Forest Stewardship Plan for the [redacted] Property

[redacted] County, NC

April 16th, 2020

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Parcel IDs: [redacted] & [redacted]

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1| INTRODUCTION AND LANDOWNER OBJECTIVES

On March 12th, 2020, EcoForesters conducted a forest assessment of the approximately 39-acre property (Parcel IDs: [redacted] & [redacted]) owned by [redacted] located in [redacted] of [redacted] County, North Carolina (see Property Location Map, Appendix A) to create a forest stewardship plan. The purpose of this plan is to map and describe the general forest condition and set forth management actions that will improve the forest based on the landowner's objectives. The forest management objectives of the landowner are listed below:

1. Conduct ecologically-based commercial timber management to improve the health and vitality of the forest ecosystem.
2. Protect high water quality.
3. Maintain and/or increase biodiversity, improve habitat for wildlife, and protect rare & unique species.
4. Maintain and improve the forest's recreation values for hiking and nature observation.
5. Maintain aesthetic appeal.

2| PROPERTY & NATURAL RESOURCE SUMMARY

2.1 Property Description & Summary

Location & Access: The property consists of forested slopes, streams, and a small semi-wooded glade. Structures are located west-centrally and consist of two houses and a shed (see Stand Map, Appendix A). The access from [redacted] via [redacted] is the primary access to the property. Several old logging and other forest roads are still present, and many of them are still used as walking trails. While most of the existing roads would need maintenance/re-establishment to be used for future logging operations, the western steepest portion of the property is too steep and rocky for the building of logging roads. Existing roads should be used as much as possible before establishing new roads. Adjoining Parcels are mostly privately owned in the south, east, and north; towards the west, the property adjoins National Park property that is part of the [redacted]. Some houses are located close to the property on the eastern and southern edge of the property. The property is located on the southeastern slopes of [redacted], which, towards the north, connects to the [redacted] and the [redacted] while towards the south, over [redacted], the mountains fizzle out into the [redacted] periphery and mountain developments.

Terrain, Water & Soils: Situated between 2460 and 3040 feet of elevation, the property itself is located on slopes and ridges with predominantly east to southeast facing slopes. These range from mostly gently and moderately sloped (10-50+ % slope) to rather steep (60-75+ % slope) in the western corner of the property (see Slope Map, Appendix A). The general east to southeast-facing slope is intersected by several coves and ridges running southeast in the northwestern portion of the property while the

southeastern portion of the property is shaped more broadly. The 2-3 unnamed streams are tributaries to [redacted] Creek which flows into the [redacted] River which is within the [redacted] River watershed.

The soils vary from more productive in coves and bottomlands, to rocky and more nutrient-poor on upper slopes with convex topography (see Soil Reports and Soil Map in Appendix B). The steep western corner of the property is particularly rocky with several places of exposed rock as well as a small semi-wooded glade and associated rock outcrops.

Forest: The forest of the property consists of 3 main forest types: Montane Oak-Hickory Forest, Chestnut Oak Forest, and Rich Cove Forest (see Table 1). The forest types are variable in composition especially for the Chestnut Oak Forest for which a younger portion of the type (Stand 2.1) has been individually assessed. The small semi-wooded glade and small associated rock outcrop are located on the steep western section of the property and represent habitats at risk. Mild to moderate infestations of non-native invasive plants were found throughout the property (but primarily in the forests around the structures) currently posing a threat to these areas. While the diversity of forest types is due to a variation in topography, soils, and aspect, the most recent short-term impact on the forest composition has been the decline of pines primarily in Stand 2.1 due to the southern pine beetle as well as the decades of historic fire regime suppression in the drier forest types.

Table 1: Three main Forest Types were found on the property. Here they are listed with their respective acreage.

Forest Type*	Acres
1. Montane Oak-Hickory Forest	23
2. Chestnut Oak Forest	14
3. Rich Cove Forest	1
4. Non-Forest/House Site	1
TOTAL:	39

* To classify forest types, EcoForesters uses the ecological community classification system based on the North Carolina Natural Heritage Program's Fourth Approximation of Natural Community Types. (http://cvs.bio.unc.edu/pubs/4thApproximationGuideFinalMarch2012.pdf

2.2 Wildlife Habitat

There are four necessities that all wildlife requires for survival: food, water, shelter, and breeding habitat. Our management recommendations, while improving the health of the forest, they simultaneously aim to improve wildlife access to these categories as well. With them we intend to help improve year-round browse from saplings and shrubs, a greater supply of hard mast, seeds, and berries, habitat through standing and downed deadwood, along with maintaining or improving the quality of areas surrounding streams.

The property is connected to a larger section of forested land through the [redacted] and [redacted] ranges, which, primarily towards the west connects to the [redacted] Mountains and onwards to the [redacted] Mountain Range. This area towards the northeast provides the necessary wildlife corridor that ensures that a variety of species can more easily travel between the property and the greater habitat hotspot ([redacted] National Forest and all of its associated Mountain Ranges) with ample and suitable habitat

along the way. Such connectivity to larger blocks of conserved land like national or state public lands increases the ecological value of the property, substantiates its importance to the greater area, and may help attract a variety of species.

Riparian areas especially, the land surrounding creeks, streams, ponds, and other surface water occurrences, provide critical habitat for wildlife (see Photo 1). Numerous species are dependent on these buffer zones as the proximity to water creates habitats ideal for many insects, mammals, and birds among others. By creating buffer zones between the surface water and the upland forest types, healthy riparian areas are crucial for maintaining good water quality as they provide a filter for pollutants such as nutrients and sediment.

Photo 1: One of the streams on the property that represents some of the riparian habitats on the property.

A diversity of wildlife habitat on the property is represented by the three forest types, streams, as well as the small glade and associated rock outcrops. While the property is forested, the circumstances of an often thick shrub layer and a shade-tolerant midstory prevent the forest from naturally regenerating with the appropriate species composition. This will degrade the wildlife value of the forest over time as more and more valuable mast trees (such as oaks and hickories that provide acorns and hickory nuts for wildlife) fall out of the canopy. The amount of available year-round browse has also been reduced with the decades of fire-regime suppression that once forced advanced regeneration and shrubs to regularly re-sprout while increasing berry production and the abundance of grass on the forest floor. Management to sustain oaks and hickories in the overstory, establishing structural diversity for a patchwork of light dispersion, and the reintroduction of natural disturbance regimes is, therefore, crucial.

Because the property consists of a more or less continuous canopy, little early successional habitat (i.e. very young forest) was found except for Stand 2.1 where the southern pine beetle has killed the majority of overstory trees and allowed hardwoods to regenerate. As such habitats provide shelter and food sources for wildlife, they also increase wildlife diversity and abundance. Coarse woody material was observed in abundance in Stand 2.1 as a result of fallen trees killed by the southern pine beetle as well as in the form of some uprooted trees on and around the glade that fell likely due to thin soils. However, though some was observed, there is also a lack of over-mature trees and snags which, alike coarse woody material, can provide important habitat for birds, small mammals, and amphibians. With the increased

abundance of small mammals, birds, and insects, their natural predators are also drawn to the area which again increases the species diversity. Additionally, controlled burns of the understory would increase the herbaceous layer offering increased forage for wildlife.

Signs of several species were observed on the property including scat of deer and bears, though countless other species are likely present as well including raccoon, opossum, eastern cottontail, squirrels, and more. It may also be possible that protected timber rattlesnakes are present in and around the rock outcrop in Stand 2.2.

Photo 2: The small semi-wooded glade and associated small rock outcrops that could be home to some uncommon plant and animal species.

At-Risk habitat: The glade and associated rock outcrops (see Photo 2), though small, represent an at-risk habitat that is quickly disappearing around these mountains. While this habitat may shelter several animal species, it also provides space to grow for several uncommon plant species that depend on habitats such as these. Plants observed on the day of the inventory in the off-season include Heuchera sp. and Micranthes sp.. The, in North Carolina, threatened plant, [redacted] was also observed during the property inventory. Other protected species that have been documented by the North Carolina Natural Heritage Program (NCNHP) to be present within a radius of one-mile around the property include eastern [redacted] and [redacted]. Under circumstances, these species could also find growing habitat on this property if it is appropriately managed. Other species documented by the NCNHP in this one-mile radius include the [redacted] and [redacted] along with several at-risk natural communities.

2.3 Management History

The forest was heavily cut, probably mostly clear-cut, around the turn of the 20th century, as was much of the Appalachians. Some steep, rocky and hard to access places may have remained undisturbed since then possibly leaving a scattering of older trees of 100+ years old. In the decade of and after the chestnut blight (in the mid-1930s until 1950), another round of pre-emptive or salvage logging may have gone through to harvest the chestnuts while they were still sound, and at the same time harvested other valuable timber as well. These harvests were probably heavy “high-grade” cuts that removed all the biggest, best formed, and most valuable trees. This kind of harvest is usually implemented as a “diameter limit” cut still today (i.e. cut all commercially valuable trees above a certain diameter, usually about 16

inches) and often euphemistically called a “selective” cut. This type of harvest typically reduces the diversity and quality of the forest by removing the fittest trees – and their genetics – from the stand.

The property was likely most recently logged in those aforementioned harvests between the 1930s and the 1950s. Some of the area near and around the house may have gotten harvested more recently.

In about the last 70 years most of these forests have not seen any logging (except for some occasional extraction by the landowners themselves within the last 30 years) and, therefore, for the most part, have had a more or less continuous canopy in place for decades. They exhibit a rather even-aged forest structure. The exception is the area of Stand 2.1 where the southern pine beetle killed much of the pine overstory (recently before 2005) leaving young forest to regenerate and introducing vital structural diversity to the forest. Much of the forest on this property is dominated by Chestnut Oak and Montane Oak-Hickory Forests which historically have benefited from fire. The most ongoing impact on the greater forest composition has, therefore, been a history of fire suppression that has led to an increase in fire-intolerant species and a decrease in fire-tolerant species shifting the forest away from its historic composition. In addition, it has increased the density of the understory and midstory which has increased the fuel accumulation on the forest floor over many decades; this may cause hotter fires if burned at an inappropriate time such as periods of a long drought.

2.4 Invasive Species

Non-Native Invasive Plants:

Non-native invasive plant species are present and include the high priority species Oriental bittersweet, multiflora rose, miscanthus, and Japanese spirea as well as moderate to lower priority species such as periwinkle, Wineberry, and Japanese Knotweed (see **Invasive Species Severity Map and Severity Definitions** in Appendix A for details).

Moderate infestations were observed on the western edge of Stand 4 to Stand 1.2 as well as in Stand 2.2 on its eastern edge to Stand 1.2. Both of these infestations are primarily caused by Oriental bittersweet but also by other species such as multiflora rose and Japanese spirea. The growth and regeneration of the understory, shrub layer, and advanced regeneration has been impacted and larger seed-producing Oriental bittersweet vines are present in the canopy. Japanese spirea has a heavy presence in the shrub layer while multiflora rose is also scattered throughout.

Mild infestations of Oriental bittersweet, Japanese spirea, and multiflora rose were observed around the center of the property that includes recently disturbed areas with higher light levels, as well as moist areas such as along the streams and the wetter forest types. This includes Stands 1.2, 3.1, 3.2, the eastern portion of Stand 2.2, the southern portion of Stand 2.1, and the edges of the Non-Forest Area 4. See Photo 3 for an example.

Occasional infestations will not be described in detail (nor will be included in Table 2). On the Non-Native Invasive Severity Map in Appendix A, these areas are marked as ‘Occasional’ due to the observation of scattered invasive species, their proximity to larger infestations, and/or the potential for scattered invasive plants to be present. At the same time, we do not exclude the possibility of areas marked as not having an infestation to be entirely free of non-native invasive species.

Please review EcoForesters' **Non-native Invasive Species Severity Definitions** on the back of the **Non-native Invasive Species Severity Map** in Appendix A for details on how we determined the appropriate severity for each infestation.

Table 2: The Risk of Individual Invasive Species Spreading & Causing more Ecological Damage by Stand

Species	**High**	**Medium**	**Low**
Oriental Bittersweet	1.2, 2.2, 2.1. 3.1, 3.2	4	
Multiflora Rose	1.2, 2.2, 2.1, 3.1, 3.2,	4	
Miscanthus		4	
Japanese Spirea	1.2, 2.2, 3.1, 3.2,	4	
Periwinkle			4
Wineberry		3.1	
Japanese Knotweed			4

Table 2 lists the non-native invasive species found on the property by stand and categorizes them based on their threat to the surrounding forests. This was also used in determining the management actions in respect to the invasive species.

The invasive species will likely continue to spread to and become more severe in areas where the soil is more productive such as along streams. From these areas, they will spread, though generally somewhat slower, to either side into the drier and less productive forest types. Invasive species will also continue to spread in areas where disturbance has occurred as light conditions there are favorable and the soil often has been more exposed for better germination of seeds.

Because the high priority species Miscanthus is present on the property only at a single very low infested location (Area 4) in low abundance and nowhere else on the property, we, therefore, highly recommend the complete eradication of the species. By eradicating the species early on it may be possible to prevent its establishment in other forest edges and penetrate the forest with future disturbance and potential controlled burns. This could allow the landowner to focus on the control and monitoring of other species present instead.

Oriental bittersweet is one of the greatest threats to southern Appalachian forests as it is shade-tolerant and can climb up, overtop, and eventually kill mature healthy trees. It can, therefore, take over and destroy entire portions of the forest if not actively controlled. This species should be the highest priority species to treat.

It is a high priority to treat these mild to moderate infestations before they spread and become much harder to control. It is always easier, and cheaper, to control non-native plants earlier than to wait to respond to increasingly worse infestations. For sustainable forest management, it is also essential to control these non-native invasive plants well before *and* after any harvesting or other disturbance is planned. The longer ahead of any harvest that invasive plants are controlled, the more it will help reduce invasive species population growth and establishment. Seeds of invasive plants that can germinate several

years later may still be present in the seed bank and will readily germinate should high-light conditions arise and soil disturbance occur.

We, therefore, require that any seed-producing plants along with Oriental bittersweet, multiflora rose, and Miscanthus on the property be controlled within a period of 5 years between 2020-2025 to control these species down to the mild to occasional level. The next 10 years (2025-2035) are then required to be used for follow-up treatments and monitoring to ensure as few invasive species present as possible. At the beginning of these 10 years, the lower priority species (Japanese spirea and wineberry should also be controlled.) We also recommend the control of the Japanese knotweed and periwinkle within this time period. Additional monitoring and follow up treatments should be conducted every few years and especially before any planned disturbance. Otherwise, increased disturbance (such as a harvest or a controlled burn) would create more growing space for the invasive plants while, at the same time, allowing in more sun to stimulate new growth.

Photo 3: A mild infestation of Oriental bittersweet that is common throughout the property. Notice the vine climbing up a young tree, the first step of strangling it and shading out its crown.

If uncontrolled for extended periods, these invasive plants would prevent native trees from regenerating and seriously compromise the future forest ecologically and economically.

General Recommendation: We recommend following EcoForesters' 7 Ps that provide a guideline on how to address invasive problems in an orderly progression to ensure the most effective rate of their control (see **Appendix C for more information on the 7 Ps).** In general, EcoForesters recommends starting invasive control on the outer edges of the infestation, especially the higher elevation areas (or at the upstream parts of the creeks) and working down and inward toward the center of the infestation to control their spread. Also, any seed-producing plants should be targeted first as some invasive seeds are viable for several years. Therefore, ongoing control and monitoring are essential. These treatments would come at a cost to the landowner but would help maintain forest biodiversity and health, as well as increase the future income-potential of the forest. See the forest type-level recommendations for specific treatments. EcoForesters can help plan and execute this work. More information on the species and control methods can be found in the management section of each forest type, in Appendix C, or visit our

website for info on our invasive species control services (https://www.ecoforesters.org/services/invasive-species-control-crew/).

Non-Native Invasive Insects:

A few individual American ash trees were observed on the property. Ash trees are currently under attack from the Emerald Ash Borer (EAB) as the insect has reached our area and already has destroyed large areas of ash trees. Should the owner desire to retain this species of tree, it is recommended to treat trees still in good health for a treatment to be effective. Early treatment is key because it may already be too late to treat trees showing signs of decline from EAB. Because of seasonality, it was difficult to assess the health and therewith the treatability of the trees.

The loss of Ash in this area is the result of the continued introduction of pests and disease into forests around the world. The process of occasional tree death is natural and contributes greatly to the process of stand dynamics. It creates small canopy gaps for advanced regeneration to grow into and provides standing deadwood for wildlife that eventually falls to become coarse woody material. However, the loss of an entire species over the forest landscape is not natural. If untreated, the species will likely be lost from this forest though some seedlings and saplings may persist (as are present on this property). The Emerald Ash Borer generally moves through the landscape killing all ash within 5-6 years when the insect tends to leave the area. It is, therefore, possible to renew the species' presence in the forest by treating still healthy enough ash trees to retain the species in the current canopy that can act as a future seed source. More information on EAB and treatment methods can be found in Appendix D.

3| FOREST RESOURCES & STEWARDSHIP

In consideration of the forest management history, current conditions, and the landowner's objectives, EcoForesters, in consultation with the landowner, suggests the management actions as follows.

Plan Summary

These tables (Tables 3-4) will serve as a summary of the forest conditions and management recommendation which will be put forth and further described, by Forest Type, in the following sections.

Table 3: Management Actions by Forest Type (FT) | Forest Stand Improvement (FSI)

Forest Type / Stands	Suggested Management Action	Target Date	Cost/ Revenue	Requirement
All Forest Types	Control higher risk non-native invasive species down to the occasional level and focus on seed-producing plants.	2025 (5 years)	Cost[1]	Required for PUV
All Forest Types	Continued monitoring for invasive species in particular at high-risk locations and control of lower priority species.	2025-2035	Cost[1]	Required for PUV
Area 4	Eradicate the infestation of Miscanthus	2025	Cost[1]	Highly Recommended[+]
FT 1 & FT 2	Consider implementing controlled burns at about 3 - 10-year intervals once invasive plants have been controlled.	Whenever possible	Cost[1,2]	Recommended[+]
Stand 2.1	Conduct FSI crop-tree release work.	2020-2025	Cost [1]	Recommended[+]
FT 1 & FT 2	Conduct midstory removal FSI work by cut-and-leave/hack-and-squirt treatments in combination with controlled burns.	4-7 years before a harvest	Cost[1]	Recommended[+]
Stand 1.1 (and other Stands if accessible / profitable)	In accessible parts of stands, we recommend crown thinning harvests.	2030 – 2035	Some Revenue	Recommended[+]
FT 1, FT 2 & FT 3	In accessible parts of stands, we recommend group selection, Femelschlag, crown thinning[(FT 1, 3)], & shelterwood[(FT 1, 2)] harvests.	2040 - 2050	Some Revenue	Required for PUV
All Forest Types	Monitor proper stand re-initiation, invasive plant & grapevine problems, as well as erosion issues (immediately) after any harvest or major disturbance.	After 1-2 growing seasons	Cost [1]	Highly Recommended[+]

Table 3 (continued) Management Actions by Forest Type (FT) | Forest Stand Improvement (FSI)				
Forest Type / Stands	**Suggested Management Action**	**Target Date**	**Cost/ Revenue**	**Requirement**
All Forest Types	Conduct crop tree release FSI work after any harvest or major disturbance.	5-15 years after harvest.	Cost [1]	Recommended[+]
FT 3 (& Wherever Found)	Treat healthy ash if desired.	*Before* trees show decline.	Cost	Optional
Non-Forest	(1) Convert edges and powerline ROW to native grassland/wildflower meadow. (2) Feather field-to-forest ecotone with shrubs.	No Target Date	Cost	Optional[+]
Entire Property	Reassess forest in an updated stewardship plan.	2030	Cost	Required for PUV

[1] Cost-share assistance may be available from the NRCS for this pre-commercial treatment through EQIP (see Appendix D).
[2] Controlled burning cost and liability may be fully absorbed through a federal program administered by NCFS.
[3] Cost-share assistance could be available for this action from the NCFS Forest Development Program (FDP) (see Appendix D).
[+]These optional treatments may benefit forest health and diversity but come at a cost to the landowner so are not required.

To protect water quality, extra care must be taken around any surface water or wetland areas in all stewardship actions. Therefore, buffers, called streamside management zones (SMZs), must be established at least 50 feet from any surface water and all forestry best management practices (BMPs, http://ncforestservice.gov/water_quality/bmp_manual.htm) must be rigorously met, or exceeded, to minimize ground disturbance in these areas particularly. Still, there are many other BMP recommendations that must be followed: they are critically important for avoiding liability for impacting water quality, such as stable road and skid trail layout, construction, and the final stabilization at the end of management activities.

Table 4: Basal Area (sqft) per acre by diameter class (DBH) and Forest Type									
Forest Type	<4"	4-8"	8-12"	12-16"	16-20"	20-24"	>24"	Total BA	Acres
FT 1: Montane Oak-Hickory Forest	4	30	50	52	20	6	-	162	23
FT 2: Chestnut Oak Forest (except Stand 2.1)	3	33	10	30	30	13	3	120	6
FT 2: Stand 2.1	50	33	27	-	-	-	-	113	8
FT 3: Rich Cove Forest	-	20	55	35	25	10	5	150	1

Forest Type 1: Montane Oak-Hickory Forest (23 acres)

Photo 4: The Montane Oak-Hickory Forest was rich in white oak as well as other oak in the overstory along with a large amount of yellow-poplar in some locations. However, little advanced oak and hickory regeneration was observed.

Description of Typical Forest Type: Montane Oak-Hickory Forests are unique in that white oak, which competes best only in very specific sites, is a significant component, though it is uncommon to see forests with this characteristic today on private land. As white oak is one of the most valuable trees in the mountains, it was often targeted for harvest during logging events over the past century reducing the species' presence in the forest. This forest type is found predominantly on upper to middle slopes and ridges below 4000 feet in elevation. They occur on moderately productive soils on the less steep slopes which can hold some moisture but are also subject to dry periods. These sites are more xeric (dry) and with less productive soils than found in Rich Cove Forests, but more mesic (moist) and more productive than Chestnut Oak Forests. The generally common white oak in the overstory is complemented by a mixture of other oaks, hickories, and pines. The shrub layer may often have components of mountain laurel.

Historically, a fire regime has been an integral part of managing these oak-dominated forest types in the Southern Appalachians by controlling shade-tolerant and fire-intolerant species such as red maple, sourwood, and others for the benefit of oaks, hickories, southern yellow pines, and the herbaceous ground layer.

Forest Type on the Property: On this property, Montane Oak-Hickory Forests occur on the broader slopes of low to medium steepness of the entire southeastern portion of the property (Stand 1.1), some of the areas surrounding the streams in the northwest of the property (Stand 1.2), as well as a small corner in the north of the property. While the slopes are generally mild, the aspect is primarily east to southeast facing.

Table 5: Stand Acreages

Stand 1.1	17 acres
Stand 1.2	5 acres
Stand 1.3	1 acres

Notable parts of the stand include some areas in the center of Stand 1.2 just southwest of where the streams flow together where the slope turns relatively flat and the shrub layer is dominated by spicebush representing a more mesic and alkaline portion of the forest.

As the entire forest was likely clear-cut 70-90 years ago or, at least in part, used as pasture, the generally typical Montane Oak-Hickory Overstory is heavily co-dominated by yellow-poplar.

