Central District • Kissimmee River Basin

Draft Report

Nutrient TMDLs for Lake Fran (WBID 3169G3), Lake Kozart (WBID 3169G4), Lake Richmond (WBID 3169G6), Lake Walker (WBID 3169G5) and Lake Beardall (WBID 3169G8) and Documentation in Support of the Development of Site-Specific Numeric Interpretations of the Narrative Nutrient Criterion

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January 2025

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Executive Summary

This report presents the total maximum daily loads (TMDLs) developed to address the nutrient impairments for the following lakes with waterbody identification (WBID) numbers: Lake Fran (WBID 3169G3), Lake Kozart (WBID 3169G4), Lake Richmond (WBID 3169G6), Lake Walker (WBID 3169G5) and Lake Beardall (WBID 3169G8). These lakes are located in the Kissimmee River Basin in Orange County, Florida and are situated in the City of Orlando in the headwaters of the Shingle Creek Watershed. These waterbodies have exceedances of the applicable lake numeric nutrient criteria (NNC) in subsection 62-302.531(2), F.A.C.

The five waterbodies were identified as impaired for nutrients based on elevated chlorophyll *a*, total nitrogen (TN) and total phosphorus (TP) concentrations exceeding the numeric nutrient criteria (NNC) in subsection 62-302.531(2), Florida Administrative Code (F.A.C.). The lakes 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 June 2017.

Pursuant to paragraph 62-302.531(2)(a), F.A.C., the nutrient TMDLs will, upon adoption, constitute the site-specific numeric interpretation 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 NNC in subsection 62-302.531(2), F.A.C.

TMDLs for TN and TP have been developed, and **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 (CWA) and guidance developed by the U.S. Environmental Protection Agency (EPA).

Table EX-1. Summary of TMDL supporting information for Lakes Fran, Kozart, Richmond, Walker and Beardall.

Type of Information	Description
Waterbody name/ Waterbody identification (WBID) number	Lake Fran (WBID 3169G3), Lake Kozart (WBID 3169G4), Lake Richmond (WBID 3169G6), Lake Walker (WBID 3169G5) and Lake Beardall (WBID 3169G8)
Hydrologic Unit Code (HUC) 8	Kissimmee River Basin – 03090101
Use classification/ Waterbody designation	Class III/Fresh
Targeted beneficial uses	Fish consumption; recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife
303(d) listing status	Lakes Fran, Kozart, Richmond, Walker and Beardall: Verified List of Impaired Waters for the Kissimmee River Group 4 Basin adopted via Secretarial Order in June 2017.
TMDL pollutants	Total nitrogen (TN) and total phosphorus (TP)
TMDLs and site-specific interpretations of the narrative nutrient criterion	**Lake Fran (WBID 3169G3), Lake Kozart (WBID 3169G4), Lake Richmond (WBID 3169G6), Lake Walker (WBID 3169G5) and Lake Beardall (WBID 3169G8)** **TN:** 1.10 milligrams per liter (mg/L), expressed as an annual geometric mean (AGM) not to be exceeded. **TP:** 0.05 mg/L, expressed as an AGM not to be exceeded.
Concentration reductions required to meet the TMDLs	**Lake Fran (WBID 3169G3):** 14 % TN reduction and 50 % TP reduction to achieve a chlorophyll *a* target of 20 micrograms per liter (µg/L) **Lake Kozart (WBID 3169G4):** 55 % TN reduction and 64 % TP reduction to achieve a chlorophyll *a* target of 20 µg/L **Lake Richmond (WBID 3169G6):** 63 % TN reduction and 50 % TP reduction to achieve a chlorophyll *a* target of 20 µg/L **Lake Walker (WBID 3169G5):** 30 % TN reduction and 55 % TP reduction to achieve a chlorophyll *a* target of 20 µg/L **Lake Beardall (3169G8):** 0 % TN reduction and 50 % TP reduction to achieve a chlorophyll *a* target of 20 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, specifically, the Office of Watershed Services, Watershed Assessment Section, and the Watershed Evaluation and TMDL Section. DEP also recognizes the City of Orlando and the Orange County Environmental Protection Division for their contributions towards understanding the issues, history, and processes at work in the lake watersheds.

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µg/L	Micrograms Per Liter
Ac	Acre
AGM	Annual Geometric Mean
BMAP	Basin Management Action Plan
BMP	Best Management Practice
°C	Celsius
$CaCO_3$	Calcium Carbonate
CWA	Clean Water Act
DEP	Florida Department of Environmental Protection
EPA	U.S. Environmental Protection Agency
F.A.C.	Florida Administrative Code
DOH	Florida Department of Health
DOT	Florida Department of Transportation
F.S.	Florida Statutes
ft	Foot
FWRA	Florida Watershed Restoration Act
HUC	Hydrologic Unit Code
ID	Insufficient Data
in	Inches
IWR	Impaired Surface Waters Rule
LA	Load Allocation
MDL	Method Detection Limit
mg/L	Milligrams Per Liter
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer System
NA	Not Applicable
NAD	North American Datum
NNC	Numeric Nutrient Criteria
NOAA	National Oceanic and Atmospheric Agency
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
OIA	Orlando International Airport
OSTDS	Onsite Sewage Treatment and Disposal System
PCU	Platinum Cobalt Unit
PLRG	Pollutant Load Reduction Goal
POR	Period of Record
SFWMD	South Florida Water Management District
SJRWMD	St. Johns River Water Management District

SWIM	Surface Water Improvement and Management (Program)
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
USDA	U.S. Department of Agriculture
WBID	Waterbody Identification (Number)
WLA	Wasteload Allocation
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 Lakes Fran, Kozart, Richmond, Walker and Beardall, located in the Kissimmee River Basin in Orange County.

Pursuant to paragraph 62-302.531(2)(a), Florida Administrative Code (F.A.C.), the nutrient TMDLs will also constitute the site-specific numeric interpretation of the narrative nutrient criterion set forth in Paragraph 62-302.530(48)(b), F.A.C., that will replace the otherwise applicable numeric nutrient criteria (NNC) in subsection 62-302.531(2), F.A.C.

These five waterbodies are impaired for nutrients using the methodology in the Identification of Impaired Surface Waters Rule (IWR) (Chapter 62-303, F.A.C.). They were included on the Verified List of Impaired Waters for the Kissimmee River Basin that was adopted by Secretarial Order in June 2017.

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 nutrient concentrations for Lakes Fran, Kozart, Richmond, Walker and Beardall and associated nutrient reductions that would restore the waterbodies so that they meet their applicable water quality criteria for nutrients.

1.2 Identification of Waterbodies

For assessment purposes, the Florida Department of Environmental Protection (DEP) divided the Kissimmee River Basin (Hydrologic Unit Code [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 Fran is WBID 3169G3, Lake Kozart is WBID 3169G4, Lake Richmond is WBID 3169G6, Lake Walker is WBID 3169G5 and Lake Beardall is WBID 3169G8. The lakes are located in the Upper Kissimmee River subwatershed.

Lakes Fran, Kozart, Richmond, Walker and Beardall are part of a system of eight connected lakes in the western part of Orlando in Orange County, within an area bounded by Interstate 4 to the east and South Kirkman Road to the west. Lake Fran is the downstream lake of a system of lakes that includes Lakes Kozart, Richmond, Walker, Clear, Mann, Beardall and Lorna Doone. For the purposes of this report, the eight lakes and their drainage basins are collectively referred to as the Lake Fran Watershed. **Figure 1.1** shows the location of the Lake Fran Watershed in Orange County and **Figure 1.2** is a detailed map of the Lake Fran Watershed showing the eight lakes and their contributing basins, and the major geopolitical and hydrologic features surrounding them.

Lakes Fran, Kozart, Richmond, Walker and Beardall are located in the western portion of the City of Orlando and are part of the headwaters of Shingle Creek. Lakes Fran, Kozart, Richmond and Beardall are man-made and are located in an area that in the past, prior to development, was predominantly wetlands. Lake Walker, a natural lake, located just west of Clear Lake, flows into the southwest part of Clear Lake, which has an outlet channel that flows west into Lake Fran. Lakes Kozart, Richmond and Mann have outlet channels that enter a canal system flowing into Lake Fran. The outlet of Lake Fran exits to a canal system that flows into Shingle Creek. Additionally, surface water can exit portions of the Lake Fran Watershed through drainage wells installed in Lakes Richmond and Lorna Doone (City of Orlando 2019). Lake drainage wells, used to control lake water levels in the Orlando area, allow lake water to flow directly into the aquifer, usually the Floridan aquifer system (Schiffer 1998).

The five impaired lakes are small in size, with surface areas ranging from 3 acres (ac) (Lake Beardall) to 70 ac (Lake Fran). Lakes Kozart, Richmond, and Walker have surface areas of 7, 35, and 4 ac, respectively. The mean lake depths are 9.0 feet (ft) in Lake Fran, 7.7 ft in Lake Walker, 6.2 ft in Lake Beardall, 5.3 ft in Lake Richmond, and 4.3 ft in Lake Kozart. Residential and commercial development dominate land use in the area.

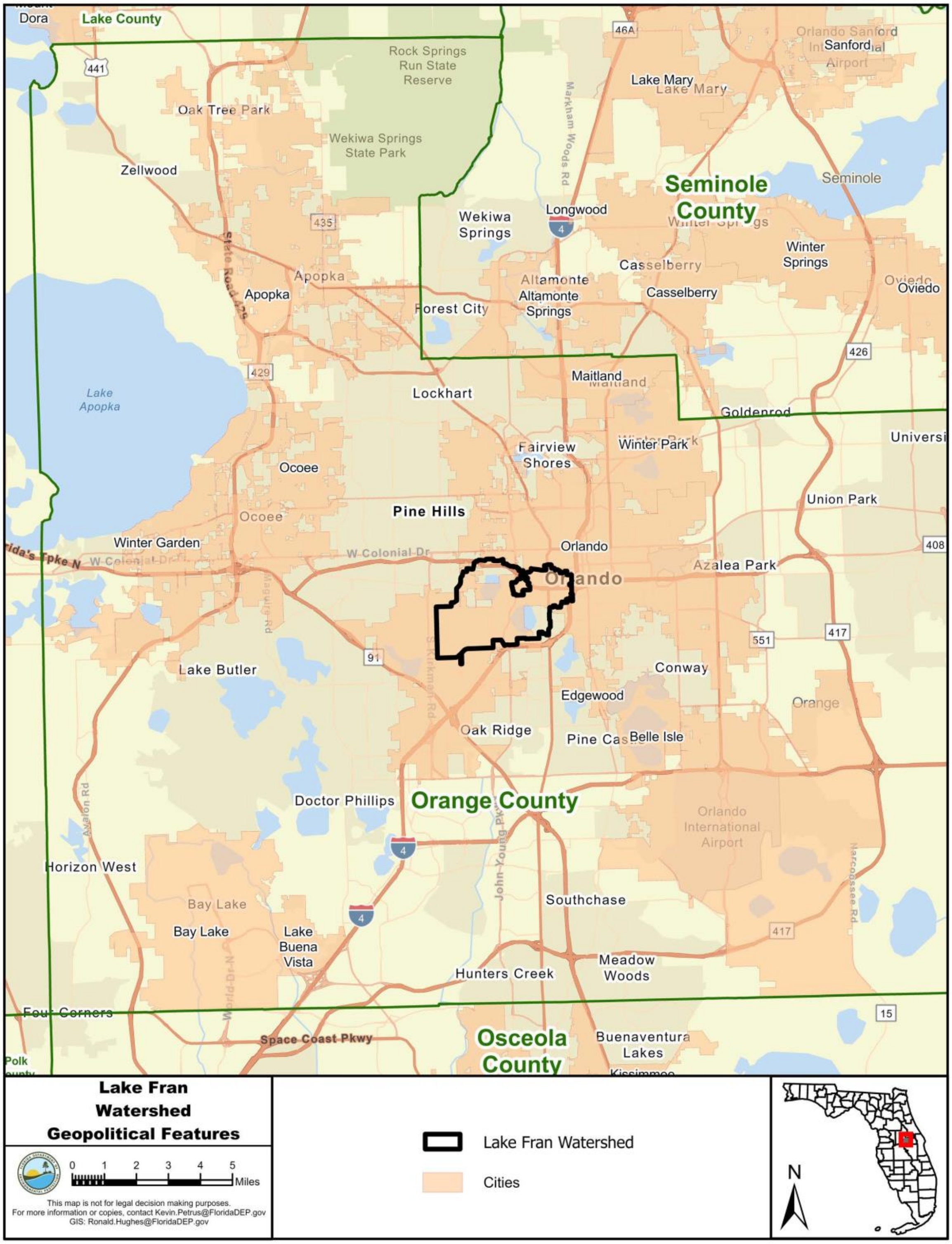

Figure 1.1. The Lake Fran Watershed with major geopolitical and hydrologic features in the Upper Kissimmee River subwatershed.

