 

***Forest Management Plan***

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

|  |  |  |
| --- | --- | --- |
|  | ***CHECK-OFFS*** | ***Administrative Box*** |
| CH61 |  | CH61A | CH61B | STEWARDSHIP | Cost Share | Case No.  | 234-000 | Orig. Case No. |  |
| cert [ ]  | cert [ ]  | cert [ ]  | new [x]  | EEA [ ]  | Owner ID  | 0000100 | Add. Case No. |  |
| recert [ ]  | recert [ ]  | recert [ ]  | renew [ ]  | Other [ ]  | Date Rec’d  |  |  |  |
| amend [ ]  | amend [ ]  | amend [ ]  | Climate [x]  | Birds [x]  | Plan Period  | 2021-32 |  |  |
|  | Conservation Rest. [ ]  | Rare Spp. Hab. | No |  |  |
| Plan Change to | CR Holder |  |  |  |  |

***OWNER, PROPERTY, and PREPARER INFORMATION***

Property Owner(s) Sample Family

Mailing Address Main Street 2, Sturbridge, MA 01566 Phone 413-200-0000

Email Address

Property Location Town(s) Brimfield Road(s) Main Road

**Plan Preparer** Millie QuercusMass Forester License # 1000

413-300-9999

Mailing Address Main Street, Brimfield, MA 01010 Phone

***RECORDS***

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Assessor’s Map No. | Lot/Parcel No. | DeedBook | DeedPage | TotalAcres | Ch61/61A61B*Excluded*Acres | Ch61/61A61B**Certified**Acres | Stewshp*Excluded*Acres | StewshpAcres |
| 10 | 20 | 1500 | 200 | 76.6 |  |  | 0 | 76.6 |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  | **TOTALS** | 76.6 |  |  | 0 | 76.6 |

**Excluded Area Description(s) (if additional space is needed, continue on separate paper)**

N/A

***HISTORY*** Year acquired 2012 Year Management began 2012

Are boundaries marked: Yes [x]  blazed/painted/flagged/signs posted (circle all that apply) No [ ]  Partially [ ]

 What treatments have been prescribed, but not carried out (last 10 years if plan is a recert.)?

 stand no. treatment reason

(If additional space is needed, continue on separate page)

Previous Management Practices (last 10 years)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Stand # | Cutting Plan # | Treatment | Yield | Acres | Date |
| 1, 2, 3 | 000-6638-14 | Selection | 263Mbf,43cd | 80 | 2015 |
|  |  |  |  |  |  |

Remarks: (if additional space is needed, continue on separate page)

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# Landowner Goals

Please **check** the column that best reflects the importance of the following goals:

*(goals may change over time and this table may be updated to reflect any changes)*

|  |  |
| --- | --- |
| **Goal** | **Importance to Me** |
| HIGH | MED | LOW | N/A, DON’T KNOW |
| Improve access for walking/skiing/recreation | **** |  |  |  |
| Improve hunting or fishing |  |  | **** |  |
| Maintain or enhance privacy |  |  | **** |  |
| Preserve or improve scenic beauty | **** |  |  |  |
| Protect special features, including those of historical or personal significance | **** |  |  |  |
| Enhance the quality and/or quantity of forest products**\*** | **** |  |  |  |
| Practice agroforestry (e.g., silvopasture, forest farming, alley cropping, windbreak, riparian buffer, food forest) |  |  |  | Need more information |
| Produce income from timber products, or other products and services |  | **** |  |  |
| Produce firewood for personal use |  |  | **** |  |
| Enhance habitat for birds | **** |  |  |  |
| Enhance aquatic habitat in streams, ponds, and other wetlands | **** |  |  |  |
| Enhance habitat for wildlife | **** |  |  |  |
| Promote diversity of plant species and habitat types | **** |  |  |  |
| Increase forest resiliency | **** |  |  |  |
| Minimize damage from forest pests | **** |  |  | How? |
| Protect water quality | **** |  |  |  |
| Sequester and/or store carbon to mitigate climate change | **** |  |  |  |
| Suppress or eradicate invasive plants | **** |  |  |  |
| Lower property taxes |  | **** |  |  |
| Protect land from development  |  | **** |  |  |

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

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

Protect water quality, improve habitat and forest quality. Improve access for recreational purposes. After a large tornado

crossed a small section of the property, the family is more concerned about climate change and storm impacts.

#### Stewardship Purpose

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

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

**Signature(s): Date: 1/13/2022**

**Property Overview, Regional Significance, and Management Summary**

**Property Goals Overview**

This 74.395-acre property is located on Main Road in Brimfield, MA. The Sample family is concerned about climate change and would like to increase carbon storage. They also have a long-standing interest in wildlife and would like to improve upon habitats for birds. The Sample family intends to keep their woodlot forested, which is one of the most important steps in mitigating climate change. This will allow for storing and sequestering carbon, maintaining wildlife habitat, and providing a wood source for society’s needs. They will be exploring estate planning for conservation as a consideration for generational planning.

Many of the Samples’ goals relate to creating a healthy, resilient forest, which is the foundation of adapting the forest to anticipated climate change. Their identified goals would ensure that the forest both sequester and store carbon over time. Complex structure, with areas of both young and old forest, helps the landscape be more resilient to large-scale disturbance such as wind and ice. Objectives relating to recreational access and the improvement of scenic beauty can be incorporated into both active and passive forest management. The identification of special landscape features, by the Samples, will be an important first step to the management of their property.

**Property Description**

This property contains two upland forest stands and one lowland riparian stand that is comprised of a mix of hardwood and softwood tree species. Diversity of tree species, age classes, and sizes help create a structurally complex forest; this complexity is important for wildlife species and for having a forest that can adapt to a changing climate, thereby storing more carbon.

This property provides good habitat diversity for birds and other wildlife. The trees species diversity is also good. Like most forests in Massachusetts, age class/ structural diversity is fair. The trees are primarily pole (i.e., 9 to 12 inches in diameter) to sawtimber size (i.e.,12 to 18 inches in diameter). There is a closed canopy layer with few trees in the mid-strata and the understory is lacking/ patchy in many areas of the property. One area of concern, regarding long-term vigor and resilience, is the lack of young trees in the understory (i.e., forest regeneration). Although open conditions allow a person to easily walk through the forest, the lack of a new generation of desired trees, such as [insert species here], may be problematic for the forest to self-renew. This situation is likely due to a combination of deer browse pressure and the lack of sunlight reaching the forest floor, which is reflected in the even-aged forest structure of these woodlands. Improving structural diversity is a priority over the next 10 years through the forest management activities described in this plan.

While structural diversity may be lacking, the existing trees on the Sample property are overall in good condition. Most trees appear to be healthy and not under extreme stress.

Understory plant density is fair throughout the property. Birds and other wildlife typically benefit from a dense understory plant component. Some harvesting can be done in Stands 1, 2, and 3 to improve this critical vegetative layer. Over time, this property will naturally develop small areas of dense understory plant growth as individual trees or groups of trees in the canopy are damaged by natural causes. Invasive plants are found throughout the property in small amounts, with higher populations in Stands 2 and 3. Addressing invasive species will be important for both wildlife populations and ensuring that the forest can regenerate after stand-disturbing events (e.g., forest management or natural events, such as wind or ice).

