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Draft

Perdido River and Bay Watershed Characterization

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Version History

Date	Version	Location(s) in Document	Summary of Revision(s)
09/07/2016	1	All	Initial draft Watershed Characterization (Sections 1, 2, 3, 4, and 6) submitted to NWFWMD.
10/18/2016	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.
12/5/2016	5	Throughout	Numerous revisions to address District comments.

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Abbreviations and Acronyms List

ADEM	Alabama Department of Environmental Management
ALDNR	Alabama Department of Conservation and Natural Resources
BFA	Bream Fisherman Association
BMAP	Basin Management Action Plan
BMP	best management practice
CWA	Clean Water Act
DO	dissolved oxygen
ECUA	Emerald Coast Utilities Authority
EPA	U.S. Environmental Protection Agency
ERP	Florida - Environmental Resource Permitting
ESA	Endangered Species Act
F.A.C.	Florida Administrative Code
°F	Fahrenheit
FDACS	Florida Department of Agriculture and Consumer Services
FDEC	Florida Demographic Estimating Conference
FDEP	Florida Department of Environmental Protection
FDOH	Florida Department of Health
FDOT	Florida Department of Transportation
FEMA	Federal Emergency Management Agency
FGS	Florida Geological Survey
FHWA	Federal Highway Administration
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
GIWW	Gulf Intracoastal Waterway
HABs	harmful algal blooms
IWR	Impaired Surface Waters Rule

LOST	local option sales tax
MAP	Mapping, Assessment, and Planning
MFLs	minimum flows and levels
mgd	million gallons per day
MS4s	municipal separate storm sewer systems
NAS	Naval Air Station
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
OFWs	Outstanding Florida Waters
OSTDS	onsite sewage treatment and disposal systems
PERCH	Partnership for Environmental Research and Community Environmental Health
RAP	Reasonable Assurance Plan
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
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
TNC	The Nature Conservancy

UF-IFAS	University of Florida 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
WFRPC	West Florida Regional Planning Council
WMA	Water Management Area
WWTF	wastewater treatment facility

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1.0 Introduction

This watershed characterization has been prepared in support of development of a Surface Water Improvement and Management (SWIM) plan for the Perdido River and 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.

The Perdido River and Bay watershed begins in southwest Alabama, extends into western Florida and southward to the Gulf of Mexico. The watershed includes the Perdido River, Elevenmile Creek, Perdido Bay, Big Lagoon, Tarkiln Bayou, and Wolf Bay and their tributaries (NWFWMD 2012) which are located in Escambia County, Florida; Baldwin County, Alabama; and Escambia County, Alabama (Figure 2-1). Although a large portion of the watershed is located in Alabama, 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 improve 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 plans integrate a number of complementary programs and activities to protect and restore watershed resources and functions. They are designed to address water quality and natural systems challenges that are more broadly 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 Perdido River and 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 District developed a draft Perdido River and Bay SWIM Plan in 2012 that recognized three priority objectives that 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;
2. Natural systems protection, enhancement, and restoration, including estuarine, stream, wetland, and riparian habitat restoration; and
3. Protection and, as necessary, restoration of floodplain functions.

This 2017 SWIM Plan assesses progress made toward the implementation of actions identified in the 2012 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 the SWIM program, watersheds are the logical 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 under the purview of all jurisdictions and agencies involved in the watershed. Among these are local, state, and federal regulatory and management 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; integrate the efforts of local governments, state and federal agencies, and private entities to pool resources and achieve mutual objectives and goals; and present innovative, sustainable solutions to watershed issues.

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2.0 Watershed Description

2.1 Introduction

The Perdido River and Bay watershed covers approximately 745,000 acres and extends from southeastern Alabama through westernmost Florida to the Gulf of Mexico. Approximatley 30 percent of the watershed (349 square miles) is in Florida, while the remaining 70 percent falls within Alabama. The basin includes three U.S. Environmental Protection Agency (EPA) Level 4 ecoregions and encompasses 32 unique habitat types recognized by the Florida Natural Areas Inventory (FNAI). These habitats include freshwater lakes, streams, rivers, bays, and estuaries.

Perdido River and Bay watershed attributes:

- **Two states: Alabama and Florida;**
- **One Florida county and two Alabama counties;**
- **Three EPA Level 4 ecoregions;**
- **32 Unique Natural Communities; and**
- **1,165 square miles (349 in Florida).**

The Perdido River, which drains to the Gulf of Mexico via Perdido Bay, begins as a surface water-fed blackwater stream. Several creeks contribute to the Perdido River. The Styx and Blackwater rivers converge with the Perdido River from the west, close to the mouth of Perdido Bay. The Perdido Bay estuary covers approximately 50 square miles and is connected to the Gulf of Mexico through Perdido Pass and Pensacola Bay via Big Lagoon. Big Lagoon is bordered by Perdido Key to the south and the Naval Air Station (NAS) Pensacola, Grande Lagoon, and Big Lagoon State Park to the north. The Perdido Pass is a man-made opening with currents predominantly controlled from wind action and modified by the local bottom topography (Judge *et al.* 1992). Where it meets the Gulf of Mexico, the Perdido Pass is protected by a rock jetty on the west and a combined rock weir and jetty on the east. Old River enters Perdido Pass from the east between Florida Point and Ono Island. The Gulf Intracoastal Waterway (GIWW) passes through the southern portion of the bay (Kirschenfeld *et al.* 2002). Tarkiln Bayou is located along the eastern portion of the bay. With a natural shoreline and forested drainage basin, this is among the last remaining undeveloped bayous in northwest Florida (Kirschenfeld *et al.* 2002).

The unique ecosystems comprising the Perdido River and Bay watershed fall under the jurisdiction of multiple county and local governments, state and federal agencies, and the West

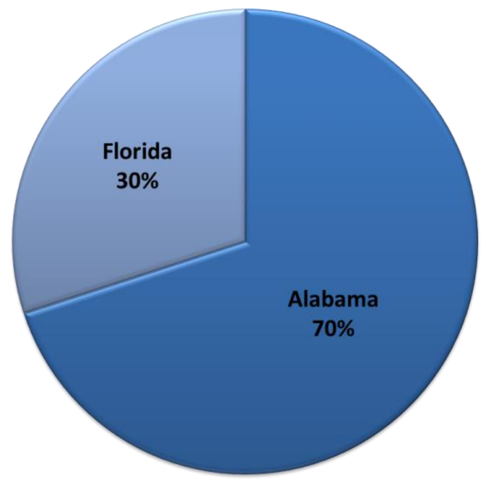
Florida Regional Planning Council (WFRPC) (WFRPC 2016). These entities manage natural resources, establish conservation lands, implement land use and land management plans and regulations, and establish best management practices (BMPs) that directly influence water quality and habitat integrity.

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

2.2 Geographic Characteristics

2.2.1 Geography

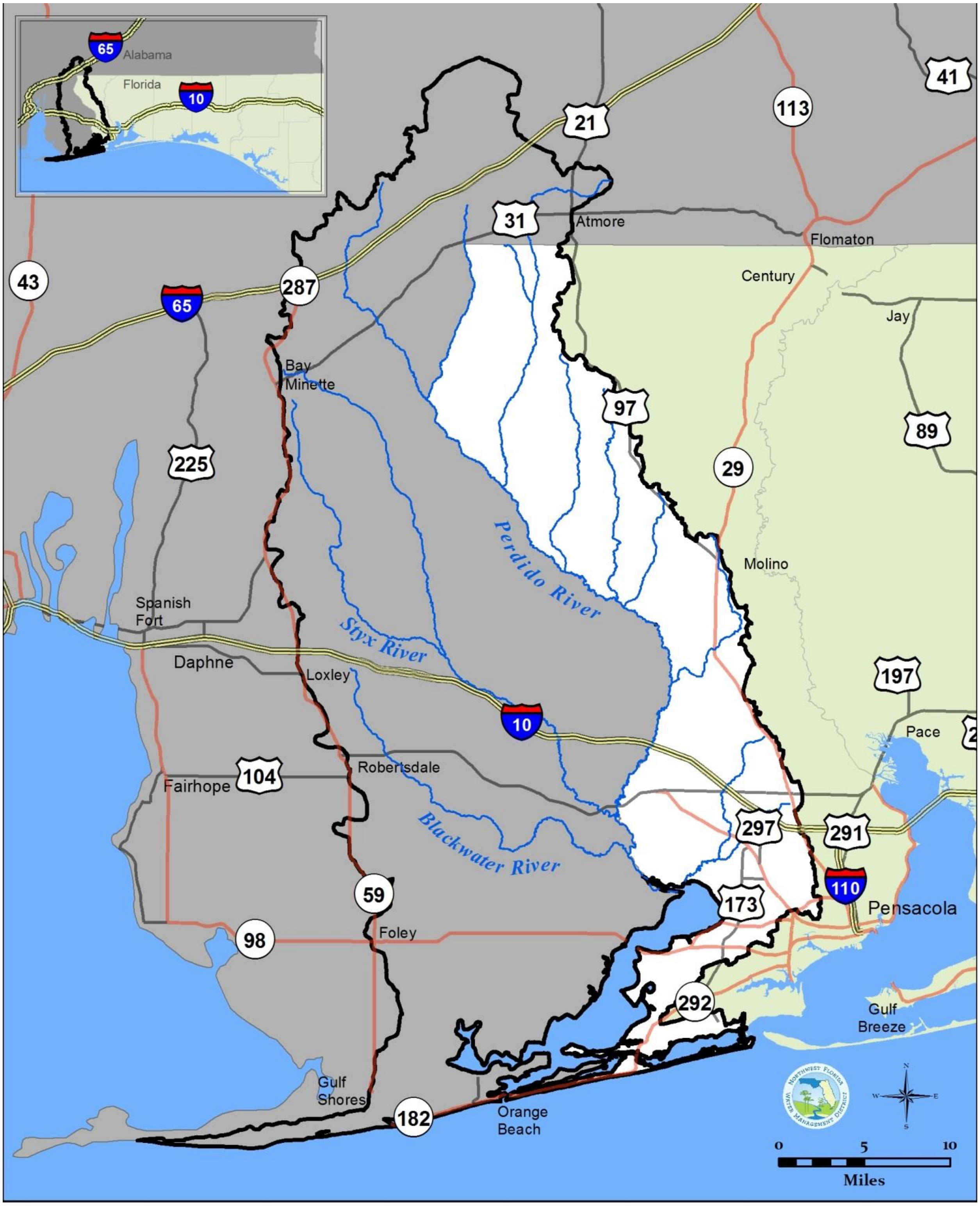
The Greater Perdido River and Bay watershed spans portions of Alabama and Florida and ultimately drains into the Gulf of Mexico. The watershed covers approximately 745,000 acres (not including Perdido Bay). Of this, 30 percent is located in Escambia County, Florida, the western-most county in the Florida Panhandle. The remaining 70 percent of the watershed is located in Baldwin and Escambia counties in Alabama (see Figure 2-1) (NWFWMD 2012). The Perdido River is formed by the confluence of Fletcher and Perdido Creeks in western Escambia County, Alabama. The river's headwaters originate north of Interstate 65 in northeastern Baldwin and western Escambia counties of Alabama, approximately 140 miles north of where it empties into Perdido Bay.



Source: NWFWMD 2012.

Figure 2-1 Proportion of the Greater Perdido River and Bay Watershed by State

The Perdido River forms roughly 58 miles of the boundary between Florida and Alabama (NWFWMD 2015) (see Figures 2-2). The remaining portion of the east-west state boundary meanders southward through Perdido Bay and around the east end of Ono Island (Alabama), before turning south across Perdido Key and entering the Gulf of Mexico roughly two miles east of where Perdido Bay empties into the Gulf of Mexico at Perdido Pass in Orange Beach, Alabama.

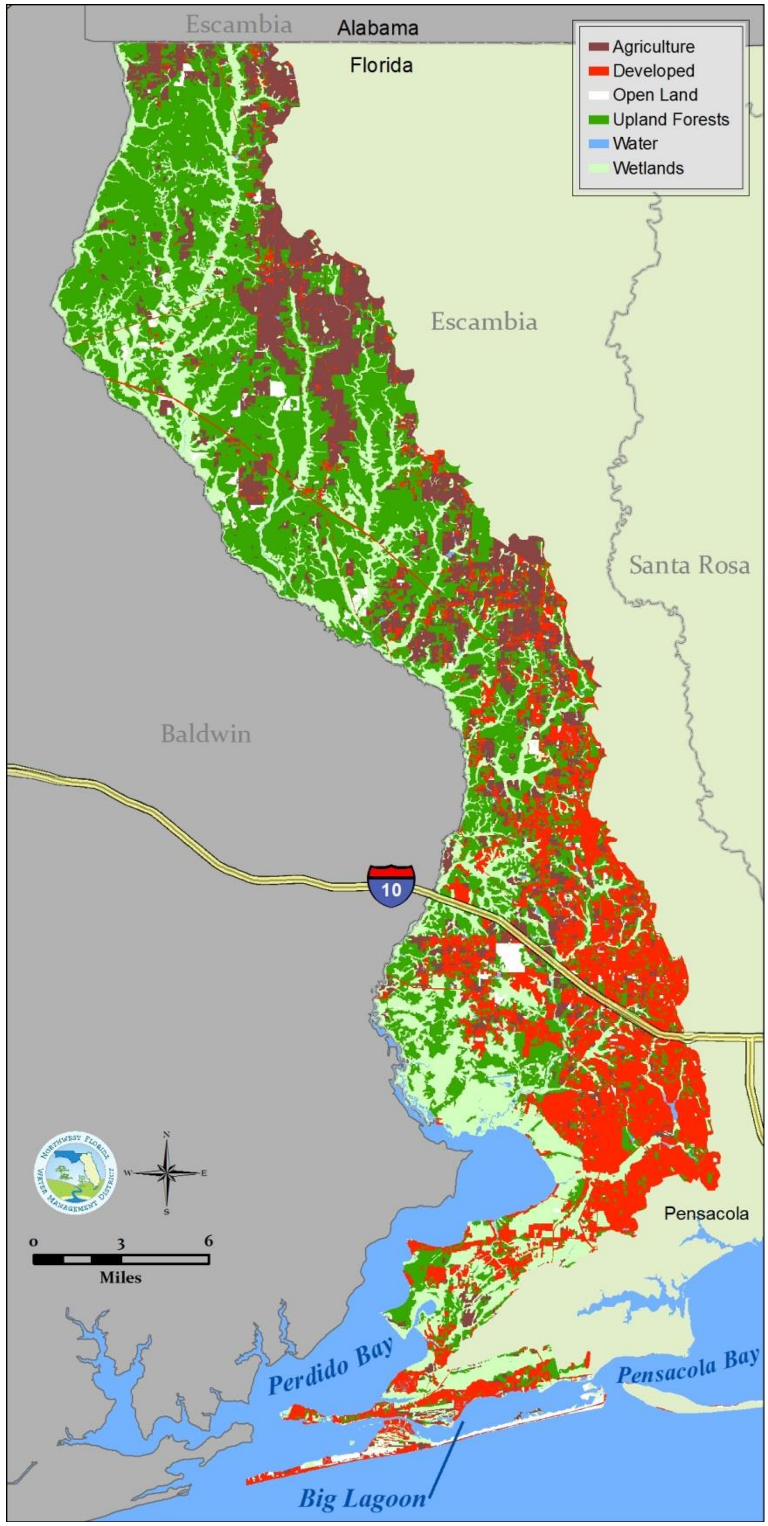


Sources: Federal Highway Administration (FHWA) 2014; National Oceanic and Atmospheric Administration (NOAA) 2015a, U.S. Geological Survey (USGS) 2015, 2016a.

Figure 2-2 Greater Perdido River and Bay Watershed (including Alabama)

2.2.2 Land Use and Population

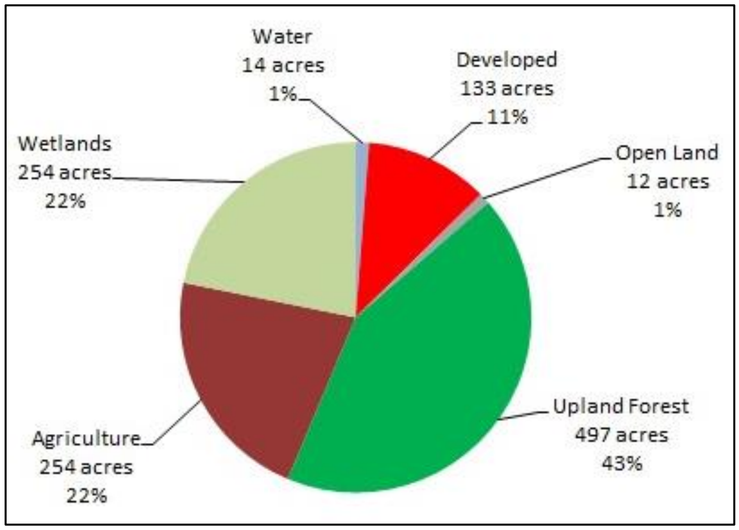
Land use in the northern portion of the watershed, north of Interstate 10, consists primarily of a mixture of agricultural uses, interspersed with low-density residential areas (Figure 2-3 and Table 2-1). There are smaller areas classified by the county for conservation, rural mixed use and low density residential in the eastern-most portion of the watershed. In Florida, urban development is concentrated in the southern portion of the watershed, within the Pensacola metropolitan area. This development extends west from the City of Pensacola, to include Perdido Key, Big Lagoon, and Innerarity Point (NWFWMD 2012). Counties and municipalities within the watershed (primarily Baldwin County, Alabama, and Escambia County, Florida) guide land uses through the development of comprehensive plans, future land use maps, and land development regulations, which are updated regularly. The Escambia County Comprehensive Plan serves as a guideline for compatibility issues related to land management, natural resource preservation, historical preservation, and infrastructure needs in Escambia County (Escambia County 2014).



Sources: Florida Department of Environmental Protection (FDEP) 2015a; FHWA 2014; NOAA 2015a; USGS 2015.

Figure 2-3 Land Use and Land Cover

In Florida's portion of the watershed, most residential, commercial, industrial, and institutional land use areas are concentrated in the greater Pensacola metropolitan area, which extends to the southwest portion of the county. In Alabama's portion of the watershed, Escambia and Baldwin counties are dominated by silvicultural land uses. Approximately 75 percent of the basin in Baldwin County and 70 percent of the basin in Escambia County are timberland (U.S. Department of Agriculture [USDA] 2004). In Florida, as of 2004, Escambia County contained approximately 242,500 acres of private timberlands and 8,300 acres owned by state, local, or federal government (USDA 2004). Figure 2-4 shows the general land use of the entire watershed (including the Alabama portion).



Sources: FDEP 2015a; USGS 2011.

Figure 2-4 General Land Use of Greater Perdido Bay Watershed (including Alabama)

Significant floodplain wetlands can be found adjacent to the Perdido River and its tributaries, as well as other areas of low elevation proximate to Perdido Bay.

Table 2-1 2012-2013 Land Use within the Perdido River and Bay Watershed (Florida Portion)

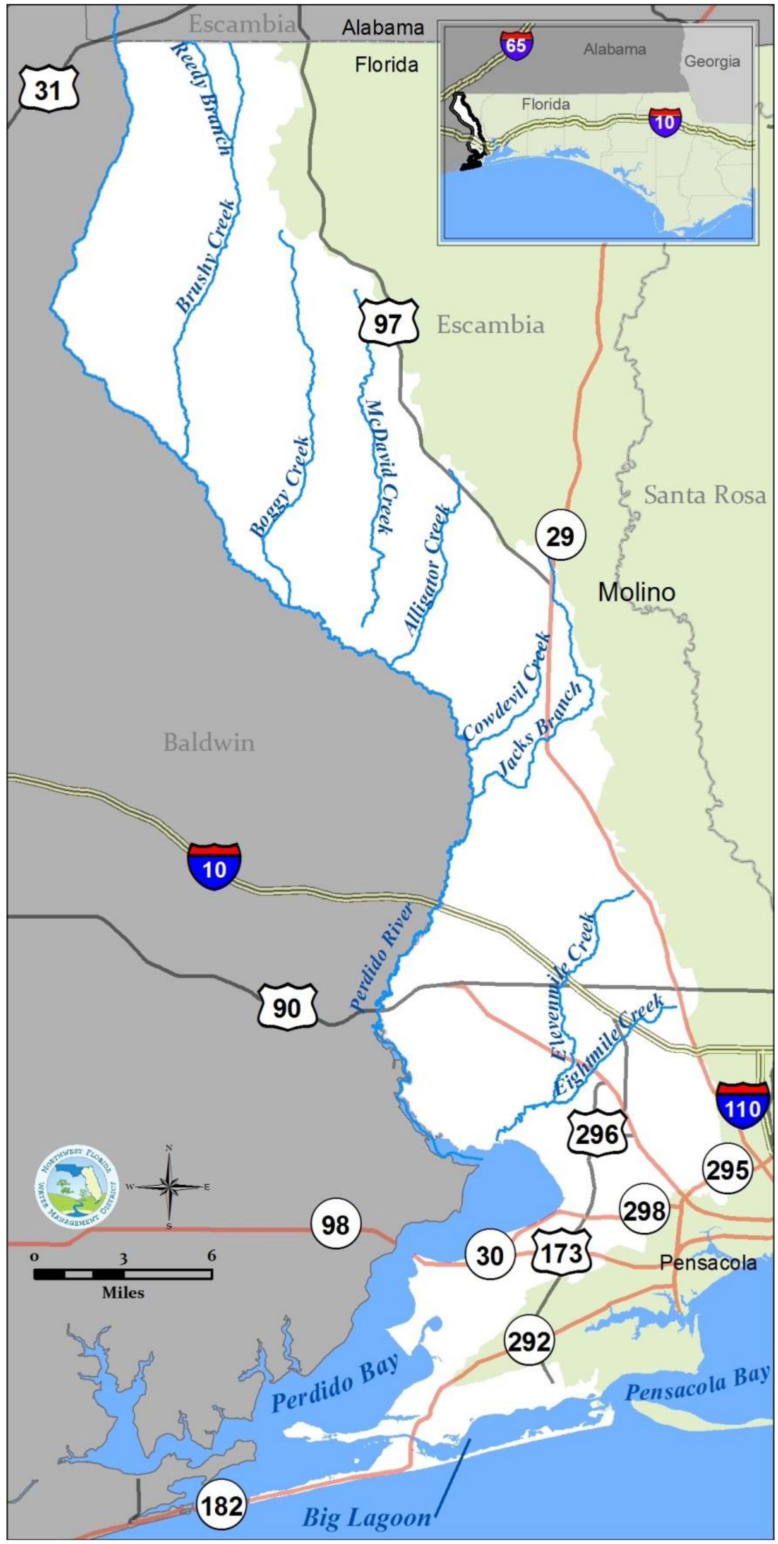
General Land Use Category	Estimated Square Miles	Percent of Basin (Florida Portion)
Agriculture	52.8	15.1
Developed	70.8	20.3
Open Land	7.7	2.2
Upland Forests	133.9	38.4
Water	2.8	0.8
Wetlands	80.1	23.0

Source: FDEP 2015a.

Portions of the watershed are designated conservation lands, including Perdido River Water Management Area (WMA), Gulf Islands National Seashore, Betty and Crawford Rainwater Perdido River Nature Preserve, three state parks, and the Fort Pickens Aquatic Preserve. The Fort Pickens Aquatic Preserve is immediately offshore and associated with Big Lagoon and the Gulf of Mexico in the region of the Gulf Islands National Seashore. Conservation lands within the watershed provide a buffer system that helps to protect water quality, provide flood protection, and sustain integrated terrestrial and aquatic ecosystems. Conservation areas including parks, management areas, and preserves, are discussed in more detail in Section 3.5.1.

