Southwest District • Kissimmee River Basin

Draft Report

Nutrient TMDLs for Lake Marion (WBID 1480) and Lake Pierce (WBID 1532A) and Documentation in Support of the Development of Site-Specific Numeric Interpretations of the Narrative Nutrient Criterion

Casey Luzius
Division of Environmental Assessment and Restoration
Florida Department of Environmental Protection

April 2020

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

Executive Summary

This report presents the total maximum daily loads (TMDLs) developed to address the nutrient impairments for two lakes located in east Polk County. Lake Marion and Lake Pierce are located near the Cities of Haines and Lake Wales.

Lake Marion and Lake Pierce were originally identified as impaired for nutrients based on elevated annual average Trophic State Index values. Now both waterbodies have exceedances of the applicable lake numeric nutrient criteria (NNC) in Subsection 62-302.531(2), Florida Administrative Code (F.A.C.). Lake Marion and Lake Pierce were verified as impaired for nutrients and were included on the Verified List of Impaired Waters for the Kissimmee River Basin (Group 4 in Assessment Cycle 3), adopted by Secretarial Order in July 2017.

Pursuant to Paragraph 62-302.531(2)(a), F.A.C., these 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.

TMDLs for total nitrogen (TN) and total phosphorus (TP) have been developed. **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 Marion and Lake Pierce

Type of Information	Description
Waterbody name and waterbody identification (WBID) number	Lake Marion (WBID 1480) and Lake Pierce (WBID 1532A)
Hydrologic Unit Code (HUC) 8	03090101
Use classification/ Waterbody designation	Class III/Fresh
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 Kissimmee River Group 4 Basin, adopted via Secretarial Order in 2017
TMDL pollutants	TN and TP
TMDLs and site-specific interpretations of the narrative nutrient criterion	**Lake Marion (WBID 1480):** **Chlorophyll *a*:** 20 micrograms per liter (µg/L), expressed as an annual geometric mean (AGM) concentration not to be exceeded more than once in any 3-year period. **TN:** 25,653 kilograms per year (kg/yr), expressed as a 7-year average of annual loads not to be exceeded. **TP:** 1,222 kg/yr, expressed as a 7-year average of annual loads not to be exceeded. **Lake Pierce (WBID 1582A):** **Chlorophyll *a*:** 24 µg/L, expressed as an AGM concentration not to be exceeded. **TN:** 38,172 kg/yr, expressed as a 7-year average of annual loads not to be exceeded. **TP:** 1,431 kg/yr, expressed as a 7-year average of annual loads not to be exceeded.
Load reductions required to meet the TMDLs	**Lake Marion (WBID 1480):** A 75 % TN reduction and a 67 % TP reduction to achieve a chlorophyll *a* target of 20 µg/L. **Lake Pierce (WBID 1532A):** An 58 % TN reduction and a 62 % TP reduction to achieve a chlorophyll *a* target of 24 µg/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 (DEAR), specifically, the Office of Watershed Services, Watershed Assessment Section, Standards Development Section, Water Quality Restoration Program, Southwest Regional Operations Center, South Regional Operations Center, and Watershed Evaluation and TMDL Section. DEP also recognizes Polk County for its contributions towards understanding the issues, history, and processes at work in the Lake Marion and Lake Pierce Watersheds.

For additional information regarding the development of this report, contact the DEAR office at:

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

Contents

List of Figures

List of Tables

Acronyms and Additional Abbreviations Used in Report

µg/L	Micrograms Per Liter
ac	Acre
ac/ft	Acre-Feet
AGM	Annual Geometric Mean
BMAP	Basin Management Action Plan
BMP	Best Management Practice
$CaCO_3$	Calcium Carbonate
CFR	Code of Federal Regulations
CWA	Clean Water Act
DEAR	Division of Environmental Assessment and Restoration
DEP	Florida Department of Environmental Protection
EMC	Event Mean Concentration
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
°F	Degrees Fahrenheit
F.A.C.	Florida Administrative Code
FDOT	Florida Department of Transportation
F.S.	Florida Statutes
ft	Feet
FWRA	Florida Watershed Restoration Act
hm^3/yr	Cubic Hectometers Per Year
HUC	Hydrologic Unit Code
in/yr	Inches Per Year
IWR	Impaired Surface Waters Rule
kg	Kilograms
kg/yr	Kilograms Per Year
LA	Load Allocation
m	Meter
m^2	Square meters
mg/L	Milligrams Per Liter
$mg/m^2/yr$	Milligrams Per Square Meter Per Year
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer System
m/yr	Meters Per Year
NA	Not Applicable
N/A	Not Available
NAVD88	North American Vertical Datum of 1988
NNC	Numeric Nutrient Criteria

NPDES	National Pollutant Discharge Elimination System
OSTDS	Onsite Sewage Treatment and Disposal System
PCU	Platinum Cobalt Unit
PLRG	Pollutant Load Reduction Goal
SFWMD	South Florida Water Management District
SJRWMD	St. Johns River Water Management District
SWFWMD	Southwest Florida Water Management District
SWIM	Surface Water Improvement and Management
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TSI	Trophic State Index
U.S.	United States
USACE	U.S. Army Corps of Engineers
WBID	Waterbody Identification (number)
WLA	Wasteload Allocation
WQS	Water Quality Standards
WWTF	Wastewater Treatment Facility

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 Marion and Lake Pierce, located in the Kissimmee River Basin. The TMDLs will also constitute the site-specific numeric interpretations of the narrative nutrient criterion set forth in Paragraph 62-302.530(48)(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 these particular waterbodies, pursuant to Paragraph 62-302.531(2)(a), F.A.C. These lakes were verified as impaired for nutrients using the methodology in the Identification of Impaired Surface Waters Rule (IWR) (Chapter 62-303, F.A.C.), and were included on the Verified List of Impaired Waters for the Kissimmee River Basin adopted by Secretarial Order in July 2017. The IWR is implemented using a 5-year basin rotation, with Florida's 52 hydrologic unit code (HUC) basins distributed among 29 basin groups.

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 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 Marion and Lake Pierce needed to restore these lakes and allow for the attainment of their applicable designated uses.

1.2 Identification of Waterbody

For assessment purposes, the Florida Department of Environmental Protection (DEP) divided the Kissimmee River Basin (HUC 8 – 03090101) into watershed assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or surface water segment. Lake Marion is WBID 1480 and Lake Pierce is WBID 1532A. **Figures 1.1** and **1.2** show the location of the lake WBIDs in the basin and major geopolitical and hydrologic features in the region.

Lake Marion (WBID 1480) is a large lake located directly north of Lake Pierce in east Polk County. Lake Marion discharges into Lake Marion Creek on the north end of the lake. Lake Marion receives water from wetlands called Indian Head Swamp on the south end of the lake. Lake Pierce (WBID 1532A) is a large lake located directly south of Lake Marion in east Polk County. Lake Pierce discharges into Catfish Creek on the south end of the lake. **Table 1.1** summarizes the lakes' general hydrologic characteristics.

Table 1.1. Characteristics of Lake Marion and Lake Pierce

[1] Data from University of South Florida Water Institute 2019.
ac = Acres; ac-ft = Acre-feet; ft = Feet; N/A = Not available.

Lake Name	Lake Surface Area (ac)	Lake Volume (ac-ft)	Mean Depth (ft)	Maximum Depth (ft)	Watershed Area (ac)
Marion[1]	3,006	33,066	11	9	24,518
Pierce[1]	3,779	26,453	7	11	35,714

1.3 Watershed Information

1.3.1 Population and Geopolitical Setting

According to data available from the U.S. Census Bureau, the population of Polk County is 708,009, with a density of 393.8 people per square mile (U.S. Census Bureau 2010). Polk County occupies an area of 1,798 square miles, and there are 299,421 housing units in the county, with a housing density of 166.5 houses per square mile. Lake Marion is located near Haines City, which has a population of 25,091. Lake Pierce is located near the City of Lake Wales, with a population of 16,577.

1.3.2 Topography

Lake Marion and Lake Pierce are located in the Lake Wales Ridge Transition region (75-34), which is characterized by extensive areas of poorly drained soils such as Satellite and Basinger series (Griffith et al. 1997). Peaty muck Samsula soils border many of the lakes. The sand pine and scrub-covered ridge contains soils similar to the edges of the Lake Wales Ridge. The lakes in this region are mostly acidic, with approximately a third of them being alkaline. They are low to moderate in nutrients and are slightly to moderately colored.

The elevation in the Lake Marion Watershed ranges from 88 feet (ft) above the North American Vertical Datum of 1988 (NAVD88) to 215 ft NAVD88, and from 70 to 272 ft NAVD88 in the Lake Pierce Watershed.

1.3.3 Hydrogeological Setting

The hydrology of the lakes is determined in part by the topography, but also by their similar soil geology, aquifer/groundwater interactions, and climate.

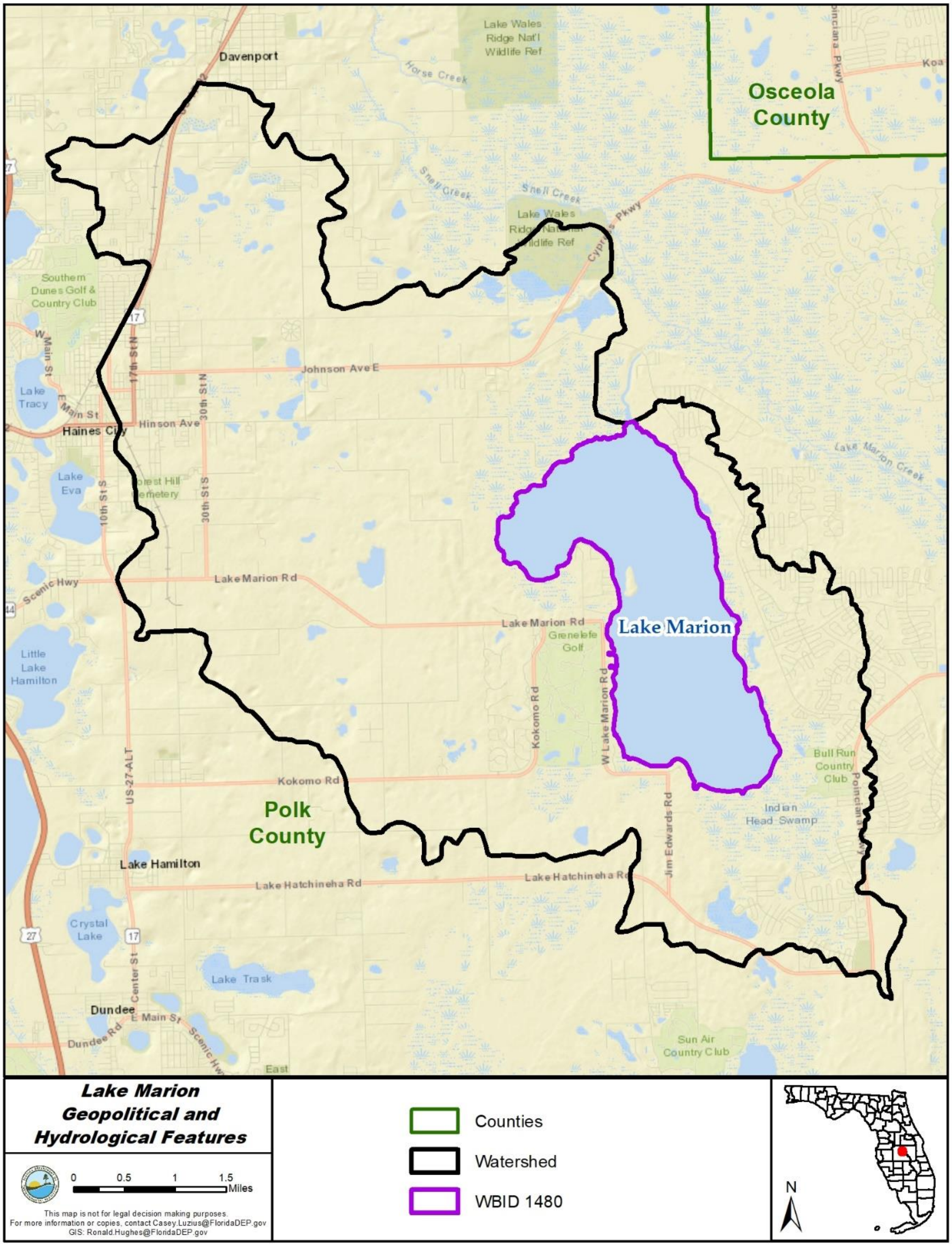


Figure 1.1. Location of Lake Marion (WBID 1480) in the Kissimmee River Basin and major geopolitical and hydrologic features in the region

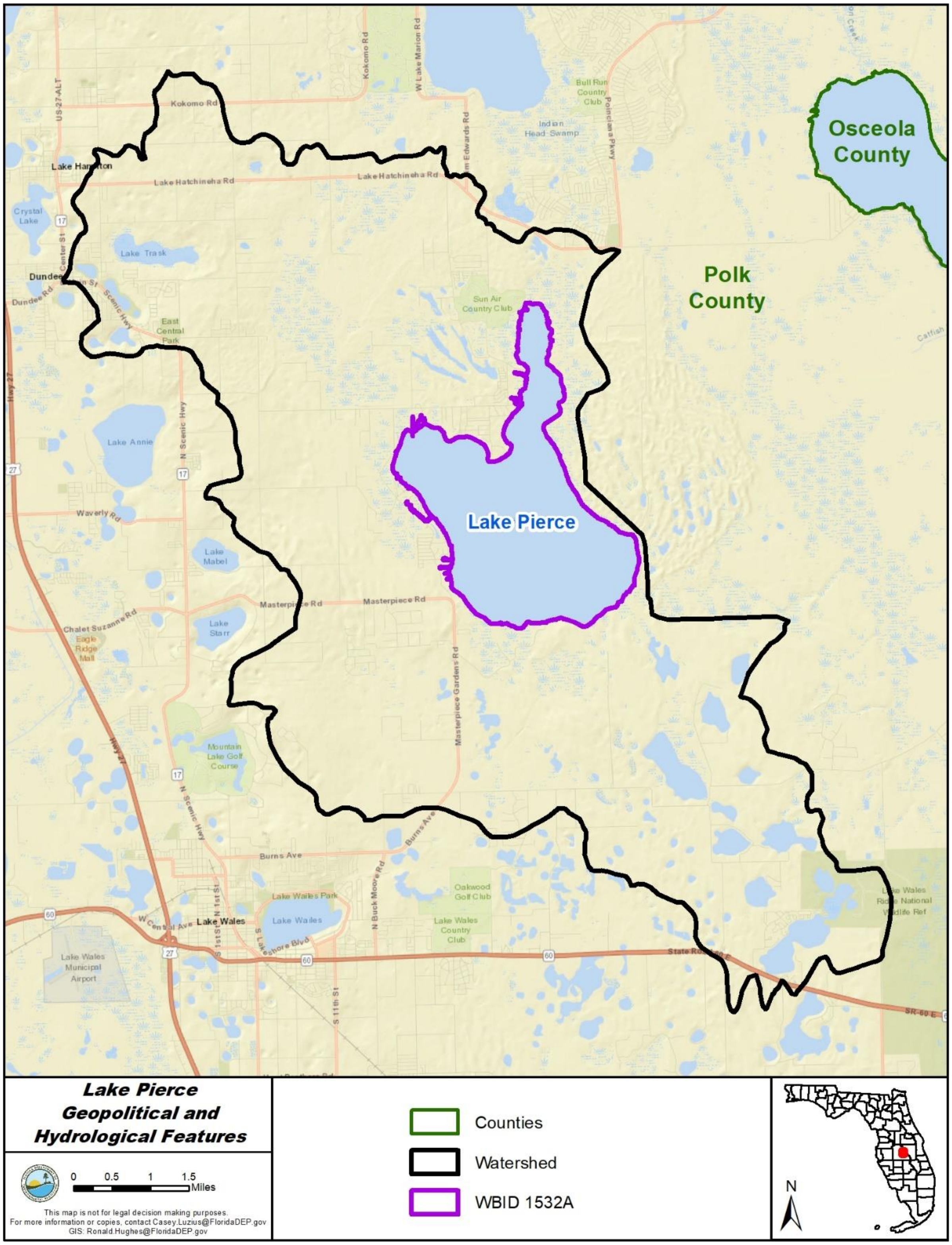


Figure 1.2. Location of Lake Pierce (WBID 1532A) in the Kissimmee River Basin and major geopolitical and hydrologic features in the region

The climate of the watershed areas is subtropical, with an annual average temperature of 73 degrees Fahrenheit (°F.). Annual rainfall in or near this part of the Kissimmee Basin averages 50 to 56 inches, with a defined rainy season occurring from June to September, and 60 % of the rainfall occurring during that period. The long-term average annual rainfall for Polk County is 52 inches/year (in/yr), based on data from the Southwest Florida Water Management District (SWFWMD) recorded from 1915 to 2017.

