Brunswick and Columbus County Game Land Complex Management Plan

2018 – 2028

N.C. Wildlife Resources Commission staff has extensively contributed to the development and preparation of this plan through their various fields of professional expertise. All content, management strategies, recommendations, goals, and needs for change were developed using the best available science and professional working knowledge of the Brunswick and Columbus County Game Land Complex, its habitats, and terrestrial and aquatic species. Careful consideration has been given to all input received from the public, external agencies, and organizations that have an interest in or use the game land to ensure a that comprehensive management program is administered on these game lands. The successful implementation of the plan will depend on the continued input and support from all interested parties.

PLAN DEVELOPMENT TEAM MEMBERS

- **David Allen**, Coastal Wildlife Diversity Supervisor, Division of Wildlife Management
- **Steven Bailey**, Facility Construction Engineer, Division of Engineering and Lands Management
- **John Carpenter**, Avian Wildlife Diversity Biologist, Division of Wildlife Management
- **Richie Clark**, Central Coastal Ecoregion Management Biologist, Division of Engineering and Lands Management
- **Michael Fisk**, District 4 Fisheries Biologist, Division of Inland Fisheries
- **Jeff Hall**, Wildlife Diversity Biologist, Division of Wildlife Management
- **Isaac Harrold**, Program Manager, Division of Engineering and Lands Management
- **Tommy Hughes**, Coastal Ecoregion Supervisor, Division of Engineering and Lands Management
- **Bill Johnstone**, Southern Coastal Ecoregion Technician Supervisor, Division of Engineering and Lands Management
- **Josh McConnell**, District 4 Area Sargent, Division of Enforcement
- **Colleen Olfenbuttal**, Bear/Furbearer Biologist, Division of Wildlife Management
- **Thomas Padgett**, District 4 Wildlife Biologist, Division of Wildlife Management
- **Casey Phillips**, Central Coastal Ecoregion Wildlife Forester, Division of Engineering and Lands Management
- **Jason Sellers**, Bolivia Team Leader, Division of Engineering and Lands Management
- **Ken Shughart**, Southern Coastal Ecoregion Forest Manager, Division of Engineering and Lands Management
- **Evin Stanford**, Deer/Turkey Biologist, Division of Wildlife Management
- **David Turner**, Northern Coastal Ecoregion Management Biologist, Division of Engineering and Lands Management
- **Chesley Ward**, Southern Coastal Ecoregion Management Biologist, Division of Engineering and Lands Management
- **Brent Wilson**, Northern Coastal Ecoregion Wildlife Forester, Division of Engineering and Lands Management

EXECUTIVE SUMMARY

The Brunswick and Columbus County Game Land Complex includes 3 separate game lands consisting of 6 different tracts of land and totals 28,963 acres in size. These properties include the NCWRC-owned portions of Columbus County Game Land and Green Swamp Game Lands, as well as Juniper Creek Game Land. They are owned by the state of North Carolina and the North Carolina Wildlife Resources Commission is the primary custodian. State ownership of this property dates back to 1996 when 5,973 acres were purchased in Columbus County. These game lands are managed for primary users which include hunters, trappers, anglers, and wildlife viewers. Some of the properties' signature species include white-tailed deer, black bear, eastern wild turkey, and a variety of waterfowl species. In addition to primary users, there are an increasing number of non-traditional users on North Carolina Game Lands that include hikers/walkers, horseback riders, researchers, paddlers, target shooters, and others. Ten different habitat types occur on this complex of game lands, each with its own ecological value. Floodplain Forest habitat, by far, makes up the largest portion of the cover types on this property covering 71%. Twenty-three threatened, endangered, rare, or special concern species are thought or know to occur in the habitats found on this game land. Management goals include providing a diversity of habitat types and forest age classes through science based land management that are properly interspersed and juxtaposed across the landscape to ensure that a wide variety of terrestrial and aquatic wildlife species are maintained on the game land. Land managers strive to maintain game species at huntable levels through science based land management and sound regulations and to provide quality habitat for endangered, threatened, and rare species located on the game land to ensure their populations are maintained or increased. Additionally, extensive effort is made to provide sufficient infrastructure and opportunities to allow all game lands users a quality experience while on the game land with minimal habitat degradation and minimal conflict among user groups. To ensure these goals are met the NCWRC will need to collect various types of information regarding the species on the game land and the users of the game land, secure funding to accomplish management goals, acquire additional properties as they become available, maintain and develop regulations that promote sustained use of natural resources, and develop relationships with conservation partners that help meet management goals.

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INTRODUCTION

North Carolina Wildlife Resources Commission

The North Carolina Wildlife Resources Commission (hereafter referred to as NCWRC) was established in 1947. Prior to 1947, the tasks of managing state owned Wildlife Management Areas were executed by the Department of Conservation and Development. General dissatisfaction with the program led to the creation of the Wildlife Resources Law in 1947 that established the North Carolina Wildlife Resources Commission.

Since 1947, the NCWRC has been dedicated to the conservation and sustainability of the state's fish and wildlife resources through research, scientific management, wise use, and public input. The NCWRC is the state regulatory agency responsible for the enforcement of fishing, hunting, trapping and boating laws and provides programs and opportunities for wildlife-related educational, recreational and sporting activities.

Game Lands Program

The NCWRC's Game Lands Program is administered by the Division of Engineering and Lands Management and is an important component of the Division. This program and the land it supports are historic in nature and are recognized by hunter and non-hunter alike as one of the gems of the NCWRC. Land management practices on NCWRC holdings allow the agency to play a critical role in managing, acquiring, recovering, and enhancing wildlife habitat for rare and common species identified in various action plans to be applied on a landscape scale. North Carolina's Game Lands Program includes approximately 2,000,000 acres of public and private lands managed through professional staff for public hunting, trapping, and fishing. These lands are spread all across the state. North Carolina's national forests are designated as game lands, collectively comprising more than a million acres.

Since the program's beginnings in the early 1970's, game lands have been acquired and managed largely with funds derived from the sale of North Carolina's hunting and fishing licenses, as well as appropriations from the federal excise tax (Federal Aid in Wildlife Restoration Act) on sporting arms, ammunition, and archery equipment. Appropriately, the NCWRC and the public viewed these lands as hunting, trapping, and fishing grounds. That viewpoint is expanding as both funding sources and public interest have changed.

As the number of licensed hunters both nationally and in North Carolina has been declining, non-consumptive activities such as bird watching, hiking, and biking have been on the rise. At the same time, the majority of new money used to purchase game lands has come from state trust funds designed to promote clean water, aid in conservation of endangered species, and from the mitigation of wetlands lost to construction and highway projects. This has prompted state officials and conservation groups to see a larger role for North Carolina's game lands. The NCWRC recognizes the need to provide for a larger and more diverse group of game land users.

Game Lands Program Mission Statement and Objectives

Consistent with the original establishment legislation for the NCWRC, the mission of the Game Lands Program is:

> "...to enhance, facilitate, and augment delivery of comprehensive and sound wildlife conservation programs. Inherent in delivery of a lands program consistent with this mission is the feasibility and desirability of multiple uses on lands owned by the state within the system. In addition to hunting, fishing, trapping, and wildlife viewing as primary uses, we recognize the desirability of providing opportunities for other activities on state-owned game lands that are feasible and consistent with the agency's mission, and compatible with these traditional uses."

The NCWRC's Game Lands Program management objectives are:

- To provide, protect, and actively manage habitats and habitat conditions to benefit aquatic and terrestrial wildlife resources
- To provide public opportunities for hunting, fishing, trapping, and wildlife viewing
- To provide for other resources-based game land uses to the extent that such uses are compatible with the conservation of natural resources and can be employed without displacing primary users
- To provide an optimally sustainable yield of forest products where feasible and appropriate and as directed by wildlife management objectives

PURPOSE AND NEED FOR THE PLAN

The NCWRC developed this Game Land Management Plan (hereafter referred to as Plan) to provide a foundation for the management and use of Columbus County, Green Swamp, and Juniper Creek Game Lands in Columbus and Brunswick Counties, North Carolina. The Plan will serve as a guide for the NCWRC's management actions and direction over the next 10 years and is considered amendable. The Plan will be periodically reviewed and compared to successes and failures of objectives set forth. Amendments will be made based on these successes and failures providing the NCWRC with the ability to implement adaptive resource management. Fish and wildlife conservation will receive top priority in game lands management, and wildlife-dependent recreation will be allowed and encouraged as long as it is compatible with, and does not detract from, the mission of the Game Lands Program or the purposed for which it was established. Hunting, fishing, trapping, and wildlife viewing are recognized as traditional uses on game lands and will continue to be allowed and encouraged. Non-traditional uses will be allowed on game lands as long as they are feasible and consistent with agency's mission and compatible with these traditional uses.

The Plan was prepared by a development team composed of NCWRC staff that provided a variety of expertise to address different components of the Plan, which included staff from the divisions of Engineering and Lands Management, Wildlife Management, Inland Fisheries, and Law

Enforcement. In developing this Plan, the development team incorporated the input of state agencies, nongovernmental organizations, local citizens, and the general public through a series of public input meetings, as well as an online comment session through the NCWRC's website. This public involvement and the planning process itself are described in other sections of the Plan.

All aspects of game land management were considered in the development of the Plan and include but are not limited to; fish and wildlife communities, forest management, infrastructure development and maintenance, public uses, fish and wildlife information needs, financial assets and future needs, future plans for acquisition, regulations and enforcement, and existing and needed partnerships and collaboration.

The purpose of the Plan is to develop proposed actions that best achieve the purpose of the Game Lands Program. It will serve to attain the goals and objectives developed for the game land, contribute to the Game Lands Program mission, address key problems, issues, and relevant mandates, and provide consistency with sound principles of fish and wildlife management.

More specifically, the Plan is needed to:

- Provide a clear direction for game land management
- Provide game land neighbors, users, and government officials with an understanding of NCWRC management actions on and around the game land
- Ensure that NCWRC management actions, including wildlife management and recreational activities, are consistent with the mandates of the Game Lands Program
- Provide a basis for the development of budgetary requests for operations, maintenance, and improvement needs

Again, this Plan is written based on a ten-year planning horizon and is considered a living document that can be amended and updated based on adaptive resource management. This will give managers the ability to make changes to the Plan based on varying conditions such as: updates and improvements on management strategies, changes created by catastrophic weather events, informative data received through research and surveys, and changes of wildlife population and ecosystem responses to implemented management strategies.

REGIONAL CONTEXT

Mid-Atlantic Coastal Plain of North Carolina

In North Carolina, a large diversity of fish and wildlife habitats exist across three distinct regions of the state: the Coastal Plain, the Piedmont, and the Mountains (Figure 1). These regions fall within much larger ecoregions, span state borders, and link North Carolina to neighboring states. The Brunswick and Columbus County Game Land Complex is located in Brunswick and Columbus Counties, which lies within the Mid-Atlantic Coastal Plain of North Carolina. This ecoregion is characterized by flat lands extending inland from the coast an average of 125 miles (NCWRC 2005), with the combined land and water areas covering nearly half the area of the state. Elevations increase inland at roughly one foot per mile. This ecoregion ranks among the top 10 in the continent in number of reptile, bird, and tree species (Ricketts et al. 1999) and is particularly diverse from an avifauna standpoint because it lies at the southern end of the range for many northeastern bird species and the northern end for many southeastern bird species. In fact, North Carolina is the only state where some bird species are found year-round.

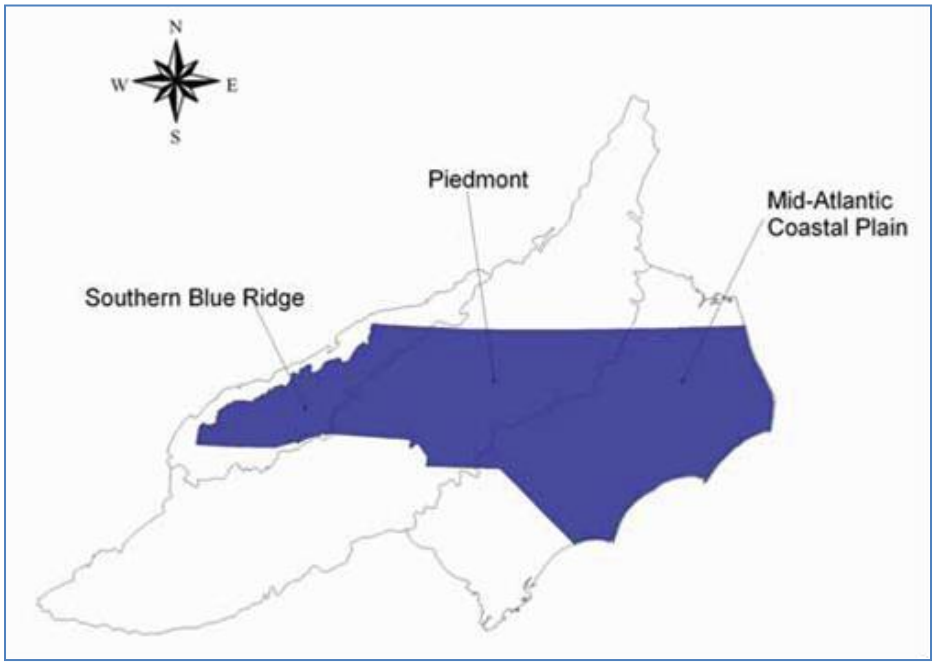
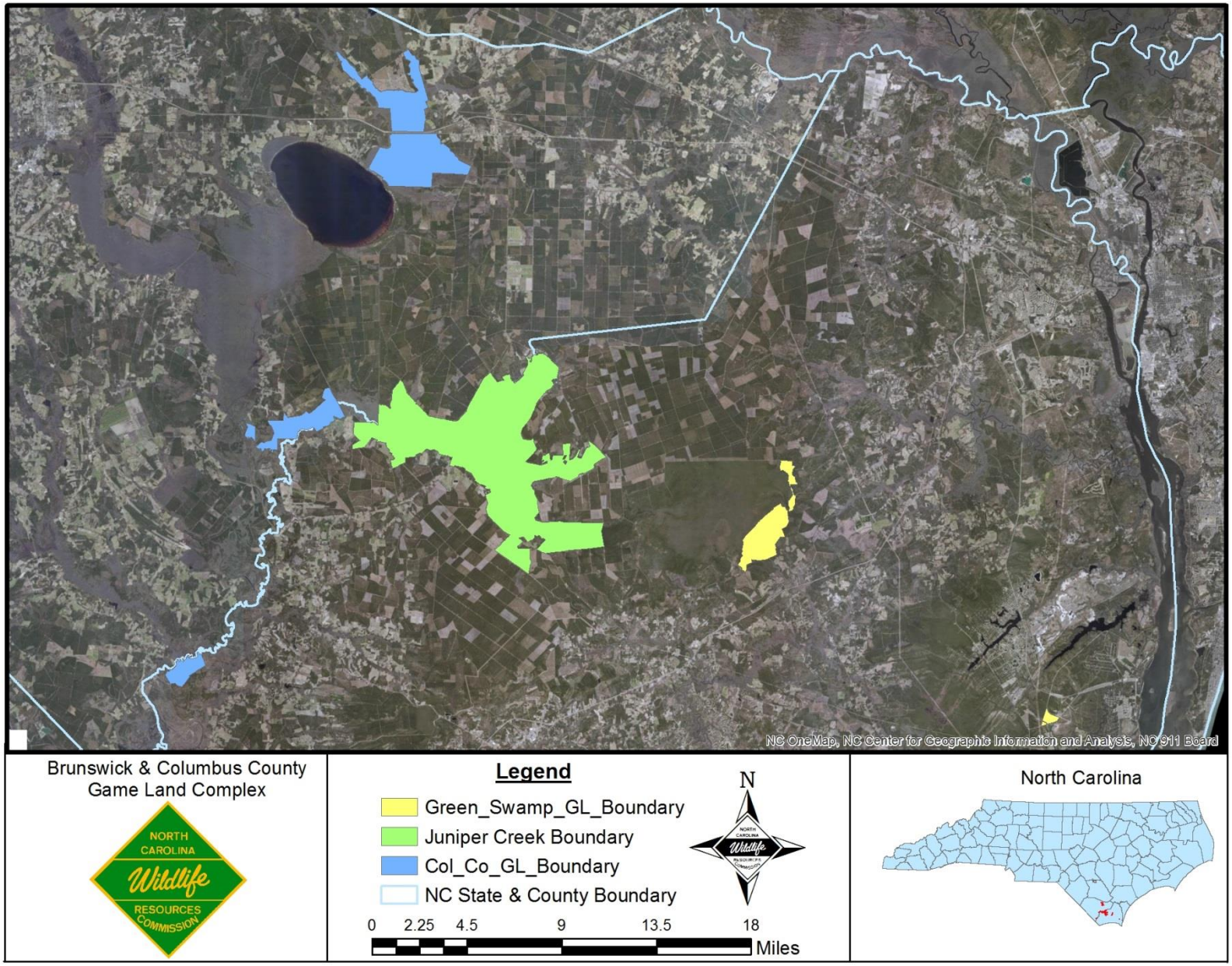


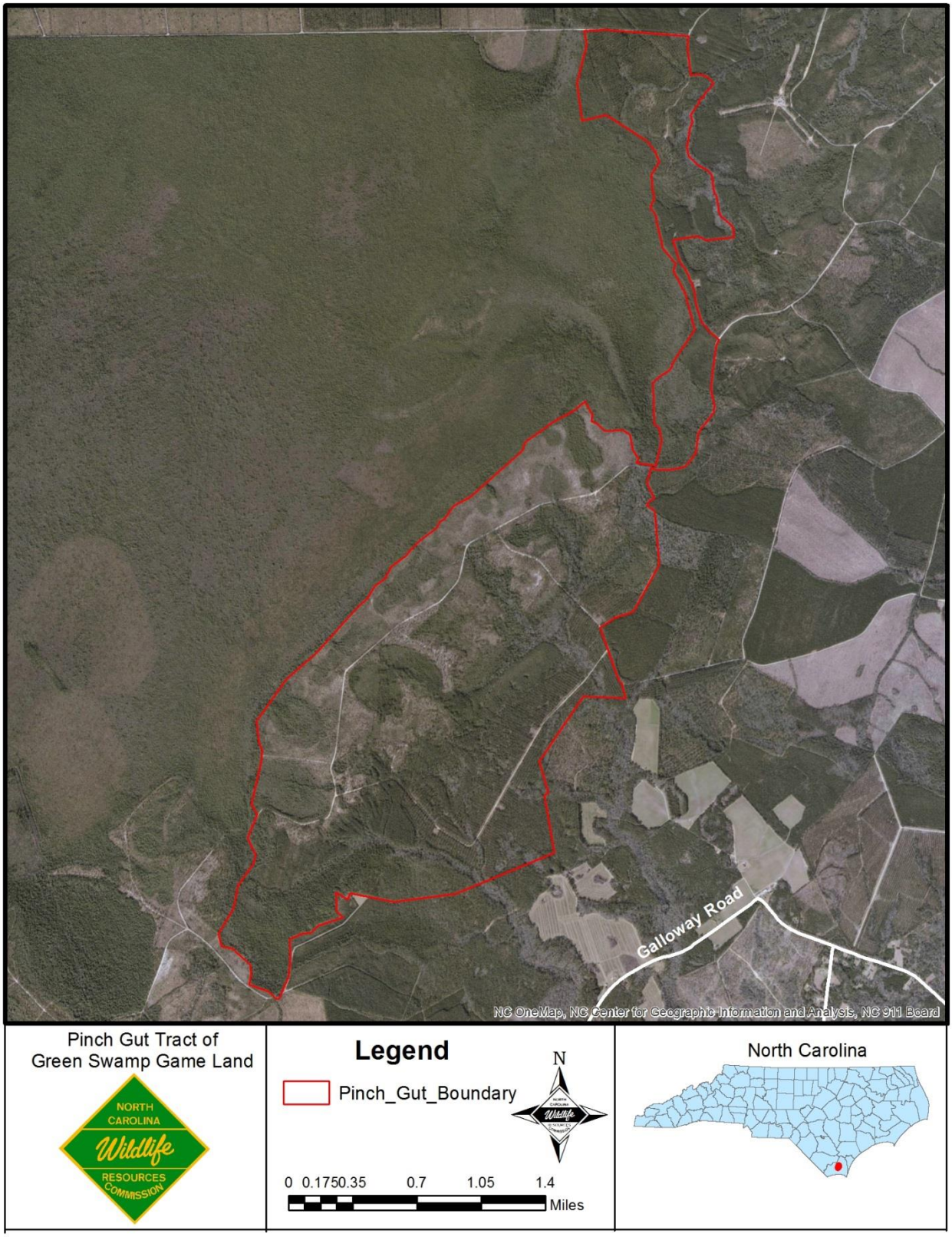
Figure 1 - Ecoregion delineations of North Carolina (data source: NC GAP; ecoregions as defined by Bailey 1995).

Many of the factors impacting wildlife species conservation can be traced to larger, landscape-level issues with habitat loss being the most obvious threat. Longleaf pine was historically found in all but the wettest sites in the Coastal Plain but now only exists on less than 3% of its historical range (Frost 1993). Over 97% of these forests have been lost to agriculture, pine plantations, and the interruption of historical fire regimes (Brockway and Outcalt 1998). Habitat fragmentation largely due to land conversion and fire suppression also greatly impact habitats in the Coastal Plain of North Carolina. As habitats in this area become more dissected and isolated, they become smaller, sometimes causing them to become ecologically dysfunctional.

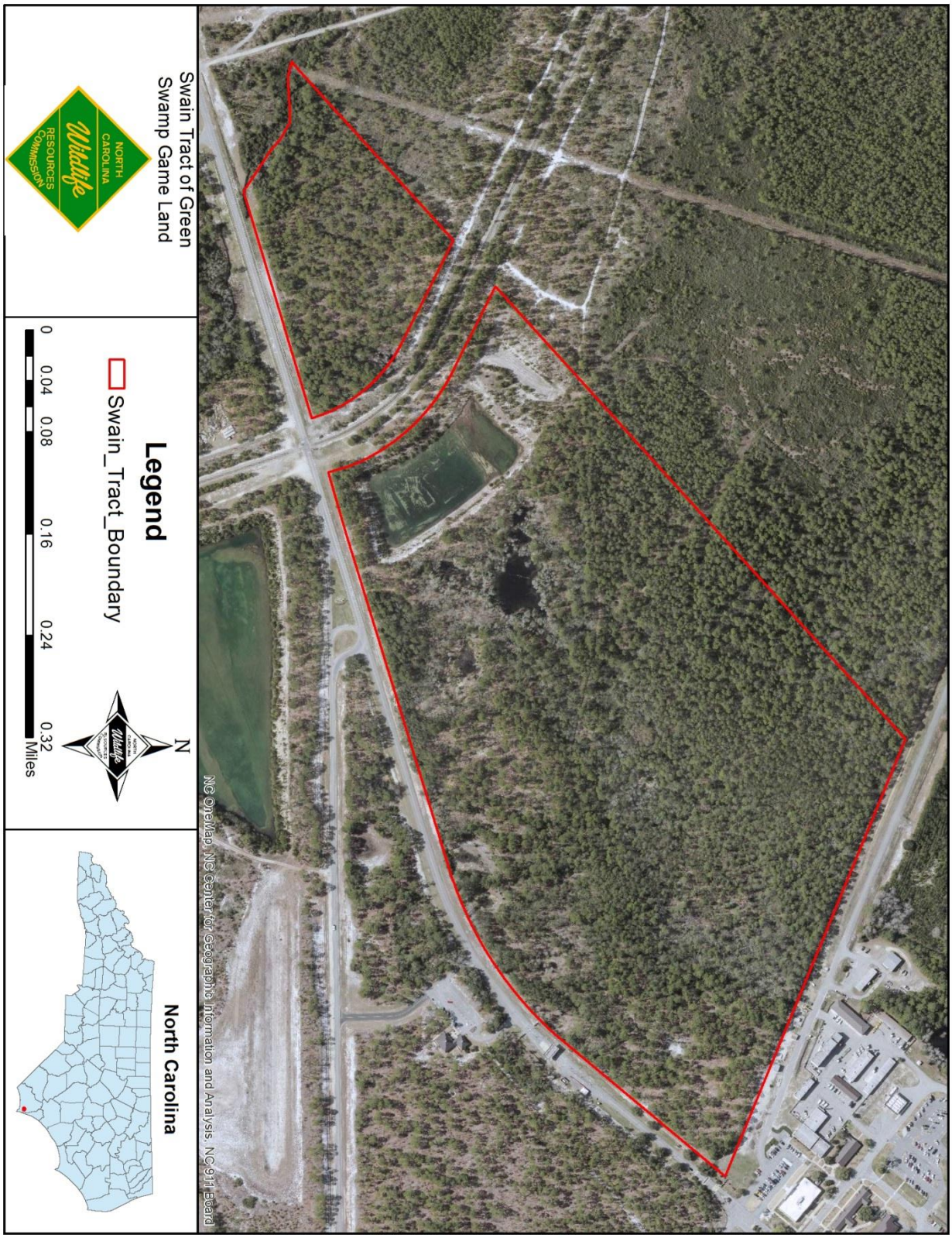
This game land complex lies within a region that was historically dominated by fire driven ecosystems. Fire has been an important sculptor of the landscape, and has been used as a management tool for thousands of years (Van Lear et al. 2005). In the early twentieth century, there was a push to eliminate fire from the landscape in the United States. People portrayed fire as both destructive and damaging, largely unaware of the beneficial and maintenance aspects of burning. The U.S. Forest Service and other state forestry agencies preached and practiced fire exclusion (Van Lear et al. 2005), and this has led to increased fuel loading across the United States on both private and public lands. The suppression of fire on the landscape has taken a toll and altered many fire-adapted ecosystems and adjacent ecotones (Duerr 2007). The Mid-Atlantic Coastal Plain was no exception to these events.



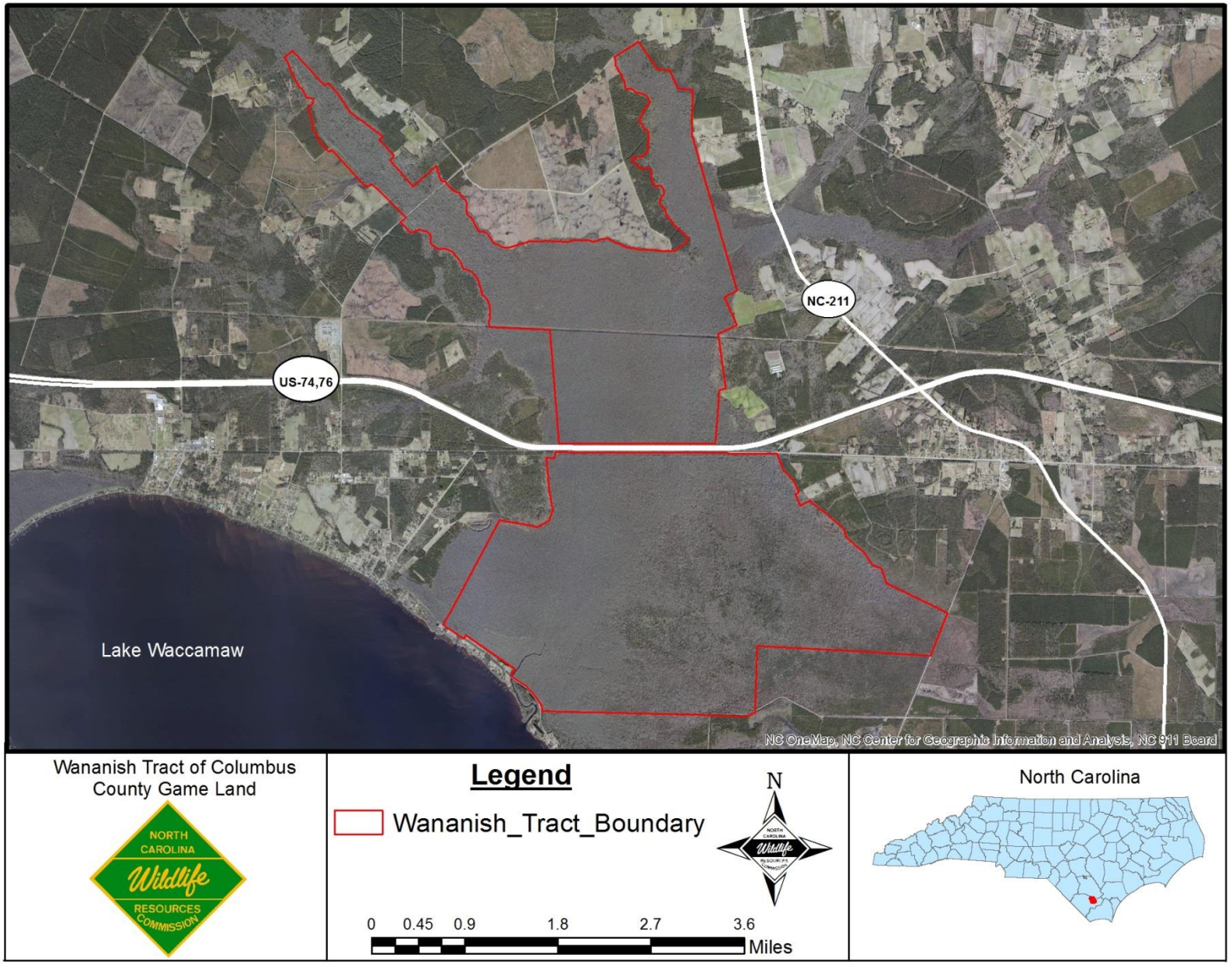
Map 1 – Brunswick and Columbus County Game Land Complex.



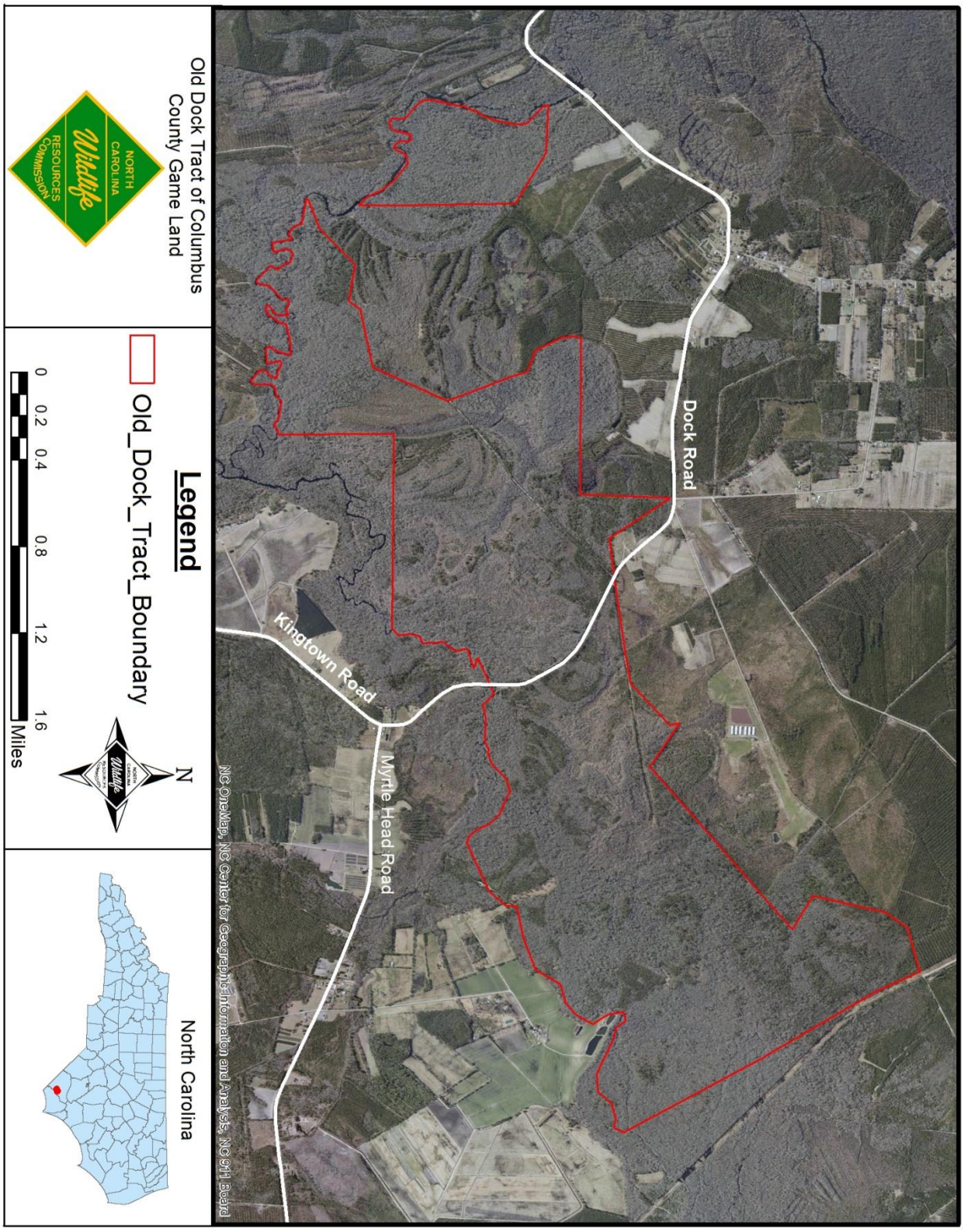
Map 2 – Pinch Gut Tract of Green Swamp Game Land.



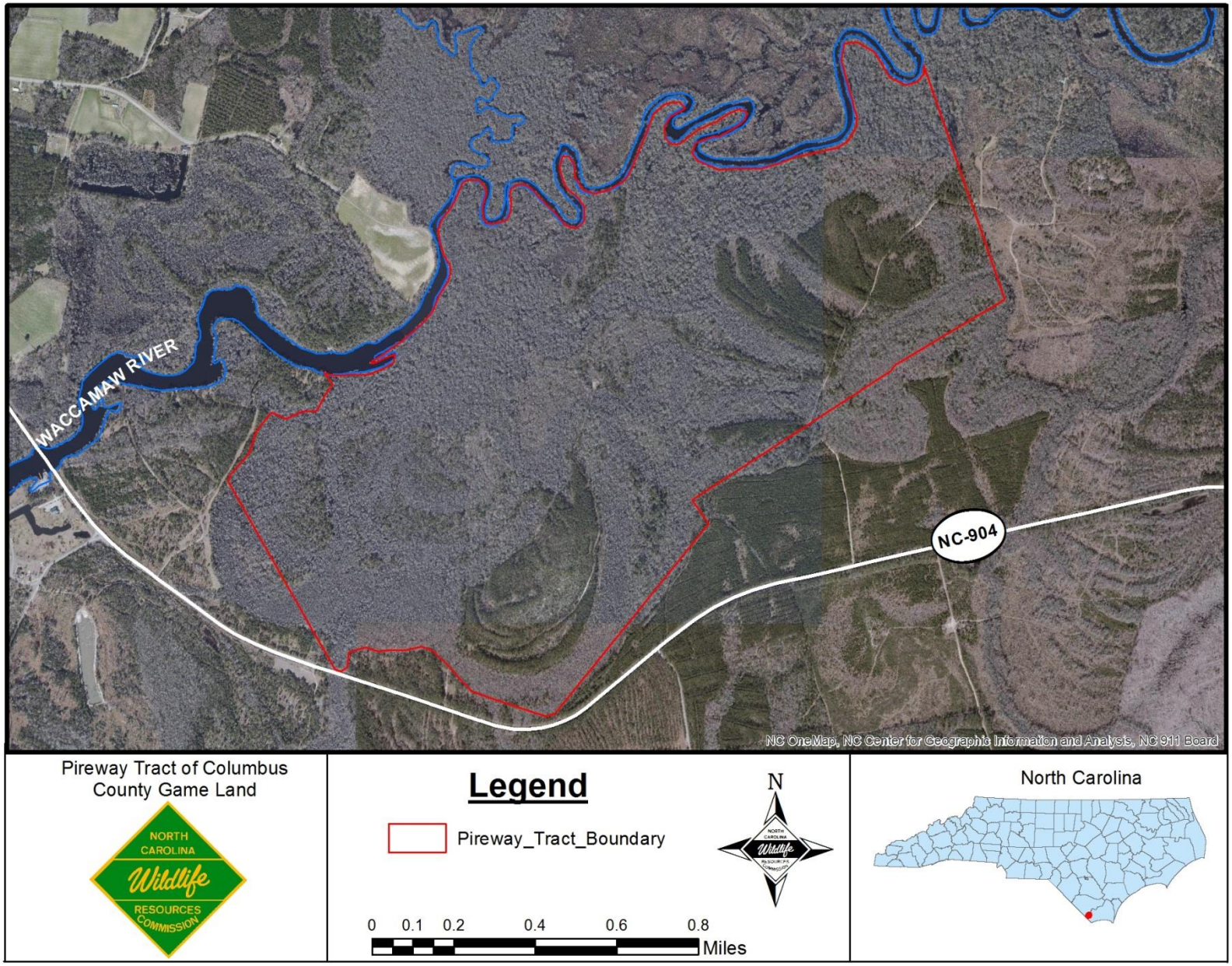
Map 3 – Swain Tract of Green Swamp Game Land.



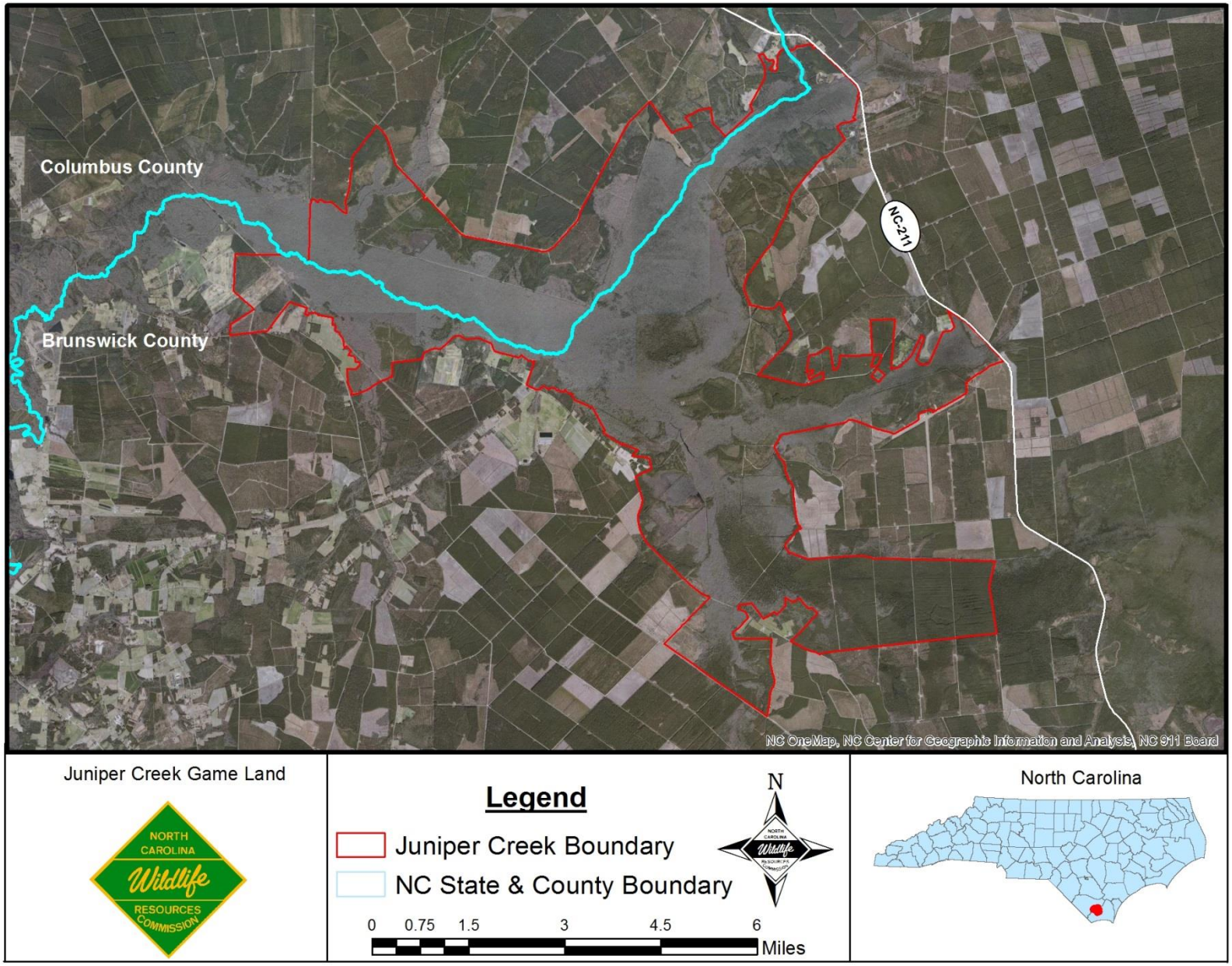
Map 4 – Wananish Tract of Columbus County Game Land.



Map 5 – Old Dock Tract of Columbus County Game Land.



Map 6 – Pireway Tract of Columbus County Game Land.



Map 7 – Juniper Creek Game Land.

Role and Importance of the Brunswick and Columbus County Game Land Complex

The Brunswick and Columbus County Game Land Complex consists of three separate game lands including Columbus County (8,408 acres), Green Swamp (2,048 acres), and Juniper Creek Game Land (18,507). Together they are comprised of six tracts of land with Columbus County Game Land having three tracts (Wananish, Old Dock, and Pireway Tracts), Green Swamp Game Land having two tracts (Pinch Gut and Swain Tracts), and Juniper Creek Game Land being a tract of its own. See Maps 1 - 7. Collectively they total 28,963 acres in size. This area of the state lies in and around the Green Swamp region and is characterized by its relatively intact aquatic ecosystem with an outstanding and diverse assemblage of aquatic species, many of them rare and endemic to the Waccamaw River Basin.

These properties provide important protection of numerous natural features with a nationally and state significant set of natural areas. They lie within or completely encompass eight state natural areas which include; Friar Swamp Natural Area, Juniper Creek Floodplain Natural Area, Juniper Creek/Driving Creek Aquatic Habitat Natural Area, Green Swamp Natural Area, White Spring Ponds Complex Natural Area, Waccamaw Island Savanna and Bottomlands Natural Area, Camp Branch Savanna Remnant Natural Area, and Waccamaw River Cross Swamp Bottomlands Natural Area.

With the exception of the Herbert Swain Tract of Green Swamp Game Land, these sites contain extensive swamp habitat that provides a critical connection between the Green Swamp and Juniper Creek and Waccamaw River floodplains. Lake Waccamaw, the Waccamaw River, and Juniper Creek are well known for their rich assemblage of aquatic species. This blackwater system has been proposed by the Wildlife Diversity Program of NCWRC as an Aquatic Conservation Area. These sites protect over 100 miles of riparian buffer, more than 20,000 acres of floodplain forests, and provides habitat for numerous rare plant and animal species. The channel of Juniper Creek and neighboring streams meander through the swampy floodplains and create a diverse habitat. Deep pools and shallow areas, sandy, silty, peaty, and even rocky bottoms, and wide bends provide varied habitats for many aquatic species.

The Carolina Pygmy sunfish is a small fish endemic to the Waccamaw drainage and Juniper Creek contains the largest and heathiest known population of this State Threatened and Federal Species of Concern. Also, endemic to the waters in and around Juniper Creek is the Waccamaw spike, a freshwater mussel also State Threatened and a Federal Species of Concern. Another fish species found in this drainage is the State Special Concern Broadtail madtom. These fish and others depend on feeding within the flooded swamp forests for portions of the year.

Role and Importance within Regional Conservation Partnerships, Priorities, and Plans

There are several conservation partnerships, priorities, and plans that, in some respects, dictate and obligate management practices that occur on the Brunswick and Columbus County Game Land Complex. These obligations stem from: criteria set by entities that allocate monies used to purchase land and/or fund habitat management projects, memorandums of understanding between partners, rare and endangered plant and animal species, public utilities rights-of-ways, and

research and surveys objectives set forth by the NCWRC. Along with the NCWRC's legal mandates and initiatives, other planning activities directly influence the development of the Plan. Various groups and agencies develop and coordinate planning initiatives involving regional, state, and local agencies, local communities, non-governmental organizations, and private individuals to help restore habitats for fish and wildlife on and off public lands.

The NCWRC is involved in cooperative partnerships in an effort to reduce the declining trend in biological diversity. Management considerations for habitats targeted in this Plan reflect the North American Waterfowl Management Plan which includes the Atlantic Coast Joint Venture, Partners in Flight Plan, the South Atlantic Migratory Bird Initiative (SAMBI), and the North Carolina Wildlife Action Plan.

The Atlantic Coast Joint Venture focuses on the middle and upper Atlantic Coast and concentrates their efforts on the conservation of habitat for native birds in the Atlantic Flyway. Within the Atlantic Coast Joint Venture is the joint venture formed between the NCWRC, U.S. Fish and Wildlife Service, and private conservation organizations.

The Partners in Flight Plan emphasizes land bird species as a priority for conservation. Habitat loss, population trends, and the vulnerability of species and threats to habitats are all factors used in the priority ranking of species. Further, biologists from local offices of the U.S. Fish and Wildlife Service, the NCWRC, and conservation organizations have identified focal species for each habitat type from which they will determine population and habitat objectives and conservation actions.

In 2001 Congress, recognizing the need for funding and planning to support the conservation, protection, and restoration of the full range of wildlife species, began providing annual funding allocations to supplement existing state fish and wildlife conservation programs. The new funding required each state and territory to develop a Wildlife Action Plan. The North Carolina Wildlife Action Plan was submitted in 2005 to meet this obligation. The Action Plan provides a conservation outline for agencies, organizations, industries, and academics across the state to advance the sound management of North Carolina's fish and wildlife resources into the future. It identifies critical fish and wildlife resources and priority conservation needs and promotes proactive conservation measures to ensure cost-effective solutions ("keeping common species common") instead of reactive measures enacted in the face of imminent losses (NCWRC, 2005)

In 1996, 2003, 2007, 2012, and 2013 the North Carolina Natural Heritage Trust Fund assisted with funding used to purchase all 28,963 acres of land that comprises the Brunswick and Columbus County Game Land Complex. The North Carolina Natural Heritage Trust Fund provided supplemental funding to select state agencies for the acquisition and protection of important natural areas, to preserve the state's ecological diversity and cultural heritage, and to inventory the natural heritage resources of the state.

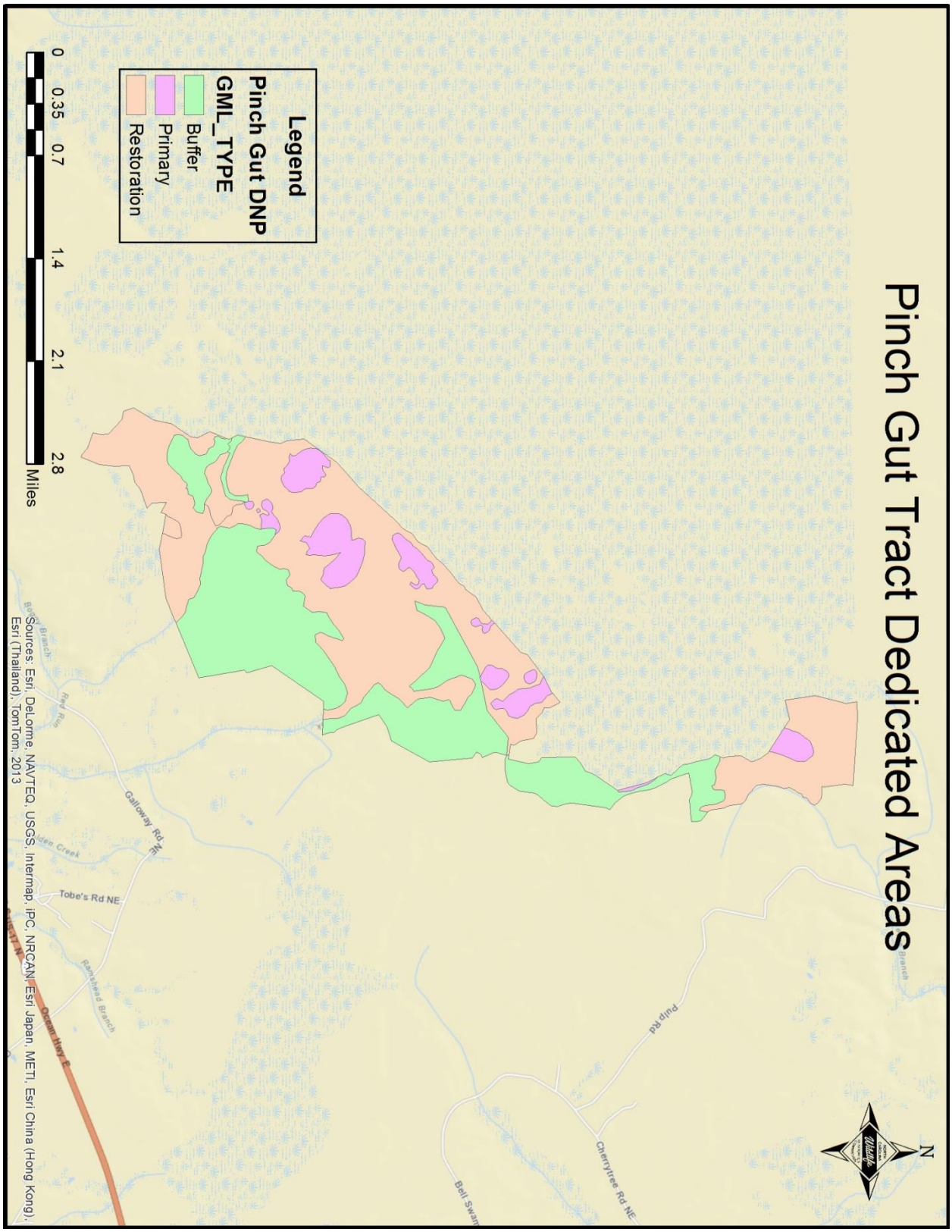
Lands pursued with these funds are subject to be dedicated under the North Carolina Nature Preserves Act and based on ecological values are designated into four classifications, Primary, Buffer, Restoration, and Special Management Areas (*See Maps 8 – 13*). These designations determine the type of protection that an area receives within a property.

The Primary areas of these game lands are the portions which have the highest quality, receive the greatest protection, and have the greatest ecological significance. The primary boundary is drawn to include the good quality communities and rare species locations and makes up 20,460 acres of this complex of game lands. It includes the most intact natural communities and rare plant and animal populations.

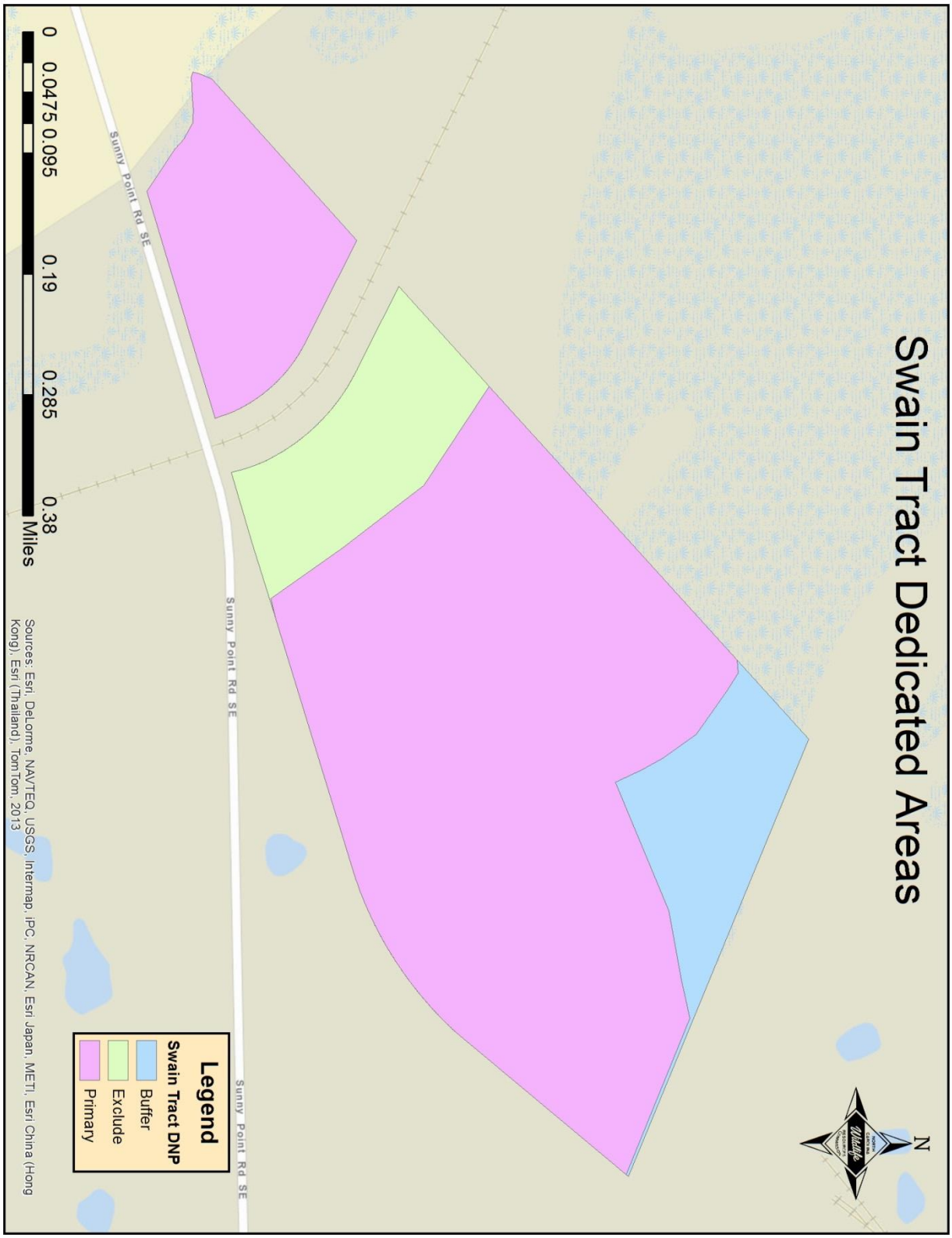
The Buffer area is an area that serves as a buffer to the Primary area and makes up 8,503 acres. It includes the more altered lands that are embedded in the primary areas, intrude into the primary areas, or are crucial for the connection of natural lands. These sites possess the lower quality vegetation which can contribute habitat for wider ranging species, especially if it is restored to a more natural condition.

Rules for management of Primary and Buffer areas can be found in the Articles of Dedication for Columbus County Game Land Dedicated Nature Preserve, Juniper Creek Game Land Dedicated Nature Preserve, and Green Swamp Game Land Dedicated Nature Preserve. These documents are available upon request to NCWRC staff.

