Northwest District • Ochlockonee–St. Marks Basin

Final Report

Nutrient TMDLs for Lake Talquin (WBIDs 1297X, 1297Y, and 1297Z)

and Documentation in Support of the Development of Site-Specific Numeric Interpretations of the Narrative Nutrient Criterion

Ansel Bubel
Division of Environmental Assessment and Restoration
Florida Department of Environmental Protection

August 2021

2600 Blair Stone Road
Mail Station 3000
Tallahassee, FL 32399-2400
https://floridadep.gov

Executive Summary

Lake Talquin is located between Leon and Gadsden Counties, Florida. The waterbody was identified as impaired for nutrients based on the numeric nutrient criteria (NNC) for high-color lakes and was added to the 303(d) list by Secretarial Order on March 19, 2009, as the segments with waterbody identification (WBID) numbers 1297D and 1297C. Recent WBID revisions have split the waterbody into three WBIDs, now numbered 1297X, 1297Y, and 1297Z. The three segments were verified as impaired for nutrients using the methodology in the Identification of Impaired Surface Waters Rule (IWR) (Chapter 62-303, Florida Administrative Code [F.A.C.]), and were included on the Verified List of Impaired Waters for the Ochlockonee–St. Marks Basin Group adopted by Secretarial Order on October 2, 2019. This report presents total maximum daily loads (TMDLs) for total nitrogen (TN) and total phosphorus (TP). **Table EX-1** lists supporting information for the TMDLs. The TMDLs were developed in accordance with Section 303(d) of the federal Clean Water Act and guidance developed by the U.S. Environmental Protection Agency.

Table EX-1. Summary of TMDL supporting information for Lake Talquin

Type of Information	Description
Waterbody name/ WBID number	Lake Talquin/1297X, 1297Y, and 1297Z
Hydrologic Unit Code (HUC) 8	03120003
Use classification/ Waterbody designation	Class III/Freshwater
Targeted beneficial uses	Fish consumption, recreation, and propagation and maintenance of a healthy, well-balanced population of fish and wildlife
303(d) listing status	Verified List of Impaired Waters for the Group 1 basins, Ochlockonee–St. Marks River, adopted via Secretarial Order dated March 19, 2009
TMDL pollutants	TN, TP
TMDLs and site-specific interpretations of the narrative nutrient criterion	**Chlorophyll *a*:** Generally applicable NNC for a high-color lake. **TN:** 1,134,850 kilograms per year (kg/yr), expressed as a 7-year average load not to be exceeded. **TP:** 112,326 kg/yr , expressed as a 7-year average load not to be exceeded.
Load reductions required to meet the TMDLs	A 19 % TN reduction and a 21 % TP reduction to achieve the chlorophyll *a* target of 20.0 micrograms per liter (µg/L).
Concentration-based water quality modeling targets – for information only	**Chlorophyll *a***: WBID 1297Z = 19.3 µg/L, WBID 1297Y = 20.0 µg/L, WBID 1297X = 17.5 µg/L **TN**: WBID 1297Z = 0.81 milligrams per liter (mg/L), WBID 1297Y = 0.84 mg/L, WBID 1297X = 0.73 mg/L **TP**: WBID 1297Z = 0.084 mg/L, WBID 1297Y = 0.070 mg/L, WBID 1297X = 0.062 mg/L

Acknowledgments

This analysis was accomplished thanks to significant contributions from staff in the Florida Department of Environmental Protection (DEP) Division of Environmental Assessment and Restoration, specifically, the Office of Watershed Services, Watershed Assessment Section, Standards Development Section, Water Quality Restoration Program, Tallahassee Regional Operations Center, and Watershed Evaluation and TMDL Section. Modeling support was provided by Tim Wool, Amanda Howell, Craig Hesterlee, and Glenn Fernandez with the U.S. Environmental Protection Agency Region 4.

For additional information regarding the development of this report, please contact the Division of Environmental Assessment and Restoration office at:

2600 Blair Stone Road
Mail Station 3000
Tallahassee, FL 32399-2400
Phone: (850) 245–8668

Contents

List of Figures

List of Tables

Chapter 1: Introduction

1.1 Purpose of Report

This report presents the total maximum daily loads (TMDLs) developed to address the nutrient impairment of Lake Talquin, located in the Ochlockonee–St. Marks Basin. The TMDLs for total nitrogen (TN) and total phosphorus (TP) will also constitute the site-specific numeric interpretations of the narrative nutrient criterion set forth in Paragraph 62-302.530(90)(b), Florida Administrative Code (F.A.C.), that will replace the otherwise applicable numeric nutrient criteria (NNC) in Subsection 62-302.531(2), F.A.C., for this particular waterbody, pursuant to Paragraph 62-302.531(2)(a), F.A.C. The waterbody was verified as impaired for nutrients using the methodology in the Identification of Impaired Surface Waters Rule (IWR) (Chapter 62-303, F.A.C.), and was included on the Verified List of Impaired Waters for the Ochlockonee–St. Marks Basin adopted by Secretarial Order on March 19, 2009. The nutrient impairment was reconfirmed in October 2019.

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and provides water quality modeling targets needed to achieve compliance with applicable water quality criteria based on the relationship between pollutant sources and water quality in the receiving waterbody. The TMDLs establish the allowable loadings to Lake Talquin that would restore the waterbody so that it meets its applicable water quality criteria for nutrients.

1.2 Identification of Waterbody

For assessment purposes, the Florida Department of Environmental Protection (DEP) divided the Ochlockonee–St. Marks Basin (Hydrologic Unit Code [HUC] 8 – 03120003) into watershed assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or surface water segment. Lake Talquin comprises WBIDs 1297Z, 1297Y and 1297X. **Figure 1.1** shows the location of Lake Talquin in the basin and major geopolitical and hydrologic features in the region, and **Figure 1.2** contains a more detailed map of the WBIDs.

1.2.1 Lake Talquin (Upper) (WBID 1297Z)

WBID 1297Z (Upper) makes up the eastern section of the lake, exchanges water with WBID 1297Y at their boundary, and includes 3,073 acres (38 %) of the 8,127 acres (U.S. Geological Survey [USGS] National Hydrography Dataset [NHD] of the open waters of Lake Talquin. This area receives drainage from the Ochlockonee River and numerous small tributaries in Leon and Gadsden Counties (**Figure 1.3**).

1.2.2 Lake Talquin (Middle) (WBID 1297Y)

WBID 1297Y (Middle) makes up the central section of the lake, exchanges water with WBID 1297X and 1297Z at their boundary and includes 3,518 acres (43 %) of the 8,127 acres of the open waters of Lake Talquin. This area receives drainage from the Little River and numerous small tributaries in Leon and Gadsden Counties (**Figure 1.3**).

1.2.3 Lake Talquin (Lower) (WBID 1297X)

WBID 1297X (Lower) makes up the western section of the lake, including the outflow structure (Corn Hydroelectric Facility). The lower part of the lake includes 1,536 acres (19 %) of the 8,127 acres of the open waters of Lake Talquin. This area exchanges water with WBID 1297Y at their boundary and includes drainage from the Ocklawaha and Hammock Creeks in Gadsden County, Freeman and Harvey Creeks in Leon County, and numerous small tributaries (**Figure 1.3**).

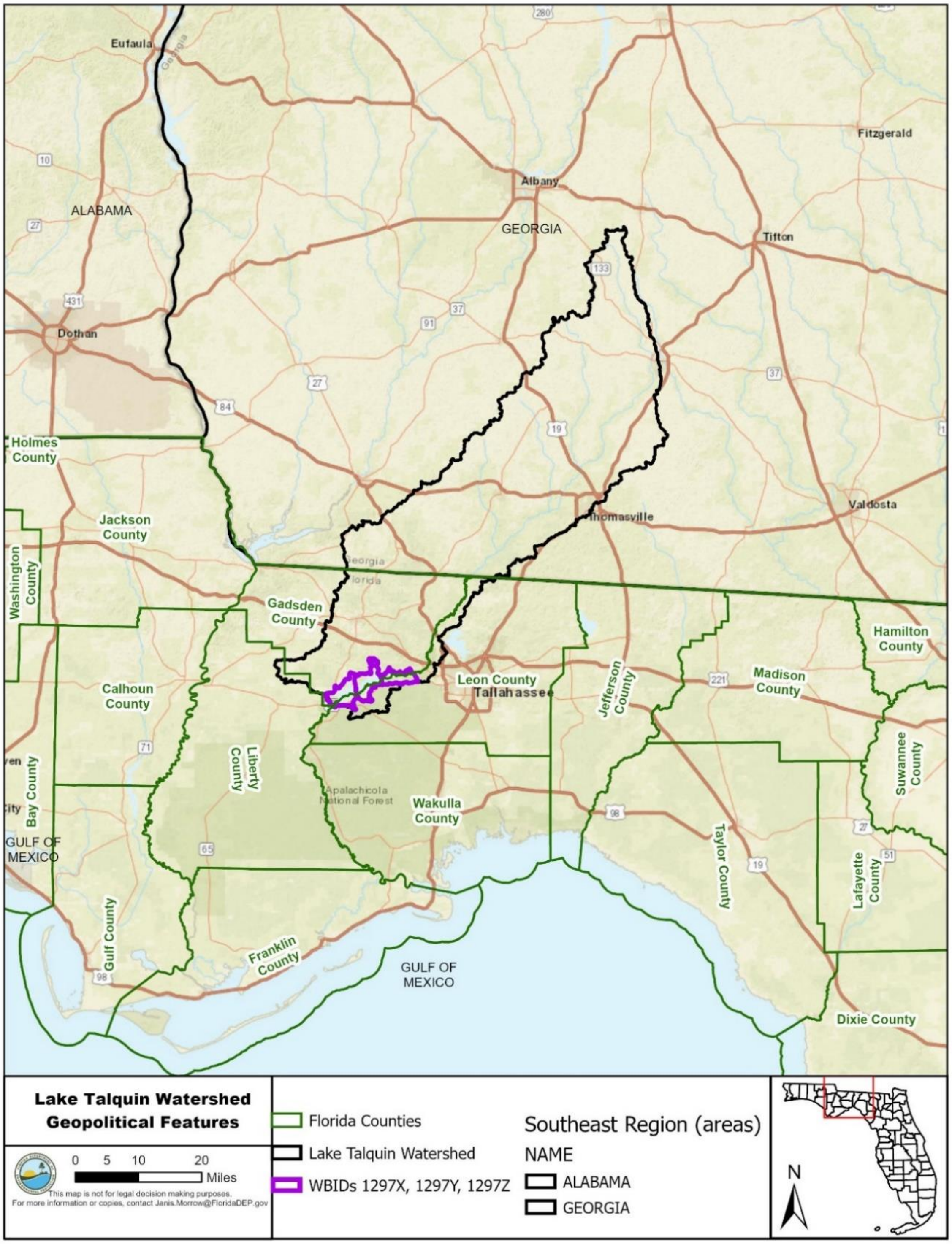

Figure 1.1. Location of Lake Talquin (WBIDs 1297X, 1297Y, and 1297Z) in the Ochlockonee–St. Marks Basin and major hydrologic and geopolitical features in the area

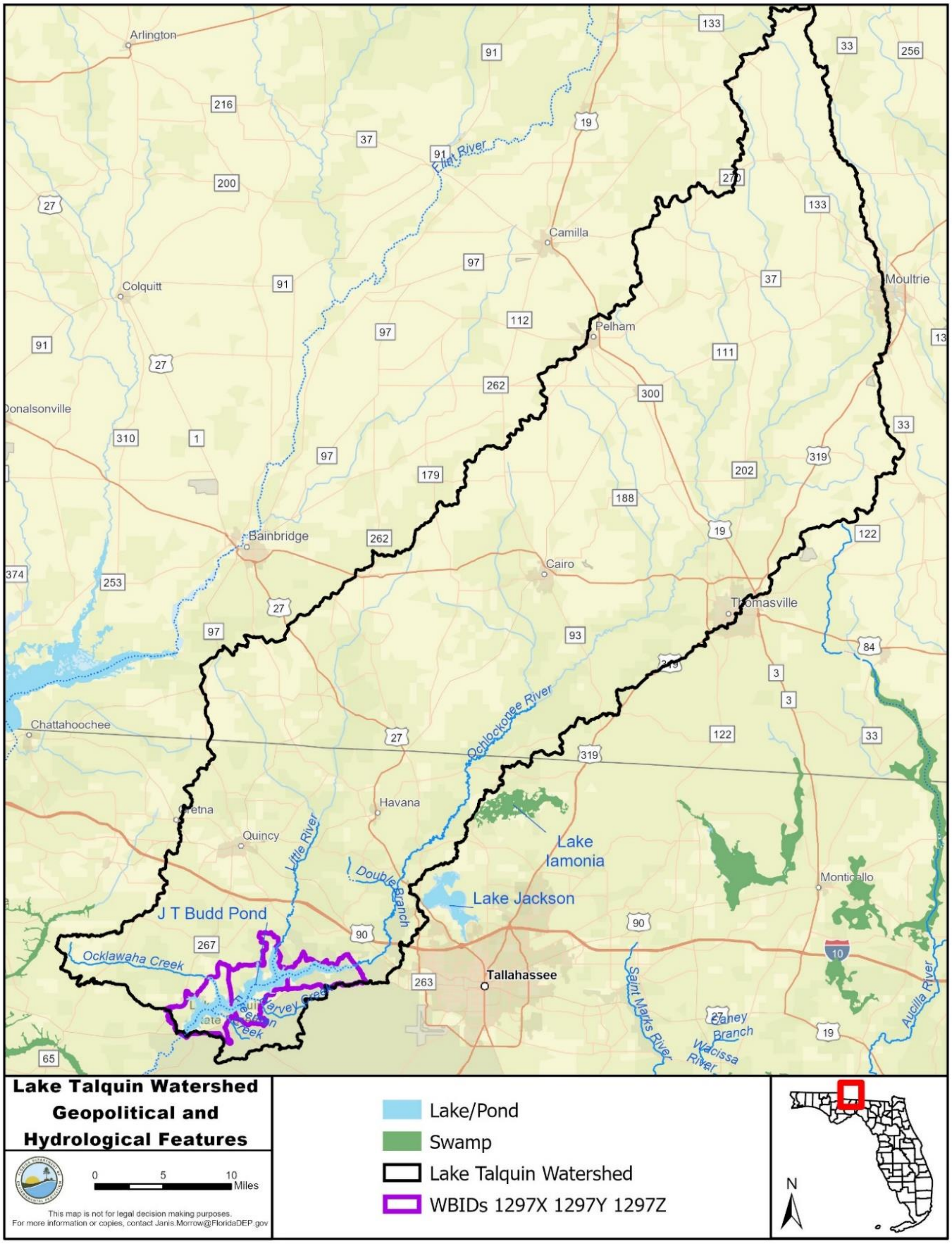

Figure 1.2. Detailed map of the Lake Talquin Watershed and WBIDs

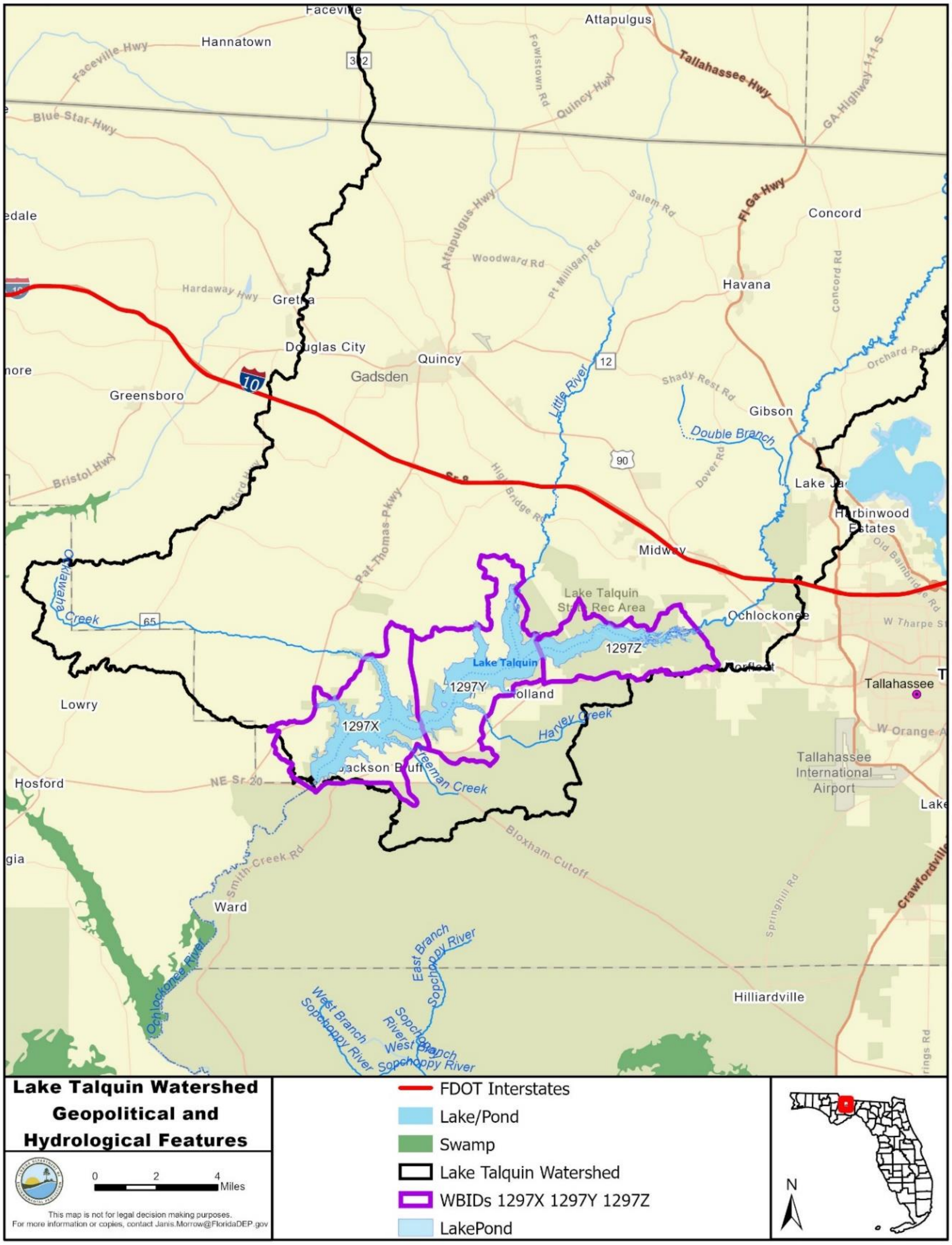

Figure 1.3. Lake Talquin Watershed area within Florida

1.3 Watershed Information

1.3.1 Population and Geopolitical Setting

The watershed of Lake Talquin begins in Georgia and includes a portion of south Georgia. Most of the landscape in the watershed is sparsely settled, with several small- to medium-sized towns distributed throughout the watershed. Major centers of population in the Georgia portion of the watershed include Tifton, Moultrie, Thomasville, and Cairo. Major population centers in Florida include Gretna, Havana, and Quincy.