Both waterbodies are located in the Cypresshead Formation (Pliocene), characterized by reddish brown to reddish orange, unconsolidated to poorly consolidated, fine to very coarse grained, clean to clayey sands (Scott 2001). The Cypresshead Formation is at or near the surface, and because of the permeable sands, this region comprises a part of the surficial aquifer found in Florida and eastern Georgia. Both watersheds are located in the Tertiary-Quaternary Dunes, characterized by sediments that are fine to medium quartz sand with varying amounts of disseminated organic matter. The sand dunes form at elevations greater than 100 feet above sea level (Scott 2001).

The soils in the lake watersheds comprise Hydrologic Soil Groups A, A/D, B, B/D, and C/D. These groups are based on the National Cooperative Soil Survey. Group A type soils are typically well-drained, have deep water tables, and consist of sandy, textured soils with a relatively low runoff potential. Group B type soils are typically loamy with some silt component, a moderately coarse texture, and a lower infiltration rate than Group A soils and are therefore classified as moderately well-drained. Group C type soils are sand, clay, and loam with more fine textures and lower infiltration rates, especially when wet. Group D type soils are variable in texture but generally have a greater clay component and are often found at lower topography with higher water tables that generate a higher hydrologic runoff response. When Group A/D, Group B/D, and Group C/D are unsaturated, they behave like Groups A, B, and C soils and when unsaturated like Group D soil.

Figures 1.3 and **1.4** display the distribution of soil types in the Lake Marion and Lake Pierce Watersheds, respectively. A majority of soils in both lake watershed areas consists of a mix of well-drained, sandy, textured soils ("A" soils) (**Tables 1.2** and **1.3**, respectively).

Table 1.2. Soil type acreage and percent in the Lake Marion Watershed

Note: Hybrid soil types are A/D, B/D, and C/D.

Hydrologic Group	Acres	% of Watershed
No Data	3,278	13.37
A	15,428	62.93
A/D	4,722	19.26
B	329	1.34
B/D	736	3.00
C/D	25	0.10
Total	**24,518**	**100.0**

Table 1.3. Soil type acreage and percent in the Lake Pierce Watershed

Note: Hybrid soil types are A/D, B/D, and C/D.

Hydrologic Group	Acres	% of Watershed
No Data	4,735	13.26
A	23,443	65.64
A/D	6,344	17.76
B	757	2.12
B/D	432	1.21
C/D	3	0.01
Total	**35,714**	**100.0**

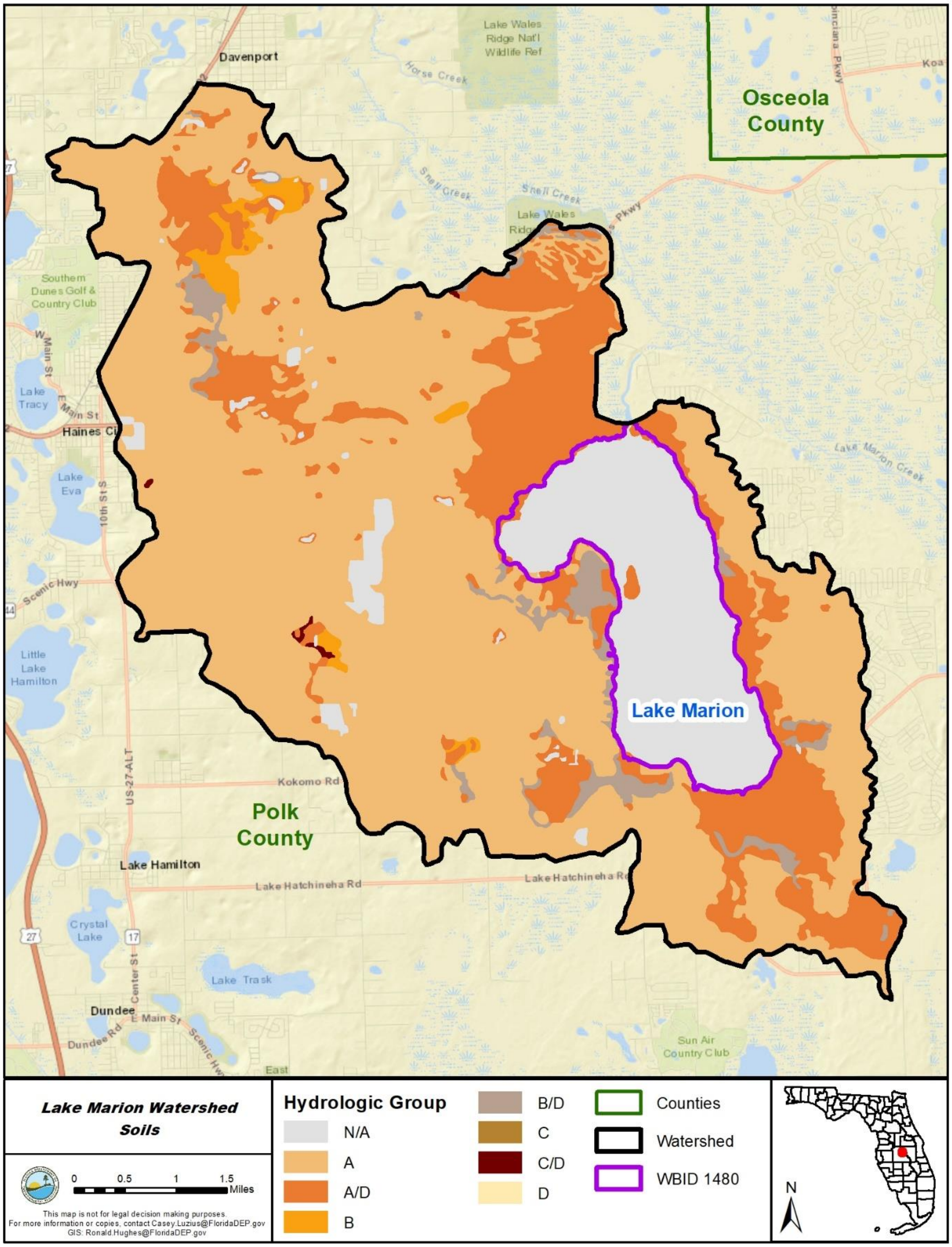


Figure 1.3. Hydrologic soil groups in the Lake Marion Watershed

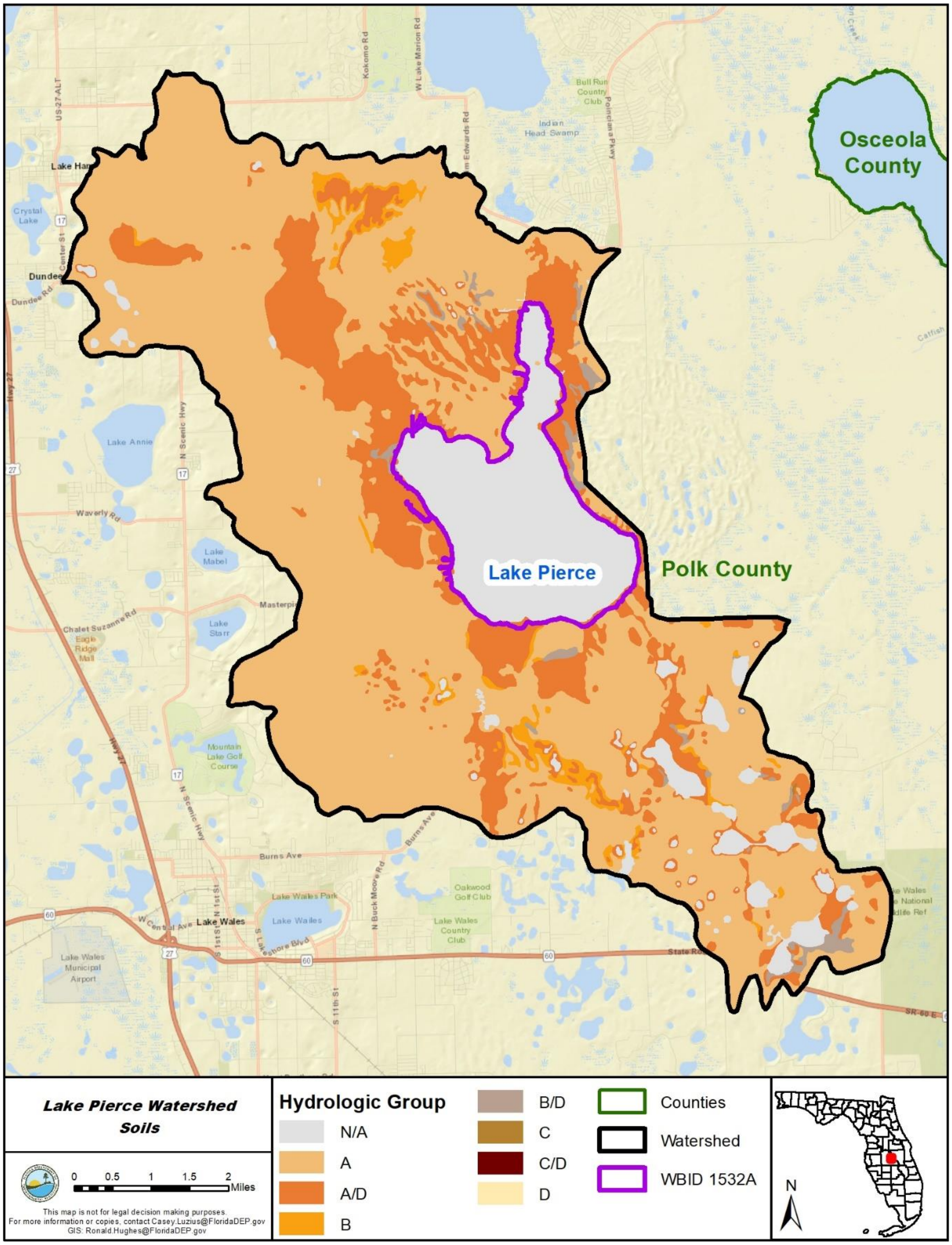


Figure 1.4. Hydrologic soil groups in the Lake Pierce Watershed

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 U.S. Environmental Protection Agency (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 annually to include basin updates.

2.2 Classification of the Waterbody and Applicable Water Quality Standards

Lake Marion and Lake Pierce are Class III (fresh) waterbodies, 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(48)(b), F.A.C. Florida adopted NNC for lakes, spring vents, and streams in 2011. These were approved by the EPA in 2012 and became effective in 2014.

The applicable lake NNC are dependent on alkalinity, measured in milligrams per liter as calcium carbonate (mg/L $CaCO_3$) and true color (color), measured in platinum cobalt units (PCU), based on long-term period-of-record geometric means (**Table 2.1**). The long-term averages of geometric means for alkalinity in Lake Marion and Lake Pierce are 41 and 38 mg/L $CaCO_3$, respectively. The long-term averages of geometric means for color in Lake Marion and Lake Pierce are 36 and 34 PCU, respectively. The geometric means were calculated based on the results in the IWR Run 57 Database. Using this methodology, Lake Marion and Lake Pierce are both classified as low-color, high-alkalinity (≤40 PCU and >20 mg/L $CaCO_3$).

The chlorophyll *a* NNC for low-color, high-alkalinity lakes is an annual geometric mean (AGM) value of 20 micrograms per liter (µg/L), not to be exceeded more than once in any consecutive 3-year period. The associated total nitrogen (TN) and total phosphorus (TP) criteria for a lake can vary annually, depending on the availability of data for chlorophyll *a* and the concentrations of chlorophyll *a* in the lake.

If there are sufficient data to calculate an AGM for chlorophyll *a* and the mean does not exceed the chlorophyll *a* criterion for the lake type in **Table 2.1**, then the TN and TP numeric interpretations for the calendar year are the AGMs for lake TN and TP samples, subject to minimum and maximum limits. If there are insufficient data to calculate the AGM for chlorophyll *a* for a given year, or the AGM for chlorophyll *a* exceeds the values in the table for the lake type, then the applicable nutrient interpretations for TN and TP are the minimum values. These values are listed in **Table 2.1**, as specified in Subparagraph 62-302.531(2)(b)1., F.A.C.

Table 2.1. Chlorophyll *a*, TN, and TP criteria for Florida lakes (Subparagraph 62-302.531[2][b]1., F.A.C.)

* For lakes with color > 40 PCU in the West Central Nutrient Watershed Region, the maximum TP limit is the 0.49 mg/L TP streams threshold for the region.

Long-Term Geometric Mean Lake Color and Alkalinity	AGM Chlorophyll *a* (µg/L)	Minimum Calculated AGM TP NNC (mg/L)	Minimum Calculated AGM TN NNC (mg/L)	Maximum Calculated AGM TP NNC (mg/L)	Maximum Calculated AGM TN NNC (mg/L)
>40 PCU	20	0.05	1.27	0.16*	2.23
≤ 40 PCU and > 20 mg/L $CaCO_3$	20	0.03	1.05	0.09	1.91
≤ 40 PCU and ≤ 20 mg/L $CaCO_3$	6	0.01	0.51	0.03	0.93

2.3 Determination of the Pollutant of Concern

2.3.1 Data Providers

The majority of lake nutrient data used in the most recent assessment period came from stations sampled and monitored by Polk County (21FLPOLK…). **Figures 2.1** and **2.2** show the lake sampling locations with the most data in the two watersheds, respectively. **Table 2.2** lists the monitoring stations for the major contributors of chlorophyll *a*, TN, and TP data from 2009 to 2015 for each lake.

In 1999, Polk County began sampling for corrected chlorophyll *a*, the form of chlorophyll *a* used to assess chlorophyll *a* in the IWR. The other sampling organizations have conducted monitoring intermittently. The individual water quality measurements discussed in this report are available in the IWR Run 57 Database and are available on request.