The U.S. Navy has six facilities in Florida's portion of the watershed encompassing over 3,000 acres including:

- Saufley Field, supporting the Naval Education and Training Professional Development Center;
- Bronson Outlying Landing Field;
- Site 8A Outlying Landing Field;
- NAS Pensacola;



Sources: FHWA 2014; NOAA 2015a; USGS 2015, 2016a.

Figure 2-5 Features of the Perdido River and Bay Watershed (Florida Portion)

- Blue Angel Recreation Park; and
- Naval Technical Training Center Corry Station.

There are also two outlying fields in the Alabama portion of the watershed (NWFWMD 2012).

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).

As is the case across much of northwest Florida, the Perdido River and Bay watershed has experienced population growth that has resulted in the transformation of land use in many areas from rural and agricultural uses to urban/suburban uses. Typical effects of urbanization include increased NPS pollution, the generation of additional wastewater and stormwater, and habitat loss and fragmentation. In 2015, the population of Escambia County was approximately 311,000 individuals (U.S. Census Bureau 2015). The University of Florida's Bureau of Economic and Business Research projects a 2.89 percent increase in Escambia County's population from 2015 through 2025 and an additional 3.25 percent from 2025 through 2040 (Florida Demographic Estimating Conference [FDEC] 2016). Along with this population growth, increases in development, waste production, use of recreational areas, as well as land use changes, are anticipated.

The majority of Escambia County's population growth is occurring in the southern half of the watershed. Significant future population growth is projected for the Cantonment area, as reflected by local government planning initiatives such as the Escambia County Mid-West Sector Plan (Escambia County 2011; The Florida-Alabama Transportation Planning Organization 2010). The Sector Plan emphasizes urban development and community design in central Escambia County, and promotes cohesive and sustainable development (Escambia County 2011).

Within Florida's portion of the watershed, there are no incorporated areas or cities. However, there are several notable communities in Florida, including the western portion of the Pensacola metropolitan area, as well as the communities of Beulah, Pine Forest, Bellview, Myrtle Grove, Perdido Key, Innerarity Point, Walnut Hill, and Barrineau Park (Figure 2-5). Municipalities in Alabama's portion of the watershed include Atmore, Bay Minette, Elberta, Foley, Gulf Shores, Loxley, Orange Beach, Perdido Beach, Robertsdale, and Summerdale.

2.3 Physical Characteristics

The Perdido River and Bay watershed can be characterized geographically by its physiographic regions 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, ecoregions 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).

2.3.1 Physiographic Region

Gulf Coastal Plain

The Perdido River and Bay watershed, including Alabama'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 (Omernik 1995). Within this greater physiographic region, the Florida portion of the Perdido River and Bay watershed contains two localized physiographic regions separated by a relic marine escarpment: the Western Highlands to the north and the Gulf Coastal Lowlands to the south (USDA 2004).

The Western Highlands encompass most of the watershed, extending from a height of 378 feet in elevation in Alabama down to a relict marine escarpment near Perdido Bay at an elevation of 100 to 120 feet (Rupert 1993). The rolling hills of the Western Highlands have sandy soils and generally dry conditions, with groundwater emerging from lower slopes to create hillside seepage bogs (Wolfe *et al.* 1988). A series of gently sloping marine terraces make up the coastal lowlands around Perdido Bay and inland from the Gulf of Mexico (Rupert 1993). A series of sand dune and beach ridge systems run along the coast, including Perdido Key dunes, which can reach 45 feet in elevation (Rupert 1993). 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 Perdido River and 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) includes two Level 4 sub-regions: the Southern Pine Plains and Hills and the Floodplains and Low Terraces. The Southern Coastal Plain includes three (Level 4) sub-regions: the Gulf Coast Flatwoods, Floodplains and Low Terraces, and Gulf Barrier Islands and Coastal Marshes (Table 2-3 and Figure 2-6) (EPA 2013a; Griffith *et al.* n.d.).

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

USGS Physiographic Region	Sub-Regions
Gulf Coastal Plains	Western Highlands
	Gulf Coastal Lowlands
EPA Level 3 Ecoregion	**Level 4 Ecoregion**
Southeastern Plains	Southern Pine Plains and Hills
Southern Coastal Plain	Gulf Coast Flatwoods
	Gulf Barrier Islands and Coastal Marshes

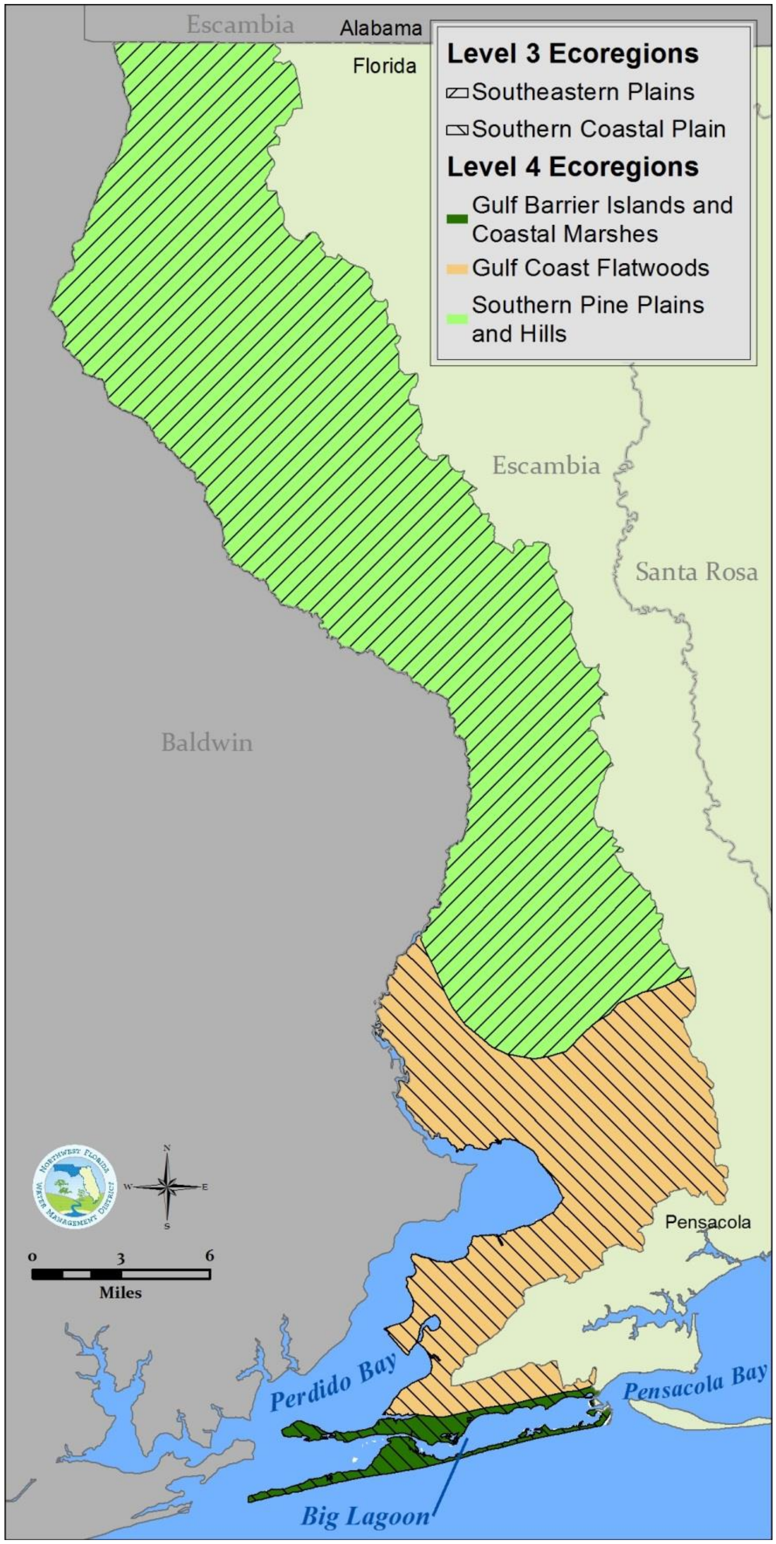
Sources: EPA 2013b, 2013c.

Southeastern Plains and Sub-regions

The Southeastern Plains Level 3 ecoregion makes up the northern portion of the Perdido River and 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 sub-category of the Southeastern Plains ecoregion is found within the Perdido River and Bay watershed:

- **Southern Pine Plains and Hills.** The Southern Pine Plains and Hills sub-region can be found throughout the northern half of the watershed. Once comprised of almost all southern mixed forest and longleaf pine forests in the upland areas, this ecoregion has since been replaced mostly by slash and loblolly pine plantations. Soils are well- to moderately-drained ultisols and alfisols with fine sandy loam or silt loam surface texture.



Sources: EPA 2013b, 2013c; NOAA 2015a.

Figure 2-6 Level 3 and 4 Ecoregions

Southern Coastal Plain and Sub-regions

The Southern Coastal Plain Level 3 ecoregion makes up the southern portion of the Perdido River and Bay watershed, from just south of

Interstate 10 to the coast. This ecoregion is generally lower in elevation, with less relief and wetter soils than the Southeastern Plains. The flat plains of this region exhibit a variety of natural features ranging from coastal lagoons, marshes, and swampy lowlands to upland pine forests, as well as barrier islands along the coast. In the Perdido River and Bay watershed, much of the Southern Coastal Plain region is developed, with extensive wetlands occurring in low-lying areas adjacent to the Perdido River and Perdido Bay. Notable conservation lands in this ecoregion include portions of the Perdido River WMA, Marcus Bayou, and Tarkiln Bayou Preserve State Park. Two Level 4 sub-categories of the Southern Coastal Plain ecoregion are found within the Perdido River and Bay watershed:

- **Gulf Coast Flatwoods.** The Gulf Coast Flatwoods ecoregion is located throughout the southern portion of the watershed and is described as 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.
- **Gulf Barrier Islands and Coastal Marshes.** The Gulf Barrier Islands and Coastal Marshes region makes up the entire coastline of the Perdido River and Bay watershed adjacent to the Gulf of Mexico. This region contains salt and brackish marshes, dunes, beaches, and barrier islands. Cordgrass (*Spartina spp.*) and saltgrass (*Distichlis spp.*) are common in the intertidal zone, while xeric coastal strand and pine scrub vegetation occur on parts of the dunes, spits, and barrier islands.

2.3.3 Climate

The climate of the Perdido River and 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 that are less moderated by the Gulf. Summers are often hot and humid and winters cool and dry. At the National Weather Service Forecast Office, Mobile/Pensacola Station from 1981-2010, the mean minimum temperature was 41.6 Fahrenheit (°F) in January and the mean maximum was 89.9°F in July (National Oceanic and Atmospheric Administration [NOAA] 2014a). Precipitation is generally higher in the coastal portion of the Perdido River and Bay watershed than the northern reaches. Perdido Key’s mean annual precipitation is 63 inches with July being the rainiest (mean monthly between 7 and 8 inches) and April being the driest (3.97 inches) (Intellicast 2016).

Tropical disturbances can generate very destructive winds of up to 200 miles per hour. On average, hurricanes occur in the watershed approximately once every eight years. In addition to damaging winds and flooding caused by hurricanes, the hazard of erosion also increases when more than 1/2-inch of rain falls in less than two hours (USDA 2004). Daylong rains 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.

2.3.4 Geology

The Perdido River and Bay watershed follows much of the general stratigraphy of the western Florida Panhandle. Much of the watershed's geologic features are a product of prehistoric marine deposition during periods when sea level was higher than the present. Near-surface formations include dolomitic limestones, sandy clayey limestones, and finally, shell beds, clayey sands, and sands (USDA 2004). Overlying most geologic formations in the watershed are unconsolidated Holocene siliciclastic sediments (nearly pure quartz sands with minor heavy mineral sands) (USDA 2004). These sands were deposited during sea level fluctuations, and are presently found on the watersheds' barrier

Sources: NOAA 2015a; USDA 2013.

Figure 2-7 Hydric Soils in the Watershed

islands. Relict Pleistocene beach ridges and dunes can be found between Perdido Key and Big Lagoon (USDA 2004). 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. Sandy soils dominate the watershed, particularly in the rolling hills of the western highlands. In the coastal lowland portion of the watershed, sandy soil is underlain by clay resulting in poor drainage (Rupert 1993). 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. Carbon stored in soil decreases 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 the hydrology of streams and impacts habitat and water quality. The effects of sedimentation and erosion on water quality are discussed further 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 Perdido River and Bay watershed have developed on beds of clayey and sandy parent materials. Most of the upland soils are well developed, with distinct horizons that exhibit the vertical movement of iron and organic materials. 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 the Perdido River and Bay watershed. At the turn of the 20th century, when timber resources had been depleted, a variety of vegetables and other crops were grown in the watershed with the main crops being small grain, cotton, soybeans, and corn. Livestock operations also contribute to the agricultural industry within the watershed (USDA 2004). Qualities of the soil, such as erodibility and permeability, greatly influence factors such as groundwater recharge and the potential for groundwater contamination. The acreage of cropland has been decreasing slightly because of the changing economics of crop production and growing pressure from urban development as the population of the county has been increasing.

Hydric soils, which are common throughout the watershed (Figure 2-6), 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" (USDA 2016). Soils that exhibit hydric properties are important indicators of wetlands and floodplains. Hydric soil, in conjunction with hydrophytic vegetation and hydrologic properties, are used to define the jurisdictional boundaries of wetlands in the National Food Security Act Manual (USDA 1994) and 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 2016).

2.4 Hydrologic Characteristics

The Perdido River and Bay watershed contains surface waters including streams, rivers, salt marshes and freshwater wetlands, and a limited number of small freshwater lakes, occupying approximately 53,015 acres (or seven percent) of Florida's portion of the watershed (FDEP 2015a).

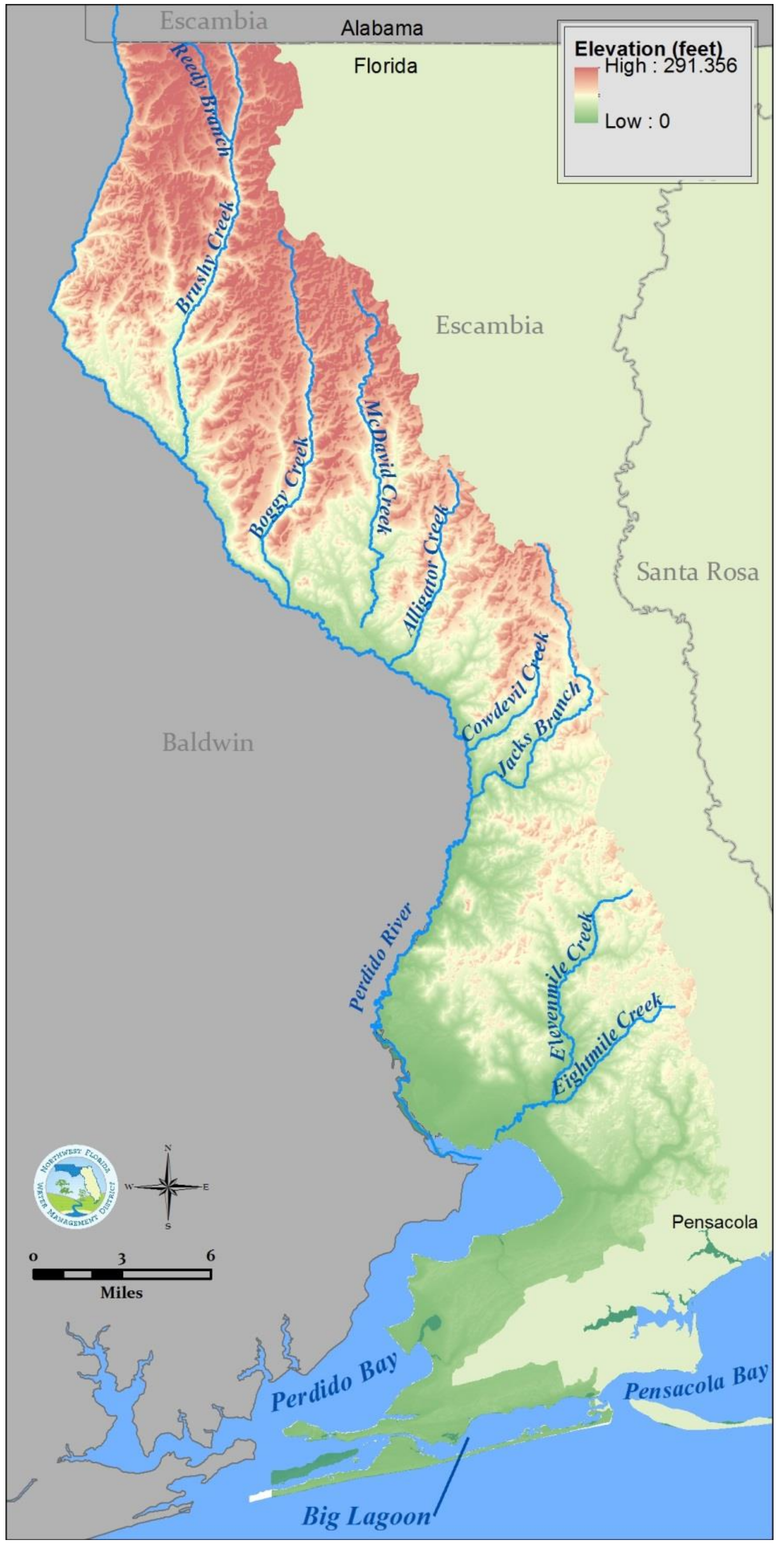
2.4.1 Major Rivers, Tributaries, and Coastal Waterbodies

Receiving a majority of its water from surface runoff, the Perdido River begins in Baldwin County, Alabama, and discharges into Perdido Bay approximately 65 miles from its headwaters. Several rivers in Alabama, including the Styx River and the Blackwater River, converge with the Perdido River from the west and close to its mouth at Perdido Bay. While no major Florida rivers discharge into Perdido River, there are several tributaries in the Florida portion of the watershed which empty directly into the river before it reaches Perdido Bay. These Florida tributaries include Reedy Branch, Brushy Creek, Alligator Creek, Jacks Branch, Cowdevil Creek, and McDavid Creek. Additionally, Eightmile Creek and its tributary Elevenmile Creek discharge directly to Perdido Bay northeast of the mouth of the Perdido River (Figure 2-8).

Perdido Bay covers approximately 50 square miles and is connected to the Gulf of Mexico primarily through Perdido Pass in Orange Beach, Alabama, and to a lesser extent, through Pensacola Bay (eastward via the GIWW and Big Lagoon). The pass entrance is protected by a rock jetty on the west and a combined rock weir and jetty on the east. Old River enters the Pass from the east between Florida Point and Ono Island. Big Lagoon is bordered by Perdido Key to the south and Big Lagoon State Park, the NAS Pensacola, and the Grande Lagoon community to the north (Kirschenfeld *et al.* 2002).

Tarkiln Bayou is the largest bayou on Perdido Bay and is characterized by a shallow sand and mud bottom estuary rimmed by *Juncus* marsh and flatwoods. Water depth in Tarkiln Bayou is generally shallow, ranging from 3 to 6 feet. Water levels at the narrow neck and mouth of the bayou are typically shallow enough to walk across during low tide. The bayou receives freshwater from small, irregular streamlets through the adjacent baygall and flatwoods natural communities and via overland sheet flow (FDEP 2006).

On the eastern portion of the Perdido Bay, north of Tarkiln Bayou, lies Marcus Bayou. Alligator Bayou lies in the upper portion of the bay, north of the Perdido River mouth. Graham Bayou is situated in the Alabama portion of the bay and is connected to Perdido Bay via Wolf Bay.



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

Figure 2-8 Topography and Major Waterbodies

2.4.2 Lakes

Lakes (including some large man-made impoundments) in the Perdido River and Bay watershed cover approximately 81 acres (FDEP 2008a; USGS 2016b). Some of the more prominent of these lakes include Lake Fan, Black Lake, Reeder Lake, Wicker Lakes, Tee Lake, and Crescent Lake. Lake Fan is located to the east of Eightmile Creek, adjacent to Highway 297. Reeder Lake is located to the west and is connected to the Blackwater River and is surrounded by little development. Tee Lake is located on Chambers Point and is directly connected to the Bay due east of Elevenmile Creek's confluence to the Bay. Crescent Lake is located in the highly developed residential areas along Marcus Bayou. Within and among the lakes are an array of aquatic, wetland, and upland habitats.

2.4.3 Gulf Intracoastal Waterway (GIWW)

The GIWW is a 1,100-mile system of inland channels and tributaries traversing the Gulf Coast from Brownsville, Texas, to St. Marks, Florida, passing through the Perdido River and Bay watershed (Florida Department of Transportation [FDOT] 2008; The Gulf Intracoastal Canal Association 2016). The waterway was constructed to provide a fast and safe route for ships and imported cargo up the eastern coast of the U.S. The channel between Pensacola Bay and Mobile Bay was completed early in 1934. The route followed Big Lagoon, Old River, Perdido Bay, Bay La Launch, Wolf Bay, Portage Creek, Bon Secour River, and Bon Secour Bay. Besides altering these natural waterways, the project involved two land cuts totaling approximately seven miles in length. During World War II, the GIWW from Apalachee Bay, Florida, to Corpus Christi, Texas, was widened to accommodate wartime traffic. The completed GIWW was approximately 12 feet deep by 125 feet wide (Alperin 1983). The Gulf Intracoastal Canal Association provides oversight and guidance for the GIWW in Texas, Louisiana, Mississippi, Alabama, and Florida (FDOT 2008; The Gulf Intracoastal Canal Association 2016). Impacts and effects of the GIWW on water quality can be found in Section 3.2.2

2.4.4 Groundwater Systems

Groundwater fills the pores and interstitial spaces in subsurface rocks and sediments, with recharge generally occurring in areas with higher topographic elevations, and discharge occurring in areas with lower elevations such as along streams, bays, and the Gulf of Mexico. The surficial aquifer system, also referred to as the sand and gravel aquifer, is the sole major source of potable water in this region. The sand-and-gravel aquifer in Escambia County is highly productive and of generally good quality. As described by the NWFWMD (2014), the Floridan aquifer system dips from the northeast to the southwest, with the elevation of the top of the system ranging from approximately 350 feet below sea level in northern Escambia County to more than 1,450 feet below sea level in the southwest, where it discharges into the Gulf of Mexico. Due to the depth of the upper Floridan aquifer and its poor quality of water, the sand-and-gravel aquifer, with its high availability of water in wells less than 300 feet deep, is a much preferred source of water.

The intermediate confining unit is an effective, regional confining unit, which significantly restricts groundwater flow between the sand-and-gravel aquifer and the underlying Floridan aquifer system. The intermediate confining unit does contain a minor aquifer, the Escambia Sand. However, poor water quality, limited thickness, and depths of 600 to 900 feet to the top of the unit make the Escambia Sand an unviable groundwater source for human use.

The Perdido River has a sand and gravel bed that is closely connected to the sediments within the sand-and-gravel aquifer, from which it receives much of its base flow (FDEP 2006). Streams within the watershed receive up to 55 – 76 percent total base flow from groundwater seepage (USGS 1965). For example, Elevenmile Creek receives approximately 68 percent of its flow from groundwater (FDEP 2008a).

