Central District • Middle St. Johns River Basin

Draft Report

Nutrient TMDLs for Kasey Lake (WBID 3002Q), Kelly Lake (WBID 3002S), and Lake Lotta (WBID 3002G) and Documentation in Support of the Development of Site-Specific Numeric Interpretations of the Narrative Nutrient Criterion

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Executive Summary

This report presents the total maximum daily loads (TMDLs) developed to address nutrient impairment in Kasey Lake, Kelly Lake and Lake Lotta located in the Middle St. Johns Basin in Orange County. All three waterbodies were identified as impaired for nutrients based on elevated chlorophyll *a* concentrations and, in Kasey Lake, both total nitrogen (TN) and total phosphorus (TP) concentrations, and Kelly Lake and Lake Lotta, only TP, exceeding numeric nutrient criteria. These lakes were added to the 303(d) list by Secretarial Order in April 2020 as the segments with waterbody identification (WBID) numbers 3002Q, 3002R, and 3002G, respectively.

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 total nitrogen (TN) and total phosphorus (TP) have been developed. **Table EX-1** lists supporting information for the TMDLs. The TMDLs were developed in accordance with Section 303(d) of the federal Clean Water Act and guidance developed by the U.S. Environmental Protection Agency.

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

Type of Information	Description
Waterbody name/ WBID number	Kasey Lake (WBID 3002Q), Kelly Lake (WBID 3002R) and Lake Lotta (WBID 3002G),
Hydrologic Unit Code (HUC) 8	03080101
Use classification/ Waterbody designation	Class III/Fresh
Targeted beneficial uses	Fish consumption; recreation, and propagation and maintenance of a healthy, well-balanced population of fish and wildlife
303(d) listing status	Verified List of Impaired Waters for the Middle St. Johns Group 2 Basin adopted via Secretarial Order in 2020 for Kasey Lake and Lake Lotta, and in 2022 for Kelly Lake
TMDL pollutants	TN and TP
TMDLs and site-specific interpretations of the narrative nutrient criterion	**Kasey Lake (WBID 3002Q) and Kelly Lake (WBID 3002R):** **TN**: 0.91 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. **Lake Lotta (WBID 3002G):** **TN**: 1.27 mg/L, expressed as AGM not to be exceeded. **TP**: 0.03 mg/L, expressed as an AGM not to be exceeded.
In-lake concentration reductions required to meet the TMDLs	**Kasey Lake (WBID 3002Q): A** 29 % TN reduction and 62 % TP reduction to achieve the chlorophyll *a* criterion of 20 µg/L for low-color, high-alkalinity lakes. **Kelly Lake (WBID 3002R): A** 56 % TN reduction and 84 % TP reduction to achieve the chlorophyll *a* criterion of 20 µg/L for low-color, high-alkalinity lakes. **Lake Lotta (WBID 3002G):** A 0 % TN reduction and 50 % TP reduction to achieve the chlorophyll *a* criterion of 20 micrograms per liter (µg/L) for high-color 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 (DEAR), specifically, the Office of Watershed Services, Watershed Assessment Section, Standards Development Section, Water Quality Restoration Program, Central Regional Operations Center, and Watershed Evaluation and TMDL Section. DEP also recognizes the City of Orlando and Orange County for its contributions towards understanding the issues, history, and processes at work in the Kasey Lake, Kelly Lake, and Lake Lotta Watersheds. Thank you to Eric Tano and Casey Luzius for work on previous versions of these TMDLs.

