New Hampshire
Forest Action Plan – 2020

Department of Natural and Cultural Resources
Division of Forests and Lands
Acknowledgements

This document was developed by the New Hampshire State Forest Action Plan team:

Brad Simpkins, Director (former), NH Division of Forests and Lands
Tracey Boisvert, NH Division of Forests and Lands
Susan Francher, NH Division of Forests and Lands
William Guinn, NH Division of Forests and Lands
Kyle Lombard, NH Division of Forests and Lands
Steven Roberge, UNH Cooperative Extension
Sabrina Stanwood, NH Division of Forests and Lands

with review and guidance from the New Hampshire Forest Advisory Board:

Carol Foss, New Hampshire Audubon
Dennis McKenney, Forester
John Caveney, Forester
Jack Bronnenberg, Logger
Tom Thomson, Forest Landowner
Mark Ducey, University of New Hampshire
Steven Roberge, UNH Cooperative Extension
Charles Niebling, Innovative Natural Resource Solutions
David Publicover, Appalachian Mountain Club
Jasen Stock, NH Timberland Owners Association
James Oehler, NH Fish and Game
Jack Savage, Society for the Protection of NH Forests
USDA Forest Service, White Mountain National Forest
Mark Zankel, The Nature Conservancy in NH

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CONTENTS

Introduction .................................................................................................................................................. 6

About New Hampshire’s Forests ................................................................................................................. 6

Forest Action Plan Components ................................................................................................................. 8

Stakeholder Engagement .............................................................................................................................. 8

What We Heard .......................................................................................................................................... 9

About the Division of Forests and Lands ................................................................................................... 10

FOREST RESOURCE ASSESSMENT .......................................................................................................... 12

1. Total Area of Forest Land & Forest Land Trends ................................................................................. 12

2. Forest Land Conversion ......................................................................................................................... 18

3. Soil Productivity ................................................................................................................................... 20

4. Fish & Wildlife Habitat .......................................................................................................................... 25

5. Matrix Woodland Communities .......................................................................................................... 28

   Exemplary Matrix Woodland Communities .......................................................................................... 28

   Rare Plants Occurring in Matrix Woodland Communities ....................................................................... 28

   Status of Matrix Woodland Communities ............................................................................................ 29

6. Watershed Values ................................................................................................................................... 32

7. Forest Insects & Disease – Native and Invasive .................................................................................... 40

   Insects: .................................................................................................................................................. 40

   Diseases: ................................................................................................................................................ 43

8. Terrestrial Invasive Plants ...................................................................................................................... 45

9. Fire Management .................................................................................................................................... 47

   Wildfire Protection .................................................................................................................................. 47

   Prescribed Fire ....................................................................................................................................... 50

10. Climate Change ................................................................................................................................. 53

    Forest Carbon ...................................................................................................................................... 60

11. Large Forestland Blocks ...................................................................................................................... 64

12. Conservation Lands .............................................................................................................................. 68

13. Forest-Related Recreation Trends and Opportunities ......................................................................... 72

14. Population Trends ............................................................................................................................... 76

15. Development Pressure .......................................................................................................................... 83

16. Housing Density ................................................................................................................................... 89

17. Forest Landowner Trends and Potential for Change ......................................................................... 92

18. Trends in Size of Forestland Ownership ............................................................................................. 95

NH Forest Action Plan - 2020
21. Legal, Institutional, and Policy Framework .......................................................................................................................... 111
   New Hampshire forest policy and law ................................................................................................................................. 111
   State and Institutional Framework ....................................................................................................................................... 113
   Forest management standards/guideline .............................................................................................................................. 115
   Forest-related assessment & planning .............................................................................................................................. 115
Priority Landscapes ......................................................................................................................................................... 118
   Forest Stewardship Priority Areas .................................................................................................................................. 121
Multi-State Priorities ....................................................................................................................................................... 123

Goals-Strategies-Actions ..................................................................................................................................................... 127
   FOCUS AREA – FOREST ECOLOGY ................................................................................................................................. 127
   FOCUS AREA – WILDFIRE MANAGEMENT ...................................................................................................................... 129
   FOCUS AREA - FOREST HEALTH .................................................................................................................................. 131
   FOCUS AREA - FOREST MANAGEMENT ........................................................................................................................ 133
   FOCUS AREA - CLIMATE CHANGE .................................................................................................................................. 136
   FOCUS AREA - URBAN & COMMUNITY FORESTS ............................................................................................................. 137
   FOCUS AREA - LAND CONSERVATION ............................................................................................................................. 139
   FOCUS AREA – FOREST BASED ECONOMY ...................................................................................................................... 142
   FOCUS AREA - FOREST POLICY & INSTITUTIONAL FRAMEWORK ...................................................................................... 146
   FOCUS AREA - EDUCATION & OUTREACH ..................................................................................................................... 148

Forest Resource Strategies Matrix ........................................................................................................................................... 151

National Priority Accomplishments ........................................................................................................................................ 157

New Hampshire Forest Legacy Program .................................................................................................................................... 172
   Forest Legacy Program Requirements in the State Forest Action Plan ................................................................................ 202

Appendices .............................................................................................................................................................................. 204
   Appendix A  Insects and Diseases in NH Affecting Trees ........................................................................................................ 204
   Appendix B  US Dept. of Commerce - Outdoor Recreation Activities ...................................................................................... 205
   Appendix C  NH Forest Legacy Program Completed Projects .............................................................................................. 207
   Appendix D  New Hampshire Forest Legacy Program Application ........................................................................................ 209
   Appendix E  NH Forest Legacy Program Selection Criteria ................................................................................................ 228

References .................................................................................................................................................................................. 230
Tables and Figures

Figure 1  NH Forested Acreage 1600-2017 .......................................................... 12
Figure 2  Forest Cover and Population in New England ....................................... 13
Figure 3 2016 Land Cover ........................................................................... 14
Figure 4 Area of Timberland by Species Group .................................................. 15
Figure 5 Percent Forestland Size Classes by County – 2008 ................................. 16
Figure 6 Percent Forestland Size Classes by County – 2018 ................................. 16
Figure 7 Change in Forestland Size Classes by County ....................................... 17
Figure 8 Loss of Forestland in NH ................................................................... 18
Figure 9 Forest Soil Calcium availability in the U.S. ............................................. 22
Figure 10 Important Forest Soils for New Hampshire ........................................... 24
Figure 11 NH Wildlife Action Plan Habitat Tiers ................................................ 27
Figure 12 Woodland Communities in New Hampshire ......................................... 31
Figure 13 Major Watersheds in New Hampshire .................................................. 33
Figure 14 NH Lakes Water Quality Trends .......................................................... 34
Figure 15 NH Rivers Water Quality Trends ......................................................... 35
Figure 16 US Trends in Atmospheric Mercury Emissions ...................................... 36
Figure 17 Remote Pond Pollution Trends 2014 .................................................... 36
Figure 18 NH Impaired Waters ........................................................................ 37
Figure 19 Forests Important to Surface Drinking Water ........................................ 38
Figure 20 Development Threat to Forests Important to Surface Drinking Water .... 39
Figure 21 NH Insect and Disease Forest Damage ............................................... 41
Figure 22 Invasive Plant Occurrences ................................................................ 45
Figure 23 Wildfire Hazard Map ....................................................................... 48
Figure 24 Fires Incidents from 1992 to 2018 ......................................................... 49
Figure 25 Trend in average annual temperature for NH and the US ....................... 53
Figure 26 Trend in average annual precipitation for NH and the US ...................... 54
Figure 27 NH Resilient Landscapes .................................................................. 58
Figure 28 NH Resilient and Connected Landscapes ............................................. 59
Figure 29 Percentage of forest carbon stocks within each forest ecosystem component for NH .......................................................... 60
Figure 30 Total forest carbon per acre in New Hampshire 2005 to 2018. ................. 61
Figure 31 Carbon storage by forest type in NH ................................................. 62
Figure 32 Tons of carbon by age class on forestland ............................................ 62
Figure 33 Tons of carbon per acre by age class .................................................. 63
Figure 34 Total tons of carbon on public and private forest land ......................... 63
Figure 35 Large Forest Block comparison ........................................................... 65
Figure 36 Conserved Large Forest Blocks by Type ............................................. 66
Figure 37 Permanently Conserved Land in New Hampshire ............................... 69
Figure 38 Protected land in NH, 1998 – 2019 ...................................................... 70
Figure 39 Forest-Related Recreation Sales in NH 2005-2015 ............................... 72
Figure 40 NH Outdoor Recreation Economic Output by Activity (direct, indirect, & induced) .......................................................... 74
Figure 41 Participation rate of 5 most popular outdoor activities ........................... 75
Figure 42 NH Population 1960-2017 ................................................................. 76

NH Forest Action Plan - 2020
Introduction

For over 60 years New Hampshire has been evaluating and assessing the needs of the state’s forests. The first New Hampshire Forest Resources Plan was written by a committee appointed by Gov. Sherman Adams in 1952. In 1981, the state codified this tradition by passing the “Forest Resources Planning Act,” RSA 220 (recodified in 1996 to RSA 227-I) requiring a comprehensive assessment of forest resources and statewide plan be prepared every ten years.

In the 2008 Farm Bill, under Title VIII – Forestry, (reauthorized in the 2018 Farm Bill) the Cooperative Forestry Assistance Act of 1978 was amended to include the requirement that each state develop a long-term, statewide assessment and strategies for forest resources. These assessments and strategies (collectively referred to as State Forest Action Plans) are required in order to receive cooperative forestry assistance funds. Cooperative Forestry Assistance Funds include Forest Health, Forest Fire Assistance, Private Land Stewardship, Urban Forest Assistance, and the Forest Legacy Program. The plan is also required to address the three USDA Forest Service national priorities:

- Conserve and Manage Working Forest Landscapes for Multiple Values and Uses
- Protect Forests from Threats
- Enhance Public Benefits from Trees and Forests

The 2020 New Hampshire Forest Action Plan is the state’s sixth statewide forest assessment and plan. It is a revision of the New Hampshire Statewide Forest Resources Assessment and The New Hampshire Forest Resources Strategies, both published in 2010. The 2020 plan reflects the input provided by individuals and groups within the NH natural resource community and from the public, and review of existing plans and assessments.

About New Hampshire’s Forests

In pre-settlement times, New Hampshire was extensively covered by forests. As the state became colonized, forest cover started to decline, and reached its lowest point in the late nineteenth century, at
47%. This directly corresponded with the highpoint of agriculture, primarily sheep farming. Extensive logging was also occurring at this point in the state’s history, particularly in the White Mountains. These past land practices significantly shaped the forest of today. Following cultural and policy changes such as farm abandonment and the passage of the Weeks Act, the state experienced a tremendous resurgence in forest growth. Trees quickly recolonized grazed and cutover lands, and once again, forest cover reached a high point of 87% in 1960. Since that second peak, we have started to lose forest cover, albeit at a much more gradual pace. According to recent US Forest Service Forest Inventory and Analysis (FIA) statistics, an average of nearly 5,000 acres of forestland have been converted each year to non-forest uses, primarily development.

Today, New Hampshire contains just over 4.7 million acres of forestland, and remains the second most forested state in the country, at approximately 82% according to the most recent FIA data. While the state is losing forested acreage each year due to conversion to non-forest uses, statistics show the remaining forest is getting older and bigger. Annual net growth, which is gross growth minus mortality and tree removal, is 84 million cubic feet (FIA). In addition to an increase in the volume of trees, sampling shows that the actual number of trees in larger diameter size classes has increased while the number of trees in the 12-inch and smaller diameter size classes has decreased. That said, our forests of today are not quite as structurally diverse as they once were, with a large percentage of the forest being of similar age. This has created a dearth of very old forests, as well as very young forests, and therefore creates concerns for flora and fauna that depend on the habitats these age classes provide.

While structure is relatively uniform, our forests are wonderfully diverse in terms of natural communities and species composition, particularly for being a relatively small state geographically. With elevations ranging from sea level to the highest peaks in the northeastern United States, and stretching from the Gulf of Maine to the Canadian border, New Hampshire has a range of ecological habitats. Most prevalent, in regards to forest types, is maple/beech/birch, which represent >50% of the forest, followed by White Pine, Red Oak, and then Spruce/fir.

Forestland ownership is predominantly private, with over 128,000 landowners representing over 70% of the forested acreage. After this is federal ownership at about 18%, followed by state and local municipalities at almost 10%. Combining public lands with land trusts and private lands under conservation easements, approximately 34% of the state is under some type of conservation protection. While New Hampshire should be proud of its conservation achievements, to understand how to protect, manage and conserve New Hampshire’s forests we need to understand the private forestland owner. Why do they own forestland? What are the issues they face? What prevents them from selling land for conversion? How do we incentivize keeping forests as forest? Understanding the answers to these questions are paramount if we are to retain a healthy and productive forest.
Forest Action Plan Components
The New Hampshire Forest Action Plan is a comprehensive assessment of forest-related resources and a suite of 42 recommended strategies and 159 associated actions to address issues, opportunities and program priorities, regardless of ownership. The 2020 plan combines the two separate 2010 Assessment and Strategies documents into a single document.

The Forest Resource Assessment section of the plan is a compilation of available information and data that reflect current conditions and trends in New Hampshire’s forests. The 2010 assessment used the framework of the Montreal Process Criteria and Indicators as the basis of the report. The 2020 assessment updates much of the information in the 2010 report and also contains information on topics not in the 2010 assessment such as invasive plants, climate change and forest carbon storage. It includes elements required by the Cooperative Forestry Assistance Act for State Forest Action Plans, by New Hampshire state law (RSA 227-I), and by Forest Legacy Program Implementation Guidelines (USDA Forest Service, 2017).

The maps in the Priority Landscapes section highlight the geographic regions of the state that provide extraordinary rural forest benefits and urban forest opportunities. This section also includes a Forest Stewardship Program priority map. This map identifies geographic program priority areas that are no more that 50% of eligible Forest Stewardship acres, for delivering landowner assistance.

The priority landscape maps were created using overlay analysis of the most current data layers available from state and federal agencies. Many of these layers require frequent updating, and some, like soils, are incomplete. In addition, some data layers will become outdated and may be replaced with newer or different data. As such, this analysis should be considered a snapshot in time.

The Goals/Strategies/Actions section is organized by Focus Areas, which are issue areas identified as important through professional assessment, public outreach and stakeholder involvement. Each focus area includes a brief discussion of the importance of this issue and includes a goal, generally stated as a desired future condition, strategies that identify specific areas of effort intended to achieve the goal, and recommended actions.

Strategies are crafted to be clear in describing how to meet the goal, but broad enough to reflect the many ways that agencies and organizations within the forest community can contribute to addressing each goal. Strategies that contribute to more than one goal are identified in the Forest Resource Strategies Matrix. The actions identified under each strategy recommends ways in which the strategies might be accomplished. These actions are not intended to represent all possible actions; many more may be identified during the life of this plan.

The New Hampshire Forest Legacy Program (NHFLP) section contains an update to the NHFLP Assessment of Need documents (1994 and 2004). Information in this section, as well as in the assessment section, satisfy the eligibility requirements detailed in the Forest Legacy Program Implementation Guidelines. This section also contains a crosswalk that enables the reader to easily locate the required components within the plan.

Stakeholder Engagement
The purpose of the forest action plan is to guide the work of the NH forest resource community in response to the issues and opportunities facing all forest lands of the state. To do so requires that the
Once completed, a draft of the plan was reviewed by the New Hampshire Forest Advisory Board (NHFAB). The NHFAB is statutorily required to advise and assist the Division in the development of the plan. The draft plan was revised based on NHFAB input and released for public comment.

What We Heard

One common theme we heard during public outreach was the necessity to maintain and strengthen public policy that allows forestland owners to keep their land as forests, without undue expense and burden. A key component of this is tax structure. Delving into the archives of forest taxation in New Hampshire reveals a century of discussion regarding this issue, and study committees and commissions too numerous to count. However, no other tax policy has done a better job of maintaining forests as forests than Current Use. The benefit of current use is best summed up by the Declaration of Public Interest (RSA 79-A:1), which states:

> It is hereby declared to be in the public interest to encourage the preservation of open space, thus providing a healthful and attractive outdoor environment for work and recreation of the state’s citizens, maintaining the character of the state’s landscape, and conserving the land, water, forest, agricultural and wildlife resources. It is further declared to be in the public interest to prevent the loss of open space due to property taxation at values incompatible with open space usage. Open space land imposes few if any costs on local government and is therefore an economic benefit to its citizens. The means for encouraging preservation of open space authorized by this chapter is the assessment of land value for property taxation on the basis of current use.

One of the many benefits provided by private forests is recreation. Combined with ample public lands and those owned by land trusts, New Hampshire is a mecca for outdoor enthusiasts. But, with recreation comes challenges. Another common theme heard during this planning cycle. As usage and visitation to our forests have continued to increase, so too have the concern over impacts. Whereas a decade ago recreation only played a small role in the responses we heard, this time the pressures of increased recreation, both motorized and non-motorized, were front and center. As we strive to develop a greater understanding and appreciation by the public of our forests and trees, and the important role they play in our everyday lives, it’s expected they will be out enjoying the forest more. How then do we strike a balance? How do we ensure that while more people are out enjoying the forest, they aren’t “loving it to death”?

Recreation is only one of the many ways in which trees and our forests provide economic benefits. While forest-based recreation is responsible for approximately $3.1 billion annually to our state’s economy, the forest products industry is responsible for an additional $1.5 billion of direct economic output according to a recent study released in January 2020. This report also indicated about 7,200 direct jobs attributed to this sector, and upwards of 12,000 total jobs supported. While these numbers are good, the forest products sector has had challenges over the last several years. The decline and closure of pulp mills...
throughout the region has been occurring over the last two decades. However, a strong biomass market with eight large-scale electric-producing plants had been a bright spot for low-grade markets. As the declining price for natural gas made biomass electric production less cost effective, this once bright spot has also begun to fade, leaving the future of low-grade markets in question. Likewise, global market factors such as tariffs and trade wars have inserted turbulence into sawlog markets. For these reasons, and others, the future of forest products markets was another often-heard issue received during the gathering of feedback. While existing markets are in flux, there are many new and developing potential markets on the horizon. From mass timber buildings to biofuels to a host of products using nano-cellulose, these burgeoning technologies can likely play a positive role in the future of forest products markets in New Hampshire and the broader region.

Another topic that played only a minor role in the last plan, but was much more prevalent during this planning process, was the role of climate change and how it will influence the future of our trees and forests, and general ecosystem health. While the science of climate change is still developing, and it is unclear what type of scenario we will be facing in the future (based on different carbon output models), what is known is it will be an additional stressor on our forests. While individual tree species may react differently, with some potentially benefitting, the natural community as a whole will likely be negatively impacted. Effects from this slow-moving crisis may include infrastructure problems due to more extreme events, reduced timber harvesting windows due to warmer winters, and a change in species composition, particularly for species where New Hampshire is the southern part of their range. Our forests can play a role in mitigating the influence this threat will bring. A healthy, diverse forest will not only be more resilient to the impacts, it will also play a critical role in the capture and storage of carbon, thereby reducing potentially worse consequences.

Lastly, considerable response was received regarding the threat of invasive and nonnative pests and pathogens that negatively impact our forests. Dubbed the “wildfire of the East”, one only need observe the long-lasting impacts of invasive pests as Dutch Elm disease, Chestnut Blight, Gypsy moth, Hemlock Wooly Adelgid, and Emerald Ash Borer to see how devastating they can be to both the environment and the economy. In the plant realm, glossy buckthorn, honeysuckle, Japanese barberry, garlic mustard and others have become a significant hindrance to forest management in the southern part of the state. The long list of potential threats only continues to grow, as a global economy and trade quickly disperse insects, plants and diseases that would otherwise never make it here on their own. Developing threats such as Asian Longhorned Beetle, Southern pine beetle, and Oak wilt are among a few of the forest threats at our doorstep. How the state is able to rapidly detect, respond, and manage an outbreak of a forest pest is paramount to the future of our forest resource, and all of the other attributes that depend on a healthy resource.

This document includes conditions and trends of forest resources in the state; and threats to forestlands and resources. The plan serves as a guide to address the issues facing New Hampshire’s public and private forests for use by government agencies, educational institutions, non-profit organizations, landowners, and private industry engaged in work related to New Hampshire’s trees and forests.

**About the Division of Forests and Lands**
The Department of Natural and Cultural Resources, Division of Forests and Lands (DFL) is the agency responsible for the development of this plan. The division is statutorily responsible for execution of “all matters pertaining to forestry, forest management, and forestlands within the jurisdiction of the state...” This is accomplished through responsible management of the state’s forested resources; by providing forest resource information and education to the public; and through the protection of these resources.
for the benefit of the state’s citizens, visitors, and forest industry. Program areas within DFL include Forest Management, Land Management, Forest Protection, Planning & Community Forestry, Natural Heritage, and Forest Health. Cooperative Forestry Programs are administered jointly through an agreement with University of NH Cooperative Extension to provide technical assistance to New Hampshire’s forest landowners, support skills development for resource professionals, and educate NH’s citizens about rural and urban forest environments.
FOREST RESOURCE ASSESSMENT

1. Total Area of Forest Land & Forest Land Trends
There are several methods and data sources that can be used to determine the current status of forested acreage in New Hampshire and the trends of forest cover. USDA Forest Service Forest Inventory and Analysis (FIA) data has been used previously to estimate forest acreage and it is one of two sources we are using in this assessment. Historic data on forest cover for New Hampshire comes from Harvard Forest.

According to FIA, current forest area in New Hampshire is 4,714,647 acres, representing 82% of the 5,742,660 land area acres in the state. Using a combination of FIA and Harvard Forest data, Figure 1 shows the trend in forest acreage in the state. After the farm abandonment in the mid-1800s, forest acreage increased until it reached a peak around 1970 at 5.1 million acres. We have lost almost 390,000 acres of forest to other uses – mostly developed - since then. This area of loss is about the size of Sullivan County.

![NH Forested Acreage 1600-2017](image)

Figure 1 NH Forested Acreage 1600-2017
Source: USDA Forest Inventory & Analysis and Harvard Forest

It is also helpful to understand land use trends and population trends. Figure 2 from Harvard Forest provides an insightful juxtaposition of the two. This graph, from the 2017 Wildlands and Woodlands report, modifies historic forest cover information from Forests in Time (Foster and Aber (2004) with additional data from USFS FIA state reports.

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1 The Forest Inventory & Analysis (FIA) is the U.S. census on forests. A series of fixed in-woods plots are measured and re-measured over time across the nation’s private and public forests yielding a wealth of information including status and trends in forest area and location; in the species, size, and health of trees; in total tree growth, mortality, and removals by harvest; in wood production and utilization rates by various products; and in forest land ownership, among other data and information. FIA is the base standard for understanding U.S. forests.
Figure 2 Forest Cover and Population in New England
Source: Harvard Forest

Figure 3 shows a spatial distribution of land cover types based on the 2016 National Land Cover Database (NLCD) released by the US Geological Survey (2019). Forests dominate New Hampshire in this map. A tabular accounting of land cover types from the USGS data is found in Table 1 below showing that forests cover 4,364,790.5 acres. NLCD is a satellite-based analysis of land cover. Through this analysis a clearcut would be categorized as barren or shrub/scrub land. The FIA is based on statistical sampling and clearcut acreage is not considered non-forested.

Table 1 Land Cover for New Hampshire

<table>
<thead>
<tr>
<th>Class Description</th>
<th>Total Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barren Land</td>
<td>27,180.6</td>
</tr>
<tr>
<td>Cultivated Crops</td>
<td>16,028.2</td>
</tr>
<tr>
<td>Deciduous Forest</td>
<td>1,303,768.2</td>
</tr>
<tr>
<td>Developed, High Intensity</td>
<td>21,842.4</td>
</tr>
<tr>
<td>Developed, Low Intensity</td>
<td>149,544.7</td>
</tr>
<tr>
<td>Developed, Medium Intensity</td>
<td>78,858.2</td>
</tr>
<tr>
<td>Developed, Open Space</td>
<td>242,758.7</td>
</tr>
<tr>
<td>Emergent Herbaceuous Wetlands</td>
<td>35,515.3</td>
</tr>
<tr>
<td>Evergreen Forest</td>
<td>1,129,933.4</td>
</tr>
<tr>
<td>Hay/Pasture</td>
<td>167,239.9</td>
</tr>
<tr>
<td>Herbaceuous</td>
<td>68,888.9</td>
</tr>
<tr>
<td>Mixed Forest</td>
<td>1,931,088.9</td>
</tr>
<tr>
<td>Open Water</td>
<td>202,695.7</td>
</tr>
<tr>
<td>Shrub/Scrub</td>
<td>191,787.9</td>
</tr>
<tr>
<td>Unclassified</td>
<td>101.7</td>
</tr>
<tr>
<td>Woody Wetlands</td>
<td>373,314.6</td>
</tr>
</tbody>
</table>
Figure 3 2016 Land Cover
Source: US Geological Survey
In acreage terms, New Hampshire’s forests are dominated by northern hardwood. Figure 4 shows that approximately 2,346,000 acres are found in this category. The next largest forest type category is white pine/red pine, followed by oak/hickory and spruce fir. Many of the changes in forest acreage from 1997 to 2018 have been minor however, the white pine/red pine group is on the decline, as is the aspen/birch type.

![Figure 4 Area of Timberland by Species Group](source)

Data also indicates that trees within New Hampshire’s forests are getting larger. Figures 5 and 6 show forestland size classes by county for 2008 and 2018. FIA defines the small stand-size class as having trees less than 5 inches diameter breast height (DBH). Medium stand-size class trees are between 5 inch DBH and 9 inch DBH for softwoods and between 5 inch and 11 inch DBH for hardwoods. Large stand-size class trees are 9 inches DBH or greater for softwoods and 11 inches DBH or greater hardwoods.

Figure 7 shows the percent change in size classes by county between 2008 and 2018. All counties show a trend toward larger diameter stands, with Sullivan, Rockingham, and Grafton counties seeing the greatest percent increases. There has also been a corresponding decrease in the area of medium diameter stands in all counties. The trend toward larger diameter stands has been occurring since 1997 (USDA Forest Service, FIA). Changes in the small diameter size class varies by county with the largest decrease in area

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2 FIA defines Timberland as forest land that is producing or is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. Currently inaccessible and inoperable areas are included.
occurring in Belknap (-10%) and Rockingham (-8%) counties and the largest increase occurring in Hillsborough and Sullivan counties (+4% each).

**Figure 5** Percent Forestland Size Classes by County – 2008
*Source: USDA Forest Service, Forest Inventory and Analysis*

**Figure 6** Percent Forestland Size Classes by County – 2018
*Source: USDA Forest Service, Forest Inventory and Analysis*
Figure 7 Change in Forestland Size Classes by County

*Source: USDA Forest Service, Forest Inventory and Analysis*
2. Forest Land Conversion

*Forestland conversion* means a change of use from trees to either agricultural fields or pasture or a developed use where trees are no longer on the site. Using the FIA data referenced earlier, Figure 8 shows a reduction of 126,710 acres of forest statewide from 1983 to 2017. That is about half the size of Strafford County.

![NH Forested Acre Reductions 1983-2017](image)

**Figure 8 Loss of Forestland in NH**  
*Source: USDA Forest Inventory and Analysis*

FIA defines forestland as land that has at least 10 percent tree cover and is not currently developed for nonforest use. Generally the minimum area is one acre in size with a natural or unmaintained understory. While this data source does not explicitly describe it, we can assume that the reduction was largely from conversions of forestland to developed uses. Further analyses below, using other data sources, discuss the specific land use changes that have occurred.

The US Geological Survey periodically publishes land cover spatial data that categorizes land in the US according to its general cover type (hardwood forest, developed, water, agriculture, etc). The National Land Cover Database (NLCD) provides nationwide data on land cover and land cover change at a 30 meter resolution. A new update of these data was released in 2019 (reflecting land cover classes in 2016) that allows us to compare with past land cover data sets that allow us to better understand land use changes our state is experiencing.

Table 2 below shows the changes in forest land cover in New Hampshire from 2001 to 2016 from the USGS land cover data.
Table 2 NLCD Land Cover Change Index 2001-2016

<table>
<thead>
<tr>
<th>Land Cover Change Class</th>
<th>Total Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other to Forest</td>
<td>4,281</td>
</tr>
<tr>
<td>Forest to Other</td>
<td>21,301</td>
</tr>
<tr>
<td>Net loss of Forest</td>
<td>17,020</td>
</tr>
</tbody>
</table>

*Other is comprised of the following Land Cover Classes** (Agriculture, Developed or Barren)  
**Land Cover classes were derived from National Land Cover Dataset; The following classes were compiled into the developed class: Developed, Open Space; Developed, Low Intensity; Developed, Medium Intensity; Developed, High Intensity. The following classes were compiled into the forest class: Deciduous Forest; Evergreen Forest; Mixed Forest. The land cover classes that make up the agriculture class include the following: Hay/Pasture & Cultivated Crops. The NLCD Land Cover class Barren Land makes up the Barren class. The following land cover classes were not included in the above analysis: Open Water, Wetlands (woody & emergent herbaceous), shrub/scrub, & herbaceous.

Source: US Geological Survey

Over the comparison time period (2001 to 2016), which included the great recession of 2008-09, only 0.5% of forest land changed to other land cover types (ag, developed or barren).
3. Soil Productivity

Soil quality (acid deposition/sulfur/nitrogen)

Forest soil quality resulting from acid deposition of sulfur and nitrogen dioxide deposition has been an important issue since the effects from these pollutants were first understood in the 1970s. When humans burn fossil fuels, whether in coal-fired power plants or from use of fuel oils to heat buildings, sulfur dioxide (SO2) and nitrogen oxides (NOx) are released into the atmosphere. Those air pollutants react with water, oxygen, and other substances to form airborne sulfuric and nitric acid. Winds may spread these acidic compounds through the atmosphere and over hundreds of miles. When this acid reaches Earth, either through wet (rain) or dry deposition, it flows across the surface in runoff water, enters water systems, and sinks into the soil. This results in acidic effects on both water and terrestrial ecosystems.

So how does this affect trees and their reproduction, growth and maturation? The acid deposits leach the soil of essential nutrients such as calcium and causes aluminum to be released in the soil, which makes it harder for trees to take up water. Tree leaves and needles are also harmed by these pollutants.

Some soils are better able to neutralize these acids than others. But in areas where the soil's "buffering capacity" is low, such as parts of the U.S. Northeast and especially at higher elevations, the harmful effects of acid rain are much greater.

In the U.S., the Clean Air Act of 1990 targeted acid rain, putting in place pollution limits that helped cut sulfur dioxide emissions 88 percent between 1990 and 2017. Air-quality standards have also driven U.S. emissions of nitrogen dioxide down 50 percent in the same time period. These trends have helped forests especially susceptible to the effects of acid rain, such as spruce forests in New England, and some fish populations recover. But recovery takes time, and soils in the northeastern U.S. and eastern Canada have only recently shown signs of stabilizing nutrients.

Recent research, much of which comes from researchers using the Hubbard Brook Experimental Forest in the White Mt. National Forest in New Hampshire have shown that, indeed, the results of cut-backs in these pollutants from the Clean Air Act implementation have been positive. A list of researchers published the following in March of 2018 in Environmental Science and Policy:

"... The quality of air and fresh water across much of the United States vastly improved in recent decades in response to the Clean Air and Clean Water Acts and other rules and policies. We point to recently observed decreases in air pollution and its effects ... in declines in atmospheric sulfur and nitrogen deposition that acidify the environment..."

Further, research on red spruce, the species considered most affected by acid deposition especially at high elevations, is showing a rebound. In the journal Science of the Total Environment in 2018, a research team found that:

"Following growth declines and increased mortality linked to acid deposition-induced calcium depletion, red spruce (Picea rubens Sarg.) in the northeastern United States are experiencing a recovery. We found that more than 75% of red spruce trees and 90% of the plots examined in this study exhibited increasing growth since 2001... Overall, we predict sustained favorable

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conditions for red spruce in the near term as acid deposition continues to decline and non-traditional growing season (fall through spring) temperatures moderate, provided that overall temperatures and precipitation remain adequate for growth."

The Forest Inventory and Analysis of the USDA Forest Service began collecting soil quality data for NH in the period from 2002-2005 as part of the regular FIA plot measurements. It was an initial attempt at collecting soil data and information systematically with the notion that it would be done again in the future, but after a substantial time delay since the first collection of this data. The re-measurement would determine if any trend information about soil quality could be determined. The re-measurement of soils data, according to FIA officials, has been underway in the last couple of years of field measurement of NH FIA plots. Data is not expected for a couple of years. Data collected at a small sample of the FIA plots includes:

- Duff depth
- Mineral soil density
- Rock content
- Carbon percentage
- Nitrogen
- PH
- Trace elements

Research using the FIA soils data has been published over the years. In particular, a national review of a key soil health indicator – calcium availability – was published in a paper by Charles H. Perry & Michael Amacher of the USDA Forest Service in 2012. “Patterns of Soil Calcium and Aluminum Across the Conterminous United States” includes the following map (Figure 9) of soil calcium distribution.

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4 Kosiba, AM, et al, The surprising recovery of red spruce growth shows links to decreased acid deposition and elevated temperature, Science of The Total Environment, 637-638 1480 – 1491, 2018/10/01

5 FIA plots are located to represent approximately 6,000 acres of forest. Soils information is collected on about 6% of the plot sites.
Figure 9 Forest Soil Calcium availability in the U.S.
Source: Charles H. Perry & Michael Amache, Patterns of Soil Calcium and Aluminum across the Conterminous US

The major finding is that soils in the dryer climates have more available calcium as compared to the wetter climates in the U.S. While the nutrients found in soil are a function on many things, including parent material, available calcium is a critical factor in building plant cell walls and other plant material growth so it is essential to tree growth and health.

Distribution of important forest soil groups

The federal Natural Resource Conservation Service of the USDA and its predecessors provided soils information to the states for decades. In 2019, this data for New Hampshire soils are rich and detailed. These data can be organized into Important Forest Soil Groups which is a simplification of the various soil types into 5 basic categories (plus a 6th which is not categorized) for soils beneath our forests allowing an understanding of productivity relative to other soils:

Group IA consists of the deeper, loamy, moderately well-drained and well-drained soils. Generally, these soils are more fertile and have the most favorable soil-moisture conditions. Successional trends are toward climax stands of shade-tolerant hardwoods such as sugar maple and beech. Early successional stands frequently contain a variety of hardwoods such as sugar maple, beech, red maple, yellow, gray, and white birch, aspen, white ash, and northern red oak in varying combinations with red and white spruce, balsam fir, hemlock, and white pine. The soils in this group are well-suited for growing high-quality hardwood veneer and sawtimber, especially, sugar maple, white ash, yellow birch, and northern red oak. Softwoods are usually less abundant and are best managed as a minor component of predominantly hardwood stands. Hardwood competition is severe on these soils. Successful natural regeneration of softwoods and the establishment of softwood plantations requires intensive management.
**Group IB** generally consists of soils that are moderately well-drained and well-drained, sandy or loamy-over-sandy, and slightly less fertile than those in group 1A. Soil moisture is adequate for good tree growth but may not be quite as abundant as in group 1A. Successional trends and the trees common in early successional stands are similar to those in group 1A. However, beech is usually more abundant on group IB and is the dominant species in climax stands. Group IB soils are well-suited for growing less-nutrient- and-moisture-demanding hardwoods such as white birch and northern red oak. Softwoods generally are scarce to moderately abundant and managed in groups or as part of a mixed stand. Hardwood competition is moderate to severe on these soils. Successful regeneration of softwoods and the establishment of softwood plantations are dependent upon intensive management. The deeper, coarser-textured, and better-drained soils in this group are generally suitable for conversion to intensive softwood production.

**Group IC** soils are derived from glacial outwash sand and gravel. The soils are coarse textured and are somewhat excessively drained to excessively drained and moderately well-drained. Soil moisture and fertility are adequate for good softwood growth but are limiting for hardwoods. Successional trends on these soils are toward stands of shade-tolerant softwoods, such as red spruce and hemlock. White pine, northern red oak, red maple, aspen, gray birch, and paper birch are common in early successional stands. These soils are well-suited for high quality softwood sawtimber, especially white pine, in nearly pure stands. Less site-demanding hardwoods such as northern red oak and white birch have fair to good growth on sites where soil moisture is more abundant. Hardwood competition is moderate to slight. With modest levels of management, white pine can be maintained and reproduced. Although chemical control of woody and herbaceous vegetation may be desirable in some situations, softwood production is possible without it.

**Group IIA** consists of diverse soils and includes many of the soils that are in groups IA and IB. The soils in IIA, however, have limitations such as steep slopes, bedrock outcrops, erodibility, surface boulders, and extreme stoniness. Productivity of these soils isn't greatly affected by those limitations, but management activities such as tree planting, thinning, and harvesting are more difficult and more costly.

**Group IIB** soils are poorly drained. The seasonal high water table is generally at a depth of 12 inches or less. Productivity is lower than in IA, IB, or IC. Fertility is adequate for softwoods but is a limitation for hardwoods. Successional trends are toward climax stands of shade-tolerant softwoods, such as red spruce and hemlock. Balsam fir is a persistent component in nearly all stands. Early successional stands frequently contain a variety of hardwoods such as red maple, yellow, gray, and paper birch, aspen, and white and black ash in varying mixtures with red spruce, hemlock, balsam fir, and white pine. These soils are well-suited for spruce and balsam fir pulpwood and sawtimber. Advanced regeneration is usually adequate to fully stock a stand. Hardwood competition isn't usually a major limitation, but intensive management by chemical control of competing woody and herbaceous vegetation may be desirable.

**Not Rated** Several mapping units in New Hampshire are either so variable or have such a limited potential for commercial production of forest products that they haven't been placed in a group. Examples are very poorly drained soils and soils at high elevations.

The map in Figure 10 shows both the spatial distribution of Important Forest Soils throughout the State and also the percentage breakdown of the categories by county and percentage. An analysis of these data show that all counties except for Cheshire County have at least 50% of their forest acreage in IA and IB soils – the best forest soils in the grouping.
IIB soils, the least productive poorly drained soils, are between 6-13% of the land area in the counties. Strafford and Rockingham Counties lead the list at 13% and 12% IIB soils by land area. This is logical as these two counties contain the flattest terrain of NH’s counties.

A small note – the soils data does not include the White Mt. National Forest lands – some 740,000 acres in the three northern counties.

Figure 10 Important Forest Soils for New Hampshire
Source: USDA Natural Resource Conservation Service
4. Fish & Wildlife Habitat

Without a doubt, the best information available on wildlife habitat in New Hampshire is through the State’s Wildlife Action Plan (WAP). Through an exhaustive process beginning in 2003, the first WAP was released in 2005 by the NH Fish and Game Department. As required, it was updated and released again in 2015. As part of national fish and wildlife planning to protect species under threat or in decline, the US Fish and Wildlife Service—NH Fish and Game’s sister federal agency—requires each state to develop a WAP as a prerequisite to accessing federal funds for state fish and wildlife conservation activities. The 2015 New Hampshire WAP can be accessed at https://www.wildlife.state.nh.us/wildlife/wap.html.

The core of the WAP is in the following sections of the plan:

- **Identifying Wildlife at Risk**—Identifying New Hampshire’s declining wildlife populations, and wildlife that are indicative of the diversity and health of the state’s wildlife, is step one in the plan. This section has four detailed appendices: A. Species Profiles, B. Habitat Profiles, C. Habitats and Natural Communities Crosswalk, and D. Rare Plant Species and Wildlife Habitats.
- **Assessing Wildlife Habitat Condition**—This section covers the location and condition of key wildlife habitat in New Hampshire. Maps that describe these habitats are available.
- **Evaluating Threats to Species and Habitats**—After describing wildlife at risk and the various wildlife habitats in the state, the WAP covers the problems that may adversely affect wildlife and their habitats, based on published scientific literature and the expert opinions of wildlife professionals. This was all developed with input from dozens of wildlife and habitat experts, in addition to those actually employed by NH Fish and Game. Threat factors—such as spatial extent, severity, immediacy, certainty, likelihood and reversibility—were given ratings, which were compared between the original 2005 WAP and the 2015 WAP so that an assessment of progress could be determined.
- **Action Plan**—The final part of the WAP lays out a series of proposed actions to address the threats to species and habitats.

In addition to wildlife benefits, additional economic benefits are clearly articulated in the WAP:


The culmination of the WAP from a visual perspective is a set of maps on important wildlife habitat that resulted from the many assessments and rankings in the WAP. All wildlife species native to New Hampshire were eligible for identification as Species of Greatest Conservation Need (SGCN), including game species, nongame species, freshwater fish, and marine animals. Information on their populations, habitats, risks and status throughout the Northeast were considered during the process. A total of 169 species are identified as SGCN, of which thirty species are listed as state-endangered and twenty one as state-threatened. The WAP also identifies twenty-seven distinct habitats that support both common species and SGCN.

Wildlife habitat condition was assessed and mapped for the twenty-seven habitat types. These maps and the underlying data are used for species recovery, land conservation, and habitat restoration efforts. Risk
assessments were conducted for the twenty-seven habitats and 169 SGCN, and eleven different threat categories with thirty-seven sub-categories were ranked in terms of their potential impact on each species and habitat throughout New Hampshire.

Saltmarshes, warm-water rivers and streams, dunes, lowland spruce-fir forest, and vernal pools had the greatest number of high-ranking threats. Commercial and residential development, pollution, disease, and climate change are among the higher-ranking risk factors that impact the health of wildlife populations and habitats.

The summation of the 2015 WAP is represented by the highest ranked wildlife habitat by ecological condition map shown in Figure 11. Highest ranked habitat statewide are in pink and the habitats of regional importance are in green. These data are available at a very fine scale so that it can be seen and made use of for land management even at the scale of a hundred acres. Table 3 below shows the acreages of the ranked habitat areas.

Table 3 Wildlife Action Plan Ranked Habitat Acreage.

*Source: NH Wildlife Action Plan 2015*

<table>
<thead>
<tr>
<th>Tiers</th>
<th>Total Acreage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest Rank Habitat by Condition in NH</td>
<td>1,389,809</td>
</tr>
<tr>
<td>Highest Rank Habitat by Condition in Biological Region</td>
<td>1,050,873</td>
</tr>
<tr>
<td>Supporting Landscapes</td>
<td>1,549,275</td>
</tr>
</tbody>
</table>
Figure 11 NH Wildlife Action Plan Habitat Tiers.
Source: NH Fish and Game Department and GRANIT.
5. Matrix Woodland Communities

New Hampshire is a mosaic of natural communities that range from common and widespread types that cover hundreds or thousands of acres across broad areas of the state, to uncommon or rare types that are small and restricted to a specific part of the state. Across much of the landscape, a few forest types form a matrix, with other natural community types occurring as patches embedded within that matrix. We describe in a later section the five matrix woodland communities and their statuses in New Hampshire.

Exemplary Matrix Woodland Communities

NH Natural Heritage designates all rare natural community types, and high-quality examples of more common community types, as exemplary. Exemplary natural communities represent the best remaining examples of New Hampshire’s biological diversity. NH Natural Heritage identifies and tracks exemplary natural community occurrences to inform conservation decisions. None of the five matrix woodland communities occurring in New Hampshire are rare types, therefore exemplary examples often are large, older forests with little history of human-related impacts in and around the woodland community.

In the northeast, at least 200 years is required to develop an old forest structure, although some old-growth traits begin to develop after 100 years. Trees in New Hampshire’s old forests typically have long trunks free of lower branches, deeply furrowed or plated bark, heartwood decay, large and prominent roots, and thick limbs. Snags and downed logs in all stages of decomposition are abundant. Typical canopy species include red spruce, hemlock, yellow birch, beech, sugar maple, and black gum. Most of the tree species are shade-tolerant, although blowdowns also create opportunities for gap colonizers such as paper birch and quaking aspen. Beneath the canopy, the forest floor undulates with pits and mounds where trees have fallen and decomposed.

