<Woodland Owner>
Forest Management Plan

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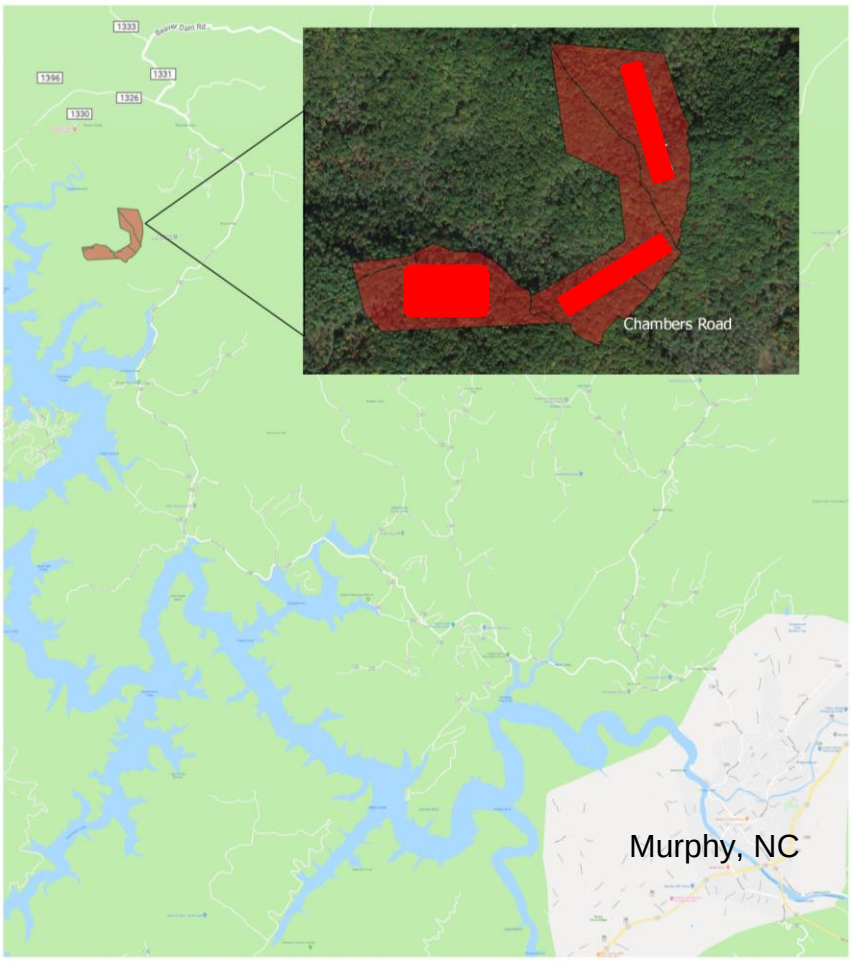

Figure 1. <Woodland owner> Family Properties, Ogreeta Region of Lake Hiwassee, Cherokee County, NC

FOREST MANAGEMENT PLAN

LANDOWNER: <WOODLAND OWNER>
XXX WESTON DRIVE
XXXXXXXXXX, NC XXXXXX

LOCATION: Description: <WOODLAND OWNER> PROP XXX/XX XXXX/XXX
PIN: XXXXXXXXXXXXXXX
Coordinates NAD 83 decimal degrees: XX.XXXX° Lat, -XX.XXXX° Long

DATE: October 30, 2018

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PURPOSE OF A FOREST MANAGEMENT PLAN FOR PUV TAX DEFERMENT

A forest management plan is a short-range (10-year) planning guide for a private woodland owner that is interested in enhancing and enjoying multiple benefits from their forested property. The State of North Carolina recognizes "non-industrial private forest" owners (NIPF) like you own the majority of forestland in NC. In fact, close to 61% of all NC timberland is owned by NIPF owners. Much of the timber fueling NC's timber industry is expected to come from this group. Forestry in NC is big and contributed much to our state's economy. In 2013, forest industry generated $18.7 billion in output and created over 70,000 jobs. For a summary of the impact of forestry in North Carolina – please refer to NCSU Extension Forestry's Economic Impact Data found at: https://forestry.ces.ncsu.edu/economic-impact-data. In 2016, NIPF timber sales in Cherokee County's 252 thousand acres of timberlands amounted to $2.6 million in delivered forest products (https://content.ces.ncsu.edu/2016-income-of-north-carolina-timber-harvested-and-delivered-to-mills) . This generates sales tax for the county and the state.

North Carolina has a stake in providing incentives for NIPF owners to keep their land in active "working forests" to provide a continued supply of timber for the state's economy and well-being. Therefore, the state has developed the "Present Use Value" (PUV) tax deferment program. This program is designed to allow NIPF owners who have 20+ contiguous acres in forest and who **follow** a written management plan accepted by their county's tax office receive a continual deferment on their land taxes. This has the ability to reduce land taxes 50% or more, and reduces the hardship of a high tax burden of landowners wishing to keep their lands in working forests.

The management plan written for the NIPF owner is a guide to help the landowner get the most out of their enjoyment of the land and fulfill the most important objectives landowner have in terms of recreation,

forest health, wildlife , and water quality. The process of writing a plan for a landowner is an opportunity to help educate the landowner about "good" forestry and how harvesting timber not only contributes to the goals of the PUV program but also accomplishes other landowner objectives in terms of wildlife habitat, overall forest health, and future income generation. These plans are written for the landowner to get actively involved with their land. When bettering the land for future generations you are putting a part of you in it, making it your own. The purpose of the plan is therefore to give the landowner sound, practical advice, on timber health, harvesting, and regeneration strategies that minimizes negative impacts on our forests and forest ecosystems while maximizing the positive effects.

