Land Management Plan for Fort Benning ACUB Lands

October 2017

The Nature Conservancy in Georgia

in cooperation with Fort Benning

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LAND MANAGEMENT PLAN OVERVIEW

INTRODUCTION

The *Fort Benning ACUB Lands* are those that have been protected for conservation purposes via the mechanisms and funding associated with the Army Compatible Use Buffer (ACUB) Program at Fort Benning. These lands may be characterized, mapped, and named several different ways, and are typically referenced by The Nature Conservancy (Fort Benning's only Eligible Entity and primary ACUB partner) as the Chattahoochee Fall Line. The term "Fort Benning ACUB Lands" is used in this Land Management Plan to emphasize its specific role in achieving Fort Benning's objectives for landscape-scale ecological restoration which benefits Fort Benning. In particular, these objectives include aiding and enhancing the recovery of the federally-endangered red-cockaded woodpecker, securing the viability of the candidate-for-listing gopher tortoise and preventing these and other at-risk species from creating regulatory burdens on Army training. Additional benefits to Fort Benning include watershed and wetland protection, deflection of residential/commercial development that can be incompatible with military training on the Fort and with prescribed fire operations (whether on the Fort or on ACUB lands strategic to habitat objectives), carbon sequestration, and other ecological services.

Many other benefits, beyond those explicitly associated with Fort Benning's military training mission, can also be enabled by this Plan, such as all the conservation benefits mentioned above in the broader context of the mission of The Nature Conservancy (to protect the lands and waters upon which all life depends) and the needs of the public for ecological services and enjoyment of nature. Additional benefits include public and private recreation, protection of natural resource-based economies, forest resilience and wildfire reduction, eco-tourism, esthetics, and quality of life. In many cases these additional benefits bring additional partners, supporters, and funding sources to the Fort Benning ACUB Program, resulting in institutional collaboration such as the Chattahoochee Fall Line Conservation Partnership, the Chattahoochee Fall Line Wildlife Management Area (WMA), and various related efforts around research and land management.

The Fort Benning ACUB Lands currently (2017) comprise approximately 27,000 acres, and for the purposes of the Plan are considered to lie in Muscogee, Marion, and Talbot Counties (Georgia) to the

north and east of Fort Benning itself. These lands represent multiple ownerships, and include lands held in fee by The Nature Conservancy subject to Army contingent rights, lands held in fee by private landowners subject to ACUB conservation easements, and lands held in fee by the State of Georgia subject to ACUB conservation easements. ACUB conservation easements are also subject to Army contingent rights, and are currently held by either The Nature Conservancy or the Chattahoochee Valley Land Trust. In case of any conflict between this Land Management Plan and ACUB conservation easements (which often reference more tract-specific land management plans), the easement language and associated documents must control. However, this Plan is intended as a guiding document for future management plans and management-plan revisions, and is generally expected to be consistent with existing plans.

The multiple ownerships comprising the Fort Benning ACUB Lands are tabulated by acres in Table 1 on the next page, and illustrated by the map in Figure 1.

Much of the management effort will be geared toward restoration of natural communities that have been altered by past land-use on recently acquired tracts. As restoration work is completed, management will then focus on maintenance of these natural communities.

This **Land Management Plan ("the Plan")** for Fort Benning ACUB Lands was prepared by The Nature Conservancy but builds on past planning efforts that included Georgia DNR's Wildlife Resources Division and Fort Benning's Environmental Management Division, Natural Resources Management Branch. The Plan shall be updated at least every 10 years to review past accomplishments; make necessary amendments and address new land management or restoration requirements that may be recommended by any governmental entities for developing ecosystem service credits, including, but not limited to, red-cockaded woodpecker-related benefits. An ACUB Advisory Board must approve this Plan and all amendments to it.

An essential tenet of this Plan is recognition of the intricate complexity of the natural environment. The soils, hydrology, climate, and disturbance history have all influenced the vegetation patterns observed on this fascinating landscape. Fire clearly plays an integral role in restoring and maintaining this landscape's natural communities and rare species.

PURPOSE

This Plan for Fort Benning ACUB Lands will serve to identify and prioritize the immediate and long-range management needs of the landscape. While the Plan is based upon many site visits, discussions, and lessons learned in the field, it is expected that modifications will be made as additional knowledge is obtained, including but not limited to new occurrences of rare species, refined forest stand data, better understanding of the requirements needed to sustain the significant natural communities found onsite, and lessons from adaptive management (both onsite and on other conservation lands). The Plan focuses on management issues in native habitats, as well as for restoring native habitats that have been lost, or significantly altered, due to past land-use or land-management practices.

Using adaptive management techniques and guided by monitoring, Fort Benning ACUB Lands will be managed in accordance with the following primary objectives:

(a) Protect, conserve, restore, and maintain fire-adapted upland forest dominated by longleaf pine, with continuity sufficient to allow viable populations of native wildlife to survive, disperse, and interact;

(b) Protect and enhance the habitat attributes that enable the recovery and viability of threatened, endangered, and at-risk species native to the region, including but not limited to the red-cockaded woodpecker and the gopher tortoise;

(c) Protect and conserve embedded wetlands, riparian areas, shoals, seeps, and upland rock outcrops with unique plant communities that result from the combination of fire history, Fall Line geology, and upland/wetland hydrology, and whose integrity is critical to aquatic biodiversity, watershed function, downstream water quality, and rare ecosystems.

Secondary objectives include:

(a) Create a strong public-private partnership that can serve as a model for other conservation sites.

(b) Accommodate and facilitate public recreation, research, teaching, nature study and appreciation, and historical and cultural interpretation that are appropriate to Fort Benning ACUB Lands. Support other compatible recreational, educational, and scientific activities without detrimentally impacting its intrinsic ecological and wildlife values.

(c) Use Fort Benning ACUB Lands as a model for management, including an outdoor laboratory and demonstration site for restoration of fire-suppressed longleaf pine forests, and restoration of longleaf pine sites that have been converted to other vegetation types.

(d) Ensure long-term viability of Fort Benning ACUB Lands by looking beyond site boundaries, and working closely with the Chattahoochee Fall Line Conservation Partnership (CFLCP) and other appropriate partnerships.

(e) Increase awareness of and appreciation for the species and natural communities of Fort Benning ACUB Lands at the regional level.

MANAGEMENT RESPONSIBILITY

Management responsibility for Fort Benning ACUB Lands will vary according to landowner, but all land managers should be guided to the extent practical by this Plan, most formally and rigorously for those lands owned by The Nature Conservancy or the State of Georgia. Existing conservation easement lands owned in fee by private landowners are restricted to varying degrees to be managed with the same or substantively similar objectives, but may sometimes diverge from the objectives of this Plan, depending on negotiated easement terms. It shall be the responsibility of ACUB partners engaged with any ACUB lands to encourage adoption of the primary objectives above (and the management strategies provided in this Plan to achieve them).

Table 1. Acreage by landowner type and tract.

	Landowner	Tract	Acres
ACUB Fee Lands	TNC	Blackjack (CFLWMA)	792.00
		Brown Springs	1,143.77
		Fort Perry (CFLWMA)	1,276.76
		Juniper East	3,790.49
		Juniper West	1,611.72
		Kendall Creek	817.37
		Little Pine Knot	993.90
		Oakland Farm	1,005.45
		Pine Knot	2,010.91
		Total	*13,442.35*
	State of GA	Almo (CFLWMA)	7,773.55
		Fort Perry (CFLWMA)	1,220.94
		Total	*8,994.49*
ACUB Easement Lands	Private with TNC Easement	Dreelin	488.00
		Prevatt	1,100.60
		Total	*1,588.60*
	Private with CVLT Easement	Flournoy	2,580.50
		McLaurin	310.57
		McLemore	158.13
		Merritt	165.49
		Total	*3,214.69*
		Grand Total	**27,240.12**

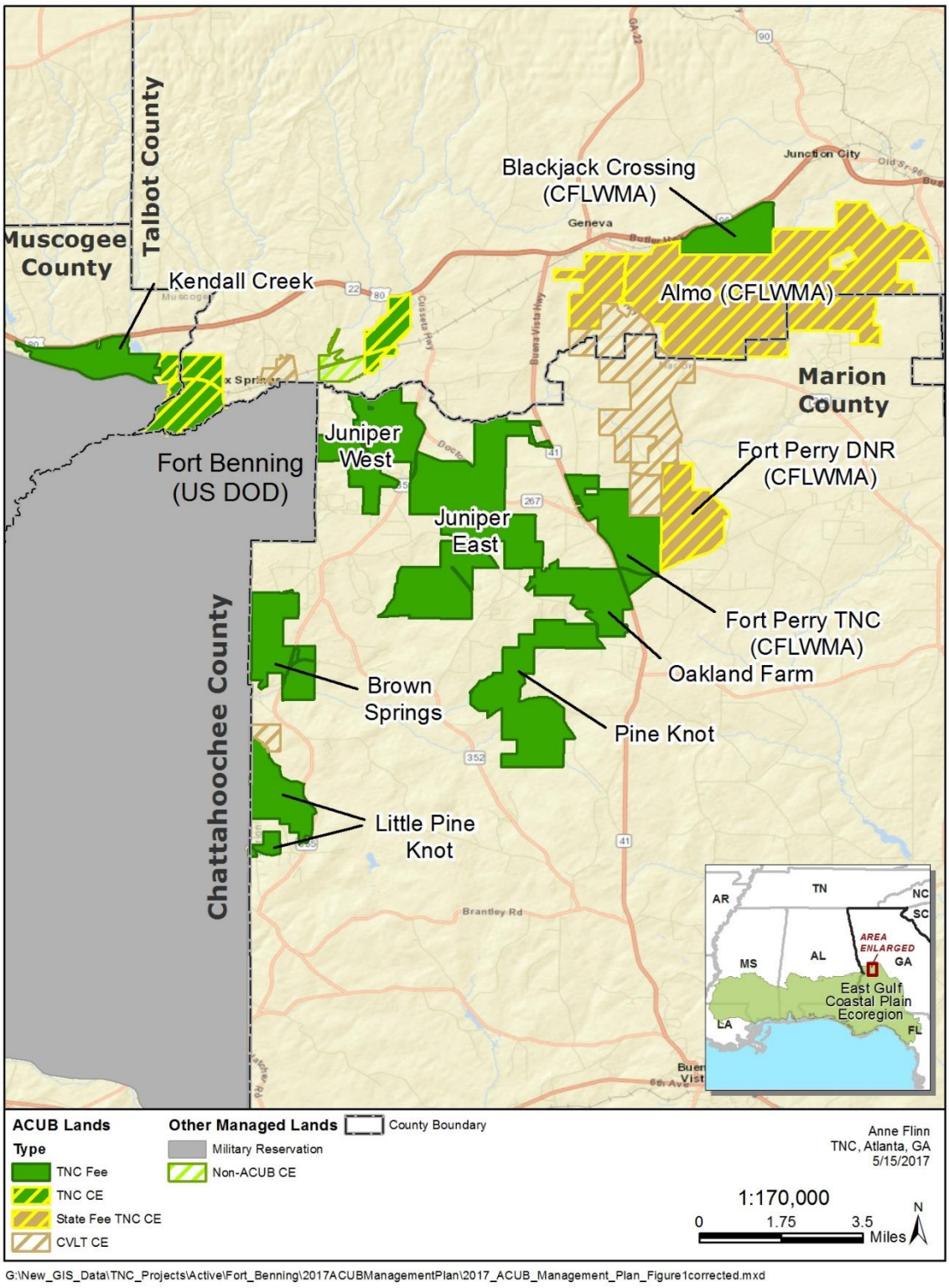

Figure 1. 2017 ACUB lands, with ownership category and tract names for fee lands.

BACKGROUND AND LAND-USE HISTORY

The Fort Benning ACUB Lands were assembled and protected over the period 2007 to 2017, primarily by The Nature Conservancy but with important roles by the State of Georgia and the Chattahoochee Valley Land Trust.

The landscape includes extensive acreage in industrial-style pine plantations, whether established by prior industrial owners or non-industrial private landowners. These stands are often planted in loblolly pine, which has been favored for intensive management by the timber industry since the mid-twentieth century across many sites. Sand pine and slash pine, both non-native to the Georgia Fall Line, occupy some sites; the former being invasive and undesirable, the latter less so. Planted stands of longleaf pine have become increasingly prevalent on the ACUB lands both before and after their conservation protection, and are likely to overtake loblolly in acreage in the coming years. The upland component of the ACUB lands owned in fee by TNC and the State of Georgia is currently about half planted pine and the other half naturally-regenerated pine or pine-hardwood mixtures. Of the planted portion, about half of that is loblolly; planted longleaf comprises only slightly less than half. More detail appears in Table 2 under Site Description.

Components of the native longleaf pine forest remain on many sites, albeit most such sites were fire-excluded and overstocked with early-successional hardwoods, volunteer loblolly pines, and mid-story vegetation until the initiation of ACUB land management practices. Gopher tortoise populations exist in many early successional and/or roadside areas, responding favorably to forest management and restoration. While red-cockaded woodpecker very likely occurred on this landscape in decades past, contiguous areas of fire-managed mature pines are currently not likely large enough to support breeding/nesting groups east of the Fort Benning boundary. Restoration of such habitat is of course one of the primary management objectives for Fort Benning ACUB Lands.

While over 80% of the landscape may be considered upland, there are also significant wetland systems including bottomland or other mesic-site hardwoods, Atlantic white cedar stands, evergreen shrub bogs, and various herbaceous ponds, bogs, and seeps.

Non-forest areas were typically avoided in ACUB land protection prioritization, except where forested areas were recently clear-cut, or were strategic for adjacency or connectivity to enable the restoration of habitat corridors. Open pasture previously grazed by cattle is the most typical non-forest acreage, and can be considered a temporary condition.

In addition to commercial forestry operations, typical past land-use on these lands included game management and hunting, and to a lesser extent cattle pasture and other agricultural pursuits, and sand mining where deep sandy soils dominate. Evidence of naval stores operations dating from the mid-twentieth century or older can be found in many residual natural stands and buffer strips, often associated with stumps or snags representing legacies of the original longleaf pine forest. Many of the current planted and natural forests almost certainly occupy lands once farmed for row crops in the nineteenth and early twentieth century, though some of the landscape is so dry and sandy it may have never been farmed.

SITE DESCRIPTION

Ecologically, the Fort Benning ACUB Lands are located within the historic range of longleaf pine. Importantly, their location at the interface of different ecological regions provides a high degree of landscape diversity and an accompanying natural diversity in plant and animal species and a great variety of natural ecological communities, with and without longleaf pine. In particular, the location may be considered a meeting place of the Coastal Plain and Piedmont ecoregions and primarily belongs to the Physiographic subregion known as the Fall Line sandhills (Figure 2). This subregion includes some of

the oldest coastal plain geology to be found in Georgia. The deep sands, complex topography, and sandstone outcrops found across the Fort Benning ACUB Lands are indicative of that geologic history, which is important to understanding the nature of this landscape.[1]

GEOLOGY

The late Cretaceous Period is generally considered to represent a span of just over 30 million years, from 100 million to 66 million years ago, the end of which represents the end of the Mesozoic Era, and the end of the age of dinosaurs. This period also represents a time during which the Atlantic Ocean reached the height of its penetration into what is now the southeastern U.S. As it receded over more recent history, the sea left a succession of marine-sediment layers covering the crystalline rocks of the piedmont and mountains, and creating the mostly gentle terrain of the southeastern coastal plain. These coastal-plain sediments are divided into a number of "formations," the oldest four of which are named (in order of decreasing age) the Tuscaloosa, the Eutaw, the Blufftown, and the Cusseta, all of which outcrop to some degree on the Fort Benning ACUB Lands. Younger sediments lie on top of older ones, but the older sediments "outcrop" on the surface further inland than younger ones. The oldest and most interior of these coastal plain sediments, the Tuscaloosa Formation, outcrops on some of the driest portions of the landscape, and is primarily of alluvial or riverine origin, rather than marine, but still constitutes a continuous band of deposition parallel to the ancient coastline. All younger formations have some degree of marine origin and associated fossils.

The Fall Line, usually defined as the interface between the oldest coastal plain sediments and the underlying crystalline rock of the piedmont, is often mapped along the upper edge of the Tuscaloosa Formation, just north of U.S. Highway 80 and Georgia Highway 96 (the "Fall Line Freeway") which roughly bounds the Fort Benning ACUB Lands along their most northern extent. The Fall Line sandhills are often delineated as a distinct physiographic subregion between the piedmont and the more expansive part of the coastal plain, encompassing a band of complex topography that includes the Late Cretaceous outcrops described above, and the well-known elevational gradient that creates shoals and waterfalls along rivers and streams that descend through this zone. This complexity is evident in Fort Benning ACUB Lands, especially on the Kendall Creek and Almo tracts, but also in the diversity of upland and wetland settings across the larger landscape. In addition to sandhills and ridges that probably originated as shoreline, barrier island, and alluvial delta deposits, the older Tuscaloosa formation legacies include outcrops of sedimentary rock, primarily sandstone but with constituents that can be characterized as siltstone, claystone, mudstone, and ironstone, often stained by the oxidation of iron with remarkable colors ranging from brown and red to pink and purple, in nodules, concretions, or tables of crumbly rock, or in sands and clays apparent in road cuts and other disturbed areas. The geological record here is also characterized by "nonconformities" in which the ages of adjacent formations are disparate enough to indicate massive erosional loss or other ancient disturbances.

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[1] The following discussion of the geology of the Fall Line sandhills assembled by Wade Harrison (TNC), based primarily on:
New Georgia Encyclopedia (online). Coastal Plain Geologic Province: Original entry by William J. Frazier, Columbus State University, 08/30/2007 http://www.georgiaencyclopedia.org/articles/science-medicine/coastal-plain-geologic-province
Stratigraphy of the Outcropping Cretaceous Rocks of Georgia By D. HOYE EARGLE GEOLOGICAL SURVEY BULLETIN 1014 UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1955 http://pubs.usgs.gov/bul/1014/report.pdf
Soil Survey of Chattahoochee and Marion Counties, GA by Alfred Green, NRCS. November 1997. http://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/georgia/GA620/0/chattahoochee_marion.pdf]

ECOLOGY

The ecological character of the Fall Line sandhills is heavily influenced by this complex geology. For example, (1) the interface between ecological systems of higher elevations to the north, and coastal plain systems to the south creates unusual ecological combinations, e.g. flora of montane slopes and ravines juxtaposed with fire-adapted pine woodland and/or frequently saturated Atlantic white cedar swamps; (2) complex topography and hydrology created "fire shadows" and "fire islands", introducing spatial diversity and discontinuity to the longleaf pine woodlands that occurred somewhat more expansively throughout much of the coastal plain; (3) deep sands, where they occurred (like other sandhill formations throughout the coastal plain) became population centers, and later refugia, for drought-tolerant, fire-adapted, and sand-adapted species and communities such as longleaf pine and gopher tortoise-- not only because of their inherent physical character but also because they were less desirable for agriculture and residential centers as human settlement and development altered the landscape.

Historically, the landscape of the Fort Benning ACUB Lands was primarily occupied by plant communities dominated by longleaf pine (*Pinus palustris*) and associated species. Communities dominated by longleaf pine have been impacted adversely by logging and removal of natural seed sources, grazing, fire suppression, fragmentation, conversion to non-longleaf pine tree plantations, and other land development activities. Today, longleaf pine occurs as plantations and some naturally regenerated areas on the driest sites with deep sands and typical xeric sandhill vegetation. Loblolly pine forests and mixed pine/hardwood forests are also common throughout the region. Atlantic white-cedar swamps, a high priority habitat, can be found in a few locations along the Black Creek and Juniper Creek drainages.

SOILS AND TOPOGRAPHY

Fort Benning ACUB Lands consist mainly of deep, well drained, sandy soils. Topography is complex, and while the landscape is typically characterized by rolling terrain with low to moderate slopes of less than 25%, the Fort Benning ACUB Lands include steeper slopes associated with dissection by streams. Along with topographic contours, Figure 4 illustrates broad soil groups in which much of this landscape is categorized as “Lakeland” (very deep sand in surface profile, A and C horizons) and “Vaucluse” (thinner sand surface with a dense, brittle B-horizon that contains masses of oxidized iron), with a small number of parcels along the northern border of Fort Benning in the “Norfolk” group (very deep sandy loam with A, E, B and C horizons).