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Acronyms and Abbreviations

µg/L	Micrograms Per Liter
AGM	Annual Geometric Mean
BMAP	Basin Management Action Plan
BMP	Best Management Practice
$CaCO_3$	Calcium Carbonate
CFR	Code of Federal Regulations
CWA	Clean Water Act
DEAR	Division of Environmental Assessment and Restoration
dem	Digital Elevation Model
DEP	Florida Department of Environmental Protection
DO	Dissolved Oxygen
EPA	U.S. Environmental Protection Agency
°F	Degrees Fahrenheit
F.A.C.	Florida Administrative Code
FDOT	Florida Department of Transportation
F.S.	Florida Statutes
FWRA	Florida Watershed Restoration Act
HUC	Hydrologic Unit Code
IWR	Impaired Surface Waters Rule
kg	Kilograms
LA	Load Allocation
mg/L	Milligrams Per Liter
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer System
NA	Not Applicable or Not Available
NNC	Numeric Nutrient Criteria
NPDES	National Pollutant Discharge Elimination System
OFS	Outstanding Florida Springs
OSTDS	Onsite Sewage Treatment and Disposal System
PCU	Platinum Cobalt Unit
PLRG	Pollutant Load Reduction Goal
SJRWMD	St. Johns River Water Management District
SWIM	Surface Water Improvement and Management
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
USGS	U.S. Geological Survey
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 Kasey Lake, Kelly Lake and Lake Lotta, located in the Middle St. Johns 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 waterbodies were verified as impaired for nutrients using the methodology in the Identification of Impaired Surface Waters Rule (IWR) (Chapter 62-303, F.A.C.), and were included on the Verified List of Impaired Waters for the Middle St. Johns River Basin adopted by Secretarial Order in April 2020 (Kasey Lake and Lake Lotta) and July 2022 (Kelly Lake).

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 Kasey Lake, Kelly Lake and Lake Lotta and associated nutrient reductions that would restore the waterbodies so that they meet their applicable water quality criteria for nutrients.

1.2 Identification of Waterbody

For assessment purposes, the Florida Department of Environmental Protection (DEP) divided the Middle St. Johns River Basin (Hydrologic Unit Code [HUC] 8 – 03080101) into watershed assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or surface water segment. Lake Kasey is WBID 3002Q, Kelly Lake is WBID 3002R and Lake Lotta is WBID 3002G. **Figures 1.1, 1.2,** and **1.3** show the location of the lake WBIDs in the basin and major geopolitical and hydrologic features in the region.

Kasey Lake and Kelly Lake are small lakes located in northwest Orlando in central Orange County. Kasey Lake does not receive water from any waterbodies and discharges into Kristy Lake through a pipe. Kristy Lake also discharges its water into Kelly Lake to control stormwater overflow. There is a pump station at Lake Kelly, which is set to automatically turn on at elevation 72 ft-NGVD and turn off at 71 ft-NGVD (CDM 2005). The force main runs south to and then easterly along North Lane and it discharges to a gravity system that flows to Lake Orlando (**Figure 1.4**). The Kasey Lake and Kelly Lake Watershed boundaries were provided by the City of Orlando.

Lake Lotta (WBID 3002G) is located in west Orlando in Orange County. The lake discharges into Lake Rose but does not receive drainage from another waterbody.

Table 1.1 summarizes the lakes' general hydrologic characteristics.

Table 1.1. Characteristics of Kasey Lake, Kelly Lake and Lotta.

[1] Data from City of Orlando Public Works Department 2016.
NA = Not available.

Lake Name	Lake Surface Area (acres)	Lake Volume (acre-feet)	Mean Depth (feet)	Maximum Depth (feet)	Watershed Area (acres)
Kasey[1]	4	33	9	13	74
Kelly[1]	4	NA	NA	9	64
Lotta[1]	44	~486	12	14	908

1.3 Watershed Information

1.3.1 Population and Geopolitical Setting

Kasey Lake and Kelly Lake are located in the City of Orlando in Orange County. Lake Lotta is situated in unincorporated Orange County, near the City of Ocoee. According to data available from the U.S. Census Bureau (2023), the population of Orange County is 1,471,416 and the City of Orlando has a population of 320,742.

