Massachusetts Department of Conservation and Recreation

Silviculture Prescription
Goodale-Chipman Lots

Massachusetts Department of Conservation and Recreation
Bureau of Forestry

Northeast District
Marlborough-Sudbury State Forest
Hudson and Marlborough, MA

Prepared by:

Mike Waterman - Management Forester-Northeast District
Will Holden - Seasonal Forestry Assistant-Northeast District
Massachusetts Department of Conservation and Recreation
25 Shattuck Street, Lowell- MA 01852
michael.j.waterman@state.ma.us 978-937-2092 ext. 109

September 28, 2020

Approved by:

Management Forestry
Program Supervisor William R. VanDoren (ACTING) Date: 23 October 2020

Site Data:

Cultural and Historical:

The Goodale-Chipman project is located in the Marlborough-Sudbury State Forest in the southeast section of the town of Hudson and the northeast section of the city of Marlborough, Middlesex County, Massachusetts, respectively. This project area is located west of White Pond Road and south of Concord Road (Appendix Maps 1, 2 and 3). This area of Marlborough-Sudbury State Forest is part of approximately 1000 acres acquired by the Commonwealth beginning in the 1930's. These lands, purchased from David Goodale (Goodale Lot) and the Marlborough Forestry Service (Chipman Lot), along with other acquisitions, were consolidated into what is now Marlborough-Sudbury State Forest.

Previous land use of this area was subsistence farming, livestock grazing, and forestry. Evidence of previous agricultural use prior to state ownership can be seen by the old stone walls located along the north and west side of the Goodale Lot and the eastern side of the Chipman Lot project. At the time of acquisition these particular properties were abandoned agricultural fields and lands reverting back to a forested condition naturally.

Geology and Soils:

Several thousand years ago this area was covered by the Wisconsin Glacier and the current landscape bears witness to this period and the subsequent retreat of the glacier and the soils deposited during this time. This area of Middlesex County has, in general, relatively thin soils and rocky outcrops, with the underlying bedrock close to the surface. The soils in this area generally fall into the glaciofluvial (glacial outwash) and glacial till types.[i]

Elevations within the project area range from approximately 190 feet to approximately 250 feet. The topography can be described as generally rolling (0%-10% slope) in nature interrupted by short steep areas, such as the interface of Goodale Stands 1 and 2 (15%-25% slope), with a generally northerly and westerly aspect.

The majority of the soils found in the project area fall into the Freetown, Hinckley, Windsor, Deerfield, Carver, Charlton-Hollis and Paxton soils series (Appendix Map 4 and 5). The common theme among these soils is a sandy-loamy-stony nature due to glacial origin. Soil productivity is low to moderate on these soils with site indices at base age 50 ranging from 57 for eastern white pine (*Pinus strobus*) for the Windsor series to 67 for black oak (*Quercus velutina*) for the Paxton series.[ii] Soil productivity will be protected during this project, since harvesting will occur during dry stable conditions (*i.e.* no operations during "spring breakup") to

avoid rutting and deep disruption of the soil profile, and since partial overstory cover will be retained limiting soil warming.

Department of Conservation and Recreation (DCR) Management Guidelines of 2012 state that "*Forest 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 Geographic 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 verifies a generally low to moderate productivity of these forest stands.[iii]

Climate:

The weather in this area of Massachusetts is typical with seasonally changing conditions. According to the National Weather Service data set, this area has an annual average precipitation of 48.07" and a mean annual temperature of 47.5°F.[iv]

Severe weather events are not uncommon for the area and affect forest development over time. Wind is the most significant driver of forest development in this area, creating canopy gaps on the scale of broken crowns of individual trees to many acres of toppled stems. These winds, in general, originate from the south and southwest during warmer months, and north and northwest during cooler periods of the year. These forests have also seen major episodic weather events (*i.e.* hurricanes, ice storms, *etc.*) and these events too can have a drastic influence on forest development both temporally and spatially.

Hydrology and Watershed:

The Goodale-Chipman project area has two small potential vernal pools and four wetland complexes located within the project areas (see detail maps). The Assabet River, White Pond, and Lake Boon are located within a few miles of the project. The Sudbury Reservoir, managed by DCR Division of Water Supply Protection, is located approximately three miles southwest of the project and the area as a whole is part of the Concord River Watershed.

Resource areas will be identified in the field with flagging and paint. These areas will be mapped in accordance with regulations found within the most recent edition of the Massachusetts Forestry Best Management Practices Manual.[v] There are no wetland or stream crossings within the project.

Archeological Features:

Located within the project areas is evidence of prior ownership and land use. Prior to state ownership these properties were used for livestock grazing, subsistence farming, and timber management and forestry. Stone walls are found in and around both the Goodale and Chipman lot project areas. Internal stone walls are discontinuous and therefore equipment will have no need to cross any of the stone walls during project implementation.

A review conducted by the DCR Archeologist of the project areas indicated that there are no known pre-contact sites recorded within the project area.

Recreation:

This area is most widely used for passive recreation. Hunting, hiking, and mountain biking are the most prevalent activities in this forest. Illegal all-terrain vehicle use is an issue but confined mostly to the main forest trails. There are no developed parking areas located near the project, so recreation use is generally light. The harvest area will be posted when work on this project is ongoing to alert constituents to program activities, and closed during operational hours.

Existing legal trails within the project areas will be utilized to access the project areas. Slash will be treated to promote rapid decomposition and a light appearance by lopping or crushing by equipment. As noted in the management guidelines document, forest management activities occurring within trail corridors will focus on retaining larger diameter, healthy trees and promote a safe experience for recreational users. Forest management activity will help to reduce the number of dead and dying trees located along forest trails.

Wildlife:

The Goodale-Chipman project area is used by a variety of native wildlife species. There is evidence of ungulate species (white-tailed deer (*Odocoileus virginianus*)) feeding and bedding, along with other small animals and a variety of avian species such as turkeys, chipmunk, squirrel, and pileated woodpecker. Anticipated impacts by these animals on regeneration should be minimal as opening up the forest canopy will allow grasses, forbs, and other forms of browse to become more plentiful. Additionally, impacts on wildlife will be mitigated through low-impact forestry practices discussed later in the “Sale Layout and Harvesting Systems” section.

The proposed activity for the Goodale-Chipman project areas will provide positive benefits to wildlife by increasing species diversity and vertical structure of the forest. Releasing advanced

regeneration will be a benefit to animals that utilize younger forests as part of their life cycle. The increased sunlight will also stimulate the herbaceous and shrub vegetation component of the stands benefitting foraging animal species. Animals such as New England cottontail, box turtle, ruffed grouse, and a variety of songbirds, insects, and reptiles need young forests. Young forest habitat is of high need in the state to meet wildlife diversity needs as stated in the Massachusetts 2015 State Wildlife Action Plan (p. 268). There will be positive wildlife benefits from young forest habitat patches, however the planned silvicultural treatments will not provide large substantial patches of early successional habitat and any young forest habitat created by this project will be ephemeral; therefore future cuts will be needed to create more of this habitat type.[vi]

Retention of large (>18" DBH) known cavity trees, snag trees, and coarse woody material (CWM) 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 trees of mast-producing species (oak and cherry) will benefit native wildlife through the increased production of nuts and fruits. Reserving areas from management (filter strips) will benefit species that require these features for parts or all of their life cycles.

MassWildlife has provided recommendations for this project with a focus on potential for restoration of the project area to shrub barrens habitat as the site has historically shown fire and disturbance-dependent communities. Careful consideration of this recommendation and evaluation of site habitat history has been made; however with the proximity of this site to local residential communities, habitat management through prescribed fire techniques along with wildfire considerations with this habitat type may cause safety concerns. Therefore, shrub barrens will not be encouraged through silvicultural treatment in this project; rather, a focus will be on even-age forest management (shelterwood) to release advanced regeneration of existing common tree species (see "Objectives" section).