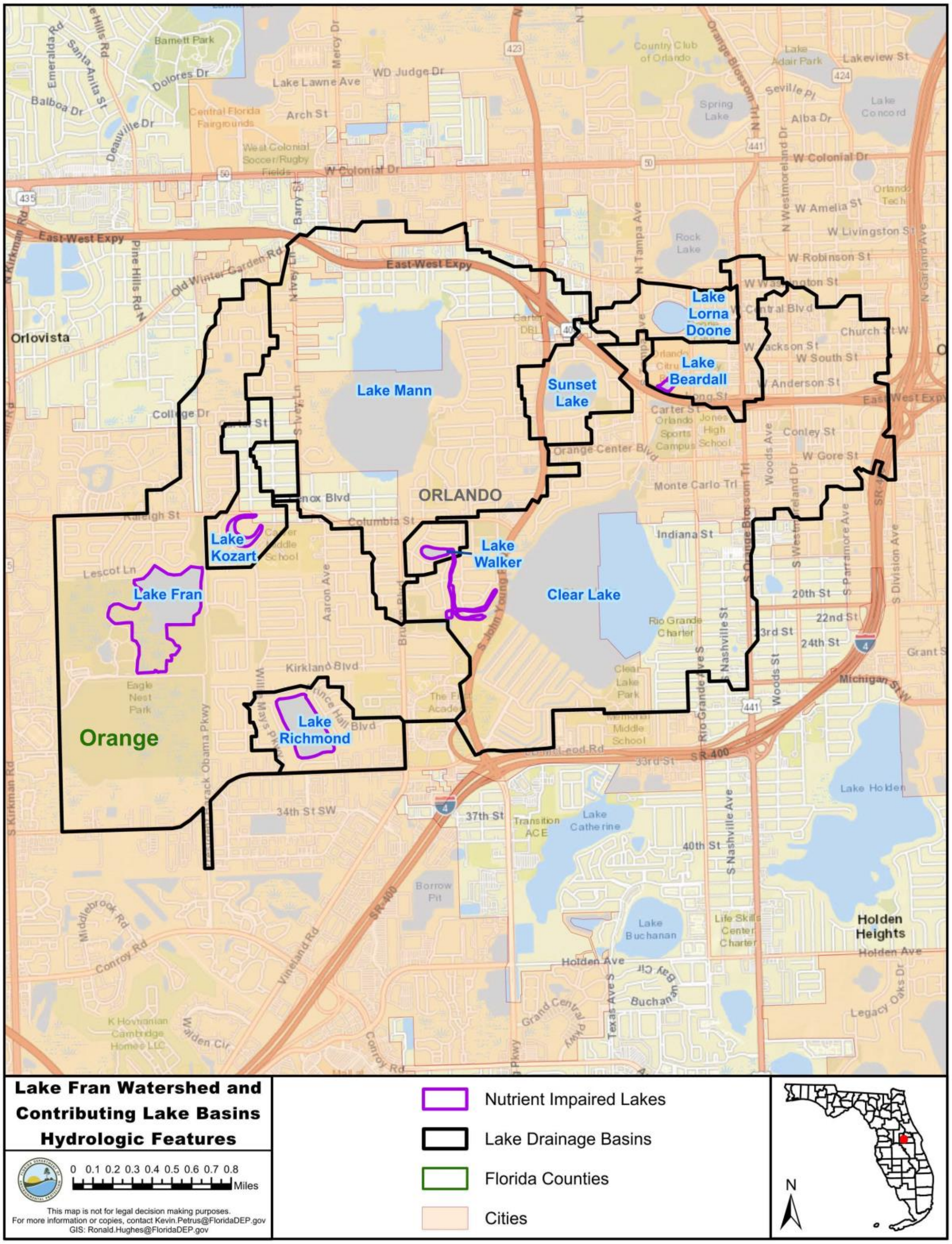

Figure 1.2. Location of Lakes Fran, Kozart, Richmond, Walker and Beardall and major hydrologic and geopolitical features in the area.

1.3 Watershed Information

1.3.1 Population and Geopolitical Setting

According to data available from the U.S. Census Bureau (2019), the population of Orange County is 1,393,452, with a density of 1,268.5 people per square mile. The county occupies an area of 903.43 square miles and contains 556,896 housing units, with a housing density of 616 houses per square mile. Lakes Fran, Kozart, Richmond, Walker and Beardall are situated in the City of Orlando, which has a population of 287,442.

1.3.2 Topography

Most of the impaired lakes, with the exception of Lake Fran, are located in the Orlando Ridge lake region, an urbanized karst area of low relief where the lakes are characterized as clear, alkaline, hardwater lakes of moderate mineral content (Griffith et al. 1997). Lake Fran lies in the Apopka Upland lake region, near the western border with the Orlando Ridge region. The Apopka Upland consists of residual sand hills modified by karst processes, with many small lakes and scattered sinkholes (Griffith et al. 1997). The elevations in the Lake Fran Watershed range from 95 to 110 ft North American Datum (NAD) 1983.

1.3.3 Hydrogeological Setting

The greater hydrogeological context in which these lakes function is determined in part by the topography, but also by their similar soil geology, aquifer/groundwater interactions, and climate.

The climate of the region is humid subtropical in the Köppen classification system. It is characterized by warm, relatively wet summers and mild, relatively dry winters. Annual average temperatures in the region are 23° Celsius (°C). Annual rainfall averages 129 centimeters (50.8 in.), and the majority of the rainfall occurs from June through September (Schiffer 1998).

The surficial geology in the Orlando area is composed of a complex mixture of Middle Eocene to Quaternary carbonate and siliciclastic sediments. A combination of factors, including fluvio-deltaic deposition, marine deposition, the dissolution of underlying carbonates (karstification), the erosion of sediments as a result of eustatic changes in sea level, and structural features have influenced the geology of this area.

The hydrologic characteristics of soil can significantly affect the capability of a watershed to hold rainfall or produce surface runoff. Soils are generally classified as one of four major types, as follows, based on their hydrologic characteristics (Viessman et al. 1989). Type A soils have high infiltration rates even if thoroughly wetted. They consist chiefly of deep, well-drained to excessively drained sands or gravels. These soils have a high rate of water transmission. Type B soils have moderate infiltration rates if thoroughly wetted. They consist chiefly of moderately deep to deep, moderately well-drained to well-drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission. Type C soils have slow infiltration rates if thoroughly wetted. They consist chiefly of soils with a layer that impedes the downward movement of water, or soils with moderately fine to fine texture. These soils have a slow rate of water transmission. Type D soils have very slow infiltration rates if thoroughly wetted. They consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a clay pan or clay layer at or near the surface, and shallow soils over nearly impervious materials. These soils have a very slow rate of water transmission.

The hydrologic soil types in the Lake Fran Watershed are tabulated in **Table 1.1.** Type C/D soils are predominant and comprise 35% of the watershed area. **Figures 1.3** displays the spatial distribution of the soil hydrologic groups in the Lake Fran Watershed. The map is based on the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) 2010 dataset developed by the National Cooperative Soil Survey.

Table 1.1. Hydrologic soil groups and acreages (Ac) in the Lakes Fran watershed.

Hydrologic Soil Group	Ac	%
A	848	16
A/D	1,329	25
B/D	313	6
C/D	1,914	35
Unspecified	999	18
Total	**5,402**	**100**

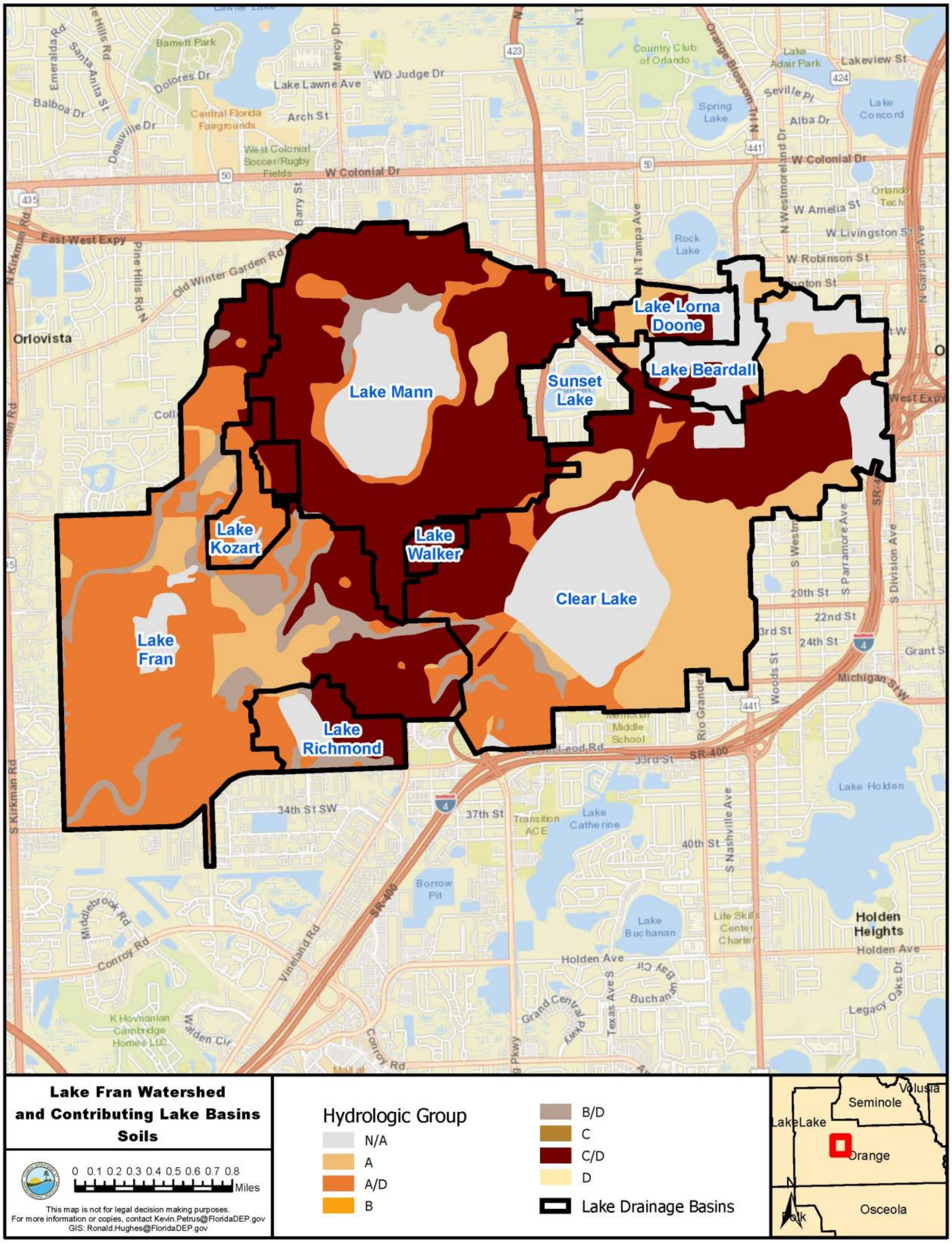

Figure 1.3. Hydrologic soil groups in the Lake Fran watershed.

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 last amended in 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.). In the past, the state's 303(d) list has been amended annually to include basin updates for 20 % of the state every year, conducted as part of a rotating basin approach to cover the whole state every 5 years. Beginning with the 2022 biennial assessment, the state's 303(d) list is amended biennially and will consist of a statewide assessment every two years.

2.2 Classification of the Waterbody and Applicable Water Quality Standards

Lakes Fran, Kozart, Richmond, Walker and Beardall 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 impairments for these waterbodies is Florida's nutrient criterion in paragraph 62-302.530(48)(b), F.A.C.

The applicable lake NNC are dependent on alkalinity, measured in milligrams per liter (mg/L) as calcium carbonate ($CaCO_3$) and true color (color), measured in platinum cobalt units (PCU), based on long-term period of record (POR) geometric means. For the purpose of subparagraph 62-302.531(2)(b)1., F.A.C., color is assessed as true color and should be free from turbidity. Lake color and alkalinity are based on a minimum of 10 data points over at least 3 years with at least 1 data point in each year. Based on available color and alkalinity results (**Table 2.1**), all five lakes are characterized as low-color (≤ 40 PCU), high-alkalinity (> 20 mg/L $CaCO_3$). The POR data for the lakes are from IWR Database Run 65.

Table 2.1. Long-term geometric means for color and alkalinity for the POR.

Waterbody	POR for Color	Long-Term Geometric Mean Color (PCU)	POR for Alkalinity	Long-Term Geometric Mean Alkalinity (mg/L $CaCO_3$)
Lake Fran	2012–2022	32	2005–2022	66
Lake Kozart	2012–2019	39	1993–2019	92
Lake Richmond	2012–2022	17	1993–2022	59
Lake Walker	2012–2019	21	1993–2019	58
Lake Beardall	2012-2022	19	1993-2022	89

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. **Table 2.2** lists the NNC for Florida lakes specified in subparagraph 62-302.531(2)(b)1., F.A.C. 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 listed in **Table 2.2**, then the TN and TP numeric interpretations for that calendar year are the AGMs of lake TN and TP samples, subject to the minimum and maximum TN and TP limits in the table. 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 numeric interpretations for TN and TP are the minimum values.

Table 2.2. Chlorophyll *a*, TN, and TP criteria for Florida lakes (Subparagraph 62-302.531(2(()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.

Note: Values shown in boldface type and shaded represent the relevant NNC for Lakes Fran, Kozart, Richmond, Walker and Beardall.

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 sources of nutrient data for Lakes Fran, Kozart, Richmond, Walker and Beardall used in the most recent verified assessment period, beginning in 2010, are stations sampled by the City of Orlando. The city began monitoring Lake Walker in 1988, Lake Beardall in 1989, Lakes Kozart and Richmond in 1990, and Lake Fran in 1999. The majority of the nutrient data for all five impaired lakes are from the city's monitoring program. **Figure 2.1** show the sampling locations for these nutrient-impaired lakes in the Lake Fran Watershed. The city's sampling locations are denoted by the station prefix of 21FLORL.

The water quality measurements discussed in this report are available in the IWR Run 65 Database and are available on request.