1.3.2 Topography

Lake regions in Florida have been defined by the U.S. Environmental Protection Agency (EPA) and are based on regions of similarity in physical, chemical, and biological characteristics along with their associations with landscape features (Griffith et al. 1997). Kasey Lake, Kelly Lake and Lake Lotta are all located in the Apopka Upland region (75-16), which is characterized by many small lakes and sinkholes with elevations ranging from 70 to 150 feet. The physical and chemical characteristics of the lakes in this region are varied, and lake water levels can decrease significantly through drought periods. There are some acidic, clear, soft water lakes of low mineral content, some clear lakes with moderate nutrients (some may lack macrophytes), and some darker water lakes that still have circumneutral pH values. The current land cover consists of citrus, pasture, and urban and residential development. Candler-Apopka-Astatula and Tavares-Zolfo-Millhopper are the most common soil associations, developed over more silt and clay than the coarser clastic rocks of the Mount Dora Ridge (Brooks 1981; 1982).

1.3.3 Hydrogeological Setting

The hydrology of the lakes is determined in part by the topography and 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. Annual rainfall averages 129 centimeters, and the majority of the rainfall occurs from June through September (U.S. Geological Survey [USGS] 1996).

The Kasey Lake and Kelly Watersheds are located in the Undifferentiated Sediment and Cypresshead Formation geological regions. The Undifferentiated Sediment is characterized by siliciclastics comprising gray, tan, brown to black, unconsolidated to poorly consolidated, clean to clayey, silty, unfossiliferous, variably organic-bearing sands ranging from blue-green to olive green in color, and poorly to moderately consolidated, sandy and silty clays.

Lake Lotta Watersheds is located in the Cypresshead Formation (Pliocene), characterized by reddish-brown to reddish-orange, unconsolidated to poorly consolidated, fine to very coarse-grained, clean to clayey sands (Scott 2001). The Cypresshead Formation is at or near the surface, and because of the permeable sands, this region encompasses a part of the surficial aquifer found in Florida and eastern Georgia.