In order to remain in the PUV program, the landowner **must be active** in carrying out their plan. The county audits each property in PUV every 7-8 years. The landowner receiving PUV tax status with no intention of carrying out any forest management may lose PUV deferment and be required to pay the "highest-and-best-use" tax rate plus penalties of 3 years of back-taxes and interest.

Do not miss the opportunity to make a difference in your land – make it the best it can be for the land's sake, your betterment, and enjoyment, and for future generations.

PROPERTY OVERVIEW

The property owned by A. <woodland owner>, hereafter called " <woodland owner> Tract", is a tract of approximately 32.92 acres. Currently the tract is completely forested with little improvements except for some trails used for recreation and hunting. The entire ~33 acres is the focus of this management plan. The property is located off <woodland owner> Road in the Ogreeta Community near Lake Hiwassee in Cherokee County NC. The property is approximately less than 1 mile from Lake Hiwassee and slightly more than 12 miles Murphy, NC. See the relative tract location in Figure 1 on the plan cover page. This plan was written in conjunction with two other family ownership plans. Together the three ownerships comprise over 90 acres for timberland. The family members agreed that any management activities could be conducted simultaneously to allow for better opportunities of harvesting, etc. See the acreage and position of the <woodland owner> Tract in relation to the other two ownerships in Figure 2. There was a Forest Stewardship Plan developed for the land in these three ownerships and some work has been done (particularly wildlife habitat) in conformance to that plan. I was given permission to use some the basic information as pertains to timber management, the focus of this PUV plan. Objectives such as recreation, endangered species, wildlife habitat, and others than are expressly addressed in the Stewardship Plan are not addressed here except as where management recommendations may affect them. Please refer to the original Stewardship Plan for outstanding details on those other objectives.

Figure 3 shows majority of the tract is a south facing side slope of the ridge leading up to Bill Top, the highest point on the tract. There are two major south facing spur ridges further down slope from the ridge top and three south facing hollows. Two of the hollows had water during the site visit on August 11, 2018 a week or so after a saturating rain system. These streams flow into <woodland owner> Creek and ultimately into Lake Hiwassee. A small portion (3-4 acres) of the northern most portion of the property lies on the north side of Bill Top as is best described as a north facing side slope. The property ranges in elevation from

approximately ~2230' at Bill Top to ~1700' at the southernmost corner. This tract does not directly border land managed by the Nantahala National Forest, USFS, but it is within 1000 feet of it.

The soils are derived primarily from metamorphosed shales and sandstones and tend to be stony, acidic, and relatively shallow with sharp flat (slate-like) rock within 20" of the soil surface. With the exception of the hollows, most of the site can be characterized as relatively stony, shallow, and drier on the upper side slopes and deeper, and moister as the slope lessens midway down the tract to the lower section. Soils found on the tract according to the NRCS Soil Survey of Cherokee County are:

Table 1. Soil Survey Listing of Soils found on the <woodland owner> Tract. "AOI" refers to Area of Interest, the tract. The map unit symbols relate to the soils map of the tract in Figure 3.

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
JbC	Junaluska-Brasstown complex, 8 to 15 percent slopes	2.8	8.6%
JbD	Junaluska-Brasstown complex, 15 to 30 percent slopes	8.9	26.9%
JbE	Junaluska-Brasstown complex, 30 to 50 percent slopes	0.1	0.2%
LkD	Lonon-Northcove complex, 15 to 30 percent slopes, bouldery	3.1	9.3%
NtE	Northcove-Lonon complex, 30 to 50 percent slopes, very bouldery	2.8	8.5%
SbE	Snowbird loam, 30 to 50 percent slopes, stony	2.3	6.9%
ScF	Soco-Stecoah complex, 50 to 95 percent slopes, rocky	12.5	37.9%
ThB	Thurmont-Dillard complex, 2 to 8 percent slopes	0.6	1.7%
Totals for Area of Interest		**32.9**	**100.0%**

The Map Unit Symbols relate to the symbols seen in Figure 4, the tract soils map. The third letter in the map unit symbol denotes slope class. Roughly, 10% of the tract is less than 15% slope. Roughly, 51% of the tract is less than 30% and the remaining 49% is over 30% slope. A slope greater than 30% presents significant limitations to harvest equipment and logging access road development. It often requires dramatic soil movement for road creation or widening of existing roads. Soil is the foundation of forest plant and animal life. Good soil conservation is necessary if productive forests are to be maintained. Many forestry activities have the potential to adversely impact the soil and degrade water quality through erosion and sedimentation. Best Management Practices, often referred to as BMP's, are general recommendations on how to conduct various forestry activities to conserve the soil and protect water quality. They can be found at: http://www.ncforestservice.gov/water_quality/bmp_fieldguide.htm. Any reputable forester will ensure that any harvesting or other management activities on the tract will adhere to all BMP's. As soils are such an important factor in forest management, a detailed description of each soil series is given below.

There are four major soil series/complexes located on the property. These are Lonon-Northcove complex, Junaluska-Brasstown complex, Snowbird fine sandy loam and Junaluska-Brasstown complex. The site index

listed for tree species is an estimate of the relative productivity of those soils for that species. All site indices will be for base age of 50 years and refers to how tall the selected tree species will grow in 50 years. Thus a white pine that is 100 feet tall in 50 years (site index = 100) is on a better than a white pine that only grows 85 feet in 50 years (site index = 85).

Lonon-Northcove or Northcove-Lonon complex:

is a very deep, well-drained soil found in coves. This soil complex comprises around 15% of the tract, located on the drainage through the lower west side of the tract. In this region, this soil complex is often used for pasture and recreation. This soil type is well suited for timber production. It is a highly productive soil with a site index of 86 for eastern white pine.