New Hampshire’s old forests are valuable and endangered natural ecosystems. They provide habitat for a wide variety of animals, microorganisms, and flowering plants. Additionally, many mosses, lichens, and fungi depend on these forests. Scientists derive substantial knowledge about forest structure and function from studies of old growth. Although tree girth in New Hampshire’s old forests may be smaller than one might expect, one can’t help noticing that something remarkable exists in the nature of these old stands.

Rare Plants Occurring in Matrix Woodland Communities

Several rare plant species occur in our five matrix woodland communities. Appalachian oak-pine forests have more locally rare plant species compared to other matrix woodland communities, in part because many temperate forest species reach the northeastern end of their geographic ranges in southern New Hampshire. Examples include licorice goldenrod (Solidago odora), hairy bedstraw (Galium pilosum), bird-foot violet (Viola pedata), slender knotweed (Polygonum tenue), wild goat's-rue (Tephrosia virginiana), smooth small-leaved tick-trefoil (Desmodium marilandicum), round-leaved trailing tick-trefoil (Desmodium rotundifolium), running groundsel (Packera obovata), and reflexed sedge (Carex retroflexa).

In the hemlock-hardwood-pine community, the rare three-birds orchid (Triphora trianthophora) may occur in stands dominated by beech. The center of the distribution for the globally rare small whorled pogonia (Isotria medeoloides) occurs in New Hampshire in this forest type. Rare plant species that occur in New Hampshire’s high-elevation spruce-fir community and the lowland spruce-fir community include heart-leaved twayblade (Neottia cordata), broad-leaved twayblade (Neottia convallarioides), false toadflax (Geocaulon lividum), and dwarf blueberry (Vaccinium cespitosum). The northern hardwood-conifer community can support the rare pink shinleaf (Pyrola asarifolia).
Status of Matrix Woodland Communities

Matrix woodland communities are areas dominated by similar tree species and/or species groups. These broad woodland categories may occur on many different soil types and terrain. Below are descriptions of these woodland communities and their status, taken directly from the WAP:

**Appalachian Oak-Pine:** Appalachian oak-pine forests are found mostly below 900 feet elevation in southern New Hampshire and along the Connecticut River in western New Hampshire. The nutrient-poor, dry, sandy soils and warm, dry, climate influences the typical vegetation including oak, hickory, mountain laurel, and sugar maple. Many wildlife species use these forests for part or all of their life cycle including whip-poor-wills, black bears, state-endangered and federally-threatened northern long-eared bat and state endangered eastern hognose snakes. Traditionally, Appalachian oak-pine forests were influenced by frequent fires, which change the age structure of the forest, helping to promote wildlife diversity. Intense development pressure particularly in the southeast corner of New Hampshire has dramatically reduced naturally occurring fires and increased fragmentation of this forest type. Incorporating habitat conservation into local land use planning, protecting unfragmented blocks, and adopting sustainable forestry are a few examples of conservation strategies for Appalachian oak-pine forests.

**Hemlock-Hardwood-Pine:** Hemlock-hardwood-pine forests are comprised of mostly hemlock, white pine, beech, and oak trees. Since this is a transitional forest, it can occur at different elevations and over different types of soil and topography, so the composition of vegetation can be variable. This forest type is the most common in New Hampshire and covers nearly 50% of the state and provides habitat for numerous wildlife species such as the cerulean warbler, tri-colored bat and bobcat. Many of the species that use this habitat type require large blocks of unfragmented forest such as the northern goshawk and black bear. Since this forest type is so common, it is sometimes overlooked in conservation efforts. Development and fragmentation are primary threats to the continued existence of hemlock-hardwood-pine forest. Some conservation strategies for hemlock-hardwood-pine forests are incorporating habitat conservation into local land use planning, protecting unfragmented blocks of land, and educating landowners.

**High-Elevation Spruce-Fir:** High-elevation spruce-fir forests can be found generally between 2,500 and 4,500 feet in elevation on upper mountain slopes and ridge tops. Harsh climatic extremes and highly erosive soils play a significant role in determining the vegetative species found in this habitat type, which typically includes red spruce, balsam fir, and paper and yellow birches. High-elevation spruce-fir forest has a very limited distribution in New Hampshire, covering approximately 4% of the state's land area, and provides some of the last areas relatively free of human disturbance. The wildlife species that are found in this habitat include the federally threatened and state endangered Canada lynx and American marten. Spruce grouse and Bicknell’s thrush also use this habitat. Not only do the trees at this elevation have to cope with the harsh climate, but they must also deal with the stress effects of acid deposition. The high elevation also presents another potential threat: wind energy and communication infrastructure. High-elevation spruce-fir soils are also shallow, so forestry operations can easily damage the fragile soils. Conservation strategies for high-elevation spruce-fir forests include habitat protection and examining potential wildlife habitat degradation from wind farm construction.

**Lowland Spruce-Fir:** Lowland spruce-fir forests typically occur between 1,000 and 2,500 feet in elevation and are comprised of a mosaic of lowland spruce-fir forest and red spruce swamp communities. Typical vegetation includes red spruce, balsam fir, hobblebush, and bunchberry. Although lowland spruce-fir covers approximately 10% of the state, it provides habitat for over 100 vertebrate species from spruce
grouse to black bear to hoary bats. Lowland spruce-fir forests also contain very important deer wintering areas. During heavy snow years, these forests provide an area for white-tailed deer to yard up where the conifer trees provide food and shelter from the heavy snow. The federally threatened and state endangered Canada lynx as well as the American three-toed woodpecker and American marten. In some areas, cutting has converted the landscape to northern hardwood-conifer forest or created significant amounts of early successional habitat. Some conservation strategies for lowland spruce-fir forests are to protect unfragmented blocks of land and to maintain late successional habitat.

**Northern Hardwood-Conifer:** This habitat type is typically found between 1,400 and 2,500 feet in elevation and is usually made up of hardwood trees such as American beech, sugar maple, yellow birch, and conifer trees such as eastern hemlock, white pine, and balsam fir. Most of northern hardwood-conifer habitat occurs in central and northern New Hampshire. This woodland community provides habitat for many wildlife species including bald eagles and the state threatened peregrine falcons who nest on cliffs but hunt over the forest. Other typical species in this habitat include ruffed grouse, wood thrush and the state-endangered and federally-threatened northern long-eared bat. Development pressure is heavy within some parts of this habitat type. Forest harvesting is common and if done sustainably produces the diversity of age classes and species which is beneficial to wildlife. Forestry also has increased this type of habitat by converting spruce-fir habitats to the more economically valuable northern hardwoods. Some conservation strategies for northern hardwood-conifer forests are incorporating the habitat into local conservation planning, protecting unfragmented blocks of land, and advocating for the adoption of sustainable forestry.

Figure 12 shows the spatial distribution of the various woodland communities. As seen in Table 4 below, the hemlock-hardwood-pine community has the largest acreage at 2,039,333 acres. Next, and in order, come northern hardwood-conifer, Appalachian oak-pine, high-elevation spruce-fir, and then lowland spruce-fir.

**Table 4 Woodland Communities Acreages.**
*Source: NH Wildlife Action Plan, 2015*

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Matrix Forest Types</strong></td>
<td></td>
</tr>
<tr>
<td>Appalachian oak-pine</td>
<td>688,082</td>
</tr>
<tr>
<td>Hemlock-hardwood-pine</td>
<td>2,039,332</td>
</tr>
<tr>
<td>High-elevation spruce-fir</td>
<td>351,521</td>
</tr>
<tr>
<td>Lowland spruce-fir</td>
<td>219,044</td>
</tr>
<tr>
<td>Northern hardwood-conifer</td>
<td>1,263,455</td>
</tr>
</tbody>
</table>
Figure 12 Woodland Communities in New Hampshire.
Source: NH Wildlife Action Plan 2015, NH Fish and Game Department and GRANIT.
6. Watershed Values

a. Area of forest land adjacent to surface water

Riparian zones – those areas immediately adjacent to surface water – are extremely valuable lands from a wildlife habitat and water quality perspective. Legal buffers exist when conducting forest harvesting operations. These are found in the so-called Basal Area Law, RSA CHAPTER 227-J. Within any 12 month period, harvesting can only remove up to 50% of the basal area of trees within 50 to 150 feet of the high water level as described more fully in Table 5 below. Collectively, those legal requirements cover over 516,888 acres of land in the Granite State.

Table 5 Area of forest land adjacent to surface waters

<table>
<thead>
<tr>
<th>Riparian Management Zones</th>
<th>Legally Required (Basal Area Law)</th>
<th>Total Acreage in New Hampshire</th>
<th>Recommended**</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Riparian Management Zone (feet)</td>
<td>Total Acreage in New Hampshire</td>
<td>Riparian Management Zone (feet)</td>
</tr>
<tr>
<td>Intermittent Streams*</td>
<td>0</td>
<td>none</td>
<td>75</td>
</tr>
<tr>
<td>1st and 2nd Order Streams</td>
<td>50</td>
<td>103,508.38</td>
<td>100</td>
</tr>
<tr>
<td>3rd Order Streams</td>
<td>50</td>
<td>27,765.05</td>
<td>300</td>
</tr>
<tr>
<td>4th Order Streams and larger streams</td>
<td>150</td>
<td>92,942.72</td>
<td>300</td>
</tr>
<tr>
<td>Pond &lt; 10 acres</td>
<td>50</td>
<td>39,783.22</td>
<td>100</td>
</tr>
<tr>
<td>Lake or Great Pond (&gt; 10 acres)</td>
<td>150</td>
<td>252,888.81</td>
<td>300</td>
</tr>
<tr>
<td><strong>Total Riparian Management Acreage</strong></td>
<td>516,888.17</td>
<td>1,040,353.41</td>
<td></td>
</tr>
</tbody>
</table>

*Intermittent Streams were defined from the NHD Plus High resolution Hydrography dataset by using the attributes FCODE=46003 (Intermittent) AND Stream Order = 1
** Recommended riparian zones are from Good Forestry in the Granite State

Good Forestry in the Granite State, a voluminous document built by a wide-ranging team of stakeholders and most recently revised and republished in a 2nd edition in 2010, recommends additional riparian buffers to provide more protection to these sensitive lands. These recommendations are voluntary and the buffers recommended range from 75 feet to 300 feet. The area of those buffers in New Hampshire total over 1,040,353 acres.

b. Forest land by watershed

In Figure 13 below, the area of the major watersheds in New Hampshire can be found. At over 1.3 million acres, the largest is the Merrimack River watershed. However, if we combine the three Connecticut River sub-watersheds, those total over 1.6 million acres. Table 6 provides an acreage breakdown for all the watersheds shown in the map.

Table 6 Major Watershed Acreage in NH

<table>
<thead>
<tr>
<th>HUC 8 Watershed Name</th>
<th>Acres</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Androscoggin River</td>
<td>462,583.40</td>
<td>7.79</td>
</tr>
<tr>
<td>Saco River</td>
<td>556,245.67</td>
<td>9.36</td>
</tr>
<tr>
<td>Salmon Falls-Piscataqua Rivers</td>
<td>531,283.09</td>
<td>8.94</td>
</tr>
<tr>
<td>Pemi - Winni</td>
<td>965,370.02</td>
<td>16.25</td>
</tr>
<tr>
<td>Contoocook River</td>
<td>488,971.24</td>
<td>8.23</td>
</tr>
<tr>
<td>Merrimack River</td>
<td>976,898.17</td>
<td>16.45</td>
</tr>
<tr>
<td>Upper Connecticut River</td>
<td>583,306.88</td>
<td>9.82</td>
</tr>
<tr>
<td>Middle CT River</td>
<td>504,143.20</td>
<td>8.49</td>
</tr>
<tr>
<td>Lower CT River</td>
<td>871,311.19</td>
<td>14.67</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>5,940,112.87</td>
<td>100.00</td>
</tr>
</tbody>
</table>

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7 According to the Hydrologic Unit Code (HUC) eight digit convention
Figure 13 Major Watersheds in New Hampshire
c. Water quality in forested areas

Since New Hampshire is so densely forested, any water quality information about the State’s lakes and rivers, positive or negative, is relative to forested areas. The NH Department of Environmental Services, Water Division, collects monitoring data on water quality of all waters of the State.

Figure 14 shows three water quality datasets for NH lakes for the period 1985-2015. Much of the data behind this graph comes from the Volunteer Lake Assessment Program the agency has coordinated with lay lake monitors across the State for decades. Phosphorus levels (green) have stayed relatively steady over time with an appearance of slight reductions over the last 10 years. More data will be needed to determine if there is a downward trend showing.

For chlorophyll-a (in red), an indicator of algal growth (the more algae shown suggests more nutrient pollution in the aquatic ecosystem) the trend appears similar to phosphorus – largely steady over the past three-decade period with possible slight downward trend in recent years. Again, this recent trend may or may not continue over time.

Lastly, transparency, a measure of overall clarity in the water, is showing a positive upward trend (meaning an increase in transparency – a positive measure) in the last four years of data. While it appears significant, more data will determine if this is a true trend, but it appears to be a good sign for water quality in NH lakes.

![Figure 14 NH Lakes Water Quality Trends](image)

**Figure 14 NH Lakes Water Quality Trends**

*Source: NH Department of Environmental Services, Water Division*

In Figure 15 NH river water quality trends are shown. The metric used is conductance\(^8\), a measure of water’s ability to conduct electrical flow, is useful as a general measure of stream water quality. According

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\(^8\) Conductivity in water – is a measure of water’s capability to pass electrical flow. This ability is directly related to the concentration of ions in the water. These conductive ions come from dissolved salts and inorganic materials such as alkalis, chlorides, sulfides and carbonate compounds (pollutants).
to Theodore Diers of the NH DES Water Division⁹, the trend in recent years appears to be slightly increasing. This is likely from increased use of road salt and, generally, results from stormwater runoff into rivers in the State.

![Figure 15 NH Rivers Water Quality Trends](image.png)

**Figure 15 NH Rivers Water Quality Trends**
*Source: NH DES, Water Division*

Additional water quality information from the NH Water Division at DES includes:

- While all 1200 lakes and ponds and 16,000+ river miles are still considered impaired relative to mercury levels in fish, the mercury deposition rate has rapidly declined in recent decades (see Figure 16). Since mercury bio-accumulates in fish, it will be a long time before the actual level of mercury sees a decline in actual fish populations. The mercury in fish today may have come from atmospheric deposition 40 years ago.
- Remote pond (see Figure 17) monitoring suggests good trends with increasing pH levels or stable readings; predominantly stable acid neutralizing capacity (ANC); reduced sulfate; and reduced conductivity. The decrease in sulfate concentration and specific conductance in all ten ponds along with moderate overall increase in pH suggests air quality regulations are successfully reducing acid-causing pollutants (Acid Rain Status and Trends, NH Department of Environmental Services).
- Invasive water plant infestations have been increasing (milfoil, fanwort, water chestnut, elodia, pondweed, etc), not a good trend.
- At least 90% of NH water pollution problems are a result of storm drain runoff. This tends to affect rivers and streams much more than ponds and lakes.

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⁹ Personal communication Ted Diers, March 12, 2019.
Figure 16 US Trends in Atmospheric Mercury Emissions
Sources: NH Department of Environmental Services, Water Division, Volunteer Lake Assessment Program results (1985-2017)

Figure 17 Remote Pond Pollution Trends 2014
Source: NH Department of Environmental Services, Water Division
Additional NH water quality data can be found in Figure 18 which shows impaired waters in NH and their potential for recovery and protection. The impairment is not necessarily from forestry activities but is more a result of general development and habitat loss from development and permanent land use change.

Figure 18 NH Impaired Waters
Source: NH Department of Environmental Services
Drinking water is most important to humans and an effort by the USDA Forest Service program called Forests to Faucets was designed to better understand the quality of our drinking water sources and where they are at risk. Figure 19 is a spatial representation of forest sub-watersheds importance to drinking water in NH communities. Darker is more important in the map.

Figure 19 Forests Important to Surface Drinking Water
Source: USDA Forest Service, Forests to Faucets
Also from Forests to Faucets, Figure 20 shows those sub-watersheds most at risk in the Granite State. Low index values represent low development threat areas to forests that are important to surface drinking water sources, whereas high values represent high threat.

**Figure 20 Development Threat to Forests Important to Surface Drinking Water.**  
*Source: USDA Forest Service, Forests to Faucets*
7. Forest Insects & Disease – Native and Invasive

As with all states, New Hampshire has its share of damaging forest insects and diseases affecting growth and productivity of forests, ultimately impacting people and economies that depend on them. While many native pests such as saddled prominent and spruce budworm cause serious forest damage today’s critical threats are non-native invasive problems accidentally moved from around the world in a global economy. These invasive pests and diseases find host trees in NH where there are limited natural controls to slow their spread. As an example, there is a large suite of pathogens native to NH that destroy outbreaks of forest tent caterpillar or spruce budworm, but there is no known group of biocontrols to stop the emerald ash borer, woolly adelgid, Asian longhorned beetle or red pine scale.

**Insects:**
Current insect outbreaks of greatest influence on New Hampshire forests include:

**Hemlock Woolly Adelgid** (HWA) is a non-native invasive from Asia. It feeds through piercing mouthparts in the phloem of small branches and can kill Eastern Hemlock trees. Populations fluctuate from year to year depending on late winter temperatures. In 2017, New Hampshire saw a decline in HWA population but populations are again building in 2020. Hemlock Woolly Adelgid, was first detected in Portsmouth in 2000. HWA is a tiny wingless insect with two generations per year. The majority of feeding takes place in the fall, winter and spring. Infestations can be heavy along the coast and in southern NH. Mortality can be severe when trees are stressed by drought or other insects and disease. As of 2020, the majority of tree mortality in NH is at sites where both HWA and elongate hemlock scale coexist. In southern states it’s common to have 50% tree mortality where HWA has occurred for more than 10 years.

**Elongate Hemlock Scale** (EHS) is an exotic from Asia and feeds in a similar way as adelgid but in the foliage of hemlock rather than the twigs. Because it feeds on the needles and damages the photosynthesis capabilities it’s considered more lethal to hemlocks in NH.
Emerald Ash Borer (EAB) is a non-native invasive beetle first discovered in North America in Michigan near Detroit in the summer of 2002. Emerald ash borer likely arrived in the United States on solid wood packing material carried in cargo ships originating in its native Asia. As of October 2019, it’s found in 35 states, and the Canadian Provinces of Ontario, Quebec, New Brunswick, Nova Scotia and Manitoba. EAB was first detected in New Hampshire in 2013. The EAB is currently in more than 100 towns in NH and all Counties except Coos.

The adult beetles feed on ash foliage but cause little damage. Larvae (the immature stage) feed on the cambium and inner bark of ash trees, disrupting the tree’s ability to transport water and nutrients. All infested trees are eventually killed by larval feeding when high population levels completely girdle the cambium. EAB can fly several miles on its own but the most common means of long distance spread is through the movement of infested firewood. After trees are cut, EAB can still emerge from the logs or firewood for several months if the material is not heat treated or debarked. Eventually all of NH’s ash
forests will be challenged by EAB and the largest trees with thick bark and lots of cambium will die. There is a future for ash species in NH forests if young ash stands and ash regeneration is encouraged while work on biocontrol parasitoids continue to develop in our region.

In the meantime, slowing the spread with responsible adherence to best management practices and the out-of-state firewood quarantines will give more time for landowners to plan their response and give scientists more time to develop control strategies.

Forest Tent Caterpillar is a native insect that feeds on the leaves of hardwood trees in its larval caterpillar stage. Sugar maple stands are particularly preferred by the tent caterpillar in the northern Counties but oaks are highly susceptible in the southern Counties. At times it can cause extensive damage as it did between 2005 and 2008 and between 2015 and 2018. Generally, trees will recover after a forest tent caterpillar infestation but areas with droughty soils, high elevations or poor timber management practices can be severely damaged from two or more years of infestation.

Red Pine Scale was originally introduced to North America in the 1940’s from Asia and found in NH at Bear Brook State Park in 2012. Red Pine Scale is an invasive insect that kills red pine trees by feeding in the small branches of the live crown. Adults are wingless, soft-bodied insects similar to adelgids with piercing sucking mouthparts. Red Pine Scale has two generations per year in NH as does the woolly adelgid. Red pine has no resistance to RPS and there are no established biocontrol agents. Mortality takes between two and four years depending on tree health at the time of infestation.

Spruce Budworm is a native moth that seriously impacted spruce-fir forests in northern New Hampshire and elsewhere in the region throughout the 1900’s. The larvae feed on spruce and especially balsam fir needles. Spruce budworm populations are cyclical with a period of approximately 40 years between epidemics. The last New Hampshire outbreak ended in 1983 with severe defoliation in the late 1970s and early 1980s. Recently, populations in Quebec have increased with millions of acres defoliated in the last 6 years. To date, no elevated budworm populations have been seen in NH and it’s unlikely to take place until there is substantially more mature contiguous stands of balsam fir.

Asian Longhorned Beetle is a non-native invasive wood-boring insect that feeds on a variety of hardwoods including maple, birch, elm, ash, poplar, horse chestnut, and willow, among others. Native to China and Korea, the beetles are approximately 1.5 inches long and shiny black, with white spots on their wing cases. Major outbreaks in New York and Massachusetts continue to cost millions of dollars annually to control. Because sugar maple is a preferred host any spread into NH would be devastating to the maple syrup industry, tourist industry and the urban forests where sugar maple is a key component.

Gypsy Moth is arguably the most damaging forest pest in NH’s history but no major outbreaks have occurred in 30 years and there is no expectation that it will expand to landscape levels again. Gypsy moth can be found in every town of NH and we get periodic population increases that cause several hundred acres of defoliation but before the outbreak expands to something more serious it is controlled by a fungus (entomophaga maimaiga), and a virus (nucleopolyhedrosis virus). Both the fungus and the virus were introduced in NH more than 75 years ago and they are both found commonly in the naturalized population of gypsy moth today. Recent outbreaks in southern New England that caused thousands of acres of gypsy moth damage and severe mortality in oak stands, was exacerbated by droughty spring weather for several years in a row. The fungus and virus struggle to be effective in dry conditions.

Balsam Woolly Adelgid (BWA) is an exotic forest pest that has likely caused more tree mortality in NH the past 20 years than any other insect. BWA was introduced to Nova Scotia around 1900 and spread through
NH starting around 1960. Today it can be found in most fir stands below 2000’ elevation. BWA feeds at the base of the buds and along the bole of the tree. Evidence of feeding at the buds would be gouty, disfigured, swollen branch tips giving the tree a “bottle brush” shape. Feeding along the bole of the tree is evidenced by patches of white dots that are cottony in texture and appearance. Heavy feeding by BWA causes overproduction of lignin in the wood structure and growth is suppressed to the point that drought and other stressors kill the tree.

Diseases:
White Pine Needle Damage or “needlecast” has been identified extensively throughout the range of white pine in New Hampshire and elsewhere in the northeast. This is not a single pathogen but a combination of native fungi found on white pine needles.

Needles of mature white pine trees become straw-colored to brown before they are prematurely shed from the canopy. In some cases, only a few main branches are symptomatic whereas on other trees, the entire canopy exhibits symptoms. One feature of the disease is that despite significant needle browning and premature shedding of two and three year old needles, the current season’s needles are elongated and appear healthy.

Caliciopsis canker was first reported in New Hampshire in 1997 and is generally considered a weak perennial fungus, which attacks thin barked areas of the branch and bole. Cankers can be elongated depressions with profuse pitching on the stem or an extreme roughening of the bark just below the branch whorls. Black “hair like” fruiting structures persist throughout the year and the spores mature in late winter and spring. Spores are disseminated by wind and rain and typically enter through bark lenticels or small insect wounds. The highest incidence of disease to date has been noted on suppressed, understory trees and trees in very dense stands. Management practices which create increased sunlight and air-flow may decrease spore production and dissemination.

White Pine Blister Rust has traditionally been a major threat to white pines and their ecosystems. The rust is a non-native fungus (Cronartium ribicola) accidentally imported to North America on pine seedlings from Europe around 1900. All of the North American white pines are susceptible but in NH white pine is the species of concern.

In NH, from the 1920’s to the 1970’s thousands of field personnel spent millions of hours destroying various shrub species in the genus ribes to try and control the statewide outbreak. Ribes plants such as black currants and gooseberries are the alternate host for this rust disease so by removing the alternate host the disease cycle can be eliminated.

All species of white pine are susceptible at all ages; however seedlings and young trees are more easily infected and die more quickly as a result of infection. Spores drift in the wind and survive the longest close to the ground where moisture is trapped by dense foliage and brush. When pine grows in height and no live foliage is close to the ground risk of infection decreases.

Today, NH’s white pine forests are predominately mature forests with a small percentage of trees in the seedling/sapling size class making the risk of blister rust infection much lower than the era of reforestation 100 years ago. The statewide infection rate is below 1% of all white pine and considered endemic. The NH Division of Forests and Lands, in cooperation with the NH Department of Agriculture, Markets & Foods has lifted the quarantine on several species of gooseberries and currants which can now be planted for
berry production. These approved species can be found at nhdfl.org and have been fully vetted as *ribes* species with low risk of contracting blister rust fungi that could in turn infect white pine.

**Beech Bark Disease (BBD)** is a tree disease affecting American beech in NH and it was first reported in NH around 1920. Today the leading edge of the outbreak is in the Midwest. All stands of beech in NH have some level of infestation. BBD is initiated by feeding on the bark by a species of scale insect accidently introduced from Europe more than 100 years ago. Once the scale insect starts feeding the neonectria fungi use that site to penetrate into the tree and cankers start growing. As the cankers grow in size and coalesce the bark is severely disfigured and eventually causes structural failure and tree mortality. There are beech trees more resistant than others. Today's management strategies consist of trying to encourage more resistant trees and remove highly cankered trees through silvicultural practices or herbicides.

**Oak Wilt** is a disease caused by a fungus that disrupts the transport of water throughout a tree. It's a serious disease that affects all oak trees. Red oaks are most susceptible to oak wilt and can die within a few weeks to 6 months of infection. While it has been found in more than 20 states, oak wilt is not yet known in New Hampshire. The closest outbreak is in New York.

Oak wilt is spread most often between trees through the roots, although it can also be spread by beetles. When the roots of oak trees become fused together, they can share nutrients and some diseases. The oak wilt fungus *Ceratocystis fagacearum* grows in the water-conducting vessels of a tree and prevents the movement of water. As water movement slows, the leaves wilt and drop off, ultimately leading to death of the tree.

Control of oak wilt is possible so finding infected trees early is critical. It’s much easier to control the spread around a quarter acre pocket versus a five acre infection court. Control includes cutting trees, trenching around infested areas to sever root grafts or using stump treatments of herbicides to kill roots of trees grafted to roots of infested trees.
8. Terrestrial Invasive Plants

According to the NH Department of Agriculture, Markets and Food, non-native invasive species have become an overwhelming problem resulting in impacts to the natural environment and managed landscapes. Invasive species typically possess certain traits that give them an advantage over most native species. The most common traits include the production of many offspring, early and rapid development, adaptability and tolerance of a broad range of environmental conditions and, the lack of natural controls to keep them under control. These traits combined allow certain non-native species such as Oriental bittersweet - *Celastrus orbiculatus*, Japanese barberry - *Berberis thunbergii*, and others to become highly competitive and dominant in many of New Hampshire's natural and artificial landscapes. In some instances, species such as the Norway maple - *Acer platanoides* or Tree of heaven - *Ailanthus altissima*, rely on their ability to excrete toxic chemicals from their roots which interferes with or prevents the establishment of native species within its rooting zone. Furthermore, studies have shown that invasives can reduce natural diversity, impact endangered or threatened species, reduce wildlife habitat, create water quality impacts, stress and reduce forest and agricultural crop production, damage personal property, and cause health problems. Within the United States, the adverse economic impacts resulting from invasive species currently exceeds $100 billion annually. Unfortunately, New Hampshire is not immune, every community in the state is impacted by at least one invasive plant and as the number of invasive populations grow so does the potential for greater dispersions. Figure 22 shows confirmed occurrences of several invasive plants that the general public has entered into a National database on invasive species called EDDMaps. By no means is this map a depiction of all outbreaks but it does illustrate that invasive plants are frequently found near population centers and disturbed ecosystems. The most threatening invasive plants in NH (listed below) are most common in southern NH where woodlots are smaller and there is more edge habitat between non-forest and forested habitat. The most disruptive invasive plants already existing in NH are here to stay and we need to focus efforts on slowing the spread to new locations and be diligent about best management practices that provide an opportunity for native species to compete.

Several of the most disruptive terrestrial invasive plants in NH forests include:
**Glossy Buckthorn** (*Frangula alnus*) is native to Europe and likely been in the Northeast for 200 years. Seed is most often spread by birds but forestry equipment, recreational vehicles and soil transportation can create new outbreaks. The forestry issue it creates is due to the dense canopy it creates under shaded environments. Natural regeneration does not compete well.

**Oriental Bittersweet** (*Celastrus scandens, L.*) is a vine native to Asia introduced to North America in the late 1800’s. This species produces prolific amounts of seed each fall and all types of wildlife spread the seed. Bittersweet climbs trees and shrubs girdling the cambium or weighs down the tree crown causing branch breakage and shading of native foliage.

**Japanese Barberry** (*Berberis vulgaris*) is a shrub species introduced in the late 1800’s from Japan because it was resistant to many rusts diseases and deer did not browse on it. It flushes leaves early in the spring and maintains foliage later than native shrubs giving it a distinct competitive advantage. Seed ripens in the fall and birds spread the plant. Barberry has the ability to grow well in all light conditions so it easily chokes out native seedlings and low vegetation.

**Bush Honeysuckle** (*Lonicera maackii*) is another introduced plant from Pacific Rim Countries for it's ability to stabilize soils and produce fruit for wildlife. Unfortunately it escaped it’s plantings and grows in such dense formations that native plants can't compete. Foliage persists longer than native plants and wildlife inadvertently spread the seed.

**Burning Bush** (*Euonymus alatus*) was imported to North America more than 100 years ago from Asia due to its brilliant red fall foliage. Burning bush has several traits that make it invasive in our forests. It can thrive in all light conditions, produces yearly fruit, and can reproduce aggressively through vegetative reproduction when the parent plant is disturbed.

There are many invasive species emerging as threats to our forests such as Norway maple and tree of heaven to go along with all the invasive plants spreading closer to NH like kudzu and giant hogweed. The list of invasive grasses and sedges also continue to grow as more seed is accidentally spread by recreationist, wildlife, construction, forestry, and wind.

Strategies to slow the spread of invasive plants in NH and keep those not in NH from arriving need to focus on public education and local control. It’s critical that people understand their role in creating the problem through landscape plantings, recreational activities, poor vegetative management and lack of knowledge.

A list of restricted or prohibited invasive plant species compiled by the NH Invasive Species Council can be found at [https://www.agriculture.nh.gov/divisions/plant-industry/invasive-plants.htm](https://www.agriculture.nh.gov/divisions/plant-industry/invasive-plants.htm). Agencies with authority for invasive upland plant species include the NH Department of Agriculture, Markets & Food (NHDAMF), Division of Plant Industry and for aquatic plant species, the NH Department of Environmental Services (NHDES) Exotic Species program.
9. Fire Management

Wildfire Protection
New Hampshire experiences wildfires on a seasonal basis with spring and fall being the most active times of the year. Wildfire Management focuses on strategies to keep the frequency and size of wildfires to a minimum reducing costs and risks to people and structures; and protecting New Hampshire’s forests and natural communities. The Division of Forests and Lands is responsible by state law for providing wildland fire detection, prevention, and suppression on all lands in the state, except within the boundaries of the White Mountain National Forest. This accounts for over 4.1 million acres that fall under state jurisdiction for wildland fire protection.

Each year New Hampshire experiences approximately 175 wildfires. These fires burn approximately 225 acres collectively, although this figure can vary considerably depending on weather. Large fires (>100 acres) though once common, are now a rarity. However, in the spring of 2015 the state experienced a 275-acre wildfire, which was the largest in many years. In 2016, New Hampshire experienced another large fire that burned 190 acres. In 2017 the state had a busy fall fire season with a very complex 75-acre fire. In addition to wildfires, the state experiences approximately 125 illegal outdoor fires that are extinguished before they become a wildfire.
New Hampshire relies on community fire departments for initial attack, and the state provides a leadership support role. The exception to this is the unincorporated towns in the northern portions of the state where the division takes more of an initial attack responsibility.

The primary methods of fire detection in New Hampshire are through citizen reports, fire towers, fire service personnel, and air patrols. The state operates and maintains 15 part-time fire detection lookout towers located throughout the state. The state also uses the Civil Air Patrol to conduct aerial fire detection.

New Hampshire is a heavily forested state with a large population which lives within the Wildland Urban Interface. The division and the forest rangers work with communities to help develop Community Wildfire Protection Plans (CWPP’s). Throughout the state this is commonly completed with a town’s Hazard
Mitigation Plan which allows the forest ranger, town planners and emergency responders to participate in the comprehensive risk management process for the town.

**Figure 24 Fires Incidents from 1992 to 2018**
*Starred communities have developed Community Wildfire Protection Plans*

The New Hampshire Fire Management Program is more than suppression. The fire management strategy includes preparedness, assistance to communities, suppression/support, equipment, training of fire personnel and volunteers, community mitigation, prescribed burns, hazardous fuels reduction, law enforcement, prevention and education. New Hampshire’s fire prevention program is very active, with numerous presentations reaching tens of thousands of people each year.

On average the Forest Protection Bureau responds to 625 fire related calls for service each year.
Prescribed Fire

Fire Adapted Communities in NH - Fires have impacted the landscape of New Hampshire for generations. The frequency, geographical distribution, and intensity have varied during different eras. In pre-settlement times, there were more fires of lower intensity around Native American villages (Chapter 5, Indian Fires in the Prehistory of New England, authors: William A. Patterson III and Kenneth E. Sassaman. Holocene Human Ecology in northeastern North America, Edited by George P. Nicholas, Plenum Publishing Corporation, 1988). During colonial times and the industrial revolution era, fires were larger and more geographically dispersed and were associated with land clearing as well as industrial activities and infrastructure. In the 20th and 21st centuries, more fires were inadvertently caused by humans from activities such as camping and residential brush pile burning.

Over the past 100 years, natural resource managers began to better understand the ecological benefits of forest fires. We now know that certain forest types and wildlife habitats are adapted and depend on fire for their maintenance and regeneration.

Prescribed Fire in NH – Prescribed fire is used in New Hampshire to meet a range of management goals that benefit public safety, forest-based recreation, wildlife management, silviculture, agriculture, invasive species management and sustaining unique natural communities.

The University of New Hampshire, Cooperative Extension Service conducted surveys with the following results.

<table>
<thead>
<tr>
<th>Summary Statistics</th>
<th>Municipal Fire Departments</th>
<th>State Agencies</th>
<th>Federal Agencies</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td># of burns</td>
<td>34</td>
<td>24</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>Acres burned</td>
<td>216.3</td>
<td>113.8</td>
<td>220.5</td>
<td>185.0</td>
</tr>
<tr>
<td>Ac / burn</td>
<td>6.36</td>
<td>4.74</td>
<td>18.38</td>
<td>12.33</td>
</tr>
<tr>
<td>% of total burns</td>
<td>41.5%</td>
<td>45.3%</td>
<td>30.0%</td>
<td>42.8%</td>
</tr>
<tr>
<td># of towns where burns occurred</td>
<td>19</td>
<td>24</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>% of towns where burns occurred</td>
<td>14.1%</td>
<td>10.2%</td>
<td>3.0%</td>
<td>3.8%</td>
</tr>
</tbody>
</table>
Hazard Reduction—Dangerous fuel loads (i.e. vegetation) can be burned and reduced in a controlled way to minimize the risk of difficult to control wildfires.

Wildland Fire Training - Local fire departments require a significant amount of training to combat fires, both structural and wildfires. Prescribed burns provide an excellent opportunity for firefighter trainees to get first-hand experience on how to control forest fires.

Forestry – Prescribed fire can encourage oak regeneration, and is currently used in some regions of the northeast to promote these species.

Agriculture – Wild blueberry growers have found by experience and research that periodic pruning via fire can stimulate higher yields and can reduce certain insects and diseases. Also, prescribed fire has been used to maintain pastures and increase nutrients of the forage.

Improve Wildlife Habitat & Maintain Rare Natural Communities – There are a host of natural communities and associated wildlife in NH that benefit from fire including pine barrens, rocky ridges, grasslands, and shrublands. Pine barrens in particular support a suite of species that are regionally and globally rare. These include the federal and state endangered Karner Blue Butterfly (NH’s state butterfly), and nearly a dozen other rare moths and butterflies. Natural communities with soils that are well to extremely well-drained require periodic fire to maintain their structure and species composition. Of NH’s 414 endangered or threatened plant species, 108 occur in these types of dry to semi-dry soil conditions.

Aesthetics & Outdoor Recreation - Prescribed fire can be used to maintain aesthetics and views.
Table 7 Fire Adapted & Dependent Natural Communities in NH

<table>
<thead>
<tr>
<th>NH Fire Dependent Natural Communities</th>
<th>NH Moderately Fire Prone Natural Communities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appalachian oak - pine rocky ridge (S3)</td>
<td>Appalachian wooded talus (S1S2)</td>
</tr>
<tr>
<td>Chestnut oak forest/woodland (S1S2)</td>
<td>Bayberry - beach plum maritime shrubland (S1)</td>
</tr>
<tr>
<td>Circumneutral rocky ridge (S1)</td>
<td>Coastal rocky headland (S1)</td>
</tr>
<tr>
<td>Dry Appalachian oak forest (S3)</td>
<td>Maritime meadow (S1)</td>
</tr>
<tr>
<td>Dry red oak - white pine forest (S3S4)</td>
<td>Maritime shrub thicket (S1)</td>
</tr>
<tr>
<td>Jack pine rocky ridge (S1)</td>
<td>Maritime wooded dune (S1)</td>
</tr>
<tr>
<td>Mixed pine - red oak woodland (S1S2)</td>
<td>Oak - mountain laurel forest (S3)</td>
</tr>
<tr>
<td>Pitch pine - Appalachian oak - heath forest (S1)</td>
<td>Red oak - black birch wooded talus (S1S4)</td>
</tr>
<tr>
<td>Pitch pine rocky ridge (S1)</td>
<td>Red oak - ironwood - Pennsylvania sedge woodland (S2)</td>
</tr>
<tr>
<td>Pitch pine - scrub oak woodland (S1S2)</td>
<td>Red spruce - heath - cinquefoil rocky ridge (S3S4)</td>
</tr>
<tr>
<td>Red oak - pine rocky ridge (S3S4)</td>
<td>Rich Appalachian oak rocky woods (S2)</td>
</tr>
<tr>
<td>Red pine rocky ridge (S2)</td>
<td>Rich red oak rocky woods (S2S3)</td>
</tr>
<tr>
<td>Red pine - white pine forest (S2S3)</td>
<td>Semi-rich oak - sugar maple forest (S2S3)</td>
</tr>
<tr>
<td>Riverwash plain and dunes (S1)</td>
<td></td>
</tr>
<tr>
<td>Subalpine rocky bald (S2)</td>
<td></td>
</tr>
</tbody>
</table>

Fire-prone natural communities in New Hampshire with state ranks in parentheses. State ranks describe rarity of the natural community within NH. Visit the "Natural Communities of New Hampshire" online or read Sperduto and Nichols (2004) for more information.

**S1 (Critically Imperiled):** At very high risk of elimination due to extreme rarity (generally one to five occurrences), very steep declines, or other factors.

**S2 (Imperiled):** At high risk of elimination due to a very restricted range, very few examples (generally six to 20 occurrences), steep declines, or other factors.

**S3 (Vulnerable):** At moderate risk of elimination due to restricted range, relatively few examples (generally 21 to 100 occurrences), or vulnerable to elimination because of other factors.

**S4 (Apparently Secure):** Occasional to somewhat widespread but not uncommon or rare; possible cause for long-term concern due to declines or other factors.

**S5 (Secure):** Demonstrably common, widespread, and abundant.
10. Climate Change
Since the mid-20th century, scientists have recorded an unprecedented warming of temperatures across the earth. The scientific consensus is that the cause is due to human influences, also known as the anthropogenic climate change. (IPCC 2013, John et al. 2016) The largest human influence on rising temperatures, since the mid 1900’s, has been the increase of greenhouse gases such as carbon dioxide (CO2), methane and nitrous oxide in the earth’s atmosphere. Within the Northeast, temperatures increased by approximately 2.4 °F (1.3 °C) between 1901 and 2011 (Janowiak et al. 2017). In New Hampshire, average annual temperatures have increased 3 °F with the greatest warming occurring during the winter with an increase of about 4 °F since 1900 (www.statesummaries.ncics.org/nh). These warming trends have resulted in warmer winter nights, days with temperatures below freezing reduced by two weeks, and a lengthening of the growing season by twelve to forty-two days since 1960 in northern New Hampshire and by fifteen to fifty-two days in southern New Hampshire (Wake et al. 2014). In addition, the growing season is predicted to be extended by 3-7 weeks in northern New Hampshire and by 2-5 weeks by the year 2100 depending on the emission’s scenario (Wake et al. 2014). (Kunkel et al. 2013, Ning et al. 2015). A longer growing season means a shorter frost-free period with less snowfall and shorter duration of snowpack. Milder winters have led to a decrease in the amount of precipitation falling as snow and the duration of snowpack (Campbell et al. 2010). With less snowpack, there is an increased risk of soil frost and root damage during the winter from less insulation from the snow (Groffman et al. 2012). Increased summer temperatures and more variable summer precipitation increase the risk of stress on riparian and floodplain vegetation due to lower summer flows. Figure 25 shows the New Hampshire and national average temperature trends.

![Figure 25 Trend in average annual temperature for NH and the US](Source: National Centers for Environmental Information, National Oceanic and Atmospheric Administration (NOAA))
increase in precipitation observed in the fall (+3.0 inches) and the smallest increase in winter (+0.6 inches) (Janowiak et al. 2017). Perhaps the greatest impact in New England of a changing climate is the occurrence of extreme precipitation events (Speirre and Wake 2010, Wake et al. 2014). The amount of precipitation falling in very heavy events (heaviest 1% of all daily events) across the Northeast increased 71% between 1958 and 2012, more than any other region in the country (Melillo et al. 2014). Although it is not possible to attribute a single extreme weather event to having been caused by climate change, climate change does increase the likelihood for these events to occur (Kunkel et al. 2012). For example, there has been a strong increase in the intensity, frequency, and duration of hurricanes, especially the frequency of the strongest hurricanes (Category 4 and 5), in the North Atlantic since the 1970s due to warming sea surface temperatures (Walsh et al. 2014). Figure 26 shows New Hampshire and US annual precipitation trends.

![Figure 26 Trend in average annual precipitation for NH and the US](source)

**Impact on Trees**

According to the Fourth National Climate Assessment, forests are already responding to the ongoing shift to a warmer climate, and changes in the timing of leaf-out affect plant productivity, plant–animal interactions, and other essential ecosystem processes (USGCRP, 2018). Warmer late-winter and early-spring temperatures in the Northeast have resulted in trends towards earlier leaf-out and blooming. Seasonal differences in Northeast temperature have decreased in recent years as winters have warmed three times faster than summers. The structure of forests, including the abundance of different tree species and the distribution of different ages of trees, is expected to change in response to climate change, but the degree and how it will change may differ amongst forest types (Janowiak et al. 2017, Manomet and NWF 2012, NHFG 2013). It is likely that our species-based definitions of natural communities may change, as individual plants react differently to increases in temperature and changes in the hydrological regime (NHFG 2013). Models of tree species abundance have been developed to provide insights into how tree species may respond into the future under low-emissions and high-emissions scenarios (Janowiak et al. 2017). For example, the Climate Change Tree Atlas (www.fs.fed.us/nrs/atlas) models future suitable habitat in the Northeast for 2100 and suggests that individual tree species will respond differently over time as the temperature warms. This model projects future suitable habitat of tree species, and suggests that spruce and fir will decline across the region, as will most of the northern conifer species (Janowiak et al. 2017). However, red maple, black cherry and red oak are expected to fare well with a changing climate. Sugar maple and yellow birch, are expected to decrease in the high emissions
scenario, while under the low emissions scenario little change is expected in habitat suitability across the landscape. Sugar maple is a species that has fairly specific soil requirements, it does well on good quality soils; a species like this may not be able to shift its range within the region with greater warming expected under the high emissions scenario due to soil limitations. Table 8 shows future projections of New Hampshire’s 20 most common tree species by volume under low and high climate change scenarios (USDA Forest Service Climate Change Atlas).

