Southwest District • Withlacoochee Basin

Draft Report
Nutrient TMDLs for Mud Lake (WBID 1467)

Division of Environmental Assessment and Restoration
Florida Department of Environmental Protection

May 2026

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 impairment for Mud Lake with **w**ater**b**ody **id**entification (WBID) number 1467. This lake is located near the City of Polk City in Polk County and is within the Upper Withlacoochee Planning Unit that is part of the larger Withlacoochee Basin.

Mud Lake was identified as impaired for nutrients based on 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.). Mud Lake was included on the Verified List of Impaired Waters for the Withlacoochee Basin adopted by Secretarial Order in July 2022 for the Biennial Assessment 2020-2022. The U.S. Environmental Protection Agency (EPA) added Mud Lake to Florida's 2022 303(d) list for chlorophyll *a*, TN, and TP and tracks through its Assessment, Total Maximum Daily Load Tracking and Implementation System (ATTAINS).

The TMDLs are based on the generally 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 and guidance developed by the U.S. Environmental Protection Agency.

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

Type of Information	Description
Waterbody name/ WBID number	Mud Lake/WBID 1467.
Hydrologic Unit Code (HUC) 8	03100208 (see **Section 1.2** for additional information).
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	Placed on the Verified List of Impaired Waters for the Withlacoochee Basin adopted via Secretarial Order on July 11, 2022.
TMDL pollutants	TN and TP.
Generally applicable chlorophyll *a* criterion	**Colored (color > 40 platinum cobalt units [PCUs]) lake:** **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 consecutive 3-year period.
TMDLs	**Mud Lake (WBID 1467):** **TN:** 27 % reduction in in-lake concentration to meet the generally applicable NNC for colored lakes. **TP:** 67 % reduction in in-lake concentration to meet the generally applicable NNC for colored lakes.

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 Watershed Services Program, Watershed Assessment Section, Standards Development Section, Water Quality Restoration Program, and Watershed Evaluation and TMDL Section. DEP also recognizes the Polk County Parks & Natural Resource Division for their contributions towards understanding the issues, history, and processes at work in the Mud Lake watershed.

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

2600 Blair Stone Road
Mail Station 3000
Tallahassee, FL 32399-2400
Phone: (850) 245–8469
https://floridadep.gov/dear

Contents

List of Figures

List of Tables

List of Acronyms and Abbreviations

µg/L	Micrograms Per Liter
AC	acre
AGM	Annual Geometric Mean
ATTAINS	Assessment, Total Maximum Daily Load Tracking and Implementation System
BMAP	Basin Management Action Plan
BMP	Best Management Practice
$CaCO_3$	Calcium Carbonate
CFR	Code of Federal Regulations
CWA	Clean Water Act
DEP	Florida Department of Environmental Protection
EPA	U.S. Environmental Protection Agency
°F	Degrees Fahrenheit
F.A.C.	Florida Administrative Code
FDOH	Florida Department of Health
FDOT	Florida Department of Transportation
FLGFWF	Florida Game & Freshwater Fish Commission
FLUCCS	Florida Land Use, Cover and Forms Classification System
F.S.	Florida Statutes
ft	Feet
FWC	Florida Fish and Wildlife Conservation Commission (formerly known as Florida Game & Freshwater Fish Commission)
FWRA	Florida Watershed Restoration Act
HUC	Hydrologic Unit Code
ID	Insufficient Data
IWR	Identification of 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
NAVD	North American Vertical Datum
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
POR	Period of Record

PQL	Practical Quantitation Limit
SWFWMD	Southwest Florida Water Management District
SWIM	Surface Water Improvement and Management (Program)
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
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 Mud Lake, located in the Upper Withlacoochee Planning Unit that is part of the larger Withlacoochee Basin in Polk County. The TMDLs are established to achieve the generally applicable numeric nutrient criteria (NNC) in subsection 62-302.531(2), Florida Administrative Code (F.A.C.), and are intended to attain the corrected chlorophyll *a* criterion applicable to the lake. The TMDL targets are not being adopted as site-specific interpretations of the NNC because the generally applicable NNC fully protect designated uses.

Mud Lake was verified as impaired for nutrients using the methodology in the Identification of Impaired Surface Waters Rule (IWR) (Chapter 62-303, F.A.C.). The lake was included on the Verified List of Impaired Waters for the Withlacoochee Basin that was adopted by Secretarial Order in July 2022.

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 Mud Lake 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) has divided the Withlacoochee Basin (Hydrologic Unit Codes [HUC 8] - 03100208) into watershed assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each surface waterbody or waterbody segment. Mud Lake is identified as WBID 1467. **Figure 1.1** shows the location of the watershed in the basin and major geopolitical and hydrologic features in the region.

Mud Lake is located in Polk City, Florida within Polk County. The Mud Lake watershed encompasses 1.8 square miles (1,180 acres) in north central Polk County. The estimated surface area of the lake is 139 acres, and the average depth is 3 ft. (0.91 m) with a maximum depth of 9 ft. (2.7 m). The normal pool topographic elevation of the water surface is 138.5 feet North American Vertical Datum (NAVD88) (Polk County, 2023). Mud Lake receives flow from a canal located in a residential neighborhood in the western area of the watershed, which is included within the Mud Lake Outlet (WBID 1467B). The lake has control structures at the inlet on the western side, and at the outlet on its northeastern end (**Figure 1.2**). The outlet flows into Pony Creek (WBID 1426) which then discharges to the Upper Withlacoochee River (**Figure**

1.1). WBID 1467B and WBID 1426 are not verified impaired for nutrients. The watershed land use consists of urban development, predominantly residential throughout the basin, and agricultural activity primarily located in the southern area.

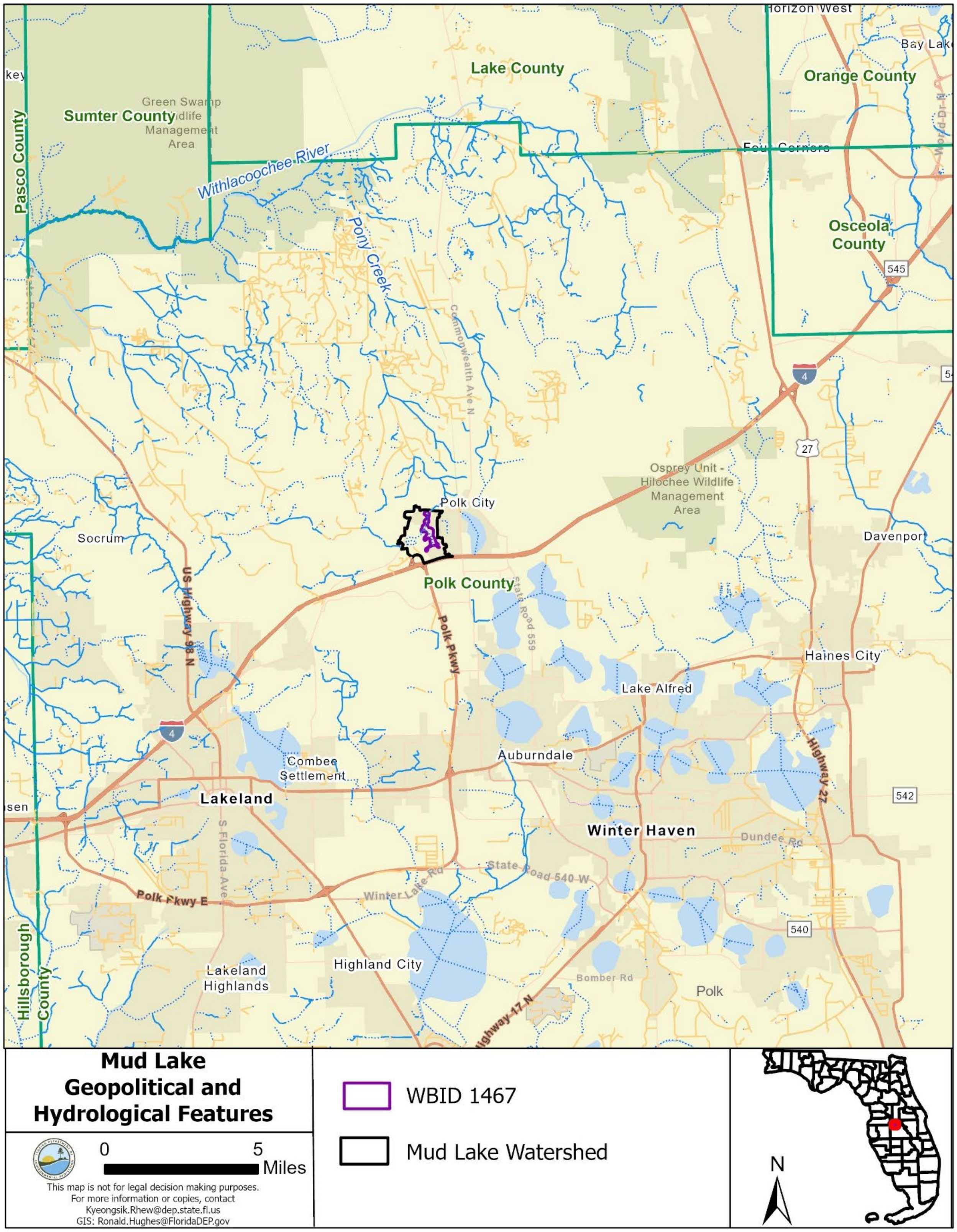

Figure 1.1. Mud Lake Watershed and major geopolitical and hydrological features.

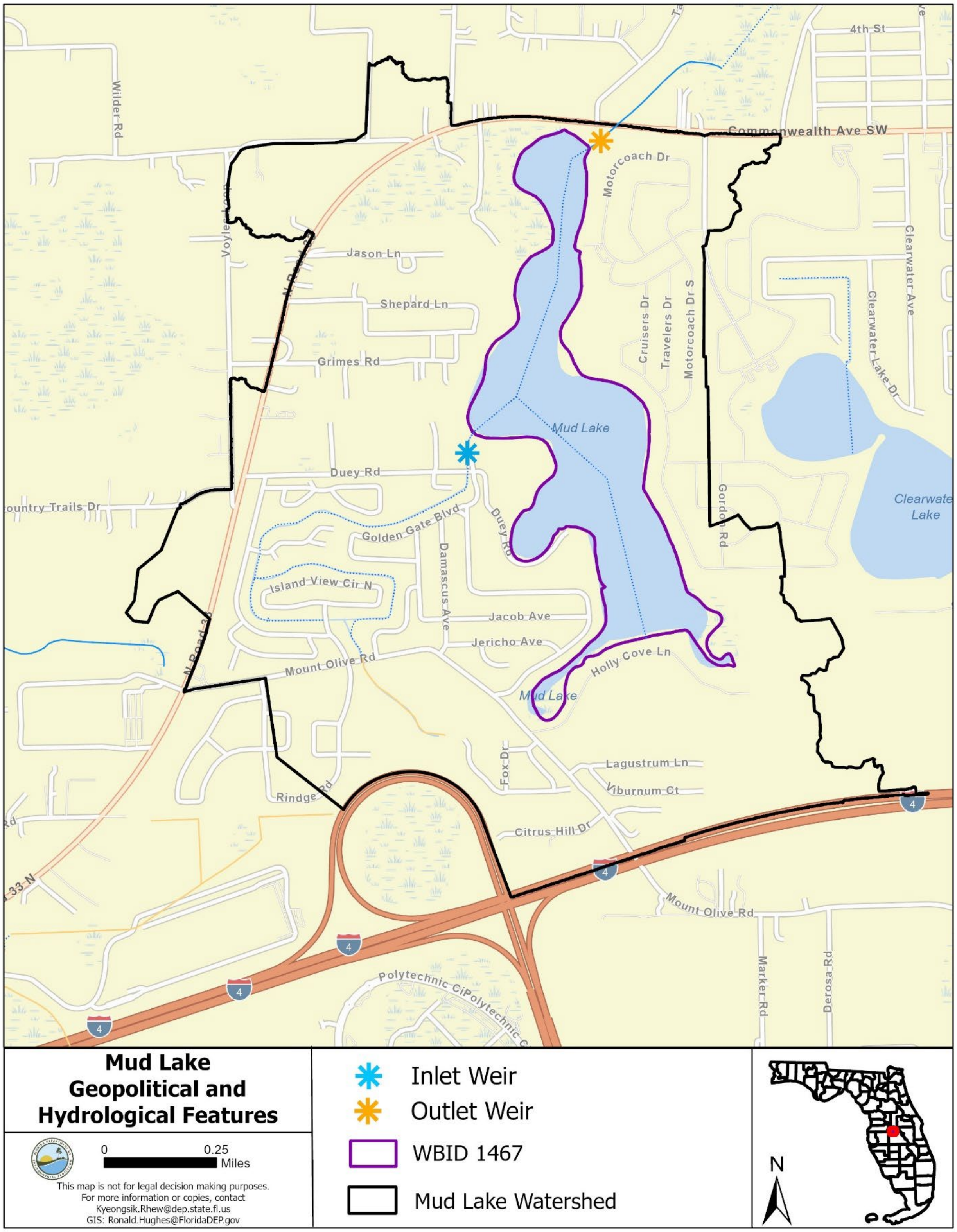

Figure 1.2. Mud Lake (WBID 1467) and the Mud Lake Watershed, and Inlet and Outlet Locations.

1.3 Watershed Information

1.3.1 Population and Geopolitical Setting

Mud Lake and its watershed are in Polk City, Florida within Polk County. According to data available from the U.S. Census Bureau (2024), the population of Polk County is 852,783, with a density of 424 people per square mile. The county occupies an area of 2,011 square miles and contains 364,796 housing units, with a housing density of 181 houses per square mile. Polk City has a population of 2,713 (U.S. Census Bureau 2020).

1.3.2 Topography

Mud Lake lies in the Southwestern Flatlands Lake Region (Region 75-36), which consists of lakes that range from somewhat acidic to alkaline and are typically highly colored and eutrophic (Griffith et al. 1997). The elevations in the Mud Lake watershed range from 140 to 170 ft.