The surficial aquifer system is generally a thin, unconfined aquifer composed of discontinuous mixtures of Pleistocene and recent alluvium and terrace deposits. The aquifer ranges in thickness from 350 to 530 feet. In southern Escambia County, the sand-and-gravel aquifer includes a surficial zone, low-permeability zone, and main-producing zone (NWFWMD 2013). A 2007 interpretation shows the potentiometric surface in northern Escambia County at a height of approximately 220 feet above sea level. From this high point, water levels in the aquifer decline to the east, west, and south. In the northern half of the watershed, the Escambia and Perdido rivers are major discharge points for the aquifer. South of Cantonment, water levels in the main producing zone increase, reaching an elevation of about 60 feet above sea level near the intersection of Interstate 10 and Highway 29. From this point, groundwater elevations decline in all directions moving towards points of discharge such as wells, the Perdido and Escambia rivers, small streams, Perdido Bay, and the Pensacola Bay system (NWFWMD 2013). 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.

Historical pollution has impacted the surficial zone of the sand-and-gravel aquifer in the southern half of the watershed. Because the main-producing zone is recharged from the surficial zone, contamination at the surface has spread to the main-producing zone (Roaza *et al.* 1991). Nearly half of the public supply wells in southern Escambia County have documented the presence of contaminants, including chlorinated solvent, petroleum hydrocarbon, and pesticide contamination (Ma *et al.* 1999). Water from these wells is treated before being introduced into the water distribution systems (NWFWMD 2013).

2.5 Ecosystem Services

The Perdido River and 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. These provide habitat for various plant and wildlife species, many of which are rare and protected. Human benefits include tourism, recreational opportunities, flood protection, 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 also be financially valuable when the cost of protecting ecosystems for improved water quality is compared with investment in major restoration efforts; oftentimes investing in the management of natural resources for improved water quality is less expensive and more efficient than infrastructure (USDA 2015). 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 (National Research Council [NRC] 2001; Novitzki *et al.* 1997). Wetland functions can be grouped into three general categories: hydrologic, water quality protection and improvement, and habitat (Abbruzzese and Leibowitz 1997). Hydrologic functions include water storage, flood attenuation, and regulation of discharge to surface and groundwaters.

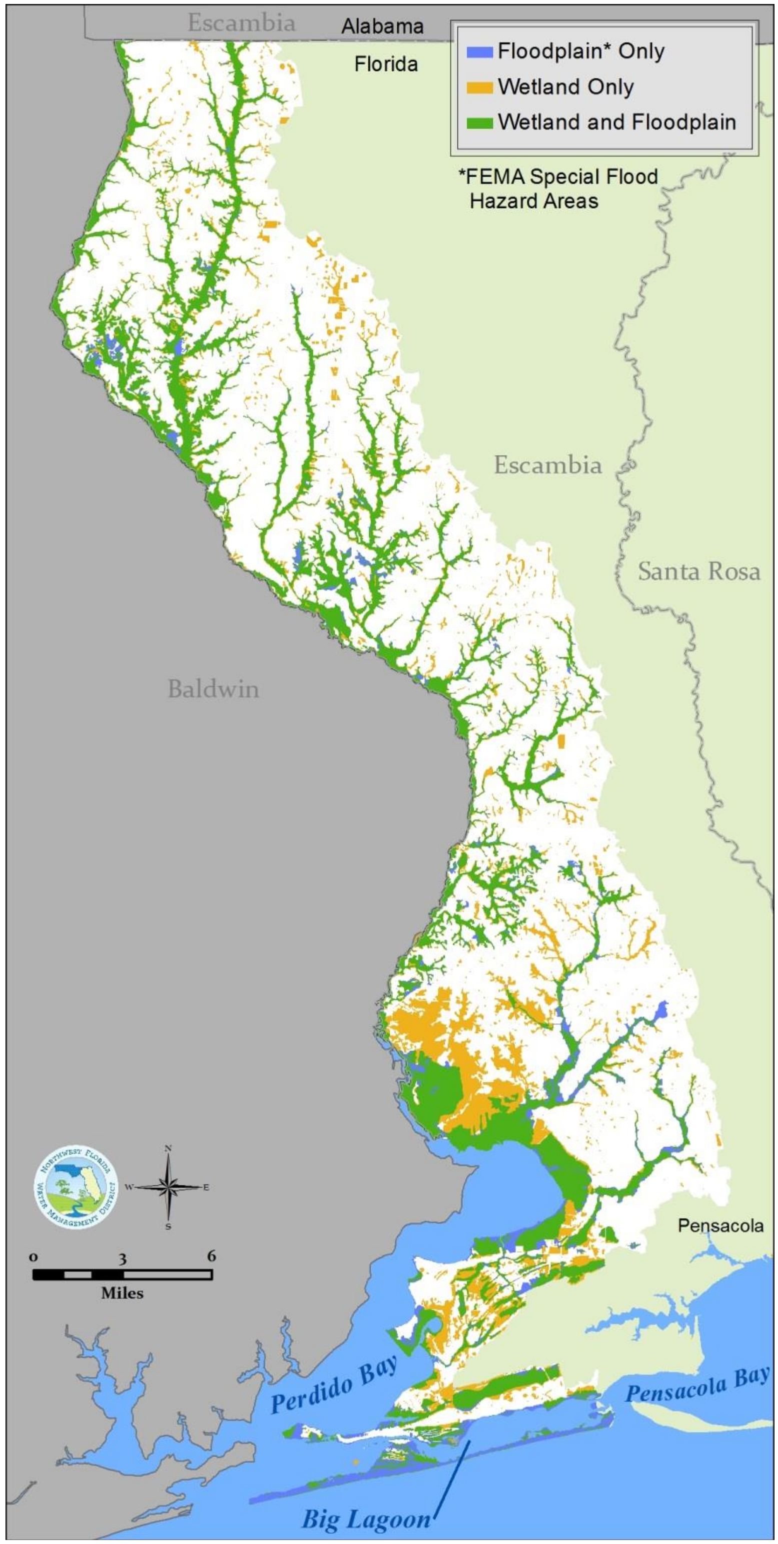
Floodplains along the watershed's rivers and other tributaries reduce runoff energy, which in turn, reduces erosion and protects water quality downstream. Healthy riparian ecosystems within the watershed support vegetative communities that can aid in the absorption of potential flooding, and attenuate and reduce wave energy during storms (Conservation Tools 2016; TEEB 2016). Figure 2-9 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.

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 such as oyster reefs, seagrass beds, and emergent marshes aid in the buffering of storm impacts, shoreline erosion, and sedimentation. During coastal storms, these features help protect the mainland by acting as wind buffers and absorbing potential flooding (Conservation Tools 2016; Florida Division of Recreation and Parks 2016a). 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.



Sources: Federal Emergency Management Agency (FEMA), FDEP and U.S. Fish and Wildlife Service (USFWS) 2016; FHWA 2014; NOAA 2015a; USGS 2015.

Figure 2-9 Floodplains and Wetlands

2.5.4 Commercially and Recreationally Important Fish and Wildlife

The numerous waterbodies and wetlands within the Perdido River and Bay watershed are critical to the health of economically important fisheries in the area. Freshwater rivers, 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*), redbreast sunfish (*Lepomis auritus*), redear sunfish (shellcracker) (*Lepomis microlophus*), longear sunfish (*Lepomis megalotis*), chain pickerel (*Esox niger*), and bluegill (*Lepomis macrochirus*). Some commercially and recreationally important fish and shellfish of Perdido Bay and Big Lagoon include shrimp (*Penaeus spp*.), spotted seatrout (*Cynoscion nebulosus*), red drum or redfish (*Sciaenops ocellatus*), blue crab (*Callinectes sapidus*), Gulf flounder (*Paralichthys albigutta*), striped mullet (*Mugil cephalus*), and white mullet (*Mugil curema*) (National Park Service 2016a). In addition to the commercial 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).

Waterbodies within the Perdido River and 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 Perdido River and Bay watershed (and other Florida watersheds) are essential for those utilizing fisheries for subsistence.

All surface waters within the Perdido River and Bay watershed are classified by the state of Florida (FDEP) as Class III, which means that they are safe for swimming and fishing, but generally are not suitable for potable use or shellfish harvesting.

All areas within the watershed, including in Alabama, are unclassified regarding shellfish harvesting. Therefore, no areas have been designated as either approved or prohibited for shellfish harvesting. Recreational fishing occurs throughout the Perdido River and Bay watershed including the Gulf Islands National Seashore; however, commercial fishing, including shrimping and crabbing, is prohibited within waters of the National Seashore, which is bounded by the GIWW on the north side and one mile from the low tide line on the south side (National

Parks Service 2016). The only official ongoing commercial fishing in Perdido Bay is for mullet (Turpin 2016).

2.5.5 Recreation and Aesthetic Value

The waterbodies and wetlands within the Perdido 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 (Florida Fish and Wildlife Conservation Commission [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. In 2014, the Escambia County and Santa Rosa County extension offices launched a program called Naturally EscaRosa to help both locals and visitors locate both agritourism and ecotourism opportunities in the area (University of Florida Institute of Food and Agricultural Sciences [UF-IFAS] 2016a). According to the Florida State Parks System Direct Economic Impact Assessment, Perdido Key State Park hosted 28,103 visitors in the 2013/2014 fiscal year, approximately 3,200 more visitors than in 2010/2011 (FDEP 2011a). Tarkiln Bayou attracted nearly 4,000 more visitors in 2013/2014 than in 2010/2011, with an annual total of 7,206 visitors. The estimated total economic impact of these parks ranges from $1 – 2 million (FDEP 2014a). This suggests that there is a high demand for pristine natural areas for recreation visits in the Perdido River and Bay watershed.

The Perdido River and 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 (The Nature Conservancy [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 Great Gulf Coast Arts Festival, Gallery Nights, and Feature Artist Shows in Pensacola, the Annual Wine and Art Festival on Perdido Key, and the Orange Beach Arts Festival. In Florida, arts and culture are the number one driver for in-state tourism and the number two driver for out-of-state tourists (Destination Analysts 2015).

2.6 Ecological Resources

The Perdido River and 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 Perdido River and Bay watershed, there are 32 unique natural communities within 15 broader community categories recognized by the FNAI (FNAI 2010, 2016a, 2016b, 2016c).

Approximately 58,667 acres, or 26 percent, of the watershed is comprised of freshwater and tidal wetlands (Federal Emergency Management Agency [FEMA], FDEP, and U.S. Fish and Wildlife Service [USFWS] 2016). Among the estuarine communities are aquatic systems with a wide range of salinity levels that support a wealth of biological diversity, including a number of rare and/or endemic species (Kirschenfeld *et al.* 2002). Aquatic habitats within the watershed include salt marshes, seagrass beds, oyster bars and reefs, and hard-bottom reefs. These habitats support wintering migratory waterfowl and many marine organisms, including juvenile sea turtles and commercially and recreationally important fish and shellfish. 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 (Barbier *et al*. 2011).

In deeper portions of the bay and adjacent to the Gulf of Mexico, habitat is present for the West Indian manatee and three species of threatened and endangered sea turtles. Adjacent beach and dune communities provide nesting grounds for sea turtles and habitat for the endangered Perdido Key beach mouse (*Peromyscus polionotus trissyllepsis*) (USFWS 2016).

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 Perdido River and

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

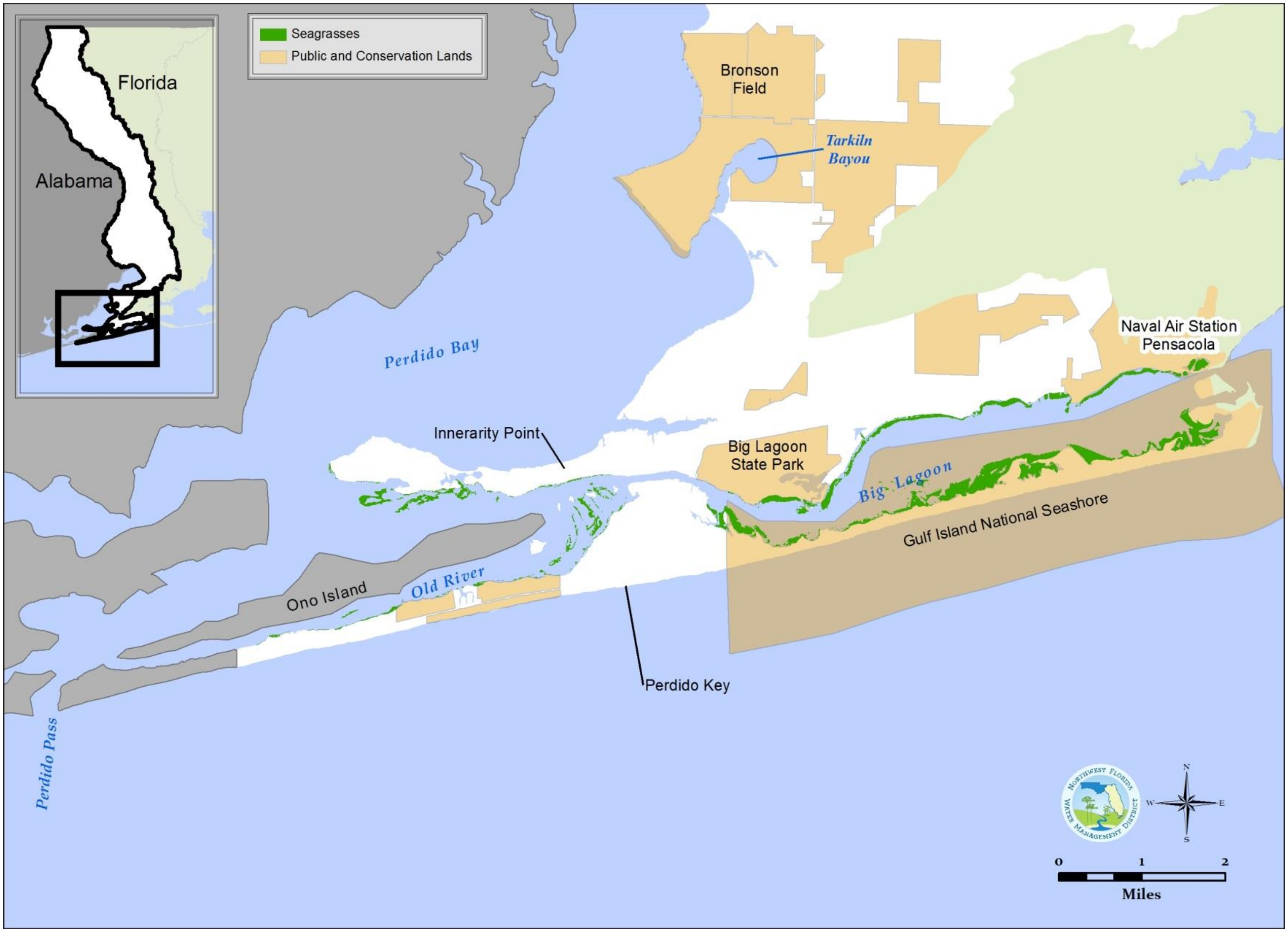
Seagrass beds (Figure 2-10) are extremely important as they provide crucial protective and foraging habitat for many marine species and are critical to the spawning cycle of many fish and invertebrate species, many of which are of great commercial and recreational significance. Among these are shrimp, eastern oysters (*Crassostrea virginica*), spotted seatrout, Gulf menhaden (*Brevoortia patronus*), red drum or redfish, blue crab, Gulf flounder (*Paralichthys albigutta*), striped mullet, white mullet, and bay scallop (*Argopecten irradians*) (Kirschenfeld *et al.* 2002). Seagrass beds are a protected habitat recognized by both the state and federal agencies. Three species of seagrasses have been found in Perdido Bay and include: wigeon grass (*Ruppia maritime*), shoal grass (*Halodule wrightii*), and turtle grass (*Thalassia testudinum*) (Kirschenfeld *et al.* 2002).

2.6.2 Oyster Reefs

The availability of hard substrate for colonization is a determining factor for the establishment of oyster reefs. Oyster reefs have been widely demonstrated to improve water quality, protect shorelines by abating wave energy, stabilize bottom sediments, and provide habitat for fish, crab, and other invertebrates.

2.6.3 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. Major floodplains within the watershed are found along the Perdido River, River Styx, and Blackwater River.



Sources: FWC 2015a; FNAI 2016b; NOAA 2015a.

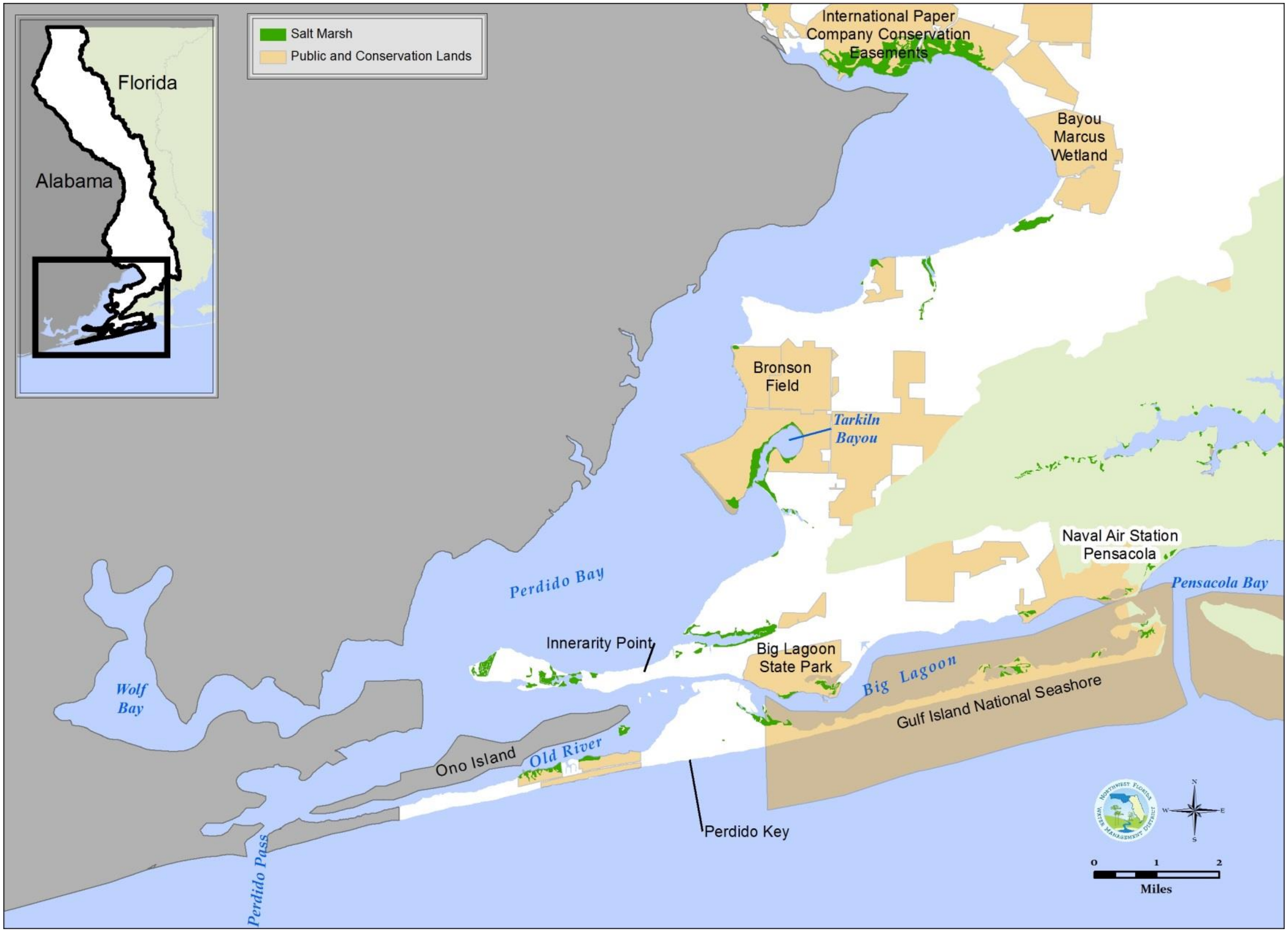
Figure 2-10 Seagrass Coverage in the Florida Portion of the Watershed

The Perdido River and Bay watershed is home to some of the region's few remaining extensive wet prairies, which are one of the most diverse plant communities in the southeast. Wet prairies and their population of unique carnivorous plants are a vanishing natural community type (FDEP 2006). Tarkiln Bayou Preserve State Park's wet prairies are home to several listed plants including large-leaved jointweed (*Polygonella macrophylla*), white-topped pitcher plant (*Sarracenia leucophylla*), and red pitcher plant (*Sarracenia rubra*). Designated animal species within the preserve include a variety of birds of prey, neotropical migrants, and waterfowl (FDEP 2006; Florida Division of Recreation and Parks 2016a).

2.6.4 Emergent Marsh

Marshland is abundant in the Perdido River and Bay watershed (Figure 2-11). 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 water-ward side by smooth cordgrass (*Spartina alterniflora*). The *Juncus* and *Spartina* zones are very distinctive and can be separated easily by elevation.

Salt marshes are among the most productive plant communities on Earth (Fernald 1998). Among the most abundant 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 (*Cladium jamaicense*), maidencane (*Panicum hemitomon*), giant cutgrass (*Zizaniopsis miliacea*), and cattails (*Typha spp*.); but may contain large interspersed patches of black needlerush. In contrast with more coastal salt marshes, these sites lack the extensive salt flats of saltgrass (*Distichlis spicata*), glasswort (*Salicornia spp.*), and salt barrens.



Sources: FNAI 2016b; FWC 2011; NOAA 2015a.

Figure 2-11 Saltmarsh Coverage in the Florida Portion of the Watershed

2.6.5 Coastal Barrier Systems

The Perdido River and Bay watershed has a coastal barrier system consisting of Perdido Key. The barrier system consists of many unique habitats and natural systems including beaches, foredune and relic dunes habitat, tidal marsh, brackish ponds and lagoons, coastal grasslands, and upland forest and scrub communities (National Park Service 2014). Barrier islands and peninsulas buffer adjacent bays and coastal areas from storm impacts and create calm saline conditions in landward waters, which promotes seagrass establishment. The majority of Perdido Key is managed by the National Parks Service as part of the Gulf Islands National Seashore (National Park Service 2014).

2.6.6 Terrestrial Communities

Upland communities, which include mesic flatwoods, sandhill, scrub, scrubby flatwoods, upland hardwood forests, wet flatwoods, and xeric hammocks, provide important habitat, as well as economic and other resources. Federally listed species supported by upland communities within the watershed include the gopher tortoise (*Gopherus polyphemus*), the reticulated flatwoods salamander (*Ambystoma bishopi*), the eastern indigo snake (*Drymarchon corais couperi*), and the red-cockaded woodpecker (*Picoides borealis*), all of which have been documented on the watershed's conservation lands.

2.6.7 Migratory Bird Flyways

The Florida Panhandle falls within two major migratory bird biological flyways; the Atlantic Flyway, and the Mississippi Flyway. "Biological" flyways delineate the major migration corridors, while "administrative" flyways are based on the state jurisdictional boundaries that best mimic biological flyways for management purposes. The state of Florida falls within the Atlantic administrative flyway, and the Perdido River and Bay watershed is within the Mississippi biological flyway. This migratory route generally follows the Mississippi River on the west and the Appalachian Mountains on the east (Bird Nature 2001). Millions of individuals representing over 325 bird species use this route to travel from their breeding grounds in the northern U.S. and Canada to their wintering grounds along the Gulf of Mexico and in Central and South America (Audubon 2011). Many of these species, including least terns (*Sternula antillarum),* Wilson's plover (*Charadrius wilsonia*), piping plovers (*Charadrius melodus*), American oystercatchers (*Haematopus palliates*), and others, occur throughout the Perdido River and Bay watershed and across a wide variety of habitats. Many of these are area transients, using this area as a resting/feeding ground for summer or winter migrations. Others are accidental visitors far from their native ranges. Many of those birds and their critical habitats were affected by the Deepwater Horizon oil spill (Audubon 2011).

