Onslow Bight Conservation Design Plan

Second Iteration

November 22, 2022

Island Creek, Croatan National Forest; Photo by: N.C. Coastal Land Trust

Prepared by

North Carolina Coastal Land Trust

With contributions from

The Nature Conservancy

North Carolina Natural Heritage Program

Department of the Navy, U.S. Marine Corps

North Carolina Wildlife Resources Commission

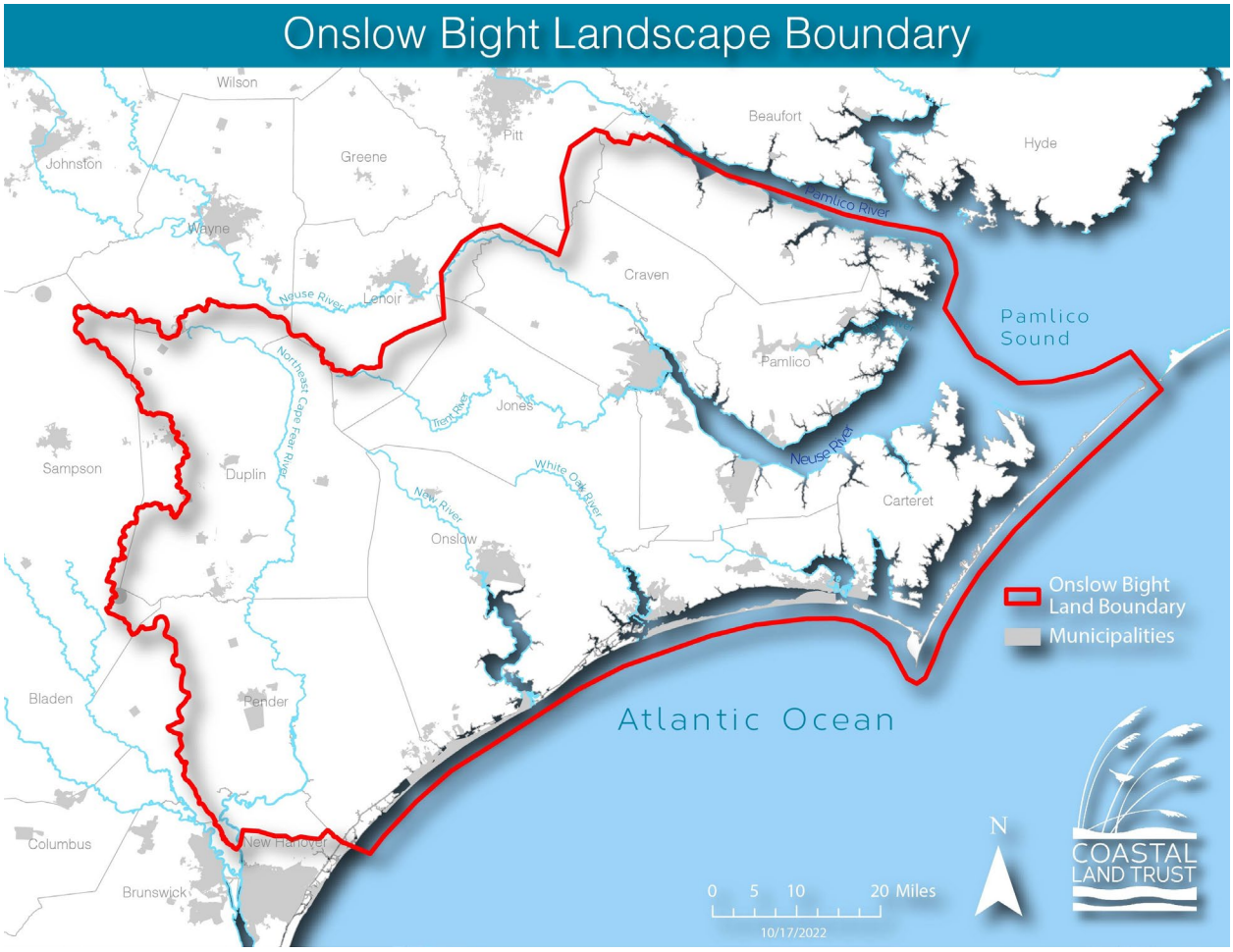
The Conservation Fund

Ducks Unlimited

North Carolina Coastal Federation

I. Background

The Onslow Bight Landscape includes all or portions of thirteen counties (Beaufort, Carteret, Craven, Duplin, Jones, Lenoir, New Hanover, Onslow, Pamlico, Pender, Pitt, Sampson and Wayne) in the mid-coastal region of Eastern North Carolina (see map below). The term "Bight" means a long gradual bend or recess in the shoreline that forms a large open bay which can be found along the North Carolina mid-coast south of Cape Lookout National Seashore. Overall, the Onslow Bight Landscape hosts barrier islands, marshes, riverine wetlands, pocosins, longleaf pine savannas and many other coastal ecosystems. The area supports exceptionally significant occurrences of animal and plant communities, several of which are endemic to the region. The rural character of the area, coupled with the flora and fauna and supporting geophysical characteristics, have created a natural environment with abundant opportunities to enjoy fishing, hunting, camping, hiking, canoeing, and other resource-based outdoor recreational opportunities. Many residents, permanent and seasonal, have chosen the area because of the many amenities afforded by the natural environment.



Launched in May 2001, the Onslow Bight Conservation Forum (OBCF) is a collaborative partnership between varying organizations and agencies dedicated to protecting the Onslow

Bight landscape while addressing the needs of man and nature. A Memorandum of Understanding (MOU) between 12 agencies and organizations (The Nature Conservancy, Marine Corps Base Camp Lejeune, North Carolina Wildlife Resources Commission, North Carolina Department of Environment and Natural Resources, Marine Corps Air Station Cherry Point, U.S. Fish and Wildlife Service, U.S. Forest Service, Endangered Species Coalition, North Carolina Coastal Federation, North Carolina Coastal Land Trust, Natural Resources Conservation Service and North Carolina Department of Transportation) was signed in March 2003 which formally established the OBCF. Additional signatories to the MOU came in later updates (2006, 2012) and include: North Carolina Forest Service, Ducks Unlimited, Coastal Plain Conservation Group, The Conservation Fund, and U.S. Marine Corps Air Station New River. The mission of the OBCF is to "provide for open discussion among the participants conserving the long-term conservation and enhancement of biological diversity and ecosystem sustainability throughout the Onslow Bight landscape compatible with the land use, conservation and management objectives of the participating organizations and agencies."

In January 2002, the OBCF created the "Reserve Design" subcommittee (or the Design Committee) to share "priorities amongst the various members, collecting information from all relevant sources, and creating a coordinated conservation vision for the region." The first iteration of the Onslow Bight Conservation Design Plan (hereinafter the "OBCF Plan") was prepared by the Onslow Bight Design Committee of the Onslow Bight Conservation Forum (OBCF) and approved by the OBCF on October 7, 2004. This first iteration defined conservation targets, set forth conservation priorities within the landscape, and articulated certain actions that partners might take individually or in mutual cooperation to work towards a common conservation vision. The 2004 Conservation Design Plan presented acquisition/protection as well as management strategies.

A considerable amount of conservation work has been completed by the signatories (hereinafter "partners") in the 18 years since the first OBCF Plan was prepared. This second iteration will provide highlights of conservation work completed by some of the partners as well as updated conservation targets, priorities, and strategies. This updated plan also addresses climate resiliency strategies to help create a more resilient Onslow Bight landscape. The North Carolina Coastal Land Trust (NCCLT) has taken the lead in preparing this second iteration of the OBCF Plan with assistance from many of the partners including The Nature Conservancy (TNC) and North Carolina Natural Heritage Program (NCNHP). This plan update was supported through the Open Space Institute's Land and Climate Catalyst Program, which is made possible with major funding from the J.M. Kaplan Fund, with additional support from general individual contributions.

"The challenges we all face are so much greater than anything one organization can do alone; our only chance at success is to work together – practitioners, funders, communities, and residents – toward our shared vision of a better future for all." Peter Howell, Executive Vice President, Conservation Capital Program, Open Space Institute

Similar to the 2004 OBCF Plan, the second iteration sets forth a vision for one coastal region, the Onslow Bight landscape that blends the conservation of its unique natural features

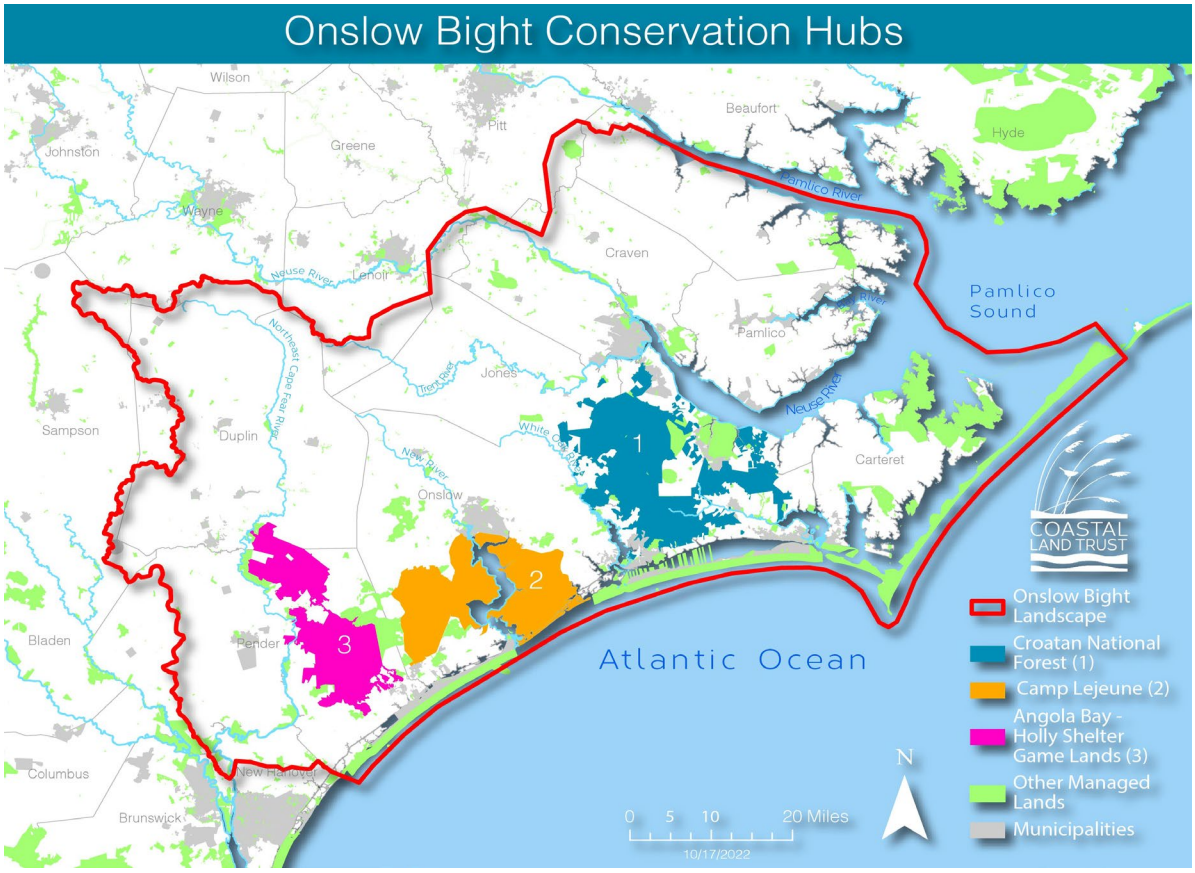
with traditional future human uses of the land. This plan seeks to preserve for future generations these conservation values while simultaneously ensuring the continued production and processing of forest and agricultural products, new industry, tourism, military training and the growth these varied activities bring.

II. The Onslow Bight Landscape

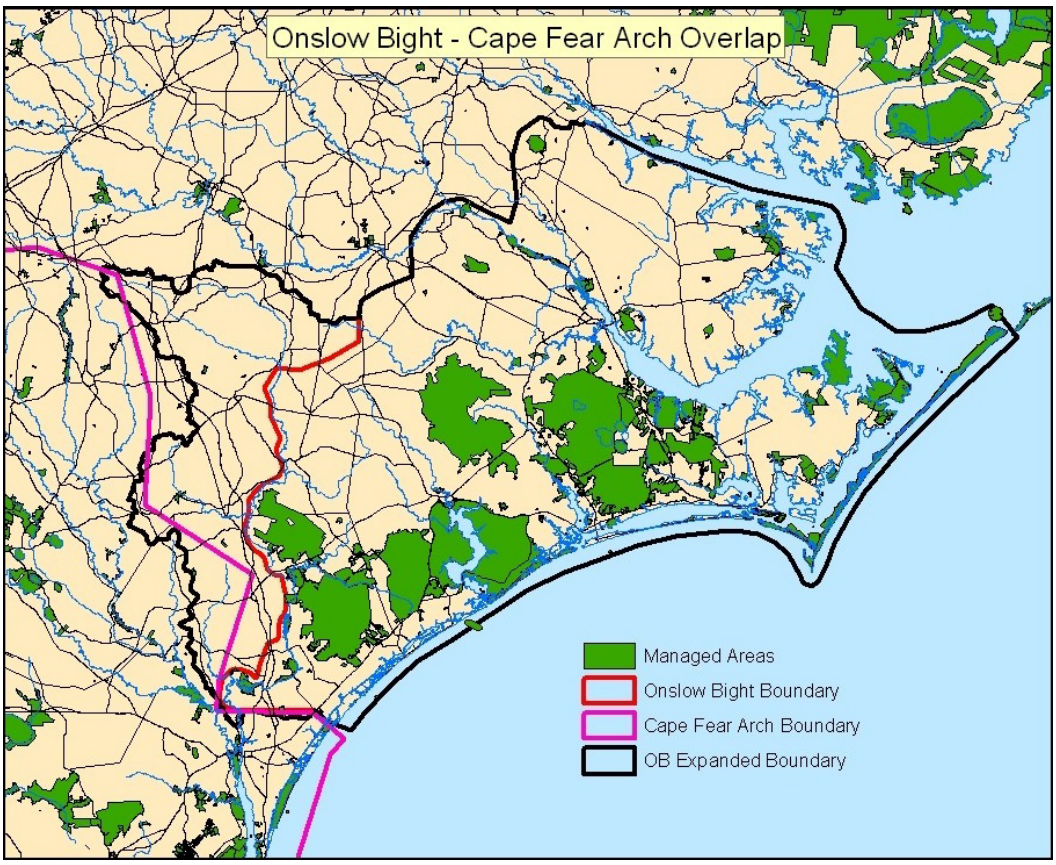
The Onslow Bight landscape encompasses the region extending from the lower Northeast Cape Fear River to the Pamlico River and from offshore waters to approximately 50 miles inland. The landscape described in the 2004 OBCF Plan was revised in 2005 and again in 2011 to include the entire watersheds of the Northeast Cape Fear and Trent Rivers and extensive amounts of working lands nearer the inner Coastal Plain. The landscape boundary begins at the southern end at Rich Inlet extending across northern New Hanover County to include the large expanse of floodplain marshes and forests near the mouth of the Northeast Cape Fear River and a portion of the 421 Sand Ridge. Then turning north it follows the watershed boundary of the Northeast Cape Fear River to southern Wayne County and then eastward where it follows the northern boundary of the Trent River watershed. Southeast of Kinston the boundary turns north and crosses the Neuse River downstream from this city and then extends further to the Pamlico River downstream from Washington, NC. From there the Onslow Bight Landscape follows the river downstream to the Pamlico Sound before exiting estuarine waters and into the Atlantic Ocean through Ocracoke Inlet. Overall, the landscape is ecologically diverse with numerous rare plant and animal species and natural communities, including several species and communities that are entirely or largely restricted to the area (endemics). Although variation exists along the general northeast/southwest axis, the landscape is unified by several ecological features and functions, especially the longleaf pine/pocosin ecosystem and the historic role played by fire.

Prescribed Burn at Weyerhaeuser Company's Cool Springs Tract, Craven County
Photo Courtesy of Jeff Hall

The Onslow Bight landscape includes many large areas managed for various purposes including conservation, as well as numerous smaller conservation sites and unprotected Natural Areas identified by N.C. Natural Heritage Program (hereinafter "Natural Heritage Natural Areas"). The larger managed areas are Holly Shelter Game Land, Angola Bay Game Land, Marine Corps Base Camp Lejeune, Croatan National Forest, Marine Corps Air Station Cherry Point, Cedar Island National Wildlife Refuge, N.C. Coastal Federation's North River Farms, Cape Lookout National Seashore and Goose Creek Game Land. For the purposes of this plan update, three main conservation or core areas (hereinafter referred to as "Conservation Hubs") are highlighted: (1) Croatan National Forest (approximately 160,000 acres); (2) Marine Corps Base Camp Lejeune (156,000 acres); and (3) Angola Bay/Holly Shelter Game Lands (97,670 acres) as shown in the map below. Definitions of some of the terms and acronyms used in the Plan Update are included in **Appendix A**. It should be noted that the Managed Lands data layer includes projects funded by N.C. Land and Water Fund; some of which are not yet conserved.



As noted above, the original western boundary of the Onslow Bight landscape which generally followed the Northeast Cape Fear River was expanded in 2011 to include both sides of the river along with more land within this subwatershed. This boundary expansion creates some overlap with the eastern boundary of the Cape Fear Arch Conservation Collaboration's geographic area of interest (www.capefeararch.org). The map below highlights this boundary expansion and the area of overlap.



The Onslow Bight landscape has been highlighted in the North Carolina Wildlife Action Plan, The Nature Conservancy's Mid-Atlantic Coastal Plain Ecoregional Plan, and in several of the N.C. Division of Water Quality's Basinwide Water Quality Management Plans. The Onslow Bight lies within the U.S. Fish and Wildlife Service's Atlantic Coast Joint Venture planning area.

III. Accomplishments within Onslow Bight Landscape (2004 to Present)

A considerable amount of conservation work has been completed by the partnering organizations and agencies over the past 18 years since the release of the 2004 Onslow Bight Conservation Plan. Below are highlights of land conservation and/or restoration activities completed by some of the partners since 2004.

U.S. Marine Corps- Since 2004, the Marine Corps has closed 35 easement acquisition projects in support of its Readiness & Environmental Protection Integration (REPI) encroachment protection program executed via the Naval Facilities Engineering Command, Mid-Atlantic. These projects were accomplished with the collaboration and support of seven (7) different non-governmental organizations (NGOs) who partner with the Department of the Navy by signing an Encroachment Protection Agreement, originally executed as a Memorandum of Understanding in 2004 and replaced with a more formal contract in 2009. These projects include 17 closings on behalf of Marine Corps Installation East-Marine Corps Base Camp Lejeune, which secured over

5,016 acres from development incompatible with the military mission. The Marine Corps contributed a total of $13.5M in cost share and a total of $3.9M for natural resource management toward these projects near Marine Corps Base Camp Lejeune. Thanks to partner cost share contributions, the Marine Corps realized a total cost avoidance of over $10.1M on these projects. Marine Corps Air Station Cherry Point has executed 18 projects securing over 11,836 acres, for which the Marine Corps contributed a total of $18M in cost share and realized a cost avoidance of $22M from partner contributions. The Marine Corps' Encroachment Protection Agreement is actively managed to support annual deposits of REPI funding, which are held in escrow for real estate acquisition projects within the approved military mission footprint (see Appendix B for map of military mission footprint).

N.C. Clean Water Management Trust Fund Board Members Take Helicopter Tour with Representatives of Marine Corps Air Station Cherry Point Photo courtesy of NCCLT

The Red-cockaded Woodpecker (RCW) Recovery and Sustainment Program (RASP) was developed by the Marine Corps in cooperation with the U.S. Fish and Wildlife Service and was approved in a Biological Opinion dated September 20, 2012. The primary purpose of the RASP is to allow Marine Corps Base Camp Lejeune to maintain and enhance operational and training flexibility while promoting recovery of the RCW on compatible, off-base properties. A fact sheet on the RASP program along with the information on another Marine Corps led program, the Market Based Conservation Pilot Program (2012-2015), is included in **Appendix B**.

Eastern North Carolina Sentinel Landscape

The Sentinel Landscape Partnership was established in 2013 through a Memorandum of Understanding between the U.S. Department of Agriculture (USDA), Department of Defense (DoD), and Department of the Interior (DOI) with the aim of promoting compatible land use around military installations through conservation and enhanced management of farms, forests, ranches, and natural lands and resources. Authorized by Congress under §317 of the fiscal year (FY) 2018 National Defense Authorization Act (P.L. 115-91, 10 U.S.C. §2684a note), Section 317(d) allows, but not does require, the Secretaries of the Interior and Agriculture to give eligible landowners or agricultural producers within designated sentinel landscapes priority consideration for financial or technical assistance programs by that Secretary's department. As of fiscal year (FY) 2022, the Sentinel Landscape Partnership's Federal Coordinating Committee (FCC) has designated ten Sentinel Landscapes across the U.S.: Avon Park Air Force Range, Florida; Camp Bullis, Texas; Camp Ripley, Minnesota; Eastern North Carolina; Fort Huachuca, Arizona; Georgia; Joint Base Lewis-McChord, Washington; Middle Chesapeake, Maryland, Delaware, and Virginia; Northwest Florida, and Southern Indiana. Within these Sentinel Landscapes, USDA, DoD, and DOI work with state, regional, and local partners to connect private working and natural landowners with voluntary assistance programs (e.g., tax credits, agricultural loans, continuing education, technical support, conservation easements, disaster relief) that support conservation and sustainable management. In doing so, partner organizations incentivize cost-effective outcomes that simultaneously support military readiness, enhance economic and ecological benefits of farms and forests, and safeguard and augment the quality and quantity of our public-trust, natural resources.

Recognizing the co-benefits of natural and working land conservation to military readiness, in 2005, representatives from military installations, state agencies, NGOs, and private landowners began convening to discuss shared opportunities and to pursue mutually beneficial conservation actions. Ultimately coalescing into the North Carolina Sentinel Landscape Partnership, a 2016 REPI Challenge grant application by this group of diverse stakeholders was the impetus for its recognition by the federal Partnership's FCC as a designated Sentinel Landscape, the Eastern North Carolina Sentinel Landscape (ENCSL).

The ENCSL covers 33 counties in North Carolina's Coastal Plain and Sandhills, spanning nearly 11 million acres (Fig. x). The ENCSL is anchored by five key military installations and ranges, which are: Fort Bragg Army Base, Dare County Range, Marine Corps Base (MCB) Camp Lejeune, Marine Corps Air Stations (MCAS) Cherry Point, and Seymour Johnson Air Force Base (AFB). In the year following its federal designation, the North Carolina General Assembly established the ENCSL Committee with the charge of developing and implementing programs to protect working lands in support of military readiness.

Since its establishment, ENCSL partners have protected roughly 181,000 acres of land through easement or acquisition and enrolled nearly 1.1 million acres of land in some form of voluntary program that provides landowners with financial or technical assistance to promote sustainable land use practices, restore habitats, and/or conserve critical natural resources (see: https://sentinellandscapes.org/landscapes/eastern-north-carolina/). In recent years, the Sentinel Landscape Partnership has dramatically increased climate adaptation and resilience as a focus in recognition of the cross-cutting, exacerbating impacts of a changing climate to military readiness, agricultural productivity, and natural resources. Bolstering the ability of DoD to support off-installation projects focused on climate resilience, in 2019, Congress took the step of expanding 2684a authority in the John S. McCain National Defense Authorization Act for Fiscal Year (FY) 2019 (Public Law 115-232) to include agreements that that enhance military installation resilience to extreme weather events or changing environmental conditions. An additional legal authority, 16 U.S.C. § 670c-1, which allows DoD to fund natural infrastructure projects, further bolstered REPI's authority to support projects aimed at advancing installation climate resilience. ENCSL partner organizations have and continue to be a model for embracing climate resilience and adaptation efforts across the landscape and are currently working to expand the identification and implementation of regional- and landscape-scale climate resilience initiatives and projects.

The Nature Conservancy (TNC)- TNC's land conservation work within the Onslow Bight landscape has primarily focused around the Marine Corps Base Camp Lejeune and N.C. Wildlife Resources Commission's (NCWRC) Holly Shelter Game Land in partnership with the military, NCWRC, State Parks and other non-profit organizations. Since 2005, five new TNC preserves were created around the periphery of Holly Shelter Game Land totaling 8,666-acres--Shaken Creek Savanna, McLean Savanna, Sages Ridge, Flat Swamp and Merrick's Creek in Pender and Onslow Counties. Overall, TNC has conserved 18,670 acres within the Onslow Bight landscape since 2004 which included adding to existing state game lands or establishing new ones at Stones Creek, Folkstone and Rocky Run as well as contributing acreage to the State's Sandy Run Savanna State Nature Preserve established in 2007 (now at 3,086 acres).

In addition, TNC has led an effort to work with partners on longleaf pine forest restoration work within the Onslow Bight Landscape. Since 2010, TNC has applied for and received six National Fish and Wildlife Foundation (NFWF) Longleaf Landscape Stewardship grants (the most recent award begins January 1, 2023) for the Onslow Bight Partnership. These awards have been critical to the support of shared prescribed fire crews, aerial ignition and prescribed fire contracts, training and professional development of practitioners, private landowner outreach and longleaf restoration and management at a landscape scale. Partners that have contributed to and have received support from these awards include: TNC, NCCLT, U.S. Forest Service, N.C. State Parks, NCWRC, N.C. Forest Service, Bladen Lakes Prescribed Burn Association, and Forest Stewardship Guild (Forest Her Program, North Carolina Tree Program). In the past 12 years these awards and the contributions of partners to match these awards has resulted in 114,368 acres of prescribed fire in the Onslow Bight (80,098 directly supported by NFWF funds), 684 acres of longleaf pine planting, over 4,000 acres of hardwood midstory control, 137 acres of ground layer planting, and outreach to over 500 private landowners.

The Nature Conservancy's Shaken Creek Savanna *Photo Courtesy of Hervey McIver*

The Conservation Fund (TCF)- In April 2015, TCF acquired 90.71 acres from the Hurst-Turner family to expand Hammocks Beach State Park in Onslow County. The property was conveyed in two phases to the State of North Carolina: the first in June 2016 and the second in December 2016. In October 2017, TCF acquired 29.37 acres to create a new park for the Town of Emerald Isle and to buffer Bogue Field from incompatible development (Carteret County). The property was conveyed to the Town of Emerald Isle in May 2018. In September 2021, TCF also acquired 4.107 acres to create the first park for the Town of Bogue which also helps to buffer Bogue Field from incompatible development. The property will be conveyed to the Town of Bogue in early 2023.

NC Coastal Land Trust (NCCLT)- NCCLT has conserved approximately 29,700 acres of land within the Onslow Bight landscape since 2004. This includes over 12,500 acres placed under permanent conservation easement; over 340 acres purchased by NCCLT and then transferred to local governments (e.g., City of Havelock, Craven County) to become new nature parks; over 8,800 acres transferred to NCWRC to be added to existing public game lands (e.g., Carteret County and Neuse River Game Lands) or to create new state conservation areas (e.g., Brown's Island); over 45 acres transferred to N.C. Division of Parks and Recreation (Fort Macon State Park, Lea Island); over 531 acres transferred to U.S. Forest Service to become part of the Croatan National Forest; and the remaining 7,400+acres were retained by NCCLT to be managed as nature preserves.

NCCLT has carried out prescribed burning (contract burns); timber thinning, longleaf pine planting and/or invasive plant management on its preserves. NCCLT's initiatives within the Onslow Bight Landscape include: (1) conserving land that buffers or connects parcels within the Croatan National Forest; (2) partnering with Marine Corps Air Station Cherry Point and Marine Corps Base Camp Lejeune to buffer these military installations and their outlying landing fields from encroachment; and (3) protecting forested riparian buffers along the mainstem of the Neuse and Northeast Cape Fear Rivers. Finally, NCCLT, in partnership with TNC, NCWRC, NCCF, DU and/or others, has submitted 24 successful federal North American Wetlands Conservation Act (NAWCA) grants which focus on, or include, habitat protection and/or restoration work in the Onslow Bight region.

Longleaf Pine Forest at the 5,000+acre Salters Creek Tract purchased by NCCLT in partnership with Marine Corps Air Station Cherry Point and NCWRC (now part of the Carteret County Game Land). Photo Courtesy of Carla Roth

NC Coastal Federation (NCCF)- Since 2004, NCCF has acquired over 10,115 acres in fee simple or conservation easement within the Onslow Bight landscape, including the 6,000-acre North River Wetlands Reserve. NCCF has recently completed wetlands restoration work on the North River Reserve, considered one of the largest wetland restoration projects in North Carolina. For more information on this wetlands restoration project, see https://www.nccoast.org/project/north-river-wetlands-preserve/. NCCF has also constructed over seven miles of living shorelines, which protect and improve water quality, create wildlife habitat and build resilience to storm damage and erosion, including large living shorelines in the

communities of Oriental, Atlantic, Carteret Community College, on Highway 24 in Swansboro and at Marine Corps Air Station Cherry Point in Havelock. In addition, NCCF has worked with many local governments to install stormwater retrofits in their communities, to restore water quality and prevent flooding.

Aerial View of the Wetlands on NCCF's North River Preserve in Carteret County. Photo courtesy of NCCF

US Fish and Wildlife Service (USFWS)- USFWS has worked with numerous private landowners and non-profit organizations to carry out wildlife habitat restoration work through the Partners for Fish and Wildlife Habitat program. Since 2004, USFWS has completed a total of 22 Partners projects, including 609 acres of longleaf planted, 520 acres of timber stand improvements, and 981 acres of prescribed burning.

As noted earlier, USFWS and the U.S. Marine Corps completed development of a RCW RASP program designed to expand landscape-level, long-term species recovery while promoting the Marine Corps' ability to accommodate training and readiness on Marine Corps Installations East/Marine Corps Base, Camp Lejeune. RASP is based on analyses of long-term, observed dispersal of RCWs in studied woodpecker populations within complex landscapes, including Camp Lejeune and the Croatan National Forest. Over 31,612 acres within the Onslow Bight ecosystem area have been assessed for potential RCW conservation outside of federally owned lands.

Finally, surveys for the federally threatened Eastern Black Rail (*Laterallus jamaicensis* spp. *jamaicensis*) as well as for the federally threatened Northern long-eared bat (*Myotis septentrionalis*) have been carried out by USFWS. Carteret County (e.g., Cedar Island Marshes)

continues to be an important breeding location for Eastern Black Rail. According to Gary Jordan of USFWS, there have been documented occurrences of the Northern long-eared bat in all of the Onslow Bight counties except for Duplin County to date.

Ducks Unlimited (DU)- DU has partnered with USFWS, NCWRC, and/or private landowners to enhance or restore more than 4,600-acres of wetlands within the Onslow Bight landscape since 2004. Specifically, DU and partners have enhanced/restored 655 acres in Beaufort County; 932 acres in Carteret County; 24 acres in Craven County; 865 acres in Jones County; 208 acres in Onslow County; 1,701 acres in Pamlico County and 220 acres in Pender County. DU has also secured two conservation easements on a total of 789 acres along the Pamlico River in Beaufort County and partnered with other organizations to protect another 372 acres in Carteret, Craven, and Jones Counties 2004. Thus, DU has conserved a total of 1,161 acres of land within the Onslow Bight since 2004.

DU partnered with NCWRC to enhance wetlands at Goose Creek Game Land.
Photo courtesy of Ducks Unlimited

N.C. Wildlife Resources Commission (NCWRC)- NCWRC took the lead in acquiring 11 tracts of land across six counties totaling 6,804 acres in the Onslow Bight landscape since 2004 which includes reallocation from other state and federal agencies. These 11 tracts host a variety of plant communities ranging from marsh and bottomlands to pine uplands and pocosins adding land to the Carteret County, Cape Fear Wetlands (New Hanover and Pender Counties), Goose Creek (Beaufort and Pamlico Counties), Holly Shelter (Onslow and Pender Counties), Neuse River (Craven County) and Stones Creek (Onslow County) Game Lands, as well as creating two new game lands, the Light Ground Pocosin (Pamlico County) and Voice of America (Beaufort County) Game Lands. The Voice of America Game Land was created, in large part, to conserve the largest known breeding habitat for Henslow's Sparrows (*Ammodramus henslowii*) in the Southeast.

The NCWRC focus on active management for habitat conservation and improvement includes an aggressive prescribed burning program. Efforts on 10 game lands within the Onslow Bight has yielded over 64,000 acres burned since the inception of the conservation collaborative. The agency also participates in longleaf pine restoration initiatives, establishing 3,375 acres of longleaf and associated understory plant communities during the period. Recently initiated in 2020, the NCWRC is partnering with TNC to implement hydrological restoration on 7,500 acres of drained pocosin at Angola Bay Game Land. The primary intent of the project achieved by soil rewetting is to enhance the pocosin vegetative community, reduce the potential of organic soil consumption from a wildfire event and improve downstream resiliency during flood events. Funding has been secured, baseline monitoring completed, a consultant-generated engineering plan developed and procurement of materials underway, with installation of water control structures slated in the coming year.

NCWRC Conservation Technician, Patrick Conner, is retrieving data from a monitoring well at Angola Bay Game Land in Pender County.
Photo courtesy of NCWRC

NCWRC entered into a RASP program agreement with the Department of the Navy in 2017 on a 2,726-acre tract of Stones Creek Game Land and 12,269-acres of the Bear Garden Tract within Holly Shelter Game Land toward the objective of providing sufficient foraging habitat over time for a combined 60 groups of RCWs. The cooperative project will alleviate some of the Camp Lejeune obligation toward the recovery goal for the Mid-Atlantic Coastal Plain RCW population, while accelerating longleaf restoration initiatives on the game lands. The current management strategy is to harvest off-site pine species and reforest with longleaf pine, while reestablishing associated understory species and reintroducing prescribed fire. At year five of the project, harvest and replanting at the Stones Creek Tract is 80% complete. At the Bear Garden Tract, progress with harvesting and reforestation is 24% and 13% respectively. Additionally, 30 miles of road have been upgraded to facilitate management.

2004-2022 ONSLOW BIGHT CONSERVATION SUMMARY STATISTICS:

- OVER 67,000 ACRES CONSERVED THROUGH FEE TITLE OR CONSERVATION EASEMENT
- OVER 10,000 ACRES OF WETLANDS RESTORED
- OVER 146,000 ACRES OF LONGLEAF PINE FOREST BURNED
- OVER 1,200 ACRES OF LONGLEAF PINE PLANTED
- 35 REPI ENCROACHMENT PARTNERSHIP PROJECTS COMPLETED
- 24 NAWCA AND 6 NFWF Longleaf Pine PARTNERSHIP GRANTS AWARDED

IV. Conservation Targets

One of the primary objectives of the OBCF is to conserve elements of the region's biodiversity. Biodiversity is composed of species, the genes they contain, the communities and ecosystems they form, and the processes that connect them. Similar to the 2004 OBCF Plan, this plan update includes a list of "conservation targets," ecosystems or natural communities which may by themselves be rare or vulnerable or which host habitat for rare and/or vulnerable plant and/or animal species. Partners have expressed interest in focusing on habitat for "at-risk" species, in order to maintain healthy and viable populations, and thus reduce the possibility of considering a species for Federal listing. The protection of natural community conservation targets should capture enough of the important habitats for rare species. N.C. Natural Heritage Program provided an updated list of animal, plant and natural community targets for the Onslow Bight landscape which are included in **Appendix C**. Below are descriptions of the general natural community targets. In addition, examples of Species of Greatest Conservation Need (SGCN) from the 2015 N.C. Wildlife Action Plan associated with some of the general natural community targets are highlighted (more information on SGCN can be found at https://www.ncwildlife.org/plan). It is important to note that some SGCN may be included as primary animal conservation targets for the Onslow Bight, but not all.

Longleaf pine and pocosin ecosystem: Longleaf pine and pocosin communities coexist as a mosaic over much of the landscape on broad interstream terraces. Longleaf pine communities are also found on sandy ridges scattered throughout. Especially critical are wet pine savanna communities with many rare plants and animals, including several species and communities that are largely or entirely restricted to the Onslow Bight region. Associated with this ecosystem are

11 natural community (including one near-endemic), 37 plant targets (one endemic and five near-endemic species), and 22 animal targets (one near-endemic species). The following are SGCN examples for longleaf pine habitats: Red-cockaded Woodpecker (*Picoides borealis*), Bachman's Sparrow (*Aimophila aestivalis*), Carolina gopher frog (*Rano capito*), and mimic glass lizard (*Ophisaurus mimicus*). For pocosin, Wayne's Black-throated Green Warbler (*Dendroica virens waynei*) and Southern bog lemming (*Synaptomys cooperi heloletes*) are two SGCN's.

David Allen, retired NCWRC biologist, and Laura Brockington, Duke University M.S. Candidate, in a Longleaf Pine Stand at Holly Shelter Game Lands. NCCLT Staff Photo

Barrier and estuarine islands: This vulnerable ecosystem includes many rare plants, rare animals and natural communities, including several that are globally restricted. Associated with this ecosystem are seven natural community, seven plant targets, and eleven animal targets. Notable SGCN species include Piping Plover (*Charadrius melodus*), Red Knot (*Calidris canutus*), and nesting sea turtles.

Hutaff Island, Pender County *Photo Courtesy of Walker Golder*

Non-riverine wet hardwood and swamp forests: These include the globally rare Non-riverine Wet Hardwood Forest and Wet Marl Forest natural communities. The Onslow Bight contains all known occurrences of Wet Marl Forest. Conservation targets associated with this ecosystem are three natural communities, three plants, and two animal species. SGCN examples include Rafinesque's big-eared bat (*Corynorhinus rafinesquii*), Northern yellow bat (*Lasiurus intermedius*), and Eastern woodrat (*Neotoma floridana),*

Rocky Point Marl Forest, Pender County *Photo Courtesy of Mike Schafale*

Small depression wetlands and natural lake shorelines: These scattered depressions include small ponds within longleaf pine communities that contain many rare species. Small pools that are flooded in winter and spring, and then dry out in summer, are critical breeding habitats for amphibians, and are especially vulnerable to land use changes. Natural lake shorelines can support highly diverse plant and animal communities with several rare species. Conservation targets associated with this ecosystem include five natural communities, eleven plants, and four animals. SGCN examples include Eastern tiger salamander (*Ambystoma tigrinum*), Dwarf salamander (*Eurycea quadridigitata*) and Four-toed salamander (*Hemidactylium scutatum*) for small depression wetlands and Bald Eagle (*Haliaeetus leucocephalus*) for lake shorelines.

Maritime forest including coastal fringe forests: Maritime forests are found along barrier islands and the mainland coast. Coastal fringe forests are pine/hardwood communities that occur along the mainland edge and include the globally rare Calcareous Coastal Fringe natural community, as well as the uncommon Coastal Fringe Evergreen Forest and Coastal Fringe Sandhill community. These coastal fringe forests are among the most vulnerable communities due to land use changes close to the coast. Conservation targets associated with coastal fringe forests include three natural communities, one plant, and one animal. Examples of SGCN associated with maritime forests include Eastern Painted Bunting (*Passerina ciris*), oak toad (*Bufo quercicus*), and Eastern coral snake (*Micrurus fulvius*).

Coastal Fringe Forest along Newport River, Carteret County
Photo Courtesy of Scott Pohlman

Coastal Plain marl outcrops: These small and isolated outcrops support two rare communities and a globally rare fern. In North Carolina, the Coastal Plain Marl Outcrop community is largely restricted to the Onslow Bight region. Conservation targets associated with this ecosystem include one natural community and one plant.

NCCLT's Island Creek Preserve, Jones County *Photo Courtesy of Mike Schafale*

Blackwater and brownwater floodplains: These include cypress–gum swamps, bottomland hardwoods, and freshwater tidal marshes. These wetlands are especially important for migratory birds, native bats, and several other rare plant and animal species. Conservation targets associated with this ecosystem include ten plants and two animals. SGCN examples include Swallow-tailed Kite (*Elanoides forficatus*), Anhinga (*Anhinga anhinga*), Little Blue Heron (*Egretta caerulea*), Southeastern bat (*Myotis austroriparius*), and Eastern mudsnake (*Farancia abacura abacura*).

Mesic and dry hardwood forests: Typically dominated by oaks and hickories, natural examples of these forests occur only where fire has been naturally excluded, such as along steep stream slopes. These habitats support a few rare species and one rare community -- the Coastal Plain Subtype of Basic Mesic Forest. Conservation targets associated with this ecosystem include one natural community, two plants and four animal species. SGCN examples include Cooper's hawk (*Accipiter cooperii*), Wood Thrush (*Hylochichla mustelina*), Eastern spadefoot (*Scaphiopus holbrookii*), timber (canebrake) rattlesnake (*Crotalus horridus*) and Eastern box turtle (*Terrapene carolina*).

Special animal habitats: These include a number of habitats at multiple scales. Habitat for resource or area-limited rare species is of particular concern. Sandy areas for colonial waterbird nesting, habitat for the Crystal Skipper (A*trytonopsis quinteri*) and sea turtle nesting areas are critical sites within the broader barrier island natural community target. Vernal pools are worth noting as special animal habitats but generally exist as small patches within coastal fringe or longleaf community targets. Specific nesting and foraging habitat for the Red-cockaded Woodpecker within the extensive longleaf ecosystem deserves special focus. At the ecosystem or landscape scale, it is worth noting that ecosystems are not closed systems, and may include areas of lesser-quality habitat, used by animals for foraging and movement. Ensuring the healthy presence of top carnivores as a group (e.g. bobcat, black bear) provides a general indication of the health of the larger landscape.

Tern colony at New Dump Island, Core Sound, Carteret County
Photo courtesy of NCWRC

Estuarine marshes: The salt marshes, brackish marshes and tidal freshwater marshes of our estuaries are among the most biologically productive habitats in nature. Estuarine marsh habitats occur all along the North Carolina coast on the mainland side of barrier islands, the mainland side of large sounds, and in the lower reaches of many river systems. SGCN species associated with marsh habitat include Saltmarsh Sharp-tailed Sparrow (*Ammodramus caudocutus*), Eastern Black Rail (*Laterallus jamaicensis ssp. jamaicensis*), Gull-billed Tern (*Sterna nilotica*), diamond-backed terrapin (*Malaclemys terrapin*), and the sea turtles.

Estuarine marsh complex at Hutaff Island. *Photo courtesy of Walker Golder*

Open Habitats with Native Species/Early Successional Habitats: Early successional habitats are generally open areas characterized by low woody vegetation and herbaceous plants. In North Carolina, mountain balds, piedmont prairies, and longleaf pine savannas are examples of open habitats with native species that have become very rare (it should be noted that longleaf pine habitats including savannas are also listed as a conservation target above). Abandoned farm fields, clearcuts, open pine stands, field borders, transmission line rights-of-way, and meadows that host native grasses and forbs can also be beneficial to wildlife or may have other ecological value. These "early successional habitats" are dependent on some type of human maintenance (e.g., prescribed fire, mowing). The N.C. Wildlife Action Plan identifies numerous SGCN associated with early successional habitats including Northern Bobwhite (*Colinus virginianus*), Bachman's sparrow (*Aimophila aestivalis*), Henslow's sparrow (Ammodramus henslowii), Prairie Warbler (*Dendroica discolor*), Star-nosed mole (*Condylura cristata*), Eastern diamondback rattlesnake (*Crotalus adamanteus*), and Eastern coachwhip (*Masticphis flagellum*).

All of the above natural communities have been identified as high priority conservation targets. Based somewhat on ecological significance of target association (e.g. number of globally rare elements for which Onslow Bight landscape is important to survival) and perceived threat, these are listed in approximate order of priority for future conservation. However, it must be stressed that they are all high priority targets, and the difference between top and bottom, in terms of importance to the Onslow Bight landscape, is not great.

V. Threats to Conservation Targets

Similar to the 2004 Onslow Bight Plan, below are some general threats to the animal, plant, and natural community conservation targets within the Onslow Bight Landscape.

Habitat alteration or loss due to land use change: This occurs throughout the landscape where natural habitat is altered or lost due to other human uses of the land (e.g., residential or commercial development). The detrimental impacts of these uses vary in degree, with high-density development having the worst impact and intensive timber management the least. Some of these uses may impact some targets while minimally impacting others; for example, land conversion to intensive timber management may not greatly affect bears but could have devastating impacts on species requiring more open habitats like the RCW and natural groundcover species.