**Forest Management**

Warmer temperatures, increased extreme weather events, and greater likelihood that precipitation will fall as rain in winter, may negatively impact timber harvesting operations and cause a decrease in harvest productivity. Areas that require timber harvesting to be done under frozen ground conditions may experience fewer days of operation in the winter. If there are fewer days with optimal conditions for timber harvesting due to a changing climate, substantial acreage may become effectively inaccessible without suitable ground conditions. This scenario effectively shrinks the total availability of timberland for management. Increased precipitation and extreme weather events will likely increase the costs for road development and maintenance to mitigate water quality impacts. The damage to trees from extreme events such as severe drought and high wind instigate insect outbreaks and wildfires which, in turn, may result in increased salvage harvesting.

<table>
<thead>
<tr>
<th>Species</th>
<th>Northern Forest Region</th>
<th>Southern &amp; Coastal NE</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LOW CLIMATE CHANGE</td>
<td>HIGH CLIMATE CHANGE</td>
<td></td>
</tr>
<tr>
<td>Eastern white pine</td>
<td>●</td>
<td>●</td>
<td>▼</td>
</tr>
<tr>
<td>Red maple</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Northern red oak</td>
<td>▲</td>
<td>▲</td>
<td>●</td>
</tr>
<tr>
<td>Eastern hemlock</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Sugar maple</td>
<td>●</td>
<td>▼</td>
<td>●</td>
</tr>
<tr>
<td>Yellow birch</td>
<td>●</td>
<td>▼</td>
<td>●</td>
</tr>
<tr>
<td>Red spruce</td>
<td>▼</td>
<td>▼</td>
<td>▼</td>
</tr>
<tr>
<td>Balsam fir</td>
<td>▼</td>
<td>▼</td>
<td>▼</td>
</tr>
<tr>
<td>American beech</td>
<td>●</td>
<td>▼</td>
<td>●</td>
</tr>
<tr>
<td>Paper birch</td>
<td>▼</td>
<td>▼</td>
<td>▼</td>
</tr>
<tr>
<td>White Ash</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

Table 8 Projections for future suitable habitat – Climate Change Atlas
Water Resources

Major river and stream flooding events are generally expected to increase in frequency and intensity in the Northeast as a result of the increases in heavy precipitation events (Demaria et al. 2016). These kinds of events have a dramatic impact on streams. Flooding can either add or remove substrate from a section of river, and in the process alter habitat for fish, mussels, or macroinvertebrates. Damage to roads, culverts, and other infrastructure can cause sedimentation or otherwise impair waterways.

Beyond extreme rainfall, other changes in climate are expected to affect hydrology, water quality, and aquatic habitats. Warmer air temperatures and longer growing seasons can increase water temperatures, making water bodies less suitable for trout and other coldwater species, even in the absence of increased hydrological variability. (Staudinger et al. 2015, Williams et al. 2015). Base flows in the region’s streams may be reduced and low base flows may occur more frequently as a result of earlier peak flows, more variable summertime precipitation, and increased frequency of abnormally hot weather (Walsh et al. 2014, Demaria et al 2016). However, streams with adequate sources of groundwater are generally more resistant to climate change (Chu et al. 2008). Populations of fish or other aquatic organisms that are already isolated as a result of river fragmentation may be particularly susceptible to additional stresses resulting from climate change. In such cases, fragmentation reduces the ability for species to recolonize an area where they have been extirpated (NHFG 2013).

Wildlife

Wildlife will respond in several ways to habitat changes that occur as a result of climate change. The gradual shift in the vegetative species composition will correspondingly create changes in habitat types and distribution. These changes in habitat may have less of an impact to some species while others will feel these effects more profoundly. Species that are more mobile may have a greater ability to shift into habitats that have experienced less change and remain more suitable. Species which can only move short distances may experience accelerated declines or disappear locally in the event that habitat conditions change considerably over time. For example, the predicted decline in northern conifer species has the potential to diminish the habitat availability for wildlife which depends on evergreen tree species for their
habitat needs (NHFG 2014). As a result, locations on the Forest which continue to be favorable to the
growth of softwood as the climate changes (known as refugia) may have increased importance for wildlife
habitat over time as the abundance of evergreen species declines.

Warming temperatures and a corresponding decrease in the extent and duration of snowpack will likely
also influence wildlife distribution. Mammals adapted to snow including snowshoe hare may shift to
habitats at higher elevations where snow is more certain. Additionally, changes to vegetation composition
over time resulting from a changing climate may influence the growth of nut and berry (mast) producing
species, impacting the type and amount of food resources available to wildlife. Impacts on the
synchronicity, abundance and vigor of mast cycles may impact the fitness of individual animals and wildlife
population productivity over time.

Forest Health
Climate change is expected to increase many threats to forest health, including insect pests, diseases and
invasive plants. Directly, some invasive plant species are disproportionately able to take advantage of an
increased CO2 environment, and many insect pests and invasive plant species may be able to expand their
ranges northward in response to warmer temperatures (Ramsfield et al. 2016, Ziska et al. 2009). Some
insect pests and invasive plants have so far been prevented from establishing or increasing in population
in northern NH due to the cold winters, and warming temperatures decrease the probability of cold lethal
temperatures. For example, mortality of hemlock woolly adelgid is dependent on cold temperatures
during winter as well as the timing of cold snaps. Warming trends will limit the probability of occurrence
of cold lethal temperatures in NH and we may see northward migration of this and other insect species.
Additionally, there is the potential for an accelerated life cycle of certain insect pests, allowing them to
propagate more often and increase their populations rapidly with longer growing seasons (Ramsfield et
al. 2016). Alternatively, tree pests such as spruce budworm are on the southern end of their range, and
warming trends may limit the survival of this insect in NH in the future (Régnière et al. 2012). However,
overall warming temperatures will make our trees more susceptible to insects and diseases over time, as
all of these forms of stress continue to increase.

Recreation
Recreational activities are already seeing some impacts due to climate change, largely due to direct effects
of temperature shifts and changes to precipitation patterns and severity. There is the possibility that
these effects may increase and have more significant impacts on recreational use in the future. Less
distinct seasons with milder winter and earlier spring conditions are already altering ecosystems and
environments in ways that adversely impact tourism, farming, and forestry. The region’s rural industries
and livelihoods are at risk from further changes to forests, wildlife, snowpack, and streamflow (USGCRP,
2018).

Trails utilized by all types of user groups are at high risk from both temperature and precipitation
extremes. Unusually dry periods have the effect of destabilizing soils by causing overly dry surfaces and
sub-surfaces, thus making them more susceptible to erosion by heavy precipitation or mechanical
disturbances. Conversely, periods of heavy rainfall or extended periods can have the effect of making
trails that were traditionally used, no longer viable due to overly wet trail surfaces that cannot be easily
crossed without an investment in reconstruction and constant maintenance. There will be an increase in
costs associated with continuing to maintain proper trail management.
During winter, traditional patterns of freezing of wet soils is relied upon, as well as sufficient snowfall patterns and amounts in order to provide a connected winter trail network for over-the-snow trail uses. Unusually warm periods with rainfall, not typical in the winter, make it increasingly difficult to maintain a consistently connected winter trail network.

**Resiliency to Climate Change**

The Nature Conservancy’s Resilient and Connected Landscapes project mapped areas that are estimated to be most climate resilient; and climate corridors and movement zones to design connected landscapes that facilitate species range shifts (figure 28). The project is designed to help inform and support conservation strategies in the face of a changing climate. It identified Resilient Sites (figure 27) in New Hampshire that will retain high quality habitat and continue to support a diverse array of plants and animals (far above average terrestrial resilience). These are sites that have both complex topography and connected land cover and are places where conservation action is most likely to succeed in the long term. Securing resilient sites safeguards natural benefits such as fresh drinking water and clean air for local communities now and into the future.

![New Hampshire's Resilient Landscapes](image)

**Figure 27 NH Resilient Landscapes**

*Source: The Nature Conservancy*
New Hampshire's Resilient and Connected Landscapes

Legend

- Resilient
- Climate Flow
- Climate Corridor

Source: The Nature Conservancy

Figure 28 NH Resilient and Connected Landscapes

Source: The Nature Conservancy
Forest Carbon

Forests are both a source and a sink for carbon. Forests remove carbon dioxide from the atmosphere through photosynthesis (sequestration) to create energy. Through this process they capture and store carbon in the form of wood, and other organic matter such as leaves, bark, and roots. In New Hampshire it is estimated that live trees account for 42 percent of forest carbon and soil organic carbon accounts for 38 percent of forest carbon (Figure 29).

![Forest Carbon Diagram](image)

**Figure 29** Percentage of forest carbon stocks within each forest ecosystem component for NH

*USDA Forest Service, Forest Inventory and Analysis, 2017*

Forests release carbon through respirations and through decomposition. Forest carbon can also be reduced due to land conversion or timber harvesting. When considering the loss of forest carbon due to timber harvesting, the type of forest products being removed from the site must also be taken into account. Durable wood products that are long lasting and are not burned or that do not decompose can store carbon for a long time. Veneer and high quality lumber are generally long-lived products that are maintained for a long period of time because of their high value. By-products of sawtimber such as sawdust, slabs and edgings are often re-processed as paper pulp or as biomass fuel. Biomass fuels also include chips and pellets made from low grade forest products which are burned for heating buildings or to produce energy, often in the form of steam for electrical production or municipal heating or optimally both products. The burning of biomass chips or pellets as a fuel does produce carbon dioxide that is released into the atmosphere. Biomass chips offset the use/burning of fossil fuels which would release in the atmosphere carbon products that otherwise have been stored and would continue to be stored for a
very long time out of the atmosphere. Figure 30 indicates that the ton of carbon per acre on forestland in New Hampshire has increased since 2005 (USDA FIA 2017).

![Figure 30: Total forest carbon per acre in New Hampshire 2005 to 2018. USDA Forest Service, Forest Inventory and Analysis, 2017](image)

The rate at which a forest sequesters carbon generally peaks in young to intermediate-aged forests. Older forests continue to sequester carbon, but at a slower rate. The rate at which any given forest sequesters carbon is influenced by a variety of factors in addition to age including forest type and site condition (Catanzaro & D’Amato, 2019).

The amount of forest carbon being stored increases with age and in the northeast typically peaks at around 200 years. Although, as with carbon sequestration, the amount of forest carbon stored can vary by forest type and age class. Figure 31 shows the total carbon storage by forest type in New Hampshire, based on 2017 USDA Forest Inventory and Analysis data. Figure 32 shows tons of carbon by age class in New Hampshire Forests, figure 33 show tons of carbon per acre by age class. Figure 34 compares total tons of carbon on public vs private forest land.
Figure 31 Carbon storage by forest type in NH
*USDA Forest Service, Forest Inventory and Analysis, 2017*

![Figure 31 Carbon storage by forest type in NH](image)

Figure 32 Tons of carbon by age class on forestland
*USDA Forest Service, Forest Inventory and Analysis, 2017*

![Figure 32 Tons of carbon by age class on forestland](image)
Figure 33 Tons of carbon per acre by age class
*Source: USDA Forest Service, Forest Inventory and Analysis*

Figure 34 Total tons of carbon on public and private forest land
*Source: USDA Forest Service, Forest Inventory and Analysis*
11. Large Forestland Blocks

Large undeveloped and unfragmented forested blocks of land are very important for wildlife and biodiversity conservation. New Hampshire is blessed with many areas that fit this description. Researchers have chosen forest blocks of 1,000 acres or more as important for these purposes. Figure 35 shows both the current status of 1,000+ acre forested blocks (in green) and the change seen in these blocks since 2006 (in orange).

Table 9 below details the acreage of forest blocks in New Hampshire across this 13 year period, with a loss of 2,450.15 acres.

Table 9 Forest Blocks of 1,000 acres or more in NH

| NH's Large Forest Block Comparison (2006 - 2019) (Forest Blocks Greater than 1000 Acres) |
|---------------------------------|---------------------------------|
| Total Number of Forest Blocks  | Total Large Forest Block Acreage |
| 2006 Large Forest Blocks       | 688                             | 3,434,752.68                     |
| 2019 Large Forest Blocks       | 677                             | 3,432,302.53                     |
| Acres of Large Forest Block Loss from 2006 - 2019 | 2,450.15                       |

*Given the reduction in the number of large forest blocks from 2006 to 2019, one might expect the “Acres of Large Forest Block Loss from 2006 - 2019” value to be higher. However, in addition to forest block loss, there are some additional 2019 large forest blocks that were not identified in 2006. This is due to the reclassification of some road segments from “maintained” to “not maintained”. These additional areas of 2019 large forest blocks are not differentiated in the table above (Table 2).

Typically, an area becomes fragmented and no longer a contiguous 1,000 acre or larger forest block when a permanent road intersects and divides the area. The methodology to develop the forest block spatial comparison is described below in the footnote9:

9 To mimic the forest block methodology previously used for NH, the following datasets for New Hampshire, Vermont, Maine, Massachusetts and Quebec were considered fragmenting features and incorporated to create a fragmenting features data layer in the GIS software: the most current road data, rivers/streams, waterbodies, the most current utility line data for New Hampshire, Massachusetts, Maine and Vermont, the most current rail road data for New Hampshire, Massachusetts, Maine, and Vermont.

Road data used was a combination of state, provincial, and USGS data. Only maintained road classes were considered fragmenting and were included in the model. The same water feature data layers were used from the 2006 methodology. Maintained roads include classes I – IV. Private gravel roads are not considered fragmenting features. These roads do have a fragmenting impact though it is less significant than paved and more heavily used public roads.

Utility line data included the following: pipeline data, power transmission line data and telephone line data. Active and inactive railroads include active rail service, multiple use i.e., active and recreation, abandoned rail service ROW in public ownership, unknown status, out of service, right-of-way (ROW) used for hiking and biking, other ROW used for hiking and biking and rapid transit. All data for states surrounding New Hampshire were clipped to a 20-mile buffer of NH.

The modeling process applied a 100-meter buffer around the maintained road features; no buffer was applied to the rest of the input data layers. All fragmenting features were combined and intersected with the analysis area, resulting in two output classes: fragmenting features and forest blocks. Using the 2006 forest block methodology, large forest blocks were determined if they had an unfragmented area greater or equal to 1,000 acres. Large differences between the 2006 and 2019 forest block data went through a quality control process to ensure accuracy by checking these areas using the latest aerial imagery.
Figure 35 Large Forest Block comparison
The level of permanent conservation of large forest blocks in NH can be found in Figure 36 below.

Figure 36 Conserved Large Forest Blocks by Type
Table 10 shows that 47% of large forest block areas in New Hampshire are permanently conserved.

**Table 10 Forest Block Acreage Protection in NH**

<table>
<thead>
<tr>
<th>2019 Forest Block Conserved Land Acreage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Conserved Acres</strong></td>
</tr>
<tr>
<td><strong>Fee - Publicly or Privately Owned</strong></td>
</tr>
<tr>
<td><strong>Conservation Easement</strong></td>
</tr>
<tr>
<td><strong>Other (i.e., Deed Restriction</strong></td>
</tr>
<tr>
<td><strong>Total Conserved Acres (%)</strong></td>
</tr>
</tbody>
</table>
12. Conservation Lands

At over 1.775 million acres of land permanently conserved through public ownership, fee ownership by a non-governmental conservation organization or conservation easement on private lands, New Hampshire has one of the highest percentages of protected land east of the Mississippi River. This area, of course, includes some agricultural land but the vast majority (over 95%) is forestland.

Forestland protection is accomplished through the efforts of a vast number of federal and state agencies, municipal conservation commissions, and statewide & local land trusts; often working in partnership to achieve a common goal. There are more than 40 active state and local land trusts in New Hampshire. A map of the geographical coverage of land trusts can be found on page 197 (Figure 71) and a list of NH land trusts can be found on the New Hampshire Land Trust Coalition website at https://nhltc.org/find-land-trust.

Funding for forest land conservation comes from many sources. Federal sources include the USDA Forest Service Forest Legacy Program, US Fish and Wildlife Service, and the Natural Resources Conservation Service. State funding resources include the Land and Community Heritage Investment Program, State Conservation Committee (Mooseplate Grants), New Hampshire Fish and Game Department, and New Hampshire Department of Environmental Services; although it should be noted that often grant programs managed by state agencies are funded through federal sources. In addition, grants and donations from private organizations and individuals have played an important role in protection of the state’s forested landscape.

Table 11 shows the acreage totals broken down by public fee, non-profit fee and private lands with conservation easements. Over 740,000 acres of the public fee land is found in the White Mt. National Forest in Coos, Grafton and Carroll Counties in the northern third of the State.

Table 11: Permanently Conserved Land in New Hampshire

<table>
<thead>
<tr>
<th>Ownership Type</th>
<th>Total Acreage in NH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Land Fee</td>
<td>1,109,946</td>
</tr>
<tr>
<td>NGO Fee</td>
<td>149,662</td>
</tr>
<tr>
<td>Privately Owned with Conservation Easement</td>
<td>539,977</td>
</tr>
</tbody>
</table>

Source: NH GRANIT

Figure 37 shows the same data on conserved lands in spatial form but in the broader categories of Fee (both public and private), conservation easements on private land and a third small category of Other which is largely private land that has deed restrictions but no conservation easement. In some cases an easement is held on public or NGO owned land; these areas are accounted for in the Fee category in both Table 11 and Figure 37.
Figure 37 Permanently Conserved Land in New Hampshire
Source: GRANIT
Figure 38 shows the trend in permanently protected land in New Hampshire from 1998 to 2019.

![Protected Land in NH](image)

**Figure 38 Protected land in NH, 1998 – 2019**
*Source: NH GRANIT*

Current Use – Current use is a voluntary program that allows landowners who own 10 or more acres to be taxed at its “current use” (e.g. capacity to grow a forest or agricultural crop) as opposed to its highest and best use (e.g. potential house lot). While not permanently protected, this program’s assessment of the farm or forest land at a rate commensurate with its “use” helps enable the landowner to afford keeping the land open and undeveloped.

The New Hampshire Constitution was amended in 1968 to allow for the assessment of property at its current use. And, when passed into law in 1973 the New Hampshire General Court acknowledged the importance of open space and Current Use’s role in maintaining if with the adoption of RSA 79-A:1:

**79-A:1 Declaration of Public Interest.**

It is hereby declared to be in the public interest to encourage the preservation of open space, thus providing a healthful and attractive outdoor environment for work and recreation of the state’s citizens, maintaining the character of the state’s landscape, and conserving the land, water, forest, agricultural and wildlife resources. It is further declared to be in the public interest to prevent the loss of open space due to property taxation at values incompatible with open space usage. Open space land imposes few if any costs on local government and is therefore an economic benefit to its citizens. The means for encouraging preservation of open space authorized by this chapter is the assessment of land value for property taxation on the basis of current use. It is the intent of this chapter to encourage but not to require management practices on open space lands under current use assessment

This major public policy is a significant deterrent to development, but it does not prevent development from occurring. Within the Current Use program there are also two incentives to encourage landowners to allow non-motorized recreation and develop a formal written management plan for the property. Landowners choosing to enroll their forest land in the “forestland with documented stewardship”
category are required to have a management plan written by a licensed forester, have the land in the Tree Farm program, or have a certificate documenting the land’s conformance with the Sustainable Forestry Initiative Standard (SFI) or Forest Stewardship Council (FSC)-US Forest Management Standards in exchange for a reduction in their tax assessment. Landowners may also receive an additional 10 percent reduction in their tax assessment if they choose to take the “recreational discount”. Choosing to take the recreational discount obligates the landowner to allow pedestrian recreation (i.e. hunting, hiking, fishing, etc.) on their property. Enrollment in the Current use program has remained steady over the past decade (See Table 17 on Page 112).
13. Forest-Related Recreation Trends and Opportunities

Forest-based recreation is an important part of NH’s culture and economy. New Hampshire’s natural beauty and abundance of lakes and rivers, trails, and forested lands not only attract tourists who participate in a variety of active outdoor recreation pursuits, but also provide opportunities for close-to-home participation by resident (NH Statewide Comprehensive Outdoor Recreation Plan, 2019). Understanding trends in public forest-related recreation in New Hampshire requires looking at a number of sources of data and information.

The North East State Foresters Association, whose directors are the state foresters in the Northern Forest states of Maine, New Hampshire, New York and New Hampshire, published a series of reports using federal and state data on the economic value of forests in those states. The series included data drawn from the USDA Forest Service National Survey on Recreation and the Environment (NSRE). The Survey, no longer being conducted, released periodic data about recreation spending in each state. From these sources, NEFA published New Hampshire recreation spending, reduced from the raw data to relate it only to forest-related recreation endeavors. Figure 39 below shows the results of those summaries for the last three reports issued.

![New Hampshire Forest-Related Recreation Sales](image)

**Figure 39 Forest-Related Recreation Sales in NH 2005-2015**
*Source: NEFA and National Survey on Recreation and the Environment (NSRE) - Annual Sales*

These data suggest a general upward trend in forest-related recreation economic activity although the recession took place in the middle of the 2005 and 2015 years of data and may have moderated the 2011 mid-year finding.

There are other outdoor recreation data available for NH that can inform this assessment. These are from the following sources and reports:

New Hampshire Forest Action Plan
• 2018 Bureau of Economic Analysis Outdoor Recreation Satellite Account
• 2017 Outdoor Industry Association Outdoor Recreation Participation Report
• 2016 National Survey of Fishing, Hunting and Wildlife-Associated Recreation

The US Department of Commerce, through its research and data arm, the Bureau of Economic Analysis, provides the primary national and state source of economic activity for the U.S. In the Outdoor Recreation Jobs and Economic Impact Act of 2016 law (federal legislation), the agency was mandated to collect and maintain data and information about the outdoor recreation economic impact in the country. This source includes data on many outdoor recreation activities (see Appendix B for the complete list).

While clearly some activities on the list are not related directly to forests, many are. For the purposes of this report, we have eliminated many activities from the list so that the most likely forest-related activities are:

1. Bicycling (All recreational bicycling, including BMX, E-bikes, Mountain, On-road)
2. Boating/Fishing
3. Climbing/Hiking/Tent Camping
4. Driving for pleasure (Gas spending only)
5. Geocaching/Orienteering/Rock hounding
6. Hunting/Trapping/Shooting (including Archery)
7. Motorcycling/ATVs (Off-road, On-road)
8. Other Conventional Activities
9. Other Conventional Air and Land activities
10. Photography
11. Running/Jogging/Walking
12. RVing
13. Snow activities (Dog mushing, Skiing, Sleighing, Snowboarding, Snowmobiling, Snow shoeing, Tubing)
14. Wildlife watching/Birding

Figure 40 show the total economic effect (direct, indirect and induced) of many outdoor recreation activities in New Hampshire. Hunting/shooting and trapping was shown to have the largest economic impact of all forest-based recreation activities in 2017.
In a study by Plymouth State University, released in March 2020, the estimated total effect of spending by forestland outdoor recreation participants is $3.1 billion (table 12). The study also estimates that private lands contribute more than public lands. The total output for private lands is estimated to be $2.3 billion while state and municipal lands contribute $464 million and $350 million for federal lands.

Table 12 Summary of Forestland Outdoor Recreation Economic Contributions

<table>
<thead>
<tr>
<th>Impact Type</th>
<th>Employment</th>
<th>Labor Income</th>
<th>Value Added</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Effect</td>
<td>18,131</td>
<td>$687</td>
<td>$1,025</td>
<td>$1,767</td>
</tr>
<tr>
<td>Indirect Effect</td>
<td>3,315</td>
<td>$209</td>
<td>$366</td>
<td>$599</td>
</tr>
<tr>
<td>Induced Effect</td>
<td>5,314</td>
<td>$285</td>
<td>$470</td>
<td>$759</td>
</tr>
<tr>
<td>Total Effect</td>
<td>26,760</td>
<td>$1,181</td>
<td>$1,861</td>
<td>$3,125</td>
</tr>
</tbody>
</table>

* Note: Value added is the sum of labor income, other types of property income (such as dividends, interest income, rent income, and profits), and taxes on production and imports. Output is the sum of value added and the cost of all the inter-industry purchases required for production.
Another data source, the non-governmental Outdoor Industry Association Outdoor Recreation Participation Report from 2017, provides some statewide data on outdoor recreation activities in New Hampshire. Sourced from a very large national sample survey conducted in 2016-17, some key findings for New Hampshire include:

- 69% of residents participate in some outdoor recreation activity every year;
- Over 79,000 jobs in NH are in the outdoor recreation sector (the so-called high tech sector has 44,000 jobs);
- Annual consumer spending in the outdoor recreation sector is $8.7 billion;
- Wages and salaries in the sector is $2.6 billion per year; and
- The sector generates over $528 million in state and local tax and other revenues annually.

Figure 41 shows the top five most popular activities by participation rate (Nationally) for ages 6+ as well as a breakdown for participation rate in Youth (Ages 6 – 17) and Young Adults (Ages 18 – 24).

![Figure 41 Participation rate of 5 most popular outdoor activities](https://www.nhstateparks.org/getmedia/cea99eb7-d642-4d98-92ab-98e3c6c567a3/9-19-FINAL-SCORP-WEBSITE.pdf)

Additional information on outdoor recreation in New Hampshire can be found in the NH Statewide Comprehensive Outdoor Recreation Plan on the New Hampshire State Parks website at https://www.nhstateparks.org/getmedia/cea99eb7-d642-4d98-92ab-98e3c6c567a3/9-19-FINAL-SCORP-WEBSITE.pdf
Like most northeastern U.S. states, New Hampshire’s population has been growing slowly over the last 50 years. As a percentage, NH’s population has grown faster than most New England states but not nearly as fast as other regions of the country such as the southwest. The current official NH population estimate as of 2017 from the NH Office of Strategic Initiatives is 1,342,795.

![NH Population 1960-2017](image)

*Figure 42 NH Population 1960-2017*
*Source: US Census and NH Office of Strategic Initiatives*

Figure 42 shows the statewide trend in population growth since 1960 while Figure 43 shows the trend by county. Hillsborough and Rockingham Counties lead the state with actual and percent growth increases in population since 1960.

![NH Population by County 1960-2017](image)

*Figure 43 NH Population by County*
*Source: US Census and NH Office of Strategic Initiatives*
New Hampshire’s population is ranked 41st in the U.S. In New England, New Hampshire is ranked 3rd out of 6 states, just ahead of Maine:

Table 13 New England Population 2018

<table>
<thead>
<tr>
<th>State</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Massachusetts</td>
<td>6,902,149</td>
</tr>
<tr>
<td>Connecticut</td>
<td>3,572,665</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>1,356,458</td>
</tr>
<tr>
<td>Maine</td>
<td>1,338,404</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>1,057,315</td>
</tr>
<tr>
<td>Vermont</td>
<td>626,299</td>
</tr>
</tbody>
</table>

Source: U.S. Census

Fastest growing states

US Census data compares New Hampshire to national population trends. The U.S. population grew by 0.6 percent and Nevada and Idaho were the nation’s fastest-growing states between July 1, 2017, and July 1, 2018. Both states’ populations increased by about 2.1 percent in the last year alone. Following Nevada and Idaho for the largest percentage increases in population were Utah (1.9 percent), Arizona (1.7 percent), and Florida and Washington (1.5 percent each). During this one-year timeframe, New Hampshire grew by .4 %, lower than the national average, but faster than all but one New England state:

Table 14 New England States % population growth 2017-2018

<table>
<thead>
<tr>
<th>State</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Massachusetts</td>
<td>0.6</td>
</tr>
<tr>
<td>Connecticut</td>
<td>-0.03</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>0.4</td>
</tr>
<tr>
<td>Maine</td>
<td>0.3</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>0.08</td>
</tr>
<tr>
<td>Vermont</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Source: U.S. Census

New Hampshire Population Projections

In a research project completed in 2016 by an outside consultant, the (then) NH Office of Energy and Planning released population projections for the State. Highlights of the findings from that report included:

• The total New Hampshire state population is projected to be 1,432,730 in 2040, an increase of 116,260 or 8.8 percent from the 2010 Census population of 1,316,470.

• The absolute number of births will decline slightly from about 66,000 in the 2010 to 2015 period to 65,000 in the 2035 to 2040 period. This will result from continued low levels of fertility but a relatively large Millennial generation population.

• The number of deaths will increase sharply from 56,500 in the 2010 to 2015 period to nearly 96,000 in the 2035 to 2040 period due to the aging of the Baby Boom generation.

• By 2040, every New Hampshire county is projected to experience natural decline – an excess of deaths over births.

• The population age 65 and over will increase from 178,268 in 2010 to 408,522 in 2040, an increase of 230,200.

• The population age 85 and over will increase from 24,761 in 2010 to 85,121 in 2040, an increase of 60,300.

• The population under age 15 will decline from 232,182 in 2010 to 214,819 in 2040 and fall from 17.6 percent to 15.0 percent as a proportion of the total population.

Two graphs help to illustrate the population projections. Figure 44 shows the statewide projection which rises steeply in the early part of the period to 2040 but then moderates the rate of increase towards the last 7-10 years.

The county projections for the same period found in Figure 45 show steep increases in Hillsborough, Merrimack, Rockingham and Strafford Counties. Cheshire and Sullivan Counties show no gain and Coos County shows a decrease in population for the projected period. This Figure shows the geographies of likely highest future population growth to be Hillsborough, Merrimack, Rockingham and Strafford Counties. It would follow that the heaviest pressure on land use change from forest to developed status will be those same Counties.
Figure 45 NH Population Projections to 2040 by County

Source: NH Office of Strategic Initiatives

A map of population density changes by town can be found in Figure 49.

The potential impact on New Hampshire’s forests can be seen in the USDA Forest Services Northern Forest Futures Project. The Project is a window on tomorrow’s forests, revealing how today’s trends and choices can change the future landscape of the Northeast and Midwest. Using the latest Forest Inventory and Analysis (FIA) data and scientific projections, the Northern Forest Futures Project helps visualize what’s here today and what to expect tomorrow. Ultimately, this project informs decision-making about the sustainable management of public and private forests in the northern United States.

Three possible futures are modeled in the Project for each Northern State in the US. For NH, the following three figures show possible futures. In each of the scenarios as population increases the acres for forestland and timberland decrease.

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11 Each possible future set of variables includes: greenhouse gas emissions, population, and income and energy consumption https://www.nrs.fs.fed.us/futures/projections/state/?state=NH
Figure 46 Moderate Growth Future NH - Northern Forest Futures Project

Figure 47 High Growth Future NH - Northern Forest Futures Project

Figure 48 Low Growth Future NH - Northern Forest Futures Project
Figure 49 Population Density Changes 2006-2018 for NH
Source: U.S. Census and NH Office of Strategic Initiatives
Placeholder – possible graph showing effect of increasing population
15. Development Pressure
Evidence for development pressure is implied in some of the data in the next section of this report on population trends.

A unique research project further reinforces this finding. The project researchers describe it as follows:

The Established Program to Stimulate Competitive Research (EPSCoR) was established by the National Science Foundation in 1979 to strengthen science and engineering infrastructure in states that historically have received less support from federal research grants. Through this program, states develop collaborations between higher education institutions, industry, and government to build research capacity, engage stakeholders, and increase economic competitiveness.

In New Hampshire, the NH EPSCoR program strategically directs federal investments in world-class research infrastructure to support scientific research and STEM education that benefits the Granite State.

The Data Discovery Center, developed and housed at the University of New Hampshire, hosts data and products from the NH EPSCoR research project.

This EPSCoR work can be considered the most sophisticated modeling of possible NH growth and land use change due to development pressure available. The modeling scenarios developed project to the year 2100.

Rather than develop a single projection for population and land use change over time, the project looks at 4 distinct possible futures, each developed with a set of assumptions. This is described by the project as:

Two main scenarios of the future emerged from the key informant interviews and from a review of existing plans, visions, and surveys. The first scenario is characterized by dispersed development, with a focus on traditional one and two-acre lot residential zoning where most residents continue to live in houses adjoining private lawns, gardens, or small wooded lots (Backyard Amenities). The second vision is characterized by concentrated development with a focus on protection of public woods, open spaces, and waterways for local recreation (Community Amenities).

A third scenario represents a variation on the Community Amenities scenario combined with a significant expansion of agricultural lands (Agricultural Expansion). We also include a continuation of current trends in land cover change (Current Trends). One way that the Current Trends scenario differs from the Backyard Amenities scenario in that population growth is more limited, so less land conversion occurs overall. Like recently published land cover scenarios for Massachusetts (Thompson et al. 2011, 2014), our scenarios capture a broad range of alternatives for land cover composition. The Backyard Amenities and Community Amenities scenarios represent different ends of a spectrum comprising the differences between 1) traditional zoning and smart growth focused on compact urban planning and redevelopment (i.e., dispersed versus concentrated development) and 2) the degree to which ecosystem services are prioritized during development and land management. Thus, our land cover scenarios lie on a continuum from dispersed development that does not prioritize ecosystem services to concentrated development that does prioritize ecosystem services.

The scenarios are:

![Figure 50 Land Use Projections for NH based on the Backyard Amenities Scenario](source: NH EPSCor)

**Linear Trends** - Population grows as a linear extrapolation of 1990-2010 rates based on U.S. Census data. The population increases by 103,608 people per decade, resulting in a state population of 2.2 million by 2100, up from the 2010 population of 1.3 million.

![Figure 51 Land Use Projections for NH based on the Linear Trends Scenario](source: NH EPSCoR)
Small Community Amenities - Under this and the Large Community Amenities (below) scenarios there are two different population scenarios used. (1) high projected population growth based on the ICLUS A2 population scenario; (2) Extended NH Office of Energy and Planning (OEP) population projections for New Hampshire counties for 2010-2040 were extrapolated out to 2100.

![Figure 52 Land Use Projections for NH based on the Small Community Scenario](Source: NH EPSCoR)

Large Community Amenities - Under this and the Small Community Amenities (above) scenarios there are two different population scenarios used. (1) high projected population growth based on the ICLUS A2 population scenario; (2) Extended NH Office of Energy and Planning (OEP) population projections for New Hampshire counties for 2010-2040 were extrapolated out to 2100.

![Figure 53 Land Use Projections for NH based on the Large Community Amenities Scenario](Source: NH EPSCoR)
The same data above is displayed spatially in Figures 54 and 55 below under two broad scenarios for possible futures. In Figure 54 the data shows development increasing in a linear fashion from recent trends to the year 2100. Figure 55 shows development projections in a robust development scenario with development rates far exceeding recent trends since the recession of 2008-09.

![Figure 54 Land Cover Change Projections – Linear Trends](image)

*Source: NH EPSCoR*
In a similar study Harvard Forest's New England Futures Scenarios project describes potential changes in the New England landscape to the year 2060. The project compares the potential impact of four scenarios to recent trends in four land uses: development, agriculture, land conservation, and forestry/timber harvesting. The four scenarios were built around two drivers of landscape change: natural resource planning & innovation (high or low) and Socio-economic connectedness (local or global). These drivers...
provide and axes for the scenario matrix. Figure 56 provides a brief description of the four scenarios and their position within the matrix.

**Figure 56 New England Futures Scenarios Project matrix**  
*Source: Harvard Forest, 2014*

While the scenarios differ slightly from the NH EPSCoR project, the results are similar. Figure 57 illustrates the projected land cover and land use change by scenario. More information about this project can be found at [https://harvardforest.fas.harvard.edu/other-tags/future-scenarios](https://harvardforest.fas.harvard.edu/other-tags/future-scenarios).

**Figure 57 New England Futures Scenarios, land cover and land use change.**  
*Source: Harvard Forest*
16. Housing Density
State housing density and population density metrics help us understand how New Hampshire’s population is distributed, the density of development, and the opportunity for conservation in the State’s landscape. Also contributing to housing density are local land use regulations mandating minimum lot sizes and/or imposing occupancy restrictions. Comparing New Hampshire’s situation with the rest of the country further facilitates understanding.

Table 15 shows both population and housing unit density for New Hampshire. It includes national figures as well to allow us to compare the Granite State with national densities. In that regard, New Hampshire’s population and housing density are denser than the U.S. on average but that is to be expected as vast areas in the western U.S. are public lands and those millions of acres – without people in residences or buildings - affect the statistics.

Table 15 NH Population & Housing Density

<table>
<thead>
<tr>
<th>Location</th>
<th>Population</th>
<th>Housing units</th>
<th>Area in square miles</th>
<th>Density per square mile of land area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Total area</td>
<td>Water area</td>
</tr>
<tr>
<td>United States</td>
<td>281,421,906</td>
<td>115,904,641</td>
<td>3,794,083.06</td>
<td>256,644.62</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>1,342,612</td>
<td>638,260</td>
<td>9,349.94</td>
<td>381.84</td>
</tr>
<tr>
<td>Belknap Co.</td>
<td>61,073</td>
<td>38,625</td>
<td>468.55</td>
<td>67.26</td>
</tr>
<tr>
<td>Carroll Co.</td>
<td>48,172</td>
<td>40,909</td>
<td>992.24</td>
<td>58.44</td>
</tr>
<tr>
<td>Cheshire Co.</td>
<td>77,290</td>
<td>35,799</td>
<td>729.15</td>
<td>21.75</td>
</tr>
<tr>
<td>Coos Co.</td>
<td>33,292</td>
<td>21,088</td>
<td>1,831.44</td>
<td>31.06</td>
</tr>
<tr>
<td>Grafton Co.</td>
<td>90,170</td>
<td>52,939</td>
<td>1,750.08</td>
<td>36.75</td>
</tr>
<tr>
<td>Hillsborough Co.</td>
<td>408,296</td>
<td>172,535</td>
<td>892.2</td>
<td>15.84</td>
</tr>
<tr>
<td>Merrimack Co.</td>
<td>148,796</td>
<td>65,695</td>
<td>956.49</td>
<td>22.06</td>
</tr>
<tr>
<td>Rockingham Co.</td>
<td>304,932</td>
<td>133,746</td>
<td>793.96</td>
<td>99</td>
</tr>
<tr>
<td>Strafford Co.</td>
<td>126,795</td>
<td>54,218</td>
<td>383.91</td>
<td>15.15</td>
</tr>
<tr>
<td>Sullivan Co.</td>
<td>43,796</td>
<td>22,706</td>
<td>551.92</td>
<td>14.54</td>
</tr>
</tbody>
</table>

Source: 2000 (for US data) & 2018 Census updated with 2017 housing units from NH Housing Finance Authority

Compared to the other New England states, New Hampshire’s population and housing density are in the lower range in the region with Maine and Vermont, as would be expected. Figure 58 shows this graphically.
Rhode Island has the highest population density (1,018) per square mile as well as the housing density at 453 housing units per square mile. Maine is the least dense state in the region for population and housing (43 people per sq. mi. and 24 housing units per sq. mi.).

Compared with the rest of the country, New Hampshire is in the lower tier of population and density. New Jersey has the densest population at 1208 people per square mile and densest housing at nearly 500 units per square mile.

As might be expected, the New Hampshire population and housing densities increased from 2010 to 2018. Population increased by 3% during the period and housing density by 3.2%.

A spatial representation of housing density in New Hampshire can be found in Figure 59. Rockingham and Hillsborough Counties show the highest density with Strafford County following and then Merrimack and Belknap Counties. These data should be considered in context of the greater Boston area in Massachusetts immediately to the south.

Figure 58 Population and Housing Density, NE 2018
Source: US Census, 2018
Figure 59 Housing Density in New Hampshire
Source: US Census, 2018
17. Forest Landowner Trends and Potential for Change
The National Woodland Owner Survey (NWOS) of the USDA Forest Service has conducted several surveys of private woodland owners throughout the U.S. with results useable at the state level. Looking at data from the 2006, 2013, and 2018 (under review) surveys we can make some comparisons to understand trends in the twelve year period for New Hampshire. The data comparisons for the rest of this section using NWOS data and information, are for owners of 10 acres or more of forestland.

The first important information to understand is who owns the forestland in New Hampshire. Figure 60 suggests some slight changes in NH forestland owners between 2006 and 2018. For private owners, family forest owners\(^\text{12}\) acres increased slightly from 2006 to 2013 and declined in 2018. The opposite is true for other private owners, decreasing in the period from 2006 to 2013 and rebounding slightly by 2018. Corporate ownership remained relatively steady throughout the period. For public ownership, federal ownership increased slightly while state and local ownership (towns and counties) remained relatively steady.

![NH Forest Ownership 2006, 2013, 2018 (acres)](image)

**Figure 60 NH Forest Ownership Size Changes 2006-18**
Source: National Woodland Owners Survey, USDA Forest Service

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\(^{12}\) Family Forest Owners in the U.S. - Families, individuals, trusts, estates, family partnerships, and other unincorporated groups of individuals that own forest land. This group is a subset of nonindustrial private forest owners.
Forest ownership tenure – the length of time landowners have owned their land – is important to know for many reasons. Shorter tenure ownerships tend to lead to more land conversion, parcelization and fragmentation. Figure 61 shows decreased acres in land ownership tenure in all categories except the 25-49 year category.

![NH Private Forest Ownership Tenure](image)

**Figure 61 NH Private Owner Tenure**
Source: *National Woodland Owners Survey, USDA Forest Service*

An area of possible concern is the age of forestland owners in New Hampshire. The 2018 NWOS shows a shift from the 45 – 54 year age group to older age groups (figure 62). In fact, the survey indicates that 65 percent of forestland owners are age 65 and older. This would indicate the potential for a large turnover in forestland ownership.

![Age of NH Forestland Owners](image)

**Figure 62 Age of NH Forestland Owners**
Source: *National Woodland Owners Survey, USDA Forest Service*
Lastly, in 2018, family forest owners in New Hampshire owned their land for a myriad of reasons (see Figure 63 above). The five top reasons were:

- To enjoy beauty or scenery
- To protect wildlife habitat
- To protect nature and biologic diversity
- Privacy
- To protect water

The 2018 survey indicates that approximately 16 percent of family forest ownerships (10+ acres) had forest management plans, with nine percent written by a private consulting forester. Although 77 percent of family forest ownerships reported having had trees harvested.
18. Trends in Size of Forestland Ownership

Understanding the trends in the size of forest ownerships in NH may be as important as parcelization and fragmentation resulting from subdivision. Change in use from forestland to development often results in negative effects to biodiversity, conservation and wildlife. This change can also result in a reduction in timber base, affecting the timber supply chain of foresters, loggers, truckers and mills. On a national scale, the National Woodland Owner Survey from 2013 concluded:

“Corporations control 18% of the forestland across the U.S. with a large percentage of this land being controlled by a relatively small number of owners. The large (defined as owning 45,000 acres of more forestland) corporate owners are different in terms of behaviors, attitudes, and structures than the [family forest] owners ...”.

Data from the first survey of corporate owners in 2018 will provide some insights into these business owners of private forestland. This data was not available at the time of this report. For non-corporate private owners in New Hampshire, Figure 64 below provides some trend information on ownership size by comparing the results of the 2006, 2013 and 2018 (preliminary) NWOS.