Rare and Endangered Species:

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

The Chipman lot, however, does fall within a priority habitat for Eastern Box Turtle (*Terrapene carolina*), a species of special concern according to Mass Wildlife data. This species of turtle uses bog-lands and uplands during various parts of its life cycle.[viii] Therefore, this area of the project will be subject to review by the Natural Heritage and Endangered Species Program once a cutting plan is submitted for this project. Restrictions placed on the project may include seasonal timing and/or equipment limitations.

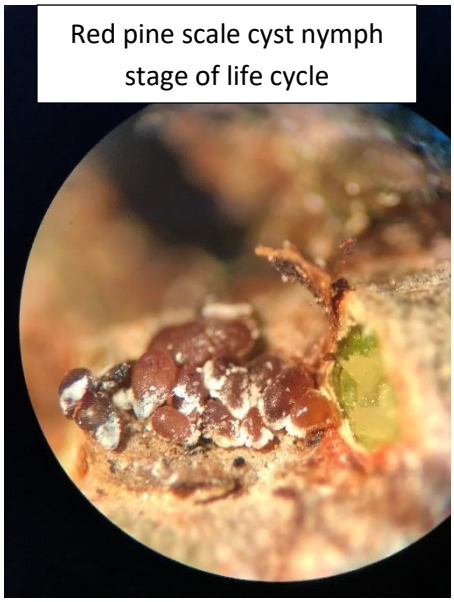
Insects and pathogens:

Red pine declining due to red pine scale

The area of Middlesex County in which this project is located was subject to Gypsy moth (*Lymantria dispar*) outbreaks in the 1980's and again in 2016. This outbreak was caused as a result of environmental conditions beneficial to population growth of this introduced pest to Massachusetts. 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.[ix] Many dead oak trees can be found in Goodale Stand 2 and Chipman Stand 1 as a result of this pest. Standing dead trees along forest roads and trails will be cut to protect public safety. Trees cut will be left onsite as CWM for wildlife benefits. Dead trees more than a tree-length away from trails and roads will be left as standing snags for wildlife benefits.

Within the project area is a red pine-white pine plantation (Goodale Stand 1). Unfortunately, the red pine (*Pinus resinosa*) found on this site are susceptible to the fungal pathogen *Diplodia* blight (*Diplodia pinea*), and red pine scale (*Matsucoccus resinosae*). Red pine infected by these pathogens can experience rapid decline in vigor leading to extensive mortality.[x,xi] The red pine within this stand are confirmed to be infested with red pine scale and are showing signs of rapid decline. Red pine will be preferentially removed from Goodale Stand 1 along main forest roads and trails. Within Goodale Stand 1, and more than a tree-length away from roads and trails, several red pine trees per acre will be allowed to succumb to red pine scale to become snags for wildlife.

Red pine scale cyst nymph stage of life cycle



Caliciopsis canker (*Caliciopsis pinea*) is another concern for pine forests in New England. This native fungus damages the thin bark of white pine trees causing trees to ooze pitch profusely. Trees affected by this pathogen 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. *Caliciopsis* can be found in high density stands of white pine on sandy well drained soils and was noted on some trees within Goodale Stand 3. Management

strategies that allows for greater temperature and sunlight may decrease risks to white pine.[xii]

Current and Potential Vegetation:

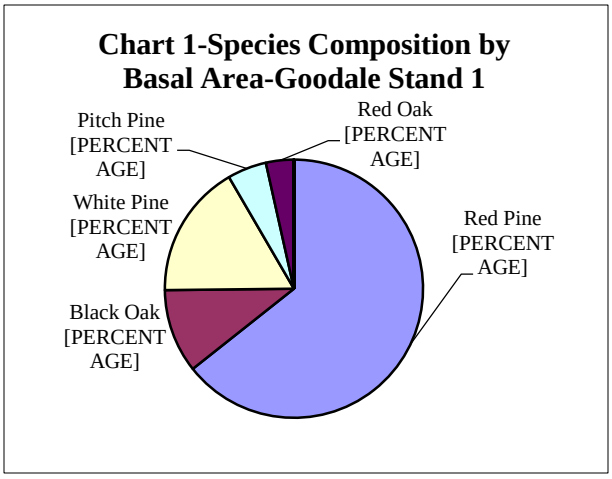
Methodology:

A GIS grid was developed in order to conduct a thorough stand exam of the project areas. Two phase or "Big BAF" sampling was conducted at 58 inventory plots collecting attributes on the overstory trees (≥ 5" diameter at breast height (DBH)) and understory trees (1" ≤ DBH < 5") within the project. New Hampshire Forests and Lands, Fox DS Cruiser version 2007.2 was used to process the overstory data. Understory vegetation (shrubs and herbaceous plants) was sampled at each inventory plot using standards set forth in the DCR Manual for Continuous Forest Inventory for regeneration plots (0.0026 acre plot size).[xiii] CWM was sampled using 100 ft. transects established at each inventory plot.

Evaluating data gathered during stand examination helps inform the decision making process and provides a basis to guide vegetation management. Foresters use basal area, relative density, trees per acre and other data to recommend a course of action (prescription) for forested landscapes.

Results:

The project area consists of 4 stands of native and non-native vegetation that has been managed for fuelwood and timber products since the 1980's[xiv]. Goodale Stand 1 (±40 acres) is an even-aged white pine-red pine plantation that was treated in 2015-16 with a preparation and seed cut as part of a shelterwood silvicultural system. The forest canopy of this stand consists of (in decreasing order of basal area), red pine, eastern white pine, black oak, pitch pine (*Pinus rigida*), and northern red oak (*Quercus rubra*) (Chart 1, Appendix Tables 1 & 2).



The forest canopy of this area is a combination of white pine and red pine planted by Civilian Conservation Corps crews in the 1930's. The trees are generally even-aged and sawtimber-sized with a median stand diameter of 12.1". The majority of the trees are in a dominant or codominant canopy

position, as trees that occupied the intermediate and suppressed canopy positions were harvested during 2015-16. Live tree basal area for this stand is approximately 90 ft^2/ac; there are 138 trees per acre with white pine being the most common tree species when including all size classes in terms of frequency and is moderately stocked with an estimated relative density of 51%.

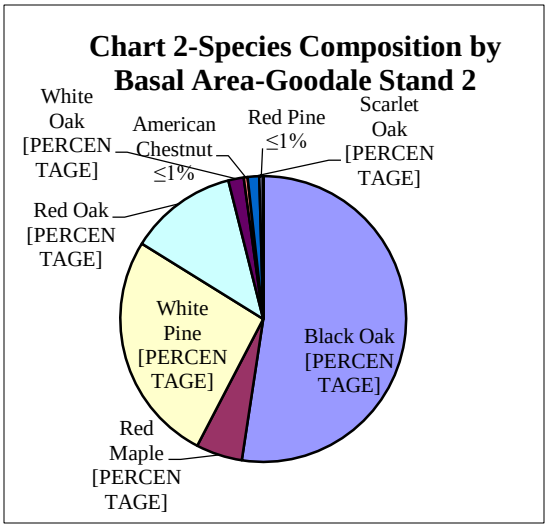
The understory and potential vegetation of Stand 1 comprises primarily native tree and shrub species. White pine, red oak, and red maple (*Acer rubrum*) were most commonly found in the understory along with lesser amounts of other species to the amount of approximately 6700 trees per acre in all size categories. (Appendix Table 3).