CLIMATE

The climate in Muscogee, Marion, and Talbot Counties is temperate, with an average temperature of 74° F. The area is within U.S.D.A. plant hardiness zone 8a. Annual rainfall averages 53 inches, with 104 rainy days on average. Summer and winter months are typically the wettest, and fall is the driest time of year.

HYDROLOGY

The Fort Benning ACUB Lands lie in the middle Chattahoochee River watershed (HUC 03130003). Almost all streams originating on these lands (Figure 5) flow westward toward the Chattahoochee River. Primary drainages are the Black Creek / Juniper Creek drainage in the more northerly portion of the landscape, and the Pine Knot Creek drainage in the more southerly part. Both join with Upatoi Creek, a major tributary of the Chattahoochee River that flows through Fort Benning. Smaller portions of the ACUB Lands are drained by other Upatoi tributaries, and small portions may occupy other watersheds entirely, but lack any defined drainageways.

Characteristic of much of the Fall Line sandhills, the Fort Benning ACUB Lands tend to lack broad wetlands or floodplains. Wetlands tend to be confined to narrow dissected drainages, as illustrated in Figure 4.

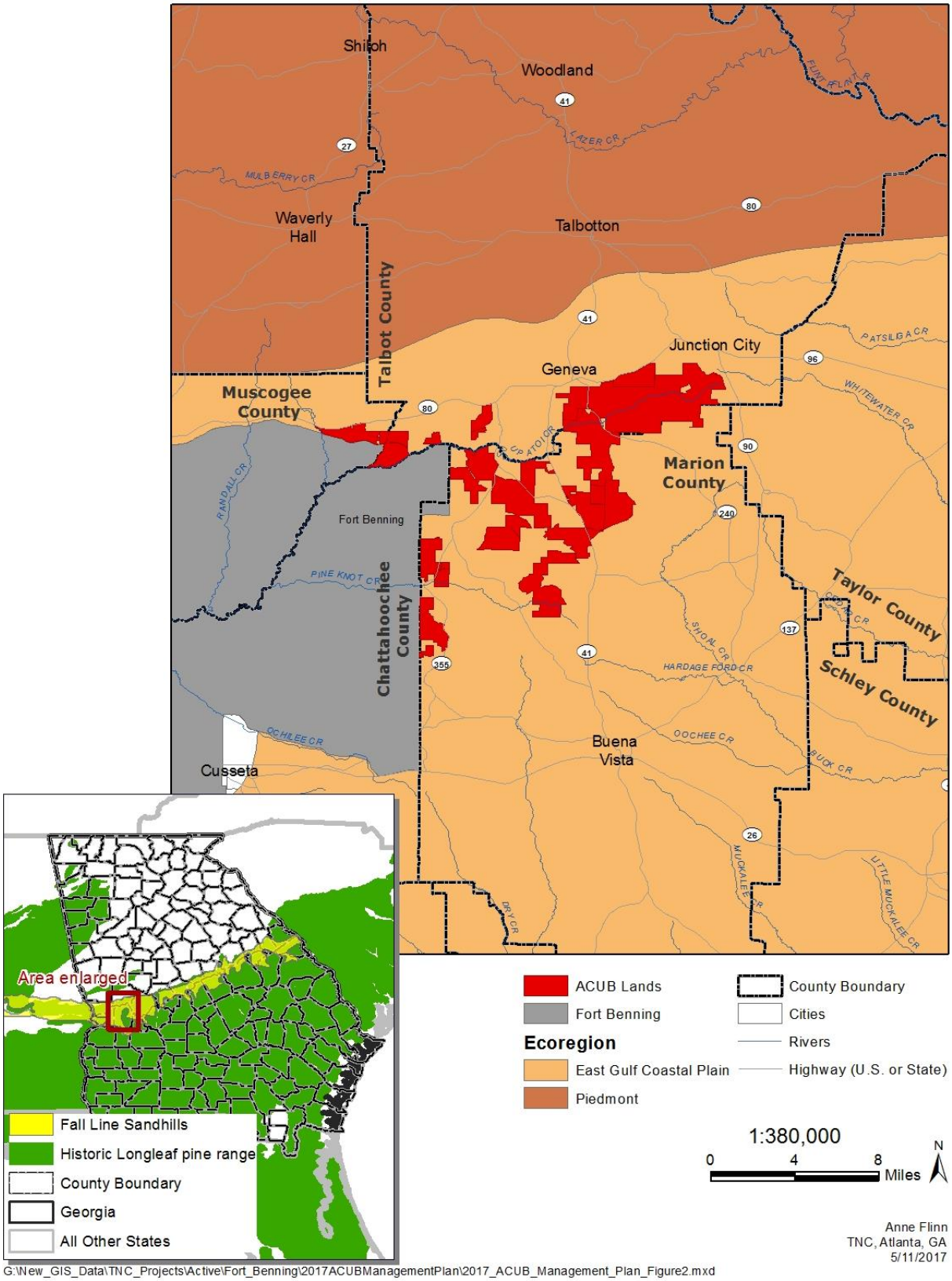

Figure 2. Location of ACUB lands within the historic longleaf pine range, Fall Line Sandhills, and East Gulf Plain Ecoregion.

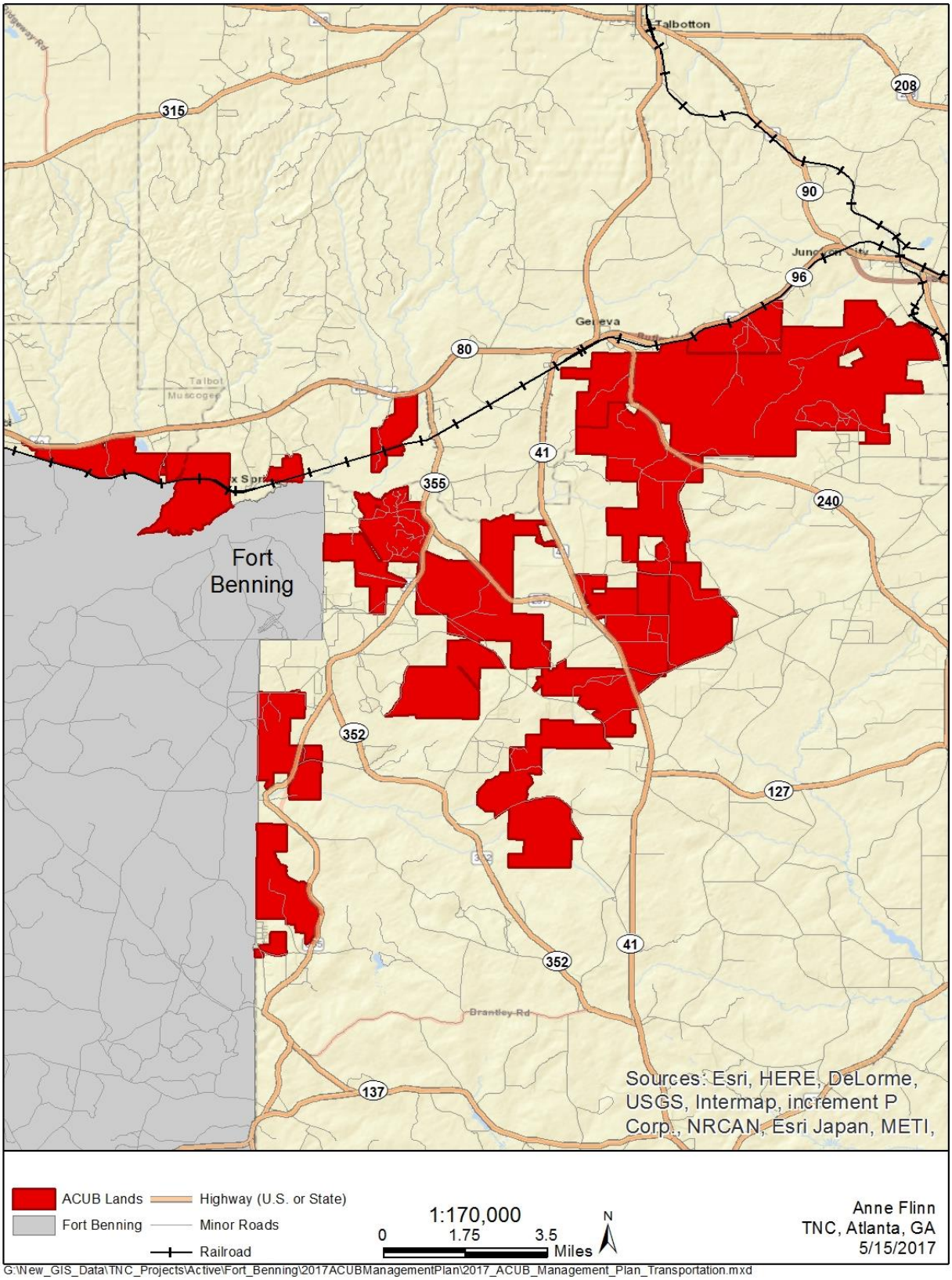

Figure 3. Transportation infrastructure in the vicinity of Fort Benning ACUB Landscape.

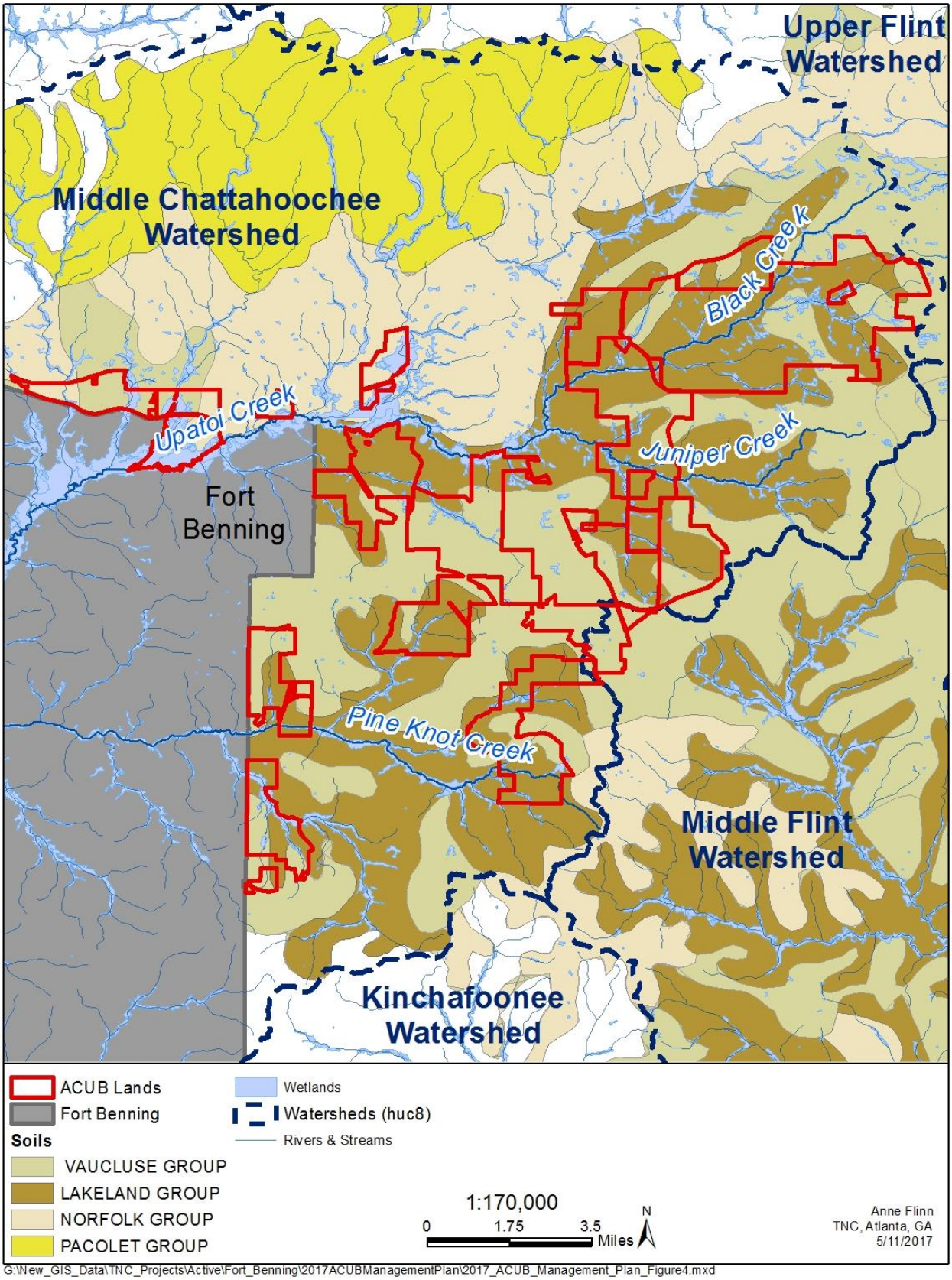

Figure 4. Soil groups, topography, and hydrology of Fort Benning ACUB Landscape.

DESIRED FUTURE CONDITIONS

The goal of this management plan is to achieve habitat restoration by restoring or emulating natural ecological processes. While precise predictions and acreages for different habitat types at Fort Benning ACUB Lands are difficult to project, the management recommendations provided below should result in an increase in longleaf pine natural communities and a decrease in loblolly pine, and especially sand pine, in the uplands. Within fifty years, most anthropogenic communities should no longer be present on ACUB Fee Lands; these will generally be converted to upland longleaf communities.

In the meantime, target conditions described below under "Landcover Type Descriptions" provide a useful indication of desired future conditions. While their potential spatial arrangements and acreage are not currently quantified, a path towards such forecasting is provided in the "Forest Management" section (Harvest Scheduling).

LANDCOVER CLASSIFICATION

This section describes Fort Benning ACUB Lands by broadly defined landcover classes based on dominant vegetation as measured in a comprehensive forest inventory conducted in 2016-17. Only lands owned in fee by TNC or the State of Georgia (The "ACUB Fee Lands") are included in this classification analysis, but the landcover classes are appropriate for the entire landscape.

Many more detailed habitat types could be described based on understory plant communities and soils, but such detail is incomplete at present and unavailable without more detailed field inventory. A current habitat/landcover map of the ACUB Fee Lands is shown in Figure 5, with acreage and average age of timber stands tabulated in Table 2, based on a 2016-17 forest inventory augmented with additional information and ground-truthing where necessary. Additional mapping based on this inventory and other analyses is provided under "Forest Management" later in the Plan.

LANDCOVER TYPE DESCRIPTIONS

The following section provides general habitat and landcover descriptions and lists natural plant communities known to occur on the Fort Benning ACUB Lands, described by the National Vegetation Classification System. Plant associations of conservation concern are described and the NatureServe community name and rarity ranks are given along with a summary of rare species. Ecological inventories from Fort Benning provide some guidance on the ecological overview, target conditions, and management of these plant associations[2]. While some management implications and notes are provided in this section, management guidance for forest resources, fire, invasive species, and rare species are provided in greater detail in later sections of the Plan. While detailed inventory and mapping for timber resources has been acquired and still being assessed, an ecological characterization of all natural plant communities occurring on the Fort Benning ACUB Lands is not yet available. This Plan will be updated as additional inventories are completed. Percentages given below apply to the extent of these landcover types on the ACUB Fee Lands, based on 2016-17 forest inventory (augmented by additional data where necessary).

[2] The Nature Conservancy, 2003. Fort Benning Plant Associations: Ecological Overview, Target Conditions and Management. A report to the Department of Defense in partial fulfillment of Phase II, Task IV of the Vegetation Characterization Project Cooperative Agreement DAMD17-00-2-0017

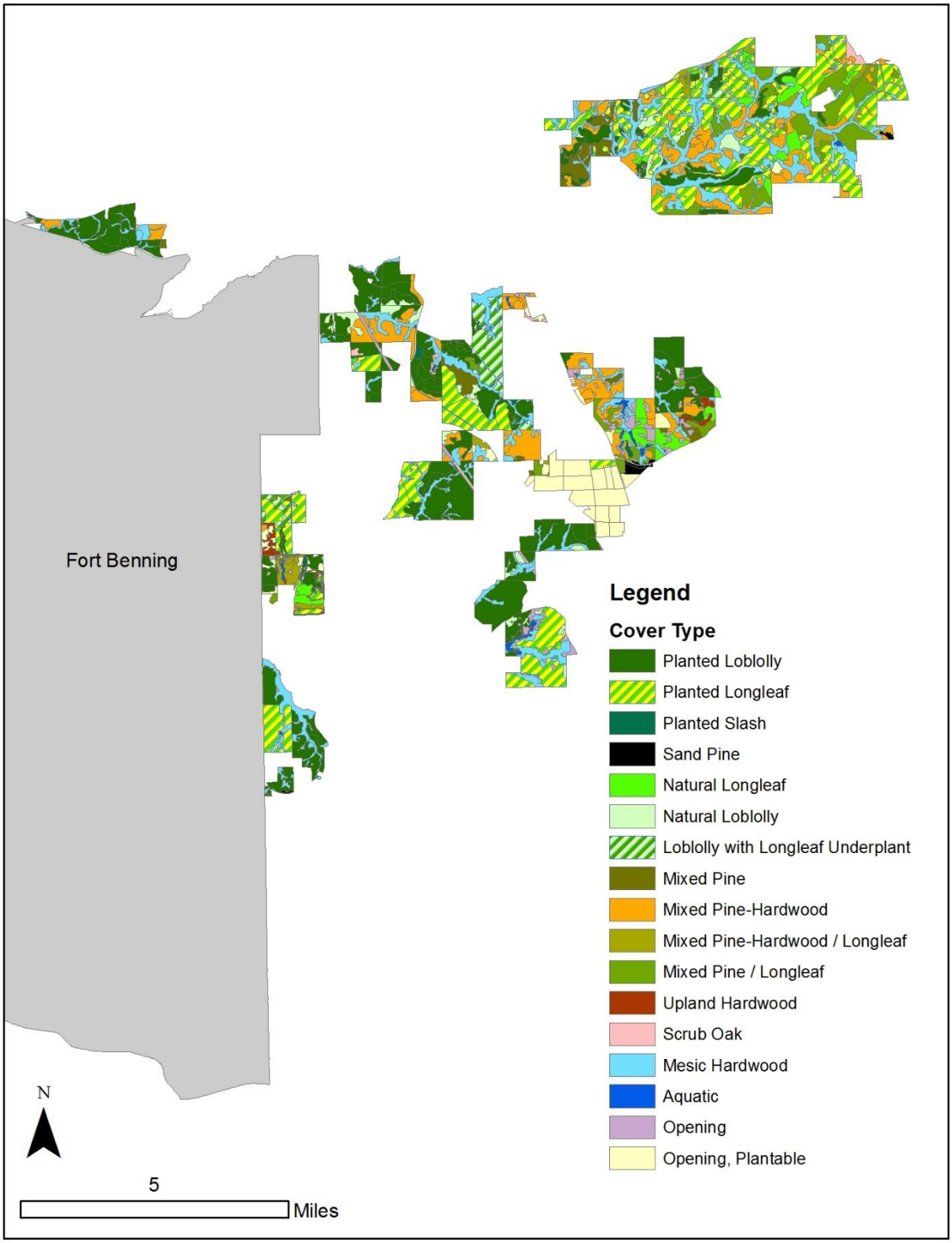

Figure 5. Current Habitat/Landcover Types on TNC and State fee-lands portion of Fort Benning ACUB Lands, based on 2016-17 forest inventory (augmented by additional data where necessary).

TABLE 2. Current Habitat/Landcover Types on ACUB Fee Lands, based on 2016-17 forest inventory (augmented by additional data where necessary).

