

Forest Management Plan

Prepared for:

The Kennebec Water District

China & Vassalboro | Kennebec County | Maine

Prepared by:

Abigail Glidden FI#3989

Under the supervision of:

Jason Tyler LF#3240

June 2019



Comprehensive Land Technologies, Inc.

PO Box 146

South China, Maine 04358

207-445-3151

TABLE OF CONTENTS

GENERAL DESCRIPTION AND SCOPE OF THE PLAN	1
LANDOWNER GOALS AND OBJECTIVES	2
ACREAGE OF LAND USE/COVER TYPES (APPROXIMATELY 343.5 ACRES TOTAL)	2
FORESTLAND—PRODUCTIVE	2
North and South Narrows Peninsulas	2
North Shore	3
South Shore	3
GENERAL CONDITION OF WOODLOT	4
HISTORY AND GENERAL PROPERTY DESCRIPTION	4
PROPERTY TAX STATUS	5
BOUNDARY LINES	5
ACCESS	5
FOREST HEALTH	6
Emerald Ash Borer	6
Brown Tail Moth	6
Hemlock Woolly Adelgid	6
Gypsy Moth	6
Beech Bark Disease	7
White Pine Weevil	7
TERRAIN AND HYDROLOGY	7
SOILS INFORMATION	8
Lyman-Tunbridge Series	8
Lamoine Series	8
Paxton and Paxton-Charlton Series	8
Woodbridge Series	8
Scio Series	9
Rifle Series	9
Ridgebury Series	9
Biddeford Series	9
Hartland Series	9
Scantic Series	9
NON-TIMBER RESOURCES AND RECOMMENDATIONS	13
THREATENED AND ENDANGERED SPECIES, AND RARE OR EXEMPLARY NATURAL COMMUNITIES	13
Recommendations	13
FISH AND WILDLIFE HABITAT ELEMENTS	13

Recommendations	13
WATER QUALITY, WETLANDS, RIPARIAN AREAS	13
Recommendations	14
HISTORICAL, CULTURAL, AND ARCHEOLOGICAL SITES.....	14
Recommendations	14
RECREATIONAL OPPORTUNITIES	14
Recommendations	15
LONG-RANGE SILVICULTURAL GOALS AND OBJECTIVES	15
LEGAL OBLIGATIONS.....	15
INDIVIDUAL STAND DESCRIPTIONS AND PRESCRIPTIONS	16
FIELD METHODS STATEMENT.....	16
North and South Narrows Peninsulas.....	16
Remaining Shoreline Property	17
NORTH NARROWS PENINSULA (52.5 ACRES) CHINA, MAINE	17
North Stand A Description (Approximately 37 acres—SH3A)	17
North Stand A Prescription	20
North Stand B Description (Approximately 15.5 acres—H2B)	21
North Stand B Prescription	23
SOUTH NARROWS PENINSULA (63.5 ACRES) CHINA, MAINE.....	24
South Stand A Description (Approximately 23 acres—S3A)	24
South Stand A Prescription	26
South Stand B Description (Approximately 17 acres—S3A)	27
South Stand B Prescription	30
South Stand C Description (Approximately 23.5 acres—HS3B).....	30
South Stand C Prescription	33
STAND TYPE 1—H3A.....	33
Stand Type 1 General Description and Prescription	33
Site Specifics for Stand Type 1	34
STAND TYPE 2—S3A	36
Stand Type 2 General Description and Prescription	36
Site Specifics for Stand Type 2	37
STAND TYPE 3—SH3A.....	38
Stand Type 3 General Description and Prescription	38
Site Specifics for Stand Type 3	39
MANAGEMENT ACTIVITIES	39
PROPERTY LINES	39
UPDATED SIGNAGE.....	39
ACCESS.....	40

NORTH NARROWS PENINSULA HARVEST PLAN 2020/2021.....	40
SOUTH NARROWS PENINSULA HARVEST PLAN 2020/2021	41
SHORELINE PROPERTY HARVESTING PLAN	44
2018–2028 PROJECT SCHEDULE (NORTH AND SOUTH NARROWS PENINSULAS HARVESTS ONLY).....	45
2028–2038 PROJECTED PROJECT SCHEDULE (NORTH AND SOUTH NARROWS PENINSULAS HARVESTS ONLY)	46
REFERENCES	48

LIST OF FIGURES

Figure 1: Location Map	1
Figure 2: North Stand A Diameter Distribution by Basal Area per Acre	18
Figure 3: North Stand B Diameter Distribution by Basal Area per Acre	21
Figure 4: South Stand A Diameter Distribution by Basal Area per Acre	24
Figure 5: South Stand B Diameter Distribution by Basal Area per Acre	27
Figure 6: South Stand C Diameter Distribution by Basal Area per Acre	31

LIST OF TABLES

Table 1: Cover Type Descriptions.....	3
Table 2: North and South Narrows—Forest Soil Series, Acreage, Drainage Class, and Parent Material ...	10
Table 3: North and South Narrows—Soil Type Attributes: Site Index, Harvesting Equipment Operability, and Soil Rutting Hazard.....	10
Table 4: Soil Type Attributes for All Shoreline Property	11
Table 5: Sample Plots per Stand and Inventory Accuracy	16
Table 6: North Stand A Inventory Metrics	19
Table 7: North Stand A Pulpwood Volume by Species	19
Table 8: North Stand A Sawlog Volume by Species	19
Table 9: North Stand A Growth and Mortality.....	20
Table 10: North Stand B Inventory Metrics	22
Table 11: North Stand B Pulpwood Volume by Species.....	22
Table 12: North Stand B Sawlog Volume by Species	22
Table 13: North Stand B Growth and Mortality.....	23
Table 14: South Stand A Inventory Metrics	25
Table 15: South Stand A Pulpwood Volume by Species	25
Table 16: South Stand A Sawlog Volume by Species	26
Table 17: South Stand A Growth and Mortality.....	26
Table 18: South Stand B Inventory Metrics	28
Table 19: South Stand B Pulpwood Volume by Species.....	28
Table 20: South Stand B Sawlog Volume by Species	29
Table 21: South Stand B Growth and Mortality.....	29
Table 22: South Stand C Inventory Metrics	31
Table 23: South Stand C Pulpwood Volume by Species.....	32
Table 24: South Stand C Sawlog Volume by Species	32
Table 25: South Stand C Growth and Mortality	33
Table 26: North Stand A (36.7 acres) Sawlog Harvest Volume and Value	40
Table 27: North Stand A (36.7 acres) Pulp Harvest Volume and Value	40

Table 28: North Stand B (15.5 acres) Sawlog Harvest Volume and Value	41
Table 29: North Stand B (15.5 acres) Pulp Harvest Volume and Value	41
Table 30: South Stand A (23 acres) Sawlog Harvest Volume and Value	42
Table 31: South Stand A (23 acres) Pulp Harvest Volume and Value	42
Table 32: South Stand B (17 acres) Sawlog Harvest Volume and Value	42
Table 33: South Stand B (17 acres) Pulp Harvest Volume and Value	43
Table 34: South Stand C (23.5 acres) Sawlogs Harvest Volume and Value	43
Table 35: South Stand C (23.5 acres) Pulp Harvest Volume and Value	44
Table 36: Project Schedule by Activity for This Planning Period	45
Table 37: Project Schedule by Activity for 2028–2038	46
Table 38: North Stand A (36.7 acres) 2038 Sawlog Harvest Volume and Value	47
Table 39: North Stand A (36.7 acres) 2038 Pulp Harvest Volume and Value	47
Table 40: North Stand B (15.5 acres) 2038 Pulp Harvest Volume and Value	47
Table 41: South Stand A (23 acres) 2038 Sawlog Harvest Volume and Value	47
Table 42: South Stand A (23 acres) 2038 Pulp Harvest Volume and Value	47
Table 43: South Stand B (17 acres) 2038 Pulp Harvest Volume and Value	48
Table 44: South Stand C (23.5 acres) 2038 Sawlog Harvest Volume and Value	48
Table 45: South Stand C (23.5 acres) 2038 Pulp Harvest Volume and Value	48
Table 46: Conversion by Species for Converting Cubic Feet to Tons.....	49

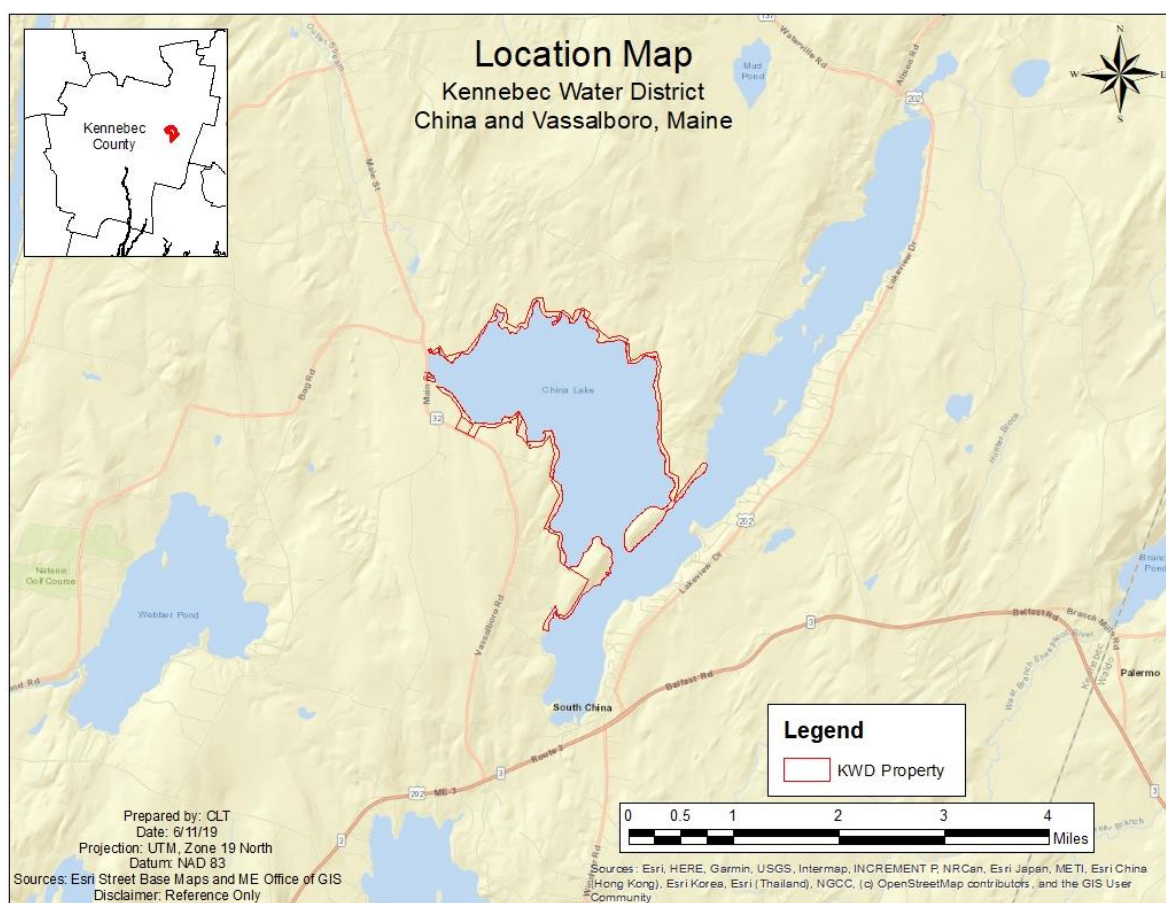
LIST OF APPENDICES

Appendix 1: Forest Stand Type Maps
Appendix 2: Court Case for Access to South Narrows Peninsula/Hawker’s Point
Appendix 3: Forest Health Photos
Appendix 4: Wetlands and Terrain Map
Appendix 5: Soil Type Maps
Appendix 6: Maine Natural Areas Program
Appendix 7: Department of Inland Fisheries and Wildlife Guidelines: Managing Deer Wintering Areas in Northern, Western, and Eastern Maine
Appendix 8: Maine Historic Preservation Commission Results
Appendix 9: Quabbin Reservoir Massachusetts: Managing a Watershed Protection Forest
Appendix 10: Northern Hardwood (Revised) Stocking Guide
Appendix 11: Eastern Hemlock Stocking Guide
Appendix 12: Eastern White Pine (Revised) Stocking Guide
Appendix 13: Mixed Wood Stocking Guide
Appendix 14: 2016 Maine Stumpage Report
Appendix 15: Net Present Value Calculation for 2038
Appendix 16: Glossary of Terms and Acronyms

GENERAL DESCRIPTION AND SCOPE OF THE PLAN

This forest management plan has been prepared for the Kennebec Water District (KWD), whose current mailing address is P.O. Box 356, Waterville, Maine 04901. This plan encompasses the KWD's forested land around the West Basin of China Lake, situated in China and Vassalboro, Kennebec County, Maine (see Figure 1: Location Map). The North Narrows Peninsula and a portion of the northern shore can be found on the Town of China Tax Map 37 Lot 34, and the South Narrows Peninsula and a portion of the southern shore can be found on the Town of China Tax Map 26 Lot 17. The portions of shorefront property in Vassalboro can be found on the Town of Vassalboro Tax Map 11 Lot 32, Map 11 Lot 58, Map 11 Lot 33, Map 11 lot 54, and Map 20 Lot 34. In total, this plan encompasses approximately 343.5 acres of shorefront property.

Figure 1: Location Map



Approximately ten miles of shoreline property around of the West Basin of China Lake, including the North and South Narrows Peninsulas, were part of a major property acquisition between 1909 and 1928. This property serves to protect the water quality of the West Basin of China Lake, the KWD's sole water source used to produce and distribute safe, high quality water.

This plan has been written to provide a description of the land's past use, the current condition of the property and resources, and the future potential for the forestland and resources. The plan should serve as a tool to guide the KWD's decision makers and land managers to maintain and improve the resources on the property and to achieve their long-term goals and objectives. This plan meets the requirements of the WoodsWise Program and the requirements to enroll in the Maine Tree Growth Tax Law. This plan should be reassessed in 10 years and modified and/or amended to accommodate any changes across the property, or if the landowner goals and/or objectives change.

LANDOWNER GOALS AND OBJECTIVES

The primary goal of the property is to grow and harvest commercial forest products to establish and perpetuate an uneven aged, mixed species forest to protect the water quality in China Lake. This goal will be met through the objectives of having periodic timber harvests every 15–20 years that follow applicable Best Management Practices (BMPs) and utilize silvicultural systems that will produce an uneven aged, mixed species forest.

Secondary goals include locating, marking, and maintaining clear boundary lines, maintaining access roads, and establishing a physical presence on the KWD property to improve public relations. The objectives are to brush, blaze, and paint all of the KWD's property lines within this planning period. Additional objectives include improving and maintaining the access roads when the periodic timber harvests occur.

ACREAGE OF LAND USE/COVER TYPES (APPROXIMATELY 343.5 ACRES TOTAL)

FORESTLAND—PRODUCTIVE

Table 1: Cover Type Descriptions on the following page, and KWD All Stands Forest Type Map in Appendix 1: Forest Stand Type Maps, provide definitions and illustrations of the following land uses and cover types.

North and South Narrows Peninsulas

The North and South Narrows Peninsulas include part of China Tax Map 37 Lot 34, part of China Tax Map 26 Lot 17, and consists of approximately 116 acres as follows.

- North Narrows Peninsula: 52.5 acres of productive forestland
 - North Stand A: 37 acres SH3A (mixed wood)
 - North Stand B: 15.5 acres H2B (hardwood)
- South Narrows Peninsula: 63.5 acres of productive forestland
 - South Stand A: 23 acres S3A (softwood)
 - South Stand B: 17 acres S3A (softwood)
 - South Stand C: 23.5 acres HS3B (mixed wood)

North Shore

The North Shore includes the remaining acreage of China Tax Map 37 Lot 34, and Vassalboro Tax Map 11 Lot 32, and consists of approximately 115 acres as follows.

- Stand Type 1 (Stand 1G - Stand 1H): 8.5 acres H3A (hardwood)
- Stand Type 2 (Stand 2D - Stand 2E): 97 acres S3A (softwood)
- Stand Type 3 (Stand 3C): 9.5 acres SH3A (mixed wood)

South Shore

The South Shore includes the remaining acreage of China Tax Map 26 Lot 17, Vassalboro Tax Map 11 Lot 58, Vassalboro Tax Map 11 Lot 54, Vassalboro Tax Map 11 Lot 33, Vassalboro Tax Map 20 Lot 34, and consists of approximately 97.5 acres as follows.

- Stand Type 1 (Stand 1A - Stand 1F): 50.5 acres H3A (hardwood)
- Stand Type 2 (Stand 2A - Stand 2C): 24 acres S3A (softwood)
- Stand Type 3 (Stand 3A - Stand 3B): 23 acres SH3A (mixed wood)

Table 1: Cover Type Descriptions

Forest Classification Code	Description
Composition	
S	Softwood dominant, composes >75 percent of present vegetation
SH	Softwood majority, composes 50–70 percent of present vegetation
HS	Hardwood majority, composes 50–75 percent of present vegetation
H	Hardwood dominant, composes >75 percent of present vegetation
Size Class (height)	
1	Young growth, < 30 feet, regeneration
2	Mid growth, 30–50 feet, small merchantable
3	Mature growth, >50 feet, merchantable
Stocking	
A	75–100 percent crown closure, fully stocked
B	30–75 percent crown closure, medium stocked
C	0–30 percent crown closure, sparsely stocked

*For example, SH3A means softwood majority, composes 50–70 percent of present vegetation, mature growth, >50 feet, merchantable, and 75–100 percent crown closure, fully stocked.

Less Represented Land Uses/Cover Types

- Reserved forestland (productive): not present during this planning period.
- Non-commercial/unproductive forestland: not present during this planning period.
- Non-forested area: 9.5 acres total, located in Stand 1G, Stand 1H and Stand 3C.
- Water bodies: not present during this planning period.
- Wetland: 5.5 acres total, located in Stand 1A, Stand 1G, Stand 2A, Stand 2D and Stand 3C.
- Developed land: not present during this planning period.
- Agricultural land: not present during this planning period.

GENERAL CONDITION OF WOODLOT

HISTORY AND GENERAL PROPERTY DESCRIPTION

In 1903, China Lake was chosen to become the new sole source of the KWD's water source. Between 1909 and 1928, this property around the West Basin of China Lake was purchased. Prior to the KWD's ownership of this property, the land was used for agricultural purposes and several homesteads dotted the shoreline of the West Basin. Once the property acquisition by the KWD began, an extensive pine planting program was initiated in 1914 to reforest the agricultural land. Approximately 178,500 trees were planted between 1914 and 1928. The program was intended to provide erosion control and later provide income through timber harvesting.

A forester began working with the KWD in 1965 to provide recommendations and help maintain the value of the forestland. Since the tree planting program, periodic thinning treatments and selective cuttings were conducted to promote growth and vigor. The first selective cutting was completed in 1974. Shortly after this first cutting, timber harvesting activity along the north shore came to a halt due to many public complaints about the cutting. In addition, as a result of an access dispute to the South Peninsula, a scheduled thinning in 1988 was not conducted. Access was not resolved until 1991, and in 1992 a thinning was scheduled. At this point the trees were experiencing distress from overcrowding. The option of clearcutting the entire stand and replanting was considered, but the alternative to thin the stand and allow for recovery and natural regeneration was chosen and conducted in 1992.

In the winter of 1995–1996, three severe winter storms (November 11–12, January 19–20, and January 26–27) with strong opposite prevailing winds resulted in substantial blowdowns across the North and South Narrows Peninsulas. A salvage harvest was conducted in February and March of 1996. In May of that same year, it is recorded that students from Erskine Academy planted 8,000 trees on the Narrows Peninsulas—primarily on the South Narrows Peninsula/Hawker's Point. The windstorm and salvage operation have strongly altered the structure and composition of the stands.

The majority of the ownership around the West Basin of China Lake, including the Peninsulas is fully stocked with mostly commercial species in mixed wood, hardwood, and softwood dominated stands that are described in greater detail under the Individual Stand Descriptions section of this plan. A small beach (less than 2,000 square feet) exists on the southern tip of the North Narrows Peninsula with a couple of picnic tables that are often utilized during the summer months by boaters and other recreationists using the lake. Another small beach (less than 2,000 square feet) exists on the northern tip of the South Narrows Peninsula. Both beaches have outdated signage regarding the KWD's water source and the general restrictions on the use in the West Basin of China Lake and the shoreline property.

PROPERTY TAX STATUS

Currently, the KWD has no property tax exemptions in the town of China or Vassalboro. The property is eligible to be enrolled in the Maine Tree Growth Tax Law Property Tax Bulletin No. 19, where the forested property can be valued on the basis of productivity. The application deadline to apply is April 1st of each year and the decision to enroll is long term. The property must be recertified and approved by a Maine licensed Forester every 10 years, and the landowner must comply with the associated written forest management plan for the property.

BOUNDARY LINES

The boundary lines on the KWD's property are in poor condition. In 1909, the original concrete monuments were set on the corners of the property. Monuments have since been relocated or replaced in cases where the monuments were in poor condition or missing. In 1995, 1996, and 1998, several monuments were replaced or reset. The current survey for the KWD's shoreline property dated December 17, 1997 was prepared by A.R.C.C. Land Surveyors Inc. of Lewiston, Maine. Though some of the corner monuments were recently relocated, the lines between the monuments are nonexistent or are in poor condition with the exception of few locations where bits of old wire fencing and stone walls are present.

One of the landowner's goals is to locate, mark, and maintain clear boundary lines. This can be achieved by permanently blazing and painting the lines between the monuments. Clearly marking and maintaining these property lines will also help with improving the KWD's outreach with abutting landowners and the general public. As of June 2019, one mile of property line work has been completed starting on the far northeastern portion of the property (near North Narrows Peninsula). These lines have been brushed, blazed and painted in blue. In addition, blue painted posts engraved with "KWD" were installed in non-forested/open field areas along the property line.

ACCESS

Access to the property, other than from the shores of China Lake, is limited. Lake access is useful for monitoring the property and for small scale maintenance projects, such as boundary line work. Road access for management and harvesting purposes to the North Narrows Peninsula is from the southern end of Neck Road and can be accessed from Lakeview Drive/Route 202 in China. Road access for management and harvesting purposes to the South Narrows Peninsula is from the end of Clark Road, off Vassalboro Road/Route 32 in China. In 1991, there was a dispute involving access to the South Narrows Peninsula (Hawker's Point). The dispute was resolved through a court case which resulted in granting/maintaining an 18-foot-wide easement as it appears on the face of the earth to the KWD (see Appendix 2: Court Case for Access to South Narrows Peninsula/Hawker's Point).

Existing access roads are in poor condition and currently only support foot traffic. These access routes will require improvements for timber harvesting activities to occur. Improving and maintaining access roads is recommended to achieve the landowner's goals, facilitate management and monitoring, and provide access in the event of an emergency (forest pest outbreak, forest fire, injury, etc.).

FOREST HEALTH

The forestland on this property appears to be in moderate-to-good health. Natural tree senescence is occurring on the property due to lack of active management. Periodically monitoring the forest for evidence of forest pests and diseases, storm damage, and general tree decline and mortality is key to maintaining a healthy forest over time and to prevent detrimental outbreaks.

Emerald Ash Borer

Emerald ash borer (EAB) is an invasive beetle that was recently found in both northern and southern Maine. The larvae of this pest feed on the inner bark of ash trees and disrupts the tree's ability to transport water and nutrients, ultimately killing the tree. Quarantines are now in place in York County, and the northeastern corner of Aroostook County. These quarantines regulate the movement of ash products as nursery stock, chips, other ash products with bark, firewood, pulpwood, lumber, etc. The Maine Department of Agriculture, Conservation, and Forestry announced that future forests will include far fewer ash trees, and EAB will devastate ash in Maine. Forest management options for ash on this property should include maintaining only healthy ash on good sites for retention as a component of the forest. An even more important objective will be to promote a more diverse mix of native species that will in turn promote development of a forest that will remain resilient and economically productive as EAB devastates ash species. Other objectives should include conserving and utilizing the value of the ash with the threat of EAB now within state bounds. The stands should be monitored frequently for evidence of this beetle where species of ash are present. Sample photos of EAB, and EAB evidence can be found in Appendix 3: Forest Health Photos.

Brown Tail Moth

Brown tail moth is an invasive forest pest known to be harmful to both forest and human health. The tiny hairs on the moth can cause reactions and rashes similar to that of poison ivy (dermatitis). The larval stage of the brown tail moth most commonly feeds on the foliage of species of oak, cherry, and apple. This defoliation can cause stunted growth and cause the tree to become more susceptible to other stressors. The exposure risk rating for brown tail moth for this general area is currently moderate where defoliations have been mapped and/or continuous stretches of overwintering webs were found in adjacent towns. If overwintering webs are found on the property, they should be destroyed to help reduce the populations. The property should be monitored for signs of severe defoliation so the appropriate management strategies can be made.

Hemlock Woolly Adelgid

Eastern hemlock is a large component of several stands on the property and is vulnerable to the hemlock woolly adelgid forest pest. The hemlock woolly adelgid quarantine areas currently include southern portions of Kennebec County. Although this pest has not yet been detected in this area, the hemlock dominated stands should still be monitored frequently for signs of this pest as future climate changing conditions could result in increased chances of infestations. Sample photos of hemlock woolly adelgid evidence and damage can be found in Appendix 3: Forest Health Photos.

Gypsy Moth

Gypsy moth is an invasive forest pest known to feed on the foliage of a wide variety of species including oak, aspen, maple, and grey birch, however they will feed on hemlock and pine as well. Trees can

typically withstand several years of defoliation by gypsy moth, although they become less vigorous and more susceptible to other stressors such as other defoliators, diseases, or drought. The Gypsy moth quarantine is present in this area. Although evidence of gypsy moth has not been found on the property, it should be monitored for signs of severe defoliation so the appropriate management strategies can be made and implemented.

Beech Bark Disease

American beech is vulnerable to beech bark disease and is present on most American beech species on this property. This disease degrades the quality of a tree and can perpetuate onto new sprouts from the same root system. Management should focus on removing the beech component from affected stands and only favor those beech trees that exhibit smooth bark and resistance to this disease. Sample photos of evidence and damage from this disease can also be found in Appendix 3: Forest Health Photos.

White Pine Weevil

White pine weevil tends to be a common forest pest in eastern white pine stands and can degrade the quality of trees when grown in open conditions. Some of the pine present on the property appear to have evidence of past white pine weevil damage but is not currently a major concern. In future management recommendations, it is important to maintain adequate shade on the understory to prevent future weevil damage on the white pine growing stock and to prevent undesirable species from becoming established. Sample photos of evidence and damage from this pest can also be found in Appendix 3: Forest Health Photos.

TERRAIN AND HYDROLOGY

The North Narrows Peninsula is a low-to-moderately productive site overall, and well suited for harvesting operability with few limitations. The elevation on this peninsula increases from approximately 190 feet above sea level at the shoreline to North Stand B where the elevation is at its highest at about 290 feet above sea level.

The South Peninsula is a moderately productive site overall with the exception of the eastern shore where the soils are low lying and poorly drained. Although the entire peninsula is suited for harvesting operability in the right conditions, the eastern shore poses a greater risk for soil rutting. The elevation on this peninsula increases from approximately 190 feet above sea level at the shoreline up into South Stand B where the elevation is at its highest at about 350 feet above sea level. The slope on the eastern side of this peninsula is moderately steep while the western side has a more gradual slope down towards the lake.

The terrain across the remaining shoreline property varies from little to no slope, to moderately steep sloping in areas. The elevation change increases from approximately 190 feet above sea level and ranges from 220–280 feet. Overall the harvesting operability across the property is moderately suited to well suited everywhere except for few locations where streams/wetlands discharge into the lake. In addition to these wetland/stream areas, harvesting in steeply sloping areas should be scheduled for the right ground conditions to allow for operability with minimal ground disturbance (see Appendix 4: Wetlands and Terrain Map).

Ultimately, all melting snow and rainfall runoff across the shoreline property directly discharges into China Lake. China Lake is part of the Kennebec Watershed that eventually discharges into the Kennebec River via Outlet Stream.

SOILS INFORMATION

The soils data and information described in this section were gathered from the National Cooperative Soil Survey which is operated by the United States Department of Agriculture (USDA), Natural Resource Conservation Services (NRCS). The Web Soil Survey provides and defines each soil type for the given area and soil characteristics such as drainage, aspect, surface stoniness, parent material, harvesting operability, etc. (See Table 2, Table 3, and Table 4). Site index, an expression of forest site quality based on the height of free-growing dominant or codominant trees at a base age of 50, is used to measure the productivity of a site and can be derived from the soils data. For example, a Site Index of 66 for eastern white pine means that at age 50, the average height of dominant and codominant eastern white pine trees will be approximately 66 feet tall (see Appendix 5: Soil Type Maps).

Lyman-Tunbridge Series

The intermingled Lyman-Tunbridge complex varying in percent slopes, are somewhat excessively drained, loamy, rocky soil. Soil depths can range from shallow to moderately deep and can exhibit potentially high surface runoff. Common tree species associated with this soil type include American beech, white ash, yellow birch, paper birch, northern red oak, sugar maple, eastern white pine, eastern hemlock, red spruce, white spruce, and balsam fir.

Lamoine Series

The Lamoine soil series are somewhat poorly drained silt loam. This series typically exhibits deep soils with moderate potential for surface runoff. Common tree species include eastern white pine, balsam fir, red spruce, white spruce, eastern hemlock, red maple, yellow birch, gray birch, paper birch, sugar maple, alders, and aspen.

Paxton and Paxton-Charlton Series

The Paxton and Paxton-Charlton soil series are well drained, very stony, fine, sandy loam. Soil depths are typically deep and surface runoff potential can range from negligible to fairly high. Common tree species include northern red oak, sugar maple, red maple, gray birch, white ash, beech, white pine, and hemlock.

Woodbridge Series

The Woodbridge soil series are moderately well drained and loamy soils that are formed in Lodgment till. Soil depths are typically deep to bedrock and surface runoff is moderate to very high. Common tree species associated with this soil series include red oak, white ash, sugar and red maple, hemlock, and white pine.

Scio Series

The Scio soil series are moderately well drained soils formed in alluvial sediments and dominated by silt and very fine sand. These soils are often found on terraces, old alluvial fans, lake plains, outwash plains, and lakebeds. The potential for surface runoff is very low to high. Common tree species associated with this soil series include red oak, sugar maple, black cherry, hemlock, and white pine.

Rifle Series

The Rifle soil series are very poorly drained soils formed in organic deposits in bogs, depressional areas within ground moraines, end moraines, outwash plains and lake plains. These soils also have moderately rapid permeability and surface runoff, and internal drainage is very slow. Common tree species associated with this soil series include tamarack, black spruce, paper birch, balsam fir, black ash, and northern white cedar.