3

3.0 Current Watershed Conditions and Water Resource Issues

3.1 Introduction

Increasing population, industrialization, and development in northwest Florida and southern Alabama are correlated with land use changes and an increased need for new or improved infrastructure. The Perdido River and Bay watershed experiences water quality challenges across both states. Within Florida, agricultural and silvicultural activities are concentrated in the upper reaches of the watershed, while urban land uses are predominantly in the central and southern portions of the watershed (Figure 2-4). Both agricultural and urban land uses can generate NPS pollution and cause physical impacts that present long-term challenges for the watershed. 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 is provided to inform future planning, development, preservation, and restoration efforts within the watershed. Further discussion of ongoing management activities for water quality protection and improvement, including BMPs, land use planning, and other water quality protection and improvement techniques, can be found in Section 5.0.

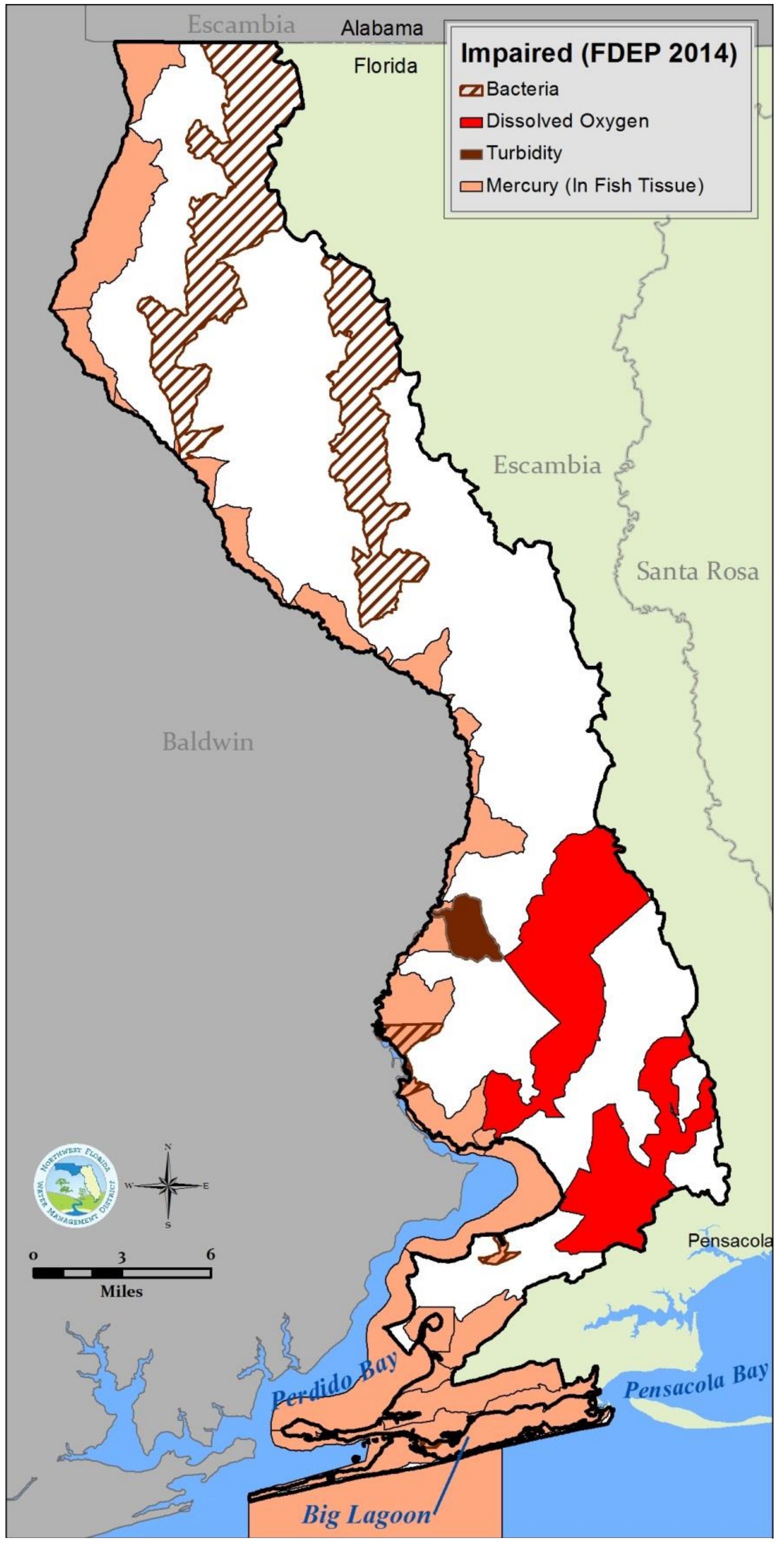
3.2 Water Quality

The following discussion identifies impaired waterbodies (per FDEP) throughout the Perdido River and 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 function.

Of the 72 waterbody segments in the Perdido River and Bay watershed, FDEP has identified 28 impaired segments with 32 total impairments, including 22 segments for mercury in fish tissue, six segments for bacteria (five for fecal coliforms and one for beach advisories), one segment for turbidity, and three segments for dissolved oxygen (DO) (FDEP 2014b). Since some of the segments are impaired for more than one pollutant, the number of impairments exceeds the number of impaired segments. Figure 3-1 illustrates the distribution of identified impaired waters. 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 2014b). In March 2018, the state is scheduled to adopt an updated list of impaired waters for this watershed.



Sources: FDEP 2014b; NOAA 2015a.

Figure 3-1 Impaired Waterbody Segments in Florida's Portion of the Watershed

Authorities in Florida issue human fish consumption advisories for mercury in fish tissue. The advisories are issued by the Florida Department of Health (FDOH) in cooperation with the FWC and the

FDEP. Current fish consumption advisories within the Perdido River and 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 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); however, there are currently no approved shellfish harvesting areas in the Perdido River and Bay watershed. 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 the FDEP. These advisories are discussed further in sections 5.2.3 (shellfish harvesting) and 5.2.4 (beach advisories).

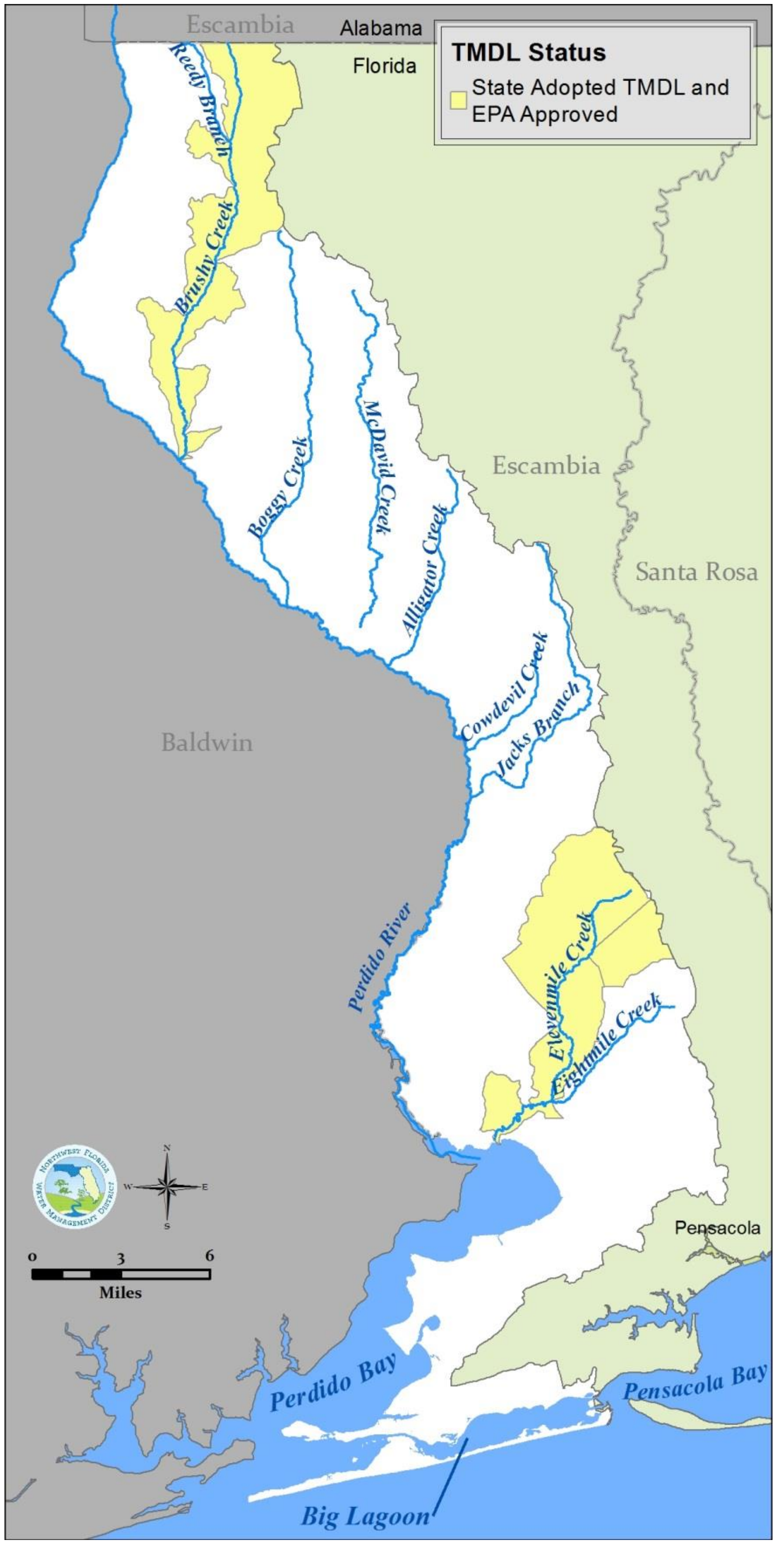
3.2.2 Total Maximum Daily Load (TMDL) Assessments

A TMDL is a tool used by the EPA and the State to establish the maximum amount of a pollutant that a waterbody can receive and still meet state water quality standards. For impaired waters, TMDLs are used to identify the pollution reduction required to restore water quality. Three TMDLs have been adopted by the FDEP for fecal coliform in the Perdido River and Bay watershed (FDEP 2016a):

- Brushy Creek (waterbody identification number [WBID] 4) (FDEP 2012);
- Elevenmile Creek (WBID 489) (FDEP 2008b); and
- Tenmile Creek (WBID 489A) (FDEP 2008b).

EPA regulations allow states to place certain impaired waterbodies into a separate category to bypass TMDL development if they already have control programs in place to restore water quality. These programs, known as Reasonable Assurance Plans (RAPs), act as an alternative to TMDLs. A RAP has been adopted by FDEP to address the un-ionized ammonia impairment in Elevenmile Creek (WBID 489) and restore water quality with the relocation of International Paper's effluent discharge to a wetland treatment system, as required by the company's permit (FDEP 2014c).

The FDEP has adopted a statewide TMDL for reducing the human health risks associated with consuming fish taken from waters that are considered impaired due to elevated mercury levels. Mercury impairments are based upon potential human health risks (fish consumption advisories), not exceedances of water quality criteria (FDEP 2013). 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 (FDEP 2013). It is estimated that approximately 0.5 percent of mercury from anthropogenic sources is from Florida (FDEP 2013). 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 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 2013).



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

Figure 3-2 TMDLs in the Watershed

Table 3-1 TMDLs Adopted by the FDEP

Waterbody Name	WBID(s)
Fecal Coliform	
Bushy Creek	4
Elevenmile Creek	489
Tenmile Creek	489A
Mercury	
Bayou Garcon (older data)	987
Bayou Garcon (current data)	987
Big Lagoon	1004
Bridge Creek (Tidal Portion)	872B
Direct Runoff to Bay	1014
Direct Runoff to Bay	1018
Direct Runoff to Bay	991
Gulf of Mexico (Escambia County; Perdido Bay)	8001
Perdido Bay	974
Perdido Bay (Lower Segment)	797A
Perdido Bay (Upper Segment)	797
Tarkiln Bayou	945
Tee And Wicker Lakes	784
Weekly Bayou	935
Direct Runoff to Stream	72
Direct Runoff to Stream	72D
Direct Runoff to Stream	72E
Direct Runoff to Stream	72F
Perdido River	2F
Perdido River	462A
Perdido River	462B
Perdido River	462C

Source: FDEP 2016b

Table 3.1 and Figure 3-2 show the FDEP's adopted TMDLs for the Perdido River and Bay watershed (FDEP 2016a). The FDEP is scheduled to develop TMDLs for the remaining impairments over the next ten years (FDEP 2014b).

There are no pending or adopted Basin Management Action Plans (BMAPs) to implement the fecal coliform TMDLs or the adopted TMDLs for mercury in the Perdido River and Bay watershed (FDEP 2016b).

Once a TMDL or RAP is adopted by the state, the waterbody segment is removed from the state's impaired waters list. That being said, these waters remain a priority for restoration and restoration funding from the state. In the case of the 22 segments with mercury TMDLs, consumption of fish from these waters should be limited to protect human health as directed by the FDOH. This is important, as these segments will be removed from the impaired waters list when it is updated in 2018.

Elevenmile Creek (WBID 489) and Tenmile Creek (WBID 489A) were removed from the impaired waters list with the adoption of the fecal coliform TMDLs in 2008, as was Elevenmile Creek (WBID 489) with the adoption of the un-ionized ammonia RAP. It is expected that with the adoption of the fecal coliform TMDL for Brushy Creek (WBID 4) in 2012, it will be removed from the updated impaired waters list in 2016. (FDEP 2014c).

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.

3.2.3 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, wastewater treatment facilities, mines and borrow pits, and marinas, among others. The National Pollutant Discharge Elimination System (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.

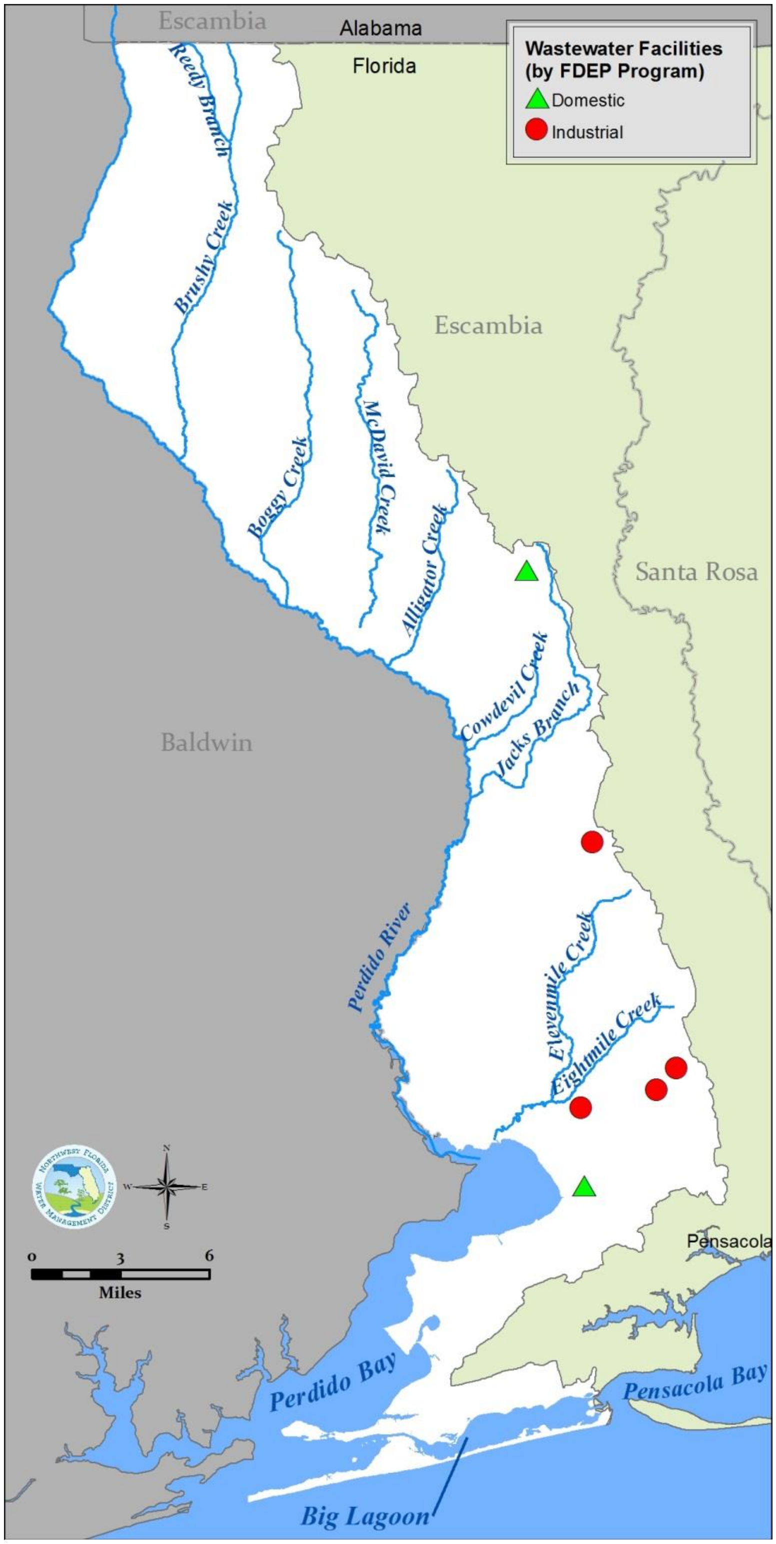
Permits for point source facilities are reviewed and renewed at designated intervals. Specific permits are issued based on the results of water quality-based effluent limit studies. The NPDES Permit Writers' Manual encourages permit writers to consider the impact of every proposed surface water discharge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

There are currently 339 facilities permitted through the NPDES in the Perdido River and Bay watershed including construction permits and other discharges. Together, these facilities hold a total of 364 permits, with some facilities holding multiple permits for multiple types of discharges. For example, a wastewater treatment facility 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 western urban fringe of Pensacola, which extends into the Perdido River and Bay watershed. Of the watershed's total 364 permits, 281 permits are for activities within the Pensacola metropolitan area. Other major centers of NPDES activities are located in Cantonment, 20 miles north of Pensacola, along the Perdido River, and near the town of Molino in east-central Escambia County.

Wastewater Treatment Facilities

Wastewater treatment facilities (WWTFs), 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 disposal can introduce nutrients, bacteria, and other pollutants to surface and groundwaters. There are two permitted domestic wastewater facilities and four industrial wastewater facilities within the watershed (Figure 3-3). Wastewater facilities are located in densely populated areas, with the highest concentration of facilities south of Eightmile Creek (FDEP 2015b).



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

Figure 3-3 Permitted Wastewater Facilities within the Perdido River and Bay Watershed

Among the largest sources of industrial wastewater in the Perdido

River and Bay watershed is International Paper's pulp and paper mill in Cantonment. The facility discharges directly to surface waters and has had a history of water quality violations (FDEP 2006). Discharge of up to 28 million gallons per day (mgd) of untreated wastewater to Elevenmile Creek has caused water quality problems in the creek and downstream in Perdido Bay. In 2013, International Paper upgraded its treatment facility and installed a ten-mile pipe system to a new 1,381-acre treatment wetland. An average daily flow of 23.5 mgd was removed from Elevenmile Creek and transferred to the receiving wetlands (Nutter and Associates, Incorporated 2015). International Paper owns over 3,000 acres of wetlands north of Perdido Bay which have also been extensively planted to provide wildlife habitat (International Paper 2014). As this facility has been generally regarded as the most substantial single pollutant source affecting Perdido Bay, success of the upgraded treatment system may be among the most important near-term factors affecting water quality in the bay (Livingston 2001; North Escambia 2014). The mill continues to be an economic driver in the watershed; in 2014, International Paper announced plans to reinvest more than $90 million in the mill over a five-year period in order to increase energy efficiencies and strengthen its competitive position (North Escambia 2014).

In 2015, the Bayou Marcus Water Reclamation Facility, owned by Emerald Coast Utilities Authority, discharged 5.89 mgd of treated wastewater to a treatment wetland along the upper eastern shore of Perdido Bay. This WWTF has the permitted capacity of 8.2 mgd with discharge to over 1,000 acres of treatment wetlands (ECUA 2016a; FDEP 2015c).

Treated wastewater from multiple treatment facilities has been successfully reused for beneficial purposes across Escambia County. Facilities that have implemented reuse activities include the Emerald Coast Utilities Authority (ECUA) and Pensacola Beach WWTFs. In 2010 ECUA's Central Water Reclamation Facility WWTF came online to replace the Main Street facility (ECUA 2016b). The ECUA's Central Water Reclamation Facility is expected to provide up to 31.85 mgd of reclaimed water, including 20 mgd for power generation and industrial uses at the Gulf Power Crist Facility and 8 mgd for industrial uses at International Paper (FDEP 2015c). Available reclaimed water is projected to increase to 8.37 mgd for 2015 – 2035 (FDEP 2015c; 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. For facilities that already have reuse programs, finding additional recipient sites could reduce surface water discharges. 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.

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. 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 Perdido River and Bay watershed, there are two hazardous waste facilities registered as EPA Biennial Reporter facilities, both of which are located in the Pensacola metropolitan area. 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, 157 closed, three abandoned, and 123 active petroleum contamination tracking sites within the watershed are registered with the Storage Tank and Petroleum Contamination Monitoring (STCM) database. There are seven contaminated dry-cleaning sites eligible for the state-funded Dry-cleaning Solvent Cleanup Program within the basin. The majority of STCM and dry-cleaning sites are located in developed areas in the southern portion of the watershed, particularly around the Pensacola metropolitan area and in Cantonment. In the northern reaches of the watershed, STCM and dry-cleaning sites are located predominantly in the town Walnut Hill.

There are three recently deleted EPA National Priority List (NPL) Superfund sites within the Perdido River and Bay watershed: Pioneer Sand Company, Beulah Landfill, and Dubose Oil Products Company. Sites that have been deleted from the NPL list have either been remediated or no longer pose a risk to human health. Additionally, there are five non-NPL sites in the watershed including the former Burleson Van Rental, International Paper Mill, Rapid Management Co., C & D Landfill, Sinclair & Valentine Co., Inc., and Woods Dry Cleaning & Laundry. 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.

Landfills and Solid Waste Disposal Facilities

Landfills and solid waste disposal facilities are potential sources of contamination to surface and groundwaters through the percolation of rainwater into waste materials and the leaching of soluble toxins. In the Perdido River and Bay watershed, there are a total of 58 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. Replacing conventional covers with evapotranspiration tree covers may offer an effective means of protecting groundwater from contamination by landfill leachates (Abichou *et al.* 2012).

The majority of landfills and solid waste disposal facilities are located in the lower reaches of the watershed in close proximity to the major developed areas within and surrounding the Pensacola metropolitan area and Cantonment (Table 3-2). 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 Escambia County near Pensacola (FDEP 2014d). The USGS recognizes the sand and gravel mine, known as Pit #6, operated by the Clark Site Contractors, Inc., as the only major mining operation within the Perdido River and Bay watershed.