The topography on this property ranges from gently sloping to steep. A stream runs through Stand 3 and features a scenic waterfall, which is a popular hiking destination. A small stream/ spring is also found in the northeast corner of Stand 1. The Sample family recognized that an important first step of land ownership is to identify and mark the boundaries of their land. Currently, the property boundaries are marked with paint but may need to be refreshed by the end of this 10-year period.

The Natural Heritage and Endangered Species Program (NHESP) identifies approximate areas of threatened and endangered species. According to MA GIS maps, this property does not contain any vernal pools or Priority Habitat for endangered species at this time. However, it is important to check updated NHESP maps (available through the MA MassMapper website) prior to any timber harvesting – properties with the above-mentioned habitats typically have modified operating restrictions. This information will also be assessed by MA DCR any time a Forest Cutting Plan is submitted for the property.

**Regional Significance**

Identifying and protecting historical features is important to the Sample family. The Sample property contains many cultural remnants of years past. Stonewalls and barbed wire indicate past agricultural use. Old cisterns are found along the stream in the northeast corner of Stand 1; these were used by the Thomas family until the early 2000s. Early European development brought about land clearing for agriculture. Farming was the primary occupation for much of Southern New England until the Industrial Revolution in the mid-1800s. The total acreage of open farmland peaked around 1850, then began to decrease as New Englanders pursued the western frontier or took up other occupations locally.

We currently have more forestland in New England now than we did over the last 200 years. However, our forests are threatened by development, insects, diseases, climate change, and many other factors. From 2015 to 2018, the Brimfield area experienced a gypsy moth infestation, reminiscent of the significant outbreak in 1980-1981. The recent outbreak has resulted in the Brimfield area being hit much harder than it was in the 1980s, with areas that still include considerable mortality. The insect pest hemlock wooly adelgid has been an ongoing problem on this property. A recent harvest was conducted, in part, to salvage dead and dying hemlock. The emerald ash borer has also been found nearby and is likely to cause widespread mortality of ash in the coming years. Management that promotes a diversity of species, structure, and age classes can help make forests more resilient against these threats.

The area surrounding the Sample property is approximately 90% forested and 10% residential. The local landscape is relatively unfragmented, with many large parcels of contiguous forestland. Much of the land to the south is protected as a state forest or by a wildlife sanctuary. Most of the land to the north of the property is privately owned. The heavily forested landscape is important for supporting interior-dwelling birds that need large areas of forests, such as the black-throated blue warbler and the black-throated green warbler, which are both found on the property. The forestland in this area is made up of predominantly mature trees. However, young forest habitat is important for supporting a wide range of bird species, such as the chestnut-sided warbler and the eastern towhee. A recent tornado affected the southern region of the property, which resulted in areas of predominantly 9-year-old plant growth. However, the amount of young forest (<15-20 years old) is still well below the general goal of approximately 10% of young forest condition and structure. While the creation of some young forests on this property would contribute to the conservation of a declining group of species, the Samples are not currently ready to do so. Though, they may consider doing so in their next management cycle (2032-2041). Finally, protecting this property from development would help to maintain the forest and the other important features of this area.

**Climate Change Impacts and Vulnerabilities**

All available climate models agree that temperatures will increase across all seasons in the Northeast region over the next century. The projected increase in annual temperature ranges from 3 to 10°F by the end of the century. While it is difficult to predict how future precipitation will change, total annual precipitation is generally expected to increase over the next 100 years. The greatest precipitation increases are expected to occur during the winter, where warmer temperatures will result in more winter precipitation falling as rain instead of snow. There is more uncertainty as to whether precipitation will increase or decrease during the growing season. Even with moderate increases in rainfall, there may be more frequent droughts in the summer and/ or fall because higher temperatures will lead to greater water loss from evaporation and transpiration.

Below is a list of anticipated impacts on Massachusetts forests, with consideration of how each may affect the Sample woodlot:

• **Extreme precipitation and more frequent and intense weather events are expected in the Northeast region throughout the next century**

• **Soil moisture patterns will change, with greater risk of drier soil conditions or drought later in the growing season**

**The Sample property** is characterized by moderate to steep slopes that are often associated with vulnerability to intense windstorms, but the overall northwest aspect significantly reduces this risk as storms typically do not come from this direction. In this region, southeast-facing slopes are in the most vulnerable position to hurricane winds.

Soils underlying the property are of glaciofluvial origin and include the Hinckley, Canton, and Gloucester series, which range from well-drained to excessively-drained. The western portion of the tract is mostly Hinckley soils, while Canton and Gloucester soils dominate the eastern portion. These soils include sandy till and are generally deeper at the bottom of the hill, while they become thinner and rockier towards the upper parts of the property. Soil drainage conditions mean that the property has a relatively low vulnerability to erosion and sedimentation associated with extreme precipitation events, especially given the topography. However, it is vulnerable to drier soil conditions and drought, which can hinder seed germination and establishment.

• **Forest insect pest and pathogen outbreaks are expected to increase in occurrence and inflict more damage**

• **Low-diversity systems are at greater risk**

The topography of the Sample woodlot is highly varied, especially on the western side. Considering the whole property, forest composition is fairly diverse with a range of conifers (e.g., white pine, hemlock) and hardwoods (e.g., oaks, hickories, maples, birch species, white ash, poplar, black cherry) represented. In the near-term, the most vulnerable species is hemlock due to the level of infestation of invasive elongate hemlock scale, along with some hemlock woolly adelgid. Much of the relatively small component of white ash will likely succumb to the emerald ash borer, with this beetle confirmed to be present locally. Oaks and hickories are expected to grow well in future conditions, while impacts from pests such as *Lymantria dispar* (gypsy moth) are hard to predict.

• **Many northern tree species will face increasing stress from climate change**

• **Conditions may become more favorable for some southern tree species**

• **Species and forest types that are more tolerant of disturbance have less risk of declining across the landscape**

The largest stand (Stand 1) is dominated by white pine and hemlock, two species which are projected to have poor capability for adapting to changing climate conditions. With hemlock facing many stressors, from invasive insects and being a species that does not respond to disturbance well unless it is fully established as an understory tree, it is a species at high risk on the Sample property. Other northern species on the Sample property which may not compete as well due to lengthening growing season and regeneration failure are eastern white pine, due to warmer winters and increased spring precipitation increasing native needle cast fungi, and white ash due to a variety of health issues. Trees on the Sample property that may adapt well to the changing climate are red oak and sugar maple, especially on the more mesic soils and protected areas. Birch, poplar, and black cherry respond well to disturbance and are less of a concern on the Sample property.

* **Populations of key herbivores will be affected**

White-tailed deer populations are relatively high in south-central Massachusetts and deer will likely benefit from milder winters, while moose are uncommon and projected to become increasingly less so at the southern edge of their range. Deer browse is already observed to be heavy on oak seedlings, while less so on black birch and maple. Protecting oak seedlings from browse will be an important part of maintaining species diversity on the Sample property.

• **Many non-native, invasive species will increase**

Invasive plants are present on the property and mostly found at moderate levels at the top of the hill in Stands 2 and at a higher density along the woods road at the southern edge of the property (Stand 3) that was grazed by a tornado approximately 10 years ago. The present non-native species include Asiatic bittersweet, autumn olive, Japanese barberry, and winged euonymus. Well-adapted to changing conditions, these invasives are likely to expand their populations, especially in areas where disturbance occurs. Controlling the existing invasives and monitoring for future infestations will be an important part of the management of the Sample property.