Fragmentation of existing habitat: Fragmentation isolates populations of species and poses a threat when such isolation results in inbreeding and reduced genetic diversity. Even with the protection of all existing habitat further fragmentation can occur when the area between natural areas changes to more detrimental land use. Habitat fragmentation can occur in a variety of ways including from residential development near existing conservation areas or highway construction that bisects natural habitats.

Habitat loss and fragmentation due specifically to the lack of frequent, appropriate burning in fire-dependent natural communities: Having land in a protected ownership does not ensure the protection of conservation targets in fire-dependent ecosystems. Proper management for many of the conservation targets requires controlled burning. In addition, privately-owned habitat important to the natural landscape often suffers from the lack of fire.

Overexploitation of species: The collecting of marketable species such as Venus fly traps, spotted and box turtles can threaten populations if not properly managed. Species such as pygmy rattlesnakes and other herpetofauna are also the target of collectors.

Hydrologic alteration: Drainage ditches and the over-pumping of groundwater lower water tables at local and regional scales. The health and stability of wetland and many upland communities depend on the natural water table range and are jeopardized when it is consistently and artificially lowered. Ditches and pumping can also alter the hydrology within riverine forest and aquatic systems by changing flow regimes. By removing water from the landscape more quickly ditches reduce groundwater infiltration, floodwater storage, and cause more extreme flows downstream.

Poor and/or declining water quality: Non-natural sedimentation and water-borne pollutants detrimentally affect aquatic life and the various riverine forest communities. Sedimentation affects in-stream habitats, the profile of the floodplain, and stream character in general. Excess nutrients due to fertilizer runoff and other sources will negatively impact streams in a number of ways, such as altering the natural community composition by promoting some species over others, or even causing algal blooms and contributing to fish kills. Toxic pollutants are inherently harmful.

Invasive and exotic species: Non-native species introduced into natural systems can have devastating effects on native species and can completely alter natural communities. Numerous

examples of this problem occur in both aquatic and terrestrial systems in the Onslow Bight landscape including alligator weed (*Alternanthera philoxeroides*), Chinese privet (*Ligustrum sinense*), common reed *(Phragmites australis*), Chinese wisteria (*Wisteria sinensis*), and fire ants (Solenopsis invicta) among many more.

Climate change: Effects on North Carolina's coast from climate change are likely to include accelerated sea-level rise, more pronounced storm flooding and other consequences of global warming. A rising ocean will reshape the coast and heighten hurricane damage. Climate change may result in changes in temperature and precipitation patterns that negatively affect biodiversity.

VI. Conservation Focus Areas

In the 2004 Onslow Bight Conservation Plan, ten (10) conservation corridors were identified as the best locations for future conservation of land that would connect major core areas of conservation. The 10 corridors were drawn based on 1998 infrared photography but included some areas not suitable for conservation and/or restoration (e.g., residential areas). The primary purpose of the corridors was to direct future protection of land (with suitable or restorable habitat) to locations that would allow easy movement of the corridor's conservation targets. For many species habitat corridors should be continuous between the core areas to be effective while discontinuous habitat ("stepping stones") could be appropriate for the movement/dispersal of such species as the Red-cockaded Woodpecker.

The ten corridors identified per the 2004 Plan are listed below (detailed maps are included in **Appendix D**). All but two of the corridors are located between core areas. The other two are corridors within large managed areas (interior corridors), i.e., Camp Lejeune Marine Corps Base and Croatan National Forest. These "interior" corridors are designed to connect existing suitable habitat within managed areas where such habitat is discontinuous and other non-conservation management goals are involved. All the corridors, both interior and otherwise, are meant to highlight the importance of connectivity between core areas.

1. Camp Lejeune Marine Corps Base/Holly Shelter Game Land Corridor
2. Camp Lejeune Marine Corps Base Interior
3. Camp Lejeune Marine Corps Base/Croatan National Forest Corridor
4. South Croatan National Forest/Hofmann Forest Corridor
5. Croatan National Forest/Hofmann Forest Corridor
6. Croatan National Forest Interior
7. Croatan National Forest/Tucker Creek Corridor
8. Croatan National Forest/Marine Corps Base Air Station Runway Complex Corridor
9. Croatan National Forest/Cedar Island National Wildlife Refuge Corridor
10. Pamlico Peninsula Corridor

For the Onslow Bight Conservation Plan Update, some of these conservation corridors have been consolidated and/or redrawn slightly; some have been eliminated due to increased development, and three areas have been added for a new total of nine (9) corridors. Of the new nine, three corridors serve to buffer the three Conservation Hubs—Croatan National Forest, Camp Lejeune Marine Corps Base, and Holly Shelter/Angola Bay Game Lands. Another four—

Pamlico Passage, Hofmann Highway, Carteret Crescent, and Cape Fear Connector—serve as corridors between existing smaller managed lands or large timberlands; and the last two—Old Stump Sound and Tricounty Headwaters represent large areas with numerous tidal or headwater creeks that are important for water quality and/or wetlands/floodplain protection and/or restoration/enhancement. Below is the list of the nine new corridors (hereinafter referred to as "Conservation Focus Areas" (CFA) with general descriptions, ecological significance and conservation work completed to date.

Camp Lejeune/Greater Sandy Run Buffer CFA

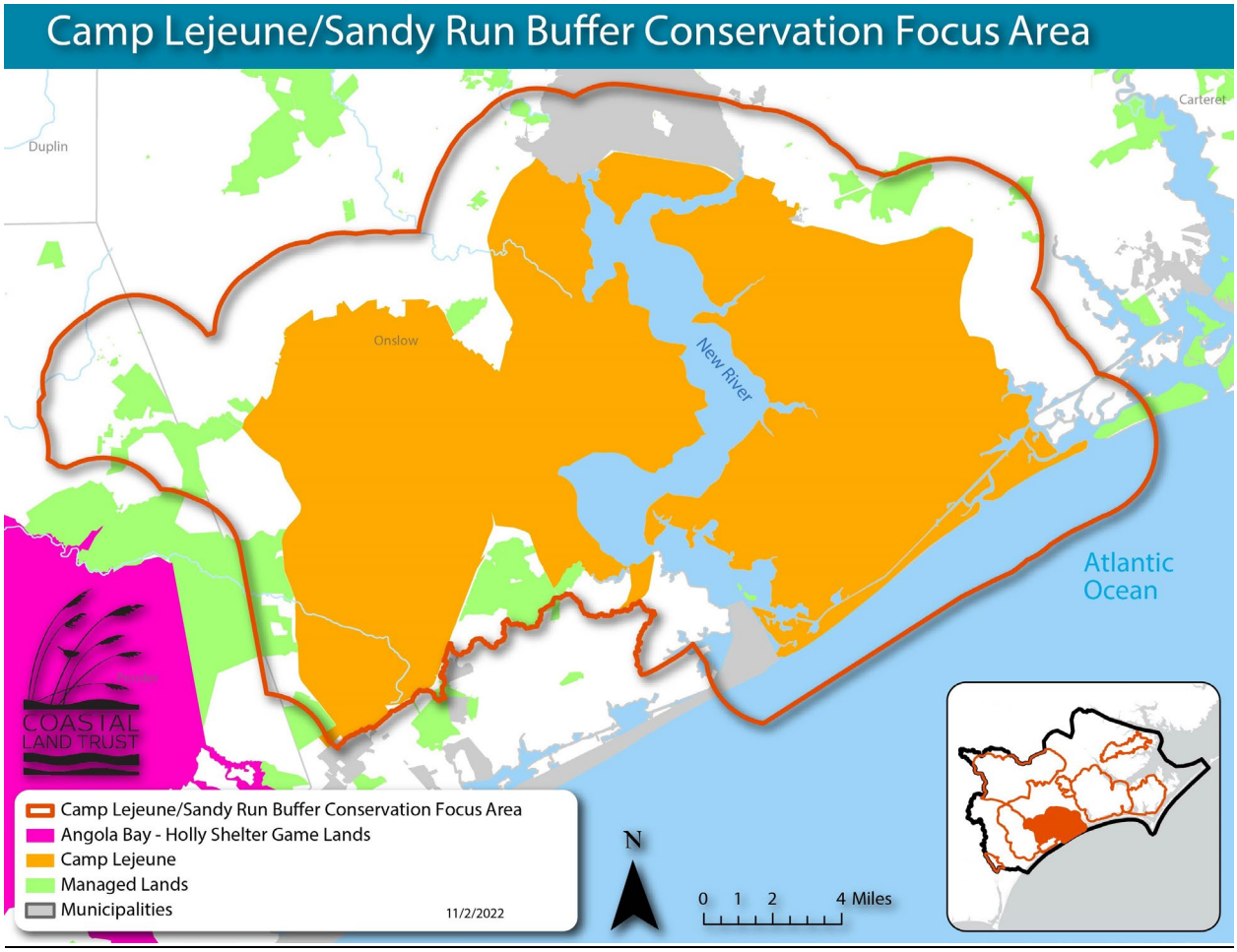
Description: This CFA includes the 156,000+acre Marine Corps Base Camp Lejeune/Greater Sandy Run in Onslow County. It also includes a two-mile buffer around the entire installation which is mostly in Onslow County but includes a small section of Pender County. This CFA consolidates Corridors 1 and 2 from the 2004 Plan. The City of Jacksonville lies to the north of the CFA and the small towns of Dixon and Sneads Ferry lie to the south. The CFA is bisected by the New River Estuary. The Camp Lejeune/Greater Sandy Run Buffer CFA western boundary abuts the eastern boundary of the Angola Bay-Holly Shelter Buffer CFA. The southern boundary of the Camp Lejeune/Greater Sandy Run Buffer CFA abuts the Old Stump Sound CFA. There is considerable residential development occurring around the Base and obviously some land within the 2-mile buffer is no longer be suitable for conservation. Any opportunities to conserve undeveloped land adjacent to the Base or within this buffer is important to minimize encroachment on military training and to serve as a buffer for habitat management (e.g., smoke buffer).

Conservation Significance: The ecological significance of the Marine Corps Base Camp Lejeune cannot be overstated. According to the N.C. Natural Heritage Program's 1999 Natural Inventory of Onslow County, the Base "contains some of the highest quality longleaf pine and pocosin habitat anywhere, including some of the highest quality examples of the Pine Savanna, Wet Pine Flatwoods, and Pine/Scrub Oak Sandhill Communities." In addition, Camp Lejeune also hosts some of the highest quality examples of the Small Depression Pond natural community. It contains one of three global populations for Hirst's witchgrass (*Dichanthelium* sp. 1); one of two N.C. populations for many-flowered grass-pink (*Calopogon multiflorus*), and one of the world's largest populations of the Venus fly trap (*Dionaea muscipula*). In addition, there is a relatively large population of RCWs (over 142 active clusters, Craig Ten Brink, pers. com, Nov. 2022), a federally endangered species. Other federally listed species known to occur on Camp Lejeune include rough-leafed loosestrife (*Lysimachia asperulaefolia*), Piping Plover (*Charadrius melodus*), Red Knot (*Calidris canutus*), Eastern Black Rail (*Laterallus jamaicensis* sp. *jamaicensis*) and seabeach amaranth (*Amaranthus pumilus*), loggerhead sea turtle (*Caretta caretta*), green sea turtle (*Chelonia mydas*) and Kemp's ridley sea turtle (*Lepidochelys kempii*). It should also be noted that the Base hosts one of the few remaining sites where Eastern Diamondback Rattlesnakes (*Crotalus adamanteus*), a state endangered species, have still been found. N.C. Natural Heritage Program has designated the Base as an ecologically significant "macrosite" which is essentially a large area that contains many smaller natural heritage natural areas. Indeed, the Camp Lejeune Center Macrosite contains 14 embedded natural heritage natural areas including the Camp Lejeune Alligator Meadow Limesinks, Camp Lejeune

Loosestrife Pocosin, the Camp Lejeune Lyman Road Cypress Savanna, and the Camp Lejeune Pondspice Meadow.

The Greater Sandy Run Area, is a separate training area of Camp Lejeune, which also hosts important habitats with two large pocosins and longleaf pine communities interspersed on sand ridges and low flats. This area is generally bounded by U.S. Highway 17 on the east and southeast, and Highway NC 50 on the west. There are 3 separate natural heritage natural areas within the Greater Sandy Run Area (Greater Sandy Run Pocosin, Padgett Swamp Road, and the South Bay Road Natural Areas). Greater Sandy Run serves as a critical linking component between the main base at Camp Lejeune, the Maple Hill Savannas, and Holly Shelter Game Land in Pender County. Aside from the main base and Greater Sandy Run area, this CFA includes numerous stand-alone natural heritage natural areas located around the periphery of the military installation including a portion of New River Swamps and Marshes, New River Inlet and some of the Maple Hill Savannas.

Conservation Work to Date: Considerable conservation work has been completed in the area between Camp Lejeune's Greater Sandy Run and the Holly Shelter Game Land due largely to Encroachment Partnerships between Camp Lejeune, the State of North Carolina, TNC, and NCCLT. For example, south of Greater Sandy Run, NCCLT acquired the 239-acre Everett Creek Preserve near Snead's Ferry, and NCWRC and TNC partnered to purchase several tracts that now comprise the 4,146-acre Stones Creek Game Lands near Dixon and Folkstone. On the east side of the CFA, TNC acquired the 1,181-acre Horse Swamp Preserve. On the west side of Greater Sandy Run near Maple Hill, the N.C. Division of State Parks' 3,086-acre Sandy Run Savanna State Nature Preserve was established in 2007 largely from several parcels TNC previously acquired. In addition, N.C. Department of Transportation acquired approximately 595-acres to create the Haws Run wetland mitigation site that straddles the Onslow/Pender County line. The City of Jacksonville (90 acres), Town of Surf City (1,750-acres) and Onslow County Water & Sewer Authority (915-acres) own and manage lands used for wastewater sprayfields and open space within, or near, the CFA. Finally, NCCLT purchased 253-acres of land along the New River and Blue Creek which were transferred to Onslow County to become the Oakhurst Nature Park on the north side of the CFA.



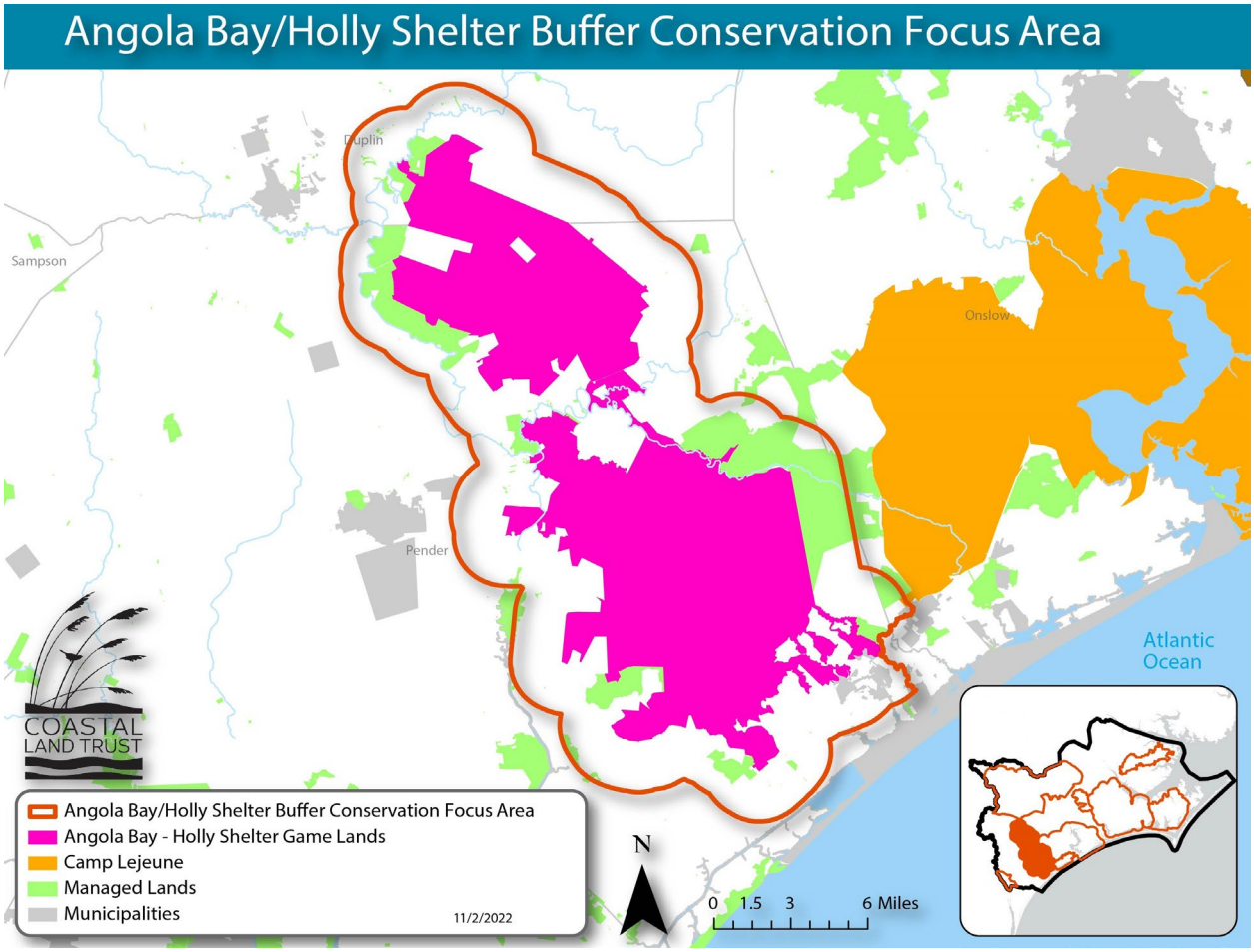
Angola Bay/Holly Shelter Game Lands CFA

Description: The Angola Bay/Holly Shelter CFA includes the 34,150-acre Angola Bay and 63,250-acre Holly Shelter Game Lands as well as a two-mile boundary around this game land complex in Pender and Duplin Counties. This CFA abuts the Camp Lejeune/Sandy Run Buffer CFA on the east. There are no major municipalities within this CFA. The Northeast Cape Fear River flows through the CFA along the western boundary.

Conservation Significance: The N.C. Natural Heritage Program designated Holly Shelter Game Land along with the several natural heritage natural areas to the north and west as the "Holly Shelter Macrosite." As noted in the 2000 Natural Areas Inventory of Pender County, the macrosite "contains some of the most extensive and highest quality longleaf pine and pocosin habitat anywhere, and includes globally significant populations for the Federally and State Endangered Red-cockaded Woodpecker (*Picoides borealis*), and three plant species: Federally and State Endangered Cooley's Meadowrue (*Thalictrum cooleyi)*, Federally and State endangered Golden Sedge *(Carex lutea*), and the Savanna onion (*Allium* sp. 1)." N.C. Natural Heritage Program also notes that the macrosite "contains the most extensive contiguous area of

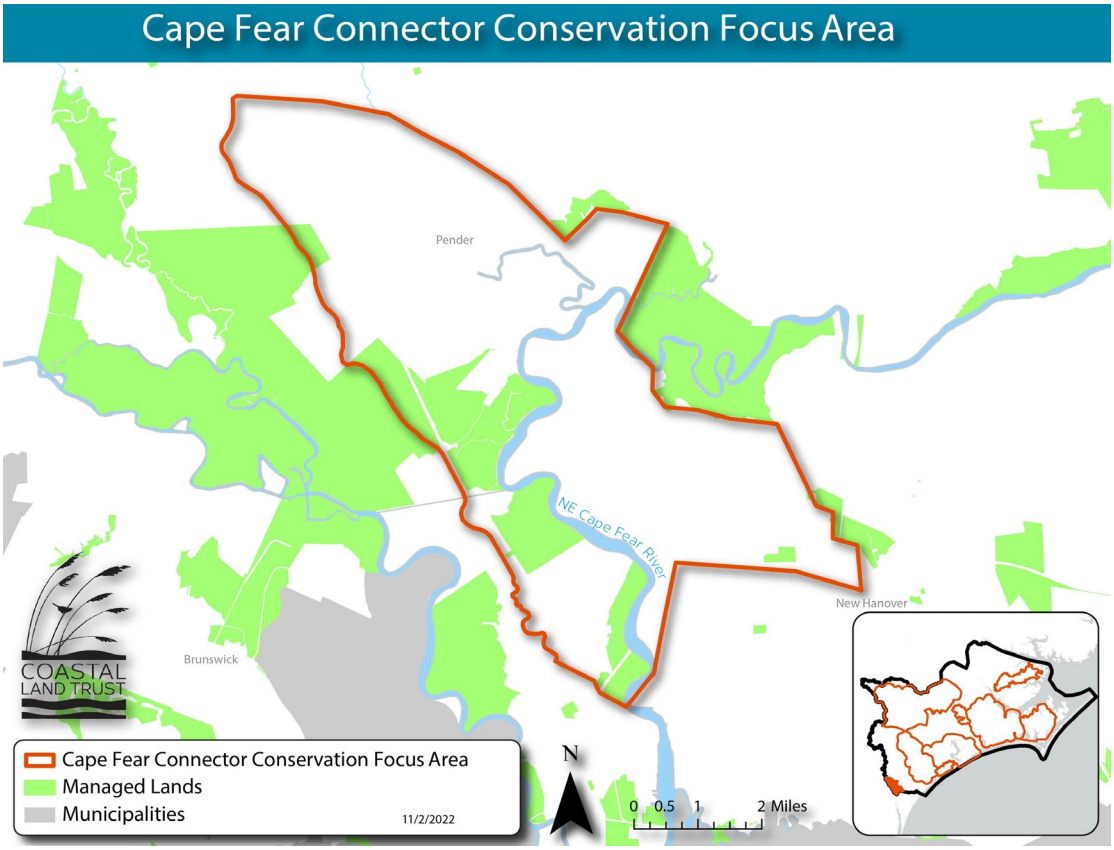
savanna and flatwoods habitat remaining in North Carolina." There are approximately 38 active RCW clusters on Holly Shelter Game Land (Brent Wilson, NCWRC, pers. com. 2022). There is also a small population of the state endangered Carolina gopher frog (*Rana capito*). Angola Bay Game Land is designated by N.C. Natural Heritage Program as a natural heritage natural area of exceptional significance. According to the Pender County Inventory, it is "an example of a domed (elevated) pocosin, a rare habitat type globally restricted to the Coastal Plain of North and South Carolina." Angola Bay Game Land provides important habitat for black bear (*Ursus americanus*) as well as numerous migratory songbirds.

Conservation Work to Date: Considerable land conservation work has been completed in this CFA by TNC and NCWRC. In 2002, TNC purchased over 29,000 acres of land between Angola Bay and Holly Shelter Game Lands from International Paper Company, including the 14,391-acre Bear Garden Tract, and transferred all to NCWRC to be managed as part of the game land complex. TNC also conserved 12 tracts totaling 6,058-acres that comprise the Shaken Creek Savanna Preserve in 2005 located on the northeast side of Holly Shelter Game Land. As noted earlier, N.C. Division of State Parks' Sandy Run Savannas State Nature Preserve lies just to the northeast of this CFA. Also within this CFA, TNC protected the 1,413-acre McLean Savannah in 2010, the 459-acre Sages Ridge Preserve in 2013, and the 270-acre Merrick Creek Preserve. Along the Northeast Cape Fear River west of Holly Shelter, TNC acquired 4 tracts totaling 1,940-acres that were transferred to the State to become part of Holly Shelter Game Land. Along the Northeast Cape Fear River west of Angola Bay Game Land, NCCLT conserved and owns the 526-acre Murray Preserve and holds conservation easements over an additional 3,800+acres of privately-owned land.



Cape Fear Connector CFA

Description: The Cape Fear Connecter CFA includes the lands along a portion of U.S. Highway 421 between the Northeast Cape Fear and Cape Fear Rivers north and northwest of the City of Wilmington in Pender and New Hanover Counties. This CFA lies between two portions of the 7,260-acre Cape Fear River Wetlands Game Land, the Roan Island Tract along the Cape Fear to the west and the Belhammon Tract along the Northeast Cape Fear River to the east.

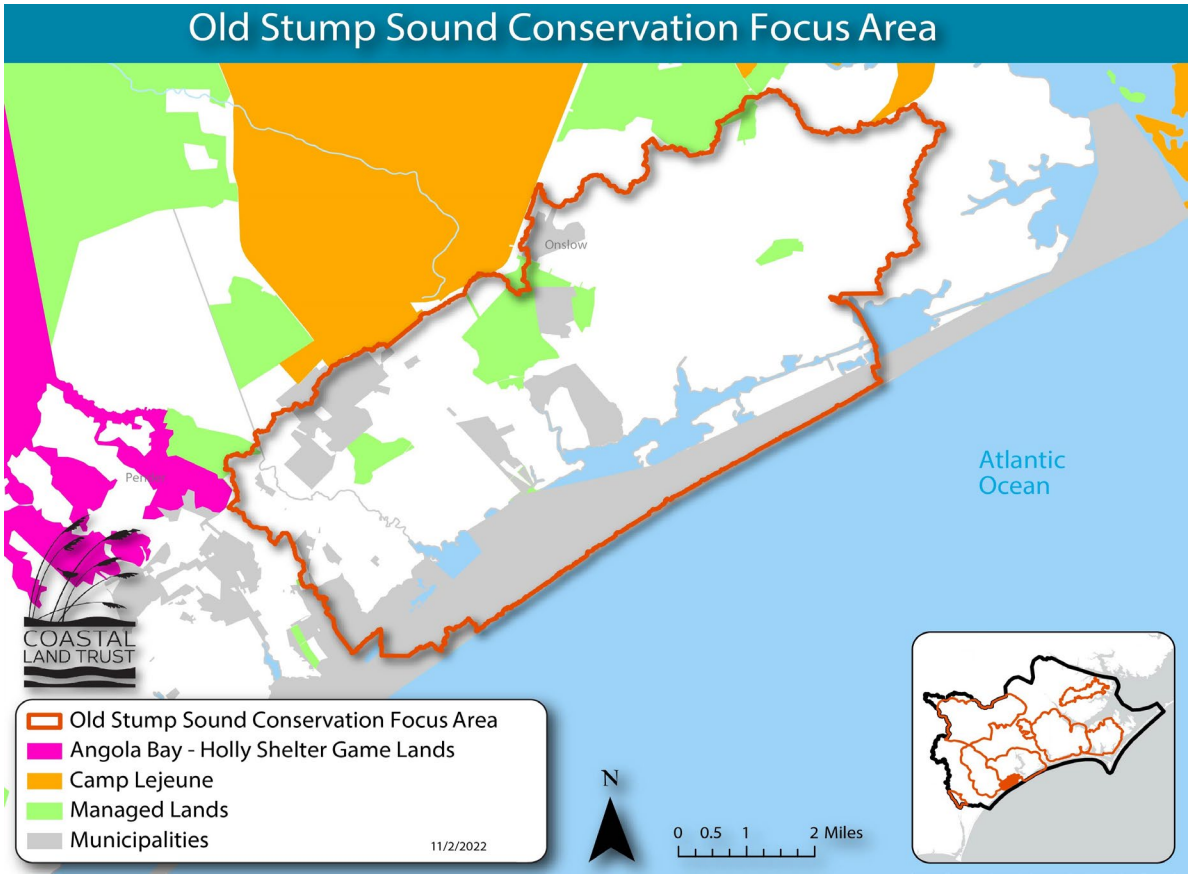


Conservation Significance: Two exceptionally significant natural heritage natural areas occur within this CFA, the Northeast Cape Fear River Floodplain on the east side and the 421 Sand Ridge to the west. Significant portions of these two natural heritage natural areas are currently unprotected.

Conservation Work to Date: Along the Northeast Cape Fear River, UNC-Wilmington owns 700+acres of wetlands in Pender County, New Hanover County owns another 700-acres of open space in New Hanover County, and NCCLT owns 487-acres of wetlands (Royal Preserve). NCCLT made an unsuccessful attempt to purchase the old 700+acre BASF Vitamin Plant along U.S. 421 in New Hanover County which hosted longleaf pine stands and extensive bottomland hardwoods along the Cape Fear River. The plant site was later sold for sand mining. TNC has been working to purchase and conserve another large tract along U.S. 421 that hosts a significant RCW population along with frontage along the Cape Fear River.

Old Stump Sound CFA

Description: The Old Stump Sound CFA lies between U.S. Highway 17 to the north, and Topsail Island and the Atlantic Ocean to the south in Onslow County. It includes numerous tidal creeks--six Hydrological Unit Codes (HUC), Old Mill Creek, Morris Landing, South Morris Landing, Kings Creek, Turkey Creek, and Alligator Bay--and 12 subwatersheds, which flow into Stump Sound near Topsail Island. Protection of land within this CFA, along with the Newport River watershed, are water quality and shellfish habitat priorities for NCCF. The Newport River watershed is included in the Carteret Crescent and Croatan Buffer CFAs.



Conservation Significance: There are several small natural heritage natural areas within this CFA including Turkey Creek Marshes, Kings Creek Marshes, Folkstone Savannas, North Topsail Beach Maritime Forest, Surf City Maritime Forest, and Topsail Sound Maritime Forests. This area is experiencing considerable residential development pressure. Conserving riparian buffers along the tidal creeks as well as any protecting/restoring larger parcels will help minimize water quality deterioration. The northern portion of the CFA also provides buffer to Camp Lejeune.

Conservation Work to Date: The Old Stump Sound CFA contains a portion of Stones Creek Game Land owned by the State and managed by NCWRC as well as a couple of small parcels

owned by Onslow County or the Town of Surf City and managed as open space. NCCF owns the 52-acre Morris Landing Tract and the N.C. Division of Coastal Management manages the 62 acre Permuda Island Coastal Reserve in Stump Sound. NCCF is developing a separate conservation/restoration plan for the Old Stump Sound area.

Croatan National Forest Buffer CFA

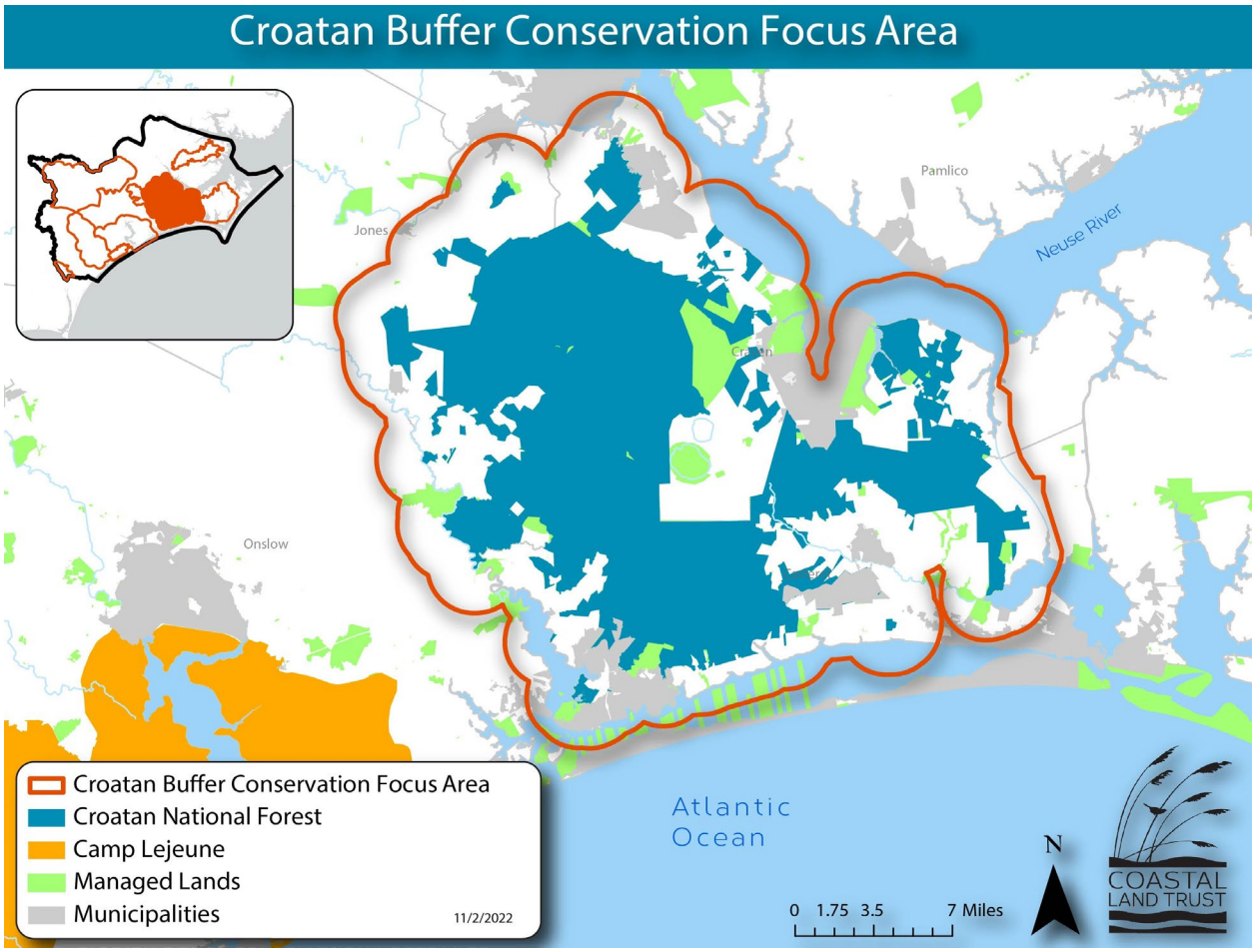
Description: The Croatan National Forest Buffer CFA in Carteret, Craven and Jones Counties includes the entire 160,000+acre national forest along with a 2-mile, more or less, buffer around it. This CFA consolidates Corridors 6, 7 & 8 from the 2004 Onslow Bight Plan. The CFA essentially lies between the White Oak River to the west and the Neuse River to the east. The Cities of New Bern and Havelock, and the Towns of Bogue, Newport, and Cape Carteret lie all or partially within this CFA. There is considerable development pressure along the U.S. 70 corridor (currently being upgraded to Interstate status) as well as along N.C. Highway 24 and Bogue Sound.

Conservation Significance: The Croatan National Forest is one of the ecological gems on the North Carolina coast. One of four National Forests in North Carolina, the Croatan is considered to be the only true coastal forest in the East. The Croatan National Forest hosts expansive longleaf pine forests, saltwater estuaries, pocosins, bottomland hardwoods and maritime forest. The Croatan has 3 designated Wilderness Areas; Catfish Lake, Sheep Ridge, and Pocosin Wilderness Areas. The N.C. Natural Heritage Program has designated the Croatan National Forest as an ecologically significant "megasite" with numerous embedded natural heritage natural areas including all of the Wilderness Areas, Little Road Longleaf Pine Savannas; Catfish Bay Impoundment Bay Rims; Paupers Island/Goodwin Creek; Southwest Prong Flatwoods, Holston Creek, Hibbs Road Pine Ridges; Masontown Pocosin, White Oak Marshes and Swamps; Island Creek, Nine Foot Road/Broad Creek Pinewoods; Millis Road Savannas and Pocosins; Hadnot Creek Ponds and Longleaf Pine Woods; Patsy Pond Limesink Complex; Pringle Road Bay Rims; Union Point Pocosin; Newport River and Black Creek Wetlands; and others. According to Kathleen Mahoney, U.S. Forest Service Wildlife Biologist, there are 62 active RCW clusters on the Croatan National Forest. According to Brent Wilson, NCWRC, there are an additional 2 active clusters on the adjacent Croatan Game Land (i.e., Pettiford Creek Tract).

Conservation Work to Date: NCCLT, in partnership with Marine Corps Air Station Cherry Point, has purchased and/or secured easements on almost 500 acres near the west gate of the main base in Havelock (Craven County) and 50-acres near the Marine Corps Auxillary Landing Field Bogue (Carteret County). NCCLT has conserved an additional 300-acres along the White Oak River. NCCF has acquired over 2,500+acres along the White Oak River that was transferred to the state to become part of the White Oak River Game Land. In addition, NCCLT purchased the 879+acre Pettiford Creek and Ahearn Tracts and transferred them to the State to

be managed as part of the Croatan Game Land by NCWRC. In 2018, NCCLT received $7.3M from litigation brought against N.C. Department of Transportation (NC DOT) by the Sierra Club over NC DOT's proposed U.S. 70 Havelock Bypass that goes through a portion of the Croatan National Forest. As part of the settlement, NC DOT, Sierra Club and NCCLT entered into a Memorandum of Agreement which provided $7.3M to NCCLT to establish the Croatan Protection Fund ($5.3M) and the Croatan Revolving Loan Fund ($2M). The settlement funds were to purchase in fee title or conservation easement land within the proclamation boundary of the Croatan National Forest in Carteret, Craven and Jones Counties. To date, NCCLT has purchased 7 properties in and around the Croatan totaling over 1,900-acres; 2 of the properties were transferred to the U.S. Forest Service to be managed as part of the Croatan National Forest. One property will be transferred to Craven County to become the new Brice's Creek Nature Park. NCCLT has conservation easements over the 1,000+acre Walkers Millpond and Black Creek Tract part of Weyerhaeuser Company's Carteret 6 Tract and owns over 500-acres of estuarine marsh along the Newport River.

In addition, NCCF owns over 200 acres along the Newport River south of Mill Creek Road. In 2020, NCCF, in partnership with Carteret County and the Marine Corps Air Station Cherry Point, purchased about 76-acres of land along Bogue Sound between J. Bell Lane and Red Barn Road. A portion of this property is the future site of NCCF's new office and the Fred and Alice Stanback Coastal Education Center. Finally, there are several wetlands mitigation sites in this CFA including Weyerhaeuser Company's 676-acre wetland mitigation bank in the headwaters of Brice's Creek (Craven County); N.C. Department of Transportation's 355+acre Clayhill Farms Mitigation Site near Hunters Creek in Jones County, and N.C. Department of Transportation 4,000+acre Croatan/Long Bay Mitigation Site west of Havelock (which is surrounded by the Croatan National Forest) in Craven County.



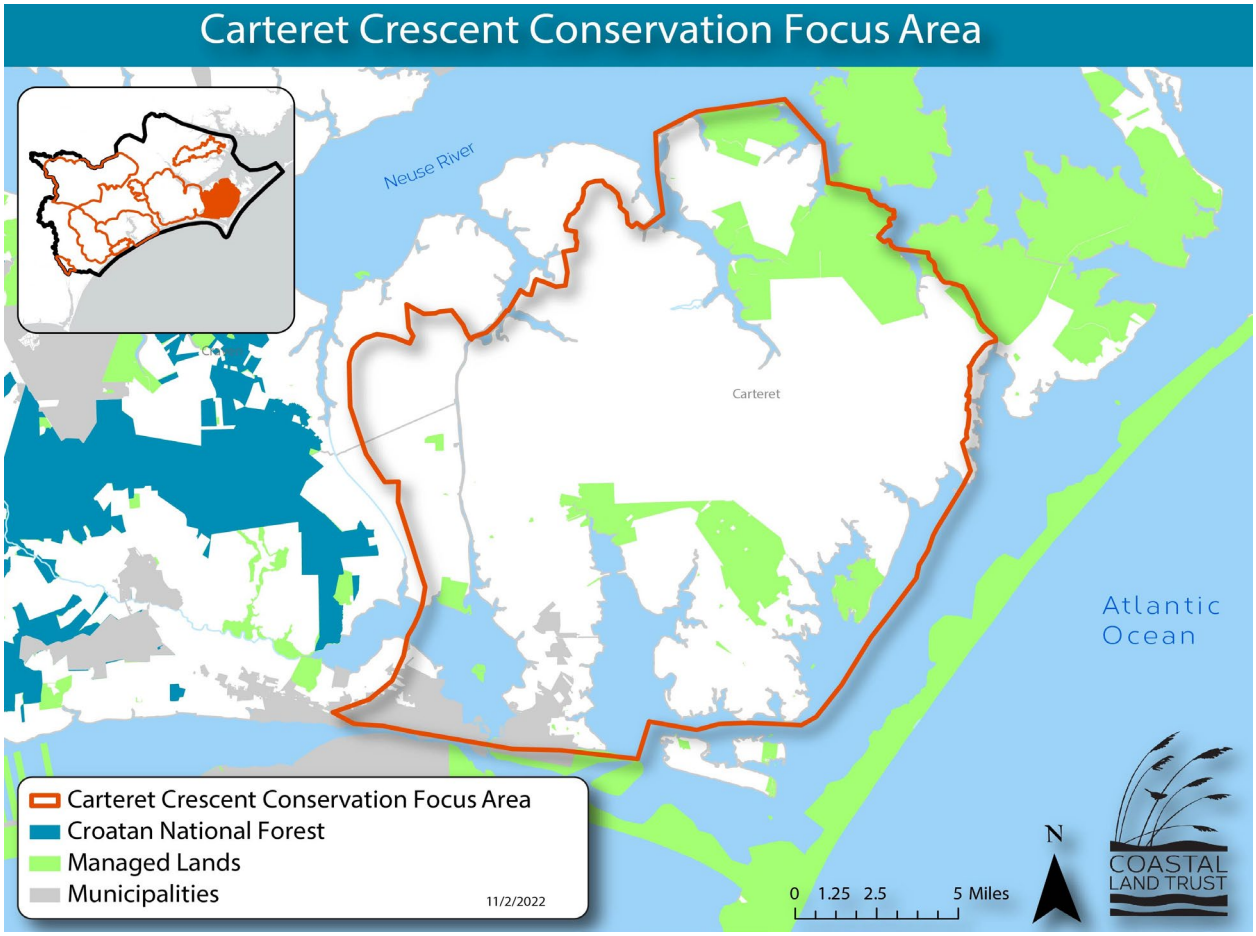
Carteret Crescent CFA

Description: The Carteret Crescent CFA expands upon Corridor 9 (Croatan National Forest/Cedar Island) from the 2004 Plan which connected a portion of the 160,000-acre Croatan National Forest to the 14,000+acre Cedar Island National Wildlife Refuge in Carteret County. The Carteret Crescent CFA abuts the Croatan National Forest Buffer CFA to the west and covers a large area south of the Neuse River and north of the Newport River and Core Sound extending east to a portion of NCWRC's Carteret County Game Land (specifically the 5,100+acre Salters Creek Tract), the Cedar Island National Wildlife Refuge, and Marine Corps Air Station Cherry Point's 11,000+acre Piney Island Bombing Target on Turnagain and Long Bays. It essentially covers a large portion of Carteret County often referred to as "Down East."

Conservation Significance: The CFA includes two isolated natural heritage natural areas (Sea Gate Woods and North River Brackish Marshes). This CFA includes extensive areas of privately-owned timberlands and croplands. There are areas within the CFA that appear to have longleaf pine ecosystem restoration potential, and if conserved and restored, may serve as

"stepping stones" between the eastern and western ends of the corridor over time. RCWs once occurred in low numbers on the Cedar Island National Wildlife Refuge as well as on private landholdings near the Piney Island Bombing Range, but are believed to have "blinked" out. Since some of these private lands are being, or have been purchased, and transferred to NCWRC (e.g., Wooten Tract, Salters Creek Tract), it is possible that suitable RCW habitat may be available in the future with proper timber management and prescribed burning. The estuarine marshes along Cedar Island and NCWRC's Carteret County Game Land are believed to be important for the federally threatened Eastern Black Rail (*Laterallus jamaicensis ssp. jamaicensis*).