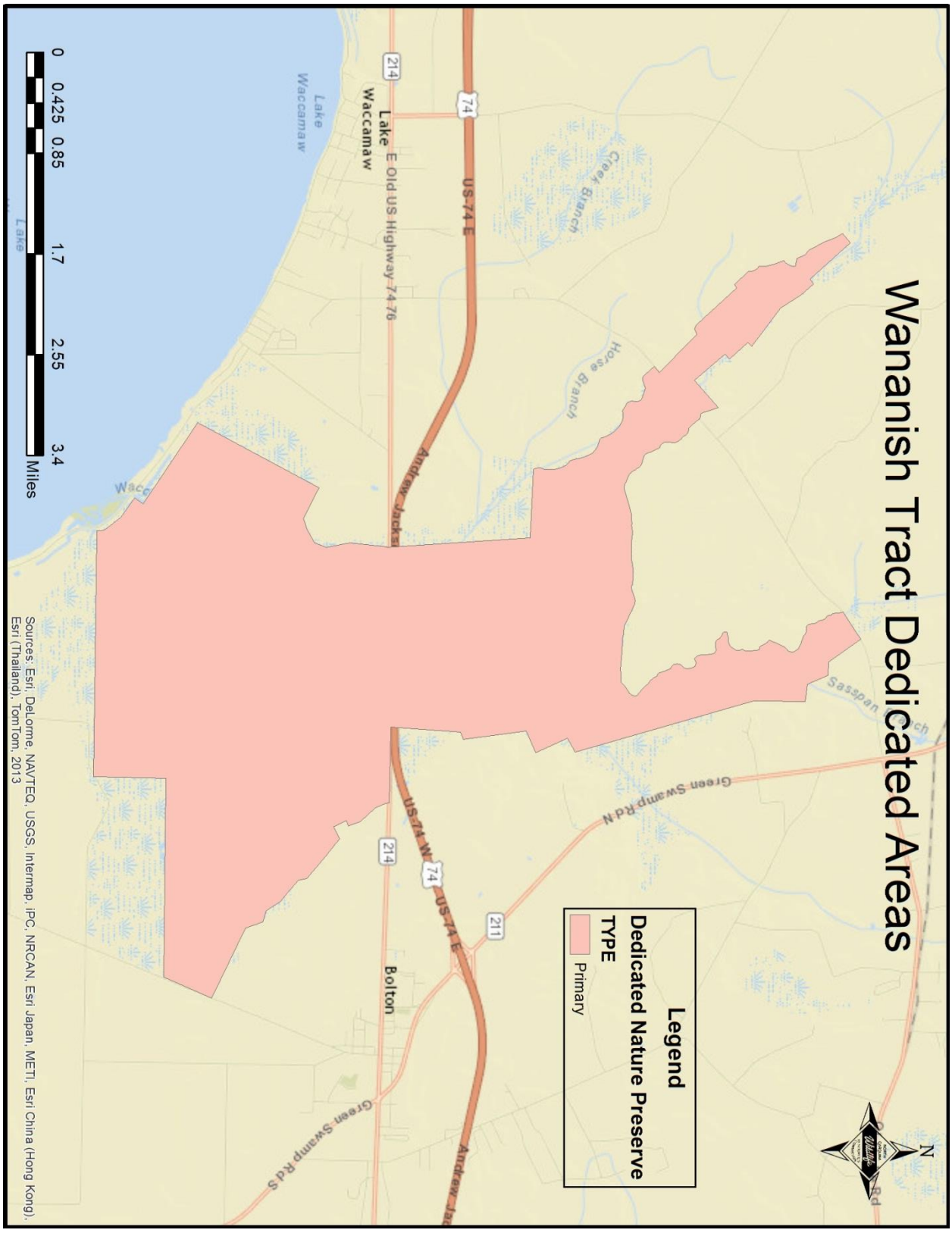
In 2008, the NCWRC entered into a Memorandum of Understanding (MOU) with the North Carolina Forest Service to facilitate the cooperation of the two parties in fire management activities. These activities include, but are not limited to, mitigation, training, wildfire prevention, and wildfire suppression. Among others, the guidelines set by this MOU mandates the NCWRC to conduct all prescribed fire operations pursuant to the North Carolina Smoke Management Plan.



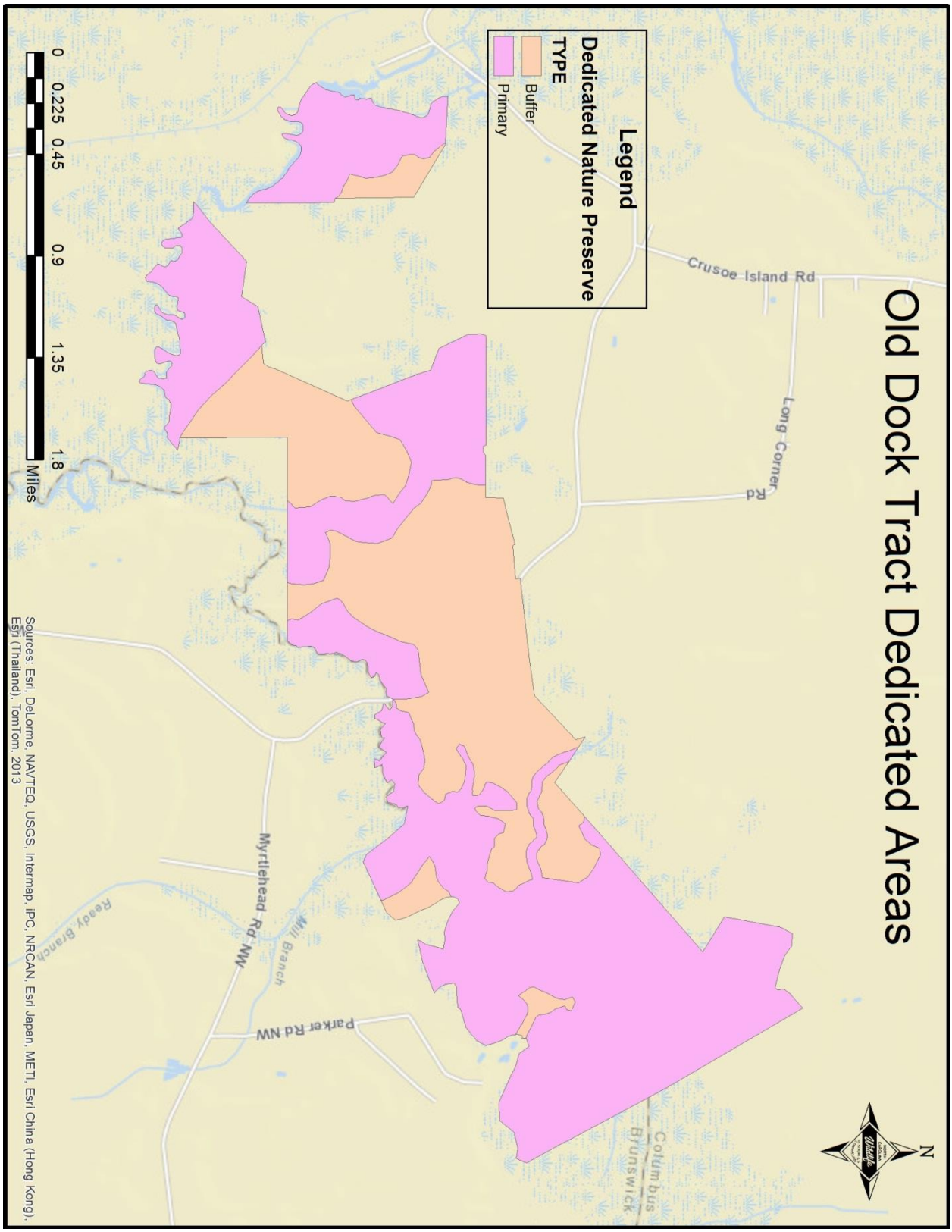
Map 8 – Dedicated areas of the Pinch Gut Tract of Green Swamp Game Land.



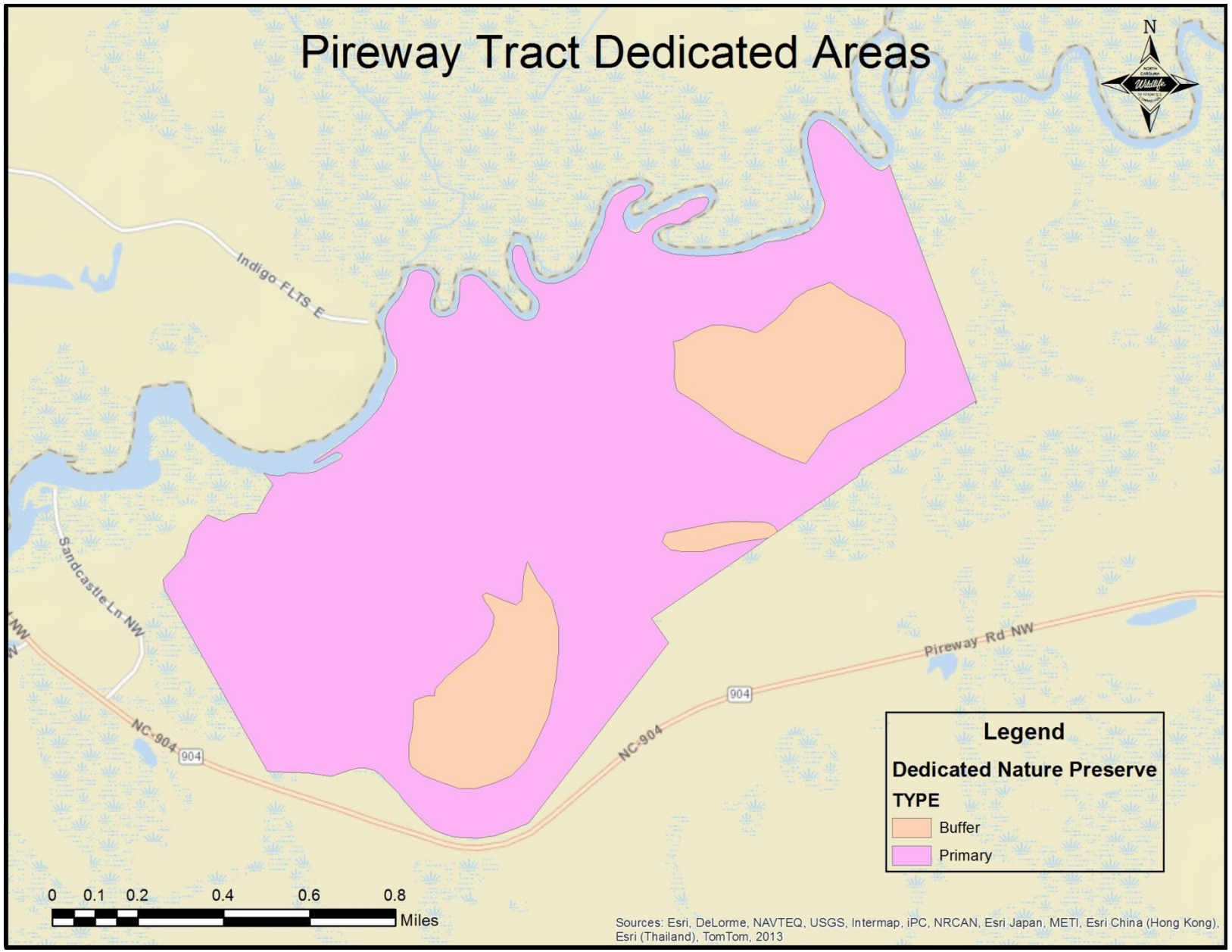
Map 9 – Dedicated areas of the Swain Tract of Green Swamp Game Land.



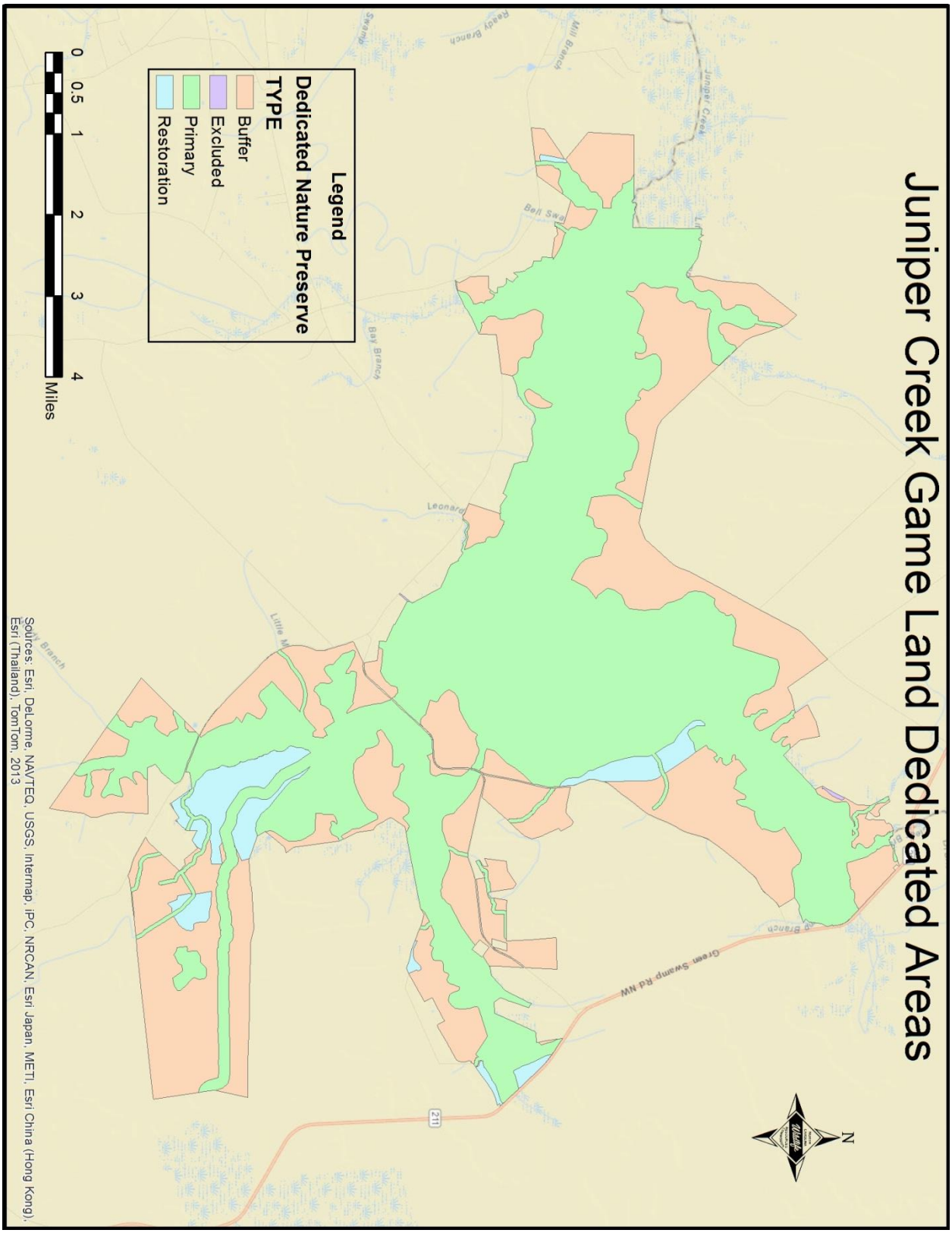
Map 10 – Dedicated areas of the Wananish Tract of Columbus County Game Land.



Map 11 – Dedicated areas of the Old Dock Tract of Columbus County Game Land.



Map 12 – Dedicated areas of the Pireway Tract of Columbus County Game Land.



Map 13 – Dedicated areas of Juniper Creek Game Land.

GAME LAND SPECIFIC INFORMATION

Topographic Features

The land and water areas of the Coastal Plain make up nearly half the area of the state. It can be divided roughly into two sections: the tidewater area, which is mostly flat and swampy, and the interior portion, which is gently sloping and naturally well drained. Throughout both sections, the soils consist of soft sediment with little or no underlying hard rock near the surface.

Climate

The climate of the Brunswick and Columbus County Game Land Complex is characterized by hot, humid summers with temperatures occasionally climbing above 95 degrees Fahrenheit, and moderate winters with temperatures seldom going below 20 degrees Fahrenheit. Since the flow of air over North Carolina is predominately from west to east, the continental influence is much greater than the ocean influence. Therefore, the state experiences a fairly large variation in temperature from winter to summer.

The most important single influence contributing to the variability of North Carolina's climate is altitude. In all seasons of the year, the average temperature varies more than 20 degrees Fahrenheit from the lower coast to the highest elevations (SCONC).

In the winter, the greater part of North Carolina is partially protected by the mountain ranges from the frequent outbreaks of cold air which move southeastward across the central states. Such outbreaks often move southward all the way to the Gulf of Mexico without attaining sufficient strength and depth to cross the heights of the Appalachian Mountain Range. When cold waves do break across, they are usually altered by the crossing and the descent on the eastern slopes of the Appalachian Range. Winter temperatures in the Coastal Plain are altered by the Atlantic Ocean which raises the average winter temperature and decreases the average day-to-night range.

In the spring of the year, the storm systems that bring cold weather southward reach North Carolina less often and less forcefully, and temperatures begin to modify. The rise in average temperatures is greater in May than in any other month (SCONC).

Differences in temperature across the state are no less pronounced in the summer than in the winter. The warmest days in the summer are found in the interior rather than near the coast. In Whiteville during the warmest month of the year, July, the average maximum temperature is 88 degrees Fahrenheit. In the coldest month of the year, January, the average minimum temperature is 31.7 degrees Fahrenheit (SERCC).

While there are no distinct wet or dry seasons in North Carolina, average rainfall does vary throughout the year. Precipitation is normally greatest in the summer, with July being the wettest month. Summer rainfall is also the most variable, occurring greatly in connection with spotty showers and thunderstorms. Daily showers are not uncommon, nor are periods of one to two weeks without significant rainfall. Fall is the driest season, with November being the driest

month. Precipitation in winter and spring occurs mostly in connection with migratory low pressure systems that appear more regularly and in a more even distribution than summer showers (SCONC). Snow and sleet occur on an average once or twice a year on the coast with little more occurrences over the southeastern half of the state. Average winter snowfall in the Coastal Plain is about one inch.

All rivers in North Carolina commonly have a maximum flow in late spring, with a minimum flow in the fall of the year. It is rare for any but the smallest streams to be dry at any time, however, all are likely to flood. The most severe floods are those during autumn which are typically associated with hurricanes. Rarely will a single hurricane cause major flood damage, but two in succession, or one coming after a very wet spell, can be very destructive (SCONC).

Soils

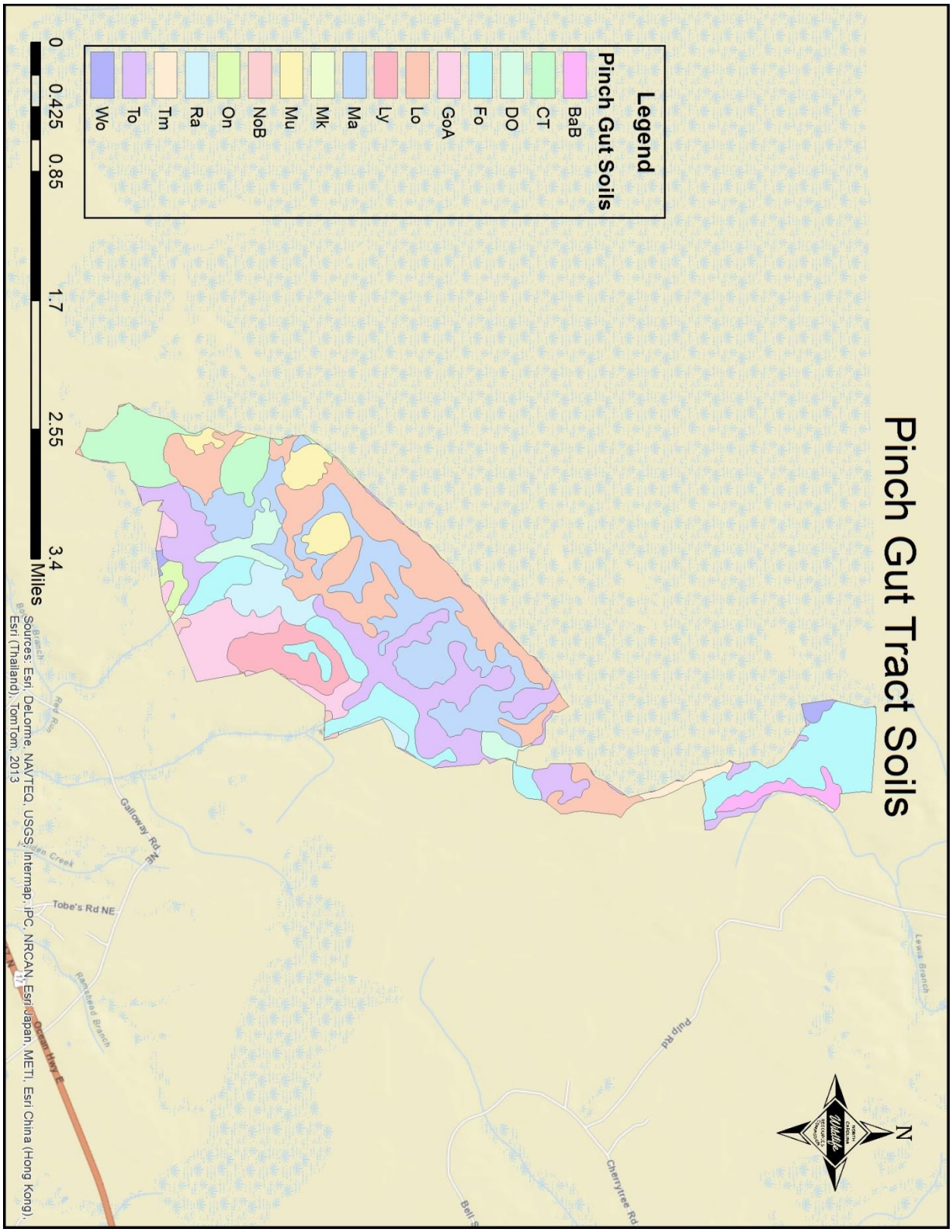
Soil characteristics are among the most critical factors in determining natural community distribution and composition. Natural communities are directly influenced by soil chemistry, moisture, and texture. Many of the counties' rarer natural community types are restricted primarily because of their association with uncommon soil types. Soils in Brunswick and Columbus Counties range from nearly pure sand on dry ridges, bay rims, sandhills, and river shorelines, to organic mucks in pocosin and floodplain swamps. Soils on upland terraces typically are a mixture of sand and peat, and range from sandy to loamy textures. The only exposed rock in these counties is coquina limestone ("marl"), which occurs along the shores of the Waccamaw River, Lake Waccamaw, and the Cape Fear River. However, limestone is near the surface in some areas, where it influences biotic communities by reducing the acidity typical of most Brunswick and Columbus County soils. These limestone-influenced soils are very rare, and support one of the rarest and most significant natural communities in North Carolina, the Pine Savanna Very Wet Clay Variant.

The moisture content of soil is particularly critical in determining the distribution of natural communities. Soil moisture is influenced by topography, substrate composition, and elevation above groundwater. In concert with other factors such as fire, soil moisture influences natural community structure and composition. The majority of remaining natural community sites in Brunswick and Columbus Counties occur on wet soils. This is primarily due to the conversion of drier sites to pine plantations and cropland.

Soils identified on the Pinch Gut Tract of Green Swamp Game Land are: Baymeade fine sand, Croatan muck, Dorovan muck, Foreston loamy fine sand, Goldsboro fine sandy loam, Leon fine sand, Lynchburg fine sandy loam, Mandarin fine sand, Muckalee loam, Murville mucky fine sand, Norfolk loamy fine sand, Onslow fine sandy loam, Rains fine sandy loam, Tomahawk loamy fine sand, Torhunta mucky fine sandy loam, and Woodington fine sandy loam. See *Table 1* and *Map 14*.

Soil Series	Abbreviation
Baymeade fine sand	Bab
Croatan muck	CT
Dorovan muck	DO
Foreston loamy fine sand	Fo
Goldsboro fine sandy loam	GoA
Leon fine sand	Lo
Lynchburg fine sandy loam	Ly
Mandarin fine sand	Ma
Muckalee loam	Mk
Murville mucky fine sand	Mu
Norfolk loamy fine sand	NoB
Onslow fine sandy loam	On
Rains fine sandy loam	Ra
Tomahawk loamy fine sand	Tm
Torhunta mucky fine sandy loam	To
Woodington fine sandy loam	Wo

Table 1 – Soil series and abbreviations for the Pinch Gut Tract of Green Swamp Game Land.

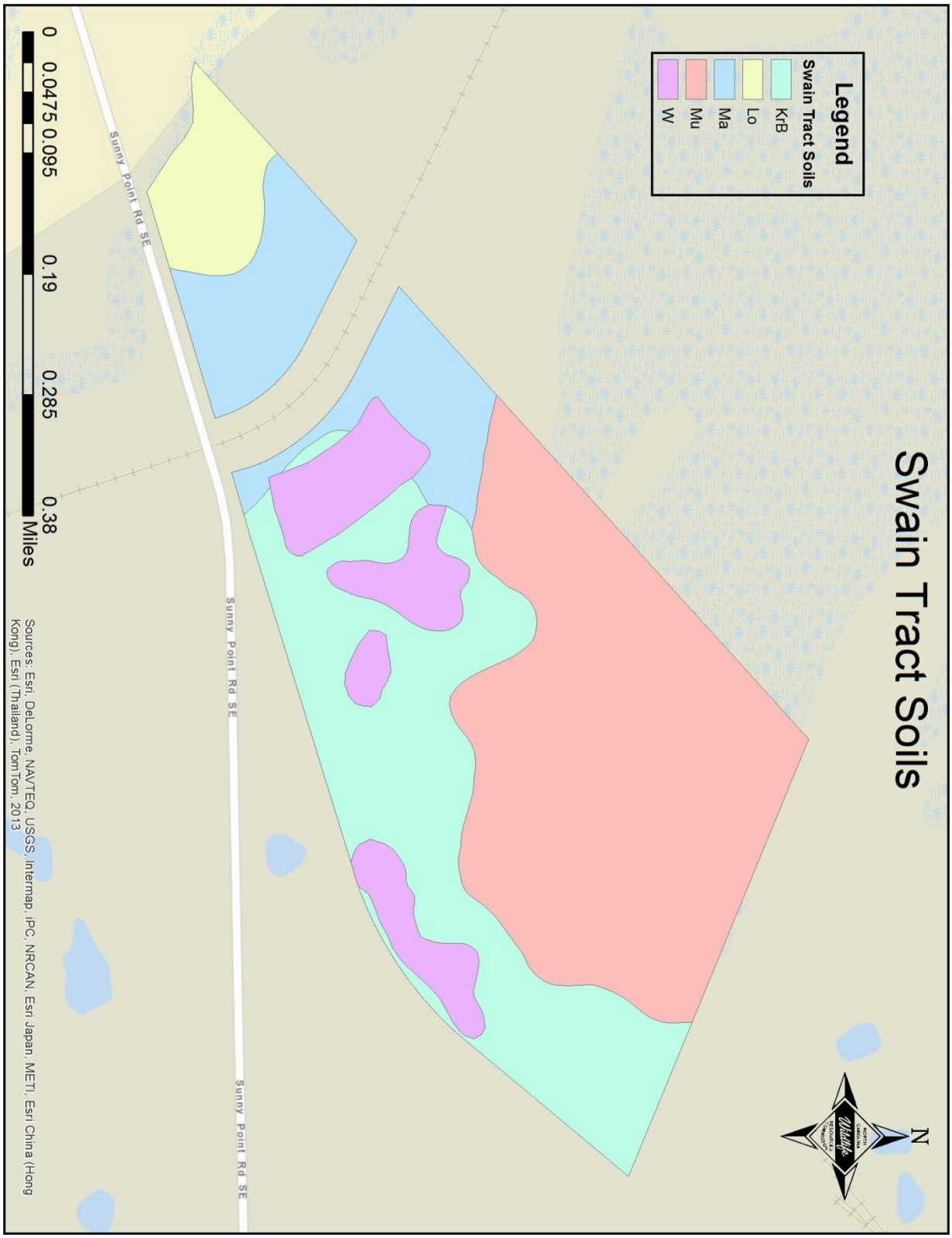


Map 14 – Soils of the Pinch Gut Tract of Green Swamp Game Land.

Soils identified on the Swain Tract of Green Swamp Game Land are: Kureb fine sand, Leon fine sand, Mandarin fine sand, and Murville mucky fine sand. See *Table 2* and *Map 15*.

Soil Series	Abbreviation
Kureb fine sand	KrB
Leon fine sand	Lo
Mandarin fine sand	Ma
Murville mucky fine sand	Mu

Table 2 – Soil series and abbreviations for the Swain Tract of Green Swamp Game Land.

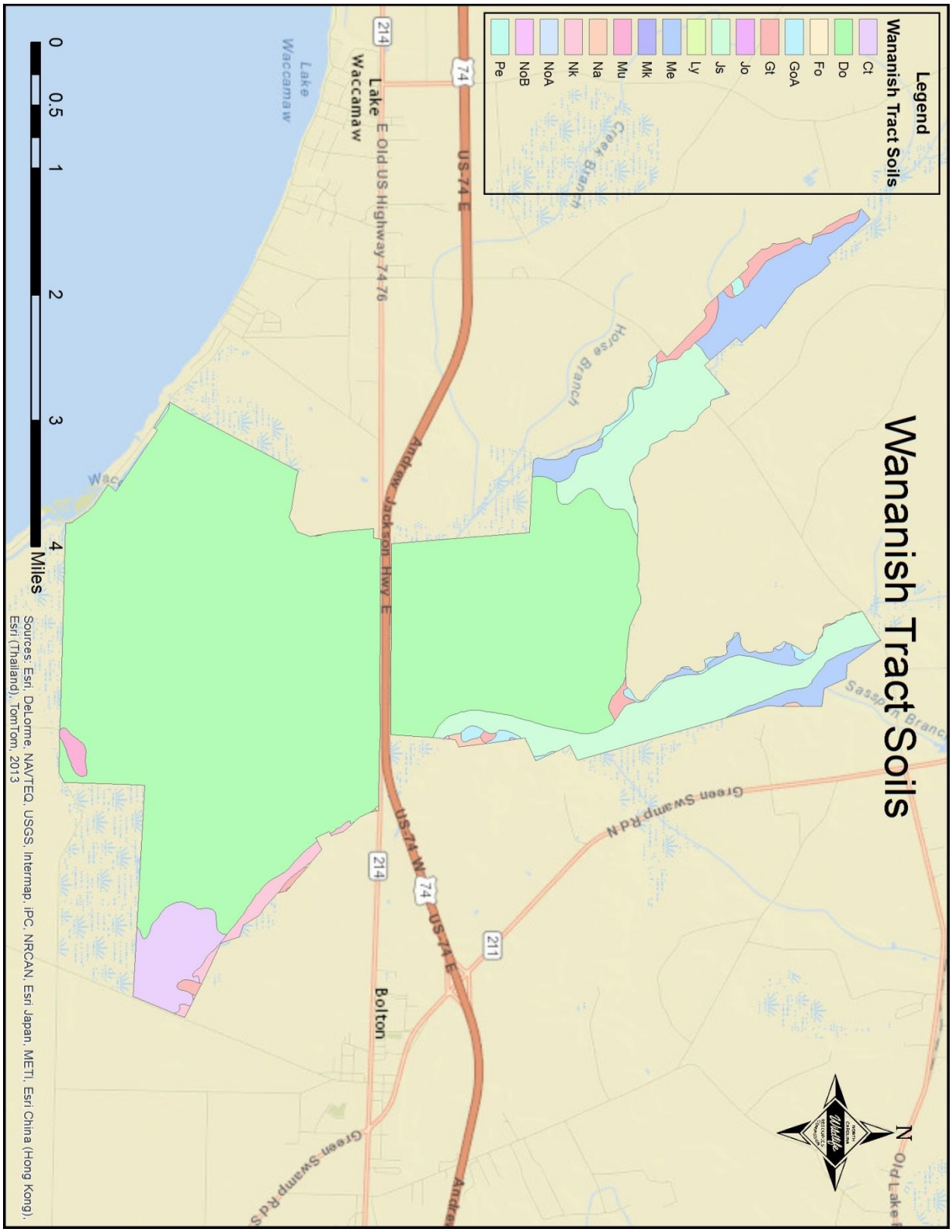


Map 15 – Soils of the Swain Tract of Green Swamp Game Land.

Soils identified on the Wananish Tract of Columbus County Game Land are: Croatan muck, Dorovan muck, Foreston loamy fine sand, Goldsboro fine sandy loam, Grifton fine sandy loam, Johns fine sandy loam, Johnston loam, Lynchburg fine sandy loam, Meggett fine sandy loam, Muckalee sandy loam, Murville fine sand, Nahunta very fine sandy loam, Nakina fine sandy loam, Norfolk loamy fine sand – 0 to 2 percent slopes, Norfolk loamy fine sand – 2 to 6 percent slopes, and Pender fine sandy loam. See *Table 3* and *Map 16*.

Soil Series	Abbreviation
Croatan muck	Ct
Dorovan muck	Do
Foreston loamy fine sand	Fo
Goldsboro fine sandy loam	GoA
Grifton fine sandy loam	Gt
Johns fine sandy loam	Jo
Johnston loam	Js
Lynchburg fine sandy loam	Ly
Meggett fine sandy loam	Me
Muckalee sandy loam	Mk
Murville fine sand	Mu
Nahunta very fine sandy loam	Na
Nakina fine sandy loam	Nk
Norfolk loamy fine sand – 0 to 2 percent slope	NoA
Norfolk loamy fine sand – 2 to 6 percent slope	NoB
Pender fine sandy loam	Pe

Table 3 – Soil series and abbreviations for the Wananish Tract of Columbus County Game Land.

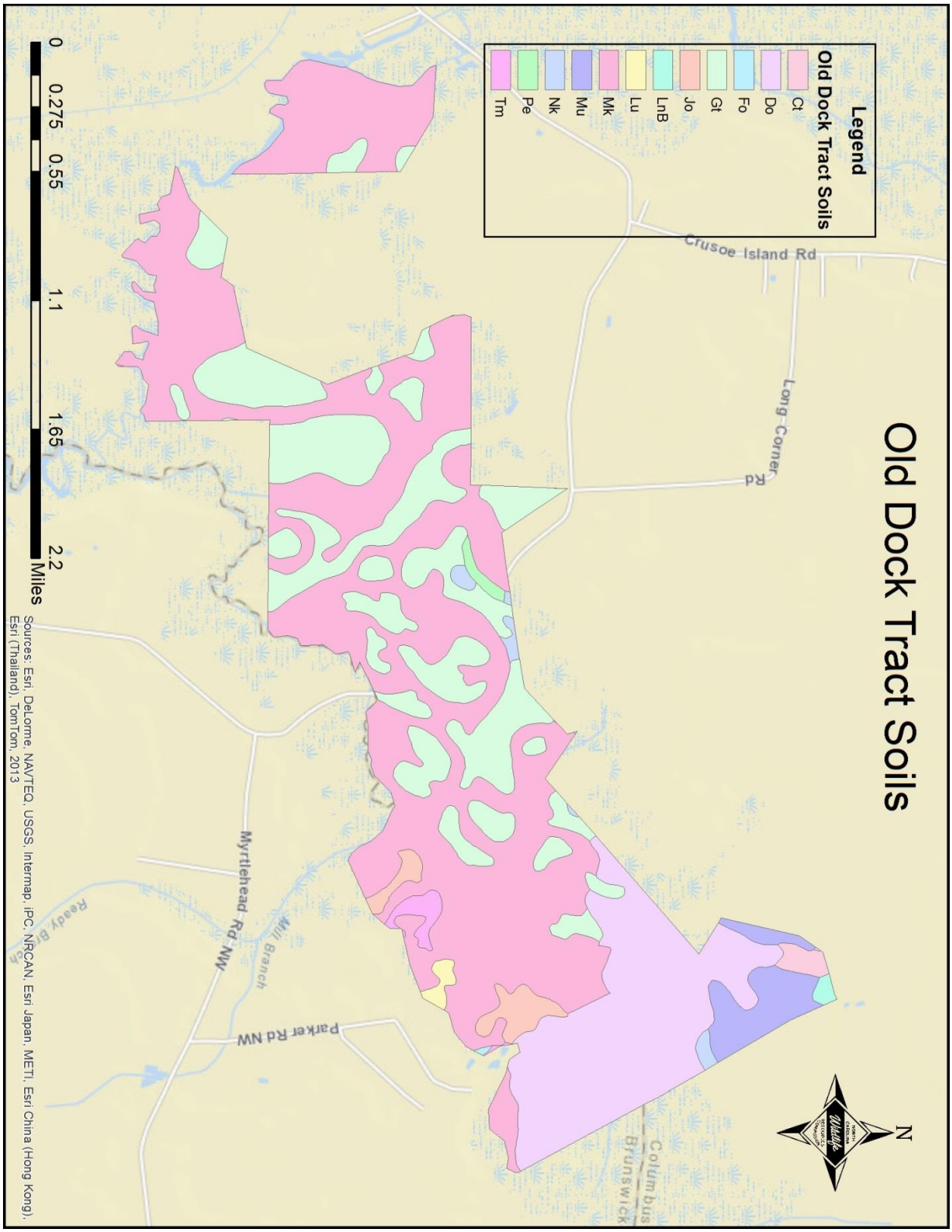


Map 16 – Soils of the Wananish Tract of Columbus County Game Land.

Soils identified on the Old Dock Tract of Columbus County Game Land are: Croatan muck, Dorovan muck, Foreston loamy fine sand, Grifton fine sandy loam, Johns fine sandy loam, Leon sand, Lumbee fine sandy loam, Muckalee sandy loam, Murville fine sand, Nakina fine sandy loam, Pender fine sandy loam, and Tomahawk loamy fine sand. See *Table 4* and *Map 17*.

Soil Series	Abbreviation
Croatan muck	Ct
Dorovan muck	Do
Foreston loamy fine sand	Fo
Grifton fine sandy loam	Gt
Johns fine sandy loam	Jo
Leon sand	LnB
Lumbee fine sandy loam	Lu
Muckalee sandy loam	Mk
Murville fine sand	Mu
Nakina fine sandy loam	Nk
Pender fine sandy loam	Pe
Tomahawk loamy fine sand	Tm

Table 4 – Soil series and abbreviations for the Old Dock Tract of Columbus County Game Land.

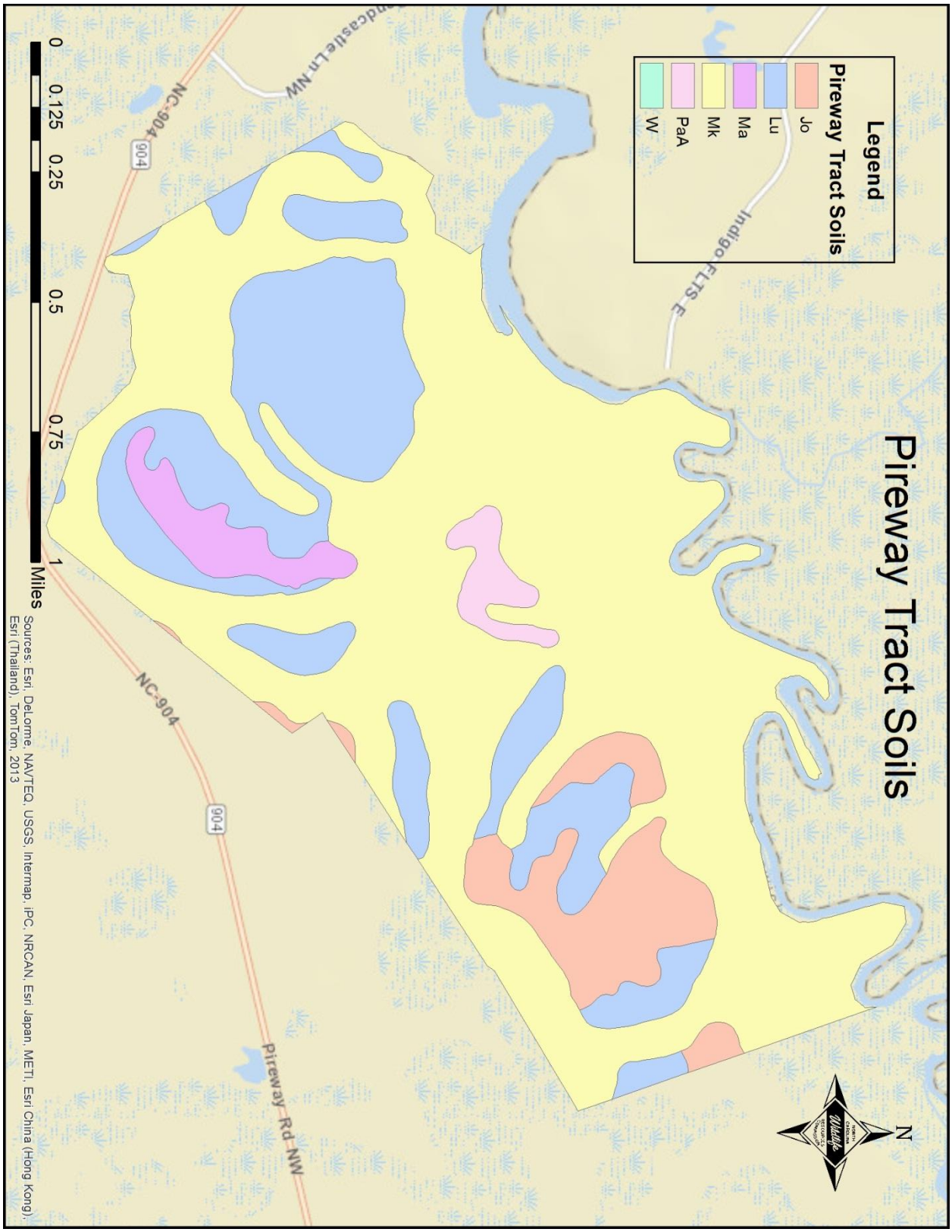


Map 17 – Soils of the Old Dock Tract of Columbus County Game Land.

Soils identified on the Pireway Tract of Columbus County Game Land are: Johns fine sandy loam, Lumbee fine sandy loam, Mandarin fine sand, Muckalee loam, and Pactolus fine sand – 0 to 2 percent slope. See *Table 5* and *Map 18*.

Soil Series	Abbreviation
Johns fine sandy loam	Jo
Lumbee fine sandy loam	Lu
Mandarin fine sand	Ma
Muckalee loam	Mk
Pactolus fine sand – 0 to 2 percent slope	PaA

Table 5 – Soil series and abbreviations for the Pireway Tract of Columbus County Game Land.

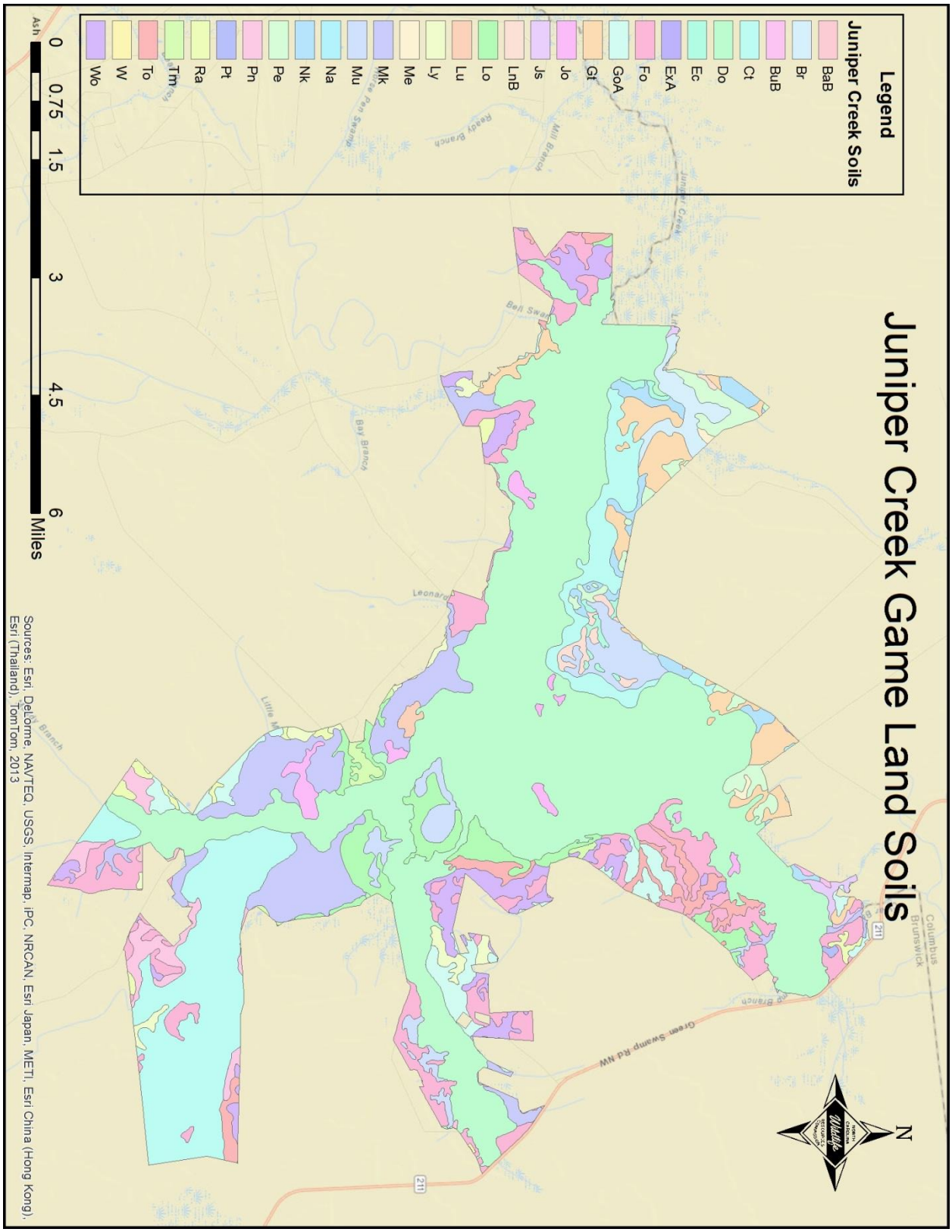


Map 18 – Soils of the Pireway Tract of Columbus County Game Land.

Soils identified on Juniper Creek Game Land are: Baymeade fine sand, Brookman loam, Butters loamy fine sand, Croatan muck, Dorovan muck, Echaw loamy sand, Exum very fine sandy loam, Foreston, loamy fine sand, Goldsboro fine sandy loam, Grifton fine sandy loam, Johns fine sandy loam, Johnston loam, Leon sand, Leon fine sand, Lumbee fine sandy loam, Lynchburg fine sandy loam, Meggett fine sandy loam, Muckalee loam, Murville fine sand, Nahunta very fine sandy loam, Nakina fine sandy loam, Pender fine sandy loam, Pantego mucky loam, Pits, Rains fine sandy loam, Tomahawk loamy fine sand, Torhunta mucky fine sandy loam, and Woodington fine sandy loam. See *Table 6* and *Map 19.*

Soil Series	Abbreviation
Baymeade fine sand	Bab
Brookman loam	Br
Butters loamy fine sand	BuB
Croatan muck	Ct
Dorovan muck	Do
Echaw loamy sand	Ec
Exum very fine sandy loam	ExA
Foreston loamy fine sand	Fo
Goldsboro fine sandy loam	GoA
Grifton fine sandy loam	Gt
Johns fine sandy loam	Jo
Johnston loam	Js
Leon sand	LnB
Leon fine sand	Lo
Lumbee fine sandy loam	Lu
Lynchburg fine sandy loam	Ly
Meggett fine sandy loam	Me
Muckalee loam	Mk
Murville fine sand	Mu
Nahunta very fine sandy loam	Na
Nakina fine sandy loam	Nk
Pender fine sandy loam	Pe
Pantego mucky loam	Pn
Pits	Pt
Rains fine sandy loam	Ra
Tomahawk loamy fine sand	Tm
Torhunta mucky fine sandy loam	To
Water	W
Woodington fine sandy loam	Wo

Table 6 – Soil series and abbreviations for Juniper Creek Game Land.



Map 19 – Soils of Juniper Creek Game Land.

Hydrology

The Brunswick and Columbus County Game Land Complex lies in the Lumber River Basin, which covers an area of approximately 3,329 square miles. It has approximately 2,222 miles of freshwater streams, 9,865 acres of acres of freshwater lakes, and 4,680 acres of estuarine or saline waterbodies (NCDWQ 2010). All or parts of ten counties lie within the basin with 54 municipalities. Land cover in the basin includes, 25.9% agricultural lands, 25.7% forest land, 26.1% wetlands, 6.7% developed, and 15.6% other, which includes rural transport, small water areas, lakes, and estuaries (NCDWQ 2010). This major river basin is divided into four sub-basins, two of which the Game Land Complex are within; the Waccamaw and Long Bay Sub-basins.

Maintenance of the fresh groundwater depends on the amount of rainfall. Due to the sandy nature of the soils, rainfall infiltrates the soil and enters the water table aquifer with little or no surface runoff. However, after the ground becomes saturated during periods of extensive rainfall, some runoff occurs in roadside ditches and small intermittent freshwater ponds.

Habitats

The Brunswick and Columbus County Game Land Complex is made up of eleven different habitat types varying in size and location. Floodplain Forest habitat makes up the majority of this site consisting of 70.9% of the area. Loblolly and Slash Pine Plantation comprises the next largest portion, consisting of 22.2%. Wet Pine Plantation habitat comprises 1.8% and Pocosin habitat comprises 1.5%. Wet Pine Savanna makes up 1.5% and Dry Coniferous Woodlands make up 1.0%. Dry Longleaf Pine, Early Successional, Borrow Pits, Mixed Hardwoods/Pine, and Small Wetland Community habitats make up 1.1% combined. Each of these habitat types plays its own important role in the ecology of the region and will be described in greater detail later in the Plan.

Surrounding Land Use

Historically, this area of the state has been valued for its silvicultural output. The production of tar, turpentine, and pitch from Brunswick and Columbus Counties' extensive longleaf pine forests played an important role in North Carolina's socioeconomic history, resulting in the "Tar Heel State" nickname. After that industry declined in the nineteenth century, agriculture and timber production increased. Overexploitation of these natural resources contributed to the region's economic struggles during the era of the Great Depression.

With the exception of the Swain Tract of Green Swamp Game Land, these properties are located in very rural areas of the state where silviculture is the largest industry and the factor that determines the surrounding land use. Agriculture is the second largest industry but these lands are minimal in comparison to forested lands. Very few residential areas are in close proximity to these game lands.

During the last century, many pocosins within the Green Swamp Region have been drained for silviculture as commercial logging in the area developed. Federal and state environment and agricultural regulations have, however, helped decrease the rate of degradation over the past 30

years. The last century has also seen an increase in diversity in Brunswick and Columbus Counties' economies. Agriculture remains dominant, but industry has grown dramatically. Both crop agriculture and industrial growth are primarily taking place far from all of these properties except the Swain Tract. Timber production remains the dominant economic force within close proximity to this site, due to its less fertile soils and limited transportation infrastructure.

The Swain Tract is located in very close proximity to residential and industrial growth in Brunswick County and is directly adjacent to the Military Ocean Terminal at Sunny Point.

History

In 1795, the State of North Carolina gave a massive land grant to three men for cutting the timber and mining peat in and around the Green Swamp Region. Intensive commercial logging in the Green Swamp started around 1904. As commercial logging developed, a large portion of the Green Swamp and Waccamaw River watershed, which abuts the Green Swamp, were converted from longleaf pine savannas and pocosin wetlands to loblolly pine plantations.

Three different private timber companies owned significant acreage in the Green Swamp Region from 1906 to 1977. In the early 1900s, the Waccamaw Lumber Company clear cut almost the entire swamp for the first time. Federal Paper Board again harvested much of the longleaf pine timber in the swamp, and trenched many of the savannas before replanting them with longleaf pine. As a result, few areas of old-growth longleaf remain in the swamp. Between 1906 and 1977, many of the old-growth pines were harvested and the beneficial, periodic fires on upland sites were suppressed from this landscape.

Historically, upland mineral soils on these tracts would have supported longleaf pine-wiregrass systems, which burned naturally on about 1-3 year interval. Upland portions of these tracts have been managed by a variety of timber management scenarios over time, which initially perpetuated longleaf pine. Effective control of wildfires beginning in the 1940's impacted longleaf pine regeneration and maintenance of the longleaf pine community. Subsequently, plantations of slash and loblolly pine were established on this property, probably first by Federal Paper Board.

Ownership of properties in the Brunswick and Columbus County Game Land Complex by the NCWRC dates back to 1996 when a 5,973 acre tract of land was purchased with funding from the North Carolina Natural Heritage Trust Fund. Since then, seven additional acquisitions were made to comprise the 28,963 acre Complex. See *Table 7*.

To promote early successional habitat, timber harvesting and prescribed burning was initiated in 2007, resulting in 1,351 acres of timber harvests, 1,948 acres in active prescribed burn rotation, and 206 acres of longleaf pine restoration.

North Carolina is not only known for its natural history, but also its rich historical/cultural resources. Several archaeological sites have been identified on properties in the Brunswick and Columbus County Game Land Complex that provide tangible evidence of the varied use of the property by the past residents of the area. These archaeological sites include prehistoric Indian

habitation sites, tar kilns, river landings, and colonial plantations. Because the sites can be easily damaged, unauthorized artifact collecting activities on all state owned property including NCWRC owned lands are prohibited by the Archaeological Resources Protection Act (G.S 70 Article 2).

DATE	ACRES	COST	FUNDING SOURCE	COST PER ACRE	GAME LAND – TRACT	TOTAL ACREAGE	TOTAL COST
1996	5,973	$1,716,000	Natural Heritage Trust Fund	$287.29	Columbus County Game Land – Wananish Tract	5,973	$1,716,000
2003	2,435	$1,180,365	Natural Heritage Trust Fund and Clean Water Management Trust Fund	$484.75	Columbus County Game Land – Old Dock & Pireway Tracts	8,408	$2,896,365
2007	18,506	$17,245,235	Natural Heritage Trust Fund, Clean Water Management Trust Fund, NCWRC, and The Nature Conservancy	$931.87	Juniper Creek Game Land	26,914	$20,141,600
2012	712	$1,364,000	Natural Heritage Trust Fund and U.S. Fish and Wildlife Service	$1,915.73	Green Swamp Game Land – Pinch Gut Tract	27,626	$21,505,600
2012	338	$658,000	Natural Heritage Trust Fund	$1,946.74	Green Swamp Game Land – Pinch Gut Tract	27,964	$21,505,938
2012	83	$130,000	Natural Heritage Trust Fund and U.S. Fish and Wildlife Service	$1,566.26	Green Swamp Game Land – Swain Tract	28,047	$21,635,938
2013	454	N/A	Land Donation from The Nature Conservancy	N/A	Green Swamp Game Land – Pinch Gut Tract	28,501	$21,635,938
2013	462	N/A	Land Donation from The Nature Conservancy	N/A	Green Swamp Game Land – Pinch Gut Tract	28,963	$21,635,938

Table 7: History of land acquisition for the Brunswick and Columbus County Game Land Complex.

