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St. Marks River and Apalachee Bay Watershed Characterization

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Version History

Date	Version	Location(s) in Document	Summary of Revision(s)
08/12/2016	1	All	Initial draft Watershed Characterization (Sections 1, 2, 3, 4, and 6) submitted to NWFWMD.
8/30/2016	2	Throughout	Numerous edits and comments from District staff
11/10/2016	3	Throughout	Numerous revisions to address District comments.
11/23/2016	4	Throughout	Numerous edits and comments from District staff
11/28/2016	5	Throughout	Numerous revisions to address District comments.

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Abbreviations and Acronyms List

ARPC	Apalachee Regional Planning Council
AWT	Advanced Wastewater Treatment
BMAP	Basin Management Action Plan
BMP	best management practice
cfs	cubic feet per second
CWA	Clean Water Act
DO	dissolved oxygen
EPA	U.S. Environmental Protection Agency
ERP	Florida - Environmental Resource Permitting
ESA	Endangered Species Act
F.A.C.	Florida Administrative Code
FDACS	Florida Department of Agriculture and Consumer Services
FDEC	Florida Demographic Estimating Conference
FDEP	Florida Department of Environmental Protection
FDNR	Florida Department of Natural Resources
FDOH	Florida Department of Health
FDOT	Florida Department of Transportation
FEMA	Federal Emergency Management Agency
FGS	Florida Geological Survey
FNAI	Florida Natural Areas Inventory
F.S.	Florida Statutes
FWC	Florida Fish and Wildlife Conservation Commission
FWRI	Fish and Wildlife Research Institute
GEBF	Gulf Environmental Benefit Fund
GEMS	Gulf Ecological Management Site
GIS	Geographic Information Systems
GWTV	Groundwater Temporal Variability
HABs	harmful algal blooms
IWR	Impaired Surface Waters Rule
MFLs	minimum flows and minimum water levels
mg-N/L	milligrams of nitrogen per liter
mgd	million gallons per day
MS4s	municipal separate storm sewer systems

NFWF	National Fish and Wildlife Foundation
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPL	National Priority List
NPS	nonpoint source
NRC	National Research Council
NRCS	Natural Resources Conservation Service
NRDA	Natural Resource Damage Assessment
NWFWMD	Northwest Florida Water Management District
NWR	National Wildlife Refuge
OFWs	Outstanding Florida Waters
OSTDS	onsite sewage treatment and disposal systems
PBTS	Performance Based Treatment Systems
RESTORE Act	Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act
RWSP	Regional Water Supply Plan
SAV	submerged aquatic vegetation
SEAS	Shellfish Environmental Assessment Section
SHCA	Strategic Habitat Conservation Areas
SIMM	Seagrass Integrated Mapping and Monitoring
SMZs	Special Management Zones
SLAMM	Sea Level Affecting Marshes Model
START	Solutions To Avoid Red Tide
STCM	Storage Tank and Petroleum Contamination Monitoring
SWIM	Surface Water Improvement and Management
SWTV	Surface Water Temporal Variability
TEEB	The Economics of Ecosystems and Biodiversity
TMDL	total maximum daily load
TN	total nitrogen
TNC	The Nature Conservancy
TPS	Thomas P. Smith Water Reclamation Facility
TRRF	Tram Road Reuse Facility
UF-IFAS	University of Florida’s Institute of Food and Agricultural Sciences
USACE	U.S. Army Corps of Engineers

USDA	U.S. Department of Agriculture
USDOC	U.S. Department of Commerce
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WBID	waterbody identification number
WMA	water management area
WWTF	wastewater treatment facility

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1.1 SWIM Program Background, Goals, and Objectives

1.2 Purpose and Scope of 2017 SWIM Plan

1.0 Introduction

This watershed characterization has been prepared in support of an update to the Surface Water Improvement and Management (SWIM) plan for the St. Marks River and Apalachee Bay watershed. The SWIM plan is intended to provide a framework for resource management, protection, and restoration using a watershed approach. The SWIM Program is administered through the Northwest Florida Water Management District (NWFWMD) and includes management actions to address water quality, natural systems, and watershed functions and benefits. This plan is an update to the original plan which was developed in 1997 and updated in 2009 (NWFWMD 2009).

The St. Marks River and Apalachee Bay watershed begins in southern Georgia and includes Apalachee Bay, the St. Marks River, and the Wakulla River, as well as their tributaries, which are located primarily in Leon, Jefferson, and Wakulla counties (Figure 2-1). The watershed also includes numerous springs, including Wakulla Spring, the St. Marks River Rise, and the Spring Creek Springs Group. Although a small portion of the watershed is located in Georgia, the scope of this plan, for implementation purposes, is limited to the Florida portion.

1.1 SWIM Program Background, Goals, and Objectives

SWIM Plans have been developed pursuant to the SWIM Act, which was enacted by the Florida Legislature in 1987 and amended in 1989 through sections 373.451-373.459, Florida Statutes (F.S.). Through this Act, the Legislature recognized threats to the quality and function of the state's surface water resources. The Act authorized the state’s five water management districts to:

- Develop programs to provide improved management of surface waters and associated resources;
- Develop plans identifying current conditions and processes affecting the quality of surface waters;
- Identify strategies and management actions to restore and protect waterbodies; and
- Conduct research to improve scientific understanding of the causes and effects of the degradation of surface waters and associated natural systems.

The SWIM program addresses overarching goals and priorities through the identification and implementation of projects, which are vetted and prioritized by the District and local stakeholders, with public input. Projects may include stormwater treatment and floodplain restoration for water quality improvement, wetland and aquatic habitat restoration, resource assessments, and public outreach and awareness initiatives, among others.

Surface Water Improvement Management Plans integrate complementary programs and activities to protect and restore watershed resources and functions. They are also designed to address water quality and natural systems challenges that are more generally outlined in the District's strategic plan.

In addition to the SWIM Act of 1987, the following Florida Statutes and administrative codes support and complement the SWIM program:

- **Chapter 259, F.S.: Florida Forever Act: Land Acquisitions and Capital Improvements for Conservation or Recreation;**
- **Chapter 375, F.S.: Land Acquisition Trust Fund;**
- **Section 403.067(7)(A)4, F.S.: Total Maximum Daily Loads (TMDLs);**
- **Section 373.042, F.S.: Minimum Flows and Minimum Water Levels;**
- **Chapter 62-302, Florida Administrative Code (F.A.C.): Surface Water Quality Standards;**
- **Chapter 62-303, F.A.C.: Identification of Impaired Surface Waters; and**

  Chapter 62-304, F.A.C.: TMDLs.

1.2 Purpose and Scope of 2017 SWIM Plan

Development of the 2017 St. Marks River and Apalachee Bay SWIM Plan update (hereafter called the 2017 SWIM Plan) is funded by a grant from the National Fish and Wildlife Foundation's (NFWF) Gulf Environmental Benefit Fund (GEBF), with the intent to further the purpose of the GEBF to remedy harm and eliminate or reduce the risk to Gulf resources affected by the Deepwater Horizon oil spill.

The 2009 St. Marks River and Apalachee Bay SWIM Plan recognized three priority objectives that also address three of the NWFWMD's statutory areas of responsibility relating to watershed management:

1. Water quality protection and improvement, focusing on prevention and abatement of nonpoint source (NPS) pollution in the upper reaches of the basin;
2. Natural systems protection, enhancement, and restoration, including stream, wetland, aquatic, and riparian habitat restoration on lands purchased for conservation in the lower basin; and
3. Protection and, if necessary, restoration of floodplain functions.

In the St. Marks River and Apalachee Bay watershed, major stakeholders include:

- **The NWFWMD**
- **U. S. Department of Agriculture**
- **U.S. Department of the Interior**
- **U.S. Fish and Wildlife Service**
- **Florida Department of Environmental Protection**
- **Florida Fish and Wildlife Conservation Commission**
- **Florida Department of Agriculture and Consumer Services**
- **Florida Department of Economic Opportunity**
- **Apalachee Regional Planning Council**
- **The Nature Conservancy**
- **The NFWF**
- **The Trust for Public Lands**
- **Apalachee Audubon**
- **Leon, Wakulla, and Jefferson counties**
- **Municipalities, including Tallahassee, St. Marks, and Monticello**
- **Friends of St. Marks National Wildlife Refuge**
- **Friends of the Apalachicola National Forest**
- **Unincorporated communities, including Crawfordville, Panacea, Lloyd, Medart, Newport, Shadeville, and Shell Point**
- **And many others**

This 2017 SWIM Plan assesses progress made toward the implementation of actions identified in the 2009 Plan, while also addressing new issues, ongoing challenges, and opportunities for achieving watershed protection and restoration. Further, the 2017 SWIM Plan describes the watershed's physical characteristics and natural resources, provides an assessment of the watershed's current condition, and identifies priority challenges affecting watershed resources and functions. The 2017 SWIM Plan also prescribes a set of management actions to meet those challenges and needs. Management actions are generally limited to those within the mission and scope of the NWFWMD SWIM program, recognizing the ongoing initiatives and needs of local communities and other agencies.

For the purposes of SWIM, watersheds are the ecological and geographical units for planning and managing restoration efforts along Florida's Gulf Coast. Successful watershed management requires coordination and implementation of complementary programs and projects in coordination with jurisdictions and agencies involved in the watershed. Among these are local, state, and federal agencies; conservation land management organizations; non-governmental organizations; and other interested stakeholders.

The 2017 SWIM Plan identifies projects and opportunities to leverage funding from many sources; integrating the efforts of local governments, state and federal agencies, and private entities to pool resources and achieve mutual objectives and goals; and to present innovative, sustainable solutions to watershed issues.

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2.0 Watershed Description

2.1 Introduction

St. Marks River and Apalachee Bay watershed attributes:

- **Two states: Georgia and Florida**
- **Three Florida counties**
- **Three EPA Level 4 ecoregions**
- **25 Unique Natural Communities**
- **One of the world's largest and deepest freshwater springs**
- **748,800 acres**

The St. Marks River and Apalachee Bay watershed covers approximately 748,800 acres and extends from the red hills of southern Georgia through the Big Bend of Florida. Approximatley 91 percent of the watershed (678,400 acres) is in Florida, while the remaining nine percent falls within Georgia. The basin includes three U.S. Environmental Protection Agency (EPA) Level 4 ecoregions and encompasses 25 habitat types recognized by the Florida Natural Areas Inventory (FNAI). These habitats include freshwater lakes, streams, rivers, wetlands, springs, bays, and estuaries. The St. Marks River, which drains to the Gulf of Mexico via Apalachee Bay, begins as a surface water-fed blackwater stream, which becomes submerged at Natural Bridge and re-emerges with additional groundwater flow one half-mile south at St. Marks River Rise. The St. Marks River also receives water from several smaller Floridan aquifer springs (Barrios 2006). The Wakulla River, the largest tributary of the St. Marks River, is a spring-fed river which merges with the St. Marks approximately five miles north of Apalachee Bay. The Apalachee Bay estuary covers approximately nine square miles and is influenced by both the St. Marks River and the Ochlockonee River, which is addressed under a separate SWIM plan.

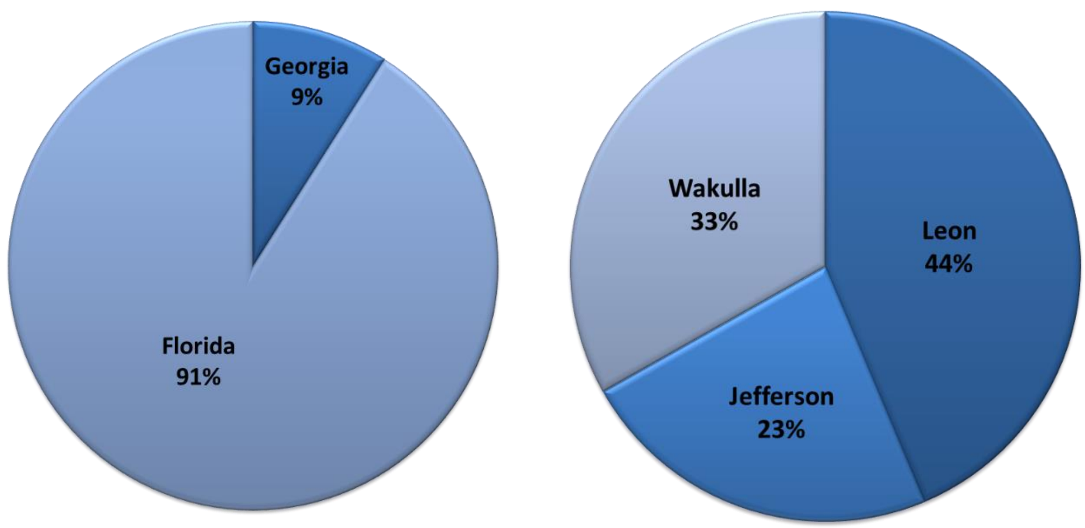
The unique ecosystems comprising the St. Marks River and Apalachee Bay watershed fall under the jurisdiction of multiple county and local governments, state and federal agencies, and the Apalachee Regional Planning Council (ARPC). These entities not only manage natural resources, but also shape their expression across the landscape by establishing conservation lands, implementing land use and land management plans and regulations, and establishing best management practices (BMPs) that directly influence water quality and habitat integrity.

This section provides an overview of the physical, hydrological, and ecological characteristics, as well as the land use and population dynamics of the St. Marks River and Apalachee Bay watershed.

2.2 Geographic Characteristics

2.2.1 Geography

The St. Marks River and Apalachee Bay watershed spans portions of Georgia and Florida and ultimately drains to the Gulf of Mexico. Within Florida, the watershed includes portions of Leon and Jefferson counties in its upper reaches, as well as coastal Wakulla and Jefferson counties in the lower reaches (see Figures 2-1 and 2-2).

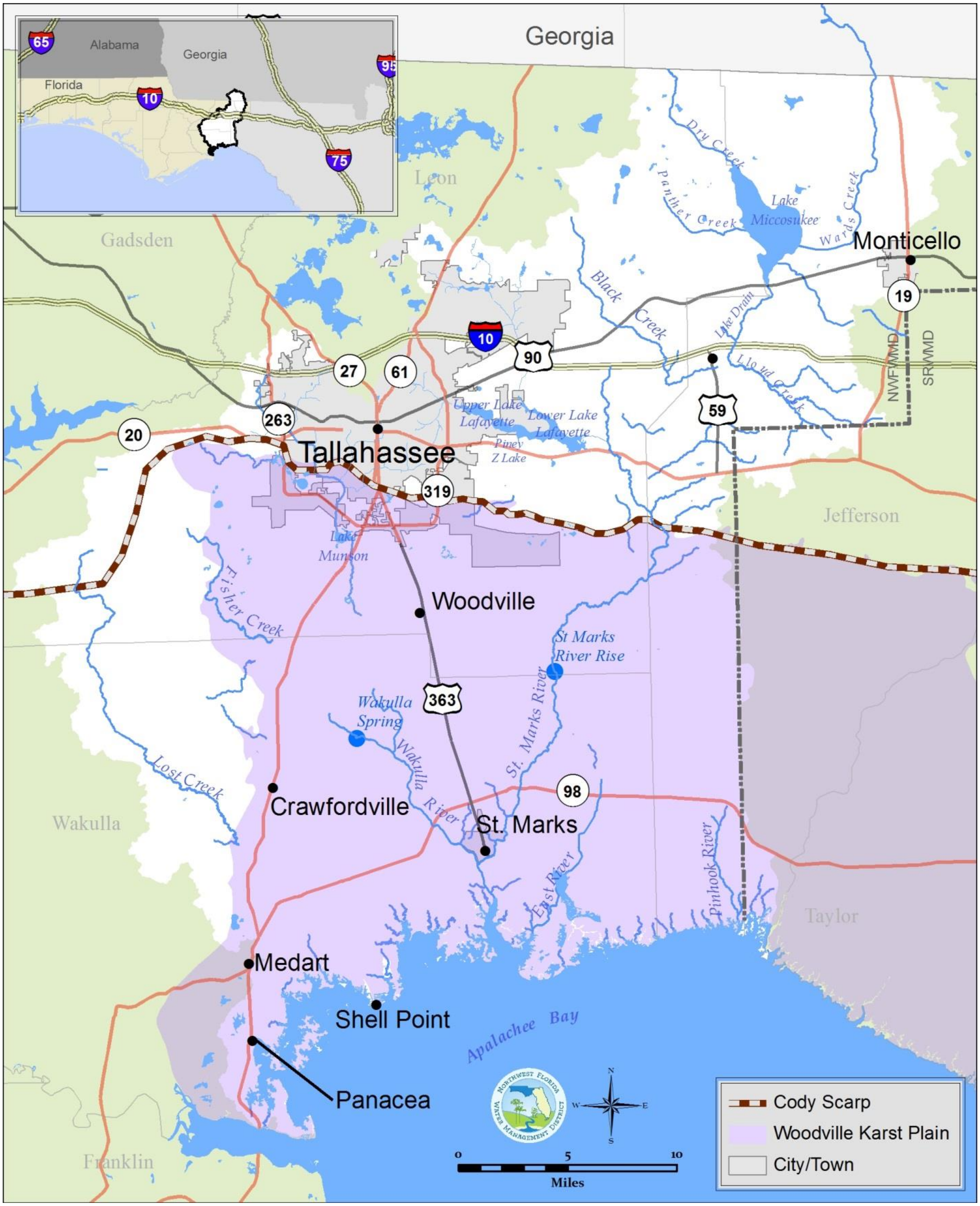


Source: NWFWMD 2009

Figure 2-1 Proportion of the St. Marks River and Apalachee Bay Watershed by State and Florida County

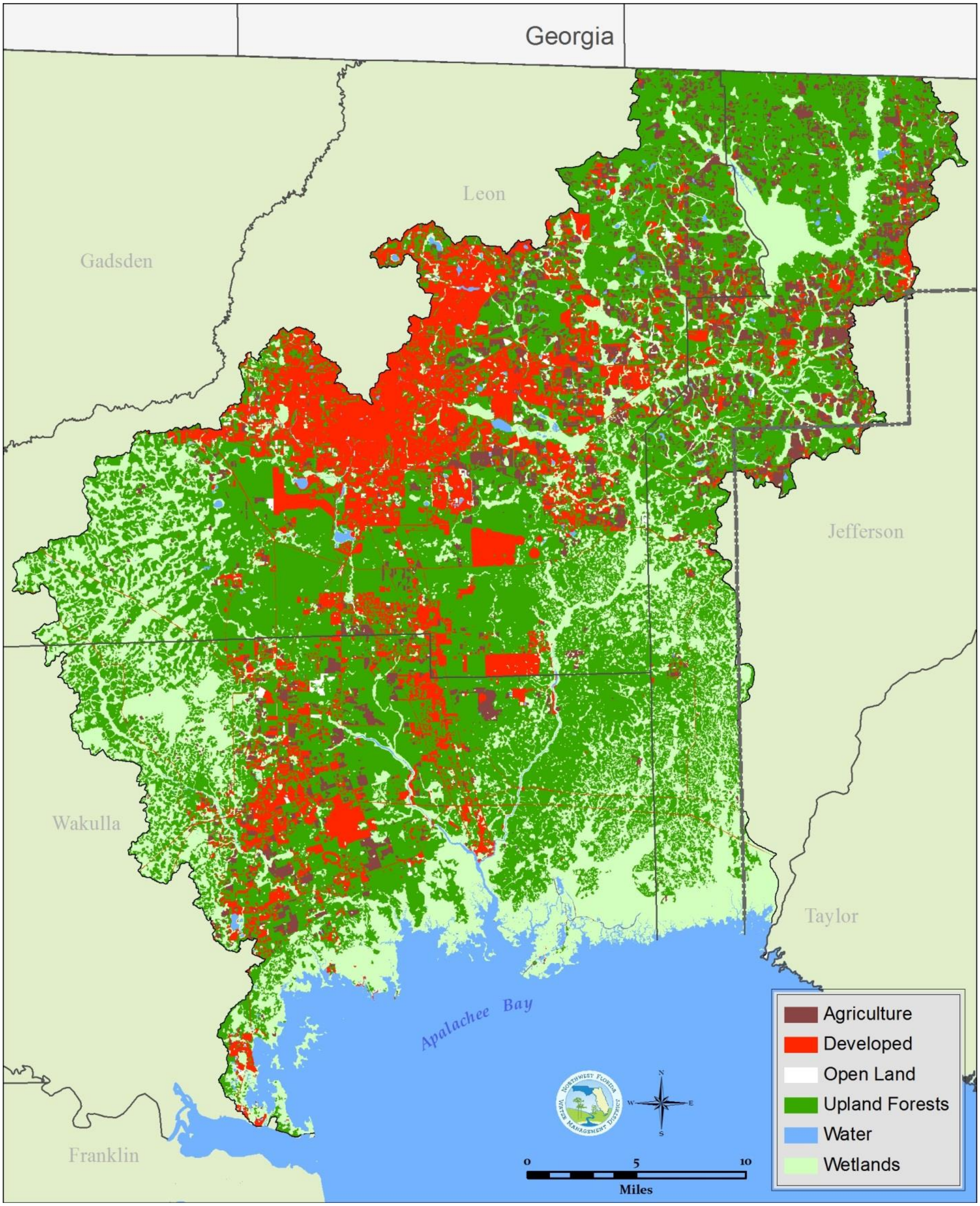
Sources: Federal Highway Administration ([FHWA]; National Oceanic and Atmospheric Administration (NOAA) 2015a; U.S. Geological Survey (USGS) 2015.

Figure 2-2 Greater St. Marks River and Apalachee Bay Watershed



Sources: FGS 2015a; FHWA 2014; NOAA 2015a; USGS 2015.

Figure 2-3 Features of the St. Marks River and Apalachee Bay Watershed (Florida Portion)



Sources: FDEP 2015a; NOAA 2015a.

Figure 2-4 2012-2013 Land Use and Land Cover

The ten-mile long Wakulla River is the major tributary to the St. Marks River, beginning at the first-magnitude Wakulla Spring and merging with the St. Marks River at the City of St. Marks about five miles north of Apalachee Bay. Surface water features of the watershed are shown in Figure 2-3.

Unlike many other watersheds in the NWFWMD, developed areas occur primarily in the middle and upper, non-coastal portions of the watershed. This includes the majority of the Tallahassee metropolitan area, the state's capitol and seventh largest city. Stormwater from the City of Tallahassee drains into the Lake Lafayette and Lake Munson systems. The City of St. Marks is the only municipality in the southern portion of the watershed. The communities of Crawfordville and Panacea, in Wakulla County, and Woodville, in Leon County, are all within the Woodville Karst Plain. Significant coastal portions of the watershed are designated conservation lands or otherwise designated for resource management, including the St. Marks National Wildlife Refuge (NWR), the Apalachicola National Forest, the St. Marks Mitigation Bank, and the Flint Rock Wildlife Management Area.

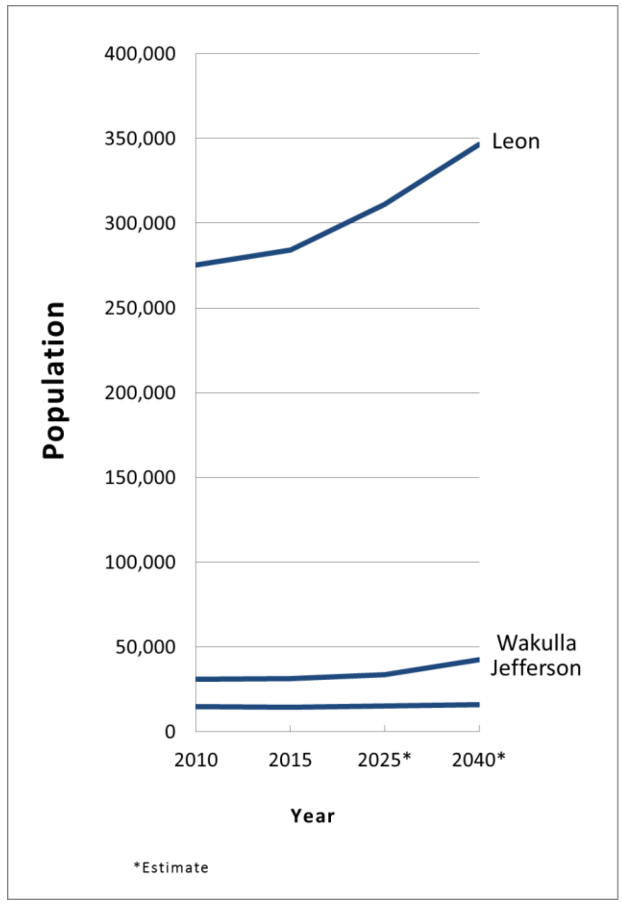
2.2.2 Land Use and Population

Land use in the northern watershed consists of a mix of agriculture, silviculture, and residential uses (Figure 2-4 and Table 2-1). In Georgia's portion of the watershed, Thomas County is dominated by agricultural land uses. Thomas County is nearly three-quarters agricultural, including crops and forested lands (Thomas County 2008). Within Florida's portion of the watershed, agriculture occurs in northern Leon County. Significant palustrine wetlands can be found adjacent to Lake Miccosukee and Lake Lafayette, while riparian and palustrine wetlands are found along the St. Marks and Wakulla rivers, as well as their tributaries and other areas of low elevation. Most residential, commercial, industrial, and institutional land use areas are concentrated in the urban centers of Tallahassee and Crawfordville, with additional development in the City of St. Marks and the community of Panacea. The western portion of the watershed is dominated by the Apalachicola National Forest, a mixture of upland forest and wetlands. The southeastern-most portion of the watershed consists of silviculture and conservation lands, with exceptions including the City of St. Marks and community of Panacea. Coastal portions of the watershed are predominantly wetlands and include the conservation lands of St. Marks NWR and the Flint Rock Wildlife Management Area.

Significant holdings of conservation land and protected natural areas can be found throughout the watershed. Conservation lands account for approximately 34 percent or 230,800 acres of the land area within the Florida portion of the basin. Large tracts of the Apalachicola National Forest and the St. Marks NWR are situated in the southern half of the watershed. Other notable public lands are the Flint Rock Tract, Wakulla State Forest, the Wakulla Springs State Park, and lands owned and managed by the NWFWMD. Private conservation lands include private forests and hunting plantations with conservation easements, and wetland mitigation lands, such as the Westervelt Company's St. Marks Mitigation Bank (FNAI 2016a, 2016b).

Together, these lands provide a significant buffer system that helps protect water quality, provide flood protection, and sustain integrated terrestrial and aquatic ecosystems. Conservation areas, including parks, forests, and preserves, are discussed in more detail in Section 3.5.3.

While the relationship between land use and pollutants (particularly nutrients) has been well documented, the extent of that relationship and its potential effect on downstream ecosystems is also dependent upon proximity to surface water bodies, as well as how connected the aquifer is to the surface in a given location (Geisenhoffer 2014).



Source: FDEC 2015.

Figure 2-5 Population Trends of Florida Counties in the St. Marks River and Apalachee Bay Watershed Counties

As is the case across much of northwest Florida, the St. Marks River and Apalachee Bay watershed has experienced considerable population growth (Figure 2-5 and Table 2-2). This growth has resulted in the transformation of land use in many areas from rural and agricultural to urban/suburban in character. Typical effects of urbanization include increased NPS pollution, the generation of additional wastewater and stormwater, and habitat loss and fragmentation. The University of Florida's Bureau of Economic and Business Research projects the largest increases in population to occur in Leon and Wakulla counties (Florida Demographic Estimating Conference [FDEC] 2015). Along with this population growth, increases in development, waste production, use of recreational areas, as well as land use changes are anticipated.

Leon County occupies the largest proportion (296,095 acres or approximately 44 percent) of the St. Marks River and Apalachee Bay watershed in Florida. Leon County contains the watershed's largest city, Tallahassee, as well as its largest population and second greatest projected growth rate (9.56 percent increase from 2015-2025 and 21.93 percent increase from 2015-2040) (FDEC 2015). Land use change has continued in the Tallahassee metropolitan area since the 2009 SWIM Update, including the 2014-2015 airport expansion, development and expansion of suburbs, and the expansion of pedestrian routes within the city.

Table 2-1 St. Marks River and Apalachee Bay Watershed 2012-2013 Land Use

General Land Use Category	Estimated Square Miles	Percent of Basin (Florida Portion)
Agriculture	69.5	6.7
Developed	157.0	15.1
Open Land	6.7	0.6
Upland Forests	518.7	49.8
Water	12.0	1.2
Wetlands	278.1	26.7

Source: FDEP Land Use – Land Cover data, 2012-2013.

Wakulla County is the second largest county within the Florida watershed occupying approximately 33 percent (224,957 acres). Wakulla County makes up the southeastern portion of the basin including the majority of the watershed's coastline. The City of St. Marks, located on the St. Marks River, is the only municipality within the county's portion of the watershed. Unincorporated communities in Wakulla County include Crawfordville, Panacea, Newport, Shadeville, and Shell Point. The population of Wakulla County has nearly tripled since 1980, exceeding the rate of growth of the state as a whole (NWFWMD 2009). The population of Wakulla County is anticipated to continue increasing; with population projections for 2015 – 2025 showing an increase of 7.5 percent and projections for 2025 – 2040 showing an increase of an additional 26.9 percent (FDEC 2015).

Jefferson County occupies approximately 157,278 acres, or 23 percent, of the St. Marks River and Apalachee Bay watershed in Florida. The City of Monticello is the only incorporated community in Jefferson County's portion of the watershed.

Table 2-2 St. Marks River and Apalachee Bay Watershed Population (Based on Census Tracts)

County	Population 2010
Jefferson	6,659
Leon	228,300
Wakulla	28,208
Total	263,167

Source: U.S. Census Bureau 2010.

2.3 Physical Characteristics

The St. Marks River and Apalachee Bay watershed can be characterized geographically by its physiographic and ecoregions. First introduced by Nevin Fenneman and extensively mapped by the U.S. Geological Survey (USGS), physiographic regions are based on landforms and the geologic formations responsible for their expression across the landscape. Defined by the EPA, ecoregions are geographic areas with similar ecosystems that are used for research, management, monitoring, and assessment. Ecoregions can be similar in extent to physiographic regions due to the interactions between geology, hydrology, and ecology, but unlike physiographic regions, are defined by both their biotic and abiotic characteristics. Ecoregions are identified by analyzing patterns in soils, vegetation, climate, land use, wildlife, and hydrology, as well as geology and landforms (EPA 2016a).

The watershed's major physiographic regions and ecoregions are both divided by the Cody Scarp, a relic escarpment of the Pleistocene epoch, when sea level was nearly 200 feet higher than it is today. Due to lower permeability geology, some rainfall above the Cody Scarp runs off as surface flow, rather than infiltrating through the soil and into the Floridan aquifer. Below the Cody Scarp, however, where confining units are very thin or absent and karst features are more pronounced, rainwater directly recharges the Floridan aquifer and there is very little surface water runoff. The Cody Scarp is the most prominent landform of the region's physiography, and differences in hydrology above and below the scarp influence the region's unique ecology.

2.3.1 Physiographic Region

Gulf Coastal Plain

The St. Marks River and Apalachee Bay watershed, including Georgia's portion, lies within the Gulf Coastal Plain physiographic region, which is characterized by gently rolling hills, sharp ridges, prairies, and alluvial floodplains underlain by sediments of sand, gravel, porous limestone, chalk, marl, and clay (NWFWMD 2009). Within this greater physiographic region, the Florida portion of the watershed contains two localized physiographic regions separated distinctly by the Cody Scarp: the Northern Highlands, located north of the Cody Scarp; and the Gulf Coastal Lowlands, located south of the Cody Scarp.

The Northern Highlands are characterized by greater topographic relief (five to 12 percent slopes) and extensive sand and clay deposits overlying limestone bedrock. The Northern Highlands portion of the St. Marks watershed is located in a sub-region known as the Tallahassee Hills subdivision. South of the Cody Scarp, the Gulf Coastal Lowlands form an expansive, gently sloping plain dominated by karst features, which extends to the Gulf of Mexico (USGS

2013). Additional details on the geology and soils of these physiographic regions can be found in Appendix A.

2.3.2 Ecoregions

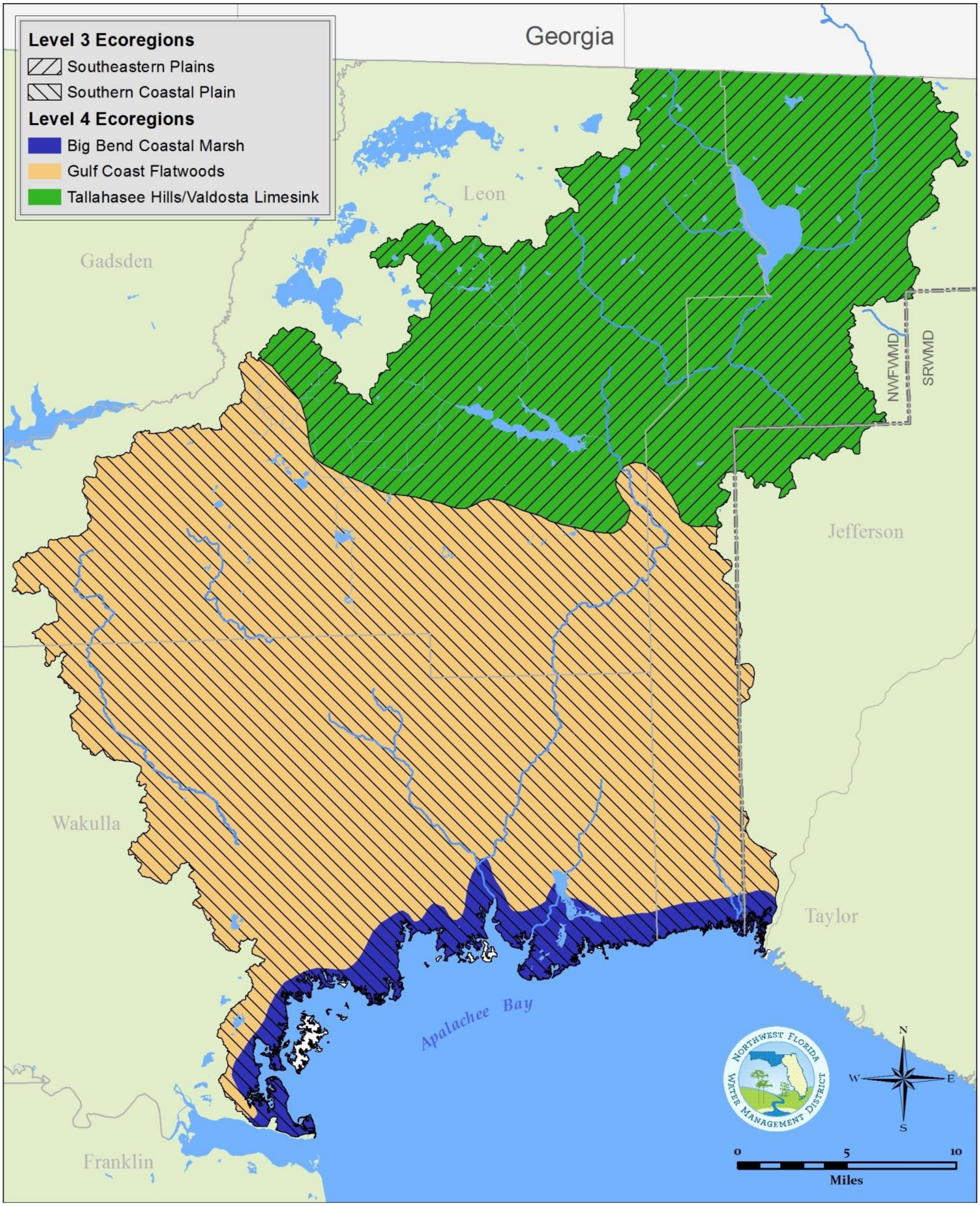
Southeastern Plains and Southern Coastal Plain

Two EPA Level 3 ecoregions occur in the St. Marks River and Apalachee Bay watershed: the Southeastern Plains and Southern Coastal Plain. Level 4 ecoregions are smaller divisions of Level 3 ecoregions with more detailed descriptions. Divisions at this scale allow for the identification of locally defining characteristics and the formulation of specific, locally oriented management strategies (Omernik 1995). The portion of the watershed lying within the Southeastern Plains ecoregion (Level 3) is further classified as the Level 4 sub-region of Tallahassee Hills/Valdosta Limesink. The portion of the watershed located in the Southern Coastal Plain ecoregion (Level 3) includes two Level 4 sub-regions: the Gulf Coast Flatwoods and the Big Bend Coastal Marsh (Table 2-3 and Figure 2-6) (EPA 2013a, 2013b; Griffith *et al.* n.d.).

Table 2-3 Hierarchy of USGS Physiographic Regions and EPA Ecoregions (Level 3 and 4) in the Watershed

USGS Physiographic Region	Sub-Regions
Gulf Coastal Plains	Northern Highlands/ Tallahassee Hills
	Gulf Coastal Lowlands
EPA Level 3 Ecoregion	**Level 4 Ecoregion**
Southeastern Plains	Tallahassee Hills/Valdosta Limesink
Southern Coastal Plain	Gulf Coast Flatwoods
	Big Bend Coastal Marsh

Source: EPA 2013c.



Sources: EPA 2013c, 2013c; NOAA 2015a (counties); USGS 2015 (waterbodies).

Figure 2-6 Level 3 and 4 Ecoregions

Southeastern Plains and Sub-regions

The Southeastern Plains Level 3 ecoregion makes up the northern portion of the St. Marks River and Apalachee Bay watershed. As the largest Level 3 ecoregion in the eastern U.S., the Southeastern Plains extend from near the Gulf of Mexico in the south to Maryland in the north. This expansive ecoregion is covered by a mosaic of cropland, pasture, forest, and wetland. Prone to abundant rainfall and a long growing season, relatively poor sandy soils found in much of the ecoregion limit agricultural competitiveness with many other regions. Natural forests of pine, hickory, and oak once covered most of the ecoregion, but much of the natural forest cover has been replaced by heavily managed timberlands.

One Level 4 subcategory of the Southeastern Plains ecoregion is found within the St. Marks River and Apalachee Bay watershed:

- **Tallahassee Hills/Valdosta Limesink.** The Tallahassee Hills/Valdosta Limesink region encompasses the Tallahassee region and most of the northeastern portion of the watershed. The region extends approximately 18 miles from the Georgia state line and is characterized by hills that average 120 feet high. (USDA 1981). The Tallahassee Hills/Valdosta Limesink ecoregion combines two slightly different areas, both influenced by underlying limestone. The Floridan aquifer is thinly confined in this region and streams are often intermittent. In the west, the Tallahassee Hills area has rolling, hilly topography that is more forested. Clayey sands weathered to a thick red residual soil are typically found at or near land surface. Topographic relief decreases towards the east and the Valdosta Limesink area has more solution basins with ponds and lakes and more cropland.

Southern Coastal Plain and Sub-regions

The Southern Coastal Plain Level 3 ecoregion makes up the southern portion of the St. Marks River and Apalachee Bay watershed, from just south of Tallahassee and the Cody Scarp to the coast. This ecoregion is generally lower in elevation, with less relief and wetter soils than the Southeastern Plains. It consists primarily of flat plains with such features ranging from coastal lagoons, marshes, and swampy lowlands, to upland pine forests, as well as barrier islands along the coast. In the St. Marks River and Apalachee Bay watershed, much of the Southern Coastal Plain region is conservation land, including the Apalachicola National Forest, the St. Marks NWR, and the Flint Rock WMA. The following Level 4 subcategories of the Southern Coastal Plain ecoregion are found within the St. Marks River and Apalachee Bay watershed:

- **Gulf Coast Flatwoods.** The Gulf Coast Flatwoods make up the majority of the Southeastern Coastal Plains including much of the southern St. Marks River and Apalachee Bay watershed. This ecoregion occurs extensively in Wakulla and Jefferson counties' portions of the watershed; as well as in Leon County south of the Cody Scarp. The Gulf Coast Flatwoods ecoregion is a narrow region of nearly level terraces and alluvial and deltaic deposits composed of Quaternary sands and clays. The wet sandy flats and broad depressions of this ecoregion are typically poorly drained and swampy in nature. Many of the more well-drained areas in the ecoregion have been cleared for use as pasture or cropland.
- **Big Bend Coastal Marsh.** The Big Bend is a marsh-dominated coast extending from the vicinity of Panacea in Wakulla County to Anclote Keys in Pasco County. The entire Big Bend region is recognized as a distinctive, tide-dominated, open marsh coast. The Big Bend's intertidal zone is comprised of approximately 160,618 acres of tidal wetlands dominated by black needlerush (*Juncus roemerianus*). Thin sediments overlie a karst limestone shelf of the St. Marks Formation (where present), the Suwanee Limestone, and the deeper underlying Ocala Limestone. Coastal forest thrives inland on the tidal marsh and scattered tree islands, or hammocks, dot the intertidal zone at elevated locations. In some places, the adjacent upland consists of land development, pine plantation, or hydric hammock. Common characteristics in the Big Bend include a broad low-gradient offshore shelf, an open coast, low sediment supply, a one-meter tide range, low wave energy, near-surface limestone, and spring-fed rivers and flow from the Floridan aquifer (Raabe *et al.* 2004). Within the St. Marks River and Apalachee Bay watershed, the Big Bend Coastal Marsh ecoregion can be found at the St. Marks NWR.