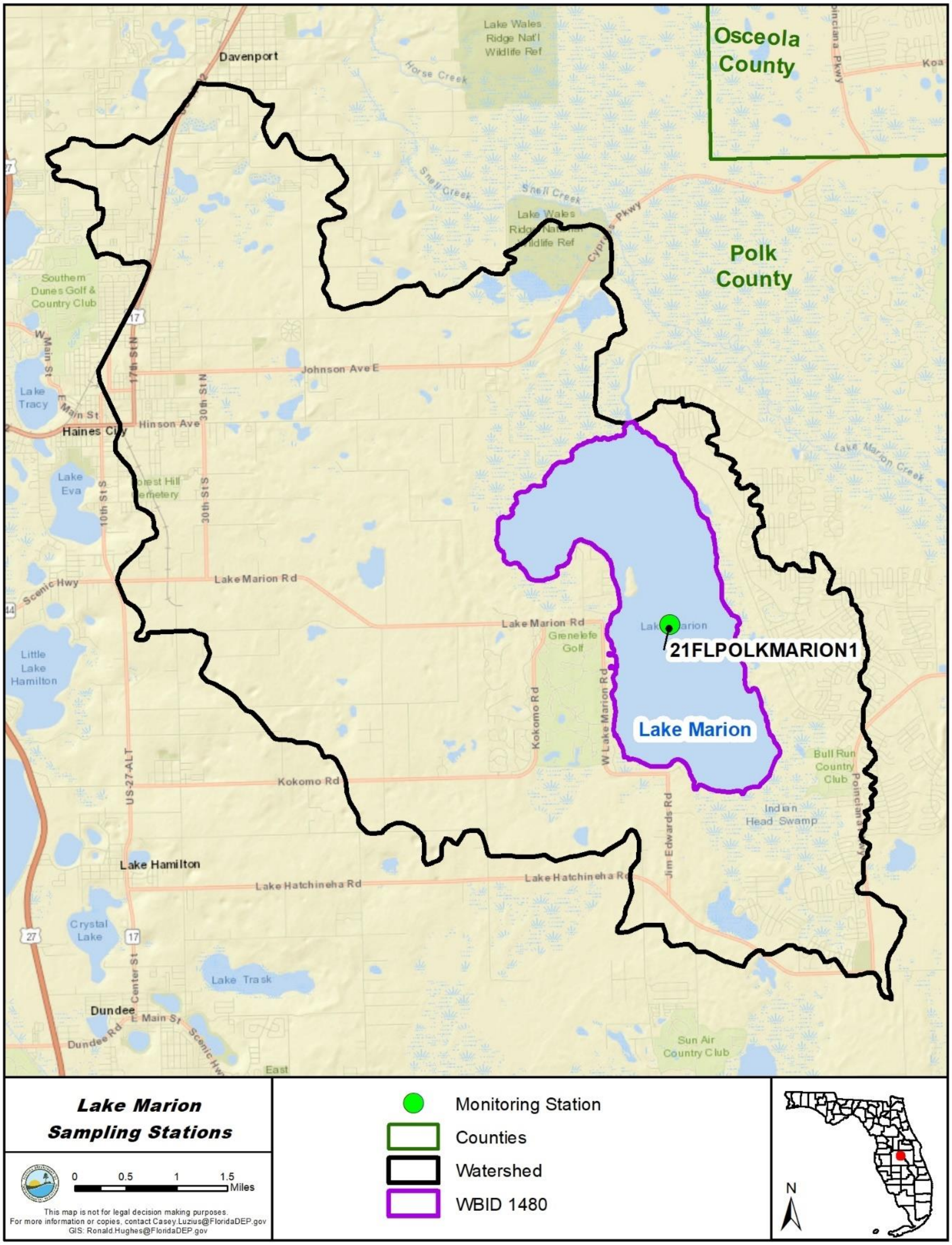


Figure 2.1. Monitoring stations in the Lake Marion Watershed

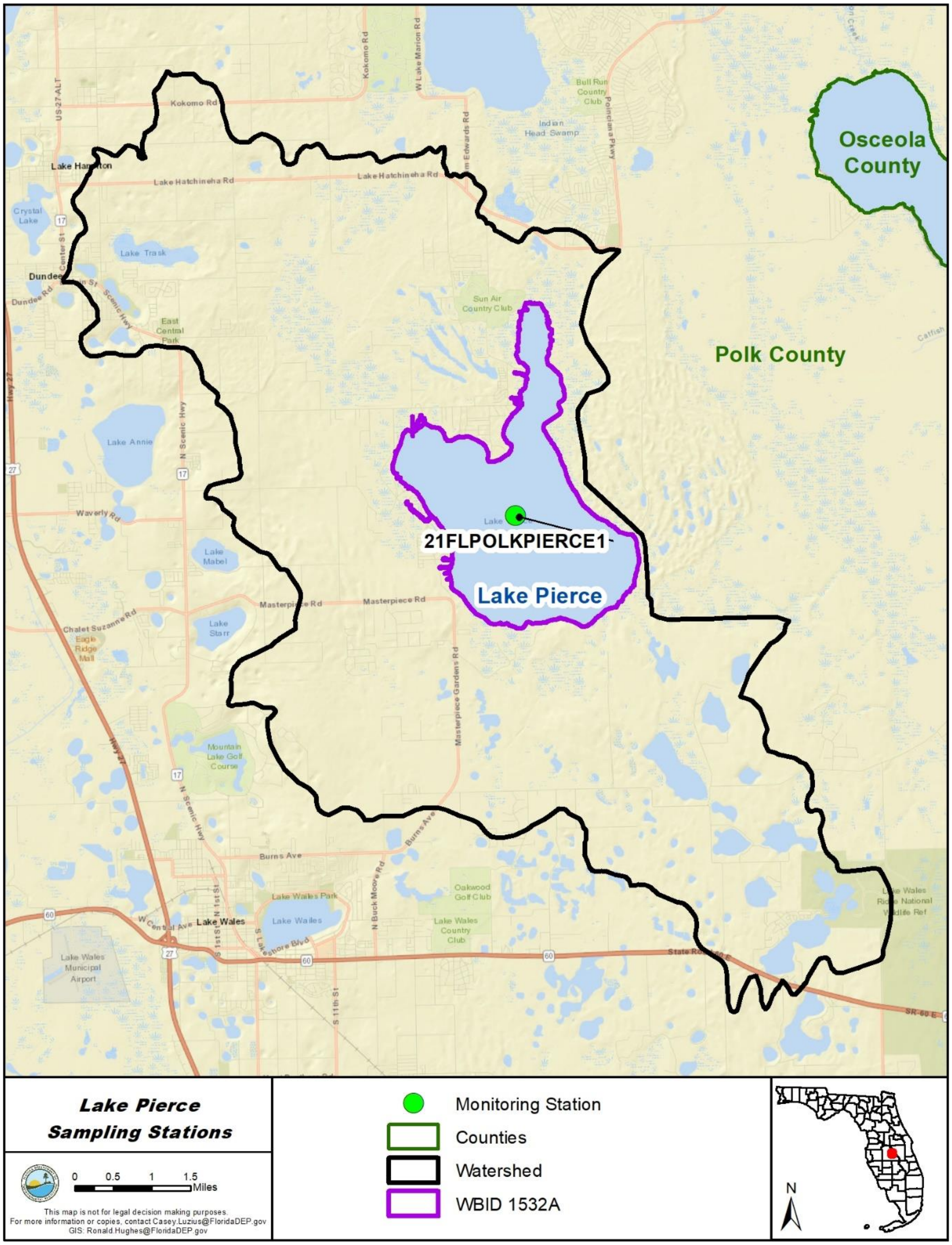


Figure 2.2. Monitoring stations in the Lake Pierce Watershed

Table 2.2. Monitoring stations for Lake Marion and Lake Pierce in the Kissimmee Basin

Lake	WBID	Station Identification
Marion	1480	21FLPOLKMARION1
Pierce	1532A	21FLPOLKPIERCE1

2.3.2 Information on Verified Impairment

For the Cycle 3 basin assessment completed in 2017, the NNC were used to assess the lakes for the verified period (January 1, 2009–June 30, 2016) during the Group 4, Cycle 3 assessment based on data from the IWR Run 53 Database. Lake Marion and Lake Pierce were assessed as impaired (Category 5) for chlorophyll *a*, TN, and TP, and the lakes were added to the Verified List. **Tables 2.3**, **2.4**, and **2.5** list the chlorophyll *a*, TN, and TP AGMs, respectively, for Lake Marion and Lake Pierce, calculated using the data from 2009 to 2015 in the IWR Run 53 Database.

Table 2.3. Lake Marion and Lake Pierce chlorophyll *a* AGM values (µg/L), 2009–15

Note: Values shown in boldface type and shaded are greater than the NNC of 20 µg/L chlorophyll *a* for Lake Marion and Lake Pierce. Rule 62-302.531, F.A.C., states that the applicable numeric interpretations for TN, TP, and chlorophyll *a* shall not be exceeded more than once in any consecutive 3-year period.

Year	Lake Marion	Lake Pierce
2009	**53**	**61**
2010	**63**	**52**
2011	**59**	**55**
2012	**66**	**66**
2013	**54**	**59**
2014	**50**	**42**
2015	**44**	**37**

Table 2.4. Lake Marion and Lake Pierce TN AGM values (mg/L), 2009–15

Note: Values shown in boldface type and shaded are greater than the NNC of 1.05 mg/L TN for Lake Marion and Lake Pierce. Rule 62-302.531, F.A.C., states that the applicable numeric interpretations for TN, TP, and chlorophyll *a* shall not be exceeded more than once in any consecutive 3-year period.

Year	Lake Marion	Lake Pierce
2009	**2.28**	**2.55**
2010	**2.02**	**2.17**
2011	**2.22**	**2.24**
2012	**2.41**	**2.57**
2013	**1.98**	**2.34**
2014	**1.94**	**2.00**
2015	**1.73**	**1.59**

Table 2.5. Lake Marion and Lake Pierce TP AGM values (mg/L), 2009–15

Note: Values shown in boldface type and shaded are greater than the NNC of 0.03 mg/L TP for Lake Marion and Lake Pierce. Rule 62-302.531, F.A.C., states that the applicable numeric interpretations for TN, TP, and chlorophyll *a* shall not be exceeded more than once in any consecutive 3-year period.

Year	Lake Marion	Lake Pierce
2009	**0.07**	**0.08**
2010	**0.07**	**0.06**
2011	**0.08**	**0.04**
2012	**0.08**	**0.06**
2013	**0.08**	**0.04**
2014	**0.08**	**0.05**
2015	**0.06**	0.02

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

3.1 Establishing the Site-Specific Interpretation

Pursuant to Paragraph 62-302.531(2)(a), F.A.C., the nutrient TMDLs presented in this report, upon adoption into Chapter 62-304.515, F.A.C., 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. **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 Marion and Lake Pierce 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 growth. In Florida waterbodies, nitrogen and phosphorus are most often the limiting nutrients. 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 a better approach to controlling 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).

3.2 Site-Specific Response Variable Target Selection

The development of the generally applicable lake NNC was based on the selection of a protective chlorophyll *a* criterion and the subsequent evaluation of the relationship between chlorophyll *a* and TN and TP to develop TN and TP concentrations protective of designated uses (DEP 2012). Based on several lines of evidence, DEP developed a chlorophyll *a* criterion of 20 µg/L for lakes with high color. DEP demonstrated that the chlorophyll *a* criterion of 20 µg/L is protective of designated uses and maintains a healthy, well-balanced community of aquatic flora and fauna in high-color lakes. There are no available data suggesting that Lake Marion requires lower chlorophyll *a* levels. Therefore, DEP has determined that the generally applicable chlorophyll *a* NNC for a lake with high color is appropriate, and it will be used as the TMDL target.

The TMDL targets Lake Pierce are based on estimated natural background water quality conditions. For Lake Pierce, the analysis that led to the response variable target and nutrient TMDLs considered predicted lake conditions using a water quality model. Model results show that background conditions in Lake Pierce have higher chlorophyll *a* concentrations than the existing criteria. The target represents the 80th percentile of the model-simulated annual chlorophyll *a* results. Therefore, DEP set the site-specific chlorophyll *a* target at the background condition, which is inherently protective of designated uses.

3.3 Numeric Expression of the Site-Specific Numeric Interpretation

The site-specific interpretations of the narrative nutrient criterion for TN and TP were determined by using the watershed and waterbody models described in **Chapter 5** to determine the TN and TP loadings that would achieve the chlorophyll *a* criterion of 20 µg/L in every year for Lake Marion and 24 µg/L in every year for Lake Pierce. For Lake Marion and Lake Pierce, nutrient and chlorophyll *a* loadings were simulated from 2007 to 2016.

Seven-year averages were calculated from yearly TN and TP loads that achieved the chlorophyll *a* targets. The maximum 7-year average TN and TP load was chosen as the site-specific interpretation of the narrative nutrient criterion. The resulting TN and TP target loads for Lake Marion are 25,653 and 1,222 kilograms per year (kg/yr), respectively. The resulting TN and TP target loads for Lake Pierce are 38,172 and 1,431 kg/yr, respectively. **Table 3.1** summarizes the site-specific interpretations of the narrative nutrient criterion for the lakes.

Table 3.1. Site-specific interpretations of the narrative nutrient criterion

Note: Frequency refers to the time interval not to be exceeded. TN and TP are not to be exceeded.

Waterbody/ WBID	AGM Chlorophyll *a* (µg/L)	7-year Average TN Load (kg/yr)	7-year Average TP Load (kg/yr)
Lake Marion/ 1480	20	25,653	1,222
Lake Pierce/ 1532A	24	38,172	1,431

DEP also determined the in-lake TN and TP concentrations, for informational purposes only, corresponding to the load-based TN and TP site-specific interpretations of the narrative criterion that attain the target chlorophyll *a* concentration of 20 µg/L for Lake Marion and 24 µg/L for Lake Pierce. Based on the simulated chlorophyll *a* concentrations, a distribution of the yearly simulated nutrient concentrations was derived in the modeling approach, and the 80th percentile of this distribution was selected as the restoration TN and TP concentrations. The statistical derivation of the 80th percentile is consistent with a 1-in-3-year exceedance rate.

For Lake Marion, the TN and TP AGM concentrations of 0.75 and 0.04 mg/L, respectively, are not to be exceeded more than once in any consecutive 3-year period. For Lake Pierce, the TN and TP AGM concentrations of 1.11 and 0.03 mg/L, respectively, are not to be exceeded more than once in any consecutive 3-year period.

3.4 Downstream Protection

As discussed in **Section 1.2**, Lake Marion (WBID 1480) is a large lake located directly north of Lake Pierce in east Polk County. Lake Marion discharges into Lake Marion Creek (WBID 1472A1) on the north end of the lake and flows into Lake Hatchineha (WBID 1472B). Lake Marion Creek was delisted for chlorophyll *a* in the 2017 Group 4 assessment and Lake Hatchineha was previously impaired for nutrients based on the Trophic State Index (TSI) but is no longer being assessed with this method and therefore was also delisted. Lake Pierce (WBID 1532A), a large lake located directly south of Lake Marion in east Polk County, discharges into Catfish Creek on the south end of the lake. The creek flows into a network of agricultural canals and Lake Hatchineha (WBID 1472AB). The reductions in nutrient loads described in this TMDL analysis are not expected to cause nutrient impairments but to improve water quality in downstream waters.

3.5 Endangered Species Considerations

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, the National Oceanic and Atmospheric Administration, and the National Marine Fisheries Service), to ensure that any federal 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.

