<Woodland Owner> Forest Stewardship Plan Example #1 (~2005)

Prepared by
James Jeuck, NCRF #795
Natural Resource Management and Mapping Service
nrmms01@gmail.com

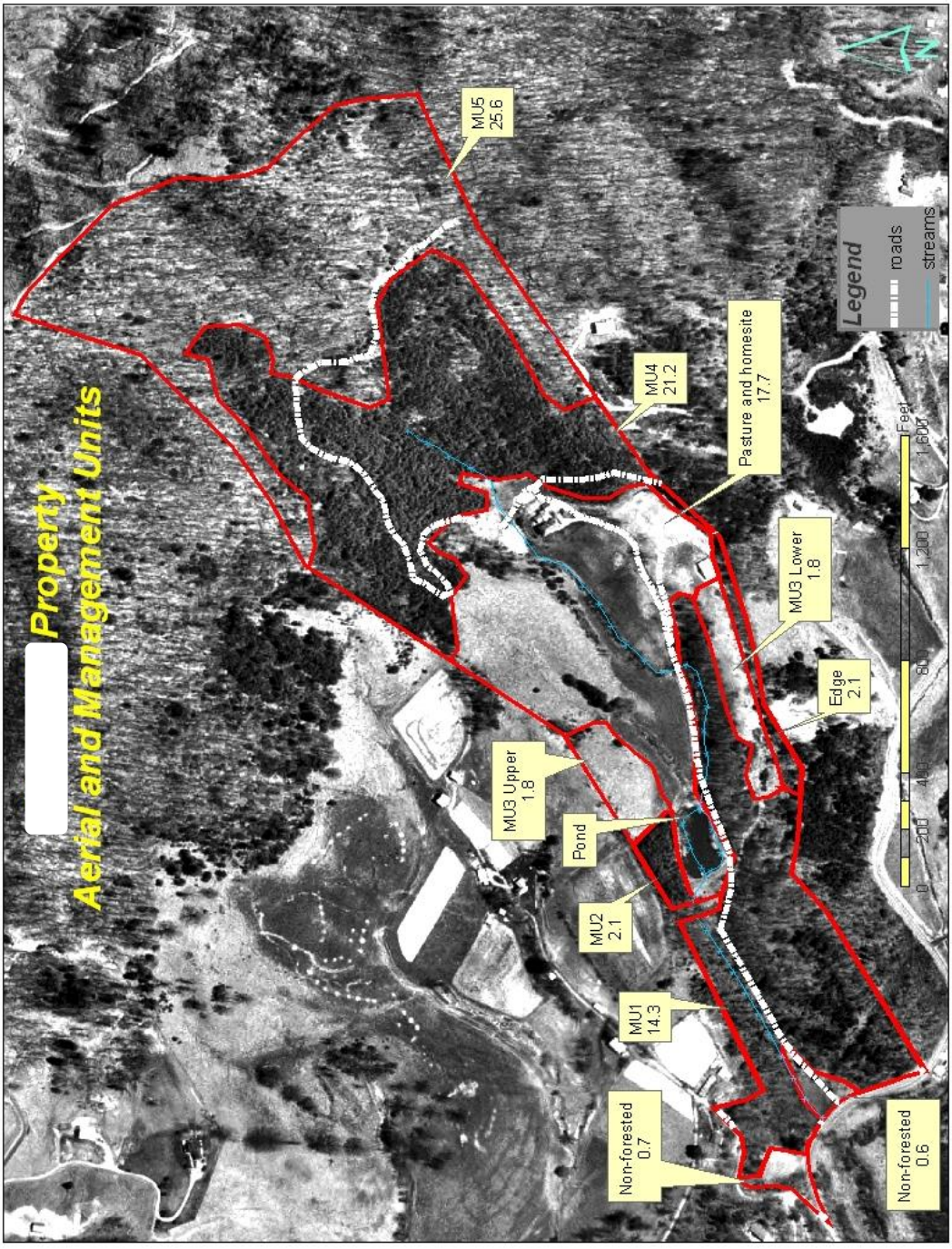


Table of Appendices

FOREST STEWARDSHIP PLAN

LANDOWNER: <Woodland Owner>

LOCATION: Crabtree Area, Clyde, Haywood County, North Carolina

DATE: December 2005

PREPARED BY: James A. Jeuck - N.C. Registered Forester No. 795

PROPERTY DESCRIPTION

The property of John and Suzanne <Woodland Owner> (called in this document the <Woodland Owner>s Property) includes approximately 86 acres in a southwest-facing drainage on the south side of Mill Mountain. Roughly 63.9 acres of the property are currently forested or will be planted to forest. The remaining 22.1 acres are used for pasture, homesite, or pond. The northeast property line follows a ridgeline leading to Mill Mountain and the southwest boundary borders Big Branch Road. The property's general location can be found in the center of the Clyde 7.5 Minute Quadrangles (see <Woodland Owner> locator map in Appendix A and B). The property is a southwest drainage with roughly 3000 feet of perennial creek that drains into Big Branch Creek that leads to the Pigeon River (<Woodland Owner> Topography map in Appendix B). The creek is used to sustain a 1 acre pond. The land varies in elevation from around 2560 feet on Big Branch Road to about 3440 feet near the top of Mill Mountain. The land varies in slope with moderate slopes at the lower portion to very steep as it increases in elevation. The majority of the property has soils that are steep to very steep, deep, well-drained loams.

This property has long history of grazing and subsistence farming. The creek shows signs of accelerated erosion problems typical of such historic land use. The hardwood forest area in the higher elevation has a mix of age classes that no doubt resulted from selective harvesting for lumber and firewood and woodland grazing. The lower portion of the property was subsistence farmed and grazed until roughly 45 – 50 years ago when much of it was left to revert naturally back to forest while other areas were still used for grazing. The <Woodland Owner>s purchased this property roughly 22 years ago and planted some of the eroded areas in white pine (approximately 24 acres) in 10 foot X 10 foot spacing. Access to the property is very good. There exists roughly 2600 feet of main access road following the perennial creek (<Woodland Owner> Aerial Photography and Management Units map in Appendix C). The property also has roughly 1000 feet secondary roads and 4200 feet of old roads leading up the mountain that are used primarily for trail access to the upper end of the property. These roads are in very good shape and could be opened for access roads with minimal work.

For the purposes of this plan the forested areas are broken into five management units (MUs) based on vegetation types and location (Appendix C):

MU1: On the southwest (lower) side of the property, this area is comprised of mostly yellow poplar roughly 35-45 years old with a small pocket of older mixed hardwoods such as southern red oak, black oak and hickory. This unit is contains a riparian zone and the main access road. (approximately 14.3 acres).
MU2: This is a small white pine stand planted on eroded soils next to the pond approximately 22 years ago. It was planted at about 10 foot spacing, has closed canopy within the past 5+ years and has virtually no understory component (approximately 2.1 acres).
MU3: This is comprised of two a small areas of old pasture land that the <Woodland Owner>s would like to plant or allow to naturally succeed into forested areas (approximately 3.6 acres Lower area 1.8 acres, Upper area 1.8 acres).
MU4: This is another white pine plantation the <Woodland Owner>s planted some 22 years ago when they first purchased the property. It was also planted at 10 foot spacing and has closed canopy rough 5+ years ago. There is little understory vegetation. (approximately 21.2 acres).
MU5: An older mixed hardwoods stand with a mix of age classes ranging from 35 to over 100 years. This unit has a high component of black oak, chestnut oak, and northern red oak and was probably the result of selective harvesting and woodland grazing (approximately 25.6 acres).

There is also roughly 22.1 acres the residential, pasture, forested boundary (called "edge" on the map) and pond area not included in this plan.

The varied vegetation types and good mast and forage species such as oak, hickory, and berry producing shrubs like blackberry makes the property conducive to good habitat for deer, turkey, grouse, rabbit, squirrel, songbirds, and predatory species.

OWNERS OBJECTIVES

1. Timber: Maintain and / or improve timber stocking and forest health, and encourage a high diversity of vegetation types on the property. Planted

2. Wildlife: Improve and maintain the diversity and quality of habitat for game and non-game wildlife through the development of wildlife food plots.

3. Soil and Water Quality: Guard against soil erosion and protect water quality by applying appropriate soil and water conservation practices particularly in the road system. Propose a seasonal road system to provide access to the top of the property in a manner that minimizes negative impacts on soil and water quality.

4. Aesthetics and Recreation: Enhance the recreational value of the property by improving accessibility to areas of natural beauty. Maintain their system of trails that will allow them to access and enjoy the back side of the property.

MANAGEMENT PLAN

As stated above, for the purposes of this plan, this property is divided into 5 areas that make up the management units.

Units 1, 2, 4, and 5 have timber data information taken on them to describe timber species, stocking, and growth characteristics.

Descriptive terms used in the management plan are defined below:

Basal area per acre (BA) –is a density measurement. It is defined as the cross-sectional area (in ft^2) of all stems at 4.5 feet above the ground. Good stocking ranges from 90 – 150 ft^2 /acre depending on the timber species and the management objectives involved. I usually state the total BA for the unit and then break it down into percent BA by tree species – this helps to generate a picture of the diversity found on the unit.

Site index – is an estimate of the timber growth and productivity of the site. This varies by soil, tree species, and microclimate. It is estimated from the total age of a tree Vs its total height. A 50 year-old oak that has grown 100 feet tall is on a much more productive site than a 50 year-old oak that has grown 65 feet tall. Site index values range from 50 (very poor) to around 120 (very good).

Percent interest rate being grown by trees – this is a rough estimate of the diameter growth rate per year as a comparison against other rates of interest. A rule of thumb is when the interest rate grown by trees drops below about 5%, the stand is not growing as well as it could and may require that some silvicultural activities take place in order to improve stand productivity.

Age of the stand –some stands of timber are "even-aged" meaning the trees are more or less the same age, while other stands are "uneven-aged" with a mix of age classes. I try to characterize the management unit as such with an approximate average age class or range in the case of uneven-aged stands.

Please refer to the document "*Understanding Forestry Terms – A Glossary for Private Landowners"* in Appendix E.

Soils

The soils found on the property are given below and their location can be seen in Appendix D that includes a soils map of the property. The information (including reported site indices) given was summarized from the "*Haywood County Soil Survey",* by the Natural Resources Conservation Service. You can access this book at your county library and if you wish to read the full description of each soil type listed below – I have included the page number where you can find the information.

Cullowhee – Nikwasi complex (CxA) (pg 27): 0 – 2 percent slope (approximately .6 acres). These are nearly level, poorly drained, soils found on narrow flood plains. If Nikwasi soil, it is considered a wetland soil. These soils are are moderately suited for pasture, poorly suited for roads as they are prone to flash flooding. It is best to keep live stock fences out of stream areas near these soils to reduce erosion of stream banks.

Edneyville-Chestnut Complex (EdF) (pg 36): 50 to 90 percent slopes (approximately 13.3 acres). These are moderately to very deep, well-drained, loamy soils with a gravely loam surface layer. These soils are related to the Plott series but are not as productive and are found mid-to upper-slope on the south-to-west-facing slopes. Both erosion hazard and equipment limitations for this soil ranges from **moderate** to **severe** as the slope gets steeper.

Evard loam (EvD, EvE, EwF) (pg 38): 15 – 90 percent slope (approximately 8.8 acres). These soils are moderately suited for pasture, ornamental crops and orchards. Forest tree species suited for these soils include upland hardwoods such as white oaks, hickory, scarlet oak, and chestnut oak along with eastern white pine and shortleaf pine. The most common timber species used to reforest these soils is eastern white pine. Site indices for chestnut oak ranges from 55 to 77, and for yellow poplar, 80 – 95, moderate to high for both species. Northern red oak site index is not reported. Both erosion hazard and equipment limitations for this soil ranges from **moderate** to **severe** as the slope gets steeper.

Fannin loam, (FnE2) (pg 43): 30 – 50 percent slopes, eroded (approximately 25.7 acres). These are steep, very deep, well drained soils on side slopes of low mountains and intermountain <Woodland Owner>s. Elevation ranges from 2,500 to 3,500 feet. These soils are considered poorly suited for woodland due to slope. Hardwoods that do well on these soils are drier species such as white oak, chestnut oak, scarlet oak, and hickory. Yellow pines and eastern white pines tend to due better of the more eroded sights. Wheeled and tracked vehicles can be used on these sights but rutting can occur during wet seasons so keep vehicles off during those times. It is advised to cable yard only on the steeper slopes.

Hayesville clay loam (HaC2, HaD2) (pg 46): 8 – 30 percent slopes, eroded (approximately 20.5 acres). These soils are moderately steep, very deep, well drained soil on ridges and side slopes of intermountain <Woodland Owner>s and low mountains. Elevation ranges from 2500 – 3500 feet. Much of this land has been overused in the past for pasture and crops without good erosion control practices and therefore the topsoil is moderately eroded in most area this soil is found. It is moderately suited for pasture but erodes easily and is expensive to maintain. It is moderately suited for wood land primarily yellow poplar and eastern white pine. Site indices for these are

reported as: yellow poplar – 85 (moderately productive), eastern white pine – 77 (moderately productive). Erosion and equipment limitations are moderate for this soil due to slope.

Saunook loam (ScB, SdC, SeE) (pg 66): 15 – 30, 30 - 50 percent slopes (approximately 15.4 acres). These soils are moderately sloping to steep, very deep, well-drained stoney loam soils that are found to drainages and coves. Elevation ranges from 2500 – 3500 feet. These areas make highly productive pasture land; however, care must be taken to keep the cattle out of the streams these soils often are found nearby. These soils are also excellent timber soils and high value species (black walnut, ash, and oaks) can be found growing on them due to the deep loamy conditions. The reported site indices for yellow poplar on this soil type is 107 (high productivity). No site index was reported for northern red oak. Both erosion hazard and equipment limitations for this soil ranges from **moderate** to **severe** as the slope gets steeper.

Timber Estimates –

Nine sample points were taken on the <Woodland Owner>s property, three were taken in MU1, one in MU2 and, one in MU4, and four in MU5. All tree species for pulpwood (5 - 9 inch dbh) and sawtimber (10 + inches) were sampled using a 10 BAF prism.

For basic estimates of current (marketable) timber, that is from 5 inches dbh up, standard timber cruise software was used. All stems were 5 inches to 9 inches dbh were entered as "pulpwood" and 10+ inches dbh were entered as "sawtimber". Pulpwood estimates lumped together all species while sawtimber estimates broke out volumes by species. The results generated gave per acre and total volume for the management unit as well as the basal area / acre estimates by tree species and utilization. Current timber estimates were computed and summarized using the *CRUSTALI* timber cruise software.

It is important to keep in mind that volumes estimates in this inventory are not very reliable because of the small number of the samples taken for each management unit. It is not the object of a stewardship plan to provide reliable estimates of current (or future) timber volumes but rather reliable estimates on the ***trends*** and ***general picture*** of what is going on in the landowner's property. The data collected provides very adequate estimates for this and should be interpreted as such.

Cost Share Monies –

Many of the practices and treatments discussed in this document may have some cost share opportunities offered through the Forest Land Enhancement Program (FLEP). FLEP practices that are recognized for a management unit are listed in the management decisions for that unit as well as the current cost share rates. For more information on FLEP please refer to Appendix F.

Management Unit 1 – Yellow poplar

Present Condition

Size: Approximately 14.3 acres

Soils: Fannin loam, (FnE2) 30-50% slopes, Hayesville clay loam (HaC2, HaD2) 15-50% slopes, Cullowhee – Nikwasi complex (CxA) 0 – 2% slopes

Site Index: Yellow poplar – 85

Diameter Growth Rate: 5.0%

Aspect / Elevation: Southwest / 2560 - 2680

Vegetation: Predominantly a mixed northern hardwoods stand with a high component of yellow poplar resulting from natural regeneration after grazing practices ceased some 45 years ago. There is also a small area (roughly 1 acre) of older (>90 years) hardwoods southern red oak, black oak, and hickory in an area where woodland grazing occurred included in this MU. This long narrow unit is at the lowest portion of the property and one drives through it upon entering the property thus it has a high degree of aesthetic value associated with it. The unit also has a perennial stream running through the middle in it by the access road that requires special attention if any management activity occurs here. Except for the older oak component, the yellow poplar is fairly uniform is size and age class. On average, yellow poplar represents 72% of the sawtimber basal area (Table 1 below) and 73% of the timber volume while all other hardwoods account for remaining 28% and 27% respectively. Table 1 is the result of 3 sample points (roughly 1.7% sample of the sawtimber) – it is a very small sample but at least gives the trend of the vegetation diversity in this stand:

Table 1 – CRUSTALI Software Summary of current poplar stand (MU1) on the <Woodland Owner>s property, Haywood County, NC.

MU1 — Prism Cruise Volume Summary — 11/26/2005

	Per Acre			14.3 - Acres		Ave Tree		Cruise		
Product	Volume	Trees	BA	Volume	Trees	Volume	DBH	Plts	Size	%Cr
Sawtimber	Board									
Southern red	1463.72	9.7	13.3	20931	139	150.90	15.9	3	0.14	2.9
Black oak	564.54	0.9	3.3	8073	13	627.27	25.9	3	0.37	7.7
Yellow Poplar	6761.51	82.2	59.9	96690	1175	82.26	11.6	3	0.07	1.5
Hickory	209.44	6.1	3.3	2995	87	34.33	10.0	3	0.05	1.1
Red maple	236.14	4.2	3.3	3377	60	56.22	12.0	3	0.08	1.6
Sawtimber	**9235.35**	**103.1**	**83.1**	**132066**	**1474**	**89.58**	**12.2**	**3**	**0.08**	**1.7**
Pulpwood	Cubic									
All	88.35	12.2	6.7	1263	174	7.24	10.0	3	0.05	1.2
Pulpwood	**88.35**	**12.2**	**6.7**	**1263**	**174**	**7.24**	**10.0**	**3**	**0.05**	**1.2**
STAND		115.3	89.8		1648		11.9	3	0.08	1.6

Overall, this stand has an average basal area of 90 ft^2/acre, 92% of which is in sawtimber and 8% is in pulpwood. This is a relatively uniform stand of trees, the most volume and/or growing space is being used by yellow poplar with little recruitment of pulpwood trees into the canopy. The basal area of 90 ft^2/acre is a fairly open stand when discussing the growth habits of yellow poplar. This is probably the result of phasing out grazing during the the establishment of the yellow poplar and relatively poor regeneration conditions. Yellow poplar is capable of growing fairly tightly with basal areas of 130 – 150 ft^2/acre. The number of trees per acre, average diameters, and basal area together show this is a stand of trees that are fairly widely spaced (for yellow poplar) and have just reached sawtimber size over the past few years. There is little competition in the canopy and the trees are still free to grow at relatively good rates (5%). The site index for yellow poplar is moderate (85) partly because of the soil type and partly because of the past use of the property.

Other tree species observed were black cherry, flowering dogwood, striped maple, white pine, and eastern hemlock. The few hemlocks in this unit is being attacked by hemlock wooley adelgid (HWA) an exotic forest pest that is killing the hemlocks in this area. If the <Woodland Owner>s deem it desirable to treat these trees they can refer to the discussion of HWA in Appendix H.

Shrub species seen include: mountain laurel, poison ivy, blueberry, and blackberry, greenbriar, and multiflora rose. The herbaceous species include many types of fern, grasses, and flowering forbs like Solomon seal, false Solomon seal, and Jack-n-the-pulpit . Multiflora rose and greenbriar are thickest near the margins of the unit where more sunlight is available. These species may cause problems during the regeneration phase of a new stand of trees and would

probably need to have some control actions taken such as herbicides. Included in Appendix G is a discussion of some of the more problematic invasive exotics in this area and control methods for them.

Wildlife: This unit currently provides excellent wildlife cover. Access to water and open areas is excellent. The species mix (particularly with the mixed oak in the middle) provides hard and soft mast for wildlife.

Soils/Water: The majority of this unit appears to be fairly well stabilized since grazing practices ceased but soil compaction and accelerated erosion had no doubt taken its toll on this unit. The stream in middle of the unit is deeply carved – this results when runoff and scouring of the stream banks is excessive to what the stream channel can accommodate, is this case from the soil compaction and exposed soils that can occur from grazing. The current stand is rehabilitating the soils in this area. They have and will continue to gain back productivity as a result of forestry rather than grazing.

Any management activity would need to strictly follow best management practices that will minimize soil erosion and stream sedimentation impacts. This should be fairly easy to accomplish given the excellent access road already established on this unit.

Recreation: The <Woodland Owner>s enjoy the use of this unit and have some walking trails through it. This units adds to wide diversity of land use types, species mixes, and age classes in their ownership and the proximity to their residential area lends itself well to nature hiking and wildlife observation.

Landowner Objectives:

- Continue to develop this stand for future crop trees (circa age 60 - 70) while maintaining beauty and minimizing adverse water quality problems.
- Maintain existing roads and trails for access, hiking, and wildlife viewing.

Management Assessment and Decisions:

Timber

The best option is to continue to let the stand grow for another 20 years allowing the landowners to enjoy the aesthetic value of it and reassess the stand for the possibility of harvest at that time. If they would like to harvest at that time and would like to minimize the visual impact of harvesting while ensuring good regeneration of yellow poplar in this area, then conducting a series small patch cuts of 1 – 5 acres may be employed in 5 – 10 year intervals. Yellow poplar is a shade intolerant species requiring full sunlight for establishment, it is very

good at natural regeneration when given adequate sunlight both from seed source and root / stump sprouts. Natural regeneration will be very successful as the 65+ years since grazing occurred will allow the soils become more productive. Small clearcuts would be very easy to conduct given the superior access to this site and they would also greatly enhance small mammal, song bird, and predator populations by adding more diversity to the age class structure of this management unit.

