

**FOREST MANAGEMENT PLAN
for the
Wolf Creek Town Forest
Weare, New Hampshire
Tax Map: 407 Lot: 4**

Mapped Acres: 70.5 acres per tax map



This large wetland structure is associated with the Pisquiqua River and can be found near the heart of the Wolf Creek lot.

**Prepared for: The Town
of
Weare, NH**

December, 2017

**Prepared by:
Meadowsend Consulting Co.
Meadowsend Timberlands, Ltd.**

**PO Box 966
New London, NH 03357
(603) 526-8686
mtlforests.com**

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FOREST INFORMATION SUMMARY

Landowner: Town of Weare, NH

Physical Address: Tobey Hill Road, Weare, NH

Mailing Address: 15 Flanders Memorial Road, Weare, NH 03281

Phone: 603-529-7525

Email: conservation@weare.nh.gov.

Tract Name: Wolf Creek Town Forest

Acres: 70.5 deeded

Located in: Weare, New Hampshire

Tax Map/Lot: Map 407, Lot 4

Deed Book/Page: 8760/0911

Conserved Status: Town of Weare Conservation Commission controlled

Tree Farm Status: need to enroll

Cost Share Status: None

ROW: From the north on wildwood road.

PLAN INTRODUCTION AND PURPOSE

This plan's purpose is to provide the landowner, the Town of Weare, New Hampshire, with a comprehensive description of the property's make-up and proposed management activities. It is meant to be a "User's Guide" that reflects the landowner's objectives and will remain flexible as changes in the property condition or objectives change through time. This plan is meant to actively cover a 10-year period, though it will remain useful for a far longer period of time and may be updated and amended as needed, rather than re-created. This plan meets and exceeds the requirements of the Tree Farm program, Documented Stewardship category of New Hampshire's Current Use Program.

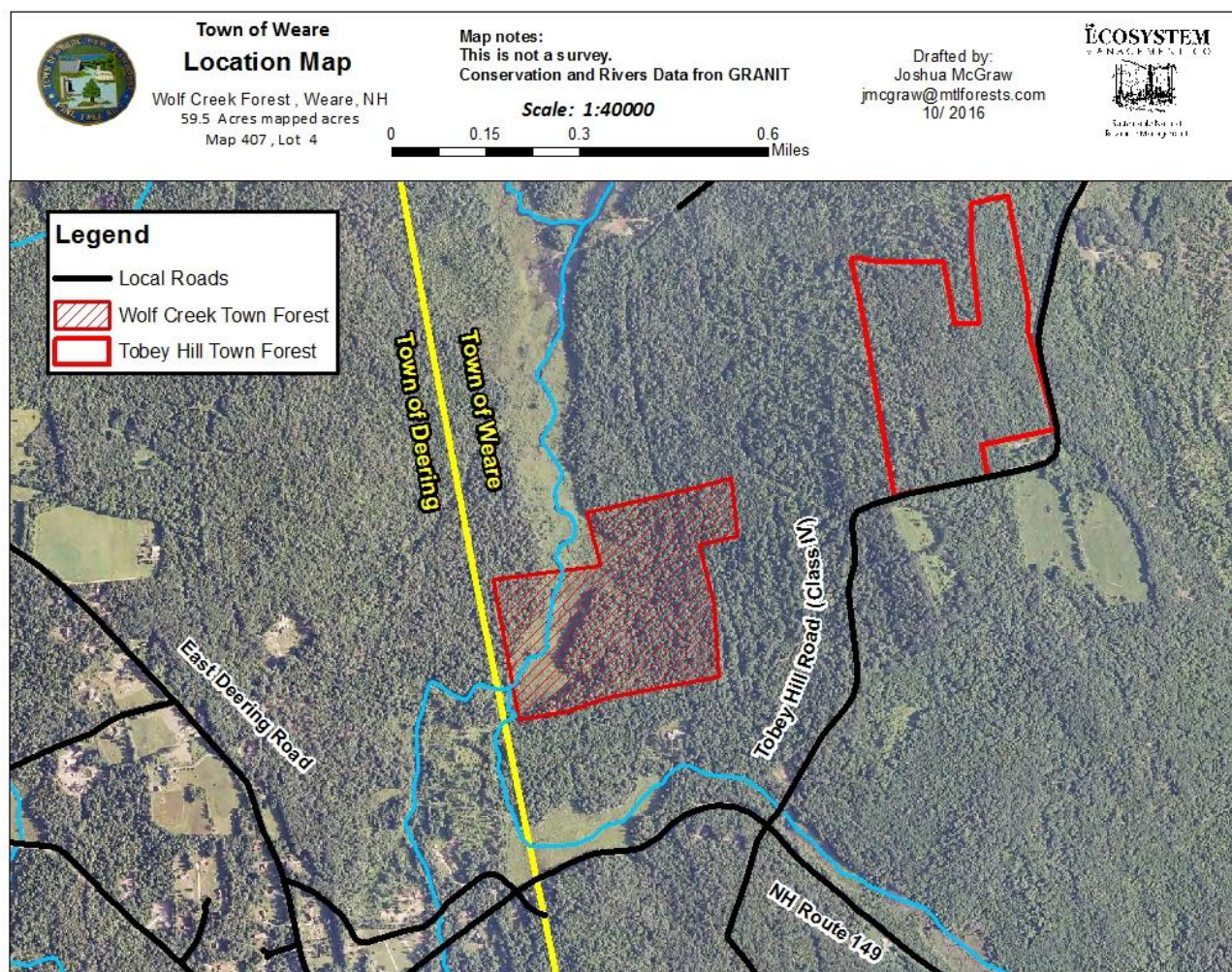


A pair of mature legacy hemlocks found growing near the center of the Wolf Creek parcel.

PROPERTY LOCATION AND BRIEF DESCRIPTION

The Wolf Creek Forest is owned by the Town of Weare, NH and is under the supervision of the town conservation commission. The 59.5-acre woodland is located in the south-western portion of the town of Weare near the Deering-Weare town line. The lot can be accessed from the south via NH route 149 onto the lower class six portion of Tobey Hill Road. From the north, the property is accessed via route 114 and 77. From the intersection of 114 and 77 head west onto Reservoir Drive, turn left onto Thorndike Road and continue until the Shady Hill Road - Hodgedon Road intersection, turn hard right onto Shady Hill Road and continue until you reach Tobey Hill Road. Follow Tobey Hill Road until it turns into a class six road. You will pass the Tobey Hill Town Forest and the Wolf Creek lot is to the west.

The tract is entirely forested dominated by a mix of hemlock and hardwoods featuring red oak, red maple, white ash and black birch. The lot features the west branch of the Piscataquog River, passing through the western portion, with a large wetland structure surrounding the main channel.



GREATER LANDSCAPE PERSPECTIVE

As one of two Town of Weare ownerships in the general vicinity and many conserved parcels, Wolf Creek Forest is located 1.5 miles due south of the Horace Lake and abuts the Piscataquog River, which has been designated into the NH Rivers Management and Protection Program. The program, run by the Department of Environmental Services, protects designated rivers for their outstanding natural and cultural resources. Providing a diverse array of educational, recreational, scenic, and ecological services the Piscataquog River and surrounding landscape benefits from protection by multiple local organizations including the Piscataquog Land Conservancy, the Society for the Protection of New Hampshire Forests, New England Forestry Foundation, Audubon Society of New Hampshire, riverfront towns, state agencies and many private landowners. This land-protection helps to ensure the surrounding landscape is carefully managed for both timber and protection of natural habitat.

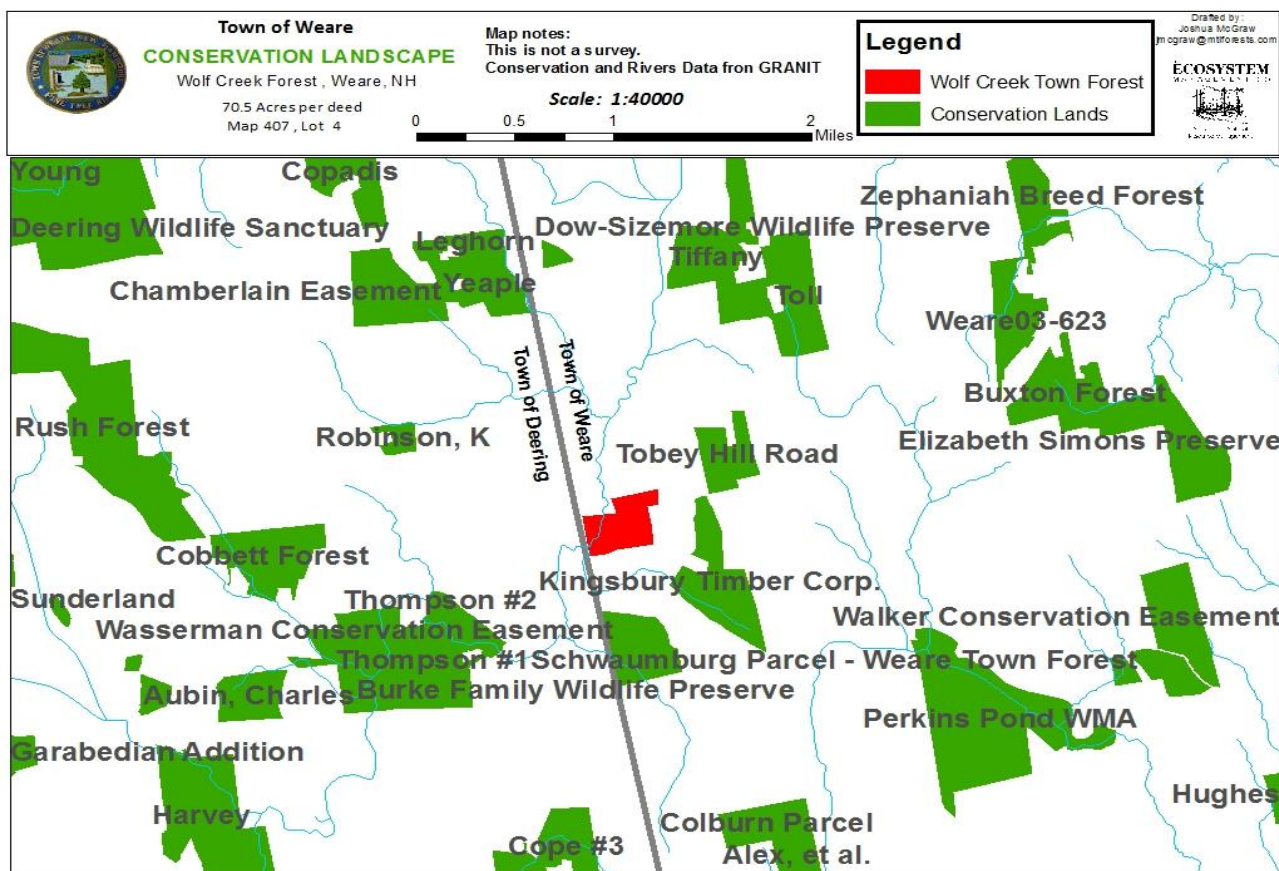


Figure 1 Town of Weare Conservation Landscape

LANDOWNER OBJECTIVES

It is not always possible, nor practical, to achieve every landowner objective on each acre of land. Some objectives, “*Be responsible stewards of the land*” for example, by their nature are practiced on the entire parcel. But often the more specific objectives are better applied to sections of the land best suited to meet those objectives, though often multiple landowner objectives can be met in the same area. For example, the habitat of certain wildlife species can often be improved while meeting objectives for growing timber. Red oak, a hard mast food source for many wildlife species such as White-Tailed Deer and Turkeys is also a good tree to grow for timber. In addition, the opening of the forest canopy during timber harvesting allows more sunlight to hit the forest floor, prompting growth of herbaceous and woody trees and shrubs providing browse, shelter and structural complexities utilized by almost all wildlife species.

Other wildlife objectives could be met through forest management. For example, some forest stands could be improved based on the wildlife habitat they provide. Snag trees and down logs could be created, living cavity trees could be managed for by releasing them from competition. Perch trees could be released or intentionally left protected to meet specific habitat requirements. Forest species diversity could be increased through selective thinning. Forest structure can be manipulated to provide habitat in different levels of the forest. For wildlife species that require dense, undisturbed, mature forest, timber harvesting likely would not be a complimentary management objective. The inverse is true as well; old agricultural areas that have not yet reforested are excellent places to manage open wildlife habitat with a lot of edge through periodic mowing and/or brush hogging. Dynamic planning that allows for islands of shrubby vegetation within these areas would provide shelter and often harbor soft mast species as a food source. Pruning of old apple trees found in these areas is another way to improve wildlife habitat. In these areas timber harvesting obviously is not a compatible objective, but recreation could be if hiking trails were created to provide opportunities for wildlife viewing.

A landowner who has multiple and multifaceted objectives should first clearly identify and then prioritize them. The forest management plan created to meet these objectives is a crucial tool providing an analysis of what the landowner has to work with, a detailed management scheme in which objectives are met according to priority and practicality, and a projection of the expected outcome of management.

Wolf Creek / Weare Town Forest Ownership Objectives:

1. The first goal of stewardship is to maintain the diversity of plant and animal life in the Town Forests to sustain ecological processes.
2. The second objective is to maintain a healthy and vigorous forest that can sustainably yield forest products.
3. Hunting, fishing, hiking, botanical observation, and wildlife observation are important functions of the Town Forests. The properties will be managed to maintain and enhance these recreational opportunities.
4. Maintain Tree Farm status

WOODLOT HISTORY

Prior to European settlement, the land use history of the Wolf Creek Forest is assumed to be similar to the surrounding New England landscape. In the several thousand years prior to European arrival, Indian tribes used the lands here for hunting, fishing, and seasonal agriculture. These uses most certainly impacted the landscape, but arguably unsubstantially compared to European settlers. Up until the late 1700's the landscape remained relatively undisturbed except for small villages established primarily further south in Massachusetts and southern New Hampshire in the 1600's. Due to the steep topography, soil types and remaining barbed wire, Wolf Creek was likely used exclusively as a pasture for livestock.

The previous ownership focus was on commercial timber harvesting, with evidence of at least two different harvests occurring. The earliest harvest (2002) appears to have been a conventional, chainsaw and skidding operation while the most recent cutting (2012) appears to have been of the cut to length operation type. Every corner of the parcel has seen timber harvested, minus the wetlands to the west and the very steepest, rocky ground to the east.



Above – The left two photos show cutting histories, with chainsaw work being the older above and the more recent cut-to-length bar saw shown below. The right two photos show evidence of the agrarian past, with barbed wire shown above and stone stacking shown on a ledge outcrop below.

FOREST INVENTORY PROCEDURES

A forest inventory was conducted to evaluate the timber types, wildlife, recreational and cultural resources found on the property. The forest inventory also was used to evaluate the stocking and composition of the forest and the volume of the merchantable timber on the woodlot. Data was collected at points established on a 2 acre systematic grid.

For the cruise a 20-BAF prism was used to sample trees 5.5 inches and larger at each point. The trees which fell within the sample at each point were recorded by species, diameters tallied to the nearest inch, growing stock status, and crown position. The trees were also tallied as sawlogs, pulpwood, or a combination of the two. A 5-BAF prism was used to collect data including species, diameter, status, and crown position on trees between 2 and 6 inches in diameter. Information on snags, cavity trees, and regeneration was also collected. Photographs were taken at each point and at other points of interest.

Products estimated in tallied trees greater than 6 inches in diameter were graded in multiples of eight feet. Hardwood sawlogs were estimated to a 10 inch small-end diameter while spruce and fir softwood logs were estimated to a 6 inch small-end diameter and pine to an 8 inch small-end diameter. Pulpwood was estimated in eight foot lengths up to a minimum 4 inch top.

In order to more accurately determine volume and make forest management and wildlife habitat recommendations, the property was broken into separate management areas called forest stands. Stands were differentiated from each other primarily on the basis of natural community type and past land use, but also considered soils, tree size, species composition, and density. As with any large piece of land, there are many micro-stands on the property (small areas within a larger stand that are distinct, such as a small pocket of rocky ground or a forested seep) but these variations are too subtle to map and too numerous to describe. These subtleties are best left to the intuitive forester to sort out when applying any sort of silvicultural treatment. The computer program ASSISI was used to process the data collected at the sample points to the entire forest. The detailed computer program output is not included as part of this plan but is available, if needed, from The Ecosystem Management Company.

Often to simplify operations on a large tract, forest stands are compiled to make up operational compartments. Compartments are helpful to identify sections of the property that utilize the same access system.