**Climate Change Challenges and Opportunities for Management**

The Samples have a property that is a good match for promoting an overall **“resilience”** approach to managing with projected future climate conditions in mind. This approach will allow for the forest on the property to experience some changes with the goal of retaining existing species and habitat characteristics as much as possible, while understanding that some characteristics will change. Secondary strategies include **“resisting”** climate change in the vulnerable habitat along the stream and potentially promoting **“transition”** to future-adapted species and plant communities as the property is monitored for regeneration successes/failures.

Protecting the regeneration capacity of the forest is an important goal and objective at the Sample Property, as it is in most other managed forests. Successful regeneration is a basic indicator of forest sustainability that refers to the ability of mature forest trees to produce seed that germinates into young trees that have the capability to grow into the canopy and ultimately replace the older trees as they decline or die. While species composition may shift over time, regeneration is essential to maintaining a healthy natural forest. Unfortunately, forest regeneration at the Sample property faces some common threats or resource concerns, including forest insect pests, deer herbivory, and invasive plants. These are described in the paragraphs above, below, and in the more detailed stand descriptions.

**Challenges**

Managing the forest, largely stocked with species projected to have poor climate adaptation capability, presents a significant challenge. Stand 1 comprises of 80% of property by land area and is dominated by two species, hemlock and white pine, that are anticipated to decline over different time horizons. As the elongate hemlock scale and adelgid-infested hemlock declines and experiences more significant mortality, the Sample family is interested in conducting pre-emptive salvage harvesting that will require careful planning and execution. While hemlock is under stress from both climate changes and exotic pests, it is also an important component of our forests, providing a unique habitat type for wildlife and shade conditions for upper-level streams. The Samples are interested in a resistance strategy to attempt to maintain hemlock on the landscape where feasible.

**Opportunity**

While it is expected that over the long-term hemlock and white pine will decrease in numbers, oaks and other hardwoods may expand their range. Since red oak, hickories, and other hardwoods are a secondary component of the property, this provides an opportunity for the Sample family to experiment with silvicultural strategies.

While market conditions are favorable for the harvest of hemlock and white pine, there is an opportunity to regenerate parts of the property improving stand structure and enhancing resilience. Creating and maintaining access from Main Road for periodic timber management should be considered before the next entry.

Although regenerating oak is already difficult with current levels of deer herbivory and may become more so in the future, there is room for expanding existing approaches and trying new ones. The Samples do allow hunting with permission. The next logical step would be to monitor deer impacts and hunting more closely, and then to intensify deer hunting if warranted. If possible, coordinating efforts with nearby large landowners (especially MA DCR, as the State Forest abuts the property) will help increase the success of hunting initiatives. The use of tree shelters, planting tree seedlings, constructing deer exclosures, and leaving tree tops and brush after harvesting can also aid the regeneration of oak, as well as other species, to maintain and increase tree diversity.

Since invasive plant species are likely to spread, monitoring both the relatively concentrated population of invasives in the southwestern corner of the property and outlying invaders will become increasingly important. Since invasives can aggressively colonize disturbed areas, this will be especially critical in areas that experience natural disturbance (e.g., canopy gaps resulting from windthrow) and those where timber harvesting is carried out. Projects the Samples have agreed to pursue are a chemical treatment with follow up hand-pulling or cutting, and various types of monitoring of the invasives.

**Carbon Storage and Sequestration Opportunities**

A forest that is adapted to climate change is an important part of climate mitigation through the sequestering and storing of carbon. The Sample’s forest currently stores more than an estimated 2800 tons of carbon, an amount equivalent to the CO2 emissions released from burning more than 1 million gallons of gasoline. This amount is not static, as living vegetation continually absorbs more carbon dioxide while decaying plants release it back into the atmosphere. The challenge is to increase forest carbon storage over the long-term while accounting for inevitable reductions resulting from different types of disturbances, both natural and those caused by humans. Due to past harvests, the basal area of the forest is on the low to moderate end (10th -70th percentile, depending on stand), compared to other stands in this part of Massachusetts. However, because the trees are taller than they would be in an unmanaged stand of equivalent basal area, carbon stocks are likely to be slightly higher than the basal area suggests.

Considering current forest health issues and looking at the projections for the most common tree species on the property, the Sample’s have an opportunity to increase long-term carbon storage and overall sequestration by continuing active management, which includes timber harvesting to achieve their biodiversity goals. Without active management, declining vigor of hemlock due to pest infestations will lead to lower sequestration rates, and ultimately the loss of carbon stocks as trees succumb to mortality. While periodic harvests will lead to short-term carbon loss, this strategy will aim to regenerate species projected to grow well in the future and maintain an overstory of healthy trees needed to meet both storage and sequestration goals. Increased growth in remaining trees, as well as new seedlings that become established after harvest, will increase sequestration rates. Over the long-term, shifting species composition towards a forest more dominated by oaks and other hardwoods, while still maintaining white pine and as much hemlock as possible as a major species, will create a more complex forest structure that can store more carbon per acre.

Small natural disturbances may help to increase sequestration rates. However, if disturbances are significant enough to lead to an undesirable decrease in carbon stocks, harvest schedules can be adjusted.

The soil carbon pool is one of the largest pools in the forest ecosystem. The soil carbon will be protected during timber harvesting by ensuring that the soil is in a stable condition, either frozen or dry, during operations. Where soils have higher soil moisture, these areas will either be avoided or timber mats will be used to prevent impacts. The number of skid roads will be minimized through careful, advanced planning.

The planned enrichment planting in the canopy gaps in Stand 1 with the planned deer browse prevention tactics will increase carbon sequestration, while also improving resilience.

Control or removal of invasive plant species that compete with native regeneration will also improve sequestration rates and carbon stocks over the long-term.

**Bird Habitat Characteristics**

Songbirds and other wildlife thrive when a variety of habitat options are available. Some of the factors that affect habitat suitability include: level of canopy cover, midstory tree density, understory tree density, food value (e.g., acorns, berries, insects, etc.), thermal characteristics, topography, water resources, latitude, and many more. The types of wildlife present on a property depends on all these factors combined. Some species will benefit from diverse habitat characteristics, whereas others prefer more specific, consistent habitats, such as large tracts of dense interior forest, or large open areas.

Habitat strengths observed on the property include a variety of hardwood and softwood trees under a relatively closed canopy, coarse and fine woody material, managable levels of invasive plants, and wetter areas within the riparian corridors. Habitat features that are lacking include areas with a developed midstory (5-30’) and understory (0-5’), snags, and cavity trees. Young forest is present in the tornado area, but there is an opportunity to add more.

**Management Summary**

The Samples have many goals for their property. Finding a balance between climate action, wildlife habitat, and recreation is critical to them. To help achieve these goals, management activities that can compliment each goal has been chosen for this 10-year management period. A timber harvest that can produce some revenue while taking into consideration tree health and stressors, a road system that can withstand larger rain events and become a recreational trail system, and improving habitat conditions through snag creation and invasive plant removal are top priorities. Finding areas of the property that can act as climate refugia and areas that can serve as early successional habitat for wildlife are being explored. Finally, the Samples hope to increase their awareness of the conditions of their woodlands and potential climate impacts.