Junaluska-Brasstown complex:

is an upland soil found on the ridges and side slopes of the property, which makes probably makes up 36% of the tract. There is a band at the steep point of the side slope just below Bill Top with a lot of rock outcrops and very shallow soils. The soil complex is also found on the spur ridges running downslope on the lower east side of the property.

These soils are found on steep slopes ranging typically from 15 to 50 percent. These soils are a fine sandy loam in the surface layer and have high clay content below 5 inches in depth. This soil is moderately acidic, which will require lime for food plot plantings. This soil is moderately suited for timber production. It produces less volume than the other soil complexes and has fewer valuable species. The commercial species found on this soil include white oak, black oak, scarlet oak, and white pine. Site indices for these species are 70 for white oak, 70 for black oak, 70 for scarlet oak, and 90 for white pine.

Care is needed to prevent soil compaction. The use of heavy equipment should be restricted to dry periods. When soils are wet, skid trails and unsurfaced roads are soft and slick due to the clay content in this soil. Other limitations include low strength and frost action as well as unearthed areas may expose seams of rock, which could have a high content of sulfur. Because sulfur materials are highly acidic, sediments washed into adjacent streams or lakes can increase stream or lake acidity and thus could harm aquatic life. On slopes of 3-15 percent, this soil has a good rating for planting grasses and legumes for wildlife.

Snowbird fine sandy loam:

is a very deep, well-drained soil found in the north facing side slope north of Bill Top property, roughly 7% of the tract. Slopes are very steep in the area where these soils are found. This soil type is well suited for timber production due to productivity, but poorly suited for such due to steep slopes. It is a highly productive soil with a site index of 100 for yellow-poplar and 80 for northern red oak. Care is needed to prevent soil compaction and this soil type has a severe erosion hazard. The use of heavy equipment should be restricted to dry periods. When soils are wet, skid trails and unsurfaced roads are soft and slick due to the high organic matter and clay content in this soil. Other limitations include low strength and frost action as well as unearthed areas may expose seams of rock.

Soco-Stecoah complex:

is a moderately deep, well drained but rocky soil found on the upper half of the tract on a very steep slope. This represents about 38% of the tract. Suitability for hardwoods of moderately low with sites of 76 for scarlet oak, 68 for chestnut oak, and 82 for white oak. For softwoods, 68 for shortleaf pine and 87 for eastern white pine. Soils are poorly suited for logging equipment, roads, and landing due to steepness and erodibility. Care must be given for proper road drainage techniques to reduce the erosion hazards. The underlying rock bed is subject to mass movement risk, on-site investigation may be required prior to road construction. Soils can be droughty making it hard to revegetate roadsides. Avoid any logging during wet periods to avoid rutting. Livestock should not be allowed to graze in areas managed for woodlands.

Timber Markets

Cherokee County: Timber markets for pine and hardwood sawtimber and pulpwood exist in Cherokee County. The market is good for hardwood sawtimber, white pine sawtimber, and pulpwood, and very good for yellow pine sawtimber and pulpwood. High quality yellow-poplar has a high value in the near-by peeler log market. Contracting the services of a registered consulting forester is strongly recommended when the decision is made to sell timber. There are many pitfalls or problems that can occur with timber sales and a consulting forester can insure that your interests are protected and that you receive the best possible price for the wood. One of the most important and frequently overlooked management practices determining yield or returns from timber investments is tax management. Accurate records reflecting timber basis and expenses, along with the utilization and timing of capital gains and reforestation tax incentives can make a tremendous difference in financial returns. The counsel of an accountant specializing in forestry tax matters is recommended. More details on timber basis and timber taxes can be found at the end of this plan

Figure 2. <woodland owner> Tract acreage and position relative to other family member tracts.