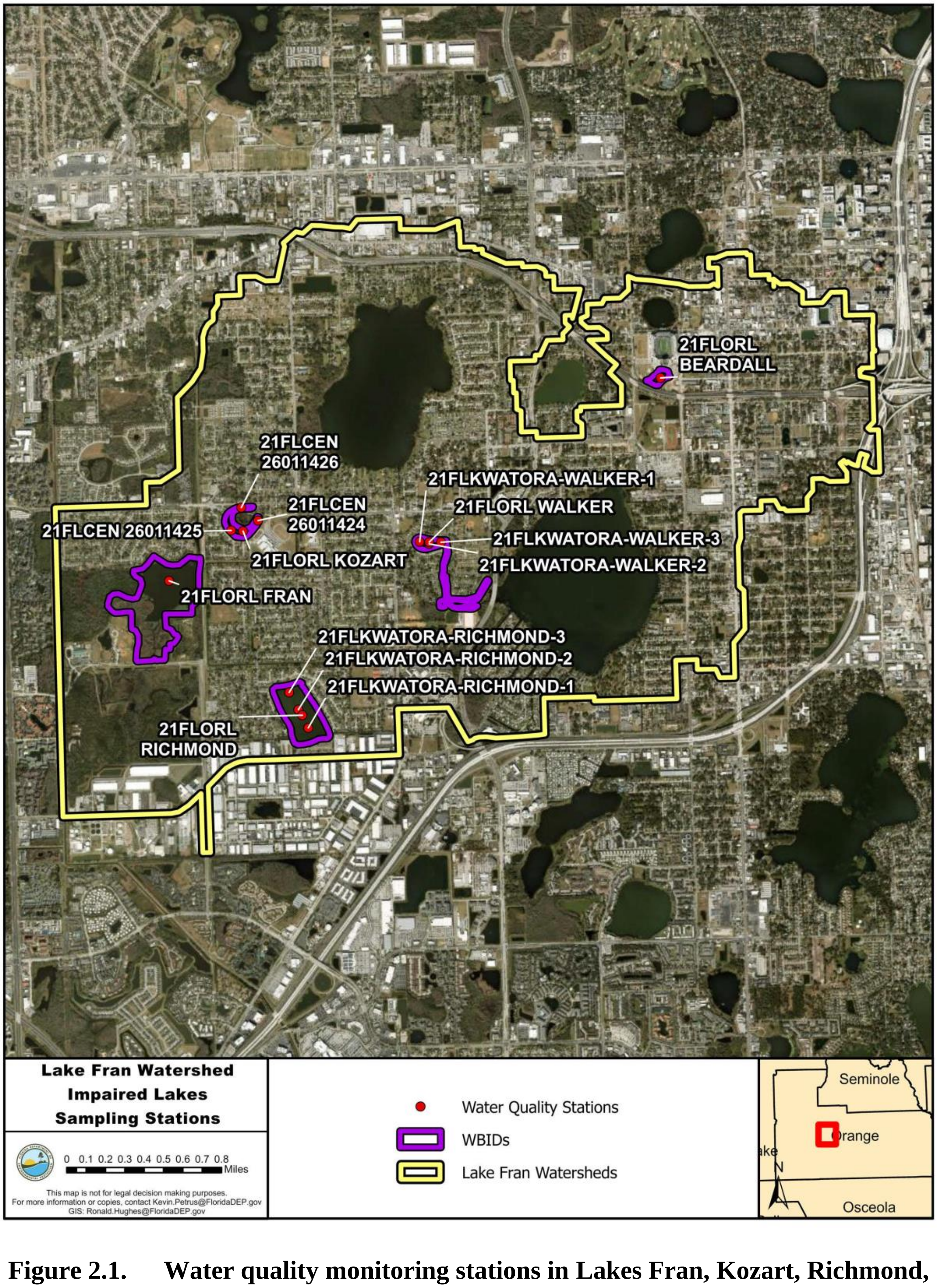

Figure 2.1. Water quality monitoring stations in Lakes Fran, Kozart, Richmond, Walker and Beardall.

2.3.2 Information on Verified Impairment

Lakes Fran, Kozart, Richmond, Walker and Beardall were assessed for nutrients, and identified as impaired, as part of the Group 4, Cycle 3 IWR assessment. Lakes Fran, Kozart, Richmond, and Walker were assessed as impaired for chlorophyll *a*, TN, and TP; and Lake Beardall was assessed as impaired for TP. The verified period was January 1, 2009, to June 30, 2016. Data for the Group 4, Cycle 3 IWR assessment are stored in the IWR Run 53 Access Database.

During the 2024 biennial assessment, Lake Beardall was assessed as impaired for nutrients (chlorophyll *a*) in the verified period of January 1, 2015, to June 30, 2022. Data for the 2024 biennial assessment are stored in the IWR Run 64 Access Database.

All five lakes are nutrient impaired (Category 5), except for TN in Lake Beardall, as AGM values for chlorophyll *a*, TN and TP exceeded the NNC more than once in a three-year period during the respective verified periods. **Tables 2.3** through **2.5** list the lakes' AGM values for chlorophyll *a*, TN, and TP, respectively, calculated using the results found in the IWR Run 65 Database for 2010-21, which represents the planning and verified periods for the 2024 biennial assessment.

Table 2.3. Chlorophyll *a* AGM values (μg/L), 2010-21.

ID = Insufficient data
Note: Values shown in boldface type and shaded are greater than the NNC for lakes. 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 three-year period.

Year	Lake Fran	Lake Kozart	Lake Richmond	Lake Walker	Lake Beardall
2010	20	**62**	**32**	20	19
2011	**22**	**44**	**24**	**33**	ID
2012	20	ID	**34**	**35**	ID
2013	**22**	ID	ID	20	8
2014	**29**	**47**	**44**	ID	16
2015	**37**	**32**	**42**	**51**	**33**
2016	17	**27**	**43**	**33**	10
2017	**46**	**54**	**44**	ID	6
2018	**32**	**23**	**64**	**39**	5
2019	**39**	**58**	**67**	**39**	19
2020	**46**	ID	**62**	ID	**21**
2021	**54**	ID	**73**	ID	**22**

Table 2.4. TN AGM values (mg/L), 2010-21.

Note: Values shown in boldface type and shaded are greater than the NNC for lakes. 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 three-year period.

Year	Lake Fran	Lake Kozart	Lake Richmond	Lake Walker	Lake Beardall
2010	1.09	**2.48**	**1.90**	1.35	0.98
2011	**1.15**	**2.47**	**1.68**	**1.56**	0.75
2012	1.38	**2.22**	**2.41**	**1.47**	0.81
2013	**1.28**	**2.45**	**2.57**	1.58	0.99
2014	**1.17**	**1.99**	**2.02**	ID	0.88
2015	**1.12**	**1.55**	**1.66**	**1.10**	0.96
2016	1.07	**1.89**	**2.16**	0.94	0.75
2017	**1.10**	**1.85**	**2.45**	ID	0.83
2018	0.92	**1.20**	**1.73**	0.89	0.63
2019	**1.16**	**1.58**	**2.12**	0.80	0.68
2020	0.97	ID	**2.29**	ID	0.80
2021	1.03	ID	**2.99**	ID	0.88

Table 2.5. TP AGM values (mg/L), 2010-21.

Note: Values shown in boldface type and shaded are greater than the NNC for lakes. 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 three-year period.

Year	Lake Fran	Lake Kozart	Lake Richmond	Lake Walker	Lake Beardall
2010	0.07	**0.10**	**0.07**	0.07	0.08
2011	**0.07**	**0.10**	**0.05**	**0.10**	**0.05**
2012	0.09	**0.11**	**0.10**	**0.11**	**0.05**
2013	**0.09**	**0.10**	**0.09**	**0.10**	0.06
2014	**0.10**	**0.10**	**0.07**	ID	0.05
2015	**0.08**	**0.11**	**0.06**	**0.09**	**0.09**
2016	**0.10**	**0.13**	**0.09**	**0.11**	0.06
2017	**0.10**	**0.09**	**0.08**	ID	0.05
2018	**0.09**	**0.11**	**0.10**	**0.06**	0.04
2019	**0.10**	**0.14**	**0.09**	**0.08**	0.07
2020	**0.08**	ID	**0.07**	ID	**0.07**
2021	**0.08**	ID	**0.07**	ID	**0.06**

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 will, upon adoption into Rule 62-304.625, F.A.C., constitute the site-specific numeric interpretation 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 interpretation of the narrative nutrient criterion. **Appendix B** summarizes the relevant details to support the determination that the TMDLs provide for the protection of Lakes Fran, Kozart, Richmond, Walker and Beardall, 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. The limiting nutrient is defined as the nutrient(s) that limit plant growth (both macrophytes and algae) when it is not available in sufficient quantities. A limiting nutrient is a chemical necessary for plant growth, but available in quantities smaller than those needed for the optimal growth of algae, represented by chlorophyll *a*, and macrophytes.

In the past, management activities to control lake eutrophication focused on phosphorus reduction, as phosphorus was generally recognized as the most 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 support 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 generally applicable chlorophyll *a* criteria for lakes were established by taking into consideration multiple lines of evidence, including an analysis of lake chlorophyll *a* concentrations statewide, comparisons with a smaller population of select reference lakes, paleolimnological studies, expert opinions, user perceptions, and biological responses. Based on the evidence, DEP concluded that an annual average chlorophyll *a* of 20 µg/L in colored, high-alkalinity lakes is protective of the designated uses of recreation and aquatic life support (DEP 2012). Color and alkalinity were used as morphoedaphic factors to predict the natural trophic status of lakes. Colored (>40 PCU), high-alkalinity (>20 mg $CaCO_3$/L) lakes are naturally mesotrophic or eutrophic.

The generally applicable chlorophyll *a* criteria are assumed to be protective of individual Florida lakes, absent information that shows either (1) more sensitive aquatic life use (i.e., a more responsive floral community), or (2) a significant historical change in trophic status (i.e., a significant increasing trend in color and/or alkalinity). Long-term datasets of color, alkalinity, and nutrients for the lakes in the Lake Fran Watershed suggest that they do not differ from the population of lakes used in the development of the NNC. Therefore, DEP has determined that the generally applicable chlorophyll *a* criterion for low-color, high-alkalinity lakes is appropriate for the lakes, will serve as the TMDL water quality restoration target, and will remain the applicable water quality criterion.

3.3 Numeric Expression of the Site-Specific Numeric Interpretation

Empirical equations describing the relationships between chlorophyll *a* and nutrient concentrations (TN and TP), using AGM values for all eight lakes in the Lake Fran Watershed, were applied in the TMDL development approach, explained in detail in **Chapter 5**. The lakes are all low-color, high-alkalinity lakes and are in the same hydrologic network. This approach uses the simple linear regression relationships between nutrients and chlorophyll *a* to set the nutrient target concentrations. The linear regression equations representing the relationships between chlorophyll *a* AGMs and TN and TP AGMs were used to identify the in-lake nutrient concentrations necessary to achieve the chlorophyll *a* restoration target of 20 µg/L.

Applying the equations indicate the site-specific numeric interpretation of the narrative criterion and TMDL target for TN is 1.10 mg/L and for TP is 0.05 mg/L. The target concentrations are then used to determine the percent reductions in current in-lake concentrations necessary to meet the targets, for the period from 2013 to 2022.

The nutrient criteria are all expressed as AGM concentrations in these lakes. The chlorophyll *a* concentration is expressed as an AGM concentration not to be exceeded more than once in any consecutive three-year period. The TN and TP concentrations are expressed as AGM concentrations never to be exceeded. **Table 3.1** summarizes the nutrient concentration targets 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. Chlorophyll *a* shall not be exceeded more than once in any consecutive three-year period. TN and TP are never to be exceeded.

Waterbody/ WBID	AGM Chlorophyll *a* (µg/L)	Chlorophyll *a* Frequency	AGM TN (mg/L)	TN Frequency	AGM TP (mg/L)	TP Frequency
Lake Fran/ 3169G3	20	Once in a three-year period	1.10	No exceedance	0.05	No exceedance
Lake Kozart/ 3169G4	20	Once in a three-year period	1.10	No exceedance	0.05	No exceedance
Lake Richmond/ 3169G6	20	Once in a three-year period	1.10	No exceedance	0.05	No exceedance
Lake Walker/ 3169G5	20	Once in a three-year period	1.10	No exceedance	0.05	No exceedance
Lake Beardall/ 3169G8	20	Once in a three-year period	1.10	No exceedance	0.05	No exceedance

3.4 Downstream Protection

Lake Fran, the downstream lake in the system of lakes that includes Lakes Kozart, Richmond, Walker, Clear, Mann, Beardall and Lorna Doone, has an outlet that discharges to the upper reaches of Shingle Creek (WBIDs 3169G1 and 3169A). The TN and TP AGMs in these stream segments are less than the applicable Peninsular nutrient region stream thresholds of 1.54 mg/L for TN and 0.12 mg/L for TP. The TMDL nutrient targets established for these lakes are also less than the applicable nutrient region thresholds. In the most recent verified assessment period of 2015-22, the maximum nutrient AGMs were 0.95 mg/L TN and 0.11 mg/L TP in WBID 3169G1, and in WBID 3169A the maximum AGMs were 0.74 mg/L TN and 0.06 mg/L TP. Additionally, achieving the TMDL TP nutrient target established for the lakes in this system is expected to result in lower downstream TP concentrations than what are currently observed in Shingle Creek.

The reductions in nutrient concentrations prescribed in the TMDLs are not expected to cause nutrient impairments downstream and will actually improve water quality in waterbody segments downstream by reducing algal biomass and associated nutrients transported downstream.

3.5 Endangered Species Considerations

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

Administration, and 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 and 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 aquatic species present in the Lake Fran Watershed. Furthermore, water quality improvements resulting from these restoration efforts are expected to positively affect aquatic 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. 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" 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.

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. 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 discharging into the watershed of Lake Fran.

4.2.2 Municipal Separate Storm Sewer System (MS4) Permittees

The Lake Fran Watershed includes areas within the jurisdictions of the City of Orlando and Orange County (**Figure 1.2)**. The stormwater collection systems in the Lake Fran Watershed owned and operated by the City of Orlando are covered by an NPDES MS4 Phase I permit (FLS000014). The systems owned and operated by Orange County and Florida Department of Transportation (DOT) District 5 in the county are covered by an NPDES MS4 Phase I permit (FLS000011). For more information on MS4s in the watersheds, send an email to NPDES-stormwater@dep.state.fl.us.