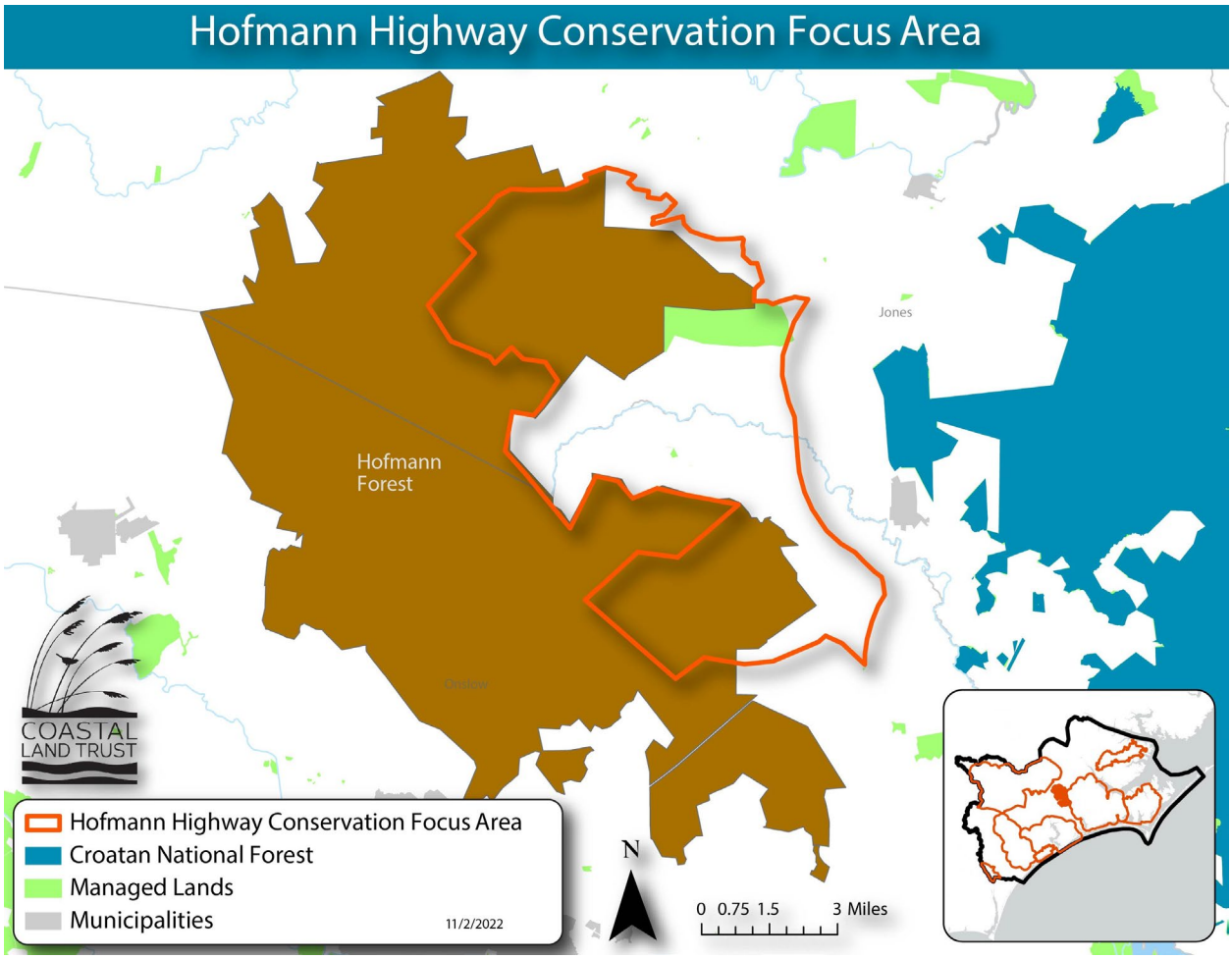
Conservation Work to Date: N.C. Coastal Federation purchased over 6,000-acres of ditched and drained wetlands in the headwaters of the North River back in 2002, and recently completed hydrological and vegetation restoration work there. In 2019, NCCLT purchased over 5,400-acres along Salters Creek and Long Bay from the Trustees of the Sailors Snug Harbor and transferred 5,100-acres (Salters Creek Tract) to the state to be managed by NCWRC as part of the Carteret County Game Land. NCCLT also partnered with Marine Corps Air Station Cherry Point to secure conservation and restrictive easements on over 4,400 acres of privately-owned land on the Luken's Island peninsula and purchased the 1,300+acre Bay River Investments Tract in fee title there (also transferred to NCWRC). In addition, NCCLT partnered with Marine Corps Air Station Cherry Point to secure easements on over 1,100-acres at Jarrett's Bay. NCCLT owns 201-acres west of Adams Creek/Intracoastal Waterway (Sea Gate Woods Preserve). DU purchased over 600-acres along the Newport River and Core Creek and transferred it to NCWRC to be managed as part of the Carteret County Game Lands. TCF is currently working with Marine Corps Air Station Cherry Point to purchase over 5,000-acres just south of the Piney Island Bombing Range.



Hofmann Highway CFA

Description: The Hofmann Highway CFA lies between the small towns of Belgrade and Maysville, south of Pollocksville and north of the City of Jacksonville in Jones and Onslow Counties and includes eastern portions of the Hofmann Forest as well as lands along a portion of the upper White Oak River and U.S. Highway 17. The landscape consists of several large privately-owned timberland tracts as well as numerous smaller parcels of managed forest land, cropland, as well as residences. The Hofmann Highway CFA abuts a portion of the western boundary of the Croatan National Forest Buffer CFA at U.S. Highway 17.

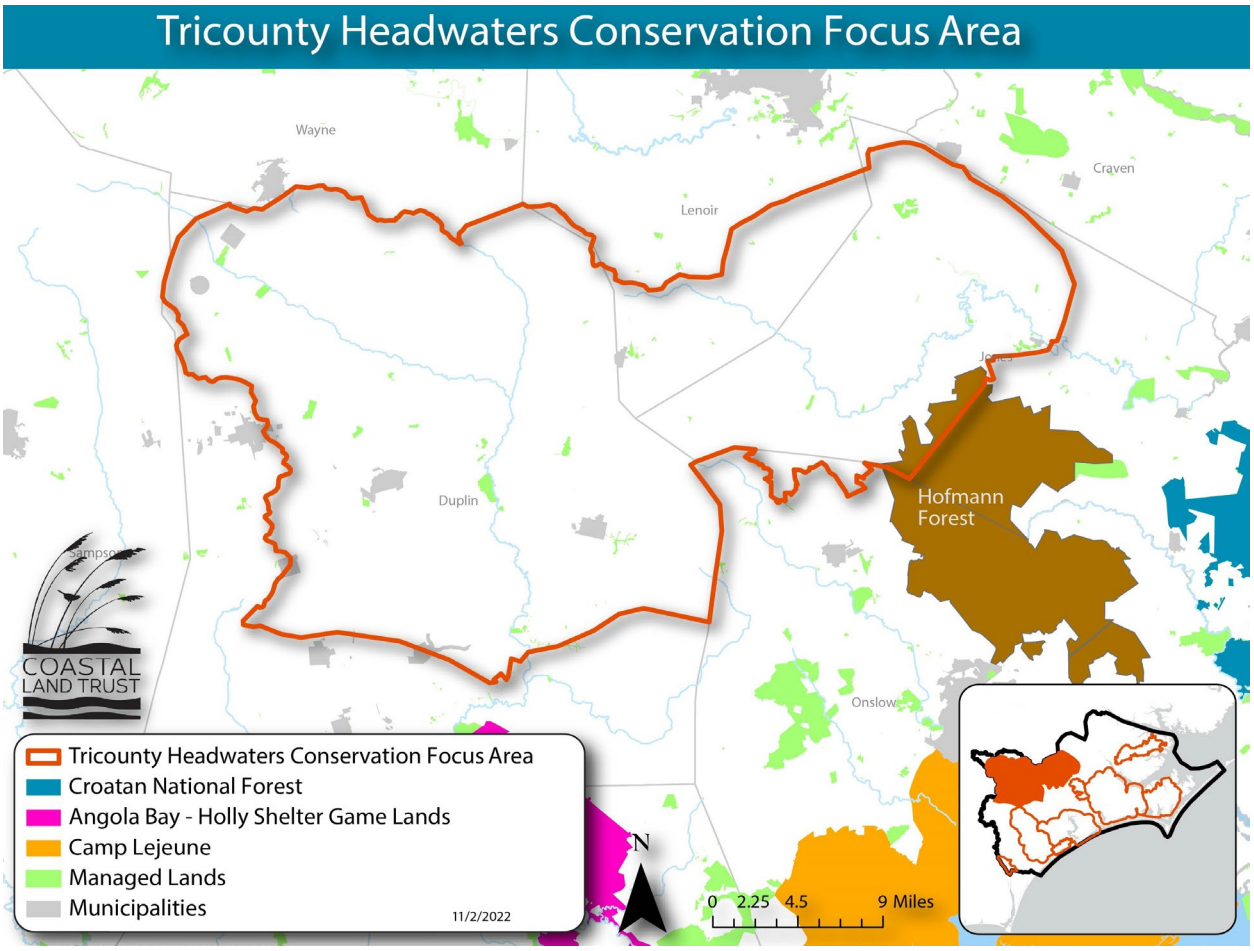
Conservation Significance: The primary purpose of the Hofmann Highway CFA is to connect the 79,000+acre Hofmann Forest with a portion of the Croatan National Forest. The Hofmann Forest is owned by N.C. State University's Natural Resources Foundation and was bought in the 1930s for research and to provide income for N.C. State's forestry program. The Hofmann Forest consists primarily of managed timberlands but there are/were areas of mature longleaf pine forest on sand ridges as well as extensive intact pocosin wetlands. The property hosts the headwaters of the White Oak River and provides important habitat for black bear. The property is not under any conservation restrictions.



Conservation Work to Date: In 2010, TNC and Croatan National Forest staff worked with N.C. Department of Transportation to have it design and construct wildlife underpasses as part of improvements to U.S. Highway 17 in this area. In 2013, N.C. State University and the Natural Resources Foundation had planned to sell the Hofmann Forest to an Illinois-based agribusiness company. Some N.C. State professors, foresters and environmentalists sued over the proposed sale, arguing that the state constitution mandates conserving public lands for public benefit. The case went to the state Supreme Court, but went undecided because the sale had fallen through by then. N.C. State then agreed to sign a long-term lease on approximately 56,000-acres of Hofmann Forest with an Alabama-based firm, Resource Management Service, LLC to continue timber harvesting and production while the university retained ownership of the land. A wetlands mitigation bank was established on approximately 450-acres. The Navy and Marine Corps were negotiating easements on a portion of the forest but nothing was finalized. The university was also considering conservation easements over the 18,000-acre Big Open Pocosin. Some land has been sold for agriculture or development. TNC is conducting a site assessment on a portion of Hofmann Forest to determine potential for wetlands (peatland) restoration.

Tricounty Headwaters CFA

Description: The Tricounty Headwaters CFA encompasses the headwaters of the Trent and Northeast Cape Fear Rivers in Duplin, Jones and Lenoir Counties. It is predominantly a rural area consisting mostly of farm and forest land. There are a few scattered towns (e.g., Pink Hill, Potters Hill, Deep Run) but no major municipalities. The Tricounty Headwaters CFA abuts and includes a portion of the Hofmann Forest on its southeastern boundary.



Conservation Significance: This CFA hosts a portion of the Northeast Cape Fear River Corridor Natural Heritage Natural Area of Exceptional Significance and a few other isolated natural heritage areas (e.g., Goshen Swamp and Nobles Millpond of general ecological significance). The Tricounty Headwaters region was highlighted as an important area to conserve forested riparian buffers, to restore headwater wetlands, and to conserve working farm and forestland. The small towns of Chinquapin in Duplin County as well as Trenton and Pollocksville in Jones County have been repeatedly flooded during storm events (e.g., Hurricanes Floyd and Florence) and may benefit from floodplain conservation/wetlands restoration work in this headwaters area.

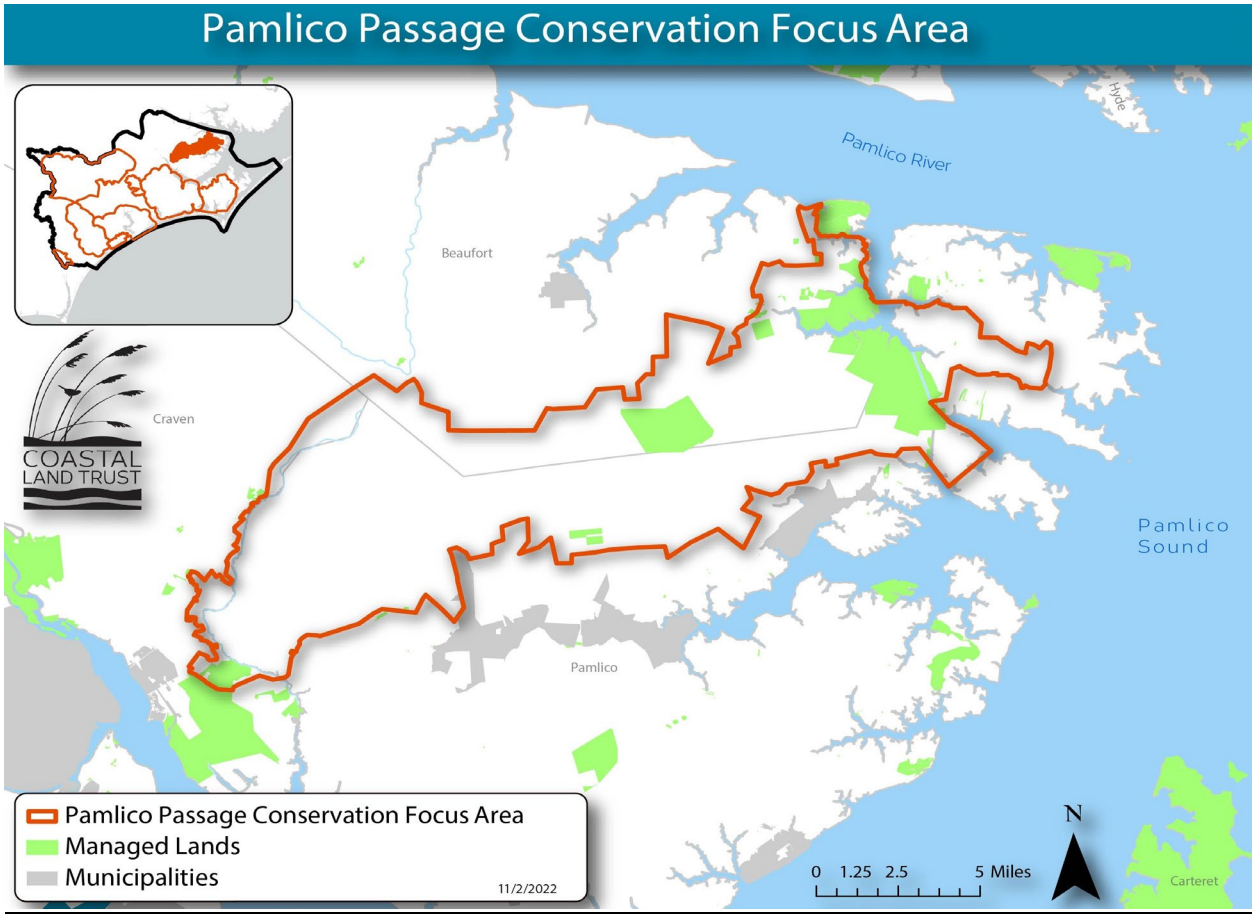
Conservation Work to Date: Duplin County owns 45-acres of open space north of Beulaville and N.C. Department of Transportation has a 585-acre wetland mitigation site along the Northeast Cape Fear River north of Highway 258. There are numerous small (under 100-acres) easements held by various groups such as the N.C. Department of Agriculture (Swine Buyout Program or Conservation Reserve Enhancement Program), U.S. Fish and Wildlife Service, Duplin County Soil and Water District, and N.C. Division of Mitigation Services.

Pamlico Passage CFA

Description: The Pamlico Passage CFA expands upon Corridor 10 from the 2004 Plan. It spans from NCWRC's 5,600+acre Neuse River Game Lands near the Town of Bridgeton in Craven County north along Upper Broad Creek (north of Highway 55) east to NCWRC's 8,200+acre Goose Creek Game Land near the Town of Hobucken in Beaufort and Pamlico Counties. NCWRC holds a conservation easement on about 1,500-acres of the Parker Farm owned by Nutrien Phosphate in between the game lands. To the north of the Pamlico Passage CFA lies a large phosphate mine, located near the Town of Aurora in Beaufort County. It is considered one of the largest phosphate mines in the world. The mine was constructed in 1964 by Texas Gulf who sold it to the Potash Corporation of Saskatchewan (PCS Phosphate) in 1995. PCS sold the plant to Nutrien Phosphate in 2018. Much of the land within the Pamlico Passage CFA appears to be in privately-owned pine plantation or farmland.

Conservation Significance: The Pamlico Passage CFA hosts the 11,000+acre Suffolk Scarp bogs (also known as the Northwest Pocosin) along Upper Broad Creek, a Natural Heritage Natural Area of high ecological significance as well as the 1,100+acre Bay City Low Pocosin. Several exceptionally significant natural heritage natural areas occur within the Goose Creek Game Land. The privately-owned 4,500+acre Jones Island Tract near Hobucken is another natural heritage natural area of very high ecological significance. It abuts the CFA just south of the Goose Creek Game Lands in the Pamlico Sound.

Conservation Work to Date: Aside from the Neuse River and Goose Creek Game Lands managed by NCWRC, and NCWRC's Parker Farm conservation easement, NCCLT holds conservation easements on the 52-acre Hughes Farm and the 29-acre Morgan Swamp/Klein Tract in Craven County. In addition, the N.C. Department of Agriculture holds Conservation Reserve Enhancement Program easements on several small tracts in Craven County. NCCLT is working with NCWRC to purchase over 400-acres just south of the Town of Vandemere on the Bay River, Smith and Newton Creeks, that will become part of Goose Creek Game Land. It abuts the southern boundary of the Pamlico Passage CFA.



Aside from the nine CFA's listed above, the Onslow Bight Conservation Forum identified priority estuarine areas in the Onslow Bight Landscape which are highlighted in **Appendix E**. Some of these areas overlap with one or more CFA's as identified in this plan update.

VII. Conservation Strategies

Long-term protection of the conservation targets within the Onslow Bight landscape depends on securing protection of and appropriate management on important habitat areas and abating threats to the land and management activities. Core areas are places with known site-specific significant resources, such as habitat for rare species or high quality or rare natural communities. They are usually in good ecological condition but may be somewhat degraded or in need of restoration even though significant resources are still present. These core areas are most worthy of preservation and natural area management as they are the most threatened in the sense that they have the most to lose ecologically. Areas of high quality/high integrity should be the most resilient, and their conservation will help maintain viability of ecosystems and species, and perhaps even mitigate some of the effects of climate change. Core areas that currently exist within managed areas should be managed for the conservation targets and, if possible expanded in area. Action should also be taken to create functional corridors between core areas within a managed area or between adjoining managed areas. As noted above, ecosystems are not closed

systems, and areas outside of core areas may be utilized for foraging and movement. These ecosystem functions should be considered, for conservation of at-risk species, as well as for general wildlife and plant life, since they are interconnected.

The following are general conservation strategies along with examples of specific action items for the Onslow Bight landscape.

Acquisition of Priority Lands from Willing Landowners**:** Increased land conservation is greatly needed to protect, and ensure viability of, the conservation targets. Acquisition may occur in fee simple or by perpetual conservation easement or agreement. While partnering agencies and organizations that engage in land conservation likely have their own internal priorities, the following is a list of land types in priority order based on their contribution towards protection of conservation targets within the Onslow Bight landscape:

1. (**Highest Priority**) Land that is designated, all or in part, as a Natural Heritage Natural Area of exceptional, very high or high ecological significance by the N.C. Natural Heritage Program (includes lands that qualify for such designation) and that is still in relatively good shape (it is close to its natural ecological and hydrological condition) and/or easily restorable (i.e., with minimal soil disturbance) that either occurs within one of the designated CFA's OR is located outside of a CFA but adjacent to or helps connect existing conservation areas or managed lands.
2. (**Very High Priority**) Land that is designated as a Natural Heritage Natural Area of exceptional, very high or high ecological significance and that is still in relatively good shape (it is close to its natural ecological and hydrological condition) and/or easily restorable that does not occur within a CFA or adjacent to an existing conservation area or managed land.
3. (**High Priority**) Land that is (1) designated as a Natural Heritage Natural Area of moderate or general ecological significance that is located within one of the CFA's or adjacent to an existing conservation area or managed land, OR (2) land that is not a designated as a Natural Heritage Natural Area and is still in relatively good shape (it is close to its natural ecological and hydrological condition) and/or easily restorable that is located either within one of the designated CFA's or lies adjacent to an existing conservation area or managed land, OR (3) land that contains significant acreage (500 acres or more) in relatively good shape (it is close to its natural ecological and hydrological condition) and/or easily restorable located anywhere in the Onslow Bight landscape.
4. (**Moderate Priority**) Land of any acreage that is either designated as a Natural Heritage Natural Area of moderate or general ecological significance or not designated and may or may not be more disturbed (requires greater restoration effort) that is located outside of a CFA and not near an existing conservation area or managed land but hosts important water quality, connectivity, working lands, scenic, recreational, and/or wildlife habitat values.

Relative threat is a very important factor to weigh with the above criteria in deciding where to direct acquisition resources. Should a lower priority tract of land be significantly threatened with conversion to another use in the short-term, the decision may be made to put resources there rather than towards a less threatened, higher priority tract. In addition, land acquisition always responds to opportunity, and efforts should be made to acquire important lands that become for sale. Ideally, acquisition of natural heritage natural areas should be by a

conservation agency or group with management capability, or in conservation easement with a very interested and willing landowner.

As noted earlier, a considerable amount of land conservation work has been carried out through partnerships with the military that specifically focused on conserving land adjacent to existing military bases and outlying landing fields and/or under Critical Military Training Routes. This important work should continue and should be prioritized with appropriate military installation input.

Action Item: Establish a Committee to further prioritize lands within the Onslow Bight landscape. Considering public funding limitations for land conservation, and the fact that many funders want information as to how a proposed project meets the objectives of a regional plan, parcel prioritization may be useful to the partners. In 2022, NCCLT, with assistance from a Duke University Stanback Intern, identified ecological and climate resilience criteria and evaluated and prioritized land parcels within each of the CFA's. This report is included in **Appendix F**. Committee may review, edit, and adopt this parcel prioritization strategy or come up with a different prioritization strategy.

Implement Habitat Enhancement and/or Restoration where needed on Managed Lands and Priority Private Lands: Active management is required for certain natural community targets and several of the partners are engaged in upland and/or wetland habitat enhancement or restoration projects. For example, Camp Lejeune, USFS, NCWRC, N.C. State Parks, TNC and NCCLT have carried out timber harvesting/thinning, mechanical mid-story control, and/or prescribed burning along with tree planting and groundcover restoration on military, national forest, state-owned game and park lands, and nature preserves to enhance and/or restore longleaf pine habitats, a high priority natural community target within the Onslow Bight. Indeed, enhancement and restoration of longleaf pine forests has received considerable attention nationally and regionally since the development of the 2004 Onslow Bight Plan.

Periodic fire is essential for maintaining healthy longleaf pine and pocosin ecosystems. In 2005, shortly after the establishment of the Onslow Bight Conservation Forum, several partners worked together to establish the Onslow Bight Fire Learning Network, a partnership among burn practitioners, university researchers and other interested partners to improve fire management. Sharing practical burn information, improved fire and weather modeling, more effective communication to key stakeholders and the public and understanding health concerns were among the outcomes of the Network. Out of it arose a MOU establishing the Onslow Bight Stewardship Alliance allowing better cooperation and improved resource sharing among the burn staff of Croatan National Forest, Camp Lejeune, Cherry Point, NCWRC, State Parks and TNC. This alliance has recently lapsed but there is interest in renewing it.

In 2005, the Longleaf Alliance, a non-profit organization, stressed the need for a focused, range-wide restoration approach, which they named *America's Longleaf-A Restoration Initiative for the Southern Longleaf Pine Forest.* The Southeast Regional Partnership for Planning and Sustainability (SERPPAS) also highlighted longleaf pine as one of its top conservation priorities. Under the leadership of the U.S. Forest Service, Department of Defense,

and U.S. Fish and Wildlife Service, a Regional Working Group of diverse organizations was formed in October 2007 to develop a conservation plan and to launch ***America's Longleaf Initiative*** as an umbrella for the collaborative efforts by many stakeholders to ensure the conservation plan's implementation. And in 2010, the North Carolina Longleaf Pine Coalition was established with a mission to promote the maintenance and restoration of North Carolina's longleaf pine ecosystem, including its cultural and economic values, by forming a collaborative network of diverse stakeholders to provide strategic leadership across the historic range while also supporting local restoration activities. The Coalition coordinates closely with on-the-ground restoration efforts including the Onslow Bight Conservation Forum, Cape Fear Arch Conservation Collaboration, Greater Uwharrie Conservation Partnership, and the Sandhills Conservation Partnership (for more information, see https://www.nclongleaf.org/About.html.). Under the America's Longleaf Initiative, Longleaf Implementation Teams (LIT) were designated throughout the range of the forest. North Carolina has 3 LITs including the Onslow Bight LIT. TNC has taken the lead in managing tasks and collecting information requested of this team.

The Longleaf Alliance serves as a clearinghouse for information on longleaf pine enhancement and management practices (information at https://longleafalliance.org/what-is-longleaf/restoration-management/). In addition, the N.C. Forest Service, S.C. Forestry Commission and VA Department of Forestry developed a web-based GIS tool, the Longleaf Pine Interactive Decision Support Tool (https://www.nclongleaf.org/maps.html) to bring together the best available geographic information relative to longleaf pine restoration and conservation in North Carolina, South Carolina and Virginia. And the Florida Natural Areas Inventory initiated the development of a comprehensive map database of documented longleaf pine locations and ecological conditions across its range referred to as the Southeast Longleaf Ecosystems Occurrences Geodatabase (LEO GBD). Florida Natural Areas Inventory is working with the Longleaf Alliance in close conjunction with the America's Longleaf Initiative.

Action Items: (1) Develop a LEO map for the Onslow Bight landscape highlighting areas of existing high quality longleaf pine and potential longleaf restoration areas. Overlay LEO map with known RCW occurrences (and possibly other priority conservation targets like Carolina gopher frog and Bachman's sparrow). Prioritize areas/parcels for conservation, restoration, and/or enhancement based on this mapping effort. (2) Increase the number of active RCW clusters in the Onslow Bight. Croatan National Forest, Holly Shelter and Croatan Game Lands and Marine Corps Base Camp Lejeune presently host 244 active RCW clusters. These publicly-owned lands within the Onslow Bight comprise the U.S. Fish and Wildlife Service's designated Mid-Atlantic Coastal Plain RCW Recovery Unit. The population goal for this recovery unit is between 275 to 350 active clusters. (3) Reestablish the RCW Committee to determine how and where to increase the number of RCW clusters on public and private lands to meet the recovery unit goal. (4) Promote the reestablishment of the OB Stewardship Alliance to facilitate cooperation among burn staffs.

Management of Core Areas and Functional Corridors: Dovetailing with the conservation strategy above, encourage cooperation among partners (where feasible) to increase on-the-ground management activity. Management by partners of core areas and functional corridors (as defined in Appendix A) should be done in a manner conducive to enhancing habitat for

conservation targets, and effective conservation means protecting targets in the long-run. Such conservation-minded management on both existing and future sites should be directed towards:

1. Ecological restoration of sufficient quantity and quality to ensure viable habitats for target species.
2. Management (across ownership boundaries) to reach ecosystem goals and perhaps coordinated through a management subcommittee; striving for continuous improvement and maximizing ecosystem benefit.
3. Introducing and/or maintaining fire into ecologically appropriate sites. This may require a direct approach, as many areas are already fire-suppressed, and prescribed burning is increasingly difficult as development increases.
4. Coordinated monitoring and research to better understand ecological systems and inform effective management. Management should be an adaptive process, stressing cooperation not just among the signatory partners, but public at large.

Educate and Work with Private Landowners: Much of the land within the Onslow Bight landscape is privately-owned. In many instances, private landowners, whether corporate or individual, do not wish to sell their property or place it under a perpetual conservation easement or agreement but are willing to cooperate and manage their land for conservation. When and where possible, partners should work with willing landowners to: (1) place term easements on priority properties; (2) provide technical management assistance, and/or (3) provide cost-share or direct financial support for appropriate habitat management activities such as native tree planting, groundcover restoration and/or prescribed burning through various cost-share programs (e.g. U.S. Fish and Wildlife Service's Partners for Fish and Wildlife Program, Natural Resources Conservation Service's Wildlife Habitat Incentives Program, U.S. Department of Agriculture's Conservation Reserve Enhancement Program, etc.). Partners should educate and encourage prescribed burning within pine-dominated stands and other fire dependent communities.

It should be noted that private landowners, as well as forestry consultants, are sometimes reluctant or unwilling to conduct prescribed burning due to high and recurring cost as well as real and/or perceived liability issues. Several existing partnerships are focusing on how to address these issues. For example, the North Carolina Prescribed Fire Council (https://ncprescribedfirecouncil.org/) has a mission "to foster cooperation among all parties in North Carolina with an interest or stake in prescribed fire." Their goal is "to optimize burning opportunities for the benefit of natural ecosystems and wildlife and to reduce the risk of damage from wildfires." In addition, SERPPAS and N.C. State Extension developed the *Comprehensive Strategy for Prescribed Fire to Restore Longleaf Pine in the Southeast w*ith a goal to develop a comprehensive regional strategy to increase prescribed burning in the Southeast. Of particular interest to private landowners and forestry consultants is information on prescribed burning liability insurance (for more information see (https://sites.cnr.ncsu.edu/southeast-fire-update/insurance//).

Private landowners are also reluctant to proactively manage for some of the priority conservation targets, i.e., federally listed animal species like RCWs, due to real and/or perceived concerns about liability under the Endangered Species Act. When and where possible, partners

should educate landowners about any available programs and/or incentives for protecting and managing for specific federally listed species. For example, in 2006, the North Carolina state-wide RCW Safe Harbor Agreement became effective and was developed to address the conservation needs of the RCW in the State of North Carolina and the concerns of North Carolina non-federal property owners (see ttps://www.ncwildlife.org/Conserving/Programs/Safe-Harbor-Program). NCWRC has taken the lead in working with private landowners on "Safe Harbor" agreements.

Action Items: (1) Identify current disincentives to prescribed burning and support initiatives and/or changes in regulations to remove these disincentives. (2) Identify and work with private landowners with suitable or restorable lands adjacent to existing RCW clusters and encourage Safe Harbor Agreements. (3) Promote the establishment of one or more localized prescribed burn associations (PBA) which are groups of private landowners sharing interest in burning their land who learn together, share resources and participate in helping one another on burns. There is financial support to help PBA establishment and equipping with basic tools.

Enhance Habitat within Pine Plantations at Targeted Sites: Within the Onslow Bight Landscape pine silviculture is a major land use. While not ideal for the conservation of most target species or natural communities, this land use is considerably more beneficial to conservation targets than suburban development and many other land uses. In a number of instances, pine plantations function as important buffers to managed areas (e.g. the RCW MOU between Weyerhaeuser Company and Croatan National Forest) as well as provide habitat for many wildlife species. On private landholdings within the CFA's, it is desirable to identify and prioritize areas where there are privately-owned pine plantations that might be made more wildlife friendly. In these locations where the private landowner is willing, a timber management plan could be developed that would create, for example, islands or "stepping stones" of longer-rotation, more open (lower basal area) and/or other appropriate pine management that enhances the movement of various wildlife species between existing conservation areas or managed lands. N.C. Cooperative Extension Service provides information on creating wildlife-friendly pine plantations (https://faculty.cnr.ncsu.edu/christophermoorman/wp-content/uploads/sites/9/2016/02/won38.pdf). Both the N.C. Tree Farm and N.C. Forest Stewardship Programs promote incorporating wildlife habitat protection/enhancement on privately-managed timberlands.

Action Item: Develop incentives for private individual and corporate forest landowners to enhance select managed pine stands for wildlife. As an example, N.C. Longleaf Coalition (www.nclongleaf.org) developed the North Carolina Longleaf Honor as a means to recognize private landowners that meet certain eligibility requirements to manage longleaf pine stands. Perhaps, a similar Honor Roll or recognition program could be developed for wildlife-friendly pine plantation stands.

Protect and Maintain Open Habitats with Native Species/Early Successional Habitat: High quality early successional habitat supports a number of rare and/or priority plant and animal species and includes open grasslands or pine savanna with a predominance of native grasses and forbs (occasionally with carnivorous or other rare plants) or even fields planted with native warm

season grasses. Early successional habitat requires frequent disturbance (i.e., active management) to suppress tree growth. When possible and appropriate, partners should protect and manage high quality early successional habitat. For example, NCWRC acquired the 2,800+acre Voice of America Site A in Beaufort County that consists primarily of open grassland that supports the only documented nesting site for Henslow's Sparrows in North Carolina. Besides the Henslow's Sparrow, this site is home to numerous bird species, including the Grasshopper Sparrow, Eastern Meadowlark, Eastern Kingbird, Bobwhite Quail and Bald Eagle. NCWRC maintains this grassland through periodic prescribed burning. It should also be noted that some areas within power line rights-of-way host open savannas or grasslands with a few containing federally listed or rare plant species (e.g., on the Croatan National Forest). Some power companies have signed voluntary agreements with N.C. Natural Heritage Program and the underlying landowner to protect rights-of-way with rare plants from herbicide applications, mowing during the growing season, and/or mowing when soils are very wet (to avoid rutting). These agreements need to be monitored for compliance and periodically updated as companies change hands or leadership. Regular meetings with power company transmission foresters may help highlight the importance of these areas and avoid mishaps (e.g., accidental spraying by contractors).

Incorporate Wildlife Planning into Road Project Design: Well-traveled roads are an impediment to the movement of many wildlife species including deer, black bear, fox, bobcat, and various herpetofauna. Among the many challenges wildlife face in North Carolina is the risk of death or disruption to habitat connectivity caused by the state's extensive road network. In addition, collisions between wildlife and vehicles are a constant risk to travelers on North Carolina's roadways. Well-designed wildlife road underpasses or crossings allow safe passage for wildlife while also reducing wildlife-vehicle collisions.

Several road projects are in various stages of design and construction within the Onslow Bight Landscape that will likely have detrimental impacts on wildlife. These include U.S. Highway 17 in Craven, Jones and Onslow Counties, U.S. Highway 70 in Craven County ("Havelock Bypass"), and N.C Highway 55 in Craven and Pamlico Counties. Future new roads and improvements on existing roads will also occur. When possible and appropriate, partners should provide site-specific functional wildlife corridor design recommendations to the N.C. Department of Transportation (NCDOT) for specific road sections that hopefully will be translated into on-the-ground structural or other accommodations. It is important to note that partner engagement should begin at the earliest stages in the road planning process, prior to environmental review and permitting. Coordination is needed with both NCDOT and various regulatory agencies (e.g. U.S. Army Corps of Engineers and N.C. Department of Environment and Natural Resources).

Wildlands Network, a national non-profit organization, conducted a statewide analysis and report *(Priority Wildlife Road Crossings to Reconnect Wildlife Habitat and Improve Road Safety*, 2022 Wildlands Network) to identify the top 20 highest-priority wildlife crossing sites in North Carolina. Two of the top 20 priorities lie within the Onslow Bight landscape: (1) U.S. Highway 70 through the Croatan National Forest in Craven and Carteret Counties; and (2) U.S. Highway 17 near the west side of the Marine Corps Base Camp Lejeune in Onslow County.

The purpose of the 2022 Report is that it "serves as a guide to the locations in North Carolina with the greatest need for new wildlife crossings and retrofitting existing infrastructure."

Action Item: NCDOT is a signatory to the Onslow Bight Conservation Forum. Work with NCDOT to obtain a list of ongoing Transportation Improvement Plans within the landscape. Identify specific future road projects near managed lands and natural heritage natural areas and other areas of conservation concern. Encourage consideration of wildlife underpasses/crossings where appropriate. It should be noted that TNC and USFS worked successfully with NCDOT to incorporate several wildlife crossings along U.S. Highway 17 near the Croatan National Forest between Maysville and Jacksonville.

Work with and Educate Local Governments: Where appropriate, partners collectively and/or individually should proactively become stakeholders in regional and local planning efforts to educate local governments about the conservation values and targets within the Onslow Bight landscape. Such engagement should be at multiple levels -- from the State and Council of Governments (COG) level to counties and municipalities. The Joint Land Use Study (JLUS) involving Onslow County and Camp Lejeune Marine Base is a good example of this cooperation.

Educate local governments about the economic value of land conservation. Many studies have shown that well planned conservation can enhance local economies by bringing in outside recreational users, improving overall quality of life for residents, and increasing property values. In a November 9, 2022 press release by Made X MTNS Partnership, the U.S. Department of Commerce's Bureau of Economic Analysis (BEA) released economic data for 2021 demonstrating outdoor recreation's powerful and positive impact on the U.S. economy, "Despite less than ideal conditions surrounding inflation, workforce, and global supply chains, North Carolina's outdoor recreation economy showed strong growth in 2021, with a 22.6% increase in total outdoor recreation spending that outpaced the national average of 21.7%. . .This year's report shows that, by BEA measure metrics, outdoor recreation creates $11.8 billion in value added for North Carolina, accounts for 1.8% of its GDP, and supports over 130,000 jobs."

Action Items: (1) Gather relevant studies that document the economic value of conservation lands to local communities in North Carolina and distill into a format that can be used by partners as they engage in regional and local planning endeavors. (2) Work with local governments to create new parks and nature preserves as well as to protect land along the proposed Mountains-To-Sea Trail (MST) within the Onslow Bight landscape to provide opportunities for outdoor recreation and wildlife habitat protection. A map of the MST route in the Onslow Bight is included in Appendix F. (3) Finally, highlight work completed by NCWRC's Green Growth program (www.ncwildlife.org/greengrowth) in the Onslow Bight region. Green Growth is a non-regulatory program developed by NCWRC to provide tools to local governments interested in conserving wildlife habitat and other natural resources.

Cooperate in Research: Gaps exist in our knowledge of the ecology and management of the conservation targets. Where scientific literature or other information sources cannot answer critical questions, partners should cooperate in planning, funding and implementing research

projects that seek answers. Areas of knowledge needed are many and include the extent of species-area relationships required for long-term survival of target species, appropriate design of functional corridors, short and long-term hydrologic dynamics and the extent of species loss due to long-term fire suppression among many others. Focus on where we need to obtain more information about ecosystems, and base management decisions on the needs of the whole rather than on just one or two separate components. These areas of interest provide potential of teaming with academic institutions/graduate students.

Action Item: Share information from pertinent research involving conservation targets and/or threats to them through presentations at Onslow Bight meetings (e.g., VA Tech's RCW research at Camp Lejeune).

Develop an Outreach/Education Strategy: Partners believe that the vision contained in this document enhances the present and future quality of life within the landscape. Achieving this vision, however, requires the understanding and support of the people, leaders and stakeholders within the Onslow Bight Landscape. The partners, collectively and individually, should reach out and educate these people with a strategy that entails:

1. Building popular and political support for the vision of viable conservation in the region that positively contributes to people's quality of life and the economy. This effort should also entail educating the public about the importance of particular land management activities, especially the proper role of fire, in achieving ecological and public safety goals.
2. Reaching out to and engaging critical stakeholders whose participation is important to achieving our vision. Such stakeholders would include governmental agencies and officials, the forest and agriculture industries and certain private landowners among others.

Action Items: (1) Develop and publicize partnership success stories on projects of possible interest to general public, i.e., that help the military; that provide public access; on the benefits of prescribed fire; on the general conservation significance of the Onslow Bight region, etc. (2) Consider crafting articles for possible publication in *Our State* or *Wildlife in North Carolina* magazines that reach the general public. (3) Support outdoor environmental education work by NCCF, Nature Connect and Weyerhaeuser Company (Cool Springs Environmental Education Center) that teach local school children about nature. (4) Consider reestablishing an Onslow Bight website.

Combat Invasive Species: Invasive plant and animal species can wreak havoc on natural areas as well as working farm and forest lands. Invasive species spread quickly and can displace native species reducing biodiversity and competing with native organisms for limited resources. Some invasive species can cause costly economic and ecological damage each year including crop decimation and clogging of water facilities and waterways. Partners that own and manage conservation land should identify invasive plant and animal species whenever possible and implement eradication efforts, as time and resources allow. Partners that provide technical management assistance to private landowners should include education on invasive species and cost-share assistance for control strategies. Information on successful control methods should be shared and whenever possible, efforts should be made to collaborate on eradication strategies.

Action Item: Host an Onslow Bight meeting that focuses on invasive species eradication efforts (what works and what doesn't) and/or host an educational workshop for private landowners on invasive species that are of particular threat to conservation targets in the region.

Minimize Impacts to Water Quality and Aquatic Habitats: Protecting, enhancing, and restoring water quality is an important goal for the Onslow Bight Conservation Forum. The Onslow Bight landscape hosts portions of four major river basins: Neuse River, Cape Fear, White Oak, and the Pamlico. N.C. Division of Environmental Quality (NCDEQ) developed a series of Basinwide Water Quality Management Plans that report on biological, chemical and physical water quality monitoring data as well as identify water quality threats and abatement strategies by subbasin (https://deq.nc.gov/about/divisions/water-resources/water-planning/basin-planning-branch). These basin plans are required under North Carolina General Statute 143.215.8B and are approved by the Environmental Management Commission approximately every 10 years.

Per NCDEQ's *2009 Neuse River Basinwide Water Quality Management Plan* there are 8 subbasins of the lower Neuse River within the Onslow Bight landscape:
03-04-05 (Neuse River, Stony Creek, Bear Creek);
03-04-08 (Core Creek and Neuse River);
03-04-09 (Swift Creek);
03-04-10 (Neuse River Estuary near New Bern);
03-04-11 (Trent River);
03-04-12 (Neuse River);
03-04-13 (Bay River and Pamlico Sound) and,
03-04-14 (Thorofare and West Thorofare Bay in Carteret County).

Per the *2005 Cape Fear River Basinwide Water Quality Management Plan* there are 3 subbasins of the lower Cape Fear River within the Onslow Bight:
03-06-22 (Northeast Cape Fear, Rockfish Creek-Duplin County);
03-06-23 (Northeast Cape Fear River, Burnt Mill Creek, Burgaw Creek-Pender County); and
03-06-24 (Masonboro Sound, Topsail Sound and the Intracoastal Waterway (ICWW)).

Per the *2007 White Oak River Basinwide Water Quality Management Plan* there are 5 subbasins of the White Oak River all within the Onslow Bight landscape:
03-05-01 (White Oak River, Queen Creek, Bear Creek around Swansboro);
03-05-02 (New River and tributaries around Jacksonville);
03-05-03 (Bogue Sound and Newport River including Morehead City, Beaufort and Cape Carteret);
03-05-04 (North River, Jarrett Bay, Nelson Bay and Core Sound); and
03-05-05 (Core Sound and Cape Lookout National Seashore).

Per the *2014 Tar-Pamlico River Basinwide Water Quality Management Plan* portions of two subbasins lie within the Onslow Bight;
03020104 (Pamlico River, includes areas near Goose Creek Game Land) and,
03020105 (Pamlico Sound, includes areas along Core Sound).

Water quality problems within these subbasins are varied. For example, the 2009 Neuse River Basinwide Water Quality Management Plan notes that non-point source run-off from a variety of land use practices is a primary source of water quality impacts. In the Masonboro, Topsail Sound and ICWW subbasin of the Cape Fear River, many of the tidal creeks such as Turkey Creek, Kings Creek, and Old Mill Creek along with Topsail Sound and the ICWW are designated as "Impaired for shellfish harvesting" primarily due to stormwater run-off. Indeed, the Old Stump Sound CFA was created to highlight this area and to encourage actions to improve water quality and shellfish habitat. In Subbasin 03-06-22 of the Cape Fear that includes a portion of the Northeast Cape Fear and tributaries in Duplin County, there is a high number of concentrated animal feeding operations (449 registered swine operations alone) with associated agricultural run-off. And in Subbasin 03-06-23 of the Cape Fear that includes a portion of the Northeast Cape Fear and tributaries in Pender County, there is increasing residential development along with associated stormwater run-off from the Wilmington/Hampstead areas. The updated 2021 White Oak River Water Resources Plan reports "development, road building, wetland ditching and draining and de-snagging have the potential to cause degradation of aquatic habitats and water quality in the White Oak River." The Plan further cites stormwater run-off, wastewater treatment plant discharges, marinas, golf courses, and animals as potential pollution sources in the subbasins along Bogue Sound. Suggested water quality issues in the Tar-Pamlico Basin are stormwater and agricultural run-off, septic tank leaks, and even small localized animal problems (e.g., horse barn near one creek up near Cedar Island).

Overall, population growth in coastal areas of North Carolina continues to increase with concurrent increases in residential and commercial development, impervious surfaces and stormwater run-off contributing to water quality problems. According to the 2011 Amendment to the N.C. Coastal Habitat Management Plan, land use along coastal North Carolina has shifted from agricultural uses in the 1980s to urban and rural development particularly among the 20 coastal counties. Indeed, the N.C. Office of State Budget and Management reported an overall 9.98% population increase from 2010 to 2019 in the 20 coastal counties. It is estimated that between 2019 and 2039, the populations of many coastal counties will increase by more than 16-30 percent. The 2011 Amendment to the N.C. Coastal Habitat Management Plan states, "the most pressing threat to water quality in Region 2 appears to be non-point source pollution from "Inner Banks" development and agricultural drainage." In addition, with increased development comes an increasing demand for shoreline stabilization.