1.3.2 Hydrologic Setting

The Lake Talquin watershed (**Figure 1.4**) covers 1,568.92 square miles, of which 73.3 % (1,150.3 square miles) is located in Georgia, with the remaining 26.7 % (418.7 square miles) in Florida. The surface area of the lake is 12.64 square miles (8,087 acres), and it has an average depth of 13.1 feet, with a maximum depth of 30 feet. The lake discharges into the Ochlockonee River, which discharges into Ochlockonee Bay and the Gulf of Mexico. The Ochlockonee River and Swamp, Attapulgus, and Willacoochee Creeks all form in Georgia and flow into Florida, forming the majority of the freshwater flow into Lake Talquin. Within just a few miles of entering Florida, in sequence, Attapulgus Creek, Swamp Creek, and Willacoochee Creek join, giving rise to the Little River, the second largest tributary to Lake Talquin.

The Ochlockonee River originates south of the Town of Sylvester in Worth County, in southwest Georgia. It flows 206 miles before crossing into Florida, contributing over half the water for Lake Talquin (a long-term average flow of 1,530 cubic feet per second [cfs] of the 2,500 cfs leaving the lake) (61 % of total outflow), eventually emptying into Ochlockonee Bay. In Florida, the river forms the western boundaries of Leon and Wakulla Counties and the eastern boundaries of Gadsden, Liberty, and Franklin Counties.

1.3.3 Geological Setting

Lake Talquin lies in the Quincy Hills division of the Tifton Uplands District. The Tifton Uplands region (locally known as the Tallahassee Hills) consists of clay-capped ridges that have been eroded and dissected by streams, with a relatively high potential for runoff (DEP 2011). The geology in the area is dominated by clayey sand and clayey limestone of the Torreya Formation, which is a part of the Hawthorn Group (Scott 1988).

Additional information about the watershed hydrology and geology is available in the document *Water Quality Assessment Report: Ochlockonee–St. Marks* (DEP 2003) and the document, *Report on Lake Talquin, Gadsden and Leon Counties, Florida* (U.S. Environmental Protection Agency [EPA] 1977).

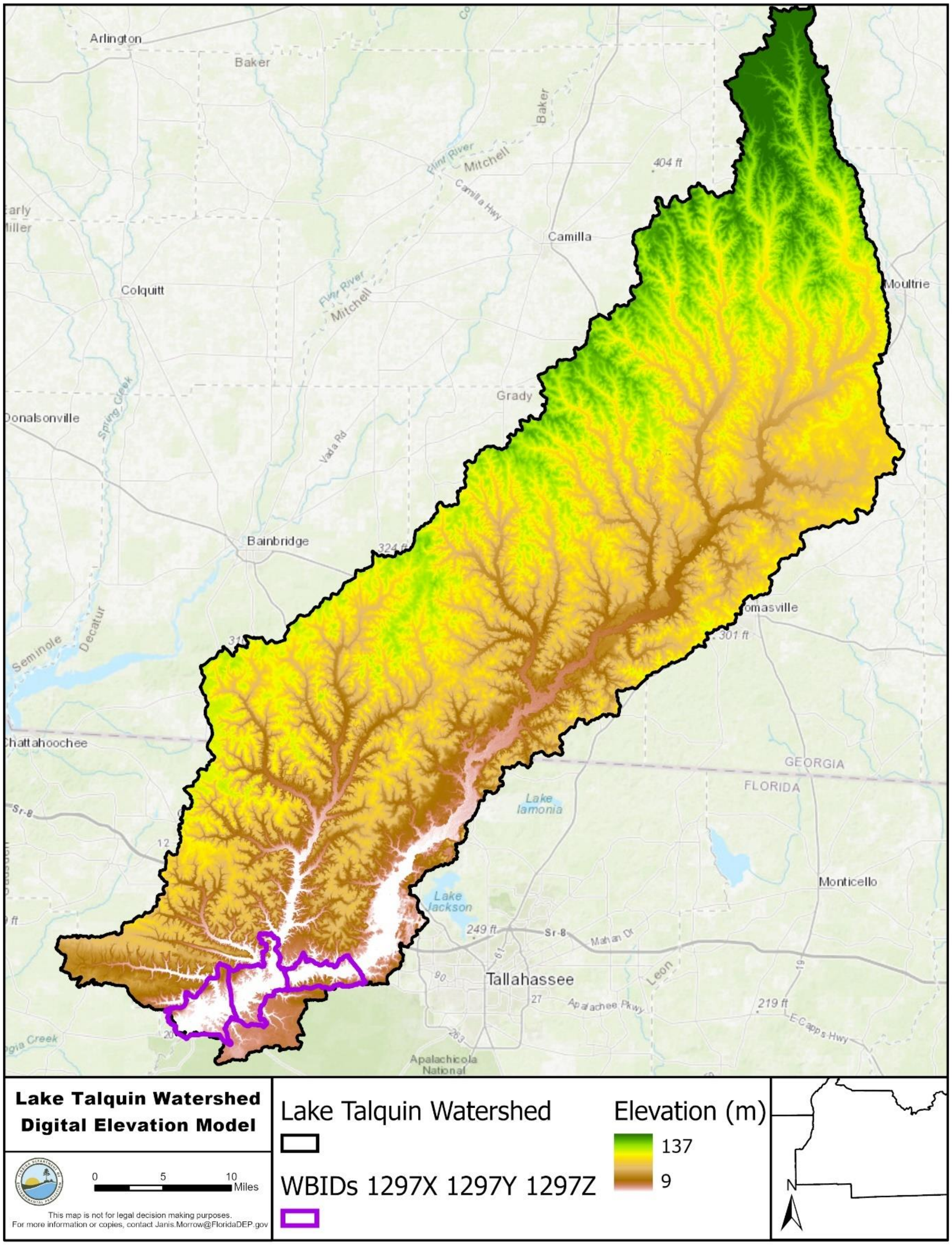

Figure 1.4. Topography of the Lake Talquin Watershed

Chapter 2: Water Quality Assessment and Identification of Pollutants of Concern

2.1 Statutory Requirements and Rulemaking History

Section 303(d) of the federal Clean Water Act (CWA) requires states to submit to the EPA lists of surface waters that do not meet applicable water quality standards (impaired waters) and establish a TMDL for each pollutant causing the impairment of listed waters on a schedule. DEP has developed such lists, commonly referred to as 303(d) lists, since 1992.

The Florida Watershed Restoration Act (FWRA) (Section 403.067, Florida Statutes [F.S.]) directed DEP to develop, and adopt by rule, a science-based methodology to identify impaired waters. The Environmental Regulation Commission adopted the methodology as Chapter 62-303, F.A.C. (the IWR), in 2001. The rule was amended in 2006, 2007, 2012, 2013, and 2016.

The list of impaired waters in each basin, referred to as the Verified List, is also required by the FWRA (Subsection 403.067[4], F.S.). The state's 303(d) list is amended regularly to include basin updates.

2.2 Classification of the Waterbody and Applicable Water Quality Standards

Lake Talquin is a Class III freshwater waterbody, with a designated use of fish consumption, recreation, and propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The Class III water quality criterion applicable to the verified impairment (nutrients) for this waterbody is Florida's nutrient criterion in Paragraph 62-302.530(90)(b), F.A.C. Florida adopted numeric nutrient criteria (NNC) for lakes, spring vents, and streams in 2011. These were approved by EPA in 2012 and became effective in 2014. The lake NNC, set forth in Subparagraph 62-302.531(2)(b)1., F.A.C., are expressed in annual geometric mean (AGM) values for chlorophyll *a*, TN, and TP, further described in **Chapter 3**.

Based on the extensive analysis of data from Florida lakes, DEP has concluded that the most accurate determination of lake health is based on the area of the state where a lake is located, its long-term color and alkalinity, and the level of nutrients and chlorophyll *a* present (**Chapter 3**). These data are best assessed as the long-term geometric mean (GM) for color and alkalinity and as the AGM for TN, TP, and chlorophyll *a*. As such, the presentation of data for the lake will use the period of record (POR) GMs for color and alkalinity and AGMs for nutrients and chlorophyll *a*.

The numeric nutrient thresholds for lakes in Rule 62-302.531, F.A.C., vary depending on color, alkalinity, and chlorophyll *a* AGM concentration. The POR GMs for alkalinity and color for the upper portion of the lake, WBID 1297Z, are 17 milligrams per liter (mg/L) and 61 platinum cobalt units (PCU), respectively. The POR GMs for alkalinity and color for the middle portion of the lake, WBID 1297Y, are 16 mg/L and 55 PCU, respectively. The POR GMs for alkalinity and color for the lower portion of the lake, WBID 1297X, are 14 mg/L and 54 PCU, respectively. All three WBIDs are characterized as high color, in which case alkalinity does not impact the threshold concentrations for nutrients and chlorophyll *a*. The threshold for chlorophyll *a* is an AGM less than or equal to 20 micrograms per liter (µg/L), the TP AGM can range between 0.05 and 0.16 mg/L, and the TN AGM can range between 1.27 and 2.23 mg/L, depending on the chlorophyll *a* AGM concentration (**Chapter 3**).

2.3 Determination of the Pollutant of Concern

2.3.1 Data Providers

The Lake Talquin water quality data collected during the assessment planning period (January 2006–December 2015) and verified period (January 2011–June 2018) are from stations sampled by Leon County Public Works, Florida LakeWatch, DEP, Biological Research Associates, and McGlynn Laboratories, Inc. Leon County and Florida LakeWatch conducted routine monitoring of Lake Talquin, and Leon County collected the majority of available lake nutrient data used for the 2019 assessment. **Figure 2.1** shows the sampling locations for data used in the assessment.

The individual water quality measurements discussed in this report are available in IWR Database Run 56 and are available on request.

2.3.2 Information on Verified Impairment

Water quality in Lake Talquin was evaluated during the 2018 to 2019 assessment cycle. Each of the three lake WBIDs was compared with the applicable NNC for high-color lakes and its impairment status was determined. During this process, all three WBIDs in Lake Talquin were identified as being impaired for chlorophyll *a*, TP, and TN. DEP adopted TMDLs for these parameters on October 2, 2019, by Secretarial Order. **Table 2.1** summarizes the results of the latest water quality assessment.

Table 2.1. Lake Talquin nutrient assessment status, 2018–19

WBID	Chlorophyll *a* (µg/L)	TN (mg/L)	TP (mg/L)
1297X	Impaired	Impaired	Impaired
1297Y	Impaired	Impaired	Impaired
1297Z	Impaired	Impaired	Impaired

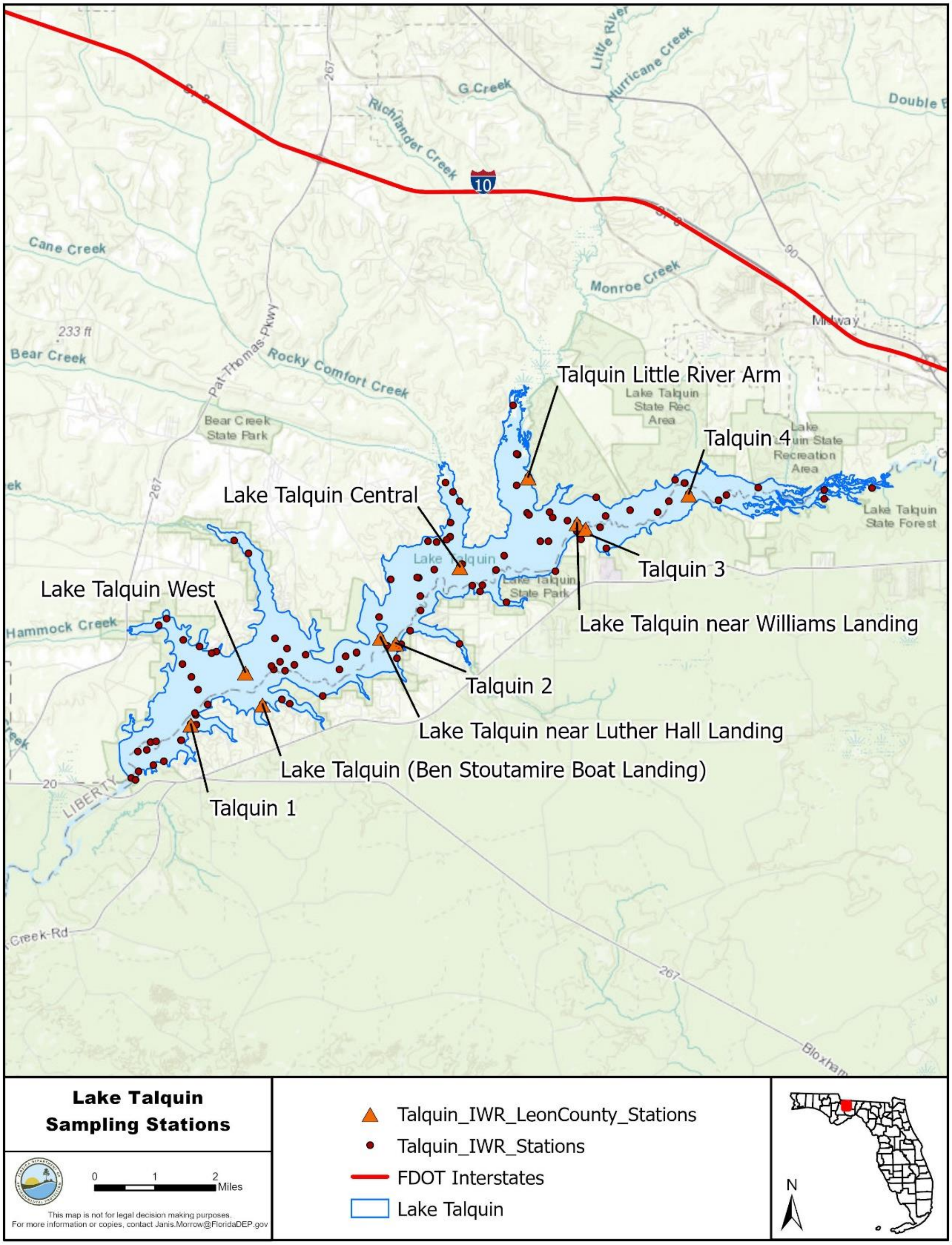

Figure 2.1. Lake Talquin water quality stations sampled in the assessment period, 2018–19

Chapter 3: Site-Specific Numeric Interpretations of the Narrative Nutrient Criterion

3.1 Establishing the Site-Specific Interpretations

The nutrient TMDLs for TN and TP presented in this report, upon adoption into Chapter 62-304.305 , F.A.C., will constitute the site-specific numeric interpretations of the narrative nutrient criterion set forth in Paragraph 62-302.530(90)(b), F.A.C., that will replace the otherwise applicable NNC in Subsection 62-302.531(2), F.A.C., for this particular waterbody, pursuant to Paragraph 62-302.531(2)(a), F.A.C. **Table 3.1** lists the elements of the nutrient TMDLs that constitute the site-specific numeric interpretations of the narrative nutrient criterion. **Appendix B** summarizes the relevant details to support the determination that the TMDLs provide for the protection of Lake Talquin and for the attainment and maintenance of water quality standards in downstream waters (pursuant to Subsection 62-302.531[4], F.A.C.), and to support using the nutrient TMDLs as the site-specific numeric interpretations of the narrative nutrient criterion.

When developing TMDLs to address nutrient impairment, it is essential to address those nutrients that typically contribute to excessive plant or algal growth. In Florida waterbodies, nitrogen and phosphorus are most often the limiting nutrients. The limiting nutrient is defined as the nutrient(s) that limits plant growth (both macrophytes and algae) when it is not available in sufficient quantities. A limiting nutrient is a chemical that is necessary for plant growth, but available in quantities smaller than those needed for algae, represented by chlorophyll *a*, and macrophytes to grow.

In the past, management activities to control lake eutrophication focused on phosphorus reduction, as phosphorus was generally recognized as the limiting nutrient in freshwater systems. Recent studies, however, have supported the reduction of both nitrogen and phosphorus as necessary to control algal growth in aquatic systems (Conley et al. 2009, Paerl 2009, Lewis et al. 2011, Paerl and Otten 2013). Furthermore, the analysis used in the development of the Florida lake NNC supports this idea, as statistically significant relationships were found between chlorophyll *a* values and both nitrogen and phosphorus concentrations (DEP 2012).