4.3 Nonpoint Sources

Pollutant sources that are not NPDES wastewater or stormwater dischargers are generally considered nonpoint sources. Nutrient loadings in the Lake Fran Watershed are primarily generated from nonpoint sources. Nonpoint sources include loadings from land surface runoff, baseflow, 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 watersheds. Nutrients can be flushed into receiving waters 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 can produce.

Table 4.1 summarizes land use for each of the eight lake drainage basins located in the Lake Fran Watershed (City of Orlando 2019). Individual lake drainage basin boundaries were provided by the city. **Figure 4.1** shows similar information graphically that was obtained from the Statewide Land Use/Land Cover Dataset (DEP 2021a).

The drainage basin areas for the individual lakes in the Lake Fran Watershed vary considerably. Of the four nutrient-impaired lakes, the immediate Lake Fran drainage basin is the largest, at 1,674 ac (**Table 4.1**). In addition, Lake Fran receives drainage contributions from the seven upstream lakes in the watershed, resulting in a total drainage area of 5,400 ac. The drainage basin areas for Lakes Kozart, Richmond and Walker are less than 200 ac, with Lake Walker's being the smallest at 41 ac. The dominant land use throughout the area is medium-density residential, covering 39 % of the entire watershed (**Table 4.1**). The highest percentage of residential land use (medium- and high-density residential) occurs in the Lake Walker drainage area (83 %). The lowest percentage of residential land use (40 %) occurs in the immediate basin area for Lake Fran where natural areas, upland forest and wetlands, codominate. Most of the natural land area throughout the watershed is located in the vicinity of Lake Fran.

Table 4.1. Land use summary for the Lake Fran watershed, by lake drainage basin (ac) (SFWMD 2017–19; SJRWMD 2013–16).

SJRWMD = St. Johns River Water Management District
* 0 value indicates the negligible presence of a land use.

Land Use Classification	Fran Basin	Kozart Basin	Richmond Basin	Walker Basin	Beardall Basin	Clear Basin	Lorna Doone Basin	Mann Basin	Total Acres	% of Watershed
Residential Medium Density	667	89	83	32	4	691	28	492	2,086	38.6
Urban and Built-Up	378	15	43	2	133	492	67	258	1,387	25.7
Water	71	7	34	4	3	378	15	275	788	14.6
Wetlands	247	7				46		27	328	6.1
Residential High Density	48	0	11	2	11	106		80	258	4.8
Upland Forest	182	0						7	190	3.5
Transportation, Communication, and Utilities	0				10	81		53	144	2.7
Residential Low Density	0					22		116	139	2.6
Rangeland	71								71	1.3
Barren Land	9								9	0.2
Total	**1,674**	**118**	**172**	**41**	**160**	**1,816**	**111**	**1,308**	**5,400**	**100**

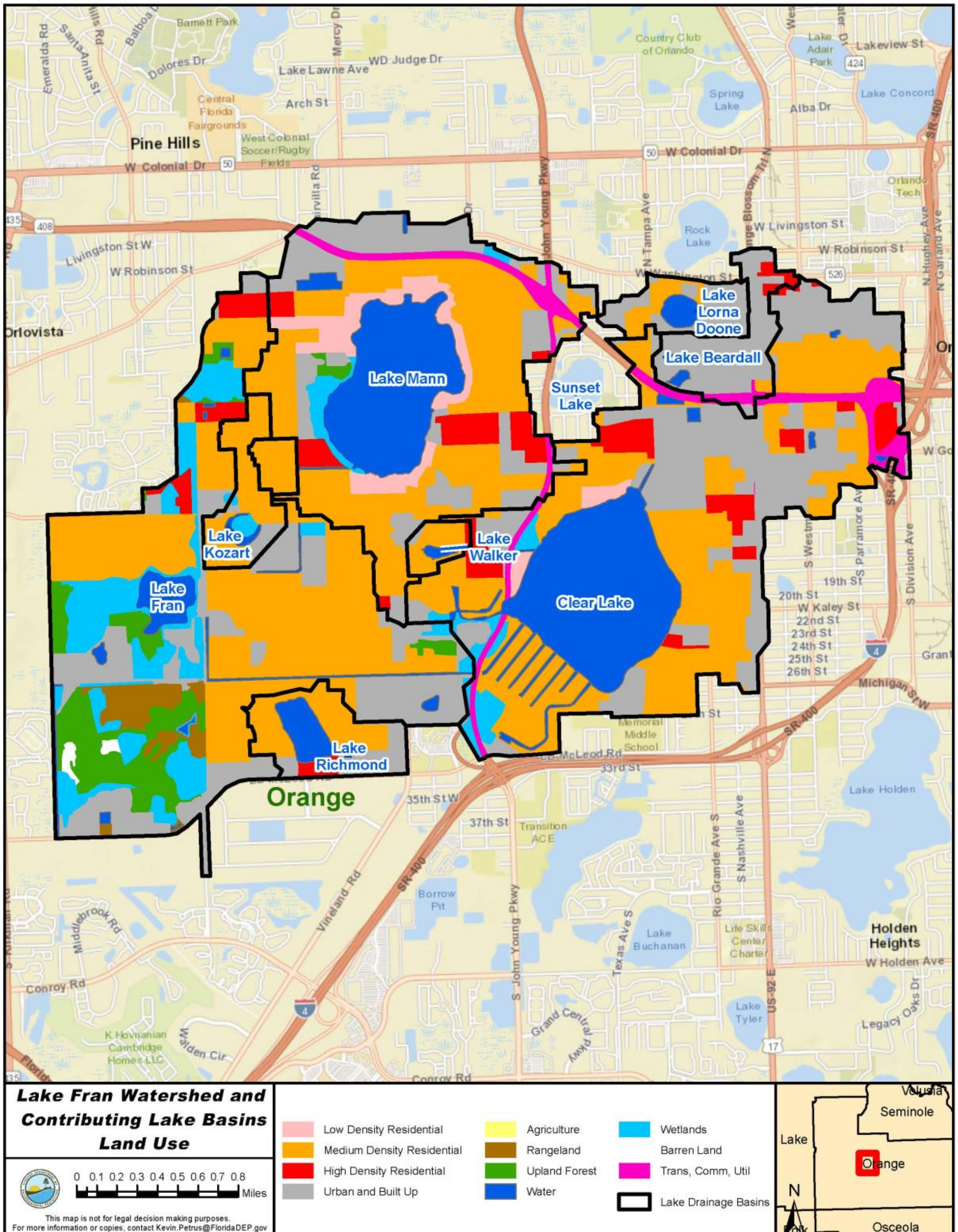

Figure 4.1. Land use in the Lake Fran watershed (SFWMD 2017–19; SJRWMD 2013–16).

4.3.2 Onsite Sewage Treatment and Disposal Systems (OSTDS)

OSTDS, commonly referred to as septic systems, are used to treat domestic wastewater 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. 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 (DOH) maintains a list of OSTDS by county, and the DOH Florida Water Management Inventory dataset was used to determine the number of septic systems in the Lake Fran Watershed. **Figure 4.2** shows the locations of OSTDS in the watershed in 2024 based on centroids of parcels with known, likely, or somewhat likely septic systems, and **Table 4.2** lists the number of OSTDS by individual lake drainage basins. There are 468 OSTDS in the Lake Fran Watershed, with the largest numbers, 85 % of the total, located in the Clear Lake and Lake Mann drainage basins. The number of septic systems in the individual drainage basins of the five impaired lakes is small. However, since Lake Fran receives drainage contributions from the seven upstream lakes in the watershed, all of the OSTDS are in the contributing area to Lake Fran. The largest number of systems is clustered to the northeast of Lake Kozart, to the north of Lake Mann, and east of Clear Lake. The OSTDS clusters are generally located outside the Orlando city limits.

Table 4.2. Number of OSTDS in the Lake Fran watershed, 2024.

Lake Drainage Basins	Number of OSTDS
Beardall	10
Clear	201
Fran	34
Kozart	18
Lorna Doone	8
Mann	196
Richmond	1
Walker	0
Total	**468**

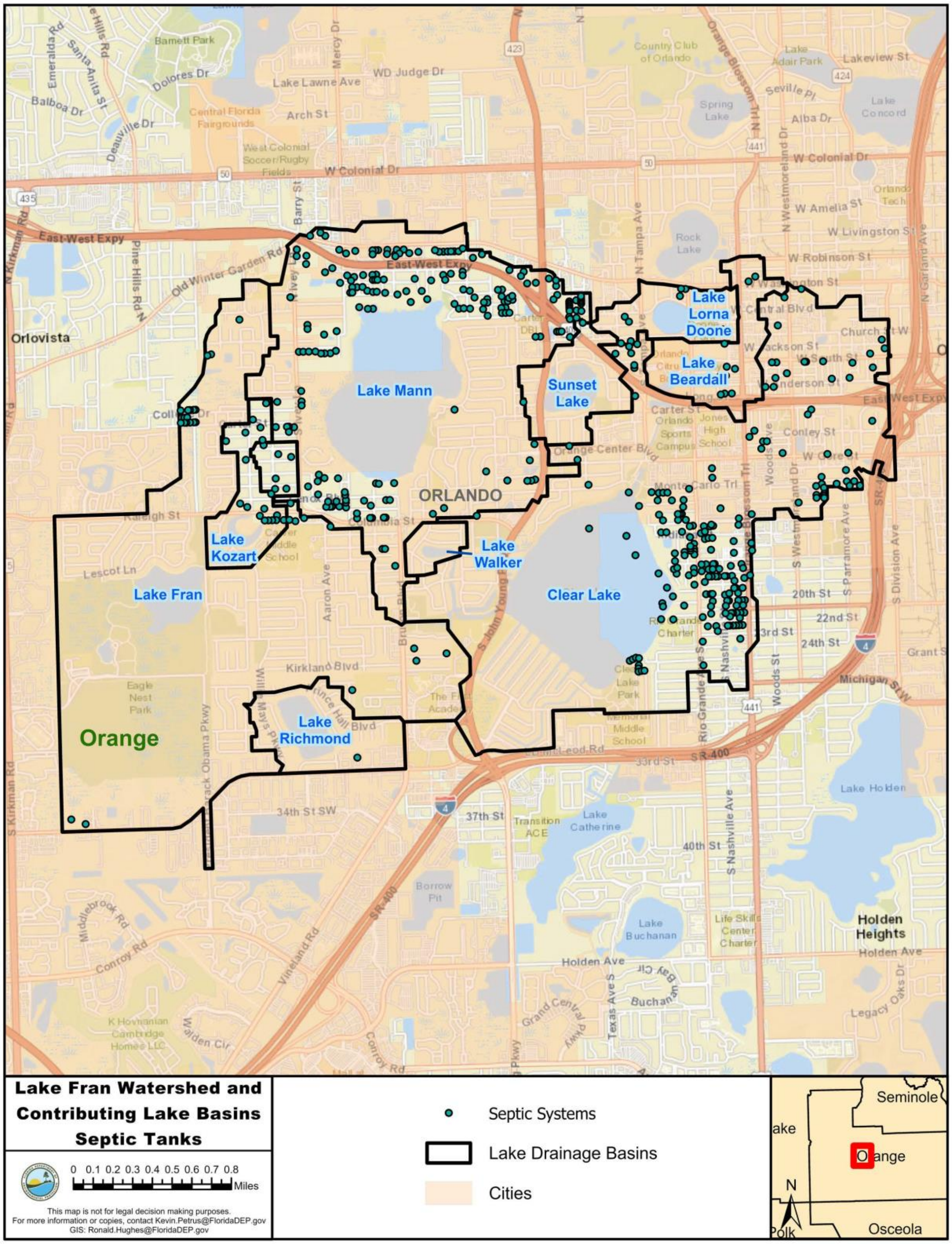

Figure 4.2. OSTDS (septic systems) in the Lake Fran watershed (FDOH 2024).

Chapter 5: Calculation of the TMDLs

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 (e.g., rainfall, point source discharge) 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 Lakes Fran, Kozart, Richmond, Walker and Beardall and to identify the maximum allowable TN and TP lake concentrations and the necessary reductions in the in-lake nutrient concentrations, so that the lakes will meet the TMDL restoration target for chlorophyll *a* and thus maintain their function and designated use as Class III freshwaters.

5.2 Evaluation of Water Quality Conditions

5.2.1 Water Quality Data-Handling Procedures for TMDL Development

For the water quality analyses conducted for TMDL development, AGMs were used to be consistent with the expression of the adopted NNC for lakes. The results found in the IWR Run 65 Database were used to calculate AGMs. The AGMs were calculated using a minimum of four samples 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, defined as values greater than or equal to the method detection limit (MDL) but less than the practical quantitation limit (PQL), were used as reported. Values reported as either compound analyzed for but not detected or is less than the MDL, "U" or "T" qualifier codes, respectively, were changed to the MDL divided by the square root of 2. Values with "G" or "V" qualifier codes, associated with results that do not meet data quality objectives, were removed from the analysis. Negative values and zero values were also removed. Multiple sample results collected in the same day at the same station 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 IWR methodology in Chapter 62-303, F.A.C. The IWR methods are designed to determine compliance with surface water quality criteria that focuses more on measurement uncertainty associated with qualified results. For results reported to be less than the MDL or PQL, the IWR rule follows the same method used for determining compliance with permit effluent limits. Results applied in TMDL development are used in part to describe the variability in ambient water quality, and not compliance with criteria, and for this reason results reported as less than the MDL or PQL are expressed differently when calculating AGMs. Therefore, the AGMs listed in **Tables 2.3** through **2.5** in **Chapter 2** may not exactly match the AGMs used in these analyses and for TMDL development.