![NH Private Forest Owner Parcel Size (acres)](attachment:image)

**Figure 64 NH Total Acreage of Non-Corporate Forest Ownership by Ownership Acreage Size Classes**  

Additional data from the National Woodland Owners Survey can be found at [https://www.fia.fs.fed.us/nwos/results](https://www.fia.fs.fed.us/nwos/results).
19. Urban and Community Forests

Urban and community forests are the trees, plants and associated ecosystems anywhere where people are. They include trees in public parks, town commons, community forests and trees along New Hampshire’s roads and highways. Like electricity and water, an urban tree canopy is part of a community’s infrastructure. New Hampshire’s urban forests provide a wide range of ecological, economic and social benefits for the nearly 800,000 residents, 60 percent of the state’s population, who live in urban areas (U.S. Census Bureau, 2012).

Although New Hampshire remains a predominantly rural state, it is becoming more urbanized. According to “US Urban Forest Statistics, Values, and Projections” (Nowak et al., 2018), New Hampshire’s urban land increased from 6.1% in 2000 to 7.2% in 2010, and is projected to increase to 10.5 % by 2060 (Figure 65). In addition, while New Hampshire remains in the top five for percent of urban tree cover, the percent of urban tree cover decreased from 57.4% in 2009 to 56.3% in 2015 (Figure 66).

![Figure 65 Percent of land classified as urban in 2010 and projected percent of land classified as urban in 2060. Source: “US Urban Forest Statistics, Values, and Projections” (Nowak et al., 2018)](image-url)

Urban and community trees and forests provide a variety of ecological and economical values including storm water management, reduced energy use, noise abatement, improved air quality, and atmospheric carbon sequestration. Through shading and cooling trees can reduce urban heat islands in the face of warming temperatures. New Hampshire’s urban forests are estimated to remove about 5,700 tons of air pollutants a year, to the health benefit of over $15 million. The value of avoided energy use is estimated to be over $14.5 million per year and the amount of CO2 sequestered by urban trees in New Hampshire is estimated to be more than 244,000 tons per year (Nowak et al.; 2018).

State Urban Forestry programs receive funding through the USDA Forest Service State and Private Forestry Urban and Community Forestry program. In compliance with reporting requirements, New Hampshire Division of Forests and Lands (DFL) annually tracks local urban forestry program development for 234 communities through the Community Assistance Reporting System (CARS). These data show trends in the capacity of communities to manage their urban forests and can reveal both successes and opportunities for continued improvement. In 2019 DFL reported that there are 68 managing communities and 95 developing communities in New Hampshire (Figure 67). Managing communities must have an urban tree management plan, tree ordinances and/or policies, and advocacy or advisory group, and professional urban tree staff.

Figure 66 Annual percent tree cover change in urban areas
Source: "Declining urban and community tree cover in the United States" David J. Nowak, Eric J. Greenfield 2017
Community Forests – New Hampshire has a long tradition of community-owned forest land, in fact, the oldest town forest in the United State was established by the town of Newington in 1710. Cities and towns own forest land for a variety of reasons including recreation, wildlife habitat, water & wetland protection, timber management, and education. In 2018 UNH Cooperative Extension, the Norther Forest Center, and the NH Association of Conservation Commissions completed a multi-year inventory of town-owned forests to “quantify the economic, ecological and social contributions they make locally and to the state.”

Survey results include:

- Town owned forests cover 180,439 acres made up of 1,691 parcels (about 4% of NH forestland)
- 119,640 acres are permanently protected (69%)
- 97,888 acres are covered by stewardship plans (54%)
- 127,867 acres are managed with foresters or other natural resource professionals

20. Forest Industry
It has been said that keeping the forest industry healthy provides a reason for private forest owners to hold onto their land and not sell or develop it. That is certainly true for some private forest owners. The forest products industry in New Hampshire, as with the rest of the Northeast U.S., has undergone significant changes in the 2009 to 2019 period. A sampling of key changes follows.

After a few years of market turmoil, particularly with low-grade timber markets, the Northeast’s forest industry is showing signs of stability and some real opportunities for growth. The region is not out of the dark days yet and in all likelihood some power plants that use low-grade timber will close in the next few years – but the markets are providing returns for landowners and real efforts are underway to find the next generation of uses for our forest resource.

The forest industry is comprised of dozens of individual markets, each with their own influences and dynamics. In simplest terms, timber products fall into three categories – sawlogs (used to make lumber), pulpwood (used for paper production) and low-grade which includes biomass (used in electricity and thermal production – i.e. heating buildings). We should also not forget traditional firewood in that low-grade category as it is more valuable than other low-grade timber such as chips for power plants.

Figure 68 below sets the stage for understanding the connection between forest products markets and forest landowners from decision to harvest and the value perspective.

Figure 68 Volume and Value to Landowner of Products from a Typical Timber Harvest in NH
Source: North East State Foresters Association, 2015 (from NH harvest data – DRA and Forests & Lands)

The conclusion from the graph is simple: from each timber harvest, the vast majority of timber volume is lower value products of pulpwood, and biomass for energy. The vast majority of value comes from
sawlogs, which has the smallest percentage of volume. Even for woodlots that may have been improved through careful thinnings over decades, a high percentage of volume harvested will still be lower value timber. That is simply because as you go up the bole (stem) of the tree, the value decreases – and a lot of volume is in the upper tree in forests. Figure 69 describes this phenomenon.

![Figure 69 Forest Products Derived from a Single Tree](image)

Figure 69 Forest Products Derived from a Single Tree
Source: Innovative Natural Resource Solutions, LLC

In the paragraphs below, the full forest products suite when timber is harvested in NH is described.

**Sawlogs** – When sawed, sawlogs get turned into lumber. For spruce-fir or hemlock, that is structural lumber, used in construction as 2x4 and larger as the framing or backbone of a building. For white pine and hardwoods, a range of uses include flooring, furniture and siding are the end products. There are other applications that have nothing to do with construction – pallets, reels and boxes, or mats to drive heavy equipment over soft ground for example – but much of the lumber industry grows and shrinks with building construction. To understand the health of the construction industry, an important first thing to do is to look at housing starts, and those have seen a steady increase since the rapid crash that came in 2008. In the past year, we have seen over 14 million housing starts – more than double the same period in 2008-2009. These amounts, however, are still far lower than pre-recession levels.
What that has meant for forest landowners and mills in the Northeast is steadily growing demand. Data from New England & New York show that sawlog harvests are rebounding from the post-recession crash, and that sawmills in the region are increasing production. This is great for landowners, loggers and manufacturers. There is more to the story, however, as low-grade markets are struggling – see below.

Of course, sawmills are not without challenges. We are seeing increased pressure from exports – including significant new demand from China for a range of species and products although recent tariffs from the Trump Administration have caused China to fight back with more strict enforcement of phyto-sanitary requirements for raw log shipments. While this export market can provide short-term benefits (in the form of more money) for landowners and some loggers, foreign competition for logs can strain local mills, and make these anchors of the rural economy in the region less economically viable.

Some sawmills, particularly those producing softwood, are starting to have a hard time moving their residuals – which is necessary for continued operation. When a facility buys cylinders (logs) and sells rectangles (boards), lots of by-product is produced. The chips, sawdust and bark need to go somewhere, and loss of pulp mill markets since 1999 – particularly in New Hampshire and Maine – is starting to be a real concern for softwood sawmills as they make plans for continued production increases. While the most lucrative market for wood chips (residues) from sawmills is pulp mills, these chips can and are used in biomass electricity generating plants, but the price can be a lot less and there is more competition of supply for those markets (see below). Further, these chips have a higher average moisture content than those from whole trees because they are just from the very wet sapwood on the outer part of the tree. These do not burn as well as drier chips from within the log.

That brings us to pulpwood. In New Hampshire, it represents at least a third of the volume harvested and 13 percent of the stumpage value to landowners. While the percentage might be different in other parts of the region, the constant is that pulpwood is larger in volume and lower in value than sawlogs. Maine’s pulp mills are the markets for New Hampshire harvested pulpwood (except for a small volume that travels west to the New York pulp mills). Pulp mills have faced challenges, and since 2014 Maine has lost markets for about three million tons of pulpwood and chips annually and most of the market loss has been in
softwoods. For landowners and loggers, this has represented a loss of critical markets for low-grade wood. While the market losses have been concentrated in Maine, the impacts are regional. Landowners and loggers in parts of Vermont, New Hampshire and Southern New England that only a few years ago were at the edge of a Maine mill’s procurement zone, now find themselves too far away to economically sell wood to these markets. The good news is that the remaining pulp and paper mills in Maine and New York are stable and even growing in their pulpwood consumption.

**Biomass**, low-grade timber derived wood chips used for the production of electricity, is important by volume, but in reality provides little economic return to the landowner. In New Hampshire, it was almost half of the harvested volume, but less than a tenth of the stumpage revenue to landowners. That doesn’t mean it’s not important – in fact the importance may be increasing in some regions as markets for pulpwood shrink. And it is very important for cash flow to loggers harvesting and chipping this material.

Biomass faces some economic challenges. Wholesale electricity prices – the prices that matter for power generators – have been in steady decline for the past several years. A combination of inexpensive natural gas and lack of demand growth have pushed prices lower, and there is no reason to think that will change any time soon. Some states are taking steps to support their biomass facilities – Maine is at the end of two years of above-market payments to four biomass plants, and earlier this year New Hampshire modified their Renewable Portfolio Standard to bolster biomass until 2020 although this change has been challenged by Eversource – the utility required to purchase the power for 3 years and is before the NH Supreme Court. A 2019 attempt with new legislation passed the House and Senate but was, in August 2019, vetoed again by the Governor. These measures are temporary, and will end. When they do, the economic viability of biomass plants – and thus the market for millions of tons of low-grade wood annually – will be in question. As of this writing, 4 of the 6 older wood-fired power plants in NH have shut down and the 5th and 6th may do the same soon. This represents over 1.4 million tons of wood chips – a huge market for low-grade wood.

While much of this sounds bleak, all is not lost from the forest economy’s standpoint. Across the region, actions are underway to secure new markets for low-grade wood – replacing some of what has been or will be lost in pulpwood and biomass. A new facility producing bio-oil, a liquid fuel derived from wood, has been proposed in upstate New York and is also looking at Maine. And Maine industry leaders are working together to support existing markets and bring in new markets – biofuels, biochemical and biochar companies have all been in the state evaluating the significant forest resource, the robust logging infrastructure and the opportunities that lost markets have created.

The forest industry – growing, harvesting and processing wood – is undergoing profound change across the Northeast. Mills have closed, and many (if not most) will never re-open. While this can be disconcerting, the forest – upon which the entire industry relies – remains strong, adding volume year after year. The forest – and the people that build their livelihoods from it – serve as the strong foundation for a changing industry.

**Wood and wood products production, consumption, and trade**

With the background described above, understanding the actual harvested volumes by products and the trends for New Hampshire is very helpful towards understanding the timber economy. New Hampshire is fortunate to have a robust set of data describing timber harvest levels each year that results from the Report of Cut forms filed for every timber harvest in the State. Figure 71 shows the harvest levels by
product and volume for the period of 2000-2017. The harvest data has been normalized to tons for all products so the various products can be compared.

Figure 71 NH Timber Harvest Volumes 2000-2017
Source: NH Division of Forests & Lands

During this period, total harvest levels have not varied that much although the mix of products harvested has varied. Total harvest levels peaked in 2004 at 3.4 million tons with three other peaks in 2010, 2014, and 2016 each year at 3.3 million tons of timber harvested. Sawlog volumes have decreased slightly annually from the earlier year harvests as have pulpwood volumes. Biomass production increased as the two newest wood-fired power plants in Portsmouth and Berlin came on line in 2006 and 2014. Biomass volume would see a sharp downturn if 2018 and 2019 numbers were available.

Figure 72 may be an easier way to look at these same NH harvest data. This approach looks at the percent of each product harvested in a year. At least 70-80% of the volume harvested comes from lower value products of pulpwood, firewood and biomass.
NH Mill Production

The data above help inform what NH wood-using mills are actually using each year in terms of volume of timber, but the numbers are not always synonymous because some timber harvested in other states is used by NH mills and some timber from NH is milled in others states or even overseas in the case of sawlog exports. The timber import/export situation has not been studied in recent years but a 2013 report “The Economic Importance of New Hampshire Forests” from the North East State Foresters Association includes robust data and information on the subject – see Figure 73. This shows that, except for pulpwood, since NH no longer has pulp mills, the processing mills use about the same amount of timber that is harvested for their sector of mill. In each case, however, there are imports and exports of raw material from neighboring states.

The conclusion to be drawn from this data is that we have a robust forest products economy in NH and that it is part of a regional forest products economy.

Figure 72 Percent of NH Timber Harvest by Product
Source: NH Division of Forests & Lands
Figure 73 Wood Flows in and out of New Hampshire
Source: North East State Foresters Association, 2013

In New Hampshire under State law RSA 227-I:9, sawmills and concentration yards are required to be registered with the NH Division of Forests & Lands. Primary processing mills – sawmills – are also annually required to report the volume of lumber sawed in the previous year. Figure 74 below shows that out of 210,645 MBF (thousand board feet)\(^{13}\) processed by sawmills in 2017 White Pine dominated the species processed with well over half, or 116,597 MBF processed in that year. Spruce-fir and Hemlock were the next largest species processed with 51,921 MBF for Spruce-fir and 13,193 MBF for Hemlock.

For hardwood species, Red Oak is the dominant species sawed with 15,291 MBF sawed that year and Sugar Maple a poor second with 4,001 MBF sawed.

\(^{13}\) MBF or thousand board feet – the measurement unit for sawed lumber. One (1) board foot equals a piece of wood 1” thick by 12” long and 12” wide.
While understanding the output of the NH sawmill industry for the most recent year where data is available is helpful, trends in sawmill processing are more important. Figure 75 shows the same sawmill processing output data for the years 2010-2017. The graph shows no real trend but a normal up and down level of activity for the 8-year period. The average for those years is 205,601,000 board feet. This shows a fairly steady forest industry sector in the years since the recession.
In addition to volume output data from the sawmills operating in NH, a more useful economic indicator of the health of the sawmill and entire forest products industry sector in New Hampshire is the value of the economic output from the mills in the State. Figure 76 shows the economic output of the forest products industry for 1997-2017 through the gross domestic product metric for four major sub-sectors of the forest products industry: forestry/logging, wood products manufacturing (sawmills), furniture and related product manufacturing (secondary wood products), and paper.

![N.H. Forest Products Industry Gross Domestic Product ($ Millions)](image)

**Figure 76 NH Forest Products Industry GDP 1997-2017**

*Source: U.S. Dept. of Commerce, Bureau of Economic Analysis*

Some major findings can be gleaned from this graph. First, the closure of the pulp and paper mills in Berlin and Groveton can be seen as that sector drops to less than half of its former output after 2002. The remaining paper manufacturing is taking place in the paper mills in the State that purchase market pulp but have no pulp mills. The second major finding is that sawmill (Wood product manufacturing) output is fairly steady and has recovered nicely since the recession and is at higher levels than 20 years ago. The 2018 data is not available as of this writing but from anecdotal information, the sawmill sector continued its upward climb in 2018. The forestry sector – which includes logging and forestry work, is fairly steady over the period with some overall increase in recent years even from pre-recession years. Secondary wood manufacturing has also been fairly steady for the period.

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14 Gross domestic product, or GDP, for an industry includes value added, which is equal to its gross output minus its intermediate purchases from domestic industries or from foreign sources.
Wood energy is not included in Figure 76 but we have robust economic data for that sub-sector from a study conducted by Plymouth State University for the N.H. Timberland Owners Association. In that study, the direct economic effect of the 6 independent wood-fired power plants in the state is about $255 million per year. Add to that the two larger wood-fired power plants in Berlin and Portsmouth and the total annual economic value to the State is estimated at $396 million.

Low-grade markets located in New Hampshire are primarily the 8 stand-alone biomass electricity generation plants described above. Firewood is another local low-grade market. For the biomass power plants, Figure 77 shows the available data on the usage of wood chips. This is a very large market for low-grade wood. This most recent year shows over 2 million tons of low-grade wood chips used in these plants (it was nearly 3 million tons at the peak year of 2016). To compare with the NH sawmill timber use to get a better understanding of scale we need to convert to the same units – tons. For comparison this shows the recent 2017 sawmill year: 210,645 MBF = 1,053,225 tons. That means in 2016, the biomass electricity plants used over 3 times the amount of wood for the year as all the sawmills combined. Sawmills, of course, produce a vastly more valuable product to the economy but the comparison is useful to understand the scale issue.

At the time of this writing in 2019, the fate of most of the 8 biomass electricity plants is in question due to the reduction in prices for wholesale electricity prices and Renewable Energy Certificate prices and a legislative approach to saving the plants that has failed to date.
Growth/Drain of Timber

A basic measure of the sustainability of timber is comparing annual growth of timber to the removals—i.e. growth/drain. Using data from the USDA Forest Service Forest Inventory and Analysis (FIA), Figure 78 shows, using the most recent data from 2017\textsuperscript{15}, that NH is growing\textsuperscript{16} about twice as much timber as is being harvested—a healthy metric.

![NH Net growth of timber vs harvest 2017 (cu. ft.)](image)

**Figure 78** Net Growth of Timber vs. Harvest in NH 2017

*Source: USDA Forest Service, Forest Inventory & Analysis*

A better metric can be used to understand what is happening to the volume of the timber in the forests of NH—standing inventory over time. If harvesting is less that net growth over time, then standing inventories will increase. Figure 79 below shows just that phenomenon. With data from the FIA, NH standing volume is increasing for the period from 2005-2017. In fact, NH’s tree volume has been increasing for many decades. Since the 1950s when this kind of data has been collected, every year shows more standing volume of trees than the previous. More detailed data shows that we have a forest that is growing bigger in size (tree diameter and height) and older.

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\textsuperscript{15} FIA data is gathered on rolling basis, with about 5 years for a state’s inventory to be completed. The data used here is the most recent which includes data from 2017 and the previous 4 years.

\textsuperscript{16} Net growth is gross timber growth less mortality. Net growth less harvest removals is the most accurate way of determining timber sustainability.
Figure 79 NH Standing Timber Volume 2005-2017
Source: USDA Forest Service, Forest Inventory and Analysis
21. Legal, Institutional, and Policy Framework

New Hampshire forest policy and law

New Hampshire has a series of laws and regulations that impact management of timber and non-timber attributes on forestland in New Hampshire. The state’s laws are not found in a comprehensive forest practices act like some states – where all the forestry related topics fall under one title – but the list of laws in New Hampshire, is nevertheless, wide-ranging.

New Hampshire has laws relating to timber tax (Intent to Cut and Report of Cut), water quality protection (wetland and alteration of terrain laws), forester licensing, and some wildlife related regulations. Other states in the region have similar laws and regulations, though some are packaged in forest practices acts. Table 16 provides a comparison of broad law categories for New Hampshire and the surrounding states of Maine, Massachusetts and Vermont.

Table 16 Forestry Laws and Regulations – NH and Surrounding States

<table>
<thead>
<tr>
<th>Type of Law</th>
<th>NH</th>
<th>VT</th>
<th>ME</th>
<th>MA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forester Licensing</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Logger Licensing</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Forest Practices Act</td>
<td>*X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Water Quality regulations</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Timber tax</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intent to Harvest permitting</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Cutting/Management Plan Approval</td>
<td>Certain</td>
<td>Certain</td>
<td>Certain</td>
<td>X</td>
</tr>
</tbody>
</table>

*while not a comprehensive forest practices act, Vermont has what is referred to as a Heavy Cut Law

One area covered by laws in all three of these states but not New Hampshire is that of intensity of cutting practices not associated with road or wetland buffers – or more specifically – clearcutting or heavy cutting. All three of these states regulate certain size (or larger) clearcuts to an extent. Permits and extra planning is required when associated with these kinds of harvest. New Hampshire is the only state of these four with a timber (severance) tax.

Current use taxation program – In 1973 the NH General Court enacted RSA-79-A, the current use taxation law. It is a taxing strategy aimed at making it easier for landowners to keep their open space undeveloped by taxing it on its income-producing capability rather than at its real estate market value. Assessment rate ranges for forestland are established each year in 3 broad categories: white pine, hardwood, and other. In addition, owners who meet criteria for responsible land stewardship may receive lower assessment. Other current use assessment categories include farm land, unproductive land, and wetland. Current use landowners can also receive an additional 20% rate adjustment if they keep their land open and without fee all year for public pedestrian recreation access.
Table 17 Current Use Land Trends

<table>
<thead>
<tr>
<th>Tax Year</th>
<th>Total Acres in Current Use</th>
<th>Percent of Total Land</th>
<th>Total Acres in All Forestland Categories</th>
<th>Total Acres in Stewardship Category</th>
<th>Percent of current use land w/recreation adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>2,976,500</td>
<td>51.83%</td>
<td>2,598,531</td>
<td>1,013,777</td>
<td>47.78%</td>
</tr>
<tr>
<td>2012</td>
<td>3,001,578</td>
<td>52.27%</td>
<td>2,614,650</td>
<td>1,041,615</td>
<td>48.21%</td>
</tr>
<tr>
<td>2013</td>
<td>2,998,328</td>
<td>52.21%</td>
<td>2,612,366</td>
<td>1,018,596</td>
<td>48.46%</td>
</tr>
<tr>
<td>2014</td>
<td>3,000,817</td>
<td>52.25%</td>
<td>2,615,756</td>
<td>1,027,019</td>
<td>48.97%</td>
</tr>
<tr>
<td>2015</td>
<td>3,003,299</td>
<td>52.30%</td>
<td>2,617,670</td>
<td>1,027,779</td>
<td>48.98%</td>
</tr>
<tr>
<td>2016</td>
<td>3,008,456</td>
<td>52.39%</td>
<td>2,623,405</td>
<td>1,021,450</td>
<td>49.59%</td>
</tr>
<tr>
<td>2017</td>
<td>3,007,356</td>
<td>52.37%</td>
<td>2,623,318</td>
<td>1,021,952</td>
<td>50.02%</td>
</tr>
<tr>
<td>2018</td>
<td>3,008,034</td>
<td>52.38%</td>
<td>2,623,181</td>
<td>1,010,909</td>
<td>49.71%</td>
</tr>
<tr>
<td>2019</td>
<td>3,001,655</td>
<td>52.27%</td>
<td>2,618,989</td>
<td>989,019</td>
<td>50.20%</td>
</tr>
</tbody>
</table>

**Forest policy development** - New Hampshire does not have a single natural resources agency. However, several mechanisms are in place to facilitate communication among state agencies with common concerns. The Cooperative Land Management Program (CLMP) was formed in the mid 1970's to develop consistent land use policies and provide coordinated management of the state's natural resources agencies. At the project level, the state land management team (SLMT) provides coordinated, interdisciplinary resource planning and management assistance on state-owned lands.

At the state policy level, the Council on Resources and Development (CORD) was formed in accordance with RSA 162-C to consult on "common problems in the fields of environmental protection, natural resources, and growth management." CORD is responsible for resolving differences or conflicts over development and resource management, reviewing disposition of state-owned real property, and overseeing the LCIP monitoring program.

New Hampshire also has several legislatively established advisory board and committees designed to facilitate discussion regarding natural resource related policies and issues among a broad range of interests. Examples include the State Forest Advisory Board established in RSA 227-I to advise and assist the Division of Forests and Lands in facilitating dialogue between diverse interests on forest related issues and to advise the State Forester in the development and implementation of the forest resources plan, and state programs and policies; and the Nash Stream Forest Citizens Committee established in RSA 12-A:9 to

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17 Members of CLMP comprise an executive committee, which includes the directors of Fish and Game Department, Division of Forests and Lands, Division of Parks and Recreation, and Water Resources, and a working committee made up of key resource managers in each agency.

18 Core team members of SLMT are professional and technical specialists from Fish and Game Department, Division of Forests and Lands, Division of Parks and Recreation, Natural Heritage Inventory, Trails Bureau and the Division of Historic Resources.

19 Members of CORD are the agency leaders of the Office of State Planning, Division of Public Health, Fish and Game Department, Department of Natural and Cultural Resources, Department of Environmental Services, Department of Agriculture, Department of Safety, Department of Education, and Department of Transportation.
advise the Department of Natural and Cultural Resources on management issues related to the Nash Stream Forest.

State and Institutional Framework

State Agencys

The New Hampshire Division of Forests and Lands (DFL) is housed within the Department of Natural and Cultural Resources (DNCR). Other divisions within DNCR include Parks and Recreation, Historical Resources, State Library, and Council on the Arts.

The mission of DFL is to protect and promote the values provided by trees, forests and natural communities. This mission is accomplished through responsible management of the state’s forested resources; by providing forest resource information and education to the public; and through the protection of these resources for the continuing benefit of the state’s citizens, visitors, and forest industry. Program areas within DFL include Forest Management, Land Management, Forest Protection, Planning & Community Forestry, Natural Heritage, and Forest Health. Cooperative Forestry Programs are administered jointly through an agreement with University of NH Cooperative Extension to provide technical assistance to New Hampshire’s forest landowners, support skills development for resource professionals, and educate NH’s citizens about rural and urban forest environments.

The statutory authority and guidance for the Division is set forth in RSA’s 227-G:3, where it states the agency “shall execute all matters pertaining to forestry, forest management, and forestlands within the jurisdiction of the state…”

Available capacity and resources to accomplish the goals and missions of the various agencies as they pertain to forests and trees is variable over time. This variability can affect staffing and program implementation and remains one of the most significant barriers to accomplishing objectives. Using the division of forests and lands as an example, since it is the state agency with primary jurisdiction over forestry-related matters, it is evident how funding sources have changed. The division’s budget consists of three types of revenue: general funds, federal funds, and “other” funds, which is primarily agency-generated income. In 2008, the state provided $3,033,832 in general funds for the operation of the division. Twelve years later, the division is receiving $2,975,961. For federal funding, in 2008 the division received $1,422,040, while in 2020 it is receiving $962,753. These considerable decreases have put pressure on the agency to generate other sources of revenue. During this same timeframe, total personnel count has dropped from 55 positions to 50, while the agency has had to respond to increasing demands.

Other New Hampshire state agencies that impact forestry:

<table>
<thead>
<tr>
<th>Agency</th>
<th>Duties and programs impacting forests/forestry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department of Revenue Administration</td>
<td>Administration of state timber tax laws</td>
</tr>
<tr>
<td>Department of Environmental Services</td>
<td>Wetlands permitting for timber harvest operations</td>
</tr>
<tr>
<td>Fish and Game Department</td>
<td>Wildlife Action Plan implementation, threatened &amp; endangered species, habitat management considerations</td>
</tr>
<tr>
<td>Department of Agriculture, Markets, and Food</td>
<td>Invasive species – including plants, control of forest-related pests – native and non-native</td>
</tr>
<tr>
<td>Department of Safety</td>
<td>Division of Fire Standards &amp; Training – wildland fire training, Emergency Management – response to natural disasters</td>
</tr>
</tbody>
</table>
Federal Agencies

There are several important federal agency partners within New Hampshire’s natural resource community. Chief among them is the USDA Forest Service. All three branches of the Forest Service have a presence in our state.

National Forest Systems - The White Mountain National Forest (WMNF) was established in 1914 as a result of the Weeks Act of 1911. The forest is nearly 800,000 acres and is an important source of forest products and forest-based recreation for the state. With the passage of the Good Neighbor Authority, collaborative work between the NH Division of Forests and Lands and the WMNF has been formalized and expanded with agreements that include natural heritage inventory work being done on the forest.

Forest Service Research – Northern Research station programs in New Hampshire include research staff at the Durham Field Office working on many issues including sustaining forests, forest disturbance, forest carbon, inventory & monitoring. New Hampshire is also home to two experimental forests; Hubbard Brook Experimental Forest and Bartlett Experimental Forest.

State & Private Forestry - The State and Private Forestry (S&PF) organization of the USDA Forest Service reaches across the boundaries of National Forests to States, Tribes, communities and non-industrial private landowners. S&PF is the federal leader in providing technical and financial assistance to landowners and resource managers to help sustain the Nation’s forests. Federal grant program areas implemented by the Division of Forests and Lands are State Fire Assistance, Forest Health, Urban Forestry Assistance, Forest Stewardship, and the Forest Legacy Program.

Natural Resource Conservation Service (NRCS) provides financial and technical assistance to forest landowners who want to make conservation improvements to their land and incentives to forest landowners wanting to put their land under long-term easements. NRCS forest-related financial assistance programs include the Environmental Quality Incentives Program (EQUIP) and Conservation Stewardship Program (CSP). While CSP is targeted to agricultural producers, maple syrup producer can qualify for this program.

There are 5 U.S. Fish and Wildlife Service (USFW), National Wildlife Refuges (NWR) in NH. The Great Bay NWR in Newington, the John Hay NWR in Newbury, the Wapack NWR in Greenfield, and the Umbagog National Wildlife Refuge in Errol, NH. The Silvio O. Conte National Fish & Wildlife Refuge, which is within the Connecticut River corridor, is located within parts of New Hampshire, Vermont, Massachusetts, and Connecticut. The U.S. Fish and Wildlife Service also have a field office in Concord, NH. The Division of Forests and Lands works with USFS on habitat management issues of mutual interest and on threatened & endangered species issues.

Colleges and Universities

University of New Hampshire - The University of New Hampshire is a public research university with its main campus in Durham, New Hampshire. It was founded and incorporated in 1866 as a land grant college...
in Hanover in connection with Dartmouth College, moved to Durham in 1893, and adopted its current name in 1923. The university offers an Associate in Applied Science (A.A.S) degree in Forest Technology through the Thompson School of Applied Science, a Bachelor of Science in Forestry (B.S.F.) degree, and a Master of Science degree in Natural Resources: Forestry. The A.A.S and S.S.F degree programs are accredited by the Society of American Foresters.

Other New Hampshire Colleges and Universities with forestry-related programs include Dartmouth College, Plymouth State University, Keene State College, Antioch College, and Great Bay Community College.

**Forest management standards/guideline**
New Hampshire has a variety of management practices manuals and guidelines that provide landowners and resource management professionals with information on a wide variety of resource management topics. The table below provides a brief list of New Hampshire management practices guidelines.

<table>
<thead>
<tr>
<th>Publication</th>
<th>Agency</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good Forestry in the Granite State: Recommended Voluntary Forest Management Practices for New Hampshire</td>
<td>UNH Cooperative Extension, NH Division of Forests &amp; Lands</td>
<td>2010</td>
</tr>
<tr>
<td>Best management Practices for Erosion Control During Trail Maintenance and Construction</td>
<td>NH Division of Parks and Recreation</td>
<td>2016</td>
</tr>
<tr>
<td>Trails for People and Wildlife</td>
<td>NH Fish &amp; Game Department</td>
<td>2019</td>
</tr>
</tbody>
</table>

**Forest Certification**
Third-party certification is based on the premise that consumers are seeking assurances that their wood products come from sustainably managed forests. The three primary certifying programs are Sustainable Forestry Initiative® (SFI®), Forest Stewardship Council® (FSC®), and the American Tree Farm System® (ATFS) a program of the American Forest Foundation. Between them there are over 118 million acres certified in the United States.

Independent, third-party certified forests meet strict standards for ecological, social and economic sustainability. The benefits of forest certification include: helping the forest industry remain competitive in global markets that increasingly demand certified raw materials, assurance of high standards of sustainable forestry practice as validated by independent third-party audits, and continuous improvement.

<table>
<thead>
<tr>
<th>Acres of Certified Forest Land – New Hampshire</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>FSC</td>
<td>291,631</td>
<td></td>
<td></td>
<td>924,056*</td>
</tr>
<tr>
<td>SFI</td>
<td>181,479</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tree Farm</td>
<td>450,946</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*includes approximately 129,000 acres dual certified by both FSC and SFI

Source: Innovative Natural Resource Solutions, LLC. 2019

**Forest-related assessment & planning**
Beyond the state statutory requirement for a Forest Resources Plan to be revised every 10 years, a significant amount of forest related planning goes on in New Hampshire. The Forest Stewardship Program
(FSP), funded with federal dollars, has encouraged forest management planning on private forestlands since its creation in the federal Cooperative Forestry Assistance Act as amended in 1990. The FSP works in partnership with state forestry agencies, cooperative extension, and conservation districts to connect private landowners with the information and tools they need to manage their forests. Table 18 shows the number of new and revised Forest Stewardship Plans from 2006 through 2019. Stewardship plans, or multi-resource management plans, are required by Federal Forest Legacy Program Implementation Guidelines. Total NH Forest Legacy Program multi-resource management plan acres is approximately 264,000. New Hampshire forest land that are part of the American Tree Farm Program and properties enrolled in the New Hampshire Current Use tax program in the documented stewardship category must also have written management plans. Other private forestland is required to be covered by forest management plans includes the acres under the SFI and FSC forest certification programs.

Table 18 NH Forest Stewardship Program Plans

<table>
<thead>
<tr>
<th>Year</th>
<th>New Plans</th>
<th>Revised Plans</th>
<th>New Acres</th>
<th>Revised Acres</th>
<th>Total Plans</th>
<th>Total Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>72</td>
<td>10</td>
<td>10,032.04</td>
<td>1,216.71</td>
<td>82</td>
<td>11,248.75</td>
</tr>
<tr>
<td>2007</td>
<td>103</td>
<td>22</td>
<td>19,022.60</td>
<td>9,242.83</td>
<td>125</td>
<td>28,265.43</td>
</tr>
<tr>
<td>2008</td>
<td>13</td>
<td>47</td>
<td>7,380.60</td>
<td>1,284</td>
<td>60</td>
<td>8,664.60</td>
</tr>
<tr>
<td>2009</td>
<td>45</td>
<td>11</td>
<td>6,917.30</td>
<td>2,451.60</td>
<td>56</td>
<td>9,368.90</td>
</tr>
<tr>
<td>2010</td>
<td>67</td>
<td>16</td>
<td>12,511.06</td>
<td>3,830</td>
<td>83</td>
<td>16,341.06</td>
</tr>
<tr>
<td>2011</td>
<td>48</td>
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Source: UNH Cooperative Extension

The New Hampshire Division of Forests and Lands has multi-resource management plans covering almost 70,000 acres of state-owned forest land, predominantly on the agency’s largest reservations. In addition, the Division has comprehensive inventory and timber harvest planning processes that guide management
on all properties. The revision of the White Mountain National Forest Plan (covering over 800,000 acres – nearly all of which is in NH) was completed in 2005.

Statewide plans have become more numerous than one would expect. Though not all of them affect forests specifically, many involve forestlands, forest industry, or other areas of concern to New Hampshire’s forest community. The recently revised Wildlife Action Plan through NH Fish & Game is one such plan that directly affects NH’s forests since its recommendations for conservation and management largely fall on forested habitats. Table 19 provides a brief list of the statewide plans.

Table 19 List of Statewide Plans

<table>
<thead>
<tr>
<th>Statewide Plan</th>
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<tr>
<td>NH Wildlife Action Plan--update</td>
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<td>NH Long Range Transportation Plan</td>
<td>2010</td>
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<td>State Comprehensive Outdoor Recreation Plan</td>
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<td>Climate Change Action Plan</td>
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<td>White Mountain National Forest Plan</td>
<td>2005</td>
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<td>NH Energy Strategy Plan</td>
<td>2018</td>
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<td>State Development Plan</td>
<td>2000</td>
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<td>Ten Year Strategic Plan – NH Division of Parks</td>
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Priority Landscapes

Federal Statewide Forest Assessment and Strategy requirements include identification of areas or regions of the state that are a priority and the identification of multi-state priorities. The Rural and Urban Priority Area maps below were developed by the Division of Forests and Lands using a simple overlay analysis of available statewide data as described below.

Rural Forest Priority Areas

The Rural Forest Priority Areas overlay analysis identifies valuable rural forested landscapes that provide many ecosystem services while supporting important socioeconomic benefits. The data layers used in this analysis are Unfragmented Forest Blocks, which captures large areas of intact forested lands. Important forest soils isolates highly productive sites for important tree species. NH Wildlife Action Plan - Habitat Tiers identifies overlap between forested lands and important habitat for wildlife species. Proximity to Conserved Lands locates opportunities to expand or connect forested areas to mitigate impacts from fragmentation. Ability to Produce Clean Water ranks watersheds by the benefits they provide to their respective water resources based on the amount of forest cover. Resilient and Connected Landscapes are zones found to exhibit high ecological diversity. These areas are best fit to provide refuge form the possible impact of climate change.

Urban Forest Priority Areas

The analysis for Urban Priority Areas focused on identifying communities with high population density, low canopy cover and potential future urban expansion. Census designates places, incorporated places and Urban Clusters identify population centers and locate where New Hampshire’s Urban Forests reside. The National Land Cover Dataset – Tree Canopy Layer provides information on how much canopy cover exists in the Urban Landscape. EPA’s housing density projections for 2030 lend insight to future development and the expansion of urban and suburban areas into the exurban and rural landscape.
Forest Stewardship Priority Areas

The Forest Stewardship Program is a USDA Forest Service funded program that encourages the long-term stewardship of private forest land. The New Hampshire Forest Stewardship Program is implemented jointly by UNH Cooperative Extension and the NH Division of Forests and Lands. The program encourages landowners to voluntarily adopt a sound stewardship ethic that will sustain the resources on their land for the benefit of themselves and others, today and in the future. Several agencies and organizations within New Hampshire’s forestry community provide technical and educational assistance to landowners through workshops, publications and site visits. Close working relationships within the forestry community ensures common messages, sharing of resources, mutual support of goals and creditability with target audiences.

In the past 3 years (FY17 -19), the US Senate marks requested that the Forest Service “consider developing outcome-based reporting for this program and urges the Service to reevaluate whether allocating program funding using the current allocation formula is the most effective use of program resources.” In February 2018 a Modernizing Team was organized to develop viable options to better focus and prioritized Federal investment, achieve outcomes on priority lands, serve landowners, and leverage partnerships.

As part of Forest Stewardship Modernization states are directed to identify geographic program priority areas that are no more that 50% of eligible Forest Stewardship acres, for delivering landowner assistance. The following map shows areas of high stewardship potential in dark green. Analysis layers included in the map are:

- **Soil: Important Forest Soils (NRCS: NH Granit)**
  - All soils in IA and IC classes = 1
- **Forest Patch Size: Unfragmented forest blocks (TNC)**
  - Blocks > 1000 acres = 1
- **Habitat Quality: Wildlife Action Plan (NHF&G: NH Granit)**
  - Wildlife Habitat Tiers 1 and 2 = 1
- **Proximity to Private Conservation Lands (Consh: NH Granit)**
  - All parcels over 50ac w/ 1000ft buffer and parcels under 50 = 1
- **Proximity to Public Lands (Consh: Granit)**
  - All parcels over 50ac w/ 1000ft buffer =1
- **Climate Change: Resilient and Connected Landscapes (TNC)**
  - Lands classified as climate flow zones and climate corridors = 1
- **Wildland Fire: Wildland Urban Interface (Silvis Lab: UW-Madison)**
  - Lands classified as interface and intermix = 1
- **Water Quality: Important areas for surface drinking water (Forests to Faucets 2.0: USFS)**
  - HUC-12 watersheds in 70-90 percentile = 1

The analysis excludes all developed land, waterbodies, barren land, corporate forestland, and public fee owned lands. High priority lands (dark green) represent areas with 3 or more overlapping analysis layers.
New Hampshire Forest Stewardship Program Priority Areas Map

Legend
- Ineligible Lands
- Stewardship Potential
- High Stewardship Potential
- COUNTIES

0 5 10 20 Miles

New Hampshire Division of Forests & Lands
Multi-State Priorities

The New Hampshire Division of Forests and Lands has a long and successful tradition of working collaboratively on projects and issues. Projects have ranged from Forest Health efforts such as Emerald ash borer detection and eradication to wildland fire prevention with the Northeastern Forest Fire Protection Compact and participation in the four-state North Eastern State Foresters Association (NEFA). These cooperative efforts enable states to better address areas of common opportunity or concern.

New Hampshire has identified the following multi-state priority forest areas:

**Northern Forest Lands (NFL)** – New Hampshire’s northern most county (Coos) lies within the planning area for NFL which stretches over 20 million acres from Maine to New York. This area was the focus of a regional study and planning effort in the 1990’s. Issues needing attention include forest land conservation, economic development and community infrastructure.

**States:** Maine, New Hampshire, Vermont, New York
Connecticut River Valley - The Connecticut River is the largest river in New England. It flows south from northern New Hampshire and forms the state border between Vermont and New Hampshire. Continuing through western Massachusetts and into central Connecticut, it flows into Long Island Sound. According to the US Forest Service publication “Forest on the Edge” this is one of the most at-risk areas of New England for forest fragmentation. Issues associated with this area include invasive species control, urban and agricultural runoff impacting water quality, fisheries and wildlife habitat.

States: Vermont, New Hampshire, Massachusetts, Connecticut
Quabbin to Cardigan Corridor - The Quabbin to Cardigan region encompasses more than 3,000 square miles in the Monadnock Highlands of central Massachusetts and western New Hampshire. The region contains one of the largest remaining areas of intact contiguous forest in central New England. The region is the watershed boundary between the Connecticut and Merrimack River valleys and the highlands provide habitat for many species of migratory birds and wide-ranging wildlife—animals that are in decline elsewhere in New England due to habitat fragmentation. The area’s forests also form the basis of a vibrant tourism, recreation and forest products economy.

To address issues of concern in the region the Quabbin to Cardigan Partnership (Q2C) was formed in 2000. Since that time the partnership’s efforts have helped to protect more than 90,000 acres. The Q2C partnership includes a unique assemblage of 31 state and federal public agencies, private conservation groups, forestry organizations and landscape-scale partnerships.

States: New Hampshire and Massachusetts
GOALS-STRATEGIES-ACTIONS

FOCUS AREA – FOREST ECOLOGY

Forests support a variety of ecosystems, species, and genes — collectively referred to as biological diversity — along with important processes that tie these all together (Wildlife Society, July 2015). Biological diversity, or biodiversity, enables an ecosystem to respond to external influences, to recover following disturbance, and to maintain essential ecological processes. Forests with diversity at landscape, species, and genetic scales are better able to absorb and recover from disturbances and remain fully functioning forest ecosystems (Millennium Ecosystem Assessment 2005).

In general, forest ecosystems that have greater diversity are considered more resilient. Northern forests are long-lived and widespread so they are inevitably afflicted by catastrophic weather, wildfires, insects, diseases, invasive species, atmospheric pollution, and climate change. Sustaining biodiversity is among the top concerns commonly expressed about northern forests (Shifley, Stephen R. et al., 2012, Forests of the Northern United States).

The foundation for successful biodiversity protection is a network of representative, high-quality examples of a region’s natural community types, and by extension, their constituent species and underlying ecological processes. Conserving an adequate number of viable examples of each forest natural community type will protect the majority of New Hampshire’s species (Sperduto, D. and B. Kimball, Nature of New Hampshire, 2011).

Invasive plants can cause significant ecological and economic harm and are impacting New Hampshire’s forests. They out-compete native plants and destroy important natural communities such as floodplain forest. Invasive plants cause widespread impact to our forests, fish, wildlife, endemic plants and natural communities. Landowners can manage invasive plants to protect their forests and natural communities from degradation using resources such as Picking Our Battles “A Guide to Planning Successful Invasive Plant Management Projects.” This manual takes a large scale approach and prioritizes shared invasive plant “battles” which allows for restoration projects to be more effective in the long-term and maximize the efficient use of resources.