Purpose of the Brunswick and Columbus County Game Land Complex and its importance within the region

The Brunswick and Columbus County Game Land Complex serves to augment the mission and objectives of the Game Lands Program which was stated previously in the Introduction. Its uniqueness is defined by the region that it is a major component of, the Green Swamp Region, which is recognized for featuring a complex of longleaf pine savannas and limesink ponds bound together by thousands of acres of forested wetlands. These properties themselves are dominated by floodplain forests with 71.0% of its area made up of a mosaic of this habitat type. It is part of a unique and larger mosaic of the Waccamaw River landscape and is surrounded by sandy longleaf

pine and creek floodplain communities. This outstanding cluster of numerous palustrine and terrestrial communities supports an extraordinary number of rare plants and animals.

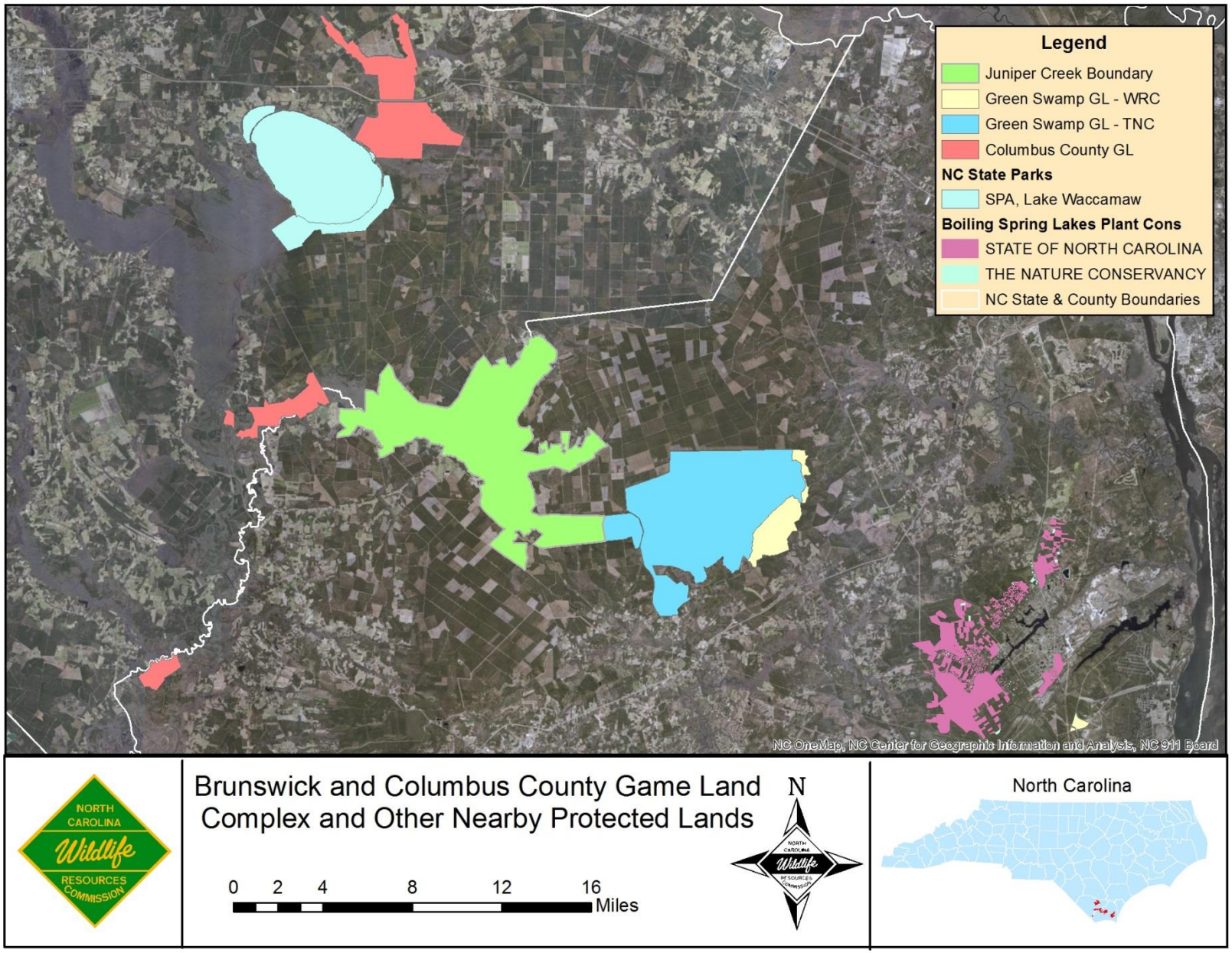
With a significant amount of land in this region already in North Carolina state ownership or owned by The Nature Conservancy there is an excellent opportunity to permanently protect a substantial portion of this unique mosaic, with spatial relationships intact. Other protected lands in close proximity to the properties in this Complex include Lake Waccamaw State Park (11,097 acres), The Green Swamp Preserve (17,424 acres), and the Boiling Spring Lakes Plant Conservation Preserve (6,042 acres). See *Map 20*.

It is clear that the interactions between the natural communities found within this region, and on the game land, are important; in fact, many of the rare species of plants and animals are found in the communities' ecotones. Therefore, protecting these communities and their spatial relationships is critical to the successful achievement of the Game Lands Program objectives.

In addition to its ecological importance, the Brunswick and Columbus County Game Land Complex offers recreational opportunities for the public interest and makes it a destination for many user groups. Traditional game land users seek out this game land and are provided the opportunity to hunt, fish, trap, and watch wildlife found in the various habitats. Hunting on game lands within this complex varies from three days per week to six days per week. Unique hunting opportunities are allowed for species such as dove, deer, bear, waterfowl, turkey, small game, as well as furbearer trapping.

One of the most important developments in the recovery of North Carolina's black bear populations began in 1971 with the creation of a bear sanctuary system (NCWRC 2012). Currently there are 490,000 acres of designated bear sanctuary in North Carolina with 17,406 of those acres located on Columbus County (8,506 acres) and Juniper Creek Game Lands (8,900 acres). Portions of Juniper Creek Game Land were enrolled into the black bear sanctuary system prior to ownership by the state, having been enrolled by the previous landowner, International Paper Company. The role of this program is to protect core areas of habitat that encompass the relatively small home ranges of breeding females. The idea is that females reproduce in the sanctuaries, and bear populations would increase and expand into surrounding areas. The bear sanctuary system has been one of the most successful and important innovations in the history of bear management in North America and has been a primary factor in the recovery of bear populations in North Carolina.

The black bear sanctuary system has proven to be an effective tool for increasing and maintaining a healthy population of bears in North Carolina. In line with the latest North Carolina Black Bear Management Plan, our sanctuary system needs the flexibility to allow adjustments in the amount of sanctuary in a given Bear Management Unit to meet management goals. It is clear that adjusting this one variable can have more of an impact than changes in season structure (NCWRC 2012). Ideally, we would like to add or remove sanctuary based on bear population objectives, in combination with hunter desires and human-bear interactions.



Map 20 – Brunswick and Columbus County Game Land Complex and other nearby protected lands.

Specific Goals of the Brunswick and Columbus County Game Land Complex

Restoration of longleaf pine on all sites where it was historically found is a long-term goal of the Brunswick and Columbus County Game Land Complex. Longleaf pine was historically found in all but the wettest sites in the Coastal Plain but now only exists on less than 3% of its historical range (Frost 1993). Prior to ownership by the State, most of the upland sites on these game lands had been converted to loblolly pine plantations. Prescribed fire will be the most appropriate management technique to manage the sites and will be applied on a 1–3 year interval.

Not only will fire be used on the existing and restored longleaf sites, but it will also be the dominant tool used manage other sites on this game land. Ecotones, transitional areas between two communities, require the application of prescribed fire to remain as areas that have a great diversity of plants and animals. Not only does fire in pine communities affect the composition and structure of the pine communities themselves, but also affects surrounding ecosystems and ecotones that exist in between (Duerr 2007). Upland sites that are currently occupied by slash and loblolly pine will also be maintained and managed with the use of prescribed fire.

Additionally, the goals of the Brunswick and Columbus County Game Land Complex are to:

- Provide for a diversity of habitat types and forest age classes though science based land management practices that are properly interspersed and juxtaposed across the landscape to ensure that a wide variety of terrestrial and aquatic wildlife species are conserved on the game land.
- Conserve popular sport fish and game species at huntable/fishable levels through science based land management and sound regulations.
- Provide quality habitat across the game land for endangered, threatened, and rare species to promote sustainable and perpetual populations.
- Provide sufficient infrastructure and opportunity to allow compatible and appropriate game lands users a quality experience while on the game land with minimal habitat degradation and minimal conflict among user groups.

Measures of success for the Brunswick and Columbus County Game Land Complex

- Wildlife and fish inventories/surveys indicate that a wide variety of species are present at sustained levels and are properly managed on the game land.
- Surveys and inventories of target sport fish and game species indicate that population levels of these species are being managed at sustained levels.
- Inventories/surveys indicate that populations of endangered, threatened, and rare species found on the game land are being maintained or restored.
- Inventories/surveys indicate that previously unknown populations or previously unknown endangered, threatened, and rare species are found on the game land.
- Surveys of game land users indicate a high level of user satisfaction.

HABITAT COMMUNITIES

Floodplain Forest

The Coastal Plain floodplain forest habitat includes several different community types, two of which are found on properties within the Brunswick and Columbus County Game Land Complex; bottomland hardwoods and blackwater cypress-gum swamps. Floodplain forests are typically located near rivers, lakes, and streams, but some of this property's floodplain forests are simply low-lying areas or depressions where water naturally collects after rain events or occurs within wetland habitats.

These forest systems of the Coastal Plain are now only small fragments and sections of the original millions of acres present before European settlement and have been lost or altered by development, drainage, agriculture, and logging (Weller and Stegman 1977). Several wildlife species that once occupied large floodplain systems are gone or greatly reduced in numbers.

Bottomland hardwoods in blackwater systems occur on high parts of the floodplain away from channels and may be dominated by laurel oak, water oak, willow oak, red maple, sweetgum, and loblolly pine (Schafale and Weakley 1990). They are characterized and maintained by a natural hydrologic regime of alternating wet and dry periods generally following seasonal flooding events. Shrub layers can be very dense and switch cane can be common. Vines can be dense and the herb layer is usually sparse. Flooding occurs in these sites occasionally but they are seldom disturbed by flowing water. They are important natural communities for maintenance of water quality, providing a very productive habitat for a variety of fish and wildlife species, and are important in regulating flooding and stream recharge. Blackwater rivers carry little inorganic sediment so flooding does not provide a substantial nutrient input (Schafale and Weakley 1990). These areas may carry fires (due to dense lower layers of vegetation) when dry and the occurrence of fire would affect the plant community composition and structure.

Blackwater Cypress-Gum Swamps contain just a few tree species tolerant of nearly permanent flooding: bald cypress, pond cypress, and swamp black gum. These communities get little input of nutrients due to the poor inorganic sediment load carried by blackwater rivers and the infertile acidic soils and wetness produce slow growth in the trees (Schafale and Weakley 1990). The difference between cypress and gum dominance is probably related to logging history, but environmental factors such as flooding frequency and depth, water chemistry, soil type and latitude also contribute (Schafale and Weakley 1990). Since cypress-gum swamps flood for long periods of time, their vegetational diversity is usually low but they may serve as important habitat for some aquatic animals and plants. Hollow cypress and swamp black gum are particularly important for bats, chimney swifts and other cavity dwelling species. Additionally, several colonial waterbird species rely on swamp forests for nesting habitat.

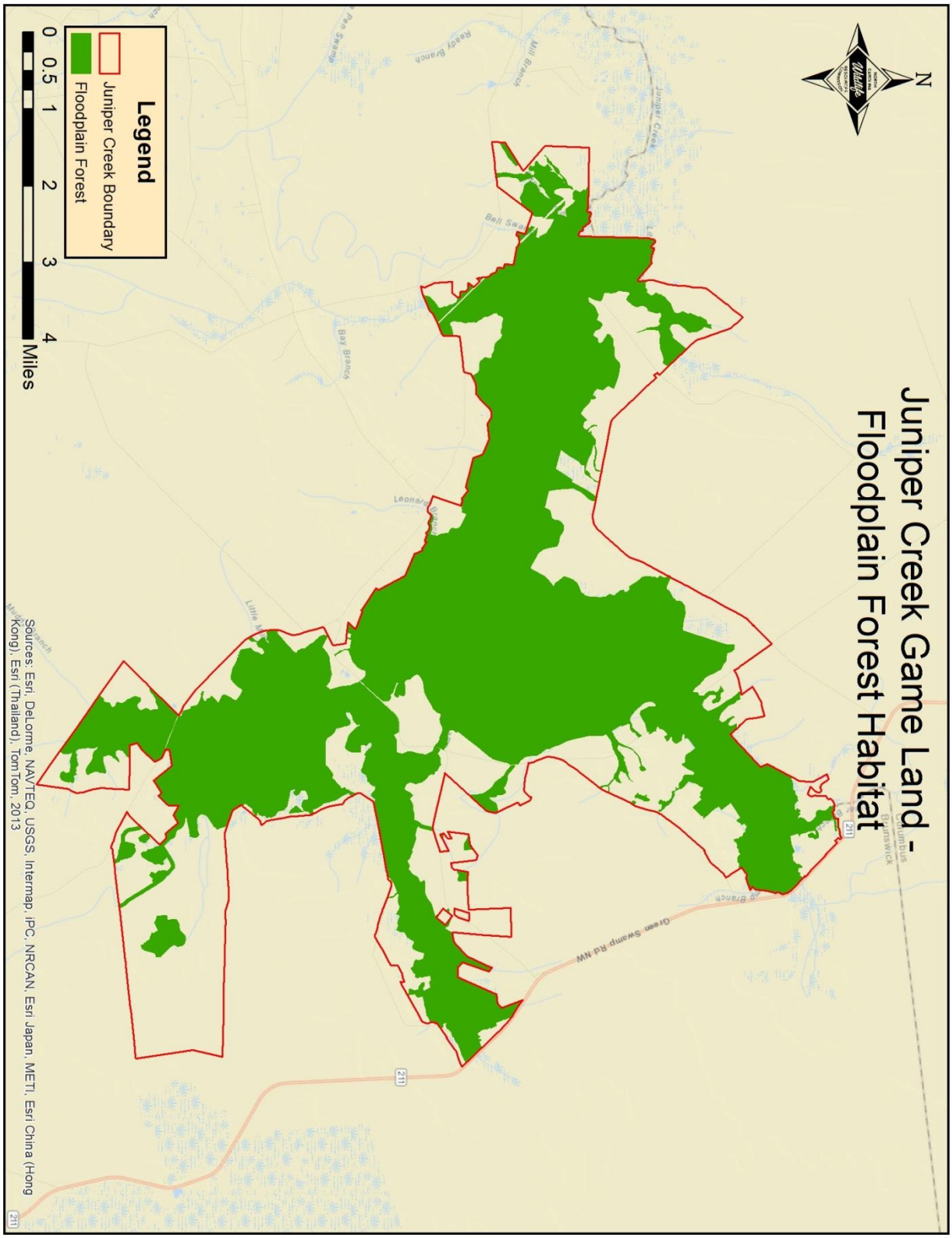
A. Location and condition of habitat (see Maps 21 – 26)

Approximately 20,544 acres (70.6%) of floodplain forests occur on this Complex of game lands. 11,730 acres occurs on Juniper Creek Game Land, with 8,312 acres occurring on Columbus County Game Land, and 502 acres occurring on Green Swamp Game Land. The condition of Coastal Plain floodplain forests of all types have been greatly reduced in recent years throughout North Carolina and the entire southeast (Weller and Stegman 1977, Schafale and Weakley 1990) by a variety of anthropogenic factors.

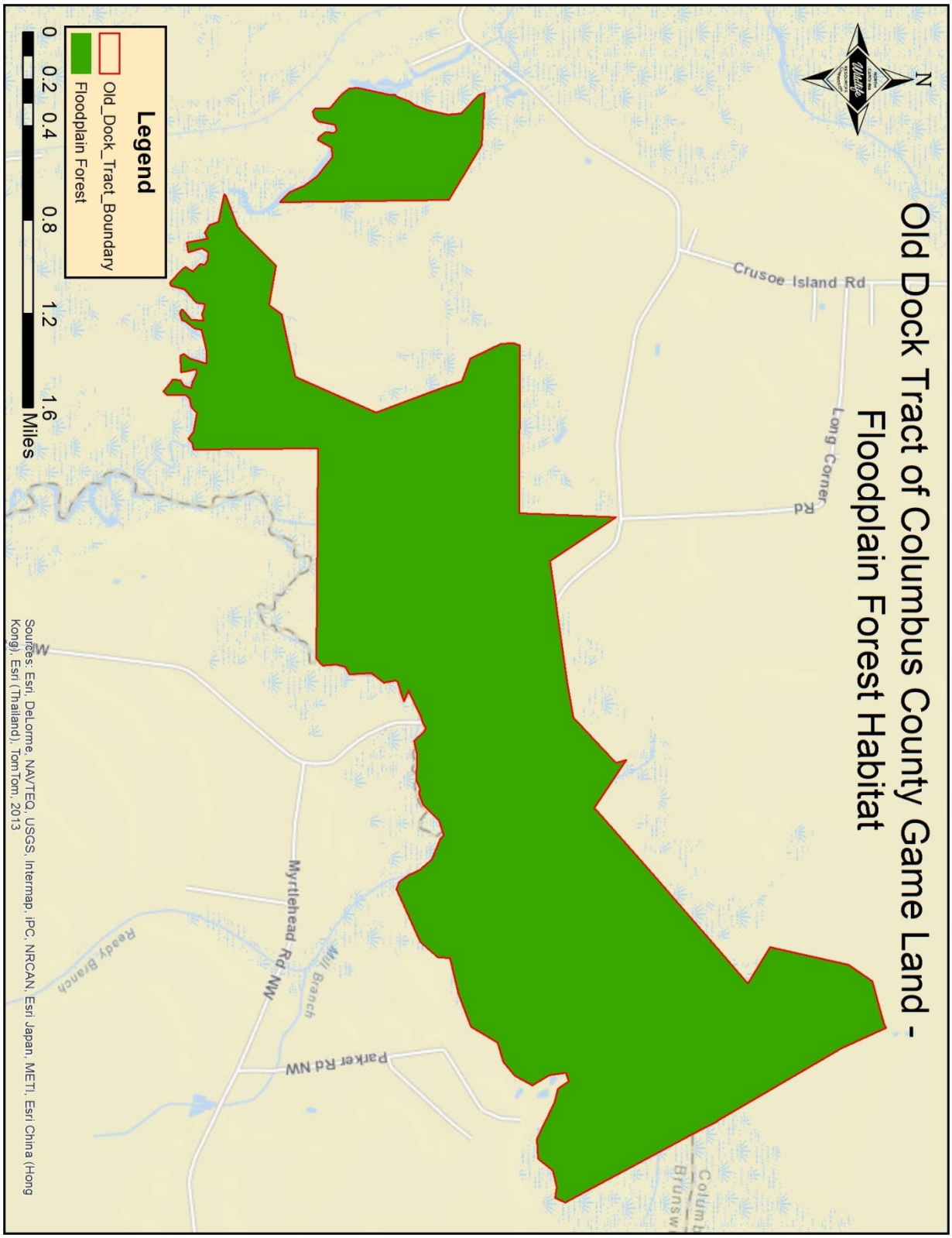
Factors that impact these systems include flooding regime patterns that have been changed by dams and other development, habitat fragmentation, changes in water chemistry and organic matter loads, increased nitrogen from agricultural and development-related runoff, exotic species and high-grading of stands and logging that reduces wide buffers. All of these factors individually or interactively produce abrupt or gradual changes in floodplain plant and wildlife communities. Schafale and Weakley (1990) stated that blackwater systems in the Coastal Plain have high sediment loads, which is a major problem.

Non-point source and point source pollution from a variety of human introduced activities has greatly increased in many drainages due to growing human population. Untreated storm water runoff from large cities and towns is a major problem that impacts both aquatic life and terrestrial wildlife associated with floodplain forests.

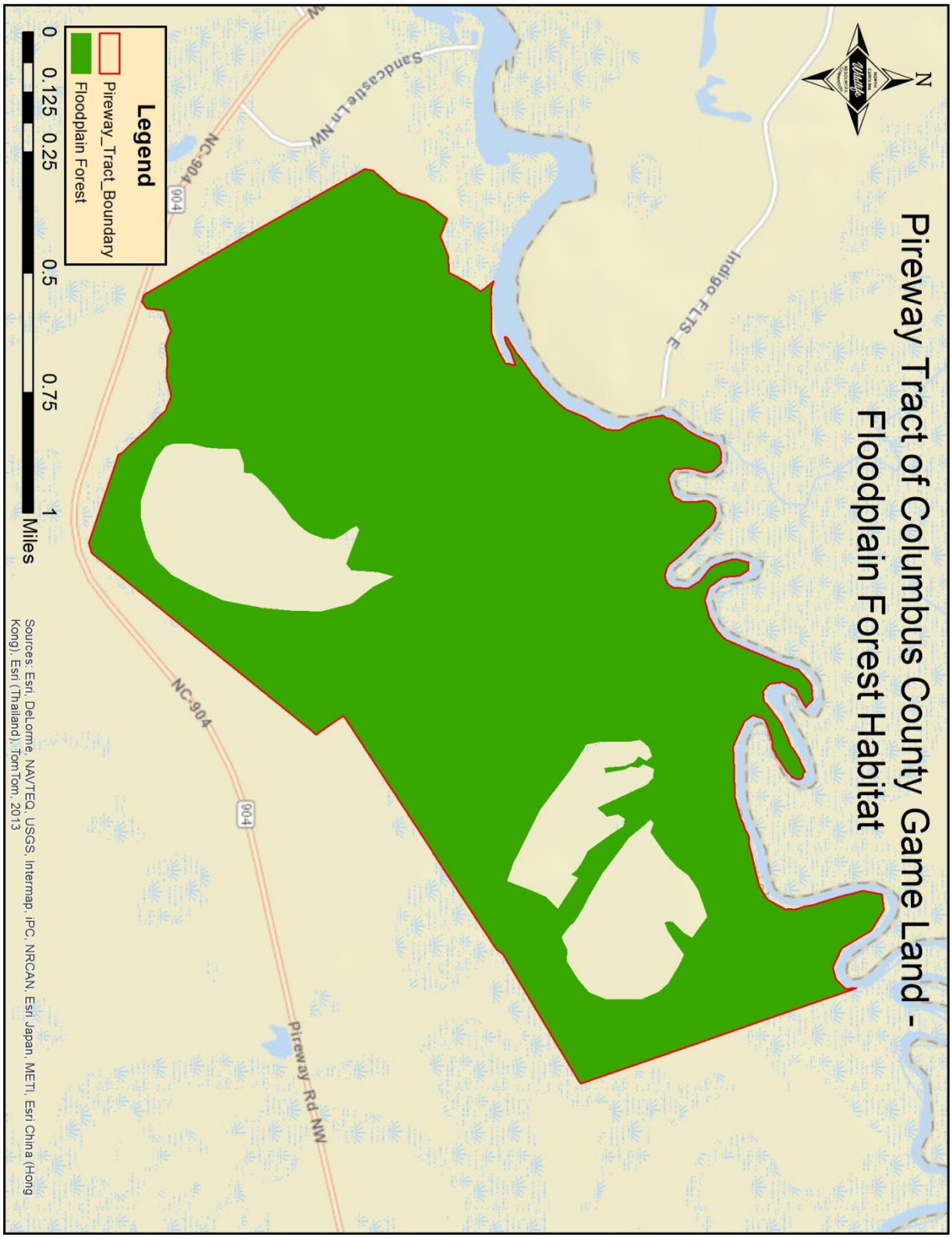
The vast majority of these habitats are unburnable because of wet fuels. Sites that are burned consist of transitional areas between upland sites and the wetter bottomlands and are areas included into active burn compartments.



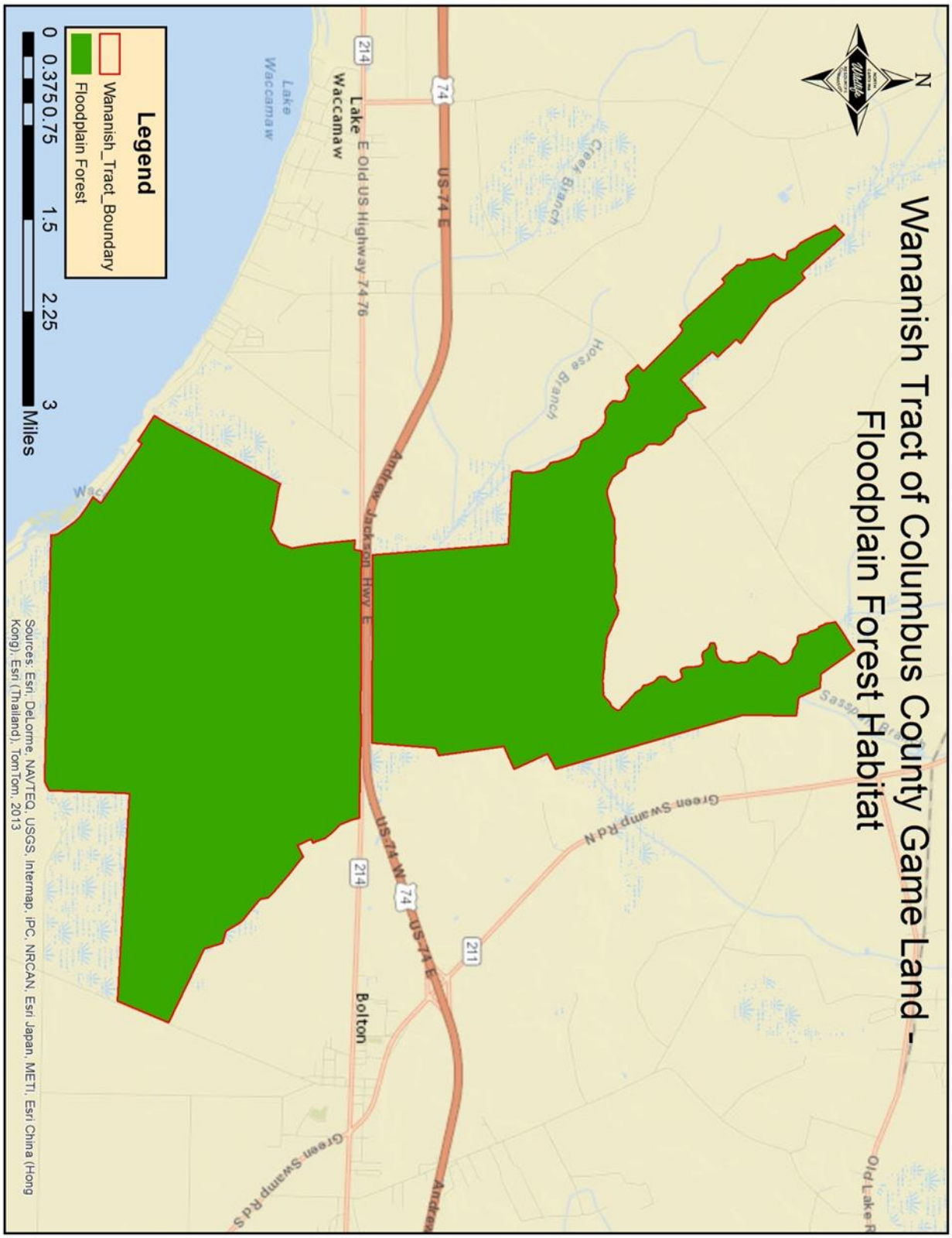
Map 21 – Floodplain forest habitat on Juniper Creek Game Land.



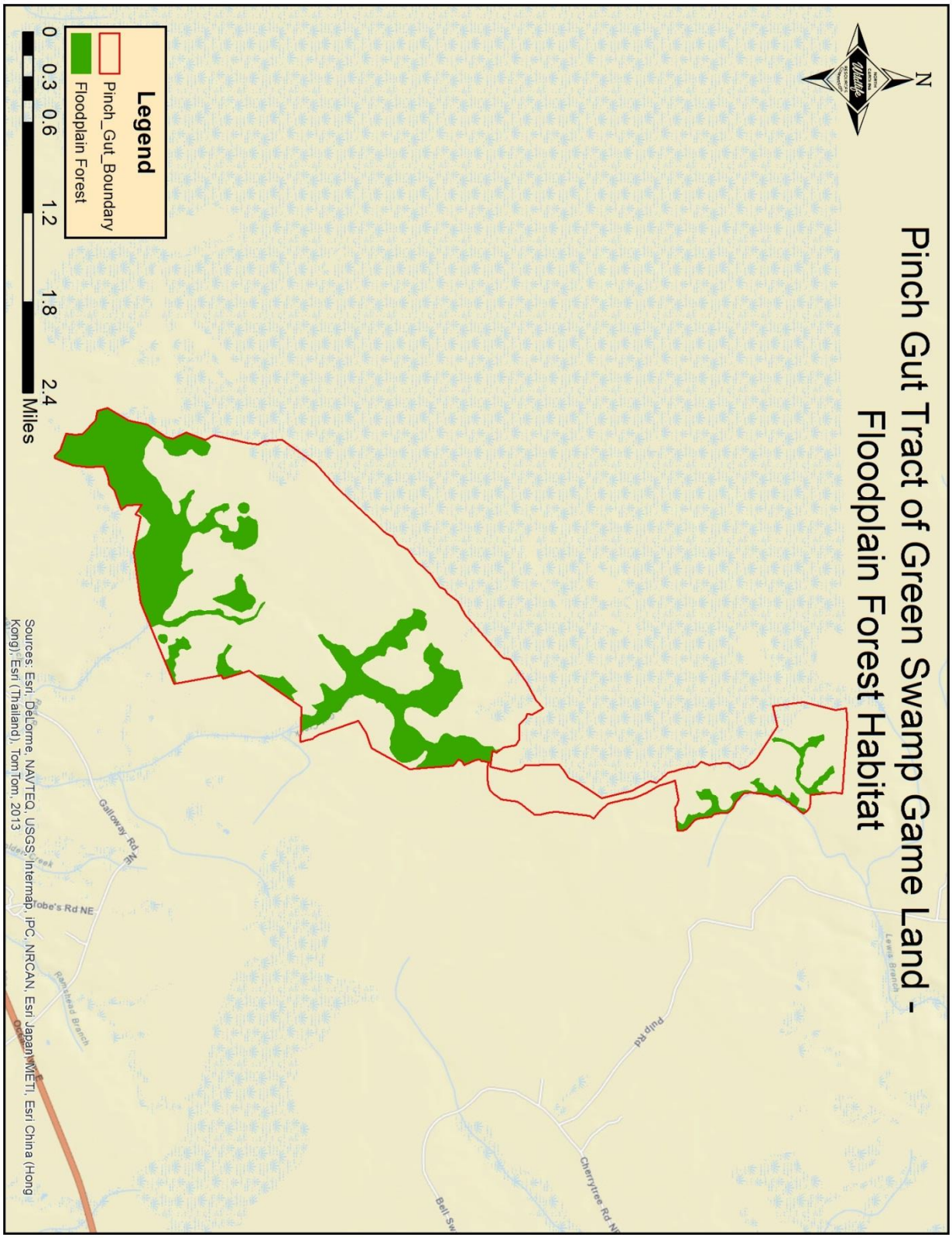
Map 22 – Floodplain forest habitat on the Old Dock Tract of Columbus County Game Land.



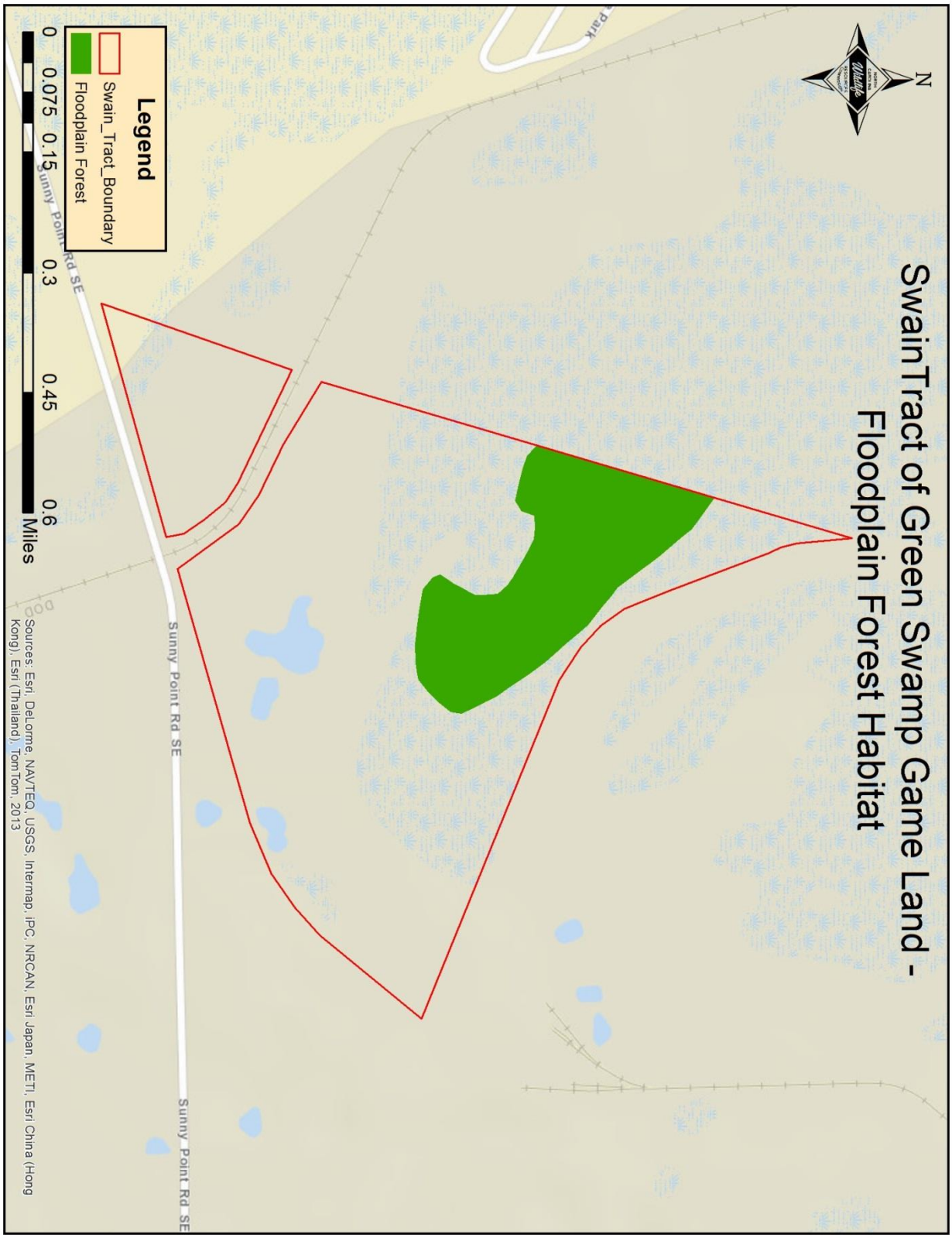
Map 23 – Floodplain forest habitat on the Pireway Tract of Columbus County Game Land.



Map 24 – Floodplain forest habitat on the Wananish Tract of Columbus County Game Land.



Map 25 – Floodplain forest habitat on the Pinch Gut Tract of Green Swamp Game Land.



Map 26 – Floodplain forest habitat on the Swain Tract of Green Swamp Game Land.

Priority non-game species associated with floodplain forest habitat

Taxonomic Group	Common Name	Scientific Name	State Status (Federal Status)	Natural Heritage Program State and Global Rank
Birds	Anhinga	*Anhinga anhinga*	SR	
Mammals	Star-nosed Mole	*Condylura cristata*	SC	S_2, G_5T_2Q
	Rafinesque's Big-eared Bat	*Corynorhinus rafinesquii*	T	S_3,$G_3G_4T_3$
Amphibians	Mabee's Salamander	*Ambystoma mabeei*	SR	S_2, G_4
	Dwarf Salamander	*Eurycea quadridigitata*	SC	S_2, G_5
	Four-toed Salamander	*Hemidactylium scutatum*	SC	S_3, G_5
Reptiles	Timber (Canebrake) Rattlesnake	*Crotalus horridus*	SC	S_3, G_4

Priority game species associated with floodplain forest habitat

Taxonomic Group	Common Name	Scientific Name
Birds	American Woodcock	*Scolopax minor*
	Wood Duck	*Aix sponsa*
	Hooded Merganser	*Lophodytes cucullatus*
	Eastern Wild Turkey	*Meleagris gallopavo silvestris*
Mammals	North American River Otter	*Lontra canadensis*
	American Beaver	*Castor canadensis*
	White-tailed Deer	*Odocoileus virginianus*
	American Black Bear	*Ursus americanus*
	Raccoon	*Procyon lotor*
	Bobcat	*Lynx rufus*
	Eastern Gray Squirrel	*Sciurus carolinensis*

B. Problems affecting species and habitat

Lack of old growth characteristics (canopy gaps, vine tangles, hollow trees, dead and downed woody debris) and fragmentation of stands are concerns for floodplain forest communities on these properties. A lack of standing dead or older trees has impacted the availability of quality bat and chimney swift roosting and breeding sites and nesting productivity for species such as wood duck and hooded merganser. Lack of downed woody material has impacted a variety of amphibians and reptiles.

Fragmentation of stands throughout the last century has contributed to the loss of intact, large riparian corridors and the width of many corridors has been greatly reduced. Breeding area-sensitive bottomland hardwood birds have likely been impacted by the loss of intact woodland systems. High-grading of stands has changed plant species diversity and stand vegetative structure. Forestry activities (e.g., logging) have reduced colonial waterbird and eagle nesting areas. Increases in amounts of non-native plants (e.g., privet, Japanese grass, Chinaberry, Japanese honeysuckle) and the overall loss of large canebreaks are partly due to the lack of infrequent fire and also certain logging practices. Understory vegetative diversity has declined in many areas due to modified flooding regimes and increases in invasive non-native plant species.

Drainage of wetlands has exacerbated the problems in and adjacent to floodplain forest habitats. This habitat loss impacts all floodplain species, including furbearers, breeding amphibians, overwintering birds, and migrant species that use these areas as stopover sites. Water quality is also an issue in certain major river drainages that negatively affects many invertebrates, fish, amphibians and reptiles.

C. Conservation actions necessary to conserve the species and habitat and priorities for implementation

Efforts should be made to retain mature floodplain forests which would provide large trees that could potentially contain natural cavities and provide food beneficial to wildlife. Large tracts of mature bottomland forests will naturally provide quality food and cover without human efforts.

One of the most important resources bottomland forests provide for wildlife is mast produced by mature trees. Production of hard mast from trees such as oaks and hickories, and soft mast from plants such as black gum and wild grapes can be increased by clearing small areas around individual trees and shrubs. This will reduce competition and increase vigor, resulting in greater mast production. Natural events such as tree falls and wind storms will create small disturbed openings where many plants that provide food for wildlife can thrive

There is a need to monitor floodplain forests for non-native plant and animal species such as nutria, Chinese privet, multiflora rose, Chinaberry and Japanese honeysuckle. Invasive plants are usually characterized by fast growth rates, high fruit production, rapid vegetative spread and efficient seed dispersal and germination. Not being native to North Carolina, they lack the natural predators and diseases which would naturally control them in their native habitats. The rapid growth and reproduction of invasive plants allows them to overwhelm and displace existing vegetation and, in some cases, form dense one-species stands. Invasive exotic plants and animals disrupt the ecology of natural ecosystems, displace native plant and animal species, and degrade biological resources. Aggressive invaders reduce the amount of light, water, nutrients and space available to native species.

To control invasion of these habitats by non-native species, efforts should be made to prevent accidental introductions, eradicate existing infestations, and minimized disturbance to these habitats.

D. Desired future condition

The desired future condition of floodplain forests on properties within the Brunswick and Columbus County Game Land Complex is to allow them to grow to maturity and contain old growth characteristics. This includes cavity trees located throughout the stands for cavity nesting birds and dens for mammals, dead and stressed trees throughout the stand for future cavities and structure for insect foraging birds, vines that provide foraging habitat for songbirds, and coarse debris (10 inches in diameter or greater) on the ground to provide den sites and habitat for invertebrates, amphibians and reptiles.

Buffers of 300-600 feet will be maintained along streams and their adjacent wetlands, floodplain, and slopes. Buffer width will be adjusted to include contiguous, sensitive areas such as slopes or erodible soils where disturbance may adversely affect water quality, streams, wetlands, or other water bodies.

E. Future forest management

To reach the desired future condition of mature stands with old growth characteristics, no timber harvests will occur in floodplain forests on these properties. Where a floodplain forest occurs within a burn compartment, prescribed fire will be allowed to run through the stand. If invasive plant species become a problem and prescribed fire does not prove to be an effective method of control, mechanical and/or chemical controls may be employed to remove the invasive species.

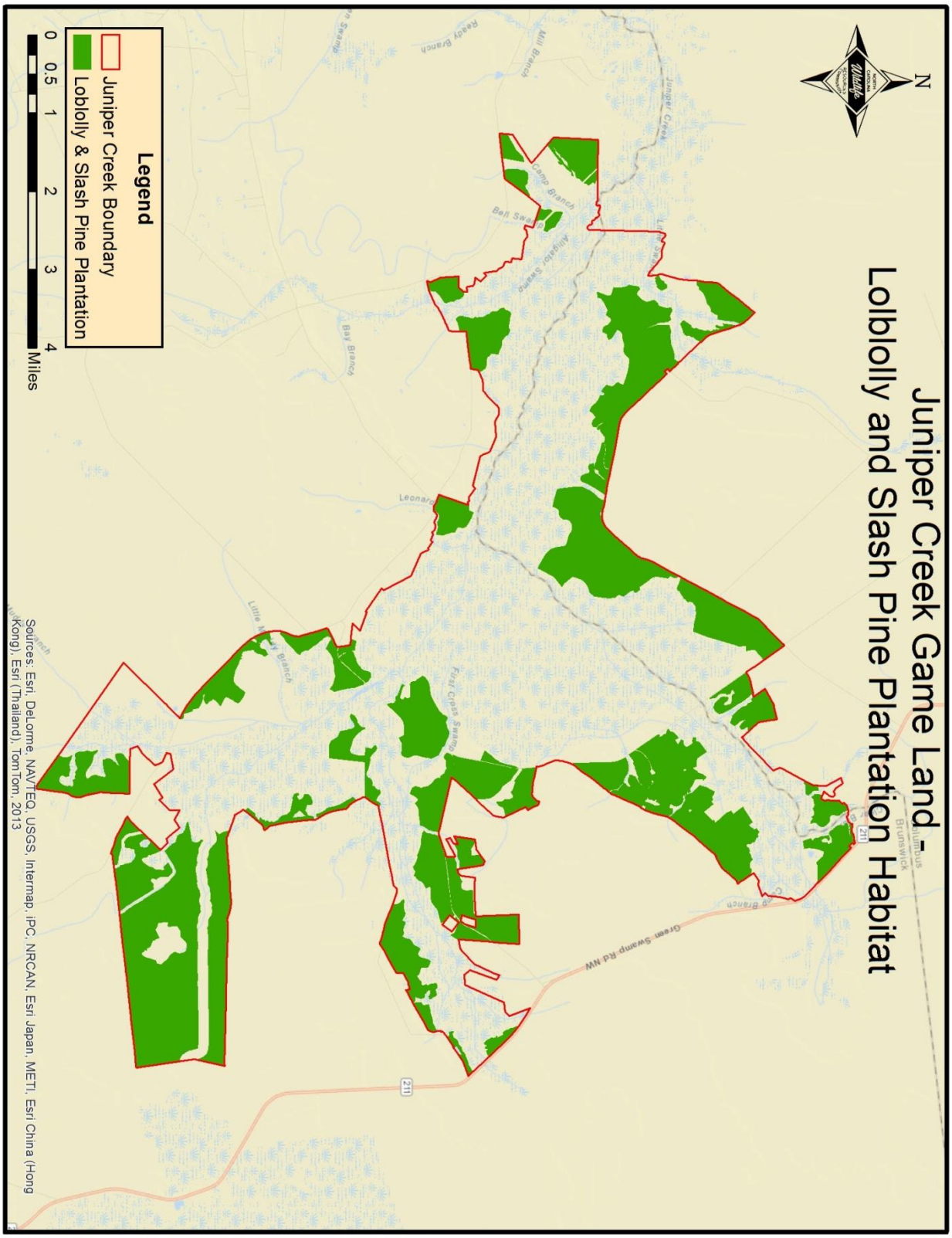
Loblolly and Slash Pine Plantations

This cover type consists of loblolly and slash pine. The understory and midstory in these areas ranges from dense growing pocosin shrubs (e.g., wax myrtle, fetterbush, and titi) and hardwood tree species (e.g., oaks, hickories, sweetgum or red maple) to bare ground or pine straw. Midstory and understory species composition and structural diversity in plantations are influenced by soil type, fire regime, and the amount of sunlight reaching the forest floor. This in turn determines the wildlife species present at various stages in the history of the stands.

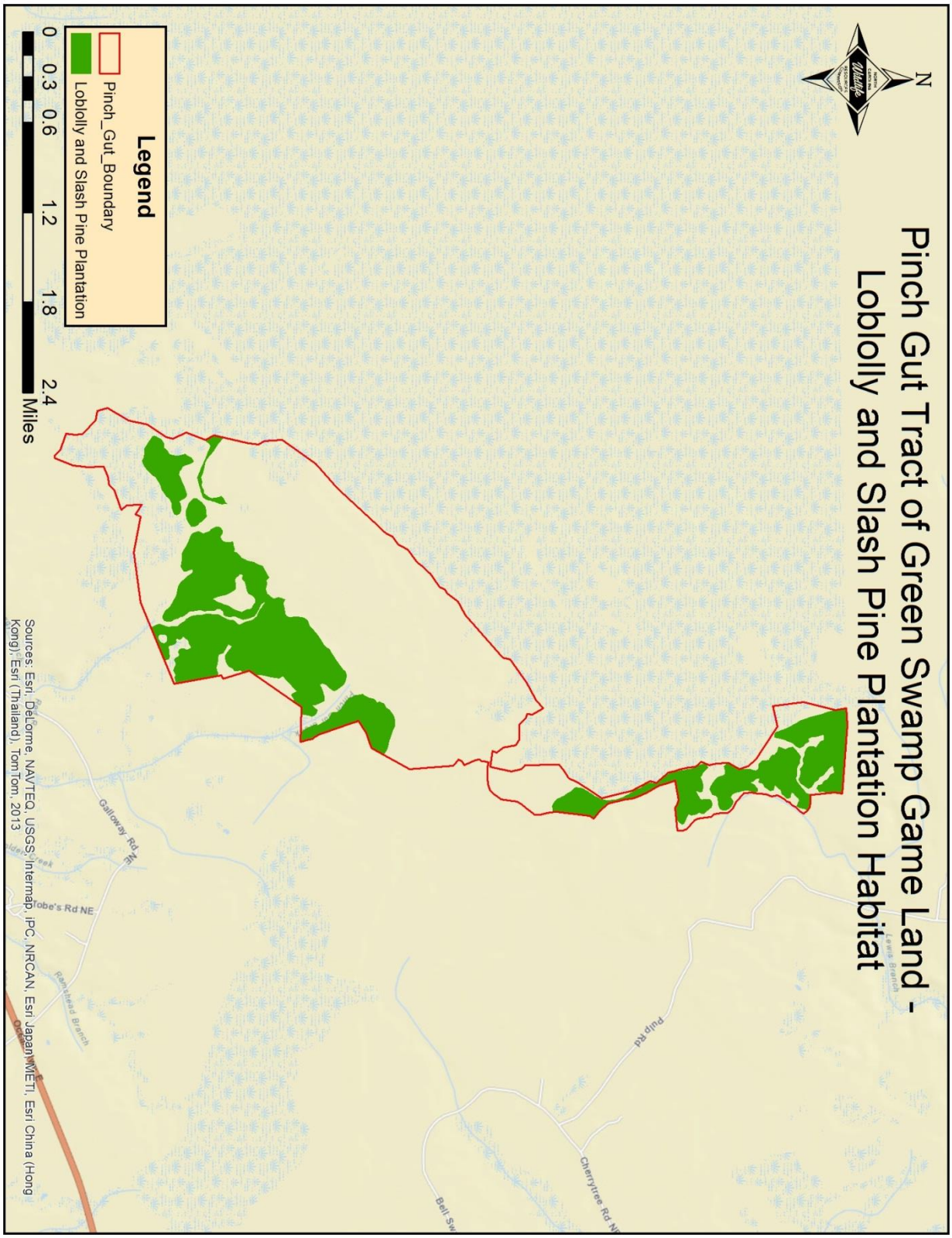
A. Location and current condition of habitat (see Maps 27 – 29)

This cover type consists of 6,456 acres, which makes up 22% of the total cover of these game lands. Juniper Creek Game Land has 5,779 of these acres while Columbus County Game Land has 97 acres, and Green Swamp Game Land has 580 acres of this cover type. The vast majority of this cover type is found on Juniper Creek Game Land. Under previous ownership, this cover type was managed for maximum timber production, which was the justification for planting off-site species of loblolly and slash pine on historical longleaf sites and the drainage of wetter sites. Consequently, many stands in this habitat still consist of these off-site species and were heavily stocked upon acquisition. Since acquisition by the NCWRC, many stands have been thinned. Since 2009, 120 acres have been clearcut and restored to longleaf pine. Furthermore, these habitats were guarded from fire for a significant time, which greatly impacted the diversity and structure of other vegetation within them. Many of the plantations have been incorporated into active burn units with permanent fire breaks in place. These prescribed burning activities have resulted in improvements to the condition of this habitat. Thinnings and burning have created and maintained an open canopy in many of the stands and the condition of this habitat continues to improve with continued use of these management techniques.

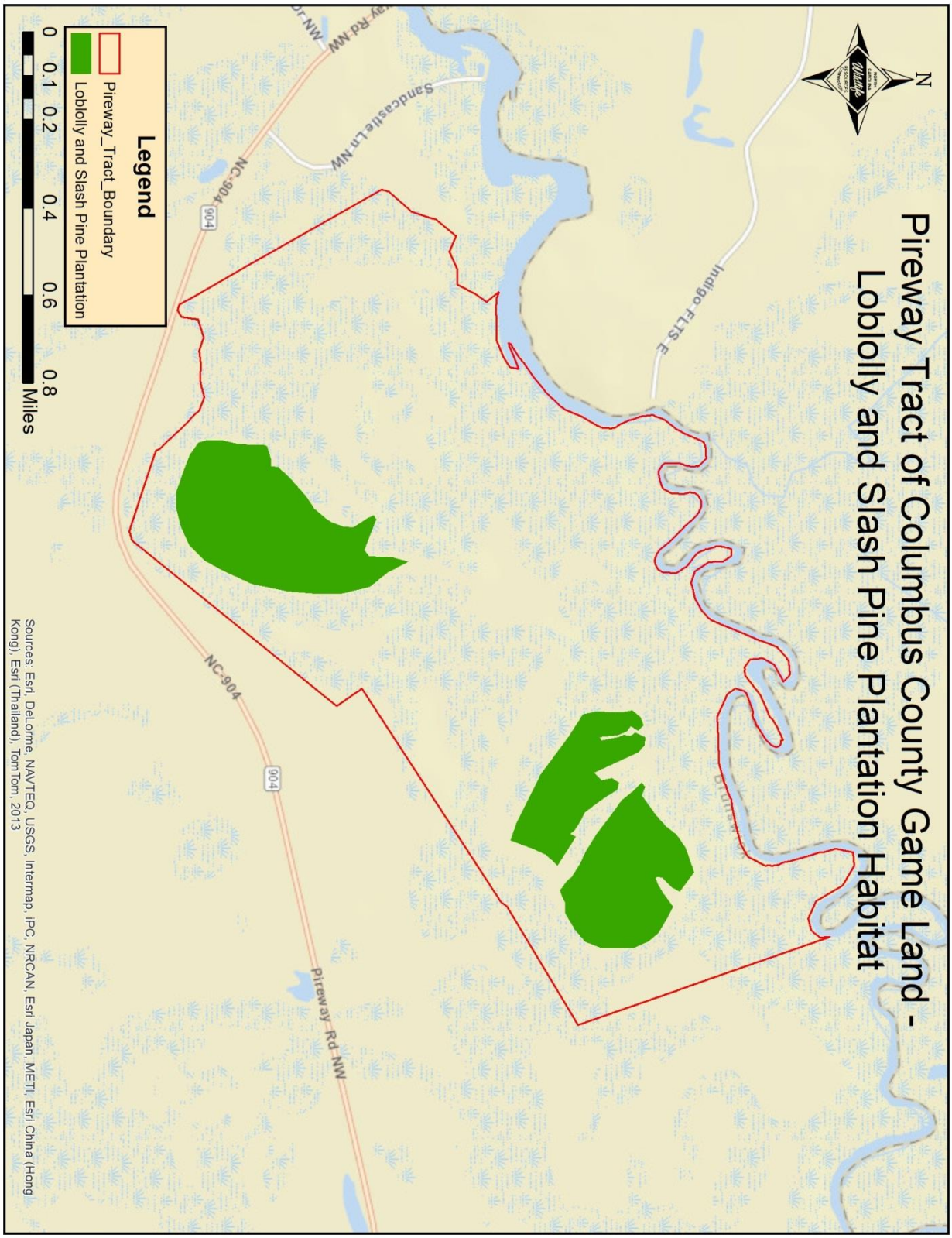
Diversity in plant species composition and the configuration of vertical layers and horizontal patterns of vegetation define the differences between naturally regenerating stands and plantations (Allen et al. 1996). From stand initiation to final harvest, plantation forestry provides habitat for early successional species, pine specialist, and some forest species for short periods of time. Plantations provide habitat for edge- and grassland-dependent species during the initial years following establishment (Stauffer et al. 1990, Allen et al. 1996). On the game lands within this complex that have plantations, there are stands in different stages of rotation, creating what could be considered an uneven-aged forest. With uneven-aged forests, the mosaic created by clearcut stands interspersed through stands of older trees creates a diverse environment that provides habitat for a variety of wildlife.



Map 27 – Loblolly and Slash Pine Plantation habitat on Juniper Creek Game Land.



Map 28 – Loblolly and Slash Pine Plantation habitat on the Pinch Gut Tract of Green Swamp Game Land.



Map 29 – Loblolly and Slash Pine Plantation habitat on the Pireway Tract of Columbus County Game Land.