5.2.2 Relationships Between Water Quality Variables

Water quality monitoring for nutrients in all five impaired lakes in the Lake Fran Watershed has been conducted primarily by the City of Orlando. **Figures 5.1** through **5.3** show the POR chlorophyll *a*, TN, and TP AGM values, respectively, for impaired lakes in the Lake Fran Watershed.

Figure 5.1 shows the chlorophyll *a* AGM values for the POR in these impaired lakes. Sufficient data were available, in most years, from 1992 to 2019 for Lakes Kozart, Richmond, Walker and Beardall to calculate AGM values. Lake Fran had a shorter data record (2001 to 2022) available to calculate AGM values. Lakes Kozart, Richmond and Walker, situated upstream of Lake Fran, had chlorophyll *a* AGMs consistently above the chlorophyll *a* NNC of 20 µg/L. Lake Kozart values were in most years higher than those of the other lakes, ranging from 23 to 62 µg/L. Lake Richmond AGMs ranged from 24 to 73 µg/L, and AGMs in Lake Walker ranged from 20 to 51 µg/L. Lake Beardall chlorophyll *a* AGMs have increased over time. Prior to 2009, the AGMs were less than 20 µg/L, ranging from 2 to 16 µg/L. Since then, the AGMs have fluctuated more, being greater than the chlorophyll *a* NNC in 2009, 2015, and 2020-22. The AGMs in Lake Fran have also increased over time. Prior to 2009, the values were less than the chlorophyll *a* NNC, ranging from 10 to 18 µg/L. Between 2009 and 2022, most of the Lake Fran chlorophyll *a* values were above the NNC and ranged from 17 µg/L in 2016 to 54 µg/L in 2021.

Figure 5.2 displays the TN AGM values from 1992 to 2022. Lakes Kozart and Richmond had higher values compared with the other three lakes. Over the POR the Lake Kozart AGMs ranged from 1.20 to 2.93 mg/L and in Lake Richmond the values varied from a low of 1.27 mg/L to a high of 2.99 mg/L. In Lake Walker the AGMs fluctuated from 0.80 to 1.81 mg/L and in Lake Fran the values ranged from 0.91 mg/L to 1.38 mg/L. The lowest TN AGM values, ranging from 0.63 to 1.49 mg/L, occurred in Lake Beardall in most years.

Figure 5.3 shows the TP AGM values from 1992 to 2022. Over the monitoring period, Lakes Kozart and Walker exhibited the highest values. The AGM values ranged from 0.07 to 0.15 mg/L in Lake Kozart and from 0.05 to 0.14 mg/L in Lake Walker. Lake Richmond AGM results ranged from 0.04 to 0.10 mg/L during the POR. Lake Fran values in the 2000–22 period ranged from 0.04 to 0.10 mg/L, with the highest values occurring in more recent years. In Lake Beardall the AGMs have fluctuated from 0.04 to 0.11 mg/L, with the largest variation in AGMs occurring after 2005.

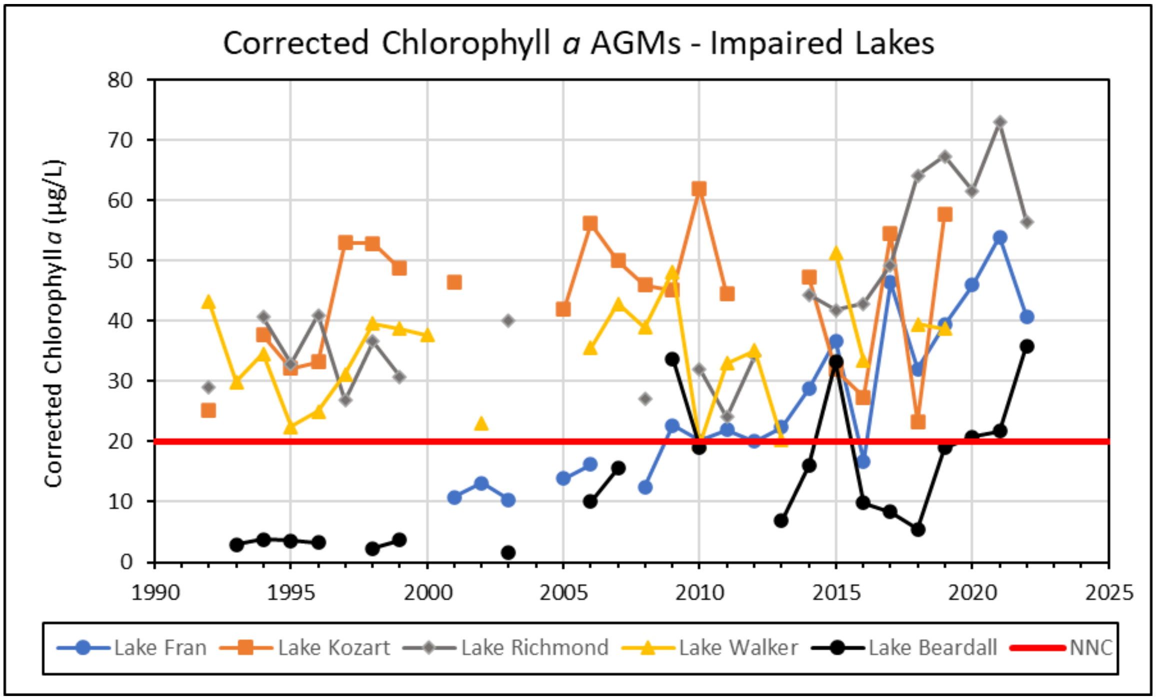

Figure 5.1. Chlorophyll *a* AGM values in the POR for the nutrient impaired lakes.

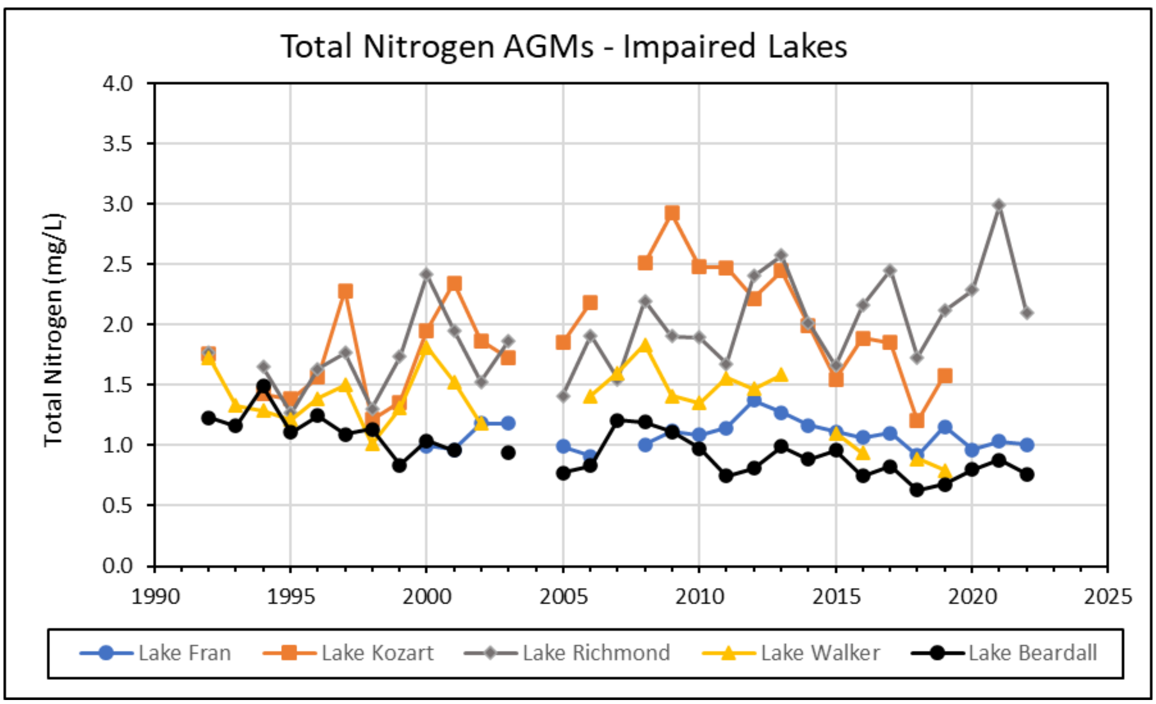

Figure 5.2. TN AGM values in the POR for the nutrient impaired lakes.

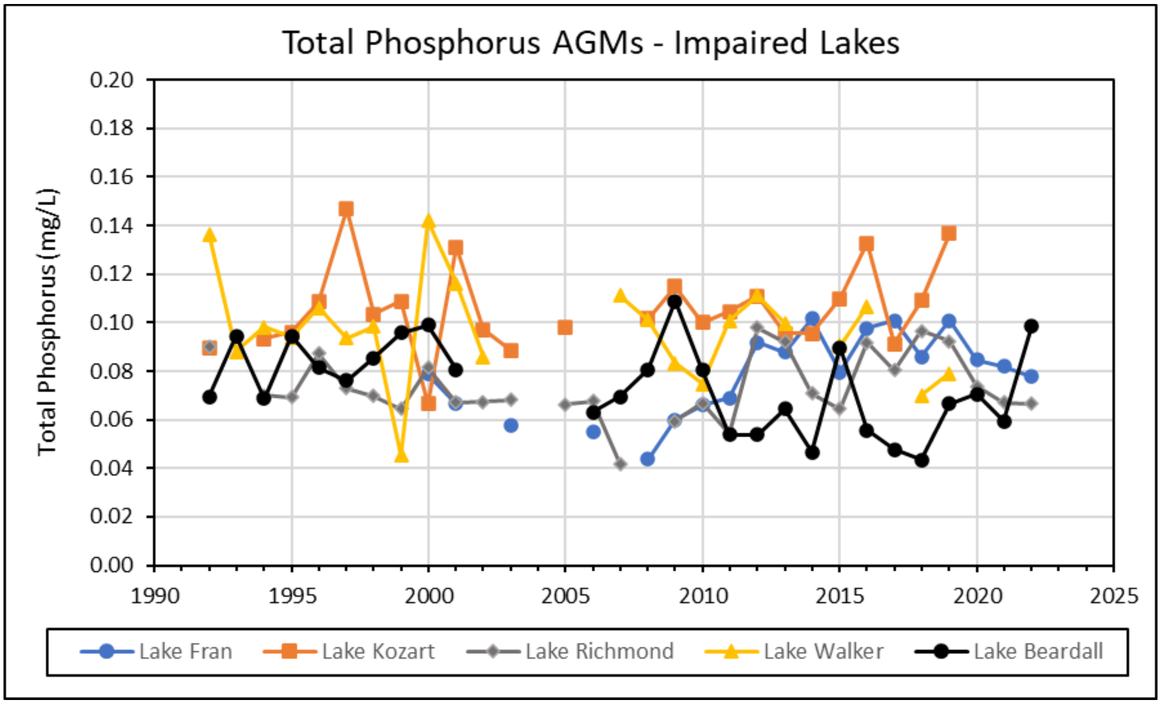

Figure 5.3. TP AGM values in the POR for the nutrient impaired lakes.

Figures 5.4 through **5.6** show the POR chlorophyll a, TN, and TP AGMs, respectively, for the three lakes in the Lake Fran watershed (Lakes Clear, Lorna Doone, and Mann) that are not exceeding the applicable NNC (assessed as not impaired for nutrients).

The chlorophyll *a* AGM values for the lakes assessed as not impaired are presented in **Figure 5.4.** The highest values occurred in the early part of the monitoring period and were generally at or above the chlorophyll *a* NNC of 20 µg/L prior to 2003. The greatest decline in AGMs occurred in Lake Mann where the lowest values occurred in the last six years, being than 15 µg/L. After 2000, the values ranged from 4 to 27 µg/L in Clear Lake and from 5 to 25 µg/L in Lake Lorna Doone, with the majority of the AGM values being less than 20 µg/L.

Figure 5.5 displays the TN AGM values, in the period of 1990 to 2022, for the lakes meeting the applicable NNC. In this period the values were generally lowest in Lake Lorna Doone, ranging from 0.53 to 1.03 mg/L. The AGMs in Clear Lake fluctuated between 0.52 and 1.47 mg/L. The highest TN values generally occurred in Lake Mann and varied from 0.62 to 1.74 mg/L.

Figure 5.6 shows the TP AGM values from 1990 to 2022 for the three lakes meeting the applicable NNC. The highest AGMs in all three lakes occurred prior to 1995 and were considerably higher than the values after this time. Since 1995 the AGMs were similar in Clear Lake, Lake Lorna Doone, and Lake Mann with most of the values being less 0.04 mg/L. The

AGM values have remained relatively steady in the last 25 years, with only a few years with values at 0.05 mg/L in Lake Lorna Doone and Lake Mann.

Figure 5.7 shows annual rainfall in the area of the lakes, as recorded at the Orlando International Airport (OIA) National Oceanic and Atmospheric Agency (NOAA) weather station. The long-term average rainfall at this location is 48.97 inches per year. During the lakes' monitoring period, the largest rainfall deviations from the long-term average occurred prior to 2008.