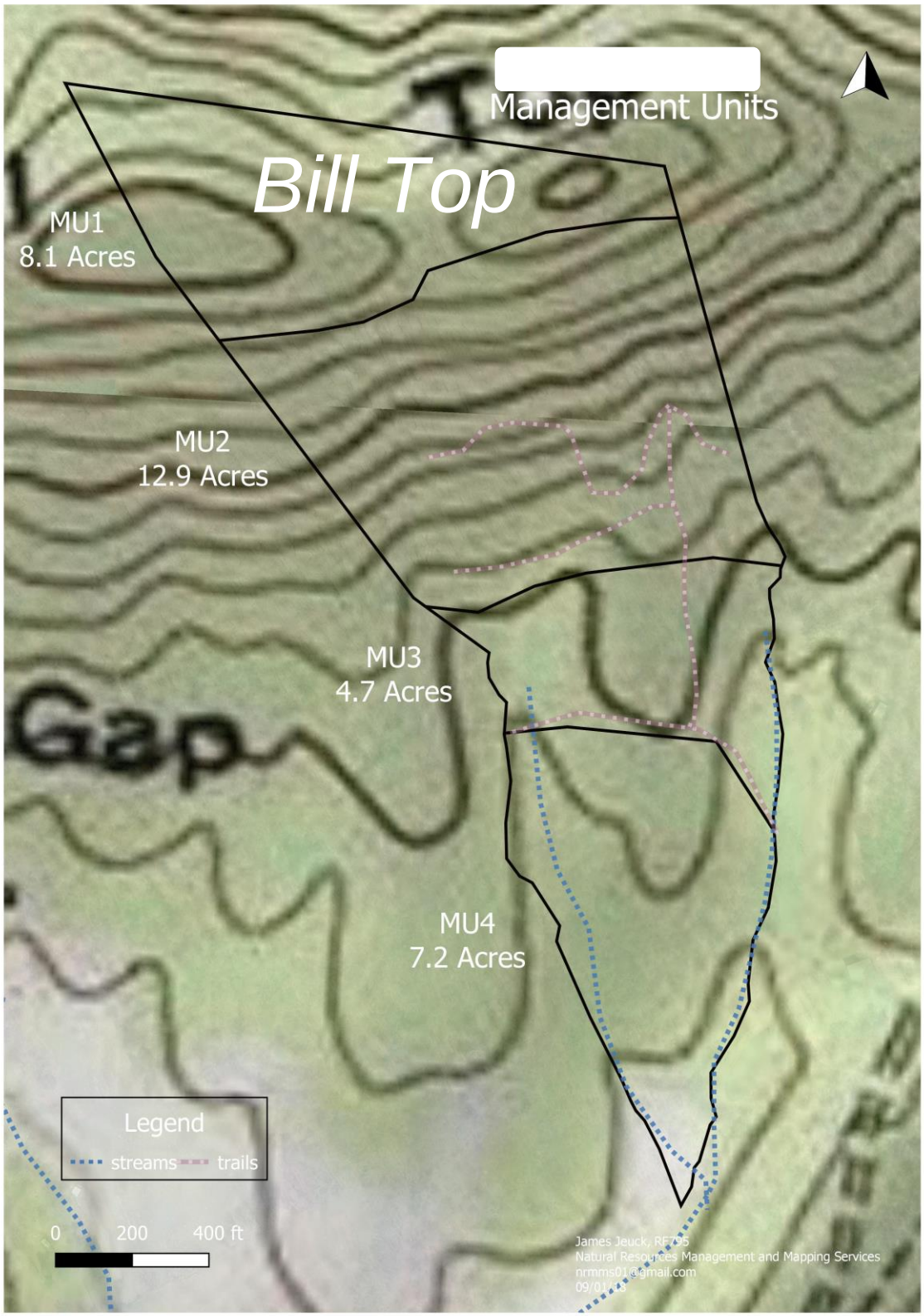

Figure 3. Topographic map of <woodland owner> Tract. Trails are approximate based on field observations and aerial photography interpretation.

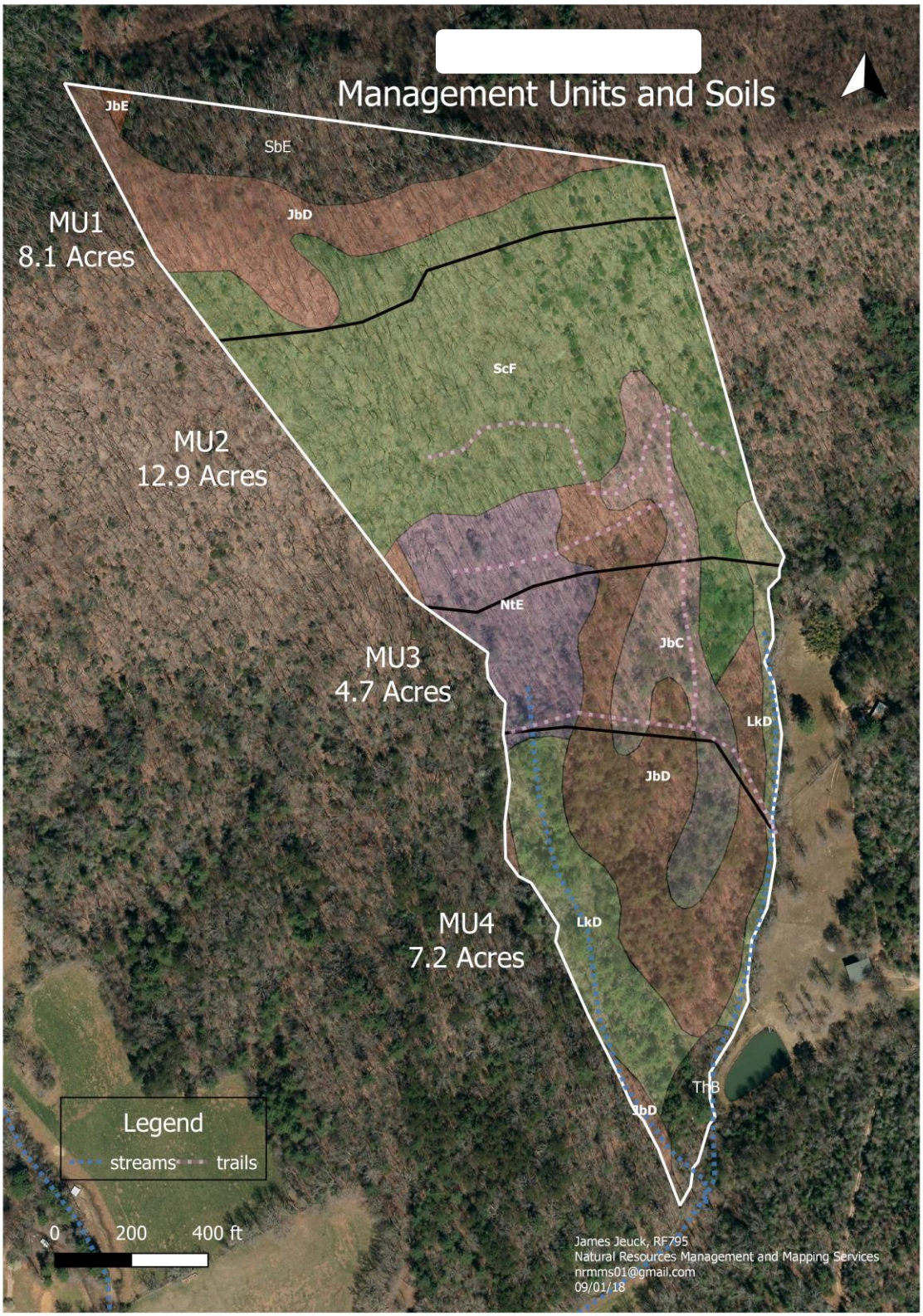

Figure 4. Aerial and soils of <woodland owner> management units (MUs). Trails are approximate based on field observations and aerial photography interpretation.