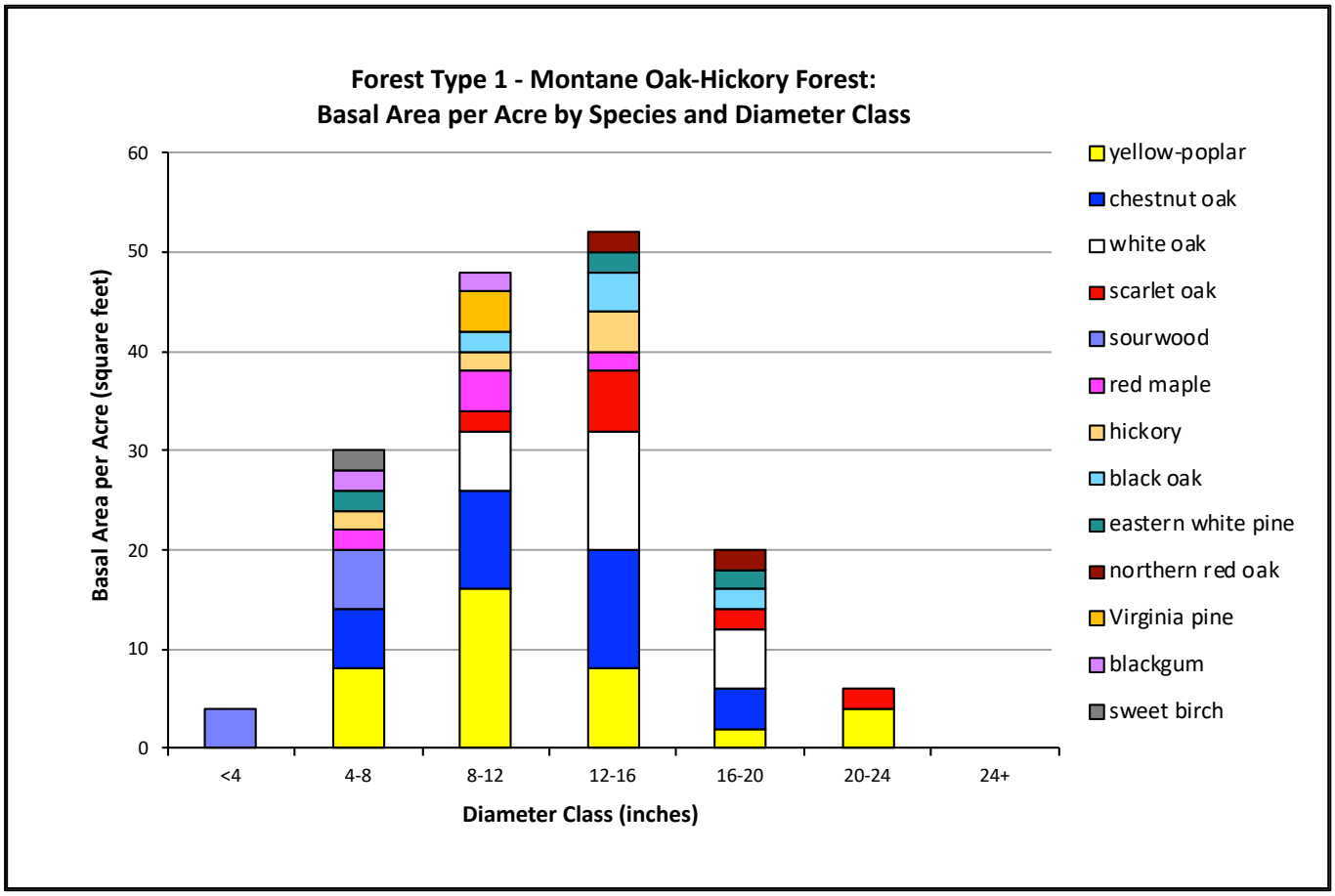


Figure 1: Only a very small amount of the average basal area of 160 square feet per acre is composed of oaks, yellow-poplar, white pine, and hickory with merchantable diameters between 16 and 24 inches at breast height.

Composition & Resources: The overstory is dominated by chestnut oak, white oak, and yellow-poplar. Other species include scarlet oak, black oak, red maple, as well as scattered hickory, eastern white pine, Virginia pine, northern red oak, and blackgum. The midstory is dominated by sourwood, red maple, white pine, American beech but also dogwood, blackgum as well as scattered sweet birch and black cherry. The shrub layer is sparse but, where present, composed of scattered mountain laurel, rosebay rhododendron, and greenbrier. The advanced regeneration is sparse, but where present, is primarily composed of red maple, blackgum, sourwood, white pine, and American beech, as well as more scattered sassafras, eastern red-cedar, hickory, chestnut oak, and American holly. Characteristically, Stand 1.2 is

more variable in composition while having a greater component of spicebush in its southwestern portion. Stand 1.1 is more uniform in composition with a drier shrub and herb layer.

Only a very small amount of the average basal area of 160 square feet per acre is composed of oaks, yellow-poplar, white pine, and hickory with merchantable diameters between 16 and 24 inches at breast height. However, some of the smaller diameter yellow-poplar (down to 14 inches DBH) could also have some economic value if sold to the right mill. Smaller diameter classes have a much larger basal area per acre but, except for the 12-16-inch diameter class, are heavier in yellow-poplar with less chestnut oak, white oak, and scarlet oak. The 12-16-inch diameter class has a significant amount of white oak, chestnut oak, and scarlet oak that could benefit from a crown release. The current overstory, though dominated by valuable species, is not yet stocked with enough volume to justify the removal of merchantable logs. As yellow-poplar on average grow at about 2.5" in diameter per decade (and oaks generally grow slower than that), it will take about 10 years for enough of the trees to reach an appropriate size to be of merchantable value. The smaller diameter classes, as they currently stand, however, are not in a position to replenish a Montane Oak-Hickory Forest composition of the overstory after a future harvest. Similarly, there is not enough oak and hickory advanced regeneration to accomplish this replenishment after a harvest either.

The threat of invasive species is mild in the majority of the area. Stand 1.1 is largely without such infestations so care should be taken to not introduce invasive species into this portion of the property by causing disturbance to the stand before invasive species have been controlled in the stands around it.

Succession & Ecology: The abundance of mature oak is ecologically beneficial for many reasons such as forest health, ample hard mast for wildlife, and a good prospect for regenerating oaks with proper management actions. These stands are currently succeeding from the Stem-exclusion to the Understory Re-Initiation phase of forest succession.

The high component of yellow-poplar in the forest overstory in addition to a continuous canopy suggests that much of the area of these stands likely regenerated from pasture, grazing, or a clear-cut 70-80 years ago. Over time, some of the yellow-poplar, not as well-suited for these somewhat drier conditions will begin to decline allowing for subordinate and intermediate oaks to advance into the upper canopy. However, this process may occur too late for oaks, which may also have begun their decline due to the competition in the canopy. This, in turn, would allow for advanced regeneration in the under and midstory to advance. As the shade-tolerant red maple and sourwood are dominant there, the forest would slowly shift towards a red maple-dominant species composition. Without active management, such as a prescribed fire (or mimicking disturbance), or significant natural disturbance, shade-tolerant red maple, sourwood, white pine, and beech will increase at the expense of shade-intermediate species such as oaks and hickories as well as shade-intolerant species such as yellow pines (most of which are more valuable both economically and ecologically than red maple and sourwood). However, this process could only fuel the establishment of the non-native invasive species already present in some of these or neighboring stands if those are not controlled. The threat of non-native invasive species in many of these stands is posing a significant risk to the future health and resilience of the forest. See Section 2.3 and the Invasive Species Severity Map in Appendix A for details. If left to fend on its own, the natural ecological process described above could affectively halt the natural process of forest regeneration, leaving the forest in an unhealthy state with a transition towards a dominance of invasive shrubs and vines.

Management Recommendations:

The goals for these stands are to actively manage the forest to return it to its historical Montane Oak-Hickory composition. Practically this means to increase the amount of oak, hickory and pitch pine present in the overstory, midstory, and advanced regeneration. While a diversity of oaks, hickories, and pitch pine are important, the focus should be on white, northern red, and black oak. At the same time, red maple, sourwood, white pine, and American beech should be limited from the midstory and advanced regeneration by providing conditions (or mimicking techniques) that allow oak and hickory to compete better. Because a continuous canopy has been in place for decades without the natural process of gap-phase dynamics allowing more light to the forest floor, the forest could be on track of transitioning to more shade-tolerant species that thrive in the current shady conditions. Management should mimic gap-phase dynamics and historic fire disturbance regimes should be reinstalled for the goal to once again re-establish a multi-aged forest dominated by diverse oak and hickory in the overstory.

Recommendation 1: ***Invasive Control*** *[Required for PUV]* Treat all plants (especially those that are seed-producing) of Oriental bittersweet, multiflora rose, Miscanthus, and Japanese spirea on the property within a period of 5 years between 2020-2025 to control these species down to the occasional level. The following 10 years are then required to be used for follow-up treatments and monitoring to ensure as few invasive species present as possible. At the beginning of these 10 years, the lower priority species (periwinkle and Japanese knotweed) should also be controlled. Additional monitoring and follow up treatments should be conducted every few years and especially before any planned disturbance. Before a future harvest, non-native invasive species should only be present at the occasional to mild level (species dependent).

Recommendation 2: ***Prescribed Fire*** *[Recommended +]* Consider using controlled burns for stands in this forest type to reduce red maple, sourwood, and white pine regeneration (once invasive species have been controlled). This practice would promote oaks and hickories and prepare the forest floor for their regeneration. With hotter fires, midstory maples and yellow-poplar could also be reduced allowing more light to reach establishing oak regeneration. Growing season fires, especially in early spring and at about 3 to 10-year burn intervals, would be most beneficial for removing competition from oak regeneration.

Periodic burns would also be beneficial *following* a future harvest. Burning to remove the less-desired competition from the desired oak and hickory regeneration after a harvest should be conducted when advanced regeneration has reached about 1-2 inches diameter at the base or when most appropriate after consulting with a forestry or controlled burn professional. Potential damage to timber quality and revenue should be noted if too hot burns are conducted in accessible portions of the forest *before* a harvest.

Though controlled burning could be challenging due to difficulties of fire line establishment access, the landowner could investigate opportunities for prescribed fire with the NC Forest Service if interested (other local burn crews could also be pursued). Should the property be within 10 air-miles of US Forest Service land, the cost and liability of a controlled burn might even be absorbed by the NC Forest Service through the Community Protection Plan (https://www.ncforestservice.gov/fire_control/fc_cpp.htm). Funding for controlled burns is also available through the NRCS Environmental Quality Incentive Program

(EQIP). See Appendix D for more information on the benefits of controlled burning as well as information on EQIP.

Recommendation 3: ***Midstory Removal FSI*** *[Recommended +]* Midstory removal forest stand improvement work through the elimination of the shade-tolerant red maple, sourwood, and white pine would ensure the regeneration of ecologically and economically more valuable tree species (oak & hickory) in the better-suited light-conditions for an impending harvest. This can be achieved through a cut-and-leave or hack- and-squirt treatment of very tall advanced regeneration and up to 8" - 10" DBH suppressed trees of the species mentioned above. Controlled burns may also be used to kill smaller stems or reduce re-sprouts of those already cut (see Recommendation 2). While the hack-and-squirt method will prevent the less-desired stems from re-sprouting through chemical means, the cut-and-leave method, if followed by a controlled burn 1-3 years after completion, could achieve similar results. These treatments should be carried out in locations where oak and hickory seedlings and small saplings are already present but overshadowed by the species to be cut. Such treatments could be conducted before or 2-4 years after a burn and ideally 5-10 years before a harvest. This will increase the regenerative success of oak and hickory as they will be able to establish in the years after a burn (if not already present) and further solidify their presence in the stand.

Recommendation 4: ***Harvest – Crown Thinning*** *[Recommended+]* After one or two returns of prescribed fire (Recommendation 2), some of the trees may have reached a big enough diameter at breast height to make a crown thinning harvest profitable between 2030-2035. During this harvest, target trees that are of poor form and vitality (mostly remove yellow-poplar) while inversely selecting the most vital, healthy, and vigorous trees for release (especially diverse oak and pitch pine, but also hickory). This would speed up the growth of the remaining trees that were selected making them increasingly valuable both ecologically and economically. This could increase the value of the trees for the next harvest (Recommendation 5) while also introducing enough light onto the forest floor to spur the regeneration of oaks and herbaceous species. This harvest could be conducted simultaneously with a Midstory Removal treatment (Recommendation 3) and predominantly applies to Stand 1.1. It should be conducted at least 10 years before the harvest outlined in Recommendation 5.

A prerequisite for this recommendation is to control invasive species as described in Recommendation 1, though it could occur earlier than suggested in this recommendation IF non-native invasive species are controlled at a faster pace than required.

Recommendation 5: ***Harvest*** *[Required for PUV]* In accessible portions of the forest type we recommend shelterwood, Femelschlag (see Glossary for definition), and/or group selection (0.25 to 2 acres) harvests between 2040 and 2050. This would create small canopy gaps promoting early successional habitat and the regeneration of oak species. Oak regeneration would be most successful if the harvests are combined with controlled burning (see next recommendation) to reduce competition from shade-tolerant species within the establishing advanced regeneration. Commercial harvests should be conducted in accessible parts of the stands when adjacent stands are being harvested. During harvests, a variety of healthy oak species and hickory should be left while removing red maple and yellow-poplar

combined with some harvest of the oak and hickory basal area. The residual BA for shelterwood harvests should be between 40 and 60 square feet per acre.

A prerequisite for this recommendation is to control invasive species as described in Recommendation 1, though it could occur earlier than suggested in this recommendation IF non-native invasive species are controlled at a faster pace than required.

Recommendation 6: ***Post-Harvest FSI*** *[Recommended +]* Conduct Forest Stand Improvement work 5-15 years after any harvest favoring species diversity but especially oak (particularly white, northern red, and black oak), hickory, and pitch pine by the removal of competing red maple, yellow-poplar, sourwood, blackgum, white pine, and Virginia pine. This work increases the species diversity and richness across the forest type by reducing the less-desired competition from ecologically and economically desired species. While oak, hickory, and yellow pines should be focused on in these actions, other species of high ecological value may also be favored. Similar outcomes may be achieved by conducting controlled burns with the right conditions (as mentioned in Recommendation 2).

As part of this improvement work, also control invasive plant species that may have come up as part of harvesting operations.

Forest Type 2: Chestnut Oak Forest (14 acres)

Description of Typical Forest Type: Chestnut Oak Forests are found on dry sites, predominantly ridgelines, and exposed convex slopes. Given their topographical position, soils here tend to be drier, rockier, thinner, and lower in nutrients; this subsequently causes slower tree growth. However, these are also the sites where slower-growing, more drought-tolerant trees like oaks and hickories can compete best. Generally, these forests are dominated by chestnut oak with a co-dominance of scarlet oak, black oak or northern red oak and may include just as large components of sourwood, black gum, and several other scattered tree species in the over- and midstory. The understory can be composed of dominating rosebay rhododendron, mountain laurel, or an herb layer instead of shrubs.

Photo 5: An image of the Chestnut Oak Forest in Stand 2.2 above the glade. The forest type in Stand 2.3 is denser with mountain laurel and rhododendron in the shrub layer and Stand 2.1 is composed of smaller diameter trees with a different species composition.

The Chestnut Oak Communities are fire-adapted systems. They were regularly burned for thousands of years by both Native Americans and naturally occurring fires. This process reduced competition for fire-adapted oak and yellow pine species from non-fire-adapted shade-tolerant species such as red maple, sourwood (when young), and white pine that often crowd the understory's advanced regeneration. Some hotter fires also created small canopy gaps (as did storms and ice) by killing fire-intolerant species in the overstory, such as red maple, which in turn allowed the surviving fire-tolerant oak and others to establish into advanced regeneration and thrive in better light conditions.

Forest Type on the Property: On this property, Chestnut Oak Forests occur on the steep east-facing slope in the west of the property (Stand 2.2), the broad north-central ridge facing to the southeast (Stand 2.1), and the northeast-facing slope to the north of it (Stand 2.3). The two latter stands are much more gently sloped than the first.

Table 6: Stand Acreages

Stand 2.1	8 acres
Stand 2.2	3 acres
Stand 2.3	3 acres

The small semi-wooded glade and associated small rock outcrops are notable portions of stands in this forest type.

Though not much management has occurred in Stands 2.2 and 2.3, Stand 2.1 has been heavily impacted by the death of overstory pine species as a result of the southern pine beetle outbreak there about 20 years ago. This has significantly affected the stand's species composition and structure and will, therefore, be treated somewhat separately from the rest of the stands.

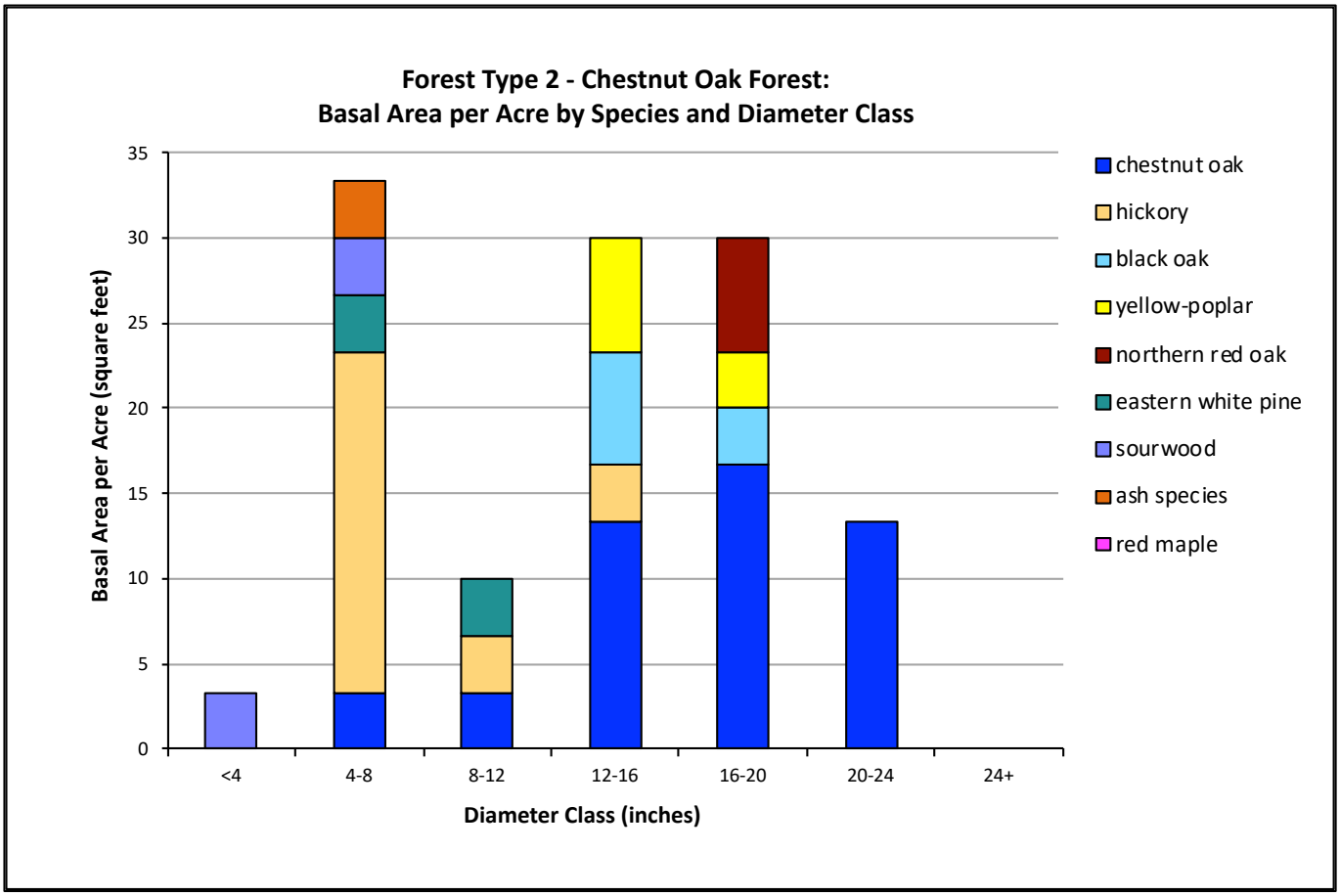


Figure 2: About one-quarter of the average basal area of 120 square feet per acre (for Stands 2.2 & 2.3) is composed of chestnut oak (and some northern red & black oak) with merchantable diameters between 16 and 24 inches at breast height.

Composition & Resources: The overstory is dominated by chestnut oak. Other species include black oak, northern red oak, and yellow-poplar, as well as scattered hickory, scarlet oak, and occasional elm (Stand 2.2) and post oak (Stand 2.3). The midstory is primarily composed of hickory, along with lesser amounts of white pine, sourwood, yellow-poplar, black cherry, sassafras, blackgum, and ash. The Shrub layer in Stand 2.2 is composed of maple-leaf viburnum, serviceberry, greenbrier, Japanese spirea, as well as scattered spicebush and Allegheny chinquapin. In Stand 2.3, the shrub layer is characteristic of more of a Dry Heath Chestnut Oak Forest Subtype with larger amounts of mountain laurel and rosebay rhododendron, but also azaleas. While Stand 2.2 has little advanced regeneration aside from mulberry,

ash, and the occasional oak sapling, Stand 2.3 does not have a large amount of advanced regeneration aside from abundant white pine along with occasional maple and sourwood.

Stand 2.1, on the other hand, is very different from the latter two stands (see Figure 3). It is composed of yellow-poplar, red maple, scarlet oak, chestnut oak, and sourwood in the overstory. Other species there include scattered northern red oak, hickory, pitch pine, Virginia pine, and black cherry. The midstory is composed of a similar composition as the overstory but more white pine, and red maple. Along with some scattered mountain laurel, occasional rhododendron, and blueberry in the shrub layer, the advanced regeneration here is thick with white pine, red maple blackgum, sourwood, and American holly. Lots of dead, fallen, and decomposing pines are on the forest floor as coarse woody material.

About one-quarter of the average basal area of 120 square feet per acre (for Stands 2.2 & 2.3) is composed of chestnut oak (and some northern red & black oak) with merchantable diameters between 16 and 24 inches at breast height. The up-and-coming diameter class of 12”-16” at breast height has similar amounts of chestnut oak but more black oak and yellow poplar. Smaller diameter classes have a lower basal area per acre with significantly more hickory while at the same time significantly less oak in addition to increased white pine (in Stand 2.3). The current overstory is stocked with enough volume to justify the

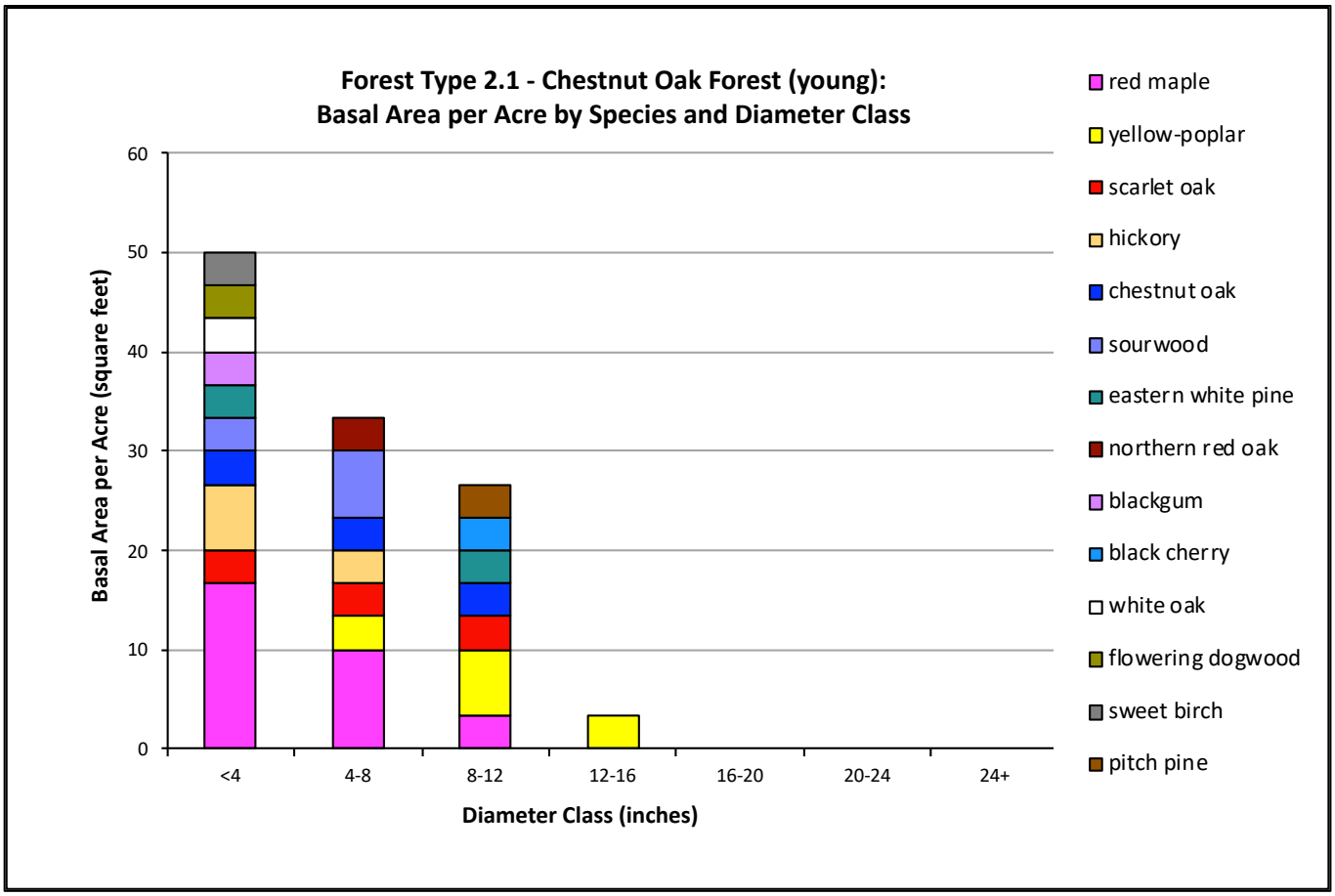


Figure 3: In general Stand 2.1 has trees of significantly smaller diameters with an average basal area of 113 square feet at DBH. The current overstory of this stand is therefore not stocked with enough volume for the removal of merchantable logs in the near future.

removal of merchantable logs in 5-15 years (though a harvest should wait until neighboring stands are being harvested to make the harvest profitable and more ecologically beneficial and to wait until non-native invasive species have been controlled). The smaller diameter classes, as they currently stand, however, are not in a position to replenish a Chestnut Oak Forest composition of the overstory after a future harvest. Similarly, there is not enough oak and hickory advanced regeneration to accomplish this replacement after a harvest either.

