dcr | **Massachusetts Department of Conservation and Recreation**

Silviculture Prescription
West Hill Lot

Massachusetts Department of Conservation and Recreation
Bureau of Forestry

Northeast District
Townsend State Forest
Townsend, MA

Prepared by:

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Approved by:

Management Forestry Program Supervisor

William N. Hill, CF Digitally signed by William N. Hill, CF DN: cn=William N. Hill, CF, o=MA Bureau of Forestry, ou=Management Forestry Program, email=william.hill@state.ma.us, c=US Date: 2018.05.30 08:50:09 -04'00'

Date: March 21,2018

William N. Hill, CF

Site Data:

Cultural and Historical:

The Townsend State Forest is located in the north central section of the Town of Townsend, Middlesex County, Massachusetts. This project area (± 110 acres total) is located east of Fessenden Hill Road, and an unnamed woods road leading from Brookline Road (Rt. 13) along a westerly and northerly route eventually connecting with Fessenden Hill Road (Appendix Map 1). This area of Townsend State Forest is part of approximately 1700 acres deeded to the Commonwealth in the 1930's by the Fessenden Companies based in Townsend. These lands, along with other acquisitions, were consolidated into what is now Townsend State Forest (Appendix Map 2).

Previous land use of this area was subsistence farming, livestock grazing and timber extraction. Evidence of previous land use prior to state ownership can be seen in the stone walls and old cellar holes found along Fessenden Hill Road. At the time of acquisition these properties were heavily cut over to provide the raw material necessary for the manufacture of barrels and other lumber products. Cutting was focused on trees that could provide the material necessary for industry and little focus was placed on promoting the long term viability of the forest. Extractive cutting of these forest lands left them in a degraded condition subject to outbreaks of wildfire.

Periodic fires are documented throughout the history of this area both anthropogenic caused and naturally occurring. The historical natural fire regime is classified as a "Type III" (35-100 years frequency, mixed severity).[1] The last large forest fire in this area began on April 16, 1927 and burned over 28 square miles of land. It is thought that this fire was caused by the nearby Boston and Maine rail line (now abandoned) to the west of the project area.

The forest that occupies the project area is the direct result of these man-made and naturally occurring events. The forest stands in the project area consist of native hardwood-softwood stands and a white pine (*Pinus strobus*) plantation (planted in the 1930's by the Civilian Conservation Corps (CCC)).

Geology and Soils:

This area of Middlesex County has, in general, relatively thin soils, rocky outcrops, and the underlying bedrock close to the surface as a result of glacial activity several thousand years ago. The soils in this area generally fall into the glaciofluvial (glacial outwash) and glacial till types.[2]

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[1] Massachusetts Department of Conservation and Recreation, Bureau of Forestry and Fire Control, Hazard Mitigation-Federal Assitance 2004, Northern Middlesex County Hazardous Fuel Mitigation Planning / Treatment/Community Awarness

[2] USDA, NRCS, Soil Survey of Middlesex County, 2009

The project area soils consist of several different series. Soils in the project area fall into the Charlton-Hollis, Hollis-Rock, Canton, Freetown, Scarboro, Whitman, Scituate, and Montauk soils series (Appendix Map 3). The common theme among these soils is a sandy-loamy-stony nature due glacial origin. Soil productivity is moderate to good on these soils with site indexes ranging from 55 (eastern white pine) for the Hollis-Rock series to 75 (eastern white pine) for the Montauk series.[3]


Balance rock left by glacier

Elevations within the project area range from approximately 450 feet in the southerly and easterly portions of the project area rising to approximately 600 feet in the northerly section of the project. The topography can be described as generally rolling (0%-10% slope) in nature, interrupted by short steep rocky outcrops (15%-25% slope) with an easterly and southerly aspect.

DCR Management Guidelines of 2012 state that "*Forests stands will be classed on a continuum and considered for silvicultural treatments that generally fit their productivity, structural complexity (or potential thereof) and diversity.*" Analyzing the site productivity and complexity using Geographical Information System (GIS) data layers of prime forest soils, potential vegetation complexity, late successional potential, forest diversity, early successional potential, continuous forest inventory (CFI) site index, and CFI stand structure suggests low to moderate productivity of these forest stands.[4]

Climate:

The project area is typical for this area of New England with weather patterns varying from season to season. According to the National Oceanic and Atmospheric Administration this area has an annual average precipitation of 47.59" and a mean annual temperature of 45.1°F.[5]

Weather patterns affect forest development within this area with wind being the most significant driver of forest development over time. These winds, in general, originate from the south and southwest during warmer months, and north and northwest during cooler periods of the year.

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[3] USDA, Web Soil Survey, National Cooperative Soil Survey, generated 12/14/17

[4] Goodwin, D.W., and Hill, W.N., 2012. Forest Productivity and Stand Complexity Model (A GIS Grid Analysis using ARCGIS), Massachusetts Department of Conservation and Recreations, Amherst, MA

[5] US Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Service, Annual Climatological Summary, Ashburnham North, MA US COOP:190192, generated 12/14/17

Episodic weather events (i.e. hurricanes, ice, etc.) are major factors in forest development throughout New England. The 2008 ice storm caused damage to portions of the project area ranging from lost and broken branches, to broken tops, toppled trees and damage to regeneration. Hardwood trees, in general, incurred more damage than softwood trees due to the latter's physical structure. These episodic events create micro sites where regeneration may become established creating a mosaic of age and species across the landscape.

Hydrology and Watershed:

The project area is part of the Nashua River Watershed. Water discharge from the forest flows through many small intermittent streams and eventually ends up in the Squannacook River which flows approximately nine miles southeasterly into the Nashua River. The nearest public water supply source is located approximately 1.5 miles south of the project area.

There are several intermittent streams, forested wetlands, swamps and two potential vernal pools found in and near the project area (Map 1). No work will be conducted within resource areas other than utilization of existing forest roads for access. All stream crossings located within the project area will be made with temporary structures that will be removed at cessation of operations.

