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

Silviculture Prescription
Stonewall Lot

Massachusetts Department of Conservation and Recreation
Bureau of Forestry

Mid State District
Oakham State Forest
Oakham, MA

Prepared by:

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INTRODUCTION

The Oakham State Forest complex is comprised of three isolated parcels (Appendix, Locus Map).

Parcel #	Approximate Acreage	Town	Local Access
1	567	Oakham	Spencer Road, East Hill Road, Flint Road
2	85	Oakham	Sanders Road
3	41	Rutland	Landlocked, East Hill Road via abutters

Parcels 1 and 2 are located in the southern portion of the town of Oakham and parcel 3 is located on the Oakham/Rutland town line in the town of Rutland. This silvicultural prescription will focus strictly on parcel 1. Currently no forest management is planned for parcels 2 and 3.

As stated in the "Landscape Designations for DCR Parks & Forests: Selection Criteria and Management Guidelines", Oakham State Forest is designated as a Woodland. This project is being conducted at this time for the following reasons:

1. The forest stands at Oakham State Forest are approaching 110 years in age and are even aged. Forest structure is uniform and consists of mature trees. There is a lack of vegetative diversity, structural complexity and resiliency to natural disturbance.
2. The plantations which remain on the property are in poor condition, have stagnated in growth and are beginning to decline.
3. Access to the proposed project area is excellent, with opportunities to improve and repair interior forest roads and provide gate installations through in-kind services.
4. The state forest has an extensive history of past forest management activities.

Project Objectives

The overall goal of this prescription is to provide a range of ecosystem services as well as demonstrate and provide educational examples of excellent forestry to landowners and the general public. More specifically, this prescription seeks to:

1. Implement uneven aged management (group selection) to enhance and promote vegetative diversity, structural complexity and forest productivity.
2. Implement even aged management (shelterwood method with reserves) to prepare an even-aged, mature mixed oak forest to regenerate a diverse mixture of native species.
3. Implement even aged management (clearcutting with reserves) to prepare even-aged plantations of non-native Norway spruce and red pine to regenerate a diverse mixture of native species.
4. Implement harvesting techniques and best management practices that protect and enhance forest productivity, soil and water resources.
5. Use in-kind services to improve the existing infrastructure at the state forest.
6. Provide an opportunity to educate the public on forest resource management.
7. Provide an opportunity to support the local forest products industry.

SITE DATA

Cultural and Historical

Oakham State Forest, named herein the Stonewall Lot, is a conglomerate of thirteen parcels of land that were purchased individually beginning in 1916, comprising approximately 567 acres located in the town of Oakham, Massachusetts (Appendix, Acquisition Map). The final three purchases were recorded in

1966. Access to this lot can be made largely from Spencer Road; however interior forest roads may also be accessed from Flint Road and East Hill Road.

Nearly half of the Stonewall Lot is comprised of reforestation lots[1]. The State Forest Commission purchased the Asa T. Jones Reforestation Lots #172 and 173 in 1921 containing approximately 127 acres (Appendix, Reforestation Lot Map #172-173). The Fullam Reforestation Lots #46 and #131 were purchased in 1916 and are approximately 121.5 acres (Appendix, Reforestation Lot Maps #46 and #131). A 1929 planting map filed at the DCR Central Region Office details the vegetative condition of these reforestation lots in 1929. It notes various plantings, weedings and cuttings that were implemented prior to 1929 by the State Forest Commission. In addition to the work done by the State Forest Commission, the Civilian Conservation Corps (CCC) camp S-55 from Spencer State Forest built truck roads, water holes and performed various forestry work at the Stonewall Lot including site preparation (cleaning, slash burning, gypsy moth treatments) for reforestation plantings and release cuttings of existing forest stock between 1933-1935 (Berg, 1999 and DCR archives).

In 1929, the Fullam Lots consisted of forest regrowth that likely occurred from agricultural abandonment in the late 1800's. This included a mixture of red maple (*Acer rubrum)*, grey birch (*Betula populifolia)*, northern red oak (*Quercus rubra)* and white oak (*Quercus alba)* species, all of which were in the 3-6" diameter size class that were described as being fair to poor quality with 60-80% crown closure. Given this description, it is estimated that these stands were approximately 15-20 years old at the time of mapping in 1929. The lots were entirely planted to eastern white pine (*Pinus strobus)*. Some areas were weeded prior to planting and smaller areas were planted with a mixture of white pine and Norway spruce (*Picea abies)*. It is indicated that some areas were planted to white pine in 1909, other areas contain no indication of a specific planting date and it is assumed that the planting was done between 1909 and 1929. The State Forest Commission conducted a release cutting on a portion of the young white pine plantation in 1929 and 1931. The CCC conducted a release cutting and tree pruning between October 1, 1934 and April 1, 1935.

As mapped in 1929, vegetative growth at the Jones Lots was younger and smaller in size compared to the Fullam Lots. It contained a mixture of white pine, eastern hemlock (*Tsuga canadensis)*, grey birch, red maple, white oak, northern red oak, aspen (*Populus spp.)*, hickory (*Carya spp.)* and ash (*Fraxinus spp.)* species in mostly the 1-3" diameter size class, with small pockets of 5" diameter sizes, of mostly poor quality with 60-80% crown closure. By this description, it can be determined that agricultural abandonment occurred on the Jones Lots later than the Fullam Lots and the growth in 1929 is estimated to be 10-15 years old at the time of mapping. The majority of the Jones Lots were planted to white pine and Norway spruce in 1915-1916. A CCC progress map from October 1, 1934 to April 1, 1935 notes that slash was cleaned (lopped, piled and burned) and girdled trees were left onsite after a release thinning conducted in 1934 on a portion of the Jones Lots.

In addition, release cuttings and gypsy moth treatments were conducted along the eastern edge of the property by the CCC between 1934 and 1935. The CCC also performed roadwork by building new truck roads and reinforcing existing roads including culvert improvements and installation as well as daylighting of roads. Fire suppression was one of the primary reasons for the infrastructure improvements implemented within these large tracts of open land. In addition to the road work

[1] The Reforestation Act of 1908 was passed by the Massachusetts Legislation "which authorized the acquisition of lands for the purpose of experiment and illustration of forest management" (Foster, 1998). Under this law, lands purchased were to be managed to produce sustainable forest growth and water quality protection.

conducted, fire ponds were constructed throughout the area to allow for emergency water access in the case of fire by engine trucks.

After the CCC camps closed, active forest management ceased until 1981. In 1981, a timber sale treated 30 acres of the Stonewall Lot, cutting 109,260 board feet of mostly red oak and black oak (*Quercus velutina)* with some white oak and white pine also being cut. Subsequently, approximately 542 cords of firewood were cut from over 182 acres of the Stonewall Lot between 1981 and 1987 including the harvesting of residual topwood from the 1981 timber sale and one home fuelwood lot in 1986. These cuts acted as a crown thinning (thinning from above or crop tree release), whereas trees with poor quality or vigor were harvested to allow trees growing with good form and vigor to continue to grow and increase in diameter size.

There are four cellar holes present on the property as well as many stonewalls that serve either as the property boundary or parcel boundaries that are now interior walls (Appendix, Harvest Map). The presence of these features is a testament to the agricultural land use history of the property. This includes land use and management for agriculture in the 18th and 19th centuries followed by agricultural abandonment and subsequent regrowth to forest in the late 19th and early 20th centuries to present day. This project was reviewed by the DCR archeologist. Per their recommendations, all cellar holes, wells, trashpits and stonewalls or other associated features will be GPS'd, photographed, flagged and protected prior to harvesting operations.

Geology and Soils

The terrain varies throughout the project area from flat and rolling to moderately sloped. Nearly 80% of the harvest area located in the upland areas is underlain by glacial till soils. The remainder is underlain by soil types that are poorly to very poorly drained. Approximately 30% of the upland soils are well drained, 49% are moderately well drained and 1.5% are somewhat excessively well drained. Harvesting operations will only take place where the soils are suitable for the use of machinery. There are six soil types that make up the upland portion of the project area with two additional soil types that underlie wetlands. The different soil types present within the project area span multiple stands. The soil descriptions and maps were derived from the USDA-NRCS Web Soil Survey (Appendix, Soils Map).

The majority of the project area is underlain by the Woodbridge-Paxton association (910C = 3-15% slopes, extremely stony). This is a moderately well drained soil (20-43 inches deep to a restrictive layer) that is comprised of coarse-loamy lodgment till derived from gneiss, granite and/or schist. It encompasses nearly 49% of the total harvest area. The next most prevalent soil is the Charlton-Chatfield association (926C = 3-15% slopes, extremely stony) which encompasses 25% of the project area. This soil type is well drained with a depth that is greater than 80 inches to a restrictive layer. Its parent material is of friable coarse-loamy eolian deposits over friable coarse-loamy basal till derived from granite and gneiss. The Charlton-Paxton association (902E = 15-45% slopes, extremely stony) underlies 4.1% of the harvest area and is previously described above. The Merrimac fine sandy loam (254B = 3-8% slopes) underlies 1.5% of the harvest area and is somewhat excessively drained. It is more than 80 inches deep to a restrictive layer and originates from glacial outwash. The Charlton-Chatfield-Hollis association (926C = 15-45% slopes, extremely stony) underlies 1% of the harvest area and is more than 80 inches deep to a restrictive layer. It originates from friable coarse-loamy eolian deposits over friable coarse-loamy basal till derived from granite and gneiss. Approximately 14% of the project area is

underlain by the Bucksport and Wonsqueak mucks (59A = 0 to 2% slopes). This soil is very deep (80 inches to a restrictive layer) and very poorly drained. It originates from herbaceous and woody plant material. Lastly, the Ridgebury-Whitman association (918B = 0-8% slopes, extremely stony) underlies 6% of the harvest area. This soil type is poorly drained and is 14-19 inches deep to a restrictive layer. It originates from friable coarse-loamy eolian deposits over dense coarse-loamy lodgment till derived from granite and gneiss. This soil type is mapped in upland and lowland portions of the project area.

Site Productivity

Regionally, glacial till soils would provide suitable conditions to grow vigorous sugar maple (*Acer saccharum)*, white ash (*Fraxinus americana*), northern red oak and hemlock. White pine is likely to be outcompeted by many hardwood species on glacial till soils. Alternatively, white pine will out-compete those hardwood species previously noted on glacial outwash soils that are droughty and more nutrient poor.

The dominance of glacial till soils in the project area leads management to favor those species that grow vigorously on the more nutrient rich, moisture bearing soils that glacial till soils provide. This is not to say that white pine will not grow on these soils, nor will they compete with hardwoods that grow well on these soil conditions. It is certainly possible that individual white pine trees can grow into the upper canopy on glacial till soils if they grow up from stand establishment with northern red oak on the same site. The Paxton fine sandy loam, Charlton-Paxton association and the Woodbridge-Paxton association have a site index of 70 for northern red oak.

The DCR Management Guidelines state that forest stands will be classed and considered for silvicultural treatments that generally fit their productivity, structural complexity (or potential thereof) and diversity. An analysis of the Stonewall Lot site history (land use; agriculture/logging) and conditions (soil types, productivity; vegetation cover) suggests that the majority of the property has a medium to low productivity and complexity. This implies that the site is suited for both even-aged management and uneven-aged management (Goodwin and Hill, 2012).

Climate

The mean annual temperature of this project area is 46.8 degrees Fahrenheit with a mean annual precipitation of 44.6 inches (NOAA, 2018). There have been no significant disturbances of the project area due to weather. The December 2008 ice storm caused minimal crown damage to overstory trees. Recent gypsy moth (*Lymantria dispar dispar*) infestations and subsequent large spread defoliation as seen in the southern and coastal portions of Massachusetts have only mildly affected the Stonewall Lot, with no mortality evident.

As is typical for New England, wind and therefore weather patterns in Massachusetts vary greatly from season to season and even day to day. It is typical in the summer and spring for winds to come from the southeast and southwest. It is common for weather patterns to come down from the north and northeast in fall and winter. These weather patterns can contain both high or low pressure systems and any form of weather historically common to New England. Weather can be a major disturbance in this area of Massachusetts. Hurricanes, wind and ice have had major impacts on this landscape in the past and will continue to do so in the future.

Hydrology and Watershed

The Stonewall Lot is located in the southeastern portion of the Chicopee River Watershed. The Chicopee River Watershed is Massachusetts largest watershed, covering nearly 720 square miles in the central portion of the state. There are wetland resources and streams on the property which flow into the Fivemile and Sevenmile Rivers, Brook Pond which drains into the Fivemile River and Browning Pond which flows into the Sevenmile River. Both the Fivemile and Sevenmile Rivers flow into the Quaboag River, approximately eight miles south of the Stonewall Lot. The Quaboag River flows into the Chicopee River, along with the Swift River and Ware River, in the village of Three Rivers (Palmer, MA).