2.3.3 Climate

The climate of the St. Marks River and Apalachee Bay watershed is largely determined by its subtropical latitude (29.9°-30.6°N) and proximity to the Gulf of Mexico. Daily temperature variations tend to be less along the coast relative to areas of the watershed further inland, which are less moderated by the Gulf. Summers are often hot and humid and winters cool and dry. For the Tallahassee region from 1981-2010, the mean minimum temperature was 39.7°F in January and the mean maximum was 92.0°F in July (National Oceanic and Atmospheric Administration [NOAA] 2011). Mean annual precipitation is 63 inches with July being the rainiest (mean maximum 8 inches) and September being the driest (mean 3 inches). The average annual precipitation for 2002 – 2014 was approximately 60 inches, with the northernmost reaches of the watershed receiving 2 to 4 inches less than the coastal and middle portions of the watershed (Southeast Regional Climate Center 2007). Rainfall events that last longer than 24 hours in summer are rare and are usually associated with tropical storms. Tropical storms and hurricanes can affect the area during June through November. Winter and spring rains are generally associated with large scale, continental weather developments (USDA 1989).

2.3.4 Geology

Much of the watershed's geologic features are a product of prehistoric marine deposition during periods when sea level was higher than the present. Geologic features of the St. Marks and Apalachee Bay watershed are divided distinctly by the Cody Scarp. Above the escarpment, the Tallahassee Hills region is directly underlain by unconsolidated sand and clayey (surficial) deposits of Pleistocene to Holocene age. Beneath the surficial deposits, the Miocene age Hawthorn Group, comprised largely of clayey sediments, functions as a semi-confining unit between the surficial sands and underlying limestones of the Floridan aquifer. North of the Cody Scarp, the uppermost carbonate unit in the Floridan aquifer is either the St. Marks Formation or the Suwannee Limestone. Below the Cody Scarp, the surficial sediments and semi-confining unit are absent in many areas and the St. Marks Formation or Suwannee Limestone occur at or near land surface.

In southern Leon and Wakulla counties, the limestone formations that underlay the watershed include solution channels and conduits that have formed as the limestone has slowly dissolved due to percolation of acidic rainfall and surface water over many years (Lewis et al. 2009). The development of karst features like sinkholes and solution channels depends on the amount of exposure the limestone has had to this acidic water. In the Woodville Karst Plain of southern Leon County and Wakulla County, the development of these features is the most advanced. In the northern portion of the watershed where the Floridan aquifer is semi-confined by lower permeability Hawthorn Group clays, limestone dissolution and conduit development is much less advanced and there are fewer karst features (Kinkaid 2006). Unfortunately, these dissolution features provide pathways for pollutants from stormwater runoff and other anthropogenic sources to be rapidly transported into the groundwater. Some hydrologic connectivity between surface waters and the Floridan aquifer exists for lakes with sinkhole features. Discharge of groundwater can occur in areas with lower elevations such as at springs and along streams, bays, and the Gulf of Mexico. The hydrologic characteristics of springs and karst features are discussed further in Section 2.4. More details on the geology of the watershed may be found in Appendix A.

2.3.5 Soils

In addition to serving a critical role in forest and agricultural production and management, soils intercept and absorb surface water runoff, thereby, preventing erosion and water quality impairments when properly managed. Clay-rich soils in the Tallahassee Hills (Red Hills) contribute to surface water level and flow variability within the watershed, as they tend to absorb rainwater slowly and naturally generate more runoff. Qualities of the soil, such as erodibility and permeability, greatly influence factors such as runoff or groundwater recharge and the potential for groundwater contamination. The pH and clay content of the soil also influence soil cation exchange capacity and potential to retain certain contaminants. Additionally, storing carbon in soil is one strategy to decrease the concentration of the greenhouse gas carbon dioxide in the atmosphere. At a global scale, soil can store four times more carbon than living biomass (trees, grasses, etc.) (Vasques and Grunwald 2007).

When soils erode from the landscape, they contribute sediment to surface waters, which changes hydrology of streams and impacts habitat and water quality. The effects of sedimentation and erosion on water quality are further discussed in Section 3.2. However, well managed soils can contribute to improved water quality. Soils store rainwater, runoff, and stormwater in pore spaces, which regulates groundwater recharge, helps mitigate flooding, and increases the duration that water is available for plant uptake. Soils can be amended with organic material to create agricultural benefits, but unlike the vegetation they support, mature soils are not generally considered to be renewable resources on human time scales. The formation of soils that can support ecologically distinct communities can take anywhere from hundreds to thousands of years, depending on the environment.

Soils within the St. Marks River and Apalachee Bay watershed range from moderately drained clay-rich soils of the Red Hills to well-drained sandy soils along the coast. Soils within the northern portion of watershed have formed on beds of clayey and sandy parent materials. Upland soils of the Red Hills are well developed, with distinct horizons that exhibit the vertical movement of iron and organic materials. Below the Cody Scarp, younger forest soils with generally higher fertility dominate the uplands. Hydric soils occur in wetlands and floodplains across the watershed, while younger poorly developed soils can be found along the coast line and in heavily disturbed areas. Detailed information about soils within the watershed is provided in Appendix A.

Forest production and crop/pasture land are the major uses of soil in Florida's portion of the St. Marks River and Apalachee Bay watershed. Historically, corn, peanuts, soybeans, watermelons, and a few vegetables were farmed across Leon County (USDA 1989). Qualities of the soil, such as erodibility and permeability, greatly influence factors such as groundwater recharge and the potential for groundwater contamination. Soil erosion is problematic for about two thirds of cropland and pastureland in Jefferson County alone (USDA 1981).

Sources: NOAA 2015a; USDA 2013; USGS 2015.

Figure 2-7 Hydric Soils in the Watershed

Hydric soils, which are common throughout the watershed, are defined as soils "formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part" (Figure 2-7) (USDA 2016b). Soils that exhibit hydric properties are important indicators of wetlands and floodplains. Hydric soils, in conjunction with hydrophytic vegetation and hydrologic properties, are used to define the jurisdictional boundaries of wetlands in the U.S. Army Corps of Engineers (USACE) Wetlands Delineation Manual (USACE Environmental Laboratory 1987). Understanding the distribution of hydric soils is useful for agricultural purposes, land-use planning, conservation planning, and assessment of potential wildlife habitat (USDA 2016b). Hydric soils within the St. Marks River floodplain consist primarily of loamy /clayey soils, whereas hydric soils within the Wakulla River floodplain are primarily mucky mineral soils (Research Planning, Inc. 2016).

2.4 Hydrologic Characteristics

There are two integrated drainage systems between the northern and coastal portions of the watershed: the St. Marks River system and the coastal drainage system consisting of small surface and groundwater fed tributaries and karst features including the Spring Creek Springs Group. Surface waters in the watershed include freshwater lakes, springs, sinks, streams, salt marshes, and freshwater wetlands, which collectively account for approximately 280,117 acres (or 41 percent) of Florida's portion of the watershed (FDEP 2015a).

2.4.1 Major Rivers, Tributaries, and Coastal Waterbodies

The St. Marks River, which flows approximately 35 miles before discharging into the Apalachee Bay, begins as an intermittent blackwater stream and flows south collecting surface water drainage from much of eastern Tallahassee. The stream submerges at Natural Bridge and re-emerges one-half mile south at the St. Marks River Rise, with its flow greatly augmented by the contribution of groundwater. Discharge measurements indicate that, on average, about 80 percent of the discharge in the St. Marks River at Newport is contributed by spring discharge from the St. Marks River Rise. The St. Marks River Rise is a first magnitude spring with a long-term median discharge of approximately 350 cubic feet per second (cfs). The groundwater contribution area for the St. Marks River Rise extends into southwest Georgia and overlaps the St. Marks River surface water basin. The upper St. Marks River receives intermittent surface flow from four sub-basins in the upper watershed: Lake Miccosukee, Patty Sink Drain, Black Creek (upper), and Lake Lafayette sub-basins. During moderate to wet periods, flow discharges from Lake Lafayette into the St. Marks River via an outlet structure (Lewis et al. 2009).

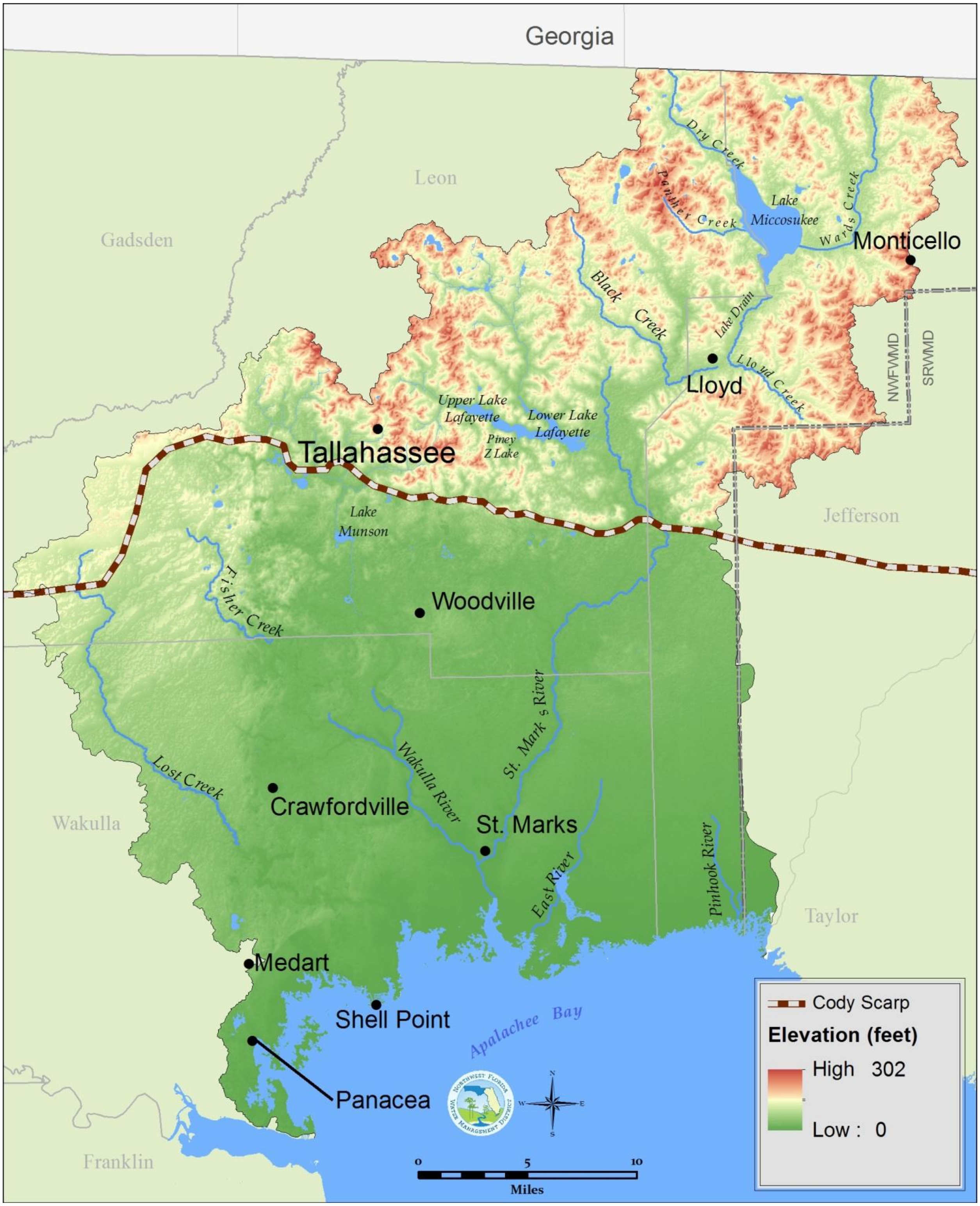
The main tributary of the St. Marks River is the Wakulla River, which originates in northern Wakulla County at Wakulla Spring and flows south approximately ten miles before joining the St. Marks River at the City of St. Marks, about five miles north of Apalachee Bay. The Wakulla River is an exemplary spring run and receives the vast majority of its freshwater flow from Wakulla Spring, a first magnitude spring with a median discharge of approximately 620 cfs (402 million gallons per day [mgd]). Wakulla Spring is located at Edward Ball Wakulla Springs State Park and is among the largest and deepest freshwater springs in the world (Lewis et al. 2009). There is little direct surface water runoff to the Wakulla River; however, several sinking streams that discharge to the Floridan aquifer via swallets (e.g., Lost Creek, Fisher Creek, Jump Creek, and Black Creek swallets). Surface water flowing into the Lost Creek swallet runs underground through the aquifer and conduit systems and discharges to either the Spring Creek Springs Group or Wakulla Spring, depending on hydrologic conditions. The Spring Creek Springs Group is a first-magnitude submarine spring consisting of 14 known spring vents that discharge into Oyster Bay.

A number of lakes in the St. Marks River and Apalachee Bay watershed are not connected with surface channels, and are essentially closed, internally drained basins that recharge the underlying Floridan aquifer. In addition to the St. Marks River, Apalachee Bay also receives water from the East River (Figure 2-8).

Located in the western extent of Florida's Big Bend coastline, Apalachee Bay is in direct contact with the Gulf of Mexico and includes smaller, more isolated embayments, including Dickson, Dickerson, Purifier, Skipper, and Oyster bays. Apalachee Bay is a shallow estuary open to the Gulf of Mexico and receives a major source of freshwater flow directly from the St. Marks River. Freshwater also enters Apalachee Bay from the Ochlocknee River on its western side, as well as through a number of adjacent small tidal creeks and springs, particularly the first-magnitude Spring Creek Springs Group and several offshore vents (further discussed in Section 2.4.3). This Plan focuses on the portion of the bay from Ochlockonee Point in the west to coastal Jefferson County, just west of the Aucilla River. This includes tidal portions of the St. Marks and Wakulla rivers, as well as Dickerson Bay and Oyster Bay.

2.4.2 Lakes

There are over 100 lakes in the St. Marks River and Apalachee Bay watershed, encompassing about 10,650 acres. Some closed basin lakes in the northern extent of the watershed are breached in places by karst features, enhancing the transmission of surface water to underlying aquifers (NWFWMD 2009).



Sources: Florida Geological Survey (FGS) 2015b; NOAA 2015a; USGS 2015, 2016a, 2016b.

Figure 2-8 Topography and Major Waterbodies

Much of urban Tallahassee drains to Lake Munson, located southwest of the city, and Lake Lafayette, located to the east. Lake Munson is a cypress-lined impoundment of Munson Slough covering 255 acres. Lake Munson receives stormwater from Tallahassee and provides floodwater equalization for areas downstream. Early Spanish records from the year 1705 indicate that Lake Munson once flowed into the Wakulla River. The lake now drains south via Munson Slough several miles to Ames Sink and several other sinks, which discharges to the Floridan aquifer (NWFWMD 2009). The waters of Lake Munson may still reach the Wakulla Spring via aquifer discharge. Urban stormwater flows into these sinkholes south of Lake Munson, overflowing from one to the other, as they are overwhelmed by the flow of stormwater. Under most circumstances, this water goes directly into the sinks, but during major floods events, it breaches the sinks and fills low lying areas like the slough system (McGlynn 2003).

Lake Lafayette was once an ancient tributary of the St. Marks River that is now generally a closed basin, connected intermittently to the river during moderate to high water conditions. The lake system has been the subject of multiple hydrologic alterations that have resulted in four distinct lake sections: Upper Lake Lafayette, Piney Z Lake, Lower Lake Lafayette, and Alford Arm. The construction of earthen dikes to separate the four sections of the Lake Lafayette System resulted in the isolation of Falls Chase Sink (sometimes called Upper Lafayette Sink), located in Upper Lake Lafayette, which historically drained the entire basin. The entire lake system, including Falls Chase Sink, which is hydrologically connected to the aquifer, receives drainage from eastern Tallahassee (NWFWMD 2009). The third subdivision of Lake Lafayette, Lower Lake Lafayette, is the only part of Lake Lafayette still connected to the St. Marks River (McGlynn 2006). The hydrology of the Lake Lafayette system results in a direct pathway for stormwater and surface water runoff from the City of Tallahassee to enter the St. Marks River.

2.4.3 Springs and Sinkholes

Approximately 42 sinkholes north of the Cody Scarp have been identified and mapped, along with about 232 sinkholes and 66 springs mapped below the scarp. There are also numerous unmapped sinkholes. The system has three first magnitude (over 100 cfs discharge) springs: Wakulla Spring, the St. Marks River Rise, and the submarine Spring Creek Springs Group, and three second magnitude (between 10-100 cfs discharge) springs; Horn Spring, Sally Ward Spring, and Chicken Branch Spring (Copeland 2003; FGS 2004, 2015).

Wakulla Spring is located in Edward Ball Wakulla Springs State Park about 20 miles (32.2 kilometers) south of Tallahassee. Wakulla Spring is one of the largest and most dramatic of Florida’s springs, with a median discharge of 620 cfs (402 mgd) (Howard T. Odum Springs Institute 2014). The spring pool is roughly circular with a diameter of 315 feet north to south.

The maximum pool depth is 185 feet. The vent opening is a horizontal ellipse along the south side of the pool bottom and is estimated to measure 50 feet by 82 feet. Along with a few smaller springs nearby, including Sally Ward Spring, Wakulla Spring provides the vast majority of inflow to the Wakulla River (Howard T. Odum Springs Institute 2014).

River rises are sites where some or all of the water from a river re-surfaces after flowing some distance underground. St. Marks River Rise is classified as a first magnitude spring with an average discharge of 350 cfs. The combined groundwater contribution zone for Wakulla Spring and the St. Marks River Rise includes an area of approximately 1,920 square miles (1,229,210 acres) (Chelette 2002).

Ames Sink is the receiving body for water flowing from Munson Lake and Munson Slough. On most occasions, Ames Sink drains most of the outflow from Lake Munson to the Floridan aquifer. From there, the water travels to Wakulla Spring where it is again discharged as surface water. Some of this water in the Floridan aquifer also discharges along the coast or offshore. Based on tracer test results, water can travel from Ames Sink to Wakulla Spring in as little as just over three weeks (Kincaid and Werner 2008). Falls Chase Sink in Upper Lake Lafayette drains a significant portion of eastern Tallahassee (McGlynn 2006). Although Falls Chase Sink historically drained the entire basin through hydrologic connectivity with the Floridan aquifer, the lake system has been altered with impoundments that have created four distinct lake arms and isolated Falls Chase Sink (McGlynn 2006).

The Spring Creek Springs Group, which is tidally influenced, is considered to be one of the largest groups of submarine springs in terms of flow. The spring discharge is approximately 416 cfs (269 mgd), based on data measured by the USGS during 2007 through 2010. There are 14 known vents in the Spring Creek Springs Group, including four major vents. Most vents, including Spring Creek No. 1 and Spring Creek No. 2, discharge into the widened mouth of Spring Creek before it reaches the Gulf of Mexico.

Fred George Sink is a historically and hydrologically important sinkhole feature that forms a direct conduit to the upper Floridan aquifer. Recently, efforts have been underway by Leon County and the City of Tallahassee to restore the area’s hydrology by reestablishing the natural flow of on-site creeks (Florida Communities Trust 2010).

Sources: FGS 2015c; NOAA 2015a; USGS 2015, 2016a, 2016b.

Figure 2-9 Major Karst Features in the Watershed

2.4.4 Groundwater Systems

The hydrogeology of the St. Marks River and Apalachee Bay watershed is characterized by the complex interaction between surface water and groundwater, due to the limestone bedrock below the region and the karst hydrogeology. Groundwater fills the pores and interstitial spaces in subsurface rocks and sediments, with higher recharge generally occurring in areas where the aquifer is unconfined. Groundwater recharge rates are dependent on the presence/absence and thickness of the Hawthorn formation, which consists primarily of low permeability clays. Below the Cody Scarp, this confining layer is generally very thin or absent and above the scarp the confining layer exists, but may be perforated by sinkholes and swallets in some areas. As a result, more rainfall above the Cody Scarp runs off as surface flow into lakes and streams, rather than infiltrating through the soil and into the Floridan aquifer. However, some of the lakes (particularly the larger, deeper ones) in this region have breached the confining unit and may act as points of recharge to the underlying Floridan aquifer.

The St. Marks River and Apalachee Bay watershed has four hydrostratigraphic units: the surficial aquifer system, the intermediate system, the Floridan aquifer system, and the sub-Floridan confining unit.

The surficial aquifer system is the uppermost aquifer and is comprised of discontinuous mixtures of Pleistocene and recent alluvium and terrace deposits. Water in the surficial aquifer system is recharged through direct infiltration of rainwater; and therefore, fluctuates in elevation due to droughts or seasonal differences in rainfall. It yields very little water and typically is hydraulically connected to shallow lakes and ponds.

Below the surficial aquifer system is the Hawthorn Group, a low permeability unit which comprises the Intermediate Confining Unit or the Intermediate Aquifer system (e.g., the intermediate system). Within the Woodville Karst Plain, the Hawthorn Group is thin or absent, and the Upper Floridan aquifer is unconfined (Interflow Engineering 2015).

The Floridan aquifer underlies the entire St. Marks River and Apalachee Bay watershed. As described by the NWFWMD (2014), the Floridan aquifer system consists of a thick sequence of carbonate units of varying permeability, the top of which dips from the northeast to the southwest, with the elevation of the top of the system ranging from approximately 100 feet above sea level to more than 1,200 feet below sea level, where it discharges into the Gulf of Mexico. The Floridan aquifer is considered one of the most productive groundwater supplies in the U.S., due to its highly porous structure. The Floridan aquifer system provides the primary drinking water source in Leon, Wakulla, and surrounding counties (Interflow Engineering 2015).

Groundwater recharging the Floridan aquifer north of Wakulla Spring travels to the south and southwest towards Wakulla and Sally Ward springs. Because of the karstic nature of this region, surface water and groundwater mixing can occur as demonstrated by the variable water quality observed at Wakulla Spring.

The groundwater contribution area for Wakulla Spring extends further north and west into Gadsden County and southwest Georgia, while the contribution area for the St. Marks River Rise extends north into southwest Georgia and to the eastern-most extent of the watershed. Several groundwater flow tracer studies have been conducted in the vicinity of Wakulla Spring showing the hydrologic connection between Wakulla Spring and the Tallahassee sprayfield. The very high rates of groundwater flow and relatively short travel times indicate the presence of large natural conduits in the limestone formations that supply groundwater to the springs. There is minimal surface water input for the Wakulla River, other than swallet inflows.

Services Provided by Healthy Ecosystems of the St. Marks River and Apalachee Bay Watershed include:

- **Water purification;**
- **Flood control;**
- **Streambank stabilization;**
- **Buffering of coastal storms;**
- **Nutrient cycling;**
- **Fish and wildlife resources; and**
- **Long-term resiliency.**

2.5 Ecosystem Services

The St. Marks River and Apalachee Bay watershed supports ecological resources and provides many benefits and services for people within the watershed. The ecological resources include the watershed's associated rivers, streams, and bays, as well as upland forests and wetlands, which provide habitat for various plant and wildlife species, many of which are rare and protected. Human benefits include tourism, recreational opportunities, fisheries, and the economic benefits related to each.

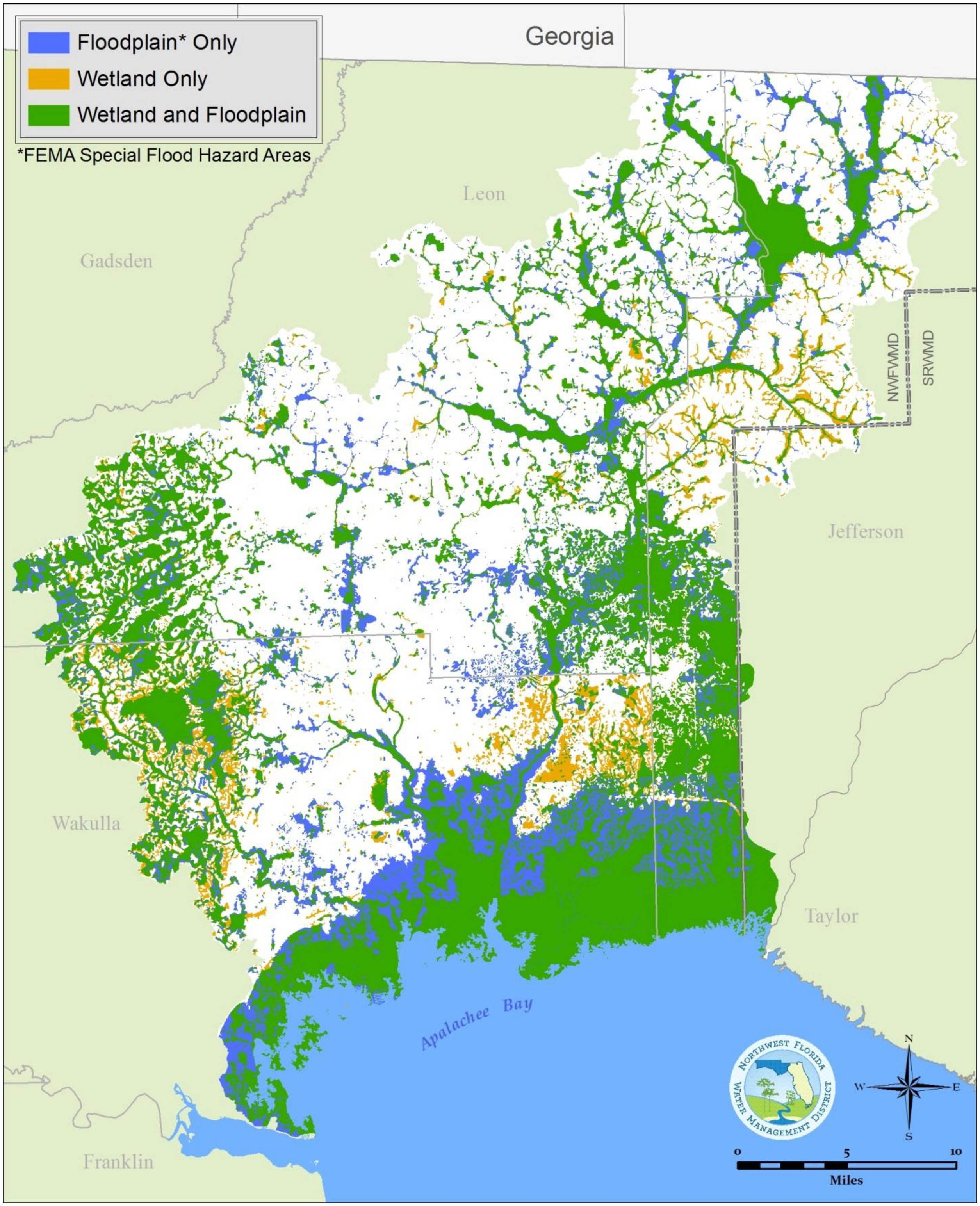
Watersheds, and the unique ecosystems that comprise them, play an important part in the global hydrological cycle (The Economics of Ecosystems and Biodiversity [TEEB] 2016). Healthy watersheds provide services such as water purification, groundwater and surface flow regulation, erosion and flood control, and streambank stabilization. Healthy watersheds can be financially valuable when the cost of protecting ecosystems for improved water quality is compared with investment in major restoration efforts; investing in the management of natural resources for improved water quality is often less expensive and more efficient than infrastructure (USDA

2015). Healthy watersheds also provide significant value through their role in production of fish and wildlife resources.

2.5.1 Hydrologic Functions

Interrelated functions performed by wetlands and associated natural systems are widely recognized and have been described by numerous authors (Novitzki *et al.* n.d.; National Research Council [NRC] 2001). Wetland functions can be grouped into three general categories: hydrologic, water quality protection and improvement, and fish and wildlife habitat (Abbruzzese and Leibowitz 1997). Hydrologic functions include water storage, flood attenuation, and regulation of discharge to surface and groundwaters.

Floodplains along the watershed's rivers and other tributaries reduce runoff energy, which in turn reduces erosion and protects water quality downstream. Healthy riparian ecosystems within the watershed support vegetative communities that can aid in the absorption of potential flooding, and attenuate and reduce wave energy during storms (Conservation Tools 2016; TEEB 2016). Figure 2-10 shows the correlation between the location of Special Flood Hazard Areas and floodplains. While floodplains have extensive ecological benefits, development within floodplains can be detrimental to both the hydrologic cycle of the watershed and to the buildings and structures within the floodplain.



Sources: FEMA, FDEP and USFWS 2016; NOAA 2015a.

Figure 2-10 Floodplains and Wetlands

2.5.2 Nutrient Cycling

Wetlands, floodplains, and riparian areas aid in distributing nutrients from their overstory vegetation litter to the wider ecosystem during flooding events. Wetland and riparian vegetation and associated root systems also aid in the attenuation of excess nutrients in stormwater runoff from upland areas, as well as reduce the amount of exposed soil, thus reducing the potential for erosion and downstream sedimentation.

2.5.3 Sediment Stabilization

Coastal features, including the watershed's extensive salt marshes (for example, coastal portions of the St. Marks NWR), aid in the buffering of storm impacts, shoreline erosion, and sedimentation. During coastal storms, these features help to protect the mainland by acting as wind buffers and absorbing potential flooding (Conservation Tools 2016). Among the essential functions of natural coastal features is to ensure long-term resiliency, including adapting to coastal change and protecting human communities and natural systems from shoreline erosion.

2.5.4 Commercially and Recreationally Important Fish and Wildlife

The numerous waterbodies and wetlands within the St. Marks River and Apalachee Bay watershed are critical to the health of economically important fisheries in the area. Freshwater lakes, streams and some swamps within the watershed provide a variety of recreational fishing opportunities, as they support popular species such as largemouth bass (*Micropterus salmoides*), black crappie (*Pomoxis nigromaculatus*), and redear sunfish (shellcracker) (*Lepomis microlophus*) (U.S. Fish and Wildlife Service [USFWS] 2013a). Freshwater systems also provide habitat for many species of migratory waterfowl of interest to recreational hunters in the region including rails (*Rallidae*), common moorhen (*Gallinula chloropus*), snipe, ducks, geese, coot (*Fulica*), and woodcock (*Scolopax*) (FWC 2015a). In addition to the commercial shellfish (Figure 2-11) and seafood industries, recreational fishing generated $691,547 in total sales in Gulf Coastal Florida, making it a major economic driver in the region (U.S. Department of Commerce [USDOC] 2012).

Source: Photo by Jade Marks.

Figure 2-11 Blue crabs are an important recreational and commercial seafood species.

Waterbodies within the St. Marks River and Apalachee Bay watershed also support local subsistence fisheries. Subsistence fishing refers to fishing carried out primarily for the purpose of obtaining food (or money for food), rather than participation in the commercial or strictly recreational fishing industry. A study sponsored by Impact Assessment, Inc., under contract from the National Marine Fisheries Service in 2003, focused on Florida's west coast, investigating fishing-dependent communities (Huang 2003). Since the late 1970s, these communities experienced a population decline due to increases in shoreline development, overfishing, and permit requirements (Huang 2003). The health and public access of the waterbodies within the St. Marks River and Apalachee Bay watershed (and other Florida watersheds) are essential for those utilizing fisheries for subsistence.

Surface waters within the St. Marks River and Apalachee Bay watershed are classified by the state of Florida (FDEP) as either Class II or III. Areas of Apalachee Bay along the Wakulla County coastline are designated as Class II or shellfish propagation/harvesting waters because they include commercially viable oyster beds. However, commercial harvesting is prohibited in areas east of Live Oak Island, including the mouth of the St. Marks River and adjacent offshore waters. This designation does not apply to scallop harvesting, which is a major recreational activity in the seagrass beds in Apalachee Bay (NWFWMD 2009). All other waters in the Ochlockonee and St. Marks basins are designated Class III or recreation/propagation/fish and wildlife waters.

The watershed contains significant areas that are approved or conditionally approved for shellfish harvesting (see Figure 2-11). All waters in the St. Marks River (except those in the City of St. Marks), the St. Marks NWR, the Wakulla River and waters within the Big Bend Seagrasses Aquatic Preserve are Outstanding Florida Waters (OFWs) and receive additional protection to maintain ambient conditions with no degradation. Some commercially and recreationally important fish and shellfish of the St. Marks River and Apalachee Bay watershed include shrimp (*Penaeus spp*.), eastern oysters (*Crassostrea virginica*), spotted seatrout (*Cynoscion nebulosus*), Gulf menhaden (*Brevoortia patronus*), red drum or redfish (*Sciaenops ocellatus*), blue crab (*Callinectes sapidus*), stone crabs (*Menippe mercenaria*), Gulf flounder (*Paralichthys albigutta*), striped mullet (*Mugil cephalus*), white mullet (*Mugil curema*), and bay scallop (*Argopecten irradians*). Across the five counties within the Big Bend Seagrasses Aquatic Preserve, the Florida Fish and Wildlife Conservation Commission (FWC) reported harvests of 3,686,776 pounds of fish and shellfish in 2009, with an estimated value of over $6 million (FDEP 2014a).

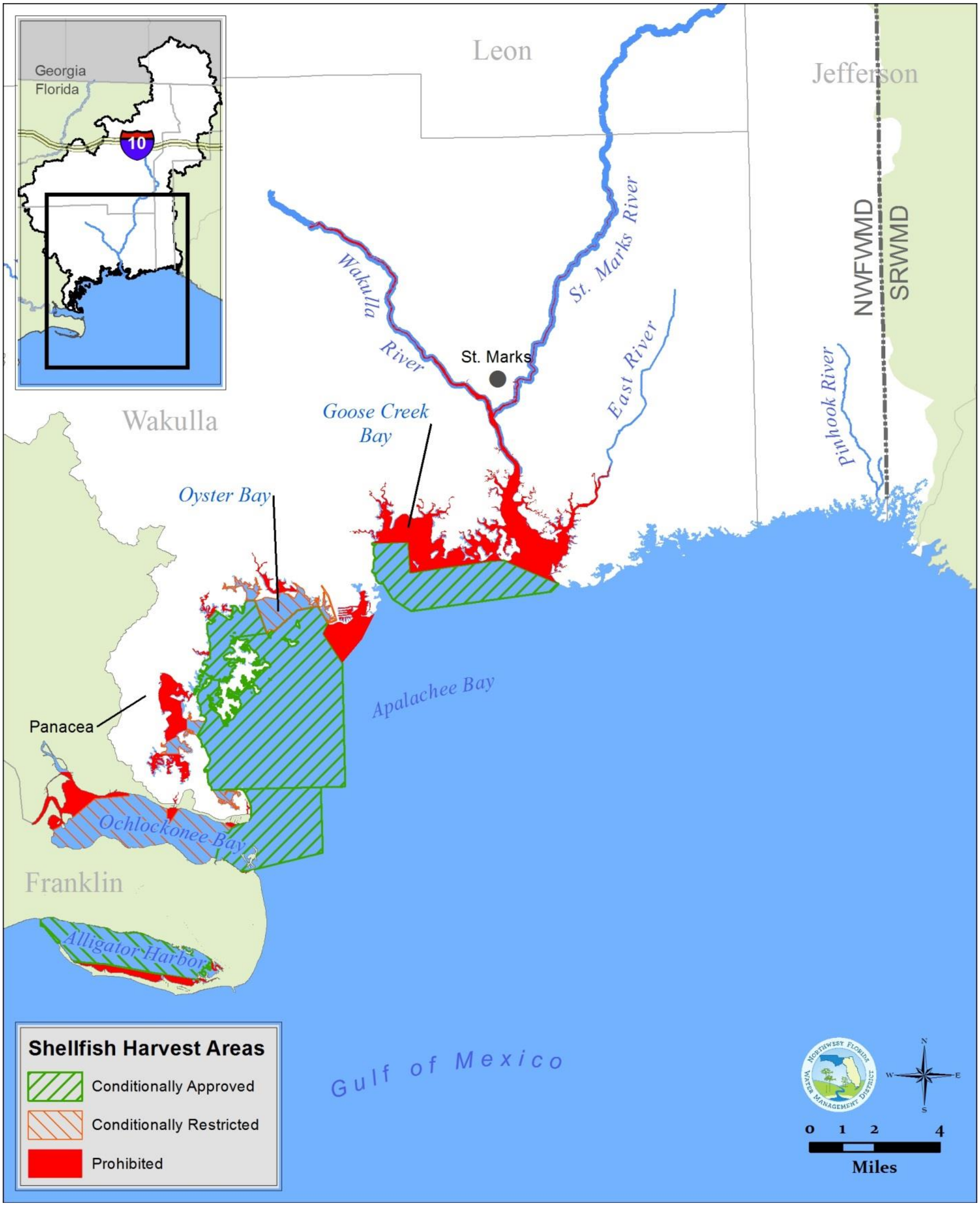
Blue crabs make up approximately 40 percent of Wakulla County's total commercial seafood production (by dollar value) (Gulf States Marine Fisheries Commission 2015). Grouper

(*Epinephelinae*) make up the majority of the offshore species, comprising about a third of the finfish catch. Stone crab and shrimp harvests, although an order-of-magnitude smaller than blue crab, also contribute significantly to the area's commercial fisheries.

2.5.5 Recreation and Aesthetic Value

The waterbodies and wetlands within the St. Marks River and Bay watershed offer other important recreational values besides fishing, as tourists are attracted to the Florida Panhandle for the mild climate, beaches, golfing, hunting, boating, and other water sports (FWC 2014). Increases in visitors utilizing water resources leads to economic growth in surrounding communities, as visitors will financially contribute not only to recreational activities associated with the water, but also to hotels, restaurants, and retail establishments.

As observed in many coastal areas, ecotourism is becoming an increasingly essential component of the economic health of communities within the watershed. Public and private entities such as state and national parks, preserves, conservation lands, and management areas (described in Section 3.5) attract tourists, leading to increased awareness and protection of valuable natural resources. The presence of diverse habitats, as well as rare, imperiled, endemic, and protected species, are additional drivers for people to visit and contribute to the watershed. A 2007 study on nature-based recreation in the Apalachicola River region estimated that the Apalachicola National Forest hosts approximately 393,000 visitors annually, while the St. Marks NWR attracts approximately 8,000 visitors annually. Together, these parks have an estimated economic value of between $1.81 million and $3.16 million (Shrestha *et al.* 2007). According to the Florida State Parks System Direct Economic Impact Assessment, the Wakulla Springs State Park, including the historic lodge, hosted a total of 224,725 visitors in the 2013/2014 fiscal year and generated total economic impacts of $17.6 million while directly supporting nearly 250 jobs; an increase in revenue of approximately $6 million from the 2010/2011 fiscal year (FDEP 2011a, 2014b). These studies suggest that there is a high demand for pristine natural areas for recreation visits in the St. Marks River and Apalachee Bay watershed (Shrestha *et al.* 2007).



Sources: FDACS 2016a; NOAA 2015a; USGS 2015, 2016b.

Figure 2-12 Shellfish Harvesting Areas

The St. Marks River and Apalachee Bay watershed also provides visual aesthetics; thereby, facilitating local art and community-based activities. Nature has always played a role in creative expression, and Florida, in particular, has influenced countless artists (both local and visiting). By working to conserve natural areas, communities can nurture the artistic spirit and promote future generations to continue preserving and utilizing nature for artistic expression (TNC 2016a). Museums, fishing tournaments, and festivals revolving around local art, seafood, and other cultural affairs are important economic drivers, as well as opportunities to bring communities together around heritage and the unique natural environment found in the area. Some of these events include the St. Marks NWR Monarch Butterfly Festival, Wakulla Wildlife Festival, the St. Marks NWR Wildlife Heritage and Outdoor Festival, Wild about Wakulla Week, the Word of the South Festival, and various fresh and saltwater fishing tournaments such as Children's Fishing Tournament and the St. Marks Stone Crab Festival (Visit Wakulla 2016).

2.6 Ecological Characteristics

The St. Marks River and Apalachee Bay watershed supports a diversity of natural habitats, including upland, coastal, transitional, wetland, aquatic, estuarine, and marine communities (FNAI 2010). Natural Communities are characterized and defined by a combination of physiography, vegetation structure and composition, topography, land form, substrate, soil moisture condition, climate, and fire. They are named for their most characteristic biological or physical feature (FNAI 2010). Based on Geographic Information Systems (GIS) analysis of the St. Marks River and Apalachee Bay watershed, there are 25 unique natural communities within 15 broader community types categorized by the FNAI.

Approximately 280,118 acres, or 41 percent, of the watershed is comprised of freshwater and tidal wetlands that provide habitat for wetland-dependent species, such as the threatened wood stork (*Mycteria Americana*) (Federal Emergency Management Administration [FEMA], FDEP, and USFWS 2016). These habitats include forested floodplains and floodplain swamps, alluvial streams, baygall, blackwater streams, clastic upland lakes, depression marshes, dome swamps, and many others (NWFWMD 2009; USFWS 2016). Prominent habitats associated with Apalachee Bay include tidal marshes, creeks, and flats, as well as seagrass and oyster beds (FNAI 2010; NWFWMD 2009).

This section provides a summary of habitats and natural communities found in the watershed, particularly those most-influenced by surface water management activities, as well as information about some of the more important biological resources associated with them. More detailed information on the habitats and natural communities observed in the St. Marks River and Apalachee Bay watershed, as well as the species those habitats support, are described in Appendices B and C (FNAI 2010, 2016a, 2016b, 2016c).