The project areas are located within the Squannassit Area of Critical Environmental Concern (ACEC). ACEC areas provide protection to public and private groundwater supplies, provide flood control, and protect valuable fisheries and important wildlife habitat. Therefore, in order to minimize any site impacts there will be no cutting within 50 feet of streams, wetlands, or potential vernal pool areas. Resource areas will be buffered in the field with flagging and mapped in accordance with regulations found within the most recent edition of the Massachusetts Forestry Best Management Practices Manual.[6]

Current and Potential Vegetation:

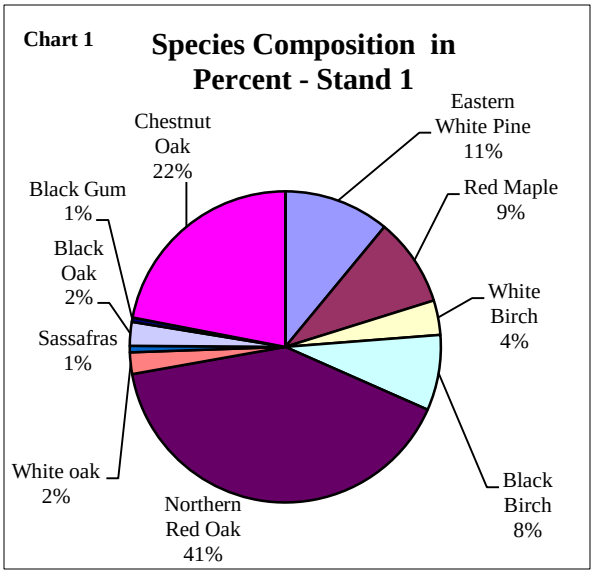
Methods:

A geographic information system (GIS) grid was developed in order to conduct a thorough stand exam within the project areas. Two stage variable radius plot or "BigBAF" sampling was conducted at 55 plots to inventory the overstory component of the project area. Fox DS Cruiser was used to process the overstory data for incorporation into this document.[7] Understory vegetation was sampled at each inventory point using standards set forth in the DCR Manual for Continuous Forest Inventory for regeneration plots (0.0300 acre plot size). One

[6] Catanzaro, P., Fish, J., Kittredge, D., Massachusetts Forestry, Best Management Practices Manual, 2013 Edition
[7] FOX DS Cruiser version 2007.2, New Hampshire Forests and Lands

hundred foot coarse woody material transects were conducted from each inventory point. In house software was used to process understory and coarse woody material data.

Results:



The forest canopy of Stand 1 (±104 acres) consists of (in decreasing order of dominance), northern red oak (*Quercus rubra*), chestnut oak (*Quercus prinus*), white pine, red maple (*Acer rubrum*), black birch (*Betula lenta*), paper birch (*Betula paparifera*), black oak (*Quercus velutina*), white oak *(Quercus alba*), and other tree species such as sassafras (*Sassafras albidum*), and black gum *(Nyssa sylvatica*) (See Chart 1 and Appendix Tables 1 & 2 for overstory statistics).

The current overstory trees in this stand are generally even aged (approximately 90 years) and are a result of trees that were either too small to be harvested prior to State ownership or became established after the forest fire. This stand contains approximately 89 square feet of basal area and approximately 212 trees per acre with red oak and chestnut oak comprising the majority of the stand. The stand is moderately to well stocked with an estimated relative density of 76.3.

The understory of Stand 1 consists of native tree and shrub vegetation. Red maple, eastern white pine, black birch, and chestnut oak are the most common species of trees found in the regeneration portion of the understory along with lesser amounts of northern red and black oak species along with American chestnut (*Castanea dentata*) sprouts (See Appendix Table 3). No invasive species were noted during stand examination.

Shrub vegetation found in this section of the project is dominated by mountain laurel (*Kalmia latifolia*), with lesser amounts of eastern teaberry (*Gaultheria procumbens*), lowbush blueberry (*Vaccinimum angustifolium)*, highbush blueberry *(Vaccinimum corymbosum)*, American witch-hazel (*Hamamelis virginiana),* starflower (*Trintalis sp*.), and cinnamon fern (*Osmunda cinnamomea*). Other species such as sheep laurel (*Kalmia angustifolia*), clubmoss (*Lycopodium sp.*), Canada mayflower (*Maianthemum canadense*), northern dewberry (*Rubus flagellaris*), bracken fern (*Pteridium sp.*) and various unidentified grasses were noted in this stand (See Appendix Table 4).

The high proportion of mountain laurel (up to 75% cover in many inventory plots) found in the ground cover component of this stand is an extreme impediment to forest regeneration.

This high percentage of cover limits the ability of seedlings, specifically size class' 1 & 2, to become established in the understory of the forest due to shading.

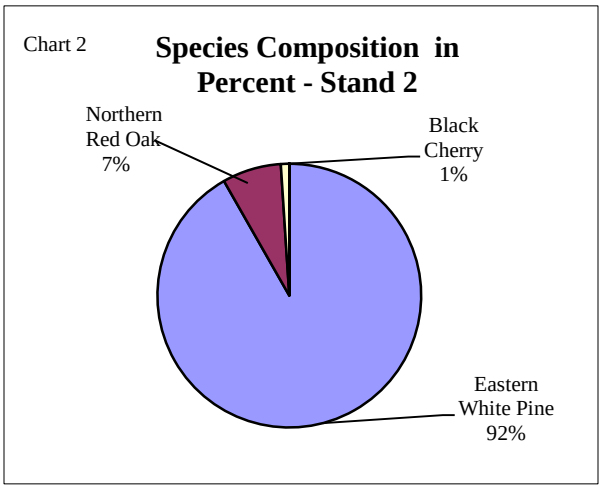
Course wood material (CWM) and snags are scattered throughout the stand. It is estimated that there is approximately 377 cubic feet per acre of course woody material. This material consists of both sound and decayed types. CWM is beneficial to animals and insects that utilize it for cover and foraging opportunities.[8] The estimated amount of CWM more than meets the DCR management guidelines recommended minimum of 256 cubic feet per acre.