Ridgebury Series

The Ridgebury soil series are somewhat poorly to poorly drained soils formed in Lodgment till. Runoff in these soil types is negligible to medium. Common tree species associated with this soil series include gray birch, yellow birch, red maple, hemlock, elm, spruce, and balsam fir.

Biddeford Series

The Biddeford soil series are very deep and very poorly drained soils. These soils are often formed in glaciolacustrine or glacialmarine deposits on coastal lowlands and in river valleys, and this soil can be intermittently ponded. Common tree species associated with this soil series include northern white cedar, red spruce, black spruce, balsam fir, and red maple.

Hartland Series

The Hartland series are very deep and very well drained soils. They are formed in silty eolian or glaciolacustrine deposits and the potential for surface runoff is low to high. Common tree species associated with this soil series include white pine, white oak, red oak, sugar maple, ash, yellow and white birch, American beech, and hemlock.

Scantic Series

The Scantic soil series are poorly drained silt loam. These soils are typically deep with slow surface runoff and good infiltration. Common tree species associated with this soil series includes red maple, elm, gray birch, white ash, balsam fir, red and white spruce, tamarack, and some eastern white pine.

Table 2: North and South Narrows—Forest Soil Series, Acreage, Drainage Class, and Parent Material

Peninsula & Stand	Soil Symbol	Soil Series Name & Description	Acres	Drainage Class	Parent Material
North Stand A & B	HrB	Lyman-Tunbridge complex, 0–8 percent slopes, rocky	10.8	Somewhat excessively drained	Loamy supraglacial till
North Stand A & B	HrC	Lyman-Tunbridge complex, 8–15 percent slopes, rocky	41.7	Somewhat excessively drained	Loamy supraglacial till
South Stand C	BuB2	Lamoine silt loam, 3–8 percent slopes	2.1	Somewhat poorly drained	Fine glaciomarine deposits
South Stand A & B	PcB	Paxton very stony fine sandy loam, 3–8 percent slopes	11.4	Well drained	Coarse-loamy lodgment till
South Peninsula	PcC	Paxton very stony fine sandy loam, 8–15 percent slopes	32.9	Well drained	Coarse-loamy lodgment till
South Stand A & C	PeD	Paxton-Charlton very stony fine sandy loams, 15–30 percent slopes	13.8	Well drained	Coarse-loamy lodgment-till
South Stand C	ScA	Scantic silt loam, 0–3 percent slopes	3.3	Poorly drained	Glaciomarine deposits

Table 3: North and South Narrows—Soil Type Attributes: Site Index, Harvesting Equipment Operability, and Soil Rutting Hazard

Peninsula & Stand	Soil Symbol	Site Index	Harvest Equipment Operability*	Soil Rutting Hazard*
North Stand A & B	HrB	53 - Northern red oak	Well suited—N/A	Moderate—low strength 0.38
North Stand A & B	HrC	53 - Northern red oak	Well suited—N/A	Moderate—low strength 0.38
South Stand C	BuB2	60 - Eastern white pine	Moderately suited—wetness 0.83	Severe—wetness 0.83
South Stand A & B	PcB	66 - Eastern white pine	Moderately suited—wetness 0.17	Moderate—wetness 0.17
South Peninsula	PcC	60 - Sugar maple	Moderately suited—wetness 0.17	Moderate—wetness 0.17
South Stand A & C	PeD	66 - Eastern white pine	Moderately suited—slope 0.50 and wetness 0.17	Moderate—wetness 0.17 and low strength 0.38

Peninsula & Stand	Soil Symbol	Site Index	Harvest Equipment Operability*	Soil Rutting Hazard*
South Stand C	SCA	60 - Eastern white pine	Moderately suited—wetness 0.83	Severe—wetness 0.83

*Rating reasons: numeric ratings 0–1.00, 0 being no limitation for soil feature.

Table 4: Soil Type Attributes for All Shoreline Property

Map Unit Symbol	Map Unit Name	Natural Drainage Class	Harvesting Equipment Operability*	Site Index (white pine)
Bo	Biddeford mucky peat, 0–3 percent slopes	Very poorly drained	Poorly suited (low strength and wetness)	N/A
BuB2	Lamoine silt loam, 3–8 percent slopes	Somewhat poorly drained	Moderately suited (low strength)	N/A
HfC	Hartland very fine sandy loam, 8–15 percent slopes	Well drained	Moderately suited (low strength)	N/A
HfD	Hartland very fine sandy loam, 15–25 percent slopes	Well drained	Moderately suited (low strength)	N/A
HrB	Lyman-Tunbridge complex, 0–8 percent slopes, rocky	Somewhat excessively drained	Well suited	56
HrC	Lyman-Tunbridge complex, 8–15 percent slopes, rocky	Somewhat excessively drained	Well suited	56
HrD	Lyman-Tunbridge complex, 15–35 percent slopes, rocky	Somewhat excessively drained	Moderately suited (slope)	56
HtD	Lyman-Abram-Rock outcrop complex, 15–35 percent slopes	Somewhat excessively drained	Moderately suited (slope)	56
PcB	Paxton very stony fine sandy loam, 3–8 percent slopes	Well drained	Moderately suited (low strength)	66
PcC	Paxton very stony fine sandy loam, 8–15 percent slopes	Well drained	Moderately suited (low strength)	66
PdB	Paxton-Charlton fine sandy loams, 3–8 percent slopes	Well drained	Moderately suited (low strength)	66

Map Unit Symbol	Map Unit Name	Natural Drainage Class	Harvesting Equipment Operability*	Site Index (white pine)
PdC2	Paxton-Charlton fine sandy loams, 8–15 percent slopes, eroded	Well drained	Moderately suited (low strength)	66
PdD2	Paxton-Charlton fine sandy loams, 15–25 percent slopes, eroded	Well drained	Moderately suited (low strength & slope)	66
PeB	Paxton-Charlton very stony fine sandy loams, 3–8 percent slopes	Well drained	Moderately suited (low strength)	66
PeC	Paxton-Charlton very stony fine sandy loams, 8–15 percent slopes	Well drained	Moderately suited (low strength)	66
PeD	Paxton-Charlton very stony fine sandy loams, 15–30 percent slopes	Well drained	Moderately suited (low strength & slope)	66
RcA	Ridgebury fine sandy loam	Poorly drained	Well suited	67
RdA	Ridgebury very stony fine sandy loam	Poorly drained	Well suited	67
RF	Rifle mucky peat	Very poorly drained	Poorly suited (low strength)	N/A
ScA	Scantic silt loam, 0–3 percent slopes	Poorly drained	Moderately suited (low strength)	N/A
SkB	Scio very fine sandy loam, 3–8 percent slopes	Moderately well drained	Moderately suited (low strength)	75
WrB	Woodbridge fine sandy loam, 3–8 percent slopes	Moderately well drained	Moderately suited (low strength)	67
WsB	Woodbridge very stony fine sandy loam, 3–8 percent slopes	Moderately well drained	Moderately suited (low strength)	67

*Rating reason in parenthesis

NON-TIMBER RESOURCES AND RECOMMENDATIONS

THREATENED AND ENDANGERED SPECIES, AND RARE OR EXEMPLARY NATURAL COMMUNITIES

According to the results from the Maine Natural Areas Program (MNAP) review (see Appendix 6: Maine Natural Areas Program Results) there is a mapped Deer Wintering Area along the northwestern shore in Vassalboro. There is also a moderate value Inland Waterfowl and Wading Bird Habitat (IWWH). The MNAP also notes that any lack of data may indicate minimal survey efforts rather than an absence of rare features. However, the general area is also mapped as Atlantic salmon critical habitat because of the proximity to China Lake and associated streams that flow into the Kennebec River. Atlantic salmon require cool, clean, well-oxygenated water in streams, rivers, ponds, and lakes.

Recommendations

Active forest management can help to maintain the Deer Wintering Area habitat to ensure the continued availability of conifer shelter and continuous cover (see Appendix 7: DIFW Guidelines for Wildlife—Managing Deer Wintering Areas in Northern, Western, and Eastern Maine). The Maine Department of Inland Fisheries and Wildlife recommends maintaining a 250-foot undisturbed buffer (of permanent clearings, roads, etc.) around the IWWH area and wetland. Within this buffer, uneven-aged forest management is recommended, no trees should be cut within 75 feet of the shoreline, and snags and cavity trees should be left to provide nesting sites for waterfowl and several other wildlife species. The management recommendations will also help to maintain the important potential critical habitat for Atlantic salmon. Harvesting recommendations in this plan are designed to maintain and protect these habitats, the water resource, follow applicable BMPs to prevent sedimentation into the lake, and maintain adequate native vegetation.

FISH AND WILDLIFE HABITAT ELEMENTS

This forested property around the West Basin of China Lake has potential to provide suitable habitat for several wildlife species because of the proximity to the lake and adjacent forestland. Evidence of small mammals and several bird species were observed during the inventory and site visits to the property.

Recommendations

Although the landowner's objectives do not directly address wildlife and wildlife habitat as a priority, the recommended forest conditions that apply to the landowner's goals will increase the structural diversity across the property and will incidentally suit several wildlife species. The property should be periodically monitored for evidence of over-browsing and/or detrimental effects to the growing forest by wildlife species.

WATER QUALITY, WETLANDS, RIPARIAN AREAS

The property in this plan surrounds the entire West Basin of China Lake. Several small freshwater forested/shrub wetlands, freshwater emergent wetlands, and riverine/streams classified by the U.S. Fish and Wildlife Service National Wetlands Inventory are found across the property (see Appendix 4: Wetlands and Terrain Maps).

Recommendations

The water quality of China Lake is a high concern for the KWD as it serves as their sole water source. Properly managing the forest resources is very important because it can directly impact the water quality in the lake. Managing for commercial forest products and protecting the water quality of China Lake can be executed properly by following all applicable BMPs outlined in the Maine Forest Service's *Best Management Practices for Forestry: Protecting Maine's Water Quality*. The KWD's intent is to go above and beyond the BMP standards as water quality is one of their main concerns. BMPs are intended to minimize the risk of sediment and other pollutants from getting into waterbodies, maintain the natural flow of water in streams and wetlands, and protect shoreland vegetation. Other considerations and management actions to protect the water quality while timber harvesting include considering and planning timber harvests during dry or frozen conditions when the ground is more stable, diverting the flow of direct runoff away from water bodies when road and trail building, maintaining bank integrity and approaches to water crossings, and designing crossings appropriately for the length of time they remain in place. For example, permanent trail or road crossings that will not be maintained should be designed for at least a 25-year flood event, and temporary crossings should be removed at the end of the harvest. In addition to conventional nonpoint source pollution controls, all harvesting equipment should carry spill kits. To achieve the goals and intent of going above and beyond the BMP standards, qualified contactors and licensed foresters should be used to conduct and oversee the timber harvesting operations recommended in this plan. These recommendations geared toward protecting water quality combined with the silvicultural systems prescribed in this plan will make strong efforts to achieve the landowner's goals of growing and harvesting commercial forest products to establish and perpetuate an uneven aged, mixed species forest to protect the water quality in China Lake.

HISTORICAL, CULTURAL, AND ARCHEOLOGICAL SITES

The evidence of old cellar holes and stone walls found throughout this property supports the history of past settlement and previous use of the land for agricultural purposes. As previously mentioned, several homesteads used to dot the shoreline of the West Basin of China Lake prior to the KWD's acquisition of the property. The results from the Maine Historic Preservation Commission (MHPC) Archaeology and Historic Resources Review noted that there were no Native American (prehistoric) archeological sites known because no survey has been conducted. However, there is potential for the area within fifty yards of the lake to be sensitive. The MHPC also notes that there are possible and known sites of former houses, barns, and outbuildings that are shown on an 1861 map of the area and are now recognizable as foundations or cellar holes (see Appendix 8: Maine Historic Preservation Commission Results).

Recommendations

It is recommended to be cautious when harvesting within fifty yards of the water. If any evidence of Native American (prehistoric) archeology is found, MHPC should be contacted. Prior experience in preserving old stone walls and cellar holes suggests removing any trees (where possible without further damaging the structure) that are growing up within the cellar holes or stone walls. Removing these trees will help preserve and prevent the structures from being destroyed by new growth.

RECREATIONAL OPPORTUNITIES

The KWD prohibits the use of their forested property to the public and to recreation in general. This is part of an effort to protect the public drinking water source. The KWD also prohibits bathing, swimming,

water skiing, and personal watercraft use on the West Basin of China Lake. Maine Law (Chapter 120 An ACT to Prevent the Pollution of the Waters of China Lake) enacted in 1969, forbids trespass on the Kennebec Water District's property bordering the lake for the purpose of preventing pollution to the public water supply. A boat landing facility for public access to China Lake is located in East Vassalboro off from Route 32, and at the southern tip of the North Peninsula, there is a small beach with two picnic tables that are utilized during the summer months by boaters and other recreationists using the lake. There are also signs posted here to inform the public about the restrictions in the West Basin of China lake and on the shoreline property.

Recommendations

Developing and posting updated signs at the beach access points, boat landings, and at other access points to the KWD's property is recommended to establish a physical presence on the property and to improve public relations. Posting updated signage will help to inform and educate the public about the restrictions within the West Basin of the lake, its use as a public water supply, and the forest management occurring on the ownership.

LONG-RANGE SILVICULTURAL GOALS AND OBJECTIVES

The long-range silvicultural goals across the property are to establish and maintain an uneven aged, diverse vertical and horizontal forest structure of mixed species, and to maintain a continuous forest cover in perpetuity. According to the watershed forest management of the Quabbin Reservoir which is part of Boston's primary water supply, an optimal watershed protection forested landscape contains layers or patch characteristics of regeneration, vigorous young and middle age trees and stands to sequester nutrients and accumulate biomass, and mature trees and stands to ensure the mixed species regeneration (see Appendix 9: Quabbin Reservoir Massachusetts: Managing a Watershed Protection Forest). The recommendations proposed in this plan will strive to achieve a similar diverse forested landscape and should always utilize adaptive forest management. The objectives involve releasing desirable, high vigor, and middle age trees that will be able to sustain potential environmental stressors. Additional objectives include opening up patches for regeneration while maintaining mature trees through active sustainable forest management. The recommended long-term silvicultural systems include thinning treatments, irregular shelterwood and selection harvests on a 20–30 year cycle to guide the development and maintenance of structurally diverse stands. These objectives are particularly important to meet the landowner's goals of growing and harvesting commercial forest products and protecting the water quality of China Lake.

LEGAL OBLIGATIONS

The recommended timber harvests on this property should follow all pertinent laws, rules, regulations, and guidelines in the State of Maine as detailed in the *Forestry Rules of Maine 2017 2nd Edition*. The Department of Agriculture, Conservation, and Forestry must be notified prior to timber harvesting by submitting a Forest Operations Notification of Intent to Harvest to the Maine Forest Service. A landowner report of harvesting activities will be required at the end of each year for active/open FONS.

Timber harvesting activities must be consistent with the *Town of China Land Use Ordinance Chapter 2, Section R—Timber Harvesting, and Section 7—Guidelines for Timber Harvesting in China*. The town of China has their own Shoreland Zoning Standards, and portions of this property fall within the town of China Shoreland Zoning. This zoning ordinance outlines specific restrictions and conditions that must be

met when harvesting timber. Consulting with a licensed Forester and the Town of China Code Enforcement Officer is recommended to ensure compliance when timber harvesting. In addition, and only required in the Town of China, a separate Notice of Intent to Harvest Timber must also be submitted and approved by the town Code Enforcement Officer.

Timber harvesting activities in the Town of Vassalboro must be consistent with the *Maine Forest Service Rule - Chapter 21 Statewide Standards for Timber Harvesting and Related Activities in Shoreland Areas*. This zoning ordinance outlines specific restrictions and conditions that must be met when harvesting timber in shoreland areas. Consulting with a licensed Forester is recommended to ensure compliance when timber harvesting.

There are no clear-cuts under the Maine Forest Practices Act (Maine Forest Service Chapter 20) recommended, nor are any liquidation harvests under Maine Forest Service Chapter 23 recommended in this plan. Other than the access easement to the South Narrows Peninsula, there are no known easements or deed restrictions associated with the property.

INDIVIDUAL STAND DESCRIPTIONS AND PRESCRIPTIONS

FIELD METHODS STATEMENT

North and South Narrows Peninsulas

The property corner monuments and boundaries were located and marked with a GPS unit using the land survey provided by the KWD. A pre-cruise inventory was conducted in the fall of 2017 to determine the coefficient of variation across the property and the total number of sample plots necessary to measure in the final forest inventory. The 2013 Geolibary Orthophotos from the Maine Office of GIS and on-the-ground field notes were used to delineate stand boundaries.

Per NRCS requirements, a final forest inventory was implemented to show that the estimated mean basal area per acre for each inventoried stand was within an allowable error less than 30 percent with a probability (confidence level) of 68 percent (see Table 5). To meet this requirement and reduce any bias, a GIS platform was used to systematically place 12 variable radius sample plots across the North Narrows Peninsula and 24 variable radius sample plots across the South Narrows Peninsula. The final forest inventory was conducted in January of 2018.

Table 5: Sample Plots per Stand and Inventory Accuracy

Stand	Acreage	Sample Plots	Inventory Sampling Error in Percent with 68 percent Confidence Level
North Stand A	37	7	5.3
North Stand B	15.5	5	13.3
South Stand A	23	7	9.1
South Stand B	17	7	13.1
South Stand C	23.5	10	10.7

The center of each sample plot was located on the ground with a handheld GPS unit. At each sample plot center, a 15 basal area factor (BAF) prism was used to determine the in trees that would be inventoried in that plot. For every in tree, the species, value class (1=desirable quality tree, 2=acceptable quality tree, and 3=live cull tree), and diameter at breast height (DBH) was measured and recorded. A large BAF (combined 15 and 20 BAF prisms) were used to determine the in height trees to measure at each sample plot. DBH was measured using a diameter tape and tree heights were measured using a vertex 4 haglof. A sapling inventory was conducted at each sample plot center to record the tree species and DBH on every tree ≤ 4.5 inches DBH within an 8-foot fixed radius (1/217-acre plot).

Microsoft Excel was used to summarize the inventory data and Microsoft Access was used to input data into the Forest Vegetation Simulator (FVS) and Suppose Interface, USDA Forest Service program. The Northeast FVS variant was used to derive specific measurements about each inventoried stand, simulate management actions, and project the future condition of each stand. It is also important to note that when simulating harvests in FVS, the sapling inventory data was included in the projections. All data interpretation is assumed to be as accurate as known possible and is subject to the accuracy of the field methods, the data summarization, and the FVS projected models. Volume estimates were generated using the tree value classes and current market specifications for pulpwood and sawlogs. FVS outputs of pulpwood were calculated and reported in cubic feet and outputs of sawlogs were calculated and reported in board feet using the international $\frac{1}{4}$ -inch log rule.

Remaining Shoreline Property

Several site visits to the property were made between Fall 2017 and June 2019 to collect data for property line work and to make field observations and ocular estimates about the forested stands along the shoreline property.

See Appendix 1: Forest Stand Type Maps for illustrations of the following stand descriptions.

NORTH NARROWS PENINSULA (52.5 ACRES) CHINA, MAINE

North Stand A Description (Approximately 37 acres—SH3A)

Stand Composition and Structure

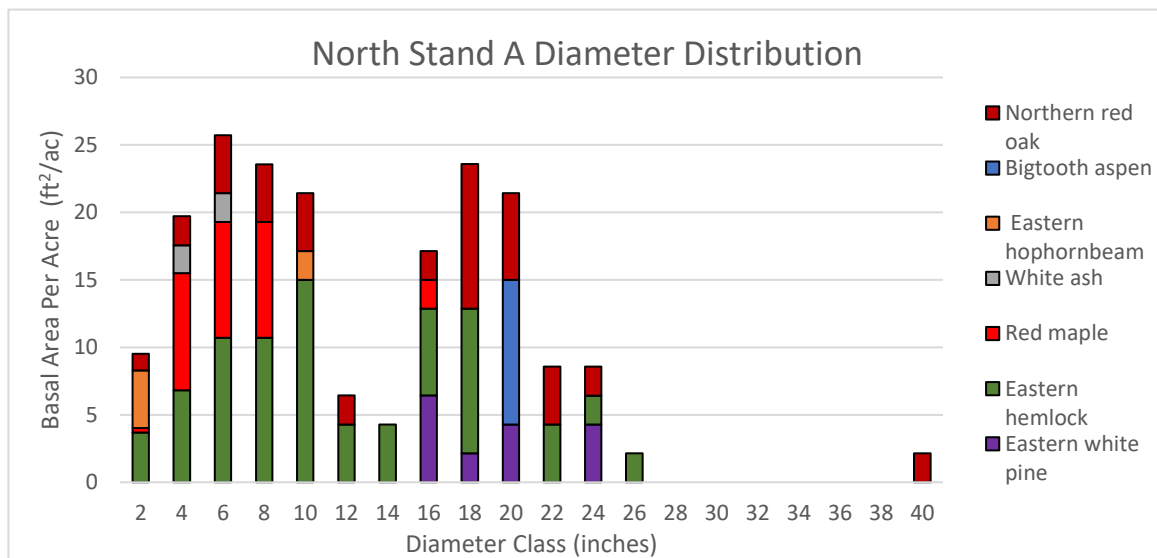
North Stand A is a mixed wood stand where neither hardwood nor softwood species dominate the species composition over the other. Softwood species make up approximately 51 percent of the total basal area. Of that 51 percent, 42 percent is eastern hemlock ranging in diameter classes from 2–26 inches, and eastern white pine in the 16–24 inch diameter classes comprise 9 percent of the softwood species basal area. Hardwood species of northern red oak in the 2–12 inch and 16–24 inch diameter classes make up 24 percent, and red maple in the 2–8 inch diameter classes make up 14 percent of the total basal area. Present species also include bigtooth aspen in the 20 inch diameter class, white ash in the 4–6 inch diameter classes and eastern hophornbeam in the 2 and 10 inch diameter classes. This distribution is displayed in Figure 2: North Stand A Diameter Distribution by Basal Area per Acre.

The majority of this stand is in the stem exclusion stage of development where sunlight is restricted from reaching the understory, and new age classes are excluded. In these areas of the stand, there is little to no understory present. Portions of the stand are in the understory re-initiation stage of development which has allowed sunlight to penetrate through gaps in the canopy as a result of overstory tree mortality and/or branch abrasion. This has allowed for some of the advance regeneration

in the understory to become established. The present understory species in these areas include eastern hemlock, northern red oak, red maple, and eastern hophornbeam.

There is also a small 0.34-acre forested wetland as classified by the U.S. Fish and Wildlife Service National Wetlands Inventory in the northern portion of this stand.

Figure 2: North Stand A Diameter Distribution by Basal Area per Acre



Stand Age/History

The diameter distribution of this stand suggests a multi-structured, uneven aged stand. The concentration of basal area is split between merchantable trees in larger diameter classes (16–26 inches) and trees in the smaller (4–10 inch) classes. In general, this stand does not appear to have been salvaged to the same extreme degree as North Stand B during the 1996 salvage harvest. Although, the structure of this stand suggests events that allowed a new age class to become established through some disturbance event and/or canopy openings from overstory tree mortality and branch abrasion.

Stand Stocking/Quality/Volume

The majority of the merchantable size class of this stand is mature growth of greater than 50 feet in height, and the stand is overstocked with 75–100 percent crown closure.

The overall quality of the merchantable trees in this stand ranges from desirable to acceptable in terms of potential forest products. Acceptable quality eastern hemlock accounts for 33 percent of the total merchantable volume per acre on this stand followed by desirable quality northern red oak making up 21 percent, desirable quality eastern white pine making up 13 percent, and acceptable quality bigtooth aspen making up 8 percent of the total merchantable volume. The total per acre values for the standing volume on this stand are displayed in Table 6, Table 7, and Table 8 below.

Table 6: North Stand A Inventory Metrics

	Basal Area (square feet/acre)	Trees Per Acre	Quadratic Mean Diameter (inches)
Including saplings	195	1,178	5.5
Trees >4.5 inches DBH	174	372	9.3

Table 7: North Stand A Pulpwood Volume by Species

Product	Volume (cubic feet/acre)	Volume (tons/acre)
Red maple pulp	325	8.13
White ash pulp	32	0.80
Red oak pulp	378	12.10
Aspen pulp	342	7.35
Hophornbeam pulp	45	1.35
Eastern hemlock pulp	1,384	34.6
White pine pulp	24	0.42
Total pulp	2,530	64.74

Table 8: North Stand A Sawlog Volume by Species

Species/Product	Volume (board foot/acre)	Volume (MBF/Acre)
Red maple logs	250	0.25
Red oak logs	4,822	4.82
Eastern hemlock logs	1,648	1.65
White pine logs	3,173	3.17
Total logs	9,893	9.89

Growth Rate

A site index of 53 for northern red oak was derived from the soils data and applied to this stand in FVS to project growth. At a base age of 50, the average height of dominant and codominant trees is expected to average 53 feet.

Based on the FVS projections for this stand, the average growth per year is approximately 90ft³ per acre. With no active management, this volume per acre will typically start to decline overtime and/or the mortality rate will increase. Active management will increase the volume per acre per year and capture mortality (see Table 9).

Table 9: North Stand A Growth and Mortality

	Unmanaged		Managed	
Year	Growth/Year (cubic feet/acre)	Mortality/Year (cubic feet/acre)	Growth/Year (cubic feet/acre)	Mortality/Year (cubic feet/acre)
2018	90	20	*62	*1
2028	98	27	75	4
2038	98	31	*62	*0
2048	93	42	75	3
2058	91	51	96	4

* Represents year of active management.

North Stand A Prescription

North Stand A is almost entirely within the 250 foot Shoreland Zoning buffer. A thinning throughout the diameter range is recommended within this planning period to remove the mature and poor quality stems and release the young and middle age class trees. This thinning should favor and promote species of northern red oak and eastern white pine as they are more resilient to changes in climate conditions. The thinning should also favor the desirable quality red maple and aim to reduce a portion of the hemlock component. The stem exclusion eastern hemlock/northern red oak/aspen dominated areas of the stand will benefit from this treatment by improving growth on the residual trees. In areas where advance regeneration is present, desirable species that exhibit high vigor and are of desirable and acceptable quality growing stock should be favored. This thinning treatment will remove no more than 40 percent of the total volume per acre of trees 4.5 inches DBH or greater, and will leave a well-distributed stand of trees per town of China Shoreland Zoning Ordinances. The average residual stand basal area will be reduced to approximately 117ft² per acre (suggested residual stocking for mixed wood stands (see Appendix 10: Northern Hardwood (Revised) Stocking Guide). The removal should be focused on the unacceptable quality trees, the mature eastern hemlock, mature northern red oak and all aspen to capture their value as several snags are already present.

The small 0.34-acre forested wetland classified by the U.S. Fish and Wildlife Service National Wetlands Inventory in the northern portion of this stand should be avoided when harvesting.

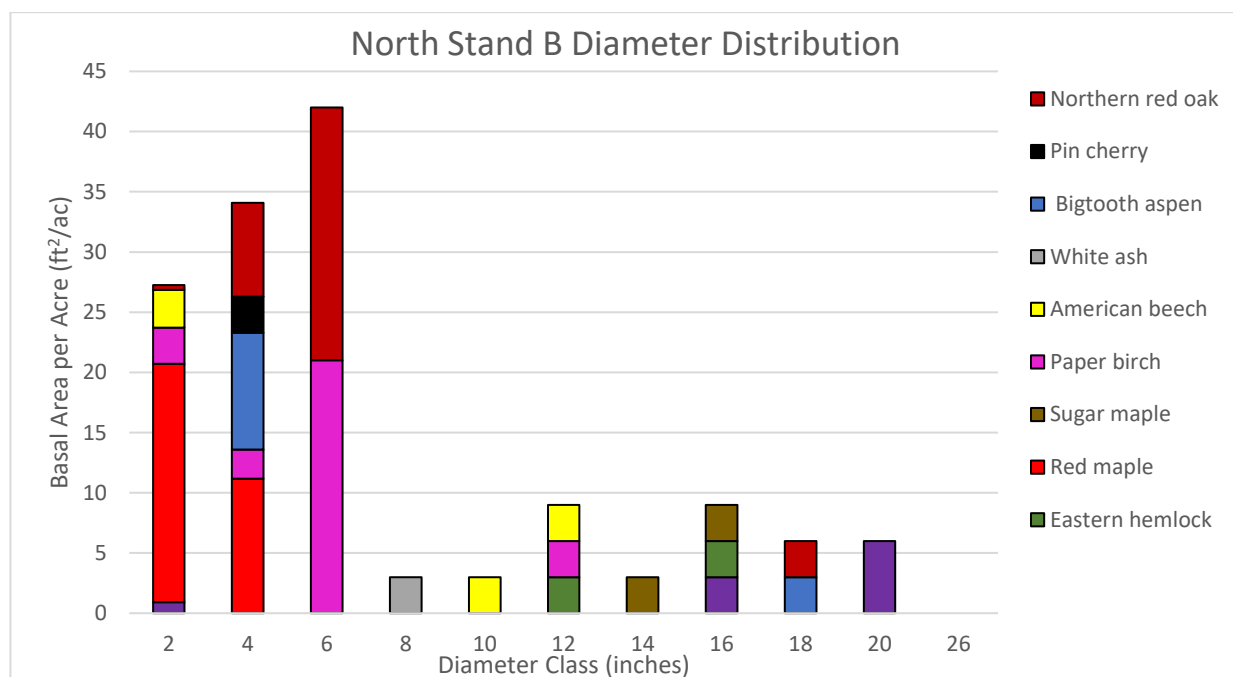
This stand should be monitored periodically and reentered in roughly 15–20 years (or in sync with treatments in North Stand B) for continuous cover irregular shelterwood establishment cuts to open the stand up enough to promote the regeneration of new age classes while maintaining continuous cover to promote an uneven aged multi-structured stand. The stand should be reevaluated at the end of this planning period and before further management action occurs.

North Stand B Description (Approximately 15.5 acres–H2B)

Stand Composition and Structure

North Stand B is dominated by mixed hardwood species. Roughly 22 percent of the total basal area is comprised of northern red oak in the 4–6 inch diameter classes and 18 inch diameter class. Red maple in the 2–4 inch diameter class also makes up roughly 22 percent of the total basal area, and approximately 20 percent of the basal area is made up of paper birch in the 2–6 inch and 12 classes. Present species also include eastern white pine in the 16 and 20 inch diameter classes, bigtooth aspen, eastern hemlock, sugar maple, white ash, and pin cherry scattered through the diameter classes. This distribution is displayed in Figure 3.