Priority non-game species associated with loblolly and slash pine plantations

Taxonomic Group	Common Name	Scientific Name	State Status (Federal Status)	Natural Heritage Program State and Global Rank
Birds	Cooper's Hawk	Accipiter cooperii	SC	S_3S_4B, S_4N, G_5
	Bachman's Sparrow	Peucaea aestivalis	SC	S_3B, S_2N, G_3
Reptiles	Timber Rattlesnake	Crotalus horridus	SC	S_3, G_4
	Pigmy Rattlesnake	Sistrurus miliarius	SC	S_3, G_5

Priority game species associated with loblolly and slash pine plantations

Taxonomic Group	Common Name	Scientific Name
Birds	Eastern Wild Turkey	Meleagris gallopavo silvestris
	Northern Bobwhite Quail	Colinus virginianus
	Mourning Dove	Zenaida macroura
Mammals	American Black Bear	Ursus americanus
	White-tailed Deer	Odocoileus virginianus
	Eastern Fox Squirrel	Sciurus niger
	Eastern Gray Squirrel	Sciurus carolinensis

B. Problems affecting species and habitats

Besides the obvious conversion of these stands to off-site species of loblolly and slash pine, fire suppression prior to NCWRC ownership is the greatest problem affecting the condition of this habitat. This has caused some stands to consist of a dominant midstory of hardwoods, increased heavy fuel loads, inhibited the growth of grasses and forbs on the forest floor, and decreased the occurrence of rare and endangered species. Most of the understory grass, forb, and shrub layers are lost when the canopy of a newly planted timber stand closes, typically 7-15 years after planting. The forest canopy is one of the foremost determinants of the microhabitat within a forest. It affects plant growth and survival, hence determining the nature of the vegetation, and wildlife habitat (Jennings et al. 1999).

Because tracts of land within this Complex that have this cover type were recently acquired, only 11 % (710 acres) have seen the reintroduction fire. Only 2.2% (139 acres) of loblolly and slash pine plantations have been burned more than once and have a fire return interval of 3 years. The remaining 8.8 % (571 acres) have been burned once. Due to heavy fuel loads created by the lack of periodic fires, heavily stocked stands with abundant ladder fuels, , and untimely and unfavorable weather, game land managers have struggled to reintroduce fire to significant acreage of this cover type. Additionally, managers have delayed burning stands until they have been thinned and had adequate time to recover from the stresses of these timber operations. Furthermore, managers face the challenge of keeping stands on other game lands in their existing and active burn rotations while continuing to add new stands into the prescribed burning program.

While some of these stands have been thinned enough to provide an open canopy and others have been restored to longleaf pine, many stands continue to have high tree densities and the understory vegetation is dominated by tall ericaceous shrubs and hardwood tree species. Of the 6,456 acres of loblolly and slash pine plantation on these properties, 1,107 acres have been thinned and 120 have been clear cut. Additionally, fire has only been reintroduced into these stands over the last 8 years but had been suppressed for decades before its reintroduction. These intensively managed pine plantations lack age diversity within the stands and few stands will reach maturity within the ten year planning horizon.

Long-term damage from extensive site preparation and drainage of some of these sites pose problems to this habitat as well. Because poorly drained soils with high seasonal water tables greatly affected survival and growth of planted seedlings, drainage by previous owners was conducted to improve soil trafficability for harvesting and planting operations and to reduce stress on planted trees caused by excessive soil water conditions. Furthermore, these techniques have affected the hydrology of these sites in the form of altering outflow rates, evapotransporation, and reduction of water table elevations.

These intensive site preparation techniques can also affect soil quality in many ways. Powers et al. (1990) cited that intensive site preparation can lead to soil nutrient loss, organic matter removal, and the alteration of soil structure and site hydrology. Childs et al. (1989) cited compaction, surface soil mixing and displacement, and soil removal as being serious threats to the physical quality of forest soils as well.

C. Conservation actions necessary to conserve the species and habitat and priorities for implementation

Unlike nearly all other forest types mentioned in this Plan, the loblolly/slash pine forest is mostly non-natural. Therefore, there is a need to return acreage in this cover type to natural communities, most notably longleaf pine communities where soils are appropriate, in turn decreasing the overall acres of loblolly and slash plantations. Restoring site-appropriate stands back to dry longleaf communities should be the primary goal of this cover type.

In order to accomplish this goal, loblolly and slash pine overstories should be removed and regenerated to longleaf pine using the most appropriate silvicultural technique to the site. Once longleaf is established, it should be managed in uneven-aged stands using selection cuts in the same manner as current longleaf stands on this game land.

Additional older aged pine acreage is needed. Therefore, on sites with soils not conducive to longleaf restoration, pine stands should be managed on long rotation (e.g., 60-100+ years) or in uneven-aged stands. Where appropriate, forest management techniques should be used to mimic the characteristics of older stands, which include canopy gaps, dead and downed material, and the retention of cavity trees. Basal areas should be maintained at levels that allow for an herbaceous understory, i.e., 40-60 ft^2/acre. When available, mature hardwood trees should be retained and released during harvest operations.

Equally high in priority is for this cover type is the restoration and continued implementation of a natural fire regime, regardless of the overstory pine species. This will involve working towards resolving smoke management issues, negative public sentiment, and liability concerns associated with prescribed burning. Restoration of natural fire frequency, intensity, and seasonality is critical for pine-related reptiles, amphibians, and their prey (Bailey et al. 2004), as well as other pine-related wildlife.

The upland forested areas on properties within the Brunswick and Columbus County Game Land Complex will continue to be managed for open canopies to allow sunlight to reach the forest floor. This will be accomplished through thinning of pine stands and conversion of slash and loblolly pine plantations to longleaf pine where appropriate. Stands with hardwood dominated midstories will be controlled on a site-specific basis. Prescribed fire will be the primary tool to prevent hardwoods from dominating the midstory and causing canopy closure. When and if fire proves to be ineffective at accomplishing this goal, herbicide or mechanical removal will be considered for a midstory treatment. Prescribed fire will also be used to maintain, restore, and improve existing native vegetation.

Cooperative efforts related to management activities need to continue and expand with largescale "commercial" forest landowners to continue to try and improve habitat conditions at the landscape and stand level for a variety of wildlife species (Measells et al. 2002). Additionally, continued cooperative efforts with red-cockaded woodpecker working groups (for translocation, or to manage the Sandhills and coastal populations of red-cockaded woodpeckers) is needed.

D. Desired future conditions

The desired future condition for this habitat type is restored, site-suitable vegetation communities with a primary emphasis on the longleaf pine/wiregrass ecosystem and a 3-year fire return interval.

Due to the young age of the majority of the plantations on properties within the Brunswick and Columbus County Game Land Complex (the average plantation age is 28 years), our first goal within the ten year planning horizon is to restore 5%, or approximately 325 acres, to longleaf pine. We will consider an acre "restored" once longleaf has been planted. We plan to achieve this goal utilizing the following timber management practices. See Future Forest Management below for planned restoration strategies. Once longleaf is established it will be managed as dry or wet pine savanna, depending on soil and site conditions.

Our second goal is to maintain an average fire return interval of 3 years. It is our thought that with continued application of prescribed fire and the continued growth of timber within these young stands, we will be able to accomplish management objectives with a 3 year burning cycle. Older, larger trees will produce more fine fuels to carry fire throughout the burn compartments and the grassy and herbaceous ground cover should improve and be less sparse, hence further improving the ability to carry fire throughout the stand. Burning of these compartments will be accomplished with the use of existing natural and engineered fire breaks. The 3 year fire return interval will continue to restore the understory component, which will facilitate conversion to longleaf savanna cover type.

E. Future forest management

Where soil types are appropriate, plantations of loblolly and slash pine will be converted to longleaf pine/wire grass communities. Stand age, stocking, site index, soil type, and spatial orientation will determine when and how appropriate stands are converted to longleaf pine. Silvicultural techniques for conversion will include row thinning, selection harvest, and clear-cutting. Some stands may be thinned to a low basal area (20-30 ft^2/acre) and underplanted with longleaf pine. Specific timber harvest prescriptions will be made in the annual forest management plans.

During harvest operations, attempts will be made to establish permanent locations for loading decks and primary skid trails that will facilitate the continuous entries required for selection harvests and uneven-aged management. All harvest operations will follow North Carolina Forestry Best Management Practices for soil and water quality.

Once the final harvest of loblolly or slash pine has been made, containerized longleaf plugs will be planted with a spacing that allows for multiple future wildlife management options (i.e., >500 trees per acre). Mechanical site preparation practices (e.g., v-sheering, bedding) will be avoided for longleaf restoration sites to minimize disturbance of native ground cover. Native understory plantings will be considered following timber harvests in areas lacking native understory or a substantial native seed-bank.

While stands are growing to an age appropriate for harvest and conversion, basal areas will be maintained at 50 - 80 ft^2/acre. When stands become overstocked and basal areas are too high, they will be commercially thinned. This will maintain an open canopy and promote a vigorous understory.

Dry Longleaf Pine

Different subtypes often grade into each other or occur as a mosaic on the landscape. Frequent fire maintains a canopy dominated by longleaf pine, an open midstory, and an understory dominated by wiregrass or other grasses and forbs. Subtypes occurring on this property are the Mesic Pine Flatwood and Xeric Sandhill Scrub communities.

Mesic Pine Flatwood sites occur on mesic (non-wetland) sites and have a closed to open canopy of longleaf pine occasionally mixed with loblolly pine (Schafale and Weakley 1990). The low shrub layer can be dense and the herb layer is dominated by wiregrass in frequently burned areas. These communities historically experienced frequent low to moderate intensity fires that maintained a rather open canopy, open to sparse shrub layer, and thick diverse herb layer (Schafale and Weakley 1990).

Xeric Sandhill Scrub sites occur on deep sand ridges and swale systems, which include Carolina bay rims and sandy uplands of the southern Coastal Plain. Longleaf pine dominates the open canopy with open to dense understory of turkey oak. Most of these communities naturally experienced frequent low intensity fires with the peak fire season thought to be in early summer (Schafale and Weakly 1990).

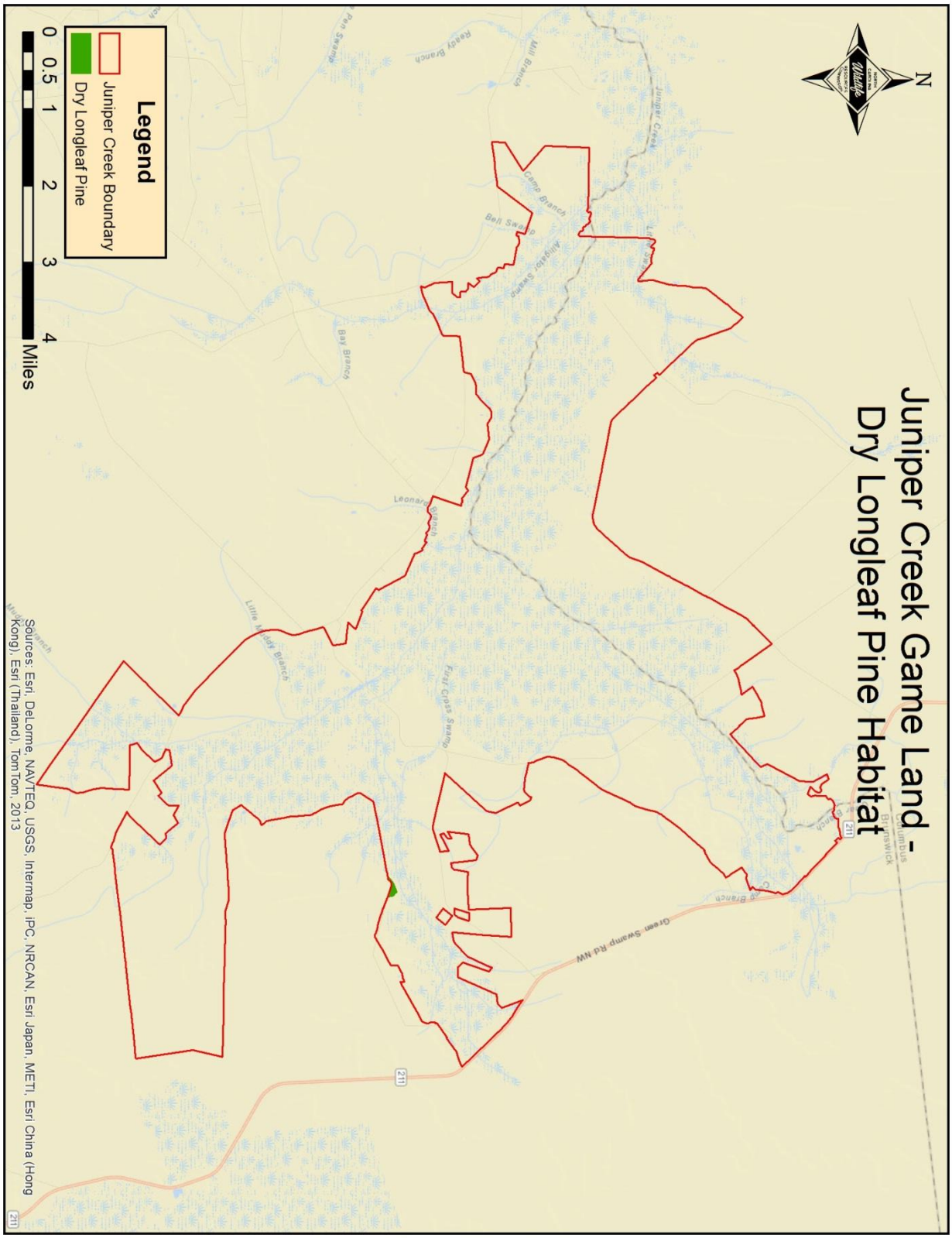
When fire is absent or infrequent in these communities, scrub oaks, other hardwoods, and shrubs become common in the midstory and shade out native grasses and forbs. The historical expanse of longleaf pine habitats likely supported stable populations of many early seral species without the understory of a mature or old growth pine forest. Longleaf pine is a very long lived species, so the old growth component of this habitat type was very significant.

A. Location and current condition of habitat (see Maps 30 - 31)

Approximately 270 acres of dry longleaf pine communities occur on the Brunswick and Columbus County Game Land Complex, and comprises less than 1% of the property. 263 acres are found on the Pinch Gut Tract of Green Swamp Game Land and the remaining 7 acres is found on Juniper Creek Game Land. The sandy rims and upland sites were historically dominated by this cover type but land conversion and fire suppression has drastically changed vegetative composition of these sites on this property. Most of these sites were converted to loblolly and slash pine plantations while others were heavily harvested and never reforested.

Since these properties were purchased by the NCWRC, 120 acres of loblolly and slash pine stands were clearcut and converted back to native longleaf pine. Heavily harvested longleaf sites hold remnant patches of longleaf pines and have been established as active burn compartments but oak-dominated midstories are clear evidence of the lack of fire.

The 7 acres of the cover type found on Juniper Creek Game Land has been burned twice since the property was acquired in 2007 and has a fire return interval of 3 years. The remaining 263 acres on the Pinch Gut Tract of Green Swamp Game Land has just recently been burned for the first time in 2014.



Map 30 – Dry longleaf pine habitat on Juniper Creek Game Land.

Map 31 – Dry longleaf pine habitat on the Pinch Gut Tract of Green Swamp Game Land.

Priority non-game species associated with dry longleaf pine habitat

Taxonomic Group	Common Name	Scientific Name	State Status (Federal Status)	Natural Heritage Program State and Global Rank
Birds	Bachman's sparrow	*Aimophila aestivalis*	SC	S_3B, S_2N, G_3
Amphibians	Oak toad	*Bufo quercicus*	SR	S_3G_5
	Ornate Chorus Frog	*Pseudacris ornata*	SR	S_3G_5
	Carolina gopher frog	*Rana capito*	T	S_2, G_5T_2Q
Reptiles	Timber(canebrake) rattlesnake	*Crotalus horridus*	SC	S_3G_4
	Pigmy rattle snake	*Sistrurus miliarius*	SC	S_3G_5

Priority game species associated with dry longleaf pine habitat

Taxonomic Group	Common Name	Scientific Name
Birds	Northern Bobwhite Quail	*Colinus virginianus*
	Eastern Wild Turkey	*Meleagris gallopavo silvestris*
	Mourning Dove	*Zenaida macroura*
Mammals	White-tailed Deer	*Odocoileus virginianus*
	Eastern Fox Squirrel	*Sciurus niger*

B. Problems affecting species and habitat

Mature dry longleaf pine habitat is only found in one isolated patch on Juniper Creek Game Land and is small in acreage. Though historically dispersed across this region of the State in a mosaic with other communities, mature stands of this cover type are scattered. There are potentially several hundred acres in the plantation cover type on these appropriate for conversion to dry longleaf pine habitat.

The potential for dominant hardwood midstories found in these stands poses additional problems and threats to these habitats. However, prescribed burning activities set to take place in the ten year planning horizon will assist in reducing and/or maintaining this component. Ground cover in these stands ranges from fair to poor. The lack of fire prior to ownership by the NCWRC has posed challenges and problems in ground cover restoration efforts.

All of these areas have been incorporated into active burn compartments but it will take the continued application of prescribed fire over many years to negate the impacts of fire suppression in the years prior to NCWRC ownership.

Finally, loblolly pine is a prolific annual seeder and seedlings initiate height growth immediately. Loblolly regeneration will be a significant competitor in young longleaf stands and will have to be aggressively dealt with.

C. Conservation actions necessary to conserve the species and habitat, and priorities for implementation

The highest conservation priority for this cover type is to incorporate unburned stands into active burn compartments. Frequent prescribed fire is an essential part of longleaf pine ecosystem restoration and management. Although the lack of prescribed fire in some stands is directly related to the vulnerability of young trees, other stands have not been burned because of challenges previously stated. Great effort should be made to overcome these challenges. Creation of permanent fire breaks is imperative. Methods to overcome smoke management issues will be critical in implementing a prescribed fire regime on these stands. Manpower needs should be identified and efforts should be made to ensure that help is available.

Another conservation priority in this cover type is to increase the age structure distribution. Essentially, this will involve removing acres of loblolly and slash pine plantation and planting longleaf pine on sites with appropriate soil types. During the establishment phase of the conversion process, emphasis should be placed on retaining species diversity of the herbaceous groundcover and suppression of competing loblolly pine regeneration. Subsequently, maintaining or increasing the ability to apply frequent prescribed fire will also be a top priority.

Maintaining a diverse vertical structure with older, large diameter trees across the landscape should also be a priority during the conversion process. This will need to be balanced with the competition that mature loblolly and slash pine trees will present in longleaf plantings in the form of shading and regeneration.

Preservation of additional elements of older forests like coarse woody debris and large diameter snags should also be a priority while establishing new acres in this cover type.

Prescribed growing season fire needs to increase in these systems and midstory reduction and maintenance is essential.

D. Desired future condition

The desired future condition for this cover type is an open savanna with an uneven-aged longleaf canopy, an open midstory, and a diverse herbaceous groundcover. Frequent prescribed fire will be the primary method used to promote and maintain desirable species/community associations. These fires will suppress hardwoods; however, a minor oak component in the midstory is a natural condition and is beneficial to wildlife. When and if fire proves to be ineffective at accomplishing this goal, herbicide or mechanical removal will be considered for a midstory treatment. Prescribed fire will also be used to maintain, restore, and improve existing native herbaceous vegetation.

As previously stated, increasing this cover type on the landscape is a high conservation priority. Therefore, our goal for the 10-year planning horizon will be to add 250 acres of dry longleaf pine communities to the Brunswick and Columbus County Game Land Complex through conversion of loblolly and slash plantation. We will consider an acre converted once longleaf has been planted.

E. Future forest management

Silvicultural techniques for conversion will include selection harvest, patch clearcutting, and clearcutting. Stand age, stocking, site index, soil type, and spatial orientation will determine when and how loblolly and slash pine plantations are converted to longleaf pine. Specific timber harvest prescriptions will be made in the annual forest management plans developed each year.

Once the final harvest of loblolly or slash pine has been made, containerized longleaf plugs will be planted with a spacing that allows for multiple future wildlife management options.

Herbaceous plantings will be considered following timber harvests in areas lacking native understory or a substantial native seed-bank.

All new longleaf plantings will be managed towards a perpetual, uneven-aged forest. Row thinning may be used for initial entries and selection harvests will be used once mature age classes have been reached. Initial placement of primary skidding trails and loading decks will be made with long term harvest operations in mind and will allow for future entries. All operations will follow North Carolina Forestry Best Management Practices for soil and water resources.

Wet Pine Savanna

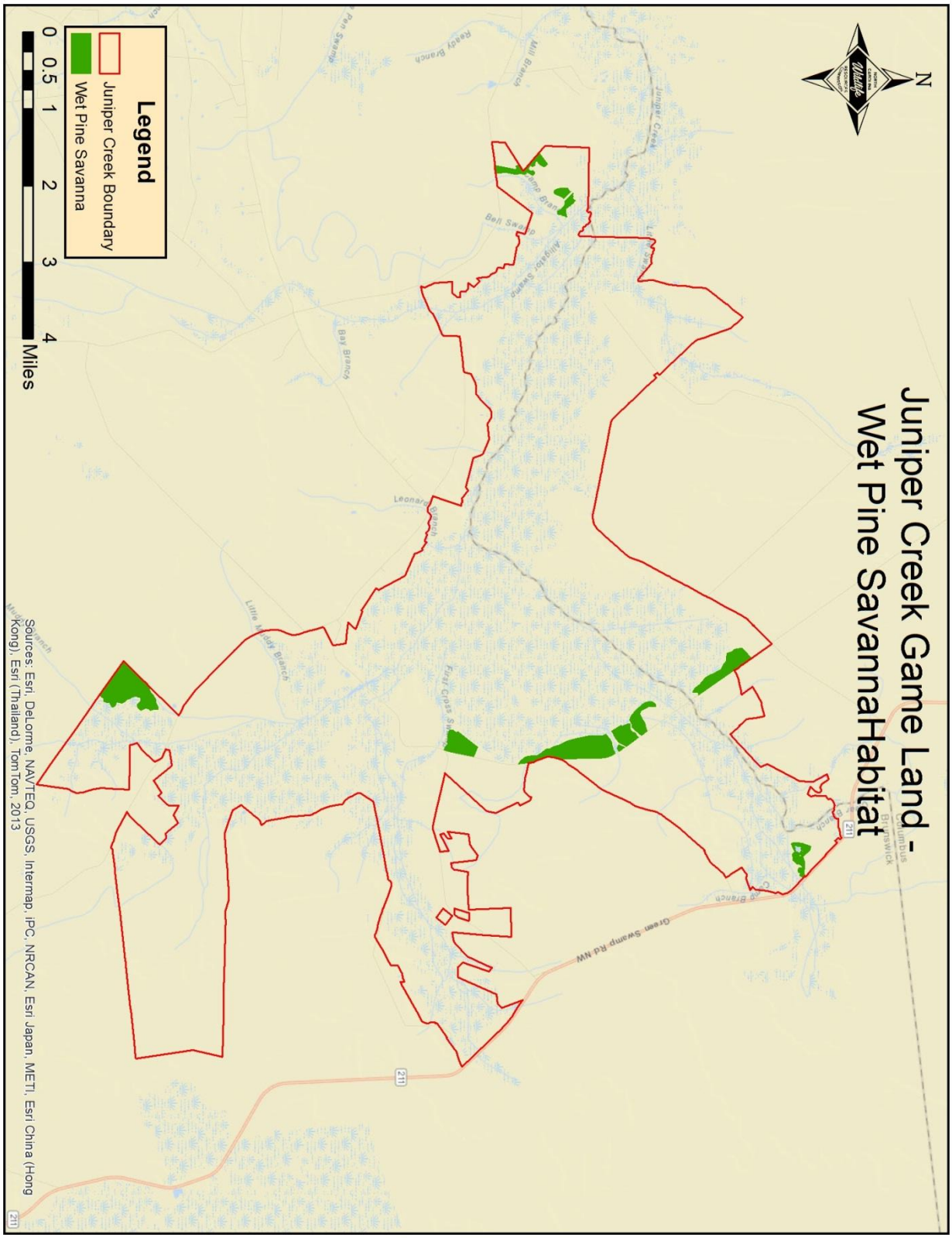
This habitat type includes pine savanna communities which are mineral wetlands that under natural conditions are subject to frequent burning (Schafale and Weakley 1990). With fire, they are characterized by an open canopy dominated by longleaf pine or pond pine, an open midstory, and an understory comprised of some mixture of wiregrass, cane, herbs, and pocosin shrubs depending on soil moisture and fire frequency. Some of the herbaceous plant diversity in these systems, particularly in pine savannas, is the highest in temperate North America if burned on a consistent and frequent basis. When fire is suppressed, a dense shrub understory develops and herb diversity declines drastically. These pine communities are similar to dry longleaf pine communities in that they often grade into each other and can occur as a mosaic on the landscape. They may also grade into pond pine woodlands and pocosins.

A. Location and condition of habitat (see Map 32)

There are approximately 431 acres (1.5%) of wet pine savanna on the Brunswick and Columbus County Game Land Complex and all sites occur on Juniper Creek Game Land. The condition of these communities has been greatly reduced due to fire suppression. In the absence of fire, herb diversity and density greatly decline as shrubs present in the understory or surrounding habitat quickly invade and attain dominance.

Wet pine savannas on Juniper Creek Game Land are only found in seven isolated patches across the property. These sites occur on wet, flat areas and on low "islands" surrounded by floodplain forest habitat. Four of these sites are recently established since NCWRC acquisition. The fire frequency on the other three sites is unknown but groundcover habitat was marginal upon acquisition. However, with the reintroduction of prescribed fire, their condition has improved.

Two stands along Tram and Camp Branch Roads (198 acres) had loblolly and slash pines. These areas contain mature trees and were thinned in 2014, which resulted in the removal of loblolly and slash pines. These actions coupled with burning have improved the quality of these habitats by opening canopies, reducing midstories, and stimulating the growth of herbaceous ground cover.



Map 32 – Wet pine savanna habitat on Juniper Creek Game Land.

Priority non-game species associated with wet pine savanna

Taxonomic Group	Common Name	Scientific Name	NC Status (Federal Status)	Natural Heritage Program State and Global Rank
Birds	Bachman's sparrow	*Aimophila aestivalis*	SC	S_3B, S_2N, G_3
Amphibians	Mabee's Salamander	*Ambystoma mabeei*	SR	S_3, G_4
	Oak Toad	*Bufo quercicus*	SR	S_3, G_5
	Ornate Chorus Frog	*Pseudacris ornata*	SR	S_3, G_5
	Carolina Gopher Frog	*Rana capito*	T	S_2, G_3
	Dwarf Salamander	*Eurycea quadridigitata*	SC	S_2, G_5T_2Q
Reptiles	Mimic Glass Lizard	*Ophisaurus mimicus*	SC	S_2, G_3
	Pigmy Rattlesnake	*Sistrurus miliarius*	SC	S_3, G_5

Priority game species associated with wet pine savanna

Taxonomic Group	Common Name	Scientific Name
Birds	Eastern Wild Turkey	*Meleagris gallopavo silvestris*
	Northern Bobwhite Quail	*Colinus virginianus*
	Mourning Dove	*Zenaida macroura*
Mammals	American Black Bear	*Ursus americanus*
	White-tailed Deer	*Odocoileus virginianus*
	Eastern Fox Squirrel	*Sciurus niger*
	Eastern Gray Squirrel	*Sciurus carolinensis*

B. Problems affecting species and habitats

Many of the problems affecting dry longleaf pine communities on these properties also affect the wet pine savanna communities. Prior conversions of these sites to intensively managed pine plantations, lack of fire, and the fragmentation of these habitats have all caused problems. Previous intensive site preparation in the form of draining and clearing of adjacent sites has altered hydrology and the vegetative assemblages.

The construction of fire lines in wetland ecotones degrades these microhabitats and may decrease floral diversity. The rutting caused by logging equipment also alters the micro-topography of these ridge/drain complexes.

C. Conservation actions necessary to conserve the species and habitat and priorities for implementation

The highest priority in this habitat type is the maintenance of a frequent fire return interval. Growing season fires should be encouraged, although seasonality is not as important as frequency (Robbins and Myers 1992). Efforts should be made to better understand the temporal effects of prescribed burning on the plant and animal communities in these wet savannas. Additionally, because of ever increasing obstacles to prescribed fire (e.g., smoke sensitive areas, public misconceptions), alternatives to burning (e.g., mechanical and chemical treatments) must be explored. These alternatives may also be useful in the initial restoration of long fire-suppressed savannas.

The current placement of fire lines should be examined on a case by case basis for each burning compartment. Establishing any new fire lines in wetland ecotones should be weighed against the ability to safely, effectively and frequently apply fire to the landscape. If there are lines that can be modified to restore these transition zones, this should be a high priority.

Additionally, if rehabilitation of fire breaks is needed, it should occur as soon as possible after the burn is completed. The highest priority for this restoration should be any permanent breaks that are currently affecting hydrology or water quality. Efforts to explore hydrologic restoration of extensively drained sites would prove beneficial to efforts on the Brunswick and Columbus County Game Land Complex as well as other NCWRC holdings with wet savanna habitat.

Snags should be retained during timber harvests to increase the numbers available for cavity-using wildlife species. Efforts need to be made to maintain sufficient levels of woody debris in stands for reptiles, amphibians and small mammals. In disturbed sites, consideration should be given to create borrow sites or ponds for breeding use by amphibians, which are scarce in most flatwoods and savannas devoid of pools or open water.

Because of the potential for a great number of rare plants and animals in these habitats, protection of remaining sites is of utmost importance and urgency. Land acquisition and easements should be promoted through cooperation with conservation partners. Regional landscape-level conservation initiatives such as those in the Sandhills, Cape Fear ARCH, and Onslow Bight regions for dry longleaf pine also apply to wet pine savanna communities. Identified funding sources for acquisition include the Natural Heritage Trust Fund, Coastal Wetlands Grants, Forest Legacy, and Recovery Land Acquisition Grants.

D. Desired future condition

Our desired future condition for this cover type is to maintain an open, savanna-like understory with high plant species diversity and a vertical structure.

Because fire return interval is highly correlated with plant species diversity and an open understory, we will use it as our metric for success in this cover type. Currently 337 acres (78%) of this cover type has a fire return interval of 2.5 years. The remaining 94 acres (22%) of this habitat have only been burned once because they have just recently been incorporated in an active burn rotation. Our goal is to maintain a fire return interval of 3 years or less.

Additionally, we will attempt to rehabilitate 100% of any fire breaks that are created using a traditional fire plow within 6 months of creation. We will continue to use existing roads, trails, and natural breaks to conduct prescribed burns whenever possible. Finally, every attempt will be made not to establish new fire breaks in the wetland ecotone.

E. Future forest management

Timber in this habitat type will be harvested using single and group selection cuttings to maintain uneven aged stands. Harvest decisions will be primarily influenced by stocking. Specific harvest prescriptions will be detailed in the annual forest management plans developed each year.

Where available, existing openings from previous harvest operations will be used for loading decks. Logging slash will be distributed back into the stand to maintain course woody debris. Care will be taken to shut operations down when conditions become conducive to rutting and North Carolina Forestry Best Management Practices will be strictly adhered to.

Dry Coniferous Woodlands

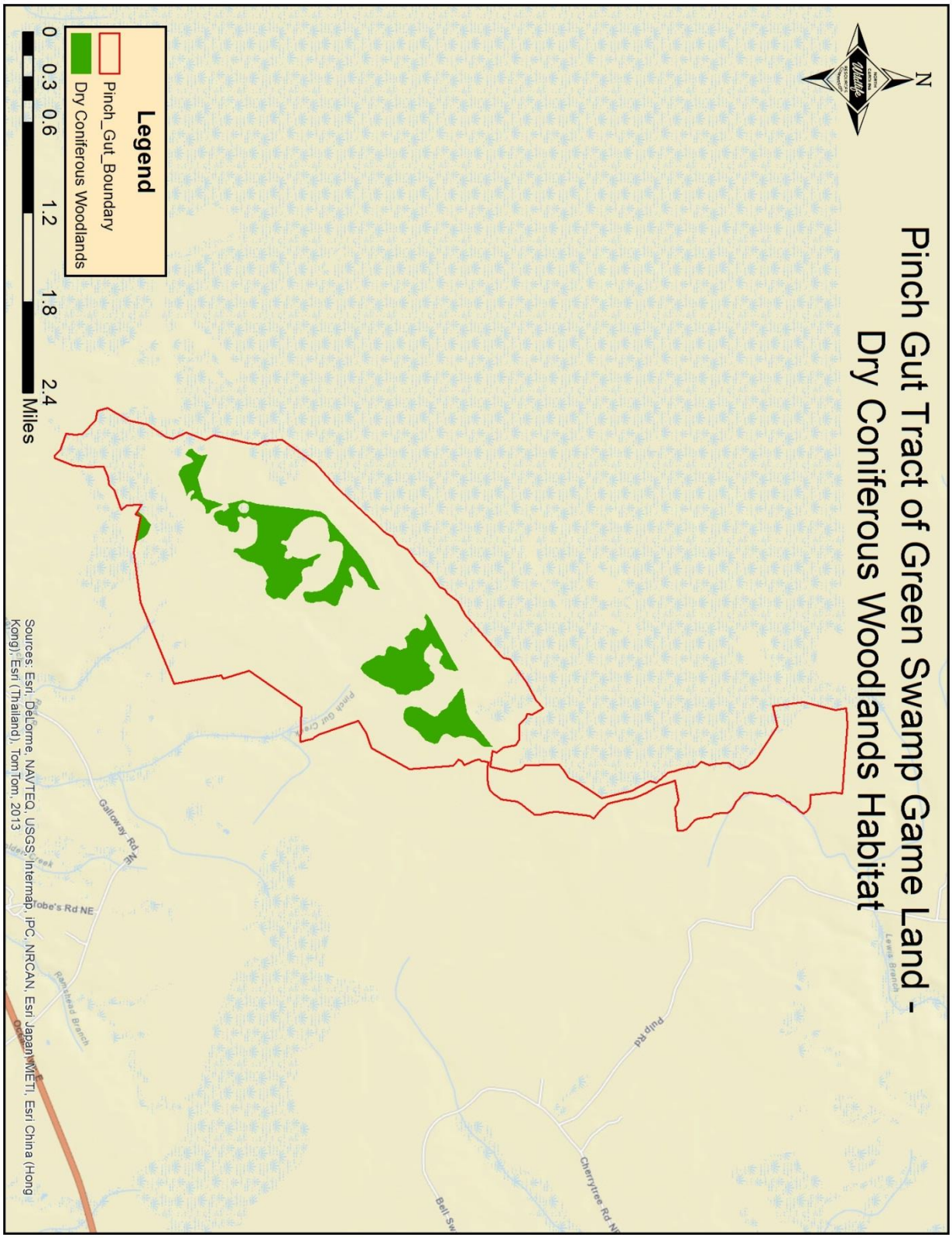
Non-longleaf pine coniferous woodlands occur throughout the Coastal Plain in areas that have naturally regenerated after being harvested or, due to the lack of fire, lost their original longleaf component and naturally regenerated in other pine species. The understory and midstory in these areas may be dominated by dense growing pocosin shrubs and/or hardwood species such as oaks, hickories, sweetgum, or maple. The exact midstory and understory species composition and structural diversity in these habitats is greatly influenced by management strategies which include timber harvests, prescribed burning, and treatments of the midstory component. This in turn determines the wildlife species present at various stages in the history of the stands.

A. Location and condition of habitat (see Maps 33 and 34)

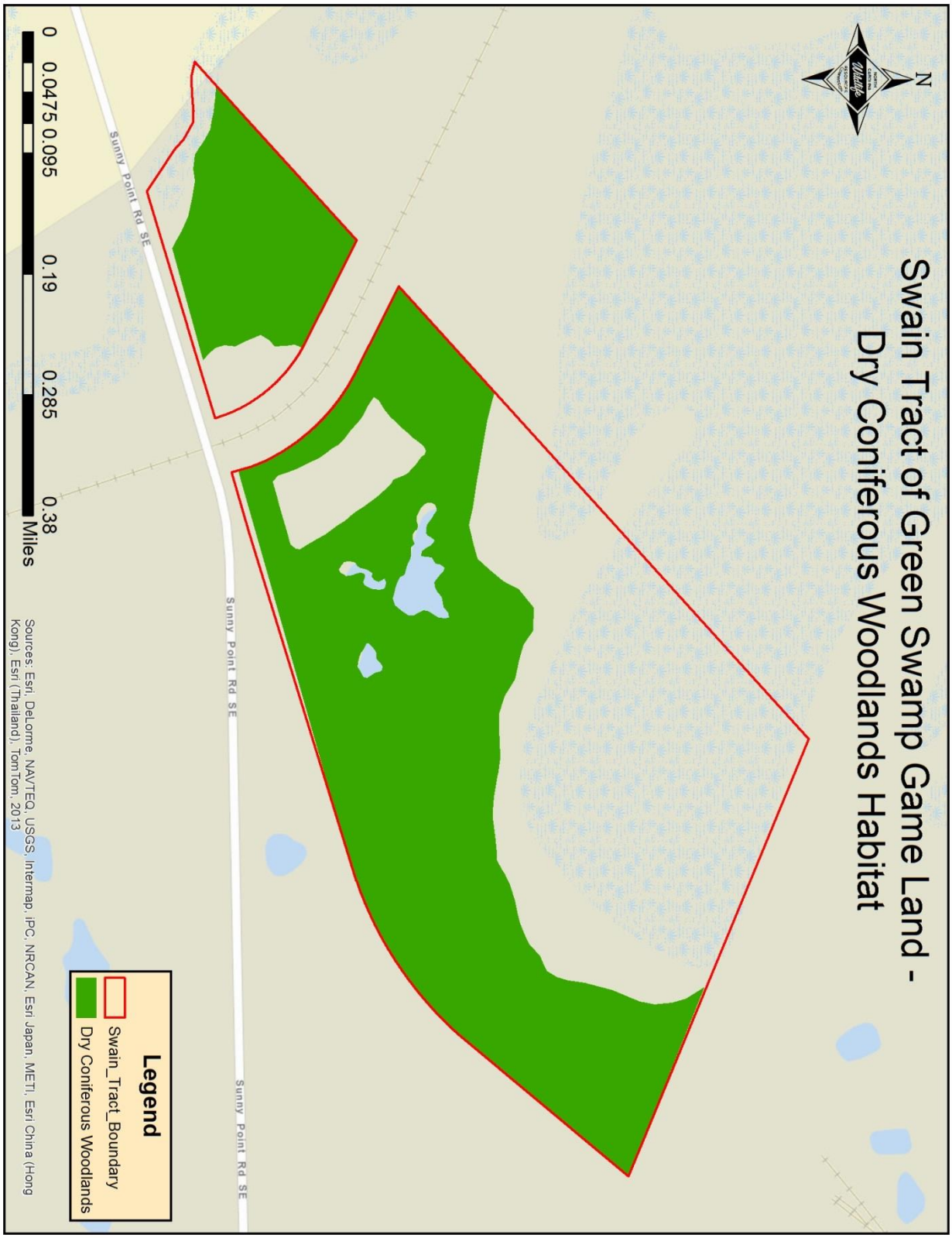
Dry coniferous woodland sites on the Brunswick and Columbus County Game Land Complex are found on the Pinch Gut (241 acres) and Swain Tracts of Green Swamp Game Land (44 acres) and make up 1% (285 acres) of the Complex. These sites were spared conversion to pine plantations and were probably allowed to naturally regenerate after they were last harvested under previous ownership. Decades of fire suppression is evident. These sites are in generally poor structural condition with a dense midstory and sparse to moderate understory. Herbaceous ground cover consisting of grasses and forbs is generally sparse due to the overall lack of sunlight availability.

Due to drainage, some of these sites occur on the property where they would not have occurred historically. Draining of adjacent sites was conducted to alter the hydrology in order to establish loblolly and slash pine plantations. Some of these sites would probably have been in some wetland community type because of higher water tables and less outflow rates causing soils to be saturated most of the year. Other sites on this property are thought to have historically been longleaf pine communities, but because of improper management and the exclusion of fire, they naturally evolved into loblolly and slash pine dominated stands.

Currently, 149 acres (52.5%) of the dry coniferous woodlands on these properties are in an active burn rotation which was just recently started on these acres in 2015. The remaining 92 acres on the Pinch Gut Tract and 44 acres on the Swain Tract consist of sites that are located in areas that simply have not been added to the burning rotation because of the short time since NCWRC acquisition.



Map 33 – Dry Coniferous Woodland habitat on the Pinch Gut Tract of Green Swamp Game Land



Map 34 – Dry Coniferous Woodlands habitat on the Swain Tract of Green Swamp Game Land.

Priority non-game species associated with dry coniferous woodlands

Taxonomic Group	Common Name	Scientific Name	State Status (Federal Status)	Natural Heritage Program State and Global Rank
Birds	Cooper's Hawk	Accipiter cooperii	SC	S_3S_4B, S_4N, G_5
	Bachman's Sparrow	*Peucaea aestivalis*	SC	S_3B,S_2N, G_3
Reptiles	Timber Rattlesnake	*Crotalus horridus*	SC	S_3G_4
	Pigmy Rattlesnake	*Sistrurus miliarius*	SC	S_3, G_5

Priority game species associated with dry coniferous woodlands

Taxonomic Group	Common Name	Scientific Name
Birds	Eastern Wild Turkey	*Meleagris gallopavo silvestris*
	Northern Bobwhite Quail	*Colinus virginianus*
	Mourning Dove	*Zenaida macroura*
Mammals	American Black Bear	*Ursus americanus*
	White-tailed Deer	*Odocoileus virginianus*
	Eastern Fox Squirrel	*Sciurus niger*
	Eastern Gray Squirrel	*Sciurus carolinensis*

B. Problems affecting species and habitat

Besides the obvious regeneration of these stands to off-site species of loblolly and slash pine, fire suppression prior to NCWRC ownership is the greatest problem affecting the condition of this habitat. This has caused stands to consist of a dominant midstory of hardwoods, increased fuel loads, inhibited the growth of grasses and forbs on the forest floor, and decreased the occurrence of rare and endangered species. Most of the understory grass, forb, and shrub layers are lost when the canopy of a newly harvested and naturally regenerated timber stand closes, typically 7-15 years after planting. The forest canopy is one of the foremost determinants of the microhabitat within a forest. It affects plant growth and survival, hence determining the nature of the vegetation, and wildlife habitat (Jennings et al. 1999).

C. Conservation actions necessary to conserve the species and habitat and priorities for implementation

Fire should continue to be applied to these habitats and the fire frequency should be maintained to at least once every three years on tracts that can feasibly be burned. Restoration of natural fire frequency, intensity, and seasonality is critical for pine-related reptiles, amphibian, and their prey (Bailey et al. 2004), as well as other pine-related wildlife.

On dry coniferous woodland sites that were historically dry longleaf communities, restoration of these natural communities should be the primary goal. Additional older aged pine acreage is needed. Therefore, on sites with soils not conducive to longleaf restoration, pine stands should be managed on long rotation (e.g., 60-100+ years) or in uneven-aged stands. Where appropriate, forest management techniques should be used to mimic the characteristics of older stands, which include canopy gaps, snags, dead and downed material, and the retention of cavity trees. Basal

areas should be maintained at levels that allow for an herbaceous understory, i.e., 40-60 ft^2/acre. When available, mature hardwood trees should be retained and released during harvest operations.

Accessible areas of this cover type should continue to be managed for open canopies to allow sunlight to reach the forest floor. Where appropriate, this will be accomplished through thinnings of pine stands and conversion of dry coniferous woodlands to longleaf pine communities. Stands with hardwood dominated midstories should be controlled on a site-specific basis. Prescribed fire will be the primary tool to prevent hardwoods from dominating the midstory and causing canopy closure. When and if fire proves to be ineffective at accomplishing this goal, herbicide or mechanical removal will be considered for a midstory treatment. Prescribed fire will also be used to maintain, restore, and improve existing native herbaceous vegetation.

D. Desired future conditions

The desired future condition for this habitat type is restored, site-suitable vegetation communities with a primary emphasis on the longleaf pine/wiregrass ecosystem and a 3-year fire return interval. On wetter sites that may have historically been wetland habitat, pine stands should be managed on long rotation to allow maturation which will provide characteristics beneficial to wildlife. These characteristics include canopy gaps, snags, dead and downed wood, and cavity trees.

Our second goal is to establish and maintain an average fire return interval of 3 years. It is our thought that with continued application of prescribed fire and the continued growth of timber within these stands, we will be able to accomplish management objectives with a 3 year burning cycle. Older, larger trees will produce more fine fuels to carry fire throughout the burn compartments and the grassy and herbaceous ground cover should improve and be less sparse, hence further improving the ability to carry fire throughout the stand. Burning of these compartments will be accomplished with the use of existing natural and engineered fire breaks. The 3 year fire return interval will continue to restore the understory component, which will facilitate conversion to longleaf savanna cover type on appropriate sites.

E. Future forest management

Stands that are accessible will be managed for low basal areas and open canopies via commercial thinnings. Where accessibility and soils allow, stands will be converted back to longleaf pine when the current stands mature or when they can be incorporated into sales of adjacent stands.

Mixed Hardwoods and Pine

5.65 acres (<1%) of the Brunswick and Columbus County Game Land Complex is made up of mixed hardwoods and pine habitat. This type of habitat is an oak-dominated natural community. It includes sites that may have been longleaf pine stands at one time, but without fire have regenerated into closed canopy mixed hardwood/pine stands with crowded midstory development and low understory species diversity.

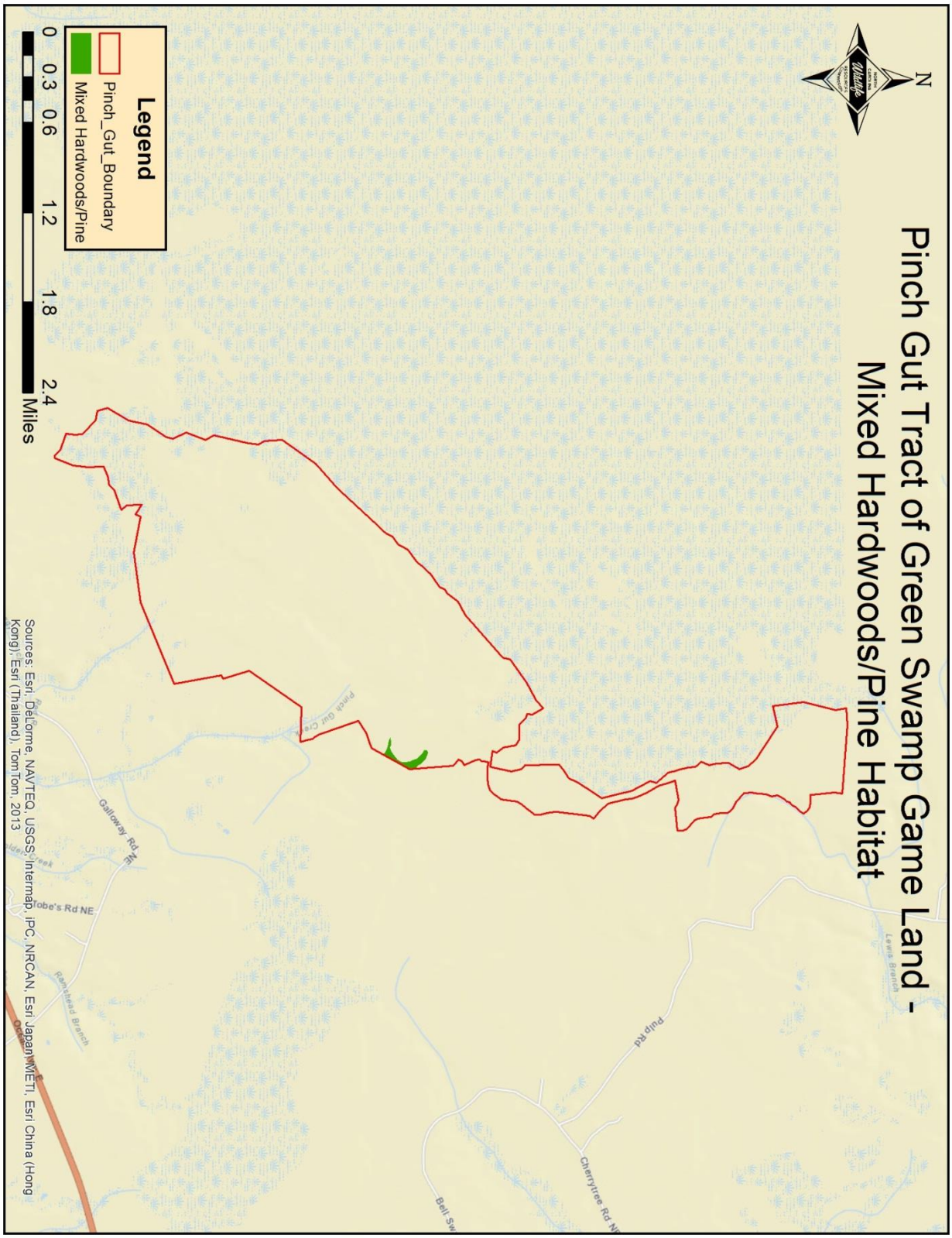
In the Coastal Plain of North Carolina, two examples of these oak dominated communities exist but only the Dry Mesic Oak-Hickory Forest cover type is found on these properties. This is an upland community and was once one of the predominant cover types in the Piedmont, and although not as common in the Coastal Plain, it was clearly widespread before European settlement and land clearing (Schafale and Weakley 1990).

A. Location and condition of habitat (see Map 35)

The 5.65 acres of this cover type is located in one isolated patch on the Pinch Gut Tract of Green Swamp Game Land. Oak dominated forest communities are located throughout the Coastal Plain, but are no longer common except in small patches, as is the case on this game land. Most of the forests have been logged or cleared at least once in the past 300 years, and many have been cleared multiple times. The quality of these communities depends primarily upon the age of the canopy trees, management history, and degree of fragmentation of the tract. The condition of these stands has degraded over time with habitat fragmentation, fire suppression, and the resultant lack of understory and crowned midstory development.

The existing Dry Oak-Hickory Forest habitat on this game land has experienced the same outcome. It is isolated, probably due to fragmentation by clearcutting and conversion to loblolly and slash pine plantations. In these stands, fire has been non-existent for at least the last two decades, they lack significant groundcover, and the midstory has crowned, preventing much sunlight from reaching the forest floor.

Judging by the limited number of pines, red maple, tulip poplar, and sweetgum, no disturbance has occurred in these stands in many years, probably since it was last timbered. These forests on this game land are uneven-aged with old trees occasionally present. The last disturbance that these stands experienced coupled with the lack of fire has changed the species composition and structure. It is believed that these sites were once dominated by longleaf pine but the lack of frequent fire has resulted in dominance by oaks, hickories, and other hardwood species.



Map 35 – Mixed hardwoods/pine habitat on the Pinch Gut Tract of Green Swamp Game Land.

Priority non-game species associated with mixed hardwood and pine forest habitat

Taxonomic Group	Common Name	Scientific Name	State Status (Federal Status)	Natural Heritage Program State and Global Rank
Birds	Cooper's Hawk	Accipiter cooperii	SC	
Amphibians	Four-toed Salamander	Hemidactylium scutatum	SC	S_3, G_5
Reptiles	Timber (Canebrake) Rattlesnake	Crotalus horridus	SC	S_3, G_4

Priority game species associated with mixed hardwood and pine forest habitat

Taxonomic Group	Common Name	Scientific Name
Birds	Eastern Wild Turkey	Meleagris gallopavo silvestris
Mammals	White-tailed Deer	Odocoileus virginianus
	American Black Bear	Ursus americanus
	Raccoon	Procyon lotor
	Bobcat	Lynx rufus
	Eastern Gray Squirrel	Sciurus carolinensis
	Eastern Fox Squirrel	Sciurus niger

B. Problems affecting species and habitat

Conversion to single-aged loblolly pine stands and lack of canopy gaps have been problems for this habitat type and the wildlife species that utilized them. The lack of canopy gaps affects bird species that rely on those gaps for foraging areas such as nightjars, eastern wood-pewee, northern flicker, and red-headed woodpecker. Also, the potential and realized impacts by gypsy moths and other non-native plants and animals are becoming a growing concern throughout the hardwood dominated communities.

C. Conservation actions necessary to conserve the species and habitat and priorities for implementation

Use of infrequent prescribed fire and canopy gap management may be needed to improve forest structural heterogeneity because frequent fire will limit shrub and understory development necessary to breeding bird species. Management and protection of mixed hardwoods/pine stands to promote future large, unfragmented tracts is especially important for amphibians, reptiles, small mammals and bats.

This cover type on the Pinch Gut Tract exists on a site that was historically a longleaf pine community. Within the oak-mixed hardwoods/pine habitat, we must attempt to retain as many of the embedded habitats as possible. However, in the event of destructive impacts from catastrophic events such as hurricanes or wildfires, mixed hardwood stands should be considered for conversion back to longleaf pine habitat where appropriate.

D. Desired future conditions

Our desired future condition for this habitat type is to dedicate these lands to old growth habitat, which include cavity trees, dead and downed woody debris, and snags. As stated earlier, prescribed fire has been absent for at least the last two decades. The implementation of an infrequent prescribed fire regime will be considered based on other burning priorities and feasibility. To minimize damage to older hardwoods, prescribed fires would be conducted during the dormant season and would ideally be cool fires with low intensity.

Mirroring the location and condition of these habitats across North Carolina, this community on the Pinch Gut Tract is in a small patch that is isolated. Without the application of prescribed fire, canopy gaps could be created by selective removal of trees that have contributed to midstory canopy closure. If burning these areas proves to be feasible, determination of fire return interval would be based on results achieved by the initial burn and fuels loads relative to the ability to carry fire through these stands.

E. Future forest management

In order to maintain perpetual mixed hardwood/pine habitats on the Brunswick and Columbus County Game Land Complex, no timber harvests will take place in this cover type over the next ten year planning horizon. Specific burning prescriptions will be made in the annual forest management plans developed each year. Field staff will determine if the need of selective, non-commercial removal of trees is conducive to opening the midstory canopy for foraging areas, which will also be addressed in the annual forest management plan, if applicable.