Management Unit 2 White pine

Present Condition

Size: Approximately 2.1 acres

Soils: Hayesville clay loam (HaC2, HaD2) 15-50% slopes

Site Index: White pine – 77 (from Haywood County Soil Survey)

Aspect: South to southwest

Vegetation: The pines were planted 20 years ago at a spacing of roughly 12 X 12 feet (about 300 trees per acre) the average dbh of the trees is about 10 inches. The basal area is roughly 164 square feet / acre of stems. The average height is roughly 50 feet and the stand appears to be growing very well considering the site it was planted, but the canopy closed and there is strong competition for resources. There is virtually no understory since the canopy closed.

Wildlife: This unit has opportunity for very good wildlife cover. Access to water and cover is excellent. Many songbirds were observed.

Soils/Water: This small stand is helping to restore the eroded soils in this unit.

Landowner Objectives:

- Continue to develop this stand for future crop trees. If the <Woodland Owner>s elect, they could thin the stand some. Maintain / develop access roads for hiking, wildlife viewing and crop tree management activities.

Management Assessment and Decisions:

Timber : The stand should be allowed to grow for another 20 to 40 years and be reassessed for the possibility of harvest at that time. In the meanwhile, if the <Woodland Owner>s elect, the stand could benefit from a moderate thinning operation. This would reduce competition and increase the health and vigor of the residual trees. Although there is not much market for the pulpwood – access is relatively easy and it may be possible to have this unit thinned in conjunction with thinning in MU 4. Included in Appendix I is a NC DFR document that covers the basics of thinning operations, why they are performed and how to conduct them. I would suggest performing a moderate thinning to get the white pines to a basal area of 100 per acre for this soil type. This would mean removing roughly 65 square feet / acre. The spacing between trees should be roughly 15 feet between stems to achieve this. It is of the utmost importance that the remaining stems do not get scarred – it would be to the <Woodland Owner>s's advantage to work with a consulting forester who may identify reputable loggers who will do a good job at keeping the residual stems from getting damaged.

Recreation/Aesthetics – This small unit serves as a shelter on one side of the pond. It has a high aesthetic appeal. A thinning would allow more sunlight into the lower portion of the unit and allow for more herbaceous species to grow in creasing the aesthetic appeal of this area. If this area were thinned, afterwards light periodic fires in this unit would be easy to carry out and would have enormous benefits in developing more herbaceous species in the understory.

Management Unit 3 Conversion of grazing land to mixed hardwoods

Present Condition:

Size: Approximately 1.8 upper portion, 1.8 lower portion

Soils: Hayesville clay loam (HaC2, HaD2) 15-50% slopes

Site Index: Yellow poplar - 85 (from the Haywood County Soil Survey.

Aspect: Upper portion: southeast, lower portion: northwest

Vegetation: The upper portion consists of grasses that the <Woodland Owner>s have attempted to establish over the years. There are still areas of exposed soils in this area. The lower portion had grazing ceased on it roughly five years hence and have allowed it to naturally regenerate. This area shows signs of a good species mix. Some oaks, yellow poplar, and white ash were observed but the predominant regenerating species observed was black locust. Regeneration of trees is difficult is there is very strong competition from multiflora rose and blackberry that is growing thick in this area.

Wildlife: This area currently good wildlife cover. Access to water and cover is excellent. The species mix within the unit is diverse with ample hard and soft mast species. Many songbirds were observed as well as squirrels and rabbits.

Soils/Water: The soils in this area were fairly compacted as a result of past grazing practices. On steeper slopes accelerated erosion occurred removing much of the A-horizon and reducing productivity. Allowing hardwoods to grow on these areas would greatly benefit the soils.

Recreation: These areas contain a high degree of visual exposure and the aesthetic appeal could be enhanced by allowing them to develop healthy trees.

Landowner Objectives:

- Remove the multiflora rose in the lower area and plant both areas with a mixture of native hardwoods

Management Assessment and Decisions:

Timber / Wildlife:

The removal of the multiflora rose in the lower 1.8 acre area is essential to getting this site re-established correctly. The acreage is relatively small so this could most effectively be done by hiring a brush cutting crew to cut stack and burn the rose.

Summer time after the first flush is the best time to do this as the rose has used up some of its reserves. The rose will sprout again and when it does apply and herbicide such as Garlon to it to kill it back. There may need to be several applications to knock it back sufficiently. In the late fall both areas could be planted to a mixture of native hardwoods. The NC DFR nursery has a wide variety of seedlings to choose from. Although they will stop selling their seedlings in "packs", mixtures can still be purchased. I would suggest that the following seedlings be used in these areas: black walnut, crab apple, persimmon, hickory, chestnut oak, and wild plum – these are essentially the native species in the "wildlife west" pack. The upper area would need to be planted at 10 X 10 foot spacing (roughly 800 seedlings) and the lower area – because it already has seedlings established would only need about ½ as much (400 seedlings) to be inter-planted. Cost for this would be roughly:
$200 site preparation (lower area)
$270 (1200 hardwood seedlings)
$200 planting costs
The NC DFR catalog can view viewed at this address (it requires Adobe Reader) (http://www.dfr.state.nc.us/publications/seedcatalog.pdf).

There is cost shae money available for site preparation, seedling purchase and planting available the the Forest land Enhancement Program (FLEP). The county office of NC DFR can provide you with more information on this.

Management Unit 4 White pine

Present Condition:

Size: Approximately 21.1 acres.

Soils: Edneyville-Chestnut Complex (EdF) 50 – 90% slopes; Evard loam (EvD) 15 – 30% slopes; Fannin loam, (FnE2) 30 – 50% slopes, eroded; Hayesville clay loam (HaD2) 15 – 30% slopes; Saunook loam (SdC, SeE) 15 – 50% slopes

Aspect: Southwest (2720' – 3120' elevation)

Site index: 70 white pine

Diameter growth rate: 5.5%

Vegetation: This area was pasture land converted to white pine by the <Woodland Owner>s roughly 30 years ago. One sample point was taken on this uniform stand showing to be of moderate site index and growth rate, most likely due to relatively poor soil conditions resulting from long term grazing. Inside the stand, the understory is sparse due to canopy closure some 10 years ago. The basal area (Table 2 below) is not high for good soil conditions; however, it may be too dense for this stand and a thinning would certainly increase growth rates, vigor and forest health. This stand also offers wonderful wildlife cover and has a perennial creek running through it. There is some evidence of top damage due to ice storms and possibly white pine weevil as there were a number of multiple topped stems on the unit. The stand offers a wonderful aesthetic diversity to the property and the road through the stand is used by the <Woodland Owner>s as a hiking trial to the top of the property. This road could be opened up for forest management access if need be.

Table 2 – CRUSTALI Software Summary of current white pine stand (MU4) on the <Woodland Owner>s Property, Haywood County, NC.

MU4 Prism Cruise Volume Summary 11/26/2005

	Per Acre			19.3 - Acres		Ave Tree		Cruise		
Product	Volume	Trees	BA	Volume	Trees	Volume	DBH	Plts	Size	%Cr
Sawtimber	Board									
White Pine	6187.21	133.6	90.0	119413	2578	46.31	11.1	1	0.07	0.3
Sawtimber	**6187.21**	**133.6**	**90.0**	**119413**	**2578**	**46.31**	**11.1**	**1**	**0.07**	**0.3**
Pulpwood	Cubic									
All	614.25	214.2	50.0	11855	4134	2.87	6.5	1	0.02	0.1
Pulpwood	**614.25**	**214.2**	**50.0**	**11855**	**4134**	**2.87**	**6.5**	**1**	**0.02**	**0.1**
STAND		348	140		6712		8.6	1	0.04	0.2

Landowner Objectives:

- Maintain a healthy stand of timber
- Maintain the road / hiking trail

Management Assessment and Decisions:

Timber

This unit could benefit from a thinning operation if the <Woodland Owner>s elect to do so. Trees marked so get the basal area to around 100 square feet per acre should follow the guidelines below:

1) try to keep the spacing to around 17 feet to achieve this
2) try to remove stems that have bends or snapped tops in them

Although there is not a strong market for white pine many the trees are within the sawtimber size class. The current growth rate suggests that the <Woodland Owner>s could wait for a few years and keep an eye on the market so they could get the best price for their timber. Until then, the timber will continue to grow and add value. It would be best to work with a consulting forester that stays abreast of the markets so he/she can inform the <Woodland Owner>s as to when conditions are good for a thinning sale. A consulting forester could also administer the thinning operation, making sure it is carried out correctly within the guidelines of Best Management Practices and coordinate it with other management activities on the property. The county office of NC DFR maintains a list of highly reputable registered consulting foresters in the region.

Management Unit #5 Mixed Upland Oaks

Present Condition:

Size: Approximately 27.5 acres.

Soils: Edneyville-Chestnut Complex (EdF) 50 – 90% slopes; Evard loam (EvD, EvE, EwF) 15 – 90% slopes; Fannin loam, (FnE2) 30 – 50% slopes, eroded; Hayesville clay loam (HaD2) 15 – 30% slopes; Saunook loam (SeE) 30 – 50% slopes

Aspect: NW (2740 - 3440 foot elevation)

Site index: Black oak – 78 (average from three trees)

Diameter Growth Rate: Black oak – younger stem (35 years) 7.0% , older stems (average two stems 90 and 120 years) < 2.5%

Vegetation: This is predominantly a very steep, moderately dry site and in some places very rocky. Most of the soils here contain fairly high amounts of clay and tend to be on the acidic side. They are moderately productive but can become fairly unproductive if excessive erosion takes place due to overuse. The Fannin soils tended to get overgrazed in this county and this has resulted in moderate amounts of erosion and it is not unusual to see timber productivity less than optimal on these soils. However, the site index and the growth rates on the less steep slopes appear to be moderately good for black oak. This unit has a mix of age classes due to the woodland grazing, selective harvesting, and old home sites that occurred in and near this unit. The dominant species here are oaks (Table 3 below) with chestnut oak making up roughly 44% of the sawtimber basal area. Collectively oaks make up 74% of the timber on this unit and there is a high value in the acorns (and hickory nuts) produced as hard mast for wildlife. Other tree species observed but not in the inventory were: hemlock, sassafras and yellow poplar. The basal area for all live stems of 120 square feet per acre suggests the stand is slightly too dense for good oak production. Competition could be reduced and productivity and health / vigor of residual trees could increase by bringing the basal area down to 90 – 100 square feet per acre.

Regeneration appears to be very good with white pine, hickory, black oak, chestnut oak, northern red oak, and red maple seedlings observed.

Table 3 – CRUSTALI Software Summary of current mixed oak stand (MU 5) on the <Woodland Owner>s Property, Haywood County, NC.

MU 5 — Prism Cruise Volume Summary — 11/26/2005

	Per Acre			27.5 - Acres		Ave Tree		Cruise		
Product	**Volume**	**Trees**	**BA**	**Volume**	**Trees**	**Volume**	**DBH**	**Plts**	**Size**	**%Cr**
Sawtimber	**Board**									
White Pine	865.69	18.7	12.5	23806	514	46.29	11.1	4	0.07	1.0
Northern red	390.22	1.4	2.5	10731	39	278.73	18.1	4	0.18	2.6
White oak	956.89	7.3	7.5	26314	201	131.08	13.7	4	0.10	1.5
Black oak	1887.06	25.8	22.5	51894	710	73.14	12.6	4	0.09	1.3
Chestnut oak	4753.85	43.7	47.5	130731	1202	108.78	14.1	4	0.11	1.6
Hickory	157.08	4.6	2.5	4320	127	34.15	10.0	4	0.05	0.8
Red maple	847.45	15.7	12.5	23305	432	53.98	12.1	4	0.08	1.2
Sawtimber	**9858.24**	**117.2**	**107.5**	**271102**	**3223**	**84.11**	**13.0**	**4**	**0.09**	**1.3**
Pulpwood	**Cubic**									
All	144.68	52.5	12.5	3979	1444	2.76	6.6	4	0.02	0.3
Pulpwood	**144.68**	**52.5**	**12.5**	**3979**	**1444**	**2.76**	**6.6**	**4**	**0.02**	**0.3**
CULL-WILDLI	**Unit Not**									
CULL	273.33	39.8	20.0	7517	1095	6.87	9.6	4	0.05	0.7
CULL-WILDLI	**273.33**	**39.8**	**20.0**	**7517**	**1095**	**6.87**	**9.6**	**4**	**0.05**	**0.7**
STAND		**209.5**	**140.0**		**5761**		**11.1**	**4**	**0.07**	**1.0**

Wildlife: The overstory contains high mast value for wildlife and also has a diverse understory for wildlife. Understory observed were sourwood, serviceberry, poison ivy, mountain hyacinth, false Solomon seal, Solomon seal, hawthorn, blackberry, Christmas fern, various grasses, New Jersey tea, mountain laurel, and rhododendron. The stoney sites, rhododendron thickets, and grasses along the road provides excellent cover, den sites, and food sources for many different wildlife species. It is very good grouse and turkey habitat. Access to water and cover is excellent. The species mix within the unit is diverse with ample hard and soft mast species. Many songbirds, woodpeckers, were observed as well as predatory birds. The <Woodland Owner>s have installed bluebird boxes along the trail that runs up through the unit.

Soils/Water: The steepness of the slope makes any major activity taking place in this unit difficult for traditional wheeled equipment. If future management operations such as harvesting does take place it is important to do so in such a way that soils remain intact. This may require use of cable equipment on the steeper slopes. Access to the top of the unit could be achieved through the adjacent property (on the backside of Mill Mountain) and could serve to set up a cable yarding system along the ridge line.

Recreation: The <Woodland Owner>s enjoy this unit very much as an area to hike and observe wildlife. Any forestry activity that occurs here would need to maintain a high degree of aesthetic appeal in this unit.

Landowner Objectives:

- Continue to develop this stand for future crop trees (circa age 60 - 140) while maintaining beauty and wildlife aspects of this unit..
- Maintain access roads for hiking, wildlife viewing and crop tree management activities.

Management Assessment and Decisions:

Timber

The <Woodland Owner>s do not wish to harvest at present and would like to allow the timber resources to continue to grow under the current conditions for the next 30 + years and have it re-assessed at that time (circa age 60 - 140) for a possible harvest. If the <Woodland Owner>s elect to do so, during that time they could take advantage of the crop tree management techniques discussed in Appendix I of this document. A crop tree is one that provides some type of value for the landowner. That value can be a market value of the tree, a wildlife value or simply an aesthetic importance to the landowner. Many times the landowner chooses a combination of these three values in determining crop which trees to keep and which to remove. If the crop is timber then trees of high market value (both in species and form) should be chosen. The largest oldest trees may not necessarily be the crop trees – there may be a younger / smaller tree with a higher later value that should be chosen and the larger, less valuable trees around it girdled or removed. If the value wildlife mast then trees with high value in seed / nut productivity should be chosen.

The document in Appendix I guides the landowners through the process of determining crop trees based on the landowners objectives, how to inventory for crop trees and techniques used for favoring them through fuel wood cutting and/or girdling techniques. Also, the NC DFR will come out and provide a demonstration marking for crop tree management to show landowners how it is done. The <Woodland Owner>s could use this technique to slowly, but methodically, to reduce the basal area in the more dense areas of the unit and favor the crop trees. The thinned trees could be felled for fire wood – the tops could be piled for small wildlife brush piles.

If the <Woodland Owner>s do in fact desire to provide a final harvest in 30+ years – here are some options they could consider:

1) Look into creation of American chestnut stands in the higher portions of this unit (where there is more full sunlight) – this would require small clearcuts and site preparation.

2) On the mid to lower portion of this unit, prepare the site for advanced regeneration of oaks where they would like northern red oak to become established during regeneration.

Both of the above species are very desirable from timber, wildlife, and aesthetic aspects and establishment of them could be achieved by performing small clearcut operations (“patchcuts”).

Northern red oak would best be established if it were established in the understory well in advance of any harvesting. Natural regeneration or planting in the unit under partial shade for 5 – 10 years prior to harvest the overstory allow the roots systems become established before opening the site up to the full sunlight that a patchcut.

Techniques for these possible target species discussed below will also allow other species in this unit to become established as well maintaining a good species diversity. These techniques, if performed correctly, will result in major component of the stand becoming the target species. When it comes time to perform the actual harvests and regeneration techniques it would be best if the <Woodland Owner>s contact a reputable consulting forester to help plan the details of what is outline in this document.

American chestnut

In 20-30 years American chestnut re-establishment should be fairly common. The American Chestnut Foundation has been making great strides in getting this species back into the American landscape. The <Woodland Owner>s's property is an ideal candidate for getting this species re-established in this region. Indeed chestnut was very common in the Upper Crabtree region particularly in the higher elevations (3000 feet and higher). Although there is not much silvicultural documentation on American chestnut, it is known that American chestnut requires full-sunlight to become established – necessitating small clearcuts. Commercial sale of American chestnut growing stock will not be available for another 5 – 10 years but if the <Woodland Owner>s do decide to do this at a later date, the upper portions MU5 would be ideal. The site would require small patchcuts of 1 -2 acres in areas that receive full sunlight, some site preparation such as burning and some herbicide treatment to reduce competition may be required and then planting of the seed or seedlings at 10 X 10 foot spacing would result in adequate regeneration. The <Woodland Owner>s may want to look at the American Chestnut Foundation's website: http://www.acf.org/default.htm for a re-introduction to this species. It would be good to contact a consulting forester to work out the details during the removal of the overstory, site preparation, and planting of chestnut when it is time to do so.

There is cost-share money available for site preparation and hardwood planting through the Forest Land Enhancement Program (FLEP) in FLEP Practice #2 for this region for up to $33 / acre and $102 / acre respectively for these practices. Please contact the local NC DFR office for details.

Northern Red Oak

Research conducted at Bent Creek Experimental Research Station has determined that one of the best ways to regenerate northern red oak during a harvest is to establish the oak seedlings long in advance to the harvest. This is done through a series of cuttings designed to allow more light to reach the forest floor thereby providing enough light for young oak seedlings while not enough light for some of the major competitors of oak to succeed. This allows the oak seedlings to develop strong root systems and be able to compete well when the overstory is finally removed during the harvest. Therefore, successfully regenerating northern red oak in the least intensive effort requires some planning and action well in advance of the final harvest. A good suggestion is that when the decision is made as to what year (or range of years) a harvest will be performed, then 10 years prior to that, an inventory be taken to see what advanced regeneration of northern

red oak exists throughout the stand. It may very well be that the crop tree management techniques mentioned above (if performed) opened the understory enough to provide for adequate regeneration of oak. If so, then just continue to let them grow until the final harvest and utilize their sprouts. If not, then a preparation cut may need to be in order. This would be designed to remove approximately 25 – 30% of the canopy cover to allow for the light to reach the floor and provide energy for the young oak seedlings. This would be conducted using the same criteria as the crop tree management techniques – in other words – make the residuals the crop trees to be harvested in the following ten years. The stems could be girdled or cut. If girdled they would remain on site serving as wildlife den trees or they could later be used for firewood if access is good. If the stems are cut they need to be extracted from the site and the site cleared enough to establish natural regeneration of oak seedlings.

Over the few years after the preparation cut it is important to inventory the site for oak establishment. The current amount of northern red oak basal area is not very high and it may require planting seedlings in the areas that have the preparatory cuts to help establish this species. If it appears that the previous years had poor acorn crops and seedling establishment is poor it may be necessary to plant seedlings in order to get around 200+ seedlings /acre (about a 10 X 10 foot spacing). Once seedling establishment looks good, then a plan for the final harvest could be performed. It would be best to have the seedlings at least 1" at the root crown before harvesting the overstory (about 7-10 years). It really does not matter if the seedlings are damaged during the harvest as they will sprout vigorously afterwards. The final harvest, at this point, could be a series of clearcuts in conjuction with the harvesting suggested for American chestnut re-establishment of 1 - 2 acres to open the site up for the regeneration to full sun. There obviously will be other species and the stand will still have a strong diversity but this technique helps the odds that a **major** component of the new stand is northern red oak as is currently the situation.

There is cost-share money available for this through the Forest Land Enhancement Program (FLEP) in FLEP Practice #3 for this region for up to $90 / acre. Please contact the local NC DFR office for details.

Natural Regeneration

If the <Woodland Owner>s would like to, they may perform a harvest operation on this unit at any time. However, this is not mandatory, the stand will continue to grow at a moderate for many years and only increase in value. If and when the <Woodland Owner>s do choose to harvest this stand, they should probably harvest the unit in small blocks of 1 - 5 acres and stagger the timing to create different age classes on his property and to stagger income flow from such operations. Aside from the possible planning of the three species mentioned above, natural regeneration on this unit will be excellent and diverse due to the wide variety of tree species found on this unit. A good harvest / regeneration method should consider the following:

1) Harvest this site using small clear cut operations that must employ cable yarding on the steeper, very unstable soils and restricting track or wheeled vehicles only to the less steep

slopes. As access to this most of this unit is excellent, a cable yarding system should be relatively easy to carry out.

2) As much as possible, leave dead trees standing for wildlife den trees
3) As much as possible, create piles from brush and tops for wildlife habitat
4) Vigorous growth of competing species such as multiflora rose should be knocked back using Crossbow or an equivalent at least for the first year or two until sprouting stems become established.

Again, if and when the <Woodland Owner>s do decide to perform any harvesting, they would best be served by hiring a reputable registered consulting forester to serve as their agent in the timber sale to ensure they get the best price and that all forestry operations adhere to their wishes and best management practices. Included in Appendix K are some important guideline prior to selling timber that landowners should know.