The following forest type designations are often used in the forest type map:

COVER TYPES

H ≥ 50% dominant & co-dominant trees are hardwood
 S ≥ 50% dominant & co-dominant trees are softwood
 HS = Mixed species but dominated by hardwood
 SH = Mixed species but dominated by softwood

SIZE CLASS

1 = Seedlings or regeneration - 90% of stems < 3" DBH
 2 = Saplings or small poles 3" - 8" DBH
 3 = Large poles and/or small sawtimber 9" - 12" DBH
 4 = Sawtimber 13" and larger

CROWN CLOSURE/DENSITY

A = 75-100% crown closure of co-dominant or dominant trees
 B = 50-74% crown closure of co-dominant or dominant trees

C = 0-49% crown closure of co-dominant or dominant trees

Wolf Creek Forest Inventory:

Forest data was collected at points on a systematic grid providing approximately 1 point for every 2 forested acres. The property is represented by one forested stand.

GEOLOGICAL ATTRIBUTES

Physiographic Regions

Northern New England can be broken down into different physiographic regions, also called eco-regions. The regions are separated from one another based on a combination of climate regimes, topography, surficial geology, and soils. This in turn influences the plant and animal distribution in those regions.

Wolf Creek Physiographic Regions:

Wolf Creek is located in the Southwest NH lowlands Depicted as area 5 (green) on the map below. According to the book *The Nature of New Hampshire* ¹ This section covers the southwestern /Central portion of the state. The Ashuelot, Contoocook, and Piscataquog Rivers are the main drainages and the terrain is complex, with rolling hills of small to medium size. Elevations in this area are generally less than 1000'. Bed rock in this area is mainly granite that is resistant to weathering. The forests are mainly comprised of Laurentian mixed forests and Appalachian oak and pine types.

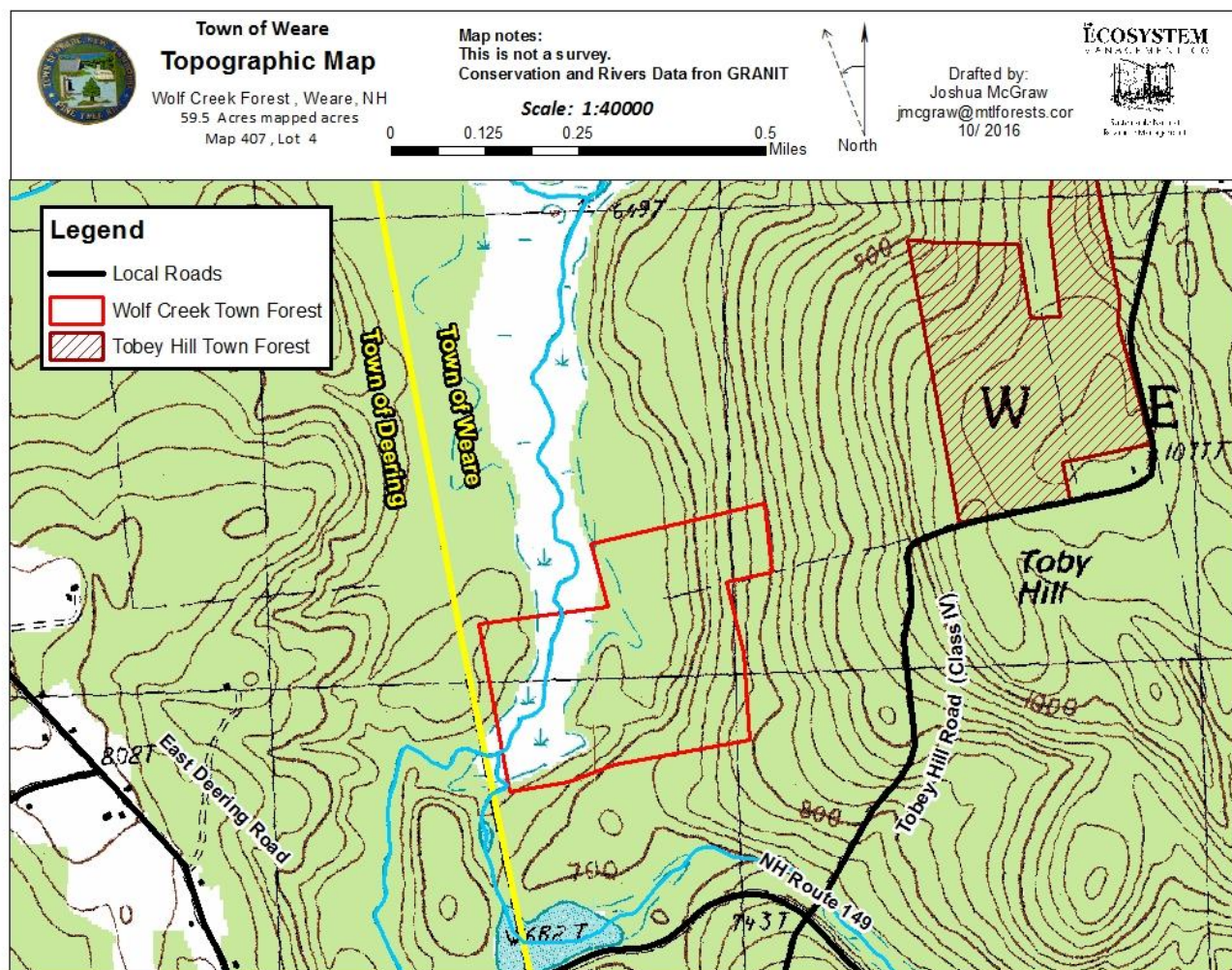
Topography and Aspect

The present land formations of New England were shaped by the latest glaciation during the Pleistocene Era, which began approximately two million years ago. At that time New England was covered by ice approximately 1 mile thick. The glaciers receded 10,000 to 12,000 years ago leaving behind the mountains, hills, gullies and valleys we are familiar with today. Following primary succession where pioneer species including lichen, algae and fungi in combination with abiotic factors like wind and water slowly built up soils, the forest began to re-grow. Over long periods of time the forest has evolved to the mix of species found here today largely determined by soil type, topography, and aspect but also shaped by more recent land use history.

Wolf Creek Forest Topography and Aspect:

Wolf Creeks main topographic feature is a western slope that cascades downhill to the Piscataquog river and its surrounding wetland systems. This western slope features steep sections of red oak and hemlock growing on relatively shallow soils, with granite bedrock ledge systems protruding up from below in areas.

¹ *The Nature of New Hampshire*, Daniel Sperduto and Ben Kimball, 2011.



Soils

Soils are the substrate upon which all trees grow. Soil productivity is influenced by the rock from which the soil is derived. For example, soils derived from limestone, or calcium-rich bedrock, tend to be more nutrient rich because of a higher pH. As pH increases more nutrients become available. On the other hand, soils derived from granite, or more acidic bedrock, tend to have a lower pH which locks up nutrients. Not only do different soil types largely drive the mix of vegetation found on a site, soil is also critical to productive tree growth, one of the primary objectives of forest management. Sound forest management strives to grow the tree species best suited for the site. Fighting the site, for example trying to grow high quality sugar maple on acidic soils, will result in poorly formed, low vigor trees with a higher susceptibility to insect and disease problems. Hence, it is important to consider your soil types when determining landowner and management objectives. Additionally, maintenance and consideration of the long-term productivity of the soil resource is a critical component to sustainable forest management.

The threats to the soil resource include the loss of soil through erosion, compaction of the soil from heavy equipment traffic, and nutrient loss through both leaching and timber harvesting. Erosion results in the direct loss of soil. Compaction reduces soil productivity. Most soil types include about 50% space between particles and soil compaction, which eliminates this space, directly reduces the amount of air and water soil can hold which is required for most soil processes. Nutrient leaching increases when soil is exposed during a timber harvest and when intensive timber harvesting occurs repeatedly.

Measures to avoid these threats include²:

- Avoid whole-tree removal, particularly on low-fertility sites (i.e., shallow to bedrock soils, coarse sands, wetlands, and area with high water tables), unless replacement of nutrients and organic matter is considered
- Conduct harvest operations during the season of the year that is most appropriate for the site. Operating on snow or frozen ground, whenever possible, minimizes effects of the soils and forest floor.
- Choose harvest equipment to suit the site and minimize disturbance. For example, in dry conditions, and in some wet conditions, consider using tracked vehicles to reduce rutting.
- Minimize skid-trail width using techniques such as bumper trees when appropriate.
- Establish skid trails that follow land contours where possible rather than directed straight uphill.
- When possible, conduct whole-tree harvests of hardwoods during dormant leaf-off season to retain nutrients on site.
- Avoid or minimize practices that disturb the forest floor, remove the organic soil or cover it with mineral soils, except as necessary to accomplish silvicultural goals and to regenerate certain tree species.

² Soil management recommendations from the publication Biodiversity in the Forests of Maine; Flatebro, Gro, Foss, Carol, and Pelletier, Steven, 1999, UMCE Bulletin #7147

Wolf Creek Soils:

There are several different soil types identified on Wolf Creek. The soils are mapped by the United States Department of Agriculture, Natural Resource Conservation Service (formally the Soil Conservation Service). A soils map and description are included in the appendix of this plan.

The bulk of the productive forest soils on the tract belong to the Forest Group IB. According to the NRCS, 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, which is a feature species at Wolf Creek. 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.

Wetland and Water Resource

Water features are an integral part of the forest ecosystem. Brooks, streams, ponds and wetlands all provide essential riparian habitat and functions. According to the publication Good Forestry in the Granite State, riparian areas provide flood control, regulate streamflow and protect water quality by filtering and retaining sediment, nutrients, and other pollutants from upslope areas. Riparian areas also regulate temperature of aquatic habitat by shading streams, provide large, woody material to create pools, riffles, debris-jams, and related aquatic habitat, provide leaves, twigs, fruit and insects which contribute energy to drive aquatic food webs. Riparian areas also provide habitat for feeding, cover, and travel for many amphibians, birds, furbearers, and reptiles. Tall trees within riparian areas provide primary nesting sites for bald eagles, osprey, and colonial water birds. Topography, elevation, bedrock, and soils dictate the water features found on a particular tract of land. The protection of water quality is an integral part of sound, sustainable forest management.

The following are recommended actions to improve and manage the wetland and water resource³:

Riparian, Wetland and Stream Ecosystems:

- Establish Riparian Management Zones (RMZs) along streams, rivers, wetlands, ponds, and lakes.
- Include maintaining or restoring riparian functions and values as silvicultural objectives in RMZs.
 - Retain trees with cavities, standing dead trees, downed logs, and large supra-canopy trees (especially white pine).
 - Leave wind firm trees that are well-distributed. Leave other vegetation, including existing groundcover.
 - Choose a regeneration system most likely to maintain riparian functions and values and rapidly

3 Good Forestry in the Granite State: Recommended Voluntary Forest Management Practices for New Hampshire, 2010.

- regenerate the site with the desired trees. Choosing a method is complicated by wet soils and the desire to maintain forest structure that contributes to wildlife habitat and other ecological values.
- Use uneven-aged techniques such as single tree or small group selection, maintaining 60 to 70 percent crown closure or full stocking as recommended in silvicultural guides.
 - Use even-aged techniques such as shelterwood or patch cuts to achieve regeneration goals when rapid regeneration is likely.
 - Maintain 60 to 70 percent crown closure or full stocking as recommended in silvicultural guides.
 - Locate new truck roads and log landings outside RMZs, except where doing so would result in greater overall adverse environmental impacts.
 - Design roads and skid trails within RMZs to minimize the long-term impacts of water quality and wildlife habitat. Apply BMPs. Put roads to bed using BMPs to stabilize the soil, control run-off, and control unwanted vehicular access at the end of the harvest.
 - Minimize ground disturbance. Operate ground-based equipment when the ground is dry or frozen.
 - Time harvesting to avoid disturbance to nesting birds and other sensitive species.
 - Leave the area closest to the stream, pond or wetland unharvested to provide increased protection to aquatic habitat, protect wildlife trails, and allow a reliable long-term supply of cavity trees, snags, and down woody material. Larger zones increase the protection of non-timber values; however, no-harvest zones may not always be consistent with ecological or silvicultural objectives.
 - Keep trees along banks to stabilize shorelines.
 - Avoid leaving isolated riparian management zones with long distances of abrupt edge. Riparian forests next to heavy cuts, agricultural, or urban land uses may be subject to increased edge effects (e.g. invasives, nest predation) and risk of blowdowns. Practices that minimize these risks include limiting harvest within the riparian management zone, increasing the width of the zone, or feathering the edges of a heavy cut.

Wolf Creek wetland and Water Resource:

Protection of the wetland and water resources on Wolf Creek are a high priority and an important goal for the Town of Weare on all of their lands. The wetland and water resources on Wolf Creek are in fact significant due to the fact that the North Branch of the Piscataquog River runs through the tract.



Above – the boundary of Wolf Creek is shown with the North Branch of the Piscataquog river passing from North to West.

NATURAL PROCESSES

One of the objectives of sustainable management is to mimic natural processes occurring on both forested and open land. Certain natural processes can be sped-up, slowed down, or enhanced through management. Some processes in which nature sets the precedent cannot be “managed” at all. To consider the role these processes play in management activities, it is important to identify and explore the major ones.

Succession

This is a process which takes place naturally on any piece of land, be it forest, wetland, open land, or even developed land. The temporal scale on which this is viewed is important. On a geologic time scale processes such as glaciation, global temperature, and plate tectonics all play a role. In the life of an individual, land-use patterns play the biggest role, but natural disturbances, insect and disease infestations, fire, and natural aging processes all contribute to succession. The process of succession heavily influences silvicultural prescriptions and management objectives.

Different trees species are predisposed to grow in certain conditions and in terms of forest succession this is dictated by the amount of sunlight available to the seedling. It is expressed as a plants shade tolerance. In general, if allowed to develop naturally, a forest will develop from early successional species that generally require full sunlight to develop, such as white birch, aspen and white pine, to late successional trees like hemlock, red spruce, sugar maple, beech, and yellow birch that can regenerate in their own shade.

Often, early successional species also require some sort of soil scarification and typically are fast growing and shorter lived than late successional species. As early successional species develop they shade the ground as their crowns spread in the canopy, changing the growing conditions on the forest floor to favor late successional, more shade tolerant species. Once a forest hits a late successional stage it will remain in that state until there is a disturbance, such as a wind storm, that changes the amount of sunlight hitting the forest floor and thereby bringing it back to an earlier stage of succession. Wildlife habitat and the species that use a particular habitat change as succession progresses.

Wetland areas undergo change over time as well. Areas of open water become filled-in over long periods of time, a process known as eutrophication. Bogs generally exhibit patterns of zonation: on the fringes they are wooded, there is then a zone of partially decomposed peat, and towards the middle there may be open water. Streams change course over time, forming oxbows and new channels. They also erode deep ravines and change the topography over time.

While every management decision cannot possibly be analyzed on every level, it is important to consider what the possible outcomes of a management decision might be. Through prudent consideration, management can be designed to achieve a set of desired results, including accelerating or retarding successional trends.

Water & Nutrient Cycling

This natural process is crucial in maintaining the long-term stability of a forested ecosystem. All types of vegetation, including trees, are involved in nutrient and water cycling. The removal of all trees and other vegetation

from a site will lead to less water uptake and thus more runoff. Increased runoff often leads to the leaching of nutrients in the soil which changes down-stream water chemistry. Many nutrients are sequestered in trees and vegetation. The inevitable result of the removal of vegetation from a site is a loss of some nutrients. How water and nutrients are “managed” have important implications for forest productivity.

Most of a tree’s nutrients are concentrated in the leaves, limbs and branches. The bole of the tree has relatively few reserve nutrients. There is some concern that whole-tree harvesting can deplete nutrients from a site because the entire tree is removed. In a thinning situation on productive soils where only a portion of the trees are removed, this is probably not a concern. In clear-cuts, or when whole-tree methods are employed on the same area repeatedly, the potential for nutrient loss is real and must be considered. Soils and sites influence nutrient status and leaching as much as the vegetation. Dry sandy soils or thin soils on high elevations and ridgelines are inherently low in fertility and are prone to rapid leaching.

Adaptation

A plant’s ability to adapt over time helps it to survive in a changing world. Furthermore, the passing of genes from one generation to the next allows the best adapted to thrive. Trees that are expressing themselves well are usually well-adapted to their environment. An example is red spruce’s ability to withstand the harsh growing conditions of the area in which it lives. At high elevation with thin, dry soils. Red spruce has adapted to its environment over thousands of years. Well adapted trees should be encouraged through management decisions favorable to them. While the genetic makeup (genotype) of individual trees or stands of trees is not practical to determine, forest management should encourage trees of superior appearance (phenotype) and high vigor that are free from obvious defects.