Table 3.1. Lake Talquin site-specific interpretation of the narrative nutrient criterion

Analyte	Expression
TN	1,134,850 kg, expressed as a 7-year average load not to be exceeded
TP	112,326 kg, expressed as a 7-year average load not to be exceeded

3.2 Site-Specific Response Variable Target Selection

The generally applicable chlorophyll *a* criterion was selected as the primary response variable for the Lake Talquin TMDLs. There is no information available to DEP that points to the need for an alternate endpoint for the TMDLs. In order to achieve the chlorophyll *a* target, TN and TP loads from the watershed were iteratively reduced using the Lake Talquin models (See chapter 5). A margin of safety was added when calculating the necessary TN and TP reductions by selecting a chlorophyll *a* endpoint of 20.0 µg/L that was achieved in every year under the TMDL scenario. Chlorophyll *a* concentrations are highest in the upper and middle portions of the lake and therefore, these portions of the lake drove the nutrient reductions under the TMDL scenario. Given that Lake Talquin is colimited by both nitrogen and phosphorus, reductions in both nutrients are necessary to reduce chlorophyll *a* and to maintain a ratio of nutrients consistent with a healthy lake. **Chapter 5** describes in more detail how the models were used to derive this scenario.

3.3 Numeric Expression of the Site-Specific Numeric Interpretations

The TMDL loads from the model scenario described in **Chapter 5** will be adopted as site-specific water quality criteria. Given that the TMDL scenario is protective of the generally applicable chlorophyll *a* criterion, this parameter will not be changed from the generally applicable NNC.

For informational purposes only, the TN and TP concentrations corresponding to achieving the chlorophyll *a* criterion of 20 µg/L and the loading criteria are as follows:

TN: WBID 1297Z = 0.81 mg/L, WBID 1297Y= 0.84 mg/L, WBID 1297X = 0.73 mg/L

TP: WBID 1297Z = 0.084 mg/L, WBID 1297Y = 0.070 mg/L, WBID 1297X = 0.062 mg/L

These concentrations are AGMs, not to be exceeded, when the site-specific TN and TP loads are met. These nutrient concentrations serve as the concentration-based restoration targets.

3.4 Downstream Protection

Lake Talquin flows downstream into the Ochlockonee River. The river below the lake is not impaired for chlorophyll *a*, TN, or TP. Therefore, the current lake conditions are not currently causing or contributing to an impairment downstream. The implementation of the TMDLs will improve water quality conditions both in Lake Talquin and in the Ochlockonee River below the lake. Therefore, the TMDL reductions derived for Lake Talquin will also be protective of the Ochlockonee River.

3.5 Endangered Species Consideration

Section 7(a)(2) of the Endangered Species Act (ESA) requires each federal agency, in consultation with the services (i.e., the U.S. Fish and Wildlife Service [FWS] and the U.S.

National Oceanic and/or Atmospheric Administration [NOAA], National Marine Fisheries Service [NMFS]), to ensure that any action authorized, funded, or carried out is not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of designated critical habitat. The EPA must review and approve changes in water quality standards (WQS) such as setting site-specific criteria.

Prior to approving WQS changes for aquatic life criteria, the EPA will prepare an Effect Determination summarizing the direct or indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action. The EPA categorizes potential effect outcomes as either (1) "no effect," (2) "may affect, not likely to adversely affect," or (3) "may affect: likely to adversely affect."

The service(s) must concur on the Effect Determination before the EPA approves a WQS change. A finding and concurrence by the service(s) of "no effect" will allow the EPA to approve an otherwise approvable WQS change. However, findings of either "may affect, not likely to adversely affect" or "may affect: likely to adversely affect" will result in a longer consultation process between the federal agencies and may result in a disapproval or a required modification to the WQS change.

The FWS online Information for Planning and Conservation (IPaC) tool identifies the Gulf sturgeon and several freshwater mussels as species that are potentially affected by activities in the area of Lake Talquin.

The Gulf sturgeon (*Acipenser oxyrinchus*), a threatened fish species that historically inhabited the Ochlockonee River system, is typically found in the large coastal rivers and estuaries along the Gulf Coast of North America. It is an anadromous fish living mainly in the slower moving riverine waters or nearshore marine waters along the east coast, and migrating periodically into faster moving freshwater areas to spawn. Gulf sturgeon, unlike other anadromous species, do not appear to migrate long distances offshore. They are benthic feeders. Juveniles are thought to feed on benthic insects and crustaceans. Mollusks, crustaceans, and macroinvertebrates are the primary food of adult Gulf sturgeon. The delineated critical habitat for this species does not include the Ochlockonee River because there does not appear to be a large sturgeon population present.

Several threatened and endangered freshwater mussels are endemic to the Ochlockonee River system, including the Ochlockonee moccasinshell (*Medionidus simpsonianus*), the oval pigtoe (*Pleurobema pyriforme*), the purple bankclimber (*Elliptoideus sloatianus*), and the shinyrayed pocketbook (*Lampsilis subangulata*). The main threat to these mussel species appears to be the damming of the Ochlockonee River, which occurred when the Jackson Bluff dam was built in 1927, creating Lake Talquin. High ammonia concentrations can be toxic to freshwater mussels, and the required reductions to meet the TMDLs should result in lower ammonia concentrations, which will in turn benefit mussel populations in the watershed. According to the Florida Fish and Wildlife Conservation Commission:

> *These mussels are filter feeders that primarily eat plankton and detritus (dead organic matter). Freshwater mussels face a host of threats due to an increased human population and development. The main threat to freshwater mussels is the impoundment of waterways. Waterways are impounded for fresh water supply, flood control, and hydropower. Impounding waterways causes the water current's velocity to decrease, causing sediment to build up in the river and cover the mussels. Impoundments also cause habitat fragmentation, separating mussel populations and individual mussels from algae and host fish (FWS 2006). River dredging also threatens to destroy freshwater mussel populations on the river floors. The Asian clam (Corbicula fluminea), an invasive species, can outcompete the oval pigtoe for resources in its habitat (Florida Natural Areas Inventory 2001). Pesticide and chemical pollution pose a significant threat to mussels, since they are filter feeders and may ingest chemicals directly from their habitat.*

Chapter 4: Assessment of Sources

4.1 Types of Sources

An important part of the TMDL analysis is the identification of pollutant source categories, source subcategories, or individual sources of the pollutant of concern in the target watershed and the amount of pollutant loading contributed by each of these sources. Sources are broadly classified as either point sources or nonpoint sources. Historically, the term point sources has meant discharges to surface waters that typically have a continuous flow via a discernable, confined, and discrete conveyance, such as a pipe. Domestic and industrial wastewater treatment facilities (WWTFs) are examples of traditional point sources. Point sources also include certain urban stormwater discharges, such as those from local government master drainage systems, construction sites over five acres, and a wide variety of industries (see **Appendix A** for background information on the federal and state stormwater programs). In contrast, the term "nonpoint sources" is used to describe intermittent, rainfall-driven, diffuse sources of pollution associated with everyday human activities, including runoff from urban land uses, agriculture, silviculture, and mining; discharges from septic systems; and atmospheric deposition.

To be consistent with CWA definitions, the term "point source" is used to describe traditional point sources (such as domestic and industrial wastewater discharges) and stormwater systems requiring an NPDES stormwater permit when allocating pollutant load reductions required by a TMDL (see **Section 6.1** on **Expression and Allocation of the TMDL**s). However, the methodologies used to estimate nonpoint source loads do not distinguish between NPDES and non-NPDES stormwater discharges.

4.2 Point Sources

4.2.1 NPDES Point Sources

When these TMDLs were being developed, 10 NPDES-permitted wastewater facilities that discharge to surface waters were identified in the Lake Talquin Watershed.

In Florida, currently only two WWTFs with the potential to impact Lake Talquin have NPDES permits allowing direct discharge to waters in the Lake Talquin Watershed (**Figure 4.1** and **Table 4.1**). These facilities, which are permitted through the NPDES Program in Florida, are the Arvah B. Hopkins Power Plant, located on Beaver Creek; and the Quincy domestic wastewater treatment plant (WWTP), located along Quincy Creek.

In Georgia, there are currently eight NPDES surface water dischargers (six domestic and two industrial facilities) (**Figure 4.1** and **Table 4.1**) discharging to tributaries to Lake Talquin. These facilities are permitted by Georgia.

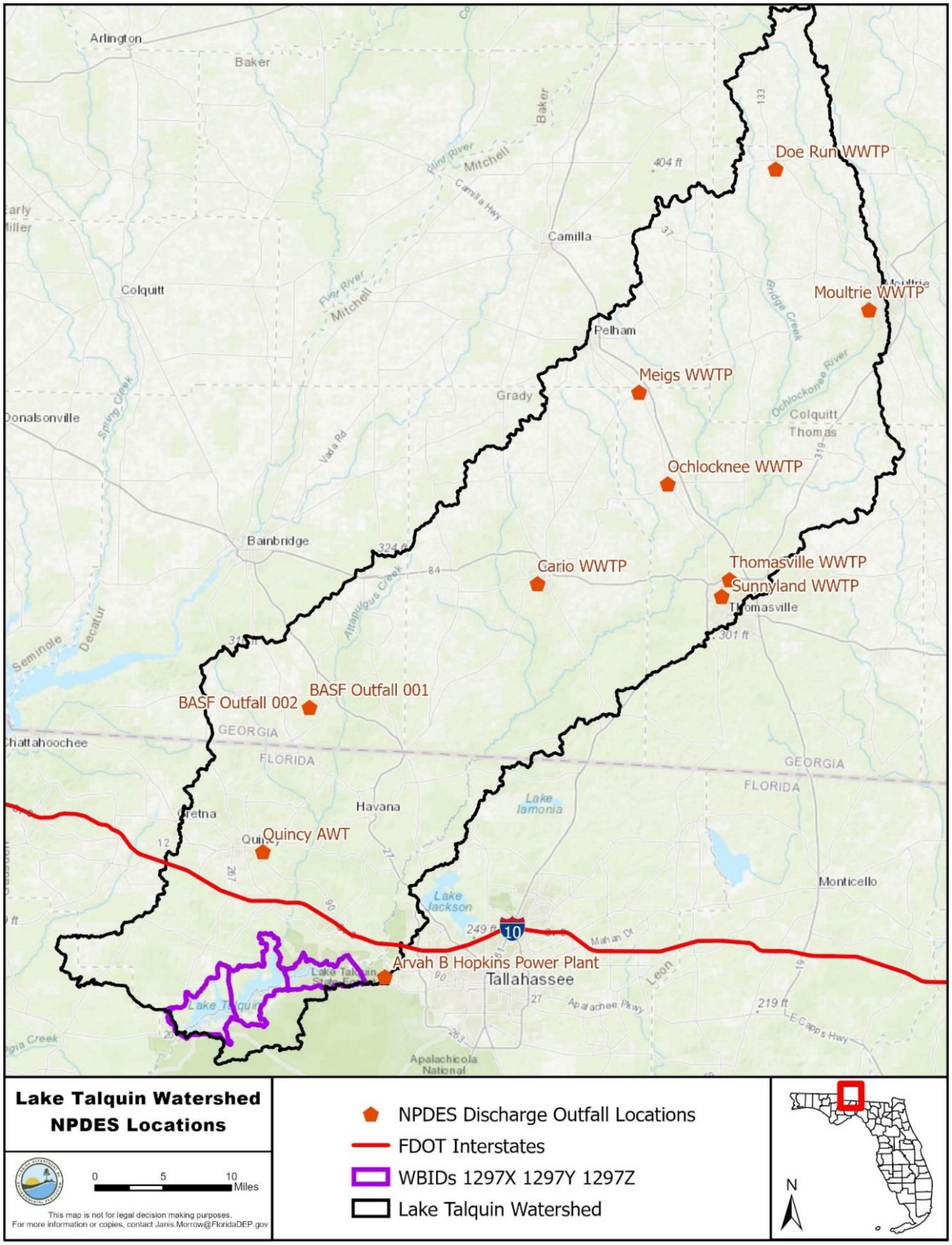

Figure 4.1. Permitted NPDES discharges in the Lake Talquin Watershed

All of the NPDES dischargers to surface water were used in developing either the Loading Simulation Program in C++ (LSPC) model that delivers loadings to the Water Quality Analysis Simulation Program (WASP) models, or is input directly into the WASP models as a time series.

Table 4.1. Permitted NPDES facility discharges

FL = Florida, GA = Georgia

Facility Name	Permit Number	State	Subwatershed	Type of Facility
A.B. Hopkins Power Plant	# FL0025518	FL	Beaver Creek	Industrial
Quincy WWTF	# FL0029033	FL	Little River	Domestic - Advanced treatment
BASF Attapulgus facility	# GA0001678	GA	Little River	Industrial – Facultative lagoons
Cairo Water Pollution Control Plant (WPCP)	# GA0025771	GA	Ochlockonee River	Domestic - Secondary treatment
Doerun WPCP	# GA0021717	GA	Ochlockonee River	Domestic - Secondary treatment
Meigs	#GA0048178	GA	Ochlockonee River	Domestic - Secondary treatment
Moultrie WPCP	#GA0024660	GA	Ochlockonee River	Domestic - Secondary treatment
Ochlocknee	#GA0046370	GA	Ochlockonee River	Domestic - Secondary treatment
Sunnyland (also known as Genesis Project/ Affinity)	#GA001279	GA	Ochlockonee River	Industrial
Thomasville WPCP	#GA0024082	GA	Ochlockonee River	Domestic - Secondary treatment

4.2.2 Municipal Separate Storm Sewer System (MS4) Permittees

MS4s may also discharge pollutants to waterbodies in response to storm events. To address stormwater discharges, EPA developed the NPDES stormwater permitting program in two phases. Phase 1, promulgated in 1990, addresses large and medium-size MS4s located in incorporated areas and counties with populations of 100,000 or more. Phase 2 permitting began in 2003.

Regulated Phase II MS4s are defined in Rule 62-624.800, F.A.C., and typically cover urbanized areas serving jurisdictions with a population of at least 10,000 or discharging into Class I or Class II waters, or into Outstanding Florida Waters (OFWs). In the Lake Talquin Watershed, the stormwater collection systems owned and operated by Leon County and the Florida Department of Transportation (FDOT) District 3 (NPDES MS4 Permit FLS000033) in Leon County are covered by a Phase I-C NPDES MS4 permit (**Figure 4.2** and **Table 4.2**). The MS4 area (highlighted in purple) is 66.8 square miles, or 16 % of the 419 square miles of the watershed located in Florida.

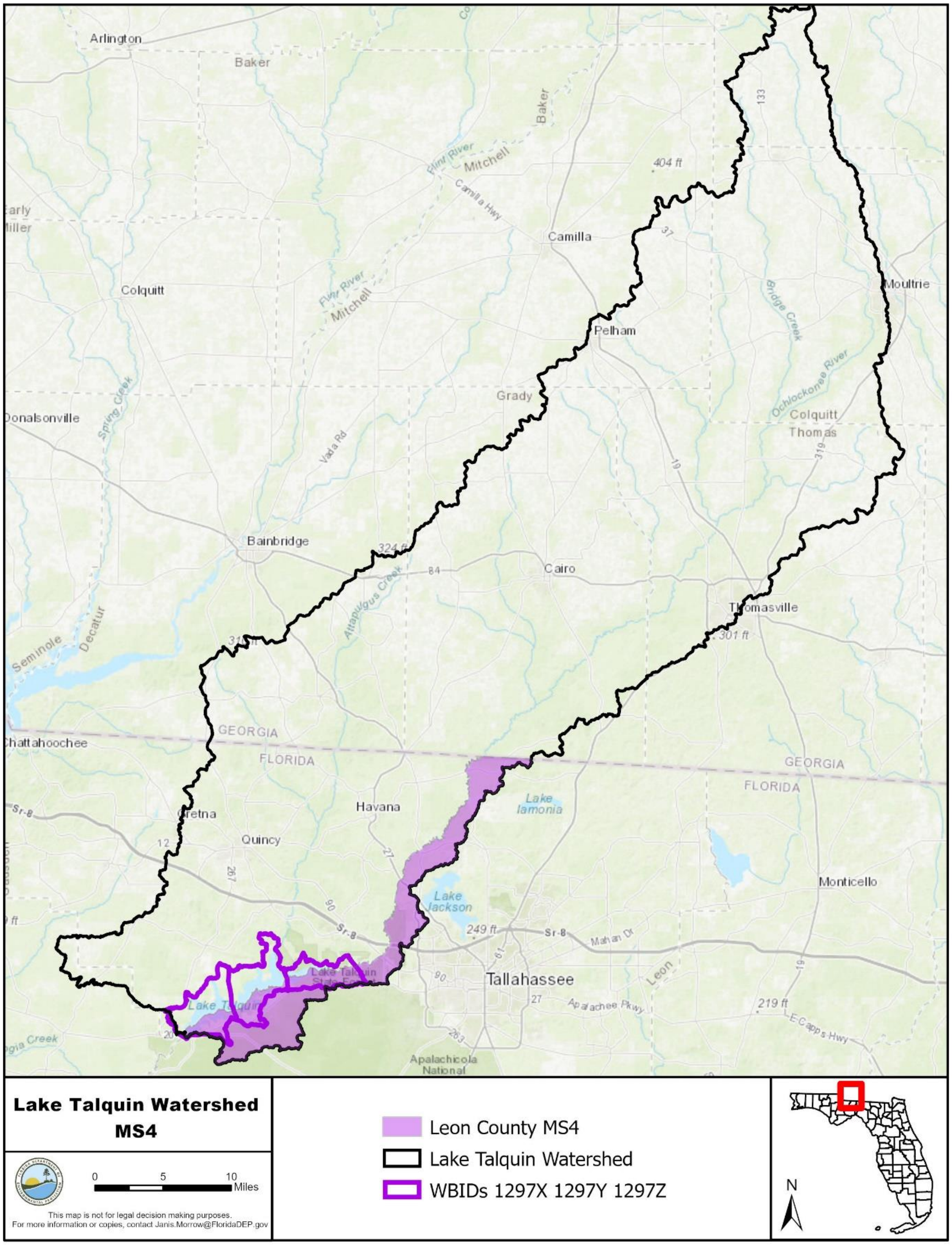

Figure 4.2. Location of MS4 permittees in the Lake Talquin Watershed

Table 4.2. NPDES MS4 permits with jurisdiction in the Lake Talquin Watershed

Permit Number	Permittee/Copermittees	Phase
FLS000033	Leon County	I

4.3 Nonpoint Sources

Pollutant sources that are not NPDES wastewater or stormwater dischargers are generally considered nonpoint sources. Nonpoint sources addressed in this analysis primarily include loadings from surface runoff, groundwater seepage entering the lake, and precipitation directly onto the lake surface (atmospheric deposition).

