.2 is water)
TOWNS: Whately, Williamsburg and Hatfield
TOPO SHEET: Williamsburg

True North
1" = 2083'
1" = 25,000"



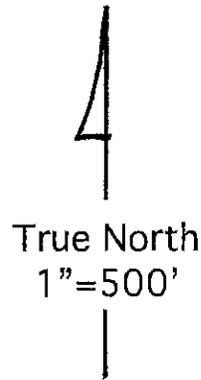
Forest Stand and Boundary Map
 City of Northampton, DPW
 Mountain Street Reservoir
 Hatfield & Whately, MA

Chestnut Mountain
 Stand 1 — 151.3 acres
 &
Mountain Street Reservoir Central Shore (East)
 Stand 2 — 18.8 acres



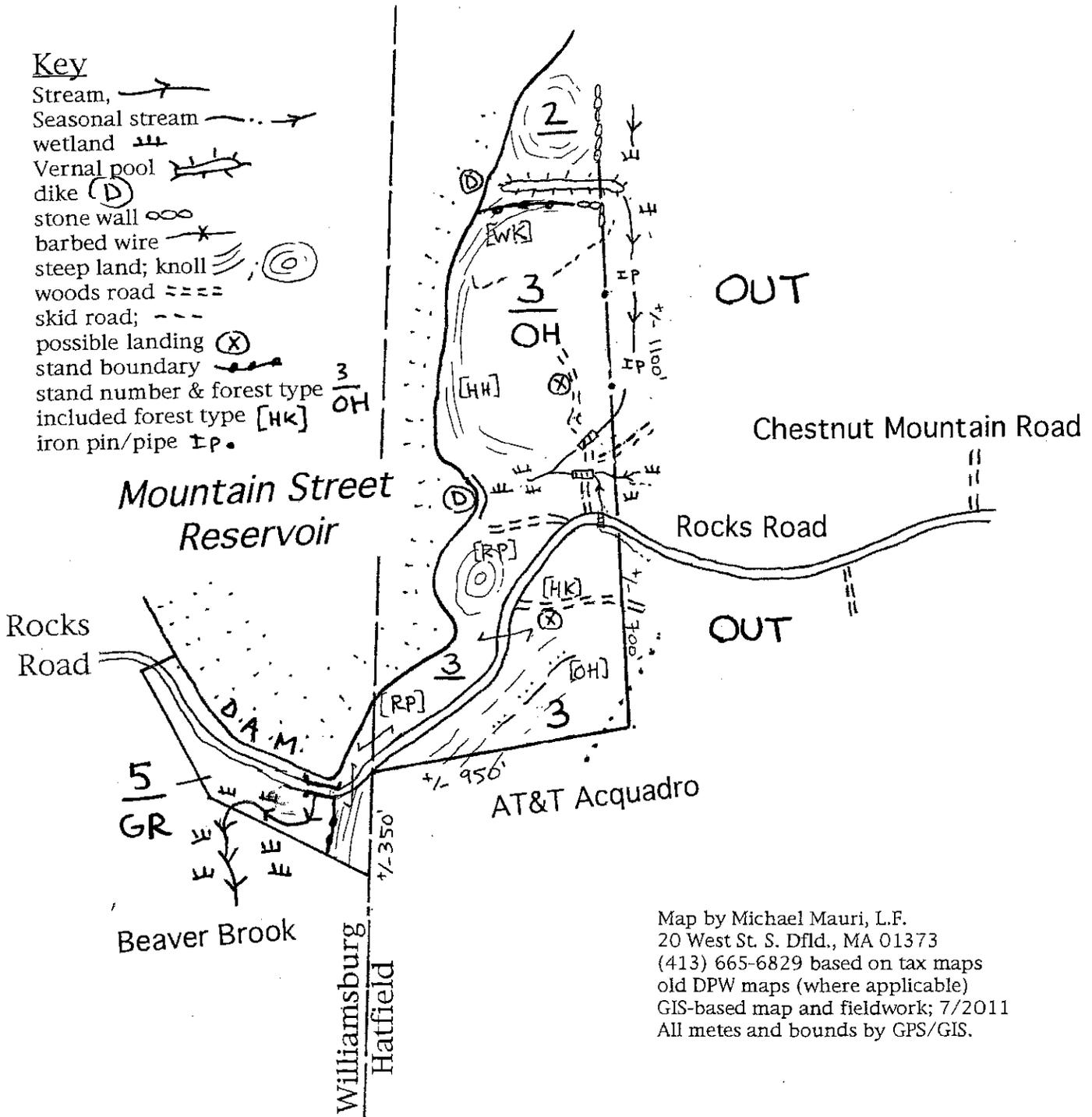
Forest Stand and Boundary Map
 City of Northampton, DPW
 Mountain Street Reservoir
 Hatfield & Williamsburg, MA