Disturbance

All-natural systems are prone to disturbance, and forests are no exception. Ice storms, fire, micro-bursts of high winds, hurricanes, floods, long-term weather patterns, and insect and disease outbreaks all affect forests. Approximately 12,000 years ago, New England was covered by ice perhaps a mile thick. When the glacier first retreated, the landscape resembled the arctic tundra. It has changed dramatically since then, and is now a fairly complex forest system. More recent disturbances are often responsible for creating a multiple age structure to a natural forest. For example, a small area of blow-down created by a high wind will often regenerate to shade-intolerant species, thereby setting back succession.

As with the majority of forestland in New Hampshire, this forest has seen widespread destruction from the great hurricane of 1938. It is still possible to see the “pit and mound” structures created when tree roots are pulled from the ground as the trees were blown down. The root ball eventually decays, but leaves a mound of soil next to the pit where the roots once were. These pit and mound structures resulting from the ’38 hurricane can be found throughout New England. New Hampshire sustained some of the highest winds from that storm and as a result lost a record amount of timber, mostly pine.

The 1938 hurricane and the more recent 1998 ice storm which affected millions of acres of forestland in

New England are examples of natural disturbances that had wide spread effects. If allowed to recover without human influence, the forest will, over time, grow back usually with a more complex structure than it had before.

A more diverse forest has many more niches for biological development. This increased complexity leads to a wide variety of species. In areas of significant disturbance, the most severely damaged trees will begin to decay and rot. As the dead and dying trees decompose, the abundance of snags will dramatically increase. An increase in wood boring insects will be followed by an increase in woodpeckers and other insectivores that will excavate cavities for other birds and small mammals. As limbs and broken tops of the trees begin to decompose, nutrients will leave the wood and leach into the soil. Some nutrients will be recycled further as the snags begin to fall and decompose. The cycle of the forest is thus a continuum consisting of many inter-relationships.

No discussion about disturbances would be complete without considering human impacts. Human disturbances in recent history have done more to influence the present state of our forests than any natural events. Human disturbances of the forest include clearing, logging, fire, pollution, and the introduction of exotic species. In the 300 years since European settlement, virtually all of the forests in New England have been cut; some areas have been cut more than five times. Much of the land was stumped and used for agricultural purposes. Soils were depleted by a lack of attention to water and nutrient cycling. Intensive development and subsequent paving of former forested land eliminates natural processes for the foreseeable future. Air pollution and global warming pose real threats to our forests. The introduction of chestnut blight and Dutch elm disease essentially extirpated those species from our forests. The introduction of invasive exotic species poses similar threats. Invasive exotic species are a cause of great concern because of their prolific nature and exotic characteristics enable them to vastly out-compete native plants, having a drastic impact on biodiversity.

Should any large-scale disturbance, natural or human-caused occur, an adaptive approach to management would then be carried out.

NATURAL COMMUNITIES⁴

As written in the book *Natural Communities of New Hampshire* by Daniel Sperduto and William Nichols, "Natural communities are recurring assemblages of plants and animals found in particular physical environments. New Hampshire has a fascinating and complex variety of natural communities, from tidal marshes to alpine meadows, river banks to mountain forests, and streams to lakes. Each type of natural community has a unique set of environmental conditions that support certain species adapted to those conditions."

"Just as individual organisms can be classified into species, plant assemblages can be classified into natural community types. Classifying natural communities is a useful way of viewing the landscape because it allows us to distill the broad range of complex interactions between species and their environments into a limited number of units that share certain key features."

"Natural community types are usually defined in terms of plants because they are easy to study, often compose the physical structure to which most other organisms respond, and are sensitive indicators of physical

4 All information on Natural Communities referenced from the publication: Natural Communities of New Hampshire, Daniel Sperduto and William Nichols, New Hampshire Natural Heritage Bureau and The Nature Conservancy, 2004.

and biological factors that influence many types of organisms.”

“The need to classify natural communities is fundamentally pragmatic: People need a way to sort out, understand, and communicate about nature’s complexity on order to be good stewards.”

Determining natural community types can be a challenge because it is uncommon to find land that has not been influenced by human intervention. Past agricultural and silvicultural practices often change the plant communities that you would find on any given acre naturally. Identifying natural communities then becomes a process of understanding the past management activities, the physical conditions of the site, and the plant communities currently found there and determining to the best of our ability what community would occupy that site without human intervention. Natural community types found here have been identified on a broad level to the best of our ability. A more comprehensive and detailed study by an ecologist would be required to determine natural community types on a more fine-grained and certain basis.

Wolf Creek Natural Communities:

Wolf Creeks forest falls into the Hemlock – Beech - Oak– Pine natural community. This Natural Community is the most common found in southern and central NH. Properties like Wolf Creek, which have been subject to agriculture and timber harvesting are dominated by mid successional timber types like red oak, white pine, red maple, and black or paper birch. The most recent timber harvests have placed most of the up and coming regeneration into the above described community type.



Above – The makeup of wolf creek is shown with red oak small saw timber to the right and in the foreground, young red maple (Center) and hemlock and white pine regeneration (right) can be seen.

Rare Species and Unique Natural Communities

An in-depth flora and fauna survey was not within the scope of this plan. There were no known endangered plants or animals encountered while collecting the data for this plan.

The Natural Heritage Inventory, in Concord, New Hampshire, has been contacted and shows no records of rare or endangered plants or animals on the property. Reference NHB NHB16-3858

It is possible other species exist, and close adherence to conservation practices discussed in New Hampshire's "Good Forestry in the Granite State" and Best Management Practices, in addition to recommendations from the book "Biodiversity in the Forests of Maine" will help to protect any unknown occurrences.

In addition, the Northern Long-Eared Bat is newly listed as threatened. Northern long-eared bats use their maternity roost trees and hibernacula repeatedly for many years. Unless a survey or other information indicates otherwise, if the habitat around a roost is intact and the tree is suitable, one would conclude that the tree is likely an occupied maternity roost during the pup season (June 1 - July 31). Similarly, one could assume that a hibernaculum remains occupied unless a survey or other information indicates otherwise.

Therefore, if a northern long-eared bat roost tree or hibernacula is officially documented on or near a project area, any incidental take of bats will be exempted by the 4(d) rule if one follows these conservation measures:

- Do not conduct any activities within ¼ mile of known, occupied hibernacula;
 - Do not cut or destroy a known, occupied roost tree from June 1 to July 31 (the pup season);
 - Do not clear-cut (and similar harvest methods that cut most or essentially all trees from an area, e.g., seed tree, shelterwood, and coppice) within a ¼ mile of known, occupied roost trees from June 1 to July 31.
- NHFG wildlife action plan, long eared bat.

INVASIVE EXOTIC SHRUBS

Invasive exotic shrubs and vines, such as barberry, Asiatic bittersweet, Japanese honeysuckle, multiflora rose, and both glossy and common buckthorn, well established throughout much of New England are causing a new realm of problems for landowners because they are able to out-compete what native trees and shrub regeneration we do have. These shrubs are responsible for a decline in biodiversity and are capable of greatly impeding the regeneration of native trees as they die or are harvested. Most invasives were introduced as landscaping plants. Their great popularity and success are due to their prolific growing characteristics. Buckthorn was often planted as a hedgerow because of its fast and dense growth. Barberry is a common landscape shrub because of its attractive form and very hardy growing characteristics. Honeysuckle, ironically, was introduced as a wildlife conservation plant because of the great amount of soft mast, or berries, it produces. All three produce great quantities of berries, which are all eaten by songbirds, turkeys, and many other wildlife species which then spread their seeds through their excrement.

The characteristics that made these shrubs successful as introduced plants are the very reasons they are

such a problem in the natural landscape. They are prolific, hardy, produce vast quantities of seeds, and virtually are able to out-compete all native vegetation. They typically leaf out earlier in the spring and keep their leaves longer into the fall, providing them a much longer growing season and competitive advantage. Their seeds last many years in the soils and can build up to great quantities that germinate when conditions are favorable, such as an increase in sunlight on the forest floor after a harvest.

The problem doesn't end there. Controlling invasive exotic shrubs is nearly impossible after they have become established. Even if you eradicate them completely from your land, a daunting task at that, their seed will continue to be distributed from neighboring land by birds and other wildlife. Still, putting an effort into controlling them will have short term benefits which may be enough to give native plants a chance to get established. The control techniques will be described in detail in the appendix, but briefly they consist of manual, mechanical, and chemical means. Knocking these plants back prior to a timber harvest will produce the greatest benefit. Ignoring them and opening up the forest through a harvest gives them the greatest advantage.

Wolf Creek Invasive Species:

Currently no invasive species were noted at Wolf Creek. Due to its proximity to the wetlands in the area and those areas propensity to attract bird species and the seeds they carry, the possibility of outbreaks exists. For now, the recommended treatment includes a combination of practices. When large openings are planned to be made in the forest, existing invasive shrubs found should be manually pulled prior to the cutting. After the opening is made, continue monitoring and pull seedlings as they become established. This is best done in the spring or fall after a heavy rain. Because invasives typically leaf out early and keep their leaves longer than native shrubs they are easily identified at those times of year. Heavy rain loosens the soil, making it easier to get the entire root system.

WILDLIFE ECOLOGY

Habitats

The American Heritage Dictionary defines habitat as "the area or type of environment in which an organism or ecological community normally lives or occurs." Wildlife habitat takes on many different forms. The components of habitat -- *food, water, cover* and *spatial relationships* -- are all interrelated.

Food for animals varies widely. Herbaceous plants, woody plants, mast or nuts, fruits and berries, insects and grubs, prey, and carrion are all eaten by wildlife. The location and abundance of food sources plays a primary role in determining the quality of the habitat for any species.

Water is required by all living things. Standing water, running water, seeps, and springs are all used. Some animals use water only periodically, while others live in and around it.

Cover is analogous to protective shelter. Cavities in trees, brush piles, nests, ledge outcrops, dense softwood cover and holes in the ground are used to provide cover for different animals.

Spatial relationships, or patterns, tie the habitat components together. If all the habitat requirements of a particular species are found within its "home range", the animal will probably remain in the vicinity. Creating the

proper juxtaposition of food, cover, and water is important for wildlife to be attracted to and remain in a particular area. Travel corridors are used by many species to move from one habitat type to another. Ridgelines, streams, and other riparian areas commonly serve as travel corridors.

Habitat Types

Forested Habitat

Forest habitats can be classified in several different ways. One is by species composition, another is through age-class or successional stage, and a third is the vertical diversity or the distribution of canopy layers within a forest. The more diverse a property is in these three areas typically increases the diversity, or “richness,” of wildlife that can be found there. Different wildlife species use different tree species, different layers of the forest structure, and different size or age class trees. Some songbirds can only be found in the upper canopy of hardwood trees for example, while other songbirds prefer specific species of trees, such as the pine siskin. Snags and down logs are important parts of forest structure as well. A large number of songbirds and small mammals require tree cavities for nesting, and standing dead trees provide important feeding sites as well.

The upland hardwood areas attract species which browse and/or feed on hard mast, notably white-tailed deer, turkeys, and black bear. Many resident and neo-tropical birds also use these upland areas. Birds such as the red-eyed vireo, white breasted nuthatch, chickadee, hermit thrush, and various woodpeckers are likely visitors to these areas. Softwood areas, especially those along riparian zones are used by many species. Furbearers, such as mink, beaver, otter, fisher, raccoon, and ermine could all be expected. Some of the dense softwood areas could be used both as deer yard and as a corridor for wildlife movement.

According to Good Forestry in the Granite State, deer wintering areas are important for the survival of deer in New Hampshire because it is near the northern limit of their geographic range. Special habitat characteristics of deer wintering areas allow deer to maximize their daily food intake and minimize the amount of energy they expend to move, keep warm, and avoid predators. Most deer wintering areas occur at elevations below 2,000 feet in lowland softwood stands, such as eastern hemlock in the southern part of the state. Deer wintering areas are often associated with watercourses and riparian areas. Only about 3% of New Hampshire's land base meets the habitat requirements for deer wintering. Deer use of wintering areas varies within and between winters, based mainly on differences in snow depth. Deer move into wintering areas when snow depth exceeds 10 to 12 inches. During mild winters deer may range far from softwood shelter or not use a wintering area at all.

Wetland Habitat

In terms of resource value and diversity, riparian areas exceed all others in importance. The areas around streams and other wetland areas provide critical habitat including breeding and nesting sites for many species. Riparian areas also filter runoff thereby keeping the water clean. Riparian areas also are used as travel corridors for animals and fish moving to different habitats and from property to property. Characteristics of good corridors include softwood for cover and steep stream banks which aid in allowing the animals a sense of protection.

Openland and Edge Habitat

According to Good Forestry in the Granite State, "Non-forested uplands and wetlands provide "critical" habitat for about 22 percent of new England's wildlife species and seasonally important habitat to nearly 70 percent, including "species of greatest conservation need" such as eastern towhee and new england cottontail. The value of these openings depends on the surrounding landscape. They are more beneficial in large areas of continuous forest cover than in areas with a mixture of forest and non-forest habitats."

The size of the opening is important as well. In general, openings less than 2 acres usually don't attract wildlife species that don't already occur in the vicinity. But, small openings increase the amount and type of foraging and cover available to species already present.

The edge of openings is important as well. Edges occur at the boundary of two habitats, and have their own distinct characteristics and often high levels of biodiversity. Maximizing edge is generally a good way to increase diversity and quality of habitat.

Habitat Management Approach

Two approaches to wildlife habitat management are commonly applied. The *featured species* approach caters to one or two chosen species. Management specifically for white-tailed deer or for ruffed grouse is an example. The species richness approach focuses on creating and improving a variety of habitat types to maximize benefit to wildlife.

The *species richness* approach to habitat management is generally the most applicable technique; however, some practices are aimed at specific species. Birds of all types are of special interest to the landowners. Fortunately, managing for a diversity of wildlife species will in fact improve bird habitat as well since different birds use different species mixes, canopy layers, and different types of opening sizes, and communities. Managing for species richness attempts to provide habitats for as many different species as the property can support. The species richness approach encourages a diverse, healthy ecosystem.

Another common goal for management is to maintain a forest structure typical of a natural forest and to encourage natural forest processes. Manipulation of the forest to benefit a particular species will be discouraged on a large scale. While certain management practices will be beneficial to some species and detrimental to others, the overall goal of management is to create a rich and diverse habitat for wildlife.

Certain wildlife practices should be routinely followed during logging operations, or as separate wildlife habitat enhancement activities. An example is the practice of leaving or creating dead or dying snags where they do not endanger people or aesthetic values. Snags are very important to many species, especially birds and insects. Another practice is to leave or create some coarse woody debris on the ground for use by insects, invertebrates, and fungi. Coarse woody debris should include large diameter low-value trees, which are cut or fall naturally and left in place in the woods. These large pieces of decomposing wood are important for nutrient cycling, water retention, carbon sequestering and microbial activities. Black bears often work these logs over looking for grubs and ants. Several reptiles and amphibians utilize the moist cover provided by these decaying logs. Coarse woody debris is a component of the natural forest and contributes to ecosystem function.

Recommendations for wildlife habitat management⁵:

Snags, cavity trees, and down logs:

- Avoid damaging existing downed woody material during harvesting, especially large (16"+) hollow logs and stumps.
- Leave downed woody material on site after harvest operations when possible.
- Leave several sound downed logs well distributed on the site, where possible. Especially important are logs >12 inches dbh and > 6 feet long. Hollow butt sections of felled trees are also good choices.
- Create additional snag trees by girdling large cull pine where possible. Attempt to retain or create a minimum of 4 secure cavity or snag trees per acre, with one exceeding 24" dbh and three exceeding 14" dbh. In areas lacking cavity trees, retain live trees of these diameters with defects likely to lead to cavity formation.
- Retain as many live trees with existing cavities and large unmerchantable trees as possible.
- When possible, avoid disturbing cavity trees, snags, and upturned trees roots from April to July to avoid disrupting nesting birds and denning mammals.
- Retain trees with cavities, standing dead trees, downed logs, large trees, and large super canopy trees in the riparian management zone to the greatest extent possible.