Habitat/Landcover Type	Approximate Acreage	Percent	Average Age in 2018	General Description
Planted Loblolly	5677.5	25.2%	28.6	Loblolly pine plantations of various ages
Planted Longleaf	4746.4	21.1%	15.6	Longleaf pine plantations of various ages
Planted Slash	39.1	0.2%	29.0	Slash Pine plantations of various ages
Planted/naturalized Sand Pine	76.0	0.3%	30.1	Sand pine plantations and "naturalized" sand pine
Natural Longleaf	681.8	3.0%	50.2	Natural stands dominated by longleaf pine
Natural Loblolly	512.8	2.3%	35.4	Natural stands dominated by loblolly pine
Loblolly with Longleaf Underplant	579.8	2.6%	31.1	Loblolly that has been heavily thinned and underplanted with longleaf pine
Mixed Pine	474.4	2.1%	40.7	Mixtures that include some component of any extant pine species, but without a significant component of longleaf pine or hardwoods.
Mixed Pine-Hardwood	2379.1	10.6%	42.8	Same as Mixed Pine but with significant hardwood component.
Mixed Pine with Longleaf	1310.7	5.8%	32.6	Same as Mixed Pine but with significant longleaf pine component.
Mixed Pine-Hardwood with Longleaf	364.3	1.6%	70.6	Same as Mixed Pine but with significant components of both Hardwood and Longleaf.
Upland Hardwood	111.9	0.5%	45.7	Mixed Hardwoods, with only minor component of pine, in upland forest setting.
Scrub Oak	121.2	0.5%	41.3	Dry, sandy sites dominated by scrub oaks (e.g. turkey oak, bluejack oak, blackjack oak, sand post oak), typically not closed-canopy forest, with only minor component of longleaf pine.
Mesic Hardwood	3602.2	16.0%	44.9	Bottomland hardwood, stream floodplains, and seepage forests, including lowland mixed pine-hardwood.
Aquatic	118.40	0.5%	0.0	Lakes, ponds, and other open water, including naturally-occurring beaver impoundments where they are large/stable enough to delineate.
Opening	510.5	2.3%	0.0	Roads and impervious surfaces, managed wildlife openings; herbaceous seepage bogs; utility rights-of-way.
Opening, Plantable	1201.7	5.3%	0.0	Agricultural fields, pastures, and other openings to be restored to forest.
Total	22,507.8			

Mesic Hardwood Forests

Mesic Hardwood forests cover approximately 16% of the ACUB Fee Lands. These hardwood areas are mostly lowland areas, often floodplain (bottomland) or seepage forests associated with the riparian areas of clearwater creeks, drains and ponds. However, this cover type also includes some upland hardwood dominated areas where pine species are absent or occur at very low densities due to fire exclusion and/or historical harvest of the pine species. In the lowlands, typical tree species include red maple, gum, sweetbay, and mesic-adapted oaks. In lowland areas some longleaf pine may also occur along with loblolly, spruce (*Pinus glabra*), and pond pine (*Pinus serotina*). The understory is typically sparse, often with a good component of cane (*Arundinaria tecta*). The predominant plant association is the *Nyssa biflora - Acer rubrum var. rubrum / Lyonia lucida Forest* (G3) which is associated with many of the

floodplains along ACUB streams. The *Quercus phellos - Quercus nigra - Quercus alba / Chasmanthium (laxum, sessiliflorum*) Forest (G3) is another dominant forest type. This infrequently flooded forest occurs along small floodplains in slightly higher positions than the surrounding seasonally flooded forests.

Small stream swamps and wooded seepage bogs also occur in patchy distribution along Black Creek and its tributaries. These are distinctive areas at the bottom of gentle slopes, nearby or adjacent to streams, where groundwater seeps from the terrain (see the Aquatic Habitats section below). There are instances where the hydrology is saturated, but the site is also subject to temporary flooding. In these cases, the flora indicates that the effects of saturation overwhelm those of the temporarily flooded condition. Dominance by swamp black gum (*Nyssa biflora*) is characteristic. Some stands may have sweetbay (*Magnolia virginiana*) as a co-dominant. These areas are typically bounded above by pine or mixed pine-hardwood dominated uplands, and may grade down into a stream floodplain forest. In the floodplain forests, there will be more evidence of flooding, and more mineral soil will be exposed, in contrast to the seepage forest where there will be accumulations of organic matter, including *Sphagnum* mosses.

Mesic hardwood forest consisting of oak and beech tend to be limited in extent and located in distinctly concave landforms on a variety of aspects. The mesic hardwood-dominated areas grade up into dry-mesic hardwood forest, or directly into pine or pine-hardwood dominated uplands. In some cases, the dry-mesic hardwood areas may be only a narrow ecotone between the mesic, fire-sheltered ravine and the pine-dominated, fire-dependent uplands. They may grade down into a seepage or floodplain forest.

Habitat Significance of Mesic Hardwood Forests
These hardwood forest habitats represent important refugia and habitat in a fire-dominated landscape. They also provide important buffers to waterbodies.

Rare and uncommon plant species that occur in these areas include orchids (*Platanthera* spp.), sweet pitcher plant (*Sarracenia rubra*) [G4/S2 State Threatened], Atlantic white cedar (*Chamaecyparis thyoides*) [G4/S2], and Carolina bogmint (*Macbridea caroliniana*) [G2G3/S1].

Mixed Pine-Hardwood[3]
Mixed Pine-Hardwood forest is a significant habitat type and collectively covers approximately 13% of the ACUB Fee Lands. This loosely-defined habitat type encompasses numerous mixed forest types including variations of the fire-suppressed longleaf pine sandhill described above, to pine-sweetgum/water oak dominated types, to mesic and transitional slope areas between low lying creeks and the higher, drier sandhills. In many cases these areas have a greater hardwood component than pine and could be considered a "mixed hardwood pine" (i.e. hardwood > pine) cover type. In general, these areas have not regularly experienced fire, so the hardwood midstory is tall and this forest type has transitioned to a mixed pine-hardwood community. The overstory varies from a mixture of pine species (longleaf and loblolly) with a mature mixed upland oak component (turkey oak, post oak, and sand post oak) on slopes, and with more mesic oaks and other hardwoods in wetter, low lying areas. Much of this area would likely be good a candidate for restoration of the longleaf pine sandhill associations described above. The reintroduction of fire is critical to successful restoration when sandy soils are present. Therefore, fuel availability is a primary concern.

In general, the management objective for the mixed pine hardwood areas will be to transition them toward a pine (longleaf) dominated forest type, such as those described under the **Natural Longleaf** section below. This objective will be achieved through various forestry operations such as prescribed fire and mechanical hardwood removal. Herbicides may also be used if appropriate. Better stand delineations

[3] In context of Table 2 and Figure 5, includes **Mixed Pine-Hardwood with Longleaf**, and **Upland Hardwood**.

describing the various stand compositions and conditions may be needed to prescribe the most appropriate management actions for these areas.

However, some dry-mesic to dry-hardwood forests appear to have some degree of natural protection from frequent fire. In these sites, dominance by hardwood species may be a naturally occurring phenomenon. These sites include the walls of dry ravines, and sites on slopes in dissected topography. Factors of slope and aspect play a role in the degree of fire-sheltering at these sites. In particular, sites with coarser-textured soils would tend to develop a more xeric-adapted flora than those on a finer-textured soil with the same aspect. The tendency to develop a dry to dry-mesic flora instead of a mesic one will be more accentuated on south to west-facing slopes. The aspect may also help determine whether fire-dependent pines or fire-intolerant hardwoods occupy the site; a slope or concavity facing in the direction of the prevailing winds would be more likely to be the recipient of more frequent fire than one facing away from these winds, which would tend to drive fire in the direction of the site. Even in relatively fire-sheltered sites, fire plays an important role by removing excessive leaf litter and exposing mineral soils, opening up the shrub layer, and helping create canopy gaps. In some cases, the dry-mesic hardwood areas may be only a narrow ecotone between the mesic, fire-sheltered ravine and the pine-dominated, fire-dependent uplands.

Habitat Significance of Mixed Pine-Hardwood

The mixed-pine hardwood areas on Fort Benning ACUB Lands provide important habitat for many endangered, threatened, and declining plant and animal species. Generally, many of the species found in the natural longleaf habitat type can be found in the mixed-pine hardwood habitat, but are often in more patchy distributions and lower abundance due to reduced habitat quality (i.e. encroachment by hardwoods due to the lack of fire). Rare plants that may occur in this habitat include sandhills golden aster (*Pityopsis pinifolia*) [G4/S2] and Pickering's dawnflower (*Stylisma pickeringii*) [G4/S2]. Although apparently globally secure and not ranked in the State of Georgia, Georgia beargrass (*Nolina georgiana*) [G4/SNR] has been observed on the Almo Tract, which may represent a slight westward extension of the range within the Fall Line sandhills (pers comm Partick 2011). Sandhill bean (*Phaseolus polystachios var. sinuatus*) [G5T3/S2], while not currently documented may also occur. Nestronia (*Nestronia umbellata*) [G4/S3], a rare woody plant may also occur. Rare animal species that may utilize this habitat type include the gopher tortoise (*Gopherus polyphemus*) [G3/S2 candidate for federal listing as Threatened], pine snake (*Pituophis melanoleucus*) [G4/S3], eastern diamondback rattlesnake (*Crotalus adamanteus*) [G4/S4], and Bachman's sparrow (*Peucaea aestivalis*) [G3/S2]. The Eastern fox squirrel (*Sciurus niger*) is considered secure (S5) in Georgia, but data suggests that populations are declining due to the loss of their preferred habitat, open pine dominated forests and woodlands maintained by regular fire. In the absence of fire, this habitat becomes a mixed-pine habitat type with more dense vegetation favoring the more common gray squirrel. The Southeastern pocket gopher (*Geomys pinetis*) [G5/S2] has also been observed in open sandy areas.

Natural Loblolly Pine

With similar characteristics as Mixed Pine-Hardwood forest, some stands may be so dominated by loblolly pine as to be classified simply as Natural Loblolly (but only about 2% of ACUB Fee Lands). Loblolly dominance may be due to old-field or early-successional origins that allowed a dense thicket to become established with later self-thinning or partial cutting helping maintain the stand. Such stands may also have originated from planting but have lost all or most plantation characteristics. Because their origin is frequently a result of land use, they can occur across many different site conditions, and may take on the management implications and habitat significance of Mixed Pine-Hardwood, Mixed Pine, Planted Loblolly Pine, and even Natural Longleaf Pine, depending on land use and fire history. However some active treatment (e.g. underplanting) to transition such forest to longleaf pine will typically be necessary, unless the site is a natural fire shadow or fire island in which case some other successional pathway may be appropriate.

Natural Longleaf Pine

Collectively, the natural longleaf pine habitat type covers only about 3% of the ACUB Fee Lands. This highly-desirable habitat is considered part of the Atlantic Coastal Plain Fall-line Sandhills Longleaf Pine Woodland ecological system. It is mostly the *Pinus palustris* - *Pinus* (*echinata, taeda*) - *Quercus* (*incana, margarettiae, falcata, laevis*) Woodland association (fire-suppressed longleaf pine sandhill). These areas are all classified as non-planted, often containing an uneven age structure, with some longleaf pine trees known to exceed 300 years in age. These areas usually exhibit little mechanical disturbance in the understory, but are often fire–suppressed with a midstory and overstory density that range from a forest to an open woodland structure. Areas on ACUB Fee Lands that have a much higher stocking of overstory and midstory hardwoods than of longleaf pine, have generally been classified as the Mixed Pine Hardwood habitat type described above. With continued fire management, this forest structure will transition towards a woodland structure and hardwood densities will decline favoring longleaf pine. This habitat type occurs on upland sites ranging from gently rolling, broad ridgetops to steeper sideslopes, as well as locally in mesic swales and terraces. Most soils are predominantly well drained to excessively drained and contain classic Fall Line sandhill habitat. The overstory is dominated by scattered mature longleaf pine with a midstory of upland oaks (turkey oak, southern red oak, and blackjack oak). This community may rapidly grade downhill into a more mesic type of longleaf habitat (not delineated in the current classification) and sometimes loblolly pine-dominated vegetation. This is due to a combination of soil texture and slope/aspect. Disturbed areas formerly occupied by longleaf sandhills may presently contain mixtures of turkey oak, other scrub oaks, and yellow haw (*Crataegus flava*). Some parts of the ACUB Fee Lands with such characteristics, about 0.5% of the 3% natural longleaf mentioned above are classified as Scrub Oak since very little longleaf pine remains. A juvenile and/or suppressed cohort of longleaf pine seedlings or saplings in such areas, even where canopy trees are very rare or lacking, is a favorable indicator for future restoration of this community.

Habitat Significance of Natural Longleaf Pine

The natural longleaf pine areas on Fort Benning ACUB Lands provide important habitat for many endangered, threatened, and declining plant and animal species. Rare species known to occur on Fort Benning ACUB Lands include plants such as sandhills golden aster (*Pityopsis pinifolia*) [G4/S2] and Pickering's dawnflower (*Stylisma pickeringii*) [G4/S2]. Although apparently globally secure and not ranked in the State of Georgia, Georgia beargrass (*Nolina georgiana*) has been observed on the Almo Tract which may represent a slight westward extension of the range within the Fall Line sandhills (pers comm Patrick 2011). Sandhill bean (*Phaseolus polystachios var. sinuatus*) [G5T3/G2] has not yet been documented, but is very likely to occur on the Fort Benning ACUB Lands. Rare animal species known to occur on the Fort Benning ACUB Lands include the gopher tortoise (*Gopherus polyphemus*) [G3/S2 candidate for federal listing as Threatened], pine snake (*Pituophis melanoleucus*) [G4/S3], eastern diamondback rattlesnake (*Crotalus adamanteus*) [G4/S4], southern hognose snake (*Heterodon simus*) [G2/S2] and Bachman's sparrow (*Peucaea aestivalis*) [G3/S2], gopher frog (*Rana capito) [G3/S3]*. The Eastern fox squirrel (*Sciurus niger*) is also found in this habitat. The Southeastern pocket gopher (*Geomys pinetis*) [G5/S2] has also been observed on the Fort Benning ACUB Lands. With restoration and management this habitat will become important habitat for the endangered red-cockaded woodpecker (*Picoides borealis*) [G3/S2] allowing the population known to occur on nearby Fort Benning to expand and thrive.

Pinus palustris – Pinus (echinata, taeda) / Quercus (marilandica, laevis) /Schizachyrium scoparium Woodland – (CEGL008491) (G3) is a plant association of conservation concern that occurs on Fort Benning ACUB Lands. The common name is the longleaf pine - (shortleaf pine, loblolly pine) / (blackjack oak, turkey oak) / little bluestem Woodland.

Target Conditions and Quality Indicator Species

The target condition for this woodland association is an open canopy dominated by *Pinus palustris* with lesser amounts of *Pinus taeda* and *Pinus echinata*. The stand should be patchy and contain a heterogeneous, uneven-aged structure that includes *Pinus palustris* varying in age from old growth (> 100 years old, "flat top" morphology) to grass-stage regeneration. The subcanopy and shrub layers should be sparse to patchy and include *Quercus marilandica, Quercus laevis, Quercus incana, Quercus margarettiae, Quercus falcata, Crataegus flava, Diospyros virginiana, Sassafras albidum, Vaccinium arboreum, Vaccinium tenellum, Vaccinium stamineum, Vaccinium myrsinites, Gaylussacia dumosa, Rhus copallinum,* and *Rubus cuneifolius.* Ground cover varies with time since fire and soil moisture levels vary; however, stand has at least enough herbaceous ground cover, needle fall, and easily burned leaf litter to carry a continuous prescribed or naturally occurring fire. Herbaceous groundcover is dominated by native grasses and forbs including *Schizachyrium scoparium, Aristida purpurascens, Andropogon ternarius, Andropogon gyrans, Pityopsis aspera, Pteridium aquilinum, Cnidoscolus stimulosus, Rhynchosia reniformis, Sericocarpus tortifolius, Eriogonum tomentosum, Aureolaria pectinata, Phaseolus polystachios var. sinuatus, Agrimonia incisa, Yucca filamentosa,* and *Stylisma pickeringii var. pickeringii*. Surface soils within this association are typically sands or sandy loams. Frequent fire is an integral part of management. The presence of this plant community is one presumed source of the naming of the Blackjack Crossing Tract.

Open Areas

These areas mostly consist of human altered areas including woods roads, utility rights-of-way, agricultural fields (usually pasture), wildlife food plots, and small log decks or cutover areas created after timber harvesting. Such openings and fields make up approximately 7% of the ACUB Fee Lands, about two-thirds of which are likely to be restored to forest; the balance represent permanent roads and rights-of-way, managed wildlife plots, and non-forest habitats.

Habitat Significance of Open Areas

Open areas provide important habitat for many wildlife species, both game and non-game. Some open areas will continue to be maintained as wildlife openings for game species so long as their cumulative size does not exceed five percent (5%) of the tract on which they occur. Others may be replanted to longleaf pine, or allowed to fill in by natural succession.

There are several seepage bogs known to occur in this cover type. A description of this habitat type can be found in the Aquatic Habitats section below. While vegetation management by utility companies has kept the habitat open and many rare species still occur here, and/or utilize the edges or habitat transitions that rights-of-way afford, it is hoped that mowing and herbicides can be eliminated in favor of fire as the primary vegetation management strategy.

Planted Loblolly (or Slash) Pine

Planted loblolly pine makes up just over 25% of the total ACUB Fee Lands; planted slash less than half of one percent. These areas are comprised of even-aged pine stands of various age classes, planted as seedlings. The oldest were established in the mid-1980s but many were established as recently as the mid-2000s. Generally speaking, the understory of these stands is disturbed and usually fire-excluded until recently. Typical understory species include *Andropogon sp. and* other grasses, vines, and a large amount of blackberry, which is indicative of disturbance.

Habitat Significance of Planted Loblolly/Slash Pine

Target conditions for these plantations will be restored sandhill or slope/transitional habitat with an open pine woodland structure and a longleaf component, though existing loblolly pine, if healthy, may be retained and can provide habitat structure and fine fuels, with longleaf introduced gradually. These areas

will need future thinning and prescribed fire to move them toward this desired condition. When restored, these areas may provide important habitat for many endangered, threatened, and declining plant and animal species. While not native to this part of Georgia, slash pine is somewhat more fire tolerant than loblolly, and can become naturalized, co-existing with loblolly and/or longleaf or other native pine species. It is not considered invasive, and like loblolly pine, may provide desirable habitat structure and fine fuels.

Planted Longleaf Pine

Planted longleaf pine makes up almost 24% of the ACUB Fee Lands. These areas are comprised of even-aged longleaf pine stands of various age classes, planted as seedlings. The oldest were established in the late 1980s though others were only recently established, both before and after TNC's recent acquisitions. Generally speaking, longleaf was historically but infrequently planted on the driest and sandiest soils, competing with sand pine, and sometimes loblolly, as a commercially-viable species for less fertile sites. Lands on which conservation objectives prevail increasingly includes planted longleaf on a wider range of sites. Also, unlike other planted pine types described here, planted longleaf increasingly occurs as an "underplanted cohort" beneath a sparse residual overstory canopy of loblolly or mixed pine species in which the longleaf pine component is not adequate for natural regeneration. About 2.6% of the 24% of ACUB Fee Lands noted above as planted to longleaf actually occurs as "underplanting" beneath a heavily thinned, much older canopy of planted loblolly pine.

Habitat Significance of Planted Longleaf Pine

Target conditions for these plantations will be restored sandhill habitat with an open pine woodland structure with a diverse herbaceous understory. These areas will need future thinning and prescribed fire to move them toward this desired condition. When restored, these areas may provide important habitat for many endangered, threatened, and declining plant and animal species.

Sand Pine

Native to northern Florida and coastal Alabama and considered an invasive species in Georgia, sand pine stands now cover less than 1% of ACUB Fee Lands. The occur either as planted stands, or residual trees along edges or inoperable areas of stands previously harvested planted stands, or as naturalized re-growth from seed or stumps of previously harvested planted stands. The latter may also occur intermingled with longleaf plantations. Eradication efforts are on ongoing. Sand pine was historically planted on the driest and sandiest soils, those that historically supported longleaf pine sandhill habitats, as a commercially-viable species for less fertile sites, valued primarily for its ability to grow substantial volumes of low-grade fiber, rather than its timber attributes.

Habitat Significance of Planted Sand Pine

The habitat significance of such areas in their current condition is entirely "negative" and they represent a threat to adjacent habitats via seeding. While sand pine periodically experiences stand-replacement fire in its native range, it is difficult to control or eradicate with fire, despite its tendencies to remain dense and limby, and to create deep mats of pine litter. Those same tendencies create unfavorable habitat conditions for almost all native species of conservation concern on Fort Benning ACUB Lands. Because sand pine was usually established as a fast-growing fiber resource on sandy, infertile, otherwise "non-productive" sites for commercial wood production, very likely longleaf pine sandhill sites, these areas are important to restore. When restored, they may provide important habitat for many endangered, threatened, and declining plant and animal species, or will at least provide continuity in fire management and overstory habitat structure.