DEP is not aware of any endangered species present in the lakes discussed in this TMDL analysis. Based on the U.S. Fish and Wildlife Service online Information for Planning and Conservation tool, the only endangered species listed are terrestrial; there are no aquatic, amphibious, or anadromous endangered species. It is expected that water quality improvements from these restoration efforts directed towards a more natural system will positively impact any species living in the lakes and their respective watersheds.

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. In contrast, the term "nonpoint sources" was 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.

However, the 1987 amendments to the CWA redefined certain nonpoint sources of pollution as point sources subject to regulation under the EPA's National Pollutant Discharge Elimination System (NPDES) Program. These nonpoint sources included 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).

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**). However, the methodologies used to estimate nonpoint source loads do not distinguish between NPDES and non-NPDES stormwater discharges, and as such, this source assessment section does not make any distinction between the two types of stormwater.

4.2 Point Sources

4.2.1 Wastewater Point Sources

There are no NPDES-permitted wastewater facilities that discharge to Lake Pierce or to surface waters in the Lake Pierce Watershed. There is, however, one NPDES wastewater facility located in the Lake Marion Watershed.

The NPDES-permitted industrial wastewater facility in the Lake Marion Watershed (Permit Number FLG110259) is the Argos USA concrete batch plant. This facility does not normally discharge from its wastewater containment system to offsite groundwater or surface waters of the state. However, in the event of a 25-year, 24-hour storm event, the facility is permitted to discharge to surface waters up to the volume of rainfall on the retention facilities.

4.2.2 Municipal Separate Storm Sewer System (MS4) Permittees

The Lake Marion and Lake Pierce Watersheds are covered by Polk County's NPDES MS4 Phase I permit (FLS000015). Florida Department of Transportation (FDOT) District 1 and the Cities of Davenport and Haines are copermittees for the MS4 permit in the Lake Marion Watershed. FDOT District 1 and the Towns of Dundee and Lake Hamilton are the copermittees for the MS4 permit in the Lake Pierce Watershed. For more information on MS4 facilities in the watersheds, send an email to: npdes-stormwater@dep.state.fl.us. **Table 4.1** lists the MS4 permittee/copermittees and their MS4 permit numbers.

Table 4.1. NPDES MS4 permits with jurisdiction in the two watersheds

Permit Number	Permittee/ Copermittee	Phase
FLS000015	Polk County	I
FLS000015 copermittees	FDOT District 1 – Polk City of Haines City of Davenport Town of Dundee Town of Lake Hamilton	I

4.3 Nonpoint Sources

Pollutant sources that are not NPDES wastewater or stormwater discharges are generally considered nonpoint sources. Nutrient loadings to Lake Marion and Lake Pierce are primarily generated from 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 a watershed. Nutrients can be flushed into a receiving water through surface runoff and stormwater conveyance systems during stormwater events. Both human land use areas and natural land areas generate nutrients. However, human land uses typically generate more nutrient loads per unit of land surface area than natural lands produce. **Table 4.2** lists 2014 land use for the Lake Marion Watershed, and **Table 4.3** lists 2014 land use for the Lake Pierce Watershed, based on data from SWFWMD. **Figures 4.1** and **4.2** shows the land use information graphically. These data were applied in the development of watershed loadings to the lakes, described in **Section 4.4**. The watershed loadings were then used in the development of the lake water quality model documented in **Chapter 5**.

The Lake Marion Watershed covers an area of 24,518 acres (38 square miles). Agriculture comprises 32 % of the watershed, residential 22 %, and wetlands 13 %. The Lake Pierce

Watershed covers an area of 35,714 acres (56 square miles). Agriculture comprises 46 % of the watershed, water 14 %, and residential 14 %.

Table 4.2. SWFWMD land use in the Lake Marion Watershed in 2014

Code	Description	Acres	% of Watershed
1100	Low-Density Residential	2,446.31	9.98
1200	Medium-Density Residential	1,920.99	7.84
1300	High-Density Residential	1,093.91	4.46
1400	Commercial	251.82	1.03
1500	Light Industrial	298.47	1.22
1600	Extractive/Quarries/Mines	629.21	2.57
1700	Institutional	210.01	0.86
1800	Recreational	634.75	2.59
1900	Open Land	624.08	2.55
2000	Agriculture	7,815.06	31.88
3000	Rangeland	649.91	2.65
4000	Forest/Rural Open	1,332.42	5.43
5000	Water	3,057.86	12.47
6000	Wetlands	3,308.62	13.49
7000	Barren Land	158.49	0.65
8000	Communication and Transportation	85.85	0.35
	Total	**24,517.78**	**100.0**

Table 4.3. SWFWMD land use in the Lake Pierce Watershed in 2014

Code	Description	Acres	% of Watershed
1100	Low-Density Residential	3,171.87	8.88
1200	Medium-Density Residential	1,214.94	3.40
1300	High-Density Residential	451.31	1.26
1400	Commercial	75.06	0.21
1500	Light Industrial	99.81	0.28
1600	Extractive/Quarries/Mines	487.00	1.36
1700	Institutional	171.14	0.48
1800	Recreational	247.36	0.69
1900	Open Land	151.09	0.42
2000	Agriculture	16,370.97	45.84
3000	Rangeland	538.73	1.51
4000	Forest/Rural Open	2,986.88	8.36
5000	Water	4,828.72	13.52
6000	Wetlands	4,766.22	13.35
7000	Barren Land	95.69	0.27
8000	Communication and Transportation	57.21	0.16
	Total	**35,713.98**	**100.0**

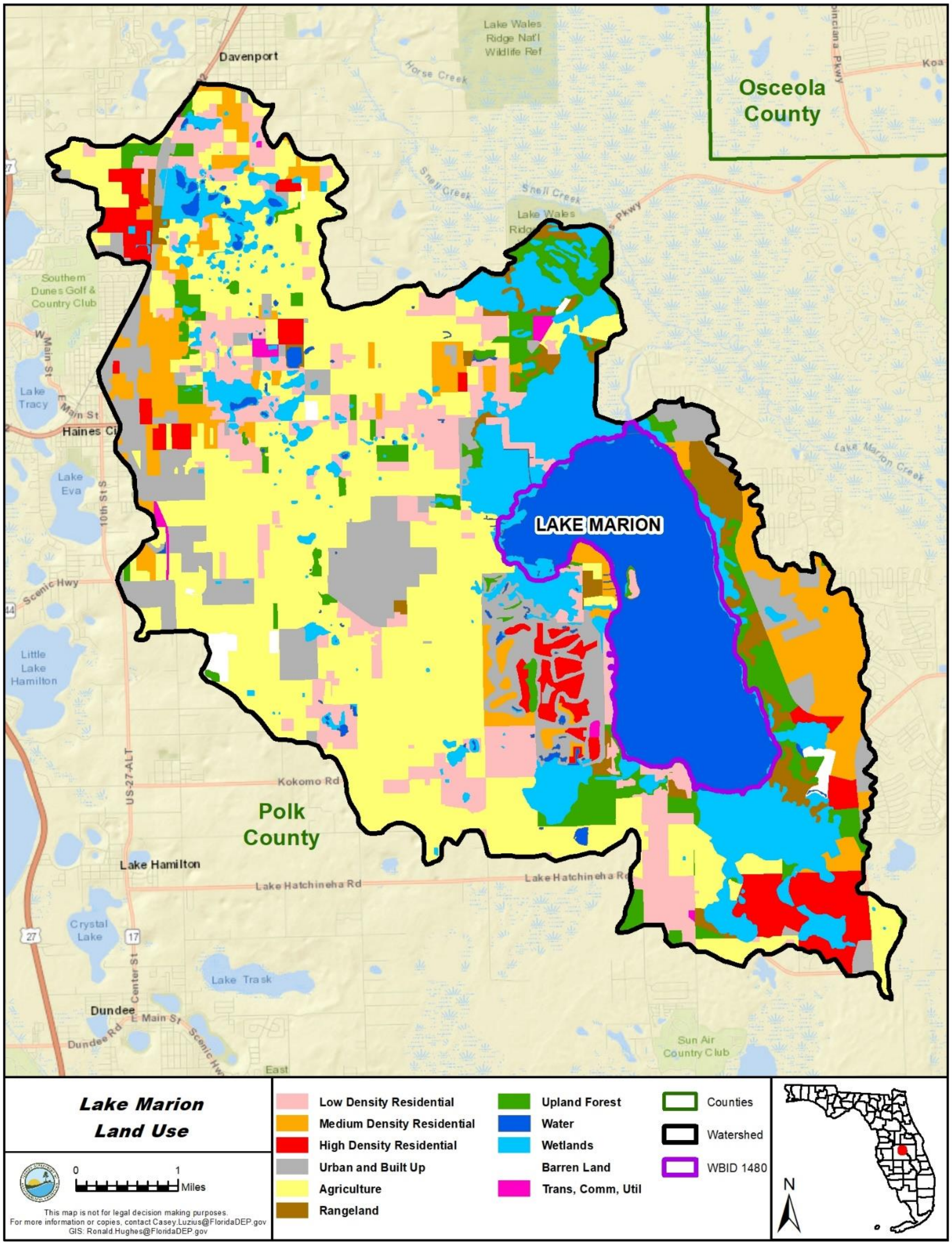


Figure 4.1. Land use in the Lake Marion Watershed in 2014

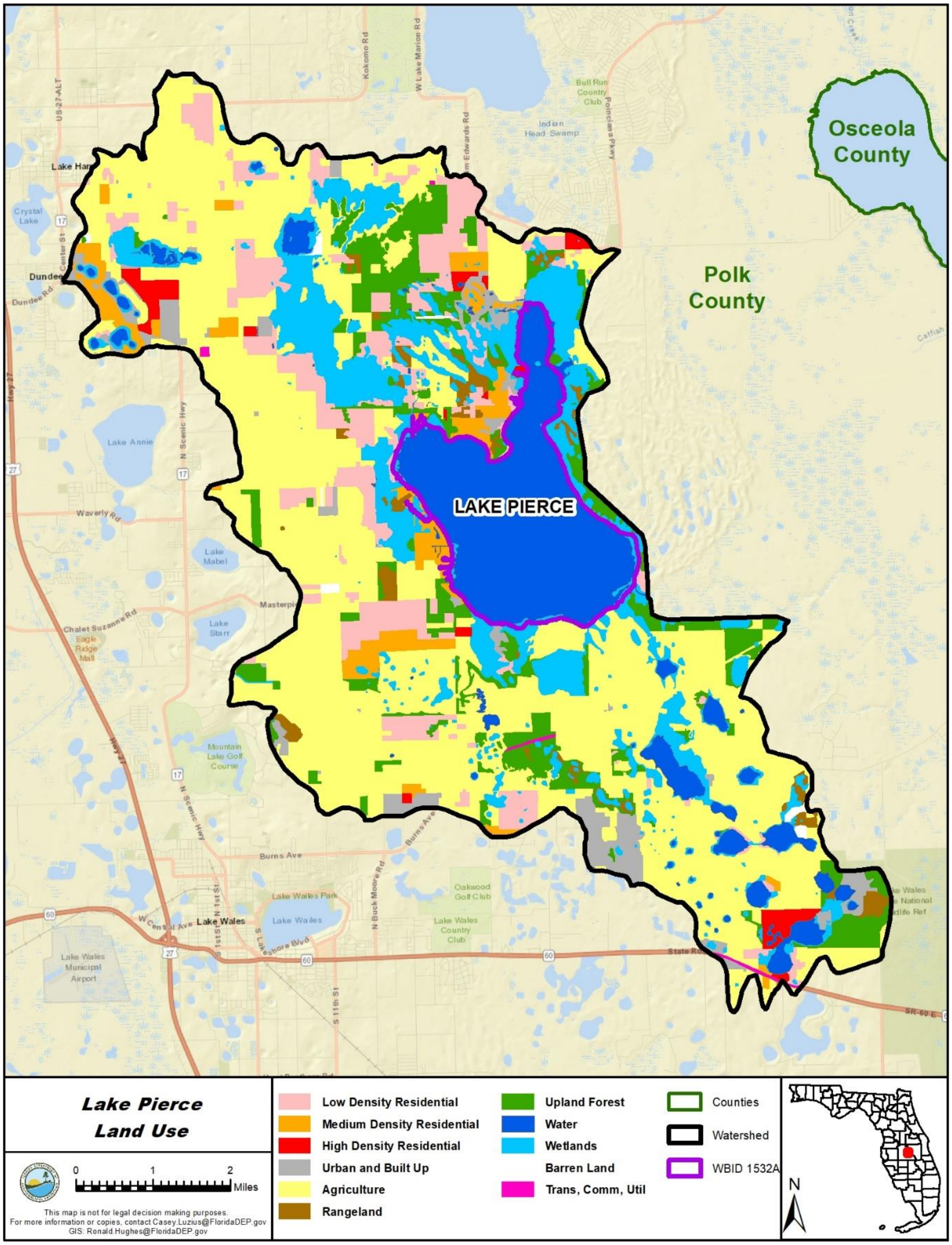


Figure 4.2. Land use in the Lake Pierce Watershed in 2014

4.3.2 Onsite Sewage Treatment and Disposal Systems (OSTDS)

OSTDS, including septic systems, are commonly used in rural areas where providing central sewer service is not cost-effective or practical. When properly sited, designed, constructed, maintained, and operated, OSTDS are a safe means of disposing of domestic waste. The effluent from a well-functioning OSTDS is comparable to secondarily treated wastewater from a sewage treatment plant. However, OSTDS can be a source of nutrients (nitrogen and phosphorus), pathogens, and other pollutants to both groundwater and surface water.

The Florida Department of Health maintains a list of septic systems by county, and the Polk County 2018 Database was used to determine the number of known, likely, and somewhat likely number of septic systems in the watersheds. Currently, there are 3,580 septic systems in the Lake Marion Watershed and 3,267 septic systems in the Lake Pierce Watershed. **Figures 4.3** and **4.4** show the OSTDS locations in the two watersheds, respectively.