Figure 3: North Stand B Diameter Distribution by Basal Area per Acre



This stand exhibits an understory re-initiation stage of development. The 1995–96 wind storm and salvage harvest altered this stand to its current condition by opening up the canopy and allowing advance regeneration to become established and released in the understory. Present understory species include red maple, paper birch, bigtooth aspen, American beech, pin cherry and northern red oak.

Stand Age/History

The diameter distribution of this stand suggests a multi-structure, uneven aged stand. As previously mentioned, the disturbance event in 1995–96 opened the canopy up significantly allowing advance regeneration to become established and released while residuals from the original age class remained. This previous disturbance event created the current structure of the stand with the majority of the basal area concentrated in the smaller diameter classes. An old road utilized during the salvage harvest also runs through the center of this stand.

Stand Stocking/Quality/Volume

The majority of the trees in this stand are small merchantable stems in the mid growth to mature growth size class averaging heights of approximately 30–50 feet. The stocking of this stand is medium stocked with approximately 50–75 percent crown closure.

Acceptable quality paper birch makes up 24 percent of the total merchantable volume per acre followed by acceptable quality northern red oak making up 16 percent, desirable quality eastern white pine making up 12 percent, and American beech making up 9 percent of the total merchantable volume per acre. As the diameter distribution displays, most of the basal area is concentrated in the smaller diameter size classes. The total per acre values for the standing volume on this stand are displayed in Table 10, Table 11 and Table 12.

Table 10: North Stand B Inventory Metrics

	Basal Area (square feet/acre)	Trees Per Acre	Quadratic Mean Diameter (inches)
Including saplings	144	2,863	3.0
Trees >4.5" DBH	92	389	6.6

Table 11: North Stand B Pulpwood Volume by Species

Species/Product	Volume (cubic feet/acre)	Volume (tons/acre)
Sugar maple pulp	98	2.70
American beech pulp	160	4.32
Paper birch pulp	415	10.79
White ash pulp	63	1.58
Red oak pulp	279	8.39
Aspen pulp	91	1.96
Eastern hemlock pulp	159	3.98
White pine pulp	56	0.98
Total pulp	1,321	35.22

Table 12: North Stand B Sawlog Volume by Species

Species/Product	Volume (board foot/acre)	Volume (MBF/acre)
Sugar maple logs	453	0.45
Red oak logs	510	0.51

Species/Product	Volume (board foot/acre)	Volume (MBF/acre)
White pine logs	1,456	1.46
Total logs	2,419	2.42

Growth Rate

A site index of 53 for northern red oak was derived from the soils data and applied to this stand in FVS to project growth. At a base age of 50, the average height of dominant and codominant trees is expected to average 53 feet.

Based on the FVS projections for this stand, the average growth per year is approximately 82ft³/acre. With no active management, this volume per acre will typically start to decline overtime and/or the mortality rate will increase. Active management will increase the volume per acre per year and capture mortality (see Table 13).

Table 13: North Stand B Growth and Mortality

Year	Unmanaged		Managed	
	Growth/Year (cubic feet/acre)	Mortality/Year (cubic feet/acre)	Growth/Year (cubic feet/acre)	Mortality/Year (cubic feet/acre)
2018	82	15	58*	1*
2028	81	34	75	5
2038	123	41	62*	1*
2048	122	48	66	3
2058	127	47	73	7

* Represents year of active management

North Stand B Prescription

The silvicultural systems recommended in this stand should serve as a restoration tool from the past wind storm and salvage harvest. This past event initiated the desirable long-term structure, but resulted in residual low quality regeneration on portions of this stand. A crop tree release is recommended in this planning period and should be scheduled at the same time as the thinning in North Stand A. This type of thinning can be beneficial in hardwood stands to promote growth and increase the quality of individual trees. Released crop trees will develop larger root systems overtime, thus increasing their resilience to potential environmental stressors. The crop trees to focus on releasing should exhibit qualities of high vigor, single stem when possible, and of a desirable species such as northern red oak, sugar maple, and red maple. These crop trees will need to be marked prior to harvesting and should be spaced accordingly to promote radial growth without initiating epicormic branching. A basal area of approximately 75ft²/acre (quality line residual stocking for northern hardwood stands) (see Appendix

10: Northern Hardwood (Revised) Stocking Guide) should be retained, a total removal of approximately 69ft²/acre.

This stand should be monitored periodically and reentered in roughly 15–20 years. Some of the mature crop trees previously released should be harvested at this time while others should be retained to achieve an uneven aged, multi-structure stand with patch characteristics of regeneration, young-middle aged trees, and mature trees. A low thinning to remove the stems in the lower canopy classes to capture future mortality from self-thinning or differentiation, and the removal of the unacceptable growing stock is also recommended. Species of eastern white pine, northern red oak, sugar maple, and red maple of desirable quality should be favored. The stand should be reevaluated at the end of this planning period and before further management action occurs.

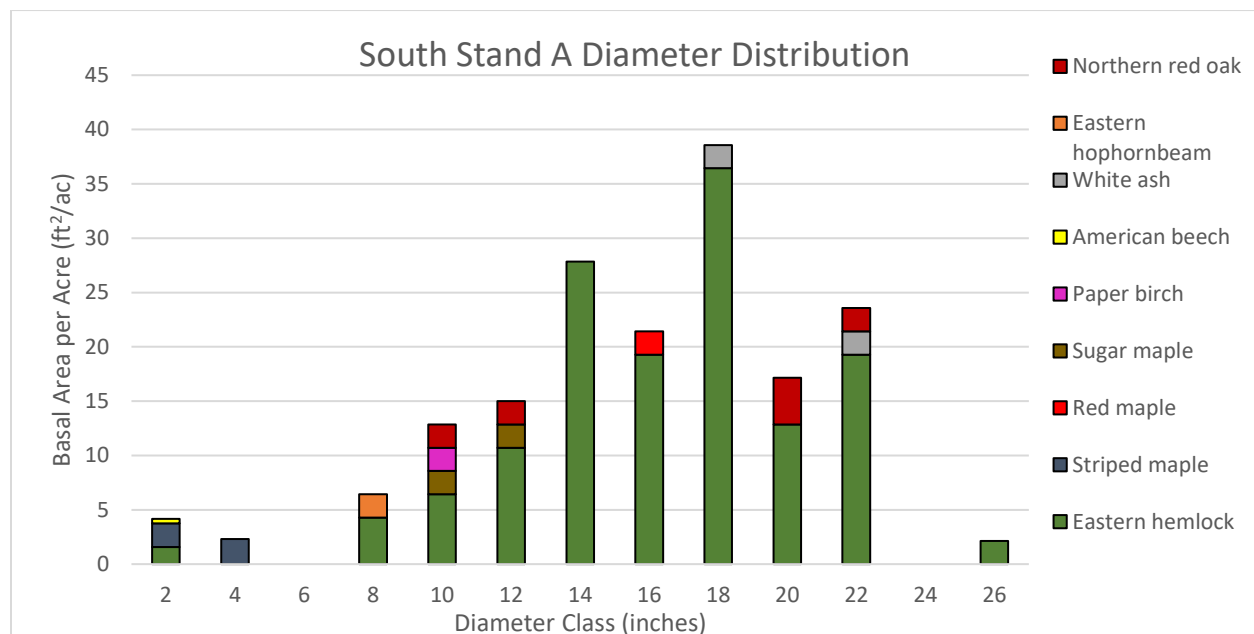
SOUTH NARROWS PENINSULA (63.5 ACRES) CHINA, MAINE

South Stand A Description (Approximately 23 acres—S3A)

Stand Composition and Structure

South Stand A is a softwood dominated stand of predominantly eastern hemlock ranging from the 8–26 inch diameter classes and accounts for 82 percent of the total basal area per acre. The remaining 18 percent of the total basal area is made up of mostly hardwood species. Of that 18 percent of hardwood species, 6 percent of the stand is northern red oak ranging in the 10–12 and 20–22 inch diameter classes. Present species also include sugar maple, red maple, paper birch, American beech, white ash, striped maple, bigtooth aspen and eastern hophornbeam. This distribution is displayed in Figure 4.

Figure 4: South Stand A Diameter Distribution by Basal Area per Acre



This stand exhibits similar structure and development to North Stand A. The majority of the stand is in the stem exclusion stage of development with small portions in understory re-initiation. The understory is made up of mostly eastern hemlock, striped maple, eastern hophornbeam, and sugar maple.

Stand Age/History

The diameter distribution displays a multi-structure, even aged stand, generally speaking of the hemlock component. A significant old road runs the length of this stand and a few skid trails branch off this road. Other than the use of the road in this stand, it does not appear to have been as greatly affected by the 1995–96 wind storm or salvage harvest.

Stand Stocking/Quality/Volume

The merchantable size class of this stand is mature growth of greater than 50 feet in height, and fully to overstocked with 75–100 percent crown closure.

Acceptable quality eastern hemlock accounts for 67 percent of the total merchantable volume per acre on this stand followed by desirable quality eastern hemlock making up 19 percent, acceptable quality northern red oak making up 6 percent, and desirable quality white ash making up 3 percent of the merchantable volume per acre. The total per acre values for the standing volume on this stand are displayed in Table 14, Table 15 and Table 16 below.

Table 14: South Stand A Inventory Metrics

	Basal Area (square feet/acre)	Trees Per Acre	Quadric Mean Diameter (inches)
Including saplings	172	855	6.1
Trees >4.5" DBH	165	142	14.6

Table 15: South Stand A Pulpwood Volume by Species

Species/ Product	Volume (cubic feet/acre)	Volume (tons/acre)
Red maple pulp	54	1.35
Sugar maple pulp	112	3.08
Paper birch pulp	57	1.48
White ash pulp	11	0.28
Red oak pulp	312	9.98
Hophornbeam pulp	38	1.14
Eastern hemlock pulp	3,251	81.28
Total pulp	3,835	98.59

Table 16: South Stand A Sawlog Volume by Species

Species/ Product	Volume (board foot/acre)	Volume (MBF/acre)
White ash logs	764	0.76
Eastern hemlock logs	5,378	5.38
Total logs	6,142	6.14

Growth Rate

A site index of 60 for sugar maple was derived from the soils data and applied to this stand in FVS to project growth. At a base age of 50, the average height of dominant and codominant trees is expected to average 60 feet.

Based on the FVS projections for this stand, the average growth per year is approximately 84ft³/acre. With no active management, this volume per acre will typically start to decline overtime and/or the mortality rate will increase. Active management will increase the volume per acre per year and capture mortality (see Table 17).

Table 17: South Stand A Growth and Mortality

Year	Unmanaged		Managed	
	Growth/Year (cubic feet/acre)	Mortality/Year (cubic feet/acre)	Growth/Year (cubic feet/acre)	Mortality/Year (cubic feet/acre)
2018	84	3	53*	0*
2028	84	15	55	1
2038	85	18	40*	0*
2048	88	28	62	1
2058	83	33	90	3

* Represents year of active management

South Stand A Prescription

South Stand A is almost entirely within the 250 foot Shoreland Zoning buffer. A thinning throughout the diameter range is recommended within this planning period to release a larger component of the hardwood species and the young and middle age class trees. The thinning should favor the desirable quality northern red oak and sugar maple trees. The stem exclusion hemlock dominated areas of the stand will benefit from this treatment by improving the growth of the residuals. In areas where advance regeneration is present, desirable species that exhibit high vigor and are of desirable and acceptable quality growing stock should be favored. This thinning treatment will remove no more than 40 percent of the total volume per acre of trees 4.5 inches DBH or greater, and will leave a well-distributed stand of trees per town of China Shoreland Zoning Ordinances. The average residual stand basal area will be reduced to approximately 103ft²/acre. Although this is below the suggested residual stocking line for

eastern hemlock stands (see Appendix 11: Eastern Hemlock Stocking Guide), the goal is to open the stand up enough to release some intermediate shade tolerant species and promote a more mixed species stand. The removals should focus on the unacceptable quality trees, the mature eastern hemlock, mature northern red oak, and all aspen and paper birch species to capture their value as several snags are already present. Removing some of the poor quality and mature stems of northern red oak may promote the establishment of oak saplings and sprouts to meet the goal of shifting toward a more mixed species stand.

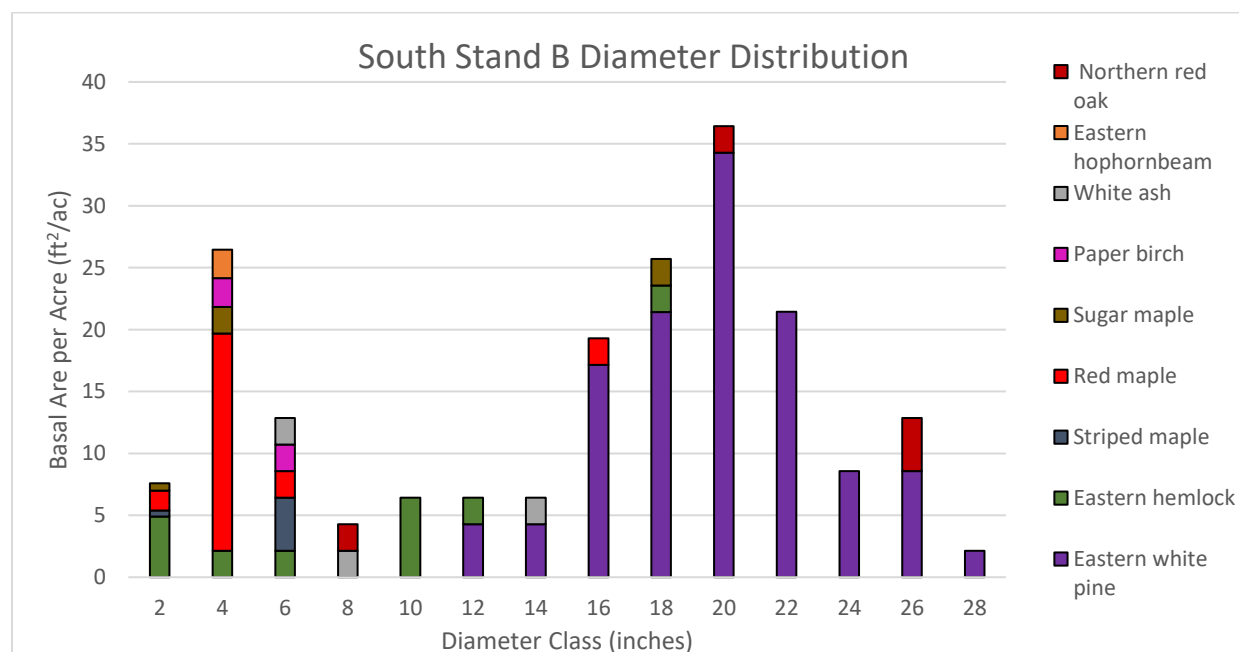
This stand should be monitored periodically and reentered in roughly 15–20 years, or in sync with treatments in South Stands B and C. Continuous cover irregular shelterwood establishment cuts are recommended to open the stand up enough to promote the regeneration of new cohorts while maintaining continuous cover to achieve an uneven aged multi-structure stand. The stand should be reevaluated at the end of this planning period and before further management action occurs.

South Stand B Description (Approximately 17 acres—S3A)

Stand Composition and Structure

South Stand B is a softwood stand of predominantly eastern white pine in the 12–28 inch diameter classes that accounts for 62 percent of the total basal area per acre. Eastern hemlock scattered in the 2–8 inch, 10, 12, and 18-inch diameter classes makes up 10 percent of the total basal area per acre. Hardwood species of red maple, white ash, sugar maple, striped maple and paper birch ranging in the 2–10 inch diameter classes, and northern red oak in the 8, 20, and 26 inch classes accounts for the remaining 28 percent of total basal area per acre in this stand. This distribution is visually displayed in Figure 5.

Figure 5: South Stand B Diameter Distribution by Basal Area per Acre



Portions of the stand are in the stem exclusion stage of development, generally speaking of the white pine component, where light is restricted from reaching the understory. Portions of the stand are also in

the understory re-initiation stage of development which has allowed sunlight to penetrate through gaps in the canopy due to overstory tree death and/or branch abrasion. This has allowed for some of the advance regeneration of the hardwood species in the understory to become established. The understory is made of up mostly hardwood species of red maple, sugar maple, northern red oak, striped maple, paper birch and eastern hemlock.

Stand Age/History

The diameter distribution suggests an uneven aged, multi-structure stand overall with the eastern white pine component being of the same age. The majority of the pine in this stand appears to be part of the original white pine planting program that took place between 1914 and 1928 to reforest the old agricultural land. According to historical records, this stand received several thinning treatments (last done in 1992), and there is still evidence of the past salvage harvest and old skid trails throughout this stand, but not to the same extent as in South Stand C.

Stand Stocking/Quality/Volume

The merchantable size class of this stand is mature growth of greater than 50 feet in height, and fully stocked with 75–100 percent crown closure.

Desirable quality eastern white pine makes up 68 percent of the total merchantable volume per acre in this stand followed by acceptable quality eastern white pine making up 14 percent. Acceptable quality eastern hemlock makes up 4 percent and acceptable quality northern red oak makes up 4 percent of the total merchantable volume per acre in this stand. The total per acre values for the standing volume on this stand are displayed in Table 18, Table 19 and Table 20 below.

Table 18: South Stand B Inventory Metrics

	Basal Area (square feet/acre)	Trees Per Acre	Quadratic Mean Diameter (inches)
Including saplings	197	957	6.1
Trees >4.5" DBH	174	275	10.8

Table 19: South Stand B Pulpwood Volume by Species

Species/Product	Volume (cubic feet/acre)	Volume (tons/acre)
Red maple pulp	89	2.23
Sugar maple pulp	10	0.28
Paper birch pulp	36	0.94
White ash pulp	69	1.73
Red oak pulp	185	5.92
Eastern hemlock pulp	206	5.15

Species/Product	Volume (cubic feet/acre)	Volume (tons/acre)
White pine pulp	439	7.68
Total pulp	1,034	23.91

Table 20: South Stand B Sawlog Volume by Species

Species/Product	Volume (board foot/acre)	Volume (MBF/acre)
Sugar maple logs	399	0.40
Shite ash logs	198	0.20
Red oak logs	382	0.38
Eastern hemlock logs	398	0.40
White pine logs	22,187	22.19
Total logs	23,564	23.57

Growth Rate

A site index of 66 for eastern white pine was derived from the soils data and applied to this stand in FVS to project growth. At a base age of 50, the average height of dominant and codominant trees is expected to average 66 feet.

Based on the FVS projections for this stand, the average growth per year is approximately 92ft³/acre. With no active management, this volume per acre will typically start to decline overtime and/or the mortality rate will increase. Active management will increase the volume per acre per year and capture mortality (see Table 21).

Table 21: South Stand B Growth and Mortality

Year	Unmanaged		Managed	
	Growth/Year (cubic feet/acre)	Mortality/Year (cubic feet/acre)	Growth/Year (cubic feet/acre)	Mortality/Year (cubic feet/acre)
2018	92	21	61*	1*
2028	103	28	78	3
2038	94	36	54*	*1
2048	88	51	65*	2
2058	79	53	77	4

* Represents year of active management

South Stand B Prescription

The eastern white pine in this stand is in a position where it is economically and ecologically mature and should be perpetuated. A low thinning in the dense stem exclusion pine dominated areas in combination with a crown thinning is recommended in this planning period. This thinning should focus on removing the trees competing in the lower canopy classes to capture future mortality from self-thinning or differentiation. It should also focus on removing the lower quality mature pine that show signs of environmental stress and damage, or are lacking straight stems and healthy crowns. Trees that are likely to produce good seed crops should be favored during this thinning. Where hardwood trees such as sugar maple, northern red oak, and red maple are present, a crop tree release thinning is recommended to promote growth and to establish the desired mixed species composition. This stand should be marked prior to harvesting and treatments should favor trees that exhibit desirable quality and high vigor. A basal area of approximately 112ft²/acre should be retained in this stand, removing about 85ft²/acre. This removal will bring the white pine portions of the stand down to medium stocking (see Appendix 12: Eastern White Pine (Revised) Stocking Guide) which will allow improved growth on the residuals.

This stand should be monitored periodically and reentered in roughly 15–20 years (or in sync with treatments in South Stand A and C) for single tree and group selection cuts to open the stand up enough to promote the regeneration of new age classes while maintaining patch characteristics of regeneration, young-middle aged trees, and mature trees. The stand should be reevaluated at the end of this planning period and before further management action occurs.

South Stand C Description (Approximately 23.5 acres—HS3B)

Stand Composition and Structure

South Stand C is a mixed wood stand where neither hardwood nor softwood species dominate the species composition over the other. Eastern white pine ranging in the 14–30 inch diameter classes makes up 31 percent of the total basal area per acre. Red maple, ranging in the 2–12 inch diameter classes, makes up 20 percent, eastern hemlock mostly in the 6–12 inch and scattered in the 16, 20 and 24 inch diameter classes makes up 13 percent, and sugar maple ranging in the 4–16 inch diameter classes makes up 10 percent of the total basal area. Species of northern red oak scattered in the 4–8 and 24–26 diameter classes, white ash, paper birch, American beech, and bigtooth aspen scattered in the 2–12 inch diameter classes make up the remaining 26 percent of total basal area per acre in this stand. While the total basal area is scattered across the diameter class range, eastern white pine is predominantly concentrated in the larger diameter classes. This distribution is displayed in Figure 6.

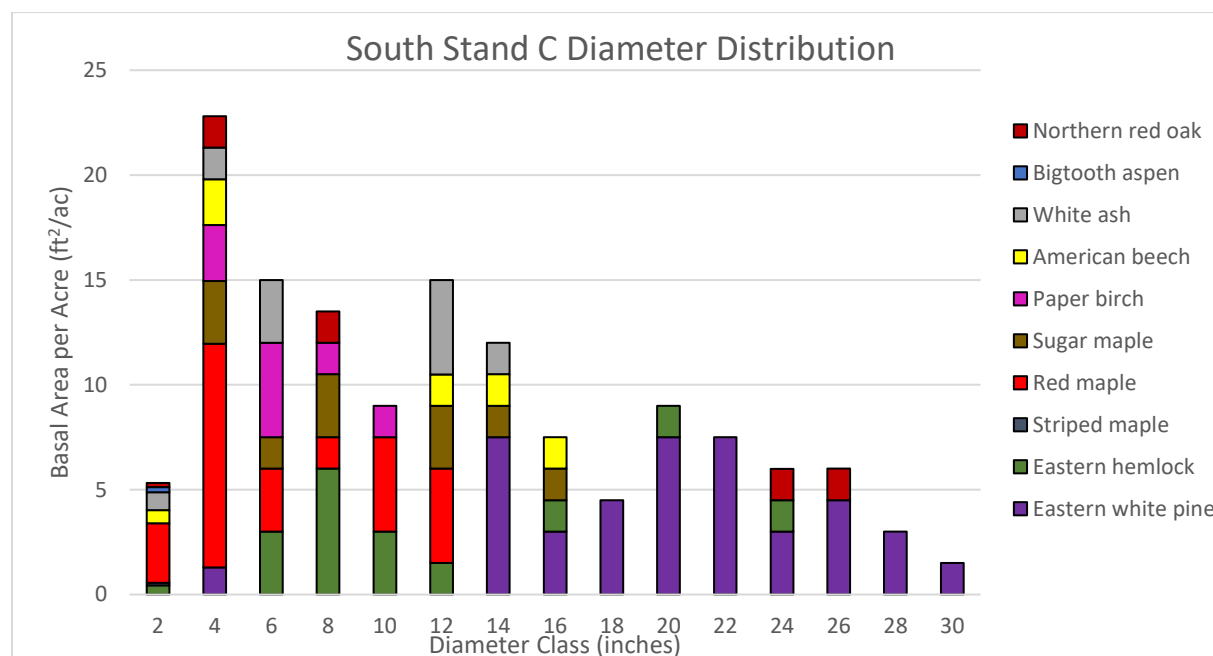
This stand is in the understory re-initiation stage of development. The disturbance event in 1995–96 allowed sunlight to penetrate through the large gaps in the canopy, allowed saplings to become established and advance regeneration in the understory to become released. The understory is mostly comprised of red maple, sugar maple, striped maple, paper birch, scattered white ash, northern red oak, American beech, white pine and eastern hemlock. The future growing stock in this stand is of the desirable mixed species composition.

Stand Age/History

The diameter distribution displays an uneven aged multi-structure stand. The eastern white pine in this stand appears to be part of the original planting that took place between 1914 and 1928 to reforest the old agricultural land. This stand was significantly impacted by the wind storm and salvage harvest in

1995–96. It created openings for new age classes to become established while some residuals of eastern white pine from the original age class remained. It is likely that prior to this event, the structure and composition of this stand looked like that of South Stand B and was mostly dominated by eastern white pine.

Figure 6: South Stand C Diameter Distribution by Basal Area per Acre



Stand Stocking/Quality/Volume

The merchantable size class of this stand is mature growth of greater than 50 feet in height, and medium stocked with 30–75 percent crown closure.

Desirable quality eastern white pine makes up 33 percent of the total merchantable volume per acre, and acceptable quality eastern white pine makes up 15 percent. Acceptable quality eastern hemlock makes up 12 percent, and acceptable quality red maple makes up 10 percent of the total merchantable volume per acre. The total per acre values for the standing volume on this stand are displayed in Table 22, Table 23, and Table 24 below.

Table 22: South Stand C Inventory Metrics

	Basal Area (square feet/acre)	Tree Per Acre	Quadratic Mean Diameter (inches)
Including saplings	138	1229	4.5
Trees >4.5" DBH	117	252	9.2

Table 23: South Stand C Pulpwood Volume by Species

Species/Product	Volume (cubic feet/acre)	Volume (tons/acre)
Red maple pulp	287	7.18
Sugar maple pulp	184	5.06
American beech pulp	130	3.51
Paper birch pulp	136	3.54
White ash pulp	146	3.65
Red oak pulp	40	1.28
Eastern hemlock pulp	367	9.18
White pine pulp	228	3.99
Total pulp	1,518	37.38

Table 24: South Stand C Sawlog Volume by Species

Species/Product	Volume (board foot/acre)	Volume (MBF/acre)
Sugar maple logs	295	0.30
White ash logs	204	0.20
Red oak logs	600	0.60
White pine logs	7,092	7.09
Total logs	8,191	8.19

Growth Rate

A site index of 66 for eastern white pine was derived from the soils data and applied to this stand in FVS to project growth. At a base age of 50, the average height of dominant and codominant trees is expected to average 66 feet.

Based on the FVS projections for this stand, the average growth per year is approximately 95ft³/acre. With no active management, this volume per acre will typically start to decline overtime and/or the mortality rate will increase. Active management will increase the volume per acre per year and capture mortality (see Table 25).

Table 25: South Stand C Growth and Mortality

Year	Unmanaged		Managed	
	Growth/Year (cubic feet/acre)	Mortality/Year (cubic feet/acre)	Growth/Year (cubic feet/acre)	Mortality/Year (cubic feet/acre)
2018	95	9	67*	0*
2028	90	28	75	3
2038	88	34	55*	1*
2048	93	33	84	4
2058	99	46	98	

* Represents year of active management

South Stand C Prescription

Roughly half of this stand is within the 250 foot Shoreland Zoning buffer. The past disturbance event initiated the desirable structure and the present growing stock of fairly desirable quality and species. It is recommended to maintain this structure through the continuous cover irregular shelterwood system. Patches of young high quality trees of desirable species such as sugar maple, red maple, eastern white pine, northern red oak, and eastern hemlock should be favored and retained as continuous cover. Establishment gaps should create new age classes through the removal of unacceptable growing stock and the poor quality mature white pine and mature northern red oak. It is important to leave residual trees during these establishment cuts that serve as high vigor growing stock, legacy trees, and those of good seed tree qualities to perpetuate the desirable species composition and structure. This silvicultural system will remove no more than 40 percent of the total volume per acre of trees 4.5 inches DBH or greater, and will leave a well-distributed stand of trees per town of China Shoreland Zoning Ordinances. The average residual stand basal area will be reduced to approximately 85ft²/acre, minimum stocking for this mixed wood stand (see Appendix 13: Mixed Wood Stocking Guide). The basal area to be removed from this stand will be approximately 53ft²/acre. This harvest should be conducted within this planning period and harvested at the same time as South Stand A and B.

This stand should be monitored periodically and reentered in roughly 15–20 years (or in sync with treatments in South Stand A and B) for additional continuous cover irregular shelterwood establishment cuts to continue promoting the regeneration of new age classes while maintaining continuous cover and patch characteristics of regeneration, young-middle aged trees, and mature trees. The stand should be reevaluated at the end of this planning period and before further management action occurs.

STAND TYPE 1—H3A

Stand Type 1 General Description and Prescription

Stands labeled 'Stand 1' (some exceptions to this description apply) are mixed hardwood stands that dominate >75 percent of the present vegetation. The majority of these stands are in the poletimber-sawtimber (7"–12" DBH) to sawtimber (>12" DBH) size class of mature growth (>50', merchantable growth) and fully stocked with 75–100 percent crown closure. Most of the species found in stands of this type include red maple, sugar maple, species of ash, northern red oak, aspen, paper and yellow

birch and American beech. Occasionally scattered within these stands eastern white pine and eastern hemlock can be found. The wooded portions of these stands appear to have had very little disturbance in the last 20–30 years with few exceptions. This also coincides with the history of forest management provided by KWD. These stands appear to be moderately productive overall and the quality of merchantable trees in these stands range from acceptable to desirable in terms of potential forest products. A portion of, if not all of the forested portions of these stands fall within the 250-foot buffer required on the lake. The regulations of timber harvesting within these buffers are important and must be followed.

Where permitted, these stands would benefit from crop tree release and thinning treatments that focus on removing the poor-quality and low vigor trees and some of the mature trees. These treatments are recommended during this planning period. This type of thinning can be beneficial in hardwood stands to promote growth and increase the quality of individual trees. Released crop trees will develop larger root systems overtime, thus increasing their resilience to potential environmental stressors. The crop trees to focus on releasing should exhibit qualities of high vigor, single stems when possible, and of a desirable species such as northern red oak, sugar maple, and red maple. These thinnings should also focus on capturing the value in the aspen, diseased beech, and ash (see EAB in the Forest Health section) and promoting growth on the desirable species. These thinning treatments (when within the 250 foot buffer on the lake) will remove no more than 40 percent of the total volume per acre of trees 4.5 inches DBH or greater, and will leave a well-distributed stand of trees per town of China Shoreland Zoning Ordinances and State Wide Standards that the Town of Vassalboro follows. Single stems should be shaded where possible to prevent epicormic branching. Epicormic branching is an important aspect to consider especially in northern hardwood stands. This occurs when dormant buds on the bole/main stem of the tree emerge as a result of increased and over exposure to light. Epicormic branching can lower the quality and potential of a sawlog in the future. Epicormic branching can be minimized by keeping some shade on the boles of potential saw logs trees, or by not overexposing the residual single hardwood stems.

