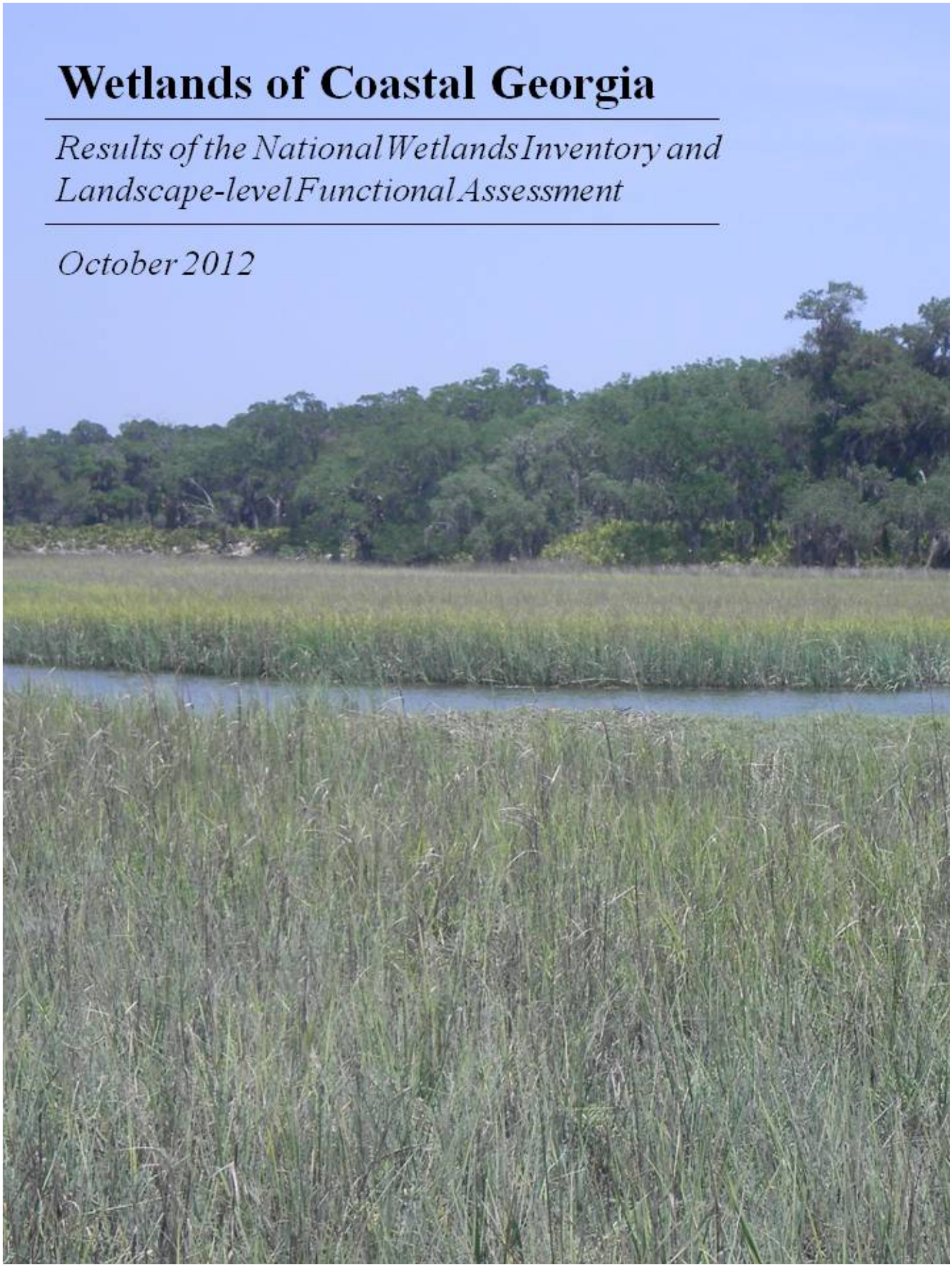
Wetlands of Coastal Georgia

Results of the National Wetlands Inventory and Landscape-level Functional Assessment

October 2012



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Results of the National Wetlands Inventory and Landscape-level Functional Assessment

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Introduction

Coastal Georgia was among the first areas in the nation to be inventoried by the National Wetlands Inventory Program (NWI) of the U.S. Fish and Wildlife Service (FWS or Service). That early wetland mapping work was done in cooperation with the Georgia Department of Natural Resources (DNR) in the late 1970s, and though it was not widely distributed, it was instrumental in formulating NWI procedures. In the late 1980s the NWI was again conducted for coastal Georgia, and the results of the inventory were published in the form of hardcopy 1:24,000 scale maps that were later digitized to be used as a data layer in geographic information systems (GIS) applications. A history of the NWI in the area is included in this report. Much change has occurred since the 1980s inventory and the original mapping is no longer relevant for most of the coastal counties, especially in areas where development activity and natural coastal geophysical processes have taken place.

Remote sensing technology has advanced considerably since the early mapping was conducted; better quality aerial imagery is increasingly available and geospatial technology has evolved to make desktop interpretation of digital imagery possible. These advances allow production of a more comprehensive inventory with both improved detection (i.e., more wetlands identified) and better classification detail. The NWI also created additional descriptors for landscape position, landform, water flow path, and waterbody type (LLWW descriptors) to expand wetland classification. The enhanced classification, referred to as NWI+, allows for more detailed classification of types that can be used to perform a preliminary assessment of functions for wetlands in the region. Recognizing this, the Coastal Resources Division (CRD) of the DNR, utilizing a grant from the U.S. Environmental Protection Agency and in cooperation with FWS, elected to update the NWI for the six coastal counties: Chatham, Bryan, Liberty, McIntosh, Glynn, and Camden.

This document reports on the methods and the findings of the updated and enhanced wetland inventory. It includes information on wetland status (e.g., acreage of different wetland types) and a preliminary functional assessment of wetlands. The functional assessment highlights wetlands that are predicted to perform eleven functions at significant levels and includes thematic maps showing the location of these wetlands.

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History of the National Wetlands Inventory in Coastal Georgia

The DNR has a relationship with the NWI that dates back to the 1970s. The NWI update described in this report is the third iteration of the NWI for coastal Georgia. With ever-improving mapping techniques, each wetlands inventory has been of greater detail and precision.

When the NWI became operational in 1976, coastal Georgia was among the first places where mapping and classifying wetlands on a regional scale using the new Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979), then in the working draft stage of completion, was attempted. The initial coastal Georgia NWI effort took place from 1977 through 1979. The DNR's Game and Fish Division, Coastal Fisheries Section (under contract to the FWS) provided the photo-interpretation and field checking of the wetland delineations that were provided to the FWS for map production. The study area for the project extended from the South Carolina state border southward to the Florida border and westward from the ocean about 30 miles. Photo-interpreters from the Coastal Protection Section delineated wetlands that they were able to observe through ten-power stereoscopes directly on to mylar overlays attached to color infrared (CIR) or black and white aerials varying in scale from 1:76,000 to 1:130,000, taken from 1973 to 1978. Wetlands were classified only to the system, subsystem, and class level. The minimum size of wetlands delineated was between 5 and 20 acres. The wetland maps produced from these delineations were at a scale of 1:100,000. The maps were not widely distributed and were used primarily as a source of information for an atlas associated with Ecological Characterization of the Sea Island Coastal Region of South Carolina and Georgia Vol. III, Biological Features of the Characterization Area (Sandifer 1980), prepared by the Biological Services Program of the FWS.

During the 1980s, interest in wetland management and regulation increased. With encouragement from natural resource managers, the NWI started production of large-scale wetland maps from stereoscopic photo-interpretation of high altitude aerial photographs. Optical devices called zoom transfer scopes were used to match the wetland delineations with U.S. Geological Survey (USGS) 1:24,000 scale quadrangle base maps and produce hardcopy wetland maps at 1:24,000. In addition to increasing the scale of the wetland maps, the level of classification detail was also improved. Wetlands were now being classified in accordance with the Cowardin et al. (1979) classification system to the subclass level, including water regime modifiers and special modifiers where they could be observed from the aerial photographs or where collateral information was available.

Significant in the production of improved wetland maps by the NWI was the development of the National High Altitude Program (NHAP) for the acquisition of consistent and systematic aerial photography coverage of the United States. The program, begun in 1978, enabled federal agencies to combine funds to acquire aerial photography to support a wide range of uses. The Department of the Interior, especially USGS and the FWS, was a regular contributor to the program. Under direction of the USGS, the program simultaneously acquired 1:80,000-scale panchromatic and 1:58,000-scale CIR positive images. NHAP acquired aerial photography from 1980 to 1987.

Coastal Georgia, because of its high density of wetlands, continued to be a priority for the NWI. In the mid-1980s, with the availability of high quality NHAP color infrared imagery taken in March of 1983 and February of 1984, the NWI undertook a second inventory of the area. Using a photo-interpretation and drafting contractor, Martel Laboratories in St. Petersburg, Florida, wetlands were again identified through ten-power stereoscopic analysis and delineated on clear mylar overlays attached to the NHAP CIR images. The late winter, leaf-off, NHAP imagery, proved to be an excellent wetland mapping data source. The minimum size of wetlands delineated ranged from one acre for high contrast features such as farm ponds to five acres for most vegetated wetland types. The identification and classification of wetlands from the imagery was supported by the use of collateral information including USGS topographic maps, Natural Resources Conservation Service (NRCS) Soil Surveys, and other ecoregional documentation, along with limited ground truth acquisition. Once the delineations were completed and reviewed by the FWS, they were transferred optically (using zoom transfer scopes) to fit the corresponding 1:24,000-scale USGS topographic base maps. The draft maps, showing the wetland delineations and classifications, were then distributed upon request to interested parties for review, a number of which participated with the FWS in field checking the maps. Based on comments returned to the FWS, the maps were edited and prepared for final distribution. These procedures were standard practice for the NWI for nearly two decades.

The 1980s version NWI maps for Georgia were well received by wetland managers, regulators, and others involved in land planning and management. In the early 1990s, the Georgia Geological Survey became a distribution center for the NWI, copying and mailing maps to users upon request, facilitating their wide application. Shortly thereafter, the use of NWI was institutionalized in the tax code by the Georgia Department of Revenue by making any area of a landowner's property shown as wetland by the NWI as eligible for a Conservation Use Assessment for Environmentally Sensitive Property. In 2000, the Georgia Department of Community Affairs developed guidelines for preparation of local wetlands ordinances that incorporated the use of the NWI in the planning and development process (See Figure 1).

In the late 1990s, GIS technology was advancing rapidly. Natural resources professionals were finding GIS tools invaluable for their work. Recognizing this, the Environmental Protection Division of the DNR partnered with the NWI by funding the digitization of the 1980s version hard-copy NWI maps, which the FWS posted on their website, making them internet-accessible. Partnerships like this helped make the NWI one of the first standardized data layers broadly available to GIS users.

By the mid-2000s, the landscape of coastal Georgia had changed considerably since the previous NWI period. The value of wetlands was much better understood and interest in their sound management had increased significantly. Also the NWI had developed techniques to expand wetland classification to include hydrogeomorphic-type descriptors that significantly increased the descriptive information about mapped wetlands and allowed NWI data to be used to produce a preliminary landscape-level assessment of wetland functions. In 2008, as a result of these factors, the Coastal Resources Division of the Department of Natural Resources, in cooperation with the FWS, elected to utilize grant funding from the U.S. Environmental Protection Agency to update and enhance the NWI data for coastal Georgia.

This report provides an overview of the process of updating the NWI for the six coastal counties, the results of the NWI, as well as the process and results of enhancing the NWI and conducting a preliminary landscape-level assessment of wetland functions for the area.

Figure 1. Georgia Department of Community Affairs (GDCA) guidelines for preparation of local wetlands ordinances as published on the GDCA website in September 2000. This version of the guidelines is provided as historical reference only. Contact information contained in the guidelines may no longer be current.

WETLANDS: GUIDELINES

Step One: Identify and Map

A local government does not need to start from scratch to create a wetlands map. This information has already been produced. National Wetlands Inventory (NWI) maps, as they are called, are available in both digital (computer) and paper format.

A. Obtain the wetlands map.

1. The paper maps can be obtained by calling either of the following:

Division of Natural Resources Georgia Natural Heritage Program 2117 U.S. Highway 278 SE Social Circle, Georgia 30025 Phone: 770.918.6411	OR	Georgia Geologic Survey Room 4063 19 Martin Luther King Jr. Dr. SW Atlanta, GA 30334-9004 (404) 657-6127 FAX: 404-657-8379

2. The digital maps are available on the World Wide Web at www.nwi.fws.gov. Some areas of the state have been digitally mapped and are available for downloading.

B. Create a wetlands map.

An RDC or local government can create a map using available data.

1. Find the selected area on your Digital Ortho Quadrangle (DOQ) CD. Use this data as your base. [*Every RDC has a CD containing DOQs for their region. This data is broken down by County.]*
2. Download the Department of Transportation (DOT) road data at www.GIS.state.ga.us. *[This can be found within this website by going to 'clearinghouse', 'data library', 'browse data', 'theme search'.]* If your RDC has its own road system data this can also be used. Overlay this data on the DOQ base map.
3. Download the National Wetlands Inventory Maps from www.nwi.fws.gov./download.htm. All of these maps will be available on DCA's website soon. Overlay this data on the DOQ base map.

C. Review the wetlands map.

Review the maps to see if there are wetlands in the city or county's jurisdiction (Call DCA for assistance if necessary.) If wetlands are present within the jurisdiction, local wetland protection criteria must be adopted.

Step Two: Design and Prepare Ordinance

- Wetland protection requires coordination with the U.S. Army Corps of Engineers for review of projects that may require a Section 404 Permit. For more information regarding this regulatory program, go to www.sas.usace.army.mil/permit.htm or call the Savannah District Regulatory Branch at 1.800.448.2402 or 912.652.5995.

- Review the Rules for Environmental Criteria (Rule 391-3-16-.03) and think about which local regulations or procedures should trigger the wetland review process. The Rules are available from DCA's website (http://www.dca.state.ga.us/planning/ocp_rules/envtoc.html) or by calling the DCA Office of Coordinated Planning Division at 404-679-5279 or email to esmith@dca.state.ga.us. Also refer to *Designing, Implementing, and Enforcing* a local ordinance for additional information. In the absence of other regulations, you may need a stand-alone ordinance.

- **Design a coordination process.** Incorporate provisions into your regulations that require builders and developers to submit proposed projects for wetlands review. If it appears that wetlands are present on the proposed development site, the applicant should submit the project to the U.S. Army Corps of Engineers for a jurisdictional wetlands determination and possibly a 404 permit. No local permit must be issued on a project that appears to contain wetlands until a determination has been made by the Corps of Engineers on whether jurisdictional wetlands exist on the site.

  Decide who will have the *responsibility* at the local level of comparing the sites of proposed projects to wetlands maps and referring projects that appear to contain wetlands to the Corps.

  1. If there **are no** jurisdictional wetlands on site, the local government permitting process can proceed.

  2. If there **are** jurisdictional wetlands on the site that will be disturbed by the proposed development, the applicant must first obtain a wetlands alteration permit from the Corps of Engineers.

     > *Sending every developer to the Corps for a determination would needlessly overburden the Corps staff resources and delay the developers local permitting process. Therefore, it is important for the local government to compare a project to a "wetlands map" and if the project appears to be near or within a wetland area then the developer needs to consult with the U.S. Army Corps of Engineers before issuance of any local permit.*

Step Three: Local Legal Review
Prepare the ordinance and have the city/county attorney review the draft ordinance prior to its adoption. This review should focus on ensuring that the local government is not violating the rights of developers and property owners, which can lead to expensive lawsuits.

Step Four: Submit to DCA for Review
All local governments must submit their environmental ordinances to the DCA for review and approval. The local government can submit directly to DCA or to the RDC. DCA prefers the ordinance to be in draft form when submitted but this is not required.