There are nine potential vernal pools, wooded swamps, shrub swamps and intermittent streams located within the project area or on its edge. All wetlands, potential vernal pools and streams will have appropriate buffers and filter strips as indicated in the Massachusetts Forestry Best Management Practices Manual (BMPs). These buffers and filter strips will be delineated in the field prior to harvesting. This will aid in directional felling away from these resource areas. No equipment will operate in streams or wetlands except on pre-existing woods roads and trails or at designated crossings approved by a forest cutting plan. It is unknown at this time if any stream or wetland crossings will be required as a part of this project. Extensive planning efforts will reduce site impacts and avoid stream and wetland crossings at all opportunities. There are several existing culverts within the project area on the interior forest roads.

Full consideration has been given to any impacts that this particular timber harvesting operation will have within the Chicopee River Watershed. Appropriate measure will be taken in order to mitigate and prevent erosion (i.e. water bars, seeding, slashing of skid roads, etc.). Slash will be left on site not only to provide nutrients to the soil and for habitat purposes, but to also slow overland flow of water and to promote percolation of water into the soil.

Wildlife

A review of the Natural Heritage and Endangered Species Program (NHESP) atlas shows that there are no habitat restrictions located within the project area. NHESP will review the project prior to any harvesting to determine if any limitations or modifications will be required. There are signs of deer and turkey using this area. Deer browse is not problematic for the regeneration at this time. Pileated woodpecker sign was observed in the project area. Large and small mammals and numerous bird species are assumed to utilize the project area. As outlined in the DCR Management Guidelines (Commonwealth of Massachusetts, 2012), selected large trees will be reserved as wildlife trees for future snag and den trees. Snags, dead trees and coarse woody debris will be retained for habitat as well. A minimum of two cords of coarse woody debris (256 cubic feet) will be maintained per acre. Browse for wildlife will be enhanced during the harvest and for many years after the harvest as regeneration becomes established. Mast and fruit producing trees such as hickory, oak and black cherry (*Prunus serotina*) will be retained whenever possible. There are very few American beech (*Fagus grandifolia)* trees on the property. They will be retained as long as they are not severely affected by beech bark disease. As mentioned previously, there are nine potential vernal pools located on the property. All potential vernal pools will be treated as certified vernal pools.

The oak acorn is the most important hard mast producer in New England because of its high caloric content needed by many species of wildlife and insects. They produce much more hard mast per acre compared to American beech which is the second most important hard mast producing species in New

England (Leak et al, 2017). Species that forage on acorns include blue jays, fisher, gray fox, white tailed deer, meadow vole, squirrels, chipmunks, wild turkey, white footed mouse and black bear. Oak species make up approximately 45% of all growing stock volume in the Eastern United States (Dey, 2014). Decline in the successful ability to regenerate oak species could negatively impact wildlife species significantly. Every effort will be made from an ecological standpoint to regenerate a diverse mix of oak species at the Stonewall Lot.

Recreation

All aesthetic considerations will be made to legal recreational users of the state forest. Slash will be disposed of according to BMP's. Larger trees along the edges of trails will be retained. As mentioned in the DCR Management Guidelines for roads and trails, hazard trees will be harvested along the truck roads, skid trails and hiking trails (Commonwealth of Massachusetts, 2012). Directional felling to protect residual trees, wetlands, woods roads and trails will also be implemented. Removal of potentially hazardous trees to aid in public safety will be implemented.

There are many passive recreational uses of the Stonewall Lot. Hiking, mountain biking, cross country skiing, snowshoeing, hunting, equestrian use, and permitted snowmobiling are potential uses of this state forest. The interior forest roads are permitted snowmobile trails and are maintained by the Coldbrook Snowmobile Club. Many of these roads will be utilized as main truck/access roads or skid trails. Active harvesting operations will be planned to minimize impacts to recreational users as much as possible. The project area will be closed to the public during active logging hours for safety reasons.

Single use mountain bike trail construction is being planned for many portions of the Stonewall Lot. After several meetings with the New England Mountain Bike Association, it has been agreed upon that the standard trail buffers that are outlined in DCR's Management Guidelines for Woodlands (Commonwealth of Massachusetts, 2012) will not be applied to these newly constructed mountain bike trails.

Current Vegetation

The Stonewall Lot consists of four forest stand types. Stand 1 is 417 acres of mixed oak, stand 2 is 47 acres of white pine-oak, stand 3 is a 3 acre red pine plantation and stand 4 is a 4 acre mixed softwood plantation (Appendix, Harvest Map). The most common overstory species is northern red oak, black oak, white oak and white pine. Other associated species include Norway spruce, red maple, shagbark hickory (*Carya ovata)* and white ash, among others.

The Stonewall Lot is largely dominated by a mixture of mature oak trees (Stand 1). This includes northern red oak, black oak, scarlet oak (*Quercus coccinea)* and white oak. White pine, hemlock and mixed hardwoods including red maple, hickory and white ash are also present (Stand 2). Norway spruce and red pine (*Pinus resinosa*) occur as a result of plantings (Stands 3 and 4). Small white pine plantations also occur on the property, but due to the competition from naturally seeded hardwoods, these plantations are less prominent throughout the project area. Forest age is generally between 100-110 years old; 110 being the oldest practical estimate given the records previously described. It is hard to appropriately age the forest without using generalities because the Commonwealth pieced the greater state forest together over time by acquiring several parcels of land that each has their own unique land use histories.

There are many noticeable differences between the forest types that were mapped over most of Stonewall Lot in 1929 compared to what is present today. The majority of the white pine that was planted and tended to in the early part of the current forest's establishment does not occur in the present forest today. Instead, mature oak is dominant. There are many theories as to why the white pine fell out of the main canopy. One being that due to the presence of glacial till soils, white pine was outcompeted by hardwood species, notably northern red oak, which is more suited to these growing conditions. Another idea is that there is a large quantity of American chestnut (*Castanea dentata)* stump sprouts in the understory throughout the property. It is likely that the American chestnut was a dominant species on this property before the chestnut blight (*Cryphonectria parasitica)* caused mass mortality in the early 20th century. Chestnut loss likely provided the opportunity for oak to become established in its absence on the property.

Lastly, it is important to keep in mind the diverse agricultural practices that occurred in the region and the function that farm abandonment had on the development of today's forests. Farms were not always abandoned abruptly. In some cases, farms were scaled back and slowly discontinued over time. It is possible that the former homesteads of the Stonewall Lot had developed savannah like livestock grazing in their later agricultural tenancy of the landscape. These grazing woodlots would likely have been grazed and cut over aggressively and even periodically burned whether intentionally or not. Established and competitive young oak stems, notably red oak, respond well to top killing events. They will prolifically re-sprout when top killed, creating a competitive advantage over other hardwood species and most conifers.

It is concluded that the soil conditions and therefore site productivity of the Stonewall Lot, combined with past land use, specifically farming practices combined with the effects of fire and the loss of the chestnut, could have created the current forest condition that is found at the Stonewall Lot today, predominantly throughout the mixed oak stand (stand 1).

The red pine plantation, although small, is mature, fully stocked and has stagnated in growth. These stand conditions often bring about a higher susceptibility of disease and infestation. Red pine scale (*Matsucoccus matsumarae)* and diplodia tip blight (*Sphaeropsis sapinea)* often infest and infect declining stands of red pine and is capable of causing mortality within one growing season. Red pine plantations have faced rapid decline and mortality throughout the region as a result of stagnated growing conditions and the two previously listed biological agents. Diplodia tip blight is present in the red pine plantation and as a result has left this stand in a state of decline with mortality present throughout.

Caliciopsis canker (*Caliciopsis pinea*) is present in scattered occurrences at the Stonewall Lot. This native fungus causes wounds on the thin bark of white pine trees, causing excessive pitching on the bole of the tree. While mortality is low region wide from this canker, it does have the potential to lessen the vigor of the infected tree and can reduce the merchantability of the tree for wood products.

STAND DATA

Stand Descriptions

Stand 1 – Mixed Oak

Stand 1 is a 417 acre mixed oak stand located in five separate locations throughout the harvest area (Appendix, Harvest Map). The dominant overstory species is red oak. Black oak, white oak and white

pine also occur in the overstory in lesser amounts (Appendix, Table 1). This stand is approximately 110 years old. Using the northern red oak stocking guide for New Hampshire (Leak et al, 2017), stand 1 is at the A line (overstocked), with 110.6 square feet of basal area per acre, 121.7 trees per acre and a relative density of 91%. The quadratic mean diameter is 12.9 inches (Appendix, Table 1).

Stand 1 underwent several treatments since establishment, most of which have been previously described. Portions of this stand were former reforestation lots, planted to a mixture of conifers. These plantations largely failed. A section of this stand in the southern portion of the property still contains Norway spruce in the understory as a result of being overtopped by what makes up the mature overstory of native hardwoods. The overstory consists of mostly co-dominant trees with intermittent dominant red oak or white pine trees present.

Regeneration occurs in the understory throughout the majority of the stand. Red oak, white pine and red maple seedlings are the most dominant regeneration species present. Additionally, red maple and white pine are present in the suppressed and intermediate crown classes as saplings and poletimber (Appendix, Table 2). Beaked hazelnut (*Corylus cornuta*), black huckleberry (*Gaylussacia baccata*), lowbush blueberry (*Vaccinium angustifolium*), wintergreen (*Gaultheria procumbens*), witch hazel (*Hamamelis virginiana*) and a diversity of fern species are the most common ground and understory shrub species present (Appendix, Table 3).

There are 8.3 snags per acre inventoried in this stand (Appendix, Table 4). There is an estimated volume of 273 ft^3 per acre of coarse woody debris in the stand. Overall tree health is good. Gypsy moth defoliations have been mild in the most recent outbreak, with no mortality evident in the stand. Deer browse is minimal at this time. Witch hazel is very dense and tall in some portions of this stand. This could be an indication that deer browse was more severe at some point in the past, whereas deer prefer not to browse on witch hazel because of the astringent compounds contained in the vegetation.

<u>Stand 2 – White Pine-Oak</u>

Stand 2 is a 47 acre white pine-oak stand that is located in three separate locations throughout the harvest area (see Harvest Map). Most of the overstory white pine in this stand is a result of plantings. The dominant overstory species is white pine. Red oak, red maple, hemlock, white oak and black oak also occur. This stand is roughly 100-110 years old. The basal area is 125.5 square feet per acre with 103.7 stems per acre. The quadratic mean diameter is 14.9 inches and the estimated relative density is 69% (Appendix, Table 5). As with stand 1, portions of stand 2 have undergone past forest management as described above. The overstory white pine is healthy at this time. Caliciopsis canker is present in portions of the stand. The basal area is low, 40-60 square feet per acre in portions of the stand on the west side of Spencer Road from past forest management. Regeneration in this area is prolific and is in the stem exclusion phase of stand development. It is in this area that caliciopsis canker was observed. Increased air flow and sunlight will be encouraged in the next harvesting operation to mitigate fungus spread.

White pine, red oak and red maple seedlings and saplings make up the majority of the regeneration in the understory. The white pine and red oak regeneration are at a size and density whereas the stems are considered established and competitive (Lancaster and Leak, 1978 & Leak et al, 2017). American chestnut, black birch (*Betula lenta*), hemlock, and white ash are also present in lesser amounts (Appendix, Table 6). Ground species present in this stand are associated with upland forest ecosystems and include wintergreen, black huckleberry, lowbush blueberry, Lycopodium species and a diverse mixture of ferns (Appendix, Table 7).

There are 2.9 snags per acre in this stand. Each snag measured was less than 15 inches dbh (Appendix, Table 8). There is an estimated 216.5 ft³ of coarse woody debris. Overall tree health is good. Caliciopsis canker is not widespread. White pine needlecast is not problematic on this property at this time, nor is the hemlock woolly adelgid (*Adelges tsugae*) or elongate hemlock scale (*Fiorinia externa*).

Stand 3 – Red Pine Plantation

Stand 3 is a 3 acre red pine plantation located in the eastern portion of the property (Appendix, Harvest Map). The dominant overstory species is red pine. White pine also occurs in the overstory in lesser amounts (Appendix, Table 9). This stand is roughly 80-85 years old. Using the red pine stocking chart (Benzie, 1977), this plantation is overstocked with 260 square feet of basal area per acre, 319.3 trees per acre and a relative density of 123%. The quadratic mean diameter is 12.2 inches (Appendix, Table 9). This stand has never been treated. Mortality is present throughout from the effects of stand stagnation and diplodia tip blight. The overstory is very uniform and consists of co-dominant trees.