**Forest Stand Summary**

For the purposes of this report a forest stand is an easily defined area that is relatively uniform in composition and structure.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Stand | Acres | Forest/Habitat Type | Important Observations regarding Bird Habitat, Climate Change, CarbonOr Unique Features and Attributes | Climate Risk  | Carbon/Acre |
| 1 | 61 | White Pine – Hemlock | Variable topographyConifers - an important habitat feature, hemlock stands favored by black-throated green warbler. Some soft mast species.Abundant conifer regeneration, but oaks impacted by deer browse.Coarse woody debris, leaf litter, and nesting cavities enhance habitatHemlock experiencing health issues - both hemlock and white pine have poor adaptation capacity.Soils are susceptible to drought | Moderate to High – due to species composition, droughty soils, and topography | 34.6 t/ac |
| 2 | 11.3 | Oak – Hardwood | Stream buffer area with scenic waterfall; flatter than other standsHemlocks in stream buffer are an important habitat featureEmerald ash borer expected to kill most white ash (minor component)Oaks and hickories provide hard mast for wildlife. Good coarse and fine woody debris, and leaf litter.Invasive plant presence higher than Stand 1, but lower than Stand 3 | Low to Moderate – except concerns near stream buffer | 51.9 t/ac |
| 3 | 4.3 | White Pine - Oak | Mixedwood stand with good structural diversitySouthern edge grazed by 2011 tornado has younger plant growthInvasive plant populations highest in this area and likely to spreadSoils are susceptible to drought | Moderate – due to soils and invasive plants Low – due to age, size, and species diversity | 25.95 t/ac |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |

**STEW 1 WK 61 9.9 102 sqft 5.5MBF WP 60**

 Stand 1 contains a mix of primarily small sawtimber sized (11-15 inches in diameter) sized trees, with scattered trees greater than 20 inches, mainly white pine. Hemlock and white pine dominate, with lesser numbers of black oak, red maple, white oak, paper birch, red oak, pitch pine, black birch, white ash, scarlet oak, hickory, sugar maple, poplar, and black cherry. Hemlock and white pine are considered at-risk species for climate change whereas black cherry, sugar maple, and poplar are expected to do well under various climate scenarios. The health of the hemlocks is impacted by two invasive insects, as hemlock scale is widespread in this stand and hemlock woolly adelgid is found where the scale is not.

 Approximately 73% of the trees in this stand are AGS (Acceptable Growing Stock). These are trees with good health, good structural qualities, and potential for future forest products. Some trees have great qualities for wildlife or biodiversity but would not necessarily fall under the AGS category. These trees have characteristics of broken crowns, cavities, multiple tops, and other “defects.” Retaining such trees in the stand promotes birds and other wildlife species. Snags provide opportunities for nest cavity excavation by the yellow-bellied sapsucker and the northern flicker, which may be re-used in subsequent years by other species. This stand has fewer than the recommended 5 medium to large snags per acre. The annual growth rate for this stand is approximately 9.9Mbf.

 A harvest was done in this stand, as well as Stands 2 & 3, in 2014-2015. Small canopy gaps were created with thinning done between the gaps. Approximately 129 Mbf white pine, 109 Mbf hemlock, 1 Mbf red maple, 15 Mbf red oak, 6 Mbf black oak, and 43 cords of firewood were harvested.

 The understory density and distribution in this stand is currently fair. Regeneration of hemlock and white pine, established after the last harvest, is abundant in some areas; white pine is in the larger gaps, while hemlock is along gap edges. There is heavy deer browse on oak, while herbivory is having less of an impact on other species, such as black birch and maples. Species found in this layer include black birch, red oak, white pine, red maple, hemlock, hickory, spruce, lowbush blueberry, hazelnut, blackberry, raspberry, and ferns. Lady slippers were also observed during 2020 field visits. Many wildlife species, especially songbirds, prefer a dense understory layer where food and cover are abundant. Approximately 50% of the understory is made up of at-risk species.

 The midstory density in this stand is also fair. Hemlock, black birch, chestnut, red maple, white pine, and witch hazel saplings and poles are found in the midstory. Mid-story density is low due to the last thinning where many of the suppressed trees were removed. Remaining stems are straight with vigorous crowns. About 60% of the trees are considered at-risk for climate change.

 The invasive plants multiflora rose, Asiatic bittersweet, and Japanese barberry were also found in small amounts throughout this stand – <10% of the area, but dense where present. Invasive plants can be detrimental to the health of native plant communities as they spread rapidly and out-compete native vegetation. The fruit and vegetative growth they provide can also disrupt the natural diets of birds and other wildlife. Some other species to look out for include winged euonymus, bush honeysuckle, glossy buckthorn, and swallowwort, for they are common in the area, but not yet observed on the Sample property. Invasive plants can quickly get out of hand, and control can be difficult because of the existing seed bank, root systems, and the potential for new establishment from neighboring properties. If control is desired, the sooner that removal is started the better. There may be cost-share money available through the NRCS EQIP program to help with removal.

 From 2015 to 2018, this area has experienced a gypsy moth outbreak that has caused varying degrees of stress and mortality, primarily to oaks. In some instances, another insect, the two-lined chestnut borer, has been attacking trees that are already under stress from gypsy moth defoliation. The trees in this stand do not appear to be under significant stress from these outbreaks.

 According to the USDA soil survey, this stand contains a Hinckley loamy sand, a Gloucester fine sandy loam, and a Canton fine sandy loam. The Hinckley soil, which makes up the majority of the stand, is very deep and excessively drained. The Gloucester soil is very similar to the Hinckley soil. The Canton soil is very deep, extremely stony, and well drained. Timber productivity is good for most of the stand, but better for pine rather than oak.

The topography is moderately sloping to steep. Access for management and recreational purposes is fair; the steep slopes limit easy access to some areas. Erosion is currently not a significant problem in this stand. A few small intermittent streams cross through the northern end of the stand. A small number of cisterns were located around these streams, which provided water to the Thomas residence until the early 2000s.

Bird and other wildlife habitat features

 Some nesting cavities are present in this stand. Large dead or dying trees can provide nesting cavities for wildlife, including owls, fisher, raccoons, porcupine, squirrels, black bears, chickadees, and many others. A Focal Bird that nests in cavities is the northern flicker. The foliage of the pine and hemlock in this stand provides great thermal cover for wildlife throughout the year. These trees also provide good fall and winter roosting locations for species such as ruffed grouse. Seeds from hemlock and white pine can provide food for a variety of birds, such as pine siskin and gold finch, particularly in the winter when less food is available.

 Acorns, hickory nuts, and hazelnuts provide a good source of hard mast, which is an important food source for species such as deer, turkey, bear, wood ducks, moose, and squirrels. Many of the same wildlife species also utilize soft mast food sources such as blueberry, black cherry, blackberry, and raspberry, including Focal Birds such as the wood thrush and veery.

 Coarse woody debris (CWD), or fallen trees and limbs, creates excellent habitat for birds, small mammals, reptiles, amphibians, invertebrates, etc. This material can be used as den sites, nesting cavities, and to provide an important insect food source for birds and other wildlife. This material is also essential for soil nutrient recycling and carbon sequestration. CWD levels are currently good in this stand. CWD will increase naturally over time or can be boosted by leaving material on the ground after a timber harvest. Harvesting was done most recently in 2015, and before that in 1989 and 1998. Slash, or fine woody debris, can be collected to make concentrated piles, which provide great cover or den sites for species such as rabbits, foxes, bears, turtles, and birds, such as towhees, cardinals, sparrows, and many more. Fine woody debris levels are currently good. This stand also contains a good amount of hardwood leaf litter, which encourages soil invertebrate food for birds and nesting habitat for oven birds.