Roads and Trails

There is an excellent road through the <Woodland Owner>'s property. There is also a very well maintained series of walking trails from old access roads leading up the side of the mountain through MU4 and MU5. If these trail are to be developed for future forest management roads, it would be good to refer to the supplemental document, *A Guide to Road Design in the Mountains,* included with this document.

Forest health issues:

The management of the exotics such as multiflora rose in the lower MU3 and MU3 / MU1 interface should be explored as these aggressive plants could create forest health issues. The use of chemical herbicides may be the best way to stop the exotics as they are both prolific root sprouters and cutting them only seems to stimulate growth rather than killing them. Included in Appendix I are documents on three important invasive species and suggested control methods.

The hemlocks are in danger of dying from hemlock wooly adelgid attack. This exotic forest pest can be treated for on an annual or bi-annual basis but it can get costly. It would be best to identify which trees would be worthwhile saving and concentrate on preserving these. A root drench technique is the least expensive and can be done by the landowner (a 10 inch dbh tree will cost about $25.00). Trees near water sources should be stem injected to protect aquatic animals from being poisoned. There is special equipment and the technique is tricky so it pays to have a specialist provide that service for you. Please contact the County NCDFR or the county extension office for a list of names of people providing this service. Included in Appendix H is some basic information on the hemlock wooly adelgid.

Time Line of Activities -

Please be aware that these are only suggestions of the proposed activities and that the landowner may elect to do any of these at his/her own time frame or none at all.

Year	Activity	Unit	Supporting Agency
2006 – 8	Explore alternatives for site preparation and planting hardwood mix	MU 3	Landowner / NC DFR
2007	Explore the possibility of thinning white pine stands	MU2 / 4	Landowner / Consulting Forester
2006 - 2021	Crop tree management –	MU5	Landowner / NC DFR
2026	Establishment of northern red oak advanced regeneration	MU5	Landowner / NC DFR
2036 –	Re-assess for possible timber harvest	MU1 / 4 / 5	Landowner
2036	If harvest occurs explore site prep / planting of American chestnut in chosen areas	MU5	Landowner / NC DFR
2036	If harvest occurs, assess establishment of advanced regeneration of northern red oak and sugar maple in areas chosen	MU5	Landowner / NC DFR

Appendices

Please note that most of this information was taken from the NC DFR website

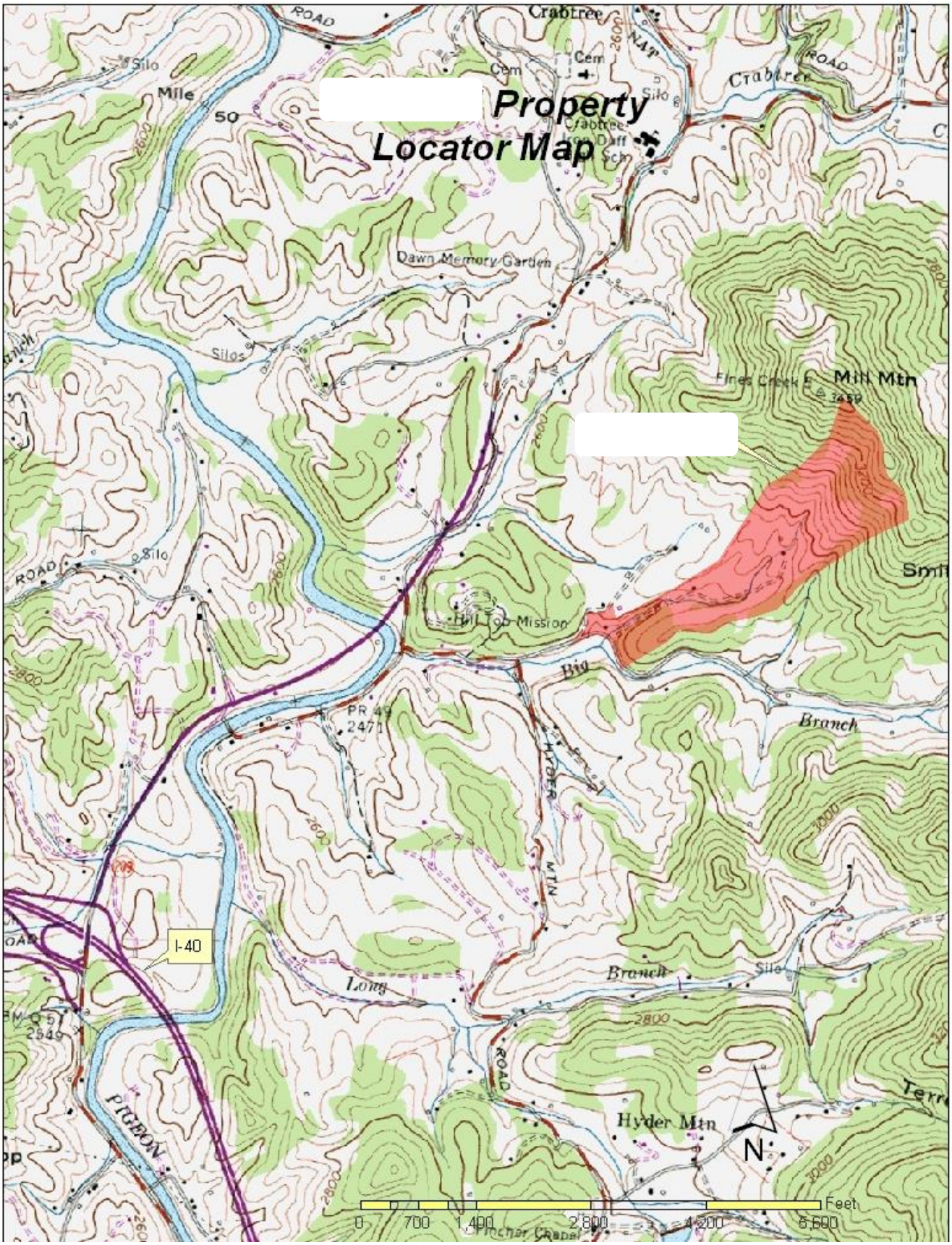
http://www.dfr.state.nc.us/

And

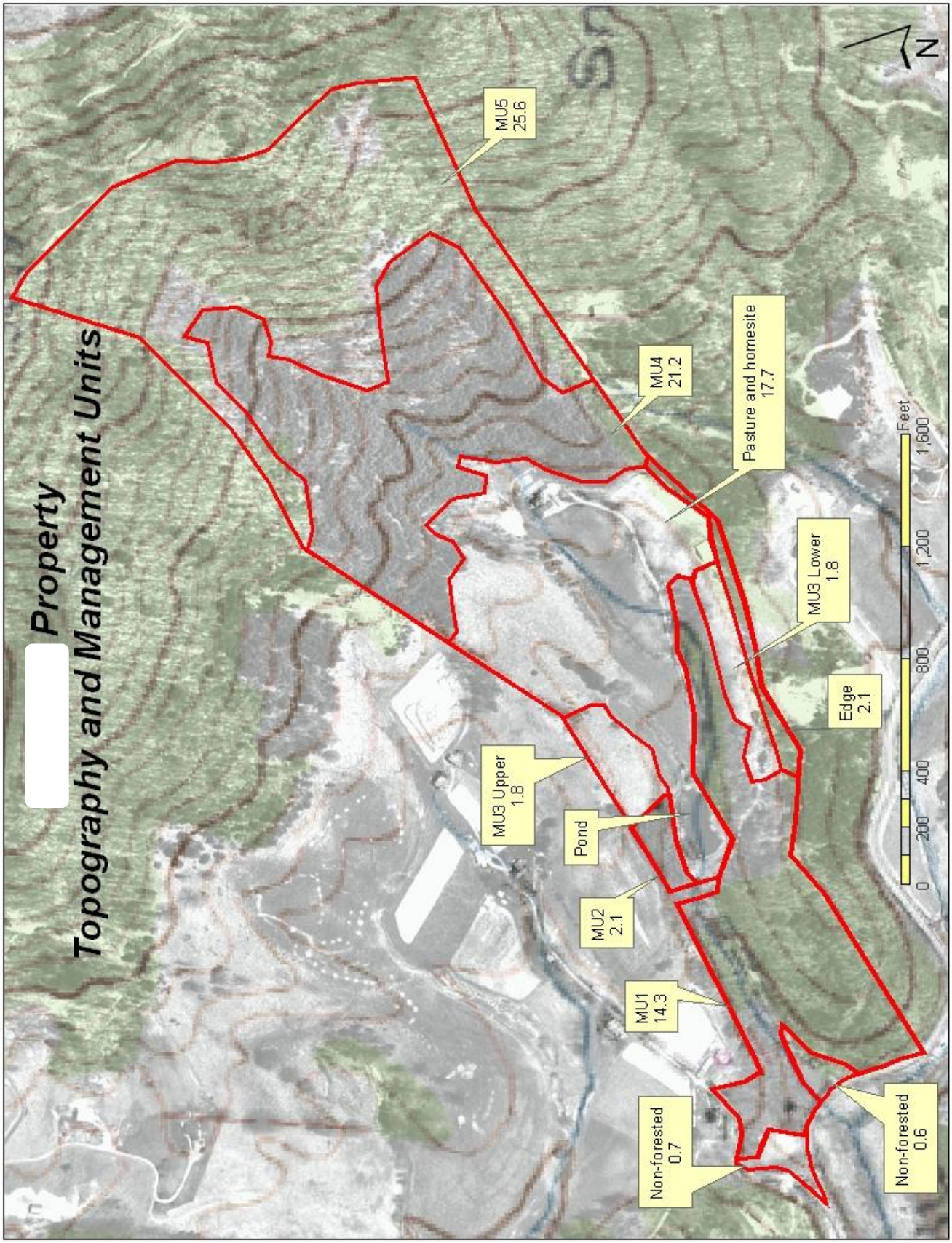
the NC State University Cooperative Extension Service

http://www.ces.ncsu.edu/ForestResources/

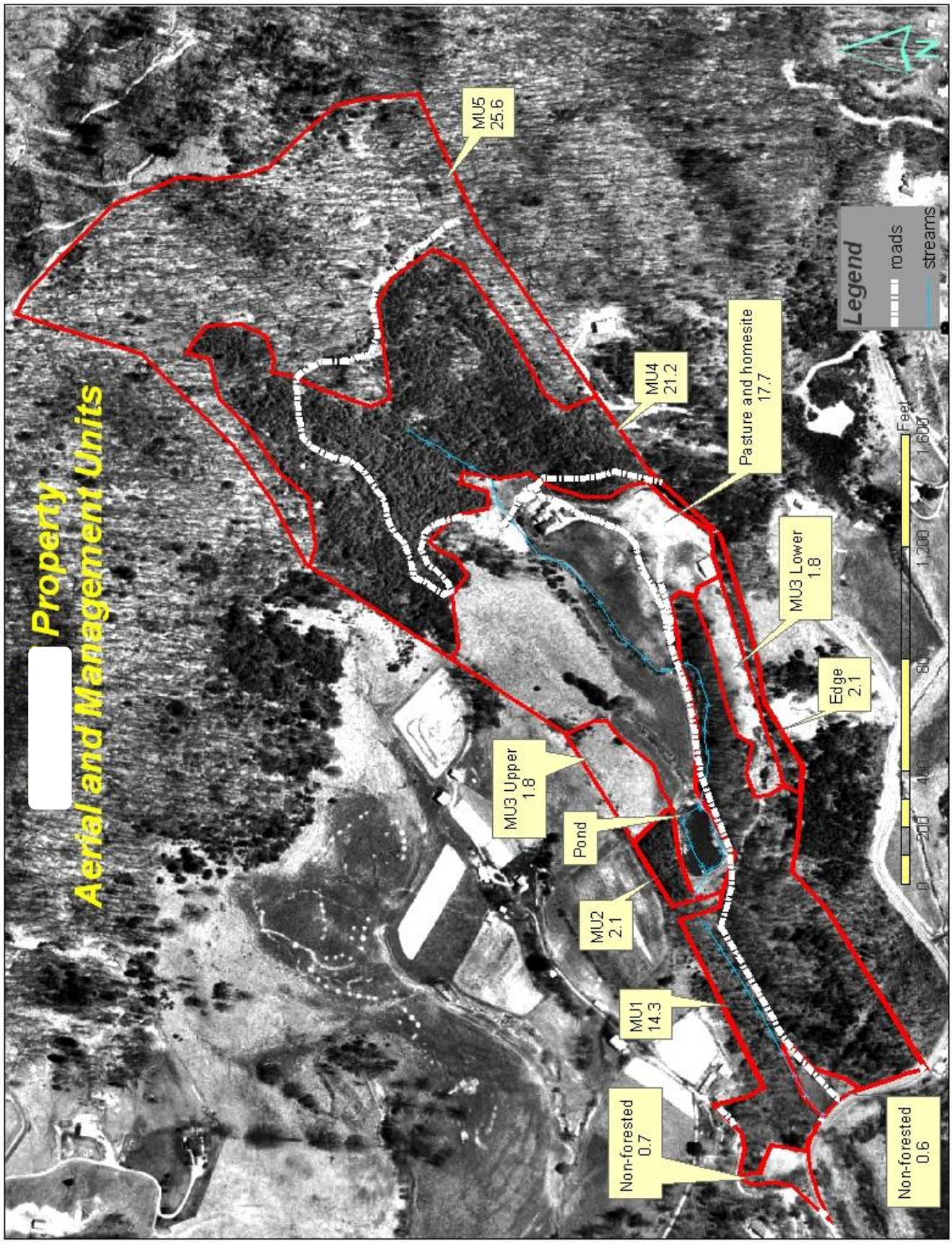
It is highly recommended that you go to these websites and see all the many other documents you can download that will provide you with a wonderful amount of information.


Property
Locator Map
Crabtree
Cem
Mile
50
Dawn Memory Garden
Silos
Mill Mtn
3459
Hill Top Mission
Big
Branch
PR 49
2471
HYDER
MTN
I-40
Long
Branch
Silo
ROAD
Hyder Mtn
PIGEON
N
0
700
1,400
2,800
4,200
5,600
Feet

Appendix A


Property
Topography and Management Units
MU5
25.6
MU4
21.2
Pasture and homesite
17.7
MU3 Lower
1.8
Edge
2.1
MU3 Upper
1.8
Pond
MU2
2.1
MU1
14.3
Non-forested
0.7
Non-forested
0.6
N
0
200
400
800
1,200
1,600
Feet

Appendix B


Property
Aerial and Management Units
MU5
25.6
MU4
21.2
Pasture and homesite
17.7
MU3 Lower
1.8
Edge
2.1
MU3 Upper
1.8
Pond
MU2
2.1
MU1
14.3
Non-forested
0.7
Non-forested
0.6
Legend
roads
streams
Feet
0
200
400
800
1,200
1,600
N

Appendix C

Property
Soils and Management Units
EvE
EvD
EvE
EwF
EdF
SeE
HaD2
FnE2
MU5
25.6
MU4
21.2
Pasture and homesite
17.7
FnE2
SdC
EvD
MU3 Lower
1.8
FnE2
ScB
HaD2
ScB
HaD2
Edge
2.1
MU3 Upper
1.8
Pond
HaC2
W
HaC2
HaD2
MU2
2.1
MU1
14.3
FnE2
Non-forested
0.7
HaC2
CxA
Non-forested
N

Appendix D

Appendix E: Note the document was taken from the NC State Extension Forestry Woodland Owners Notes webpage and all credit goes to them -

http://www.ces.ncsu.edu/nreos/forest/woodland/catalog.html

Understanding Forestry Terms

A Glossary for Private Landowners

In discussing forestland management and everyday forest operations, you will often hear and read words and phrases that are unique to the natural resources professions. You will also encounter some common terms that have special meanings when applied to forestry. This publication lists and defines more than 150 forest resource terms to help you in conversing with others about forestry matters and in making informed decisions about your forestland.

A

ACRE — An area of land measuring 43,560 square feet. A square 1-acre plot measures 209 feet by 209 feet; a circular acre has a radius of 117.75 feet.

AESTHETICS — (a) Sensitivity to or appreciation of the forest's beauty through recognition of its unique and varied components. (b) Beauty through an orderly appearance.

ALL-AGED or UNEVEN-AGED MANAGEMENT — The practice of managing a forest by periodically selecting and harvesting individual trees or groups of trees from the stand while preserving its natural appearance. Most common in hardwood forests.

ALL-AGED or UNEVEN-AGED STAND — A forest stand composed of trees of different ages and sizes.

ANNUAL — A plant that lives or grows for only one year or one growing season.

ANNUAL WILDLIFE SEED MIXTURE — A mixture of soybean, millet, cow pea, sorghum, lespedeza, buckwheat, and other seeds from which single-season plants are grown to serve as food or protective cover for wildlife. Some mixtures reseed naturally, while others require reseeding, light disking, and fertilization.

B

BASAL AREA — (a) The cross-sectional area (in square feet) of a tree trunk at breast height (4.5 feet above the ground). For example, the basal area of a tree that measures 14 inches in diameter at breast height is about 1 square foot. (b) The sum basal areas of the individual trees within 1 acre of forest. For example, a well-stocked pine stand might have a basal area of 80 to 120 square feet per acre.

BEDDING — Land prepared before planting in the form of small mounds. The prepared land concentrates topsoil and elevates the root zone of seedlings above temporary standing water. Fertilizer is often incorporated into the bedding.

BIOLOGICAL DIVERSITY — The variety of life forms in a given area. Diversity can be categorized in terms of the number of species, the variety in the area's plant and animal communities, the genetic variability of the animals, or a combination of these elements.

BLOCK — An area of land or timber that has been defined for management purposes. One block may be composed of stands of different species or ages.

BOARD FOOT — A unit of wood measuring 144 cubic inches. A 1-inch by 12-inch shelving board that is 1 foot long is equal to 1 board foot. Board foot volume is determined by:

length (feet) x width (inches) x thickness (inches)

BOLE — The main trunk of a tree.

BUFFER STRIP — A narrow zone or strip of land, trees, or vegetation bordering an area. Common examples include visual buffers, which screen the view along roads, and streamside buffers, which are used to protect water quality. Buffers may also be used to prevent the spread of forest pests.

C

CANOPY — A layer or multiple layers of branches and foliage at the top or crown of a forest's trees.

CAPITAL GAINS — Profit on the sale of an asset such as timber, land, or other property. Reporting timber sales as capital gains provides certain tax advantages over reporting revenues as ordinary income.

CHIP-n-SAW — A cutting method used in cutting lumber from trees that measure between 6 and 14 inches diameter at breast height. The process chips off the

rounded outer layer of a log before sawing the remaining cant or rectangular inside section into lumber. Chip-nsaw mills provide a market for trees larger than pulpwood and smaller than sawtimber.

CLEAR-CUT HARVEST — A harvesting and regeneration method that removes all trees within a given area. Clear-cutting is most commonly used in pine and hardwood forests, which require full sunlight to regenerate and grow efficiently.

CLIMAX COMMUNITY — A relatively stable and undisturbed plant community that has evolved through stages and adapted to its environment.

COMPETITION — The struggle between trees to obtain sunlight, nutrients, water, and growing space. Every part of the tree—from the roots to the crown—competes for space and food.

CONSERVATION — The protection, improvement, and wise use of natural resources for present and future generations.

CONSERVATION RESERVE PROGRAM (CRP) — A federal program designed to remove highly erodible, marginal farmland from production through a one-time cost-sharing payment to establish trees, grass, or other cover. The landowner receives a 10-year annual rental payment to maintain the cover.

CONTROLLED BURN — (See Prescribed Burn.)

CORD — A stack of round or split wood consisting of 128 cubic feet of wood, bark, and air space. A standard cord measures 4 feet by 4 feet by 8 feet. A face cord or short cord is 4 feet by 8 feet by any length of wood under 4 feet.

COST-SHARE ASSISTANCE — An assistance program offered by various state and federal agencies that pays a fixed rate or percentage of the total cost necessary to implement some forestry or agricultural practice.

COVER — (a) Any plant that intercepts rain drops before they reach the soil or that holds soil in place. (b) A hiding place or vegetative shelter for wildlife from predators or inclement weather.

CROP TREE — Any tree selected to grow to final harvest or to a selected size. Crop trees are selected for quality, species, size, timber potential, or wildlife value.

CROWN — The branches and foliage at the top of a tree.

CROWN-CLASS — A tree classification system based on the tree's relative height, foliage density, and ability to intercept light. Crown-class measures past growth performance and calls attention to crop trees that could benefit from future thinning and harvest operations. There are four classifications:

Dominant Trees — Larger-than-average trees with broad, well-developed crowns. These trees receive direct sunlight from all sides and above.

Codominant Trees — Average-to-fairly large trees with medium-sized crowns that form the forest canopy. These trees receive full light from above but are crowded on the sides.

Intermediate Trees — Medium-sized trees with small crowns below the general level of the canopy. Intermediate trees receive little direct light, are poor crop trees, and should be removed during thinning operations.

Suppressed or Overtopped Trees — Small trees that grow below the tree canopy and receive no direct sunlight from any direction.

CRUISE — A survey of forestland to locate timber and estimate its quantity by species, products, size, quality, or other characteristics.

CULL — A tree or log of marketable size that is useless for all but firewood or pulpwood because of crookedness, rot, injuries, or damage from disease or insects.

CUTTING CONTRACT — A written, legally binding document used in the sale of standing timber. The contract specifies the provisions covering the expectations and desires of both buyer and seller.

CUTTING CYCLE — The planned time interval between major harvesting operations within the same stand—usually within uneven-aged stands. For example, on a 10-year cutting cycle in a hardwood stand, trees are harvested every 10 years.