It is estimated that there are approximately 18 standing snags per acre in this stand. All snag observations were less than 12" and of hardwood species. Standing snags will be retained for wildlife benefits unless adjacent to trails and main haul roads in which case they will be cut to protect public safety. If these snags need to be cut, they will be left onsite as CWM.

Management guidelines recommend leaving 1-3 live, large diameter (>18") and 4 live 12" to 18" diameter trees per acre that may develop into cavity and den trees. These types of trees will be identified during marking operations for retention within the stand.

Stand 2 (± 9 acres) is a white pine plantation consists of (in decreasing order of dominance) white pine, red oak, and a few black cherry (*Prunus serontina*) trees (See Chart 2 and Appendix Tables 5 & 6 for overstory statistics).

Chart 2



This stand is an even aged plantation that was most likely planted by the CCC crews in the mid to late 1930's. This stand contains approximately 200 square feet of basal area and approximately 473 trees per acre with white pine comprising 92% of the stand. The red oak and black cherry trees that have pioneered into the stand occur in the intermediate to co-dominant canopy position within the stand. The stand is approaching an overstocked condition with an estimated relative density of 98.1.

The understory vegetation is composed of native tree species with red oak and white pine being the most commonly observed species along with lesser amounts of other hardwood species (See Appendix Table 7). No invasive species were noted in this section of the project area.

The shrub component of this area contains similar species as stand 1 with the addition of species such as maple leaf viburnum (*Viburnum acerifolium*) (See Appendix Table 8).

[8] https://www.forestguild.org/EF_CWM

Course woody material for this stand is estimated at 512 cubic feet per acre and is predominately white pine trees that have died as a result of competition within the stand. Standing snags are estimated to be approximately 81 per acre, predominately white pine and all less than 12 inches diameter at breast height. Similar standards as Stand 1 for retention of snags will be followed.

Insects and pathogens:


Gypsy Moth egg masses

The years 2016 and 2017 saw the resurgence of Gypsy moth (*Lymantria dispar*) outbreaks similar to those seen in the early 1980's throughout the Commonwealth. Under normal weather conditions the fungus *Entomophaga maimaiga* keeps the insects in check. However the drought conditions of the previous seasons created conditions detrimental to the fungus, allowing gypsy moth populations to rise dramatically. During stand examination many egg masses were noted at the base of trees, and some feeding damage was noted to tree canopies. Oak species are preferred by this destructive pest, and repeated defoliation can lead to crown dieback and eventual mortality affecting the diversity of the forest.[9]


Caliciopsis canker

Caliciopsis canker (*Caliciopsis pinea*) is a native fungus that damages the thin bark of pine trees. The fungus damages the pine trees resulting in dramatic pitch oozing. Trees affected by this can suffer reduced crown density and reduced vigor. Over the long term these weakened trees may become more susceptible to secondary attacks eventually leading to mortality. Caliciposis can be found in high density stands of white pine on sandy well drained soils. Management strategies that allows for greater temperature and sunlight may decrease risks to white pine.[10]

Archeological Features:

Prior to State ownership this area was used for grazing livestock, growing and extraction of timber, and subsistence farming. Evidence of these activities includes; old stone walls, wells, water holes and cellar holes around and within the project area. No crossings of stone walls will be needed as there is ample access for equipment. No cellar holes are located within the project area. There is an old well and remains of a pump house located within Stand 2, but these features are located within a wetland resource where no harvesting will take place.

[9] https://ag.umass.edu/fact-sheets/gypsy-moth
[10] https://extension.unh.edu/resources/files/Resource000999_Rep1148.pdf

Comments provided by the DCR Archeologist indicate that there is no known pre contact sites located within the project area.


Old well site

Wildlife:

The oak and white pine overstory within the project areas provides valuable habitat and food to native wildlife species. These forests provide mast (both hard and soft types) to many species of wildlife that feed on them along with valuable habitat for rearing young. Species noted within the area include: white tail deer (*Odocoileus viginianus*), moose (*Alces alces*), black bear (*Ursus americanus*), coyote (*Canis latruns*) and a variety of avian, amphibian, and invertebrate species.

The project will provide positive benefits to wildlife by increasing species diversity along with horizontal and vertical structure of the forest. Establishing vigorous regeneration will provide habitat to animals that utilize younger forests as part of their life cycle. Creation of gaps within the forest will provide an "edge" effect that is attractive to many bird species for nesting and foraging. These gaps will also stimulate the herbaceous and shrub vegetation due to increased sunlight penetration to the forest floor benefitting foraging animal species. Mastication of thick patches of Mt. Laurel by equipment will allow additional grasses and shrubs to become established providing further browse and soft mast foraging opportunities for wildlife.

Retention of large (>18"DBH) known cavity trees, snag trees, and course woody material on the forest floor will benefit invertebrates, amphibians, and small mammal species that depend on them for their life cycles. Retention and release of large mast producing species (oak and cherry) will benefit native wildlife through the increased production of nuts and fruits. Reserving areas from management (wetlands, filter strips, and potential vernal pools) will benefit species that require these features for parts or all of their life cycles.


Cavity Tree

Rare and Endangered Species:

Review of the 13th Edition of the Massachusetts Natural Heritage Atlas shows that the project area does not fall within priority habitats for rare and endangered species.[11]

Recreation and Aesthetics:

This area is widely used by constituents for passive recreation with walking, mountain biking, bird watching, cross country skiing, and hunting being the most common activities. Illegal all terrain vehicle use occurs within the forest, but is confined mostly to main forest roads.

Implementing this prescription will have limited impacts on recreational users of this forest. The project area will be closed during hours that active harvesting operations are taking place which will help mitigate any issues with recreation. All legal trails will be treated utilizing the standards contained within the DCR Management Guidelines document pertaining to forest management within trail corridors. As noted in the management guidelines document forest management activities occurring within trail corridors will focus on retaining larger diameter, healthy trees and promoting a safe experience for recreational users.