2.6.1 Seagrass Beds

Apalachee Bay supports one of the most extensive continuous seagrass systems in the U.S. (Figure 3-7) (Lewis *et al*. 2009; Florida Department of Natural Resources [FDNR] 1988). Much of this system is encompassed within the Big Bend Seagrasses Aquatic Preserve (FDNR 1988). The Northern Big Bend Region extends from the mouth of the Ochlockonee River on the west to the Steinhatchee River on the east and south. It includes most of the Big Bend Seagrasses Aquatic Preserve, the largest aquatic preserve in Florida, which encompasses about 450,000 acres of seagrass beds and salt marsh and is one of the most expansive seagrass beds in the country. Nearshore waters are also substantially protected by the St. Marks NWR. These habitats support wintering migratory waterfowl and many marine organisms, including juvenile Ridley sea turtles (*Lepidochelys kempii*) and commercially and recreationally important fish and shellfish.

Seagrass beds in the Apalachee Bay are considered extremely important as they provide crucial protective and foraging habitat for many marine species and are critical to the spawning cycle of many fish and invertebrate species, many of which are of great commercial and recreational significance to the area. Among these are shrimp, eastern oysters, spotted seatrout, Gulf menhaden, red drum or redfish, blue crab, Gulf flounder, striped mullet, white mullet, and bay scallop.

Seagrass beds are a protected habitat recognized by both the state and federal agencies. The shallow waters of the Apalachee Bay are dominated by shoal grass (*Halodule wrightii*) and turtle grass (*Thalassia testudinum*), and in deeper waters, manatee grass (*Syringodium filiforme*). Star grass (*Halophila engelmanni*) and widgeon grass (*Ruppia maritima*) can also be found within estuarine waters. Seagrass in the Apalachee Bay was estimated to occupy about 58,100 acres in the early 1970s. Later mapping by the National Wetland Inventory indicated approximately 29,630 acres along the Apalachee Bay coastline. Nine species of submerged aquatic vegetation (SAV) have been identified in the Wakulla River (Lewis *et al.* 2009). Seagrass coverage within the watershed is shown in Figure 2-13.

2.6.2 Oyster Reefs

Oyster bars are found in most river mouths in the watershed, including the St. Marks, East, and Wakulla rivers (USFWS 2010; Florida Sportsman 2016). Oyster bars also are present throughout Apalachee Bay (Visit Florida n.d.). The St. Marks NWR has constructed oyster reefs that were designed to provide roosting area for whooping cranes to utilize during the winter as a part of the Whooping Crane Eastern Partnership (USFWS 2008). Portions of the Apalachee Bay and the adjacent Ochlockonee Bay are Class II designated waters, meaning shellfish propagation or harvesting is a designated use (USFWS 2006).

2.6.3 Emergent Marsh

In the salt marshes and nearshore tidal areas, species are adapted to the highly variable temperatures and salinities. Some species migrate in and out as necessary to take advantage of the food and shelter derived from the primary coastal habitats such as oyster reefs, marshes and seagrasses. The St. Mark's NWR and the Wakulla Spring and River system support a variety of biotic communities and maintain high levels of biodiversity (Lewis *et al.* 2009). There are also many rare and endemic species in the watershed. FNAI includes 92 occurrences of rare and endangered plants (31) and animals (61) within the basin. Wakulla Spring serves as a winter thermal refuge site for the West Indian manatee (*Trichechus manatus*). The St. Marks River and Apalachee Bay watershed supports a wealth of biological diversity including a number of rare and/or endemic species, largely due to its rich, diverse mosaic of natural community types.

Estuarine marshland is abundant in the lower St. Marks River and Apalachee Bay watershed. Apalachee Bay's coast is nearly contiguous salt marsh (Apalachicola Region Resources on the Web [ARROW] Almanac 2005), while brackish marshes line the lower Wakulla and St. Marks rivers (Research Planning, Inc. 2016). Marsh species composition is influenced by a combination of salinity tolerance and differences in soil type, elevations and competitive interactions. Salt marshes are similar to brackish marshes in that they serve as a transition between terrestrial and marine systems. Generally, salt marshes are intertidal and develop along relatively low energy shorelines. Unlike brackish marshes, they may be found under significantly more saline conditions. Salt marshes in the Florida Panhandle are usually characterized by large, fairly homogeneous expanses of dense black needlerush (*Juncus roemerianus*). Often, they are accompanied on the waterward side by smooth cordgrass (*Spartina alterniflora*). The *Juncus* and *Spartina* zones are very distinctive and can be separated easily by elevation. Early estimates of salt marsh habitat in the vicinity of the St. Marks River were provided for a larger section of Apalachee Bay (McNulty *et al.* 1972) and included the area from Alligator Harbor eastward to the Econfina River. Within this larger area, approximately 137,600 acres of tidal marsh were mapped. True salt marshes appear limited to the higher salinity regions of the St. Marks/Apalachee Bay.

Estuarine vegetation in the St. Marks River, below the confluence with the Wakulla River, was recently characterized using aerial photography and field sampling (Research Planning, Inc.

2016). In the upper estuary, contiguous hardwood forests include oaks, cedar, cabbage palms, and swamp bay tolerant of some inundation and low salinity. Sawgrass (*Cladium jamaicense*) is dominant in the upper estuary and is interspersed with black needlerush (Research Planning, Inc. 2016). Further south in the estuary, needlerush is prevalent along the river edge and transitions to sawgrass, then hardwood forest. The lower estuary is dominated by saltmarsh cordgrass (*Spartina alterniflora*) along the river edge and transitions to black needlerush; with hardwood forest and sawgrass absent (Research Planning, Inc. 2016).

Salt marshes are among the most productive plant communities on Earth (Fernald 1998). Among the most abundant and productive species found in salt marshes are mussels (*Mytilidae*), oysters, fiddler crabs (*Uca sp*.), marsh periwinkles (*Littoraria irrorata*), crown conchs (*Melogena corona*), mullet, and blue crabs. Emergent freshwater and brackish marshes are dominated by sawgrass, maidencane (*Panicum hemitomon*), giant cutgrass (*Zizaniopsis miliacea*), and cattails (*Typha spp*.). In contrast with more coastal salt marshes, these sites lack the extensive salt flats of salt grass (*Distichlis spicata*), glasswort (*Salicornia spp*.), and salt barrens. Riparian freshwater marshes are found in the upper portions of Wakulla River, while the middle and lower river contain brackish marsh. Seventy-four species of emergent marsh plants were identified in the Wakulla River alone (Lewis *et al.* 2009).

2.6.4 Palustrine, Riparian, and Floodplain Habitats

Riparian habitats include those areas along waterbodies that serve as an interface between terrestrial and aquatic ecosystems. Riparian areas are important fish and wildlife habitats that promote ecological diversity and assist in mitigating or controlling NPS pollution. Riparian vegetation can be effective in removing excess nutrients and sediment from surface runoff and shallow groundwater and in shading streams to optimize light and temperature conditions for aquatic plants and animals. Riparian vegetation, especially trees, is also effective in stabilizing streambanks and slowing flood flows, resulting in reduced downstream flood peaks. Floodplain swamps, alluvial forest, and bottomland forest Tupelo swamp, mixed hardwood swamp, hardwood hammock, and ironwood hammock are the primary types of riparian habitat found in the St. Marks River and Apalachee Bay watershed (Research Planning, Inc. 2016). Minor amounts of riparian freshwater marsh also are found along the upper reaches of the Wakulla River (Lewis *et al.* 2009).

Compared to the Wakulla River, the channel of the St. Marks River is more incised and exhibits a greater change in topographic elevation along its length. On a small scale, the low floodplains exhibit localized topographic relief in the form of hummocks and sloughs. Generally, the percentage of cover by sedges (*Cyperaceae*) decreases from the low plain to the upper slope, while the percentage of woody vegetation increases. Important canopy species in the St. Marks River floodplain include American hornbeam or ironwood (*Carpinus caroliniana*), swamp tupelo (*Nyssa sylvatica* var. *biflora*), pond cypress (*Taxodium asendens*), bald cypress (*Taxodium distichum*), swamp bay (*Persea palustris*), ironwood (*Carpinus caroliniana*) (Research Planning, Inc. 2016), sweetbay magnolia (*Magnolia virginiana*), and American sweetgum (*Liquidambar styraciflua*); while swamp dogwood (*Cornus foemina*), bald cypress (*Taxodium distichum*), and Walter viburnum (*Viburnum obovatum*) dominated the subcanopy on the lower floodplain (Light *et al.* 1993).

Because changes in elevation on the St. Marks floodplain can mean a substantial decrease in soil moisture, small scale relief creates a variety of hydrologically diverse habitats. A study of the St. Marks River hydrology, vegetation, and soils determined that the lower-lying portions of the floodplain flood up to four times a year and stay inundated for one to four weeks, while upslope flood waters recur roughly every five years (Light *et al.* 1993).

The Wakulla River floodplain is relatively broad and flat, with little topographic relief. Soils are comprised of mucky mineral materials and the seasonal high water level is at or near land surface (Research Planning, Inc. 2016). Important canopy species in the Wakulla River floodplain include swamp tupelo (*Nyssa sylvatica* var. *biflora*), pumpkin ash (*Fraxinus profundus*), swamp bay (*Persea palustris*), and bald cypress (*Taxodium distichum*) (Research Planning, Inc. 2016).

2.6.5 Terrestrial Communities

Terrestrial habitats within the St. Marks River and Apalachee Bay watershed include mesic flatwoods sandhill and scrub communities, scrubby flatwoods, slope forests, upland hardwood forests, wet flatwoods, and xeric hammock. The conditions of these habitats vary widely across the watershed, depending on land use, land management, and other factors.

Upland forest communities support a number of threatened and endangered species including the gopher tortoises (*Gopherus polyphemus*), frosted flatwoods salamanders (*Ambystoma cingulatum*), eastern indigo snake (*Drymarchon corais couperi*), and red-cockaded woodpeckers (*Leuconotopicus borealis*); all of which have been documented in the Apalachicola National Forest and other conservation lands.

Longleaf pine and associated wiregrass communities across the Apalachicola National Forest have been significantly altered by human activities in the last century. Since 1987, native longleaf pine forests across Florida have been reduced by 22 percent and have largely been replaced by slash pines (USDA 1999). Sand pine-scrub ecosystems, which make up portions of the Apalachicola National Forest, have historically been regenerated by stand replacing fires that have been suppressed in recent decades. Without regular disturbance, this community succeeds toward a xeric hardwood hammock community in which the scrub oaks eventually shade out endemic understory plants. There are significant opportunities to improve these ecosystems by implanting more frequent prescribed burning intervals that target larger tracts of forest (U.S. Department of Agriculture [USDA] 1999).

Notable springs within the St. Marks River and Apalachee Bay watershed include:

- **Wakulla Spring;**
- **St. Marks River Rise Spring;**
- **Sally Ward Spring;**
- **Horn Branch Spring;**
- **Chicken Branch Spring; and**
- **Spring Creek Springs Group.**

Source: FGS 2015c

2.6.6 Springs

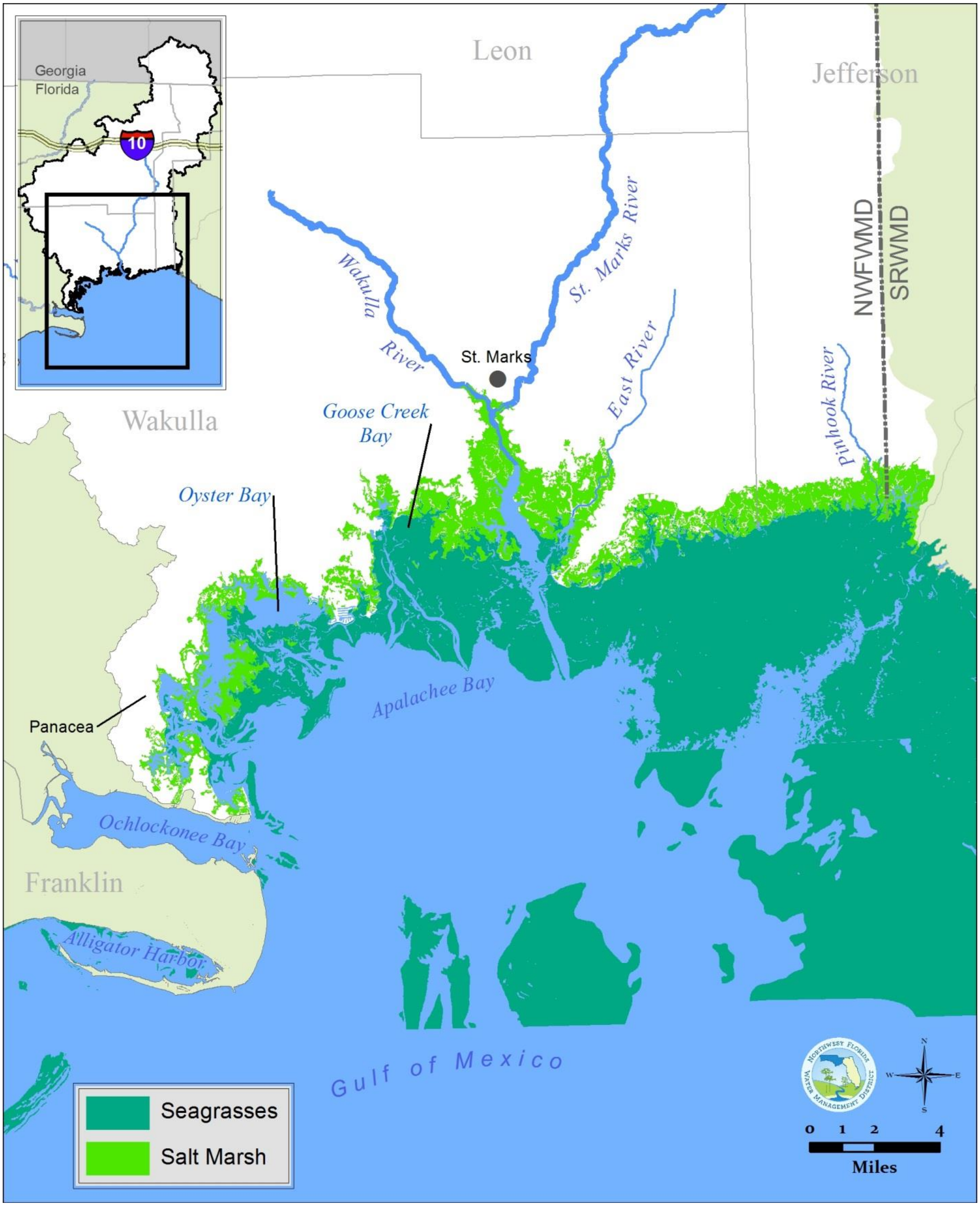
Florida's springs are significant natural resources, as they can support entire ecosystems and protected species, can provide high quality water and recreational use, and feed rivers, estuaries, or nearshore waters dependent on clean, clear, fresh water. Florida has more springs than any other state due to underlying geologic formations containing porous marine limestone that holds and transports more water than other areas, making the Floridan aquifer system one of the most productive freshwater aquifer systems in the world (Florida's Springs 2016).

2.6.7 Atlantic Flyway

Florida is in the "Atlantic Flyway," a migratory route for birds that generally follows the Atlantic Coast of North America and the Appalachian Mountains (Bird Nature 2001). Millions of individuals representing over 500 bird species use this route because there is little extreme mountainous terrain and it has good sources of water, food, and cover over its entire length. Forty percent of all species that use the Atlantic flyway are federally recognized species of conservation concern (Audubon 2011). Many of these species, including Red Knots (Calidris canutus), Virginia Rails (Rallus limicola), soras (Porzana carolina), Pectoral Sandpipers (Calidris melanotos), Black Terns (Chlidonias niger) and others, occur seasonally in the St. Marks River and Apalachee Bay watershed and across a wide variety of habitats. Many of these species are area transients, using this area as a resting/feeding ground during spring or fall migration. Others are accidental visitors, far from their native ranges.

The St. Marks coastal marshes, seagrass beds, and riverine estuaries are important wintering and migration areas for many bird species, including several diving ducks of national importance (Redheads [Aythya Americana] and Lesser Scaup [Aythya affinis]). In 1931, the St. Marks NWR was established to provide wintering grounds for migratory bird species. Today, significant portions of the lower St. Marks basin and adjacent lands lie within the St. Marks NWR. The refuge occupies nearly 70,000 acres in Jefferson, Wakulla, and Taylor counties, of which 54,017 acres fall within the St. Marks River and Apalachee Bay. The NWR also includes 32,000 acres of aquatic habitat in Apalachee Bay. Situated between the Atlantic and Mississippi Flyways, the refuge provides important breeding, wintering, and stopover habitat for Neotropical migratory birds (e.g., songbirds, raptors, and shorebirds). Of the 278 avian species documented at the refuge, 142 are categorized as neotropical migratory birds, including all but three of the refuge's 48 listed warblers, tanagers, vireos, and new world finches (USFWS 2013b).

The managed impoundments at the refuge provide a mix of habitats and water depth capabilities suitable for many migratory species. Blue-winged Teal (Anas discors), Northern Pintail (Anas acuta), American Widgeon (Anas Americana), Mallard (Anas platyrhynchos), and many other ducks are common in the impoundments and may exceed 8,000 birds on any single survey event (USFWS 2006, 2013b). Many species of migratory waterfowl are also found at Wakulla Spring and river.



Sources: FWC 2011, 2015b; NOAA 2015a; USGS 2015, 2016a, 2016b.

Figure 2-13 Seagrass and Salt Marsh Coverage

3

3.0 Current Watershed Conditions and Water Resource Issues

3.1 Introduction

Increasing population, industrialization, and development in northwest Florida are correlated with land use changes and an increased need for added infrastructure. The St. Marks River and Apalachee Bay watershed experiences water quality challenges across both states. Agricultural and silvicultural activities that generate NPS pollution are concentrated in the upper reaches of the watershed, while urban point and NPS pollution are long-term challenges in the Tallahassee metropolitan area. With proper planning and management practices, the impacts of human activities and development that can diminish the overall health of the ecosystem and its many benefits for the people and communities can be reduced.

The following summary of issues related to water quality, point and NPS pollution, eutrophication, harmful algal blooms (HABs), conserved and managed lands, and floodplains should inform future planning, development, preservation, and restoration efforts within the watershed.

Further discussion on management activities for water quality protection and improvement, such as BMPs, land use planning, and other water quality protection and improvement techniques, can be found in Section 6.0.

3.2 Water Quality

The following discussion identifies impaired waterbodies (per FDEP) throughout the St. Marks River and Apalachee Bay watershed, the potential sources of pollution responsible for those impairments, and ecological indicators of water quality.

3.2.1 Impaired Waters

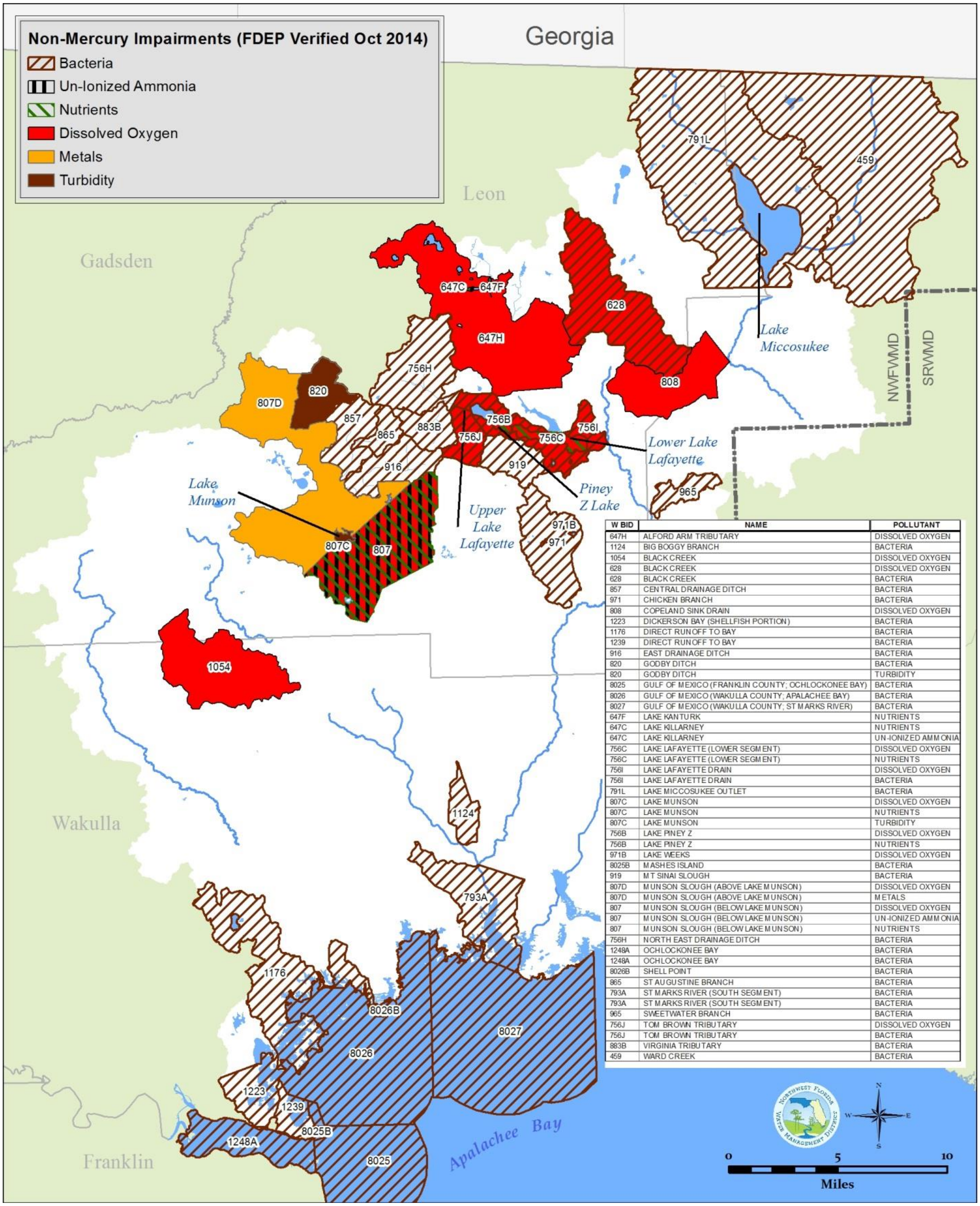
All states are required to submit lists of impaired waters (waters too polluted or degraded to meet state water quality standards, including applicable water quality criteria and designated uses, such as drinking water, recreation, and shellfish harvesting) to the EPA under Section 303(d) of the Clean Water Act (CWA) (EPA 2016b). In Florida, the FDEP is responsible for fulfilling this purpose.

Of the 101 waterbody segments in the St. Marks River and Apalachee Bay watershed, the FDEP has identified 37 impaired segments. Since some of the segments are impaired for more than one pollutant, the number of impairments exceeds the total number of impaired segments. There are 52 total impairments in the watershed, including 28 segments for bacteria (21 for fecal coliforms, one for beach advisories, and six for shellfish harvesting classification), 14 segments for dissolved oxygen (DO), five segments for nutrients, two segments for turbidity, one segment for un-ionized ammonia, one segment for iron, and one segment for lead (FDEP 2014c). The impaired waters and the pollutant causing the impairment are shown in Figure 3-1. The list of impaired waters, including the pollutant causing the impairment can be found in Appendix D. The list is based on data current through June 2012 (FDEP 2014c). In March 2019, the state is scheduled to adopt an updated list of impaired waters for the watershed, with data current through June 2017.

The FDEP identified six waterbody segments as verified impaired for bacteria in the St. Marks River and Apalachee Bay watershed, based on shellfish classifications issued by the FDACS (FDEP 2014c):

- St. Marks River (South Segment) (waterbody identification number [WBID] 793A);
- Direct Runoff to Bay (WBID 1176);
- Dickerson Bay (Shellfish Portion) (WBID 1223);
- Direct Runoff to Bay (WBID 1239);
- Coastal Apalachee Gulf West (WBID 8026); and
- Gulf of Mexico (Wakulla County, St. Marks River) (WBID 8027).

The FDEP identified one beach segment as verified impaired for bacteria in the St. Marks River and Apalachee Bay watershed, based on beach advisories issued by the county health departments (FDEP 2014c): Shell Point (WBID 8026B).



W BID	NAME	POLLUTANT
647H	ALFORD ARM TRIBUTARY	DISSOLVED OXYGEN
1124	BIG BOGGY BRANCH	BACTERIA
1054	BLACK CREEK	DISSOLVED OXYGEN
628	BLACK CREEK	DISSOLVED OXYGEN
628	BLACK CREEK	BACTERIA
857	CENTRAL DRAINAGE DITCH	BACTERIA
971	CHICKEN BRANCH	BACTERIA
808	COPELAND SINK DRAIN	DISSOLVED OXYGEN
1223	DICKERSON BAY (SHELLFISH PORTION)	BACTERIA
1176	DIRECT RUNOFF TO BAY	BACTERIA
1239	DIRECT RUNOFF TO BAY	BACTERIA
916	EAST DRAINAGE DITCH	BACTERIA
820	GODBY DITCH	BACTERIA
820	GODBY DITCH	TURBIDITY
8025	GULF OF MEXICO (FRANKLIN COUNTY; OCHLOCKONEE BAY)	BACTERIA
8026	GULF OF MEXICO (WAKULLA COUNTY; APALACHEE BAY)	BACTERIA
8027	GULF OF MEXICO (WAKULLA COUNTY; ST MARKS RIVER)	BACTERIA
647F	LAKE KANTURK	NUTRIENTS
647C	LAKE KILLARNEY	NUTRIENTS
647C	LAKE KILLARNEY	UN-IONIZED AMMONIA
756C	LAKE LAFAYETTE (LOWER SEGMENT)	DISSOLVED OXYGEN
756C	LAKE LAFAYETTE (LOWER SEGMENT)	NUTRIENTS
756I	LAKE LAFAYETTE DRAIN	DISSOLVED OXYGEN
756I	LAKE LAFAYETTE DRAIN	BACTERIA
791L	LAKE MICCOSUKEE OUTLET	BACTERIA
807C	LAKE MUNSON	DISSOLVED OXYGEN
807C	LAKE MUNSON	NUTRIENTS
807C	LAKE MUNSON	TURBIDITY
756B	LAKE PINEY Z	DISSOLVED OXYGEN
756B	LAKE PINEY Z	NUTRIENTS
971B	LAKE WEEKS	DISSOLVED OXYGEN
8025B	MASHES ISLAND	BACTERIA
919	MT SINAI SLOUGH	BACTERIA
807D	MUNSON SLOUGH (ABOVE LAKE MUNSON)	DISSOLVED OXYGEN
807D	MUNSON SLOUGH (ABOVE LAKE MUNSON)	METALS
807	MUNSON SLOUGH (BELOW LAKE MUNSON)	DISSOLVED OXYGEN
807	MUNSON SLOUGH (BELOW LAKE MUNSON)	UN-IONIZED AMMONIA
807	MUNSON SLOUGH (BELOW LAKE MUNSON)	NUTRIENTS
756H	NORTH EAST DRAINAGE DITCH	BACTERIA
1248A	OCHLOCKONEE BAY	BACTERIA
1248A	OCHLOCKONEE BAY	BACTERIA
8026B	SHELL POINT	BACTERIA
865	ST AUGUSTINE BRANCH	BACTERIA
793A	ST MARKS RIVER (SOUTH SEGMENT)	BACTERIA
793A	ST MARKS RIVER (SOUTH SEGMENT)	BACTERIA
965	SWEETWATER BRANCH	BACTERIA
756J	TOM BROWN TRIBUTARY	DISSOLVED OXYGEN
756J	TOM BROWN TRIBUTARY	BACTERIA
883B	VIRGINIA TRIBUTARY	BACTERIA
459	WARD CREEK	BACTERIA

Sources: FDEP 2014c; NOAA 2015a; USGS 2015, 2016a, 2016b.

Figure 3-1 Currently Listed Impaired Waterbody Segments

Water quality conditions within the St. Marks River and Apalachee Bay reflect the frequent interaction between surface and groundwaters. The closed basin lakes in the more northern extent of the watershed are breached in places by karst features, enhancing leakage to underlying aquifers. To the south, the Woodville Karst Plain receives stormwater runoff generated in the Tallahassee area, as well as locally. The runoff and associated NPS pollution can be recharged directly into the Floridan aquifer through karst features and generally unconfined conditions. Affected groundwater later reemerges as surface water through numerous springs. This vulnerability of groundwater quality affects both drinking water resources and springs that discharge back into surface waters (NWFWMD 2009).

Because of the relatively low density of development, particularly in the Gulf Coastal Lowlands, most of the watershed's rivers and lakes and the estuary are in relatively good condition. This is due largely to the creation of the St. Marks NWR and the Apalachicola National Forest in the 1930s by the federal government. Together, these publicly owned areas comprise more than 630,000 acres and contain most of the wetlands and coastal areas of the Ochlockonee and St. Marks basins. As long as this land remains undeveloped and is responsibly managed, this significant buffer will continue to provide protection to the rivers and coastal environment (FDEP 2003).

Authorities in Florida issue human fish consumption advisories for mercury in fish tissue. The advisories in Florida are issued by the Florida Department of Health (FDOH) in cooperation with the FWC and the FDEP. Current fish consumption advisories within the St. Marks River and Apalachee Bay watershed can be found at the FDOH website (www.floridahealth.gov). Health advisories prohibiting the harvesting of shellfish due to potential bacterial contamination are issued by the FDACS. Shellfish advisories and seasonal closures within the St. Marks River and Apalachee Bay watershed can be found on the FWC website (www.myfwc.com), and the FDACS website (http://www.freshfromflorida.com/Divisions-Offices/Aquaculture/Shellfish-Harvesting-Area-Classification). County health departments in the state of Florida monitor beaches and other public swimming areas for bacterial contamination and issue health advisories closing beaches when bacterial counts are too high. Beaches that have more than 21 beach closures in a year are identified as impaired by FDEP. These advisories are discussed further in sections 6.2.3 (shellfish harvesting), 6.2.4 (beach advisories), and 6.4.1 (mercury in fish tissue).

To restore waterbodies with impaired water quality, protect public health, preserve valuable habitat, natural resources, and ecosystem services, and ensure long-term sustainability and resilience, it is critical to identify sources of point and NPS pollution, causes of degradation, and the current status and health of natural systems and floodplains within the watershed. A comprehensive understanding of watershed conditions and resource issues will inform and facilitate management actions, including planning and permitting.

3.2.2 Total Maximum Daily Loads (TMDLs)

A TMDL represents the maximum amount of a given pollutant a waterbody can assimilate and still meet water quality standards, including its applicable water quality criteria and designated uses (such as drinking water, recreation, and shellfish harvesting). Total maximum daily loads are developed for waterbodies that are verified as not meeting adopted water quality standards to support their designated use. They provide important water quality restoration goals to guide restoration activities. They also identify the reductions in pollutant loading required to restore water quality.

Table 3-1 and Figure 3-2 show the FDEP's adopted TMDLs for the St. Marks River and Apalachee Bay watershed (FDEP 2008, 2010, 2012, 2013a, 2013b, 2013c, 2016d). The FDEP is scheduled to develop TMDLs for most of the remaining impairments over the next ten years (FDEP 2014c).

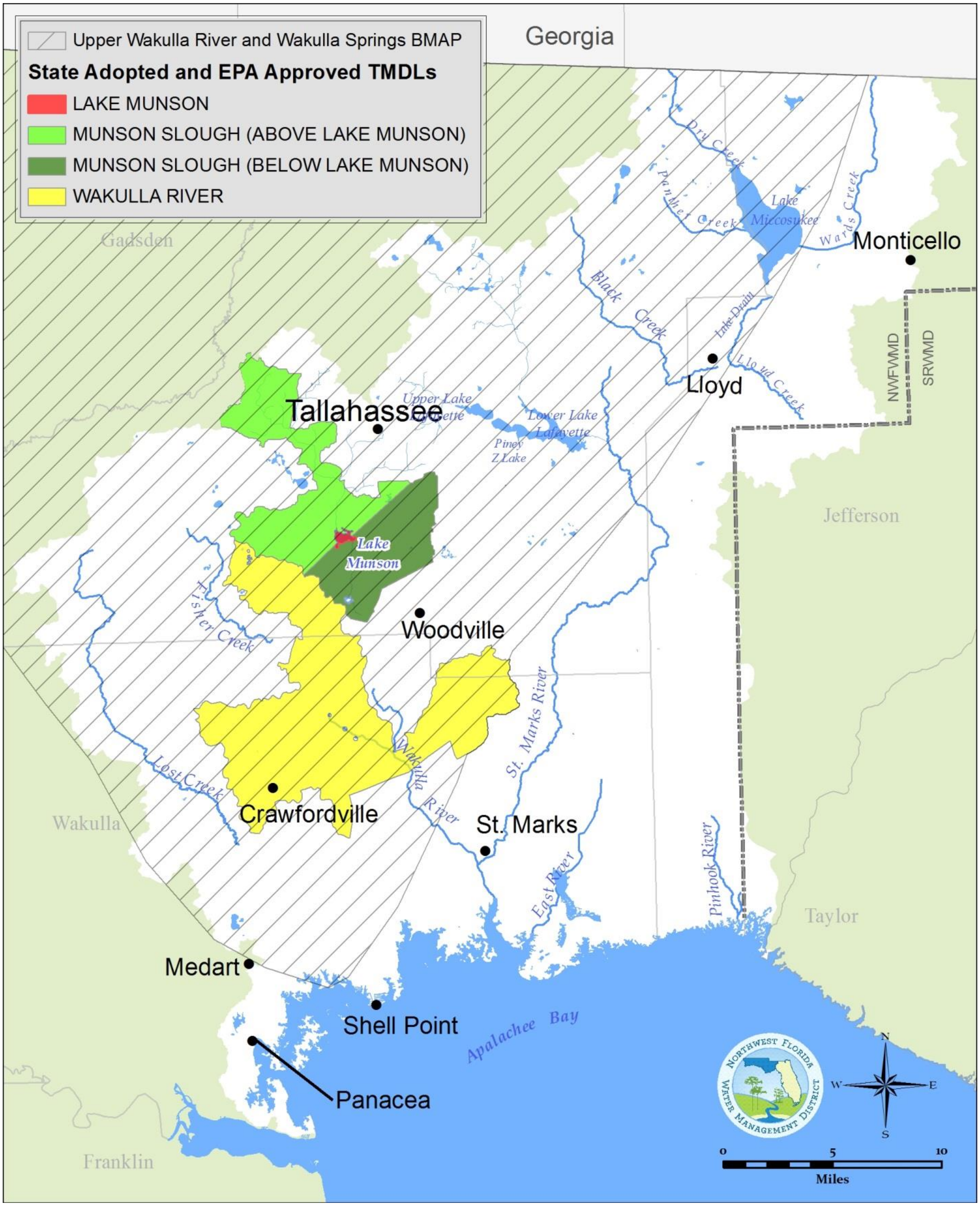
Table 3-1 TMDLs Adopted by the FDEP

Waterbody Name	WBID(s)
Fecal Coliform	
Munson Slough	807D
Dissolved Oxygen	
Munson Slough	807D
Lake Munson	807C
Munson Slough below Lake Munson	807
Nutrients	
Lake Munson (TSI)	807C
Wakulla River (Biology)	1006
Turbidity	
Lake Munson	807C
Un-ionized Ammonia	
Munson Slough below Lake Munson	807
Mercury	
Lake Miccosukee Outlet	791L
St Marks River (South Segment)	793A
St Marks River	793B
Newport Spring	793X
St Marks Spring	793Y
Wakulla River	1006

Wakulla River Between Bridges	1006W
Wakulla Spring	1006X
Direct Runoff to Bay	1071
East River	1089
Spring Creek Drain	1146
Direct Runoff to Bay	1176
Walker Creek	1188
Dickerson Bay (Shellfish Portion)	1223
Gulf of Mexico (Wakulla County; Apalachee Bay)	8026
Gulf of Mexico (Wakulla County; St Marks River)	8027
Gulf of Mexico (Jefferson County; Wakulla County)	8028
Moore Lake	889A

Sources: FDEP 2008, 2010, 2012, 2013a, 2013b, 2013c.

The FDEP has adopted a statewide TMDL for reducing the human health risks associated with consuming fish taken from waters impaired for mercury. Mercury impairments are based upon potential human health risks (fish consumption advisories), not exceedances of water quality criteria. There are no known relationships between environmental and ecological conditions and mercury levels in fish. The primary source of mercury is atmospheric deposition with 30 percent from natural sources and 70 percent from anthropogenic international sources outside of North America. It is estimated that approximately 0.5 percent of mercury from anthropogenic sources is from Florida (FDEP 2013a). Only a very small part of mercury in the environment is in the form of methylated mercury, which is biologically available and able to enter the food chain. For these reasons, the statewide TMDL that the FDEP has adopted for mercury includes a reduction target for fish consumption by humans and by wildlife and an 86 percent reduction in mercury from mercury sources in Florida (FDEP 2013a).



Sources: FDEP 2015b, 2016a; NOAA 2015a; USGS 2015, 2016a, 2016b.

Figure 3-2 Non-mercury TMDLs in the Watershed

TMDLs for restoring water quality in segments that pose a threat to human health are a high priority and will be developed by the FDEP in the next five years. The high priority TMDLs in the St. Marks River and Apalachee Bay watershed include the following segments and parameters (FDEP 2014c):

- St. Marks River (South Segment) (WBID 793A), fecal coliform, fecal coliform (shellfish classification);
- Direct Runoff to Bay (WBID 1176), fecal coliform (shellfish classification);
- Dickerson Bay (Shellfish Portion) (WBID 1223), fecal coliform (shellfish classification);
- Direct Runoff to Bay (WBID 1239), fecal coliform (shellfish classification);
- Coastal Apalachee Gulf West (WBID 8026), fecal coliform (shellfish classification);
- Shell Point (WBID 8026B), fecal coliform (beach advisory); and
- Gulf of Mexico (Wakulla County, St. Marks River) (WBID 8027), fecal coliform (shellfish classification).

Although the 26 segments with adopted TMDLs have been removed from the verified list, they remain a priority for restoration and funding from the state (FDEP 2014d). In the case of the 18 segments with mercury TMDLs, fish consumption should be limited to protect human health as directed by the FDOH.

Total maximum daily loads are implemented through the development and adoption of Basin Management Action Plans (BMAPs) that identify the management actions necessary to reduce the pollutant loads. There is one adopted BMAP in the St. Marks River and Apalachee Bay for the Upper Wakulla River and Wakulla Spring basin (FDEP 2015c, 2016b). The BMAP provides for phased implementation of strategies necessary to achieve the nitrate load reductions required in the TMDL. Since the TMDL was adopted in 2012, the largest source of loading to the Upper Wakulla River and Wakulla Spring, the City of Tallahassee's Thomas P. Smith Water Reclamation Facility (TPS) was upgraded to reduce nitrate concentrations by approximately 80 percent. Further reductions in nitrate concentrations are expected in the river and springs due to this upgrade, as well as other completed actions in the basin. Given the need for further monitoring to determine to what extent additional reductions are needed, the BMAP will use a sufficiency-of-effort evaluation based on source categories to move forward with reductions in the first five-year implementation period (FDEP 2015c).

To ensure sufficiency for addressing onsite sewage treatment and disposal systems (OSTDS), the FDEP is undertaking an OSTDS Initiative, in cooperation with the FDOH, City of Tallahassee, Leon County, Wakulla County, and other parties. The objective of the OSTDS Initiative is to identify and implement effective, financially feasible strategies to reduce nutrient loads from

OSTDS sources. The FDEP and stakeholders will identify options for addressing OSTDS loading, identify effective strategies for the Upper Wakulla River and Wakulla Springs Basin, establish educational and outreach programs, determine responsibilities, and identify funding sources and an implementation schedule for the management strategies (FDEP 2015b). Additional management strategies may be required in the next BMAP iteration, unless more current water quality data indicate that the designated uses have been achieved.

For point sources to surface waters, both wastewater treatment facilities (WWTFs) and municipal separate storm sewer systems (MS4s), the BMAP, and required TMDL reductions are enforceable through National Pollutant Discharge Elimination System (NPDES) or state permits. For non-MS4 sources, the BMAP requirements and TMDL reductions are enforceable under Section 403.067, F.S. Furthermore, an agricultural NPS discharger included in a BMAP must demonstrate compliance with required reductions by either implementing the appropriate BMPs or conducting water quality monitoring prescribed by the FDEP or a water management district that demonstrates compliance with state water quality standards (FDEP 2015b).

3.2.3 Point Source Pollution

The EPA defines point source pollution as any discernible, confined, and discrete conveyance from which pollutants are or may be discharged, including, but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft (EPA 2015a). Examples of point sources include industrial facilities, landfills, WWTFs, mines and borrow pits, and marinas, among others. The NPDES, administered by the EPA, is the permitting program authorized to regulate point source pollution. Within Florida, this permitting has been delegated to the FDEP.

Permits for point source facilities are reviewed and renewed at designated intervals. Specific permits are issued based on the results of water quality-based effluent limit studies. The NPDES Permit Writers' Manual encourages permit writers to consider the impact of every proposed surface water discharge on the quality of the receiving water.