These stands should be monitored periodically and reentered in roughly 15–20 years. Some of the mature crop trees previously released should be harvested at this time while others should be retained to achieve an uneven aged, multi-structure stand with patch characteristics of regeneration, young-middle aged trees, and mature trees. A low thinning to remove the stems in the lower canopy classes to capture future mortality from self-thinning or differentiation, and the removal of the unacceptable growing stock is also recommended. Species of northern red oak, sugar maple, and red maple of desirable quality should be favored. The stand should be reevaluated at the end of this planning period and before further management action occurs.

Site Specifics for Stand Type 1

Stand 1A (Approximately 4 acres) China, Maine

Stand 1A is located west of the South Narrows Peninsula on the south shoreline. Three acres of this stand is categorized under the 'Stand Type 1' description and prescription and one acre of this stand is classified by the U.S. Fish and Wildlife Service National Wetlands Inventory as wetland. Approximately half is labeled Freshwater Emergent Wetland and the other half Freshwater Forested/Shrub Wetland. These wetlands should remain unimpacted during harvesting operations.

Stand 1B (Approximately 24 acres) China, Maine

Stand 1B is located on the south shoreline in the Town of China and is approximately 24 acres. All 24 acres are considered under the 'Stand Type 1' description and prescription. There are a few riverine/streams that run through this stand. BMP's should be followed when crossing these riverine/streams. Brush and corduroy or timber mats, if need be, should be used on these crossing and the integrity of the stream shoreline should be maintained. The harvesting operability on this stand is moderately suited to well suited.

Stand 1C (Approximately 20 acres) Vassalboro, Maine

Stand 1C is located on the south shoreline in the Town of Vassalboro and is approximately 20 acres. This stand is adjacent to Stand 1B and is very similar in conditions. This stand also has a few riverine/streams that pass through and discharge into the lake. In addition, less than one half acre of this stand is labeled as a Forested Wetland, and as previously mentioned, BMP's should be followed. The harvesting operability on this stand is also moderately suited to well suited, likely due to some low-lying wet areas. There is also approximately 350 feet of frontage on Route 32 on this stand. This will be useful for access and yard/landing purposes for the surrounding stands.

Stand 1D (Approximately 1 acre) Vassalboro, Maine

Stand 1D is located along the eastern shoreline, this stand is about 1 acre in size. This small hardwood stand was part of the original property acquired in early 1900s. About half of this stand is considered a Forested Wetland by the U.S. Fish and Wildlife Service National Wetlands Inventory, yet still falls under the 'Stand Type 1' and is well suited for harvesting equipment operability.

Stand 1E (Approximately 1.5 acres) Vassalboro, Maine

Stand 1E (Map 11, Lot 33) is approximately 1.5 acres in size and was not part of the original shoreline property acquisition in the early 1900's. However, the management appears to be very similar to that of adjacent stands within the original shoreline property acquisition, and the stand meets the characteristics of 'Stand Type 1.' There is also roughly 170 feet of road frontage on Route 32 as well, making access and harvesting operability favorable.

Stand 1F (Approximately 1 acre) Vassalboro, Maine

Stand 1F (Map 20, Lot 34) is approximately 1 acre in size, also not part of the original shoreline property acquisition in the early 1900s. This parcel currently does not match all the 'Stand Type 1' characteristics, but it is hardwood dominant. This stand has more shrubby cover and is in the seedling to sapling (0.51"–3" DBH) and sapling to poltimber (3"–7" DBH) size class. Roughly 20 years ago, this stand was significantly less forested than it is presently, and in addition, a small drainage ditch passes through this stand. There are no immediate management recommendations for this stand as it should take time to grow and become more vegetated.

Stand 1G (Approximately 8 acres) Vassalboro, Maine

Stand 1G is approximately 8 acres in size, with roughly 4.5 acres classified under 'Stand Type 1.' One acre is classified as a U.S. Fish and Wildlife Service National Wetlands Inventory Freshwater Emergent Wetland, and roughly 2.5 acres are non-forested. The KWD has a facility located on this stand with a gravel road off from Stanley Hill Road. This access road will be beneficial for timber harvesting activities

and to access portions of the north shoreline. The forested areas of this stand along the shoreline obtains the characteristics of 'Stand Type 1.' The non-forested/open areas of this stand should be left unmaintained in order to grow back into forestland for optimal watershed management.

Stand 1H (Approximately 10 acres) China, Maine

Stand 1H is approximately ± 10 acres in size and is located on the east shore of the East Basin of China Lake. This stand only has approximately 4 forested acres with characteristics of 'Stand Type 1.' The remaining 6 acres are non-forested/open areas. The non-forested/open areas of this stand should be left unmaintained in order to grow back into forestland for optimal watershed management. Access to this stand is limited and would need to be through abutting landowners and/or from the North Narrows Peninsula.

STAND TYPE 2—S3A

Stand Type 2 General Description and Prescription

Stands labeled 'Stand 2' (some exceptions to this description apply) are softwood stands that dominate >75 percent of the present vegetation. The majority of these stands are in the sawtimber (>12" DBH) size class of mature growth (>50', merchantable growth) and fully stocked with 75–100 percent crown closure. Most of the species found in stands of this type include a mix of both planted and naturally occurring eastern white pine and red pine, eastern hemlock, northern white cedar, balsam fir, spruce, planted scots/scotch pine, tamarack and scattered hardwood species. The wooded portions of these stands appear to have had very little disturbance in the last 20–30 years with few exceptions from patches of blow downs. This also coincides with the history of forest management provided by KWD. Many of the stands under this stand type appear to have passed the stages of being productive as natural tree senescence is occurring due to the lack of active forest management. Most of these stands are in the stem exclusion stages of development where light is restricted from reaching the understory. As a result, there is very little understory/regeneration present in some areas of these stands. Although, in areas where small disturbances have occurred, the desired mixed species and multi-structure stand is naturally occurring. The quality of merchantable trees in these stands range from acceptable to desirable in terms of potential forest products. A portion of, if not all of the forested portions of these stands fall within the 250-foot buffer required on the lake. The regulations of timber harvesting within these buffers are important and must be followed.

The mature trees in these stands are in a position where they are economically and ecologically mature and should be perpetuated. A low thinning in the dense stem exclusion areas in combination with a crown thinning is recommended in this planning period. This thinning should focus on removing the trees competing in the lower canopy classes to capture future mortality from self-thinning or differentiation. It should also focus on removing the lower quality mature trees that show signs of environmental stress and damage, or are lacking straight stems and healthy crowns. Trees that are likely to produce good seed crops should be favored during this thinning. Where hardwood trees are present in both the understory and overstory, a crop tree release thinning is recommended to promote growth and to establish the desired mixed species composition. This stand should be marked prior to harvesting and treatments should favor trees that exhibit desirable quality and high vigor. The long-term goal is to achieve the mixed species, multi-structure stand throughout the shoreline property. These thinning treatments (when within the 250 foot buffer on the lake) will remove no more than 40 percent of the total volume per acre of trees 4.5 inches DBH or greater, and will leave a well-distributed stand of trees

per town of China Shoreland Zoning Ordinances and State Wide Standards that the Town of Vassalboro follows.

These stand should be monitored periodically and reentered in roughly 15–20 years for single tree and group selection cuts to open the stand up enough to promote the regeneration of new age classes (where not already present) while maintaining patch characteristics of regeneration, young-middle aged trees, and mature trees. The stand should be reevaluated at the end of this planning period and before further management action occurs.

Site Specifics for Stand Type 2

Stand 2A (Approximately 16 acres) China, Maine

Stand 2A is located on the east shore of the East Basin of China Lake and is approximately 16 acres in size. There is roughly 1 acre of Freshwater Forested/Shrub Wetland classified by the U.S. Fish and Wildlife Service National Wetlands Inventory. According to the Maine Department of Inland Fisheries and Wildlife (MDIFW), this wetland is also associated with a moderate value IWWH. See Threatened and Endangered Species, and Rare or Exemplary Natural Communities section for detail regarding management recommendations for this portion of the stand. This stand closely follows the description for ‘Stand Type 2.’ The access to most of this stand will be through the South Narrows Peninsula.

Stand 2B (Approximately 4 acres) China, Maine

Stand 2B is located on the south shoreline and is approximately 4 acres in size. There is a riverine/stream that runs through the north part of this stand and more or less serves as the stand type boundary between this stand and Stand 3A. This 4 acres meets the description and prescription for ‘Stand Type 2,’ and the harvesting operability is moderately suited across this stand.

Stand 2C (Approximately 5 acres) Vassalboro, Maine

Stand 2C is located on the south shoreline adjacent to Stand 1C and Stand 3B, both of which have frontage on Route 32. This stand is approximately 5 acres in size and has the characteristics of that described under ‘Stand Type 2.’ There is a riverine/stream that runs through this stand and discharges into the lake. This stand is well suited for harvesting equipment operability.

Stand 2D (Approximately 39 acres) Vassalboro, Maine

Stand 2D is located on the north shoreline and is approximately 39 acres. There is roughly 2 acres in total of wetlands classified by the U.S. Fish and Wildlife Service National Wetlands Inventory, one being a Freshwater Emergent Wetland and the other Freshwater Forested/Shrub Wetland. Several riverine/streams run through this stand and discharge into the lake. In addition, most of this stand is associated with a Deer Wintering Area according to MDIFW. The dense conifer cover in this stand is an important aspect for DWAs and should be maintained and perpetuated through timber harvesting activities. These activities should retain areas of contiguous conifer cover while also opening up small patches for regeneration to be released to perpetuate the dense coniferous cover. This regeneration will also provide browse for the deer to feed on. More specific guidelines for managing for DWAs can be found in the Appendix 8: DIFW Guidelines for Wildlife—Managing Deer Wintering Areas in Northern, Western, and Eastern Maine. This stand aligns with the description and prescription for ‘Stand Type 2.’

Stand 2E (Approximately 60 acres) China, Maine

Stand 2E is located on the north shoreline and is roughly 60 acres in size. This stand is also where some of the planted conifer species described in 'Stand Type 2' can be found. Several riverine/streams run through this stand and discharge into the lake. This is also the largest and contiguous stand of a similar stand type along the shoreline property. The stand is moderately to well suited for harvesting equipment operability, but the access for harvesting is limited. Access from this stand will need to come through abutting landowners in more than one location. Portions of this stand can be very steep and harvesting in these areas will need to be done in the right conditions.

STAND TYPE 3—SH3A

Stand Type 3 General Description and Prescription

Stands labeled 'Stand 3' (some exceptions to this description apply) are mixed wood stands where softwood composes 50–70 percent of the present vegetation. The majority of these stands are in the poletimber-sawtimber (7"–12" DBH) to sawtimber (>12" DBH) size class of mature growth (>50', merchantable growth) and fully stocked with 75–100 percent crown closure. The majority of the species found in stands of this type include eastern white pine, northern red oak, red and sugar maple, eastern hemlock, balsam fir, ash, aspen, paper and yellow birch, and American beech. These stands appear to have had very little disturbance in the last 20–30 years with few exceptions of blow downs. These stands appear to be moderately productive overall and the quality of merchantable trees in these stands range from acceptable to desirable in terms of potential forest products. A portion of, if not all of the forested portions of these stands fall within the 250-foot buffer required on the lake. The regulations of timber harvesting within these buffers are important and must be followed.

Stands of this type already meet the desired mixed species composition, but they need to achieve the uneven aged multi-structure for an ideal and productively working forested watershed. A thinning throughout the diameter range is recommended in these stands to remove the mature and poor quality stems and release the young and middle age class trees while also maintaining a multi-structure stand of mixed species. These thinning should favor and promote species of northern red oak and eastern white pine as they are more resilient to changes in climate conditions. In areas where advance regeneration is present, desirable species that exhibit high vigor and are of desirable and acceptable quality growing stock should be favored. These thinning treatments will remove no more than 40 percent of the total volume per acre of trees 4.5 inches DBH or greater and will leave a well-distributed stand of trees per town of China Shoreland Zoning Ordinances and State Wide Standards followed by the Town of Vassalboro. The removals should be focused on the unacceptable quality trees, the mature eastern hemlock, mature northern red oak, ash, and all aspen to capture the value in these species.

This stand should be monitored periodically and reentered in roughly 15–20 years for continuous cover irregular shelterwood establishment cuts to open the stand up enough to promote the regeneration of new age classes while maintaining continuous cover to promote an uneven aged multi-structured stand. The stand should be reevaluated at the end of this planning period and before further management action occurs.

Site Specifics for Stand Type 3

Stand 3A (Approximately 14 acres) China, Maine

Stand 3A is located on the south shoreline in China and is approximately 14 acres in size. This stand has a riverine/stream that passes through and discharges into the lake. Access to this stand is very limited, although there is a field adjacent to this stand where access may be potentially arranged. This stand meets the characteristics as described in 'Stand Type 3.'

Stand 3B (Approximately 9 acres) Vassalboro, Maine

Stand 3B (Map 11, Lot 54) is located adjacent to Stand 1C and has approximately 640 feet of road frontage on Route 32. This lot was not part of the original shoreline property acquisition during the early 1900s. This property was acquired around 2006 and since KWD's ownership there does not appear to have been any timber harvesting activities. A homestead was present on the property prior to 2006. Since KWD's ownership, the homestead has been removed and the area is slowly reverting to forestland. With road frontage on Route 32 and with the majority of the stand outside of the 250 foot buffer on the lake, this stand will be useful in providing yard/landing space for timber harvesting activities. This stand has similar characteristics of that described under 'Stand Type 3.'

Stand 3C (Approximately 11 acres) China, Maine

Stand 3C is located adjacent to the North Narrows Peninsula. The wooded portion of the stand that matches the 'Stand Type 3' description is approximately 9.5 acres. Approximately 1 acre is non-forested/field, and roughly 0.5 acres is classified as a Freshwater Forested/Shrub Wetland by the U.S. Fish and Wildlife Service National Wetlands Inventory. In addition, a riverine/stream discharges from this stand to the lake. The existing access to this stand and to the North Narrows Peninsula is on the east side of this stand. Improvements to this access will need to be made prior to timber harvesting activities. With the access in close proximity to the lake, the wetland, and riverine/stream, it will be important to time activities during ideal conditions in addition to applying all applicable BMPs.

MANAGEMENT ACTIVITIES

PROPERTY LINES

Non-silvicultural management activities recommended on this property to meet the landowner's goals and objectives include the continuation of locating, brushing, permanently blazing and painting the property lines. This action is important to meet the goal of maintaining clear boundary lines and establishing a physical presence on the KWD's property to improve public relations. Maintaining clear property lines will also facilitate future management. All of the KWD's property lines around the West Basin of China Lake should be brushed, blazed, and painted within this planning period.

UPDATED SIGNAGE

Other recommendations to establish a physical presence on the KWD's property to improve public relations include developing and posting updated signs at access points to the ownership. Updated signage will be beneficial in informing and educating the public on the forest management occurring on the property, and in reminding the public that trespassing is forbidden.

ACCESS

Road access is critical for harvesting and will facilitate monitoring activities. Improvements to access routes of both the North and South Narrows Peninsula will be required for the proposed harvest. Approximately 3,000 linear feet of road will need improvement for access to the North Narrows Peninsula, and approximately 2,000 linear feet of road will need improvement for access to the South Narrows Peninsula. There is potential to approach abutting landowners to discuss options for gaining existing and potentially creating new access ways to the northern and southern shoreline property with an agreement of terms from both parties, the KWD and the abutting landowners. Gaining additional access ways will facilitate management. These potential access points can be addressed at the time those specific harvests are proposed.

NORTH NARROWS PENINSULA HARVEST PLAN 2020/2021

North Stand A and North Stand B should both receive the thinning treatments outlined in their corresponding prescription sections of this plan. Optimal conditions to harvest these stands would be in the dry summer months or frozen winter conditions and should be conducted by a qualified contractor. Based on a harvest simulation from FVS, the thinning in North Stand A will remove approximately 4 MBF (thousand board feet) of logs per acre and approximately 32 tons of pulpwood per acre. The estimated stumpage value from this thinning will be plus or minus \$917.00 per acre. The break down for these values by product, species and stumpage price for this stand are found in Table 26 and Table 27.

Table 26: North Stand A (36.7 acres) Sawlog Harvest Volume and Value

Product	Volume (MBF/Acre)	Price/MBF	Stumpage/Acre	Stumpage/Stand
Red maple logs	0.100	\$127.00	\$12.70	\$466.09
White pine logs	1.269	\$157.00	\$199.23	\$7,311.85
Eastern hemlock logs	0.659	\$67.00	\$44.15	\$1,620.42
Red oak logs	1.929	\$263.00	\$507.33	\$18,618.90
Total logs	3.957		±\$763.41	±\$28,017.26

Table 27: North Stand A (36.7 acres) Pulp Harvest Volume and Value

Product	Volume (Tons/Acre)	Price/Ton	Stumpage/Acre	Stumpage/Stand
White pine pulp	0.167	\$3.00	\$0.50	\$18.40
Eastern hemlock pulp	13.843	\$4.00	\$55.37	\$2,032.11
Hophornbeam pulp	0.535	\$8.00	\$4.28	\$156.99
Aspen pulp	2.939	\$9.00	\$26.45	\$970.75
Red oak pulp	4.835	\$8.00	\$38.68	\$1,419.64
White ash pulp	0.316	\$8.00	\$2.53	\$92.92

Product	Volume (Tons/Acre)	Price/Ton	Stumpage/Acre	Stumpage/Stand
Red maple pulp	3.253	\$8.00	\$26.02	\$955.02
Total pulp	32.182		±\$153.84	±\$5,645.84
Stand Total			±\$917.25	±\$33,663.10

The thinning in North Stand B will remove approximately 1 MBF of logs per acre and approximately 17 tons of pulpwood per acre. The estimated income from this thinning will be plus or minus \$354.00 per acre. The break down for these values by product, species and price for this stand are found in Table 28 and Table 29.

Table 28: North Stand B (15.5 acres) Sawlog Harvest Volume and Value

Product	Volume (MBF/Acre)	Price/MBF	Stumpage/Acre	Stumpage/Stand
White pine logs	0.697	\$157.00	\$109.43	\$1,696.15
Sugar maple logs	0.217	\$ 250.00	\$54.25	\$840.88
Red oak logs	0.244	\$ 263.00	\$64.17	\$994.67
Total logs	1.158		±\$227.85	±\$3,531.69

Table 29: North Stand B (15.5 acres) Pulp Harvest Volume and Value

Product	Volume (Tons/Acre)	Price/Ton	Stumpage/Acre	Stumpage/Stand
White pine pulp	0.485	\$3.00	\$1.46	\$22.58
Eastern hemlock pulp	1.907	\$4.00	\$7.63	\$118.22
Aspen pulp	0.936	\$9.00	\$8.43	\$130.59
Red oak pulp	4.274	\$8.00	\$34.19	\$529.94
White ash pulp	0.757	\$8.00	\$6.05	\$93.81
Paper birch pulp	5.164	\$8.00	\$41.31	\$640.33
American beech pulp	2.069	\$8.00	\$16.55	\$256.58
Sugar maple pulp	1.285	\$8.00	\$10.28	\$159.37
Total pulp	16.877		±\$125.90	±\$1,951.42
Stand Total			±\$353.75	±\$5,483.11

SOUTH NARROWS PENINSULA HARVEST PLAN 2020/2021

South Stand A, South Stand B, and South Stand C should all receive the silvicultural treatments outlined in their corresponding prescription sections of this plan. Optimal conditions to harvest these stands

would be in the dry summer months and should be conducted by a qualified contractor. Based on a harvest simulation from FVS, the thinning in South Stand A will remove approximately 2.5 MBF of logs per acre and approximately 39 tons of pulpwood per acre. The estimated stumpage value from this thinning will be plus or minus \$380.00 per acre. The break down for these values by product, species and price for this stand are found in Table 30 and Table 31.

Table 30: South Stand A (23 acres) Sawlog Harvest Volume and Value

Product	Volume (MBF/Acre)	Price/MBF	Stumpage/Acre	Stumpage/Stand
Eastern hemlock logs	2.151	\$67.00	\$144.12	\$3,314.69
White ash logs	0.306	\$164.00	\$50.18	\$1,154.23
Total logs	2.457		±\$194.30	±\$4,468.92

Table 31: South Stand A (23 acres) Pulp Harvest Volume and Value

Product	Volume (Tons/Acre)	Price/Ton	Stumpage/Acre	Stumpage/Stand
Eastern hemlock pulp	32.512	\$4.00	\$130.05	\$2,991.09
Hophornbeam pulp	0.457	\$8.00	\$3.66	\$84.11
Red oak pulp	3.999	\$8.00	\$31.99	\$735.73
White ash pulp	0.110	\$8.00	\$0.88	\$20.31
Paper birch pulp	0.596	\$8.00	\$4.77	\$109.60
Sugar maple pulp	1.229	\$8.00	\$9.84	\$226.22
Red maple pulp	0.542	\$8.00	\$4.34	\$99.81
Total pulp	39.445		±\$185.52	±\$4,266.87
Stand Total			±\$379.82	±\$8,735.79

The thinning in South Stand B will remove approximately 10 MBF of logs per acre and approximately 10 tons of pulpwood per acre. The estimated income from this thinning will be plus or minus \$1,674.00 per acre. The break down for these values by product, species and price for this stand are found in Table 32 and Table 33.

Table 32: South Stand B (17 acres) Sawlog Harvest Volume and Value

Product	Volume (MBF/Acre)	Price/MBF	Stumpage/Acre	Stumpage/Stand
White pine logs	9.582	\$157.00	\$1,504.37	\$25,574.36
Eastern hemlock logs	0.172	\$67.00	\$11.52	\$195.91
Sugar maple logs	0.172	\$250.00	\$43.00	\$731.00

Product	Volume (MBF/Acre)	Price/MBF	Stumpage/Acre	Stumpage/Stand
Red oak logs	0.165	\$263.00	\$43.40	\$737.72
White ash logs	0.086	\$164.00	\$14.10	\$239.77
Total logs	10.177		±\$1,616.40	±\$27,478.75

Table 33: South Stand B (17 acres) Pulp Harvest Volume and Value

Product	Volume (Tons/Acre)	Price/Ton	Stumpage/Acre	Stumpage/Stand
White pine pulp	3.457	\$3.00	\$10.37	\$176.29
Eastern hemlock pulp	2.224	\$4.00	\$8.90	\$151.25
Red oak pulp	2.562	\$8.00	\$20.49	\$348.37
White ash pulp	0.749	\$8.00	\$6.00	\$101.93
Paper birch pulp	0.407	\$8.00	\$3.25	\$55.29
Sugar maple pulp	0.121	\$8.00	\$0.97	\$16.49
Red maple pulp	0.964	\$8.00	\$7.71	\$131.04
Total pulp	10.483		±\$57.69	±\$980.67
Stand Total			±\$1,674.08	±\$28,459.42

The silvicultural system in South Stand C will remove approximately 3 MBF of logs per acre and approximately 14.5 tons of pulpwood per acre. The estimated income from this thinning will be plus or minus \$626.00 per acre. The break down for these values by product, species and price for this stand are found in Table 34 and Table 35 Table 34.

Table 34: South Stand C (23.5 acres) Sawlogs Harvest Volume and Value

Product	Volume (MBF/Acre)	Price/MBF	Stumpage/Acre	Stumpage/Stand
White pine logs	2.737	\$157.00	\$429.71	\$10,098.16
Sugar maple logs	0.114	\$250.00	\$28.50	\$669.75
Red oak logs	0.232	\$263.00	\$61.02	\$1,433.88
White ash logs	0.079	\$164.00	\$12.96	\$304.47
Total logs	3.162		±\$532.18	±\$12,506.25

Table 35: South Stand C (23.5 acres) Pulp Harvest Volume and Value

Product	Volume (Tons/Acre)	Price/Ton	Stumpage/Acre	Stumpage/Stand
White pine pulp	1.640	\$3.00	\$4.92	\$115.62
Eastern hemlock pulp	3.539	\$4.00	\$14.16	\$332.64
Red oak pulp	0.489	\$8.00	\$3.91	\$91.88
White ash pulp	1.408	\$8.00	\$11.27	\$264.80
Paper birch pulp	1.367	\$8.00	\$10.94	\$257.07
American beech pulp	1.355	\$8.00	\$10.84	\$254.72
Sugar maple pulp	1.956	\$8.00	\$15.64	\$367.64
Red maple pulp	2.771	\$8.00	\$22.17	\$521.04
Total pulp	14.525		±\$93.85	±\$2,205.40
Stand Total			±\$626.03	±\$14,711.65

Although tree value classes were assigned to each inventoried tree, the variability in assigning a standing tree a product quality class is very high. A 10–15 percent variation in volume and value can be applied to these values as a result of variability, accuracies, defect, etc. The average stumpage values per product and unit were obtained from the 2016 Maine Stumpage Report for the Capital Area, which includes Kennebec County (see Appendix 14: 2016 Maine Stumpage Report).

SHORELINE PROPERTY HARVESTING PLAN

The timber harvesting recommended in this plan for the remaining shoreline property should be followed out within this planning period as options for access are acquired and as the landowners and land managers see fit per several factors. The timing of timber harvesting activities should be flexible in the case of a forest pest outbreak, natural disturbance event, changing climate conditions, to take advantage of ideal site conditions, to take advantage of favorable wood markets, etc. These harvesting activities should be proposed by the land managers by stands/sections and with approval from KWD. It is recommended that a Maine Licensed Forester directs and over sees the recommended harvesting activities that should be conducted by a qualified contractor. Overall, adaptive forest management is going to be key in managing a forested watershed. Reevaluating as or when things change is also very important and key to successfully managing a forest for the longer term.

2018–2028 PROJECT SCHEDULE (NORTH AND SOUTH NARROWS PENINSULAS HARVESTS ONLY)¹

Assuming the recommended management actions occur, the 2018–2028 project schedule, Table 36, is a rough timeline and estimate of costs and earnings. These values are subject to change based on the landowner’s decisions, market conditions, and weather. At the end of this planning period, the property should be reevaluated and updates to this management plan should be made accordingly to encompass any changes.

Table 36: Project Schedule by Activity for This Planning Period

Activity	Extent/Location	Time Frame	Estimated Cost or Income
Forest Management Plan	North & South Narrows Peninsulas (116 acres)	May 2018	N/A (UMaine Forestry Senior Capstone)
Comprehensive Management Plan	North & South Narrows Peninsulas & Remaining Shoreline Property	June 2019	Cost of \$3,500
Brush, Blaze & Paint Property Lines	One Mile - North Narrows/Neck Road	May –June 2019	Cost of \$1,500
Brush, Blaze & Paint Property Lines	All KWD Ownership Property Lines	2019–2028	Cost of \$1,500/mile 9 miles = ($\pm$ 13,500)
Access Road Improvements	North Narrows Access Road $\pm$ 3,000 feet	In sync with 2020/2021 Harvest	Cost of \$5/foot = ($\pm$ \$15,000)
	South Narrows Access Road $\pm$ 2,000 feet	In sync with 2020/2021 Harvest	Cost of \$5/foot = ($\pm$ \$10,000)
2020/2021 North Narrows Peninsula Harvest	North Stand A	Dry Summer 2020/2021	$\pm$ \$33,663
	North Stand B	Dry Summer 2020/2021	$\pm$ \$5,483
2020/2021 South Narrows Peninsula Harvest	South Stand A	Dry Summer 2020/2021	$\pm$ \$8,736
	South Stand B	Dry Summer 2020/2021	$\pm$ \$28,459
	South Stand C	Dry Summer 2020/2021	$\pm$ \$14,712

¹ Only includes recommended harvests on the North and South Narrows Peninsulas.

Activity	Extent/Location	Time Frame	Estimated Cost or Income
Net Income			±\$47,553

2028–2038 PROJECTED PROJECT SCHEDULE (NORTH AND SOUTH NARROWS PENINSULAS HARVESTS ONLY)²

Assuming the 2018–2028 suggested project schedule is followed, the 2028–2038 project schedule is recommended (see Table 37), and subject to change based on previous management actions, markets, and the condition of the property. The projected harvest values by stand for 2038 are found in Table 37 through Table 45. The income projected from the 2028–2038 project schedule is worth approximately \$36,674 today based on the management that occurs between 2018–2038 with a 2 percent discount rate (see Appendix 15: Net Present Value Calculation for 2038).

Table 37: Project Schedule by Activity for 2028–2038

Activity	Extent/Location	Time Frame	Estimated Cost or Income
Forest Management Plan Update	North & South Narrows Peninsulas (116 acres)	2028–2038	Cost of (±\$1,000)
Brush, Blaze & Paint Property Lines	All KWD Ownership Property Lines	2028–2038	Cost of \$500/mile 10 miles = (±\$5,000)
Access Road Improvements	North Narrows Access Road ±3,000 feet	In sync with 2038 Harvest	Cost of \$3/foot = (±\$9,000)
	South Narrows Access Road ±2,000 feet	In sync with 2038 Harvest	Cost of \$3/foot = (±\$6,000)
2038 North Narrows Peninsula Harvest	North Stand A	Dry Summer 2038	±\$54,908
	North Stand B	Dry Summer 2038	±\$1,530
2038 South Narrows Peninsula Harvest	South Stand A	Dry Summer 2038	±\$2,556
	South Stand B	Dry Summer 2038	±\$2,322
	South Stand C	Dry Summer 2038	±\$14,180
Net Income			±\$54,496

² Only includes recommended harvests on the North and South Narrows Peninsulas.