 Some Focal Birds such as the black-throated green warbler, prefer to nest in stands of hemlock.

**Climate Change Impacts and Considerations**

 The combination of site conditions and the fact that Stand 1 is dominated by white pine and hemlock, two species which are projected to have poor capability for adapting to changing climate conditions, is cause for concern. Deer impacts on oak regeneration will likely prevent oaks and associated species, such as hickory, from becoming a larger component of the canopy without intervention. In the near-term, conditions are more dire for hemlock as invasive hemlock scale, along with some hemlock woolly adelgid, is widespread and this species grows best in undisturbed conditions. Moreover, the susceptibility of the Hinckley, Gloucester, and Canton soils to drier conditions and drought will probably exacerbate forest health issues in the future. Although only small populations of invasive plants are present, they are likely to spread if left unchecked, especially in areas where there are canopy openings.

 Of the three stands on the property, climate risks are highest in this stand, which is also the largest stand by size. In the short-term, it will be important to monitor the condition of the hemlocks and to develop a response plan in the likely event that increased mortality is observed. Although currently robust, white pine is also projected to decline over a longer timeframe. A passive approach will likely lead to an increasing amount of dead hemlock and potentially other species, which would have benfits for some wildlife species, while impacting aesthetics, increasing fire risk, and potentially creating hazards along trails. Active management could help reduce mortaility in remaining trees and shift the species composition of the stand to include a greater component of hardwoods, especially oaks and hickories, with better climate adapation capacity, while still retaining a large amount of pine and hemlock on the northwest facing slopes and in pockets with more moisture. This strategy would sustain some carbon stock losses in the short-term, but increase sequestration and create the conditions for higher carbon stocks in the long-term.

The areas of steeper slopes are more vulnerable to soil erosion. Increasing rainfall and extreme storms can exacerbate exising problems. Old skid trails should have water bars maintained as necessary and the road network location re-examined before another harvest. Filterstrips BMPs should be strickly adhered to, to protect the stream and stream-side soils.

**Desired Stand Condition**

 The desired future condition for this stand is an uneven-aged mix of good quality, native trees and shrubs. The desired composition includes a higher percentage of oaks and hickories, while still retaining a large amount of pine and as much hemlock as possible. Skid roads used during forest management will be retained in good condition for passive recreation.

 A harvest which continues to create canopy gaps and enlarges gaps created during past management will move this stand toward a more uneven-aged condition with a higher stand complexity, which is an important strategy for many of our responsibility birds as well as climate adaptation and mitigation. Protection from browse for seedlings and removal of invasives will ensure the stand can perpetuate after a large canopy disturbance event, such as a windstorm.

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| **Condition** | **Action** | **Focal birds that may benefit** |
| Interior Forest Condition with high complexity | Create some larger canopy gaps  *- group selection*  *- expanding gap* | black-throated blue warbler, black-throated green warbler, Canada warbler, eastern wood-pewee, wood thrush |
| Increased native plant and tree presence/ diversity | Uneven aged management *- Single Tree & Group  Selection*Invasive Plant Control | American woodcock, black-and-white warbler, black-throated blue warbler, black-throated green warbler, Canada warbler, chestnut-sided warbler, eastern wood-pewee, northern flicker, ruffed grouse, veery, white-throated sparrow, yellow-bellied sapsucker |
| Increase/maintain CWD and snags | Leave some dead trees standing and dead wood on the ground after harvest, Create brush piles | Canada warbler, northern flicker, ruffed grouse, veery, white-throated sparrow |

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| **STEW** | **2** | **OH** | **11.3** | **11.0”** | **153sqft** | **9.5Mbf****15cd** | **WP-60** |

 Stand 2 contains an above-average mix of small sawtimber sized (12 to 16 inches in diameter) hemlock, red oak, red maple, black oak, yellow birch, white pine, hickory, white ash, white oak, and elm. Canopy closure is about 80% with dappled light reaching the forest floor and a canopy height near 60’. Approximately 70% of the trees in this stand are AGS (acceptable growing stock), with full crowns and good vigor. The annual growth rate is around 1.8 Mbf/ acre/ year. Most of the species in this stand (75%) are expected to grow fair to well under changing climate conditions. There are few snags in this stand due to the young age of the trees.

 Although white ash populations are relatively low, it should be noted that the exotic insect pest, the emerald ash borer (EAB), has been found in the area over the last few years. This insect is expected to kill most of the ash trees in its multi-state-wide path. Initial damage from this insect can be identified by small, D-shaped exit holes on the bark, accompanied by “blonding” – a paling of the bark created when layers of bark are removed by the exiting insects. Unfortunately, there are no reasonable prevention methods for this insect. Trees affected by EAB can be used for lumber if caught early, but are predominantly used for firewood.

 The understory density in this stand is sparse and evenly distributed, which is typical of stands with high canopy closure. Understory plant species include hemlock, red oak, red maple, spicebush, blackberry, raspberry, ferns, Canada mayflower, and the invasive exotic plants winged euonymus, Japanese barberry, and Asian bittersweet. Invasive plant levels are moderate, were at least 20% of the stand is affected, which is higher in this stand than Stand 1.

 A midstory is considered trees 6 to 30’ tall. The midstory density of this stand is variable where percent cover at approximately 15%. This layer contains a similar species mix to the overstory including hemlock, yellow birch, hickory, red maple, and red cedar. The species mix is due to the relatively young nature of the stand (red cedar is often an invader of pasture land) and moist conditions that favor yellow birch and red maple. Overall, the vigor is good. Coarse woody debris, fine woody debris, and leaf litter levels are good in this stand.

 Although this property contains many steep slopes, this stand is quite flat. A stream flows through the stand and appears to have taken many channels throughout time, leaving behind abandoned gullies in the otherwise flat topography. This may have been partially influenced by farmers. Hemlock is concentrated along the stream and is an important feature, maintaining shade, habitat value, and scenic value.

 A small waterfall is also found in this stand along the stream. This area is a great destination for hikers and is a favorite spot for the Sample family. This portion of the property is open to the neighbors for passive recreation. Just upstream from the waterfall is a wetland with variable hydrology and blow-downs that occur on a semi-regular basis.

 According to the USDA soil survey, this stand contains the same Hinckley loamy sand described for Stand 1.

Bird and other wildlife habitat features

Stream corridors, like this one, can act as a transition zone with higher levels of plant diversity. High gradient stream with meandering flow and bordering vegetated wetlands help maintain a complex forest with blow downs, dead or dying trees, and complex stream habitat with pools and riffles. A Focal Bird that is known for nesting in this habitat includes the Canada warbler.

**Climate Change Impacts and Considerations**

 Of the three stands on the property, climate risks are lowest here in Stand 2, as the dominant species are projected to have good adaptation capacity and soils are more mesic along the stream corridor. However, the shaded stream corridor that keeps the water cool and provides good habitat for fish and other aquatic species is at risk of becoming somewhat less shaded if the hemlocks and conifers present along its banks decline. In addition, the white ash trees that grow well in mesic soils and are more common than elsewhere on the property, are projected to mostly, or entirely, drop out of the species mix due to ash yellows and emerald ash borer. Deer impacts on the regeneration of oaks and other preferred browse species are a concern here, as elsewhere on the property.

 Populations of invasive plants are higher here than in Stand 1, and they are likely to spread if left unchecked, especially in areas where there are canopy openings. The walking trail from the main road has a somewhat steep slope down to the waterfall and may be more vulnerable to erosion during expected extreme rain events here than in other areas.