Existing legal trails within the project areas will be utilized to access stands for harvesting operations. No slash will remain within 25' of trails, and slash will be treated by equipment to promote rapid decomposition and a light appearance.

Evaluation of Data and Projected Results:

Objectives:

As documented in the Landscape Designations for DCR Parks and Forests: Selection Criteria and Management Guidelines document, Townsend State Forest is designated as a Woodland. As noted in the Management Approach for Woodlands section of the document this project fulfills the ecosystem services that Woodlands provide. Woodlands provide a range of ecosystem services such as, but not limited to, clean water, wildlife habitat, recreation opportunities and sustainable production of renewable wood products.

The West Hill Lot Project major objectives are:

- Improve access to the project area utilizing in kind services for the benefit of first responders, recreational users and DCR staff.
- Remove all hazard trees along trails within project area to protect public safety.
- Use uneven and even age forest management to increase species diversity and forest structure for the benefit of wildlife.
- Promote vigorous regeneration of native species within forest stands currently limited due to competition for resources.
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[11] http://maps.massgis.state.ma.us/map_ol/oliver.php reviewed 1/2/2018

Silvicultural Prescription:

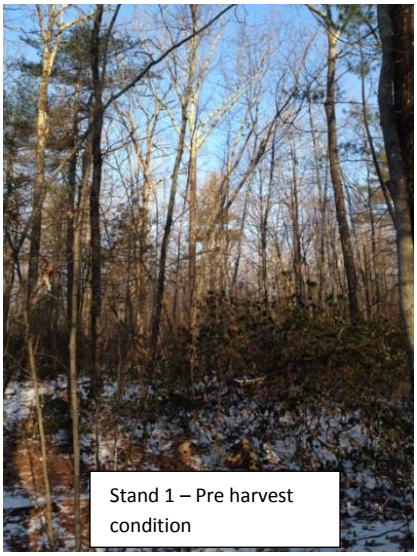
As discussed in previous sections the forest stands within the project areas are generally even aged oak-white pine and a white pine plantation forest types.

Trees will be individually marked for removal (cut tree marked) using DCR standard marking regime. Cutting boundaries will be triple marked with 45 degree slashes to denote cutting areas. Potential vernal pools and wetlands will be buffered minimum of 50 feet where no cutting will occur and no principal skid trails (except existing forest roads) will be located within 100 feet of these features. Fifty foot no cut filter strips will be placed along streams and no trees will be removed in these filter strips except those required for equipment access at an approved stream crossings. All features will be marked with paint and identified as required by law when filing a Ma Ch132 Forest Cutting Plan with the Bureau of Forestry and the local conservation commission.

Stand 1:

The major goals for this stand are:

- Demonstrate multi aged silviculture techniques that will establish needed regeneration within the stand due to interference caused by Mt laurel.
- Remove poorly formed, less vigorous and damaged trees.
- Create diverse habitats that benefit native wildlife and build forest resilience to stressors by increasing vertical and horizontal structure.
- Improve soil structure through the retention of coarse woody material of all sizes.



Stand 1 – Pre harvest condition

This stand will be treated using an expanding gap irregular shelterwood system. [12] It is recommended that up to 60 ≤1/3 acre gaps be placed randomly across the stand to mimic natural disturbance patterns with the intent of regenerating approximately 15%-20% of the stand. Outside of these gaps, trees will be thinned to promote canopy expansion, diameter increment, and tree vigor. Desirable species such as red oak and white pine will be favored for retention, while low grade black birch, white birch and red maple will be targeted for removal.

Gap placement within this stand will focus on:

- Advance regeneration that may be released.
- Proximity to preferred retention trees that can provide a source of seed.
- Areas where trees have damaged crowns or composed of low vigor specimens.
- High densities of Mt Laurel preventing tree regeneration.

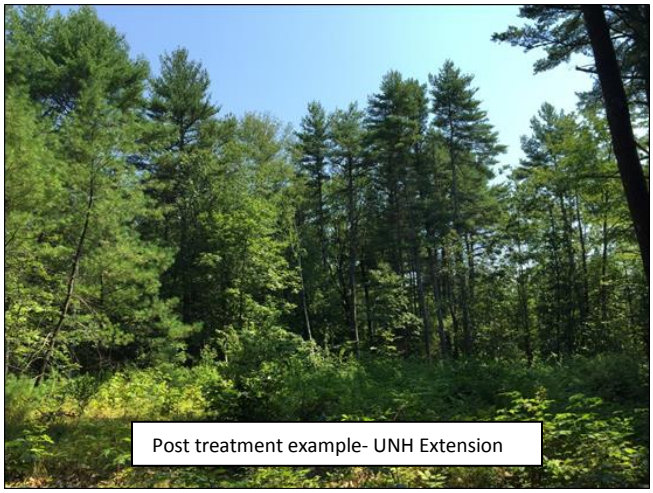
[12] https://extension.unh.edu/articles/Expanding-Gap-Shelterwoods-Flexible-System-Regenerating-Mid-tolerants

Target residual basal area within gaps will be between 0-20 ft^2 BA/ac, with residual BA consisting of existing advance regeneration (oak or pine) or potential legacy/wildlife tree(s). Follow up treatments within 15-20 years will focus on expanding these gaps with the intention of regenerating the stand over 100 years.

Recommended harvesting guidelines outside of gaps:

Stand	Current BA Ft^2	Current Relative Density	Target Residual BA Ft^2	Target Residual Relative Density
1	89	76%	51	43%

Post treatment, outside of gaps, the residual stand will consist of larger trees in the dominant and codominant canopy position. Within gaps, sunlight will penetrate to the forest floor stimulating shrub and herbaceous vegetation to increase in abundance and diversity. Increased sunlight availability will create conditions favorable for the establishment of a new cohort of trees and also release advance regeneration to accelerate growth into the canopy.