1.3.3 Hydrogeological Setting

The Mud Lake watershed is located in a humid subtropical climate zone characterized by hot and humid summers, mild winters, and a wet season between June and September. The watershed's long-term average rainfall was 54.01 inches per year (in/yr) from 1893 to 2025. Rainfall data were obtained from the Northeast Regional Climate Center Online Weather Data (2026) at the Plant City weather station. The annual average temperature was 72.2 degrees Fahrenheit (° F).

The hydrologic characteristics of soil can significantly influence the capability of a watershed to hold rainfall or produce surface runoff. Soils are generally classified as one of four major types 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. When unsaturated, Group A/D, B/D, and C/D soils are characteristic of Group A, B, and C soils, respectively, and when saturated they are more characteristic of Group D soils.

Table 1.1 lists the soil hydrologic groups in the Mud Lake watershed. Type A and A/D soils predominate in the watersheds, occupying nearly 80% of the area. The Unclassified group represents the lake bottom sediments. **Figure 1.3** contains detailed maps of the soil hydrologic groups in the watershed.

Table 1.1. Hydrologic soil groups and acreages in the Mud Lake Watershed.

Hydrologic Soil Group	Area (acres)	%
A	373.9	32
A/D	548.0	46
B	22.7	2
B/D	0.1	0
C/D	56.3	5
Unclassified	178.6	15
Total	**1,179.5**	**100**

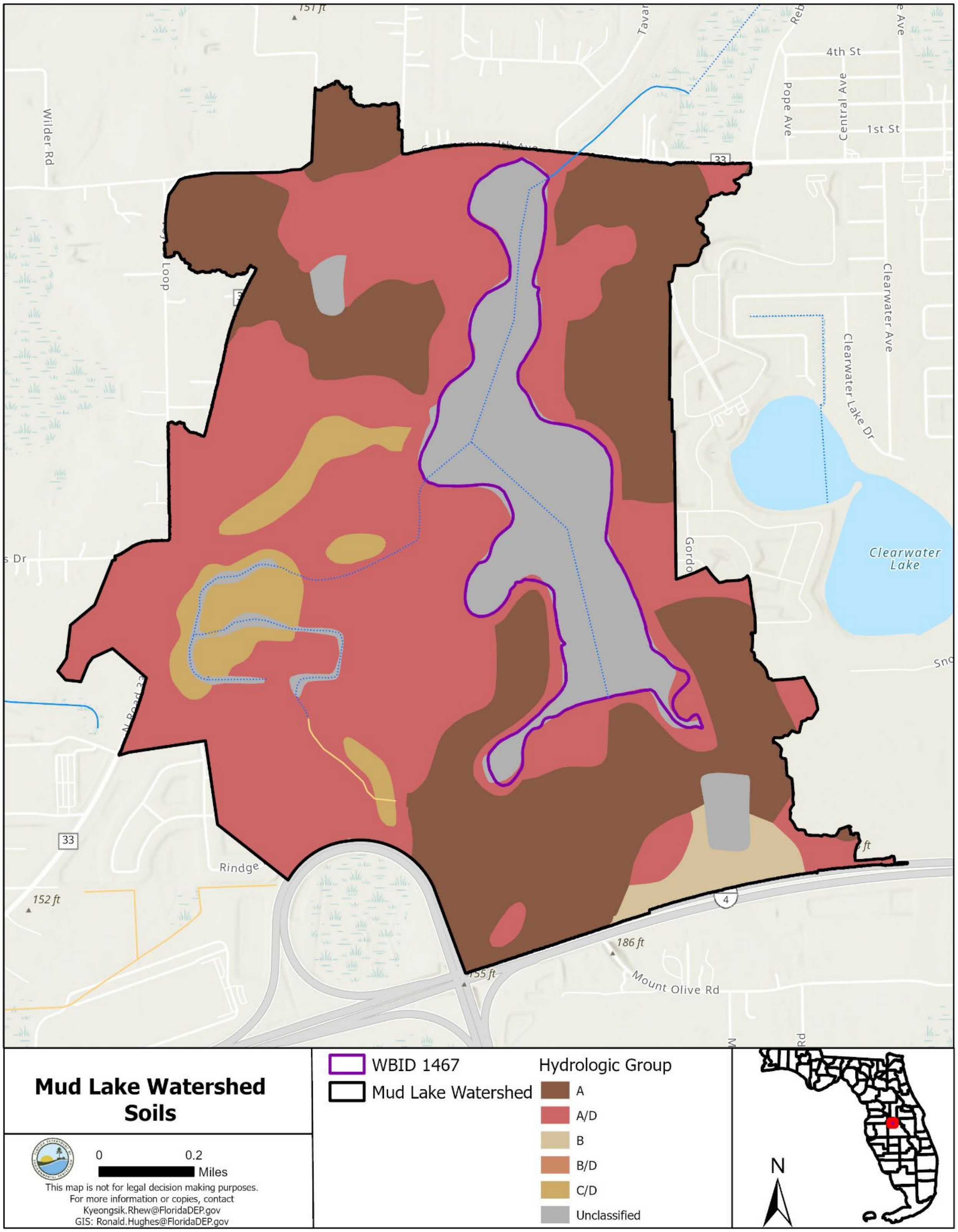

Figure 1.3. Hydrologic soil groups in the Mud Lake Watershed.

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 rule was amended several times since 2001, most notably for the implementation of NNC in 2013 and to incorporate revisions to the fecal indicator bacteria criteria in 2016. The rule was last amended in November 2025.

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.). Prior to 2022, the state's Verified List was 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 five years. However, beginning with the Biennial Assessment 2020-2022, the Verified List is now amended biennially and is a comprehensive statewide assessment every two years.

2.2 Classification of the Waterbodies and Applicable Water Quality Standards

Mud Lake is a Class III (fresh) waterbody, with a designated use of fish consumption, recreation, and propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The Class III water quality criteria applicable to the verified impairments for this waterbody are Florida's nutrient criteria in Paragraph 62-302.530(48)(b), F.A.C. Florida adopted NNC for lakes, estuaries, 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 (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 ten data points over at least three years with at least one data point in each year. Based on available color and alkalinity results (**Table 2.1),** Mud Lake is characterized as colored lake (> 40 PCU). The POR data for the lake are from IWR Database Run 67.

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

Waterbody	POR for Color	# of Years of Color Data	# of Color Samples	Long-Term Geometric Mean Color (PCU)	POR for Alkalinity	# of Years of Alkalinity Data	# of Alkalinity Samples	Long-Term Geometric Mean Alkalinity (mg/L $CaCO_3$)
Mud Lake	1993–2025	33	121	48	2002–2025	21	105	20

Table 2.2 lists the NNC for Florida lakes specified in subparagraph 62-302.531(2)(b)1., F.A.C. The chlorophyll *a* NNC for colored lakes is an annual geometric mean (AGM) value of 20 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 AGM does not exceed the chlorophyll *a* criterion for the lake type listed in **Table 2.2**, then the corresponding numeric interpretations for TN and TP are the maximum values. 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 corresponding 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][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.
Note: Values shown in boldface type and shaded represent the relevant NNC for Mud Lake

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 data providers for Mud Lake include DEP, Southwest Florida Water Management District (SWFWMD), Florida Fish and Wildlife Conservation Commission (FLGFWF), and Polk County

Natural Resources Division. **Table 2.3** lists the data providers for Mud Lake, including corresponding stations and monitoring beginning and ending dates. Polk County (station prefix 21FLPOLK…) was the primary data provider for the assessment that identified the nutrient impairment. **Figure 2.1** shows the lake sampling locations.

Table 2.3. Mud Lake data provider.

Sampling Station	Data Provider	Activity Beginning Date	Activity Ending Date
21FLCEN G4CE0114	DEP	2016	2016
21FLGFWF03100208-ML-01	FLGFWF	2002	2003
21FLGFWF03100208-ML-02	FLGFWF	2002	2003
21FLGFWF03100208-ML-03	FLGFWF	2002	2002
21FLGFWF03100208-ML-04	FLGFWF	2002	2003
21FLPOLKMUD SHORE	Polk County	2019	2019
21FLPOLKMUD1	Polk County	1993	2025
21FLSWFD17668	SWFWMD	2003	2003
21FLTPA 28095038150280	DEP	2004	2004
21FLTPA 28100248150343	DEP	2004	2004
21FLTPA 28101318150396	DEP	2004	2013
21FLTPA 28102548150398	DEP	2004	2004
21FLTPA 28104078150392	DEP	2004	2004
21FLWET 281639728184111	DEP	2014	2014
21FLWET 281704478184465	DEP	2014	2014

The individual water quality measurements discussed in this report are available in IWR Run 67 database and are available on request.

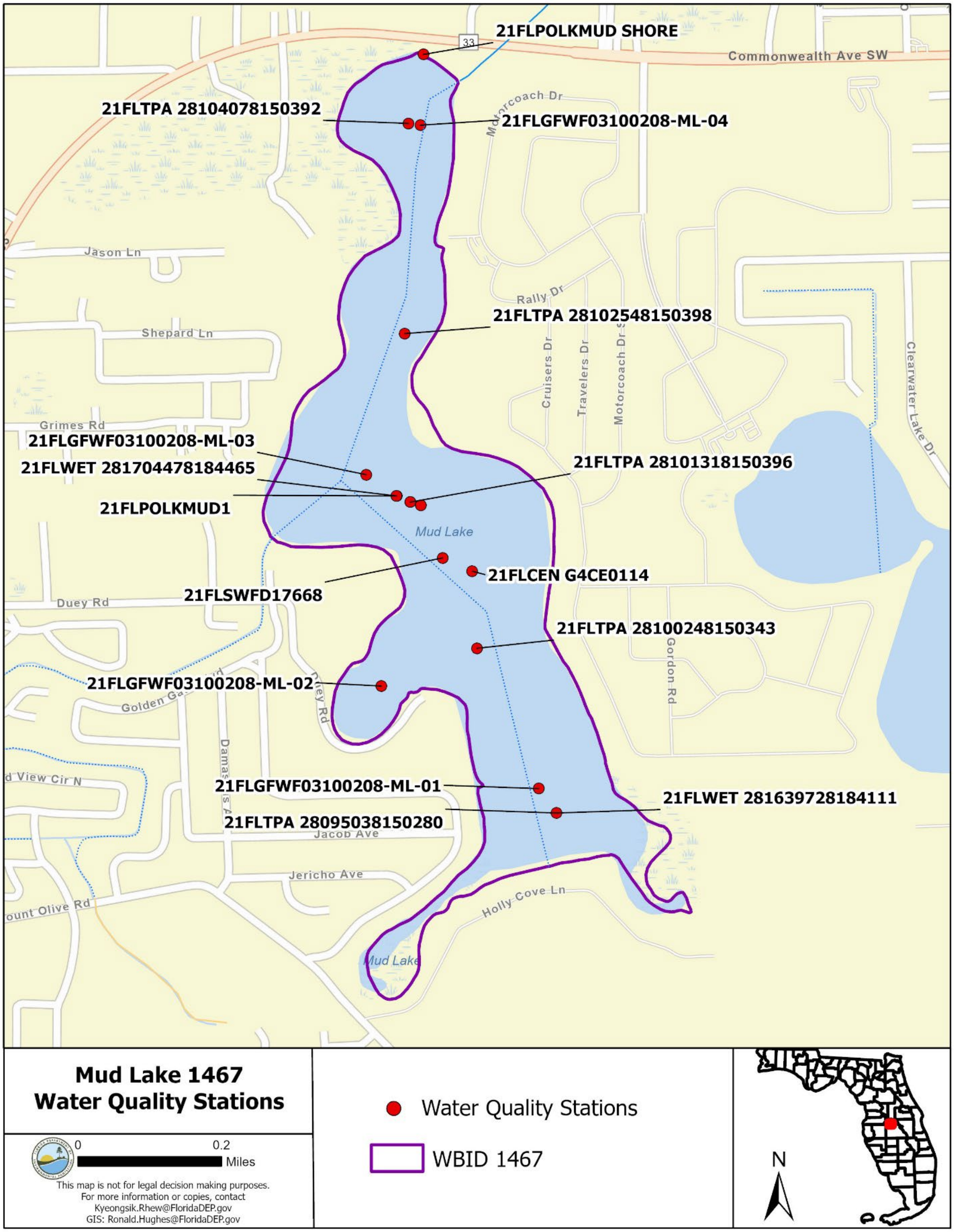

Figure 2.1. Water quality monitoring stations in Mud Lake.

2.3.2 Information on Verified Impairment

Mud Lake (WBID 1467) was assessed for nutrients as part of the Biennial Assessment 2020-2022. The verified period was January 1, 2013, to June 30, 2020. Data for this assessment are stored in the IWR Run 60 database. The lake was identified as nutrient impaired (Category 5) and was included on the Verified List of Impaired Waters.

Tables 2.4 lists the lake AGM values for chlorophyll *a*, TN, and TP for the 2013–20 verified period and AGM results for subsequent years, calculated using the most recent results found in the IWR Run 67 database. To be assessed as impaired (Category 5) for nutrients, AGMs for a particular nutrient had to have exceeded the NNC more than once in a three-year period.

Table 2.4. Mud Lake AGM values for the 2013–24 period.

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	Chlorophyll *a* (µg/L)	TN (mg/L)	TP (mg/L)
2013	14	1.13	0.04
2014	17	1.13	0.02
2015	12	1.04	0.04
2016	10	0.97	0.06
2017	17	1.13	0.05
2018	**34**	**1.42**	**0.15**
2019	**35**	**1.33**	**0.08**
2020	14	1.06	0.06
2021	**25**	**1.41**	**0.08**
2022	**37**	**1.75**	**0.09**
2023	**26**	**1.35**	ID
2024	**43**	**1.71**	**0.07**

Chapter 3: Assessment of Sources

3.1 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, reuse water, agriculture, silviculture, and mining; discharges from septic systems; atmospheric deposition; and herbicide application.