Non-tree vegetation found in this stand comprises native species; with huckleberry (*Gaylussacia* spp.), low bush blueberry (*Vaccinium angustifolium*) and grasses being the most commonly observed (Appendix Table 4). Some invasive glossy buckthorn (*Frangula alnus*) plants were noted in this stand during the course of field work but the population was small and scattered such that they did not fall into inventory plots. These plants were hand pulled during stand examination.

CWM and snags are found throughout the stand. It is estimated there are 362 cubic feet of CWM and 17 (<12" DBH, softwood and hardwood) snags per acre within the stand. Management guidelines recommend maintaining a minimum of 256 cubic feet per acre of CWM and a minimum of 5 dead snags (> 10" DBH) per acre. This stand was previously harvested utilizing a cut-to-length type operation which accounts for the greater-than-expected volume of CWM as this material would be cull pieces of logs and unmerchantable tops left onsite during harvest. Snags, or trees with the potential to become snags for wildlife purposes, will be retained during operations unless they are within one tree length of forest trails, in which case they will be cut and left onsite as CWM.

The management recommended for this stand is to release the new cohort of trees established during previous silvicultural treatments within it by using a shelterwood with reserves system. With this system most of the overstory trees are removed to increase available sunlight and nutrients to established advanced regeneration. Several trees per acre (oaks and white pine in this case) are reserved for non-timber values such as wildlife food production, legacy purposes, and future snag recruitment.

Goodale Stand 2 (±52 acres) is an even-aged oak-white pine forest type and consists of (in decreasing order of basal area, black oak, eastern white pine, northern red oak, and red maple, along with lesser amounts of other tree species (Chart 2, Appendix Tables 5 & 6).



The trees in this stand are generally even-aged and are a result of agricultural abandonment and natural regeneration to forest cover. Live tree basal area in this stand is approximately 91 ft^2/ac and there are approximately 150 trees per acre. The stand is moderately stocked with an estimated relative density of 66%.

The understory of Stand 2 consists primarily of white pine, red maple, and white oak; these being the most common species of trees found in the regeneration portion of the understory, along with lesser amounts of red oak, black cherry, black oak, sassafras (*Sasafras albidum*) and American chestnut (*Castanea dentata*) sprouts (Appendix Table 7).

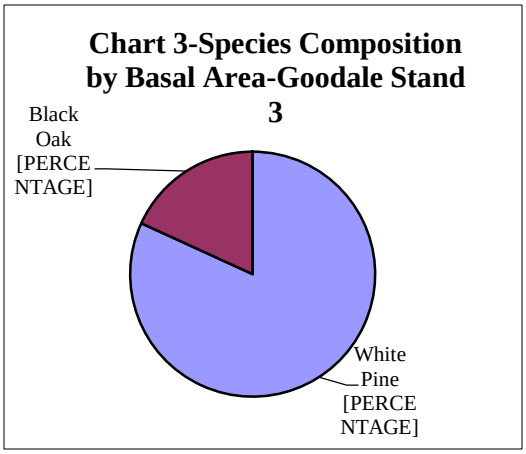
Shrub vegetation found in this stand is of similar composition as Stand 1 (Appendix Table 8). A few glossy buckthorn plants were noted during stand exam and pulled.

CWM and snags are scattered throughout the stand. It is estimated that there are approximately 140 cubic feet per acre of CWM. This material consists of both sound and decayed types. It is estimated that there are approximately 10 snags per acre in this stand. All tallied, sampled snags were less than 12" and both softwood and hardwood species. Snags will be retained following the same standards as Stand 1.

Analysis of the data for this stand shows a moderately stocked condition with a relative density of 66%. A commercial thinning reducing relative density to approximately 40% is recommended to improve vigor of trees and allow canopy expansion of the remaining stand. Removed trees would consist of low grade, low quality, damaged, diseased, or suppressed trees of low vigor.

Goodale Stand 3 (±12 acres) is an even-aged white pine-oak forest type. This stand was treated along with Stand 1 in 2015-16 and also in the 1980's with firewood removals under the "Cut-a-Cord" program. The density of the stand was reduced during the previous harvests to create the conditions to release established advanced regeneration and also to recruit new

seedlings into the stand. The overstory trees that were left in the previous harvest were in the dominant and codominant canopy positions and the basal area was reduced to between 40-50 ft^2/ac. Current stand live tree basal area has increased since the harvest and is currently estimated at 43 ft^2/ac, with a median stand diameter of 20", and relative density is 18% (Chart 3, Appendix Tables 9 & 10).



The understory of Stand 3 has responded well to previous treatments and an excellent younger cohort of white pine, black, white and red oaks, and red maple regeneration has become established as the future forest (Appendix Table 11).

Herbaceous species composition is similar to the other stands found within the project area. Again, some glossy buckthorn plants were observed during stand examination and pulled at the same time (Appendix Table 12).

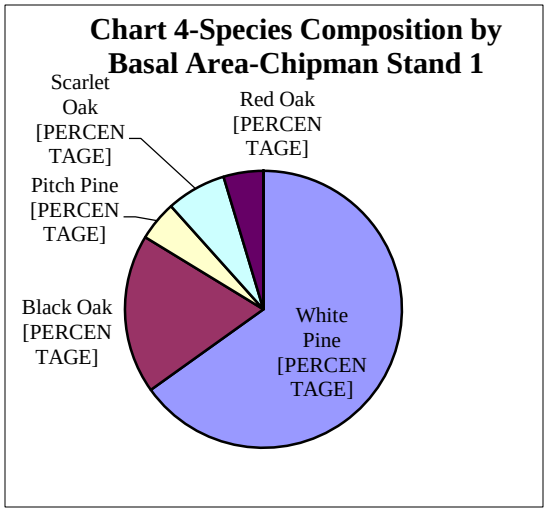
CWM is scattered throughout the stand. It is estimated that there are approximately 287 cubic feet per acre of course woody material. This material consists of both sound and decayed types. No snags were measured at inventory plots; however, they were observed throughout the stand and will be retained as noted in previous sections.

The recommended management for this stand is to allow for more growing space of advanced regeneration through an intermediate treatment consisting of weeding and cleaning of this stand. Foresters use these types of treatments to guide the development of the existing cohort of trees towards the future forest. This treatment will involve the cutting and leaving in-place of smaller trees that have broken tops, excessive lean, signs of disease, *etc.* This will be done in-house by Forestry staff.

The ±3 acre wetland complex located within this stand will have no silvicultural treatments. Inventory work conducted during stand examination showed no invasive plants present at this time. Follow-up observations will be conducted annually to monitor for these plants. If discovered, they will be mechanically removed or treated with herbicides by licensed applicators.

Chipman Stand 1 (±10 acres) is white pine-oak forest type very similar to other stands found within the project and was treated in the 1980's with a firewood harvest. The species

composition by basal area is like other stands within the project with white pine and black oak being the most common tree species. Live tree basal area in this stand is approximately 110 ft^2/ac and there are approximately 180 trees per acre. The stand is moderately stocked with an estimated relative density of 65 (Chart 4, Appendix Tables 13 & 14).



The regeneration component of this stand is composed of species similar to those in other project stands and the majority is white pine and white oak (estimated at 1650 and 1200 stems per acre respectively). Also, the herbaceous layer is similar in species composition to the other stands within the project with huckleberry being the most common plant (Appendix Tables 15 & 16).

CWM is estimated at 134 cubic feet per acre and approximately 40 snags per acre. Most of the snag observations are small white pine trees that have died due to overstory shading.

The relative density of 65% shows that this stand is in a moderately stocked condition. A commercial thinning reducing relative density to approximately 40% is recommended to improve vigor of trees and allow canopy expansion of the remaining trees. Trees favored for removal would be low grade, low quality, damaged, diseased and suppressed trees of low vigor.