Post treatment example- UNH Extension

Stand 2:

The major goals for this stand are:

- Demonstrate two aged silvicultural techniques to regenerate white pine and oak species.
- Improve size, quality and vigor of residual trees.
- Provide wildlife habitat and food to native species.
- Improve soil structure through the retention of coarse woody material of all sizes.

This stand will be treated using a shelterwood with reserves silvicultural technique with the goal of having two distinct age classes present in this stand. The shelterwood with reserves is a modification of the traditional shelterwood system where some of the shelter trees are held past the overstory removal cut of a traditional 2 or 3 cut shelterwood system. The reason to do this is to reserve a portion of dominant legacy oak and pine trees within the stand to provide diverse habitats for the benefit of wildlife species.

As discussed in the Current and Potential Vegetation portion of this document this stand is approaching an over-stocked (A line) condition with a relative density of approximately 98%.[13] When forest stands approach this level of stocking, mortality due to competition for resources occurs as less vigorous trees begin to succumb. Reducing the stocking to the B line will reduce crowding within the stand and allow residual trees to respond with increased diameter increment and biomass growth as the stand will be fully stocked with healthy vigorous specimens, but not so low that the stand will not be fully occupied by desirable trees. Reducing the stocking below the B-line would not be recommended as this would increase the likely hood of wind throw damage to the residual stand.


Stand 2 - Pre harvest condition

The harvest conducted in this stand at this entry will be the preparatory and establishment cut of a shelterwood with reserves silvicultural system that will provide the conditions necessary for the establishment of seedlings. Evaluation of regeneration response to this harvest in 10 to 15 years will dictate whether the overstory can be removed in the second cut (2 cut shelterwood), or whether another reduction in stocking is needed in order to fully secure adequate seedling recruitment within the stand, thus moving the final overstory removal out an additional harvesting cycle (3 cut shelterwood).

Recommended harvesting guidelines:

Stand	Current BA Ft^2	Current Relative Density	Target Residual BA Ft^2	Target Residual Relative Density
2	200	98	122	52

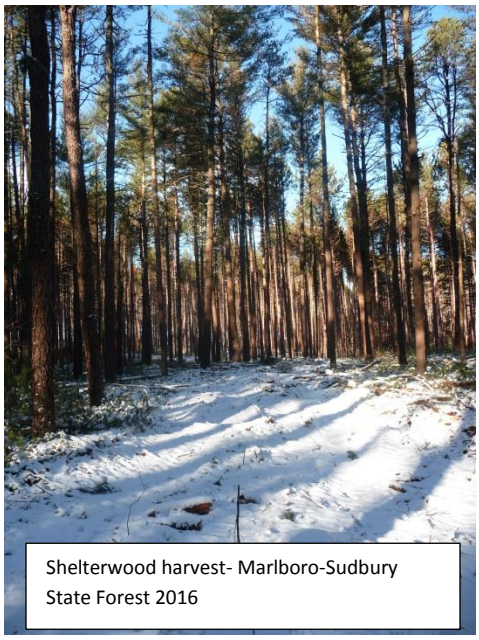
Reserve trees within this stand will be those species occupying the dominant and co-dominant canopy positions, have full crowns, and have the potential to provide wildlife habitat or food.

Trees targeted for removal:

- Trees with low live crown ratios
- Trees of poor form and vigor
- Diseased and dying trees
- Trees in the suppressed and intermediate canopy position that will succumb to mortality.

[13] Lancaster K.F., Leak, W.B., A Silvicultural Guide to White Pine in the Northeast, USFS General Technical Report NE-41, 1978

Post-harvest there will an obvious reduction in stocking with trees more widely spaced. Residual trees will be those occupying the dominant and co-dominant canopy position and average diameter distribution will consist of larger specimens. Sunlight penetration to the forest floor will stimulate herbaceous and shrub species to readily occupy the site but not so high as to encourage shade intolerant species (e.g. white birch) over desirable mid shade tolerant oak and pine. Scarification by harvesting equipment will prepare a necessary seed bed for oak and pine seedlings to become established in the stand within 3 – 5 years.



Shelterwood harvest- Marlboro-Sudbury State Forest 2016

Sale Layout and Harvesting Systems:

Access to the project area will be off of Fessenden Hill Road and Route 13. It is anticipated that one landing will be used for this project (See detail map) and that several skid trails will need to be laid out prior to harvesting activity. Principal skid trails will be laid out with flagging and paint during marking operations avoiding wetland resources and steep slopes. Any stream crossings required for harvesting operations will meet or exceed those specifications found in the Massachusetts Forestry Best Management Practices Manual. There will be no harvesting in wetlands or filter strips along streams unless removals are needed at an approved stream crossing for equipment access. All crossings will be removed at the cessation of operations and principle skid trails will be stabilized with water bars and seed mix as needed at the direction of the forester in charge.

Due to the large quantity of non-saw timber quality forest products this project will be open to all harvesting systems both conventional and mechanized (whole tree harvesting). However, equipment will not be allowed to exceed the recommended 6 P.S.I of ground pressure to prevent soil compaction. Scarification to bare mineral soil will be encouraged throughout the project area to provide a suitable seed bed for desirable species.

A MGL Ch. 132 Forest Cutting Plan will be filed with the Massachusetts Department of Conservation and Recreation Service Forestry Division and local conservation commission prior to harvesting operations. Mandatory best management practices, as required by law, will be implemented to safeguard important ecological features (wetlands, potential vernal pools, streams, etc.).

In Kind Services:

Road repair and rough grading portions of Fessenden Hill Road are anticipated as part of this project. Sections of road will need suitable crushed stone to firm up the road base to support heavy trucks and improve access for future projects and recreational users.