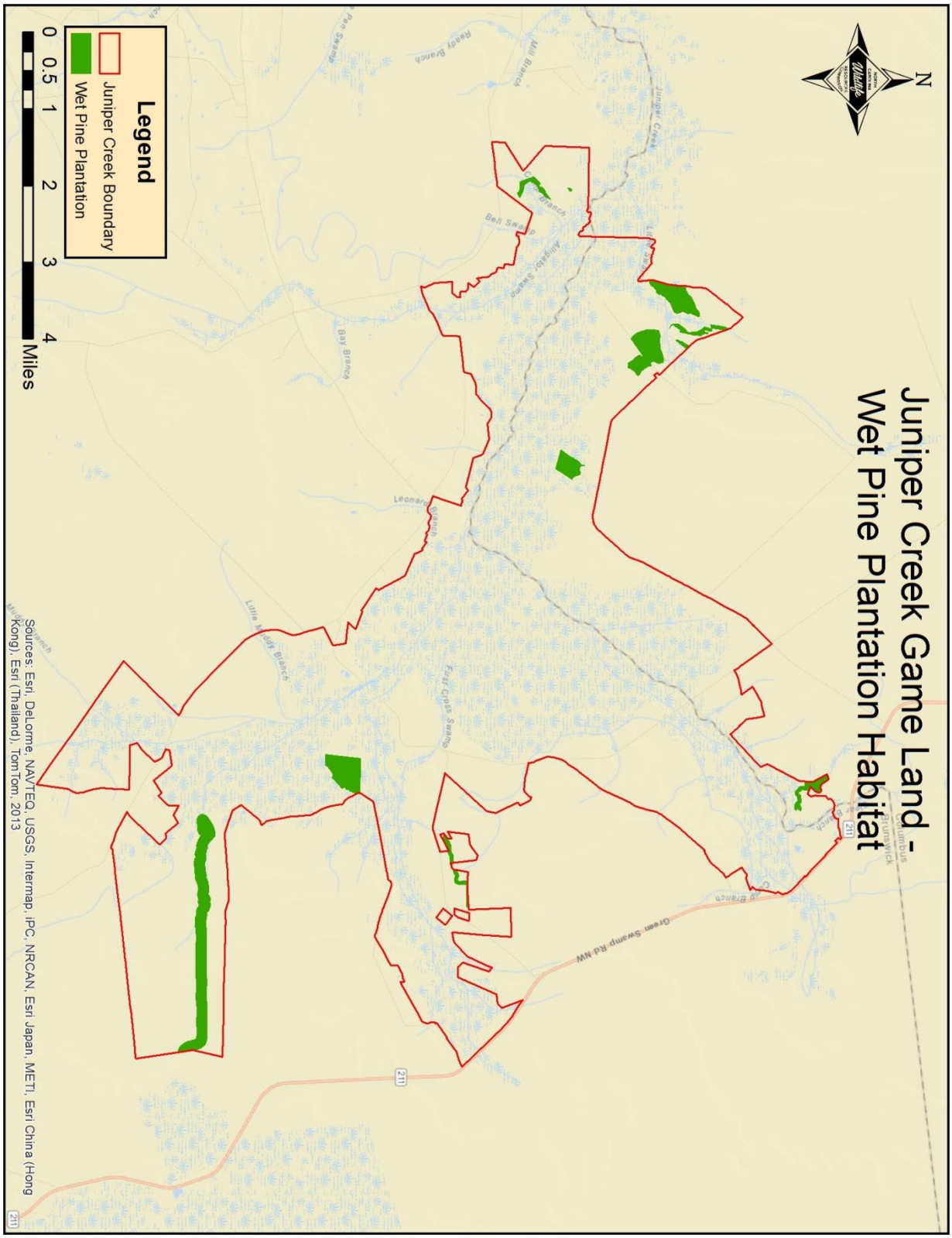
Wet Pine Plantation

Wet Pine Plantation habitat consists of areas that were converted from a wetland community type to a non-natural loblolly or slash pine plantation. These sites usually lie on the fringes of existing wetlands or in low-lying areas that have poor drainage. Land conversion to the plantation cover type was conducted decades ago before federal, state, and local wetland regulations protected these areas. Silvicultural drainage of these sites was conducted to improve soil trafficability for timber harvesting and site preparation, to increase the number of days per year that harvesting and site prep can be conducted with minimal soil damage, and to improve seedling survival and early growth rates of trees.

A. Location and condition of habitat (see Map 36)

Five hundred twenty-six acres (1.8%) of this cover type exists on Juniper Creek Game Land. Even though drainage of these and adjacent areas occurred, the wet pine plantation habitats on these properties continue to have very high water tables and are seasonally flooded. Planting, site preparation, and harvesting probably occurred during years of drought conditions. Otherwise, poor soil trafficability would have prohibited these actions.

Understories are dominated by hardwoods species such as red maple, sweet gum, and oak while the herb layer is sparse. Some sites have very dense shrub layers and others have dense vines. These pine plantations lack age diversity within the stands and no old growth stands are present. They lack canopy gaps and are overstocked.



Map 36 – Wet Pine Plantation habitat on Juniper Creek Game Land.

Priority non-game species associated with wet pine plantations

Taxonomic Group	Common Name	Scientific Name	State Status (Federal Status)	Natural Heritage Program State and Global Rank
Birds	Cooper's Hawk	Accipiter cooperii	SC	S_3S_4B, S_4N, G_5
	Bachman's Sparrow	Peucaea aestivalis	SC	S_3B, S_2N, G_3
Reptiles	Timber Rattlesnake	Crotalus horridus	SC	S_3, G_4
	Pigmy Rattlesnake	Sistrurus miliarius	SC	S_3, G_5

Priority game species associated with wet pine plantations

Taxonomic Group	Common Name	Scientific Name
Birds	Eastern Wild Turkey	Meleagris gallopavo silvestris
	Northern Bobwhite Quail	Colinus virginianus
	Mourning Dove	Zenaida macroura
Mammals	American Black Bear	Ursus americanus
	White-tailed Deer	Odocoileus virginianus
	Eastern Fox Squirrel	Sciurus niger
	Eastern Gray Squirrel	Sciurus carolinensis

B. Problems affecting species and habitats

Fire suppression has certainly led to a decline in some of the diversity of these habitats but the alteration of hydrology from ditches associated with forestry practices is the biggest factor impacting this habitat type. Non-native plant species (e.g., Privet, Japanese grass) are also competing with native vegetation in some areas, especially those frequently disturbed. Although little of this quality habitat remains, it can be burned more safely than those sites with organic soils. Therefore the potential exists to improve the condition of these areas.

C. Conservation actions necessary to conserve the species and habitat and priorities for implementation

Unlike most other forest types in this Plan, the wet pine plantation forest is mostly non-natural through conversion of other types to pine plantations. Therefore, there is a need to decrease this habitat type and return acreage to natural types wherever feasible. Otherwise, the management of these non-longleaf pine woodlands should occur in efforts to promote large, unfragmented acreage on this landscape. Fire should be reintroduced and fire frequency should be once every 3 years.

D. Desired future conditions

Two options are available for the desired future condition of these habitats. The first is to allow areas to succeed with the current vegetative communities and manage them as pine woodlands. The other is to decrease acreage of this cover type and restore that acreage to the natural community.

Areas allowed to succeed with their current vegetation would involve the reintroduction of fire in areas that could feasibly be incorporated into the prescribed burning program and the reduction of canopy trees. However, these areas pose challenges for both of these management strategies because of the facts that they have very high water tables and are seasonally flooded. Treatment options will be considered on a case-by-case basis.

Some of these sites may be identified to be restored to their natural community type but this will involve well planned strategies as well. This option would potentially include the removal of the pine overstory and the plugging of ditches to restore the natural hydrological cycle. As with the other option, treatments will be considered on a case-by-case basis.

E. Future forest management

Forest management by way of timber harvest in this cover type is likely not to occur. Because of the low trafficability of the soils, high water tables, and seasonal flooding regime, we currently do not intend to disturb these areas with logging equipment. Management of each site will be determined on a case-by-case basis. It is most feasible to allow these areas to continue to grow in order to allow maturation which will provide characteristics beneficial to wildlife. These characteristics include canopy gaps, snags, dead and downed wood, and cavity trees.

Non-forested Early Successional Habitat

This cover type is represented best by land where most trees have been removed either through natural means or by human activity. These communities form soon after a disturbance and generally consist of herbaceous annuals and perennials that quickly occupy disturbed sites. They reproduce seeds that are disturbance-adapted or can be widely dispersed by wind, water, or animals. Early successional habitat can be a mix of grasses, legumes, wildflowers, vines, shrubs and saplings. In general, sod-forming grasses such as fescue and bermudagrass provide minimal wildlife value; while grasses that grow in individual clumps, such as switch grass and broomstraw, provide greater value for wildlife. Small patches of vines or shrubs contribute to habitat value, but woody vegetation should not shade out the grasses and forbs.

These communities are characterized by high productivity and provide habitat for many disturbance-adapted wildlife species. Early successional habitats are highly ephemeral and in the absence of further disturbance, the attractiveness and productivity of these habitats declines. Across the nation, the single category of wildlife experiencing the most declines consists of those that depend on natural early successional habitats.

This habitat type requires frequent disturbances that suppress or reset ecological succession. These disturbances include activities such as timber harvests, mechanical treatments, burning, and herbicide treatments to maintain this condition. However, environmental factors such as weather events, climate, and natural fires play a role in creation and maintenance of this habitat as well. Without these disturbances or active management, natural plant succession will limit the longevity of many of these habitats.

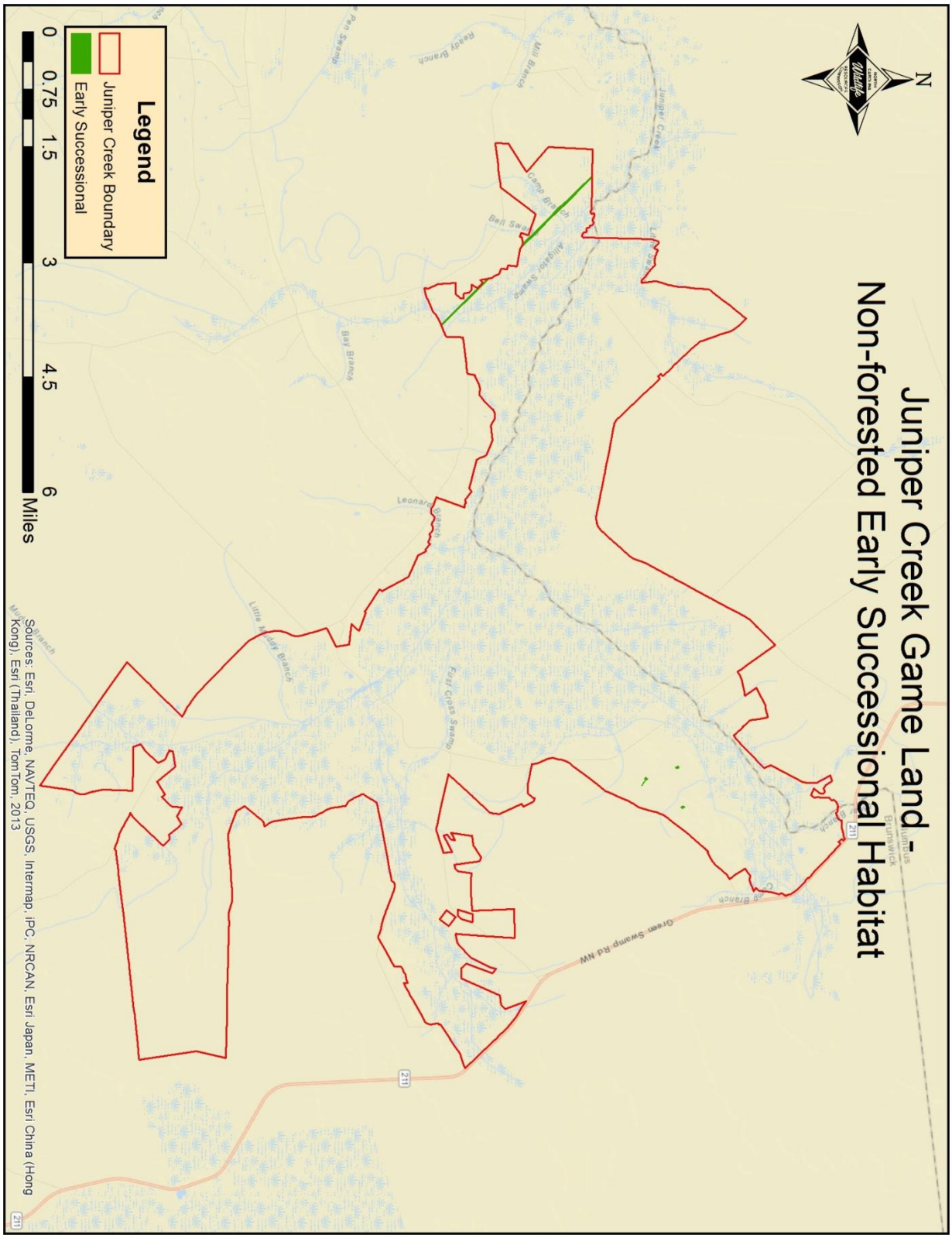
Historically, both large and small areas of these habitats were created by catastrophic natural fires, anthropogenic fires, large-scale wind events, insect pests, or pathogens such as fungal diseases that all cause significant canopy loss in forests.

A. Location and condition of habitat (see Map 37)

Approximately 28 acres (<1%) of non-forested early successional habitat occurs on the Brunswick and Columbus County Game Land Complex and is all located on Juniper Creek Game Land. Only 2 of those acres are planted wildlife openings that were established in 2014 through a grant with the North Carolina National Wild Turkey Federation. These game lands exist in a forest-dominated landscape and pose challenges to accomplishing objectives set forth by land managers for the cover type. Currently, it is found in power line rights-of-ways and nearby woodlands, existing as developed wildlife openings amongst other habitats, or is created by disturbances. Although not included in the acreages for this cover type, important early successional habitat also occurs and is managed for in the understory of frequently burned open pine habitats.

Quality early successional habitats have declined significantly over the past half-century and were nearly non-existent on these properties when purchased by the NCWRC. This was due to the suppression of fire, over-stocked pine plantations, and the fragmentation of this habitat. The majority of upland sites on this Complex of game lands consist of pine plantations. Consequently,

there are more frequent disturbances to the forests and soils and from cutting and replanting; all of which could benefit quail (Cobb et al. 2002), and other early successional wildlife species. Since its purchase by the NCWRC, many activities have occurred to increase the quantity and quality of this cover type. These activities include but are not limited to the creation of wildlife openings, prescribed burning, seeding of native ground cover, and herbicide applications to control undesirable vegetation.



Map 37 – Non-forested early successional habitat on Juniper Creek Game Land.

Priority non-game species associated with early successional habitat

Taxonomic Group	Common Name	Scientific Name	State Status (Federal Status)	Natural Heritage Program State and Global Rank
Birds	Bachman's Sparrow	*Peucaea aestivalis*	SC	
	Loggerhead Shrike	*Lanius ludovicianus*	SC	S_3B, S_3N, G_4
Mammals	Star-nosed Mole	*Condylura cristata*	SC	S_2, G_5T_2Q
Reptiles	Eastern Coachwhip	*Masticophis flagellum*	SR	S_3, G_5

Priority game species associated with early successional habitat

Taxonomic Group	Common Name	Scientific Name
Birds	Northern Bobwhite Quail	*Colinus virginianus*
	Mourning Dove	*Zenaida macroura*
	Eastern Wild Turkey	*Meleagris gallopavo silvestris*
	American Woodcock	*Scolopax minor*
Mammals	White-tailed Deer	*Odocoileus virginianus*
	Raccoon	*Procyon lotor*
	Gray Fox	*Urocyon cinereoargenteus*
	Red Fox	*Vulpes vulpes*
	Eastern Cottontail Rabbit	*Sylvilagus floridanus*

B. Problems affecting species and habitat

The biggest challenge is providing this habitat in a forested landscape, which requires intensive and constant management through multiple land management practices such as prescribed burning, herbicide treatments, timely soil disturbance, and planting of native grasses and forbs. These activities maintain non-forested openings that provide this habitat in a mosaic with other communities throughout the game land.

Invasive species can cause problems in early successional habitats. Fire ants kill newly hatched ground nesting birds, reptiles, and new born mammals. Brown-headed cowbirds parasitize bird nests and many exotic plant species take advantage of the light conditions in early successional habitats. Invasive plant species such as tall fescue, bermudagrass, and other sod-forming grasses form a dense structure at ground level. This makes it difficult for young wildlife to travel through these areas, limits seed and invertebrate availability, and precludes the native seedbank from germinating.

Early successional habitats in the powerline right-of-ways and roadsides on these game lands have the potential to provide quality early successional habitat if managed properly. However, they can be adversely affected by too frequent or poorly timed mowing and herbicide treatments (Bramble et al. 1992). Juniper Creek Game Land has 2.2 miles of power line right-of-ways and approximately 87 miles of roads and trails. Additionally, Green Swamp Game Land has 7.3 miles of roads and trails and Columbus County Game Land has 3.8 miles of roads and trails. Some of

the road shoulders have been widened to allow quicker drying of the roadbed and to also provide this habitat component. Improper management of these areas could potentially cause more harm than benefit.

C. Conservation actions necessary to conserve the species and habitat, and priorities for implementation

The creation of additional non-forested linear openings should occur. Plantings of native grass and forb mixtures to support breeding birds, small mammals, and herpetofauna should be implemented into the management practices for this cover type when needed. If daylighted road shoulders and other wildlife openings prove to have little or no native grasses and forbs in their seedbank, consideration should be given to mechanically planting these areas with a native plant mixture.

Connecting smaller patches of habitat with corridors should be given priority. Non-forested openings should continue to be maintained with fire/and or timely disking and rotations of fallow areas. Non-native, sod-forming grasses should be controlled through the application of herbicide and restored to native vegetation. Areas where these grasses have encroached should be identified and implementation of herbicide application should occur. Other invasive, non-native species should be dealt with on a case-by-case basis.

D. Desire future condition

As stated earlier, there are currently 28 acres in this cover type. It is our desire to increase the total acreage of non-forested early successional habitat on these game lands by 35%, or 10 acres, over the ten year planning horizon for a total of 38 acres. These additional 10 acres will include daylighted road shoulders and planted wildlife openings. It should be noted that due to limited actions allowed by North Carolina Natural Heritage Program dedications on the game land, the creation of additional non-forested early successional habitat is challenging.

Eradication of non-native grasses found in some of the wildlife openings mentioned earlier should be completed. Encroachment of these grasses in field borders should also be eliminated.

Game land managers should use no-till agriculture practices in planted wildlife openings where feasible. Invasive grasses, shrubs, and trees within openings will be removed to allow for desirable, native vegetation to grow. To allow for a variety of plant growth stages within the openings, trees and shrubs will be selectively cut.

These habitats should be highly dynamic and highly productive seral stages. This consists of a great diversity of vigorously growing grasses, forbs, shrubs, and young trees that provide excellent food and cover for wildlife. They would be managed with fire, rotational disking, or some other type of disturbance.

E. Future forest management

Because this cover type does not consist of any timber, no future forest management will occur.

Pocosin

Four hundred nine, or 1.5%, of the Brunswick and Columbus County Game Land Complex is made up of pocosin habitat. These peatland communities include high pocosins, bay forests, and streamhead pocosins. These communities occur on peatlands of poorly drained interstream flats, and peat-filled Carolina bay depressions and swales of the eastern Coastal Plain (Schafale and Weakley 1990). The streamhead communities occur primarily in the Sandhills along small headwater streams, either on flat bottoms or extending up adjacent seepage slopes.

Extremely acidic in nature due to organic soils, generally these habitats are nutrient poor and usually continuously saturated with water. Fires were historically associated with droughts, and fire frequency and intensity strongly influence vegetative structure dominance, composition, stature, and diversity. All but the streamhead communities occur along a gradient of moisture, nutrients, and peat depth and typically occupy different locations with the domed peatlands of interstream flats and Carolina bays and swales. The wettest sites, typically the center of bays, may contain only low shrubs and stunted pond pine, with beds of sphagnum, pitcher plants, and cranberry. Higher, drier sites are characterized by an extremely dense shrub layer.

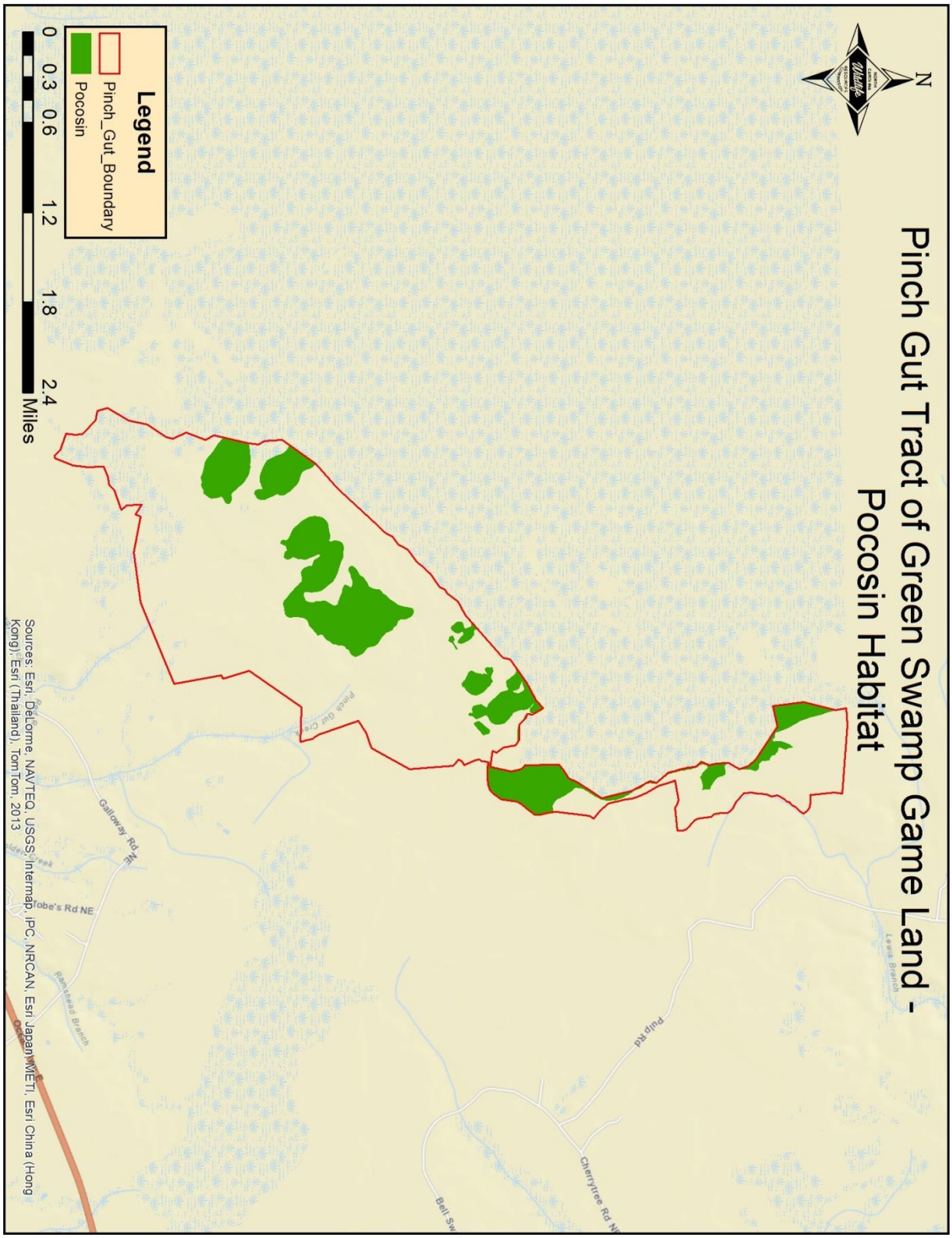
High pocosins are extremely nutrient poor with little normal nutrient input other than rainfall. Under natural conditions, fire was an important component shaping the structural diversity of these communities. Compared to other pocosin habitats in North Carolina, they are intermediate between low pocosin and pond pine woodlands in terms of location, depth of peat, shrub height and density, and stature of trees. The shrub layer is typically 1.5-3 meters in height and trees still tend to be scattered and small in stature.

Bay forests occur throughout the game land and, according to Schafale and Weakley (1990), typically exist as a mosaic with other pocosin communities. They occur on shallow organic soils and the canopy is dominated by loblolly bay, sweet bay, and red bay. Bay forests are believed to be a late-successional community that replaces other pocosin communities after a long absence of fire. These bay forests may be solely a product of fire suppression, or there may be sites which naturally supported them (Schafale and Weakley 1990).

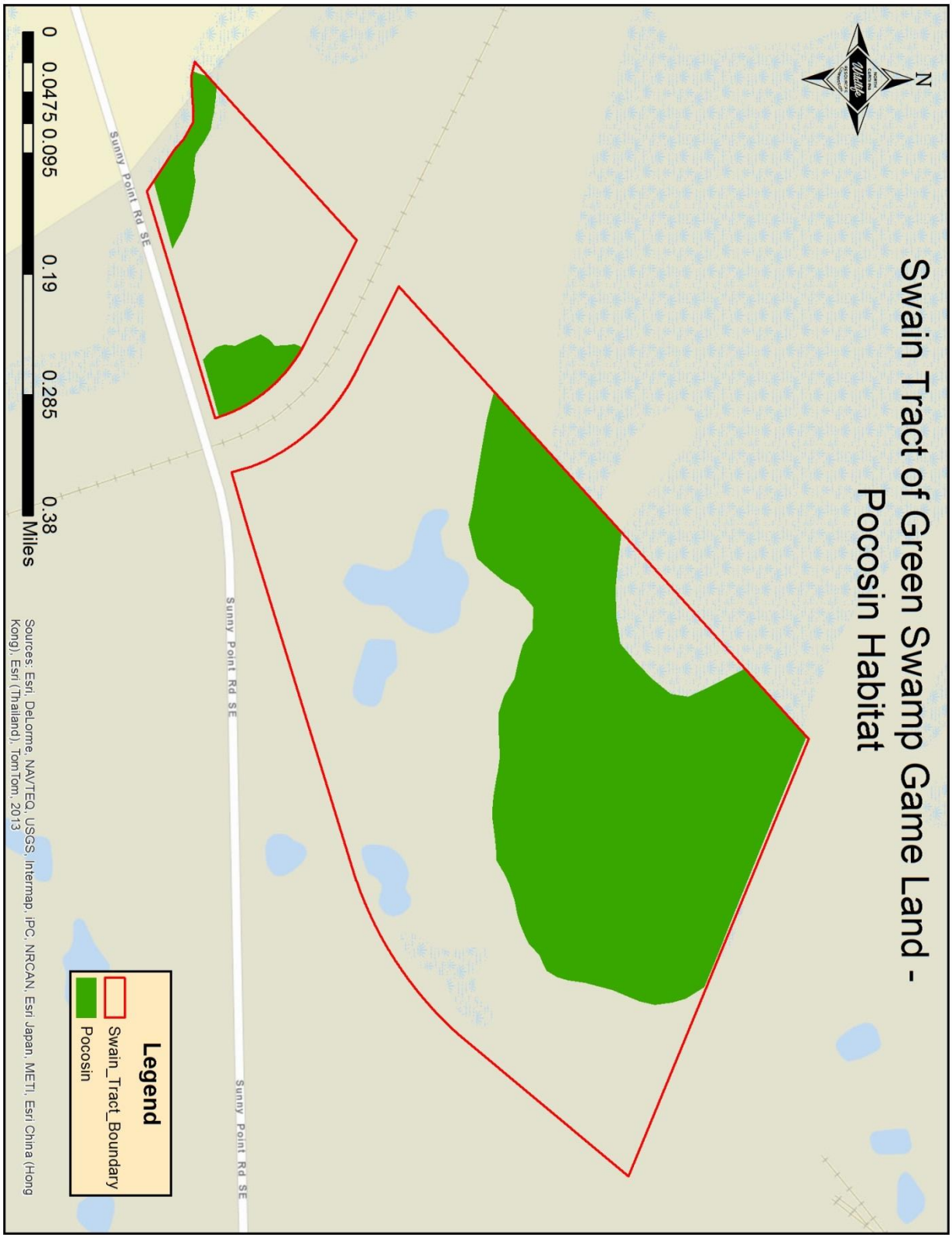
Streamhead pocosin communities resemble peatland pocosins but they are found in very different physical settings: ravines in permanently saturated Sandhill seeps. These habitats are subject to influence from fire on adjacent uplands and are characterized by an open canopy of pond pine, with potential for red maple, sourwood, swamp black gum, and tulip poplar. A dense shrub layer is usually present and herbs are sparse. There is a higher shrub and tree diversity in these communities due to nutrients released by burning in adjacent uplands and more frequent disturbance from fires that burn into the edges (Schafale and Weakley 1990).

Location and condition of habitat (see Maps 38 – 39)

Pocosin habitats within this Complex of game lands are found on the Pinch Gut (378 acres) and Swain Tracts (31 acres) of Green Swamp Game Land. The condition of pocosin habitats in much of the Coastal Plain is poor due to fire suppression, changes in hydrology, intensive silviculture, and conversion of forest types. Fire suppression has undoubtedly altered the condition of pocosin habitats on these game lands but fire has been reintroduced into these communities where feasible. However, ever increasing obstacles of using prescribed fire (e.g., smoke sensitive areas and public misconceptions) coupled with the fact that some of the pocosin habitats on these properties are adjacent to property lines poses challenges to reintroducing fire into these communities. The ecotones between upland sites and the lowland pocosin habitats are burned when feasible and great effort has been put forth to reduce and sometimes eliminate the installation of fire breaks in these ecotones. Smaller pocosins, that are found within upland communities or pocosins that allow substantial fire breaks to be installed, have been burned in prescribed fire efforts.



Map 38 – Pocosin habitat on the Pinch Gut Tract of Green Swamp Game Land.



Map 39 – Pocosin habitat on the Swain Tract of Green Swamp Game Land.

Priority non-game species associated with pocosin habitat

Taxonomic Group	Common Name	Scientific Name	State Status (Federal Status)	Natural Heritage Program State and Global Rank
Mammals	Star-nosed Mole	Condylura cristata	SC	S_2, G_5T_2Q
Amphibians	Oak Toad	Bufo aquercicus	SR	S_3, G_5

Priority game species associated with pocosin habitat

Taxonomic Group	Common Name	Scientific Name
Mammals	American Black Bear	Ursus americanus
	White-tailed Deer	Odocoileus virginianus
	Raccoon	Procyon lotor

Problems affecting species and habitats

Fire suppression is an important factor threatening the pocosin habitats on game lands within this Complex due to the strong influence fire has on their vegetative structure, composition, and diversity. As stated previously, the location of some of the pocosin habitat coupled with the constraints associated with prescribed fire, reintroduction of fire into these communities creates a challenge for game land managers. The volatility of fuels in these communities and smoke management concerns also pose everlasting challenges to addressing this threat. It is our concern that the build-up of fuels due to the lack of fire will result in these stands burning in wildfire conditions and that the fire will be so intense that the ground will burn, thus killing the entire stand. Some wildfires can be beneficial, acting as a renewing force, releasing nutrients that stimulate seed germination and quick regrowth from root sprouts, regenerating plant communities. Intense fire is a natural part of pocosin systems, but extensive peat consumption, especially in ditched peatlands, is a significant impact.

The advance of red bay wilt in the region, within the implementation horizon of this plan, will likely alter the vegetation composition coupled with short-term increases in dead fuel loading resulting in impacts to fire intensity.

C. Conservation actions necessary to conserve the species and habitat and priorities for implementation

The most important action necessary to manage this habitat type is the application of prescribed fire. It can be used to increase the heterogeneity in these pocosin habitats related to vegetative dominance, stature and diversity. Growing season fires should be encouraged, although seasonality is not as important as frequency (Robbins and Myers 1992). Fire will increase vegetative structure and should promote the establishment of herbaceous groundcover in some community types. Rare species associated with peatland pocosins are dependent on the combination of wet conditions and frequent fire.

To date, burning on these properties has been accomplished on uplands with minimal use of fire breaks in the ecotones between the upland sites and pocosin habitats, especially in winter when moisture serves to prevent fires from burning out of control in the pocosin. Efforts should continue to be made to burn in this manner and ecotone management should be prioritized based on feasibility of burning without fire breaks. Few of the fire breaks on these game lands are made up of existing roads and trails that require very little to no manipulation before burns are conducted. Bare, mineral soil is upturned on these roads and trails with a tractor and disk harrow and eliminates the need for breaks to be installed with a fire plow. This activity greatly minimizes disturbance to ecotones, reduces erosion and changes to hydrology, and eliminates the need for fire break rehabilitation.

The placement of fire breaks should be examined on a case-by-case basis for each burn unit containing pocosin ecotones that may be used for fire breaks and a determination should be made on-site. Establishing new fire breaks in pocosin ecotones should be weighed against the ability to safely, effectively, and frequently apply fire to this landscape. Where feasible, modification of fire breaks in these transition zones should be strongly considered. Additionally, any needed rehabilitation of fire breaks should occur immediately following the completion of a prescribed burn. The highest priority should be given to lines that may affect the hydrology or water quality of a given site.

Because pocosin habitats are particularly important for wintering birds due to the high amount of soft mast available, protection and proper management is necessary to provide for these species. These pocosin habitats also provide for a greater number of wildlife species including black bears. In a study done by Jones and Pelton (2003), black bears preferred pocosins and clearcuts over managed pine habitats presumably because of the superior cover and food provided by these cover types. This has also been reported for pocosin habitats by Landers et al. (1979), Hellgren and Vaughan (1988), Hellgren et al. (1991), and Lombardo (1993). Pocosins also provide for black bears a sanctuary from human activity by providing areas of impenetrable escape and hiding cover.

Though extensive amounts of pocosin lands are already protected, some specialized types require more protection, such as the Carolina bays. Acquisition partnerships through conservation partners will be important. Opportunities may be presented to take advantage of initiatives and programs that promote pocosin restoration such as Forest Landbird Legacy Program, Partners for Wildlife, and the North American Wetland Conservation Act. Identified funding sources for potential land acquisition include the North Carolina Natural Heritage Trust Fund, Coastal Wetland Grants, Forest Legacy, and Recovery Land Acquisition Grants.

D. Desired future condition

Our desired future condition for this cover type is for the plant communities within pocosin habitats to include permanent water, seasonally flooded areas, areas dominated by cane and diverse herbaceous plants with open canopy, and other areas dominated by dense shrubs.

We intend to continue to maintain our pocosin habitats with prescribed fire when it can be done safely and effectively. In the pocosin habitats that currently have suitable fire breaks; 315 acres (77%) have been burned once since acquisition of their respective properties. The remaining 94 acres lie within burn units and simply have not been incorporated in an active burn rotation. It is our full intention to reintroduce fire into these areas within the next 2 years. Where possible and fuel and weather conditions allow we will continue to burn these areas.

As stated earlier, size and location of pocosin habitats on these properties poses challenges to using prescribed fire in some cases. The characteristics of some of these pocosin habitats (*i.e.*, large size, proximity to other properties, high fuel loads, inaccessible) make it challenging to control fires set under prescription. Smoke management guidelines also present their own unique challenges when burning these areas containing such high fuel loads. In large pocosins without suitable fire breaks we will attempt to use wildfires to maximize the ecological benefits of this occurrence.

One metric for successful management of these habitats will be to identify the pocosin habitats with high wildlife risks and to work closely with the North Carolina Forest Service to manage wildfires in these areas to maximize the ecological benefits in the case of these events. This will include but is not limited to maximizing burnout operations to include pocosin communities and minimizing the use of plowed and/or pushed lines to safely contain wildfires. However, the highest priorities in the event of a wildfire will be the safety and protection of human life, dwellings, and structures.

Additional management actions we may use to manage this cover type include increasing the size of burn compartments, conducting aerial ignition burns, and/or contract burning some of these areas. Other options will be entertained as they arise.

There are currently several fire breaks on this property that require the use of a bulldozer and traditional fire plow while other burnable units not yet in rotation will also require the use of this equipment. As a less intrusive alternative, we will use a farm tractor and disk harrow to establish and maintain fire breaks whenever possible. In the event that a bulldozer and traditional plow are used to establish burn compartments or to gain control of an out of control fire, we will attempt to rehabilitate 100% of these plow lines within 6 months of creation. Finally, every attempt will be made not to establish new fire lines in the pocosin ecotones.

E. Future forest management

Approximately 173 acres (42%) of pocosin habitat on these game lands have been dedicated as Primary areas by the North Carolina Natural Heritage Program. In these areas, the cutting or removal of dead or alive trees is prohibited. Furthermore, due to frequently saturated soils and the high risk of rutting and ground damage due to logging operations, no active forest management will take place in these areas on the Brunswick and Columbus County Game Land Complex, except in the case of restoration after natural catastrophic events.

Small Wetland Communities

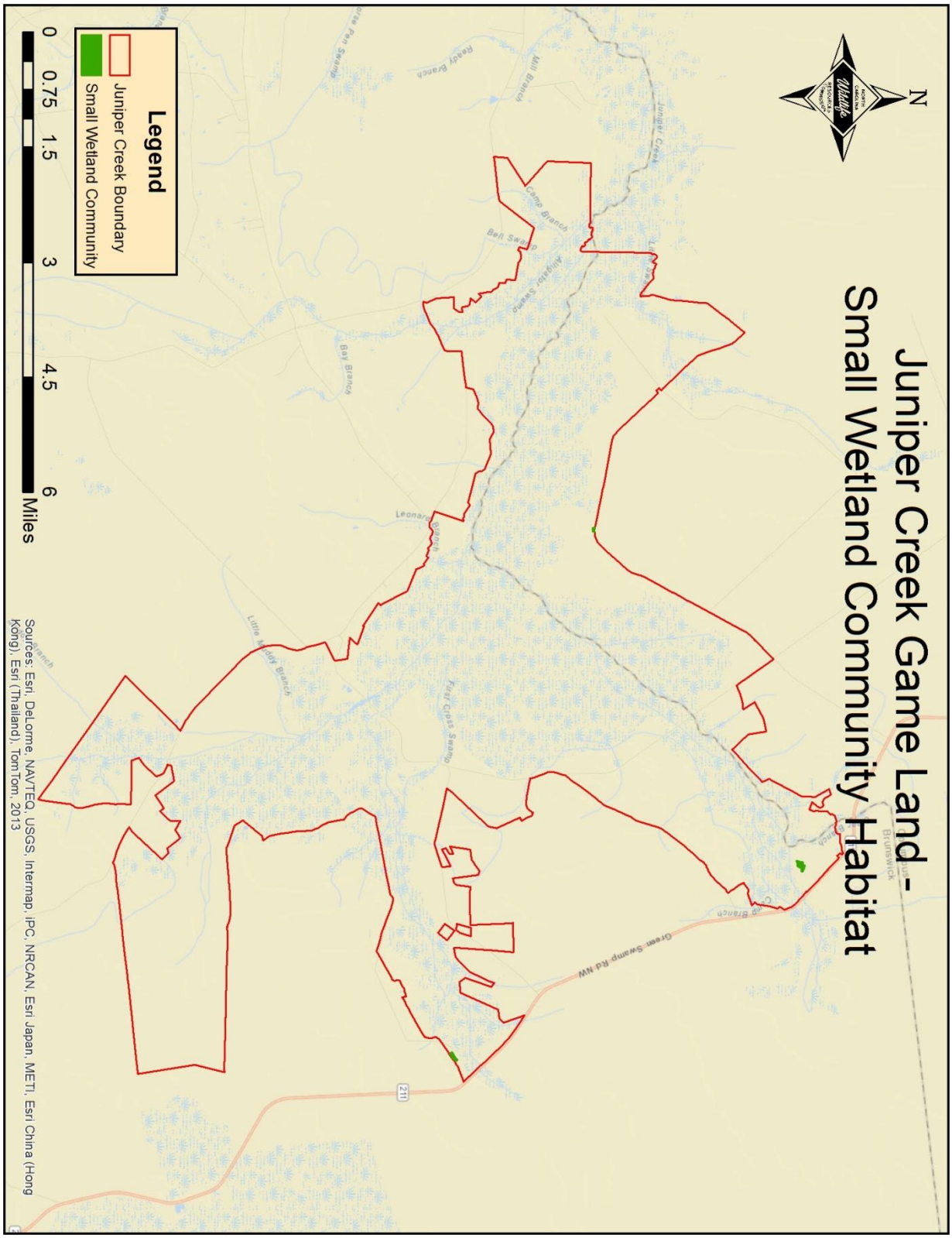
Small wetland communities comprise 9.35 acres (<1%) of the Brunswick and Columbus County Game Land Complex's total acreage. These communities include ephemeral pools and small depression pocosins. They are often mimicked by borrow pit and scrape sites along small dirt roads. These depressions may hold water for a significant portion of the year and most are important habitat for many reptiles and amphibians that are rare or with poorly understood habitat needs.

Ephemeral pools are small sites that flood seasonally and occur throughout the Coastal Plain and Sandhills (Schafale and Weakley 1990). For the most part, ephemeral pools on this property were created during road repairs and are called "borrow" or "scrape" pits. They are dominated by a dense to sparse herb layer and when dry are subject to fires spreading from adjacent uplands. These ephemeral pools are almost always key amphibian breeding sites because they contain no fish.

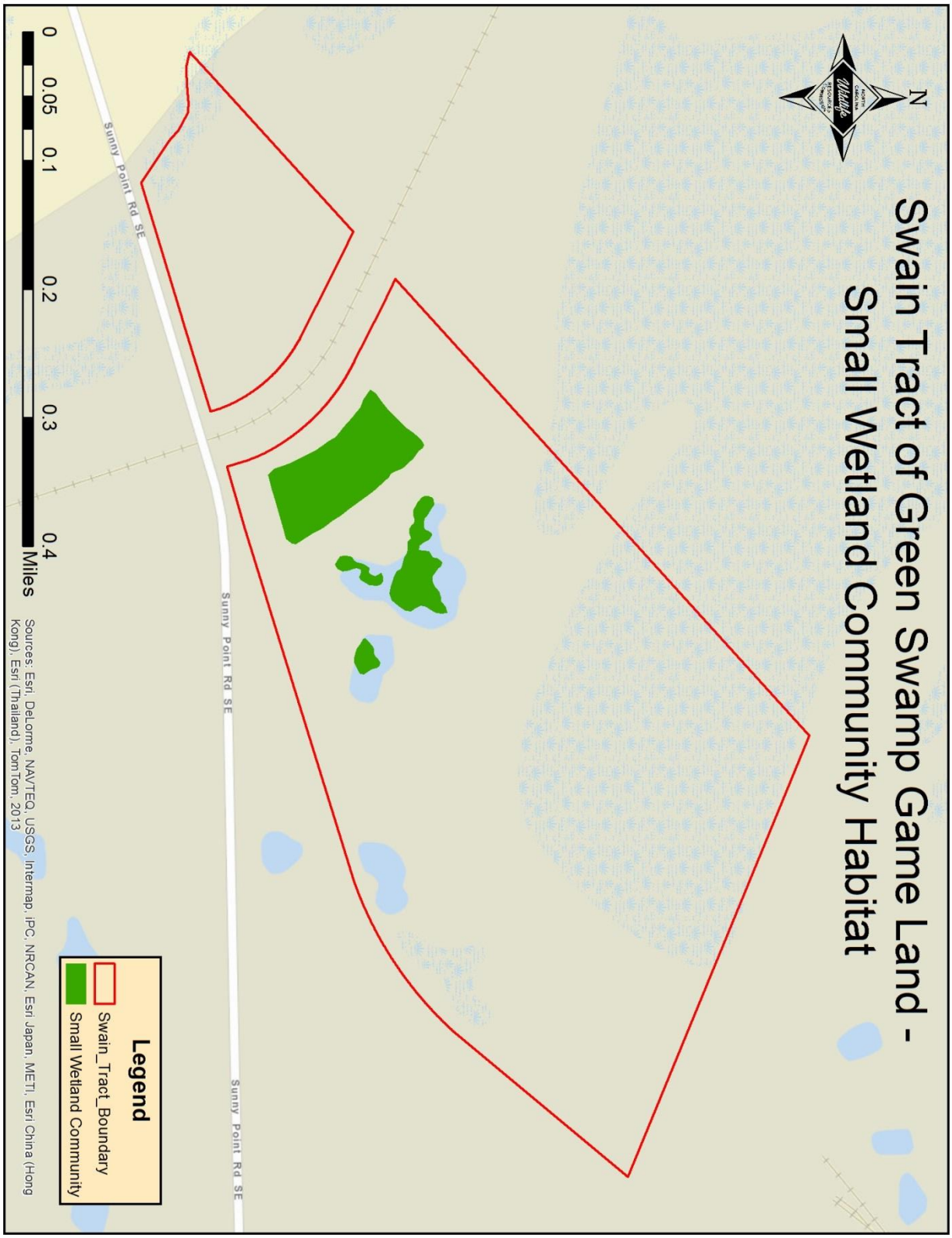
Small Depression Pocosin sites are small depressions found throughout the Coastal Plain and seldom distinguished on soil maps. Historically, portions of these depressions likely burned from fires spreading from adjacent uplands (Schafale and Weakley 1990). These are also important amphibian breeding sites since they rarely contain fish.

A. Location and condition of habitat (See Maps 40 – 41)

These ponds and sinks occur on the Swain Tract of Green Swamp Game Land and Juniper Creek Game Land. Three of the four wetlands on the Swain Tract are considered to be natural depressions. The other pond on the Swain Tract and the ponds on Juniper Creek are borrow pits that were probably dug to relocate the soil for the building of dirt roads in the area. These ponds and sinks are thought to be in poor to fair condition due to woody plant encroachment. This is primarily due to the lack of fire. Ideally, common species of woody vegetation are "knocked back" from the depressions edges due to the historical frequent fire in the ecosystem.



Map 40 – Small Wetland Community habitat on Juniper Creek Game Land.



Map 41 – Small Wetland Community habitat on the Swain Tract of Green Swamp Game Land.

Priority species associated with small wetland communities

Taxonomic Group	Common Name	Scientific Name	State Status (Federal Status)	Natural Heritage Program State and Global Rank
Mammals	Star-nosed Mole	*Condylura cristata*	SR	S_2, G_5T_2Q
Amphibians	Mabee's Salamander	*Ambystoma mabeei*	SR	S_3, G_4
	Oak Toad	*Bufo quercicus*	SR	S_3, G_5
	Dwarf Salamander	*Eurycea quadridigitata*	SC	S_2, G_5T_2Q
	Ornate Chorus Frog	*Pseudacris ornate*	SR	S_1S_2, G_5
	Carolina Gopher Frog	*Rana capito*	T	S_1, G_3
Reptiles	Eastern Chicken Turtle	*Deirochelys reticularia*	SR	S_3, G_5
	Glossy Crayfish Snake	*Regina rigida*	SR	S_2S_3, G_5
	Black Swamp Snake	*Seminatrix pygaea*	SR	S_2, G_5

B. Problems affecting habitat and species

Nearby roads have a great potential to negatively impact amphibians and reptiles using these wetlands. Vehicular traffic on these nearby roads can cause mortality when wildlife traveling to and from these sites are ran over by traffic. These roads also create isolation of breeding populations, or separate wetland habitats from upland habitats that are used during non-breeding portions of amphibian and reptile life cycles.

The lack of periodic fires on these sites has also had impacts on the quality of these habitats. Under a natural fire regime, woody vegetation, at least along the perimeters, would be controlled and plant succession would be reset. Over time and without fire, these small wetland communities succeed to a closed canopy forest; the sunny microhabitats gradually disappear as the interior becomes shaded.

Factors affecting hydrology and water quality also diminish the quality of these habitats. Most amphibians are highly sensitive to changes in water quality. An increase in impervious surfaces due to development has caused excess storm water runoff into adjacent seasonal wetlands.

These isolated wetlands are very valuable to amphibians because they typically do not support fish and other predators of amphibian eggs. The introduction of fish, bullfrogs, and other predatory species can devastate the breeding efforts of amphibians in these small wetlands.

Because the borrow pits are located directly adjacent to roads, there is always a high probability that all-terrain vehicles and other recreational vehicles may be used to enter these sites. These recreational vehicles cause significant soil disturbance, increase erosion and sedimentation, elevate vehicle related mortality rates, and cause noise-related disruptions of faunal activities.

C. Conservation actions necessary to conserve the species and habitat and priorities for implementation

Protection of these sites and surrounding areas is the most critical conservation need in Coastal Plain small wetland sites. The maintenance of contiguous gradients between wetland and adjacent upland sites is critical for seasonal migration and dispersal of amphibians.

Wetland restoration efforts should focus on restoring natural hydrology, water quality, and plant communities. Efforts should continue to be made to reduce run-off, erosion, and pollution of small wetland communities.

Continuing to allow prescribed fire in uplands to burn into and/or through depression wetlands during dry seasons or dry years is recommended.

All-terrain vehicles are not allowed on game lands and "off-roading" or "mud bogging" in highway vehicles is also prohibited. Continued and greater efforts to eliminate these activities, especially in and around these wetland community sites, should be given high priority.

D. Desired future condition

Our desired future condition of the small wetland communities on these properties is to maintain the fire return interval of 3 years on burn blocks containing these habitats. This would help control undesirable woody vegetation in and around these areas that pose threats to their ecological role on the landscape.

E. Future forest management

No forest management activities will be conducted in these habitats.

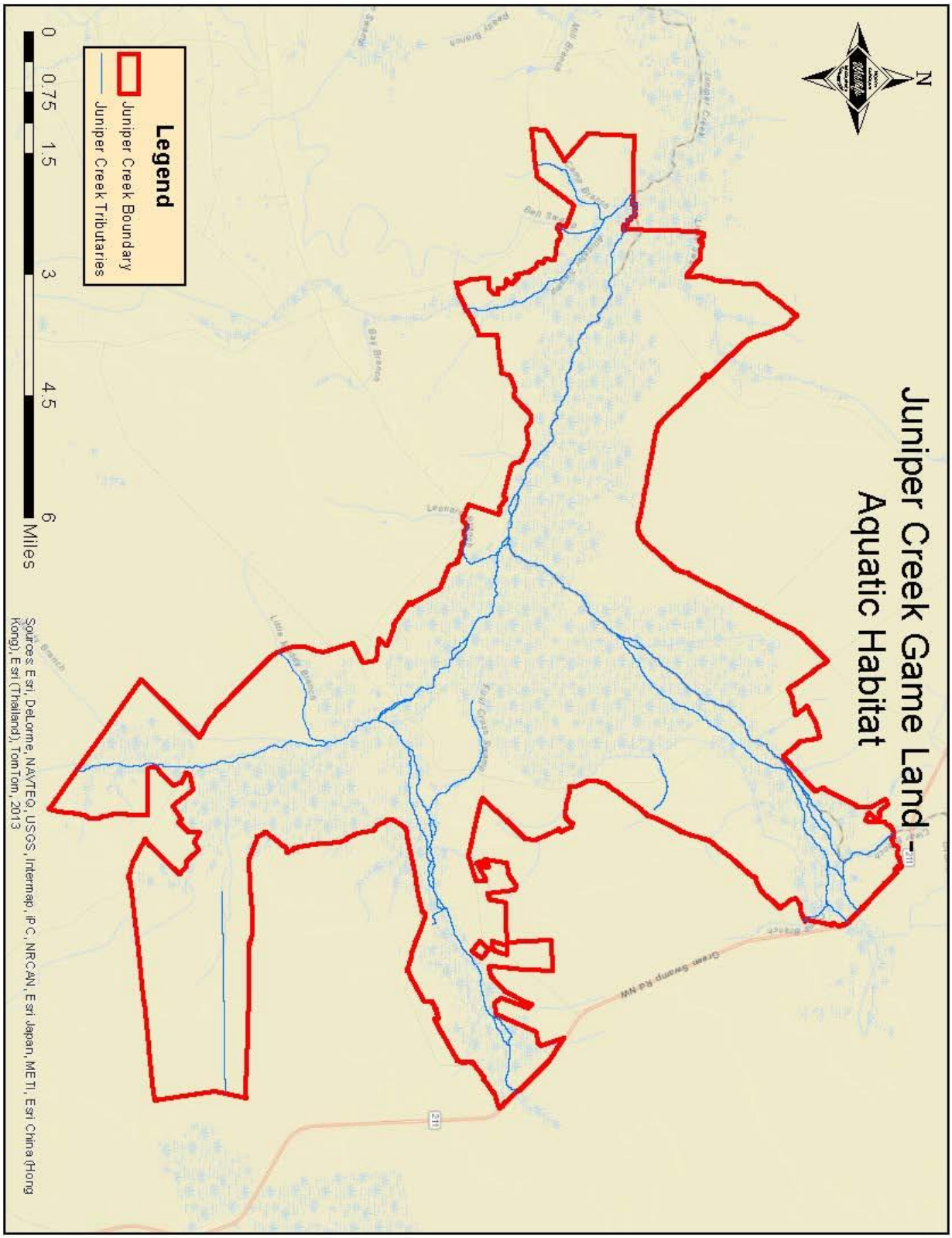
Rivers, Creeks, and Streams

The Brunswick and Columbus County Game Land Complex and its rivers, creeks, and streams lie within the Lumber River basin. This basin is made up of four hydrological units including the Lumber River, Little Pee Dee, Waccamaw, and Carolina-Coastal. The Coastal Plain waters are typically meandering and are associated with swamps, hardwood bottoms, wetland communities, and peatlands (NCDWQ 2003).

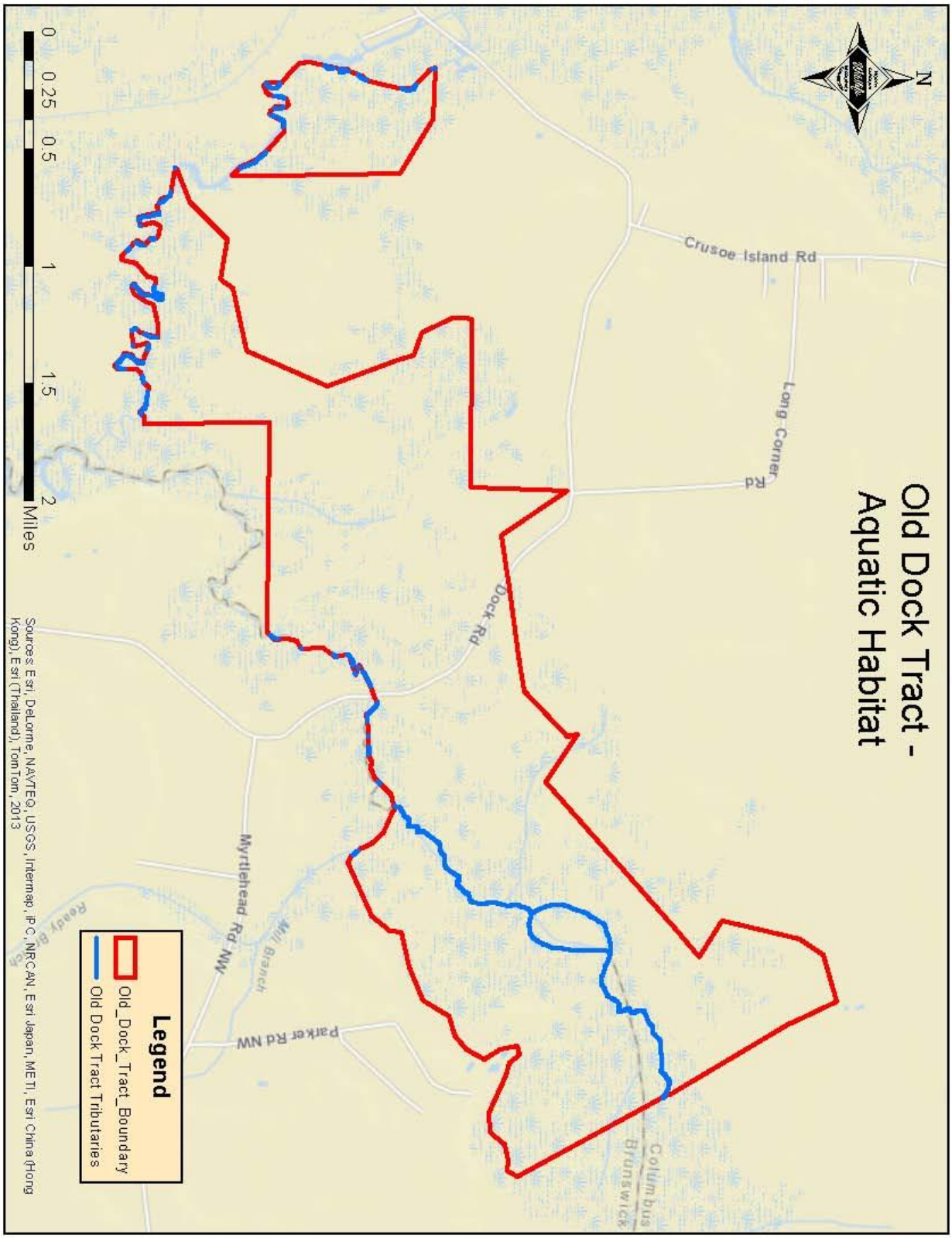
Land use within the Lumber River Basin is 60% forest land, 25% agricultural/cultivated cropland, 7.1% urban, and 8% other (NCDWQ 2003). Impaired streams in the basin total 252 miles and causes of impairment include mercury and fecal coliform (NCDWQ 2003). Sources of pollutants include industrial and municipal emissions, municipal wastewater outfalls, urban runoff, and discharges from animal farms.