Regeneration occurs in the understory throughout most of the stand. Areas that have died or blown over have the highest density of growth. Red oak, red maple and hickory seedlings and saplings are the most dominant species in the understory (Appendix, Table 10). Ground species present in this stand include mostly Canada mayflower (*Maianthemum canadense*) and starflower (*Trientalis borealis*), among others (Appendix, Table 11). There are 18.3 snags per acre inventoried in this stand (Appendix, Table 12). All of the measured snags were under 12" dbh. There is an estimated volume of 1,791 ft³ per acre of coarse woody debris in the stand as a result of red pine mortality in the past several years. This stand has been failing for nearly a decade and at this time poses a safety risk to the public.

Stand 4 – Softwood Plantation

Stand 4 is a 4 acre softwood plantation located in the northern portion of the property (see Harvest Map). Dominant overstory species include white pine, red pine, Norway spruce, white ash and red oak (Appendix, Table 13). This stand is roughly 80-85 years old. The basal area is calculated at 110 square feet per acre. There are 64 trees per acre with a relative density of 59%. The quadratic mean diameter is 17.8 inches (Appendix, Table 13). This stand has never been treated. There are very large individual stems of Norway spruce and red pine trees in this plantation. Hardwood species, mostly red oak, white ash, red maple and aspen, have reached into the co-dominant and dominant crown classes. There is a component of smaller diameter spruce in the intermediate and suppressed crown classes underneath an overstory of mixed conifers and hardwoods. This plantation is essentially surrounded by stonewalls. The ground is virtually stone free and there is earth mounding on the uphill side of the each north-south running stonewall on the edge of the stand, which is an indicator that this area was tilled and planted prior to state acquisition.

Regeneration occurs in the understory throughout most of the stand, particularly in areas where groups of plantation trees have fallen out of the upper canopy over time. Areas that have died or blown over have the highest density of growth. Red oak, red maple, white ash and aspen seedlings and saplings are the most dominant species in the understory (Appendix, Table 14). Ground species present in this stand include Canada mayflower and wild sarsaparilla (*Aralia nudicaulis*), among others (Appendix, Table 15). There are 8.8 snags per acre inventoried in this stand (Appendix, Table 16). There is an estimated volume of 425 ft³ per acre of coarse woody debris in the stand. Norway spruce and red pine have been dying out of this stand for several years.

EVALUATION OF DATA AND PROJECTED RESULTS

Silvicultural Prescription and Desired Results

Stand 1 – Mixed Oak

Stand 1 will undergo the first stage of a two-stage even aged shelterwood (with reserves) regeneration system. The purpose of this cutting is to uniformly thin the overstory so that more light can permeate to the understory and ground layers to partially release advanced regeneration as well as establish new regeneration. Maintaining the right amount of shade from the overstory is essential to the survival of germinating and existing seedlings, particularly for red oak which is mid shade tolerant. Desirable advanced regeneration will be protected where present.

To help guide the management decisions in this stand, reference was made to the "*Ecology and Management of Northern Red Oak in New England*" published by UNH Cooperative Extension (Leak et al, 2017). There is currently a diverse amount of tree species in the understory as advanced regeneration. However the majority of those stems are under 4.5 feet tall and are comprised mostly of oak seedlings. These oak seedlings are the result of a large acorn crop from the fall of 2015. It is likely that a large component of these oak seedlings will not grow large enough to be considered established and competitive. For an oak seedling to be considered established, the root collar should be ¼" diameter and to be considered competitive, the root collar should be ¾" diameter (Leak et al, 2017). Since there is a significant amount of regeneration in the smaller size classes, the regeneration approach will be to thin the overstory using a uniform shelterwood method to bring the basal area down from 110.6 square feet of basal area to 80 square feet per acre on average.

This treatment will encourage the best formed, most vigorous trees to remain in the overstory. If possible, residual trees should be released on all 4 sides and should be as uniformly spaced as possible. Thinning should encourage seed bearing oak trees (between 20-22" DBH) whenever possible. Red oak should be favored, as well as stems of other native tree species that are well formed and vigorously growing to maintain a maximum amount of species diversity within the stand. Thought should be given in this treatment as to which trees would be best utilized as legacy reserve trees from this current stand as a new stand is being regenerated. The reserve trees should include a mixture of diverse native species that are large in diameter or are capable of growing larger in diameter.

The short term desired future condition is to increase the amount of light to the understory to partially release advanced regeneration, provide an opportunity for new regeneration to become established and to begin the process of removing the overstory. Greater vertical complexity and species diversity will be attained through this thinning by encouraging the growth of healthy native tree and shrub species in the understory.

Thinning along interior roadways and recreational trails will also be implemented for user safety. Interior forest roads will be brushed back, approximately 15 feet on either side for maintenance purposes. Per the DCR Management Guidelines (Commonwealth of Massachusetts, 2012), 1-3 live, large diameter (>18" dbh) trees per acre and 4 live, 12" to 18" dbh trees per acre will be retained for future snag and den trees for wildlife.

Stand 2 – White Pine-Oak

Stand 2 will be treated with the uneven aged group selection method. In this entry, approximately one half of the acreage in this stand will be regenerated with openings, of varied sizes, not to exceed 1 acre. The main objective of this treatment is to release the pine and oak advanced regeneration and establish

regeneration where it is absence, by removing the overstory in segments while reserving legacy trees in the main overstory. Therefore this treatment will aim to release areas of competitive advanced regeneration in this entry, followed similarly by one future entry which will establish regeneration to achieve at least three age classes. By using this uneven aged regeneration approach, stand structure can become diversified along with greater species diversity. Thinning between gaps should be limited to skid trails. Portions of the original overstory will be reserved in each gap in this entry and in future entries for structure and wildlife benefits.

By applying group selection, the forester will be able to implement group openings in locations that are that are variable in size and which will therefore aim to regenerate a broad mixture of species that prefer varying levels of light to grow. The size of the group opening to be cut is generally determined by the species desired to regenerate the site (Lamson & Leak, 2000). For example, small openings (1/10 acre and less) and light thinnings favor shade tolerant tree species such as sugar maple and hemlock. Larger openings and heavier thinnings favor shade intolerant species such as cherry, poplar and birch tree species. Opening sizes between 1/4 to 2/3 acre will regenerate a mixture of shade tolerant, shade intolerant and partially shade tolerant species (oak, white pine, red maple) (Lamson & Leak, 2000). Therefore, applying a mixture of group selection openings will create more of an opportunity to achieve a greater level of species diversity within the stand.

Group selection mimics small scale natural disturbances that occur more frequently in natural forest stands than large scale disturbances such as the Great Hurricane of 1938. Laying the groups out in the field will focus on access and slope as well as potential impacts to water resources, aesthetic buffers and recreational impacts, among others. As mentioned above, group openings will be implemented in areas that benefit advanced regeneration or expand on previous natural disturbances or past management practices.

Thinning along interior roadways and recreational trails will also be implemented for user safety. Interior forest roads will be brushed back, approximately 15 feet on either side for maintenance purposes. Per the DCR Management Guidelines (Commonwealth of Massachusetts, 2012), 1-3 live, large diameter (>18" dbh) trees per acre and 4 live, 12" to 18" dbh trees per acre will be retained for future snag and den trees for wildlife.

<u>Stand 3 (Red Pine Plantation) and Stand 4 (Softwood Plantation)</u>
Stands 3 and 4 will undergo the even aged regeneration method of clearcutting with reserves. This treatment will provide an early successful forest condition on the property that has not existed here since farm abandonment and subsequent plantings over 100 years ago. The main objective of this treatment is to remove the non-native plantations from the property while simultaneously providing early successional habitat conditions for wildlife species that require this condition to fulfill a part of their life cycle. The forests of Massachusetts are largely made up of mostly older trees, whereas forests that are under 30 years old make up a small percentage of our landscape (Massachusetts Audubon Society, 2016). Many species of migratory song birds that nest in Massachusetts seek the habitat condition that is created when this management approach is applied on the landscape.

Per the DCR Management Guidelines (Commonwealth of Massachusetts, 2012), 1-3 live, large diameter (>18" dbh) trees per acre and 4 live, 12" to 18" dbh trees per acre will be retained for future snag and den trees for wildlife. They will also serve as reserve legacy trees. Reserve trees will mostly be clustered within each clearcut for structural support. Interior forest roads will be brushed back, approximately 15 feet on either side for maintenance purposes.

EXPECTED RESULTS

Stand 1 – Mixed Oak

Immediately after the harvest, several conditions in the stand will have changed. There will be an obvious increase in the amount of growing space in the stand. The basal area and relative density will be lower. This will allow for more growing space for overstory trees which were retained, additional growing space and increased light availability for any regeneration which will become established in the understory and for advanced regeneration that is already present. Diameter size of the residual trees will slowly begin to increase throughout the stand. This first regeneration cut will likely have increased acorn production per acre allowing ample seed to be spread throughout the forest (Leak et al, 2017).

In 5-10 years after treatment, the site should be reviewed for the next entry. Another treatment should be applied as long as there are 200 stems of established and competitive advanced oak regeneration (3/4" basal diameter, 4 feet tall). If regeneration is not adequate, another shelterwood harvest should be conducted after a good acorn crop in the fall whereas the acorns can be driven in the ground by logging equipment and any advanced regeneration of oak can be crushed so that it may vigorously re-sprout (Leak et al, 2017).

Once regeneration is deemed adequate, an overstory removal may be applied to the stand, reserving a portion of the overstory trees for legacy, structure and wildlife benefits.

Stand 2 – White Pine-Oak

After the harvest, there will be many group openings scattered throughout stand 2. They will begin to regenerate a mixture of native tree and shrub species depending on group opening size and aspect relative to increased light exposure. Smaller group openings will provide the light requirements for the growth of more shade tolerant species such as hemlock and sugar maple. Larger openings, closer to one acre in size will favor the growth of shade intolerant species such as cherry, poplar and birch. Medium sized group openings will provide the light requirements for a mixture of shade intolerant, shade tolerant and partially shade tolerant species (white pine, oak, red maple). Advanced regeneration will have been either fully released if within an opening, or partially released on the perimeter of openings with increased diffuse light. In areas with little to no advanced regeneration, the openings will provide increased sunlight for species to become established.

Approximately 15 years after treatment, it is anticipated that another treatment would be scheduled. The goal will be to finish regenerating stand 2 by using group selection. This treatment would mimic the first treatment with another set of group openings being harvested in stand 2. The group openings in the second treatment will work to expand upon the group openings cut in the first treatment. By this time, the original group openings that were cut should have adequate established advanced regeneration. Saplings and poletimber will likely make up the majority of the advanced regeneration present in the openings. Species diversity and vertical complexity will have been enhanced from the original, pre-harvest condition of stand 2.

Stand 3 - Red Pine Plantation & Stand 4 - Softwood Plantation

As a result of this treatment, these stands will have been entirely flooded with light. The site will first be regenerated by a thick mat of Rubus species, including raspberry and blackberry species as well as many other herbaceous plants and shrubs. This will make way for shade intolerant species to become established and overtop the herbaceous layer in just a few years. Species present may include, pin

cherry *(Prunus pensylvanica*), black cherry, gray birch, white birch (*Betula papyrifera*) and aspen. In many decades, these shade intolerant trees will fall from the main canopy allowing growing space for moderately shade tolerant tree species such as red oak, red maple, black birch (*Betula lenta)*, yellow birch (*Betula alleghaniensis)* and white pine to make a competitive run for the upper canopy. The shade tolerant hemlock, sugar maple and American beech (*Fagus grandifolia)* will remain in the understory until a disturbance event occurs which gives individual trees the opportunity to grow into the upper canopy.

It may be possible during the first 30-40 years to perform a pre-commercial or commercial treatment in these stands. These treatments could be evaluated for applicability in conjunction with other treatments on the property periodically.

Timber Harvest Schedule

This silvicultural prescription will be implemented over the course of two separate timber sales. The first sale will encompass the northern half of the property, including the land area to the north and west of East Hill Road and the northern section of the property that is on the west side of Spencer Road. Stand 3 will also be harvested. The second timber sale will focus on the remainder of the property and will be harvested separately (Appendix, Timber Sale Schedule Map).

Logging System Requirements

These harvests will be completed using a either a cut to length logging system or a chainsaw with a forwarder. Use of a cut to length system or a chainsaw will allow for increased levels of slash and woody material to be left on site, effectively replenishing nutrients to the forest soil, providing cover and habitat for wildlife and mitigating erosion by slowing the overland flow of water. The residual slash can also work to protect young regeneration from browsing damage.