Appendix

Table 1 – Stand 1 Overstory Statistics						
			Sawtimber	Total	Total	Topwood
	Sawlog	Pulp	Mean	Bf	Cords	Cords
Species	Bf/Acre	Cords/Acre	Ht (logs)	(Stand)	(Stand)	(Stand)
Eastern White Pine	670.1	1.7	3.0	69686.1	179.3	8.7
Red Maple	24.3	1.7		2528.4	171.9	
White Birch	0.0	0.8		0.0	87.9	
Black Birch	97.2	1.3		10113.7	134.8	
Northern Red Oak	2876.2	3.1	1.8	299122.3	319.1	113.5
White Oak	48.6	0.0		5056.9	4.0	
Sassafras	0.0	0.1		0.0	11.3	
Black Oak	108.1	0.3	1.5	11240.1	30.0	6.2
Black Gum	0.0	0.1		0.0	6.5	
Chestnut Oak	770.4	3.0	1.8	80126.1	308.8	30.7
Total	**4594.9**	**12.1**		**477873.6**	**1253.6**	**159.1**

Table 2 – Stand 1 Overstory Statistics						
	Total	Total	BA/ac			
Species	Trees/Acre	BA/Acre	by Spp	QMD	Rel Density	% AGS
Eastern White Pine	18.5	9.8	11.0%	9.9	4.1	59.2%
Red Maple	43.7	8.2	9.2%	5.9	7.7	12.2%
White Birch	12.6	3.2	3.6%	6.8	2.9	6.3%
Black Birch	27.1	7.0	7.8%	6.9	6.3	22.9%
Northern Red Oak	55.3	36.2	40.6%	11.0	32.6	84.5%
White Oak	7.0	2.0	2.2%	7.2	1.9	40.0%
Other Hardwood	3.2	0.6	0.7%	5.9	0.6	0.0%
Black Oak	3.1	2.2	2.5%	11.4	1.9	54.5%
Black Gum	2.9	0.4	0.4%	5.0	0.4	100.0%
Chestnut Oak	39.4	19.6	22.0%	9.6	18.0	59.2%
Total	**212.8**	**89.2**	**100.0%**	**8.8**	**76.3**	**59.64%**
		Median Stand Diameter ->>		**10.7**	**76.3**	<<- Estimated Relative Density

Table 3 – Stand 1 Regeneration Data					
	Size	Class			
Species	1	2	3	4	**TOTAL**
Red Maple	51	6	128	134	**319**
White Oak	38	19	13	0	**70**
Striped Maple	0	0	6	0	**6**
White Pine	45	45	102	77	**268**
Sassafras	6	0	6	0	**13**
Black Birch	19	6	45	19	**89**
American Chestnut	45	13	6	0	**64**
Chestnut Oak	38	0	0	6	**45**
Red Oak	32	26	0	0	**57**
TOTAL	**274**	**115**	**306**	**236**	**932**

Table 4-Stand 1 Shrub Data	
Species	**AVG. % COVER**
Mountain Laurel	**38.0**
Tea Berry	**5.3**
Sheep Laurel	**0.8**
Lowbush Blueberry	**2.1**
Grass	**0.7**
Highbush Blueberry	**1.6**
Cinnamon Fern	**0.4**
Witch Hazel	**1.7**
Tree Club Moss	**0.3**
Dewberry	**0.2**
Star Flower	**0.2**
Canada Mayflower	**0.5**
Bracken Fern	**0.1**

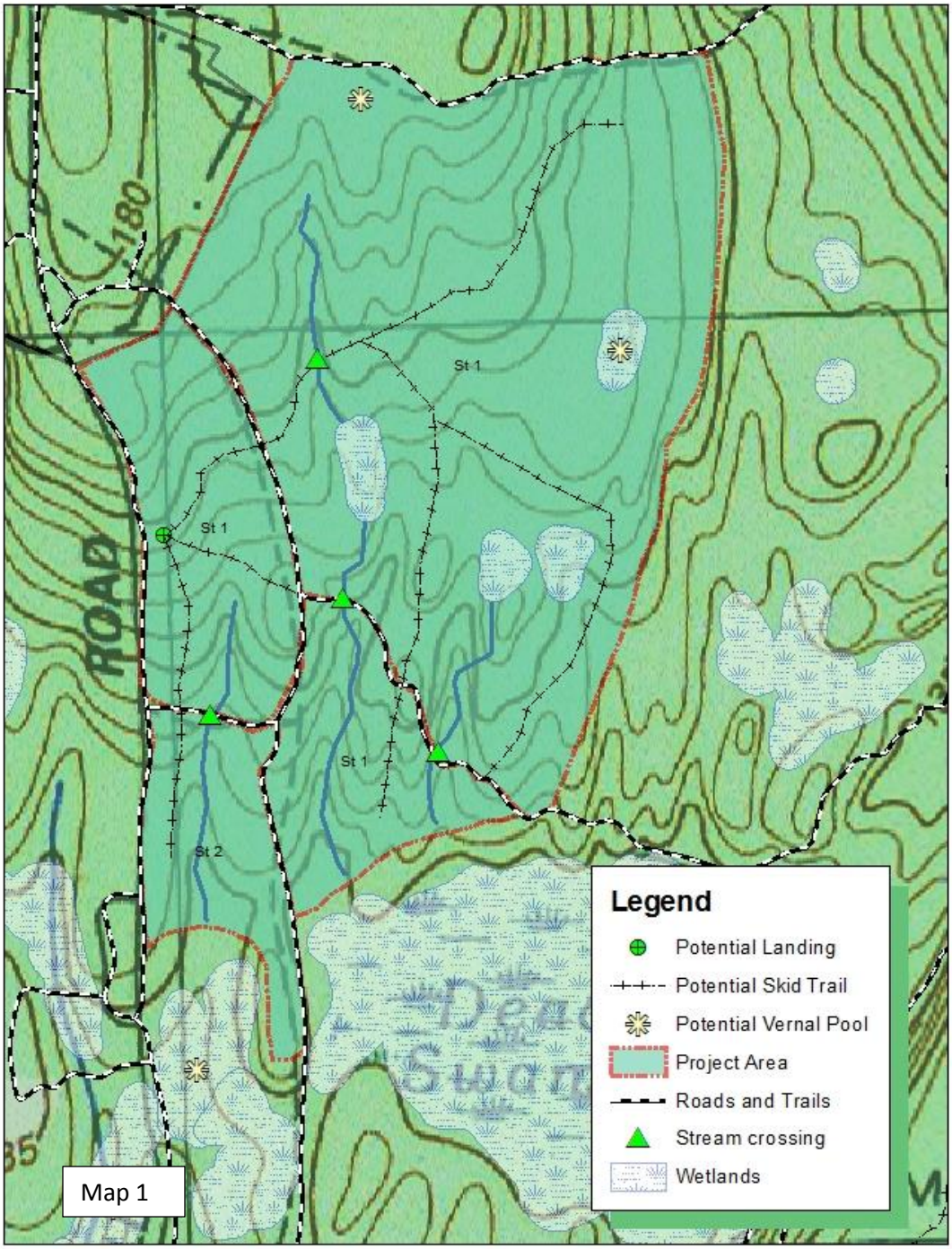
Table 5 – Stand 2 Overstory Statistics						
			Sawtimber	Total	Total	Topwood
	Sawlog	Pulp	Mean	Bf	Cords	Cords
Species	Bf/Acre	Cords/Acre	Ht (logs)	(Stand)	(Stand)	(Stand)
Eastern White Pine	9591.3	34.0	2.4	90157.8	319.7	24.4
Northern Red Oak	1131.1	0.9	1.8	10632.3	8.9	4.2
Black Cherry	0.0			0.0		
Total	**10722.4**	**35.0**		**100790.1**	**328.6**	**28.6**