Mountain Street Dam
 Stand 5 — 2.8 acres
 &
 Rocks Road East
 Stand 3 — 24.6 acres



Key

- Stream,
- Seasonal stream
- wetland
- Vernal pool
- dike (D)
- stone wall
- barbed wire
- steep land; knoll
- woods road
- skid road;
- possible landing (X)
- stand boundary
- stand number & forest type $\frac{3}{OH}$
- included forest type [HK]
- iron pin/pipe IP.

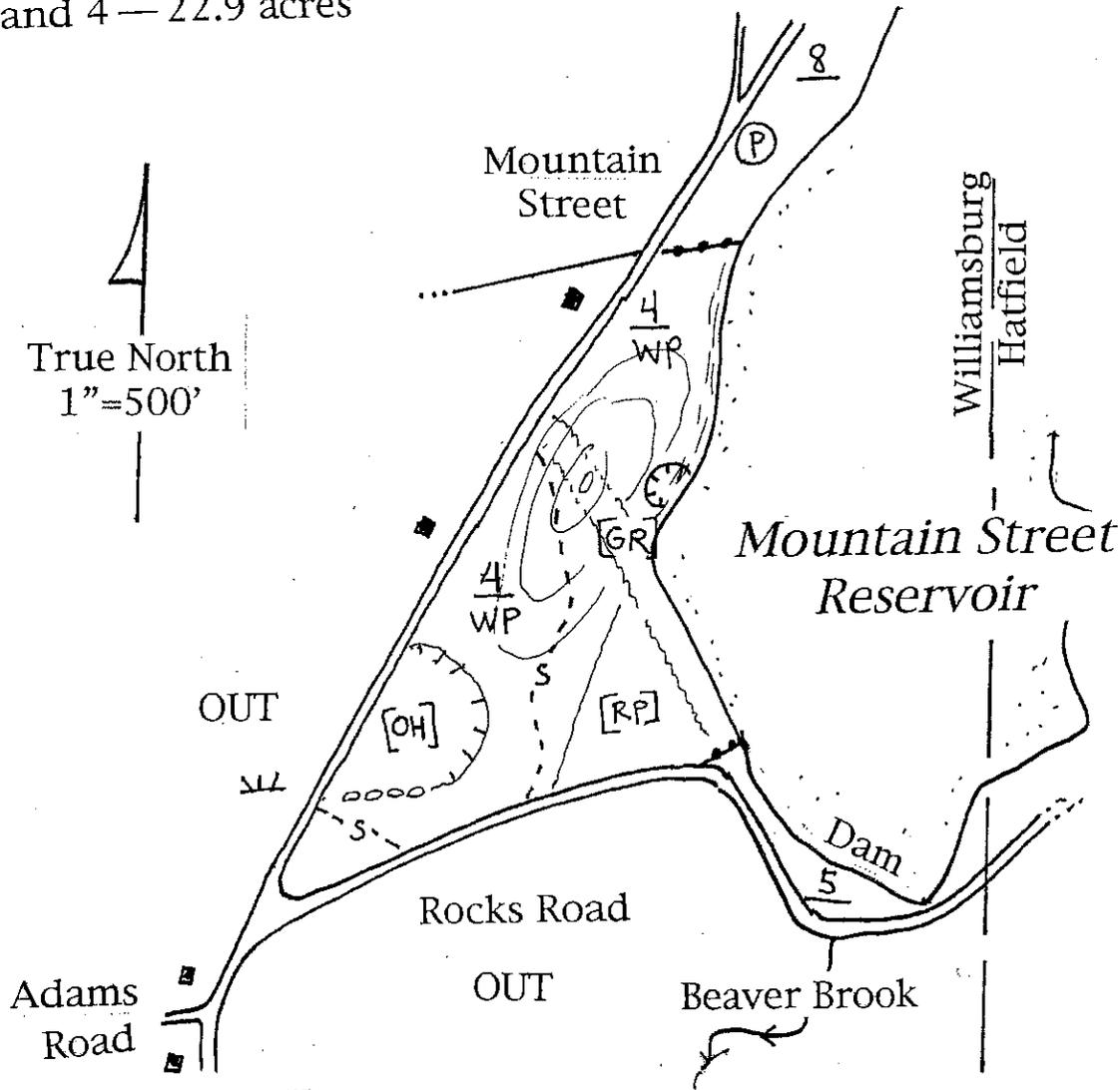


Map by Michael Mauri, L.F.
 20 West St. S. Dfld., MA 01373
 (413) 665-6829 based on tax maps
 old DPW maps (where applicable)
 GIS-based map and fieldwork; 7/2011
 All metes and bounds by GPS/GIS.