As previously stated, the minimum goal for downed woody debris to be left on site is 256 ft^3 per acre as directed by current DCR Management Guidelines (Commonwealth of Massachusetts, 2012). Stand 2 is the only stand that is currently below this threshold with approximately 216.5 ft^3 per acre. Maintaining residual slash in this stand from harvesting operations will likely meet the requirements without any further action being required.

Access to the lot for removal of wood products is available from Spencer Road, Flint Road and East Hill Road.

Marking Guidelines
General

1.) Skid roads will be flagged and delineated clearly with paint.
2.) Triple striping with paint will indicate the timber harvest edge, property boundaries, wetland buffer edges, vernal pool buffer edges, filter strip edges on streams and any other areas which machinery should not travel beyond. All trees marked with triple striping are not to be harvested.
3.) Triple striping may be used to protect pockets of advanced regeneration where appropriate.
4.) Trees which exhibit excellent form, regardless of species and size class will be retained to encourage species diversity.
5.) Trees targeted for removal will be poor in health and vigor, have obvious defects such as crook, sweep, excessive limbiness, decay, epicormic branching and multiple leaders or are suppressed.
6.) Sawtimber trees will be marked with a horizontal strip that wraps 360 degrees around the tree's bole at breast height.
7.) Cordwood and pulpwood trees will be marked at breast height by a vertical slash that is visible on all sides of the tree to be removed.
8.) 1-3 live, large diameter (>18" dbh) trees per acre and 4 live, 12" to 18" dbh trees per acre will be retained for future snag and den trees for wildlife.
9.) Thinning along skid trails will be implemented. The extent of thinning should not be further than what a cut to length harvester can reach for on the skid trail, or 20 feet from the edge of the skid trail, whichever is shorter.
10.) Brushing back of all interior forest roads will be implemented, 15 feet on each side of the road.

Stand 1 – Mixed Oak

1.) A cut tree marking system using blue paint will be implemented.
2.) This stand will be thinned from a basal area of 110.6 ft square feet of basal area per acre to an average basal area of approximately 80 square feet per acre. Effort will be made to maintain an even spacing.
3.) Trees to be released and retained should be those that are in the dominant and co-dominant size class that exhibit large and healthy crowns and are wind firm. A diverse mix of native species should be released and retained. Oak species should be favored, followed by white pine and other healthy native species.
4.) All red maple and beech regeneration, down to 1" dbh should be cut within the entire stand area.

Stand 2 – White Pine-Oak

1.) Group selection will be implemented using a cut tree marking system using blue paint.
2.) Group openings will not exceed one acre in size. Group opening shape will be irregular and benefit the establishment of advanced regeneration.
3.) The perimeter of the openings will be delineated with two horizontal strips using red paint. The group number will be written along the perimeter in several locations. All trees that are double striped will not be harvested unless they are marked additionally with blue paint.
4.) Reserve trees will be marked within the group openings with a single horizontal strip around the tree bole in white paint. A large "L" may be marked on the tree if necessary (white paint). There should be a diverse arrangement of reserve trees between each respective group opening. Generally, in smaller openings (less than 0.5 acres), if reserve trees are grouped they

should be placed along the opening's edge. In larger openings, reserve trees can be either grouped or scattered, and should be inconsistent from gap to gap. If reserve trees are grouped, they can be placed in sensitive areas, such as areas containing desirable advanced regeneration.

Stand 3 - Red Pine Plantation

1.) A cut tree marking system will be implemented using blue paint.
2.) Reserve trees will be marked within the clearcut with a single horizontal strip around the tree bole in white paint. A large "L" may be marked on the tree if necessary (white paint).
3.) Reserve trees will be grouped. Placement of the reserve trees within the clearcut should be away from striking distance of the main interior forest road that bisects the plantation.
4.) If possible, reserve trees should be native species (white pine, red oak). Particular attention to reserving mature aspen should be made, specifically for yellow bellied sapsucker feeding opportunities.

Stand 4 - Softwood Plantation

1.) A cut tree marking system will be implemented using blue paint.
2.) Reserve trees will be marked within the clearcut with a single horizontal strip around the tree bole in white paint. A large "L" may be marked on the tree if necessary (white paint).
3.) Reserve trees will be grouped. Placement of the reserve trees within the clearcut should be away from striking distance of the main interior forest road on the southern edge of the plantation.
4.) Reserve trees should be native species as well as larger diameter Norway spruce with the healthiest crowns.

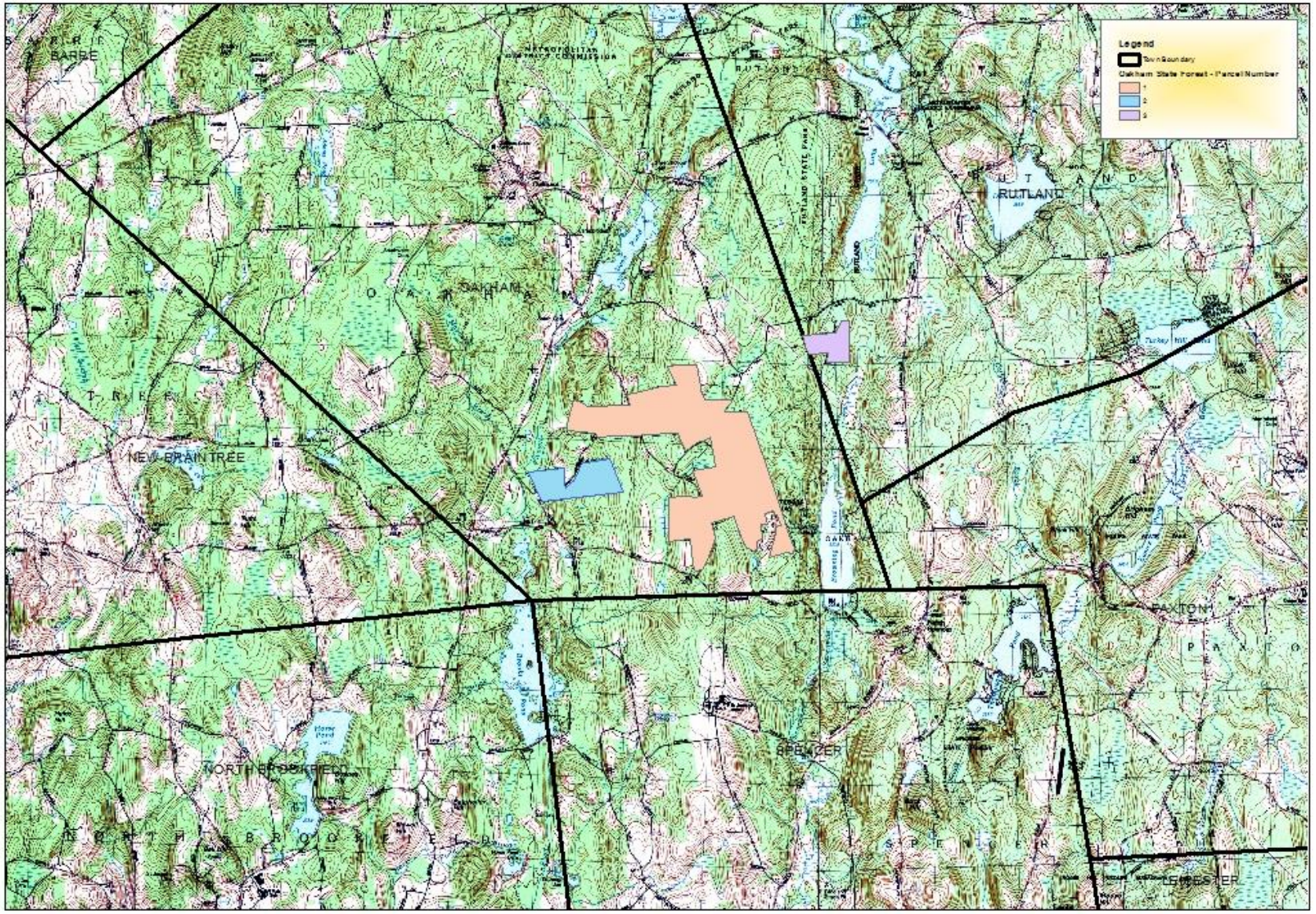
APPENDIX

1 inch = 5,000 feet

0 2,050 4,100 8,200 Feet

Locus Map
Oakham State Forest Complex

N



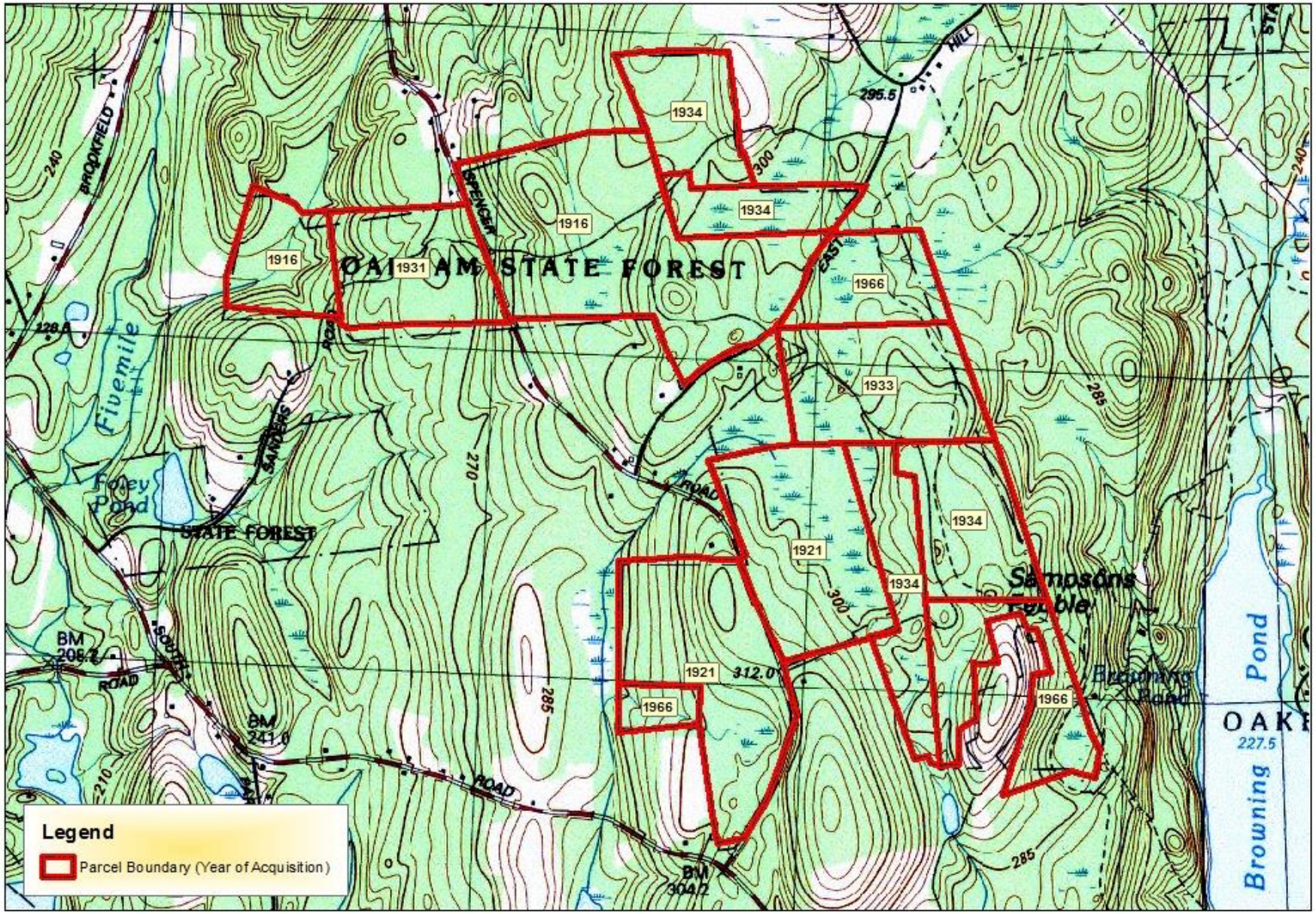
Map prepared by: Joelle Vautour, DCR Management Forester - August 2018