4.3.1 Land Uses

Land use is one of the most important factors in determining nutrient loadings from the Lake Talquin Watershed. Nutrients can be flushed into a receiving water through surface runoff and stormwater conveyance systems during stormwater events. Both anthropogenic (human influenced) use areas and natural land areas generate nutrients. However, anthropogenic uses typically generate more nutrient loads per unit of land surface area than natural lands can produce. **Table 4.3** lists land use in the entire watershed (both Florida and Georgia) in 2006, based on data from the National Land Cover Database (NLCD). **Figure 4.3** shows the information graphically.

Table 4.3. Lake Talquin Watershed land use, 2006

Land Use Code	Land Use	Acres	Square Miles	%
11	Water	13,629	21	1.4
21	Urban Built-Up	47,743	75	4.8
22	Low-Density Residential	14,205	22	1.4
23	Medium-Density Residential	2,442	4	0.2
24	High-Density Residential	1,200	2	0.1
31	Barren Land	1,663	3	0.2
41	Upland Forest	307,306	480	30.6
52	Rangeland	78,766	123	7.8
81	Agriculture	280,676	439	28.0
90	Wetlands	256,403	401	25.5
Total		**1,004,035**	**1,569**	**100**

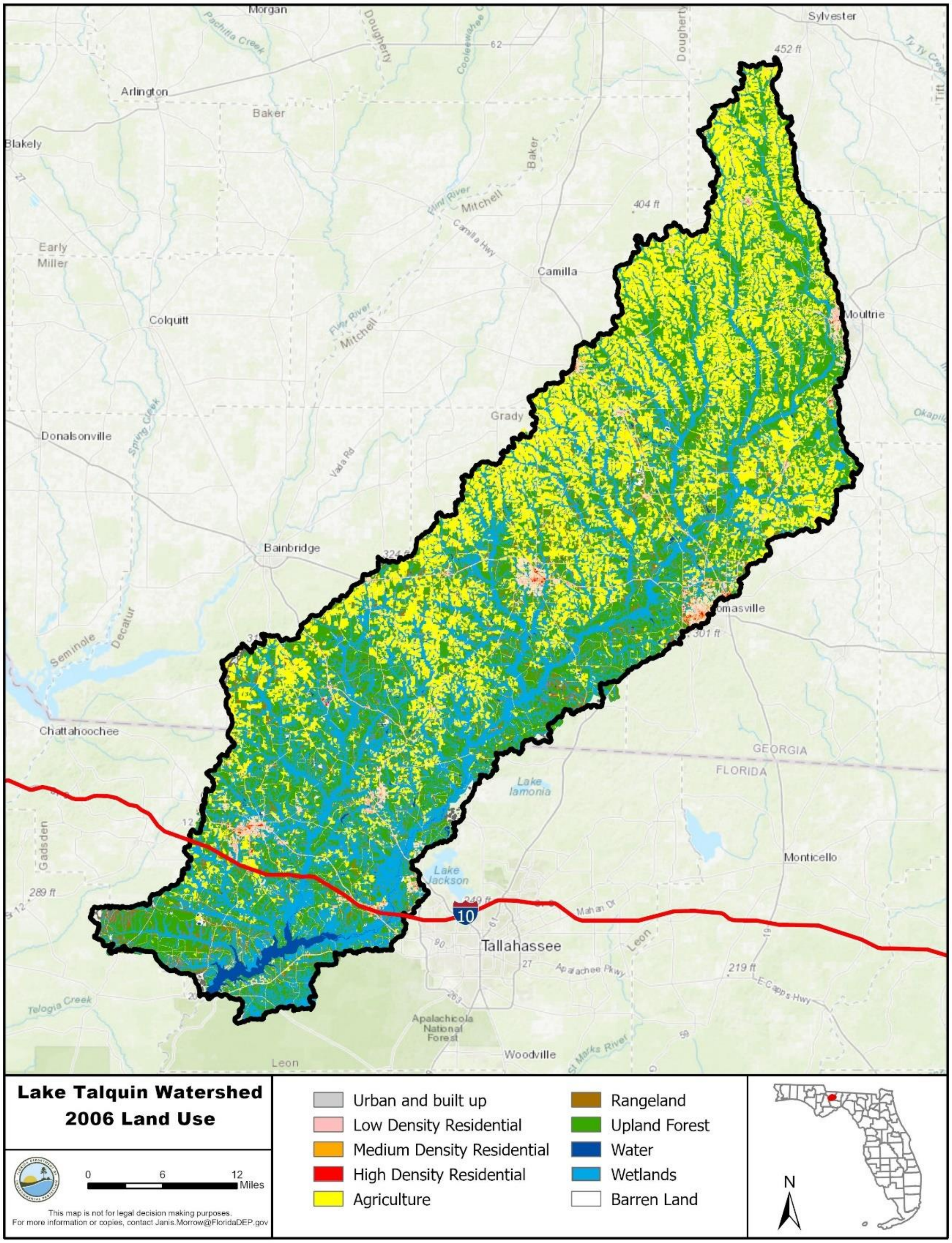

Figure 4.3. Land use in the Lake Talquin Watershed, 2006

4.3.2 Atmospheric Deposition

The National Atmospheric Deposition Program (NADP) National Trends Network (NTN) monitors precipitation chemistry at a network of 250 sites across the country. Ammonia and nitrate are among the constituents measured at these sites. The NADP Quincy (FL14) site, located in Gadsden County, has been operational since 1984. Precipitation-weighted mean annual concentrations for ammonium and nitrate from the Quincy NADP site were downloaded and used in the modeling.

Chapter 5: Determination of Assimilative Capacity

5.1 Determination of Loading Capacity

Nutrient enrichment and the resulting problems related to eutrophication tend to be widespread and are frequently manifested far (in both time and space) from their sources. Addressing eutrophication involves relating water quality and biological effects such as photosynthesis, decomposition, and nutrient recycling as acted on by environmental factors (rainfall, point source discharge, etc.) to the timing and magnitude of constituent loads supplied from various categories of pollution sources. Assimilative capacity should be related to some specific hydrometeorological condition during a selected period or to some range of expected variation in these conditions.

The goal of this TMDL analysis is to determine the maximum allowable TN and TP loadings from the watershed, so that Lake Talquin will meet the TMDL targets and thus maintain its function and designated uses as a Class III water.

5.2 Lake Talquin Model Set

The model set for Lake Talquin is comprised of a Loading Simulation Program C++ (LSPC) watershed model, an Environmental Fluid Dynamics Code Fortran (EFDC) hydrodynamic model and a Water Quality Analysis and Simulation Program (WASP) water quality model. This suite of models simulates loading from point and non-point sources in watershed using LSPC, which are transported within the rivers using WASP, and then transported within Lake Talquin using EFDC and WASP.

Nutrient loading from the Lake Talquin Watershed was modeled using mechanistic water quality models in order to capture the full range of processes affecting the fate and transport of nutrients between their source and Lake Talquin. A two-model combination, LSPC and WASP, was set up by EPA and used by DEP in order to represent the loading from point and nonpoint sources in the watershed.

5.2.1 Watershed LSPC Model

LSPC water quality model is widely used to predict loadings from non-point sources within a hydrologically connected watershed. This model is based on the algorithms in Hydrological Simulation Program - FORTRAN (HSPF), but it has been recoded into the C programming language and a modern interface and model input structure have been developed.

As with other watershed models, the main inputs driving the model are land use and precipitation. Given that the watershed covers two states, the Florida land use geographic information system (GIS) layers (Florida Land Use, Cover, and Forms Classification System [FLUCCS]) and Georgia land use trends (GLUT) were combined into a unified layer that represents the watershed.

The LSPC model is well calibrated to the observed flow and water quality data. Calibration information is available in the supplemental Lake Talquin EPA report (2020).

LSPC groups subwatersheds and represents the hydrology of these smaller subunits. Water delivered to streams is transported using the WASP model described below.

5.2.2 River WASP Models

WASP is a state-of-the-art model used for simulating water quality dynamics in streams, lakes, and estuaries. For one-dimensional flowing water segments, WASP can simulate both the transport and water quality of a connected network.

The WASP model was set up in order to predict the fate and transport of nutrients from both point and nonpoint sources in the Ochlocknee and Little River tributary systems and the simulation of lake water quality dynamics. A detailed description of the model setup is available in the supplementary *Lake Talquin Modeling Report* developed by EPA Region 4 (2020).

5.2.3 Lake EFDC Model

The EFDC model is a hydrodynamic model that can simulate complex mixing in lakes and estuaries. It is typically set up with a three-dimensional grid in order to simulate complex transport patterns in lakes and estuaries. The model calculates the transfer and conservation of mass, momentum, and energy within and between cells.

EFDC is being used to simulate the mixing and transport within Lake Talquin. The calibrated EFDC Model is used by the WASP model during the simulation of water quality in Lake Talquin. EFDC uses data on flow from the Ochlockonee River, Little River, small tributaries, rainfall, evapotranspiration, and flow out of the lake as inputs. Using these inputs, EFDC is used to calculate the transport within Lake Talquin. In order to maintain mass balance between the three USGS gauges, a flow correction was applied using the Fortran program provided by EPA. Further details regarding the setup of EFDC and the flow balance approach can be found in the EPA Lake Talquin modeling report EPA (2020).

The EFDC Model setup for Lake Talquin consists of a three-dimensional grid setup encompassing the lower, middle, and upper portions of Lake Talquin. The EFDC Model is well calibrated to the observed lake surface elevation (see **Figure 5.1** and **Table 5.1**). The full details of the EFDC model setup and calibration can be found in the EPA Lake Talquin modeling report (2020).

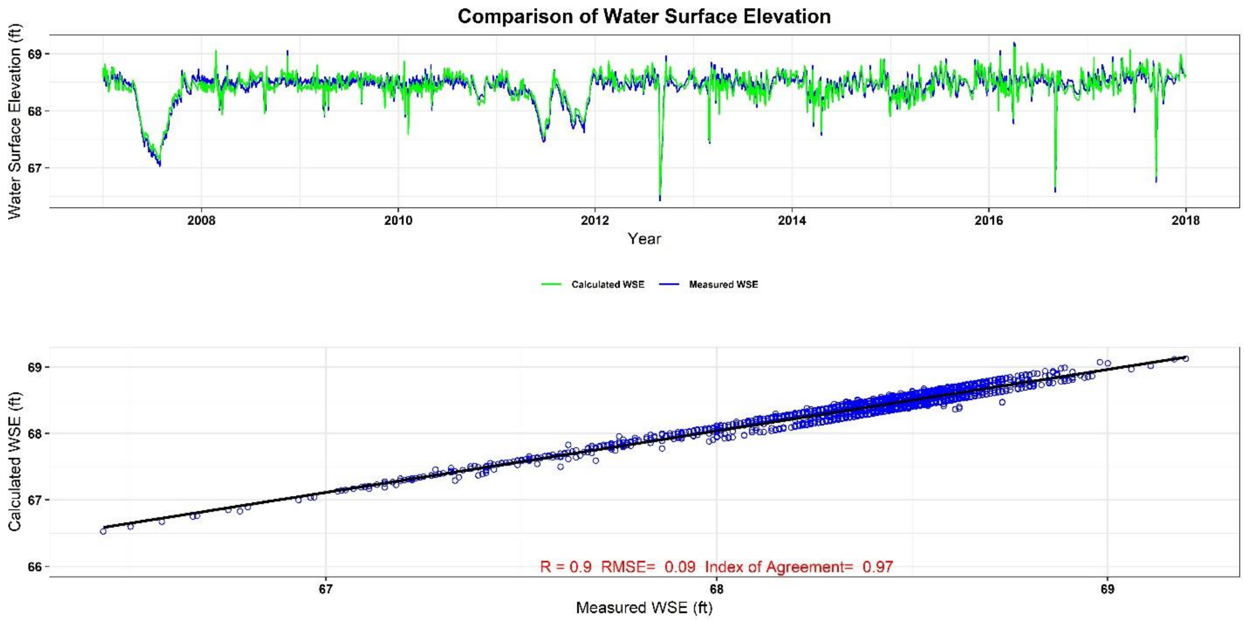

Figure 5.1. Lake surface elevation calibration in EFDC

Table 5.1. Model fit statistics for the measured and simulated lake water level

Statistic	USGS Lake Talquin Dam Pool	Average
Number of observations	3,636	3,636
Observed mean	20.86	20.86
Simulation mean	20.87	20.87
Mean error	0.01	0.01
Mean absolute error	0.04	0.04
Root mean square error (RMSE)	0.05	0.05
Coefficient of determination (R^2)	0.63	0.63
Spearman coefficient	0.70	0.70
Percent bias (PBias)	0.00	0.00
Nash	0.52	0.52
Index of agreement	0.88	0.88

5.2.4 Lake WASP Model

For three-dimensional systems, WASP relies on EFDC to calculate the hydrodynamic transport through the flow grid. WASP can use a range of different water quality algorithms, the most sophisticated of which is the Advanced Eutrophication Module.

WASP has been set up as the receiving water quality model for both Lake Talquin and its major tributaries (Ochlockonee River and Little River). The Advanced Eutrophication Module of WASP was used for Lake Talquin. A three-dimensional EFDC grid was developed for the lake to provide necessary hydrodynamic inputs to WASP. Loadings from the LSPC watershed model and the WASP tributary models were the primary inputs to the Lake Talquin WASP model. The full details of the WASP lake and tributary models, including setup and calibration, are provided in the EPA modeling report (2020).

Figures 5.2, 5.3, and **5.4** show examples of lake calibration results for TN, TP, and chlorophyll *a*, respectively, as documented by EPA (2020). As the three graphs demonstrate, the WASP model for Lake Talquin is well calibrated for TP, TN, and chlorophyll *a*. The grid numerical results for the EFDC and WASP models are postprocessed in zones that correspond to the boundaries of the three WBIDs comprising Lake Talquin (**Figure 5.5**).

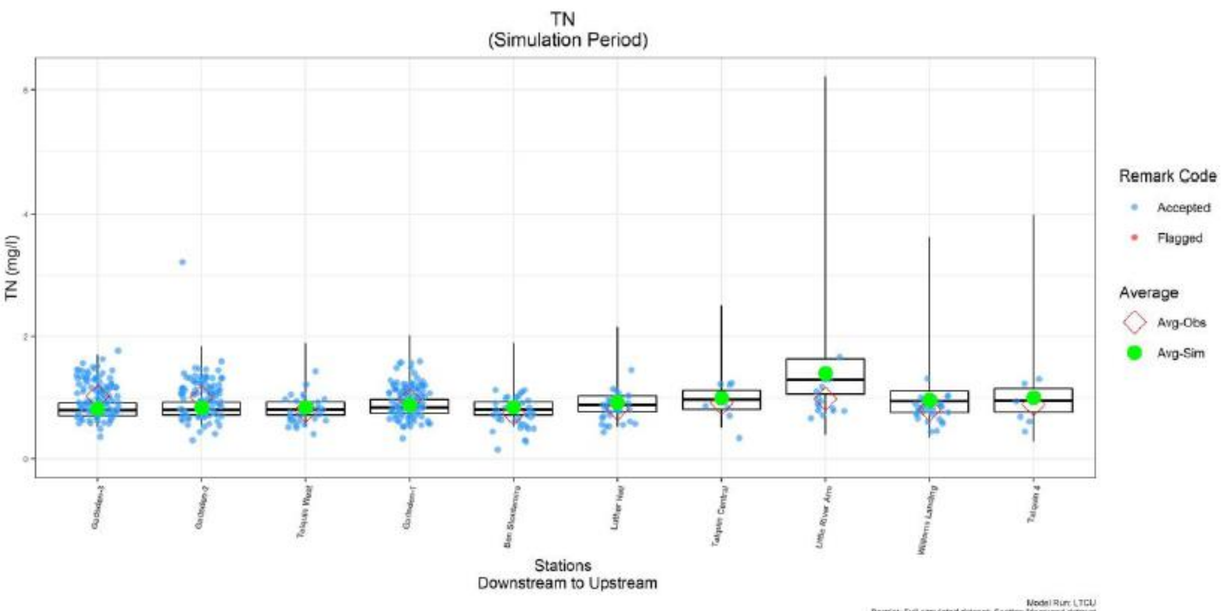

Figure 5.2. Lake Talquin TN calibration

5.2.5 Model Review and Acceptance

The Lake Talquin model set was used to derive the current Lake Talquin TMDLs were set up by EPA Region 4 in 2017. The models were thoroughly reviewed by stakeholders from 2018 to 2021; many updates and adjustments were made and documented in the EPA model report; and a final model set was presented to the stakeholder group at a public meeting on March 31, 2021. DEP has not received any significant comments regarding the final model set for Lake Talquin. The final model set was thoroughly reviewed and vetted by DEP and Georgia Environmental Protection Division and was found to be a well-calibrated model set for use in TMDL development and wasteload allocation derivation.