Habitat Connectivity:

- Avoid harvests that isolate streams, ponds, vernal pools, deer wintering areas, or other sensitive habitats.
- Maintain the matrix of the landscape in relatively mature, well-stocked stands. Where even-aged management is practiced, consider the cumulative effects of multiple cuts and include wider habitat connectors as necessary.
- Consider opportunities for coordinating habitat connectivity with other, on-going land management efforts that maintain linear forested ecosystems, such as hiking trail corridors and natural buffer strips retained to protect water quality. This may require expanding the physical size of the connector habitat and increasing structural values to fulfill multiple management goals. Also consider the potential for effects that may arise because of incompatible uses (e.g., heavily-used ATV or snowmobile routes around and through deer yards).

Deer Wintering Areas:

- Identify dense stands of mature softwood as potential DWAs, particularly in riparian ecosystems.
- Whenever possible, schedule harvests in DWAs during December through April.
- Protect advance conifer regeneration during timber-harvesting operations.
- When conducting harvests in coniferous forests adjacent to watercourses, maintain an unbroken conifer canopy along shorelines to protect riparian travel corridors.

⁵ Wildlife habitat management recommendations from the publication Biodiversity in the Forests of Maine; Flatebro, Gro, Foss, Carol, and Pelletier, Steven, 1999, UMCE Bulletin #7147

- When planning harvests within any DWA, (strive to) maintain a closed-canopy coniferous overstory over at least 50 percent of the area at any given time. Avoid constructing major haul roads within DWAs.
- Throughout the remainder of the DWA, maintain forage areas that provide a steady, abundant source of accessible browse by clearcutting 1 to 5 acre openings using a 40-year rotation and 10 year cutting cycle. Locate browse cuts within 100 feet of core shelter areas (dense, mature softwood that provides cover).
- To help avoid over-browsing attempt to maintain high levels of understory woody vegetation throughout the remainder of the tract.

Wolf Creek Wildlife Habitat Types:

The most important habitat type on the Wolf Creek Tract is the wetland system associated with the Piscataquog river.

There is essentially no open or early successional habitat found on the tract except for what is associated with the wetland system to the west. Though there currently are no landowner objectives to create permanent open habitat on site, early successional habitat could be created by making openings of at least an acre or two in size scattered throughout the tract. These openings can also be placed along wetlands as long as done appropriately in a way that does not negatively impact water quality. Over time the openings will become re-forested, and new ones can be created elsewhere. Creating pockets of early successional habitat is the single practice that would benefit wildlife the greatest by increasing biodiversity, structural diversity, browse, and abundance of mast producing species.

There are so many components to wildlife habitat it is difficult to even begin to address them all here. Management goals on Wolf Creek should strive to accomplish the following:

- Create additional snags, cavity tree candidates and down logs from larger, low grade pines.
- Avoid disturbing wet depressions like the vernal pool to the south.
- Protect travel corridors.
- Increase browse and create additional structure by making variable sized openings in the forest.
- Release existing browse and mast producing shrubs: blueberry, viburnums, Rubus sp., hazelnut, winterberry, etc.

FOREST STRUCTURE and MANAGEMENT APPROACH

Structure and Age Class Distribution

The size and distribution of vegetation layers make up the structure of the forest including vertical spacing and horizontal layers. Vertical spacing is simply the density of individual plants, shrubs and trees. The horizontal layers are usually described in four levels including ground cover, understory, mid-story, and overstory. The ground cover includes herbaceous plants and small woody plants. The understory includes tree seedlings and small saplings and woody shrubs. The mid-story includes pole size trees and tall saplings, topped by the overstory of the largest trees. Often the different horizontal layers with the exception of ground cover are associated with different age classes of trees, but this is not always the case. A slow, growing shade tolerant trees species, such as Eastern hemlock, can remain in the understory for many years biding time until space an opening above is created. Age structure in a forest system can be simple, with one distinct age class called even-aged. Two-aged forests are just as they sound, two distinct age classes. And forest with more complex age structure are called un-even aged.

Understanding forest structure conditions is important for management. It determines the general type of silviculture to be applied and is closely related to biological diversity and wildlife habitat.

Wolf Creek Structure and Age Class Distribution:

The forestland on this property is dominated by an even aged forest, with the last round of harvesting providing the openings to allow the current second age class of trees to develop. The dominant trees in the canopy are 60 + years old with scattered older trees (i.e. boundary and interior legacy trees). The second age class is anywhere from 0 to 6 + years old as the last round of harvesting occurred in 2012.

Stocking, Timber Quality, and Volumes

Stocking is a term used by foresters to describe the relative density of the trees in a stand. Stands may be under stocked, over stocked, or fully stocked. Stands which are fully stocked have trees which are wholly utilizing the growing space available to them. Volume refers to the quantity of merchantable timber found on the property. Timber quality specifically relates to the products found in a tree. A poor-quality timber tree may be an excellent quality wildlife tree, and vice versa.

Wolf Creek Stocking, Timber Quality, and Volumes:

On Wolf Creek, the quality and size of timber resources is evenly distributed. The highest quality timber product is found in red oak, with much of this being small sawtimber. Red maple represents the largest volume, with 203 cords (which includes sawtimber). Of that 203 cords amount, only 22% is sawtimber. The red oak component represents the highest value and quality on site, with 51% of the total 173 cords being sawtimber. Softwood stocking on site is primarily Hemlock, with 123 total cords on site, 46 cords or 37% of the hemlock being sawtimber. Total saw product stocking property wide is around 2700 feet per acre. Several tables and graphs will depict this and remaining data in the Tract Level Data section below.

Forest Health

Forest health can be discussed on an individual tree or disease, or it may refer to the functioning of the complete forest ecosystem. Many forest diseases and pests are ubiquitous and found on a landscape level. At times their presence can signify the forest as a whole being unhealthy, or they can signify more isolated, individual health issues. Health concerns include a whole host of issues, such as tree diseases, insect pests, invasive exotic shrubs, pollution, and soil acidification. Sound forest management can reduce the negative impacts of health issues and often improve overall forest health, where poor management often exacerbates health problems.

Wolf Creek Forest Health:

Typical forest health problems can be found on Wolf Creek, though none are of a level that would require salvage treatment. Improvement based silviculture that targets diseased or low vigor trees giving healthy trees more room to grow should provide adequate maintenance.

Damage from the white pine weevil is also present. The white pine weevil targets the bud on the leaded stem in a sapling to pole size pine for laying its eggs, which kills the bud forcing one of the lateral branches to take over as the new leader. This results in a crooked or multi-stemmed pine, which doesn't affect the health of the tree.



Left – incredible yearly growth show on a white pine sapling of 34+ inches in one year.

Right – Damage from the white pine weevil showing the leading stem dead and brown from larval attack.



Properly thinning a stand targeting infected trees for removal is often an adequate control measure. When working in the pine, trees showing the presence of any diseases should be targeted for removal.

Spider heart is present in the oak. Spider heart appears from the outside as a black seam on the butt of red oak. It is often associated with poor growing conditions, though not always. It degrades the butt log of the tree.

Other diseases and insect problems to be aware of include hemlock woolly adelgid and emerald ash borer. Hemlock Woolly Adelgid (HWA) is present in surrounding towns and continues a slow spread through southern New Hampshire. Because it is likely HWA will become a reality here, management strategies should be

geared towards increasing vigor in the



Left – Decline from HWA can appear as crown loss and decline.

Right – The underside of hemlock branches and needles will reveal white flocculence or “puffs” if HWA is present.

existing hemlock.



Emerald ash borer, a non-native wood-boring beetle wreaking havoc on urban forests and ash populations has recently been detected in New Hampshire. Fortunately for Wolf Creek Forest ash is a minimal component, except in the rich hardwood areas. Management objectives in preparation for the inevitable arrival of the ash borer here include maintaining an ash component in the forest and promoting a diversity of native species. Pre-salvage harvest of ash is not recommended, and could be more devastating to the ash population than the beetle itself.

Harvesting damage can lead to decreased vigor within forests, often through basal scars (bumping trees) and root damage via harvesting equipment movements. Residual stand damage appears to be low on Wolf Creek with basal scars being scattered, and rutting from equipment rates (and therefore root damage) seems low.

Growth Rates and Allowable Cut

An in-depth growth study was beyond the scope of this management plan; some rules-of-thumb do apply. A tree's growth is directly related to the substrate (soil) on which it is located. Wet, ledgy, and dry areas do not promote rapid growth of trees. Lower elevation and cool moist but well drained areas support better tree growth as the soils are deeper and more fertile. The average woodlot in New England grows at a rate of .42 cords per acre per year. Additionally, the average managed woodlot in New Hampshire grows at a rate of 2 to 4 percent per year.

Allowable cut is the volume that can be sustainably harvested from a defined area. Typically, allowable cut is equal to or less than growth, and is calculated by multiplying the growth rate times the commercial forested acres multiplied by the years between harvest entries.

Harvest History

The recent harvest history of individual tracts of land is ideally garnered through records kept by the landowner, but often this is not the case. When no records exist, the history is gleaned through field evidence including age and distribution of stumps, existing or historical access infrastructure, and through forest structure. Wolf Creeks harvest history is well known, with a conventional harvest having occurred in 2002 and a cut-to-length harvest occurring in 2012.

Forest Management Approach

Forest management utilizes a combination of silvicultural techniques that typically are separated into two general categories, even-age and uneven-aged management. Even-aged management methods include clear-cut (removal off all trees within a designated area), seed tree (similar to a clear-cut but with residual trees for seed source), shelterwood (removal of most overstory trees leaving enough to create sufficient shade to create a micro-environment for regeneration; once regeneration is established the residual overstory trees are removed in either one or two further entries), overstory removal (removal of the overstory to release established regeneration) and patch cut (a small clear-cut, usually less than 2 or 3 acres in size) applications and may be used to regenerate a new stand when deemed necessary. Uneven-aged management methods generally include single tree (removal of single trees to regenerate shade tolerant species) and group selection (removal of groups of trees to regenerate shade tolerant species) used to regenerate small areas resulting in uneven age classes in a given stand. Often applied techniques fall somewhere in between these two text-book defined categories. One may define a large group opening (uneven-age management) as a small clear-cut (even-age management). Improvement thinnings often fall somewhere in between as well, depending on the intended results and the actual results. A thinning may result in improved growth of the overstory trees, an even-aged treatment. A thinning may also provide similar conditions as single tree selection, an uneven-aged technique, and result in regeneration of shade-tolerant species. Crop tree release, a practice where designated "crop trees" are released from shade of competing trees on typically 2 to 3 sides, falls somewhere in between as well. Given the variability of site quality and stocking, even within a defined stand, unless even-aged management is specifically called for, management typically will fall in the uneven-age category.

Traditionally, the intent of uneven-age management is to attain forest stocking conditions that mimic a specific diameter/age distribution. But, practically speaking, uneven-age management is often carried out as a simpler form of multiple-age management resulting in the introduction of a new age-class on a portion of a stand each harvest entry. Given the even-aged condition of the majority of land in New England, encouraging multiple age classes is a more attainable, practicable goal and in effect, desirable goal. To clarify discussion of management technique the term multiple-age management will replace traditional uneven-aged management, but will utilize the same techniques including single tree and group selection.

Applied Silviculture

Below are the generalized silvicultural systems and methods that will be broadly applied to the natural forest communities found on the ownerships and the forest stands within. The methods and their corresponding cutting cycles, rotation ages and target diameters are described and will serve as management guidelines for application in the field. Silvicultural systems are designed to grow and regenerate trees for timber. Comprehensive management will combine components of silviculture described below with other practices to meet the entire complex of ownership objectives which often include but are not limited to wildlife habitat, protection and enhancement of riparian and wetland systems, and enhancement of natural biodiversity.

Red Oak Silviculture

Silviculture will focus on high quality saw timber and on creating and maintaining multiple age classes of species well suited to the site. Multiple age classes will primarily occur in pockets as the stand is treated over time, with the goal of the oldest age class reaching 100+ years.

Twenty-year harvest intervals should result in an average of 20% of the overstory removed at each entry over a 100 year span. Even-aged stands that are being converted to multiple-age will take several entries to establish stocking that can support this type of sustainable harvest.

The art and science of growing red oak is complicated due to regeneration challenges. Good seed years for oak average every 3-5 years. However, two major obstacles affect the germination success of the acorn. As a highly coveted food resource by most wildlife, the acorn is heavily used and if the wildlife does not find the acorn, insects like the acorn grub do. According to USFS studies, up to 500 acorns are required to produce one seedling, but generally 1% of acorns become available for regenerating northern red oak successfully. Thus, the availability of viable acorns is naturally scarce.

To successfully germinate, the acorn prefers exposed mineral soil, ideally in well-drained, deep loams. Scarifying the duff layer during logging operations in the snow-less seasons best does this. Oak's overall survival is most importantly related to light intensity levels. For the seedlings/saplings to photosynthesis optimally it requires 30% light intensity in the open, where under a closed forest canopy, light intensities are less than 10%. Therefore, heat and space are critical. Once the seed germinates rapid and vigorous taproot development occurs. This root growth contributes to another challenge of oak management, where it causes very slow initial shoot development and competition for light from other species is very common. Thus, achieving lasting regeneration success of oak, weeding of interfering species is often a requirement. The success of regenerating oak is highly dependent on the combination of the availability of viable seed, soil scarification, adequate light levels, implementation of weeding applications and seed distribution by wildlife.

Overall, the oak silvicultural system will be multiple-age or even age. Methods of this system to best achieve the requirements of oak will involve group selection, patch/gap, shelterwood or seed-tree silviculture. These methods will be used for both regeneration and thinning applications. For multiple age systems the cutting cycles of oak dominant types will be between 15-25 years with crop tree diameters of 16-22 inches. With even-age systems the rotation age will be 80-100 years.

During thinning and release applications it is important to maintain minimal direct light exposure to oak boles. Maturing and mature oak stems have large reserves of sensitive hidden buds that respond easily to increased light levels, resulting in epicormic branching and severe quality loss. During these cutting entries, releasing crop trees on eastern and northern sides, while maintaining heavier shade conditions on the south and west sides will ensure less opportunity for epicormic branching.

White Pine Silviculture

White pine trees generally produce a seed crop every 7 to 10 years during a period commonly known as a “cone year”. The 100-200 seeds produced by each cone are delicately small and remain viable for a short period after dispersal, approximately a year. Because the pine seed is so small, it does not have the stored energy necessary to grow through the forest duff layer, particularly under shady conditions. This means exposed mineral soil, ideally in deep well-drained sandy loams, and heat are required for successful seed germination. Keeping this in mind, these conditions need to be present during the seeds year of viability.

To create these requirements, the silvicultural method most appropriate for pine, or most softwood regeneration for that matter, is even-age. Silvicultural techniques that are best applied where opportunity exists are patch, shelterwood and seed-tree cuts. These techniques provide the stand dynamics required for pine regeneration that include space, heat, light, uniform canopy level, tight geotropic structure, hence an even-aged structure. Timing of treatments is most effective during the snow-less season, where maximum soil scarification is attained.

Another variable in obtaining sufficient pine regeneration is the overall ability of the soil to grow hardwood trees. A soil with a high site index for hardwoods is best suited to grow hardwood. In these soils there is a high level of available nutrients that will undoubtedly permit a layer of hardwood regeneration so thick that whatever pine is established will be overgrown readily. This hardwood competition is often seen on the nutrient poor sites as well, but these soils that are better suited for pine. On these sites pre-commercial weeding of the hardwoods is required for the pine continuance. This hardwood competition is due to the fact that once the seed germinates it has a slow growth rate for approximately 5 years before more rapid growth begins. Site wise, sandy soils, well-drained and low cation exchange, provide excellent pine sites. Timing, silvicultural technique and soil type is critical to promote the continuity of the pine resource.

Hemlock-Hardwood Silviculture

Silviculture will focus on high quality saw timber and on creating and maintaining multiple age classes of species well suited to the site. Multiple age classes will primarily occur in pockets as the stand is treated over time, with the goal of the oldest age class reaching 100+ years.

Twenty-year harvest intervals should result in an average of 20% of the overstory removed at each entry over a 100 year span. Even-aged stands that are being converted to multiple-age will take several entries to establish stocking that can support this type of sustainable harvest.

Hemlock-Hardwood communities are largely managed using a multiple-age system. Methods of multiple-age management involve a combination of single-tree and group selection silviculture and mimic single-tree and

canopy gap disturbances. These silvicultural methods are used to create and/or maintain a multi-aged stand of largely mid-tolerant and shade tolerant species. Residual stand basal area densities following cuts will typically range between 60-90 square ft./acre for the hardwood and 110-200 square ft./acre for areas dominated by hemlock. Where mixed types exist, basal area densities will average between the two types.