A. Location and condition of habitat (see Maps 42 – 45)

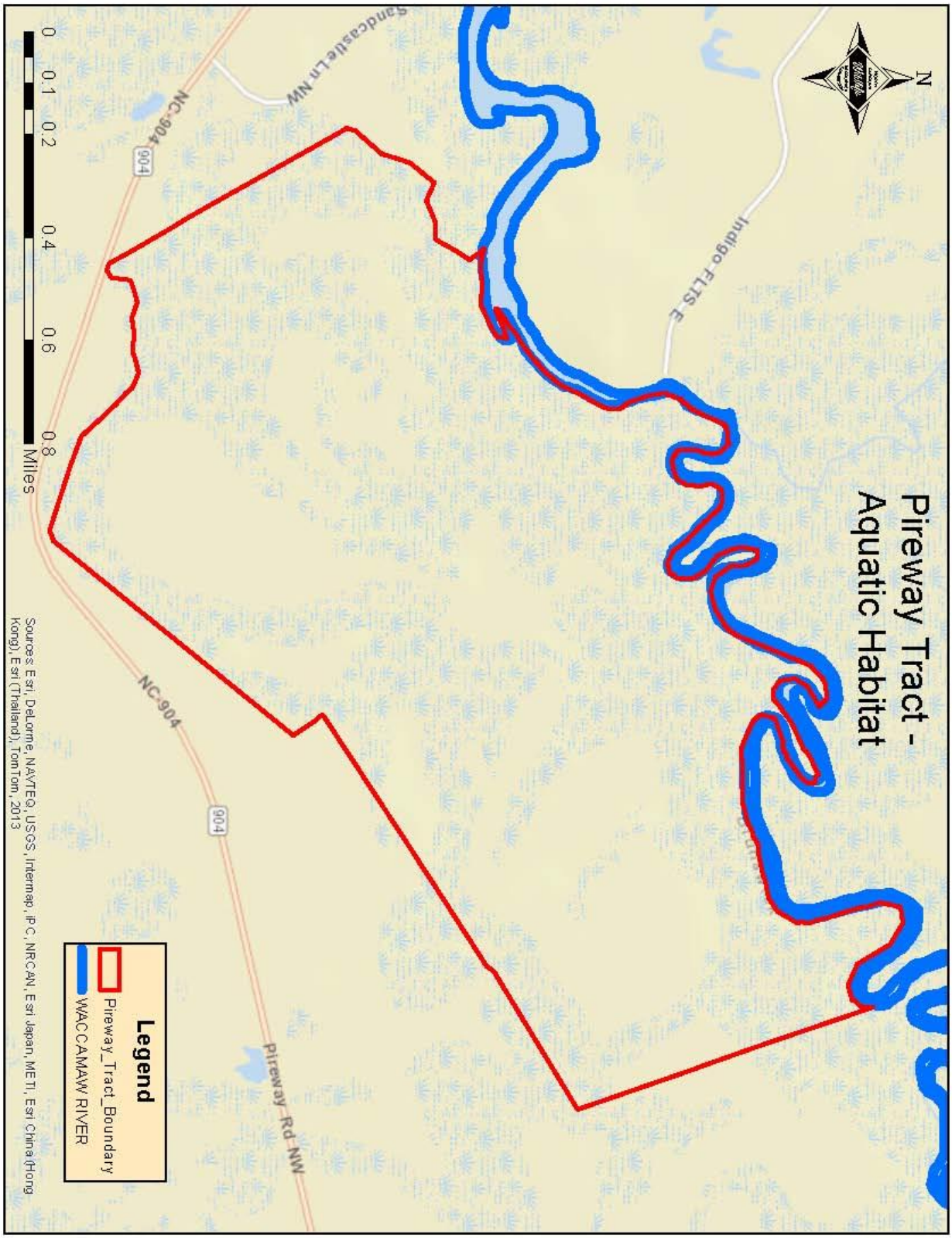
The aquatic habitats within this complex of game lands are located on Juniper Creek Game Land and all three tracts of Columbus County Game Land. Juniper Creek Game Land includes Driving Creek, Juniper Creek, Bear Pen Islands Swamp, First Cross Swamp, Second Cross Swamp, Honey Island Swamp, Alligator Swamp, Bell Swamp, Leonard Branch, Camp Branch, Muddy Branch, Little Muddy Branch, and Clear Branch. Tributaries located on Columbus County Game Land include Second Creek, Third Creek, Big Creek, Juniper Creek, Friar Swamp, Slap Swamp, Mill Branch, Sassapan Branch, and parts of Lake Waccamaw. The Pireway and Old Dock Tracts of Columbus County Game Land border the Waccamaw River.



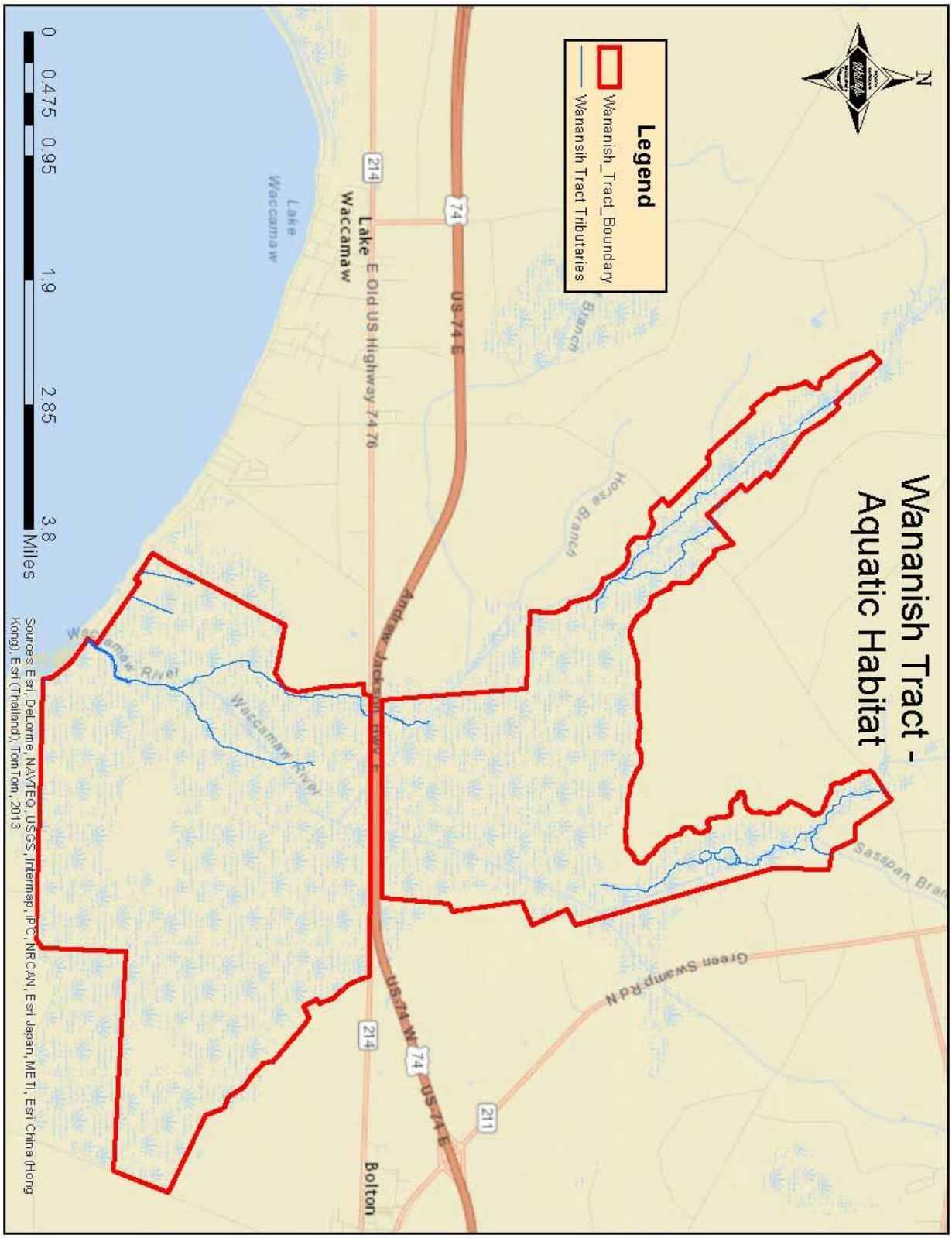
Map 42 – Aquatic habitat on Juniper Creek Game Land.



Map 43 – Aquatic habitat on the Old Dock Tract of Columbus County Game Land.



Map 44 – Aquatic habitat on the Pireway Tract of Columbus County Game Land.



Map 45 – Aquatic habitat on the Wananish Tract of Columbus County Game Land.

Priority aquatic species in the Lumber River/Lower Pee Dee River basin

Taxonomic Group	Common Name	Scientific Name	State Status (Federal Status)	Natural Heritage Program State and Global Rank
Fish	Carolina Pygmy Sunfish	*Elassoma boehlkei*	T	W_3, S_3G_5
	Waccamaw Darter	*Etheostoma perlongum*	SC	
	Waccamaw Killifish	*Fundulus waccamensis*	SC	
	Waccamaw Silverside	*Menidia extensa*	T (T)	
	Broadtail Madtom	*Norurus n. sp.*	SC	
Mussels	Pod Lance	*Elliptio folliculate*	SC	
	Waccamaw Spike[1]	*Elliptio waccamawensis*	E	
	Yellow Lampmussel[1]	*Lampsilis cariosa*	E	
	Waccamaw Fatmucket[1]	*Lampsilis fullerkati*	T	
	Eastern Lampmussel[1]	*Lampsilis radiata radiata*	T	
	Tidewater Mucket[1]	*Leptodea ochracea*	T	
	Eastern Creekshell[1]	*Villosa delumbris*	SR	
Crayfish	Waccamaw Crayfish	*Probambarus braswelli*	SC	
Snails	Waccamaw Snail	*Amnicola sp.*	SC	
	Waccamaw Siltsnail	*Cincinnati sp.*	SC	
	Rotund Mysterysnail[1]	*Viviparus intertextus*	SR	

[1]*Species is only found in Lake Waccamaw, not in the Lumber River basin proper.*

B. Problems affecting species and habitat

Numerous problems affect species and their habitats in these tributaries found on this complex of game lands. Sources of non-point pollution in the area include agriculture, forestry, construction, and storm water discharges. The most significant pollutant is sedimentation in these habitats. Land clearing, agriculture, and wetland filling all contribute to stream habitat degradation (NCWRC 2005). The Lumber River basin has a significant number of swine farms and poor or improper management of animal discharges contributes to organic pollution in the basin and results in high concentrations of fecal coliform. Other point sources include industrial and municipal discharges that contribute toxic compounds and elements such as ammonia, chlorine, and mercury (NCWRC 2005).

C. Priority research, survey, and monitoring efforts needed to identify factors to assist in restoration/conservation of species

Inventory: distributional and status surveys – General surveys are needed to complete the distributional status of fish, mussels, crayfish, and snails (in order of need).

Research to facilitate appropriate conservation actions

- Research should focus on life history studies of priority species and for taxa which little information is known.

Monitoring – Long-term monitoring must be improved across species groups, habitats, and management actions. We must develop monitoring plans that coordinate with existing monitoring programs and overall goals and objectives wherever possible.

- Conduct long-term monitoring to identify population trends
- Conduct special purpose monitoring
- Assess non-native species impacts

D. Conservation actions necessary to conserve the species and habitat and priorities for implementation

Habitat conservation and restoration – Provide support for land protection (e.g., acquisition, easements, buffers).

- Work with local conservation and watershed groups to promote and protect the Lumber watershed (e.g., NC Natural Heritage Program, US Fish & Wildlife Service, Natural Resources Conservation Service, Ecosystem Enhancement Program, Lumber River Conservancy, Friends of Lake Waccamaw State Park, The Nature Conservancy, Winyah Rivers Foundation, Waccamaw Riverkeeper, and Lumber River Consortium).
- Identify priority areas for habitat protection (areas with high species diversity, rare species, and endemic species). Identify specific areas that are critical to the survival of species (e.g., spawning areas) and/or diverse communities.
- Promote and support conservation and restoration efforts within the Commission.
    - Incorporate aquatic priorities into the Watershed Enhancement Program prioritization process, and into game lands and acquisitions.

Population management and restoration

- Reintroduce or augment rare mollusk and fish species populations in areas where water quality and stream habitats have recovered sufficiently to support them.

Data collection, management, and dissemination among agencies

- Improve the quality of data obtained from survey permit holders (this includes capturing data from standard scientific collection permit reports, as well as endangered species permits).
- Improve data exchange with NC Natural Heritage Program.

Partnerships – Support partnerships to achieve common goals, improve efficiency and prevent duplication of efforts.

- Coordinate sampling with other resource groups.
- Issue collection permits for research activities and educational purposes that help achieve specific conservation goals and objectives.

- Support the development and application of an aquatic nuisance species management plan with other agencies/groups.

- Participate in guidance of academic research projects to help achieve specific conservation goals and objectives.

Education/outreach

- Develop new web-based resources; improve and maintain existing web resources (mussel, crayfish, and fish atlases, etc.).

- Develop and disseminate print media, including stand-alone documents, press releases, newspaper and magazine articles, and displays.

- Direct public involvement/outreach:
  - Deliver oral presentations.
  - Participate in educational activities.

- Seek opportunities for direct outreach throughout the basin.

Species and habitat protection efforts

Technical guidance and permit review – Minimize negative impacts on species and habitats (partners include: US Army Corps of Engineers, NC Division of Water Quality, NC Division of Land Quality, US Fish & Wildlife Service).

- Increase efficiency and effectiveness of the technical guidance and permit review process.

- Provide technical guidance to conserve habitats for priority species.

Water quality and habitat protection – Work with regulatory agencies (e.g., US Army Corps of Engineers, NC Division of Water Quality, NC Division of Land Quality, US Fish & Wildlife Service, etc.) to conserve and restore water and habitat quality.

- Support strengthening of water quality protection.
  - Support water quality rules and watershed designations that conserve habitats for priority aquatic species. Outstanding Resource Water and High Quality Water designations should be supported wherever the criteria for designation are met, especially in watersheds that support priority species.

  - Support incentive and information programs that help reduce sedimentation/erosion (e.g., fencing livestock from streams, improve tilling practices), minimize pesticide and herbicide use, modernize wastewater treatment facilities, etc.

  - Specific issues needing to be addressed in this basin include:
    - Secondary and cumulative impacts upon water quality

- Buffer ordinances
- Water supply watershed protection
- Ordinances more stringent than state requirements
- Protect headwaters

Land-use planning – Improve coordination with local and regional land-use planning efforts to affect water quality and habitat conservation.

- Support establishment of riparian buffers along streams, implementation of low impact development and better storm water management through program coordination, cooperative projects, and technical guidance.

Species protection – Support and utilize species listing processes and associated programs to conserve imperiled species and their habitats.

- Support federal and state species listing processes.
  - Focus analysis and synthesis of inventory and monitoring data and reporting to inform decision making pertaining to initial species listing and status revision.
  - When warranted, make recommendations for state listing to the Commission's Nongame Wildlife Advisory Committee.

Permitting – Help ensure that reliable information is provided for project impact assessments by issuing endangered species and scientific collection permits to qualified applicants.

- Improve processes for reviewing applications and tracking performance.

INFRASTRUCTURE DEVELOPMENT AND MAINTENANCE

Objectives/Considerations

(Resource Management, Infrastructure Needs, Biological Impacts, and User Experience Satisfaction)

The built infrastructure should provide for sufficient access and use for wildlife-related recreation, support management activities, contribute to the greatest functionality, and should not negatively impact sensitive habitats or wildlife resources. Some guiding principles for developed infrastructure on Brunswick and Columbus County Game Land Complex are listed below:

- Access and accommodations for users (parking lots and roads open for vehicular travel) should remain in the best possible condition at all times, and remedied in a reasonable time after any failure or damage.
- 2-wheel drive, all-weather access should be provided to popular areas, key locations, and strategic access points on the game land.
- Periodic (or emergency) maintenance and repair should be performed on all infrastructure contained on the game land to keep assets in the highest working order and function.
- Infrastructure should be repaired, renovated, or replaced prior to exceeding the reasonable "life span" expectancy when feasible.
- The aesthetic appeal and integrity of Brunswick and Columbus County Game Land Complex should be maintained.
- Through traffic (i.e. cars driving *through*, not *to* the game land) should be discouraged.
- Disabled access should be made to new and existing facilities where possible.
- Erosion related to infrastructure should be avoided, minimized and/or mitigated.
- Traffic speeds (non-DOT roads) should be slow (<30 mph) for public safety, to encourage slower, scenic driving, to minimize conflicts between vehicles and pedestrians, and to minimize wildlife-vehicle collisions and reduce road-kill wildlife mortality.
- Trails, firebreaks, and roads will not be designated for the exclusive use of particular user groups or activities.
- Some of the species found on the game land are sensitive to the direct and indirect impacts of roads and other development. Large tracts of forest free from roads and other infrastructure should be maintained.
- While meeting user and management needs, built infrastructure should leave a minimal footprint on the game land.

Assessments of existing infrastructure throughout Brunswick and Columbus County Game Land Complex were conducted by Engineering & Lands Management staff in 2015. The infrastructure

maps included in the appendices of this document show the locations of existing public roads, administrative access roads, trails, and gates within the game land. The results of the assessments along with recommendations for maintenance and improvements are discussed by category below.

Road Assessment

See Appendix III, Road Infrastructure Map.

The tracts that comprise Brunswick and Columbus County Game Land Complex include the Juniper Creek Game Land, Green Swamp Game Land, and Columbus County Game Land.

Most tracts within the Complex have access from one or multiple NCDOT maintained roads. Tracts without frontage on a state maintained road have access via an access easement across private property. NCWRC maintains a road network within most of the tracts to provide the public and staff with additional access to the properties. At Juniper Creek Game Land, numerous roads at the perimeter for the Game Land are shared access roads, which are jointly used and maintained by NCWRC and the adjoining property owners.

The game land roads provide public access, administrative access, and firelines. The focus of this assessment is on the approximately 45 miles of year round and seasonal public access roads maintained by NCWRC. Public access activities include but are not limited to the following: hunting, fishing, hiking, wildlife viewing, geocaching, and other outdoor recreation.

Existing Road Conditions

The overall condition of the public access roads vary from good to poor. The roads primarily are sand/soil roads with two travel lanes and drainage ditches on each side. The roads have limited gravel coverage, are sensitive to moisture and become difficult to traverse when wet. Maintenance demands are considerable given the sensitivity to moisture and location of many roads in flood prone areas. Most of the roads were constructed for timber management access prior to the properties being purchased by the State of North Carolina. A limited portion of the roads have been improved by the installation of stone driving surface. More of the roads have been improved by daylighting of the road area (removing trees to allow sunlight to reach the road surface). The roads require periodic maintenance with a motor grader to remove rutting and maintain drainage off of the roads.

Many of the roads within the Complex are shared access roads, which provide access to both the Game Lands and to private properties. The shared access roads provide additional challenges for maintenance and improvements, as efforts must be coordinated with private parties. The shared access roads are also periodically used by private parties for timber management activities, which can damage the roads.

An example of a major road that is in good condition is Big Timber Road, from Makatoka Road to Driving Creek Road, on the Juniper Creek Game Land. Big Timber Road provides access into the southern portion of the game land. The portion from Makatoka Road to Driving Creek road has and all weather gravel surface averaging 20' wide. Drainage ditches are located on both sides of the road. The travel way is elevated above the natural ground surface on either side of the road. Cross drainage is provided by one bridge and multiple corrugated metal culverts.

Future Road Improvements

The majority of roads within the Brunswick and Columbus County Game Land Complex are in fair to poor condition. The primary improvements needed are crowning and drainage improvements to reduce saturation of the road surface and installation of a gravel driving surface. Some road sections also need additional ditches and cross drain pipes and daylighting and opening of the road corridor. Many of the existing culvert and bridges are reaching the end of their useful life and will require replacement. The existing roads and intersections are of sufficient width to allow parking along the roads without restricting travel on the roads. Designated parking areas should be marked at high usage areas. The future road improvements have been broken down into high, medium, and low priorities. It should be a goal to perform the high priority projects over the next 10 years with the medium priority projects done next as resources allow. At the end of this ten year period, a new assessment will be performed and new priorities set.

A project is currently underway to improve Tram Road (Juniper Creek Game Land), from Camp Branch Road to Little Swamp Road. Since this project is underway, Tram Road has not been listed as a priority project.

HIGH PRIORITY

The following roads are high priority:

- Juniper Creek GL – Fernside Road and Camp Road
- Juniper Creek GL – Swamp Road
- Juniper Creek GL – Ernest Canady Road, Driving Creek Road, Lattay Hanes Road
- Juniper Creek GL – B Sykes Road
- Juniper Creek GL – New Road

Juniper Creek GL – Fernside Road and Camp Road

Fernside Road and Camp Road are located in the northern portion of the Juniper Creek GL and are located solely on game land property. The two roads form a loop through the property and connect to Little Swamp Road at either end. Fernside Road has recently been improved by daylighting a substantial section of the road. Future improvements would include additional daylighting, drainage improvements, and installation of a stone driving surface. The two roads total 6.7 miles in length. The cost of the road improvements is estimated to be $840,000.

Juniper Creek GL – Swamp Road

Swamp Road is located solely on game land property and forms a connection between Camp Branch Road and Makatoka Road. Swamp Road is currently not passable due to drainage cuts through the road and unstable sections. Future improvements would include daylighting the road corridor, culvert installations and replacements, and installation of a stabilized stone driving surface. The road totals 1.9 miles in length. The cost of the road improvements is estimated to be $320,000.

Juniper Creek GL – Ernest Canady Road, Driving Creek Road, Lattay Hanes Road

Ernest Canady Road, Driving Creek Road, and Lattay Hanes Road form a loop around the southeastern portion of Juniper Creek GL, from Makatoka Road to Big Timber Road. All three of these roads are shared access roads, where the road forms the boundary between game land property and private land. NCWRC plans to utilize these roads in the near future for timber management activities. The roads are also periodically used by private land owners for timber management. The roads are currently passable, but become difficult to navigate when wet. Sections of the road also deteriorate quickly when subjected to heavy truck traffic. Future improvements would include daylighting a portion of the road corridor, crowning the road, removal of high shoulders, culvert replacements, and installation of a stabilized stone driving surface. The roads total 6.1 miles in length. The cost of the road improvements is estimated to be $765,000.

Juniper Creek GL – B Sykes Road

B Sykes Road is located solely on game land property and forms a connection between Ernest Canady Road and Driving Creek Road. The road is currently only passable by four wheel drive vehicles due to wet and rutted sections. NCWRC staff has installed gravel on portions of the road to improve access. Future improvements would include culvert replacements, subgrade stabilization, crowning the road section for drainage, and installation of a stabilized stone driving surface. The road is 1.1 miles long and the cost of improvements is estimated to be $165,000.

Juniper Creek GL – New Road

New Road is a shared access road that connects Bear Pen Airstrip Road to Big Timber Road. New Road is not currently passable in wet periods due to soft subgrade and flooding of the road. When open, New Road allows passage on game land roads from NC 211 to Makatoka Road. Future improvements would include drainage improvements, raising the road surface, and installation of a stabilized stone driving surface. The road section is 1.0 mile long. The cost of road improvements is estimated to be $150,000.

MEDIUM PRIORITY

Juniper Creek GL – Short Swamp Road
Juniper Creek GL – Big Timber Road (Driving Creek Road to New Road)
Juniper Creek GL – Bear Pen Island Road
Columbus County GL – Old Dock Tract
Columbus County GL – Pireway Tract

Juniper Creek GL – Short Swamp Road

Short Swamp Road is located solely on game land property and forms a connection between Fernside Road and Little Swamp Road. The road is currently in fair condition. The road surface is elevated above the ground level on either side of the road. Future improvements would include daylighting of the road corridor and installation of a stone driving surface. The road section is 0.5 mile long. The cost of road improvements is estimated to be $60,000.

Juniper Creek GL – Big Timber Road (Driving Creek Road to New Road)

Big Timber Road, from Driving Creek Road to New Road, is in fair condition. The road section shows signs of rutting when used in wet periods. The road has a soil/sand driving service and does not have ditches in all locations. Future improvements would include improvements to drainage and installation of a stone driving surface. The road section is 1.2 miles long. The cost of road improvements is estimated to be $140,000.

Juniper Creek GL – Bear Pen Island Road

Bear Pen Island Road is a spur road off of Big Timber Road, which provides access towards Juniper Creek. Bear Pen Road is envisioned as providing hunters with vehicular access to the center of a land tract, with other trails radiating outward. The road is in poor condition, primarily due to a deteriorating bridge and the low lying nature of the road. Future improvements would include replacement of the existing bridge with another bridge or culvert, raising the elevation of sections of the road, and installation of a stone driving surface. The road section is 0.6 mile long. The cost of road improvements is estimated to be $100,000.

Columbus County GL – Old Dock Tract

There is an existing access road into the western section of the Old Dock Tract, near the Columbus/Brunswick County line. The road section is 0.8 mile long. The road is in fair condition, but portions are subject to flooding. Future improvements would include daylighting the road corridor, improving drainage, and installation of additional gravel. The cost of road improvements is estimated to be $100,000.

Columbus County GL – Pireway Tract

An access road across private property is used to enter the Pireway Tract of the Columbus County GL. The road section is 0.3 mile long and a designated parking area is located at the end of the access road. The access road is in poor condition. Recommended improvements include daylighting the road as may be acceptable to the land owner, improving drainage along and across the road, and installation of a gravel driving surface. It is further recommended that gravel be installed at the designated parking area and that signage be installed on NC 904 to direct users to the parking area. The cost of road improvements is estimated to be $45,000.

LOW PRIORITY

Green Swamp GL – Pinch Gut Tract (Access Road)

The Pinch Gut Tract of the Green Swamp GL does not have access from a public road. Access to the tract is provided by a 2.2 mile long shared access road. The access road is also used by adjoining property owners and to access a television tower. The access road is in fair condition and is not all weather accessible. The road does not have a gravel surface and is not well crowned. There are several locations where storm water is washing across the road. Future improvements would include crowning the road, installation of cross drainage and drainage ditches in locations, and installation of a stone driving surface. This road is on private property and shared with other users, so improvements would have to be coordinated with the other users. The total cost of road improvements is estimated to be $260,000.

Road Maintenance

All roads require inspection and maintenance to function well and avoid damage and deterioration. Maintenance should be performed regularly, as the longer the delay in needed maintenance, the more damage will occur and the more costly the repairs will be.

Typical Road Maintenance Practices

- Inspect roads regularly, especially before the winter season and following heavy rains.
- Keep ditches and culverts free from debris (see also Culvert Maintenance Section of this Management Plan).
- Remove sediment from the road or ditches where it blocks normal drainage.
- Regrade and shape the road surface periodically to maintain proper surface drainage.
    - Typical road should be crowned at approximately 4%, or ½" per foot.
    - Some roads may not require a crown, but should have a constant cross slope (super-elevation).
    - Gravel should be distributed at an even depth across the road.
    - Gravel should have an even distribution of fine and course materials.

    - Keep downhill side of the road free of berms, unless intentionally placed to control drainage.
    - Proper maintenance and grading of the road will require a motorgrader and a roller.
- Avoid disturbing soil and vegetation in ditches, shoulders, and cut/fill slopes to minimize erosion.
- Maintain shoulders on both sides of the road to ensure oncoming vehicles have enough room to pass. Shoulders should be relatively flat and periodically mowed.
- Maintain an erosion-resistant surfacing such as grass or rip-rap in ditches.
- If it is determined that a road needs major repairs or upgrade, contact Regional Supervisor and Design Services to schedule an assessment.

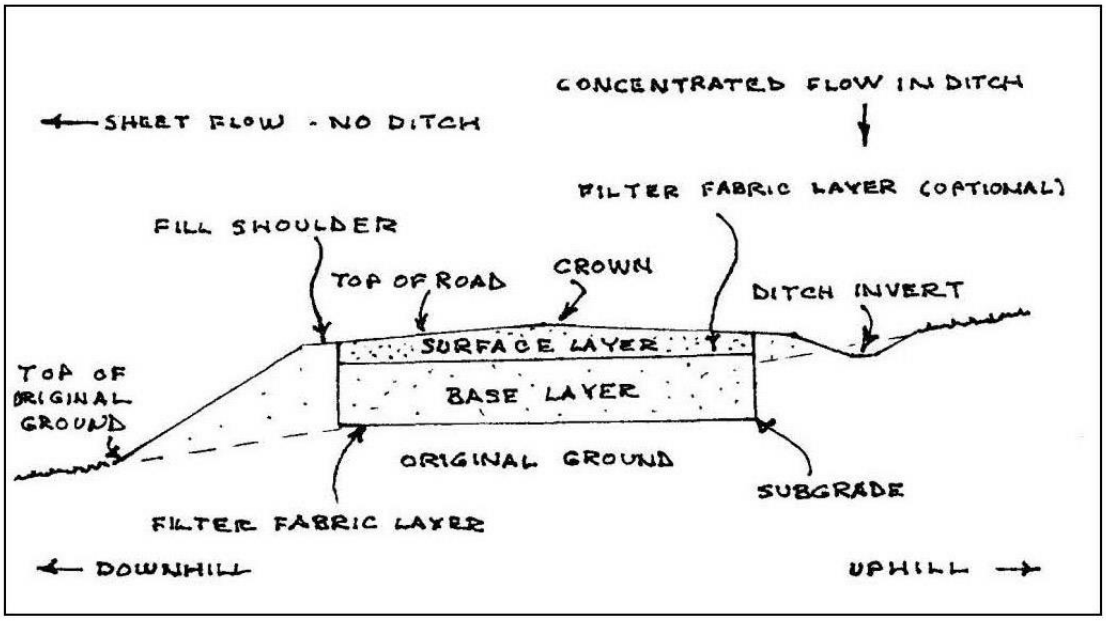


Figure 2 – Typical Road Cross-Section – Canaan, NH Highway Department

Road Safety Features

- Remove trees and other vegetation as necessary to provide adequate sight distance and clear travel way.
- Install and maintain road signage. This includes:
    - Stop signs –Should be installed at every major road intersection, with the signs on the minor roads.
    - Warning signs – Should be installed to warn the public of any road closures or problems in the game land.
    - Road/Route signs – Should be installed at every major road intersection.

- Information kiosks with Game Land Road Map – Entry signs should be installed at key entrances to the game land off of DOT roads. Information kiosks should be located near the major entrances and parking areas.

Gates

Gates should be used on game lands for maintenance and habitat conservation. For maintenance purposes, gates should be used to limit access to roads that are unsafe or are in disrepair, or to limit use on roads to certain times a year in order to minimize the wear and deterioration of the road. If a road is considered unsafe or in disrepair, field staff should contact an engineer. The engineer will perform an inspection to determine the best course of action to repair or upgrade the road. All gates installed on game lands should the standard swing gate and painted orange or yellow for maximum visibility. No cable gates should be installed, and any existing cables should be replaced.

TROUBLESHOOTING

Road Surface Problems

Problem: Longitudinal erosion of the road surface
Possible Causes:

- Flat or U-Shaped road. A crown or super-elevation of the road is needed to shed water laterally off the outer edges of the road surface.
- Small ridge of soil or grass growth along the outer edge of the road is preventing water from draining off the road surface. Edge needs to be graded to remove this ridge.
- Water is traveling in a wheel rut. Road needs to be regraded. This problem often results from soft roads.
- Road ditch is not large enough and overflows onto road surface. Install more frequent turnouts to get water away from the road or increase the size of the ditch.

Problem: Lateral erosion cutting across the road surface
Possible Causes:

- Most often occurs at a low spot in the road or where a ditch filled in and no longer functions. Water builds up and overtops and erodes the road surface. A culvert should be installed in this location.

Problem: Potholes
Possible Causes:

- Potholes are typically caused by insufficient crown or road cross slope. The road should be re-graded to remove the potholes, then re-crown or super-elevate the road as necessary.

Ditch Problems

Problem: Bottom of ditch is eroding
Possible Causes:

- Slope of ditch is too steep to handle the flow without additional protective measures, which include additional vegetation, erosion control mats, rip-rap, check dams, etc.
- Ditch is too small to handle the volume of water flowing through it. May need to install periodic turnouts to reduce flow through the ditch.
- Bottom of ditch is too narrow and needs to be widened to a parabolic shape.

Problem: Sides of ditches are slumping or eroding
Possible Causes:

- Side-slopes are too steep and need to be lessened by reshaping the profile.
- Side-slopes need to be stabilized with additional vegetation, erosion control mat, or rip-rap.

Parking Areas

Currently, there are two designated parking areas within the Brunswick and Columbus County Game Land Complex.

One parking area is located on the Herbert Swain Tract of the Green Swamp Game Land. This portion of the game land is located adjacent to the Sunny Point Military Ocean Terminal. The parking area is marked and provides the public with a location to park off of Sunny Point Road. This parking area is in good condition.

The second parking area is located on the Columbus County Game Land, near the Pireway Boat Access Area. This section of game land is accessed by an easement across private property. Once on the game land, the parking area provides users a location to park and access the game land on foot. This parking area is in fair condition. Installation of stone base and drainage improvements to the parking area and access road are needed to allow all weather access.

Most of the access roads within the Brunswick and Columbus County Game Land Complex are wide enough to allow parking at the side of the road, while maintaining through traffic. Intersections of access roads also provide wide areas for potential parking and turning around.

Over the duration of this Management Plan, it is recommended that additional parking areas should be provided. Creating parking areas at administrative access points off of NCDOT maintained roads allows for all weather access points to be easily created, with minimal impact to the game land.

Any new parking area should provide a gravel surface (approximately 6” layer of compacted ABC stone) and provide enough parking for three to five vehicles. Depending on the amount of use,

clearing, and grading required, it is estimated that each parking area will cost between $5,000 and $15,000.

Gates

There are 71 existing gates located throughout the game land, which limit access to certain roads and portions of the game land. The majority of the gates on the game land are pipe gates with some cable gates. The cable gates should be phased out in favor of pipe swing gates, for safety concerns. Periodic maintenance and replacement of gates is required, primarily due to vandalism.

The game land is typically closed outside of hunting season, with all gates closed and locked. Some gates on the game land are opened/closed during specific times of the year, typically for deer and turkey hunting seasons.

Drainage Structure Assessment

Dams

There are no known dams located on the Brunswick and Columbus County Game Land Complex.

Waterfowl Impoundments

There are no managed impoundments on the Brunswick and Columbus County Game Land Complex.

Culverts

Due to the size of the game land complex and total number of culverts, inspection of all culverts annually is impractical. Culverts on the game land complex are typically corrugated metal culverts that are submerged during parts of the year. In the past, there have been some issues with culverts becoming clogged by woody debris. Some of the culverts are difficult to inspect and unblock due to being submerged most of the year. NCWRC staff have identified several culverts that are in need of replacement and a project is in progress to perform this work. It is anticipated that additional culverts will require replacement during road improvement projects and as part of road maintenance.

(Culverts replaced on perennial streams should allow the passage of aquatic organisms.)

Culvert Maintenance

Culvert maintenance is performed to extend the life and ensure proper function of the installed drainage structure. The accumulation of sediment and/or debris at the inlet or outlet of a culvert or damage such as crimping of the pipe effectively reduces the diameter and flow capacity of the pipe.

Culvert maintenance includes removal of accumulated sediment and/or debris that prevents passage of water (and organisms) through culvert inlets, outlets, and connected drainage ways. It may also include reinforcement of eroding inlets and outlets by installing riprap or other erosion control measures. Damaged culverts and culverts requiring frequent repeat maintenance should be considered for future remediation via redesign and reinstallation.

The following items should be checked for and addressed as part of routine maintenance inspections:

- partial or complete blockage of the inlet or outlet of the pipe with sediment, stone, leaves, woody debris, refuse, or any other items that could affect flow through the culvert
- evidence of scour, bank, or channel bed erosion near the inlet or outlet of the culvert
- evidence of flow overtopping the road at the culvert location
- damage to the pipe including crimping of the inlet or outlet, crushing or piercing of the pipe
- severe corrosion of the pipe
- damage to headwalls

Staff should inspect ditches and culverts as part of their regular road maintenance activities. This inspection is especially important during leaf-fall and following periods of heavy rain. Staff should consider the location of the culvert before performing maintenance using heavy equipment. Culverts located in active stream channels, dedicated or critical habitat areas may require special permission or installation of erosion control measures before maintenance can commence. Leaves and woody debris that have accumulated in or around the inlet of the culvert should be removed immediately using hand tools, if possible. Removal of accumulated silt and/or gravel from ditches approaching the culvert inlet should be performed using a small excavator, backhoe, or a tractor equipped with a scrape blade. Sediment in or around the immediate vicinity of the pipe inlet or outlet should be removed using hand tools to prevent damaging the culvert. Cleaned out material is to be pulled away from the culvert then hauled and spread at a site where it cannot be washed back to the culvert area.

Repeat problems with sediment collecting around the inlet may indicate the existence of an erosion problem originating from the slopes, streams, or ditch lines in the vicinity of the culvert. Identification and stabilization of these problem areas through practices such as seeding or matting could improve performance of the culvert and reduce maintenance requirements.

Flow overtopping the road at the culvert location generally indicates that the pipe is undersized and could warrant resizing and replacement. Any damage to the culvert, as described above, may also necessitate replacement of the pipe. If maintenance staff identifies any culverts that may need replacement, they should contact engineering staff to calculate the peak flow capacity and diameter of the new pipe.

Boundary

The Brunswick and Columbus County Game Land has approximately 111 miles of boundary line that is maintained. Most of this boundary adjoins private land (without road access), though there is considerable boundary mileage adjoining DOT road frontage, shared access roads, and along major creeks. Annually, around 20 miles are painted and posted. NCWRC staff and private contractors are utilized to mark the boundaries. It is expected that contract boundary posting will continue in the future on an as needed basis.

RECREATIONAL FACILITIES ASSESSMENT

See Appendix III, Road Infrastructure Map.

Boating Access Areas

There are two public boating access facilities in the Brunswick and Columbus County Game Land Complex, both within the Columbus County Game Land.

The Pireway Boat Access Area is located on the Waccamaw River in western Brunswick County. The access area is in good condition. The site includes two single lane ramps, a floating courtesy dock, gravel parking, and concrete sidewalk from the handicap parking to the ramp area. The ramps and dock were renovated in 2007.

The Lake Waccamaw Boat Access Area is located on Lake Waccamaw in Central Columbus County. The parking area is in fair condition. The ramps are in poor condition. The parking area is gravel, and there is not currently any handicap accessible parking spaces. The site includes two single lane ramps, three fixed docks, and a substantial amount of bulkhead. The ramps have broken and uneven concrete areas that make launching boats difficult. The fixed docks and bulkheads show signs of settlement, as the walking surfaces are no longer level. The boat ramps were installed in 1975 and the fixed docks were installed in 1980. This BAA is currently being evaluated for improvements.

Public Fishing Access

There are no Public Fishing Access Areas on the Brunswick and Columbus County Game Land Complex.

Shooting Ranges

There are no shooting ranges on the Brunswick and Columbus County Game Land Complex.

Hunter Access Bridges

There are a limited number of hunter access bridges within the Juniper Creek Game Land. The bridges allow easy access across road side drainage ditches, which are often flooded. Access bridges that are beginning to deteriorate will require replacement. There are additional locations on the Juniper Creek Game Land where access bridges would provide increased access to the public.

NON-TRADITIONAL USES

Geocaching

Geocaching is a recreational activity, in which participants use a GPS receiver or mobile device to hide and locate hidden containers, or caches, located somewhere outdoors. Game lands have become a very popular geocaching location, with hundreds of hidden caches. At this time, it is not known how extensively the Brunswick and Columbus County Game Land Complex is utilized for geocaching. There are no major infrastructure elements required for this non-traditional use, but it would be beneficial to the participants to provide parking areas near the start/end of the geocaching trails.

Hiking/Camping

The Brunswick and Columbus County Game Land Complex currently includes two designated primitive camping areas, both located on the Juniper Creek Game Land. The camping areas are cleared areas adjacent to access roads. The camping areas do not have restrooms or running water. One camping area is located at the intersection of Fernside Road and Camp Road. The second camping area is located off of Bear Pen Road.

The game land contains many miles of roads, trail, and fire lines. It is anticipated that the existing network of roads, trails, and fire lines will be sufficient to meet demand for hiking, hunting, and other uses. Hikers and hunters are not restricted to roads and trails and are welcome (and encouraged) to walk across all open portions of Brunswick and Columbus County Game Land Complex. As demand increases, staff will evaluate the need for establishing additional trails.

RECREATIONAL FACILITY MAINTENANCE

Maintenance of recreational facilities is critical to the overall operation of the game land program. Typical use of the game lands is dispersed, however, recreational facilities concentrates users on a specific area or feature. This concentration of users, whether it is a boating access, fishing access, shooting range, or other use, results in a need to ensure the facility is safe and functional. Routine site visits for inspection and maintenance will accomplish this goal. Site visits should consist of two actions: (1) Inspection for safety issues and functionality, (2) Actual maintenance activities.

1. Inspections should examine the following items
    a. Safety inspection items:

Facility components

- Decking
- Handrails
- Structural supports (piles, substructure, and floats)
- Fasteners (bolts, screws, and nails)

Slip or trip hazards

- Uneven walking surfaces
- Mud on walking surfaces
- Ponded water on walking surfaces
- Drop-offs

Overhead

- Dead trees or limbs
- Overhead utilities

b. Functionality Inspection Items

Parking

- Surface condition (ruts, potholes, gravel)
- Delineation (wheel stops, paint)

Ramp

- Blockages (sediment, wood)
- Surface condition

Pier/Dock

- Bollards
- Wooden components
- Bumpers

Shooting range

- Berms
- Target area
- Benches
- Shelter (roof, structure, and floor)

Signage

- Kiosk (entrance, regulation, and information)
  - ADA
  - No Parking
  - Keep Ramp Clear

2. Maintenance activities should include routine and corrective activities
   a. Routine Activities include:
      - Litter and debris removal
      - Grass mowing
      - Woody vegetative growth control

b. Corrective activities can include but not be limited to:
    - Lumber replacement
    - Sign replacement
    - Minor grading
    - Tree or limb removal

Over time recreational facilities degrade to the point that routine maintenance activities cannot provide corrective action. Examples of this level of degradation include but are not limited to: structural problems, persistent and/or severe erosion issues, and broken/or severely degraded concrete. Once this level of degradation is reached, supervisory personnel should inspect the facility and determine the scope of the needed repairs. If major repairs are required, supervisor personnel should contact an engineer for assistance.

PUBLIC USES

As stated previously in the Game Lands Program Mission Statement, primary public uses of North Carolina game lands are hunting, fishing, trapping, and wildlife viewing. However, the NCWRC recognizes the desirability of providing opportunities for other activities on state-owned game lands that are feasible and consistent with the agency's mission, and compatible with these traditional uses.

As the human population of North Carolina has rapidly grown, state-owned game lands have received increasing pressure to provide public outdoor recreation opportunities. These uses include traditional activities such as hunting, fishing, trapping, and wildlife viewing, as well as other outdoor recreation pursuits. While hunting, fishing, trapping and wildlife viewing are the primary public uses of state-owned Game Lands, the NCWRC has always allowed and supported other dispersed and non-developed recreational activities. The funding sources of the NCWRC, however, are focused on natural resources management rather than recreational development. Because of this, the NCWRC must exercise care in providing for recreational activities that may not be compatible with the natural resources for which the lands are valued and the primary management objectives of these lands.

As a response to these increasing pressures, the NCWRC developed a Game Lands Use Evaluation Procedure to provide a statewide framework for determining appropriate uses for NCWRC-owned or controlled game land properties.

DIFFERENT USER GROUPS OF THE BRUSWICK AND COLUMBUS COUNTY GAME LAND COMPLEX

Based off of anecdotal information and input received from the public input processes that occurred from 16 February to 10 April 2015, we have made our best determination of different user groups that occur on the Brunswick and Columbus County Game Land Complex. They are listed below and are discussed in greater detail following their listing.

Traditional game land users:

- Hunters
- Trappers
- Anglers
- Wildlife viewers

DISCUSSION OF TRADITIONAL GAME LAND USERS

Hunters, anglers, trappers, and wildlife viewers make up the vast majority of groups that use game lands within this Complex. Hunters make up largest number of traditional users with anglers, wildlife viewers, and trappers consisting of the remainder, in order of numbers, respectively.

As discussed earlier in the Plan, Juniper Creek Game Land is a six-day-per-week area and both Columbus County and Green Swamp Game Lands are three-day-per-week areas. During the public comment period, no comments were received that expressed dissatisfaction with the structure of hunting days allowed on these areas. Overall, we believe that traditional users are satisfied with hunting opportunities provided on these game lands.

Waterfowl hunters

Waterfowl hunting on these areas does not occur at very high levels. Opportunities are limited by the available habitat for wintering waterfowl. None of these properties has managed waterfowl impoundments and water levels are not manipulated with water control structures. Natural bodies of water where water pools and the floodplains of Juniper Creek, and the Waccamaw River and its drainages provide small pockets of open water that waterfowl hunters utilize. Wood ducks are the primary species of duck that are harvested on the properties with the occasional opportunity to harvest other puddle duck species such as green-winged teal and mallard.

On the Wananish Tract of Columbus County Game Land, waterfowl hunters will enter Big Creek and paddle upstream to huntable areas. The Old Dock Tract of Columbus County Game Land usually provides hunting opportunities for wood ducks on the south side of Dock Road when seasonal flooding occurs during the hunting season. The Pireway Tract of Columbus County Game Land is adjacent to the Waccamaw River, a popular destination for waterfowl hunters, and the floodplain swamps on the property also provide opportunities to harvest waterfowl when seasonal flooding occurs.

Juniper Creek Game Land provides a few opportunities to waterfowl hunt in and directly adjacent to Juniper Creek, in the power line rights-of-ways when they flood, and within flooded timber in floodplain forest habitat.

Neither the Swain nor Pinch Gut Tracts of Green Swamp Game Land provide waterfowl hunting opportunities.

Deer hunters

Deer hunting opportunities on these properties are thought to be good, depending on each individual tract of land and are directly related to available deer habitat. Based off of game land hunter harvest data collected when big game animals are registered, an average of 83 deer has been harvested over the past 7 years (2008-2014) on Columbus County Game Land. *See Table 8 and 11*. An average of 38.7 deer per year has been harvested on Juniper Creek Game Land and an average of 16 deer per year has been harvested on Green Swamp Game Land; both averages are from harvest reports from 2008-2014. *See Tables 9 – 11*. Realistically, these numbers are open to interpretation because we don't know the amount of effort that was put forth to harvest these numbers of deer. Anecdotal information based on the fact that access and use is allowed three-days-per-week on Columbus County and Green Swamp Game Land and that nearly 72% of the habitats on these properties consists of wetland habitat, leads us to conclude that deer hunters do well on these game lands.

Additionally, the harvest data for Green Swamp Game Land include deer harvested on the portion of Green Swamp Game Land that The Nature Conservancy owns and cannot be distinguished by tract. However, it is safe to assume that because all but 83 acres, which includes the Swain Tract, are made up a contiguous tract and both owners manage their properties similarly; these numbers are certainly comparable, regardless of where on the game land deer were harvested. Anecdotal information based on the fact that access and use is allowed three-days-per-week and the fact that over half of the habitat on this game land is very dense, almost inaccessible pocosin habitat, leads us to conclude that deer hunters do well on Green Swamp Game Land.

It should be noted that deer harvest data for Columbus County Game Land in 2009 are probably incorrect. It is our thought that because Juniper Creek Game Land, which is partially located in Columbus County and in close proximity to Columbus County Game Land, was a newly acquired property, hunters erroneously reported deer being harvest on Juniper Creek Game Land as being harvested on Columbus County Game Land.

Year	Antlered Buck	Button Buck	Doe	TOTAL
2008	30	2	31	63
2009*	146*	20*	109*	275*
2010	38	6	32	76
2011	17	4	28	49
2012	16	2	18	36
2013	15	2	6	23
2014	25	2	32	59
TOTAL	**287**	**38**	**256**	**581**

Table 8 – Reported deer harvest on Columbus County Game Land – 2008 through 2014

Year	Antlered Buck	Button Buck	Doe	TOTAL
2008	19	0	14	33
2009	6	0	7	13
2010	22	2	18	42
2011	20	8	31	59
2012	28	4	16	48
2013	20	4	19	43
2014	16	2	15	33
TOTAL	**131**	**20**	**120**	**271**

Table 9 – Reported deer harvest on Juniper Creek Game Land – 2008 through 2014

Year	Antlered Buck	Button Buck	Doe	TOTAL
2008	8	2	3	13
2009	3	1	3	7
2010	7	2	9	18
2011	11	3	9	23
2012	9	0	4	13
2013	7	1	7	15
2014	14	2	7	23
TOTAL	**59**	**11**	**42**	**112**

Table 10 – Reported deer harvest on Green Swamp Game Land – 2008 through 2014

Year	Antlered Buck	Button Buck	Doe	TOTAL
2008	57	4	48	109
2009	155	21	119	295
2010	67	10	59	136
2011	48	15	68	131
2012	53	6	38	97
2013	42	7	32	81
2014	55	6	54	115
TOTAL	**477**	**69**	**418**	**964**

Table 11 – Reported deer harvest on the Brunswick and Columbus County Game Land Complex – 2008 through 2014

Overall, we currently believe that deer hunting opportunities, which include hunter access, supplemental plantings, habitat management, and the numbers of deer are adequate to satisfy this user group. However, we recognize the desire of some deer hunters that would like to see more plantings of annual and perennial crops and believe that this would improve the opportunity to harvest deer. It should be noted that additional effort has been made lately to establish more annual and perennial crops available to deer and deer hunters.

Turkey hunters

Turkey hunting opportunities on the Brunswick and Columbus County Game Land Complex are thought to be good. Based off of game land hunter harvest data collected when big game animals are registered, an average of 3.8 turkeys per year has been harvested over the past 6 years (2009-2014) on Columbus County Game Land. An average of 4.5 turkeys per year has been harvested on Juniper Creek Game Land and an average of 1.7 turkeys per year has been harvested on Green Swamp Game Land; both averages are from harvest reports from 2009-2014. *See Tables 12 – 15*. Realistically, these numbers are open to interpretation because we don't know the amount of effort that was put forth to harvest these numbers of turkeys. Anecdotal information based on the fact that access and use is allowed three-days-per-week on Columbus County and Green Swamp Game Land and that nearly 72% of the habitats on these properties consists of wetland habitat, leads us to conclude that turkey hunters do well on these game lands.

We currently believe that turkey hunting opportunities on the Brunswick and Columbus County Game Land Complex are sufficient. We believe that infrastructure, supplemental plantings, habitat management, and the numbers of turkeys available to harvest are at levels to satisfy this user group. Each year approximately two acres of chufa is planted specifically for the benefit of turkeys and turkey hunters. Chufa is a small, nut-like tuber that is relished by turkeys and is the most popular crop planted for turkeys. Because of restrictions imposed by baiting laws, no plantings specific to turkeys (chufa) are established until after the spring turkey season. Planting of chufa prior to or during turkey season could potentially give an unfair advantage to turkey hunters and is prohibited.

Year	Beard Greater Than 7 Inches	Beard Less Than 7 Inches	TOTAL
2009	1	0	1
2010	2	1	3
2011	3	0	3
2012	3	1	4
2013	3	3	6
2014	6	0	6
TOTAL	**18**	**5**	**23**

Table 12 – Reported turkey harvest on Columbus County Game Land – 2009 through 2014

Year	Beard Greater Than 7 Inches	Beard Less Than 7 Inches	TOTAL
2009	3	0	3
2010	3	1	4
2011	1	1	2
2012	2	5	7
2013	7	0	7
2014	3	1	4
TOTAL	**19**	**8**	**27**

Table 13 – Reported turkey harvest on Juniper Creek Game Land – 2009 through 2014

Year	Beard Greater Than 7Iinches	Beard Less Than 7 Inches	TOTAL
2009	1	0	1
2010	0	1	1
2011	1	1	2
2012	1	1	2
2013	2	0	2
2014	1	1	2
TOTAL	**6**	**4**	**10**

Table 14 – Reported turkey harvest on Green Swamp Game Land – 2009 through 2014

Year	Beard Greater Than 7 Inches	Beard Less Than 7 Inches	TOTAL
2009	5	0	5
2010	5	3	8
2011	5	2	7
2012	6	7	13
2013	12	3	15
2014	10	2	12
TOTAL	**43**	**17**	**60**

Table 15 – Reported turkey harvest on the Brunswick and Columbus County Game Land Complex – 2009 through 2014

Bear hunters

Bear hunting is only allowed on portions of Juniper Creek Game Land and the Pinch Gut and Swain Tracts of Green Swamp Game Land. All of Columbus County Game Land (8,506 acres), a portion of Juniper Creek Game Land (8,900 acres), and the portion of Green Swamp Game Land that The Nature Conservancy owns (17,424 acres) are enrolled in the Black Bear Sanctuary Program.

Bear hunting opportunities on Juniper Creek and the WRC-owned portions of Green Swamp Game Land are thought to be good. Habitat conditions in this part of the state are very favorable for black bears with large expanses of uninhabited woodlands and swamplands with dense cover. The vast areas of upland pine, lowland hardwoods, swamps, and pocosins provide excellent bear habitat.

Based off of game land hunter harvest data collected when big game animals are registered, an average of 3 bears per year has harvested over the past 7 years (2009-2014) on Columbus County Game Land and only one bear was harvested on Green Swamp Game Land from 2012 to 2014. *See Tables 16 – 17.* There was no bear hunting allowed on Green Swamp Game Land until the NCWRC purchased properties and added them to this game land.

Year	Male	Female	TOTAL
2008	0	0	0
2009	0	1	1
2010	2	0	2
2011	3	0	3
2012	6	1	7
2013	3	0	3
2014	5	0	5
TOTAL	**19**	**2**	**21**

Table 16 – Reported black bear harvest on Juniper Creek Game Land – 2009 through 2014

Year	Male	Female	TOTAL
2012	1	0	1
2013	0	0	0
2014	0	0	0
TOTAL	**1**	**0**	**1**

Table 17 – Reported black bear harvest on Green Swamp Game Land – 2012 through 2014

Small game hunters

Small game hunting opportunities are thought to be good on this property. This determination is made off of anecdotal information alone because hunters are not required to report the harvest of small game. Currently, small game hunters are allowed the opportunity to harvest quail, rabbits, gray squirrels, opossums, bobcat, coyote, and beaver.