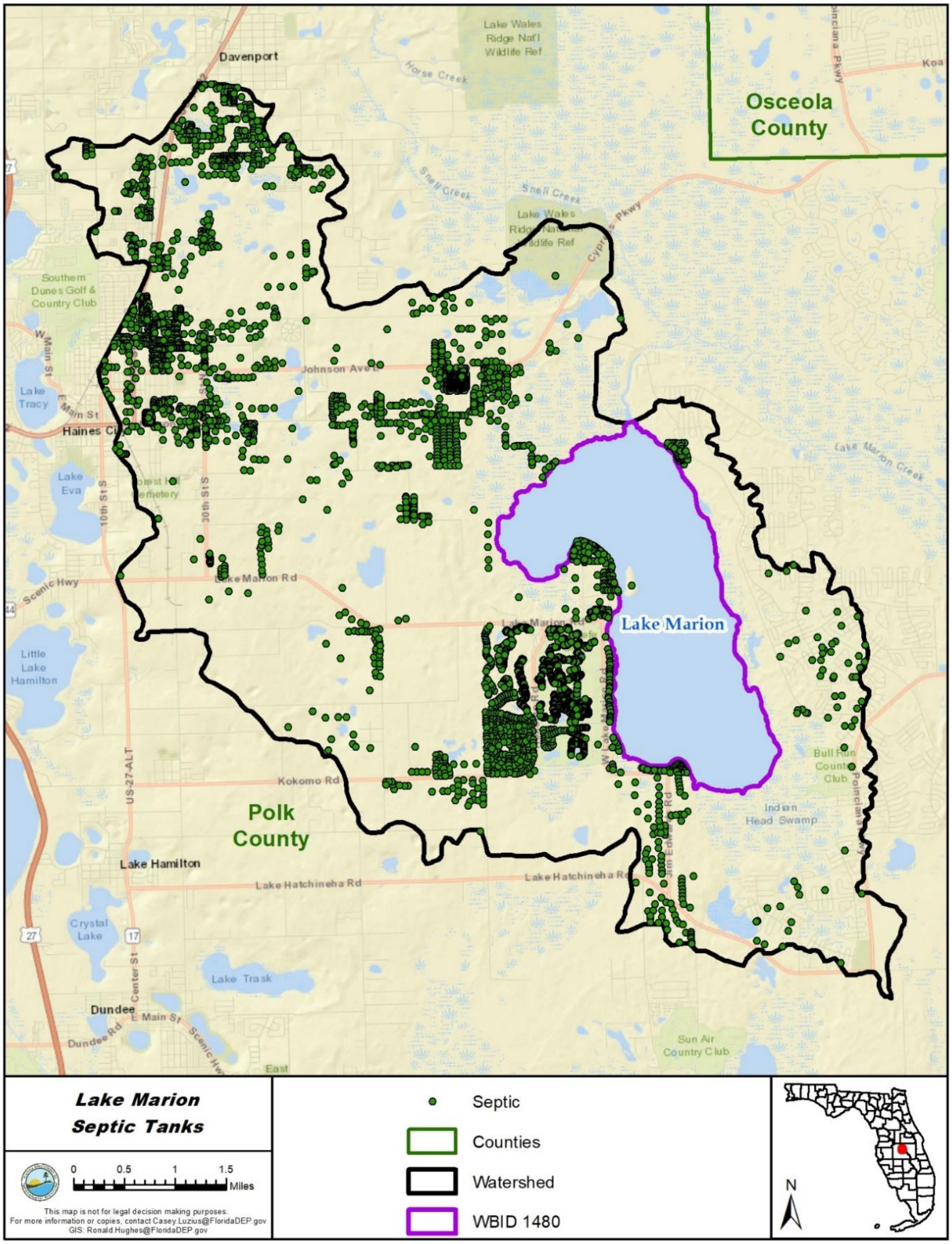


Figure 4.3. OSTDS in the Lake Marion Watershed

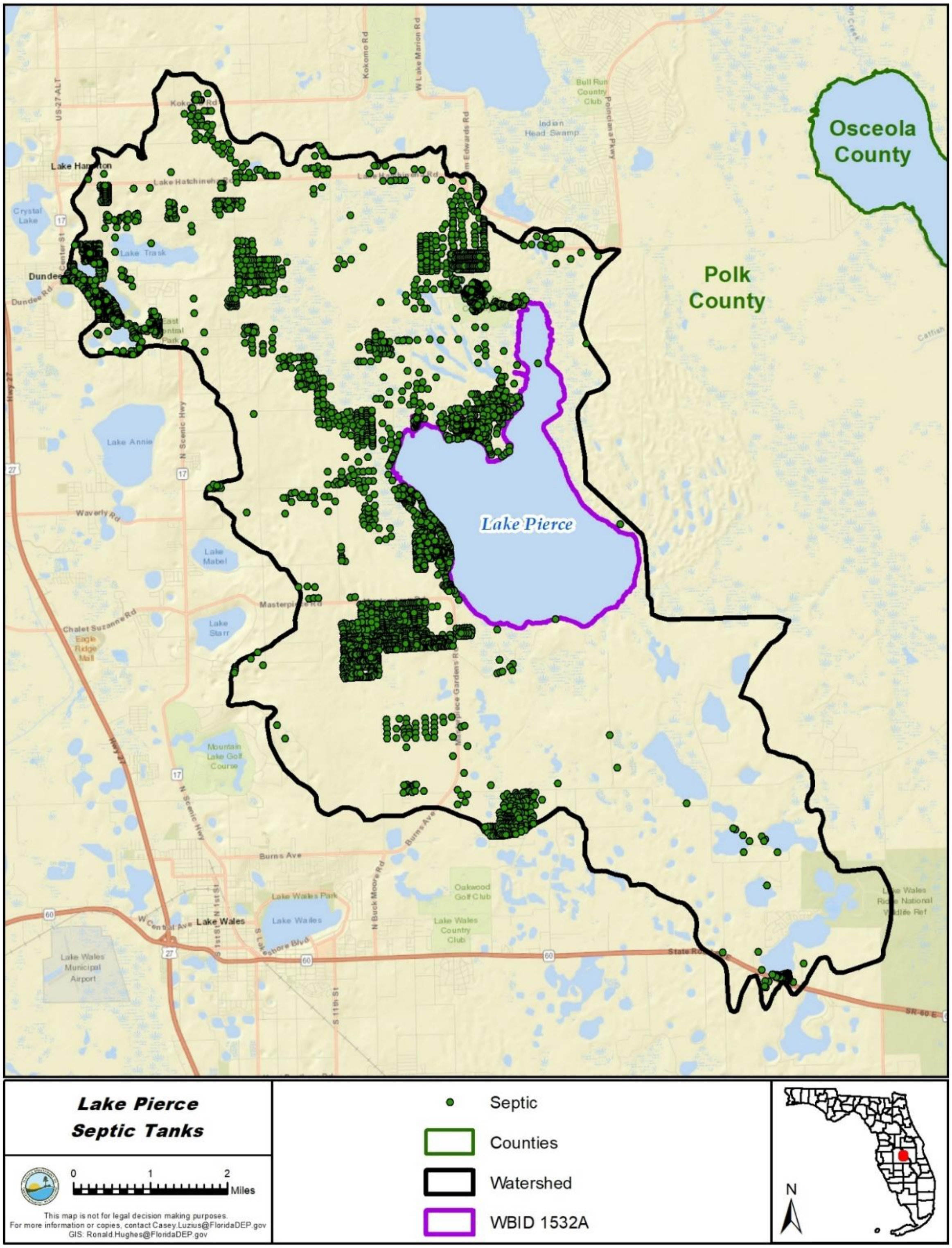


Figure 4.4. OSTDS in the Lake Pierce Watershed

4.3.3 Atmospheric Deposition

Nutrient loadings from the atmosphere are an important component of the nutrient budget in many Florida lakes. Nutrients are delivered through two pathways: wet atmospheric deposition with precipitation and dry particulate-driven deposition. Atmospheric deposition to terrestrial portions of the Lake Marion and Lake Pierce Watersheds is assumed to be accounted for in the loading rates used to estimate the watershed loading from land. There are no known complete atmospheric deposition data for Lake Marion and Lake Pierce. Therefore, loading from atmospheric deposition directly onto the water surface was estimated based on data collected by the St. Johns River Water Management District (SJRWMD) in Lake Apopka. These included both wet and dry atmospheric deposition data.

The dry deposition portion is expressed as a per area loading rate (areal loading rate) on an annual scale. The area of each lake was multiplied by the annual areal loading rate to calculate the total annual dry deposition. Wet deposition is delivered by precipitation (South Florida Water Management District [SFWMD] data), and annual wet deposition is therefore expressed as a concentration of solutes in precipitation multiplied by the total volume of precipitation. An annual areal loading rate was then calculated by dividing the wet deposition for each entire lake by the lake surface area. Atmospheric deposition values for the years beyond 2012 were estimated by averaging dry deposition and rainfall components for wet deposition values from 2000 to 2012. The TN and TP atmospheric loading rates averaged from 2007 to 2016 were 868 and 45 milligrams per square meter per year ($mg/m^2/yr$), respectively. The average atmospheric loads for Lake Marion for TN and TP were 10,555 and 547 kg/yr, respectively. The average atmospheric loads for Lake Pierce for TN and TP were 13,272 and 688 kg/yr, respectively.

4.3.4 Evaporation

There are no full evaporation data for Lake Marion and Lake Pierce; therefore, values from the Lake Roberts TMDL report were used (Kang 2017). The potential evapotranspiration data were obtained from the Lisbon weather station from 2000 to 2012 by SJRWMD. The evaporation data were converted to lake evaporation by multiplying by a pan coefficient of 0.76. Values beyond 2012 were calculated using an average of the available data. **Table 4.4** lists the evaporation data calculated for Lake Roberts.

Table 4.4. Annual total evaporation for Lake Roberts, 2000-12

m/yr = meters per year

Year	Lake Evaporation (m/yr)
2000	1.14
2001	1.10
2002	1.16
2003	1.13
2004	1.00
2005	0.99
2006	1.06
2007	1.02
2008	1.01
2009	1.03
2010	1.01
2011	1.08
2012	1.05
Average	1.06

4.4 Estimating Watershed Loadings

To simulate nutrient loading from the Lake Marion and Lake Pierce Watersheds, the Natural Resources Conservation Services curve number model approach was used, following the procedure in Fulton et al. 2004. This approach estimates runoff volume by taking into consideration the land use type, soil type, and antecedent moisture condition of the soil. Curve numbers from 20 to 100 are assigned to different land use–soil combinations to represent different runoff potentials.

Rainfall is the driving force of the curve number simulation. The rainfall data used in this TMDL analysis were from SFWMD (DBKEY Station). The curve number model used watershed runoff calculations and multiplied the runoff by the TN and TP event mean concentrations (EMCs) to calculate the total watershed nutrient loads. EMCs were based on general land use descriptions and were spatially averaged data in Florida (Harper 2012; 1994), and land use descriptions for the EMCs were matched with SWFWMD 2014 land use coverage. Nutrient loading directly deposited onto the lake surface from the atmosphere and nutrient loadings from groundwater seepage were also estimated.

The simulated nutrient loads were then entered into a lake eutrophication model, BATHTUB, by the U.S. Army Corps of Engineers (USACE) to simulate in-lake TN, TP, and chlorophyll *a* concentrations. **Tables 4.5** and **4.6** list the runoff volumes from the curve number model and in-lake TN and TP loads for Lake Marion and Lake Pierce (2007–16), respectively, for the model periods.

Table 4.5. Curve number model runoff volumes and nutrient loadings to Lake Marion

hm^3/yr = cubic hectometers per year
kg/yr = kilograms/year

Year	Runoff Volume (hm^3/yr)	TN Load (kg/yr)	TP Load (kg/yr)
2007	8.69	13,541	1,593
2008	10.47	16,315	1,919
2009	13.88	21,629	2,544
2010	14.90	23,218	2,731
2011	20.16	31,415	3,695
2012	9.04	14,087	1,657
2013	8.24	12,840	15,10
2014	9.04	14,087	1,657
2015	24.85	38,723	4,555
2016	11.10	17,297	2,035

Table 4.6. Curve number model runoff volumes and nutrient loadings to Lake Pierce

hm^3/yr = cubic hectometers per year
kg/yr = kilograms/year

Year	Runoff Volume (hm^3/yr)	TN Load (kg/yr)	TP Load (kg/yr)
2007	11.35	17,145	1,699
2008	13.92	21,028	2,084
2009	18.24	27,553	2,731
2010	19.68	29,729	2,946
2011	27.15	41,013	4,064
2012	11.93	18,022	1,756
2013	10.72	16,194	1,605
2014	11.43	17,266	1,711
2015	33.03	49,895	4,945
2016	14.45	21,828	2,163

4.4.1 Estimating Septic Tank Flow Rates and Loads

Flow was estimated to include septic tank contributions in the watershed loading. To estimate flow, the following equation was used:

$$S * P * W * flr * 365 = \text{Flow rate (gallons/year)}$$

Where:

S = # of known septic systems within 200 meters.
P = average number of people per household.
W = individual water consumption (70 gallons/day).
flr = flow loss rate (15 %).

The number of known and likely septic systems within a 200-meter (m) buffer of Lake Marion and Lake Pierce was 239 and 277, respectively. According to the U.S. Census Bureau, Polk County had an average of 2.82 people per household who individually use approximately 70 gallons of water per day with a flow loss rate of 15 % (EPA 2002; Tetra Tech 2017). The number of septic systems, the number of people per household, the individual water consumption, and a value of 0.85 were multiplied to estimate the total flow rate for septic systems. Flow rates were converted to cubic hectometers for modeling. Both Lake Marion and Lake Pierce have an estimated septic tank flow of 0.06 hm^3/yr.

Inorganic nutrients (i.e., nitrate nitrogen and ammonia) are the main nutrients associated with septic systems, since the majority of phosphorus loads to groundwater from septic systems are adsorbed onto soil particles immediately or very soon after discharge. For modeling purposes, these various forms of nutrients are referred to as TN. The following equation was used to estimate nitrogen loading from septic systems:

S * P * I * L = Total TN (lbs) from septic systems

Where:

S = # of known septic systems in groundwater zones.
P = average number of people per household.
I = # lbs TN per person per septic tank.
L = percentage of TN lost during seepage.

The number of septic systems was multiplied by the number of people per household. These values were then multiplied by 9.012, which is the approximate pounds of TN per person seeping from a septic tank per year (EPA 2002; Toor et al. 2011), and by 0.50, which accounts for the 50 % nitrogen loss that occurs as septic tank effluent moves through the unsaturated zone to groundwater. Lake Marion and Lake Pierce have a septic tank nitrogen load of 3,037 and 3,520 lbs/yr (1,378 and 1,597 kg/yr), respectively.

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 assimilative capacity of Lake Marion and Lake Pierce and to identify the maximum allowable TN and TP loadings and the associated nutrient source reductions, so that the lakes will meet the TMDL targets and thus maintain their function and designated use as Class III waters.

5.2 Evaluation of Water Quality Conditions

Figures 5.1 and **5.2** show the chlorophyll *a* AGM values and annual rainfall for Lake Marion and Lake Pierce, respectively. There are no clear direct relationships between rainfall and chlorophyll *a* in either of the lakes. The lack of strong relationships between nutrients and rainfall suggests that adjustments for seasonality and rainfall are unlikely to affect the TMDL determination.

For the water quality analysis conducted for TMDL development, AGMs were used to be consistent with the expression of the adopted NNC for lakes. They were calculated using a minimum of four sample results per year, with at least one of the samples collected in the May-to-September period and at least one sample collected from other months. Values with an "I" qualifier code were used as reported. Values with "U" or "T" qualifier codes were changed to the minimum detection limit divided by the square root of 2. Values with "G" or "V" qualifier codes were removed from the analysis for quality control reasons. Negative values and zero values were also removed. Multiple sample results collected in the same day were averaged.

The AGM calculation method for this purpose is somewhat different than the one used to calculate AGMs for performing water quality assessments, following the methodology in Chapter 62-303, F.A.C. Therefore, the AGMs listed in **Chapter 2** may not exactly match the AGMs used for TMDL development.

5.3 Critical Conditions and Seasonal Variation

The lakes' estimated assimilative capacity is based on annual conditions, rather than critical/seasonal conditions, because (1) the methodology used to determine assimilative capacity does not lend itself very well to short-term assessments; (2) DEP is generally more concerned with the net change in overall primary productivity in the segment, which is better addressed on an annual basis; and (3) the methodology used to determine impairment is based on annual conditions (AGM values).