Mixed Pine
This loosely-defined category makes up 20% of the ACUB Fee Lands and includes mixtures of loblolly, shortleaf, slash, or longleaf, with the amount of longleaf pine being an important factor for management. Mixed Pine forest without an adequate longleaf component may require longleaf planting.

Habitat Significance of Other Pine
Target conditions for these areas will be restored sandhill habitat or slope/transitional habitat with an open pine woodland structure and a longleaf component, though existing loblolly, shortleaf, or slash pine, if healthy, may be retained and can provide habitat structure and fine fuels, with longleaf introduced gradually. These areas will need future thinning and prescribed fire to move them toward this desired condition. When restored, these areas may provide important habitat for many endangered, threatened, and declining plant and animal species.

Aquatic Habitats
These habitat types account for less than 1% of the ACUB project area. However, there is a disproportionately high percentage of plant and animal diversity found in the ACUB watersheds. In many cases these are not entirely discrete habitat types. Several of the categories listed may be represented along an elevational gradient with overlap of species.

Streams

The perennial streams that flow through the ACUB project area have sandy substrates, abundant coarse woody debris, and often have undercut banks. Turbidity is low due to the coarse sands that characterize local soils.

Significance and Rare Species
These streams provide habitat for a number of vertebrates. Among species of conservation concern are the alligator snapping turtle *(Macrochelys temminckii*, listed as threatened in Ga), and the broadstripe shiner (*Pteronotropis euryzonus*, listed as Rare in Ga). There are additional rare fish and invertebrate species potentially present in these streams based on general distribution data (See table below). Survey work should be done to determine which of these species are present. Among plants of note are loose water-milfoil (*Myriophyllum laxum*) which is an aquatic plant is found in ACUB drainages, and Carolina bogmint (*Macbridea caroliniana*) which grows along stream banks. Disjunct populations of Atlantic white cedar **(***Chamaecyparis thyoides*) are found in this part of Georgia, and there are isolated stands along several ACUB streams.

Stream water quality can be maintained by minimizing soil disturbance in watersheds. This includes activities related to forestry, prescribed fire, and road maintenance. Best management practices should set minimum guidelines, and in some cases more conservative measures can be taken to reduce negative impacts.

Ponds

There are two types of impoundments found along the streams on this landscape: man-made ponds and beaver ponds. While different in origin, they share many characteristics. Both types harbor high herbaceous plant diversity along the pond margins and on tussock islands.

Significance and Rare Species
Species include many carnivorous plants (*Sarracenia rubra*, and *S. psitticina*), and a variety of orchids. Red milkweed (*Aesclepias rubra*) and Chapman's beakrush (*Rhyncospora stenophylla*) also inhabits these areas. In some areas there are Atlantic white cedar as well. These wetlands provide habitat for waterfowl,

and wading birds, including wood storks.

Fire plays an important role along the pond margins, where many rare herbaceous species are found. Soil disturbance should be kept to a minimum in the vicinity of ponds, which will protect water quality and protect rare plant communities.

Seepage Slope Wetlands

Unique plant associations often form where impervious materials such as sandstone or claystone retain water near the surface allowing wetland plants to proliferate. These wetlands are often upslope from streams and thus embedded within upland habitat. This significantly increases the plant diversity found in uplands. Similar to the wetlands along streams and ponds, these habitats will become dominated by wetland shrubs such as gallberry (*Ilex glabra*), fetterbush species (*Luecothoe axillaris* and *Lyonia lucida*), and white titi (*Cyrilla racemiflora*), in the absence of fire. Switch cane (*Arundinaria tecta*) and *Sphagnum* moss are often present in these habitats as well.

Significance and Rare Species

Carnivorous plants favor this habitat and include *Sarracenia, Drosera*, and *Utricularia*. Orchids include northern fringed orchid (*Platanthera blephariglottis*). Coal skinks (*Pleistiodon anthracinus*) are a vertebrate species which utilize the sphagnum seeps that are common in this type of habitat.

Frequent fire promotes a highly diverse plant assemblage by allowing herbaceous vegetation to compete with woody species. It will be necessary to burn these areas during drier periods of the year or in drier years be most effective.

Ephemeral Upland Ponds

These are naturally occurring wetlands embedded within upland habitat. The ideal condition is a pond basin with open canopy and abundant emergent herbaceous vegetation. On ACUB Lands many of these ponds have been altered by human excavation, which impacts the hydroperiod and vegetation.

Significance and Rare Species

These wetlands serve as breeding sites for many winter-breeding amphibians including tiger salamanders (*Ambystoma tigrinum*) and ornate chorus frogs (*Psuedacris ornata*). There is a breeding population of gopher frogs (*Lithobates capito*, listed as "rare" in Georgia) in the northeastern portion of Ft. Benning and adults have been observed in gopher tortoise burrows on the Oakland Farm tract of the ACUB Fee Lands, so it is possible that additional gopher frog populations will be documented as using wetlands elsewhere on the Fort Benning ACUB Lands. Striped newts (*Notophthalmus perstriatus*, state threatened) use this type of habitat as well, so survey efforts should continue for this species on ACUB.

Fire suppression has allowed hardwoods to invade some of these ponds, making them unsuitable for many of the species that rely on this habitat type. Where possible, these wetlands should be burned when the pond basin is dry. This will help eliminate hardwoods and promote herbaceous vegetation. The use of targeted herbicide treatments may be considered as well to quickly remove larger hardwoods or those not effectively managed with fire alone.

Management of man-made ponds may include administering public fishing where approved by both DNR and TNC (see Public Use, below), stocking with native species, use of chemicals and fertilizers to manage aquatic flora, and activities necessary to maintain dams, spillways, water control structures, and publicly-accessible areas. Whether such activities take place on lands owned in fee by DNR or TNC, they should be undertaken in a manner that protects the conservation values noted in the Conservation Easements for lands owned by DNR.

HIGH PRIORITY SPECIES ON FORT BENNING ACUB LANDS

Table 3 lists the high priority species known to occur, or have the high potential to occur, on the Fort Benning ACUB Lands. Occurrences (documented) are noted as to being found on Fort Benning itself versus Fort Benning ACUB Lands. Inventories of rare species on ACUB Lands are incomplete, and will be updated periodically.

PLANTS

As described in the previous sections, there are numerous wetland habitats on Fort Benning ACUB Lands which harbor high-priority plant species. They occur as herbaceous seepage bogs, ponds and swamps sometimes influenced by beavers. The **sweet pitcher plant (*Sarracenia rubra*)** occurs in all of these types of wetlands. Sweet pitcher plant is ranked as G2/S2 and is considered State Threatened in Georgia. On the Blackjack Crossing tract, sweet pitcher plant is restricted to least three herbaceous seepage bogs that occur in a powerline right-of-way. These herbaceous bogs were historically maintained in open condition by fire and probably occurred in greater extent in the sandhills under historical fire frequencies and intensities. Today, this habitat has been drastically degraded. Other rare plants occurring in these wetlands include the **northern fringed orchid (*Platanthera blephariglottis*)** G4G5/S2 and **Chapman's beakrush (*Rhynchospora stenophylla*)** G4/S2. **Red milkweed (*Asclepias rubra*)** G4G5/S1 was thought to be extirpated from the State but was rediscovered in the seepage bogs on Blackjack Crossing where it occurs with significant stands of *Arundinaria sp.* There is extensive beaver influenced wetlands and bogs on the Pine Knot tracts which also include red milkweed, the best known population in the State. These wetlands are also important habitat for **parrot pitcher plant** (*Sarracenia psittacina*) which represents over a 100-mile range extension for the species. **Clearwater butterwort** (*Pinguicula primuliflora*) can be found in the sandy streams which flow into these wetlands. **Atlantic white cedar** (*Chamaeyparis thyoides*) sites on the Fort Benning ACUB Lands are of great conservation significance due to their good to excellent condition and disjunct inland occurrence. On the Almo tract most of the Atlantic white cedar occurs on an 80-acre inholding owned by a private landowner. On the Fort Perry tract the Atlantic white cedar occurs on the TNC-owned portion. Sweet pitcher plant often occurs with the cedar and **loose water-milfoil (*Myriophyllum laxum*)** G3/S2S3 has been observed in the ponds where cedar is growing on the periphery.

TABLE 3. High Priority Species that occur, or are likely to occur, on Fort Benning ACUB Lands.

Taxonomic Group	Scientific name	Common Name	Global (G) and State (S) rarity ranks	Found on Fort Benning	Found on ACUB Lands
Birds	*Peucaea aestivalis*	Bachman's sparrow	G3/S2	X	
	Colinus virginianus	bobwhite quail	G4/S5	X	X
	Falco sparverius paulus	southeastern American kestrel	G5T4/S2	X	X
	Mycteria americana	wood stork	G4/S2 US Endangered, State Threatened	X	X
	Picoides borealis	red-cockaded woodpecker	G3/S2 US/State Endangered	X	
Plants	*Asclepias rubra*	red milkweed	G4G5/S1		X
	Carex exilis	coastal sedge	G5/S1		X
	Chamaecyparis thyoides	Atlantic white cedar	G4/S2		X
	Macbridea caroliniana	Carolina bogmint	G2G3/S1		X
	Myriophyllum laxum	loose water-milfoil	G3/S2S3	X	X
	Nestronia umbellata	Nestronia	G4/S3	X	X
	Nolina georgiana	Georgia beargrass	G4/SNR		X
	Phaseolus polystachios var sinuatus	sandhill bean	G5T3/S2?	X	
	Pinguicula primuliflora	butterwort	G3/S1 State Threatened		X
	Pityopsis pinifolia	sandhills golden aster	G4/S2	X	X
	Platanthera blephariglottis	northern fringed orchid	G4G5/S2		X
	Rhynchospora stenophylla	Chapman's beakrush	G4/S2	X	X
	Sarracenia psittacina	parrot pitcher plant	G4/S2S3	X	X
	Sarracenia rubra	sweet pitcher plant	G4/S2 State Threatened	X	X
	Stylisma pickeringii	Pinkering's dawnflower	G4/S2	X	
	Trillium reliquum	relict trillium	G3/S3 US/State Endangered	X	X
Herpetofauna	*Ambystoma tigrinum*	tiger salamander	G5/S3S4	X	
	Crotalus adamanteus	eastern diamondback rattlesnake	G4/S4?	X	X
	Gopherus polyphemus	gopher tortoise	G3/S2 US Candidate as Threatened	X	X
	Heterodon simus	southern hognose snake	G2/S1S2 State Threatened	X	

Taxonomic Group	Scientific name	Common Name	Global (G) and State (S) rarity ranks	Found on Fort Benning	Found on ACUB Lands
Herpetofauna (cont'd)	*Notophthalmus perstriatus*	striped newt	G2G3/S2 US Candidate as Threatened		
	Pituophis melanoleucus	pine snake	G4/S3	X	X
	Rana capito	gopher frog	G3/S3	X	X
	Macrochelys temminkii	Alligator snapping turtle	G3G4/S3	X	X
	Plestiodon anthracinus pluvialis	Southern Coal skink	G5/S1		
Mammals	*Geomys pinetis*	Southestern pocket gopher	G5/S2 State Threatened	X	
	Sciurus niger	Eastern fox squirrel	G5/S5	X	X
	Spilogale putorius	Spotted skunk	G4/S3	X	
Fish	*Cyprinella callitaenia*	Bluestripe shiner	G2G3/S2	X	
	Etheostoma parvipinne	Goldstripe darter	G4G5/S2S3	X	
	Notropis chalybaeus	Ironcolor shiner	G4/S3		
	Notropis harperi	Redeye chub	G4/S3		
	Notropis hypsilepis	Highscale shiner	G3/S3		
	Pteronotropis euryzonus	Broadstripe shiner	G3/S3	X	X
	Pteronotropis welaka	Bluenose shiner	G3G4/S1 State Threatened		
Mussels	*Anodonta heardi*	Apalachicola floater	G2/S4	X	
	Elliptoideus sloatianus	Purple Bankclimber	G2/S2 US/State Threatened		
	Hamiota subangulata	Shinyrayed Pocketbook	G2/S2 US/State Endangered		
	Medionidus penicillatus	Gulf Moccasinshell	G2/S1 US/State Endangered		
	Pleurobema pyriforme	Oval Pigtoe	G2/S1 US/State Endangered		

HERPETOFAUNA

The habitats on Fort Benning ACUB Lands provide some of the best opportunities for the conservation of a number of imperiled herpetofauna. The eastern diamondback rattlesnake (*Crotalus adamanteus*), pine snake (*Pituophis melanoleucus*), and southern hognose snake (*Heterodon simus*) have all been observed on the ACUB Fee Lands, and will likely increase with habitat management and restoration.

An especially important conservation species in the Fall Line sandhill ecosystem is the gopher tortoise (*Gopherus polyphemus*). The gopher tortoise is a state protected species in Georgia and is a candidate for federal listing. Gopher tortoises dig long, deep burrows in the sandy soils that provide refugia to allow

them to regulate their body temperature and escape from fire. This keystone species is important because roughly 300 species of animals are known to use the burrows of gopher tortoises for shelter from summer heat, winter cold, natural fires and predators, including pine snakes, eastern diamondback rattlesnakes, and gopher frogs. The ACUB Fee Lands, and some additional lands under ACUB conservation easements, have been surveyed by DNR and found to have a robust population of gopher tortoises which will be protected from future development. The reintroduction of fire and the transition from planted pine to natural longleaf forest should provide more suitable habitat and enhance the gopher tortoise population.

BIRDS

Restoration of habitat for the federally endangered red-cockaded woodpecker **(**RCW, *Picoides borealis***)** on the Fort Benning ACUB Lands is a priority conservation objective. Currently there are no known populations on the Fort Benning ACUB Lands. Although there are some mature longleaf pine trees that could serve as cavity trees, there is generally a lack of multiple large (>150 ac) contiguous stands to support a viable population. However, there is a significant population on nearby Fort Benning, and the protection and restoration of large forested tracts in the immediate area provides opportunity for future expansion or relocation of RCW via natural dispersal and/or translocation, once timber has matured enough to support significant nesting habitat. While this Plan contemplates protection, restoration, and recovery of many imperiled species, an overriding focus on the RCW is necessary and appropriate given the status of the Fort Benning population as one of 13 Primary Recovery Populations for this federally endangered species, and the motivation by numerous partners, including Fort Benning and the USFWS, to expand and connect habitat in support of the species.

Nesting boxes have been installed for the southeastern American kestrel **(***Falco sparverius paulus***)** on the Blackjack Crossing tract.

MAMMALS

The habitat on the Fort Benning ACUB Lands provides good habitat for the fox squirrel (*Sciurus niger*) and southeastern pocket gopher (*Geomys pinetis*).

FOREST MANAGEMENT

VISION

Restoration and maintenance of native biological diversity, within a longleaf pine-dominated upland matrix, is the guiding philosophy of the Plan. Plants, animals, uplands, wetlands, and watersheds are all viewed as components of the system. All management actions and silvicultural treatments should be evaluated in context of the impacts those actions have on the entire system. At this point in time (2017), the management activities that impact the most acres across Fort Benning ACUB Lands are fire, timber management, and reforestation. Other activities that impact the landscape include grazing, groundcover restoration, invasive species control, and hunting. All management activities can be viewed as tools used to move the Fort Benning ACUB Lands towards a more functional, self-sustaining ecological state. Based on the fire-maintained longleaf pine ecosystem desired future conditions identified throughout this plan, monitoring of resource change will inform decisions that lead to continuous refinement in management actions. In the sections that follow, four of these tools are defined in greater detail: 1) timber management, 2) reforestation, 3) groundcover restoration, and 4) fire management.

The concept of "indicator species" as measures of ecological health and sustainability has long permeated ecological management planning, and underpins the Endangered Species Act itself. Accordingly, a significant focus in this Plan will be the restoration and connectivity of fire-managed longleaf and other southern yellow pine habitats for the RCW and the gopher tortoise, both being good indicators of the health of the longleaf pine ecosystem. The RCW in particular has such exacting requirements for habitat structure (both biological and regulatory) that forest management on the Fort Benning ACUB Lands should always consider how or whether such requirements can be accommodated, even though achievement of the necessary structure may be far in the future. Still, emphasis on RCW, gopher tortoise, and other imperiled species should not undermine the vision described above to focus on the entire system, rather than its individual components.

FOREST HABITAT STRUCTURE

Data from the 2016-17 forest inventory provide insight into the structural attributes of timber stands on about 22,000 acres of ACUB Fee Lands. The data include information on tree species composition, stand age, stand size structure (e.g. frequency of tree stems within diameter ranges), and measures of stand stocking (number of trees per acre, basal area per acre, and various measures of stem volume per acre). In addition, advance regeneration of longleaf pine, presence of invasive species, presence of tortoise burrows, and groundcover conditions were all tallied on sample plots throughout this land base. These data represent a rich source of both site-specific and landscape-scale information for the kinds of forest and habitat planning contemplated below, and should be "mined" for such insights as appropriate.

High-level "snapshots" of forest structure and spatial arrangement, based on this inventory and other information where available, are presented in Figure 6-8. Unlike Figure 5, which depicts landcover across the ACUB Fee Lands, the timber stands or habitat areas illustrated in Figures 6-8 are confined to lands deemed restorable to RCW and/or gopher tortoise habitat, i.e. fire-manageable uplands, and certain lowlands or bottomlands know to retain a longleaf pine component, excluding roads, utility rights-of-way, and other likely-permanent openings, which represents 80% of the land base.

Figure 6 illustrates the spatial distribution of stand age (as of 2018) across all restorable habitat on Fort Benning ACUB Lands. For the inventoried ACUB Fee Lands, this age is based on coring sample trees, or known planting year. Age information for easement lands, not covered by the forest inventory, are conservative estimates based on about 25 years of historic imagery. Therefore, areas classified as 21-30 years old may actually be older than that.

Figure 7 depicts all of the Fort Benning ACUB Lands, with hypothetical RCW clusters placed at likely RCW recruitment locations under the assumption that habitat can be restored to suitable nesting conditions in the number of years indicated. The locations were determined via procedures documented in a 2012-2013 RCW population modeling exercise, which addressed two alternative ACUB landscapes, one of which closely approximates the current Fort Benning ACUB lands.[4] While complex assumptions were used in that analysis as to contiguous habitat and sufficient acreage per cluster, some of the assumptions for the creation of this map are more simplistic. The "cluster circles" illustrated are a quarter-mile in radius (actual territories or "foraging partitions" may be larger), and the indicated number of years required to reach suitability for nest cavities presumes pine trees must be at least 60 years old to support either natural or artificial cavities (though artificial cavities could be placed in suitable trees less than 60 years old), that any extant pine trees (regardless of species) will be suitable, and that the maximum stand age for any stands at least 5 acres in size within the illustrated quarter-mile circle is a credible estimate of the age of trees that will be suitable for cavities.

While Figure 7 represents an instructive "what-if" scenario based on the current protected-lands configuration and pine age class structure, it should not necessarily be considered a credible estimate of when nor where RCW clusters might appear (nor be placed) on Fort Benning ACUB Lands. Tree age alone is an inadequate indicator of habitat suitability, so timing may vary considerably. Even more important, the successful restoration of isolated habitat patches, sufficiently mature, are of no practical value to RCWs until they have adequate spatial proximity to enough occupied habitat to provide demographic function. One or two isolated RCW groups recruited miles away from any others would not likely persist, and should not contemplated.

Figure 8 depicts only the ACUB Fee Lands, and illustrates the distribution of basal area per acre (an indication of stand density or stocking), as inventoried in restorable habitat in 2016-17. For both habitat considerations as well as health and economic value of timber stands, high levels of pine basal area per acre (e.g. 100+ square feet per acre) indicate management concerns and opportunities.

[4] Doug Bruggeman, 2013. Evaluation of Encroachment Partnering Parcels on the Fort Benning Landscape using Landscape Equivalency Analysis and Pattern Oriented Modeling for Red-cockaded Woodpecker. Report to The Nature Conservancy by Ecological Services and Markets Inc. 27 p.