Additionally, eight small-scale mines and borrow pits within the watershed have been identified by the FDEP, several of which are located near streams, creeks, tributaries, and other waterbodies (FDEP 2014d, 2015b). In Alabama, there are three permitted sand and clay mines in Baldwin County and one that is inactive (Alabama Department of Environmental Management [ADEM] 2011; Alabama Department of Industrial Relations 2010).

Table 3-2 Florida Solid Waste Facilities in the Perdido River and Bay Watershed

Type of Landfill/Solid Waste Facility	Number of Facilities
Active Sites	10
Not Permitted/Registered	1
Inactive (Registered and Non-Registered)	12
No-Further Action Facilities	1
Never Operated/Permit Never Used	1
Postponed	1
Closed Facilities	28
Registered (No Further Information)	4

Source: FDEP 2016c.

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 2015d, 2015e).

Marinas are located throughout the southern portion of the watershed, both on the mainland and the watershed's numerous peninsulas and barrier islands. There are currently two Clean Marina-designated marinas in the watershed: NAS Pensacola Sherman Cove on Big Lagoon, and Holiday Harbor Marina on Old River (FDEP 2015e). 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

NPS 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 onsite sewage treatment and disposal systems (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 Perdido River and 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 Perdido River, associated tributaries, and Perdido Bay.

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 runoff 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 2016d). In urban areas, lawns, roadways, buildings, commercial and institutional properties all contribute to NPS pollution (EPA 2016d). Potential pollutants associated with stormwater include solids, oxygen-demanding substances, nutrients, pathogens, petroleum hydrocarbons, metals, and synthetic organics (EPA 2016d). 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 Perdido River and Bay watershed is concentrated around the Pensacola metropolitan area, with additional development occurring around Cantonment. Extensive redevelopment is occurring in the coastal portions of the watershed as hundreds of rental buildings, representing tens of thousands of units, are being bought by developers, emptied of renters and turned into condominiums for quick resale, mostly to investors and speculators, as so-called condo conversions. Target areas for redevelopment include Perdido Key and Pensacola Beach (The Florida-Alabama Transportation Planning Organization 2010).

In the Perdido River and Bay watershed, two municipalities currently hold Municipal Separate Storm Sewer System ([MS4] NPDES Stormwater) permits for stormwater conveyance (not combined with sewer) that discharges to waters of the state; including Escambia County and NAS Pensacola. Along with developments adjacent to Perdido Bay and its many bayous and lagoons, tributaries and rivers that feed the bay are also vulnerable to NPS pollution associated with stormwater.

Most urban stormwater sources are located in the southern portions of the watershed, for example, the western reaches of Pensacola, Ono Island, and Perdido Key. Hardened, outdated stormwater infrastructure moves sediments, nutrients, petroleum products, toxic metals, and other stormwater contaminants directly from roads and impervious surfaces and transports them directly to surface waters with little to no treatment. Urbanization also 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).

In 1991, Escambia County established a Stormwater Master Plan and program to reduce flooding frequency and to improve the water quality of runoff entering surface waterbodies. Under this program, the county has developed stormwater studies for 11 of 23 basins in the Perdido River and Bay watershed including (Curb 2011):

- Elevenmile Creek;
- Eightmile Creek;
- Beverly Parkway;
- Bayou Marcus;
- Millview;
- Bronson Field;
- Paradise Beach;
- Sandy Creek Weekly Bayou;
- Tarkiln Bayou;
- Perdido River South; and
- Jack’s Branch.

These studies aim to reduce NPS pollution, reduce flooding, and enhance transportation by incorporating detailed modeling and prioritizing capital improvement projects (Curb 2011; Hatch Mott MacDonald 2003). Among the project needs identified were dirt road paving, restoring streams, constructing stormwater ponds, and installing stormwater retrofits in established neighborhoods. Projects have been funded primarily through the county's local option sales tax (LOST); however, LOST funds alone will not be enough to implement all of the identified projects and conduct the remaining basin studies.

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.

Silviculture and Agriculture

Silviculture and related industries have long been major economic drivers in the region. Silviculture was Escambia County's top industry until the turn of the 20th century, when forest resources became depleted. In northwest Florida, forest products and services have been valued at approximately $1.21 billion per year (Hodges *et al.* 2005). In 2004, USDA estimated that approximately 157,500 acres, or 63 percent of the productive woodland, is managed for pine, including slash pine, longleaf pine, and loblolly pine (USDA 2004). Today, Escambia County's economy has shifted away from silviculture; however, pulp, paper, and allied products are still one of the county's top five exports (FDACS 2013; FDOT 2013). 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.* 2005).

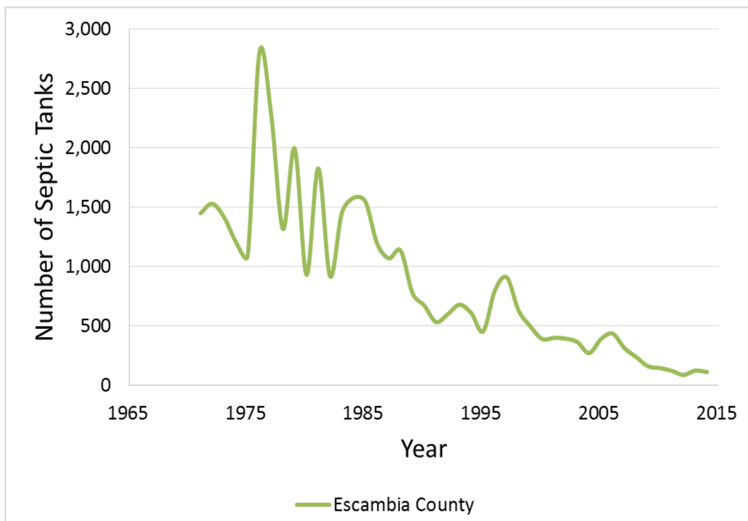
Early residents of Escambia County did not turn to farming until forest resources were nearly exhausted in the early 1900s (USDA 2004). By 1992, 27,701 acres of Escambia County were used for crops including corn, small grain (wheat and oats), hay, soybeans, and cotton, as well as smaller quantities of sorghum, vegetables, and specialty crops (U.S. Department of Commerce Economics and Statistics Administration 1992; USDA 2004). The forecasted agricultural lands for 2025 and 2035 in Escambia County are 48,004 and 48,066 acres respectively, approximately 4,500 to 5,600 of which is irrigated (FDACS 2015). Most soils well-suited to agriculture are found in the northern half of the Escambia County. As urban growth spreads out from Pensacola into the Perdido River and Bay watershed, agricultural lands in the central and southwestern parts of the county are being converted to suburban and urban land uses. However, in the northern parts of the county, agriculture maintains a strong, viable presence (USDA 2004).

Today, agriculture in Escambia County consists largely of the same crops produced in the early 1900s with some irrigation of fruit crops, sod, and ornamentals. Agricultural water use in Region I was estimated at 2.57 mgd in 2010 and is projected to increase by 0.75 mgd to 3.32 mgd, or by 29 percent, by 2015 (NWFWMD 2013).

Silvicultural practices such as ditching, landscape alteration, fertilizer application, road construction, 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 (EPA 2016e, Stanhope *et al.* 2008). Where appropriate, BMPs such as those developed and coordinated by FDACS are employed and 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) that 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.

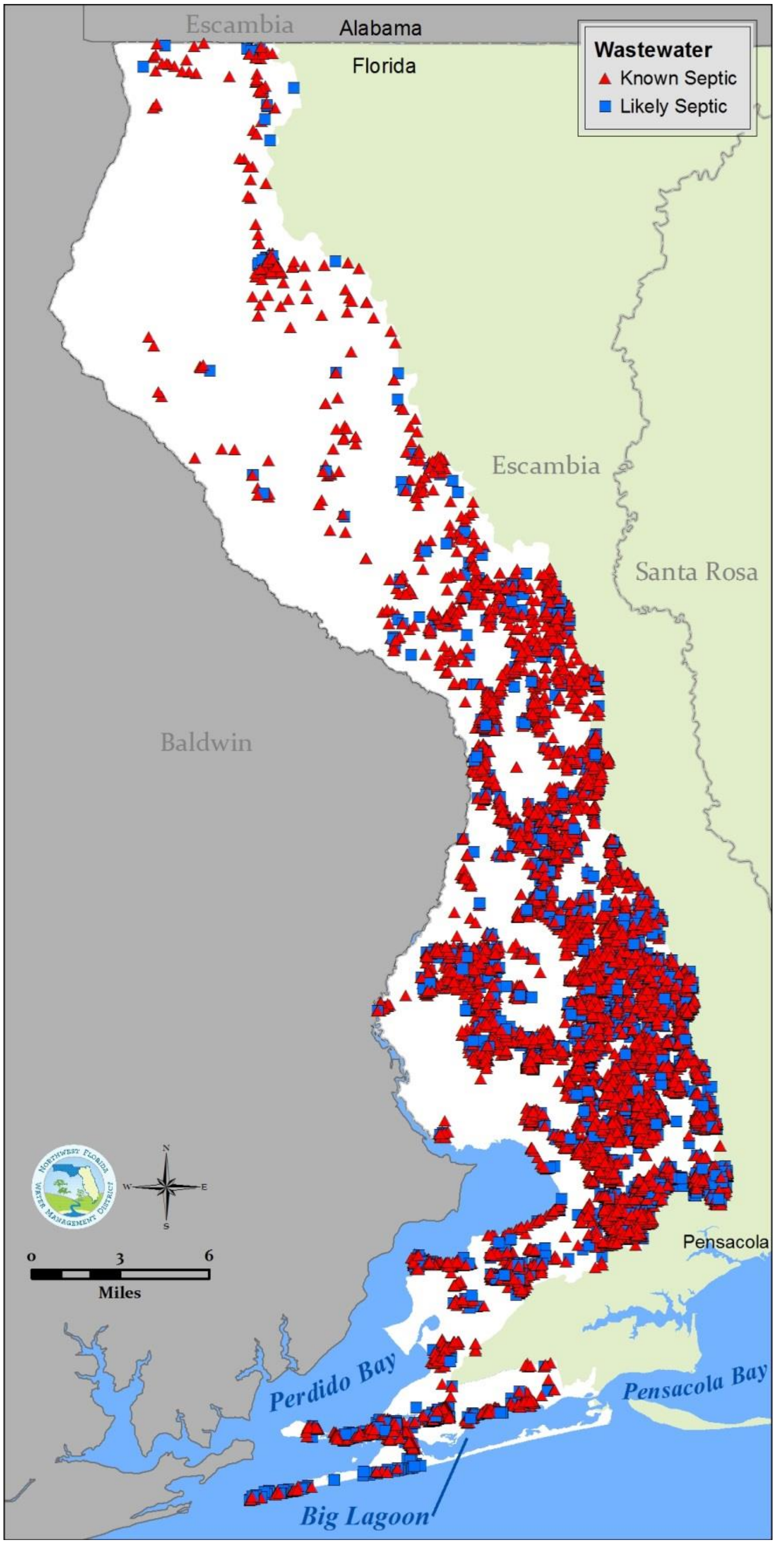
Onsite Sewage Treatment and Disposal Systems (OSTDS)

OSTDS 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. Well-designed and maintained septic systems are 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).



Source: FDOH 2015a

Figure 3-4 New Septic System Installations by Year



Sources: FDOH 2015b; NOAA 2015a.

Figure 3-5 Septic Tank Locations in the Perdido River and Bay Watershed

Across the watershed, new septic installations have declined rapidly since their peak use in the late 1970s. By the early 1990s, new septic installations in Escambia County had declined by 50 percent (Figure 3-4) (FDOH 2015a).

According to 2012 FDOH permitting data, there were are at least 12,355 new or existing septic tanks in the Perdido River and Bay watershed; however, at least 1,728 permits had been issued to abandon septic tanks, presumably due to connection to a centralized sewer collection system (FDOH 2012). Figure 3-5 shows the likely locations of septic tanks as of 2015.

In the Perdido River and Bay watershed, most rural and unincorporated communities, and a number of suburban communities and subdivisions near Pensacola rely on OSTDS systems for wastewater treatment. Affected areas extend from the northern reaches of the watershed, where OSTDS systems are relatively sparse, south through the Ensley, and western Pensacola area where OSTDS systems are heavily concentrated. ECUA continues to extend sewer service to previously unserved areas, particularly those on the coast (Escambia County 2010).

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 rapidly increase sediment inputs to surface waters. 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 Natural Resources Conservation Service (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).

Freshwater streams across the watershed have been impacted by the erosion of dirt roads and subsequent deposition of sediment into waterways. In 1991, Escambia County had 282 miles of unpaved dirt roads and used more than 100,000 cubic yards of fill material per year to grade these roads. When roads are graded, much of the applied fill material washes off the roadways and enters streams or stormwater drainage systems (TNC 2014). Escambia County is working to address this with a program to pave dirt roads from hilltop to hilltop. Baldwin County, Alabama, has also been addressing this and expects most dirt roads to be paved by 2020 (FDEP 2006).

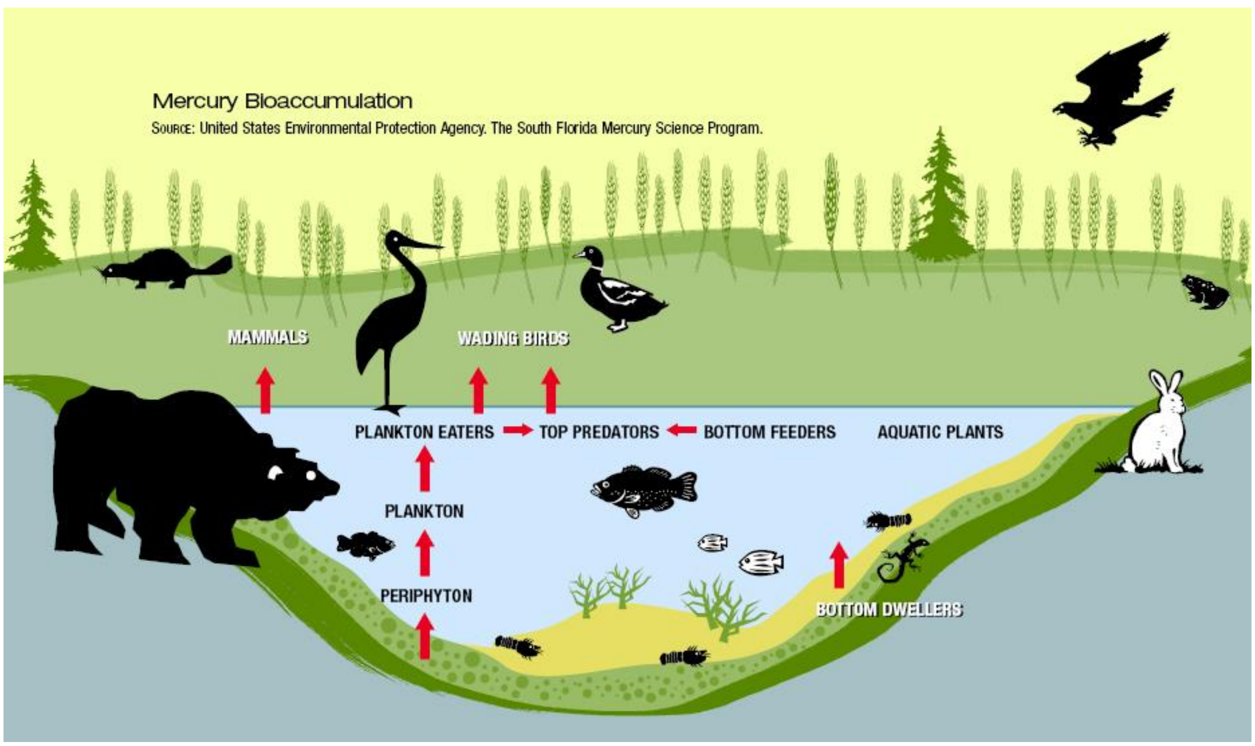
In the northern reaches of the watershed, Pliocene Citronelle Formation soils, topped by variable depth Pleistocene and Holocene undifferentiated sediments, are easily erodible and contribute to sedimentation in streams (FDEP 2006; Rupert 1993). Erosion caused by water is a major management concern in Escambia County, especially in areas of cropland that have slopes of more than two percent. The loss of the surface layer because of erosion reduces the productivity of soil. Also, water is polluted as sediment leaves the site and enters streams and ponds.

Adverse impacts associated with sedimentation include smothering of submerged aquatic vegetation (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).

Atmospheric Deposition

While many impacts to water quality result from direct input to surface waters, either as point source 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).



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

Figure 3-6 Bioaccumulation of Methyl-Mercury

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. Four segments were removed from the impaired list for mercury in fish in 2014 due to the adoption of TMDLs for mercury (FDEP 2014c). To protect human health, fish consumption should be limited from segments with mercury TMDLs, according to guidance from the FDOH.

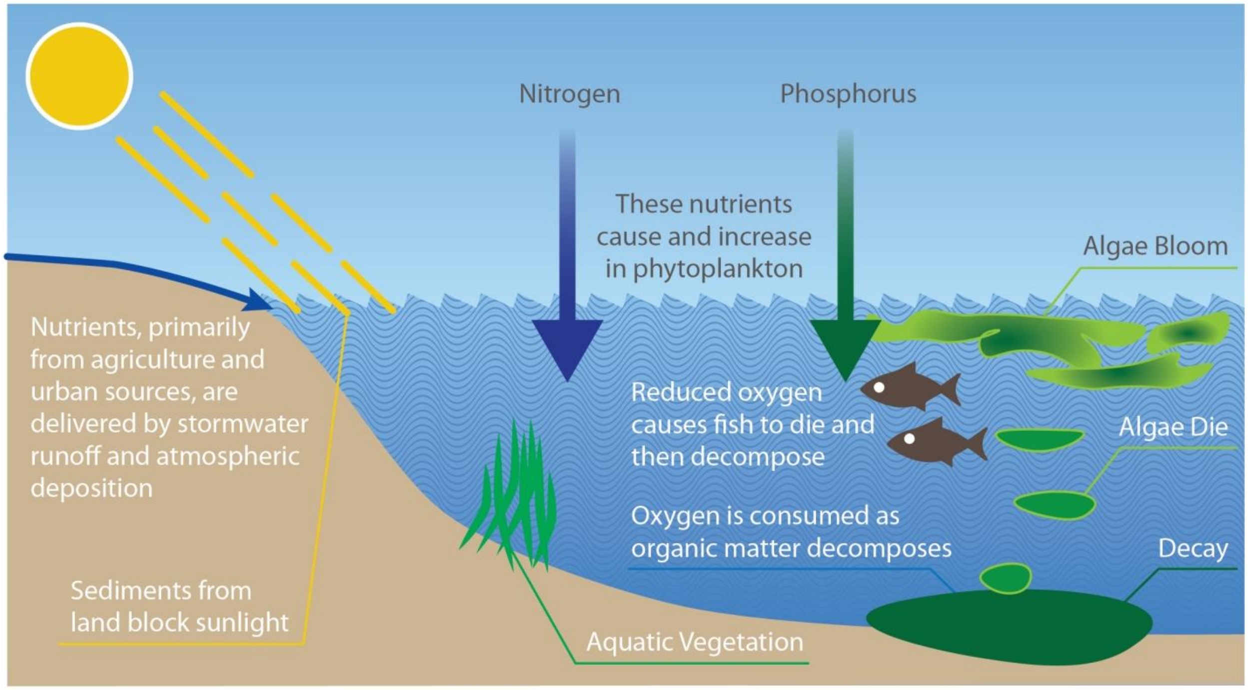
Nitrogen inputs from industry, sewage, and wastewater treatment discharges and agriculture are most likely the primary point source discharges of nutrients to waterways in the Perdido River and Bay watershed. However, atmospheric deposition of nitrogen from fossil fuel combustion may also be a source 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). 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. 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 3-8 illustrates how the eutrophication process can occur.



Source: Graphic by Ecology and Environment, Inc.

Figure 3-7 Eutrophication Process

A NOAA estuarine eutrophication survey found that tidal waters of the bay exhibited increasing levels of nuisance and toxic algae, along with increasing nitrogen, phosphorus, hypoxia, anoxia, and biological stress. For example, Wolf Bay (the largest tributary to southwestern Perdido Bay) has experienced eutrophication caused by nitrate and phosphate runoff from an increase in agricultural land use (Livingston 2001).

Harmful Algal Blooms (HABs) and Aquatic Life Mortality Events

Harmful algal blooms periodically occur in coastal Gulf of Mexico waters. Harmful algal blooms monitoring resources include federal and state advisories and bulletins. Although 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 (NOAA 2014b).

HABs 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 2014b). Red tide, caused by the microscopic algae *K. 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 2015b).

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 2014b). 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 2015b). 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.

3.3 Habitat Quality in Receiving Waters

3.3.1 Subtidal Communities

Subtidal communities in the Perdido River and Bay watershed predominantly include seagrass beds and unconsolidated sediment. Portions of Big Lagoon were repeatedly exposed to crude oil and weathered residue from the Deepwater Horizon oil spill during the summer of 2010 (FWC 2015b).

A long-term analysis of changes in sediment nutrient concentrations in portions of the watershed was conducted from 1989 to 1999. As early as 1989, ammonia (nitrogen) and orthophosphate were detected in sediment samples collected in Perdido Bay. Runoff from Elevenmile Creek caused higher phosphorus concentrations in bay sediments near the creek's point of discharge (Livingston 2001). Phosphorus in sediments was relatively low from 1989 to 1993, and in 1994, there was an increase in Perdido Bay and Wolf Bay with no associated increases seen in Perdido River or the upper submerged grass beds, suggesting a contribution of phosphorus from the Champion paper mill (currently International Paper) on Elevenmile Creek. This trend continued into 1996. After phosphorus-loading by the mill was reduced in 1997 and 1998, phosphorus in the sediments decreased everywhere, except for the mouth of Elevenmile Creek itself. In 1999, when mill activities resumed, there was a corresponding increase in sediment phosphorus (Livingston 2001). The long-term impacts of this nutrient loading can lead to eutrophication. Eutrophication (defined in Section 3.2.3), in particular, 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 the estuary. In addition to providing habitat, seagrass meadows have a wave dampening effect that protects shorelines during storm events. Additionally, seagrass coverage is indicative of water quality, due to their need for clear water to allow adequate sunlight.

Seagrass communities in the watershed have been severely impacted by historical pollution. From 1940 to 1992, approximately 90 percent (877 acres) of the historical continuous seagrass coverage was lost. Degraded water quality, due to increased shoreline and watershed development, stormwater runoff, septic tanks, WWTF effluent, industrial discharges, agriculture, silviculture, and natural occurrences (e.g., hurricanes) has been the main contributor to the loss of seagrasses in Perdido Bay (Kirschenfeld *et al.* 2006). Natural events also impact seagrasses in Perdido Bay. For example, Hurricane Frederick, which made landfall at Mobile Bay in 1979, did considerable damage to Perdido Bay seagrasses (Miller 1998).

In the ten-year period from 1992 to 2002, it appears that the rate of seagrass loss may have declined, but Perdido Bay still continued to lose an additional seven acres, or 2.6 percent, of its seagrass coverage (Kirschenfeld *et al.* 2006).

Mapping data from 1987 and 2002 showed large-scale losses (80 percent) of seagrasses over 15 years. In 2002, only 115 acres of seagrass remained in the bay. Seagrass maps from 1940 showed that seagrasses then covered 1,186 acres and that most of the acreage was located in the lower portions of Perdido Bay (Kirschenfeld *et al.* 2006). A study of the short-term effects of the 2004 hurricane season found that seagrasses tolerated these storms well (Byron and Heck 2006).