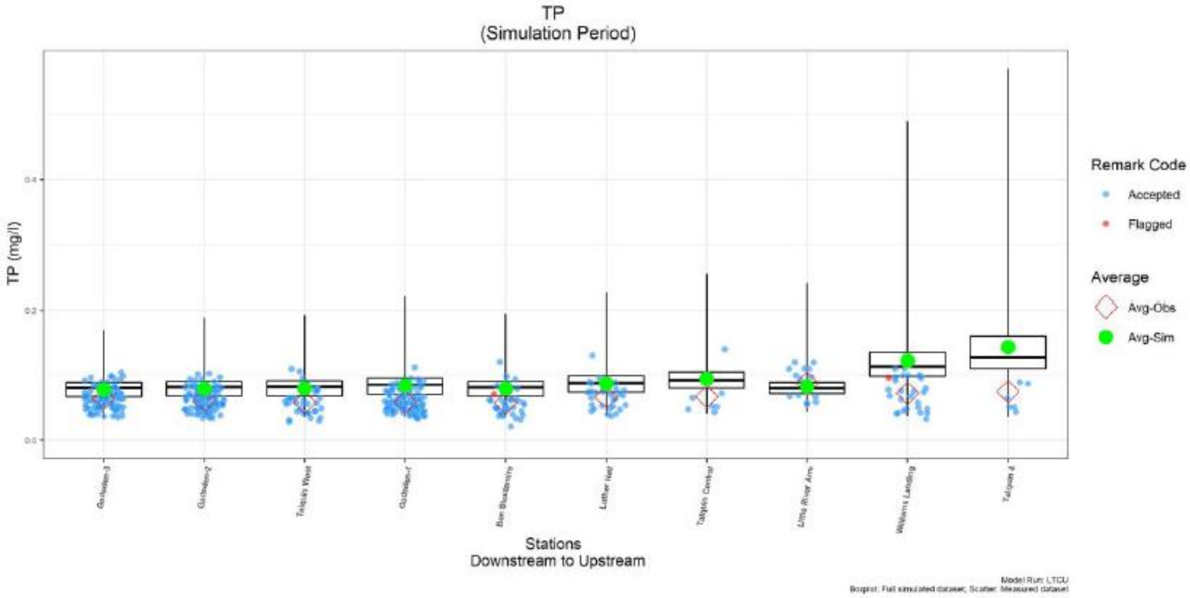

Figure 5.3. Lake Talquin TP calibration

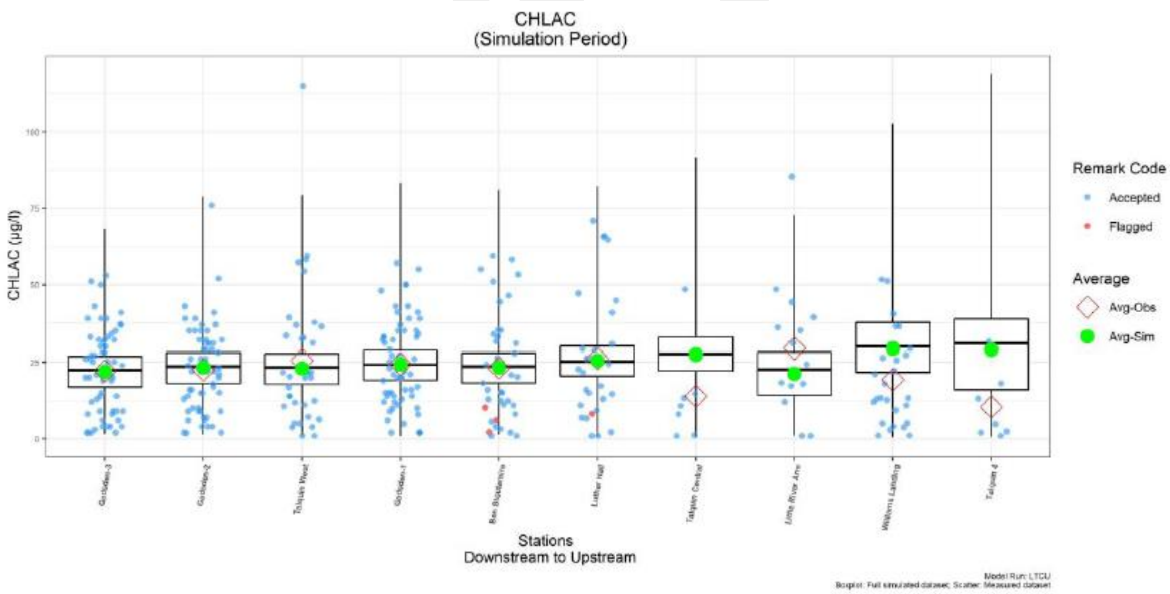

Figure 5.4. Lake Talquin chlorophyll *a* calibration

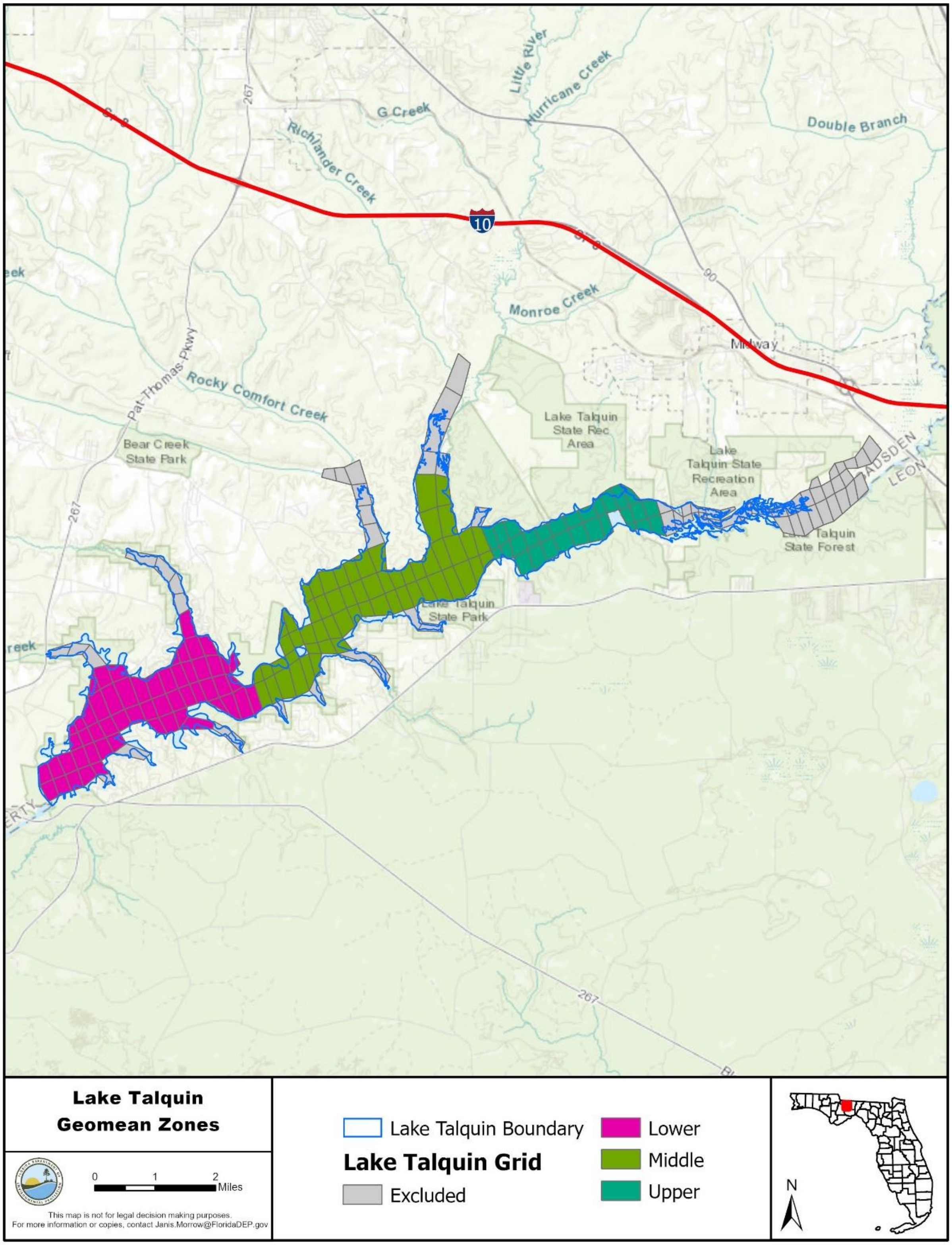

Figure 5.5. Lake Talquin model evaluation zones

5.3 Critical Conditions and Seasonal Variation

Algal growth in Lake Talquin follows a seasonal pattern and is highest in late spring and early fall (**Figure 5.6**). This pattern is driven primarily by changes in residence time over the year, with the dry months of late spring having the longest residence time, while the higher flows in the summer rainy season reduce residence time, limiting algal growth. The pattern of a chlorophyll peak in late spring, which is apparent in Lake Talquin, is also commonly observed in lakes across Florida.

Lake Talquin is sensitive to dry conditions, and water quality is worse in years with lower precipitation and therefore lower overall flow (**Figure 5.7**). The models for Lake Talquin are set up on a long-term basis and are designed to protect the lake in all flow conditions. Nutrient sources generally cannot modulate loadings in response to hydrology, and thus reductions in the overall loading rate from anthropogenic sources are necessary in order to protect Lake Talquin in all years.

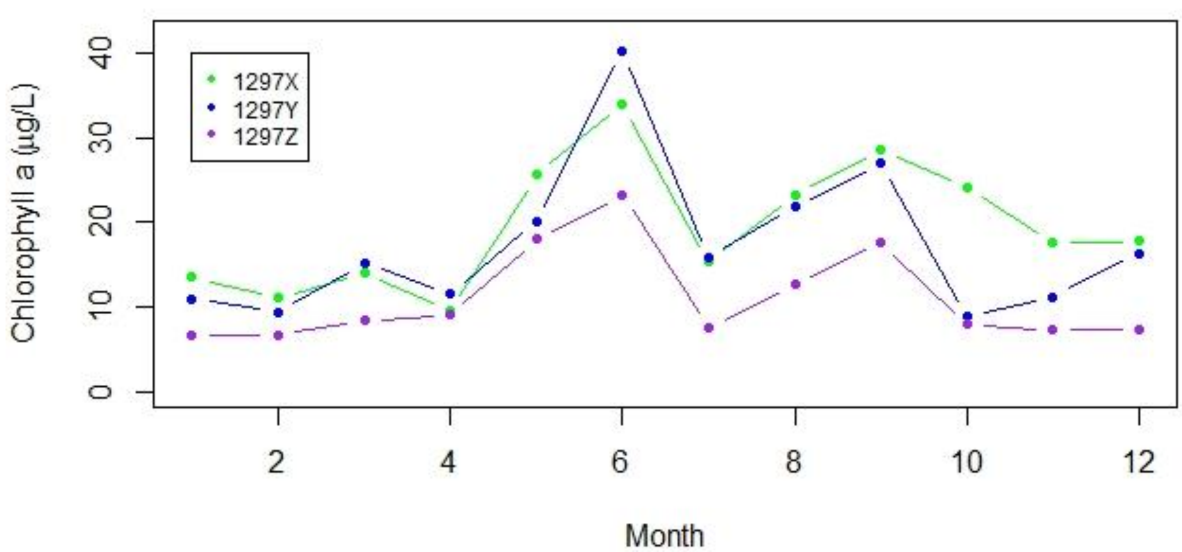

Figure 5.6. Monthly chlorophyll data in the Lake Talquin WBIDs

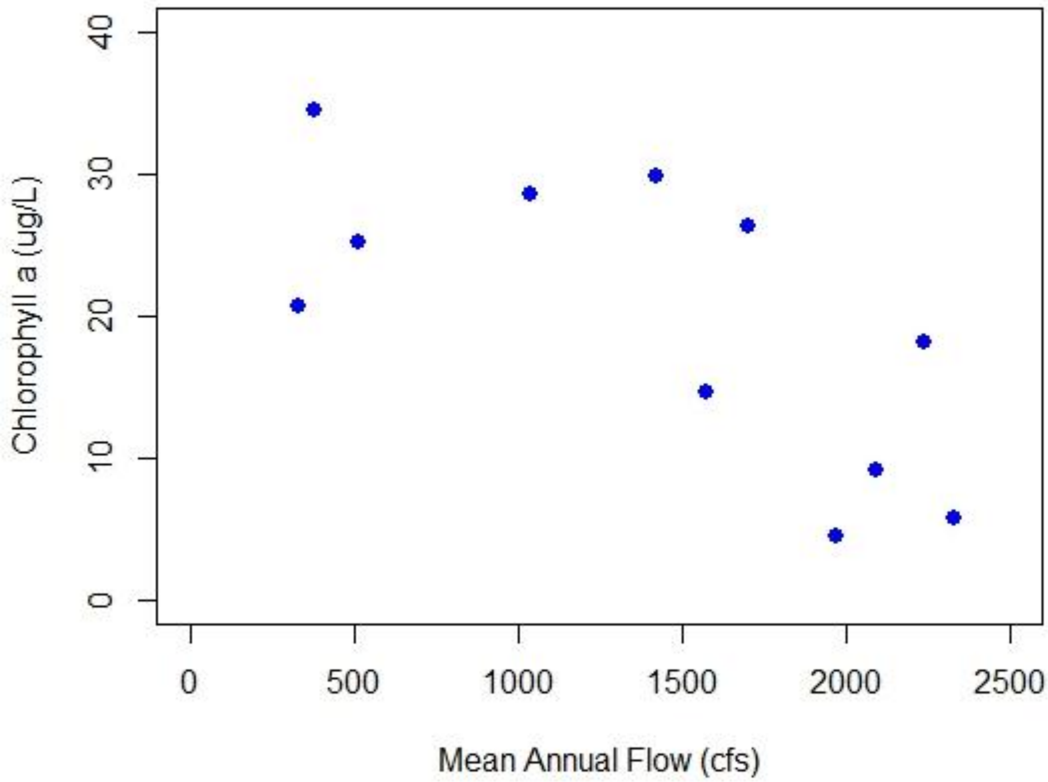

Figure 5.7. AGM chlorophyll *a* in the Lower Lake Talquin WBID plotted as a function of mean annual flow at the Bloxom Cutoff Road USGS station (2008–18)

5.4 Water Quality Targets for Model Scenarios

To protect Lake Talquin, DEP used end points for modeling that would protect water quality under all conditions. The TMDL reduction scenario was developed in order to achieve a maximum AGM chlorophyll *a* concentration of 20.0 µg/L[1] in each of the three Lake Talquin WBIDs. Chlorophyll *a* concentrations vary among the three WBIDs and therefore the reductions specified in the TMDLs will be driven by the WBID with the highest concentrations.

It is therefore expected that the two WBIDs that did not drive the overall reductions will be able to achieve chlorophyll *a* concentrations below the TMDL target. Setting the chlorophyll target with no exceedances ensures that the resulting reductions in TN and TP will cause the lake to meet the generally applicable lake criteria in all years by limiting primary productivity. Setting TMDL scenarios to the magnitude of the applicable NNC without any allowed exceedances is a

[1] This approach to setting the chlorophyll end point was used in the following Florida TMDLs: Bear Gulley Lake, Bethel Lake, Lake Adair, Lake Agnes, Lake McLeod, Lake Searcy, Lake Gem, Lake Persimmon, Lake Roberts, and Lake Tallavana.

standard modeling practice used by DEP that introduces a margin of safety into the calculation of the TMDLs.

EPA created a background model run to verify that the selected targets were not below natural background conditions. This scenario was created by removing all anthropogenic point sources and changing anthropogenic landuses in LSPC back to natural. The resulting scenario was run to determine the pre-disturbance water quality conditions within Lake Talquin. See the Lake Talquin Modeling report for more details regarding this scenario.

5.5. Wasteload Allocations for Florida Facilities

5.5.1 Quincy WWTF

The Quincy WWTF, an advanced wastewater facility located north of Tallahassee, is the only NPDES discharger in the Lake Talquin Watershed operating with tertiary level treatment, also referred to as advanced wastewater treatment (AWT). Other NPDES facilities are operating with a lower standard of treatment and correspondingly higher nutrient concentrations in their discharge to surface waters.

5.5.2 Arvah B. Hopkins Generating Station

The Arvah B. Hopkins generating station is a natural gas powerplant that powers the City of Tallahassee. The facility discharges cooling water to Beaver Creek, which flows into the upper portion of Lake Talquin. From the point of discharge, Beaver Creek runs two miles, passing through two large wetland areas, before reaching the ponded portion of the Ochlockonee River floodplain. This area of the floodplain is impacted by backwater effects from Lake Talquin, and the flow path through much of the floodplain is permanently flooded.