Forest Stand and Boundary Map
 City of Northampton, DPW
 Mountain Street Reservoir
 Williamsburg, MA

Map by Michael Mauri, L.F.
 20 West Street, S. Deerfield, MA 01373
 (413) 665-6829, based on tax maps,
 old cutting maps (where applicable)
 GIS-based maps and fieldwork
 by M.M., 2/2012

Mountain Street Southwest
 Stand 4 — 22.9 acres



True North
 1"=500'

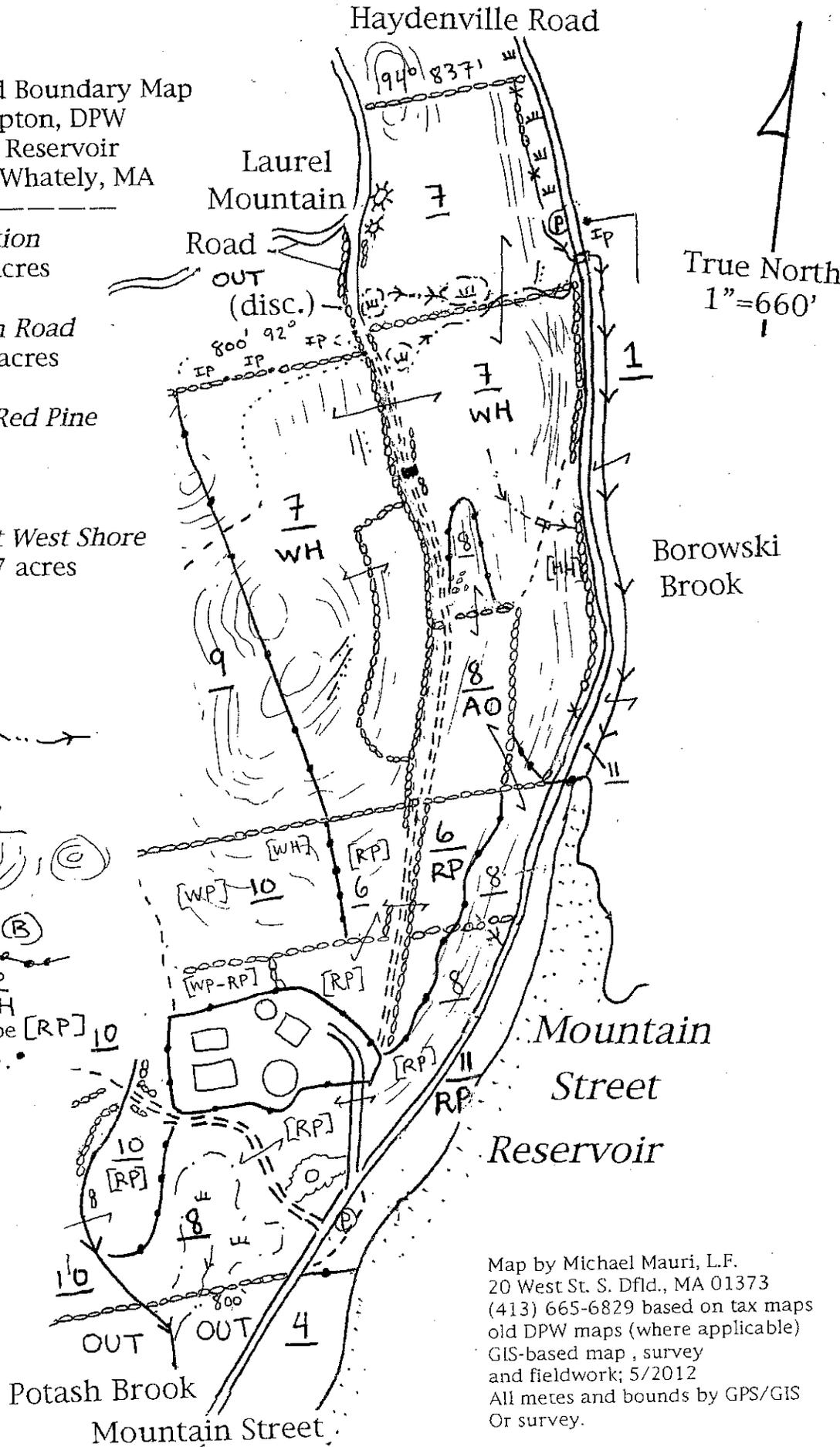
- Key**
- water
 - stone wall
 - barbed wire
 - steep land; knoll
 - borrow pit
 - snowmobile trail
 - building
 - stand boundary
 - stand number & forest type
 - included forest type [OH]
 - parking; iron pin