According to the 2015 Seagrass Integrated Mapping Monitoring (SIMM) project conducted by FWRI, seagrass coverage in Perdido Bay increased by approximately 18 percent between 2002 and 2009 (FWC 2015b). During this monitoring period, quality was not determined; however, localized propeller scarring near developed areas was noted as posing a threat to ecosystem health and a stressor to seagrass communities. Seagrasses are also impacted by natural events such as El Niño and tropical cyclones (FWC 2015b). 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.

Additional information about seagrass monitoring efforts and the relationship between SAV and water quality can be found in Section 5.0.

Limited data exists on the quality and quantity of oyster habitat in Perdido Bay. Periodic salinity stratification and hypoxia/anoxia can increase oyster mortality and negatively impact other aquatic species (Livingston 2001).

3.3.2 Intertidal Communities

Intertidal communities within the Perdido River and Bay watershed include salt marsh and unvegetated intertidal mud flats, which occur throughout the bay system, including the coastal barrier complex. Little research has been conducted on the quality of intertidal communities for this watershed. Where urban and coastal development has occurred, impacts to intertidal communities are likely, which may result in reduced wildlife habitat.

3.3.3 Freshwater Systems

In rural areas, land clearing associated with agriculture, silviculture, and recreation, as well as dirt road erosion, have led to increased soil erosion and sedimentation in the Perdido River drainage basin. Habitat quality in freshwaters systems is largely dependent upon local water quality conditions (further discussed in Section 3.2).

Terrestrial uplands, which influence the hydrology of freshwater systems including wetlands, have undergone significant alteration across the watershed. For example, on lands now protected as Tarkiln Bayou Preserve State Park, six major drainage ditches have altered hydrology across the park. Several of these ditches were installed to increase drainage both on- and off-site for silviculture, adjacent residential developments, and nearby agricultural lands. Many vast areas of wet prairie that were historically present on the landscape are rapidly transitioning to wet flatwoods due to lack of frequent fire and alteration of hydrology (FDEP 2006).

Another example of wetland alteration in the watershed has been the historic use of recreational off-road vehicles, which create major rutting along traditional jeep trails. Rutting has occurred in Tarkiln Bayou Preserve State Park prior to public acquisition, resulting in 50- to100-foot long holes that hold up to 3 or 4 feet of water (FDEP 2006). Planting and harvesting activities associated with the silviculture industry have also caused significant alteration of wetland hydrology in many portions of the watershed. Associated impacts are caused primarily by the disturbance of wetlands in preparation of planting monoculture pine plantations, the construction of logging roads, and rutting caused by heavy equipment during harvesting (FDACS 2016a).

Although it is not a critical component of the scope 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 2006). 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 2006; FWC 2015c; Mack *et al.* 2000; Vitousek 1986).

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 2014).

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, grasslands 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 that suggests 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 Perdido River and Bay watershed, major riverine systems, streams, wetlands, low-lying areas, coastal areas, and closed basins are subject to significant flooding. Flooding is 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 (FEMA 2006).

Federal Emergency Management Agency digital flood maps indicate that 46,927acres (approximately 21 percent) of the Perdido River and Bay watershed are designated as Special Flood Hazard Area (Figure 2-8). Lands prone to flooding with the greatest potential for economic damage are developed areas in the lower watershed around Perdido Bay and the Gulf of Mexico, including Perdido Key and neighborhoods along Bayou Marcus Creek, Eightmile Creek, and Elevenmile Creek. The major tributaries to the Perdido River and many feeder streams are also vulnerable to flooding.

3.4.2 Recent Flood Events

Storm surges from tropical storms and hurricanes inundate areas on the coast and surrounding Perdido Bay, and the lower portions of Elevenmile, Eightmile, and Bayou Marcus creeks (NWFWMD 2012). Hurricane Ivan made landfall west of Perdido Key in 2004. Storm surges caused the most severe damage to homes, businesses, roads, and other infrastructure in Escambia and Santa Rosa counties, Florida, with an estimated storm insured damages of $3 billion to $10 billion. In addition to flooding events associated with tropical systems and major storm fronts, other sustained periods of precipitation periodically affect riverine floodplains and other low-lying areas in the watershed. In the spring of April 2014, areas within the Perdido River and Bay watershed experienced over 20 inches of precipitation in two days (NOAA 2014c). Many low-lying inland areas within the watershed, that had never experienced flooding during historical tropical events, were completely inundated. This rain event resulted in an estimated $90 million in damage (Brown 2014). Accurate delineation of the floodplain, including its topography and physiography are imperative for adequate floodplain management.

3.4.3 Floodplain Management

Flood protection needs within the Perdido River and 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.

Escambia County has addressed urban flooding through its stormwater management program (Hatch Mott MacDonald 2003). Since 1991, 129 local flood problems have been alleviated in the Perdido River and Bay watershed at a cost of approximately $30 million (Curb 2011).

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 Mapping, Assessment, and Planning (MAP) program (currently), and county and watershed-based Flood Insurance Studies, the SWIM program, storm surge modeling, and other cooperative efforts. Additionally, ongoing land acquisition 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.

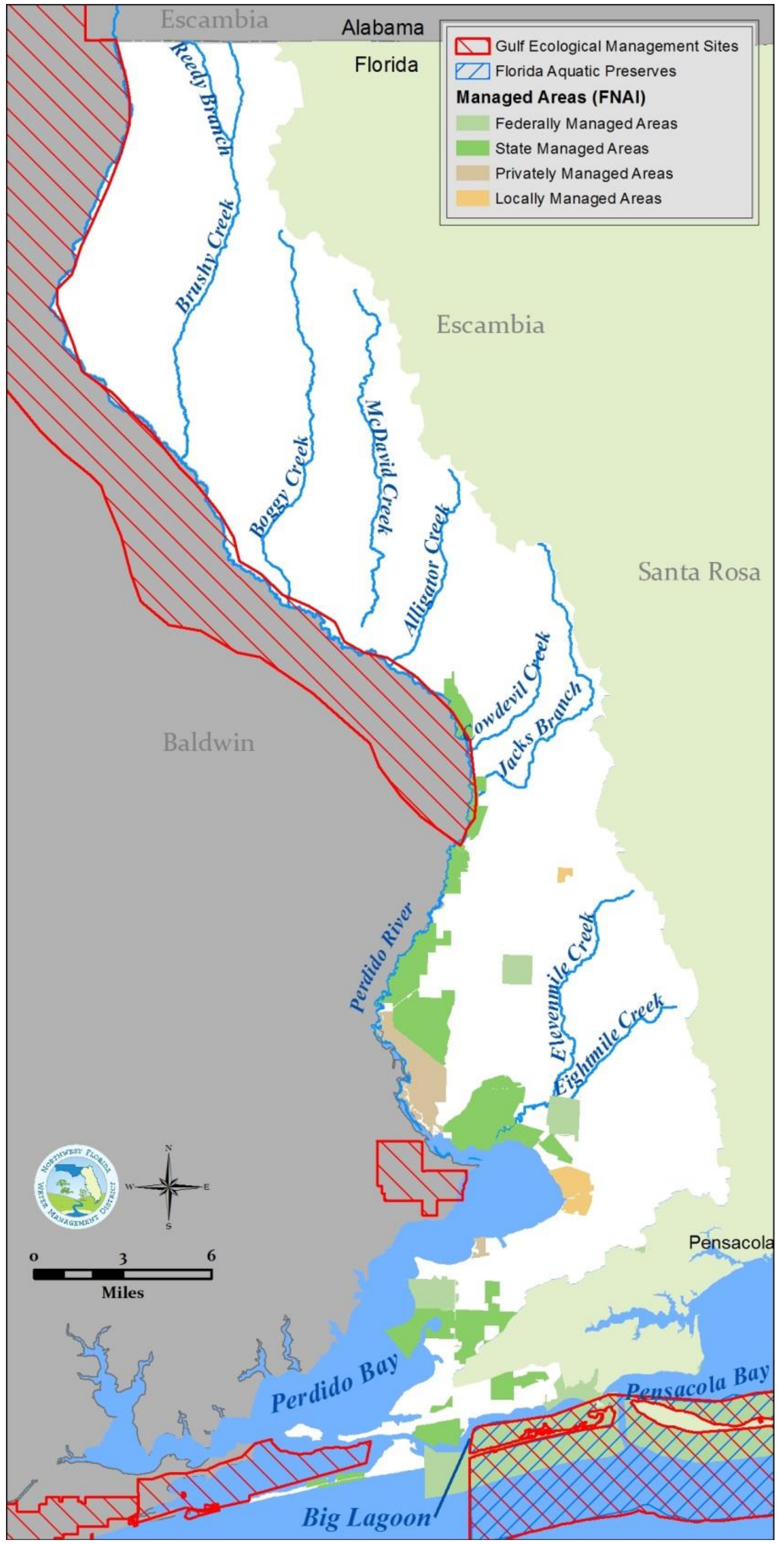
Finally, implementation of the Environmental Resource Permitting (ERP) program in northwest Florida helps ensure flood protection is addressed in an integrated manner with water quality protection. Florida's ERP Program regulates activities that alter surface water flows, including activities in uplands 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 Perdido River and Bay watershed system contains conservation and protected lands (Figure 3-7) that are listed with short descriptions in Appendix E. Conservation lands account for approximately three percent, or 20,943 acres, of the land area within the Florida portion of the basin. Within the watershed are three state parks and preserves that are managed by the Florida State Parks system (www.floridastateparks.org) and two state parks managed by the Alabama State Parks (www.alapark.com) system, as well as one national park managed by the U.S. National Park Service (Alabama State Parks 2015; National Park Service 2016b). Across the District, conservation lands account for an average of 31 percent of the land area in a given watershed. Compared to other watersheds in the Florida Panhandle, the Perdido River and Bay watershed has relatively few conservation lands (approximately nine percent of total land area) to protect high quality habitats, support a diversity of wildlife, and promote surface water quality. Undeveloped lands, that are responsibly managed, act as a buffer to provide protection to the rivers and coastal environment.

The NWFWMD owns and manages over 211,000 acres across the District and protects an additional 12,403 acres through conservation easements. Nearly 6,300 acres managed by the district are within the Perdido watershed. These lands include the Perdido River WMA, which provides joint conservation and recreational use, and the Dutex and Perdido I and II mitigation areas. The Perdido River WMA is located adjacent to the Perdido River from its confluence with Penasula Creek to the river's mouth. This tract is also managed by FWC as a Wildlife Management Area. The WMA is not contiguous, but rather consists of four large tracts separated by less than three miles of non-conservation land in any given place, and also includes 810 acres on Perdido Bay. The WMA is managed to protect water resources, rare species, multiple habitats, and provide for a variety of recreational activities. Land-management activities include prescribed burning, timber management, groundcover restoration, reforestation, and other activities (FWC 2016a, 2016b; NWFWMD 2016b).



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

Figure 3-8 Conservation Lands within the Perdido River and Bay Watershed

Additionally, the Alabama Department of Conservation and Natural Resources (ALDNR) manages the Perdido River Wildlife

Management Area, which is primarily used for big and small game hunting (ALDNR 2016).

The National Park Service owns and manages the Gulf Islands National Seashore (approximately 912 acres), within the watershed, established in 1971. The seashore holds an abundance of natural resources including fragile coastal dunes, scrub, and estuarine marsh ecosystems, as well as a plethora of marine species, birds, and the protected gopher tortoise (National Park Service 2016b).

Throughout the watershed are seven state parks, preserves, and forests encompassing over 20,000 acres, the majority of which are managed by various branches of the FDEP and the FDACS (Figure 3-9). The FDEP 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 5.4.8). The Nature Conservancy owns and manages the 2,331-acre Betty and Crawford Rainwater Perdido River Nature Preserve, located adjacent to the Perdido River WMA and the Perdido River just north of its mouth into Perdido Bay.

Escambia County’s Jones Swamp wetland preserve, located west of Warrington, provides a greenway extending from the Bayou Chico basin in the Pensacola Bay watershed to state conservation lands within the Perdido River and Bay watershed. In addition to protecting an ecologically significant corridor in an expanding area, the preserve protects water quality and provides important public recreation lands and greenspace (NWFWMD 2013).

Within Alabama’s portion of the watershed, there are approximately 22,500 acres of conservation lands, including Baldwin State Forest, Gulf State Park, Splinter Hill Bog, Lillian Swamp, and Perdido River Wildlife Management Area (USGS 2010). In 2006, the Mobile Bay National Estuary Program identified four projects for acquisition (NWFWMD 2012):

- AIG Baker/Reeder Lake Tract (2,124 acres of longleaf pine flatwoods and wetlands);
- IP Perdido River Tracts (30,000 acres of longleaf pine);

- Lillian Swamp (pine savanna wetlands); and
- Perdido River Delta, LLP Connector (longleaf pine and upland hardwood forest near the top of the watershed incorporating Dyas Creek).

3.5.2 Critical Habitat and Strategic Habitat Conservation Areas

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 Perdido River and Bay watershed contains numerous rare, endemic, federally and state-protected species, and/or species of special concern listed under the Endangered Species Act (ESA). In Florida, the FWC maintains the state list of animals designated as "Federally Designated Endangered or Threatened, State-designated Threatened, or State-designated Species of Special Concern," in accordance with F.A.C. Rules 68A-27.003 and 68A-27.005, respectively.

The ESA also provides special protection for Critical Habitat of certain species, which may include an area that is not currently occupied by the species, but that will be needed for its recovery.

Certain natural areas within the watershed have been identified by the FWC as Strategic Habitat Conservation Areas (SHCAs). SHCAs are important habitats in Florida that do not have conservation protection and would increase the security of rare and imperiled species if they were protected. Within the Perdido watershed, SHCAs have been identified for several species including the Cooper's hawk (*Accipiter cooperii*) and the swallowtail kite (*Elanoides forficatus*). SHCAs occur adjacent to the Perdido River, including the Perdido River WMA (Endries *et al.* 2009).

The Perdido River and Bay watershed includes designated critical habitat for a variety of protected species, including the threatened Gulf sturgeon (*Acipenser oxyrinchus desotoi*), several threatened and endangered species of freshwater mussels, the threatened piping plover

(*Charadrius melodus*), and the endangered Perdido Key Beach Mouse (*Peromyscus polionotus trissyllepsis*).

The FDACS publishes a list of the protected plants of Florida, including those species listed as federally threatened and endangered by the USFWS (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.

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 Perdido River and Bay watershed (FDEP 2014). Fort Pickens Aquatic Preserve, off the coast of Escambia County, includes 34,000 acres of submerged lands. The preserve is located adjacent to Gulf Islands National Seashore, and includes sandy bottom and seagrass bed habitat which is home to threatened and endangered species including the loggerhead sea turtle (*Caretta caretta*), the southeastern snowy plover (*Charadrius nivosus*), the least tern (*Sternula antillarum*), and the black skimmer (*Rynchops niger*). Fort Pickens Aquatic Preserve includes portions of Big Lagoon (as well as parts of Santa Rosa Sound and Pensacola Bay), extending northward to the Gulf Intracoastal Waterway. The preserve also includes submerged lands in the Gulf of Mexico up to three miles south of the coastline (Florida Department of Natural Resources 1992).

3.5.4 Outstanding Florida Waters (OFWs)

Of particular interest in the Perdido River and Bay watershed are the waterbodies designated as OFWs. The FDEP designates OFWs (under section 403.061[27], F.S.), 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 2015f). Outstanding Florida Waters within the Perdido River and Bay watershed include the Perdido River and waterbodies within the boundaries of Big Lagoon State Park, Gulf Islands National Seashore, and Perdido Key State Park (F.A.C. Rule 62-302.700 [9]; TNC 2014).

3.5.5 Gulf Ecological Management Sites (GEMS)

The Perdido River and Bay watershed includes five GEMS: the Lower Perdido Bay, Orange Beach Maritime Forest, Fort Pickens State Park Aquatic Preserve, Lillian Swamp, and Perdido River Corridor. 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. 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).

4.0 Related Resource Management Activities

Over the years, management plans and activities in the Perdido River and 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 agencies and initiatives, 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 cooperative planning, funding, management, and execution. The NWFWMD coordinates its efforts with these entities to facilitate project implementation, as well as to obtain data, strengthen monitoring activities, and exchange information.

4.1 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.

4.1.1 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 2016h).

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.

4.1.2 Natural 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 five projects to implement in the Perdido River and Bay watershed (FDEP 2016e):

- **Artificial Reef Creation and Restoration** ($11,463,587, Escambia, Santa Rosa, Okaloosa, Walton, and Bay counties) – off the coast of Escambia County, will develop both deepwater "nearshore reefs" within nine nautical miles of shore and shallower "snorkeling reefs" within 950 feet of shore and at depths of less than 20 feet.
- **Perdido Key Dune Restoration** ($611,234) – restoration of coastal dune 2.2 miles east of Perdido Pass and extending six miles to the east. The project will restore appropriate dune vegetation to approximately 20 acres of degraded beach dune habitat, including habitat used by the federally endangered Perdido Key Beach Mouse. In addition, gaps in existing dunes within the project area will be re-vegetated to provide a continuous dune structure.

- **Perdido Key State Park Beach Boardwalk Improvements** ($588,500) – will remove and replace six existing boardwalks leading to the beach from two public access areas along Perdido Key.
- **Big Lagoon State Park Boat Ramp Improvement** ($1,483,020) – will add an additional lane to the boat ramp, expand boat trailer parking, and improve traffic circulation at the boat ramp at the State Park. A new restroom facility will be constructed and connected to the ECUA regional sanitary sewer collection system.

4.1.3 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 updates of the 2017 SWIM plans through the GEBF. There are no other projects currently funded by the NFWF in the Perdido River and Bay watershed (FDEP 2016d).

4.1.4 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 Perdido Bay watershed identifies 25 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 2012 Perdido River and Bay Draft SWIM Plan—the subject of this report (TNC 2014).

4.2 Water Quality Monitoring

The majority of the monitoring data in the Perdido River and Bay watershed, including chemical and biological data, has been collected by or for the FDEP Northwest District (FDEP 2008c). 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 the FDEP Surface Water Temporal Variability (SWTV) and Status Networks; FDACS Shellfish Environmental Assessment Section (SEAS); the FDOH Florida Healthy Beaches monitoring program; and the Bream Fisherman Association (BFA).

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

4.2.1 FDEP/NWFWMD

As part of Florida's SWTV Monitoring Network, the NWFWMD assists the FDEP with the collection of monthly samples from 78 fixed sites, including three sites within the Perdido River basin. A site in northern Escambia County is on Brushy Creek at Nakomis Road. A second site is located on the Perdido River at Barrineau Park. The third site is located on Elevenmile Creek in the southern portion of the basin. 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. These water quality stations are on USGS-gauged streams, which provide for calculated stream discharges (FDEP 2016e).

4.2.2 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 2008c). 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.

4.2.3 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. The FDACS is not currently monitoring any shellfish harvesting areas in Perdido Bay (www.freshfromflorida.com/Divisions-Offices/Aquaculture/Shellfish-Harvesting-Area-Classification/Shellfish-Harvesting-Area-Maps).

4.2.4 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 (FDOH 2005). 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 2008c).

4.2.5 The Bream Fishermen Association (BFA)

The BFA is an organization of local fishermen that has assisted the city, county, state, and region as an environmental steward in protecting northwest Florida and south Alabama waters by performing regular water quality assessments since the 1970s. The BFA, established in the mid-1960s, was officially chartered as a non-profit organization in 1970. During the 1970s and 1980s, the BFA expanded their water sampling program to include 93 quarterly stations. Today, the BFA collects samples at 48 quarterly stations in Escambia, Santa Rosa, and Okaloosa counties (BFA 2016).

4.3 Submerged Aquatic Vegetation (SAV) Monitoring

Since 2009, the FWC's FWRI has monitored changes in the extent, density, and patchiness of seagrass in Perdido Bay as part of the SIMM program. The maps are generated through photointerpretation of high-resolution imagery. The status of seagrasses in the watershed is discussed in Section 3.3.1.

4.4 Water Quality Restoration and Protection Programs

Water quality in the Perdido River and Bay watershed is protected through several programs working together to restore water quality and prevent degradation. These programs include FDEP's Watershed Assessment program; 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 the 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 Florida Forever, regional mitigation for state transportation projects, and local government efforts to protect resources and provide for flood protection. The following section provides an overview of these programs and their contribution to water quality restoration and protection.

4.4.1 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.

Total maximum daily loads are implemented through the development and adoption of BMAPs that identify the management actions necessary to reduce the pollutant loads. The BMAPs 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. In the Perdido River and Bay watershed FDEP has adopted three TMDLs for fecal coliform, a statewide TMDL for mercury (in fish tissue), and one RAP for Elevenmile Creek (discussed in Section 3.2). There are no pending or adopted BMAPs in the Perdido River and Bay watershed (FDEP 2016b). Verified impaired waters may be subject to TMDL development in the future.

4.4.2 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. An NPDES permit includes limits on the composition and quantity of a discharge, monitoring and reporting requirements, and other provisions to ensure that the discharge does cause pose a threat to human health or quarter quality. 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.

As part of the MS4 program, Escambia County's Stormwater Program has delineated the county into 41 drainage basins. The basins have been numerically ranked based on the severity of water quality and drainage issues to establish an order of priority for remediation. A countywide Stormwater Master Plan has been completed (Hatch Mott MacDonald 2003). Countywide drainage plans have either been completed or are underway for 23 individual drainage basins. Within the Perdido River and Bay Basin, about 13 stormwater master plans are proposed or underway. Each plan describes current stormwater structural controls and identifies and recommends water quality and drainage improvement projects. Funding for stormwater retrofits is provided by a local option sales tax, which was approved by Escambia County voters in 1992. The intent of the tax is to help pay for capital improvement projects that address flooding, improve access to residential and commercial properties (improve transportation), and improve stormwater quality. The local option sales tax was most recently reapproved by voters in 2008 and will be in effect until December 31, 2017. Revenue generated by the tax has provided funding to pave dirt roads and improve drainage and transportation. As of February 2003, $37.3 million had been spent for projects to primarily improve drainage, $28.4 million to primarily improve transportation, and $16.2 million to pave dirt roads (Hatch Mott McDonald 2003).

4.4.3 Domestic and Industrial Wastewater Permits

Florida regulates domestic and industrial wastewater discharges to surface waters and 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).

4.4.4 Best Management Practices (BMPs)

BMPs 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.

BMPs have been developed and adopted into rules for silviculture, row crops, container plants, cow-calf, and dairies. The BMP manuals can be accessed on the FDACS website (FDACS 2016b). A draft BMP manual for poultry has been developed and adoption is expected by late 2016 (FDACS 2016b).

4.4.5 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 ERPs 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.

4.4.6 Regional Mitigation for State Transportation Projects

Under section 373.4137, F.S., the NWFWMD offers optional mitigation services for road projects to the FDOT when the use of private mitigation banks is not feasible and impacts to wetlands cannot be avoided. A regional mitigation plan (a.k.a., Umbrella Plan) has been developed, and is updated annually, to address mitigation needs submitted to the NWFWMD by FDOT. Components of the Umbrella Plan include the federally permitted "In-Lieu Fee Program" instrument and other mitigation projects (NWFWMD 2016a). The District's mitigation plan is developed and implemented in consultation with the FDOT, FDEP, USACE, EPA, USFWS, U.S. National Marine Fisheries Service, and FWC and is maintained and available for review at http://www.nwfwmdwetlands.com/.