Many of the partners are engaged in actions to improve/enhance water quality. For example, NCCLT, TNC, DU, NCWRC, and TCF have conserved land with miles of forested riparian buffers and/or acres of wetlands and floodplain forests that filter pollutants and store floodwaters. NCCF has done extensive wetlands restoration work, plugging ditches and planting trees, at its 6,000-acre North River Preserve in Carteret County. NCCF is planning a similar wetlands restoration project on land along the Newport River in Carteret County. These wetland restoration projects will not only enhance local water quality but will also improve shellfish and fisheries habitats. Indeed, the Newport River, and Stump Sound in Onslow County, have been identified in NCCF's *Oyster Restoration and Protection Plan for North Carolina: A Blueprint for Action 2021-2025* as two of the state's most important and endangered shellfish growing

waters. The 2021 Oyster Plan identifies strategies for protecting, restoring, harvesting and educating about oysters in coastal North Carolina (https://www.nccoast.org/wp-content/uploads/2021/08/Oyster-Blueprint-2021-2025-FINAL-web.pdf). N.C. Division of Environmental Quality's 2016 Coastal Habitat Protection Plan (CHPP) and 2021 Amendment focuses on the long-term enhancement of coastal fisheries through habitat protection and enhancement efforts and identifies Strategic Habitat Areas along the coast. Strategic habitat Areas are "specific locations of individual fish habitats or systems of fish habitats that have been identified to provide exceptional habitat functions or that are particularly at risk due to imminent threats, vulnerability or rarity." (See https://deq.nc.gov/about/divisions/marine-fisheries/habitat-information/coastal-habitat-protection-plan,).

NCCF has also taken a lead role in assisting local governments, schools, and others with low-impact development (LID) techniques to protect and restore coastal water quality by minimizing and/or preventing polluting stormwater run-off. LID techniques include installing rain gardens, cisterns and rain barrels along with using ecoroofs and porous pavement. For more on LID strategies, see https://www.nccoast.org/protect-the-coast/restore/low-impact-development/. These actions should continue and be expanded if possible, as funding allows.

Action Items: (1) Coordinate with RiverKeepers at Sound Rivers (Tar-Pamlico and Neuse River), Coastal Carolina River Watch (White Oak and New Rivers) and Cape Fear River Watch (Cape Fear River) to identify land conservation and other water quality improvement projects that best protect and enhance local water quality along their respective river reaches within the Onslow Bight. (2) Collaborate among partners to identify, conserve and/or restore large wetland habitats especially in areas that help meet the goals of the above-mentioned basinwide plans, CHPP, or 2021 Oyster Plan. (3) Work with NCWRC fisheries biologists to create a map of priority fisheries habitats within the Onslow Bight (e.g., fish nursery habitat, shad/herring runs). (4) Identify properties with degraded wetlands or with stream channels blocked by artificial structures (e.g. poorly designed culverts) where landowners may consider programs that would fund restoration.

Control Poaching of Rare Species: State law N.C.G.S. §14-129.3 elevated Venus fly trap poaching from a misdemeanor to felony status and went into effect Dec. 1, 2014. If convicted, poachers face up to 29 months in prison and fines. Each plant taken is considered an individual offense. Previously, as a misdemeanor, the maximum fine was $50. Thus, collecting Venus fly traps from public lands is a Class H felony; stealing a plant from someone else's property without written permission, is also a felony. This legislation has certainly helped deter fly trap poaching.

As far as herpetofauna, there have been efforts to collaborate between state and federal agencies to control collecting of snakes, turtles, etc. For example, NCWRC enforcement officers coordinate with USFS to share information, and potentially issue citations, regarding poaching on the Croatan National Forest (Jeff Hall, NCWRC, pers. comm. Nov. 2022). Cross-agency collaboration like this should continue as resources allow. Non-governmental conservation land managers, e.g., NCCLT, TNC, DU, NCCF, generally have their preserves posted and/or gated (and sometimes with security cameras), but should be vigilant regarding potential poaching.

Develop Climate Resiliency Strategies: General scientific consensus indicates that human activities, primarily the human burning of fossil fuels, have warmed Earth's surface and its ocean basins, which continue to impact Earth's climate. The National Aeronautics and Space Administration's Global Climate Change program has collected statements from numerous organizations and agencies as well as multiple peer-reviewed studies published in scientific journals from research groups across the world that show that climate-warming trends over the past century are extremely likely due to human activities (see https://climate.nasa.gov/scientific-consensus.). A few of these statements are shared below.

- The Intergovernmental Panel on Climate Change- "Since systematic scientific assessments began in the 1970s, the influence of human activity on the warming of the climate system has evolved from theory to established fact."
- The U.S. National Academy of Sciences- "Scientists have known for some time, from multiple lines of evidence, that humans are changing Earth's climate, primarily through greenhouse gas emissions."
- U.S. Global Change Research Program- "Earth's climate is now changing faster than at any point in the history of modern civilization, primarily as a result of human activities."

The time for debate is over and there is pressing need for action. While many of the partners are already engaged in a variety of natural climate solutions, i.e., conservation, restoration, and improved land management activities that help remove and store carbon from the atmosphere), more needs to be done. The following are general strategies to contribute towards a more resilient Onslow Bight Landscape.

1. Strategically Conserve More Forest Land: It is well known that forests (and grasslands) help mitigate climate change by capturing carbon dioxide and storing carbon in forest biomass and soils. Protecting existing forest land not only conserves these "carbon sinks" but also prevents significant greenhouse gas emissions by keeping the forest land from being developed. Strategic land conservation also helps conserve plant and animal diversity and can connect landscapes giving species a better chance of weathering temperature shifts and other changes. The U.S. Fish and Wildlife Service's 2012 *National Fish, Wildlife and Plants Climate Adaptation Partnership* includes (1) conserving and connecting habitat, and (2) managing species and their habitats as two major overarching goals. Overall, partners should prioritize and protect parcels of land based on their ecological significance and their likely resiliency to climate change. TNC defines a resilient site as "an area of land where high microclimatic diversity and low levels of human modification provide species with connected, diverse climatic conditions they will need to persist and adapt to changing regional climates." TNC developed a mapping tool to assess the resilience of natural landscapes to climate change (see https://maps.tnc.org/resilientland/). This mapping tool can be used by partners to prioritize parcels for future conservation that best contribute to climate resiliency. As one example, NCCLT has incorporated TNC's resilient lands mapping tool into a prioritization strategy for the CFA's identified in this plan update (see Appendix F).

2. Collaborate, Conserve, and Restore Land that Helps Build Resilient Communities. Over the past couple decades, numerous hurricanes have ravaged communities in coastal North Carolina with major river flooding and/or storm surge including Hurricanes Dorian (2019), Florence (2018); Matthew (2016); Irene (2011) and Floyd (1999). Some inland communities in the Onslow Bight have been flooded multiple times (e.g., Trenton, Pollocksville, and Chinquapin). Communities nearest the coast have not only experienced flooding but shoreline erosion (e.g., Ocracoke Island). Unfortunately, the frequency and intensity of these storm events is anticipated to increase as the North Carolina coast is likely to face warmer and wetter conditions in the future. Many organizations and studies have noted that conserving floodplain forests and wetlands is one of the most cost-effective ways to mitigate flood impacts to communities as these forests slow and store floodwaters. Indeed, preserving wetlands and natural areas alongside rivers and streams is highlighted as a critical resilience strategy in N.C. Division of Environmental Quality's 2020 *N.C. Climate Risk Assessment and Resilience Plan*. When possible, partners should collaborate with local communities to identify, conserve, and/or restore headwater wetlands and floodplain forests to increase community resilience downstream. The Tri-County Headwaters CFA has been included as an area that may benefit from such partnerships, i.e., for the small towns of Trenton and Pollocksville in Jones County and Chinquapin in Duplin County. The construction of "living shorelines" is another approach to protect coastal areas from regular flooding and storm damage. The U.S. Department of Agriculture's Climate Hubs website (https://www.climatehubs.usda.gov/hubs/northeast/project/living-shorelines/) highlights the importance of living shorelines and notes that "By using wetland plants, natural structures, and shellfish breakwaters, wave energy is absorbed and erosion is reduced." NCCF has been a leader in developing living shorelines with partners and communities along the coast of North Carolina.

3. Manage for Healthy Forests to Maintain and Enhance Carbon Stocks: According to the U.S. Forest Service, America's forests sequester 866 million tons of carbon a year, which is roughly **16% of the US annual emissions** (depending on the year). Broad or general strategies for maintaining or enhancing carbon stocks include avoiding conversion of forests to other land uses, minimizing forest and soil disturbance, reforesting lands that have been cleared or disturbed; maintaining or restoring hydrology; eradicating invasive plant species; restoring or maintaining fire in fire-adapted ecosystems; increase structural complexity in forests by leaving dead wood; and promoting species and structural diversity to enhance carbon storage. It is important to note that forest management will need to be adaptive since climate changes (temperature increases, changes in precipitation, etc.) may affect forest's ability to store carbon over time. Todd Ontil, et al published an article, *Forest Management for Carbon Sequestration and Climate Adaptation* (Journal of Forestry, Volume 118, Issue 1, Pages 86-101) in January 2020 that includes a practitioner's guide to Forest Carbon Management along with a menu of strategies and potential actions that adapts forests to a changing climate and benefit forest carbon by reducing climate-related carbon losses, sustaining forest health, or enhancing future productivity of forest ecosystems. Another concept that has been put forth is that there are land areas with "irrecoverable carbon." Goldstein et al states that irrecoverable carbon refers to carbon that if released,

i.e., due to anthropogenic causes such as timbering or development, could not be restored by 2050, when most policymakers agree that the world must reach net-zero emissions to avoid even more serious consequences of climate change. Goldstein et al has mapped out irrecoverable carbon areas across the world. NCCLT used this data and mapped out irrecoverable carbon areas at low resolution within the Onslow Bight (Appendix F). This data suggests that there are areas particularly important to maintain existing carbon stocks (see Goldstein et al 2021 article at https://nature.com/articles/s5=41893-021-00803-6).

4. Restore Upland and Wetland Forests on Cleared and/or Hydrologically Altered Land: Partners should collaborate to conserve and/or restore large areas of cleared and/or hydrologically altered land back to upland or wetland forests whenever possible to increase carbon storage and improve wildlife habitats. Conserving and/or restoring forest lands with heavy organic soils (peat) is particularly important (save peat for peat's sake). Peatlands are formed by the accumulation of organic matter built up over many years. In the case of pocosin peatlands, it can be thousands of years. Several inches to more than 10-feet of organic matter can be built up under the correct conditions, making these lands a carbon sink for North Carolina. Under drained (or drought) conditions, the pocosins emit a significant amount of carbon as carbon dioxide, and artificial drainage converts natural peatlands from historically stored carbon to a source of carbon to the atmosphere. Wildfire has also converted peatlands from carbon sinks to carbon sources. Restoring peatlands through reintroduction of wetland hydrology (rewetting), stops the loss of carbon from these soils, and in fact, converts them from a source of carbon to a sink. In addition to the carbon benefits, replacing hydrologic conditions and restoring healthy pocosin wetlands is important for providing wildlife habitat; sequestering nitrogen, mercury and carbon; protecting estuarine water quality; lessening the frequency and severity of wildfires; and limiting flooding. The North Carolina's Natural and Work Lands Action Plan provides additional details and recommendations (See https://www.ncnhp.org/nwl/natural-and-working-lands/). It should be highlighted that TNC is currently working with a variety of partners to restore peatlands across the Southeast which is not only helping with carbon storage but also reducing the likelihood of catastrophic wildfires (and large carbon emissions) and is helping communities downstream recover more quickly from flood events (See https://www.nature.org/en-us/about-us/where-we-work/united-states/north-carolina/stories-in-north-carolina/north-carolina-peatlands/), Within the Onslow Bight Landscape, TNC is working with NCWRC to restore hydrology on over 7,000-acres of ditched peat lands at Angola Bay Game Land. Other large-scale and/or peatland restoration projects like this may follow.

5. Conserve Estuarine Marsh (Blue Carbon) as well as Marsh Migration Space: According to the 2011 *Amendment to the N.C. Coastal Habitat Protection Plan*, "coastal vegetated habitats (e.g., tidal marshes, seagrasses, mangroves) are recognized for their ability to mitigate climate change via sequestration of disproportionately large amounts of carbon in both above-and below-grown plant biomass as well as within their soils. . .ranking amount the densest carbon sinks globally, vegetated coastal habitats and their stores of carbon, dubbed "blue carbon," play a considerable role in addressing global climate change." The 2011 Amendment further notes that, "incentivizing conservation,

protection of marsh migration corridors, and increasing active wetland restoration efforts are critical to coastal wetland's continued ability to sequester greenhouse gases." Obviously protecting coastal marsh habitat within the Onslow Bight is critical not only for sequestering carbon but in continuing to enhance water quality and provide fish and shellfish breeding and nursery habitat. However, coastal marsh is obviously vulnerable to sea level rise (inundation) so it is important to not only conserve marsh but also land adjacent to the marsh as possible migration space. TNC's Terrestrial and Coastal Resilient Lands mapping tool as noted earlier provides a means to identify areas that may be suitable as marsh migration space (TNC's defines "marsh migration space" as low-lying areas that could accommodate future tidal habitats."). NOAA's Sea Level Rise Viewer Mapping Tool (https://coast.noaa.gov/slr/) not only shows what coastal lands will be affected by varying degrees of sea level rise but also highlights areas important for marsh migration. NCCLT used NOAA's Tidal Marsh Resilience Data and mapping tool to generally map out marsh resilience areas within the Onslow Bight region (Appendix F). This data indicated regions within the CFA's with the most resilient marsh areas. Additional mapping and prioritizing of marsh migration areas within the Onslow Bight should be carried out. Coastal marsh that lies adjacent to considerable development and/or hardened structures may not be able to migrate inland, and may be lost to sea level rise. These marsh areas are viewed as less resilient.

6. Share Climate Resilience Strategies and Communicate Results with General Public: Partners involved in specific climate resiliency work should share results whenever possible. This includes the identification of funding sources to support climate resiliency work. Some land trusts are involved in carbon market/offset programs as a way to raise capital to conserve more land. For example, the Land Trust Alliance, in partnership with Finite Carbon and The Climate Trust have created a carbon offset pilot program (see LTA's link to this program along with a list of tools and strategies on climate adaptation and resiliency (https://landtrustalliance.org/resources/learn/topics/climate-change/Programs/land-and-climate-program) in **Appendix G**). Open Space Institute has put together some suggestions on how to communicate with the public on climate change (https://www.openspaceinstitute.org/research/how-to-talk-about-climate-change-2018).

APPENDIX A
DEFINITIONS OF TERRESTRIAL CATEGORIES

Conservation of terrestrial, wetland and aquatic targets within the Onslow Bight landscape will require conservation-minded management on lands determined to be critical to the long-term protection of the targets. These target areas include lands currently managed by public agencies and conservation non-profits, and lands requiring acquisition from, or formal management agreements with, willing landowners. Long-term conservation will also require identifying and abating threats to the ecological functions of these lands and to implementing necessary management activities. In order to accurately describe conservation strategies, different types of land (and waters) are defined as follows:

Core Areas – contain conservation targets having biological significance; contain SNHAs and serve primary needs of the targets; land containing habitat in good natural condition or mixed with highly restorable habitat.

Managed Areas – Land under management by a single public or non-profit entity; management goals may be quite varied throughout the area and conservation may be a secondary goal or limited to certain sites within the managed area; core areas, corridors and buffers may exist within managed areas and may overlap onto land outside.

Isolated sites – Small sites not extensive in area nor clustered with other sites that contain important habitat for conservation targets. The isolated sites may not have landscape function that sites in core areas or corridors have, but are still important.

Corridors or Conservation Focus Areas – Generally large areas that have been mapped out for the purpose of defining where to focus conservation strategies; broad corridors that may contain core areas and may exist inside and out of managed areas.

Functional Corridors - Land connecting core areas that contains habitat suitable for the specified conservation targets and is managed for the same; ecologically functional such that species may move through; may require restoration. Functional corridors generally exist or should be established within the mapped broad corridor study areas.

Buffer – Land typically alongside core areas and/or managed areas that serve to protect these areas from outside threats; may contain lower quality or non-restorable habitat; land use and management within buffers intended to prevent activities that may result in management changes or restrictions on adjoining core areas and corridors, or degrade conservation targets (e.g. smoke buffers that preclude development).

Common Acronyms Used in Onslow Bight Conservation Plan Update

CFA = Conservation Focus Area
DoD = Department of Defense
DoI = Department of Interior
DU = Ducks Unlimited
ENSL = Eastern North Carolina Sentinel Landscape
EP = Encroachment Partnership
MCAS = Marine Corps Air Station
MOU = Memorandum of Understanding
NAWCA = North American Wetlands Conservation Act
NCCF = North Carolina Coastal Federation
NCCLT = North Carolina Coastal Land Trust
NCNHP = North Carolina Natural Heritage Program
NCWRC = North Carolina Wildlife Resources Commission
NFWF = National Fish and Wildlife Foundation
NGO = Non-governmental Organization
OBCF = Onslow Bight Conservation Forum
RASP = Red-cockaded Woodpecker Recovery and Sustainment Program
RCW= Red-cockaded Woodpecker
REPI = Readiness and Environmental Protection Integration
SGCN = Species of Greatest Conservation Need
TCF = The Conservation Fund
TNC = The Nature Conservancy
USDA = United States Department of Agriculture
USFWS = United States Fish and Wildlife Service

APPENDIX B
RASP AND MARKET BASED CONSERVATION FACT SHEETS AND MILITARY BUFFER MAP

Red-cockaded Woodpecker Recovery and Sustainment Program

The Red-cockaded Woodpecker (RCW) Recovery and Sustainment Program (RASP) was developed by the Marine Corps in cooperation with the U.S. Fish and Wildlife Service (FWS), and was approved in a Biological Opinion dated September 20, 2012. The primary purpose of the RASP is to allow Marine Corps Base Camp Lejeune to maintain and enhance operational and training flexibility while promoting recovery of the RCW on compatible, off-base properties.

Under the RASP, the Department of Navy (DON) funds management of designated properties by land managers, according to plans approved by MCB Camp Lejeune and the FWS. Approved habitat management includes restoration of longleaf pine, timber thinning, prescribed burning, and other forest management activities performed to restore the longleaf pine ecosystem.

Through the RASP, off-base properties with the capability to enhance RCW conservation by providing new habitat will be identified, protected by conservation easements, and managed in perpetuity, thereby enhancing the recovery of the Coastal North Carolina Primary Core RCW population. In return, these properties will be included as part of MCB Camp Lejeune's recovery landscape, and the portion of the RCW recovery goal attained onboard MCB Camp Lejeune can be reduced - opening up more on-base land for military operations and training.

The Naval Facilities Engineering Command, Mid-Atlantic (NAVFAC MIDLANT) developed and executed the official partnering agreement between the DON and the National Fish & Wildlife Foundation (NFWF) outlining the business processes of the RASP. NAVFAC also developed the conservation easement which will secure all RASP properties. NFWF solicited property owners for participation in the RASP and will manage funds provided by DON in a perpetual endowment to pay participating landowners for compliant management activities over time.

NAVFAC MIDLANT, NFWF and the NC Wildlife Resources Commission (WRC) conducted two real estate closings in 2017 executing two projects:

The first closing was executed on August 9, 2017, on the Stones Creek Game Land in Onslow County, NC. The Stones Creek Game Land is a 2,725.77-acre property in southern Onslow County owned by the WRC. DON's total financial contribution to the Stones Creek RASP project was $2,657,101. This covers easement consideration, as well as short and long-term land management activities, which will now be conducted by WRC to meet RCW recovery standards (as applicable to Federal agencies). The WRC will manage the Stones Creek Game Land with a goal of producing 12 active RCW Clusters.

The second closing was executed September 13, 2017, on the Bear Garden Tract of the Holly Shelter Game Land in Pender County. The Bear Garden Tract is a 12,268.76-acre property in eastern Pender County also owned by the WRC. DON's total financial contribution to the Bear Garden RASP project was $16,984,153. This covers easement consideration, as well as short and long-term land management activities, which will now be conducted by WRC to meet RCW recovery standards (as applicable to Federal agencies). The WRC will manage the Bear Garden tract with a goal of producing 48 active RCW Clusters.

Following the real estate closings, NFWF serves as the Endowment Manager and Program Administrator for the RASP. NFWF will invest DON funds to perpetuate an endowment, which

they will use to make annual payments to WRC for their land management in accordance with RCW recovery goals published by the FWS. NFWF will also enforce land management agreements and ensure WRC complies with the approved land management plans for each property. NFWF will inspect the properties annually and provide reports to NAVFAC MIDLANT, as required by the RASP partnering agreement.

The WRC is the Land Manager. They will perform all short and long-term forest/land management activities on the Stones Creek and Bear Garden properties, in accordance with the terms and conditions of the land management agreements, in perpetuity. They will allow annual inspection of the properties and provide annual reports to NFWF. The first year (2018) of management activities on both tracts has been initiated by the WRC.

As of 2018, there are no known active RCW clusters on these two properties, and RCWs will not be captured on MCB Camp Lejeune and relocated there. Current habitat conditions on these two properties do not support RCW. However, the RASP will implement intensive forest restoration and management to provide habitat that will attract the birds from nearby sites on MCB Camp Lejeune and Holly Shelter Game Lands. The RCW will then establish new populations on Stones Creek and Bear Garden and grow as habitat conditions allow.

The 60 potential clusters to be "grown" on Stones Creek and Bear Garden will be included in the overall landscape referenced during future consultations with the FWS as projects potentially impacting the RCW are discussed. Expanding the qualifying RCW habitat beyond installation borders will greatly reduce the likelihood of an on-base construction project resulting in a jeopardy Biological Opinion from FWS, which is generally considered a show stopper.

Increasing RCW habitat beyond installation boundaries via the RCW RASP does not authorize a "take" (impacting active clusters) of RCW onboard MCB Camp Lejeune. Any future project that may result in loss of RCW clusters or other "take," as defined in the Endangered Species Act, will be the subject of a separate consultation. In addition, the RASP does not authorize reduction in management effort on remaining RCW habitat. MCB Camp Lejeune will continue to manage all remaining suitable, or potentially suitable, habitat for RCW.

In summary, the RASP has the following benefits to the Marine Corps training mission and RCW conservation:

- RASP makes more land on base available for training projects that may impact RCW.
- It allows for a portion of MCB Camp Lejeune's RCW recovery goal to be attributed to off-base properties.
- It ensures flexibility and capacity for future Marine Corps range development.
- It reduces the likelihood that a future construction project at MCB Camp Lejeune will jeopardize RCW recovery
- It will strengthen and stabilize RCW Coastal North Carolina Primary Core population by:
    - creating corridors between subpopulations,
    - expanding the geographic area managed for RCW, and
    - bolstering vulnerable populations.

Market-Based Conservation (MBC) Pilot Program Description

Using authority of 10 USC 2684a, the MBC Encroachment Protection Agreement (i.e. "the Agreement) was the Naval Facilities Engineering Command Mid-Atlantic's (NAVFAC MIDLANT) contract to "partner" with the NC Foundation for Soil & Water Conservation (i.e. "the Foundation") and execute a pilot program for the US Marine Corps from 2012 to 2015. The Marine Corps Installations Command (MCICOM) decided in March of 2014 to discontinue solicitations for participation in the program but asked NAVFAC MIDLANT to execute 17 landowner contracts which were pending at that time. NAVFAC MIDLANT executed those 17 landowner contracts in 2015.

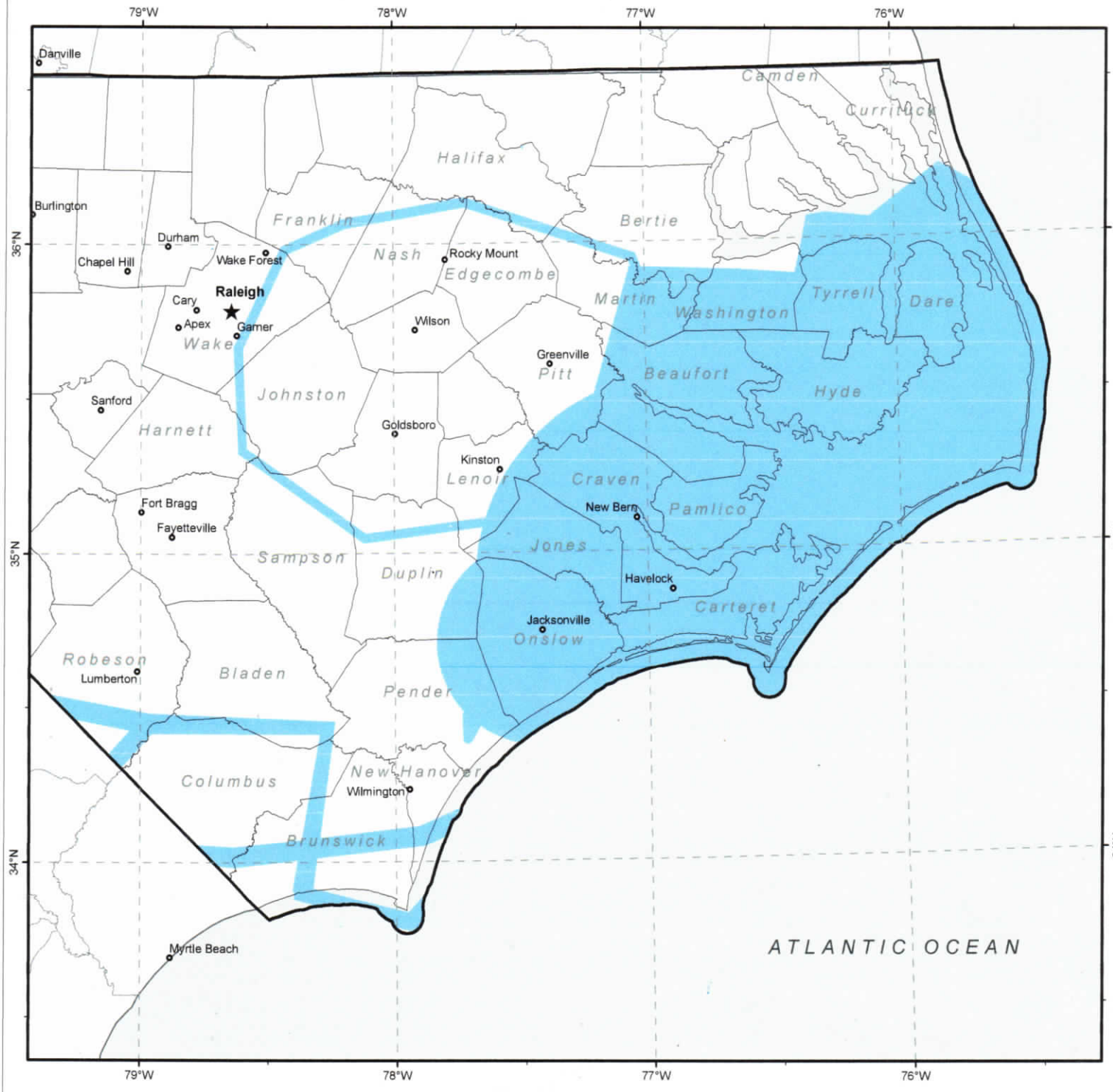
The program was established as follows – The Foundation established partnerships with the local Soil & Water Conservation Districts of 18 NC counties lying under a 2-mile wide military training route (MTR) used by USMC aircraft. Each county District then held "outreach workshops" with private landowners to solicit bids for their participation in the MBC pilot. Bids represented what landowners wished to be paid in exchange for signing a Landowner Contract with the Foundation, which required landowners to record deed restrictions in the county Register of Deeds office. The bid process was considered a "reverse auction," because lower bids were more attractive to the Government than higher bids. To be eligible for a contract, landowners also had to provide copies of approved Land Management Plans and proof of enrollment in county Present Use Value (PUV) tax deferment programs, which lower taxes on properties with active/enrolled agricultural and forestry programs. The goal of the MBC pilot was to measure the effectiveness of "market-based" incentives to prevent private landowners from converting their agricultural properties to other uses which might conflict with military overflight.

The Marine Corps funded the 10, 20 and 30-year Landowner Contracts using Readiness & Environmental Protection Integration (REPI) funds from the Office of the Secretary of Defense (OSD). NAVFAC is not a direct party to the Landowner Contracts nor the Declaration of Restrictions. However, NAVFAC is a third-party beneficiary on the Landowner Contracts and can take action in the event the Foundation dissolves or fails to enforce the contracts. NAVFAC reviewed all of the real estate due diligence deliverables procured by the Foundation (appraisal, title opinions, mapping) to ensure compliance with 10 USC 2684a, US Department of Justice title standards, etc. and provided funding to the Foundation, which the Foundation invested and actively manages in order to make annual payments to the landowners for compliant program participation and land use over the life of each contract. NAVFAC made a one-time, lump-sum payment to the Foundation for all required contract funding, and the Foundation invested these funds in accordance with requirements of 10 USC 2684a.

Assistant Secretary of the Navy (ASN) and NAVFAC attorneys opined that the only authority available to execute this program in 2012 was 10 USC 2684a, and the Real Estate Product Line of NAVFAC MIDLANT received the tasking. NAVFAC MIDLANT Real Estate drafted the MBC Agreement, which it executed in September 2012. The Agreement obligated $2M for the pilot. The Principle Deputy Assistant Secretary of the Navy for Energy, Installations and Environment {PDASN(EI&E)} approved the MBC Agreement.

MCICOM ended program solicitation in 2014, providing no funding beyond the original $2M. MCICOM considered the pilot inefficient, due mainly to complex real estate due diligence triggered by the use of 10 USC 2684a and the fact that there was very little development threat to these rural, agricultural properties. Of 36 applications (bids) submitted to NAVFAC, 17 actually met program requirements and survived solicitation, appraisal, title and inspection scrutiny. NAVFAC and the Foundation executed these 17 contracts, and the Foundation reports to NAVFAC semi-annually on the status of invested funds.

EPA Map



ME EDITION **0002**, SERIES **0009**, SHEET **0012**
CENTRAL AND EASTERN NORTH CAROLINA

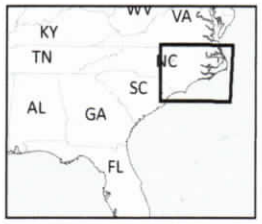
- ★ Capital
- ○ City
- USMC Mission Footprint
- State Boundary
- County Boundary

N

SCALE 1:2,000,000

0 10 20 Kilometers

0 10 20 Miles



SPHEROID . . . . . GEODETIC REFERENCE SYSTEM 1980
PROJECTION . . . . . UNIVERSAL TRANSVERSE MERCATOR
HORIZONTAL DATUM . . . . . NORTH AMERICAN DATUM 1983
GRATICULE . . . . . ONE DEGREE LATITUDE-LONGITUDE TICS

This MCIEAST-CAMLEJ map was produced by the
Regional Geospatial Information & Services Division, G-F
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Publication Date: 07 February 2019

Map generated using the Geographic Information System
Managed by the Installation Geospatial Information & Services Office
Regional Geospatial Information & Services Division, G-F,
Marine Corps Installations East – Marine Corps Base Camp Lejeune

FOR REFERENCE ONLY

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APPENDIX C
PRIMARY CONSERVATION TARGETS IN THE ONSLOW BIGHT
Provided by N.C. Natural Heritage Program

Table 1: Onslow Bight Primary Natural Community Targets.

Natural Community	com group	G rank	Endemism
Calcareous Coastal Fringe Forest (Northern Subtype)	C	G1	N
Interdune Pond	B	G1	
Maritime Shrub Swamp (Dogwood Subtype)	B	G1	N
Natural Lake Shoreline (Sweetgum Subtype)	L	G1	N
Natural Lake Shoreline Marsh (Typic Subtype)	L	G1	
Pocosin Opening (Pitcher Plant Subtype)	P	G1	
Sandy Pine Savanna (Rush Featherling Subtype)	P	G1	N
Tidal Red Cedar Forest	E	G1	E
Very Wet Loamy Pine Savanna	P	G1	N
Wet Loamy Pine Savanna	P	G1	N
Wet Marl Forest	N	G1	E
Coastal Plain Marl Outcrop (Bluff Subtype)	O	G1?	N
Pocosin Opening (Sedge-Fern Subtype)	P	G1G2	
Tidal Freshwater Marsh (Narrowleaf Pondlily Subtype)	E	G1G2	N
Tidal Swamp (Mixed Subtype)	E	G1G2	E
Wet Pine Flatwoods (Depression Subtype)	P	G1G2Q	
Coastal Fringe Evergreen Forest (Typic Subtype)	C	G2	N
Estuarine Beach Forest	E	G2	
Interdune Marsh	B	G2	
Maritime Evergreen Forest (Mid Atlantic Subtype)	B	G2	
Maritime Swamp Forest (Typic Subtype)	B	G2	
Maritime Wet Grassland (Southern Hairgrass Subtype)	B	G2	
Nonriverine Wet Hardwood Forest (Oak Flat Subtype)	N	G2	
Northern Wet Pine Savanna	P	G2	
Peatland Atlantic White Cedar Forest	P	G2	
Pine/Scrub Oak Sandhill (Coastal Fringe Subtype)	P	G2	
Sand Barren (Coastal Fringe Subtype)	P	G2	

Natural Community	com group	G rank	Endemism
Small Depression Drawdown Meadow (Boggy Pool Subtype)	D	G2	
Wet Pine Flatwoods (Sand Myrtle Subtype)	P	G2	
Coastal Fringe Shell Woodland	C	G2?	E
Coastal Plain Cliff		G2?	
Nonriverine Swamp Forest (Sweetgum Subtype)	N	G2?	
Small Depression Drawdown Meadow (Typic Subtype)	D	G2?	
Tidal Freshwater Marsh (Mixed Freshwater Subtype)	E	G2?	
Vernal Pool (Typic Subtype)	D	G2?	
Xeric Sandhill Scrub (Coastal Fringe Subtype)	C	G2?	
Cypress Savanna (Typic Subtype)	D	G2G3	
Low Pocosin (Titi Subtype)	P	G2G3	
Maritime Dry Grassland (Typic Subtype)	B	G2G3	
Mesic Pine Savanna (Coastal Plain Subtype)	P	G2G3	
Nonriverine Swamp Forest (Cypress-Gum Subtype)	N	G2G3	
Nonriverine Wet Hardwood Forest (Oak-Gum Slough Subtype)	N	G2G3	
Small Depression Pocosin (Typic Subtype)	D	G2G3	
Tidal Freshwater Marsh (Threesquare Subtype)	E	G2G3	
Dune Grass (Bluestem Subtype)	B	G3	N
Dune Grass (Southern Subtype)	B	G3	
Estuarine Fringe Loblolly Pine Forest (Loblolly Pine Subtype)	E	G3	
High Pocosin (Evergreen Subtype)	P	G3	
Maritime Shrub (Stunted Tree Subtype)	B	G3	
Natural Lake Shoreline Swamp (Cypress Subtype)	L	G3	
Pond Pine Woodland (Typic Subtype)	P	G3	
Sand Flat	E	G3	
Upper Beach (Southern Subtype)	B	G3	
Wet Pine Flatwoods (Typic Subtype)	P	G3	
Wet Sandy Pine Savanna (Typic Subtype)	P	G3	
Marsh Hammock	E	G3?	
Pine/Scrub Oak Sandhill (Mixed Oak Subtype)	P	G3?	

Natural Community	com group	G rank	Endemism
Sandhill Seep (Wet Subtype)	P	G3?	
Small Depression Pond (Open Lily Pond Subtype)	D	G3?	
Small Depression Pond (Typic Marsh Subtype)	D	G3?	
Bay Forest	P	G3G4	
Brackish Marsh (Smooth Cordgrass Subtype)	E	G3G4	
Basic Mesic Forest (Coastal Plain Subtype)	M	G4	

Key

com group: community group
B = Barrier island communities
C = Coastal fringe forests
D = Small depression wetlands
E = Estuarine communities
L = Natural lakes and shorelines
M = Mesic and dry hardwood forests
N = Non-riverine Wet Hardwood and Swamp Forests
O = Coastal Plain marl outcrops
P = Longleaf pine and pocosin ecosystem

G rank: Global rarity rank assigned by NatureServe. G1 is rarest, typically with 5 or fewer global occurrences. Community varieties are assigned a "T" rank. A question mark following the G or T rank indicates rank uncertainty. In this table, a T rank is treated as if it were a G rank (e.g., G5T3 = G3).

Endemism: native and restricted to a particular region
E = Endemic to Onslow Bight
N = Near-endemic to Onslow Bight (>than 50% of known occurrences)

Table 2: Onslow Bight Primary Plant Targets.

Scientific Name	Common Name	com group	G rank	Endemism
Carex lutea	Golden sedge	P	G1	N
Coreopsis aristulata	Short-awned Coreopsis	P	G1	E
Dichanthelium hirstii	Hirst's panicgrass	D	G1	N
Isoetes microvela	Thin-wall quillwort	F	G1	
Mononeuria paludicola	Godfrey's Sandwort	O	G1	
Solidago villosicarpa	Hairy seed or coastal goldenrod	C	G1	E
Thalictrum cooleyi	Cooley's meadow-rue	P	G1	N
Allium sp. 1	Savanna onion	P	G1G2	N
Aristida simpliciflora	Southern threeawn	P	G1G3	
Aeschynomene virginica	Virginia jointvetch	E	G2	
Amaranthus pumilus	Seabeach amaranth	B	G2	
Asplenium heteroresiliens	Marl spleenwort; Carolina spleenwort	O	G2	
Eupatorium paludicola	Bay Boneset	D	G2	
Hypericum sp. 2	A St. John's-wort	P	G2	
Packera crawfordii	Crawford's ragwort	P	G2	
Trichostema nesophilum	Dune bluecurls	B	G2	
Calopogon multiflorus	Many-flowered grass-pink	P	G2G3	
Dichanthelium caerulescens	Cypress witchgrass	B,P	G2G3	
Lobelia boykinii	Boykin's lobelia	D	G2G3	
Microlejeunea epiphylla (A liverwort)	A Liverwort	B	G2G3	
Oenothera riparia	Riverbank Evening-primrose	F	G2G3	
Rhynchospora pleiantha	Coastal beaksedge	D	G2G3	
Scleria bellii	Smooth-seeded Hairy Nutrush	P	G2G3	N
Carex calcifugens	Calcium-fleeing Sedge	B	G3	
Chasmanthium nitidum	Shiny woodoats	F	G3	
Cirsium lecontei	LeConte's thistle	P	G3	
Dichanthelium neuranthum	Nerved witchgrass	B	G3	
Dionaea muscipula	Venus fly trap	P	G3	N?
Lindera melissifolia	Pondberry	D	G3	
Litsea aestivalis	Pondspice	D	G3	
Ludwigia lanceolata	Lance-leaf primrose-willow	B,D	G3	
Lysimachia asperulifolia	Rough-leaved loosestrife	P	G3	N?
Muhlenbergia torreyana	New Jersey muhly	P	G3	
Myriophyllum laxum	Loose watermilfoil	D	G3	
Parnassia caroliniana	Carolina grass-of-parnassus	P	G3	

Plantago sparsiflora	Pineland plantain	P	G3	
Polygala hookeri	Hooker's milkwort	P	G3	
Polygonum glaucum	Seaside or seabeach knotweed	B	G3	
Rhexia aristosa	Awned meadow-beauty	D	G3	
Rhynchospora galeana	Short-bristled beaksedge	P	G3	
Rhynchospora macra	Southern white beaksedge	P	G3	
Rhynchospora thornei	Thorne's beaksedge	P	G3	
Solidago verna	Spring-flowering goldenrod	P	G3	N
Spiranthes longilabris	Giant spiral ladies'-tresses	P	G3	
Tridens chapmanii	Chapman's triden	M	G3	
Cardamine longii	Long's bittercress	F	G3?	
Sagittaria chapmanii	Chapman's arrowhead	D	G3?	
Carex godfreyi	Godfrey's sedge	F	G3G4	
Carex verrucosa	Warty sedge	D	G3G4	
Lejeunea bermudiana (a liverwort)	A liverwort	F,N	G3G4	
Peltandra sagittifolia	White arrow arum	P,F	G3G4	
Platanthera integra	Yellow-fringeless orchid	P	G3G4	
Rhynchospora decurrens	Swamp forest beaksedge	F,P	G3G4	
Sagittaria weatherbiana	Grassleaf arrowhead	F	G3G4	
Schoenoplectus etuberculatus	Canby's bulrush	D,F	G3G4	
Solidago leavenworthii	Leavenworth's goldenrod	P	G3G4	
Thalictrum macrostylum	Piedmont meadow-rue	E,N,P	G3G4	
Xyris stricta	Pineland yellow-eyed grass	D	G3G4	
Agalinis virgata	Beach false foxglove	P	G3G4Q	
Coreopsis palustris	Beadle's Coreopsis	F	G3G4Q	
Spiranthes eatonii	Eaton's Ladies'-tresses	P	G3Q	
Amorpha georgiana	Georgia Indigo-bush	P	G3T2	
Trillium pusillum var. pusillum	Dwarf or least trillium	F,N,P	G4T3	
Dichanthelium cryptanthum	Hidden-flowered Witchgrass	P,F	GUQ	

com group: community group
B = Barrier island communities
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O = Coastal Plain marl outcrops
P = Longleaf pine and pocosin ecosystem

Proposed priority by G rank and endemism (a T rank is treated as if it were a G rank; e.g., G5T3 = G3)
G1/T1 endemic/near-endemic; other G1/T1s; G1G2/T1T2 endemic/near-endemic; other G1G2/T1T2s; G2/T2 endemic/near-endemic; other G2/T2s; G2G3/T2T3; G3/T3s; G3G4/T3T4; G3G5/T3T5

G rank: Global rarity rank assigned by NatureServe. G1 is rarest, typically with 5 or fewer global occurrences. Plant varieties are assigned a "T" rank. A plant or animal may have a G4 rank range-wide (e.g., *Trillium pusillum*), but a variety can be much less common, with a T rank of 3 (e.g., *Trillium pusillum var. pusillum*). A question mark following the G or T rank indicates global abundance uncertainty. A "Q" following the rank indicates uncertainty relative to the taxonomic rank of the element (e.g., whether it should be a species, variety, hybrid, synonym, etc.). In this table, a T rank is treated as if it were a G rank (e.g., G5T3 = G3). Species and their varieties are ranked in the following order: G1/T1 endemic/near-endemic; other G1/T1;G1G2/T1T2 endemic/near-endemic; other G1G2/T1T2; G2/T2 endemic/near-endemic; other G2/T2; G2G3/T2T3; G3/T3; G3G4/T3T4; G3G5/T3T5

Endemism: native and restricted to a particular region
E = Endemic to Onslow Bight
N = Near-endemic to Onslow Bight (>than 50% of known occurrences)

Table 3: Onslow Bight Primary Animal Targets.