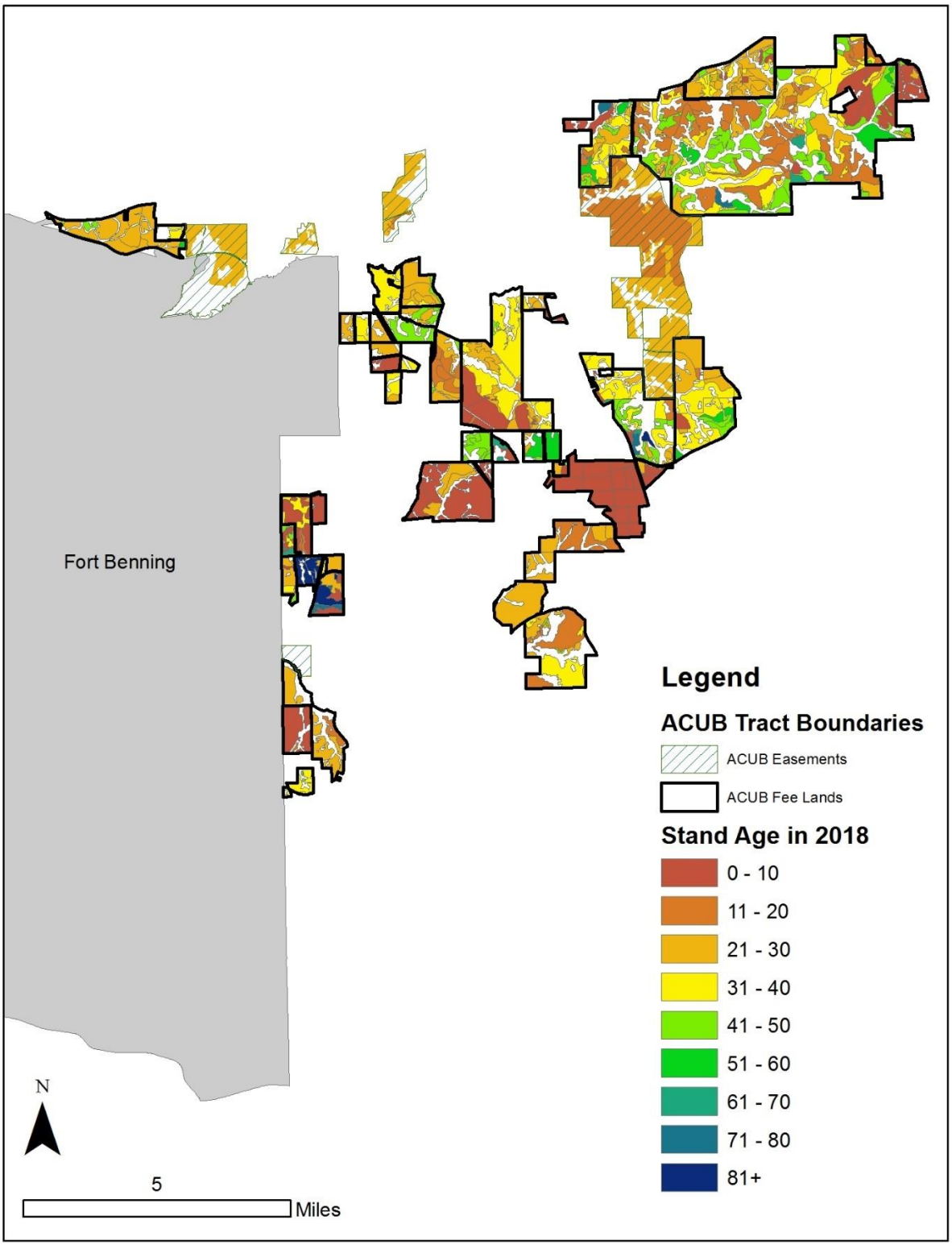

Figure 6. Stand age (as of 2018) on Fort Benning ACUB Lands restorable to longleaf pine. For the inventoried ACUB Fee Lands, this age is based on coring trees, or known stand-establishment (planting) year. Age information for easement lands, not covered by the forest inventory, are conservative estimates based on about 25 years of historic imagery.

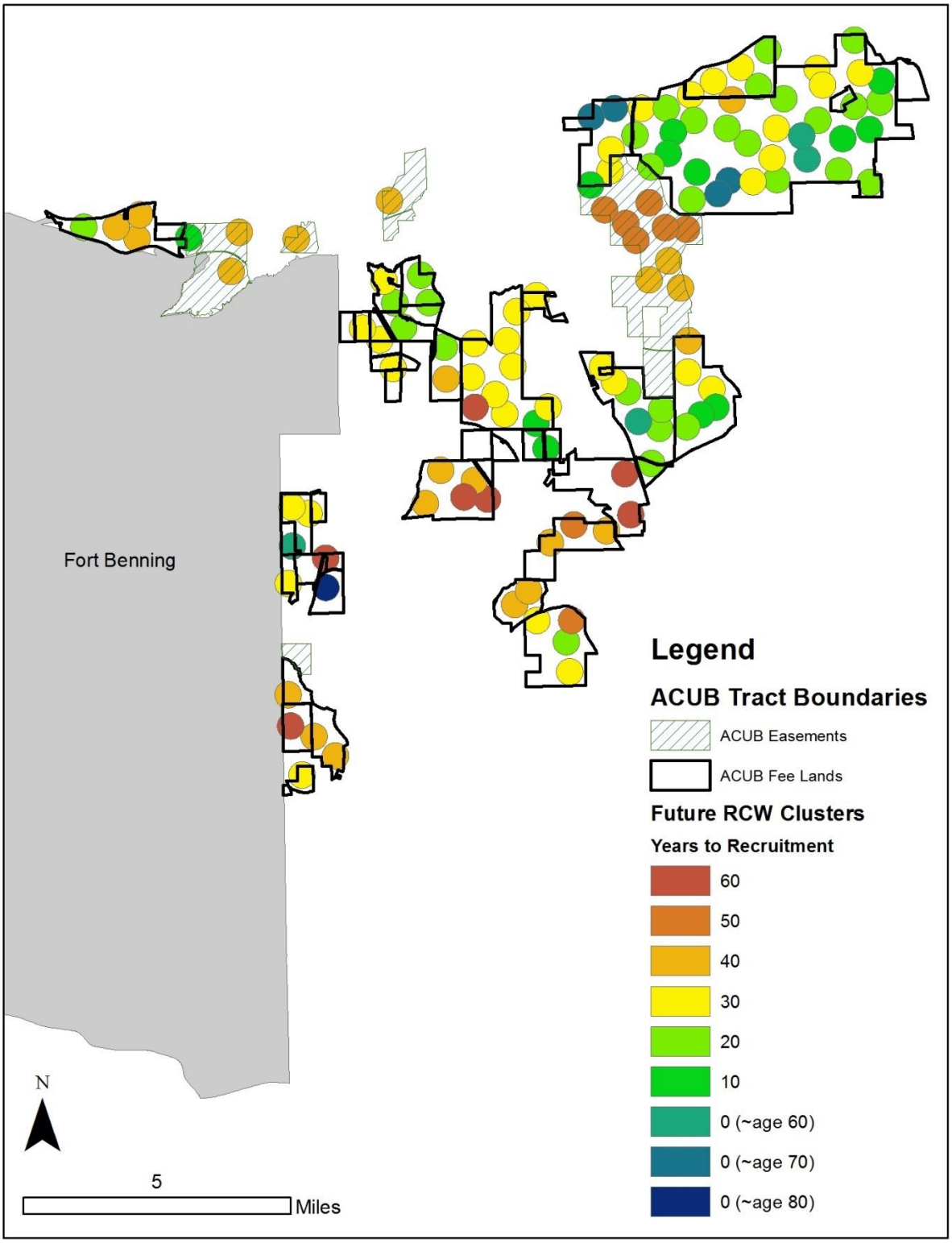

Figure 7. Hypothetical future RCW clusters (drawn with quarter-mile radius) placed at likely recruitment locations across Fort Benning ACUB lands, with estimated years necessary for current habitat to reach age suitable for RCW cavities. See text for caveats.

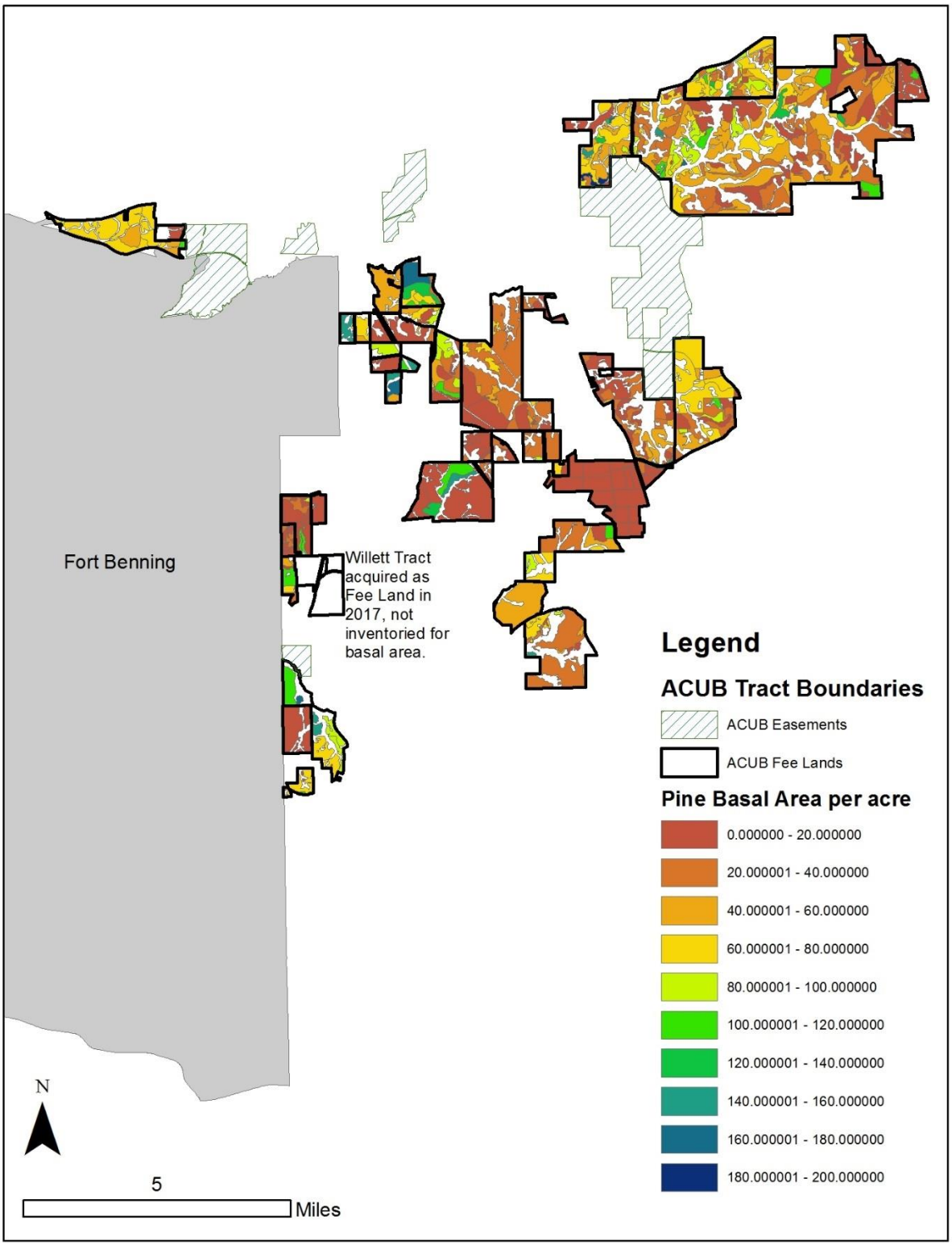

Figure 8. Pine basal area per acre for stands restorable to longleaf pine on inventoried ACUB Fee Lands, as measured in 2016-17 forest inventory.

TIMBER HARVESTING

All timber harvests will focus on maintaining or improving stand and habitat conditions associated with a sustainable and functional longleaf ecosystem. Location, timing, and types of timber harvest on ACUB Fee Lands will be identified as part of an annual process. Timber harvesting operations should be implemented by foresters and harvest crews, that ACUB Resource Managers identify or have experience with, who have demonstrated success in executing ecologically sound timber harvest, including consideration of soil, wetlands, rare plants, snags, wildlife, and residual trees. Harvest by heavy machinery should be conducted under conditions which reduce the likelihood of extensive rutting. All timber harvest operations shall at a minimum be conducted in accordance with Georgia's Best Management Practices for Forestry. All timber harvest operations will require regular (perhaps daily) monitoring by the appropriate land manager to ensure that guidelines are being followed. Specific point(s) of contact should be designated to serve as liaison(s) with the timber operators.

Fire management is critical to integrate with forest management and other stand-specific silvicultural treatments. Fire management is referenced frequently in this section and is also described in greater detail in the "Fire Management section below.

A list of silvicultural techniques and a set of timber management prescriptions applicable to the Fort Benning ACUB Lands are described below. These are intended to be general guidelines, which move the ACUB landscape towards desired future conditions. The prescriptions are written in such a way as to allow for adaptive flexibility in management activities, and should be tailored to on-the-ground conditions, as well as evolving experience and increased knowledge.

In addition, these prescriptions and silvicultural techniques, coupled with forest inventory data and habitat objectives, can be used to formulate a theoretical, spatially-explicit long-term harvest timeline, using a **harvest scheduling model**. In this application, the model may rely on discrete assumptions such as residual basal area, thinning ages, underplanting densities, etc., whether uniformly applied or tailored to various stand or site attributes available in the data. Such a rule-based modeling exercise provides a long-term forecast, based on an objective set of assumptions, but rarely does it represent reality. It is useful so long as it is based on the best input information available, and so long as it can be periodically updated to reflect actual on-the-ground progress. A list of these discrete assumptions is provided in Table 4 below.

Silvicultural Techniques

Thinning. Specify a residual basal area in square feet per acre (BA) sufficient to provide for forest structure and fuel continuity while encouraging growth and vigor of canopy trees, with a focus on transitioning to multi-aged stands in the future which will provide important foraging and nesting habitat for RCW in the future. Additional details on foraging and nesting habitat are addressed in greater detail throughout this plan. Determine how many harvest entries should take place under different conditions. Consider frequency of "take-out rows" when thinning planted stands, e.g. remove every 3rd, 4th, or 5th row but reduce density of rows as well. Conventional wisdom suggests residual BA in the 60-80 range promotes good stand health, or 50-60 BA on very poor sites (SI < 60). Harvest feasibility and RCW habitat quality (especially as habitat nears suitability for occupation) will drive on-the-ground decisions. A consideration also related to both harvest merchantability and RCW suitability in longleaf plantations is the degree to which aggressive thinning, leaving almost "open-grown" trees, might promote limbiness and poor form in canopy trees (or risk losing canopy trees to windthrow and lightning strikes). Natural-grown longleaf, while inhabiting open park-like stands, often develops in dense patches of regeneration that self-thin and self-prune. Such a structure is difficult to mimic in uniformly-spaced plantations, but may suggest lighter, more frequent thinnings, rather than heavier one-time thinnings, at least until a "final thinning" intended to open up the stand for regeneration.

Clearcutting. including large-scale liquidation of offsite timber and patch clearcuts within thinned areas. Some "patch clearcuts" may take on the appearance of "group selection" as a silvicultural technique, but should probably be utilized opportunistically, i.e. where it makes sense to remove the overstory in specific places, rather than as widespread silvicultural technique. New clearcuts necessary for ecological restoration near active RCW clusters or recruitment clusters should be no larger than 40 acres. Clearcuts up to 80 acres are acceptable if they are at least 1 mile from active or recruitment clusters.[5] It would be desirable for private landowners in the region to be aware of and consider this guidance but this plan recognizes private property rights and as such this consideration only applies on ACUB properties actively managed under this plan.

Modified Seed-tree or Irregular Shelterwood. These are essentially regeneration harvest techniques (sometimes referred to in this document as "final thinning"), intended to transition even-aged stands to two-aged stands. They may be applicable on ACUB lands either to recruit a new cohort of longleaf pine from a sparse residual canopy, after removing hardwoods or off-site pines, or to create growing space for planted longleaf seedlings in cases where no longleaf pine seed source is present but some residual pine canopy is desired.

The Stoddard-Neel Approach to uneven-aged silviculture is a widely-accepted but artful technique which has its greatest relevance or distinction when applied in a well-developed mature stand dominated by longleaf pine in which multiple age classes exist. This condition is rare on the Fort Benning ACUB Lands, but it is the desired future condition for most, if not all, of the upland pineland, and so it can be considered the most widespread technique for the future of these lands (assuming they continue to be harvested), if only rarely practiced in the near term.[6] The Stoddard-Neel Approach relies on frequent prescribed fire, careful timber marking that removes trees from any, or all, age or size classes, and a very conservative approach to managing harvest removals. Conservative means that expected growth and recruitment will easily keep up with removals, and important components of all age classes are retained and sustained over time, though they may occupy different spatial locations (i.e. small openings, patches of regeneration, old-growth trees, trees of various intermediate sizes and ages, and good candidates for RCW nesting trees). Importantly, the standing timber is never liquidated all at once, and no mathematical formula (other than removals less than or equal to growth) is used to regulate stand density. While well-suited to longleaf pine, this approach to timber marking and managing harvest levels is perhaps less sustainable with other southern pines.

Improvement Cuts are harvests often desirable in treating fire-excluded stands intended for ecological restoration, in which prescribed fire alone may be inadequate for the removal of off-site, invasive, or overstocked trees. On ACUB lands this technique may be used to "cut everything except longleaf" and/or to establish a pine-dominated habitat structure with little or no midstory, prior to reintroducing fire. In some cases, this technique may grade into the regeneration techniques described above.

Salvage Operations following wildfire, insect/disease, or storm events may be considered on a case by case basis, and may often take the form of patch clearcuts.

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[5] U.S. Fish and Wildlife Service. 2003. Recovery plan for the red-cockaded woodpecker (Picoides borealis): second revision. U.S. Fish and Wildlife Service, Atlanta, GA. 296 pp.

[6] It should be noted that in its broadest sense, Stoddard-Neel *includes* all the other techniques described here, which are typically necessary to some degree in order to move even-aged and/or fire-excluded stands to the condition in which the distinguishing features of Stoddard-Neel become relevant. In that sense, we might advocate for practicing Stoddard-Neel silviculture everywhere, but that description can be misleading.

Spatial Constraints to Accommodate RCW Habitat[7]. The ACUB landscape already includes some areas of potential foraging habitat for active RCW Potential Breeding Groups (PBGs) on the east boundary of Fort Benning, and as stand growth and restoration proceeds, recruitment clusters may be established in future nesting habitat on ACUB lands where sufficient foraging habitat exists. As such scenarios become clear, whether for potential foraging habitat for RCWs on-post, or both nesting and foraging habitat for RCWs off-post, timber management strategies can be tailored to accommodate or enable them.

Because ACUB lands currently tend to support even-aged stands in various stages of development and ecological restoration, the "Managed Stability Standard" provides helpful tools for arranging various attributes of forest composition and structure to support RCWs. While the more rigorous "Recovery Standard" should be the ultimate goal, until there is a more contiguous multi-aged longleaf pine matrix throughout the ACUB landscape, that standard would not apply.

The Managed Stability Standard, for instance, contemplates that each RCW group nesting in a "recruitment cluster" of trees that were deemed suitable for artificial cavities should have at least 75 acres of foraging habit within a quarter-mile of the cluster, on which there are a total of at least 3000 square feet of pine basal area in trees at least 10 inches in dbh and at least 30 years old. If uniformly distributed, that would be 40 BA on 75 acres, but there may be variation within reasonable limits, and that 75 acres can itself be dispersed within a 125-acre circle among various even-aged stands and stand conditions, provided that those being utilized for foraging have adequate fire management, with little or no midstory, with a reasonable range of densities and tree size. The balance of the 125-acre circle may include unsuitable regenerating stands, or denser stands awaiting restoration.

In some cases, the silvicultural prescriptions below may require adjustment to maintain appropriate foraging densities, but regulatory requirements for creditable RCW habitat must be balanced against the realities of ecological restoration. For instance, it may not be possible to fully develop new cohorts of young longleaf pine under an even-aged pine canopy, while simultaneously providing quality foraging habitat for RCWs on the same acreage.