The current focus of management here will be to create openings for regeneration to become established and to release the better quality and vigorous overstory where it exists, especially red oak. These goals will be accomplished by removing about 1/3 of the overstory in groups, focusing on removing those individuals of high risk and poor quality and leaving the individuals that are of high quality and vigor. A secondary factor in placement of these groups is to create conditions suitable for regeneration. Summer harvesting that scarifies the soil will create conditions most conducive to regeneration of desired species, such as red oak, white birch, and white pine if possible.

Definitions of Silvicultural Treatments

Definitions of specific silvicultural treatments are listed below and are largely taken from the Society of American Foresters dictionary. Deviations from these treatments will be specified in stand prescriptions.

Crown Thinning (Even-age management): the removal of trees from the dominant and codominant crown classes in order to favor the best trees of those same crown classes

Free Thinning (Even-age or Multiple-Age management): the removal of trees to control stand spacing and favor desired trees, using a combination of thinning criteria without regard to crown position

Low Thinning (Even-age or Multiple-Age management): the removal of trees from the lower crown classes to favor those in the upper crown classes

Selection Thinning (Even-age or Multiple-Age management): the removal of trees in the dominant crown class in order to favor the lower crown classes

Patch Cut (Even-age or Multiple-Age management): the cutting of essentially all trees, producing a fully exposed microclimate for the development of a new age class (typically all Patch Cuts are laid out by delineating the boundary with marking paint; Patch Cut size will be specified in Silvicultural Prescription)

Strip Cut (Even-age management): the cutting of essentially all trees in a strip, producing a fully exposed microclimate for the development of a new age class (all Strip Cuts laid out by delineating the boundary with marking paint; Strip Cut dimensions will be specified in Silvicultural Prescription)

Clear Cut (Even-age management): the cutting of essentially all trees, producing a fully exposed microclimate for the development of a new age class (all Clear Cuts laid out by delineating the boundary

with marking paint; Clear Cut size will be specified in Silvicultural Prescription)

Seed Tree (Even-age management): the cutting of all trees except for a small number of widely dispersed trees retained for seed production and to produce a new age class in fully exposed microenvironment; (seed trees may or may not be removed after regeneration is established depending on 1: harvest opportunity 2: protection of established regeneration 3: long term success of regeneration)

Shelterwood (Even-age or Multiple-Age management): the cutting of most trees, leaving those needed to produce sufficient shade to produce a new age class in a moderated microenvironment —note the sequence of treatments can include three types of cuttings: (a) an optional preparatory cut to enhance conditions for seed production, (b) an establishment cut to prepare the seed bed and to create a new age class, and (c) a removal cut to release established regeneration from competition with the overwood; cutting may be done uniformly throughout the stand (uniform shelterwood), in groups or patches (group shelterwood), or in strips (strip shelterwood); in a strip shelterwood, regeneration cuttings may progress against the prevailing wind

Single Tree Selection (Multiple-Age management): individual trees of all size classes are removed more or less uniformly throughout the stand, to promote growth of remaining trees and to provide space for regeneration

Group Selection (Multiple-Age management): trees are removed and new age classes are established in small groups; the width of groups is commonly approximately twice the height of the mature trees with smaller openings providing microenvironments suitable for tolerant regeneration and larger openings providing conditions suitable for more intolerant regeneration (Patch Cutting differentiated from Group Selection in that Group boundaries are not delineated with marking paint where Patch Cut boundaries are; Group Selection size will be specified in Silvicultural Prescription)

Crop Tree Release (Even-age and Multiple-Age management): the crown release of selected trees on two to preferably three sides (Number of Crop Trees to be released per acre will be specified in Silvicultural Prescription)

Sustainability

It is recognized that from a social, economic, and wildlife habitat standpoint, forests must be managed in a sustainable, long-term way. Because trees can either naturally regenerate or be replanted in an area from which they have been harvested, trees are considered a renewable resource. For this reason, it is possible to harvest trees in a forest, repeatedly, in a way that is sustainable. This implies that portions of the forest may be clear-cut or regenerated at certain times. A balanced age class distribution, as previously discussed, is typically utilized for sustainable forest management. Often on smaller tracts, there isn't enough acreage to efficiently manage for balanced age classes, so sustainable forest management is accomplished through managing for

multiple age classes of trees combined with health, vigorous growth, diversity, and soil/water quality. This type of management allows for sustained periodic harvesting on a regular basis, though some entries will be more improvement based. The scale of sustainability varies with the size of the ownership. The treatments prescribed in this plan are designed to be sustainable over the long term. All of the stands which call for uneven-age management will be able to be re-visited every 15 to 20 years (the “cutting cycle”). Stands which call for even-age management will ultimately have to be regenerated at the end of their rotation age (60 to 120 years, depending on species and forest type), though interim thinning can be applied at 10-20 year intervals in most timber types.

The modern view of sustainability recognizes the need for the entire ecosystem to be sustained, not just one component of the system like timber. If all of the components of the forest are considered, the entire system can function in a sustainable fashion. The Northern Forest Lands Council has identified the following benchmarks of sustainability:

- Maintenance of soil productivity
- Conservation of water quality, wetlands, and riparian zones
- Maintenance or creation of a healthy balance of forest size and age classes
- Protection of unique or fragile natural areas
- Conservation and enhancement of habitats that support a full range of native flora and fauna
- A continuous flow of forest products
- The improvement of the overall quality of the timber resource
- The consideration of aesthetic concerns during timber harvesting
- The continuation of opportunities for recreation

Forest Economics

Economics, while often not an overriding management goal, is an essential part of the management objectives. The carrying costs of owning land alone are expensive. In addition, forestry services critical to proper long-term management involves some expense. In well-managed forests these costs are often viewed as necessary capital investments or annual expenses to achieve owner objectives. Timber management is a primary way for landowners to generate modest income from a naturally renewable resource through careful, thoughtful, and forward thinking management.

Forests add value in three ways. *Physical growth* accounts for the gains in volume over time. The faster an individual tree grows, the faster the tree increases in value if it is of sufficient quality. Whatever the product, additional volume increases value.

The second way forests increase in value is through *product development*. As a sapling, a tree has no merchantable value. Pole timber can often be marketed as firewood or pulpwood. Once a tree grows into the sawtimber size class (and if it is of sufficient quality) it can be sold for sawlogs or even veneer. The per-unit value increase from pulpwood to sawlogs to veneer is very large, in some cases 1000% or more. It would be unwise from an economic standpoint to cut a pulpwood size tree that could eventually grow into a valuable saw log. Furthermore, an individual tree growing rapidly into sawtimber size is a tree which will have a high rate of return,

as will a stand of such trees.

The third way forests add -- or possibly lose -- value is through *relative price changes* in the value of various forest products. The demand for forest products is cyclical, especially for low-value, bulk commodity items such as pulpwood and chip wood.

Briefly, thoughtful forest management can positively influence growth rates, quality of growing stock and thus product development, with an educated awareness of market trends. This “value-growth” approach is a key part of sustainable management and allows for periodic economic returns.

OPERATIONAL CONSIDERATIONS

Boundaries and Property Survey

Identification and monumentation of property boundaries is one of the first management tasks every landowner should undergo, regardless of their interest in active harvesting. The old idiom is true, good fences make good neighbors. Clearly marked boundary lines prevents a multitude of problems, not the least of which is timber trespass.

Property boundaries often include a mix of stone walls and sections of barbed wire fence, but this isn't always the case. Boundary lines should be monumented with permanent blazes which are cut into trees using an ax and then painted with a long-lasting paint. Proper blazing techniques are specific, with rules about location and size of the blaze depending on its location along the line. To protect the historical integrity of a line, new blazes should not be made over old blazes. The blazes should be painted every 10 to 15 years. If monumentation doesn't exist, a survey may be required to establish the location of the boundary lines.

Wolf Creek Boundary and Survey:

The boundaries on Wolf Creek are now completely blazed. The surveying company Meridian Land Services, Inc” located and flagged the centerline of the western portion of the property’s boundary lines using surveying equipment, then they were blazed. Painting of the property boundary is scheduled for the summer of 2018. A copy of the newly surveyed and monumented boundary is found in the Appendix.

Access, Operability, and Water Quality Protection

Most management requires a network of skid trails, truck roads and wood landings. Efficient and sound layout of this important infrastructure is an art in itself. There are a whole host of requirements, rules, and recommendations for forest roads and trails and location of landings. In most states a reference of Best Management Practices exists outlining regulations to prevent erosion and protect water quality during timber operations. General rules of thumb apply, roads and skid trails should not be too steep, should neither be located on sensitive sites nor too close to water, wetlands and riparian areas, should be appropriately sized, and should utilize proper water diversion structures. Often the access network is the most expensive component of land management, but when properly laid out they not only facilitate timber harvesting, they can enhance landowner access, improve wildlife habitat, and provide recreational assets.

Any time heavy equipment is used in the woods there is the potential for water quality problems. Skid trails in the wrong place or used during the wrong time of the year can cause soil erosion and sedimentation. To avoid water quality problems, proper planning is critical. The timing of the job is the most important factor in maintaining water quality. Access roads and skid trails should be properly laid out initially. Soil compaction and rutting is the most eminent danger where the ground is wet. Knowledge of specific soil characteristics, drainage location and, often, winter logging can minimize impacts.

Buffer strips along wetland areas and other riparian zones should not be encroached upon. Predetermined buffer widths can be somewhat impractical for planning purposes. A better method is to use on-site indicators and conditions to determine adequate buffer widths. Despite this, some recommended buffer widths are presented on Brooks, Water and Wetlands section of this plan providing a general outline of buffer guidelines. Factors such as topography, a distinctive change in forest cover type, evidence of travel corridors and concentration areas for wildlife, recreational use, and aesthetic concerns should all be used to determine appropriate buffer widths and locations. Depending on the situation, some thoughtful and sensitive individual tree harvesting can be done within buffers to encourage a diverse forest structure.

After any logging, water bars and other drainage-control structures should be installed. Landing areas or places of exposed soil should be seeded and mulch hay may also be required. All brook crossings should be properly restored with the banks mulched and seeded. The most effective safeguard of water quality is a careful equipment operator with common sense and proper supervision from the forester. All access roads and interior skid roads should be maintained according to the publication Best Management Practices For Forestry by the State of New Hampshire Department of Resources and Economic Development. Another good resource for roads is Good Forestry in the Granite State.

Wolf Creek Access and Operability:

Access to wolf creek during the last round of harvesting in 2012 appears to have been gained via permission from neighboring lands to the south and to the east. There is an access to the north provided by wildwood road that was utilized sometime around 2002, but reports from the time indicate this is not the best avenue of approach. Operability is generally good on site, with a fully mechanized cut-to-length operation being able to complete the last round of harvesting on nearly the entire parcel. Small areas of steep ledge and rock restrict areas on the slope to the east, while the wetland system to the west restricts operability there.

Local Markets and Logging Capacity

As of the last few years the markets have been so variable it is difficult, if not impossible to predict what they will be a year or even a month from now. Though in general conditions have slowly improved and are better than they were during the midst of the economic crisis of recent years, low grade markets continue to spiral downward.

Understanding wood markets is essential to a successful timber harvest, and takes diligent attention. Establishing good, long lasting relationships with mills in the area and as far as Canada is also an integral component. Given the variability of markets, successful timber harvest planning needs to be flexible to accommodate changing market conditions.

The local logging capacity and infrastructure are in place to carry out the treatments prescribed in this plan. However, due to the uncertainty in current markets and unstable weather patterns, many loggers are finding it difficult to make ends meet. MEADOWSEND foresters have established long term relationships with what we consider to be the best loggers out there. To maintain these relationships, we try our best to provide consistent work, but at certain times weather and market conditions prevent steady work.

Currently, several different methods of logging are available to accomplish prescribed silvicultural treatments. There are positive and negative aspects to each method, and the type of equipment needs to be matched to the terrain and the objectives of the job.

Traditionally, the most common method of logging involves the use of rubber-tired cable 'skidders', which skid trees to the landing that are cut with chainsaws. This equipment is capable of working on steep rugged ground with little difficulty. Large diameter trees are not a problem for well-powered skidders. A well-planned job can leave the forest appropriately stocked as skidders can maneuver quite well. There are, however, some downsides to this method. The skidder operators have to be both highly trained and conscientious. Skidders can have an impact on soils if they are not operating at the right time of year or if they are not operated in a thoughtful, professional manner. Soil compaction and soil rutting can have detrimental impacts on long-term soil productivity.

In more recent years a mechanized form of logging has become more common in this region. Mechanical tree harvesters cut the trees instead of a chainsaw. The harvester is commonly on tracks, similar to an excavator. The machine has a harvesting saw-head mounted on a boom, with a fifteen to twenty foot reach. Trees are cut and placed in bunches in the woods and are then dragged to the landing area by either grapple or cable skidders. This logging system has several benefits, most of which involve the mechanical harvester. The harvester has the ability to cut a tree, carry it upright, and place it anywhere. The trees are generally placed in bundles along a skid trail, avoiding damage to the trees left behind. A good harvester operator can cut enough trees to keep two or more skidders busy. As long as the harvester operator is skilled, the skidder operators can do their job with minimal damage to the residual trees. This system of logging is capable of producing a high volume of wood in a short amount of time. This may or may not be good, depending on the objectives. All the soil compaction issues raised above are valid here as well.

So called low-impact logging methods involve the use of animals, bulldozers, or forwarders. The first two are slow, and they cannot economically drag wood very far. They can work on steep slopes, however. A

forwarder is a skidder-like piece of equipment that carries the trees out of the woods, rather than dragging them. There is less ground pressure applied so soil compaction can be kept to a minimum. The forwarder is highly maneuverable and it can work in very tight spaces. This logging method is often called a cut -to-length system because the trees are processed (bucked) where they lie. The cut-up wood is then loaded onto the forwarder. When it heads to the landing it is not dragging seventy or more feet of tree behind it. Forwarders work best on fairly level ground and are not well-suited to steep or rocky ground. Forwarders have the ability to carry the wood quite a distance, and they require minimal landing space. The relatively high cost of this logging system could be offset by lower road construction costs.

New equipment for logging is always being developed. The push towards an ecosystem approach to forest management will result in the design of more environmentally friendly logging equipment. High flotation tires, tracked equipment and biodegradable hydraulic and chainsaw oils are examples.

Forest Products Utilization

Any time a tree is cut, it is important that it is utilized in such a way that the most value is derived from it. The first step in proper utilization is to know the markets. Specifications for forest products can vary widely from one mill to the next. Once a destination for a particular product is chosen, each tree needs to be carefully evaluated before it is cut. A mistake that turns a veneer log into a saw log can be very costly, especially if it recurs throughout the job.

With the exception of cut-to-length systems, most utilization decisions are made on the landing. A piece of equipment called the loader-slasher has become very commonplace with the advent of mechanized logging. The slasher portion is a circular saw which cuts the trees to a specific product length. The loader handles the tree and is capable of loading trucks and piling the tops of the trees to be chipped. This is a quick, safe and economical way of processing the wood, but it does have some drawbacks. The loader operator is quite a distance from the wood that is being sawn, thus high value logs may not be carefully looked at and cut precisely enough to maximize return to the landowner.

The more traditional method of bucking trees into products involves the chainsaw. The trees are skidded to the landing, measured, and cut by hand. The logger has more of an opportunity to look the entire tree over carefully. After the wood is cut, it is important to properly sort the wood by grade and product so the trucker delivers to the designated mill or processing facility.

Accomplishing Treatments

Commercial treatments are those which involve the harvesting and selling of forest products. These treatments should be laid out and supervised by a forester. The most crucial part of good forest management takes place on the ground, not in this document. The science of forest management is still in its infancy, and the intuition of the forester on the ground is crucial to success. There are many components of a timber harvesting operation that need to fall into place if the treatment is to be successful. The two most important components are a knowledgeable, willing seller and a willing, competent buyer. A stable market for the product being sold is also important.

If an agreement can be made between the seller and buyer through a timber sale contract, the logistics of the operation need to be fully considered. Suitable access and landing areas need to be located; the timing of the operation, payment schedules, and other issues need to be addressed. Patience is often required, as well as good weather conditions. Market issues play an important role as well.

COMPLEMENTARY MANAGEMENT OBJECTIVES

Recreation, Education and Aesthetics

There are numerous ways active forest management can enhance and complement recreational opportunities, not the least of which is the creation of trails and roads providing access into the forest. Depending on landowner interests this access network can be used for motorized and non-motorized recreation

opportunities. Activities a landowner is interested in, such as bird watching and photography, can often be worked into the management objectives or can become a driving principle of management.