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Study Area

The study area is composed of Georgia's six coastal counties, each with direct access to the Atlantic Ocean. They are, from north to south: Chatham, Bryan, Liberty, McIntosh, Glynn, and Camden Counties. The counties cover a land area of approximately 3,159 square miles and represent about 5.5 percent of the State of Georgia (Figure 2). County acreages used in this study are based on the 2006 United States Census Bureau, Geography Division, TIGER/Line Shapefiles.

Figure 2. Study Area.

Overview of NWI's Wetland Definition and Classification System[1]

Since some readers may be unfamiliar with the Service's wetland definition and classification system and this system serves as the foundation for this report, an introduction to the definition and classification is presented here. Other readers may simply proceed to the next section of this report on page 19. Idealized wetland plant community descriptions for coastal Georgia with typical NWI classifications are included in Appendix B.

Wetland Definition

Conceptually, wetlands usually lie between the better drained, rarely flooded uplands and the permanently flooded deep waters of lakes, rivers, and coastal embayments. Wetlands include the variety of marshes, bogs, swamps, shallow ponds, and bottomland forests that occur throughout the country. They usually form in upland depressions or along rivers, lakes and coastal waters in areas subject to periodic flooding. Some wetlands, however, occur on slopes where they are associated with groundwater seepage areas or drainageways.

For mapping wetlands, the Service defines wetlands as follows:

> "Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year." (Cowardin et al. 1979)

This definition emphasizes three key attributes of wetlands: (1) hydrology - the degree of flooding or soil saturation, (2) wetland vegetation (hydrophytes), and (3) hydric soils. All areas considered wetland must have enough water at some time during the year to stress plants and animals not adapted for life in water or saturated soils. Most wetlands have hydrophytes and hydric soils present, yet many are nonvegetated (e.g., tidal mudflats). Wetlands typically fall within one of the following four categories: (1) areas with both hydrophytes and hydric soils (e.g., marshes, swamps, and bogs), (2) areas without hydrophytes, but with hydric soils (e.g., farmed wetlands), (3) areas without soils but with hydrophytes (e.g., seaweed-covered rocky shores), and (4) periodically flooded areas without soil and without hydrophytes (e.g., gravel bars and tidal mudflats). All wetlands must be periodically saturated or covered by shallow water during the growing season, whether or not hydrophytes or hydric soils are present. Effectively drained hydric soils that are no longer capable of supporting hydrophytes due to a major change in hydrology are not considered wetland. Areas with effectively drained hydric soils are, however, good indicators of historic wetlands, which may be suitable for restoration.

[1] This chapter was derived nearly verbatim from Tiner (2010).

The Service does not generally include permanently flooded deep water areas as wetland, although nontidal shallow waters (ponds) are classified as wetland. Instead, these deeper waterbodies are defined as deepwater habitats, since water, not air, is the principal medium in which dominant organisms live. Along the coast in tidal areas, the deepwater habitat begins at the extreme spring low tide level. In nontidal freshwater areas, this habitat starts at a depth of 6.6 feet (2 meters [m]) because the shallow water areas are often vegetated with emergent wetland plants.

Wetland Classification

For the NWI, wetlands were classified following the Service's official wetland classification: Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979). This classification system has also been adopted as the federal wetland classification standard by the Federal Geographic Data Committee. The following discussion represents a simplified overview of the Service's wetland classification system. Since some of the more technical points have been omitted from this discussion, readers are advised to refer to the official classification document (Cowardin et al. 1979) when attempting to classify a wetland and should not rely solely on this overview.

The Service's wetland classification system is hierarchical or vertical in nature, proceeding from general to specific, as noted in Figure 3 and Appendix A. In this approach, wetlands are first defined at a rather broad level - the *system*. The term *system* represents "a complex of wetlands and deepwater habitats that share the influence of similar hydrologic, geomorphologic, chemical, or biological factors." Five systems are defined: marine, estuarine, riverine, lacustrine, and palustrine. The marine system generally consists of the open ocean and its associated high-energy coastline, while the estuarine system encompasses salt and brackish marshes, nonvegetated tidal shores, and brackish waters of coastal rivers and embayments. Freshwater wetlands and deepwater habitats fall into one of the other three systems: riverine (rivers and streams), lacustrine (lakes, reservoirs, and large ponds), or palustrine (e.g., marshes, bogs, swamps, and small shallow ponds). Thus, at the most general level, wetlands can be defined as either marine, estuarine, riverine, lacustrine or palustrine (Figure 3).

Each system, with the exception of the palustrine, is further subdivided into *subsystems*. The marine and estuarine systems both have the same two subsystems, which are defined by tidal water levels: (1) subtidal - continuously submerged areas and (2) intertidal - areas alternately flooded by tides and exposed to air. Similarly, the lacustrine System is separated into two systems based on water depth: (1) littoral - wetlands extending from the lake shore to a depth of 6.6 feet (2 m) below low water or to the extent of nonpersistent emergents (e.g., arrowheads, pickerelweed, or spatterdock) if they grow beyond that depth and (2) limnetic - deepwater habitats lying beyond the 6.6 feet (2 m) mark at low water. By contrast, the riverine system is further defined by four subsystems that represent different reaches of a flowing freshwater or lotic system: (1) tidal - water levels subject to tidal fluctuations for at least part of the growing season, (2) lower perennial - permanent, flowing waters with a well-developed floodplain, (3) upper perennial - permanent, flowing water with very little or no floodplain development, and (4) intermittent - channel containing nontidal flowing water for only part of the year.

Figure 3. Wetland and deepwater habitat classification hierarchy (Cowardin et al. 1979).

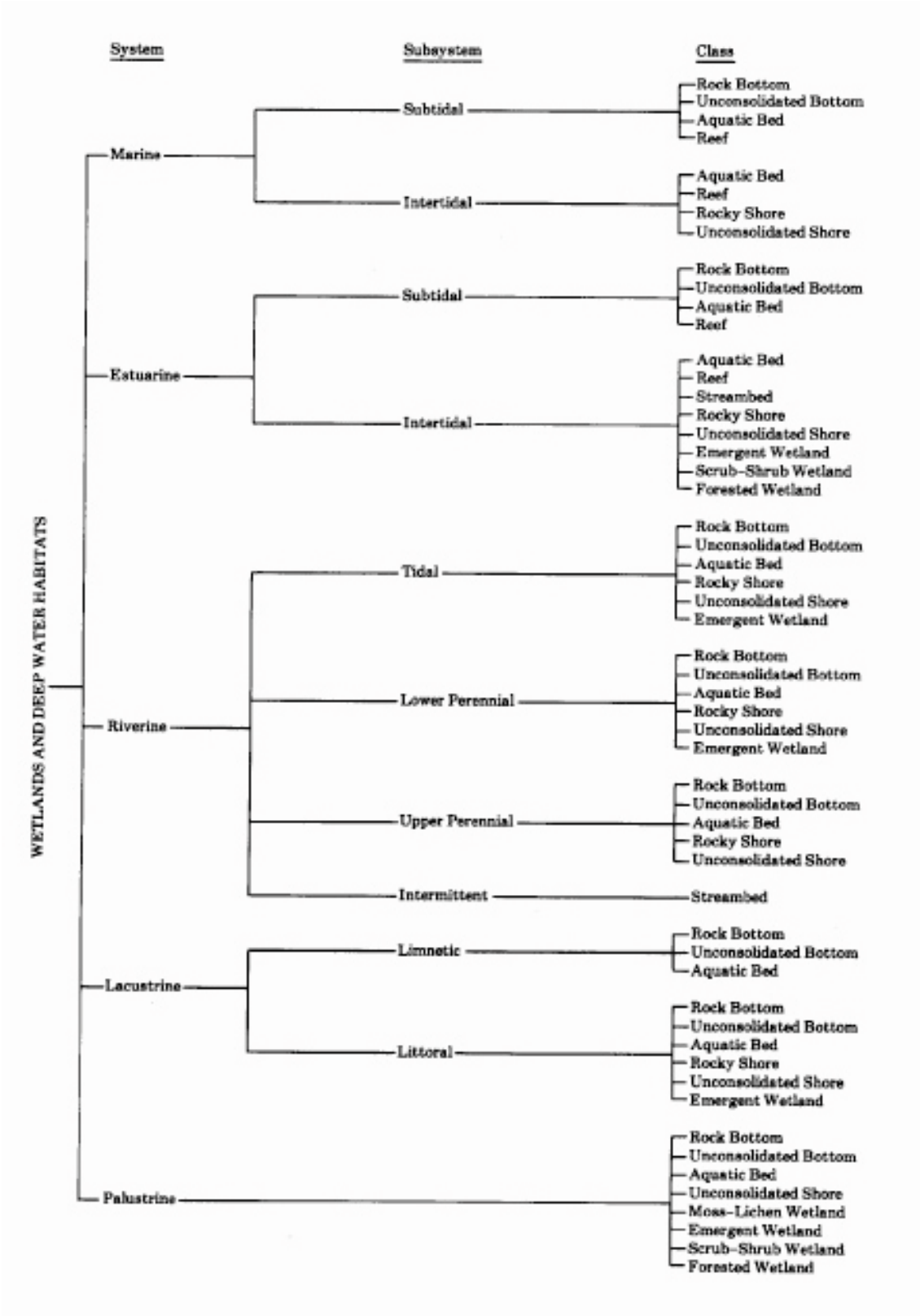
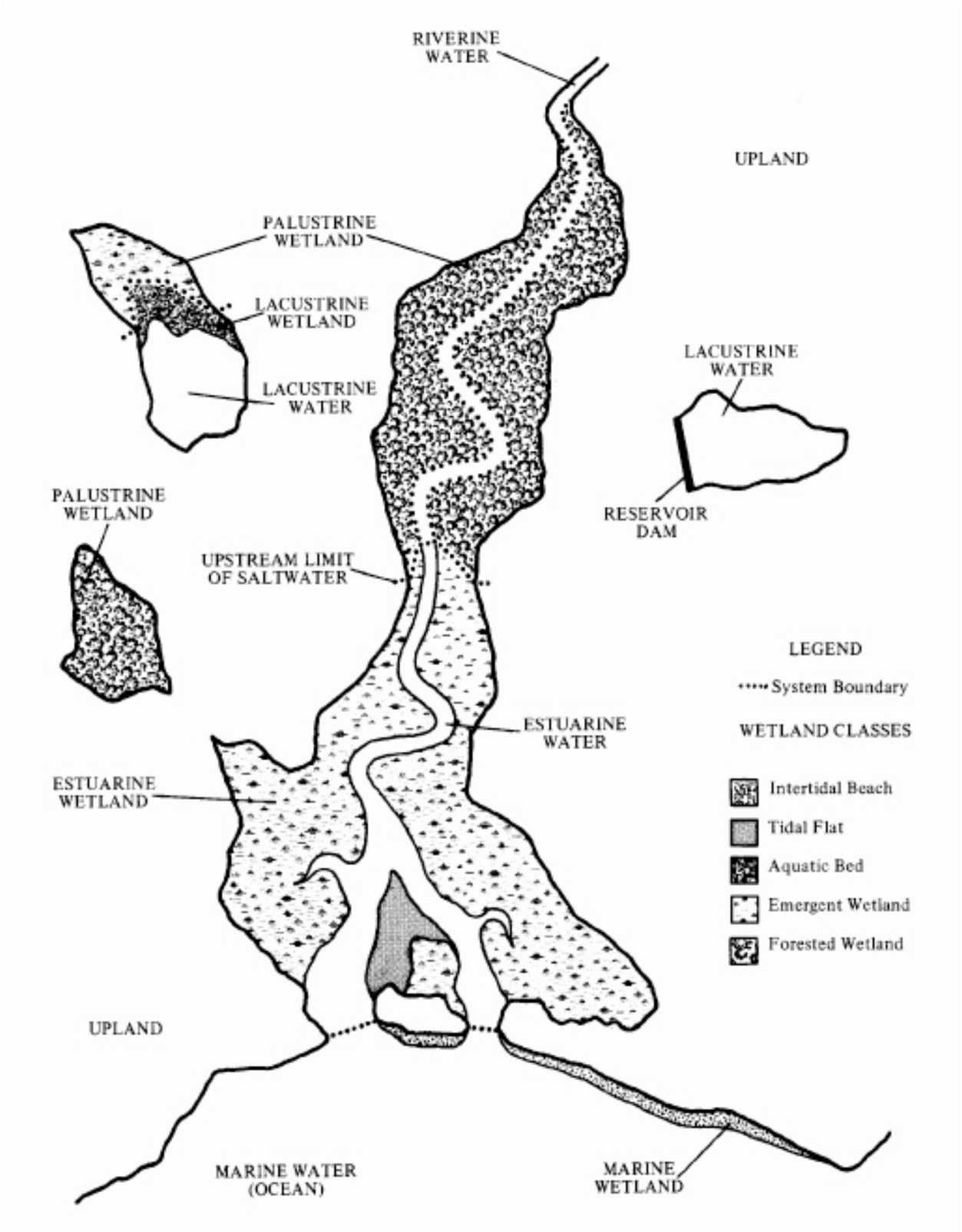


Figure 4. Schematic drawing showing positions and types of wetlands on the landscape.



The next level - *class* - describes the general appearance of the wetland or deepwater habitat in terms of the dominant vegetative life form or the nature and composition of the substrate, where vegetative cover is less than 30% (Table 1). Of the 11 classes, five refer to areas where vegetation covers 30% or more of the surface: Aquatic Bed, Moss-Lichen Wetland, Emergent Wetland, Scrub-Shrub Wetland, and Forested Wetland. The remaining six classes represent areas generally lacking vegetation, where the composition of the substrate and degree of flooding distinguish classes: Rock Bottom, Unconsolidated Bottom, Reef (sedentary invertebrate colony), Streambed, Rocky Shore, and Unconsolidated Shore. Permanently flooded nonvegetated areas are classified as either Rock Bottom or Unconsolidated Bottom, while exposed areas are typed as Streambed, Rocky Shore, or Unconsolidated Shore. Invertebrate reefs are found in both permanently flooded and exposed areas.

Each class is further divided into *subclasses* to better define the type of substrate in nonvegetated areas (e.g., bedrock, rubble, cobble-gravel, mud, sand, and organic) or the type of dominant vegetation (e.g., persistent or nonpersistent emergents, moss, lichen, or broad-leaved deciduous, needle-leaved deciduous, broad-leaved evergreen, needle-leaved evergreen, and dead woody plants). Below the subclass level, *dominance level* can be applied to specify the predominant plant or animal in the wetland community.

To allow better description of a given wetland or deepwater habitat in regard to hydrologic, chemical, and soil characteristics and to human impacts, the classification system contains four types of specific modifiers: (1) Water Regime, (2) Water Chemistry, (3) Soil, and (4) Special. These modifiers may be applied to class and lower levels of the classification hierarchy.

Water regime modifiers describe flooding or soil saturation conditions and are divided into two main groups: tidal and nontidal. Tidal water regimes are used where water level fluctuations are largely driven by oceanic tides. Tidal regimes can be subdivided into two general categories, one for salt and brackish water tidal areas and another for freshwater tidal areas. This distinction is needed because of the special importance of seasonal river overflow and groundwater inflows in freshwater tidal areas. By contrast, nontidal modifiers define conditions where surface water runoff, ground-water discharge, and/or wind effects (i.e., lake seiches) cause water level changes. Both tidal and nontidal water regime modifiers are presented and briefly defined in Table 2.