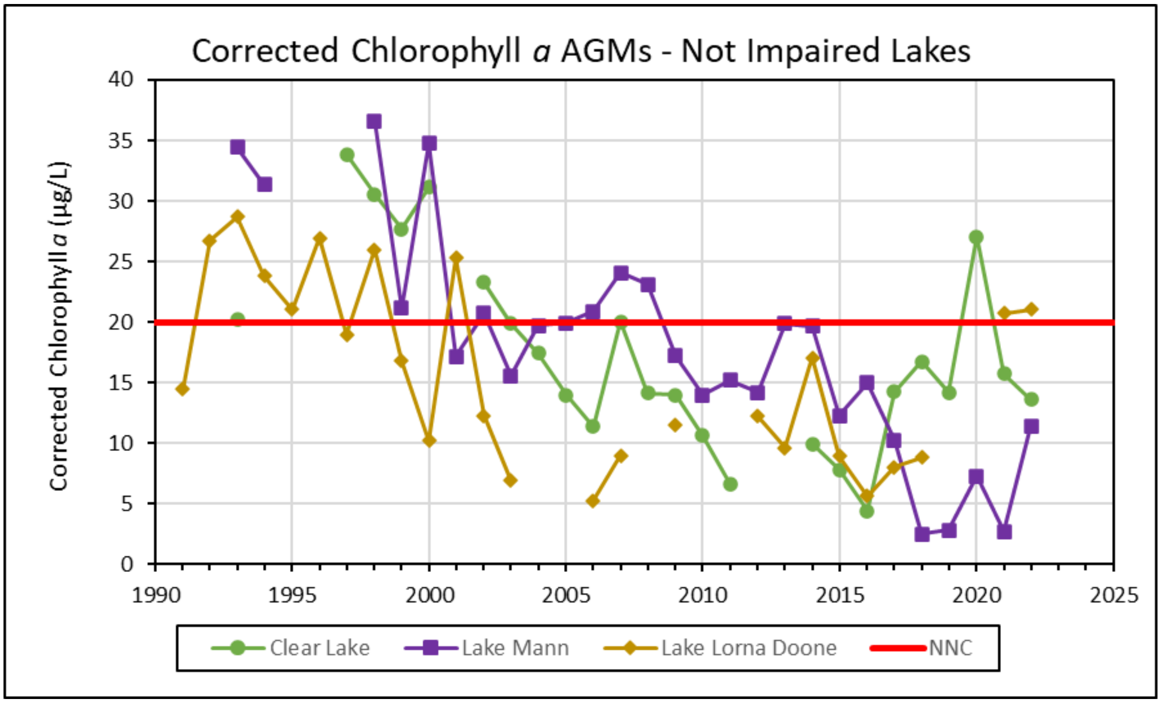

Figure 5.4. Chlorophyll *a* AGM values in the POR for lakes not exceeding the applicable NNC.

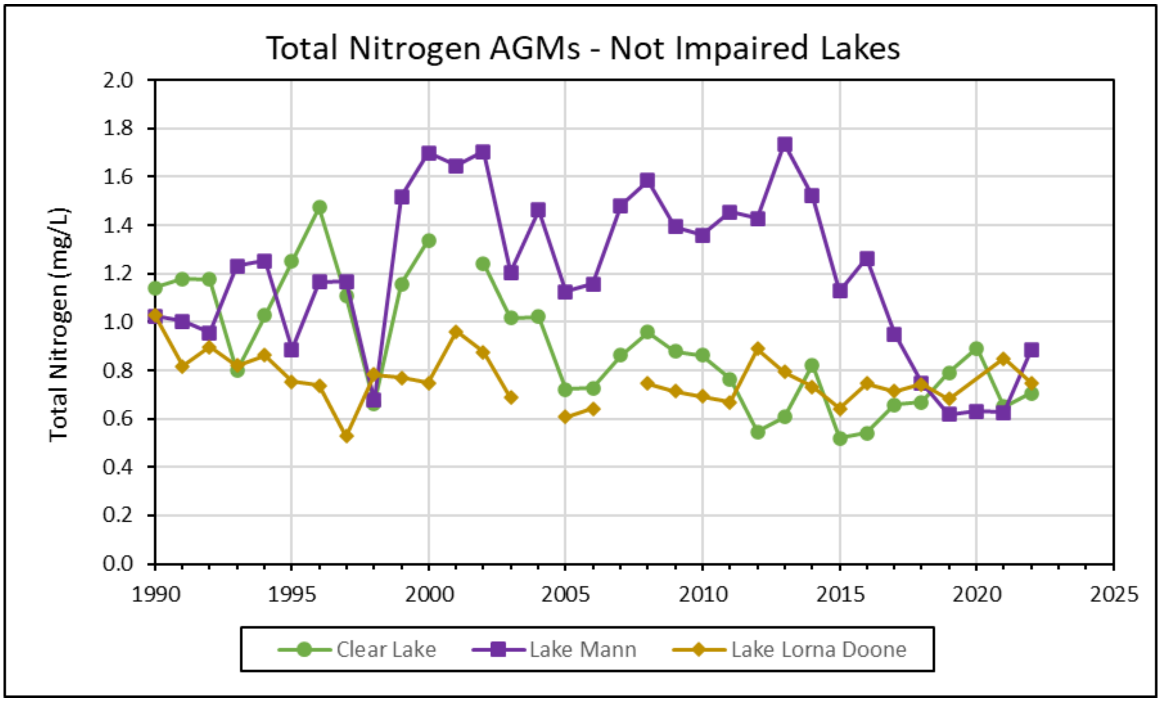

Figure 5.5. TN AGM values in the POR for lakes not exceeding the applicable NNC.

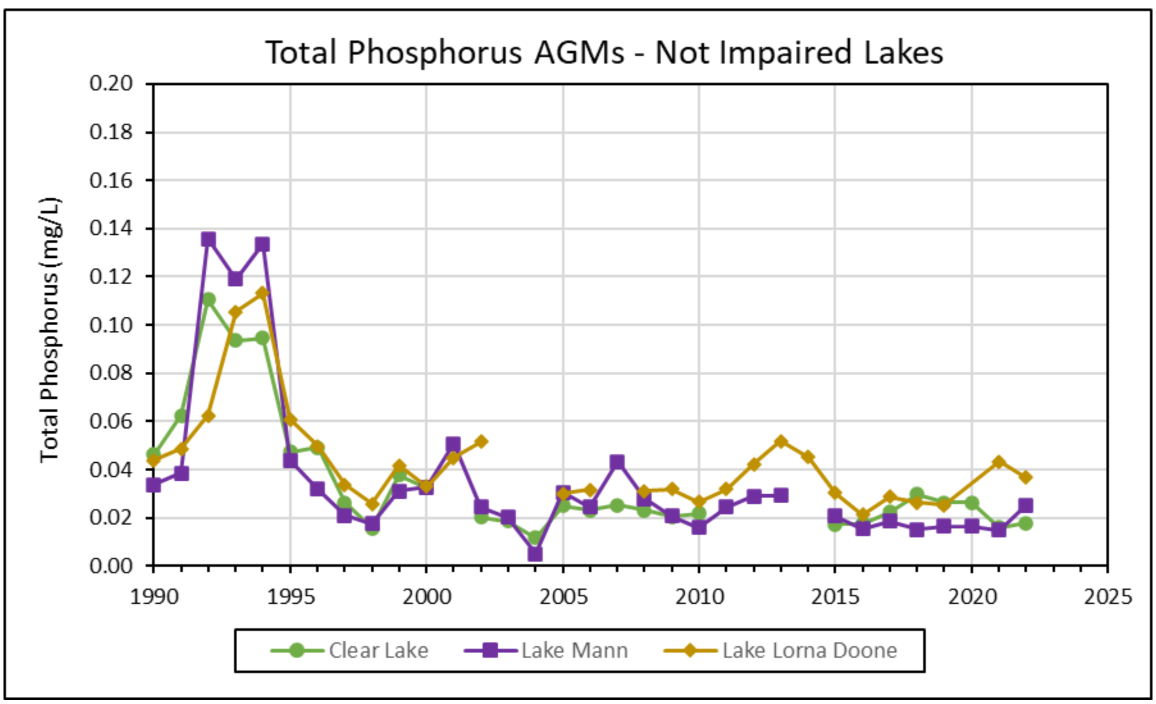

Figure 5.6. TP AGM values in the POR for lakes not exceeding the applicable NNC.

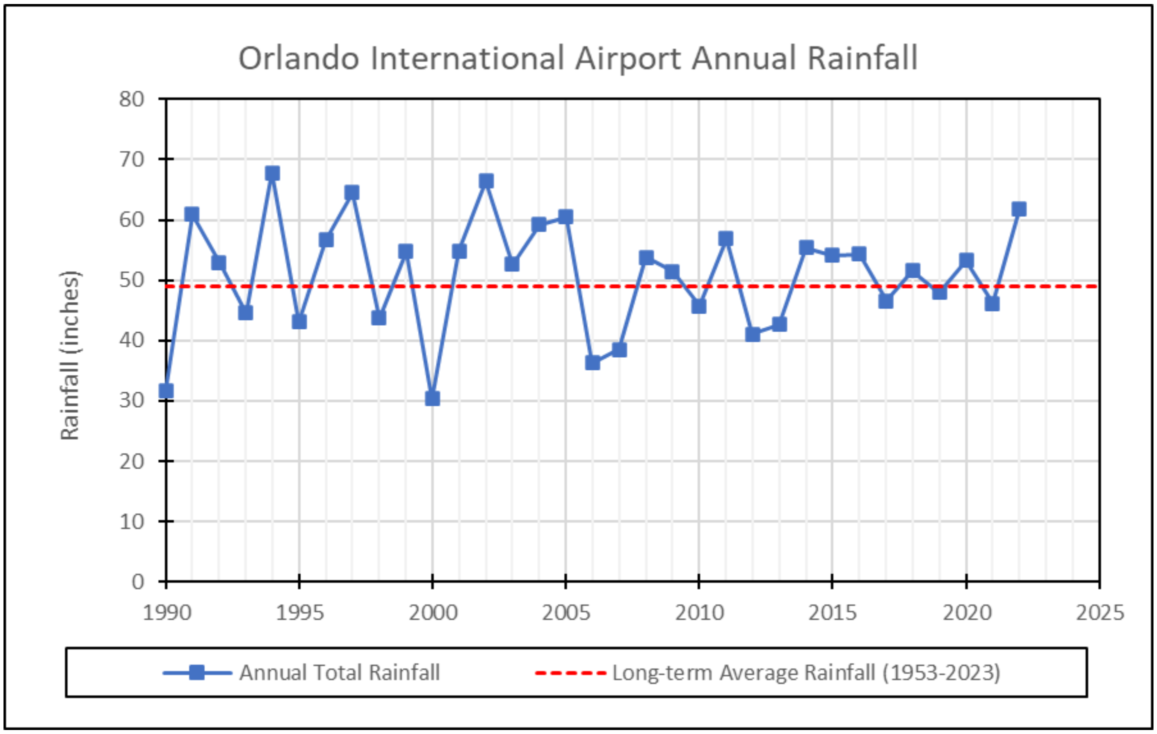

Figure 5.7. OIA annual rainfall, 1990–2022.

Relationships between nutrients and chlorophyll *a*, were evaluated by grouping the AGM values for all the lakes located in the contributing area of Lake Fran. The eight lakes in this area are characterized as low-color (≤ 40 PCU), high-alkalinity (> 20 mg/L $CaCO_3$) lakes. Additionally, the lakes are part of the same hydrologic network where the outlets of Lakes Kozart, Richmond, Walker, Clear, Mann, Beardall and Lorna Doone discharge to drainage channels that flow into Lake Fran. The relationships between chlorophyll *a* and TN AGMs (**Figure 5.8**) and chlorophyll *a* and TP AGMs (**Figure 5.9**), when combining the AGMs for all eight lakes indicate a strong positive response of chlorophyll *a* to nutrient concentrations. The relationships are based on data in the 2008–2022 period. During this time frame there were sufficient data to calculate AGMs for at least five lakes in each year. The AGMs are log-transformed (natural log) in the figures as the chlorophyll *a*, TN, and TP values are not normally distributed. The simple linear regression results indicate that 50 % of the variation in chlorophyll *a* is explained by TN concentrations and 58 % of chlorophyll *a* variation is explained by TP concentrations.

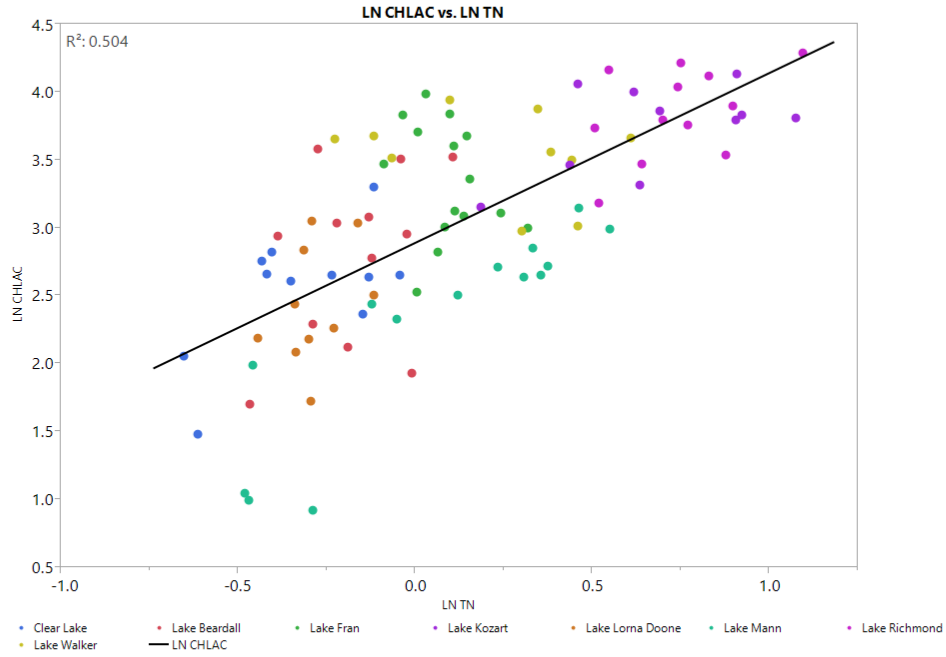

Figure 5.8. Relationship between chlorophyll *a* and TN AGM values for lakes in the Lake Fran watershed during the 2008-2022 period.