In human terms the woods are inherently a messy place; trees are often blown down or losing limbs and natural mortality creates snags. Slash reduction following logging, an ice storm or crop tree release operation is important to maintain the visual quality of an area. Brush piles for wildlife cover could be built in areas which are not visually sensitive. Coarse woody debris or large pieces of trees can be left in areas not readily visible. Roads and trails should be designed so they are pleasing to the eye and fit into the natural landscape: poorly planned and constructed trails may lead to future eyesores. Water bars and other erosion control methods should be in place at the end of any job. Proper clean-up of log landing areas is also very important. Debris left from logging operations can be very unsightly; it can be brought back into the woods or buried following landing use. After the landing is pushed off it should be limed, fertilized, and seeded. Following tips and recommendations in the publication A Guide to Logging Aesthetics collaboratively produced by NRAES, NH Cooperative Extension, and SPNHF.

While all of the approaches to aesthetic management take extra time, hence extra cost, it is well worth it in the long run as they conform to owner objectives and good forest stewardship. Monies should be set aside for putting a logging job “to bed”. If the logging contractor is required to do this work it should be spelled out beforehand so that the cost can be determined and it is not left for the logger to do as an additional practice.

Numerous opportunities exist for education on a managed woodlot from hosting forestry workshops to providing research opportunities, the possibilities are numerous and varied. Should the landowners be interested in hosting an educational workshop MEADOWSEND foresters would be happy to help organize and facilitate such an event.

Wolf Creek Recreation, Education and Aesthetics:

The town of Weare actively promotes low impact recreation on all town properties. Due to the location of Wolf Creek and the lack of road frontage, access can present one issue for users. The main recreational use of the property appears to be hunting, with several older trails and shooting lanes being found in the underbrush of the lot.

Following recommendations in the Guide to Logging Aesthetics publication will provide good results. Some of the basic recommendations for aesthetics are emulated in good management:

- protect soils and avoid working in mud season or wet areas
- use proper felling techniques
- clean and re-seed landings and roads where necessary

The educational opportunities on Wolf Creeks Woodlands are extensive and include everything from interpretive trails, workshops, geocaching, to kiosks and informational pamphlets.

In addition, MEADOWSEND foresters are happy to offer tours to the public about forest management on town owned lands. Contacting New Hampshire Cooperative Extension professionals and involving the County Forester and Wildlife Specialists are also a good source for education and workshops.

Archaeological Attributes

Protection and enhancement of archaeological attributes should be an objective of every landowner. Stonewalls, cellar holes, and old wells are the most common features found on forestland. These cultural artifacts provide an important link to past land use and history. Guidelines exist to protect these features, and in general are obvious- don't damage or disrupt existing features. If a stonewall has to be crossed, either create a permanent bar-way or be prepared to replace stones after the job has been completed.

OTHER CONSIDERATIONS

Social Climate

There always have been mixed feelings among the general public concerning forest management and, in particular, timber harvesting. While many people use forest products, most do not fully understand how they are produced. People's perceptions of what may be happening and what is actually occurring are often quite different. A timber harvesting project designed for wildlife habitat improvement or salvage cutting due to wind storm damage or other natural disturbances may sometimes require patch clear cutting. The idea of any type of tree cutting may upset people unless they understand that it was thoughtfully planned and done purposefully with due consideration for the environment.

Tours of the property or signage for educational purposes can often stimulate interest in management and dispel negative assumptions. In addition to the MEADOWSEND foresters, the Extension and County Foresters may be willing to assist owners with educational events.

Tree Farm

The American Tree Farm System is the largest and oldest woodland certification system in America. It specializes in certifying management of private forests as sustainable in ecological and economic terms. Tree Farm works "to give people the tools they need to be effective stewards of America's forests", provides recognition and validation of family forest owners commitment to sustainable stewardship, and helps protect the forest for future generations. In addition, Tree Farm Certification provides access to some better timber markets. Eligibility requirements are a woodlot with at least 10 acres that is under a forest management plan which meets Tree Farm Standards (this document meets trees farm standards). To enroll, the forest must be inspected to verify the Tree Farm Standards have been met.

Wolf Creek Tree Farm:

Wolf Creek will be enrolled into Tree Farm program along with all the other town forests.

Taxes, Laws and Required Permits

New Hampshire:

Best Management Practices: BMP's are for protecting water quality during forest harvests. Some BMP's are

mandatory and others are voluntary. All BMP's are documented in Best Management Practices for Forestry: Protecting New Hampshire's Water Quality.

Current Use: Current Use is an "open space" taxation program (RSA 79-A). It is a property taxing strategy designed to encourage landowners to keep their open space undeveloped. It taxes agricultural and forestland on its "current use" rather than its real estate market value. Minimum requirements are 10 acres in size and buildings and other improvements must be excluded. Landowners must apply to their town and commit their land to open space conservation. When land is developed it is charged a land use change tax. Current use tax rates are variable, with the lowest rates given to un-posted land under Stewardship Category. This plan meets the Stewardship Category of Current Use.

Timber Tax Law: Ten percent of the value of every timber sale is returned to towns where cutting takes place (RSA 227-J:5 and 79:10). The State of New Hampshire requires filing an "Intent to Cut" form for loggers, foresters and landowners who wish to harvest timber. The Intent to Cut form is for tax purposes since timber is only taxed once it is cut, and is used to make municipal assessing officials aware of cutting operations. Once filed, a Report of Wood Cut form is filed with the town.

Wetlands Law: If harvesting is to occur in or near wetland areas, or which requires stream crossings, a Notification of Minimum Wetlands Impact must be filed with NH DES.

Driveway Permit: A driveway permit is required for vehicles entering a state road from the harvest site. The Driveway Permit application needs to be sent to and approved by the Dept. of Transportation.

Basal Area Law: This law (RSA 227-J:9) regulates cutting over 50% of the basal area adjacent to certain waters and along public highways and requires a Basal Area Variance Request.

Slash Law: The slash law (RSA 227-J:10) is intended to reduce fire danger caused by slash and to improve the aesthetics along roads and water bodies. It prohibits leaving slash in or near year round streams, bodies of water, and along public roads, along railroad beds, on or within 25 feet of the property of another, in a cemetery, and within 100 feet of any occupied structure.

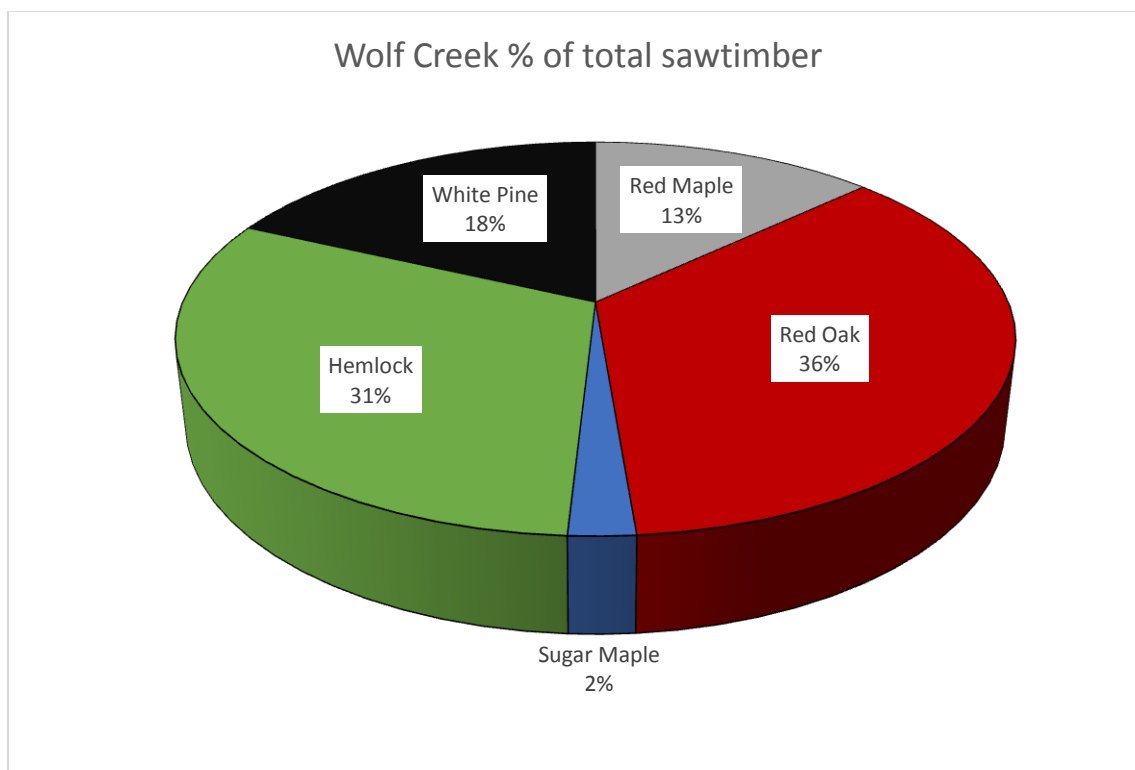
TRACT LEVEL DATA

WOLF CREEK

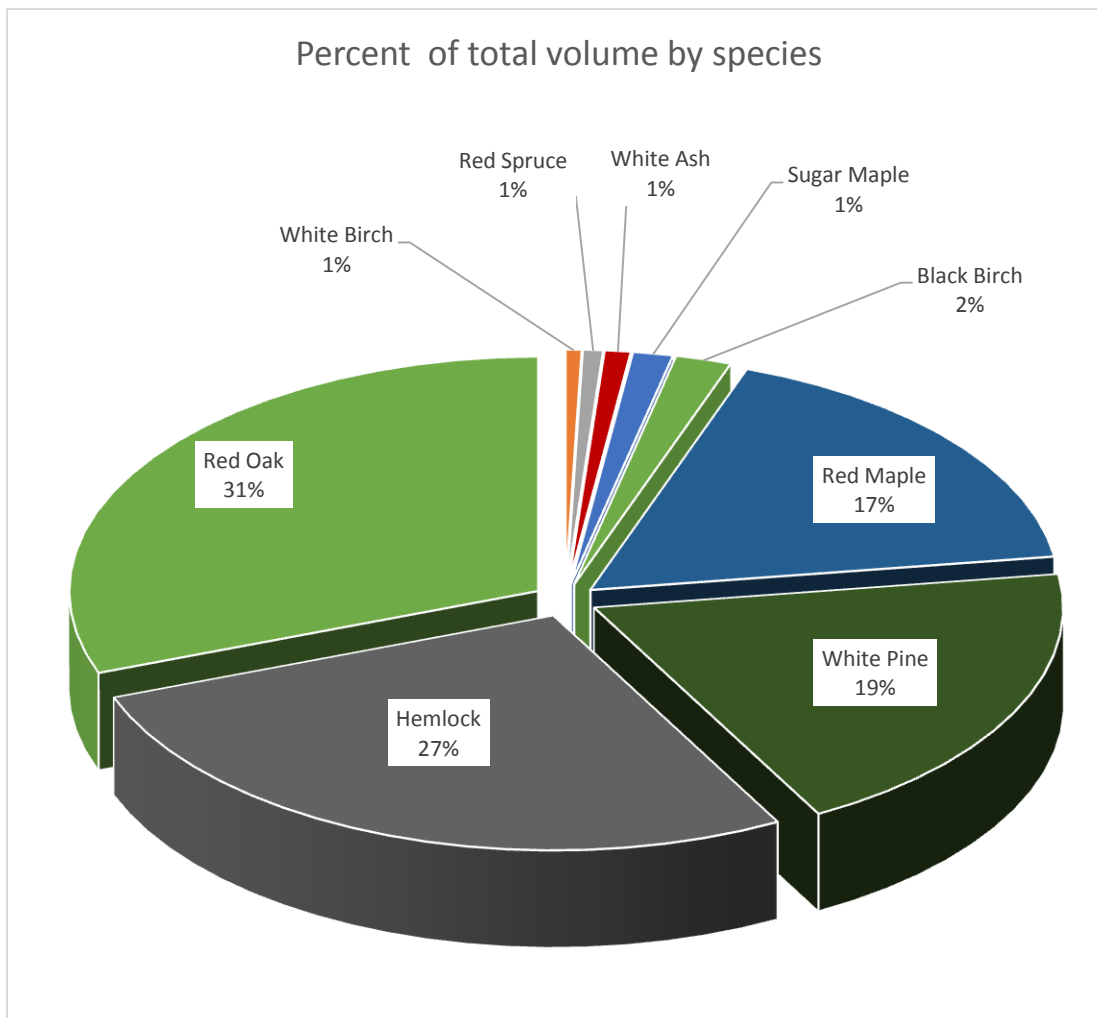
TOTAL FOREST STOCKING

41.44 Forested and Operable Acres

Species	sawlog (BF)	Tie (BF)	Total BF	Pulp (CDS)	Growing Stock CDS	Cull (CDS)	Total Volume (CDS)	% Cords
Hardwood								
American Beech	0.00	0.00	0	13.00	0.00	0.00	13.00	1.8%
Black Birch	0.00	0.00	0	21.00	12.00	0.00	33.00	4.7%
Red Maple	10,562.00	5,206.00	15768	157.00	10.00	6.00	203.00	28.9%
Red Oak	28,877.00	19,212.00	48089	89.00	0.00	0.00	173.00	24.6%
Sugar Maple	1,768.00	1,361.00	3128	27.00	0.00	0.00	33.00	4.7%
Yellow Birch	2,074.00	2,074.00	4148	12.00	0.00	0.00	19.00	2.8%
Total Hardwood	43,281.00	27,853.00	71,134.00	319.00	22.00	6.00	474.00	
Softwood								
Balsam Fir	0.00	0.00	0	9.00	0.00	0.00	9.00	1.2%
Hemlock	25,120.00	0.00	25120	77.00	0.00	0.00	123.00	17.6%
Red Spruce	0.00	0.00	0	4.00	0.00	0.00	4.00	0.6%
White Pine	14,655.00	2,736.00	17391	53.00	9.00	0.00	91.00	13.0%
Total Softwood	39,775.00	2,736.00	42,511.00	143.00	9.00	0.00	227.00	
Total Volume	83,056.00	30,589.00	113,645.00	462.00	31.00	6.00	701.00	



Wolf Creek



TREATMENT SCHEDULE

Stand #	Stand Type	Acres	Treatment	Year*
1	RO HE RM 3/B	41.4	LTG	2026
all			Enroll property into Tree Farm	Asap
all			Paint and sign boundary	2018
all			Update forest management plan	2026

*Weather and markets may prolong completion of entire ownership to more than 1 harvest season/year.

FOREST STAND DATA

Stand 1



Figure 2 Stand 1 is comprised mostly of eastern hemlock, due to the shaded understory conditions.



Figure 3 17 + acres of stand 1 are found along Stonewalls .

GENERAL ATTRIBUTES

Natural Community Type:	Hemlock-beech-oak-pine
-------------------------	------------------------

Stand Age:	60 + years		
Stocking Level:	Just at B line stocking for mixed word stands		
Past Management History:	Two harvests (2002 & 2012) conventional and mechanized.		
Insects/Damage/Disease:	White pine weevil,		
Timber Quality:	Good red oak growing stock, red maple and hemlock average to below average.		
Invasives:	None noted, but likely scattered present.		
Total BA Per Acre:	93	Trees Per Acre:	295
Total AGS BA Per Acre:	50	% AGS Sawtimber:	73.2%
Quadratic MSD:	7.6	Site Quality:	

Silvicultural Objectives

Management system:	Even-aged
Desired Composition:	Red Oak, Hemlock and White Pine.
Crop tree target diameter:	
Wildlife Management:	Protect and enhance wetland system to the east.