D

DAYLIGHTING — A practice in which trees shading an access road are removed to increase the sunlight on the roadway and along its periphery. This relatively inexpensive practice maximizes forest edge and cover for wildlife and maintains passable roads year-round.

DIAMETER AT BREAST HEIGHT (DBH) — The diameter of a tree measured in inches at breast height—a standard 4.5 feet above the ground.

DIAMETER-LIMIT CUTTING — A selection method in which all marketable trees above a specified diameter are harvested. Diameter-limit cutting can lead to longterm degradation of the stand.

DIRECT or BROADCAST SEEDING — (a) Sowing seed for broad coverage from the air or on the ground. (b) Seeding of forest stands, roadways, or specified plots for wildlife.

DRUM CHOPPING — A site preparation technique in which logging debris is leveled by a bulldozer pulling a large drum filled with water. Chopped areas are often burned to further reduce debris and control sprouting before seedlings are planted.

E

ECOLOGY — The science or study of the relationships between organisms and their environment.

EDGE — The transition between two different types or ages of vegetation.

ENDANGERED or THREATENED SPECIES — A species is endangered when the total number of remaining members may not be sufficient to reproduce enough offspring to ensure survival of the species. A threatened

species exhibits declining or dangerously low populations but still has enough members to maintain or increase numbers.

ENVIRONMENT — The interaction of climate, soil, topography, and other plants and animals in any given area. An organism's environment influences its form, behavior, and survival.

EROSION — The wearing away of land or soil by the action of wind, water, or ice.

EVAPOTRANSPIRATION — The evaporation of water from the soil and the transpiration of water from the plants that live in that soil. Approximately one-quarter of a forest's annual rainfall returns to the air through evapotranspiration.

EVEN-AGED MANAGEMENT — A forest management method in which all trees in an area are harvested at one time or in several cuttings over a short time to produce stands that are all the same age or nearly so. This management method is commonly applied to shadeintolerant conifers and hardwoods.

F

FIREBREAK — Any nonflammable barrier used to slow or stop fires. Several types of firebreaks are mineral soil barriers; barriers of green, slow-burning vegetation; and mechanically cleared areas.

FLASHBOARD RISER — A versatile water control device used in the coastal plain to manage water movement. Water levels are physically altered to control fire and maintain beneficial soil characteristics to reduce soil oxidation and soil damage caused by heavy equipment.

FLAT or STRAIGHT PLANTING — Planting trees directly into the ground without beds or, in some cases, without first moving logging debris.

FORAGE — Vegetation such as leaves, stems, buds, and some types of bark that can be eaten for food and energy.

FORB(S) — Any herb other than grass.

FOREST CERTIFICATION — The means of protecting forests by promoting environmentally responsible forestry practices. Forests are evaluated according to international standards and certified as well managed by a qualified independent auditor (or certifier). Wood or wood products from those forests are then labeled so that consumers can identify them.

FUEL LOADING — A buildup of fuels, especially easily ignited, fast-burning fuels such as pinestraw.

FUSIFORM RUST — A disease resulting in a canker or swollen area on the limbs or trunks of pine trees from orange spores produced by infected oak leaves. Fusiform rust degrades stem quality and tree value, often leading to breakage, disfigurement, and eventual death of the tree.

G

GIRDLING — A physical cutting or disruption of the cambial sap flow within a tree. Girdling by humans, animals, or insects can often kill a tree.

GREEN TREE RESERVOIR (GTR) — A wooded area that has been intentionally flooded to benefit migratory ducks and waterfowl. GTRs may be planted with a grain crop, such as millet, the summer before the winter flooding. The GTR can be an effective, low-cost method of luring waterfowl into forested tracts.

GROUP SELECTION — (a) The removal of small groups of trees to regenerate shade-intolerant trees in the opening (usually at least ¼ acre). (b) A specific type of selective cutting.

H

HABITAT — (a) An area in which a specific plant or animal can naturally live, grow, and reproduce. (b) For wildlife, habitat is the combination of food, water, cover, and space.

HARDWOODS (DECIDUOUS TREES) — Trees with broad, flat leaves as opposed to coniferous or needled trees. Wood hardness varies among the hardwood species, and some are actually softer than some softwoods.

HIGH-GRADING — A harvesting technique that removes only the biggest and most valuable trees from a stand and provides high returns at the expense of future growth potential. Poor quality, shade-loving trees tend to dominate in these continually high-graded sites.

I

IMPROVEMENT CUT — An intermediate cut made to improve the form, quality, health, or wildlife potential of the remaining stand.

FOREST DEVELOPMENT PROGRAM (FDP) — A state- and industry-funded cost-sharing program administered by the North Carolina Division of Forest Resources. The program pays landowners for approved tree site preparation and planting activities.

FOREST LAND ENHANCEMENT PROGRAM (FLEP) — A federally funded cost-sharing program administered by the North Carolina Division of Forest Resources. FLEP provides technical, educational, and cost-share assistance to promote sustainability of nonindustrial private forestlands. It is unique with regard to most other forestry cost-share programs in that it emphasizes practices that will improve the condition of an existing forest stand. Such practices may include precommercial thinning, prescribed burning, and release of seedlings from vegetative competition.

FOREST MANAGEMENT — (a) Proper care and control of wooded land to maintain health, vigor, product flow, and other values (soil condition, water quality, wildlife preservation, and beauty) in order to accomplish

specific objectives. (b) The practical application of scientific, economic, and social principles to forest property.
FOREST MANAGEMENT PLAN — Written guidelines for current and future management practices recommended to meet an owner's objectives.
FOREST STEWARDSHIP PLAN — A written document listing activities that enhance or improve forest resources (wildlife, timber, soil, water, recreation, and aesthetics) on private land over a 5-year period.
FOREST STEWARDSHIP PROGRAM — A cooperative, technical-assistance program designed to encourage multiple resource management on private forestland. Emphasis is placed on preharvest planning to enhance and protect forest-based resources. Authorized under the 1990 Farm Bill, the program is based on national guidelines but is set by individual states.
FOREST TYPE — Groups of tree species commonly growing in the same stand because their environmental requirements are similar. North Carolina examples include pine and mixed hardwood; cypress, tupelo, and black gum; and oak and hickory.
FORESTRY — The science, art, and practice of managing and using trees, forests, and their associated resources for human benefit.
INCENTIVE — A reward for improving forest management. Incentives include reimbursement of some expenses but can also take the form of an abatement of property or income tax.

J

J-ROOT or L-ROOT — An improperly planted seedling that takes a J-shaped configuration in the planting hole. Such seedlings often die prematurely, grow poorly, and are susceptible to windthrow.

K

KG AND PILE — A site preparation method in which stumps are pushed up, sheared off, or split apart by a specially designed blade mounted on a bulldozer. Debris is then piled or placed in long rows (windrows) so that an area can be bedded or flat planted.
KG BLADE — A bulldozer-mounted blade used in forestry and land-clearing operations. A single spike splits and shears stumps at their base.

L

LEGUMES — Plants that produce organic nitrogen from nitrogen gas in the air. These plants, which typically form seeds in pods, include soybeans, peas, alfalfa, lespedeza, and locust.
LOG RULE or LOG SCALE — A table based on a diagram or mathematical formula used to estimate volume or product yield from logs and trees. Three log rules are used today in North Carolina: Scribner is the common scale for pine; Doyle is the common hardwood scale; and the International 1/4" Rule best measures mill output, although it is used less frequently than the other log scales.

M

MARGINAL LAND — Land that does not consistently produce a profitable crop because of infertility, drought, or other physical limitations such as shallow soils.
MARKETING — The selling of timber or other forest resources. Successful sellers seek a satisfactory price through competition, skillful negotiation, knowledge of timber markets, and the aid of a competent broker or consultant.
MARKING — (a) The physical process of selecting trees to be cut or left during a harvest. (b) delineating a boundary. Marking is usually done by spraying a spot of bright paint on a prominent part of the tree.
MAST — Fruits or nuts used as a food source by wildlife. Soft mast include most fruits with fleshy coverings, such as persimmon, dogwood seed, or black gum seed. Hard mast refers to nuts such as acorns and beech, pecan, and hickory nuts.
MATURE TREE — A tree that has reached a desired size or age for its intended use. Size, age, or economic maturity varies depending on the species and intended use.
MBF — Abbreviation denoting 1,000 board feet. MBF is a typical unit of trade for dimension lumber and sawtimber stumpage. (It takes 11 MBF of wood to build an average 1,900-square-foot house.)
MENSURATION or BIOMETRICS — (a) The measurement and calculation of volume, growth, and development of individual trees or stands and their timber products. (b) A measurement of forestlands.
MERCHANTABLE HEIGHT — The stem length, normally measured from the ground to a 10-, 6-, or 4-inch diameter top, above which no other saleable product can be cut. Diameter, local markets, limbs, knots, and other defects collectively influence merchantable height.
MIXED STAND — A timber stand in which less than 80 percent of the trees in the main canopy are of a single species.
MULTIPLE USE — The management of land or forest for more than one purpose, such as wood production, water quality, wildlife, recreation, aesthetics, or clean air. (See Stewardship.)

N

NATURAL STAND (NATURAL REGENERATION) — A stand of trees grown from natural seed fall or sprouting.
NUTRIENTS — Elements necessary for growth and reproduction. Primary plant nutrients are nitrogen, phosphorus, and potassium.
PRESENT USE VALUATION — Property tax relief classification based on the land's productivity for agriculture, horticulture, or forestry production, rather than for market value. Can result in substantial tax savings

in areas where land values are high. Some restrictions and penalties apply, including a 3-year rollback provision with interest. Consult your county tax supervisor for details.

PRESERVATION — An attempt to keep forests in an undisturbed state through the control of internal and external influences.

PULPWOOD — Wood used in the manufacture of paper, fiberboard, or other wood fiber products. Pulpwood-sized trees are usually a minimum of 4 inches in diameter.

PURE STAND — A timber stand in which at least 75 percent of the trees in the main crown canopy are of a single species.

R

RAPTOR — A bird of prey such as an owl, hawk, osprey, or eagle.

REFORESTATION — Reestablishing a forest by planting or seeding an area from which forest vegetation has been removed.

REGENERATION CUT — A cutting strategy in which old trees are removed while favorable environmental conditions are maintained for the establishment of a new stand of seedlings.

REGISTERED LANDS — A permit-only hunting program in which land is registered with and patrolled by the Wildlife Resources Commission. Hunters without a permit issued by the landowner are cited for trespass and prosecuted without need for the landowner to appear in court or swear out a warrant.

REPRODUCTION — (a) The process by which young trees grow to become the older trees of the future forest. (b) The process of forest replacement or renewal through natural sprouting or seeding or by the planting of seedlings or direct seeding.

RESIDUAL STAND — Trees left in a stand to grow until the next harvest. This term can refer to crop trees or cull trees.

O

ON THE STUMP — Standing, uncut timber.

P

PERENNIAL — Plants that live or grow for more than one year. Some resprout from a root system or reseed themselves every year.

PERENNIAL WILDLIFE MIXTURE — A mixture of all or some of the following: shrub lespedeza, partridge pea, cowpea, annual lespedeza, reseeding soybeans, and other perennial plants that are beneficial to wildlife.

PEST — Any organism that is out of place or causes stress to a desired organism.

PESTICIDE — Any chemical used to kill or control pests.

PHOSPHATE — A chemical compound that aids root growth and is essential in energy transfer. It is commonly incorporated into beds as triple super phosphate (TSP) at time of planting.

PLANT or HABITAT DIVERSITY — A variety of food or cover for wildlife. Variation may occur at one point in time or over a period of time such as during the course of a season. Seasonal diversity of food and cover is often critical to the survival of a species.

PLANTATION — Planted pines or hardwoods, typically in an ordered configuration such as equally spaced rows.

POLES or POLETIMBER — Trees from 5 to 7 inches in diameter at breast height.

PREDATOR — An animal that preys on and devours other animals.

PREDATOR GUARD — A physical barrier used to keep one animal from eating another. Usually refers to protection devices on nest boxes.

PRESCRIBED or CONTROLLED BURN — The use of fire under specific environmental conditions to achieve forest management objectives. Used to reduce hazardous fuel levels, control unwanted vegetation, favor desired vegetation, and improve visibility and wildlife habitat.

ROOT COLLAR — The transition zone between stem and root at the ground line of a tree or seedling.

ROTATION — The number of years required to establish and grow trees to a specified size, product, or condition of maturity. A pine rotation may range from as short as 20 years for pulpwood to more than 60 years for sawtimber.

S

SALE, LUMP SUM (BOUNDARY) — The sale of specified timber on a specified area. The volume may or may not be estimated and published. The buyer is responsible for determining correct volume. The seller guarantees ownership and boundaries.

SALE, UNIT — A timber sales arrangement in which the buyer pays for forest products removed in units (measured in cords, MBF, or units of weight). Determination of units removed from the area is verified by mill tally, scale tickets, and buyer's or seller's tally.

SALVAGE CUT — The harvesting of dead or damaged trees or of trees in danger of being killed by insects, disease, flooding, or other factors in order to save their economic value.

SAPLING — A small tree, usually between 2 and 4 inches diameter at breast height.

SAWLOG or SAWTIMBER — A log or tree that is large enough (usually 10 to 12 inches in diameter) to be sawed into lumber. Minimum log length is typically 8 feet.

SCARIFYING — For soil: The removal of the top litter layer of an area (usually in strips) for site preparation. For seed: The abrasion or weakening of the seed coat to encourage germination.

SEDIMENTATION — The deposition or settling of soil

particles suspended in water.

SEED TREE CUT — A harvesting method in which a few scattered trees are left in the area to provide seed for a new forest stand. Selection of seed trees should be based upon growth rate, form, seeding ability, wind firmness, and future marketability. This harvesting method produces an even-aged forest.

SEED YEAR — A year in which a given species produces a large seed crop over a sizable area. Some species of trees produce seeds irregularly.

SEEDLING — (a) A tree, usually less than 2 inches diameter at breast height, that has grown from a seed rather than from a sprout. (b) A nursery-grown tree that has not been transplanted in the nursery.

SELECTIVE CUTTING — The periodic removal of individual trees or groups of trees to improve or regenerate a stand.

SHADE-INTOLERANT TREES — Trees that cannot thrive in the shade of larger trees.

SHEARING — Slicing or cutting trees or stumps at the ground line. Shearing may be done at harvest or with a KG blade during site preparation.

SHELTERWOOD CUT — Removing trees on the harvest area in a series of two or more cuttings so new seedlings can grow from the seed of older trees. This method produces an even-aged forest.

SILVICULTURE — The art, science, and practice of establishing, tending, and reproducing forest stands of desired characteristics. It is based on knowledge of species characteristics and environmental requirements.

SITE INDEX — A relative measure of forest site quality based on the height (in feet) of the dominant trees at a specific age (usually 25 or 50 years, depending on rotation length). Site index information helps estimate future returns and land productivity for timber and wildlife.

SITE PREPARATION — Preparing an area of land for planting, direct seeding, or natural reproduction by burning, chemical vegetation control, or by mechanical operations such as disking, bedding, scarifying, windrowing, or raking.

SLASH — (a) Tree tops, branches, bark, or other residue left on the ground after logging or other forestry operations. (b) Tree debris left after a natural catastrophe.

SOFTWOOD (CONIFER) — A tree belonging to the order Coniferales. Softwood trees are usually evergreen, bear cones, and have needles or scalelike leaves. They include pine, spruces, firs, and cedars.

SOIL TEXTURE — The feel or composition of the soil (sand, silt, or clay) as determined by the size of the soil particles.

SOIL TYPE — Soils that are alike in all characteristics, including texture of the topsoil. Soil maps and information on site index, erodibility, and other limiting properties are available from your county Soil Conservation Service offices.

SPECIES — A group of related organisms having common characteristics and capable of interbreeding. Loblolly and Virginia pine are common species that can be interbred.

STAND — An easily defined area of the forest that is relatively uniform in species composition or age and can be managed as a single unit.

STEWARDSHIP FOREST — A privately owned forest tract that exhibits integrated forest management to protect and enhance wildlife, timber, recreation, natural beauty, and soil and water quality.

STOCKING — A description of the number of trees, basal area, or volume per acre in a forest stand compared with a desired level for balanced health and growth. Most often used in comparative expressions, such as well-stocked, poorly stocked, or overstocked.

STREAMSIDE MANAGEMENT ZONE (SMZ) — An area adjacent to a stream in which vegetation is maintained or managed to protect water quality. The width depends on slope, but 50 feet is the normal minimum. Trees may be removed from SMZs as long as the stream bed is not disrupted and sufficient vegetation is left to protect water quality.

STUMPAGE — The value or volume of a tree or group of trees as they stand uncut in the woods (on the stump).

SUCCESSION — The natural sequence of plant community replacement beginning with bare ground and resulting in a final, stable community in which a climax forest is reached. Foresters, wildlife biologists, and farmers constantly battle ecological succession to try to maintain a particular vegetative cover.

SUCCESSIONAL DISKING or MOWING — A wildlifeenhancement practice in which a disk harrow or rotary mower is used to knock down existing vegetation every 1 to 3 years to promote the regrowth of annuals, legumes, forbes, and perennials.

SUSTAINABLE FORESTRY — The practice of meeting the forest resource needs and values of the present generation without compromising the similar capability of future generations.

SUSTAINED YIELD — Management of forestland to produce a relatively constant amount of wood products, revenue, or wildlife.

T

THINNING — A tree removal practice that reduces tree density and competition between trees in a stand. Thinning concentrates growth on fewer, high-quality trees, provides periodic income, and generally enhances tree vigor. Heavy thinning can benefit wildlife through the increased growth of ground vegetation.

TIMBER STAND IMPROVEMENT (TSI) — Improving the quality of a forest stand by removing or deadening undesirable species to achieve desired stocking and

species composition. TSI practices include applying herbicides, burning, girdling, or cutting.

TOLERANT SPECIES — A species of tree that has the ability to grow in the shade of other trees and in competition with them.

TREE FARM — A privately owned forest or woodland in which timber crop production is a major management goal. Many tree farms are officially recognized by the American Tree Farm System, an organization sponsored by the American Forestry Council.

TREE SPACING — The distance between trees, which is most often regulated at the time of planting or during a harvest or thinning operation. Spacing, like stand density, affects understory vegetation, seed production, growth rate, and wildlife habitat.

U

UNDERSTORY — (a) The layer formed by the crowns of smaller trees in a forest. (b) The trees beneath the forest canopy.

W

WATER BAR — A diagonal ditch or hump in a trail that diverts surface water runoff to minimize soil erosion.

WATER CONTROL — Management of water (both surface and subsurface) to maintain plant growth, water quality, wildlife habitat, and fire control.

S O I L T Y P E

•

WILDLIFE — A broad term that includes nondomesticated vertebrates, especially mammals, birds, and fish.

WINDROW — A long, narrow row of vegetation, debris, and some soil created during site preparation and clearing operations.

WINDTHROW — Trees uprooted by excessive wind. Shallow-rooted trees are almost always affected.

Appendix F

(The following is a briefing document originally prepared by the USDA Forest Service)

New Multimillion Dollar Forest Service Program Gives NIPF Owners Boost

The 2002 Farm Bill has authorized the Forest Service to launch a multimillion-dollar forestry program to assist nonindustrial private forest (NIPF) landowners in what will be known as the Forest Land Enhancement Program (FLEP). Authorized for $100 million for program years 2002-2007, the program has scheduled $20 million in its inaugural year (FY2003) to be distributed through State forestry agencies.

Through FLEP, State forestry agencies can provide a wide array of educational, technical and financial services that are intended to ensure that the nation's NIPFs and related resources continue to provide sustainable forest products and safeguard the health of our water, air, and wildlife.

FLEP is a voluntary program in each State and participation by landowners is voluntary. In each State participating in the program, the State Forester and State Forest Stewardship Coordinating Committee will jointly develop a State priority plan that is intended to promote forest management objectives and describe FLEP in their State. The State priority plan will identify educational activities and their outcome, describe the technical assistance to be provided and its outcomes, and describe the cost-share components that will be available to NIPF landowners and the public values of these practices.

The FLEP program replaces two previous conservation incentives programs: the Stewardship Incentive Program (SIP) and the Forestry Incentives Program (FIP). State forestry agencies can use FLEP funds to provide assistance to NIPF owners to achieve a broad array of natural resource objectives. The Forest Service and State forestry agencies are guided by the following principles:

- Establish, manage, maintain, protect, enhance, and restore NIPF lands.
- Enhance the productivity of timber, habitat for flora and fauna, soil, water, air quality, wetlands, and riparian buffers of these lands.
- Assist owners and managers to more actively manage NIPF lands to enhance and sustain the long-term productivity of timber and non-timber forest resources.
- Reduce the risk and help restore, recover and mitigate the damage to forests caused by fire, insects, invasive species, disease, and damaging weather.
- Increase and enhance carbon sequestration opportunities.
- Enhance implementation of agroforestry practices.
- Encourage and leverage State, Federal, and local resource management expertise, financial assistance and educational programs that support FLEP.

NIPF owners who wish to participate in the cost-share component of FLEP must complete one or more of the sustainable forestry practices available in their State as described in a forest management plan.

In each state, the State forester or their representative will evaluate the management plans submitted by NIPF owners and approve them for participation in FLEP. Eligibility criteria for FLEP are slightly broader than for SIP and FIP to encourage broader participation.

FLEP allows treatment of up to 1,000 acres per year and variances of up to 5,000 acres if significant public benefits will accrue. The maximum FLEP cost-share payment for any practice may be up to 75 percent. The aggregate payment to any one landowner through 2007 may not exceed $100,000.

States will be responsible for their program accomplishments reporting using the Internet and web sites. Reports will cover educational assistance, technical assistance, and cost-share practices implemented.