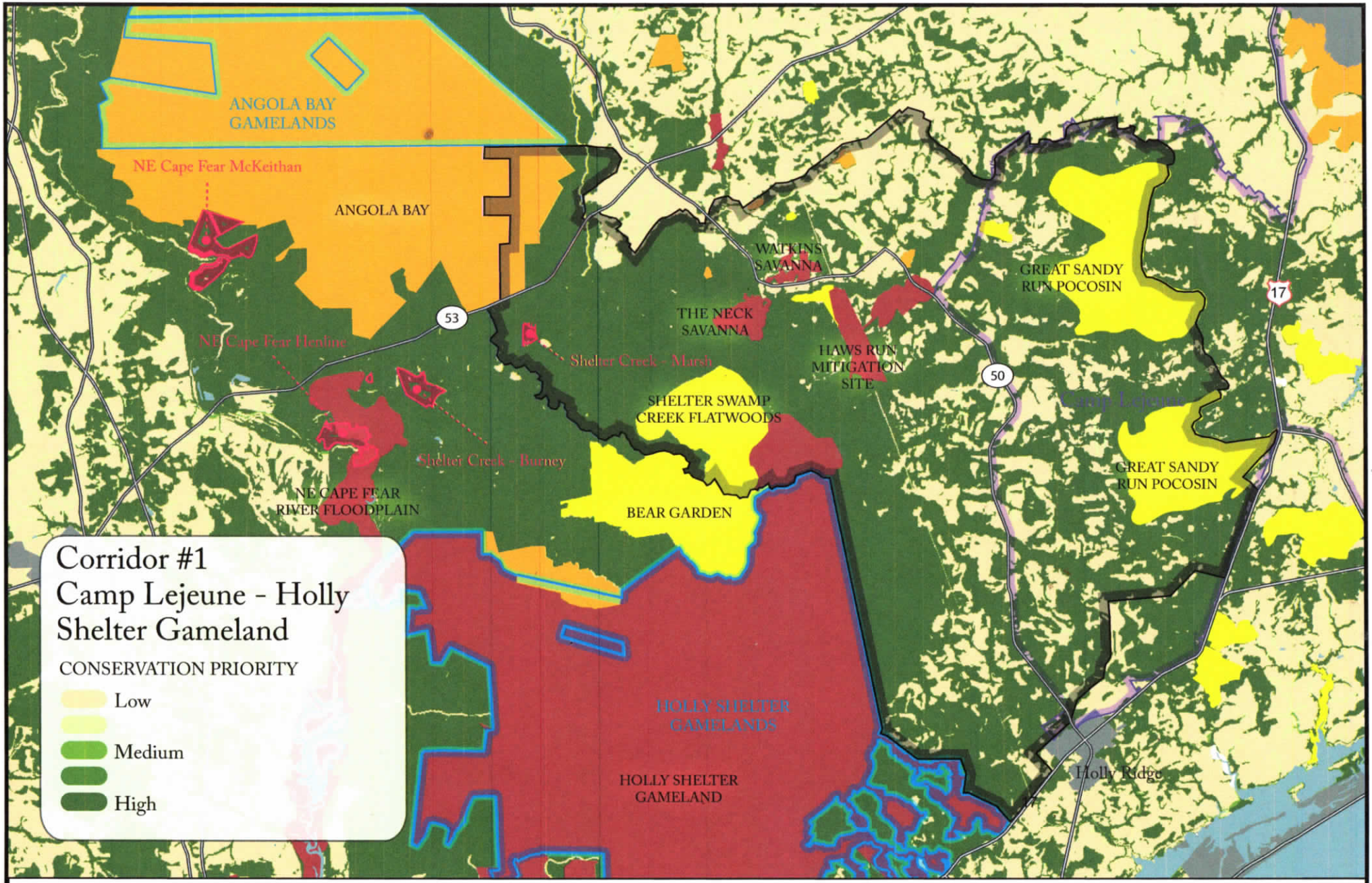
Scientific Name	Common name	Com Group	G Rank
Atrytonopsis quinteri	Crystal skipper	B	G1
Hemipachnobia subporphyrea	Venus flytrap cutworm moth	P	G1
Lepidochelys kempii	Kemp's ridley	E	G1
Chlorochroa dismalia	Dismal swamp green stink bug	N	G1G3
Gabara sp. 1	a Noctuid Moth	P	G1G3
Ammospiza caudacuta	Saltmarsh Sparrow	B,E	G2
Dermochelys coriacea	Leatherback	E	G2
Euphyes berryi	Berry's Skipper	D, F	G2
Heterodon simus	Southern hognose snake	P	G2
Necturus lewisi	Neuse River Waterdog	R	G2
Noturus furiosus	Carolina Madtom	R	G2
Callophrys irus	Frosted elfin	P	G2G3
Eotettix pusillus	Little Eastern Grasshopper	P	G2G3
Melanoplus decorus	Decorated Spur-throat Grasshopper	P	G2G3
Rana capito	Carolina gopher frog	D,P	G2G3
Spartiniphaga carterae	Carter's noctuid moth	P	G2G3
Trichechus manatus	West Indian manatee	E	G2G3
Agrotis carolina	Carolina Agrotis	P	G2G3Q
Atrytone arogos arogos	Arogos skipper	P	G2G3T1T2
Datana robusta	a Prominent Moth	P	G2G4
Nematocampa baggettaria	Baggett's Nematocampa	P,M	G2G4
Acipenser brevirostrum	Shortnose sturgeon	E	G3
Callophrys hesseli	Hessel's Hairstreak	P, D	G3
Caretta caretta	Loggerhead	B,E	G3
Charadrius melodus melodus	Piping plover	B	G3
Chelonia mydas	Green turtle	B	G3

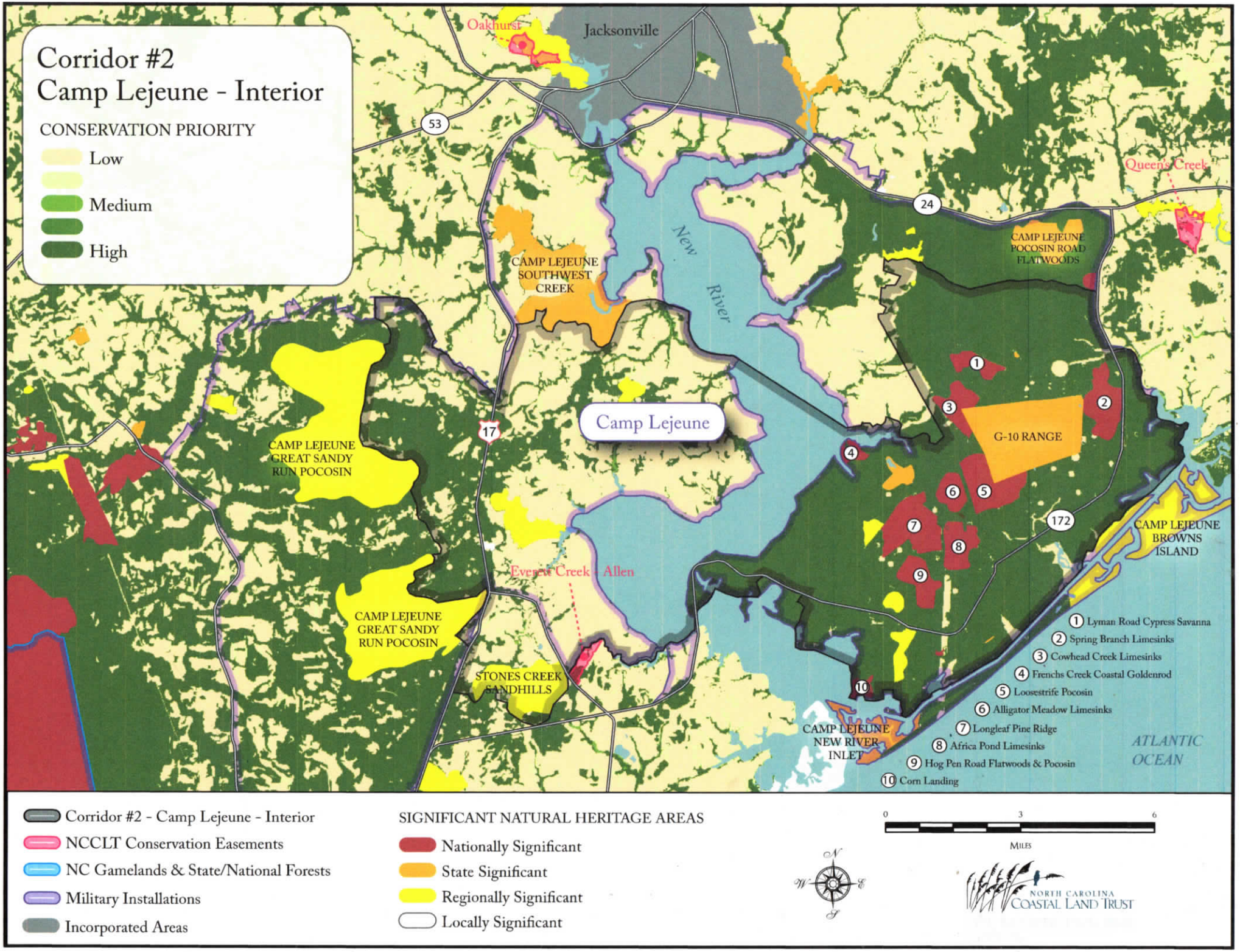
Crotalus adamanteus	Eastern diamondback rattlesnake	P	G3
Dryobates borealis	Red-cockaded woodpecker	P	G3
Notropis bifrenatus	Bridle shiner	R	G3
Ophisaurus mimicus	Mimic glass lizard	P	G3
Peucaea aestivalis	Bachman's sparrow	P	G3
Procambarus medialis	Pamlico Crayfish	P	G3
Ptichodis bistrigata	Southern Ptichodis (a moth)	P	G3
Pygarctia abdominalis	Yellow-edged Pygarctia	P	G3
Acronicta perblanda	a moth	F	G3G4
Acronicta sinescripta	A dagger moth	P	G3G4
Amblyscirtes alternata	Dusky roadside-skipper	P	G3G4
Amblyscirtes reversa	Reversed roadside-skipper	P	G3G4
Catocala myristica	Nutmeg Underwing	M	G3G4
Corynorhinus rafinesquii macrotis	Eastern Big-eared Bat	F,M	G3G4
Exyra semicrocea	a Pitcher-plant Moth	P	G3G4
Lithophane lemmeri	Lemmer's pinion (moth)	F	G3G4
Macrochilo santerivalis	An owlet moth	E	G3G4
Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon	E	G3T3
Ammodramus henslowii	Henslow's sparrow	P (early)	G4
Calephelis virginiensis	Little metalmark	P	G4
Crotalus horridus	Timber rattlesnake	P,M, N	G4
Euphyes bimacula	Two-spotted skipper	P	G4
Hyla andersonii	Pine Barrens Treefrog	P	G4
Laterallus jamaicensis	Black rail	E	G4
Mycteria americana	Wood Stork	F,D	G4
Myotis austroriparius	Southeastern myotis	F,M	G4
Papaipema appassionata	Pitcher-plant Borer Moth	P	G4
Pseudacris ornata	Ornate Chorus Frog	P, D, F	G4
Sternula antillarum	Least tern	B	G4
Calidris canutus rufa	Red Knot - rufa subspecies	B	G4T2
Malaclemys terrapin centrata	Carolina diamondback terrapin	E	G4T4
Alligator mississippiensis	American alligator	L, R	G5
Charadrius wilsonia	Wilson's plover	B	G5
Coluber flagellum flagellum	Coachwhip	P, B	G5
Haematopus palliatus	American oystercatcher	B	G5
Regina rigida	Glossy crayfish snake	L, R	G5
Setophaga virens waynei	Wayne's Black-throated Green Warbler	N	G5T1
Lampropeltis getula sticticeps	Outer Banks kingsnake	B	G5T2Q
Nerodia sipedon williamengelsi	Carolina water snake	E	G5T3
Passerina ciris	Eastern painted bunting	B, C	G5T3T4
Seminatrix pygaea paludis	Carolina Swamp Snake	L, R	G5T4
Sistrurus miliarius miliarius	Carolina Pigmy rattlesnake	P	G5T4
Neotoma floridana floridana	Eastern woodrat - coastal plain population	N,M	G5T5

Dargida aleada	An Armyworm Moth	B	GNR
Waterbird colony	Colonial waterbirds nesting site	B,E	GNR
Meropleon cinnamicolor	A borer moth	E	GU
Pyreferra ceromatica	Annointed sallow moth	P	GU

com group: community group
B = Barrier and estuarine island communities
C = Coastal fringe forests
D = Small depression wetlands
E = Estuarine/sound communities
F = Blackwater and brownwater floodplains
L = Natural lakes and shorelines
M = Mesic and dry hardwood forests
N = Non-riverine Wet Hardwood and Swamp Forests
O = Coastal Plain marl outcrops
P = Longleaf pine and pocosin ecosystem
R = Riverine

APPENDIX D
CONSERVATION CORRIDORS IDENTIFIED
PER THE 2004 ONSLOW BIGHT PLAN


ANGOLA BAY GAMELANDS
NE Cape Fear McKeithan
ANGOLA BAY
WATKINS SAVANNA
GREAT SANDY RUN POCOSIN
THE NECK SAVANNA
53
17
NE Cape Fear Henline
Shelter Creek - Marsh
HAWS RUN MITIGATION SITE
50
SHELTER SWAMP CREEK FLATWOODS
Camp Lejeune
Shelter Creek - Burney
GREAT SANDY RUN POCOSIN
NE CAPE FEAR RIVER FLOODPLAIN
BEAR GARDEN
Corridor #1
Camp Lejeune - Holly Shelter Gameland
CONSERVATION PRIORITY
Low
Medium
High
HOLLY SHELTER GAMELANDS
HOLLY SHELTER GAMELAND
Holly Ridge
Corridor #1 - Camp Lejeune - Holly Shelter Gameland
NCCLT Conservation Easements
NC Gamelands & State/National Forests
Military Installations
Incorporated Areas
SIGNIFICANT NATURAL HERITAGE AREAS
Nationally Significant
State Significant
Regionally Significant
Locally Significant
N
W
E
S
0
3
6
MILES
NORTH CAROLINA COASTAL LAND TRUST


Corridor #2
Camp Lejeune - Interior
CONSERVATION PRIORITY
Low
Medium
High
Oakhurst
Jacksonville
53
24
17
172
Queens Creek
New River
Camp Lejeune
CAMP LEJEUNE SOUTHWEST CREEK
CAMP LEJEUNE POCOSIN ROAD FLATWOODS
CAMP LEJEUNE GREAT SANDY RUN POCOSIN
G-10 RANGE
CAMP LEJEUNE BROWNS ISLAND
Everett Creek - Allen
CAMP LEJEUNE GREAT SANDY RUN POCOSIN
STONES CREEK SANDHILLS
CAMP LEJEUNE NEW RIVER INLET
ATLANTIC OCEAN
1 Lyman Road Cypress Savanna
2 Spring Branch Limesinks
3 Cowhead Creek Limesinks
4 Frenchs Creek Coastal Goldenrod
5 Loosestrife Pocosin
6 Alligator Meadow Limesinks
7 Longleaf Pine Ridge
8 Africa Pond Limesinks
9 Hog Pen Road Flatwoods & Pocosin
10 Corn Landing
Corridor #2 - Camp Lejeune - Interior
NCCLT Conservation Easements
NC Gamelands & State/National Forests
Military Installations
Incorporated Areas
SIGNIFICANT NATURAL HERITAGE AREAS
Nationally Significant
State Significant
Regionally Significant
Locally Significant
0
3
6
MILES
N
W
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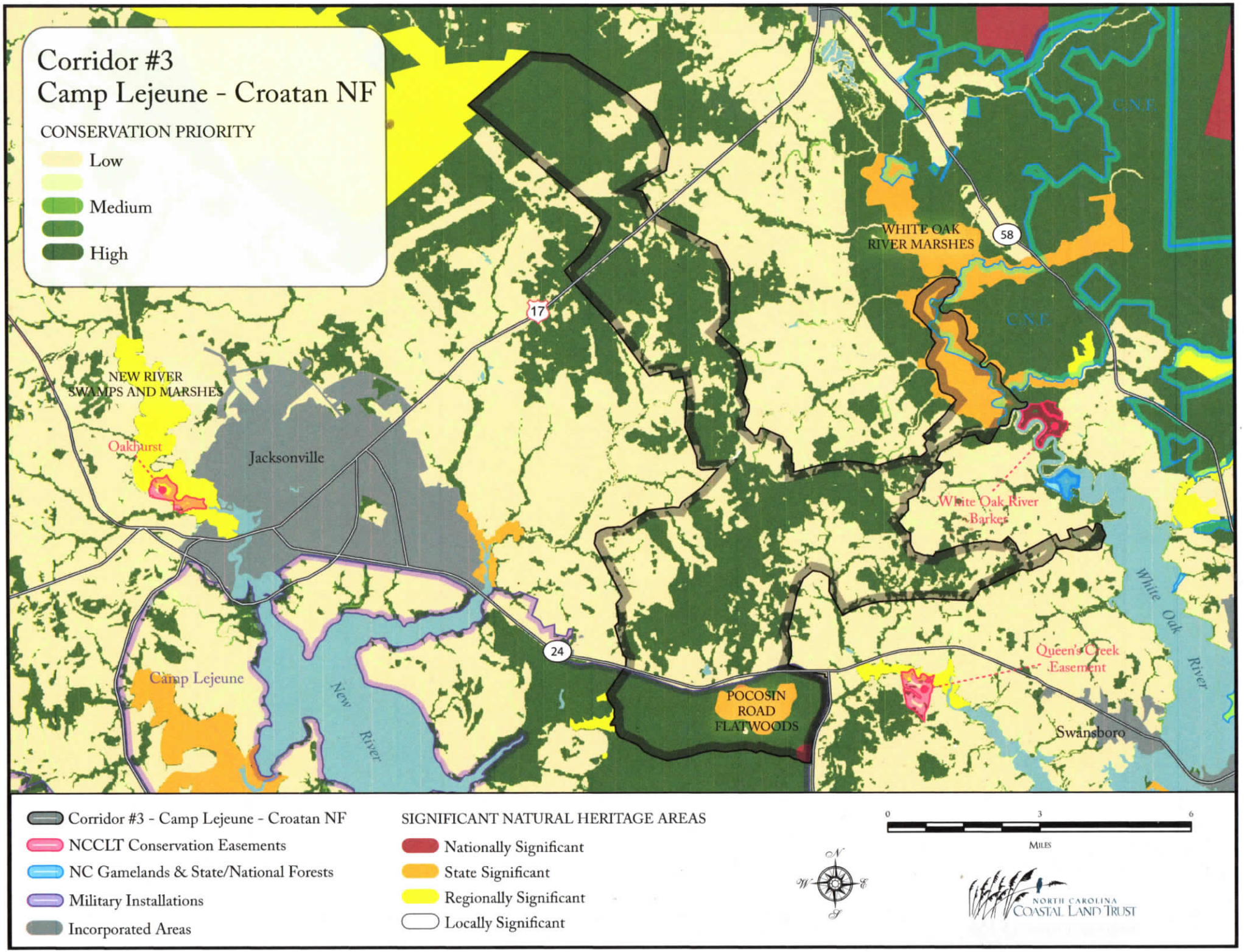
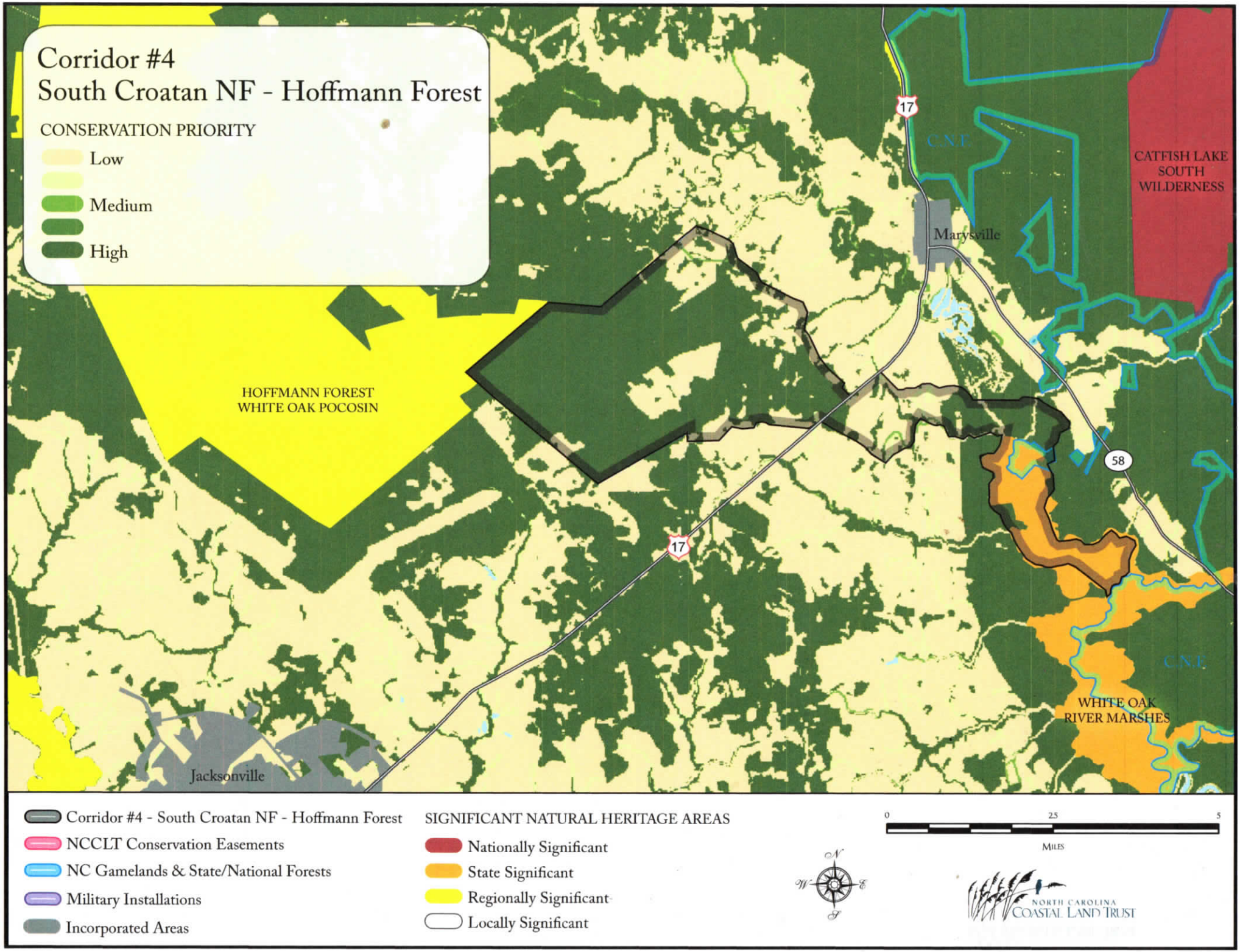
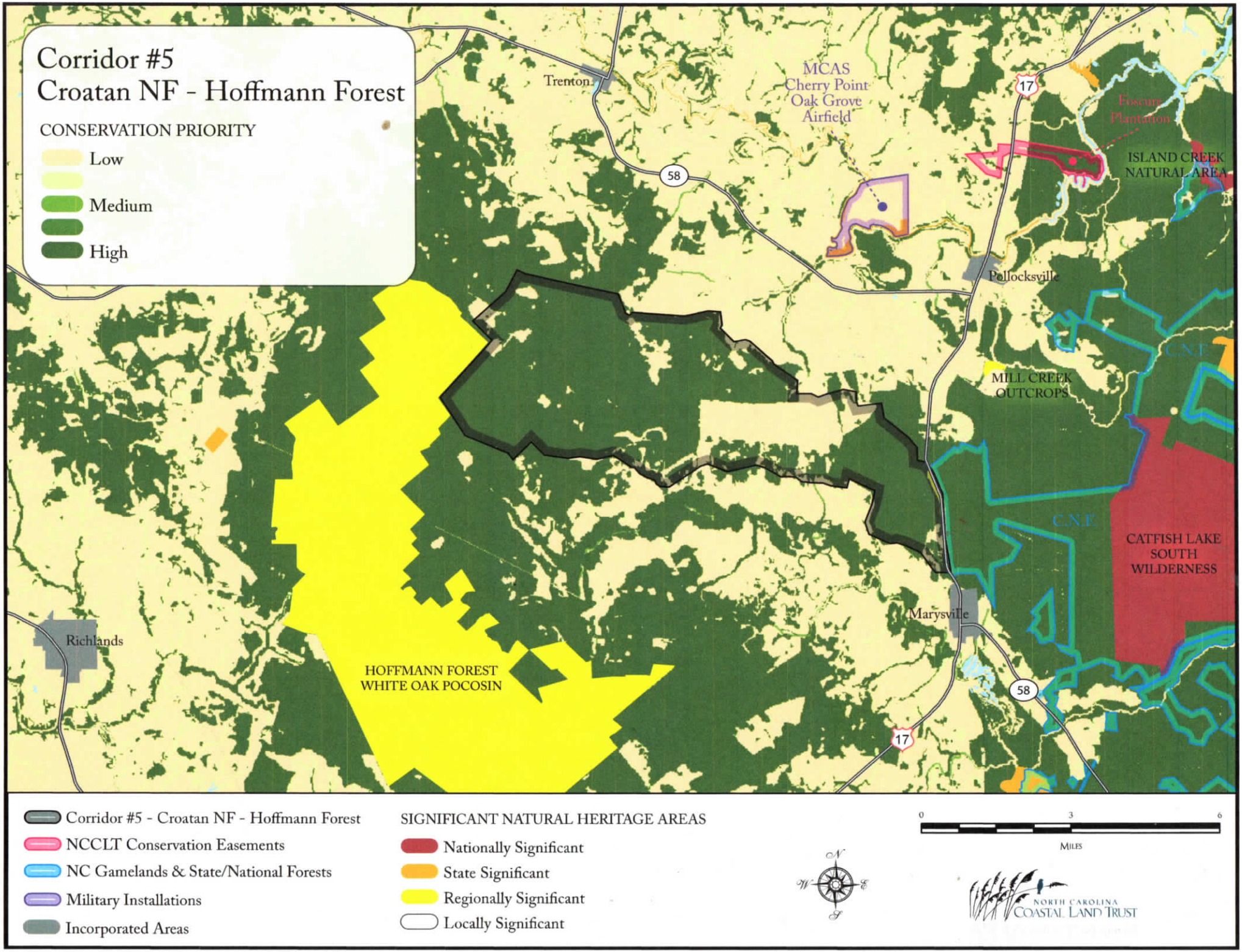
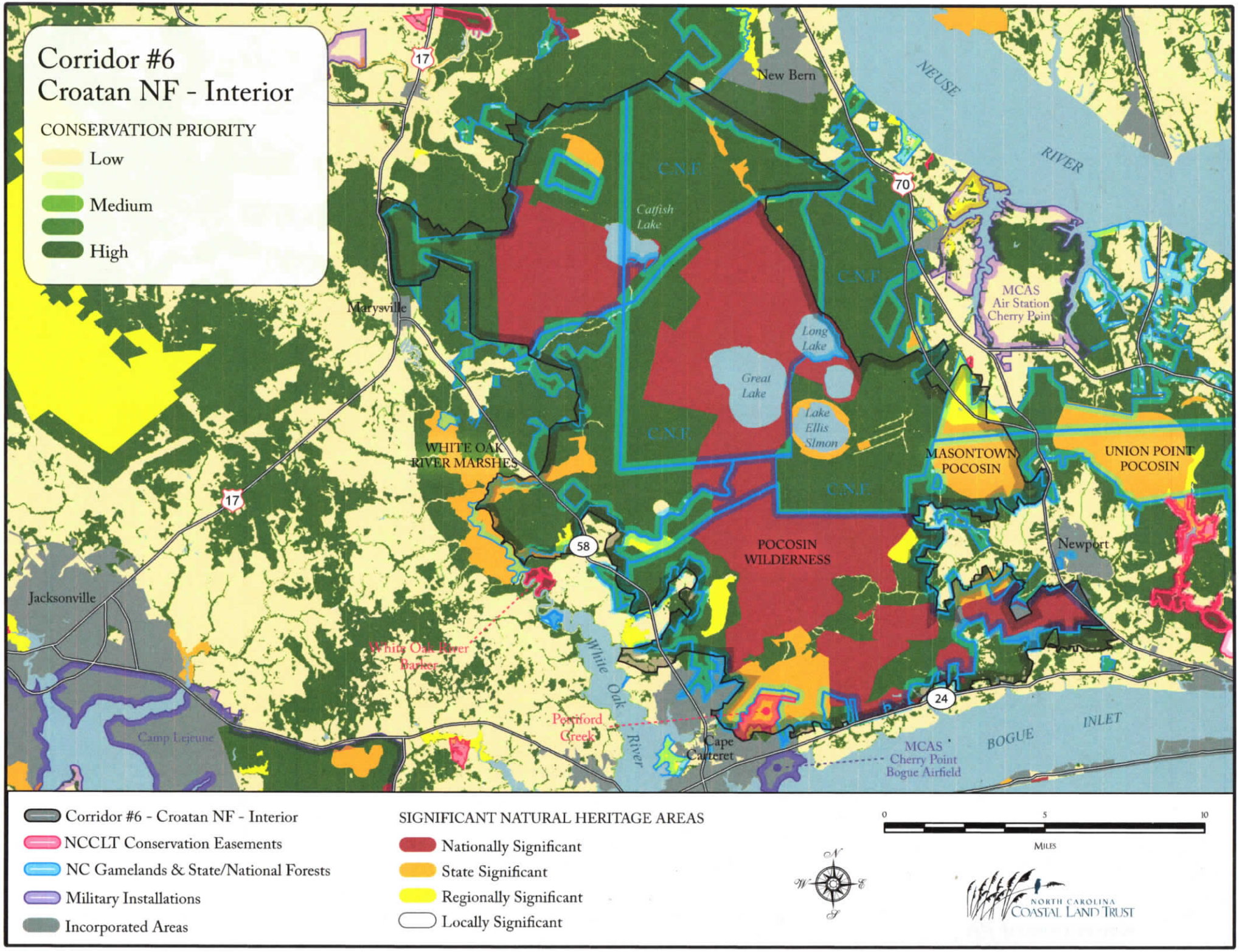
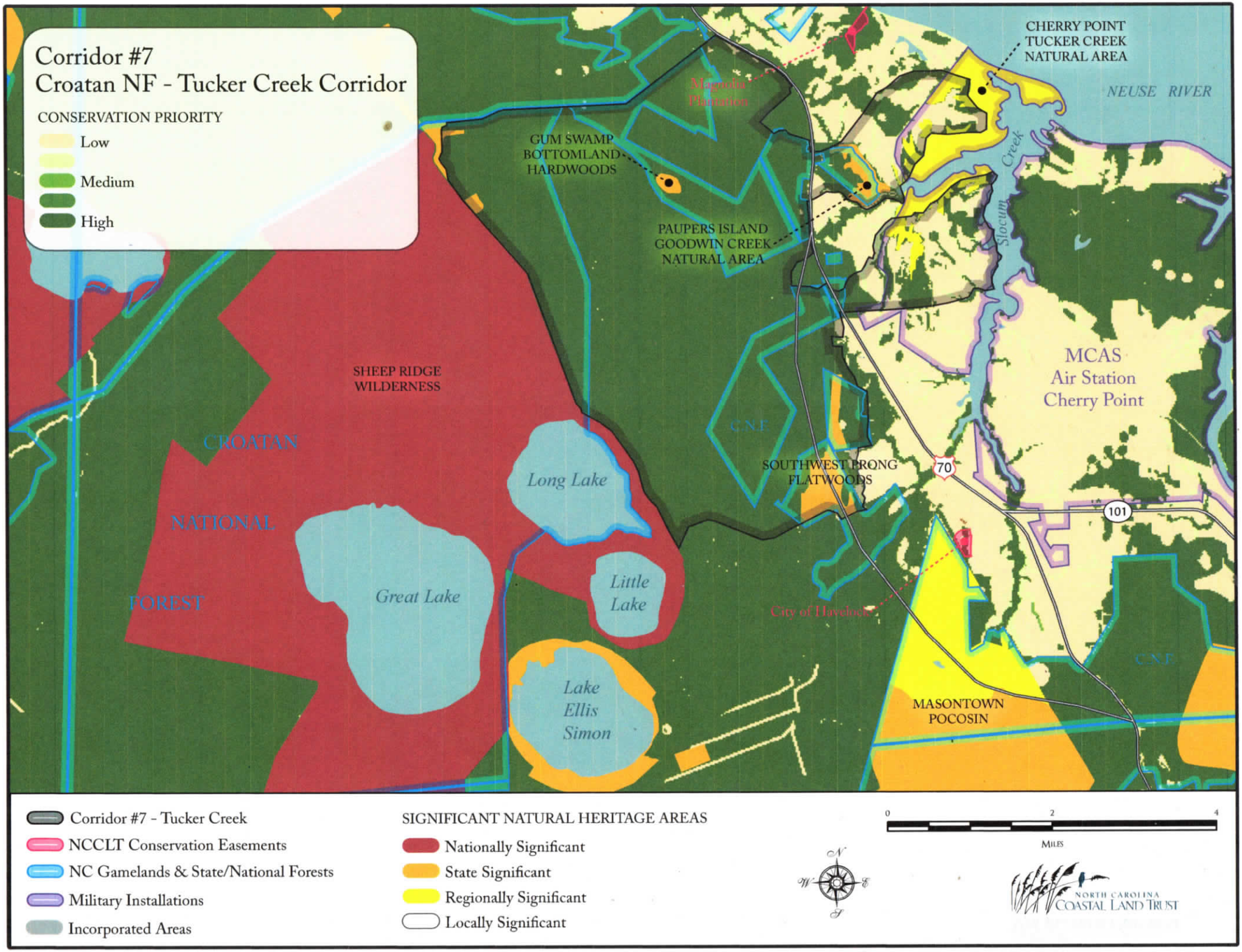
NORTH CAROLINA COASTAL LAND TRUST

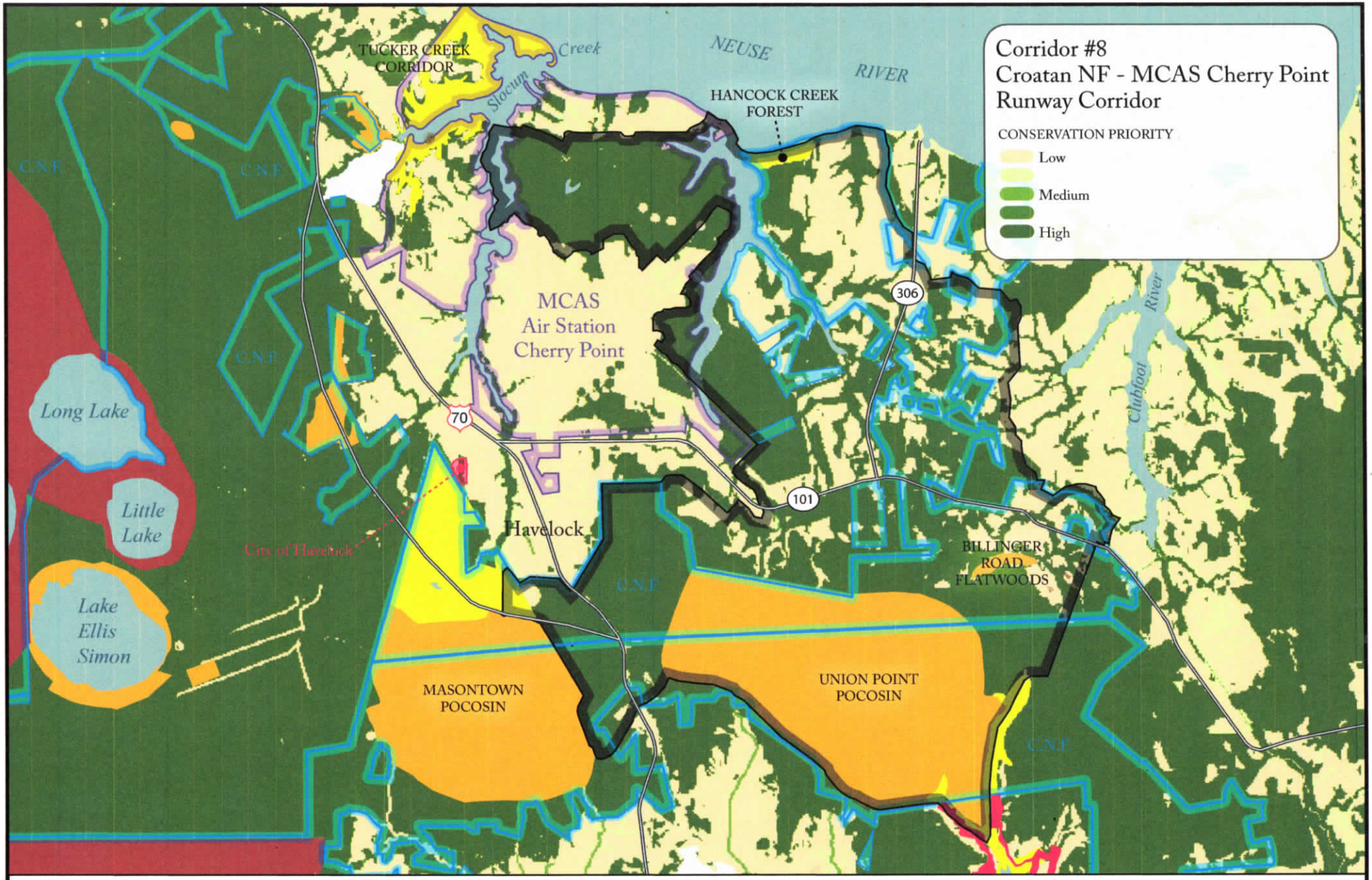

Corridor #3
Camp Lejeune - Croatan NF
CONSERVATION PRIORITY
Low
Medium
High
C.N.F.
WHITE OAK
RIVER MARSHES
58
17
C.N.F.
NEW RIVER
SWAMPS AND MARSHES
Oakhurst
Jacksonville
White Oak River
Barker
White Oak River
Queen's Creek
Easement
Camp Lejeune
New River
24
POCOSIN
ROAD
FLATWOODS
Swansboro
Corridor #3 - Camp Lejeune - Croatan NF
NCCLT Conservation Easements
NC Gamelands & State/National Forests
Military Installations
Incorporated Areas
SIGNIFICANT NATURAL HERITAGE AREAS
Nationally Significant
State Significant
Regionally Significant
Locally Significant
N
W
E
S
0
3
6
MILES
NORTH CAROLINA
COASTAL LAND TRUST

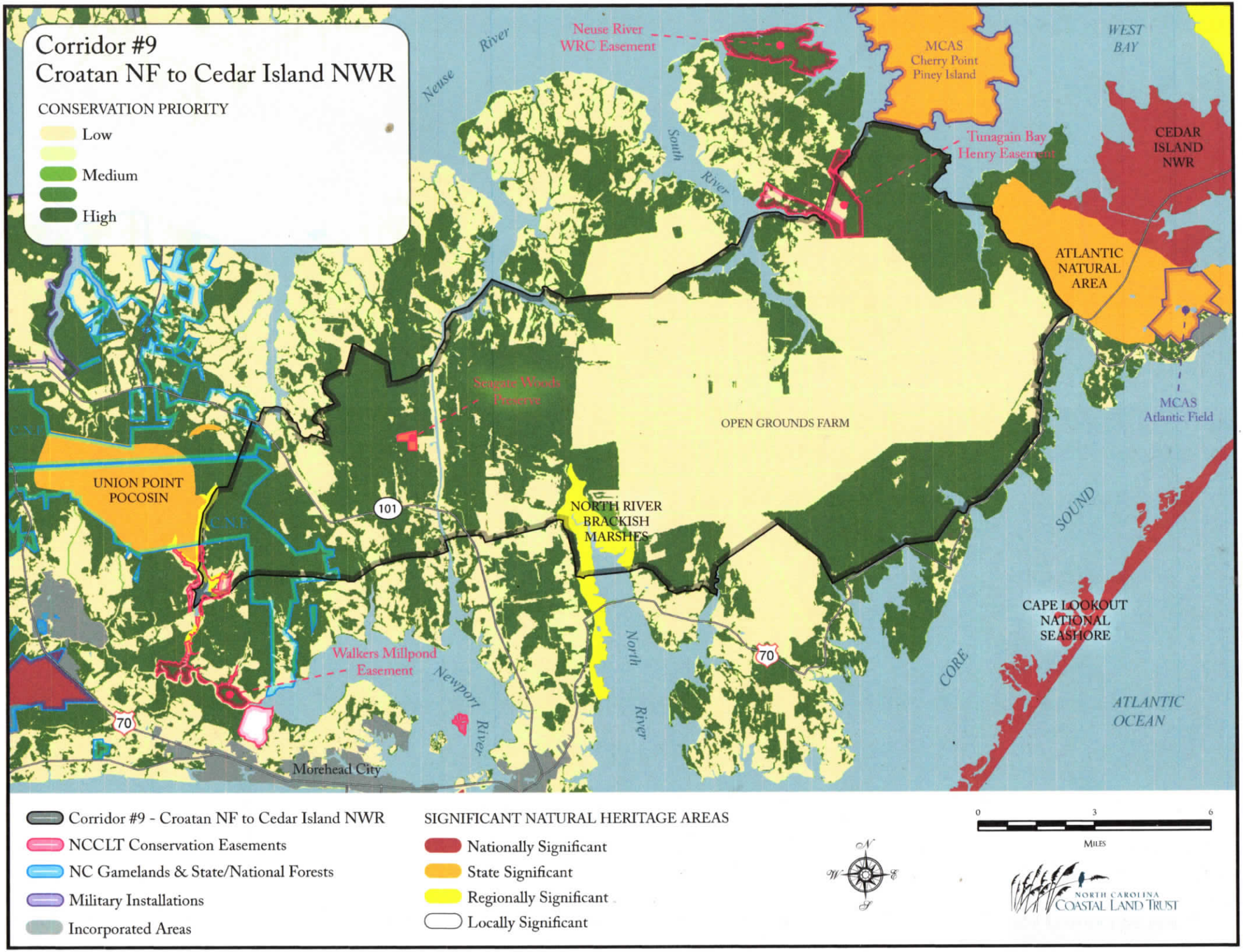

Corridor #4
South Croatan NF - Hoffmann Forest
CONSERVATION PRIORITY
Low
Medium
High
HOFFMANN FOREST
WHITE OAK POCOSIN
17
C.N.F.
CATFISH LAKE
SOUTH
WILDERNESS
Marysville
58
17
C.N.F.
WHITE OAK
RIVER MARSHES
Jacksonville
Corridor #4 - South Croatan NF - Hoffmann Forest
NCCLT Conservation Easements
NC Gamelands & State/National Forests
Military Installations
Incorporated Areas
SIGNIFICANT NATURAL HERITAGE AREAS
Nationally Significant
State Significant
Regionally Significant
Locally Significant
N
W
E
S
0
2.5
5
MILES
NORTH CAROLINA
COASTAL LAND TRUST


Corridor #5
Croatan NF - Hoffmann Forest
CONSERVATION PRIORITY
Low
Medium
High
Trenton
MCAS
Cherry Point
Oak Grove
Airfield
17
Foscue
Plantation
ISLAND CREEK
NATURAL AREA
58
Pollocksville
C.N.F.
MILL CREEK
OUTCROPS
C.N.F.
CATFISH LAKE
SOUTH
WILDERNESS
Marysville
Richlands
HOFFMANN FOREST
WHITE OAK POCOSIN
58
17
Corridor #5 - Croatan NF - Hoffmann Forest
NCCLT Conservation Easements
NC Gamelands & State/National Forests
Military Installations
Incorporated Areas
SIGNIFICANT NATURAL HERITAGE AREAS
Nationally Significant
State Significant
Regionally Significant
Locally Significant
N
W
E
S
0
3
6
Miles
NORTH CAROLINA
COASTAL LAND TRUST


Corridor #6
Croatan NF - Interior
CONSERVATION PRIORITY
Low
Medium
High
New Bern
NEUSE
RIVER
17
70
C.N.F.
Catfish Lake
Marysville
Long Lake
Great Lake
Lake Ellis Simon
MCAS Air Station Cherry Point
WHITE OAK RIVER MARSHES
MASONTOWN POCOSIN
UNION POINT POCOSIN
58
POCOSIN WILDERNESS
Newport
Jacksonville
White Oak River Barker
White Oak River
Pettiford Creek
24
Camp Lejeune
Cape Carteret
MCAS Cherry Point Bogue Airfield
BOGUE INLET
Corridor #6 - Croatan NF - Interior
NCCLT Conservation Easements
NC Gamelands & State/National Forests
Military Installations
Incorporated Areas
SIGNIFICANT NATURAL HERITAGE AREAS
Nationally Significant
State Significant
Regionally Significant
Locally Significant
0
5
10
MILES
N
W
E
S
NORTH CAROLINA COASTAL LAND TRUST