Since 1997, the NWFWMD has implemented mitigation at numerous sites, including three in the Perdido River and Bay watershed: Dutex (810 acres), located on Perdido Bay; Perdido I (220 acres dedicated to mitigating the U.S. 90 Escambia County Weigh Station impacts); and Perdido II (restoration of 67 acres of hydric pine flatwoods, forested mixed wetlands, and mesic pine flatwoods). Perdido I and II are part of the 5,456 acres of wetlands and forested upland buffers acquired from International Paper Company located in the Perdido River WMA (NWFWMD 2016a).

4.4.7 Florida Forever Work Plan and Other Conservation Programs

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. The watershed includes significant areas on the approved Florida Forever lands acquisition list, including Coastal Headwaters Longleaf Forest, Perdido Pitcher Plant Prairie, and Lower Perdido River Buffer (FDEP 2016g).

The District owns and manages 6,261 acres in fee simple and four acres in less than fee between the Perdido River and Bay. The project area is mostly undeveloped and contains a diverse list of species. Acquisition of any floodplain area along the Perdido River, whether in fee or less than fee, will significantly protect the water resources of the area as well as enhance water quality protection efforts for the Perdido Bay system. Priority purchases will be concentrated on parcels adjacent to existing District lands along the river, around the river mouth, and designated tributaries. Currently, the District owns 810 acres along Perdido Bay. Priority purchases will be concentrated on parcels adjacent to the bay which can enhance water quality protection and mitigate for wetland impacts associated with FDOT highway construction in southern Escambia County. Approximately 1,447 acres have been identified for possible acquisition (NWFWMD 2016b).

The Nature Conservancy's Betty and Crawford Rainwater Perdido River Nature Preserve protects an additional 2,331 acres, including eight miles of riverfront, along the Perdido River in Alabama. The white top pitcher plant and numerous other rare and imperiled plants are found on the preserve property. The preserve land was purchased from International Paper by TNC, which manages the land (Timber Mart–South Market Newsletter 2003). The preserve is named for Betty and Crawford Rainwater, whose trust funds contributed funds toward its purchase (FDEP 2008).

In Alabama, several tracts of land within the Perdido River and Bay watershed in Baldwin County have been acquired for preservation. The ALDNR Forever Wild Land Trust Acquisition Program, in partnership with NOAA's Coastal Impact Assistance Program funds, the Alabama Forestry Commission, and a U.S. Forest Service Forest Legacy grant, purchased the following tracts of land: Perdido River Longleaf Hills Tract in 2006, Lillian Swamp South Addition in 2003, and Lillian Swamp-Caney Bayou Tract in 2003 (ALDNR 2006). These tracts geographically complement TNC's Betty and Crawford Rainwater Perdido River Nature Preserve and the additional proposed state acquisition of the Lower Perdido River Buffer.

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.

4.4.8 Minimum Flows and Levels (MFLs)

Section 373.042, F.S., requires each water management district to develop MFLs for specific surface and groundwaters within their jurisdiction. The MFLs for a given waterbody is the limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area. MFLs 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).

Establishment of an MFL involves a series of steps ranging from identification of priority waterbodies to the adoption of FDEP rules codifying each MFL. 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 levels below an adopted MFL.

The technical evaluation for each MFL is expected to require approximately five years of data collection and analysis. Data collection has begun and will occur concurrently for several waterbodies. Starting in 2018, one MFL assessment is expected to be completed annually within the NWFWMD. There are no MFL assessments scheduled for any waters in the Perdido River and Bay watershed (NWFWMD 2016c).

4.4.9 Coastal Alabama Clean Water Partnership

The Coastal Alabama Clean Water Partnership is a coalition of Alabama governmental agencies, private organizations and citizens, and businesses created to provide solutions for the protection and preservation of aquatic resources in Alabama (FDEP 2008c). The Coastal Alabama Clean Water Partnership specifically works with the Perdido River and Bay Basin, Mobile Bay Basin, and Escatawpa River Basin within Alabama. The partnership is a project of the Mobile and Baldwin County Alabama Soil and Water Conservation Districts and the ADEM. Auburn University Marine Extension and Research Center provides project facilitation. A Steering Committee composed of environmental interests, government, and business interests directs the activities of the partnership by setting policy and providing oversight.

4.4.10 EPA Gulf Ecology Division

The EPA, Gulf Ecology Division Laboratory in Gulf Breeze, Florida, is a primary research facility of the EPA's Office of Research and Development National Health and Environmental Effects Research Laboratory. The lab assesses the ecological condition, ecological services and values of estuaries, coastal wetlands, SAV, and coral ecosystems of the Gulf of Mexico and the southeastern United States; determines causes of ecological impairment; predicts future risk to populations, communities and ecosystems from multiple aquatic stressors; supports the development of criteria to protect coastal environments; and transfers scientific technology to federal and state agencies, industry, and the public (EPA 2016f).

4.4.11 Bay Area Resource Council (BARC)

The BARC was created from the Escambia/Santa Rosa Coast Resource Planning and Management Committee formed in February 1985 by then Governor Bob Graham. An interlocal agreement between Escambia and Santa Rosa counties, and the cities of Pensacola and Gulf Breeze was established in May 1987 to solidify the organization into an entity that could accept funding and promote the goals of the committee. The City of Milton has since joined the BARC. The BARC's goal is improving the area's quality of life and the waters of the Pensacola Bay Basin through community participation and coordination with local governments, citizens, academia, and the private sector. The WFRPC serves as staff to the BARC (WFRPC 2016b). Although the focus of the BARC has historically been focused on the Pensacola Bay system, it is also interested in issues of the Perdido Bay system. If selected by the Gulf Coast Ecosystem Restoration Council for the creation of an estuary program, Pensacola and Perdido bays will likely be part of a single estuary program that will be managed by the BARC.

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

The 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 Pensacola Bay watershed and the state of Florida. Such programs and partnerships include the Fisheries and Aquatic Sciences and Marine Sciences Program, the Aquatic and Invasive Plants Center, the Florida Cooperative Fish and Wildlife Research Unit, the Florida Partnership for Water, Agriculture and Community Sustainability, the Natural Resources Leadership Institute, the Wetland Biogeochemistry Laboratory, the Sea Grant, 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 property owners across the state to minimize the need for commercial pesticides and fertilizers, through environmentally friendly BMPs.

4.4.13 Escambia County Stormwater Initiatives

Escambia County's local option sales tax (LOST) has funded projects to reduce NPS pollution from stormwater, including dirt road paving, restoring streams, constructing stormwater ponds, and installing stormwater retrofits in established neighborhoods.

In response to the large flooding event in April 2014, the Escambia County Stormwater Advisory Team was created to identify conditions associated with the April 2014 flooding and to assist Escambia County staff. The rainfall caused damage to both public and private stormwater facilities across the county, but mostly in the southern area. A needs assessment and a county-wide stormwater recommendation report were drafted to rank priority drainage projects and provide recommendations for stormwater within Escambia County (Escambia County 2016).

4.4.14 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 long-standing 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 Perdido 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:

- **Wolf Bay Watershed Watch** – Wolf Bay Watershed Watch is a community advocacy group whose mission is to promote the protection and preservation of the natural resources of the Wolf Bay watershed (Alabama Water Watch 2002). Wolf Bay is connected to the western end of Perdido Bay in Alabama. This watershed organization is affiliated with the larger Alabama Watershed Watch organization coordinated by Auburn University’s Department of Fisheries Allied Aquaculture and International Aquaculture and Aquatic Environments. Wolf Bay Watershed Watch, formed in 1998, collects water quality samples from Wolf Bay and Perdido Bay, and members participate in coastal cleanups. More recently, the group participated in the preparation of a NPS pollution management guide, the *Wolf Bay Plan: A Stakeholder’s Guide to Protecting the Watershed* (Wolf Bay Watershed Project 2005). The Wolf Bay Watershed Project is a multiagency initiative formed for the purpose of developing the plan for improving and protecting Wolf Bay. The plan was prepared with funding from an ADEM Clean Water Act, Section 319 grant.
- **Gulf Coastal Plain Ecosystem Partnership** – The Gulf Coastal Plain Ecosystem Partnership is a voluntary partnership between ten private and public land owners in western Florida and includes the following governmental, business, and environmental interests: the U.S. Department of Defense, FDEP, Florida Division of Forestry, International Paper, Conecuh National Forest (in Alabama), Nokuse Plantation, NWFWMD, National Park Service, FWC, and TNC. The parties operate together under a 1996 Memorandum of Understanding for the management of about one million acres of northwest Florida and south Alabama. The partnership is directed by a Steering Committee composed of two representatives of each participating organization (Albrecht 2006). The purpose of the partnership is to provide a collaborative approach to the preservation and management of natural lands. It was initially formed in response to extensive loss of longleaf pine and aquatic habitats and to increase the land buffers

surrounding military reservations (http://www.cooperativeconservationamerica.org/viewproject.asp?pid=544). Members of the partnership have agreed to a set of land management principles directed at ecosystem preservation by using prescribed burns, recovering listed species, restoring aquatic habitat, providing public outreach, and sharing and exchanging relevant information and technology on new land management and protection techniques. Through collaboration and the pooling of resources, the partners are able to leverage the purchase of additional conservation lands. Within the Perdido River and Bay Basin, the partnership has provided review and assistance for the FDEP's Tarkiln Bayou Burn Plan and assistance with purchases of the Betty and Crawford Rainwater Perdido River Nature Preserve along the Perdido River.

- **Partnership for Environmental Research and Community Environmental Health (PERCH)** – The University of West Florida Partnership for Environmental Research and Community Environmental Health (PERCH) was formed to provide input to the University of West Florida regarding environmental health studies, and investigate questions pertaining to environmental pollution and how it may affect human health. The partnership is funded by federal appropriation grants (University of West Florida PERCH 2016).
- **Panhandle Watershed Alliance** – The Panhandle Watershed Alliance was formed to develop a regional approach to monitoring water quality for six northwest Florida and south Alabama watersheds, including the Perdido, Escambia/Conecuh, Yellow/Shoal, Choctawhatchee, and St. Andrew Bay watersheds (Panhandle Watershed Alliance 2016). The Alliance serves as a clearinghouse for regional water quality data and the identification of status, trends, and data gaps. The monitoring approach is designed to provide reliable, viable and usable data to the public and resource managers in order to identify and prioritize threats to the ecosystem (Panhandle Watershed Alliance 2016).
- **Friends of Perdido Bay/Perdido Bay Foundation** – The Friends of Perdido Bay was formed in response to wastewater discharges from Champion's (currently International Paper) paper plant located in Cantonment (http://www.friendsofperdidobay.com). The Friends have participated with government and other interest groups with a 2000 plan for monitoring Perdido Bay. The Perdido Bay Foundation is a charitable trust formed in 1997 for the purpose of improving water quality in Perdido Bay. The foundation's activities are organized and coordinated through a Board of Directors.
- **Florida Geological Survey's (FGS's) Aquifer Vulnerability Assessment Model –** The FGS 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).

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Appendix A Geology and Soils in the Perdido River and Bay Watershed

The Perdido River and Bay watershed encompasses two localized physiographic regions divided by a relict marine escarpment just north of Perdido Bay: the Western Highlands to the north and the Gulf Coastal Lowlands to the south (Rupert 1993).

The northern extent of the watershed contains the Pliocene Citronelle Formation, which consists of sedimentary deposits ranging in size from clay to gravel; however, sands are the most common size fraction. The deposits are commonly cross-bedded, lenticular, graveliferous sands with an occasional thin bed of clay and varying amounts of silt and clay that can weakly indurate the sediment. In some areas, thicker discontinuous layers of sandy clay can create semi-confined groundwater conditions or perched water table conditions. Overlying most geologic formations in the watershed are unconsolidated Holocene siliciclastic sediments (nearly pure quartz sands with minor heavy mineral sands) (USDA 2004). These sands were deposited during sea level fluctuations prior to the permanent land emergence of the Florida plateau during the Miocene epoch (23.3 to 5.3 million years ago). These same sediment deposits form much of the coastal sand dunes, beach ridges (i.e., spit between Perdido Bay and Big Lagoon), and barrier islands.

Fluvial processes, in conjunction, are also greatly responsible for the modern land surface of the Perdido Bay watershed. The larger stream valleys within most of the watershed commonly contain deposits of Pleistocene and Holocene alluvium, especially along the Perdido, Blackwater, and River Styx. Most of these sediments are derived from erosion of the Citronelle Formation, as well as upstream sources of undifferentiated sands, clays, and gravels (Green *et al.* 2002).

In the Gulf Coastal Lowlands, ancient marine geomorphic features including beach ridges, spits, bars, dunes, and terraces make up the modern topography. 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 Perdido River and Bay watershed.

Soils within the Perdido River and 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 Perdido River and 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 Perdido River and Bay watershed, soils found north of the relic escarpment in the Western Highlands physiographic region are primarily ultisols (Collins 2010). Ultisols are the most common soil type in the watershed and are the watershed's primary agricultural and silvicultural soils. Their high clay content contributes to nutrient and water retention, when properly managed.

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 north of Cantonment in Perdido WMA and directly east of the WMA, as well as on Perdido Key and the land-ward coastline of Big Lagoon 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. Within the Perdido River and Bay watershed, spodosols can be found throughout the central Gulf Coastal Lowlands physiographic region, particularly at Tarkiln Bayou Preserve State Park and the non-conservation lands to the south and east of the park. The presence of spodosols indicates an area that was historically dominated by a pine over-story.

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 coastal portion of the watershed at Tarkiln Bayou Preserve State Park, Innerarity Point, and the land-ward coastline of Big Lagoon (Collins 2010).

Appendix B Threatened and Endangered Species within the Watershed

The Perdido River and 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 compiled from multiple sources (FNAI 2010; FWC 2016c; USFWS 2016):

Plants:

Scientific Name	Common Name	FNAI	State	Federal	Natural Communities
Agrimonia incisa	Incised Groove-bur	S2	T	N	Terrestrial Habitat(s): Forest/Woodland, Woodland - Conifer, Woodland - Mixed
Andropogon arctatus	Pine-woods Bluestem	S3	T	N	Lacustrine: wet pine flatwoods, seepage wetlands, bogs, wet pine savannas
Baptisia calycosa var. villosa	Hairy Wild Indigo	S3	T	N	N/A
Calamovilfa curtissii	Curtiss' Sandgrass	S3	T	N	Palustrine: mesic and wet flatwoods, wet prairie, depression marsh Terrestrial: mesic flatwoods
Calopogon multiflorus	Many-flowered Grass-pink	S2S3	T	N	Palustrine Habitat(s): Bog/fen, forested wetland herbaceous wetland Terrestrial Habitat(s): Forest Edge, Forest/Woodland, Grassland/herbaceous, Savanna, Woodland - Conifer
Carex baltzellii	Baltzell's Sedge	S3	T	N	Terrestrial Habitat(s): Forest/Woodland, Woodland - Mixed
Chrysopsis godfreyi	Godfrey's Goldenaster	S2	E	N	Terrestrial: grassland/herbaceous, sand/dune, shrubland/chaparral

Scientific Name	Common Name	FN AI	State	Federal	Natural Communities
Cladonia perforata	Perforate Reindeer Lichen	S1	E	LE	Terrestrial Habitat(s): Sand/dune, Shrubland/chaparral
Lachnocaulon digynum	Bog Button	S3	T	N	Riverine Habitat(s): Pool Palustrine Habitat(s): Bog/fen, forested wetland
Lilium iridollae	Panhandle Lily	S2	E	N	Palustrine Habitat(s): Bog/fen, herbaceous wetland, Riparian, scrub-shrub wetland
Linum westii	West's Flax	S1	E	N	Palustrine: dome swamp, depression marsh, wet flatwoods, wet prairie, pond margins
Litsea aestivalis	Pondspice	S2	E	N	Palustrine Habitat(s): Bog/fen
Lobelia boykinii	Boykin's Lobelia	S1	E	N	Palustrine Habitat(s): Forested wetland, herbaceous wetland, scrub-shrub wetland Terrestrial Habitat(s): Forest/Woodland, Savanna, Woodland - Conifer
Lupinus westianus	Gulf Coast Lupine	S3	T	N	Terrestrial: beach dune, scrub, disturbed areas, roadsides, blowouts in dunes
Magnolia ashei	Ashe's Magnolia	S2	E	N	Terrestrial: slope and upland hardwood forest, ravines
Malaxis unifolia	Green Adder's-mouth Orchid	S3	E	N	Palustrine: floodplain forest Terrestrial: slope forest, upland mixed forest
Macranthera flammea	Hummingbird Flower	S2	E	N	Palustrine: seepage slope, dome swamp edges, floodplain swamps Riverine: seepage stream banks Terrestrial: seepage slopes
Matelea alabamensis	Alabama Spiny-pod	S2	E	N	Terrestrial Habitat(s): Cliff, Forest - Hardwood, Forest - Mixed, Forest Edge, Forest/Woodland, Woodland -

Scientific Name	Common Name	FNAI	State	Federal	Natural Communities
					Hardwood, Woodland - Mixed
Nuphar advena ssp. ulvacea	West Florida Cowlily	S2	N	N	Riverine Habitat(s): Medium river, spring/spring brook
Pinguicula primuliflora	Primrose-flowered Butterwort	S3	E	N	Palustrine: bogs, pond margins, margins of spring runs
Platanthera integra	Yellow Fringeless Orchid	S3	E	N	Palustrine: bogs, wet flatwoods Terrestrial: bluff
Polygonella macrophylla	Large-leaved Jointweed	S3	T	N	Terrestrial: scrub, sand pine/oak scrub ridges
Pteroglossaspis ecristata	Giant Orchid	S2	T	N	Terrestrial Habitat(s): Forest Edge, Forest/Woodland, Old field, Savanna, Shrubland/chaparral, Woodland - Conifer
Quercus arkansana	Arkansas Oak	S3	T	N	Sandy or sandy clay uplands or upper ravine slopes near heads of streams in deciduous woods.
Rhexia parviflora	Small-flowered Meadowbeauty	S2	E	N	Palustrine Habitat(s): Bog/fen, forested wetland, scrub-shrub wetland
Rhexia salicifolia	Panhandle Meadowbeauty	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
Rhododendron austrinum	Florida Flame Azalea	S3	E	N	Lacustrine: shaded ravines & in wet bottomlands on rises of sandy alluvium or older terraces.
Sarracenia leucophylla	White-top Pitcherplant	S3	E	N	Palustrine: wet prairie, seepage slope, baygall edges, ditches

Scientific Name	Common Name	FN AI	State	Federal	Natural Communities
Sarracenia rubra	Sweet Pitcherplant	S3	T	N	Palustrine: bog, wet prairie, seepage slope, wet flatwoods Riverine: seepage stream banks
Stewartia malacodendron	Silky Camellia	S3	E	N	Palustrine: baygall Terrestrial: slope forest, upland mixed forest; acid soils
Tephrosia mohrii	Pineland Hoary-pea	S3	T	N	Longleaf pine-turkey oak sandhills; driest sites.
Xyris longisepala	Karst Pond Xyris	S2S3	E	N	Palustrine Habitat(s): Herbaceous wetland, Riparian, temporary pool
Xyris scabrifolia	Harper's Yellow-eyed Grass	S3	T	N	Palustrine: seepage slope, wet prairie, bogs
Xyris stricta var. obscura	Kral's Yellow-eyed Grass	S1	N	N	Lacustrine: sandhill upland lake margins

Animals:

Scientific Name	Common Name	FNAI	State	Federal	Natural Communities
Ants, Bees, and Wasps					
Hesperapis oraria	Gulf Coast Solitary Bee	S1S2	N	N	N\A
Stoneflies					
Tallaperla cornelia	Southeastern Roachfly	S1	N	N	N/A
Beetles					

Scientific Name	Common Name	FNAI	State	Federal	Natural Communities
Selonodon santarosae	Santa Rosa Cebrionid Beetle	S1	N	N	Terrestrial
Fish					
Acipenser oxyrinchus desotoi	Gulf Sturgeon	S2	FT	LT	Estuarine: various Marine: various habitats Riverine: alluvial and blackwater streams
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
Crystallaria asprella	Crystal Darter	S1	ST	N	Riverine Habitat(s): creek, medium river, Moderate gradient
Etheostoma proeliare	Cypress Darter	S2	N	N	Riverine Habitat(s): creek, Low gradient, medium river, Pool Lacustrine Habitat(s): Shallow water Palustrine Habitat(s): forested wetland
Fundulus jenkinsi	Saltmarsh Topminnow	S2	SSC	SC	Estuarine Habitat(s): Herbaceous wetland, Lagoon, Tidal flat/shore Palustrine Habitat(s): Herbaceous wetland
Hybognathu s hayi	Cypress Minnow	S1S2	N	N	Riverine Habitat(s): creek, Low gradient, medium river, Pool Lacustrine Habitat(s): Shallow water Palustrine Habitat(s): Forested wetland
Macrhybopsi s sp. 2	Florida Chub	S2	N	N	N/A
Percina austroperca	Southern Logperch	S2	N	N	Riverine Habitat(s): Creek, Low gradient, medium river, Moderate gradient

Scientific Name	Common Name	FNAI	State	Federal	Natural Communities
Pteronotropis welaka	Bluenose Shiner	S3S4	SSC	N	Riverine Habitat(s): Creek, Low gradient, medium river, Pool
Amphibians					
Ambystoma bishopi	Reticulated Flatwoods Salamander	S2	FE	LE	Terrestrial: slash and longleaf pine flatwoods that have a wiregrass floor and scattered wetlands
Desmognathus monticola	Seal Salamander	S1	N	N	Riverine Habitat(s): Creek, High gradient, Moderate gradient, spring/spring brook Palustrine Habitat(s): Riparian
Reptiles					
Alligator mississippiensis	American Alligator	S4	FT(S/A)	SAT	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	Loggerhead Sea Turtle	S3	FT	T	Terrestrial: sandy beaches; nesting
Chelonia mydas	Green Sea Turtle	S2S3	FE	LE	Terrestrial: sandy beaches; nesting
Crotalus 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 Sea Turtle	S2	FE	LE	Terrestrial: sandy beaches; nesting

Scientific Name	Common Name	FNAI	State	Federal	Natural Communities
Drymarchon couperi	Eastern Indigo Snake	S3	FT	LT	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	ST	C	Terrestrial: sandhills, scrub, scrubby flatwoods, xeric hammocks, coastal strand, ruderal
Graptemys ernsti	Escambia Map Turtle	S2	N	N	Riverine Habitat(s): big river, Low gradient, medium river, Pool Palustrine Habitat(s): Riparian Terrestrial Habitat(s): Sand/dune
Heterodon simus	Southern Hognose Snake	S2	N	N	Palustrine Habitat(s): Riparian Terrestrial Habitat(s): Grassland/herbaceous, Old field, Savanna, Woodland - Conifer, Woodland - Hardwood, Woodland - Mixed
Macrochelys temminckii	Alligator Snapping Turtle	S2	SSC	N	Estuarine: tidal marsh Lacustrine: river floodplain lake, swamp lake Riverine: alluvial stream, blackwater stream
Nerodia clarkii clarkii	Gulf Salt Marsh Snake	S2	N	N	Estuarine: tidal marsh Lacustrine: river floodplain lake, swamp lake Riverine: alluvial stream, blackwater stream
Pituophis melanoleucus mugitus	Florida Pine Snake	S3	SSC	N	Lacustrine: ruderal, sandhill upland lake Terrestrial: sandhill, scrubby flatwoods, xeric hammock, ruderal

Scientific Name	Common Name	FNAI	State	Federal	Natural Communities
Birds					
Athene cunicularia floridana	Florida Burrowing Owl	S3	SSC	N	Terrestrial Habitat(s): Grassland/herbaceous, Sand/dune
Charadrius nivosus	Snowy Plover	S1	ST	N	Estuarine: exposed unconsolidated substrate Marine: exposed unconsolidated substrate Terrestrial: dunes, sandy beaches, and inlet areas.
Peucaea aestivalis	Bachman's Sparrow	S3	N	N	N/A
Picoides borealis	Red-cockaded Woodpecker	S2	FE	LE	Terrestrial: mature pine forests
Rallus longirostris scottii	Florida Clapper Rail	S3?	N	N	Estuarine Habitat(s): Herbaceous wetland, Tidal flat/shore
Rynchops 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
Sternula antillarum	Least Tern	S3	ST	N	Estuarine: various Lacustrine various Riverine: various Terrestrial: beach dune, ruderal. Nests common on rooftops
Thalasseus maximus	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	FNAI	State	Federal	Natural Communities
Thalasseus sandvicensis	Sandwich Tern	S2	N	N	Marine: near shore Estuarine: bay/sound, lagoon, river mouth/tidal river, tidal flat/shore Terrestrial: sand/dune
Mammals					
Corynorhinus rafinesquii	Rafinesque's Big-eared Bat	S2	N	N	Palustrine Habitat(s): Riparian Terrestrial Habitat(s): Forest - Hardwood, Suburban/orchard, Urban/edificarian, Woodland - Hardwood Subterranean Habitat(s): Subterrestrial
Myotis austroriparius	Southeastern Bat	S3	N	N	Riverine Habitat(s): Aerial Palustrine Habitat(s): Aerial, forested wetland, Riparian Terrestrial Habitat(s): Forest - Conifer, Forest - Hardwood, Forest - Mixed, Forest Edge, Forest/Woodland, Suburban/orchard, Urban/edificarian, Woodland - Conifer, Woodland - Hardwood, Woodland - Mixed Subterranean Habitat(s): Subterrestrial
Neofiber alleni	Round-tailed Muskrat	S3	N	N	Estuarine Habitat(s): Herbaceous wetland Lacustrine Habitat(s): Shallow water Palustrine Habitat(s): Bog/fen, herbaceous wetland
Peromyscus polionotus trissyllepsis	Perdido Key Beach Mouse	S1	FE	LE	Terrestrial Habitat(s): Grassland/herbaceous, Sand/dune
Ursus americanus floridanus	Florida Black Bear	S2	N	N	Palustrine: forested wetland, riparian Terrestrial: forest - hardwood, forest - mixed

Sources: FNAI 2010; FWC 2016f; 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 32 unique natural communities recognized by the FNAI within the Perdido River and 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 (5) 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	
Bluff	Bluff is a habitat characterized as a steep slope with rock, sand, and/or clay substrate that supports sparse grasses, herbs, and shrubs. This community type can be found along the Perdido River.
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, mesic flatwoods occupy relatively small, low-lying areas (FNAI 2010). This community type can be found across vast expanses of Tarkiln Bayou Preserve State Park (FDEP 2006).