Program implementation will commence 30 days after the publication of an interim rule in the Federal Register (anticipated towards the end of December 2002). A formal 60-day comment period will follow. A final rule is anticipated for December 2003.

Residual funds remaining in SIP and FIP from the FY 2002 appropriations are in the process of being obligated by the Forest Service and the Natural Resources Conservation Service.

- U.S. Farm Bill, Title VII - Forestry
- Interim Final Rule (PDF)
- State Priority Plan (PDF)

Appendix G

Exotic Invasive Species

Of serious concern to many forest landowners is the presence of invasive exotic species. Exotic species are plants or animals, including insects, which have been introduced, intentionally or accidentally, to a region where they do not naturally occur. Outside of their native ecosystems, exotic species are no longer subject to predators and diseases that normally help maintain population balance within their native range. Without these controls the alien species tend to takeover, invading the landscape and replacing their native counterparts. As a result, biodiversity decreases radically and the nutritious food and specialized shelter provided by native species are no longer available in adequate quantities to support populations of native birds and animals that depend on them for survival. Native plants and animals may become threatened or endangered, and in the most serious situations, extinct.

Exotic invasive species may also be termed nonnative, exotic, non-indigenous invasive species, or alien species. Exotic invasive plants are also known as noxious weeds or alien plant species. They come in the form of trees, shrubs, ferns, grasses, forbs, vines or water plants. They may also be birds (i.e. European starling), insects (i.e. hemlock woolly adelgid, German cockroach), fish (i.e. snakehead, rainbow trout), or mammals (i.e. wild boar).

Two species of nonnative invasive plants were immediately evident while taking inventory of the forest plots. Multiflora rose (*Rosa multiflora*) was noted in relative abundance along portions of roadside and in open areas presumed to have once been grazed. This exotic plant can become very troublesome in that it can quickly claim an opening and make travel through the area literally painful, if not impossible. It forms dense clumps along right-of-ways and forest margins, and can climb high into trees. Multiflora rose can be difficult to control as it spreads by bird-dispersed seed, prolific sprouting, and stems that root where they contact the soil. Control can be achieved with herbicides that move through the plant to the root. Herbicides can be applied to the leaves (foliar application), to cut stems at the base of the plant (stump spray), or mixed in an oil or diesel fuel and applied to the bark at the base of the shrub (basal application). Multiflora rose can be effectively treated with herbicides of low toxicity such as glyphosate or triclopyr. This nonnative rose puts forth leaves in early spring usually six weeks before native plants break bud. This is an excellent time to make foliar applications as surrounding native plants will not be damaged by the spray. Do not spray while in flower. (Note: Certain formulations of triclopyr should not be used near water. Please ask a pesticide professional before treating with herbicides).

Asian or Oriental bittersweet (*Celastrus orbiculatus*) was also noted along the roadside. This Asian vine is a nightmare here in North Carolina, and it has recently placed on the state's noxious weed list making it illegal to sell the plant (alive or dried) within the state. The vine is woody, deciduous, and twining, climbing high into tree crowns often forming dense thickets on the ground and heavy masses in tree tops. This vine is also a threat to young forests containing sapling trees as it twines tightly around the developing tree stem resulting in deformity and growth restriction as it impedes the natural flow of nutrients inside the tree. The plant reproduces prolifically from seed spread by birds, other animals and people. Within the property, it appears that bittersweet is beginning to establish a small colonies, as the plants seen were young and not too widespread. This exotic can be extremely difficult to manage and addressing early

infestations is critical for economic reasons. A triclopyr containing herbicide is recommended. Do not spray while in bloom. The flowers are orange-yellow, tiny and appear in small clusters in the leaf axils.

Other invasive exotic plants may be present on the property but were not seen due to the season and snow cover. It is likely that an exotic grass known as Nepalese browntop or Japanese stiltgrass (*Microstegium vimineum*) is present or will be in the near future. This weed is rapidly invading forestland in our region, infesting coves and glades and any disturbed sites. The open understory, prevalent on the property, creates prime conditions for the establishment of this incredibly prolific grass. It will quickly replace other ground covers, including native grasses and native wildflowers. Our native wildlife will not use this grass for forage or shelter. Please watch carefully for this grass and remove it whenever you see it. It is an annual, so it can be pulled and won't come back from root matter. It can be kept from seeding by cutting in late summer to prevent the formation of seed heads. Unfortunately, if it does seed, the seeds are viable in the soil and duff for at least 5 years. This is one of few exotic weeds that do not require chemical treatments to control, but early recognition and management are key to infestation prevention.

There are many excellent resources to aid in identification of exotic pest plants, and many of the best resources are free. A book, *Nonnative Invasive Plants of Southern Forests*, a USDA Forest Service publication, is available at no cost. It can be requested via email at pubrequest@srs.fs.usda.gov , by phone: 828-257-4830, or mail: Southern Research Station, P.O. Box 2680, Asheville, NC 28802. It can also be downloaded or viewed from http://www.srs.fs.usda.gov/fia/manual/exotic_pest_plants.htm or http://www.invasive.org/weeds .

Included below are some other documents taken from the web on these species and their control.

Multiflora Rose Control

Daniel J. Childs, Extension Weed Specialist, Purdue University

Multiflora rose *(Rose multiflora)* has, over the past several years, invaded nearly every county in Indiana. This woody perennial plant is a bramble with short spines or thorns on the stems and leaf petioles. It produces many clusters of small, white flowers in late May to early June. Many of southern Indiana's permanent grass pastures contain from a few scattered shrubs to large, dense stands of multiflora rose. While they provide habitat for wildlife, these shrubs compete with the existing forage, resulting in a reduction of the available grazing areas for livestock.

Complete eradication of multiflora rose from a pasture or fence row is quite difficult. However, employing the right control strategies and being persistent can result in success. Generally, no single treatment will provide complete control without destroying the pasture. A combination of chemical, mechanical, and cultural control practices, including grazing, is necessary to eradicate multiflora rose from a pasture.

Chemical Control

The use of herbicides to control multiflora *rose* has been a popular practice for many years. Certain herbicides that were once used to kill these shrubs are no longer available or registered, but several effective herbicides are still on the market. Many of these products contain 2, 4-D as one of their herbicidal components. These products include Weedone 170, Weedone CB, Crossbow, Tordon RTU and ACME Super Brush Killer. Other herbicides not containing 2, 4-D that are labeled for controlling multiflora rose in pastures or fence rows include Banvel, GarIon, Roundup, Spike, Krenite, and Ally, Several of these herbicides can be applied either as a dormant or foliar treatment.

Dormant applications can generally be made anytime while the shrub is dormant, with the preferred time being late winter or early spring, prior to the resumption of growth. Some applications may be made as a basal bark treatment involving solutions containing diesel oil or kerosene as the carrier. These treatments are applied to the lower areas of the canes, including the crown. Banvel herbicide can be applied as an undiluted, "spot concentrate" treatment directly to the soil within 6-8 inches of the crown. Crossbow has a label for applying a horizontal, thin line of undiluted herbicide across all stems at a height where the stems are less than 1/2 inch in diameter. Although not necessarily a dormant treatment, Tordon RTU and Weedone 170 can be sprayed or painted on freshly cut stumps.

Dormant treatments have certain advantages over foliar applications. Since basal applications do not require coverage of the entire shrub, less volume is needed; therefore, less time and energy are required for treating individual shrubs. Also, farmers may be less busy during the winter months than they are in May and June, when foliar treatments are applied.

Foliar treatments are generally made in late spring, when the shrub is green and actively growing. The label for Krenite, however, recommends application from July to first fall coloration. Thorough spray coverage of the foliage (some herbicide labels recommend treating stems and trunk as well as foliage) is essential for good control. Large spray volumes are generally required to obtain this coverage. Products such as Roundup, Ally, Banvel, Crossbow, ACME Super Brush Killer, and Weedone 170 have a label for foliar applications.

Many of the above-mentioned herbicides may be used in perma- -nent grass pastures to control multiflora rose, while others have only non-crop labels (i.e. fence rows). The following products are labeled for use in pastures.

1. Ally

2. Banvel

3. Crossbow

4. Roundup

5. Spike

Follow label restrictions regarding grazing and haying.

These products have a non-crop label.

1. ACME Super Brush Killer

2. Garlon

3. Krenite

4. Tordon RTU

5. Weedone 170

Table 1 gives the results of a multi-flora rose herbicide trial conducted in the winter of 1988-89 and spring of 1989. Both dormant and foliar treatments were applied at three locations in Indiana (Orange, Jefferson, and Warren counties). The percent control results were obtained by the averaging of two replications per treatment and then the averaging of all three sites.

Follow-up treatments of these herbicides the following season(s) may be necessary to provide complete control. As mentioned earlier, mechanical and/or cultural control practices should be used in combination with chemical applications for best results.

Mechanical Control

Pulling individual shrubs out of the ground with a heavy chain and tractor can be successful only if all the roots are removed. If root pieces remain, new plants will regenerate from these.

Repeated mowing of the tops has proven to be effective and is generally a good management practice for controlling all types of weeds in a pasture. Research at West Virginia University indicated that three to six mowings per season for more than one year may be necessary to provide a high percentage of plant death.

Cultural - Biological Control

Sheep and, more often, goats are known to forage on multiflora rose growing in pastures. This is documented in several university trials. Research at West Virginia University suggests that the grazing of goats for two seasons at a rate of eight to ten goats per acre will be necessary to provide effective control. Ken Simeral, an Ohio extension agent, recommends raising angora goats to fight infestations of multiflora rose in pastures. An added benefit is the profits from 10 to 30 lbs. of mohair produced per goat per year.

Certain insects and diseases are being studied for their effect on multiflora rose. One such disease, called "Rose Rosette," has been detected in several counties in southern Indiana as well as some counties in the central and north central parts of the state. Rose

Rosette produces a bright red, witches'-broom-type foliar growth at the end of the canes. Studies conducted by J.W. Amrine at West Virginia University show the disease to be transmitted from plant to plant by a tiny mite. The disease will eventually spread throughout the entire plant, and the plant will generally die within two years after infection. This author has observed hundreds of dead and dying multiflora rose shrubs in southern Indiana as a result of this disease. As climatic conditions favor the development of the mite populations, the spread of this disease among multiflora rose will increase, perhaps to the point of total eradication in several areas of southern Indiana.

Table 1. Multiflora Rose Herbicide Trials

Herbicide**	Application method	Rate & carrier	Control* Dormant treatments 6 month (%)	Dormant treatments 12 month (%)	Foliar treatments 3 month (%)	Foliar treatments 12 month (%)
Banvel	Spot Concentrate	1 oz. Banvel per shrub	90	98	–	–
	Foliar	1.5% solution in water	–	–	100	99
Crossbow	Basal Bark	4% solution in kerosene	100	100	–	–
	Thin-line	0.7 oz. Crossbow per shrub	80	94	–	–
	Foliar	1.5% solution in water	–	–	100	95
Garlon 4	Basal Bark	20% solution in kerosene	100	100	–	–
Tordon RTU	Cut Stump	Applied undiluted to stumps	100	100	–	–
Weedone 170	Basal Bark	4% solution in kerosene	98	100	–	–
	Cut Stump	Applied undiluted to stumps	100	94	–	–
	Foliar	1.5% solution in water	–	–	99	95
ACME S.B.K.	Basal Bark	5% solution in kerosene	90	95	–	–
	Foliar	1.2% solution in water	–	–	99	96
Spike 20P	Spot Treatment	0.25 oz. per 22 sq. ft. of ground surface	89	95	63	84
Ally	Foliar	1 oz. per 100 gal. water	–	–	100	100
Roundup	Foliar	1.0% solution in water	–	–	98	100
Weedone LV4	Foliar	3.0% solution in water	–	–	100	96

*Percent control for 3-, 6-, and 12- month observations are defined as: 100% control = no regrowth from crown and no living/green leaves present.

**Read and follow all label directions regarding rates, precautions, and grazing restrictions.

From: http://www.fnr.purdue.edu/inwood/past%20issues/multiflora%20rose%20control.htm

Oriental Bittersweet

(Celastrus orbiculatus)

Description: A deciduous woody vine in the family (). The vine has a twining or trailing growth pattern, with constricting and girdling stems that vary in size and can reach over 6 inches in diameter. Leaves are glossy green and round, with blunt-toothed margins. Greenish-yellow flowers are produced in the leaf axils during May and early June. Red berry-like fruits enclosed in yellow capsules develop during the fall and remain on vines through most of the winter.

Life History: A prolific invasive that reproduces by seeds, above ground stems (stolons), below ground stems (rhizomes) and shoots from the roots (root-suckering). Plants are primarily pollinated by insects, but wind pollination is also successful. Seedling germination begins in mid-spring. The germination rate is very high (95%), with low-light environments yielding the highest number of plants. Vegetative reproduction is common, and results in large clones or patches that originate from a few original plants.

Distinguishing Features: This plant is easily confused with American bittersweet (*Celastrus scandens*), a native climbing vine. Correct identification must be made before controls are attempted. There are differences in the species' fruit covers, fruit location, and leaf shape. American bittersweet fruit covers are orange, while Oriental bittersweet fruit covers are yellow. American bittersweet fruit is located at branch tips, while Oriental bittersweet fruits arise in the leaf axils. American bittersweet leaves are pointed, while Oriental bittersweet leaves are rounded with blunt teeth. Of the two, Oriental bittersweet is much more common in the region today.

Habitat: Prefers open sites such as road sides, hedgerows, and thickets, but its shade tolerance has allowed it to spread into forested areas. Grows prolifically if light levels increase, typically as a result of canopy openings . Most abundant in stands representing early stages of succession and upland habitats.

Range: Native to eastern Asia, Japan, Korea, and China. It grows throughout most of New York except the interior Adirondacks. It is a major invader in coastal areas, such as the Long Island Sound.

Spread: Introduced in the 1860s as an ornamental, it is still sold as a horticultural plant. At nurseries it is sometimes mislabeled as American bittersweet. Vines and mature fruits are gathered for wreaths and floral arrangements. It was planted extensively for erosion control along highways and as "conservation" plantings for wildlife food and cover. The plant's fruits are eaten and dispersed by birds and small mammals.

Problems: Dense stands of vines can shade and suppress native vegetation. Its climbing habit kills nearby plants by preventing photosynthesis, constricting stems, and toppling trees. Young forests, thickets, and upland meadows are most vulnerable to invasion and dominance. Detrimental effects are similar to Kudzu. Once established, it is very difficult to control. There is evidence that it can hybridize with American bittersweet, thus threatening genetic integrity of the native species.

From: http://www.ipcnys.org/Obitterfact.pdf

MANAGEMENT: Oriental bittersweet root-suckers prolifically, especially after the main vine is damaged or cut. The plant is an abundant seed producer, and control measures must be repeated until the seed bank is depleted. This can take several years in established stands.

Manual Removal

Light infestations can be controlled by cutting the vines and hand pulling the roots, preferably before fruits emerge. The entire root system must be removed because pieces left behind can resprout. If fruits are present, vines should be bagged and disposed of in a landfill. Unless cutting is done on a weekly basis to exhaust root stores or is combined with herbicide treatment, cutting will only stimulate vigorous growth.

Herbicide Application

Systemic herbicides that are taken into the roots, such as glyphosate (e.g., Roundup) or triclopyr (e.g., Garlon), have been used successfully in bittersweet management. If control is necessary in places with grass cover, Triclopyr is preferred because it does not kill monocots. A combination of cutting and herbicide treatment resulted in 100% root kill in several studies. First, plants are cut or mowed early in the growing season and allowed to resprout. Approximately one month after cutting, a foliar application of triclopyr or glyphosate herbicide, mixed at 1%-2% in water, is applied to the regrowth using a sprayer. Sprayers should be adjusted for a mist, so that the herbicide does not drip off target plants. This method was conducted for over four years on one site with no non-target damage.

In areas where the large vines are growing on trees, the cut-stump method is preferred. After the last killing frost, vines should be cut at the ground level. An herbicide containing triclophr should be applied directly to the cut surface immediately. A sponge applicator is effective. Vines hanging in the trees will decompose and fall within 1-2 years. **Herbicides may only be applied according to label directions; infringement is a violation of federal law. On public land, herbicides may be applied only by licensed applicators.**

Prepared May 2001

For more information on control measures, please contact:

IPC
INVASIVE PLANT COUNCIL OF NYS

IPC NYS
200 Broadway, 3rd Floor
Troy, NY 12180
(518) 271-0346
www.ipcnys.org

The IPC NYS receives support from the New York Community Trust/Kraft Family Foundation, the National Fish and Wildlife Foundation, the New York State Biodiversity Research Institute, and The Nature Conservancy.

Wild Grape

Wild grape is a deciduous vine with large leaves growing up to 6 inches across. Leaves form alternately on the vine. The leaves usually have toothed margins and have 3 lobes, resembling maple leaves. The leaves are palmately veined. Vines produce forked trendrils which wrap around plants, fences, etc. for support allowing them to climb over fences and landscape plants.

Wild grapes spread by seeds. Flowers are produced in late spring and early summer. The flowers and purplish black fruit grow in massed groups. The fruit, which is much smaller than commercial grapes is produced late summer through fall.

Wild grapes are found throughout central and eastern North America.

Integrated Pest Management Control Recommendations:

Cultural Practices:
Different wild grape species thrive on different growing conditions from sun to shade, dry to moist soils. Wild grapes are weeds of landscapes, nurseries, fence rows, and abandoned areas. The vines of wild grapes can be pulled or cut back to the ground.

Herbicide Use:

For optimum control, make your herbicide application to wild grape that is young and actively growing. Due to the woody nature of the vines and spreading habit, better results may be obtained with an oil base ester product. Fall clean up using an ester herbicide will provide effective management.

From: http://www.weedalert.com/weed_pages/wa_wild_grape.htm

Appendix H

The Hemlock Woolly Adelgid (*Adelges Tsuga Annand*)

The hemlock woolly adelgid (HWA) is a serious pest of Canadian hemlock, Tsuga canadensis, in the northeastern states. This insect was discovered in Connecticut in 1985 and has spread rapidly to both cultivated and forest hemlocks.

Adelgids are small, soft-bodied insects that are closely related to aphids. They have piercing-sucking mouth parts, which are inserted to remove plant sap for food. The HWA feeds primarily on young branches causing cessation of tree growth, discoloration and premature drop of needles, the dieback of branches and possible death of the tree in as little as one year.

Description and Life History

The females are oval, blackish-grey, about 2mm in length and serve as the overwintering stage. The brownish-orange, very small, oblong eggs are laid in cottony white egg sacs (about 50 eggs per sac) on young twigs from late march to May. The presence of the egg sacs offers the most visible diagnostic evidence of an HWA infestation. The eggs hatch into reddish-brown crawlers (nymphs) from early April through early June and begin feeding on the sap of young twigs, maturing into adults in a few weeks. Some of the adults are wingless and remain on hemlock for a second generation, while the winged forms may fly to nearby hemlocks or spruces.

None of the common native and exotic spruces appear to be suitable hosts for the winged HWA to complete its life cycle. Second generation crawlers initially feed on new twigs during July but become dormant in late summer through early autumn. Crawlers resume feeding in mid-October and develop into the overwintering adults.

Pest Management and Control

Infestations of the HWA can be detected early by periodically examining young twigs for the presence of the egg sacs. They are readily observed in the spring before the eggs have hatched. Keep in mind that remnants of old egg sacs may remain on twigs long after the eggs have hatched and the insect has been controlled. Early detection is very important because injury to hemlock may develop quickly. That is why periodic examinations are an important practice in the control of the HWA.

Several insecticides are available that will provide excellent HWA control. Insecticides should not be applied on a preventive basis. Many of the hemlocks in Connecticut will not be infested and will not need treating. Controls should be applied only when HWA infestations are observed.

An excellent time to control an HWA infestation is from July through September after the eggs have hatched and the young adelgids are relatively unprotected. Summer oil and insecticidal soap have been found to provide excellent control with one application, provided complete coverage is made in this time period. Both insecticides kill only by direct contact. Thorough coverage with a drenching spray is essential for control. Dormant oil is effective for HWA control when applied in April to mid-May. It will also control scale insects and mites at the same time.

Other insecticides capable of controlling HWA include acephate, dimethoate and malathion. Thorough coverage of the insect is essential for effective management. More than one application may be needed for effective control where it is difficult to achieve complete coverage of the plant. Unfortunately, natural enemies, such as disease, parasites and predators, have not been numerous enough to achieve significant management, but they may offer hope in the future.

Pesticides for HWA Control	
Common Name	***Trade Name***
acephate	**Orthene**
dimethoate	**Cygon**
insecticidal soap	**Safer's, M-Pede**
malathion	**Malathion, Cythion**
horticultural oil	**Volck, etc.**

Also – you can purchase Advanced Tree and Shrub Insecticide made by Bayer company at any garden supply- make sure you read the label carefully so you know how much to use and keep it 50 feet away from streams when using it.

From: http://www.hort.uconn.edu/ipm/homegrnd/htms/46wooly.htm

Appendix I

THINNING PINE STANDS

What Is Thinning?
Thinning is the cutting or removal of certain trees from a stand to regulate the number, quality and distribution of the remaining "crop" trees. If the cut material can be marketed, the thinning is "commercial." Where markets do not exist for the removed trees (usually because they are too small), the thinning is considered precommercial."