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 a National Pollutant Discharge Elimination System (NPDES) stormwater permit when allocating pollutant load reductions required by a TMDL (see **Section 5.1** 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.

3.2 Point Sources

3.2.1 Wastewater Point Sources

There are no NPDES-permitted wastewater facilities that discharge to Mud Lake or that discharge to surface waters in the Mud Lake watershed.

3.2.2 Municipal Separate Storm Sewer System (MS4) Permittees

The stormwater collection systems in the Mud Lake watershed, which are owned and operated by Polk County, in conjunction with the Florida Department of Transportation (FDOT) District 1, are covered by an NPDES Phase I MS4 permit (Permit No. FLS000015). The City of Polk City is a co-permittee in the MS4 permit and a portion of the watershed is within the city limits.

For more information on MS4s in the watersheds, send an email to NPDES-MS4@FloridaDEP.Gov.

3.3 Nonpoint Sources

Pollutant sources that are not NPDES wastewater or stormwater dischargers are generally considered nonpoint sources. Nutrient loadings to Mud Lake are mainly generated from nonpoint sources. Nonpoint sources addressed in this analysis primarily include loadings from surface runoff, baseflow, and precipitation directly onto the lake surface (atmospheric deposition).

3.3.1 Land Use

Land use is one of the most important factors in determining nutrient loadings from the Mud Lake 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 can produce. **Table 3.1** lists land use in the watershed based on the statewide land use land cover dataset (including the land use dataset from SWFWMD 2023). **Figure 3.1** shows the information graphically.

Table 3.1. Land use in the Mud Lake Watershed, 2023.

FLUCCS = Florida Land Use, Cover and Forms Classification System

FLUCCS Codes	Land Use Classification	Area (ac)	% of Watershed
1000	Urban and Built-Up	48.0	4
1100	Residential Low Density	226.1	19
1200	Residential Medium Density	150.4	13
1300	Residential High Density	243.4	21
2000	Agriculture	186.6	16
3000	Rangeland	24.4	2
4000	Upland Forest	12.5	1
5000	Water	166.2	14
6000	Wetland	104.9	9
8000	Transportation	17.0	1
Total		**1179.5**	**100**

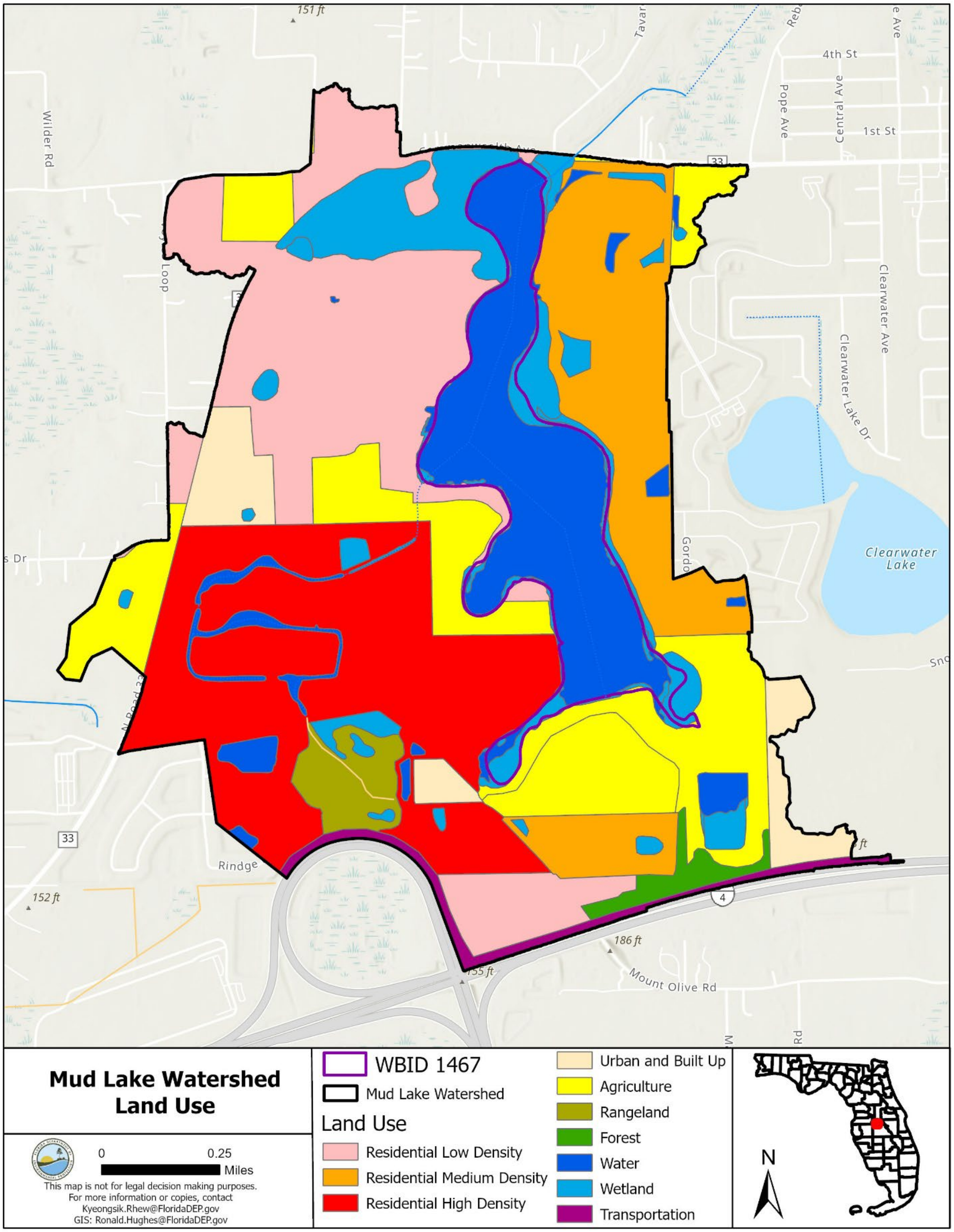

Figure 3.1. Land use in the Mud Lake Watershed, 2023.

3.3.2 Onsite Sewage Treatment and Disposal Systems (OSTDS)

OSTDS, including septic systems, are commonly used 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 (FDOH) maintains a list of septic systems by county, and the FDOH Florida Water Management Inventory dataset was used to determine the number of septic systems in the Mud Lake watershed. **Figure 3.2** shows the locations of OSTDS in the watershed in 2025 based on centroids of parcels with known, likely, or somewhat likely septic systems. There are estimated 413 septic systems in the Mud Lake watershed (**Table 3.2**).

Table 3.2. Number of OSTDS in the Mud Lake watershed, 2025.

Watershed	Number of OSTDS
Mud Lake	413

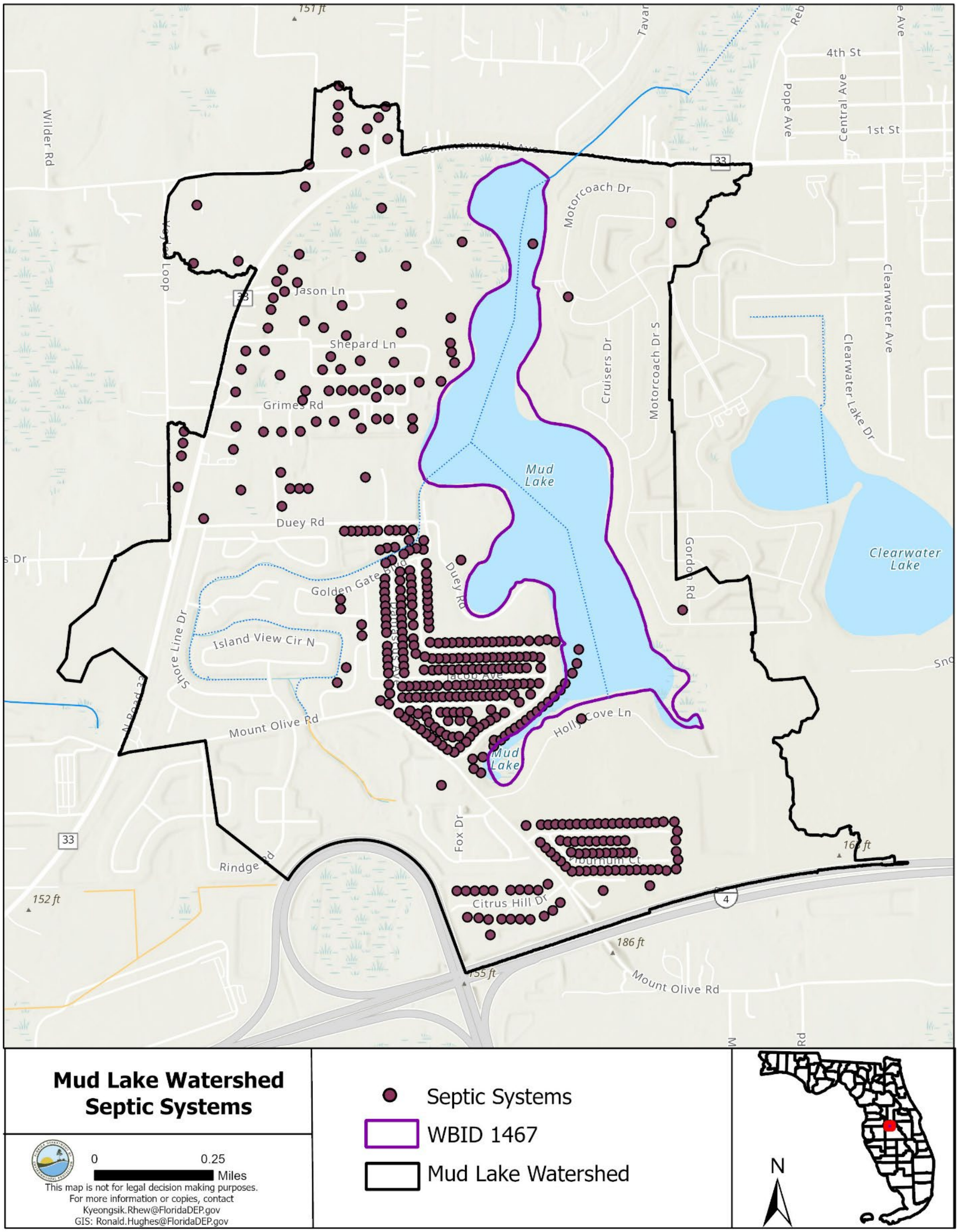

Figure 3.2. OSTDS (septic systems) in the Mud Lake Watershed (FDOH 2025).

Chapter 4: Determination of Assimilative Capacity

4.1 Overview

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 identify the necessary reductions in the in-lake nutrient concentrations, so that the lake will meet the TMDL restoration target for chlorophyll *a* and thus maintain its designated uses as a Class III freshwater.

4.2 Evaluation of Water Quality Conditions

4.2.1 Water Quality Data-Handling Procedures for TMDL Development

For the water quality analyses conducted for TMDL development, AGMs were used in order to be consistent with the expression of the adopted NNC for lakes. The AGMs 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, 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 two. Values with "G", “Q”, "V", or “Y” 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 on 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 **Table 2.4** in **Chapter 2** may not exactly match the AGMs used in these analyses and for TMDL development.

4.2.2 Relationships Between Water Quality Variables

For Mud Lake, water quality data have been collected at 17 sampling stations starting in 1993 (**Table 2.3** and **Figure 2.1**). Prior to 2002, the limited amount of data available for the lake are insufficient to calculate AGM values. **Figures 4.1** through **4.3** show the water quality AGMs from this period based on the IWR Run 67 database. Standard data quality assurance practices were followed when evaluating the data and developing the TMDLs.

Chlorophyll *a* AGM values from 2002 to 2024 for Mud Lake (**Figure 4.1**) have exceeded the maximum magnitude of the chlorophyll *a* criterion of 20 µg/L 18 times out of 23 and have ranged from 11.3 to 58.2 µg/L during this period.

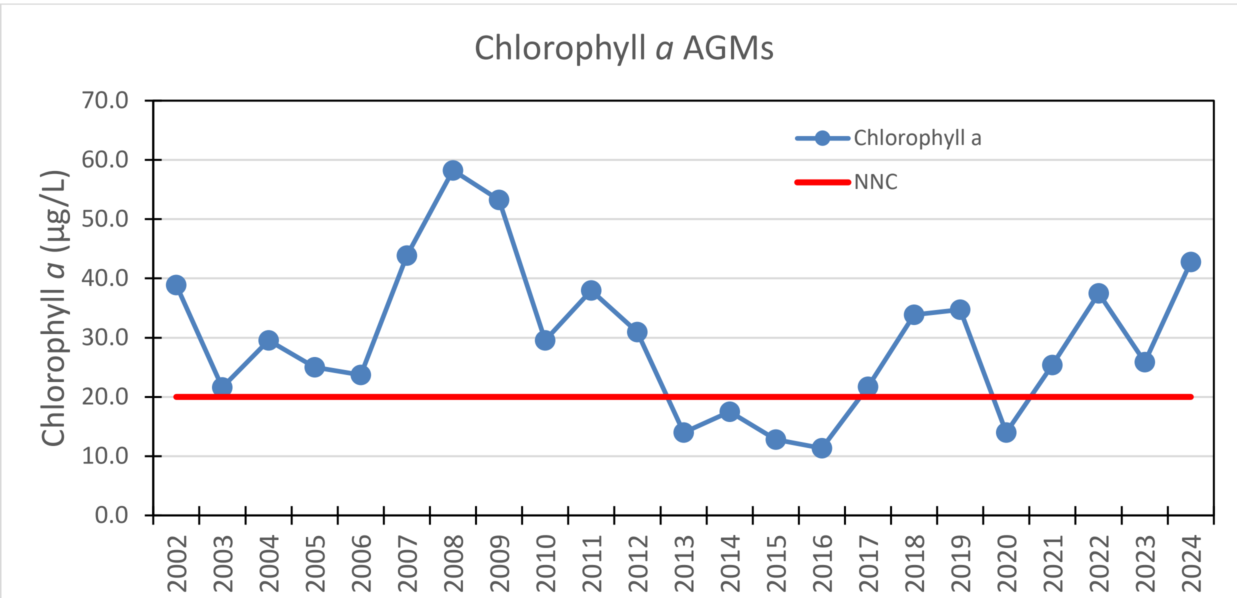

Figure 4.1. Chlorophyll *a* AGM values for Mud Lake, 2002–24.