Access and Terrain

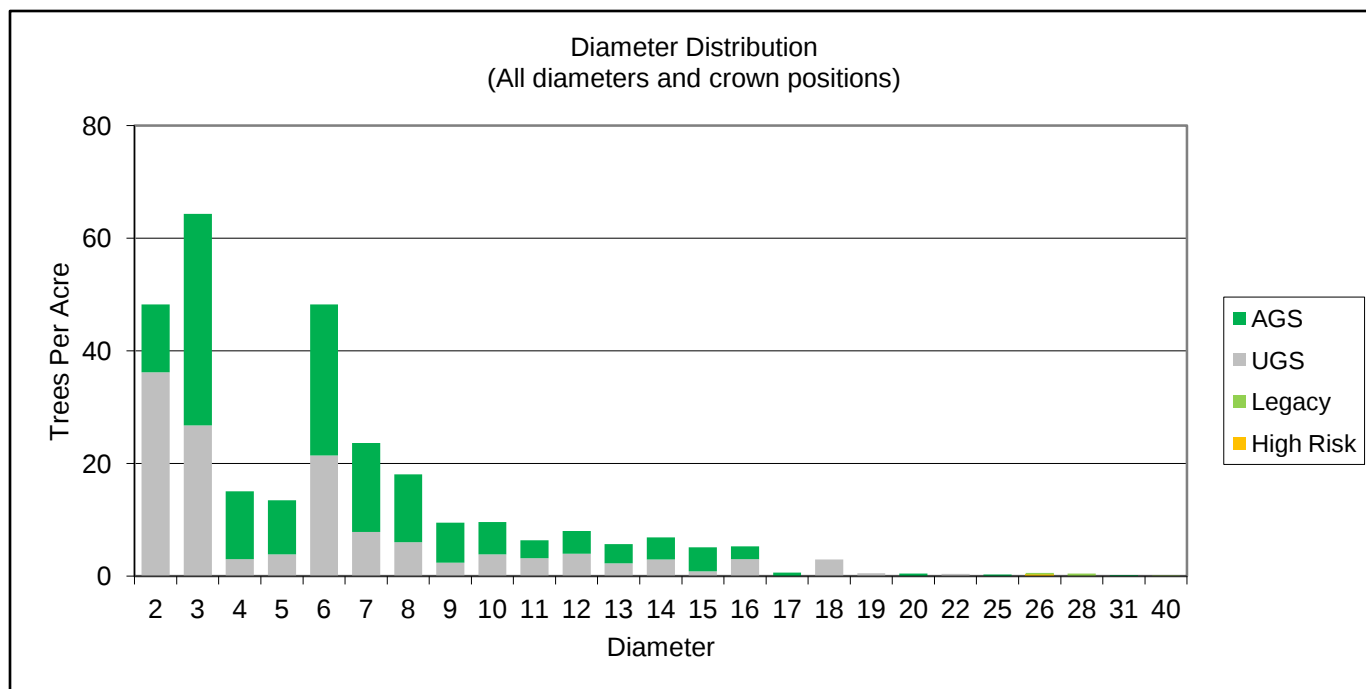
Access to Town Road and Landing Sites:	To the North: Wildwood road. To the South and East – access granted via permission.
Truck/woods Roads:	No internal roads.
Terrain:	Steady, uphill grade from west to east. Operable.

Stand 1: This stand is a classic hemlock- beech beech-oak-pine forest community. Red oak is the dominant species type, followed by red maple and hemlock in volume and trees per acre. Accessibility is good from the south and east, with neighbors providing historic landing options. Operability is good overall as well, with mechanized harvesting crews having no issues in the past.

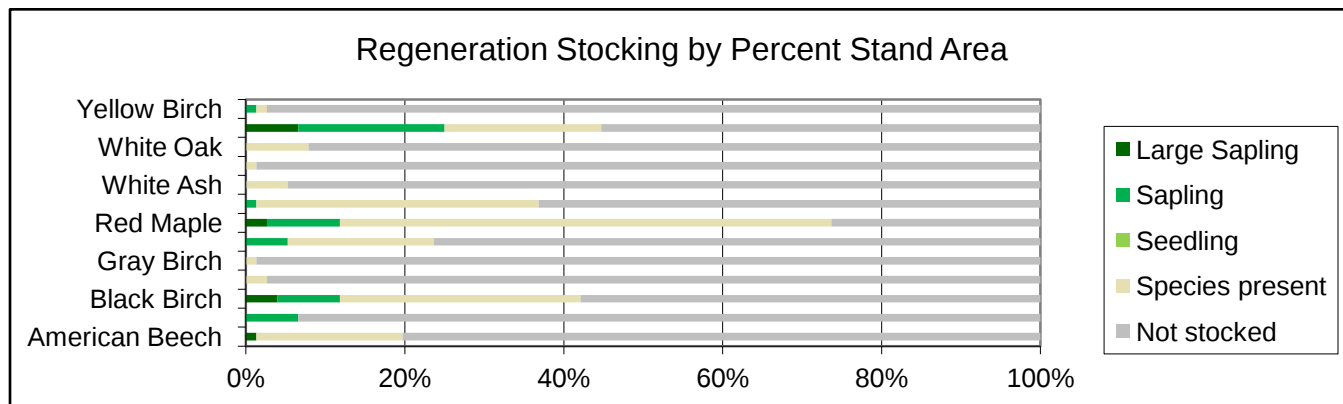
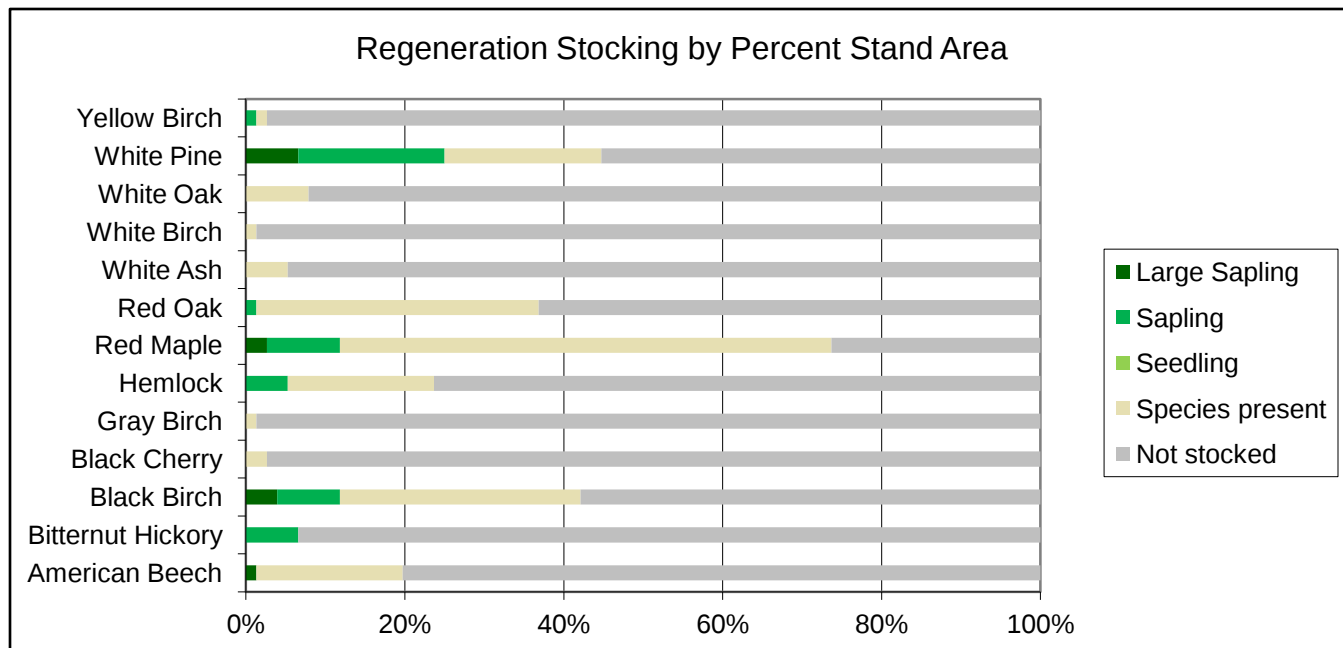
Silviculture Management Objectives: With the most recent round of harvesting occurring in 2012, this property and its current stocking levels do not call for active management at this time. Of the properties trees growing at this time, roughly 73% of them are categorized as acceptable growing stock and should be allowed to grow. The property will be revisited during the next planning cycle, and basal area and stocking will be re-assessed at that time.

Table 1.1: Forest Composition and Volume

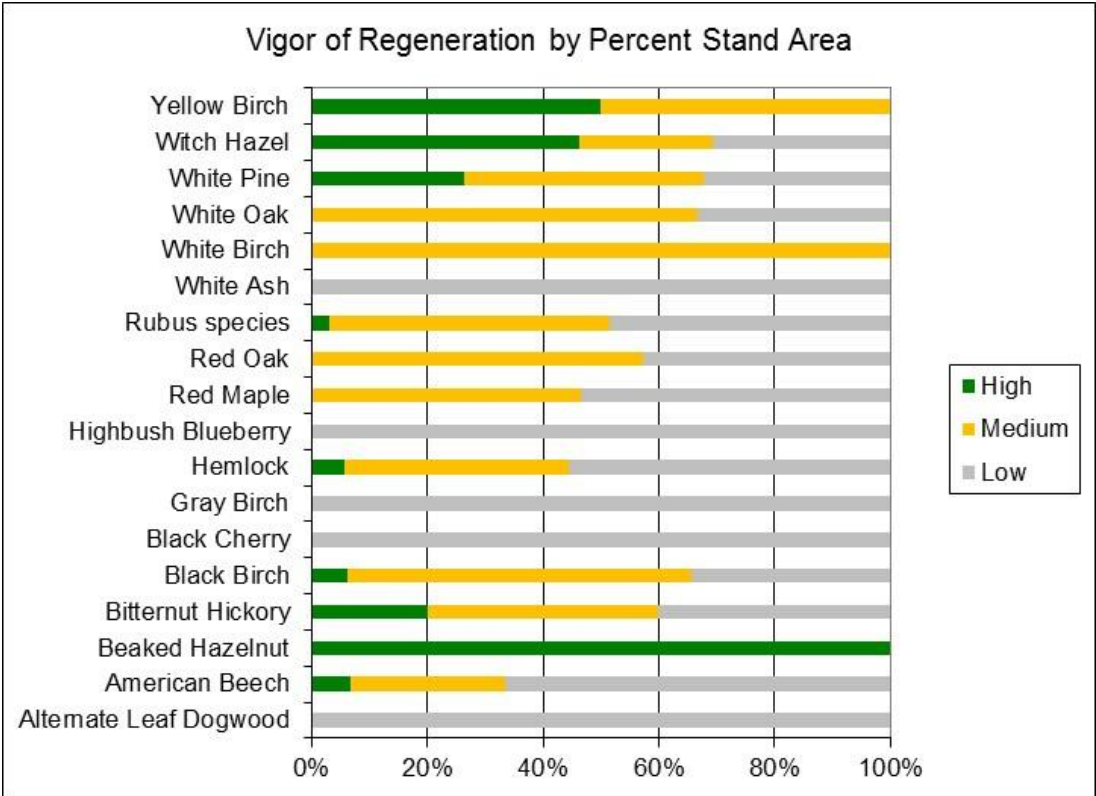
Species	% TPA	Veneer (bf)	Sawlog (bf)	Pallet/Tie (bf)	Pulp (cd)	Growing Stock (cd)	Legacy (cd)	Total Volume in Cords	High Risk	AGS Saw	% AGS Saw
American Beech	0.3%	0	0	0	0	0.0	0.0	0.3	0.0	0	0%
Black Birch	7.4%	0	0	0	1	0.3	0.0	0.8	0.0	0	0%
Red Maple	37.3%	0	255	126	4	0.2	0.0	4.9	0.0	381	100%
Red Oak	12.8%	0	698	464	2	0.0	0.0	4.2	54.7	716	62%
Sugar Maple	4.8%	0	43	33	1	0.0	0.0	0.8	0.0	76	100%
Yellow Birch	1.0%	0	50	50	0	0.0	0.0	0.5	0.0	50	50%
Total Hardwood Per Acre:	63.6%	0	1,045	673	8	0.5	0.0	11.4	54.7	1,223	71%
Balsam Fir	1.0%	0	0	0	0	0.0	0.0	0.2	0.0	0	0%
Hemlock	27.6%	0	607	0	2	0.0	0.0	3.0	0.0	607	100%
Red Spruce	2.6%	0	0	0	0	0.0	0.0	0.1	0.0	0	0%
White Pine	5.1%	0	354	66	1	0.2	0.0	2.2	0.0	180	18%
Total Softwood Per Acre:	36.4%	0	961	66	3	0.2	0.0	5.5	0.0	787	77%
Total Volume Per Acre:	100.0%	0	2,006	739	11	1	0	17	55	2,010	73%
Stand Volume:		0	83,055	30,588	462	30	0	700	2,267	83,194	



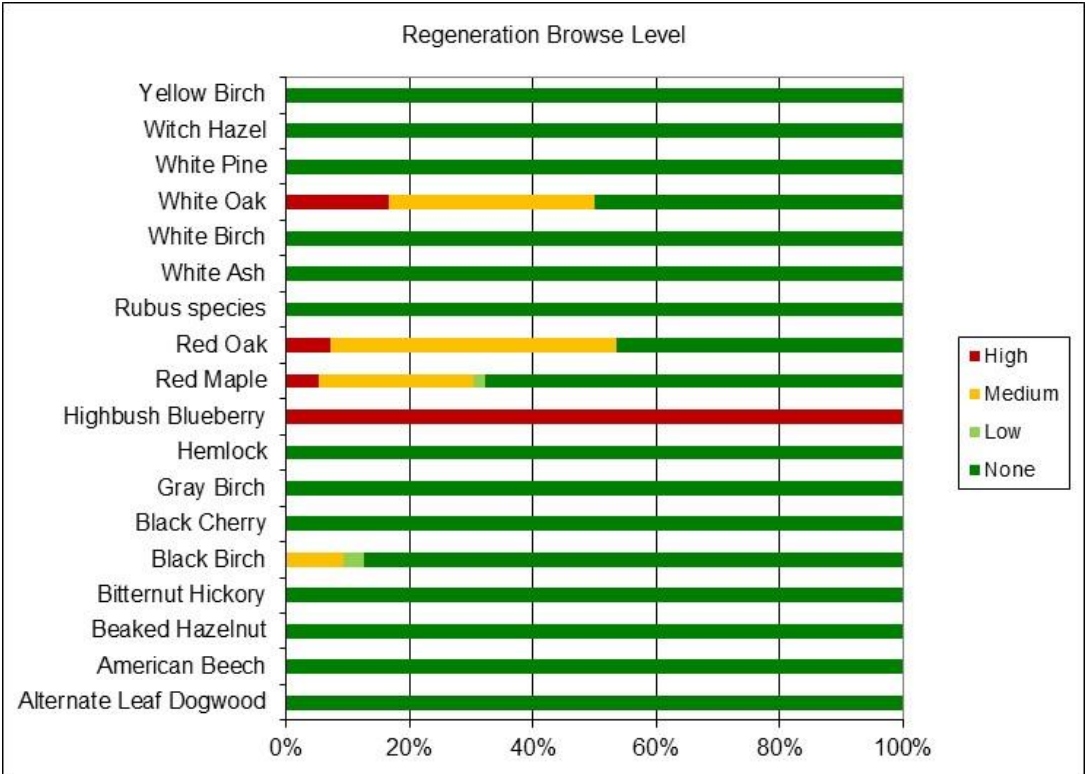
Graph 1.1: Diameter distribution showing trees per acre on the Y axis, diameter class on the X axis and tree condition. Includes trees in all canopy positions down to 2 inches in diameter.



Graph 1.2 and 1.3: Tree (1.2) and shrub (1.3) species regeneration stocking by percent of stand, species and stocking class. The species is considered "stocked" if it meets at least one of three stocking levels including 2 stems between 0.5 and 1.5 inches in diameter (Large Sapling), 5 stems between 3 and 5 feet tall (Sapling), or 25 seedlings less than 3 feet tall (Seedling). If a species is present but does not meet one of these conditions, it is recorded as present but not stocked.



Graph 1.4: Vigor of regeneration and shrub species.



Graph 2.5: Browse level of regeneration and shrub species.

Table 1.2: Standing dead trees per acre by size and decay class.