In the current modeling, the power plant discharge nutrient load is input directly into the Lake Talquin WASP model as a worst-case scenario. Data analysis from the sampling of Beaver Creek indicates that in reality, significant phosphorus assimilation is taking place between the point of discharge and the confluence with the Ochlocknee River (Memo from the City of Tallahasseee, June 18, 2020). Not taking this real-world phosphorus assimilation into account overestimates the impact of the powerplant discharge on the lake. Even so, the analysis of measured data from the effluent and Beaver Creek and modeling results indicate that the discharge has the potential to contribute to only a small increase in phytoplankton growth in the impaired lake.

5.5.3 Final Wasteload Allocations

When setting the permit limit for both Florida facilities, the goal is to hold the line at the current discharge limits. Therefore, the 95th percentile of the current discharge flow and the 95th percentile of the measured nutrient concentrations in the effluent were established as the wasteload allocation.

Table 5.2. Wasteload allocation for Florida facilities

Facility	Flow (mgd)	TN (kg/day)	TP (kg/day)
Arvah B. Hopkins	1.80	2.70	6.60
Quincy	1.2	13	4

The final wasteload allocation for the Quincy WWTF is a maximum flow rate of 1.2 million gallons per day (mgd), a maximum TN loading of 13 kilograms per day (kg/day), and a maximum TP loading of 4 kg/day (Table 5.2).

The final wasteload allocation for the Hopkins WWTF is a maximum flow rate of 1.80 million gallons per day (mgd), a maximum TN loading of 2.70 kilograms per day (kg/day), and a maximum TP loading of 6.6 kg/day (Table 5.2).

5.6 Calculation of the TMDLs

In order to generate the TMDL model scenario, loadings to Lake Talquin were reduced until the chlorophyll *a* target of 20.0 µg/L was achieved in every year in each of the three lake zones. The model simulation run used to derive the Lake Talquin TMDL was created by EPA. As a first step, the wasteload allocation given above for the Quincy WWTP was entered in place of the current measured discharge into the Little River WASP model, and the wasteload allocation given above for the Hopkins facility was included in the Lake Talquin WASP model. During the second step, inputs into Lake Talquin from the River WASP models and the direct LSPC basins were reduced at the pour points to the lake. When making reductions to the tributaries, equivalent reductions were made in the anthropogenic loading in order to fairly distribute the reductions. This approach ensures that no individual contributing basin is reduced below the background conditions when deriving the TMDL scenario.

The controlling zones in the lake are the middle and upper portions of Lake Talquin. These areas currently experience the highest primary productivity and therefore require the greatest nutrient reductions to meet the chlorophyll *a* target. The TMDL is based on the loading reduction scenario in which all three zones of the lake meet the TMDL target.

In the derived TMDL scenario, the chlorophyll *a* never exceeds an AGM concentration of 19.3 µg/L in the upper segment, 20.0 µg/L in the middle segment, and 17.5 µg/L in the lower segment (**Table 5.3, Table 5.4,** and **Figure 5.8**). For TP, the upper segment never exceeds an AGM concentration of 0.084 mg/L, the middle segment never exceeds an AGM of 0.070 mg/L, and the lower segment never exceeds an AGM of 0.062 mg/L (**Table 5.3, Table 5.4**, and **Figure 5.8**).

For TN, the upper segment will never exceed an AGM concentration of 0.81 mg/L, the middle segment never exceeds an AGM of 0.84 mg/L, and the lower segment never exceeds an AGM of 0.73 mg/L (**Table 5.3** and **Table 5.4**).

Table 5.3. Lake Talquin maximum AGM concentrations modeled under the TMDL condition

Analyte	Lower Zone (WBID 1297X)	Middle Zone (WBID 1297Y)	Upper Zone (WBID 1297Z)
TN (mg/L)	0.73	0.84	0.81
TP (mg/L)	0.062	0.070	0.084
Chlorophyll *a* (ug/L)	17.5	20.0	19.3

Table 5.4. Lake Talquin AGM concentrations modeled under the TMDL condition

Lower Zone (WBID 1297X)

Year	TN (mg/L)	TP (mg/L)	Chlorophyll *a* (ug/L)
2008	0.67	0.059	16.6
2009	0.65	0.062	17.4
2010	0.61	0.058	15.1
2011	0.62	0.046	14.4
2012	0.65	0.043	13.2
2013	0.67	0.061	17.2
2014	0.73	0.062	17.5
2015	0.70	0.056	17.0
2016	0.69	0.059	17.3
2017	0.71	0.058	17.4

Middle Zone (WBID 1297Y)

Year	TN (mg/L)	TP (mg/L)	Chlorophyll *a* (ug/L)
2008	0.74	0.068	17.1
2009	0.74	0.070	19.0
2010	0.70	0.063	13.7
2011	0.78	0.052	15.7
2012	0.78	0.051	15.9
2013	0.80	0.069	18.4
2014	0.82	0.069	15.3
2015	0.84	0.062	16.5
2016	0.78	0.069	19.2
2017	0.78	0.067	20.0

Upper Zone (WBID 1297Z)

Year	TN (mg/L)	TP (mg/L)	Chlorophyll *a* (ug/L)
2008	0.71	0.080	13.3
2009	0.70	0.084	16.9
2010	0.74	0.076	11.4
2011	0.81	0.065	15.5
2012	0.78	0.065	19.3
2013	0.69	0.084	14.5
2014	0.67	0.083	10.4
2015	0.76	0.075	13.5
2016	0.69	0.082	13.9
2017	0.68	0.082	18.4

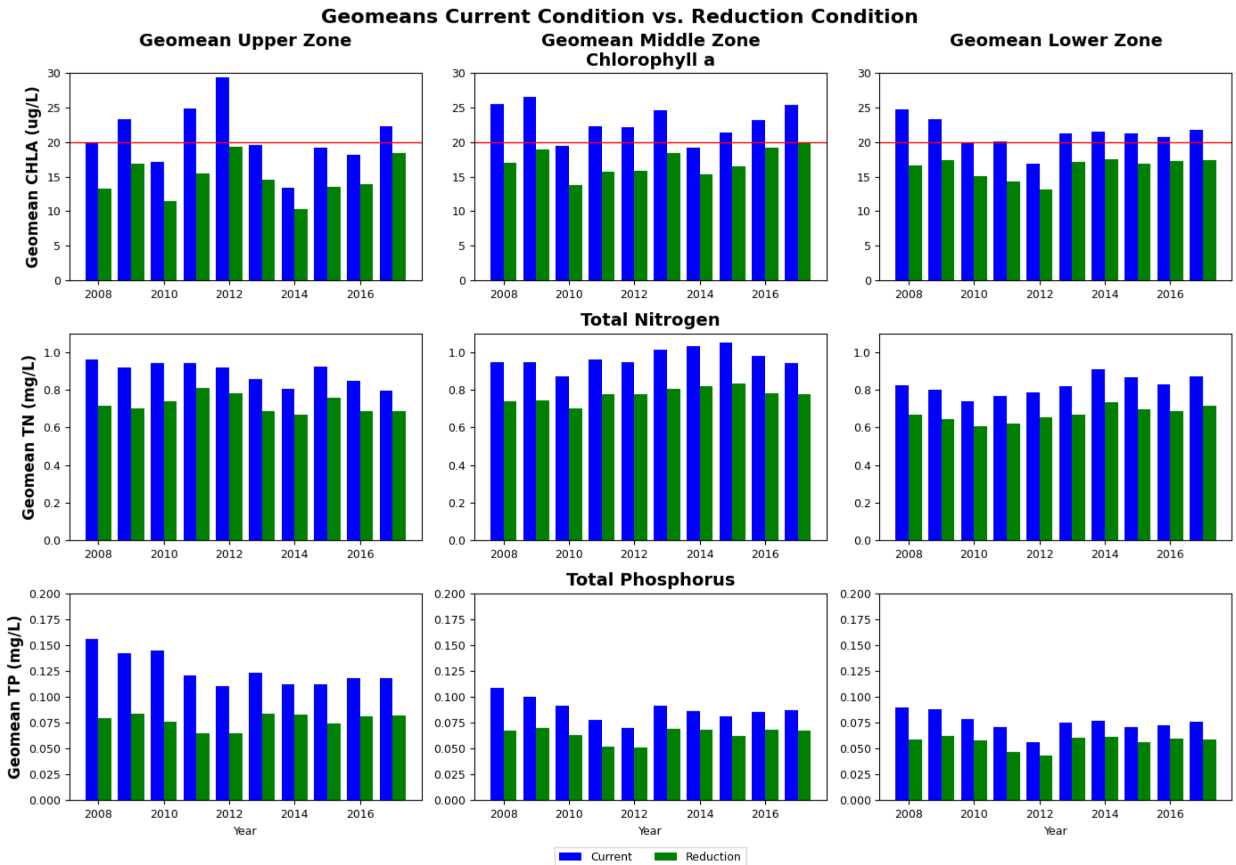

Figure 5.8. Annual geometric mean TN, TP, and chlorophyll *a* in Lake Talquin

The TMDL scenario calls for a 19 % reduction in the TN loads and a 21 % reduction in the TP loads from the watershed. Nutrient reductions need to be achieved in all years for all contributing tributaries. The Ochlockonee River system is the largest source of nutrients to Lake Talquin and correspondingly requires the largest reduction of phosphorus (27 % reduction) (**Figure 5.9, Figure 5.10** and **Table 5.5**). The Little River system contributes much more nitrogen than phosphorus to Lake Talquin and correspondingly needs to achieve the largest percent reduction of nitrogen (21 % reduction) (**Figure 5.9, Figure 5.10,** and **Table 5.5**,). Only minor reductions need to be made in the smaller tributaries directly draining to Lake Talquin (**Figure 5.9**, **Figure 5.10**, and **Table 5.5**), given that a majority of the land in these watersheds is already protected in various parks and preserves.

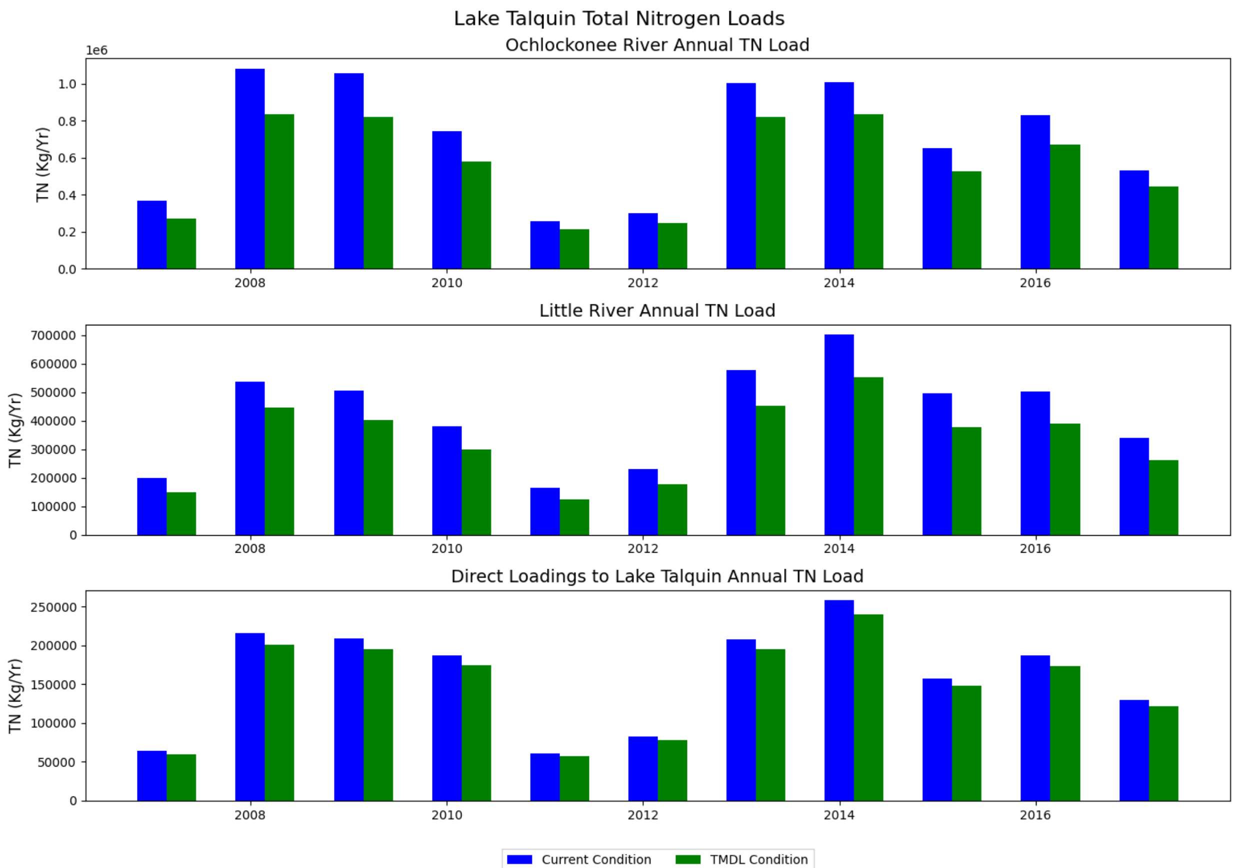

Figure 5.9. Modeled TN loads under the current condition scenario and TMDL scenario

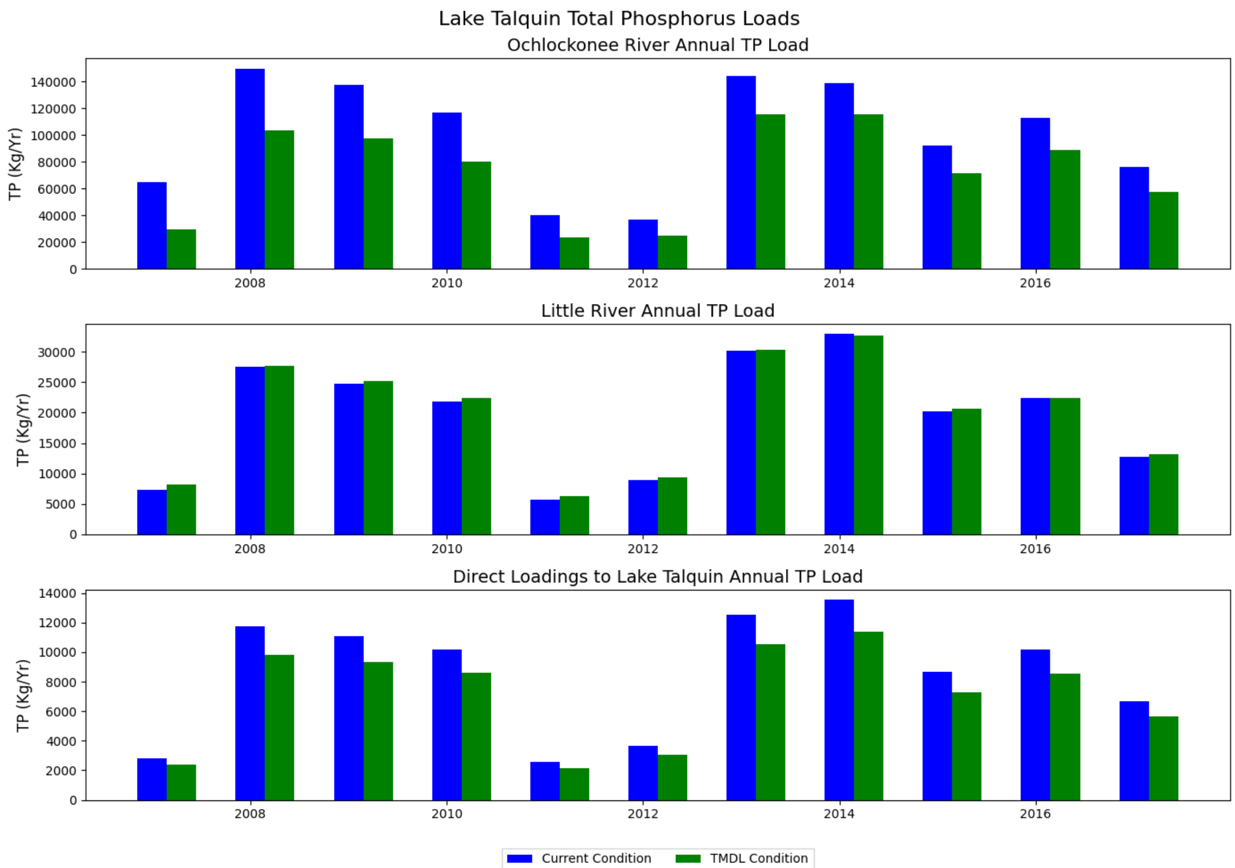

Figure 5.10. Modeled TP loads under the current condition scenario and TMDL scenario

Table 5.5. Lake Talquin current and TMDL condition nutrient loads, 2008–17

kg/yr = Kilograms per year

Basin Name	Model Basin Name	Current TN (kg/yr)	Current TP (kg/yr)	TN TMDL (kg/yr)	TP TMDL (kg/yr)	% TN Reduction	% TP Reduction
Ochlockonee River	Ochlockonee River	778404	109224	620706	80033	20%	27%
Little River	Little River	442812	21695	350481	22051	21%	0%
Runoff Little River Area	LSPC 60168	3595	67	3559	65	1%	3%
Rock/Comfort Creek	LSPC60114	37548	3380	31165	2468	17%	27%
Ocklawaha	LSPC 60127	21982	1904	20223	1619	8%	15%
Hammock Creek	LSPC 60166	8053	562	7489	562	7%	0%
Freeman	LSPC 60128	16055	599	15412	533	4%	11%
Harvey	LSPC 60126	32429	1086	31456	989	3%	9%
Polk	LSPC 60169	10444	325	10235	296	2%	9%
Runoff from Upper	LSPC 60125	31085	1089	30464	1013	2%	7%
Runoff from Lower	LSPC 60167	13066	319	12674	291	3%	9%

Chapter 6: Determination of Loading Allocations

6.1 Expression and Allocation of the TMDL

The objective of a TMDL is to provide a basis for allocating loads to all the known pollutant sources in a watershed so that appropriate control measures can be implemented and water quality standards achieved. A TMDL is expressed as the sum of all point source loads (wasteload allocations, or WLAs), nonpoint source loads (load allocations, or LAs), and an appropriate margin of safety (MOS), which accounts for uncertainty in the relationship between effluent limitations and water quality:

$$\mathbf{TMDL = \sum WLAs + \sum LAs + MOS}$$

As discussed earlier, the WLA is broken out into separate subcategories for wastewater discharges and stormwater discharges regulated under the NPDES Program:

$$\mathbf{TMDL \cong \sum WLAs_{wastewater} + \sum WLAs_{NPDES\ Stormwater} + \sum LAs + MOS}$$

It should be noted that the various components of the revised TMDL equation may not sum up to the value of the TMDL because (1) the WLA for NPDES stormwater is typically based on the percent reduction needed for nonpoint sources and is also accounted for within the LA, and (2) TMDL components can be expressed in different terms (for example, the WLA for stormwater is typically expressed as a percent reduction, and the WLA for wastewater is typically expressed as mass per day).