Water chemistry modifiers are divided into two categories which describe the water's salinity or hydrogen ion concentration (pH): (1) salinity modifiers and (2) pH modifiers. Like water regimes, salinity modifiers have been further subdivided into two groups: halinity modifiers for tidal areas and salinity modifiers for nontidal areas. Estuarine and marine waters are dominated by sodium chloride, which is gradually diluted by fresh water as it moves upstream in coastal rivers. On the other hand, the salinity of inland waters is dominated by four major cations (i.e., calcium, magnesium, sodium, and potassium) and three major anions (i.e., carbonate, sulfate, and chloride). Interactions between precipitation, surface runoff, groundwater flow, evaporation, and sometimes plant evapotranspiration form inland salts which are most common in arid and semiarid regions of the country. Table 3 shows ranges of halinity and salinity modifiers which are a modification of the Venice System (Remane and Schlieper 1971). The other set of water chemistry modifiers are pH modifiers for identifying acid (pH<5.5), circumneutral (5.5-7.4) and alkaline (pH>7.4) waters. Some studies have shown a good correlation between plant distribution and pH levels (Sjors 1950; Jeglum

1971). Moreover, pH can be used to distinguish between mineral-rich (e.g., fens) and mineral-poor wetlands (e.g., bogs).

The third group of modifiers - soil modifiers - are presented because the nature of the soil, which exerts strong influences on plant growth and reproduction as well as on the animals living in it. Two soil modifiers are given: (1) mineral and (2) organic. In general, if a soil has 20 percent or more organic matter by weight in the upper 16 inches, it is considered an organic soil, whereas if it has less than this amount, it is a mineral soil. For specific definitions, please refer to Appendix D of the Service's classification system (Cowardin et al. 1979).

The final set of modifiers - special modifiers - were established to describe the activities of people or beavers affecting wetlands and deepwater habitats. These modifiers include: excavated, impounded (i.e., to obstruct outflow of water), diked (i.e., to obstruct inflow of water), partly drained, farmed, and artificial (i.e., materials deposited to create or modify a wetland or deepwater habitat).

Table 1. Classes and subclasses of wetlands and deepwater habitats (Cowardin et al. 1979).

Class	**Brief Description**	**Subclasses**
Rock Bottom	Generally permanently flooded areas with bottom substrates consisting of at least 75% stones and boulders and less than 30% vegetative cover.	Bedrock; Rubble
Unconsolidated Bottom	Generally permanently flooded areas with bottom substrates consisting of at least 25% particles smaller than stones and less than 30% vegetative cover.	Cobble-gravel; Sand; Mud; Organic
Aquatic Bed	Generally permanently flooded areas vegetated by plants growing principally on or below the water surface line.	Algal; Aquatic Moss; Rooted Vascular; Floating Vascular
Reef	Ridge-like or mound-like structures formed by the colonization and growth of sedentary invertebrates.	Coral; Mollusk; Worm
Streambed	Channel whose bottom is completely dewatered at low water periods.	Bedrock; Rubble; Cobble-gravel; Sand; Mud; Organic; Vegetated
Rocky Shore	Wetlands characterized by bedrock, stones or boulders with areal coverage of 75% or more and with less than 30% coverage by vegetation.	Bedrock; Rubble
Unconsolidated Shore	Wetlands having unconsolidated substrates with less than 75% coverage by stone, boulders and bedrock and less than 30% vegetative cover, except by pioneer plants.	Cobble-gravel; Sand; Mud; Organic; Vegetated
Moss-Lichen Wetland	Wetlands dominated by mosses or lichens where other plants have less than 30% coverage.	Moss; Lichen
Emergent Wetland	Wetlands dominated by erect, rooted, herbaceous hydrophytes.	Persistent; Nonpersistent
Scrub-Shrub Wetland	Wetlands dominated by woody vegetation less than 20 feet (6 m) tall.	Broad-leaved Deciduous; Needle-leaved Deciduous; Broad-leaved Evergreen; Needle-leaved Evergreen; Dead
Forested Wetland	Wetlands dominated by woody vegetation 20 feet (6 m) or taller.	Broad-leaved Deciduous; Needle-leaved Deciduous; Broad-leaved Evergreen; Needle-leaved Evergreen; Dead

Table 2. Water regime modifiers, both tidal and nontidal groups (Cowardin et al. 1979).

Group	Type of Water	Water Regime	Definition
Tidal	Saltwater and brackish areas	Subtidal	Permanently flooded tidal waters
		Irregularly exposed	Exposed less often than daily by tides
		Regularly flooded	Daily tidal flooding and exposure to air
		Irregularly flooded	Flooded less often than daily and typically exposed to air
	Freshwater	Permanently flooded-tidal	Permanently flooded by tides and river or exposed irregularly by tides
		Semipermanently flooded-tidal	Flooded for most of the growing season by river overflow but with tidal fluctuation in water levels
		Regularly flooded	Daily tidal flooding and exposure to air
		Seasonally flooded-tidal	Flooded irregularly by tides and seasonally by river overflow
		Temporarily flooded-tidal	Flooded irregularly by tides and for brief periods during growing season by river overflow
Nontidal	Inland freshwater and saline areas	Permanently flooded	Flooded throughout the year in all years
		Intermittently exposed	Flooded year-round except during extreme droughts
		Semipermanently flooded	Flooded throughout the growing season in most years
		Seasonally flooded	Flooded for extended periods in growing season, but surface water is usually absent by end of growing season
		Saturated	Surface water is seldom present, but substrate is saturated to the surface for most of the season
		Temporarily flooded	Flooded for only brief periods during growing season, with water table usually well below the soil surface for most of the season

Intermittently flooded	Substrate is usually exposed and only flooded for variable periods without detectable seasonal periodicity (not always wetland; may be upland in some situations)
Artificially flooded	Duration and amount of flooding is controlled by means of pumps or siphons in combination with dikes or dams

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Table 3. Salinity modifiers for coastal and inland areas (Cowardin et al. 1979).

Coastal Modifiers[2]	**Inland Modifiers**[3]	**Salinity (‰)**	**Approximate Specific Conductance (Mhos at 25° C)**
Hyperhaline	Hypersaline	> 40	> 60,000
Euhaline	Eusaline	30-40	45,000-60,000
Mixohaline (Brackish)	Mixosaline[4]	0.5-30	800-45,000
Polyhaline	Polysaline	18-30	30,000-45,000
Mesohaline	Mesosaline	5-18	8,000-30,000
Oligohaline	Oligosaline	0.5-5	800-8,000
Fresh	Fresh	< 0.5	< 800

[2]Coastal modifiers are employed in the marine and estuarine systems.

[3]Inland modifiers are employed in the riverine, lacustrine and palustrine systems.

[4]The term "brackish" should not be used for inland wetlands or deepwater habitats.

Methods

Updating the National Wetlands Inventory

The Coastal Resources Division of the Georgia Department of Natural Resources, with assistance from a support contractor, Atkins North America, Inc. (formerly PBS&J), updated the NWI for Coastal Georgia with strict adherence to the Wetland Mapping Standard of the Federal Geographic Data Committee (FDGC) Wetland Subcommittee (2009) and following the Data Collection Requirements and Procedures for Mapping Wetland, Deepwater and Related Habitats of the United States (Dahl et al. 2009). Both documents were available in final draft format at the beginning of the project making it possible to apply the new mapping standards to the coastal Georgia NWI updates. The FWS actively participated in the updating process by providing quality control review of the draft wetland delineations to assure that the revised NWI was consistent with the NWI nationally and suitable for inclusion as a part of the wetland data layer of the National Spatial Data Infrastructure.

Photo Interpretation

An on-screen or "heads up" digitization process was employed using ArcMap 9 software for identifying, classifying, and delineating wetlands. Wetlands were interpreted from USGS high resolution (0.5 meter) color orthoimagery taken in 2006. The orthoimagery also served as the base photography for displaying the NWI update. For locations along the southern coast where USGS imagery was unavailable, Florida Bureau of Survey and Mapping LABINS high resolution color infrared imagery taken in 2004 served as the base photography. In locations along the western portion of the study area where neither of these data sets were available , National Agriculture Imagery Program (NAIP) imagery taken in 2007 was utilized as the base photography. Care was taken to place wetland boundaries of well-defined features within 20 feet of the boundary position on the imagery, as practicable, to ensure that National Map Accuracy Standards were met. The imagery was routinely interpreted at a scale of approximately 1:7000, but was viewed at much larger scales as interpretation questions arose. Regular utilization of collateral data was an important part of the wetland identification and classification process. Digital geo-referenced collateral information was layered in the GIS for contemporaneous viewing during the interpretation process. Wetlands were classified in accordance with the Cowardin et al. (1979) to system, subsystem, class, subclass level with water regime and special modifiers. The minimum size wetland regularly mapped and classified was between 0.25 to 0.5 acres.

During the interpretation process, natural resource professionals routinely reviewed collateral digital data sets, as available, including the 2007 NAIP imagery, USGS Orthophoto Quadrangle color-infrared imagery with one-meter resolution (taken in 1999), USGS 1:24,000 topographic quadrangles, the USGS National Hydrography Dataset (NHD) (published in 2009) depicting streams, the NRCS soil survey geographic data (SSURGO), LiDAR elevation data for Glynn County, the previous NWI representing 1983 conditions, and the DNR Wildlife Resources Division National Vegetation Classification System data for Glynn County and portions of other counties.

Ground Truth Acquisition

Field verification or ground truth acquisition is essential to every high quality remotely sensed natural resources inventory. Field verification took place from August 2008 to October 2009. Seventy-six person days were expended visiting 378 sites. Site visits were limited to those areas that were accessible by roads or short excursions on foot. Special care was taken to avoid trespassing on private property. Sites were selected that either (1) would provide information not discernible from aerial photographs in combination with the collateral data, (2) had conflicting information, or (3) were needed to verify the preliminary delineations. Site visits took place on four occasions (August 25-28, 2008, December 7-12, 2008, March 30-April 3, 2009, and October 5-9, 2009) and were led by Atkins, with periodic accompaniment by the DNR, The Nature Conservancy, Mulkey Engineering and Consultants and FWS.

Quality Control of Wetland Delineation and Classification

Wetland interpretations, delineations, and classifications were reviewed at least two times prior to submittal for review by the FWS for evaluation and comment. The initial review was provided by an experienced wetland scientist. Upon completion of the review, the delineations were returned to the original photo interpreter for correction as necessary. Once corrections were made, the work was reviewed again by a wetland scientist other than the initiator of the work. Sites where delineation or classification uncertainty remained were tagged for field review. Additional editorial corrections were made after each field review exercise.

Topological Review

Once project scientists were satisfied that wetland boundaries and classifications were accurately assigned, a topological review was conducted. This review is designed to ensure polygons had no overlap or multipart features. The FWS Wetland Verification Tool was then applied to the data set as a final quality control check for incorrect wetland codes, adjacent wetlands, sliver wetlands, sliver uplands, lake and pond sizes,.

Submittal of Draft NWI Updates to FWS

Draft data files were submitted to the FWS Southeast Regional NWI Coordinator for review and evaluation on a regular basis as sections of the coast were completed. After each review, editorial comments were discussed with the FWS Coordinator to ensure that they were interpreted correctly and to incorporate suggestions for improvement into the ongoing database development. Final editorial changes were then incorporated into the database.

Final Database and Map Products

After the incorporation of all editorial comments and suggestions, work areas were edge-matched, topology was rechecked, and the FWS verification tool was reapplied as a final check. The updated NWI was submitted to CRD as a single, high quality seamless ESRI ArcGIS 9.2 File Geodatabase in

Albers Equal Area Conic, NAD 83, meters projection. The updated NWI for coastal Georgia can be viewed online at the FWS NWI Wetland Mapper Site (http://www.fws.gov/wetlands/Data/Mapper.html). In addition to the geodatabase, nearly 300 interactive 1:12,000 scale orthophoto maps were produced in PDF format. Map layers, which can be turned on or off at the user's discretion, include the updated NWI, the aerial photograph used as the mapping base, the contour lines, USGS hydrographic data, the roads network, and geographic place names. The PDF maps are named in accordance with the USGS orthophoto quarter quadrangle for which they represent (e.g., Hinesville SE).

Enhancing the NWI Data for Functional Assessment

Background

A set of abiotic attributes were developed by FWS to increase the information contained in the NWI database and to create what is known as the NWI+ database. The four groups of attributes describe:

(1) landscape position (relationship of a wetland to a waterbody if present: marine—ocean, estuarine—tidal brackish, lotic—river/stream, lentic—lake/reservoir, and terrene—not significantly affected by such waters, or no waterbody present, or the source of a stream);
(2) landform (physical shape of the wetland—basin, flat, floodplain, fringe, island, and slope);
(3) water flow path (inflow, outflow, throughflow, isolated, bidirectional-nontidal, and bidirectional-tidal); and
(4) waterbody type (different types of estuaries, rivers, lakes, and ponds).

Collectively, the attributes are known as LLWW descriptors, which represent the first letter of each descriptor (landscape position, landform, water flow path, and waterbody type). Dichotomous keys have been developed to interpret these attributes (Tiner 2003b). Other modifiers are also included in these keys to further describe wetland characteristics. LLWW descriptors can be added to the NWI database by interpreting topography from digital raster graphics (DRGs) or digital elevation model data (DEMs), stream courses from the NHD and/or aerial imagery, and waterbody types from aerial imagery. The interpretations can be done by employing some automated GIS routines, coupled with manual review and interpretation by wetland specialists.

The NWI+ database adds value and increases the functionality of the original NWI database. Besides providing more features that can be used to predict wetland functions from the NWI database, NWI+ makes it possible to better characterize the nation's wetlands. For example, all of the palustrine wetlands, which account for 95 percent of the wetlands in the conterminous United States, can now be linked to rivers, streams, lakes, and ponds, where appropriate, so that the acreage of floodplain wetlands, lakeside wetlands, and geographically isolated wetlands can be reported. The Wetlands Subcommittee of the FGDC recognized the value added by the LLWW descriptors and recommended that they be included in wetland mapping to increase the functionality of wetland inventory databases (FGDC Wetlands Subcommittee 2009).

Adding Abiotic Descriptors to the NWI Database

For this project, LLWW descriptors were applied to all wetlands in the NWI digital database in accordance with the definitions and dichotomous keys developed by the FWS (Tiner 2003a). Section 4 of this document provides a set of simplified dichotomous keys for applying these descriptors (see Appendix C for coding scheme). For consistency and accuracy, the LLWW descriptors were added to the NWI database by the wetland scientists who updated the NWI and were familiar with the study area. NWI data were viewed with on-line USGS topographic maps (DRGs) to identify wetlands along streams and general slope characteristics. Aerial imagery was used to determine waterbody types (e.g., ponds). Six wetland landscape positions (including two lotic types) describing the relationship between a wetland and an adjacent waterbody were identified:

(1) marine – on the shores of the open ocean and its embayments,
(2) estuarine – associated with tidal brackish waters (estuaries),
(3) lotic (river or stream; see below)– along freshwater rivers and streams and periodically flooded, at least during high discharge periods (including freshwater tidal reaches of coastal rivers),
(4) lentic – in lakes, reservoirs, and their basins where water levels are significantly affected by the presence of these waterbodies, and
(5) terrene – isolated or headwater wetlands, fragments of former isolated or headwater wetlands that are now connected to downslope wetlands via drainage ditches, and wetlands on broad, flat terrain cut through by streams but where overbank flooding does not occur (e.g., hydrologically decoupled from streams).

Lotic wetlands were further separated by river and stream sections based on watercourse width (i.e., polygon = river; linear = stream at a scale of 1:24,000) and then divided into one of five gradients:

(1) high (e.g., shallow mountain streams on steep slopes – not present in the study area),
(2) middle (e.g., streams with moderate slopes – not present in the study area),
(3) low (e.g., mainstem rivers with considerable floodplain development and slow-moving streams),
(4) intermittent (i.e., periodic flows), and
(5) tidal (i.e., under the influence of tides).