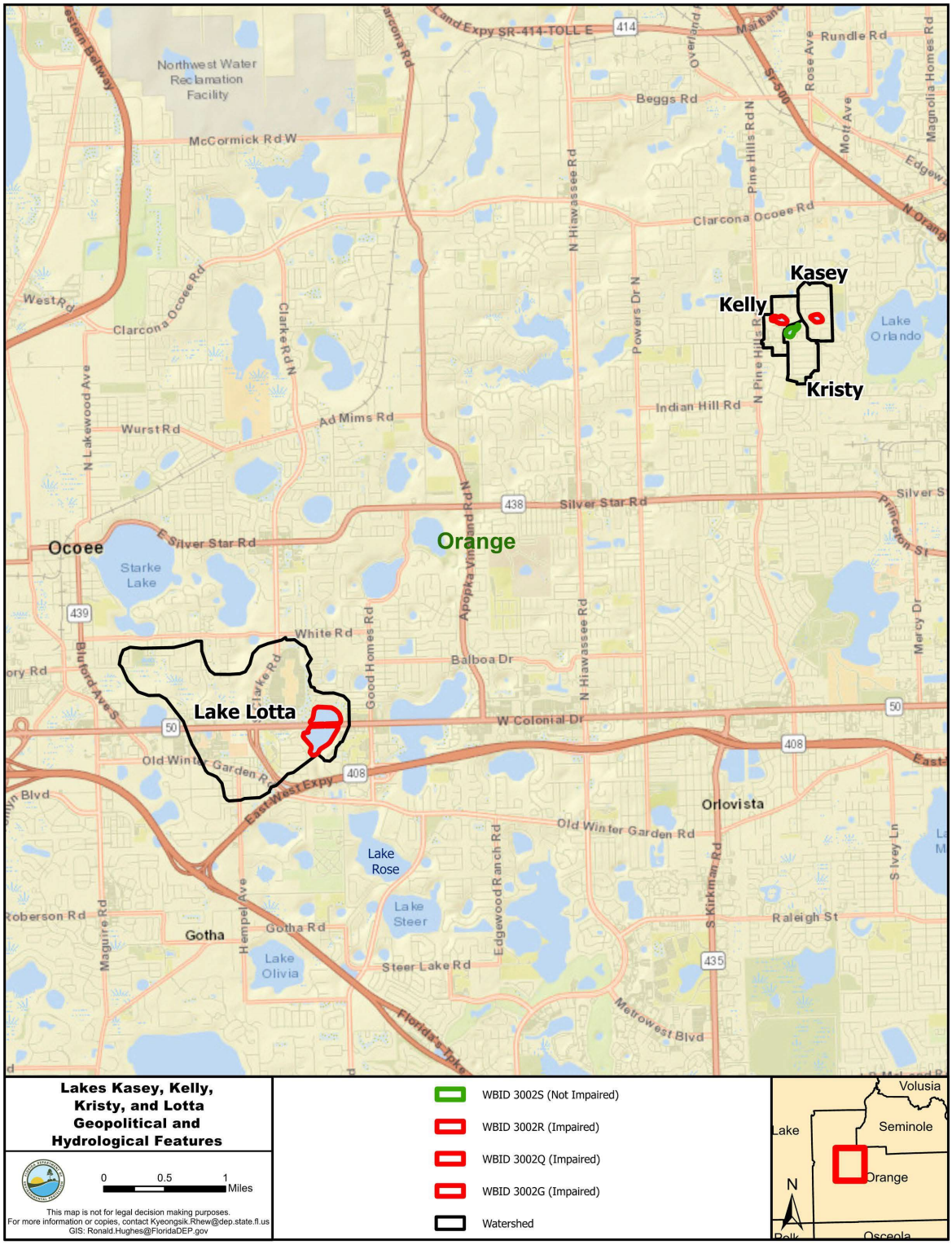


Figure 1.1. Location of Kasey Lake (WBID 3002Q), Kelly Lake (WBID 3002R), and Lake Lotta (WBID 3002G) in the Middle St. Johns River Basin and major geopolitical and hydrologic features in the region.