Landowner Objectives

These management objectives are from the Forest Stewardship Plan written for the <woodland owner> Family. These objectives have not changed.

Timber: Sustainable timber production is a main concern for most of the property and management units. The existing timber will be managed on sawtimber rotations maintaining stand vigor. This means approximately 60-80 year rotations for both white pine and hardwoods stands. Management will consist of harvesting the property using silvicultural techniques best suited for the stand and practical extraction methods that minimize soil disturbance. While large clearcut are not acceptable, smaller ones may be used to create encourage timber sales and also as a means to create patches of early successional wildlife habitat. Stand conversion to pine is not acceptable but regeneration of existing white pine stands on proper sites may be allowed. Timber stand improvements to maintain forest health and make preparations for regeneration will be used in the hardwood stands. Flexibility in the timber management scheme will allow for the enhancement of other forest resources occurring on the tract.

Wildlife: The wildlife habitat will be managed to produce as much hard and soft mast as possible, preserving existing sources of mast. The creation of new forest openings suitable for wildlife food plots will be practiced and planted into suitable wildlife food mixtures. Existing woods roads, field edges, and future logging decks will be planted into preferred wildlife food mixtures. This will improve habitats for deer, turkey, squirrels, and songbirds. Wildlife habitat improvement will be for wildlife observation and hunting for family members and friends. Good wildlife habitat will provide more opportunities for enjoying both the fauna and flora of this area.

Soil and Water: Proper management of soil and water can improve and maintain the productivity and quality of the property. Streamside management zones (SMZ's), proper harvesting, and reforestation techniques should be utilized along streams and Shoal Creek to protect soil and water quality. "Forestry Best Management Practices Manual" included in the Appendix contains recommendations that should be followed to protect soil and water quality. Proper layout and stabilization of the skid road system is critical to the protection of soils and water resources of the property. When necessary erosion control structures along with soil stabilizing grass mixtures will be employed to help reduce the potential for erosion.

Aesthetics/Recreation: Protecting and improving aesthetics for enjoyment was a concern. The creek area offers a natural beauty that has seen little disturbance by human activities. The use of woods roads and trails for ATV is a concern to enjoy the beauty and natural resources of the property.

MANAGEMENT PLAN

The <woodland owner> and <woodland owner> Tracts are adjacent and share similar topography and land use history. Much of the land was either open grazed or woodland grazed with periodic selection timber harvests. The succeeding forest vegetation and therefore management units are similar between the two and data collected was combined to give a slightly better approximation of the important metrics (age, site productivity, stand density and stocking, and approximate volume estimates).

The ridge at Bill Top the top the land was utilized for timber production and cattle grazing. This is a relative productive soil on the ridgeline and north side of the ridge (MU1). The immediate south side of the ridge (MU2) is very steep with shallow bedrock and rock outcrops. This is the least productive management unit. Below MU2, the slope becomes more concave with deeper soils (MU3). This was probably open grazed for a period and left to naturally regenerate into yellow-poplar and yellow pines some 35-45 years ago. At the bottom of the <woodland owner> tract is a ~7 acre white pine plantation (MU4) approximately 60 years old. MU4 is the most likely unit for any immediate timber harvest scenario. There are streams forming boundaries on each lateral side of the <woodland owner> tract so establishing and maintaining proper stream crossings and riparian buffers are essential when performing any soil disturbing activities.

Definitions

Descriptive terms used in the management plan are defined below:

Basal area per acre (BA) – a tree stem 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.

Average diameter – most stem sizes range quite a bit in a stand of timber, so I give an estimate of the average diameter. Diameter is measured at 4.5 feet above the ground – also called dbh (diameter at breast height).

Average height – the average total tree height of the canopy trees is given.

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 versus 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 for oak typically range from 50 (very poor) to around 95 (very good).

Percent interest rate being grown by trees (i.e. diameter growth rate) – 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.

Timber Estimates

Seven sample points were taken on the <woodland owner> property, one sample was taken in each MU1, MU2; two samples were taken in MU3; and three samples were taken in MU4. All tree species for pulpwood (5 - 11 inch dbh) and saw timber (12 + inches) were sampled using a 10 BAF prism.

For basic estimates of current (marketable) timber that is from 5 inches dbh and up standard timber volume estimates were calculated. The results generated gave per acre and total volume for the management unit as well as the basal area / acre estimates by tree species. **Please note**: *any volume estimates are from extremely small samples and are NOT to be taken as estimates by which a timber sale should be based. They are simply broad estimates that allow basic comparison with the other management units and a general guide for management planning.*

Management Unit 1 – Mixed Hardwoods

Size: Approximately 8.1 acres
Aspect: E-W ridgeline with northern and southern side slopes, 2240'- 2100' elevation
Age: ~60+ year (yellow-poplar), upland oaks ~90-100
Site Index: 92 yellow-poplar
Diameter Growth Rate: <3.8% yellow-poplar, <3% upland oaks

Metrics of growing stock:

Species	SAWTIMBER (10"+)				PULPWOOD (5-9")			
	MBF per acre	Basal Area per acre	Trees per acre	Value per acre	Cubic feet per acre	Basal Area per acre	Trees per acre	Value per acre
yellow pine	-	-	-	$ -	196	10	18	$ 206
upland oaks	5.5	50	21	$ 875	150	10	51	$ 157
yellow-poplar	7.0	80	64	$ 1,119	-	-	-	$ -
TOTAL	**12.5**	**130**	**84**	**$ 1,993**	**346**	**20**	**69**	**$ 364**

Non-timber vegetation / understory: briar, holly, red maple, cucumbertree, black oak.