$\frac{1}{WP}$

Forest Stand and Boundary Map
 City of Northampton, DPW
 Mountain Street Reservoir
 Williamsburg & Whately, MA

- Red Pine Plantation
- Stand 6 — 15.3 acres
- &
- Laurel Mountain Road
- Stand 7 — 95.2 acres
- &
- Old Orchard & Red Pine
- Stand 8 — 33.7 acres
- &
- Mountain Street West Shore
- Stand 11 — 12.7 acres

- Key**
- Stream,
 - Seasonal stream
 - wetland
 - vernal pool
 - stone wall
 - barbed wire
 - steep land; knoll
 - cellar hole
 - gate
 - bittersweet infest
 - stand boundary
 - stand number & forest type
 - included forest type
 - iron pin/pipe



Map by Michael Mauri, L.F.
 20 West St. S. Dfld., MA 01373
 (413) 665-6829 based on tax maps
 old DPW maps (where applicable)
 GIS-based map, survey
 and fieldwork; 5/2012
 All metes and bounds by GPS/GIS
 Or survey.

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) Edward S. Smith Date 6/25/12

Owner(s) _____ Date _____

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

Plan Preparer [Signature] Date 6-22-12

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

Approved, Service Forester Sean Sibbey Date 7/31/2012

Approved, Regional Supervisor _____ Date _____

In the event of a change of ownership of all or part of the property, the new owner must file an amended Ch. 61/61A plan within 90 days from the transfer of title to insure continuation of Ch. 61/61A classification.

Owner(s) City of Northampton Town(s) Hatfield, Whately & Williamsburg

MTN

STAND DESCRIPTIONS

Outreach Plan in Conjunction with Forest Stewardship
Planning: Northampton DPW
Ryan & West-Whately Reservoir Watershed
and Mountain Street Reservoir Watershed
6/6/2012

Purpose: Help develop public awareness of the role of forest management in sustaining the forested watersheds that supply water to most residents of the City of Northampton

Practice 1: create multiple-use/repeat-use educational brochure

Target audience: City residents and water users, abutters, general public; commissions of affected towns

Message: objectives and methods of forest management in a watershed setting

Advertising: include as bill stuffer to water customers; possible press release and posting on City website or other web-based platform; distribute at hikes (see below); possibly mail to abutters; possibly mail to Conservation Commissions and other commissions of Whately, Conway, Hatfield and Williamsburg and to libraries in affected towns.

Evaluation: (1) brochure is created and printed; (2) brochure has been mailed out to every water customer Conservation Commissions and other commissions of Whately, Conway, Hatfield and Williamsburg and to libraries in affected towns

STAND DESCRIPTIONS

Practice 2: offer educational hikes to show forest features (good and bad) and also before and after implementation of management practices

Target audience: City residents and water users, abutters, general public; commissions of affected towns; landowners

Message: concrete examples of forest management in a watershed setting (e.g. timber harvesting, invasive species control, etc.)

Advertising: include as bill stuffer to water customers; possible press release and posting on City website or other web-based platform; distribute at hikes (see below); possibly mail to abutters; possibly mail to Conservation Commissions and other commissions of Whately, Conway, Hatfield and Williamsburg

Evaluation: 10 hikes over a 10-year period