There are currently 758 facilities permitted through the NPDES in the St. Marks River and Apalachee Bay watershed including construction permits and other discharges. Together, these facilities hold a total of 804 permits, with some facilities holding multiple permits for multiple types of discharges. For example, a WWTF may be registered in two different NPDES databases and hold a permit for both bio-solids and stormwater.

Most permitted facilities are concentrated in the northern reaches of the watershed, primarily in the incorporated area of Tallahassee. Of the watershed's total 804 permits, 692 are for activities within the Tallahassee metropolitan area. Other major centers of NPDES activities are located in Monticello, the City of St. Marks, and Crawfordville.

Due to the connections between groundwater and surface waters in karst areas, even beneficial reuse discharges must be well planned and regulated to protect water quality. Pollutants entering the groundwater may also emerge in surface waters via seepage and spring discharges. A groundwater tracing project in the Woodville Karst Plain conducted by the Florida Geological Survey (FGS) found groundwater connections between Leon Sinks, a karst area south of Tallahassee featuring a number of sink holes, and disappearing streams to the west (Kincaid 2003; NWFWMD 2009).

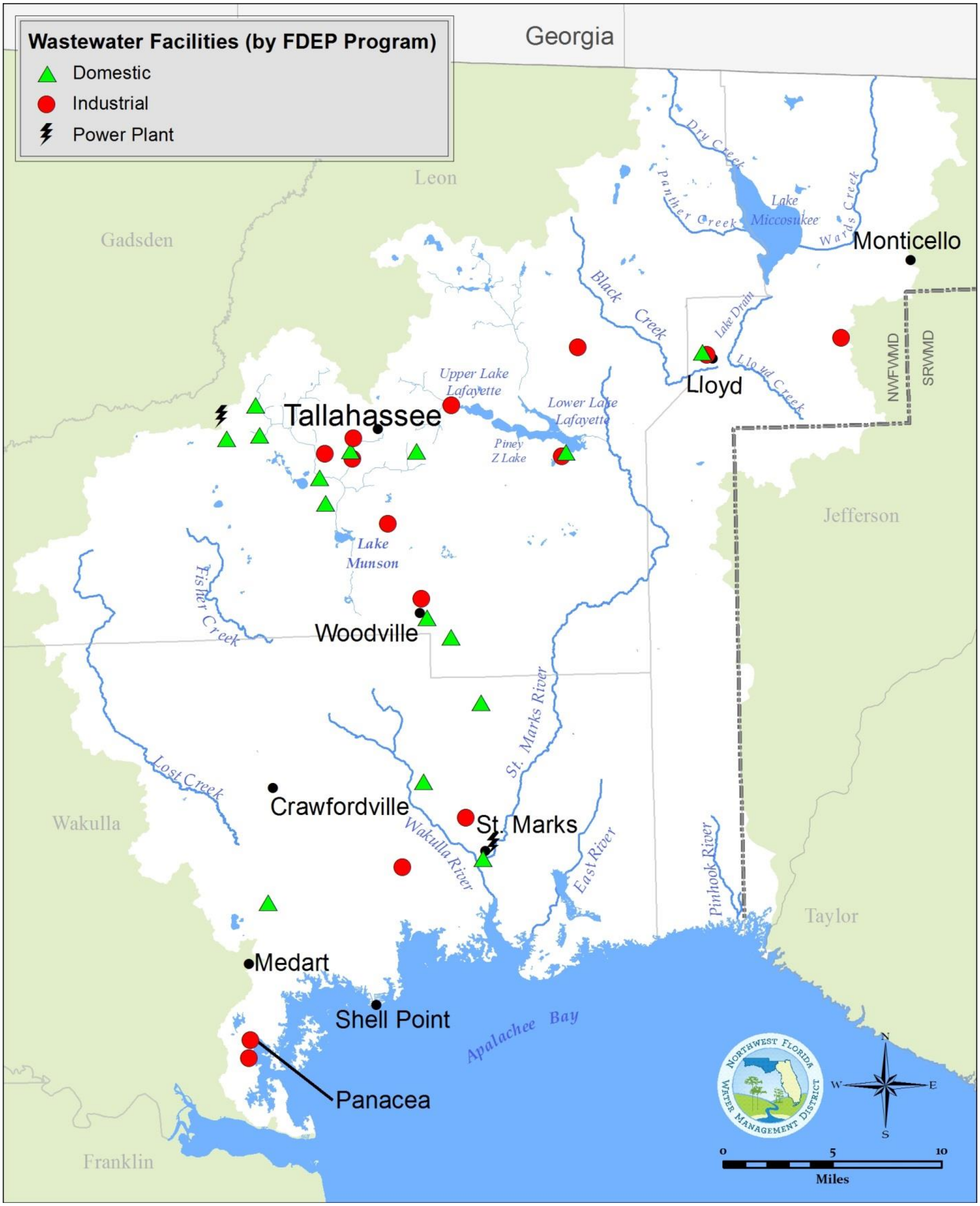
Wastewater Treatment Facilities

Wastewater treatment facilities (WWTF), particularly those near streams, rivers, and the coast, as well as those constructed on highly permeable soil and karst geology, are potential sources of point source pollution. Wastewater discharges can introduce nutrients, bacteria, and other pollutants to surface and groundwaters. There are 14 permitted domestic wastewater facilities and 14 industrial wastewater facilities active within the watershed, as well as two power plants. However, Tallahassee's Arvah B. Hopkins Generating Station is located on the western watershed divide and discharges to the Ochlockonee River watershed. Most domestic wastewater facilities are located in densely populated areas, or serve housing subdivisions or schools, with the highest concentration of facilities located in Leon County near Tallahassee. Other facilities are located in Woodville, St. Marks, and Panacea. Among the industrial facilities are several concrete batch plants and a concentrated animal feeding operation in Jefferson County.

The City of Tallahassee's wastewater treatment system is comprised of the TPS, the Lake Bradford Road WWTF, the Southeast Farm and the Tram Road Reuse Facility (TRRF) (City of Tallahassee 2016). The TPS has by far the largest permitted capacity of any domestic system in the watershed at 26.5 mgd, while all other facilities are below 0.5 mgd. Treated effluent from TPS is discharged at the Southwest sprayfield at the TPS facility and at the Southeast Farm sprayfields eight miles east of the TPS facility for agricultural reuse. Additionally, the TRRF supplies a limited amount of public access reclaimed water for irrigation in the southeast portion of the city (City of Tallahassee 2015, 2016).

In 2006, the City of Tallahassee committed to sizeable capital investment in Advanced Wastewater Treatment (AWT) improvements at its TPS treatment facility. The first phase of upgrades included a new headworks facility, pump station, multiple storage and feed facilities. Deep bed denitrifying filters were placed into service in August 2011. Updates to biological nutrient removal basins continued through 2015 (Hazen and Sawyer 2013). In 2015, the TPS treated approximately 19.2 mgd of raw sewage (FDEP 2015d). As a result of the new denitrifying filters coming online, nitrogen concentrations have been below 2 milligrams per liter since October 2012 (Hazen and Sawyer 2013; NWFWMD 2013).

Treatment flows for the next largest facilities in the watershed in 2015 were Winco Utilities, Inc., 0.39 mgd; Meadows - At - Woodrun WWTF, 0.08 mgd; the City of St. Marks WWTF, 0.04 mgd; and Sandstone Ranch WWTF, 0.03 mgd (FDEP 2015d). The City of St. Marks' sewage treatment plant sends treated wastewater to Tallahassee's Purdom Power Plant for industrial reuse. The Purdom plant uses zero-discharge technology.



Sources: FDEP 2015e; NOAA 2015a; USGS 2015, 2016a, 2016b.

Figure 3-3 Permitted Wastewater Facilities within the St. Marks River and Apalachee Bay Watershed

Landfills and Solid Waste Disposal Facilities

Landfills and solid waste disposal facilities are a potential source of contamination to surface and groundwaters through the percolation of rainwater into waste materials and the leaching of soluble toxins. In the St. Marks River and Apalachee Bay watershed, there are a total of 80 landfills and solid waste disposal facilities recognized by the FDEP, including landfills, yard waste disposal facilities, and construction and debris disposal landfills (Table 3-1). Many of these facilities are closed or inactive, but may still pose a threat to water quality through the leaching of capped waste, if not managed properly. A 2012 study at the Leon County Solid Waste Management Facility in Tallahassee identified eucalyptus and cottonwood as potential evapotranspiration tree covers to replace conventional covers and control percolation into landfill waste. Surface runoff was very small (one percent of precipitation) for both evapotranspiration tree covers, but was much higher for the conventional cover (13 percent of precipitation). The percolation rates after the tree establishment period was lower for eucalyptus and cottonwood than in the conventional cover. Replacing conventional covers with evapotranspiration tree covers may offer an effective means of protecting groundwater from contamination by landfill leachates (Abichou *et al.* 2012).

Table 3-2 Florida Solid Waste Facilities in the St. Marks River and Apalachee Bay Watershed

Type of Landfill/Solid Waste Facility	Number of Facilities
Active Sites	10
Not Permitted/Registered	5
Inactive (Registered and Non-Registered)	16
No-Further Action Facilities	2
Closed Facilities	45
Registered (No Further Information)	2

Source: FDEP 2016a.

Most landfills and solid waste disposal facilities are located in the upper reaches of the watershed in close proximity to the major developed areas within and surrounding Tallahassee and Crawfordville (Table 3-1). The Leon County Sanitary Landfill is located next to Lower Lake Lafayette. This landfill was identified as a possible source for impairment of this portion of the lake (FDEP 2003). A comprehensive list of the solid waste facilities, their location, and status is maintained by the Solid Waste Section of the FDEP (FDEP 2016c).

Mines and Borrow Pits

Mining and extraction activities near waterbodies can cause turbidity, sedimentation, and smothering, if not managed appropriately. Mining activities within the watershed are somewhat limited, with a number of small sand and clay mines sparsely distributed across southern Leon and northern Wakulla counties. Two small limestone mines can be found in southern Wakulla County (FDEP 2014e). The USGS recognizes the Sadberry Mine operated by the Roberts Sand Company, Inc., as the only major mining operations within the St. Marks River and Apalachee Bay watershed.

Additionally, 19 small-scale mines and borrow pits within the watershed have been identified by the FDEP, many of which are located near streams, creeks, tributaries, and other waterbodies (FDEP 2014e, 2015b). Sand mines smaller than 20 acres are exempt from noticing to the FDEP under Chapter 378.804, F.S., and are, therefore, not held to the same reclamation standards as larger mines.

Industrial Facilities and Superfund Sites

Degradation of water and/or sediment by toxic chemicals can impact surface water quality and the health of associated upland and aquatic habitats and generate contaminated food chains in which top predators are most significantly harmed. Chemical contaminants can also be harmful to humans, particularly through consumption of seafood containing elevated quantities of mercury, polychlorinated biphenyls, dioxin and other harmful chemicals. Public health agencies monitor concentration levels of undesirable chemicals that occur in public natural resource land and recreational waters (EPA 2015b, 2015c).

In Florida’s portion of the St. Marks River and Apalachee Bay watershed, there are 14 hazardous waste facilities registered as EPA Biennial Reporter facilities, 13 of which are in Tallahassee, while one (St. Marks Powder, Inc.) is in the City of St. Marks. EPA Biennial Reporter facilities handle hazardous waste and are required to report to the EPA Administrator at least once every two years (EPA 2016c).

Additionally, 355 closed, two abandoned, and 233 active petroleum contamination tracking sites within the watershed are registered with the Storage Tank and Petroleum Contamination Monitoring (STCM) database. There are 23 contaminated dry cleaning sites eligible for the state-funded Dry-cleaning Solvent Cleanup Program within the basin. Most STCM and dry-cleaning sites are located in historically developed areas in the northern portion of the watershed in Tallahassee and Monticello, with additional sites in Crawfordville and St. Marks.

There are currently no EPA National Priority List (NPL) Superfund sites within the St. Marks River and Apalachee Bay watershed. However, eight non-NPL Superfund sites are located within the basin:

- 2858 Mahan Drive Mercury Spill, Tallahassee;
- Cascade Landfill, Tallahassee;
- Davis Refining Corporation, Tallahassee;
- Gulf States Chemical Company, Lloyd;
- Mar Ked, Inc., Tallahassee;
- Mitchell Brothers, Inc., Tallahassee;
- St Marks Terminal, St. Marks; and
- St. Marks Powder, Inc., St. Marks.

A non-NPL site is a Superfund site that has not been placed on the NPL list through the EPA's formal process for assessing hazardous waste sites; however, the EPA can take short-term cleanup actions on non-NPL sites under the emergency removal program. The Cascade Park Gasification Plant/Landfill was not placed on the NPL, but the EPA considers it an NPL-caliber site. The Cascade Park Gasification Plant/Landfill site includes an area where a manufactured gas plant operated from 1895 until the 1950s. The site also includes Centennial Field, a former landfill and former athletic field. The City of Tallahassee and the state of Florida placed a cap over the landfill and removed more than 98,000 tons of contaminated material from the former gas plant. In 2008, the EPA awarded the site Region 4's "Excellence in Site Reuse" award, an honor given to those who go above and beyond in their Superfund site redevelopment efforts. In April 2010, the city began building the 26-acre Cascade Park and stormwater management facility which includes trails, playgrounds, a 16-foot waterfall, interactive fountains, a war memorial, and a state-of-the-art amphitheater for concerts and community events (EPA 2016d).

The defunct St. Marks Refinery on the bank of the St. Marks River in the City of St. Marks is a 55-acre site with significant environmental contamination from decades of asphalt and petroleum production. Contaminants found in sampling include dioxin, oils and grease, organics, and pentachlorophenol (PCP) (FDEP 2003). Dioxin has been found in the soil, groundwater, and sediment (FDEP 2003). In 2009, the City of St. Marks received an Environmental Protection Agency Brownfields Assessment grant to determine the extent of contamination at the former refinery, which positioned the city to receive an EPA cleanup grant in 2013. In 2014, the City of St. Marks received a Brownfields Revolving Loan Fund sub-grant from the Tallahassee Brownfields Coalition to continue cleanup, construction, and renovation on the former refinery (City of Tallahassee 2014).

In 2010, 16.86 mgd of wastewater were treated at the larger domestic WWTFs within the watershed. While the full amount was reused, less than one percent was used in place of potable water for outdoor irrigation or other uses. Facilities within the watershed are projected to increase their reusable reclaimed wastewater to 19.98 mgd by 2035 (NWFWMD 2013).

Wastewater reclamation that supports beneficial reuse has the potential to further decrease pollution in surface waters, while also limiting or reducing potable water demand. In Tallahassee, reclaimed water has been used to irrigate landscaping and recreational facilities in the Southwood area. Wakulla County is seeking funding for a reuse system for the county WWTF, located outside the watershed, to transmit reclaimed water for golf course irrigation at the Wildwood Resort Golf Course located within the watershed. A portion of funding for this project has already been secured, and the District has pledged to support the county in seeking this funding (NWFWMD 2013). For facilities that already have reuse programs, finding additional recipient sites could reduce the demand for potable water. Potential recipient sites include irrigated public areas such as recreational fields and landscaped areas of public facilities, roadway medians, greenway trails, and irrigated agricultural fields, as well as golf courses and cooling towers. Due to the ready interchange of surface and groundwater in this karst region, the nutrient levels in reclaimed water must be taken into consideration when considering land-based applications.

Marinas

Due to the location of marinas at the water's edge, there is a strong potential for marina waters to become contaminated with pollutants generated from the various activities that occur at marinas—such as boat cleaning, fueling operations, and marine head (sanitary sewage) discharge—or from the entry of stormwater runoff from parking lots and hull maintenance and repair areas into marina basins. Although some of these would be considered NPS pollution, many of them are point sources (e.g., hull painting, engine maintenance, etc.). Such facilities have the potential to release pollutants, including vessel wastewater, oil and grease, heavy metals, and other pollutants. Actual pollution from marinas can depend on the availability of pump-out facilities and the level and consistency of marina BMP implementation (FDEP 2015f, 2016e).

There are only a few marinas located in the watershed, which include several small, local marinas and access points located on the bay at Shell Point, Panacea, and in the City of St. Marks. There are currently no Clean Marina designations and only limited septic pump-out facilities in the watershed (FDEP 2015g). Water quality will likely continue to improve if the marinas implement BMPs and become certified under the Florida Clean Marina Program.

3.2.4 Nonpoint Source (NPS) Pollution

Nonpoint source pollution is generated when stormwater runoff collects pollutants from across the landscape (lawns, pavement, highways, dirt roads, buildings, farms, forestry operations, and construction sites, etc.) and carries them into receiving waters. Pollutants entering the water in this way include nutrients, microbial pathogens, sediment, petroleum products, toxic metals, pesticides, and other contaminants. Pollutants entering the groundwater may also emerge in surface waters via seepage and spring discharges. Typical categories of NPS pollution include surface runoff of stormwater, leaching from agricultural areas, in urban lands through OSTDS (e.g., septic tanks), as well as erosion and sedimentation from un-vegetated lands including construction sites and unpaved roads. Atmospheric deposition of nitrogen, sulfur, mercury, and other toxic substances via fossil fuel combustion may also contribute to NPS pollution.

In addition to causing current water quality challenges, NPS pollution is likely to be one of the most significant threats to future environmental quality in the St. Marks River and Apalachee Bay watershed. Increases in population and land use changes from rural to urban or suburban, especially in areas located near waterbodies, has the potential to increase stormwater runoff and associated pollutants into the St. Marks River, associated tributaries, and many of the watershed's upland lakes. The runoff and associated NPS pollution can then be recharged to the groundwater through karst features and generally unconfined conditions. Affected groundwater may later reemerge as surface water through numerous springs.

Basins dominated by upland forest, wetland-cover, and low densities of impervious surface tend to be associated with good water and habitat quality (Allan *et al*. 1997; Wang *et al*. 1997). Vegetation provides habitat, regulates runoff, maintains surface and surficial groundwater flow, prevents erosion, and moderates effects of floods and droughts. Wetland functions include floodwater storage, sediment and shoreline stabilization, and fish and wildlife habitat. Riparian and in-stream vegetation contribute to nutrient cycling and primary production, which may remove nutrient pollutants transported by stormwater, such as nitrogen and phosphorus, from surface waterbodies. Urban areas typically have less vegetation and wetland areas that moderate flows and provide recharge, storage and treatment for runoff. Additionally, vegetated areas within urban zones tend to be heavily managed landscaped tracts where the use of fertilizers, pesticides, and herbicides pose additional concerns for NPS pollution and water quality (EPA 1993).

Urbanization and Stormwater

Stormwater is the main contributor to NPS pollution and is closely associated with land use. Urban land use, especially medium- to high-density residential, commercial, and industrial uses have the highest NPS pollution per acre due to increased impervious surface area that increases runoff and generates stormwater (EPA 2016e). In urban areas, lawns, roadways, buildings, commercial and institutional properties all contribute to NPS pollution (EPA 2016e). Potential pollutants associated with stormwater include solids, oxygen-demanding substances, nutrients such as nitrogen and phosphorus, pathogens, petroleum hydrocarbons, metals, and synthetic organics (EPA 2016e). Urbanization causes the most severe environmental impacts associated with NPS pollution, including degraded water and sediment quality and physical degradation of benthic and littoral communities (Booth and Jackson 1997; Ferguson and Suckling 1990).

Intensive land use in the St. Marks River and Apalachee Bay watershed is concentrated around the Tallahassee metropolitan area, with additional development occurring around Crawfordville, Monticello, St. Marks, and unincorporated communities, particularly in the northern reaches of the basin. A comparison of land cover images generated by FWC for 1985–1989 and 2003 indicates that the Apalachee Region has lost more than six percent of natural lands to urban development and conversion to agriculture, with the majority of urban development occurring in Leon and Wakulla counties (Endries *et al.* 2009).

In the St. Marks River and Apalachee Bay watershed, five municipalities currently hold MS4 (NPDES Stormwater) permits for stormwater conveyance (not combined with sewer) that discharges to waters of the state; including Leon County, Florida State University, Florida Agricultural and Mechanical University, the Federal Correctional Institution, and the City of Tallahassee. Very few developed areas generating stormwater runoff are in close proximity to Apalachee Bay. However, many tributaries and rivers that feed the bay are vulnerable to NPS pollution associated with stormwater.

Stormwater runoff carries pollutants from the Tallahassee urban area into the spring contribution area through Munson Slough, Ames Sink, and other karst features. Karst features can rapidly transport surface pollutants into and through groundwater (Chanton 2008). The extensive systems of underground conduits are probably important pathways for the potential transport of contaminants (Kinkaid 2003).

Lakes Munson receives urban stormwater runoff from Tallahassee and is, therefore, among the most problematic areas affected by NPS pollution. Lake Munson, including Munson Slough, has historically experienced nutrient enrichment, low DO, algal blooms, high bacteria counts, and degraded sediment conditions (Bartel and Ard 1992). Water quality in the lake has reportedly improved since sewage discharge was discontinued and restoration efforts were initiated (Bartel and Ard 1992; FDEP 2003; McGlynn 2006).

Upper and Lower Lakes Lafayette and Piney Z Lake are affected by intensive NPS pollution, manifested as nutrient enrichment, low DO, and bacterial contamination (FDEP 2003). Lake Piney Z underwent high-density residential development in the early 2000s with the creation of the 369-acre Piney Z Plantation. Alford Arm, one of the four branches of Lake Lafayette, receives stormwater runoff from Lake McBride and adjacent residential communities (McGlynn 2006). Approximately 108 million gallons of urban stormwater flow into Upper Lake Lafayette during a typical rainfall event in Tallahassee. Stormwater source areas for the Lake Lafayette basin include the highly urbanized 15,000-acre watershed comprising central Tallahassee; a 255-acre City of Tallahassee park and sports complex; the 194-acre Federal Correctional Institute; and the Piney Z Plantation (McGlynn 2006).

By 2009, the City and County jointly spent about $183,775,877 on completed or ongoing stormwater improvements in the Lake Lafayette and Lake Munson sub-basins that drain to the St. Marks River and Apalachee Bay (NWFWMD 2009). Buck Lake Road and Killearn Acres have also undergone recent improvements, including drainage and stormwater upgrades (Leon County 2010, 2011a). In Leon and Jefferson counties, Lake Miccosukee receives rural surface water runoff from largely agricultural lands, and has problems with excess nutrients, low DO, and high bacteria counts (FDEP 2003). Substantial stormwater retrofit challenges remain, particularly in the unincorporated areas of the watershed as stormwater discharges will continue to increase with population growth and urbanization.

Additionally, hardened, outdated stormwater infrastructure moves petroleum products, toxic metals, and other stormwater contaminants directly from roads and impervious surfaces and transports them straight into surface waters with little to no treatment. Vegetated buffers and softer stormwater management techniques are needed to slow and treat stormwater. Reducing stormwater discharge velocities through green infrastructure facilitates bioremediation and biological uptake/storage of pollutants. Urbanization leads to the channeling of surface water, increased erosion, and habitat loss. Resulting hydrologic effects include increased peak discharge volume and velocity, decreased time for runoff to reach receiving waters, increased frequency and severity of flooding, a lowered water table, and reduced dry weather stream flow (EPA 1993). Lowering of the water table in urban streams causes disconnection between the stream channel and adjacent riparian vegetation and floodplains. This ultimately leads to reduced hydrologic function and reduced ecosystem services such as denitrification and flood control (Walsh *et al*. 2005).

While existing urban areas contribute significantly to NPS pollution, the expansive urban-rural fringe, which hosts new development and construction sites, introduces new NPS, and expands the extent of impervious surfaces in the watershed. BMPs, green infrastructure, and the best available science must be utilized in the planning and construction of new facilities to maintain the hydrologic integrity of the St. Marks River and Apalachee Bay watershed.

Silviculture and Agriculture

In northwest Florida, all forest products and services have been valued at approximately $1.21 billion (FDACS 2014). These forests also support recreational opportunities for residents and millions of visitors to the state, bolstering the tourism and ecotourism industries. Managed forests also provide important environmental services such as biodiversity, hydrologic function, and mitigation of global climate change by sequestering 5.8 million tons of atmospheric carbon per year statewide (FDACS 2014; Hodges *et al.* 2015).

Silviculture and related industries have been major economic drivers in the St. Marks River and Apalachee Bay watershed for many centuries. Woodland resources consist of large private plantations, small privately owned tracts, and large corporate ownerships. Northeastern Leon County has historically hosted expansive private plantations, many of which ranged from 5,000 to 25,000 acres. Southeastern Leon County has historically hosted extensive pulpwood production operations of farmed slash pine (USDA 1979). Today, Leon County's economy relies less on silviculture; however, lumber and wood products are still one of the county's top five exports (Florida Department of Transportation [FDOT] 2013a). Although agriculture and silviculture were not identified as Jefferson County's top growing industries, lumber and wood products are the county's number one top export, at nearly 106,000 tons of lumber exported annually (FDOT 2013b). Similarly, Wakulla County exports approximately 52,000 tons of lumber annually, and the "Agriculture, Forestry, Fishing, and Hunting" industry category was identified as one of the county's top five growing industries in 2013 (FDOT 2013c).

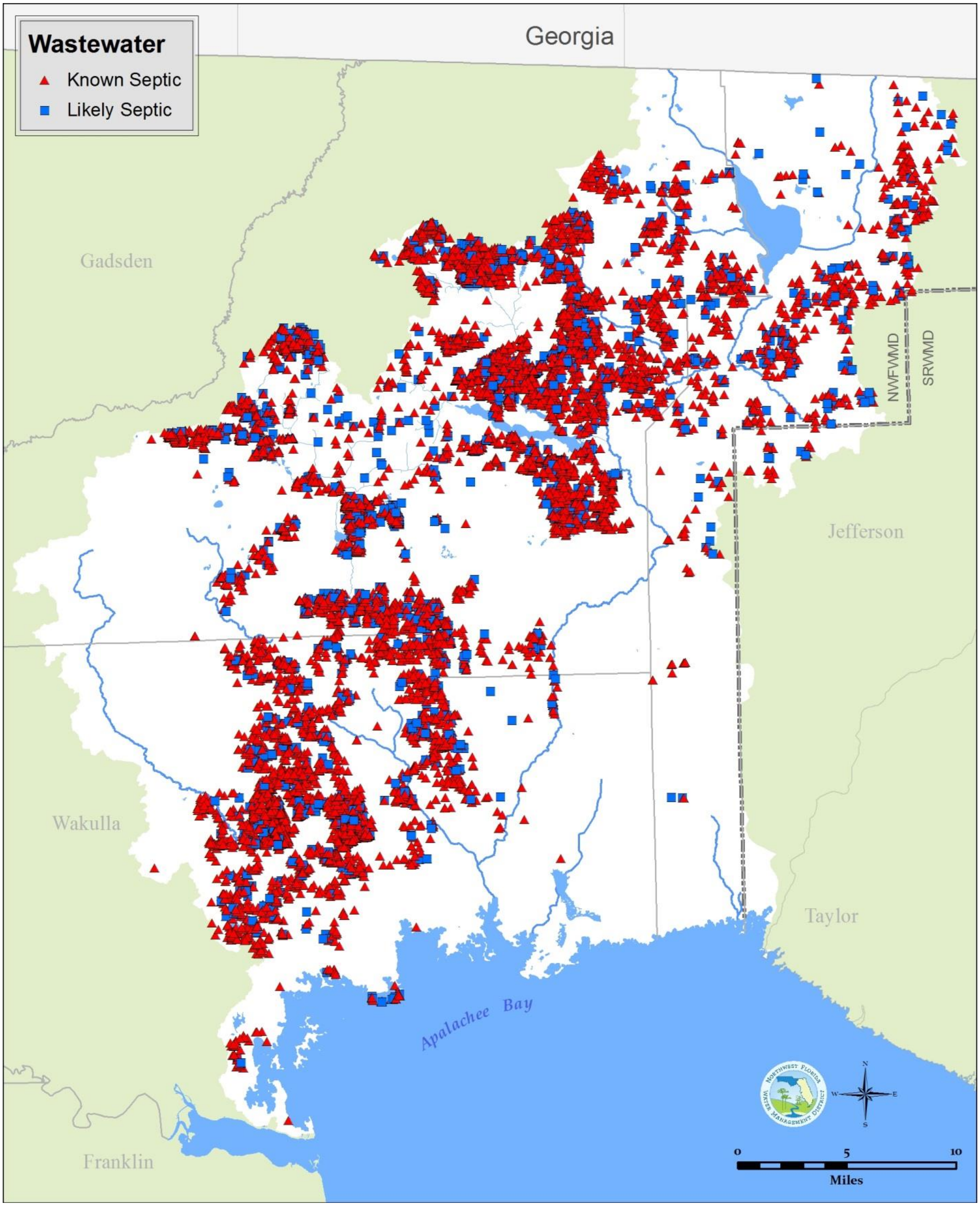
Additionally, the ARPC reports that there are approximately 13 major crops, not including silviculture, grown to produce income across the Apalachee region which encompasses the St. Marks River and Apalachee Bay watershed (ARPC 2015). Agricultural commodities include ornamentals, hay, sod, peanuts, grapes and some vegetables. Agricultural water use in Region VII was estimated at 1.98 mgd in 2010 (NWFWMD 2013).

Silvicultural practices such as ditching, landscape alteration, road construction, fertilizer application, and harvesting can result in effects such as habitat fragmentation, stream channelization, erosion, sedimentation, nutrient enrichment, discharge of untreated runoff, as well as effects on water temperature, DO, and pH (Stanhope *et al.* 2008). Where appropriate, BMPs such as those developed and coordinated by FDACS, are employed; however, silviculture has been found to be consistent with the maintenance of excellent water quality (FDEP 1997; NWFWMD 1998). Silvicultural BMPs establish Special Management Zones (SMZs), which consist of specific areas associated with waterbodies within which certain activities are limited. Implementation of SMZs and other BMPs protect water quality by reducing discharges of sediments, nutrients, logging debris, and chemicals, as well as by reducing water temperature fluctuations and riparian habitat disturbance. Agricultural BMPs have also been developed for row crops, container plants, and cow/calf, and dairies (FDACS 1993, 2016).

Onsite Sewage Treatment and Disposal Systems (OSTDS)

Onsite sewage treatment and disposal systems are potential widespread sources of nutrients and other pollutants. Significant concentrations of OSTDS can result in degraded water quality in groundwater and proximate surface waters. A well-designed and maintained septic system is effective for containing pathogens, surfactants, metals, and phosphorus. However, greater mobility of nitrogen in soils prevents complete treatment and removal of nitrogen. Dissolved nitrogen is frequently exported from drainfields through the groundwater (NRC 2000). Additionally, OSTDS in areas with high water tables or soil limitations may not effectively treat other pollutants, including microbial pathogens. These pollutants can enter surface waters as seepage into drainage ditches, streams, lakes, and estuaries (EPA 2015d; NRC 2000).

According to 2012 FDOH permitting data, there are at least 14,685 new or existing septic tanks in the St. Marks River and Apalachee Bay watershed; however, at least 771 permits have been issued to abandon septic tanks, presumably due to connection to a centralized sewer collection system. Figure 3-4 shows the likely locations of septic tanks as of 2015.

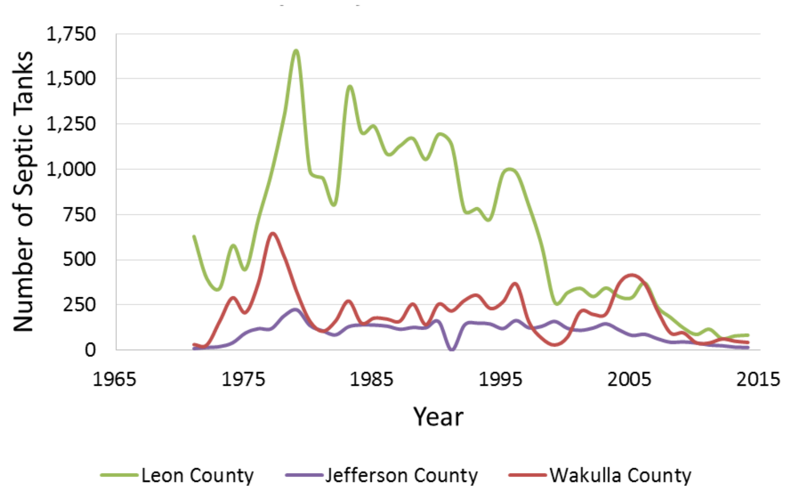


Sources: FDOH 2015a; NOAA 2015a; USGS 2015, 2016a, 2015b.

Figure 3-4 Septic Tank Locations in the St. Marks River and Apalachee Bay Watershed

In the St. Marks River and Apalachee Bay watershed, most rural and unincorporated communities, and a number of suburban communities and subdivisions near Tallahassee rely on OSTDS systems for wastewater treatment. Affected areas extend from the northern reaches of the watershed, south through Wakulla County to communities on the St. Marks River. When a karst aquifer is close to the surface, there is limited ability for soils to attenuate nitrate from septic systems (Harden *et al.* 2008). Performance Based Treatment Systems (PBTS) can be utilized over conventional systems or aerobic treatment units when higher treatment levels are required.

A 2010 study found that the average nitrogen concentration effluent discharged from household PBTS, in Wakulla County, was 30 milligrams of nitrogen per liter (mg-N/L) (Harden *et al.* 2010). Taking N-attenuation into account, a conventional septic tank and a PBTS have nitrogen inputs to the aquifer of approximately 45 and 20 mg-N/L, respectively. Although PBTS performed better than conventional septic systems, the study also found that 39 percent of systems examined were not functioning properly (Harden *et al.* 2010). Recent (2015) studies conducted by the FDOH focused on the development of passive nitrogen reduction technologies using a two-stage biofiltration process. Prototype tests for this technology resulted in reduced total nitrogen influent values by 90 to 95 percent prior to effluent dispersal at into the soil or landscape (FDOH 2015b). Consequently, septic systems in the St. Marks River and Apalachee Bay watershed are a significant source of nitrogen to groundwater, which is innately linked to surface water in this dynamic karst system (Harden *et al.* 2010).



Source: FDOH 2015c.

Figure 3-5 New Septic System Installations by Year

Across the watershed, new septic installations have declined significantly since their peak use in the late 1970s. By the mid-1990s, Leon County began to see a decline in new septic installations, while Jefferson County septic installations have declined gradually over the past 20 years (FDOH 2015c). Wakulla County saw a peak of new septic installations in 2005 (Figure 3-5). However, the County also added 8,200 linear feet of sewer lines in the same year, as well as 5,700 linear feet of sewer in 2004 (FDOH 2015; Wakulla County 2005).

A Leon County ordinance, passed in 2010, requires new development and redevelopment within the Primary Springs Protection Zone, which is located predominantly south of Tram and Orange roads in Tallahassee, to use performance-based septic systems (Leon County Ordinance No. 09-12). Additionally, systems that fail and need to be repaired are required to upgrade to a performance-based system, unless the property owner qualifies for an exemption (Leon County 2016a). Wakulla County currently has a policy that requires performance-based treatment systems for parcels less than five acres within the Wakulla Spring Planning Area (which extends from the county line south to the Wakulla Springs State Park, beginning just west of Bloxham Cutoff to just east of Woodville Highway), within 150 feet of karst features, within 300 feet of a first or second magnitude spring, or on parcels less than 0.229 acres (Howard T. Odum Florida Springs Institute 2014).

Erosion and Sedimentation

Erosion and sedimentation are natural phenomena that can be significantly accelerated by human activities, with resulting undesirable water quality consequences. Natural factors such as highly-erodible soils, steep unstable slopes, and high rainfall intensities, are important factors in erosion and sedimentation (Reckendorf 1995). However, natural erosion is typically a slow process. Human-induced erosion, however, can cause rapid increases in sediment inputs to surface waters resulting in major increases in sediment flux. Construction activities, unpaved roads, abandoned clay pits, and agricultural and silvicultural practices lacking proper BMPs are common sources of sedimentation. Accelerated stream bank erosion, caused by increased runoff associated with impervious surfaces, can also be a significant and increasing source of sedimentation into receiving waters.

The NRCS has calculated approximate rates of erosion for various land use types in the region including cropland (8.3 tons/acre/year), pasture/hayland (0.5 tons/acre/year), and forest land (0.8 tons/acre/year). The NRCS recognizes gullies and cropland as the largest erosion sources, followed by dirt roads, forest land, other uses, pasture, and streambanks (USDA and U.S. Forest Service 1993).

Adverse impacts associated with sedimentation include smothering of SAV and other benthic habitats, degraded shellfish beds and tidal flats, fill in riffle pools, and increased levels of turbidity and nutrients in the water column. Additionally, increased sediment accumulation in surface waters changes the hydrology and holding capacity of waterbodies by reducing channel depth and accommodation space and altering channel morphology, which exacerbates flooding issues. Sediment accumulation in channels and waterways also impedes navigation and increases the need for costly dredging activities (Reckendorf 1995).

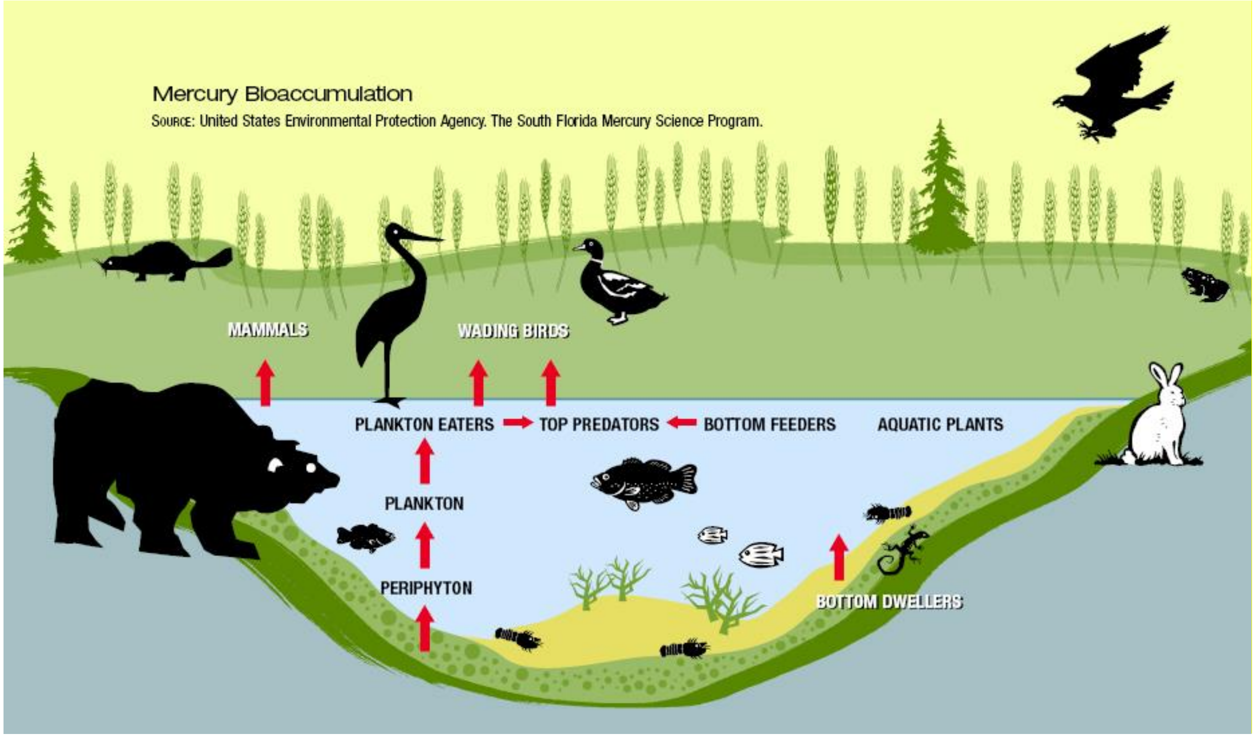
Sedimentation is also an ongoing water quality problem for the watershed's lakes, particularly those located in close proximity to urban development. Sediment and debris deposited by stormwater have been mechanically removed from Lake Munson and Lake Miccosukee to improve open water habitats within the lakes (McGlynn 2003). Although the removal of sediments from lakes and ponds is a well-established management practice, a study of five Leon County lakes and ponds found that on average, mechanical excavation of sediment also removed an average of 177 reptiles and amphibians per site. Researchers collected a total of 883 individuals of 31 species from the five lakes during sediment removal, suggesting that mortality from such excavations could be detrimental to local reptile and amphibian populations (Aresco and Gunzburger 2004). Preventing sedimentation to ensure that mechanical excavation is not necessary provides a financially and ecologically sound alternative.

Atmospheric Deposition

While many impacts to water quality result from direct input to surface waters, either as point or NPS, some pollutants such as nitrogen and mercury can enter surface waters through atmospheric deposition.

Florida is particularly susceptible to mercury contamination of fish, due in part to the state's latitude, geographical setting, and meteorology, which allows a high rate of mercury deposition from the atmosphere onto its lands and surface waters. Additionally, biochemical conditions in Florida waterbodies and sediment are conducive to the conversion of mercury from atmospheric deposition, to the more toxic and bio-accumulative methyl-mercury form (EPA 1997).