**Goal - New Hampshire’s forests are comprised of healthy and sustainable populations of biologically diverse native plants and animals.**

**Strategies:**

1. Improve collection of statewide information on the identity, location, status and condition of exemplary natural communities and forests with rare plant species.
• Encourage natural community surveys to be conducted on all lands, regardless of ownership, with permission
• Locate and map fire adapted and fire-dependent natural communities in NH
• Increase use of new technology and modeling for better efficacy

2. Manage NH forests for biological diversity.
   • Encourage the incorporation the Wildlife Action Plan into forest management/stewardship planning
   • Encourage use of “Good Forestry in the Granite State” across all ownerships
   • Encourage landowners to work with foresters and other ecological professionals when drafting forest management plans and planning timber harvests
   • Increase training to foresters, other natural resource managers, and landowners on best practices for identification and protection of rare species and natural communities

3. Protect identified important natural communities and forests with rare species from conversion and degradation
   • Promote and advocate for policies at all levels of government that provide incentives for landowners to protect important natural communities and rare species
   • Reduce fragmentation around important areas to provide a buffer and reduce likelihood of introduction of invasive species
   • Focus on connected forested parcels and corridors for species movement and migration.
   • Use conservation easements and fee ownership for permanent protection of the most critically-imperiled natural communities

4. Promote prescribed fire as a beneficial tool for ecosystem maintenance/restoration in fire adapted and fire-dependent natural communities
   • Participate in the NH Prescribed Fire Council
   • Increase the number of prescribed fire training opportunities and wildfire assignments to increase the number of experienced practitioners
   • Coordinate with partners to help ensure capacity is available through improved strategic planning, use of dedicated prescribed fire crews, greater flexibility to use fire personnel across units, and more effective use of partner capacity
   • Explore capacity of the Northeastern Forest Fire Protection Compact (NFFPC) to expand their support of resource sharing for prescribed fire activities (training, mobilization, etc.)
   • Improve public awareness and acceptance of prescribed fire by using wildfire incidents and other related news to communicate the significant differences between uncontrolled wildfire smoke and prescribed fire smoke impacts on air quality and public health.
FOCUS AREA – WILDFIRE MANAGEMENT

Wildfire has, and will, continue to be a threat for which New Hampshire must be prepared. New Hampshire is fortunate to have a good record regarding wildfires as compared to many other parts of the country. Significant wildfire activity in New Hampshire is largely driven by deviations from normal, or “typical” weather and fuel conditions. During an average year, this state experiences approximately 250 wildfires which burn 250 acres. These averages can vary wildly though during times of drought or exceptional dryness, or due to unnatural fuel buildups such as from a wind event or ice storm. While much of the state is covered by forest types that are not considered to be high-hazard, such as northern hardwoods, there are pockets of high-hazard areas that dot the state. Examples of fire-prone fuel types include pitch pine and scrub oak, red pine rocky ridges, dry Appalachian oak, oak-pine, and phragmites.

The Division of Forests and Lands is the state agency with statutory authority over wildfire management on all lands outside of the White Mountain National Forest. For the National Forest and the portion of the Appalachian Trail that runs through New Hampshire, the U.S. Forest Service has primary jurisdiction. However, for the vast number of wildfire incidents in the state it is local fire departments that provide initial attack. When fires become large or complex the state provides support and incident command. For wildfires on or near the National Forest, the state and Forest Service have an agreement in which we provide mutual aid to each other. If fire activity exceeds the capacity of in-state resources, there are agreements and statutes in place to allow mutual aid from outside the state via the Northeast Forest Fire Compact and a Master Stafford Act Agreement with federal partners.

While preventing and suppressing wildland fires remains a high priority within the state, there is a growing recognition that lack of fire is having a negative impact on some of our unique natural communities that are fire-dependent or fire-adapted. Ensuring we have an aggressive program for detecting and suppressing wildfires, while also being able to use fire as a management tool, has created a transition from strictly fire suppression organizations to fire management organizations.

Goal - Keep the frequency and size of wildfires to a minimum reducing costs and risks to people and structures; and protecting New Hampshire’s forests and natural communities.

Strategies:

5. Ensure local fire departments and first responders are prepared to safely and effectively handle initial attack of wildfires
   - Conduct annual training for local Forest Fire Wardens and firefighters
• Maintain agency Personal Protective Equipment (PPE) and town tool resale programs for towns and cooperators
• Acquire vehicles and equipment through the Federal Property Acquisition programs to supplement local fire departments
• Collaborate with State Fire Academy and Fire Standards and Training Commission to provide an adequate level of wildfire suppression training standards for all firefighters

6. Maintain and enhance capacity to respond and manage incidents that become large, complex or extended attack
• Support training and staffing of local Type III incident management team(s)
• Provide advanced level ICS and command and general staff training for forest rangers, special deputy wardens, and others.
• Provide an emergency firefighter mobilization program.
• Coordinate with NH Homeland Security and Emergency Management for in-state support of wildfire incidents.
• Participate in resource sharing through the Northeast Forest Fire Protection Compact and the Master Agreement with the US Forest Service.
• Provide adequate equipment and supplies for large incidents by pre-positioning caches that can rapidly be deployed to supplement local resources.

7. Maintain and improve systems to prevent and detect wildfires
• Provide an early detection system for prompt discovery of fires which is both effective in function and efficient in cost.
• Evaluate wildfire causes through aggressive investigation and tailor fire prevention efforts to focus on these areas.

8. Ensure a robust planning and intelligence effort for pre-season and pre-event wildfire readiness and preparedness
• Maintain current weather stations for fire weather forecasting and determine gaps where additional weather data is needed.
• Work towards county-level Community Wildfire Protection Plans while supporting hazard mitigation planning efforts of individual communities.
• Working with Homeland Security and Emergency Management, develop plans for mitigation of “event-fuels” that result from damaging weather events and increase hazard by creating an unnatural buildup of fuels.
• Actively participate in and promote the implementation of the Northeast Regional Cohesive Wildland Fire Management Strategy.
FOCUS AREA - FOREST HEALTH

Healthy and productive forests, rural or urban, are comprised of native trees, shrubs, and other vegetation, which provides ecosystem resources to all other flora and fauna to maintain a balance of habitat needs. Forests have always been challenged by such things as changing climates, native insect and pathogen outbreaks, competition for soil nutrition, and wildlife herbivory. However, in the past century damage from invasive plant introductions, invasive insect and disease dissemination, pollution, and poor land use practices have all intensified the stress on our native forests and their ability to maintain proper function.

Several historic forest health events in New Hampshire have changed our forest landscape. They include the introduction of white pine blister rust which killed millions of white pine seedlings in the early 1900’s; the 1938 hurricane that destroyed billions of board feet of white pine; gypsy moth introduced from Europe in the late 1800’s; and spruce budworm outbreaks in the 1970’s. Today a few of our major forest health issues include emerald ash borer, invasive plant competition, White Pine needlecast, Hemlock woolly adelgid, and elongate hemlock scale. Most are invasive pests or plants from Pacific Rim Countries. Emerging threats include Asian longhorned beetle, oak wilt and beech leaf disease which is different than beech bark disease. If current, emerging, or future threats are not mitigated in an appropriate or timely manner, forest ecosystem functions and the values they provide will be diminished. Values that include recreation, timber, wildlife habitat, carbon storage and carbon sequestration, are all at risk when forest health is threatened.

Goal – Minimize impacts to forests from damage causing agents including invasive plants, insects and disease, natural disturbances, mechanical wounding, wildlife browse, pollution, and poor land management strategies.

Strategies:

9. Provide a system or method(s) that can rapidly detect changes in forest health conditions to allow quick response to mitigate impacts
   - Annually survey forest resource via an aerial platform
   - Support a web-based system of early-reporting of forest health concerns by landowners, concerned citizens, natural resource professionals, and others
     - Landowners, foresters, loggers, wildlife biologist and others should incorporate reporting into everyday forest-based activities
   - Use trapping of pests in focused areas to monitor for presence and population levels
   - Increase use of new technologies such as drones and remote sensing, as well as citizen science, to bolster detection efforts
   - Focus on urban forests when insect and disease distribution pathways are trade or commerce related
10. Rapidly respond to developing forest health issues to control the population and/or slow the spread.
   - Enact and enforce quarantines and control areas expeditiously when doing so will effectively limit spread and/or damage to the forest resource
   - Develop and support education and outreach programs that inform the public on how to prevent movement of pests, pathogens and plants

11. Implement control and mitigation strategies to eradicate or reduce forest damage-causing agents
   - Develop and implement appropriate pesticide or herbicide application practices and programs
   - Coordinate and support statewide biocontrol activities
   - Provide management advice to landowners on best practices to prevent and mitigate damages
   - Monitor effectiveness of control efforts

12. Collaborate statewide, regionally, nationally and internationally with agencies and stakeholders responsible for maintaining forest health and protection
   - Participate in state, regional and international committees to coordinate response, share information, and develop best practices for managing threats to forest health
   - Cooperate with National Association of State Foresters initiatives to promote forest health
   - Support and enhance the ability to provide mutual aid to emerging forest health issues, such as through the Northeast Forest Fire Protection Compact
   - Increase resources for forest health research
   - Participate in Northeast-Midwest State Foresters Association activities
   - Coordinate with USFS Forest protection programs and expertise
FOCUS AREA - FOREST MANAGEMENT

Forests have been deeply woven into the economic and cultural fabric of New Hampshire since the earliest days of settlement. They played a significant role in New Hampshire’s origins and in the nation’s struggle for independence. The people of New Hampshire and its elected officials have continuously recognized the importance of forests for the economy, environment, and the New Hampshire way of life.

New Hampshire is the second most forested state in the nation, with 83 percent of the state’s land mass covered by forestland. Three-quarters of New Hampshire’s forests are privately owned. This places a large responsibility on private landowners, as well as the public landholders in the state. Good stewardship of forests reflects greatly on what people perceive as the values and qualities of the state as a whole.

As New Hampshire’s population continues to grow, the proportion of the people that owns working forestland declines. As a result, the public becomes more disconnected from forests and the local benefits they provide. It is important that landowners, public decision makers, program volunteers, youth, and the public understand the need for caring for and using our forests sustainably.

Properly done, active forest management can contribute to the maintenance of New Hampshire’s forest landscape. The sustainable harvest of forest products allows New Hampshire landowners to realize income and contributes to the state’s forest-based economy, while maintaining healthy, diverse surroundings that provide clean water, wildlife habitats, an abundance of outdoor recreation opportunities, and the scenic backdrop to our state.

Public lands, while occupying less than a quarter of the forests in the state, offer the opportunity to demonstrate sound forest management practices to private landowners, industry professionals such as licensed foresters and loggers, and to other members of the public. These lands also provide a variety of ecological and social values such as late-successional forests, large unfragmented forest blocks, and remote recreational opportunities. Public lands include federal lands, state lands, county lands and lands held by municipalities.

**Goal - Manage forest lands using sound forestry principles to provide forest products, a viable forest based economy, recreation opportunities, scenic values, healthful surroundings, climate mitigation, clean water, and biologically diverse populations of plants and animals.**

**Strategies:**

13. Provide leadership in sustainable forest management on public lands
   - Demonstrate sound forest management practices on all public forestlands
• Manage for high value forest products while protecting habitats for animals and plants, conserving water quality, preserving rare and exemplary natural communities, and providing recreational opportunities.
• Utilize “Good Forestry in the Granite State: Recommended Voluntary Forest Management Practices for New Hampshire”.
• Continue to evaluate the feasibility of third party certification for public forestlands

14. Promote and support sustainable forest management on private lands that takes in consideration, along with the production high quality forest products, multiple objectives such as forest recreation, wildlife habitat, resiliency, and providing ecosystem services.
• Collaborate with University of New Hampshire Cooperative Extension, Granite State Division of American Foresters, New Hampshire Timber Harvesting Council, wildlife biologists and other natural resource professionals to provide structured training to licensed foresters, certified loggers, and landowners
• Encourage the development and implementation of forest management/stewardship plans, and the use of licensed foresters on privately owned forestlands
• Encourage private landowners to utilize the resources provided by UNH Cooperative Extension such as one-on-one property visits to privately owned forestlands, educational landowner events, and educational materials
• Update and encourage the use of “Good Forestry in the Granite State: Recommended Voluntary Forest Management Practices for New Hampshire”
• Update and encourage the implementation of “New Hampshire Best Management Practices for Erosion Control on Timber Harvesting Operations”
• Support relevant strategies in the NH Wildlife Plan that address habitat management and outreach
• Evaluate third party certification for eligible private forestlands
• Employ restorative silviculture on degraded stands or forests

15. Evaluate the conditions of New Hampshire’s forest by obtaining relevant, reliable, timely, and statistically sound data on its use and status.
• Increase statistical sampling above and beyond the current FIA where necessary.
• Promote the use of Continuous Forest Inventory plots on commercial and industrial forestlands.
• Support the development and use of technologies that allow the efficient mapping and assessment of forest types and structure.

16. Encourage the establishment of natural regeneration to provide adequate levels of desired, native tree species.
• Implement silvicultural strategies that favor species that provide a mix of economic, habitat, and ecological values.
• Limit the spread of invasive plants by recreational activities, logging and construction equipment, and other sources and control established invasive plants prior to implementing forest operations.
• Protect established regeneration from herbivory with techniques such as “slash walls” or fencing.
17. Support a state forest nursery that focuses on native trees and shrubs that are important for conservation and wildlife habitat, and that uses local seed sources to the greatest extent possible to preserve local genetic stock.
- Develop a robust marketing program highlighting available native tree and shrub species.
- Create an online store for state forest nursery credit card purchases
FOCUS AREA - CLIMATE CHANGE

Climate change impacts the health and diversity of New Hampshire’s forests. Changes already occurring to New Hampshire’s climate include warmer winters, reduced snowfall and snow-on-ground days, increased rainfall, rising sea level, and more severe weather events that result in increased risk of flooding. Potential impacts on forests may include a reduction in suitable habitat for boreal species like balsam fir, red spruce and black spruce and greater abundance of species with a current range that extends to southern New England such as red maple, northern red oak, black cherry, and American basswood (Janowiak et al, 2018). Warmer temperatures may also favor invasive plants, insects and diseases, further stressing New Hampshire’s forests.

As our ecosystem changes, forest landowners and land managers are considering how to adapt. At both a property and landscape scale increasing forest diversity and resiliency is key to responding to our changing ecosystem.

Goal - New Hampshire forests contribute to mitigation of climate change and are managed with an objective that they can best adapt to climate change with minimal adverse social, environmental and economic impacts.

Strategies:

18. Promote the role of forests in the mitigation of climate change
   - Collaborate with researchers such as the Forest Ecosystem Monitoring Cooperative (FEMC) to study the impacts of forest management on carbon storage and sequestration
   - Encourage management that promotes both carbon storage and sequestration
   - Explore how the state can promote greater participation by landowners in the existing forest carbon offset markets or the development of new programs or regional markets
   - Support policies that provide for substantial reductions in greenhouse gas emissions from the largest contributors

19. Incorporate adaptation strategies for climate change in forest management plans that include resistance, resilience and transition.
   - Expand the availability of climate adaptation workshops for forest land managers, such as are offered by the Northern Institute of Applied Climate Science and others
   - Encourage the use of resources like Increasing Forest Resiliency for an Uncertain Future (Catanaro, D’Amato, and Huff, 2016), TNC’s Resilient and Connected Landscapes project, and Forest Adaptation Resources: Climate Change Tools and Approaches for Land Managers, 2nd edition (Swanson and Janoviak, 2016) in forest conservation and management planning
   - Encourage, and update as needed, the use of Emergency Erosion Control Techniques for Dealing with Severe Weather Conditions During an Active Timber Harvest (UNH Cooperative Extension, 2019) as a response to severe weather events during timber harvesting
FOCUS AREA - URBAN & COMMUNITY FORESTS

Urban and community trees, forests and ecosystems provide tremendous social, economic and environmental benefits. They make communities livable and sustainable. Conserving this resource and its benefits requires investments in planning and maintenance. Communities, businesses and residents with sound community forest programs have found that these investments pay substantial benefits.

As New Hampshire becomes more urbanized, the need to manage our urban environment to handle the increased pressure grows. Community, non-profit, government and private-sector partners work together to encourage, enable and enhance sound management of New Hampshire’s urban forest ecosystems; recognizing that healthy and sustainable urban & community forests are integral to healthy and sustainable communities.

The goal of New Hampshire’s Urban and Community Forestry program is to promote the stewardship of urban and rural forest landscapes to enhance the quality of life in New Hampshire communities. The New Hampshire Division of Forests and Lands (NHDFL) in a joint program with the UNH Cooperative Extension (UNHCE) provides assistance to communities, including technical assistance, information and education. Urban and Community Forestry Programs have focused largely on engaging the public though the Natural Resource Stewards Program, the Community Forestry Advisory Council (CFAC) and other efforts.

Professional organizations and businesses contribute to urban and community trees, forests, and ecosystems, including the members of the New Hampshire Landscape Association (NHLA), the New Hampshire Arborists Association (NHAA) with their Certified Arborist Program, the NH Plant Growers Association, garden clubs and utilities. Participants in urban and community programs include natural resource professionals and volunteers, local governments, social groups, neighborhood improvement associations, conservation organizations, tree boards and conservation commissions.

With the acquisitions of large, well-managed town owned lands designated as Town Forests or Community Forests the topic of "Community Forests" takes on a greater emphasis relating to sustaining working forests and long-term stewardship objectives. Recently UNH Cooperative Extension, in partnership with the Northern Forest Center and the New Hampshire Association of Conservation Commissions, completed a multi-year study to inventory town-owned forests and quantify the economic, ecological and social contributions they make.

*Goal – Urban trees and community forests are viewed as having ecological and social values and are well managed.*
Strategies:

20. Support municipalities, volunteer groups, and professional organizations in the planning, management and maintenance of urban and community forests.
   - Encourage and support the creation of community tree committees and tree wardens to ensure that informed decisions are being made to maximize the benefits of street trees and community forests.
   - Engage with local partners such as business leaders and developers as part of community efforts to increase the number and health of trees in urban areas.
   - Promote better use of emerging technology and tools, such as i-Tree, i-Naturalist, stormwater pits, drones, and the Urban Forest Management Plan toolkit
   - Develop an urban tree grants program to support appropriate selection and planting of street/urban trees and promote follow-up tree care practices, including proper mulching, watering, and pruning. Encourage the use of native trees when possible.
   - Encourage participation in the Tree City USA and Tree Campus USA programs that recognize community and educational institutions commitment improving the care of their urban trees.
   - Continue to train, support, and manage Natural Resources Steward volunteers and the NH Big Tree Program.

21. Support acquisition and management of forestland and conservation easements by, and on behalf of, municipalities that support recreational opportunities, sustainable forestry, and other uses as appropriate and consistent with local priorities.
   - Support programs that assist municipalities to acquire forestland including LCHIP, the Drinking Water and Groundwater Trust Fund (DWG TF); the Department of Environmental Services’ Aquatic Resource Mitigation (ARM) Fund, State Conservation Committee Conservation Grant Program, and the USDA Forest Service Community Forest Program.
   - Provide assistance and support other efforts to help develop management plans and planning documents for community forests.
   - Encourage municipalities to provide the public open access and equitable opportunities on community forests that may not normally be available on private lands.
   - Support the recommended action of the final report of the NH Water Sustainability Commission (2012) to “Capitalize and target public and private funding programs to support investment in green infrastructure.”

22. Work with existing organizations, agencies, and programs to promote existing and create new education curricula that focus on urban and community forestry issues.
   - Integrate PLT’s Teaching with i Tree into NH teacher training workshops.
   - Seek partnerships within the healthcare community and other community organizations to develop and deliver educational programs on design, development and maintenance of urban forests to improve health and wellness.
   - Provide assistance for community outreach efforts such as Arbor Day celebrations, tree plantings, and Earth Day celebrations.
FOCUS AREA - LAND CONSERVATION

Permanent land conservation is an extremely important component in ensuring the long-term success and sustainability of the State’s forest based economy, by providing large tracts of permanently protected land that can provide opportunities for sustainably-harvested forest products indefinitely. Conserved lands also ensure protection of many other important ecological attributes such as critical habitats, biodiversity, and wildlife habitats; water shed and water quality protection; and climate-change resiliency. Conserved lands contribute to our overall wellbeing by protecting our drinking water resources, providing opportunities for healthy outdoor recreation such as hiking or other traditional outdoor activities such as hunting and fishing.

Approximately 1.775 million acres of land are currently protected in New Hampshire. Many conserved lands are owned and managed by governmental entities such as the White Mountain National Forest, Umbagog National Wildlife Refuge, the State of New Hampshire, and local municipalities or by state-wide or local, non-governmental organizations. Other lands are protected through conservation easements or, less frequently, deed restrictions.

Conservation easements continue to be a popular conservation tool in New Hampshire because they allow lands to remain in private ownership, providing continued opportunities for private landowners to contribute to, and profit from, New Hampshire’s forest-based economy, while at the same time protecting many important ecological attributes. Conservation easements also create unique, long-term responsibilities for easement-holding entities, who must ensure that permanent legal protections and restrictions on the property continue to be upheld, and conservation values protected, in perpetuity. Effective conservation easement stewardship requires routine monitoring and good landowner relationships, as well as financial investment and planning to ensure that adequate funding exists to uphold the easement holder’s legal responsibilities.

Conservation lands can sometimes be acquired through donations but most often require funding through multiple resources including private fundraising, various grants, and other sources. Some important land protection grant programs in New Hampshire include the Forest Legacy Program, the Land and Conservation Heritage Investment Program, Land and Water Conservation Fund, Aquatic Resource Mitigation Program, and the Groundwater Protection Fund. Municipalities also often play a role by providing local conservation funds.

New Hampshire has a strong tradition of public and private, non-governmental organization collaboration for land conservation efforts, both for funding and for strategic conservation planning. State-wide,
regional, and conservation plans such as TNC’s resilient landscape study and the Wildlife Action Plan, as well as this Forest Action Plan, help guide long-term strategic conservation planning and project development. Over the life of this plan, and beyond, partnership and collaboration will continue to be a critical component in reaching our land conservation goals.

**Goal – Keep Forests as Forests: Permanently protected lands include working forests, important habitats, significant natural communities, and critical ecosystems and watersheds.**

**Strategies:**

23. Support efforts to conserve and sustain large, contiguous forest blocks across the state.
   - Identify large forest blocks suitable for forest management, providing landscape resiliency, watershed protection, opportunities for species to migrate and other ecosystem services using the most recent available science and tools.
   - Conserve lands with large forest blocks using a wide range of conservation options; public acquisition, conservation easements, fee ownership by conservation organizations, current use, etc.
   - Identify opportunities for collaboration between conservation partners for potential landscape-scale conservation projects.
   - Encourage conservation protection instruments that contain language allowing for sustainable, properly managed timber harvesting, where appropriate, based on sound silvicultural practices.
   - Continue to implement the New Hampshire Forest Legacy Program in accordance with NH’s approved Assessment of Need.
   - Ensure that strategic conservation planning resources, such as those available in the assessment portion of this document and from The NH Statewide GIS Clearinghouse (GRANIT), NH Wildlife Action Plan (WAP), Regional Conservation Partnerships (RCPs), The Nature Conservancy (TNC) are incorporated into landscape-scale land conservation efforts.

24. Ensure that public and private funding is available for permanent land conservation.
   - Identify and advocate for additional state, federal and local funds to support conservation of private forest land through acquisition of conservation easements or use of alternative conservation tools.
   - Identify and pursue opportunities for conservation funders (including federal, state, and local governments and private foundations and land trusts), to provide incentives for the costs associated with permanent land protection, such as legal expenses, surveys, and stewardship monitoring.

25. Support efforts to ensure that public and private entities holding conservation interests, either fee or conservation easement, have the necessary staff and resources for the long-term stewardship of already conserved lands.
   - Identify opportunities to secure adequate stewardship endowment funding for long-term monitoring, stewardship, and enforcement, if necessary.
• Ensure that conservation land data layers in GRANIT are up-to-date and accurate to provide useful landscape-scale information for avoiding conservation lands and other ecological resources during early stage planning of large-scale or linear development projects
• Support and promote accreditation of local land trusts through programs such as Land Trust Accreditation Commission

26. Support conservation efforts that are intended to encourage healthy lifestyles.
• Promote opportunities for permanently protected, locally owned and managed community forests
• Identify and pursue opportunities to create connections between large conserved lands and more developed population centers
• Identify opportunities to partner with other outside groups (such as the Foundation for Healthy Communities, Health Insurance Companies, and local hospitals) to encourage healthy outdoor activities on conserved land
FOCUS AREA – FOREST BASED ECONOMY

New Hampshire’s forests are a destination for tourists, a source of raw materials for the state’s forest products industry, and a contributor of jobs, particularly in rural communities. For over 300 years, forests have been an integral part of the state’s economy. The rivers in colonial days powered sawmills, while large white pines were used for ships’ masts. Pulp mills were active through much of the 1900s in addition to small, local sawmills that littered communities throughout the state. The pulp mills and sawmills required a sustained supply of wood from the land that created interconnectedness between the forests, businesses and community. While the number of sawmills has declined over time, the productive capacity of the remaining mills is greater. As a result, we have fewer but larger mills.

Since the last New Hampshire Forest Resource Plan was written, New Hampshire has encountered a number of industry challenges including the loss of regional pulp mills; a reduction of operating biomass power plants in the state, and a trade war disproportionately affecting hardwood lumber export demand and pricing. In addition, enterprises up and down the supply chain have grappled with production challenges related to labor, regulation, energy costs, and COVID-19.

Despite these challenges, New Hampshire’s forest based economy is diverse and resilient. New Hampshire’s sawmills have continued to be opportunistic, taking advantage of markets that have developed, investing in technology when profitable, and adapting as needed to be successful. The outlook for low-grade timber markets remains challenging. Although the trend in recyclable and environmentally friendly food packaging such as paper cups and straws, as well as increased online shopping and shipping, has created a surge in certain specialty paper markets, traditional paper and biomass power markets have contracted. Resulting in some paper pulp plants in Maine that were mothballed this past decade reopening, other mills completing major upgrades, while other closing. Another area of growth has resulted from several schools, hospitals and community centers that are converting their infrastructure to enable the use of biomass chips or wood pellets for heating purposes. Although this does not currently represent significant volumes of low-grade timber consumption, it is a step in the right direction.

New Hampshire, along with the northeastern states and eastern Canadian provinces, is one of the few places in this world where maple syrup and other maple sugar products are produced in significant quantities. New Hampshire has approximately 525 sugarmakers producing maple syrup, sugar and other maple products such as creams, cotton candy and coated nuts. Annual state production of maple syrup is 160,000 gallons, worth over $6 million on 600,000 taps. On average, each tap produces a little over 0.25 gallons (1 quart) or $10 of syrup. The number of sugarmakers producing syrup and taps in NH have grown little over the past decade. However, the state has almost doubled its production of gallons of syrup from roughly 80,000 to 160,000 gallons. This can be attributed to the long tenure of sugarmakers and the adoption of new technology to increase production of maple sap to produce more syrup.
Both the production of forest products from New Hampshire’s forests, and the recreation and tourism opportunities New Hampshire’s forests support are integral to the state’s economy. The value of the combined forest products manufacturing and forest-related recreation industries in New Hampshire total approximately $2.8 billion annually. Of this, forest-based manufacturing contributes approximately $1.5 billion, and employs over 7,000 individuals. Approximately 1.4 million cords of timber is harvested each year.

An emerging opportunity for forest landowners is to participate in what are known as “ecosystem service markets.” Simply put, ecosystem services are benefits that people obtain from nature. Intact forests can provide a wide range of ecosystem services including water filtration, erosion control, habitat, air filtration and carbon sequestration, among others. Ecosystem services were traditionally considered as free, however regulatory and non-regulatory markets have been developing to compensate landowners for providing these benefits to society. Ecosystem service markets provide mechanisms for sellers – landowners whose lands are producing those benefits – to monetize the value of these services. Buyers can range from private entities (e.g., fossil fuel power generators and airlines offsetting carbon emissions, water supply providers funding protection of key watershed lands to reduce filtration expenses) to for-profit and nonprofit investors (e.g., entities that purchase and bank wetland restoration credits for resale to developers to mitigate wetland impacts) to government. Some ecosystem service markets are well developed (e.g., wetland mitigation) while others are emerging (e.g., carbon sequestration). These markets can be compatible with a landowner’s forest management goals and may offer additional and alternative sources of revenue for landowners, particularly if market mechanisms are developed that enable sustainable forestry and smaller-scale owners to more fully participate.

Strong and diverse markets for forest-based products and services will support a robust forest economy and allows landowners to practice sustainable forest management. Revenue streams from forestland enable landowners to pay property taxes and incentivize keeping their forests as forests rather than converting forests to other uses. The good forestry that provides a sustained yield of high quality forest products also supports economic, ecological, and societal benefits for New Hampshire and its residents.

Goal – Public and private forests support a viable forest-based economy that includes a strong forest products industry, outdoor recreation and tourism, and ecosystem services markets.

Strategies

27. Support and enhance the existing forest products industry
   - Collaborate with federal, state and local partners including the Department of Business and Economic Affairs, the University of New Hampshire, and NGOs to promote the use of local and regional wood products
     - Promote the use of locally produced wood pellets and firewood
     - Support the development of local markets, manufacturing and industries that utilize forest products in the state
   - Promote value-added processes before wood material is exported
   - Promote the use of local wood and mass timber in construction. Explore the possibility of establishing a manufacturing plant in northern New England for mass timber or other promising products
   - Promote the use of specialty paper products such as packaging and paper straws.
• Support legislation that provides incentives for retrofitting biomass plants to more efficient cogeneration facilities
• Promote local non-timber forest resources such as maple syrup, mushrooms, and Christmas trees

28. Support development of, and access to, ecosystem service markets that provide economic incentives for private landowners to own and sustainably manage their land.
• Encourage research and development that quantify and assign values to ecosystem services, and of identify markets, opportunities and avenues for monetization.
• Learn from and adapt pilot efforts underway elsewhere that are developing and testing strategies for making ecosystem service markets accessible to smaller-scale landowners (e.g., ownerships <2500 acres) by lowering transaction costs, aggregating ownerships to scale for investment, and other means.
• Encourage and support education and outreach programs that help landowners and land managers understand the ecosystem service market opportunities, including the impacts on their ability to practice sustainable forestry.

29. Support development of new forest products markets
• Formalize a collaborative partnership between DFL and DBEA to promote forest products market development
• Create in statute an ongoing forest products industry advisory group
• Identify opportunities for UNH to use resources to develop new products
• Collaborate with NGO’s in the development and support of new forest products markets

30. Support and enhance the forest-based recreation and tourism industry
• Collaborate with public and private partners including the Division of Parks and Recreation, the Division of Travel and Tourism Development, the University of New Hampshire, and private landowners to provide and promote forest-based recreation and tourism
• Provide a well-maintained and appropriately sited network of trail systems for various forms of recreational uses across the state
• Explore, and allow where appropriate, new forms of forest-based recreation and associated revenue streams
• Encourage public and private lands to remain open for public use by engaging law enforcement and the justice system in addressing abusers of private and public lands to reduce damage to the environment and vandalism of property. Practical protective regulations may be needed to support the efforts of law enforcement and the courts.
• Provide support to landowners to assist in managing legal and illegal recreational use on their property.

31. Identify and prioritize barriers to the expansion of existing and development of new forest products manufacturing.
• Recruit and retain quality labor
• Reduce energy costs
• Improve transportation infrastructure
- Support sustainable wood supply through forest management education programs for forest landowners
FOCUS AREA - FOREST POLICY & INSTITUTIONAL FRAMEWORK

New Hampshire has a tradition of cooperative policy development with many examples of people working together to achieve common goals. Private sector businesses, non-governmental organizations, public agencies and elected officials have created an atmosphere of problem solving and policy making in an open, transparent and inclusive processes. New Hampshire continues the culture of collaboration rather than contention attitudes among the forestry sectors. The cost of this public participation system is minimal in comparison with the benefit.

Examples of collaboration can be found in numerous places. The Timber Harvesting Council is made up of representatives from the logging and forestry industry, University of New Hampshire Cooperative Extension, and the University of New Hampshire two-year forestry program. The New Hampshire Tree Farm Program is jointly managed by five co-sponsors, including the Society for the Protection of New Hampshire’s Forests, the Society of American Foresters, The New Hampshire Timberland Owner’s Association, UNH Cooperative Extension, and the Division of Forests and Lands. The Tilton Diner Group is an entity made up of state, academic, and non-profit partners that meets with the leadership of the White Mountain National Forest to offer support, and act as a sounding board for challenges and opportunities.

For the Division of Forests and Lands a key component of this collaborative culture is the NH Forest Advisory Board (FAB). Authorized under RSA 227-I:5, FAB advises the Division of Forests and Lands on "factors affecting the use, ownership, and management of forest resources." The mission of the NH Forest Advisory Board is to advocate implementation of the recommendations of the NH Forest Resources Plan (Forest Action Plan), coordinate forest policy development, facilitate dialogue between diverse interests, assure opportunities for public participation in forest policy development, and to advise the State Forester in the development of state programs and policies. This board provides valuable volunteer input and needed interaction among the stakeholders in New Hampshire’s natural resource community.

While New Hampshire does not have a single natural resource conservation agency, there are several mechanisms in place to facilitate communication among state agencies with common concerns. The Cooperative Land Management Program (CLMP), State Land Management Team (SLMT), and the Council on Resources and Development (CORD) were formed to facilitate cooperative natural resource policy development and management among state agencies (see Assessment section 20).

**Goal – New Hampshire has the legal and institutional framework necessary for collaborative forest policy development and conservation/management of our forested resources.**
Strategies:

32. Support programs and policies that encourage sustainable forest management and open space protection.
   • Support the development of community-based research that studies the social, environmental, and economic impacts of open space and conservation land to municipalities
   • Support land management and tax policies, such as the Current Use Tax Program, that encourage sustainable forest management
   • Support programs like the NH Tree Farm program, which encourages private forest owners who actively manage their forests in a sustainable manner for multiple values

33. Enforce natural resource and public safety laws and rules on public and private lands.
   • Coordinate with local officials, fire departments and state agencies
   • Provide necessary resources for adequate patrol and response to remote areas
   • Enact new legislation, in cooperation with the forest industry and state agencies, such as improved tracking of forest products.

34. Determine impact of current forest-based recreation and suitable type and location of expanded forest-based recreational use.
   • Collaborate with the next Statewide Comprehensive Outdoor Recreation Plan process to encourage consideration of the recreation impacts on public and private forest land
   • Develop and encourage the use of GIS-based recreational trail planning tools such as the Trails for People and Wildlife recreational trail planning tool

35. Cultivate and support partnerships between state and federal agencies, natural resource organizations, and other conservation stakeholders.
   • Support multi-jurisdictional efforts such as North East Forest Fire Protection Compact and the urban forest strike team
   • Participate in inter-agency efforts like the Cooperative Land Management Program and State Land Management Team
   • Expand opportunities for the use of federal authorities such as Good Neighbor and Shared Stewardship to accomplish mutual organizational goals
FOCUS AREA - EDUCATION & OUTREACH

The largest responsibility for the health, productivity and resiliency of New Hampshire’s forests is in the hands of private forest landowners. Collectively they own three-quarters of the state’s forestland and their private decisions and actions impact the state’s forestland and the public benefits these lands provide. Reaching these landowners and the professionals they hire is critical to establishing and maintaining knowledgeable forest stewards who make well-informed management and ownership decisions. Furthermore, opinions and perceptions from the general public can impact policies affecting forest landownership, management and conservation. Providing opportunities to reach and inform the general public can create an understanding of the need for caring for and using our forests sustainably.

The New Hampshire Division of Forests and Lands (NHDFL), in a joint program with the UNH Cooperative Extension (UNHCE) Natural Resources Program, has been providing private forestland owners and some public owners with research-based forest stewardship programs which included technical assistance, information, education and access to financial incentives. Forest Stewardship plans and implementation of the state’s Wildlife Action Plan (WAP) are encouraged. From the start, these programs have promoted the use of private sector foresters. Licensed foresters in the state now number over 250. UNHCCE provides an unbiased list of licensed foresters offering services to landowners in the state, along with a guide on selecting a forester. As a result, New Hampshire has one of the highest (if not the highest) ratios of foresters offering services to the public per acre of forestland in the nation. This emphasis on consulting foresters has multiplied the availability of foresters to private landowners over strictly public programs and has greatly multiplied the opportunity to bring forest stewardship messages to landowners, public decision makers and the public.

Providing and supporting outreach and education for New Hampshire’s forest stewards - forest landowners and the professionals they hire – and the general public gain a greater appreciation of New Hampshire’s forests. They can appreciate the value of the state’s forests and the services they provide to landowners and the greater public. Providing and supporting opportunities for this diverse audience to understand and learn about the importance of the state’s forests will help to ensure New Hampshire’s forest are healthy, productive and resilient into the future.

Goal – The general public and stewards of New Hampshire’s forests understand the importance of forests as an asset, providing ecosystem services, materials for forest products, wildlife habitat, recreational and tourism opportunities, clean water, climate mitigation and other ecosystem opportunities. These individuals are engaged and educated at the appropriate level to meet the challenges they will face in the future such as climate change, changing markets and new forest health issues.
Strategies:

36. Support efforts for private forestland owners to develop forest management plans for their lands.
   - Forestland owners participate in programs such as the NRCS’s EQIP program for financial assistance for management plans.
   - Forestland owners meet with UNHCE County Foresters or participate in UNHCE programs to learn about the management planning process and options.
   - Forestland owners are referred to NH licensed foresters to develop forest management plans.
   - Support efforts for private forestland owners to develop or participate in initiatives to create landscape forest management plans.
     - Forestland owners participate in educational programs such as “Woods Forums” or other program to learn about their forest and the role it plays in the landscape.

37. Support comprehensive programs for landowner education offered by UNH Cooperative Extension, natural resource agencies and private conservation organizations such as New Hampshire Timberland Owners Association (NHTOA) and the Society for the Protection of New Hampshire Forests (SPNHF).
   - Encourage landowners to participate in one-on-one woodlot visits with UNHCE County Extension Foresters.
   - Encourage landowners to participate in educational events such as workshops, woods forums, and timber harvesting tours on public and private forest land.
   - Periodically evaluate the focus of existing landowner education programs offered by UNH Cooperative Extension and others.
   - Promote natural resource education designed to reach landowners who have the greatest impact on the forested landscape such as large ownerships, within the landscape of large forest blocks.
   - Encourage efforts to utilize technology and other new outreach methods to reach private landowners to provide educational resources and motivate stewardship of their forestland.
   - Regularly update and promote the use of educational resources, such as TakingActionforWildlife.org, NHbugs.org and NHWoods.org, which provide resources and guidance to landowners on managing the forestland, wildlife habitats, forest health, and incorporates relevant statewide strategies into resources land managers and forestland owners can apply to their lands.

38. Provide quality education programs for natural resource professionals, including foresters, loggers, arborists, and other resource professionals to increase their knowledge and competency and help satisfy continuing education units to meet licensing and certification requirements.
   - Evaluate and adapt programs to address new challenges.
   - Provide and support programs, events and educational opportunities for the natural resource community offered by agencies and organizations such as the NHDF&L, UNHCE, GSDSAF, NHTOA, and SPNHF. Support the New Hampshire Professional Logger Program.
   - Support education and training that reaches non-traditional professionals outside of the forestry community.

39. Promote and support efforts to reach the general public and new audiences to highlight the importance of NH’s forestland.
• Support Nature on Tap events
• Partnering with organizations outside of the forestry & natural resources community

40. Develop and support education and outreach programs that inform the public on forestry rules and laws
• Cooperate with and support programs offered by UNHCE, non-governmental organizations and state agencies about forestry laws and rules (eg. the Forestry Laws for Municipal Officials workshop)
• Use Forest Fire wardens, Deputies, local fire departments, and the network of fire towers to disseminate a robust wildfire prevention message, targeting causes and seasonality

41. Increase Public Awareness and Environmental Education to Promote Stewardship
• Create environmental education programs that focus on urban and community forestry issues
• Provide leadership for community outreach programs such as Tree City USA, Tree Campus USA, and Firewise

42. Invest resources in education to connect youth to the outdoors
• Support and develop educations programs, such as Project Learning Tree, Project Wet, Project Wild, 4-H, and Envirothon that connect children and young adults to natural resources
• Develop a long-term, sustainable organizational structure for New Hampshire Project Learning Tree. Endorse expansion of New Hampshire Project Learning Tree into all school districts with support from state conservation and land management organizations and programs
• Generate interest in the field and recruit future natural resource professionals
FOREST RESOURCE STRATEGIES MATRIX

The Forest Resource Strategies Matrix demonstrates the interconnection between strategies, identifies the National Priority or Priorities that are addressed by each the strategy and associated actions, suggests the source of resources needed to accomplish the strategies and actions, and identifies the state and federal programs that would be involved with or impacted by implementation of the strategies.

Program abbreviations:
State:
- FM – Forest management
- FP – Forest Protection
- PCF – Planning & Community Forestry
- LM – Land Management
- NHB – Natural Heritage Bureau
- SFH – State Forest Health
- UNH-CE – UNH Cooperative Extension

Federal Cooperative Programs:
- FS – Forest Stewardship
- SFA – State Fire Assistance
- UF – Urban Forestry Assistance
- FL – Forest Legacy Program
- VFA – Voluntary Fire Assistance
- FH – Federal Forest Health
- FMU – Forest Marketing and Utilization
## New Hampshire's Forests

### Goal 1: Forest Health

- **Objective:** Maintain healthy populations of biologically diverse native plants and animals.
- **Narrative:** New Hampshire's forests are comprised of healthy and sustainable populations of biologically diverse native plants and animals.
- **Strategies:**
  - **State/Local, Federal:** NHB, FM, FS, UNH-CE

### Goal 2: Wildfire Management

- **Objective:** Keep the frequency and size of wildfires to a minimum, reducing costs and risks to people and structures; and protecting New Hampshire's forests and natural communities.
- **Strategies:**
  - **State, Municipal, Federal:** FP, SFA, VFA

### Goal 3: Forest Management

- **Objective:** Minimize impacts to forests from damage causing agents including invasive insects and disease, natural disturbances, mechanical wounding, wildlife browse, pollution, and poor land management strategies.
- **Strategies:**
  - **State, Municipal, Federal:** FP, SFA, VFA
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**Goal** – Manage forest lands using sound forestry principles to provide forest products, a viable forest based economy, recreation opportunities, scenic values, healthful surroundings, climate mitigation, clean water, and biologically diverse populations of plants & animals

| 13 | | | | State, Federal | FM, SFH, NHB, FP |
| 14 | | | | State, Private | FM, UNH-CE, SFH, PCF, NHB |
| 15 | | | | State, Federal | PCF, FM, UNH-CE |
| 16 | | | | State, Federal, Private | FM, FH, UNH-CE |
| 17 | | | | State, Federal | FM, FS |
### Goal – NH forests contribute to mitigation of climate change and are managed with an objective that they can best adapt to climate change with minimal adverse social, environmental and economic impacts.

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### Goal – Urban trees and community forests are viewed as having ecological and social values and are well managed

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### Goal – Keep Forests and Forests: Permanently protected lands include working forests, important habitats, significant natural communities, and critical ecosystems and watersheds.