We currently believe that there exists ample infrastructure on these game lands to satisfy this user group.

Webless migratory game bird hunters

Webless migratory game bird hunting opportunities on this property are thought to be poor and occur at very low levels on the Brunswick and Columbus County Game Land Complex. Anecdotal information gathered from personal experiences, observations, and conversations with hunters leads us to make this determination. These species include mourning dove, woodcock, snipe, rails, gallinules, and moorhens. Rails, gallinules, and moorhens rarely occur in this part of North Carolina. Strategies to increase the use of this game land by this user group may include a newsletter that identifies game lands that offer this opportunity or an article in the North Carolina Wildlife magazine that promotes opportunities for hunters to harvest these species.

We believe that there is no additional infrastructure needed to satisfy the needs of this user group. Additionally, we believe that our current level of species and habitat management is sufficient for webless migratory game birds.

Trappers

Trapping of furbearers currently occurs at low levels and any management strategies that promote trapping should be implemented. No public comment was received that indicated satisfaction, or the lack of, with trapping opportunities on these properties. It should be noted that local laws in both Brunswick and Columbus County prohibit the setting of a leghold steel trap from March 1 to January 1, or the last day of deer season, whichever is later.

We are currently unaware of any specific infrastructure needs that would provide better opportunities for trappers. Additionally, we believed that ample opportunity is provided to trappers and there are no additional strategies we could implement to increase the use of this Game Land Complex by trappers.

Anglers

Fishing opportunities on game lands within this Complex exist on Juniper Creek Game Land and the Old Dock and Wananish Tracts of Columbus County Game Land. Current management for game fish on these properties includes the statewide regulations with no unique regulations imposed. These include a largemouth bass minimum size limit of 14 inches except two which may be less than 14 inches and a creel limit of five fish per day. For sunfish, there is no minimum size limit and the daily creel limit is 30 in combination with no more than 12 redbreast sunfish. Refer to the most recent NCWRC's Inland Fishing, Hunting, and Trapping Regulations Digest to identify these rules.

Due to the habitat restrictions (*i.e.*, shallow, acidic water with low productivity) utilizing management tools (e.g., stocking or herbicide treatment) to enhance the fishery are likely cost prohibitive. However, the implementation of sediment control measures and other actions that protect these aquatic habitats can benefit the health of the watershed in these locations.

Non-traditional game land users:

- Paddlers
- Hikers and runners
- Horseback riders
- Researchers, universities, and museums
- Photographers and artists
- Sight seers
- ATV riders and off-road vehicles
- Campers
- Stargazers
- Target shooters
- Bicyclists
- Geocachers

DISCUSSION OF NON-TRADITIONAL GAME LAND USERS

We have attempted to determine all game land users of the Brunswick and Columbus County Game Land Complex and have made determinations of appropriateness and compatibility for each use based on the fact that hunting, fishing, trapping, and wildlife viewing are the primary uses. As long as non-traditional uses do not negatively influence the wildlife resources that the NCWRC manages or negatively impact traditional uses, they may be determined as appropriate and compatible.

Of all the known non-traditional uses that currently occur on these game lands, only one activity is considered to be inappropriate and incompatible. However, some other non-traditional uses require special consideration and are only considered to be appropriate and compatible under certain circumstances. These conditions are outlined in the following sections of the Plan.

Non-traditional users are strongly encouraged to refer to the NCWRC's Inland Fishing, Hunting, and Trapping Regulations Digest to identify hunting and trapping seasons as well as specific days and times that hunting and trapping occurs on the game land. Out of safety concerns, all game land users are also strongly encouraged to wear blaze orange while using game lands. This will ensure that they are easily seen by other game land users.

As stated earlier, hunting and trapping occurs six-days-per-week (Monday through Saturday) on Juniper Creek Game Land and three-days-per-week (Monday, Wednesday, and Saturday) on Columbus County and Green Swamp Game Lands. No hunting or trapping is allowed on Sundays.

Paddlers

Based off of anecdotal information, the only paddling that occurs on the Brunswick and Columbus County Game Land Complex is on Juniper Creek. The use of this creek by paddlers is considered compatible because it does not interfere with or detract from the Game Lands Program objectives, and as long as it doesn't interfere with or displace traditional uses during the times that they are taking place, should not be problematic. Impacts to hunters, anglers, trappers and wildlife viewers are considered minimal and avoidable.

Hikers and runners

The use of these properties by hikers and runners is considered compatible because it creates minimal disturbance to the natural resources and is consistent with the NCWRC's policies and objectives. Hikers and runners traditionally stick to established roads and trails and their impact to the road systems is essentially non-existent.

Horseback riders

Horseback riding on these game lands is considered compatible as long as riders stay on trails that are deemed compatible and designated for this use. Riders are encouraged to not venture outside of these areas because of potential negative impacts to wildlife habitat.

It is our recommendation that this activity be regulated through our permit system in order to manage use. Concerns about the use of this game land by horseback riders stems from the potential negative impacts to the natural resources of game lands. Newsome et. al (2002) conducted a study on the effects of horse riding on national parks and other natural ecosystems in Australia and determined that environmental impacts include but are not limited to soil degradation and compaction, erosion, loss of vegetation height and cover, change in plant species composition, degradation of existing roads and trails, the introduction of invasive grass and weed species, accidental transport of fungal pathogens, and the loss of vegetation, which are all common problems associated with horse use.

Researchers, universities, and museums

The use of these game lands by researchers, universities, and museums is considered compatible and does not impact management objectives of the Game Lands Program. These entities' uses of game lands usually involve the collection of data for research and educational purposes. It poses very minimal threats to traditional game land users and does not interfere with or disturb the natural resources of this property. These activities are usually handled through NCWRC's permitting process.

Photographers and artists

The use of these properties by photographers and artists is considered compatible. Photographers and artists create very little impact to the natural resources of the game land and their impacts to roads and trails is minimal.

Sight seers

Joy riding and sightseeing on the Brunswick and Columbus County Game Land Complex is considered a compatible use as long as they stay on designated roads and trails open to vehicular traffic. These include open gated and ungated roads and trails. Impacts to natural resources are essentially non-existent and impacts to roads and trails are minimal as long as drivers adhere to ethical and practical driving behaviors.

ATV riders and other off-road vehicles

The use ATV's and other off-road vehicles on these game lands is considered an inappropriate use. More times than not, these vehicles create disturbance and cause destruction to valuable resources on game lands. They greatly degrade roads and trails and create erosion and water quality concerns when driven in and around streams. Because these vehicles are very agile and maneuverable, riders tend to stray away from developed roads and trails and into areas that land managers desire to be undisturbed. These actions can be detrimental to various plant and animal communities and offset previous efforts made to conserve and manage these areas.

It should be noted that ATV use is currently allowed only by disabled sportsman that have been deemed eligible for this use. This activity is handled through NCWRC's permitting process.

Because ATV's and other off-road vehicles have such a great potential to cause harm and create disturbance to natural resources and other game land users, their use on these properties is prohibited, except as excluded by regulations designated for permitted hunts.

Campers

Camping on this Complex of game lands is considered a compatible use. There are two existing camping areas on Juniper Creek Game Land. Because camping is restricted to September 1 through February 28 and March 31 through May 14, camping causes no conflicts with the interests and management objective of the NCWRC.

Additionally, camping opportunities are offered year-round on nearby State Parks.

Stargazers

Stargazing is considered a compatible use on this Complex of game lands. Because the window of opportunity for this activity is restricted to nighttime hours, it has very little potential to create conflict with traditional users. Its impacts to natural resources are non-existent and impacts to infrastructure are minimal. These activities are usually handled through special use permits.

Target shooters

There are currently no restrictions to target shooting on game lands within the Brunswick and Columbus County Game Land Complex. It is considered a compatible activity as long as it does not create safety concerns for the shooter or other game land users and staff, does not cause destruction to NCWRC property, and shell casings are retrieved after being discharged.

The NCWRC is currently involved in the design and implementation of shooting ranges on game lands. Upon implementation of a designated shooting range within 30 miles of these game lands, all target and recreational shooting activities will be limited to that area.

Bicyclists

Bicycling on this game land complex is considered compatible as long as bicyclists stay on designated roads and trails. Impacts to natural resources can be minimized by regulating use through numbers, timing, and conditions of trails.

We strongly believe that if this activity becomes problematic through overuse, it should be managed through NCWRC's permitting process in order to regulate use. Our concerns of overuse stem from potential negative impacts of biking. Cessford (1995) reviewed the off-road impacts of mountain bikes and found that environmental impacts included but were not limited to injury and destruction of ground-level vegetation, change in plant species composition along biking trails, compaction and reduced water infiltration-capacity of well drained soils, increased occurrence of runoff, excessive erosion from enhanced water flows, development of multiple parallel tracks, and the development of informal tracks including shortcuts and switchbacks.

The use of these properties by bicyclists is currently very low but it continues to grow in popularity and should therefore be monitored and periodically evaluated.

Geocachers

We are currently unaware of any geocaching activities that take place on these game lands. However, geocaching is considered a compatible activity as long as the NCWRC's geocaching policy is adhered to.

INFORMATION NEEDS

Our current state of knowledge about wildlife occurrences on the Brunswick and Columbus County Game Land Complex is somewhat limited. Our best knowledge is of big game species. Successful big game hunters are required to identify the game land from which they harvest big game during the registration process. However, distributions and occurrences of cryptic species such as reptiles, amphibians, and small mammals (including bats) are under-surveyed and their relative distribution and abundance are unknown and misunderstood. It would seem appropriate to work closely with the Natural Heritage Program to develop a biological inventory similar to the Bladen County Natural Area Inventory conducted by LeBlond and Grant in 2005.

Our current knowledge of game animals is limited, even though we know the number of harvested big game on these game lands. Currently, there are no surveys in place to track changes in population trends of even the most sought after big game animals (deer, bear, and turkey). At present we must make assumptions based on hunter harvest data and county-wide deer density estimates. Management practices and regulations should not be based on assumptions, but on best available science.

The following is our current knowledge of our priority species. These priority species were identified because they are game animals that are hunted or trapped on these properties or they have a state or federal status. They are either known or thought to occur on these game lands. Included in this information are inventory and management needs, and research recommendations for the future. The appropriateness of tracking population trends for some wildlife species will be evaluated and appropriate techniques will be identified when it is determined such actions are warranted and only when appropriate levels of staff and finances are available.

The identification of game land hunters (or other users) would allow the NCWRC to generate a general observation survey in which data on the observations of multiple species could be collected by hunters or any game land user interested in recording the requested information. This cooperation of game land users would supplement our survey efforts and potentially reduce workloads required by NCWRC staff to collect this information. The use of other surveys is proposed to target hunters in order to determine hunter effort. Information derived from these surveys coupled with other information collected by field staff will give NCWRC biologists the ability to better estimate and track population trends. This valuable information will help staff determine the best management techniques to implement in order to achieve our desired future conditions.

Reports of diseased animals (regardless of species) should be investigated and, when possible, attempts will be made to diagnose the cause of infection. Also, as specific disease surveillances are conducted (Chronic Wasting Disease, Lymphoproliferative Disease Virus, etc.), the game land will be incorporated into the effort when appropriate.

NON-GAME WILDLIFE SPECIES

Neotropical Migratory Songbirds

Current Knowledge

The Brunswick and Columbus County Game Land Complex has the potential to support a large number of landbirds throughout the year, many of which are designated as priority species in the 2015 Wildlife Action Plan (Table 18). High levels of use in this area have been predicted during the spring (Map 46) but less so during the fall (Map 47) migration period (La Puma and Buler 2013). Species diversity during the breeding season is based on previous research conducted on private property adjacent to Juniper Creek Game Land (WRC unpub. data, Table 19). In 2013, a swallow-tailed kite nest was found 32 km north of the Juniper Creek Game Land's floodplain forest (Carpenter and Allen 2013). The game land offers >10,000 acres of suitable habitat for other priority species including Prothonotary warbler and possibly the wood stork.

Inventory/Monitoring Needs

Standardized point count surveys may be initiated to document species occurrence as it relates to ongoing habitat management. Many of the game land habitats are inaccessible therefore priority should be given to 1) areas undergoing longleaf pine restoration, and 2) aerial surveys of the floodplain forests to monitor for the presence of swallow-tailed kite and wood stork nests. All opportunistic encounters of priority species should be cataloged throughout these properties.

Management Needs

There are currently no specific management needs for neotropical migratory songbird species.

Research Needs

No research needs are currently warranted within the Brunswick and Columbus County Game Land Complex. However, monitoring efforts may present opportunities to assist with answering specific questions and conducting hypothesis-driven research in the future.

Red-cockaded woodpecker (RCW)

Current Knowledge

According to 2015 NC Natural Heritage Program data (NCNHP 2012), five RCW encounters were documented from 1986-2005 that were within 10 km of Juniper Creek Game Land. The most recent observations come from The Nature Conservancy's Green Swamp Ecological Preserve and were an average 3.5 km from this property. The primary role of Juniper Creek Game Land in RCW recovery will be to serve as a corridor between populations in the Sandhills and southeast Coastal Plain.

Inventory/Monitoring Needs

The status of the RCW cluster in the Green Swamp Ecological Preserve in Brunswick County should be checked annually. If active RCW clusters are identified within 0.5 miles of Juniper Creek Game Land, stands that meet the RCW Recovery Plan's (USFWS 2003) criteria should be routinely surveyed for cavity trees. This includes:

1. Pine and pine-hardwood stands over sixty (60) years of age;
2. Pine and pine-hardwood stands under sixty (60) years of age containing scattered or clumped pine trees over sixty (60) years of age;
3. Hardwood-pine over sixty (60) years of age adjacent to pine and pine-hardwood stands over thirty (30) years of age; and
4. Pine stands containing sawtimber, including stands thought to be generally less than sixty (60) years of age but containing scattered or clumped trees over sixty (60) years of age.

Management Needs

All land management techniques and practices in pine dominated stands should follow the recommendations provided by Part I, Section 3 of the U.S. Fish and Wildlife Service's RCW Recovery Plan (2003:pp 71-117). Restoration of longleaf pine habitat, including prescribed fire, has been shown to benefit other species (Taillie et al. in review) and should be implemented where appropriate on a continual basis.

Research Needs

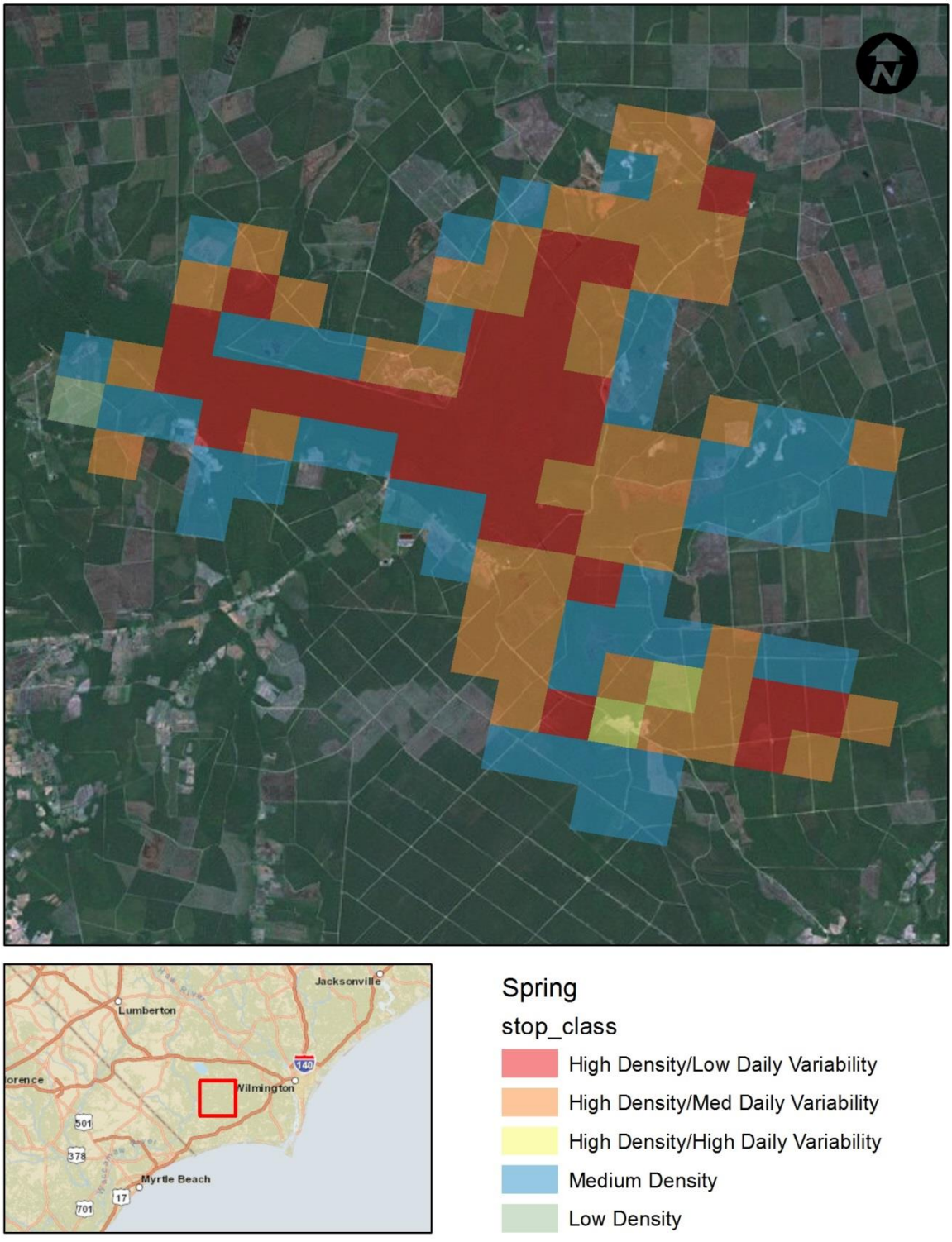
Due to no known active clusters within range of Juniper Creek Game Land, RCW research needs are not warranted within Juniper Creek Game Land at this time. However, opportunities should be evaluated as habitat conditions evolve.

Common Name	Scientific Name
Acadian Flycatcher	*Empidonax virescens*
American Kestrel	*Falco sparverius*
Bachman's Sparrow	*Peucaea aestivalis*
Bald Eagle	*Haliaeetus leucocephalus*
Black-crowned Night-Heron	*Nycticorax nycticorax*
Brown-headed Nuthatch	*Sitta pusilla*
Little Blue Heron	*Egretta caerulea*
Loggerhead Shrike	*Lanius ludovicianus*
Louisiana Waterthrush	*Parkesia motacilla*
Northern Bobwhite	*Colinus virginianus*
Northern Harrier	*Circus cyaneus*
Prairie Warbler	*Setophaga discolor*
Prothonotary Warbler	*Protonotaria citrea*
Red-cockaded Woodpecker	*Picoides borealis*
Red-headed Woodpecker	*Melanerpes erythrocephalus*
Rusty Blackbird	*Euphagus carolinus*
Savannah Sparrow	*Passerculus sandwichensis*
Swainson's Warbler	*Limnothlypis swainsonii*
Swallow-tailed Kite	*Elanoides forficatus*
Wood Stork	*Mycteria americana*
Worm-eating Warbler	*Helmitheros vermivorus*
Yellow-throated Warbler	*Setophaga dominica*

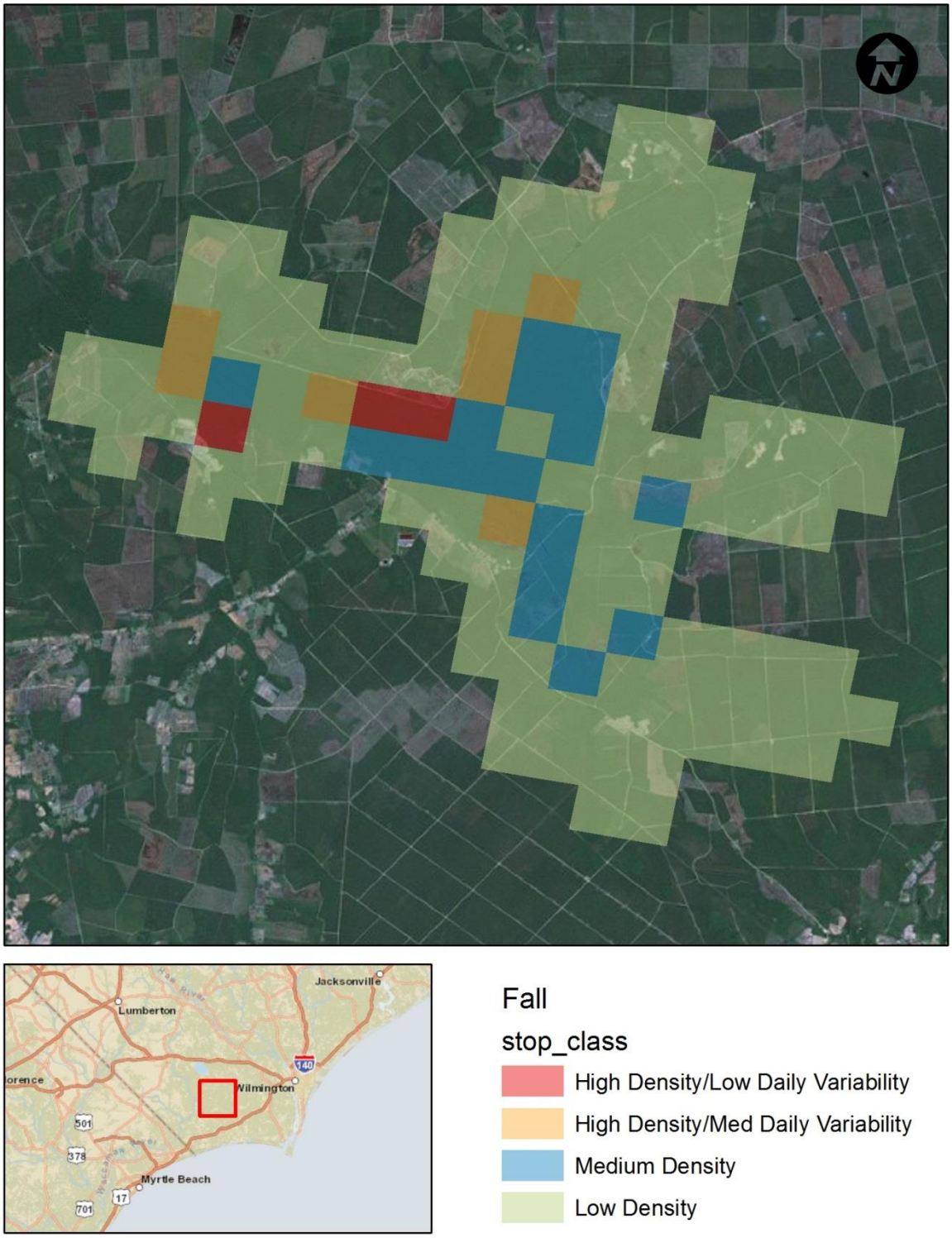
Table 18 – Landbirds likely to occur on the Brunswick and Columbus County Game Land Complex presently, including additional species not likely to occur now but that which may be supported in the future with planned habitat improvements.

Common Name	2011	2012	Total
Bachman's Sparrow	2	4	6
Brown-headed Nuthatch	2	1	3
Blue Grosbeak	1	1	2
Brown Thrasher	4	1	5
Carolina Wren	5	3	8
Chipping Sparrow	-	1	1
Common Grackle	2	-	2
Common Yellowthroat	32	28	60
Eastern Bluebird	3	1	4
Eastern Kingbird	-	2	2
Eastern Towhee	4	2	6
Eastern Wood-Pewee	-	2	2
Great-crested Flycatcher	-	6	6
Gray Catbird	-	2	2
Hooded Warbler	-	2	2
Indigo Bunting	3	-	3
Louisiana Waterthrush	1	-	1
Mourning Dove	1	-	1
Northern Cardinal	5	2	7
Northern Mockingbird	-	1	1
Orchard Oriole	1	4	5
Pine Warbler	21	18	39
Prairie Warbler	12	19	31
Prothonotary Warbler	-	3	3
Red-bellied Woodpecker	1	-	1
Red-headed Woodpecker	4	2	6
Ruby-throated Hummingbird	1	1	2
Tufted Titmouse	-	1	1
White-eyed Vireo	-	1	1
Worm-eating Warbler	2	-	2
Winter Wren	-	1	1
Yellow-breasted Chat	2	-	2
Totals	111	114	225

Table 19 – Landbird species captured during two breeding seasons at Green Swamp Ecological Preserve, Brunswick County, NC. The presence of most of these on Juniper Creek Game Land, Columbus County Game Land, and the Pinch Gut Tract of Green Swamp Game Land is presumed based on availability of similar habitats.



Map 46 – Classified bird stopover density use of Juniper Creek Game Land during 2009 and 2010 Spring migration seasons (La Puma and Buler 2013).



Map 47 – Classified bird stopover density use of Juniper Creek Game Land during 2008 and 2009 Fall migration seasons (La Puma and Buler 2013).

- *MAMMALS:*

RAFINESQUE'S BIG-EARED BAT

Current knowledge

Rafinesque's big-eared bats are not known to occur on properties within the Brunswick and Columbus County Game Land Complex. This species is however, predicted to occur in this area of the State, according to the North Carolina Gap Analysis Project. Unlike many other bat species that are crepuscular, this bat species is nocturnal. It nests in tree cavities and man-made structures that provide refuge such as abandoned building and bridges. They are insectivores and are moth-specialists. The best available evidence indicates that this species has declined drastically. They are considered a threatened species in North Carolina.

Management needs

Protection and management of the floodplain forests should continue. Coastal Plain habitats of this species for roosting and foraging include many of the floodplain forest communities on these game lands but foraging has also been documented in young pine plantations. They roost in hollow trees, under loose bark, old buildings, and beneath bridges, at least in the warmer months. Foraging habitat may be critical to species survival and should therefore be protected.

Inventory and monitoring needs

If manpower is available, a series of mist-netting surveys should be implemented in an attempt to collect information to close gaps in the distribution data of this bat species. A cooperative biological inventory should be conducted with the assistance of the Natural Heritage Program to explore and update the small mammal communities on these properties. Observations should be reported to staff or recorded on the NCWRC's online Wildlife Observation Application to document occurrences and/or range expansion for this species.

Research needs

There are currently no known research needs.

STAR-NOSED MOLE

Current knowledge

The star-nosed mole is not known to occur on the Brunswick and Columbus County Game Land Complex. This species is however, predicted to occur in this area of the State, according to the North Carolina Gap Analysis Project. The coastal and Sandhills habitats for star-nosed moles include pocosins, wetlands, saturated bottomlands, and longleaf pine habitat. Neither forest age nor successional stage has been reported as a critical factor determining habitat suitability for this species (Laerm et al. 2007). This species is of special concern in North Carolina.

Management needs

Not enough data currently exist to make detailed management recommendations at this time. However, we believe that protection and management of the previously mentioned habitats are suitable actions for management of star-nosed moles.

Inventory and monitoring needs

A cooperative biological inventory should be conducted with the assistance of the Natural Heritage program to explore and update the vertebrate communities on these game lands. Observations should be reported to staff or recorded on the NCWRC's online Wildlife Observation Application to document occurrences and/or range expansion for this species.

Research needs

There are currently no known research needs.

REPTILES AND AMPHIBIANS:

Current Knowledge

The amphibian and reptile species richness on Brunswick and Columbus County Game Land is currently unknown. This is chiefly mostly due to the cryptic nature of these types of animals.

Inventory and monitoring needs

Surveys targeted at Wildlife Action Plan priority upland and aquatic reptilian and amphibian species should be created to increase our knowledge of local populations and how they are distributed throughout the landscape. The institution of an incidental observation reporting system should be instituted. Observations of priority species should be reported to help increase our understanding of species distribution. It seems logical to research the potential of using the reporting tool in PAWS to disseminate observations.

Management needs

Timing of prescribed fire should be discussed among staff to create a plan that poses reduced potential to harm slow moving reptiles and amphibians during late dormant season and growing season burning operations. During logging operations low ground pressure equipment should be utilized as applicable. It would be preferred that such operations should be conducted during winter months, as much as possible, to reduce the impacts to amphibians and reptiles.

Research needs

No research needs are warranted at this time.

GAME ANIMALS

EASTERN WILD TURKEY

Current knowledge

With the increase in habitat enhancements mentioned earlier, available turkey habitat has increased in size and quality, including nesting and brooding habitat. In response, the use of this game land by wild turkeys has increased during that time. However, the lack of baseline data has left gaps in our knowledge of turkey populations on this property. Age and sex data can be derived from harvest reports, and although useful, this minimal information is inadequate for managing turkey on the area.

Over the past six seasons (2009-2014), turkey harvests on Columbus County and Juniper Creek Game Lands have averaged 0.2 gobblers/mile^2. Over the past two seasons, since acquisition, turkey harvests on Green Swamp Game Land have averaged 0.36 gobblers/mile^2. Turkey hunting is currently allowed three days per week on Columbus County Game Land and six days per week on Juniper Creek and Green Swamp Game Lands. Beginning in 2014, the first 6 hunt days of the spring turkey season are designated for youth-only hunting, which has previously been limited to opening day of the season. Statewide daily and seasonal bag limits apply; 1 turkey per day and 2 turkeys per season.

Inventory and monitoring needs

Currently, baseline data for turkey abundance on game lands is minimal. However, several options are available to gather these data. Wild Turkey Summer Observation Surveys could better be utilized by increasing participants, a turkey hunter observation survey, and/or a deer hunter survey that allows deer hunters to report turkey observations in the fall and winter of the year. A survey has currently been proposed that would obtain valuable information from game land turkey hunters (see *Appendix V*). This information would potentially help determine hunter effort and the number of gobbling turkeys heard. Another could be gobbling bird point counts conducted by NCWRC staff. These surveys could provide information used to estimate densities and/or population trends of turkeys.

Management needs

Current levels of hunter harvest should be maintained until better data exists. Primary methods for habitat maintenance and enhancement should be the use of prescribed fire, long timber rotations, and open land management. The maintenance and/or improvement of field borders in agricultural areas will provide nesting and escape cover and areas for bugging.

Research needs

There are currently no known research needs.

NORTHERN BOBWHITE QUAIL

Current knowledge

Northern bobwhite quail primarily inhabit early successional habitat found in non-forested areas and in forest communities with open canopies and an herbaceous understory. Transitional areas found between community types are critical for quail, especially areas between upland sites and pocosin communities in this region of the state. Pocosins provide excellent escape cover when quail flee from predators of other disturbances. Hunting opportunities on this property for quail are provided from late November to the end of February on open hunt days.

There is currently very little high quality habitat provided on these game lands for northern bobwhite quail. Non-forested early successional habitat is only present in measurable acreage on Juniper Creek Game Land in the power line rights-of-ways and only makes up 0.1% of the total area of this complex of game lands.

Inventory and monitoring needs

These surveys should continue in order to establish longer term populations trends.

Management needs

Current hunting opportunities should be maintained. Existing land management practices should continue to provide suitable habitat with an emphasis on improving the quality and acreage of early successional habitat. Wide road shoulders, linear openings, and power line rights-of-ways should only be treated with herbicide and/or mowing if hardwood or pine encroachment threatens the ecological benefit of these areas. If mowing is the only viable option, it should be done in late winter to minimize the amount of time between the treatments and spring green-up. This specific timing will also minimize negative impacts to quail and other low level nesting birds. Spot treatments with herbicide are recommended over broadcast treatments. Selective herbicides that target woody vegetation should be used as opposed to non-selective herbicides. Where feasible, prescribed burning and/or disking should be given initial consideration as techniques to control plant succession in these areas. If disking is the most appropriate technique, it should be conducted in fall and winter.

Eradication of non-native, invasive grasses in early successional habitats should be given high priority. Efforts should be made to minimize the encroachment of trees into non-forested openings. Some special consideration should be given to the transitional areas between upland habitats and pososins. When appropriate, these areas should be burned and construction of firebreaks in these areas should be avoided.

Research needs

There are currently no known research needs.

WEBLESS MIGRATORY GAME BIRDS

Current knowledge

Mourning doves, snipe, and woodcock are known to occur on in Columbus and Brunswick Counties of North Carolina. However, moorhens, gallinules, and the 4 rail species (clapper, sora, king, and Virginia) are not known to occur on these properties. Dove hunting opportunities exist in planted wildlife openings. Opportunities for hunting the other webless migratory birds exist in wetland habitats that are preferred by these species. Seasons and frameworks are determined by the United States Fish and Wildlife Service (USFWS), but generally run from September through February.

Inventory and monitoring needs

The dove banding program should continue in Brunswick County and be expanded to include Columbus County. Efforts should be greatly increased to trap and band an extensive number of doves on and off the game land. In previous years, the number of doves banded in this area has been low.

Management needs

Current hunting opportunities should be maintained following the framework set by the USFWS. Current land management practices should provide suitable habitat for webless migratory birds. These practices include management of wildlife openings, wetland habitats, and upland pine woodlands.

Research needs

There are currently no known research needs.

WATERFOWL

Current knowledge

Waterfowl are fairly common on Columbus County and Juniper Creek Game Lands, especially during their winter and spring migrations. They are less common on Green Swamp Game Land. The majority of wood ducks in the Atlantic Flyway are year-round residents but a small percentage is migratory. The most common species that occur on these properties are wood ducks. Other species are known to occur on this game land but their numbers are low.

Hunting is allowed three days per week on Columbus County Game Land and six days per week on Juniper Creek and Green Swamp Game Lands.

Management needs

Providing quality moist-soil vegetation, open water, and flooded timber should continue to be the primary goals of habitat management for waterfowl on these game lands.

Inventory and monitoring needs

There are currently no inventory and monitoring needs for waterfowl on these game lands.

Research needs

There are currently no known research needs.

WHITE-TAILED DEER

Current knowledge

White-tailed deer are the most abundant big game species on the Brunswick and Columbus County Game Land Complex with densities ranging from 15-29 deer/mi^2 (see *Appendix IV*). Deer hunting on these properties follows the Eastern Deer Season and hunting currently occurs six days per week on Green Swamp and Juniper Creek Game Lands and three days per week on Columbus County Game Land. Maximum harvest (either sex the entire season) is allowed.

From anecdotal information, hunter success is considered to be moderate on these game lands, although deer densities are thought to be adequate for the habitat provided on the game land. Due to the extensive floodplain forest habitat on this game land (20,544 acres or 71%), the challenges of hunting these areas, and the potential of these areas acting as a refuge for deer, especially during the season when hounds are present, one would suspect the harvest to be relatively low.

With the increase in direct habitat enhancement through the creation of planted openings, extensive timber thinning and prescribed burning, available deer habitat in size and quality has increased and the herd should respond accordingly. Taken together, with better access and better habitat, hunter success should increase over time as well.

Derived from harvest data collected during the big game registration process over the last 3 seasons (2012-2014)

- An average of 0.72 antlered bucks per square mile has been harvested.

- Doe harvests make up 42.3% of the total harvest on the Brunswick and Columbus County Game Land Complex. This falls short of our statewide objective of at least 50% of the total deer harvest consisting of does.

- Doe harvests make up 31.3% of the total deer harvest on the Brunswick and Columbus County Game Land Complex prior to peak breeding season (October 31). This is lower than our statewide objective of at least 50% does in the total harvest prior to peak breeding.

- Antlered buck harvests make up 68.8% of the total deer harvest on the Brunswick and Columbus County Game Land Complex prior to peak breading season (October 31). Our statewide objective is for no more than 20% of antlered bucks to be harvested prior to peak breeding.

Inventory and monitoring needs

To better understand the dynamics of the deer herd on this complex of game lands, there is a great need to collect basic biological data on harvested animals. Sex and age structure are of primary importance. We can identify the individuals that register harvested deer on these properties, and we have the ability to contact them after a hunt. At the minimum, we could conduct mail surveys of hunters to determine success rates, hunter effort, and perhaps other pertinent information relative to deer hunting on this property.

The collection of biological data and general harvest information of deer have been poor on these game lands since their enrollment in the Game Lands Program. Over the last 3 years, no biological data has been collected from any of the 293 deer harvested on these properties. With the advent of the electronic big game reporting system that identifies selected game lands, we are currently able to collect basic harvest information (sex, adult-fawn, date) on the deer harvested on this property. Although useful, this minimum information is inadequate in managing deer on the area.

If a survey was developed to target our game land deer hunters, the NCWRC could implement a jawbone/biological data mail survey. We believe other mail surveys that help to determine hunter effort would also be beneficial to increasing our knowledge of deer populations on game lands. We could improve our response rate by offering incentives for hunters to participate in these surveys. Rewards similar to the hats that cooperators of the Bear Cooperator Program receive would suffice. These rewards could be hats, tee shirts, or even decals. The collection of these biological data would allow us to make the science-based regulation changes, and/or changes to management techniques needed to meet the state deer management goals and objectives mentioned earlier.

Other methods to collect baseline information for deer densities and/or population trends should be implemented. These data could be collected with the use of a Forward Looking Infrared (FLIR) monocular, spotlights, camera trap surveys, or track count surveys.

FLIR is a new tool for the NCWRC. This is a thermal imaging monocular that detects infrared radiation, including body heat. Similar to a spotlight survey, the FLIR camera will allow us to

collect deer density and trend data with direct observations. It is our desire to collect density and population trend estimates using this method. A trial run should be conducted to ensure that this application is viable across all habitat types. There is a concern that the FLIR camera will not be effective in very dense plant communities like pocosins because of impenetrability. However, this is yet to be determined.

Track counts could be a substitute for the FLIR survey. Juniper Creek Game Land and the Pinch Gut Tract of Green Swamp Game Land have an extensive road network with soils that are suitable for this type of survey. The Old Dock and Pireway Tracts of Columbus County Game Land have marginal vehicular access for this type of survey. The Wananish Tract has no road system in place. Although not a direct observation, this is a survey method that has long standing history.

Staff will continue investigating whether new methods may better assist us in monitoring and managing the deer population trends on these properties.

Management needs

It is our desire to manage deer on the Brunswick and Columbus County Game Land Complex in accordance to with the statewide deer management goals and objectives outlined in the Ad Hoc Deer Evaluation Procedure. This document is available upon request. As a habitat generalist, the white-tailed deer will benefit from the continuation of current land management practices.

The potential exists for improved open land management. This would have limited benefit for the deer population, but would provide better opportunities for hunter harvest. A few requests were made during the public input session to improve wildlife openings on these properties. These improvements could include the establishment of perennial clover and increased acreages of annual grains such as oats, rye grass, and wheat during the deer hunting seasons.

Other management needs could be derived from the previously mentioned data that is currently lacking, once it is obtained.

Research needs

There are currently no known research needs.

AMERICAN BLACK BEAR

Current knowledge

Current knowledge of black bear populations on this complex of game lands is insufficient. All of Columbus County Game Land and portions of Green Swamp and Juniper Creek Game Lands are enrolled in the Black Bear Sanctuary System totaling 17,406 acres (60% of the total area) and hunting of black bears is prohibited in these areas. Black bears are typically concentrated in and around the large pocosin and bay complexes.

From anecdotal information, black bear hunter success is thought to be good on the areas of these properties that bear hunting is allowed. Over the past six seasons (2008-2014), on Juniper Creek Game Land, an average of 1.51 bears/mile^2 have been harvested on Juniper Creek Game Land on the 8,900 acres that bear hunting is allowed. No bears have been harvested on the Pinch Gut and Swain Tracts of Green Swamp Game Land since NCWRC acquisition.

The bear season for these counties is typically a three-week-long season that traditionally is during the first three weeks in December. This allows 18 days of hunting on these properties. The North Carolina Black Bear Management Plan states that Objective #1 of the Coastal Bear Management Unit is to maintain the coastal bear population at current levels. Strategy #1 for the objective is to maintain the current bear season structure for all Coastal Bear Management Unit counties.

Inventory and monitoring needs

Currently, baseline density and relative abundance is marginal for these areas. Track counts could be established using the existing road networks. Photo points could also be utilized to collect baseline data. Efforts should continue to collect sex, weight, and age data from hunter harvested bears on and around these game lands.

Management needs

Bears on the Brunswick and Columbus County Game Land Complex should be managed following the guidelines outlined in the North Carolina Black Bear Management Plan (NCBBMP) and in conjunction with the sanctuary objectives. The entire NCBBMP can be viewed by visiting www.ncwildlife.org.

Many studies have concluded that black bear habitat preferences are simply a function of food. Therefore, any land management practices to improve or sustain food availability (soft and hard mast) will benefit black bears. Continued long rotation timber harvest, open land management, and prescribed fire will enhance and maintain habitats for black bears on these properties. Black bears move extensive distances during certain times of the year. It is important for movement to occur between the various subpopulations of bears across the state to help maintain bear numbers and genetic connectivity. Corridors can also assist in reducing human-bear interactions by decreasing the proximity of traveling bears to human development. As such, corridors for movement are important. Continued acquisition of adjacent lands would support efforts to meet the NCBBMP objective 4 (strategies 3, 4, 5, and 6).

As the availability of huntable areas decrease, acquisition of land would also assist in NCBBMP objective 1 and objective 2, strategy 6. NCWRC game lands will become increasingly important in providing bear hunting opportunities and population management via harvest.

We believe that existing portions of this property should continue their enrollment in the Black Bear Sanctuary Systems because it provides a core area of outstanding habitat quality that will support a breeding nucleus of bears that will disperse off the area that can be available for hunter harvest.

Research needs

There are currently no known research needs.

FURBEARERS

Current knowledge

Game lands within this complex provide hunting opportunities for bobcat, fox, raccoon, opossum, and coyote. Trapping opportunities exist for beaver, bobcat, coyote, raccoon, river otter, mink, and long-tailed weasel. Although these resources exist on the game land, they are somewhat under-utilized. Trapping is currently allowed six days per week on Juniper Creek and Green Swamp Game Land and three days per week on Columbus County Game Land.

Inventory and monitoring needs

Inventory and monitoring should be considered on an as needed basis. Scent stations and track counts could be used for some species.

Management needs

Current trapping seasons should be maintained to allow for trapping opportunities and the harvest of surplus furbearers. Current land management techniques should continue and desired future conditions should be met to benefit furbearers in each habitat type.

Research needs

There are currently no known research needs.

GRAY AND FOX SQUIRRELS

Current knowledge

Gray squirrels are a common small game species found on this complex of game lands but fox squirrels are rare, which is indicative of the lack of the mostly open, mature pine-oak forests that they prefer. Gray squirrels inhabit numerous forest types, although they are most abundant in hardwood forests containing a variety of mast-producing trees. On this game land, they commonly occur in the floodplain forests, mixed hardwoods and pine forests, and occasionally in the pine woodlands.

Because fox squirrels are solitary animals, their population densities are generally low, even in areas where they are considered common. Large areas of habitat are needed to support viable populations. They inhabit mostly open, mature pine-oak forests but also occur in pine-dominated habitats as well.

Tree cavities are very important for both squirrel species for rearing young and protection from winter weather.

Squirrel hunting is currently allowed Monday, Tuesday, and Wednesday on Columbus County Game Land and Monday through Saturday on Green Swamp and Juniper Creek Game Lands during open seasons.

Inventory and monitoring needs

There are currently no inventory and monitoring needs but they should be considered on an as-needed basis.

Management needs

Current hunting opportunities should be maintained. Protection and maintenance of all forest types on these properties will provide habitat needs for both squirrel species. Burning of pine woodlands and increased acreage of longleaf pine communities will be most beneficial to fox squirrels. Hard mast producing trees and cavity trees should be protected and maintained.

Research needs

There are currently no known research needs.

EASTERN COTTONTAIL AND MARSH RABBITS

Current knowledge

Eastern cottontail rabbits commonly occur on this complex of game lands in open land where shrubs, grasses, and forbs dominate. Briar patches, brush piles, and other dense vegetation are needed for escape cover. Interspersion of different cover types is ideal for rabbits.

Marsh rabbits, being semiaquatic animals, require dense habitat adjacent to a permanent supply of water, such as the borders of lakes, streams, canals, ditches and marshes.

Rabbit hunting currently occurs at low levels on this property and is allowed Monday, Wednesday, and Saturday on Columbus County Game Land and Monday through Saturday on Green Swamp and Juniper Creek Game Lands during open seasons.

Inventory and monitoring needs

There are currently no inventory and monitoring needs but they should be considered on an as-needed basis.

Management needs

Current hunting opportunities should be maintained. Land management techniques that provide brushy cover will be beneficial for rabbits. These include thinning and burning of pine communities, early successional habitat management, and the creation and/or protection of brush piles and briar thickets.

WARM WATER NON-GAME FISH

Current knowledge

As the Juniper Creek watershed is the only locality in NC where the regionally-endemic Carolina Pygmy Sunfish has been successfully collected within the last 15 years, protection of the habitats closely affiliated with this unique fish is critical. The entire range of the species consists of extremely localized populations in the Lumber and Santee drainages in North and South Carolina. Between the Juniper Creek and Columbus County Game Lands, along with The Nature Conservancy's Green Swamp Preserve, over 25% of the Juniper Creek watershed is managed by state and non-profit natural resource organizations. The Carolina Pygmy Sunfish, along with its congenerics, the Banded Pygmy Sunfish and the Everglades Pygmy Sunfish, has a long-documented affinity with roadside ditches, swamps, and blackwater streams with slow-moving or pooled water and beds of emergent vegetation in which to seek shelter. They will also use piles of leaf material or other small organic debris. All three species, along with the Banded Sunfish are undergoing status review by the NCWRC across their ranges on the Coastal Plain of NC.

The Banded Sunfish appears to be particularly abundant in Juniper Creek, which provides another vital incentive for aquatic habitat protection. During the course of a three-year rare fishes survey of the SE NC Coastal Plain by NCWRC staff, this species was largely not found until the 2014 surveys in Juniper Creek. This suggests a dramatic decline in its range, but the drivers remain unclear.

All of these fishes, along with other species unique to the Coastal Plain's stream-swamp aquatic communities, are threatened by degradation of water quality. This includes reductions in dissolved oxygen (DO) levels, pH, disappearance of native emergent vegetation, heavy loads of inorganic matter/decay, and the vulnerability inherent to species such as the Carolina Pygmy Sunfish, which has a short life span (1-2 years) and frequent fluctuations in population densities which coincide with the ephemeral nature of their shallow-water habitats.

Inventory and monitoring needs

Degradation of water quality could also pose a threat to the Carolina Pygmy Sunfish. 100% of the Waccamaw River subbasin is designated as Swamp Waters, which have unique characteristics and species assemblages (DWQ 2010). Further research and monitoring are needed to assess the status of these waters and determine if there are problems with enforcement and management of the ecosystem.

Management needs

In the Juniper Creek watershed, the most significant factor observed affecting these habitats during 2014 surveys was the result of road grading/widening. Sediment and sand from roads was pushed into ditches inhabited by these fishes, as well as cut branches and trees. In places where this occurred, the reduced water quality due to the decay of the woody materials, along with the heavy sedimentation smothering emergent vegetation, made these habitats often inhospitable to both plants and fishes. It is recommended that all grading/roadwork be done in such a manner so as to avoid pushing material into roadside ditches, and any quantities of cut woody debris be disposed of in upland areas or otherwise removed.

Research needs

Further research and monitoring are needed to assess the status of these waters and determine if there are problems with enforcement and management of the ecosystem.

WARM WATER GAME FISH

Current knowledge

Current management for game fish on these properties are the statewide regulations with no unique regulations imposed. These include a largemouth bass minimum size limit of 14 inches except two that may be less than 14 inches and a creel limit of five fish per day. For sunfish, there is no minimum size limit and the daily creel limit is 30 in combination with no more than 12 redbreast sunfish.

Several fish species found in water on these game lands have consumption advisories because of elevated levels of mercury. Mercury bioaccumulation can be more common in Coastal Plain waters because of the reduced buffering capacity of Coastal Plain soil types. Chain pickerel and yellow perch should not be consumed by women of childbearing age, pregnant women, nursing mothers and children under 15. For all other people, only one meal per week should be consumed. Other species that fall within these advisories that are likely to occur in these waters are largemouth bass, bowfin (blackfish), catfish, and warmouth. Sunfish, which include flier, should not be consumed more than two meals per week for women of childbearing age, pregnant women, nursing mothers and children under 15 and no more than four meals per week for all other people.

Inventory and monitoring needs

There are currently no known inventory and monitoring needs for warm water game fish on this complex of game lands.

Management needs

The game fish in the waters on these properties should continue to be managed under the current regulations as described above. The priority species should be designated as game fish and nongame fish. Since all game fish species that are currently targeted in these game lands waters have some level of consumption advisory associated with them, a sign or kiosk placed in strategic locations providing this information would be beneficial. Due to the habitat restrictions (i.e., shallow, acidic water with low productivity) utilizing management tools (e.g., stocking or herbicide treatment) to enhance the fishery are likely cost prohibitive.

Research needs

There are currently no research needs.

FINANCIAL ASSESTS AND FUTURE NEEDS

The financial assets of the Brunswick and Columbus County Game Land Complex include a variety of assets in the form of infrastructure, personnel, vehicles, and heavy equipment. It should be noted that the large majority of these assets are also used to manage other game lands in the Southern Coastal Ecoregion and some assets, including personnel, are periodically used in other areas of North Carolina where they may be needed by the NCWRC to achieve management objectives in those areas.

Equipment and other asset needs are evaluated annually and operating budgets are allocated annually based on these equipment needs, upcoming projects, the costs of normal operating procedures, and the availability of these funds.

Staffing

The current game land management staff of game land complex includes two permanent, full-time technicians and a full-time temporary technician that works eleven months out of the annual cycle. One of these technicians is the Team Leader and assumes the most responsibility for implementing work duties. Additional staff that assist with management of these properties includes the Southern Coastal Ecoregion Management Biologist, Southern Coastal Ecoregion Wildlife Forester, and Southern Coastal Ecoregion Technician Supervisor. Overseeing all previously mentioned staff is the Coastal Ecoregion Supervisor that supervises personnel throughout the entire Coastal Region. See Map 46 showing the Southern Coastal Ecoregion work area.

There are currently no needs for additional personnel. However, because the previously mentioned staff also conducts management activities on other game lands and boating access areas within the work area, additional staffing needs will be evaluated if demands for more intensive management increases or additional lands are acquired.

Infrastructure

This complex of game lands is managed by staff at a nearby wildlife management depot in Bolivia that serves as a headquarters for land management operations in the area. This location includes a large metal building that includes a shop area, offices, restrooms, and room for storage of tools and supplies.

In compliance with rules for storing hazardous materials, one small storage shed is on-site for the storage of containerized combustible liquids and herbicides.

Additional buildings include a 1-bay open storage shelter used to shelter equipment. There are currently plans to add additional open, sheltered structures that would protect equipment from outside elements.

Other infrastructure throughout these game lands includes numerous culverts for drainage, gates that are used to control access, and two bridges for vehicular traffic.

As described in the Infrastructure Section of this Plan, there are major infrastructure upgrades planned over the ten year planning horizon for these game lands.

Heavy equipment and vehicles

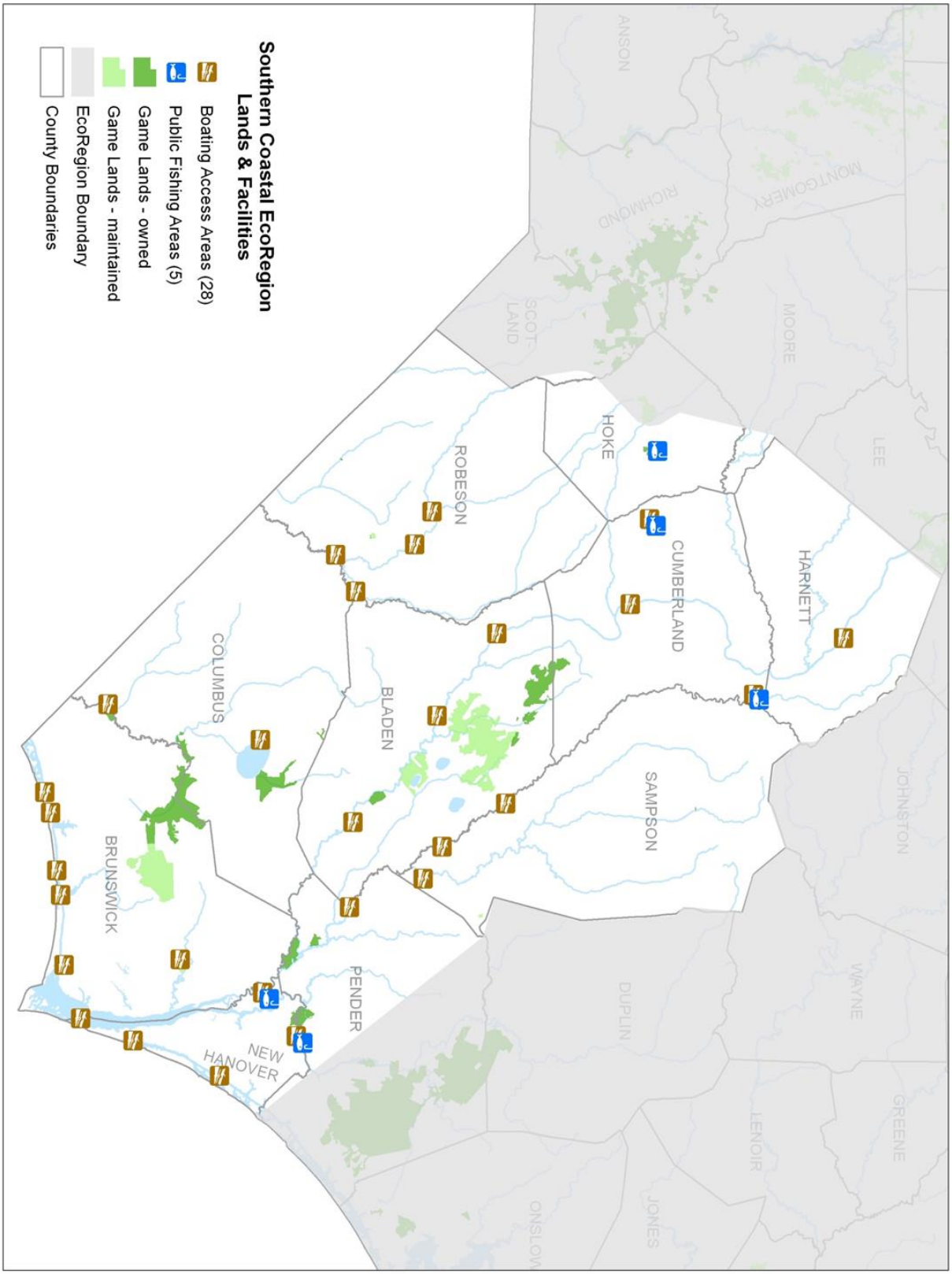
There is currently an adequate supply of heavy equipment and vehicles to conduct management activities on the Brunswick and Columbus County Game Land Complex. Heavy equipment includes three farm tractors with various implements, one backhoe, one motor grader, and one bulldozer. Tractor implements include but are not limited to disk harrows, rotary mowers, a cultipacker, and fertilizer spreader. Other equipment includes one ATV, one UTV, two motorized boats, and two small, one-man creek boats.