 The stream has a braided channel and shows signs of moving throughout the flatter areas of the stand. Increased storm events will probably increase the movement of the stream. Management of the stand will become more challenging without frozen soil conditions. The Sample family has 2 small footbridges and is concerned about flooding and the movement of the stream channel.

 A climate opportunity in this stand is to maintain the riparian function for water quality, to create a refugia to protect the sensitive riparian buffers, and to maintain Hemlock well into the future. This stand also has the highest current carbon stocks, and is likely to maintain or increase carbon sequestration rates in the future as the growing season lengthens. Abundant moisture means that growth is less likely to be limited by drought in this stand as temperatures warm.

Desired Stand Condition

 The desired future condition for this stand is a healthy, productive stream buffer with large, old trees capable of storing a high per acre volume of carbon. The main climate strategy employed will be resistance. In general, a reserve approach will be used. However, there will be the need to create small gaps to move the stand toward a more uneven-aged condition and to reduce stressors caused by overcrowding as needed to help maintain at-risk species such as ash and hemlock and to ensure regeneration. Due to the mesic nature of the soils, controlling the invasive species and developing a monitoring protocol to keep populations in check is a high priority for both wildlife considerations and climate adaptation/mitigation. Also, of importance, are reducing footpath and trailside hazards, maintaining aesthetics, and protecting soils and the footbridges from flooding and erosion.

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| Healthy, diverse wetland area contains CWD, snags, and tip-ups | Single Tree & Group Selection with invasive treatment | black-throated blue warbler, black-throated green warbler, Canada warbler, eastern wood-pewee, wood thrush, yellow-bellied sapsucker, northern flicker, ruffed grouse, veery, white-throated sparrow |

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| **STEW** | **3** | **WO** | **4.3** | **10.6”** | **75sqft** | **5.7Mbf****8.1cd** | **WP-60** |

 Stand 3 is located in the southwest corner of the property, along an old CCC road leading from the main road. This is a young stand with a mix of pole to sawtimber sized red oak, hemlock, white ash, white pine, hickory, yellow birch, red maple, and black birch. The vigor of this closed canopy stand is high. Approximately 73% of the trees in this area are AGS. The annual growth rate for this stand is around 0.7 Mbf.

 Stand density, tree age, and size is variable due to a tornado that grazed the property and openings during the 2015 timber harvest. The variable nature of this stand results in a high diversity of stand structure, percent cover, and snags than other portions of the property. Although the tornado was a significant, negative event for the Sample family, it created the most diversity on the property.

 The understory density in this stand is good with percent cover being 20% in the main portion of the stand and at least 60% in the tornado section. Native plants include white pine, white oak, black birch, red oak, chestnut, red maple, hickory, hemlock, sugar maple, white ash, hazelnut, lowbush blueberry, and ferns. The midstory density is also good. Many smaller trees were released by the tornado and are now small poles with expanding crowns. This layer contains black birch, hemlock, white pine, and witch hazel. Coarse woody debris, fine woody debris, and leaf litter levels are good in this stand. The species mix is 50-50 with respect to climate vulnerability.

 Where the tornado passed through the stand, most of the overstory was damaged and has regenerated to a dense mix of hardwood saplings. Unfortunately, this area contains the invasive plants winged euonymus, autumn olive, and Japanese barberry, which are interfering with native plants such as red oak, white pine, red maple, gray birch, black birch, black cherry, red cedar, blackberry, raspberry, and grape.

 According to the USDA soil survey, this stand contains the same Hinckley soil described for Stand 1.

Bird and other wildlife habitat features

 This stand contains the most complexity on the property in terms of tree species mix, ages, and sizes. Trees damaged and left standing by the tornado provide cavities and important structures for birds and other wildlife. In areas where the stand has been opened up, blackberries, raspberries, regenerated pin cherry, as well as other shade intolerant species have been established. This habitat provides good nesting opportunities for early successional birds such as the chestnut-sided warbler and eastern towhee. This type of early successional habitat is fleeting and without intervention, it will only be suitable for another 5 to 10 years. The Sample’s are considering a small harvest to create more early successional habitat over the next management cycle.

**Climate Change Impacts and Considerations**

 Some of the same considerations for Stand 1 also apply to the much smaller Stand 3. Although, hemlock and white pine are less dominant here with oaks and other hardwoods comprising a greater percentage of the canopy trees. The susceptibility of the mostly Hinckley soils to drier conditions and drought will likely exacerbate the decline of the hemlock.

 Carbon stocks are somewhat low in this stand, as a result of past disturbance. However, the more variable structure is a positive for carbon sequestration rates. Drier soil conditions may negatively impact both carbon stocks and sequestration rates for tree species susceptible to drought. Drought may also lead to greater mortality of oaks during gypsy moth (*Lymantria dispar dispar*) outbreaks.

 The higher populations of invasive plants and the likelihood of spread is the greatest concern in this stand, especially when combined with the deer impacts on the regeneration of oaks and other preferred browse species that make it hard for desired hardwoods to compete with the invasives. The greatest concentration of invasives are located on a log landing off the CCC road.

**Desired Stand Condition**

 The desired future condition is to allow natural successional processes to continue. Due to the presence of a dense understory and adequate mid-strata, the stand is at a level of high carbon sequestration. Large overstory trees retained after past management, which survived the tornado, are contributing to carbon storage. The southern portion of the stand with younger trees adds structural and species diversity and composition. This will change as early-successional species, such as pin cherry, yield to mid-successional species.

 Invasive plant control should be a priority.

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| **Condition** | **Action** | **Responsibility birds that may benefit** |
| Early successional habitat | No Management  |  |
| Increased native plant and tree presence/ diversity | Invasive Plant Control | American woodcock, black-and-white warbler, black-throated blue warbler, black-throated green warbler, Canada warbler, chestnut-sided warbler, eastern wood-pewee, northern flicker, ruffed grouse, veery, white-throated sparrow, yellow-bellied sapsucker |
| Increase/maintain CWD and snags | No Action - Leave dead trees standing and dead wood on the ground  | northern flicker, white-throated sparrow, yellow-bellied sapsucker |

**Management Recommendations**

For the purposes of this report, management practices with an object code of *CH61* are required to be accomplished as a commitment to the Massachusetts Current Use Program. Practices with object codes of *STEW* are voluntary and are provided as suggestions of activities that can help you achieve your woodland objectives.