1 inch = 1,300 feet

0 500 1,000 2,000 Feet

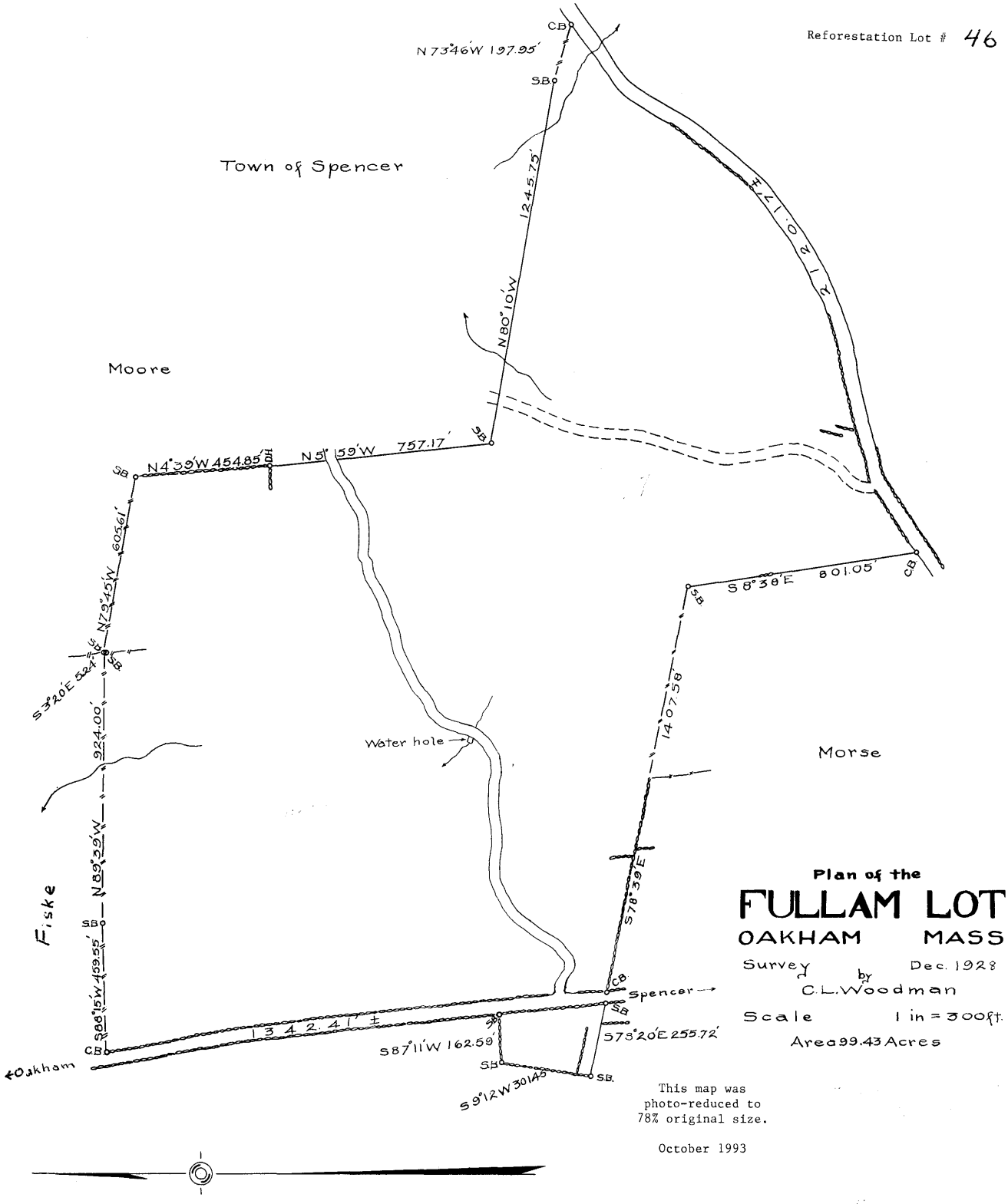
Acquisition Map
Stonewall Lot
Oakham State Forest

N



Map prepared by: Joelle Vautour, DCR Management Forester - August 2018

Reforestation Lot # 46



Plan of the

FULLAM LOT

OAKHAM MASS

Survey by C.L. Woodman Dec. 1928

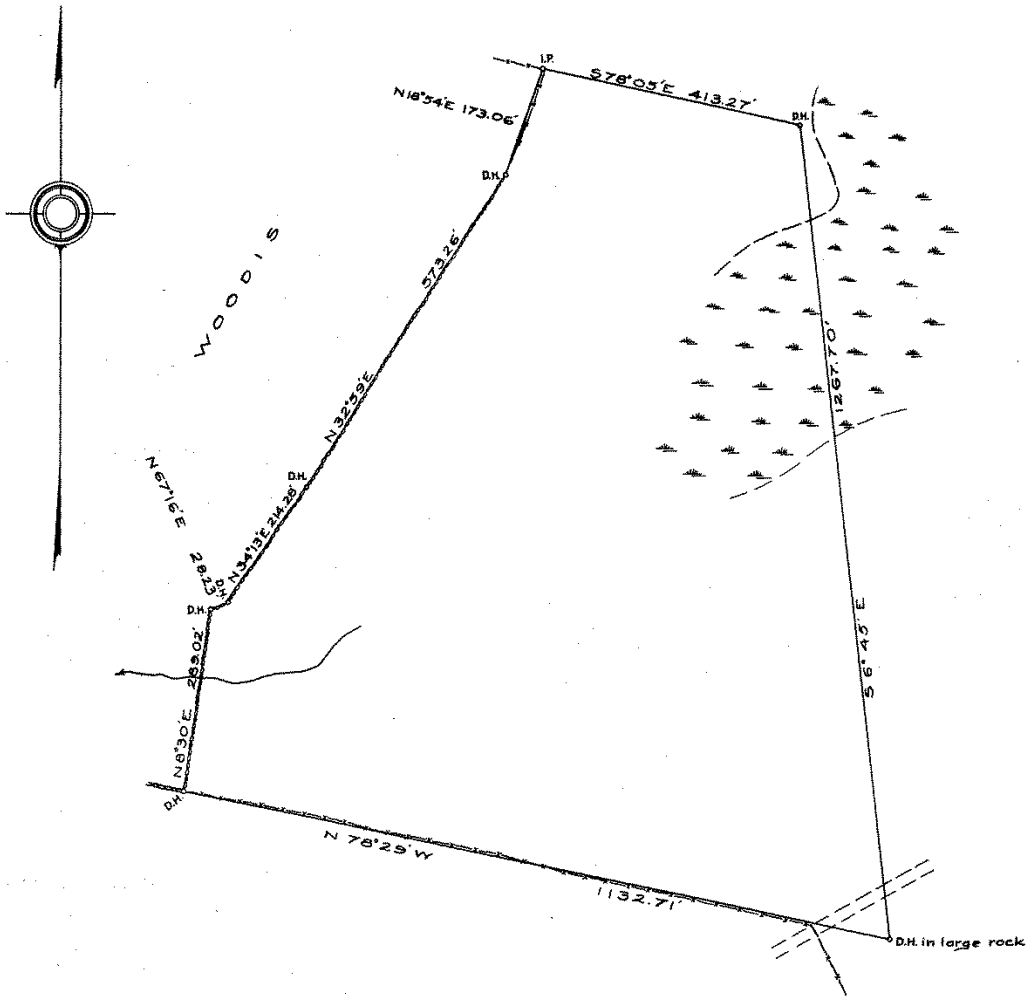
Scale 1 in = 300 ft.

Area 99.43 Acres

This map was photo-reduced to 78% original size.

October 1993

REFORESTATION LOT NO. 131
STATE OWNED



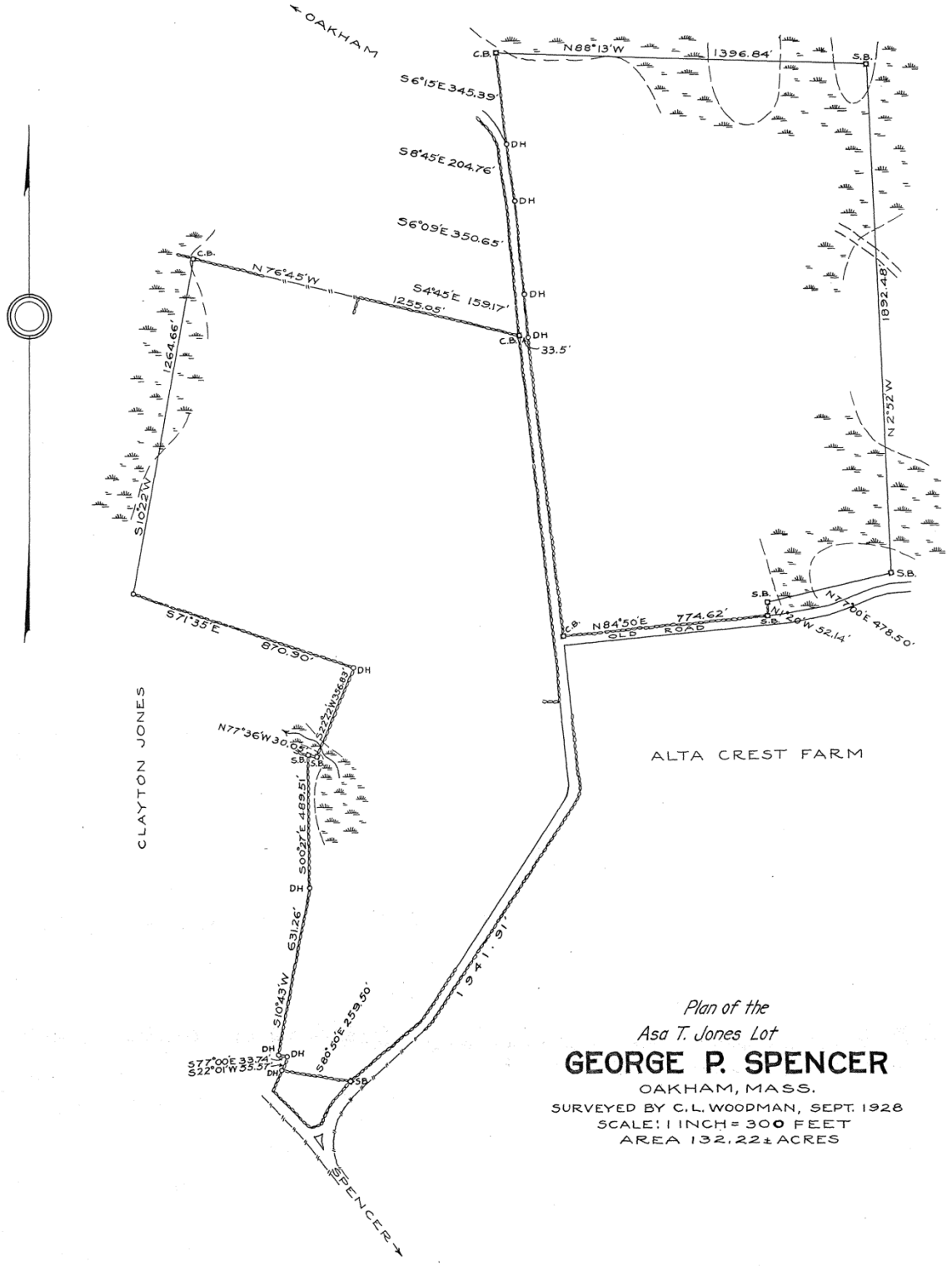
PLAN OF

FULLAM LOT

OAKHAM, MASS.
SURVEYED BY C.L. WOODMAN SEPT. 1928
SCALE: 1 INCH = 150 FEET
AREA 22.06 ACRES

F.G.H. 4/4/29

REFORESTATION LOTS NO. 172-173
STATE OWNED



Plan of the

Asa T. Jones Lot

GEORGE P. SPENCER

OAKHAM, MASS.