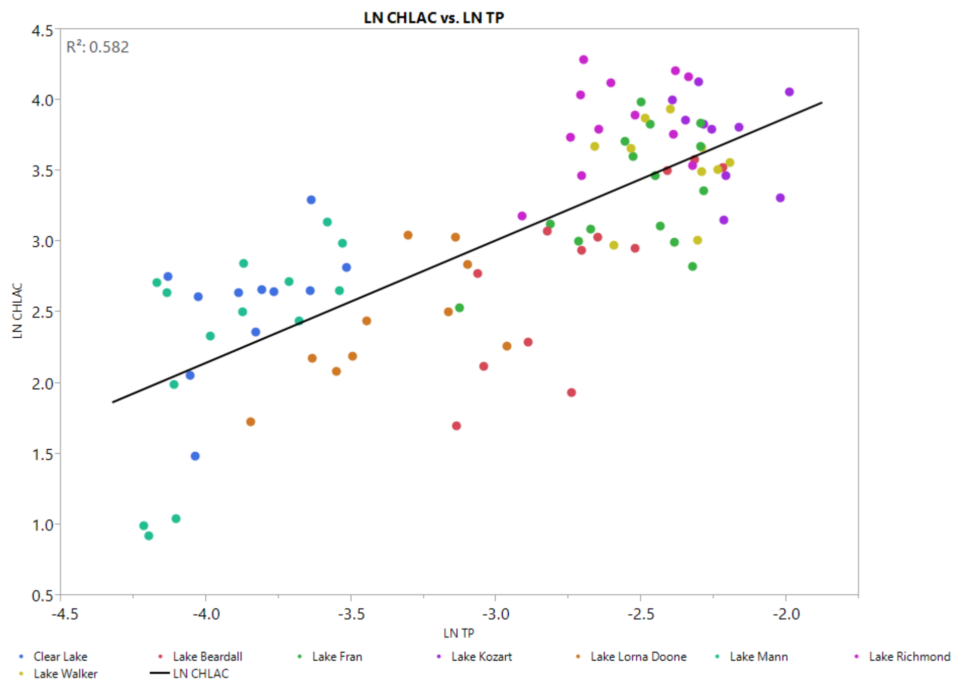

Figure 5.9. Relationship between chlorophyll *a* and TP AGM values for lakes in the Lake Fran watershed during the 2008-2022 period.

5.3 Critical Conditions and Seasonal Variation

The estimated assimilative capacity is based on annual conditions, rather than critical/seasonal conditions, because (1) the methodology used to determine assimilative capacity in Florida lakes 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, (3) the methodology used to determine impairment is based on annual conditions, and (4) the chlorophyll *a* criterion used as the TMDL restoration target is expressed as an AGM.

5.4 Water Quality Analysis to Determine Assimilative Capacity

The strong positive significant relationships (p values < 0.0001) of chlorophyll *a* to in-lake TN and TP concentrations as shown in **Figures 5.8** and **5.9**, respectively, support applying simple linear regression models to establish the TMDL nutrient targets. The linear regression equations for the relationships can be used to identify the TN and TP AGM concentrations needed to achieve the chlorophyll *a* restoration target of 20 µg/L. As discussed in **Chapter 3**, the NNC chlorophyll *a* threshold of 20 µg/L, expressed as an annual geometric mean, was selected as the response variable target for TMDL development. **Appendix C** provides the detailed regression results and parameter estimates for the simple linear regression analyses. The relationships are based on the AGMs in the period of 2008-2022, which represents the most complete set of AGM values for the eight Lake Fran watershed lakes. The 2008–2022 period, included years with both above- and below-average precipitation. Rainfall measured at the Orlando International Airport indicate that 2012 and 2013 were years with below-average precipitation, while 2008, 2011, 2014-16 and 2022 were years with above-average precipitation.

To evaluate the effects of nutrient interactions on chlorophyll *a* concentrations, a multiple linear regression (MLR) analysis was conducted using the same AGMs applied in the development of the simple linear regression models. The results of the MLR analysis show a significant relationship between lake chlorophyll *a* levels and nutrient (TN and TP) concentrations. The regression model indicates that 69% of the variation in chlorophyll *a* is attributed to TN and TP concentrations (r squared adjusted = 0.69, p values < 0.0001). **Appendix D** presents detailed regression results and parameter estimates for the relationship.

The MLR equation was used to confirm that the chlorophyll *a* restoration target can be achieved with the TN and TP concentrations derived using the simple linear regression models, as explained in **Section 5.5**.

5.5 Calculation of the TMDLs

The DEP developed the generally applicable statewide NNC based on robust empirical relationships between nutrients and chlorophyll *a* derived from a large dataset of lakes statewide, and an evaluation of the relationships between chlorophyll *a* and TN and TP in those lakes. Similarly, for this TMDL effort, empirical relationships between chlorophyll *a* and TN and TP concentrations were developed using data from the eight lakes in the Lake Fran watershed characterized as low-color (≤ 40 PCU), high-alkalinity (> 20 mg/L $CaCO_3$). The regression equations representing the relationships between chlorophyll *a* AGMs and TN and TP AGMs are as follows:

Natural Log of Corrected Chlorophyll *a* AGM = 2.89307 + 1.25044 * Natural Log of TN AGM

Natural Log of Corrected Chlorophyll *a* AGM = 5.61427 + 0.86638 * Natural Log of TP AGM

As explained in **Chapter 3,** the generally applicable chlorophyll *a* criterion of 20 µg/L for low-color, high-alkalinity lakes is appropriate for the lakes in the Lake Fran watershed and will serve as the water quality restoration target. The available information suggests that designated use attainment for the five lakes would be protected at the chlorophyll *a* criterion. The TN and TP limits necessary to achieve the chlorophyll *a* restoration target are derived using the Lake Fran watershed linear regression equations. The TN and TP values were input into the equations to two decimal places, consistent with the significant figures used to express the generally applicable NNC, to determine the nutrient concentrations that will not cause the chlorophyll *a* concentration to exceed 20 µg/L. Application of the equations indicate the TN and TP AGM concentrations necessary to meet the chlorophyll *a* criterion are 1.10 mg/L and 0.05 mg/L, respectively.

The TN and TP target concentrations were then input to the following MLR equation to evaluate the effect of nutrient interactions on chlorophyll *a* concentrations:

Natural Log of Corrected Chlorophyll *a* AGM = 4.74670 + 0.72289 * Natural Log of TN AGM + 0.60388 * Natural Log of TP AGM

Applying the nutrient concentrations, derived using the simple linear regression models, in the MLR equation results in a chlorophyll *a* AGM of 20 µg/L, which confirms the restoration target is attainable accounting for the interaction of in-lake TN and TP conditions.

The lakes are expected to meet the applicable chlorophyll *a* criterion and maintain their function and designated use as Class III freshwater when surface water nutrient concentrations are reduced to the target concentrations, addressing the anthropogenic contributions to the water quality impairments.

The method used to determine the reductions needed to attain the nutrient TMDLs is the percent reduction approach. Existing lake nutrient conditions used in the percent reduction calculations were selected by considering the nutrient concentrations measured in the 2013 to 2022 period.

The existing nutrient conditions used to calculate the required reductions were the maximum TN and TP AGMs in each lake that exceeded the water quality targets. The geometric means were calculated from nutrient results available in the IWR Run 65 Database.

The equation used to calculate the percent reductions is as follows:

$$\frac{\textbf{[measured exceedance (maximum AGM) – target]}}{\textbf{measured exceedance (maximum AGM)}} \textbf{ X 100}$$

Table 5.1 lists the percent reductions in the maximum AGM concentrations needed to achieve the TN AGM target of 1.10 mg/L and the TP AGM target of 0.05 mg/L. The TN percent reductions range from a high of 63% in Lake Richmond to a low of 14% in Lake Fran. All the lakes TP percent reductions are 50% or greater, with the highest reduction, 64%, for Lake Kozart. The nutrient AGM TMDL values and the associated percent reductions address the anthropogenic nutrient inputs contributing to the exceedances of the chlorophyll *a* criterion.

Table 5.1. Reductions required in existing TN and TP concentrations to meet water quality targets for the Lake Fran watershed impaired lakes.

ID - Insufficient Data; ND - No Data

Year	Lake Fran TN AGM (mg/L)	Lake Fran TP AGM (mg/L)	Lake Kozart TN AGM (mg/L)	Lake Kozart TP AGM (mg/L)	Lake Richmond TN AGM (mg/L)	Lake Richmond TP AGM (mg/L)	Lake Walker TN AGM (mg/L)	Lake Walker TP AGM (mg/L)	Lake Beardall TP AGM (mg/L)
2013	1.28	0.09	2.45	0.10	2.57	0.09	1.58	0.10	0.06
2014	1.17	0.10	1.99	0.10	2.02	0.07	ID	ID	0.05
2015	1.12	0.08	1.55	0.11	1.66	0.06	1.10	0.09	0.09
2016	1.07	0.10	1.89	0.13	2.16	0.09	0.94	0.11	0.06
2017	1.10	0.10	1.85	0.09	2.45	0.08	ID	ID	0.05
2018	0.92	0.09	1.20	0.10	1.73	0.10	0.89	0.07	0.04
2019	1.16	0.10	1.58	0.14	2.12	0.09	0.80	0.08	0.07
2020	0.97	0.08	ND	ND	2.29	0.07	ND	ND	0.07
2021	1.03	0.08	ND	ND	2.99	0.07	ND	ND	0.06
2022	1.01	0.08	ND	ND	2.10	0.07	ND	ND	0.10
Maximum AGM	1.28	0.10	2.45	0.14	2.99	0.10	1.58	0.11	0.10
TMDL Target	1.10	0.05	1.10	0.05	1.10	0.05	1.10	0.05	0.05
% Reduction to Meet Target	14	50	55	64	63	50	30	55	50

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:

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

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

$$\textbf{TMDL} \cong \sum \textbf{WLAs}_{\textbf{wastewater}} + \sum \textbf{WLAs}_{\textbf{NPDES Stormwater}} + \sum \textbf{LAs} + \textbf{MOS}$$

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, which state that TMDLs can be expressed in terms of mass per time (e.g., pounds per day), toxicity, or other appropriate measure; see 40 Code of Federal Regulations (CFR) § 130.2(i). The TMDLs for Lakes Fran, Kozart, Richmond, Walker and Beardall are expressed in terms of in-lake nutrient concentration targets and the percent reductions in existing lake nutrient conditions necessary to meet the targets, and represent the lake nutrient concentrations the waterbodies can assimilate while maintaining a balanced aquatic flora and fauna (see **Table 6.1**). These TMDLs are expressed as maximum AGM values for TN and TP, not to be exceeded. The lakes' 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. This protects each lake's designated use.

Table 6.1 lists the TMDLs for the Lake Fran Watershed. The TMDLs will constitute the site-specific numeric interpretation 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 Lakes Fran, Kozart, Richmond, Walker and Beardall.

Note: MOS is implicit.
NA = Not applicable
[1] The TMDLs represent the AGM lake concentrations (mg/L) not to be exceeded.
[2] The required percent reductions listed in this table represent the reductions of in-lake concentrations and do not directly reflect reductions in source loadings.

Waterbody Name (WBID)	Parameter	TMDL (mg/L)[1]	WLA Wastewater (% reduction)	WLA NPDES Stormwater (% reduction)[2]	LA (% reduction)[2]
Lake Fran (3169G3)	TN	1.10	NA	14	14
Lake Fran (3169G3)	TP	0.05	NA	50	50
Lake Kozart (3169G4)	TN	1.10	NA	55	55
Lake Kozart (3169G4)	TP	0.05	NA	64	64
Lake Richmond (3169G6)	TN	1.10	NA	63	63
Lake Richmond (3169G6)	TP	0.05	NA	50	50
Lake Walker (3169G5)	TN	1.10	NA	30	30
Lake Walker (3169G5)	TP	0.05	NA	55	55
Lake Beardall (3169G8)	TN	1.10	NA	0	0
Lake Beardall (3169G8)	TP	0.05	NA	50	50

6.2 Load Allocation

The TMDLs are based on the percent reductions in in-lake nutrient concentrations. To achieve the LA, decreases in current TN and TP loads to the lakes will be required to meet the percent reductions, as specified in **Table 6.1**. The percent reductions represent the generally needed TN and TP reductions from all 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.

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 wastewater facilities discharge into the lakes or the watersheds of Lakes Fran, Kozart, Richmond, Walker and Beardall. Therefore, a WLA for wastewater discharges is not applicable.

6.3.2 NPDES Stormwater Discharges

The Lake Fran Watershed, which includes the drainage basins of Lakes Fran, Kozart, Richmond, Walker and Beardall are covered by the MS4 Phase 1 permits issued to the City of Orlando (Permit No. FLS000014) and Orange County (Permit No. FLS000011), with DOT District 5 as a copermittee. Areas within these jurisdictions may be responsible for reductions in current anthropogenic TN and TP loadings to the lakes, equivalent to the percent reductions indicated in **Table 6.1**.

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 MOS

The MOS can either be implicitly accounted for by choosing conservative assumptions about loadings or water quality response, or explicitly accounted for during the allocation of loadings. 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.