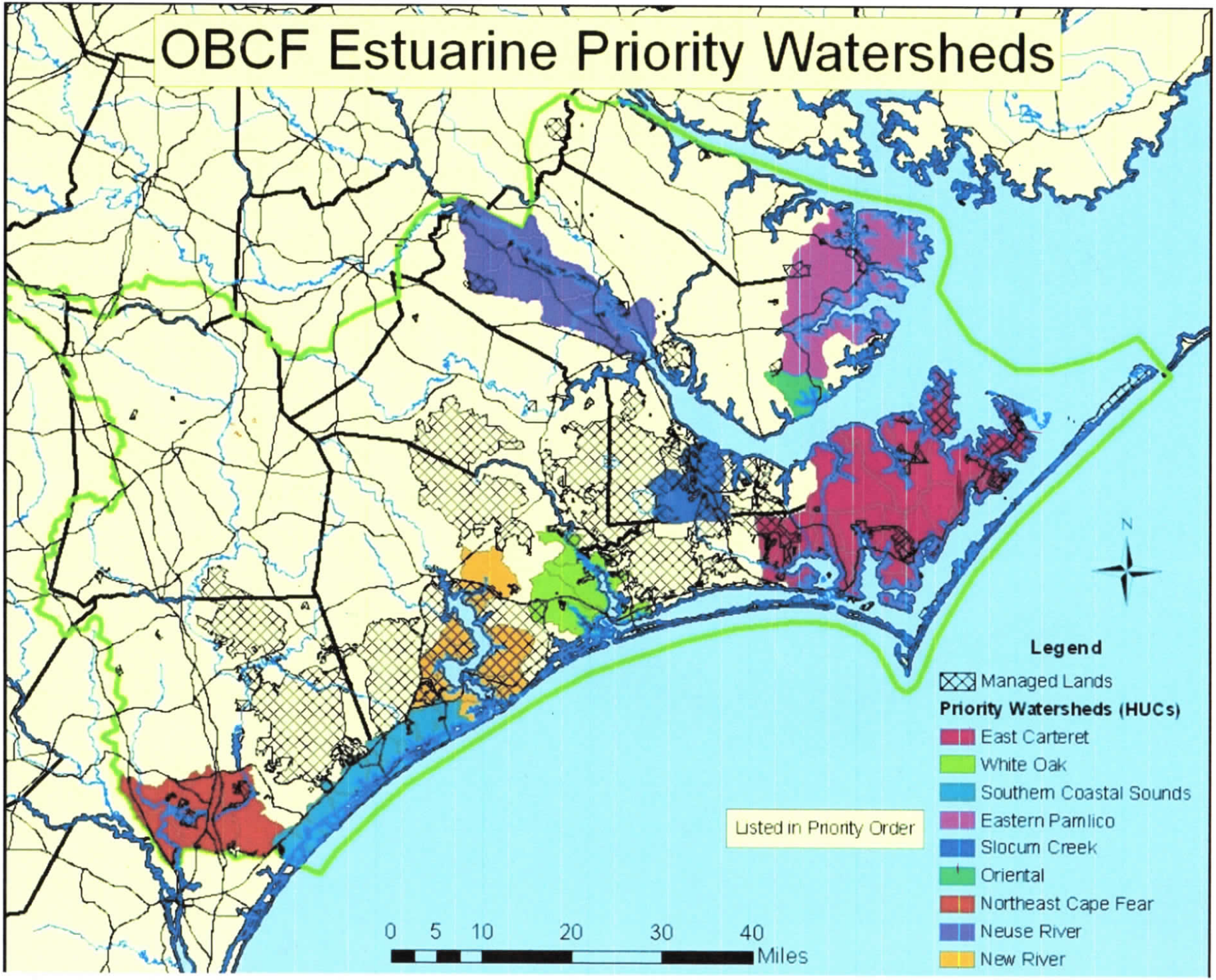

Corridor #7
Croatan NF - Tucker Creek Corridor
CONSERVATION PRIORITY
Low
Medium
High
CHERRY POINT
TUCKER CREEK
NATURAL AREA
NEUSE RIVER
Magnolia Plantation
GUM SWAMP
BOTTOMLAND
HARDWOODS
Slocum Creek
PAUPERS ISLAND
GOODWIN CREEK
NATURAL AREA
MCAS
Air Station
Cherry Point
SHEEP RIDGE
WILDERNESS
C.N.F.
CROATAN
NATIONAL
FOREST
Long Lake
Great Lake
Little Lake
Lake Ellis Simon
SOUTHWEST PRONG
FLATWOODS
70
101
City of Havelock
C.N.F.
MASONTOWN
POCOSIN
Corridor #7 - Tucker Creek
NCCLT Conservation Easements
NC Gamelands & State/National Forests
Military Installations
Incorporated Areas
SIGNIFICANT NATURAL HERITAGE AREAS
Nationally Significant
State Significant
Regionally Significant
Locally Significant
N
W
E
S
0
2
4
MILES
NORTH CAROLINA
COASTAL LAND TRUST


Corridor #8
Croatan NF - MCAS Cherry Point
Runway Corridor
CONSERVATION PRIORITY
Low
Medium
High
TUCKER CREEK CORRIDOR
Slocum Creek
NEUSE RIVER
HANCOCK CREEK FOREST
C.N.F.
MCAS
Air Station
Cherry Point
306
Clubfoot River
70
101
Long Lake
Little Lake
Lake Ellis Simon
City of Havelock
Havelock
BILLINGER ROAD FLATWOODS
MASONTOWN POCOSIN
UNION POINT POCOSIN
Corridor #8 - Croatan NF - MCAS Cherry Point Runway
NCCLT Conservation Easements
NC Gamelands & State/National Forests
Military Installations
Incorporated Areas
SIGNIFICANT NATURAL HERITAGE AREAS
Nationally Significant
State Significant
Regionally Significant
Locally Significant
0
2
4
MILES
NORTH CAROLINA
COASTAL LAND TRUST


Corridor #9
Croatan NF to Cedar Island NWR
CONSERVATION PRIORITY
Low
Medium
High
Neuse River
Neuse River WRC Easement
MCAS Cherry Point Piney Island
WEST BAY
South River
Tunagain Bay Henry Easement
CEDAR ISLAND NWR
ATLANTIC NATURAL AREA
Seagate Woods Preserve
OPEN GROUNDS FARM
MCAS Atlantic Field
C.N.F.
UNION POINT POCOSIN
101
NORTH RIVER BRACKISH MARSHES
SOUND
CAPE LOOKOUT NATIONAL SEASHORE
Walkers Millpond Easement
Newport River
North River
70
CORE
ATLANTIC OCEAN
Morehead City
Corridor #9 - Croatan NF to Cedar Island NWR
NCCLT Conservation Easements
NC Gamelands & State/National Forests
Military Installations
Incorporated Areas
SIGNIFICANT NATURAL HERITAGE AREAS
Nationally Significant
State Significant
Regionally Significant
Locally Significant
N
W
E
S
0
3
6
MILES
NORTH CAROLINA COASTAL LAND TRUST


Corridor #10
Pamlico Peninsula
CONSERVATION PRIORITY
Low
Medium
High
Goose Creek Gamelands
OYSTER CREEK PINE HAMMOCKS
Aurora
33
PAMLICO POINT MARSHES
Goose Creek Gamelands
Neuse River Cool Springs
17
NORTHWEST POCOSIN
BAY CITY LOW POCOSIN
JONES ISLAND
Brant Island Restricted Military Area
Vandemere
Bay River
304
Bayboro
PAMLICO SOUND
55
SOUTH PRONG NATURAL AREA
New Bern
DUCK CREEK FLATWOODS
306
70
LIVE OAK BAY
Neuse River
Oriental
Neuse River WRC Easement
MCAS Cherry Point Piney Island
Corridor #10 - Pamlico Peninsula
NCCLT Conservation Easements
NC Gamelands & State/National Forests
Military Installations
Incorporated Areas
SIGNIFICANT NATURAL HERITAGE AREAS
Nationally Significant
State Significant
Regionally Significant
Locally Significant
N
W
E
S
0
4
8
Miles
North Carolina Coastal Land Trust

APPENDIX E
ONSLOW BIGHT ESTUARINE PRIORITY WATERSHEDS


OBCF Estuarine Priority Watersheds
N
Legend
Managed Lands
Priority Watersheds (HUCs)
East Carteret
White Oak
Southern Coastal Sounds
Eastern Pamlico
Slocum Creek
Oriental
Northeast Cape Fear
Neuse River
New River
Listed in Priority Order
0 5 10 20 30 40
Miles

APPENDIX F

PARCEL PRIORITIZATION STRATEGY

DEVELOPED BY LAURA BROCKINGTON, M.S. STUDENT, DUKE UNIVERSITY

AND N.C. COASTAL LAND TRUST

Onslow Bight Conservation Plan Update
Parcel Prioritization Report

North Carolina Coastal Land Trust
Laura Brockington, Duke Stanback Fellow
August 2022

METHODOLOGY

Conservation Focus Areas

The purpose of this project was to identify and prioritize parcels of land within the Onslow Bight landscape for potential future conservation. The Onslow Bight landscape includes all or a portion of ten (10) counties in the mid-coast of North Carolina. First, we identified Conservation Focus Areas (CFAs), which are defined for the purpose of this project as areas within the Onslow Bight that have the potential to connect or expand upon existing large, protected lands or "conservation hubs" (e.g., 160,000-acre Croatan National Forest, 63,580-acre Holly Shelter Game Lands). We selected nine CFAs for this prioritization analysis. The Pamlico Passage, Carteret Crescent, and Hofmann Highway CFAs were adapted from the 2004 Onslow Bight Conservation Plan but edited to encompass a larger area. These CFAs connect the Neuse River Game Lands to the Goose Creek Game Lands, the Croatan National Forest to Cedar Island National Wildlife Refuge, and NCSU Foundation's Hofmann Forest to the Croatan National Forest, respectively. We created two-mile buffers around the Croatan National Forest, Angola Bay and Holly Shelter Game Lands, and Marine Corps Base Camp Lejeune and then edited the buffers to not overlap bordering CFAs to create the Croatan Buffer, Angola Bay-Holly Shelter Buffer, and Camp Lejeune Buffer CFAs. We manually drew the Cape Fear Connector CFA to include the areas between the Cape Fear River Wetlands Game Lands and the Cape Fear Arch landscape. The Tricounty Headwaters CFA was drawn to encompass the headwaters of the Trent and Northeast Cape Fear Rivers in Jones, Duplin, and Lenoir counties. This CFA does not have any conservation hubs but represents an important area to conserve working farm and forest land. Finally, the Old Stump Sound CFA is the combination of six Hydrological Unit Code (HUC) 12 subwatersheds (Old Mill Creek, Morris Landing, South Morris Landing, Kings Creek, Turkey Creek, and Alligator Bay), which all flow into Stump Sound near Topsail Island. Protection of land within this CFA along with the Newport River watershed are water quality priorities for the North Carolina Coastal Federation, an Onslow Bight Conservation Forum partner. The Newport River watershed is included in the Carteret Crescent and Croatan Buffer CFAs.

Criteria Identification

The first step in creating our land prioritization strategy was to identify the criteria to use to measure each parcel's conservation and climate resiliency value. We selected eight criteria: climate resilience, biodiversity, proximity to already managed/protected areas, current carbon storage, the containment of significant natural heritage areas, stream frontage, threat of urban growth (i.e., and conversion), and parcel size. For the Tricounty Headwaters CFA, we used total carbon storage, stream frontage, the containment of significant natural heritage areas, and parcel size.

Data Collection

After determining which criteria would be used for the model, datasets were collected to represent all criteria. We used eight datasets in total for the prioritization model. The table below outlines the criteria, dataset used, and the dataset source.

Criteria	Dataset	Source
Climate resilience	Resilient Sites	The Nature Conservancy
Biodiversity	Biodiversity and Wildlife Habitat Assessment	NC Natural Heritage Program
Proximity to managed areas	Managed Areas	NC Natural Heritage Program
Containment of Significant Natural Heritage Areas	Significant Natural Heritage Areas	NC Natural Heritage Program
Stream frontage	Surface Water Classifications	NC Department of Environmental Quality
Threat of urban growth	Sleuth Urban Growth 2050	NC State University
Parcel size	County Parcels	NC One Map
Carbon storage	Total Carbon 2010	The Nature Conservancy

Climate Resilience

We found numerous datasets that measured climate resiliency, however, many of those datasets did not cover the entire Onslow Bight landscape and would therefore not provide an even measure for all CFAs. We chose The Nature Conservancy's (TNC) Resilient Sites data layer because it covers our entire study area and uses a diverse range of inputs to compute the final resilience score. TNC created this data layer by combining two previous datasets, Resilient Sites for Terrestrial Conservation, created in 2016, and Resilient Coastal Sites, created in 2019. Although both datasets had the goal of measuring a site's ability to maintain species diversity and ecological function as the climate changes, the inputs used to calculate that ability varied greatly. The resilience score in the terrestrial dataset was calculated based a site's connectedness, landscape diversity, fragmentation, geology and soils, elevation, and landforms (TNC, 2016). In the coastal dataset, resilience was calculated based on a site's tidal complex, migration space, and buffer areas (TNC, 2019). In both datasets, resilience scores were calculated within ecoregions based on all cells of the same geophysical setting. The final Resilient Sites dataset generalized a resilience score for all sites, terrestrial or coastal.

Biodiversity

To measure biodiversity, we used the North Carolina Natural Heritage Program's Biodiversity and Wildlife Habitat Assessment dataset, which was created as part of the NC Conservation Planning Tool and most recently updated in July of 2021. This dataset is widely used across the state and identifies areas most important to maintain healthy ecosystems in terms of the "biodiversity of species (aquatic and terrestrial), large-scale landscapes (core wildlife habitats and habitat connectors), and lands important to ecosystem processes (riparian buffers and wetlands)" (NCNHP, 2020). The criteria used to calculate the final biodiversity score included significant natural heritage areas, rare species occurrences, core wildlife habitats and their connections, important aquatic resources (e.g., trout streams, fish habitat, fish nursery areas, outstanding resources waters), wetlands, and watershed priorities based on federally listed species and other factors. The raster dataset depicts cells on a scale of 1 (moderate conservation value) to 10 (maximum conservation value).

Managed Lands and Significant Natural Heritage Areas

We used the Natural Heritage Program's datasets on managed lands and Significant Natural Heritage Areas across North Carolina to determine: (1) a parcel's proximity to a managed/protected area, and (2) if a parcel contains any portion of a Significant Natural Heritage Area. Managed areas refer to properties that are either owned by a non-profit conservation organization or a local, state, or federal natural resources agency and are managed for conservation or they are privately owned lands protected through voluntary conservation easements or agreements held by a non-profit conservation organization or local, state, or federal agency. In the final maps below, managed areas are identified by their owner type (fee-title ownership), although areas could have a protection method from a different level of management. For example, an NCCLT property (fee-title) would show private ownership, although it could have a state-held conservation easement on it.

Significant Natural Heritage Areas are areas of special ecological significance due to presence of rare species, high-quality natural communities, animal assemblages, or other ecological factors (NCNHP, 2020). There is overlap between the managed lands and Significant Natural Heritage Areas datasets, however Significant Natural Heritage Areas include places that are not already conserved. Both datasets are shapefiles with polygons representing managed lands or Significant Natural Heritage Areas and were most recently updated in April of 2022.

Stream Frontage

To measure stream frontage, or the amount of stream that flows through a parcel, we used the Department of Environmental Quality's dataset on surface water classifications. This dataset is a shapefile with lines representing streams across all of North Carolina. It was last updated in May of 2016.

Urban Growth

We used NC State University's dataset predicting future urban growth to measure a parcel's threat of being developed or converted to other uses. This dataset used the SLEUTH model which estimates the pattern of urbanization using four growth rules – Spontaneous Growth, New Spreading Centers, Edge Growth and Road-Influenced Growth. These four rules predict outward growth of existing urban areas, growth along transportation corridors, as well as new urbanization centers. The output raster, produced in July of 2014, shows the probability of urbanization for each cell by the year 2050. The classification includes values of 1 (already developed), and then ranges from 25 (less likely to be developed) to 1000 (most likely to be developed).

Parcel Size

We gathered county parcel data from NC One Map for all counties within the Onslow Bight. These datasets include numerous attributes, including acreage, our measure of size. Parcel data is accurate as of May of 2022.

Carbon Storage

Total carbon storage was estimated using The Nature Conservancy's forest carbon dataset developed in 2010 and used as part of their Resilient Lands Mapping Tool. This estimate includes belowground and aboveground stored carbon. However, this dataset shows a measure of the carbon stored in forests in 2010. If areas have been deforested or reforested in the last 12 years, the data will not be accurate for that area. We used this dataset as a general measure of carbon storage on a landscape scale and therefore found its estimates to be acceptable. The raster shows each cell's amount of carbon stored in metric tons per acre.

Data Preparation

All eight datasets described above had to be prepared for analysis. First, the projection of each data layer was determined. This analysis required that each layer be projected to NAD 1983 (2011) State Plane North Carolina FIPS 3200; transformations were conducted as necessary. Next, the study area and CFAs were created. We used the shapefile of the Onslow Bight landscape boundary that was updated from the original 2004 Onslow Bight Conservation Plan. We adapted the CFAs from the 2004 plan as noted earlier. to be more useful in this analysis.

We then gathered tax parcel layers for all counties that overlapped with the Onslow Bight Landscape shapefile. These counties included Beaufort, Carteret, Craven, Duplin, Jones, Lenoir, New Hanover, Onslow, Pamlico, and Pender. We merged these layers and clipped the output layer to only include parcels that were at least partially within the Onslow Bight boundary. We then extracted parcels that were 150 acres or more. We only analyzed parcels of at least 150 acres to simplify the analysis and because generally Coastal Land Trust is much more likely to purchase parcels over this limit. After that we extracted the parcels over 150 acres that intersected (were fully or partially contained in) each of our CFAs. We identified any parcels that came up twice in neighboring CFAs and made sure to only include them in one CFA. We analyzed each parcel with aerial imagery from 2020 to determine if there was any existing structure(s), development or land use that would eliminate the parcel as a future conservation priority. For example, we eliminated parcels that contained large concentrated animal feeding operations, airports, golf courses, residential development, and similar structures.

Once our parcel layer was ready for analysis, we prepared each criteria layer. We transformed all shapefiles to raster formats. We were then able to reclassify each raster into ranked categories between 1 and 10, giving the highest rank to the most preferred outcome. The Resilient Sites raster layer had a resilience score ranging from -3,502 (not resilient) to 3,500 (most resilient). We calculated the mean resilience score within the Onslow Bight, then added and subtracted half a standard deviation from the mean. This gave us the average resilience score. We then subtracted another standard deviation from the bottom limit of the average to get the below average resilience score. We added another standard deviation to the upper limit of the average to get the above average resilience score. We did that again in both directions to calculate the way above average and way below average resilience scores. We then reclassified those ranged to be between 1 and 10. We set the average range (-1,010.75 to 932.15) to 6, below average (-2,953.65 to -1,010.75) to 4, and way below average (-3,502 to -2,953.65) to 2. We set the above average range (932.15 to 2,875.05) to 8, and the way above average (2,875.05 to 3,500) to 10.

The Biodiversity and Wildlife Habitat Assessment raster layer was straightforward, as it was already ranked from 1 (moderate conservation value) to 10 (maximum conservation value), with two other classes for impervious surfaces and unranked pixels. We reclassified this layer, lessening the number of classes in the ranking from 12 to 5. We classified impervious surfaces, unranked, and pixels already ranked as 1 to 1; pixels ranked 2 and 3 as 3; 4 and 5 as 5; 6 and 7 as 7; 8, 9, and 10 to 10.

The proximity to managed lands layer was a little bit more complicated. First, we created an attribute in the parcel data table for distance to the nearest managed land area. Then we rasterized the parcel layer with the value of each pixel within each parcel as the distance to the nearest managed land area. We then reclassified the layer, giving the pixels within each parcel that abutted a managed area a 10, those within a half mile a 7, those between a half mile and two miles a 3, and any over two miles a 1.

To measure the containment of Significant Natural Heritage Areas, we first rasterized the Significant Natural Heritage Areas layer, giving pixels within Significant Natural Heritage Areas a 10 and those outside a 0. When overlayed with the parcel data, the mean Significant Natural Heritage Area was found by adding up all the pixel values (either 10 or 0) within the parcel's boundaries and dividing by the number of pixels. This value is the approximate percentage of the parcel designated as Significant Natural Heritage Area, divided by 10.

Stream frontage was calculated by first creating an attribute in the parcel data table for the length of stream within the parcel, including only one side of the stream in the calculation of length. We then rasterized the parcel layer using the stream frontage attribute so that the value of each pixel within the parcel had the value of stream frontage for the entire parcel. We reclassified the raster giving a 10 to pixels with over 10,500 feet of stream, an 8 to those with between 8,000 and 10,500 feet of stream, a 6 to those with between 6,000 and 8,000 feet of stream, a 4 to those with between 3,000 and 6,000 feet of stream, a 2 to those with between 0 and 3,000 feet of stream, and a 1 to those with no streams.

The SLEUTH Urban Growth 2050 layer was already in raster format; however, it only provided a value for pixels that were in areas predicted to be developed by 2050. We wanted to also rank pixels that were within two miles of predicted future development per the SLEUTH model, since parcels in this area would be heavily affected by nearby development. To do this, we transformed the layer into a polygon shapefile. We then created a two-mile buffer around the areas predicted to be developed by 2050. We merged the buffer and urban growth polygon and transformed the layer back into a raster. We then reclassified the raster, giving parcels most likely to be developed a 10, more likely an 8, somewhat likely a 6, and slightly likely or within the 2-mile buffer a 3. Any pixels not predicted to be developed received a 1.

TNC's dataset on carbon storage was already in raster format. We ran summary statistics to determine the average and standard deviation for carbon storage within the Onslow Bight landscape. We defined the average to be one standard deviation above and below the mean, below the mean to be one more standard deviation below the lower limit of the average, and way below to be another standard deviation below that to the smallest value within the region. The same was done for above and way above the mean. We then reclassified the raster according to those values, giving a 10 to pixels way above the mean (99 to 132), a 7 to those above the mean (84 to 99), a 5 to the average (54 to 84 metric tons of carbon stored per acre), a 3 to those below the mean (39 to 54), and a 1 to those way below the mean (23 to 39).

To rank parcels based on their size or acreage, we transformed the parcel layer to a raster with the value being the parcel's acreage. For nine of the CFAs (all but Tricounty Headwaters), we only included parcels of at least 150 acres. We then reclassified the raster based on the average parcel size within the Onslow Bight. We found the average to be 572.1 acres. We subtracted one-quarter of a standard deviation from this average for the slightly below average category (281.875 to 572.1), which we reclassified into a 5. We added one-quarter of a standard deviation to the average for the slightly above average category (572.1 to 862.325), which we reclassified into a 7. The lower limit of parcel acreage to the lower limit of the slightly below average range because the below average category (150 to 281.875) and was reclassified into a 2. The upper limit of the slightly above average range to the upper limit of the parcel acreage because the above average range (862.325 to 15,033) and was reclassified into a 10. For the Tricounty Headwaters CFA, we only included parcels of at least 400 acres. After transforming the parcel layer to a raster, we reclassified the layer as follows: between 400 and 800 acres received a 2, between 800 and 2,000 a 4, between 2,000 and 4,000 a 6, between 4,000 and 8,000 an 8, and above 8,000 a 10.

Analysis

For the final analysis, we combined all criteria layers, providing each one with a weight of how much it should be considered in the overall value for each parcel. For our analysis, the weight breakdown was as follows: biodiversity – 23%, climate resilience – 22%, proximity to managed lands – 13%, carbon storage – 12%, containment of Significant Natural Heritage Areas – 10%, stream frontage – 10%, threat of urban growth – 5%, and parcel size – 5%. We selected this weighting because we wanted the model to be primarily driven by climate resiliency which accounted for 34% (climate resilience and carbon storage) and biodiversity and landscape connectedness which accounted for 36% (biodiversity and proximity to managed lands). The final weighted overlay raster was then used to determine the overall conservation value of each parcel using zonal statistics, with parcels as zones. The mean value of the entire area within a parcel polygon was calculated from the weighted overlay and assigned as the conservation value for that parcel, which theoretically could range from 1 to 10. However, in all CFAs the value ranged between 2 and 8. We categorized the overall conservation value of each parcel into either Very High, High, or Moderate priority and highlighted these priorities on corresponding maps for the CFAs. Very High priority parcels ranged in overall conservation value from 6 to 8, High from 4 to 6, and Moderate from 2 to 4.

We further analyzed the prioritized parcels in two ways. First, we extracted parcels within one-mile of the Mountains-to-Sea Trail (MST). We created maps to highlight these parcels in all CFAs that the MST runs through – the Carteret Crescent, Croatan Buffer, Holly Shelter Buffer, Camp Lejeune & Sandy Run Buffer, and Old Stump Sound. We also extracted parcels that contain marsh migration areas in a 1.5 ft sea level rise scenario, which is predicted to occur by 2050. This data was created by the Duke University Nicholas Institute for a project that evaluated how sea level rise will drive carbon and habitat loss in the coastal zone of the mid-Atlantic region (Warnell, Olander, & Currin, 2022). The data layer was adapted from NOAA's marsh migration datasets. Warnell et al excluded developed areas and existing marsh and only included areas that are spatially contiguous with existing or projected marsh to ensure there is a clear path of migration. While TNC's Resilient Sites dataset, which we used in our prioritization model, also used NOAA's marsh migration datasets as an input, TNC did not make the same adjustments. Their dataset covered a larger geographic area and was therefore not as specific to the Onslow Bight coast when looking at the parcel level for migration space. We created maps to highlight parcels in the CFAs that contained marsh migration areas. These parcels are significant to conserve because if coastal marshes are not able to migrate inland when sea levels rise due to development or other obstructions, these marshes will disappear, releasing a considerable amount of carbon and decreasing our coast's resilience from storms.

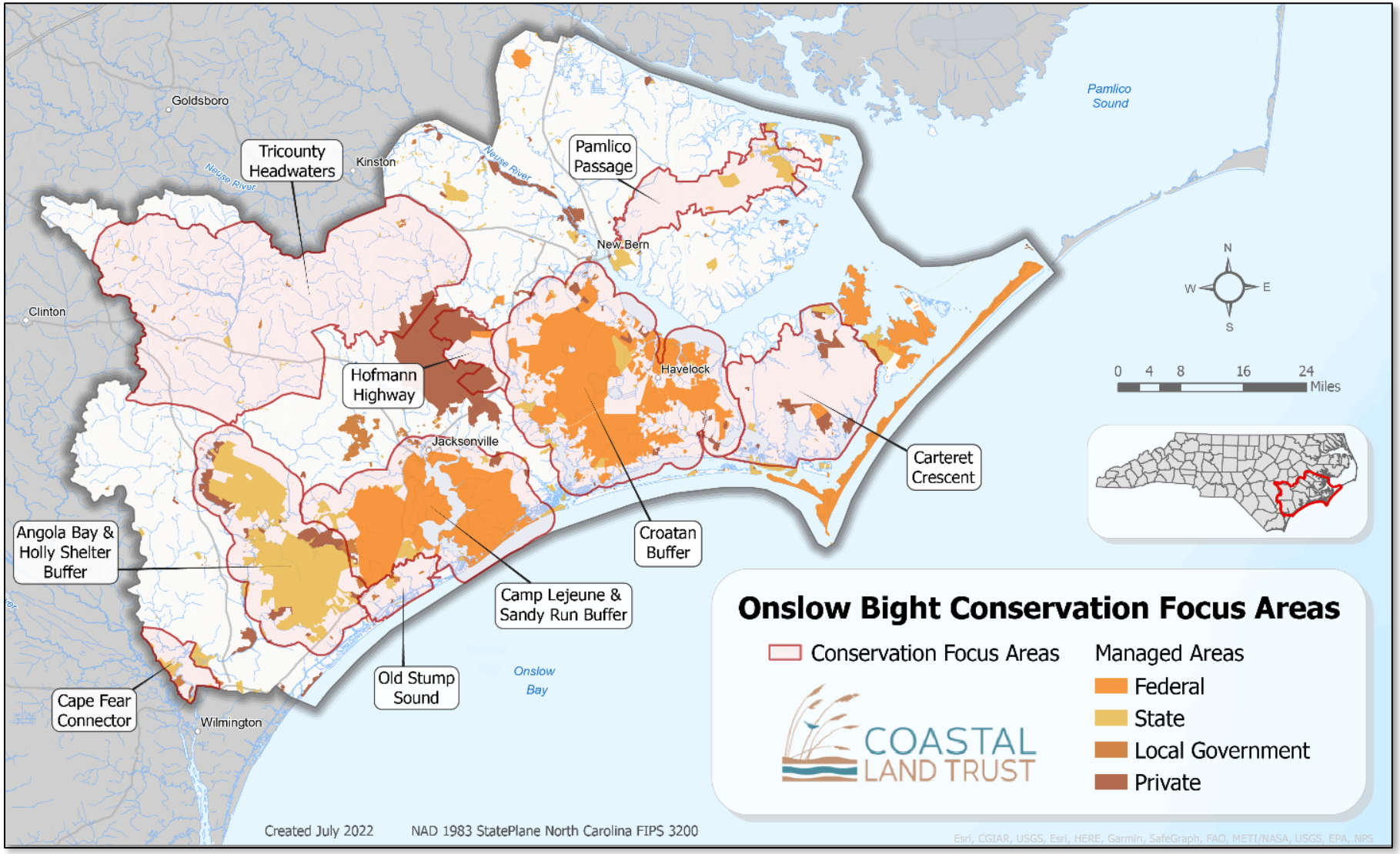
We created a map of the entire Onslow Bight landscape showing NOAA's 2010 Tidal Marsh Resilience to Sea Level Rise dataset, which showed marsh resilience in terms of management needs. The final management category was a combination of three classes – condition (high or low), vulnerability (high or low), and adaptiveness (high or low) to determine what management needs the marsh has. We reclassified this category to be more easily understood by those referencing the maps in this report. Marsh areas that have high condition (good quality marsh), low vulnerability to sea level rise, and high adaptiveness were reclassified as Most Resilient. Mash areas that have high condition, high vulnerability, and high adaptiveness were reclassified as Somewhat Resilient. Marsh areas that have high condition, low vulnerability, and low adaptiveness were reclassified as Not Resilient. Marsh areas that have high condition, high vulnerability, and low adaptiveness or low condition, high vulnerability, and low adaptiveness also as Not Resilient. Marsh areas that have low condition, low vulnerability, and low adaptiveness or low condition, high vulnerability, and high adaptiveness were reclassified as Some

Restoration Potential. Lastly, marsh areas that have low condition, low vulnerability, and high adaptiveness were reclassified as High Restoration Potential.

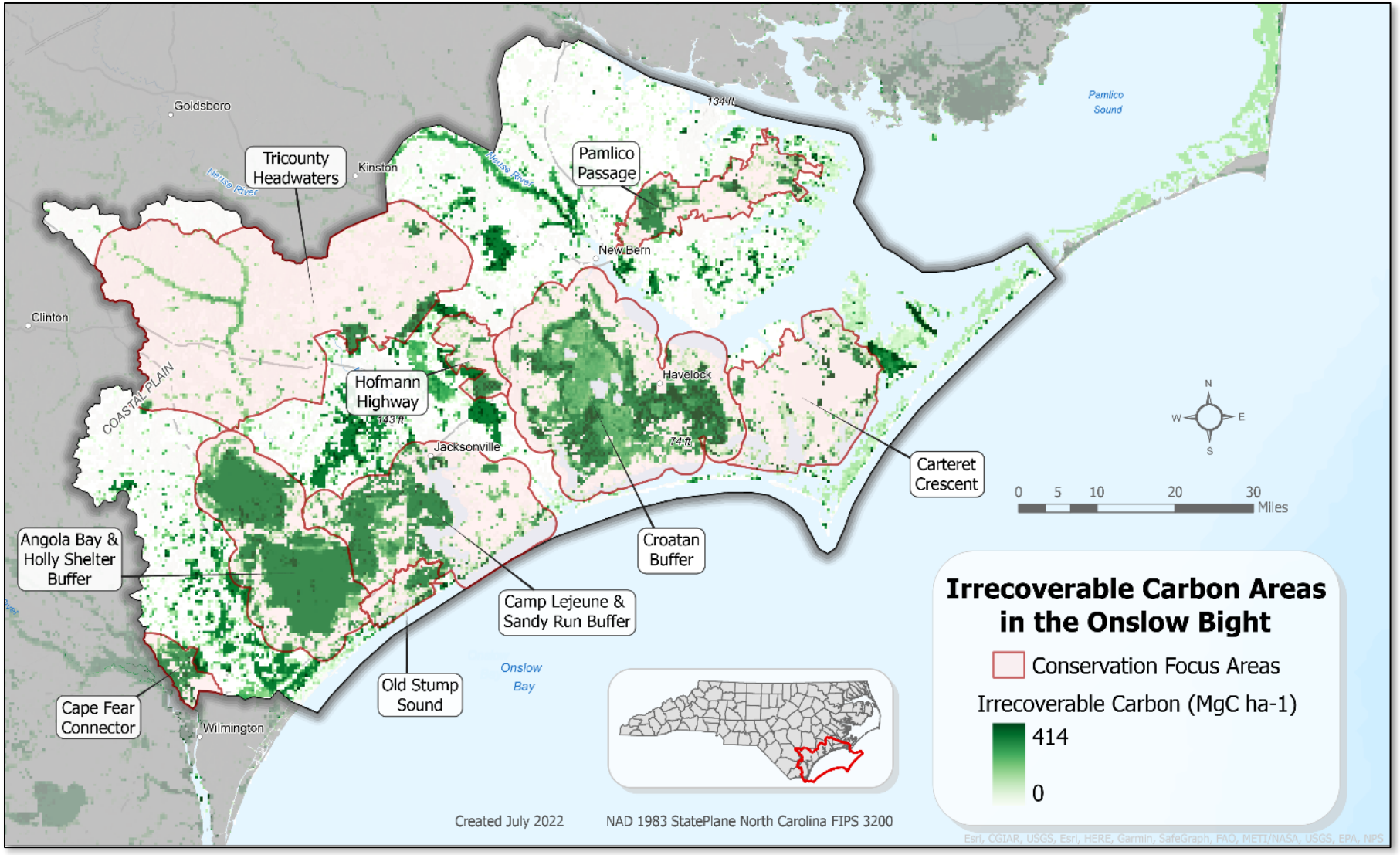
We also created a map showing areas with “irrecoverable carbon” in the Onslow Bight landscape. According to Goldstein et al, “irrecoverable carbon” refers to carbon that if released, i.e., due to anthropogenic causes such as timbering or development, could not be restored by 2050, when most policymakers agree that the world must reach net-zero emissions to avoid the catastrophic consequences of climate change. Goldstein et al mapped “irrecoverable carbon” across the globe and the data is therefore at a low resolution when looking at the much smaller scale of the Onslow Bight landscape. This data was not used in any analysis but is shown in a map below to highlight the importance of irrecoverable carbon areas within the CFAs.

RESULTS

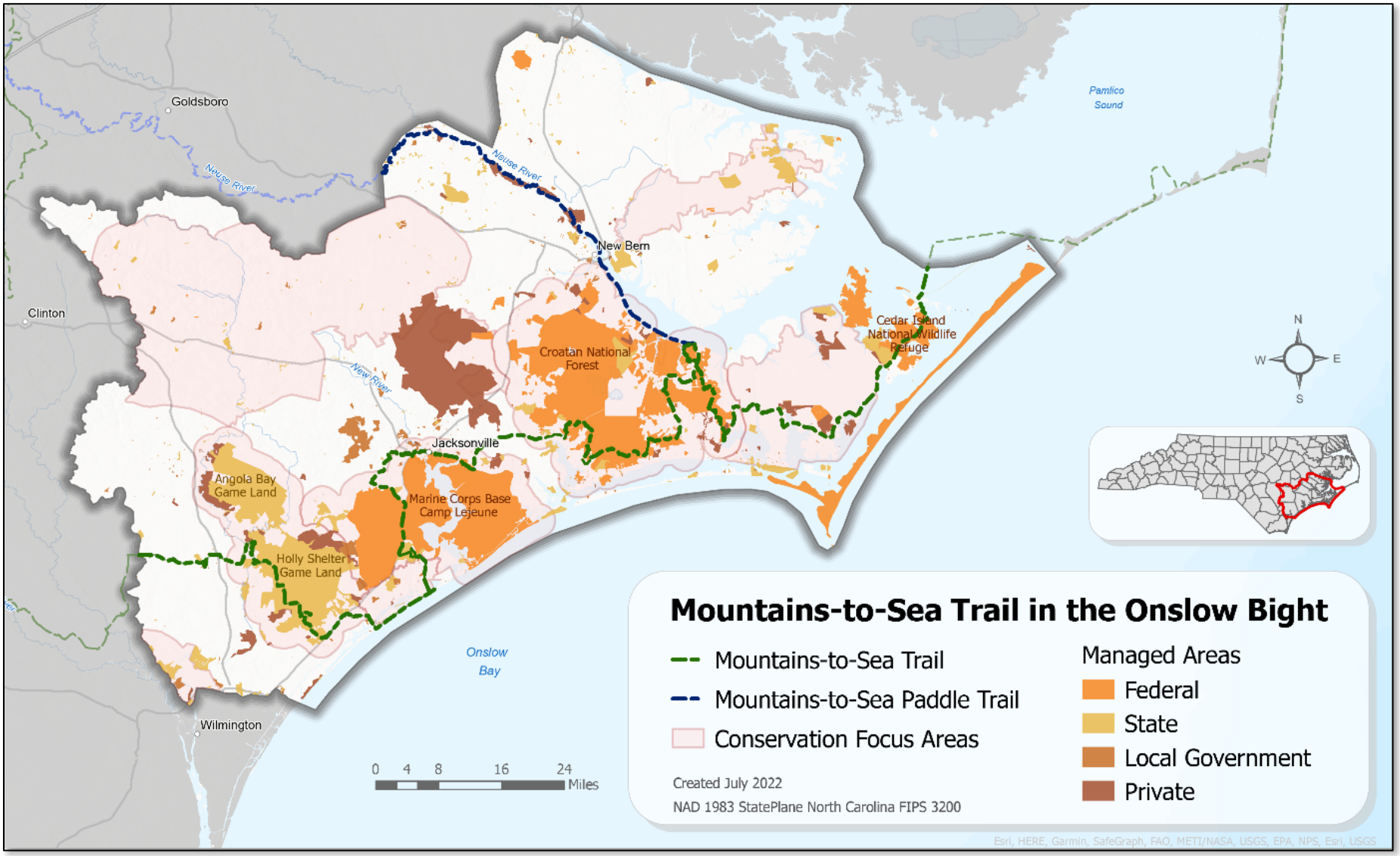
Conservation Focus Areas of the Onslow Bight Landscape



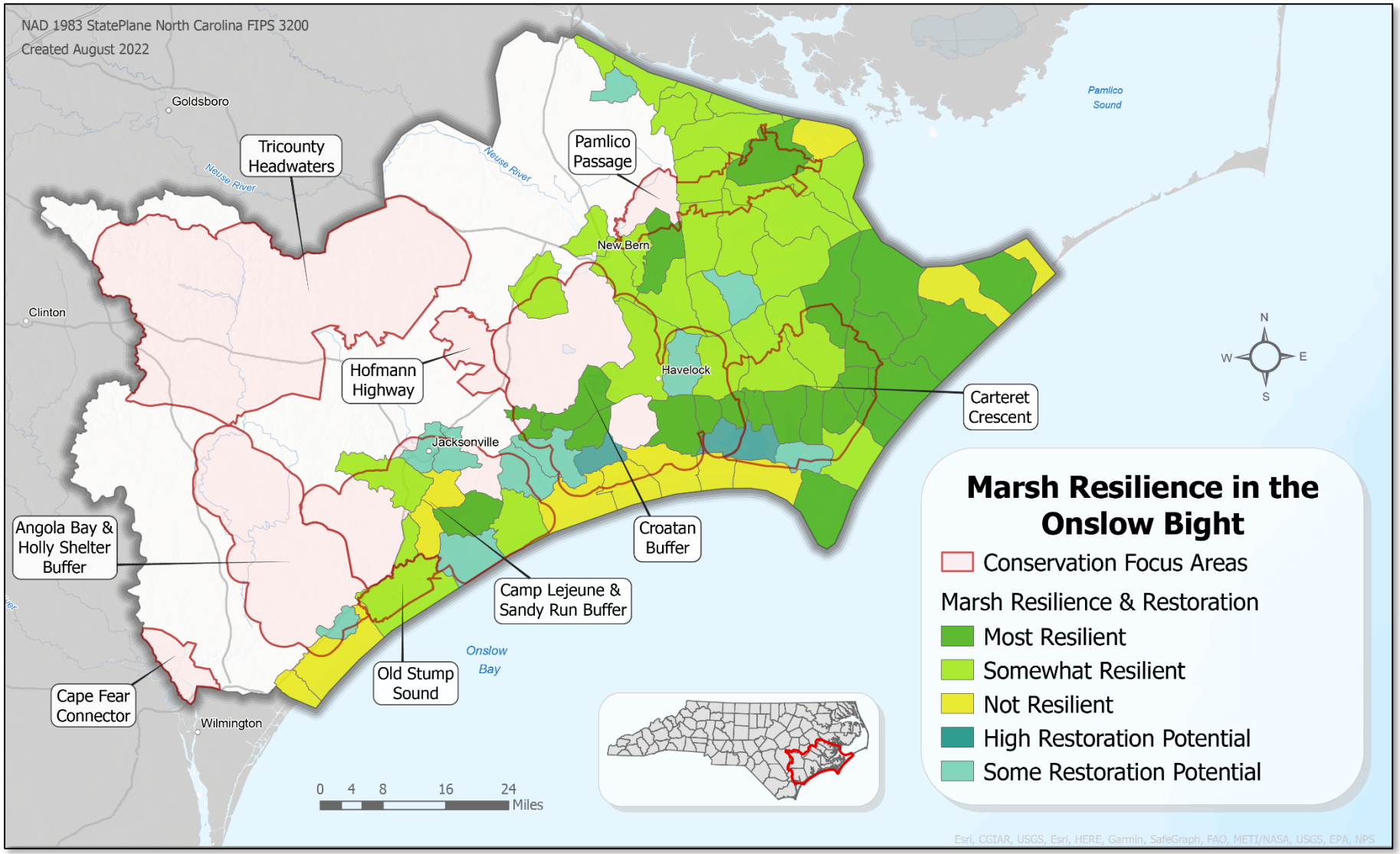
Irrecoverable Carbon in the Onslow Bight Landscape



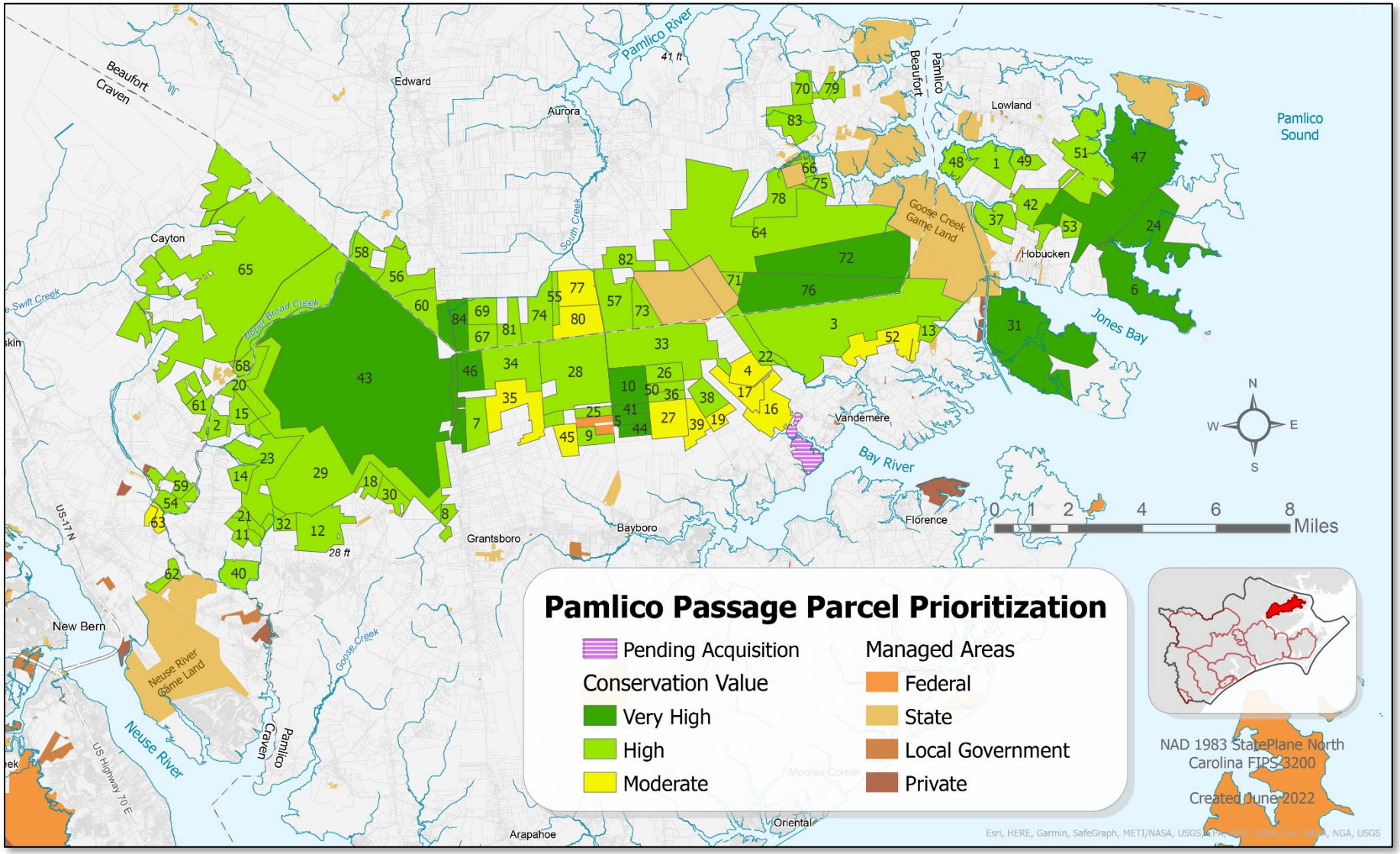
Mountains-to-Sea Trail in the Onslow Bight Landscape