Stand 2.1, in general, has trees of significantly smaller diameters with an average basal area of 113 square feet at DBH. The current overstory of this stand is therefore not stocked with enough volume for the removal of merchantable logs in the near future.

Photo 6: Notice the smaller diameter trees in this picture representing the composition of Stand 2.1.

Succession & Ecology: For Stand 2.2 & 2.3, the abundance of mature oak is ecologically beneficial for many reasons such as forest health, ample hard mast for wildlife, and a good prospect for regenerating oaks with proper management actions. These stands are currently succeeding from the Stem Exclusion to the Understory Re-initiation phase of forest succession. This transition is evidenced by occasional canopy gaps and a relatively dense midstory as well as the creation of Stand 2.1 as a larger but natural canopy gap. Over the next several decades, more trees will fall out of canopy due to increased competition, limited resources for growth, and, at times, disease (as was the case for Stand 2.1). This will cause more light to reach the mid- and understory allowing the growth of a younger age class of trees and a densening shrub layer due to the absence of fire. The ingrowth of younger trees creates multiple age-classes which normally increases vital structural diversity and subsequently increases biological diversity. For Stand 2.3 it is of particular concern that the dense rhododendron and mountain laurel cover causes deep-shade and impedes regeneration in the understory while additionally causing the gradual succession of stands to more shade-tolerant species such as red maple, sourwood, blackgum, and white pine. Red maple, sourwood, white pine, and blackgum dominance in the midstory and the smaller diameter classes signifies the species will occupy a significant portion of the future forest should the current ecological processes persist. Without active management or significant natural disturbance, those shade-tolerant species will increase at the expense of shade-intolerant species such as yellow pines as well as shade-intermediate

species such as oaks and hickories (most of which are more valuable both economically and ecologically than red maple and sourwood).

For Stand 2.1, the abundance of oak is ecologically beneficial for many reasons such as forest health, future hard mast for wildlife, and a good prospect for regenerating oaks with proper management actions. This stand is currently succeeding from the Stand Initiation Phase and is within the Stem Exclusion phase of forest succession. Red maple, sourwood, and yellow-poplar's co-dominance in the canopy and in the smaller diameter classes, along with white pine in the midstory, signify that these species will occupy a significant portion of the future forest should the current ecological processes persist. Without active management or significant natural disturbance, red maple, sourwood, yellow poplar, and white pine will outcompete the oaks and hickories that are present.

There is a threat of non-native invasive species in many areas of these stands (Particularly Stands 2.2 & 2.1) posing a significant risk to the future health and resilience of the forest. See Section 2.3 and the Invasive Species Severity Map in Appendix A for details. If left to fend on its own, the natural ecological process described above could eventually halt the natural process of forest regeneration, leaving the forest in an unhealthy state with a transition towards a dominance of invasive shrubs and vines.

Management Recommendations:

The goal for this forest type is to have the advanced regeneration and the midstory be more reflective of the overstory. A variety of oaks (especially chestnut, white, northern red, post, and black oak), hickory, as well as pine (where present in the overstory) should be promoted in the understory. To achieve this, methods mimicking natural disturbance regimes of gap-phase dynamics should be implemented and natural fire regimes of periodic burns re-established. While mimicked gap-phase dynamics will improve the light-conditions for oak regeneration and once again introduce uneven-aged structural diversity to the forest, the burns will improve the forest floor for the establishment of oak (as well as pines where present) and promote their advancement into the mid- and overstory. Shade-tolerant red maple and other fire-intolerant species such as yellow-poplar and young sourwood will be reduced and prevented from chocking the midstory. The shrub layer will also be reduced.

Recommendation 1: ***Invasive Control*** *[Required for PUV]* Treat all plants (especially those that are seed-producing) of Oriental bittersweet, multiflora rose, Miscanthus, and Japanese spirea on the property within a period of 5 years between 2020-2025 to control these species down to the occasional level. The following 10 years are then required to be used for follow-up treatments and monitoring to ensure as few invasive species present as possible. At the beginning of these 10 years, the lower priority species (periwinkle and Japanese Knotweed) should also be controlled. Additional monitoring and follow up treatments should be conducted every few years and especially before any planned disturbance. Before a future harvest, non-native invasive species should only be present at the occasional level (species dependent). For those stands without an invasive infestation, continuously monitor for non-native invasive species. Especially do so at high-risk locations such as disturbed areas and logging roads in particularly during the years preceding a harvest or other planned disturbance.

Recommendation 2: ***Forest Stand Improvement*** *[Recommended +]* Conduct Forest Stand Improvement work in Stand 2.1 within the next 5 years (2020-2025) favoring species diversity but especially oak (particularly white, northern red, black, and post oak), hickory, and yellow pines by the removal of competing red maple, yellow-poplar, sourwood, blackgum, white pine, and Virginia pine. This work increases the species diversity and richness across the forest type by reducing the less-desired competition from ecologically and economically desired species. While oak, hickory, and yellow pines should be focused on in these actions, other species of high ecological value may also be favored. Similar outcomes may be achieved by conducting controlled burns with the right conditions (as mentioned in Recommendation 3) though it may result in the damage of some of the more desired species due to the heavy fuel loading (debris on the forest floor).

Recommendation 3: ***Prescribed Fire*** *[Recommended +]* Consider using controlled burns at about 3 – 7-year intervals for stands in this forest type to reduce red maple, sourwood, blackgum, and white pine regeneration once invasive species have been controlled. This practice would also promote oaks and prepare the forest floor for their regeneration. With hotter fires, midstory maples and yellow-poplars could also be reduced allowing more light to reach establishing oak regeneration. Growing season fires, especially in early spring, are most beneficial for removing competition from oak regeneration. However, potential damage to timber quality and revenue should be noted if too hot burns are conducted in accessible portions of the forest before a harvest.

For the purpose of fuel reduction, the below-mentioned methods for midstory removal treatment could be considered if prescribed burns are impractical. While different in outcome, such treatments will also have a positive ecological impact on these forests. Both such treatments (if combined or otherwise) may serve as an ecologically beneficial fuel reduction treatment that could potentially find support (financial or otherwise) by the neighboring property owners as it would help reduce fuel around their property as well.

Specific to Stand 2.1: Prescribed fire will also beneficial in this stand once the desired trees in the canopy have increased in diameter and therewith in bark thickness which increases their tolerance to fire. An additional 10 years of growth on the trees present (especially with sped up growth as the result from the Crop Tree Release FSI work – Recommendation 2) and the further decomposition of the woody material on the forest floor would help with reducing the damage to the trees significantly.

For more information on controlled burns including potential funding sources, refer to Recommendation 2 in the Montane Oak-Hickory Forest Type 1 on page 14.

Recommendation 4: ***Midstory Removal FSI*** *[Recommended +]* Midstory removal forest stand improvement work through the reduction of the shade-tolerant red maple, sourwood, white pine, and blackgum would ensure the regeneration of economically and ecologically more valuable tree species (oak & hickory) in the better-suited light-conditions for an impending harvest. This can be achieved through a cut-and-leave or hack- and-squirt treatment of very tall advanced regeneration and up to 8” - 10” DBH suppressed trees of the species mentioned above. Controlled burns may also be used to kill smaller stems or reduce re-sprouts of those already cut (see Recommendation 3). While the hack-and-squirt method will prevent the less-desired stems from re-sprouting through chemical means, the cut-and-leave method, if

followed by a controlled burn 1-3 years after completion, could achieve similar results. These treatments should be carried out in locations where oak and hickory seedlings and small saplings are already present but overshadowed by the species to be cut. Such treatments should be conducted before or 2-4 years after a burn and ideally 5-10 years before a harvest. This will increase the regenerative success of oak and hickory as they will be able to establish in the years after a burn (if not already present) and further solidify their presence in the stand.

Specific to Stand 2.3: In addition to the improvement of light conditions, midstory removal techniques (mostly the cut-and-leave treatment for this application), when applied to the thick mountain laurel and rhododendron shrub layer, could also be used for the purpose of fuel reduction as a pre-treatment before a controlled burn. As the shrub layer has been allowed to grow through the decades of fire suppression, it would be beneficial to reduce especially ladder fuels in some areas before a burn or as a preventative to uncontrolled wildfire.

Recommendation 5: ***Harvest*** *[Required for PUV]* To benefit the overall health and resilience of the forest, wildlife, and more valuable timber resources, shelterwood, crown thinning, Femelschlag, and group selection (0.25 to 2 acres) harvests should be conducted between 2040 and 2050. This would create small canopy gaps promoting early successional habitat and the regeneration of oak species. Oak regeneration would be most successful if any of the harvest types are combined with controlled burning (see Recommendation 3) to reduce competition from shade-tolerant species within the establishing advanced regeneration.

Commercial harvests should be conducted in accessible parts of the stand when adjacent stands are being harvested. During harvests, a variety of healthy oak species and hickory should be left while predominantly removing red maple and yellow-poplar combined with some harvest of the oak and hickory basal area. The residual BA for shelterwood harvests should be between 40 and 60 square feet per acre. A prerequisite for this recommendation is to control invasive species as described in Recommendation 1, though it could occur earlier than suggested in this recommendation IF non-native invasive species are controlled at a faster pace than required.

Stand 2.1 will likely not be ready for a harvest at the above specified time, but the stand's merchantability and potential for a harvest to be ecologically beneficial should be re-evaluated at each consecutive Forest Stewardship Plan.

Recommendation 6: ***Post-Harvest FSI*** *[Recommended +]* Conduct Forest Stand Improvement work 5-15 years after the harvest favoring species diversity but especially oak (particularly white and northern red, black, and post oak), hickory, and yellow pines by the removal of competing red maple, yellow-poplar, black gum, white pine, and Virginia pine. This work increases the species diversity and richness across the forest type by reducing the less-desired competition from ecologically and economically more-desired species. While oak, hickory, and yellow pines should be focused on in these actions, other species of high ecological value may also be favored. Similar outcomes may be achieved by conducting controlled burns with the right conditions (as mentioned in Recommendation 3).

As part of this improvement work, also control invasive plant species that may have come up as part of harvesting operations.

Forest Type 3: Rich Cove Forest (1 acre)

Photo 7: Notice the abundance of spicebush in the shrub layer and the presence of Oriental bittersweet on it and advanced regeneration.

Description of Typical Forest Type: Rich Cove Forest generally occurs on mesic sites of low to moderate elevations with more productive soils. Naturally occurring Rich Cove Forests have the highest diversity of tree species of any forest type and include species such as yellow-poplar, sweet birch, ash, red maple, and scattered hickory, black walnut, magnolia, cucumber magnolia, basswood, and buckeye. While this is mostly true for naturally occurring forests of this type, yellow-poplar dominates stands on such productive soils when these forests have been clear-cut. Rich Cove Forests characteristically also have an understory herbaceous layer that is very diverse. The presence of black cohosh in the herbaceous layer and spicebush in the shrub layer are good indicators of this forest type.

Forest Type on the Property: On this property, Rich Cove Forests occur on the very gently sloped area north and south of the house where the soils are moister than in other sections of the forest. Portions of this forest type (at least Stand 3.2) were likely more open or pastured as can be seen from some remnant wolf trees that have open crowns from once being open growing.

Table 7: Stand Acreages

Stand 3.1	0.75 acres
Stand 3.2	0.25 acres

Composition & Resources: The overstory is dominated by yellow-poplar. Other species include scattered black walnut, black locust, and white oak, white pine, Virginia pine, elm, black cherry, and chestnut oak. The midstory is composed of red maple, yellow-poplar, hickory, and American beech. The shrub layer is dominated by spicebush but also hawthorn, American holly, Japanese spirea, Oriental bittersweet, wineberry, and scatted multiflora rose. Advanced regeneration is sparse but where present made up of ash, black cherry, sassafras, and a few scattered others.

About one-quarter of the average basal area of 150 square feet per acre is composed of yellow-poplar with merchantable diameters between 14 and 24 inches at breast height. Smaller diameter classes have a larger basal area per acre and are similarly dominated by yellow-poplar though some other species are present there as well. The current overstory, though dominated by yellow-poplar, is not yet stocked with enough volume to justify the removal of merchantable logs. As yellow-poplars on average grow at about 2.5" in diameter per decade, it will take around 10-20 years for enough of the trees to reach an appropriate size. Also, due to the small size of these stands, a harvest should wait until adjacent stands are being harvested.

There is a threat of non-native invasive species on both of these stands, mostly due to the presence of Oriental bittersweet but also due to the Japanese spirea, wineberry, and multiflora rose. Periwinkle and the Japanese knotweed are also approaching from the border with the Non-forest Area 4.

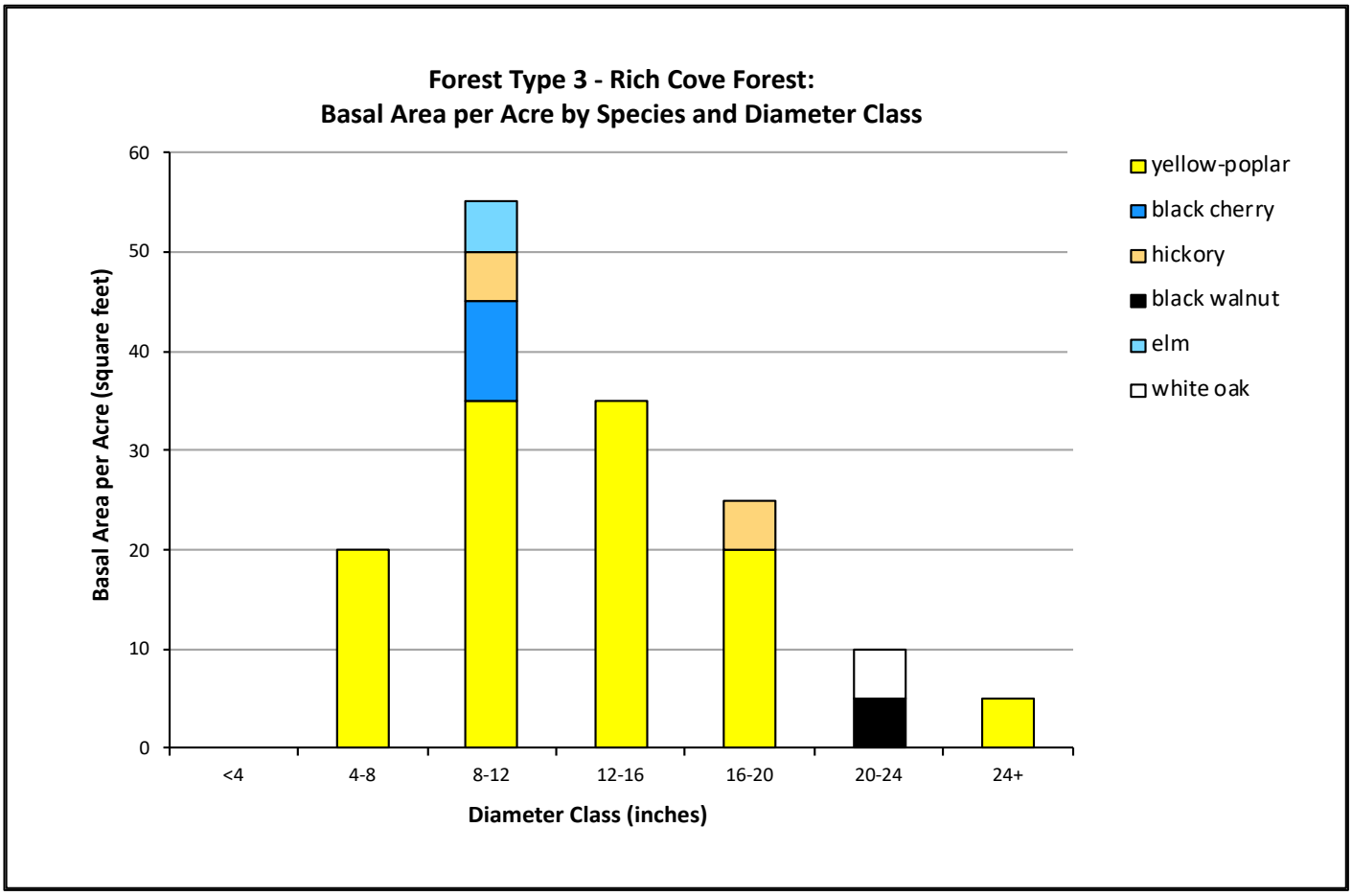


Figure 4: About one-quarter of the average basal area of 150 square feet per acre is composed of yellow-poplar with merchantable diameters between 14 and generally 20 inches at breast height.

Succession & Ecology: These stands are currently succeeding from the Stem Exclusion Phase to the Understory Re-initiation Phase of forest succession. The trees will continue to grow, forcing some individuals out of the canopy through competition. In several decades, some of the largest of the trees will begin to decline in place or by falling which creates small canopy gaps. Light will then reach the advanced regeneration in the understory and midstory allowing them to advance towards the overstory. The partial light conditions will promote shade-intermediate and shade-tolerant trees which, unlike yellow-poplar, can compete well in such conditions. This process, in turn, will create another age class and therewith species and structural diversity.

However, this process will only fuel the continued establishment of the non-native invasive species already present if those are not controlled. The threat of non-native invasive species is real in both of these stands, posing a significant risk to the future health and resilience of the forest. See Section 2.3 and the Invasive Species Severity Map in Appendix A for details. If left to fend on its own, this natural ecological process could affectively halt the natural process of forest regeneration, leaving the forest in an unhealthy state with a transition towards a dominance of invasive shrubs and vines.

Management Recommendations:

The goal for this forest type is to increase/maintain the species diversity and let the herbaceous herb layer, common to these forests, re-establish.

Because yellow-poplar thrives in high-light conditions created by timber harvests (or post pasture conditions), this forest type is dominated by yellow-poplar when it should have higher components of oaks and other typical species. Management actions that create medium light conditions and mimic natural disturbance regimes that allow for oak, basswood, elm, black walnut, and others to compete better would be appropriate. The removal of non-native invasive species will free up advanced regeneration for continued growth and will allow the herb layer to bounce back.

Recommendation 1: ***Invasive Control*** *[Required for PUV]* Treat all seed-producing plants along with Oriental bittersweet, multiflora rose, and Japanese spirea on the property within a period of 5 years between 2020 and 2025 to control these species down to the mild to occasional level. The following 10 years are then required to be used for follow-up treatments and monitoring to ensure as few invasive species present as possible. At the beginning of these 10 years, the lower priority species (Periwinkle, Japanese knotweed, and Wineberry) should also be controlled. Additional monitoring and follow up treatments should be conducted every few years and especially before any planned disturbance. Before a future harvest, non-native invasive species should only be present at the occasional level (species dependent).

Recommendation 2: ***Harvest*** *[Required for PUV]* The stands could benefit from the diversification of the forest structure and the release of ecologically as well as economically more valuable species and their regeneration. In accessible portions of the stand, we recommend crown thinning, group selection (0.25-2 acres), and Femelschlag harvests favoring black walnut, elm, and northern red oak among others along with vital and well-formed yellow-poplar. Poorly formed, less vigorous, and less vital yellow-poplar should be targeted for removal. A combination of these practices would increase both species and structural

diversity by mimicking natural disturbance regimes of gap-phase dynamics. Harvests should be completed between 2040 and 2050 in accessible parts of the stands when adjacent stands are being harvested.

A prerequisite for this recommendation is to control invasive species property-wide for the next 10 years.

Recommendation 3: ***Post-Harvest FSI*** *[Recommended +]* Conduct Forest Stand Improvement work 5-15 years after the harvest favoring species diversity but especially black walnut, northern red oak, elm, white oak, and black cherry by the removal of competing yellow-poplar, red maple, and others. This work increases the species diversity and richness across these stands by reducing the less-desired competition for ecologically and economically desired species. While the above-listed species should be focused on in these actions, other species of high ecological value may also be favored.

As part of this improvement work, also control invasive plant species that may have come up as part of harvesting operations.

Recommendation 4: ***Ash Treatment*** *[Optional]* The emerald ash borer (EAB) has already killed many ash trees in western North Carolina, yet it was difficult to assess signs of EAB on the ash trees on this property due to the seasonality of the cruise. Some of the ash trees could be treated to protect against EAB before they show signs of decline to preserve this species on the property if desired. Early treatment of these trees is key because once damage to the tree has been observed, it may already be too late for treatment. See the section on Non-Native Invasive Insects in Section 2.4 of this plan or Appendix C for details on EAB and its treatment.

Non-Forest (1 acre)

While some portion of this area is developed with structures, landscaping, and pasture, some portion (including the powerline right-of-way) yet remains cleared. We have the following optional recommendations:

Recommendation 1: ***Woody Edge Habitat Improvement*** *[Optional⁺]* The field-to-forest ecotone could be feathered by promoting/planting low growing and increasingly taller growing shrubs along the edge to ease the transition of field-to-forest which would provide different habitats for various species of wildlife and limit the direct infiltration of light into the forest interior (in turn decreasing the establishment of non-native invasive plant species along the forest edge).

Recommendation 2: ***Native Grassland Establishment*** *[Optional⁺]* Open grassland habitats can tremendously contribute to increasing the biodiversity of the ecosystem. While this open area already serves as an important refuge for different wildlife when not regularly mowed, by implementing a plan to convert this area to a native warm-season grassland/wildflower meadow with a focus on native flora, various species of insects, birds, and mammals could be attracted increasing the species diversity for this area. Grassland areas are easy to manage once established by mowing regimes from annually to every few years in the off-season (November – March) for the plants to develop seed and persist. The persistence of native grasses and wildflowers could also be improved by occasional controlled burning of the meadow.

This could be achieved in two ways. The mowing schedule could be reduced to once a year or once every few years in the offseason to promote the already established wildflowers and grasses beneficial for wildlife. (2) The already present species composition could be diversified and improved by supplementary seedings or a complete re-establishment of native wildflowers and grasses.

Native Grasses and Wildflowers for Garden & Lawn: For the option to increase wildlife value immediately around your home and lawn while maintaining or increasing its beauty, the following links may be good resources:

PennState Extension: Meadows and Prairies: Wildlife-Friendly Alternatives to Lawn
https://extension.psu.edu/meadows-and-prairies-wildlife-friendly-alternatives-to-lawn

American Society of Landscape Architects: 2015 Annual Meeting Expo Native Meadows and Grasslands: From Vision to Reality
https://www.asla.org/uploadedFiles/CMS/Meetings_and_Events/2015_Annual_Meeting_Handouts/SUN-B06_Native Meadows and Grasslands.pdf

For General Warm-season Grasses and Meadow Establishment:

Roundstone Seed: Six basic Elements for a Successful Native Grass and Forb Establishment
https://roundstoneseed.com/pdf/SixBasicElements%20-%20including%20coastal%20plains.pdf

UT Extension: A Landowner's Guide to Native Warm-Season Grasses in the Mid South
https://extension.tennessee.edu/publications/Documents/PB1746.pdf

Companies that supply native grass and wildflower seed:
https://www.prairiemoon.com/
https://roundstoneseed.com/

4| HELPFUL LINKS

EcoForesters Website
http://www.ecoforesters.org/
Best Management Practices Manual
http://ncforestservice.gov/water_quality/bmp_manual.htm
Guide to NC's Forestry Present Use Valuation (PUV) Property Tax Program
https://content.ces.ncsu.edu/north-carolinas-forestry-present-use-valuation-puv-property-tax-program
USDA NRCS Funding through the Environmental Quality Incentive Program (EQIP)
https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/financial/eqip/?cid=nrcseprd1342638
Community Protection Plan
https://www.ncforestservice.gov/fire_control/fc_cpp.htm
Non-Native Invasive Plants of Southern Forests
https://www.srs.fs.usda.gov/pubs/gtr/gtr_srs062/gtr_srs062.pdf
Wildlife and Forest Stewardship
https://content.ces.ncsu.edu/wildlife-and-forest-stewardship
More Wildlife and Forestry Links
https://forestry.ces.ncsu.edu/forestry-wildlife/
FireWise Landscaping
https://content.ces.ncsu.edu/firewise-landscaping-in-north-carolina

5| GLOSSARY OF FORESTRY TERMS

Advanced Regeneration: regeneration that is already in place in the understory before the canopy is removed. For our studies we classify a tree as advanced regeneration if it is taller than 4.5 feet and has a DBH less than 2 inches.