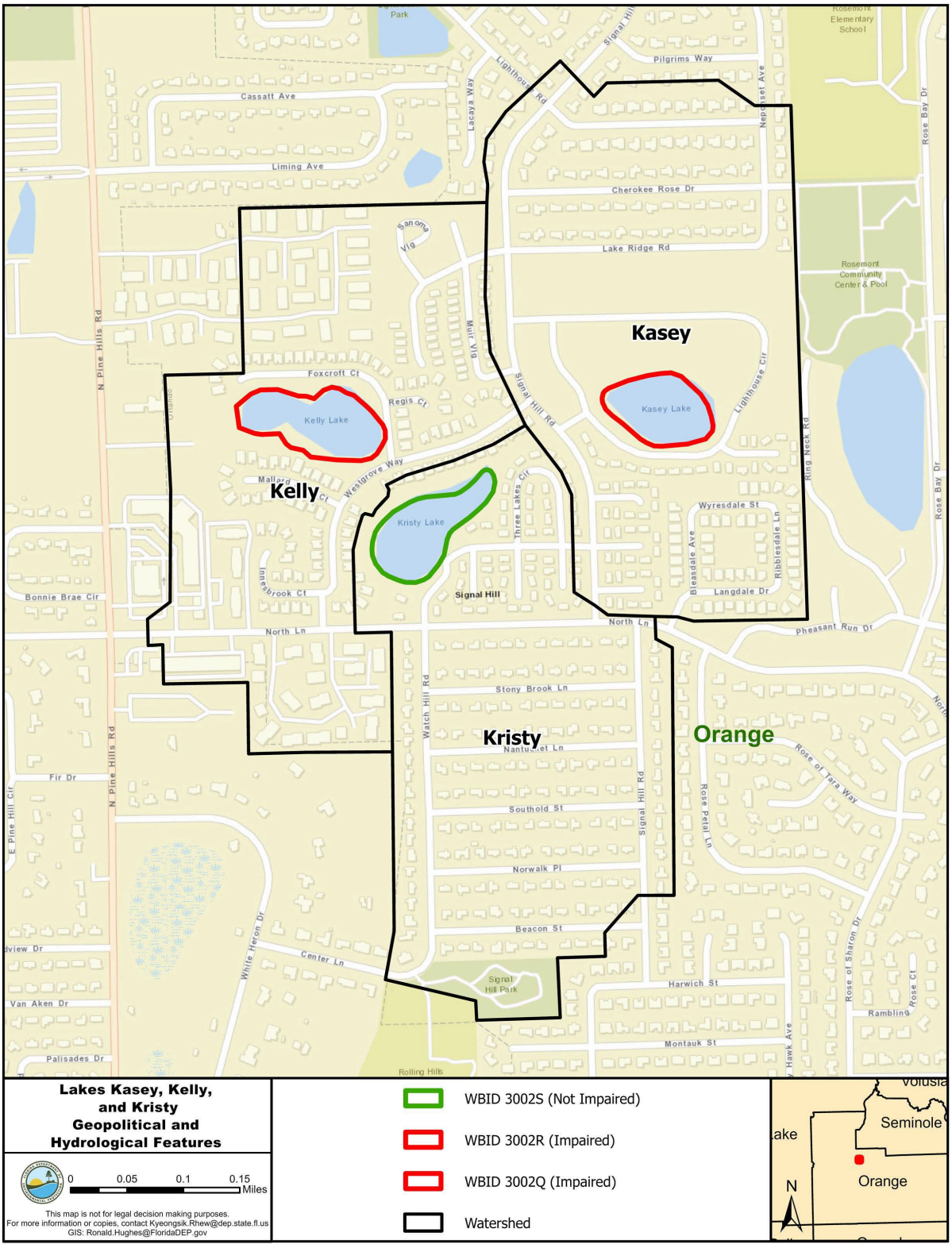


Figure 1.2. Kasey Lake (3002Q) and Kelly Lake (WBID 3002R) and watersheds.