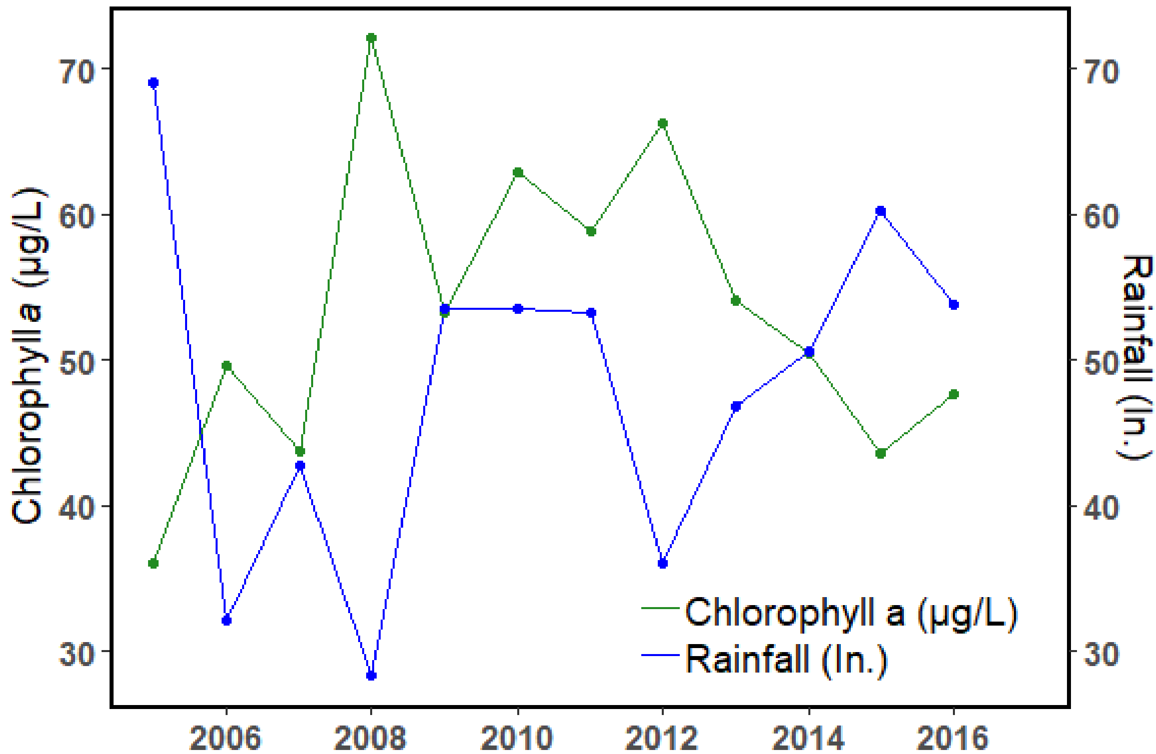


Figure 5.1. Chlorophyll *a* AGM values vs. annual rainfall in Lake Marion

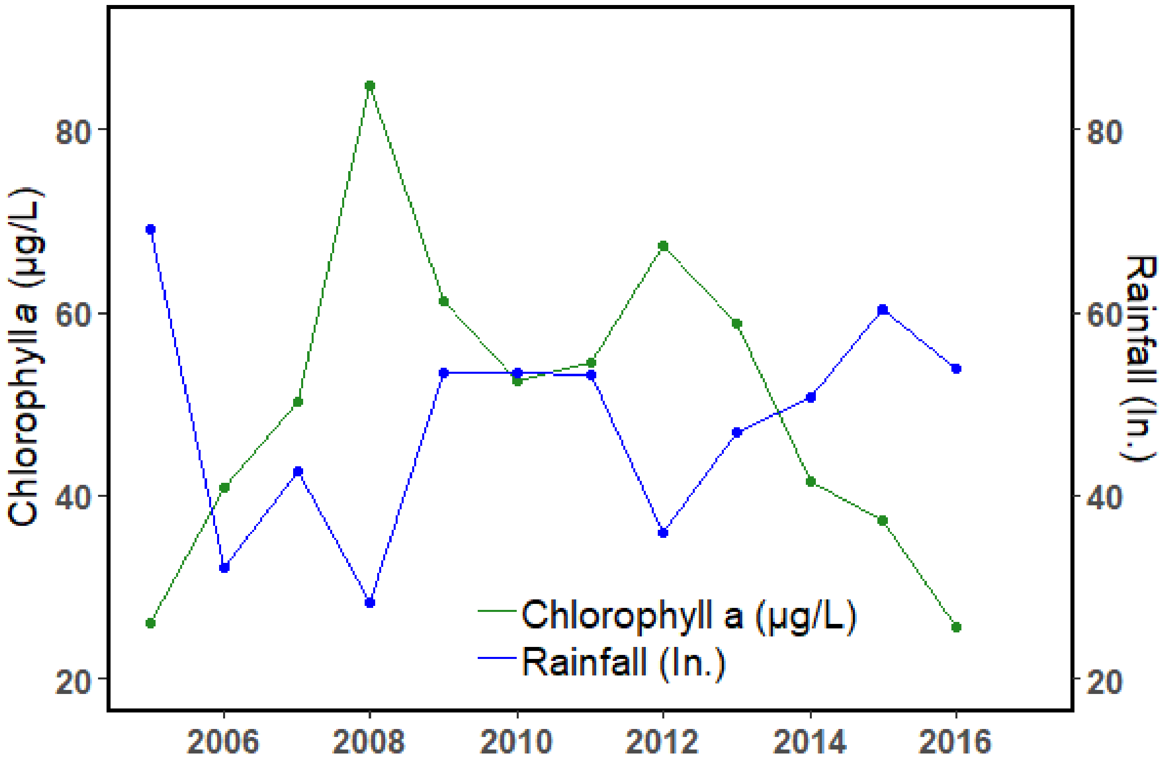


Figure 5.2. Chlorophyll *a* AGM values vs. annual rainfall in Lake Pierce

5.4 Water Quality Modeling to Determine Assimilative Capacity

The BATHTUB eutrophication model was used to predict nutrient and chlorophyll conditions for Lake Marion and Lake Pierce based on physical lake characteristics and curve number model-derived watershed loads. The BATHTUB model was then used to simulate nutrient loading conditions when the lakes had balanced aquatic flora and fauna to ensure that natural conditions would not be abated.

5.4.1 Water Quality Model Description

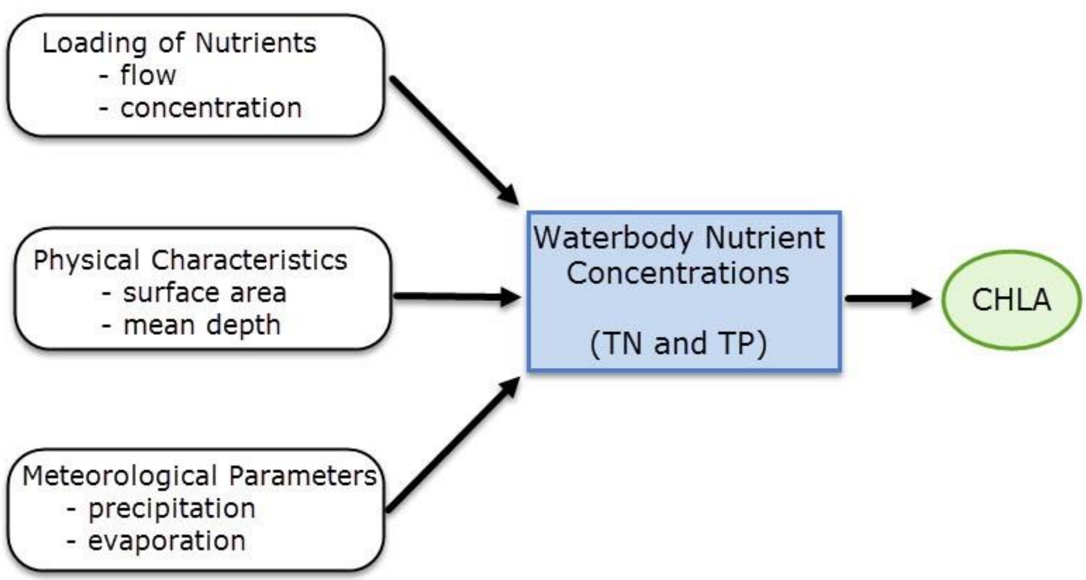
The BATHTUB eutrophication model is a suite of empirically derived steady-state models developed by the USACE Waterways Experimental Station. The primary function of these models is to estimate nutrient concentrations and algal biomass resulting from different patterns of nutrient loadings.

The user's manual (Walker 2004) describes the procedures for selecting the appropriate model for a particular waterbody. The empirical prediction of eutrophication with this approach is typically a two-stage procedure using the following two categories of models (Walker 1987):

- The **nutrient balance model** relates the nutrient concentration to the external nutrient loadings, morphometrics, and hydraulics of the waterbody.

- The **eutrophication response model** describes the relationships among eutrophication indicators in the waterbody, including nutrient levels, chlorophyll *a*, transparency, and hypolimnetic oxygen depletion.

Figure 5.3 illustrates the model concept for BATHTUB. It relates the external loading of nutrients to the waterbody nutrient concentrations and the physical, chemical, and biological responses of the waterbody to the level of nutrients. The BATHTUB model includes a suite of phosphorus and nitrogen sedimentation models, along with a set of chlorophyll and Secchi depth models. The nutrient balance models assume that the net accumulation of nutrients in a waterbody is the difference between the nutrient loadings into the waterbody from various sources and the nutrients carried out through outflow and the losses of nutrients through decay processes inside the waterbody. Different limiting factors such as nitrogen, phosphorus, light, or flushing are considered in the selection of an appropriate chlorophyll *a* model. The variety of models available in BATHTUB allows the user to choose specific models based on a waterbody's particular condition.



Chla = Chlorophyll *a*

Figure 5.3. BATHTUB model concept

5.4.2 Model Selection and Calibration

In Lake Marion, Model 01 (2ND order available phosphorus), Model 02 (2ND order decay), and Model 03 (phosphorus, nitrogen, low-turbidity) were selected to simulate phosphorus sedimentation, nitrogen sedimentation, and chlorophyll *a*, respectively. In Lake Pierce, Model 01 (2ND order available phosphorus), Model 02 (2ND order decay), and Model 03 (phosphorus, nitrogen, low-turbidity) were selected to simulate phosphorus sedimentation, nitrogen sedimentation, and chlorophyll *a*, respectively.

Calibration factors were used to fit the Lake Marion and Lake Pierce model predictions to the observed TN, TP, and chlorophyll a data. Calibration factors of 0.5, 0.9, and 1.5 were used for TP, TN, and chlorophyll *a*, respectively, to fit the Lake Marion model predictions. Calibration factors of 1.2, 0.85, and 1.75 were used for TP, TN, and chlorophyll *a*, respectively, to fit the Lake Pierce model predictions. Internal loading rates for in-lake processes for TN were set for Lake Marion at 2 and Lake Pierce at 3. Global variables input into BATHTUB included the averaging period for the analysis, precipitation, evaporation, and atmospheric loads. The averaging period for the analysis was one year, since inputs are on a year-to-year basis.

Figures 5.4, **5.5**, and **5.6** show the model-predicted results and observed concentrations for chlorophyll *a*, TN, and TP, respectively, for Lake Marion. **Figures 5.7**, **5.8**, and **5.9** show the model-predicted results and observed concentrations for chlorophyll *a*, TN, and TP, respectively, for Lake Pierce. To evaluate the model performance, the difference between the average simulated and average observed values was calculated for the model period for all the lakes. The long-term percent difference for the model period of predicted and observed chlorophyll *a*, TN, and TP was 4 %, 1 %, and 0.9 %, respectively, for Lake Marion. The long-term percent difference for the model period of predicted and observed chlorophyll *a*, TN, and TP was 3 %, 1 %, and 1 %, respectively, for Lake Pierce. Therefore, for all years the model performance for Lake Marion and Lake Pierce is considered "very good," according to generally accepted model calibration tolerance (Donigian 2000).