SURVEYED BY C. L. WOODMAN, SEPT. 1928

SCALE: 1 INCH = 300 FEET

AREA 132.22± ACRES

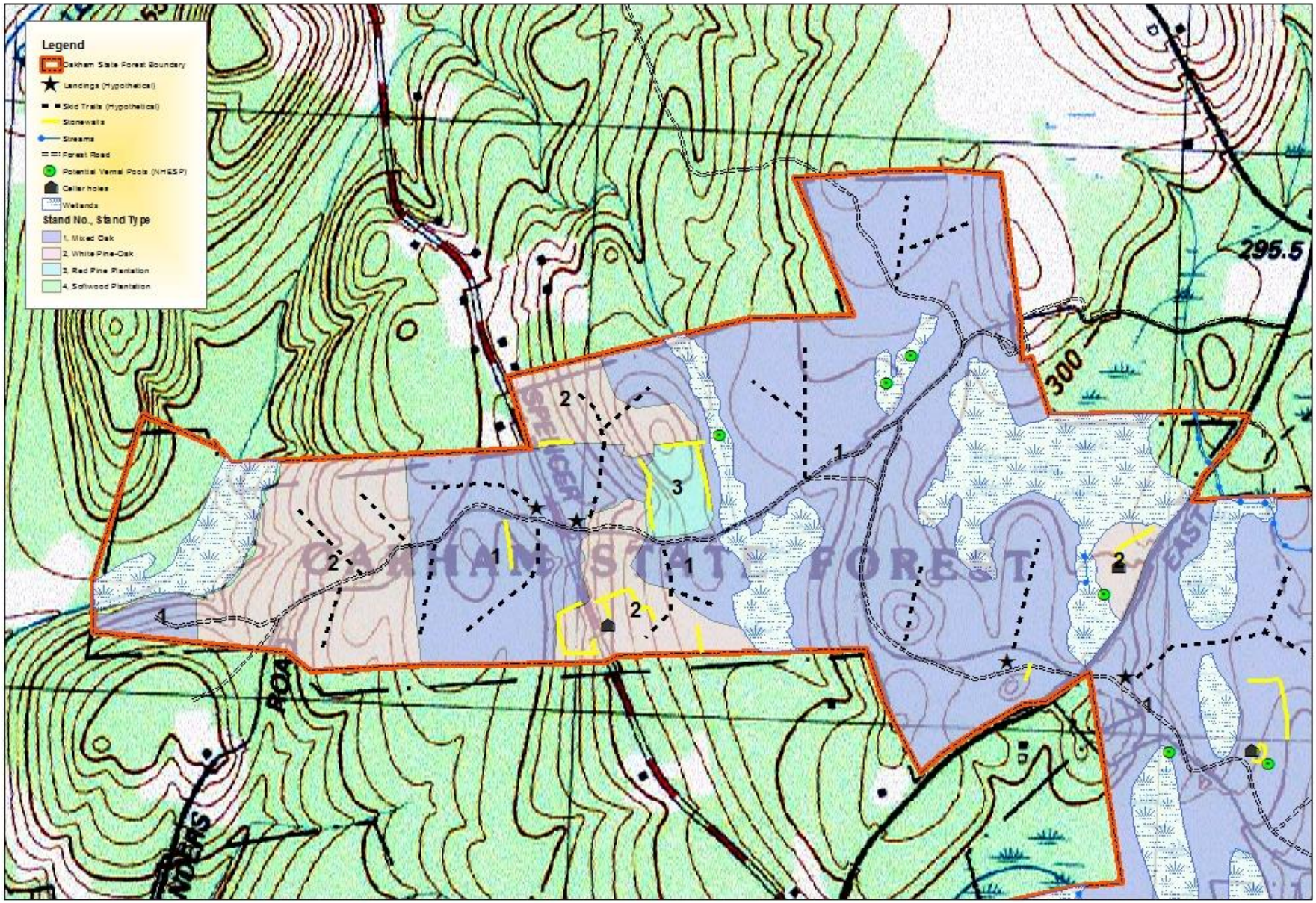
F.G.H. 4/4/29

1 inch = 700 feet

0 290 580 1,160 Feet

Harvest Map
Stonewall Lot
Oakham State Forest

N



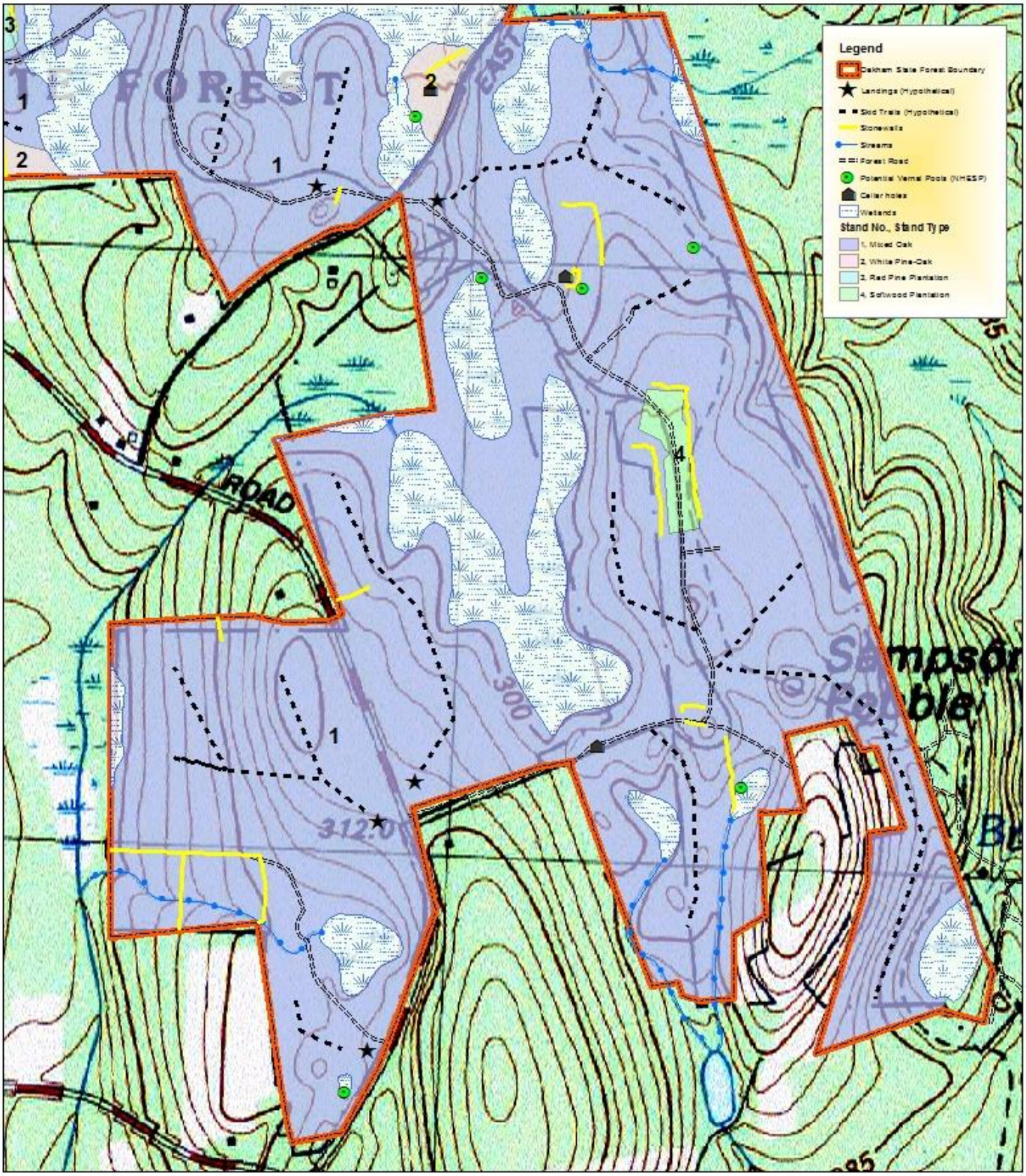
Map prepared by: Joelle Vautour, DCR Management Forester - August 2018

1 inch = 700 feet

0 290 580 1,160 Feet

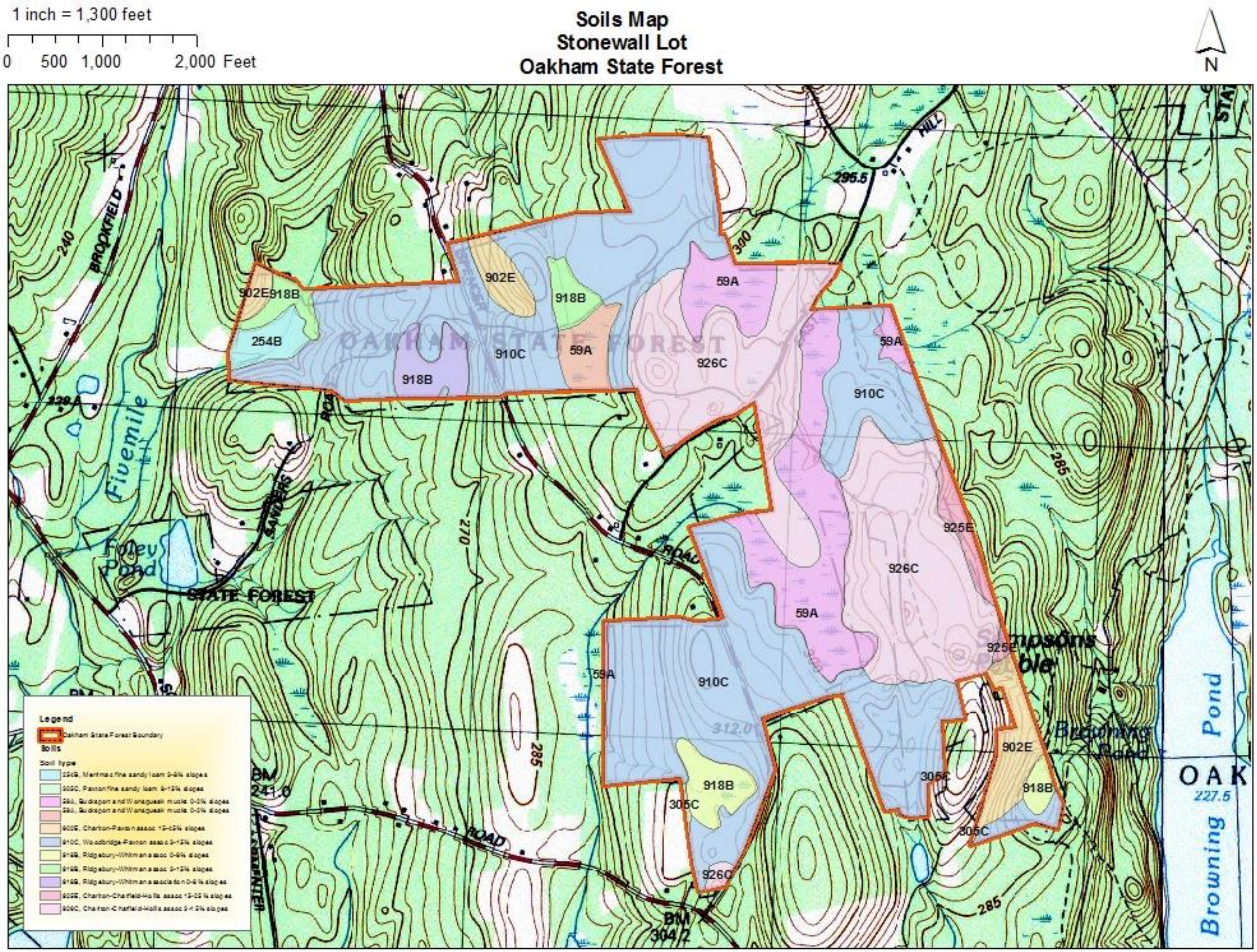
Harvest Map
Stonewall Lot
Oakham State Forest