Table 6 – Stand 2 Overstory Statistics							
	Total	Total	BA/ac				
Species	Trees/Acre	BA/Acre	by Spp	QMD	Rel Density	% AGS	
Eastern White Pine	447.8	178.0	89.0%	8.5	81.5	44.9%	
Northern Red Oak	20.1	14.0	7.0%	11.3	12.7	85.7%	
Black Cherry	4.8	2.0	1.0%	8.7	0.0	0.0%	
Total	**472.7**	**200.0**	**97.0%**	**8.8**	**94.1**	**46.0%**	
		Median Stand Diameter ->>		**10.5**	**98.1**	<<- Estimated Relative Density	

Table 7 – Stand 2 Understory Data					
	Size	Class			
Species	1	2	3	4	**Total**
White Pine	240	0	0	0	**240**
Red Oak	420	0	0	0	**420**
Red Maple	0	0	180	0	**180**
Black Birch	60	0	60	0	**120**
White Oak	120	60	0	0	**180**
TOTAL	**840**	**60**	**240**	**0**	**1140**

Table 8 – Stand 2 Shrub Data	
Species	**AVG. % COVER**
Lowbush Blueberry	**5.4**
Teaberry	**6**
Canada Mayflower	**4.4**
Mountain Laurel	**23**
Sheep Laurel	**1**
Star Flower	**0.8**
Bracken Fern	**4.4**
Witch Hazel	**2**
Cinnamon Fern	**4**
Maple Leaf Viburnum	**0.4**

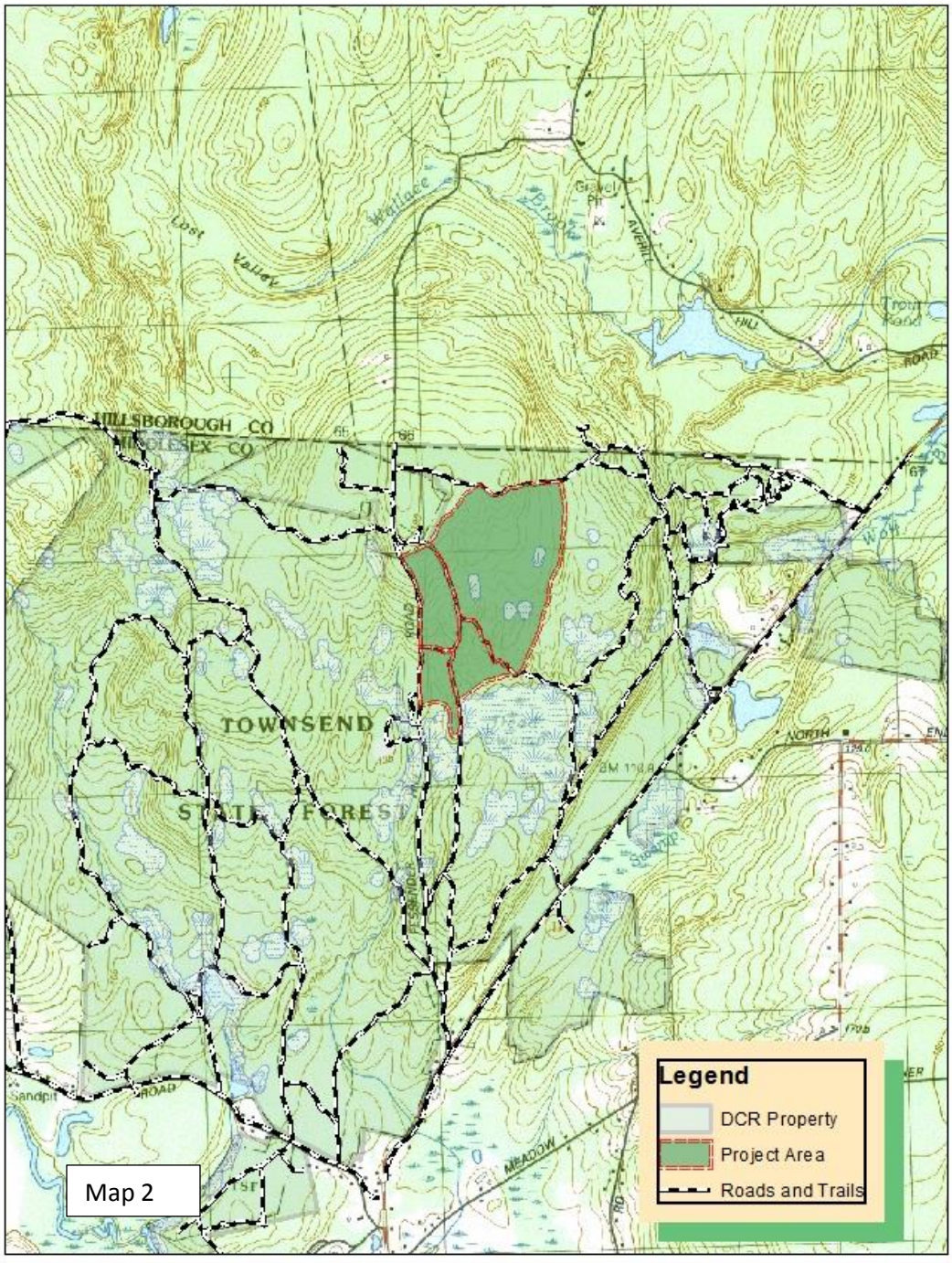
West Hill Lot Project Area
Townsend State Forest
Townsend, MA