Table 38: North Stand A (36.7 acres) 2038 Sawlog Harvest Volume and Value

Product	Volume (MBF/Acre)	Price/MBF	Stumpage/Acre	Stumpage/Stand
White pine logs	2.52	\$157.00	\$395.22	\$14,504.44
Red oak logs	3.54	\$263.00	\$929.99	\$34,130.69
Total logs	6.05		\$1,325.21	\$48,635.13

Table 39: North Stand A (36.7 acres) 2038 Pulp Harvest Volume and Value

Product	Volume (Tons/Acre)	Price/Ton	Stumpage/Acre	Stumpage/Stand
White pine pulp	0.223	\$3.00	\$0.67	\$24.60
Hardwood pulp	21.220	\$8.00	\$169.76	\$6,230.19
Total pulp	21.443		\$170.43	\$6,254.79
Stand Total			±\$1,495.64	±\$54,907.92

Table 40: North Stand B (15.5 acres) 2038 Pulp Harvest Volume and Value

Product	Volume (Tons/Acre)	Price/Ton	Stumpage/Acre	Stumpage/Stand
Hardwood pulp	12.343	\$8.00	\$98.74	\$1,530.53
Stand Total			±\$98.74	±\$1,530.53

Table 41: South Stand A (23 acres) 2038 Sawlog Harvest Volume and Value

Product	Volume (MBF/Acre)	Price/MBF	Stumpage/Acre	Stumpage/Stand
Eastern hemlock logs	0.30	\$67.00	\$20.06	\$461.35

Table 42: South Stand A (23 acres) 2038 Pulp Harvest Volume and Value

Product	Volume (Tons/Acre)	Price/Ton	Stumpage/Acre	Stumpage/Stand
Eastern hemlock pulp	20.032	\$4.00	\$80.13	\$1,842.91
Paper birch pulp	1.369	\$8.00	\$10.95	\$251.81
Total pulp	21.400		\$91.07	\$2,094.72
Stand Total			±\$111.13	±\$2,556.07

Table 43: South Stand B (17 acres) 2038 Pulp Harvest Volume and Value

Product	Volume (Tons/Acre)	Price/Ton	Stumpage/Acre	Stumpage/Stand
Eastern hemlock pulp	5.431	\$4.00	\$21.72	\$369.31
White ash pulp	14.361	\$8.00	\$114.89	\$1,953.10
Total pulp	19.792		\$136.61	\$2,322.37
Stand Total			±\$136.61	±\$2,322.37

Table 44: South Stand C (23.5 acres) 2038 Sawlog Harvest Volume and Value

Product	Volume (MBF/Acre)	Price/MBF	Stumpage/Acre	Stumpage/Stand
White pine logs	2.36	\$157.00	\$369.78	\$8,689.83
Sugar maple logs	0.11	\$250.00	\$28.54	\$670.75
Red oak logs	0.18	\$263.00	\$47.33	\$1,112.33
White ash logs	0.12	\$164.00	\$19.49	\$457.96
Total logs	2.77		\$465.14	\$10,930.87

Table 45: South Stand C (23.5 acres) 2038 Pulp Harvest Volume and Value

Product	Volume (Tons/Acre)	Price/Ton	Stumpage/Acre	Stumpage/Stand
White pine pulp	1.842	\$3.00	\$5.53	\$129.88
Eastern hemlock pulp	3.924	\$4.00	\$15.69	\$368.82
Red oak pulp	14.631	\$8.00	\$117.05	\$2,750.53
Total pulp	20.397		\$138.27	\$3,249.23
Stand Total			±\$603.41	±\$14,180.10

REFERENCES

The Forestry Rules of Maine 2017 A Practical Guide for Foresters, Loggers and Woodlot Owners, 2nd Edition. Guide Available from the Maine Forest Service and online at:
http://www.maine.gov/dacf/mfs/rules_and_regulations.html

Town of China Land Use Ordinance Chapter 2—Section R Timber Harvesting, and Section 7 Guidelines for Timber Harvesting in China. Available at the China Town Office at 571 Lakeview Drive, China, Maine 05358. Also online at: <http://china.govoffice.com/>

Statewide Standards for Timber Harvesting in Shoreland Areas, Maine Forest Service Rule - Chapter 21. Available at the Maine Department of Agriculture, Conservation and Forestry and online at: https://www.maine.gov/dacf/mfs/policy_management/water_resources/sws/sws.html

Maine Revenue Services Property Tax Division: Property Tax Bulletin No. 19. Available online at: <http://www.maine.gov/revenue/forms/property/pubs/bull19text.htm>

Best Management Practices for Forestry: Protecting Maine's Water Quality. Available online at: http://www.maine.gov/dacf/mfs/publications/handbooks_guides/bmp_manual.html

Miles, Patrick D., and W. Brad. Smith. "Specific Gravity and Other Properties of Wood and Bark for 156 Tree Species Found in North America." USDA Forest Service, Oct. 2009, pp. 8–12., doi:10.2737/nrs-rn-38. Publication used for converting cubic feet to tons.

Table 46: Conversion by Species for Converting Cubic Feet to Tons

Tree Species	Average Green Weight of Wood (lbs/ft ³)
Eastern white pine	35
Eastern hemlock	50
Eastern hophornbeam	60
Bigtooth aspen	43
Northern red oak	64
White ash	50
Paper birch	52
American beech	54
Sugar maple	55
Red maple	50

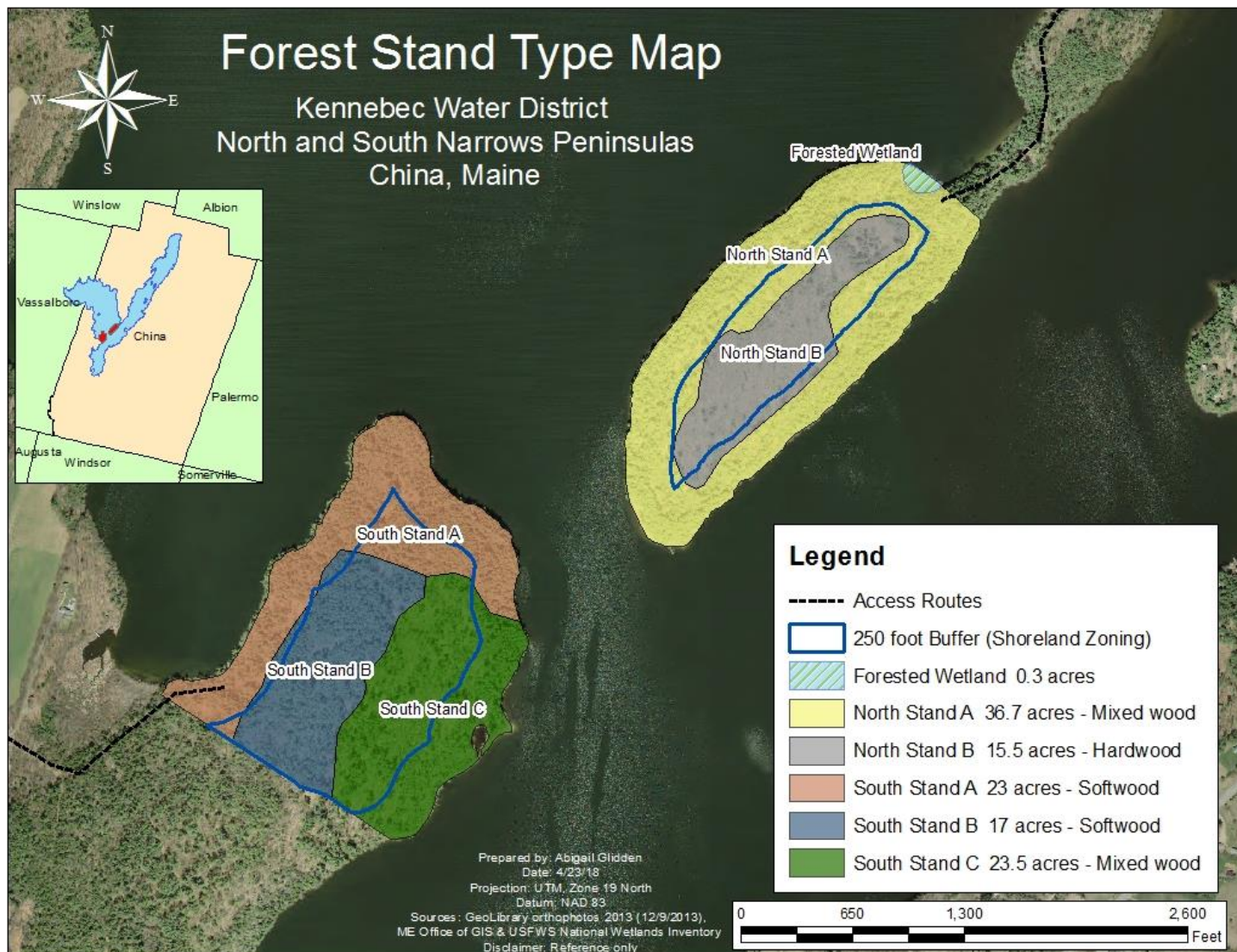
2,000 pounds = 1 ton

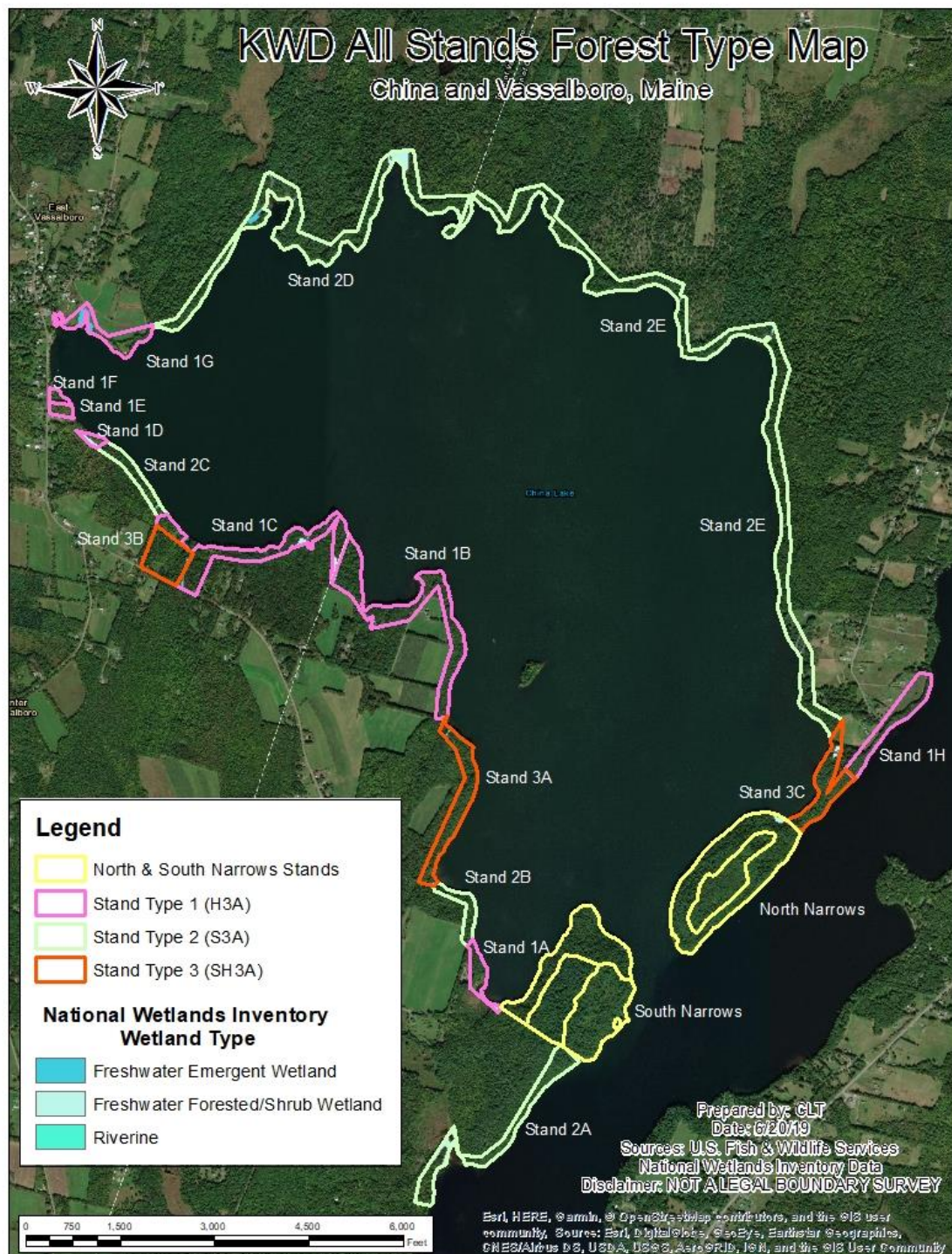
Calculation:

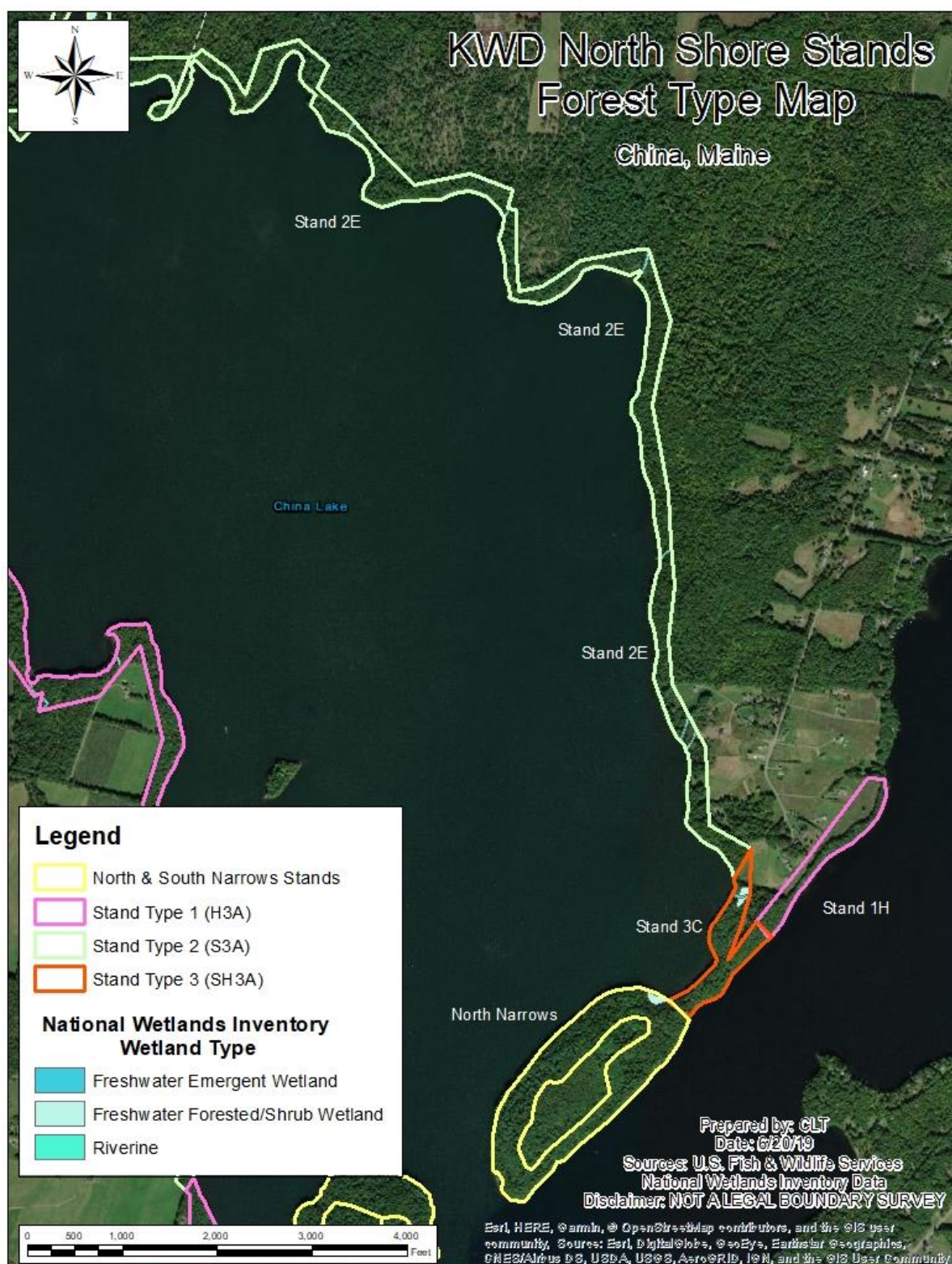
$$\text{Volume (tons)} = \frac{(\text{Volume (ft}^3) \times \text{Average Green Weight of Wood per Species (lbs/ft}^3))}{2,000 \text{ (lbs)}}$$

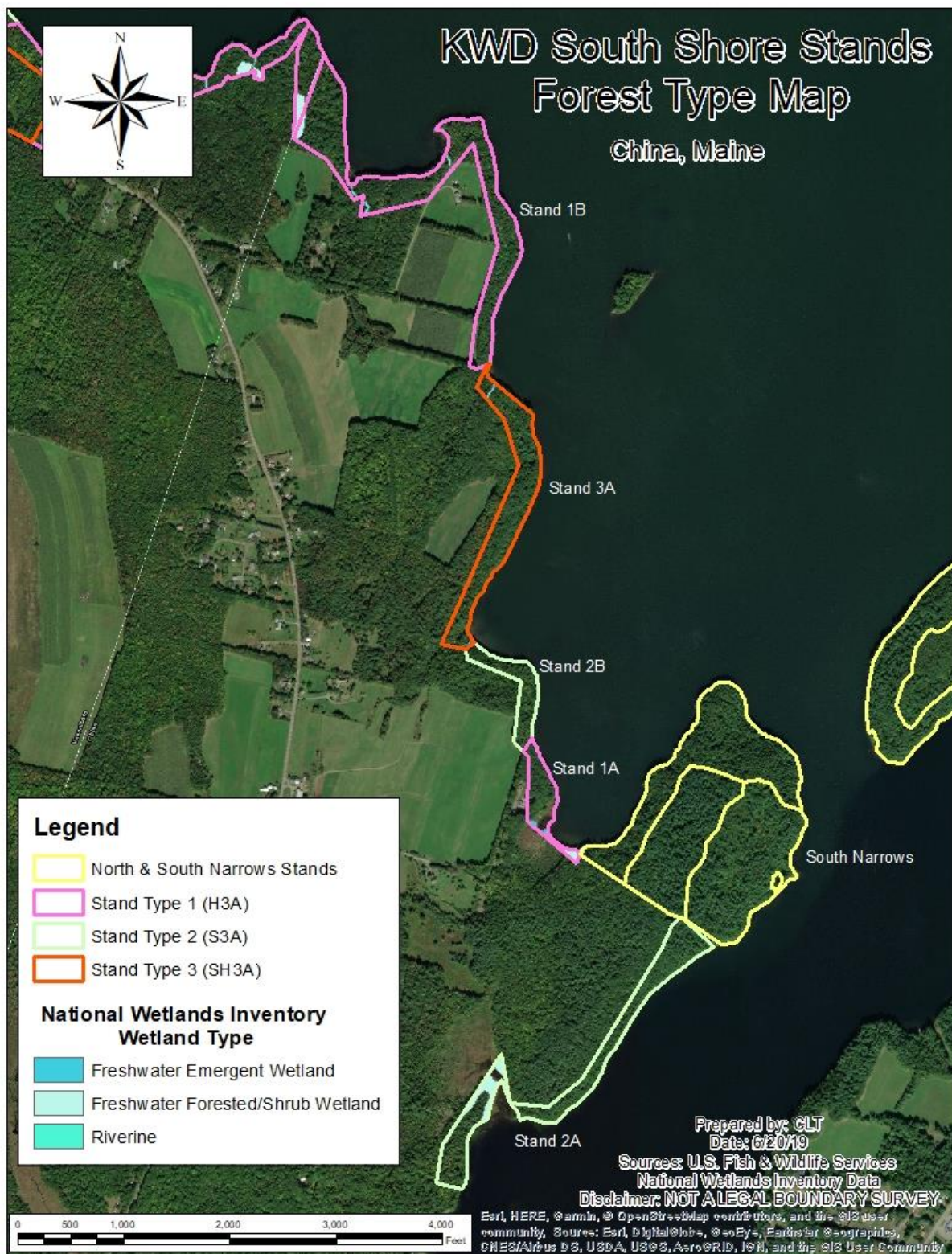
APPENDICES

Appendix 1: Forest Stand Type Maps









Appendix 2: Court Case for Access to South Narrows Peninsula/Hawker's Point

SEP 12 1991

STATE OF MAINE
KENNEBEC, SS.

RECEIVED
SEP 13 1991
CLERK
CIVIL ACTION
DOCKET NO. CV-87-43

SUPERIOR COURT
CIVIL ACTION
DOCKET NO. CV-87-43

KENNEBEC WATER DISTRICT,
Plaintiff
v.
LEWIS & MADELINE HAMILTON,
Defendants

DECISION AND ORDER

This matter has a long and fairly tortured history. It took a considerable number of years for the case to come to trial and when it was tried, it was tried to a jury. The questions presented to the jury had to do with whether or not the plaintiff Kennebec Water District had an easement over certain property of the defendants, known as the Clark Road, running to property owned by plaintiff on Hawker's Point so-called on the shore of China Lake. On the verdict form, the jury was unanimous in determining that the plaintiff had an easement by prescription, by necessity, and by implication. Further, in sub-questions, the jury determined that the easement included the right to use the road to conduct logging operations, to patrol the District's property, and to use the road for "other proper District purposes" such as fire protection.

During the trial, the parties had agreed that the jury would not be called upon to fix the exact location of the easement, if they found one, nor would they be asked to make a determination as

to the exact dimensions of the easement. These matters, the parties agreed, would be left to the court if, in fact, the jury determined that an easement did exist.

Following the return of the jury verdict, the court strongly urged the parties to attempt to work out an agreement with regard to the exact location of the easement and with regard to any other details concerning the easement, including its width and its maintenance. The parties have been able to agree with regard to the location of the easement since it is, as it appears on the face of the earth and follows a course which can be readily determined when one is on the property, i.e., there are plain signs as to exactly where the right-of-way has always gone and neither of the parties disputes this location. What remains in dispute is the width of the easement and apparently the plaintiff's rights to maintain the easement.

The jury could not by their verdict give the plaintiff anything more than it already has. In other words, it was the jury's job to determine whether plaintiff had an existing easement and they had no authority at all to award them a new easement or an easement different from the one which existed and which was shown by the evidence which the jury had to consider. The court in making its determination at the request of the parties with regard to the width of the easement and any other details concerning the maintenance of the easement, is bound by the jury verdict and is bound by the same evidence as was presented to the jury. The court has had the added benefit of a view of the

property in question and has, with the parties and counsel walked the entire length of the easement.

Keeping the above legal premises in mind; that is, that the jury only determined what the plaintiff already legally had and did not give it anything more, and that the court is bound in the same fashion, the court makes its determination with regard to the requested issues.

Utilizing the evidence presented at trial and the evidence presented by the view which the court took of the premises in question, and based in great part upon the apparent distances between fairly substantial trees on each side of the easement, the court determines that this easement always was, and therefore still is, eighteen (18) feet in width. The center line of the easement is readily apparent on the face of the earth and plaintiff's easement extends nine (9) feet on each side of that center line for a total width of eighteen (18) feet.

Under established law, a person holding a right-of-way is entitled to maintain that right-of-way to the degree required for its granted uses. The use which is of paramount importance here is the use of the right-of-way for logging purposes and the jury specifically determined that plaintiff had a right-of-way for such purposes. Plaintiff is therefore entitled to maintain the road so as to be able to use the road for those purposes and that means that plaintiff may maintain the road in such a manner as to facilitate the passage of necessary logging equipment, including, of course, trucks to haul material which results from the logging.

operation. This maintenance must be conducted only within the 18 foot right-of-way. Plaintiff does not have any right to any type of maintenance, whether it be ditching, filling, or whatever beyond the 18 foot width. Within that 18 foot width the plaintiff is entitled to do whatever is necessary to maintain the easement so that logging operations are possible, but no maintenance must be undertaken which is not necessary to accomplish that purpose.

The entry will therefore be, based on the jury verdict and the court's decision:

Judgment for plaintiff. Plaintiff has an easement over property of the defendant's over the Clark Road so-called as said easement appears on the face of the earth running to the property of the plaintiff on Hawker's Point in China, County of Kennebec and State of Maine; said easement to be eighteen (18) feet in width and subject to maintenance by the plaintiff to the degree necessary to conduct logging operations on plaintiff's property and to remove materials generated by those operations from plaintiff's property.

DATED: September 10, 1991


BRUCE W. CHANDLER
JUSTICE, SUPERIOR COURT

Appendix 3: Forest Health Photos

Hemlock Woolly Adelgid



Steven Katovich, USDA Forest Service, Bugwood.org

Beech Bark Disease



Joseph OBrien, USDA Forest Service, Bugwood.org



USDA Forest Service – North Central Research Station,
USDA Forest Service, Bugwood.org

White Pine Weevil



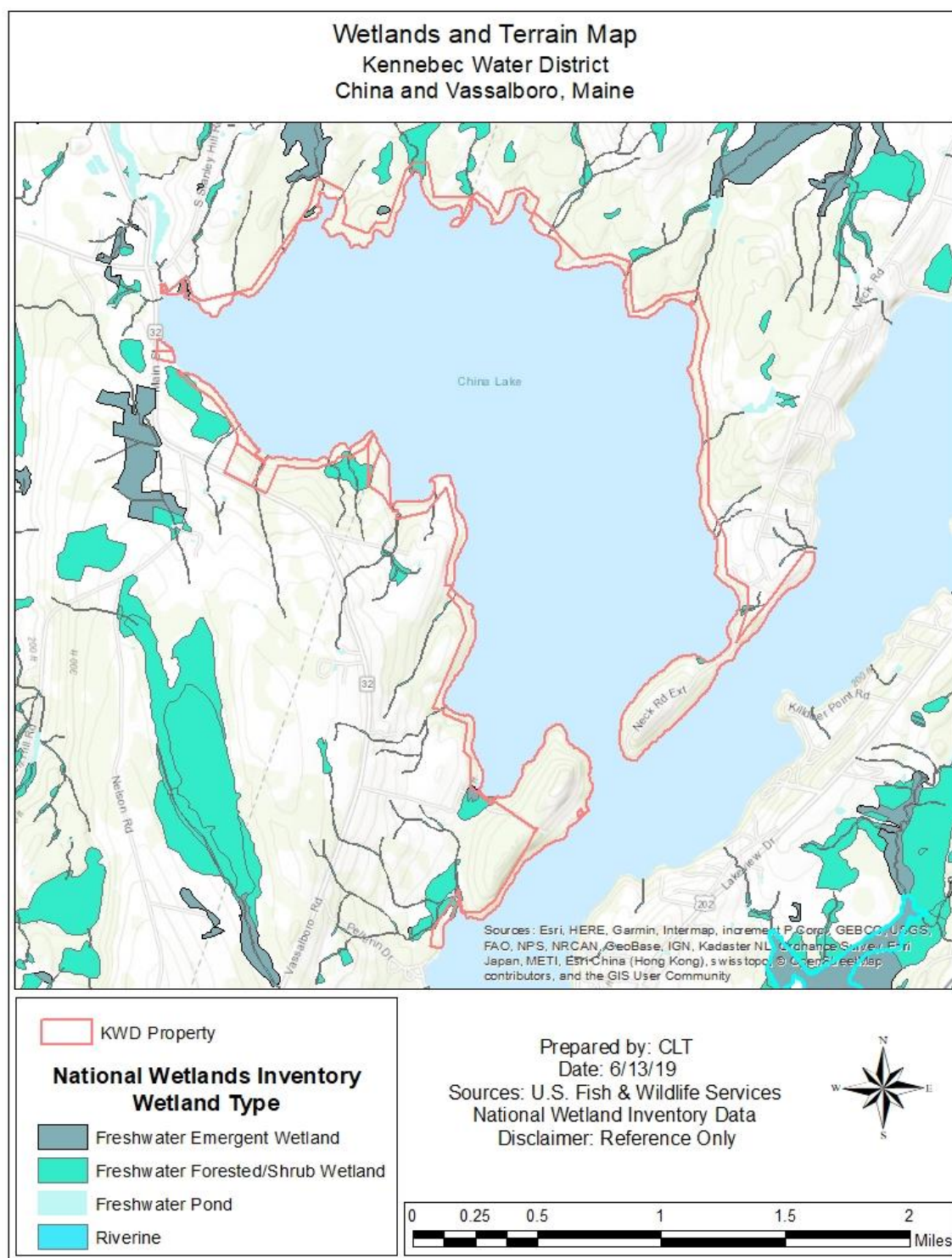
Steven Katovich, USDA Forest Service, Bugwood.org