Timber: Predominantly mixed upland hardwoods (black oak, chestnut oak, white oak, yellow-poplar, blackgum, and hickory) some white pine. The ridgetop is not steep but becomes very steep on the north and south side slopes. Soils range from very deep Snowbird soils on the ridge top and north facing slope to moderately deep and very rocky Junaluska and Soco soils on the south facing slope. The upper portion is fairly stable with more productive sites. Ridgelines often receive the full force of winds and this ridgeline shows a number of windblown stems.

The basal area of sawtimber measured was roughly 130 ft^2/acre with oaks representing 40%, and yellow-poplar 60%, of the sawtimber basal area. There is a considerable number of smaller stems but they represent only 13% of the total basal area. The average height of the dominant's crown class was around

95 feet tall and the average diameter at breast height (dbh) of sawtimber trees ranged from 12”- 30” with oaks representing some of the larger diameter classes. The growth of the trees expressed as the “interest rates being grown by trees” (pgs. 1-45 of the Forester’s Field Handbook) shows slow growth for all sawtimber.

Recommendations:

This area is a favorite location for hunting and currently has a tree stand. The adjacent property to the north had a large clearcut performed recently and the adjacent stand provides early successional habitat.

The current stand density for all stems of 150 ft^2/acre and 153 trees/acre is considered within the range of “over stocked” (>100%) for upland hardwoods. The older stems and the relatively high density accounts for the slower growth rates. This MU could be a candidate for timber harvest or a thinning operation. Mr. <woodland owner> expressed he would like to continue keeping this stand as a recreational area so if any management is performed it would likely be a low thinning for old growth wildlife habitat, hunting operability, and visual aesthetics. This would remove most of smaller stems for firewood (roughly 20 ft^2/acre). This would reduce the basal area to roughly 130 ft^2/acre. If firewood is to be extracted, access might be granted through the property to the north.

Some larger stems may also be killed in place to reduce the sawtimber basal area down to 100-110 ft^2/acre. “Leave trees” would be those stems that appear to be wind-firm and have the best chance of surviving wind throw after some of the overstory dies back. The suggested kill trees would be those showing excessive damage or top breakage. These would be killed via chainsaw girdling and herbicide application or by hack and squirt into the bark. Chainsaw girdling often works best with a “double girdle” with two chainsaws girdle cuts roughly 6-8 inches apart. The dead stems would serve as valuable wildlife snags.

A little warning on the use of herbicides when thinning stems is given by Miller et.al. in their publication of hardwood crop tree release that may apply in removal of some of the larger stems with herbicide application. *“Herbicides can damage crop trees if they are used improperly. Crop trees can be harmed from either the uptake of herbicides from the soil or translocation of chemicals through root grafts, referred to as flashback. Flashback is of particular concern when competing trees are the same genus as the crop trees. Root grafting between trees of the same genus is thought to be more pronounced in rocky soils and when trees are in close proximity to one another. Research has clearly indicated flashback potential for several upland oak species, black walnut, red maple, and American beech. Occasionally, yellow-poplar has been damaged by flashback when competing trees are very close to the crop trees. No known instances of root graft transmittance have been observed among species of different genera. Occasionally, use of herbicides that exhibit soil activity can also damage crop trees. Transmission of soil-active herbicides can be particularly problematic when the treatment involves many trees/ac and the soils are fairly porous. In summary, if the competing trees and crop trees are of different genera or the selected herbicide does not exhibit soil activity, then there is minimal risk of injury to the crop trees”* (https://www.nrs.fs.fed.us/pubs/jrnl/2007/nrs_2007_miller_001.pdf). Any herbicide use would need to be applied to the stem rather than soil application.

Figure 5A-E. MU1 ridge top. Large black oak (A)and chestnut oak (B) with relatively low density understory. Windblown stems can be seen at the ridgeline (C, D). Property adjacent on NE corner had recent timber harvest creating younger stand in background (D,E).

Management Unit 2 – Chestnut oak, unstable soils

Size: Approximately 12.9acres
Aspect: South facing side slope (approximately 2100 - 1800 feet elevation)
Age: >60 years
Site Index: 62 chestnut oak
Diameter Growth Rate: 2.3% chestnut oak

Metrics of growing stock:

Species	SAWTIMBER (10"+)				PULPWOOD (5-9")			
	MBF per acre	Basal Area per acre	Trees per acre	Value per acre	Cubic feet per acre	Basal Area per acre	Trees per acre	Value per acre
Upland oaks	7.0	80	46	$1,116	141	10	18	$148
Other hardwoods					145	10	29	$152
TOTAL	**7.0**	**80**	**46**	**$1,116**	**286**	**20**	**47**	**$300**

Non-timber vegetation / understory: briar, holly, red maple, serviceberry, blackgum.

Timber: Predominantly mixed upland oaks, with mostly chestnut oak. The side slope is very steep and is predominantly very unstable Soco soils in the upper portion leading into steep Northcove and Junaluska soils in the lower portion. This unit also contains a band of rock outcrops with extremely shallow soils adjacent. This unit was most likely woodland grazed for a long period and shows evidence of selection harvesting of the larger stems around the 1970s. This left a series of lateral skidding trails that come off a main ridgeline trail that are used for hiking and hunting. The overall site productivity is low for hardwoods and only moderate for white pine.