Map G-2 shows the generalized locations of these LLWW wetland types across the landscape. Eight landforms, describing the physical form of a wetland or the predominant land mass upon which it occurs (e.g., floodplain), were identified (Map G-3): basin, flat, floodplain, fringe, island, slope, and interfluves (see Appendix C for definitions).

Additional modifiers were assigned to indicate water flow paths associated with wetlands: bidirectional-tidal, bidirectional-nontidal, throughflow, inflow, outflow, or isolated (Map G-4). Surface water connections were emphasized because they are more readily observable than groundwater linkages. Bidirectional flow paths were assigned to all intertidal wetlands. Throughflow wetlands were identified as having either a watercourse or another type of wetland above and below them. Most lotic wetlands were observed to be throughflow types. Inflow pathways were determined where watercourses could be observed entering the wetland but no

surface water outlet could be seen. Outflow wetlands were identified as those appearing to have water leaving them and moving downstream via a watercourse or a slope wetland. Isolated wetlands were observed to be closed ("geographically isolated") depressions or flats where water appeared to come from direct precipitation, localized surface water runoff, and/or groundwater discharge. From the surface water perspective, these wetlands appear to be isolated from other wetlands since they lack an apparent surface water connection; however it should be recognized that they may be hydrologically linked to other wetlands and waterbodies via groundwater, while others may be connected by small streams that were not mapped on the collateral data sources.

Other descriptors applied to mapped wetlands include headwater, drainage-divide, and partly drained. Headwater wetlands appear to be sources of streams or wetlands along first-order (perennial) streams. Wetlands described as drainage-divide wetlands appear to have outflow in two directions to two separate drainage systems. Partly drained wetlands were typically ditched wetlands. For open water habitats, additional descriptors following Tiner (2003a) were applied, including water flow path, and pond, estuary, and lake types.

Since ponds were separated from wetlands for the LLWW classification, wetland acreage totals are different for NWI and LLWW. NWI routinely classifies open water areas 20 acres or smaller as palustrine unconsolidated bottom wetlands. These areas were not reclassified as lacustrine in the NWI database, so deepwater habitat acreage of lacustrine waters and acreage of palustrine unconsolidated bottoms based on NWI will be different than LLWW totals for lakes and ponds. Ponds were separated into three categories: natural, dammed/impounded, and excavated.

Classifications were reviewed for accuracy prior to performing the analysis of wetland functions. Despite this review, it is possible that a few wetlands may have been misclassified due to the complexity and enormity of the dataset that contained over 52,000 polygons.

Preliminary Assessment of Wetland Functions

After creating the NWI+ database (the enhanced NWI database), analyses were performed to produce a preliminary assessment of wetland functions for the study area. Both wetlands and ponds were evaluated for performance of 11 functions:

(1) surface water detention,
(2) coastal storm surge detention,
(3) streamflow maintenance,
(4) nutrient transformation,
(5) carbon sequestration,
(6) retention of sediment and other particulates,
(7) bank and shoreline stabilization,
(8) provision of fish and aquatic invertebrate habitat,
(9) provision of waterfowl and waterbird habitat,
(10) provision of other wildlife habitat,
(11) provision of habitat for unique, uncommon, or highly diverse plant communities.

The preliminary assessment of wetland functions for coastal Georgia was accomplished under the guidance of Ralph Tiner (FWS, Hadley, MA). This study employed a landscape-level functional assessment approach that may be called "Watershed-based Preliminary Assessment of Wetland Functions" (W-PAWF). W-PAWF applies general knowledge about wetlands and their functions to develop a watershed or area-wide overview that highlights possible wetlands of significance in terms of performance of various functions. The rationale for correlating wetland characteristics with wetland functions in the northeastern U.S. is described in Tiner (2003b). The procedure begins with the identification of wetland attributes or characteristics from the suite of characteristics described by the NWI, with the addition of LLWW modifiers which contribute to the performance of each wetland function. Then, using GIS technology, wetlands are selected that exhibit those particular characteristics. The information resulting from the selection process can be portrayed graphically on maps or in tabular form.

In order to develop region-specific information for the six–county study area, the relationships (formerly called correlations) developed for use in the northeastern U.S. were introduced to and reviewed by a group of Georgia scientists from federal, state, and local agencies, non-profit organizations, and academic institutions at an August 31, 2010 workshop on Little St. Simons Island. The peer group provided comments that were used to re-evaluate the relationships and tailor them to coastal Georgia. In cases where there were differences in opinions, the points were considered and decisions were made by consensus between the DNR-CRD, Atkins North America, and Ralph Tiner. A detailed rationale for the selection of Georgia specific characteristics and their relationship to wetland functions is found in Tiner (2011) included in its entirety as Appendix D. Using the sets of characteristics important to each of the 11 functions developed from the workshop, ArcView 10 software was utilized to select wetlands from the NWI+ database which exhibited those characteristics.

Data Analysis and Compilation

GIS was used to analyze the data and produce wetland statistics (acreage summaries) for the overall study area and for each of the six coastal counties. Tables were prepared to summarize the results of the NWI update (i.e., the extent of different wetland types by NWI classification) and to correlate wetland characteristics with wetland functions to identify wetlands of significance for 11 functions. After running the analyses, a series of maps was generated to display the variety of wetland types and to highlight wetlands that may perform various functions at significant levels (see Appendix G). Statistics were mostly generated from Microsoft's Excel program, whereas thematic maps were generated by ArcView software. *Special Note: When summarizing data, percentages given usually refer to percent of wetland acreage, while for convenience, the narrative will refer to them as "percent of wetlands." In reference to ponds, the actual number of ponds mapped is known, so percent of ponds by number and by acreage are reported.*

Limitations of the Inventory and the Assessment

Wetland Inventory and Digital Database

Since the NWI data were derived from 2006 imagery, they do not reflect changes in some wetlands that have occurred in the past six years. These changes may be due to permitted alterations by federal, state, and local governments or to natural processes including erosion, accretion, and sea level rise. Despite this, the 2006 database should reasonably reflect contemporary conditions because wetlands in this area are well regulated.

It is important to recognize the limitations of any wetland mapping effort derived mainly through photointerpretation techniques (see Tiner 1990, 1997, and 1999 for details). NWI data, or any other wetland data derived from these techniques, do not include all wetlands. Some wetlands are simply too small to map given the imagery used, while others avoid detection due to evergreen tree cover, dry surface conditions, or other factors. For this inventory and assessment the minimum size of the wetland targeted mapping unit was one-half acre, but many wetlands (especially ponds) smaller than this were mapped. Wetland units may contain small areas that are different from the mapped type (i.e., inclusions) due to scale and map complexity issues. For example, a 10-acre forested wetland may include small areas of emergent wetlands or small upland islands not discernable from aerial photography due to canopy cover. Drier-end wetlands such as temporarily flooded palustrine wetlands are often difficult to separate from nonwetlands through photointerpretation. Finally, despite our best attempts at quality control, some errors of interpretation and classification are likely to occur due to the sheer number of polygons in the wetland database (over 52,000).

Preliminary Assessment of Wetland Functions[5]

The landscape-level functional assessment employed in this study is preliminary, based on wetland characteristics interpreted through remote sensing and the best professional judgment of wetland specialists. Wetlands believed to be providing high and moderate levels of performance for a particular function were highlighted. The process for the qualitative assignment of ranking as high or moderate is described in detail by Tiner (2011), included in its entirety in Appendix D. In general those wetlands exhibiting the full range of characteristics supporting a particular function were assigned a high ranking while those wetlands exhibiting some, but not all characteristics, were assigned a moderate ranking. As the focus of this report is on wetlands, a functional assessment of deepwater habitats (e.g., lakes, rivers, estuaries, and submerged marine aquatic beds) and linear features such as perennial and intermittent streams was outside of the report's scope. The importance of permanently flooded habitats to fish, for example, should be obvious and the beneficial functions of small streams (even intermittent ones) to water quality and sediment retention should also be recognized (Meyer et al. 2003). No attempt was made to produce a more qualitative ranking for each function or for each wetland based on multiple functions as this would require more input from other sources, well beyond the scope of this study. For a technical review of wetland functions, see Mitch and Gosselink (2008) and for broad overviews see Tiner (2005, in press).

[5] This chapter was derived extensively from Tiner (2011), included as Appendix D.

Functional assessment of wetlands can involve many approaches. Typically such assessments are done in the field on a case-by-case basis by comparing observed features to those required to perform certain functions or by measuring actual performance. The present study is not a substitution for such evaluations, which are the ultimate assessment of individual wetland function. Yet, for a landscape-level analysis, area-wide on-the-ground assessments are not practical, cost-effective or even possible given access considerations. For watershed planning and landscape-level evaluation purposes, a more generalized assessment is optimal for targeting wetlands that may provide certain functions, especially for those functions dependent on landscape position, landform, vegetation life form, and other photointerpretable features. These preliminary results can be field-verified when evaluating particular wetlands for acquisition (e.g., for conservation of biodiversity or for preserving flood storage capacity). More recent aerial photography may also be examined to aid in further evaluations (e.g., condition of wetland/stream buffers or adjacent land use) that can supplement this preliminary assessment.

W-PAWF does not account for a wetland's opportunity to provide a function resulting from a certain land use practice upstream or the presence of certain structures or land uses downstream. For example, two wetlands of equal size and like vegetation may be in the right landscape position to retain sediments. One, however, may be downstream of a land-clearing operation that has generated considerable suspended sediments in the water column, while the other is downstream from an undisturbed forest. The former should be actively performing significant sediment trapping, while the latter is not receiving as much material. Yet if land-clearing takes place upstream of the latter area, the second wetland will likely trap sediments as well as the first wetland. The entire W-PAWF analysis typically tends to ignore opportunity whether the function has been or ever will be fully employed. W-PAWF also does not consider the condition of the adjacent upland (e.g., level of disturbance) or the water quality of the associated waterbody, which may be regarded as important metrics for assessing the health of individual wetlands.

This preliminary assessment does not obviate the need for more detailed assessments of the various functions. It should be viewed as a starting point for more rigorous assessments, as it attempts to highlight wetlands that likely provide significant functions, based on generally accepted principles and the source information used for this analysis. The data may also be useful for town-wide assessments and other geographic area-specific evaluations, yet the wetland classifications (both NWI and LLWW) should be field checked for accuracy as this will influence the functional assessment results. This assessment method could serve as a rapid site-assessment technique to gain a general sense of what functions are likely to be performed by a particular wetland, followed by a more in-depth site evaluation as necessary depending on project objectives. This is particularly true for assessing fish and wildlife habitats and biodiversity. Other sources of data may exist to help refine some of the findings of this report. Additional modeling could be done, for example, to identify habitats of likely significance to individual species of animals (based on their specific life history requirements). Georgia DNR Wildlife Resources Division data could be used to highlight wetlands supporting rare, threatened, and endangered species.

Results

The following text describes the statistical results of the circa 2006 update of the NWI, the application of LLWW types (landscape position, landform, and water flow path) to each NWI wetland polygon, and the landscape-level assessment of wetland functions. Tables summarizing the statistical findings are included.

In addition to summary tables and short narratives, the following fifteen maps showing NWI types, LLWW types and potential wetlands of significance for each of 11 functions were prepared and are available in reproducible PDF format from the Coastal Resources Division of the Georgia Department of Natural Resources. Images of these maps and county specific function maps are included in Appendix G.

Page	**Theme**
G-1	Wetlands by NWI Types
G-2	Wetlands by Landscape Position
G-3	Wetlands by Landform
G-4	Wetlands by Water Flow Path
G-5	Potential Wetlands of Significance for Surface Water Detention
G-6	Potential Wetlands of Significance for Coastal Storm Surge Detention
G-7	Potential Wetlands of Significance for Streamflow Maintenance
G-8	Potential Wetlands of Significance for Nutrient Transformation
G-9	Potential Wetlands of Significance for Carbon Sequestration
G-10	Potential Wetlands of Significance for Retention of Sediment and Other Particulates
G-11	Potential Wetlands of Significance for Bank and Shoreline Stabilization
G-12	Potential Wetlands of Significance for Provision of Fish and Aquatic Invertebrate Habitat
G-13	Potential Wetlands of Significance for Provision of Waterfowl and Waterbird Habitat
G-14	Potential Wetlands of Significance for Provision of Other Wildlife Habitat
G-15	Potential Wetlands of Significance for Unique, Uncommon, or Highly Diverse Plant Communities

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Wetlands of Coastal Georgia

NWI Types

Wetlands of the six-county region total 804,227 acres (Table 4) and cover nearly 40 percent of the study area. Palustrine wetlands (freshwater) are most abundant, occupying 432,419 acres and comprising about 54 percent of the region's wetlands. Nearly 79 percent of palustrine wetlands are forested. Palustrine emergent and scrub-shrub wetlands account for only 12 percent and 7 percent of freshwater wetlands, respectively. Estuarine wetlands are second in abundance, occupying 368,484 acres or about 46 percent of the area's wetlands. Emergent wetlands are the most common estuarine type (95%). Marine wetlands inventoried total 3,084 acres, comprised exclusively of unconsolidated shore (marine beaches and flats). Marine wetlands make up less than one percent of the coastal wetlands total. Only 151 acres of lacustrine and 90 acres of riverine wetlands were inventoried.

LLWW Types

Wetlands in the estuarine landscape position account for less than half of the wetlands (46%) in the region, while wetlands in the marine landscape position represent less than one percent of the total (Table 5). By definition, all estuarine and marine wetlands have bidirectional-tidal water flows. Almost 31 percent of the area's wetlands are in the lotic landscape position (i.e. associated with rivers and streams). Most of the region's lotic wetlands exhibited throughflow water pathways (63% of the lotic acreage) or bidirectional-tidal (freshwater tidal) water pathways. Less than one percent of the wetlands are lentic types (along lakes and deep ponds classified as palustrine unconsolidated bottoms by NWI). The water flow path of 78 percent of the lentic wetlands is classified as isolated, whereas about 22 percent of the lentic wetlands have an obvious stream running from them. Twenty-two percent of wetlands are located in the terrene landscape position, mainly in headwater locations or in isolated depressions. Most (83%) of the region's terrene wetlands are outflow types (typically the source of a stream). The remainder are either wetlands that receive surface or groundwater, which flows through the wetland and into another wetland or stream, or are geographically isolated wetlands (surrounded by upland and lacking a detectable surface water connection to other wetlands or waters).

All marine wetlands and 93 percent of the estuarine wetlands are classified as fringe landform types with open access to bays, sounds or the Atlantic Ocean. Estuarine wetlands classified as basin landforms are usually the result of partial hydrologic blockage by roads or railroad crossings. Most lotic wetlands (88%) are basin types (subject to prolonged seasonal flooding), while nearly all remaining lotic wetlands are classified as flats (subject to short-term flooding). Sixty-one percent of the terrene wetlands are classified as basins (depressions) and 39 percent as flats. Terrene basins are seasonally flooded or wetter while terrene flats are temporarily flooded or seasonally saturated. Lentic wetlands are by definition fringe landforms.

Ponds occupy 9,266 acres or one percent of the region's wetlands. A total of 4,416 ponds were inventoried, with nearly all (95%) identified as excavated (Table 6). The average size of ponds in coastal Georgia is about 2.1 acres. Nearly three quarters (74%) of ponds appear to be hydrologically isolated, while most of the remainder have outflow or throughflow water pathways.