Emerald Ash Borer

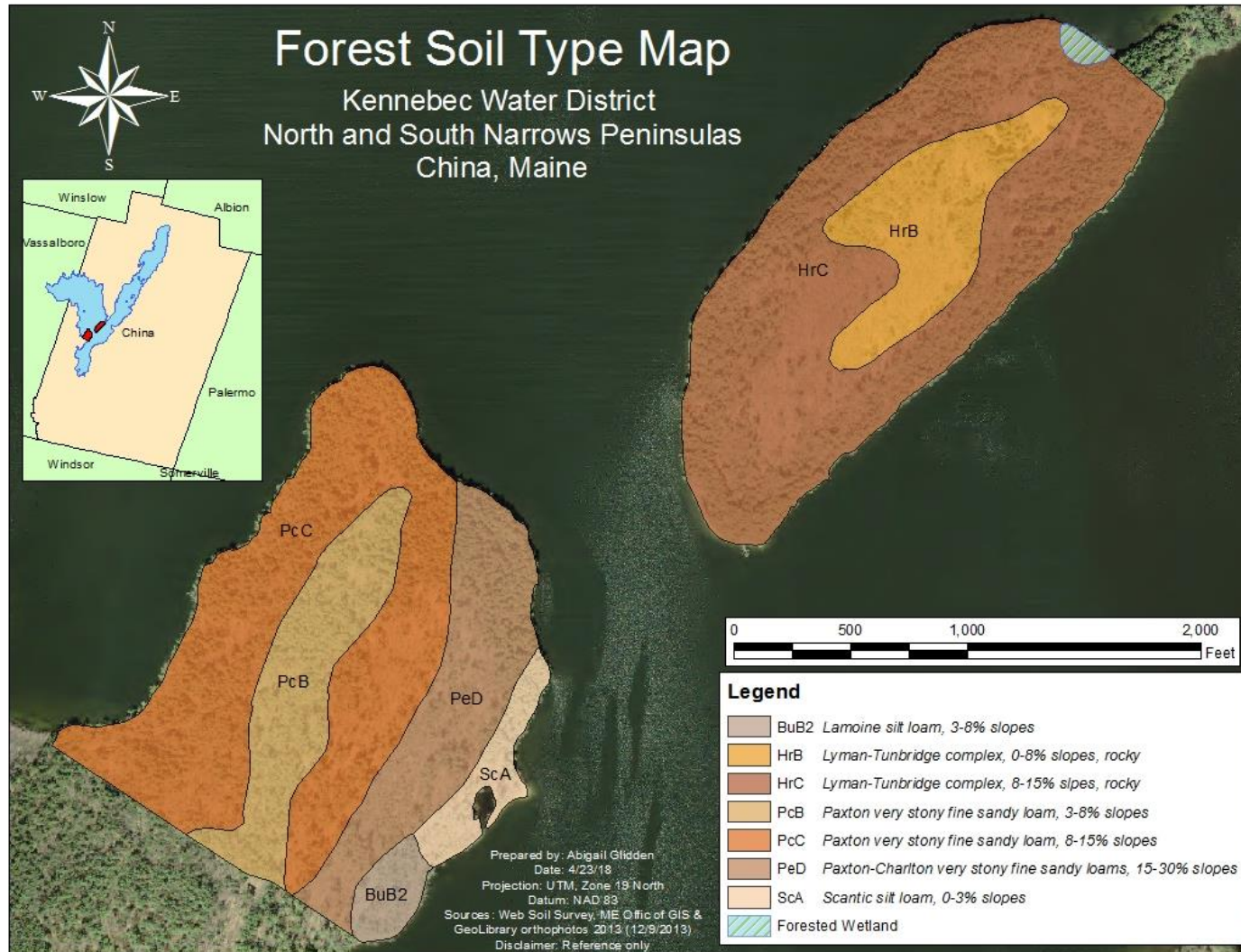


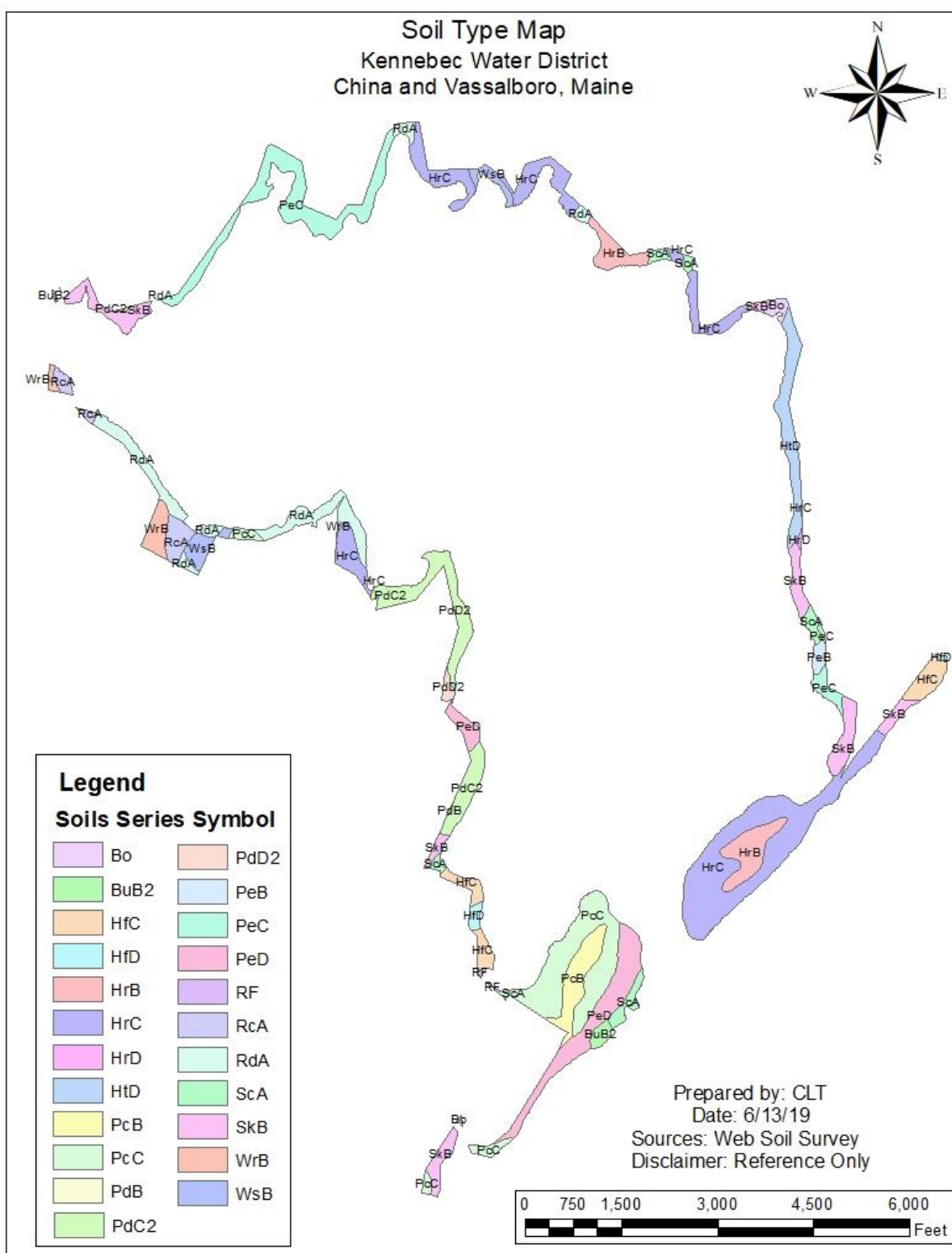
Eric R. Day, Virginia Polytechnic Institute and State University, Bugwood.org

Appendix 4: Wetlands and Terrain Map



Appendix 5: Soil Type Maps





Appendix 6: Maine Natural Areas Program



PAUL R. LePAGE
GOVERNOR

STATE OF MAINE
DEPARTMENT OF AGRICULTURE, CONSERVATION & FORESTRY
93 STATE HOUSE STATION
AUGUSTA, MAINE 04333

WALTER E. WHITCOMB
COMMISSIONER

January 5, 2018

Abigail Glidden
Via email: aglidden@cltenv.com

Re: Forest Management Plan Review

Dear Ms. Glidden:

In response to your request received on January 4, 2018, I have searched our data system for information on rare or unique botanical features, rare animal populations, and essential or significant wildlife habitats in the vicinity of the Kennebec Water District property along the West Basin of China Lake in Vassalboro and China.

For individual parcel reviews, we use a simple checklist that summarizes our findings. The enclosed checklist includes our review of several data sets, some of which are maintained by MNAP and others that are maintained by the Maine Department of Inland Fisheries and Wildlife (MDIFW), and the U.S. Fish and Wildlife Service (USFWS). If a parcel intersects with a data set maintained by MDIFW or USFWS, please contact the appropriate biologist indicated on the checklist for additional information.

This property is associated with a Deer Wintering Area. Please consider contacting the regional wildlife office for advice and recommendations to ensure the continued availability of critical conifer shelter for wintering deer while accommodating the need to manage for timber production. You can find more information about managing for deer wintering areas at the MDIFW website, http://www.maine.gov/ifw/docs/DWA_Guidelines_2.4.10.pdf.

The parcel is associated with a moderatevalue Inland Waterfowl and Wading Bird Habitat (IWWH). MDIFW recommends maintaining a 250-foot undisturbed (of permanent clearings, roads, etc.) buffer around the wetland. Within this buffer, uneven-aged forest management should be used if the landowner is going to harvest any trees. Volume removal should not exceed 30% in a 15-year period, and a well-distributed overstory should be maintained. No trees should be cut within 75 feet of the shore. MDIFW recommends that consideration be given to implementing a plan to leave snags and trees with cavities that will benefit cavity nesting waterfowl and many other wildlife species.

Good management of this habitat is consistent with good forestry, and MDIFW's regional wildlife and fisheries biologists are available to assist you in maintaining its integrity while allowing for forest management and timber procurement. According to the information currently in our files, there are no other rare species or important habitats documented within the property, though the area is mapped as Atlantic salmon critical habitat. This lack of data may indicate minimal survey efforts rather than the absence of rare features.

Thank you for using the MNAP in the forest management planning process. If you have questions about the MNAP, or if you would like more information about this site, please feel free to contact me. You can also visit us on the web at www.maine.gov/dacf/mnap.

Sincerely,

Lisa St. Hilaire

Information Manager | Maine Natural Areas Program | maine.nap@maine.gov | Phone: (207) 287-8044 | Fax: (207) 287-8040

cc: Keel Kemper, Wes Ashe, MDIFW

MOLLY DOCHERTY, DIRECTOR
MAINE NATURAL AREAS PROGRAM



PHONE: (207) 287-8044
FAX: (207) 287-8040
WWW.MAINE.GOV/DACF/MNAP

MAINE NATURAL AREAS PROGRAM
(207)287-8044 or maine.nap@maine.gov

Forest Management Plan Review

Forester: *Abigail Glidden*

Landowner: *Kennebec Water District*

Lot Name: *West Basin China Lake*

Date Received: *1.4.2017*

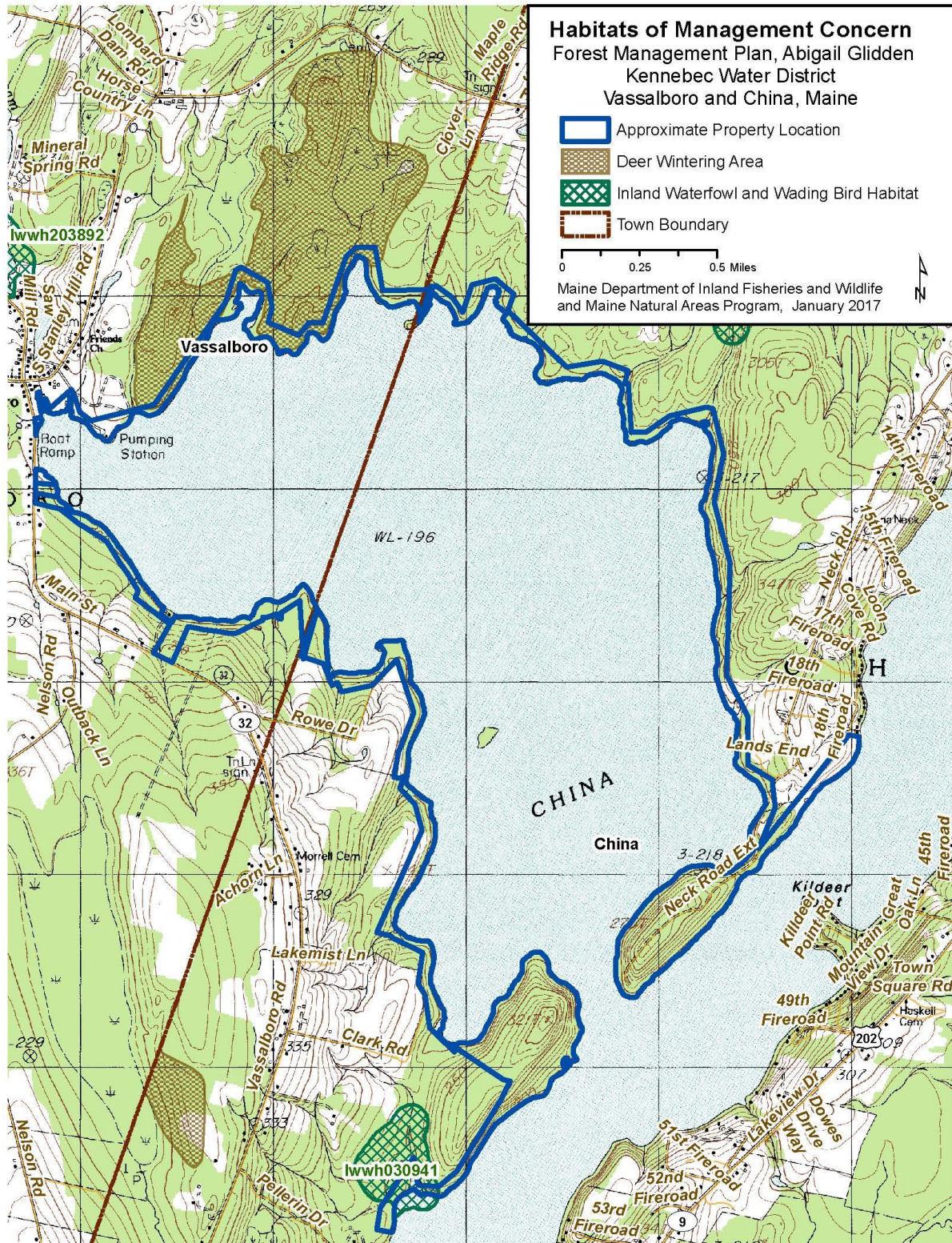
Town: *Vassalboro and China*

County: *Kennebec*

MDIFW Region: *B*

PLANT, ANIMAL, AND HABITATS	Documented to occur at the site?		Contact the following biologist to discuss conservation considerations
	YES	NO	
Plants: rare, threatened and/or endangered <i>If yes, see attached summary table.</i>	☐	☒	
Natural Communities: rare and/or exemplary <i>If yes, see attached summary table.</i>	☐	☒	
Animals: rare, threatened, or endangered <i>If yes, see attached summary table.</i>	☐	☒	
Mapped Essential Wildlife Habitats: Roseate tern Piping plover and Least tern	☐ ☐	☒ ☒	
Mapped Significant Wildlife Habitats: Deer wintering area Inland waterfowl and wading bird habitat Tidal waterfowl and wading bird habitat Significant vernal pool Shorebird feeding/roosting area	☒ ☒ ☐ ☐ ☐	☐ ☐ ☒ ☒ ☒	MDIFW Regional Wildlife Biologist, Keel Kemper, 547-5319
Wild brook trout habitat	Yes ☐	Unknown ☒	
Atlantic Salmon: Salmon critical habitat Salmon stream habitat	Yes ☒ Yes ☐	No ☐ Unknown ☒	USFWS Biologist, Wende Mahaney, 902-1569 For more information: http://www.fws.gov/mainefieldoffice/Atlantic_salmon.html
Canada lynx: The town & parcel may provide habitat for lynx	☐	☒	
LANDSCAPE CONTEXT			YES NO
Does parcel intersect with a Beginning with Habitat Focus Area? Focus Area Name: Additional information on this focus area may be available at www.maine.gov/dacf/mnap/focusarea			☐ ☒
Is the parcel adjacent to or on Conservation Lands? Owner: Ownership type: ☐ Fee ☐ Easement Area Name:			☐ ☒
Is the parcel within an area identified by MNAP as a potential inventory site for undocumented rare plants or exemplary natural communities? If so, MNAP will contact the landowner for permission prior to any inventory work.			☐ ☒

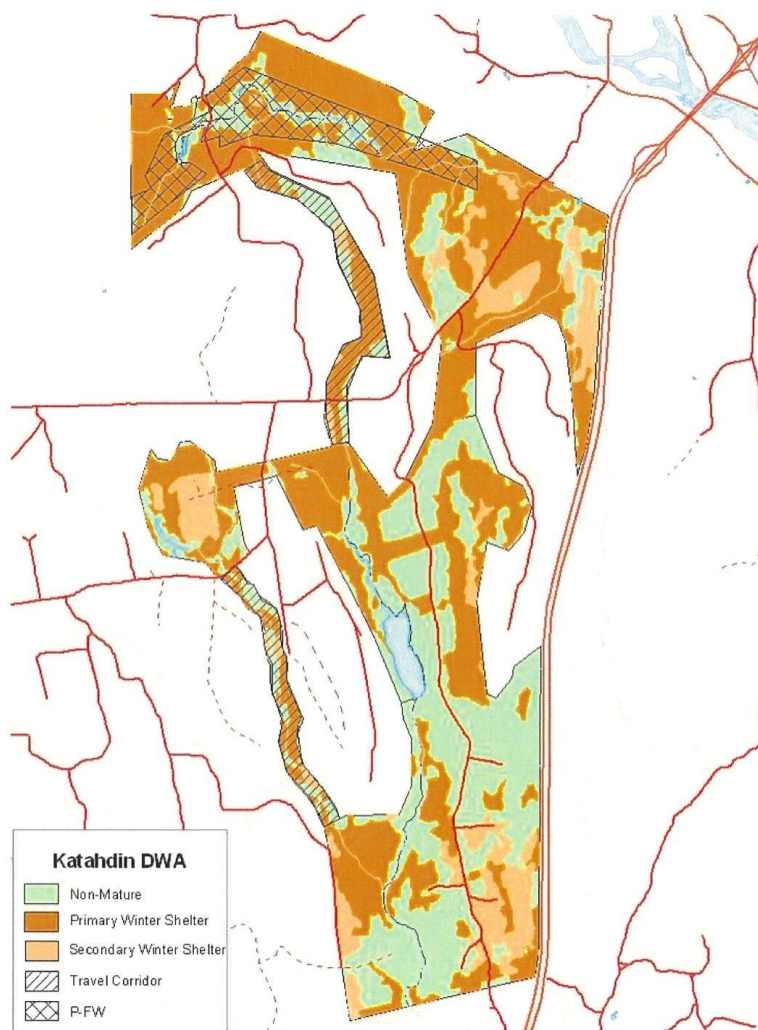
Review completed by: LRS
Date: 1-5-2018
MNAP #: 2018-01-05-LS-08



Appendix 7: Department of Inland Fisheries and Wildlife Guidelines: Managing Deer Wintering Areas in Northern, Western, and Eastern Maine

1

Guidelines for Wildlife: Managing Deer Wintering Areas in Northern, Western and Eastern Maine



Introduction

The well-being of Maine's deer herd depends, in part, on efforts of the Maine Department of Inland Fisheries and Wildlife (MDIF&W) and private landowners. Maine is almost as large as the other New England states combined, yet private landowners own 94% of the land in the State. Private landowners are integral to conserving Maine's wildlife heritage and natural resources.

These guidelines will assist landowners, loggers, foresters, and others in understanding how DWAs function and can be maintained using flexible but specific management prescriptions.



These guidelines can be applied over large geographic areas where local variations in deer use, topography, stand types, soils and land management strategies may occur. Using these guidelines along with MDIF&W staff consultation and local forester's knowledge to adjust for these site-specific variations will yield the best results.

These guidelines will increase the predictability and flexibility of DWA management recommendations. Cooperative working relationships between landowners and MDIF&W improve identification, monitoring and information sharing on areas used by deer and help guide timber harvesting activity.

Overview

Maine's white-tailed deer occupy the northeastern part of the species' range in North America. At the edge of their natural range, deer rely on specific winter habitat when severe weather threatens the animals' survival.

To survive the winter season, deer seek habitats with a combination of cover and food that minimizes net energy loss. As winter conditions change from mild to moderate and then severe, the relative importance of cover versus food changes. Deer winter habitat has been defined for managing the winter habitat requirements. During the snow-free period of the year from spring to fall, deer range over most of the landscape and use a wide variety of forest and non-forest vegetation communities. However, as snow accumulates and temperature drops, deer spend more time in older conifer-dominated forest stands associated with watercourses and valleys. Deer often return to winter in the same locations from year to year. These traditionally used areas are called deer wintering areas or deer yards and are the focus of forest management activities to provide winter habitat.

Deer wintering areas include a variety of habitat components that may change with forest condition and management strategy. These habitat components contribute to the long-term functioning of a deer wintering area as a source of winter shelter and food. White-tailed deer utilize predominantly mature coniferous forest habitat during critical winter conditions. Suitable habitat areas provide relief from winter in more stable temperatures and humidity conditions, and lower snow depths. These areas are used approximately 3 to 5 months in the winter when snow depths are greater than 12 inches. Deer movements are considered to be restricted when snow depths reach 16 inches. While shelter is the most important component of these areas for wintering deer, an interspersed forest stands providing forage and sunlight is also required to provide quality habitat. Habitat suitable for deer in winter also provides quality habitat for numerous other species associated with mature forest.

DWA Habitat Components

Deer wintering areas include a variety of habitat components that may change with forest condition and management strategy. These habitat components contribute to the long-term functioning of a DWA as a source of winter shelter and food.

Primary Winter Shelter

Primary Winter Shelter (PWS) consists of forest stands that provide shelter for deer during the most severe winter conditions. PWS has the following:

- ♦ Softwood crown closure $\geq 70\%$ mixed or solitary stands of cedar, hemlock, spruce, and fir; and
- ♦ Stand height ≥ 35 feet.



Secondary Winter Shelter

Secondary Winter Shelter (SWS) consists of forest stands that provide adequate shelter for all but the most severe winter conditions. SWS has the following:

- ♦ Softwood crown closure between 50% and 70% mixed or solitary stands of cedar, hemlock, spruce, and fir; and
- ♦ Stand height ≥ 35 feet.

Non-Mature/Future Shelter Stands

Stands mapped within a DWA that do not currently meet PWS or SWS definitions provide forage (woody browse) between and adjacent to stands that provide shelter. These stands enhance the value of a DWA, especially when managed to attain PWS or SWS criteria.

DWAs often include areas such as south facing slopes that enhance solar gain during late winter. These areas may not meet SWS or PWS criteria, but provide microclimatic benefits that contribute to DWA functioning. Local knowledge is critical to identifying these areas.

Travel Corridors

Successful functioning of DWAs on a long-term basis requires travel corridors within the DWA. Traditionally used corridors often follow streams and wetlands, or topographic features such as ridgelines and valleys. Functional corridors are wide enough to provide deer with sheltered travel ways throughout the yard, and are located to maintain direct access to winter shelter.

Winter Foods: Browse & Litterfall



Deer rely on fat reserves and an ability to minimize energy expenditures to survive during winter. Generally, hardwood and softwood winter browse only slows seasonal weight loss in deer, relative to eating nothing. Only the leaves of northern white cedar can sustain deer in winter without causing serious weight loss. Cedar and hemlock are long-lived species that provide high quality winter shelter and high-value winter food, although often in low abundance as ground-level forage in DWAs.

Litterfall is a secondary source of food for wintering deer. It consists of softwood twigs, especially of cedar and hemlock, and arboreal lichens dislodged from the canopy throughout the winter by snow, ice and wind that become

available to deer on the snow surface. As softwood stands mature, they develop more lichen biomass and contribute more litterfall. In spruce/fir dominated DWAs, balsam fir contributes the majority of lichen and litterfall biomass. While difficult to measure, litterfall may comprise as much as 50% of the winter diet for deer and are independent of browse pressure.

Spring Foods

Winter browse and litterfall is very low in protein and insufficient to support deer fetal development. Most fetal development is delayed until the final trimester of pregnancy, generally after late-March. The availability of higher quality spring foods such as grasses and clovers close to DWAs can influence survival of adults, body condition of lactating females, and thus survival of nursing fawns.

Management Guidelines

Manage each DWA as a network of mature interconnected softwood stands interspersed with non-mature, future winter shelter stands and smaller open-canopy patches of forest using these objectives:

Winter Shelter Management

- ◆ Maintain ≥ 50% of DWA acreage in a combination of PWS and SWS;
 - Maintain one half or more of this winter shelter acreage as PWS;
 - Individual blocks of winter shelter should be ≥ 25 acres and ≥ 15 chains (1 chain = 66 ft) wide;
 - All stands meeting above criteria should be connected with travel corridors (see management recommendations below);
- ◆ The remainder of the DWA should be in non-mature age-classes and managed to attain PWS or SWS criteria;
 - Maintaining ≥ 5 age classes in a DWA allows the best opportunity for meeting winter shelter goals through time;
- ◆ As site conditions allow, land managers should strive to continually improve the quality of winter shelter by managing the species composition;
 - Stands should be managed to favor and enhance the species most suited to the site while considering their abundance, distribution and winter shelter value; and
 - Removing a portion of the hardwood component can improve cover, produce browse and maintain tree health. However, care should be taken to avoid reducing the wind firmness of the residual overstory.

Special Considerations for Winter Shelter Management

In certain situations, conditions may preclude achieving desired levels of winter shelter. These include, but are not limited to:

- ◆ A skewed forest age class structure in a DWA that requires extensive forest intervention to develop a more balanced age class distribution; and/or
- ◆ Natural influences such as insects, disease, fire, or storms.

Before addressing the above factors, landowners and MDIF&W staff should discuss management plans for individual DWAs.

Travel Corridor Management

Travel corridors should be part of management plans to ensure uninterrupted deer mobility and access throughout the DWA. Depending on stand and site conditions and deer-use patterns, travel corridors can be permanently established or relocated as needed within a DWA. Permanent travel corridors should be regarded as a separate stand, and harvested lightly to preserve maximum shelter value at all times. Other guidelines for travel corridors are:

- ◆ Travel corridors should be ≥ 10 chains wide, as topography and natural stand types allow;
- ◆ Manage travel corridors for PWS criteria;
 - Travel corridors can meet SWS criteria when abutting winter shelter stands meeting PWS criteria;
- ◆ Travel corridors should be harvested using single-tree or group tree harvesting (forest openings < 40 feet in width); and
- ◆ Travel corridors meeting these conditions count toward the overall goal of maintaining 50% winter shelter.

Winter Browse Management

Maintaining an interconnected network of winter shelter and future winter shelter stands, interspersed with smaller open-canopy patches of forest, can enhance the functional area of the DWA. During moderate winter conditions, deer use a greater area of the DWA. This helps reduce browsing pressure in optimal winter shelter stands, while providing access to more nutritive browse to maintain health and condition. As conditions become more restrictive, deer favor stands with optimum winter shelter over stands with less shelter but more browse.

A constant supply of high quality browse, very close to the winter shelter, can usually be produced in the course of other scheduled treatments. Consider the location and time interval between harvests in and adjacent to a DWA to manage a constant supply of browse adjacent to winter shelter stands. These areas will shift over time as the winter shelter stands mature and are regenerated.



Spring and Autumn Food Management

Herbaceous seeding of logging roads, log landings, and other permanent forest openings can help provide early spring food as deer disperse to their summer home range and provide autumn foods as deer build fat stores. Openings where snowmelt will occur earliest, such as south facing slopes, are prime locations for seeding. Seeding can be as simple as one-time seeding of new roads and landings (dormant season seeding has produced good results) or seeding with the addition of lime, fertilizer, and mulch.

Harvest Timing

Harvesting is encouraged during wintering conditions to protect regeneration, provide a one-time but beneficial source of food for deer (tops, downed lichen, etc.), and enhance deer mobility during the operation through snow compaction by logging equipment. Winter harvesting also maximizes frozen ground conditions for harvesting low-lying softwood stands near water bodies. Summer or fall harvests may be prescribed when land scarification is desired for a favorable spruce seedbed.

Other Forest Management Activities

Road Construction

Roads located in DWAs may be detrimental to deer by:

1. Fragmenting winter shelter;
2. Allowing easier access for predators, especially coyotes, and opportunities for human disturbance;
3. Being an impediment to winter travel;
 - a. Snow banks on plowed roads may be a barrier to deer crossing the road, or may hold deer in the roadway where they are exposed to vehicular accidents and to being run by traffic; or
 - b. Unplowed roads create openings that break the cover and may hinder deer movement. The wider the opening, the greater the impediment.



Due to the above concerns, all attempts should be made to locate roads outside of DWAs. However, this is not always achievable due to various limitations of topography and site. Where no reasonable alternatives exist, non-permanent, minimal disturbance "winter" roads are the preferred option to minimize the footprint. Where unavoidable, permanent all season gravel roads may be located within a DWA.

Roads constructed in DWAs should strive for the following to maintain deer mobility:

- ◆ Road length and right-of-way clearing should be kept to a minimum while allowing for ditches, mining for road surface material, snow removal and periodic truck turnouts and landings;
- ◆ For every quarter-mile of road in a DWA identify stream, wetland and/or historical deer crossing areas where tree removal can be limited to the travel surface only, for a road length of two chains; and
- ◆ Winter roads should be allowed to reforest when capable, otherwise apply lime, fertilizer, and an herbaceous seed mixture to provide forage for deer.

Herbicide Application

The present goal of herbicide application is to release established softwood regeneration from hardwood competition on harvested softwood sites. The broad goal of DWA management also seeks to promote the timely reestablishment of softwood cover on harvested sites. The proper use and application of herbicides in DWAs may be appropriate, particularly to balance a skewed age class structure.

Precommercial Thinning

Precommercial thinning (PCT) of naturally regenerated stands is a silvicultural tool used to control crop tree spacing and encourage earlier softwood maturation, as well as controlling the stand's species composition. Within DWA areas subjected to PCT, landowners should consider encouraging tree species that will provide optimum shelter values or to help balance a DWA with a skewed age class structure by more quickly attaining conforming cover status.

Gravel Excavation

Gravel extraction in a DWA can result in the loss of existing softwood cover or established softwood regeneration, and can disrupt deer movement within the DWA.

Since sand and gravel occur in limited locations and quantities, extraction is essential to forest management. Gravel should be located close to current road construction projects to be economical. Guidelines for gravel extraction include:

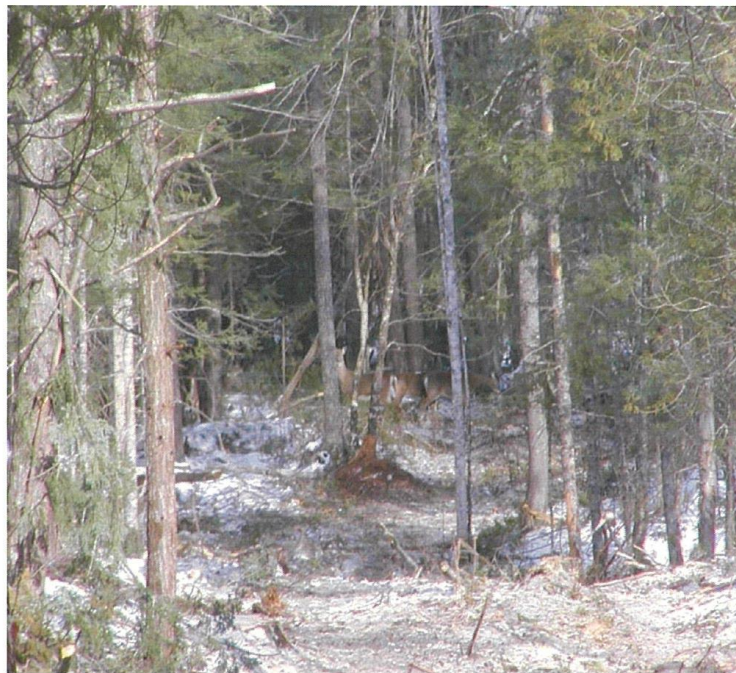
- ◆ Avoid development of gravel areas in travel corridors and winter shelter;
- ◆ Each new gravel pit should be limited to 1 acre of working pit area; and

- ◆ As gravel pits are expanded, reclaim, stabilize and revegetate spent portions with suitable softwood seedlings or with an herbaceous seed mixture designed to maximize winter shelter or food availability for deer, respectively. Gravelly sites typically need lime, fertilizer and mulch.

Other Structures, Uses, or Services

Development resulting in the permanent loss of shelter values is not compatible with DWA management goals. Landowners should consult with MDIF&W before any of the following structures, uses or services are established within a DWA:

- ◆ The erection of buildings and other structures, excluding temporary "warming shacks" used during timber harvesting, that are removed from the site after harvesting;
- ◆ Agricultural activities;
- ◆ Trails intended for winter recreation;
- ◆ Campgrounds intended for winter use;
- ◆ Recreational camps;
- ◆ Commercial sporting camps;
- ◆ Utility infrastructure;
- ◆ Solid waste disposal sites;
- ◆ Land application of septage, sludge and other residuals, and related storage and composting activities;
- ◆ Water impoundments; and
- ◆ Any other structures, uses, or services that could substantially affect or diminish the DWA as addressed under the long-term management plan.