The basal area measured was roughly 70 ft^2/acre for sawtimber (all oak). There an equal number of sawtimber and pulpwood stems and the pulpwood contributes 25% of the total basal area. The average height of the dominant's crown class was around 70 feet tall and the average dbh of sawtimber trees ranged from 8" – 24" with an average approximately 13" dbh. The growth of the trees expressed as the "interest rates being grown by trees" (pgs. 1-45 of the Forester's Field Handbook) shows very slow growth for the chestnut oak. The current stand density of 100 ft^2/acre and 93 trees/acre is considered within the range of "fully stocked" (~78%) for upland hardwoods.

Recommendations:
The majority of this MU has old skid trails that are currently used for hunting and recreation. These could be opened again upon the prospect of a future timber harvest but would require a large return on the harvest to make it worth the cost and effort. The soils dominating this MU are limits a timber production focus due to the low productivity and severe instability. However, this unit offers, particularly in the shallow soils and rock outcrops unique herbaceous species habitat. Mr. <woodland owner> would not like to engage in any activity that would further risk soil disturbance and prefers to leave this portion of the

ownership continue in its current condition. It is best to maintain this in guidance of the original forest stewardship plan of maintaining this as wildlife with a re-assessment in another 10-15 years.

Figure 6A-D. MU2 steep side slopes. Upper portion shallow and unstable soils (A-C). One of many old skidding trails that cross through the mid and lower portion of this unit (D).

Management Unit 3 – Young Mixed Pine / Hardwoods

Size: Approximately 4.7 acres
Aspect: South facing concave slope (approximately 1880 – 1750 feet elevation)
Age: ~40 years
Site Index: 108 yellow-poplar, 90 black oak
Diameter Growth Rate: 4.9% yellow-poplar, 4.3% black oak

Metrics of growing stock:

Species	SAWTIMBER (10"+)				PULPWOOD (5-9")			
	MBF per acre	Basal Area per acre	Trees per acre	Value per acre	Cubic feet per acre	Basal Area per acre	Trees per acre	Value per acre
Shortleaf pine	1.0	15	19	$163	141	10	18	$148
Upland oaks	1.0	20	23	$156				
Yellow-poplar	1.2	20	22	$184	880	35	64	$924
Other hardwood	0.6	10	10	$90	117	10	35	$123
TOTAL	**3.8**	**65**	**74**	**$593**	**1,137**	**55**	**117**	**$1,194**

Non-timber vegetation / understory: herbaceous plants, tmas fern, holly, Japanese stilt grass (invasive).

Timber: A mixture of small pole stands (yellow-poplar, yellow pine, and mixed pine/hardwoods) on a toe slope with relatively moist soil conditions. This unit was most likely an open moist grazing pasture that was allowed to return to woodland in the mid-1970s. The soils are among some of the most productive on the property and have fewer limitations as they are less steep. An old road leads up the central ridgeline through this unit making it easily accessible. Two intermittent streams originate in this unit as well.

The basal area measured was only 65 ft^2/acre for sawtimber (all oak). There are almost twice as many pulpwood stems as sawtimber stems and the pulpwood contributes to almost 50% of the total basal area. Currently, there is roughly twice the value in pulpwood as there is in sawtimber. The average height of the dominant's crown class was around 95 feet tall and the average dbh of sawtimber trees ranged from 5" – 14" with an average approximately 11" dbh. The growth of the trees expressed as the "interest rates being grown by trees" (pgs. 1-45 of the Forester's Field Handbook) shows very good for both yellow-poplar and black oak. The current stand density of 120 ft^2/acre and 190 trees/acre is considered within the range of "fully stocked" (~100%) for upland hardwoods. Yellow-poplar is capable of growing in higher densities than other species in this unit (oaks and yellow pines). It can be seen from Figure 7C pines are starting to die back due to relatively recent crown closure. Opening this stand slightly could be beneficial, provided it can be done along with some other forest management that provides incentive for loggers to do the work.

Recommendations:

Even though the current growth rate is good for the stems measured, competition will become more intense over the next decade. This is an optimal time to conduct a moderate thinning operation that would ensure the vigor of the stand for years to come. Mr. <woodland owner> is interested in regenerating the white pine in MU4 in the near future. It is recommended that when the harvest in MU4 occurs, Mr. <woodland owner> take advantage of a crown thinning (thinning from above) while the loggers are available. This type of thinning removes the poorer stems in the canopy with the goal of leaving the better stems for final harvest roughly 20-30 in the future. This recommendation suggests thinning the stand back to roughly 95-100 ft^2/acre (approximately 20-30 trees per acre) making sure there are at approximately 150 good stems / acre left behind. When marking the "take trees", make sure the spacing between the residuals is enough to provide them adequate sunlight to benefit them. In addition, the logging crew may be asked to simply cut and leave any poor stems that are neither profitable for them nor desirable to survive in the future stand. These may be used for firewood.

During that time it may be good to try to eradicate some of the Japanese stilt grass discovered in this MU. This species is capable of growing in low light conditions, but to open the site up to more sunlight will cause it to take over the site. The USFS provides a good source of information regarding Japanese stilt grass growth habit found at:
https://www.fs.fed.us/database/feis/plants/graminoid/micvim/all.html#ManagementConsiderations

Below is an excerpt on the various chemical control options: "*The University of Tennessee reported good control of Japanese stiltgrass on their Ames Plantation, but they also reported that managing for a desirable plant community after Japanese stiltgrass was controlled was "difficult". The University found good control of Japanese stiltgrass with imazameth. Because imazameth is selective for only a few plant species, it killed Japanese stiltgrass plants without killing associated native herbaceous species. Sethoxydim and fluazifop are grass-specific herbicides reported as giving some control for Japanese stiltgrass (Tu 2005 personal communication cited). "* Please refer to their website for more details on the information and their literature citing.

Figure 7A-C. MU3 south facing toe slope. Moist conditions in yellow-poplar grove (A). Sphagnum moss indicator of very moist conditions (B lower left). Yellow pine stand on the drier portion of this unit with running cedar below (C).