Evaluation of Data and Projected Results:

Objectives:

As documented in the Landscape Designations for DCR Parks and Forests: Selection Criteria and Management Guidelines document[xv], Marlborough-Sudbury State Forest is designated as a Woodland. As noted in the Management Approach for Woodlands section of that document, 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. This project will help to ensure the sustained provision of those services which Woodlands are intended to provide.

The major objectives of the Goodale-Chipman Project are:

- Remove all hazard trees along trails within project area to protect public safety.

- Use even-age forest management (shelterwood) to release advanced regeneration.
- Remove trees susceptible to disease and insect infestations.
- Thin forest stands to increase forest vigor, allow for canopy expansion, and provide food for wildlife.
- Remove invasive plant populations.
- Weed forest stands of low-quality or low-vigor advance regeneration.

Silvicultural Prescription:

Trees will be individually marked for removal (cut tree marked) using the standard DCR Management Forestry Program marking scheme. Boundaries of cutting areas will be denoted using three parallel paint lines at 45° from vertical. A strip at least 50 feet wide will denote wetland resources in which no trees will be cut; no principal skid trails (except existing forest roads) will be located within 100 feet of these features. All features will be marked with paint and identified as required by the Forest Cutting Practices Act.

All Project Stands:

The major goals for these stands are:

- Demonstrate even-aged silviculture techniques that will release and establish regeneration.
- Remove red pine trees susceptible to disease and insects.
- Remove poorly formed, less vigorous and damaged trees; giving remaining trees more growing space to allow for canopy expansion and increased diameter increment.
- Create diverse habitats that benefit native wildlife and build forest resilience to stressors by increasing vertical and horizontal structure.
- Improve forest floor and soil structure through the retention of CWM of all sizes.
- Monitor and remove invasive plants

Goodale Stand 1

This stand will be treated using the 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 which will provide diverse habitats for the benefit of wildlife species. This will be the final overstory removal cut in a 2-cut shelterwood with reserves silvicultural system in this stand.

Advance regeneration to be released

The residual basal area of the reserved trees in this stand will be between 20-40 ft^2/ac. Retained trees will be of dominant and codominant canopy positions with well-developed crowns; clustered where possible, and irregularly spaced within the stand. These overstory trees will serve as a seed bank for seedling recruitment, wildlife benefits, and legacy trees.

Post-treatment, the residual stand will consist of larger trees in the dominant and codominant canopy position and a clearly defined cohort of advanced regeneration to grow freely into the forest overstory. Increased sunlight availability will create conditions favorable for stimulation of the herbaceous layer of plants to thrive as well until canopy closure begins to shade these plants out.

Goodale Stand 2 and Chipman Stand 1

These stands will be treated using a commercial thinning. Snags, cavity trees, and wildlife trees as described in previous sections, will be retained where there is not conflict with recreational trails.

Thinning is a method of improving future growth by regulating stand density.[xvi] Thinning trees within these stands will focus on removing poor quality, low vigor, and non-native trees in both the upper (crown thinning) and lower (thinning from below) canopy positions; releasing larger diameter individuals to provide food and habitat for wildlife and also provide a seed bank for the future forest. Thinning these trees will improve their ability to

Area to be thinned-note broken tops and poorly formed trees

withstand stressors and improve the growth rates of the remaining sawtimber-quality trees.

Recommended harvest levels for these two stands are described in the table below:

Stand	Current basal area (ft^2/ac)	Current relative density (%)	Target residual basal area (ft^2/ac)	Target residual relative density (%)
Goodale Stand 2	91.6	67	60-80	40-50
Chipman Stand 1	66.9	65	50	40-50

Post-harvest this stand will appear to be more open and sunlight will penetrate to the forest floor. There will be a reduction in the relative density of this stand and the residual stand will be composed of trees in the dominant and codominant canopy positions. Follow-up treatments in 15 to 20 years should focus on regenerating the stand using an irregular shelterwood silvicultural system, if appropriate at that time.

Goodale Stand 3:

This stand will be weeded of sapling and small pole-sized trees with poor form, broken tops and other defects. Work in this stand will focus on the retention of high-quality sapling- and pole-sized pines and oaks with good form demonstrating vigorous growth.

Sale Layout and Harvesting Systems:

Access to the project area will be off White Pond and Concord Roads. The landings that will be used at both the Goodale and Chipman lots were used during previous operations (See Detail Maps 1 & 2). Principal skid trails will be laid out with flagging and paint during marking operations, avoiding wetland resources.

Commercial thin 2 year's post-harvest - Townsend State Forest

There will be no harvesting in wetlands or filter strips. Principal skid trails will be stabilized with water bars and conservation grass seed mix, as needed, at the direction of the forester in charge.

Use of a cut-to-length harvester and forwarder will be required to harvest forest products. Scarification to bare mineral soil will be encouraged throughout the project area to provide a suitable seed bed for desirable species.

Example of forwarder moving forest products to landing

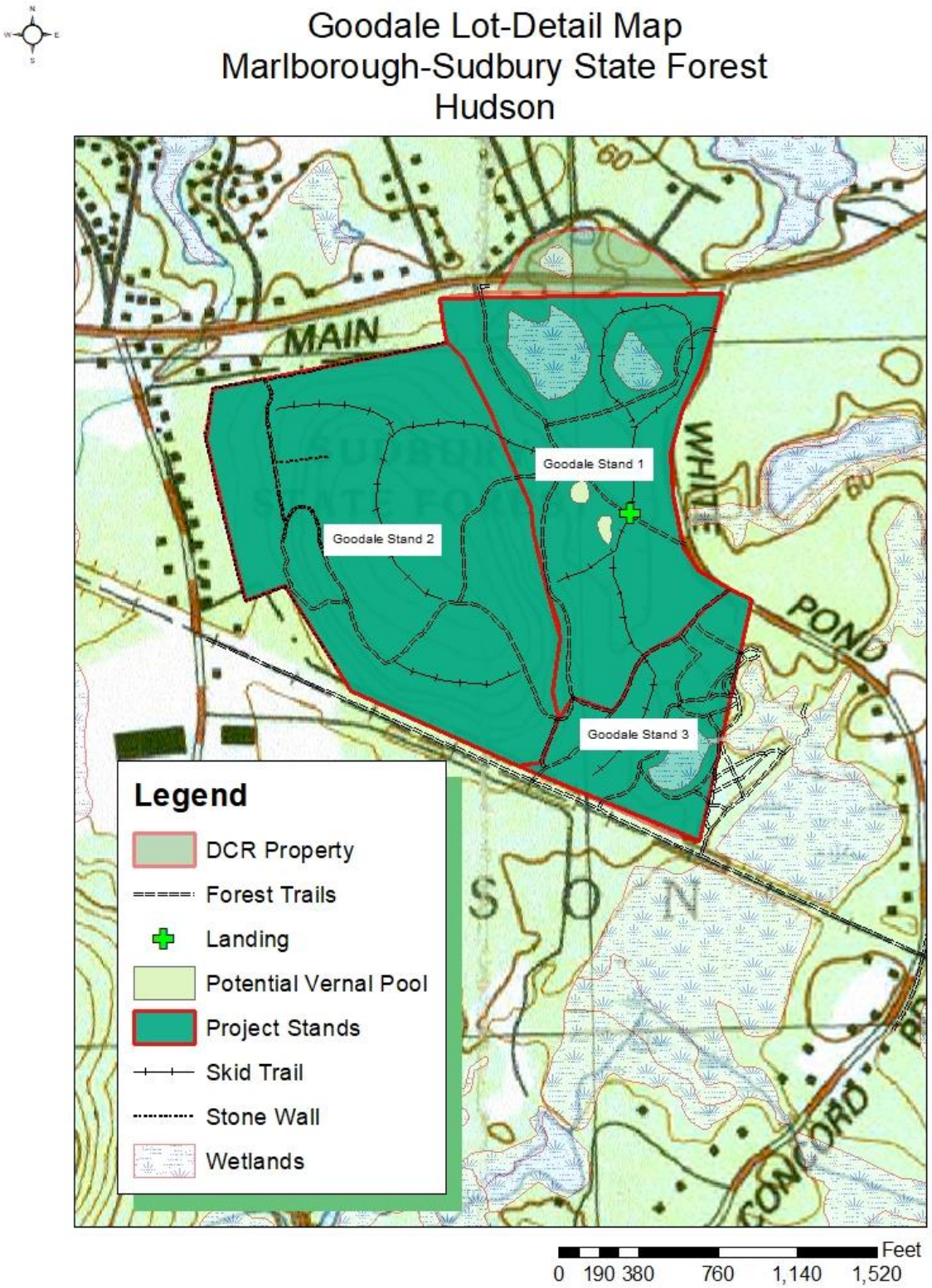
An M.G.L. Ch. 132 Forest Cutting Plan will be filed with the Massachusetts Department of Conservation and Recreation Service Forestry Division, and local Conservation Commission, prior to harvesting operations. While laying out and completing the harvest, not only will those BMPs as required by law be implemented (e.g. around wetlands and streams), the use of optional and recommended practices will be implemented where feasible and needed to offer the highest level of protection to safeguard important ecological features like potential vernal pools.