Age Class: a group of trees which are all roughly the same age and usually belong to a single cohort.

Basal Area (BA): the area of the cross section of a tree bole at 4.5 feet from groundline (DBH). A 12-inch diameter tree for example, has a basal area of 113 square inches or 0.79 square foot. Unless otherwise indicated, basal area units are in square feet.

Basal Area per Acre: the total area of the cross sections of all trees occupying a given acre of land. This measurement is used because it offers the forester the best estimate of how well any given forest site is stocked, and whether or not the site is achieving its optimum growth potential compared to its site quality. Unless otherwise indicated, basal area units are in square feet.

Best Management Practice (BMPs): forest management practices that reduce erosion and prevent or control water pollution.

Biodiversity: the variety of life forms in a given area; can be categorized in terms of number of species, variety of plant and animal communities, genetic variability or some combination of these categories.

Board Foot: a unit of measure equal to a board that is 1 inch thick, 12 inches long and 12 inches wide, or 144 cubic inches.

Canopy Closure: the canopy is considered to be “closed” if the crowns are touching and the forest floor is fully shaded.

Canopy: the general level of the tree crowns in any given forest stand. This zone may be well-defined and unbroken, such as with plantations and classic even-aged forest, or it may be multileveled and weakly defined, such as with multi-stage and uneven aged forests.

Chestnut Blight: a fungal disease introduced from Asia in the early 1900’s that attacks American chestnut trees. The disease eventually killed nearly all mature chestnut trees by 1940. Most of the chestnut trees were harvested before or shortly after the blight killed them. Fortunately, the root system is fairly resistant to the blight and the chestnut persists as shoots from the old root systems. Unfortunately, they are only able to grow for several years before the blight attacks them.

Clear-cut: a harvesting and regeneration method that removes all trees within a given area.

Co-dominant Tree- tree is level with the general level of the canopy, receiving full sun from above but only partial sun from the sides of the crown.

Cohort: an aggregation of trees that begins growth as the result of a single disturbance.

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.

Controlled Burning: the practice of using regulated fires to reduce or eliminate fuel or material on the forest floor, for seedbed preparation or to control competing vegetation. Controlled burning simulates one of the most common natural disturbances. Also called prescribed burning.

Coppice: Trees which have regenerated from shoots formed at the stumps of the previously cut trees.

Crop Tree Release: competing trees are removed whose crowns are impeding growth of a crop tree. The crop tree is selected usually based on species, form, superior health, and/or larger size. It is similar to a crown thinning, but usually applied to younger stands of trees still in the Stem Exclusion phase.

Crown Class a definition of tree position within the forest canopy. The basic four tree positions are defined as follows:

Crown Thinning: trees are removed from the upper crown classes in order to open up the canopy and favor the development of the most promising trees of the same canopy position.

Crown: the branches and foliage at the top of a tree.

DBH (diameter at breast height): measured diameter of a tree at 4.5 feet from ground line. In hilly or mountainous terrain 4.5 feet is measured from the highest side of the stump (uphill side on a slope). Certain rules for exceptions are used for trees with forks butt swell or cankers at normal 4.5 feet bole height.

Dominant Tree- A dominant ree is above the general level of the canopy and receives full sun from above and from one or more sides of t

Edge: the transition between two different types or ages of vegetation.

Even-Aged Management: a forest management method used to produce stands that are all the same age or nearly the same age by harvesting all trees in an area at one time or in several cuttings over a short time.

Even-Aged: trees are of that are of the same age or at least the same cohort.

Femelschlag Harvest: An expanding-group selection harvest for which the edges of a traditional group selection are successional expanded to create a multi-aged forest structure. This silvicultural method was developed in Germany and has shown great promise for fostering oak regeneration.

Forest Stand Improvement (FSI): Also known as Timber Stand Improvement (TSI), includes activities or treatments that improve the composition, structure, condition, health, and growth of forest stands.

Forest Type: a stand or group of stands which has been designated to one category (i.e. Montane Oak-Hickory) because of similarities such as species composition, age, structure, or site characteristics.

Grade: a system for judging the quality of timber in a tree. In forest service grading rules, grade 1 is greater than 16 inches DBH and with only minor sweep or defects. Grade 2 is greater than 14 inches DBH or greater than 16 inches and with moderate sweep or defects. Grade 3 is greater than 12 inches or greater than 14 inches and with significant sweep or defects. A tree designated as a cull has no timber value due to defects, size, or species.

Group Selection: the removal of small groups of trees to regenerate shade-intolerant trees in the opening (usually at least 1/3 acre).

Growing Space: a reference to the amount of resources (water, sunlight, soil nutrients) available to allow for tree growth. Growing space decreases and becomes very limited as competition between trees increases.

Hack & Squirt / Cut & Leave: A non-commercial forest stand improvement (FSI) method that removes the unwanted trees in the under-, mid-, and overstory. The hack & squirt method uses herbicide to kill the target trees leaving snags and reducing stump sprouts. The cut & leave method reduces the use of herbicide while accomplishing a similar treatment.

Hemlock Woolly Adelgid: Native to southern Japan, this bug was introduced to the U.S. in the 1920's and has now been established in eleven eastern states, from Georgia to Massachusetts. Appearing as a small cottony pinhead, the insect feeds on the sap of hemlocks, attaching themselves at the base of the needles. After infestation, in the southern Appalachians 90% mortality of all hemlocks can be expected within several years.

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 continually high-graded sites.

Hydric: a site having or characterized by excessive soil moisture.

Intermediate Tree- tree is generally below the general level of the canopy but occupies the lower canopy levels. Crown receives partial sun from above, but no sun from the sides.

Live Crown to Height Ratio: height of the live crown (the part of the tree with live branches) divided by the total height of the tree. It is a useful indicator of a tree's health. Trees with low live crown to height ratios are generally less vigorous and more susceptible to insect attacks and disease.

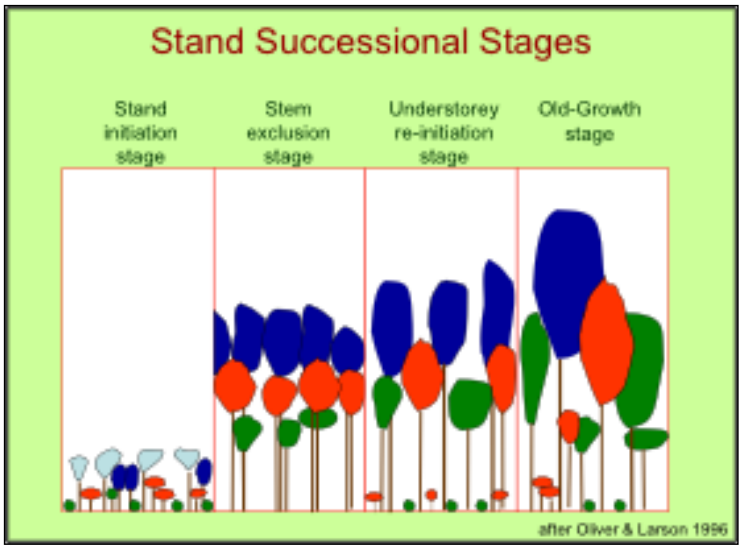
Low Thinning: trees are removed from only the lower crown classes.

Mast: fruits or nuts used as a food source by wildlife. Soft mast includes 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.

Mesic: a site that generally has moderate or generally well-balanced soil moisture levels.

Natural Regeneration: the growth of new trees in one of the following ways without human assistance: (a) from seeds carried by wind or animals, (b) from seeds stored on the forest floor, or (c) from stumps that sprout.

Old Growth: this occurs when the process of Understory Re-initiation is complete and the initial older cohort has been completely replaced by younger cohorts. Forests in this stage are usually dominated by shade tolerant species. Because there are many age classes of trees, structural and biological diversity is increased. The forest is heavily stratified with foliage extending from tree tops to the forest floor in some places. Biodiversity is also enhanced by a large number of standing and fallen dead trees. Production of wood and organic matter tend to be balanced by loss and decay. (Note this is a unique definition of old growth and there are many others which are based on other factors such as forest structure or tree age.)



Prescribed Burning: the practice of using regulated fires to reduce or eliminate fuel or material on the forest floor, for seedbed preparation or to control competing vegetation. Prescribed burning simulates one of the most common natural disturbances. Also called controlled burning.

Salvage Cut: the harvesting of dead or damaged trees, or the harvesting of trees in danger of being killed by insects, disease, flooding or other factors in order to save their economic value.

Selective Thinning: dominant trees are removed in order to stimulate the growth of the trees in lower crown classes. This method of timber harvesting is useful in order to favor shade tolerant species. However, in forests, such as most of the southern Appalachian forests, that are dominated by shade intolerant or intermediate species, selective thinning degenerates into the practice of harvesting the best trees and leaving the poorest, also known as high-grading.

Shade Intermediate: trees that can survive in partial shade, but generally do best in full sun.

Shade Intolerant: trees that require full sunlight to thrive and cannot grow in the shade of larger trees.

Shade Tolerant: trees that have the ability to grow in the shade of other trees and in competition with them.

Shelterwood Cut: removing trees in the harvest area in a series of two or more cuttings so that new seedlings can grow from the seeds 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 measurement used to quantify site quality for any given piece of forest land. Site Index is normally expressed, in the southern Appalachian forest types, by the total height of the dominant trees in the stand at 50 years of age. Site Index is always expressed for specific species or species type, as the Site Index value varies between tree species (i.e. White Pine versus Upland Oak).

Site, Site Quality: the inherent productivity of a given piece of forest land. Soil type, soil depth, slope aspect, general terrain, elevation, position on slope, local climate and local precipitation patterns all affect the site quality of a forest stand. Site quality determines the limits of any given piece of land to produce volume and tree growth, and it normally influences the tree species occupying this piece of land.

Snag: a standing dead or dying tree.

Stand Initiation: after a lethal disturbance has created a unit of vacant growing space, the trees that become established in it do not fully occupy the space. Until they do there is opportunity for additional plants to fill the empty spaces such as herbaceous annuals.

Stand: a delineated portion of forest land that shares similar characteristics in such a way that this portion of the forest can be separated from adjoining forest lands. These shared characteristics can include tree species (conifer, hardwood, mixed oaks, cove hardwoods, etc.), age of the trees, stand structure (even-aged or uneven-aged), site index or site quality, elevation, slope aspect, or special site conditions (swamp, wetlands, rocky, heavy clay soils, special wildlife habitats, etc.). This concept always needs to be used with some care, because natural diversity is such that forest land cannot be completely pigeonholed or defined fully by what is essentially a broad-brush approach.

Stem Exclusion: when canopy closure is reached and trees begin to compete with each other for limited resources. The more vigorous trees usurp the growing space and weaker ones die. This competition also limits regeneration of a younger cohort of tree species.

Stem Injection: a method of injecting herbicide directly into the cambium layer of a tree to induce mortality. This method ensures the herbicide only impacts the desired tree and does not spread unintentionally. It is commonly used in crop tree release.

Stocking: a measurement or calculated number that expresses the number of trees found on a tract or on a given unit of area (acre, hectare). This is most often expressed by actual number counts of trees (i.e. trees per acre, stems per hectare) or in Basal Area per unit area (i.e. square feet per acre, square meters per hectare). Total number of trees on a tract is meaningful and normally calculated for a timber sale bid offering, but Total Basal Area on a tract is meaningless and is never calculated.

Succession or Stand Development: a given aggregation of trees of a single age class or cohort proceeds from birth to death in a sequence of developmental steps. The steps in the following model were developed by Oliver and Larson, 1996:

Suppressed Tree- tree is generally below the level of the canopy, does not occupy the canopy layer and is fully shaded from the top and sides.

Two-aged: a stand that contains only two cohorts.

Understory Re-initiation: scattered trees that have previously been successful in competition with other trees begin to be lost to pests or other damaging agents. The surrounding tree crowns do not fully close again, and the vacancies of growing space thus allow for the growth of new trees. These trees are often advanced regeneration of shade tolerant species.

Understory: the area below the forest canopy that comprises shrubs, snags and small tree. Because the understory receives little light, many of the plants at this level tolerate shade and will remain part of the understory. Others will grow and replace older trees that fall.

Uneven-aged: a stand that contains three age-classes intermingled intimately on the same area.

Xeric: a site that is regularly deficient in moisture.

Yellow Pines: refers to a group of several pine species that are native to the southeastern United States. In terms of this plan these include shortleaf pine (*Pinus echinate*), pitch pine (*Pinus rigida*) and table mountain pine (*Pinus pungens*). This group does not include white pine (*Pinus strobus*).

Appendix A: Maps

Property Location Map

Stand Map

Forest Type Map

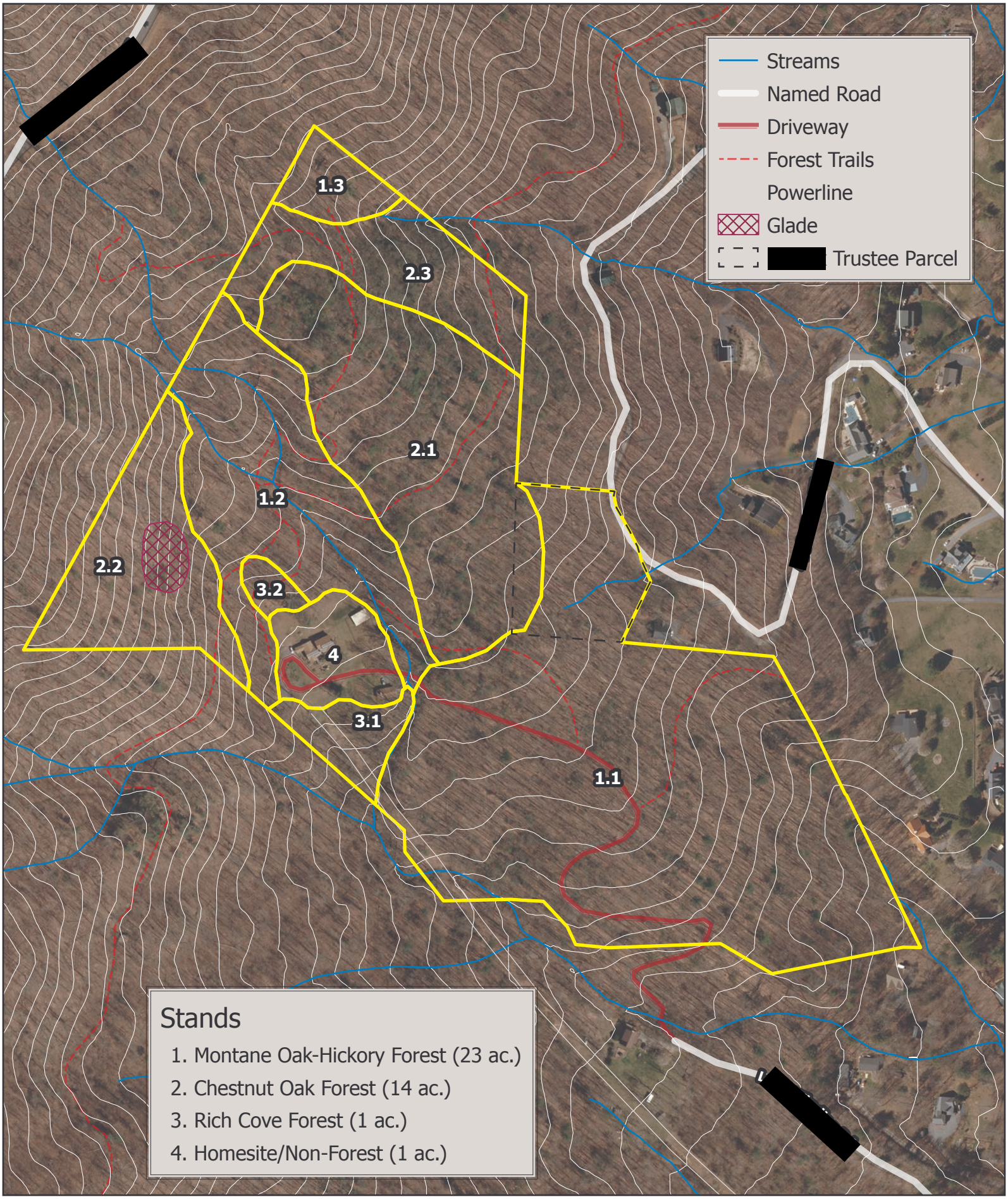
Slope Map

Tree Canopy Height Map

Invasive Species Severity Map (+ Severity Definitions)

Location Map

Removed for Privacy



EcoForesters

Date Created:
3/27/2020

Stand Map

2019 True Color Aerial Orthoimagery

0 100 200 400 600 800
US Feet

Contour Interval:
20 ft
Elevation Range:
2460 ft - 3040 ft

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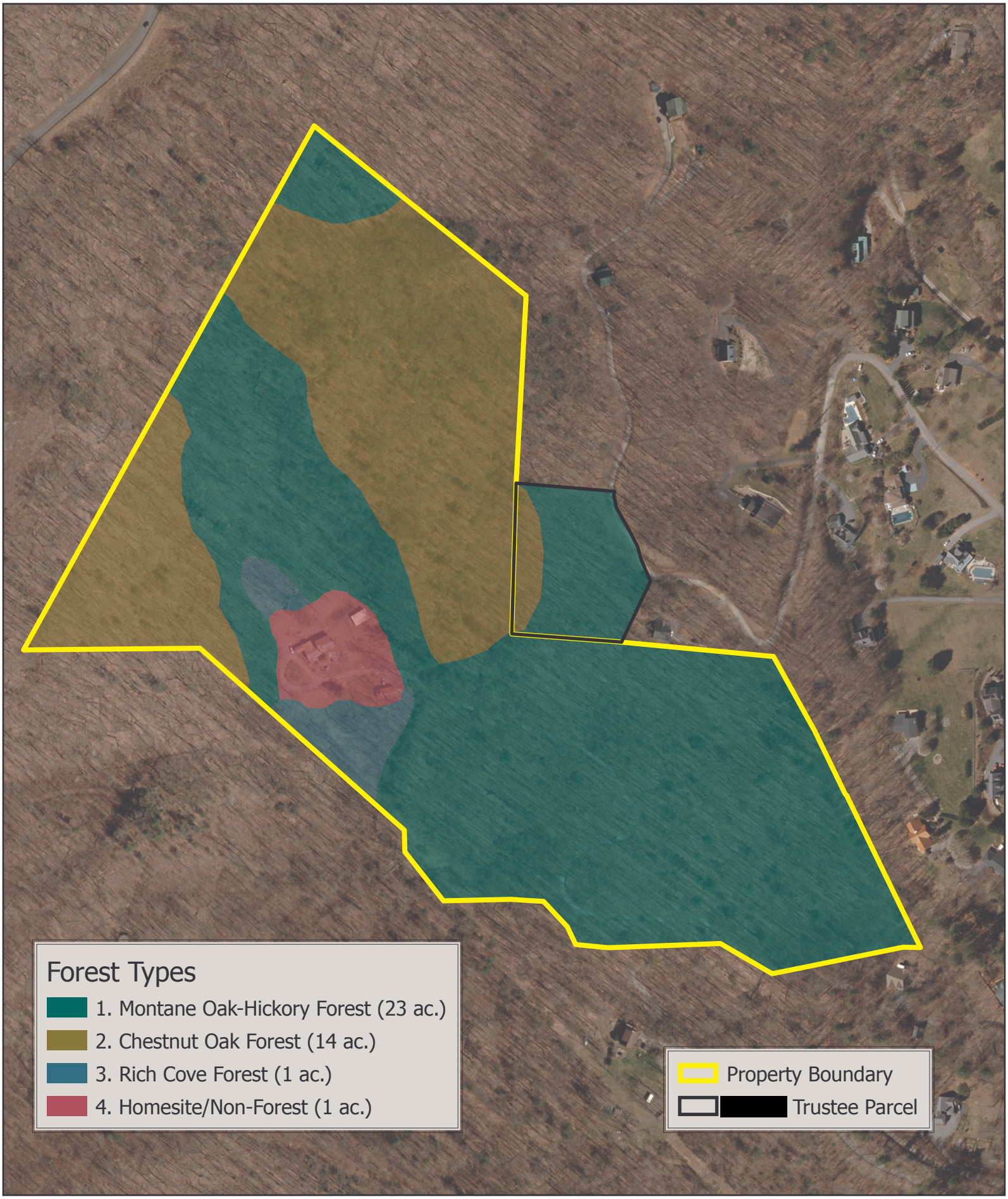

Forest Type Map

2019 True Color Aerial Orthoimagery

EcoForesters

Date Created:
3/27/2020

0 100 200 400 600 800
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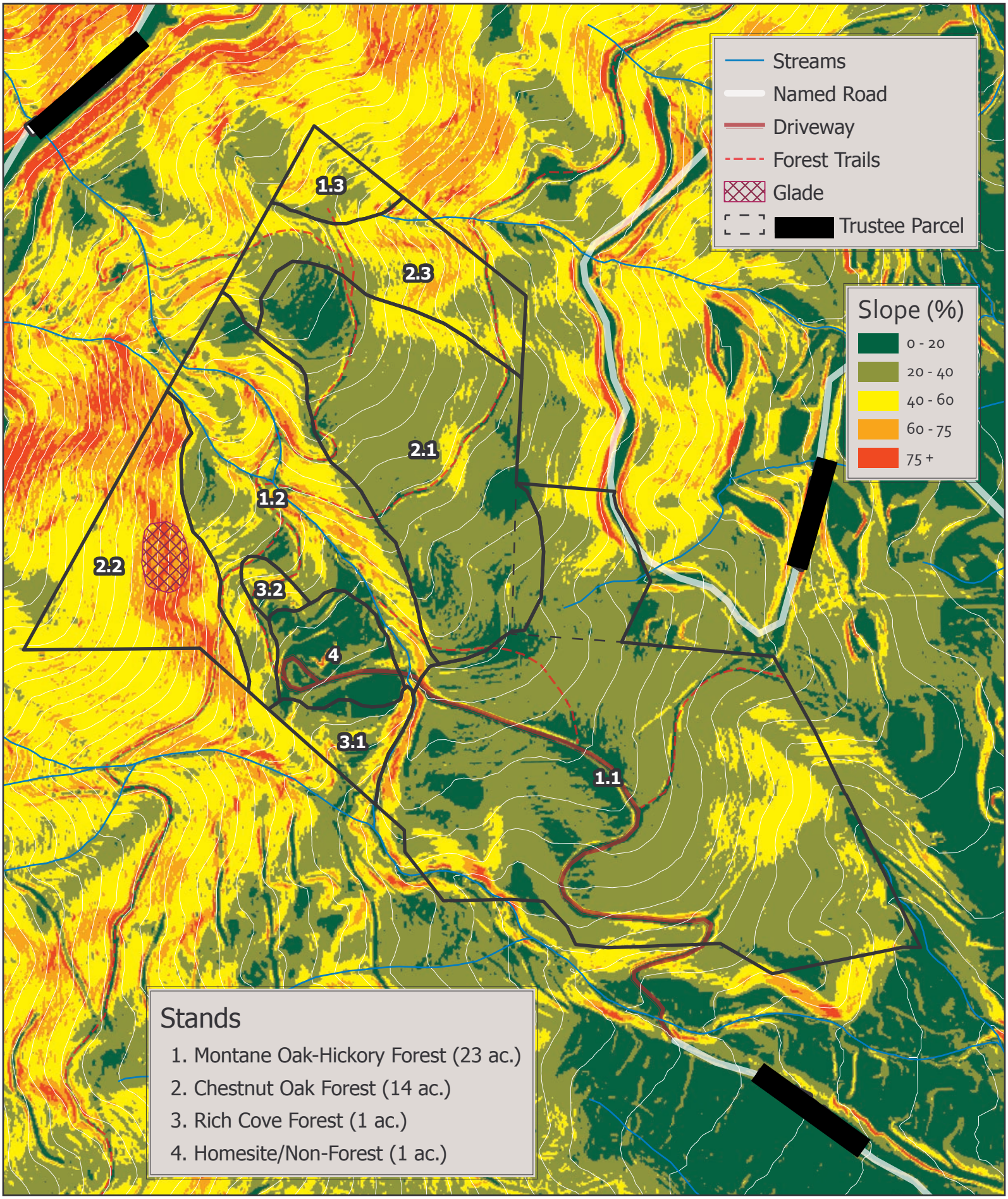