Prescriptions by Cover Type

Mesic Hardwood Forest: Generally no harvest intended. Fire and other natural processes might restore these areas to their natural composition within a reasonable time. However, if invasive exotic species become locally established, they should be eradicated via appropriate application of mechanical, chemical, or other applied management techniques before they have the opportunity to expand.

Upland Hardwood Forest: Ecologically-desirable hardwoods could be thinned opportunistically to promote natural longleaf regeneration or artificial establishment, and/or offsite hardwoods and invasives may be removed entirely from a stand, in conjunction with any adjacent harvest operations.

[7] U.S. Fish and Wildlife Service. 2003. Recovery plan for the red-cockaded woodpecker (Picoides borealis): second revision. U.S. Fish and Wildlife Service, Atlanta, GA. 296 pp.

Mixed Pine/Hardwood Forest (Longleaf pine <20BA): possible thinning to reduce offsite hardwoods, a likely scenario would be a one-time thinning to 10-30 BA of pine, depending on canopy light conditions, with site prep[8] as appropriate and then underplant longleaf. Consider whether this is best accomplished uniformly or in patches. Retain all longleaf pine.

Mixed Pine/Hardwood Forest (Longleaf pine ≥20BA): possible thinning to reduce offsite hardwood, likely scenario would be a one-time thinning to 10-30 BA of pine, or more if residual pine is longleaf. Retain as much longleaf pine as stand health can accommodate to encourage natural regeneration.

Natural Longleaf Pine: no harvest in the foreseeable future. However, in unique situations such as demonstration sites or severely overstocked stands, single-tree selection or small group selection consistent with the Stoddard/Neel Approach would be acceptable for harvesting in this stand type, in conjunction with any adjacent harvest operations

Natural Loblolly Pine, over-mature (e.g. 50 years or more, and/or un-vigorous canopy trees unlikely to respond to thinning): One-time thinning to 10-30 BA, depending on canopy light conditions, with site prep as appropriate and then underplant longleaf. Consider whether this is best accomplished uniformly or in patches.

Natural Loblolly Pine, still vigorous (e.g. younger than age 50, and/or healthy crowns capable of responding to thinning): See "8B. Planted Loblolly" below.

Mixed Pine (Longleaf pine <20BA): thin to maintain any longleaf and harvest less desirable species. Establish longleaf, with site prep as appropriate, by underplanting where residual longleaf will not be sufficient to restock stand.

Mixed Pine (Longleaf pine >=20BA): thin to maintain longleaf and harvest less desirable species

Planted Longleaf Pine: conventional thinning to appropriate BA as canopy closes; typically at least two thinning operations to promote vigorous overstory trees with moderate crown competition, residual BA 60-80. Time "final" thinning of cone-bearing trees to reduce BA to 30-40 BA and release any advance regeneration. The ultimate objective would be to set up a self-perpetuating, uneven-aged stand.

Planted Loblolly and Slash Pine, offsite (where loblolly will not reach potential, low site index areas such as deep sands): These stands should be heavily thinned, patch-clearcut, or removed via clearcut, unless critical for near-term RCW foraging habitat in which case retain most vigorous trees at necessary BA for RCW needs. Establish longleaf, with site prep as appropriate.

Planted Loblolly and Slash Pine, onsite (where loblolly can produce mature trees, higher site index and richer soils which provide fuel, timber, and forest structure): Thin with two operations at least five years apart to 60-80 BA, then a final harvest target of 10-30 BA, depending on canopy light conditions, with site prep as appropriate and then underplant longleaf. In some contexts, these stands may be managed for

[8] Preparation of the site to plant or recruit seedlings, or site prep, is mentioned frequently in this section in an "as appropriate" context. Appropriate site prep may range from nothing, to prescribed fire only, to various mechanical or chemical treatments intended to reduce and/or suppress competition more effectively or aggressively than can be achieved with fire alone. The decision as to what site prep technique is appropriate, if any, can only be made after ground inspection, and consideration of the plant community and any sensitive species or site conditions. See also the section on "Reforestation" below.

extended periods of time at 40-60 BA to provide suitable nesting and foraging habitat for RCWs as the broader landscape is undergoing restoration.

Sand Pine: eliminate where possible through clearcutting and cutting of regeneration in longleaf plantations. Longleaf plantations that have pre-merchantable sand pine need to be mechanically treated to remove all residual sand pine. Establish/enhance longleaf, with site prep as appropriate.

Scrub Oak: release existing longleaf pine regeneration, if present, or underplant if necessary. Consider some reduction in oak density to encourage longleaf pine. Establish/enhance longleaf, with site prep as appropriate.

Open Areas: these can facilitate harvest by providing logistical support for harvest operations. However, plans for minimizing disturbance and rehabilitation will be important.

Harvest Scheduling for ACUB Fee Lands

Near-term. Based on review of recent forest inventory data (e.g. Figure 8), as well as on-the-ground knowledge and site assessment, several harvest actions are proposed for immediate scheduling on the ACUB Fee Lands to advance restoration objectives and to take advantage of opportunities for harvest revenue to fund ACUB program operations. These are illustrated in Figure 9 below.

Long-term. As referenced above, a long-term spatial plan and timeline for both harvesting and habitat development on the ACUB Fee Lands is desirable to provide forecasting for habitat availability and utilization, to communicate such forecasting to partners and funders, to inform needs around program operations including reforestation and fire management, and to indicate potential harvest revenue streams to support such operations. Importantly, the habitat development objectives are intended to drive the harvest schedule, not potential revenue streams, but harvest revenue can be critical to fund non-harvest operations such as tree-planting, fire management, and monitoring.

Substantial literature and expertise is available regarding the development of long-term harvest schedules for large forest ownerships with disparate stand types and age classes. The problem faced by both public agency and private sector forest managers, when very large acreages are at play, are similar. Both the U.S. Forest Service and Weyerhaeuser Company, for instance, may wish to schedule or prioritize operations in each of hundreds or thousands of discrete timber stands in a particular geography, in a way that recognizes or accounts for the cumulative costs, revenues, environmental impacts, public perception, or other consequences of managing the entire ownership. The objectives can vary from maximizing net present value or wood production over a large geography, to creating a relatively even annual flow of costs, revenues, or wood products, to creating particular spatial patterns or ecological conditions. Frequently there are multiple competing objectives, and algorithms may be applied to address all of them simultaneously, or to optimize one objective subject to certain thresholds or constraints implied by others. The analytical approach to such problems relies on forest inventory data, mathematical models that describe how trees, stands, or forests change over time in response to forest management actions, and additional programs or algorithms that solve for an optimum or acceptable solution that can be mapped or allocated to individual timber stands. The technology and expertise required is highly specialized.

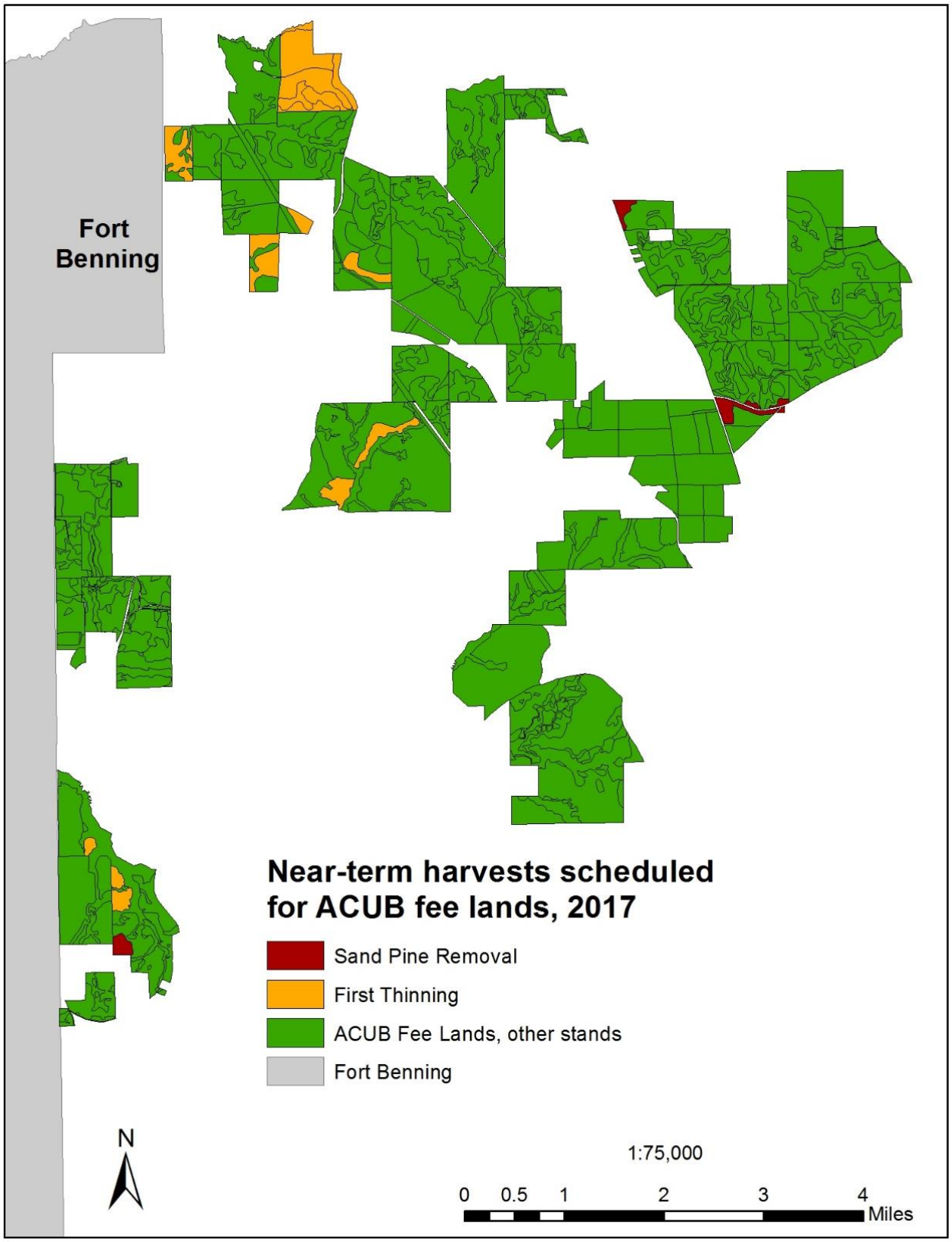

Figure 9. Near-term harvests (first-entry thinnings of loblolly pine plantations, and clearcuts or improvement cuts to remove invasive sand pine) on ACUB Fee Lands, scheduled for 2017-18.

For the ACUB Fee Lands, a harvest-scheduling analysis is sought that utilizes The Nature Conservancy's existing forest inventory data and mapping, and the habitat restoration objectives and silvicultural prescriptions embodied in this Plan, to develop a long-term harvest/habitat schedule useful for planning and messaging. This analysis will need to be periodically refreshed (possibly annually but at least every few years) to reflect the inevitable divergence between the plan and on-the-ground progress, and such experience may also inform the assumptions and data sources used for subsequent refreshes. While we can acknowledge that the model-based planning process described here will frequently diverge from actual on-the-ground accomplishments, we need not discount its utility and value. But neither should such a plan be blindly followed when it conflicts with realities and nuances obvious to managers on the ground, representing factors that the process and the models could not accommodate.[9] The resulting plan represents an estimate of the best we know about the future given current conditions and expectations.

Given the near-term focus of Fort Benning on expanding and restoring habitat for the red-cockaded woodpecker, a planning formulation for the ACUB Fee Lands could be structured as follows:

Objective:

- Minimize the time required to develop fire-managed pine-dominated habitat sufficient to support both foraging and nesting of red-cockaded woodpecker, provided that any newly regenerated pine stands should be longleaf pine.

Associated spatial objectives:

- Priority should be given to potential habitat areas that include existing or imminent nesting habitat.
- Priority should be given to creating habitat areas contiguous with Fort Benning's habitat.
- Priority should also be given to creating disjunct habitat areas of at least 5000 acres in size, provided that disjunct habitat areas should be connected to other habitat areas and/or Fort Benning with dispersal habitat (immature habitat, or forest otherwise unsuitable as foraging or nesting habitat).

Key Outputs (with spatial resolution):

- Stands to be harvested or thinned, by year.
- Estimated harvest volume and revenue, by year.
- Stands to be replanted, by year.
- Estimated site prep and planting cost, by year.
- Age, composition, and stand density of all pine habitat, by year.

Key Assumptions external to the models:

- Fire management is appropriately scheduled and implemented, coordinated with harvesting

Key Assumptions built into models:

- Assignment of simplified silvicultural prescriptions per Table 4 below.

[9] "No plan survives first contact with the enemy." – Field Marshall Helmuth von Moltke, Prussian Army, 1800-1891
"All models are wrong, some are useful."—Dr. George E. P. Box, British statistician, 1919-2013

Table 4. Discrete timber management assumptions for the major timber types on ACUB lands, intended for harvest-scheduling model assumptions. In reality, fire management considerations are necessary but are presumed (for modeling purposes) to be handled appropriately.

Habitat/Landcover Type	Approximate Acreage on ACUB Fee Lands	Prescription
Planted Loblolly	5631.8	**Thin twice to 70 BA, then final thinning to 20 BA* and underplant longleaf. If considered "off-site," clearcut and regenerate to longleaf.**
Planted Longleaf	4855.8	**Two thinnings at least ten years apart to 70 BA, then final thinning to 40 BA.**
Planted Slash	51.5	**Thin twice to 70 BA, then final thinning to 20 BA* and underplant longleaf. If considered "off-site," clearcut and regenerate to longleaf.**
Planted/Naturalized Sand Pine	76.0	**clearcut and regenerate to longleaf**
Natural Longleaf	595.2	**No harvest**
Natural Loblolly	512.8	**Thin twice to 70 BA, then final thinning to 20 BA* and underplant longleaf. If overmature, go directly to final thinning to 20 BA* and underplant longleaf.**
Loblolly with Longleaf Underplant	579.8	**Manage as "Planted Longleaf" but remove loblolly overstory with first thinning.**
Mixed Pine	474.4	**One-time thinning down to 20 BA* of mixed pine and underplant longleaf.**
Mixed Pine-Hardwood	2512.5	**Thin down to 20 BA* of pine and underplant longleaf**
Mixed Pine with Longleaf	1310.7	**One-time thinning to retain all longleaf, to encourage natural regeneration.**
Mixed Pine-Hardwood with Longleaf	194.4	**Thin to retain all longleaf, maintain current longleaf pine BA with no underplanting.**
Upland Hardwood	119.8	**No harvest**
Scrub Oak	121.2	**Underplant longleaf**
Mesic Hardwood	3602.2	**No harvest**
Aquatic	118.3	**No harvest**
Opening	502.8	**No harvest**
Opening, Plantable	1210.0	**Plant longleaf**
Total	**22469.2**	

* In these assumptions, a residual pine overstory of 20 BA (20 square feet of pine basal area per acre) is intended to represent a threshold of density in stands that require transition to longleaf pine, at or below which longleaf pine seedlings are more likely to sustain height growth, while still providing some pine habitat structure and needlefall. At BA below 20 and it may be difficult to maintain prescribed fire continuity and underplanting longleaf pine in loblolly plantations can create challenges associated with competing loblolly regeneration. In consideration of both, the application of other chemical or mechanical silvicultural treatments may be required to promote fine fuels in the groundcover and/or control loblolly regeneration. In some contexts, e.g. scenarios in which nearby RCW clusters are habitat-limited, the model may need the flexibility to retain a heavier non-longleaf pine overstory, i.e. sacrificing some years toward longleaf conversion in return for sustaining existing RCWs (a common scenario on Fort Benning). In practice, such trade-offs may sometimes be mitigated by "patchwork" heavy thinning, juxtaposed with higher densities that accommodate foraging—spatial patterns not easily simulated by harvest scheduling models.

REFORESTATION

By natural recruitment. One desirable way to regenerate longleaf pine relies on adequate residual overstory trees as a seed source. Whether by the Stoddard-Neel Approach, a heavy thinning, or a seed-tree or shelterwood harvest, a convergence of naturally-occurring and management-driven factors is contrived to "recruit" a new cohort of seedlings by natural seedfall. A good longleaf "mast year",

coupled with a well-prepared seedbed via properly timed prescribed fire, will facilitate recruitment and retention of those new seedlings. Well-timed fire-return intervals will allow young seedlings to grow in the adequate sunlight afforded by the creation of gaps resulting from aforementioned silvicultural techniques. Stands in which this approach can be taken are fairly unusual on the Fort Benning ACUB Lands, since they require a fairly uniform distribution of seed-bearing longleaf pine in the canopy, and where such stands exist they may already be self-sustaining, once fire is introduced. Still, the landcover categories noted above as "Natural Longleaf" and "Pine-Hardwood with Longleaf" and "Mixed Pine with Longleaf" may accommodate such regeneration following improvement cuts or thinnings.

By conventional tree-planting (in open patches or clearcuts). The well-drained soils of the sandhills present a challenge for planting longleaf pine. Past planting efforts on the ACUB lands have tended to result in low survival rates. There are several variables that have contributed to this outcome, some of which are natural climatic variation, others can be largely controlled by land managers. Appropriate rainfall and temperature are critical for success. Getting seedlings planted to take advantage of typical late fall/early winter rains is key. Any appropriate site preparation treatments, including burning, chemical applications, and mechanical work, need to be completed in the fall prior to planting. Selecting the most local seed source is desirable. This will provide seedlings that are well adapted to local conditions. Selecting a reputable nursery that consistently produces quality, containerized seedlings is another critical step. Trees should be refrigerated immediately after being boxed and they should be transported and staged at the planting site in refrigerated storage. Finally, planting crews need to be properly trained to plant containerized longleaf seedlings.

To guard against the possibility of low survival, the most recent plantings on ACUB Fee Lands have been at a density of 605 trees per acre, which corresponds to planting seedlings in rows, 6 feet apart within the row, on 12-foot row centers. Other more irregular spatial arrangements, where practical, are desirable but this approximate density is a good target, resulting in a stand whose density can still be managed by fire and/or thinning as necessary, should survival be very high.

On some xeric sites that can be planted quickly after harvest, fire alone or fire plus brush-cutting may be all that is needed for site prep. More frequently, especially when there is a longer span between harvest and replanting, or where more mesic and/or fire-excluded sites are prone to excessive hardwood sprouting, a chemical site prep treatment will be necessary to aid in control of woody competition. In situations where chemical site prep is needed, a chemical mix that does the best job of retaining native groundcover, and herbaceous vegetation, should be favored. Fire should be returned to the stand in the late winter/ early spring two years post-planting. Timing is critical, and the objective is to conduct this burn before longleaf bud growth begins in spring.

By underplanting beneath residual canopy. A residual overstory target ranging from 10-30 BA is advisable for underplanting, but should be carefully tailored to tree size, site quality, overstory age and health, overstory continuity, and other site conditions. Experience on Fort Benning has shown that underplanting under healthy residual pine stands (sparse but evenly space and continuous) can fail if the residual trees maintain good survival and growth. With higher site-index and taller trees, you may be able to leave more BA than on poorer sites, since there is less competition for soil moisture, and more light reaching the ground through the tall canopy. On poor sites with short trees and high competition for soil moisture leaving less (10 BA or even lower) is advisable.[10] But in either case some degree of patchiness is probably necessary to mitigate against poor survival.

[10] Dr. George Matusick, Auburn University, personal communication.

Site prep for underplanting will require fire, however because the objective is to retain overstory trees, the prescription will be more moderate than for a clearcut site. Depending on the amount and type of woody competition and the existing groundcover, a site prep herbicide application may be necessary.

Pasture reforestation presents additional challenges. Most pastures in the ACUB project area are planted in bermudagrass (*Cynodon dactylon*) or bahiagrass (*Paspalum notatum*). These grasses are extremely persistent and are resistent to chemical control. Longleaf pine establishement on these sites is costly and requires longer-term planning. Burning these sites is the first step, followed by herbicide application once the grasses have resprouted following the fire. This site prep process is repeated in the following year to eliminate as much of the grass as possible. Scalping and subsoiling are then done a few months prior to planting. A portion of the Oakland Farm tract represents an early example of pasture reforestation on the Fort Benning ACUB Lands.