**Summary of the Management Recommendations for your property**

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| ST#  | Obj Code | Desired Condition  | Management Action | Benefits | Value/Cost/Cost Sharing Opportunity |
| Bird Habitat & Focal Birds | Climate Change Adaptation | Forest Carbon |  |
|  1 | STEW | Larger canopy openings help increase oak and hickory in addition to retaining pine and hemlock | Group & single tree Selection harvest; (NRCS practice = Forest Stand Improvement) | Canopy openings benefit birds and other wildlife species | Shift composition towards a higher % of species and varied structure better adapted to future conditions | Short-term reduction; long term gain | Likely net $ gain; eligible for NRCS EQIP practices 655, 666 |
|  2 | STEW | Canopy openings favor healthy trees and create a new age class; stream corridor protected | Single tree & group selection harvest (NRCS practice = Forest Stand Improvement) | Canopy openings benefit birds and other wildlife species | Shift composition toward species and varied structure better adapted to future conditions | Short-term reduction; long term gain | Likely net $ gain; eligible for NRCS EQIP practices 655, 666 |
| 1 | STEW | Increased abundance of young oaks, hickories, and possibly other hardwoods | Enrichment planting of desired native tree species in canopy gaps;seedling protection and deer exclosure fencing(NRCS practice = Tree and Shrub Establishment) | If successful, more acorns and hickory nuts provide food for birds and wildlife | Increased abundance of young trees of species adapted to future conditions | Gain for planted trees that survive and grow to maturity | Eligible for NRCS practice 612; |
|  1, 2 | STEW | Standing dead trees, brush piles, and bird boxes provide and enhance habitat features | Girdling trees; creating brush piles; installing bird boxes (NRCS practice = Structures for Wildlife) | Create and enhance habitat for birds and other wildlife species | Enhance habitat for bird and wildlife species amidst changing conditions | Negligible; more dead wood left onsite | Eligible for NRCS EQIP practice 649 |
| ALL | STEW | Reduced deer impacts on regeneration, especially oak and other preferred hardwoods | Monitor both deer impacts on vegetation; and deer hunting and, if possible, increase deer hunting opportunitiesTree shelters | N/A | Successful natural regeneration and increase of trees and plants (esp. oaks) with good adaptation capacity | Long term gain if regen conditions improve | Significant effort; may be a combination of contractor and landownerNRCS tree shelters |
| ALL | STEW | Reduced levels of invasive plant populations and associated impacts on native plant regeneration | Invasive Plant Monitoring and Control (NRCS practice = Brush Management) | Increased abundance of native trees and plants providing food and habitat for birds and wildlife | Successful regeneration and growth of native trees and plants, especially those with good adaptation capacity | Long term gain  | Eligible for NRCS practice 314 |
| ALL | STEW | Increased awareness of forest conditions and climate impacts  | Monitoring of conditions and potential climate impacts | Opportunity to note bird & wildlife and habitat changes and respond with climate-adaptive practices to benefit species | Opportunity to note changes and respond with climate-adaptive practices | Opportunity to increase forest carbon over the long term | Significant effort; may be aided by Sample family |

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| **STEW** | **1** | WK | Group and Single Tree SelectionForest Stand Improvement | 50 | 20 sqft | 54MBF54 cds | 2025-2030 |
| Carbon and Adaptation Practice | Creating Gaps Promote Regeneration/Enhance adaptive capacity in forests (resiliency) |
| NRCS Practices | 655, 666 |

Based on the Sample’s combined goals of increasing carbon sequestration/ storage and bird habitat, it is suggested that a harvest be implemented that builds upon the 2015 harvest. Openings created during the 2015 harvest can be increased by expanding gaps to release regeneration established during the previous harvest. In addition, openings of various sizes can be created within the stand to break up the even-aged canopy, reduce the stocking of white pine and hemlock on the drier sites, and provide enough light to allow for shade intolerant species such as oak, hickory, and black cherry to germinate. Gaps should be oriented to balance maximum light reaching the forest floor and some shade retention to reduce the effects of drought and ensure regeneration success. Gap creation will be no more than 20% of the stand. A few large, high vigor trees per acre will be selected as legacy trees and left to continue growing indefinitely. Legacy trees should represent the diversity of tree species in the stand. Important wildlife trees, such as those with cavities, will also be selected for retention. Retention helps balance sequestration with carbon storage and provides structural complexity to the stand which is important for wildlife species. Since hemlock provides a unique habitat type, it will be important to maintain a component if possible. When selecting hemlocks to retain, individuals should show signs of resistance to the elongate scale and wooly adelgid and be located on more mesic soils with north or northwest facing slopes. Some trees should be retained around the hemlock since this species does not respond well to too much sun exposure.

Regeneration is necessary for both climate adaptation and carbon sequestration. These practices are designed to improve the health and function of the stand and promote the establishment of future-adapted forests.

Course woody debris will be retained after management activities for soil stabilization on slopes, wildlife habitat, carbon storage, and nutrient retention. Some of this material could also be collected into concentrated piles to create cover/ den sites for wildlife or birds, such as the veery.

Cost-share funding through the NRCS EQIP program may be available to support Forest Stand Improvement work. For more information, contact the local NRCS office in Hadley: 413-585-1000 ext. 3.

Management considerations:

Cultural sites such as cisterns and other unique features will be identified prior to management activities and protected during harvesting.

This harvest recommendation is also a good opportunity to plan for establishing periodic access for timber harvesting from the bottom of the hill along the main road. This would include identifying a log landing site and ensuring that the major skid roads leading to it are in good condition to withstand impacts from logging equipment and potential severe weather events.

Skid roads will be laid out in advance, taking into account the landowner’s desire for walking trails and to protect soils, especially on slopes, to the degree possible from heavy rain events. Best management practices will be strictly adhered to during management activities. Due to changing conditions, it is important that management be flexible and adaptive. Practices may take longer to complete than in the past due to wetter soil conditions in the winter, spring, and fall seasons.

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| **STEW** | **2** | OH | Single Tree SelectionForest Stand Improvement | 5 | 30 sqft | 9.3MBF14.7 cds | 2025-2032 |
| Carbon and Adaptation Practice | Establishing forest reserves (protecting rare and sensitive sites), Increasing time between harvests |
| NRCS Practices | 655, 666 |

In Stand 2, single-tree selection harvest is appropriate to achieving landowner goals of carbon storage, water quality protection, and aesthetics, since the canopy composition is already close to the desired future condition. Slowly moving the stand toward an uneven-aged condition, while improving growth rates will more quickly achieve higher carbon densities. Hemlocks should be lightly thinned to increase growth and allow for regeneration. Low quality hardwoods will be marked for removal, while trees exhibiting cavities or other wildlife features will be retained.

Since protecting the stream corridor is a priority, any harvesting in the riparian/ stream filter strip will be light to maintain shade near the stream and minimize potential negative effects to water quality. Special measures will include minimizing skid trails in the stream buffer area, installing water bars on slopes, swamp mats on wet soils, and the use of temporary bridges. No harvesting will occur near the waterfall except hazard trees and downed trees that present obstacles.

Due to the moderate presence of invasive species, control is important prior to the harvest or to any opening of the canopy through natural events such as wind (see management practice below). Except for the wetland, coarse woody debris is low in this stand and could be improved through the retention of slash during harvesting or through the natural mortality process.

Because of the small area and volume to be removed, any harvesting should be done in conjunction with Stand 1.

Long-term, the stand may be left to grow to act as a refugia for hemlock and to maintain the cold-water stream. Monitoring for adaptive management will be important.

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| **STEW** | **1** |  | Enrichment Planting | 5 ac |  |  | 2025-2032 |
| Carbon and Adaptation Practice |  |
| NRCS Practices | 612 Tree and shrub establishment |

Following the group- and individual-tree selection harvest, experimental enrichment planting can be conducted in some of the larger canopy gaps, especially if natural regeneration of oaks, hickories, or hemlock in Stand 2, does not reach expected levels. The tree seedlings that are planted should be species with good climate adaptation capacity that are desired as a greater component of the future stand; mainly, native oaks and hickories and possibly other hardwood species. Since planted seedlings will be vulnerable to deer browse, the project should incorporate deer browse prevention measures, such as mesh tubes for seedlings and/ or deer exclosure fencing (see below). It may be best to plant trees near trails or other easy-to-access locations so that they can be easily monitored and released from competition as necessary.