Methyl-mercury is a toxic mercury compound that biomagnifies (Figure 3-5) as it moves up the aquatic food chain (EPA 1997). While agricultural, urban, and residential stormwater NPS are all potential sources of contaminants, atmospheric deposition due to fossil fuel combustion is the most significant source of mercury. Eighteen segments were removed from the impaired list for mercury in fish in 2014 due to the adoption of TMDLs for mercury (FDEP 2014d). To protect human health, fish consumption should be limited from segments with mercury TMDLs, as directed by the FDOH.



Source: Adapted from EPA South Florida Science Program by Ecology and Environment, Inc.

Figure 3-6 Bioaccumulation of Methyl-Mercury

Although nitrogen is necessary for the function of all ecosystems, in excess, it is also a nutrient pollutant that can cause damage to aquatic systems by inducing eutrophication as described in the next subsection below. Nitrogen inputs from industry, sewage, and wastewater treatment discharges, and agriculture are most likely the primary point source discharges of nutrients to waterways in the St. Marks River and Apalachee Bay watershed. However, atmospheric deposition of nitrogen from fossil fuel combustion may also be a source within the watershed. Most oxidized-nitrogen emissions are deposited close to the emission source and can especially impact surface water in urban areas within the watershed (Howarth *et al.* 2002a, 2002b, 2002c; NRC 2000).

3.2.5 Ecological Indicators of Water Quality

Eutrophication

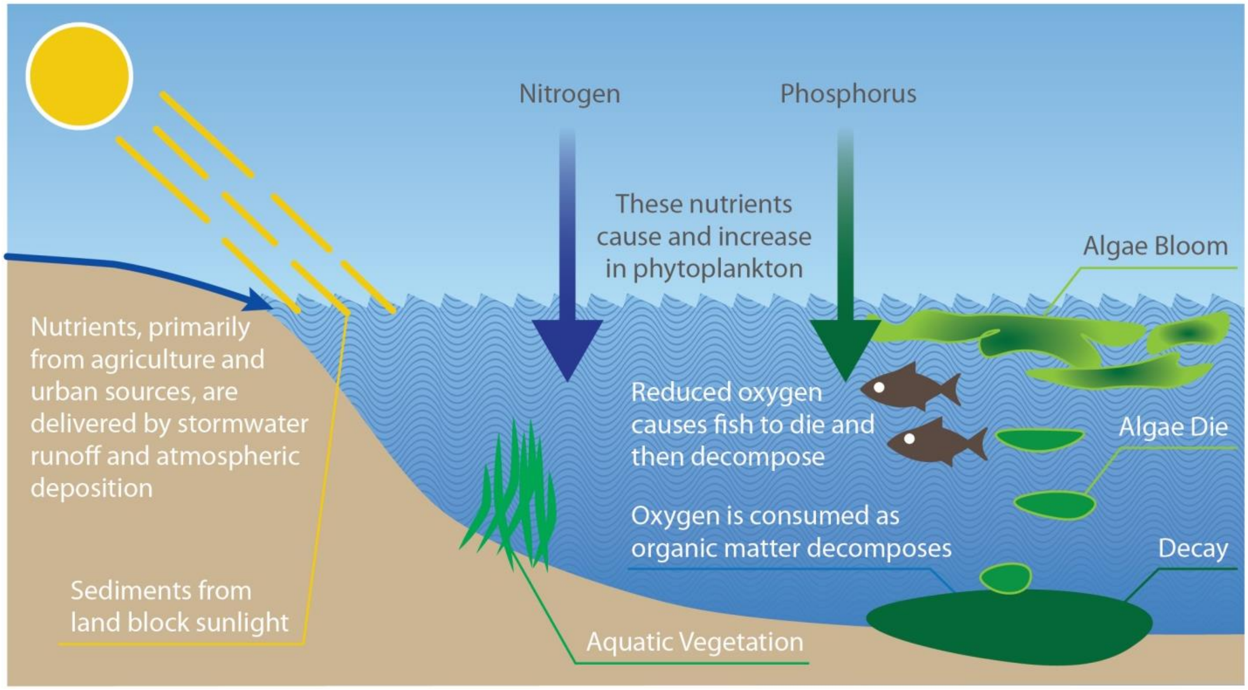
Eutrophication is defined as an increase in the rate of supply of organic matter to an ecosystem, characterized by excessive plant and algal growth due to the increased availability of one or more limiting growth factors needed for photosynthesis (Nixon 1995; Schindler 2006). Both point and NPS pollution have accelerated the rate and extent of eutrophication through increased loadings of limiting nutrients, such as nitrogen and phosphorus, into aquatic ecosystems

(Chislock *et al.* 2013). Nutrient loading over-stimulates the production of planktonic algae (floating), epiphytic algae (those attached to surfaces), and macrophytes (large plants) and leads to dense nuisance and toxic blooms.

Eutrophication is associated with major changes in aquatic community structure as a result of changes in ratios of key plant nutrients (e.g., nitrogen and phosphorus). These changes result in food webs that are less efficient in supporting key fisheries and favor algal blooms including those toxic to fish, marine mammals, birds, and people. Algal blooms can lead to low DO levels, loss of beneficial SAV, fish kills, and habitat degradation. These symptoms of eutrophication impact public health and the use of coastal ecosystems for recreation, tourism, and commercially important fisheries (Bricker *et al.* 1999). The estimated cost of damage caused by eutrophication in the U.S. alone is approximately $2.2 billion annually (Dodds *et al.* 2009). Figure 3-6 illustrates how the eutrophication process can occur.

In freshwater systems, excessive aquatic vegetation can be a problem, particularly in closed basins. Lakes in the St. Marks River and Apalachee Bay watershed are at risk for eutrophication due to their limited circulation and proximity to development. Eutrophication has been documented in several waterbodies across St. Marks River and Apalachee Bay, primarily in the densely populated Leon County. Of 13 waterbodies assessed in 2010, four exhibited yearly average phosphate levels that indicated eutrophic conditions, while two indicated hypereutrophic conditions. Eight of these waterbodies also exhibited average annual nitrogen total levels indicating eutrophic conditions (Leon County 2011b).

Chlorophyll-*a* measurements can provide a useful estimate of algal biomass and its spatial and temporal variability, which can provide guidance for decision making in the context of environmental management. At the St. Marks NWR, coliform and chlorophyll-*a* showed correlations with temperature, DO, turbidity, and pH, in coastal marshes, and may be a reliable means for assessing water quality (Hendrix 2012).



Source: Graphic by Ecology & Environment, Inc.

Figure 3-7 Eutrophication Process

Nitrate levels observed in Wakulla Spring, responsible for eutrophication and proliferation of nuisance vegetation, tripled from the 1970s through the 1990s (Chelette *et al.* 2002). This increase was largely attributable to nitrogen inputs south of the Cody Scarp. Nitrogen pollution in both the Wakulla River and Wakulla Spring has occurred predominantly in the form of nitrate and organic nitrogen. When compared to water samples from the late 1970s, data for the period of 2000 through 2007 indicate that concentrations of both nitrogen compounds increased (FDEP 2012). Nitrogen sources include atmospheric deposition, WWTFs, OSTDS or septic systems, livestock, commercial fertilizer, and sinking streams (Chelette *et al*. 2002).

The FDEP adopted a basin management action plan (BMAP) in October 2015 to address nitrate loading in the Wakulla Springs basin and upper Wakulla River, with the goal of reducing nitrate levels to 0.35 mg/L. Nitrate concentrations at Wakulla Spring have decreased significantly during the last decade due to considerable investments by local governments, state agencies, and the Florida Legislature to improve water quality (Figure 3-8). Ongoing and future springs restoration projects are anticipated to result in further decreases in nitrate levels.

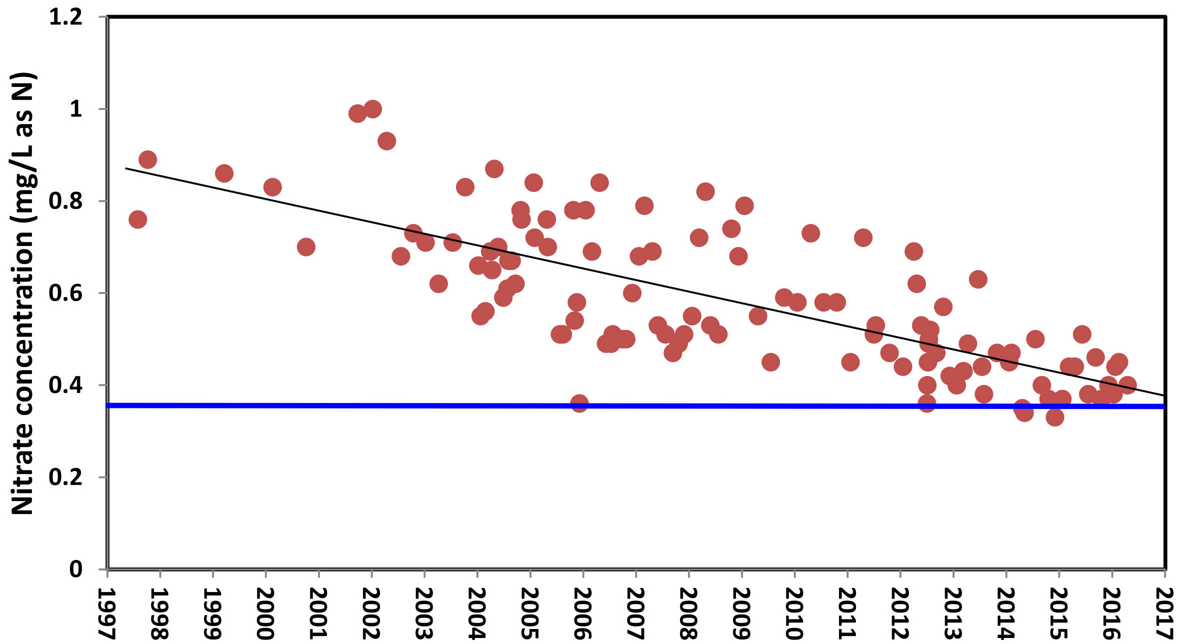


Figure 3-8 Nitrate Concentrations at Wakulla Spring: 1997 – 2016.

Harmful Algal Blooms (HABs) and Aquatic Life Mortality Events

Harmful algal blooms periodically occur in coastal Gulf of Mexico waters. Harmful algal bloom monitoring resources include federal and state advisories and bulletins. Although the NOAA is the predominant national source for HAB monitoring data, the FWC's Fish and Wildlife Research Institute (FWRI) also conducts *Karenia brevis* (*K. brevis*) HAB monitoring and currently maintains Florida's HAB Monitoring Database, one of the longest continually recorded datasets of red tide in the U.S., for more than 170 years. State- and county-level monitoring can also be a resource to citizens looking for HAB information and updates.

Harmful algal blooms occur when colonies of certain types of algae grow at increased rates within the water column and produce toxins at concentrations that have harmful effects on marine life and humans (NOAA 2014). Red tide, caused by the microscopic algae *Karenia brevis*, is one of the more common HABs in the bays and estuaries along the Gulf Coast of Florida (Solutions to Avoid Red Tide [START] 2016). *K. brevis* produces a neurotoxin that kills fish, shellfish, and marine mammals. This toxin can also cause respiratory and skin irritation in humans (START 2016). Red tide is a natural occurrence; however, increased nutrient loading, pollution, food web alterations, introduced species, water flow changes, and climate change influence the frequency and duration of blooms (NOAA 2015a).

Scientists at NOAA monitor and study HABs to detect and forecast red tide blooms to warn communities in advance of possible environmental and health effects (NOAA 2014). The NOAA is authorized by the Harmful Algal Bloom and Hypoxia Research and Control Act to assist in the control of possible HABs through research centers, labs, and funding (NOAA 2015a). Citizens can visit NOAA's Harmful Algal Bloom Operational Forecast System Operational Conditions Reports for updates on any known HAB colonies from Southwest Florida to the Texas coastline (NOAA 2016). NOAA also posts HAB bulletins with conditions reports and analyses of HABs in the Gulf of Mexico.

High chlorophyll-*a* concentrations occur across the Florida Panhandle periodically in the summer and tend to be associated with the nuisance species *Anacystis spp., Anabaena spp.,* and toxic *K. brevis*. No *K. brevis* HABs were documented in the Apalachee Bay during satellite surveys by NOAA in the fall of 2015 or during surveys by the FWC in the summer of 2016. Detailed sample information and a summary of impacts can be found through the FWC FWRI at: http://myfwc.com/redtidestatus (NOAA 2015b).

3.3 Habitat Quality in Receiving Waters

3.3.1 Subtidal Communities

Apalachee Bay supports a variety of subtidal habitats, including seagrass beds, oyster reefs, and hard-bottom reefs. Although little data is available on the existing condition of the waters containing oyster beds in the coastal waters adjacent to the St. Marks NWR (USFWS 2013b), the area has been closed at times to shellfish harvesting following major rain events. Across the Big Bend region, research has shown a 66 percent net loss of oyster reefs between 1982 and 2011 (Seavey, *et al.* 2011). Offshore oyster reefs have experienced the greatest declines, with approximately 88 percent loss. Nearshore and inshore reefs have declined by 61 percent and 50 percent, respectively (Seavey, *et al.* 2011). Long-term stressors on oyster beds in these waters include direct and indirect effects of population growth, land use change, point source and NPS pollution, upstream riparian habitat loss and degradation (USFWS 2013b).

Seagrass coverage is indicative of water quality, due to the need of seagrasses for clear water to allow adequate sunlight. Eutrophication, or excessive plant and algal growth due to nutrient availability, has been demonstrated to negatively impact aquatic habitats, including seagrass beds (Nixon 1995; Schindler 2006).

Seagrass beds are among the most important ecological components of Apalachee Bay. They may, however, be readily affected by water quality degradation and physical impacts from prop scarring (Handley *et al*. 2007; Sargent *et al*. 1995). Lewis *et al*. (2009) reports on historical seagrass coverage data for Apalachee Bay. The data are indicative of a decline in seagrass area; however, there are uncertainties with the use of these data with respect to identification of long-term trends.

Seagrass communities within the watershed have suffered damage from boat propeller scarring and mooring. Public education and marking of navigation channels can help reduce these occurrences (USFWS 2013b). Mapping data from 2001-2006 showed a slight decline in seagrass acreage in Apalachee Bay between the St. Marks and Ochlockonee rivers. Approximately 2,720 acres of previously continuous seagrass beds were found to be patchy and less extensive during the observation period. Since 2007, the density of seagrass shoots inside beds, as well as the distribution of seagrass species have declined across the Apalachee Bay and Big Bend Region (FWC 2015c). Additional information about seagrass monitoring efforts and the relationship between SAV and water quality can be found in Section 6.0.

3.3.2 Intertidal Communities

Early estimates of salt marsh habitat in the vicinity of the St. Marks River were provided for in a larger section of Apalachee Bay (McNulty *et al*. 1972) and included the area from Alligator Harbor eastward to the Econfina River. Within this larger area, approximately 137,600 acres of tidal marsh were mapped (see Figure 2-13 for most-recent coverage). Located on the interface between sea and land, saltmarsh and wetland habitats are affected by both sea level rise and hurricanes. Changes in the hydroperiod (seasonal pattern of water levels) due to regional climate shifts may also affect salt marsh habitat (USGS 1997). U.S. Geological Survey coastal flooding models indicate that as the sea level rises, a large intertidal area of Apalachee Bay will be converted from marsh to open water and from forest to marsh. According to early model predictions, coastal marsh is likely to increase slightly in land cover as it migrates upslope and replaces existing forest habitat due to the gentle slope of the landform (USGS 1997). More recent investigations at the St. Marks NWR by USFWS using the Sea Level Affecting Marshes Model (SLAMM) evaluated changes in community composition under five different scenarios ranging from 0.39 to 2.0 meters of sea level rise. Under all five scenarios, tidal swamp communities were the most heavily impacted, and tidal fresh marsh communities were replaced by salt marsh communities (USFWS 2012).

3.3.3 Freshwater Systems

Many of the watershed's upland lakes have undergone significant hydrologic alteration and suffered impacts from point and NPS pollution, particularly in the Tallahassee metropolitan area. In Lake Munson, deltas of transported sediment and accumulations of organic muck have choked the lake and blanketed the bottom of the lake (FDEP 2003). From 1934 to 1984, Lake Munson was the receiving waterbody for Tallahassee's municipal wastewater discharges. The construction of a sprayfield in 1984 for Tallahassee's municipal wastewater resulted in the removal of this discharge, which greatly improved the water quality in Lake Munson. However, it still receives significant discharge in the form of stormwater runoff from approximately 57 percent of Tallahassee's urban area (McGlynn 2006). Lake Lafayette, which was once a single waterbody has been separated into for separate lakes by a series of earthen dikes (McGlynn 2006). The Lake Lafayette System suffers from nutrient enrichment, low DO, a proliferation of aquatic vegetation, and invasive species including the channeled apple snail (*Pomacea canaliculata*) (MgGlynn 2006).

The upper reach of the Wakulla River has experienced extensive invasion by non-native aquatic plants. This has diminished native plant cover and stressed aquatic species. Hydrilla (*Hydrilla verticillata*) growth substantially impacted the ecosystem and may have contributed to the disappearance of native apple snails (*Pomacea paludosa*) and the limpkin (*Aramus guarauna*) population that feeds on them (Loper *et al*. 2005). Intensive efforts have been undertaken to remove hydrilla, including chemical treatment and mechanical harvesting. During the 2006-2007 and 2007-2008 fiscal periods, 75 acres of invasive aquatic plants (predominantly hydrilla) were treated with herbicides (Howard T. Odum Florida Springs Institute 2014). Increased numbers of manatees utilizing the spring, particularly during the winter months, has contributed to significant grazing of invasive exotics, and there has been at least one confirmed limpkin sighting in 2015 (Florida State Parks 2015; Springs Board 2015). While these signs point to an improving ecosystem, long-term maintenance will likely be needed to keep aquatic invasive under control and reduce nitrogen levels in the groundwater contribution area. Invasive aquatic plants are also a problem on the St. Marks River, notably hydrilla, water hyacinth (*Eichhomia crassipes*), and water lettuce (*Pistia stratiotes*) (FDEP 2003).

St. Marks River sub-basins, Black Creek, and Lake Weeks were verified as impaired for DO resulting from high nutrients. The Wakulla River was placed on the verified list because of a biological imbalance attributable to nutrients discharges from the springs. The report (FDEP 2003) cites trend data for Wakulla Springs and Wakulla River indicating a decrease in total phosphorus since 1970, but an overall increase in alkalinity and total nitrogen (TN) although nitrogen levels have declined in recent years. Big Boggy Branch, a tributary of the Wakulla River, has shown increasing trends for TN and fecal coliform (NWFWMD 2009).

Hydrologic conditions are another factor influencing habitat quality within the watershed. Recent water flows from north of the St. Marks NWR into the impoundments have been much less consistent than those experienced historically, with heavy flows following major rain events and virtually no flow during recent drought events. Long-term hydroperiod changes have greatly decreased the refuge's capability to manage the impoundments for migratory birds (particularly shorebirds), by limiting the ability to reliably re-flood the impoundments throughout the year (St. Marks NWR 2006).

The St. Marks NWR SLAMM model indicates that freshwater wetlands including swamps, cypress swamps, and inland fresh marsh are projected to decrease under all tested sea level rise scenarios (0.39 – 2 meters). Irregularly-flooded (predominantly freshwater) marsh habitat is the most endangered wetland type under all tested sea level rise scenarios. Under a 1.5 meter seal level rise scenario, swamps and irregularly-flooded marsh are projected to be reduced by 53 percent and 92 percent, respectively, by the year 2100 (USFWS 2012).

Although not a primary component of this plan, it should be noted that the negative impacts of invasive plant species on native communities has been widely recognized (Florida Exotic Pest Plant Council 2005). The proliferation of non-native species poses a significant threat to biodiversity as non-native species modify ecosystem structure and contribute to the decline of native species, particularly in aquatic systems (Florida Exotic Pest Plant Council 2005; FWC 2015d; Mack *et al.* 2000; Vitousek 1986). The Florida Fish and Wildlife Conservation Commission, Invasive Plant Management Section is the lead agency for coordinating control of invasive aquatic and upland plants on public conservation lands and surface waters. Additional information concerning management activities that impact habitat quality in the watershed's springs and lakes can be found in Section 6.4.9 and Section 6.4.10.

3.4 Floodplains

Floodplains provide important functions for water resources, as well as for the human community. Properly functioning floodplains, for example, protect water quality by allowing storage of floodwaters, reducing runoff velocity and preventing erosion and sedimentation. They also provide important habitat for many terrestrial and aquatic species.

In addition to impacting water resources, development and encroachment into flood-prone areas puts residents and property at significant risk. Floodplain encroachment decreases floodplain function by reducing the flood-carrying capacity, increases flood heights and velocities, and increases flood hazards and degrades natural systems in areas beyond the encroachment itself. Floodplains offer a way to attenuate potential flood effects, while also providing an ecological link between aquatic and upland ecosystems. Economic gain from floodplain development should be balanced against the resulting increase in flood hazard and associated costs (FEMA 2014a).

While severe rainfall events can lead to flooding and flood-related impacts on surface waters, drought can have severe impacts on water supply, aquifer recharge, water chemistry, DO concentrations, and other parameters that affect water quality and in-stream habitat. Maintaining the hydrological integrity of the floodplain can benefit surface water systems in drought conditions, as well as flood conditions. Floodplain vegetation reduces evaporation and increases soil water storage capacity. Riparian wetlands, marshes, and floodplain forest areas absorb high flows and stormwater runoff, then filter and slowly release it to streams and aquifers, moderating against dry times (TNC 2016b). Floodplain protection is important to support not only recharge and water storage, but also protect the quality of groundwater that may emerge later as surface water.

3.4.1 Flood Prone Areas

Northwest Florida, with its extensive river networks and other water resources, has a long history of flooding events, which makes it clear that such events will re-occur and that it is necessary to plan accordingly. Riverine floods are significant and common in northwest Florida and tend to occur along major river systems and their tributaries. Within the St. Marks River and Apalachee Bay watershed, major riverine systems, streams, wetlands, low-lying areas, coastal areas, and closed basins are subject to significant flooding. Flooding can be particularly problematic in high-growth and densely populated areas. Flooding impacts appear to be aggravated by inadequate public awareness of the potential for flooding events and associated consequences. Residents and visitors must be aware of the implications of building, living, working, and recreating in areas prone to flooding.

Federal Emergency Management Agency digital flood maps indicate that 335,142 acres (approximately 49 percent) of the St. Marks River and Apalachee Bay watershed are delineated as Special Flood Hazard Area (Figure 2-10). Lands prone to flooding are predominantly in the lower portion of the watershed in the coastal lowlands where extensive wetlands, old submerged beaches, and seagrass meadows have a wave dampening effect. Most of this region is public conservation land, so risks to private property are limited.

The coastline within the St. Marks River and Apalachee Bay watershed is an extensive low-energy area, with a gently sloping continental shelf, no offshore barrier islands, and several rivers, creeks, and marshes discharging directly into the Gulf of Mexico. During storm events, Wakulla County is susceptible to tide wave amplification. Storm surge elevations within the Apalachee Bay area are generally higher than the adjacent areas to the west and south of the bay, due to a combination of extensive offshore areas with shallow water depths and the effect of south-southeastern winds on local water movement (FEMA 2014b).

New technologies such as satellite imagery and remote sensing have been tested in Jefferson and Wakulla counties to assess tidal model performance for FEMA map modernization. These new technologies offer opportunities for modeling coastal hydrodynamics and understanding coastal flooding that are applicable and reliable in the St. Marks River and Apalachee Bay watershed (Medeiros *et al.* 2013).

3.4.2 Recent Flood Events

A 2014 Wakulla County Flood Insurance Study identified seven hurricanes since the 1830s that have resulted in damage to the watershed including extensive shoreline erosion and inundation depths of up to 10 feet (FEMA 2014b). Much of the coastal portion of the watershed south of Highway 98 is vulnerable to storm surges (FEMA 2014b). This area has little development within the watershed boundary and is mostly public land or private conservation land.

3.4.3 Floodplain Management

Flood protection needs within the St. Marks River and Apalachee Bay watershed are closely related to stormwater management, as well as land use planning and land development regulation. Thus, for both retrofit and new development, flood protection and water quality treatment efforts must be closely coordinated through the protection of floodplains, wetlands, natural hydrology, and recharge. Where necessary and appropriate, both retrofit needs and stormwater management for new development should be addressed through the construction of facilities that provide both flood protection and water quality treatment.

To facilitate the protection of floodplain and wetland resources, the NWFWMD and FEMA have identified flood hazards through the Flood Hazard Map Modernization program (originally), the FEMA Risk MAP program (MAP = Mapping, Assessment, and Planning) currently, and county and watershed-based Flood Insurance Studies, the SWIM program, storm surge modeling, and other cooperative efforts. Additionally, ongoing land acquisition and management efforts serve to protect floodplains, wetlands, and associated public benefits. Restoration efforts implemented through SWIM and wetland mitigation also help restore natural hydrology, with benefits for flood protection, habitat, and water quality.

Finally, implementation of the Environmental Resource Permitting (ERP) program in northwest Florida helps ensure flood protection is addressed in an integrated manner with water quality protection. Florida’s ERP Program regulates activities that alter surface water flows, including activities in uplands that generate stormwater runoff, and dredging and filling in wetlands and surface waters. In addition to the state wetlands permitting process, Section 404 of the CWA establishes a federal wetlands program administered by the USACE.

3.5 Unique Features and Special Resource Management Designations

3.5.1 Conservation Lands

The St. Marks River and Apalachee Bay watershed contains 461,601 acres (62 percent of the watershed) of conservation and protected lands (Figure 3-7), which are listed with short descriptions in Appendix E (FNAI 2016a, 2016b). Because of the relatively low density of development, particularly in the coastal lowland region, most of the basins' rivers and lakes and the estuary are in relatively good condition. This is due largely to the creation of the St. Marks NWR (54,017 acres within the watershed) and the Apalachicola National Forest (106,361 acres within the watershed) in the 1930s by the federal government. Together, these publicly owned areas comprise more than 630,000 acres and contain most of the wetlands and coastal areas of the Ochlockonee and St. Marks basins.

The St. Marks NWR is a continuous tract of forested land, impoundments, wetlands, and wilderness areas that comprise over 70,412 acres. Congress designated 17,746 acres of the refuge as the St. Marks Wilderness Area in 1975, to be managed under the Wilderness Act of 1964 (78 Statute 890.892: 16 United States Code 1132). The St. Marks NWR buffers Apalachee and Ochlockonee bays from runoff. Together, the Apalachicola National Forest, St. Marks NWR, the Aucilla Wildlife Management Area, and other public and private conservation lands provide a buffer system that helps to protect water quality, provide flood protection, and sustain integrated terrestrial and aquatic ecosystems. The Apalachicola National Forest, owned and operated by the U.S. Forest Service (USDA), comprises more than 571,000 acres, which includes 2,735 acres of water. Over 106,000 acres of the forest occur in the St. Marks River and Apalachee Bay watershed in Leon and Wakulla counties. The Apalachicola National Forest consists of six sub-watersheds which provide an abundance of fresh water streams, rivers, lakes, and natural springs (USDA 2016a).

The NWFWMD monitors over 12,400 acres of conservation easements across the District, including approximately 1,375 acres within the St. Marks River and Apalachee Bay watershed. A conservation easement allows the landowner and the District to preserve and protect the land's natural resource values, especially water resources, while still allowing the landowner to retain certain rights to the property. The landowner continues to manage the property and it stays on the local tax rolls. Typical District conservation easements do not grant the right of public access, unless granted by the landowner.

The FWC owns and manages the Aucilla Wildlife Management Area, which is located along the eastern boundary of the watershed. The WMA is managed to protect and restore wildlife habitat, while also providing an important resource for compatible public recreation. Land-management activities include prescribed burning, timber management, groundcover restoration, reforestation, and other activities.

Throughout the watershed are ten state parks, preserves, and forests encompassing over 14,500 acres, the majority of which are managed by various branches of the FDEP and the FDACS (Figure 3-7). The state also manages a number of conservation easements within the watershed. State-funded land acquisitions have been important in securing conservation lands within the watershed. The Nature Conservancy of Florida has been instrumental in brokering many critical land acquisitions with state funding provided through various programs such as Preservation 2000 and Florida Forever (discussed further in Section 6.4.8). The Nature Conservancy owns and manages the 680-acre Fanlew Preserve and the 8,053-acre Flint Rock Tract in Jefferson County, adjacent to the Aucilla WMA.

The watershed also includes 16 local and county parks, preserves, and greenways managed by Leon and Wakulla counties and the City of Tallassee. Recent conservation land acquisitions (using state and local funds) include buffers adjacent to Lake Munson, and Heritage Trail/Lake Piney Z and the Miccosukee Greenway and Alford Property (near Lake Lafayette).

Within the City of Tallahassee, the Tallahassee-Leon County Greenways Program was created to build a community-wide greenways system intended to protect and manage riparian corridors, floodplains, and other environmentally sensitive areas (City of Tallahassee and Leon County 2015). Additionally, the Tallahassee-Leon County Comprehensive Plan discourages urban sprawl and provides policies to map and protect floodplains, floodways, altered wetlands, watercourses, closed basins, active karst features, canopy road corridors, and highly and erodible soils (City of Tallahassee 2015).

Approximately 17,745 acres of conservation lands are owned and managed by the Tall Timbers Research Station and Land Conservancy, a private organization devoted to the research of fire ecology and to advocating prescribed fire for land management (Tall Timbers Research Station and Land Conservancy 2016).

3.5.2 Critical Habitat and Strategic Habitat Conservation Areas

The St. Marks River and Apalachee Bay watershed contains numerous rare, endemic, federally and state-protected species, and/or species of special concern listed under the Endangered Species Act (ESA). The ESA also provides special protection for Critical Habitat of certain species. Critical habitat may include an area that is not currently occupied by the species, but that will be needed for its recovery.

When considering what areas to designate as Critical Habitat for a given protected species, the USFWS considers features of the environment that provide the following:

- ✓ **Space for individual and population growth and for normal behavior;**
- ✓ **Cover or shelter;**
- ✓ **Food, water, air, light, minerals, or other nutritional or physiological requirements;**
- ✓ **Sites for breeding and rearing offspring; and**
- ✓ **Habitats that are protected from disturbances or are representative of the historical, geographical, and ecological distributions of a species.**

Source: USFWS 2015.

The St. Marks River and Apalachee Bay watershed includes designated critical habitat for the threatened frosted flatwoods salamander (*Ambystoma cingulatum*) in areas located to the east and southeast of the St. Marks River.

The FDACS publishes a list of the protected plants of Florida (Weaver and Anderson 2010). The table in Appendix B provides a list of species that are protected and tracked for the watershed, as well as their habitat requirements.

Certain natural areas within the watershed have been identified by the FWC as Strategic Habitat Conservation Areas (SHCAs). Strategic Habitat Conservation Areas are important habitats in Florida that do not have conservation protection, which would increase the security of rare and imperiled species if they were protected. Strategic Habitat Conservation Areas have been identified on 35 percent of land in the Apalachee Region including the St. Marks River and Apalachee Bay watershed. The majority of SHCAs support three species: the Florida black bear (*Ursus americanus floridanus*), swallow-tailed kite (*Elanoides forficatus*), and the Cooper's hawk (*Accipiter cooperii*). The priority SHCAs identified for bears in this region help to increase the protected lands around Apalachicola National Forest and Aucilla WMA (Endries *et al.* 2009).

3.5.3 Aquatic Preserves

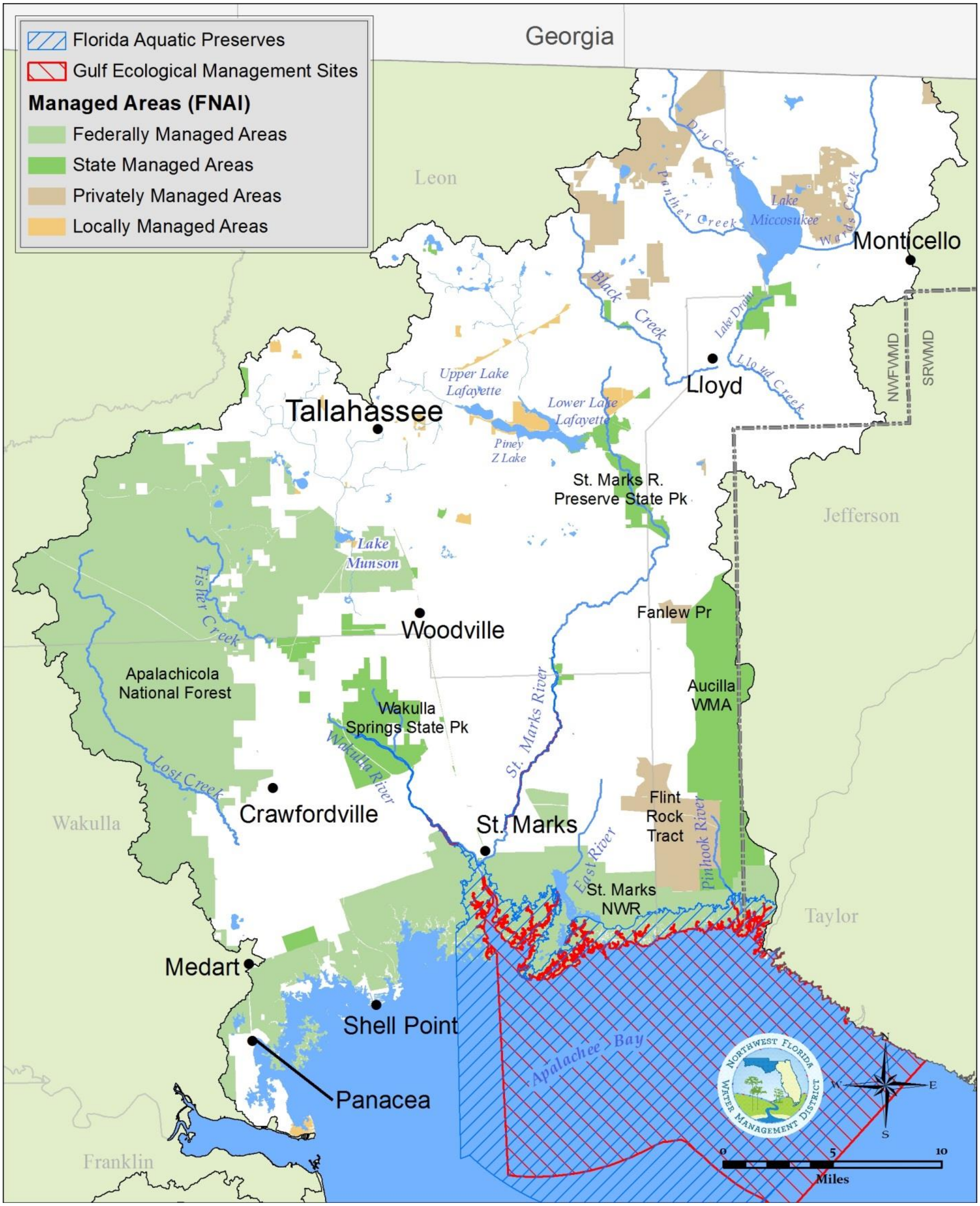
The State of Florida currently has 41 aquatic preserves, encompassing approximately 2.2 million acres of submerged lands that are protected for their biological, aesthetic, and scientific value including one preserve in the St. Marks River and Apalachee Bay watershed (FDEP 2014a). Big Bend Seagrasses Aquatic Preserve off the coast of Wakulla and Jefferson counties is the largest aquatic preserve in the state, and includes over 984,000 acres of submerged lands (FDEP 2014a). The Big Bend Seagrass Aquatic Preserve is home to over 2,000 native species of plants and animals including threatened and endangered species such as the West Indian manatee, the Atlantic hawksbill sea turtle (*Eretmochelys imbricata*), and the Kemp's Ridley sea turtle (*Lepidochelys kempii*) (FDEP 2014a). The preserve extends eastward out of the St. Marks watershed into neighboring Dixie, Taylor, and Levy counties and represents a substantial economic resource supporting the seafood industry (FDEP 2014a).

3.5.4 Outstanding Florida Waters (OFWs)

Of particular interest in the St. Marks River and Apalachee Bay watershed are the waterbodies designated as OFWs. The FDEP designates OFWs (under F.S. Section 403.061[27]), which are then approved by the Environmental Regulation Commission. The FDEP defines an OFW as "a water designated worthy of special protection because of its natural attributes. This special designation is applied to certain waters, and is intended to protect existing good water quality" (FDEP 2015h). The St. Marks River, except between Rattlesnake Branch and the confluence of the St. Marks and Wakulla rivers, is protected through designation as an OFW. Other areas within the watershed designated as OFWs include the Wakulla River, Big Bend Seagrasses Aquatic Preserve, and St. Marks NWR (F.A.C. Rule 62-302.700 [9]; FNAI 2016c).

3.5.5 Gulf Ecological Management Sites (GEMS)

The watershed includes one GEMS-designated area: the Big Bend Seagrasses Aquatic Preserve in Apalachee Bay, which encompasses 682,826 acres of submerged lands in Coastal Wakulla and Jefferson counties. The GEMS Program is an initiative of the Gulf of Mexico Foundation, the EPA Gulf of Mexico Program, and the five Gulf of Mexico states (Gulf of Mexico Foundation 2015). Designated GEMS are considered high priority for protection, restoration, and conservation by state and federal authorities due to unique ecological qualities such as habitats significant to fish, wildlife, or other natural resources (Gulf of Mexico Foundation 2015).



Sources: FDEP 2011c; FNAI 2016b; NOAA 2015a; Texas A&M University 2013; USGS 2015.

Figure 3-9 Conservation Lands within the St. Marks River and Apalachee Bay Watershed

4

4.0 Implementation and Achievements of the Previous SWIM Plan

4.1 Previous SWIM Plan Issues and Priorities

The NWFWMD developed a SWIM Plan for the St. Marks River and Apalachee Bay watershed including St. Marks River, Wakulla River, and Apalachee Bay in 1997 (NWFWMD 1997), and updated the plan in 2009. The plan recognized three priority objectives, which also address three of the NWFWMD's statutory areas of responsibility relating to watershed management:

- Water quality protection and improvement, focusing on prevention and abatement of NPS pollution in the upper reaches of the basin;
- Natural systems protection, enhancement, and restoration, including stream, wetland, aquatic, and riparian habitat restoration on lands purchased for conservation in the lower basin; and
- Protection and, if necessary, restoration of floodplain functions.

These objectives, with associated strategies, are further described in Table 4-1. The 2009 SWIM Plan also identified individual tactics that could be employed to implement the strategies in Table 4-1 including:

- Resource characterization;
- Hydrologic data collection and monitoring;
- Freshwater needs assessment;
- Local stormwater planning assistance;
- Construction of stormwater retrofit facilities and implementation of BMPs;
- Integration of Flood Hazard Map Modernization;
- Preservation of critical lands and habitats;
- Ecological restoration;
- Public education and outreach; and
- Reuse of reclaimed water.

Table 4-1 2009 SWIM Plan Objectives and General Strategies

Management Objectives	General Strategies
Water Quality Protection and Improvement	Reduce NPS pollution watershed-wide through stormwater planning, retrofits, and related activities.
	Support efforts to more effectively treat and reuse wastewater and stormwater.
Natural Systems Protection, Enhancement, and Restoration	Protect, enhance, and (as necessary) restore wetlands, aquatic habitats, and riparian and upland buffer areas.
	Develop an improved understanding of the freshwater inflow needs of riverine and estuarine ecosystems.
Flood Protection – Promoting Natural Floodplain Function	Develop/distribute improved flood maps and topographic data.
	Protect and restore floodplain areas and functions.
	Implement stormwater retrofit projects to address flood protection in an integrated manner with water quality improvement.

Source: NWFWMD 2009.

4.2 Progress toward Meeting Plan Goals and Objectives

The 2009 St. Marks River and Apalachee Bay SWIM Plan did not identify specific projects, but rather suggested a number of management objectives and strategies, as noted above, to address the watershed's challenges and improve watershed conditions (Table 4-1) (NWFWMD 2009).

Since the first SWIM Plan was approved for the St. Marks River and Apalachee Bay in 1997, considerable progress has been made both in developing an improved understanding of watershed resources and challenges and in implementing projects and initiatives to address these challenges. The projects, which are discussed in Section 6.0, include implementation of a number of stormwater retrofit projects to improve water quality and flood protection, enactment of local government initiatives and regulations protecting water resources, and significant investment in improved wastewater treatment and management systems. Additionally, ongoing scientific investigations have yielded new insights into the hydrogeology of the watershed and increased public awareness of its vulnerability. At the same time, the population of the region has been increasing at a rapid pace, bringing with it additional development and NPS pollution.

Reflecting the shared responsibility inherent in watershed management, accomplishments should be recognized on the part of numerous watershed stakeholders, including local governments, state and federal agencies, academic institutions, and others. Among the noteworthy accomplishments are:

- Implementation of major wastewater treatment improvements by the City of Tallahassee, as well as additional improvements in Wakulla County and investments in extending sewer service in both Leon and Wakulla counties.
- Implementation-dedicated programs and projects to retrofit stormwater systems and improve water quality treatment by Leon County and the City of Tallahassee.
- Implementation of ERP by the District and the FDEP.
- Implementation of four local grant projects with grant funding from the Florida Forever program, including projects to achieve urban stormwater retrofits for water quality improvement.
- The FWC Bureau of Invasive Plant Management continues to implement aquatic plan management throughout the lakes of Leon County (http://myfwc.com/wildlifehabitats/invasive-plants/).