Consistent with the recommendations of the Allocation Technical Advisory Committee (DEP 2001), an implicit MOS was used in the development of the TMDLs because of the conservative assumptions that were applied. The conservative elements are as follows:

- The reductions were developed using the highest measured AGM TN and TP values to calculate the percent reductions.
- Require that the TMDL nutrient targets are 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 respond to the permit conditions that reflect target concentrations, reductions, or WLAs 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 is contained 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 Lakes Fran, Kozart, Richmond, Walker and Beardall Watersheds are located in the Lake Okeechobee BMAP area (DEP 2020). The BMAP was adopted in December 2014 to implement the TP TMDL in the Lake Okeechobee Watershed, and activities are ongoing to reduce nutrient loads to Lake Okeechobee. An updated BMAP was adopted in February 2020. BMPs and other projects have been conducted to reduce nutrient loading to lakes in the basin. DOT District Five, Orange County, and the City of Orlando have conducted projects and educational and outreach efforts in the area to help reduce nutrient loading. Projects include detention ponds, street sweeping, curb and grate inlet baskets, and baffle boxes. Educational and outreach efforts include the illicit discharge program; Florida Yards and Neighborhoods Program; landscaping, irrigation, fertilizer, and pet waste management ordinances; public service announcements; pamphlets; and the Orange County Water Atlas website. These projects and others are further described in the Lake Okeechobee BMAP (DEP 2020) and Florida Statewide Annual Report (DEP 2021b). Additional information about BMAPs is available online.

7.3 Implementation Considerations for the Waterbody

Existing nutrient reduction and management infrastructure and plans should be included in any future pollutant mitigation strategies. 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 monitoring of the lakes for nutrient variables (chlorophyll *a*, TN and TP) should continue and be expanded, as necessary, during the implementation phase to ensure that adequate information is available for tracking restoration progress. Consideration should be given to expanding monitoring to include likely sources of nutrients to the waterbodies to better guide restoration activities.

Stakeholders should focus on nutrient control strategies that help decrease in-lake nutrient concentrations sufficient to reduce chlorophyll *a* levels below the applicable NNC. Once each lake is consistently meeting the NNC over the assessment period, it can be assumed that the TMDLs are being met.

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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 five 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 DOT 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 one and five 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 Fran, Lake Kozart, Lake Richmond, Lake Walker and Lake Beardall
Waterbody type(s)	Lake
WBID	Lake Fran (WBID 3169G3), Lake Kozart (WBID 3169G4), Lake Richmond (WBID 3169G6), Lake Walker (WBID 3169G5), Lake Beardall (WBID 3169G8) (see **Figure 1.2** of this report)
Description	Lake Fran, Lake Kozart, Lake Richmond, Lake Walker and Lake Beardall are part of the Lake Fran watershed system, located in the western area of Orlando in Orange County. The combined watershed area for these lakes is 5,400 acres. Lakes in the watershed have a combined surface area of 759 acres (14 % of the watershed). Medium-density residential is the predominant anthropogenic land use and makes up 2,086 acres (39 %) of the watershed. **Chapter 1** of this report provides more detail on the Lake Fran Watershed system.
Specific location (latitude/longitude or river miles)	The center of Lake Fran is located at Latitude N: 28°31'20", Longitude W: -81°26'43". The center of Lake Kozart is located at Latitude N: 28°31'33", Longitude W: -81°26'20". The center of Lake Walker is located at Latitude N: 28°31'29", Longitude W: -81°25'23". The center of Lake Richmond is located at Latitude N: 28°30'43", Longitude W: -81°26'03". The center of Lake Beardall is located at Latitude N: 28°32'12", Longitude W: -81°24'11". The site-specific criteria apply as a spatial average for each lake, as defined by WBIDs 3169G3, 3169G4, 3169G6, 3169G5, and 3169G8.
Map	**Figure 1.1** shows the general location of the lakes and the watershed, and **Figure 4.1** shows the land uses throughout the watershed.
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	Lakes Fran, Kozart, Richmond, Walker and Beardall are classified as low-color (<40 PCU), high-alkalinity (> 20 mg/L $CaCO_3$) 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, TP, chlorophyll a, and/or nitrate + nitrite concentrations (magnitude, duration, and frequency)	Numeric interpretations of the narrative nutrient criterion: **Lake Fran (WBID 3169G3), Lake Kozart (WBID 3169G4), Lake Richmond (WBID 3169G6), Lake Walker (WBID 3169G5), and Lake Beardall (WBID 3169G8):** **TN:** 1.10 mg/L, expressed as an AGM not to be exceeded. **TP:** 0.05 mg/L, expressed as an AGM not to be exceeded.
Period of record used to develop numeric interpretations of the narrative nutrient criterion for TN and TP	AGM values for the eight lakes in the Lake Fran Watershed from 2008 to 2022 were used to develop the empirical relationships used to set the TN and TP criteria for the five impaired lakes.
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 2008–22 period, which included years with both above- and below-average precipitation. Rainfall measured at the Orlando International Airport indicate that 2012 and 2013 were years with below-average precipitation, while 2008, 2011, 2014-16, and 2022 were years with above-average precipitation. **Figure 2.1** shows the sampling stations for impaired lakes in the Lake Fran Watershed. Monitoring stations, sampled by the city of Orlando, were located across the spatial extent and represent the spatial distribution of nutrient dynamics in the lakes, City of Orlando (21FLORL…). **Chapter 5** contains graphs showing water quality results for the variables relevant to TMDL development.

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	During the Cycle 3 assessment, the NNC were used to assess the lakes during the verified period (January 1, 2009, to June 30, 2016) based on data from IWR Database Run 53. Lakes Fran, Kozart, Richmond, and Walker were assessed as impaired for chlorophyll *a*, TN, and TP; and Lake Beardall was assessed as impaired for TP because the AGMs exceeded the NNC more than once in a three-year period. The waterbodies were added to the 303(d) list for nutrients in 2017. During the 2024 biennial assessment, Lake Beardall was assessed as impaired for nutrients (chlorophyll *a*) because the AGMs exceeded the NNC more than once in a three-year period in the verified period (January 1, 2015, to June 30, 2022), based on data from IWR Database Run 64. Lake Beardall was added to the 303(d) list for nutrients (chlorophyll *a*) in 2024.
Basis for use support	The basis for use support 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 lakes that would make the use of the chlorophyll *a* threshold of 20 µg/L inappropriate.
Approach used to develop criteria and how it protects uses	The method used to develop the criteria were simple linear regression model equations that relate chlorophyll *a* levels to the lake TN and TP AGM concentrations. The criteria are expressed as maximum AGM concentrations not to be exceeded in any year. Establishing the frequency as not to be exceeded in any year ensures that the chlorophyll *a* NNC, which are protective of designated use, is 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 method indicated that the chlorophyll *a* concentration restoration target for the lakes will be attained at the TMDL in-lake TN and TP concentration, frequency, and duration. DEP notes that there were no impairments for nutrient-related parameters (such as dissolved oxygen [DO] or un-ionized ammonia). 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 Fran, the downstream lake in the system of lakes that includes Lakes Kozart, Richmond, Walker, Clear, Mann, Beardall, and Lorna Doone, has an outlet that discharges to the upper reaches of Shingle Creek (WBIDs 3169G1 and 3169A), part of the Kissimmee River Basin. The Shingle Creek watershed is located in the Peninsular Nutrient Watershed Region. The generally applicable NNC for streams in this region, set forth in subparagraph 62-302.531(2)(c)2., F.A.C., are a TN concentration of 1.54 mg/L and a TP concentration of 0.12 mg/L. These nutrient thresholds, which are also expressed as AGMs, are higher than the AGM site-specific criteria for lakes in the Lake Fran Watershed. The reductions in nutrient loads described in this TMDL analysis are not expected to cause nutrient impairments downstream and will improve water quality in downstream waters (see **Section 3.4** of this report).
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.	The city of Orlando, and to a lesser extent the DEP, conduct monitoring for lakes in the Lake Fran Watershed. The data collected through these monitoring activities will be used to evaluate the effect of BMPs implemented in the watershed on lake TN and TP concentrations in subsequent water quality assessment periods.

Table B-5. Documentation of endangered species consideration.

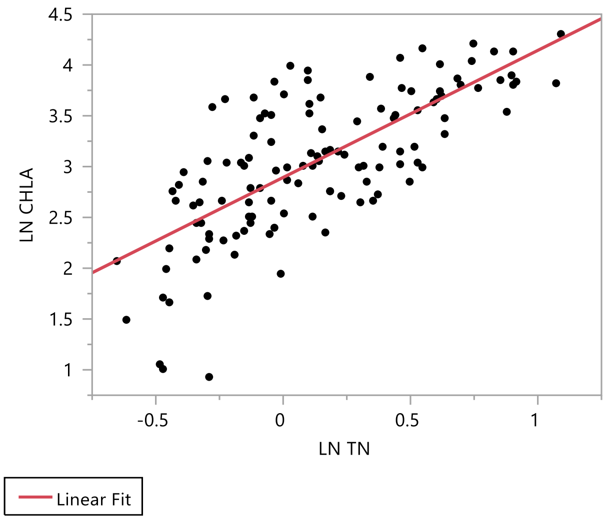
Administrative Requirements	Information for Administrative Requirements
Endangered species consideration	DEP is not aware of any endangered aquatic species present in the Lake Fran Watershed. Furthermore, it is expected that improvements in water quality resulting from these restoration efforts will 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 January 16, 2024, to initiate TMDL development for impaired waters in the Kissimmee River Basin. A rule development public workshop for the TMDLs was held on February 12, 2025.
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 a site-specific interpretation of the narrative nutrient criterion and will submit these documents to the EPA.

Appendix C: Simple Linear Regression Model Results

Bivariate Fit of Natural Log (LN) CHLAC AGM By Natural Log (LN) TN AGM
Lakes Fran, Kozart, Richmond, Walker, Clear, Mann, Beardall, and Lorna Doone, 2008–2022 Results



Linear Fit

LN CHLAC = 2.8930678 + 1.2504399*LN TN

Summary of Fit

RSquare	0.503821
RSquare Adj	0.498428
Root Mean Square Error	0.536025
Mean of Response	3.04973
Observations (or Sum Wgts)	94

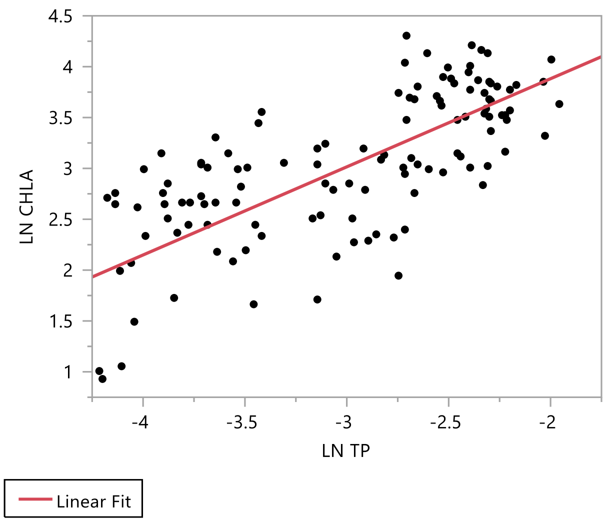
Analysis of Variance

Source	**DF**	**Sum of Squares**	**Mean Square**	**F Ratio**
Model	1	26.840895	26.8409	93.4171
Error	92	26.433727	0.2873	**Prob > F**
C. Total	93	53.274623		<.0001*

Parameter Estimates

Term	**Estimate**	**Std Error**	**t Ratio**	**Prob>|t|**
Intercept	2.8930678	0.057614	50.21	<.0001*
LN TN	1.2504399	0.129375	9.67	<.0001*

Bivariate Fit of LN CHLAC AGM By LN TP AGM
Lakes Fran, Kozart, Richmond, Walker, Clear, Mann, Beardall, and Lorna Doone, 2008–2022 Results



Linear Fit
LN CHLAC = 5.6142675 + 0.8663756*LN TP

Summary of Fit

RSquare	0.581872
RSquare Adj	0.577327
Root Mean Square Error	0.492063
Mean of Response	3.04973
Observations (or Sum Wgts)	94

Analysis of Variance

Source	**DF**	**Sum of Squares**	**Mean Square**	**F Ratio**
Model	1	30.999017	30.9990	128.0284
Error	92	22.275605	0.2421	**Prob > F**
C. Total	93	53.274623		<.0001*

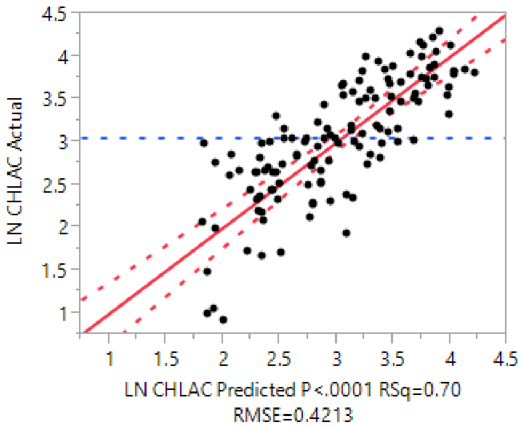
Parameter Estimates

Term	**Estimate**	**Std Error**	**t Ratio**	**Prob>|t|**
Intercept	5.6142675	0.232263	24.17	<.0001*
LN TP	0.8663756	0.076569	11.31	<.0001*

Appendix D: Multiple Linear Regression Model Results

Response LN CHLAC AGM by LN TN AGM and LN TP AGM
Lakes Fran, Kozart, Richmond, Walker, Clear, Mann, Beardall, and Lorna Doone, 2008–2022 Results
Whole Model

Actual by Predicted Plot



Prediction Expression

4.74669815762048 + 0.7228933768934 * LN TN + 0.60388195630476 * LN TP

Summary of Fit

RSquare	0.696842
RSquare Adj	0.690179
Root Mean Square Error	0.421283
Mean of Response	3.04973
Observations (or Sum Wgts)	94

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	37.123988	18.5620	104.5867
Error	91	16.150634	0.1775	**Prob > F**
C. Total	93	53.274623		<.0001*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	VIF
Intercept	4.7466982	0.247694	19.16	<.0001*	.
LN TN	0.7228934	0.123054	5.87	<.0001*	1.4645892
LN TP	0.603882	0.079335	7.61	<.0001*	1.4645892

Residual by Predicted Plot