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<td>State, Fed, Municipal, Private</td>
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</tbody>
</table>

**Goal – Public and private forests support a viable forest-based economy that includes a strong forest products industry, outdoor recreation and tourism, and ecosystem services markets.**

| 27         |                     |             |                     |                    | State, Fed, Private |

| 28         |                     |             |                     |                    | State, Fed, Private |

| 29         |                     |             |                     |                    | State, Fed, NGO, Private |

| 30         |                     |             |                     |                    | State, Fed, NGO, Private |

| 31         |                     |             |                     |                    | State, Fed, NGO, Private |

**Goal – New Hampshire has the legal and institutional framework necessary for collaborative forest policy development and conservation/management of our forested resources**

| 32         |                     |             |                     |                    | State, Federal |

| 33         |                     |             |                     |                    | State, Federal |

New Hampshire Forest Action Plan
<table>
<thead>
<tr>
<th>STRATEGIES</th>
<th>PRIORITY LANDSCAPES</th>
<th>FOCUS AREAS</th>
<th>NATIONAL PRIORITIES</th>
<th>RESOURCES NECESSARY</th>
<th>ASSOCIATED PROGRAM(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>34</td>
<td></td>
<td></td>
<td></td>
<td>State, Federal</td>
<td>FM, LM, NHB, FH, FP, SFA, VFA</td>
</tr>
<tr>
<td>35</td>
<td></td>
<td></td>
<td></td>
<td>State, Federal</td>
<td>UNH-CE, FS,</td>
</tr>
</tbody>
</table>

**Goal** – The general public and stewards of New Hampshire’s forests understand the importance of forests as an asset, providing ecosystem services, materials for forest products, wildlife habitat, recreational and tourism opportunities, clean water, climate mitigation and other ecosystem opportunities. These individuals are engaged and educated at the appropriate level to meet the challenges they will face in the future such as climate change, changing markets and new forest health issues.

| 36         |                     |             |                     | State, NGO          | UNH-CE, FM, FS,      |
| 37         |                     |             |                     | State, NGO          | UNH-CE, FM, FS, PCF  |
| 38         |                     |             |                     | State, NGO          | UNH-CE, FP, FM, PCF  |
| 39         |                     |             |                     | State, NGO          | UNH-CE, PFC, FS, UFA,FP |
| 40         |                     |             |                     | State, NGO          | UNH-CE, FM, FS, PCF  |
| 41         |                     |             |                     | State, NGO          | UNH-CE, FM, FS, FP   |
| 42         |                     |             |                     | State, NGO          | UNH-CE, FS, PFC      |
NATIONAL PRIORITY ACCOMPLISHMENTS

Recognizing the value of documenting the impact of successful implementation of plan strategies, the US Forest Service, National Association of State Foresters, and the State & Private Forestry Board determined that states should conduct a 5-year review of plan implementation progress and develop a State Forest Action Plan (SFAP) section entitled “National Priorities.” This section links plan success to the 3 national priorities. National Priorities section requirements are:

1. The National Priorities section will include three subsections based on the national priorities identified by Congress in the 2008 Farm Bill:
   • Conserve and Manage Working Forest Landscapes for Multiple Values and Uses
   • Protect Forests from Threats
   • Enhance Public Benefits from Trees and Forests

2. Each state, territory, and the District of Columbia have the flexibility to describe actions and success stories contributing to each national priority. This can be a text-only narrative or also include photos, graphics, and numeric measures.

3. The National Priorities section will be added to each FAP no later than November 20, 2015 and then updated with each FAP update.

This National Priorities section includes a representative sample of projects, both completed and ongoing, that demonstrate how state and federal investments have resulted in successful, measurable outcomes. It is not intended as a comprehensive list of New Hampshire SFAP-related projects, but rather a sampling of accomplishments and highlights from the mid-point of the 2010 State Forest Action Plan until publication of this plan.
National Priority 1.

Conserve and Manage Working Forest Landscapes for Multiple Values and Uses

State Focus Addressed: Enhancing Urban and Community Forestry

<table>
<thead>
<tr>
<th>State Issue Area(s) Addressed:</th>
<th>Managing community forests &amp; ecosystems sustainably; Supporting NH’s urban and community forests through outreach and education.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Title</td>
<td>Measure of Success</td>
</tr>
<tr>
<td>Community Forestry Advisory Council Utility Arboretum</td>
<td>Installation of Utility Arboretum demonstration area at the Urban Forestry Center. Supporting education material developed</td>
</tr>
</tbody>
</table>

Project Description:

The idea to develop the Utility Arboretum came from members of the Community Forestry Advisory Council as a way to provide education to the thousands of visitors to the Urban Forestry Center in Portsmouth, New Hampshire. In an effort to replant a large Blue Spruce plantation severely damaged by a winter storm, the display was created near main entrance to the Center. Member organizations of the Council, in partnership with New Hampshire Division of Forests and Lands, the University of New Hampshire Cooperative Extension and the USDA Forest Service, provided funding and support to purchase and plant 10 trees appropriate for planting under power lines in urban areas. The Utility Arboretum is a living example of the diversity of tree species that can be planted near utilities. These trees were selected for their mature height and unique characteristics such as flowers, foliage and shape. Planting recommended trees near utility lines as demonstrated, rather than directly under utility lines, will also reduce conflicts and help preserve the natural aesthetics of trees.
Accomplishments:

The first trees were planted by members of the Council during an Arbor Day celebration in May, 2011. The Arboretum represents a typical 100 foot span of utility wires including utility poles, wires and guy wires to provide an accurately proportioned display. Different species of deciduous and evergreen trees have been continually added to create an attractive and educational display to help visitors select the appropriate tree. Individual signs and a pamphlet describing features of each tree were created to help visitors learn about each tree and aid in their selection process. The Arboretum was completed in 2014 and has been used for several educational workshops including hands-on tree pruning classes and tree identification walks. The Tree Care Industry Association has also used the non-energized utility wires for arborist employee training including Electrical Hazard Awareness Program and Bucket Truck Operator Training. This living display prompted the creation of another utility arboretum at the University of Massachusetts Amherst – Stockbridge School of Agriculture in 2017.
National Priority 1.
Conserve and Manage Working Forest Landscapes for Multiple Values and Uses

State Focus Addressed: Good Forest Stewardship in NH’s Forests, Sustainable Forest Based Economy

<table>
<thead>
<tr>
<th>State Issue Area(s) Addressed:</th>
<th>Sustaining a forest land base; Sustaining forest management on private lands; Loss of open space</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Title</td>
<td>Measure of Success</td>
</tr>
<tr>
<td>New Hampshire Forest Legacy Program – Mahoosuc Gateway Forest Legacy Project</td>
<td>Successful acquisition of conservation easements on 14,987 acres of forest land.</td>
</tr>
</tbody>
</table>

Project Description:

The Mahoosuc Gateway/Success Project consists of two contiguous parcels, Success Tract and Success Pond Tract that sought to protect 24,200 acres of sustainably managed working woodland through acquisition of conservation easements through the Forest Legacy Program. The land is adjacent to downtown Berlin, the largest city in Coos County, an area heavily reliant on forest-based jobs and vulnerable to conversion. The Project was central to a mosaic of public lands spanning the New Hampshire/Maine border including the White Mountain National Forest, the National Appalachian Scenic Trail and Umbagog National Wildlife Refuge. It was key to a bi-state economic and conservation initiative to sustain the forest industry and develop world class outdoor recreation in the Mahoosuc Region. The lands' forests provide critical habitat for rare, threatened and endangered species, including the federally threatened Canada lynx. The project was sponsored by The Conservation Fund and had support from a wide variety of agencies and organizations.
Accomplishments:

The State of New Hampshire successfully completed acquisition of the easements in March and September of 2018. Full recreational access was acquired for the parcels, ensuring that the public will continue to enjoy the property for hunting, fishing, hiking, snowmobiling, and other recreational uses.

An adjoining 4,776 acres was acquired by the National Park Service in 2010 with $2.75 million in LWCF funding. In the immediate region, over 200,000 acres of working forest and recreation
National Priority 1.

Conserve and Manage Working Forest Landscapes for Multiple Values and Uses

State Focus Addressed: Sustaining forest management on private lands

<table>
<thead>
<tr>
<th>State Issue Area(s) Addressed: Sustaining a forest land base; Sustaining forest management on private lands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Title</td>
</tr>
<tr>
<td>New Hampshire’s Forest Stewardship Program—FY 2019</td>
</tr>
</tbody>
</table>

Project Description:

The Forest Stewardship Program promotes long-term stewardship of private forest lands, particularly in priority landscape areas. Eighty-three percent of New Hampshire is forested with the majority of the state’s forest land is privately owned. The actions of private landowners effect the quality of life for New Hampshire residents and effect wildlife habitat, the economy, the scenic backdrop for the tourism industry and the environment. These benefits depend on the informed decisions of landowners and the resource professionals who work with them. The Forest Stewardship Program provides: one-on-one technical assistance on the woodlot; information and education through workshops and social and traditional media; stewardship planning and implementation assistance; training for natural resource professionals; and comprehensive training for Coverts Cooperator volunteers.

Accomplishments:

As a result of individual contacts and workshop-based activity, the Forest Stewardship Program referred 278 landowners owning 30,690 acres to licensed foresters who wrote forest stewardship plans on 4,836 acres. Plan development by foresters represents approximately $120,900 of direct economic activity as well as improved management and timber harvesting. 19% of New Hampshire’s private forest land is managed according to an integrated forest stewardship
National Priority 1.

Conserve and Manage Working Forest Landscapes for Multiple Values and Uses

State Focus Addressed: Enhancing Urban and Community Forestry

<table>
<thead>
<tr>
<th>State Issue Area(s) Addressed:</th>
<th>Managing community forests &amp; ecosystems sustainably; Supporting NH’s urban and community forests through outreach and education.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Title</td>
<td>Measure of Success</td>
</tr>
<tr>
<td>Urban Wood Utilization</td>
<td>Operating a portable sawmill at various public events to utilize wood products produced from trees harvested in the built environment</td>
</tr>
</tbody>
</table>

Project Description:

A new Wood-Mizer LT 40 portable sawmill was purchased in September of 2016 by the Urban Forestry Center Trust to be used as an educational tool to demonstrate the benefits of utilizing local wood. Several states around the northeast have an urban wood utilization program to repurpose trees harvested in the urban environment that are not accepted at commercial sawmills due to the high potential for metal and other foreign objects that could cause significant damage to equipment and staff. Currently, no companies in New Hampshire specialize in milling urban wood and as a result logs are underutilized and made into mulch, firewood or dumped into landfills. Our program staff has conducted tours at local sawmills and have contracted with portable sawmill owners to mill forest products for our agency. Most commercial sawmills were not constructed to host tours and interrupting production schedules can put an undue strain on industry partners. The Thompson School Forest Technology Sawmill has been used by the Division of Forests and Lands and UNH Cooperative Extension for various workshops over the years. Recently long-term faculty and staff have retired and the mill in not hosting tours at this time. Our program staff talked with local mill owners and staff from other states before selecting the Wood-Mizer sawmill.

Accomplishments:

The mill has been used at several events around the state to mill trees of significant importance, to mill forest products for special events and for our agency. The mill has been used at events including the Gilmanston Elementary School as part of annual Arbor Day Events to mill logs to create an outdoor classroom, for various Scouting projects to make bat houses and to mill ships planks for the USS
Manchester crew and some of the White Oak lumber was used in the Commanders desk. The mill was also used to mill trees of local community significance including several black walnut trees removed for the Keene State College Campus near the historical Wyman Tavern to make room for building renovations and landscaping changes. The logs were harvested and milled on-site with volunteer assistance. The lumber was kiln dried by a local commercial sawmill and processed into flooring for use in the renovated building. Logs harvested for the 1938 hurricane that were stored in ponds throughout the state continue to surface and several logs with the US Forest Service stamp were milled and the lumber is on display at the Fox Forest Research facility in Hillsboro. Logs have also been milled for bridge building projects to increase public access to our forested properties around the state. The mill is available for use by local communities for special programs to educate citizens about the wise use of our natural resources.
National Priority 2.

Protect Forests from Threats

State Focus Addressed: Response to Forest Damage

<table>
<thead>
<tr>
<th>State Issue Area(s) Addressed: Responding to catastrophic events</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strategies</strong></td>
</tr>
<tr>
<td>• Strategy 118: The New Hampshire Division of Forests and Lands (NHDFL) &amp; New Hampshire Division of Homeland Security and Emergency Management, continue to work in cooperation to provide rapid response in natural resource related emergencies.</td>
</tr>
<tr>
<td>• Strategy 119: Maintain capacity to provide support to communities for suppression of wildland fires through technical assistance, specialized equipment, fire prevention, fire investigation and law enforcement through the New Hampshire Division of Forests and Lands.</td>
</tr>
</tbody>
</table>

Project Description:

The Division of Forests and Lands, Forest Protection Bureau responded to multiple large wildfire events during the past 10 years. The Bureau was able to offer support by providing leadership, equipment, and personnel. Coordination with local, state and federal resources was critical and managed very successfully during these events.
Accomplishments:

Stoddard Fire – 2016. This incident took place in the town of Stoddard. Between April 17th and 21st of 2016 there were multiple wildfires in the area with the final incident being a 199-acre wildfire on April 21st. These fires used the resources of the local fire mutual aid as well as activation of the statewide fire mutual aid system. Forest Protection staff provided leadership and coordination for suppression, including air resources and evacuations, along with firefighter resources and law enforcement. Arson was the suspected cause and with the cooperation and work of the Division of Forests and Lands, local fire department, local police department, NH Fire Marshal’s Office and NH State Police, a suspect was quickly identified, interviewed, polygraph tested and ultimately arrested on April 22, 2016. The Division of Forests and Lands worked with NH Homeland Security and Emergency Management to file a disaster declaration with FEMA. Although this request and the funding was denied, the state of NH did everything possible to secure the funding and assist the town of Stoddard.

Dilly Fire – 2017. This incident took place in the town of Woodstock. In October of 2017 a small fire started on the steep cliffs above Route 112. The fire quickly spread with extreme fire behavior on the difficult to access terrain. The fire was in proximity of a popular tourist attraction (Lost River Gorge), the White Mountain National Forest (WMNF) and the Appalachian Trail and ultimately impacted all three. The Division of Forests and Lands, Forest Protection Bureau coordinated with local, state and federal resources and private landowners during this incident. Firefighting resources were brought in from three states and the Northeast Forest Fire Compact was utilized through the Northeastern Interagency Coordination Center. The coordination on this fire shows the success of pre-planning. The work by on-the-ground leadership is what kept this fire organization intact. NH Forest Rangers, the local Fire Chief and the WMNF Zone Fire Management Officers had built prior relationships and were able to maintain successful, safe fire suppression activities across multiple jurisdictions. This was a complex incident which was managed successfully without any major injuries and contained the fire to the smallest area possible.
National Priority 2.

Protect Forests from Threats

State Focus Addressed: Protect Forests from Threats, Response to Forest Damage

<table>
<thead>
<tr>
<th>State Issue Area(s) Addressed: Threats to forests from invasive plants, insects, and diseases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Title</td>
</tr>
<tr>
<td>Emerald Ash Borer Biological Control Program</td>
</tr>
</tbody>
</table>

Project Description:

Emerald ash borer is an immensely destructive invasive beetle, which, by the time it was detected in New Hampshire in 2013, had already killed millions of ash trees throughout the Midwest, Northeast, and Southern United States. One of the main factors contributing to this destructive nature is a lack of natural enemies in North America. In response to this threat, the USDA-APHIS in partnership with other researchers began work developing a biological control program in 2002. Initial surveys for natural enemies conducted in EAB’s native range of eastern Asia found several species of parasitic wasps that attack emerald ash borer, and in 2006, the first releases were carried out after a rigorous screening process ensured that the wasps were host-specific to emerald ash borer. There are currently three species of parasitic wasps approved for release in the northern U.S.: Tetrastichus planipennisi, and Spathius agrili, which parasitize EAB larvae, and Oobius agrili, which parasitize EAB eggs. New Hampshire began participating in the biological control program in 2013 immediately after the first detection was made in Concord. Successful implementation of the program requires identification of suitable sites where releases will be carried out for two consecutive summers. Following the completion of releases at a given site, wasp establishment and spread is monitored using a variety of techniques including the use of traps and rearing of infested logs. Traps and logs are successful at monitoring for adult parasitoid emergence. Bark peeling and visual inspection of EAB larval galleries continues throughout the year tree surveying for parasitized EAB eggs and parasitoid larvae. Successful introduction of these natural enemies of
emerald ash borer throughout the state will provide a source of top down control for the otherwise enemy-free pest. In time, the natural enemies will spread across the landscape, increasing their geographic range and population size to levels where they should be capable of keeping EAB populations in check at levels sub-lethal to ash trees, allowing ash to persist as a component of our forests into the future.

**Accomplishments:**

The New Hampshire Division of Forests and Lands, in cooperation with USDA-APHIS and UNH have released over 250,000 parasitic wasps distributed over 30 locations in six counties from 2014-2019. All three species of released wasps have been recovered from at least one release site indicating successful establishment in New Hampshire’s forests. Additionally, T. planipennisi has been recovered from nearly every release site evaluated to date, and in some cases, recoveries were made several miles from the nearest release location, showing that this species is well adapted to our local environment and capable of rapid spread across the landscape.

![Image of wasp releasing process](image.png)

The majority of releases have been conducted on a purely operational basis; however, in the past few years at select sites, silvicultural treatments and insecticide applications have been incorporated into standard release protocol as part of an integrated pest management strategy aimed at increasing the effectiveness of the interacting management techniques. Some releases have also been conducted as components of various research projects conducted by USDA-APHIS and UNH aimed at better understanding aspects of parasitoid behavior, ecology, or rearing methods. Plastic containers and wooden bolts containing larval parasitic wasps are hung from an ash tree in forest infested with emerald ash borer. Upon emerging from their containers, the wasps will seek out ash borer larvae and eggs in which to lay their own eggs. Tetrastichus planipennisi larvae recovered from a tree in Concord, NH. A single female wasp can lay several dozens of eggs in a single EAB larvae. The wasp larvae here have completely consumed the beetle larva.
National Priority 3.

Enhance Public Benefits from Trees and Forests

State Focus Addressed: Sustaining Economic Benefits from NH’s forests.

| State Issue Area(s) Addressed: Keeping forest lands available for recreation and tourism |
|---------------------------------|---------------------------------|
| **Strategy** | **Measure of Success** |
| Strategy 134: Engage law enforcement and the justice system in addressing abusers of private and public lands to reduce damage to the environment and to encourage public and private lands to remain open for public use. Practical protective regulations may be needed to support the efforts of law enforcement and the courts. | Response by Forest Protection Bureau to help keep public and private lands open for use even as pressure increases. |

Project Description:

The Forest Protection Bureau needed to respond to the rapid increase of OHRV use and trail development in the state. In particular, the northern part of the state saw the creation of “Ride the Wilds”, a promotional program which encouraged the development of OHRV trails for economic and tourism value. The Forest Protection Bureau, Forest Rangers observed an extreme increase in OHRV use during the past 10 years and has fielded an increase in landowner complaints.

Accomplishments:

During this time period, the Forest Protection Bureau responded to the increase in OHRV activity and complaints and has helped to keep public and private lands open to public use. The rapid expansion of OHRV use has started to see some push back by landowners. However, the
proactive enforcement of the Forest Ranger staff has helped to prevent the closure of lands. Forest Rangers conduct targeted patrols in high traffic areas as well as sensitive wetland ecosystems to address abusers. Forest Rangers are in constant communication with private landowners, public lands managers and local/state/federal law enforcement to provide consistent enforcement and address problem areas.

One major area of accomplishment has been in Jericho Mtn. State Park in Berlin. This state park was developed for OHRV trail use and has worked with the city of Berlin to promote tourism with expansion of trails beyond the park and an annual ATV Festival. This festival brings thousands of riders into the area over a 3-day time period in August. The early years of the festival saw many issues, one of which was riders destroying wetland areas on the Head Pond side of the property. Through targeted enforcement and coordination with other agencies, Forest Rangers have dramatically reduced the amount of off-trail riding in this area and have prevented riders from abusing this wetland habitat.
National Priority 3.

Enhance Public Benefits from Trees and Forests

State Focus Addressed:  Sustaining Environmental Benefits from NH’s forests.

<table>
<thead>
<tr>
<th>State Issue Area(s) Addressed:</th>
<th>Sustaining environmental benefits by keeping forests as forests, developing timely data about NH’s forests.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project title</td>
<td>Measure of Success</td>
</tr>
<tr>
<td>Pawtuckaway State Park red cedar natural community classification</td>
<td>Conducted research and collected vegetation plot data that allowed NHB ecologists to classify and describe a new, rare natural community type for NH.</td>
</tr>
</tbody>
</table>

Project Description:

The NH Natural Heritage Bureau (NHB) working with volunteers, identified and defined the description of a new community with very old trees. This is a newly established, globally rare circumneutral red cedar rocky outcrop community in the Pawtuckaway State Park, NH.

Accomplishments:

This work led to heightened protection (as a record in NHB’s database) of the red cedar woodlands on circumneutral outcrops, a rare type of natural community in New Hampshire (S1—Critically Imperiled) and across its global range (G3—Vulnerable). The most studied example in the state, first observed by New Hampshire Natural Heritage Bureau ecologists over 15 years ago, was surveyed and formally documented in 2016 and 2017 from three adjacent slopes of the ring-dike complex known as the Pawtuckaway Mountains in Nottingham and Deerfield, NH. Stand-age studies suggest the red cedar woodland may have existed as a stable community at this site for many centuries. Since examining this site in the Pawtuckaway Mountains, one other circumneutral red cedar rocky outcrop community with similar plant species composition and cover in a comparable physical setting has been documented in southern New Hampshire. Here, we newly describe the circumneutral red cedar rocky outcrop community in New Hampshire.
NEW HAMPSHIRE FOREST LEGACY PROGRAM

Executive Summary

1. Purpose and Objective

2. New Hampshire Forest Resources
   2.1 Forest Distribution, Forest Block Size, Land Conversion and Ownership Trends
   2.2 Forest Type and Composition
   2.3 Forest Products and Trends
   2.4 Timber Management

3. Natural Resource Values of NH Forests
   3.1 Wildlife and Habitat Biological Diversity
   3.2 Water Resources
   3.3 Public Recreation Opportunities and Scenic Values
   3.4 Cultural and Historic Resources
   3.5 Soils
   3.6 Geology and Mineral Resources

4. Eligibility Criteria
   4.1 Criteria 1: Large blocks of forestland.
   4.2 Criteria 2: Proximity to core forest areas or other permanently protected lands.
   4.3 Criteria 3: Threat of conversion.
   4.5 Criteria 4: Important environmental values and public benefits:
      - Production of timber or other forest products
      - Critical wildlife and fish habitat
      - Enhancement or maintenance of biodiversity
      - Watershed, riparian or groundwater protection
      - Public recreation opportunities and scenic values
      - Historic and cultural values
      - Soil productivity
      - Other ecological, geologic features

5. Description Forest Legacy Areas
   5.1 North Country
   5.2 Connecticut River Valley
   5.3 Monadnock/Merrimack Uplands
   5.4 Pawtuckaway and Lakes / Coastal Plain

   6.1 Means of Protection
   6.2 Conservation Project Partners
   6.3 Forest Legacy Program Selection Process

7. Public Participation Process and Results

8. Recommendations

New Hampshire Forest Action Plan
Executive Summary

New Hampshire’s natural beauty is characterized by an abundance of large unfragmented areas of forests, mountains and hillsides, open valleys, rivers, lakes and coastal water resources. New Hampshire is the second most forested state in the nation. The state’s forests have traditionally supported wood and other natural products for commercial use. Forestlands provide critical habitat for wildlife, rare plants and natural communities. Forests have a key function in maintaining the ecological health of riparian corridors, headwaters and wetlands, and for the protection of drinking water source areas. The forested landscape provide the state’s primary setting for recreation and tourism opportunities. Many historic structures, archaeological sites and other features that identify New Hampshire’s historic character are found in the state’s second growth forest.

The New Hampshire Forest Legacy Program Assessment of Need (AON) along with the State Forest Action Plan are intended to meet the planning requirements of the Forest Legacy Program as outlined in the Forest Legacy Program Implementation Guidelines (2017). These documents update the New Hampshire Forest Legacy Assessment of Need 2000, as approved by the USDA Secretary of Agriculture.

This 2020 Forest Legacy Assessment of Need (AON) acts as a guiding document for implementation of the Forest Legacy Program in New Hampshire. The AON describes natural resources of the state; outlines the eligibility criteria and identifies the Forest Legacy Areas; describes the process for evaluating and selecting Forest Legacy projects; and describes the participation process undertaken to develop the Forest Action Plan and Assessment of Need.

New Hampshire’s first Assessment of Need was approved in 1994, establishing the NH Forest Legacy Program eligibility criteria and designating the North Country Forest Legacy Area. The Assessment of Need was updated in 2000, modifying the eligibility criteria and designation three additional Forest Legacy Areas.

The 2020 Assessment of Need was developed as a component of the State’s 2020 Forest Action Plan. The 2020 Assessment of Need retains four eligibility criteria. The eligibility criteria focus efforts on protecting large blocks of forestland, forests adjacent to core forests or other protected lands, land threatened with conversion to nonforest uses, and the protection of tracts that will advance the goals of the 2020 New Hampshire State Forest Action Plan (aka New Hampshire Forest Resources Plan).

The 2020 Assessment of Need retains the boundaries of the four Forest Legacy Areas (FLA). The FLAs reflect both important values present in forested areas and current threats to the forest.

- North Country
- Connecticut River Valley
- Monadnock / Merrimack Uplands
- Pawtuckaway and Lakes / Coastal Plain

Since 1996, the State of New Hampshire has employed the Forest Legacy “State Grant Option”, allowing the state to receive grants for acquisition, and hold interests in land with those funds. New Hampshire works with willing landowners and skilled conservation project partners to acquire and hold conservation easements on Forest Legacy lands. To date, the state has completed 21 Forest Legacy projects, protecting 273,252 acres. The New Hampshire 2020 Forest Action Plan and Forest Legacy Program Assessment
of Need provide analyses about New Hampshire’s forests and a framework for evaluating and protecting the most significant lands.

1. Purpose and Objective

As part of the 1990 Farm Bill, Congress created the Forest Legacy Program to help protect environmentally important private forestlands threatened with conversion to non-forest uses. The Secretary of Agriculture is responsible for the development and administration of the Forest Legacy Program. The US Forest Service in cooperation with states and other units of government is responsible for the implementation of the program. States have been granted the authority to establish criteria for their programs within the framework of the national program to help address specific needs and goals of their state.

To help maintain the integrity and traditional uses of private forest lands, the Forest Legacy Program promotes the use of conservation easements, legally binding agreements transferring a negotiated set of property rights from one party to another. Participation in the program is entirely voluntary.

The New Hampshire 2020 Forest Legacy Program Assessment of Need was conducted for the purpose of fulfilling a periodic review and revision to determine the Forest Legacy Program’s effectiveness, and to ensure the program meets the future needs of the state’s citizens and forest resources.

The 2020 Assessment of Need was prepared as a component of the updated 2020 State Forest Action Plan. The New Hampshire Department of Natural and Cultural Resources (DNCR) Division of Forests and Lands served as lead agency. The planning process included Forest Legacy Committee (FLC), conservation project partners and multiple stakeholders. During the preparation of the State Forest Action Plan and Assessment of Need, the lead State Agency, in coordination with the FLC, confirmed the eligibility criteria and Forest Legacy Areas. The eligibility criteria support the identification and protection of the most significant forest areas throughout the state. The four Forest Legacy Areas reflect both important values present in forested areas and current threats to the forest.

The State of New Hampshire 2020 Assessment of Need accomplishes the following:

1. Forest Legacy Program Assessment of Need updated as part of the NH Forest Action Plan 2020, providing information on important forest and natural resources, and background on threats of conversion.
2. Forest Legacy Area designation.
3. Eligibility criteria established for evaluating Forest Legacy projects.
4. Forest Legacy project selection process.
5. Outreach and public participation process undertaken for the State Forest Action Plan – Assessment of Need.

NH Forest Legacy Program Goal/Objectives
The goal of the New Hampshire Forest Legacy Program is to protect properties that, when taken together, display a variety of sizes, forest values to be protected, and conservation techniques.

Forest Legacy parcels must:
- Provide for the continuation of traditional forest uses including forest management and public access for outdoor recreation,
- Be threatened by conversion to non-forest uses, and
- Must possess one or more of the following important public values.
Recreation opportunities
- Waterfront and riparian areas
- Fish and wildlife habitat
- Threatened and endangered species and natural communities
- Historic and Cultural resources
- Other ecological values, scenic values, or geologic features
- Productive viable timber resource
- Soil productivity

2. New Hampshire Forest Resources

2.1 Forest Description - Distribution, Forest Block Size, Land Conversion and Ownership Trends

New Hampshire is the second most forested state in the nation, after the neighboring state of Maine. New Hampshire forests account for 4,741,185 million acres, 82.6% of the state’s 5,742,660-acre total area. The percent of forest cover ranges widely throughout the state, with the coastal watershed communities having as low below 30 percent of the land base, to North Country communities supporting up to 90 percent (SFAP Section 1 Total Area of Forest Land & Trends, Figure 3 NH Land Cover).

There is a long history of conservation accomplishments protecting critical lands in New Hampshire. As of 2019, over 1.775 million acres of land is permanently conserved through public ownership or conservation easement on private lands. Forestlands comprise over 95% of conserved land. Since 1996 the New Hampshire Forest Legacy Program has been an important contributor in this effort, conserving 56 tracts of land totaling 273,252 acres, of which 268,027 acres are protected by conservation easement, and 5,225 acres in fee (SFAP Section 11 Large Forestland Blocks, Figure 36 Conserved Forest Blocks in NH).

New Hampshire’s two primary threats of forestland conversion to nonforest uses are development and fragmentation. Over a 34-year period (1983-2017) there was a reduction in the forested land base by 126,710 acres. The reduction is accounted for primarily in the conversion of forestland to developed uses - residential (primary residential homes and second homes) and commercial development (SFAP Section 16 Housing Density, Table 14 NH Population & Housing Density, Figure 2 Forest cover and Population in New England).

New Hampshire’s forested landscape continues to be dominated by large undeveloped and unfragmented forested blocks of 1,000 acres or greater. In 2019 there were 677 properties totaling 3,432,3032 acres of large forested blocks. These lands are very important for wildlife and biodiversity conservation, and are located throughout New Hampshire with the exception of the southern section of the state. However, there has been fragmentation of large unfragmented forested areas into smaller pieces. From 2006 – 2019, there was a 2,450-acre loss, representing a .007% change in large forest block acreage (SFAP Section 11 Large Forested Blocks, Figure 35 NH Forest Block Comparison 2006-2019).

Forestland ownership in New Hampshire has not demonstrated significant changes in the past decade. Acres owned by private, family forest landowners increased slightly from 2006 to 2013, and showed a slight decline in 2018. Corporate ownership remained relatively steady throughout this period. Federal public ownership increased slightly, and state and municipal and county ownership remained relatively steady (SFAP Section 2 Forest Land Conversion, Section 17 Forest Landowner Trends, Section 18 trends in Size of Forestland Ownership).
2.2 Forest Type and Composition
Woodland communities are areas dominated by similar tree species and/or species groups. These broad categories may include many different soil types and terrain. The major woodland communities and their status are fully described in the Wildlife Action Plan (NHFG 2015) and discussed in detail in the SFAP (Section 3 Fish and Wildlife Habitat, Status of woodland communities). The four broad categories include:
- **Appalachian Oak-Pine** - Appalachian oak-pine forests are found mostly below 900 feet elevation in southern New Hampshire and along the Connecticut River in western New Hampshire.
- **Hemlock-Hardwood-Pine** – Hemlock-hardwood-pine forests are comprised of mostly hemlock, white pine, beech, and oak trees. This forest type is the most common in New Hampshire and covers nearly 50% of the state and provides habitat for numerous wildlife species.
- **High Elevation Spruce-Fir** – High-elevation spruce-fir forests can be found between 2,500 and 3,500 feet in elevation on upper mountain slopes and ridge tops.
- **Lowland Spruce-Fir** – Lowland spruce-fir forests occur between 1,000 and 2,500 feet in elevation and are comprised of a mosaic of lowland spruce-fir forest and red spruce swamp communities.

2.3 Forest Products and Trends
The forest products industry in New Hampshire, as with the rest of the Northeastern states, has undergone significant changes in the 2009 to 2019 period. While there has been market turmoil during this ten-year period, the Northeast’s forest industry has shown signs of stability and opportunities for growth. Generally stated, the vast majority of timber volume continues to be in lower value products of pulpwood, and biomass for energy. Based on forest areas and traditional use trends, the SFAP provides a detailed analysis of markets and projected growth trends (SFAP Section 20, Forest Industry). New Hampshire’s forest product industry conditions and trends are summarized below:
- **Sawlogs** provide a majority of the forest product value in the state. Harvests have rebounded from the post-recession crash of 2009, and that sawmills in the region are increasing production, to the benefit of landowners, loggers and manufacturers.
- **Pulpwood** in New Hampshire represents at least a third of the volume harvested and 13 percent of the stumpage value to landowners. The constant is that pulpwood is larger in volume and lower in value than sawlogs, and the remaining pulp and paper mills in Maine and New York are stable and even growing in their pulpwood consumption.
- **Biomass**, low-grade timber derived wood chips used for the production of electricity, is important by volume, even as current trends indicate provides little economic return to the landowner. In New Hampshire, its importance may be increasing as markets for pulpwood shrink, and shifts toward biomass sources by major utilities may signal growth.

2.4 Timber Management Opportunities
New Hampshire has a strong forest-based economy, as detailed in the SFAP Section 19 Forest Industry. The continued number of large undeveloped and unfragmented forested blocks comprised of public and private lands support the state’s timber production (SFAP Section 11 Large Forestland Blocks, Figure 67 Conserved Forest Blocks in NH). In addition, the Forest Action Plan identifies Priority Landscapes as those valuable forested landscapes providing many valuable ecosystem services while supporting important socioeconomic benefits. These forested and resource rich areas are located in all four Forest Legacy Areas, and offer timber management opportunities (SFAP Section - Priority Landscapes).
A significant amount of forest related planning goes on in New Hampshire. There are several long practiced examples. The state has a statutory requirement for a Forest Resources Plan to be revised every 10 years. The NH Forest Legacy Program requires multi-resource management plans on approximately 264,000 acres. The Forest Stewardship Program works in partnership with state forestry agencies, cooperative extension, and conservation districts to connect private landowners with the information and tools they need to manage their forests. The Forest Action Plan provides detailed analysis and guidelines for timber management opportunities (SFAP Section 21 Legal, Institutional, & Policy Framework).

3. Natural Resource Values of New Hampshire Forests

For the purposes of the Forest Legacy Program, environmentally important forests in New Hampshire are those containing either unique or critical aspects of one, or significant features of two or more, of the following natural resource attributes:

- Protection of forest resources, and support the capacity to produce timber or other forest products.
- Protection, enhancement and maintenance of wildlife and habitat biological diversity
- Protection of water resources such as watershed, riparian, wetland or groundwater.
- Ensuring access to outdoor public recreation opportunities and protection of scenic resource values
- The presence of cultural and historic resources
- Soils productivity
- Other ecological, geologic features

3.1 Wildlife and Habitat Biological Diversity

New Hampshire is rich in wildlife diversity. Protecting, enhancing and restoring wildlife species and related habitats supports the state’s ecological health, as well as human health and quality of life. A significant amount of forest-based recreation is wildlife based – fishing, hunting, photographing and observing wildlife. It also brings in revenue from hunters, anglers, wildlife watchers and outdoor activities. Increasing threats from development, and the associated conversion of forest and other wildlife habitat, degrades wildlife values.

New Hampshire is home to more than 500 species of vertebrate animals. This list would be much longer if a complete list of invertebrates (insects, crustaceans, clams and snails) were included. About 75 percent are nongame wildlife species not hunted, fished or trapped. Twenty-seven species are endangered and fourteen are threatened in the state (NHB, 2020).

New Hampshire’s Natural Heritage Bureau has classified and distinguished 197 different natural community types that collectively cover New Hampshire’s landscape. These include such habitats as floodplain forests, high elevation spruce-fir forest, bogs and fens, northern hardwood conifer forest and alpine summits. New Hampshire has the most extensive alpine habitat of any northeastern state, with approximately 4,000 acres of alpine tundra in New Hampshire, which supports 62 threatened or endangered plants. All total, New Hampshire has 414 plant species that are considered threatened or endangered at the state level (NHB, 2020). See Figure 80 New Hampshire Natural Heritage Bureau Known Biodiversity.

The state’s Wildlife Action Plan (NHFG, 2015) incorporates data, methodologies and extensive public input to identify species in greatest need of conservation, habitats that are at the greatest risk, as well as land
uses and activities that present the greatest threats to wildlife and habitat. Over 100 actions are outlined by New Hampshire stakeholders to protect and manage wildlife and habitat. Wildlife habitat information can be found in SFAP Section 3 Fish & Wildlife Habitat and in the 2015 New Hampshire WAP which can be accessed at https://www.wildlife.state.nh.us/wildlife/wap.html.

Wildlife species native to New Hampshire eligible for identification as Species of Greatest Conservation Need (SGCN) included game species, nongame species, fish and marine animals. Through an evaluation of populations, habitats, risks and status, 169 species are identified as SGCN. As noted above, 27 SGCN were listed as endangered. **Endangered wildlife** are those native species whose prospects for survival in New Hampshire are in danger because of a loss or change in habitat, over-exploitation, predation, competition, disease, disturbance or contamination. Assistance is needed to ensure continued existence as a viable component of the state's wildlife community. Fourteen of the SGCN species were listed as state threatened. **Threatened wildlife** are those species which may become endangered if conditions surrounding them begin, or continue, to decline.

Twenty-seven distinct habitats that support both common species and SGCN. By identifying and protecting high quality examples of all of New Hampshire’s natural communities, all of the state’s native wildlife species will have access to intact habitats (SFAP Section 4 Fish & Wildlife Habitat, Figure 28 Wildlife Action Plan Habitat Tiers).
Figure 80 NH Known Biodiversity
Source: NH Division of Forests and Lands, Natural Heritage Bureau
3.2 Water Resources
New Hampshire has an abundance and diversity of both surface and groundwater resources. The state’s forests have a key function in maintaining the ecological health of riparian corridors, headwaters and wetlands, and for the protection of drinking water source areas (SFAP Section 6 Watershed Values).

Watersheds
The following description of New Hampshire’s five major watershed basins – the Connecticut, Merrimack, Androscoggin, Piscataqua (Coastal), and Saco - is summarized from the Department of Environmental Services publication New Hampshire Water Resources Primer (2008) and detailed in SFAP Section 4 Watershed Values, Figure 8 Major Watersheds in NH.

The Connecticut River Watershed (including the Upper, Middle and Lower Connecticut River) spans approximately 11,250 square miles and drains 3,063 square miles in New Hampshire, about one-third of the state. The Connecticut River is the largest river in New England, with two-thirds of its length, or 275 miles, along the New Hampshire - Vermont border. There has been long standing cooperative effort between New Hampshire and Vermont to protect and preserve the river.

The Merrimack River Watershed (including the Pemigewasset-Winnipesaukee and Contocook Rivers) covers 5,010 square miles in New Hampshire and Massachusetts. The Merrimack River flows 180 miles from the White Mountains to the Atlantic Ocean. Seventy-five percent of the watershed is located in New Hampshire. The watershed contains most of the lakes and ponds in New Hampshire, and development have impacted water quality and quantity.

The Androscoggin River flows from Lake Umbagog on the New Hampshire – Maine border and runs for 170 miles. The total drainage area is approximately 3,450 square miles, with approximately 716 square miles in New Hampshire. The river has historically been used as an industrial route for logging and paper mills, and water quality has benefited from concerted restoration efforts.

The Piscataqua River Watershed (including the Salmon Falls-Piscataqua Rivers), includes Great Bay and its tributaries, and comprises the majority of New Hampshire’s coastal watershed at 730 square miles, with a combined drainage area of approximately 1,495 square miles in Maine and New Hampshire. Beginning at the confluence of the Cocheco and Salmon Falls Rivers, the Piscataqua River is entirely tidal and supports habitats and species found only in the coastal portion of the state.

The Saco River flows 40 miles and drains 1,293 square miles of Maine and New Hampshire, with 876 square miles in New Hampshire. It is one of the state’s most pristine rivers flowing primarily through the White Mountain National Forest, with a corridor of generally undeveloped and forested lands. The capacity of the river to support a diversity of wildlife species is largely assured due to the continued presence of a large contiguous forested riparian habitat.

Water Resources: Rivers, Lakes, Wetlands
The state’s five major watersheds contain over 10,000 miles of rivers and streams, 150,000 acres of lakes and ponds, and an estimated 200,000 aces of combined inland and tidal wetlands (UNH, 2016).

New Hampshire’s lakes and great ponds are emblematic of the state’s natural beauty. Statewide there are nearly 1,000 water bodies including natural lakes and ponds reservoirs and areas on rivers impounded by dams. Lake Winnipesaukee, centrally located in the Lakes Region at the foothills of the White Mountains, is the largest lake covering 69 square miles. New Hampshire’s lakes and ponds provide various uses and...
values. As human activity and development pressures in and around the waters continues, the state looks to balance the multiple uses and protect lake health (NH Department Environmental Services).

New Hampshire’s wetlands range from wet meadows to bogs, tidal marshes and wooded swamps. The predominant wetland types are palustrine forested and scrub-shrub. Many of state’s wetlands are a result of glacial activity that created depressions and deposited fine material restricting the drainage of water and building up of organic and fine sediments. Wetlands also form at the edges of rivers, lakes and streams where sediments and organic materials deposit to create shallows with abundant plant growth. Forest landscapes support the interconnected matrix of terrestrial and aquatic systems. An estimated 7,500 acres of estuarine and marine wetlands are located along the state’s 18-mile coastline (NH Department Environmental Services).

Wetlands perform the important functions of flood control, water purification, water storage and recharge for both groundwater and surface waters. These functions are more valuable with the expected increase in occurrence and severity of storm events associated with climate change. Supporting the food chain, wetlands provide food and shelter for a variety of aquatic and upland plants and animals. New Hampshire has lost fewer wetlands to filling and dredging than many coastal states. However, the landscape changes experienced in the state poses a significant challenge to ensuring protection of the important functions and values of wetlands (NH Department Environmental Services).

3.3 Public Recreation Opportunities and Scenic Values

New Hampshire’s natural beauty, characterized by an abundance of forests lands, mountains, lakes, rivers and coastal water resources, attracts tourists and provide residents with a variety of active outdoor recreation pursuits. Outdoor recreation serves diverse populations throughout the state, has a strong, positive impact on the economy, and improves the quality of life for residents and visitors. Recreation opportunities and stunning scenic vistas abound in the nearly 800,000-acre White Mountain National Forest (WMNF). The WMNF and surrounding state and private conservation lands offer extensive hiking trails, including the Appalachian Trail. In addition, recreation opportunities exist throughout New Hampshire on state and municipal lands and waterways, and on over one million acres of private forest and agricultural land (NH SCORP, 2019; SFAP Section 13 Forest-Related Recreation Trends and Opportunities).

Forested landscapes provide the state’s primary setting for recreation and tourism opportunities - including hiking, downhill and cross-country skiing, snowmobiling, hunting, camping, horseback riding, fall foliage viewing and wildlife viewing. Forest-based recreational opportunities are offered on a mix of public lands and private lands. The state has a strong tradition and favorable legal and social environment for public use on private lands. There are 3,008,034 acres of private land enrolled in Current Use Program (DNCR, 2018); many of the landowners enrolled in the program do not post their land, allowing for public use (SFAP Section 21 Legal, Institutional, & Economic Framework).

New Hampshire’s population growth has impacted the demands for public outdoor recreation opportunities. The state’s population, estimated to be 1,359,700 (U.S. Census, 2019), continues to be one of the fastest growing in the Northeast. During a five-year period, 2010 to 2016, the state’s growth rate increased to 2.0%. The 2010 Census identified 39.7 percent of the population lives in rural areas while 60.3 percent lives in urban areas. Ten percent of New Hampshire’s housing stock is for recreational or seasonal use, compared to 3 percent nationwide (NH SCORP, 2019; SFAP Section 16 Housing Density).
Outdoor recreation has a strong economic impact in New Hampshire, and the demand for public recreation is on the increase (NH SCORP, 2019). In 2019 there were 1.9 million annual visitor trips to New Hampshire. According to 2019 data, travel and tourism accounted for $216.5 million in tax revenues, $4.2 billion in visitor spending, and supported 36,600 jobs (NH Division of Travel and Tourism Development, 2019). In addition, 69 percent of NH residents participate in outdoor recreation each year (Outdoor Industry Association, 2017).

The conversion of forestland has critical implications for both tourism and scenic character. According to a 2013 study by the New England State Foresters Association, forest-based recreational activities contributed $1.4 billion in sales annually to the state’s economy. Additionally, an estimated 10,800 people are employed in forest-based recreation and tourism sectors, with cumulative payroll of $177 million annually (NH Division of Travel and Tourism, 2019).