WLAs for stormwater discharges are typically expressed as percent reduction because it is very difficult to quantify the loads from MS4s (given the numerous discharge points) and to distinguish loads from MS4s from other nonpoint sources (given the nature of stormwater transport). The permitting of stormwater discharges also differs from the permitting of most wastewater point sources. Because stormwater discharges cannot be centrally collected, monitored, and treated, they are not subject to the same types of effluent limitations as wastewater facilities, and instead are required to meet a performance standard of providing treatment to the maximum extent practical through the implementation of best management practices (BMPs).

This approach is consistent with federal regulations (40 Code of Federal Regulations [CFR] § 130.2[I]), which state that TMDLs can be expressed in terms of mass per time (e.g., pounds per day), toxicity, or other appropriate measure.

The TMDLs for Lake Talquin are expressed in terms of kg/yr and percent reduction of TN and TP and represent the loads of TN and TP that the waterbody can assimilate while maintaining a balanced aquatic flora and fauna (see **Table 6.1**). These TMDLs are based on an evaluation of model scenarios from 2008 to 2017. The department often derives load based TMDLs that are calculated as 7-year average of annual total loads to be compatible with Florida's assessment period and to cover the wet-dry meteorological cycles. The highest 7-year average was selected, with the chosen period running from 2008 - 2014. The restoration goal is to achieve the generally applicable chlorophyll a criterion of 20 µg/L, which is expressed as an AGM not to be exceeded more than once in any consecutive 3-year period, meeting water quality criteria, and thus protecting Lake Talquin's designated uses.

Table 6.1 lists the TMDLs for the Lake Talquin Watershed. The TMDLs will constitute the site-specific numeric interpretations of the narrative nutrient criterion set forth in Paragraph 62-302.530(48)(b), F.A.C., that will replace the otherwise applicable NNC in Subsection 62-302.531(2), F.A.C., for Lake Talquin.

Table 6.1. TMDL components for nutrients in Lake Talquin (WBIDs 1297X, 1297Y, and 1297Z)

Note: The LA and TMDL daily load for TN is 3,107 kg/day, and for TP 308 kg/day.
* The required percent reductions listed in this table represent the reduction from all sources.
[W] The WLA is shown for the combined Florida NPDES discharges. Georgia NPDES loads are included in the LA.

Waterbody	Parameter	TMDL (kg/yr)	WLA Wastewater (kg/yr)[W]	WLA NPDES Stormwater (% reduction)*	LA (% reduction)*	MOS
Lake Talquin	TN	1,134,850	5,731	19%	19%	Implicit
Lake Talquin	TP	112,326	3,869	21%	21%	Implicit

6.2 Load Allocation

To achieve the load allocation (LA), a 19 % and 21% reduction in current TN and TP loads, respectively, will be required.

The TMDLs are based on the percent reduction in the total watershed load. It is not DEP's intent to abate natural conditions. The LA includes loading from stormwater discharges regulated by DEP and the water management districts that are not part of the NPDES stormwater program (see **Appendix A**). Loads from NPDES facilities in Georgia are included in the LA since FDEP is not providing wasteload allocations for NPDES Facilities located in Georgia. Effluent limits to Georgia facilities will need to be calculated by Georgia Environmental Protection Division and they will demonstrate protection of Lake Talquin. These allocations will be finalized in the facility NPDES permits. The actual percent reductions may differ from the LA reductions depending on the nature of the facility's discharge and the nutrient attenuation occurring between the discharge and the lake.

6.3 Wasteload Allocation

6.3.1 NPDES Wastewater Discharges

As noted in **Chapter 4**, there are two NPDES-permitted facilities (Alvah B. Hopkins Power Plant and Quincy WWTF) that discharge into the Florida portion of the Lake Talquin Watershed.

Based on an EPA memorandum (2006), daily loads of TN and TP from point sources should be calculated. In this TMDL report, daily WLAs for Florida facilities with whole-year daily discharge were calculated as annual loads divided by 365 days (**Table 6.2**). It should be noted that the daily loads presented in this report are for informational purposes only. The implementation of the TMDLs and WLAs will be based on an annual load.

Table 6.2. Wasteload allocations for Florida NPDES dischargers

Facility	Flow (mgd)	TN (kg/day)	TP (kg/day)
Alvah B. Hopkins	1.80	2.70	6.60
Quincy	1.2	13	4

6.3.2 NPDES Stormwater Discharges

Leon County is the sole MS4 permittee in the Florida portion of the Lake Talquin Watershed. Areas within the county's jurisdiction in the watershed are responsible for reducing anthropogenic loadings in order to achieve the overall TMDLs. The majority of the watershed covered by the Leon County MS4 permit comprises natural lands in Apalachicola National Forest, Lake Talquin State Forest, Lake Talquin State Park, and Ochlockonee River Wildlife Management Area.

The intent of this TMDL is not to reductions below natural background conditions. It should be noted that any MS4 permittee is only responsible for reducing the anthropogenic loads associated with stormwater outfalls that it owns or otherwise has responsible control over, and it is not responsible for reducing other nonpoint source loads in its jurisdiction.

6.4 Margin of Safety (MOS)

The MOS is a required component of a TMDL and accounts for the uncertainty about the relationship between pollutant loads and the quality of the receiving waterbody (CWA, Section 303[d][1][c]). The MOS can either be implicitly accounted for by choosing conservative assumptions about loading or water quality response, or explicitly accounted for during the allocation of loadings. Consistent with the recommendations of the Allocation Technical Advisory Committee (DEP 2001), an implicit MOS was used in the development of these TMDLs. Considerable uncertainty is usually inherent in estimating nutrient loading from nonpoint sources, as well as in predicting water quality response. The effectiveness of management activities (e.g., stormwater management plans) in reducing loading is also subject to uncertainty.

The primary MOS in the Lake Talquin TMDL derivation is the use of the TMDL target set to the magnitude of the chlorophyll *a* NNC of 20.0 µg/L as a model-derived AGM, with a never-to-exceed frequency. Given that the criterion allows one exceedance in a 3-year period, this expression gives reasonable assurance that the selected TN and TP reductions will achieve the generally applicable chlorophyll *a* criterion under all hydrologic conditions.

Chapter 7: Implementation Plan Development and Beyond

7.1 Implementation Mechanisms

Following the adoption of a TMDL, implementation takes place through various measures. The implementation of TMDLs may occur through specific requirements in NPDES wastewater and MS4 permits, and, as appropriate, through local or regional water quality initiatives or basin management action plans (BMAPs).

Facilities with NPDES permits that discharge to the TMDL waterbody must respond to the permit conditions that reflect target concentrations, reductions, or wasteload allocations identified in the TMDL. NPDES permits are required for Phase I and Phase II MS4s as well as domestic and industrial wastewater facilities. MS4 Phase I permits require a permit holder to prioritize and act to address a TMDL unless management actions to achieve that particular TMDL are already defined in a BMAP. MS4 Phase II permit holders must also implement the responsibilities defined in a BMAP or other form of restoration plan (e.g., a reasonable assurance plan).

7.2 BMAPs

Information concerning the development and implementation of BMAPs is found in Section 403.067, F.S. (the FWRA). DEP or a local entity may initiate and develop a BMAP that addresses some or all of the contributing areas to the TMDL waterbody. BMAPs are adopted by the DEP Secretary and are legally enforceable.

BMAPs describe the fair and equitable allocations of pollution reduction responsibilities to the sources in the watershed, as well as the management strategies that will be implemented to meet those responsibilities, funding strategies, mechanisms to track progress, and water quality monitoring. Local entities usually implement these strategies, such as wastewater facilities, industrial sources, agricultural producers, county and city stormwater systems, military bases, water control districts, state agencies, and individual property owners. BMAPs can also identify mechanisms to address potential pollutant loading from future growth and development.

The entire Florida portion of the Lake Talquin Watershed lies within the Upper Wakulla River and Wakulla Springs BMAP area. While this BMAP is intended primarily to protect groundwater resources that affect the Upper Wakulla River and Wakulla Springs, the restoration projects and management strategies from the BMAP are anticipated to benefit other surface waters in the BMAP area as well. Primarily, Florida agricultural producers are required to implement BMPs in BMAP areas (or conduct extensive water quality monitoring to demonstrate that the agricultural activity is not contributing to exceedances of water quality standards). When implemented, these BMPs will lower nutrient exports to both surface water and groundwater. Additional information about BMAPs is available online.

References

Conley, D.J., H.W. Paerl, R.W. Howarth, D.F. Boesch, S.P. Seitzinger, K.E. Havens, C. Lancelot, and G.E. Likens. 2009. Controlling eutrophication: Nitrogen and phosphorus. *Science* 323: 1014–1015.

Florida Department of Environmental Protection. 2001. *A report to the Governor and the Legislature on the allocation of total maximum daily loads in Florida*. Tallahassee, FL: Bureau of Watershed Management.

———. 2003. *Water quality assessment report: Ochlockonee–St. Marks.* Tallahassee, FL: Division of WaterResource Management.

———. 2012. *Development of numeric nutrient criteria for Florida lakes, spring vents, and streams.* Technical support document. Tallahassee, FL: Division of Environmental Assessment andRestoration, Standards and Assessment Section.

———. 2013. Chapter 62-302, Florida Administrative Code. *Surface water quality standards.* Tallahassee, FL: Division of Environmental Assessment and Restoration.

Florida Watershed Restoration Act. *Chapter 99-223, Laws of Florida*.

Lewis, W.M., W.A. Wurtsbaugh, and H.W. Paerl. 2011. Rationale for control of anthropogenic nitrogen and phosphorus in inland waters. *Environmental Science & Technology* 45:10300–10305.

Paerl, H.W. 2009. Controlling eutrophication along the freshwater-marine continuum: Dual nutrient (N and P) reductions are essential. *Estuaries and Coasts* 32: 593–601.

Paerl, H.W., and T.G. Otten. 2013. Harmful cyanobacterial blooms: Causes, consequences and controls. *Microbial Ecology* 65: 995–1010.

Peene, S. June 18, 2020. Memo to the City of Tallahassee entitled "Waste Load Allocation for Arvah B. Hopkins Plant - Lake Talquin TMDL."

U.S. Environmental Protection Agency. 1977. *Report on Lake Talquin, Gadsden and Leon Counties, Florida, EPA Region IV.* Working Paper No. 274. Corvallis Environmental Research Laboratory, Corvallis, OR, and Environmental Monitoring and Support Laboratory, Las Vegas, NV.

———. 2020. *Modeling report: Lake Talquin–including Ochlockonee River and Little River, nutrients.*

Appendices

Appendix A: Background Information on Federal and State Stormwater Programs

In 1982, Florida became the first state in the country to implement statewide regulations to address the issue of nonpoint source pollution by requiring new development and redevelopment to treat stormwater before it is discharged. The Stormwater Rule, as authorized in Chapter 403, F.S., was established as a technology-based program that relies on the implementation of BMPs designed to achieve a specific level of treatment (i.e., performance standards) as set forth in Chapter 62-40, F.A.C. In 1994, DEP stormwater treatment requirements were integrated with the stormwater flood control requirements of the water management districts, along with wetland protection requirements, into the Environmental Resource Permit regulations, as authorized under Part IV of Chapter 373, F.S.

Chapter 62-40, F.A.C., also requires the state's water management districts to establish stormwater pollutant load reduction goals (PLRGs) and adopt them as part of a Surface Water Improvement and Management (SWIM) Program plan, other watershed plan, or rule. Stormwater PLRGs are a major component of the load allocation part of a TMDL. To date, they have been established for Tampa Bay, Lake Thonotosassa, the Winter Haven Chain of Lakes, the Everglades, Lake Okeechobee, and Lake Apopka.

In 1987, the U.S. Congress established Section 402(p) as part of the federal CWA Reauthorization. This section of the law amended the scope of the federal NPDES permitting program to designate certain stormwater discharges as point sources of pollution. The EPA promulgated regulations and began implementing the Phase I NPDES stormwater program in 1990 to address stormwater discharges associated with industrial activity, including 11 categories of industrial activity, construction activities disturbing 5 or more acres of land, and large and medium MS4s located in incorporated places and counties with populations of 100,000 or more.

However, because the master drainage systems of most local governments in Florida are physically interconnected, the EPA implemented Phase I of the MS4 permitting program on a countywide basis, which brought in all cities (incorporated areas), Chapter 298 special districts; community development districts, water control districts, and FDOT throughout the 15 counties meeting the population criteria. DEP received authorization to implement the NPDES stormwater program in 2000. The authority to administer the program is set forth in Section 403.0885, F.S.

The Phase II NPDES stormwater program, promulgated in 1999, addresses additional sources, including small MS4s and small construction activities disturbing between 1 and 5 acres, and urbanized areas serving a minimum resident population of at least 1,000 individuals. While these urban stormwater discharges are technically referred to as point sources for the purpose of regulation, they are still diffuse sources of pollution that cannot be easily collected and treated by a central treatment facility, as are other point sources of pollution such as domestic and industrial wastewater discharges. It should be noted that Phase I MS4 permits issued in Florida include a reopener clause that allows permit revisions to implement TMDLs when the implementation plan is formally adopted.

Appendix B: Information in Support of Site-Specific Interpretations of the Narrative Nutrient Criterion

Table B-1. Spatial extent of the numeric interpretations of the narrative nutrient criterion

Location	Description
Waterbody name	Lake Talquin
Waterbody type(s)	Lake
WBID	1297X, 1297Y, and 1297Z (see **Figure 1.3** of this report)
Description	The Lake Talquin Watershed covers an area of 1,569 square miles, of which 73.3% (1,150 square miles) is located in Georgia and the remaining 26.7% (419 square miles) in Gadsden and Leon Counties in Florida. The surface area of the lake is 8,087 acres (12.6 square miles) with an average depth of 13.1 feet and a maximum depth of 30 feet. The lake discharges into the Ochlockonee River, which discharges into Ochlockonee Bay and the Gulf of Mexico. **Chapter 1** of this report describes the Lake Talquin system in more detail.
Specific location (latitude/longitude or river miles)	The center of Lake Talquin is located at N: 30 26' 16.48"/W: -84 33'47.88." The site-specific nutrient criteria apply as spatial averages for the lake, as defined by the three evaluation zones identified in the TMDL report.
Map	**Figure B-1** shows the general location of Lake Talquin and its watershed, and **Figure B-2** shows land uses in the watershed. The predominant land use in the watershed is natural (upland forest, water, and wetlands), comprising 57.5%of the watershed area. Urban and residential land uses make up 6.5% of the watershed. Agricultural lands (including rangelands) occupy 35.8% of the land area.
Classification(s)	Class III Freshwater
Basin name (HUC 8)	Ochlocknee River Basin (03080101)

Table B-2. Description of the numeric interpretations of the narrative nutrient criterion

Numeric Interpretations of Narrative Nutrient Criterion	Information on Parameters Related to Numeric Interpretations of the Narrative Nutrient Criterion
NNC summary: Generally applicable lake classification (if applicable) and corresponding NNC	Lake Talquin is high color (> 40 PCU), in which case alkalinity does not impact the criteria for nutrients or chlorophyll *a*. The generally applicable NNC, which are expressed as AGM concentrations not to be exceeded more than once in any 3-year period, are chlorophyll a of 20 µg/L, TN of 1.27 to 2.23 mg/L, andTP of 0.05 to 0.16 mg/L.
Proposed TN, TP, chlorophyll a, and/or nitrate + nitrite concentrations (magnitude, duration, and frequency)	Numeric interpretations of the narrative nutrient criterion: TN = 1,134,850 kg/yr and TP = 112,326 kg/yr, expressed as long-term average (7-year) annual loads not to be exceeded. For assessment purposes, the long-term average annual loads will be calculated using the annual loads of the most recent 7 years in the verified period. These loadings were derived from the WASP model simulation for the period from 2008 through 2017. The TMDL condition for Lake Talquin will result in achieving the AGM chlorophyll *a* concentration of 20 µg/L, expressed as an AGM concentration target not to be exceeded more than once in any consecutive 3-year period. The TMDL loads are considered the site-specific interpretations of the narrative criterion, and the generally applicable chlorophyll a criterion of 20 µg/L as an AGM not to be exceeded more than once in any consecutive 3-year period will continue to apply, as DEP has no reason to think that it is not protective of the lake.
Concentration-based lake targets	**Chlorophyll *a***: WBID 1297Z = 19.3 µg/L, WBID 1297Y = 20.0 µg/L, WBID 1297X = 17.5 µg/L **TN**: WBID 1297Z = 0.81 mg/L, WBID 1297Y = 0.84 mg/L, WBID 1297X = 0.73 mg/L **TP**: WBID 1297Z = 0.084 mg/L, WBID 1297Y = 0.070 mg/L, WBID 1297X = 0.062 mg/L
Period of record used to develop numeric interpretations of the narrative nutrient criterion for TN and TP	The criteria are based on the application of the LSPC watershed loading model, a WASP model for the Little River, and a WASP model for the Ochlockonee River, all coupled to an EFDC and WASP model for Lake Talquin, that simulated water quality conditions for the period from 2008 to2017. The primary datasets for this period include water quality data from theIWR Database (IWR Run 61), as well as rainfall and evapotranspiration data.
How the criteria developed are spatially and temporally representative of the waterbody or critical condition	The water quality results applied in the analysis spanned the period from 2008 to 2017,which included both wet and dry years. The annual average rainfall in this period was 57.6 inches/year, while 2011, 2015, and 2017 were drier years and 2008, 2012, 2013, 2014, and 2016 were wetter years. **Figure B-3** shows the Lake Talquin stations sampled during the Cycle 4 planning period (January 2006–December 2015) and verified period (January 2011–June 2018). The stations are located throughout the lake. Water quality data for variables relevant to TMDL development are available on request.