Preliminary Functional Assessment

Sixty percent of the wetlands (including ponds) in coastal Georgia are predicted to perform eight of the eleven functions at high to moderate levels (Table 7). As much as 97 percent of the wetlands is deemed important for nutrient transformation; carbon sequestration; habitat for wildlife other than waterfowl and other waterbirds; and retention of sediment and other particulates. Over three-quarters of the wetlands are predicted to contribute to bank and shoreline stabilization. Over 60 percent of the wetlands are predicted to provide coastal storm surge detention, fish and aquatic invertebrate habitat, and waterfowl and waterbird habitat. Forty-one percent of wetlands provide surface water detention. Relatively few wetlands (23%) are located in landscape positions where they could contribute to maintaining streamflow. Only 4 percent of the wetlands are recognized as uncommon or highly diverse plant communities that contribute significantly to the area's biodiversity. These plant communities included the following types: Palustrine tidal emergent wetlands (regularly flooded, seasonally flooded-tidal, and semipermanently flooded-tidal water regimes), Palustrine tidal scrub-shrub wetlands (regularly flooded, seasonally flooded-tidal, and semipermanently flooded-tidal water regimes), Freshwater vegetated wetlands on barrier islands (semipermanently flooded, semipermanently flooded-tidal, and permanently flooded), Carolina bay wetlands (relatively intact), and Palustrine vegetated wetlands that are permanently flooded. (Note: Since this assessment was based on remotely sensed information and largely on observable life-form differences in plant communities and water regimes, it did not attempt to identify wetlands that do or may support rare or endangered species. Such wetlands would have to be identified through other means – contact Georgia's Natural Heritage Program and others for such data.)

Table 4. Wetlands of Coastal Georgia classified by NWI types (Cowardin et al. 1979).

System	Class	Acreage
Marine	Unconsolidated Shore	3,084
Total Marine Wetlands		**3,084**
Estuarine	Emergent	304,920
	Emergent/Forested	2
	Emergent/Scrub-Shrub	107
	Emergent/Unconsolidated Shore	46,206
	(Subtotal Emergent)	(351,236)
	Forested, Broad-leaved Deciduous	13
	Forested, Broad-leaved Evergreen	1,832
	Forested, Needle-leaved Evergreen	206
	Forested/Emergent	2
	(Subtotal Forested)	(2,053)
	Scrub-Shrub, Broad-leaved Deciduous	533
	Scrub-Shrub, Broad-leaved Evergreen	3,464
	Scrub-Shrub, Needle-leaved Evergreen	383
	Scrub-Shrub/Emergent	115
	(Subtotal Scrub-Shrub)	(4,495)
	Unconsolidated Shore	10,509
	Unconsolidated Shore/Emergent	190
	(Subtotal Nonvegetated)	(10,700)
Total Estuarine Wetlands		**368,484**
Lacustrine	Aquatic Bed	108
	Emergent	10
	Unconsolidated Shore	32
Total Lacustrine Wetlands		**151**
Palustrine	Aquatic Bed	826
	Aquatic Bed/Unconsolidated Bottom	6
	(Subtotal Aquatic Bed)	(832)
	Emergent	50,147
	Emergent/Aquatic Bed	178
	Emergent/Forested	1,638
	Emergent/Scrub-Shrub	548
	(Subtotal Emergent)	(52,511)
	Forested, Broad-leaved Deciduous	202,949
	Forested, Broad-leaved Evergreen	30,450
	Forested, Needle-leaved Deciduous	83,007
	Forested, Needle-leaved Evergreen	21,739

Table 4 (cont'd)	Forested/Emergent	434
	Forested/Scrub-Shrub	1,075
	(Subtotal Forested)	(339,743)
	Scrub-Shrub, Broad-leaved Deciduous	21,750
	Scrub-Shrub, Broad-leaved Evergreen	5,670
	Scrub-Shrub, Needle-leaved Deciduous	1,113
	Scrub-Shrub, Needle-leaved Evergreen	1,453
	Scrub-Shrub/Emergent	393
	Scrub-Shrub/Forested	520
	(Subtotal Scrub-Shrub)	(30,899)
	Unconsolidated Bottom	8,242
	Unconsolidated Shore	192
	Unconsolidated Shore/Emergent	1
	(Subtotal Nonvegetated)	(8,434)
Total Palustrine Wetlands		**432,419**
Riverine	Unconsolidated Shore	90
Total Riverine Wetlands		**90**
GRAND TOTAL (All Wetlands)		**804,227**

Table 5. Wetlands classified by landscape position, landform, and water flow path for coastal Georgia. Note: Ponds were treated as waterbody type (see Table 6) for summary.

Landscape Position	Landform	Water Flow Path	Acreage
Marine	Fringe	Bidirectional-tidal	3,084
Total Marine			**3,084**
Estuarine	Fringe	Bidirectional-tidal	341,187
	Basin	Bidirectional-tidal	27,334
Total Estuarine			**368,521**
Lentic	Fringe	Isolated	355
		Outflow	99
Total Lentic			**454**
Lotic River	Fringe	Bidirectional-tidal	73
	(Subtotal Fringe)		(73)
	Floodplain-basin	Bidirectional-tidal	87,044
		Throughflow	11,940
	(Subtotal Basin)		(98,983)
	Floodplain-flat	Bidirectional-tidal	4,479
		Throughflow	2,598
	(Subtotal Flat)		(7,077)
Total Lotic River			**106,134**
Lotic Stream	Basin	Outflow	57
		Throughflow	109,543
	(Subtotal Basin)		(109,600)
	Flat	Throughflow	29,744
	(Subtotal Flat)		(29,744)
Total Lotic Stream			**139,344**
Terrene	Basin	Isolated	22,975
		Outflow	85,596
	(Subtotal Basin)		(108,571)
	Flat	Isolated	6,550
		Outflow	62,266
		Throughflow	13
	(Subtotal Flat)		(68,828)
	Island	Isolated	26
	(Subtotal Island)		(26)
Total Terrene			**177,425**
GRAND TOTAL			**794,961**

Table 6. Pond acreage for coastal Georgia.

Type of Pond	Water Flow Path	Number of Ponds	Acreage
Natural	Isolated	32	38
	Mesotidal	43	126
	Outflow	44	274
	Throughflow	19	172
Total Natural Ponds		**138**	**610**
Impounded	Isolated	31	107
	Mesotidal	5	15
	Outflow	37	172
	Throughflow	7	49
Total Impounded Ponds		**80**	**343**
Excavated	Isolated	3,191	5,767
	Mesotidal	29	91
	Outflow	702	1,787
	Throughflow	276	667
Total Excavated Ponds		**4,198**	**8,313**
GRAND TOTAL		**4,416**	**9,266**

Table 7. Wetlands of potential significance for various functions for Coastal Georgia. Note: Results include ponds.

Function	Significance	Acreage	% of All Wetlands
Surface Water Detention	High	122,923	15%
	Moderate	206,768	26%
	Total	**329,691**	**41%**
Coastal Storm Surge Detention	High	462,862	58%
	Moderate	20,059	2%
	Total	**482,921**	**60%**
Streamflow Maintenance	High	57,965	7%
	Moderate	126,006	16%
	Total	**183,971**	**23%**
Nutrient Transformation	High	680,893	85%
	Moderate	101,185	13%
	Total	**782,078**	**97%**
Carbon Sequestration	High	679,414	84%
	Moderate	119,280	15%
	Total	**798,694**	**99%**
Retention of Sediments	High	567,281	71%
	Moderate	157,944	20%
	Total	**725,225**	**90%**
Shoreline Stabilization	High	605,410	75%
	Moderate	16,598	2%
	Total	**622,008**	**77%**
Fish and Shellfish Habitat	High	470,370	58%
	Moderate	38,883	5%
	Total	**509,253**	**63%**
Waterfowl and Waterbird Habitat	High	456,882	57%
	Moderate	43,552	5%
	Total	**500,434**	**62%**
Other Wildlife Habitat	High	738,574	92%

Table 7 (cont'd).

	Moderate	42,566	5%
	Total	**781,140**	**97%**
Unique, Diverse Communities	Palustrine Vegetated (H WR)	78	--
	Selected PEM (N,R,T WR)	21,462	3%
	Selected PSS (N,R,T WR)	8,843	1%
	Barrier Island (F,T,H WR)	1,307	--
	Carolina Bays (Relatively Intact)	919	--
	Total	**32,609**	**4%**

Wetlands of Bryan County

NWI Types

Bryan County, located between Chatham and Liberty counties, has 103,703 acres of wetlands covering 36 percent of the land surface. Palustrine wetlands are most abundant, occupying 82,865 acres and comprising about 80 percent of the county's wetlands (Table 8). Palustrine forested wetlands are the most common, representing nearly 88 percent of palustrine wetlands. The remaining palustrine vegetated wetlands include emergent (almost 7%) and scrub-shrub (4%) types. Estuarine wetlands are second in abundance, occupying 20,830 acres or about 20 percent of the county's wetlands. Emergent wetlands were the most common estuarine type, comprising 96 percent of estuarine wetlands.

LLWW Types

Wetlands in the estuarine landscape position account for about a fifth the county's wetlands (Table 9). By definition, all estuarine wetlands have bidirectional-tidal water flow paths. Forty-nine percent of the county's wetlands are lotic in landscape position (i.e. associated with rivers and streams). Lotic wetlands in Bryan County are typically throughflow types (89%), while most of the rest are bidirectional-tidal (freshwater tidal). Thirty percent of wetlands are located in the terrene landscape position, mainly in headwater positions or in isolated depressions. About 86 percent of terrene wetlands in the county are outflow types (typically the source of a stream).

Ninety-two percent of the estuarine wetlands are identified as fringe landform types with open access to bays, sounds or the Atlantic Ocean. Most of the remaining estuarine wetlands are partially blocked by roads or railroad crossings and therefore classified as basins. Most lotic wetlands (71%) were basin landform types, with most of the remainder being flats. Fifty-six percent of the terrene wetlands are classified as flats and 44 percent as basins (depressions).

Ponds account for only 1 percent of the freshwater wetlands (Table 10). A total of 505 ponds were inventoried in Bryan County with an average size of 2.1 acres. Nearly all appear to be excavated.

Preliminary Functional Assessment

Over half of the wetlands in Bryan County (including ponds) are predicted to perform six of the eleven functions at high to moderate levels (Table 11). Almost all wetlands (99%) of the county were deemed important for nutrient transformation, carbon sequestration, and as habitat for wildlife other than waterfowl and waterbirds. About 80 percent of the county's wetlands are predicted to be important for retention of sediment and other particulates. Over 70 percent appear important for bank and shoreline stabilization and water retention. Less than half of the wetlands (46%) seem to be important for streamflow maintenance. Between 30 and 39 percent of Bryan County wetlands are predicted to be important for coastal storm surge detention, habitat for fish and aquatic invertebrates, and habitat for waterfowl and waterbirds.

Table 8. Wetlands of Bryan County classified by NWI types (Cowardin et al. 1979).

System	Class	Acreage
Estuarine	Emergent	19,125
	Emergent/Unconsolidated Shore	914
	(Subtotal Emergent)	(20,039)
	Forested, Broad-leaved Evergreen	201
	Scrub-Shrub, Broad-leaved Deciduous	27
	Scrub-Shrub, Broad-leaved Evergreen	79
	(Subtotal Scrub-Shrub)	(307)
	Unconsolidated Shore	484
Total Estuarine Wetlands		**20,830**
Palustrine	Aquatic Bed	175
	Emergent	5,367
	Emergent/Forested	98
	Emergent/Scrub-Shrub	153
	(Subtotal Emergent)	(5,618)
	Forested, Broad-leaved Deciduous	39,254
	Forested, Broad-leaved Evergreen	14,307
	Forested, Dead	15
	Forested, Needle-leaved Deciduous	12,440
	Forested, Needle-leaved Evergreen	6,616
	Forested/Emergent	25
	Forested/Scrub-Shrub	169
	(Subtotal Forested)	(72,826)
	Scrub-Shrub, Broad-leaved Deciduous	1,663
	Scrub-Shrub, Broad-leaved Evergreen	1,352
	Scrub-Shrub, Needle-leaved Deciduous	96
	Scrub-Shrub, Needle-leaved Evergreen	77
	Scrub-Shrub/Emergent	170
	Scrub-Shrub/Forested	18
	(Subtotal Scrub-Shrub)	(3,376)
	Unconsolidated Bottom	835
	Unconsolidated Shore	35
	(Subtotal Nonvegetated)	(870)
Total Palustrine Wetlands		**82,865**
Riverine	Unconsolidated Shore	8
Total Unconsolidated Shore		**8**
GRAND TOTAL (All Wetlands)		**103,703**

Table 9. Wetlands classified by landscape position, landform, and water flow path for Bryan County. Note: Ponds were treated as waterbody type (see Table 10) for summary.

Landscape Position	Landform	Water Flow Path	Acreage
Estuarine	Fringe	Bidirectional-tidal	19,132
	Basin	Bidirectional-tidal	1,698
Total Estuarine			**20,830**
Lotic River	Fringe	Bidirectional-tidal	5
	(Subtotal Fringe)		(5)
	Floodplain-basin	Bidirectional-tidal	5,412
		Throughflow	6,810
	(Subtotal Basin)		(12,223)
	Floodplain-flat	Bidirectional-tidal	135
		Throughflow	1,513
	(Subtotal Flat)		(1,649)
Total Lotic River			**13,877**
Lotic Stream	Basin	Outflow	57
		Throughflow	24,334
	(Subtotal Basin)		(24,391)
	Flat	Throughflow	13,011
	(Subtotal Flat)		(13,011)
Total Lotic Stream			**37,402**
Terrene	Basin	Isolated	2,824
		Outflow	10,667
	(Subtotal Basin)		(13,491)
	Flat	Isolated	1,338
		Outflow	15,706
	(Subtotal Flat)		(17,045)
	Island	Isolated	12
	(Subtotal Island)		(12)
Total Terrene			**30,548**
GRAND TOTAL			**102,658**

Table 10. Pond acreage for Bryan County.

Type of Pond	Water Flow Path	Number of Ponds	Acreage
Natural	Isolated	1	11
	Throughflow	2	138
Total Natural Ponds		**3**	**148**
Impounded	Isolated	4	5
	Outflow	7	30
	Throughflow	5	37
Total Impounded Ponds		**16**	**72**
Excavated	Isolated	343	585
	Mesotidal	1	17
	Outflow	81	137
	Throughflow	61	86
Total Excavated Ponds		**486**	**825**
GRAND TOTAL		**505**	**1,045**

Table 11. Wetlands of potential significance for various functions for Bryan County. Note: Results include ponds.

Function	Significance	Acreage	% of All Wetlands
Surface Water Detention	High	31,515	30%
	Moderate	45,018	43%
	Total	**76,533**	**74%**
Coastal Storm Surge Detention	High	26,372	25%
	Moderate	4,474	4%
	Total	**30,846**	**30%**
Streamflow Maintenance	High	18,278	18%
	Moderate	29,453	28%
	Total	**47,731**	**46%**
Nutrient Transformation	High	70,801	68%
	Moderate	31,541	30%
	Total	**102,342**	**99%**
Carbon Sequestration	High	70,801	68%
	Moderate	32,828	32%
	Total	**103,629**	**100%**
Retention of Sediments	High	56,991	55%
	Moderate	26,684	26%
	Total	**83,675**	**81%**
Shoreline Stabilization	High	71,649	69%
	Moderate	569	1%
	Total	**72,218**	**70%**
Fish and Shellfish Habitat	High	33,917	33%
	Moderate	6,946	7%
	Total	**40,863**	**39%**
Waterfowl and Waterbird Habitat	High	28,796	28%
	Moderate	4,921	5%
	Total	**33,717**	**33%**

Table 11 (cont'd).

Other Wildlife Habitat	High	96,276	93%
	Moderate	5,891	6%
	Total	**102,167**	**99%**
Unique, Diverse Communities	Selected PEM (N,R,T WR)	332	--
	Selected PSS (N,R,T WR)	3	--
	Total	**335**	**--**

Wetlands of Camden County

NWI Types

Wetlands of Camden County, located at the Florida border and the largest of the coastal counties, total 171,783 acres (Table 12) and cover nearly 39 percent of the county land area. Camden County has more wetland area than any other coastal county. Palustrine wetlands are most abundant, occupying 95,603 acres and comprising about 55 percent of the county's wetlands. Forested wetlands are most common, representing nearly 78 percent of palustrine wetlands. Palustrine emergent and scrub-shrub wetlands each account for 10 percent of freshwater wetlands . Estuarine wetlands make up 75,176 acres or about 44 percent of the county's wetlands. Emergent wetlands are the most common estuarine type (96%).