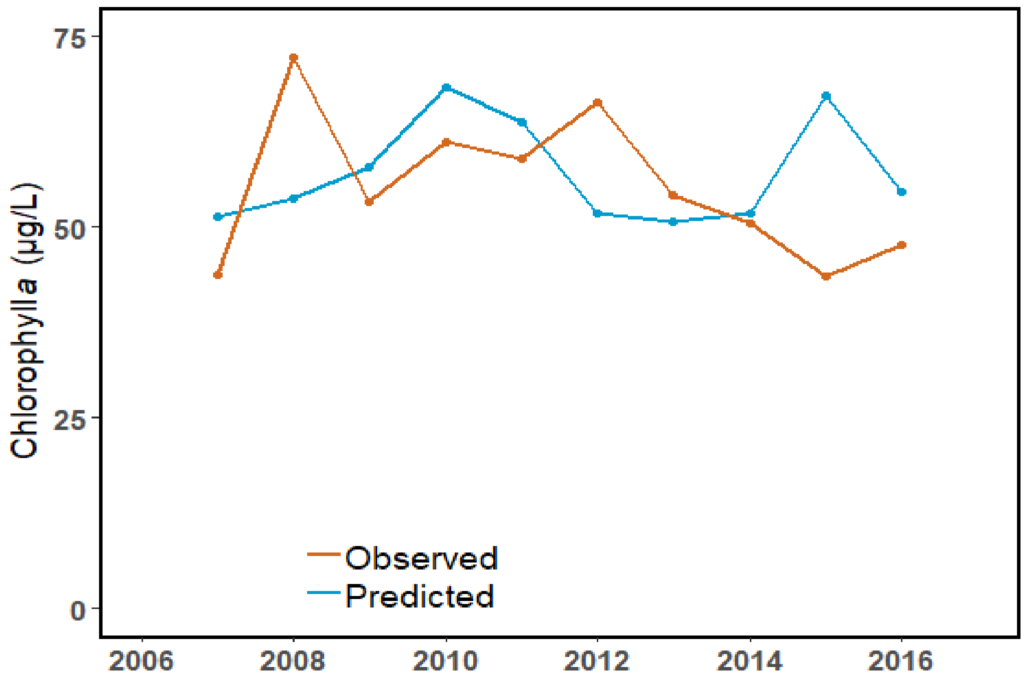


Figure 5.4. Predicted and observed chlorophyll *a* for Lake Marion

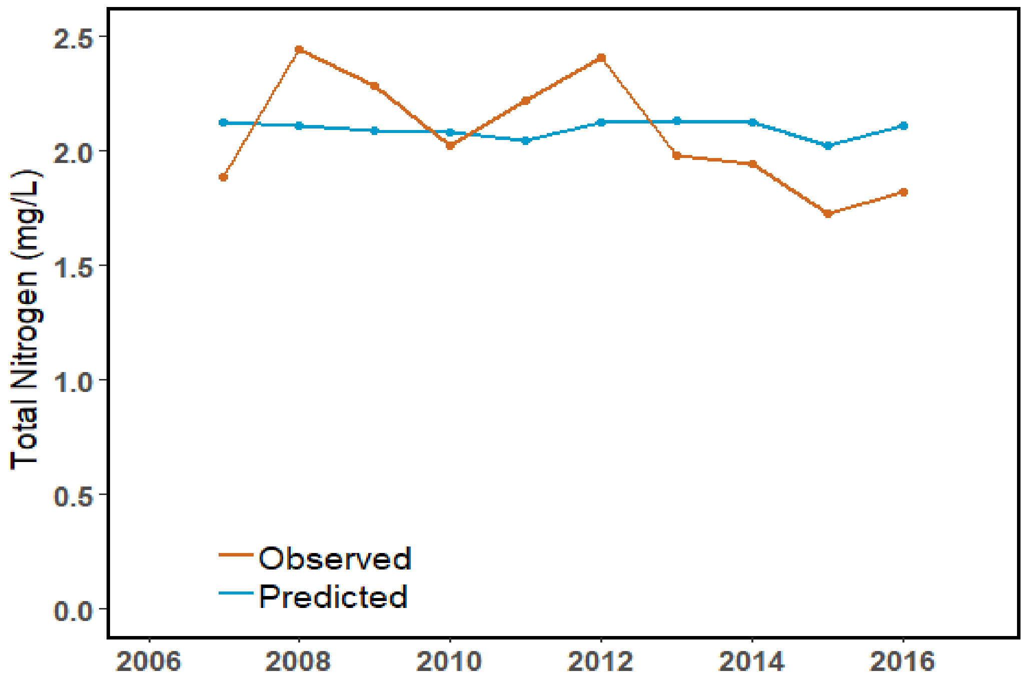


Figure 5.5. Predicted and observed TN for Lake Marion

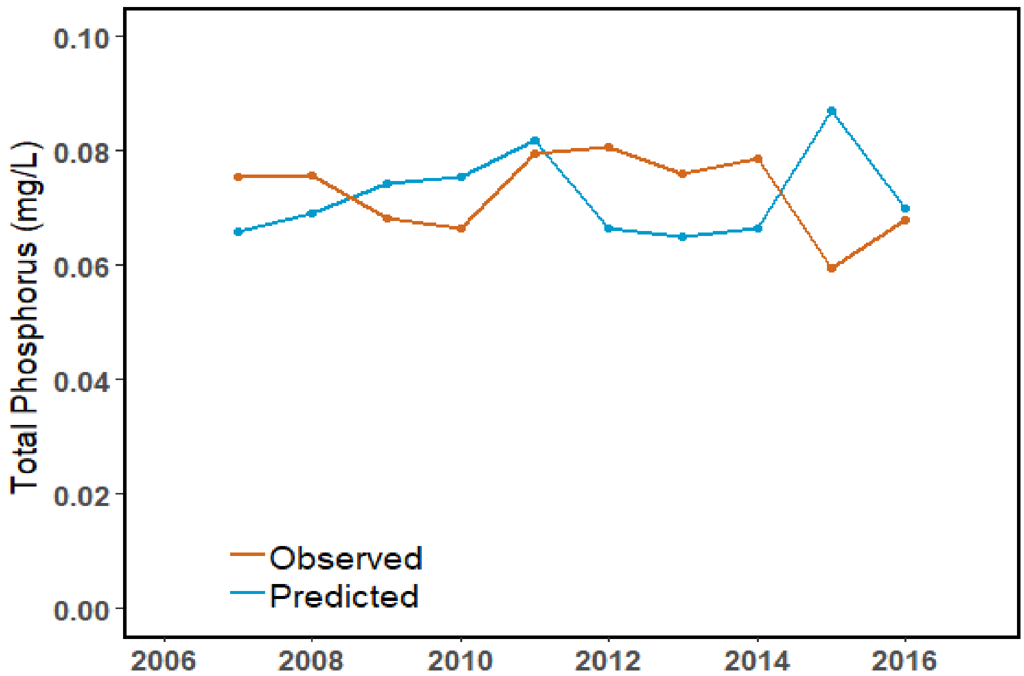


Figure 5.6. Predicted and observed TP for Lake Marion

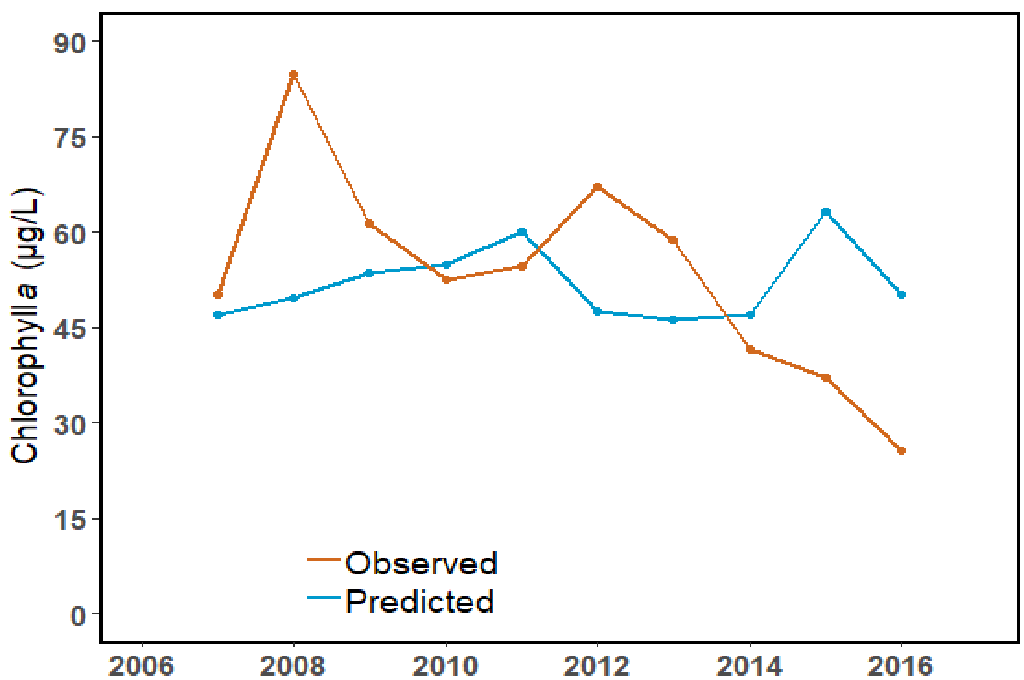


Figure 5.7. Predicted and observed chlorophyll *a* for Lake Pierce

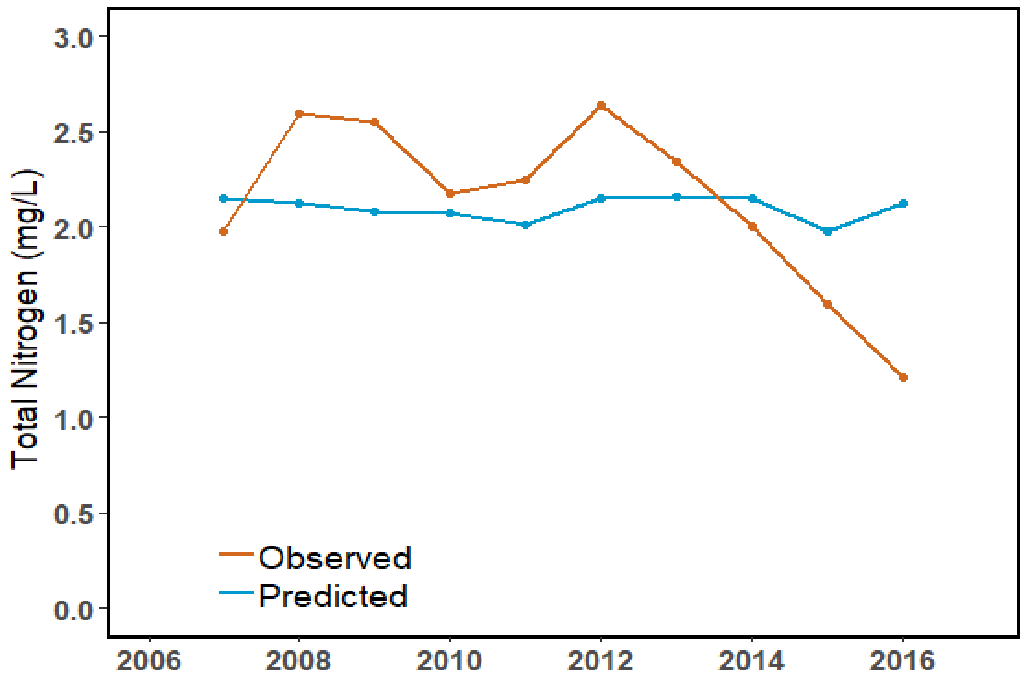


Figure 5.8. **Predicted and observed TN for Lake Pierce**

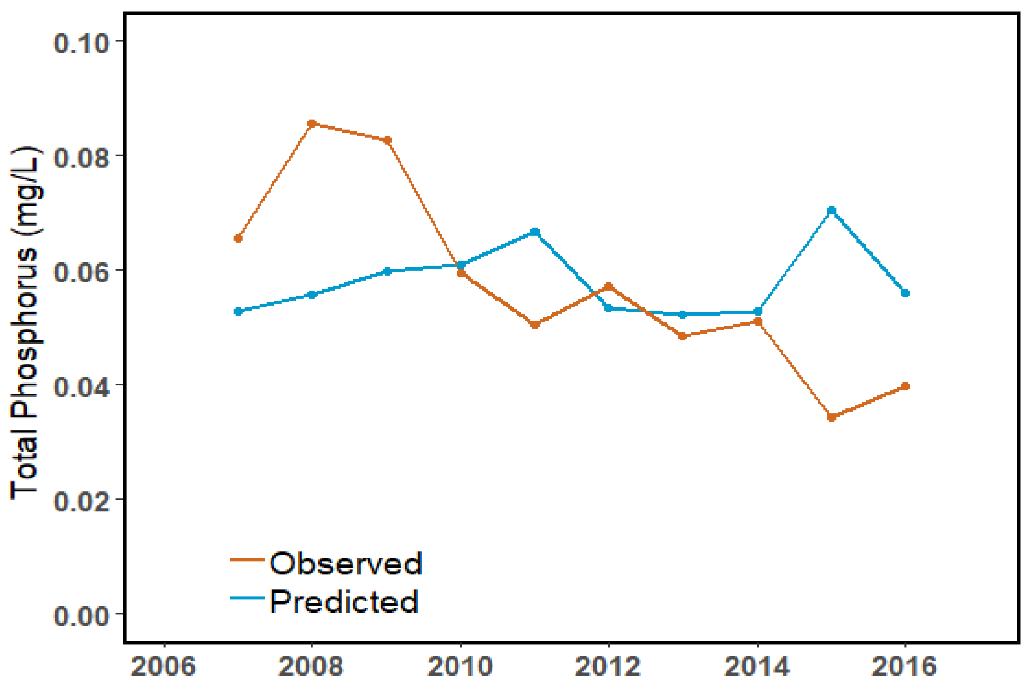


Figure 5.9. **Predicted and observed TP for Lake Pierce**

5.5 Calculation of the TMDLs

To achieve the target chlorophyll *a* concentration of 20 µg/L for Lake Marion and 24 µg/L for Lake Pierce, the existing TN and TP loads were iteratively reduced until the chlorophyll *a* target was achieved in every year of the modeling period (2007–16). Meeting the chlorophyll *a* target in every year is considered a conservative assumption for establishing TMDLs, as this will ensure that all exceedances of the nutrient targets are addressed. **Tables 5.1** and **5.2** list the BATHTUB-modeled loads for Lake Marion and Lake Pierce, respectively, including the TN and TP existing loads, the loads that achieve the criterion of 20 µg/L chlorophyll *a* for Lake Marion and 24 µg/L for Lake Pierce (TMDL condition), and their maximum 7-year averages.

The final reductions to establish the TMDLs for Lake Marion and Lake Pierce were calculated by using the maximum 7-year average of both the existing and TMDL condition TN and TP loads. The maximum 7-year averages for TN existing loads and TMDL condition loads for Lake Marion are 102,320 and 25,653 kg/yr, respectively. The maximum 7-year averages for TP existing loads and TMDL condition loads for Lake Marion are 3,729 and 1,222 kg/yr, respectively. The maximum 7-year averages for TN existing loads and TMDL condition loads for Lake Pierce are 90,090 and 38,172 kg/yr, respectively. The maximum 7-year averages for TP existing loads and TMDL condition loads for Lake Pierce are 3,798 and 1,431 kg/yr, respectively.

The general equation used to calculate the percent reductions based on maximum 7-year averages is as follows:

$$\frac{\textbf{Existing Load} - \textbf{TMDL Condition Load}}{\textbf{Existing Load}} * \mathbf{100}$$

To meet the TMDL loads for Lake Marion, the required percent reductions for the TN and TP existing loads are 75 % and 67 %, respectively. To meet the TMDL loads for Lake Pierce, the required percent reductions for the TN and TP existing loads are 58 % and 62 %, respectively. The nutrient TMDLs, which are expressed as a 7-year average load, not to be exceeded, address the anthropogenic nutrient inputs contributing to the exceedances of the chlorophyll *a* restoration target. Additionally, the TMDLs do not abate natural background in Lake Marion or Lake Pierce.

Table 5.1. Lake Marion TMDL existing and TMDL condition nutrient loads

kg/yr = kilograms/year; kg = kilograms

Year	TMDL Existing TN Loads (kg/yr)	TMDL Existing TP Loads (kg/yr)	TMDL Existing 7-year Average TN Loads (kg)	TMDL Existing 7-year Average TP Loads (kg)	TMDL Condition TN Loads (kg/yr)	TMDL Condition TP Loads (kg/yr)	TMDL Condition 7-year Average TN Loads (kg)	TMDL Condition 7-year Average TP Loads (kg)
2007	93,576	2,701			22,600	998		
2008	96,350	3,027			23,569	1,069		
2009	101,662	3,652			25,424	1,205		
2010	103,253	3,839			25,979	1,246		
2011	111,44	4,803			28,841	1,456		
2012	94,12	2,765			22,791	1,012		
2013	92,875	2,618	99,041	3,344	22,356	980	24,509	1,138
2014	94,121	2,765	99,119	3,353	22,791	1,012	24,536	1,140
2015	118,757	5,663	102,320	3,729	31,392	1,643	25,653	1,222
2016	97,331	3,143	101,701	3,657	23,912	1,094	25,437	1,206
Maximum 7-year Average			**102,320**	**3,729**			**25,653**	**1,222**

Table 5.2. Lake Pierce TMDL existing and TMDL condition nutrient loads

kg/yr = kilograms/year; kg = kilograms

Year	TMDL Existing TN Loads (kg/yr)	TMDL Existing TP Loads (kg/yr)	TMDL Existing 7-year Average TN Loads (kg)	TMDL Existing 7-year Average TP Loads (kg)	TMDL Condition TN Loads (kg/yr)	TMDL Condition TP Loads (kg/yr)	TMDL Condition 7-year Average TN Loads (kg)	TMDL Condition 7-year Average TP Loads (kg)
2007	78,711	2,671			33,253	1,156		
2008	82,593	3,055			34,931	1,250		
2009	89,119	3,702			37,753	1,408		
2010	91,294	3,918			38,693	1,460		
2011	102,578	5,036			43,572	1,733		
2012	79,587	2,757			33,631	1,177		
2013	77,759	2,576	85,949	3,388	32,841	1,133	36,382	1,331
2014	78,832	2,683	85,966	3,390	33,305	1,159	36,389	1,331
2015	111,461	5,916	90,090	3,798	47,412	1,949	38,172	1,431
2016	83,394	3,135	89,272	3,717	35,277	1,269	37,819	1,411
Maximum 7-year Average			**90,090**	**3,798**			**38,172**	**1,431**

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 Marion and Lake Pierce are expressed in terms of kilograms per year and percent reduction of TN and TP, and represent the lake nutrient loadings the waterbodies can assimilate while maintaining a balanced aquatic flora and fauna (see **Tables 6.1** and **6.2**, respectively). These TMDLs are based on the maximum 7-year averages of simulated data from 2007 to 2016 for Lake Marion and Lake Pierce.