The District's Consolidated Annual Reports (http://www.nwfwater.com/Data-Publications/Reports-Plans/Consolidated-Annual-Reports) provide listings and descriptions of specific projects that have been completed under the auspices of the SWIM and Florida Forever programs.

5.0 Related Resource Management Activities

Over the years, management plans and activities in the St. Marks River and Apalachee Bay watershed have been implemented to reduce wastewater discharges; reduce the discharges of polluted stormwater from urban and agricultural areas; and protect, preserve, and restore special areas. This section describes historical and ongoing activities and programs to address natural resource issues and water quality problems, including the impacts of the 2010 Deepwater Horizon oil spill.

Much of the progress in restoring the watershed is attributable to coordinated efforts on the part of local, state, and regional efforts, including the District, county and municipal governments, state agencies, and private initiatives. Many plans and programs share common goals, and their implementation is based on multiple groups cooperating in planning, funding, managing, and executing projects. The NWFWMD coordinates its efforts with these entities to facilitate project implementation, as well as to obtain data, strengthen monitoring activities, and exchange information.

5.1 Deepwater Horizon: RESTORE Act, Natural Resource Damage Assessment (NRDA), and NFWF Projects

The FDEP and the FWC are the lead state agencies in Florida for responding to the impacts of the Deepwater Horizon oil spill and the resulting restoration process. Restoration projects submitted through the FDEP are considered for funding under the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast Act (RESTORE Act), the NRDA, and the NFWF's GEBF.

5.1.1 RESTORE

The RESTORE Act of 2012 allocates to the Gulf Coast Restoration Trust Fund 80 percent of the CWA administrative and civil penalties resulting from the oil spill. The major means of allocation under the RESTORE Act are as follows:

Direct Component Funds ("Bucket 1"): Seven percent of these funds will be directly allocated to counties affected in Florida (5.25 percent to the eight disproportionately affected counties in the Panhandle from Escambia to Wakulla counties; and 1.75 percent to the non-disproportionately impacted Gulf Coastal counties). To receive funds under the Direct Component, each county is required to submit a Multiyear Implementation Plan, subject to review by the U.S. Department of the Treasury, detailing the county's plan to expend funds for a set of publically vetted projects and goals (FDEP 2016d).

Council-Selected Projects ("Bucket 2"): A portion of RESTORE funds will go toward projects with a wider geographic benefit (multiple states). These projects are selected by the Gulf Ecosystem Restoration Council, which includes the five Gulf States and six federal agencies. Projects can be submitted by the Council members and federally recognized Native American tribes.

Spill Impact Component ("Bucket 3"): Each of the five Gulf states will receive these funds to implement a State Expenditure Plan. In Florida, this plan is being developed through the Gulf Consortium, which was created by the Florida Association of Counties. Projects will be submitted by each of the 23 counties on Florida's Gulf Coast.

5.1.2 National Resource Damage Assessment (NRDA)

The Oil Pollution Act of 1990 authorizes certain state and federal agencies to evaluate the impacts of the Deepwater Horizon oil spill. This legal process, known as NRDA, determines the type and amount of restoration needed to compensate the public for damages caused by the oil spill. The FDEP, along with the FWC, are co-trustees on the Deepwater Horizon Trustee Council.

The NRDA Trustees have, thus far, selected one recreational use project in Wakulla County (FDEP 2016d):

- **Wakulla Mashes Sands Park Improvements** (Wakulla County, $1,500,000) – construct observation platforms, boardwalks, walking paths, and canoe/kayak launch; improvements to boat ramp area and picnic areas; and renovation of parking area and restroom facility.

5.1.3 National Fish and Wildlife Foundation (NFWF)

The NFWF established the GEBF to administer funds arising from plea agreements that resolve the criminal cases against BP and Transocean. The purpose of the GEBF, as set forth in the plea agreements, is to remedy harm and eliminate or reduce the risk of future harm to Gulf Coast natural resources. The plea agreements require the NFWF to consult with state and federal resource agencies in identifying projects. The FWC and the FDEP work directly with the NFWF to identify projects for the state of Florida, in consultation with the USFWS and the NOAA. From 2013 to 2018, the GEBF will receive a total of $356 million for natural resource projects in Florida. However, the allocation of funds is not limited to five years. NFWF funded the development of the 2017 SWIM plan updates through the GEBF. There are no additional projects currently funded by NFWF in the St. Marks River and Apalachee Bay watershed (FDEP 2016d).

5.1.4 The Nature Conservancy (TNC): Watershed Management Planning

To achieve comprehensive and long-term success for Gulf restoration, TNC facilitated a community-based watershed management planning process in 2014 and 2015 along Florida's Gulf Coast for the following six watersheds: Perdido Bay, Pensacola Bay, Choctawhatchee Bay, St. Andrew and St. Joseph bays, Apalachicola to St. Marks, and the Springs Coast. The process was designed to:

- Develop watershed-based plans that identify the most pressing environmental issues affecting each watershed and solutions that address the issues, regardless of political jurisdiction and funding source;
- Create long-term partnerships among stakeholders in each watershed and across the regions to maximize effectiveness of project implementation and funding efforts; and
- Provide a screening tool to evaluate the project priorities of these watershed plans for potential funding by the communities, the FDEP, the FWC, the NFWF, and the Gulf Coast Restoration Council (TNC 2014).

The plan developed for the Apalachicola to St. Marks watersheds, including the St. Marks River and Apalachee Bay watershed, identifies 13 projects to address seven major actions (TNC 2014):

- Protect, restore, create and/or manage natural habitat and resources and increase buffer areas;
- Increase cooperation and coordination for management, monitoring, funding, implementation, outreach, and enforcement;
- Reduce impacts to groundwater and ensure adequate fresh water availability;
- Reduce and treat stormwater;
- Reduce nutrient loading;
- Reduce sedimentation; and
- Increase economic diversification.

To complete the planning process and ensure that all of the priority issues are identified and addressed, the plan recommended updating the 2009 St. Marks River and Apalachee Bay SWIM Plan—the subject of this report (TNC 2014).

5.2 Water Quality Monitoring

The majority of the monitoring data in the St. Marks River and Apalachee Bay watershed, including chemical and biological data, has been collected by or for the FDEP Northwest District (FDEP 2003). Data-gathering activities include working with environmental monitoring staff in the NWFWMD and local and county governments to obtain applicable monitoring data from their routine monitoring programs and special water quality projects in the basin. All of the data collected by the FDEP and its partners is uploaded to the statewide water quality database for assessment.

Several water quality monitoring programs are ongoing in the watershed. These include Leon County, the NWFWMD, the FDACS Shellfish Environmental Assessment Section (SEAS), and the FDOH Florida Healthy Beaches monitoring program (FDEP 2003).

The following subsections provide an overview of these programs and some of their relevant findings.

5.2.1 FDEP/NWFWMD

Long-term trends in the water quality of Florida's waters are monitored by FDEP's Surface Water Temporal Variability (SWTV) and Groundwater Temporal Variability (GWTV) Monitoring Network. This is a statewide network of fixed sites selected to reflect the water quality impacts across the state. The GWTV network includes a quarterly water quality sample directly from the vent of Wakulla Spring. Monthly samples for the SWTV network include one sample just downstream of the Wakulla Spring pool, one station roughly one-half mile downstream that captures the contributions of Sally Ward Spring. A third sample is collected at the highway 365 bridge just below the park which captures several additional spring fed tributaries such as McBride and North Sloughs. The SWTV network also includes a station on the St. Marks River at Highway 98 where monthly water quality samples are collected. This is the only station on the St. Marks River and is the only practical location between the St. Marks Rise and the town of St. Marks where the St Marks River's freshwater character can be captured. Additionally, the NWFWMD is collecting quarterly water quality samples from the main vent of the St. Marks River Rise as part of the NWFWMD's Water Quality Trend network. Parameters monitored include color alkalinity, turbidity, suspended and dissolved solids, nutrients, total organic carbon, chlorides, sulfate, metals (calcium, potassium, sodium, magnesium), pH, conductivity, temperature, DO, total coliform bacteria, fecal coliform bacteria, *enterococci* bacteria, and *Escherichia* bacteria. The water quality stations are located on gauged streams, which provide for calculated stream discharges (FDEP 2016e). Bi-annual biological sampling is also performed on the Wakulla River in order to evaluate ecological health.

The FDEP has also developed the Nitrogen Source Inventory and Loading Tool to identify and quantify the major contributing nitrogen sources to groundwater in areas of interest. This GIS and spreadsheet-based tool provides spatial estimates of the relative contribution of nitrogen from various sources. It takes into consideration the transport pathways and processes affecting the various forms of nitrogen as they move from the land surface through soil and geologic strata that overlie and comprise the Upper Floridan aquifer (FDEP 2016e).

The Florida Geological Survey Aquifer Vulnerability Assessment model can facilitate protection of groundwater and surface waters by identifying less vulnerable areas that may support development and more vulnerable areas that should be prioritized for conservation (Arthur et al. 2007).

5.2.2 FDEP Northwest District

The FDEP's Northwest District has collected considerable biological data and conducted biological evaluations of numerous stream and other aquatic habitat sites throughout the watershed (FDEP 2003). The biological data collected by the FDEP Northwest District includes Stream Condition Index, Wetland Condition Index, and Bioassessment data, all of which are reported and accessible in the STOrage and RETrieval (STORET) database. The data is included in the Impaired Surface Waters Rule (IWR) assessments, including the most recent assessment IWR run 50 which can be found on the FDEP website: http://www.dep.state.fl.us/water/watersheds/assessment/basin411.htm.

5.2.3 Florida Department of Agriculture and Consumer Services (FDACS)

To minimize the risk of shellfish-borne illness, the FDACS continually monitors and evaluates shellfish harvesting areas and classifies them accordingly. It also ensures the proper handling of shellfish sold to the public. Under the SEAS program, FDACS monitors bottom and surface temperature, salinity, DO, surface pH, turbidity, fecal coliform bacteria, water depth, and wind direction and speed at shellfish beds.

5.2.4 Florida Department of Health (FDOH)

The Florida Healthy Beaches Program was begun by the FDOH as a pilot beach monitoring program in 1998 and was expanded to include all the state's coastal counties in August 2000. Local county health departments participate in the program with weekly monitoring of beaches for *enterococcus* and fecal coliform bacteria. The departments issue health advisories or warnings when bacterial counts are too high (FDEP 2003). The Wakulla County Health Department monitors water quality at Shell Point Beach and Mashes Sands Beach and issues beach closures and warnings when bacterial counts exceed water quality standards. Water quality data is available through the Florida Healthy Beaches Program (FDOH 2016).

5.2.5 LakeWatch

The University of Florida's LakeWatch volunteer monitoring program collects water quality data at dozens of sites within the watershed. Parameters monitored include total nitrogen, total phosphorus, chlorophyll-*a*, and *Secchi* depth, which are collected monthly at lake stations and some stream stations by citizen volunteers. Data are sometimes collected on aquatic vegetation (FDEP 2003).

5.3 Submerged Aquatic Vegetation (SAV) Monitoring

Since 2009, the FWC's FWRI has monitored changes in the extent, density, and patchiness of seagrass in the Big Bend region as part of the statewide Seagrass Integrated Mapping and Monitoring (SIMM) program. The maps are generated through photointerpretation of high-resolution imagery. The FWRI is currently conducting a study to identify the roadblocks to seagrass recovery, which may be different from the causes for the loss of seagrasses.

5.4 Water Quality Restoration and Protection Programs

Water quality in the St. Marks River and Apalachee Bay watershed is protected through several programs working together to restore water quality and prevent degradation. These programs include the FDEP's adopted TMDLs; BMPs for silviculture agriculture, construction, and other activities related to land-use and development; regulatory programs, including NPDES, domestic and industrial wastewater permits, stormwater permits, and ERP; and local efforts to retrofit stormwater infrastructure to add or improve water quality treatment. Additionally, water quality is protected through a number of conservation, mitigation, and management programs that protect water resources, aquifer recharge areas, floodplains, and other natural systems within the watershed. These programs include the Florida Forever Work Plan, regional mitigation for state transportation projects, and spring protection and restoration. The following section provides an overview of these programs and their contribution to water quality restoration and protection.

5.4.1 Total Maximum Daily Loads (TMDLs)

Total maximum daily loads are developed for waterbodies that are verified as not meeting adopted water quality standards to support their designated use. They provide important water quality restoration goals to guide restoration activities. They also identify the reductions in pollutant loading required to restore water quality. Total maximum daily loads are implemented through the development and adoption of BMAPs that identify the management actions necessary to reduce the pollutant loads. Basin Management Action Plans are developed by local stakeholders (public and private) in close coordination with the Water Management Districts and the FDEP. Although water segments with adopted TMDLs are removed from the state's impaired waters list, they remain a high priority for restoration. The FDEP has developed specific guidance for implementing fecal coliform TMDLs that focuses on identifying and removing bacteria sources (FDEP 2011b).

5.4.2 National Pollutant Discharge Elimination System (NPDES) Permitting

All point sources that discharge to surface waterbodies require a NPDES permit. These permits can be classified into two types: domestic or industrial wastewater discharge permits, and stormwater permits. All communities' NPDES-permitted point sources may be affected by the development and implementation of a TMDL. All NPDES permits include "reopener clauses" that allow the FDEP to incorporate new discharge limits when a TMDL is established. These new limitations may be incorporated into a permit when a TMDL is implemented or at the next permit renewal, depending on the timing of the permit renewal and workload. For NPDES municipal stormwater permits, the FDEP will insert the following statement once a BMAP is completed (FDEP 2003):

> *The permittee shall undertake those activities specified in the (Name of Waterbody) BMAP in accordance with the approved schedule set forth in the BMAP.*

The FDEP implements the NPDES stormwater program in Florida under delegation from the EPA. The program requires the regulation of stormwater runoff from MS4s generally serving populations of more than 10,000 and denser than 1,000 per square mile, construction activity disturbing more than one acre of land, and ten categories of industrial activity. An MS4 can include roads with drainage systems, gutters, and ditches, as well as underground drainage, operated by local jurisdictions, the FDOT, universities, local sewer districts, hospitals, military bases, and prisons.

Since 1996, the Leon County Public Works Department has sampled stormwater runoff as required by the County's NPDES MS4 permit. The permit requires sampling of streams, stormwater facilities, and sediment to document the impacts of stormwater runoff on the natural waterbodies. The ambient and stormwater sampling programs include quarterly water quality sampling and annual sediment and biological assessments of 13 lakes, 27 streams, and two rivers at a total of 73 monitoring stations. The 2016 Water Quality Report for data collected in 2015 is available as an Interactive Water Quality Data Map at the following link: http://cms.leoncountyfl.gov/Home/Departments/Public-Works/Engineering-Services/Stormwater-Management/Water-Quality-Data (Leon County 2016b).

5.4.3 Domestic and Industrial Wastewater Permits

In addition to NPDES-permitted facilities, all of which discharge to surface waters, Florida also regulates domestic and industrial wastewater discharges to groundwater via land application. Since groundwater and surface water are so intimately linked in much of the state, reductions in loadings from these facilities may be needed to meet TMDL limitations for pollutants in surface waters. If such reductions are identified in the BMAP, they would be implemented through modifications of existing state permits (FDEP 2003).

5.4.4 Best Management Practices (BMPs)

Best management practices may include structural controls (such as retention areas or detention ponds) or non-structural controls (such as street sweeping or public education). Many BMPs have been developed for urban stormwater to reduce pollutant loadings and peak flows. These BMPs accommodate site-specific conditions, including soil type, slope, depth to groundwater, and the use designation of receiving waters (such as drinking water, recreation, or shellfish harvesting).

The passage of the 1999 Florida Watershed Restoration Act (Chapter 99-223, Laws of Florida) increased the emphasis on implementing BMPs to reduce NPS pollutant discharges from agricultural operations. It authorized the FDEP and the FDACS to develop interim measures and agricultural BMPs. While BMPs are adopted by rule, they are voluntary if not covered by regulatory programs. If they are adopted by rule and the FDEP verifies their effectiveness, then implementation provides a presumption of compliance with water quality standards, similar to that granted a developer who obtains an ERP (FDACS 2016b).

Over the last several years, the FDACS has worked with farmers, soil and water conservation entities, the University of Florida's Institute of Food and Agricultural Sciences, and other interests to improve product marketability and operational efficiency of agricultural BMPs, while at the same time promoting water quality and water conservation objectives.

Agricultural land use in Leon and Wakulla counties is primarily silviculture, with some pastures and sod operations. BMPs have been developed and adopted into rules for silviculture, row crops, container plants, cow-calf, and dairies (FDACS 2016b FDACS 2016c). A draft BMP for poultry has been developed and adoption is expected by late 2016 (FDACS 2016b).

5.4.5 Florida Environmental Resource Permitting (ERP)

Florida established the ERP program to prevent stormwater pollution to Florida's rivers, lakes, and streams, and to help provide flood protection. The ERP program regulates the management and storage of surface waters and provides protection for the vital functions of wetlands and other surface waters. Environmental resource permits are designed to obtain 80 percent average annual load reduction of total suspended solids. In northwest Florida, the ERP program is jointly implemented by the NWFWMD and the FDEP.

5.4.6 Regional Mitigation for State Transportation Projects

Under Section 373.4137, F.S., the NWFWMD offers mitigation services, as an option, to the FDOT for road projects with unavoidable wetland impacts when the use of private mitigation banks is not feasible. As required by this statute, a regional mitigation plan (a.k.a., Umbrella Plan) has been developed, and is updated annually to address the FDOT mitigation needs submitted to the NWFWMD. Components of the Umbrella Plan include the federally permitted "In-Lieu Fee Program" instrument and other mitigation projects (NWFWMD 2016a). The District does not compete with private mitigation banks, one of which, the St. Marks Mitigation Bank, is located in the St. Marks River and Apalachee Bay watershed. The District's mitigation plan is developed and implemented in consultation with the FDOT, the FDEP, the USACE, the EPA, the USFWS, the U.S. National Marine Fisheries Service, and the FWC and is maintained and available for review at http://www.nwfwmdwetlands.com/.

5.4.7 Florida Forever Work Plan

Florida Forever is Florida's conservation and recreation lands acquisition program. Under section 373.199, F.S., and the NWFWMD Florida Forever 2016 Five Year Work Plan, a variety of projects may be implemented, including capital projects, land acquisition, and other environmental projects. Since its inception, the District's land acquisition program has sought to bring as much floodplain as possible of the major rivers and creeks under public ownership and protection (NWFWMD 2016b).

The watershed includes significant areas on the approved Florida Forever lands acquisition list including Wakulla Spring Protection Zone, Florida's First Magnitude Springs, Millstone Plantation, St. Joe Timberland, and the Upper St. Marks River Corridor (FDEP 2016f).

Restoration and habitat enhancement projects have been conducted to address several lakes, partly through state funding, partly by federal grants, and partly by Leon County. Much of the state funding for habitat enhancement and restoration of lakes has been made available through the FWC. The 1999 Florida Forever legislation includes a fisheries restoration program targeting Florida lakes deemed to be in priority need of attention. Starting in July 2001, funding was made available to the FWC to perform lake drawdowns, remove muck and sediments, reestablish native submersed and emergent vegetation, implement tussock control measures, and carry out other enhancements to fishery habitat through 2010 (FDEP 2003).

The NWFWMD's primary focus within the watershed has been to acquire less than fee rights on privately owned floodplain land separating existing federal and state properties. Protection of floodplain, wetland, and riparian lands bordering the river and its tributaries can protect water quality and habitat, as can protection of high recharge areas within spring groundwater contribution areas. The District presently has 1,376 acres in less than fee holdings in the area and has identified for potential fee or less than fee acquisition approximately 45,456 acres along the St. Marks and Wakulla rivers and approximately 16,583 acres in the Wakulla Springs Groundwater Contribution Area (NWFWMD 2016b).

In 2015, voters in the state passed the Florida Land and Water Conservation Amendment (Amendment 1). The amendment funds the Land Acquisition Trust Fund to acquire, restore, improve, and manage conservation lands, including wetlands and forests; fish and wildlife habitat; lands protecting water resources and drinking water sources, including the Everglades, and the water quality of rivers, lakes, and streams; beaches and shores; outdoor recreational lands; working farms and ranches; and historic or geologic sites, by dedicating 33 percent of net revenues from the existing excise tax on documents for 20 years. In 2016, the Florida legislature appropriated $15 million to Florida Forever for conservation easements and increasing water supplies.

5.4.8 Spring Protection and Restoration

Since 2013, Florida has made substantial investments to protect and restore Florida's springs, their ecological value, and the associated public benefits. More than $16 million in grant funds have been approved as of 2016, leveraging an additional $14 million in local and federal funds. Initiatives funded to date have included cooperative projects with Wakulla County, Leon County, and the City of Tallahassee to extend sewer service to areas currently served by septic systems, resulting in improved wastewater treatment and removal of septic systems from sensitive areas. Additionally, a pilot project to explore the use of advanced onsite treatment systems in rural areas of Leon and Wakulla counties within the Wakulla Spring groundwater contribution area will be competed. This pilot project is a multi-agency effort including the NWFWMD, Leon County, Wakulla County, the Florida Department of Health, FDEP, and stakeholders. These efforts are expected to contribute substantially to other priorities identified in the Upper Wakulla River BMAP (FDEP 2014f).

The current efforts complement earlier initiatives on the part of the state and local governments. In 1999, the Secretary of the FDEP formed a multiagency Florida Springs Task Force to recommend strategies for protecting and restoring Florida's springs. The Task Force was composed of a group of 16 that included scientists, planners, and other citizens. Its recommendations included action steps for research and monitoring, education, and assistance with BMPs for landowners. In November 2002, the then Florida Department of Community Affairs and the FDEP published *Protecting Florida's Springs: Land Use Planning Strategies and Best Management Practices*. This manual was based on the recommendations developed by the Florida Springs Task Force.

In 2001, the legislature approved funding for the Florida Springs Initiative in an effort to understand more about the water quality and quantity of springs throughout north and central Florida. The FDEP requested the assistance of the Northwest Florida, Suwannee River, and Southwest Florida water management districts to help collect and interpret water quality and discharge data from springs within district boundaries. This effort included activities such as sample collection and analysis, delineation of spring recharge areas, development of a groundwater monitoring network, and implementation of projects to help landowners reduce nutrient loading in spring recharge areas (NWFWMD 2005).

5.4.9 Lake Management

Restoration and habitat enhancement projects have been conducted to address several lakes, partly through state funding, partly by federal grants, and partly by Leon County. Much of the state funding for habitat enhancement and restoration of lakes has been

Existing Lake Management Plans for the St. Marks River and Apalachee Bay watershed include:

- **Lake Lafayette Management Plan (May 1996);**
- **Lake Lafayette Management Plan (July 2005);**
- **Lake Miccosukee Management Plan (March 1989); and**
- **Lake Munson Action Plan (January 1994).**

made available through the FWC. The 1999 Florida Forever legislation includes a fisheries restoration program targeting Florida lakes deemed to be in priority need of attention. Starting in July 2001, funding was made available to the FWC to perform lake drawdowns, remove muck and sediments, reestablish native submersed and emergent vegetation, implement tussock control measures, and carry out other enhancements to fishery habitat through 2010.

Leon County, the FWC, and the City of Tallahassee have committed substantial resources to restoring Lake Munson (McGlynn 2006). The Lake Munson Action Plan was implemented after record flooding in Leon County by a series of tropical storms and depressions in 1994. Leon County began the Lake Munson project in late 1999 (FDEP 2003). Recent activities include removing a sediment delta at the entry point of Munson Slough, creating a wet detention area in Lake Henrietta upstream from Lake Munson to provide floodwater equalization and improve the quality of water flowing to the lake, and regrading and stabilizing Munson Slough to reduce erosion. FWC, local governments, and state resource agencies are evaluating plans to remove muck from the remainder of the lake bottom.

In 2007, a 25-acre wet detention treatment facility with trash traps was constructed to reduce sediments, slow runoff, and reduce trash before water enters the restored and stabilized channel north of Lake Munson. During the 2006 reconstruction of Orange Avenue, a wet detention treatment facility and floodplain storage infrastructure was constructed at the intersection of Meridian and Orange Avenue. Trash capture was incorporated on the East Drainage Ditch east of Jim Lee Road. Leon County continues to monitor Lake Munson for DO, nitrogen concentrations, and other water quality parameters (Hill 2010; Richardson 2007).

Lake Miccosukee is managed by the FWC and the NWFWMD to provide high-quality wetland habitat for waterfowl, as well as hunting opportunities. In 2012, repair work was competed on the fixed-crest weir that controls water levels within the lake and allows for periodic drawdowns (Ducks Unlimited n.d.). Prior to hydrological alteration, Lake Miccosukee drained naturally through sinkholes, however, in 1954, an earthen dike was built around the larger sinkhole near the northwest shore of the lake and lake managers assumed the responsibility for regulating the lake’s water level. The 1998 management plan suggests that frequent drawdowns, up to every five years, may be necessary to maintain the lake’s sport fish population and reduce the build-up of organic materials on the lake bottom (Lake Miccosukee Technical Advisory Committee 1989). The FWC’s Aquatic Resources Enhancement Section initiated an extreme drawdown of Lake Miccosukee in March 1999 and closed the lake to fishing. Muck was then removed from four sites around the lake. In the process, approximately 25 acres of the lake bottom were scraped. To control woody tussocks and oxidize organic material, 1,300 acres on the bottom were burned.

Despite many known stormwater sources and extensive hydrologic alterations, no management plan was in place for the four lakes comprising the Lake Lafayette basin for many years. Hydrologic alterations have made managing the basin as a single unit challenging (McGlynn 2006). A project to restore Lake Piney Z in the Lake Lafayette chain was conducted from 1996 to 1998. It included a drawdown, muck removal, creation of six earthen fishing fingers and five wildlife islands, and installation of a water control structure in the 197-acre lake. The City of Tallahassee also purchased 407 acres of surrounding land. The site is now called Lake Piney Z Fish Management Area. The lake is not being utilized for fishing at this time (FDEP 2003).The 2005 Existing Status and Management Plan for Lake Lafayette and the Lake Lafayette Watershed, assesses a hydrologic budget, water quality characteristics, physical characteristics, and pollutant loading for each lake in the basin as a discrete unit. The plan offers management strategies for all four lakes, individually, as well as a discussion of restoring Lake Lafayette to a single lake system. The continuation and expansion of vegetation control/removal is recommended for all lakes in the basin, along with preventative actions such as establishing vegetative buffers, revising stormwater and construction regulations, and increasing public awareness (Leon County 2005).

5.4.10 Minimum Flows and Minimum Water Levels (MFLS)

The District's MFLs will protect springs and associated water resources in the St. Marks River and Apalachee Bay watershed. Section 373.042, F.S., requires each water management district to develop MFLs for specific surface and groundwaters within their jurisdiction. A minimum flow or minimum water level for a given waterbody is the limit below which further withdrawals would be significantly harmful to the water resources or ecology of the area (Section 373.042, F.S.). Minimum flows and minimum water levels are calculated using best available data and consider natural seasonal fluctuations; non-consumptive uses; and environmental values associated with coastal, estuarine, riverine, spring, aquatic, and wetlands ecology as specified in Section 62-40.473, F.A.C. (NWFWMD 2016c).

The process of establishing MFLs involves a series of steps including identification of priority waterbodies, data collection, technical assessments, peer review, rule-making and rule adoption. Adopted MFLs are considered when reviewing consumptive use permit applications. A recovery or prevention strategy must be developed for any waterbody where consumptive uses are currently or anticipated to result in flows or water levels below adopted MFLs.

The District is currently working on the development of MFLs for three priority waterbodies within the St. Marks River and Apalachee Bay watershed: Wakulla Spring, St. Marks River Rise, and Sally Ward Spring. Once established, the MFLs will protect the water resources and ecology of these springs. Extensive data collection is ongoing including ecologic, hydrologic, and water quality data at 58 additional sites. Technical assessments have been initiated to quantify the springs flows needed to protect and maintain water resource values such as fish and wildlife habitat, fish passage, estuarine resources, water quality, aesthetic and scenic attributes, and recreation in and on the water. The technical assessment for the St. Marks River Rise MFL is on schedule to be complete in 2018. The technical assessments for the Wakulla Spring and Sally Ward Spring MFLs are scheduled to be complete in 2020.

5.4.11 University of Florida Institute of Food and Agricultural Sciences Extension (UF-IFAS)

The University of Florida's Institute of Food and Agricultural Sciences (UF/IFAS) is a federal-state-county partnership that focuses on research, teaching, and extension to "*develop knowledge in agriculture, human and natural resources, and the life sciences, and enhance and sustain the quality of human life by making that information accessible*."

Many UF-IFAS programs and partnerships help protect water resources across the St. Marks River and Apalachee Bay watershed and the State of Florida, including the Fisheries and Aquatic Sciences and Marine Sciences Program, Aquatic and Invasive Plants Center, Florida Cooperative Fish and Wildlife Research Unit., Florida Partnership for Water, Agriculture and Community Sustainability, the Natural Resources Leadership Institute, the Wetland Biogeochemistry Laboratory, and the Shellfish Aquaculture Extension among others.

To promote environmentally sound forestry practices, the UF-IFAS offers the voluntary Forest Stewardship Program, which seeks to help private landowners develop a plan to increase the economic value of their forestland while maintaining its environmental integrity (UF-IFAS 2016b). The Extension also works with farmers and homeowners across the state to minimize the need for pesticides and fertilizers through environmentally friendly BMPs.

5.4.12 City and County Initiatives

Wakulla County, in partnership with Leon County, FDOH, and the City of Tallahassee, developed the OSTDS Initiative to reduce nitrogen inputs from septic systems to the Upper Wakulla River and Wakulla Springs Basin as part of the 2015 BMAP (FDEP 2015c).

Leon County's Water Resources Program collects quarterly data on 39 water chemistry parameters at 37 monitoring stations across the County, including 13 lakes, 27 streams, and two river systems. The program also assesses water quality using the Lake Vegetation Index, which evaluates how closely a given lake's plant community resembles a pristine condition, and the

Stream Condition Index, which evaluates the biological health of a stream based on the population and diversity of macroinvertebrates (Leon County 2016b).

The City of Tallahassee constructed a land application system for disposal of municipal wastewater in the late 1970s and eliminated the direct discharge of municipal sewage to Munson Slough in the early 1980s. This has been the most significant step toward improving water quality in Lake Munson (FDEP 2003). During the same period, Wakulla County created a municipal WWTF (spray irrigation) and required coastal residents and businesses in the communities of Panacea and Ochlockonee Bay to connect to the central system and discontinue the use of individual septic tanks. More recently, the City of Havana implemented a similar spray irrigation facility to eliminate wastewater discharge to surface water. In 2013-2014, the City of Tallahassee's TPS was upgraded to reduce nitrate loadings to Wakulla Spring by approximately 80 percent. Further reductions in nitrate concentrations are expected in the river and springs due to this upgrade, as well as other completed actions in the basin. Prior to the upgrade, the facility was identified as the largest source of nitrate loading to the upper Wakulla River and Wakulla Spring (FDEP 2015c).

The City of Tallahassee Stormwater Management Division and the Leon County Public Works Department have carried out extensive stormwater management activities for the basin. Activities have focused on implementing drainage improvements, carrying out stormwater retrofits, and restoring Tallahassee lakes. Improved treatment systems and the cessation of surface water discharges resulted in significant water quality improvements. However, not until the 1980s was urban stormwater pollution addressed as a significant concern for water quality. Since that time, state and local governments and the general public have become more aware of the need for stormwater treatment, and there are increasing numbers of stormwater projects as well as use of nonstructural management practices. The non-structural stormwater practices include public information, staff training, incident reports, and other activities to address and prevent polluted stormwater. In accordance with the 1990 Tallahassee–Leon County Comprehensive Plan, a stormwater ordinance and a stormwater utilities department were created. From the resultant Stormwater Master Plan, local stormwater planners developed a list of approximately 20 capital improvement projects to address flooding and drainage improvements. Many of these projects being implemented by the City of Tallahassee will also include a stormwater treatment or restoration component.

As required by the Tallahassee-Leon County Comprehensive Plan, an Aquifer Protection Program was established to protect wellheads, delineate high-recharge areas and areas most susceptible to ground water contamination, and identify contaminated areas. The City of Tallahassee Aquifer Protection Program is responsible for implementing the 1992 Aquifer

Recharge/Wellhead Protection Ordinance. Projects in which the city has been involved include a karst inventory of Leon County and a wellhead protection assessment and modeling project funded by the EPA. The NWFWMD and the USGS have provided support to the city (FDEP 2003).

Development guidelines and permitting requirements to prevent or minimize stormwater contamination also resulted from the Comprehensive Plan and the stormwater ordinance. New developments are now required to include adequate stormwater treatment measures. Redeveloped sites must also be retrofitted to provide treatment, and efforts are made to preserve sensitive areas (FDEP 2003). The city has constructed 11 regional facilities throughout the community that incorporate both water quality treatment as well as flood prevention into their design. In 2013-2014, the City of Tallahassee completed the Upper Lake Lafayette Nutrient Reduction Project to treat stormwater that flows into Upper Lake Lafayette. The $5.6 million project includes structural and process improvements that will greatly enhance the capacity of the existing Weems Stormwater Facility to remove pollutants. Cascades Park was constructed by the City of Tallahassee and Leon County in 2014 as a multi-purpose stormwater facility to provide flood relief in downtown Tallahassee. It offers a variety of outdoor and recreational amenities, including a state-of-the-art amphitheater, interactive water fountain, children's play area, Smokey Hollow Commemoration and miles of multi-use trails. The park was funded by Blueprint 2000 through the use of a one-cent local option sales tax.

In 1999, the City of Tallahassee Stormwater Management Division began implementing a Stormwater Pollution Reduction Program, which incorporates strategic stormwater retrofits and a management program to reduce stormwater pollution from existing developed areas. Initial phases of the process have been completed (City of Tallahassee and Environmental Research and Design 2002), including a monitoring program and development of a computer model to simulate existing and future pollutant loadings. These led to the development of a problem prioritization system to identify areas with the optimum potential for stormwater treatment list of stormwater treatment scenarios. A list of stormwater treatment alternatives and a financial plan have been developed and presented to the City Commission for review and approval. Milestones for implementation of the selected stormwater treatment alternatives will then be included in the Comprehensive Plan (FDEP 2003). For the last ten years, the City of Tallahassee has sponsored the TAPP – Think About Personal Pollution Campaign to help educate citizens on ways that they can make small personal changes in their home and yard practices to help keep local lakes, sinks, and streams cleaner. The campaign has been recognized nationally for its effectiveness.

5.4.13 Other Programs and Actions

As described in the preceding section, local governments and organizations are active participants in the restoration projects being or expected to be funded through the RESTORE Act, the NRDA, and the NFWF. These organizations have been longstanding partners in monitoring water quality and environmental health throughout the watershed. They have also been key partners in developing stormwater master plans and retrofit projects to reduce and treat stormwater, as well as building community support for watershed protection through the creation of citizen advisory councils and volunteer organizations.

Numerous citizen or citizen-government groups with a primary interest in protecting or enhancing water resources are active in the St. Marks River and Bay watershed. Most organizations have a specific geographic focus at either the watershed or waterbody level. Identified groups and their activities are as follows:

- **Apalachee Audubon** - The Apalachee Audubon is North Florida's chapter of the National Audubon Society, a non-profit organization dedicated to the "protection of the environment through education, appreciation, and conservation" through education, membership, field trips, and public programs (Apalachee Audubon 2016). The Apalachee Audubon Society Conservation Plan, which was adopted in November of 2015, outlines the organization's plans to conduct conservation activities such as direct habitat enhancement projects and wildlife monitoring to identify population trends. The Conservation plan also outlines the Apalachee Audubon's goal and intent to comment on agency resource management plans and public position statements that concern important conservation issues in North Florida (Apalachee Audubon 2015).
- **Wakulla Springs Alliance** - The Wakulla Spring Alliance (then the Wakulla Springs Basin Working Group) was organized in 1992 to protect and restore spring flow, water quality, and ecological health of Wakulla Spring and River. The Alliance works with other organizations to support federal, state, and local government agencies in protecting water resources (particularly Wakulla Springs) from further decline. The Alliance sponsors tours of the basin as well as weekly wildlife and SAV surveys, and has actively petitioned the FDEP, the NWFWD, Leon County, and other agencies to promote regulation that protects and enhances the Wakulla Springs basin. The Alliance has assisted in land acquisition for the establishment of the Wakulla State Forest, and collaborated in education and outreach activities such as A Walk for Wakulla Spring (Wakulla Springs Alliance 2016).
- **Florida Springs Institute** – The Howard T. Odum Florida Springs Institute is a non-profit organization dedicated to improving the understanding of springs ecology and

providing science-based education to the public and community leaders. In 2014, the Florida Springs Institute completed a restoration action plan for Wakulla Springs (Howard T. Odum Florida Springs Institute 2016).

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Appendix A Geology and Soils in the St. Marks River and Apalachee Bay Watershed

The St. Marks River and Apalachee Bay watershed encompasses two localized physiographic regions in Florida separated distinctly by the Cody Scarp: the Tallahassee Hills subdivision of the Northern Highlands and the Gulf Coastal Lowlands. Both physiographic regions exhibit unique geology and soils. The Tallahassee Hills have sandy and red clay soils and are characterized as having high runoff and low recharge as the Floridan aquifer is thinly confined. Intermittent streams are common. Coastal Lowlands are described as a flat, weakly dissected alluvial plain formed by deposition of continental sediments onto a submerged, shallow continental shelf, that were later exposed by sea level subsidence. Elevation ranges from 0 to 80 feet (0 to 25 meters) and the local relief varies from 0 to 100 feet (0 to 30 meters) (USDA 2007) relative to mean sea level. For coastal areas, fluvial deposition and shore zone processes are active in developing and maintaining beaches, swamps, and mud flats.

The Cody Scarp is considered one of the most persistent topographic breaks in Florida, dividing the watershed into its distinct physiographic regions. In the north, the Tallahassee Hills, surface sediments come from both river deposits and shallow seas and streams have carved the region into smoothly rolling hills (USDA 1981, 1989). The Tallahassee Hills are erosional-remnant hills and ridges that have elevations up to 260 feet, although they probably once represented a nearly flat Miocene delta plain. The Tallahassee Hills are immediately underlain by the Miccosukee Formation, which is made up of interbedded clay, silt, sand, and gravel (USDA 1981). The Miccosukee Formation caps topographically high areas on the Tifton Upland and lies uncomfortably on the Miocene Hawthorn Group–Torreya Formation. In the upper St. Marks River and Apalachee Bay watershed, limestone karst landscapes lead to hydrologic connectivity to the Floridan aquifer through a series of springs and sinkholes.

In the Coastal Lowlands, ancient marine geomorphic features including beach ridges, spits, bars, dunes, and terraces make up the modern topography. Terraces represent wave-cut platforms and depositional features that formed during still sands of the sea (USDA 1981, 1989). The Gulf Coastal Lowlands are dived into the Woodville Karst Plain and the Apalachicola Coastal Lowlands. The Woodville Karst Plain is a low, gently sloping plain consisting of sand dunes lying on a limestone surface that begins in the southern part of Leon County and extends southward through Wakulla County to the Gulf (USDA 1981). It is bounded on the west by the Apalachicola Coastal Lowlands and extends eastward into Jefferson County. It is characterized by loose quartz sand thinly veneering a limestone substratum that has resulted in sinkhole sand dune topography. In Leon County, the area rises from 20 to 60 feet in elevation and has crests of dunes rising 20 feet above the surrounding land. The porous sands have allowed rainwater to rapidly move into the soluble underlying limestone, which has been continuously and rapidly lowered from its original level (USDA 1989).

The southern portion of the watershed, located in the Gulf Coastal Lowlands is essentially flat and has a Pleistocene-age to Holocene-age sand cover extending from the Gulf of Mexico north to the Cody Scarp in Leon County. Holocene-age alluvial and eolian deposits are predominantly fine-grained quartz sand and are difficult to differentiate from Pleistocene sediment. In the Woodville Karst Plain, east of Crawfordville and Panacea, sediment is made up of quartz sand generally no more than 20 feet thick underlain by a karstic, early Miocene limestone. The eastern part of the watershed in Jefferson County encompasses a transitional geological area that separates the thick Tertiary carbonate sediment characteristic of the Florida peninsula from the predominant age-equivalent clastic sediment of western Florida. This area is underlain by thick limestones, dolomites, sands, and clays in the northern part of the state. The Northern Highlands extend over the northern two-thirds of Jefferson County and includes the Tallahassee Hills, which lies between the Florida-Georgia state line to the north, the Gulf Coastal Lowlands on the south, and the Ochlocknee River on the west.

Apalachicola Coastal Lowlands originally were the flat, sandy areas in western Leon County that is now extended into western Wakulla County, making up most of the Apalachicola National Forest. The Apalachicola Coastal Lowlands are west of U.S. Highway 319. This region is made up of flat, sandy areas underlain by thick sandy clay, clayey sand, and peat. The water table is close to the surface and during the rainy season much of the area is swampy. These sediments are underlain by early Miocene limestone. The early Miocene sediments of the St. Marks Formation, where present, are underlain by the Suwanee limestone and are overlain by the Hawthorn Group (also absent in some areas). The St. Marks Formation underlies nearly all of Wakulla County and interfaces with the Chattahoochee Formation to the west. The early Miocene Torreya Formation is characteristically a siliciclastic unit consisting of very fine or medium clayey sand to sandy silty clay. The Torreya Formation extends into northwestern and western Wakulla County (USDA 1991).