TN AGM values from 2002 to 2024 (**Figure 4.2**) have exceeded the minimum of the applicable lake NNC of 1.27 mg/L 13 times out of 23. Values over this period ranged from 0.97 to 2.70 mg/L.

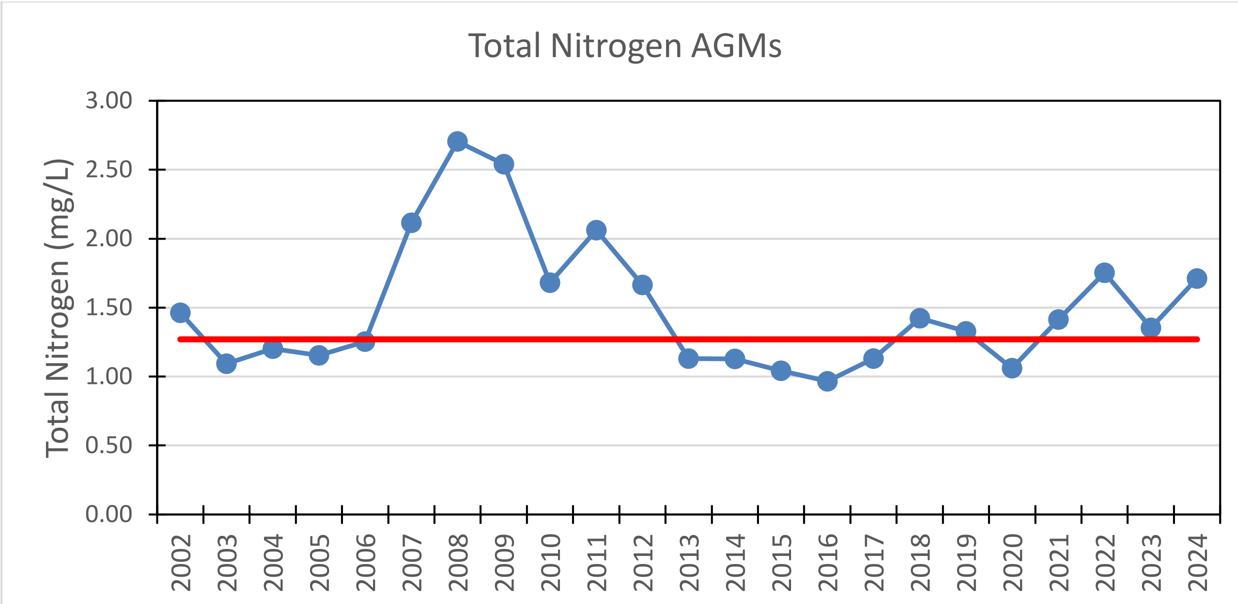

Figure 4.2. TN AGM values for Mud Lake, 2002–24.

TP AGM values from 2002 to 2024 (**Figure 4.3**) have exceeded the minimum of the applicable lake NNC of 0.05 mg/L 16 times out of 21. Values over this period ranged from 0.036 to 0.147 mg/L.

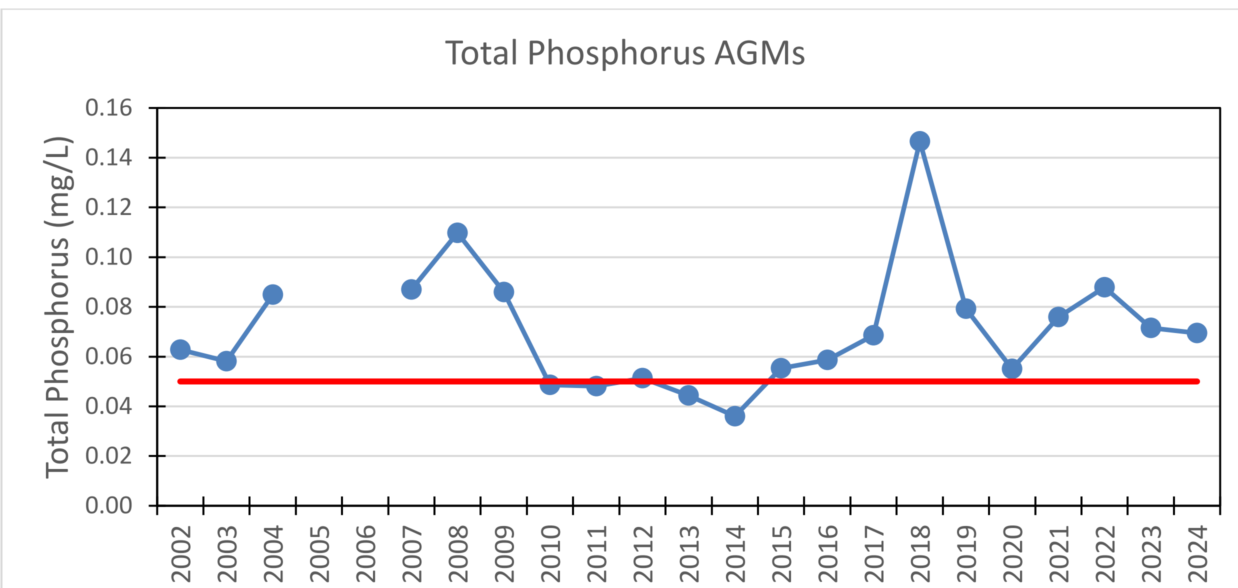

Figure 4.3. TP AGM values for Mud Lake, 2002–24.

Figures 4.4 and **4.5** show the relationships of TN and TP, respectively, on chlorophyll *a* response in Mud Lake. These graphs display the simple linear regression of each nutrient variable on chlorophyll *a*, using AGM data from 2002 to 2024. Both relationships demonstrate a significant positive response of chlorophyll *a* to increased nutrient concentrations (TN p value = 0.0001, TP p value = 0.0111). R-square value (0.8372) for TN is also high, explaining 84% of the variation in chlorophyll *a* AGMs (**Figure 4.4**). However, the TP concentration explains only 29 % of the variation in chlorophyll *a* AGMs (r-square value = 0.2938, **Figure 4.5**).

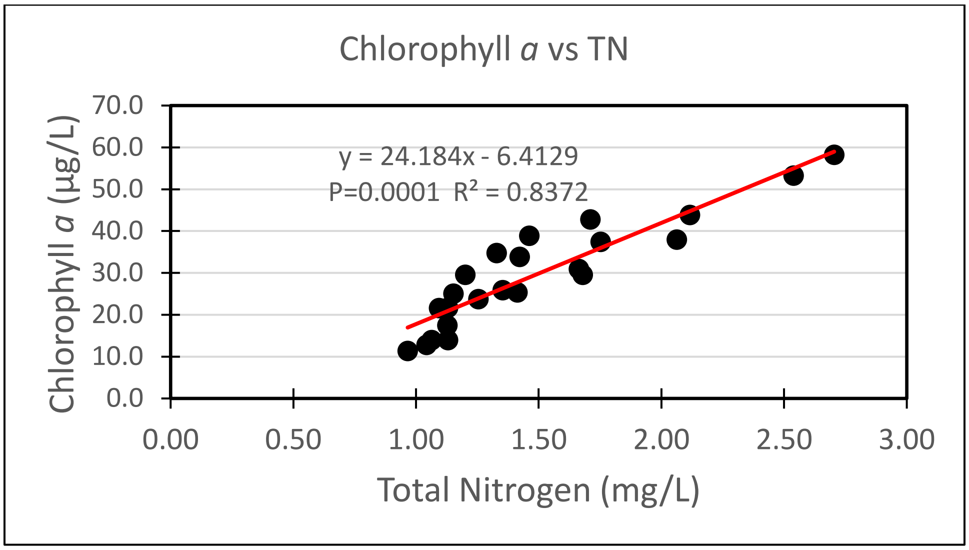

Figure 4.4. Mud Lake chlorophyll *a* AGMs vs TN AGMs.

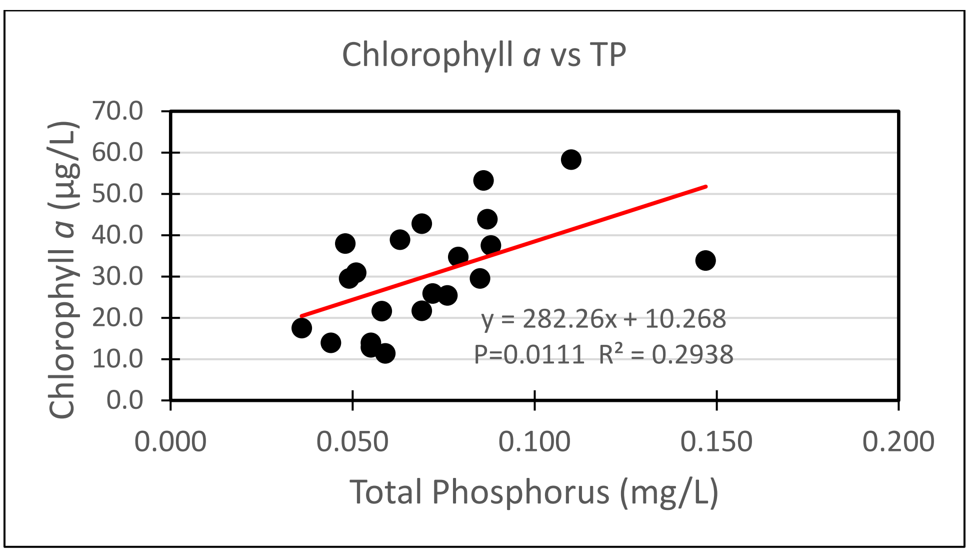

Figure 4.5. Mud Lake chlorophyll *a* AGMs vs TP AGMs.

Figure 4.6 shows radar-based rainfall estimates based on Doppler weather radar images by SWFWMD and SJRWMD. Annual rainfall data in the area of the lake (Pixel 103678) was obtained from Polk County Water Atlas. The AGMs of the water quality data were available from 2002 to 2024 for the lake and this period includes years with both above and below average precipitation. Long-term average rainfall (49.5 inches) was calculated from the data from 1995 to 2024.

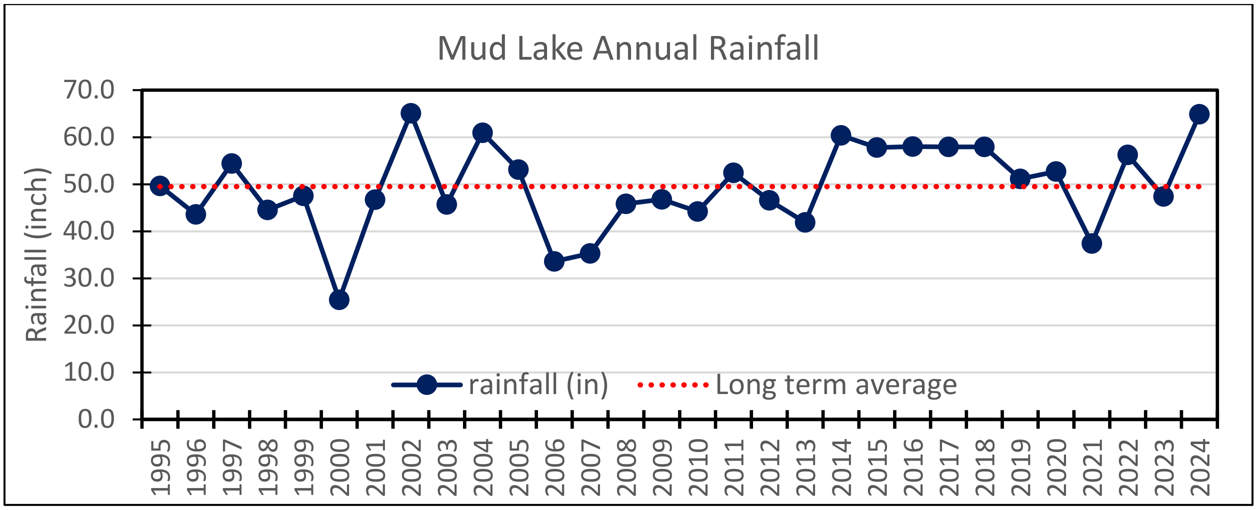

Figure 4.6. Annual rainfall in the area of Mud Lake, 1991– 2024.

4.2.3 Algal Group Composition and Other Analyses in the lake

Several factors other than watershed nutrient loadings may affect Mud Lake water quality. These factors include algal group composition and lake stratification. DEP collected water samples to enumerate the phytoplankton community and to analyze nutrients and other parameters at different depths at two sites in Mud Lake. Samples for phytoplankton enumeration and organic composition, and water quality characterization were collected in August 2014 at the center of the lake, station 21FLWQA 281704478184465 (MUD01) and near the southern end, station 21FLWQA 281639728184111 (MUD02), as presented in **Figure 2.1**. The phytoplankton community results are presented in **Appendix B.** Results for water quality, as well as depth profiles for physical and chemical parameters, are presented in **Appendix C**. Phytoplankton in the Phylum Cyanophycota (the blue-green algae) were the dominant group, representing 76 and 83 percent of the algal community based on cell densities at MUD01 and MUD02, respectively (**Figure 4.7**). Many blue-green algae taxa are capable of fixing atmospheric nitrogen.