Personnel at the Bolivia Depot are currently outfitted with an adequate supply of vehicles. These include four pickup trucks, one of which is used for prescribed burning operations and the application of herbicide on roadsides. Additional vehicles include a road tractor and trailer (18-wheeler) and a dump truck and 20-ton trailer.

As previously stated, the replacement or addition of these assets is evaluated annually based off of existing and predicted needs and are acquired if funding is available.

Financial Summary of Activities

A financial summary of activities was developed to estimate the cost of managing the Brunswick and Columbus County Game Land Complex over the ten-year planning period for which this Plan was written (See Figures 3.1 and 3.2). It should be noted that the inflation rate is calculated from the Consumer Price Index (CPI-U), which is compiled by the United States Bureau of Labor Statistics.



Map 46 – Southern Coastal Ecoregion work area.

Brunswick and Columbus Count Game Land Complex

Financial Summary of Activities

Habitat Activities

Project	Description	Activity	Quantity	Unit	Unit Cost	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023	2023-2024	2024-2025	Total
H	Firebreaks	Maintain firebreaks	3.2	mi	$525	1,680	1,722	1,764	1,808	1,853	1,899	1,946	1,994	2,044	2,094	$18,804
H	Vegetation Control	Prescribe burning	828	ac	$30	24,840	25,456	26,087	26,734	27,397	28,077	28,773	29,487	30,218	30,967	$278,037
H	Herbaceous Seeding	Seed or maintain	11	ac	$175	1,925	1,973	2,022	2,072	2,123	2,176	2,230	2,285	2,342	2,400	21,547
															Subtotal	$318,388

Operation and Maintenance Activities

Project	Description	Activity	Quantity	Unit	Unit Cost	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023	2023-2024	2024-2025	Total
O & M	Public Use Facilities	Maintain campground	3	camp	$225	675	692	709	726	744	763	782	801	821	842	$7,555
O & M	Road and Trails	Maintain gates	24	gate	$100	2,400	2,460	2,521	2,583	2,647	2,713	2,780	2,849	2,920	2,992	$26,863
O & M	Road and Trails	Maintain road	51	mi	$2,500	127,500	130,662	133,902	137,223	140,626	144,114	147,688	151,351	155,104	158,951	$1,427,121
O & M	Road and Trails	Maintain trail	37	mi	$2,500	92,500	94,794	97,145	99,554	102,023	104,553	107,146	109,803	112,526	115,317	$1,035,362
O & M	Signs and Boundaries	Maintain boundary	17	mi	$800	13,600	13,937	14,283	14,637	15,000	15,372	15,753	16,144	16,544	16,955	152,226
															Subtotal	$2,649,128

Development Activities

Project	Description	Activity	Quantity	Unit	Unit Cost	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023	2023-2024	2024-2025	Total
D	Road Upgrade	Swamp Road	1.9	mi	168,421	320,000										$ 320,000
D	Road Upgrade	B Sykes Road	1.1	mi	150,000		169,092									$ 169,092
D	Road Upgrade	New Road	1	mi	150,000			157,440								$ 157,440
D	Road Upgrade	Ernest Canady, Driving Creek, & Lattay Hanes Roads	6.1	mi	125,410				821,916							$ 821,916
D	Road Upgrade	Fernside & Camp Roads	6.7	mi	125,373					923,328						$ 923,328
D	Road Upgrade	Short Swamp Road	0.5	mi	120,000						67,440					$ 67,440
D	Road Upgrade	Big Timber Road	1.2	mi	116,667							160,832				$ 160,832
D	Road Upgrade	Bear Pen Island Road	0.6	mi	166,667							114,880				$ 114,880
D	Road Upgrade	Old Dock Tract	0.8	mi	125,000								117,360			$ 117,360
D	Road Upgrade	Pireway Tract	0.3	mi	150,000								53,928			$ 53,928
D	Road Upgrade	Pinch Gut Access Road	2.2	mi	118,182									318,032		$ 318,032
															Subtotal	$ 3,224,248
															Grand Total	**$6,191,763.95**

Figure 3.1 – Financial Summary for the Brunswick and Columbus County Game Land Complex

Inflation rate is calculated from the Consumer Price Index (CPI-U) which is compiled by the U.S. Bureau of Labor Statistics	
2013	2.07%
2012	3.16%
2010	1.64%
2009	-0.34%
2008	3.85%
2007	2.85%
2006	3.24%
2005	3.39%
2004	2.68%
2003	2.27%
10 yr Av	2.48%

Figure 3.2 – Inflation rates calculated from the Consumer Price Index

ACQUISITION PLAN

The NCWRC's plans for future acquisition will include inholdings, adjacent lands, and critical habitats. Critical habitats that have rare and/or endangered species, provide outstanding ecological benefits, or provide outstanding opportunities for game land users will be high priority. Special considerations will be given to; lands that provide corridors for the connectivity of key parcels or are critical to enhance the NCWRC's ability to protect rare habitats, the land management needs of a property, and the public access and public uses that a property provides.

Prior to any acquisition, initial land investigations will be conducted by NCWRC staff and evaluations will be submitted by Phase I and II acquisitions forms. Land will only be acquired from willing sellers and/or through donations, and all purchases will be based off of available funding. Furthermore, all potential acquisitions will be evaluated on a case-by-case basis by NCWRC staff.

ENFORCEMENT AND REGULATIONS

Currently there are two Wildlife Enforcement Officers that patrol the Brunswick and Columbus County Game Land Complex, which is part of their work area. Both are stationed in Brunswick County. In addition, there are also two more Wildlife Enforcement Officers and three supervisory staff including a Captain, Lieutenant, and Sergeant which routinely assist with enforcement and enforcement issues pertaining to the game land. Primary enforcement activities on the game land include: aircraft patrols for bait, check points for license and game compliance, foot and boat patrols, remote camera setups on bait and littering sites, nighttime poaching setups and surveillance, and routine road patrols. These activities occur throughout the year across the game land, with the highest frequency of enforcement activities occurring during hunting seasons. Critical times for the Enforcement Division on the game land occur during the first two weeks of dove season, and the deer, waterfowl, and turkey seasons.

As with most game lands, the major enforcement problems on these game lands pertain to littering, regulations violations, dogs running unleashed, license/permit issues, ATV riding, and adjoining landowner issues and conflicts.

The following is a list of regulations specifically related to the Brunswick and Columbus County Game Land Complex:

- Columbus County Game Land is three-day-per-week area
- Green Swamp Game Land and Juniper Creek Game Land are six-day-per-week areas
- All tracts of Columbus County Game Land are bear sanctuaries and bear hunting is prohibited
- Portions of Green Swamp and Juniper Creek Game Lands are in bear sanctuary and bear hunting is prohibited
- The gun either-sex deer season for these properties falls under maximum season regulations
- ATV riding is prohibited except by disabled sportsman with valid permits
- Camping is restricted to September 1 – February 28 and March 31 – May 14

PARTNERSHIPS AND COLLABORATIONS

Partnerships and collaborations among various conservation groups, universities, state and federal agencies, non-governmental agencies, non-profit groups, national organizations, clubs, and private citizens have been pivotal to the successful management of this complex of game lands. Newly created and continued partnerships between the NCWRC and these groups will be essential for meeting the goals and needs outlined in this Plan. Below is a list of partners that have assisted with conservation efforts on the Brunswick and Columbus County Game Land Complex.

North Carolina Clean Water Management Trust Fund

> Mission Statement*: "to clean up pollution in the State's surface waters and to protect, preserve and conserve those waters that are not yet polluted."*

North Carolina Natural Heritage Trust Fund

> Mission Statement: "*to receive and administer gifts, grants, devises and bequests of real and personal property to further conservation, outdoor recreation, historic preservation and waterfront and community revitalization."*

North Carolina Natural Heritage Program

> Mission Statement: "*To provide science and incentives to inform conservation decisions and support conservation of significant natural areas in our state."*

The Nature Conservancy

> Mission Statement: "*To conserve the lands and waters upon which all life depends.*"

National Wild Turkey Federation

> Mission Statement: "*Dedicated to the conservation of the wild turkey and the preservation of our hunting heritage."*

North Carolina Forest Service

> Mission Statement: "*To protect, manage and promote forest resources for the citizens of North Carolina."*

National Fish and Wildlife Federation

> Mission Statement: "*to protect and restore the nation's wildlife and habitats."*

United States Fish and Wildlife Service

Mission Statement: "W*orking with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people.*"

North Carolina State University

Mission Statement: "*As a research-extensive land-grant university, North Carolina State University is dedicated to excellent teaching, the creation and application of knowledge, and engagement with public and private partners. By uniting our strength in science and technology with a commitment to excellence in a comprehensive range of disciplines, NC State promotes an integrated approach to problem solving that transforms lives and provides leadership for social, economic, and technological development across North Carolina and around the world*."

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APPENDIX II – GLOSSARY OF TERMS

Burn compartment – a designated area that can be safely and effectively managed with the application of prescribed fire.

Basal area – a term that defines the total area of a given section of land that is occupied by the cross-section of all trees at a height of 4 ½ feet.

Chronic Wasting Disease – a fatal neurological disease of deer and elk characterized by microscopic empty spaces in the brain matter.

Clearcutting – a forestry practice in which most or all of the trees in an area are uniformly cut down.

Crepuscular – occurring or active during twilight hours.

Cryptic – used in science, groups of species that are very difficult to distinguish from one another.

Juxtaposed – the placement and location of objects side by side.

Lymphoproliferative Disease Virus – a cancer of turkey and chickens caused by a retrovirus.

Moist Soil - a technique used in waterfowl habitat management that simulates seasonal wetland hydrology by adding and removing water, most often artificially, in a systematic way to maximize food production for waterfowl and shorebirds.

Selection Harvest – in forestry, the technique of harvesting trees in a way that moves a forest stand towards and uneven-aged or even-aged condition. This technique manages the establishment, continued growth, and final harvest of multiple age classes of trees.

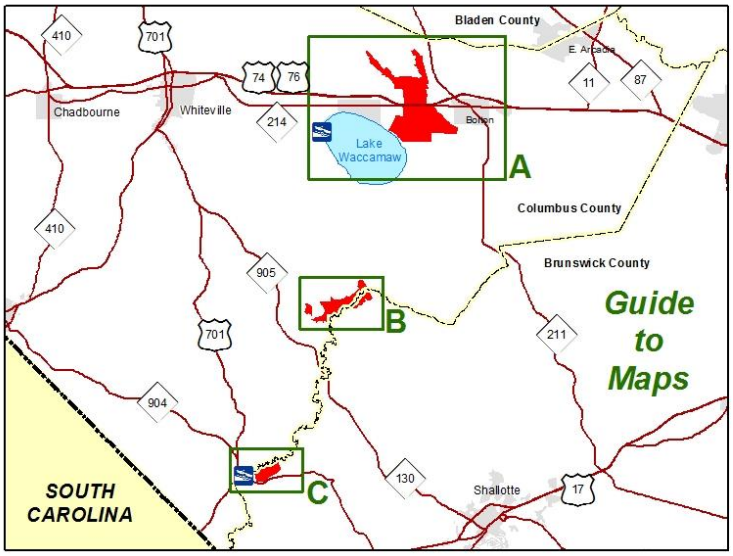
Stocking – a quantitative measure of the area within a forested stand that is occupied by trees.

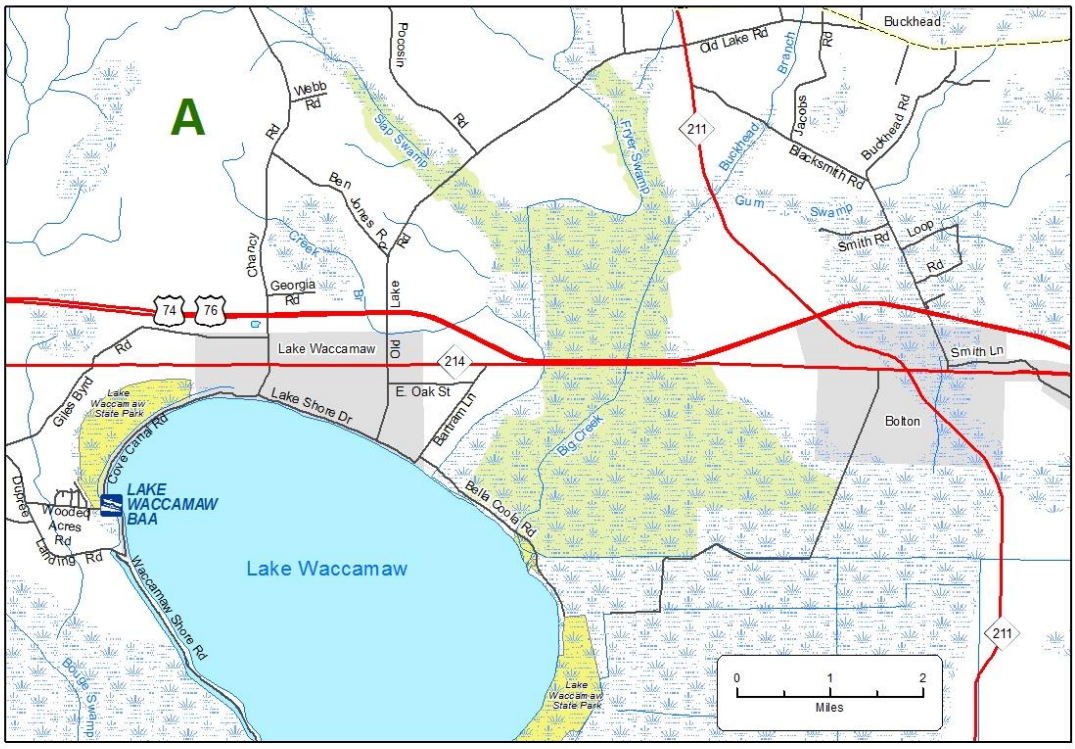
Thinning – a forestry practice in which only a portion of trees in an areas are cut down and removed. This practice is conducted to provide more growing space for the remaining trees and to allow sunlight to reach the forest floor.

APPENDIX III – INFRASTRUCTURE MAPS

COLUMBUS COUNTY GAME LAND - OVERVIEW & WATER ACCESS

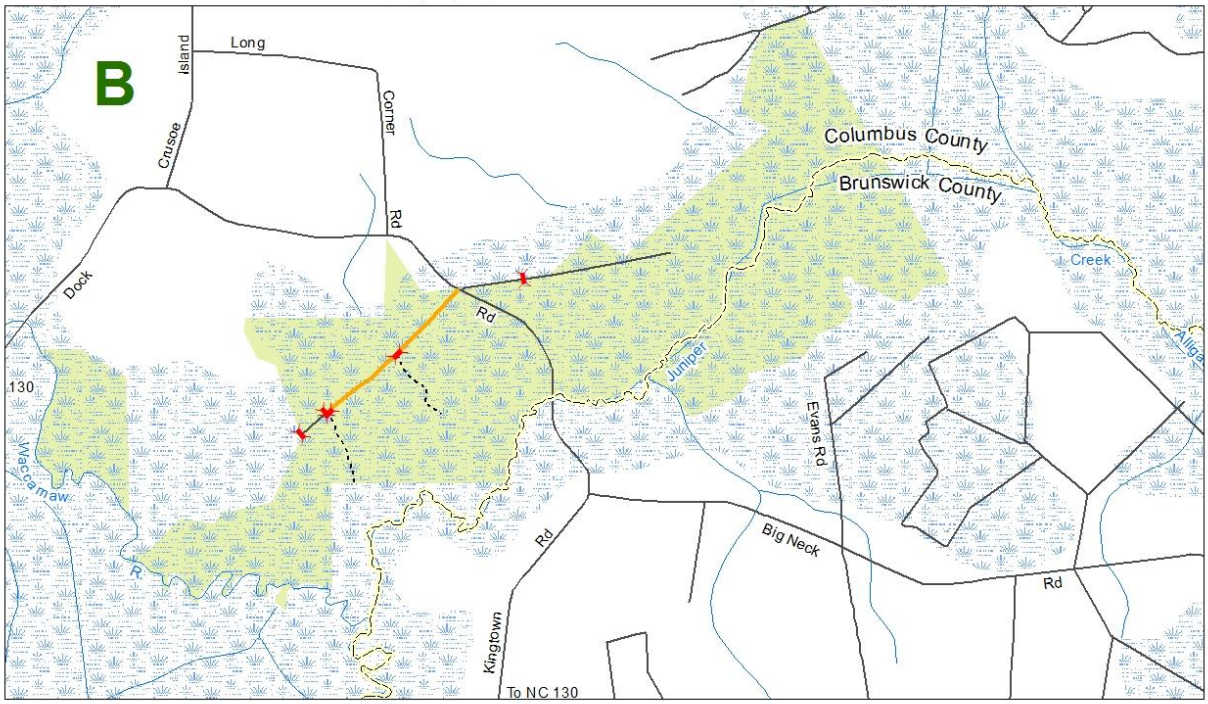
S. Coast Ecoregion, Brunswick & Columbus Counties (8,875 total acres)

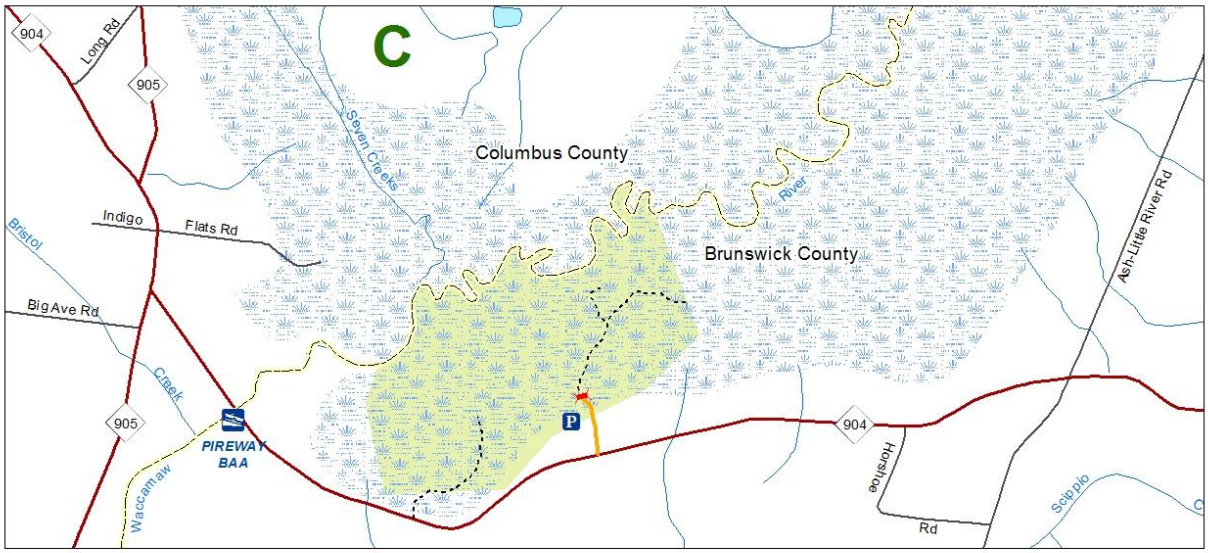




COLUMBUS COUNTY GAME LAND - ROAD NETWORK

S. Coast Ecoregion, Brunswick & Columbus Counties (8,875 total acres)





Roads Repair Rankings

medium priority

Existing Access & Facilities

gate-permanent

public parking

boating access area

trail

secondary road

primary road

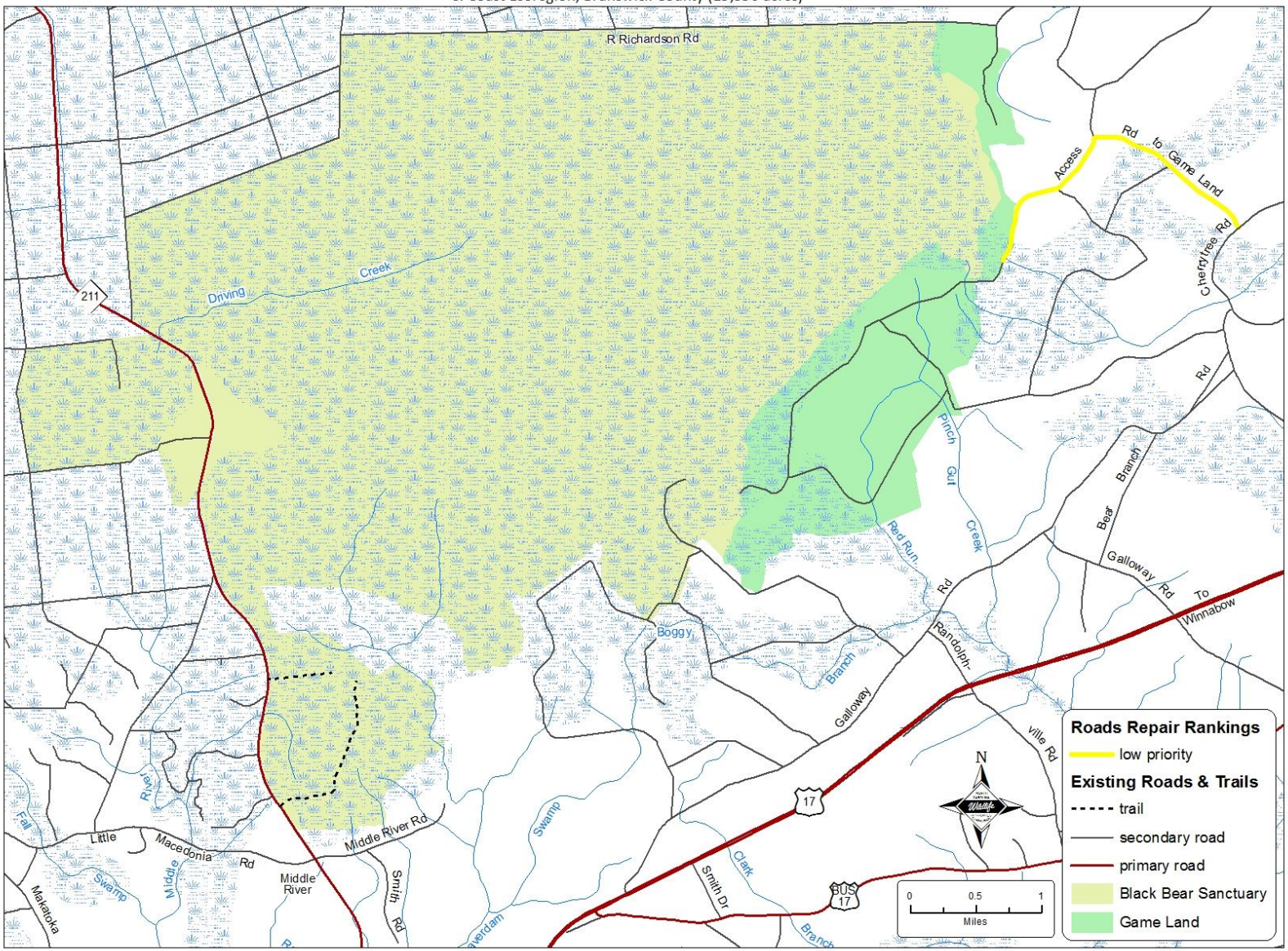
Black Bear Sanctuary

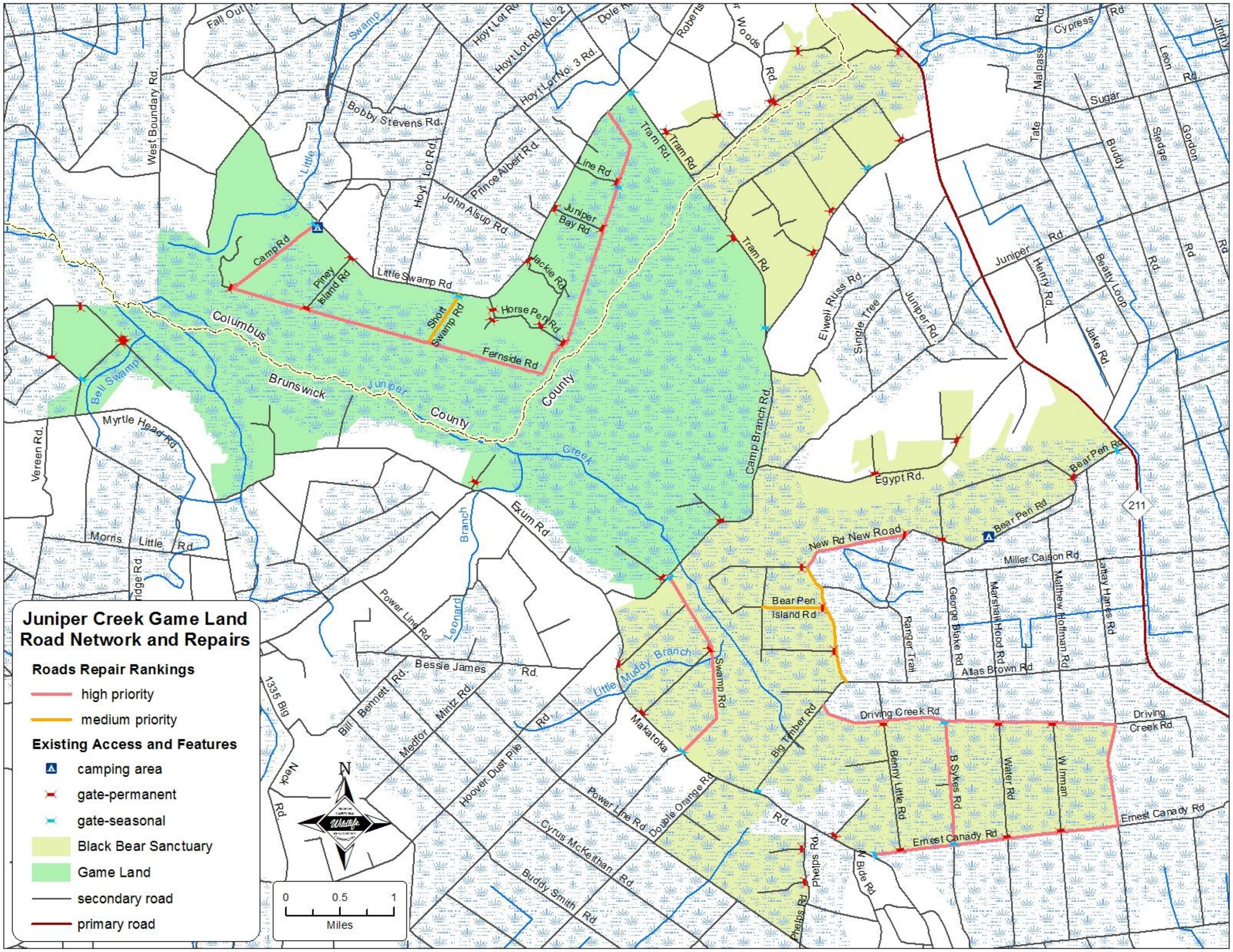
0 0.5 1

Miles

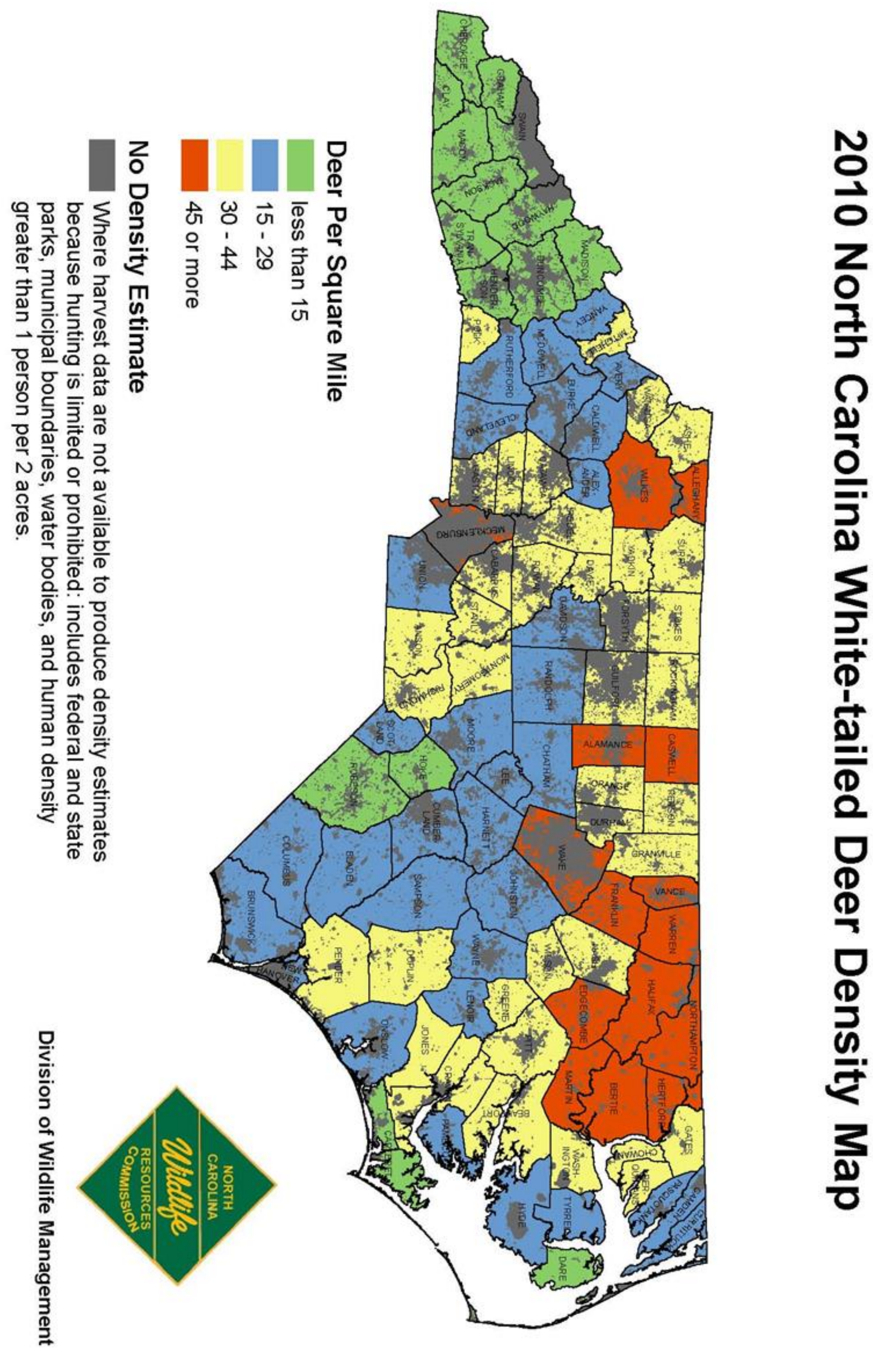
GREEN SWAMP GAME LAND - ROAD NETWORK

S. Coast Ecoregion, Brunswick County (15,356 acres)




Juniper Creek Game Land
Road Network and Repairs
Roads Repair Rankings
high priority
medium priority
Existing Access and Features
camping area
gate-permanent
gate-seasonal
Black Bear Sanctuary
Game Land
secondary road
primary road
0
0.5
1
Miles
N
Columbus
Brunswick
County
County
Juniper
Creek
Camp Rd
Piney Island Rd
Little Swamp Rd
Short Swamp Rd
Horse Pen Rd
Fernside Rd
Jackie Rd
Juniper Bay Rd
Line Rd
Tram Rd.
Tram Rd
Camp Branch Rd
Egypt Rd.
Bear Pen Rd
New Rd New Road
Bear Pen Island Rd
Swamp Rd
Makatoka
Little Muddy Branch
Big Timber Rd
Driving Creek Rd
Benny Little Rd
B Sykes Rd
Water Rd
W Inman
Ernest Canady Rd
Phelps Rd.
Phelps Rd
Bell Swamp
Myrtle Head Rd
Vereen Rd.
Morris Little Rd
West Boundary Rd.
Bobby Stevens Rd.
Hoyt Lot Rd.
Prince Albert Rd.
John Alsup Rd.
Hoyt Lot No. 3 Rd.
Dole
Roberts
Woods
Elwell Russ Rd.
Single Tree
Juniper Rd.
Exum Rd
Leonard Branch
Power Line Rd
Bessie James Rd.
Bill Bennett Rd.
Medfor
Mintz Rd.
Hoover Dust Pile Rd.
Power Line Rd
Double Orange Rd
Cyrus McKeithan Rd
Buddy Smith Rd.
1335 Big Neck Rd.
Ranger Trail
George Blake Rd
Marshall Hood Rd
Matthew Hoffman Rd
Lattay Hanes Rd
Miller Caison Rd
Atlas Brown Rd
211
Henry Rd.
Jake Rd.
Beatty Loop
Tate
Malpass
Cypress
Sugar
Buddy
Sledge
Gordon
Leon
Swamp
Little
Fall Out

APPENDIX IV – NORTH CAROLINA DEER DENSITY MAP



APPENDIX V – PUBLIC MEETING ANNOUNCEMENT

Media Contact: Jodie B. Owen
919-707-0187
jodie.owen@ncwildlife.org

FOR IMMEDIATE RELEASE

Wildlife Commission Seeks Public Input for Columbus County Game Land, Green Swamp Game Land, and Juniper Creek Game Land

Bolivia, N.C. (Feb. 10, 2015) — The N.C. Wildlife Resources Commission is holding a public meeting March 12, at 7 p.m., in Bolivia to seek input in developing a management plan for Columbus County Game Land, Green Swamp Game Land, and Juniper Creek Game Land. The meeting will be held at the Brunswick County Cooperative Extension Office located at 25 Referendum Drive, Bolivia, NC 28422.

Wildlife Commission staff will use public input from the meeting to help guide management and user activities on WRC-owned portions of Columbus County Game Land, WRC-owned portions of Green Swamp Game Land, and Juniper Creek Game Land for the next 10 years. WRC-owned portions of Columbus County Game Land encompass 8,506 acres and are located in Columbus and Brunswick Counties within the floodplain and headwaters of the Waccamaw River. WRC-owned portions of Green Swamp Game Land encompass 2,110 acres and are located in Brunswick County adjacent to N.C. 211 with a separate tract located adjacent to Sunny Point Military Ocean Terminal. Juniper Creek Game Land encompasses 18,506 acres and is located in Brunswick and Columbus Counties along N.C. 211.

"We are seeking input from all users of the Columbus County, Green Swamp, and Juniper Creek game lands and others who are interested in how the property is managed," said Lands Program Manager Isaac Harrold. "This meeting is not just for hunters and anglers. It is for wildlife watchers and photographers, birding groups, hikers, and others who have interest in Columbus County Game Land, Green Swamp Game Land, and Juniper Creek Game Land. Everyone is encouraged to provide input."

The Wildlife Commission also is accepting comments and suggestions from people who do not attend the meeting. Submit comments regarding the Brunswick and Columbus County Game Land Complex Management Plan at www.ncwildlife.org. Click on "Comment on Game Land Plans" from the scrolling icons at bottom of page. Comments also can be e-mailed to gamelandplan@ncwildlife.org. Type "Columbus County Game Land", "Green Swamp Game Land, or "Juniper Creek Game Land" on the subject line.

About the N.C. Wildlife Resources Commission

Since 1947, the N.C. Wildlife Resources Commission has been dedicated to the conservation and sustainability of the state's fish and wildlife resources through research, scientific management, wise use, and public input. The Commission is the state regulatory agency responsible for the enforcement of fishing, hunting, trapping and boating laws and provides programs and opportunities for wildlife-related educational, recreational and sporting activities. To learn more, visit www.ncwildlife.org.

Get **N.C. Wildlife Update** — news including season dates, bag limits, legislative updates and more — delivered free to your Inbox from the N.C. Wildlife Resources Commission. Go to www.ncwildlife.org/enews.

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SUMMARY OF PUBLIC INPUT

As part of the creation of the Brunswick and Columbus County Game Land Complex Management Plan, public input was solicited during March and April of 2015. With the idea that the Plan will address all current and potential issues, public input was sought to identify the concerns, desires, and needs of game land users and all interested parties. In order to achieve this, Management Biologists and Supervisory Staff created a series of seven (7) questions that encouraged people to comment on their level of satisfaction, concerns, and desires in relation to WRC game lands. Three methods were used to gather comments; public input meetings, an online comment session, and via email. Public comment was received online and through email from 16 February to 10 April 2015. The public input meeting was held on 12 March 2015 in the auditorium at the Brunswick County Cooperative Extension office in Bolivia, NC. The following is a summarization of comments received.

SUMMARY OF RESULTS

1. What habitats do you think are most important to protect and/or improve on this game land?

13 comments were received in regards to Question 1. 38% them expressed interest in protecting or improving habitat beneficial to game animals, *i.e.* ducks, deer, bobwhite quail, turkey, etc. The other 62% of the comments specifically named habitat types which included the aquatic habitats, longleaf pine savannas, small depression communities, pocosins, sand ridges and food plots.

2. Considering those that live on land and in water, what species do you think are most important to protect and/or improve on this game land?

6 comments were received in regards to Question 2. 66% of the comments expressed interest in protecting and/or improving game animals. Game animals mentioned include bears, deer, turkeys, geese, quail, beaver, and ducks. It should be noted that some comments mentioned multiple species.

2 comments stated that all wildlife were important to protect and/or improve on these game lands.

3. How do you use this game land?

6 comments were received in regards to Question 3. All comments stated that they used these game lands for traditional uses, which include hunting and wildlife viewing. 2 comments stated that in addition to hunting, they also partook in non-traditional uses; walking and camping.

4. *Please explain why you think the current level of access is or is not satisfactory on this game land?*

5 comments were received in regards to Question 4. User satisfaction in regards to access was unanimously poor. All 5 comments expressed a level of dissatisfaction with the current access. Reasons stated for dissatisfaction included a need for more boat access, the lack of foot bridges to cross large ditches and canals, and gated roads.

5. *What suggestions, if any, do you have for changing how this game land is managed and maintained?*

10 comments were received regarding Question 5. The most common topics included the continued and more frequent use of prescribed fire and more food plots and parking. Other comments included making these areas shotgun-only, posting the hunting season dates on a sign, and a need to avoid activities that would impact water quality.

6. *What would encourage you to start using the game land, or to continue using it more actively?*

6 comments were received regarding Question 6. Individuals gave a wide array of changes that would encourage them to start using or to continue using these game lands. Reasons included better access, better roads and parking, more deer, hunting seasons posted on a sign, the continued ability to hunt and fish, and more food plots.

7. *What additional comments do you have regarding this game land?*

3 comments were received in regards to Question 7. Many of them reflect comments already made to the other 6 questions. They include a request for more food plots and more access. One comment stated that they used the hunter camp ground on Juniper Creek Game Land and expressed gratitude.

1. *What habitats do you think are most important to protect and/or improve on this game land?*

Source of Input	Comment
Online	Deer & Turkey need some food plots.
Online	Columbus County Game Land includes lands in Friar Swamp and along the Waccamaw River and lowermost Juniper Creek. Friar Swamp protects the only large input stream into Lake Waccamaw, and is crucial for protecting the lake and its globally significant collection of rare mollusks and fishes. Several of those rare species also occur in Big Creek within the game land, along with an excellent expanse of swamps and occurrences of the rare Swamp Island Evergreen Forest community. The southern units protect some of the best remaining examples of the distinctive natural communities of the Waccamaw River, and harbor several rare species. They also contribute to protection of the Waccamaw River and Juniper Creek, with their outstanding collection of rare aquatic fauna.
Online	Really need some food plots started on this game land for deer & turkey.
Online	Juniper Creek Game Land encompasses almost all of the Juniper Creek corridor, one of the most fully protected stream and wetland systems in the state. It protects Juniper Creek and its tributaries, with their collection of rare aquatic fauna. In addition to its vast swamp forests and examples of rare floodplain communities, it contains several highly significant pine savanna sites. Several of these contain rare plants, and the one known as Camp Branch Savanna Remnant contains an astounding 15 rare plant species.
Online	I would like to see a more diverse use of land on all game lands. In particular, I would like to see long leaf pines planted instead of hybrid seedlings. At least along highway, field and river borders. I feel this would benefit wildlife more in general. Also, more hardwoods and fruit bearing trees since all of this is being replaced by weyerhauser seedlings on all private lands.
Online	The Swain Tract portion of Green Swamp Game Land is part of the White Springs Pond Complex, and includes several limesink ponds set in a longleaf pine landscape. The small depression communities, rare pondspice, and possibly Carolina gopher frog make this unit highly significant. The Pinch Gut portion is adjacent to the vast pocosins of the Green Swamp, but consists primarily of very dry sand ridges. Its expanse includes some areas of both wet and dry longleaf pine communities in good condition, and large areas where enough component plants remain to make them excellent sites for restoration of longleaf pine forest. One high quality wet savanna harbors several rare plants, and other rare plants are scattered through the tract.
Public Input Meeting	Upland and lowland and wetlands.
Public Input Meeting	Bear, deer, turkey.
Public Input Meeting	All game equal. Bear, deer, turkey, small game, etc.
Public Input Meeting	Good management.
Public Input Meeting	Duck impoundments.
Public Input Meeting	Wildlife, food plots, parking, shooting range.
Public Input Meeting	Wildlife, food plots, rivers, lakes.

2. *Considering those that live on land and in water, what species do you think are most important to protect and/or improve on this game land?*

Source of Input	Comment
Public Input Meeting	Bear, quail, beaver, turkey, all the other non-game species
Public Input Meeting	Bear, ducks, goose, turkeys, other birds, bears.
Public Input Meeting	Deer, turkey, quail, ducks.
Public Input Meeting	Deer, duck, geese, hog, bear, etc., turkey.
Public Input Meeting	All wildlife.
Public Input Meeting	All.

3. *How do you use this game land?*

Source of Input	Comment
Online	Deer & Turkey Hunting Love it!
Online	Deer & turkey hunting camping
Online	Deer & turkey hunting.
Public Input Meeting	Hunting.
Public Input Meeting	Hunt, fish, walk.
Public Input Meeting	For hunting.
Public Input Meeting	Hunting.
Public Input Meeting	Hunting, watching wildlife.
Public Input Meeting	Hunting and fishing.
Public Input Meeting	Walking to hunt the wildlife that's there that day. I am a non-hunter, just a wildlife enthusiast.

4. *Please explain why you think the current level of access is or is not, satisfactory on this game land?*

Source of Input	Comment
Online	The access to the game lands is not very good. On the back line there is no way to get across the canals, unless it is the old foot logs that were there when it was Juniper Creek Hunting club. Therefore, the level of any outdoor activities is highly limited. Please improve the access to the big swamp from the back line and it would be a great improvement. Access bridges every 500 to 600 yards would make a huge difference.
Public Input Meeting	More boat ramp access.
Public Input Meeting	Somewhat difficult. Gated in areas.
Public Input Meeting	The current access is poor.
Public Input Meeting	Would like to see open gates rotated seasonally.

5. *What suggestions, if any, do you have for changing how this game land is managed and maintained?*

Source of Input	Comment
Online	No specific management needs are known for Columbus County Game Land, beyond the need to avoid activities that would have impacts on water quality, and to allow the forested natural communities to continue maturing.
Online	A crucial management need is for ongoing prescribed burning in the pine savannas on Juniper Creek Game Land, especially in Camp Branch Savanna Remnant. Some of the savannas have off-site planted pines, or lack longleaf pine, and would benefit from continued restoration efforts. However, there is also a crucial need to avoid soil disturbance in these areas. The floodplain areas need no specific management beyond avoiding activities that would be detrimental to water quality or that would alter the natural forests.
Online	I think the Swain tract needs to be patrolled more, as I have found permanent tree stands with fresh corn piles for baiting deer this past season.
Online	Private clubs continue to remove NC Game land signs, publish GPS Boundary for Game lands.
Online	The greatest management need is for prescribed burning, to sustain and improve the longleaf pine communities on both tracts of Green Swamp Game Land. Fire is also likely to be beneficial to the small depression communities at the Swain tract and to the edges of the pocosin communities on the Pinch Gut tract, and to the rare species they contain.
Public Input Meeting	Game lands are well maintained already. Would like to see more food plots.
Public Input Meeting	Use of shotguns versus centerfire for safety. Additional roads, parking, foot bridges, food plots.
Public Input Meeting	Food plots, parking.
Public Input Meeting	More food plots.
Public Input Meeting	Clearly post the game season dates at a single entrance. Limit parking spaces. What is the average acreage for individual species and limit spaces to that number.

6. *What would encourage you to start using this game land, or to continue using it more actively?*

Source of Input	Comment
Online	I wish it had some food plots started. Would really help in still hunting.
Online	More access across the big canals.
Public Input Meeting	Knowing that I can. Clearly posting hunting seasons so I can avoid walking the land at that time.
Public Input Meeting	Continuing to offer hunting and fishing.
Public Input Meeting	More deer! Better roads, parking areas, concern for safety.
Public Input Meeting	Better access.

7. *What additional comments do you have regarding this game land?*

Source of Input	Comment
Online	The game lands are a great resource to any hunter. However, you could go from good to great with just a little more access.
Online	Really use the Camp site at Juniper Creek. Thanks !
Online	Plenty of high ground need food plots

North Carolina Department of Environment and Natural Resources
Office of Land and Water Stewardship

Pat McCrory
Governor

Bryan Gossage
Director

Donald R. van der Vaart
Secretary

March 30, 2015

Chesley Ward, Management Biologist
North Carolina Wildlife Resources Commission
1172 NC 53 West
Elizabethtown, NC 28337

Dear Mr. Ward:

The North Carolina Natural Heritage Program appreciates the opportunity to provide input as the North Carolina Wildlife Resources Commission (WRC) develops a management plan for the Columbus County Game Land. We also appreciate the ecosystem management approach that the WRC has historically applied to managing the Game Lands, and would encourage WRC to continue with this management philosophy, especially as natural habitats across North Carolina are degraded, and habitat fragmentation increases. Maintaining high-quality examples of North Carolina's natural ecosystems is important for native wildlife - including rare species - and the citizens of our state.

The Natural Heritage Program (NHP) welcomes a continued partnership in conservation, and of course extends an offer to assist in planning, as well as provide the information on natural resources that we have acquired over the years – often with the help of WRC biologists. We propose that WRC incorporate natural heritage data into the management plan, including the element occurrences of rare species, special animal habitats, and exemplary and rare natural communities, and particularly, the Natural Heritage Areas and Dedicated Nature Preserves that have been identified by the NHP as priorities for conservation. Our information is available spatially through GIS data layers, in site reports, and we will make NHP biologists available to provide specific information on the resources as necessary.

Columbus County Game Land includes lands in Friar Swamp and along the Waccamaw River and lowermost Juniper Creek. Friar Swamp protects the only large input stream into Lake Waccamaw, and is crucial for protecting the lake and its globally significant collection of rare mollusks and fishes. Several of those rare species also occur in Big Creek within the game land, along with an excellent expanse of swamps and occurrences of the rare Swamp Island Evergreen Forest community. The southern units protect some of the best remaining examples of the distinctive natural communities of the Waccamaw River, and harbor several rare species. They also contribute to protection of the Waccamaw River and Juniper Creek, with their outstanding collection of rare aquatic fauna. No specific management needs are known for this game land, beyond the need to avoid activities that would have impacts on water quality, and to allow the forested natural communities to continue maturing.

The Columbus County Game Land management plan intends to help guide management and user activities for the next ten years. During that time, North Carolina will most likely continue to be one of the fastest-growing states in the nation. Maintaining the integrity of natural areas and connectivity for wildlife within the Game Lands will provide a much greater opportunity for North Carolina's native diversity to remain viable. Thank you for your contribution to the conservation of our natural resources in North Carolina. Please contact me or other NHP staff if you would like additional information.

Sincerely,

Scott Pohlman

1601 Mail Service Center, Raleigh, North Carolina 27699-1601
Phone: 919-707-8600 \ Internet: www.ncdenr.gov

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North Carolina Department of Environment and Natural Resources
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Secretary

March 30, 2015

Chesley Ward, Management Biologist
North Carolina Wildlife Resources Commission
1172 NC 53 West
Elizabethtown, NC 28337

Dear Mr. Ward:

The North Carolina Natural Heritage Program appreciates the opportunity to provide input as the North Carolina Wildlife Resources Commission (WRC) develops a management plan for the Pinch Gut and Swain Tracts of the Green Swamp Game Land. We also appreciate the ecosystem management approach that the WRC has historically applied to managing the Game Lands, and would encourage WRC to continue with this management philosophy, especially as natural habitats across North Carolina are degraded, and habitat fragmentation increases. Maintaining high-quality examples of North Carolina's natural ecosystems is important for native wildlife - including rare species - and the citizens of our state.

The Natural Heritage Program (NHP) welcomes a continued partnership in conservation, and of course extends an offer to assist in planning, as well as provide the information on natural resources that we have acquired over the years – often with the help of WRC biologists. We propose that WRC incorporate natural heritage data into the management plan, including the element occurrences of rare species, special animal habitats, and exemplary and rare natural communities, and particularly, the Natural Heritage Areas and Dedicated Nature Preserves that have been identified by the NHP as priorities for conservation. Our information is available spatially through GIS data layers, in site reports, and we will make NHP biologists available to provide specific information on the resources as necessary.

The Swain Tract portion of Green Swamp Game Land is part of the White Springs Pond Complex, and includes several limesink ponds set in a longleaf pine landscape. The small depression communities, rare pondspice, and possibly Carolina gopher frog make this unit highly significant. The Pinch Gut portion is adjacent to the vast pocosins of the Green Swamp, but consists primarily of very dry sand ridges. Its expanse includes some areas of both wet and dry longleaf pine communities in good condition, and large areas where enough component plants remain to make them excellent sites for restoration of longleaf pine. One high quality wet savanna harbors several rare plants, and other rare plants are scattered through the tract. The greatest management need is for prescribed burning, to sustain and improve the longleaf pine communities on both tracts. Fire is also likely to be beneficial to the small depression communities at the Swain tract and to the edges of the pocosin communities on the Pinch Gut tract, and to the rare species they contain.

The Green Swamp Game Land management plan intends to help guide management and user activities for the next ten years. During that time, North Carolina will most likely continue to be one of the fastest-growing states in the nation. Maintaining the integrity of natural areas and connectivity for wildlife within the Game Lands will provide a much greater opportunity for North Carolina's native diversity to remain viable. Thank you for your contribution to the conservation of our natural resources in North Carolina. Please contact me or other NHP staff if you would like additional information.

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Director

Donald R. van der Vaart
Secretary

March 30, 2015

Chesley Ward, Management Biologist
North Carolina Wildlife Resources Commission
1172 NC 53 West
Elizabethtown, NC 28337

Dear Mr. Ward:

The North Carolina Natural Heritage Program appreciates the opportunity to provide input as the North Carolina Wildlife Resources Commission (WRC) develops a management plan for the Juniper Creek Game Land. We also appreciate the ecosystem management approach that the WRC has historically applied to managing the Game Lands, and would encourage WRC to continue with this management philosophy, especially as natural habitats across North Carolina are degraded, and habitat fragmentation increases. Maintaining high-quality examples of North Carolina's natural ecosystems is important for native wildlife - including rare species - and the citizens of our state.

The Natural Heritage Program (NHP) welcomes a continued partnership in conservation, and of course extends an offer to assist in planning, as well as provide the information on natural resources that we have acquired over the years – often with the help of WRC biologists. We propose that WRC incorporate natural heritage data into the management plan, including the element occurrences of rare species, special animal habitats, and exemplary and rare natural communities, and particularly, the Natural Heritage Areas and Dedicated Nature Preserves that have been identified by the NHP as priorities for conservation. Our information is available spatially through GIS data layers, in site reports, and we will make NHP biologists available to provide specific information on the resources as necessary.

Juniper Creek Game Land encompasses almost all the Juniper Creek corridor, one of the most fully protected stream and wetland systems in the state. It protects Juniper Creek and its tributaries, with their collection of rare aquatic fauna. In addition to its vast swamp forests and examples of rare floodplain communities, it contains several highly significant pine savanna sites. Several of these contain rare plants, and the one known as Camp Branch Savanna Remnant contains an astounding 15 rare plant species. A crucial management need is for ongoing prescribed burning in the pine savannas, especially in Camp Branch Savanna Remnant. Some of the savannas have off-site planted pines, or lack longleaf pine, and would benefit from continued restoration efforts. However, there is also a crucial need to avoid soil disturbance in these areas. The floodplain areas need no specific management beyond avoiding activities that would be detrimental to water quality or that would alter the natural forests.

The Juniper Creek Game Land management plan intends to help guide management and user activities for the next ten years. During that time, North Carolina will most likely continue to be one of the fastest-growing states in the nation. Maintaining the integrity of natural areas and connectivity for wildlife within the Game Lands will provide a much greater opportunity for North Carolina's native diversity to remain viable. Thank you for your contribution to the conservation of our natural resources in North Carolina. Please contact me or other NHP staff if you would like additional information.

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NC DEPARTMENT OF
NATURAL AND CULTURAL RESOURCES

Roy Cooper, **Governor**
Susi Hamilton, **Secretary**
Walter Clark, **Director, Land and Water Stewardship**

February 2, 2018

Chesley Ward, Management Biologist
Brunswick and Columbus County Game Land Complex

Dear Mr. Ward:

The North Carolina Natural Heritage Program appreciates the opportunity to review the draft Management Plan for the Brunswick and Columbus County Game Land Complex. We also welcome a continued partnership with the NC Wildlife Resources Commission (WRC) as it moves forward to implement the final management plan.

The North Carolina Natural Heritage Program (NHP) appreciates the plan's effort to maintain consistency with the Articles of Dedication. We also appreciate the recognition of the Game Land Complex's importance for North Carolina's natural diversity, as well as its ecological importance as part of a larger conservation landscape.

We are pleased to note the emphasis placed on longleaf pine communities, and associated ecotones. Where soil types are appropriate, we support the goal of converting loblolly and slash pine plantations to more natural longleaf pine/wire grass communities. We strongly support the intention of restoring and maintaining a natural fire regime through application of prescribed fire, including growing season controlled burns. We appreciate the plan to rehabilitate firebreaks, as well as the cautious approach outlined in the plan to converting wet pine plantations. The goal of control of invasive species, particularly in the floodplain forest, is also appreciated. We concur that the Juniper Creek watershed is critical for the viability of species such as the endemic Carolina Pygmy Sunfish, and appreciate the plan's recognition of the importance of intact hydrology. We support the recommendation that all grading/roadwork be conducted to not impact aquatic ecosystems, as well as the recognition of the need for further research and monitoring.

Maintaining the integrity of natural areas and connectivity for wildlife within the Game Lands will provide a much greater opportunity for North Carolina's native diversity to remain viable. Thank you for your contribution to the conservation of our natural resources in North Carolina. Please contact me or other NHP staff if you have any questions, or would like additional information.

Sincerely,

Scott Pohlman

Scott Pohlman

DEPARTMENT OF NATURAL AND CULTURAL RESOURCES
121 W. JONES STREET, RALEIGH, NC 27603 • 1651 MAIL SERVICE CENTER, RALEIGH, NC 27699
OFC 919.707.9120 • FAX 919.707.9121