UNDERSTORY GROUNDCOVER RESTORATION

Where native groundcover remains, fire should be used to enhance seed production and increase cover. Mechanical operations in these areas (including timber harvest and site preparation) should take fire management needs into account in an effort to avoid interrupting anticipated fire return intervals. Where native groundcover is sparse or absent, artificial restoration can be considered. Timing, methods and costs for groundcover restoration will be important considerations and any efforts should focus on establishing species that play critical roles in habitat functionality and sustaining prescribed fire. A first step may be to establish various grass species that help to facilitate fire spread. Grasses also provide cover and forage for wildlife. Legumes are another group to be considered for restoration. This diverse group plays a significant role in the longleaf ecosystem by fixing nitrogen, and providing food for various wildlife and pollinator species. In some cases, it may be feasible to reintroduce rare species such as orchids or carnivorous plants.

In general, the species planted will depend on the site assessment in terms of what groundcover elements are lacking and what species are suitable. What is used for restoration will also be dictated by what species are available. The most local seed source, ideally from seed collected on the ACUB project area, should be favored.

Site selection should be based on overall objectives. In areas where there is a functional native groundcover, the existing flora can be augmented with certain key species. Such areas could be thought of as supplemental sites. In heavily impacted sites, where few native elements are present, a variety of species across functional groups may be needed. A first step on such a site may be to get native grasses established to promote frequent fire. Such sites may require intensive site prep. The planting techniques used will be determined by the site, species, and type of propagule (seed or plug).

In some situations, it may be appropriate to augment or enhance populations of individual species, especially rare species, that are especially desirable as constituents of native groundcover, or simply as elements of native biodiversity. Such projects should be considered on a case-by-case basis, and tailored individually to needs or opportunities at specific sites. Treatments may include experimental out-plantings, labor-intensive removal of woody vegetation, specific fire management prescriptions, etc.

FIRE MANAGEMENT

Fire is a critical ecological driver that promotes biodiversity in the sandhills. The use of fire will be an integral part of restoring and maintaining a longleaf ecosystem on the ACUB landscape. Two important considerations regarding fire planning are seasonality and frequency. Under ideal circumstances, active fire management is a year-round process and burn units typically fall along a restoration continuum. Units that are fire-suppressed are often burned in the dormant season, i.e. restoration phase. As units are moved towards a state of greater fire resilience (i.e. maintenance phase), they can be burned under a wider range

of conditions, including during the growing season. A 2-3-year fire-return interval should be the general long-term target for the entire ACUB landscape, which results in prescribed fire being applied to 33-50% of the project area each year.

Prescribed Fire Implementation Factors

Burn Plans- All burn units on ACUB Fee Lands will have a plan completed by fire management staff and approved by the TNC GA Fire Management Officer by end of the calendar year for the coming burn season. Burn plans are used as a guiding document to ensure that fire is applied in a safe and ecologically appropriate manner which minimizes potential adverse impacts while furthering efforts to reach desired future conditions on the landscape. Unit-specific plans will be developed, reviewed and/or revised as appropriate prior to any burning seasons when the individual unit is scheduled for burning.

Burn Unit Size and Impacts on Habitat Heterogeneity- Unit size is dictated by many factors, which can include physical factors, fuels, Wildland-Urban Interface (WUI), smoke management, containment lines (firebreaks), weather, and resource availability. When all factors are considered, unit size will ultimately be dictated by weather and available resources and capacity on any given day. Units should be prepped prior to the season in a manner which maximizes the opportunities for personnel to apply prescribed fire on the vast majority of quality burn days during the fire season. Such a strategy affords the opportunity to burn large, small, or moderately sized units or sub-units of compartments as conditions allow.

Aerial Ignition - When units exceed 500 acres in size, it becomes feasible to use helicopters for ignition. As resources and capacity are available, aerial ignition will be utilized for units exceeding 500 acres in size. However, assuming sufficient resources and capacity are available on a given day to safely and effectively burn units which exceed 500 acres, burning those units should not be foregone simply because aerial assets are not available.

Firebreaks- Existing features such as established roads and drains will be used as firebreaks to the greatest degree possible. This approach will be taken to minimize additional soil disturbance and erosion and to reduce the potential for establishment and dispersal of invasive plants. The goal during firebreak construction is to strike a balance between operational safety and impact to the landscape. Breaks may be installed through blading, grading, mowing, leaf blowing, raking, using wet-lines, and other non-soil-disturbing methods. Fires should be allowed to burn out as they move into stream corridors, wetlands, and mixed hardwood forest sites rather than installing breaks around these areas. Where firebreaks need to connect to streams or wetlands, soil disturbance should be kept to a minimum while still ensuring prescribed burns can be contained in a safe, effective and efficient manner.

Along property boundaries, around structures and in other strategic locations, new permanent firebreaks have been and will be established in anticipation of prescribed fire activities or wildfire situations.

Fuel Management- Mechanical treatments such as mulching and sawing may be needed in areas where there are heavy fuel loads. Such treatments are implemented in advance of prescribed burning with the goal of moderating fire behavior. This preparatory step is especially important where there is a dense mid-story that acts as a fire ladder between surface fuels and the forest canopy. These techniques can be used to enhance defensible space around structures and to improve firebreaks. Pile burning is another tool that can be used in conjunction with mechanical treatments to reduce slash and woody debris. This is often necessary where woody fuels have accumulated around structures. Maintaining defensible space around structures is a priority. In addition to the tools discussed above, regular prescribed burning will increase the safety of structures in the event of a wildfire. In addition, fine fuels and flammable shrubs should be removed from the vicinity of all structures. It is preferred to remove fuel adjacent to structures and install firebreaks in such a way that there is no fuel between the firebreak and the structure to minimize the risks to structures.

Managing duff is one of the most challenging aspects of fire management on ACUB. Restoring fire to systems where it has been excluded for extended periods of time is a slow and delicate process. Excessive fuel loads and fires that burn and smolder into the duff layer create a multitude of challenges. Initial entry prescribed burns under these conditions must be carefully planned and executed to minimize overstory pine mortality. Fire which burns into the duff layer can do extensive damage to pine rootlets and girdle the bole of trees, which can result in mortality that typically occur within two years. Trees damaged or stressed by intense heat are also susceptible to attack by wood-boring insects which can also result in tree mortality.

Prescribed burning in areas with heavy fuel loads and suspended fuels is best conducted during the cool season under conditions of relatively high moisture and will occasionally be conducted at night. Prescribed fires in these scenarios are typically applied within a day or two of receiving at least one inch of rainfall which ensures the duff becomes thoroughly moistened. Ideally these burns are conducted with the expectation of additional rainfall within a few days so that any smoldering duff can be extinguished. This approach has proven to be successful with limited overstory tree mortality in stands with heavy duff.

In some scenarios and under certain conditions, an inch or more of rain might not be sufficient to moisten the duff. In such cases the upper duff horizon will be wet, but the deeper horizon will be dry. Duff moisture should be monitored before burning. Fire should not be applied to areas where dry duff persists. Patrol and mop-up of duff areas should be conducted following ignition. Care must be taken to extinguish duff fires before fuel moisture and humidity drop significantly. Through repetitive fires of this type, fuel loads will gradually be reduced and new deeper root growth will be encouraged. With time, these sites will be able to tolerate more frequent fires, across a wider prescription window, including growing season fires.

Cat-faced trees, legacies of naval-stores production, present a challenge to implementing prescribed fire. Allowing cat faces to burn themselves out can result in trees burning all the way through such that they fall over, or can cause damage and stress that makes the trees susceptible to mortality from insect infestations. Cat face trees can be allowed to burn to reduce the fuel load of dried resin but should be extinguished as quickly as possible. In some scenarios, strategically identified relict trees may be protected to ensure they do not catch fire or monitored closely so they can be extinguished within a few minutes to prevent tree damage and mortality. Generally, a backpack sprayer will be sufficient to extinguish recently ignited cat-face trees. When faces burn out or are extinguished quickly, there is less risk of cat faces becoming engulfed during subsequent fires.

Smoke Management- The fragmented nature of the ACUB landscape makes smoke management a critical component of the fire management program. Smoke screening is done during the planning aspect for all burn units. This process involves identifying smoke sensitive areas. These areas include, highways, neighborhoods, sensitive livestock, and areas prone to inversion. Once smoke sensitive areas are identified, weather parameters are selected so that smoke-related problems can be avoided. Smoke modeling programs can also be used to determine smoke plume trajectory and particulate concentration, at various distances from the burn unit.

Fire Training and Education- The ACUB program is well poised to provide opportunities to increase the application of prescribed fire in the local area, southeast region and perhaps nationally as well as to afford training for and development of competent fire practitioners. There are a variety of possibilities, ranging from providing training and outreach to private landowners, hosting and training natural resource professionals and students, National Wildfire Coordinating Group instruction, and others. With the advent of the new Georgia Forestry Commission led Chattahoochee Fall Line Prescribed Fire Cooperative, these

groups can be served, while advancing the vision of creating a large fire-maintained buffer around Ft. Benning.

Table 5. Fire Management Prescriptions by Habitat Type

Habitat/Landcover Type	Prescription
Mesic Hardwood Forest	MHFs are not a fire prone habitat. Fire will be allowed to creep in as conditions allow. See also Wetland Habitats below.
Upland Hardwood Forest	Low intensity prescribed burning is used to maintain suite of upland hardwood species in overstory and an open understory. Fire return interval of two to three years to stimulate herbaceous understory growth and soft mast production, while controlling woody regeneration.
Mixed Pine/Hardwood Forest	Depending on age/species composition of specific stand and its fire history, a higher intensity burn is required to impede hardwoods from further encroachment, usually on a two to three-year fire return interval. As forest management is likely implemented towards further restoration, a sufficient basal area will be maintained to provide forest structure and fuel. Prescriptions should favor fire tolerant, upland species.
Natural Longleaf Pine	Fire return interval for this habitat/landcover type is two to three years. In stands where longleaf has been fire-maintained, emphasis should be placed on maintaining forest structure, promoting longleaf recruitment, and enhancing understory. In natural longleaf stands where fire has been suppressed, emphasis should be on reducing fuels. An outline of duff burning techniques/parameters, mechanical fuel treatments to reduce mid-story fuel loads and ladder fuels are presented above.
Natural Loblolly Pine	Where loblolly pine would naturally occur (wetter soils) and where an intact fire regime exists, emphasis should be maintaining a sufficient basal area to provide forest structure and fuel for fire to creep in as conditions allow. Where loblolly has extended its reach due to fire exclusion, reintroduction of prescribed fire on a two to three-year fire regime, coupled with an appropriate forest management approach, will be sought.
Mixed Pine	Depending on age/species composition of specific stand and its fire history, a higher intensity burn is required to impede hardwoods from further encroachment, usually on a two to three-year fire return interval. As forest management is likely implemented towards further restoration, maintain sufficient basal area to provide forest structure and fuel. Prescriptions should favor fire tolerant, upland species.
Planted Longleaf Pine	Once trees have reached an age that will tolerate fire without causing mortality, the fire return interval for this habitat/landcover type is two to three years. In stands where longleaf has been fire-maintained since inception, emphasis should be placed on maintaining forest structure, promoting longleaf recruitment, and enhancing understory. In planted longleaf stands where fire has been suppressed, emphasis should be on reducing fuels. An outline of duff burning techniques/parameters, mechanical fuel treatments to reduce mid-story fuel loads and ladder fuels are presented above.
Planted Loblolly and Slash Pine	Where loblolly and slash pine would naturally occur (wetter soils) and where an intact fire regime exists, emphasis should be maintaining a sufficient basal area to provide forest structure and fuel for fire to creep in as conditions allow. Where loblolly and slash have been planted or where their reach has extended due to fire exclusion, reintroduction of prescribed fire on a two to three-year

	fire regime, coupled with an appropriate forest management approach, will be sought.
Habitat/Landcover Type	**Prescription**
Sand Pine	As sand pine is considered a nuisance species in the CFL, emphasis should be elimination through mechanical means where possible, followed by frequent fire to kill recruits.
Wetland Habitats	Many of the wetland habitats on ACUB are fire-dependent. Under previous management, even when uplands were burned, adjacent wetlands were excluded. This exclusion has taken two forms, mechanical exclusion, where firebreaks were constructed to keep fire out of these areas, and seasonal exclusion, where surrounding uplands were burned during times when the wetlands fuels were not available due to hydroperiod. Emphasis should be on allowing fire to creep into these habitat types when conditions allow.
Streams	Fire management BMPs are important to protect water quality.
Ponds	The margins of man-made ponds and beaver ponds will be fire-maintained, which will occur as byproducts of burns occurring on adjacent habitat types.
Ephemeral Upland Ponds	This habitat type needs to be fire-maintained. Once uplands are resilient to warm-season fire, prescribed fire should be used to maintain open character of wetlands as part of the fire return interval associated with adjacent habitat types.
Seepage Slopes	This habitat type needs to be fire-maintained. Once uplands are resilient to warm-season fire, prescribed fire should be used to maintain open character of wetlands as part of the fire return interval associated with adjacent habitat types.
Open Areas	Open areas are for staging areas, firebreaks, access, and medevac sites.
Roads/Impervious Surface	ACUB landscape is dissected by public roads, forest roads, food plots, and fire breaks. Where possible, these existing features should be used as fire breaks. This minimizes soil disturbance, and diminishes problems associated with erosion and invasive plants. This practice can also reduce the amount of labor required (and exposure to risk to crews associated with equipment use) to prepare burn units.

Wildfire- See Appendix A for Wildfire Response Plan.

Fire Management Progress and Planning

The Fort Benning ACUB lands are divided into three Fire Management Units to facilitate planning and operations. Figure 10 below illustrates the existing Fire Management Units which are named for their primary associated drainages. The smaller burn units delineated for the ACUB Fee Lands are each associated with a discrete annual burn plan. The burn units in Figure 10 are shaded to depict the number of prescribed burns applied to each burn unit from acquisition through the summer of 2017.

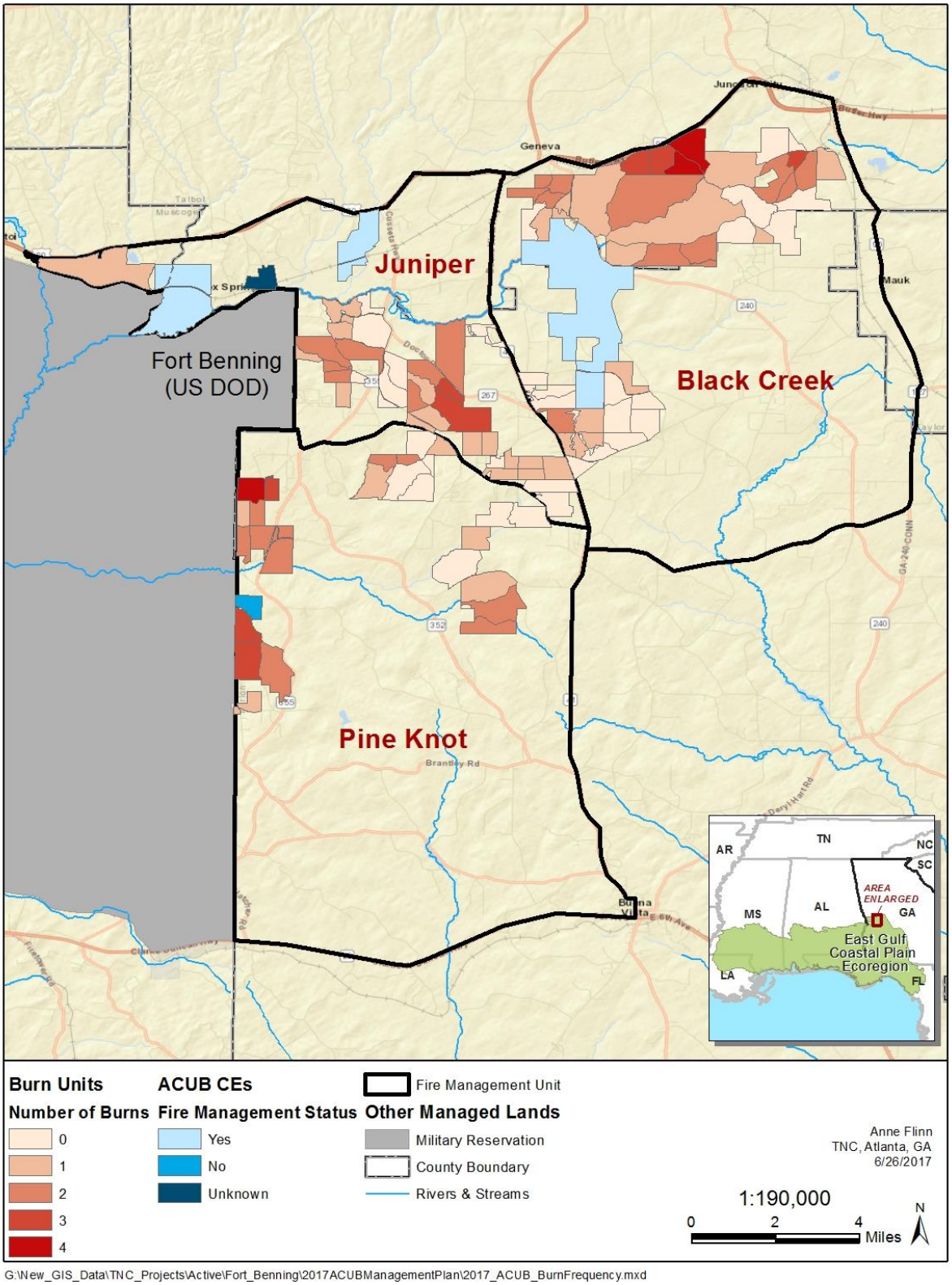

Figure 10: ACUB Fire Management Units, Fee Land Burn Frequency, and Fire management status of conservation easements.

Figures 11, 12, and 13 illustrate the specific Fire Management Unit and Burn Unit designations on ACUB Fee Lands, for each of the three Fire Management Areas.