The depth profiles in **Appendix C** and the measured dissolved oxygen (mg/L) at time of the sample collection, presented in **Figure 4.8**, exhibit patterns of lake stratification. Stratification in lakes can produce anoxic conditions, leading to the production of ammonia when organic matter is decomposed under anaerobic conditions. Water quality results for ammonia (mg N/L) at the surface and bottom of sites MUD01 and MUD02, presented in **Figure 4.9**, indicate a considerably higher level of ammonia is present at the bottom of Mud Lake at site MUD01. Ammonia has the potential to be released into the water column from sediments, and during lake mixing events, could stimulate phytoplankton growth.

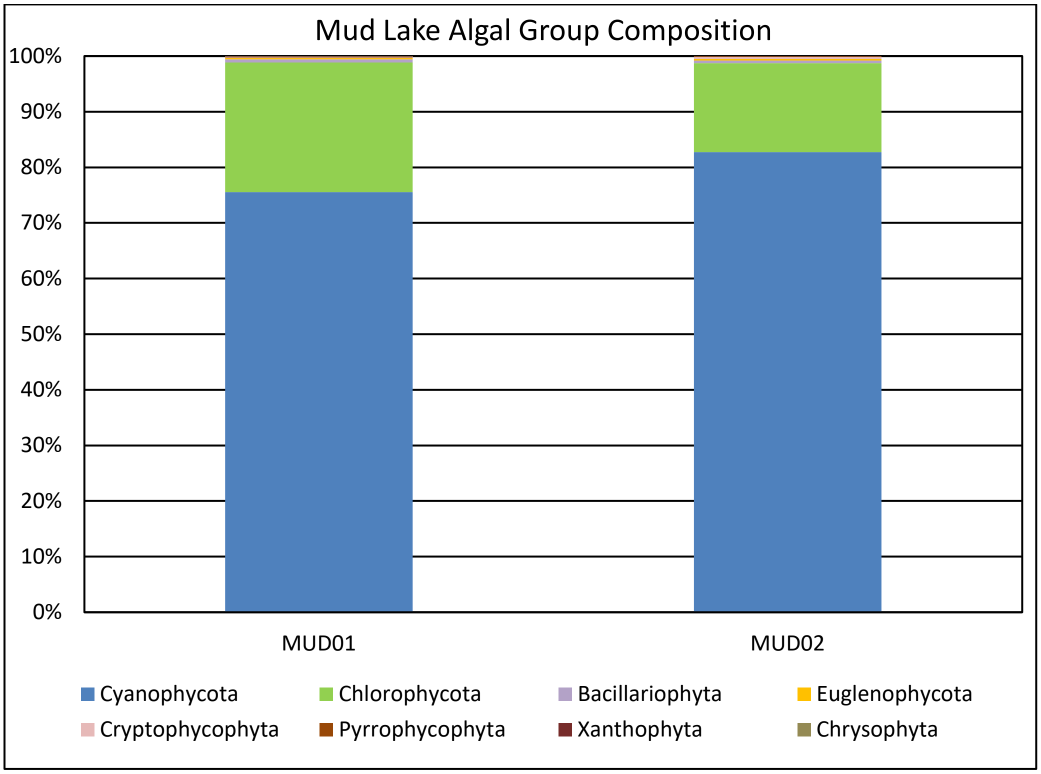

Figure 4.7. Mud Lake algal group composition by lake station.

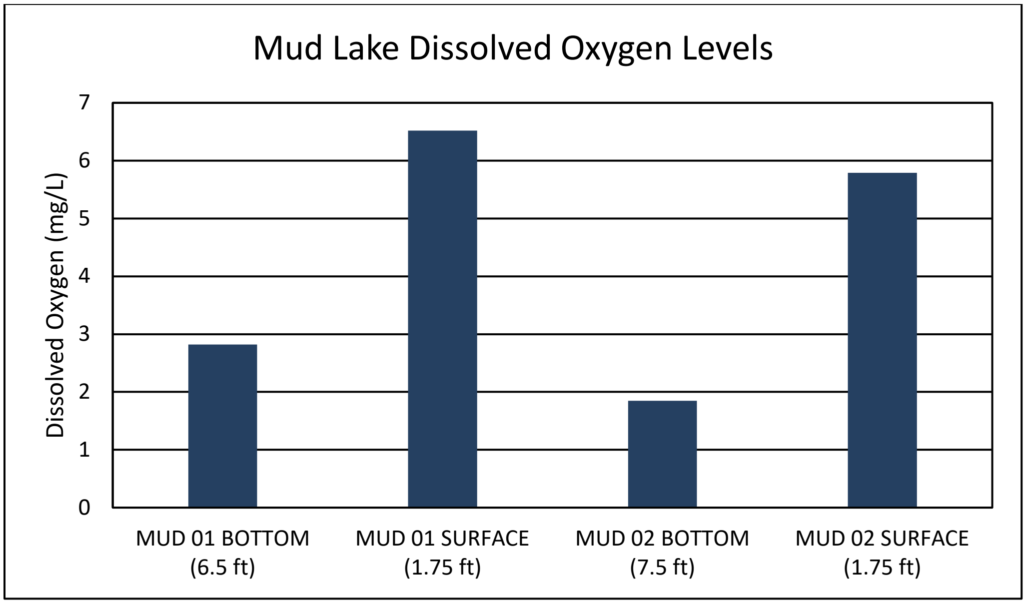

Figure 4.8. Mud Lake dissolved oxygen levels.

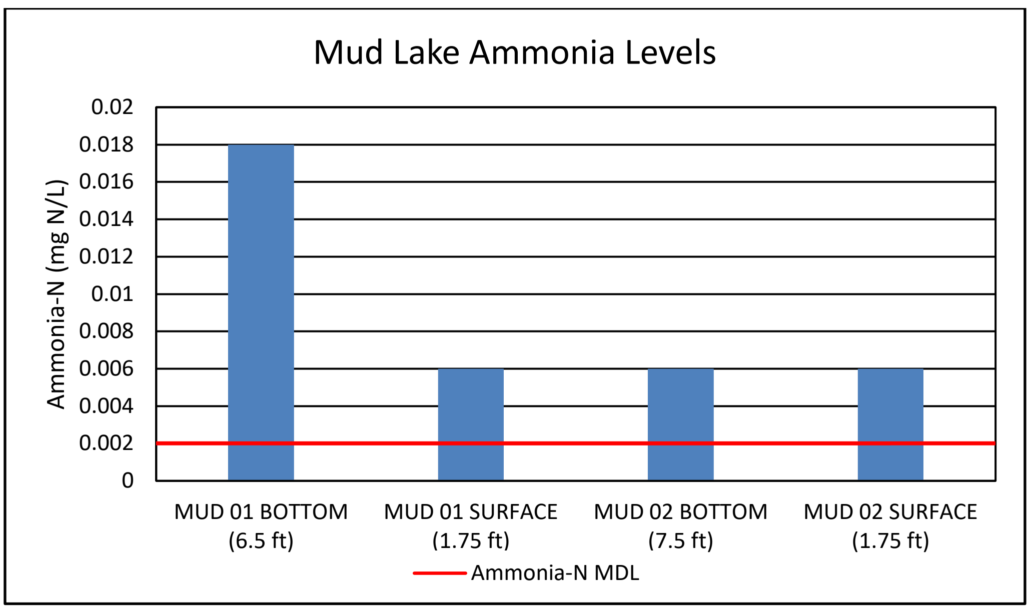

Figure 4.9. Mud Lake ammonia levels.

4.3 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 waterbody, 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 target is expressed as an AGM.

4.4 Basis of the TMDLs

The data collected by DEP and Polk County were used in evaluating the in-lake concentrations of nutrients and chlorophyll *a*. The period from 2002 to 2023 has recent, complete long-term sets of AGM values for evaluating surface water quality in Mud Lake. This analysis used nutrients and chlorophyll *a* AGMs to be consistent with the expression of the adopted NNC for lakes.

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*, TN, and TP in those lakes (DEP 2012). The dataset consists of paired nutrient and chlorophyll *a* data for 195 low-color lakes and 129 colored lakes dating from 1996 to 2008. DEP developed a chlorophyll *a* criterion of 20 µg/L for both colored (> 40 PCU) lakes and low-color (≤ 40 PCU), high-alkalinity (> 20 mg/L CaCO3) lakes, and a chlorophyll *a* criterion of 6 µg/L for low-color (≤ 40 PCU), low-alkalinity (≤ 20 mg/L $CaCO_3$) lakes. DEP (2012) has demonstrated that this criterion protects designated uses and maintains the health of a balanced community of aquatic flora and fauna.

For the colored lakes, including Mud Lake, the criterion range for TN is 1.27 to 2.23 mg/L, and 0.05 to 0.16 mg/L for TP, with an exceedance frequency of no more than once in any 3-year period. AGMs for chlorophyll *a* concentrations in the lake exceeded the NNC values for the applicable lake types; therefore, the applicable numeric interpretations for TN and TP are the minimum values in the criteria ranges, ensuring the attainment of the applicable chlorophyll *a* targets.

The individual nutrient data for Mud Lake were compared with the larger statewide nutrient datasets to see if they fell within the range of the data used to establish the generally applicable NNC. This was done to verify that Mud Lake is operating like the NNC lakes and are exhibiting the same nutrient responses to determine if site-specific criteria were needed. **Figures 4.10** and **4.11** show the TN and TP data, respectively, for Mud Lake plotted against the statewide population of colored lakes.

These graphs demonstrate that the relationship of TN and TP to chlorophyll *a* in the lake does not fall outside the range used to develop the generally applicable NNC. The TN and TP values for the lake are indicated with red triangles and green circles, respectively. The statewide lake population results are represented by the gray “x's”. The dashed line shown on these graphs bounds the distributions at the 90% prediction intervals. Lakes that plot within these intervals are characteristic of the majority of lakes in the dataset, while lakes that plot outside those bounds are not functioning in a manner consistent with the majority of lakes in the statewide dataset.

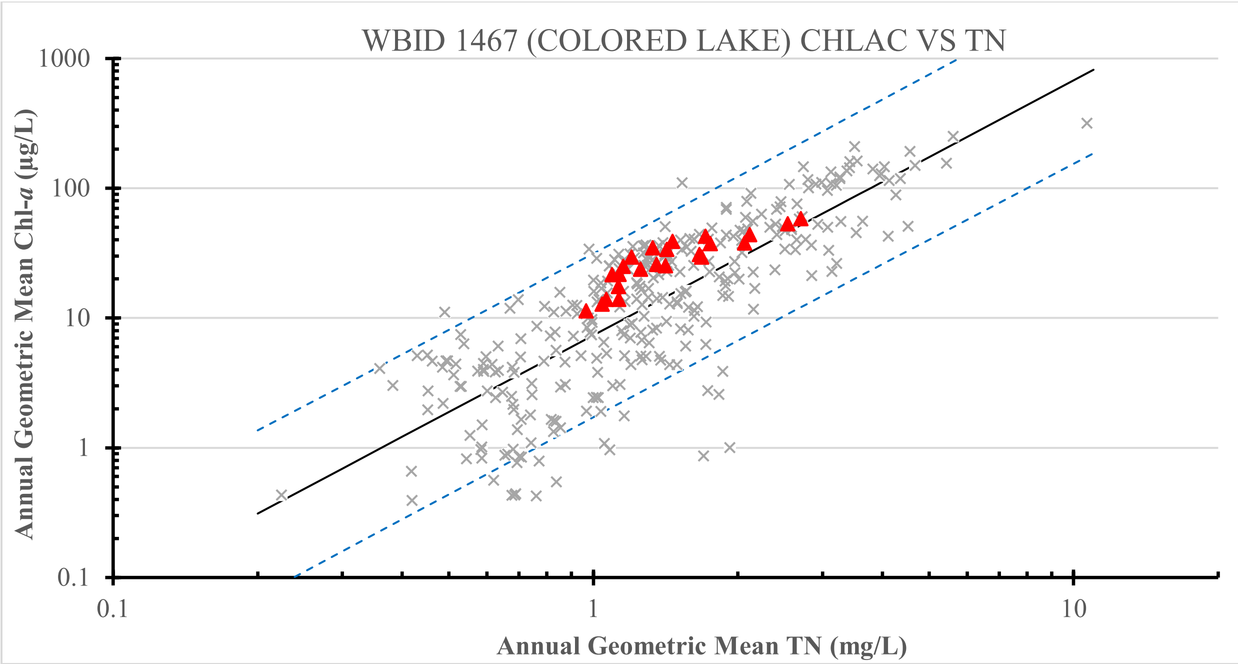

Figure 4.10. Relationship between chlorophyll *a* and TN AGMs in Mud Lake (red triangles) plotted against the statewide dataset (gray x's) used to derive the NNC for colored lakes.