MJW-12/11/17

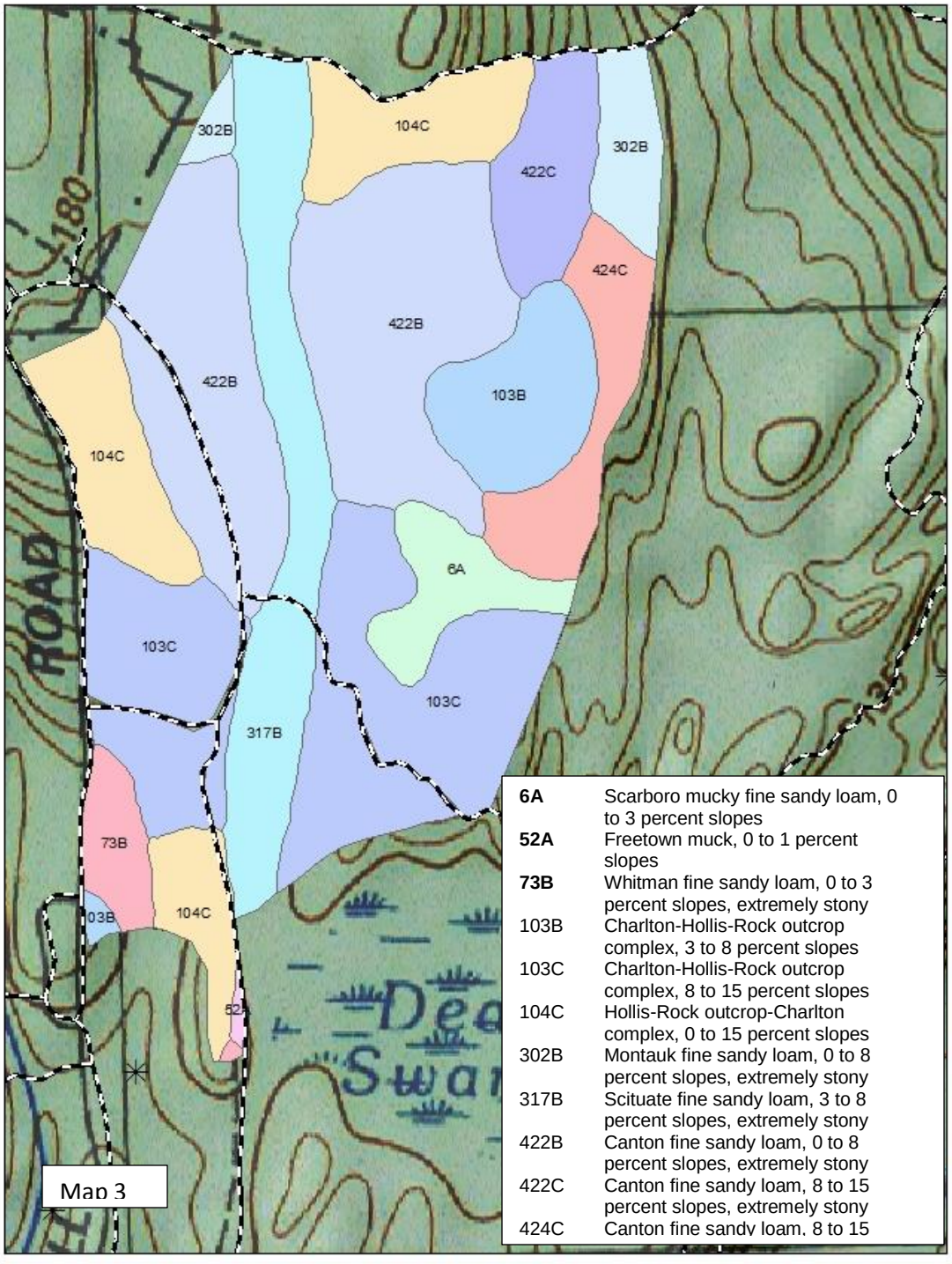
0 165 330 660 990 1,320
Feet

West Hill Lot-Locus Map
Townsend State Forest
Townsend, MA



MJW-11/29/16

West Hill Lot-Soils
Townsend State Forest
Townsend, MA



6A	Scarboro mucky fine sandy loam, 0 to 3 percent slopes
52A	Freetown muck, 0 to 1 percent slopes
73B	Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony
103B	Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes
103C	Charlton-Hollis-Rock outcrop complex, 8 to 15 percent slopes
104C	Hollis-Rock outcrop-Charlton complex, 0 to 15 percent slopes
302B	Montauk fine sandy loam, 0 to 8 percent slopes, extremely stony
317B	Scituate fine sandy loam, 3 to 8 percent slopes, extremely stony
422B	Canton fine sandy loam, 0 to 8 percent slopes, extremely stony
422C	Canton fine sandy loam, 8 to 15 percent slopes, extremely stony
424C	Canton fine sandy loam, 8 to 15

MJW-12/11/17

0 165 330 660 990 1,320 Feet