LLWW Types

Wetlands in the estuarine landscape position account for 44 percent of Camden County wetlands (Table 13). By definition, all estuarine wetlands have bidirectional-tidal water flow. Over 25 percent of the area's wetlands are lotic. Fifty-nine percent of lotic wetlands in Camden County exhibit bidirectional-tidal water flow path and 41 percent throughflow water pathways. Twenty-nine percent of wetlands are located in the terrene landscape position, mainly in headwater positions or in isolated depressions. Importantly, 88 percent of these terrene wetlands are outflow water flow path types (typically the source of a stream).

All marine wetlands and 91 percent of estuarine wetlands in Camden County are identified as fringe landscape types, having open access to a bay, sound or the Atlantic Ocean. Most of the county's remaining estuarine wetlands are partially blocked hydrologically by roads or railroad crossings and are classified as basins. Most lotic wetlands (88%) are basin types. Fifty-nine percent of the terrene wetlands are classified as basins (depressions) and 41 percent as flats.

Ponds account for about 2 percent of the freshwater wetlands. A total of 863 ponds were inventoried in Camden County, 93 percent are identified as excavated (Table 14). The average size of ponds in Camden County is nearly 2.1 acres.

Preliminary Functional Assessment

Over 60 percent of the wetlands in Camden County (including ponds) are predicted to perform 8 of 11 functions at high to moderate levels (Table 15). More than 97 percent of the wetlands are deemed important for nutrient transformation, carbon sequestration, and for providing wildlife habitat for wildlife other than waterfowl. Eighty-seven percent of Camden County's wetlands are predicted to retain sediment and other particulates. Seventy-one percent of wetlands in the county appear to provide bank and shoreline stabilization. Almost two-thirds (63%) of the wetlands are predicted to provide coastal storm surge protection and support fish and aquatic invertebrates. Over half (57%) likely provide waterfowl and waterbird habitat. Forty percent of wetlands appear to provide for surface water detention. Relatively few wetlands (19%) are located in landscape positions where they can contribute to maintaining streamflow. Only 5 percent of the wetlands are recognized as uncommon types and significant for contributing to the county's biodiversity.

Table 12. Wetlands of Camden County classified by NWI types (Cowardin et al. 1979).

System	Class	Acreage
Estuarine	Emergent	64,348
	Emergent/Forested	1
	Emergent/Scrub-Shrub	21
	Emergent/Unconsolidated Shore	7,636
	(Subtotal Emergent)	(72,006)
	Forested, Broad-leaved Deciduous	2
	Forested, Broad-leaved Evergreen	108
	Forested, Needle-leaved Evergreen	79
	(Subtotal Forested)	(189)
	Scrub-Shrub, Broad-leaved Deciduous	2
	Scrub-Shrub, Broad-leaved Evergreen	682
	Scrub-Shrub, Needle-leaved Evergreen	296
	Scrub-Shrub/Emergent	55
	(Subtotal Scrub-Shrub)	(1,035)
	Unconsolidated Shore	1,921
	Unconsolidated Shore/Emergent	25
	(Subtotal Nonvegetated)	(1,946)
Total Estuarine Wetlands		**75,176**
Lacustrine	Emergent	10
Total Lacustrine Wetlands		**10**
Marine	Unconsolidated Shore	994
Total Marine Wetlands		**994**
Palustrine	Aquatic Bed	187
	Emergent	9,281
	Emergent/Forested	159
	Emergent/Scrub-Shrub	87
	(Subtotal Emergent)	(9,528)
	Forested, Broad-leaved Deciduous	51,322
	Forested, Broad-leaved Evergreen	7,636
	Forested, Dead	39
	Forested, Needle-leaved Deciduous	10,388
	Forested, Needle-leaved Evergreen	5,468
	Forested/Emergent	43
	Forested/Scrub-Shrub	27
	(Subtotal Forested)	(74,923)
	Scrub-Shrub, Broad-leaved Deciduous	5,816
	Scrub-Shrub, Broad-leaved Evergreen	2,387
	Scrub-Shrub, Needle-leaved Deciduous	280

Table 12 (cont'd).

	Scrub-Shrub, Needle-leaved Evergreen	804
	Scrub-Shrub/Emergent	39
	Scrub-Shrub/Forested	25
	(Subtotal Scrub-Shrub)	(9,351)
	Unconsolidated Bottom	1,589
	Unconsolidated Shore	24
	Unconsolidated Shore/Emergent	1
	(Subtotal Nonvegetated)	(1,614)
Total Palustrine Wetlands		**95,603**
GRAND TOTAL (All Wetlands)		**171,783**

Table 13. Wetlands classified by landscape position, landform, and water flow path for Camden County. Note: Ponds were treated as waterbody type (see Table 14) for summary.

Landscape Position	Landform	Water Flow Path	Acreage
Marine	Fringe	Bidirectional-tidal	994
Total Marine			**994**
Estuarine	Fringe	Bidirectional-tidal	68,551
	Basin	Bidirectional-tidal	6,625
Total Estuarine			**75,176**
Lentic	Fringe	Outflow	10
Total Lentic			**10**
Lotic River	Floodplain-basin	Bidirectional-tidal	23,815
		Throughflow	1,953
	(Subtotal Basin)		(25,768)
	Floodplain-flat	Bidirectional-tidal	1,675
		Throughflow	446
	(Subtotal Flat)		(2,121)
Total Lotic River			**27,889**
Lotic Stream	Basin	Throughflow	12,410
	Flat	Throughflow	3,072
Total Lotic Stream			**15,482**
Terrene	Basin	Isolated	4,520
		Outflow	25,366
	(Subtotal Basin)		(29,886)
	Flat	Isolated	1,331
		Outflow	19,208
	(Subtotal Flat)		(20,538)
	Island	Isolated	6
	(Subtotal Island)		(6)
Total Terrene			**50,431**
GRAND TOTAL			**169,982**

Table 14. Pond acreage for Camden County.

Type of Pond	Water Flow Path	Number of Ponds	Acreage
Natural	Isolated	9	10
	Mesotidal	10	28
	Outflow	26	112
	Throughflow	4	19
Total Natural Ponds		**49**	**170**
Impounded	Isolated	2	1
	Mesotidal	1	8
	Outflow	9	43
Total Impounded Ponds		**12**	**52**
Excavated	Isolated	571	1,047
	Mesotidal	15	25
	Outflow	199	456
	Throughflow	17	52
Total Excavated Ponds		**802**	**1,579**
GRAND TOTAL		**863**	**1,801**

Table 15. Wetlands of potential significance for various functions for Camden County. Note: Results include ponds.

Function	Significance	Acreage	% of All Wetlands
Surface Water Detention	High	14,422	8%
	Moderate	53,968	31%
	Total	**68,390**	**40%**
Coastal Storm Surge Detention	High	101,505	59%
	Moderate	5,935	3%
	Total	**107,440**	**63%**
Streamflow Maintenance	High	12,989	8%
	Moderate	19,268	11%
	Total	**32,257**	**19%**
Nutrient Transformation	High	145,050	84%
	Moderate	22,205	13%
	Total	**167,255**	**97%**
Carbon Sequestration	High	144,954	84%
	Moderate	25,604	15%
	Total	**170,558**	**99%**
Retention of Sediments	High	111,657	65%
	Moderate	37,308	22%
	Total	**148,965**	**87%**
Shoreline Stabilization	High	116,721	68%
	Moderate	4,891	3%
	Total	**121,612**	**71%**
Fish and Shellfish Habitat	High	93,650	55%
	Moderate	14,570	8%
	Total	**108,220**	**63%**
Waterfowl and Waterbird Habitat	High	90,437	53%
	Moderate	7,014	4%
	Total	**97,451**	**57%**

Table 15 (cont'd).

Other Wildlife Habitat	High	155,862	91%
	Moderate	11,205	7%
	Total	**167,067**	**97%**
Unique, Diverse Communities	Barrier Island (F,T,H WR)	303	--
	Selected PEM (N,R,T WR)	3,849	2%
	Selected PSS (N,R,T WR)	4,274	2%
	Total	**8,426**	**5%**

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Wetlands of Chatham County

NWI Types

Wetlands of Chatham County, located along the northern coast below the South Carolina border, total 135,374 acres (Table 16) and cover 37 percent of the county land area. Estuarine wetlands are the most abundant, occupying 88,567 acres or about 65 percent of the county's wetlands. Emergent wetlands are the most common estuarine type (95%). Palustrine wetlands are also abundant, occupying 46,310 acres and comprising about 34 percent of the county's wetlands. Forested wetlands are the most common palustrine type, representing 65 percent of palustrine wetlands. Palustrine emergent and scrub-shrub wetlands account for 19 percent and 11 percent of freshwater vegetated wetlands, respectively. The remaining 6 percent of freshwater wetlands are nonvegetated.

LLWW Types

Wetlands in the estuarine landscape position account for 65 percent of Chatham County wetlands (Table 17). By definition, all estuarine and marine wetlands have bidirectional-tidal water flow. Approximately 21 percent of the area's wetlands are associated with rivers and streams; classified as lotic in landscape position. Over half (52%) of lotic wetlands in Chatham County have bidirectional-tidal water flow and 48 percent have throughflow water. Twelve percent of wetalnds are located in the terrene landscape position, mainly in headwater positions or in isolated depressions. Importantly, 78 percent of these terrene wetlands exhibit outflow (typically the source of a stream).

All marine wetlands and 97 percent of the estuarine wetlands are identified as fringe landform types with open access to bays, sounds or the Atlantic Ocean. The rest of county's estuarine wetlands have partial hydrologic blockage and are classified as basin types. Most of Chatham County's lotic wetlands (80%) are the basin landform type, with the remaining being the flats type. Fifty-two percent of the terrene wetlands are identified as basins (depressions) and 48 percent as flats. Over 78 percent of the terrene wetlands have water outflow and may be viewed as headwater wetlands.

Ponds account for about six percent of the county's freshwater wetlands. A total of 1,199 ponds were inventoried in Chatham County, of which 98 percent appear to be excavated (Table 18). The average size of ponds for Chatham County is 2.3 acres.

Preliminary Functional Assessment

Over three-quarters of the wetlands in Chatham County (including ponds) are predicted to perform 8 of the 11 functions at high to moderate levels (Table 19). At least 94 percent of the wetlands are deemed important for nutrient transformation, carbon sequestration, retention of sediment and other particulates, and for providing wildlife habitat for wildlife other than waterfowl. Eighty-seven percent of Chatham County's wetlands appear to be important for bank and shoreline stabilization. At least three-quarters of the wetlands in the county are predicted to provide coastal storm surge protection (77%), support fish and aquatic invertebrates (75%), and provide waterfowl and waterbird habitat (76%). Twenty-two percent of wetlands are predicted to provide surface water detention. Relatively few wetlands (8%) were located in landscape positions where they could contribute to

maintaining streamflow. Only 4 percent of the wetlands are recognized as uncommon types and significant for contributing to the county's biodiversity.

Table 16. Wetlands of Chatham County classified by NWI types (Cowardin et al. 1979).

System	Class	Acreage
Estuarine	Emergent	72,588
	Emergent/Forested	1
	Emergent/Scrub-Shrub	26
	Emergent/Unconsolidated Shore	11,670
	(Subtotal Emergent)	(84,287)
	Forested, Broad-leaved Deciduous	12
	Forested, Broad-leaved Evergreen	856
	Forested, Needle-leaved Evergreen	55
	Forested/Emergent	2
	(Subtotal Forested)	(924)
	Scrub-Shrub, Broad-leaved Deciduous	425
	Scrub-Shrub, Broad-leaved Evergreen	605
	Scrub-Shrub, Needle-leaved Evergreen	73
	Scrub-Shrub/Emergent	45
	(Subtotal Scrub-Shrub)	(1,148)
	Unconsolidated Shore	2,180
	Unconsolidated Shore/Emergent	28
	(Subtotal Nonvegetated)	(2,208)
Total Estuarine Wetlands		**88,567**
Lacustrine	Aquatic Bed	41
Total Lacustrine Wetlands		**41**
Marine	Unconsolidated Shore	453
Total Marine Wetlands		**453**
Palustrine	Aquatic Bed	179
	Aquatic Bed/Unconsolidated Bottom	6
	(Subtotal Aquatic Bed)	(185)
	Emergent	8,246
	Emergent/Aquatic Bed	77
	Emergent/Forested	116
	Emergent/Scrub-Shrub	170
	(Subtotal Emergent)	(8,608)
	Forested, Broad-leaved Deciduous	24,398
	Forested, Broad-leaved Evergreen	453
	Forested, Dead	12
	Forested, Needle-leaved Deciduous	3,412
	Forested, Needle-leaved Evergreen	1,179
	Forested/Emergent	35

Table 16 (cont'd).

	Forested/Scrub-Shrub	508
	(Subtotal Forested)	(29,997)
	Scrub-Shrub, Broad-leaved Deciduous	4,157
	Scrub-Shrub, Broad-leaved Evergreen	154
	Scrub-Shrub, Needle-leaved Evergreen	364
	Scrub-Shrub/Emergent	67
	Scrub-Shrub/Forested	223
	(Subtotal Scrub-Shrub)	(4,964)
	Unconsolidated Bottom	2,550
	Unconsolidated Shore	7
	(Subtotal Nonvegetated)	(2,557)
Total Palustrine Wetlands		**46,310**
Riverine	Unconsolidated Shore	3
Total Riverine Wetlands		**3**
GRAND TOTAL (All Wetlands)		**135,374**

Table 17. Wetlands classified by landscape position, landform, and water flow path for Chatham County. Note: Ponds were treated as waterbody type (see Table 18) for summary.

Landscape Position	Landform	Water Flow Path	Acreage
Marine	Fringe	Bidirectional-tidal	453
Total Marine			**453**
Estuarine	Fringe	Bidirectional-tidal	85,836
	Basin	Bidirectional-tidal	2,731
Total Estuarine			**88,567**
Lentic	Fringe	Outflow	41
Total Lentic			**41**
Lotic River	Fringe	Bidirectional-tidal	4
	(Subtotal Fringe)		(4)
	Floodplain-basin	Bidirectional-tidal	13,804
		Throughflow	380
	(Subtotal Basin)		(14,184)
	Floodplain-flat	Bidirectional-tidal	615
		Throughflow	166
	(Subtotal Flat)		(781)
Total Lotic River			**14,970**
Lotic Stream	Basin	Throughflow	8,202
	Flat	Throughflow	4,740
Total Lotic Stream			**12,941**
Terrene	Basin	Isolated	2,097
		Outflow	5,979
	(Subtotal Basin)		(8,076)
	Flat	Isolated	1,294
		Outflow	6,290
	(Subtotal Flat)		(7,584)
Total Terrene			**15,660**
GRAND TOTAL			**132,632**

Table 18. Pond acreage for Chatham County.

Type of Pond	Water Flow Path	Number of Ponds	Acreage
Natural	Isolated	9	7
	Mesotidal	3	12
	Outflow	4	22
	Throughflow	4	3
Total Natural Ponds		**20**	**44**
Impounded	Isolated	3	9
	Outflow	4	14
Total Impounded Ponds		**7**	**23**
Excavated	Isolated	925	1,873
	Mesotidal	4	31
	Outflow	133	432
	Throughflow	110	339
Total Excavated Ponds		**1,172**	**2,674**
GRAND TOTAL		**1,199**	**2,742**

Table 19. Wetlands of potential significance for various functions for Chatham County. Note: Results include ponds.