Management Unit 4 – Mature white pine plantation

Size: Approximately 7.2 acres
Aspect: South facing concave slope (approximately 1800 – 1700 feet elevation)
Age: ~58 years
Site Index: 97 white pine, 78 shortleaf pine
Diameter Growth Rate: 2.4% white pine

Metrics of growing stock:

Species	SAWTIMBER (10"+)				PULPWOOD (5-9")			
	MBF per acre	Basal Area per acre	Trees per acre	Value per acre	Cubic feet per acre	Basal Area per acre	Trees per acre	Value per acre
White pine*	17.9	120	87	$4,019	300	20	102	$315
Yellow-poplar	4.1	60	66	$658	899	40	84	$944
TOTAL	22.0	180	153	$4,677	901	47	118	$1,259

Non-timber vegetation / understory: holly, red maple, serviceberry, blackgum, tmas fern, grape, black birch, white ash, black oak.

Timber: A white pine plantation mixture surrounded by natural mixed pine and hardwood stand to the west and south. This unit was most likely an open moist grazing pasture that was planted to white pine in the early-1960s. The surrounding mixed pine-hardwood likely was allowed to revert to natural forest around the same time and contains white and shortleaf pines, yellow-poplar and other hardwoods. MU4 is on a toe slope with moist soil conditions and, like MU3, the soils are among some of the most productive on the property with fewer limitations based on slope. Two intermittent streams surround this unit making stream crossing for management an important consideration. Mr. <woodland owner> suggested this unit was the highest priority for management and was considering a timber sale and regeneration of the white pine unit in the near future. To make the harvest more feasible for a logger, he suggested including some of the surrounding natural mixed pine-hardwoods to the south and west, including portions of the Gerald <woodland owner> tract MU3 (please see Gerald <woodland owner> PUV plan, Jeuck, 2018). The data in the table above shows only the estimates for <woodland owner> MU4 but later will be combined with Gerald <woodland owner> MU4 for a better portrayal of the timber estimates given a harvest on both units.

Total basal area measured was close to 230 ft^2/acre with 61% of this in white pine. White pine is 67% of the sawtimber basal area. Yellow-poplar had become established on this site after the white pine was planted and had taken a considerable amount of the growing space. MU4 of the <woodland owner> tract represents the highest timber values on the properties. The average height of the dominant's crown class was around 105 feet tall (white pine) and the dbh of sawtimber trees ranged from 12" – 26" with an average approximately 14" dbh. The growth of the trees expressed as the "interest rates being grown by trees" (pgs. 1-45 of the Forester's Field Handbook) shows very slow growth. The current white pine density of 140 ft^2/acre and 136 trees/acre is considered within the range of "fully stocked" for both managed white pine (planted area). However, combined with the yellow-poplar, this stand density is very

high and no doubt contributes to the slowed growth rates. This overstocked condition and the slow growth rates suggests either a thinning or final harvest warranted in the near future.

Recommendations:

While MU4 is still not beyond the age of responding fairly well to a thinning, a final harvests of all stems (clearcut) is recommended. The soils are well suited for white pine production and so the goal would be to re-establish another white pine stand in the 7-acre area. A final harvest of MU4 could easily be accomplished in the next year or two. Access is very good and this harvest could be conducted in conjunction with a final harvest of the Gerald <woodland owner> MU4. Below is the combined estimates of the <woodland owner> MU4 and the Gerald <woodland owner> MU3 areas. Once harvested, residual tops may be piled and burned and the site replanted to white pine purchased form the NC Forest Service. There is cost share for both practices through the Forest Development Program. The <woodland owner> should contact the local NC Forest Service County Ranger for details and estimates, if any, of waiting lists for these programs.

<woodland owner> MU4 (7.2 acres) and Gerald <woodland owner> MU3 (14.1 acres) combined estimates

Species	SAWTIMBER (10"+)				PULPWOOD (5-9")			
	MBF per acre	Basal Area per acre	Trees per acre	Value per acre	Cubic feet per acre	Basal Area per acre	Trees per acre	Value per acre
Shortleaf pine	0.9	10	13	$148	138	7	34	$145
White pine*	7.5	50	35	$1,236	300	20	102	$315
Yellow-poplar	2.4	27	25	$376	300	13	28	$315
Other hardwood	0.7	13	12	$115				
TOTAL	11.5	100	84	$1,874	738	40	164	$775

Planting should be at 12'X12' spacing so Mr. <woodland owner> will not need to perform any thinning for at least 20 years (after crown closure) . At that time, a re-assessment of the stand should be performed for thinning rate estimates.

Figure 7A-E. <woodland owner> tract MU4 south facing toe slope, moist conditions in white planted area (A). Intermittent stream on the west side of <woodland owner> MU4 (B). Gerald <woodland owner> tract MU3 mixed pine-hardwood (C-E).

Timeline of Events – 5 year horizon

Year	MU	Event	Who
2019*	3,4 4	1. Light thinning MU3 (4.1 acres), timber harvest (7.1 acres), in conjunction with Gerald <woodland owner> MU3, and Jason and Catherine <woodland owner> MU1 2. Site prep / burn	1. Landowner/logger 2. Landowner / NCFS**
2020	4	1. Plant to white pine (12X12 spacing)	1. Landowner / NCFS**
2021 – 2023		1. Monitor pine establishment	1. Landowner

*Note: 2019 may not offer the best opportunity for timber removal due to weather or the economy. Some leeway should be considered when determining the best time to harvest.

**There is cost-share money through the NCFS Forest Development Program (FDP) for both site preparation and tree planting. Check with the NCFS Cherokee County Ranger for details and availability.

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