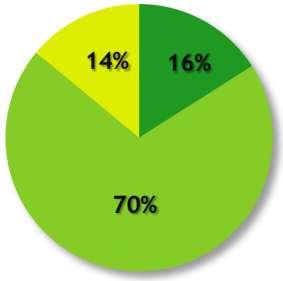
Marsh Resilience in the Onslow Bight Landscape Per NOAA's Tidal Marsh Resilience to Sea Level Rise Data

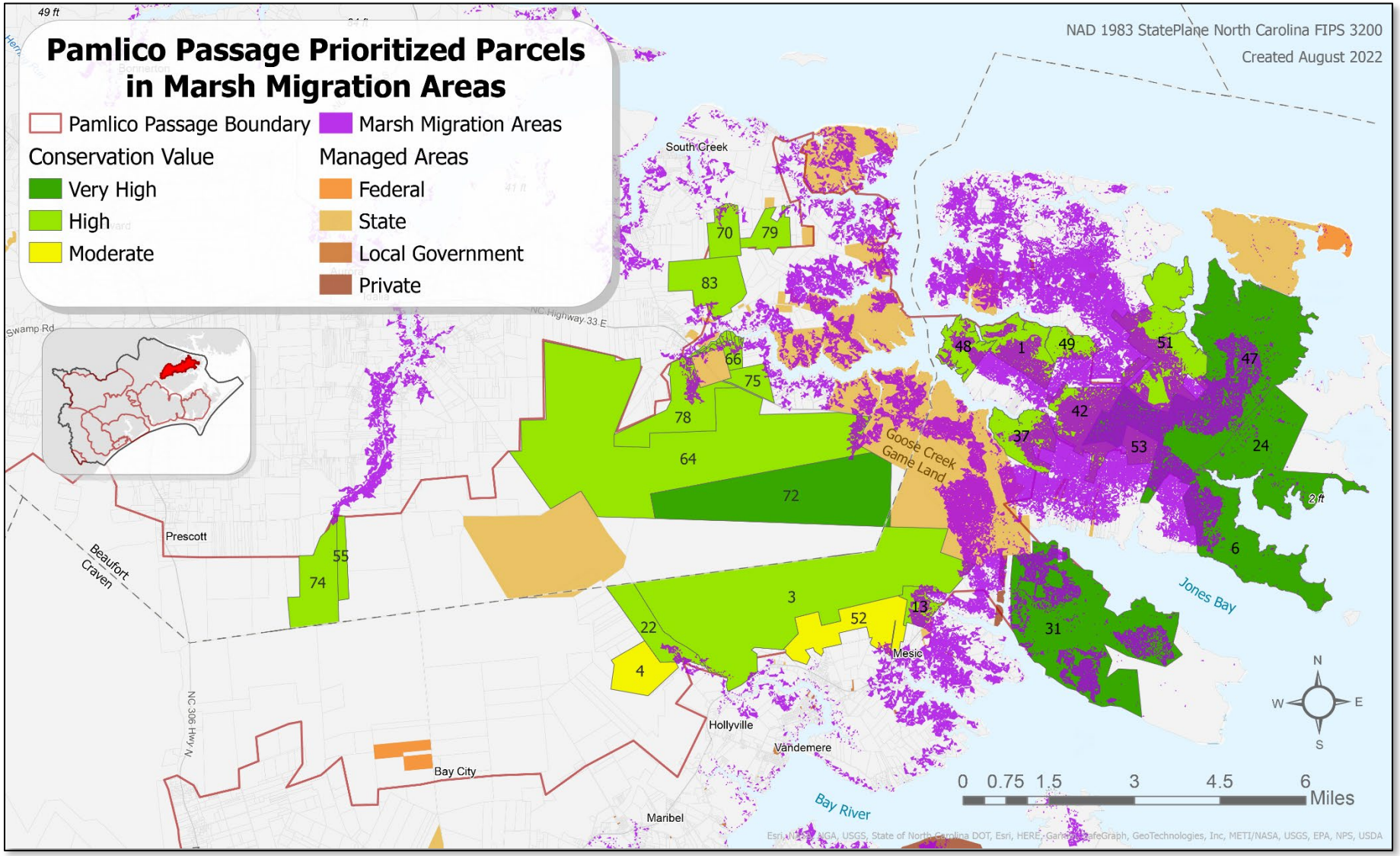


Parcel Prioritization within Pamlico Passage CFA



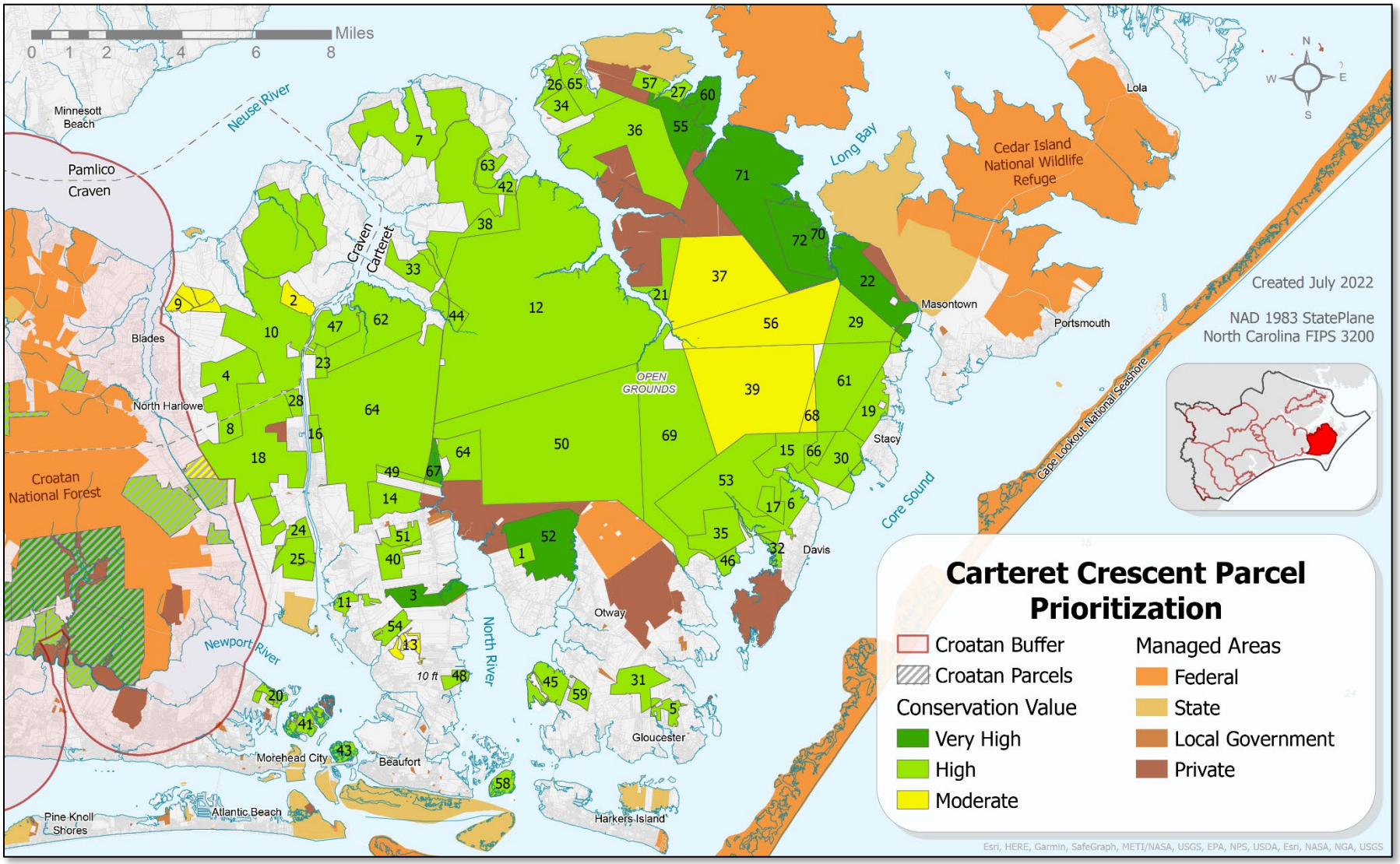
The Pamlico Passage, which covers 91,102 acres between the Neuse River Game Lands and Goose Creek Game Lands, has 84 parcels over 150 acres that were included in our analysis. Of those 84 parcels, 13 (16%) have a Very High conservation value, 59 (70%) have a High conservation value, and 12 (14%) have a Moderate conservation value. One parcel is currently pending acquisition by Coastal Land Trust.



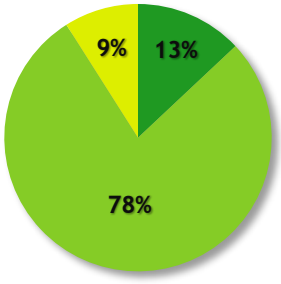

Pamlico Passage Prioritized Parcels in Marsh Migration Areas
Pamlico Passage Boundary
Marsh Migration Areas
Conservation Value
Very High
High
Moderate
Managed Areas
Federal
State
Local Government
Private
NAD 1983 StatePlane North Carolina FIPS 3200
Created August 2022
South Creek
Goose Creek Game Land
Prescott
Beaufort
Craven
Mesic
Hollyville
Vandemere
Bay City
Maribel
Bay River
Jones Bay
NC 306 Hwy N
NC Highway 33 E
Swamp Rd
0 0.75 1.5 3 4.5 6
Miles
N
W
E
S
Esri, NASA, NGA, USGS, State of North Carolina DOT, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, USDA

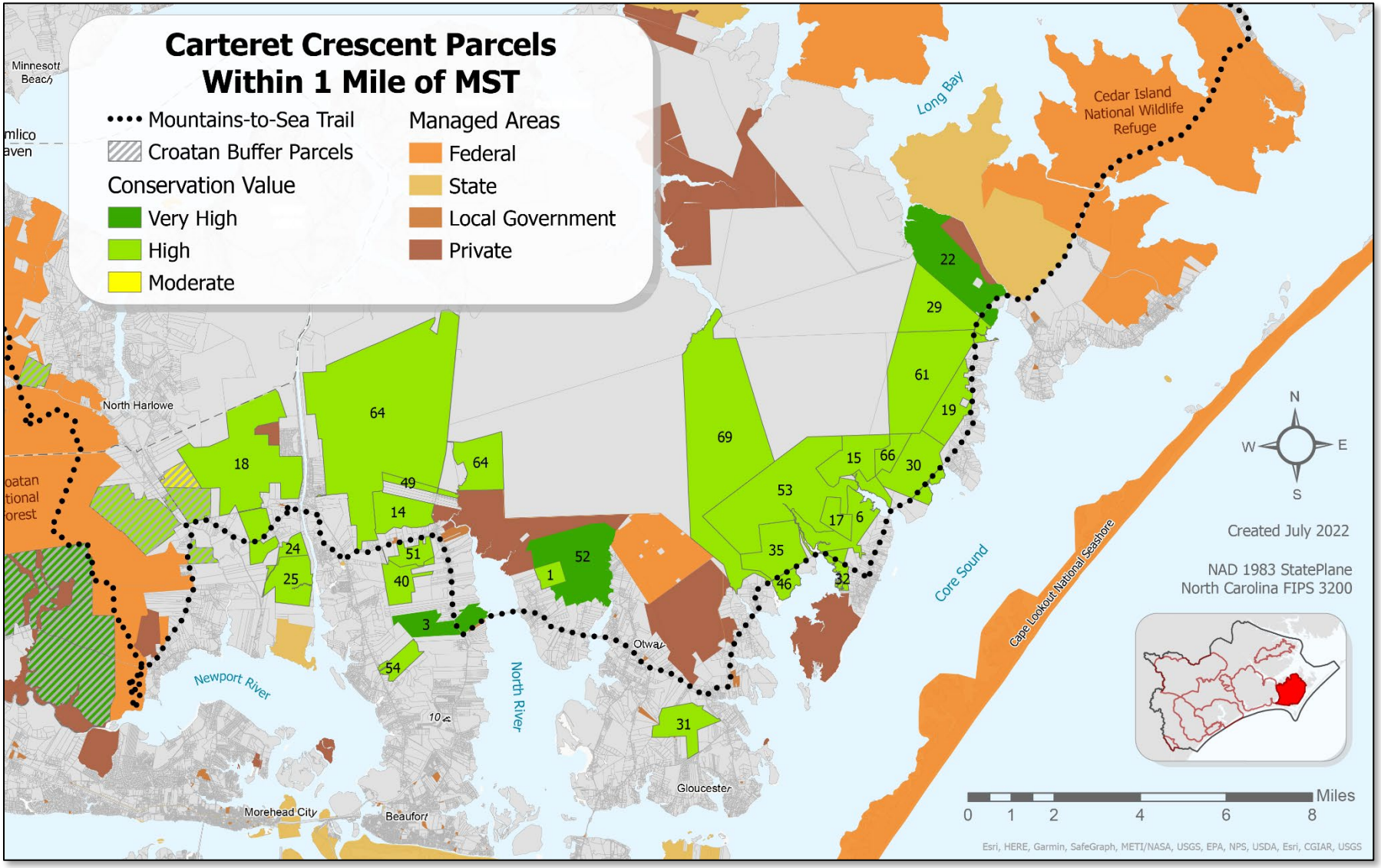
There are 26 parcels from our original analysis of the Pamlico Passage CFA that contain areas of marsh migration in a 1.5 feet of sea level rise scenario. Five of those parcels have a Very High conservation value, 19 have a High conservation value, and 2 have a moderate conservation value.

Parcel Prioritization within the Carteret Crescent CFA

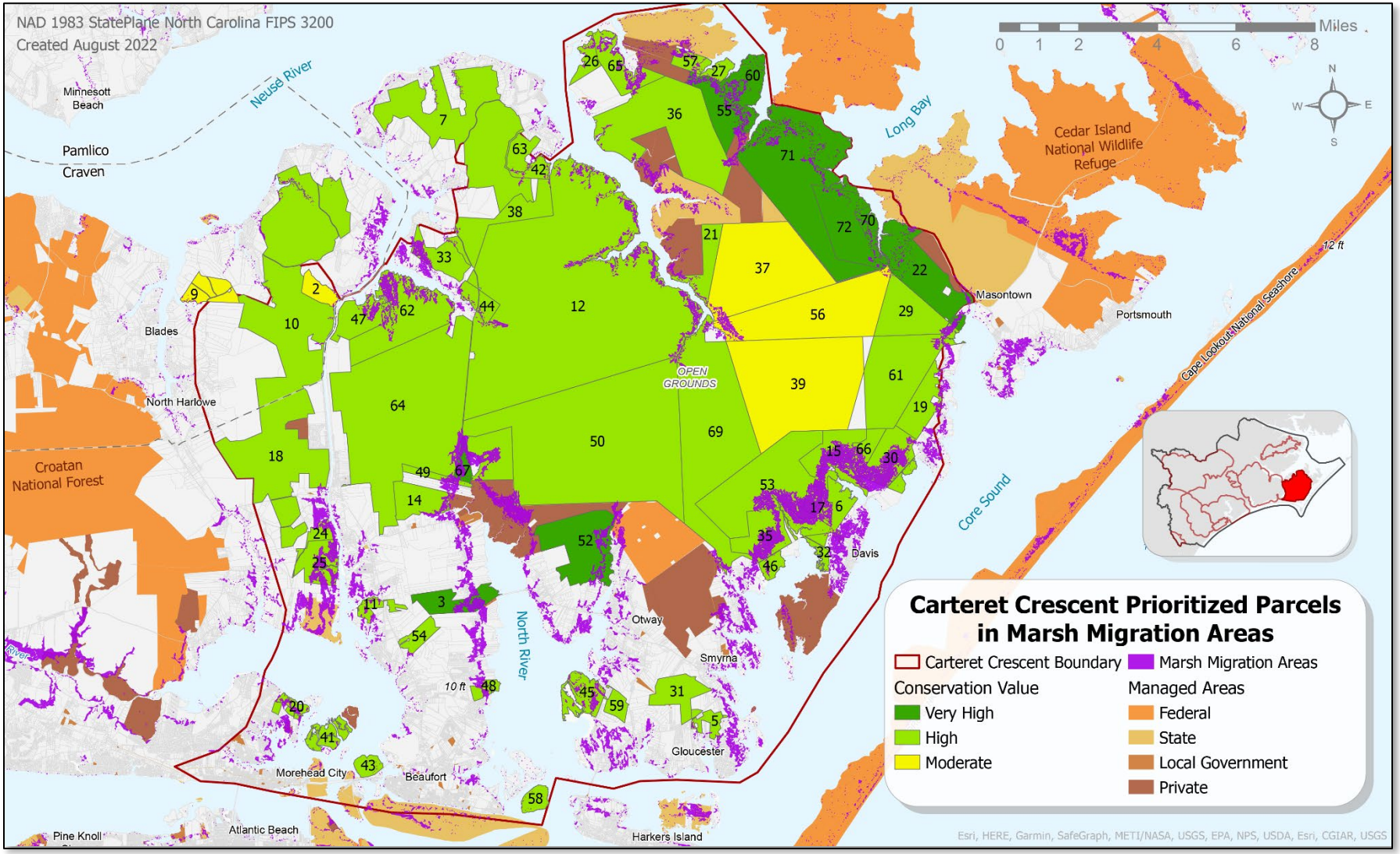


The Carteret Crescent, which spans 176,406 acres between the Croatan National Forest and Cedar Island National Wildlife Refuge, has 72 parcels over 150 acres that were included in our analysis. Of those 72, 9 (13%) have a Very High conservation value, 56 (78%) have a High conservation value, and 7 (9%) have a Moderate conservation value.



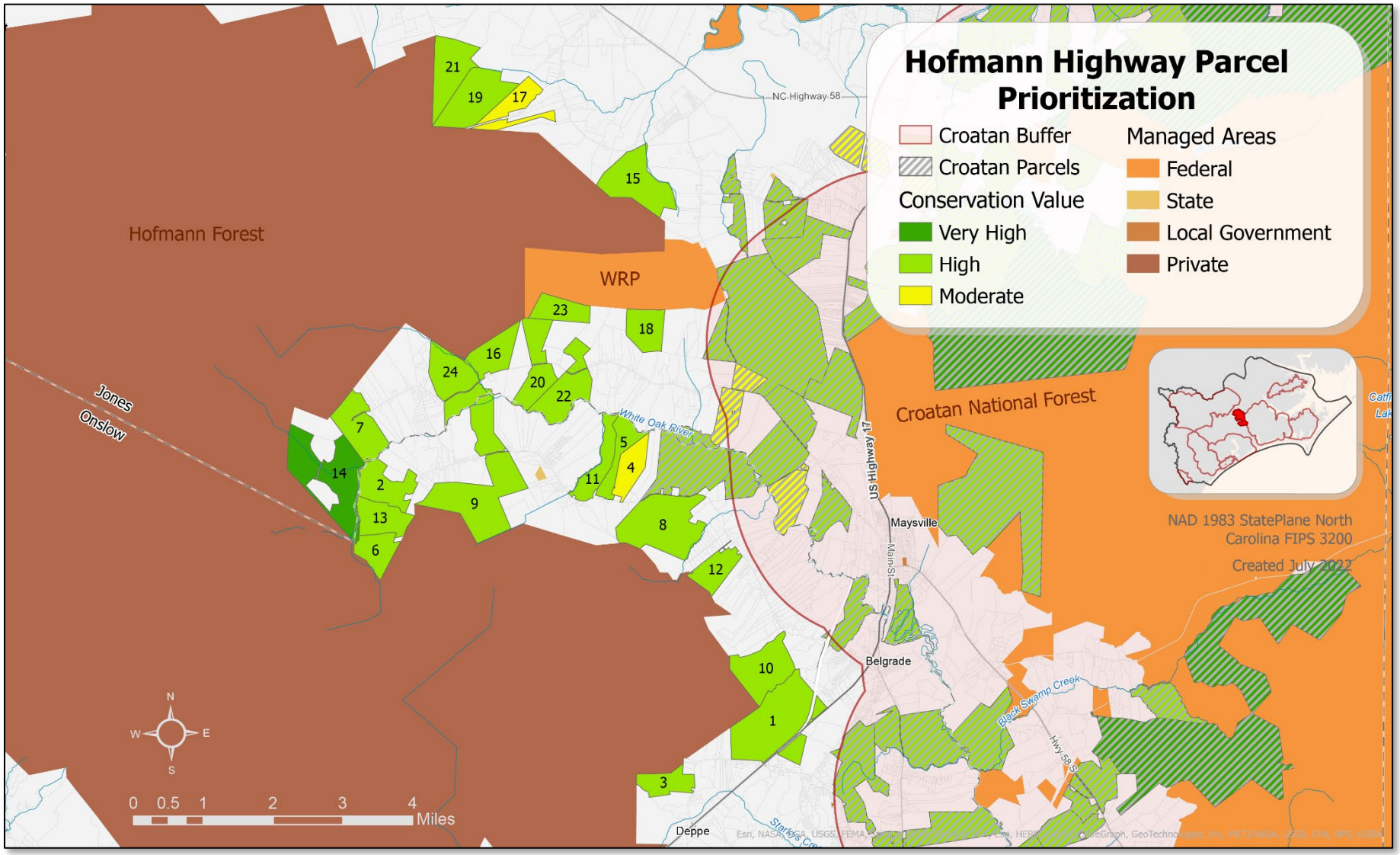

Carteret Crescent Parcels
Within 1 Mile of MST
Mountains-to-Sea Trail
Croatan Buffer Parcels
Conservation Value
Very High
High
Moderate
Managed Areas
Federal
State
Local Government
Private
Minnesott Beach
North Harlowe
Long Bay
Cedar Island National Wildlife Refuge
Core Sound
Cape Lookout National Seashore
Newport River
North River
Otway
Morehead City
Beaufort
Gloucester
N
W
E
S
Created July 2022
NAD 1983 StatePlane
North Carolina FIPS 3200
Miles
0 1 2 4 6 8
Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA, Esri, CGIAR, USGS

There are 27 parcels from our original analysis of the Carteret Crescent CFA that are located within one mile of the Mountains-to-Sea Trail. Three of those parcels have a Very High conservation value, while 24 have a High conservation value.

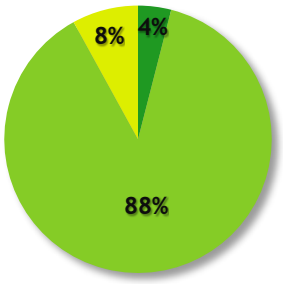

NAD 1983 StatePlane North Carolina FIPS 3200
Created August 2022
Miles
0 1 2 4 6 8
N
W
E
S
Neuse River
Minnesott Beach
Pamlico
Craven
Long Bay
Cedar Island National Wildlife Refuge
Masontown
Portsmouth
Cape Lookout National Seashore
12 ft
Blades
North Harlowe
Croatan National Forest
OPEN GROUNDS
Core Sound
Davis
Otway
Smyrna
North River
10 ft
Gloucester
Morehead City
Beaufort
Atlantic Beach
Pine Knoll
Harkers Island
Carteret Crescent Prioritized Parcels in Marsh Migration Areas
Carteret Crescent Boundary
Marsh Migration Areas
Conservation Value
Very High
High
Moderate
Managed Areas
Federal
State
Local Government
Private
Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA, Esri, CGIAR, USGS

There are 61 parcels from our original analysis of the Carteret Crescent CFA that contain areas of marsh migration in a 1.5 feet of sea level rise scenario. Five of those parcels have a Very High conservation value, 48 have a High conservation value, and 8 have a moderate conservation value.

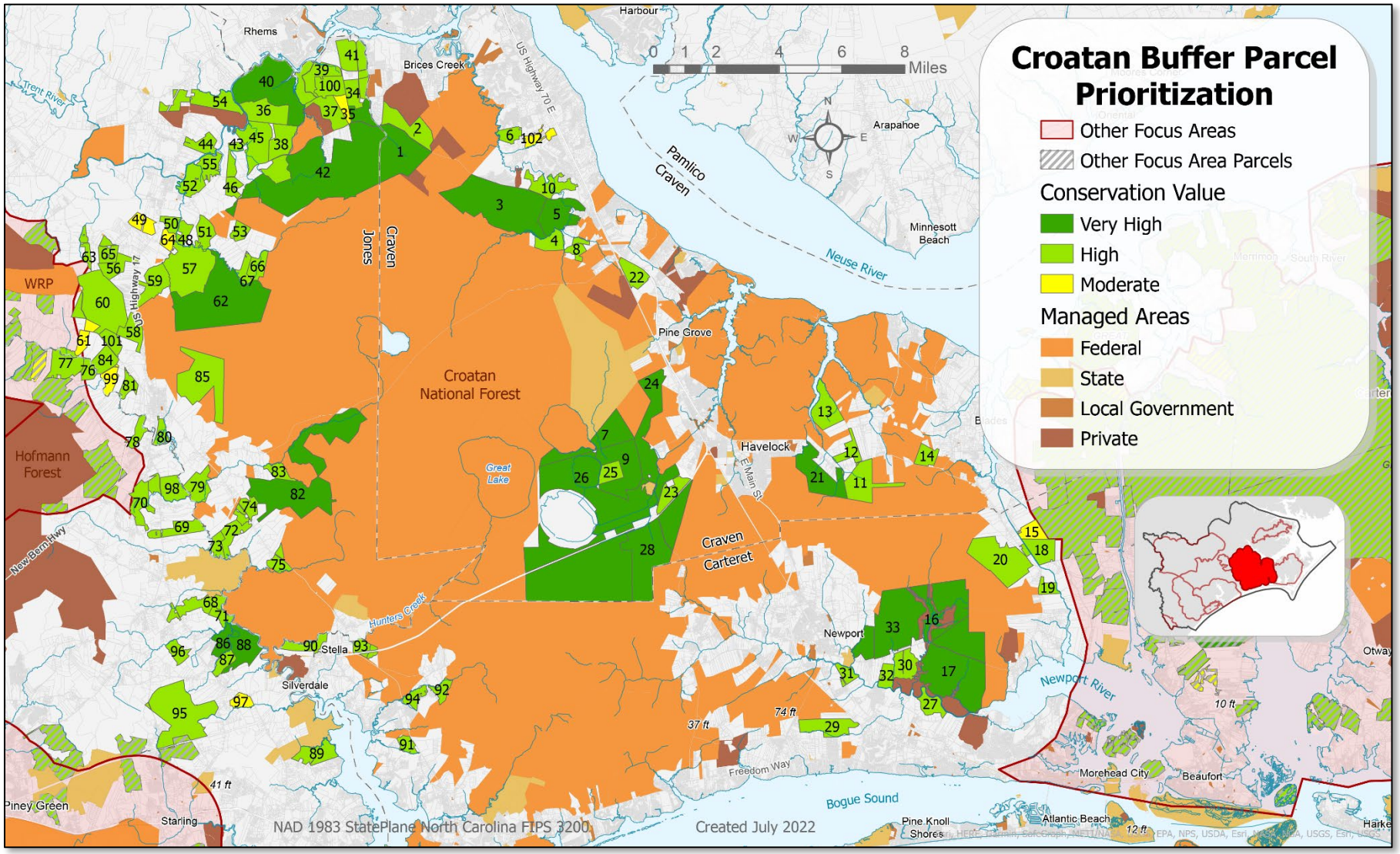
Parcel Prioritization within the Hofmann Highway CFA



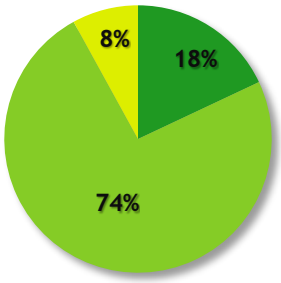
The Hofmann Highway, which covers 36,684 acres between NCSU Foundation's Hofmann Forest and Croatan National Forest, has 24 parcels over 150 acres that were included in our analysis. Of those 24, 1 (4%) has a Very High conservation value, 21 (88%) have a High conservation value, and 2 (8%) have a Moderate conservation value.

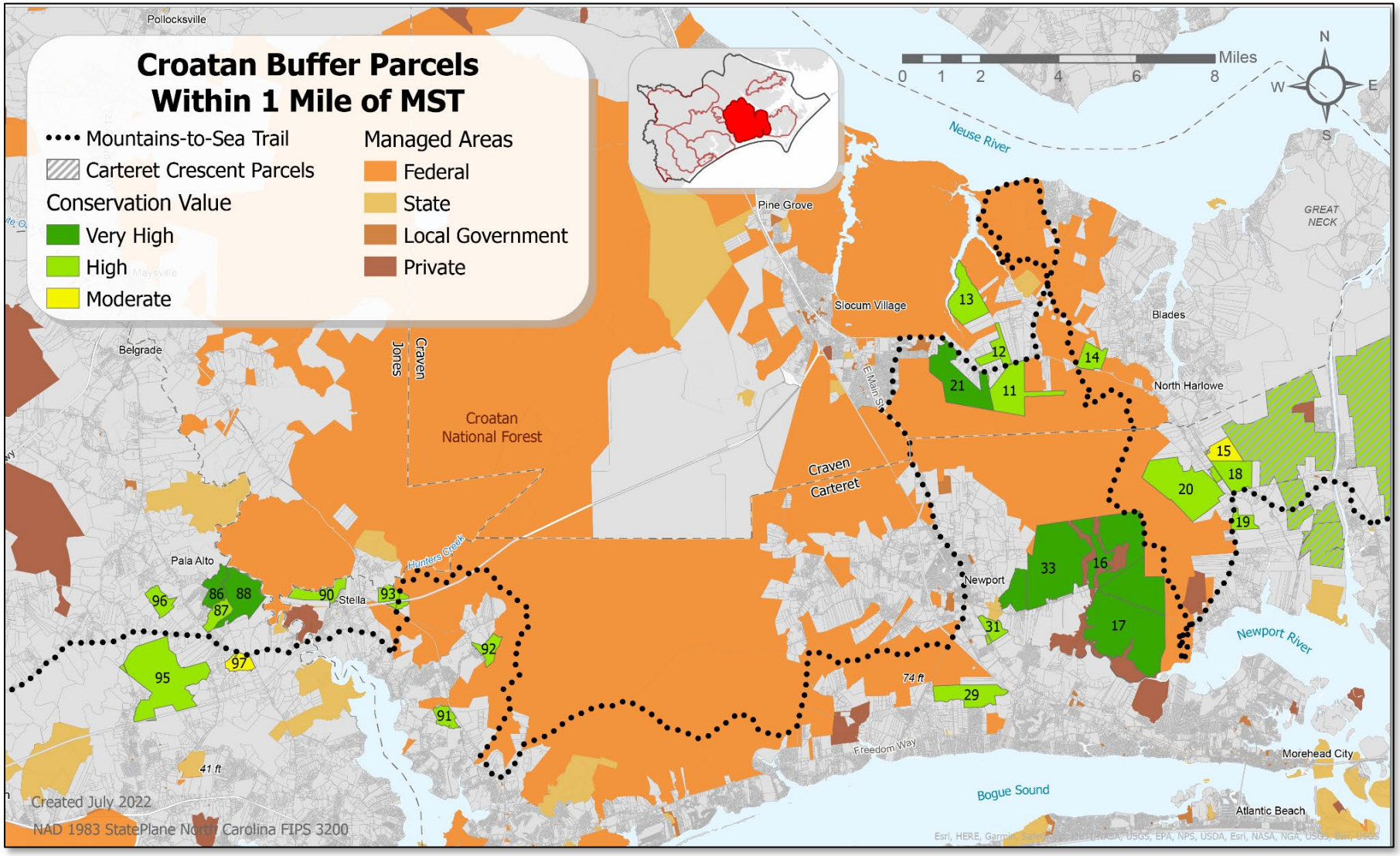


Parcel Prioritization within the Croatan Buffer CFA

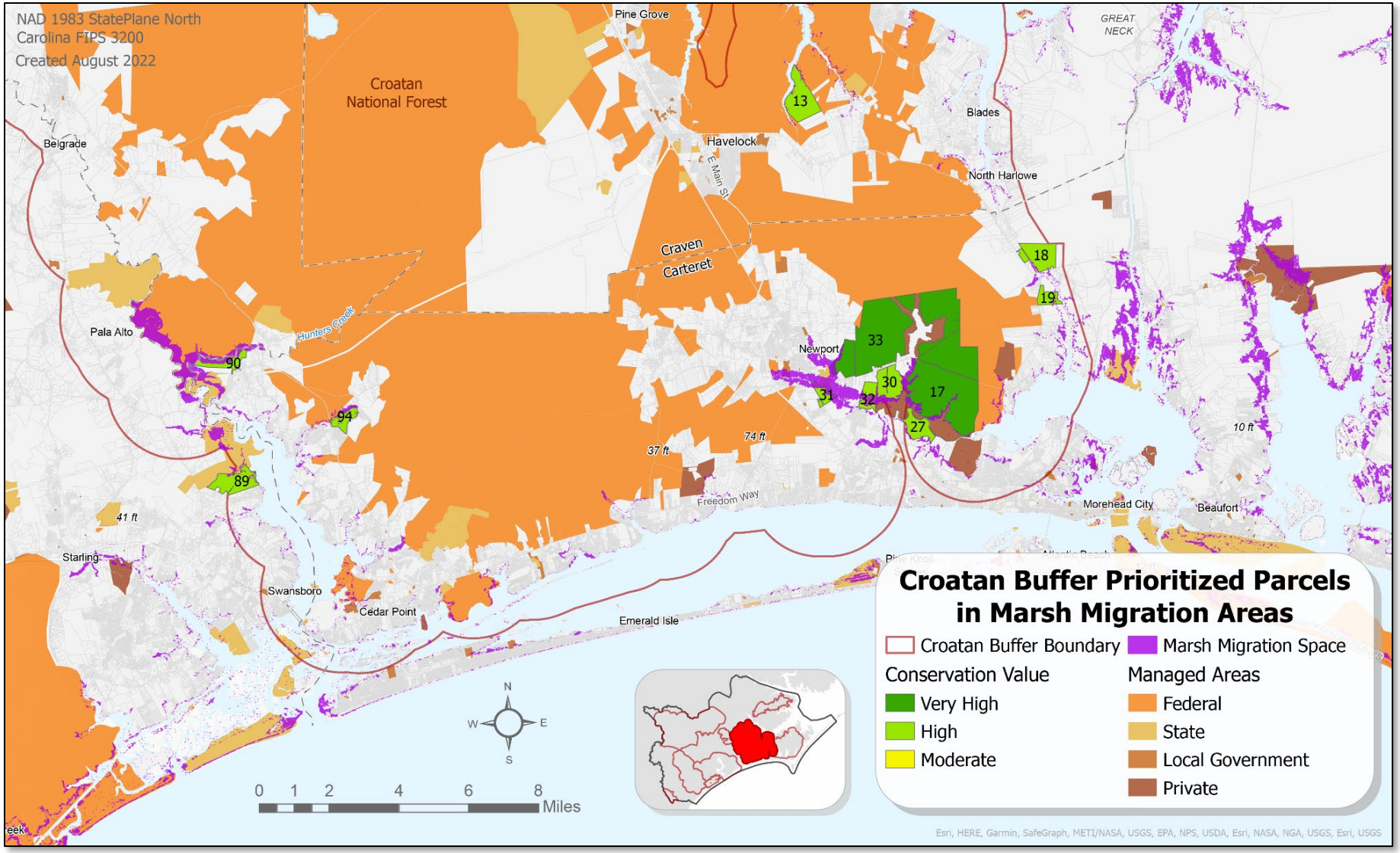


The Croatan Buffer, which covers 159,530 acres in a two-mile buffer around the Croatan National Forest, has 101 parcels over 150 acres that were included in our analysis. Of those 101, 18 (18%) have a Very High conservation value, 75 (74%) have a High conservation value, and 8 (8%) have a Moderate conservation value.



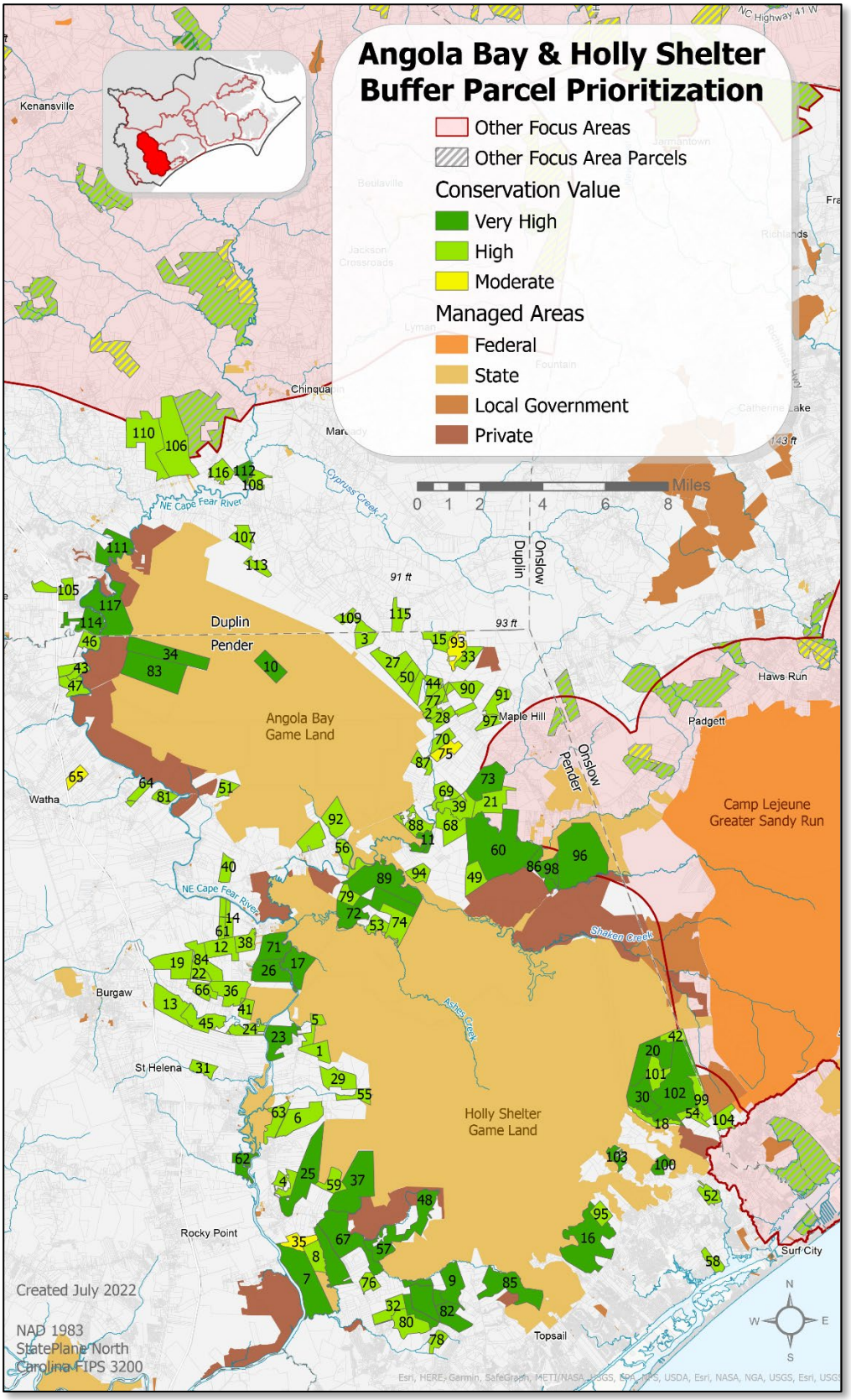

Croatan Buffer Parcels
Within 1 Mile of MST
Mountains-to-Sea Trail
Carteret Crescent Parcels
Conservation Value
Very High
High
Moderate
Managed Areas
Federal
State
Local Government
Private
Miles
0 1 2 4 6 8
N
W
E
S
Pollocksville
Neuse River
Pine Grove
GREAT NECK
Slocum Village
Blades
Belgrade
Jones
Craven
Croatan National Forest
E Main St
North Harlowe
Craven
Carteret
Hunters Creek
Paia Alto
Stella
Newport
Newport River
74 ft
Freedom Way
Morehead City
Bogue Sound
Atlantic Beach
41 ft
Created July 2022
NAD 1983 StatePlane North Carolina FIPS 3200
13
12
14
21
11
15
18
20
19
33
16
17
31
29
86
88
87
90
93
96
97
95
92
91

There are 24 parcels from our original analysis of the Croatan Buffer that are within one mile of the Mountains-to-Sea Trail. Six of those parcels have a Very High conservation value, 16 have a High conservation value, and 2 have a Moderate conservation value.