[redacted] Slope Map

2017 Lidar Data

EcoForesters

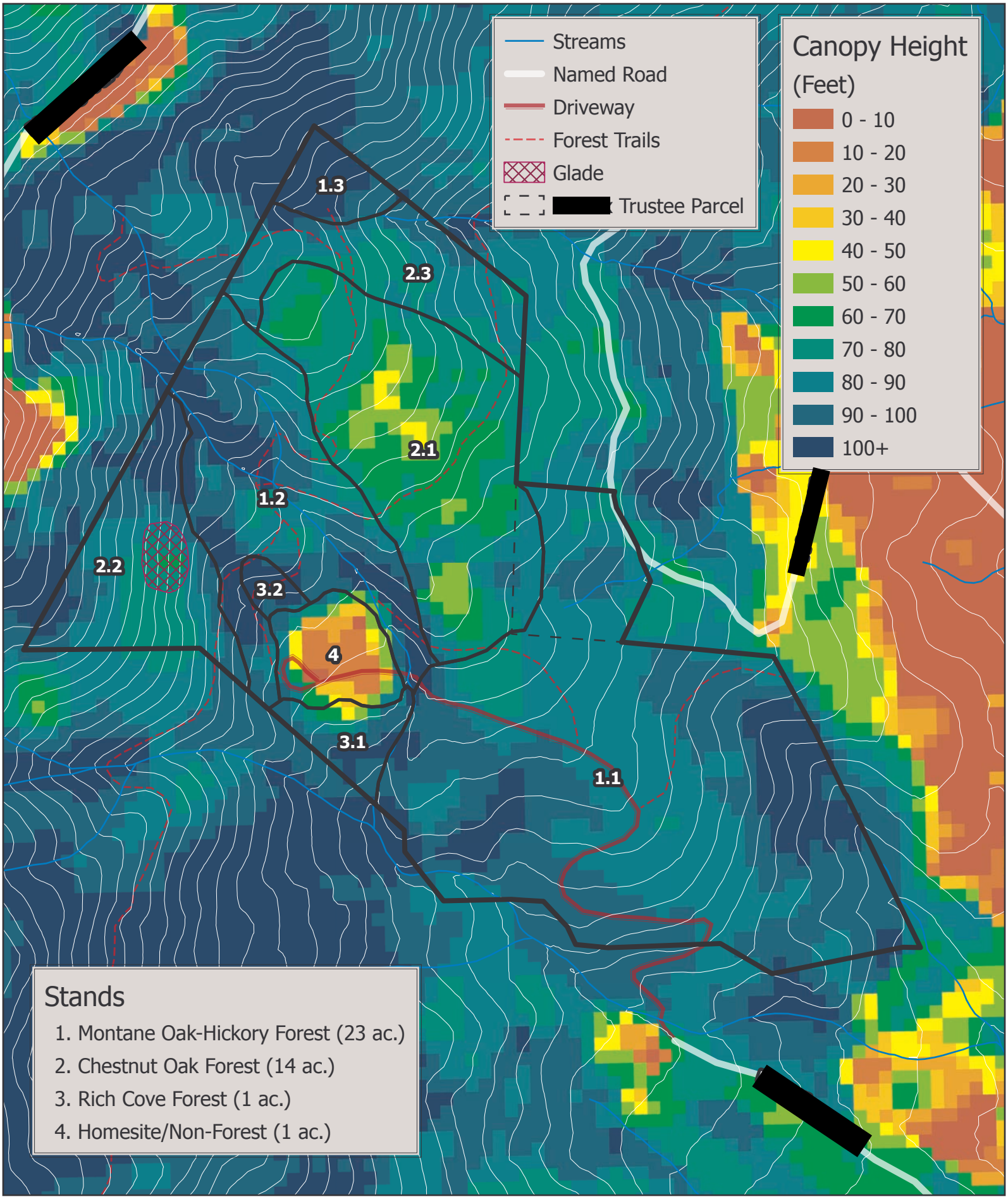
Date Created: 3/27/2020

0 100 200 400 600 800 US Feet

Contour Interval: 20 ft

Elevation Range: 2460 ft - 3040 ft

N W E S



[redacted] Canopy Height Map

EcoForesters

Date Created:
3/27/2020

2005 Lidar Data

0 100 200 400 600 800
US Feet

Contour Interval:
20 ft
Elevation Range:
2460 ft - 3040 ft

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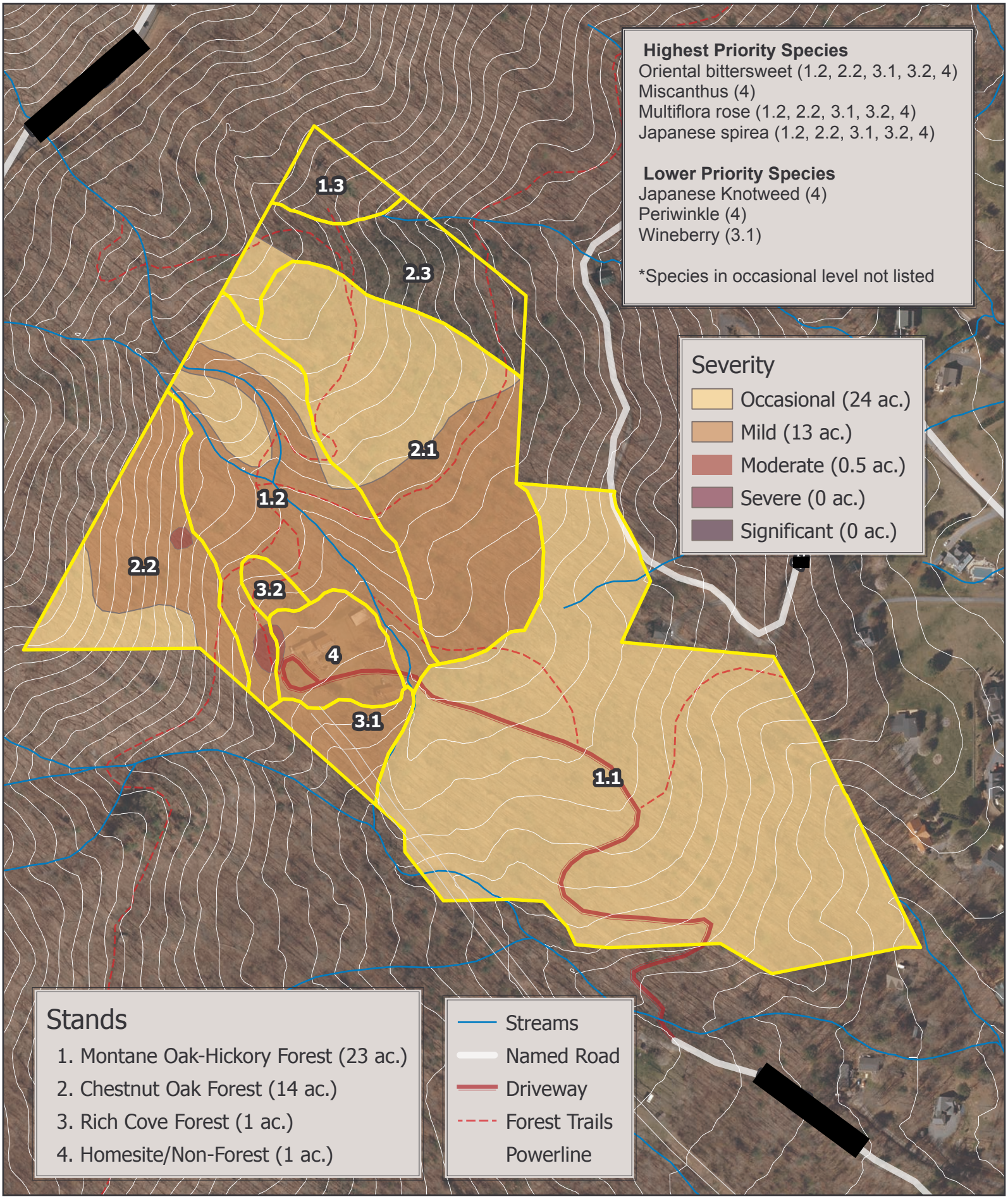


EcoForesters

[redacted] Stand Map

Date Created: 3/27/2020

2019 True Color Aerial Orthoimagery

0 100 200 400 600 800 US Feet

Contour Interval: 20 ft

Elevation Range: 2460 ft - 3040 ft

N W E S

EcoForesters' Invasive Species Severity Definitions:

Occasional: Scattered invasive plants may be present isolated on the forest floor in numbers of only a couple to a few per acre. Ground coverage of invasive plants is <1%. Seed-producing invasive plants are non-existent.

Mild: Invasive plants number several per acre with vines potentially climbing some regeneration or understory shrubs and, only on rare occasion, are found in the canopy. Ground coverage generally is >1% but <10%. Several invasive species can be present. Only a couple to a few seed-producing invasive plants may be found per acre.

Moderate: Many invasive plants were found per acre on the forest floor with vines often climbing advanced regeneration and shrubs and are restricting their natural growth. Shrubby-growth of invasive plants tends to cover between 10% and 75% of the forest floor while some vines occasionally have climbed mature trees and are present in the canopy as a seed source in numbers of few to several per acre. The natural growth of mature canopy trees has not yet been impacted. Mature seed-producing invasive trees may also be present in few to several per acre.

Significant: Invasive species are affectively impacting the natural growth of the ecosystem and have slowed, to nearly stopped, natural understory regeneration. While the shrubby-growth of invasive plants tends to cover between 50% and 100% of the forest floor, vining species are present in the crowns of canopy trees and are unquestionably impacting their natural growth and distorting their form. Mature invasive seeds-producing trees may be present in moderate to high numbers in the midstory and/or the canopy.

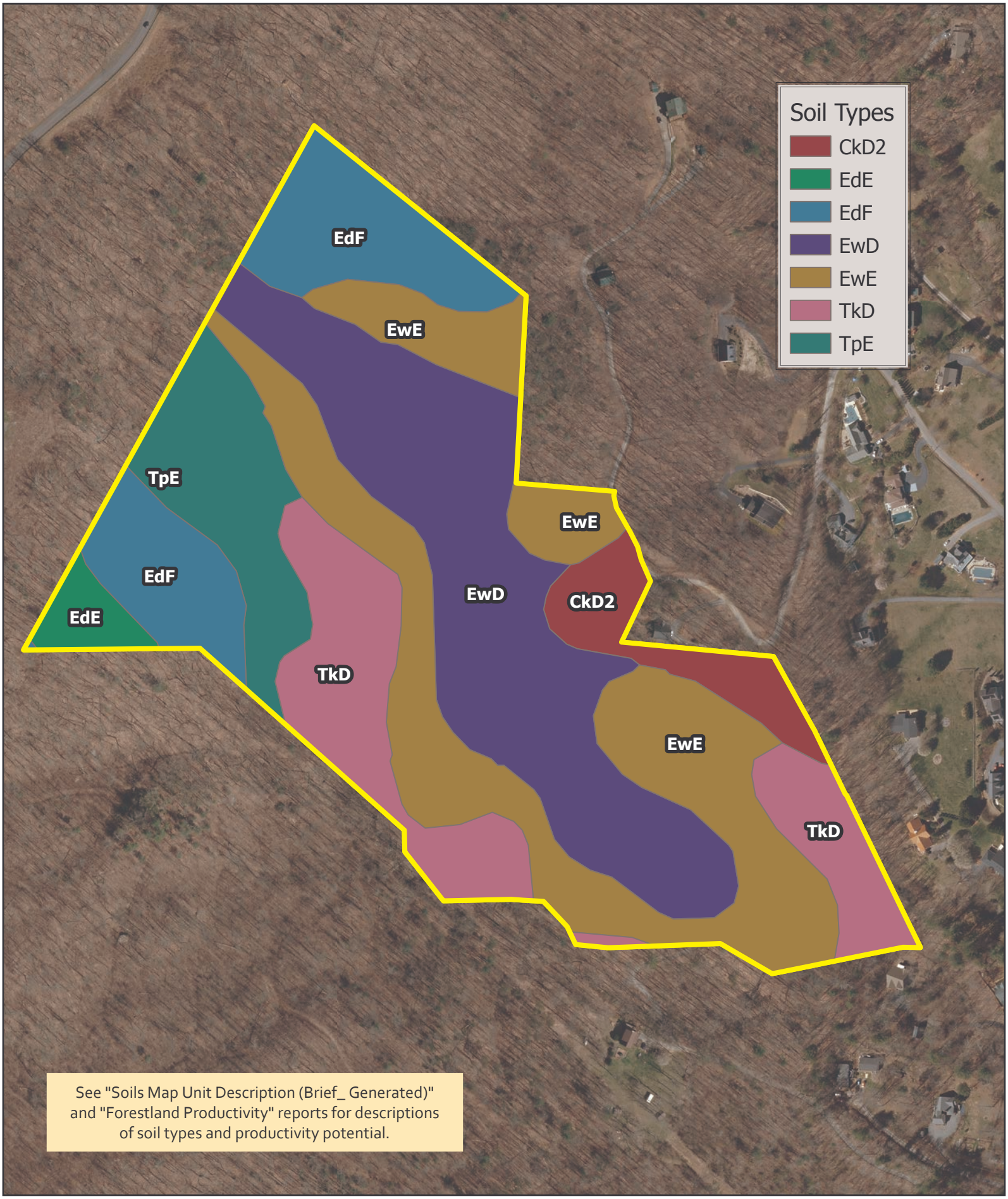
Severe: The natural environment has been completely altered by the growth of invasive plant species as canopy trees are completely overgrown or have collapsed. Trees and shrubs have nearly to completely stopped their growth under the stress of invasive species. The forest floor is covered 85% to 100% by the shrubby-growth of invasive plants. No canopy may be present in an area larger than two to three mature tree-crowns and is replaced invasive plant vegetation. If mature invasive trees are present, those many be mixed-in in the above conditions, or, alternately, have replaced the entire forests stand in a similarly-sized area. Invasive seed producing plants are abundant.

Appendix B: Soil Map & Reports

Soils Map

Soil Descriptions

Forestland Productivity



See "Soils Map Unit Description (Brief_ Generated)" and "Forestland Productivity" reports for descriptions of soil types and productivity potential.

[redacted] Soils Map

2019 True Color Aerial Orthoimagery

EcoForesters

Date Created: 3/27/2020

0 100 200 400 600 800 US Feet

N W E S

Map Unit Description (Brief, Generated)

[redacted] County, North Carolina

[Minor map unit components are excluded from this report]

Map unit: CkD2 - Clifton clay loam, 15 to 30 percent slopes, moderately eroded

Component: Clifton, moderately eroded (80%)

The Clifton, moderately eroded component makes up 80 percent of the map unit. Slopes are 15 to 30 percent. This component is on hillslopes, intermontane basins, ridges on hills. The parent material consists of residuum weathered from amphibolite or hornblende gneiss. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is high. Shrink-swell potential is moderate. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. Nonirrigated land capability classification is 4e. This soil does not meet hydric criteria.

Map unit: EdE - Edneyville-Chestnut complex, 30 to 50 percent slopes, stony

Component: Edneyville, stony (55%)

The Edneyville, stony component makes up 55 percent of the map unit. Slopes are 30 to 50 percent. This component is on mountain slopes, ridges, mountains. The parent material consists of residuum weathered from granite and gneiss that is affected by soil creep in the upper solum. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 4 percent. Nonirrigated land capability classification is 6e. This soil does not meet hydric criteria.

Component: Chestnut, stony (25%)

The Chestnut, stony component makes up 25 percent of the map unit. Slopes are 30 to 50 percent. This component is on mountain slopes, ridges, mountains. The parent material consists of residuum weathered from granite and gneiss that is affected by soil creep in the upper solum. Depth to a root restrictive layer, bedrock, paralithic, is 20 to 40 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is very low. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 4 percent. Nonirrigated land capability classification is 6e. This soil does not meet hydric criteria.

Map unit: EdF - Edneyville-Chestnut complex, 50 to 95 percent slopes, stony

Component: Edneyville, stony (45%)

The Edneyville, stony component makes up 45 percent of the map unit. Slopes are 50 to 95 percent. This component is on mountain slopes, mountains. The parent material consists of affected by soil creep in the upper solum over residuum weathered from biotite granitic gneiss and granodioritic gneiss. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 4 percent. Nonirrigated land capability classification is 7e. This soil does not meet hydric criteria.

Map Unit Description (Brief, Generated)

[redacted] County, North Carolina

Map unit: EdF - Edneyville-Chestnut complex, 50 to 95 percent slopes, stony

Component: Chestnut, stony (35%)

The Chestnut, stony component makes up 35 percent of the map unit. Slopes are 50 to 95 percent. This component is on mountain slopes, mountains. The parent material consists of affected by soil creep in the upper solum over residuum weathered from biotite granitic gneiss and granodioritic gneiss. Depth to a root restrictive layer, bedrock, paralithic, is 20 to 40 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is very low. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 4 percent. Nonirrigated land capability classification is 7e. This soil does not meet hydric criteria.

Map unit: EwD - Evard-Cowee complex, 15 to 30 percent slopes, stony

Component: Evard, stony (55%)

The Evard, stony component makes up 55 percent of the map unit. Slopes are 15 to 30 percent. This component is on mountain slopes, mountains. The parent material consists of residuum weathered from igneous and metamorphic rock. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 4 percent. Nonirrigated land capability classification is 4e. This soil does not meet hydric criteria.

Component: Cowee, stony (25%)

The Cowee, stony component makes up 25 percent of the map unit. Slopes are 15 to 30 percent. This component is on mountain slopes, mountains. The parent material consists of residuum weathered from igneous and metamorphic rock. Depth to a root restrictive layer, bedrock, paralithic, is 20 to 40 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 4 percent. Nonirrigated land capability classification is 4e. This soil does not meet hydric criteria.

Map unit: EwE - Evard-Cowee complex, 30 to 50 percent slopes, stony

Component: Evard, stony (55%)

The Evard, stony component makes up 55 percent of the map unit. Slopes are 30 to 50 percent. This component is on mountain slopes, mountains. The parent material consists of affected by soil creep in the upper solum over residuum weathered from igneous and metamorphic rock. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 4 percent. Nonirrigated land capability classification is 6e. This soil does not meet hydric criteria.

Map Unit Description (Brief, Generated)

[redacted] County, North Carolina

Map unit: EwE - Evard-Cowee complex, 30 to 50 percent slopes, stony

Component: Cowee, stony (25%)

The Cowee, stony component makes up 25 percent of the map unit. Slopes are 30 to 50 percent. This component is on mountain slopes, mountains. The parent material consists of affected by soil creep in the upper solum over residuum weathered from igneous and metamorphic rock. Depth to a root restrictive layer, bedrock, paralithic, is 20 to 40 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 4 percent. Nonirrigated land capability classification is 6e. This soil does not meet hydric criteria.

Map unit: TkD - Tate loam, 15 to 30 percent slopes, very stony

Component: Tate, very stony (85%)

The Tate, very stony component makes up 85 percent of the map unit. Slopes are 15 to 30 percent. This component is on fans, coves, mountains, drainageways. The parent material consists of colluvium derived from igneous and metamorphic rock. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is high. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 5 percent. Nonirrigated land capability classification is 4s. This soil does not meet hydric criteria.

Map unit: TpE - Toecane-Tusquitee complex, 30 to 50 percent slopes, very bouldery

Component: Toecane, very bouldery (55%)

The Toecane, very bouldery component makes up 55 percent of the map unit. Slopes are 30 to 50 percent. This component is on coves, drainageways, fans, mountains. The parent material consists of cobbly and stony colluvium derived from igneous and metamorphic rock. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 10 percent. Nonirrigated land capability classification is 7s. This soil does not meet hydric criteria.

Component: Tusquitee, very bouldery (35%)

The Tusquitee, very bouldery component makes up 35 percent of the map unit. Slopes are 30 to 50 percent. This component is on coves, drainageways, fans, mountains. The parent material consists of colluvium derived from igneous and metamorphic rock. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 10 percent. Nonirrigated land capability classification is 6s. This soil does not meet hydric criteria.