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 minimal 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 Perdido Bay and River watershed, exemplary sandhill communities can be found in the Tarkiln Bayou Preserve State Park, in the interior of Tarkiln Peninsula.
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*). Scrub is characterized by burn intervals of five to 40 years, depending on the dominant vegetation. This community type can be found throughout Perdido Key.
Scrubby Flatwoods	Scrubby flatwoods have an open canopy of widely-spaced pine trees (commonly longleaf or slash pines) and a low, shrubby understory which differ structurally from scrub communities in the respect that scrubby flatwoods lack continuous shrubby oak cover. Understory vegetation consists largely of scrub oaks and saw palmetto, often interspersed with barren areas of exposed sand. Scrubby flatwoods occur on slight rises within mesic flatwoods and in transitional areas between scrub and mesic flatwoods. Scrubby flatwoods are inhabited by several rare plant and animal species including the Florida mouse (*Podomys floridanus*), Florida scrub-jay (*Aphelocoma coerulescens*) (peninsular Florida only), gopher tortoise (*Gopherus polyphemus*), the Florida gopher frog (*Rana capito*), goldenaster (*Chrysopsis floridana*), and large-plumed beaksedge (*Rhynchospora megaplumosa*) (FNAI 2010). Within the Perdido Bay and River watershed, scrubby flatwood communities can be found throughout Perdido Key.

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*), 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 (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 througout Tarkiln Bayou Preserve State Park in both large tracts and small pockets along the edges of baygall swamps.
Xeric Hammocks	Xeric hammock is an evergreen forest typically dominated by sand live oak (*Quercus geminata*), found on deep, fine sand substrate, where fire exclusion allows for the establishment of an oak canopy. In these areas, xeric hammock can form extensive stands or as small patches within or near sandhill or scrub. These forests are also found on high islands within flatwoods or less commonly on a high, well-drained ridge within a floodplain where fire-exclusion allows for the establishment of an oak canopy. Xeric hammocks are inhabited by several rare animals including the gopher frog (*Rana capito*), gopher tortoise (*Gopherus polyphemus*), eastern diamondback rattlesnake (*Crotalus adamanteus*), and the Florida pine snake (*Pituophis melanoleucus mugitus*). Xeric hammock is most common in the central peninsula of Florida and is less common to the north where clay-rich soils create mesic conditions (FNAI 2010). Within the Perdido River and Bay watershed, xeric hammock community occurs east of Bauer Road in Tarkiln Bayou State Park.

Coastal Communities	
Beach	The beach is the immediate shoreline area of the Gulf of Mexico and consists of white quartz sand. It has few plants, except along the extreme inner edge at the base of the dunes. Organic marine debris, including seaweed and driftwood, typically form a wrack line on the shore. The upper beach area at the base of the foredune is an unstable habitat and is continually re-colonized by annuals, trailing species, and salt-tolerant grasses (FNAI 2010). Beach habitat is found along the entire Gulf front, especially at tidal passes, and some bay front shorelines in the watershed.
Beach Dune	The beach dune community includes seaward dunes that have been shaped by wind and water movement. This community is composed primarily of herbaceous plants such as pioneer grasses and forbs, many of which are coastal specialists. The vegetated upper beach and foredune are often sparsely covered by plants adapted to withstand the stresses of wind, water, and salt spray, or to rapidly recolonize after destruction. Many rare shorebirds use the Florida Panhandle's beach dunes for nesting. This community is also a major nesting area for loggerhead, green, Kemp's Ridley, and leatherback sea turtles. Beach dune habitat can be found throughout Perdido Key.
Coastal Grasslands	Coastal grassland, found primarily on broad barrier islands and capes, is a predominantly herbaceous community found in the drier portion of the transition zone between the beach dune and coastal strand or maritime hammock communities. Several rare animals use coastal grasslands for foraging and nesting, including neo-tropical migratory birds and the Perdido Key beach mouse (*Peromyscus polionotus trissyllepsis*) - one of four rare subspecies of beach mouse along the Florida Panhandle Coast. Coastal grassland can form from two major processes: the seaward build-up of a barrier island, which protects inland ridges from sand burial; and salt spray, or the development of a new foredune ridge, which protects the previously overwashed area behind it (FNAI 2010). This community type can be found along Perdido Key.

Coastal Strand	Coastal strand is an evergreen shrub community growing on stabilized coastal dunes, often with a smooth canopy due to pruning by wind and salt spray. It usually develops as a band between dunes dominated by sea oats along the immediate coast, and maritime hammock, scrub, or mangrove swamp (in peninsular Florida) communities further inland. This community is very rare on the Florida Panhandle coast where the transition zone is occupied by scrub or coastal grassland communities (FNAI 2010). This community type can be found along Perdido Key.
Maritime Hammock	Maritime hammock is a predominantly evergreen hardwood forest that occurs on deep well-drained sandy soils or sandy soils mixed with shell fragments. Maritime hammock forests grow on stabilized coastal dunes at various distances from the shoreline. Maritime hammocks provide migrating songbirds with crucial resting and foraging areas on their fall and spring migrations to and from the tropics. On the Florida Panhandle coast, maritime hammock is found only in isolated pockets where shell is mixed with sandy substrate (FNAI 2010). Within the Perdido Bay watershed, this community type can be found in Tarkiln Bayou Preserve State Park on the southwestern tip of Tarkiln Peninsula (DuPont Point) and on Perdido Key.
Shell Mounds	Shell mounds are a relic of generations of Native Americans who lived along the Florida coast and discarded clams, oysters, whelks, and other shells in small hills. These mounds of shell support an assemblage of calciphilic plant species. Originally, there were many such shell mounds along coastal lagoons and near the mouths of rivers; however, presently, many are surrounded by marshes (FNAI 2010). Shell mounds can be found along Perdido Key.

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).
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 at Tarkiln Bayou State Park in Garcon Swamp.
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 occurs on the northern sides of Tarkiln Bayou within the state park boundary.

Bog	Bog habitat typically includes areas of saturated substrates, often deep peat, and acidic conditions, with the dominant vegetation consisting of sedges and grasses. Bog habitat is often surrounded by a transition zone of trees and shrubs between the bog and upland area (FNAI 2010). In the Perdido Bay watershed, this community type can be found along the Perdido River.
Coastal Interdunal Swales	Coastal interdunal swales are marshes, moist grasslands, dense shrublands, or damp flats in linear depressions that occur between successive dune ridges on sandy barrier islands, capes, or beach plains. Dominant species tend to vary based on local hydrology, substrate, and the age of the swale, but common species include sawgrass (*Cladium sp.*), hairawn muhly (*Muhlenbergia capillaris*), broomsedge (*Andropogon virginicus*), seashore paspalum (*Paspalum vaginatum*), sand cordgrass (*Spartina bakeri*), and saltmeadow cordgrass (*Spartina patens*). Salt water intrusion and increased sand movement after storm events can reset successional processes of interdunal swale communities (FNAI 2010). For example, hurricanes and large storm events can flood swales with salt water. After this, they may become colonized, often temporarily, by more salt-tolerant species. This community type can be found along Perdido Key.
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 in dome swamps with high fire frequencies 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 in depressions along the floodplains of the Blackwater and Perdido Rivers.

Hydric Hammock	Hydric hammock is an evergreen hardwood and/or palm forest with a variable understory typically dominated by palms and ferns. This community occurs on moist soils, often with limestone very near the surface. While species composition varies, the community generally has a closed-canopy of oaks and palms, an open understory, and a sparse to a moderate groundcover of grasses and ferns. Hydric hammock occurs on low, flat, wet sites where limestone may be near the surface and soil moisture is kept high mainly by rainfall accumulation on poorly-drained soils. During heavy rains, sheet flow is slowed across the forested-floor of a hammock, resulting in greater absorption into the soil. Hammocks adjacent to salt marshes protect inland areas from damage during hurricanes and major storms (FNAI 2010). This community type is found on Perdido Key.
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 the Perdido, Styx, and Blackwater rivers and their many tributaries.

Seepage Slope	Seepage slope is an open, grass sedge-dominated community consisting of wiregrass (*Aristida stricta*), toothache grass (*Ctenium aromaticum*), pitcherplants, plumed beaksedge (*Rhynchospora plumose*), flattened pipewort (*Eriocaulon compressum*), and woolly huckleberry (*Gaylussacia mosieri*). Seepage slopes are kept continuously moist by groundwater seepage. This community occurs in topographically variable areas, with 30- to 50-foot elevational gradients, frequently bordered by well-drained sandhill or upland pine communities. The soil is often soft and mucky underfoot, in contrast to the firm texture of the bordering sandhill and upland pine soils. Seepage slopes range from the Alabama border eastward to Calhoun County in the inland portions of the Florida Panhandle. Within the Perdido Bay watershed, seepage slopes can be found along the Perdido River.
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 can be found east of Bauer Road at Tarkiln Bayou State Park.
Aquatic Communities	
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. Many of the Perdido River's smaller tributaries are blackwater streams, including several streams that feed Tarkiln Bayou (FDEP 2006).

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 Perdido River and Bay watershed seepage streams are along the Perdido, Styx, and Blackwater rivers. Seepage streams can also be found east of Bauer Road in Tarkiln Bayou State Park (FDEP 2006).
Estuarine and Marine Communities	
Salt Marsh	Salt marsh is a largely herbaceous tidal zone community commonly consisting of smooth cordgrass (*Spartina alterniflora*), which dominates the seaward edge, and needle rush (*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 Perdido River and Bay watershed.

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 within the lower portions of the Perdido Bay watershed.
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. The Rockpile Reef located just below the confluence of Eightmile Creek and the Perdido Bay is one example of a reef community in the Perdido watershed.

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 Perdido Bay and Big Lagoon.

Source: FNAI 2010.

Appendix D 2014 FDEP-verified Impaired Waterbody Segments in the Perdido River and 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 Perdido River and Bay watershed.

Waterbody Segment ID	Water Segment Name	County	Waterbody Class[1]	Parameters Assessed Using the Impaired Waters Rule (IWR)
987	Bayou Garcon	Escambia	3M	Mercury (in fish tissue)
987	Bayou Garcon	Escambia	3M	Mercury (in fish tissue)
697	Bayou Marcus Creek*	Escambia	3F	Dissolved Oxygen (Nutrients - TN)
1004	Big Lagoon	Escambia	3M	Mercury (in fish tissue)
8001C	Big Lagoon State Park	Escambia	3M	Bacteria (Beach Advisories)
872B	Bridge Creek (Tidal Portion)*	Escambia	3M	Fecal Coliform
872B	Bridge Creek (Tidal Portion)*	Escambia	3M	Mercury (in fish tissue)
1014	Direct Runoff to Bay	Escambia	3M	Mercury (in fish tissue)
1018	Direct Runoff to Bay	Escambia	3M	Mercury (in fish tissue)
991	Direct Runoff to Bay	Escambia	3M	Mercury (in fish tissue)
489	Elevenmile Creek*	Escambia	3F	Dissolved Oxygen (BOD)
489	Elevenmile Creek*	Escambia	3F	Dissolved Oxygen (Nutrients)
8001	Gulf of Mexico (Escambia County; Perdido Bay)	Escambia	3M	Mercury (in fish tissue)
974	Perdido Bay	Escambia	3M	Mercury (in fish tissue)
797A	Perdido Bay (Lower Segment)	Escambia	3M	Mercury (in fish tissue)

Waterbody Segment ID	Water Segment Name	County	Waterbody Class[1]	Parameters Assessed Using the Impaired Waters Rule (IWR)
797	Perdido Bay (Upper Segment)	Escambia	3M	Mercury (in fish tissue)
945	Tarkiln Bayou	Escambia	3M	Mercury (in fish tissue)
784	Tee And Wicker Lakes*	Escambia	3M	Mercury (in fish tissue)
935	Weekly Bayou*	Escambia	3M	Mercury (in fish tissue)
4	Brushy Creek	Escambia	3F	Fecal Coliform
72	Direct Runoff to Stream	Escambia	3F	Mercury (in fish tissue)
72D	Direct Runoff to Stream	Escambia	3F	Mercury (in fish tissue)
72E	Direct Runoff to Stream	Escambia	3F	Mercury (in fish tissue)
72F	Direct Runoff to Stream	Escambia	3F	Mercury (in fish tissue)
149	McDavid Creek*	Escambia	3F	Fecal Coliform
2F	Perdido River	Escambia	3F	Mercury (in fish tissue)
462A	Perdido River	Escambia	3M	Mercury (in fish tissue)
462B	Perdido River*	Escambia	3F	Fecal Coliform
462B	Perdido River	Escambia	3M	Mercury (in fish tissue)
462C	Perdido River	Escambia	3M	Mercury (in fish tissue)
542	Rest Area Run*	Escambia	3F	Fecal Coliform
542	Rest Area Run	Escambia	3F	Turbidity

Source: FDEP 2014b.

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 Perdido River and Bay Watershed

Within the Perdido River and Bay watershed there are approximately 20,943 acres of conservation lands, including 4,058 acres of federally managed lands, 13,236 acres state-managed, 1,134 acres of locally managed lands, and 2,514 acres of privately managed lands. One conservation land within the Perdido River and Bay watershed, Gulf Island's National Seashore, spans multiple counties and lies partially outside of the watershed. The details of these conservation lands are presented in the following table (Florida Department of Natural Resources 1992; FNAI 2016a, 2016b):

Conservation Land	Managing Agency	County(ies)	Description	Website	Acres Within Watershed
Federally Managed					
Naval Air Station (NAS) Pensacola	NAS Pensacola	Escambia	This facility is located at the mouth of Pensacola Bay on a peninsula formed by Bayou Grande and the bay. Although most of the site has been developed for mission related activities, a wide variety of habitats remain. Natural communities include beach dune, maritime hammock, sand pine scrub, mesic flatwoods, and sandhill. Includes Bronson OLF and Blue Angel Recreation Park.	http://www.cnic.navy.mil/regions/cnrse/installations/nas_pensacola.html	617.54

Conservation Land	Managing Agency	County(ies)	Description	Website	Acres Within Watershed
Blue Angel Recreational Park	NAS Pensacola	Escambia	This naval recreation area along Perdido Bay, established in 1989, includes large areas dominated by live oak and slash pine. The Park is located within the western portion of what was once Bronson outlying field (OLF), included in the NAS Pensacola.	http://www.navymwrpensacola.com/	347.94
Bronson OLF	NAS Pensacola	Escambia	An inactive naval field with no flight training mission buildings or structures remain within the OLF. Included in the NAS Pensacola.	http://www.cnic.navy.mil/content/dam/cnic/cnrse/pdfs/NAS_PENSACOLA/NAS%20Pensacola%20INRMP%202014%20Final.pdf	636.91
Saufley Field	U.S. Dept. of Defense, Navy	Escambia	The OLF encompasses four airstrips and a number of buildings south of the airfield, with majority of the surrounding airstrip area included predominately wooded areas with a variety of flora and fauna.	http://www.navfac.navy.mil/products_and_services/ev/products_and_services/env_restoration/installation_map/navfac_atlantic/southeast/nas_saufley_field.html	866.46

Conservation Land	Managing Agency	County(ies)	Description	Website	Acres Within Watershed
Navy Technical Training Center at Corry Station	NAS Pensacola	Escambia	Inactive naval air field that contains approximately 100 acres of planted pines and 0.5 acre of wetlands. The property also has a naval hospital and naval housing. There are also a few isolated patches of second growth forest on site.	http://www.netc.navy.mil/centers/ceninfodom/corry/	33.68
Site 8A OLF	NAS Whiting Field	Escambia	An inactive naval field, this site has been mostly cleared but does contain a large wetland on its eastern boundary that is home to several rare plant species. Included in the Naval Air Station Whiting Field.	http://www.cnic.navy.mil/regions/cnrse/installations/nas_whiting_field.html	636.74
Gulf Islands National Seashore	National Park Service	Escambia, Santa Rosa	This national seashore stretches 150 miles from Mississippi into Florida. In Florida, it extends from the eastern end of Perdido Key, across the mouth of Pensacola Bay, to the east end of Santa Rosa Island. It also includes other barrier islands, historic sites on the Florida mainland as well as the waters in between.	http://www.nps.gov	919.25

Conservation Land	Managing Agency	County(ies)	Description	Website	Acres Within Watershed
State Managed					
Big Lagoon State Park	FDEP Division of Recreation and Parks	Escambia	This park contains sand pine scrub on relic dunes with dune rosemary, slash pine flatwoods, titi thickets, sandy beaches, and salt marshes.	http://www.floridastateparks.org/	650.49
Fort Pickens Aquatic Preserve	FDEP Northwest District	Escambia	Located off of the coast of Escambia County, Fort Pickens Aquatic Preserve includes sandy bottom and seagrass habitat The preserve is located adjacent to Gulf Islands National Seashore,	http://www.dep.state.fl.us/coastal/sites/ftpickens/	34,000.00
Perdido Key State Park	FDEP Division of Recreation and Parks	Escambia	On a barrier island 15 miles southwest of Pensacola, this park contains large, undisturbed areas of coastal scrub and beach dune with a large population of Godfrey's golden aster.	http://www.floridastateparks.org/	294.33
Tarkiln Bayou Preserve State Park	FDEP Division of Recreation and Parks	Escambia	Located on the western border of Florida, this preserve is on a peninsula formed by Tarkiln Bayou and Perdido Bay. Natural communities include maritime hammock, mesic flatwoods, wet prairie, and sandhill.	http://www.floridastateparks.org/	3,415.67

Conservation Land	Managing Agency	County(ies)	Description	Website	Acres Within Watershed
International Paper Company Conservation Easement	FDEP Division of Recreation and Parks	Escambia	The International Paper Company Conservation Easement is a regulatory conservation easement with no public access. The easement is located at the northern edge of Perdido Bay, east of Saufley Field and south of Helms Road and Highway 90.	https://www.dep.state.fl.us/lands/FFAnnual/Lower_Perdido_River_Buffer.pdf	2,616.42
Herndon Conservation Easement	NWFWMD	Escambia	Herndon Conservation Easement is a privately owned conservation easement with no public access. The easement is located north of Perdido Bay, southwest of Site 8A OLF, and between Belle Pines Lane and Highway 90.	http://www.nwfwater.com/	4.30
Perdido River Water Management Area (and Wildlife Management Area)	NWFWMD and FWC	Escambia	The Perdido River Water Management Area is broken into multiple parcels running north along the Perdido River and just north of Perdido Bay (south of Saufley Field). The area is primarily pine plantation.	http://www.nwfwater.com/	6,254.78

Conservation Land	Managing Agency	County(ies)	Description	Website	Acres Within Watershed
Locally Managed					
R.L. Hyatt Environmental Center	School District of Escambia County	Escambia	This site consists of young, dry slash pine/longleaf pine forest dissected west to east by a dendritic drainage pattern which flows east off the property into the north arm of Elevenmile Creek. Downhill slopes support several seepage bogs with pitcher plants. The center serves the Escambia County School District.	https://ecsd-fl.schoolloop.com/rhec	124.46
Bayou Marcus Wetland	Emerald Coast Utilities Authority	Escambia	This property is managed as a receiving wetland under an operating agreement with the State. It borders the Escambia River and is on the Great Florida Birding Trail. The wetlands provide habitat for a number of rare plants and animals. A boardwalk traverses the northern portion of the site and provides access for water sampling and opportunities for visitor observation.	http://www.dep.state.fl.us/water/wastewater/dom/wetbayou.htm	1,009.73

Conservation Land	Managing Agency	County(ies)	Description	Website	Acres Within Watershed
Privately Managed					
Perdido Bay/Crown Point Preserve	Coastal Plains Institute	Escambia	This preserve contains a white-topped pitcher plant bog (wet prairie) on the eastern shores of Perdido Bay. Under a conservation easement with the State, Coastal Plains Institute manages the property to restore and maintain in perpetuity the wet prairie to its pre-settlement condition.	http://www.coastalplains.org	168.54
Betty and Crawford Rainwater Perdido River Preserve	The Nature Conservancy	Escambia	Wilderness area along the banks of the Perdido River that includes 8 miles of river shoreline. The preserve harbors many of the region's rare plant species.	http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/alabama/placesweprotect/perdido-river-nature-preserve.xml	2,346.10

Sources: FNAI 2016a, 2016b.

Appendix F Projects Funded by the National Fish and Wildlife Foundation affecting the Perdido River and 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. Over the next five years, the GEBF will receive a total of $356 million for the following natural resource projects in Florida. The following projects affecting the Perdido River and 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 Perdido River and 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.

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.

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.