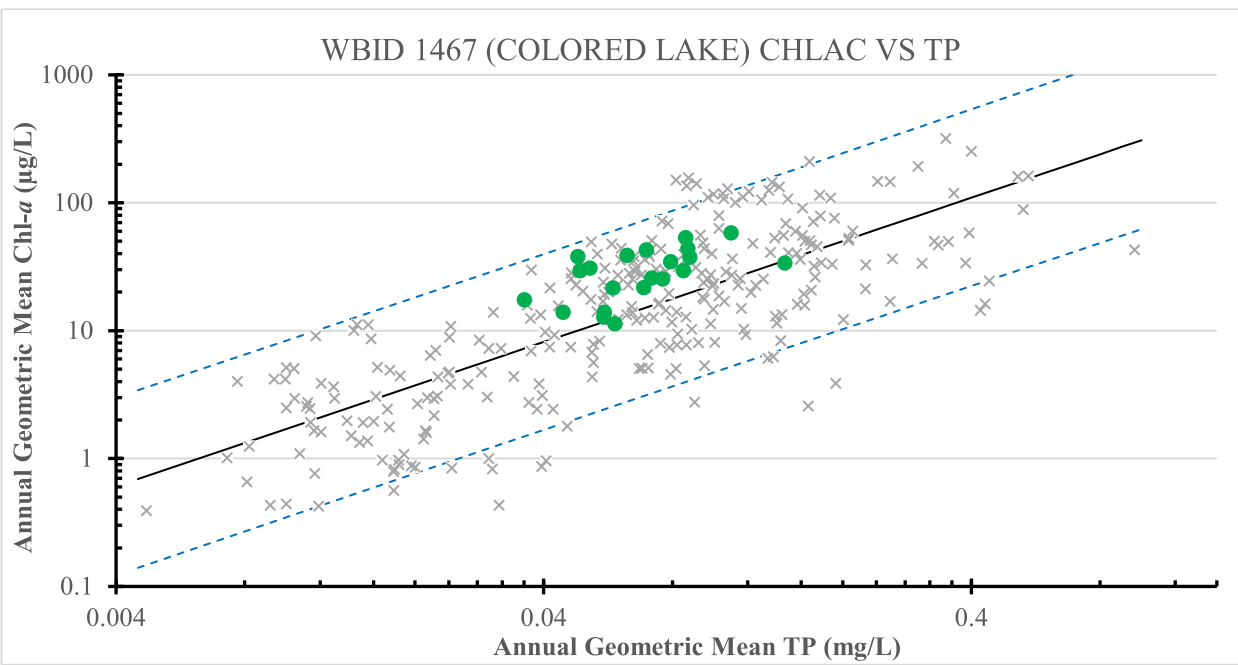

Figure 4.11. Relationship between chlorophyll *a* and TP AGMs in Mud Lake (green circles) plotted against the statewide dataset (gray x's) used to derive the NNC for colored lakes.

The available information suggests that designated use attainment for Mud Lake would be protected at the chlorophyll *a* maximum criterion of 20 µg/L. The data do not indicate that the lake responds differently from the statewide generally applicable relationships shown in **Figures 4.10** and **4.11**. Nutrient concentrations less than or equal to the lower lake NNC threshold are unlikely to exceed the chlorophyll *a* criterion (DEP 2012). Therefore, it can be concluded that basing the TMDL targets on the low-end generally applicable NNC (TN of 1.27 mg/L and TP of 0.05 mg/L) will meet the TMDL targets for chlorophyll *a* and fully protect designated uses in the lake. Additionally, the TMDL targets do not need to be adopted as site-specific interpretations of the NNC because the generally applicable lake criteria for colored lakes fully protect designated uses.

Mud Lake is expected to meet the applicable nutrient criteria and maintain its designated uses as a Class III freshwater lake 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 condition calculations are based on nutrient concentrations measured in the 2015–24 period, which is considered representative of current conditions. The existing nutrient conditions used to calculate the required reductions were the maximum values of the TN and TP AGMs in the lake that exceeded the water quality targets. The AGMs were calculated from nutrient results available in the IWR Run 67 database.

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

$$\frac{[\boldsymbol{Maximum\ Existing\ AGM\ -\ Minimum\ NNC}]}{\boldsymbol{Maximum\ Existing\ AGM}} \times 100$$

Table 4.1 lists the percent reductions in the maximum AGMs needed to achieve the TN AGM target of 1.27 mg/L and the TP AGM target of 0.05 mg/L for Mud Lake. The TN percent reduction is 27 % and the TP percent reduction is 67 % in Mud Lake. 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 4.1. Reductions required in existing TN and TP concentrations to meet water quality targets for Mud Lake.

Year	Mud Lake TN AGMs (mg/L)	Mud Lake TP AGMs (mg/L)
2015	1.04	0.06
2016	0.97	0.06
2017	1.13	0.07
2018	1.42	0.15
2019	1.33	0.08
2020	1.06	0.06
2021	1.41	0.08
2022	1.75	0.09
2023	1.35	ID
2024	1.71	0.07
Maximum	**1.75**	**0.15**
TMDL Target	**1.27**	**0.05**
% Reduction	**27**	**67**

Chapter 5: Determination of Loading Allocations

5.1 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 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). Stormwater reductions are included in both the MS4 WLA and LA, as applicable. However, in determining the overall stormwater reductions needed, DEP does not differentiate between the MS4 WLA and LA, and instead applies the same overall reductions to both as if the two categories were a single category source, unless otherwise specified.

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 Mud Lake are expressed in terms of in-lake nutrient concentration targets and the percent reductions of existing in-lake concentrations necessary to meet the targets (see **Table 5.1**). They are based on the generally applicable NNC in subsection 62-302.531(2), F.A.C. The minimum TN and TP NNC values were applied to establish the percent reduction targets for the in-lake TN and TP concentrations. The restoration target is to achieve the generally applicable chlorophyll *a* criterion of 20 µg/L for the lake, expressed as an AGM not to be exceeded more than once in any consecutive 3-year period. This threshold is protective of the lake's designated use.

Table 5.1 lists the TMDLs for Mud Lake. These are based on the generally applicable NNC in subparagraph 62-302.531(2)(b)1., F.A.C.

Table 5.1. TMDL components for nutrients in Mud Lake (WBID 1467).

Note: MOS is implicit.
NA = Not applicable
[1] The TMDLs are based on the generally applicable NNC. The minimum TN and TP NNC values shown are used to calculate the percent reductions.
[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 (WBID)	Parameter	TMDL Target (mg/L)[1]	WLA Wastewater (% reduction)	WLA NPDES Stormwater (% reduction)[2]	LA (% reduction)[2]
Mud Lake (1467)	TN	1.27	NA	27	27
Mud Lake (1467)	TP	0.05	NA	67	67

5.2 Load Allocation

To achieve the LA in Mud Lake, a 27 % reduction in current TN in-lake concentration and a 67% reduction in current TP in-lake concentration have been identified.

The TMDLs are based on the percent reduction in in-lake concentrations. The reduction needed from anthropogenic inputs will be calculated based on more detailed source information when a restoration plan is developed.

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**).

5.3 Wasteload Allocation

5.3.1 NPDES Wastewater Discharges

As noted in **Chapter 3**, no active NPDES-permitted wastewater facilities in the Mud Lake watershed discharge either into the waterbodies or their watersheds. Therefore, a WLA for wastewater discharges is not applicable.

5.3.2 NPDES Stormwater Discharges

The stormwater collection systems in the Mud Lake watershed, which are owned and operated by Polk County, in conjunction with the FDOT District 1, are covered by an NPDES Phase I

MS4 permit (Permit No. FLS000015). The City of Polk City is a co-permittee in the MS4 permit and a portion of the watershed is within the city limits.

Nonpoint sources across the watershed, including MS4 permittees, are responsible for making sufficient reductions in TN and TP to achieve the in-lake reductions of 27 % TN and 67 % TP in Mud Lake. The stormwater reductions for the TMDLs are those necessary (along with other sources) to meet the applicable NNC for the lake.

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.

5.4 Margin of Safety (MOS)

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. 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.

In this TMDL, conservative assumptions provide the implicit MOS. Specifically, the required percent reductions were calculated from the highest measured AGM TN and TP values to achieve the low end of the applicable nutrient criteria range. However, these conservative measures are only components of the MOS and are not intended to change the frequency or duration of the applicable NNC.

Chapter 6: Implementation Plan Development and Beyond

6.1 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).

6.2 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 lay out the distribution of 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.

Additional information about BMAPs is available online.

6.3 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 may also be 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 additional associated remediation projects on surface water quality. In the case of Mud Lake, the phytoplankton monitoring results and analysis of lake nutrient results in 2014 suggest that other factors besides watershed loading inputs, such as sediment nutrient fluxes and/or nitrogen fixation, may also be influencing the lake nutrient budget and the growth of phytoplankton. Approaches for addressing these other factors should be included in comprehensive management plans for the waterbodies.

Additionally, the current water quality monitoring of the lake 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.

While the low-end TN and TP applicable NNC were used to establish percent reduction targets for the in-lake TN and TP concentrations, the NNC remain the relevant water quality standards. If the chlorophyll *a* maximum criterion of 20 ug/L is achieved, the NNC set the applicable TN and TP criteria as the measured concentrations subject to the stated maximum and minimum concentrations. 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 the lake consistently meets the NNC over the assessment period, it can be assumed that the TMDLs are being met. DEP will reassess the water quality in Mud Lake as additional monitoring data becomes available through the Biennial Assessment.

Polk County developed a Mud Lake water quality management plan by contracting with Amec Foster Wheeler Environment & Infrastructure, Inc. (2015). In the management plan, they analyzed water quality and hydrology data, evaluated nutrient loads from the watershed, and recommended several management activities such as stormwater and agricultural BMPs, water quality monitoring and analyses, and in-lake treatment options to improve the water quality in Mud Lake. The DEP encourages stakeholders to consider revisiting the potential projects in the management plan to meet the nutrient TMDL restoration targets. Once the TMDL is adopted, the county may add the waterbody to its prioritization list for restoration activities.

References

Florida Department of Environmental Protection. 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.

Foster Wheeler Environment & Infrastructure, Inc. 2015. Mudd Lake water quality management plan. to Polk County Parks & Natural Resources Bartow, Florida. 150p

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.

Polk County, 2026. Polk County Water Atlas Homepage. Available at https://polk.wateratlas.usf.edu

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

U.S. Census Bureau. 2026. QuickFacts, Polk County, Florida.

———.2023. Decennial Census Polk City Town, Florida. https://data.census.gov/advanced

U.S EPA. 2026. The Assessment, Total Maximum Daily Load (TMDL) Tracking and Implementation System (ATTAINS). https://www.epa.gov/waterdata/attains

Viessman, W., Jr., G.L. Lewis, and J.W. Knapp. 1989. Introduction to hydrology. Third edition. New York: Harper Collins.

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, Homosassa River, Lake Tarpon, 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: Mud Lake Phytoplankton Results – Collected August 5, 2014

Table B-1. MUD01 Phytoplankton Results.

Phylum	Class	Order	Family	Genus	Taxon Name	# cells counted	# cells per mL	Phylum (%)
Bacillariophyta	Bacillariophyta	Bacillariophyta	Bacillariophyta	Bacillariophyta	Bacillariophyta	12	153	0.5
Chlorophycota	Chlorophyceae	Zygnematales	Desmidiaceae	Euastrum	Euastrum denticulatum	1	13	
Chlorophycota	Chlorophyceae	Chlorococcales	Chlorococcaceae	Schroederia	Schroederia setigera	1	13	
Chlorophycota	Chlorophyceae	Chlorococcales	Chlorococcaceae	Tetraedron	Tetraedron minimum	1	13	
Chlorophycota	Chlorophyceae	Chlorococcales	Chlorococcaceae	Tetraedron	Tetraedron trigonum	1	13	
Chlorophycota	Chlorophyceae	Chlorococcales	Chlorococcaceae	Chlorococcum	Chlorococcum humicola	2	25	
Chlorophycota	Chlorophyceae	Zygnematales	Desmidiaceae	Cosmarium	Cosmarium	2	25	
Chlorophycota	Chlorophyceae	Zygnematales	Zygnemataceae	Mougeotia	Mougeotia	2	25	
Chlorophycota	Chlorophyceae	Chlorococcales	Oocystaceae	Nephrocytium	Nephrocytium limneticum	4	51	
Chlorophycota	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	Chlamydomonas	5	64	
Chlorophycota	Chlorophyceae	Chlorococcales	Oocystaceae	Ankistrodesmus	Ankistrodesmus falcatus	7	89	
Chlorophycota	Chlorophyceae	Chlorococcales	Scenedesmaceae	Actinastrum	Actinastrum	8	102	
Chlorophycota	Chlorophyceae	Chlorococcales	Oocystaceae	Kirchneriella	Kirchneriella contorta	8	102	
Chlorophycota	Chlorophyceae	Chlorococcales	Scenedesmaceae	Scenedesmus	Scenedesmus quadricauda	8	102	
Chlorophycota	Chlorophyceae	Chlorococcales	Hydrodictyaceae	Pediastrum	Pediastrum	12	153	
Chlorophycota	Chlorophyceae	Chlorococcales	Scenedesmaceae	Scenedesmus	Scenedesmus bijuga	12	153	
Chlorophycota	Chlorophyceae	Chlorococcales	Scenedesmaceae	Crucigenia	Crucigenia rectangularis	16	204	
Chlorophycota	Chlorophyceae	Klebsormidiales	Elakatotrichaceae	Elakatothrix	Elakatothrix gelatinosa	16	204	
Chlorophycota	Chlorophyceae	Chlorococcales	Scenedesmaceae	Crucigenia	Crucigenia tetrapedia	20	255	
Chlorophycota	Chlorophyceae	Chlorococcales	Oocystaceae	Chlorella	Chlorella	25	318	
Chlorophycota	Chlorophyceae	Chlorococcales	Dictyosphaeriaceae	Dictyosphaerium	Dictyosphaerium ehrenbergianum	32	408	
Chlorophycota	Chlorophyceae	Chlorococcales	Oocystaceae	Oocystis	Oocystis	37	471	
Chlorophycota	Chlorophyceae	Tetrasporales	Palmellaceae	Sphaerocystis	Sphaerocystis	74	942	