N



Map prepared by: Joelle Vautour, DCR Management Forester - August 2018

Soils Map
Stonewall Lot
Oakham State Forest



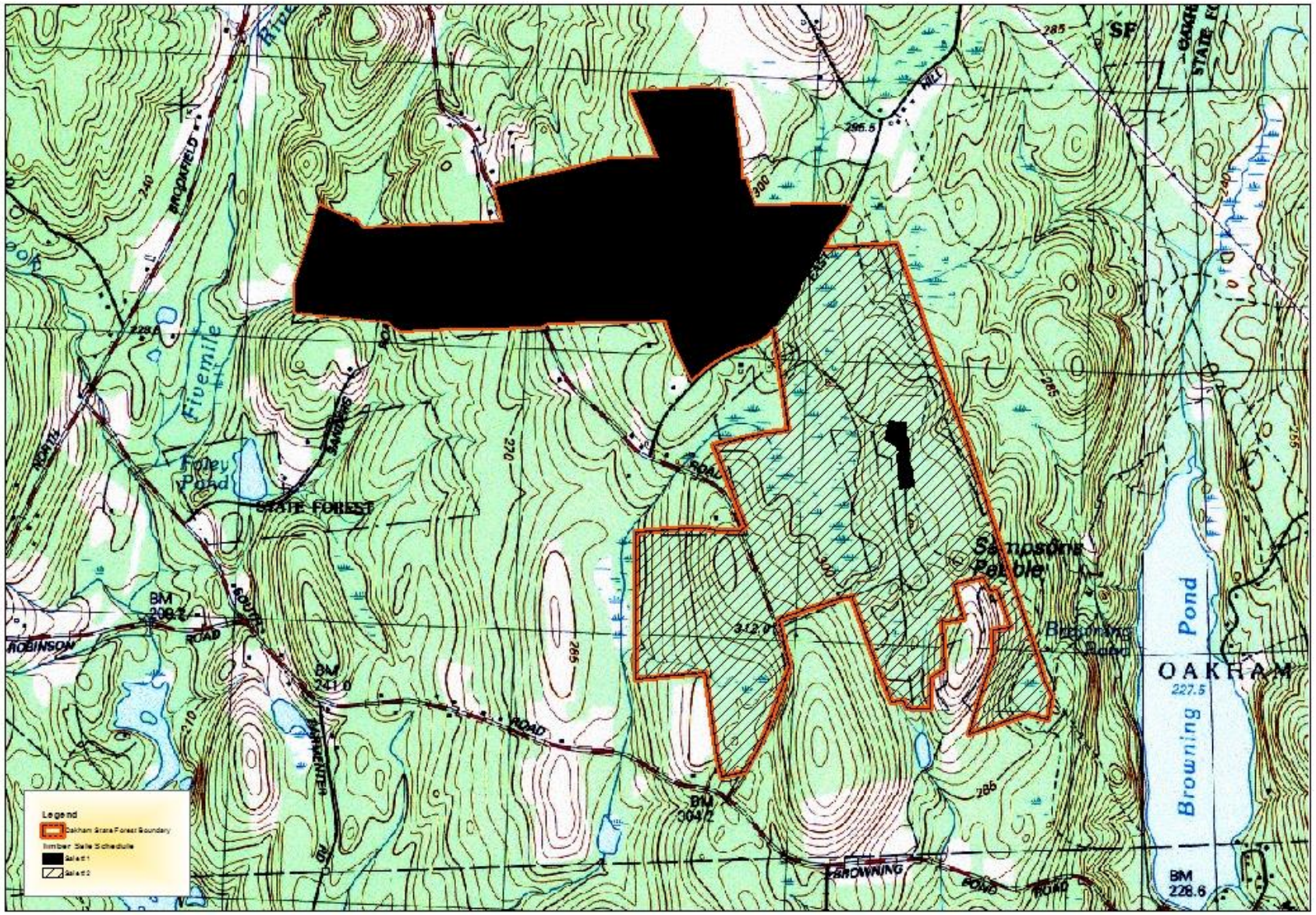
Map prepared by: Joelle Vautour, DCR Management Forester - June 2018

1 inch = 1,500 feet

0 625 1,250 2,500 Feet

Timber Sale Schedule Map
Stonewall Lot
Oakham State Forest

N



Map prepared by: Joelle Vautour, DCR Management Forester - August 2018

CURRENT CONDITIONS

Table 1. Stand 1 – Mixed Oak Overstory Data Table - (Stems ≥ 5" dbh)

STATE OF NEW HAMPSHIRE - DRED - DIVISION OF FORESTS & LANDS - FOREST MANAGEMENT BUREAU

Volume

Spp	Spp Code	Sawlog Bf/Acre	Sawlog Bf/Acre Conf.	Pulp Cords/Acre	Pulp Cords/Acre Conf.	Sawtimber Mean Ht (logs)	Total Bf (Stand)	Total Cords (Stand)	Topwood Cords (Stand)
EWP	1	414	71.0	0.85	42.21	1.3	172,532	353.6	173
RM	7	37		1.56	27.4	2.0	15,544	650.9	5
WA	8	141	121.2	0.20	80.4	1.8	58,921	82.2	23
ASP	9	167	99.9			2.1	69,806		17
YB	12	0		0.12		1.8	0	50.7	0
BB	13	0					0		
NRO	16	7,120	15.9	0.96	44.4	1.6	2,969,076	399.8	1406
WO	17	645	55.4	0.56	44.0	1.5	269,076	234.8	140
BO	22	754	57.5	0.50	56.0	1.3	314,620	206.7	217
NSPR	26	0		0.31	80.0		0	128.7	
HICKORY	28	343	97.2	0.44	60.5	2.0	143,028	182.2	40
SCAR. OAK	46	77	150.9	0.05		1.2	32,142	22.8	25
		0					0		
		0					0		
		0					0		
		0					0		
Total		9,700	10.7	5.55	22.7		4,044,743	2,312.5	2045

Fox DS Cruiser Release 2013

A PRODUCT OF THE
FOX RESEARCH FOREST
Hillsborough, NH
Developed by K. Desmarais & M. Robblee

Oakham	0
Stand	1
Acres	417
# of BA Pts.=	70
28-Jun-18	

Last Modified July 6, 2009

Type	Oak
Size Class	Sawtimber
Cruise Date	6/25/2018
Deg. Of Conf.	95 %
Student's "t"	1.995

Stocking Diagnostics

Spp	Spp Code	Total Trees/Acre	Total Trees/Acre Conf.	Total BA/Acre	Total BA/Acre Conf.	% BA/ac by Spp	QMD	Rel Density	% AGS
EWP	1	10.9	51.6	8.3	30.9	7%	11.8	3.2	72%
RM	7	20.1	35.7	8.6	25.9	8%	8.8	7.3	70%
WA	8	3.3	70.2	2.3	49.3	2%	11.3	1.9	63%
ASP	9	1.1	74.7	1.1	63.6	1%	14.0	0.7	100%
YB	12	1.1	175.7	0.9	96.3	1%	11.9	0.7	100%
BB	13	0.6		0.6	130.0	1%	12.9	0.0	100%
NRO	16	46.1	18.7	62.9	9.3	57%	15.8	54.7	98%
WO	17	11.1	51.1	8.3	29.3	7%	11.7	6.9	83%
BO	22	9.9	36.2	9.7	30.1	9%	13.4	7.9	82%
NSPR	26	5.2	95.2	1.1	78.3	1%	6.3	0.7	50%
HICKORY	28	10.5	66.1	5.4	47.9	5%	9.7	4.9	89%
SCAR. OAK	46	1.7	105.6	1.1	102.2	1%	11.0	1.0	100%
		0.0							
		0.0							
		0.0							
		0.0							
Total		121.7	14.5	110.6	7.6	100%	12.9	90	89%
					Median Stand Diameter ->>		15.7	91	*<<- Estimated Relative Density*

NOTE: This report was produced by a BETA Version of FoxDS Cruiser, a work in progress and may be subject to errors.
Relative density equations are from NED an inventory program by the USDA Forest Service, Northeastern Research Station, Burlinton, Vermont and from FOXDEN2 by Fox Research Forest, NH Division of Forest & Lands, Hillsboro, NH.
Topwood cords are not included in "Pulp Cords Per Acre". Topwood is calculated from USDA Forest Service tables.

Table 2. Stand 1 – Mixed Oak Understory Data Table – Tree Species - Stems/Acre (Stems < 1.0' tall to 5" dbh)

	SIZE CLASS				
SPECIES	**< 1'**	**1' - 4.5'**	**4.5' - 1"DBH**	**1" - 5" DBH**	**TOTAL**
American chestnut (Castanea dentata)	4.29	124.29	128.57	34.29	291.43
Black birch (Betula lenta)	0.00	0.00	4.29	4.29	8.57
Black cherry (Prunus serotina)	25.71	64.29	17.14	4.29	111.43
Eastern hemlock (Tsuga canadensis)	8.57	0.00	8.57	0.00	17.14
Eastern white pine (Pinus strobus)	497.14	98.57	8.57	77.14	681.43
Hickory spp. (Carya spp.)	12.86	30.00	4.29	8.57	55.71
Northern red oak (Quercus rubra)	3257.14	55.71	0.00	0.00	3312.86
Norway spruce (Picea abies)	0.00	4.29	0.00	0.00	4.29
Pin cherry (Prunus pensylvanica)	4.29	0.00	0.00	0.00	4.29
Red Maple (Acer rubrum)	651.43	291.43	154.29	128.57	1225.71
Sugar maple (Acer saccharum)	0.00	8.57	4.29	4.29	17.14
White ash (Fraxinus americana)	81.43	34.29	0.00	4.29	120.00
White oak (Quercus alba)	81.43	60.00	17.14	0.00	158.57
Yellow birch (Betula alleganiensis)	0.00	4.29	17.14	21.43	42.86
TOTAL	4624.29	775.71	364.29	287.14	6051.43

Table 3. Stand 1 – Mixed Oak Understory and Ground Species Data Table

SPECIES	Average Cover (%)	# Plots Observed	% of Plots Observed
Amelanchier spp.	1.0	13	18.6
Beaked hazelnut (Corylus cornuta)	3.6	20	28.6
Black huckleberry (Gaylussacia baccata)	2.4	11	15.7
Canada mayflower (Maianthemum canadense)	0.1	3	4.3
Chokecherry (Prunus virginiana)	0.2	3	4.3
Cinquefoil (Potentilla spp.)	0.1	2	2.9
Common Buckthorn (Rhamnus cathartica)	0.0	1	1.4
Dewberry (Rubus spp.)	0.3	5	7.1
Dogwood (Cornus spp.)	0.1	2	2.9
Ferns	2.7	13	18.6
Goldenrod (Solidago spp.)	0.1	4	5.7
Goldthread (Coptis trifolia)	0.1	1	1.4
Grape (Vitis spp.)	0.1	1	1.4
Grass	0.6	11	15.7
Ground cedar (Diphasiastrum digitatum)	0.1	2	2.9
Hawthorn (Crataegus spp.)	0.1	3	4.3
Highbush blueberry (Vaccinium corymbosum)	0.3	3	4.3
Hobblebush (Viburnum lantanoides)	0.3	4	5.7
Hophornbeam (Ostrya virginiana)	0.1	1	1.4
Indian cucumber root (Medeola virginiana)	0.1	3	4.3
Japanese barberry (Berberis thunbergii)	0.0	1	1.4
Loosestrife (Lythrum spp.)	0.0	1	1.4
Lowbush blueberry (Vaccinium angustifolium)	8.6	48	68.6
Lycopodium spp.	2.6	26	37.1
Mapleleaf Viburnum (Viburnum acerifolium)	1.6	14	20.0
Moss	0.3	1	1.4
Mountain laurel (Kalmia latifolia)	0.7	1	1.4
Musclewood (Carpinus caroliniana)	0.1	1	1.4
Northern spicebush (Lindera benzoin)	0.0	1	1.4
Partridgeberry (Mitchella repens)	1.4	16	22.9
Pipsissewa (Chimaphila umbellata)	0.0	1	1.4
Rubus spp.	0.5	9	12.9
Sheep laurel (Kalmia angustifolia)	3.0	20	28.6
Starflower (Trientalis borealis)	0.0	1	1.4
Striped maple (Acer pensylvanicum)	0.1	1	1.4
Striped Pipsissewa (Chimaphila maculata)	0.1	3	4.3
Wild oats (Uvularia sessilifolia)	0.0	1	1.4
Wild sarsaparilla (Aralia nudicaulis)	0.2	4	5.7
Wild strawberry (Fragaria vesca)	0.0	1	1.4
Winterberry (Ilex verticillata)	0.9	6	8.6
Wintergreen (Gaultheria procumbens)	6.6	38	54.3
Witch hazel (Hamamelis virginiana)	10.8	27	38.6
Witherod (Viburnum cassinoides)	0.3	5	7.1

Table 4. Stand 1 – Mixed Oak Snag Data Table

Species Group	<12" DBH	12.1" to 15" DBH	15.1" DBH or more	Total
Softwood	2.3	0.3	0	2.6
Hardwood	6.0	0.3	0	6.3
Total	8.3	0.6	0	8.9

Table 5. Stand 2 - White Pine-Oak Overstory Data Table - (Stems ≥ 5" dbh)

STATE OF NEW HAMPSHIRE - DRED - DIVISION OF FORESTS & LANDS - FOREST MANAGEMENT BUREAU

Volume

Spp	Spp Code	Sawlog Bf/Acre	Sawlog Bf/Acre Conf.	Pulp Cords/Acre	Pulp Cords/Acre Conf.	Sawtimber Mean Ht (logs)	Total Bf (Stand)	Total Cords (Stand)	Topwood Cords (Stand)
EWP	1	10,413	52.1	0.84	89.09	1.9	489,401	39.5	220
RM	7	485	224.3	4.84	154.4	1.7	22,813	227.3	9
NRO	16	2,650	81.3	1.32		1.6	124,539	62.2	63
WO	17	441				1.5	20,722		11
BO	22	228				1.5	10,707		6
		0					0		
		0					0		
		0					0		
		0					0		
		0					0		
		0					0		
		0					0		
		0					0		
		0					0		
		0					0		
Total		14,217	33.8	7.00	142.8		668,182	329.0	310

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Hillsborough, NH
Developed by K. Desmarais & M. Robblee

Oakham	0
Stand	2
Acres	47
# of BA Pts.=	11
28-Jun-18	

Last Modified	July 6, 2009
Type	WP-Oak
Size Class	Sawtimber
Cruise Date	6/20/2018
Deg. Of Conf.	95 %
Student's "t"	2.228

Stocking Diagnostics

Spp	Spp Code	Total Trees/Acre	Total Trees/Acre Conf.	Total BA/Acre	Total BA/Acre Conf.	% BA/ac by Spp	QMD	Rel Density	% AGS
EWP	1	53.6	38.2	63.6	26.9	51%	14.8	22.1	94%
RM	7	29.6	79.6	12.7	74.3	10%	8.9	10.5	43%
NRO	16	14.1	54.5	25.5	41.5	20%	18.2	21.7	86%
WO	17	4.6		3.6	130.0	3%	12.0	2.9	100%
BO	22	1.8		1.8	130.0	1%	13.8	1.4	100%
		0.0							
		0.0							
		0.0							
		0.0							
		0.0							
		0.0							
		0.0							
		0.0							
		0.0							
		0.0							
		0.0							
Total		103.7	42.4	125.5	34.6	86%	14.9	59	74%
						Median Stand Diameter ->>	18.0	69	*<<- Estimated Relative Density*

NOTE: This report was produced by a BETA Version of FoxDS Cruiser, a work in progress and may be subject to errors.
Relative density equations are from NED an inventory program by the USDA Forest Service, Northeastern Research Station, Burlinton, Vermont and from FOXDEN2 by Fox Research Forest, NH Division of Forest & Lands, Hillsboro, NH.
Topwood cords are not included in "Pulp Cords Per Acre". Topwood is calculated from USDA Forest Service tables.