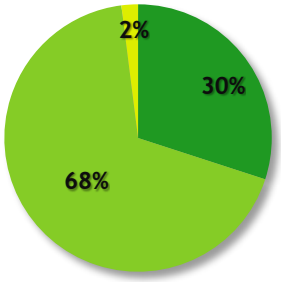

NAD 1983 StatePlane North Carolina FIPS 3200
Created August 2022
Croatan National Forest
Pine Grove
GREAT NECK
Blades
Havelock
Belgrade
North Harlowe
Craven
Carteret
Pala Alto
Hunters Creek
Newport
Morehead City
Beaufort
Starling
Swansboro
Cedar Point
Emerald Isle
Freedom Way
E Main St
74 ft
37 ft
41 ft
10 ft
13
18
19
33
30
31
32
17
27
90
94
89
Croatan Buffer Prioritized Parcels in Marsh Migration Areas
Croatan Buffer Boundary
Marsh Migration Space
Conservation Value
Very High
High
Moderate
Managed Areas
Federal
State
Local Government
Private
N
W
E
S
0 1 2 4 6 8
Miles
Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA, Esri, NASA, NGA, USGS, Esri, USGS

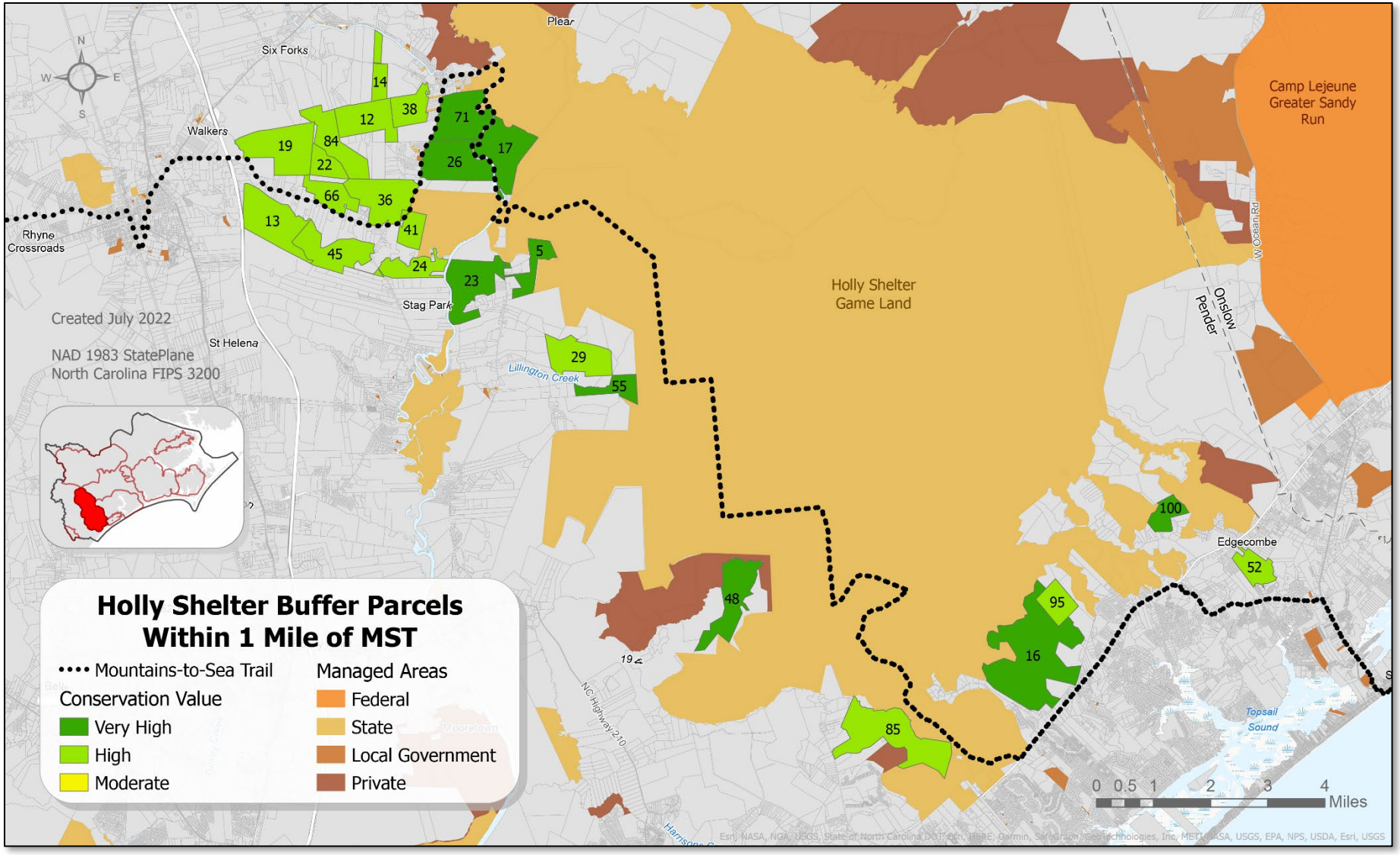
There are 12 parcels from our original analysis of the Croatan Buffer CFA that contain areas of marsh migration in a 1.5 feet of sea level rise scenario. Two of those parcels have a Very High conservation value, 10 have a High conservation value, and none have a moderate conservation value

Parcel Prioritization within the Angola Bay and Holly Shelter Game Lands Buffer CFA



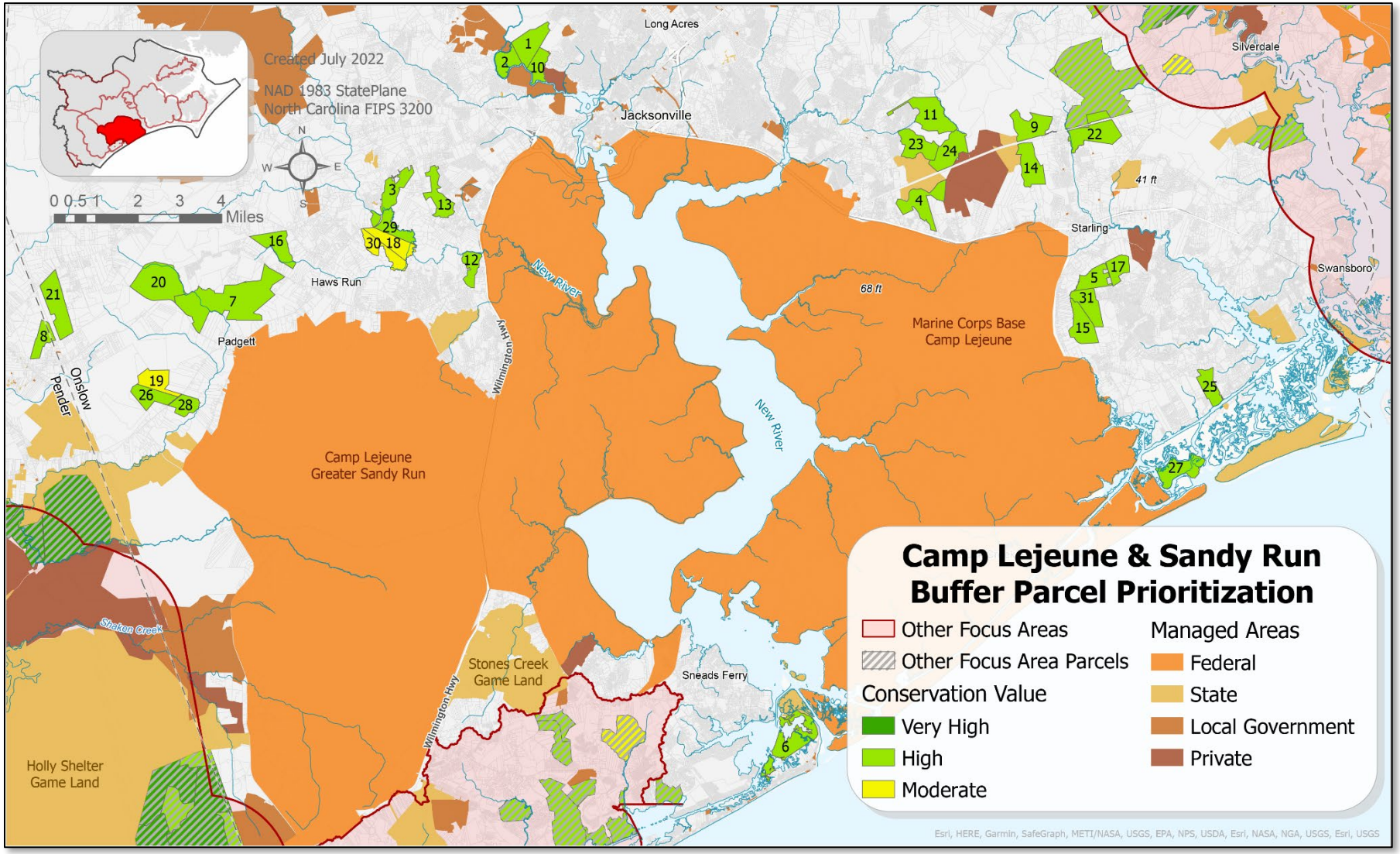
The Angola Bay and Holly Shelter Game Lands Buffer, which covers 127,696 acres in a two-mile buffer around the state-owned game lands, has 117 parcels over 150 acres that were included in our analysis. Of those 117, 35 (30%) have a Very High conservation value, 79 (68%) have a High conservation value, and 3 (2%) have a Moderate conservation value.



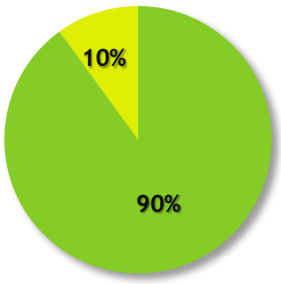

Holly Shelter Buffer Parcels
Within 1 Mile of MST
Mountains-to-Sea Trail
Conservation Value
Very High
High
Moderate
Managed Areas
Federal
State
Local Government
Private
Created July 2022
NAD 1983 StatePlane
North Carolina FIPS 3200
Holly Shelter
Game Land
Camp Lejeune
Greater Sandy
Run
Six Forks
Walkers
Rhyne
Crossroads
St Helena
Plear
Stag Park
Lillington Creek
Edgecombe
Onslow
Pender
Topsail
Sound
NC Highway 210
0 0.5 1 2 3 4
Miles

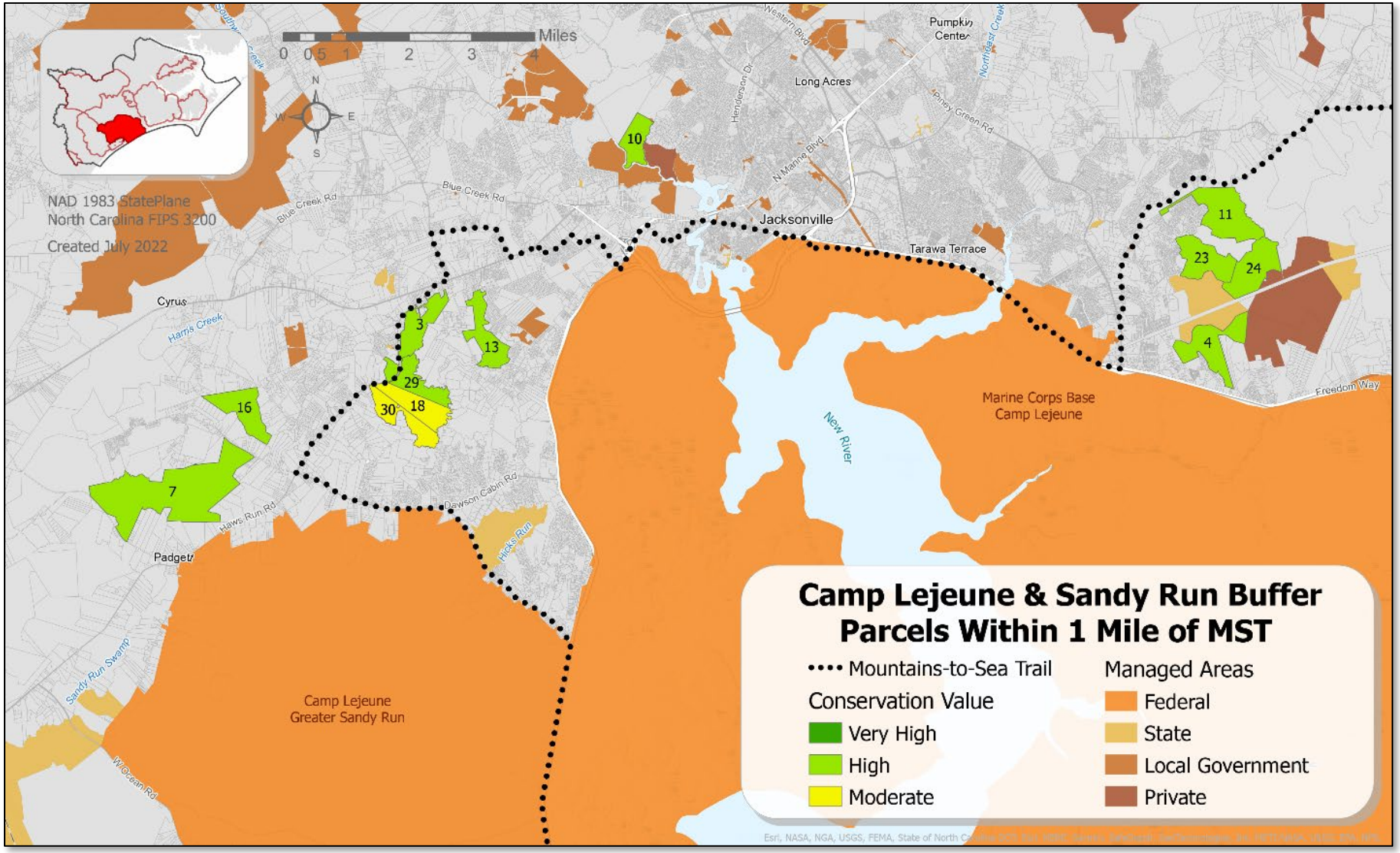
There are 25 parcels from our original analysis of the Angola Bay and Holly Shelter Game Lands Buffer that are within one mile of the Mountains-to-Sea Trail. Nine of those parcels have a Very high conservation value, while 16 have a High conservation value.

Parcel Prioritization within the Camp Lejeune and Greater Sandy Run Buffer CFA

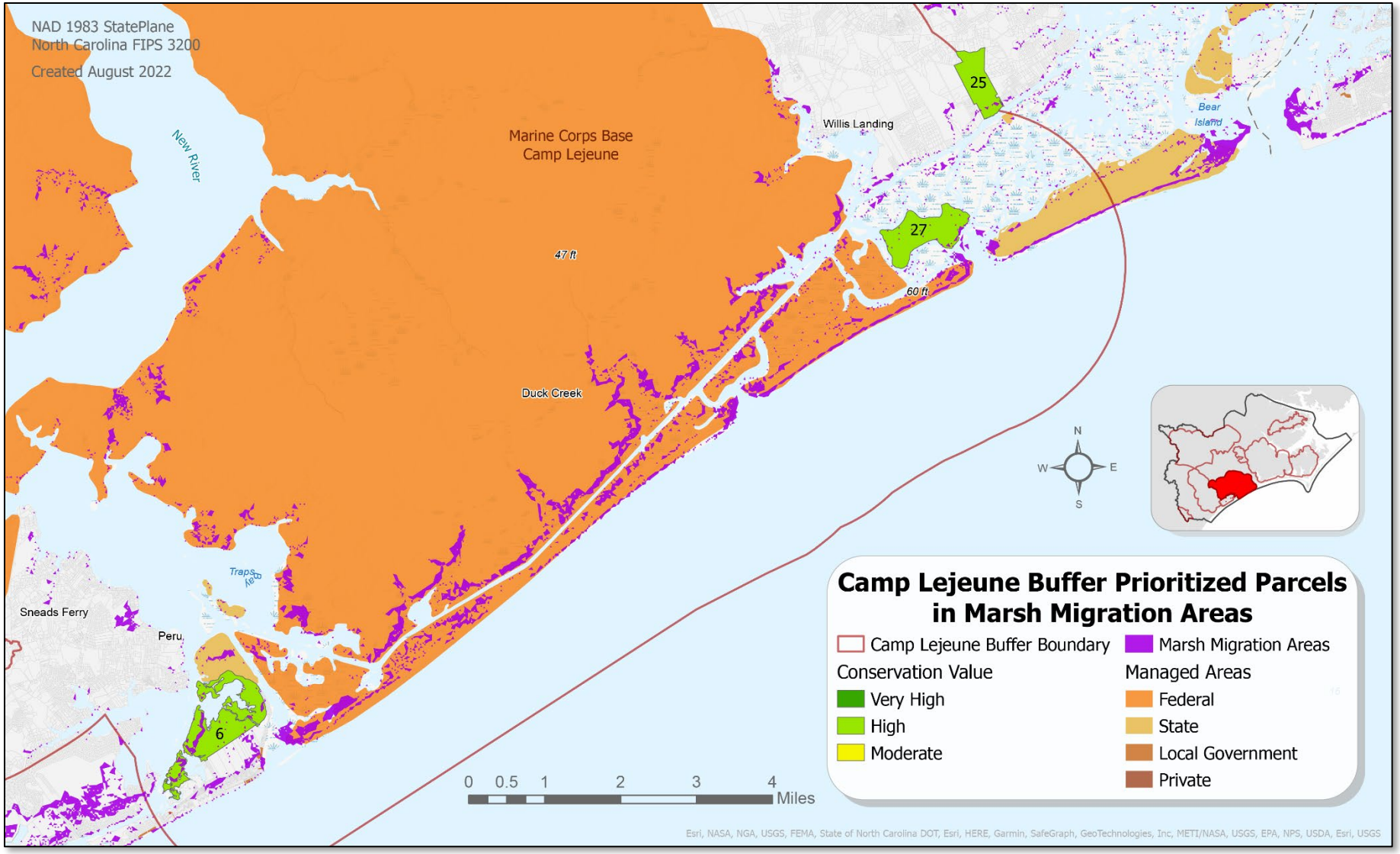


The Camp Lejeune and Greater Sandy Run Buffer, which spans 117,710 acres in a two-mile buffer around the Marine Corps Base Camp Lejeune, including the Greater Sandy Run area, has 31 parcels over 150 acres that were included in our analysis. Of those 31, none have a Very High conservation value, 28 (90%) have a High conservation value, and 3 (10%) have a Moderate conservation value.



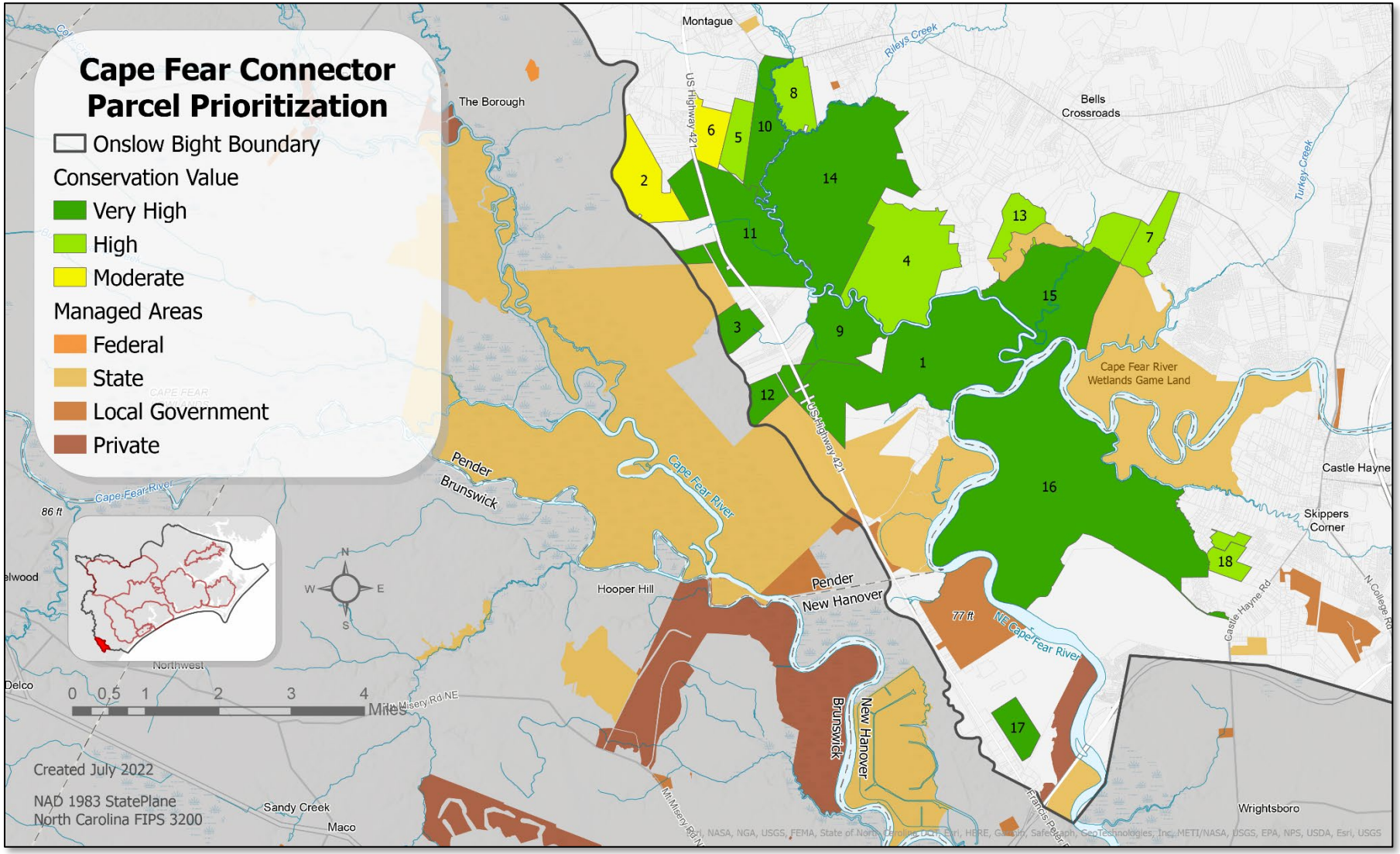

Miles
0 0.5 1 2 3 4
N
W E
S
NAD 1983 StatePlane
North Carolina FIPS 3200
Created July 2022
Jacksonville
Tarawa Terrace
Marine Corps Base
Camp Lejeune
Camp Lejeune
Greater Sandy Run
Long Acres
Pumpkin
Center
Cyrus
Padgett
New River
Blue Creek Rd
Harris Creek
Haws Run Rd
Dawson Cabin Rd
Hicks Run
Sandy Run Swamp
W Ocean Rd
N Marine Blvd
Piney Green Rd
Freedom Way
Camp Lejeune & Sandy Run Buffer
Parcels Within 1 Mile of MST
Mountains-to-Sea Trail
Conservation Value
Very High
High
Moderate
Managed Areas
Federal
State
Local Government
Private

There are 12 parcels from our original analysis of the Camp Lejeune and Greater Sandy Run Buffer that are within one mile of the Mountains-to-Sea Trail. Ten of those parcels have a High conservation value, while 2 have a Moderate conservation value.

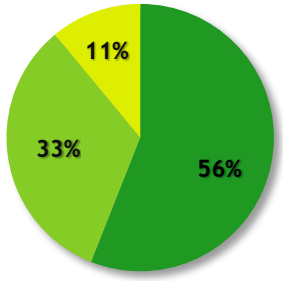

NAD 1983 StatePlane
North Carolina FIPS 3200
Created August 2022
Marine Corps Base
Camp Lejeune
New River
Willis Landing
Bear
Island
25
27
47 ft
60 ft
Duck Creek
Traps
Inlet
Sneads Ferry
Peru
6
N
W
E
S
0 0.5 1 2 3 4
Miles
Camp Lejeune Buffer Prioritized Parcels
in Marsh Migration Areas
Camp Lejeune Buffer Boundary
Marsh Migration Areas
Conservation Value
Very High
High
Moderate
Managed Areas
Federal
State
Local Government
Private
Esri, NASA, NGA, USGS, FEMA, State of North Carolina DOT, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, USDA, Esri, USGS

There are 3 parcels from our original analysis of the Camp Lejeune and Greater Sandy Run Buffer CFA that contain areas of marsh migration in a 1.5 feet of sea level rise scenario. All of those parcels have a High conservation value.

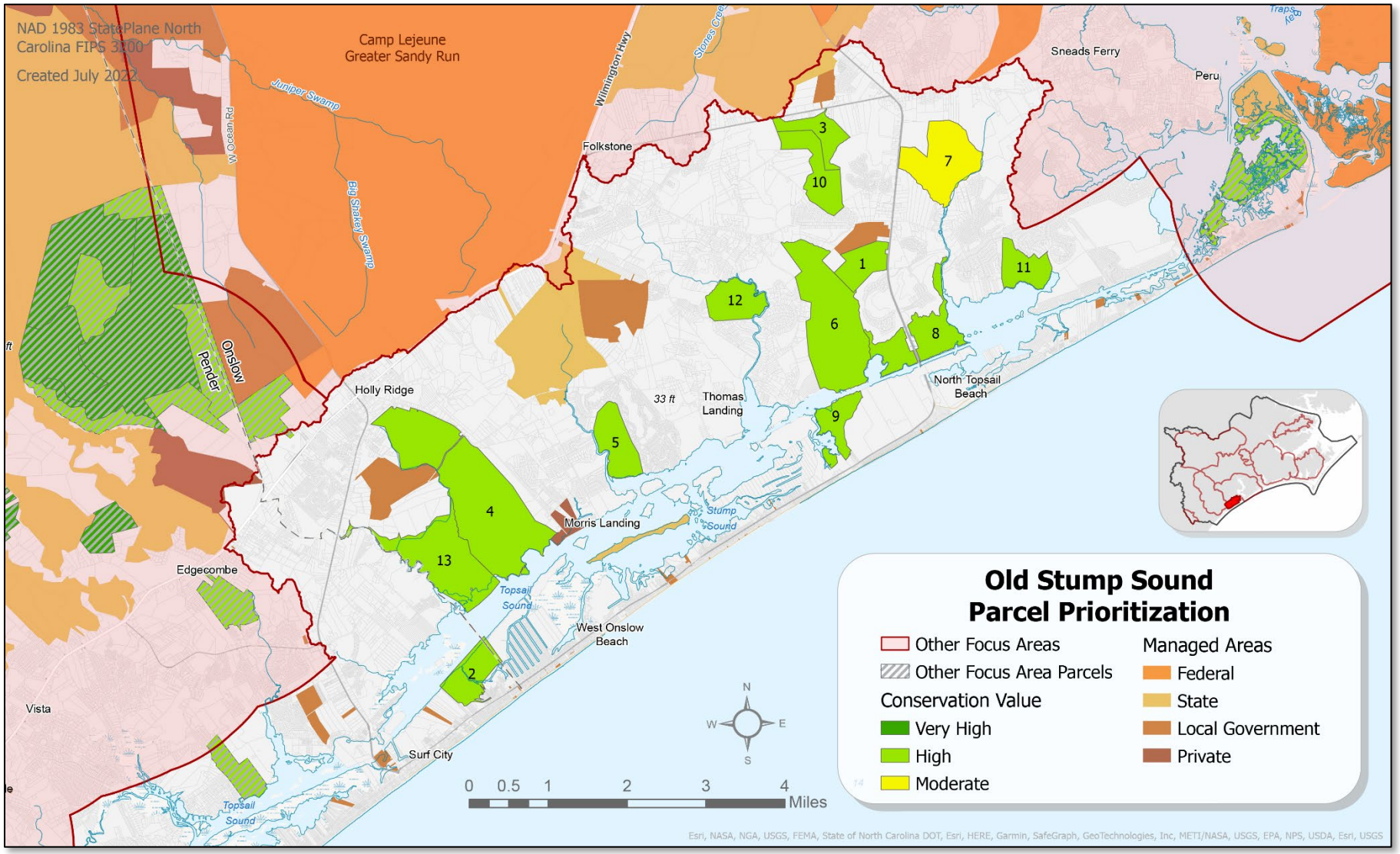
Parcel Prioritization within the Cape Fear Connector CFA



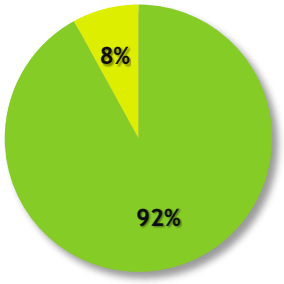
The Cape Fear Connector, which covers 25,024 acres between the Cape Fear River Wetlands Game Lands and the Cape Fear Arch region has 18 parcels over 150 acres that were included in our analysis. Of those 18, 10 (56%) have a Very High conservation value, 6 (33%) have a High conservation value, and 2 (11%) have a Moderate conservation value.

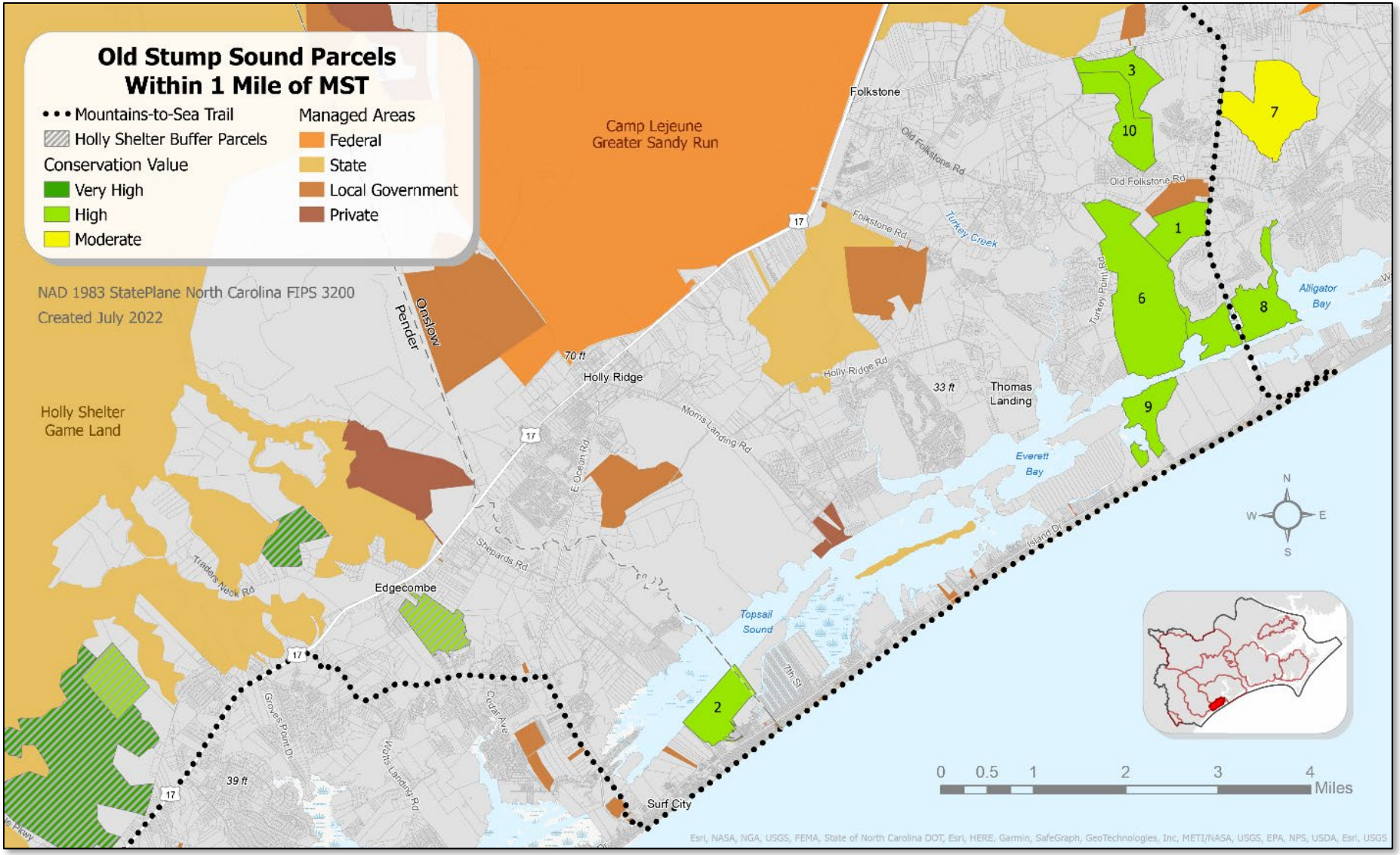


Parcel Prioritization within the Old Stump Sound CFA

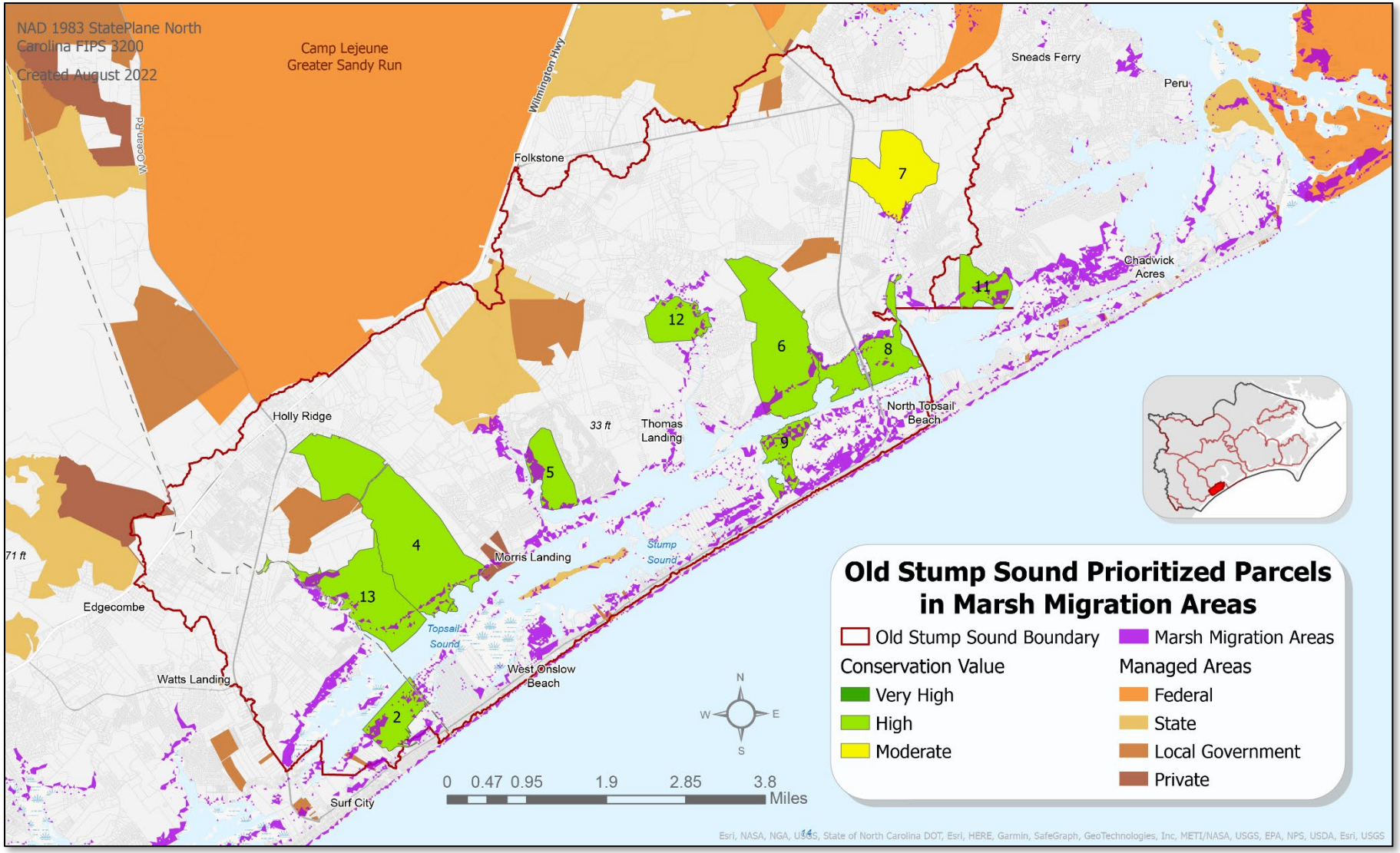


Old Stump Sound, which spans 28,689 acres around the Stump Sound, has 13 parcels over 150 acres that were included in our analysis. Of those 13, none have a Very High conservation value, 12 (92%) have a High conservation value, and 1 (8%) has a Moderate conservation value.



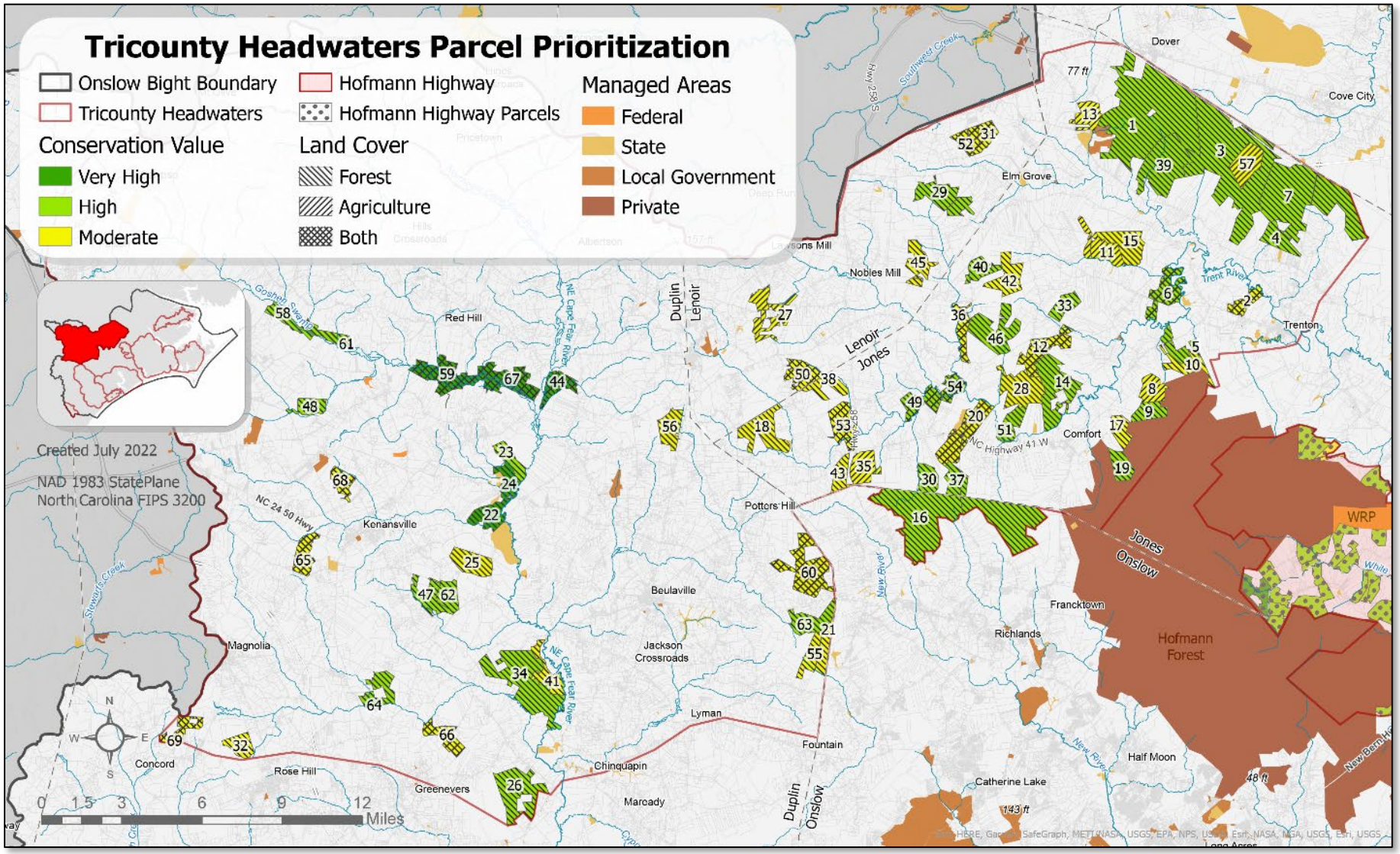

Old Stump Sound Parcels
Within 1 Mile of MST
Mountains-to-Sea Trail
Holly Shelter Buffer Parcels
Conservation Value
Very High
High
Moderate
Managed Areas
Federal
State
Local Government
Private
NAD 1983 StatePlane North Carolina FIPS 3200
Created July 2022
Camp Lejeune
Greater Sandy Run
Holly Shelter
Game Land
Onslow
Pender
Folkstone
Holly Ridge
Thomas
Landing
Edgecombe
Surf City
Topsail
Sound
Everett
Bay
Alligator
Bay
Turkey Creek
Old Folkstone Rd
Folkstone Rd
Holly Ridge Rd
Morris Landing Rd
Shepards Rd
Traders Neck Rd
Groves Point Dr
Works Landing Rd
Cedar Ave
7th St
Island Dr
Turkey Point Rd
E Ocean Rd
70 ft
33 ft
39 ft
17
1
2
3
6
7
8
9
10
N
S
E
W
0 0.5 1 2 3 4
Miles
Esri, NASA, NGA, USGS, FEMA, State of North Carolina DOT, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, USDA, Esri, USGS

There are 8 parcels from our original analysis of the Old Stump Sound that are within one mile of the Mountains-to-Sea Trail. Seven of those parcels have a High conservation value, while 1 has a Moderate conservation value.

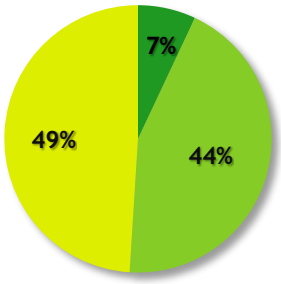

NAD 1983 StatePlane North Carolina FIPS 3200
Created August 2022
Camp Lejeune
Greater Sandy Run
W Ocean Rd
Wilmington Hwy
Folkstone
Sneads Ferry
Peru
Chadwick Acres
Holly Ridge
33 ft
Thomas Landing
North Topsail Beach
Stump Sound
Morris Landing
71 ft
Edgecombe
Topsail Sound
Watts Landing
West Onslow Beach
Surf City
0 0.47 0.95 1.9 2.85 3.8
Miles
N
W
E
S
Old Stump Sound Prioritized Parcels in Marsh Migration Areas
Old Stump Sound Boundary
Marsh Migration Areas
Conservation Value
Very High
High
Moderate
Managed Areas
Federal
State
Local Government
Private
Esri, NASA, NGA, USGS, State of North Carolina DOT, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, USDA, Esri, USGS

There are 10 parcels from our original analysis of the Old Stump Sound CFA that contain areas of marsh migration in a 1.5 feet of sea level rise scenario. None of those parcels have a Very High conservation value, 9 have a High conservation value, and 1 has a moderate conservation value.

Parcel Prioritization within the Tricounty Headwaters CFA



Tricounty Headwaters, which covers 525,029 acres upstream of the Trent and Northeast Cape Fear Rivers in Jones, Duplin, and Lenoir counties, has 69 parcels over 400 acres that were included in our analysis. Of those 69, 5 (7%) have a Very high conservation value, 30 (44%) have a High conservation value, and 34 (49%) have a Moderate conservation value. Land cover of a parcel was determined using aerial imagery from 2020, and should be groundtruthed to account for the most current land use. Forty-four parcels are thought to be in forest, 6 in agriculture, and 19 have both forest and agriculture within the parcel's boundaries.



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APPENDIX G
CLIMATE CHANGE TOOLS AND STRATEGIES

LTA - Climate Change and Impacts to Water Quality Workshop **11/17/2022**

Tools and Resources

- 4th National Climate Assessment (US Global Change Research Program)
  - Impacts, Risks, and Adaptation in the US
    - **Coastal Effects**
      - https://nca2018.globalchange.gov/downloads/NCA4_Ch08_Coastal-Effects_Full.pdf
    - **Southeastern Region**
      - https://nca2018.globalchange.gov/downloads/NCA4_Ch19_Southeast_Full.pdf
- Climate Change Response Network (Northern Institute of Applied Climate Science, USDA/USFS)
  - **Climate Adaptation Workbook**
    - https://adaptationworkbook.org/about
- USDA Climate Hubs
  - **Southeastern Climate Hub**
    - https://www.climatehubs.usda.gov/hubs/southeast/topics/
  - Special Topic: Saltwater Intrusion and Salinization on Coastal Forests and Farms
    - https://www.climatehubs.usda.gov/hubs/southeast/topic/saltwater-intrusion-and-salinization-coastal-forests-and-farms
    - *Identification, Mitigation, and Adaptation to Salinization on Working Lands in the U.S. Southeast – USDA Technical Report*
      - https://www.climatehubs.usda.gov/sites/default/files/GTR-259_revd_web.pdf
- Climate Mapping for Resilience and Adaptation (US Global Change Research Program)
  - **CMRA Toolkit** – Search New Hanover County, NC for example
    - https://livingatlas.arcgis.com/assessment-tool/explore/details
- EPA – **How's My Waterway Tool**
  - Example: Brunswick River/Cape Fear River in Wilmington, NC
    - https://mywaterway.epa.gov/community/Wilmington,%20NC/overview
- Headwaters Economic Tools – **Neighborhoods at Risk Tool**
  - Example: Greater Wilmington, NC
    - https://nar.headwaterseconomics.org/3700074440/explore/map
- First Street Foundation
  - **Flood Factor Tool**
    - Example: Greater Wilmington, NC
      - https://riskfactor.com/city/wilmington-nc/3774440_fsid/flood
- **Conservation Carbon Map** (Trust for Public Lands)
  - https://web.tplgis.org/carbonmap/
  - Create Free Account and Explore GIS Data and Mapping Tool Related to Carbon Stocks, Threats to Carbon-Rich Landscapes, Benefits of Climate Conservation Work to Protecting Drinking Water Supplies, Rare Ecosystems, and Important Habitat Cores.
- LTA – Resource Center: Climate Communications
  - Resource Hub that provides information on strategies for communicating to the public around Climate Change Impacts
    - https://landtrustalliance.org/resources/learn/topics/climate-change/climate-communications

LTA - Climate Change and Impacts to Water Quality Workshop **11/17/2022**
Tools and Resources

- Additional Climate Change Resources from the EPA
  - ***Advancing Watershed Protection Through Land Conservation – A Guide for Land Trusts***
    - https://www.epa.gov/system/files/documents/2022-07/Advancing_Watershed_Protection_Through_Land_Conservation_EPA_July_2022.pdf
  - Office of Water 2022 – 2026: ***Climate Adaptation Implementation Plan***
    - https://www.epa.gov/system/files/documents/2022-10/bh508-OW-12113_ClimateAdaptatImplementPlan_508final.pdf
  - Journal of Water & Climate Change: ***A review of climate change effects on practices for mitigating water quality impacts.*** Thomas Johnson; Jonathan Butcher; Stephanie Santell; Sara Schwartz; Susan Julius; Stephen LeDuc.
    - https://iwaponline.com/jwcc/article/13/4/1684/87748/A-review-of-climate-change-effects-on-practices
  - ***Funding Land Conservation Projects with the Clean Water State Revolving Fund***
    - https://www.epa.gov/sites/default/files/2018-10/documents/cwsrf_land_conservation.pdf
  - ***CWSRF Best Practices Guide for Financing Nonpoint Source Solutions***
    - https://www.epa.gov/system/files/documents/2021-12/cwsrf-nps-best-practices-guide.pdf