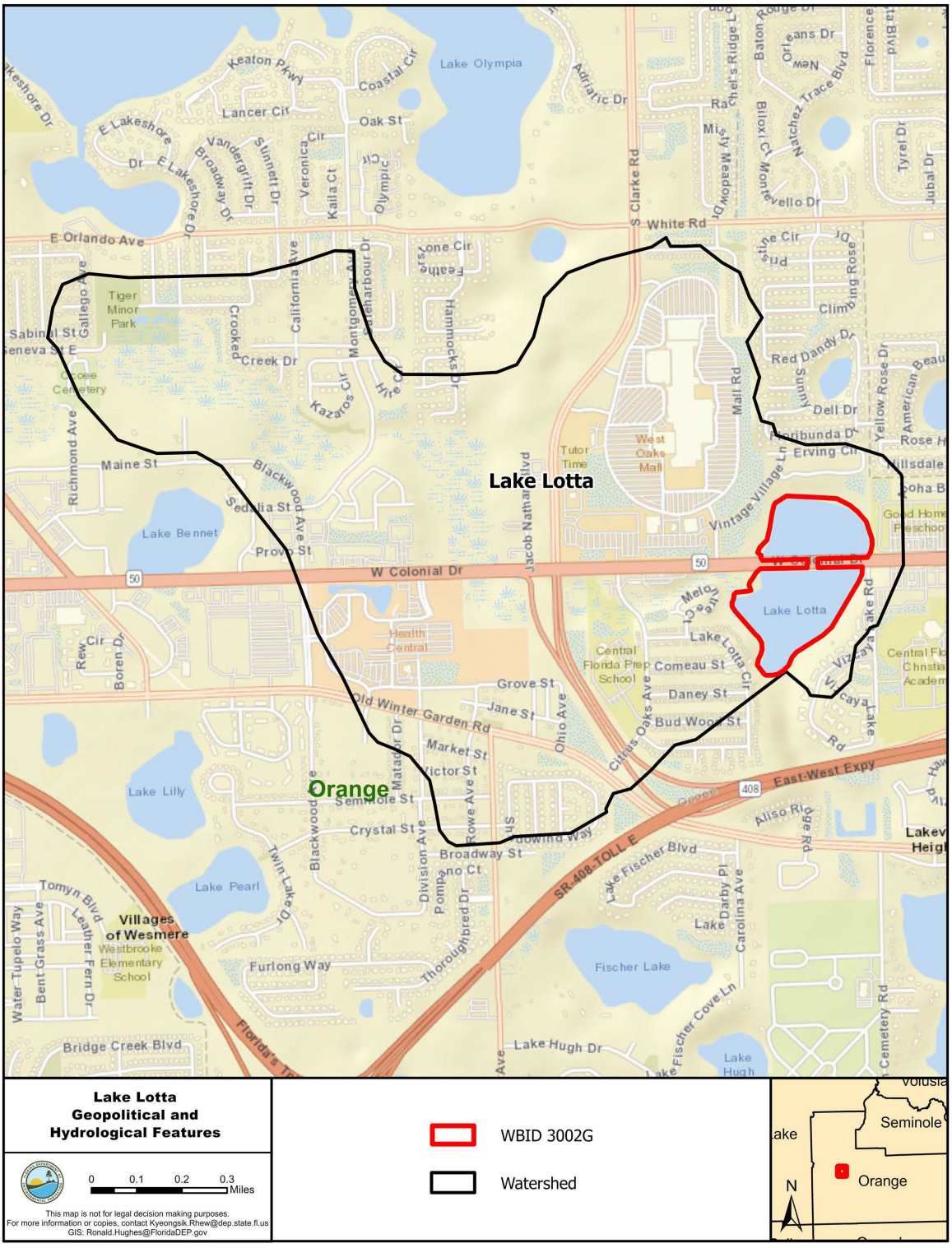


Figure 1.3. Location of Lake Lotta (WBID 3002G) in the Middle St. Johns Basin and major hydrologic and geopolitical features in the region.