Many of the geologic processes described above are a product of prehistoric marine deposition during periods when sea level was higher than present. Fluvial processes, in conjunction, are also greatly responsible for the modern land surface of the St. Marks River and Apalachee Bay watershed.

Soils within the St. Marks River and Apalachee Bay watershed have been used for extensively for crop production, silviculture, and pastureland since the state's settlement. Along with being a valuable agricultural resource, soils also protect water quality by absorbing runoff, store soil organic carbon, and help mitigate flooding. The following soils are found in the Florida portion of the St. Marks River and Apalachee Bay watershed:

Ultisols

Ultisols are intensely-weathered soils of warm and humid climates, and are usually formed on older geologic formations in parent material that is already extensively weathered (i.e., upland areas of the watershed). They are generally low in natural fertility and high in soil acidity, but contain subsurface clay accumulations that give them a high nutrient retention capacity. In the St. Marks River and Apalachee Bay watershed, soils found north of the Woodville Karst Plain where the landscape has been relatively stable over recent geologic time are primarily ultisols (Collins 2010). Ultisols are the primary agricultural and silvicultural soils of the watershed, as their high clay content contributes to nutrient and water retention, when properly managed and are found in eastern Leon County and western Jefferson County.

Entisols

Entisols are young soils that show little development, have no diagnostic horizons, and are largely unaltered from their parent material, which can be unconsolidated sediment or rock (USDA 2014). Entisols are found in the Tallahassee metropolitan area, and in northeastern Jefferson County near the Georgia border and west of Lake Miccosukee, where surficial processes are active (Collins 2010).

Spodosols

Spodosols are sandy, acidic soils, often found in cool, moist climates such as coastal conifer forests (USDA 2014). They are easily identified by their strikingly-colored horizons, which form as a result of leaching and accumulation processes. Spodosols can be found throughout the central portion of the Aucilla Wildlife Management Area and along the southern and eastern margin of Lake Miccosukee in Jefferson County (Collins 2010). The presence of spodosols indicates an area that was historically dominated by a pine (longleaf) over-story.

Alfisols

South of Tallahassee and along the coast from Medart to the eastern edge of the watershed, soils are classified predominantly as alfisols, or forest soils. Alfisols are extensive throughout Wakulla County and southern Jefferson County, making up large portions of the St. Marks NWR and the Flint Rock Wildlife Management Area. Soils within the Apalachicola National Forest are classified primarily as alfisols, inceptisols, and histosols (wetland soils).

Inceptisols

Inceptisols are described as soils in the beginning stages of soil profile development, as the differences between soil horizons are just beginning to appear in the form of color variation due to accumulations of small amounts of clay, salts, and organic material. Inceptisols occur predominantly within the Apalachicola National Forest and in the coastal portion of the watershed where the St. Marks River drains into Apalachee Bay (Collins 2010).

Histosols

Histosols are described as soils without permafrost and predominantly composed of organic material in various stages of decomposition. These soils are usually saturated, resulting in anaerobic conditions, slower rates of decomposition, and increased organic matter accumulation. Histosols generally consist of at least half organic materials and are common in wetlands (USDA 2014). Histosols in the St. Marks River and Apalachee Bay watershed occur in eastern Wakulla County, throughout the Apalachicola National Forest, and along Munson Slough within the Tallahassee metropolitan area. Many of these histosols reflect the relic hydrology prior to extensive urbanization (Collins 2010; USDA 2014). Histosols cover approximately 6,155 square miles in the state of Florida and store more organic carbon than any other soil type (Kolka *et al.* 2016; Vasques *et al.* 2010). Drainage of wetland areas and the associated decomposition of organic matter stored in histosols is a well-documented source of atmospheric carbon dioxide and methane.

Appendix B Threatened and Endangered Species within the Watershed

The St. Marks River and Apalachee Bay watershed supports a wide array of biological resources and habitats; and therefore, many species of flora and fauna. This Appendix provides a list of species that are protected and tracked for the watershed, as well as their habitat requirements (FNAI 2010; FWC 2016c; USFWS 2016):

Plants:

Scientific Name	Common Name	Regulatory Designation			Natural Communities
		FNAI	State	Federal	
Andropogon arctatus	Pinewood Bluestem	S3	T	N	Lacustrine: wet pine flatwoods, seepage wetlands, bogs, wet pine savannas
Asclepias viridula	Green Milkweed	S2	T	N	Palustrine: wet prairie, seepage slope edges
Aristida simpliciflora	Southern Threeawn	N	E	N	N/A
Aster spinulosus	Pinewoods Aster	S1	E	N	Palustrine: seepage slope Terrestrial: sandhill, scrub and mesic flatwoods
Baptisia megacarpa	Apalachicola Wild Indigo	S2	E	N	Palustrine: floodplain forest Terrestrial: upland mixed forest, slope forest
Baptisia simplicifolia	Scareweed	S3	T	N	N/A
Brickellia cordifolia	Flyer's Nemesis	S1	E	N	Terrestrial: upland hardwood forest, near streams
Sideroxylon lycioides	Buckthorn	N	E	N	Palustrine: bottomland forest, dome swamp, floodplain forest
Sideroxylon thornei	Thorn's Buckthorn	N	E	N	Palustrine: hydric hammock, floodplain swamp

Scientific Name	Common Name	Regulatory Designation			Natural Communities
		FNAI	State	Federal	
Arnoglossum diversifolia	Indian-plantain	N	T	N	Palustrine: forested wetland
Calamintha dentata	Toothed Savory	S3	T	N	Terrestrial: longleaf pine-deciduous oak sandhills, planted pine plantations, sand, open and abandoned fields, and roadsides
Calamovilfa curtissii	Curtiss's Sandgrass	S3	T	N	Palustrine: mesic and wet flatwoods, wet prairie, depression marsh
Callirhoe papaver	Poppy Mallow	S2	E	N	Terrestrial: upland mixed forest, roadsides; edge or understory
Calycanthus floridus	Sweetshrub	S2	E	N	Terrestrial: upland hardwood forest, slope forest, bluffs Palustrine: bottomland forest, stream banks, floodplains
Calystegia catesbaeiana	Catesby's Bindweed	SH	E	N	Terrestrial: Longleaf pine-wiregrass sandhill.
Cleistes divaricata	Spreading pogonia	N	E	N	N/A
Crataegus phaenopyrum	Washington Hawthorn	S1	E	N	Palustrine: basin swamp, basin marsh, edges of wet areas
Conradina canescens	Short-leaved rosemary	N	N	E	N/A
Cuphea aspera	Tropical Waxweed	S1	E	N	Palustrine: wet prairie, seepage slope Terrestrial: mesic flatwoods

Scientific Name	Common Name	Regulatory Designation			Natural Communities
		FNAI	State	Federal	
Drosera intermedia	Water Sundew	S3	T	N	Lacustrine: sinkhole lake edges Palustrine: seepage slope, wet flatwoods, depression marsh Riverine: seepage stream banks, drainage ditches
Drosera tracyi	Tracy's Sundew	N	E	N	N/A
Euphorbia telephioides	Telephus Spurge	S1	E	N	Terrestrial: mesic flatwoods; disturbed wiregrass areas, coastal scrub
Forestiera godfreyi	Godfrey's Swamp Privet	S2	E	N	Terrestrial: forest-hardwood, on wooded slopes of lake & river bluffs
Galactia smallii	Small's milkpea	N	N	E	N/A
Gentiana pennelliana	Wiregrass Gentian	S3	E	N	Palustrine: seepage slope, wet prairie, roadside ditches Terrestrial: mesic flatwoods, planted slash pine
Harperocallis flava	Harper's beauty	N	N	E	N/A
Hexastylis arifolia	Heartleaf Wild Ginger	S3	T	N	Riverine: seepage stream bank Terrestrial: slope forest
Hymenocallis godfreyi	Godfrey's spiderlily	S1	E	N	N/A
Justicia crassifolia	Thickleaved Waterwillow	S2	E	N	Palustrine: dome swamp, seepage slope Terrestrial: mesic flatwoods

Scientific Name	Common Name	Regulatory Designation			Natural Communities
		FNAI	State	Federal	
Kalmia latifolia	Mountain Laurel	S3	T	N	Riverine: seepage stream bank Terrestrial: slope forest, seepage stream banks
Lachnocaulon digynum	Panhandle Bog Buttons	S3	T	N	Riverine: pool Palustrine: bog/fen, forested wetland
Leitneria floridana	Corkwood	S2	T	N	N/A
Liatris provincialis	Godfrey's Gayfeather	S2	E	N	Terrestrial: sandhill, scrub, coastal grassland; disturbed areas
Lilium catesbaei	Catesby Lily	N	T	N	Palustrine: wet prairie, wet flatwoods, seepage slope Terrestrial: mesic flatwoods, seepage slope; usually with grasses
Linum westii	West's Flax	S2	E	N	Palustrine: dome swamp, depression marsh, wet flatwoods, wet prairie, pond margins
Lupinus westianus	Gulf Coast Lupine	S2	T	N	Terrestrial: beach dune, scrub, disturbed areas, roadsides, blowouts in dunes
Lobelia cardinalis	Cardinal flower	N	T	N	N/A
Macbridea alba	White Birds-in-a-nest	S2	E	T	Palustrine: seepage slope Terrestrial: grassy mesic pine flatwoods, savannahs, roadsides, and similar habitat

Scientific Name	Common Name	Regulatory Designation			Natural Communities
		FNAI	State	Federal	
Macranthera flammea	Hummingbird Flower	S2	E	N	Palustrine: seepage slope, dome swamp edges, floodplain swamps Riverine: seepage stream banks Terrestrial: seepage slopes
Magnolia ashei	Ashe's Magnolia	S2	E	N	Terrestrial: slope and upland hardwood forest, ravines
Magnolia pyramidata	Pyramid Magnolia	S3	E	N	Terrestrial: slope forest
Malaxis uniflora	Green Addersmouth	S3	E	N	Palustrine: floodplain forest Terrestrial: slope forest, upland mixed forest
Malus angustifolia	Southern Crabapple	N	T	N	N/A
Myriophyllum laxum	Piedmont Water-milfoil	S3	N	N	Riverine: creek, pool, spring/spring brook Palustrine: riparian, temporary pool
Nyssa ursina	Bog Tupelo	S2	N	N	Open bogs, wet flatwoods, and swamps, often with titi
Opuntia stricta	Prickly pear cactus	N	T	N	N/A
Phoebanthus tenuifolius	Narrowleaf Phoebanthus	S3	LT	N	Terrestrial: sandy pinelands
Pinckneya bracteata	Fever Tree	N	T	N	Palustrine: creek swamps, titi swamps, bogs

Scientific Name	Common Name	Regulatory Designation			Natural Communities
		FNAI	State	Federal	
Pinguicula ionantha	Panhandle Butterwort	S2	E	T	Palustrine: wet flatwoods, wet prarie, bog; in shallow water Riverine: seepage slope; in shallow water. Also, roadside ditches and similar habitat
Pinguicula lutea	Yellow Butterwort	N	T	N	Palustrine: flatwoods, bogs
Pinguicula planifolia	Swamp Butterwort	N	T	N	Palustrine: wet flatwoods, seepage slopes, bog, dome swamp, ditches; in water
Pinguicula primuliflora	Primrose-flowered Butterwort	S3	E	N	Palustrine: bogs, pond margins, margins of spring runs
Platanthera blephariglottis	Whitefringed Orchid	N	T	N	N/A
Platanthera ciliaris	Yellowfringed Orchid	N	T	N	Palustrine: bogs, wet flatwoods Terrestrial: bluff
Platanthera clavellata	Green Rein Orchid	SH	E	N	Lacustrine: seepages, springs (usually wooded); shrub borders of acid bogs; swamp woods; creek floodplains; occasionally open fens; and in the northern or mountainous part of its range, seepage slopes or sunlit stream beds, disturbed sites, such as abandoned quarries, roadbanks, ditches, and sandy-acid mine tailings
Platanthera integra	Orange Rein Orchid	S3	E	N	Palustrine: wet prairie, seepage slope Terrestrial: mesic flatwoods

Scientific Name	Common Name	Regulatory Designation			Natural Communities
		FNAI	State	Federal	
Plantanthera nivea	Snowy Orchid	N	T	N	Palustrine: bogs
Polygonella macrophylla	Largeleaf jointweed	S2	T	N	Terrestrial: scrub, sand pine/oak scrub ridges
Rhexia parviflora	Apalachicola Meadowbeau ty	S2	E	N	Palustrine: dome swamp margin, seepage slope, depression marsh; on slopes; with hypericum
Rhexia salicifolia	Panhandle Meadowbeau ty	S2	T	N	Lacustrine: full sun in wet sandy or sandy-peaty areas of sinkhole pond shores, interdunal swales, margins of depression, marshes, flatwoods, ponds and sandhill upland lakes
Ribes echinellum	Miccosukee gooseberry		E	T	Lacustrine: shores of Lake Miccosukee
Rhododendron austrinum	Florida Flame Azalea	S3	E	N	Lacustrine: shaded ravines & in wet bottomlands on rises of sandy alluvium or older terraces.
Ruellia noctiflora	Nightfloweri ng Ruellia	S2	E	N	Lacustrine: moist to wet coastal pinelands, bogs, low meadows, open pine savannahs
Salix eriocephala	Hearleaved Willow	S1	E	N	Palustrine: floodplain swamp, alluvial woodlands
Sarracenia leucophylla	Whitetop Pitcher Plant	S3	E	N	Palustrine: wet prairie, seepage slope, baygall edges, ditches
Sarracenia minor	Hooded Pitcher Plant	N	T	N	Palustrine: seepage slopes and bogs; wet flatwoods
Sarracenia psitticina	Parrot Pitcher Plant	N	T	N	Palustrine: wet flatwoods, wet prairie, seepage slope

Scientific Name	Common Name	Regulatory Designation			Natural Communities
		FNAI	State	Federal	
Sarracenia purpurea	Decumbent Pitcher Plant	N	T	N	Palustrine: bogs
Scutellaria floridana	Florida Skullcap	S1	E	T	Palustrine: seepage slope, wet flatwoods, grassy openings Terrestrial: mesic flatwoods
Spiranthes laciniata	Lace-lip Ladies'-tresses	N	T	N	Palustrine: wet flatwoods
Stachydeoma graveolens	Mock Pennyroyal	S2	E	N	Palustrine: forested wetland Terrestrial: forest edge, forest/woodland, savanna, woodland - conifer
Stewartia malacodendron	Silky Camelia	S3	E	N	Palustrine: baygall Terrestrial: slope forest, upland mixed forest; acid soils
Verbesina chapmanii	Chapman's Crownbeard	S3	T	N	Palustrine: seepage slope Terrestrial: mesic flatwoods with wiregrass
Xyris longisepala	Kral's Yelloweyed Grass	S2	E	N	Lacustrine: sandhill upland lake margins
Xyris scabrifolia	Harper's Yelloweyed Grass	S3	T	N	Palustrine: seepage slope, wet prairie, bogs

Animals:

Scientific Name	Common Name	Regulatory Designation			Natural Communities
		FNAI	State	Federal	
Invertebrates					
Elliptoideus sloatianus					
Procambarus orcinus	Woodville Karst Cave Crayfish	S1	N	N	Caves of Leon and Wakulla counties
Procambarus horsti	Big Blue Springs Cave Crayfish	S1	N	N	Subterranean springs of Jefferson and Leon counties
Crangonyx grandimanus	Florida Cave Amphipod	S2S3	N	N	caves
Crangonyx hobbsi	Hobbs' Cave Amphipod	S2S3	N	N	caves
Remasellus parvus	Swimming Little Florida Cave Isopod	S1S2	N	N	Caves
Somatochlora provocans	Treetop Emerald	S3	N	N	Riverine: Sand bottomed forest streams and seeps
Dromogomphus armatus	Southeastern Spinyleg	S3	N	N	Riverine: small spring fed streams with muck bottom
Progomphus bellei	Belle's Sanddragon	S3	N	N	Lacustrine: sandy lakes Riverine: first order sandy streams
Tachopteryx thoreyi	Gray Petaltail	S3	N	N	Palustrine: mucky seeps in forested areas, flat or on hillside and associated with either streams or ponds

Scientific Name	Common Name	Regulatory Designation			Natural Communities
		FNAI	State	Federal	
Lampsilis subangulata	Shinyrayed Pocketbook	S1	N	E	Riverine: mid-sized rivers and creeks with a clear or sandy silt floor
Amblema neislerii	Fat Threeridge	G1/S 1	N	E	Riverine: slow to moderate current rivers with sand, gravel, and rocky rubble floors
Medionidus simpsonianus	Ochlockonee moccasinshell	S1	N	E	Riverine: large creeks and mid-sized rivers of moderate current and sandy, gravel floor
Panopea bitruncata	Atlantic Geoduck	S3?	N	N	N/A
Pleurobrema pyriforme	Oval Pigtoe	S?	N	LE	Riverine: medium-sized creeks to small rivers; various substrates; slow to moderate currents
Fish					
Acipenser oxyrhyncus desotoi	Gulf Sturgeon	S2	SSC	T	Estuarine: various Marine: various habitats Riverine: alluvial and blackwater streams
Ameirus serracanthus	Spotted Bullhead	S3	N	N	Riverine: deep holes of small to medium rivers with slow to swift currents and rock substrates or sand bottoms; it also occurs over mud bottoms, typically near stumps, in impoundments

Scientific Name	Common Name	Regulatory Designation			Natural Communities
		FNAI	State	Federal	
Atractosteus spatula	Alligator Gar	S3	N	N	Riverine: sluggish pools of large rivers and their bayous, oxbow lakes, swamps, and backwaters, rarely brackish or marine waters along the coast
Micropterus notius	Suwannee Bass	S3	SSC	N	Riverine: Rivers with moderate to swift currents near limestone or woody structure
Amphibians					
Ambystoma cingulatum	Flatwoods Salamander	S2S3	N	T	Lacustrine: shallow water Palustrine: forested wetland, herbaceous wetland, riparian, scrub-shrub wetland, temporary pool Terrestrial: forest - conifer, forest/woodland, savanna, woodland - conifer
Rana capito	Gopher Frog	S3	SSC	N	Terrestrial; sandhill, scrub, scrubby flatwoods, xeric hammock (reproduces in ephemeral wetlands within these communities)
Notophthalmus perstriatus	Striped newt	S2	N	N	Terrestrial: longleaf pine-dominated savanna, scrub, or sandhill habitats Palustrine: ephemeral ponds; eggs
Desmognathus apalachicolae	Apalachicola Dusky Salamander	S3	N	N	Palustrine: seepage stream edges at bottoms of deep, moist, wooded ravines that support mixed-hardwood forest on slopes

Scientific Name	Common Name	Regulatory Designation			Natural Communities
		FNAI	State	Federal	
Reptiles					
Alligator mississippiensis	American Alligator	S4	SSC	T	Estuarine: herbaceous wetland Riverine: big river, creek, low gradient, medium river, pool, spring/spring brook Lacustrine: shallow water Palustrine: forested wetland, herbaceous wetland, riparian, scrub-shrub wetland
Caretta caretta	Atlantic Loggerhead Turtle	S3	T	T	Terrestrial: sandy beaches; nesting
Chelonia mydas	Atlantic Green Turtle	S2	E	E	Terrestrial: sandy beaches; nesting
Crotalis adamanteus	Eastern Diamondback Rattlesnake	S3	N	N	Palustrine: riparian Terrestrial: grassland/herbaceous, old field, savanna, shrubland/chaparral, woodland - conifer, woodland - hardwood, woodland - mixed
Dermochelys coriacea	Leatherback Turtle	S2	T	T	Terrestrial: sandy beaches; nesting
Drymarchoncorias couperi	Eastern Indigo Snake	S3	T	T	Estuarine: tidal swamp Palustrine: hydric hammock, wet flatwoods Terrestrial: mesic flatwoods, upland pine forest, sandhills, scrub, scrubby flatwoods, rockland hammock, ruderal
Gopherus polyphemus	Gopher Tortoise	S3	SSC	N	Terrestrial: sandhills, scrub, scrubby flatwoods, xeric hammocks, coastal strand, ruderal

Scientific Name	Common Name	Regulatory Designation			Natural Communities
		FNAI	State	Federal	
Graptomys barbouri	Barbour's Map Turtle	S2	SSC	N	Palustrine: floodplain stream, floodplain swamp Riverine: alluvial stream
Lepidochely kempii	Kemp's Ridley	S1	E	E	Terrestrial: sandy beaches; nesting
Macroclemys temminckii	Alligator Snapping Turtle	S3	SSC	N	Estuarine: tidal marsh Lacustrine: river floodplain lake, swamp lake Riverine: alluvial stream, blackwater stream
Nerodiaclarkii clarkii	Gulf Salt Marsh Snake	S3?	N	N	Estuarine: herbaceous wetland, scrub-shrub wetland
Pituophis melanoleucas	Florida Pine Snake	S3	SSC	N	Lacustrine: ruderal, sandhill upland lake Terrestrial: sandhill, scrubby flatwoods, xeric hammock, ruderal
Heterodon simus	Southern hognose snake	S2	N	N	Palustrine: sandhill, pine flatwood, sand ridges Terrestrial: coastal dunes
Thamnophis sauritus sackeni	Florida ribbon snake	S?	SSC	N	Terrestrial: pinelands, hardwood hammocks Palustrine: cypress strands, prairies, marshes, streams, ponds, bogs
Pseudemys suwanniensis	Suwannee Cooter	S3	SSC	N	Riverine: blackwater, alluvial, and spring-fed rivers, impoundments

Scientific Name	Common Name	Regulatory Designation			Natural Communities
		FNAI	State	Federal	
Birds					
Ammodramus maritimus peninsulae	Scott's Seaside Sparrow	S2	SSC	N	N/A
Aramus guarauna	Limpkin	S3	SSC	N	Estuarine: scrub-shrub wetland Palustrine: forested wetland, herbaceous wetland, riparian
Charadrius alexandrius	Snowy Plover	S2	LT	N	Estuarine: exposed unconsolidated substrate Marine: exposed unconsolidated substrate Terrestrial: dunes, sandy beaches, and inlet areas.
Charadrius melodus	Piping Plover	S2	T	T	Estuarine: exposed unconsolidated substrate Marine: exposed unconsolidated substrate Terrestrial: dunes, sandy beaches, and inlet areas. Mostly wintering and migrants.
Cistothorus Palustris marianae	Marian's Marsh Wren	S3	SSC	N	N/A
Egretta caerulea	Little Blue Heron	S4	SSC	N	Estuarine: herbaceous wetland, lagoon, scrub-shrub wetland, tidal flat/shore Riverine: low gradient Lacustrine: shallow water Palustrine: forested wetland, herbaceous wetland, riparian, scrub-shrub wetland

Scientific Name	Common Name	Regulatory Designation			Natural Communities
		FNAI	State	Federal	
Egretta rufescens	Reddish Egret	S2	SSC	N	Estuarine: tidal swamp, depression marsh, bog, marl prairie, wet prairie Lacustrine: flatwoods/prairie lake, marsh lake Marine: tidal swamp
Egretta thula	Snowy Egret	S3	SSC	N	Estuarine: bay/sound, herbaceous wetland, lagoon, river mouth/tidal river, scrub-shrub wetland, tidal flat/shore Riverine: low gradient Lacustrine: shallow water Palustrine: forested wetland, herbaceous wetland, riparian
Egretta tricolor	Tricolored Heron	S4	SSC	N	Estuarine: bay/sound, herbaceous wetland, lagoon, river mouth/tidal river, scrub-shrub wetland, tidal flat/shore Riverine: low gradient Lacustrine: shallow water Palustrine: forested wetland, herbaceous wetland, riparian
Eudocimus albus	White Ibis	S4	SSC	N	Estuarine: bay/sound, herbaceous wetland, lagoon, river mouth/tidal river, scrub-shrub wetland, tidal flat/shore Riverine: low gradient Lacustrine: shallow water Palustrine: forested wetland, herbaceous wetland, riparian

Scientific Name	Common Name	Regulatory Designation			Natural Communities
		FNAI	State	Federal	
Falco peregrinus	Peregrine Falcon	S2	E	N	Marine: aerial Estuarine: aerial, bay/sound, herbaceous wetland, lagoon, river mouth/tidal river, tidal flat/shore Riverine: aerial Lacustrine: aerial Palustrine: aerial, herbaceous wetland, riparian Terrestrial: cliff, desert, shrubland/chaparral, tundra, urban/edificarian, woodland - conifer, woodland - hardwood, woodland - mixed
Falco sparvarius paulus	Southeastern American Kestrel	S3	T	N	Estuarine: various habitats Palustrine: various habitats Terrestrial: open pine forests, clearings, ruderal, various
Haematopus palliatus	American Oystercatcher	S2	SSC	N	Estuarine: tidal flat/shore Terrestrial: bare rock/talus/scree, sand/dune
Haliaeetus leucocephala	Bald Eagle	S3	T	T	Estuarine: marsh edges, tidal swamp, open water Lacustrine: swamp lakes, edges Palustrine: swamp, floodplain Riverine: shoreline, open water Terrestrial: pine and hardwood forests
Myctera americana	Wood Stork	S2	E	E	Estuarine: marshes Lacustrine: floodplain lakes, marshes (feeding), various Palustrine: marshes, swamps, various

Scientific Name	Common Name	Regulatory Designation			Natural Communities
		FNAI	State	Federal	
Pandion haliatus	Osprey	S3S4	SSC	N	Marine: near shore Estuarine: bay/sound, herbaceous wetland, lagoon, river mouth/tidal river Riverine: big river, medium river Lacustrine: deep water, shallow water Palustrine: forested wetland, riparian Terrestrial: cliff
Picoides borealis	Red-cockaded Woodpecker	S2	T	E	Terrestrial: mature pine forests
Rhynchops niger	Black Skimmer	S3	SSC	N	Marine: near shore Estuarine: bay/sound, herbaceous wetland, lagoon, river mouth/tidal river, tidal flat/shore Riverine: big river, low gradient Lacustrine: deep water, Shallow water Palustrine: riparian Terrestrial: sand/dune
Sterna antillarum	Least Tern	S3	T	N	Estuarine: various Lacustrine various Riverine: various Terrestrial: beach dune, ruderal. Nests common on rooftops
Sterna maxima	Royal Tern	S3	N	N	Marine: near shore Estuarine: bay/sound, lagoon, river mouth/tidal river, tidal flat/shore Terrestrial: sand/dune

Scientific Name	Common Name	Regulatory Designation			Natural Communities
		FNAI	State	Federal	
Sterna sandvicensis	Sandwich Tern	S2	N	N	Marine: near shore Estuarine: bay/sound, lagoon, river mouth/tidal river, tidal flat/shore Terrestrial: sand/dune
Ammodramus maritimus juncicola	Wakulla seaside sparrow	S?	SSC	N	Estuarine: tidal marshes
Calidris canutus rufa	Red knot	S2	N	T	Estuarine: bays, tidal flats, salt marshes Terrestrial: sandy beaches Marine: aerial, near shore
Nyctanassa violacea	Yellow-crowned night heron	S3	N	N	Estuarine: bays, bayous, tidal marsh Palustrine: Cypress swamps Riverine: streams, lowland rivers
Mammals					
Mustela frenata olivacea	Southeastern Weasel	S3?	N	N	Palustrine: forested wetland, riparian Terrestrial: forest - hardwood, old field, woodland - conifer, woodland - hardwood, woodland - mixed
Myotis grisescens	Gray Bat	S1	E	E	Palustrine: caves, various Terrestrial: caves, various
Sciuris niger shermani	Sherman's Fox Squirrel	S3	SSC	N	Terrestrial: woodland - conifer, woodland - mixed

Scientific Name	Common Name	Regulatory Designation			Natural Communities
		FNAI	State	Federal	
Trichechus manatus	West Indian Manatee	S2	E	E	Estuarine: submerged vegetation, open water Marine: open water, submerged vegetation
Ursus americanus floridanus	Florida Black Bear	S2	N	N	Palustrine: forested wetland, riparian Terrestrial: forest - hardwood, forest - mixed

Sources: FNAI 2010; FWC 2016c; USFWS 2016.

Key:

FNAI STATE ELEMENT RANK

S1 = Critically imperiled in Florida because of extreme rarity (5 or fewer occurrences or less than 1000 individuals) or because of extreme vulnerability to extinction due to some natural or man-made factor.

S2 = Imperiled in Florida because of rarity (6 to 20 occurrences or less than 3000 individuals) or because of vulnerability to extinction due to some natural or man-made factor.

S3 = Either very rare and local in Florida (21-100 occurrences or less than 10,000 individuals) or found locally in a restricted range or vulnerable to extinction from other factors.

S4 = Apparently secure in Florida (may be rare in parts of range).

S5 = Demonstrably secure in Florida.

SH = Of historical occurrence in Florida, possibly extirpated, but may be rediscovered (e.g., ivory-billed woodpecker).

SX = Believed to be extirpated throughout Florida.

SU = Unrankable; due to a lack of information no rank or range can be assigned.

SNA = State ranking is not applicable because the element is not a suitable target for conservation (e.g. a hybrid species).

SNR = Element not yet ranked (temporary).

FEDERAL LEGAL STATUS

C = Candidate species for which federal listing agencies have sufficient information on biological vulnerability and threats to support proposing to list the species as Endangered or Threatened.

E = Endangered: species in danger of extinction throughout all or a significant portion of its range.

E, T = Species currently listed endangered in a portion of its range but only listed as threatened in other areas

E, PDL = Species currently listed endangered but has been proposed for delisting.

E, PT = Species currently listed endangered but has been proposed for listing as threatened.

E, XN = Species currently listed endangered but tracked population is a non-essential experimental population.

T = Threatened: species likely to become Endangered within the foreseeable future throughout all or a significant portion of its range.

PE = Species proposed for listing as endangered

PS = Partial status: some but not all of the species' infraspecific taxa have federal status

PT = Species proposed for listing as threatened

SAT = Treated as threatened due to similarity of appearance to a species which is federally listed such that enforcement personnel have difficulty in attempting to differentiate between the listed and unlisted species.

SC = Not currently listed, but considered a "species of concern" to USFWS.

STATE LEGAL STATUS

C = Candidate for listing at the Federal level by the U. S. Fish and Wildlife Service

FE = Listed as Endangered Species at the Federal level by the U. S. Fish and Wildlife Service

FT = Listed as Threatened Species at the Federal level by the U. S. Fish and Wildlife Service

FXN = Federal listed as an experimental population in Florida

FT(S/A) = Federal Threatened due to similarity of appearance

ST = State population listed as Threatened by the FFWCC. Defined as a species, subspecies, or isolated population which is acutely vulnerable to environmental alteration, declining in number at a rapid rate, or whose range or habitat is decreasing in area at a rapid rate and as a consequence is destined or very likely to become an endangered species within the foreseeable future.

SSC = Listed as Species of Special Concern by the FFWCC. Defined as a population which warrants special protection, recognition, or consideration because it has an inherent significant vulnerability to habitat modification, environmental alteration, human disturbance, or substantial human exploitation which, in the foreseeable future, may result in its becoming a threatened species. (SSC* for Pandion haliaetus (Osprey) indicates that this status applies in Monroe county only.)

N = Not currently listed, nor currently being considered for listing.

Plants: Definitions derived from Sections 581.011 and 581.185(2), Florida Statutes, and the Preservation of Native Flora of Florida Act, 5B-40.001. FNAI does not track all state-regulated plant species; for a complete list of state-regulated plant species, call Florida Division of Plant Industry, 352-372-3505 or see: http://www.doacs.state.fl.us/pi/.

E = Endangered: species of plants native to Florida that are in imminent danger of extinction within the state, the survival of which is unlikely if the causes of a decline in the number of plants continue; includes all species determined to be endangered or threatened pursuant to the U.S. Endangered Species Act.

T = Threatened: species native to the state that are in rapid decline in the number of plants within the state, but which have not so decreased in number as to cause them to be Endangered.

N = Not currently listed, nor currently being considered for listing.

Appendix C Habitats and Natural Communities

The FNAI defines a natural community as a distinct and recurring assemblage of populations of plants, animals, fungi, and microorganisms naturally associated with each other and their physical environment. Based on GIS analysis there are 25 unique natural communities recognized by the FNAI within the St. Marks River and Apalachee Bay watershed (FNAI 2010). Habitats and Natural Communities were identified using the 2010 Florida Land Use, Cover and Forms Classification System (FLUCFS) data from the NWFWMD, as well as the 2004-2013 Statewide Land Use Land Cover datasets created by the five Water Management Districts in Florida. Data were modified and refined based on aerial photograph signatures and field observations. Below are community descriptions (excerpts from FNAI 2010) with some site-specific information about many of the communities in the watershed.

Upland Communities	
Mesic Flatwoods	Mesic flatwoods can be found on the flat sandy terraces left behind by Plio-Pleistocene high sea level stands. Mesic flatwoods consist of an open canopy of tall pines (commonly longleaf pine or slash pine) and a dense, low ground layer of shrubs, grasses (commonly wiregrass), and forbs. The most widespread natural community in Florida, mesic flatwoods are home to many rare plants and animals such as the frosted flatwoods salamander (*Ambystoma cingulatum*), the reticulated flatwoods salamander (*Ambystoma bishop*) the Red-cockaded woodpecker (*Leuconotopicus borealis*) and many others. Mesic flatwoods require frequent fire (two to four years) and all of its constituent plant species recover rapidly from fire, including many rare and endemic plants. In the Panhandle north of the Cody Scarp, mesic flatwoods occupy relatively small, low-lying areas (FNAI 2010). Within the St. Marks River and Apalachee Bay watershed, healthy mesic flatwoods occur in the Apalachicola National Forest and the in the St. Marks NWR in the northeastern section of the park near the St. Marks River and the City of St. Marks (USFWS 2013b).

Sandhill	Sandhill communities are characterized by broadly-spaced pine trees with a deciduous oak understory sparse midstory of deciduous oaks and a moderate to dense groundcover of grasses, herbs, and low shrubs. Species typical of sandhill communities include longleaf pine (*Pinus palustris*), turkey oak (*Quercus laevis*), and wiregrass (*Aristida stricta var. beyrichiana*). Sandhill is observed on crests and slopes of rolling hills and ridges with steep or gentle topography. Sandhill communities are important for aquifer recharge, as sandy soils allow water to infiltrate rapidly, resulting in sandy, dry soil, with little runoff evaporation. Fire is a dominant environmental factor in sandhill ecology and is essential for the conservation of native sandhill flora and fauna (FNAI 2010). Within the St. Marks River and Apalachee Bay watershed, exemplary sandhill communities can be found extensively throughout the Apalachicola National Forest and within the Wakulla and Panacea units of the St. Mark's National Wildlife Refuge in southern Wakulla County (near Alligator Lake north of Panacea) (FNAI 2010).
Scrub	Scrub is a community composed of evergreen shrubs, with or without a canopy of pines, and is found on well-drained, infertile, narrow sandy ridges distributed parallel to the coastline. Signature scrub species include three species of shrubby oaks, Florida rosemary (*Ceratiola ericoides*), and sand pine (*Pinus clausa*), which may occur with or without a canopy of pines. Scrub is characterized by burn intervals of five to 40 years, depending on the dominant vegetation. An exemplary scrub community site is located in the southeastern corner of Compartment P9 in the St. Mark's National Wildlife Refuge.
Slope Forest	Slope forest is a well-developed, highly diverse, dense canopy forest of upland hardwoods that occurs on steep slopes, bluffs, and in sheltered ravines. In slope forests, high density and diversity is driven by competition for space, water, sunlight and nutrients. The combination of densely shaded slopes and cool, moist microclimates produces conditions that are conducive for the growth of many plant species that are more typical of the Piedmont and Southern Appalachian Mountains (FNAI 2010). Within the St. Marks River and Apalachee Bay watershed, this community type can be found throughout the Apalachicola National Forest.

Terrestrial Caves	Terrestrial caves are cavities below the surface that lack standing water. These caves develop in areas of karst topography; water moves through underlying limestone, dissolving it and creating fissures and caverns. Most caves have stable internal environments with temperature and humidity levels remaining fairly constant. In areas where light is present, some plants may exist, although these are mostly limited to mosses, liverworts, ferns, and algae. Subterranean natural communities such as terrestrial caves are extremely fragile because the fauna they support are adapted to stable environments and do not tolerate environmental changes (FNAI 2010). An exemplary site includes Cal's Cave in Wakulla County.
Upland Glade	Upland glade is a largely herbaceous community with woody inclusions that occurs on thin soils over limestone outcrops on steep topography. It is found in small openings ranging from 0.1 to 2 acres in size within an otherwise forested landscape. Open portions of upland glade are dominated by black bogrush (Schoenus nigricans) and/or other graminoids, A set of limestone-loving shrubs and trees on deeper soil within the glade, or on the edges form a shrubby transition to upland hardwood forest. Characteristic woody species include red cedar (Juniperus virginiana), eastern redbud (Cercis canadensis), and sugarberry (Celtis laevigata). In the St. Marks River and Apalachee Bay, upland glade is found primarily on Oligocene Marianna Limestone between the 130- and 150-foot contours.
Upland Hardwood Forests	Upland hardwood forests are described as having a well-developed, closed-canopy dominated by deciduous hardwood trees such as southern magnolia (*Magnolia grandiflora*), pignut hickory (*Carya glabra*), sweetgum (*Liquidambar styraciflua*), Florida maple (*Acer saccharum ssp. floridanum*), live oak (*Quercus virginiana*), American beech (*Fagus grandifolia*), white oak (*Q. alba*), and spruce pine (*Pinus glabra*), and others. This community occurs on mesic soils in areas sheltered from fire, on slopes above river floodplains, in smaller areas on the sides of sinkholes, and occasionally on rises within floodplains. It typically supports a diversity of shade-tolerant shrubs, and a sparse groundcover. Upland hardwoods occur throughout the Florida Panhandle and can be found in upper portions of the watershed. An exemplary site is located at Wakulla Springs State Park (FNAI 2010).

Wet Flatwoods	Wet flatwoods are pine forests with a sparse or absent midstory. The typically dense groundcover of hydrophytic grasses, herbs, and low shrubs occurring in wet flatwoods can vary depending on the fire history of the system. Wet flatwoods occur in the ecotones between mesic flatwoods and shrub bogs, wet prairies, dome swamps, or strand swamps and are common throughout most of Florida. Wet flatwoods also occur in broad, low flatlands, frequently within a mosaic of other communities. Wet Flatwoods often occupy large areas of relatively inaccessible land, providing suitable habitat for the Florida black bear (*Ursus americanus floridanus*) as well as a host of rare and endemic plant species (FNAI 2010). This community type is found interspersed throughout the Apalachicola National Forest. An exemplary site is located in the St. Mark's National Wildlife Refuge west of Buckhorn Creek in the Panacea Unit.
Coastal Communities	
Tidal Flat	Tidal flats are stretches of shoreline that are protected from the waves that pound the beaches. Tidal flats are also known as mudflats (because their surface soils are muds brought in by channels from uplands) and intertidal zones (because they are between the tides -- exposed at low tide and flooded at high tide). We may not see much besides mud when we look at tidal flats, but many animals see breakfast, lunch, and dinner. A world of invertebrate animals lives in and on that mud, including tube worms, sand dollars, burrowing shrimp, sea cucumbers, and assorted mollusks and crabs. Not only are there lots of different animal species, but also there are thousands of animals per square foot. These invertebrates live on tiny bits of leaves and stems of both land and aquatic plants that are brought into the mudflats in freshwater channels or by the tides. The invertebrates become food for fish and birds. When the tide comes in, fish come with it and have a feast; when the tide goes out, birds pig out. Tidal flats are essential refueling stops for migrating shorebirds. Exemplary tidal flat community is located at the St. Mark's National Wildlife Refuge.

Transitional and Wetland Communities	
Basin Marsh	Basin marshes, unlike depression marshes, are marshes that lack a fire-maintained matrix community and rather, occur in relative isolation as larger landscape features. Basin marshes are regularly inundated freshwater from local rainfall, as they occur around fluctuating shorelines, on former "disappearing" lake bottoms, and at the bead of broad, low basins marking former embayments of the last high-sea level stand. Species composition is heterogeneous both within and between marshes and generally includes submerged, floating, and emergent vegetation with intermittent shrubby patches. Common species include maidencane (*Panicum hemitomon*), sawgrass (*Cladium sp.*), bulltongue arrowhead (*Sagittaria lancifolia*), pickerelweed (*Pontederia cordata*), and cordgrass (*Spartina sp.*) (FNAI 2010). In the St. Marks River and Apalachee Bay watershed, basin marsh occurs around Lake Miccosukee.
Basin Swamp	Basin swamp is a wetland vegetated with hydrophytic trees, commonly including pond cypress (*Taxodium ascendens*) and swamp tupelo (*Nyssa sylvatica var. biflora*) and shrubs that can withstand an extended hydro-period. Basin swamps are characterized by highly variable species composition and are expressed in a variety of shapes and sizes due to their occurrence in a variety of landscape positions including old lake beds or river basins, or ancient coastal swales and lagoons that existed during higher sea levels. Basin swamps can also exist around lakes and are sometimes headwater sources for major rivers. Many basin swamps have been heavily harvested and undergone significant hydrological changes due to the conversion of adjacent uplands to agricultural and silvicultural lands (FNAI 2010). An exemplary basin swamp community is located in the Aucilla Wildlife Management Area west of the Wacissa River.
Baygall	Baygall is an evergreen-forested wetland dominated by bay species including loblolly bay (*Gordonia lasianthus*), sweetbay (*Magnolia virginiana*), and/or swamp bay (*Persea palustris*). This community can be found on wet soils at the base of slopes or in depressions; on the edges of floodplains; and in stagnant drainages. Baygalls are not generally influenced by flowing water, but may be drained by small blackwater streams. Most baygalls are small; however, some form large, mature forests, called "bay swamps." The dominance of evergreen bay trees rather than a mixture of deciduous and evergreen species can be used to distinguish baygall from other forested wetlands (FNAI 2010). An exemplary baygall community is located in the Aucilla Wildlife Management Area west of Aucilla River.