In-Kind Services:

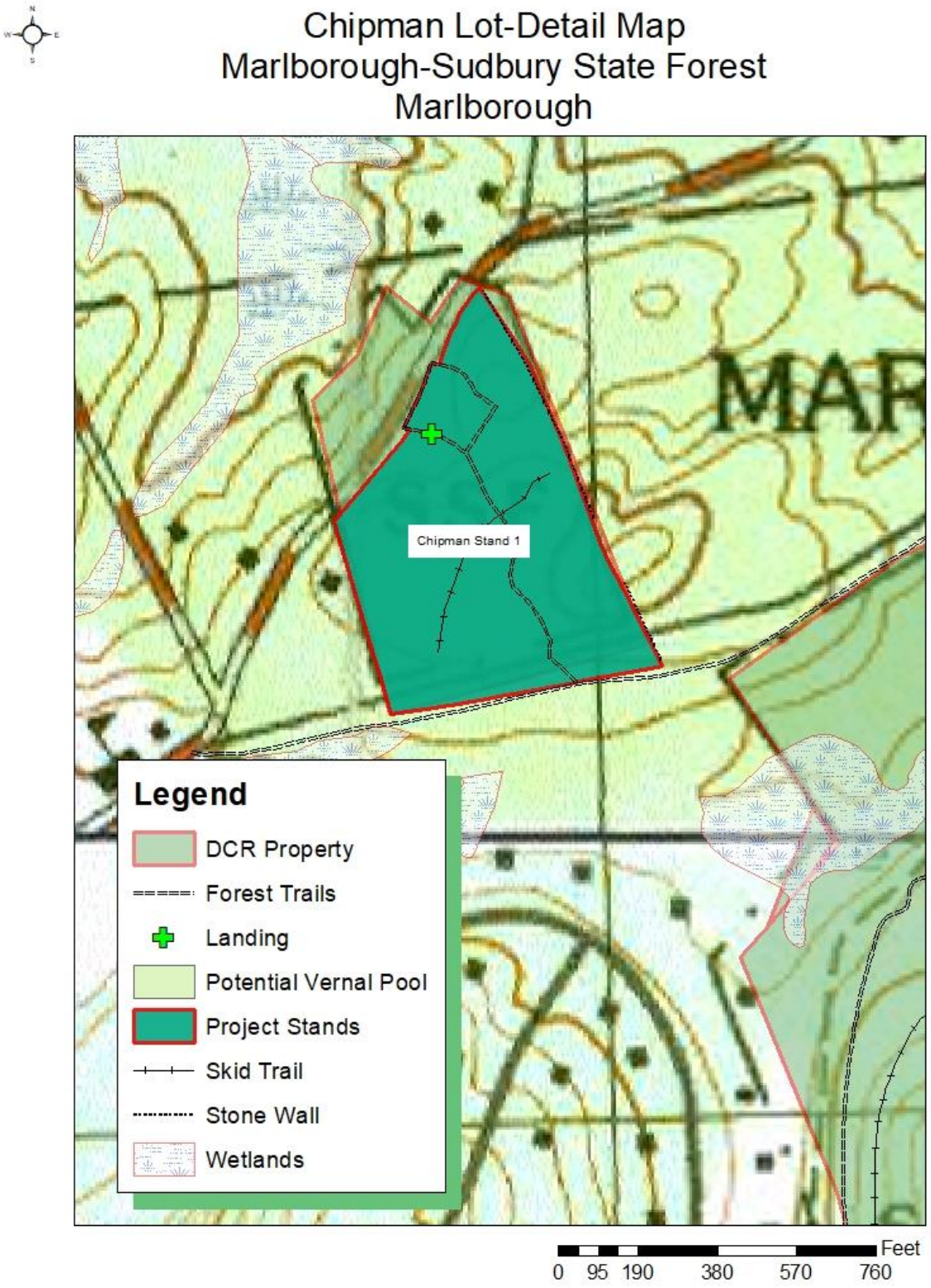
Rough grading along with typical gravel and stone installation at the entrance to the landing off White Pond Road and Concord Road are anticipated as part of this project. These improvements will be made to benefit forestry, fire control, and park operations, along with recreational users.

Appendix

Map 1:

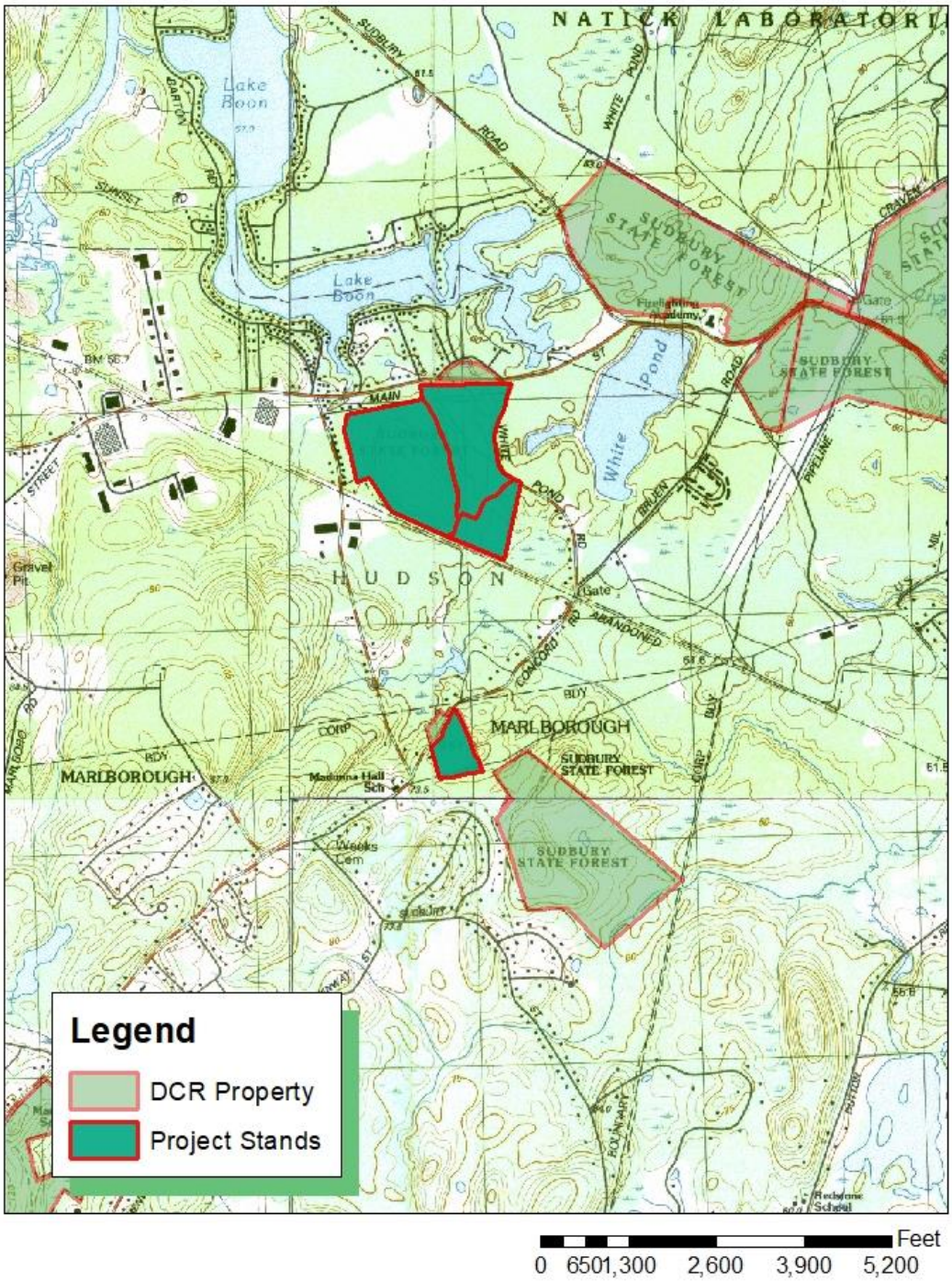


Map 2:


Chipman Lot-Detail Map
Marlborough-Sudbury State Forest
Marlborough
Chipman Stand 1
Legend
DCR Property
Forest Trails
Landing
Potential Vernal Pool
Project Stands
Skid Trail
Stone Wall
Wetlands
Feet
0 95 190 380 570 760

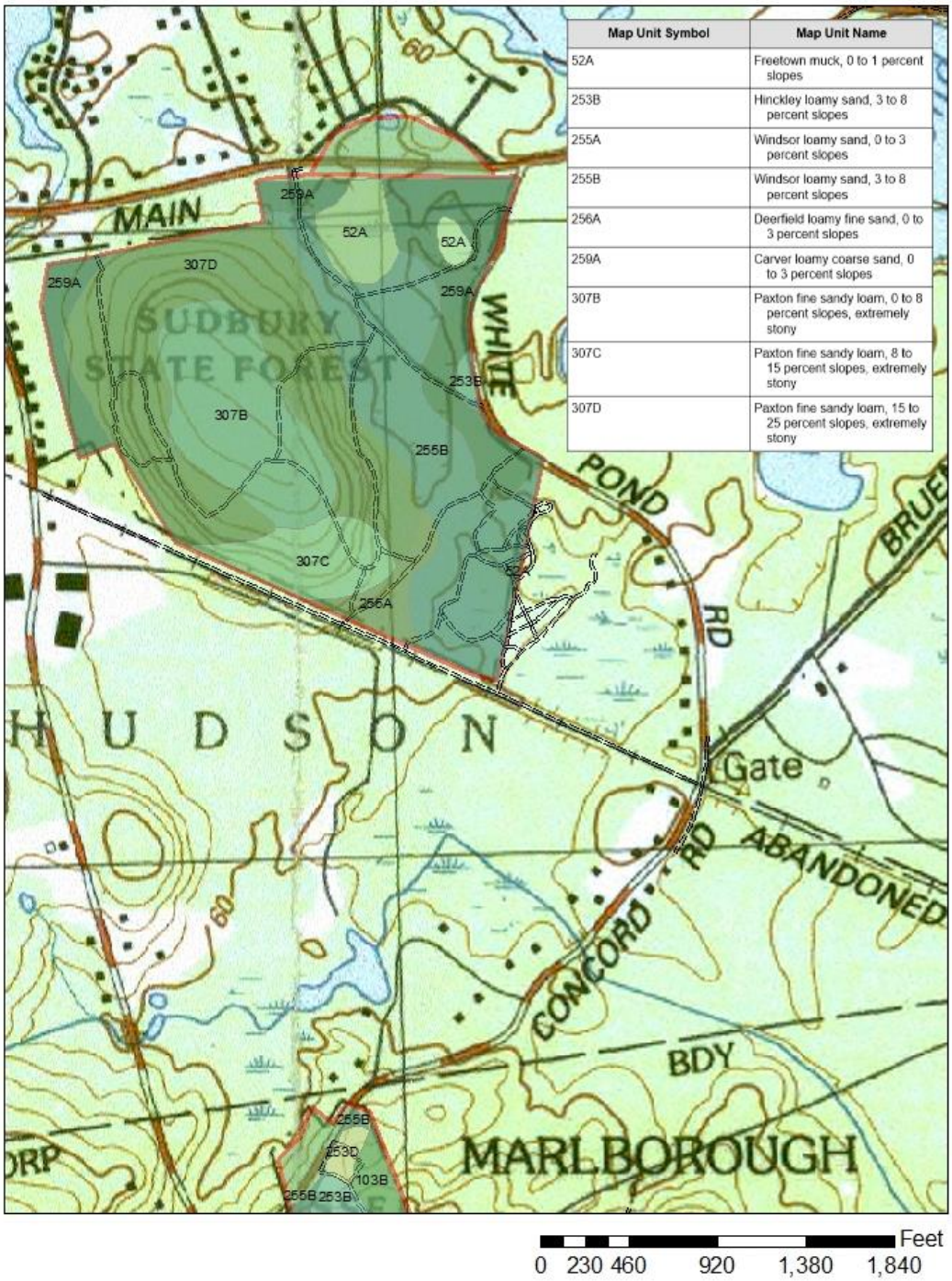
Map 3:

Goodale and Chipman Lots-Locus Map
Marlborough-Sudbury State Forest
Hudson and Marlborough



Map 4:

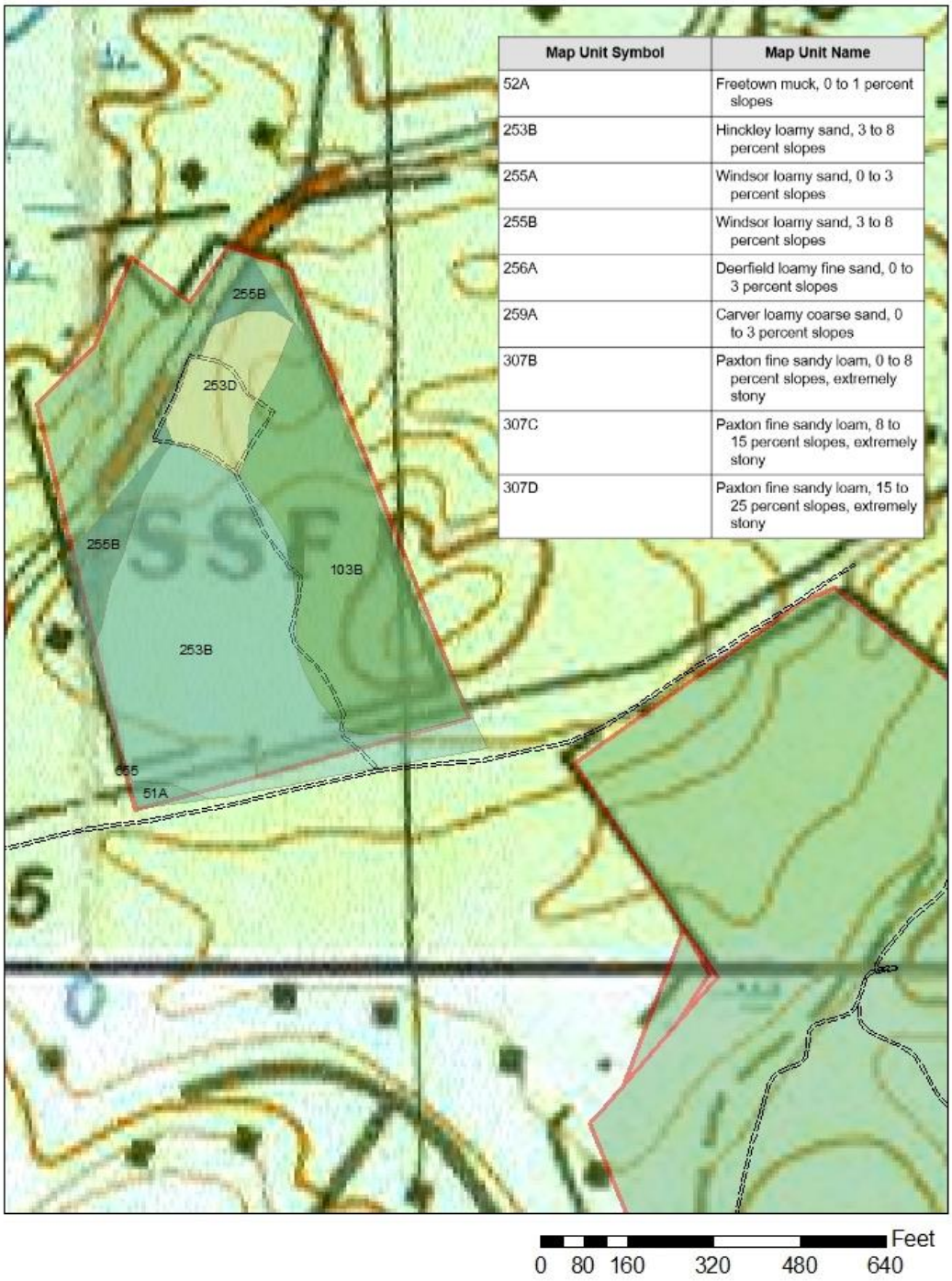
Goodale Lot-Soils Map
Marlborough-Sudbury State Forest
Hudson



Map Unit Symbol	Map Unit Name
52A	Freetown muck, 0 to 1 percent slopes
253B	Hinckley loamy sand, 3 to 8 percent slopes
255A	Windsor loamy sand, 0 to 3 percent slopes
255B	Windsor loamy sand, 3 to 8 percent slopes
256A	Deerfield loamy fine sand, 0 to 3 percent slopes
259A	Carver loamy coarse sand, 0 to 3 percent slopes
307B	Paxton fine sandy loam, 0 to 8 percent slopes, extremely stony
307C	Paxton fine sandy loam, 8 to 15 percent slopes, extremely stony
307D	Paxton fine sandy loam, 15 to 25 percent slopes, extremely stony

Map 5:

Chipman Lot-Soils Map
Marlborough-Sudbury State Forest
Marlborough



Map Unit Symbol	Map Unit Name
52A	Freetown muck, 0 to 1 percent slopes
253B	Hinckley loamy sand, 3 to 8 percent slopes
255A	Windsor loamy sand, 0 to 3 percent slopes
255B	Windsor loamy sand, 3 to 8 percent slopes
256A	Deerfield loamy fine sand, 0 to 3 percent slopes
259A	Carver loamy coarse sand, 0 to 3 percent slopes
307B	Paxton fine sandy loam, 0 to 8 percent slopes, extremely stony
307C	Paxton fine sandy loam, 8 to 15 percent slopes, extremely stony
307D	Paxton fine sandy loam, 15 to 25 percent slopes, extremely stony

(Totals of individual cells may not add up to final tally due to rounding)

Table 1			Sawtimber	Total	Total	Topwood
	Sawlog	Pulp	Mean	Bf	Cords	Cords
Species	Bf/Acre	Cords/Acre	Ht (logs)	(Stand)	(Stand)	(Stand)
Red Pine	5395.2	9.8	3.3	178041.7	324.8	16.0
Black Oak	678.8	0.7	1.6	22401.0	24.4	11.1
Eastern White Pine	2056.7	1.3	2.8	67871.6	44.3	10.4
Pitch Pine	367.4	0.4	2.0	12124.8	14.8	5.1
Northern Red Oak	285.0	0.1	1.5	9405.0	4.8	5.2
Total	**8783.2**	**12.5**		**289844.1**	**413.1**	**47.7**

Table 2			%			
	Total	Total	BA/ac			
Species	Trees/Acre	BA/Acre	by Spp	QMD	Rel Density	% AGS
Red Pine	96.4	57.5	63%	10.5	29.4	85%
Black Oak	18.4	9.4	10%	9.7	8.2	67%
Eastern White Pine	15.2	15.0	17%	13.4	5.7	83%
Pitch Pine	4.9	4.4	5%	12.9	4.7	71%
Northern Red Oak	3.4	3.1	3%	13.0	2.8	100%
Total	**138.3**	**90.6**	**99%**	**11.0**	**50.8**	**81%**
		Median Stand Diameter ->		**12.1**	**51.5**	**<<- Estimated Relative Density**

Table 3					
Species	**1**	**2**	**3**	**4**	**Total**
White Pine	3638	825	394	75	4931
Black Oak	300	0	0	0	300
White Pine	0	0	56	0	56
Red Maple	244	75	113	0	431
White Oak	188	131	75	19	413
Red Oak	131	281	56	0	469
Red Pine	0	19	0	0	19
Cherry	19	0	0	0	19
Big Tooth Aspen	56	0	0	0	56
Total	**4575**	**1331**	**694**	**94**	**6694**

Table 4	
Species	**AVG. % COVER**
Huckleberry	29.7
Lowbush Blueberry	8.1
Sheep Laurel	0.3
Grass	10.4
Lady Slipper	0.1
Ferns	1.9
Canada Mayflower	2.0
Service Berry	0.1

Table 5				Sawtimber	Total	Total	Topwood
		Sawlog	Pulp	Mean	Bf	Cords	Cords
Species	**Spp Code**	**Bf/Acre**	**Cords/Acre**	**Ht (logs)**	**(Stand)**	**(Stand)**	**(Stand)**
Black Oak	22	4751.6	3.1	1.9	247082.9	162.5	85.9
Red Maple	7	0.0	1.0		0.0	50.2	
Eastern White Pine	1	1024.3	3.9	1.6	53261.4	200.9	35.6
Northern Red Oak	16	1042.8	0.7	1.9	54227.3	34.7	18.4
White Oak	17	0.0	0.4		0.0	20.8	
American Chestnut	40	0.0	0.0		0.0	0.1	
Scarlet Oak	46	135.0		2.5	7020.6		1.1
Red Pine	2	70.6		3.0	3672.3		0.5
Total		**7024.3**	**9.0**		**365264.6**	**469.3**	**141.5**