Phylum	Class	Order	Family	Genus	Taxon Name	# cells counted	# cells per mL	Phylum (%)
Chlorophycota	Chlorophyceae	Chlorococcales	Dictyosphaeriaceae	Botryococcus	Botryococcus braunii	220	2802	23.3
Chrysophyta	Chrysophyceae	Ochromonadales	Dinobryaceae	Dinobryon	Dinobryon sertularia	2	25	0.1
Cryptophycophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Chroomonas	Chroomonas	3	38	0.1
Cyanophycota	Cyanophyceae	Nostocales	Nostocaceae	Cylindrospermopsis	Cylindrospermopsis catemaco	3	38	
Cyanophycota	Cyanophyceae	Oscillatoriales	Pseudanabaenaceae	Planktolyngbya	Planktolyngbya contorta	5	64	
Cyanophycota	Cyanophyceae	Oscillatoriales	Pseudanabaenaceae	Pseudanabaena	Pseudanabaena mucicola	5	64	
Cyanophycota	Cyanophyceae	Nostocales	Nostocaceae	Anabaena	Anabaena	16	204	
Cyanophycota	Cyanophyceae	Oscillatoriales	Pseudanabaenaceae	Limnothrix	Limnothrix vacuolifera	16	204	
Cyanophycota	Cyanophyceae	Oscillatoriales	Oscillatoriaceae	Oscillatoria	Oscillatoria limosa	20	255	
Cyanophycota	Cyanophyceae	Nostocales	Nostocaceae	Dolichospermum	Dolichospermum circinale	31	395	
Cyanophycota	Cyanophyceae	Chroococcales	Chroococcaceae	Synechocystis	Synechocystis	42	535	
Cyanophycota	Cyanophyceae	Oscillatoriales	Pseudanabaenaceae	Jaaginema	Jaaginema gracile	108	1375	
Cyanophycota	Cyanophyceae	Oscillatoriales	Pseudanabaenaceae	Planktolyngbya	Planktolyngbya limnetica	138	1757	
Cyanophycota	Cyanophyceae	Nostocales	Nostocaceae	Cylindrospermopsis	Cylindrospermopsis raciborskii	309	3935	
Cyanophycota	Cyanophyceae	Chroococcales	Merismopediaceae	Aphanocapsa	Aphanocapsa delicatissima	430	5476	
Cyanophycota	Cyanophyceae	Chroococcales	Merismopediaceae	Aphanocapsa	Aphanocapsa	540	6877	75.5
Euglenophycota	Euglenophyceae	Euglenales	Euglenaceae	Phacus	Phacus	1	13	
Euglenophycota	Euglenophyceae	Euglenales	Euglenaceae	Trachelomonas	Trachelomonas	1	13	
Euglenophycota	Euglenophyceae	Euglenales	Euglenaceae	Trachelomonas	Trachelomonas intermedia	1	13	
Euglenophycota	Euglenophyceae	Euglenales	Euglenaceae	Phacus	Phacus orbicularis	2	25	0.2
Pyrrophycophyta	Dinophyceae	Peridiniales	Glenodiniaceae	Glenodinium	Glenodinium	2	25	0.1
Xanthophyta	Xanthophyceae	Mischococcales	Centritractaceae	Centritractus	Centritractus belanophorus	1	13	0.0
					Total	2202	28044	100.0

Table B-2. MUD02 Phytoplankton Results.

Phylum	Class	Order	Family	Genus	Taxon Name	# cells counted	# cells per mL	Phylum (%)
Bacillariophyta	Bacillariophyta	Bacillariophyta	Bacillariophyta	Bacillariophyta	Bacillariophyta	7	616	0.441441
Chlorophycota	Chlorophyceae	Zygnematales	Desmidiaceae	Closterium	Closterium	1	88	
Chlorophycota	Chlorophyceae	Chlorococcales	Oocystaceae	Kirchneriella	Kirchneriella	1	88	
Chlorophycota	Chlorophyceae	Chlorococcales	Scenedesmaceae	Selenastrum	Selenastrum	1	88	
Chlorophycota	Chlorophyceae	Zygnematales	Desmidiaceae	Staurastrum	Staurastrum	1	88	
Chlorophycota	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	Chlamydomonas	2	176	
Chlorophycota	Chlorophyceae	Chlorococcales	Chlorococcaceae	Chlorococcum	Chlorococcum humicola	3	264	
Chlorophycota	Chlorophyceae	Chlorococcales	Micractiniaceae	Golenkinia	Golenkinia radiata	3	264	
Chlorophycota	Chlorophyceae	Chlorococcales	Oocystaceae	Kirchneriella	Kirchneriella contorta	4	352	
Chlorophycota	Chlorophyceae	Chlorococcales	Chlorococcaceae	Schroederia	Schroederia	4	352	
Chlorophycota	Chlorophyceae	Chlorococcales	Chlorococcaceae	Tetraedron	Tetraedron caudatum	4	352	
Chlorophycota	Chlorophyceae	Chlorococcales	Oocystaceae	Chlorella	Chlorella	6	528	
Chlorophycota	Chlorophyceae	Chlorococcales	Oocystaceae	Ankistrodesmus	Ankistrodesmus falcatus	9	792	
Chlorophycota	Chlorophyceae	Chlorococcales	Oocystaceae	Oocystis	Oocystis	11	968	
Chlorophycota	Chlorophyceae	Volvocales	Volvocaceae	Gonium	Gonium	12	1057	
Chlorophycota	Chlorophyceae	Chlorococcales	Scenedesmaceae	Crucigenia	Crucigenia tetrapedia	16	1409	
Chlorophycota	Chlorophyceae	Chlorococcales	Scenedesmaceae	Scenedesmus	Scenedesmus quadricauda	24	2113	
Chlorophycota	Chlorophyceae	Klebsormidiales	Elakatotrichaceae	Elakatothrix	Elakatothrix gelatinosa	28	2465	
Chlorophycota	Chlorophyceae	Chlorococcales	Scenedesmaceae	Scenedesmus	Scenedesmus bijuga	32	2817	
Chlorophycota	Chlorophyceae	Chlorococcales	Scenedesmaceae	Willea	Willea rectangularis	40	3522	
Chlorophycota	Chlorophyceae	Chlorococcales	Dictyosphaeriaceae	Dictyosphaerium	Dictyosphaerium ehrenbergianum	52	4578	16.024451
Cryptophycophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	Cryptomonas	6	528	0.378378
Cyanophycota	Cyanophyceae	Chroococcales	Synechococcaceae	Cyanobium	Cyanobium parvum	2	176	
Cyanophycota	Cyanophyceae	Oscillatoriales	Pseudanabaenaceae	Planktolyngbya	Planktolyngbya contorta	5	440	
Cyanophycota	Cyanophyceae	Oscillatoriales	Pseudanabaenaceae	Geitlerinema	Geitlerinema	6	528	

Phylum	Class	Order	Family	Genus	Taxon Name	# cells counted	# cells per mL	Phylum (%)
Cyanophycota	Cyanophyceae	Nostocales	Nostocaceae	Cylindrospermopsis	Cylindrospermopsis catemaco	8	704	
Cyanophycota	Cyanophyceae	Oscillatoriales	Pseudanabaenaceae	Romeria	Romeria	9	792	
Cyanophycota	Cyanophyceae	Nostocales	Nostocaceae	Dolichospermum	Dolichospermum circinale	34	2993	
Cyanophycota	Cyanophyceae	Chroococcales	Merismopediaceae	Aphanocapsa	Aphanocapsa	80	7043	
Cyanophycota	Cyanophyceae	Chroococcales	Chroococcaceae	Synechocystis	Synechocystis	94	8276	
Cyanophycota	Cyanophyceae	Oscillatoriales	Pseudanabaenaceae	Jaaginema	Jaaginema gracile	100	8804	
Cyanophycota	Cyanophyceae	Oscillatoriales	Pseudanabaenaceae	Planktolyngbya	Planktolyngbya limnetica	156	13735	
Cyanophycota	Cyanophyceae	Nostocales	Nostocaceae	Cylindrospermopsis	Cylindrospermopsis raciborskii	187	16464	
Cyanophycota	Cyanophyceae	Chroococcales	Merismopediaceae	Aphanocapsa	Aphanocapsa delicatissima	630	55467	82.714289
Euglenophycota	Euglenophyceae	Euglenales	Euglenaceae	Phacus	Phacus	2	176	
Euglenophycota	Euglenophyceae	Euglenales	Euglenaceae	Lepocinclis	Lepocinclis	3	264	0.315315
Pyrrophycophyta	Dinophyceae	Peridiniales	Glenodiniaceae	Glenodinium	Glenodinium	2	176	0.126126
					Total	1585	139543	100

Appendix C: Mud Lake Survey Results – Collected August 5, 2014

Table C-1. Water Quality Results.

Parameter	MUD01 Surface Results	MUD01 Surface Qualifier Code	MUD01 Bottom Results	MUD01 Bottom Qualifier Code	MUD02 Surface Results	MUD02 Surface Qualifier Code	MUD02 Bottom Results	MUD02 Bottom Qualifier Code
Alkalinity (mg CaCO3/L)	28		28		28		28	
Ammonia-N (mg N/L)	0.006		0.018		0.006		0.006	
Biochemical Oxygen Demand-5 Day, N-Inhib (mg/L)	1.7	I	2.1		2.8		2.3	
Calcium (mg/L)	11.7		12.2		12.2		12.3	
Chloride (mg Cl/L)	34		34		35		35	
Chlorophyll-a, Corrected (µg/L)	21		20		33		26	
Color - true (PCU)	60		61		58	A	58	
Dissolved Oxygen (mg/L)	6.52		2.82		5.79		1.85	
Fluoride (mg F/L)	0.21		0.21		0.21		0.21	
Kjeldahl Nitrogen (mg N/L)	1.1		1.1		1.2		1.2	
Magnesium (mg/L)	5.3		5.51		5.5		5.58	
NO2NO3-N (mg N/L)	0.004	U	0.004	U	0.004	U	0.004	U
O-Phosphate-P (mg P/L)	0.004	U	0.004	U	0.004	U	0.004	U
Organic Carbon (mg C/L)	15		15		15		15	
pH (SU)	6.82		6.44		6.61		6.27	
Phaeophytin-a (µg/L)	4.6		5.2		3.3		3.6	
Potassium (mg/L)	4.1		4.2		4.3		4.3	
Sample Depth (m)	0.5		2		0.5		2.3	
Sodium (mg/L)	20.3		21		21.1		21.5	
Specific Conductance (umhos/cm)	224		223		227		232	
Sulfate (mg SO4/L)	17		17		18		19	
TDS (mg/L)	148		158		152		149	
Temperature (deg. C)	31.17		30.15		31.18		30.63	
Total-P (mg P/L)	0.031		0.036		0.041		0.036	
TSS (mg/L)	4	I	2	I	4	I	3	I
Turbidity (NTU)	1.8		2.1		2.7		2.3	

A - Value reported is the arithmetic mean (average) of two or more determinations.
I - The reported value is greater than or equal to the laboratory method detection limit but less than the laboratory practical quantitation limit.
U - Indicates that the compound was analyzed for but not detected.

Figure C-1. Depth Profile for Dissolved Oxygen (mg/L) at MUD01.

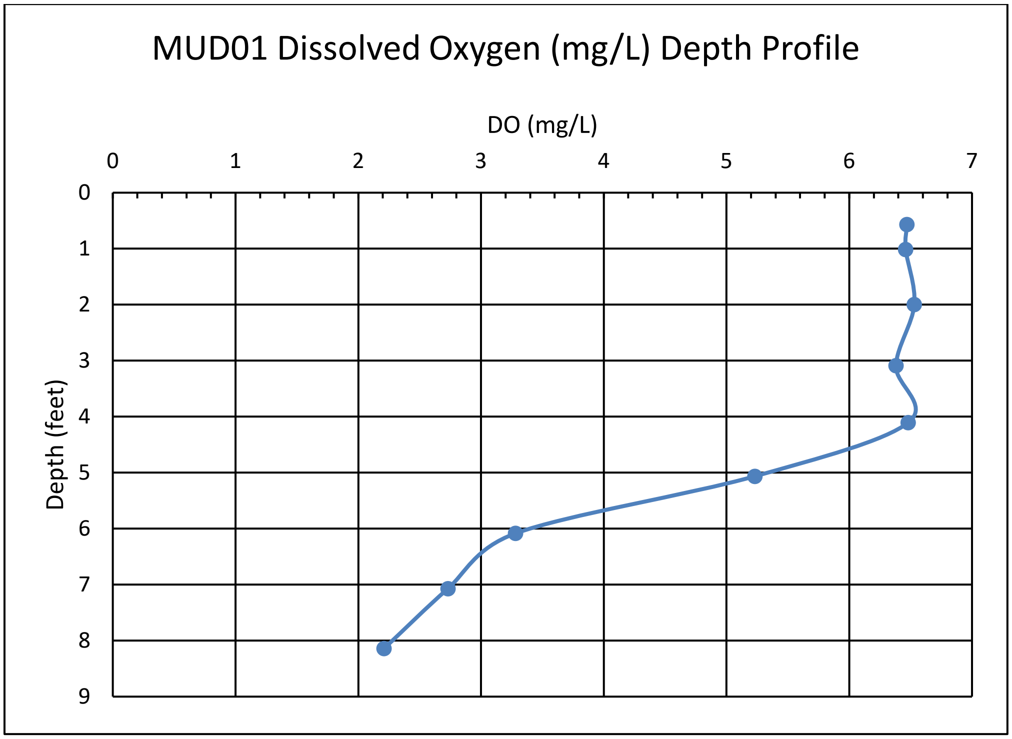

Figure C-2. Depth Profile for pH at MUD01.