Table 6. Stand 2 – White Pine-Oak Understory Data Table – Tree Species Stems/Acre (Stems < 1.0' tall to 5" dbh)

	SIZE CLASS				
SPECIES	**< 1'**	**1' - 4.5'**	**4.5' - 1"DBH**	**1" - 5" DBH**	**TOTAL**
American chestnut (Castanea dentata)	0	66.7	200	66.7	333.3
Black birch (Betula lenta)	33.3	0	0	0	33.3
Black cherry (Prunus serotina)	133.3	0	0	0	133.3
Eastern hemlock (Tsuga canadensis)	0	0	0	133.3	133.3
Eastern white pine (Pinus strobus)	766.7	66.7	0	100	933.3
Northern red oak (Quercus rubra)	1366.7	433.3	33.3	33.3	1866.7
Red maple (Acer rubrum)	200	233.3	333.3	566.7	1333.3
White ash (Fraxinus americana)	0	0	0	33.3	33.3
TOTAL	2500	800	566.7	933.3	4800

Table 7. Stand 2 – White Pine-Oak Understory and Ground Species Data Table

SPECIES	**Average Cover (%)**	**# Plots Observed**	**% of Plots Observed**
Beaked hazelnut (Corylus cornuta)	0.2	1	11.1
Black huckleberry (Gaylussacia baccata)	4.7	3	33.3
Ferns	7.9	2	22.2
Grape (Vitis spp.)	0.1	1	11.1
Grass	0.2	2	22.2
Highbush blueberry (Vaccinium corymbosum)	1.1	1	11.1
Lowbush blueberry (Vaccinium angustifolium)	11.4	7	77.8
Lycopodium spp.	2.6	4	44.4
Mapleleaf viburnum (Viburnum acerifolium)	0.3	1	11.1
Partridgeberry (Mitchella repens)	1.3	1	11.1
Serviceberry (Amelanchier spp.)	0.1	1	11.1
Sheep laurel (Kalmia angustifolia)	0.1	1	11.1
Wild oats (Uvularia sessilifolia)	0.1	1	11.1
Wintergreen (Gaultheria procumbens)	16.6	7	77.8
Witch hazel (Hamemelis virginiana)	0.3	2	22.2
Witherod (Viburnum cassinoides)	0.4	2	22.2

Table 8. Stand 2 – White Pine-Oak Snag Data Table

Species Group	**<12" DBH**	**12.1" to 15" DBH**	**15.1" DBH or more**	**Total**
Softwood	0.0	2.2	0.0	2.2
Hardwood	2.9	0.0	0.0	2.9
Total	2.9	2.2	0	5.1

Table 9. Stand 3 - Red Pine Overstory Data Table - (Stems ≥ 5" dbh)

STATE OF NEW HAMPSHIRE - DRED - DIVISION OF FORESTS & LANDS - FOREST MANAGEMENT BUREAU

Volume

Spp	Spp Code	Sawlog Bf/Acre	Sawlog Bf/Acre Conf.	Pulp Cords/Acre	Pulp Cords/Acre Conf.	Sawtimber Mean Ht (logs)	Total Bf (Stand)	Total Cords (Stand)	Topwood Cords (Stand)
EWP	1	1,366		2.95		2.0	4,099	8.9	2
RP	2	29,688	92.0	10.37	34.3	2.4	89,063	31.1	23
		0					0		
		0					0		
		0					0		
		0					0		
		0					0		
		0					0		
		0					0		
		0					0		
		0					0		
		0					0		
		0					0		
		0					0		
		0					0		
		0					0		
Total		31,054	140.6	13.32	451.9		93,161	40.0	25

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Developed by K. Desmarais & M. Robblee

Oakham	
Stand	3
Acres	3
# of BA Pts.=	2
13-Aug-18	

Last Modified	July 6, 2009
Type	Plantation
Size Class	Sawtimber
Cruise Date	8/13/2018
Deg. Of Conf.	95 %
Student's "t"	12.706

Stocking Diagnostics

Spp	Spp Code	Total Trees/Acre	Total Trees/Acre Conf.	Total BA/Acre	Total BA/Acre Conf.	% BA/ac by Spp	QMD	Rel Density	% AGS
EWP	1	46.3	872.1	20.0	130.0	8%	8.9	8.8	100%
RP	2	272.9	131.2	240.0	10.8	92%	12.7	114.3	79%
		0.0							
		0.0							
		0.0							
		0.0							
		0.0							
		0.0							
		0.0							
		0.0							
		0.0							
		0.0							
		0.0							
		0.0							
		0.0							
		0.0							
Total		319.3	275.1	260.0	195.5	100%	12.2	123	81%
					Median Stand Diameter ->>		13.4	123	*<<- Estimated Relative Density*

NOTE: This report was produced by a BETA Version of FoxDS Cruiser, a work in progress and may be subject to errors.
Relative density equations are from NED an inventory program by the USDA Forest Service, Northeastern Research Station, Burlinton, Vermont and from FOXDEN2 by Fox Research Forest, NH Division of Forest & Lands, Hillsboro, NH.
Topwood cords are not included in "Pulp Cords Per Acre". Topwood is calculated from USDA Forest Service tables.

Table 10. Stand 3 – Red Pine Understory Data Table – Tree Species Stems/Acre (Stems < 1.0' tall to 5" dbh)

	SIZE CLASS				
SPECIES	**< 1'**	**1' - 4.5'**	**4.5' - 1"DBH**	**1" - 5" DBH**	**TOTAL**
Hickory spp. (Carya spp.)	0	0	0	150	150
Northern red oak (Quercus rubrum)	1200	0	0	0	1200
Red maple (Acer rubrum)	450	0	0	600	1050
TOTAL	1650	0	0	750	2400

Table 11. Stand 3 – Red Pine Understory and Ground Species Data Table

SPECIES	Average Cover (%)	# Plots Observed	% of Plots Observed
Canada mayflower (Maianthemum canadense)	45	2	100
Highbush blueberry (Vaccinium corymbosum)	5	1	50
Serviceberry (Amelanchier spp.)	2.5	1	50
Starflower (Trientalis borealis)	7.5	2	100

Table 12. Stand 3 – Red Pine Snag Data Table

Species Group	<12" DBH	12.1" to 15" DBH	15.1" DBH or more	Total
Softwood	18.3	0	0	18.3
Hardwood	0	0	0	0
Total	18.3	0	0	18.3

Table 13. Stand 4 – Softwood Plantation Overstory Data Table - (Stems ≥ 5" dbh)

STATE OF NEW HAMPSHIRE - DRED - DIVISION OF FORESTS & LANDS - FOREST MANAGEMENT BUREAU

Volume

Spp	Spp Code	Sawlog Bf/Acre	Sawlog Bf/Acre Conf.	Pulp Cords/Acre	Pulp Cords/Acre Conf.	Sawtimber Mean Ht (logs)	Total Bf (Stand)	Total Cords (Stand)	Topwood Cords (Stand)
EWP	1	2,302				1.5	9,208		7
RP	2	6,338	1270.6			3.0	25,354		3
SPRUCE	5	2,224		1.59		3.0	8,895	6.3	1
WA	8	2,229				3.0	8,917		1
NRO	16	2,270		2.29		1.3	9,081	9.2	6
		0					0		
		0					0		
		0					0		
		0					0		
		0					0		
		0					0		
		0					0		
		0					0		
		0					0		
		0					0		
Total		15,364	206.9	3.88	1291.4		61,454	15.5	19

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Oakham	
Stand	4
Acres	4
# of BA Pts.=	2
13-Aug-18	

Last Modified July 6, 2009

Type Mixed Softwoods
Size Class Sawtimber
Cruise Date 8/13/2018
Deg. Of Conf. 95 %
Student's "t" 12.706

Stocking Diagnostics

Spp	Spp Code	Total Trees/Acre	Total Trees/Acre Conf.	Total BA/Acre	Total BA/Acre Conf.	% BA/ac by Spp	QMD	Rel Density	% AGS
EWP	1	17.3		20.0	130.0	18%	14.6	7.4	100%
RP	2	12.3	141.3	30.0	130.0	27%	21.1	12.5	100%
SPRUCE	5	11.1	663.4	20.0	0.0	18%	18.2	5.2	50%
WA	8	2.6		10.0	130.0	9%	26.6	7.5	100%
NRO	16	20.7	675.1	30.0	130.0	27%	16.3	26.1	100%
		0.0							
		0.0							
		0.0							
		0.0							
		0.0							
		0.0							
		0.0							
		0.0							
		0.0							
		0.0							
		0.0							
Total		64.0	430.0	110.0	346.5	100%	17.8	59	91%
						Median Stand Diameter ->>	20.0	59	*<<- Estimated Relative Density*

NOTE: This report was produced by a BETA Version of FoxDS Cruiser, a work in progress and may be subject to errors.
Relative density equations are from NED an inventory program by the USDA Forest Service, Northeastern Research Station, Burlinton, Vermont and from FOXDEN2 by Fox Research Forest, NH Division of Forest & Lands, Hillsboro, NH.
Topwood cords are not included in "Pulp Cords Per Acre". Topwood is calculated from USDA Forest Service tables.

Table 14. Stand 4 – Softwood Plantation Understory Data Table – Tree Species Stems/Acre (Stems < 1.0' tall to 5" dbh)

	SIZE CLASS				
SPECIES	**< 1'**	**1' - 4.5'**	**4.5' - 1"DBH**	**1" - 5" DBH**	**TOTAL**
Black cherry (Prunus velutina)	300	300	0	0	600
Northern red oak (Quercus rubra)	1050	0	0	0	1050
Quaking Aspen (Populus tremuloides)	600	0	0	0	600
Red maple (Acer rubrum)	1950	150	0	0	2100
White ash (Fraxinus americana)	600	150	0	0	750
White oak (Quercus alba)	0	150	0	0	150
TOTAL	4500	750	0	0	5250

Table 15. Stand 4 – Softwood Plantation Understory and Ground Species Data Table

SPECIES	**Average Cover (%)**	**# Plots Observed**	**% Plots Observed**
Alternate leaf dogwood (Cornus alternifolia)	2.5	1	50
Canada mayflower (Maianthemum canadense)	27.5	2	100
Grass	2.5	1	50
Mapleleaf viburnam (Viburnum acerifolium)	2.5	1	50
Partridgeberry (Gaultheria procumbens)	1	1	50
Starflower (Trientalis borealis)	2.5	1	50
Wild sarsaparilla (Aralia nudicaulis)	3.5	1	50

Table 16. Stand 4 – Softwood Plantation Snag Data Table

Species Group	**<12" DBH**	**12.1" to 15" DBH**	**15.1" DBH or more**	**Total**
Softwood	0	8.8	0	8.8
Hardwood	0	0	0	0
Total	0	8.8	0	8.8

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