For More Information

Maine Department of Inland Fisheries and Wild
284 State Street
Augusta, ME 04333
207-287-5252
www.mefishwildlife.com

Region A - Gray
358 Shaker Road
Gray, ME 04039
207-657-2345

Region B - Sidney
270 Lyons Road
Sidney, ME 04330
207-547-5300

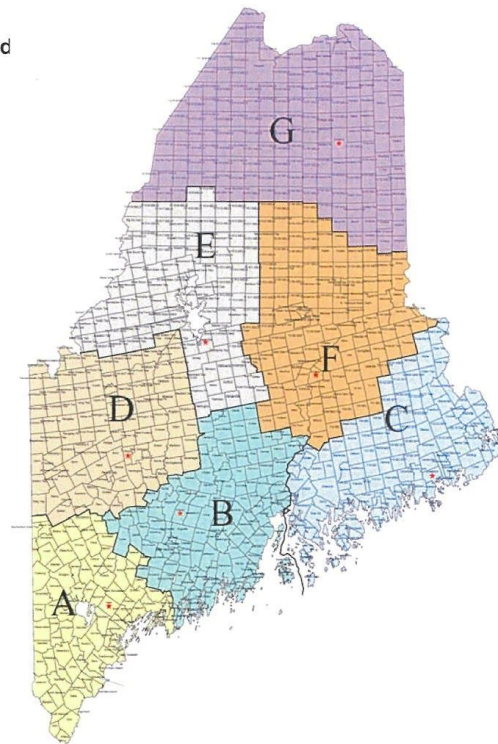
Region C - Jonesboro
PO Box 220
Jonesboro, ME 04648
207-434-5927

Region D - Strong
689 Farmington Road
Strong, ME 04983
207-778-3324

Region E - Greenville
PO Box 551
Greenville, ME 04441
207-695-3756

Region F - Enfield
73 Cobb Road
Enfield, ME 04493
207-732-4132

Region G - Ashland
PO Box 447
Ashland, ME 04732-0447
207-435-3231



Maine Forest Products Council
35 Civic Center Drive
Augusta, Maine 04330
207-622-9288
www.maineforest.org

Small Woodland Owners Association of Maine
153 Hospital Street
P. O. Box 836
Augusta, ME 04332
207-626-0005
www.swoam.org

References

- Reay, R., Blodgett, D., Burns, B., Weber, S., and Frey, T.
1990. Management Guide for Deer Wintering Areas in Vermont.
- Lavigne, G.
1999. White-Tailed Deer Assessment and Strategic Plan. Maine Department of Inland Fisheries and Wildlife.
- Pekins, P., & Tarr, M.
2009. A Critical Analysis of the Winter Ecology of White-Tailed Deer & Management of Spruce-Fir Deer Wintering Areas with Reference to Northern Maine.
- Verme, L.J.
1977. Assessment of Natal Mortality in Upper Michigan Deer. JWM 41:700-708.
- Special Management Practices for Deer Wintering Areas. Nova Scotia.

Appendix 8: Maine Historic Preservation Commission Results



January 4, 2018

Kirk F. Mohney, Director
Maine Historic Preservation Commission
55 Capitol Street
65 State House Station
Augusta, ME 04333-0065

RE: MHPC Review for Forest Management Plan

Hello Kirk,

I am writing a forest management plan and would like the following area to be reviewed for any historic properties, as defined by the National Historic Preservation Act, so the property can be managed accordingly.

I am requesting review for an area located in both South China and Vassalboro. The area of concern surrounds the West Basin of China Lake. The general location is shown on the Maine DOT topo map and the more specific area is displayed on the additional map.

If you need additional information let me know.

Thank you,

Abigail Glidden

Enclosures:
2 Maps



MAINE HISTORIC PRESERVATION COMMISSION
55 CAPITOL STREET
65 STATE HOUSE STATION
AUGUSTA, MAINE 04333

ARCHAEOLOGY AND HISTORIC RESOURCES REVIEW
FORESTRY PLAN

MHPC # F002-18 Date Received 1/8/2018
Township CHINA, VASSALBORO Forester COMPREHENSIVE LAND TECH
Parcel KENNEBEC WATER DISTRICT

*****This worksheet was completed for informational purposes only*****

Native American (Prehistoric) Archaeology (for further information: arthur.spiess@maine.gov)

- ☐ No prehistoric archaeological sites known. Based on location, soils and topography, none are expected.
- ☒ No prehistoric archaeological sites known because no survey has been conducted. However, the following area is archaeologically sensitive: within 50 yards of the lake (or see attached info)
- ☐ The property includes known sites of archaeological importance. (see attached info)

Historic Archaeology (e.g. 1800s farms, etc.) (for further information: leith.smith@maine.gov)

- ☐ No sites are known, and none are expected (based on historic maps and documents).
- ☒ There are possible sites from former houses, barns, and outbuildings shown on maps from 1850 to 1920, now possibly recognizable as foundations or cellar holes. (see attached map) 1861 *many historic properties present*
- ☒ The property contains known sites of archaeological importance. (see attached info)

Historic Buildings or Structures (For further information: megan.m.hopkin@maine.gov)

- ☐ No historic buildings or structures are known or expected on the property (based on 7.5' USGS topographic maps and MHPC records).
- ☒ Buildings or structures may exist on the property that have not been evaluated for National Register eligibility. Our office will provide an assessment if a request letter, photos of any buildings over fifty years of age that are on the subject parcel, and a 7.5" USGS topographic map with all photos keyed to it are submitted to our office.
- ☐ Buildings or structures exist on the property that are either listed in or eligible for nomination to the National Register of Historic Places. (see attached info)

The information on this worksheet is being provided for Forestry Management Planning purposes only. If any construction or ground disturbing activities on these properties will utilize federal funding, permitting or licensing, initiation of Section 106 review with the Maine Historic Preservation Commission is required pursuant to the National Historic Preservation Act of 1966.

PHONE: (207) 287-2132

FAX: (207) 287-2335

Appendix 9: Quabbin Reservoir Massachusetts: Managing a Watershed Protection Forest

Water Wildlife Forest Ecology

Massachusetts: Managing a Watershed

The Quabbin forest of central Massachusetts is the first barrier to contamination at the source of Boston's water supply. An interdisciplinary team is implementing an uneven-aged management strategy to create a watershed protection forest that both ensures water quality and enhances site productivity, biological diversity, and cultural resources. Adapting to changing conditions and learning from experience define this approach to interdisciplinary forestry. Recent green certification by SmartWood provided external review of the public forest's sustainability. Quabbin managers hope to lead local private landowners by their example.

By Paul K. Barten, Thom Kyker-Snowman, Paul J. Lyons, Thomas Mahlstedt, Robert O'Connor, and Bruce A. Spencer

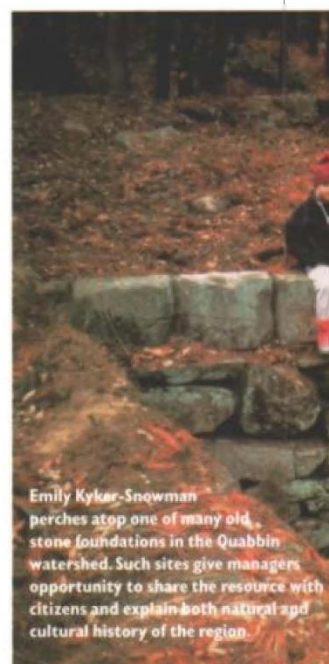
Boston's principal water supply—the Quabbin Reservoir—is surrounded by forestland managed by the Metropolitan District Commission. Instead of excluding timber harvesting in the name of watershed protection or logging just to generate revenue, the commission has designed and is implementing a plan to restructure the forest to enhance watershed protection. The commission's mandate is to “utilize and conserve... water and natural resources in order to protect, preserve and enhance the environment of the Commonwealth and to assure the availability of pure water for future generations” (Massachusetts General Laws, Chap. 92, Sect. 105).

Recent amendments to the Safe Drinking Water Act (1986, 1996) underscore the importance of protecting source water quality. The commission received a filtration waiver for three nearby communities served directly by the Quabbin Reservoir and applied for a waiver for the Boston service area. The cost of filtration is estimated at \$200 million and will increase the average ratepayer's annual bill (\$442 sewer use fees plus \$233 for water) by about 5 percent. This adds to the substantial burden on customers already paying for the court-ordered \$6 billion wastewater treatment plant in Boston Harbor and other capital programs.

In December 1997, the regional office of the US Environmental Protection Agency concluded that filtration was necessary for the Boston service area but reemphasized the importance of a “multiple barrier” approach, encompassing watershed protection, disinfection, covered distribution reservoirs, and distribution system maintenance.

No Accident of History

The development of Boston's water supply system dates from 1652, when the Water Works Company was incor-



Emily Kyker-Snowman perches atop one of many old stone foundations in the Quabbin watershed. Such sites give managers opportunity to share the resource with citizens and explain both natural and cultural history of the region.

porated to supply the city (Platt 1995). Throughout the 1700s and 1800s larger and more distant supplies were developed. Construction of the Wachusett Reservoir, started in 1895 and completed in 1908, created the world's then-largest drinking water reservoir—65 billion gallons—but Boston's rapid growth quickly overtaxed this supply. Construction of an even larger reservoir in the Swift River Valley of central Massachusetts was proposed in 1922. The steady decline of farming and water-powered mills, coupled with effects of the Great Depression, meant that most landowners reluctantly accepted the inevitable and sold their property. Ultimately, 2,500 people were displaced and four com-

rotection Forest

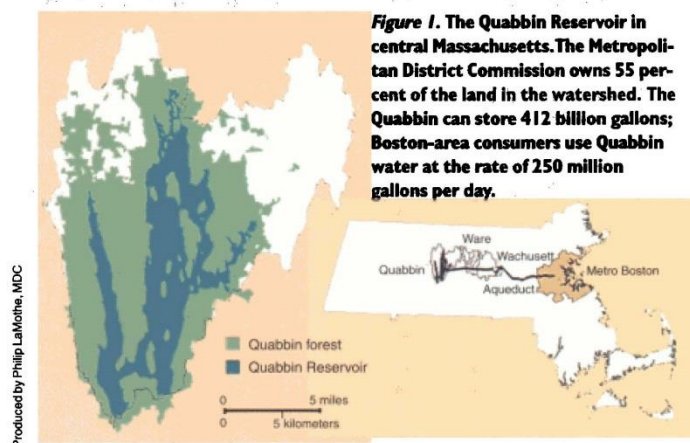


Figure 1. The Quabbin Reservoir in central Massachusetts. The Metropolitan District Commission owns 55 percent of the land in the watershed. The Quabbin can store 412 billion gallons; Boston-area consumers use Quabbin water at the rate of 250 million gallons per day.

munities—Dana, Enfield, Greenwich, and Prescott—were disincorporated to expand the water supply for 750,000 people in eastern Massachusetts.

Named with a Nipmuck Indian word meaning “meeting of many waters,” Quabbin Reservoir was completed in 1939. It has a capacity of 412 billion gallons, inundates 24,000 acres, and is one of the largest water supply reservoirs ever built (*fig. 1*). The Metropolitan District Commission, which implemented forest management in the 1930s as a key component of watershed protection, manages 53,000 acres of the 96,000-acre watershed—an unusually large proportion (55 percent) in a region where most water utilities own less than 10 percent of reservoir watersheds in narrow shoreline strips. Other public and private forestland totals 37,000 acres (39 percent); less than 5 percent of the remaining land is developed.

The forest surrounding Quabbin Reservoir reflects the economic and ecological history of New England. The classic forest ecology textbook by Spurr, Barnes, and others (now Barnes et al. 1998) and Raup’s (1966) seminal paper introduced generations of students to the Harvard Forest dioramas that depict a remarkable sequence of land-use change (*fig. 2, p. 12*). Agricultural use peaked between 1830 and 1850, when 80 percent or more of the forest was cleared (Foster 1992). The Erie Canal and settlement of the Ohio Valley led to rapid collapse of the New England farm economy. The social upheaval and economic changes brought about by the Civil War completed the transformation. Abandoned fields and pastures regenerated naturally to eastern white pine. More than a half-century later, “old field” stands were clearcut to supply nearby box and crate factories or blown down by the 1938 hurricane (Foster and Boose 1992; Coch 1995). Now, virtually the entire watershed, and

most of New England, is covered with second- or third-growth even-aged deciduous and mixed-species forest (Irland 1982; Foster 1988a; Kelty et al. 1992; MDC 1995). The forest is neither accidental nor wilderness, as sometimes described in the popular press (Conuel 1990; Yolen and Cooney 1992).

The Resource

The primary tree species listed by mean basal area from 1990 Quabbin inventory data are white, northern red, black, and chestnut oak (29 percent); white pine (26 percent); sugar and red maple (16 percent); eastern hemlock (8 percent); paper, yellow, gray, and black birch (8 percent); red pine (7 percent, plantations); white ash (3 percent); and others (3 percent). There are two predominant age classes: approximately 21,000 acres of 60-year-old forest and 32,000 acres of 90-plus-year-old forest.

Wildlife is varied and abundant. Notable additions to the typical assemblage of New England wildlife (DeGraaf et al. 1992) are nesting pairs of bald eagles, common loons, and ravens as well as breeding populations of great blue herons and several rare neotropical migratory songbird species. Once extirpated from the region, beaver and wild turkey were reintroduced in the 1960s and are now abundant. Moose are beginning to enter the watershed from New Hampshire and Vermont. Beaver and white-tailed deer present special management challenges. Before controlled hunting began in 1991, deer densities reached 40 to 60 per square mile (the statewide average is eight to 10 per square mile) and virtually eliminated forest regeneration.

Quabbin soils (< 6 feet thick, stony, and well drained) reflect the glacial history of the region. Textures vary from outwash sands to sandy loams and loams derived from glacial till, with smaller areas of organic muck. Wetlands and vernal pools constitute about

2,500 acres of commission land. Wetland conditions change in relation to beaver activity. Rolling hills are the dominant landform; slopes exceed 30 percent on just 3 percent of the forest.

The varied climate of central Massachusetts is influenced by continental and maritime air masses. Annual precipitation averages 45 inches (ranging from 29.7 inches in 1965 to 64.9 inches in 1955). The temporal distribution is relatively uniform, although September is usually the wettest month and February the driest. Thin, permeable forest soils in a well-watered climate produce water yields of approximately 50 percent of annual precipitation. Snowmelt, convective storms, or hurricanes cause annual peak discharge.

Foster (1988b) notes, "from meteorological records and forest reconstructions it has been estimated that hurricanes strike southern and central New England every 20 to 40 years, while catastrophic storms like those in 1635, 1788, 1815, and 1938 occur approximately every 100 to 150 years." Ottenheimer (1992) applied the Harvard Forest hurricane exposure model developed by Foster and Boose (1992) to the Quabbin watershed and predicted severe uprooting and stem breakage (> 75 percent of conifers, 50 to 75 percent of deciduous trees) for 37,000 acres and intermediate damage (50 to 75 percent of conifers, 25 to 50 percent of deciduous trees) on another 13,000 acres in the aftermath of a storm like the 1938 hurricane. Damage predicted for 91 percent of the watershed reflects the vulnerability of mature, even-aged stands on rolling glacial terrain with ridgelines parallel to probable hurricane tracks. In addition to hastening recovery from hurricane damage, active management can help limit insect and disease damage (e.g., oak defoliation by gypsy moths) by improving the vigor of residual trees and diversifying forest structure and species composition.

Early Management

Forest management in the Quabbin watershed has evolved steadily since the 1930s. Early work centered on reforestation of recently acquired cropland and pastures, with red pine, white pine, and Norway spruce plantations totaling 6,760 acres. In the aftermath of the 1938 hurricane, white pine salvage operations—spurred by the growing demand for raw materials to support the war effort—produced 3.5 mmbf of sawlogs. Another 20 mmbf to 30 mmbf of fallen timber, degraded by insect and fungal damage, was left to decay.



Photographs by M.H. Zimmerman, Harvard Forest Models, Fisher Museum, Harvard Forest, Petersham, Massachusetts

Figure 2. Dioramas depicting land-use history. Agricultural development in New England reached its height in 1830 (top), but westward expansion of the young nation led to farm abandonment beginning in the 1850s (middle). By 1909 second-growth white pine was ready for harvesting near Petersham, in the northeastern portion of the Quabbin watershed (bottom).

Throughout the 1950s and 1960s, timber stand improvement was the focus of silviculture and management.

The 1961 to 1965 Northeast drought marked a dramatic turn toward active watershed management by the Metropolitan District Commission. A proposal to augment supply with "high-flow skimming" on the Connecticut River via a diversion tunnel to the Quabbin sparked a complex, sometimes contentious debate about management of the entire system (Platt 1995). Ultimately, well-organized opposition by environmental groups led the commission to scrap the diversion proposal (Conuel 1990). The drought and contemporaneous research findings (Hibbert 1967; Hornbeck et al. 1970; Bosch and Hewlett 1982) inspired the conversion of 400 acres of red pine plantations to grassy fields in an attempt to increase water yields as the first phase of a more ambitious program that was never implemented. Paired watershed experiments showed that converting forests to grassy fields augmented water yield by increasing the amount of rain and snow reaching the surface while simultaneously decreasing evapotranspiration. The fields were mowed or burned to inhibit natural regeneration and maintain water yield increases; now they are maintained as early successional habitat.

In the 1980s a comprehensive program of leak repair, revised pricing,

universal metering, plumbing retrofits, and public education combined to reduce mean daily withdrawals in Boston and surrounding communities to approximately 250 million gallons per day. This rate, last recorded in the mid-1950s, fell far below the predicted 1990 usage of 390 million gallons. Before demand management, reservoir withdrawals exceeded safe yield (300 million gallons, the quantity that can be supplied on a sustained basis during the worst drought on record) from 1969 to 1983. Many doubted that the Quabbin, having dropped to 45 percent of capacity in 1967, would ever refill. Yet even with another drought in 1985, water reached the spillway in 1991 and has ranged from 87 percent to 100 percent of capacity in recent years. With concerns about quantity forestalled until 2040 or beyond, the focus has shifted to water quality.

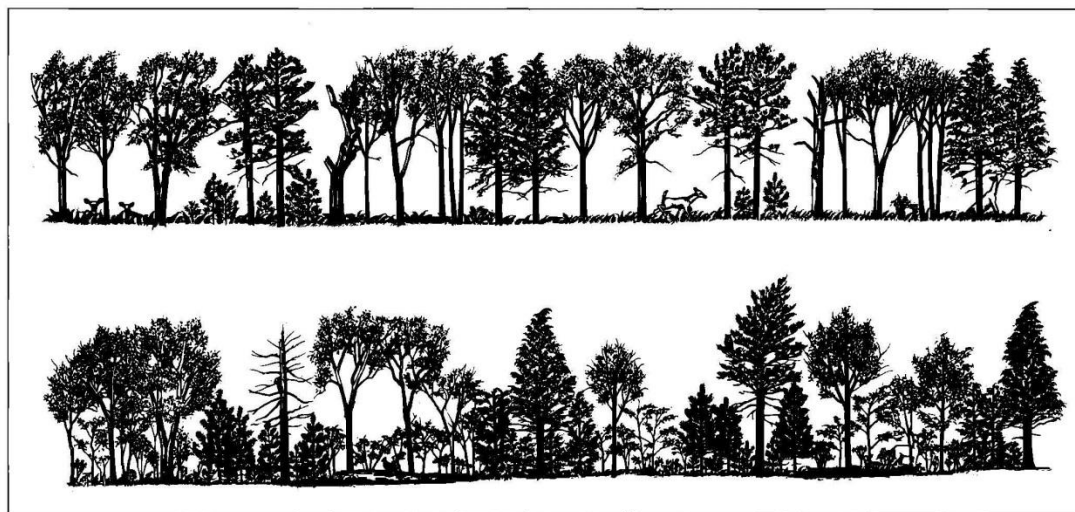
The 10-Year Plan

When the 1995–2004 management plan (MDC 1995) was being formulated, some nongovernmental organizations and members of the public advocated a permanent ban on timber harvesting. However, after an extensive review of literature on disturbance regimes, biogeochemical cycling, and management techniques, the commission proposed and later adopted uneven-aged, mixed-species silviculture to protect water quality.

Murdoch and Stoddard (1992) note that elevated nitrogen concentrations may occur in streams in New York's Catskill Mountains because the forests, last cut in the 1870s, can no longer retain all the atmospheric nitrogen entering the watersheds. This observation is consistent with the patterns and processes of ecosystem development described by Bormann and Likens (1979) and Gosz (1980). The aggradation phase of forest development exhibits maximum rates of nutrient retention and biomass accumulation followed by a transition phase when a forest may become a net exporter of nutrients. At the landscape scale, Vitousek (1985) concludes that a watershed forest comprising "a mosaic of patches could be significantly more retentive than vegetation managed in large patches."

The current plan is based on the working hypothesis that an optimal watershed protection forest contains at least three layers or patch characteristics: (1) *regeneration*, to provide a dynamic reserve in the event of catastrophic disturbance, (2) *vigorous young and middle-aged trees and stands*, to sequester nutrients and accumulate bio-

Figure 3. A schematic of the Quabbin watershed protection forest today (top) and in 60 years. Deer browsing will diminish, and two cutting cycles will create three age classes and a diversity of forest species, both plant and animal.



Illustrations by Nancy Haver

mass, and (3) *mature trees and stands*, to ensure mixed-species regeneration by producing seed and regulating temperature, light, and soil moisture. Patch, irregular shelterwood, and selection cuts on a cycle of 20 to 30 years are used to guide the development of structurally diverse stands (fig. 3). Layered canopies, undisturbed litter, and dense rooting promote soil characteristics that maximize infiltration of rain and snowmelt and limit overland flow to tributary streams and the reservoir.

During the drought of the 1960s, browsing by deer was viewed as a benefit to water yield. As the deer herd and browse damage increased throughout the 1970s and 1980s, however, the risk of little or no advance regeneration in a mature forest subject to hurricane blowdown became unacceptably high. Controlled deer hunting began in 1991 after five years of technical review, public hearings, animal rights protests, and an unsuccessful federal suit charging that endangered bald eagles would ingest lead slugs from unrecovered carcasses. The process was lengthy, difficult, and expensive (Dizard 1994) yet necessary to restore forest resilience. Baseline data on deer and regeneration were collected for the Quabbin forest as well as for nearby areas with sustained hunting pressure. Although regeneration and deer densities are highly variable, figure 4 illustrates the general response of seedlings and saplings as the hunt proceeded. Check stations staffed by commission and state wildlife biologists gather data from hunters, and the resulting population models are com-

bined with regeneration and browse surveys to guide the location and intensity of subsequent hunts. The trend toward a fern- and shrub-dominated "deer park" has been reversed.

Protecting Watershed Resources

The Metropolitan District Commission conducts a formal review to mitigate adverse impacts before the approval of each harvest plan. The review includes field inspections, written comments, and revisions from foresters and wildlife biologists as well as a water quality specialist, road supervisor, and archaeologist. It also includes a survey for both rare and invasive plant populations and invertebrate use of vernal pools.

Comprehensive best management practices (BMP) have been adapted or developed to protect watershed resources (Kittredge and Parker 1996). In addition to conventional nonpoint source pollution controls and worker safety measures, all harvesting equipment must carry spill pads to contain petroleum and hydraulic fluid leaks. No fuel or petrochemicals can be stored on site. Portable toilets are provided on landings for logging crews to limit pathogenic contamination. All flowing streams, however small, are bridged during skidding operations (Kittredge and Woodall 1997). Feller-bunchers and forwarders, rare south of Maine and Ontario, have replaced hand felling and cable skidding on many large-volume timber sales. Nineteenth-century farm roads have been upgraded to serve as permanent forest roads and landings. Daily supervision by field foresters ensures compliance with contract requirements and prompt attention to adverse changes in site and weather conditions. Harvest scheduling and postharvest reclamation of skid trails anticipate the vagaries of New England's weather.

Concerted efforts are made throughout the watershed to protect and support unusual and uncommon species and habitats. Nesting bald eagles and loons are given wide berth by harvesting operations. Habitats of state-listed rare species and important vernal pools, seeps, and wintering areas are protected with buffer zones. Programs to control wildlife populations

and impacts (e.g., deer and beaver) also are conducted where and when necessary to meet watershed management goals and protect rare species.

Rapid acquisition of watershed land in the 1920s and 1930s created a time capsule of cultural resources. Hundreds of cellar holes and foundations of houses, barns, outbuildings, churches, grange halls, schools, and mills dot the landscape. These archaeological remains, along with old roads, miles of well-preserved stone walls, stately sugar maples, dooryard lilacs, and old apple trees bear mute witness to the sacrifice required of ordinary people to supply water for Boston. The commission recently conducted a watershed-wide field survey and archival research that identified and characterized 957 cultural sites. These sites are being located using global positioning systems to develop geographic information system layers for planning and operational use. Although most harvesting operations avoid cultural sites, the staff archaeologist may direct careful removal of trees when windthrow threatens to damage masonry features.

In addition, known and potential Native American sites are identified with geographic information system overlays that assess proximity to water, soil drainage class, slope, and aspect. Strategies to protect these sites often are combined with riparian zone management specifications in timber sale contracts.

The Swift River Historical Society (with a rich collection of artifacts from the valley towns), Harvard Forest's Fisher Museum, and the Quabbin Visitors Center (50,000 visits per year) and their interpretive programs preserve the long and varied history of the region. The conservation of cultural resources in the forest presents an opportunity to develop "walk through history" tours that complement museum collections and provide unique, low-impact recreational access to the watershed.

Review and Decision Support

The successful resolution of the deer hunt controversy demonstrated the value of being proactive in researching management options and seeking both public and academic review. Annual public workshops review

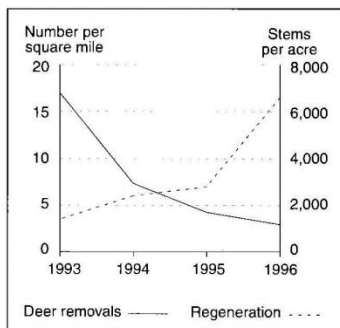


Figure 4. Deer and regeneration, Hardwick Block, Quabbin forest, 1993 to 1996.

progress toward management goals. Modifications are presented and discussed and public comments are solicited and addressed. In addition, detailed harvest plans and internal reviews are made available for public comment at the Swift River Historical Society and Quabbin Visitors Center.

Beginning in 1996, the commission also invited the participation of more than 30 scientists and managers from throughout the Northeast on the Quabbin Science and Technical Advisory Committee. The group represents a broad range of interests, disciplinary expertise, and viewpoints. Its two-day, field-oriented annual meeting has a formal agenda focused on two or three high-priority items, followed by open discussion. Throughout the year, commission managers contact committee members to seek specialized information and advice, in effect tripling the size of the professional staff.

Green Certification

In 1994, inviting its most rigorous external review to date, the commission decided to seek green certification. A proposal to review the Quabbin forestry operations was accepted in 1995 from the Rainforest Alliance SmartWood program in regional cooperation with the National Wildlife Federation. Since market price is secondary to watershed management objectives and the commission already has the most stringent BMPs and field supervision in the region, why seek certification?

First, an independent audit would provide important assurances about the sustainability of management. Second, leading by example with the largest forest in southern New England, the commission hoped to provide incentives and mechanisms to other landowners to improve their management and access lucrative markets for certified wood. Finally, an audit provided yet another vehicle for continuous improvement. After a year-long disclosure and review process, the Quabbin became the first public forestry program in the nation to be certified. The Metropolitan District Commission's program of active management to protect an irreplaceable water supply at its source and conserve a

wide range of other values is a working example of interdisciplinary forestry.

Literature Cited

- BARNES, B.V., D.R. ZAK, S.R. DENTON, and S.H. SPURR. 1998. *Forest ecology*. 4th ed. New York: John Wiley & Sons.
- BORMANN, F.H., and G.E. LIKENS. 1979. *Pattern and process in a forested ecosystem*. New York: Springer-Verlag.
- BOSCH, J.M., and J.D. HEWLETT. 1982. A review of catchment experiments to determine the effect of vegetation changes on water yield and evapotranspiration. *Journal of Hydrology* 55:3-23.
- COCH, N.K. 1995. Hurricane hazards along the northeastern Atlantic coast of the United States. *Journal of Coastal Research* Special issue no. 12: Coastal hazards:115-47.
- CONUEL, T. 1990. *Quabbin: The accidental wilderness*. Revised ed. Amherst: University of Massachusetts Press.
- DEGRAAF, R.M., M. YAMASAKI, W.B. LEAK, and J.W. LANIER. 1992. *New England wildlife: Management of forested habitats*. General Technical Report NE-144. Radnor, PA: USDA Forest Service, Northeastern Forest Experiment Station.
- DIZARD, J.E. 1994. *Going wild: Hunting, animal rights and the contested meaning of nature*. Amherst: University of Massachusetts Press.
- FOSTER, D.R. 1988a. Species and stand response to catastrophic wind in central New England, USA. *Journal of Ecology* 76:135-51.
- . 1988b. Disturbance history, community organization and vegetation dynamics of the old-growth Pisgah Forest, southwestern New Hampshire, USA. *Journal of Ecology* 76:105-34.
- . 1992. Land-use history (1730-1990) and vegetation dynamics in central New England, USA. *Journal of Ecology* 80:753-72.
- FOSTER, D.R., and E.R. BOOSE. 1992. Patterns of forest damage resulting from catastrophic wind in central New England, USA. *Journal of Ecology* 80:79-98.
- GOSZ, J.R. 1980. Biomass distribution and production budget for a nonaggrading forest ecosystem. *Ecology* 61:515-21.
- HIBBERT, A.W. 1967. Forest treatment effects on water yield. In *First International Symposium on Forest Hydrology*, eds. W.E. Sopper and H.W. Lull, 527-43. Oxford, UK: Pergamon Press.
- HORNBECK, J.W., R.S. PIERCE, and C.A. FEDERER. 1970. Streamflow changes after forest clearing in New England. *Water Resources Research* 6(4):1124-132.
- IRLAND, L.C. 1982. *Wildlands and woodlots: The story of New England's forests*. Hanover, NH: University Press of New England.
- KELLY, M.J., B.C. LARSON, and C.D. OLIVER, eds. 1992. *The ecology and silviculture of mixed-species forests*. Boston: Kluwer Academic Publishers.
- KITTREDGE, D.B., and M. PARKER. 1996. *Massachusetts forestry best management practices manual*. Amherst: University of Massachusetts and Massachusetts Department of Environmental Management.
- KITTREDGE, D.B., and C. WOODHALL. 1997. Massachusetts loggers rate portable skidder bridges. *The Northern Logger & Timber Processor* 46(4):26-27, 36.
- METROPOLITAN DISTRICT COMMISSION (MDC). 1995. *Quabbin watershed: MDC land management plan 1995-2004*. Boston: Division of Watershed Management.
- MURDOCH, P.S., and J.L. STODDARD. 1992. The role of nitrate in the acidification of streams in the Catskill Mountains of New York. *Water Resources Research* 28(10):2,707-720.