Dome Swamp	Dome swamp is an isolated, forested, and usually small depression wetland consisting of predominantly pond cypress (*Taxodium ascendens*) and/or swamp tupelo (*Nyssa sylvatica var. biflora*). This community occurs within a fire-maintained community such as mesic flatwoods and commonly occupies depressions over a perched water table. Smaller trees grow on the outer edge of the swamp where the water is shallow, while taller trees grow deeper in the swamp interior creating the characteristic dome shape. Shrubs are typically sparse to moderate, but dome swamps with high fire frequencies or fire exclusion, the shrub layer may be absent. Many dome swamps form when poor surface drainage causes the dissolution of limestone bedrock, creating depressions which fill in with peat or marl. Surficial runoff from the surrounding uplands supplies much of the water within dome swamps. Consequently, water levels in these communities fluctuate naturally with seasonal rainfall changes. Dome swamps may also be connected directly to the aquifer, where groundwater influences the hydrological regime. Thus dome swamps can function as reservoirs that recharge the aquifer. Logging, nutrient enrichment, pollution from agricultural runoff, ditching, impoundment, and invasive exotic species invasion have degraded dome swamps. Some dome swamps have been used as treatment areas for secondarily-treated wastewater (FNAI 2010). Dome swamp community can be found at the St. Marks NWR and at Wakulla Springs State Park.
Floodplain Swamp	Floodplain swamp is a closed-canopy forest community of hydrophytic trees such as bald cypress (*Taxodium distichum*), water tupelo (*Nyssa aquatica*), swamp tupelo (*N. sylvatica var. biflora*), or ogeechee tupelo (*N. ogeche*). Floodplain swamp occurs on frequently- or permanently-flooded hydric soils adjacent to stream and river channels and in depressions and oxbows within the floodplain. The understory and groundcover are sparse in floodplain swamps, which can also occur within a complex mosaic of communities including alluvial forest, bottomland forest, and baygall. As rivers meander, they create oxbows and back swamps that are important breeding grounds for fish when high water connects them to the river. Floodplain swamp communities provide important wildlife habitat, contribute to flood attenuation, and help protect the overall water quality of streams and rivers. These communities may also transform nutrients or act as a nutrient sink depending on local conditions. This makes floodplain swamps useful for the disposal of partially-treated wastewater. Artificial impoundments on rivers can severely limit the seasonal flooding effects that maintain healthy floodplain systems; particularly, the stabilization of alluvial deposits and the flushing of detritus (FNAI 2010). Floodplain swamp communities are distributed along most creeks and streams within the watershed, particularly along the St. Marks River. An exemplary site is located just east of Shell Island along the St. Mark's River just north of where the Wakulla River and St. Mark's River merge.

Wet Prairie	Wet prairie is an herbaceous community usually occurring on acidic, continuously wet, but not inundated, soils. This community can be found on somewhat flat or gentle slopes between lower lying depression marshes, shrub bogs, or dome swamps or on slightly higher wet or mesic flatwoods. Wet prairies in northern Florida are some of the most diverse communities in the U.S., with an average of over 20 species per square meter in some places and over 100 total species in any given stand. The Panhandle is a hotspot for rare plants of the wet prairie community with 25 out of the 30 rare species found in this community; 12 of these are endemic to the Panhandle (FNAI 2010). This community type is found throughout the Apalachicola National Forest. Exemplary sites are located in the Panacea Unit of the St. Mark's National Wildlife Refuge.
Aquatic Communities	
Alluvial River	
Blackwater Streams	Blackwater streams are perennial or intermittent seasonal watercourses laden with tannins (natural organic chemicals), particulates, and dissolved organic matter and iron. These dissolved materials result from the streams' origins in extensive wetlands with organic soils that collect rainfall and discharge it slowly to the stream. The dark-colored water reduces light penetration and, inhibits photosynthesis, and prevents the growth of submerged aquatic plants. Blackwater streams are frequently underlain by limestones and have sandy bottoms overlain by organics that have settled out of suspension. Blackwater streams are the most widely distributed and numerous riverine systems in the southeast Coastal Plain (FNAI 2010) and found draining into most creeks, streams and bayous in the watershed. The St. Marks River begins as a blackwater stream in the northern reaches of the watershed. Many of the St. Marks River's smaller tributaries are true blackwater streams, including several streams that traverse the Apalachicola National Forest and the St. Marks National Wildlife Refuge.

Seepage Streams	Seepage streams may be perennial or intermittent seasonal as they originate from shallow groundwater percolating through sandy upland soils. Seepage streams are small magnitude features, and unlike other stream communities in Florida, they lack a deep aquifer water source and extensive swamp lowlands surrounding their head waters. Seepage streams are generally sheltered by a dense overstory of broad-leaved hardwoods which block out most sunlight. Filamentous green algae occur sporadically within the stream, while vegetation at the water's edge may include mosses, ferns and liverworts. Seepage streams are often associated with seepage slope and slope forest communities near their head waters, and bottomland forest, alluvial forest and floodplain swamp communities near their mouths. The waters of seepage streams is filtered by percolation through deep soils which slows the release of rainwater and buffers temperature extremes, creating low flow rates of clear, cool, unpolluted water. Seepage streams are generally confined to areas where topographic relief is pronounced such as northern Florida (FNAI 2010). Within the St. Marks River and Apalachee Bay watershed seepage streams are found throughout the Apalachicola National Forest and the St. Marks National Wildlife Refuge.
Sinkhole Lakes	Sinkhole lakes typically form in deep, funnel-shaped depressions in limestone bedrock and are moderately widespread in the karst regions of the Florida Panhandle. Sinkhole depressions are geologic features which are relatively permanent; however, water levels may fluctuate dramatically due to hydrologic connectivity with the aquifer. Sinkhole lakes are characterized by clear, alkaline water with high concentrations of calcium, bicarbonate, and magnesium. The vegetation in some sinkhole lakes is absent or limited to a narrow fringe of emergent species at the edge of the water, while other sinkhole lakes are completely covered by floating vegetation. Sinkhole Lakes are considered endangered in Florida due to the threat of erosion which destroys the surrounding vegetation and pollutes the aquifer with which these lakes are closely connected (FNAI 2010). Sinkhole lakes are prevalent throughout the watershed in areas where karst geology exists. An exemplary sinkhole lake is Lake Jackson in Leon County (Tallahassee).

Spring-run Streams	Spring-run streams generally have sandy or limestone bottoms and derive most of their water from artesian openings to the underlying aquifer, making their waters clear, circumneutral, mineral-rich, and cool. These conditions are highly conducive for plant growth, thus, spring-run streams are extremely productive aquatic habitats. Good examples in the watershed are listed and described in Section 2.3. Agricultural, residential, and industrial pollutants that enter the groundwater may infiltrate the deep aquifer that feeds a Spring-run stream. Herbicides applied to control aquatic plant growth are particularly detrimental because they can induce eutrophication in spring run streams. Overuse and misuse of spring-run streams from recreation is also a threat to this unique community (FNAI 2010). Spring run streams are found throughout the northern portions of the watershed where karst geology is prominent. Within the St. Marks River and Apalachee Bay watershed, the Wakulla River is an exemplary spring-run stream.
Estuarine and Marine Communities	
Salt Marsh	Salt marsh is a largely herbaceous tidal zone community commonly consisting of saltmarsh cordgrass (*Spartina alterniflora*), which dominates the seaward edge, and needlerush (*Juncus roemerianus*), which dominates higher, less frequently flooded areas. Salt marshes form where the coastal zone is protected from large waves, either by the topography of the shoreline, a barrier island, or by location along a bay or estuary. Salt marshes support a number of rare animals and plants, and provide nesting habitat for migratory and endemic bird species. Many of Florida's extensive salt marshes are protected in aquatic preserves, but the loss of marshes and adjacent seagrass beds due to human impacts such as shoreline development, ditching, and pollution and natural stressors, such as sea level rise, have vastly reduced their numbers. Salt marshes are instrumental in attenuating wave energy and protecting shorelines from erosion (FNAI 2010) and are found in the coastal/estuarine portion of the watershed. Salt marsh communities are common throughout the St. Marks River and Apalachee Bay watershed and are particularly extensive at the St. Marks National Wildlife Refuge.

Seagrass Beds	Seagrass beds consist of expansive stands of submerged aquatic vascular plants including turtlegrass (*Thalassia testudinum*), manateegrass (*Syringodium filiforme*), and shoalgrass (*Halodule wrightii*), which occur predominantly in subtidal zones in clear low-energy coastal waters. Seagrass beds occur on unconsolidated substrates and are highly susceptible to changes in water temperature, salinity, wave-energy, tidal activity, and available light. This natural community supports a wide variety of animal life including manatees, marine turtles, and many fish, particularly spotted sea trout (*Cynoscion nebulosus*), spot (*Micropogonias undulates*), sheepshead, (*Archosargus probatocephalus*), and redfish *(Sciaenops ocellatus*). Pollution, particularly sedimentation and wastewater/sewage, have led to the widespread loss of seagrasses in nearly every bay in the Florida Panhandle (FNAI 2010). Seagrass beds occur throughout the Apalachee Bay.
Oyster/Mollusk Reef	Oyster/Mollusk reef consists of expansive concentrations of sessile mollusks, which settle and develop on consolidated substrates including rock, limestone, wood, and other mollusk shells. These communities occur in both the intertidal and subtidal zones to a depth of 40 feet. In Florida, the American oyster (*Crassostrea virginica*) dominates mollusk reef communities, but other organisms including species of sponge, anemones, mussels, the burrowing sponge anemones, mussels, clams, barnacles, crabs, amphipods, and starfish live among or within the reef itself. Mollusks are filter-feeders that remove toxins from polluted waters and improve overall water quality (FNAI 2010). However, higher levels of toxins and bacteria can contaminate and close areas for commercial harvest and human consumption. Oyster/mollusk reefs can be found throughout the Apalachee Bay.
Unconsolidated (Marine) Substrate	Unconsolidated (marine) substrate consists of coralgal, marl, mud, mud/sand, sand or shell deposited in expansive, open areas of subtidal, intertidal, and supratidal zones. Unconsolidated substrates support large populations of tube worms, sand dollars, mollusks, isopods, amphipods, burrowing shrimp, and an assortment of crabs, but lack dense populations of sessile plant and animal species. Unconsolidated substrates are an important feeding ground for bottom-feeding fish, shorebirds, and invertebrates. These areas also grade into a variety of other natural communities, making them the foundation for the development of other marine and estuarine habitats. Unconsolidated substrate communities are found throughout the estuarine and riverine portions of the watershed. They are susceptible to many types of disturbances including vehicle traffic, low-dissolved oxygen (DO) levels, as well as the accumulation of metals, oils, and pesticides in the sediment (FNAI 2010). Unconsolidated (marine) substrate can be found throughout the Apalachee Bay.

Source: FNAI 2010.

Appendix D 2014 FDEP-verified Impaired Waterbody Segments in the St. Marks River and Apalachee Bay Watershed

All states are required to submit lists of impaired waters that are too polluted or degraded to meet water quality standards and their designated use (potable, recreational, shellfish harvesting) to the EPA under section 303(d) of the CWA (EPA 2016b). The following table provides a list of 2014 FDEP designated and impaired waters in the St. Marks River and Apalachee Bay watershed.

Waterbody ID	Water Segment Name	County	Waterbody Class[1]	Parameters Assessed Using the Impaired Waters Rule (IWR)
459	Ward Creek*	Jefferson	3F	Fecal Coliform
582B	Lake Jackson*	Leon	3F	Dissolved Oxygen
582B	Lake Jackson*	Leon	3F	Nutrients (TSI)[2]
582D	Lake Jackson Outlet*	Leon	3F	Fecal Coliform
628	Black Creek*	Leon	3F	Dissolved Oxygen
628	Black Creek*	Leon	3F	Fecal Coliform
647H	Alford Arm Tributary*	Leon	3F	Dissolved Oxygen (BOD)
689	Lake Overstreet Drain*	Leon	3F	Fecal Coliform
746A	Harbinwood Estates Drain*	Leon	3F	Dissolved Oxygen (BOD)
746A	Harbinwood Estates Drain*	Leon	3F	Fecal Coliform
746A	Harbinwood Estates Drain*	Leon	3F	Iron
756B	Lake Piney Z	Leon	3F	Dissolved Oxygen
756B	Lake Piney Z	Leon	3F	Nutrients (TSI)
756C	Lower Lake Lafayette	Leon	3F	Dissolved Oxygen
756C	Lower Lake Lafayette	Leon	3F	Nutrients (TSI)
756H	North East Drainage Ditch*	Leon	3F	Fecal Coliform
756I	Lake Lafayette Drain*	Leon	3F	Dissolved Oxygen (BOD)
756I	Lake Lafayette Drain*	Leon	3F	Fecal Coliform
756J	Tom Brown Tributary*	Leon	3F	Dissolved Oxygen (BOD)

Waterbody ID	Water Segment Name	County	Waterbody Class[1]	Parameters Assessed Using the Impaired Waters Rule (IWR)
756J	Tom Brown Tributary*	Leon	3F	Fecal Coliform
758	Timberlane Run*	Leon	3F	Fecal Coliform
791L	Lake Miccosukee Outlet*	Jefferson, Leon	3F	Fecal Coliform
793A	St Marks River (South Segment)*	Wakulla	2	Fecal Coliform (3)
793A	St Marks River (South Segment)*	Wakulla	2	Fecal Coliform (SEAS Classification)
807	Munson Slough (Below Lake Munson)*	Leon	3F	Dissolved Oxygen
807	Munson Slough (Below Lake Munson)*	Leon	3F	Un-ionized Ammonia
807	Munson Slough (Below Lake Munson)*	Leon	3F	Nutrients (Chlorophyll-a)
807C	Lake Munson	Leon	3F	Dissolved Oxygen
807C	Lake Munson	Leon	3F	Nutrients (TSI)
807C	Lake Munson*	Leon	3F	Turbidity
807D	Munson Slough (Above Lake Munson)	Leon	3F	Dissolved Oxygen
807D	Munson Slough (Above Lake Munson)*	Leon	3F	Lead
808	Copeland Sink Drain*	Jefferson, Leon	3F	Dissolved Oxygen
809A	Megginnis Arm Run*	Leon	3F	Fecal Coliform
820	Godby Ditch*	Leon	3F	Fecal Coliform
820	Godby Ditch*	Leon	3F	Turbidity
857	Central Drainage Ditch*	Leon	3F	Fecal Coliform
865	St. Augustine Branch*	Leon	3F	Fecal Coliform
883B	Virginia Tributary*	Leon	3F	Fecal Coliform
916	East Drainage Ditch*	Leon	3F	Fecal Coliform
919	Unnamed Slough*	Leon	3F	Fecal Coliform
965	Sweetwater Branch*	Jefferson	3F	Fecal Coliform
971	Chicken Branch*	Leon	3F	Fecal Coliform
971B	Lake Weeks*	Leon	3F	Dissolved Oxygen
1054	Black Creek*	Leon, Wakulla	3F	Dissolved Oxygen
1124	Big Boggy Branch*	Wakulla	3F	Fecal Coliform

Waterbody ID	Water Segment Name	County	Waterbody Class[1]	Parameters Assessed Using the Impaired Waters Rule (IWR)
1176	Direct Runoff to Bay*	Wakulla	2	Fecal Coliform (SEAS Classification)
1223	Dickerson Bay (Shellfish Portion)*	Wakulla	2	Fecal Coliform (SEAS Classification)
1239	Direct Runoff to Bay*	Wakulla	2	Fecal Coliform (SEAS Classification)
8026	Coastal Apalachee Gulf West	Wakulla	3M	Bacteria (in Shellfish)
8026B	Shell Point	Wakulla	3M	Bacteria (Beach Advisories)
8027	Gulf of Mexico (Wakulla County, St. Marks River)*	Wakulla	2	Fecal Coliform (SEAS Classification)

Notes:
* = new Florida listings since 2003
Footnote 1 - Florida's waterbody classifications:
- 1 - Potable water supplies
- 2 - Shellfish propagation or harvesting
- 3F - Recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife in fresh water
- 3M - Recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife in marine water
- 4 - Agricultural water supplies
- 5 - Navigation, utility, and industrial use

Footnote 2 - TSI = trophic state index
Source: FDEP 2014a

Appendix E Conservation Lands within the St. Marks River and Apalachee Bay Watershed

Within the St. Marks River and Apalachee Bay watershed there are approximately 230,800 acres of conservation lands, including 160,553 acres of federally managed lands, 37,645 acres state-managed, 4,294 acres of locally managed lands, and 28,308 acres of privately managed lands. Ten conservation lands within the St. Marks River and Apalachee Bay watershed span multiple counties, and several extend into other watersheds. The details of these conservation lands are presented in the following table (FNAI 2016a, 2016b):

Conservation Land	Managing Agency	County(ies)	Description	Website	Acres Within Watershed
Federally Managed					
Apalachicola National Forest	US Dept. of Agriculture, Forest Service	Franklin, Leon, Liberty, Wakulla	One of Florida's premier conservation areas, this forest includes vast expanses of longleaf pine sandhills and flatwoods, and harbors the largest population of red-cockaded woodpeckers in the state. Wet prairies, seepage slopes, ravines, numerous blackwater streams can also be found in the Apalachicola National Forest.	http://www.fs.fed.us	106,361
Levy Ditch Research Natural Area	US Dept. of the Interior, Fish and Wildlife Service	Wakulla	This research natural area is part of the St. Marks National Wildlife Refuge, located just west of Panacea.	http://www.fws.gov/southeast	1
Abe Trull Research Natural Area	US Dept. of the Interior, Fish and Wildlife Service	Wakulla	This research natural area is part of the St. Marks National Wildlife Refuge located adjacent to State Road 367 (Shell Point Road).	http://www.fws.gov/southeast	26

Conservation Land	Managing Agency	County(ies)	Description	Website	Acres Within Watershed
Byrd Hammock Research Natural Area	US Dept. of the Interior, Fish and Wildlife Service	Wakulla	This research natural area is part of the St. Marks National Wildlife Refuge located south of the Coastal Highway (98) and east of Spring Creek Highway and west of Wakulla Beach Road.	http://www.fws.gov/southeast	24
Coggins Branch Research Natural Area	US Dept. of the Interior, Fish and Wildlife Service	Wakulla	This research natural area is part of the St. Marks National Wildlife Refuge located adjacent to State Road 367 (Shell Point Road).	http://www.fws.gov/southeast	20
Gum Swamp Research Natural Area	US Dept. of the Interior, Fish and Wildlife Service	Wakulla	This research natural area is part of the St. Marks National Wildlife Refuge located in eastern Wakulla County near the Flint Rock Tract.	http://www.fws.gov/southeast	103
St. Marks National Wildlife Refuge	US Dept. of the Interior, Fish and Wildlife Service	Jefferson, Taylor, Wakulla	The St. Marks National Wildlife Refuge represents a large area of protected coast from the Aucilla River to Ochlockonee Bay. Natural communities include estuarine tidal marsh, coastal hammock, wet flatwoods, mesic flatwoods, dome swamps, depression marshes, and bottomland forests. The refuge has extensive artificial impoundments managed for waterfowl and used by many other bird species.	http://www.fws.gov/southeast	54,017

Conservation Land	Managing Agency	County(ies)	Description	Website	Acres Within Watershed
State-Managed					
Alfred B. Maclay Gardens State Park	FL Dept. of Environmental Protection, Div. of Recreation and Parks	Leon	Alfred B. Maclay Gardens State Park is located within the Tallahassee metropolitan area. Significant features of the Alfred B. Maclay Gardens include a pristine upland clastic lake, sinkholes, and ravines with slope forests.	http://www.floridastateparks.org/	6
Aucilla Wildlife Management Area	FL Fish and Wildlife Conservation Commission	Jefferson, Taylor	Aucilla Wildlife Management Area, located north of St. Marks National Wildlife Refuge, includes large stretches of the Aucilla and Wacissa Rivers as well as their riparian areas and floodplains. Along with springs, blackwater streams and rivers, the WMA also includes sinkholes, limestone outcrops, and a variety of wetland habitats.	http://myfwc.com	18134
Bailey's Mill Conservation Easement	FL Dept. of Environmental Protection, Div. of State Lands	Jefferson,	Bailey's Mill Conservation Easement is a privately owned easement managed by the FDEP located south of Lake Miccosukee and adjacent to the Letchworth Mounds Conservation Easement. There is no public access on this conservation easement.	http://www.dep.state.fl.us/lands	437
Billingsley Conservation Easement	Northwest Florida Water Management District	Leon	The Billingsley Conservation Easement is a privately owned easement managed by the NWFWMD located northeast of Tallahassee and east of the Miccosukee Canopy Road Greenway.	http://www.nwfwater.com/	195

Conservation Land	Managing Agency	County(ies)	Description	Website	Acres Within Watershed
Blueprint 2000 Conservation Easement	Northwest Florida Water Management District	Leon	The Blueprint 2000 Conservation Easement is a privately owned easement managed by the NWFWMD located northwest of Lake Lafayette adjacent to the CSX Railroad. There is no public access on this conservation easement.	http://www.nwfwater.com/	132
Capital Circle Office Complex Conservation Area	FL Dept. of Management Services, Div. of Real Estate, Development & Management	Leon	This conservation area is located in southeastern Tallahassee just outside of Capital Circle Southeast near the Southwood community. There are three distinct habitats within the Capital Circle Office Complex Conservation Area: a wetland drainage basin dominated by oaks; a sandhill community with mature longleaf pines; and a sandhill community with young longleaf pines ranging from 12'-15' in height. A self-guided narrative trail system consisting of pond overlooks, wood chip paths, and interpretive signage is planned for the conservation area.		84
Carlton Farms Conservation Easement	Northwest Florida Water Management District	Leon, Wakulla	Carlton Farms Conservation Easement is a privately owned easement managed by the NWFWMD located near the Leon Sinks Geological Area in the Apalachicola National Forest. There is no public access on this conservation easement.	http://www.nwfwater.com/	63
Carpenter and Westmark Conservation Easement	Northwest Florida Water Management District	Wakulla	Carlton Farms Conservation Easement is a privately owned easement managed by the NWFWMD located adjacent to the St. Marks National Wildlife Refuge near Spring Creek. There is no public access on this conservation easement.	http://www.nwfwater.com/	359

Conservation Land	Managing Agency	County(ies)	Description	Website	Acres Within Watershed
Carroll Conservation Easement	Northwest Florida Water Management District	Wakulla	Carroll Conservation Easement is a privately owned easement managed by the NWFWMD located adjacent to the Carpenter and Westmark Conservation Easement. There is no public access on this conservation easement.	http://www.nwfwater.com/	371
Edward Ball Wakulla Springs State Park	FL Dept. of Environmental Protection, Div. of Recreation and Parks	Wakulla	Wakulla Springs State Park is centered around one of the world's largest and deepest freshwater spring, the headwaters of the Wakulla River. The park has extensive floodplain forests, swamps, upland hardwood forest, and a recent acquisition of extensive cut-over longleaf pine sandhills.	http://www.floridastateparks.org/	6042
Gerrell Conservation Easement	Northwest Florida Water Management District	WAKU	The Gerrell Conservation Easement is a privately owned easement managed by the NWFWMD located south of Natural Bridge Historic Battlefield State Park just south of the Leon/Wakulla County line. There is no public access on this conservation easement.	http://www.nwfwater.com/	145
L. Kirk Edwards Wildlife and Environmental Area	FL Fish and Wildlife Conservation Commission	Leon	The L. Kirk Edwards Wildlife and Environmental Area is part of the Lake Lafayette ecosystem. Wood stork and great egret rookeries occur on the property. FWC owns the land west of Chaires Cross Road, and the Wood Sink tract east of the road is titled to the State of Florida.	http://myfwc.com	1785

Conservation Land	Managing Agency	County(ies)	Description	Website	Acres Within Watershed
Lake Talquin State Forest	FL Dept. of Agriculture and Consumer Services, Florida Forest Service	Gadsden, Leon, Wakulla	The Lake Talquin State Forest includes the shores of Lake Talquin (an impoundment of the Ochlockonee River) and inundated historic river floodplain. It contains pine and hardwood forests and deep ravines along the edge of the lake that form refugee for many rare plants and animals. The 2018-acre Rocky Comfort Tract is jointly owned and co-managed by FDACS, FFS, and FWC.	http://www.floridaforestservice.com/index.html	19,169
Lake Talquin State Park	FL Dept. of Environmental Protection, Div. of Recreation and Parks	Gadsden, Leon, Wakulla	Lake Talquin State Park provides access to Lake Talquin, which was formed in 1927 when the Ochlockonee River was dammed. It contains extensive high quality slope and upland hardwood forests.	http://www.floridastateparks.org/	388
Letchworth Mounds Conservation Easement	FL Dept. of Environmental Protection, Div. of State Lands	Jefferson, Leon	The Letchworth Mounds Conservation Easement is a privately owned easement located adjacent to the Letchworth-Love Mounds Archaeological State Park south of Lake Miccosukee in Leon and Jefferson counties.	http://www.dep.state.fl.us/lands	1272
Letchworth-Love Mounds Archaeological State Park	FL Dept. of Environmental Protection, Div. of Recreation and Parks	Jefferson	This park contains Florida's tallest Native American ceremonial mound. The 46-foot-high structure was built between 1100 and 1800 years ago by Native Americans, one basketful of dirt at a time. The people who built the mound are believed to have been members of the Weedon Island Culture, a group of Native Americans who lived in North Florida between 200 and 800 A.D. A nature trail winds around the perimeter of the ceremonial mound.	http://www.floridastateparks.org/	190

Conservation Land	Managing Agency	County(ies)	Description	Website	Acres Within Watershed
Millstone Plantation Conservation Easement	FL Dept. of Environmental Protection, Div. of State Lands	Leon	The Millstone Plantation Conservation Easement is a privately owned easement with no public access located south of Lake McBride just north of Tallahassee.	http://www.dep.state.fl.us/lands	92
Natural Bridge Battlefield Historic State Park	FL Dept. of Environmental Protection, Div. of Recreation and Parks	Leon	Natural Bridge is the site of the second largest Civil War battle in Florida. The park includes a sinkhole where the St. Marks River drops into the earth and flows underground for one-quarter of a mile before reemerging.	http://www.floridastateparks.org/	135
Pace Conservation Easement	Northwest Florida Water Management District	Leon	Pace Conservation Easement is a privately owned easement managed by the NWFWMD located just northeast of Tallahassee.	http://www.nwfwater.com/	121
San Marcos de Apalache Historic State Park	FL Dept. of Environmental Protection, Div. of Recreation and Parks	Wakulla	Located at the confluence of the St. Marks and the Wakulla Rivers, this park is the site of an old fort. Most of the land is devoted to historical education.	http://www.floridastateparks.org/	15
St. Marks River Preserve State Park	FL Dept. of Environmental Protection, Div. of Recreation and Parks	Jefferson, Leon	The St. Marks River Preserve State Park is located along the St. Marks River south of Lower Lake Lafayette, east of Tallahassee.	http://www.floridastateparks.org/	2593
Tallahassee-St. Marks Historic Railroad State Trail	FL Dept. of Environmental Protection, Div. of Recreation and Parks	Leon, Wakulla	This is a former railroad line that has been converted to a paved 15.8-mile long recreational trail connecting Tallahassee and to the City of St. Marks. All portions of the property have been previously disturbed, but the non-maintained portions are recovering.	http://www.floridastateparks.org/	151

Conservation Land	Managing Agency	County(ies)	Description	Website	Acres Within Watershed
Wakulla State Forest	FL Dept. of Agriculture and Consumer Services, Florida Forest Service	Leon, Wakulla	Wakulla State Forest consist of cutover sandhills with remnant longleaf-wiregrass vegetation, and mixed hardwood-pine forest. The forest contains a portion of the spring-fed McBride Slough. The former "Woodville State Forest" tract in Leon County is primarily planted slash pine and sand pine in what was formerly longleaf pine-wiregrass sandhills. There are a few areas of natural longleaf, a dome swamp, and small pond.	http://www.floridaforestservice.com/index.html	4935
Locally Managed					
A. J. Henry Park	City of Tallahassee	Leon	A. J. Henry Park is a city park located in northeastern Tallahassee adjacent to Shakey Pond in the Whitfield Plantation community.	http://www.talgov.com/parks	75
Barnette W. Allen Nature Preserve	City of Tallahassee	Leon	Barnette W. Allen Nature Preserve is a city park located in central Tallahassee southeast of Leon High School.	http://www.talgov.com/parks	9
Dr. Charles Billings Greenway	City of Tallahassee	Leon	Dr. Charles Billings Greenway is a city greenway consisting of two tracts located on Silver Lake and Lake Henrietta in southwestern Tallahassee.	http://www.talgov.com/parks	25
Fallschase Greenway	Leon County	Leon	Fallschase Greenway consists of Upper Lake Lafayette in eastern Tallahassee.	http://www.leoncountyfl.gov/parks	201
Fred George Greenway	Leon County	Leon	The Fred George Greenway is located adjacent to Capital Circle Northwest in Tallahassee south of Lake Jackson.	http://www.leoncountyfl.gov/parks	164
Gil Waters Preserve at Lake Munson	Leon County	Leon	The Gil Waters Preserve at Lake Munson is located on the southern margin of Lake Munson in the southern Tallahassee metropolitan area.	http://www.leoncountyfl.gov/parks	67

Conservation Land	Managing Agency	County(ies)	Description	Website	Acres Within Watershed
Golden Aster Preserve	City of Tallahassee	Leon	The Golden Aster Preserve, located south of Lake Bradford in Tallahassee, consists of remnant sandhill with an overgrown hardwood understory.	http://www.talgov.com/parks	31
Governor's Park	City of Tallahassee	Leon	Governor's Park is a city park located in east-central Tallahassee.	http://www.talgov.com/parks	192
Harvey/Mowrey Parcel	Wakulla County	Wakulla	The Harvey/Mowrey Parcel is a tract of conservation land in Panacea near Dickerson Bay in coastal Wakulla County.		14
Indian Head Acres Park	City of Tallahassee	Leon	Indian Head Acres Park is a local park in residential community of south-central Tallahassee.	http://www.talgov.com/parks	31
J. R. Alford Greenway	Leon County	Leon	This property is a vista of rolling hills that includes natural habitats such as herbaceous marsh and hardwood/pine forests in addition to pastureland. Alford Arm is adjacent to the Lake Lafayette ecosystem.	http://www.leoncountyfl.gov/parks	789
Lafayette Heritage Trail Park	City of Tallahassee	Leon	The Lafayette Heritage Trail Park includes Lake Lafayette and adjacent property to the south and east. This trail connects Lake Lafayette with the J.R. Alford Greenway and runs adjacent to the CSX Railroad in eastern Tallahassee. The trail consists of upland mixed forest along the lakeshore. The property suffers from heavy exotic infestations.	http://www.talgov.com/parks	796
Mashes Sands Park	Wakulla County	Wakulla	Beach dune with tidal marsh and trails through scrubby flatwoods and mesic flatwoods.	http://www.wcprd.com/Parks/parks_mashessands.asp	326

Conservation Land	Managing Agency	County(ies)	Description	Website	Acres Within Watershed
Miccosukee Canopy Road Greenway	Leon County	Leon	This 6.4-mile long linear park and greenway consists of a strip of vegetation on either side of Miccosukee Road acquired to protect the historic tree canopy effect. Natural features include a 45-acre pine-oak-hickory forest on the eastern half of the property south of Miccosukee Road.	http://www.leoncountyfl.gov/parks	502
Northwest Park	City of Tallahassee	Leon	Northwest Park is a city park in northwestern Tallahassee.	http://www.talgov.com/parks	78
San Luis Mission Park	City of Tallahassee	Leon	San Luis Mission Park is located in western Tallahassee and includes a historic 1700's Spanish mission.	http://www.talgov.com/parks	69
Shepherd's Branch Habitat Mitigation Area Conservation Easement	City of Tallahassee	Leon	The Shepherd's Branch Habitat Mitigation Area Conservation Easement is managed as a gopher tortoise mitigation site by Capital Region Community Development District (owner of the property) and City of Tallahassee, which holds and monitors the conservation easement. Nest boxes for southeastern American kestrel have been installed at the site.		168
St. Marks Headwaters	Leon County	Leon	The St. Marks Headwaters consists of wetlands and wet flatwoods across much of the site, as well as some restoration areas with old field and agricultural activity.	http://www.leoncountyfl.gov/parks	755
Privately Managed					
Chemonie Plantation Conservation Easement	Tall Timbers Research, Inc.	Leon	Chemonie Plantation Conservation Easement is a privately owned easement managed by Tall Timbers that is located between northeastern Tallahassee and Lake Miccosukee in Leon County.	http://www.talltimbers.org	1938

Conservation Land	Managing Agency	County(ies)	Description	Website	Acres Within Watershed
Chemonie Trust Conservation Easement	Tall Timbers Research, Inc.	Leon	Chemonie Trust Conservation Easement is a privately owned easement managed by Tall Timbers located adjacent to the Woodfield Springs Plantation Conservation Easement in northern Leon County.	http://www.talltimbers.org	225
Crow Pond Conservation Easement	Tall Timbers Research, Inc.	Jefferson	Crow Pond Conservation Easement is a privately owned easement managed by Tall Timbers located east of the St. Marks River Preserve State Park.	http://www.talltimbers.org	114
Fanlew Preserve	The Nature Conservancy	Jefferson	The Fanlew Preserve is a tract of conservation land owned by TNC located adjacent to the northwestern boundary of the Aucilla WMA.	http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/florida/index.htm	680
Flint Rock Tract	The Nature Conservancy	Jefferson	The Flint Rock Tract is a tract of conservation land owned by TNC located adjacent to the southwestern boundary of the Aucilla WMA.	http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/florida/index.htm	8053
Horseshoe Plantation Conservation Easement	Tall Timbers Research, Inc.	LEON	Horseshoe Plantation Conservation Easement is a privately owned conservation easement managed by Tall Timbers located in northern Leon County, south of Lake Iamonia.	http://www.talltimbers.org	367
Mays Pond Plantation Conservation Easement	Tall Timbers Research, Inc.	Jefferson	Mays Pond Plantation Conservation Easement is a privately owned conservation easement managed by Tall Timbers located in northern Jefferson County, adjacent to the northwest bank of Lake Miccosukee.	http://www.talltimbers.org	5507

Conservation Land	Managing Agency	County(ies)	Description	Website	Acres Within Watershed
Merrily Plantation Conservation Easement	Tall Timbers Research, Inc.	Jefferson	Merrily Plantation Conservation Easement is a privately owned conservation easement managed by Tall Timbers located in northern Jefferson County on the Florida-Georgia border.	http://www.talltimbers.org	340
Miccosukee Hills Conservation Easement	Apalachee Land Conservancy	Leon	The Miccosukee Hills Conservation Easement consists of 11 acres of bottomland forest with the remainder primarily upland pine forest. The bottomland forests are a mix of large hardwood species, including swamp chestnut oak, tulip poplar, red maple, swamp laurel oak and water oak. The land is currently being managed for recreational use.		354
St. Marks Mitigation Bank	Westervelt Ecological Services	Jefferson, Wakulla	The St. Marks Mitigation Bank is a privately owned and managed mitigation bank on the Wakulla-Jefferson County line, adjacent to the northern boundary of the Flint Rock Tract.	http://www.wesmitigation.com/	1477
Straw Pond Conservation Easement	Tall Timbers Research, Inc.	Leon	The Straw Pond Conservation Easement is a privately owned conservation easement managed by Tall Timbers located northwest of Lake Miccosukee.	http://www.talltimbers.org	400
Sunny Hill Plantation Conservation Easement	Tall Timbers Research, Inc.	Leon	The Sunny Hill Plantation Conservation Easement is a privately owned conservation easement managed by Tall Timbers located northwest of Lake Miccosukee.	http://www.talltimbers.org	6367
Woodfield Springs Plantation Conservation Easement	Tall Timbers Research, Inc.	Leon	The Woodfield Springs Plantation Conservation Easement is to the west of Lake Miccosukee and to the southeast of Lake Iamonia. The easement is not accessible to the public.	http://www.talltimbers.org	2485

Source: FNAI 2016a, 2016b

Conservation Land	Managing Agency	County(ies)	Description	Website	Acres Within Watershed

Appendix F Projects Funded by the National Fish and Wildlife Foundation affecting the St. Marks River and Apalachee Bay Watershed

The NFWF established the GEBF to administer funds arising from plea agreements that resolve the criminal cases against BP and Transocean. The FWC and FDEP work directly with the NFWF to identify projects for the state of Florida, in consultation with the USFWS and the NOAA. From 2013 to 2018, the GEBF will receive a total of $356 million for projects in Florida. The following projects affecting the St. Marks River and Apalachee Bay watershed have been identified for funded through GEBF as of June 2016.

Project	Description
Projects with benefits to all Gulf Coastal communities, including the St. Marks River and Apalachee Bay watershed	
Benthic Mapping, Characterization, and Assessment (University of South Florida, $4,477,900)	This project will provide data on the extent and species utilization of offshore fishery habitats along the West Florida Continental Shelf – an area utilized by reef fish and sea turtle populations for shelter, feeding and spawning. It will inform sustainable fishing practices for red snapper and other reef fish, and future efforts to reduce bycatch of marine fish and sea turtles through improved management during periods of high utilization in these benthic habitats. Project partners: FWC, Florida Fish and Wildlife Research Institute, and Florida Institute of Oceanography.

Project	Description
Projects with benefits to all Gulf Coastal communities, including the St. Marks River and Apalachee Bay watershed	
Comprehensive Coastal Panhandle Bird Conservation (National Audubon, $3,205,000)	This project will improve Panhandle beach-nesting bird habitat through nesting habitat enhancements and stewardship activities that will result in increased nesting, hatching, and rearing of chicks. These efforts will result in more effective and comprehensive success throughout the Florida Panhandle for important beach-nesting species such as Black Skimmer, American Oystercatcher, Least Tern, Piping Plover and Red Knot. Project partners: FWC, Florida Park Service, National Park Service, Department of Defense, Santa Rosa Island Authority, TNC, and State University of New York.
Florida Shorebird Conservation Initiative (FWC, $1,489,800)	This proposal will sustain activities of the Florida Shorebird Alliance (FSA) to enhance shorebird and seabird populations along the Florida Gulf Coast for two years. The FSA is a statewide network of government and non-governmental organizations advancing shorebird and seabird conservation through coordinated and collaborative management, monitoring, education and outreach, and public policy activities. Partners: Florida Audubon Society.
Enhanced Assessment for Gulf of Mexico Fisheries: Phases I-III (FWC, $11,814,200)	This five-year project will expand the collection of data on both catch effort and stock assessment in the northern and eastern Gulf of Mexico. It is complementary to similar projects in Alabama and Mississippi. The data will be used to assess the recovery of reef fish stocks in association with restoration efforts implemented in response to the Deepwater Horizon oil spill, improve and expand single-species stock assessments for managed fish species, and foster improved ecosystem-based assessment and management capabilities. Project partners: NOAA and University of Florida.

Project	Description
Projects with benefits to all Gulf Coastal communities, including the St. Marks River and Apalachee Bay watershed	
Increased Capacity for Marine Mammal Response (FWC, NOAA, and other stranding organizations, $4,400,000)	This project will improve capacity and date collection efforts for the FWC's marine mammal field stations as well as eight marine mammal stranding response and research organizations working in the Gulf. The Gulf of Mexico is habitat for 22 species of marine mammals—many were directly impacted by the oil spill, all are listed under the Marine Mammal Protection Act and several are listed as endangered under the Endangered Species Act. Given the high occurrence of annual marine mammal strandings along Florida's Gulf Coast – more than 2,000 over the past five years – it is a management priority to enhance and sustain a viable stranding network.
Eliminating Light Pollution on Sea Turtle Nesting Beaches: Phases I and II (FWS, FWC, and Sea Turtle Conservancy, $3,614,400)	This project will greatly increase sea turtle hatchling survivorship on Florida Panhandle nesting beaches by correcting problematic lights on private properties with a history of sea turtle disorientations. Florida hosts over 90 percent of all sea turtle nesting in the continental U.S., including the largest population of loggerheads in the Western Hemisphere and regionally significant nesting populations of the Kemp's Ridley sea turtles.

Source: FDEP 2016d