Forestland Productivity

[redacted] County, North Carolina

[This report shows only the major soils in each map unit]

Map symbol and soil name	Potential productivity			Trees to manage
	Common trees	Site index	Volume of wood fiber	
			Cu ft/ac	
CkD2:				
Clifton, moderately eroded	Eastern white pine	95	172	Chestnut oak, Eastern white pine, White oak, Yellow-poplar
	Pitch pine	---	---	
	Scarlet oak	---	---	
	Virginia pine	---	---	
	Yellow-poplar	---	---	
EdE:				
Edneyville, stony	Black oak	---	---	Eastern white pine, Northern red oak, Shortleaf pine, Yellow-poplar
	Chestnut oak	---	---	
	Eastern white pine	90	166	
	Northern red oak	80	62	
	Scarlet oak	---	---	
	Shortleaf pine	64	97	
	Virginia pine	66	102	
	Yellow-poplar	98	104	
Chestnut, stony	Black oak	71	53	Eastern white pine, Shortleaf pine, Yellow-poplar
	Chestnut oak	69	51	
	Eastern white pine	78	139	
	Northern red oak	76	58	
	Scarlet oak	68	50	
	Shortleaf pine	---	---	
	White oak	70	52	
	Yellow-poplar	97	102	
EdF:				
Edneyville, stony	Black oak	---	---	Eastern white pine, Northern red oak, Shortleaf pine, Yellow-poplar
	Chestnut oak	---	---	
	Eastern white pine	90	166	
	Northern red oak	80	62	
	Scarlet oak	---	---	
	Shortleaf pine	64	97	
	Virginia pine	66	102	
	Yellow-poplar	98	104	
Chestnut, stony	Black oak	71	53	Eastern white pine, Shortleaf pine, Yellow-poplar
	Chestnut oak	69	51	
	Eastern white pine	78	139	
	Northern red oak	76	58	
	Scarlet oak	68	50	
	Shortleaf pine	---	---	
	White oak	70	52	
	Yellow-poplar	97	102	

Forestland Productivity

[redacted] County, North Carolina

Map symbol and soil name	Potential productivity			Trees to manage
	Common trees	Site index	Volume of wood fiber	
			Cu ft/ac	
EwD:				
Evard, stony	Chestnut oak	77	59	Chestnut oak, Eastern white pine, Shortleaf pine, White oak
	Eastern white pine	93	172	
	Hickory	---	---	
	Northern red oak	---	---	
	Pitch pine	---	---	
	Shortleaf pine	73	116	
	Virginia pine	69	107	
	White oak	---	---	
	Yellow-poplar	95	98	
Cowee, stony	Black oak	---	---	Eastern white pine, Shortleaf pine
	Chestnut oak	55	38	
	Eastern white pine	78	139	
	Northern red oak	---	---	
	Pitch pine	---	---	
	Scarlet oak	54	38	
	Shortleaf pine	78	126	
	Virginia pine	63	96	
	White oak	---	---	
	Yellow-poplar	80	71	
EwE:				
Evard, stony	Chestnut oak	77	59	Chestnut oak, Eastern white pine, Shortleaf pine, White oak
	Eastern white pine	93	172	
	Hickory	---	---	
	Northern red oak	---	---	
	Pitch pine	---	---	
	Shortleaf pine	73	116	
	Virginia pine	69	107	
	White oak	---	---	
	Yellow-poplar	95	98	
Cowee, stony	Black oak	---	---	Eastern white pine, Shortleaf pine
	Chestnut oak	55	38	
	Eastern white pine	78	139	
	Northern red oak	---	---	
	Pitch pine	---	---	
	Scarlet oak	54	38	
	Shortleaf pine	78	126	
	Virginia pine	63	96	
	White oak	---	---	
	Yellow-poplar	80	71	

Forestland Productivity

[redacted] County, North Carolina

Map symbol and soil name	Potential productivity			Trees to manage
	Common trees	Site index	Volume of wood fiber	
			Cu ft/ac	
TkD:				
Tate, very stony	Black locust	---	---	Eastern white pine, Yellow-poplar
	Eastern hemlock	---	---	
	Eastern white pine	89	164	
	Northern red oak	---	---	
	White oak	---	---	
	Yellow-poplar	92	83	
TpE:				
Toecane, very bouldery	Black cherry	---	---	Black cherry, Eastern white pine, Northern red oak, White ash, Yellow-poplar
	Eastern hemlock	---	---	
	Northern red oak	---	---	
	Yellow birch	---	---	
	Yellow-poplar	104	114	
Tusquitee, very bouldery	American beech	---	---	Black cherry, Eastern white pine, Northern red oak, White ash, Yellow-poplar
	Black cherry	83	---	
	Black locust	---	---	
	Black walnut	---	---	
	Eastern hemlock	---	---	
	Eastern white pine	100	186	
	Hickory	---	---	
	Northern red oak	---	---	
	White ash	---	---	
	White oak	---	---	
	Yellow birch	---	---	
	Yellow-poplar	103	112	

Appendix C: Invasives

EcoForesters' 7 Ps for Invasive Plants

Non-Native Invasive Identification & Control Options for Species found on the Property

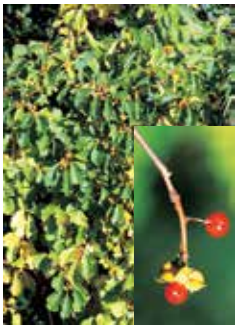
- *Oriental Bittersweet*
- *Multiflora Rose*
- *Japanese Spirea*
- *Chinese Silvergrass (Miscanthus)*
- *Wineberry*
- *Periwinkle*

Emerald Ash Borer (EAB) Treatments

EcoForesters 7 P's for Invasive Non-native Plant Management

1. **Protect** any at risk special ecological areas (rare, threatened, or endangered species or habitats) for carefully targeted invasive control.
2. **Prevent** invasives from spreading into un-infested "core" forest areas and rapidly respond to new infestations before they get established. Secondarily, the long term ongoing process of containing and controlling severe infestations can begin.
3. **Plan** for invasives control as much as 10 years before and after any forest disturbance such as timber management, as invasives can grow quickly and take over new growing space. Implement forestry practices that promote the health and vitality of diverse native species to compete more successfully with invasives over the long haul.
4. **Promote** long-term, community wide education and strategies to control existing infestations as invasive species do not respect property lines. Large-scale invasives control and sustainability is best achieved when landowners in communities work together under a cohesive approach.
5. **Prioritize** control of invasives that are the most significant threat to forest regeneration first. Species such as vines that can smother trees, have abundant seeds, are shade tolerant, and fast growing tend to be the greatest threats.
6. **Professional** planning is necessary to obtain the most cost effective and impactful results. A qualified forester can perform the complex tasks of demarcating special and core habitats, prioritizing invasives control areas, evaluating local site conditions, and assessing landowner objectives within a comprehensive invasives control plan.
7. **Persevere** as invasive species management is a long-term endeavor. Even if no invasives are present on a property, continuous monitoring for early detection and rapid response is essential. Additionally, areas that have been treated should be reevaluated regularly and management approaches adapted based on the results.

Oriental Bittersweet





Jane Hargreave

Oriental bittersweet (*Celastrus orbiculatus* Thunb.) is an attractive but very invasive deciduous, twining, and climbing woody vine to 60 feet (20 m) with drooping branches in tree crowns, forming thicket and arbor infestations. It has alternate elliptic-to-rounded leaves 1.2- to 5-inches (3 to 12 cm) long. Female plants have axillary dangling clusters of inconspicuous yellowish flowers that yield spherical fruit capsules, green maturing to yellow, that split to reveal three-parted showy scarlet fleshy-covered seeds, which remain through winter at most leaf axils. Colonizes by prolific vine growth that root at nodes and seedlings from prolific seed spread mainly by birds, possibly other animals and humans collecting and discarding decorative fruit-bearing vines. Seeds are highly viable, germinate even under dense shade, and after germination, grow rapidly when exposed to light. Most seed will germinate but only remain viable for 1 year in the soil. Resembles American bittersweet (*C. scandens* L.), which has only terminal white flower clusters that yield orange fruit capsules; leaves usually twice as large but absent among the flowers and fruit. Hybridization occurs between the two species.

Management strategies:

- Do not plant. Remove prior plantings, and control sprouts and seedlings. Bag and dispose of plants and fruit in a dumpster or burn.
- Treat when new plants are young to prevent seed formation.
- Pull, cut, and treat when fruit are not present.
- Minimize disturbance within miles of where this plant occurs, and anticipate wider occupation when plants are present before disturbance.
- Repeated cutting to groundline commonly recommended for control, while root sprouts might worsen some infestations.
- Manually pull new seedlings and tree wrench large vines when soil is moist, ensuring removal of all roots. Outlying large vines that remain after treatments will resprout, even under a forest canopy.
- Burning treatments are suspected of having minimal topkill effect due to scant litter.
- Readily eaten by goats while seed spread is possible.

Recommended control procedures:

- Thoroughly wet all leaves with one of the following herbicides in water with a surfactant (July to October): Garlon 4, Garlon 3A, or a glyphosate herbicide as a 3-percent solution (12 ounces per 3-gallon mix).
- For stems too tall for foliar sprays, to control vines less than 1-inch diameter, apply Garlon 4 as a 20-percent solution (5 pints per 3-gallon mix) in a labeled basal oil product, vegetable oil, kerosene, or diesel fuel (where permitted); or apply undiluted Pathfinder II as a basal spray to the lower 2 feet of stems. Or cut large stems and immediately treat the cut surfaces with one of the following herbicides in water with a surfactant: Garlon 4 or a glyphosate herbicide as a 25-percent solution (32 ounces per 1-gallon mix). ORTHO Brush-B-Gon and Enforcer Brush Killer are effective for treating cut-stumps and readily available in retail garden stores (safe to surrounding plants). Winter applications are effective.
- For large vines, make stem injections using Arsenal AC*, Garlon 3A, or a glyphosate herbicide using dilutions and cut-spacings specified on the herbicide label (anytime except March and April). The EZ-Ject tree injector assists in reaching through entanglements to treat, and the glyphosate shells have been found effective in winter.

* Nontarget plants may be killed or injured by root uptake.

Nonnative Roses

Multiflora rose (*Rosa multiflora* Thunb.), Macartney rose (*R. bracteata* J.C. Wendl.), Cherokee rose (*R. laevigata* Michx.), and other nonnative roses are all evergreen except multiflora. Roses are all erect, arching, or trailing shrubs to 30 feet (9 m) in height, or long and clump forming. They have pinnately compound leaves with three to nine leaflets and frequent recurved or straight thorns. Clustered or single white-to-pink flowers in early summer yield red rose hips in fall to winter. Roses colonize by prolific sprouting and stems that root when touching the soil and spread by bird- and mammal-dispersed seeds. Resemble native Carolina rose (*R. carolina* L.), swamp rose (*R. palustris* Marsh.), and climbing rose (*R. setigera* Michx.), all of which have pink flowers in spring and nonbristled leafstalk bases, but none form extensive infestations except swamp rose in wet habitat.

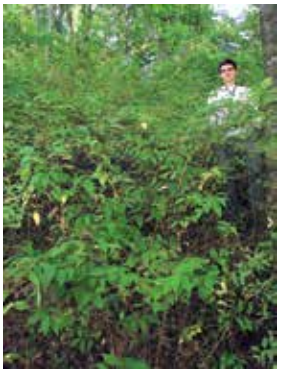
Management strategies:

- Do not plant. Remove prior plantings, and control sprouts and seedlings. Bag and dispose of fruit in a dumpster or burn.
- Treat when new plants are young to prevent seed formation.
- Cut and bulldoze when fruit are not present.
- Minimize disturbance within miles of where these plants occur, and anticipate wider occupation if plants are present before disturbance.
- Manual pulling is hindered by thorny branches and is limited to new seedlings.
- Manually pull new seedlings and tree wrench saplings when soil is moist, ensuring removal of all roots.
- Readily eaten by goats and sheep, although this activity also might spread seeds.

Recommended control procedures:

- Thoroughly wet all leaves with one of the following herbicides in water with a surfactant: [April to June (at or near the time of flowering)] Escort XP* at 1 ounce per acre in water (0.2 dry ounce per 3-gallon mix); (August to October) Arsenal AC* as a 1-percent solution (4 ounces per 3-gallon mix) or Escort XP* at 1 ounce per acre in water (0.2 dry ounce per 3-gallon mix); and (May to October) repeated applications of a glyphosate herbicide as a 4-percent solution in water (1 pint per 3-gallon mix), a less-effective treatment that has no soil activity to damage surrounding plants.
- For stems too tall for foliar sprays, apply basal sprays (January to February or May to October) using Garlon 4 as a 20-percent solution (5 pints per 3-gallon mix) in a labeled basal oil product, vegetable oil or mineral oil with a penetrant, or fuel oil or diesel fuel (where permitted); or apply undiluted Pathfinder II. Or cut large stems and immediately treat the stump tops with one of the following herbicides in water with a surfactant: Arsenal AC* as a 10-percent solution (1 quart per 3-gallon mix) or when safety to surrounding vegetation is desired, a glyphosate herbicide as a 20-percent solution (5 pints per 3-gallon mix). ORTHO Brush-B-Gon and Enforcer Brush Killer are effective undiluted for treating cut-stumps and available in retail garden stores (safe to surrounding plants).

* Nontarget plants may be killed or injured by root uptake.




Great Smoky Mtns. NP Res. Mgmt. Archive

Japanese Meadowsweet

Japanese meadowsweet or Japanese spiraea (*Spiraea japonica* L.f.) is a deciduous erect shrub to 6 feet (1.8 m) high with multiple stems and alternate branches, slender and brown, intertwining or arching outward on hillside infestations. The leaves are small, alternate, and lanceolate with irregular serrate margins. Flat-topped clusters have tiny rose-pink flower heads with festooning branch tips and turn into crowded clusters of lustrous brown seed capsules in midsummer. Dense infestations of entangled stems, branches, and foliage exclude other plants and impact animal habitat. Infestations intensify by abundant basal sprouting. Resembles several native and nonnative spiraeas, but is unique in the flat-topped, pink to pink-rose flower clusters and brown fruit clusters, the hairy branchlets and flowers, and lanceolate leaves.

Management strategies:

- Do not plant. Remove prior plantings, and control sprouts and seedlings. Bag and dispose of fruit in a dumpster or burn.
- Treat when new plants are young to prevent seed formation.
- Minimize disturbance within miles of where this plant occurs, and anticipate wider occupation when plants are present before disturbance.
- Do not treat with herbicides when leaves are yellow.
- Manually pull and tree wrench when soil is moist, ensuring removal of the roots.

Recommended control procedures:

- Thoroughly wet all leaves with Garlon 3A or a glyphosate herbicide as a 3-percent solution (12 ounces per 3-gallon mix) in water with a surfactant. Applications may be made almost any time of year, but air temperature must be above 65 °F (18 °C) to ensure absorption by the plant. September is the best time of year for application.
- Cut large stems and immediately treat the stump tops with one of the following herbicides: a glyphosate herbicide or Garlon 3A as a 25-percent solution (3 quarts per 3-gallon mix). ORTHO Brush-B-Gon and Enforcer Brush Killer are

Chinese Silvergrass




Chinese silvergrass (*Miscanthus sinensis* Andersson) is a tall, densely tufted, perennial grass, 5 to 10 feet (1.5 to 3 m) in height from a perennial root crown. It has long, slender, and upright-to-arching leaves with whitish upper midveins and many loosely plumed panicles turning silvery to pinkish in fall. Dried grass remains standing with some seed heads during winter, but seed viability is variable depending on cultivar and location. Spreading invasive cultivars have viable seeds. Species forms extensive infestations by escaping from older ornamental plantings to roadsides, forest margins, rights-of-way, and adjacent disturbed sites, especially after burning. Presently only an invasive problem in the northern tier of States in the southern region, while projected widespread plantings for biomass and biofuels could result in aggravated problems.

Management strategies:

- Do not plant. Remove prior plantings, and control sprouts and seedlings. Bag and dispose of plants and seed heads in a dumpster or burn. Sterile cultivars most commonly planted are not a problem.
- Treat when new plants are young to prevent seed formation.
- Minimize disturbance within miles of where fertile plants occur, and anticipate wider occupation if plants are present or adjacent before disturbance.
- Do not mow when there are seed heads.
- Burning treatments are suspected of having minimal effect, and dormant standing infestations in winter are highly flammable and pose a fire hazard.

Recommended control procedures:

- Thoroughly wet all leaves with one of the following herbicides in water with a surfactant (September or October with multiple applications to regrowth): Arsenal AC* as a 1-percent solution (4 ounces per 3-gallon mix). When safety to surrounding vegetation is desired, a glyphosate herbicide as a 4-percent solution (1 pint per 3-gallon mix) only to the target plants; or a combination of the two herbicides, Arsenal AC* as a 0.5-percent solution (2 ounces per 3-gallon mix) plus a glyphosate herbicide as a 4-percent solution (2 ounces plus 1 pint per 3-gallon mix). Repeat applications when new growth reaches 2 feet (60 cm) in height.

* Nontarget plants may be killed or injured by root uptake.

Invasive Plants in Pennsylvania

Wineberry

Rubus phoenicolasius Maxim.

Photo: John Randall, The Nature Conservancy, www.invasive.org

Background:

Also known as wine raspberry, this shrub from eastern Asia was introduced into the U.S. in 1890 as breeding stock for new raspberry cultivars. It is still used today by berry breeders.

Range:

This shrub is found mostly along the Appalachian ridge from Massachusetts to Tennessee, with scattered patched in New York, the Carolinas and parts of the Midwest.

pennsylvania
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
www.dcnr.state.pa.us

Description:

This is a multi-stemmed shrub that can grow up to nine feet tall under favorable conditions. The entire plant is covered in tiny, reddish hairs and sharp spines. The compound leaves are made up of three heart-shaped, toothed leaflets. The leaves alternate along the stem and are green on top, white on the under-side. White, five-petaled flowers appear in the spring and later give way to red, raspberry-like fruits in June and July.

Photo: Tuscarora State Forest

Habitat:

This shrub prefers moist, open areas like fields, roadsides and forest edges.

Biology and Spread:

The berries of this shrub are eaten by a variety of wildlife and humans, thus contributing to its spread. It also reproduces vegetatively through root nodes. New plants can also form as the branches touch the ground and root.

Ecological Threat:

This plant can form extensive, dense thickets that displace native vegetation and restrict light to lower growing vegetation. Wineberry is also host to several viruses that can affect raspberries, like raspberry yellow spot.

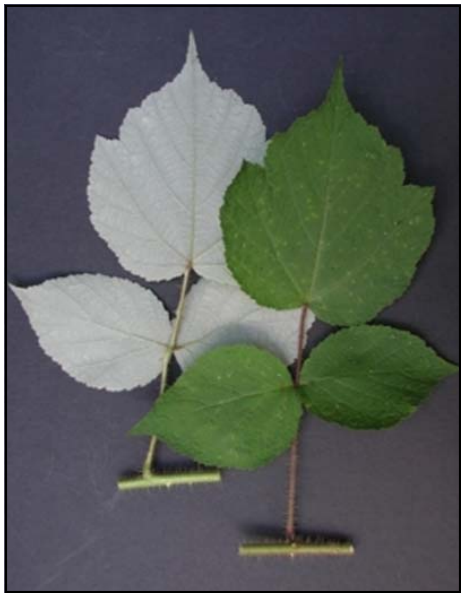


Photo: Leslie Mehrhoff, U. of Connecticut, www.invasive.org

How to Control this Species:

Manual

Plants can be removed by hand pulling with thick gloves or by using a four-prong spading fork, especially when the soul is moist. All roots and branches must be removed to prevent re-sprouting.

Chemical

Use of a systemic herbicide like glyphosate or triclopyr is also effective at controlling this species. Herbicide can be sprayed on the leaves, or the plant can be cut near the base and the herbicide painted on the exposed stump.

Look-A-Likes:

There are two native *Rubus* shrubs that might be confused with wineberry. Neither has the abundant reddish hairs and thorns (*see photo on right*) that mark wineberry.

Common blackberry
(*Rubus allegheniensis*)

Photo: Britt Slattery, USFWS

Flowering raspberry
(*Rubus odoratus*)

Photo: Sten, http://en.wikipedia.org

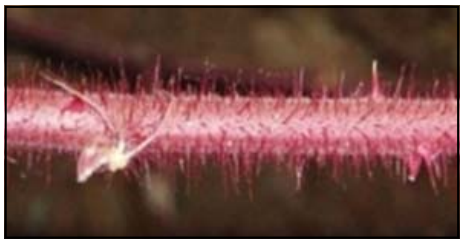


Photo: Leslie Mehrhoff, U. Of Connecticut, www.invasive.org

Native Alternatives:

In addition to the look-a-alike *Rubus* species shown below, there are other native shrubs that provide good food for wildlife, including red chokeberry (*Aronia arbutifolia*), spicebush (*Lindera benzoin*), American beautyberry (*Callicarpa americana)* and common winterberry (*Ilex verticillata*), shown below).

Photo: Dow Gardens Archive, www.forestryimages.org

References:

Center for Invasive Species and Ecosystem Health: http://www.invasive.org/browse/subinfo.cfm?sub=3072

Invasive Exotic Plant Pest Tutorial: http://www.dcnr.state.pa.us/forestry/invasivetutorial/wineberry.htm

Plant Invaders of Mid-Atlantic Natural Areas: http://www.nps.gov/plants/alien/pubs/midatlantic/midatlantic.pdf

For More Information:

To learn more about invasive species in Pennsylvania, visit:

DCNR Invasive Species Site: http://www.dcnr.state.pa.us/conservationscience/invasivespecies/index.htm

Vincas, Periwinkles

Nancy Loewenstein

Common periwinkle (*Vinca minor* L.) and bigleaf periwinkle (*V. major* L.) are evergreen (leaves always present), somewhat woody, trailing or scrambling vines to 3 feet (1 m) long and upright to 1 foot (30 cm) that form dense ground cover. They have opposite lanceolate-to-heart-shaped leaves and five-petaled pinwheel-shaped violet single flowers. They form mats and extensive infestations even under forest canopies by vines rooting at nodes. Viable seed appear to be produced only rarely.

Management strategies:

- Do not plant. Remove prior plantings, and control sprouts and seedlings. Bag and dispose of plants in a dumpster or burn.
- Treat when new plants are young.
- Mowing treatments or injury of the leaves by a string trimmer immediately prior to herbicide spraying improves control with herbicides lacking soil activity.
- Burning treatments are suspected of having minimal effect.

Recommended control procedures:

- Thoroughly wet all leaves (until runoff) with one of the following herbicides in water with a surfactant (July to October for successive years): Tordon 101[*] [‡] as a 3-percent solution (12 ounces per 3-gallon mix) or Tordon K[*] [‡] as a 2-percent solution (8 ounces per 3-gallon mix); or in spring when safety to surrounding vegetation is desired before stands become dense with new growth, Garlon 4 as a 4-percent solution (1 pint per 3-gallon mix); or during the growing season, repeatedly apply Garlon 4 or a glyphosate herbicide as a 2-percent solution in water (8 ounces per 3-gallon mix) with a surfactant. In winter, herbicide treatments should be limited to warm days.

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[*] Nontarget plants may be killed or injured by root uptake.

[‡] When using Tordon herbicides, rainfall must occur within 6 days after application for needed soil activation. Tordon herbicides are restricted use pesticides.

XHT1181

University of Wisconsin Pest Alert

UW Extension
University of Wisconsin–Extension

Provided to you by:

Homeowner Guide to Emerald Ash Borer Insecticide Treatments

R. Chris Williamson and PJ Liesch, UW Entomology

Emerald ash borer insecticide treatment considerations. *Several insecticide products are available to homeowners for control of emerald ash borer (EAB). Since the presence and infestation level of EAB is quite difficult to determine at early stages of an infestation, insecticide treatments may be merited to mitigate damage by EAB. However, not all ash trees should be treated as some may be too extensively compromised or in poor condition to receive treatment. Tree location, value, and health, as well as the cost of treatment are all factors to consider. Due to the expense of yearly insecticide treatments, one should consider the value of a particular ash tree in relation to insecticide treatment costs before making any treatments. In addition, consider the health of each tree before treating. Research suggests that insecticide treatments are significantly more effective on EAB-infested ash trees with less than 50% canopy thinning. Insecticide treatments are* ***not*** *suggested for trees with greater than 50% canopy thinning. Trees with greater than 50% canopy thinning should be removed and destroyed in accordance with established guidelines. For a more detailed discussion on this topic, see University of Wisconsin Garden Facts XHT1215, "Is My Ash Tree Worth Treating for Emerald Ash Borer".*

Emerald ash borer insecticide treatment options. *Insecticide products available for use by homeowners are summarized in Table 1. They include:*

- *ACECAP 97 Systemic Insecticide Tree Implants (acephate)*
- *Bayer Advanced Tree and Shrub Insect Control II (imidacloprid)*
- *Bayer Advanced Tree and Shrub Protect & Feed (imidacloprid)*
- *Bayer Advanced Tree and Shrub Protect & Feed II (imidacloprid + clothianidin)*
- *Bonide Annual Tree & Shrub Insect Control with SYSTEMAXX (imidacloprid)*
- *Compare N Save Systemic Tree & Shrub Insect Drench (imidacloprid)*
- *Ferti-lome Tree and Shrub Systemic Drench (imidacloprid)*
- *Optrol (imidacloprid)*
- *Ortho Bug-B-Gone Year Long Tree & Shrub Insect Control (imidacloprid)*
- *Several other products containing imidacloprid are also currently available*

Most of the products available to homeowners are systemic insecticides containing imidacloprid and are applied as soil drenches around the base of an ash tree. One granular product is also available. Recent university research suggests that applications of imidacloprid should be made in spring to be most effective. Research also has demonstrated that soil applications of imidacloprid-containing homeowner products provide excellent EAB protection for ash trees that are less than about 47 inches in circumference [i.e., 15 inches in diameter at breast height (DBH)]. Due to differences in application rates and label restrictions, treatment by a tree care professional (e.g., arborist) may be the best option for larger trees. For best results, treatment of trees should begin before trees become infested. Lastly, insecticide treatments must be repeated each year.

Be aware that many insecticide products available at hardware stores and garden centers look alike. Carefully check all product labels before purchase to make sure that you have selected the correct product/active ingredient. ALWAYS read and follow the pesticide label directions on the product that you select!

Finally, note that although ACECAP 97 Systemic Insecticide Tree Implants are available to homeowners, we do NOT recommend that homeowners use these because they require physically drilling into a tree during their application.

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University of Wisconsin Pest Alert

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Table 1 Emerald ash borer insecticide treatments available to homeowners			
Product	**Active Ingredient**	**Timing**	**Type of application**
Bayer Advanced Tree & Shrub Insect Control II (D) *Bayer Advanced Tree & Shrub Protect & Feed (D or G)* *Bonide Annual Tree & Shrub Insect Control with SYSTEMAXX (D)* *Compare N Save Systemic Tree & Shrub Systemic Insect Drench (D)* *Ferti-lome Tree & Shrub Systemic Drench (D)* *Ortho Bug B Gone year Long Tree & Shrub Insect Control (D)*	*Imidacloprid*	*Mid-April to mid-May*	*Soil Drench (D) or Granular (G)*
Optrol (D)	*Imidacloprid*	*Mid-April to mid-May and/or Early-Sept. to mid-Oct.*	*Soil drench (D)*
Bayer Advanced Garden Tree & Shrub Protect & Feed II (D)	*Imidacloprid + Clothianidin*	*Mid-April to mid-May*	*Soil Drench (D)*
ACECAP 97 Systemic Insecticide Tree Implants	*Acephate*	*Mid-May to mid-June*	*Trunk Implant*

Other emerald ash borer treatment options. *Homeowners may also contact a certified arborist or certified pesticide applicator to treat their trees. See http://www.waa-isa.org for a list of certified arborists in Wisconsin. Professionals have access to some products that are not available to homeowners.*

The University of Wisconsin does not endorse commercially available insecticide products over those available directly to homeowners. Products discussed in this fact sheet have been evaluated in university research tests on EAB.