DBH Class	Moderately punky	Punky throughout	Sound	Grand Total
<12"	3.0			3.0
12-18"	0.7	2.5		3.2
>18"	0.4	0.7		1.0
Grand Total	4.0	3.2		7.2

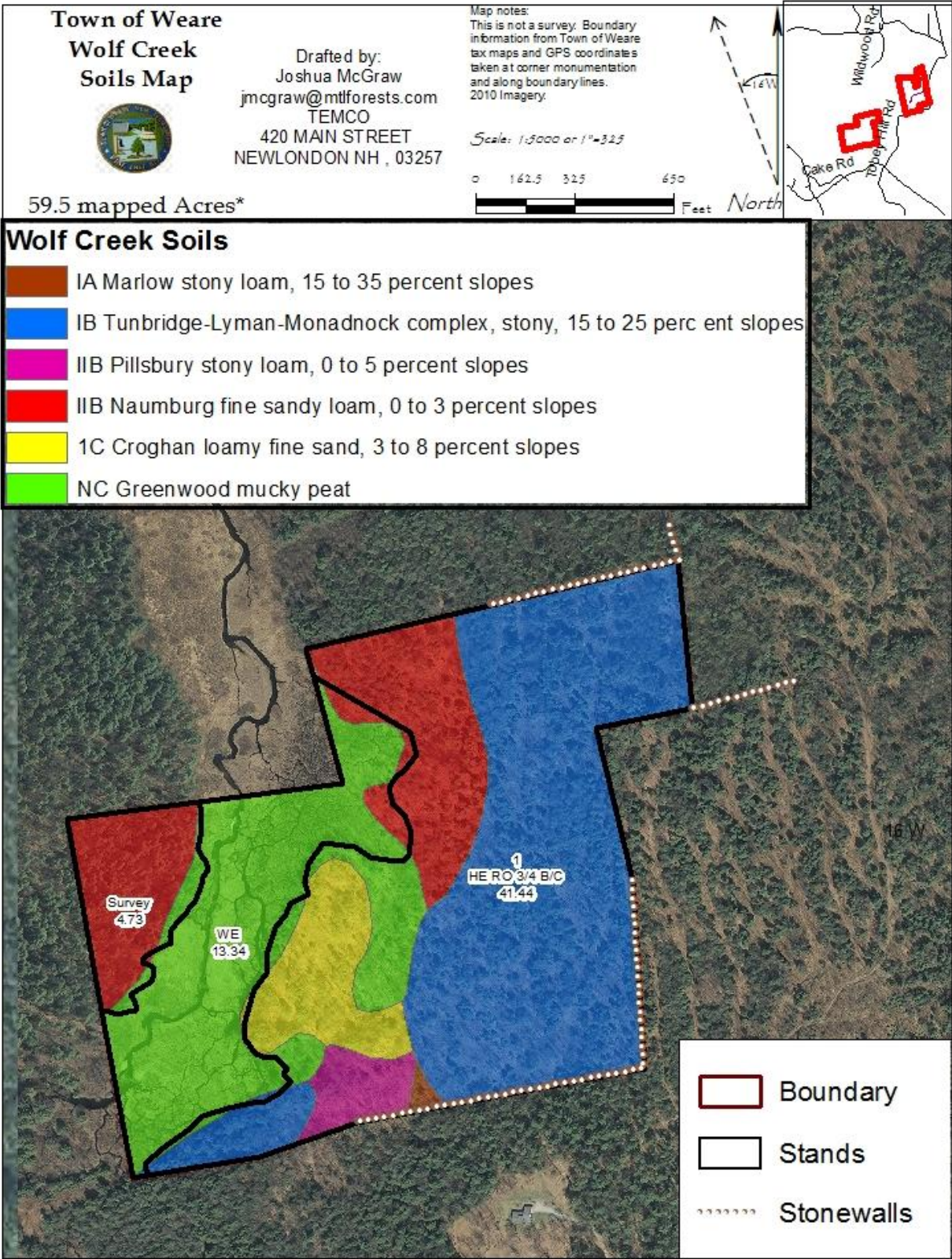
Table 1.3: Down logs per acre by size and decay class.

DBH Class	Moderately punky	Punky throughout	Sound	Grand Total
<12"	15.7	1.6	5.4	22.7
12-18"	2.3	2.0	1.3	5.7
>18"	0.5			0.5
Grand Total	18.6	3.6	6.7	28.9

APPENDIX – A

Wolf Creek

Soils Map



APPENDIX – B

Forestry Terms for The Woodland Owner

Forestry terms for the woodland owner

Carol B. Trokey, The School of Natural Resources
Fred Bergman, Missouri Department of Conservation
Updated by Jeffrey Smith

As a woodland owner, you may hear or see unfamiliar terms used by foresters or in your forest management plan or timber sale contract. Forestry is a specialized field with its own terms and abbreviations. This guide will define many of the terms commonly used in forestry and woodland management.

Acre - An area of land containing 43,560 square feet.

Advanced Reproduction - Young trees established before a regeneration cutting.

Aspect - The direction that a slope faces (north, south, etc).

Basal Area - The cross-sectional area of a tree, in square feet, at 4.5 feet from the ground (breast height). When the basal area of all trees in a stand are summed, the result is expressed as square feet of basal area per acre, which is a measure of a stand's density.

Biltmore Stick - A graduated stick used to estimate tree diameters by holding it against the tree at breast height.

Board Foot - A unit for measuring wood volumes. It is commonly used to express the amount of wood in a tree, sawlog or individual piece of lumber. A piece of wood one foot long, one foot wide and one inch thick (144 cubic inches).

Bolt - A short log or a squared timber cut from a log, usually less than 8 feet long.

Browse - Twigs and buds of small shrubs and trees eaten by deer and livestock.

Buck - To saw felled trees into shorter lengths.

Buffer Strip - A protective strip of land or timber adjacent to an area requiring attention or protection. For example, a protective strip of unharvested timber along a stream.

Cambium - The growing layer of cells beneath bark of a tree from which new wood and bark develop.

Canopy - The more or less continuous cover of branches and foliage formed collectively by the tops (crowns) of adjacent trees.

Cavity Tree - See Den Tree.

Chain - A unit of linear measurement; 66 feet.

Clear-cut - A harvest and regeneration technique that removes all trees from an area. Also called a regeneration cut.

Clinometer - An instrument for measuring vertical angles or slopes.

Co-Dominant Tree - Trees whose crowns form the general level of the forest canopy and receive full sunlight only from above.

Conifer - A cone-bearing tree with needles, such as pines, spruces and firs that produces wood commonly known as softwood.

Cord - A stack of wood containing 128 cubic feet. A standard cord measures 4 feet X 4 feet X 8 feet of wood and air.

Crop Tree - A tree identified to be grown to maturity for the final harvest cut, usually on the basis of its location with respect to other trees and its timber quality.

Crown - The branches and foliage of a tree.

Cruise - A survey of forest land to locate timber and estimate its quantity by species, products, size, quality or other characteristics; the estimate obtained in such a survey.

Cruiser Stick - See Biltmore.

Cull - A tree or log of merchantable size that, because of a defect, is useless for its intended purpose.

DBH - See Diameter Breast Height.

Defect - That portion of a tree or log which makes it unusable for the intended product. Defects include rot, crookedness, cavities and cracks.

Den Tree - A living tree with a hollow cavity in the top large enough to shelter wildlife. Also called cavity

tree.

Dendrology - The study of the identification of trees.

Diameter Breast Height (DBH) - The diameter of a tree at 4.5 feet above the ground.

Diameter Inside Bark (DIB) - The diameter inside the bark; used in log scaling.

Diameter Tape - A specially graduated tape used to directly determine tree diameter when stretched around the circumference of the tree stem.

Dibble Bar - A flat or round metal tool used to make holes for planting seedlings.

Dominant Tree - Tree with its crown above the general level of the canopy that receives full sunlight from above and partial light from the sides.

Edge - In wildlife management, the area where the variety of types of food, cover, water or terrain required by a particular species come together.

Even-Aged Management - Forest management with periodic harvest of all trees on part of the forest at one time, or over a short period to produce stands containing trees all the same or nearly the same age or size.

Face Cord - A stack of wood 4 feet high and 8 feet long, composed of logs of varying length.

Felling - The process of cutting standing trees.

Firebreak - A natural or constructed barrier utilized to stop or check fires.

Firsts and Seconds (FAS) - The highest standard grade for hardwood lumber.

Forest - A plant community dominated by trees and other wood plants.

Forest Inventory - See Cruise.

Forest Type - A group of tree species that, because of their environmental requirements, commonly grow together. Example - the oak-hickory type.

Forester - A person who has been professionally educated in forestry at a college or university.

Girdling - Completely encircling the trunk of a tree with a cut that severs the bark and cambium of the tree, usually resulting in the death of the tree.

Grading - Evaluating and sorting trees, logs or lumber according to quality.

Habitat - The type of place in which the plant or animal lives, such as forest habitat, grassland habitat and marsh habitat.

Hardwood - A term describing broadleaf trees, usually deciduous, such as oaks, maples, ashes, etc.

Harvest - In general use, removing all or portions of the trees on an area. It can mean removing trees on an area to 1) obtain income, 2) develop the environment necessary to regenerate the forest, and on occasions, 3) to achieve special objectives such as development of special wildlife habitat needs, in contrast with intermediate cuttings.

Heel-In - To store young trees before planting by placing in trench and covering roots with soil.

Height, Merchantable - Tree height up to which a particular product may be obtained. For example, if 8-inch minimum diameter sawlogs were being cut from a tree, its merchantable height would be its height up to a diameter of 8 inches.

Height, Total - Tree height from ground level to top.

High-Grading - Cutting only the high value trees from a forest property.

Hypsometer - A graduated stick used to estimate tree height. It is often combined with a Biltmore stick.

Increment Borer - An auger-like instrument with a hollow bit, used to extract cores from trees for growth and age determination.

Intermediate Cut - Removing immature trees from the forest sometime between establishment and stand harvest to improve the quality of the remaining forest stand. Contrast with a harvest cut.

Intermediate Trees - Trees with crowns below the general level of the canopy, receiving some sunlight from above but none from the sides.

Landing - A place where logs are taken to and loaded on trucks for transport to mill.

Log Rule - A table showing estimated amount of lumber that can be sawed from logs of given lengths and diameters. Commonly used in Missouri are:

1. Doyle Rule is a simple formula used in the eastern and southern United States; it underestimates the amount of lumber in small logs and overestimates large logs.

2. International 1/4" Rule is a formula rule allowing 1/2" taper for each 4 feet of length and 1/16" shrinkage for each one-inch board; closely approximates the actual sawmill lumber tally.

Logger - An individual whose occupation is harvesting timber.

Lump Sum Timber Sale - Standing timber is sold for a fixed amount agreed upon in advance; the sale may cover a given acreage, tracts, certain species or diameter classes of trees. Distinguished from a scale or unit sale in which payment is based on the amount harvested (e.g. so much per thousand board feet).

Mast - Nuts of such trees such as oak, walnut and hickory that serve as food for many species of wildlife.

Mature Tree - A tree that has reached the desired size or age for its intended use.

MBF - Abbreviation for One Thousand Board Feet.

Merchantable - The part of a tree or stand of trees that can be manufactured into a salable product.

Multiple Use - Land management for more than one purpose, such as wood production, water, wildlife, recreation, forage and aesthetics.

Overstocked - Forest or stand condition where more trees are present than at normal or full stocking.

Overstory - That portion of the trees in a stand forming the upper crown cover.

Overtopped - See Suppressed Trees.

Pallet - Tray constructed from wood used to store, load and unload various materials.

Planting Bar - A hand tool used to plant seedlings. (See Dibble Bar)

Plot Sample Cruise - A method of estimating standing timber, stocking or volume whereby all trees above a minimum diameter are tallied on plots with fixed boundaries.

Point Sample Cruise - A method for estimating standing timber, stocking or volume without establishing sample plot boundaries. An instrument such as a prism is used to make a 360° sweep from a series of sampling points, counting at each the number of stems that breast-height diameters appear larger than the fixed angle of the instrument. The average stem number multiplied by a factor appropriate to both the fixed angle and the units of measurement chosen gives the basal area per unit area of stand. (Also called variable plot sampling, prism cruising)

Pole Saw - A saw attached to a long pole for pruning tree limbs without using a ladder.

Pole Timber - Trees from 6" to 12" in diameter at breast height.

Prescribed Burning - Use of controlled fire to dispose of unwanted material, following a planned prescription of fuel, weather or other conditions.

Props - In mining, a round, squared or split timber that supports the roof.

Prism, Wedge - An instrument that incorporates a fixed angle and can be used to determine basal area. See Point Sample Cruise.

Pruning - Removing live or dead branches from standing trees to improve wood quality.

Pulpwood - Wood cut primarily for manufacture of paper, fiberboard or other wood fiber products.

Regeneration Cut - See Clear-cut.

Release - To free trees from competition by cutting, removing or killing nearby vegetation.

Reproduction - Young trees. The process by which a forest is renewed; either artificially by direct seeding or planting or naturally by self-sown seeds and sprouts.

Riparian Zone - The area adjacent to, or on the bank of, rivers and streams. Identified by vegetation, wildlife, and other characteristics unique to these locations.

Rotation - The number of years required to establish and grow trees to a specified size, product or condition of maturity. For example, oaks may have an 80-year rotation for sawlogs and Scotch pine a 10-year rotation for Christmas trees.

Salvage Cut - Harvesting damaged or defective trees for their economic value.

Sapling - Trees from 2" to 6" in diameter at breast height.

Sawtimber - Trees 12" diameter breast height and larger, from which a sawn product can be produced.

Scale Stick - A flat stick calibrated so log volumes can be read directly when the stick is placed on the small end of a standard log.

Scaling - Estimating usable wood volume in a log.

Seed Tree Harvest - Removing nearly all trees from the harvest area at one time, but leaving a few

scattered trees to provide seed for a new forest. Sometimes used in Missouri to regenerate pine.

Seedlings - New trees growing from seeds or sprouts less than 2" in diameter at breast height. Also, trees grown in a nursery for one or more years.

Selection Harvest - Harvesting of trees in small groups or as individual trees at periodic intervals to maintain an uneven-age stand. May be described as single tree or group selection system.

Shade Tolerance - The capacity of a tree to develop and grow in the shade of and in competition with other trees. An example of high shade tolerance is sugar maple.

Shearing - To trim back and shape tree branches, making foliage dense and giving the tree a conical form. Used to produce Christmas trees.

Shelterwood Harvest - A harvesting method that entails a series of partial cuttings over a period of years in the mature stand. Early cuttings improve the vigor and seed production of the remaining trees. The trees that are retained produce seed and also shelter the young seedlings. Subsequent cuttings harvest shelterwood trees and allow the regeneration to develop as an even-aged stand.

Silviculture - The art and science of producing and tending a forest.

Site - 1) A tract of land with reasonably uniform soil and climatic factors; 2) an area evaluated for its ability to produce a particular forest or other vegetation based on the combination of biological, climatic and soil factors.

Site Index - An expression of forest site quality based on the height of a free-growing dominant tree at age 50. (or age 100 in western United States).

Site Preparation - Preparing an area of land for forest establishment. May include clearing, chemical vegetation control or burning.

Skid Trail - A road or trail over which equipment or horses drag logs from the stump to a landing.

Skidding - Pulling logs from where they are cut to a landing or mill.

Slash - Debris left after logging, pruning, thinning or brush cutting. May include tree tops, branches, bark or debris left after wind or fire damage.

Snag - A standing dead tree from which leaves and most of branches have fallen. Used for wildlife.

Softwoods - See Conifer.

Stand - A grouping of trees with similar characteristics (such as species, age, or condition) that can be distinguished from adjacent groups. A stand is usually treated as single unit in management plan.

Stave Bolts - Material cut from the white oak group and used in the manufacture of wooden barrels.

Stocking - An indication of the number of trees in a stand as compared to the desirable number of trees for best growth and management. See Overstocked, Understocked.

Stumpage - The value of timber as it stands uncut in the woods (on the stump).

Succession - The replacement of one plant community by another until ecological stability is achieved.

Suppressed Trees - Trees with small crowns that are entirely below the level of the canopy, receiving no direct sunlight. Also called overtopped trees.

Thinning - Generally, a cutting or killing of trees in an immature stand to reduce the tree density and concentrate the growth potential on fewer, higher quality trees resulting in larger trees with faster growth.

Timber Stand Improvement (TSI) - All thinnings made during life of a forest stand for the purpose of improving the composition or productivity of the stand. TSI methods may include removing vines, thinning, cull tree removal and pruning.

Tree Farm - A privately owned forest or woodland in which producing timber crops is a major management goal, certified as a "Tree Farm" by the American Tree Farm System, an organization sponsored by the American Forest Foundation, Washington, D.C. Tree Farm is a registered trademark of the American Forest Foundation.

Undesirable Growing Stock - Trees of low quality or less valuable species that should be removed in a thinning.

Understocked - Insufficiently stocked with trees.

Understory - That portion of the trees and shrubs in a forest forming lower layer of vegetative growth.

Uneven-Aged Management or Stand - A stand of trees containing at least three age classes intermingled on the same area.

Veneer/Veneer Log - A thin sheet of wood sliced or peeled on a veneer machine and often used for plywood or surfacing furniture; veneer logs are the large (usually more than 18 inches in diameter), knot-free, high-quality logs from which veneer is obtained.

Volume - The amount of wood in a tree, stand of trees or log according to some unit of measurement (board foot, cubic foot, etc.)

Volume Table - A table estimating volume of wood in a standing tree based on measurements of tree, most commonly DBH and merchantable height.

Wolf Tree - An overmature tree of very large size.

APPENDIX – D

SKETCH PLAN OF BOUNDARY WORK