Table B-3. Summary of how designated use(s) are protected by the criterion

Designated Use Requirements	Information Related to Designated Use Requirements
History of assessment of designated use support	Lake Talquin was verified as impaired for nutrients and low dissolved oxygen (DO) during the Group 1 Cycle 2 verified period assessment (January 1, 2000–June 30, 2007) caused by excessive nutrients, because the Trophic State Index (TSI) threshold of 40 and the DO criterion of 5.0 mg/L were exceeded using the methodology in the IWR (Chapter 62-303, F.A.C.). As a result, the lake was included on the Group 1 Cycle 2 Verified List of Impaired Waters for the Ochlockonee–St Marks RiverBasin that was adopted by Secretarial Order on May 19, 2009. The nutrient impairment was confirmed for the Group 1 Cycle 4 verified period assessment (January 1, 2011–June 30, 2018), as Lake Talquin did not attain the generally applicable NNC for chlorophyll *a* for high-color lakes in all three lake segments. For the Group 1 Cycle 4 verified period, lake DO was assessed as not impaired in all three lake segments. The Cycle 4 assessments are based on water quality results in IWR Database Run 56.
Basis for use support	The site-specific TN and TP targets for this TMDL were established to achieve the chlorophyll *a* criterion (20 µg/L) for high-color, high-alkalinity lakes. Based on several lines of evidence discussed in detail in the technical support document for the development of NNC (DEP 2012), achieving a chlorophyll *a* AGM of 20 µg/L in this type of lake will prevent algal blooms and ensure that no harmful phytoplankton will impair designated use. There was no site-specific information indicating that a chlorophyll *a* of 20 µg/L is not protective of the designated use for this waterbody.
Approach used to develop criteria and how it protects uses	For the Lake Talquin nutrient TMDLs, DEP created loading-based criteria using a calibrated set of models to simulate loadings from the Lake Talquin Watershed, and this information was fed into the receiving water models WASP and EFDC. The TN and TP loadings to achieve the 20 µg/L chlorophyll *a* criterion in every year were determined by incrementally lowering the TN and TP loads into the lake until the chlorophyll *a* targetwas achieved.
How the TMDL analysis will ensure that nutrient-related parameters are attained to demonstrate that the TMDLs will not negatively impact other water quality criteria	Since the nutrient concentration targets are based on an ecological endpoint that is protective of both flora and fauna, other water quality criteria will not be adversely impacted and designated uses will be maintained. DEP notes that there were no impairments for DO in the lake. The proposed reductions in nutrient inputs will result in further improvements in water quality.

Table B-4. Documentation of the means to attain and maintain water quality standards for downstream waters

Protection of Downstream Waters and Monitoring Requirements	Information Related to Protection of Downstream Waters and Monitoring Requirements
Identification of downstream waters: List receiving waters and identify technical justification for concluding downstream waters are protected	Lake Talquin discharges into the Ochlockonee River, which flows to Ochlockonee Bay, which empties to the Gulf of Mexico. There are no nutrient-related impairments downstream of the lake. The Lake Talquin TMDL should improve water quality in downstream waterbodies, which are not impaired for nutrients.
Summary of existing monitoring and assessment related to the implementation of Subsection 62-302.531(4), F.A.C., and trends tests in Chapter 62-303, F.A.C.	Leon County and Florida LakeWatch conduct routine monitoring of Lake Talquin. Future monitoring results from waters upstream and downstream of Lake Talquin, and from Lake Talquin itself, will be used to assess progress towards the restoration of the lake.

Table B-5. Documentation of endangered species consideration

Administrative Requirements	Information for Administrative Requirements
Endangered species consideration	The FWS identifies the Gulf sturgeon and several freshwater mussel species as potentially affected by activities in the area of Lake Talquin. As described in **Section 3.5**, the existing water quality in Lake Talquin and the downstream Ochlockonee River and Bay segments does not appear to be negatively affecting the threatened and endangered aquatic species. The nutrient TMDLs will improve the water quality conditions in the waterbodies.

Table B-6. Documentation that administrative requirements are met

Administrative Requirements	Information for Administrative Requirements
Notice and comment notifications	DEP published a Notice of Development of Rulemaking on [date$], to initiate TMDL development for impaired waters in the Ochlockonee River Basin. A rule development public workshop for the TMDLs was held on [date$].
Hearing requirements and adoption format used; responsiveness summary	Once any needed revisions are made, DEP will publish a Notice of Proposed Rule in the *Florida Administrative Register*, and the notice will initiate a 21-day challenge period.
Official submittal to EPA for review and General Counsel certification	If DEP does not receive a rule challenge, the certification package for the rule will be prepared by DEP's program attorney. DEP will prepare the TMDL and submittal package for the TMDLs to be considered site-specific interpretations of the narrative nutrient criterion, and submit these documents to the EPA.

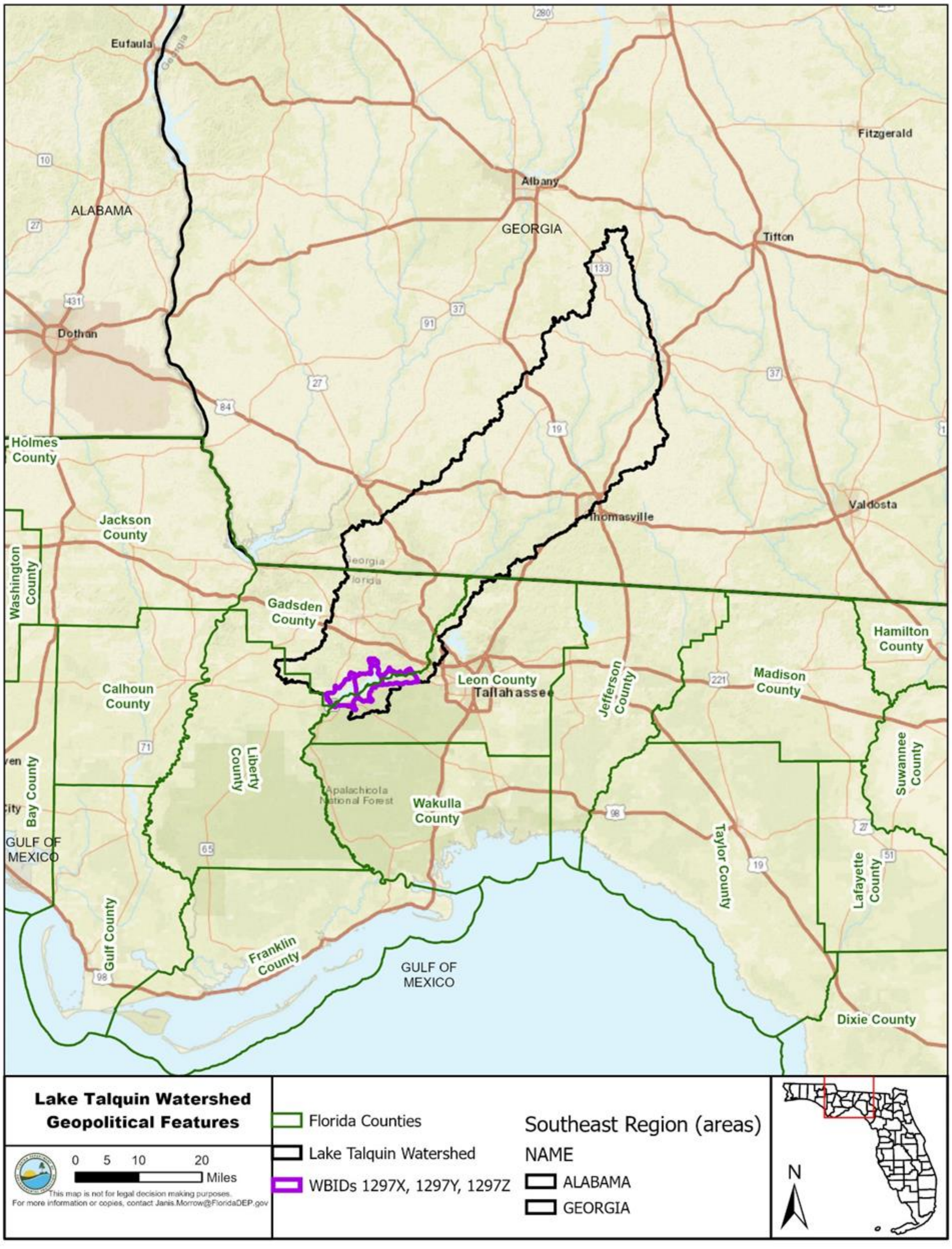

Figure B-1. Location of the Lake Talquin watershed in southwest Georgia and northern Florida

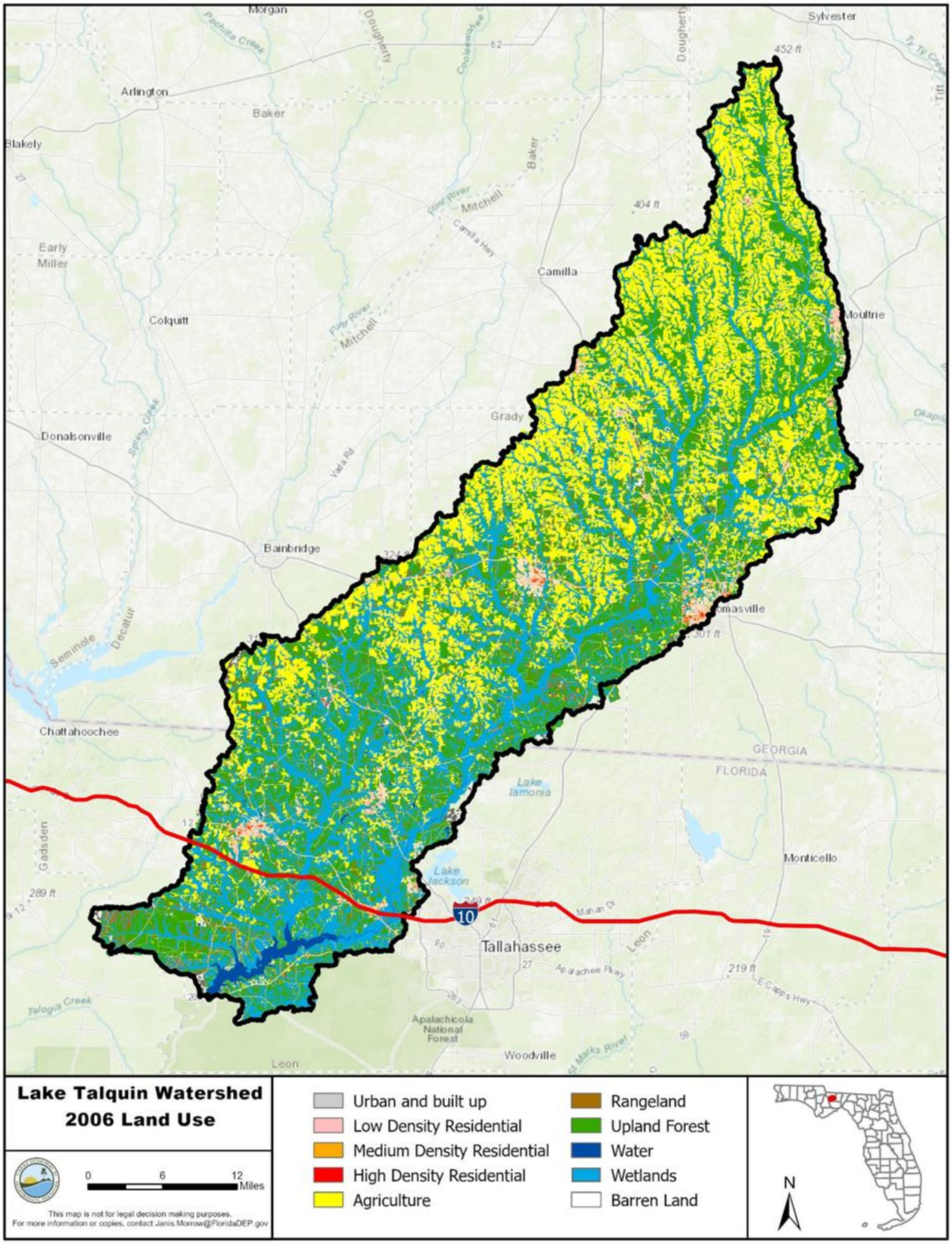

Figure B-2. Lake Talquin watershed land use, 2006

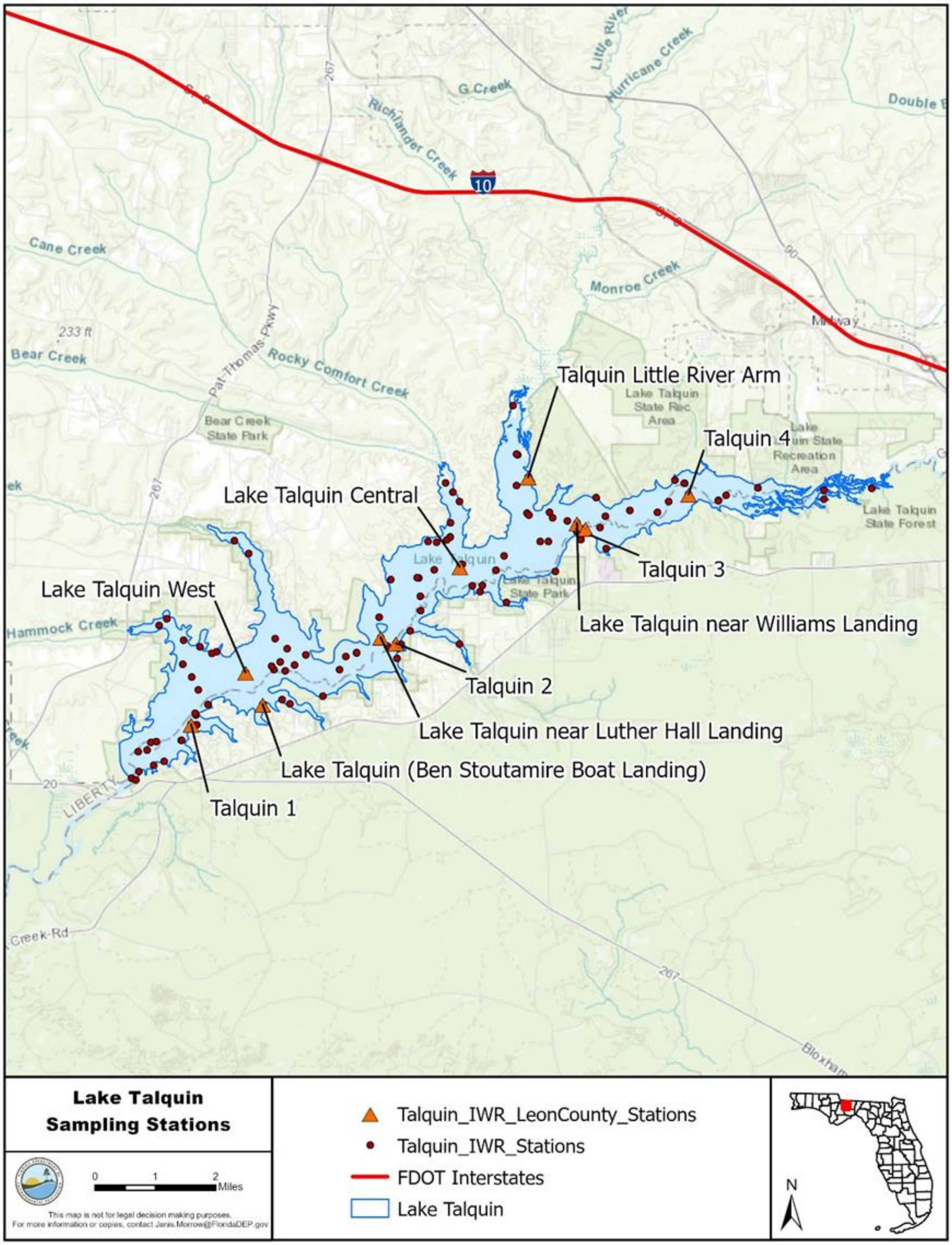

Figure B-3. Lake Talquin stations monitored in the Cycle 4 planning period and verified period