3.4 Cultural and Historic Resources
New Hampshire’s cultural resources provide an important connection to past interactions of people with the land. Since the last glaciers receded over 12,000 years ago, evidence of the earliest inhabitants is part of the landscape. Today these people are known collectively as the Abenaki, which is often translated as "People of the Dawnland." Abenaki villages were set up along rivers and lakes, providing access to water and fishing, as well as hunting and farming. Land was not owned, but used according to custom, season, and need. Many of New Hampshire’s places bear the names first given to them by the Abenaki – such as rivers named Ammonoosuc, Merrimack, Pemigewasset and Saco, and lakes named Winnipesaukee, Sunapee and Umbagog (NH State Council on the Arts, 2020). European contact began in the 1500s, and by the 1600s Abenaki populations began to decline with European expansion, bringing disease and conflict.

At the turn of the century, New Hampshire was largely (nearly 80 percent) cleared of forest for agriculture. Many historic structures, archaeological sites and other features that identify New Hampshire’s historic character are found in the state’s second growth forest. Data from the New Hampshire Division of Historical Resources statewide inventory of historical properties identified more than 10,000 individual above-ground properties, 459 historic district and areas, and 3,300 archaeological sites (NH Department of Cultural Resources, 2016).

3.5 Soils
New Hampshire soils are complex and highly variable due principally to its glacial origins. The Natural Resource Conservation Service (NRCS) mapping provides soil inventories, and organizes New Hampshire state soils into six Important Forest Soil Groups. These groupings enable the evaluation of soil productivity, provide an understanding of plant succession patterns, and soil and site interactions. Forest management guidelines for each soil group described is provided in detail in the SFAP Section 3 Soil Productivity and Figure 10 Important Forest Soils for New Hampshire, and further detailed in Good Forestry in the Granite State, Important Forest Soil Groups, 2010.

- Group IA consists of the deeper, loamy, moderately well-drained and well-drained soils.
- Group IB generally consists of soils that are moderately well-drained and well-drained, sandy or loamy-over-sandy, and slightly less fertile than those in group 1A.
- Group IC soils are derived from glacial outwash sand and gravel.
- Group IIA consists of diverse soils and includes many of the soils that are in groups IA and IB.
- Group IIB soils are poorly drained.
- Not Rated soils include several mapping units that are either so variable or have such a limited potential for commercial production of forest products that they haven’t been placed in a group.
3.6 Geology and Mineral Resources

Geology

Over a billion years of geologic history has shaped and structured New Hampshire’s landscape. Similar to the New England region, New Hampshire consists of a series of metamorphosed sedimentary and volcanic rocks of the Late Proterozoic to Devonian age, intruded by plutons and dikes. The state straddles three composite tectonostratigraphic terranes. The White Mountain range runs north-central through the state, including Mount Washington at 6,289 feet, the tallest mountain in the northeastern United States.

Volcanic rocks are found associated with the granitic rocks of the southern White Mountains. Known as the ‘Granite State’, the state is underlain with granite and metamorphic rocks. Approximately half of the state is underlain by metamorphic rocks, which are in part derived from the recrystallization of rocks which were of volcanic origin. The remainder of the rocks of the state are granitic or related rocks.

Several of New Hampshire’s outstanding geologic features include Tuckerman’s Ravine, a glacial cirque sloping eastward on the southeast face of Mount Washington; Cathedral Ledge White Horse Ledge, granite wall towers over North Conway; The Basin, Franconia State Park, a giant nature-made granite bowl formed by ice and river rocks; Flume Gorge, Franconia, a natural gorge with walls of Conway granite, extending 800 feet at the base of Mount Liberty; and Madison Boulder, Madison, the largest known glacial erratic in North America (NH Department Environmental Services; NH Geographical Survey; Paleontological Research Institution).

Mineral Resources

Non-fuel mineral production in New Hampshire – including sand and gravel – occurs throughout the state. In 2014, New Hampshire ranked 48th in the Nation in total nonfuel mineral production value. The total value of non-fuel mineral production in the state was $99,600. Nearly all production value is attributed to construction sand, gravel and crushed stone. In 2014, approximately 52% of New Hampshire’s crushed stone quantity consisted of granite, 33% was traprock, and 10% was classified as miscellaneous stone, 4% as sandstone and quartzite, and 1% as limestone. Companies in New Hampshire also quarried dimension stone, most of which was granite. Aggregates, construction sand and gravel and crushed stone, are major mineral commodities important to the construction industry (USGS, 2014).

Mining activity occurs on a limited scale in the state with sites located primarily in Grafton, Rockingham and Cheshire Counties. The most commonly listed primary commodities in New Hampshire mines are beryllium, felspar and mica. Small quantities of gemstones were produced from pegmatite locations in the State (USGS, 2014).

The state does not typically acquire land or interests in land where the mineral rights have been severed. There are two scenarios where mineral rights being held by a third-party acquisition may be considered: (1) the likelihood that a third party would exercise the right to extract minerals is extremely remote and considered negligible, and (2) the title insurance policy does not list the severed minerals rights as an exception to title.

The New Hampshire Forest Legacy conservation easements allow landowners to use gravel and sand resources for improvements, such as forest management access roads, on the conserved property. Active and reclaimed gravel and sand pits are documented in the property’s conservation easement Baseline Documentation Report. This report details the property’s resources and conditions at the time of easement transferal, and is acknowledged by the landowner and the state. The property’s extraction and
reclamation activities are monitored on an annual basis as part of the state’s stewardship easement monitoring program.

4. Eligibility Criteria

The rational for the eligibility criteria used to delineate the New Hampshire Forest Legacy Areas (FLA) are based on assessment conducted for the 2020 Forest Action Plan and Assessment of Need. The four eligibility criteria focus efforts on protecting large blocks of forestland, forests adjacent to core forests or other protected lands, land threatened with conversion to nonforest uses, and the protection of tracts that will advance the goals of the New Hampshire State Forest Action Plan. These criteria are consistent with the purposes for which the Forest Legacy Program was established, and the Forest Legacy Area criteria as set forth in the *Forest Legacy Program Implementation Guidelines* (U.S. Forest Service, 2017).

4.1 Criteria 1. Large blocks of forest land.
Provide for the continuation of traditional forest uses including forest management and public access for outdoor recreation.

4.2 Criteria 2. Proximity to core forest areas or other permanently protected lands
Contribute to the important forest areas with core forest habitats and existing conservation lands to support the viability of forest product industry, and enhance natural resource protection, wildlife connectivity, climate change resiliency and biodiversity.

4.3 Criteria 3. Threat to Conversion
Address the manner and degree of threat of forestland conversion to non-forest uses.

4.4 Criteria 4. Consistent with the goals in the NH State Forest Action Plan.
Consistent with the vision and goals for forest resources in New Hampshire, including:
- Production of timber or other forest products
- Critical wildlife and fish habitat
- Enhancement or maintenance of biodiversity
- Watershed, riparian or groundwater protection
- Public recreation opportunities and scenic values
- Historic and cultural values
- Soil productivity
- Other ecological, geologic features

5. Description Forest Legacy Areas

The four identified Forest Legacy Areas reflect both important values present in forested areas and current threats to the forest. The North Country FLA was initially identified in the first Assessment of Need (1994), and the Connecticut River Valley, Monadnock / Merrimack Uplands, and Pawtuckaway and Lakes / Coastal Plain Forest Legacy Areas were added in the 2000 Assessment of Need. The 2020 Assessment of Need includes the following four Forest Legacy Focus Areas:

5.1 North Country
Coos, Grafton and Carroll counties.
5.2 Connecticut River Valley
Portions of Sullivan and Cheshire counties

5.3 Monadnock / Merrimack Uplands
Portions of Merrimack, Sullivan, Cheshire and Hillsborough counties.

5.4 Pawtuckaway and Lakes / Coastal Plain
Belknap County, portions of Strafford, Rockingham and Merrimack counties.

Figure 81 NH Forest Legacy Areas
5.1 North Country

General Description
The North Country is the largest Forest Legacy Area in the state, including all of Coos, Grafton and Carroll counties. The northern most border connects with Canada. The Connecticut River runs from the northern tip of the region through the length of the western border, along Route 3 shared with Vermont. Route 16 runs along the eastern border with Maine. The southern portion of the area boarders New Hampshire’s Belknap, Merrimack and Sullivan counties and the other three FLAs: the Pawtuckaway and Lakes / Coastal Plain, Monadnock / Merrimack Uplands, and the Connecticut River Valley. The 750,852-acre White Mountain National Forest is prominently located in the area. The region is relatively sparsely populated, with the city of Berlin serving as the largest population center. Historically, in addition to tourism, main industries have been logging and paper manufacturing.

The North Country is an expansive pristine area known for its large unfragmented forestlands, the White Mountain range, abundant water resources, unequaled scenic quality, habitat to a great many species of wildlife, and extensive recreational opportunities. Prominent woodland communities include northern hardwood-conifer, high-elevation spruce-fur, with hemlock-hardwood-pine (SFAP Figure 12 Woodland Communities of New Hampshire).

Originally identified as a Forest Legacy Area in the 1994 Assessment of Need, the North Country has been an area of great interest for New Hampshire Forest Legacy projects, protecting 258,530 acres - over 90 percent of all NH Forest Legacy protected acres (DNCR January 2020).

Consistency with Eligibility Criteria
Criteria 1. Large blocks of forest land
This area of contains some of the largest blocks of unfragmented forestland in the state. Large blocks of private and publicly owned forestlands form an interconnected landscape, as described in Criteria 2. The area is known for its highly productive hardwood forests (SFAP Section 11 Large Forestland Blocks).

Criteria 2. Proximity to core forest areas or other permanently protected lands
The area includes vast forestlands in public and private ownership. The concerted effort to link conservation lands and unfragmented forest areas has resulted in the protection of significant forest and conservation lands, held in public and private fee ownership and/or conservation easement. New Hampshire’s northern most county (Coos) of the North Country FLA lies within the planning area for Northern Forest Lands (NFL) which stretches over 20 million acres from Maine, New Hampshire, Vermont and New York. This area was the focus of a regional study and planning effort in the 1990’s, and remains a focus for issues including forest land conservation, economic development and community infrastructure (SFAP Section - Multi-State Priorities).

Significant large public fee holdings include the US Forest Service White Mountain National Forest and US Fish and Wildlife Conte Refuge and Lake Umbagog National Wildlife Refuge. The two largest state parks in the region - Nash Stream and Franconia Notch - total over 47,000 acres. The North Country is the focus area with the highest concentration of Forest Legacy projects. Of the 273,252 acres conserved through the NH Forest Legacy program, 258,530 acres are located in the North Country. Completed Forest Legacy projects include the 146,290-acre Connecticut Lakes Project, 23,891-acre Androscoggin Headwaters Project, 23,728-acre Mahoosuc Gateway project, and 18,430-acre Bunnell Mountain project. The completed Forest Legacy projects list is found in Appendix C NH Forest Legacy Completed Projects, and
the SFAP includes all conservation lands in Section 12 Conservation Lands, Figure 37 Permanently Conserved Land in NH.

Criteria 3. Threat to Conversion
The region continues to be under the increasing threat of second home development and landowner changes. Overall, the three-county region’s population and housing density is low compared to other parts of New Hampshire and New England states. However, land conversion trends for second home development, often coupled with commercial recreation development, threatens to fragment large blocks of land. In addition, the potential for changes in forestland ownership could impact land conversion trends (SFAP Section 14 NH Population Trends; Section 17 Forest Landowner Trends & Potential for Change).

Criteria 4. Consistent with the goals in the NH State Forest Action Plan
Protection of land in this area is consistent with the Forest Action Plan goal of keeping contiguous blocks of forest intact. A number of the existing and potential Forest Legacy projects in this area adjoin or nearly adjoin existing large, unfragmented tracts of protected and productive forestland.

Conservation efforts in the FLA will protect critical wildlife and fish habitats and water resources. The three counties comprising the North Country FLA contain high ranking priority values in the state’s Rural Forest Priority Area (SFAP Section - Priority Landscapes). This area contains many "hot spots" of biological diversity associated with rare plant communities, including location of Pine Barrens, a community of high priority for protection.

Protection of New Hampshire’s scenic landscape is a high priority. The North Country is a popular outdoor recreation destination in the state, particularly for activities associated with the White Mountains and water-based recreation.

Environmental Values that will be Protected:

- Production of timber or other forest products
  The largest Forest Legacy Area in the state, the area supports unfragmented, large blocks of forest lands. The landscape of protected blocks of forests has been critical in supporting the continued production of forest products, predominately producing high quality hardwood timber.

- Critical wildlife and fish habitat
  The area supports important fish and wildlife habitat to a great many species of wildlife. Wide-ranging mammals such as deer, otter, bobcat, black bear, and moose. The retention of large blocks of contiguous forest is critical to maintaining habitat for large mammals and maintaining basic ecosystem functions. The area’s rivers and freshwater lakes and ponds provide fish habitat.

- Enhancement or maintenance of biodiversity
  The North Country includes all of New Hampshire north of the Presidential Range. The terrain is a mix of mountains and large river valleys. North Country natural communities resemble the boreal forest region of Canada. Spruce and fir forests dominate both high and low elevations, with interspersed northern hardwood forests. Boreal region plants include balsam fir, black spruce, paper birch, larch, and quaking aspen. Peatlands, lakes, and ponds are common in the lowlands. Rich fens are occasional in areas with calcium-rich bedrock.
The White Mountains are the dominant topographic feature of New Hampshire. The variety of plants and natural communities reflects the region’s topographic relief. Alpine, subalpine, and rocky ridge communities are common on the bare summits of the mountains. Spruce-fir and northern hardwood forests dominate lower elevations. Lakes, ponds, and wetlands are smaller and less frequent than in other parts of the state.

Plants in New Hampshire’s arctic-alpine region are restricted to alpine and subalpine peaks above 4,000 feet in elevation, with a few occurring on lower elevation cliffs, in ravines, and along rivers in the mountains. Most of these plants also occur in other alpine areas of northeastern North America, but are separated from their primary ranges in northern Canada. Examples of arctic-alpine region species include Bigelow’s sedge (Carex bigelowii), alpine bilberry (Vaccinium uliginosum), and highland rush (Juncus trifidus). A few species are endemic to northeastern North America, and one, dwarf cinquefoil (Potentilla robbinsiana), and occurs only in the White Mountains. See Figure 80 New Hampshire Natural Heritage Bureau Sites.

- **Watershed, riparian or groundwater protection**
The area’s forest landscape supports an interconnected matrix of terrestrial and aquatic systems. The area is characterized by abundant water resources - rivers, lakes, ponds and wetlands, and aquifers. It encompasses three watersheds - the Connecticut River, Androscoggin River and Saco River. Major rivers include Connecticut, Androscoggin, Ammonoosuc, Pemigewasset, Saco, and the upper northern portion of the Salmon Falls River. Major lakes include the First and Second Connecticut Lakes, Lake Francis, Umbagog Lake, Newfound Lake and Ossipee Lake. The southern border of the area rests on the shores of Lake Winnipesaukee. The area includes significant unfragmented wetland systems along the edges of rivers, lakes and streams. The area also serves as an important water supply for the state (SFAP Section 6 Watershed Values).

- **Public recreation opportunities and scenic values**
The region is known for its stunning scenic quality and recreational opportunities. The North Country is a vacation destination for visitors world-wide, and particularly from New England and Canada. Highly valued recreational access is available to mountains for skiing and hiking. The White Mountain range is known for its extensive trails on public and private lands, including approximately 160 miles of the Appalachian Trail. The North Country also has state-designated snowmobile trails, and off-road-vehicle trail systems. Water access is available to the region’s many rivers, lakes and ponds.

- **Soil productivity**
A largest soil group in the three-county region are Group 1A soils, consisting of deeper, loamy, moderately well-drained and well-drained soils. The soils in this group are well-suited for growing high-quality hardwood veneer and sawtimber, especially sugar maple, white ash, yellow birch, and northern red oak. The second largest is Group 1B consisting moderately well-drained and well-drained, sandy or loamy-over-sandy soils that are slightly less fertile than those in group 1A. Highly productive agricultural soils are found throughout the area, with concentrations along the Connecticut River (SFAP Section 3 Soil Productivity).

- **Historic and cultural values**
Native American sites are found in the area, principally at hilltops and along riparian corridors. The area is known for numerous cultural and historic sites, including a number of small colonial
era communities with well-preserved historic buildings and structures. Historic covered bridges provide links across the region’s rivers, notably in the communities of Jackson, Albany, Bartlett, Bath and Campton. Since 1869 the Mount Washington Cog Railroad, a National Historic Landmark, has provided access to Mount Washington, the highest peak in the eastern United States.

- **Other ecological, geologic features**
  The region is known for many of the state’s unique geologic features including the Tuckerman’s Ravine, Cathedral Ledge White Horse Ledge, The Basin, Franconia State Park, Flume Gorge, Franconia, Madison Boulder, and the Ossipee Mountain area.

**Section 5.2 Connecticut River Valley**

**General Description**
This area, located in western New Hampshire, includes communities along the Connecticut River in Sullivan and Cheshire counties. The North Country FLA is located to the north, and the Monadnock / Merrimack Uplands FLA to the west. The Connecticut River is the largest river in New England. It flows south from northern New Hampshire, forms the state border with Vermont, continues through western Massachusetts and into central Connecticut, and eventually empties into the Long Island Sound.

Land use along the corridor of the Connecticut River is primarily rural and agricultural, with forest that are predominately Appalachian oak-pine. The area contains ecologically important floodplain communities as well as a high incidence of rare, threatened and endangered plant species. Scenic values are high, associated with the forested nature of the upland hillsides juxtaposed with the highly productive farmland of the river floodplain and terraces.

**Consistency with Eligibility Criteria**

**Criteria 1. Large blocks of forest land.**
This area is in close proximity to core forest and other protected lands. Specifically, it is directly adjacent to areas of large forest blocks located in the abutting Monadnock/Merrimack Uplands area. Protection of forests in the corridor is essential to maintaining contiguity of habitat for species that require access to the riparian area along the Connecticut River.

**Criteria 2. Proximity to core forest areas or other permanently protected lands**
A substantial number of farm and forest tracts in the river corridor communities have been protected through regional, state and federal land conservation efforts. These conservation efforts have included protections for the critical riparian and wetland habitats along the main stem of the river. The corridor is part of the Silvio Conte National Fish and Wildlife Refuge. A focus of the refuge is protecting riparian and wetland habitats along the main stem of the river. The Connecticut River Valley is identified as a Multi-State Priority Forest Area (SFAP Section - Multi-State Priorities). The SFAP shows conservation lands in the Connecticut River Valley in Section 12 Conservation Lands, Figure 37 Permanently Conserved Land in NH.

**Criteria 3. Threat to Conversion**
Substantial threats of conversion exist along the Connecticut River Corridor, especially in proximity to the growing urbanizing areas of Lebanon and Keene, New Hampshire and Brattleboro, Vermont (SFAP Section 14 Population Trends; Section 17 Forest Landowner Trends & Potential for Change). According to the US Forest Service publication “Forest on the Edge” this is one of the most at-risk areas of New England for forest fragmentation. Issues associated with this area include invasive species control, urban and...
agricultural runoff impacting water quality, fisheries and wildlife habitat (SFAP Section - Multi-State Priorities).

**Criteria 4. Consistent with the goals in the NH State Forest Action Plan.**

Protection of forests in this area will keep contiguous blocks of forestland under consistent management. The corridor of the Connecticut River contains some of the highest density of Natural Heritage sites (rare, threatened or endangered species) in the state, and conservation of key tracts is essential to conserving the state’s biological diversity. The area comprising the Connecticut River Valley FLA includes moderate to high ranking priority values as identified in the state’s Rural Forest Priority Area (SFAP Section - Priority Landscapes).

**Environmental Values that will be Protected:**

- **Public recreation opportunities and scenic values**
  The area includes scenic values along the river corridor, and recreational access to forestland for hunting and water resources for fishing. The corridor is a popular fall foliage destination for travelers from throughout the northeast region.

- **Critical wildlife and fish habitat**
  The Connecticut River and its corridor provides a variety of habitats for wildlife. Due to its great length, north-south course, abundant wetlands and geographic location in the northeast, the Connecticut River is an important travel corridor for migratory birds. The area is notable for anadromous fish and species dependent on riparian areas. The diverse habitats of the river and its corridor provide breeding habitat for nearly 300 species of native vertebrate animals.

  The river travels through boreal spruce-fir forests in its headwaters, northern hardwood and mixed forests in the central sections, and drier oak forests in the southernmost part of the state. Other important wildlife habitat is located in the rich agricultural lands along the river.

- **Enhancement or maintenance of biodiversity**
  The Connecticut River Valley is long and narrow, extending from the Massachusetts border to the southern end of the North Country. The lower elevations are characterized by a relatively mild climate, and as a result, numerous plants and natural communities otherwise restricted to southern parts of the state extend far up the valley. Laurentian mixed forests and Appalachian oak and pine forests dominate, and rich woods are relatively common compared to other parts of the state. Floodplain forests are common but small, as most of the high floodplains and adjacent terraces have been converted to farmland. River channel natural communities are nearly continuous along the river, although much of the river is regulated by dams. Wetlands, ponds, and lakes are relatively uncommon. Rocky ridges and cliffs are occasional.

  Most New Hampshire species with temperate distributions occupy particular sub-regions or portions of the eastern deciduous forest. Hemlock, yellow birch, white pine, sugar maple, American beech, red maple, and black cherry occur throughout New Hampshire. Oaks, hickories, and dogwoods, representative Appalachian or central hardwood species occur mainly in central and southern parts of the state. Globally rare plant species that are largely restricted in New Hampshire to the Connecticut River Valley include Jesup’s milk-vetch (*Astragalus robbinsii* var. *jesupii*), alpine milk-vetch (*Astragalus alpinus* var. *brunetianus*), northeastern bulrush (*Scirpus*...
ancistrochaetus), and Wright's spikesedge (Eleocharis diandra). Figure 80 New Hampshire Natural Heritage Bureau Sites.

- **Watershed, riparian or groundwater protection**
The FLA is located in the Connecticut River Watershed and includes New England’s largest river. Water quality and quantity benefits from conservation actions include the protection of important stratified drift aquifers along the river corridor (SFAP Section 6 Watershed Values).

- **Production of timber or other forest products**
Productive soils in the area provide excellent timber-growing sites and support a substantial portion of the state's maple sugar industry.

- **Soil productivity**
A predominate soil group in the area is Group 1A, consisting of deeper, loamy, moderately well-drained and well-drained soils. Highly productive agricultural soils are found throughout the area, with concentrations along the Connecticut River. The second largest soil group is Group IIA, consisting of diverse soils and includes many of the soils that are in groups IA and IB, but with management limitations (SFAP Section 3 Soil Productivity).

- **Historic and cultural values**
There is a high density of Native American sites along the riverbanks. The area is known for colonial settlements and historic sites. Notable National Historic Sites include the Cornish-Windsor Bridge, Saint-Gauden’s National Park, and the earliest permanent European settlement took place in 1743 at Fort #4, in present day town of Charlestown.

- **Other ecological, geologic features**
The Connecticut River valley is internationally renowned in the research of glacial geology for the deposition of sediments that occurred in Lake Hitchcock as the ice sheet receded. Bedrock exposures and cuts are used as field study sites scientific research and refinement of the geological history of the Appalachian Mountains by the academic institutions. The geologic history of the region created the formation of aquifers in the Connecticut River Basin which communities use for water supply.

Section 5.3 Monadnock / Merrimack Uplands

**Geographic Description**
This area contains portions of Merrimack, Hillsborough, Cheshire, and Sullivan counties. It is comprised of the uplands east of the Connecticut River Corridor, east to the Merrimack River, excluding the urbanized communities of Manchester, Bedford, Merrimack, Litchfield, and Hudson in Hillsborough County. The principal geographic feature of the region is known as the Monadnock Highlands, a hilly region defining the watershed boundary between the Connecticut River and Merrimack River watersheds. The area’s boarders the North Country FLA to the north, the Connecticut River Valley FLA to the west, and Pawtuckaway and Lakes / Coastal Plain FLA to the east.

There are large areas of unfragmented forest blocks in this area. The area has large blocks of contiguous forestland that is publicly and privately owned. Many thousands of acres of this area are owned by private
non-industrial timber investors, and the area also contains a number of sawmills and forest product manufacturers.

**Consistency with Eligibility Criteria**

**Criteria 1. Large blocks of forest land.**

This area of New Hampshire contains some of the largest blocks of private non-industrial land in the state. Several tracts of northern hardwoods located along the north-south spine of the Monadnock Highlands are held by timber investors and are managed by commercial timber firms. Mapping of large forest blocks illustrates the unfragmented nature of this area (SFAP Section 11 Large Forestland Blocks).

**Criteria 2. Proximity to core forest areas or other permanently protected lands**

This area has long been a principal focus for land conservation efforts. Specifically, it contains Mt. Sunapee, a portion of Pisgah and Rollins State Parks, and major state forests and wildlife management areas. Pisgah State Park is New Hampshire's largest state park at 13,361 acres.

The Monadnock Highlands and adjacent Merrimack Hills contain most of the remaining large blocks of core forest south of the WMNF. The Monadnock / Merrimack Uplands includes a significant portion of the Quabbin to Cardigan Multi-State Priority Forest Area. The region contains one of the largest remaining areas of intact contiguous forest in central New England. The region is the watershed boundary between the Connecticut and Merrimack River valleys, and the highlands provide habitat for many species of migratory birds and wide-ranging wildlife. It supports species in decline elsewhere in New England due to habitat fragmentation. The area’s forests also form the basis for a vibrant tourism, recreation and forest products economy (SFAP Section - Multi-State Priorities).

Land trusts have protected large contiguous blocks of forestland in the region. The Quabbin to Cardigan Partnership, a two-state regional conservation partnership formed in 2000, has helped to protect more than 90,000 acres. The NH Forest Legacy program has protected 12,404-acres in the Monadnock / Merrimack Uplands FLA, including the Crotched Mountain and Pillsbury-Sunapee Highlands projects. A list of completed Forest Legacy projects is found in Appendix C, and the SFAP details existing conservation lands in Section 12.

**Criteria 3. Threat to Conversion**

Threat of conversion is generally associated with the growing suburbanization associated with cities in this region. In the area near Manchester and Nashua, fragmentation and development is among the most rapid in the state. Areas near the cities of Concord, Keene, and New London continue to experience subdivision and development. Adjacent areas have allowed for forest conservation efforts to succeed in protecting large blocks (SFAP Section 14 NH Population Trends; Section 17 Forest Landowner Trends & Potential for Change).

**Criteria 4. Consistent with the goals in the NH State Forest Action Plan.**

Conservation of lands in this area is consistent with the Forest Action Plan goal of keeping large contiguous blocks of forestland intact and under consistent management. Conservation of large blocks will help ensure continued high-quality habitat for numerous typical and common species that require large blocks, such as bear and bobcat, as well as protecting isolated areas of unusual diversity within these forest areas. Most of these lands have been traditionally open for public recreation, especially hunting and fishing, and represent important recreational resources for these traditional pastimes. The area comprising the Monadnock/Merrimack Uplands FLA contain moderate to high ranking priority values in the State’s Rural Forest Priority Area (SFAP Section - Priority Landscapes).
Environmental Values that will be Protected

- **Production of timber or other forest products**
  This area is an important forest products resource with extensive hardwood forests that supply a large number of sawmills and manufacturers. For example, Henniker, a town on the Contoocook River near Concord, hosts mills that depend on both hard and softwood resources from this area.

- **Critical wildlife and fish habitat**
  The retention of large blocks of core or contiguous forest is critical to maintaining habitat for large mammals and maintaining basic ecosystem functions. This area has the largest blocks of unfragmented forest south of the WMNF. Further, the existing large blocks of public and private protected land form the basis for linking tracts together to form a continuous protected region of many tens of thousands of acres of land.

- **Enhancement or maintenance of biodiversity**
  The Monadnock-Sunapee Highlands region occupies the area southwest of the White Mountains to Mount Monadnock in the southwestern part of the state. Laurentian mixed forests are the main forest type in the region, although Acadian spruce-fir forests cap many of the higher summits. Rocky ridges, small cliffs, and talus slopes are common. Marshes, swamps, and peatlands are common, but relatively small compared to wetlands in regions with more extensive lowland areas.

  The Merrimack River Valley region occupies lowlands along the Merrimack River from Franklin to the Massachusetts border. The historic glacial Lake Merrimack once occupied much of this valley, which is now filled with abundant stratified sand and gravel overlying fine lakebed deposits. Appalachian oak and pine forests are the main forest type, with patches of historically widespread pitch pine woodlands. Wetlands are common, including peatlands, swamps, and marshes. Floodplains occur along the Merrimack River and its major tributaries. White pine is abundant throughout the region. Many temperate plants such as scarlet oak, hickories, and sassafras reach or approach the northern end of their geographic range in the Merrimack River Valley region. A number of coastal plain species are also frequent. Globally rare plant species that occur in the Monadnock/Merrimack Uplands include small whorled pogonia (*Isotria medeoloides*), Fogg's goosefoot (*Chenopodium foggii*), quill-leaved arrowhead (*Sagittaria teres*), and American ginseng (*Panax quinquefolius*). Figure 80 New Hampshire Natural Heritage Bureau Sites.

- **Public recreation opportunities and scenic values**
  Generally, this is an area of dispersed recreation opportunities, with hunting, fishing and hiking being especially important. Lake Sunapee lies near the center of the area, providing important water-based recreation and winter sports opportunities. The area also contains a number of state-designated Scenic Byways and is a popular destination for fall foliage viewing.

- **Watershed, riparian or groundwater protection**
  The area is located within the Connecticut River and Merrimack River watersheds. Major stratified drift aquifers line the Ashuelot, Sugar, Cold, Contoocook, and Warner river corridors. The
proximity to urban areas such as Keene and Concord highlight the importance of these aquifers (SFAP Section 6 Watershed Values).

- **Historic and cultural values**
  The area’s history from early settlements and forts dates from the 1600 and 1700s to industrial mills of the late 1800s to early 1900s, and toy factories, glass makers and quarries. The homestead of President Franklin Pierce is located in Hillsborough. The region includes covered and old stone bridges, carriage roads the wind through woods past old stone foundations.

- **Soil productivity**
  The area consists of a mosaic of soil groups with Group IB being the predominate soil group. These soils generally consist of moderately well-drained and well-drained, sandy or loamy-over-sandy soils, well-suited for growing less-nutrient-and-moisture-demanding hardwoods such as white birch and northern red oak (SFAP Section 3 Soil Productivity).

- **Other ecological, geologic features**
  Mount Monadnock is the most prominent mountain peak in the area and the highest point at 3,165 feet in Cheshire County, largely composed of 400-million-year-old schist and quartzite rock.

5.4 Pawtuckaway and Lakes / Coastal Plain

**General Description**

The Pawtuckaway and Lakes / Coastal Plain FLA includes all of Belknap County, most of Strafford County, eastern Merrimack County, and the northern portion of Rockingham County. The area is south and adjacent to the North Country FLA, and to the west of the Monadnock / Merrimack Uplands FLA. The area includes the southern portion of New Hampshire’s Lakes region, a highly popular recreation area, and the hills east of Concord and south to the northerly edge of the highly fragmented Massachusetts border towns of Rockingham County. The boundary of this area roughly corresponds to those municipalities along the path of NH Route 101 running east from Manchester, and then northerly along Route 125 to the City of Rochester. The communities south and east of this boundary have been excluded from the FLA because land parcels in these municipalities are generally small, there has been extensive suburbanization in the area, and remaining forested tracts generally carry very high prices.

This area contains much of the state most productive forest soils, especially those best suited to the growth of white pine and red oak, the two most commercially valuable species in the region. Two of the state's most popular state parks, Bear Brook and Pawtuckaway, are in this area, and are surrounded by a significant number of large, unfragmented parcels located close to rapidly urbanizing areas to the west, south and east.

The Pawtuckaway and Lakes / Coastal Plain FLA has important scenic values and recreation lands. The presence of the large number of lakes brings significant numbers of seasonal vacationers to the area, and the forests of the area ensure continued high water quality in these lakes. The southern portions of the area are known to contain significant numbers of rare, threatened and endangered plants.

**Consistency with Eligibility Criteria**

*Criteria 1. Large blocks of forest land*
This area contains a number of large blocks of forestland, with most concentrated in the area of Rockingham, Strafford and Merrimack counties immediately north of Bear Brook and Pawtuckaway State Parks. These include tracts in the Towns of Allenstown, Barrington, Chichester, Deerfield, Epsom, Farmington, Middleton, Milton, New Durham, Northwood, Nottingham, and Strafford.

Other large blocks are found in close proximity to the state's largest lake, Lake Winnipesaukee, surrounding public land in the Belknap Mountain range and near the Jones Brook Wildlife Management Area in Brookfield, Middleton and New Durham. While block size in this area is not as large as in northern New Hampshire counties and in the Monadnock / Merrimack Uplands area, protection of forest blocks here is critical to maintaining a base of highly productive white pine and red oak sites, a dominant forest type in the coastal plain area (SFAP Section 11 Large Forestland Blocks).

**Criteria 2. Proximity to core forest areas or other permanently protected lands**

The area is contiguous to the existing North Country Forest Legacy Area and is ecologically similar. There are significant protected lands in the area. Two of the state's largest state parks - Bear Brook and Pawtuckaway – total over 15,000 acres. Other large units of protected land include Belknap Mountain State Forest, and major holdings of the Manchester Water Works that protect water quality in the Lake Massabesic watershed. The NH Forest Legacy program has protected 2,318-acre Moose Mountain project in the Pawtuckaway and Lakes / Coastal Plains FLA (Appendix C NH Forest Legacy Completed Projects, and the SFAP includes Section 12 Conservation Lands).

**Criteria 3. Threat to Conversion**

The threat of conversion is greater in this area than any in New Hampshire. The real estate market in Rockingham County has been one of the fastest growing since the 1980s, as noted by increases in population growth and housing starts. Major transportation corridors – NH Routes 4 and 101 - transect this area bringing pressure for commercial, industrial and residential development, particularly in the areas near Concord, Portsmouth and Manchester. Conversion threat in the northerly portion of this area are more often associated with second home development near the lakes and mountains. Most threatened are parcels of forestland with views of the lakes or potential access to water, be it major lakes or small ponds (SFAP Section 14 NH Population Trends; Section 17 Forest Landowner Trends & Potential for Change).

**Criteria 4. Consistent with the goals in the NH State Forest Action Plan.**

Protection of land in this area is consistent with the Forest Action Plan goal of keeping contiguous blocks of forest intact. A number of the potential Forest Legacy projects adjoin or nearly adjoin existing large tracts of protected and productive forestland. This area contains many “hot spots” of biological diversity associated with rare plant communities, including a number of Atlantic white cedar, a community of high priority for protection. Because this area is the focus of so much public outdoor recreation, particularly associated with water-based recreation, protection of the scenic landscape, particularly the forested mountains that form the visual backdrop for the lakes, is a high priority for the state. The area comprising the Pawtuckaway and Lakes / Coastal Plain FLA contain moderate to high ranking priority values in the state’s Rural Forest Priority Area (SFAP Section - Priority Landscapes).

**Environmental Values that will be Protected**

- **Production of timber or other forest products**
  
  This area contains the most productive soils and sites in New Hampshire for the growing of white pine and oak species most valued in the New England forest industry.
- **Critical wildlife and fish habitat**
  The area contains blocks of unfragmented habitat that are essential to the maintenance and enhancement of important game and non-game species, as development and fragmentation continue in this area and in the adjacent Seacoast region. Travel corridors between existing conservation areas, as well as expansion of protected lands is essential in order to retain key indicator species.

- **Enhancement or maintenance of biodiversity**
  The Coastal Plain region extends from the seacoast to 30 miles inland, encompassing the land south of the Lakes Region and east of the Merrimack River Valley. Elevations are mainly below 500 feet, although a few hills such as the Pawtuckaway Mountains exceed 1,000 feet.

  Appalachian oak and pine forests are the main forest types. Marshes and swamps are abundant throughout, and peatlands are frequent in the outwash areas. Tidal marshes, dunes, beaches, and rocky shores are unique features of the immediate seacoast vicinity. Coastal plain species occur in the Seacoast region and at low elevations in the Merrimack River Valley and the Lakes Region. Most are wetland or sand plain species, including Atlantic white cedar (*Chamaecyparis thyoides*), dwarf huckleberry (*Gaylussacia bigeloviana*), sweet pepperbush (*Clethra alnifolia*), beach grass (*Ammophila breviligulata*), golden heather (*Hudsonia ericoides*), and Virginia chain fern (*Woodwardia virginica*). Contained within the area are numerous important ecological resources, including a number of plant communities that are nationally rare. Globally rare and threatened species are found on a number of sites. Figure 80 New Hampshire Natural Heritage Bureau Sites.

- **Watershed, riparian or groundwater protection**
  The FLA is located primarily within the Piscataqua River Watershed, as well as the Merrimack River and Winnipesaukee Watersheds. The area is rich in water resources. Four designated rivers - the Isinglass, Cochecho, Lamprey and Oyster – flow to Great Bay Estuary and the Atlantic Ocean. The portion of the area north of the City of Rochester contains a large stratified drift aquifer. There are other smaller aquifers scattered throughout the area (SFAP Section 6 Watershed Values).

- **Public recreation opportunities and scenic values**
  Recreation and tourism are the important economic activities, and the area supports many public outdoor recreation sites. Area state parks include Pawtuckaway, Bear Brook, Ahern, Ellacoya and Endicott Rock.

- **Soil productivity**
  The area consists of a mosaic of soil groups with Group IB being the predominate soil group. These soils generally consist of moderately well-drained and well-drained, sandy or loamy-over-sandy soils, well-suited for growing less-nutrient-and-moisture-demanding hardwoods such as white birch and northern red oak (SFAP Section 3 Soil Productivity).

- **Historic and cultural values**
  The area contains a number of small colonial era communities with well-preserved historic buildings and structures. Occasional native American sites are found in the area, principally at hilltops and along riparian corridors.

*Other ecological, geologic features*
Located in the FLA is the Belknap Mountain Range, a prominent range west of Lake Winnipesaukee; the range is part of the White Mountain magma series of igneous origin and representing volcanic activity. The highest point at 2,937 feet is Mount Kearsarge.

6. Means of Protection & Forest Legacy Project Selection Process

6.1 Means of Protection
The first three Forest Legacy projects in New Hampshire were completed between 1994 – 1996. The US Forest Service served as conservation easement holder for these projects and the State of New Hampshire assumed responsibility for stewardship and monitoring.

Since 1996, the State of New Hampshire has operated under the Forest Legacy “State Grant Option”, allowing the state to receive grants for acquisition, and hold interests in land with those funds. The Department of Natural and Cultural Resources (DNCR), Division of Forests and Lands is the designed state agency to hold interests in lands. The DNCR is responsible for ensuring the monitoring of the Forest Legacy conservation easement lands held by the State of New Hampshire. The state ensures the protection of the conservation values and principals of the conservation easement are upheld.

The means of protection are as follows:
• Acquisition of conservation easements will be the preferred tool for long-term protection.

• Fee acquisition will be used as an option, but only where the resource values of a tract are such that public ownership will provide better protection. For example, fee purchase could be used to protect a site that receives extensive public recreational use or that provides public access to riparian areas such as rivers, lakes or ponds.

• Timber rights retained by the landowner will be conditioned by adherence to BMPs, harvesting plans and use of the Recommended Voluntary Forest Management Practices described in Good Forestry in the Granite State.

• No disposal of hazardous materials will be allowed on Forest Legacy tracts.

• All conservation easements will meet the provisions of the Internal Revenue Code Section 170(h) governing the tax deductibility of conservation easement donations, whether easements are purchased or donated.

• All Forest Legacy conservation easements will demonstrate long-term capacity to ensure ongoing stewardship. A Stewardship Endowment assessment will be conducted for each NH Forest Legacy property. A stewardship endowment contribution is required for all project.

6.2 Conservation Project Partners
New Hampshire works with willing landowners and skilled conservation project partners to acquire and hold conservation easements on Forest Legacy lands. The following organizations have served as project partners on completed Forest Legacy projects:
• Audubon Society of New Hampshire
• Monadnock Conservancy
• Society for the Protection of New Hampshire Forests
• Southeast Land Trust of New Hampshire
The Conservation Fund  
The Nature Conservancy, New Hampshire Chapter  
The Trust for Public Land

A list of active land trusts in the state is available from the New Hampshire Land Trust Coalition (https://nhltc.org/find-land-trust). See Figure 82 New Hampshire Land Trusts Geographic Coverage for a list and map of land trusts available to participate in future land conservation opportunities.
Figure 82 New Hampshire Land Trusts
6.3 Forest Legacy Program Selection Process

The New Hampshire Forest Legacy Program seeks to undertake projects that, when taken together, display a variety of sizes, forest values to be protected, and conservation techniques. Project selection eligibility criteria, as confirmed annually and subject to revision by the NH Forest Legacy Committee, are summarized below:

The **New Hampshire Forest Legacy Committee** consists of the following representative organizations:

- Audubon Society of New Hampshire
- New Hampshire Division of Forests and Lands, Director
- New Hampshire Division of Parks and Recreation
- New Hampshire Fish and Game Department
- New Hampshire Office of Strategic Initiatives
- New Hampshire Timberland Owners Association
- Society for the Protection of New Hampshire Forests
- The Nature Conservancy, New Hampshire Chapter
- White Mountain National Forest

**Forest Legacy Project Eligibility Criteria**

Appendix D Forest Legacy Application, Appendix E Selection Criteria for New Hampshire Forest Legacy Projects

The Forest Legacy parcels must satisfy the following four primary criteria:

1. Must provide for the continuation of traditional forest uses including forest management and public access for outdoor recreation.
2. Must be threatened by conversion to non-forest uses.
3. Must possess one or more of the following important public values (not in priority ranking):
   a. Recreation opportunities
   b. Waterfront and riparian areas
   c. Fish and wildlife habitat
   d. Threatened and endangered species and natural communities
   e. Cultural resources
   f. Other ecological values and scenic values
   g. Productive viable timber resource

Additional Considerations:

1. What is the manner and degree of threat of conversion to non-forest uses?
2. What are the administrative costs?
3. Is there documentation of its importance in an existing local, regional, or statewide planning document?
4. How do the resource values of this parcel compare with those of competing parcels?
5. What are the economic and environmental implications of the proposed conservation action?
6. Does the project complement existing protected lands?
The final recommendation of the New Hampshire Forest Legacy Committee depends on all relevant aspects of each application and all of the surrounding circumstances. Scoring consideration is given to these four categories:

- Level of Significance: Local, Regional and Statewide
- Multiple Resource Values:
  - Production of timber or other forest products
  - Critical wildlife and fish habitat
  - Enhancement or maintenance of biodiversity
  - Watershed, riparian or groundwater protection
  - Public recreation opportunities and scenic values
  - Historic and cultural values
  - Soil productivity
  - Other ecological, geologic features
- Threat to Conversion: Imminent; Probable in near future (within 5 years); Possible distant future (beyond 5 years)
- Maintenance of Traditional Uses: Fully maintained; Most can be maintained; Some maintained / Some lost.

7. Participation Process and Results
Public participation was conducted as part of the stakeholder involvement process for the 2020 NH Forest Action Plan. See State Forest Action Plan – Introduction.