Function	Significance	Acreage	% of All Wetlands
Surface Water Detention	High	9,079	7%
	Moderate	20,544	15%
	Total	**29,623**	**22%**
Coastal Storm Surge Detention	High	103,401	76%
	Moderate	1,446	1%
	Total	**104,847**	**77%**
Streamflow Maintenance	High	2,777	2%
	Moderate	7,470	6%
	Total	**10,247**	**8%**
Nutrient Transformation	High	117,184	87%
	Moderate	12,997	10%
	Total	**130,181**	**96%**
Carbon Sequestration	High	116,005	86%
	Moderate	17,304	13%
	Total	**133,309**	**98%**
Retention of Sediments	High	108,937	80%
	Moderate	18,719	14%
	Total	**127,656**	**94%**
Shoreline Stabilization	High	115,002	85%
	Moderate	2,250	2%
	Total	**117,252**	**87%**
Fish and Shellfish Habitat	High	98,106	72%
	Moderate	3,079	2%
	Total	**101,185**	**75%**
Waterfowl and Waterbird Habitat	High	99,036	73%
	Moderate	3,714	3%
	Total	**102,750**	**76%**
Other Wildlife Habitat	High	123,872	92%

Table 19 (cont'd).

	Moderate	6,086	4%
	Total	**129,958**	**96%**
Unique, Diverse Communities	Barrier Island (F,T,H WR)	163	--
	Selected PEM (N,R,T WR)	5,714	3%
	Palustrine Vegetated (H WR)	42	--
	Selected PSS (N,R,T WR)	1,514	1%
	Total	**7,433**	**4%**

Wetlands of Glynn County

NWI Types

Wetlands of Glynn County, located between McIntosh and Camden counties, comprise 125,328 acres (Table 20) and cover 42 percent of the county land area. Estuarine wetlands are the most abundant, occupying 71,484 acres or about 57 percent of the county's wetlands. Emergent wetlands are the most common estuarine type (92%). Palustrine wetlands are also abundant, occupying 52,905 acres and comprising about 42 percent of the county's wetlands. Palustrine forested wetlands are most common, representing 70 percent of palustrine wetlands. Palustrine emergent and scrub-shrub wetlands account for 17 percent and 11 percent of freshwater wetlands and scrub-shrub wetlands, respectively.

LLWW Types

Wetlands in the estuarine landscape position make up 57 percent of Glynn County wetlands (Table 21). By definition, all estuarine and marine wetlands have bidirectional-tidal water flow. Approximately 24 percent of the county's wetlands are lotic. Over half (51%) of lotic wetlands in Glynn County have bidirectional-tidal flows and 48 percent have throughflow water pathways. Seventeen percent of wetlands are located in the terrene landscape position, mainly in headwater positions or in isolated depressions. Eighty-four percent of terrene wetlands exhibit outflow and are typically the source of a stream.

All marine wetlands and 83 percent of the estuarine wetlands are identified as fringe types with open access to bays, sounds or the Atlantic Ocean. Many of the remaining estuarine wetlands were located behind roads or railroad crossings which partially block hydrologic access and are therefore classified as basin landform types. Most lotic wetlands (94%) in Glynn County are basin types. Sixty-one percent of the terrene wetlands are basins (depressions) and 39 percent are flats.

Ponds account for about 3 percent of the county's freshwater wetlands. A total of 858 ponds were inventoried in Glynn County and 97 percent appear to have been excavated (Table 22). The average size of ponds in Glynn County is 1.9 acres.

Preliminary Functional Assessment

Over 70 percent of the wetlands in Glynn County (including ponds) are predicted to perform 8 of 11 functions at high to moderate levels (Table 23). More than 93 percent of the wetlands are deemed important for nutrient transformation, carbon sequestration, retention of sediment and other particulates, and for providing wildlife habitat for wildlife other than waterfowl. Eighty-three percent of Glynn County's wetlands appear to be important for bank and shoreline stabilization. Over three-quarters (77%) of the wetlands in the county are likely to support fish and aquatic invertebrates, and provide waterfowl and waterbird habitat. Seventy-one percent appear to provide coastal storm surge protection. Twenty-nine percent of the wetlands potentially provide surface water detention. Relatively few wetlands (17%) are located in landscape positions where they can contribute to maintaining streamflow. Seven percent of the wetlands are recognized as uncommon types and significant for contributing to the county's biodiversity.

Table 20. Wetlands of Glynn County classified by NWI types (Cowardin et al. 1979).

System	Class	Acreage
Estuarine	Emergent	63,339
	Emergent/Scrub-Shrub	17
	Emergent/Unconsolidated Shore	3,004
	(Subtotal Emergent)	(66,360)
	Forested, Broad-leaved Evergreen	103
	Forested, Needle-leaved Evergreen	72
	(Subtotal Forested)	(175)
	Scrub-Shrub, Broad-leaved Deciduous	43
	Scrub-Shrub, Broad-leaved Evergreen	514
	Scrub-Shrub, Needle-leaved Evergreen	14
	Scrub-Shrub/Emergent	3
	(Subtotal Scrub-Shrub)	(574)
	Unconsolidated Shore	4,248
	Unconsolidated Shore/Emergent	128
	(Subtotal Nonvegetated)	(4,376)
Total Estuarine Wetlands		**71,484**
Lacustrine	Unconsolidated Shore	32
Total Lacustrine Wetlands		**32**
Marine	Unconsolidated Shore	906
Total Marine Wetlands		**906**
Palustrine	Aquatic Bed	97
	Emergent	8,869
	Emergent/Aquatic Bed	7
	Emergent/Forested	31
	Emergent/Scrub-Shrub	6
	(Subtotal Emergent)	(8,912)
	Forested, Broad-leaved Deciduous	19,023
	Forested, Broad-leaved Evergreen	1,326
	Forested, Needle-leaved Deciduous	14,328
	Forested, Needle-leaved Evergreen	1,867
	Forested/Emergent	4
	Forested/Scrub-Shrub	256
	(Subtotal Forested)	(36,803)
	Scrub-Shrub, Broad-leaved Deciduous	4,608
	Scrub-Shrub, Broad-leaved Evergreen	492
	Scrub-Shrub, Needle-leaved Deciduous	235
	Scrub-Shrub, Needle-leaved Evergreen	174

Table 20 (cont'd).

	Scrub-Shrub/Emergent	21
	Scrub-Shrub/Forested	61
	(Subtotal Scrub-Shrub)	(5,592)
	Unconsolidated Bottom	1,462
	Unconsolidated Shore	39
	(Subtotal Nonvegetated)	(1,501)
Total Palustrine Wetlands		**52,905**
GRAND TOTAL (All Wetlands)		**125,328**

Table 21. Wetlands classified by landscape position, landform, and water flow path for Glynn County. Note: Ponds were treated as waterbody type (see Table 22) for summary.

Landscape Position	Landform	Water Flow Path	Acreage
Marine	Fringe	Bidirectional-tidal	906
Total Marine			**906**
Estuarine	Fringe	Bidirectional-tidal	59,087
	Basin	Bidirectional-tidal	12,398
Total Estuarine			**71,484**
Lentic	Fringe	Isolated	32
Total Lentic			**32**
Lotic River	Floodplain-basin	Bidirectional-tidal	14,947
	Floodplain-flat	Bidirectional-tidal	492
Total Lotic River			**15,439**
Lotic Stream	Basin	Throughflow	13,175
	Flat	Throughflow	1,199
Total Lotic Stream			**14,374**
Terrene	Basin	Isolated	2,605
		Outflow	10,602
	(Subtotal Basin)		(13,206)
	Flat	Isolated	804
		Outflow	7,466
		Throughflow	13
	(Subtotal Flat)		(8,282)
	Island	Isolated	6
	(Subtotal Island)		(6)
Total Terrene			**21,494**
GRAND TOTAL			**123,729**

Table 22. Pond acreage for Glynn County.

Type of Pond	Water Flow Path	Number of Ponds	Acreage
Natural	Isolated	6	4
	Mesotidal	4	10
	Outflow	4	39
Total Natural Ponds		**14**	**53**
Impounded	Isolated	6	22
	Mesotidal	4	7
Total Impounded Ponds		**10**	**29**
Excavated	Isolated	653	1,068
	Mesotidal	9	18
	Outflow	157	414
	Throughflow	15	18
Total Excavated Ponds		**834**	**1,517**
GRAND TOTAL		**858**	**1,598**

Table 23. Wetlands of potential significance for various functions for Glynn County. Note: Results include ponds.

Function	Significance	Acreage	% of All Wetlands
Surface Water Detention	High	13,232	11%
	Moderate	22,662	18%
	Total	**35,894**	**29%**
Coastal Storm Surge Detention	High	87,804	70%
	Moderate	1,211	1%
	Total	**89,015**	**71%**
Streamflow Maintenance	High	4,940	4%
	Moderate	16,252	13%
	Total	**21,192**	**17%**
Nutrient Transformation	High	108,931	87%
	Moderate	9,710	8%
	Total	**118,641**	**95%**
Carbon Sequestration	High	108,780	87%
	Moderate	15,448	12%
	Total	**124,228**	**99%**
Retention of Sediments	High	95,356	76%
	Moderate	20,667	16%
	Total	**116,023**	**93%**
Shoreline Stabilization	High	97,381	78%
	Moderate	6,492	5%
	Total	**103,873**	**83%**
Fish and Shellfish Habitat	High	93,537	75%
	Moderate	3,173	3%
	Total	**96,710**	**77%**
Waterfowl and Waterbird Habitat	High	91,686	73%
	Moderate	4,298	3%
	Total	**95,984**	**77%**
Other Wildlife Habitat	High	112,600	90%

Table 23 (cont'd).

	Moderate	5,944	5%
	Total	**118,544**	**95%**
Unique, Diverse Communities	Barrier Island (F,T,H WR)	18	--
	Selected PEM (N,R,T WR)	5,897	5%
	Palustrine Vegetated (H WR)	7	--
	Selected PSS (N,R,T WR)	2,212	2%
	Total	**8,134**	**7%**

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Wetlands of Liberty County

NWI Types

Wetlands of Liberty County, located along the north central coast, comprise 126,560 acres (Table 24) and cover 36 percent of the county land area. Palustrine wetlands are the most abundant, occupying 83,716 acres or about 66 percent of the county's wetlands. Palustrine forested wetlands (70,621 acres) are the most common palustrine type, representing 84 percent of palustrine wetlands. Palustrine emergent wetlands account for 9 percent of freshwater wetlands and scrub-shrub wetlands account for 5 percent. Estuarine wetlands (42,548 acres) make up 34 percent of the county's wetlands. Emergent wetlands are the most common estuarine type (96%).

LLWW Types

Wetlands in the estuarine landscape position account for 34 percent of Liberty County wetlands (Table 25). By definition, all estuarine and marine wetlands have bidirectional-tidal water flow. Approximately 38 percent of the county's wetlands are classified as lotic. Nearly all (96%) lotic wetlands in Liberty County have throughflow water pathways. Less than 4 percent have bidirectional-tidal water flow. Twenty-seven percent of the wetlands are located in the terrene landscape position, mainly in headwater positions or in isolated depressions. Importantly, 80 percent of these terrene wetlands are outflow types that are typically the source of a stream.

All marine wetlands and 91 percent of the estuarine wetlands are identified as fringe landform types with open access to bays, sounds or the Atlantic Ocean. About 9 percent of Liberty County's estuarine wetlands are classified as basin types. The basin classification usually results from partial hydrologic blockage by roads or railroad crossings. Most lotic wetlands (85%) in the county are basin landform types. Seventy-five percent of the terrene wetlands are described as basins (depressions) and 25 percent as flats.

Ponds account for only about 2 percent of the county's freshwater wetlands. A total of 649 ponds were inventoried in Liberty County, 94 percent of which were identified as excavated (Table 26). The average size of ponds in Liberty County is 2.2 acres.

Preliminary Functional Assessment

Over 50 percent of the wetlands in Liberty County (including ponds) were predicted to perform seven of the eleven functions at high to moderate levels (Table 27). More than 92 percent of the wetlands are deemed important for nutrient transformation, carbon sequestration, retention of sediment and other particulates, and for providing habitat for wildlife other than waterfowl and other water birds. Seventy-two percent of Liberty County's wetlands are seen as important for shoreline stabilization. Sixty-four percent appear important for surface water detention. Over half (54%) of the wetlands in the county are anticipated to provide waterfowl and waterbird habitat and 43 percent are likely to support fish and aquatic invertebrates. Forty-one percent of wetlands are located in landscape positions where they could contribute to maintaining streamflow. Thirty-eight percent are predicted to provide coastal storm surge protection. Only 2 percent of the wetlands are recognized as uncommon types and significant for contributing to the county's biodiversity.

Table 24. Wetlands of Liberty County classified by NWI types (Cowardin et al. 1979).

System	Class	Acreage
Estuarine	Emergent	29,299
	Emergent/Scrub-Shrub	4
	Emergent/Unconsolidated Shore	11,653
	(Subtotal Emergent)	(40,956)
	Forested, Broad-leaved Evergreen	315
	Scrub-Shrub, Broad-leaved Deciduous	35
	Scrub-Shrub, Broad-leaved Evergreen	828
	Scrub-Shrub/Emergent	12
	(Subtotal Scrub-Shrub)	(875)
	Unconsolidated Shore	403
Total Estuarine Wetlands		**42,548**
Lacustrine	Aquatic Bed	66
Total Lacustrine Wetlands		**66**
Marine	Unconsolidated Shore	229
Total Marine Wetlands		**229**
Palustrine	Aquatic Bed	119
	Emergent	6,243
	Emergent/Aquatic Bed	78
	Emergent/Forested	1,228
	Emergent/Scrub-Shrub	73
	(Subtotal Emergent)	(7,622)
	Forested, Broad-leaved Deciduous	40,769
	Forested, Broad-leaved Evergreen	5,025
	Forested, Dead	24
	Forested, Needle-leaved Deciduous	20,346
	Forested, Needle-leaved Evergreen	4,304
	Forested/Emergent	70
	Forested/Scrub-Shrub	83
	(Subtotal Forested)	(70,621)
	Scrub-Shrub, Broad-leaved Deciduous	2,918
	Scrub-Shrub, Broad-leaved Evergreen	540
	Scrub-Shrub, Needle-leaved Deciduous	320
	Scrub-Shrub, Needle-leaved Evergreen	22
	Scrub-Shrub/Emergent	70
	Scrub-Shrub/Forested	189
	(Subtotal Scrub-Shrub)	(4,059)
	Unconsolidated Bottom	1,215

Table 24 (cont'd).

	Unconsolidated Shore	80
	(Subtotal Nonvegetated)	(1,295)
Total Palustrine Wetlands		**83,716**
Riverine	Unconsolidated Shore	2
Total Riverine Wetlands		**2**
GRAND TOTAL (All Wetlands)		**126,560**

Table 25. Wetlands classified by landscape position, landform, and water flow path for Liberty County. Note: Ponds were treated as waterbody type (see Table 26) for summary.

Landscape Position	Landform	Water Flow Path	Acreage
Marine	Fringe	Bidirectional-tidal	229
Total Marine			**229**
Estuarine	Fringe	Bidirectional-tidal	38,796
	Basin	Bidirectional-tidal	3,752
Total Estuarine			**42,548**
Lentic	Fringe	Isolated	324
		Outflow	45
Total Lentic			**369**
Lotic River	Floodplain-basin	Bidirectional-tidal	1,616
		Throughflow	2,535
	(Subtotal Basin)		(4,152)
	Floodplain-flat	Bidirectional-tidal	169
		Throughflow	470
	(Subtotal Flat)		(638)
Total Lotic River			**4,790**
Lotic Stream	Basin	Throughflow	36,411
	Flat	Throughflow	6,368
Total Lotic Stream			**42,779**
Terrene	Basin	Isolated	5,626
		Outflow	20,106
	(Subtotal Basin)		(25,732)
	Flat	Isolated	1,111
		Outflow	7,587
	(Subtotal Flat)		(8,698)
	Island	Isolated	1
	(Subtotal Island)		(1)
Total Terrene			**34,431**
GRAND TOTAL			**125,146**

Table 26. Pond acreage for Liberty County.