For more information on controlling emerald ash borer: *See http://www.entomology.wisc.edu/emeraldashborer, http://www.emeraldashborer.wi.gov or http://www.emeraldashborer.info or contact your county Extension agent. For a video demonstration of treating your ash trees using a systemic drench, see http://www.entomology.wisc.edu/new-video-protecting-your-tree-emerald-ash-borer.*

Thanks to Kristin Krokowski, Patti Nagai, Phil Pellitteri and Robert Tomesh for reviewing this document.

Appendix D: Forest Management Methods & Others

Silvicultural Treatment Methods Explained

Hack-and-Squirt & Cut-and-Leave Treatments

NRCS Environmental Quality Incentive Program [EQIP] Pamphlet

Controlled Burn Pamphlet

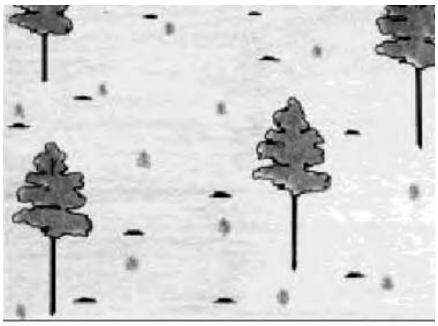
FireWise Landscaping Pamphlet

Native Warm-Season Grasses and Wildlife

NCNHP Natural Area and At Risk Species Report

Management Action Tracking Tables

SILVICULTURAL SYSTEMS


Seed-Tree

SEED-TREE: This is a silvicultural system in which most of the trees in a stand are harvested, while a select number of high-quality trees are left to produce seed for stand regeneration. These trees are eventually cut, leaving an even-aged forest stand. This method is very similar to a clear-cut, with little or no difference in the resulting changes in the environmental condition. The primary difference is that the seed-tree method can be used to encourage natural regeneration even when advance regeneration is lacking.

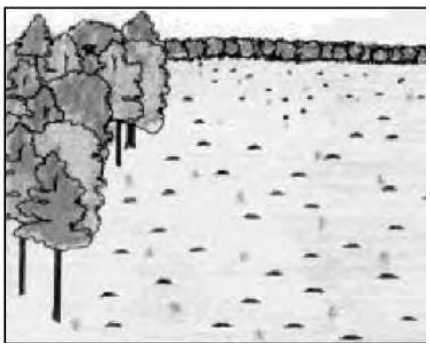
This method is most appropriate when used with light-seeded, wind-dispersed species. Seed trees should be healthy trees, indicating good genetic stock, that are good seed producers, and 6 to 15 trees should be well distributed per acre. The use of the seed-tree system should be subject to the same considerations as clearcuts.


Shelterwood

SHELTERWOOD: The shelterwood method is very similar to the seed-tree system, with at least two cuts used to remove the overstory. In a shelterwood system, however, a larger number of high-quality trees are left after the first cut. This method has a mitigating effect on the environmental conditions caused by clearcutting by lessening the increase in soil temperature and erosion, maintaining some wooded habitat, decreasing the visual impact of a harvest while increasing the amount of light that reaches the forest floor.

Generally, the shelterwood method is used to create an even-aged stand after the second cut However, it can produce two or three age classes, and may be recommended for even-aged stands being converted to multiple ages. Because the shelterwood method creates large gaps in the canopy and high levels of light to the understory, it is an important method for the regeneration of oak and other moderately shade-intolerant species.

RESERVES: In all of the above methods, it is possible to leave some good quality reserve trees – uncut trees that remain standing after a regeneration period – in order to maintain an older class of trees after regeneration has become established. Where clearcuts, seed-tree or shelterwood systems are the most appropriate silvicultural regeneration systems, it is advisable to leave reserves where possible. These can lessen environmental impacts and create two-aged stands.


Clear-cut

CLEARCUT: Clearcutting is the removal of all of the trees from a stand with one single operation or entry. Clearcutting is used to produce even-aged stands, to regenerate species that require full sunlight and to convert a stand to a different species. Although there are large-scale natural disturbances such as fires and major windstorms that occur within southern Appalachian forests and create forest openings the size of some clearcuts, they occur in any given location only rarely every few hundred years or even longer.

Management systems that employ frequent large-scale clearcuts, particularly on short rotations, do not resemble the natural ecological processes within the Appalachians. Large clearcuts radically modify the forest environment, altering habitat and soil temperature for a period of time, and if done poorly, increasing the potential for erosion. A number of wildlife species such as killdeer, ruffed grouse, and white tail deer use early successional habitat, which can be created by a clearcut, although all of these species also need forest cover and edge habitat to thrive.

For the above reasons, Appalachian Voices does not recommend large clearcuts as a common forest management practice in the Appalachian region. There are situations, however, where clearcuts provide certain restorative opportunities. In forest stands that are extremely degraded or irreversibly infested with pests or disease, it may be appropriate to employ the clearcut system. Clearcuts can also be a method of managing for certain high value shade-intolerant species, such as black cherry, although it is important to be aware that such management does not mimic the natural species composition of the area. In these instances, the clearcut should be limited to the smallest size practical, and should not be carried out in areas with extreme slope or a high potential for erosion. Your forester can help determine the most appropriate size for clearcuts.

In a sustainable forestry program, a clearcut should only be considered the first step in a successional process to encourage indigenous forest communities rather than the central technique in an ongoing management regime. Clearcuts followed by continuous pine plantations are not considered to be sustainable forestry, as pine plantations rarely replicate natural conditions

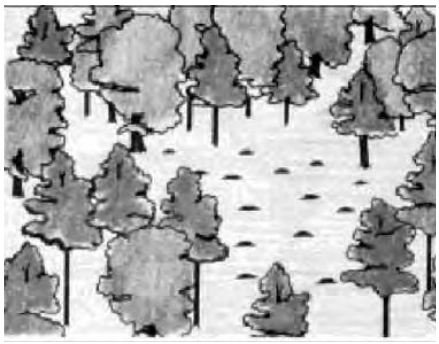
THE FORESTLAND GROUP

Andy Norris is the director of forest operations for The Forestland Group, LLC. He helps to oversee a sustainably-managed hardwood forest in Morgan County, TN. A collection of permanent certification plots have been installed on the site. These plots are measured every ten years in order to track growth trends.

Data from plots measured in 1994 and again in 2004 reveal a net volume gain of 12% after accounting for growth, removals, and deaths. According to Andy, "With the goal of cutting less than growth, we have been able to realize a net gain in volume and an increase in the residual growth rate on the property."

The silvicultural prescriptions applied on this land include improvement thinnings as well as patch clear-cuts of ten acres and less. By ensuring that growth volumes exceed harvest volumes, consistent net and residual growth gains have been realized. Also, by harvesting only the lowest quality timber on the site, the quality of remaining stocks improves steadily. To contact Andy Norris, call 615-778-1310 or email andy@forestlandgroup.com.

in the southern Appalachians. Clearcuts should be used sparingly as a means of improving forest health, rather than as an extensive long-term management practice. For landowners considering clearcutting, small, scattered clearcuts rather than large, contiguous clearcuts will enhance landscape diversity and the diversity of habitats.



Group Selection

GROUP SELECTION: Selection silviculture methods produce an uneven-aged forest landscape. Group selection involves removing small groups of trees, usually in an area with a size no larger than twice the height of the remaining trees, although smaller openings can also be created. Group selection openings are usually less than two acres in size. Because the openings are relatively small, the landscape as a whole retains the characteristics of a native, uneven-aged forest.

Group selection increases light to the understory but uses less intensive harvesting than the shelterwood system. Group selection can be used to regenerate moderately shade-intolerant species, but it is not recommended for oak unless the openings are an acre or more in size.

Because uneven-aged forests create multiple canopy layers, there is a high level of habitat diversity. In addition, openings within the forest provide small areas of both early successional habitat and edge habitat, making group selection appropriate for a number of wildlife species, including bluebirds, turkey, deer and bats.

Single-tree Selection

SINGLE-TREE SELECTION: Single-tree selection involves the removal of individual trees in a stand, and is generally used to regenerate shade-tolerant species. Each tree is evaluated independently, mature trees harvested, trees of poor form or species are removed and overly dense areas are thinned. Merchantable trees of all ages, species and sizes can be removed, but the remaining stand must have a balanced mixture of ages and sizes of high quality trees.

This method typically does not allow enough sunlight for some high-value, shade-intolerant species black cherry, yellow poplar, walnut and shortleaf pine. In practice, some half-acre openings may also be needed to regenerate a variety of species not shade tolerant. To ensure oak regeneration in a single tree selection system, you may need to do some "forest gardening" to insure oak regeneration, such as hand clearing of competing vegetation and shelters to protect against deer browsing.

In some instances it is possible to regenerate moderately shade-intolerant species using single-tree selection, particularly when a site has lower quality soil and less moisture, providing less competition for the trees you want to establish. However, when the management objective is regenerating high value hardwood species, which are often not shade-tolerant, group selection is the more appropriate uneven-aged system to use in the Southern Appalachians.

Similar to group selection, single-tree selection produces multiple canopy layers and a diversity of habitats. Although larger openings are not created, early successional habitat does not result from this silvicultural system. Single-tree selection is the least intensive silvicultural method, because it never drastically changes the composition of a stand at one time. However, the residual trees can be damaged with more frequent entries for harvest, and your soils are also more likely to be damaged through compaction. Because of this, it is critical that loggers

working in a single-tree selection system employ the least damaging and most ecologically sensitive harvest methods possible.

In the past, single-tree selection has often been mis-characterized as "high-grading," or harvesting that focuses on the removal of the best trees in a stand, leaving a degraded forest stand over time. For this reason, foresters frequently have a bias against some selection methods, which are referred to as selective harvests or diameter limit cuts in these cases.

"Properly used, selection silviculture involves harvesting the worst trees first and removing most non-timber or cull trees in addition to merchantable timber."

Both of the selection silviculture systems require frequent entries to maintain a balanced stand, and may require more roads for cost effective extraction. It is important that these entries are properly timed, based on the maturity of the trees, the health of the stand, and the integrity of the site; your forester can determine the appropriate timing.

It is also important to plan the harvesting in a manner resulting in minimal damage to the residual trees. Smaller logging equipment is helpful in minimizing impact, and it is best to have loggers that are careful and familiar with selection methods. It is imperative to have a forester or other resource professional mark trees to signify which should be harvested and which should be left. Use of selection systems also requires a logger who is well trained in directional felling; otherwise, significant damage can occur to the residual trees being left.

REGENERATION METHODS

Within silvicultural systems, forest stands are regenerated using either **natural regeneration** or **artificial regeneration**. Natural regeneration uses seeds already in the ground from the previous forest, windblown seed, stump sprouts and saplings–also called **advance regeneration**–to establish a new forest stand or new trees within a stand. Artificial regeneration relies on planted seedlings to develop a new forest stand. Artificial regeneration is most commonly used in areas under **even-aged management**–natural regeneration is also possible in these systems.

For both financial and ecological reasons, natural regeneration is often preferable. However, artificial regeneration is useful when converting a field back to forest, when changing a stand's species composition or when the quality of a forest stand is substantially degraded.

STOCKING

Stocking is the underlying concept used to manage forests for timber production, and is also useful in managing for overall forest health. Stocking refers to the number of trees in a forest stand and their relative level of crowding. When a stand contains too many trees, or is overstocked, the trees grow slowly and are often stunted. Such a stand is not as productive or healthy as it could be. In an understocked stand, there are too few trees, and they grow rapidly, producing branches low on the trunk, which makes them useless for timber.

If a stand is well stocked, it can be left to continue growing, and will produce sound healthy timber. Typically, an overstocked stand should be harvested or thinned, while an understocked stand can be left to continue growing and may be managed to encourage growth. In addition to stocking levels, management planning must account for the age of a stand, the size of trees, the species composition, and the condition of the trees.

HARDWOOD STOCKING GUIDE

Adapted from Hamilton, Rick A., and Mark A. Megalos. "Forest Land Enhancement Practices for North Carolina" by Rick Hamilton and Mark Megalos, published by the North Carolina Cooperative Extension Service: January 2004

Stocking guides based on scientific research and experience are available for both hardwoods and conifers. Forest inventory is necessary to determine your stocking level. The following table gives desirable stockings based on the average diameter (at 4.5 feet above the ground or DBH) of trees in your forest. This is merely a guide and does not mean that all the trees must be outstanding in quality and form.

Hardwood Stocking Guide

DBH	Trees/acre	Appr. ft. between trees
6	200-340	11-15
8	140-240	13-18
10	90-150	17-22
12	70-115	19-25
14+	50-90	22-29

The recommended hardwood stocking levels above have been developed primarily to provide full occupation of the site for timber production. Ideally, 40-50 higher-quality, well-spaced trees (per acre) that will be carried to final harvest are desirable. Somewhat fewer trees per acre may be tolerable if wildlife, recreation or aesthetics are primary goals or if wider spacing creates ideal conditions for understory plans you wish to keep.

Overstocking (too many trees per acre) is common and overstocked stands may need to be thinned or improved by removing smaller or poorly formed trees to restore a healthy condition. **Crop tree management** is a strategy to identify the best trees in the forest and then release them (remove their immediate neighbors) to reduce competition for water, nutrients and especially sunlight.

Stem Injection (Hack-and-Squirt)

Stem injection (including hack-and-squirt) involves herbicide concentrate or herbicide-water mixtures applied into downward incision cuts spaced around woody stems. Cuts are made by an ax, hatchet, machete, brush ax, cane knife, or a variety of cutting tools and even cordless drills. Tree injection is a selective method of controlling larger trees, shrubs, and vines (greater than 2 inches in d.b.h.) with minimum damage to surrounding plants. Stem injection is the fastest and most cost-effective method for nonnative trees and large shrubs. Injection treatments are sometimes not as effective in controlling multiple-stemmed species compared to the faster basal bark treatments, but may be easier in remote or rough terrain where a backpack sprayer might be impractical or cumbersome. Stem injection is physically demanding for the applicator, who must repeatedly and accurately strike target trees with a sharp tool before delivering the herbicide into the cut. For best results, sharpen tools frequently.

Cane knife.

Incisions must be deep enough to penetrate the bark and inner bark, slightly into the wood. Do not make multiple cuts directly above or below each other because this will inhibit movement of the herbicide within the stem. A complete girdle or frill of the stem is not needed or desirable. Space the injection cuts 1 to 1.5 inches apart edge to edge (or per label instructions) around the circumference of each trunk individually or within a clump at a convenient height. Use a handheld, chemical-resistant 1- to 2-quart spray bottle to apply 0.5 to 2 mL of concentrated herbicide or dilutions (prescribed on the label) into the cut. The amount will depend on the size of cut and how much the cut can hold without the herbicide running onto the bark. Apply herbicide to each cut until the exposed area is thoroughly wet. The herbicide should remain in the injection cut to avoid wasting herbicide and to prevent damage of surrounding plants. All injected herbicides can reach untreated plants by root grafts between like species, and uptake of root exudates by all species results in nontarget damage. Herbicides with soil activity can damage nearby plants when washed from incisions into the soil by unexpected rainfall soon after application. Avoid injection treatments if rainfall is predicted within 48 hours.

Hack-and-squirt method.

Cutting tools for hack-and-squirt treatment.

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Penetrate the bark and inner bark, slightly into the wood.

Steven T. Manning

Apply herbicide into each cut until thoroughly wet.

Special tree injectors are available that combine the cutting operation with automated herbicide delivery. For injecting some herbicides (amine formulations), the Hypo-Hatchet® Tree injector (Forestry Suppliers Inc., 800–647–5368, www.forestry-suppliers.com) consists of a steel hatchet connected to a herbicide container (worn on belt) by tubing. The injector delivers a set amount of herbicide into the cut. Daily cleaning and lubrication of the impact piston is required maintenance, along with periodic replacement of rubber o-rings and seals. Check all hoses and fittings before use for leaks and make appropriate repairs to prevent accidental exposure of herbicide to the applicator. When working with the Hypo-Hatchet in dense infestations, be mindful of the supply tubing, which might become tangled and easily disconnected.

Hypo Hatchet® Tree Injector.

Another injector is the EZ-Ject®, which consists of a steel lance that holds 400 shells of glyphosate or imazapyr herbicides (ArborSystems, 888–395–6732, www.ezject.com). The head of the lance is placed against the base of the target woody plant, and a manual thrust jams the shell through the bark into the inner bark. As with other injection methods, these shells are spaced around each stem. The EZ-Ject is the most efficient and effective injection option for treating multi-stemmed, low-branching shrubs like privets, silverthorn (*Elaeagnus pungens* Thunb.), and bush honeysuckles (*Lonicera* spp.), as well as large entangled vines like oriental bittersweet (*Celastrus orbiculatus* Thunb.). Shell jamming has been reported as a problem when using the EZ-Ject to treat extensive infestations. Removing the herbicide shells when not in use, proper use, and daily maintenance can help prevent jamming.

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EZ-Ject® tree injector.

Tree injection can be applied at most times throughout the year, but December to the middle of January seems to be least effective in the Midsouth. Prolonged cold temperatures can freeze herbicide in the cut, resulting in poor absorption. Heavy spring sapflow can wash herbicide from incision cuts, resulting in poor control and soil transfer to nontarget plants. Prolonged and severe drought is also an ineffective period.

Cut-treat the circumference of large stems, and the entire top of small stems.

Cut-Treat

Cut-treat involves applying herbicide concentrates, herbicide-water or herbicide-penetrant mixtures to the outer circumference of freshly cut stumps or the entire top surface of cut stems. Applications are made with a spray bottle, backpack sprayer, wick, or paint brush. Freshly cut stems and stumps of trees, woody vines, shrubs, canes, and bamboo stems can be treated with herbicide mixtures to prevent resprouting and to kill roots. It is critical that the cut is made as low as possible to the ground, and that the stem is treated immediately after the cut is made. Invasives not treated with herbicides after cutting invariably resprout and intensify their infestation. Cutting is usually by chainsaw or brush saw but can be made by handsaws and cutting blades.

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A 2-quart pressured spray bottle works well for stump treatment.

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Cut stems low for treating.

Cut-and-Leave

The cut-and-Leave treatment is similar to the Cut-Treat method with the only difference that no herbicide will be used after stems have been cut. This results in the disadvantage that stems of broadleaf trees will re-sprout without chemical treatment and will reestablish into the forest composition.

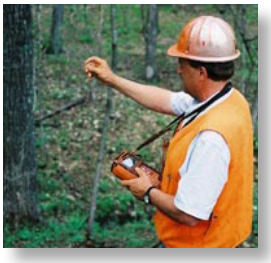
USDA

United States Department of Agriculture

Environmental Quality Incentives Program (EQIP)

Key Practices for Forestry

Since 1996, the Environmental Quality Incentives Program (EQIP) has helped farmers address resource concerns on private land. EQIP, NRCS' principal program for delivering conservation technical and financial assistance to those who need it most, supports the needs of all agricultural operations, offering ideas, science-based solutions, and guidance for successful and sustainable conservation farms and forestlands. Just select and install any of the practices described below--and many others--once you develop a conservation plan designed to address your specific resource concerns. EQIP solves problems for farmers and forest landowners.



Forest Management Plan (FMP) (Practice/Activity Code 106)

An FMP is a site-specific plan developed for clients by a Technical Service Provider. The plan addresses one or more resource concerns on land where forestry-related conservation activities or practices will be planned and applied. This practice may also qualify for benefits under Illinois State Department of Natural Resources, Forest Development Act program. Practices often included in a FMP are designed around the client's objectives to address various natural resource concerns.

Forest Stand Improvement (Conservation Practice Standard 666)

Use of Forest Stand Improvement techniques helps landowners manage species composition, stand structure, and stocking by removing selected trees and understory vegetation. Management practices can directly:

- Increase forest product quantity, quality & restore natural plant communities
- Improve vigor; initiate forest stand regeneration
- Achieve desired crop tree stocking and density levels and increase carbon storage
- Reduce potential damage from wildfire, pests, and moisture stress
- Improve aesthetics, recreation, & wildlife habitat

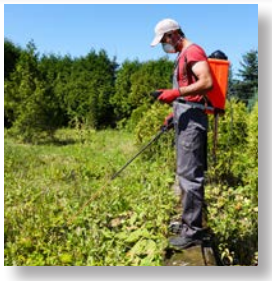
Prescribed Burning (Conservation Practice Standard 338)

Burning can be an effective tool to meet specific forestland and site preparation management objectives. Frequency and intensity of burning should be closely assessed and weighed against resource concerns and management objectives of the site. Under proper conditions, prescribed burns can:

- Achieve proper site preparation
- Reduce wildfire hazards
- Remove slash & debris
- Improve wildlife habitat
- Enhance seedling production
- Restore & maintain ecological sites
- Control undesirable vegetation & plant diseases

Brush Management (Conservation Practice Standard 314)

Brush management techniques can be used in forestland to help landowners control invasive woody species problems such as bush honeysuckle, autumn olive, and multiflora rose. Woody invasive species are very prolific at seed production and sprouting, and are mostly shade tolerant. These characteristics give them a distinct advantage over native species and often times, if not addressed completely, can takeover and even replace native plants, trees and shrubs.



Herbaceous Weed Control (Conservation Practice Standard 315)

Herbaceous weed control, similar to brush management, can be used in forestland to help landowners control invasive herbaceous weed species such as garlic mustard and Japanese stilt grass. Herbaceous weeds are very prolific at seed production and germination and are often very mobile in seed dispersal. These characteristics give them a distinct advantage over native species and often times, if not addressed completely, can takeover and even replace native plants, trees and shrubs. Herbaceous weed control is also used to treat weeds and grass in tree plantings and provide release from competition.

Tree/Shrub Site Preparation (Conservation Practice Standard 490)

Cropland or grassland sites differ from forestland sites, which can dictate site preparation needs and requirements. With proper site preparation, landowners can treat areas and improve site conditions in order to successfully establish woody plants. Considerations include:

- Type of establishment planned – natural regeneration or artificial planting
- Type of equipment used, set-up & maintenance costs
- Site preparation method /combination of methods needed—mechanical, chemical, burning
- Identification & protection of onsite cultural resources
- Cover crop needs

Tree/Shrub Establishment (Conservation Practice Standard 612)

Trees/Shrub establishment introduces woody plants to an area by planting seedlings or cuttings, direct seeding or natural regeneration. Once established, woody plants provide wildlife habitat, potential forest products, and long-term erosion control. They also improve air and water quality, sequester carbon, and enhance area aesthetics. Considerations include:

- Suitable species selection
- Type & purpose of stock
- Size & quality of stock/seed
- Appropriate site preparation needs
- Planting density/rate for intended purpose
- Continued control of plant/weed competition following establishment

Access Control (Conservation Practice Standard 472)

Access Control offers an effective forestry management tool that provides temporary or permanent exclusion of animals, people, vehicles and/or equipment from an area in order to apply, maintain or install planned conservation practices or measures. One commonly used EQIP forestry application for proper Access Control is the physical construction of a barrier fence to exclude livestock from damaging the forest application area. See also Fence (Conservation Practice Standard 382).

Riparian Forest Buffer (Conservation Practice Standard 391)

Riparian Forest Buffers consist predominantly of trees and shrubs planted adjacent to and upslope from permanent streams, lakes, ponds, wetlands and areas with ground water recharge. Riparian Forest Buffers are created for various purposes and benefits which can:

- Create shade to lower water temperatures for aquatic organisms and create camouflage for predatory fish
- Create wildlife habitat & establish wildlife corridors
- Reduce sediment, organic material, nutrients & pesticides in surface runoff
- Provide a harvestable crop of timber & fiber
- Provide protection against scour erosion within the floodplain
- Restore natural riparian plant communities

Upland Wildlife Management (Conservation Practice Standard 645)

The Upland Wildlife Management practice offers several techniques to treat upland wildlife habitat concerns identified during conservation planning. One example of forestland application for wildlife management is creation of a transitional zone of shrubs, vines and herbaceous vegetation that lies between forestland and an adjacent land use. Transitional zones can be effectively incorporated into forest management systems through Woodland Edge Feathering. For additional information, review Woodland Edge Feathering Job Sheet 645D.

controlled burning

for Healthy Forest Management in the Appalachians

What is a Controlled Burn?