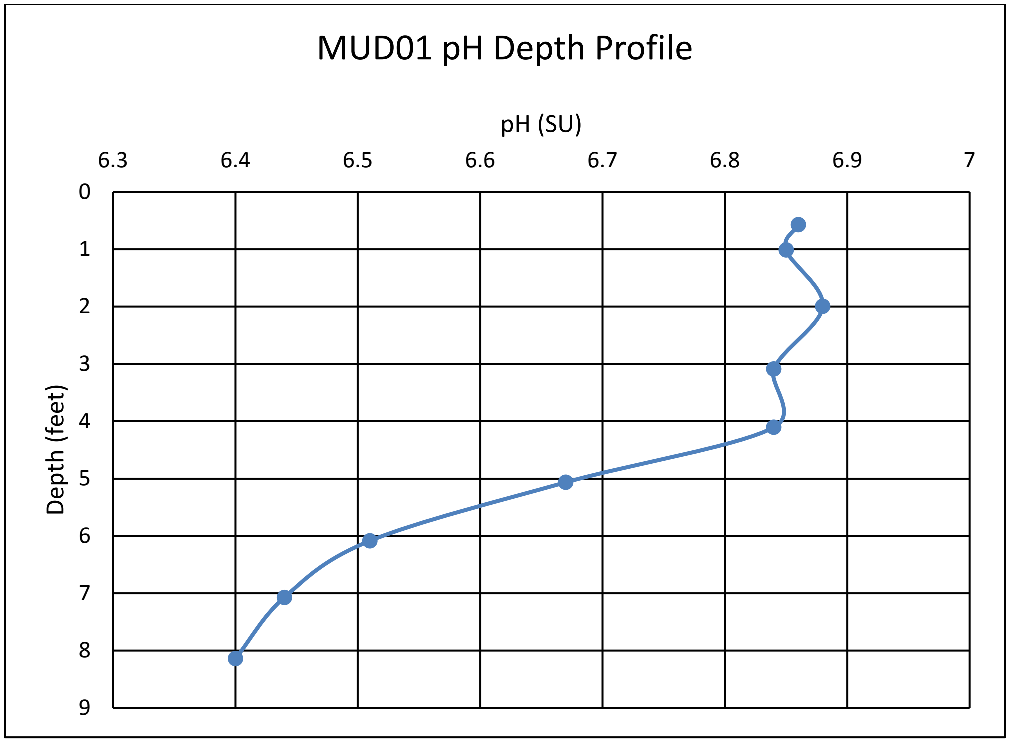

Figure C-3. Depth Profile for Specific Conductivity at MUD01.

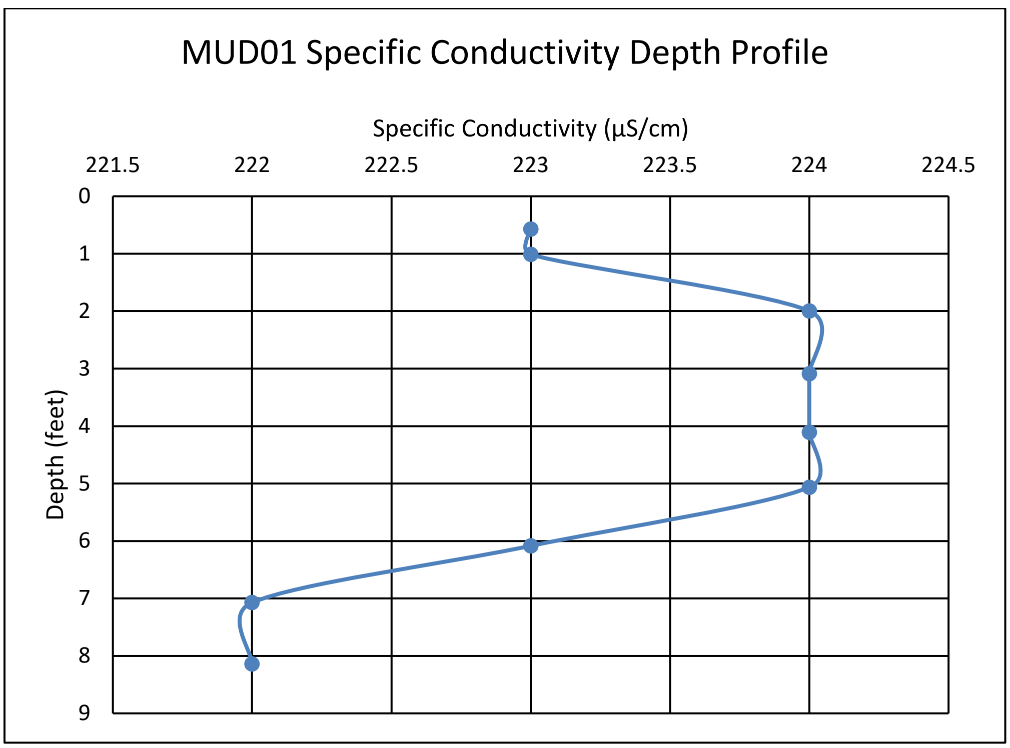

Figure C-4. Depth Profile for Temperature at MUD01.

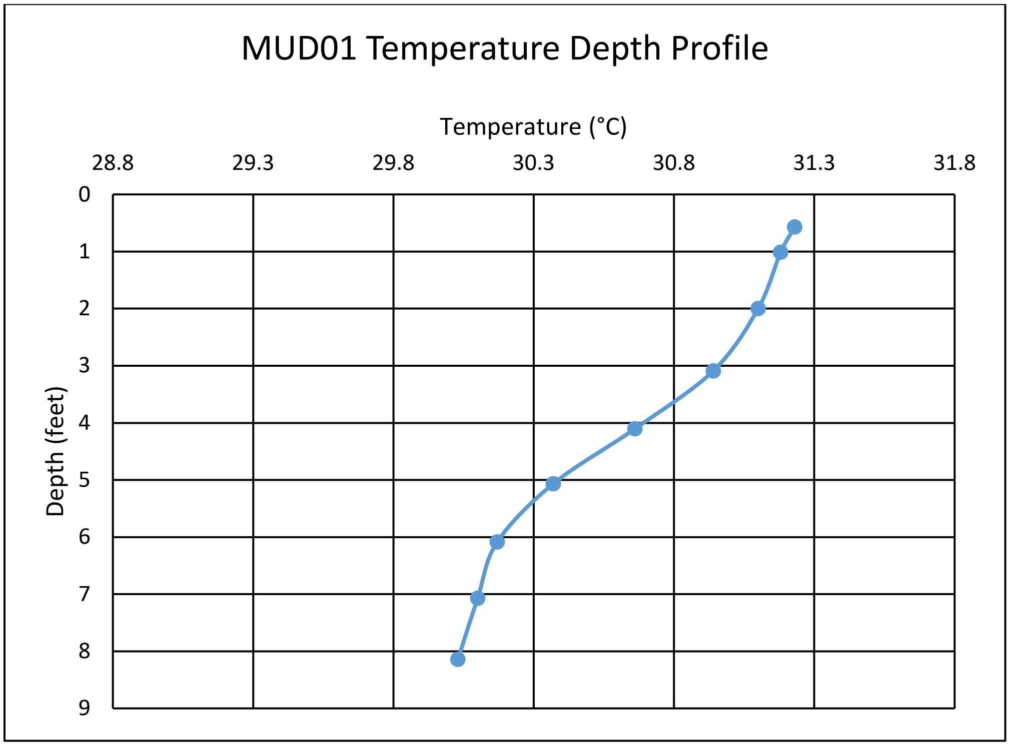

Figure C-5. Depth Profile for Dissolved Oxygen (mg/L) at MUD02.

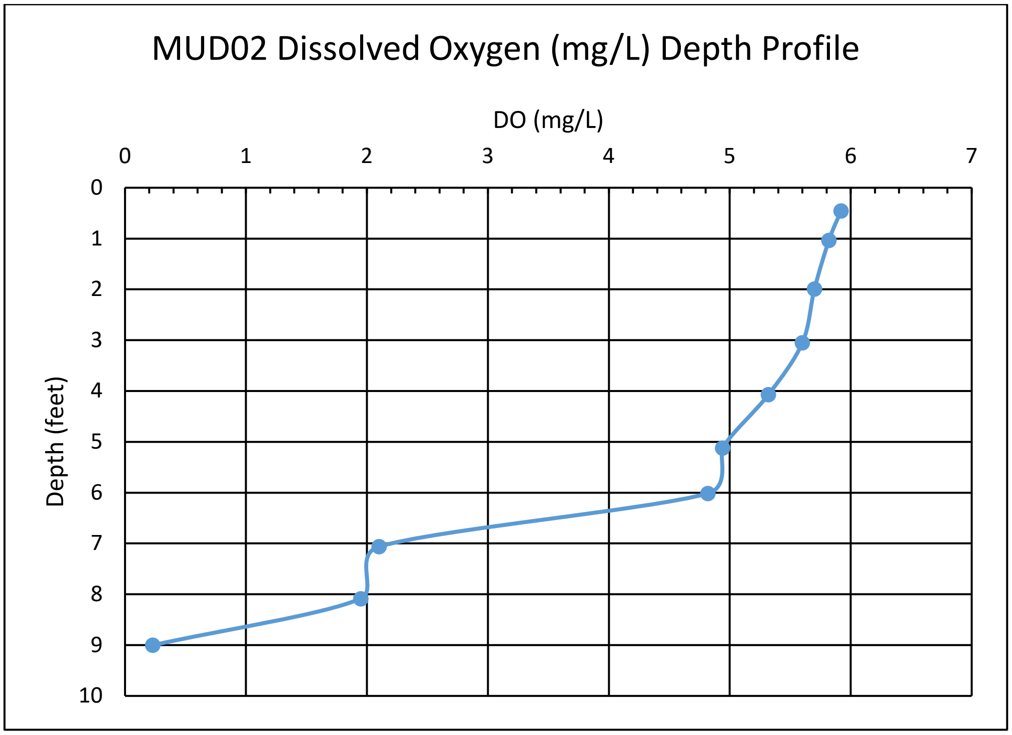

Figure C-6. Depth Profile for pH at MUD02.

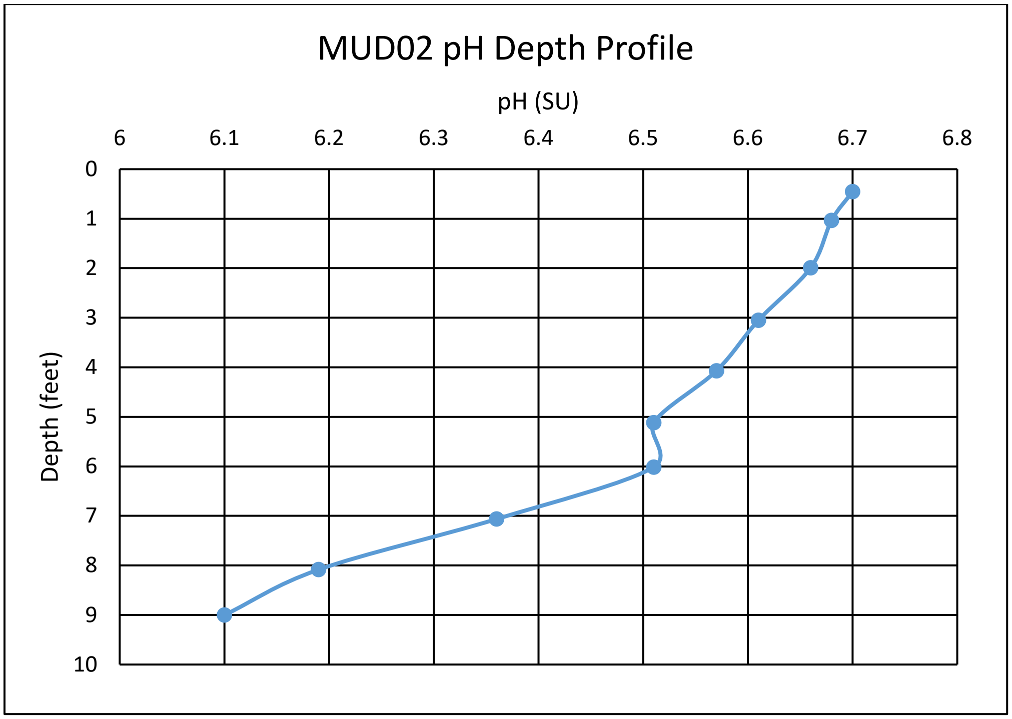

Figure C-7. Depth Profile for Specific Conductivity at MUD02.

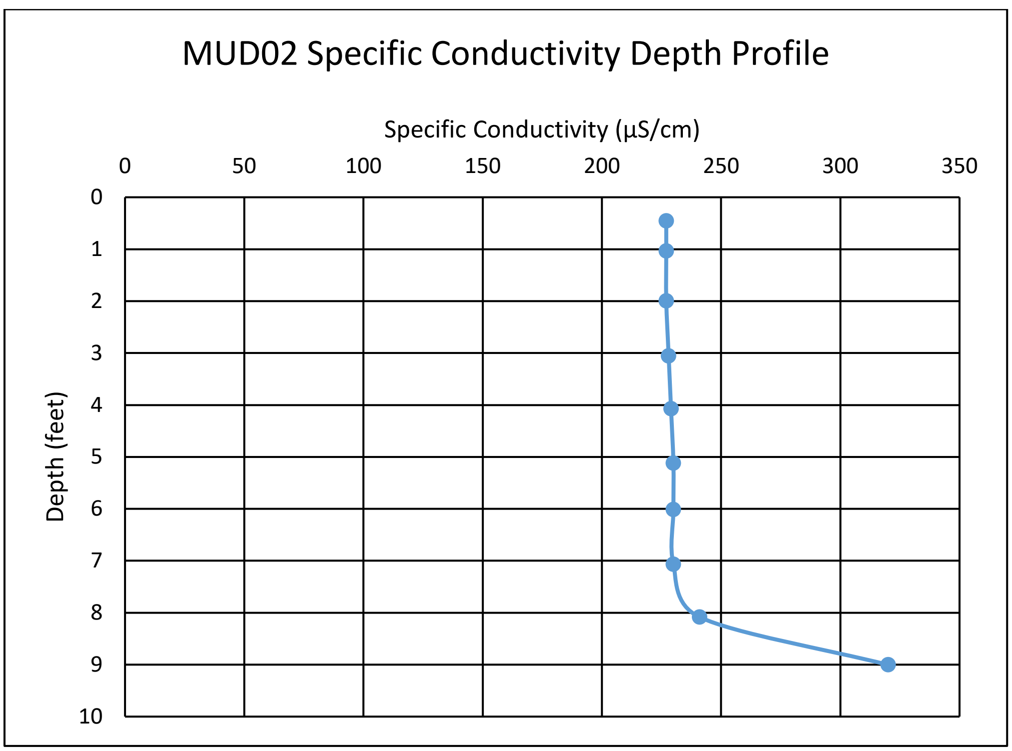

Figure C-8. Depth Profile for Temperature at MUD02.