PAULOWNIA

HARDWOOD TREES
ELONGATA CAROLINIA
"Patent Applied"

MAKE MORE \$IN LESS TIME

- Cut for lumber in 8-12 years
- Genetically Improved

Supercloned tissue cultures (not propagated from seed)

- Join the hundreds of forest farmers and lumber growers who have planted Paulownia elongata.
- Excellent profit potential from well planned and properly maintained plantations.

Call or write now for **FREE** advice.

Order Now to guarantee delivery

The trees prefer well drained, sandy loam type soils and direct sunlight.

Planting season May-September



**CAROLINA PACIFIC
INTERNATIONAL INC.**

111 Lindsey St.
Lenox, GA 31637
Phone (912) 546-4563 or
(800) 706-5037
www.paulownia.com

- OTTENHEIMER, D.G. 1992. Hurricane susceptibility and water quality at Quabbin Forest, Massachusetts. Master's thesis, SUNY College of Environmental Science and Forestry.
- PLATT, R.H. 1995. The 2020 water supply study for metropolitan Boston: The demise of diversion. *Journal of the American Planning Association* 61(2):185-99.
- RAUP, H.M. 1966. The view from John Sanderson's farm: A perspective for the use of the land. *Forest History* 10(1):2-11.
- VITOUSEK, P.M. 1985. Community turnover and ecosystem nutrient dynamics. In *The ecology of natural disturbance and patch dynamics*, eds. S.T.A. Pickett and P.S. White, chap. 18. San Diego: Academic Press.
- YOLEN, J., and B. COONEY. 1992. *Letting Swift River go*. Boston: Little, Brown and Company.

Paul K. Barten (e-mail: pkbarten@forwild.umass.edu) is associate professor, Department of Forestry and Wildlife Management, University of Massachusetts, Amherst 01003-4210; Thom Kyker-Snowman is natural resources specialist—forestry, Paul J. Lyons is natural resources specialist—wildlife, Thomas Mahlstedt is chief archaeologist, Robert O'Connor is director of natural resources, and Bruce A. Spencer is chief forester, Metropolitan District Commission, Division of Watershed Management, Belchertown, Boston, and New Salem, Massachusetts.

Appendix 10: Northern Hardwood (Revised) Stocking Guide

Northern Hardwood (Revised) Leak et al. (1987)

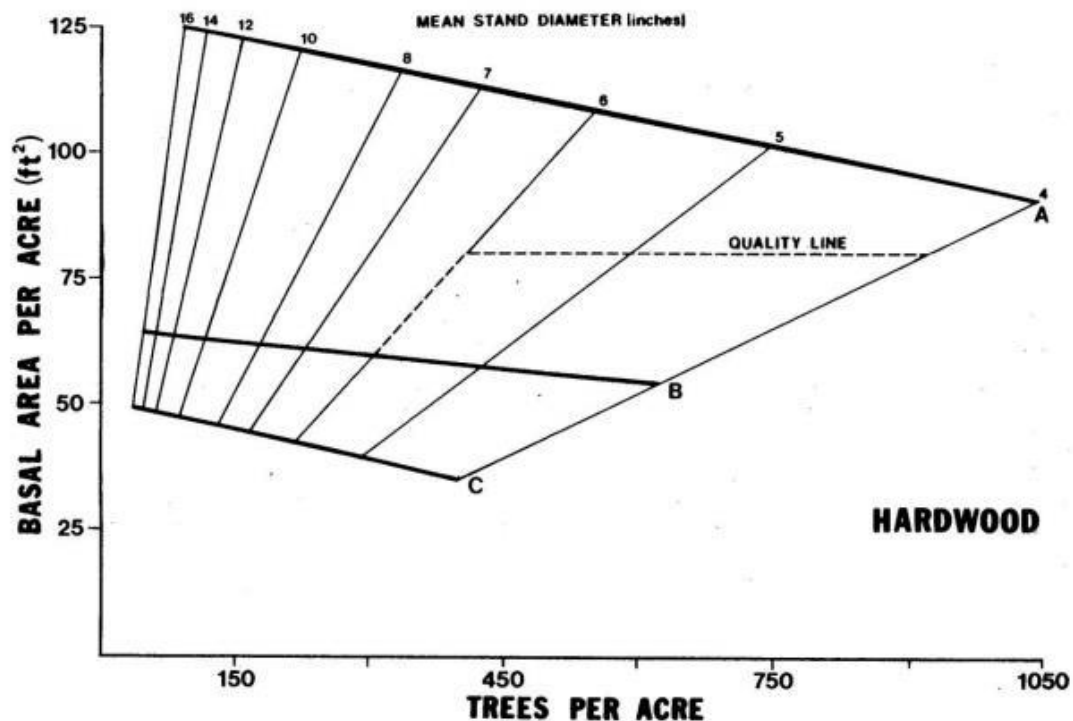


Figure 6.—Stocking guide for main crown canopy of even-aged hardwood stands (beech-red maple, beech-birch-maple) shows basal area and number of trees per acre and quadratic mean stand diameter. The A line is fully stocked, the B line is suggested residual stocking. The C-line is minimum stocking. The quality line is the density required to produce high quality stems of beech, sugar maple, yellow birch, and red maple.

Appendix 11: Eastern Hemlock Stocking Guide

Eastern Hemlock Lancaster (1985)

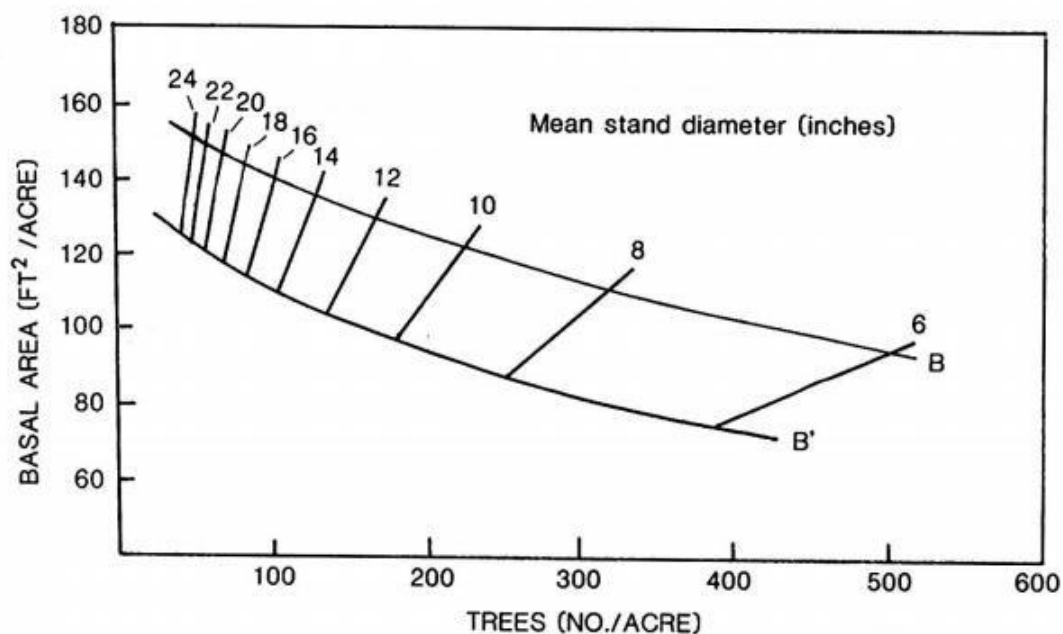


Figure 1. Residual stocking levels (B and B' levels) for even-aged hemlock stands based on number of trees, mean stand diameter, and basal area per acre. B level represents minimum residual stocking of stands with 30% or more hemlock initially. B' level applies to stands with 15 to 29% hemlock. (In mixed stands, the percentage of hemlock is based on a comparison of hardwood stems in the main crown canopy and the hemlock 6 inches DBH and larger in the overstory and understory positions.)

Appendix 12: Eastern White Pine (Revised) Stocking Guide

Eastern White Pine (Revised) Leak and Lamson (1999)

Application

In practice, we suggest using the Managed B-line and Managed C-line for stands that have been thinned at least once beginning at 8-10 inches mean stand dbh or earlier. The first thinning would use the Unmanaged B-line or Unmanaged C-line definitions. Subsequent thinnings would use the Managed B-line and Managed C-line specifications. Thinnings in older/larger previously unmanaged stands (12 inches plus mean stand dbh) probably will never fully achieve the crown sizes required for full crown closure at the Managed B-line and Managed C-line. In such stands, stocking recommendations probably should follow the Unmanaged B-line and Unmanaged C-line standards. However, additional experience will be needed to verify or revise this recommendation.

Literature Cited

- Frothingham, E. H. 1914. White pine under forest management. USDA Bull. 13, 70 p.
- Lancaster, K.F. and W.B. Leak 1978. A Silvicultural guide for white pine in the Northeast. USDA For. Ser. Gen. Tech. Rep. NE-41, 13 p.
- Leak, W.B. 1982. More on stocking guides. J. For. 80:503.
- Philbrook, James B.; James P. Barrett, and William B. Leak 1973. A stocking guide for eastern white pine. USDA For. Ser. Res. Note NE-168, 3 p.
- Seymour, R.S. and D.M. Smith 1987. A new stocking guide formulation applied to eastern white pine. For. Sci. 33:469-484.

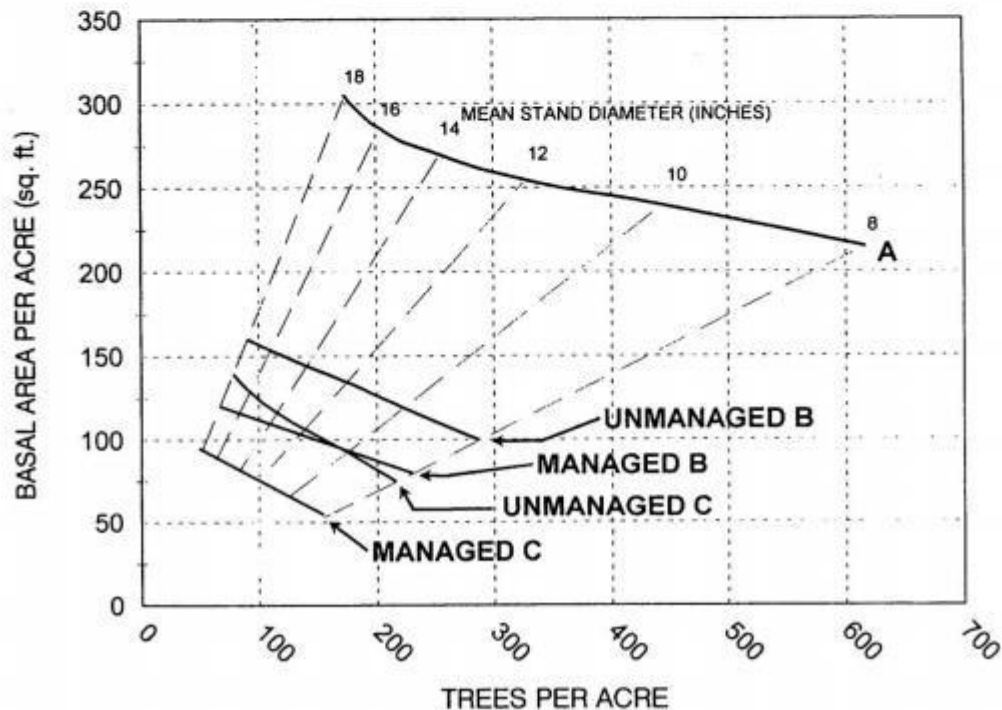


Figure 1. Revised white pine stocking guide for managed stands

Appendix 13: Mixed Wood Stocking Guide

Mixedwood Leak et al. (1987)

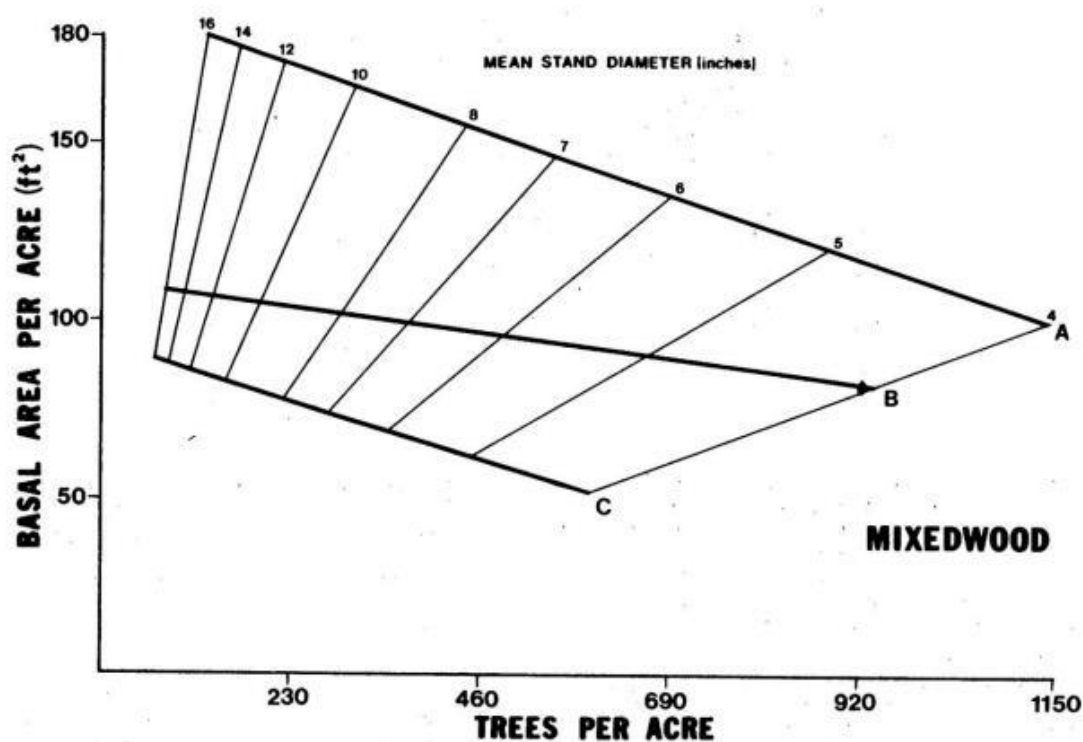


Figure 7.—Stocking guide for main crown canopy of mixedwood stands (25 to 65 percent softwoods) shows basal area and number of trees per acre and quadratic mean stand diameter. The A line is fully stocked, the B line is suggested residual stocking, the C line is minimum stocking.

Appendix 14: 2016 Maine Stumpage Report

CAPITAL AREA (KENNEBEC, KNOX, LINCOLN, AND WALDO COUNTIES)

Stumpage Prices paid to Maine Forest Landowners in 2016

These stumpage prices are based on reports from 2016 and are the most recent available. HOWEVER, prices can change significantly within weeks or months due to market conditions. This report gives a profile of roundwood prices in Maine. Values are offered as a guide to help individuals assess the fair market value of their standing trees. The average price for a county should not be applied as the exact value for a particular tract. These prices primarily reflect common wood utilization standards and markets. Wood that can be marketed locally and/or includes specialty products may in some cases increase returns to landowners. The best way for private landowners to determine current stumpage values and available wood markets is to consult with a licensed forester before harvesting.

2016						2016					
<u>BIOMASS (per ton)</u>	AVERAGE	MIN	MAX	# OF RPTS	2015 AVG:	<u>SAWLOGS (per MBF)</u>	AVERAGE	MIN	MAX	# OF RPTS	2015 AVG:
All Species	\$1.77	\$0.50	\$6.50	122	\$1.73	Ash	\$164	\$50	\$350	97	\$176
						Aspen/Poplar	\$86	\$25	\$125	11	\$118
						Beech	\$110	\$40	\$160	6	No Price
<u>BOLTWOOD (per MBF)</u>	AVERAGE	MIN	MAX	# OF RPTS	2015 AVG:	Cedar	\$67	\$35	\$125	6	No Price
Aspen/Poplar	"				No Price	Hemlock	\$67	\$20	\$150	104	\$74
Cedar	"				No Price	Red Oak	\$263	\$100	\$500	134	\$270
Red Oak	\$123	\$74	\$137	4	No Price	Red Pine	\$77	\$25	\$100	8	\$100
Red/White Maple	"				No Price	Red/White Maple	\$127	\$40	\$310	79	\$155
Sugar Maple	"				No Price	Spruce & Fir	\$96	\$40	\$157	111	\$131
White Birch	\$136	\$50	\$200	30	\$115	Sugar Maple	\$250	\$100	\$500	69	\$291
Yellow Birch	"				No Price	White Birch	\$166	\$53	\$278	97	\$168
						White Oak	\$154	\$36	\$300	8	\$189
<u>FIREWOOD (per cord)</u>	AVERAGE	MIN	MAX	# OF RPTS	2015 AVG:	White Pine	\$157	\$40	\$266	216	\$160
All Species	\$23	\$10	\$40	153	\$27	Yellow Birch	\$168	\$50	\$350	61	\$200
<u>PALLETWOOD (per MBF)</u>	AVERAGE	MIN	MAX	# OF RPTS	2015 AVG:	<u>STUDWOOD (per ton)</u>	AVERAGE	MIN	MAX	# OF RPTS	2015 AVG:
Hardwood	\$96	\$15	\$250	111	\$89	Other Species	\$9	\$3	\$25	9	\$10
Softwood	\$49	\$13	\$84	115	\$54	Spruce & Fir	\$12	\$10	\$25	11	\$17
<u>PULPWOOD (per ton)</u>	AVERAGE	MIN	MAX	# OF RPTS	2015 AVG:	<u>VENEER (per MBF)</u>	AVERAGE	MIN	MAX	# OF RPTS	2015 AVG:
Aspen/Poplar	\$9	\$4	\$20	48	\$11	Ash	\$418	\$150	\$800	10	No Price
Cedar	"				No Price	Aspen/Poplar	"				No Price
Hemlock	\$4	\$2	\$8	53	\$5	Beech	"				No Price
Mixed Hardwood	\$8	\$3	\$20	209	\$9	Red Oak	\$658	\$204	\$1,029	64	\$486
Red Pine	\$4	\$2	\$8	5	No Price	Red/White Maple	\$424	\$400	\$860	5	No Price
Spruce & Fir	\$7	\$2	\$20	57	\$8	Sugar Maple	\$678	\$283	\$1,026	12	\$597
White Pine	\$3	\$0.50	\$11	99	\$4	White Birch	\$635	\$283	\$710	10	\$507
						White Oak	"				No Price
						Yellow Birch	\$465	\$350	\$572	7	\$386

CAPITAL AREA (KENNEBEC, KNOX, LINCOLN, AND WALDO COUNTIES)

* For species with less than 3 reports, refer to either a) the statewide summary page, b) adjacent counties, and/or c) last year's price to get an indication of typical prices.

Department of Agriculture, Conservation and Forestry, Maine Forest Service, Forest Policy and Management Division

Compiled from 2016 Landowner Reports

DEFINITIONS AND NOTES	
<u>Average:</u> The average price (or mean) is calculated by multiplying the corresponding volume by the stumpage price for each species and product reported by woodland owners. These are added together and divided by the sum of all the volumes (reported with corresponding stumpage prices) for that product and species. <u>This is a weighted average.</u> <u>Biomass:</u> Above ground portion of tree that is chipped on site, usually the whole tree but sometimes only the tops and branches. <u>Board:</u> 1" thick piece of lumber 3" to 12" wide and 8' through 16' long <u>Board foot:</u> A wood volume measurement unit equal to a piece of wood 1" thick by 12" long by 12" wide. <u>Boltwood:</u> A short log of a length suitable for manufacturing turned forest products (i.e. dowels, toothpicks) or peeling veneer. <u>Conversions:</u> For converting different units of volume, a conversion table is shown on the last page of this report. <u>Cords (cds):</u> (MFS Rules Chapter 20 definition). A cord is a unit of measure of wood products 4 feet wide, 4 feet high, and 8 feet long, or its equivalent, containing 128 cubic feet when the wood is stacked and well stowed. Any voids that will accommodate a stick, log or bolt of average dimensions to those in the pile shall be deducted from the measured volume. <u>Dimension Lumber:</u> timbers 2" x 3" through 2" x 12" and 8' through 16' in length <u>Max(imum):</u> The maximum price is the highest price reported. <u>(MBF)</u> One thousand board feet. For stumpage purposes, MBF is usually determined based on log scale, not on actual recovery of lumber. <u>Min(imum):</u> The minimum price is the lowest price reported. <u>Palletwood:</u> A low grade sawlog intended to be sawn into lumber for making pallets or landscaping ties.	<u>Pulpwood:</u> Wood used to produce fiber for making paper. Though reported to the MFS in two different units (tons and pounds), the stumpage price report converts pulpwood volumes to tons. For conversions, see back page of this report. <u>Reports (# of Rpts):</u> The number of reports upon which the statistics were calculated. If there were three or fewer reports for a product and species in one county, the price statistics are not reported at the county level (to preserve confidentiality). There may be a statewide price however. <u>Sawlog:</u> A log suitable for production of boards and dimensional lumber. For some sales, prices for sawlogs are separated by grade as well as species. <u>Scale:</u> The measurement of sawlogs, pulpwood, or other wood products, usually by a licensed wood scaler or scaling facility. Also a standard by which wood products are measured. <u>Species:</u> Common Names for some species <u>Aspen:</u> poplar, popple <u>Red Maple:</u> white maple, soft maple <u>Sugar Maple:</u> rock maple, hard maple <u>White Birch:</u> paper birch <u>Studwood:</u> Sawlogs intended to be sawn into dimensional lumber. <u>Stumpage:</u> The value of standing trees. (MFS Rules Chapter 20 Definition) Typically, stumpage is the value paid by a contractor to the landowner for some or all of the standing trees in the landowner's woodlot or a designated harvest area. Stumpage prices are negotiable and should be agreed upon in advance. Written (or occasionally verbal) contracts then assure the contractor (i.e. purchaser of stumpage) of the right to harvest and remove the trees, possibly with certain conditions relating to method of payment, timing of harvest, necessary improvements, and protection of other resources. Stumpage is often determined and paid based on measure, or scale, of the harvested wood's volume and quality, by a state licensed wood scaler or scaling facility. <u>Veneer:</u> Wood peeled, sawn, or sliced into sheets of a given constant thickness.

**Conversion Table
Cord/Weight Equivalents
for various Maine Commercial Tree Species**

These conversions are used by the Maine Forest Service.

Users of this report may wish to confirm the conversion rate(s) used by individual mills and/or contractors who purchase wood.

These conversions factors are handy for making estimates and for forest inventory purposes, but are advisory only. The weight of a particular volume of wood varies greatly by species, time of year and other factors.

It is illegal in Maine to convert from one system of measurement to another for the basis of payment (e.g. convert a mill payment for pulpwood in dollars per ton to a landowner payment in dollars per cord).

Species	Cords	Tons	Pounds
Spruce Fir	1	2.1	4,200
White Pine	1	2.15	4,300
Red Pine	1	2.15	4,300
Hemlock	1	2.4	4,800
Cedar	1	1.7	3,400
Tamarack (Larch)	1	2.4	4,800
Beech	1	2.25	4,500
White Birch	1	2.25	4,500
Yellow Birch	1	2.7	5,400
Sugar Maple	1	2.7	5,400
Red Maple	1	2.25	4,500
White Oak	1	2.7	5,400
Red Oak	1	2.7	5,400
Ash	1	2.25	4,500
Aspen/Poplar	1	2.15	4,300
Softwood	1	2.3	4,600
Hardwood	1	2.7	5,400
Mixed Wood	1	2.3	4,600

For purposes of comparing volumes, a rough conversion of 1 MBF = 2 cords is commonly used.

Appendix 15: Net Present Value Calculation for 2038

$$\text{Net Present Value: } (\$54,496) \div ((1+0.02)^{20}) = \$36,674.26$$

$$\text{Net Present Value (NPV)} = (NR_t) \div ((1+i)^t)$$

Net Revenue (NR) = net revenue at time t

t: time (years from present)

i: Landowner's discount rate (assuming a 2 percent discount rate because forestland is the best option for this property)

Appendix 16: Glossary of Terms and Acronyms

Terms in this glossary were gathered from the NRCS *Understanding Your Plan: A Guide for Landowners using Managing Your Woodlands: A Template for Your Plans for the Future* (September 14, 2014).

“Natural Resources Conservation Service.” Technical Service Providers | NRCS,
www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/programs/technical/tsp/?cid

Adaptive management: A dynamic approach to forest management in which the effects of treatments and decisions are continually monitored and used to modify management on a continuing basis to ensure that objectives are being met (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998).

Age Class: A distinct aggregation of trees that originated at the same time, from a single natural event or regeneration activity or a grouping of trees (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998).

BAF: Basal Area Factor.

Basal Area: The cross-sectional area of a tree, in square feet, at 4.5 feet from the ground (at breast height). When the basal area of all the trees in a stand are added together, the result is expressed as square feet of basal area per acre, which is a measure of a stand’s density.

Biodiversity: The variety and abundance of life forms, processes, functions and structures of plants, animals and other living organisms, including the relative complexity of species, communities, gene pools and ecosystems at spatial scales that range from local through regional to global (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998).

BMPs: Best Management Practices (see Best Management Practices for Forestry: Protecting Maine’s Water Quality).

Board Feet: A unit for measuring wood volumes. It is commonly used to express the amount of wood in a tree, sawlog, or individual piece of lumber. A piece of wood 1 foot long, 1-foot-wide, and 1-inch-thick (144 cubic inches).

Canopy: The more or less continuous cover of branches and foliage formed collectively by the tops, or crowns of adjacent trees.

Crop Tree: A tree identified to be grown to maturity for the final harvest cut, usually on the basis of its location with respect to other trees and its timber quality.

Cull (tree value class 3): A tree, log, lumber or seedling that is rejected because it does not meet certain specifications for usability or grade. (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998).

Desirable Growing Stock (tree value class 1): Saleable trees that are of good form, species and quality and would be satisfactory as crop trees.

Desired species: Those species of flora and fauna designated in the management plan and not known to cause negative impacts on the local environment.

Diameter Breast Height (DBH): The diameter of a tree at 4.5 feet above the ground.

FON: Forest Operation Notification of Intent to Harvest.

Forest product: [Forest Produce] Any raw material yielded by a forest. Generally defined in Forest Acts or Ordinances, and subdivided conventionally into major forest products, i.e. timber and fuelwood, and minor forest products, i.e. all other products including leaves, fruit, grass, fungi, resins, gums, animal parts, water, soil, gravel, stone and other minerals on forest land (F. C. Ford –Robertson, Terminology of Forest Science Technology, Practice, and Products, Society of American Foresters, 1971).

FVS: Forest Vegetation Simulator.

GIS: Geographic Information System.

GPS (Global Positioning System): A commonly hand held, satellite based navigational device that records x, y, z coordinators and other data allowing users to determine their location on the surface of the earth. (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998).

Harvesting: The felling, skidding, on-site processing, and loading of trees or logs onto trucks. (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998).

Log Rules - International 1/4-inch Rule: A formula rule allowing ¼-inch saw kerf, ½-inch taper for each 4 feet of length and 1/16-inch shrinkage for each one-inch board. This measure approximates the actual sawmill lumber tally.

Management plan: Documents that guide actions and that change in response to feedback and changed conditions, goals, objectives and policies. Management plans may incorporate several documents including, but not limited to, harvest plans, activity implementation schedules, permits, research, etc.

Mature Tree: A tree that has reached the desired size or age for its intended use.

MBF: Abbreviation for 1,000 board feet.

MFS: Maine Forest Service.

MHPC: Maine Historic Preservation Commission.

MNAP: Maine Natural Areas Program.

NRCS: Natural Resource Conservation Service.

Overstocked: A forest stand condition where too many trees are present for optimum tree growth.

Overstory: That portion of the trees in a stand forming the upper crown cover.

Pulpwood: Wood cut primarily for manufacture of paper, fiberboard, or other wood fiber products.

QMD: Quadratic Mean Diameter.

Qualified contractor: Forest contractors who have completed certification, licensing, recommended training and education programs offered in their respective states.

Regeneration: The number of seedlings or saplings existing in a stand. The process by which a forest is renewed by direct seeding, planting, or naturally by self-sown seeds and sprouts.

Release: To free trees from competition by cutting, removing, or killing nearby vegetation.

Riparian: Related to, living or located in conjunction with a wetland, on the bank of a river or stream but also at the edge of a lake or tidewater – note the riparian community significantly influences and is significantly influenced by, the neighboring body of water. (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998)

Riparian Zone: The area adjacent to or on the bank of rivers and streams.

Sapling: Trees from 2 inches to 4.5 inches in diameter at breast height.

Seedling: A young plant.

Selection Harvest: Harvesting trees to regenerate and maintain a multi-aged structure by removing some trees in all size classes either singly or in small groups.

Silviculture: The art and science of growing trees, controlling establishment, composition, health and quality of forests to meet diverse needs.

Silvicultural System: The process of tending, harvesting and regenerating a forest.

Single Tree Selection: Individual trees of all size classes are removed more or less uniformly throughout the stand, to promote growth of remaining trees and to provide space for regeneration. (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998)

Site Index (SI): An expression of forest site quality based on the height of a free-growing dominant or co-dominant tree at age 50.

Skid Trail: A road or trail over which equipment carries logs from the stump to a landing.

Slash: The residue, e.g., treetops and branches, left on the ground after logging or accumulating as a result of storm, fire, girdling, or delimbing. (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998).

Snag: A standing, generally un-merchantable dead tree from which the leaves and most of the branches have fallen.

Stand: A group of trees with similar characteristics, such as species, age, or condition that can be distinguished from adjacent groups. A stand is usually treated as a single unit in a management plan.

Stand Management Recommendations: The recommended management activities that should be done in that stand, based on landowner goals and objectives.

Stand Structure: The horizontal and vertical distribution of plants in the forest, including the height, diameter, crown layers, and stems of trees, shrubs, understory plants, snags and down woody debris. (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998).

Stocking: An indication of the number of trees in a stand in relation to the desirable number of trees for best growth and management.

Sustainable forest management: The practice of meeting the forest resource needs and values of the present without compromising the similar capability of future generations (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998).

Thinning: a cultural treatment made to reduce stand density of trees primarily to improve growth, enhance forest health, or recover potential mortality. Types of thinning include: chemical, crown, free, low, mechanical, selection. (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998).

TPA: Trees per acre.

Undesirable/Acceptable Growing Stock (tree value class 2): Trees of low quality or less valuable species that should be removed in a thinning.

Understocked: Insufficiently stocked with trees.

Understory: All forest vegetation growing under an overstory. (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998).

Uneven-Aged Management or Stand: A stand of trees containing at least three age classes intermingled on the same area.

USDA: United States Department of Agriculture.

USFWS: United States Fish and Wildlife Service.

Volume: The amount of wood in a tree, stand of trees, or log according to some unit of measurement, such as board foot, cubic foot, etc.