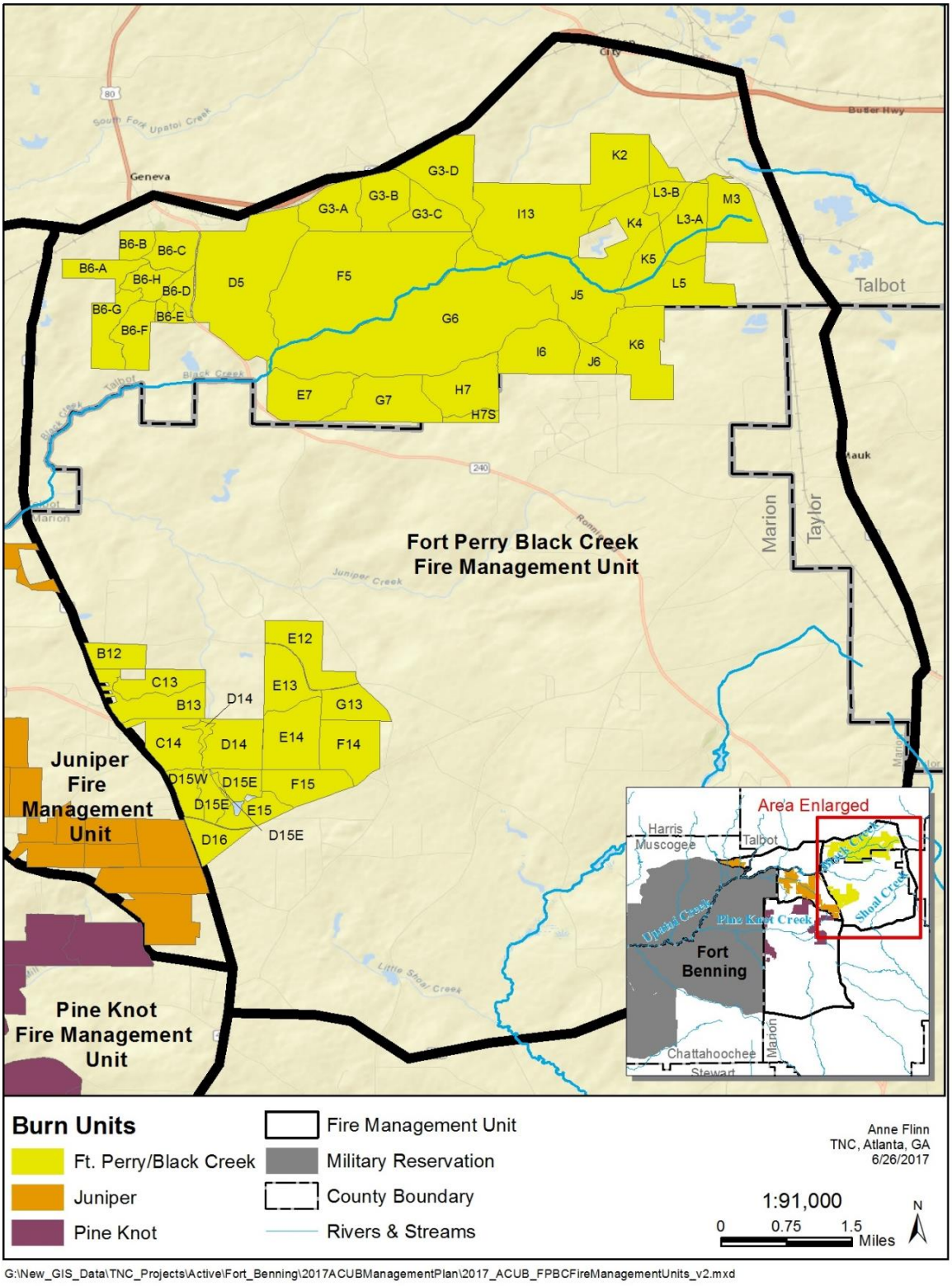

Figure 11: Fort Perry Black Creek Fire Management Unit

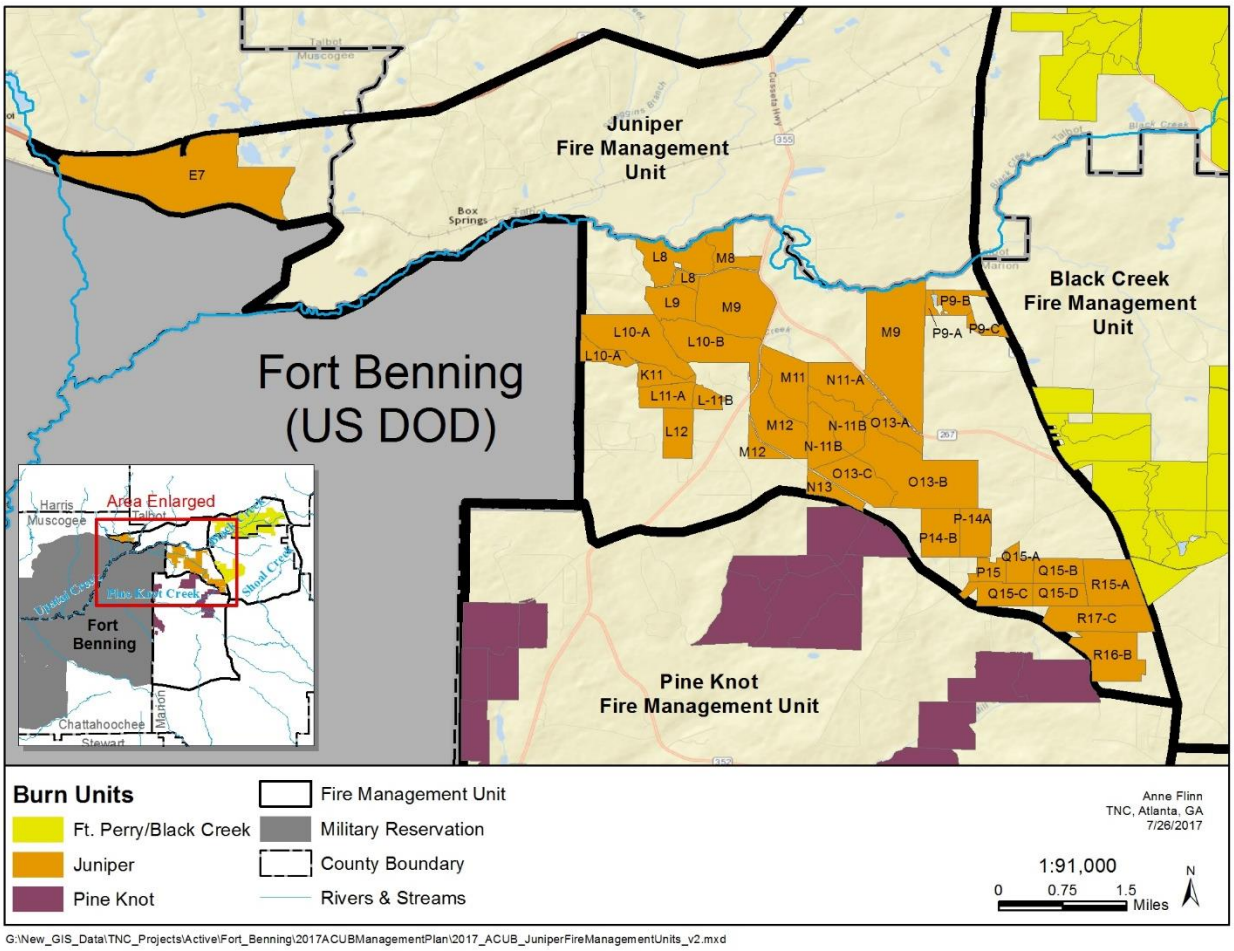

Figure 12: Juniper Fire Management Unit

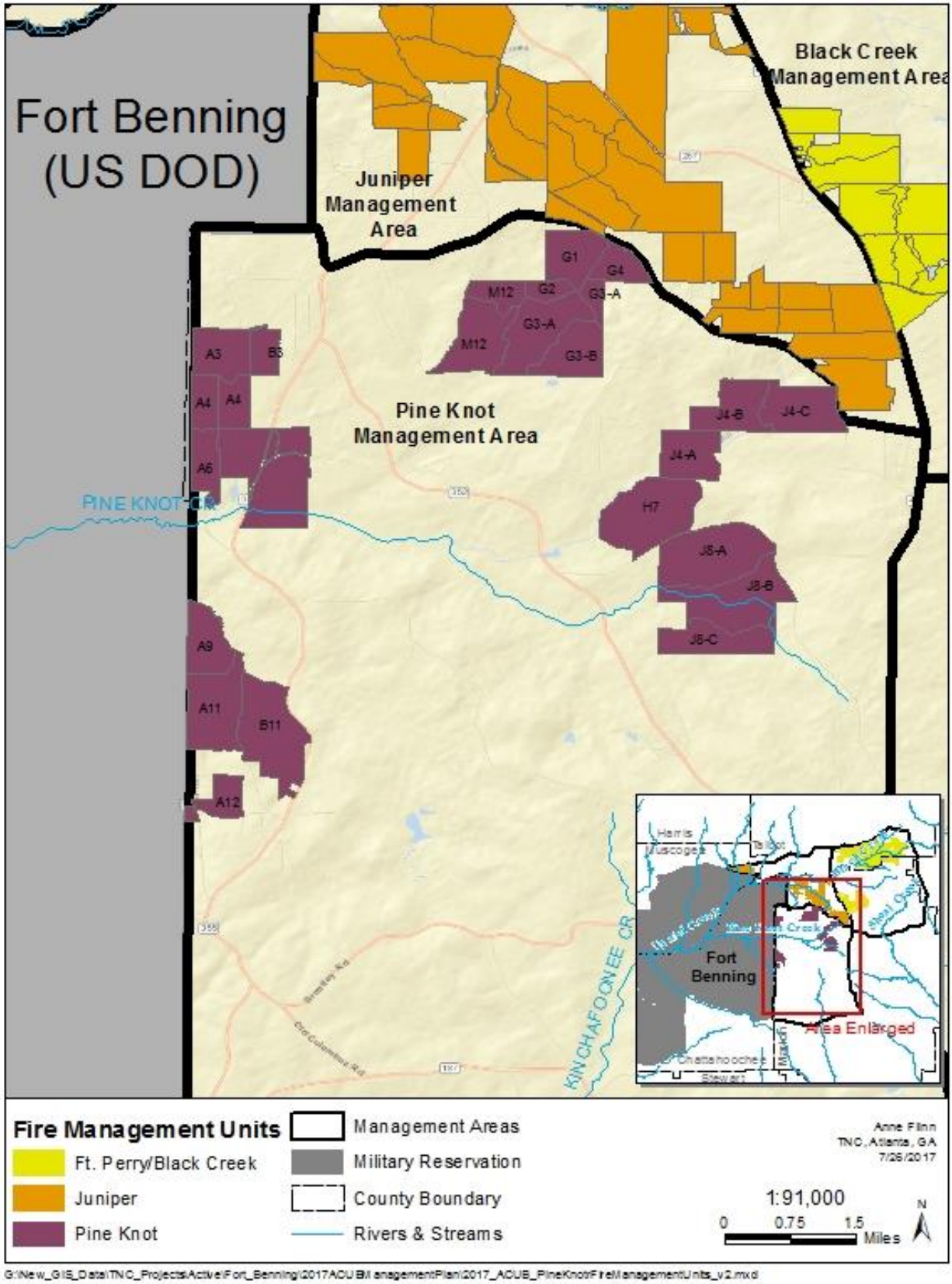

Figure 13: Pine Knot Management Unit

OTHER MANAGEMENT ISSUES

GAME MANAGEMENT AND HUNTING

Aside from the hunting opportunities afforded on the Chattahoochee Fall Line WMA, a large portion of the ACUB lands are enrolled in a Hunting Lease Program. This program is made up of groups of private individuals that pay a per-acre fee for hunting access on ACUB property. Justification for the hunting lease program includes assistance with property oversight, assistance with management of game populations (especially deer) and invasive species (non-indigenous wild pigs), and generation of program income.

Guidelines include adherence to all GA DNR hunting regulations. Those listed below are specifically tailored to the ACUB TNC lease program:

1) Species hunted: deer, wild pigs, turkey, small game excluding fox squirrel and quail
2) Harvest data for deer, wild pigs and turkey to be collected by the leasee and provided to TNC at the end of each season. Hunt clubs are encouraged to follow Quality Deer Management principles; doe harvest is a tool used to limit population growth, and only mature bucks are harvested.
3) Food plots: only permitted in areas previously disturbed, no new plots or expansion, only non-invasive annual plants can be used
4) Infrastructure: no permanent structures, no alteration of roads, gates, firebreaks, bridges, or culverts

EXOTIC SPECIES MANAGEMENT

Invasive exotic flora and fauna should be controlled due to the damage and competition they can impose on natural systems and native species. If domestic dogs, cats or livestock are found on ACUB lands, and can be identified, owners will be contacted so that the issue can be resolved. If the owners fail to remedy the problem, then animals should be captured and turned over to the proper authorities. Removal of feral animals will be addressed IAW appropriate State and local laws and regulations. Imported fire ant control should emphasize ecologically-safe methods if practical. When feasible, an attempt should be made to eradicate exotic plants using mechanical and/or chemical treatments. Particular care should be given to avoid damaging native communities, sensitive plant species, soil, and rock outcrops. Invasive exotic plants that have been identified on Fort Benning ACUB Lands include:

1) kudzu (*Pueraria lobata*)
2) Chinaberry (*Melia azerdarach)*
3) Chinese privet (*Ligustrum sinense)*
4) Chinese wisteria (*Wisteria sinensis)*
5) Japanese honeysuckle (*Lonicera japonica)*
6) mimosa (*Albizia julibrissin)*
7) bahia grass (*Paspalum notatum*)
8) Japanese climbing fern (*Lygodium japonicum*)
9) Nepalese Browntop (*Microstegium vimineum*)
10) Tropical soda apple (*Solanum viarum*)
11) Sand pine (*Pinus clausa*)
12) Cogongrass (*Imperata cylindrica*).

A detailed plan for controlling exotic and invasive plant species should be developed. In the interim, applied management techniques should depend on the collaborative of TNC, DNR, the Georgia Exotic Pest Plant Council, and other subject matter experts.

Wild Pigs

There is an existing population of non-indigenous and highly invasive wild pigs (*Sus scrofa*) on Fort Benning ACUB Lands. Pigs compete with native wildlife and damage or alter native habitats by disturbing the soil as they forage. Wild pigs consume invertebrates in the upper soil layers, the seeds of native plants and uproot tree seedlings. The resulting soil disturbance in some habitats can reduce fuels necessary to facilitate prescribed burning. This effect can be significant in upland/wetland ecotones where pigs are frequently found and can impact fires which historically burned into the edges of the wetlands.

Pig populations on ACUB lands fluctuate depending on availability of food, water levels, season, and nearby agricultural practices. Once established, populations can increase rapidly. Control of this species is necessary to ensure protection of the natural community. Because complete eradication may not be feasible, the goal should be to reduce numbers to a point that they no longer pose an ecological problem. Hunting of wild pigs is encouraged but hunting alone will not reduce or control populations to desired levels. ACUB lands should be monitored for wild pig activity and trapping should be implemented as appropriate depending on where pigs are present. Trapping should be conducted using technology that allows the trapper to electronically trigger trap gates in order to maximize the number of pigs removed with as little manpower as possible and avoid conditioning pigs to avoid traps. Targeted shooting should be employed to remove trap-shy animals. Baiting for deer and other wildlife will be prohibited on ACUB hunt leases to ensure additional resources are not being provided for wild pigs. Supplemental feeding and baiting for the expressed purposes of trapping may be permitted on a case by case basis upon approval of partner landowner an in accordance with State law.

NONGAME AND RARE SPECIES MANAGEMENT

Surveys have been conducted for rare plants and animals and shall continue on the ACUB Fee Lands. Specific management recommendations should be developed for each species and natural community of particular conservation concern. These management actions should benefit not only the species of special concern, but other native game and nongame species.

ADJACENT LANDS

When and where possible, Fort Benning ACUB landowners and land managers will strive to develop partnerships with neighboring landowners to complement and expand the conservation goals of Fort Benning ACUB Lands. Neighboring landowners should be informed about conservation opportunities such as Partners for Fish and Wildlife, Safe Harbor, and Farm Bill programs, and relevant activities and programs of the CFLCP. Management agreements, additional conservations easements, and other tools will be used as possible to further enhance conservation efforts in the area. Safe Harbor agreements should be pursued with landowners of the highest quality longleaf pine tracts. When possible, funds should be pursued to assist Safe Harbor participants with habitat management.

Neighboring tracts may become new additions to the Fort Benning ACUB Lands, should landowners be willing, and if they are prioritized by Fort Benning with funding identified. Additional tracts will be incorporated into the overall management strategy of maintaining and restoring a longleaf ecosystem and will serve to buffer existing habitats from the effects of encroachment. Disjunct tracts of exceptional natural value may also be considered for acquisition.

OUTREACH

Public Relations

The Chattahoochee Fall Line Conservation Partnership (CFLCP) works with all partners engaged in the Fort Benning ACUB Lands and surrounding landscape to provide information and build relationships with landowners and the community.

Environmental Education
The CFLCP works with landowners and the community to conserve the Fall Line's natural heritage and quality of life. The CFLCP works in a variety of ways to reach various audiences in the region such as providing field tours and presentations, organizing and participating in community events, and coordinating technical workshops for landowners and other interested parties. The CFLCP, TNC and DNR also encourage ecological research, inventory and citizen science in support of Fort Benning ACUB Lands conservation objectives.

Demonstration Sites
The complex ecological management and habitat restoration required at Fort Benning ACUB Lands will provide excellent opportunities to engage, educate, and influence land managers from across the region. Site tours should be organized in coordination with CFLCP to highlight management of selected demonstration areas. Lessons learned from and on Fort Benning ACUB Lands (positive and negative) and current research from other sites should be shared with the land management community, so that our land management activities can have a beneficial impact throughout the region.

INVENTORY, RESEARCH, AND MONITORING
Activities described in this section are most germane to lands owned in fee by TNC and the State of Georgia, but may also apply to those in private ownership subject to ACUB conservation easements. In the latter case, permission and cooperation of the private landowner, even if required by easement terms, should always be sought.

Biological Inventory and Mapping
The Fort Benning ACUB Lands may periodically require new inventory and mapping activities to assist management planning and implementation. Any necessary updates to maps and inventories will be determined annually. Any new updates will be incorporated into this Plan as needed. Locations for all known species and natural communities of conservation concern are still being mapped. These maps will be updated as new information becomes available. Exotic/invasive species should also be mapped in order to track threats to these species and natural communities.

Research
Research activities should be compatible with the objectives and plans for the Fort Benning ACUB lands, and should be designed to yield results that can be applied to their conservation and management, and to other similar sites. Scientific collecting permits should be obtained through the DNR Special Permits FPBC (770-761-3044).

Biological & Ecological Monitoring
The primary goals of the ACUB biological and ecological monitoring programs are to provide cooperative natural resource managers (TNC, DNR, Fort Benning) with information about (1) the initial condition of ACUB lands and species' populations, (2) long-term biological and ecological change, and finally (3) whether management actions are having intended effects and resulting in desirable restoration trajectories and objectives. Monitoring is a necessary step for practicing adaptation forest management. Adaptive management is a structured process of decision making in the face of uncertainty, with an aim to reduce uncertainty over time by comprehensive monitoring of effects following management actions.

Routinely monitoring the characteristics of the plant and animal populations of concern and their habitat will provide managers of Fort Benning ACUB Lands with feedback regarding management needs and the effectiveness of management actions. This information will be used to adapt management as needed to better meet objectives. Careful documentation of monitoring results will allow new information to be summarized and distributed so that it can be used by managers at other sites. Partners will work together

to develop and implement monitoring protocols of selected plant communities and the dynamics of recovering the longleaf pine forest, as well as game and non-game wildlife species.

Animal populations, particularly high priority species (endangered, threatened & at-risk) including but not limited to RCW, gopher tortoise and other candidate and proposed species for listing will be monitored in accordance with otherwise approved and executed state and federal monitoring protocols. Monitoring will be completed at the frequencies identified in those state and federal monitoring protocols and only by those individuals certified to do so in scenarios where certification may be required. The RCW Recovery Plan monitoring guidelines will be utilized to guide RCW population monitoring. Surveys for gopher tortoises will follow the line transect distance survey protocol and will be completed every 5-10 years as suggested in the gopher tortoise CCA. Other animal populations of concern, including but not limited to neo-tropical migrants, eastern diamondback rattlesnake, pine snake, southern hognose snake, gopher frog, southeastern American kestrel and fox squirrel, should also be monitored according to existing plans and those yet to be developed and formalized. It is anticipated that monitoring for these and other high priority species will be surveyed every two to three years and no less often than every five years. Any monitoring protocols or requirements established and agreed to thru formal consultation with the U.S. Fish and Wildlife Service will be executed as well. Additionally, the size and health of game animal populations on Fort Benning ACUB Lands should be monitored as needed to make suggestions regarding the number of hunter-days allowed.

Plants and plant communities of concern should be monitored at regular intervals during appropriate seasons. At a minimum, multiple permanent photo-monitoring points should be established to provide sufficient data to document changes in vegetation structure. However, a more complete monitoring program will continue to be implemented to evaluate the effects of prescribed burns on habitat structure and composition, and in particular, the populations of priority species on Fort Benning ACUB Lands. Permanent long-term monitoring plots include measures of groundcover and mid-story composition and cover, as well as longleaf pine regeneration. The Vegetation Monitoring Plan for the Fort Benning ACUB Lands, developed cooperatively between TNC and Auburn University with support from Fort Benning, is included as Appendix B.

Sites where exotic plants are controlled using herbicides or other management tools should be monitored also. In addition, National Wetland Inventory will be used to identify the distribution and type of wetlands to inform the conservation efforts of Fort Benning ACUB cooperative natural resource managers.

Together, these biological and ecological monitoring techniques should provide measures of the successes of management techniques implemented, and eventually establish the changes in species composition and natural community structure towards the desired future condition.

Environmental Monitoring

Basic environmental data that will be gathered for Fort Benning ACUB Lands include rainfall, temperature, and humidity. These data will be taken at appropriate intervals to provide crucial information to prescribed burning operations. This basic environmental information will be useful in planning and in evaluating management effectiveness. Stream flow data is of interest as well.

LIST OF APPENDICES (ATTACHED)

Appendix A – TNC Wildfire Response Plan

Appendix B – Vegetation Monitoring Plan