The restoration goal for Lake Marion and Lake Pierce is to achieve the generally applicable chlorophyll *a* criterion of 20 µg/L for Lake Marion and site-specific chlorophyll *a* of 24 µg/L for Lake Pierce, which is expressed as an AGM not to be exceeded more than once in any consecutive 3-year period, thus protecting each lake's designated use. The load-based TMDL components 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 these particular waters.

Table 6.1. TMDL components for nutrients in Lake Marion (WBID 1480)

NA = Not applicable
Note: The LA and TMDL daily load for TN is 70 kg/day, and for TP 3 kg/day.
*The required percent reduction listed in this table represent the reductions from all sources.

Waterbody Name/WBID	Parameter	TMDL (kg/yr)	WLA Wastewater (% reduction)	WLA NPDES Stormwater (% reduction)*	LA (% reduction)*	MOS
Lake Marion/ 1480	TN	25,653	NA	75	75	Implicit
Lake Marion/ 1480	TP	1,222	NA	67	67	Implicit

Table 6.2. TMDL components for nutrients in Lake Pierce (WBID 1532A)

NA = Not applicable
Note: The LA and TMDL daily load for TN is 105 kg/day, and for TP 4 kg/day.
*The required percent reduction listed in this table represent the reductions from all sources.

Waterbody Name/WBID	Parameter	TMDL (kg/yr)	WLA Wastewater (% reduction)	WLA NPDES Stormwater (% reduction)*	LA (% reduction)*	MOS
Lake Pierce/ 1532	TN	38,172	NA	58	58	Implicit
Lake Pierce/ 1532	TP	1,431	NA	62	62	Implicit

6.2 Load Allocation

To achieve the LA, the percent reductions in current TN and TP sources to the lakes, as specified in **Tables 6.1** and **6.2**, will be required. The percent reductions represent the needed TN and TP reductions from all nonpoint sources, including stormwater runoff, groundwater contributions, and septic tanks. Although the TMDLs are based on the percent reductions from all sources to the lakes, it is not DEP's intent to abate natural conditions. The needed reduction from anthropogenic inputs will be calculated based on more detailed source information when a restoration plan is developed. The reductions in nonpoint source nutrient loads are expected to result in reduced sediment nutrient flux, which is commonly a factor in lake eutrophication.

It should be noted that 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**).

6.3 Wasteload Allocation

6.3.1 NPDES Wastewater Discharges

As noted in **Chapter 4**, no active NPDES-permitted facilities in the Lake Pierce Watershed discharge into the waterbody or watershed. Therefore, a WLA for wastewater discharges is not applicable.

There is one NPDES wastewater facility in the Lake Marion Watershed. The Argos USA concrete batch plant (Permit Number FLG110259) is permitted to intermittently discharge wastewater to surface waters in the watershed during severe storm events, limited to the volume of rain that falls on the containment facility. A WLA for wastewater discharges to Lake Marion is applicable to the Argos USA facility. Based on the permitting guidance, even in the event of a large storm the retention structures are designed so that no water from the facility will flow into surface water or groundwater. Furthermore, the discharged effluent from this plant does not have the potential to increase nutrients in the watershed.

6.3.2 NPDES Stormwater Discharges

Polk County and copermittees (FDOT District 1, the Cities of Davenport and Haines, and the Towns of Dundee and Lake Hamilton) are covered by a Phase I NPDES MS4 permit (FLS000015). Areas within these jurisdictions are responsible for a 75 % reduction in TN and a 67 % reduction in TP from the current anthropogenic loading to Lake Marion and a 58 % reduction in TN and a 62 % reduction in TP loadings to Lake Pierce.

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

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. 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]). 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.

An implicit MOS was used in the development of the TMDLs because of the conservative assumptions that were applied. The TMDLs were developed using the highest TN and TP AGM values to calculate the percent reductions and requiring the TMDL targets not to be exceeded in any one year.

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 implement 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 on the development and implementation of BMAPs can be 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—such as wastewater facilities, industrial sources, agricultural producers, county and city stormwater systems, military bases, water control districts, state agencies, and individual property owners—usually implement these strategies. BMAPs can also identify mechanisms to address potential pollutant loading from future growth and development.

The Lake Marion and Lake Pierce Watersheds are located in the Lake Okeechobee BMAP area. The BMAP was adopted in December 2014 to implement the TP TMDL in the Lake Okeechobee Watershed, and activities are ongoing throughout the larger basin to reduce nutrient loads to Lake Okeechobee. Management strategies in the Lake Marion and Lake Pierce Watersheds will also address nutrient impairments for the lakes and will likely benefit the lakes at a different level than reported in the Lake Okeechobee BMAP. In Polk County, education practices (e.g., pamphlets and public service announcements) and outreach are conducted in regard to fertilizer ordinances, illicit discharges, and septic tank regulations to reduce nutrient loading to lakes including Lake Marion and Lake Pierce, are further described in the Lake Okeechobee BMAP. Additional information about BMAPs is available on DEP's website.

7.3 Implementation Considerations for the Waterbodies

In addition to addressing reductions in watershed pollutant contributions to impaired waters during the implementation phase, it is also necessary to consider the impacts of internal sources (e.g., sediment nutrient fluxes or the presence of nitrogen-fixing cyanobacteria) and the results of any associated remediation projects on surface water quality. Approaches for addressing these other factors should be included in comprehensive management plans for the waterbodies. Additionally, the current water quality and water level monitoring of Lake Marion and Lake Pierce should continue and be expanded, as necessary, during the implementation phase to ensure that adequate information is available for tracking restoration progress.

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.

Donigian, A.S., Jr. 2000. *HSPF training workshop handbook and CD*. Lecture #19. Calibration and verification issues, Slide #L19-22. EPA Headquarters, Washington Information Center, January 10–14, 2000. Presented to and prepared for the U.S. Environmental Protection Agency, Office of Water, Office of Science and Technology, Washington, DC.

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.

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

Griffith, G.E., D.E. Canfield, Jr., C.A. Horsburgh, and J.M. Omernik. 1997. *Lake regions of Florida.* EPA/R-97/127. Corvallis, OR: U.S. Environmental Protection Agency, National Health and Environmental Effects Research Laboratory.

Harper, H. 1994. *Stormwater loading rate parameters for central and south Florida.* Orlando, FL: Environmental Research and Design, Inc.

———. 2012. *BMPTRAINS MODEL: Rainfall characteristics*. PowerPoint slides. Accessed January 16, 2019.

Kang, W. 2017. *Nutrient TMDLs for Lake Roberts (WBID 2872A).* Tallahassee, FL: Division of Environmental Assessment and Restoration, Water Quality Evaluation and TMDL Program.

Lewis, W.M., W.A. Wurtsbaugh, and H.W. Paerl. 2011. Rationale for control of anthropogenic nitrogen and phosphorus in inland waters. *Environmental Science and 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.

Scott, T.M. 2001. *Text to accompany the geologic map of Florida*. Tallahassee, FL: Florida Geological Survey.

Tetra Tech. 2017. *Hydrology and water quality modeling report for the Caloosahatchee River and Estuary, Florida.* Atlanta, GA.

Toor, G.S., M. Lusk, and T. Obreza. 2011; reviewed 2018. *Onsite sewage treatment and disposal systems: An overview.* SL347. Gainesville, FL: University of Florida Institute of Food and Agricultural Sciences. Accessed March 2019.

University of South Florida Water Institute. 2019. *Polk County water atlas*. Tampa, FL: School of Geosciences, College of Arts and Sciences. Accessed October 2019.

U.S. Census Bureau. 2010. *Quickfacts: Polk County, Florida.* Website. Accessed October 2019.

U.S. Environmental Protection Agency. 2002. *Onsite wastewater treatment systems manual.* EPA 625/R-00/008. Washington, DC: Office of Research and Development.

Walker, W.W., Jr. 1987. *Empirical methods for predicting eutrophication in impoundments.* Report 4, Phase III: Application manual. Technical report E-81-9. Vicksburg, MS: U.S. Army Corps of Engineers, Waterways Experiment Station.

———. 2004 (updated from 1996). *Simplified procedures for eutrophication assessment and prediction.* Instruction Report W–96–2. U.S. Army Corps of Engineers.

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 interpretation of the narrative nutrient criterion

Location	Description
Waterbody name	Lake Marion and Lake Pierce
Waterbody type(s)	Lake
WBID	Lake Marion (WBID 1480) and Lake Pierce (WBID 1532A) (see **Figure 1.1** of this report)
Description	Lake Marion and Lake Pierce are located in Polk County. The Lake Marion Watershed covers an area of 24,518 acres (38 square miles). Agriculture comprises 32 % of the watershed, residential 22 %, and wetlands 13 %. The Lake Pierce Watershed covers an area of 35,714 acres (56 square miles). Agriculture comprises 46 % of the watershed, water 14 %, and residential 14 %. **Chapter 1** of this report provides more detail on the two watershed systems.
Specific location (latitude/longitude or river miles)	The center of Lake Marion is located at N: 28° 4' 42.30/ W: 81° 31' 53.83." The center of Lake Pierce is located at N: 28° 58' 29.80/ W: 81° 31' 22.51." The site-specific criteria apply as a spatial average for the lakes, as defined by WBIDs 1480 and 1532A.
Map	**Figures 1.1** and **1.2** show the general location of the lakes and their watersheds, and **Figures 4.1** and **4.2** show land uses in the watersheds.
Classification(s)	Class III Freshwater
Basin name (HUC 8)	Kissimmee River Basin (03090101)

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

Numeric Interpretation of Narrative Nutrient Criterion	Information on Parameters Related to Numeric Interpretation of the Narrative Nutrient Criterion
NNC summary	Lake Marion and Lake Pierce are classified as low-color, high-alkalinity lakes, and the generally applicable NNC, 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 1.05 to 1.91 mg/L, and TP of 0.03 to 0.09 mg/L.
Proposed TN and TP concentrations	Numeric interpretations of the narrative nutrient criterion: For Lake Marion, the TN and TP NNC are expressed as 7-year annual average loads not to be exceeded in any year. The loads are 25,653 and 1,222 kg/yr for TN and TP, respectively. For Lake Pierce, the TN and TP NNC are expressed as 7-year annual average loads not to be exceeded in any year. The loads are 38,172 and 1,431 kg/yr for TN and TP, respectively.
Period of record used to develop numeric interpretations of the narrative nutrient criterion for TN and TP	The criteria were developed based on the application of the BATHTUB model, which simulated hydrology and water quality conditions from 2007 to 2016. The primary datasets for this period include water quality data from IWR Run 58, SWFWMD rainfall data, and 2014 SWFWMD land use coverage. Sections **2.3** and **4.4** of this TMDL report provide a complete description of the data used in the derivation of the proposed site-specific criteria.
How the criteria developed are spatially and temporally representative of the waterbody or critical condition	The water quality results applied in the analysis were from the 2007–16 period, which included years with both above- and below-average precipitation. The long-term average annual rainfall total from SWFWMD was 45.6 inches. The SWFWMD rainfall database indicates that 2006–08 and 2012 were years with below-average precipitation, while 2005, 2009–11, and 2014–16 were years with above-average precipitation. **Figures 2.1** and **2.2** show the locations of the sampling stations in Lake Marion and Lake Pierce, respectively. Monitoring stations were located across the spatial extent and represent the spatial distribution of nutrient dynamics in the lakes.

Table B-3. Summary of how designated use is protected by the criterion

Designated Use Requirements	Information Related to Designated Use Requirements
History of assessment of designated use support	For the Cycle 3 basin assessment completed in 2017, the NNC were used to assess the lakes for the verified period (January 1, 2009–June 30, 2016) during the Group 4, Cycle 3 assessment based on data from IWR Run 53. Lake Marion and Lake Pierce were assessed as impaired (Category 5) for chlorophyll *a*, TN, and TP, and the lakes was added to the Verified List. The Cycle 3 Verified List of Impaired Waters was adopted by Secretarial Order on October 21, 2016. See **Section 2.3.3** of this report for a detailed discussion.
Basis for use support	The basis for use support for Lake Marion is the NNC chlorophyll *a* concentration of 20 µg/L, which is protective of designated uses for low-color, high-alkalinity lakes. Based on the available information, there is nothing unique about the lake that would make the use of the chlorophyll *a* criterion of 20 µg/L inappropriate. DEP evaluated a site-specific interpretation of the narrative nutrient criterion for Lake Thonotosassa based on natural background conditions using model simulation. Based on the model simulation using the site-specific data, DEP determined a site-specific AGM chlorophyll *a* criterion of 24 µg/L, expressed as not to be exceeded, and long-term average nutrient loads that would attain the chlorophyll *a* criterion.
Approach used to develop criteria and how it protects uses	For the Lake Marion and Lake Pierce nutrient TMDLs, DEP created loading-based criteria using the curve number model to simulate flows from the lake watersheds, and this information was input into BATHTUB for the lakes. DEP established the site-specific TN and TP loadings using the calibrated models to achieve an in-lake chlorophyll ***a*** AGM concentration of 20 µg/L for Lake Marion and 24 µg/L for Lake Pierce. The maximum of the 7-year averages of TN and TP loadings to achieve the chlorophyll *a* target was determined by decreasing TN and TP loads from anthropogenic sources into the lakes until the chlorophyll *a* target was 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	The methods ensure that the chlorophyll *a* concentration target of 20 µg/L for Lake Marion, and the chlorophyll *a* concentration target of 24 µg/L for Lake Lake Pierce, will be attained at the TMDL loads for TN and TP. DEP notes that no other impairments were verified for Lake Marion or Lake Pierce that may be related to nutrients (such as dissolved oxygen or un-ionized ammonia). Reducing the nutrient loads entering the lakes will not negatively impact other water quality parameters.

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	As discussed in **Section 1.2**, Lake Marion (WBID 1480) is a large lake located directly north of Lake Pierce in east Polk County. Lake Marion discharges into Lake Marion Creek (WBID 1472A1) on the north end of the lake and flows into Lake Hatchineha (WBID 1472B). Lake Marion Creek was delisted for chlorophyll *a* in the 2017 Group 4 assessment, and Lake Hatchineha was previously listed as impaired for nutrients based on the TSI, but is no longer being assessed using this method and therefore was also delisted. Lake Pierce (WBID 1532A) is a large lake located directly south of Lake Marion in east Polk County. Lake Pierce discharges into Catfish Creek on the south end of the lake. The creek flows into a network of agricultural canals and Lake Hatchineha (WBID 1472AB). The reductions in nutrient loads described in this TMDL analysis are not expected to cause nutrient impairments but to improve water quality in downstream waters.
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.	Polk County and DEP conduct routine monitoring of Lake Marion and Lake Pierce. The data collected through these monitoring activities will be used to evaluate the effect of BMPs implemented in the watersheds on lake TN and TP loads in subsequent water quality assessment cycles.

Table B-5. Documentation of endangered species consideration

Administrative Requirements	Information for Administrative Requirements
Endangered species consideration	DEP is not aware of any endangered species present in the impaired lakes. Furthermore, it is expected that improvements in water quality resulting from these restoration efforts will positively impact aquatic species living in the lakes and their respective watersheds.

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 04/27/2020, to initiate TMDL development for impaired waters in the Kissimmee River Basin. A rule development public workshop for the TMDLs was held on 05/27/2020.
Hearing requirements and adoption format used; responsiveness summary	Following the publication of the Notice of Proposed Rule, DEP will provide a 21-day challenge period and a public hearing that will be noticed no less than 45 days prior.
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 the DEP program attorney. DEP will prepare the TMDLs and submittal package for the TMDLs to be considered site-specific interpretations of the narrative nutrient criterion and will submit these documents to the EPA.