Type of Pond	Water Flow Path	Number of Ponds	Acreage
Natural	Isolated	5	6
	Outflow	5	54
	Throughflow	8	11
Total Natural Ponds		**18**	**71**
Impounded	Isolated	10	40
	Outflow	10	65
	Throughflow	2	12
Total Impounded Ponds		**22**	**117**
Excavated	Isolated	451	823
	Outflow	89	233
	Throughflow	69	170
Total Excavated Ponds		**609**	**1,226**
GRAND TOTAL		**649**	**1,414**

Table 27. Wetlands of potential significance for various functions for Liberty County. Note: Results include ponds.

Function	Significance	Acreage	% of All Wetlands
Surface Water Detention	High	39,391	31%
	Moderate	41,253	33%
	Total	**80,644**	**64%**
Coastal Storm Surge Detention	High	44,562	35%
	Moderate	3,413	3%
	Total	**47,975**	**38%**
Streamflow Maintenance	High	13,503	11%
	Moderate	37,881	30%
	Total	**51,384**	**41%**
Nutrient Transformation	High	109,273	86%
	Moderate	15,358	12%
	Total	**124,631**	**98%**
Carbon Sequestration	High	109,269	86%
	Moderate	16,882	13%
	Total	**126,151**	**100%**
Retention of Sediments	High	83,024	66%
	Moderate	33,584	27%
	Total	**116,608**	**92%**
Shoreline Stabilization	High	90,202	71%
	Moderate	692	1%
	Total	**90,894**	**72%**
Fish and Shellfish Habitat	High	51,765	41%
	Moderate	2,639	2%
	Total	**54,404**	**43%**
Waterfowl and Waterbird Habitat	High	49,767	39%
	Moderate	18,146	14%
	Total	**67,913**	**54%**
Other Wildlife Habitat	High	115,960	92%

Table 27 (cont'd).

	Moderate	8,487	7%
	Total	**124,447**	**98%**
Unique, Diverse Communities	Barrier Island (F,T,H WR)	39	--
	Selected PEM (N,R,T WR)	844	1%
	Palustrine Vegetated (H WR)	30	--
	Selected PSS (N,R,T WR)	419	--
	Carolina Bays (Relatively Intact)	919	1%
	Total	**2,251**	**2%**

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Wetlands of McIntosh County

NWI Types

Wetlands of McIntosh County, located midway along the coast, comprise 141,479 acres (Table 28) and cover 45 percent of the county's land area. McIntosh County has the greatest density of wetlands of the coastal counties. There are slightly more palustrine wetlands than estuarine wetlands in the county. Palustrine wetlands occupy 71,020 acres and estuarine wetlands total 69,878 acres. Forested wetlands (54,573 acres) were the most common palustrine type, representing 77 percent of palustrine wetlands. Palustrine emergent wetlands account for 17 percent of freshwater wetlands and scrub-shrub wetlands account for 5 percent. Estuarine emergent wetlands are the most common estuarine type (97%).

LLWW Types

Wetlands in the estuarine landscape position make up nearly 50 percent of McIntosh County wetlands (Table 29). By definition, all estuarine and marine wetlands have bidirectional-tidal water flow. Almost one-third (32%) of the county's wetlands are lotic. Most (63%) of the lotic wetlands in McIntosh County have bidirectional- tidal water flow, with the remainder having throughflow. Eighteen percent of wetlands are located in the terrene landscape position, mainly in headwater positions or in isolated depressions. Importantly, 76 percent of terrene wetlands are outflow types (typically the source of a stream).

All marine wetlands and over 99 percent of the estuarine wetlands in McIntosh County are identified as fringe landform types having open access to bays, sounds or the Atlantic Ocean. Most lotic wetlands (94%) are basin types. Seventy-three percent of the terrene wetlands are basins (depressions) and 27 percent are flats.

Ponds account for nearly 1 percent of the county's freshwater wetlands. A total of 342 ponds were inventoried in McIntosh County, 86 percent of which were identified as excavated (Table 30). The average size of ponds in McIntosh County is 1.9 acres.

Preliminary Functional Assessment

Nearly three-quarters (72%) of the wetlands in McIntosh County (including ponds) are predicted to perform eight of the eleven functions at high to moderate levels (Table 31). At least 94 percent of the wetlands were deemed important for nutrient transformation, carbon sequestration, retention of sediment and other particulates, and for providing wildlife habitat for wildlife other than waterfowl and other waterbirds. Eight-two percent are likely to provide bank and shoreline stabilization. At least 72 percent of McIntosh County's wetlands are likely to be important for waterfowl and other water bird habitat, fish and aquatic invertebrate habitat and coastal storm surge detention. Twenty-seven percent are predicted to contribute to surface water detention and fifteen percent of wetlands were located in landscape positions where they could contribute to maintaining streamflow. Four percent of the wetlands are recognized as uncommon types and significant for contributing to the county's biodiversity.

Table 28. Wetlands of McIntosh County classified by NWI types (Cowardin et al. 1979).

System	Class	Acreage
Estuarine	Emergent	56,220
	Emergent/Scrub-Shrub	39
	Emergent/Unconsolidated Shore	11,329
	(Subtotal Emergent)	(67,588)
	Forested, Broad-leaved Evergreen	250
	Scrub-Shrub, Broad-leaved Deciduous	1
	Scrub-Shrub, Broad-leaved Evergreen	756
	(Subtotal Scrub-Shrub)	(757)
	Unconsolidated Shore	1,273
	Unconsolidated Shore/Emergent	10
	(Subtotal Nonvegetated)	(1,283)
Total Estuarine Wetlands		**69,878**
Lacustrine	Aquatic Bed	2
Total Lacustrine Wetlands		**2**
Marine	Unconsolidated Shore	502
Total Marine Wetlands		**502**
Palustrine	Aquatic Bed	68
	Emergent	12,141
	Emergent/Aquatic Bed	16
	Emergent/Forested	6
	Emergent/Scrub-Shrub	60
	(Subtotal Emergent)	(12,223)
	Forested, Broad-leaved Deciduous	28,182
	Forested, Broad-leaved Evergreen	1,703
	Forested, Needle-leaved Deciduous	22,093
	Forested, Needle-leaved Evergreen	2,306
	Forested/Emergent	257
	Forested/Scrub-Shrub	32
	(Subtotal Forested)	(54,573)
	Scrub-Shrub, Broad-leaved Deciduous	2,588
	Scrub-Shrub, Broad-leaved Evergreen	745
	Scrub-Shrub, Needle-leaved Deciduous	183
	Scrub-Shrub, Needle-leaved Evergreen	13
	Scrub-Shrub/Emergent	26
	Scrub-Shrub/Forested	4
	(Subtotal Scrub-Shrub)	(3,558)
	Unconsolidated Bottom	591

Table 28 (cont'd).

	Unconsolidated Shore	7
	(Subtotal Nonvegetated)	(598)
Total Palustrine Wetlands		**71,020**
Riverine	Unconsolidated Shore	78
Total Riverine Wetlands		**78**
GRAND TOTAL (All Wetlands)		**141,479**

Table 29. Wetlands classified by landscape position, landform, and water flow path for McIntosh County. Note: Ponds were treated as waterbody type (see Table 30) for summary.

Landscape Position	Landform	Water Flow Path	Acreage
Marine	Fringe	Bidirectional-tidal	502
Total Marine			**502**
Estuarine	Fringe	Bidirectional-tidal	69,786
	Basin	Bidirectional-tidal	129
Total Estuarine			**69,915**
Lentic	Fringe	Outflow	2
Total Lentic			**2**
Lotic River	Fringe	Bidirectional-tidal	64
	(Subtotal Fringe)		(64)
	Floodplain-basin	Bidirectional-tidal	27,449
		Throughflow	261
	(Subtotal Basin)		(27,710)
	Floodplain-flat	Bidirectional-tidal	1,392
		Throughflow	3
	(Subtotal Flat)		(1,395)
Total Lotic River			**29,169**
Lotic Stream	Basin	Throughflow	15,013
	Flat	Throughflow	1,354
Total Lotic Stream			**16,366**
Terrene	Basin	Isolated	5,304
		Outflow	12,874
	(Subtotal Basin)		(18,179)
	Flat	Isolated	672
		Outflow	6,008
	(Subtotal Flat)		(6,680)
Total Terrene			**24,859**
GRAND TOTAL			**140,813**

Table 30. Pond acreage for McIntosh County.

Type of Pond	Water Flow Path	Number of Ponds	Acreage
Natural	Isolated	2	1
	Mesotidal	26	76
	Outflow	5	48
	Throughflow	1	<1
Total Natural Ponds		**34**	**125**
Impounded	Isolated	6	29
	Outflow	7	21
Total Impounded Ponds		**13**	**50**
Excavated	Isolated	248	372
	Outflow	43	116
	Throughflow	4	4
Total Excavated Ponds		**295**	**492**
GRAND TOTAL		**342**	**666**

Table 31. Wetlands of potential significance for various functions for McIntosh County. Note: Results include ponds.

Function	Significance	Acreage	% of All Wetlands
Surface Water Detention	High	15,284	11%
	Moderate	23,323	16%
	Total	**38,607**	**27%**
Coastal Storm Surge Detention	High	99,218	70%
	Moderate	3,580	3%
	Total	**102,798**	**73%**
Streamflow Maintenance	High	5,478	4%
	Moderate	15,682	11%
	Total	**21,160**	**15%**
Nutrient Transformation	High	129,654	92%
	Moderate	9,374	7%
	Total	**139,028**	**98%**
Carbon Sequestration	High	129,606	92%
	Moderate	11,218	8%
	Total	**140,824**	**100%**
Retention of Sediments	High	111,317	79%
	Moderate	20,981	15%
	Total	**132,298**	**94%**
Shoreline Stabilization	High	114,455	81%
	Moderate	1,704	1%
	Total	**116,159**	**82%**
Fish and Shellfish Habitat	High	99,396	70%
	Moderate	8,476	6%
	Total	**107,872**	**76%**
Waterfowl and Waterbird Habitat	High	96,502	68%
	Moderate	5,458	4%
	Total	**101,960**	**72%**

Table 31 (cont'd).

Other Wildlife Habitat	High	134,004	95%
	Moderate	4,954	4%
	Total	**138,958**	**98%**
Unique, Diverse Communities	Barrier Island (F,T,H WR)	784	--
	Selected PEM (N,R,T WR)	4,826	3%
	Selected PSS (N,R,T WR)	421	--
	Total	**6,031**	**4%**

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Discussion

The wetland functional assessment presented here is preliminary, based on relationships between wetland characteristics in the enhanced NWI database (NWI+) and eleven wetland functions. The assessment focused on wetlands (including ponds) and not on other aquatic habitats (deepwater habitats). Although field work played an important role in developing the NWI+ for coastal Georgia, the information reported in this study is primarily from remotely sensed data sources (i.e. from the interpretation of aerial photography), and should be utilized as a starting point when making wetland management or land use decisions. Site specific evaluations are prudent where important environmental decisions are concerned. *Users of the NWI+ data are reminded that the wetlands delineated by the updated NWI are defined in accordance with the Cowardin et al. (1979) classification and are not intended to represent jurisdictional wetlands as defined by state, local, or federal agencies.*

The functional assessment and the NWI+ database from which it was derived should always be considered in the context of the timeframe it represents. The NWI+ database, developed from aerial photographs taken in 2006, represents conditions as they existed at that time. It should be anticipated that alterations to the landscape have occurred since that time, resulting from both natural and anthropogenic causes. Similarly, the state of our understanding of how wetlands work and the values they provide is evolving. As we learn more about wetland functions and values and their relationship to their hydrogeomorphic and biological characteristics, the relationships used for this assessment can be adjusted and the NWI+ data can be reevaluated.

The precision of the NWI+ data for coastal Georgia has not been rigorously tested in a statistical fashion. To do so would be especially costly and time consuming, in part because of the vast amount of private land in the study area to which access (for field verification) is largely denied, as well as the various levels of classification detail included in the database that would need to be evaluated. Confidence in the data and an understanding of its limitations will be determined as the NWI+ and functional assessment are used, especially as they are applied and evaluated on-the-ground in practical situations.

The NWI+ data layer developed for this project can be used to answer numerous wetland planning questions and in various land use planning contexts. A GIS user guide to the NWI+ data layer is included as Appendix E. Inquiries regarding where wetlands are located, what types they are, and which ones are potentially important are virtually limitless depending only on the creativity of the GIS operator. The utility of the data layer increases as it is combined with other GIS data layers. For example, comparing the 1980s version NWI to the updated wetland inventory could provide an understanding of where and what kinds of wetlands have been lost or degraded and how the loss has affected wetland functions and values important to the residents of coastal Georgia. With this information in hand it may be possible to develop a plan to mitigate for the functional loss or to develop a plan to protect those functions from further loss or degradation.

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Recommendations

(1) Expand the NWI+ mapping and functional assessment to the next tier of counties westward in order to develop the capability to manage and evaluate wetland resources on a watershed basis. Wetlands and other water-dependent natural resources are most effectively managed on watershed basis. Until complete watersheds have been inventoried the capacity to manage wetland resources in a holistic fashion will be somewhat compromised.

(2) Encourage and contribute to the acquisition of high-resolution digital color infrared aerial photography. High quality aerial photography is an invaluable resource for a variety of land use planning applications. Color infrared aerial photography taken during leaf-off period in the late spring is especially useful for detailed delineation and classification of wetlands. For best results, imagery should be acquired during periods of normal rainfall and not during drought.

(3) Evaluate the accuracy of the wetland classifications and predicted wetland functions by conducting field investigations. Record the specific locations where discrepancies between on-the-ground observations and the NWI+ and Landscape-level Wetland Functional Assessment databases are observed. Keeping and evaluating these records would provide an index of the quality of the databases in lieu of a statistical evaluation of precision, as well as inform improvement of future updates to the databases.

(4) Conduct a wetland trend analysis to determine which types of wetlands have been lost or altered and relate this information to functions that have also been lost or impaired. Having the trend information could assist community leaders in protecting wetlands that have been vulnerable yet provide functions that local citizens wish to preserve. In addition, understanding trend analyses could assist resource managers in mitigating the losses of identified wetland functions. At a minimum, such studies should be conducted in high-growth areas and surrounding locales.

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Summary

The NWI update documented over 804,200 acres of wetlands in the six-county study area. Wetlands comprised about 40 percent of the area. Palustrine wetlands (freshwater) represented more than half (54%) of the wetlands. Palustrine forested wetland was the most common freshwater wetland type. Most (57%) palustrine forested wetlands were associated with rivers or streams (lotic). Estuarine intertidal emergent was the most prevalent saltwater type, encompassing 351,236 acres. Of the coastal counties, McIntosh County had the highest wetland density with wetlands covering 45 percent of the land surface.

From a functional standpoint, nearly all of the wetlands were predicted as having high to moderate significance for nutrient transformation, carbon sequestration, retention of sediment and other particulates and as wildlife habitat. Over three-quarters of the wetlands were predicted to be important for shoreline stabilization. More than half of the wetland acreage was recognized as important for coastal storm surge detention, fish and shellfish habitat and waterfowl and waterbird habitat.

Less wetland acreage was designated as significant for streamflow maintenance because fewer wetlands were in headwater locations than along rivers and streams or coastal waters. Wetlands identified as unique or diverse plant communities are by definition rare in the region. Only 4 percent of the area's wetlands were so designated, yet they contribute disproportionately to maintaining the area's biodiversity.

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