Table 6				%			
		Total	Total	BA/ac			
Species	**Spp Code**	**Trees/Acre**	**BA/Acre**	**by Spp**	**QMD**	**Rel Density**	**% AGS**
Black Oak	22	53.8	48	52%	12.8	38.9	83%
Red Maple	7	24.3	4.8	5%	6.0	4.4	0%
Eastern White Pine	1	44.2	24	26%	10.0	9.9	43%
Northern Red Oak	16	18.2	11.2	12%	10.6	10.1	82%
White Oak	17	4.1	1.6	2%	8.5	1.4	50%
American Chestnut	40	4.1	0.4	0%	4.2	0.4	0%
Scarlet Oak	46	0.7	1.2	1%	18.1	1.0	67%
Red Pine	2	0.4	0.4	0%	13.4	0.2	100%
Total		**149.8**	**91.6**	**100%**	**10.6**	**66.4**	**67%**
		Median Stand Diameter ->>			**13.1**	**66.4**	**<<- Estimated**
							Relative
							Density

Table 7					
Species	**1**	**2**	**3**	**4**	**Total**
Black Oak	170	0	0	13	183
White Pine	1291	287	130	91	1800
White Oak	352	104	0	0	457
Red Maple	600	104	104	65	874
Black Cherry	130	13	26	0	170
Red Oak	130	39	0	0	170
American Chestnut	0	26	0	39	65
Sasafras	65	0	0	0	65
Total	**2739**	**574**	**261**	**209**	**3783**

Table 8	
Species	**AVG. % COVER**
Grass	1.5
Beaked Hazel	0.2
Ferns	1.9
Glossy Buckthorn	0.2
Low Bush Blueberry	1.0
Huckleberry	27.6
Tree-club Moss	1.0
Canada Mayflower	0.6
Teaberry	0.1

Table 9				Sawtimber	Total	Total	Topwood
		Sawlog	Pulp	Mean	Bf	Cords	Cords
Species	**Spp Code**	**Bf/Acre**	**Cords/Acre**	**Ht (logs)**	**(Stand)**	**(Stand)**	**(Stand)**
Eastern White Pine	1	6535.4		2.9	78425.1		10.8
Black Oak	22	791.1		1.5	9493.1		5.2
Total		**7326.5**	**0.5**		**87918.2**	**0.0**	**16.0**

Table 10				%			
		Total	Total	BA/ac			
Species	**Spp Code**	**Trees/Acr**	**BA/Acre**	**by Spp**	**QMD**	**Rel Density**	**% AGS**
Eastern White Pine	1	16.2	30.0	69%	18.4	10.0	100%
Black Oak	22	10.1	6.7	15%	11.0	5.5	100%
Total		**26.3**	**43.3**	**85%**	**17.4**	**15.5**	**85%**
		Median Stand Diameter ->>			**20.1**	**18.3**	**<<- Estimated**
							Relative
							Density

Table 11					
Species	**1**	**2**	**3**	**4**	**Total**
White Oak	1000	0	0	0	1000
White Pine	2600	400	200	0	3200
Red Oak	0	0	100	100	200
Black Oak	2400	0	0	0	2400
Red Maple	300	100	0	0	400
Total	**6300**	**500**	**300**	**100**	**7200**

Table 12	
Species	**AVG. % COVER**
Lowbush Blueberry	10.0
Huckleberry	10.0
Teaberry	1.7
Glossy Buckthorn	1.7
Canada Mayflower	1.7
Ferns	1.7

Table 13				Sawtimber	Total	Total	Topwood
		Sawlog	Pulp	Mean	Bf	Cords	Cords
Species	**Spp Code**	**Bf/Acre**	**Cords/Acre**	**Ht (logs)**	**(Stand)**	**(Stand)**	**(Stand)**
Eastern White Pine	1	5272.6	5.8	1.5	52726.2	57.7	38.6
Black Oak	22	2188.3	0.4	1.7	21883.1	4.2	8.9
Pitch Pine	29	0.0	1.0		0.0	10.0	
Scarlet Oak	46	277.4	0.9		2773.8	8.8	
Northern Red Oak	16	583.0		1.5	5829.9		3.2
Total		**8321.3**	**8.1**		**83212.9**	**80.7**	**50.7**

				%			
Table 14		**Total**	**Total**	**BA/ac**			
Species	**Spp Code**	**Trees/Acre**	**BA/Acre**	**by Spp**	**QMD**	**Rel Density**	**% AGS**
Eastern White Pine	1	136.0	70.0	64%	9.7	30.1	64%
Black Oak	22	18.5	20.0	18%	14.1	16.1	88%
Pitch Pine	29	10.5	5.0	5%	9.4	6.0	0%
Scarlet Oak	46	11.7	7.5	7%	10.9	6.8	33%
Northern Red Oak	16	3.3	5.0	5%	16.8	4.3	100%
Total		**179.9**	**110.0**	**98%**	**10.6**	**63.3**	**64%**
		Median Stand Diameter ->>			**11.8**	**64.8**	**<<- Estimated**
							Relative
							Density

Table 15					
Species	**1**	**2**	**3**	**4**	**Total**
White Pine	300	450	675	225	1650
Black Oak	0	0	75	0	75
White Oak	975	75	150	0	1200
Red Maple	600	0	0	0	600
Gray Birch	225	0	0	0	225
Total	**2100**	**525**	**900**	**225**	**3750**

Table 16	
Species	**AVG. % COVER**
Huckleberry	18.8
Ferns	3.8
Buckthorn	0.3
Tree-club Moss	2.5
Canada Mayflower	0.5
Lowbush Blueberry	1.3

[i] USDA, NRCS, Soil Survey of Middlesex County, 2009
[ii] USDA, Web Soil Survey, Generated 8-18-20
[iii] Goodwin, D.W. and Hill, W.N., 2012. Forest Productivity and Stand Complexity Model (A GIS Analysis using ACRGIS), Massachusetts Department of Conservation and Recreation, Amherst, MA
[iv] National Weather Service-Climate Data (Worcester), https://w2.weather.gov/climate/getclimate.php?wfo=box, generated 8-24-20
[v] Catanzaro, P., Fish, J., Kittredge, D., Massachusetts Forestry Best Management Practice Manual, 2013 Second Edition, Massachusetts Department of Conservation and Recreation
[vi] Massachusetts Division of Fisheries and Wildlife. 2015. *Massachusetts State Wildlife Action Plan 2015*. Westborough, MA.
[vii] http://maps.massgis.state.ma.us/PRI_EST_HAB/viewer.htm Reviewed 1-16-20
[viii] https://www.mass.gov/doc/eastern-box-turtle Reviewed 8-24-20
[ix] https://ag.umass.edu/fact-sheets/gypsy-moth Reviewed 8-24-20
[x] https://www.fs.usda.gov/naspf/sites/default/files/publications/cst113diplodiacorticolabotcankerpa20200205_508.pdf Reviewed 8-24-20
[xi] https://extension.unh.edu/resources/files/Resource002617_Rep3888.pdf Reviewed 8-24-20
[xii] https://extension.unh.edu/resources/files/Resource000999_Rep1148.pdf Reviewed 8-24-20
[xiii] Manual for Continuous Forest Inventory Field Procedures, Bureau of Forestry, Division of State Parks and Recreation, February 2014 Edition, Massachusetts Department of Conservation and Recreation
[xiv] NEM183F, NEM582F, NEM1384F, NEM288F,NEM694F,NEM0113TP DCR Management Forestry Archives, Lowell
[xv] Massachusetts Department of Conservation and Recreation. March 2012. Landscape Designations for DCR Parks & Forests: Selection Criteria and Management Guidelines. https://www.mass.gov/files/documents/2016/08/qq/management-guidelines.pdf. Reviewed 8-24-20.
[xvi] Wenger et. al., Forestry Handbook, Second Edition, Society of American Foresters, pp. 420-421