A controlled burn is a planned burn used to accomplish specific goals. These goals are documented in a burn plan, or prescription. Land managers use fire as a management tool to improve forest and grassland health. The plan is tailored to each burn area because differences in fuels, weather, and topography alter fire behavior. It also documents the acceptable weather conditions for burning and describes the techniques that should be used. The controlled burn plan ensures all precautions are taken to manage the fire safely.

History of Fire in the Appalachians

Fire has a long history of transforming landscapes by influencing vegetation. Lightning-caused fires are uncommon in the Appalachians, but Native Americans intentionally set fires for thousands of years. They burned to help open the forest understory, which increased plant diversity, improved browse for wildlife, and made travelling easier. As a result, most forest communities have been shaped by fire.

Early European settlers continued to use fire as a tool to shape their surroundings. They used fire to clear land and saw that occasional fires kept ridgetops open and sunny, which increased wild blueberry crops and also provided benefits for grazing livestock. However, as time went on and human populations began to increase, fires began to be seen as destructive and state and federal agencies were created to promote fire suppression. Over time, this exclusion of fire has led to a dramatic change in our forests. Most of today's forests have a dense understory, less plant diversity, and are composed largely of fire intolerant tree species. This change in vegetation has in turn caused decrease in species diversity with a shift in wildlife species favoring those that tolerate closed canopy forest.

Why Burn?

Land managers now recognize that fire used in controlled situations can promote healthy natural systems. A series of low intensity fires can thin crowded forests, resulting in less severe disease and pest outbreaks. Fire promotes native grasses and wildflowers and helps to regenerate oaks, which in turn increases wildlife populations. Controlled burns also reduce leaf litter and woody fuels that increase wildfire intensity. Fire, in the right place at the right time, is a land management tool that can offer numerous benefits for wildlife.

Controlled Burns Accomplish Specific Management Goals

Fire benefits upland oak-hickory forests, woodlands, and pine-oak savannahs by increasing the sunlight reaching the ground and promoting seed germination. Also, periodic fires reduce competition of fire intolerant species such as maples, beech, and white pine. Over time, upland oaks and pines gradually disappear from the landscape unless this competition is reduced. Studies of forest history show fire intolerant species were uncommon on these upland areas prior to fire suppression.

Historical records also indicate some plants and animals difficult to find in the Appalachians today were once commonly found. When fire is reintroduced, plants sometimes reappear where they have not been recorded in decades. Evidence shows a great many plant and animal species respond favorably in a fire-mediated habitat. The controlled use of fire, under the direction of skilled resource managers, promotes wildlife and healthy forests.

For more information about the environmental benefits of controlled burning check out the Fire Learning Network web page at www.tncfire.org

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NC STATE UNIVERSITY

FIREWISE

Firewise Landscaping in North Carolina

Do you live in a home or community that is tucked into the woods or surrounded by marsh or shrubs? Then your home may be at risk of exposure to wildfire. You can use firewise landscaping practices to create a survivable space around your home and reduce your risk of damage from a wildfire.

What Is Firewise Landscaping?

Firewise landscaping involves creating survivable space by selecting, placing, and maintaining plants around your home that will make it less vulnerable to wildfire. Survivable space is the area extending outward from your home 30 feet or more that is designed to serve as a buffer to slow or stop a wildfire. Survivable space doesn't mean you cannot have trees in your yard. Nor does survivable space mean that your landscape will be bare or that it won't attract wildlife. Instead, firewise concepts allow you to make decisions about what you value while taking steps to reduce your risk. By using firewise landscaping, you can decrease the risk of damage to your property from a wildfire.

This publication summarizes some basic firewise concepts to use when creating a landscape around your home. It also provides lists of native plants by their flammability ratings so homeowners can make informed decisions when selecting and maintaining plants. Many of North Carolina's native plants are well-suited to firewise landscaping—they have evolved to thrive in the state's soils and climate, are non-invasive, and are best suited to provide food, shelter, and nesting sites for North Carolina's wildlife.

Basic Concepts

All vegetation is potential fuel for a fire. There are no "fireproof" plants. But the type, amount, and placement of vegetation can have a dramatic effect on fire behavior. In fact, plant choice, spacing, and maintenance are critical to firewise landscaping.

Survivable space is the area extending outward from the boundaries of your home or structure (Figure 1). The recommended distance for survivable space varies based on the kinds of vegetation around your home and the steepness of the terrain. For homes and other structures on terrain that slopes less than 20 percent, a minimum of 30 feet is recommended for survivable space. For steeper terrain, survivable space may need to extend from the structure as much as 200 feet. To determine how much survivable space is needed for your home, contact your local fire officials, the N.C. Division of Forest Resources, or your local Cooperative Extension center.

Plant Choice

Select plants with a low flammability rating for the areas nearest your house. By selecting plants with certain characteristics, you can reduce the flammability potential of your landscape and provide habitat for wildlife. Plants that are resistant to wildfire have one or more of the following characteristics:

- They grow without accumulating large amounts of combustible dead branches, needles, or leaves (example: *Cornus florida*, flowering dogwood).
- They have open, loose branches with a low volume of total vegetation (example: *Euonymus americana*, strawberry bush).
- They have low sap or resin content (example: many deciduous species).
- They have high moisture content (example: *Impatiens capensis*, jewelweed).
- They grow slowly and need little maintenance, such as pruning (example: *Carpinus caroliniana*, ironwood).
- They are short and grow close to the ground (example: *Viola pedata*, bird-foot violet).
- They can resprout following fire and thereby reduce the costs of replanting a landscape after a fire (example: *Rhus glabra*, smooth sumac).

Plant a variety of types and species. Besides being aesthetically pleasing and more attractive to a wide range of wildlife, a variety of plants will help to ensure a healthier landscape by reducing insect and disease problems. Insects and diseases tend to increase in areas where a host plant dominates the landscape. Plants that are stressed from insects and diseases are more flammable because of the loss of vigor and increased amount of dead, dry plant material.

Plant Placement

Keep plants widely spaced. Fire can race rapidly from one plant to another when there is no space between plants. Maintain ample space between plants by placing them in small irregular clusters and islands. This will reduce the threat from wildfire by decreasing the volume of fuel available to a wildfire in your landscape.

Do not plant vines or ornamental grasses within the zone of survivable space. Vines and ornamental grasses, such as switchgrass (*Panicum virgatum*), are extremely flammable plants that can cause a wildfire to spread rapidly. This is especially so if dead growth has not been removed.

Plant Maintenance

Do not forget maintenance. A landscape is a dynamic system that is constantly changing. Trees, shrubs, and herbaceous plants that have a low flammability rating and low fuel volumes can lose these characteristics over time if they are not maintained properly. Conducting seasonal maintenance activities, such as pruning, will help you to maintain the plants' firewise properties by keeping them green and healthy. When conducting maintenance, keep the following tips in mind:

- Cut and remove the dried foliage of annual and perennial herbaceous plants.
- Rake up and dispose of plant litter as it builds up over the season.
- Mow or trim turfgrass to a low height within the survivable space.
- Remove all dead branches, twigs, and leaves attached to living trees to a height of 10 feet above the ground.
- Remove all dead shrubs from within the survivable space.
- Remove vegetation encroaching on power lines.
- Remove branches within 15 feet of the chimney and roof.
- Remove vegetation touching the house or structure.
- Conduct pruning before the nesting season (April 15 through September 15) to encourage wildlife.
- Schedule and conduct maintenance with the North Carolina fire seasons (spring and fall) in mind.

Summary

Wildfire can significantly reduce the resources and services produced by North Carolina's wildlands, including wildlife habitat, recreation, clean water, timber, and scenic beauty. More than 41 percent of North Carolina's homes are located within the wildland-urban interface, the zone where human development meets or intermixes with wildland vegetation. As the state's population grows and residential development increases, the risk increases that a wildfire will encroach upon someone's home and have a significant impact on their lives. Some homeowners may have to deal only with smoke and evacuation. For others, fire often results in destruction of their homes and property. By using firewise landscaping strategies, homeowners can create landscapes with less potential fuel for a fire and minimize the risk of a wildfire spreading to their home.

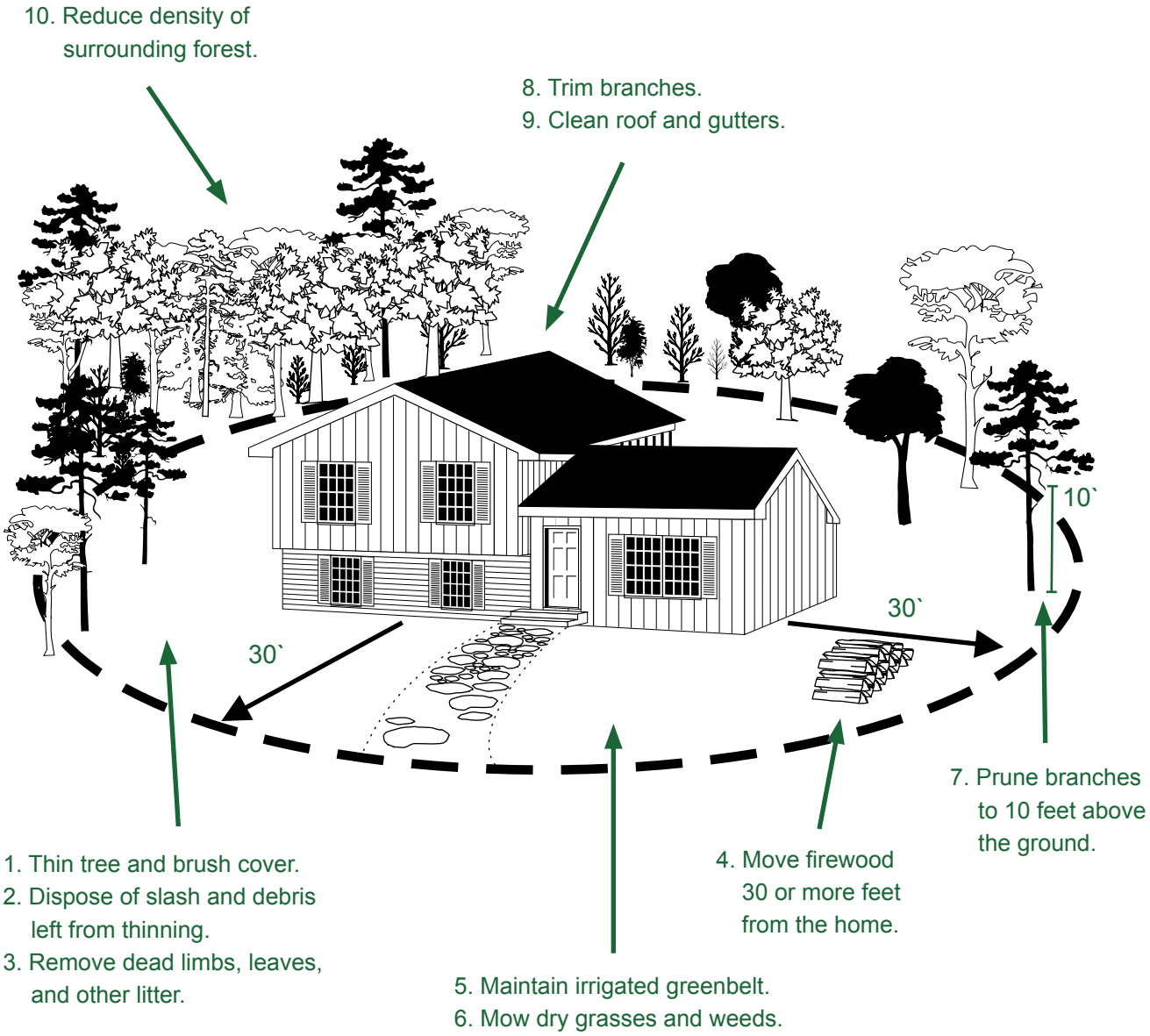

Figure 1.
An example of survivable space around a home. A firewise home has at least 30 feet of space around it that is clear of dead vegetation and flammable debris. Trees and shrubs are pruned, and the landscape consists of healthy, irrigated, fire-resistant vegetation.

NRCS Natural Resources Conservation Service
Wildlife Habitat Management Institute

WILDLIFE HABITAT COUNCIL

Native Warm-Season Grasses and Wildlife

May 2005 *Fish and Wildlife Habitat Management Leaflet* *Number 25*

Introduction

Native grasslands once covered vast expanses of North America, providing habitat that supported more than 800 native species of plants and animals. Native warm-season grasses were the dominant component of these prairie grassland ecosystems. Native warm-season grasses have minimal requirements for supplemental water or fertilizer. Once established, they are drought tolerant and almost completely disease free. Peak growth periods of these mostly perennial bunch grasses are from June through August. Like other native plants, they have coevolved with the local climate, soils, and rainfall, and are well suited to the growing conditions found in different regions across North America. Likewise, wildlife associated with grasslands are adapted to the habitats that native warm-season grasses provide.

When Europeans began to settle the North American prairies in the late 1800s, they converted large tracts of native grassland to crop production and introduced cool-season grasses. They also began suppressing fire, which had been essential to maintaining natural grasslands. Many of the introduced cool-season grasses were hardy and aggressive species that flourished in the North American climate. These species can grow in dense mats that are almost impenetrable by wildlife and consequently are poor providers of nesting and escape cover for many species. One of the most common introduced cool season grasses is fescue, which often carries a toxic endophyte fungus that can cause reproductive problems for both wildlife and livestock.

Modern development continues to change the landscape and destroy natural grasslands. Today, less than 10 percent of the original tallgrass prairie and 30 percent of shortgrass prairie remains. This loss has directly affected native wildlife; many prairie-dependent species are declining, threatened, or endangered. However, new efforts to restore pre-settlement habitats are helping to educate landowners about the benefits of grasslands. Many people do not realize that warm-season grasses can benefit humans and livestock as well as wildlife. The deep root systems of native grasses hold soil in place, reducing erosion and decreasing runoff, which helps keep waterways healthy and recharges ground water. When native grasses die, their roots decay and add significant amounts of organic matter throughout the soil, replenishing fertility.

Billy Teels, NRCS

Reconstructed tall-grass prairie

This leaflet serves as an introduction to native warm-season grasses and the benefits they provide to wildlife and livestock. The leaflet also provides an overview of the management of native warm-season grass habitat projects. Landowners are encouraged to consult with natural resource professionals to design the most suitable grassland habitat and associated management techniques for their property.

Benefits to wildlife

Native warm-season grasses provide optimum habitat conditions to more native wildlife species than do cool season grasses. They provide three of the basic habitat requirements of grassland wildlife species – food, shelter, and space. The habitat provided by native warm-season grass species is preferred by

ground-dwelling wildlife such as rabbits, wild turkeys, ring-necked pheasants, northern bobwhites, and a variety of songbirds and small mammals. Table 1 provides examples of some wildlife species associated with native warm-season grasses.

The growth form of native warm-season grasses is a key factor in their wildlife habitat value. The bunch grass open structure provides bare ground between the plants allowing for easy wildlife movement while providing protective overhead cover. Many cool-season grasses, such as tall fescue, grow too densely for easy wildlife movement. This is particularly important for seed eating birds that pick seeds from the ground. Native warm-season grasses provide effective brood rearing habitat for game birds, allowing chicks to move easily on the ground in search of food. Native warm-season grasses are generally associated with a greater number of important food sources, such as broadleaf forbs, legumes, and insects, than are cool-season grasses.

Native warm-season grasses are structurally durable, with stems capable of withstanding heavy loads of snow in the winter. This characteristic provides wildlife with winter cover and decreases winter mortality. Some warm-season grass species will stand upright even under 2 feet of snow.

Victor Love, IBM Boulder, CO

The eastern cottontail uses native warm-season grasses for food and nesting cover.

Warm-season grasses provide ideal nesting cover for many species, which consists of scattered clumps of herbaceous plants interspersed with bare soil or soil with only a light litter layer. Warm-season grasses provide particularly useful nest sites for ground-nesting birds. Their bunching nature provides the type of structure and materials important for nest building. Where warm-season grasses are harvested, typical haying dates of late June to late July enable early nests to succeed before haying. In contrast, haying

Bobwhite quail: A habitat example

Northern bobwhite populations have been in decline in the eastern U.S. since the late 1960s. Shrinking native grasslands, with corresponding increases in forest and pasture, are main causes of this decline. Bobwhite quail require habitat that has clumps of vegetation where they can nest, in close proximity to sparsely vegetated, recently disturbed areas with bare ground where quail chicks can access insects. Good quail habitat consists of native warm-season grasses, particularly broomsedge, Indiangrass, and little bluestem, interspersed with native legumes such as partridge pea, lespedezas, and beggarticks. Ideally, the landscape also provides scattered shrubs, briers, and blackberry thickets for contrast and escape cover. Quail require a minimum of nine inches of overhead cover for nesting, which is easily supplied in stands of well-managed warm season grasses.

U.S. Fish and Wildlife Service

Native warm-season grasslands provide many of the habitat requirements of the northern bobwhite.

dates of cool-season grasses are much earlier, causing the destruction of many grassland bird nests. Studies have shown that pheasants build 20 percent more nests in switchgrass than in orchardgrass/alfalfa fields. In many regions of the U.S., the use of warm-season grasses has resulted in extraordinary rebounds of several upland game bird populations. The conversion of as little as 5 percent of hayfields to warm-season grasses can increase bird populations 10-fold.

Benefits to livestock

Native warm-season grasses have been shown to be very beneficial for livestock production. Warm-season grasses thrive and provide high quality forage during hot summer months, during which time cool-season grasses are slow growing and unproductive. Approximately 60 to 90 percent of the annual growth of warm-season grasses occurs during June through August, whereas, more than 60 percent of the growth of cool-season grasses occurs before June. Landowners without adequate warm-season grass pastures frequently have to feed hay to their livestock during the height of summer. Some warm-season grasses are more palatable and produce significantly higher weight gain in livestock than some popular cool-season grasses. The ratio of weight gain by cattle feeding on big bluestem and switchgrass to those that feed on tall fescue is approximately 2:1. The high productivity of warm-season grasses, combined with their high digestibility (70% or more) and high protein content (6 to 12%) make warm-season grasses a valuable summer forage.

Lynn Betts, NRCS

Native warm-season grasses provide nutritious forage during hot summer months.

Table 1 Warm-season grassland types and associated wildlife species

	Tallgrass prairie	Mixed prairie	Shortgrass prairie
Region	Corn Belt (Kansas, Oklahoma, Iowa, Minnesota, North Dakota, South Dakota, Wisconsin, Missouri, Illinois)	Great Plains Region (North and South Dakota, Nebraska, Kansas, central Oklahoma, north central Texas)	Montana, eastern Wyoming, Colorado, western Kansas, Oklahoma panhandle, northern Texas, North and South Dakota, Alberta, Saskatchewan
Grasses	Big bluestem, Indiangrass, little bluestem, side-oats grama, switchgrass	Little bluestem, buffalo grass, grama grass	Blue grama, buffalo grass, needle grass
Associated	Pocket gophers, ground squirrels, elk, white-tailed deer, mule deer, rabbit, coyote, greater prairie-chicken, sandhill crane, loggerhead strike, waterfowl	Pronghorn, black-tailed jackrabbit, desert cottontail, coyote, eastern cottain-tail, mule deer, white-taileddeer, prairie dog, ground squirrel, gopher, burrowing owl, grassland birds	Prairie dog, pronghorn, swift fox, bison, black-tailed deer, white-tailed deer, bobcat, cougar, short-horned lizard, rattlesnake, burrowing owl, ferruginous hawk, Swainson's hawk, golden eagle, sharp-tailed grouse, sage grouse, mountain plover, killdeer

Management

Table 2 provides management considerations for landowners in planting and maintaining native warm-season grasses. Management techniques vary from region to region. Landowners are encouraged to consult local grassland management experts, local conservation districts, state wildlife agencies, or local NRCS offices for more information on site preparation, planting, burning, and grazing management.

Landowner assistance

Financial and technical assistance for native grassland projects are available from an array of government agencies and public and private organizations. Table 3 lists the contact information of organizations that can provide information about grassland management, as well as other natural resource projects, and describes their associated conservation incentive programs.

Conclusion

The benefits to both wildlife and livestock from warm-season grasses far surpass the initial investment of time and money to plant and establish them. Native warm-season grasses provide food and nesting and escape cover for a variety of grassland wildlife species. They also serve as valuable summer forage for livestock. With some assistance from local agencies, landowners can plant and maintain warm-season grasses on their properties. Native warm-season grasses provide a relatively low-maintenance land cover alternative that is extremely beneficial to both landowners and wildlife.

Top: Little bluestem (Schizachyarium scoparium), big bluestem (Andropogon gerardii). Bottom: Switchgrass (Panicum virgatum), Indiangrass (Sorghastrum nutans). Photos courtesy Charlie Rewa, NRCS.

Table 2 Management considerations for native warm-season grasses

Planning	Determine site conditions (soil types, topography, rare plants and animals, existing vegetation, hydrological characteristics)
	Identify project goals
Obtaining seed	Ensure that purchased seed has been tested by a certifying agency
	Purchase seed as Pure Live Seed (PLS) and not as bulk seed
	Consult the PLANTS National Database (*http://plants.usda.gov/*) for help with seed selection
	Consult the Plant Materials Program (*http://www.plant-materials.nrcs.usda.gov/*) for fact sheets and planting guides to select the plant releases that are best suited to a particular area and for source identified or selected releases to use for widlife purposes
	Ensure that seed does not contain undesirable species
	If collecting seed, ensure that collection is legal and that seeds are adapted to local conditions
Site preparation	If necessary, pack the soil with a cultipacker. The site is properly packed when a footprint barely registers in the soil
Planting	For sites smaller than half an acre, seed by hand
	For sites larger than half an acre, use a native drill seeder, which will reduce labor and costs, plant seed uniformly, and produce consistent successful results
Controlling weeds	Reduce weed competition during the first few years by mowing to allow sunlight to reach developing seedlings. Other methods include plowing, hand pulling, burning, grazing, or applying herbicides
Prescribed burning	Obtain a burn permit before a prescribed burn is performed
	Because proper timing of burning operations is dependent upon the landowner's objectives, landowners should consult their local NRCS office for assistance with timing of native grass burns
	Burn rotationally every three to five years
	To suppress established warm season grasses that get too dense and rank for wildlife benefit, summer or early fall burns will set back warm season grasses
Mowing	Only mow if burning is not an option
	If mowing is necessary, mow after peak wildlife nesting times on a three to five year rotation. Peak nesting times vary from region to region and can continue through the end of July in some areas
Discing	To suppress established warm season grasses that get too dense and rank for wildlife benefit, use light discing or strip discing to open stands
Rotational grazing	Do not allow warm season grasses to be grazed lower than 10 inches
	Allow grasses to regrow to approximately 18 inches before they are grazed again
	Grazing pure stands of switchgrass can be potentially toxic to horses, sheep, and goats

Table 3 Financial and technical assistance available to landowners with habitat projects

Program	Land eligibility	Type of assistance	Contact
Conservation Reserve Program (CRP)	Highly erodible land, wetland and certain other lands with cropping history; streamside areas in pasture land.	50% cost-share for establishing permanent cover and conservation practices, and annual rental payments for land enrolled in 10- to 15-year contracts. Additional financial incentives available for some practices.	NRCS or FSA state or local office
Environmental Quality Incentives Program	Cropland, rangeland, grazing land and other agricultural land in need of treatment.	Up to 75% cost-share for conservation practices in accordance with 1- to 10-year contracts. Incentive payments for certain management practices.	NRCS state or local office
Partners for Fish and Wildlife Program (PFW)	Most degraded fish and/or wildlife habitat.	Up to 100% financial and technical assistance to restore wildlife habitat under minimum 10-year cooperative agreements.	Local U.S. Fish and Wildlife Service office
Wildlife Habitat Incentives Program (WHIP)	High-priority fish and wildlife habitats.	Up to 75% cost-share for conservation practices under 5- to 10-year agreements.	NRCS state or local office

Report from the North Carolina Natural Heritage Program

Removed for Privacy

2020 MANAGEMENT ACTIONS COMPLETED
SPRING:
SUMMER:
FALL:
WINTER:

2021 MANAGEMENT ACTIONS COMPLETED
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2022 MANAGEMENT ACTIONS COMPLETED
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