8. Recommendations

Based on its review of the above information, its knowledge of the resource values of the forests of the State of New Hampshire, and the recognition that continued development for non-forest uses threatens the scenic, recreational, economic, ecological, wildlife, and cultural values of New Hampshire's forested landscape, the NH Division of Forests and Lands and the NH Forest Legacy Committee recommends the following:

1. The Forest Legacy Eligibility Criteria for Forest Legacy Areas and Projects be retained. The criteria adequately reflects the forest protection needs of the state; and

2. The four Forest Legacy Areas be retained. The defined areas - North Country, Connecticut River Corridor, Monadnock/Merrimack Uplands, and Pawtuckaway and Lakes / Coastal Plain – adequately incorporate the important forested resources in the state.
### Forest Legacy Program Requirements in the State Forest Action Plan

<table>
<thead>
<tr>
<th>Forest Legacy Program Requirement</th>
<th>AON Section</th>
<th>SFAP Location Assessment/Strategy Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Forest resources and benefits including:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Aesthetic and scenic values</td>
<td>3.3</td>
<td>13</td>
</tr>
<tr>
<td>• Fish and wildlife habitat</td>
<td>3.1</td>
<td>4</td>
</tr>
<tr>
<td>• Public recreation opportunities</td>
<td>3.3</td>
<td>13</td>
</tr>
<tr>
<td>• Soil productivity</td>
<td>3.5</td>
<td>3</td>
</tr>
<tr>
<td>• Forest products and timber management opportunities</td>
<td>2.3, 2.4</td>
<td>20, 11, 21</td>
</tr>
<tr>
<td>• Watershed values including water-quality protection</td>
<td>3.2</td>
<td>6</td>
</tr>
<tr>
<td>b. The present and future threat—as defined by the State—of conversion of forest areas to nonforest uses</td>
<td>2.1</td>
<td>1, 2, 11, 14, 15, 16</td>
</tr>
<tr>
<td>c. Historic or traditional uses of forest areas, and trends and projected future uses of forest resources</td>
<td>2.1, 2.2</td>
<td>1, 11, 20</td>
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<td>d. Current ownership patterns and size of tracts, and trends and projected future ownership patterns</td>
<td>2.1</td>
<td>17, 18</td>
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<td>e. Cultural resources that can be effectively protected</td>
<td>3.4</td>
<td>X</td>
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<tr>
<td>f. Outstanding geological features</td>
<td>3.6</td>
<td>X</td>
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<tr>
<td>g. Threatened and endangered species</td>
<td>3.1</td>
<td>4, 5</td>
</tr>
<tr>
<td>h. Other ecological values</td>
<td>3.1</td>
<td>5</td>
</tr>
<tr>
<td>i. Mineral resource potential</td>
<td>3.6</td>
<td>X</td>
</tr>
<tr>
<td>j. Protected land in the State, to the extent practical, including Federal, State, municipal, and private conservation organization lands</td>
<td>5</td>
<td>12</td>
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<tr>
<td>k. Issues identified by the State Forest Stewardship Coordinating Committee (SFSCC) and through the public-involvement process</td>
<td>7</td>
<td>Executive Overview</td>
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| Forest Legacy Program Requirement | SFAP - AON Location
Assessment/Strategy Sections |
<table>
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<tbody>
<tr>
<td>a. Identification of applicable eligibility criteria</td>
<td>FLP Section 4</td>
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<tr>
<td>b. Identification of specific Forest Legacy Areas (FLAs) for designation:</td>
<td>FLP Section 5</td>
</tr>
<tr>
<td>i. Location of each geographic area on a map and a written description of the proposed FLA boundary</td>
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<tr>
<td>ii. Summary of the analysis used to identify the FLA and its consistency with the eligibility criteria</td>
<td>FLP Section 5</td>
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<tr>
<td>iii. Identification of important environmental values and how they will be protected and conserved</td>
<td>FLP Section 4, 5</td>
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<tr>
<td>iv. The conservation goals or objectives in each FLA</td>
<td>FLP Section 5, 6</td>
</tr>
<tr>
<td>v. List of public benefits that will be derived from establishing each FLA</td>
<td>FLP Section 4, 5</td>
</tr>
<tr>
<td>vi. Identification of the governmental entity or entities that may hold lands or interests in lands (State grant option)</td>
<td>FLP Section 6.1, 6.2, 6.3</td>
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<tr>
<td>vii. Documentation of the public involvement process and analysis of the issues raised</td>
<td>FLP Section 7</td>
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<td>c. Specific goals and objectives to be accomplished by the FLP</td>
<td>FLP Section Purpose</td>
</tr>
<tr>
<td>d. Process to be used by the State lead agency to evaluate and prioritize projects to be considered for inclusion in the FLP</td>
<td>FLP Section 6.3</td>
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**Date when last Forest Legacy review has been completed with the Forest Stewardship Coordinating Committee:**  **August 7, 2020** (Required every 5 years).
### APPENDICIES

#### Appendix A  Insects and Diseases in NH Affecting Trees

<table>
<thead>
<tr>
<th>County</th>
<th>Number of Introduced Invasive Plants Species</th>
<th>Number of Introduced Invasive Insect Species</th>
<th>Number of Native Invasive Insect Species</th>
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<td>3</td>
<td>4</td>
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<tr>
<td>Cheshire</td>
<td>220</td>
<td>3</td>
<td>3</td>
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<tr>
<td>Coos</td>
<td>255</td>
<td>2</td>
<td>4</td>
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<td>Grafton</td>
<td>194</td>
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<td>4</td>
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<tr>
<td>Hillsborough</td>
<td>220</td>
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<td>3</td>
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<tr>
<td>Merrimack</td>
<td>152</td>
<td>6</td>
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<tr>
<td>Rockingham</td>
<td>225</td>
<td>6</td>
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<tr>
<td>Strafford</td>
<td>269</td>
<td>6</td>
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<tr>
<td>Sullivan</td>
<td>153</td>
<td>3</td>
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<tr>
<td><strong>Total Invasive Species in Dataset</strong></td>
<td><strong>393</strong></td>
<td><strong>8</strong></td>
<td><strong>4</strong></td>
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<table>
<thead>
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<th>Belknap</th>
<th>Carroll</th>
<th>Cheshire</th>
<th>Coos</th>
<th>Grafton</th>
<th>Hillsborough</th>
<th>Merrimack</th>
<th>Rockingham</th>
<th>Strafford</th>
<th>Sullivan</th>
<th># of counties introduced invasive is present</th>
<th>Percent Coverage</th>
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<tbody>
<tr>
<td>Balsam Woolly Adelgid</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
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<td>5</td>
<td>50</td>
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<td>Brown Marmorated Stink Bug</td>
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<td>+</td>
<td>+</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
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<td>Emerald Ash Borer</td>
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<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>40</td>
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<tr>
<td>Gypsy Moth</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
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<td>4</td>
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<tr>
<td>Hemlock Woolly Adelgid</td>
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<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
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<td></td>
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<td>Japanese Pine Bost Scale</td>
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<td></td>
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<td></td>
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<td>Spotted Wing Drosophila</td>
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<td>+</td>
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<tr>
<td>Winter Moth</td>
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<td>+</td>
<td>+</td>
<td></td>
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<th>Hillsborough</th>
<th>Merrimack</th>
<th>Rockingham</th>
<th>Strafford</th>
<th>Sullivan</th>
<th># of counties introduced invasive is present</th>
<th>Percent Coverage</th>
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<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
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<td>30</td>
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<tr>
<td>Large Aspen Tortrix</td>
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<td>+</td>
<td>+</td>
<td></td>
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<td>Spruce Beetle</td>
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<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
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<td>90</td>
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<td>Spruce Budworm</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td>100</td>
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</table>

New Hampshire Forest Action Plan
Appendix B  US Dept. of Commerce - Outdoor Recreation Activities

The US Department of Commerce, through its research and data arm, the Bureau of Economic Analysis, provides a well of and the primary national and state source of economic activity for the U.S. In the Outdoor Recreation Jobs and Economic Impact Act of 2016 law (federal legislation), the Bureau of Economic Analysis was mandated to collect and maintain data and information about the outdoor recreation economic impact in the country. This source includes data from the following outdoor recreation activities:

• Agritourism (Animal sanctuaries, Petting zoos, Pick-your-own produce farms, Vineyard tours)
• Air sports (Base jumping, Hang gliding, Skydiving)
• Amusement parks/Water parks
• Augmented reality games
• Beachgoing
• Bicycling (All recreational bicycling, including BMX, E-bikes, Mountain, On-road)
• Boardsailing/Windsurfing
• Boating/Fishing (All recreational boating, including Canoeing, Fishing, Inboard/Outboard, Kayaking, Personal watercraft, Sailing)
• Climbing/Hiking/Tent Camping
• Disc golf
• Driving for pleasure (Gas spending only)
• Equestrian
• Festivals/Sporting events/Concerts (includes Professional sports)
• Field sports (e.g., Football, Lacrosse, Soccer)
• Game area sports (e.g., Basketball, Golf, Tennis)
• Geocaching/Orienteering/Rock hounding
• Guided tours/Outfitted travel (includes Boating and Fishing charters)
• Hot springs soaking
• Hunting/Trapping/Shooting (including Archery)
• Ice skating
• Inline skating
• Kite flying
• Land/Sand sailing
• Model airplane/rocket/UAV
• Motorcycling/ATVs (Off-road, On-road)
• Other Conventional Activities
• Other Conventional Air and Land activities
• Other Conventional Water activities
• Paintball
• Photography
• Productive activities (Beekeeping, Foraging, Gardening, Panning for ore)
• Races (includes Bike and Endurance racing)
• Recreational flying (Experimental, Glider, Turboprop, Ultralight)
• Running/Jogging/Walking
• RVing
• SCUBA Diving
• Skateboarding
• Snorkeling
• Snow activities (Dog mushing, Skiing, Sleighing, Snowboarding, Snowmobiling, Snow shoeing, Tubing)
• Stand-up paddling
• Stargazing/Astronomy
• Surfing
• Swimming
• Therapeutic Programs
• Tubing/Wakeboarding
• Water Polo
• Water skiing
• Whitewater rafting
• Wildlife watching/Birding
• Yard sports (e.g., Bocce ball, Croquet)
## Appendix X: New Hampshire Forest Legacy Completed Projects by Forest Legacy Area (January, 2020)

<table>
<thead>
<tr>
<th>PROJECT NAME</th>
<th>TRACT NAME</th>
<th>ACRES</th>
<th>PROTECTION</th>
<th>LOCATION - FLA</th>
<th>LOCATION - Town</th>
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</thead>
<tbody>
<tr>
<td>13-mile Wood</td>
<td>13-mile Wood</td>
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<td>CE</td>
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<td>Errol &amp; Cambridge</td>
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<td>Androscoggin Headwaters</td>
<td>Androscoggin Headwaters North</td>
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<td>Androscoggin Headwaters South</td>
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<td>Errol, Wentworth Location, Cambridge, Dummer</td>
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<td>Androscoggin Headwaters</td>
<td>Greenough Ponds</td>
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<td>FE</td>
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<td>Bunnell Mountain</td>
<td>Bunnell Mountain</td>
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<td>Ashuelot River Headwaters I</td>
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<td>Mahoosuc Gateway/Success</td>
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3) MONADNOCK/MERRIMACK UPLANDS

| Crotch Mountain | Crotch Mountain        | 1226  | CE         | 3              | Greenfield            |
| Crotch Mountain | Thomas 1               | 53    | CE         | 3              | Greenfield            |
| Crotch Mountain | Thomas 2               | 177   | CE         | 3              | Greenfield            |
| Crotch Mountain | Thomas 3               | 144   | CE         | 3              | Greenfield            |
| Crotch Mountain | Thomas 4               | 53    | CE         | 3              | Greenfield            |
| Pillsbury-Sunapee Highlands | Cunningham Pond | 225   | CE         | 3              | Bradford, Goshen, Newbury, Washington |
| Pillsbury-Sunapee Highlands | Matthew's Road | 293   | CE         | 3              | Bradford, Goshen, Newbury, Washington |
| Pillsbury-Sunapee Highlands | Mount Cardigan State Forest Lot | 143   | FE         | 3              | Bradford, Goshen, Newbury, Washington |
| Pillsbury-Sunapee Highlands | Pillsbury-Sunapee Highlands | 6875  | CE         | 3              | Bradford, Goshen, Newbury, Washington |
| Pillsbury-Sunapee Highlands | Province Road State Forest Inholding | 27    | FE         | 3              | Bradford, Goshen, Newbury, Washington |
| Pillsbury-Sunapee Highlands | West Hill | 223   | CE         | 3              | Bradford, Goshen, Newbury, Washington |
| Rossview         | Rossview tract         | 548   | CE         | 3              | Concord               |
| Rossview         | Sherburne/Pratt        | 94    | CE         | 3              | Concord               |
| Willard Pond     | Bald Mountain Tract    | 376   | CE         | 3              | Antrim, Stoddard      |
| Willard Pond     | Dawson Tract           | 280   | CE         | 3              | Antrim, Stoddard      |
| Willard Pond     | Robb Reservoir         | 1667  | CE         | 3              | Antrim, Stoddard      |
| **Total Acres**  |                       | **12404** |           |                |                       |

4) PAWTUCKAWAY & LAKES/COASTAL PLAINS

| Moose Mountain  | Meaderboro             | 129   | CE         | 4              | Middleton, Brookfield, New Durham, Alton |
| Moose Mountain  | Moose Mountain          | 2189  | CE         | 4              | Middleton, Brookfield, New Durham, Alton |
| **Total Acres** |                       | **2318** |           |                |                       |
Appendix D  New Hampshire Forest Legacy Program Application

NEW HAMPSHIRE FOREST LEGACY PROGRAM

TRACT APPLICATION

The information requested below will be used by the New Hampshire Forest Legacy Committee to evaluate the tract you propose to enroll in the Forest Legacy Program. This information may also be used to rank Forest Legacy applications nationally. Information provided in this application may be released to the public, at the discretion of the State. You may submit any additional information (such as a survey or appraisal) that you believe might assist us in our review of your proposal. Attach additional pages if necessary. If you have any questions please call the Division of Forests and Lands at (603) 271-2214. If the application is incomplete it will be returned to you.

Please return 3 copies of the completed application and supporting material to:

Director
Division of Forests and Lands
Department of Natural and Cultural Resources (DNCR)
172 Pembroke Road
Concord, NH 03301

Project Name ________________________________
Tract Name ________________________________
Landowner names should not be used as project or tract name. If a project contains only a single tract the same name should be used for both.

Office Use Only
Date Received:_______
Received By:_________
Tract #:___________

In accordance with Federal law and U.S. Department of Agriculture policy, this institution is prohibited from discriminating on the basis of race, color, national origin, sex, age, or disability. (Not all prohibited bases apply to all programs.)

To file a complaint of discrimination, write USDA Director, Office of Civil Rights, Room 326-W,
1) County: ______________________
   Town: ______________________

2) Owner(s)         Agent         Sponsor

   Name: ______________________  ______________________  ______________________
   ______________________

   Address: ______________________  ______________________  ______________________
   ______________________  ______________________
   ______________________

   Day Phone: (____)   (____)   (____)
   Evening Phone: (____)   (____)   (____)

3) Property address if different from above:
   Address: _____________________________________________________________________

   Name of person in residence (if applicable): ___________________________________________________________________________________
4) Deed Reference  
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<th>Map#:</th>
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Assessors Information

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5) Are there any known land title defects or encumbrances or liens on the property including mortgages, easements, current use taxation (RSA 79-A), contracts, leases or outstanding rights of record (eg. industrial contracts with landowners for management, timber rights, mineral rights, etc.)?

YES_____ NO_____

If yes, please identify:

____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________

6) Are there any permanent improvements such as houses, barns, dams, antennas, all season roads, utility rights of way with structures, pipeline rights of way, etc. on the property? YES____NO_____

If yes, please explain and show on map:

____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________

7) To the best of your knowledge, are there any known present or past environmental hazards or waste on the property or abutting properties? YES_____NO_____

If yes, please explain:

____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________
8) Is there a written stewardship plan or multi-resource (forest management) plan on this tract?
   YES____  NO____

9) Tract Description (acreage)

   Forest Land
   Productive Forest Land
   Nonproductive Forest Land (steep slopes, shallow soils)

   Total Forested

   Non-Forested Land
   Open Field/Agricultural
   Water/Wetland
   Roads
   Gravel Pits
   Other (specify)

   Total Non-Forested

   Total Ownership Acreage

   Acreage Proposed for Easement

10) How much frontage does the property have on lakes, ponds, rivers and streams?

    Water Body Name  Frontage (feet)
    ___________________  ___________
    ___________________  ___________
    ___________________  ___________
    ___________________  ___________
    ___________________  ___________

11) Which of the following values pertain to this tract? (please describe each in detail):

    ___ Fish and Wildlife Habitat
    ___ Public Recreation Opportunities
    ___ Riparian Areas
    ___ Rare, Threatened and/or Endangered Species or Natural Communities
    ___ Unique or Unusual Species or Natural Communities
    ___ Part of a Large Contiguous Block of Forest Land
    ___ Cultural Resources
    ___ Scenic Resources
    ___ Timber Management
    ___ Watershed Protection
    ___ Other Ecological Values or public Benefit
Description of Resource Values. Include documentation of information sources (attach additional sheets if necessary):

_____________________________________________________________________________________________

_____________________________________________________________________________________________

_____________________________________________________________________________________________

_____________________________________________________________________________________________

_____________________________________________________________________________________________

12) How would you rate the property for production of quality wood products?

Above Average__________  Average__________  Below Average__________

13a) Identify the threat of conversion of this parcel to non-forest use:

_____________________________________________________________________________________________

_____________________________________________________________________________________________

_____________________________________________________________________________________________

13b) Describe tract characteristics that make it suitable or desirable for conversion/development (soils, terrain, views, road or water frontage, etc).

_____________________________________________________________________________________________

_____________________________________________________________________________________________

14a) Does the property lie within, or in close proximity to, a Federal or State designated special resource area (e.g. Wild and Scenic River, public water supply, etc.)?     YES_____NO_____

If yes, please explain:

_____________________________________________________________________________________________

_____________________________________________________________________________________________

_____________________________________________________________________________________________

_____________________________________________________________________________________________

14b) Is the property in close proximity to Municipal, State, or Federally owned conservation land (e.g. National Forest, State Forest, State Park, National Wildlife Refuge)?     YES________  NO ______________

If yes please explain:

_____________________________________________________________________________________________

_____________________________________________________________________________________________

_____________________________________________________________________________________________

14c) Is the property in close proximity for privately owned & protected conservation land?     YES_______NO______
If yes please explain:

_____________________________________________________________________________________________

_____________________________________________________________________________________________

_____________________________________________________________________________________________


15) The New Hampshire Forest Legacy Program requires public access. One of the primary purposes of the program is for the State to allow public pedestrian access onto forest legacy properties for activities such as hiking, fishing, hunting, cross country skiing, and also snowmobiling on designated trails. Please explain any limitations to public recreational access on this property that you would request in this project.

_____________________________________________________________________________________________

_____________________________________________________________________________________________

_____________________________________________________________________________________________


16) One of the purposes of the New Hampshire Forest Legacy Program is to retain properties in perpetuity as a sustainable tract of land for the production of sawlogs, pulpwood, and other forest products. Please explain any limitations to this purpose on this property that you would request in this project.

_____________________________________________________________________________________________

_____________________________________________________________________________________________

_____________________________________________________________________________________________


17) One of the purposes of the New Hampshire Forest Legacy Program is conserve waterfront, streams, riparian areas and the quality of groundwater and water resources. Please explain any limitations to this purpose on this property that you would request in this project.

_____________________________________________________________________________________________

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_____________________________________________________________________________________________
18) One of the purposes of the New Hampshire Forest Legacy Program is to conserve biodiversity, fish and wildlife habitats, rare plants and animals, rare and exemplary natural communities, and cultural resources. Please explain any limitations to this purpose on this property that you would request in this project.

_____________________________________________________________________________________________
_____________________________________________________________________________________________
_____________________________________________________________________________________________
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19) What rights will be retained or sold by the owner and how will those rights further the stated goals of the Forest Legacy Program to protect forest land from conversion to non-forest uses, while maintaining traditional uses?

Rights retained: ________________________________________________
________________________________________________________________________
________________________________________________________________________

Rights sold: _________________________________________________________
________________________________________________________________________

Explanation: _________________________________________________________
________________________________________________________________________

20) Please describe the general character, ownership and use of abutting lands.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

21a) Has there been an appraisal of the property and if so would you be willing to supply a copy of the appraisal to the State (this document would be kept confidential at applicants request)? Yes ______ No _______
21b) Estimate fair market value of the rights being sold (fee or easement): $__________________

22) The federal contribution to total project cost cannot exceed 75%. What are the sources and amounts of cost share for this project?
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

23) **If a conservation easement acquisition: Monitoring Endowment payment -REQUIRED**
Using the attached Land Conservation Endowment Contribution Matrix, enter the estimated amount of the conservation easement monitoring endowment payment required for this tract.

$__________________
a. Location map  
   b. USGS Topographic map with area identified 
   c. Assessors Map for tract 
   d. Photographs. Low oblique aerial photos if available 
   e. Legal Description (copy of deed) 
   f. Signed statement giving the NH Division of Forests and Lands, the USDA Forest Service and their agents permission to enter the property for review and appraisal purposes. 
   g. Letter of appointment of landowner’s agent, if applicable. 
   h. Special reports, inventories or other information or maps useful in evaluating the property for inclusion in the Forest Legacy Program. 
   i. Boundary surveys 
   j. For owners retaining resource rights: a State approved Forest Stewardship Management Plan (required prior to project closing).
I HEREBY CERTIFY THAT THE INFORMATION I HAVE INCLUDED IN THIS APPLICATION IS, TO MY KNOWLEDGE, CORRECT AND THAT ALL OWNERS OF THESE RIGHTS IDENTIFIED IN THIS PROPOSAL FOR ACQUISITION THROUGH THE FOREST LEGACY PROGRAM ARE AWARE OF THIS APPLICATION AND APPROVE OF ITS SUBMISSION.

I ALSO ATTEST THAT I UNDERSTAND THAT THE PURPOSES OF THE NEW HAMPSHIRE FOREST LEGACY PROGRAM ARE AS FOLLOWS:

- TO PRESERVE OPEN SPACES, NATURAL RESOURCES AND SCENIC VALUES, PARTICULARLY THE CONSERVATION OF PRODUCTIVE FOREST LANDS FOR THE ENJOYMENT, EDUCATION, AND BENEFIT OF THE GENERAL PUBLIC.

- TO PROVIDE FOR THE CONTINUATION OF TRADITIONAL FOREST USES INCLUDING FOREST MANAGEMENT ACTIVITIES AND OUTDOOR RECREATION.

- TO CONSERVE WATERFRONT, STREAMS, RIPARIAN AREAS AND THE QUALITY OF GROUNDWATER AND SURFACE WATER RESOURCES, AND TO CONSERVE BIOLOGICAL DIVERSITY, FISH AND WILDLIFE HABITATS, RARE PLANTS AND ANIMALS, RARE AND EXEMPLARY NATURAL COMMUNITIES AND CULTURAL RESOURCES.

- TO GUARANTEE PUBLIC ACCESS ON THE PROPERTY, WHICH WILL ALLOW THE GENERAL PUBLIC TO HIKE, HUNT, FISH, TRAP, AND PARTICIPATE IN OTHER LOW IMPACT OUTDOOR RECREATIONAL ACTIVITIES, AND SNOWMOBILE ON DESIGNATED TRAILS.

- TO RETAIN THE PROPERTY IN PERPETUITY AS AN ECONOMICALLY VIABLE AND SUSTAINABLE TRACT OF LAND FOR THE PRODUCTION OF SAWLOGS, PULPWOOD, AND OTHER FOREST PRODUCTS.

BY SIGNING THIS APPLICATION THE TITLE HOLDERS ARE CONFIRMING THEIR WILLINGNESS TO CONVEY THE PROPERTY INTEREST(S) IDENTIFIED IN THE APPLICATION AND WITH THE DEED TERMS IDENTIFIED, PROVIDED THAT THE APPLICATION RECEIVES FOREST LEGACY FUNDING. SIGNATURES ON THIS APPLICATION FORM SHALL NOT CREATE ANY ENFORCEABLE LEGAL RIGHTS ON BEHALF OF ANY APPLICANT OR TITLE HOLDER, NOR DOES SIGNING CONSTITUTE A COMMITMENT ON THE PART OF ANY PROPERTY OWNER TO SELL THE PROPERTY. IT IS MEANT ONLY TO INDICATE THAT ALL PARTIES ARE AWARE OF THE PROJECT, THE TERMS OF THE PROJECT, AND THAT IT IS BEING PREPARED FOR SUBMISSION TO THE FOREST LEGACY PROGRAM WITH THE ENDORSEMENT AND WILLINGNESS OF ALL PARTIES.

________________________________________
LANDOWNER NAME SIGNED

________________________________________
MAILING ADDRESS

NAME (TYPED OR PRINTED)

________________________________________
DAY TIME TELEPHONE NUMBER

________________________________________
LANDOWNER’S AUTHORIZED REPRESENTATIVE

NAME OF LANDOWNERS

REPRESENTATIVE

(signature)

(typed or printed)

ADDITIONAL LANDOWNER SIGNATURES

________________________________________
NAME SIGNED

________________________________________
EMAIL ADDRESS

NAME (TYPED OR PRINTED)

________________________________________
NAME SIGNED

________________________________________
EMAIL ADDRESS

NAME (TYPED OR PRINTED)
**New Hampshire Forest Legacy Program Project Budget Sheet**

Project Name: ____________________________

**Requested from Forest Legacy Program:**

<table>
<thead>
<tr>
<th>Expense</th>
<th>Amount</th>
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**Total request from Forest Legacy Program**

**Cost Share:**

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<th>Expense</th>
<th>Source of Funds</th>
<th>Cash</th>
<th>Non-cash</th>
<th>Amount</th>
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**Land Donation – Tract name**

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<th>Value</th>
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**Total Cost Share**

Note: The total cost share amount must be $\geq \frac{(\text{Forest Legacy Program funding})}{3}$
LAND CONSERVATION ENDOWMENT CONTRIBUTION MATRIX
DNCR DIVISION OF FORESTS AND LANDS
FOR FOREST LEGACY CONSERVATION EASEMENTS

This document is intended to provide information and guidance to assist project partners in approximating the amount of endowment resources that will be required by the State of New Hampshire to effectively steward, monitor, and enforce conservation easements acquired through the New Hampshire Forest Legacy Program.

Each time the State protects a property with a conservation easement, it is accepting the legal and ethical responsibility to uphold the terms of that easement in perpetuity. Quality easement stewardship involves many components to ensure that protected lands are managed and used in accordance with the terms of the easement and that conservation values are being protected over time. Stewardship activities include annual monitoring, keeping accurate records, developing and maintaining positive landowner relationships, providing easement interpretations, working with the landowner or others to resolve issues, and enforcement action if necessary.

Forest Legacy easements typically have unique responsibilities and factors affecting the cost of long term stewardship. Among these are the exceptionally large size of the land blocks subject to easement; the nature of the Forest Legacy easements as traditional “working” landscapes and allowing for relatively intense use of the property; management of special resource management areas; specific requirements involving review and approval of comprehensive stewardship plans and oversight of plan implementation; annual meeting requirements; and issues relating to the public use of the protected property. In addition, Forest Legacy easements that allow subdivision or the transfer of individual tracts, have multiple reserved rights, special management areas, etc., further increase the amount of resources necessary to steward the easement and therefore the annual cost.

The two sections that follow are intended to allow project partners to estimate the amount of endowment resources necessary for the State to adequately meet its stewardship, monitoring, and enforcement responsibilities over time. It is expected that project partners will use this information to provide a preliminary endowment contribution estimate at the time the Forest Legacy application is submitted. Forest Legacy projects often take years to complete. They sometimes change as the project progresses and many elements affecting long-term stewardship costs (such as easement language) are not finalized at the time of application. Therefore it is understood that the final endowment contribution may be different, if the conservation project changes substantially from that which is originally submitted. Final endowment contribution amounts may also need to be adjusted as the project elements, such as easement language, are finalized. This document however, should assist partners in planning at the earliest project stages for adequate stewardship endowment funding and aid in their project fundraising.

It is the state’s intent to regularly review and update this information as it better understands the long-term costs of stewarding easements such as Forest Legacy, refines its methodology for monitoring large working easements, incorporates new technologies, and assesses program costs.

The NH Treasury Department is required by statute to manage the Land Conservation Endowment for the sole purpose of providing a perpetual source of income. It has determined that in order for the endowment to grow over time, no more than 4% of the market value of the endowment (using a 12-quarter rolling average) may be withdrawn in any given year. It is important to recognize that this is a maximum, and given the current economic volatility, the Treasury Dept. may advise that this percentage be reduced in which case the amount of income available for easement stewardship would decrease.

Project partners should first use the guidelines in Section 1 to determine the base (or minimum) endowment contribution for a particular project. These amounts are intended to capture the costs associated with routine annual monitoring and other associated annual tasks, including the required annual meeting, as well as occasional minor issues or questions that may arise. It is also intended to capture costs associated with non-routine activities that may occur periodically to respond and/or review reserved rights or allowed uses that are part of the standard Legacy easement template language. It assumes that there is minimal potential for significant additional staff time required over the course of any given year, over time. This assumes a minimum contribution amount of $30,000 in all cases (which would generate a maximum of $1,200/year income based on 4%) and provides for larger contributions as the property acreage increases. Project partners should use the figures from this section as a starting point for estimating an endowment contribution for their project.
Section 2 (Additional Contribution Assessment) should then be used to determine whether optional or other non-standard easement provisions, as may be desired by the owner, will require additional endowment funds to be added to the base amount. Project partners should evaluate an individual project using both the base (minimum endowment) and the criteria outlined in Section 2 and be prepared to discuss these at the time of application submission.

For the purposes of this document and the NH Forest Legacy Program, “tract(s)” is defined as a parcel or group of parcels that are included in the project that are under a single ownership and intended to be closed on at the same time.

In addition, at the time of application, project partners should also complete the attached “Stewardship Considerations Questionnaire” and provide the State with preliminary GIS shape files approximating the project boundaries. This information will assist the State in assessing whether an individual project contains unusual or unique factors that could further increase the State’s overall stewardship responsibility over time. The State reserves the right to adjust the overall stewardship contribution amount as appropriate in such situations and will determine, on a case-by-case basis, if any additional contribution (beyond that estimated in Sections 1 and 2) is necessary. Endowment adjustments by the State will be determined early in the application process, following additional consultation with the project partner.

For questions regarding this matrix & the worksheets contact:

Tracey Boisvert  
NH Division of Forests and Lands  
603-271-2214

Susan Francher  
NH Division of Forests and Lands  
603-271-2214

Steve Walker  
Conservation Land Stewardship Program  
603-271-6809

Dea Brickner-Wood  
Forest Legacy Consultant  
603-271-2214
Section 1: Base Contribution Amount

<table>
<thead>
<tr>
<th>Acres</th>
<th>Base Contribution Amount</th>
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<tbody>
<tr>
<td>2000 acres or less</td>
<td>$30,000*</td>
</tr>
<tr>
<td>2,001 – 6,000 acres</td>
<td>$40,000</td>
</tr>
<tr>
<td>6,001 – 10,000 acres</td>
<td>$50,000</td>
</tr>
<tr>
<td>10,001 – 20,000 acres</td>
<td>$70,000</td>
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<tr>
<td>Greater than 20,000 acres</td>
<td>$80,000 (or more as determined in consultation w/ CLS and DNCR depending on total acreage)</td>
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* $30,000 = $1,200 (max. annual disbursement based on 4%)
  $40,000 = 1,600
  $50,000 = 2,000
  $70,000 = 2,800
  $80,000 = 3,200

Section 1: Base Contribution Amount = $___________
Section 2: Additional Contribution Assessment
(Forest Legacy – Reserved Rights and/or Other Non-Standard Easement Provisions)

The Forest Legacy Sample Easement Template contains multiple easement provisions, which are marked as Optional, or in the case of Lot Subdivision, Alternative. Many of the Optional/Alternative provisions, although potentially necessary to complete a particular conservation project, result in increased stewardship responsibility after that particular optional provision is exercised.

Project partners should use the criteria and information in Section 2 to assess whether the conservation easement language for their particular project will include any of the Optional/Alternative easement provisions listed below. If so, project partners can anticipate that an additional contribution beyond the base amount will be required for each of the provisions as specified. Other non-standard easement provisions proposed by project partners beyond those listed below, should be listed individually and will be assessed on a case-by-case basis by the CLS Program in consultation with DNCR to determine the additional endowment contribution needed, if any.

The totals from Sections 1 and 2 will equal the preliminary endowment cost estimate.

(Note: Optional provisions listed below are based on Legacy Template dated 10-13-2010. This list may expand or be modified based on future template easements.)

LOT SUBDIVISION “ALTERNATIVE” (2.H.):
This particular reserved right has the greatest potential to exponentially increase easement stewardship and monitoring costs over time. Each division or separate conveyance of an individual tract essentially creates a new easement with a new landowner, different management goals, new management plan, additional annual meetings, etc.

If the conservation easement will allow the owner to subdivide and/or convey individual tracts separately from the rest of the property, project partners can anticipate an additional contribution of $10,000 for each allowed subdivision and/or allowed conveyance of an individual tract.

# OF ALLOWED SUBDIVISIONS AND/OR CONVEYANCES OF INDIVIDUAL TRACTS: ______ X $10,000 $______________

WITHDRAWAL LOTS (3.J.):
If the tract(s) include one or more proposed withdrawal lots, project partners can anticipate an additional contribution of $2,500 for each allowed lot withdrawal.

# OF WITHDRAWAL LOTS PROPOSED: ________ x $2,500 = $______________

CAMP SITES (Camp Sites, Lean-To Shelters, and Yurts) (3.K.):
If the tract(s) includes one or more proposed camp sites, lean-to shelters, and/or yurts, project partners can anticipate an additional contribution of $2,500 for each structure.

# OF CAMP SITES, LEAN-TO SHELTERS, AND YURTS PROPOSED: ________ x $2,500 = $______________
Section 2 (continued) : Additional Contribution Assessment
Forest Legacy - Reserved Rights and/or Other Non-Standard Easement Provisions

**OTHER EASEMENT PROVISIONS PROPOSED BY THE APPLICANT:**
List any other easement provisions below that are proposed by the applicant but not included in the Template Language. Additional contribution amounts, if any, will be determined in consultation with the CLS Program and DNCR.

<table>
<thead>
<tr>
<th>Provision Descriptions</th>
<th>Total Amount</th>
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<tbody>
<tr>
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Section 2: Additional Contribution Assessment Total = $__________
PRELIMINARY ENDOWMENT COST ESTIMATE SUMMARY

To be completed by Project Partner:

Section 1 - Base Contribution Amount (from Page 3) = $___________
Section 2 – Additional Contribution Assessment Total (from Page 5) = $___________

TOTAL PRELIMINARY ESTIMATE = $___________

To be completed by the State:

Additional adjustments (if any) to preliminary estimate based on review by the State $___________
**Forest Legacy: Stewardship Considerations Questionnaire**

Project partners should complete the following questionnaire and provide preliminary GIS shape files approximating the project boundaries to the CLS Program and/or DNCR Division of Forests and Lands. This information will assist the State in assessing whether an individual project contains unusual or unique factors that could further increase the State’s overall stewardship responsibility over time. The CLS Program staff, in consultation with DNCR, will determine on a case-by-case basis, whether any additional contribution (beyond that estimated in Sections 1 and 2) is necessary. Endowment adjustments by the State will be determined early in the application process, following additional consultation with the project partner. Provide additional pages and/or accompanying map as appropriate.

1) Please provide information regarding the anticipated condition of the property boundaries at the time of closing. Will surveyed boundaries be blazed/painted? Marked with boundary signs (provided by DNCR), etc.? Will there be provisions for future boundary maintenance provided by the owner?

____________________________________________________________________________________________
____________________________________________________________________________________________

2) Please describe adjacent land uses (including any known future abutting land uses). Examples might include (but not be limited to) abutting developed residential lots or in-holdings, intensely logged adjacent lands, adjacent commercial/industrial activity, abutting conservation/protected lands, etc. Are there any known encroachments or other problems affecting the proposed project land from any of these areas?

____________________________________________________________________________________________
____________________________________________________________________________________________

3) Please describe the ease of access into the property by motorized vehicles. Do power line rights-of-way or utility line corridors bisect the conservation property? Are they gated? Currently being used to provide wheeled access into the property? Does the property have Class VI roads and/or other internal roads/trails with a history of motor vehicle use (such as ATV)? Does it have other unrestricted points of access? If so, how many? Please describe any other known wheeled vehicle access issues, or potential issues, on the property.

____________________________________________________________________________________________
____________________________________________________________________________________________

4) Please describe any existing buildings or other infrastructure within the bounds of the easement that will exist on the property at the time of closing. Please provide details regarding the types of structures, number, location, intended uses, etc.

____________________________________________________________________________________________
____________________________________________________________________________________________

____________________________________________________________________________________________
5) Please provide a summary of any known endangered or threatened species, species of special concern, exemplary natural communities, prime AG soils, wetlands, other natural resources, or other unique communities/land features that will require additional protections as part of the project. Please describe the types of protections that are anticipated to adequately protect these resources.

____________________________________________________________________________________________

____________________________________________________________________________________________

____________________________________________________________________________________________

6) Describe any other unusual features, property uses (existing or anticipated), project components, funding sources, notification requirements, or other unusual project elements not previously covered in this assessment that are unique to this particular project as compared with other land protection projects in the state.

____________________________________________________________________________________________

____________________________________________________________________________________________

____________________________________________________________________________________________
Appendix E  NH Forest Legacy Program Selection Criteria

SELECTION CRITERIA FOR FOREST LEGACY PROJECTS

NEW HAMPSHIRE FOREST LEGACY COMMITTEE

Overall goal: Projects taken together should display a variety of sizes, forest values to be protected, and conservation techniques.

Primary Criteria (parcels must satisfy all):

1. Must provide for the continuation of traditional forest uses including forest management and public access for outdoor recreation.

2. Must be threatened by conversion to non-forest uses.

3. Must possess one or more of the following important public values: (not in priority ranking)
   a. Recreation opportunities
   b. Waterfront and riparian areas
   c. Fish and wildlife habitat
   d. Threatened and endangered species and natural communities
   e. Cultural resources
   f. Other ecological values and scenic resources
   g. Productive viable timber resource

Additional Considerations

1. What is the manner and degree of threat of conversion to non-forest uses?
2. What are the administrative costs?
3. Is there documentation of its importance in an existing local, regional, or statewide planning document?
4. How do the resource values of this parcel compare with those of competing parcels?
5. What are the economic and environmental implications of the proposed conservation action?
6. Does the project complement existing protected lands?
Range of Criteria Values for NH Forest Legacy Tracts

The following is the scoring system for NH’s Forest Legacy Program. It is intended only as a rough approximation of the relative eligibility among applications and not as an absolute measure. The final recommendations of the New Hampshire Forest Legacy Committee will depend upon all relevant aspects of each application and all of the surrounding circumstances.

I. Level of Significance
   A. Local Significance – 10
   B. Regional Significance – 15
   C. Statewide Significance – 20

II. Multiple Resource Values
   Refer to list on page 1. One point for each present.
   0 – 7

III Treat to Conversion
   A. Imminent 20
   B. Probable in near future (w/in 5 years) 10
   C. Possible in distant future (beyond 5 yrs) 5

IV Maintenance of Traditional Uses
   A. Fully Maintained 20
   B. Most can be maintained 10
   C. Some Maintained, some lost 5
REFERENCES

2015 New Hampshire Fish and Game Department Wildlife Action Plan

2016 National Survey of Fishing, Hunting and Wildlife-Associated Recreation

2017 Outdoor Industry Association Outdoor Recreation Participation Report

2018 Bureau of Economic Analysis Outdoor Recreation Satellite Account

2019 NH Forest Block Model, 2019, The Nature Conservancy- New Hampshire

Andrei P. Kirilenko and Roger A. Sedjo, Climate change impacts on forestry, PNAS December 11, 2007 104 (50) 19697-19702; https://doi.org/10.1073/pnas.0701424104


Charles H. Perry & Michael Amacher of the USDA Forest Service “Patterns of Soil Calcium and Aluminum Across the Conterminous United States”, 2012

Conservation/Public Lands, 2013, Society for the Protection of NH Forests and Other Land Trusts/NH GRANIT

Damage Detection Data, 2019, NH Department of Natural and Cultural Resources

Early Detection & Distribution Mapping System (EDDMapS), 2019, The University of Georgia – Center for Invasive Species Ecosystem Health

Economic Contribution of the Biomass Electric Power Generation Industry in New Hampshire Calendar Year 2016 Prepared for New Hampshire Timberland Owners Association by Daniel S. Lee College of Business Administration Plymouth State University

Economic Value of New Hampshire’s Working Landscape with a Focus on Outdoor Recreation Calendar Year 2017 Prepared for New Hampshire Timberland Owners Association by Daniel S. Lee College of Business Administration Plymouth State University

Forests of New Hampshire, 2016, USDA Forest Service, CE UPDATE FS-124


Good Forestry in the Granite State, 2010 https://extension.unh.edu/goodforestry/

GRANIT – spatial data from the University of NH

Harvard Forest New England forest data

https://nwis.waterdata.usgs.gov/nh/nwis/qw

http://www.emeraldashborer.info/


New Hampshire Forest Action Plan
Impaired Waters, 2014, NH Department of Environmental Services


MassGIS Data: Massachusetts Department of Transportation (MassDOT) Roads, 2018, MassGIS

MassGIS Data: Trains, 2015, MassGIS


National Woodland Owners Survey, USDA Forest Service

Natural Resources Conservation Services - soils

New Hampshire Pipelines at 1:24,000 Scale, 1993, U.S. Geological Survey/NH GRANIT

New Hampshire Public Roads, 2018, NH Department of Transportation/NH GRANIT

New Hampshire Department of Environmental Services, Water Division – various lake and other water quality reports

New Hampshire Division of Forests and Lands, Forest Health

New Hampshire Established Program to Stimulate Competitive Research (EPSCoR) http://ddc-landcover.sr.unh.edu/resources/multimedia-library/

New Hampshire Outdoors, 2019-2023 NH Statewide Comprehensive Outdoor Recreation Plan, NH Department of Natural and Cultural Resources.


NH Invasive Insect Presence Data, 2019, NH Department of Natural and Cultural Resources

NH Population Estimates and Housing Density, 2006, 2018, U.S. Census Bureau

NH RSA 227-J – Basal Area Law

NRN- Quebec, 2019, National Road Network


Railroads, 1993, U.S. Geological Society/NH GRANIT

Railroads, 2017, MaineDOT/Maine Office of GIS Data Catalog

Roads – NG911, 2011, Maine Office of GIS Data Catalog

Shaun A. Watmoughk, Air pollution success stories in the United States: The value of long-term

SPARROW (SPAtially Referenced Regressions On Watershed attributes) models estimate the amount of a contaminant transported from inland watersheds to larger water bodies by linking monitoring data with information on watershed characteristics and contaminant sources. Explore relations between human activities, natural processes, and contaminant transport using interactive Mappers.

Soil Data, 2018, USDA/NRCS Soil Survey Center/GRANIT

State of New Hampshire, Division of Forests and Lands and Department of Revenue Administration


State of New York, Division of Lands and Forests


Surface Drinking Water Importance - Forests on the Edge, 2015, USDA Forest Service

Susskin, Lawrence et al, Summary Climate Change Risk Assessment Dover, New Hampshire March 2014 PRODUCED BY: Massachusetts Institute of Technology, Science Impact Collaborative Consensus Building Institute, National Estuarine Research Reserve System

The Economic Importance of New Hampshire Forests, North East State Foresters Association 2015


UNH Cooperative Extension – Important Forest Soils info

University of Massachusetts at Amherst Extension

USDA Forest Service Inventory & Analysis, Evalidator data access tool

USDA Forest Service Northern Forest Futures Project

USDA Forest Service – White Pine Blister Rust and other pest information


USGS National Transportation Dataset (NTD), 2019, U.S. Geological Survey

VT Electric Transmission Line Corridors - corridor lines, 2018, Vermont Open Geodata Portal

VT Rail Lines, 2017, Vermont Open Geodata Portal

VT Road Centerline, 2019, Vermont Open Geodata Portal