Why Thin?
Number of trees per acre (called stand density or stocking) affects yield and value growth of pine trees, just as site quality and age do. Like other crops, trees grow poorly if there are too many or too few per acre. Unlike most crops though, trees live long enough and grow large enough that the optimum number per acre changes. Deliberate control of stand density by thinning can improve the vigor, growth rate and quality of the remaining "crop" trees. As a result, the forest landowner benefits in three ways:

- Growth is concentrated on fewer, faster growing trees. Faster growth reduces the time required to reach harvestable size, and larger trees bring higher stumpage prices.
- Only high-quality trees are permitted to grow to final harvest, eliminating volume accumulation of low-value trees.
- Trees which would stagnate or die before final harvest can be utilized. Intermediate harvests can provide periodic income and enhance fire protection and wildlife values.

Biologically Speaking
Pine trees need growing space in which they compete for water, nutrients and light. With these inputs, the green needles in the crown manufacture food to increase the tree's size. The larger tree can support an expanded crown which, in turn, can produce still more food. As a result, the fastest growing trees are the most successful competitors. They assume a "dominant" position in the stand where they continue to receive direct sunlight both from above and the sides. Since pines cannot tolerate shade, their branches thin out and die from the ground up, as the trees become crowded or overtopped. This leaves progressively smaller live green crowns, so the trees become less competitive and eventually die. Through this natural "thinning" process, a young natural stand having thousands of trees per acre or a plantation with 600 to 1,000 trees will be reduced to a few hundred trees per acre by age 40.

Since the forest undergoes a natural "thinning" process, what advantage is to be gained by thinning deliberately? Most sites produce about the same total wood volume with either a lot of small trees or a few large ones. However, total wood volume is rarely a good indicator of market value. Individual trees determine the market product, and value increases with diameter. For example, the same volume of timber would approximately double in value if the trees were large enough to be used for chip' n' saw logs rather than pulpwood. That same volume in trees of sawtimber diameter would be about three times as valuable as chip' n' saw material.

Diameter growth is greatly influenced by stand density. To produce sufficient food for vigorous diameter growth, each tree must retain at least one-third of its height in live crown. With normal, uncontrolled competition, the amount of live crown declines to less than one-third on all except the dominant trees in a stand. Therefore, natural thinning occurs only after diameter growth has been slowed on most trees, including many crop trees.

The maximum response to thinning usually is found among the remaining vigorous trees (co-dominants) once these are relieved from competition with equals (see Figure 1). Dominant trees have already out-competed" smaller neighbors so that only removing "suppressed" trees seldom prompts much response. Smaller trees can only benefit from competition removal if and when they develop sufficient live crown. Since height growth, vigor and ability of the crown to expand decline with age, thinnings should be performed early in the stand's life. Larger volume and better wood properties make continuous fast growth preferable to the "slow-fast" response illustrated in Figure 1. Therefore, several light thinnings are better than a single heavy thinning.

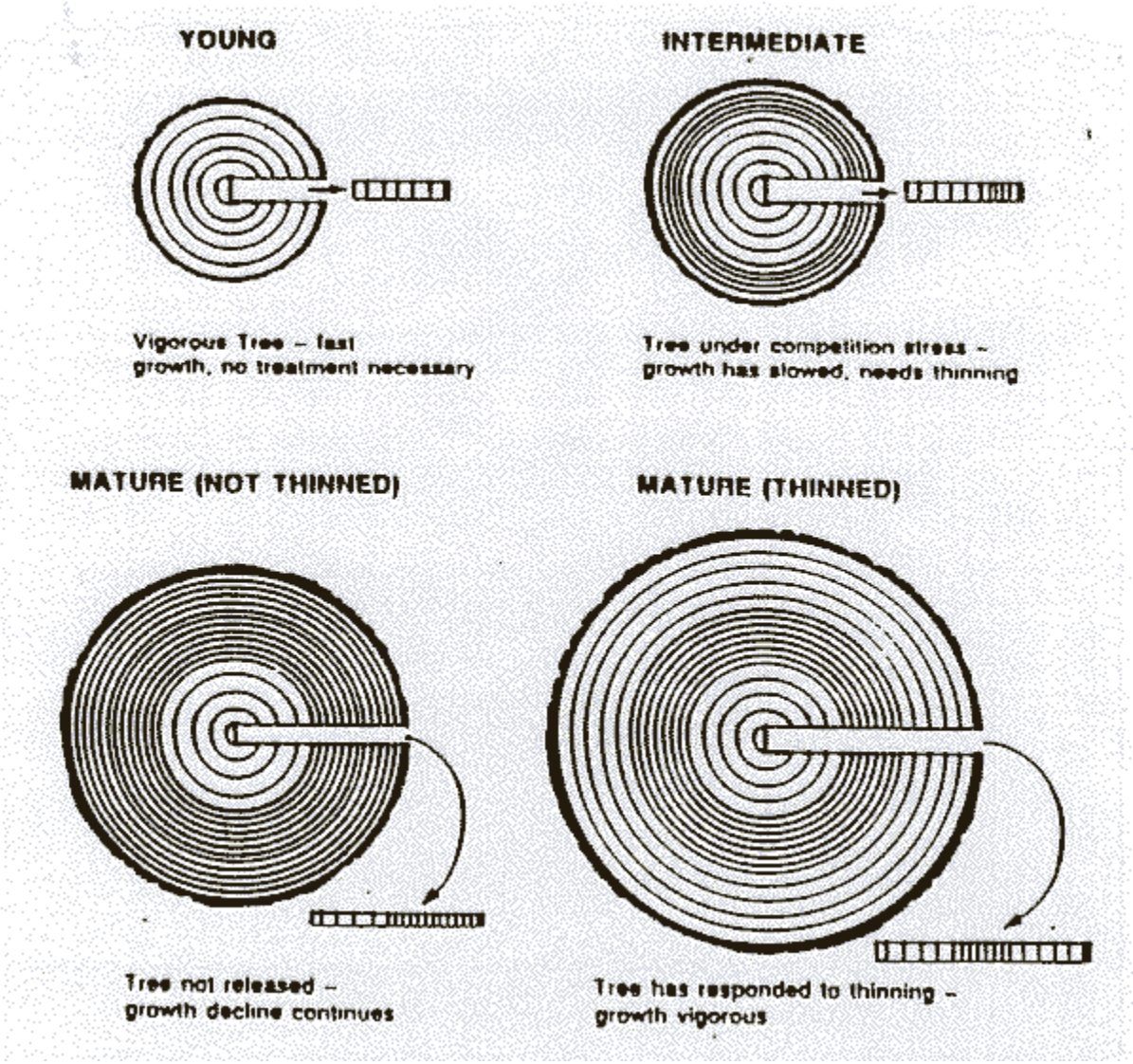


Figure 1. Tree cross section and increment cores illustrating a thinning response.

How To Measure Stand Density

Since the optimum number of trees per acre at a given age depends upon their size, foresters prefer to use "basal area" to describe stand density and evaluate stocking. A tree's basal area (BA) is the stump-top surface area exposed when that tree is cut off at 41/2 feet above the ground (breast height). Measured in square feet, BA is determined by the tree's diameter at breast height (DBH). DBH is commonly measured using a flexible tape graduated in inches and tenths which divides the circumference by 3.14 (see Figure 2).

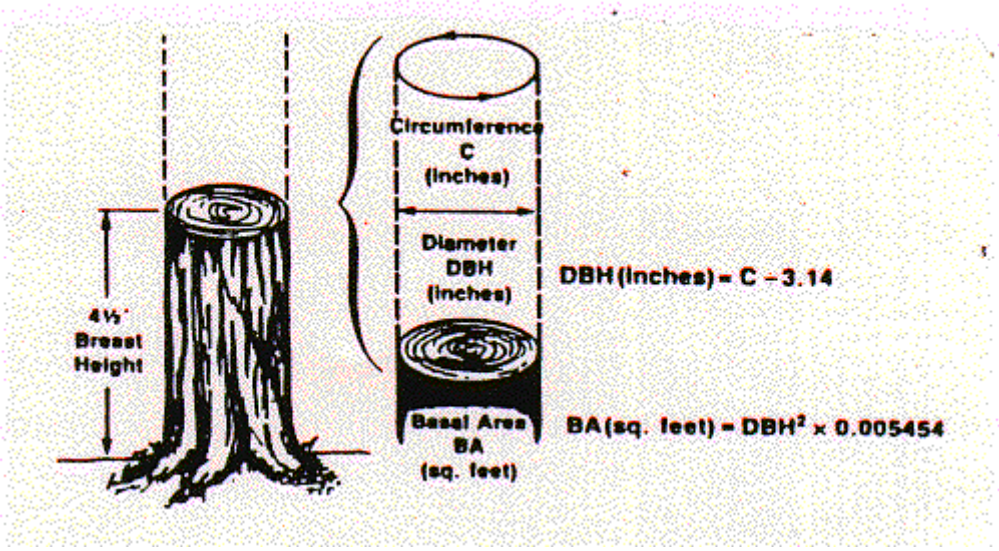


Figure 2. Measurement of the circumference, diameter and basal area of a tree.

Basal area per acre is the total of the BA's of all trees on that acre. It may be estimated by measuring all trees on a small plot of known size and then inflating the total value to a per-acre figure. For example, ten 12-inch trees on a one-tenth-acre plot (a square 66 by 66 feet or a circle with a 37.25-foot radius) would total 7.9 square feet per one-tenth acre, representing 100 trees with 79 square feet per acre (see Table 1).

Table 1. Basal area of trees of various diameters and number of trees per acre for given basal area.

Diameter Breast Height (DBH) (inches)	Basal Area Per Tree (BA) (sq ft)	Number of trees per acre for the following basal area (BA)		
4	.09	920	1,150	1,720
6	.20	410	510	760
8	.35	230	290	430
10	.55	150	180	280
12	.79	100	130	190
14	1.07	70	90	140
16	1.40	60	70	110

A much simpler method to determine basal area per acre involves using a glass prism or other type of angle gauge. Each "in" tree (those too large and too close to be offset completely by the gauge) counted while turning one complete revolution (360 degrees) represents a certain basal area per acre regardless of tree size - an amount called the instrument's "factor." The basal area per acre is estimated by counting all "in" trees surrounding a sample point and then multiplying the tally by the instrument's "factor." For example, with a "10-factor" gauge, one revolution counting nine "in" trees would indicate 9 times 10 feet or 90 square feet per acre of basal area, regardless of the tree sizes (see Figure 3).

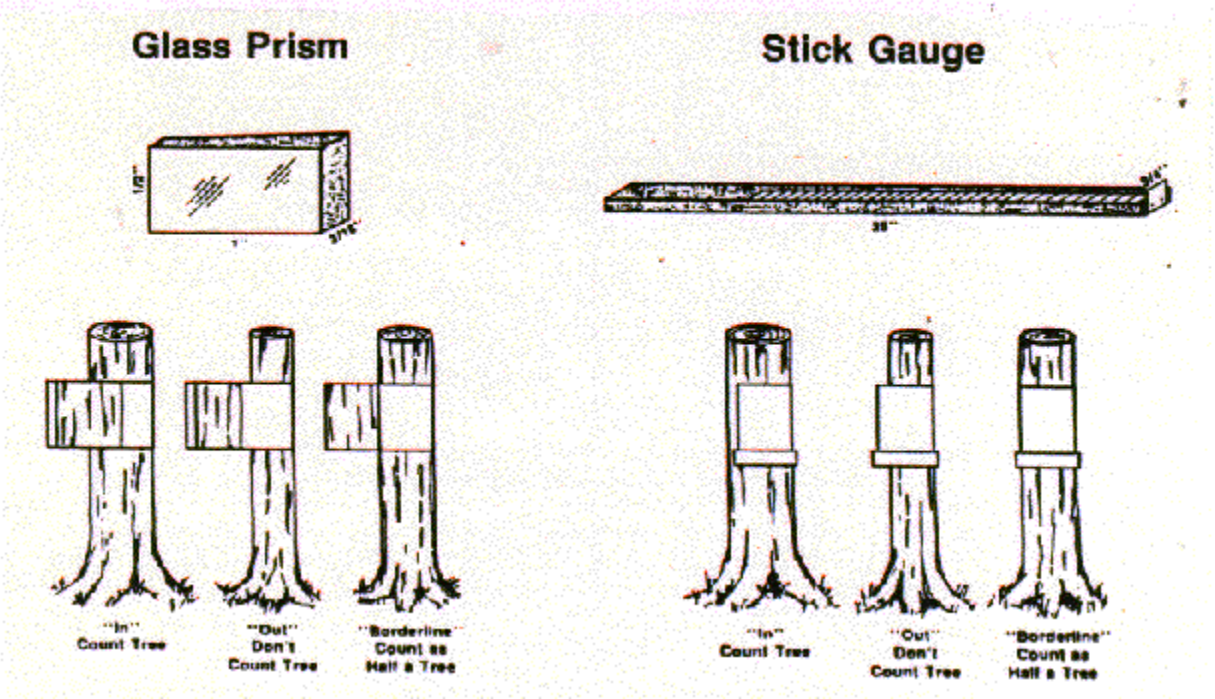


Figure 3. Using a "10-factor" angle gauge to determine if tree is "in", "out" or "borderline".

A simple " 10-factor" angle gauge may be constructed by fastening a 3/4-inch wide target to the end of a 25-inch long (Biltmore) stick. Glass prism gauges may be inexpensively purchased from forestry suppliers.

When To Thin

Basal area per acre tends to remain fairly stable over much of the forest stand's life. However, it stabilizes at 150 square feet per acre or more, a value too high to permit optimum diameter growth of crop trees. The goal of thinning is to reduce the basal area per acre to between 60 and 110 square feet as early and as often as practical, keeping only straight, healthy, vigorous and evenly spaced crop trees. Table 1, showing the basal area of trees by diameter, also includes the approximate number of trees per acre of each size which would total 80, 100 or 150 square feet per acre.

Naturally regenerated stands sometimes have such a large number of trees per acre that precommercial thinning becomes advisable. This is not usually necessary in properly established plantations where spacing among seedlings is controlled. Precommercial thinning should be performed as soon as overstocked conditions are identified, and the stands are safe from the regrowth of sprouts and weeds - generally between age 4 and 8 years. Precommercial thinning may be more critical for stand development on poor sites than on good sites because trees on poor sites require more time to express dominance and thin themselves naturally.

How To Thin

Foresters consider site quality, species, age, tree size and vigor of a stand as well as stand density when prescribing a thinning. They usually leave more basal area on good sites than on poor ones and more basal area in old stands than in young ones. Location, markets and type of logging equipment used also influence the thinning prescription. Even the weather affects recommendations, with more frequent but lighter thinnings favored in locations particularly susceptible to snow and ice damage.

Foresters usually mark all trees to be removed both at breast height and at the groundline. Paint or ink marks are useful to estimate the volume to be removed, to calculate the basal area of crop trees to be left and to check on the harvest operation to see that it is done properly. Trees to be removed should include the crooked, defective, forked, diseased and dying as well as undesirable species. Practical considerations may also require removal of entire rows for equipment access (for example, every fifth row), a step that allows selective removal from remaining rows.

In spite of the attention given the trees being cut, the valuable crop is made up of those which remain. Therefore, frequent checks are made while marking to estimate the stand density of crop trees, usually using a prism angle gauge. Sometimes the crop trees are marked rather than marking trees to be removed. This is particularly helpful in stands with numerous small or low-value trees, areas

of diseased, damaged and deformed trees and stands which might be thinned intermittently, perhaps by the landowner. In all cases, care must be taken during marking and harvesting to avoid damaging crop trees and to minimize damage to the site.

Basal area guidelines are not usually applied to precommercial thinning. Because of the small tree size and long time before harvest, preference is given to the lowest cost method for reducing the number of trees per acre. No fewer than 400 to 500 well-distributed potential crop trees should be left. Precommercial thinning may be done by hand, or it may be done by chopping or bush-hogging 7- to 8-foot parallel swaths, leaving 1- to 3-foot wide strips of standing trees. Frequently, the best alternative is a combination of the two methods, manually thinning the 3-foot strips to about 450 trees per acre. Using prescribed fire, chemicals or fertilizers for this purpose has generally been inferior to mechanical methods.

A rule of thumb which may be useful for checking stand density is based on how crop trees are spaced. Spacing is the distance between a given tree and its neighbors. The 1.75 x D Rule determines spacing (in feet) among crop trees to be 1.75 times the tree's diameter (in inches). For example, two 12-inch trees to be left should be separated by 21 feet (12 x 1.75 = 21). Application of this rule leaves approximately 80 square feet of residual basal area per acre but does not consider species, site or stand conditions (see Table 2).

Table 2. Approximate distance between trees and number of trees per acre applying the 1.75 X D Rule.

Diameter Breast Height (DBH) (inches)	Distance Between Trees (feet)	Number Trees Left (per acre)
6	10	410
8	14	230
10	17	150
12	21	100
14	25	70

Specific Recommendations
Thinning recommendations for individual species, including timing, intensity and repetition intervals, follow:

Loblolly: On the better Coastal Plain and Piedmont pine sites, loblolly is the most productive of the southern pines. Intensive management calls for thinning to about 60-110 square feet of basal area per acre as frequently as every five years. Consider thinning at age 12 on the best sites with commercial-sized trees and start later using longer intervals on poorer sites and in more dense stands. Such a schedule can produce sawtimber in as little as 30 years, depending on soil quality.

Longleaf: This species generally occurs on dry, sandy Coastal Plain sites. Thinnings may be advisable about every 10 years to reduce the basal area to 50 to 100 square feet per acre. While precommercial thinning is usually not necessary, the stocking of dense young stands should be reduced as early as practical to about 500 well distributed seedlings per acre.

Shortleaf: Although common throughout the Piedmont and Mountains and prized for its sawtimber value, shortleaf pine is slower growing than loblolly on most sites. In mixtures with loblolly pine, this species is likely to be removed in intermediate cuttings. In pure stands similar guidelines apply as for loblolly, with thinning at intervals of 5 to 1 0 years to reduce basal area to approximately 60 to 100 square feet per acre.

Slash: Now considered less desirable than loblolly in the Carolinas, slash pine was once the favored species for planting southern Coastal Plain flatwoods sites. Existing stands should never exceed about 600 trees per acre and should be thinned to 70 to 100 square feet of basal area per acre. Sapling and pole-sized stands may respond to thinnings as often as every five years, beginning as early as age 15, but a ten-year interval should be adequate after age 20.

White: Widely planted in the Mountains and upper Piedmont, white pine is extremely fast growing and frequently develops very high stand densities on the better sites. Thinnings should be light and frequent, leaving residual basal areas above 90 square feet per acre and as high as 140 in older stands on good sites. Poor pulp markets for this species have led to recommendations to plant at wide spacings. This minimizes the need for early thinning.

Virginia: Where a seed source is available, Virginia pine forms dense pure natural stands on abandoned fields and other disturbed sites of the upper Piedmont. The wood has excellent pulping properties, but numerous limbs and slow growth rate discourage sawtimber production. Precommercial thinning between 5 and 8 years of age can promote its health, vigor and volume growth as pulpwood. Site limitations, lack of wind-firmness, poor growth response after age 15 and markets generally preclude commercial thinning.

Conclusion

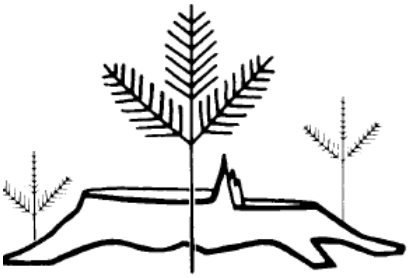
Thinning is a more expensive harvesting operation than clearcutting and, therefore, returns less money to the landowner. However, the improved utilization, intermediate cash flow and the increased value of the final crop can make thinning a profitable management decision. Not all partial cuttings are thinnings nor are they all good investments. "Cutting the best and leaving the rest" or "leaving those small (young?) trees to grow" is "high-grading" not thinning. Proper thinning requires that an adequate stand of "crop" trees remain. Landowners should seek the advice and assistance of a professional forester prior to marking or marketing a thinning.

Prepared by William E. Gardner, Extension Forest Resources Specialist (NCSU)
Originally prepared for publication by the NCSU Forestry Extension Office.

Related Links

This page last modified 09/03/02 at 1349 hrs.

Appendix G



Woodland Owner Notes

Crop Tree Management in North Carolina

Landowners today are interested in forest management that promotes environmental stewardship and produces multiple benefits. Crop tree management can do just that. This system is designed for use in timber stands of adequate quality, but which are either not ready for final harvest and regeneration or belong to landowners who place high value on continuing stand management.

Crop tree management is a seven-step system that focuses on releasing trees that yield multiple benefits (including wildlife, water quality, and aesthetics, as well as timber) through intermediate cutting treatments around crop trees with the highest potential increase in value. Crop tree management requires making decisions about individual trees rather than an entire stand or forest.

Crop tree management was developed for use on nonindustrial private forests of the Eastern United States. Small, natural, mixed hardwood stands (generally 100 acres or less) are well suited to this method of management, and it works particularly well in areas such as riparian zones, urban and community woodlots, and forest buffers. Crop tree management can be used in precommercial as well as commercially operable stands.

This publication introduces readers to the seven steps involved in implementing crop tree management. The publication is tailored to Southeast species, objectives, and forest conditions and explains how the approach might be applied to trees for wildlife, water quality, timber, and aesthetics.