Unless hiring contractors is preferred, this project could be carried out by the Sample family and scaled according to the resources and labor available. Work would need to be carried out or supervised by individuals with experience planting tree seedlings.

Cost-share funding through the NRCS EQIP program may be available to support Tree and Shrub Establishment practices. For more information, contact the local NRCS office in Hadley.

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| **STEW** | **ALL** |  | Deer Browse Control and Monitoring | ALL |  |  | 2025-2032 |
| Carbon and Adaptation Practice | Protect seedlings from animal browse |
| NRCS Practices | 655, 666 |

From a bird habitat and climate perspective, deer can have a negative impact on the landscape. When populations get too high, browsing can reduce the understory to the point that species composition can be affected or the stand may be delayed in regeneration after a canopy disturbance, which would impact carbon sequestration and storage. An understocked understory is a problem for ground- or low-nesting birds, as well.

The initial evaluation of regeneration on the Sample property indicated that deer are impacting the species composition of the forest. While hardwoods are regenerating, there is typically moderate to heavy browse on oak, hickory, and other preferred browse species. It will be important to monitor regeneration over time, especially in the years right after management activity or stand disturbance. That way, action can be taken to protect seedlings from browse, if necessary, to maintain or increase tree species composition. Seedlings are no longer susceptible to browse after they reach 6 feet in height. In some cases, on the Sample property, deer browsing on oaks have stunted their growth so that they cannot compete with the black birch, a species that is not preferred by deer. In these areas it may be effective to cut the birch back to 3-4 feet above ground level. This will provide cover for the oak seedlings while keeping the birch from overtopping them. In other cases where the understory is light, shelters may be used to protect seedlings.

A contractor will be used to release oaks and other species from overtopping birch. The Samples would be interested in doing the installation of tree shelters with some oversite. Although the Samples can certainly do pro-active monitoring, a more methodical approach would be best to quantify the impacts, which would decide if further measures are needed.

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| **STEW** | **ALL** |  | Bird Habitat – Girdling, Brush, Birdhouses | ALL |  |  | 2025-2032 |
| Carbon and Adaptation Practice |  |
| NRCS Practices | 649 |

Some of the trees on this property could be girdled to create standing dead trees, or snags, for insectivorous and/ or cavity-nesting wildlife. These wildlife trees should be created far enough away from established trails that they will not present a hazard. When choosing trees to girdle, consider first identifying good quality “crop trees” that could be released into the canopy. Some of the poorer quality trees adjacent to the crop trees should be selected for girdling. Snags should be disbursed throughout the property to reduce overlapping bird territories and maximize usage. Guidelines suggest more than 5 snags per acre that are greater than 10” in diameter.

Some birds and small mammals also use brush piles for cover and nesting. Piles can be created using material already on the ground or using small trees or treetops that are cut specifically for that purpose.

Wood duck and barred owl boxes would be good fits for this property.

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| **STEW** | **ALL** |  | Invasive Plant Monitoring and Control | ALL |  |  | 2025-2032 |
| Carbon and Adaptation Practice | Removing Invasive Vegetation |
| NRCS Practices | 314 |

Control of competing vegetation is needed to maintain ecosystem functions, as well as to facilitate regeneration of forests along desired trajectories. Invasive plant populations are currently low throughout most of this property, although they are higher in the southwest corner. Japanese barberry, multiflora rose, and Asiatic bittersweet are found in small amounts in Stand 1 (61 acres). Higher densities of the plants winged euonymus, Japanese barberry, and Asiatic bittersweet are found in Stand 2 (11.3 acres). The highest invasive plant densities are found in Stand 3 with the presence of species such as winged euonymus, autumn olive, and Japanese barberry (4.3 acres).

Controlling these non-native invasives can be difficult, but may be possible with multiple follow-up treatments, continuous monitoring, and sustained efforts to establish and encourage native vegetation in place of the invasives. Herbicide use has the highest control percentage and can be very effective at reducing or eliminating the current invasion. A cut-stump treatment can reduce the volume of herbicide needed and reduce the impacts to non-target plants. This method will kill the root system and prevent re-sprouting. It is important to use this method during the growing season so the plant will quickly absorb the chemical. It still may be necessary to cut or treat the plants again the following year, but using herbicides will considerably minimize the amount of follow-up work. Once the percentage of invasive plants has been dramatically reduced, then mechanical methods such as pulling can be used to prevent new infestations. This monitoring and control can be done by a contractor or the Sample family. There are chemicals such as those listed on the Massachusetts Sensitive Areas Materials List (https://www.mass.gov/service-details/rights-of-way-sensitive-area-materials-list) that are safe for non-aquatic plant use in and near wetlands.

Cost-share funding through the NRCS EQIP program may be available to support Tree and Shrub Establishment practices. For more information, contact the local NRCS office in Hadley.

It will be important to implement invasive plant control measures prior to conducting timber harvests in Stands 1 and 2, as described above. Conducting a harvest without controlling the invasives will likely lead to the spread of invasives into disturbed areas. However, any canopy disturbing event will have a similar effect.

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| STEW ALL |  |  Climate Impacts Monitoring |  |  |  | 2021 -2032 |   |

Monitoring for climate impacts can be combined with other types of property monitoring and carried out by the Samples or their forester. With the predicted increase in storms, the odds of a stand disturbing event increase as well. It is important that management be flexible and adaptive. It is also helpful to have a conversation in advance about the potential for a natural disaster to discuss options and to be prepared; this will allow for a quick response if necessary.

**Additional Management Considerations**

Minimize harvesting during the breeding season. Forest birds in New England typically breed from May-August. Harvesting during the winter is preferable and can help protect advanced regeneration and understory growth from damage.

Minimize extent of forest access roads and keep the width <20’. These can serve as pathways for nest predation and parasitism. Additionally, non-native species can come in on roads and establish themselves deep inside forest patches. As roads are widened habitat, quality decreases for ground foragers such as the ovenbird. Also, leaf litter becomes warmer and drier, decreasing the density of arthropods for birds to forage on.

**Signature Page** **Please check each box that applies.**

**☐  CH. 61/61A/61B Management Plan I attest that I am familiar with and will be bound by all applicable Federal, State, and Local environmental laws and /or rules and regulations of the Department of Conservation and Recreation. I further understand that in the event that I convey all or any portion of this land during the period of classification, I am under obligation to notify the grantee(s) of all obligations of this plan which become his/hers to perform and will notify the Department of Conservation and Recreation of said change of ownership.**

**x  Forest Stewardship Plan. When undertaking management activities, I pledge to abide by the management provisions of this Stewardship Management Plan during the ten-year period following approval.** I **understand that in the event that I convey all or a portion of the land described in this plan during the period of the plan, I will notify the Department of Conservation and Recreation of this change in ownership.**

**Signed under the pains of perjury:**



**Owner(s)  The Sample Family** **Date 1/24/22**

**Owner(s)** **Date**

**I attest that I have prepared this plan in good faith to reflect the landowner's interest.**

**Plan Preparer  Millie Quercus** **Date 1/22/2022**

**I attest that the plan satisfactorily meets the requirements of CH61/61A/61B and/or the Forest Stewardship Program.**

**Approved, Service Forester** **Date**

**Approved, Regional Supervisor** **Date**



**☐ Amendment**

**Signed under the pains of perjury:**

**Owner(s)** **Date**

**Plan Preparer** **Date**

**Description of Amendment:**







**Approved, Service Forester** **Date**