Crop tree management is an intermediate stand management strategy, like thinning. So what makes crop tree management different from typical thinning? Area-wide thinning, especially mechanized thinning, at its best takes out most of the poor trees, retaining most of the good trees for future harvest. The trees retained in an area-wide thinning are evenly spaced (for example, a target of 12- x 12-foot spacing, or the removal of periodic rows). Generally most of the emphasis in area-wide thinning is on the trees to be removed and the reasons for their removal. This is just the reverse of crop tree management, which focuses on retaining and managing the "best" trees with the greatest potential to produce specific benefits consistent with the landowner's goals for the property. Crop tree management singles out and "releases" only the "best" trees, regardless of their spacing or location. This release requires the removal of just those noncrop trees that are in direct crown competition with the selected crop trees. Crop tree management applies a "crown touching release"—removing or killing all trees with crowns that interfere with the crop tree. This is likely to result in an unequal distribution of

NC STATE UNIVERSITY A&T STATE UNIVERSITY COOPERATIVE EXTENSION
Helping People Put Knowledge to Work
College of Agriculture & Life Sciences • NC State University
School of Agriculture and Environmental and Allied Sciences • NC A&T State University

free-to-grow, desirable crop trees throughout the stand.

The process of crop tree management can be labor intensive and expensive. Some timber tradeoffs to enhance amenities such as beauty, wildlife habitat, and recreation may be highly desirable. Prudent investors and managers will weigh these alternative opportunities and choose the combination that yields the greatest return in satisfaction as well as economics. Research has shown that crop tree management can produce multiple benefits including timber, wildlife, and aesthetics, and still generate attractive economic returns.

Responses to management inputs and returns on forestry investments vary with site quality, tree growth, timber quality, markets, and many other factors. In North Carolina, crop tree management opportunities are most attractive on sites with high potential productivity (and responsiveness). In general these are likely to include natural mixed hardwood and pine-hardwood stands on red river bottoms, branch bottoms, coves, lower slopes, and other deep, well-drained alluvial soils.

Crop Tree Management—The Process

Step 1. Identifying the Landowner's Property Goals

The first step in crop tree management is to identify the landowner's goals for a given property. This can be accomplished by answering the question "What uses are intended for this forestland?" Goals should address both long-term and immediate desires and can take the form of statements about future conditions. In all cases, goals should be consistent with the ultimate reason for owning the land. They must be realistic and achievable, and they must be compatible with the resources available. Examples of goals include:

- Enhance recreational suitability of the property
- Enhance the beauty of the property around the house and road
- Improve deer and turkey habitat for hunting

Step 2. Establish Stand-Specific Objectives

By developing stand-specific objectives, attention is focused on the stands with the greatest potential to help the landowner achieve overall property goals. Not every stand has the same (or even any) potential to accomplish property goals. For example, improving squirrel habitat by increasing hard mast production may not be possible or practical in a pure yellow-poplar cove, but could be addressed on a nearby oak-hickory ridge. Objectives are specific actions or steps that lead toward the accomplishment of goals. Keep in mind that objectives *must be specific* to be effective. Examples of specific objectives are:

- Improve deer habitat by increasing hard-mast production in oak and hickory
- Improve recreational access by turning an old logging road into a hiking trail
- Increase the variety of fall colors that can be seen from the road or house

Step 3. Develop Crop Tree Selection Criteria

Crop tree selection criteria are developed to match specific objectives. Examples of some timber-, wildlife-, aesthetic-, and water quality-crop tree selection criteria are included in Figure 1. Like the objectives, the selection criteria may differ from stand to stand, and selection criteria are almost certain to vary among landowners. Crop tree selection criteria should be designed to guide the selection of potential crop trees. Any tree meeting multiple selection criteria would be especially desirable because it is achieving multiple objectives.

Crop trees are those trees that best meet the tree selection criteria and thereby accomplish one or more stand objectives, leading toward the satisfaction of landowner goals. Conflicts may occur among criteria, and judgment must be exercised. Give priority to one particular crop tree in each case, or weigh external factors such as site or tree characteristics or the degree to which a criterion is satisfied by crop trees elsewhere in a stand. A tree that might not qualify as a crop tree in one spot could be the best tree available in another. When selecting crop trees, pick the best tree available in each case. Table 1 provides a general list of common tree species and some of the benefits they frequently provide.

Step 4. Inventory the Property

Inventory the selected stand or property to determine whether enough crop trees meet the selection criteria (see Appendix A). By using a systematic cruise and tally sheet(s) similar to the one in this publication (see sample in Figure 2, and Appendix B), the landowner can determine how many crop trees there are per acre or per stand and how many trees should be cut to release the crop trees. Most landowners should expect to find one- to several-hundred crop trees per acre. Higher numbers imply more work, higher cost, and heavier harvest levels

Table 1. List of common tree species and their frequently attributed benefits.

Species	Benefit Capability			
	Timber	Wildlife	Aesthetics	Water Quality
ash	+	+	+	
baldcypress	+		+	+
basswood	+	+		+
beech		+	+	
black cherry		+		
blackgum	+	+	+	+
cucumber	+	+	+	
dogwood		+	+	
elm	+		+	
hemlock			+	+
hickory		+		
holly		+	+	
hophornbeam		+	+	
maple	+		+	
oak (red)				
black	+	+		+
cherrybark	+	+		+
laurel		+	+	+
live	+	+	+	+
northern red	+	+		
southern red	+	+		
scarlet	+	+	+	
water	+	+		+
willow	+	+		+
oak (white)				
white	+	+		
chestnut		+		
swamp chestnut	+	+		+
persimmon		+	+	
pine, loblolly	+			+
longleaf	+	+	+	
shortleaf	+		+	
virginia				+
white	+		+	
redcedar	+	+	+	
river birch			+	+
sassafras			+	
sourwood		+	+	
southern magnolia		+	+	
sweetgum	+		+	
sycamore	+		+	+
yellow poplar	+		+	+

TIMBER

Dominant/codominant trees

- Healthy, vigorous live crown
- No forks or major branches low on main stem
- No dead upper crown branches
- No major stem defects
- High value commercial species
- Expected longevity of 20 or more years

AESTHETIC

Attractive flowers or colorful foliage

- Large, healthy crowns
- Expected longevity of 20 or more years
- Unusual species or tree form
- Visible from house, road, or pathways

WILDLIFE

Mast-producing trees

- Adequate sunlight to crown
- Large, healthy crown
- Reliable hard mast production
- Expected longevity of 20 or more years

Cavity trees

- Expected longevity of 10 or more years

WATER QUALITY

Dominant/codominant trees

- Healthy crown and root system
- Tolerant of flooding/suited to site
- Growth/nutrient accumulation potential
- Age/longevity potential

Figure 1. Examples of crop tree selection criteria for timber, wildlife, aesthetics, and water quality.

than may be justified. Lower numbers may not represent good use of the land and indicate stands that should be managed by some other strategy or should be regenerated completely.

A typical crop tree inventory would include information about species, category of crop tree (selection criterion), free-to-grow (FTG) rating (see Step 6), and information on leave and cut trees. Figure 2 shows a sample tally sheet.

Step 5. Decide How Many Crop Trees to Release per Acre

The number of crop trees to be released per acre depends on the number of trees meeting the criteria and how heavily the stand is to be cut. Whatever the number of crop trees to be released per acre, each crop tree should receive a complete crown touching release. Note that some areas or stands simply may not have enough crop trees to justify management by this method. In such cases, alternative management strategies including complete regeneration may be more appropriate.

Step 6. Decide Which Trees to Cut to Release the Crop Trees

To determine which trees are to be cut, look up into the crown of the crop tree and divide the crown into four equal quadrants (Figure 3). Examine each quadrant to determine whether the crop tree has adequate space to grow (freedom from competing trees). This is known as determining the free-to-grow rating (FTG). The FTG can range from 0 to 4. A rating of "0" means the crop tree crown has competition from neighboring crowns on all four sides (is *not* free to grow), and a FTG rating of "4" means the crop tree has adequate space to grow on all

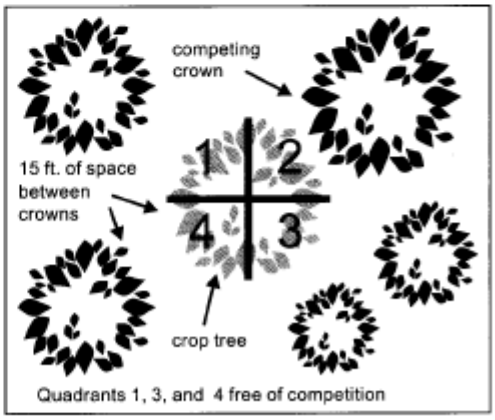


Figure 3. The crop tree in the center of this illustration has been divided into four equal quadrants. A free-to-grow rating is determined by evaluating each quadrant for competition from neighboring crowns. This tree has a free-to-grow rating of 3.

Figure 2: Sample Crop Tree Release Tally Sheet

Landowners: Jane and John Doe Date: December 15, XX

Stand ID and History: ① Abandoned ag field reverted to forest stand

Acres: 20 Number of sample plots: 20 Plot size (acres): 1/10 acres

Landowner Goals: ① To improve habitat for deer and turkey
② To improve timber quality

Stand Objectives: ① Improve habitat for deer and turkey by increasing hard mast production.
② Improve timber quality by releasing select oak to increase diameter growth.

Species	FTG*	Crop Tree Category				Competing trees to be removed
		Timber	Wildlife	Water quality	Aesthetics	
① red oak	4	X	⊗			
white oak	1	⊗	X			
hickory						X
red maple						X
red oak	1	⊗	X			
red maple						X
sweet gum						X
dogwood	0		X		⊗	
red cedar	0				⊗	
sweetgum	2	⊗				
⑳ red maple						X
sweetgum						X
river birch	2			⊗	X	
red oak	0	⊗	X			
red maple						X
sweetgum						X
yellow poplar	1	⊗		X		
sweetgum						X
elm						X
Total number sampled⊗	Conversion Factor**	150	50	10	30	440
Number per acre	A × 1/a ÷ N = B	75	25	5	15	220
Stand total	B × C = D	1500	500	100	300	4400

*FTG - Free-to-Grow Rating
- 0 - competition on all four sides
- 1 - free to grow on one side
- 2 - free to grow on two sides
- 3 - free to grow on three sides
- 4 - free to grow on all four sides

**Conversion Factor

$A \times \frac{1/a}{N} = B$ $B \times C = D$

A = total number sampled
a = size of sample plot (acres)
N = number of sample plots
B = number per acre
C = stand size (acres)
D = stand total

⊗If a tree qualifies in more than one category (for example, timber and water), count the tree only once (the circled X) in the category where it makes the greatest contribution to accomplishing the primary objective.

For example: 150 timber crop trees on 20 tenth-acre plots equals $150 \times \frac{1/0.1}{20} = 150 \times \frac{10}{20} = 75$ timber crop trees per acre

75 timber crop trees per acre on 20 acres equals 75 × 20 acres = 1500 timber crop trees in the 20-acre stand

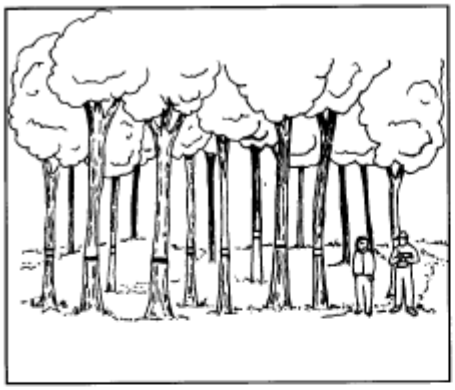


Figure 4. Visualize the proposed treatment on a small scale. In this illustration, crop trees are identified with one band of ribbon, and the trees to be cut have two.

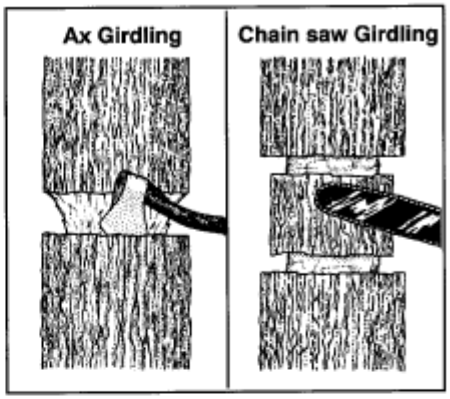


Figure 5. Example of ax and chain saw girdling.

four sides and needs no release. A crop tree is *not* free to grow in a quadrant if there is only 1 to 2 feet between the crop tree's crown and the neighboring crown. Assuming that a healthy tree crown might expand in radius 1 foot annually, the space between two competing crowns would decrease by 2 feet each year. At this rate, 15 feet between crowns would allow room for seven to eight years' growth. The ideal target of crown-touching release would be to give each crop tree an FTG of 3 or higher. Multiple entries into the stand over several years may be preferable to a single complete release of crop trees because of the risk of damage or degradation (such as that caused by storms or epicormic branching).

Step 7. Review the Proposed Treatment

Thoroughly review the stand-specific objectives for each stand, the crop tree selection criteria, and the number of crop trees to be released. Demonstrate the treatment (Figure 4) by setting up a few trial plots (1/5-acre, for example, would be a circular plot with a 52.7-foot radius). Flag the crop tree(s) with bright flagging. Mark competing trees to be cut with a different color flagging (those to be left can be marked with a third type of flagging if desired). Judge the heaviness of cutting either from flagged trees or after actual cutting on the trial plot(s). In crop tree management, only those trees directly competing with the crop trees need to be cut.

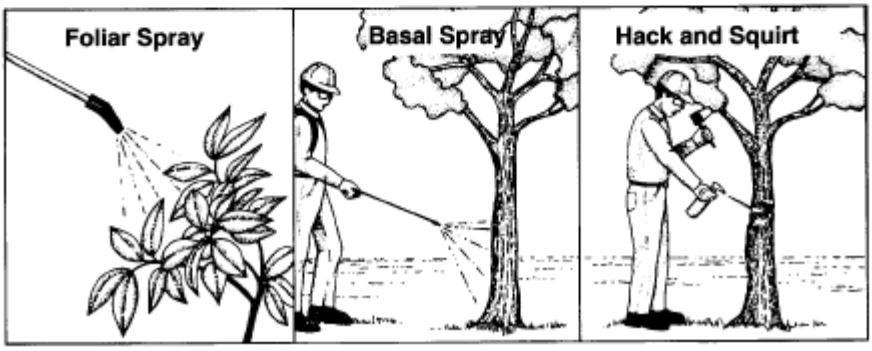


Figure 6. Three methods of applying herbicides: foliar spray, basal spray, and hack and squirt.

Those trees whose crowns do not directly compete with the identified crop trees remain in the stand. If a proposed cutting appears too heavy, reduce the number of crop trees selected for release rather than reducing the amount of release for each crop tree.

Crop Tree Release Techniques

If the competing trees to be removed have a marketable volume and value, seek help from a professional forester in marking, marketing, and harvesting the timber. If the trees to be cut are small or unsuitable for sale, they may be cut, felled, and left in place; girdled; or killed by an appropriate, labeled herbicide treatment. Mechanical girdling is the process of removing the cambium and bark from a ring around the trunk (Figure 5). This can be done with an ax or chain saw. Using an ax, cut a band of bark and living tissue 3 to 5 inches wide in a circular pattern around the tree. Using a chain saw, make two cuts, approximately 1 inch deep and 3 to 5 inches apart, in a circular pattern completely around the tree. This girdling treatment should interfere with the tree's ability to transport food. Herbicides, properly applied, can be safe, effective, and economical for controlling competing vegetation (Figure 6). Herbicides are designed for specific target species and conditions, so follow the directions on the label with respect to those conditions, timing, rate, and method of application to ensure effectiveness, personal safety, and environmental protection. Several common methods of application include foliar spray, basal spray, or squirted application to cuts through the bark (hacks or notches).

Summary

Crop tree management focuses on managing individual trees, expanding their potential to meet multiple landowner objectives. Crop tree management allows landowners to practice stewardship principles, retaining maximum control over stand conditions while accelerating progress toward multiple landowner benefits. Implementing crop tree management requires a clear understanding of property goals, establishment of appropriate stand-specific objectives, and development of suitable crop tree selection criteria. Selection of individual crop trees is guided both by the selection criteria and by desired stand conditions. A crown-touching release is applied around crop trees to free them from competition, thereby promoting accelerated growth and progress toward objectives. Crop tree management was developed primarily for small, natural, predominately hardwood stands, but could also be applied to riparian areas, urban woodlots, and other areas. However, not all stands (nor their owners) are good candidates for this labor-intensive strategy.

Appendix A
Systematic Sampling

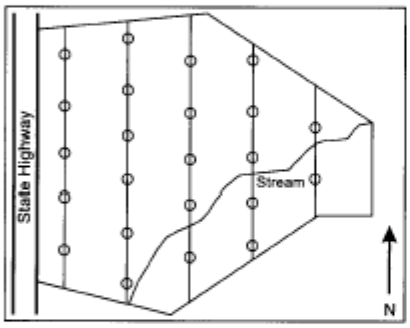
The following illustration demonstrates one way to conduct a plot sample inventory. The following calculations are used to determine the approximate number of plots to sample.

$$\frac{\text{Total area of stand (acres)}}{\text{Size of sample plot (acres)}} \times \left[\text{Percent of total area to be sampled (expressed as a decimal)}\right] = \text{approximate number of sample plots}$$

For example: A 20-acre stand sampled at a rate of 10% using tenth-acre plots would require 20 plots.

$$\frac{20 \text{ acres}}{0.1 \text{ acres}} \times 0.10 = 20 \text{ plots (target number of plots)}$$

On a map of the area to be inventoried, draw parallel lines that reasonably cover the tract. Draw the lines perpendicular to drainage patterns to pick up changes in vegetation caused by changes in soil moisture and elevation. The lines represent the approximate path to be followed in sampling. Locate plots at regular intervals that will produce approximately the target number of sample plots. For example two-chain* intervals between plots along lines five chains apart will result in one plot per acre. In the case of tenth-acre plots this comes out to a 10 percent sample. The accompanying illustration depicts a typical layout.



A 1/10 (0.1) acre plot has a radius of 37.24 feet. Using a tape measure, mark the radius in several directions from plot center, like spokes on a wheel. Mark the outer boundary of the plot by marking boundary trees with flagging or chalk. Record information on crop trees within the boundaries and on competing trees to be removed. Collect data on appropriate tally sheets for the information needed in guiding future decisions. The information gathered frequently includes species, crop tree category, free-to-grow rating (FTG), and competing trees to be removed.

To summarize the data for the stand, total the trees on all plots. Calculate the per-acre totals by

$$\text{Total number} \times \frac{1/a}{N} = \text{number per acre}$$

a = size of sample plot (acres)
N = number of sample plots

For example: 300 crop trees tallied on 20 tenth-acre plots taken in a 20-acre stand would represent 150 crop trees per acre

$$300 \text{ crop trees} \times \frac{1/0.1}{20} = 300 \times \frac{10}{20} = 150 \text{ crop trees per acre}$$

Multiply the per-acre totals by the number of acres in the stand to get a reasonable estimate of the total number of crop trees in the stand.

For example: 150 crop trees per acre × 20 acres = 3,000 crop trees in the stand

*One chain equals 66 feet. Two chains (132 feet) by five chains (330 feet) is one acre (43,560 square feet).

Appendix B

Crop Tree Release Tally Sheet

Landowners: Date:

Stand ID and History:

Acres: Number of sample plots: Plot size (acres):

Landowner Goals:

Stand Objectives:

Species	FTG*	Crop Tree Category				Competing trees to be removed
		Timber	Wildlife	Water quality	Aesthetics	
Total number sampled[1]: Ⓧ	Conversion Factor**					
Number per acre	A × 1/a + N = B					
Stand total	B × C = D					

*FTG - Free-to-Grow Rating

0 - competition on all four sides
1 - free to grow on one side
2 - free to grow on two sides
3 - free to grow on three sides
4 - free to grow on all four sides

**Conversion Factor

$A \times \frac{1/a}{N} = B$

$B \times C = D$

A = total number sampled
a = size of sample plot (acres)
N = number of sample plots
B = number per acre
C = stand size (acres)
D = stand total

Ⓧ[1]If a tree qualifies in more than one category (for example, timber and water), count the tree only once (the circled X) in the category where it makes the greatest contribution to accomplishing the primary objective.

Additional Resource Materials

The most complete reference on crop tree management is *Crop Tree Management in Eastern Hardwoods,* a 58-page book by Arlyn W. Perkey, Brenda L. Wilkins, and H. Clay Smith, published by the USDA Forest Service Northeastern Area, State & Private Forestry, as NA-TP-19-93, January 1994.

For more information on crop tree management, contact your county Extension center or visit the Internet at http://www.ces.ncsu.edu/nreos/forest/.

Prepared by

Robert E. Bardon and William E. Gardner, Extension Forestry Specialists

2,500 copies of this public document were printed at a cost of $1,391.00, or 0.56 per copy.

Published by
NORTH CAROLINA COOPERATIVE EXTENSION SERVICE

1/01—2.5M—JMG—310031 (Reprint) WON-33
E01-38928

Appendix J

Forest Operations that Benefit Wildlife

Depending on your goals, there are a number of additional forest operations that can help you achieve your management objectives. These operations also simulate natural disturbances and can be used to enhance and maintain wildlife habitat.

Thinning operations in a stand are prescribed by foresters to increase the growth rate of the best trees, to provide for periodic income, and to harvest trees that would die if left to natural forces. The remaining trees grow better because moisture and soil nutrients are more readily available. Understory growth is improved because of the increase in sunlight penetration to the forest floor. Thinning sets back succession yet leaves the mid- to late-succession trees. Deer, quail, and rabbits have more food and cover in the understory. Therefore, thinning operations can be managed in a way that enhances both timber production and wildlife. For additional information on thinning, see Woodland Owner Note 13, Thinning Pine Stands.

Prescribed or controlled burning is a forestry operation that helps reduce the risk of wildfire and the costs of preparing harvested areas for tree planting. Burning sets back succession just like a natural fire does. It is beneficial for many species of wildlife, including quail, deer, and turkeys.

Controlled burning uses a low-intensity surface fire on a one- to four-year schedule, depending on fuel conditions. Burning helps control woody vegetation, releases nutrients to the soil, and increases seed germination and herbaceous vegetation, including legumes and grasses. Controlled burning can simulate natural, lightning-caused fires that are required to regenerate and maintain longleaf forests. For more information see Extension Service publication AG-457, **Wildlife and Prescribed Burning**.

Burns also help the development of oaks in hardwood forests. Much of the predominantly oak forest present today is thought to be a result of repeated fires, grazing, and cutting practices throughout the past 200 years. A prescribed fire in a hardwood stand kills the undesirable, thin-barked tree species, such as red maple, and gives the oaks a chance to develop and dominate the stand. This reduces the need for herbicides to control the undergrowth.

Before you initiate any controlled burns on your property, be sure to enroll in the Hazard Reduction Burning Program offered by the North Carolina Division of Forest Resources (NCDFR). Through this program, you can learn to use prescribed burns safely to remove undesirable vegetation and enhance wildlife habitat in your forest. For additional information on this program, contact the NCDFR or your county Cooperative Extension Center.

Den and Mast Tree Selection. Regardless of the harvest system you use, you must consider the potential of den and mast tree selection on your land before you begin harvesting.

Den trees are trees that have one or more hollow chambers that are used by birds, mammals, and reptiles for nesting, roosting, and cover. As a rule, two to four den trees per acre should be left in any harvested or thinned area. Den trees can be as small as 5 inches or as large as 5 feet in diameter. The smaller trees may house chickadees, woodpeckers, screech owls, or flying squirrels, while the larger trees may house raccoons or occasionally a bear. If suitable den trees do not exist in your woodlands, installing man-made boxes or nests is a good alternative (see Working with Wildlife 16, Building Songbird Boxes).

Consider also the importance of **mast-producing trees**, those that produce fruits and nuts used as food sources by wildlife. While hickory, beech, persimmon, serviceberry, blackgum, American holly, hawthorne, and dogwood are not highly valued species for wood products, they produce food that is important for wildlife. Grapevines also are important mast producers, but the vines can deform your hardwood timber and reduce its value. Concentrate wild grapes on arbors in select areas where timber potential will not be affected.

Make your wildlife objectives known to the professionals conducting timber and forest management operations **before** those operations begin. Specify that mast and den trees be left undisturbed and that islands and buffers be clearly marked and protected. Wildlife management activities do not have to be expensive, but they must be planned before you harvest any timber.

Road Construction and Maintenance. Whether you enter the woods for management or recreational purposes, easy, reliable access to your property is essential. Proper location, design, and construction of roads increases the value of forest property and reduces upkeep and costs. Multiple benefits can be gained from roads having good drainage, good construction, and the application of best management practices (BMPs, or standards that **minimize** soil erosion and maintain water quality).

One practice that benefits wildlife and improves roads is known as **daylighting**. In this process, trees bordering access roads are removed to maximize the amount of sunlight that reaches the road surface and side banks. Sunlight not only enhances the growth and proliferation of shrubs, grasses, weeds, and insects available for wildlife, but it also dries the road surface. Daylighted logging roads maximize forest edge and allow year-round use. To reduce erosion, be sure to seed roads, banks, log landings, skid trails, and other areas where soil has been disturbed.

Try to restrict or regulate the use of motorized vehicles on access roads so that wildlife species fully use the newly seeded areas. Minimize disturbance and vehicle access on roads from the first of May until October to prevent disruption of nesting and brooding activities.

Ground Cover Along Roads and On Logging Sites. Establishing ground cover controls erosion, improves water quality, and can enhance the quality of wildlife food and cover. Seed germination is best in the spring and fall. Successful plantings generally require fertilization, liming, and soil preparation, so plan ahead. Have your soil tested and prepare the seedbed properly for best results. Table 5 shows appropriate combinations for general geographic areas. Because seeding recommendations vary by site, consult your county Cooperative Extension Center or your local soil conservationist about seed mixtures, rates, shrubs, and soil treatments for your area and the wildlife species you want to help.

These seed mixtures will provide valuable areas in which wildlife can graze, gather seeds, or hunt for insects. Open grasslands scattered through woodlands provide **brood range** for turkeys and grouse. Hens will take their broods to these open habitats to feed on the high concentrations of insects found there.

Wildlife Food Plots. Forest properties can be further managed to attract wildlife by planting specific food crops, although such farming can become a monumental task. If you are not experienced in growing agricultural commodities, seek assistance from your county Cooperative Extension Center.

Cost is the other deciding factor in planting food plots. For example, in the mountains, the cost to convert some areas to fields that can be worked with farm machinery can cost as much as $400 to $600 per acre. It costs about $125 per acre each year to reseed and fertilize annual food plots once they are established.

While these costs include labor and machine time, they are still extremely high and have forced many wildlife biologists and landowners to abandon food plots in forest stands. Another alternative is to coordinate wildlife habitat improvement with on-going farm and forestry operations.

If you decide to plant food plots, remember that annual plots tend to be more productive (and more expensive) than perennial plots. Annual plantings of field corn or grain sorghum are particularly beneficial, especially when mast production is low. If you decide to plant perennial plots, plan on disking, liming and fertilizing, and replanting about every three years. Make sure you plant in areas that receive adequate sunlight. Try to create openings at least 30 yards wide for permanent plots and, whenever possible, orient the long axis of the food plot to the south so it gets more sun. Also, keep in mind that perennial plots must be clipped or mowed early in the fall.

Summary

Wildlife management opportunities abound for private landowners in North Carolina. Forestry operations can be used to provide and enhance wildlife habitat, and information is available to help you get started right away. Talk to your Cooperative Extension Service agent about publications and technical assistance. Cost-share assistance is also available to help landowners manage their forestland for multiple benefits, including wildlife and other resources. Forest stewardship management can be effective and rewarding for you and the generations to come.

Appendix K

Woodland Owner Notes

Before You Sell Your Timber

Years of growth are accumulated in a mature timber stand. The annual income from all those years is frequently marketed in a single transaction. Too much is at stake to sell timber without having accurate knowledge of products, volume, and value and without knowing how to establish the next crop for continued production.

Selling timber can be complicated. Trees are usually harvested by someone other than the seller, so their ultimate value to the landowner (also called stumpage value) is reduced by harvesting as well as transportation costs. Logging costs vary from tract to tract, and even differ depending on the type of logging system used.

Also the size, quality, and species of timber are highly variable. Specialized knowledge is required to identify tree species and to estimate volume and value within utilization standards accepted by local markets. Actual product volumes cannot be determined until the logs are processed (usually after the sale). Therefore, the volume of standing timber must be estimated using one of several "log rules" applied throughout the state.

There are no daily market price reports for stumpage, nor are there any government support prices. Both demand and price for many timber products fluctuate widely. Add to this the fact that many timber sales are once- or twice-in-a-lifetime occurrences. Learning from experience can be very expensive!

This Woodland Owner Note includes sections on questions to ask before you sell your timber, how timber is measured, factors affecting timber stumpage prices, steps to marketing timber, timber taxes, and a sample invitation to bid on timber. By asking the right questions at the right time, by approaching the subject in a businesslike fashion, and by getting appropriate assistance, you can make your next (or first) timber sale both a pleasant and a profitable experience.

Before You Sell Your Timber...

Here are some questions you should ask:

- Which trees should I sell?
- How soon should I market them?
- Are property and cutting boundaries well marked?
- What is the timber volume? (By which log rule?)
- What is the growth rate?
- What is the fair market value of my timber?
- What is the current timber market price trend?
- Are the trees financially mature?
- Who and where are the appropriate timber buyers?
- What sale method should I use?
- How will the income be taxed?
- How should I reforest harvested areas?
- How can I get advice from a professional?

Distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914. Employment and program opportunities are offered to all people regardless of race, color, national origin, sex, age, or disability. North Carolina State University, North Carolina A&T State University, U.S. Department of Agriculture, and local governments cooperating.

NC STATE UNIVERSITY A&T STATE UNIVERSITY COOPERATIVE EXTENSION

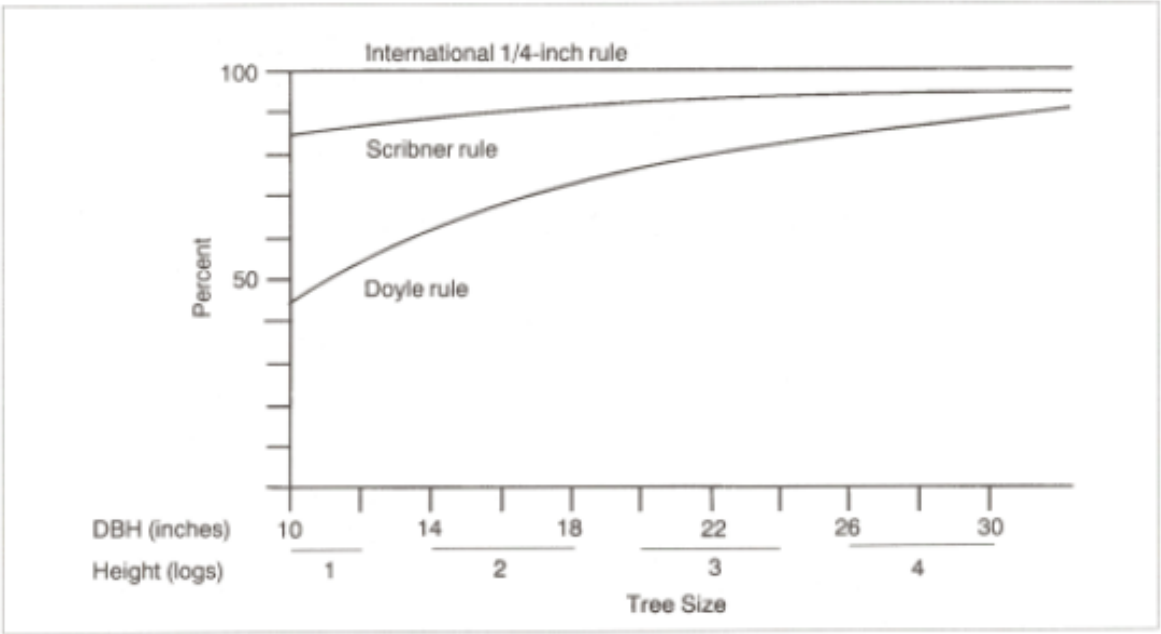


Figure 1. Relationships among three log rules in board-foot volume estimates for trees using the International 1/4-inch rule as a standard for comparison.

How Timber Is Measured

Timber owners should have at least a basic understanding of how timber volumes are customarily determined. A timber "cruise" is an inspection of a timber stand made to estimate its volume of marketable timber. In a stand of large or high-value timber, the cruise may involve measuring all merchantable trees. More commonly, the cruise is based on a systematic sample of trees on plots or strips representative of the entire stand.

Two measurements are usually needed on each tree: the diameter 4.5 feet above the ground line (diameter breast high or DBH) and the merchantable height. The height of sawtimber is generally recorded in terms of the number of "logs" (usually 16 feet long each) to some "merchantable top" (usually a small-end diameter of 7 inches or more inside the bark). Pulpwood tree height may be measured as the number of pulpwood sticks (usually 5 feet long each) or feet to a merchantable top diameter (usually 4 inches outside the bark); or total tree heights may be recorded. Tree measurements can be made using a timber scale stick or other forestry measuring device. (See Woodland Owner Note No. 5, *Measuring the Volume of Standing Trees with a Scale Stick.*)

Once the trees' diameters and heights are known, their volumes can be determined from various tree volume tables.

The Doyle, International 1/4-inch, or Scribner log rule may be used to estimate board-foot contents of measured trees. In North Carolina the Scribner rule is more frequently used for southern yellow pines, whereas the Doyle rule is more commonly used for hardwoods.

The choice of log rule can change the volume estimate significantly (Figure 1). If both the buyer and seller are aware of this and if price is adjusted for the log rule being applied, any log rule may be used because the total value of the timber (price times quantity) would remain the same. For example, a tree 14 inches in DBH containing two 16-foot logs might be estimated to contain 130 board feet by the International 1/4-inch log rule or 115 board feet by the Scribner rule but only 75 board feet by the Doyle rule. A price of $115 *per thousand board feet* ($115 per MBF) by the International 1/4-inch rule would result in a $15 stumpage value for the tree, whereas appropriately adjusted prices of $130 per MBF by the Scribner rule or $200 per MBF by the Doyle rule would be required to generate approximately the same $15 stumpage value for the tree.

Weight scaling and other timber measurement methods are sometimes used by North Carolina buyers. The choice of log rule or measurement unit is relatively unimportant to "lump sum" timber sellers. However, those who sell timber on a "per-unit" basis need to understand the units being applied. The seller should have some means of verifying measurements and know how to accurately convert measurements to more familiar units.

Factors Affecting Timber Stumpage Prices

Many variables affect the price paid for standing timber:

Species. In North Carolina, most pine timber brings higher stumpage prices than sweetgum or mixed hardwoods. High quality black walnut, black cherry, northern red oak, cherrybark oak, white oak, and yellow poplar can bring premium prices. Species price varies widely with location and with changing market demand.

Quality and size. Large, sound trees with clear logs that could be used for lumber, veneer, or export products generally bring the highest prices.

Competitive markets. Competitive bidding by primary timber processors in the buying area tends to assure that a fair market value for timber is offered. The number of bidders and their interest in a sale can be influenced by advertising, which contributes to competition and positively affects the price paid. Some situations involving specialized products, unusual harvesting conditions, or poor markets may be better handled by negotiating with an appropriate buyer.

Acreage and volume. Logging operations require high capital investments in equipment. Low volumes of timber on small acreages cannot be logged profitably by highly mechanized and efficient contractors, so stumpage values generally increase with both volume and acreage.

Location. Distance to the mill, accessibility to good roads, and ease of logging are important factors affecting the price paid for stumpage. Most logging contractors would like all of their operations to be clear-cuts, located beside paved roads, near mills, on well-drained soils, and without contractual restrictions simply because these conditions reduce logging costs. Consequently, when logging conditions are more difficult and the distance to the mill is greater, the price that the buyer is willing to pay for stumpage will be lower.

Contract provisions. Restrictions placed upon the harvest of timber may protect the site or the landowner, but they usually reduce the price paid for the stumpage. You should include contract provisions that address important considerations. (See Woodland Owner Note No. 10, *Timber Sale Agreements.)*

Steps to Marketing Timber

Be well informed and be aggressive in marketing. Buyers have more confidence in sellers who use a business-like approach. Here are some suggestions:

Consult a professional. A study by Dr. Fred Cubbage while at the University of Georgia indicated that professional help can be valuable. Landowners who received professional forestry assistance before harvesting timber averaged 23 percent more income per acre, received a price per board foot that was 64 percent higher, and had a projected income stream from future sales 120 percent higher as a result of improved regeneration and stocking.

Make certain that your timber is financially mature. Thinning may be more appropriate than clear-cutting. A short-term loan using timber as collateral could be less costly than a premature or inappropriate timber sale.

Check the current timber market demand and recent trends. Prices for sawtimber and other high-value products fluctuate widely.

Have a continuing management plan that includes reforestation. Well-planned timber sales can minimize regeneration costs.

Mark the sale boundaries clearly.

Have a registered consulting forester cruise the timber to estimate its volume, quality, and value. In preparing for a timber sale, a registered consulting forester should be willing and able to assist a landowner with all of these recommended steps. Following the harvest, these professionals also can help establish a new timber crop that will have maximum value in the

future. Professionals may charge a daily or acreage fee, or they may handle all sales-related activities for a percentage commission. A percentage commission provides a consultant with the strongest motivation to get top dollar on a timber sale, although it also could encourage selling more timber or selling it sooner. Daily or acreage charges might be less expensive, but they do not provide the motivation to get the top price and they generally remain due even if no timber is sold. A list of registered consulting foresters may be obtained from county Cooperative Extension Centers or from the North Carolina Forest Service. (See Woodland Owner Note No. 6, *A Consumer's Guide to Consulting Foresters.)*

Inform adjoining landowners of any proposed timber sales to make certain that boundary and access road locations are acceptable. Combining sales among neighboring tracts can sometimes increase volumes without substantially increasing logging costs, which could result in higher proceeds to the sellers.

Advertise the timber to all reliable buyers in the area. High-value products or tracts could attract buyers from as far away as 100 miles. Most timber buyers are listed by county in the North Carolina Division of Forest Resources publication *Buyers of Forest Products in North Carolina*. County Extension Centers and Forest Service offices frequently have this information for local counties.

Potential buyers can be notified best by sending them invitations to bid on timber (see the sample in Figure 2). Provide as much information about the timber, the tract, and contract restrictions as can be given in the bid invitation. Describe payment provisions, including any security deposits or performance bonds that will be required. Also include with the invitations copies of vicinity maps, Plat maps, or aerial photographs indicating the location of the timber offered for sale.

Conduct the timber sale as advertised. Many marketing experts believe that sealed bids usually result in a higher offer than auctions or negotiated sales. Allow at least a month for bidders to make their Own examinations, or timber cruises, before the sale is held. Reserve the right to refuse any or all bids.

A written contract in which the rights and obligations of buyer and seller are detailed should be prepared or approved by the seller's lawyer before the sale is completed. Important restrictions mentioned in the bid invitations should be included. The seller may wish to require his or her representative to hold a *performance bond* that is refunded to the buyer when all contract provisions have been satisfactorily met or used, if necessary, to correct contract violations. The contract may be used to pass title to the timber and to document that all aspects of harvest and payment meet both the buyer's and seller's approval. Contracts should be signed by both parties, notarized, and recorded in the county courthouse for protection of all concerned. A buyer may require a timber seller to produce and sign a *timber deed* and might conduct a limited search on that deed to be assured of clear title to the purchased timber. This is good business practice, but timber deeds are no substitute for contracts unless they include provisions to protect the seller.

Timber Taxes

Timber is a capital asset. Timber sales frequently involve substantial fluctuations in forest landowners' taxable incomes. Tax provisions change frequently and sometimes drastically. You should consult your tax accountant or attorney, or a good, current reference when planning your timber sale. Take advantage of favorable tax provisions to minimize your legal tax liability.

Summary

You need not sell timber frequently to sell it successfully, but marketing can be a mysterious and complex process. Remember that a single sale may be your only chance to cash in on the many years of annual income accumulated in a mature timber stand. No single publication could cover all possible marketing situations, nor could it make you an expert timber seller. But there are questions you should ask, and answers you should know. See a forester for help *before* you sell your timber. Know what to sell and when to sell. Plan for reforestation. Be a tough trader. In short, market your timber in a businesslike manner to get the most that it will bring.

Figure 2. Sample invitation to bid on timber

I, Joe Pine, offer for sale to the highest bidder all standing timber within prescribed boundaries of 30 acres as indicated on the enclosed map. The tract is bounded by hard-surfaced roads, and logging conditions are excellent.

Location. Tupelo County—5 miles east of Sycamore on State Road 1492 as indicated on enclosed county map.

Timber. The timber consists of the following species:

Loblolly pine: 1,660 trees 12 inches DBH and above, averaging 16 inches DBH, and scaling 332,000 board feet (Scribner rule), and 600 cords in tops and smaller stems.
Sweetgum: 33,000 board feet, Doyle rule.
White oak: 15,000 board feet, Doyle rule.
Yellow poplar: 12,300 board feet, Doyle rule.

Quality. The above timber is of excellent quality for export timbers, veneer, or prime sawlogs. The estimate is based on a 100 percent cruise by John Silverbell. It is shown here for information only and is not construed as implying or guaranteeing any specific amount of timber by the owner.

Inspection. The boundaries were recently surveyed and are well marked by paint, with blue flagging indicating the run of the creek. A recent aerial photograph is available for your inspection at my home.

Bids. Bids must be for a single, lump-sum amount. A minimum of 5 percent security deposit will be required of the successful bidder on the day of the sale, with the balance of payment due within 30 days. Bids will be opened at my home promptly at 11 a.m. on Saturday, January 27. You may bring your sealed bid to the house on or before January 27, or, if you wish, you may mail your bid to Joe Pine, Box 2, Sycamore, North Carolina 27001, marking the lower left corner of the envelope "Timber Bid." The owner reserves the right to reject any or all bids. We invite your inspection, appraisal, and bid.

Conditions of Sale

1. The buyer may have 24 months from the date the contract is signed in which to cut and remove the timber. The buyer will have the privilege of an additional year for 6 percent of the purchase price, provided that said payment is made before the expiration of the original cutting time.
2. The buyer is to comply with all Best Management Practices in accordance with *Forest Practices Guidelines* (15 NCAC 1L.0101-.0209) and make reasonable efforts to cut trees so that they will not fall into cultivated fields, pastures, creeks, or ponds and will immediately pull all tree tops and limbs back into the cutting area. The open land shall not be used to bunch, deck, or load logs. Fences and roads must be left in a condition no worse than before the sale (although any "in-woods" fencing within the cutting area may be ignored).
3. The buyer will use only those roads specifically designated by the owner for moving equipment and hauling.

If you have any questions, please contact:

Joe Pine
Box 2
Sycamore, NC 27001
Telephone: (919) 111-1111
E-mail: jpine@isp.com

For more information on forestry and related subjects,
visit Extension forestry on the Internet at http://www.ces.ncsu.edu/nreos/forest/

Prepared by
William E. Gardner, Extension Forest Resources Specialist
William M. Stanton, Extension Forest Resources Specialist (retired)

5,000 copies of this public document were printed at a cost of $1,56 100, or $.3 1 per copy.

Published by
NORTH CAROLINA COOPERATIVE EXTENSION SERVICE

1/01 —5M--310032 (Revised) WON-19