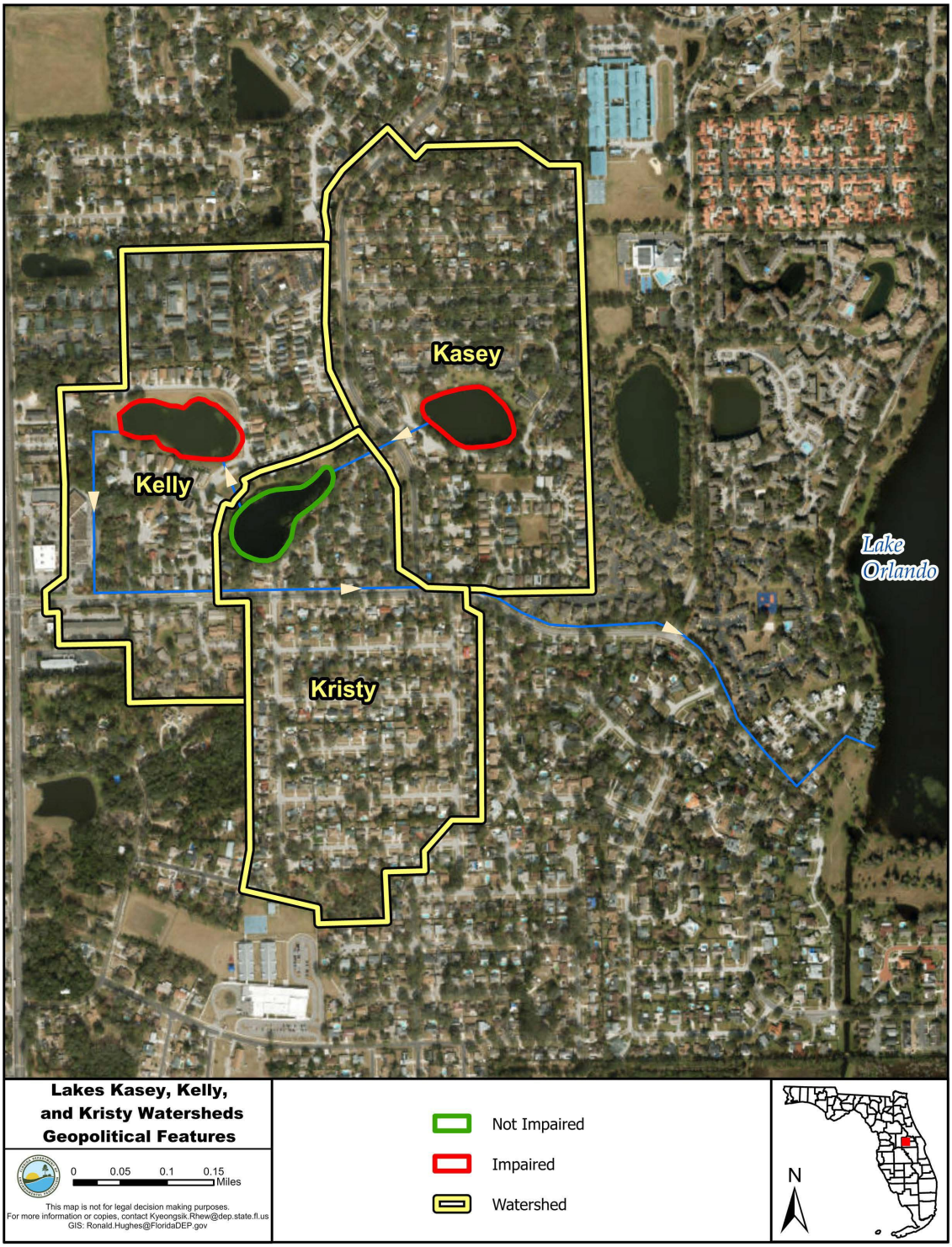


Figure 1.4. Human-modified hydrology of Kasey, Kristy and Kelly Lakes showing interbasin connections (conveyance pipes are shown in blue and yellow arrows indicate flow direction).

The soils in the Kasey Lake and Kelly Lake watersheds comprise Hydrologic Soil Groups A and A/D, based on the National Cooperative Soil Survey. Group A type soils are typically well-drained, have deep water tables, and consist of sandy, textured soils with a relatively low runoff potential. Group D type soils are variable in texture but generally have a greater clay component and are often found at lower topography with higher water tables that generate a higher hydrologic runoff response. When Group A/D is unsaturated, it behaves like Groups A and when unsaturated like Group D soil. The soils in the Lake Lotta watershed are also composed of Hydrologic Soil Groups A, and A/D. In addition to A and A/D, the Hydrologic Soil Group B/D is in the Lake Lotta watershed. Soil Groups A/D and B/D are similar in that when they are unsaturated they behave like Group A.

Figures 1.5 and **1.6** display the distribution of soil types in the Kasey-Kelly-Kristy Lake Group and Lake Lotta Watersheds, respectively. These lake watershed areas consist mostly of a mix of well-drained, sandy, textured soils ("A" soils). **Tables 1.2,** and **1.3** list the percentage of soil types in the Kasey-Kelly-Kristy Lake Group and Lotta Watersheds, respectively.

Table 1.2. Soil type acreage and percent in the Kasey-Kelly-Kristy Lake Group Watershed.

Note: Hybrid soil type is A/D.

Hydrologic Group	Kasey Lake WS (ac)	Kasey Lake WS (%)	Kelly Lake WS (ac)	Kelly Lake WS (%)	Kristy Lake WS (ac)	Kristy Lake WS (%)
A	60.2	81	59.1	93	57.4	85
A/D	11.5	15	1.5	2	6.6	10
B/D	-	-				
N/A	2.8	4	3.3	5	3.2	5
Total	**74.5**	**100**	**63.9**	**100**	**67.2**	**100**

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

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

Hydrologic Group	Acres	% of Watershed
A	760.5	84
A/D	86.5	9
B/D	7.0	1
N/A	54.3	6
Total	**908.3**	**100.0**

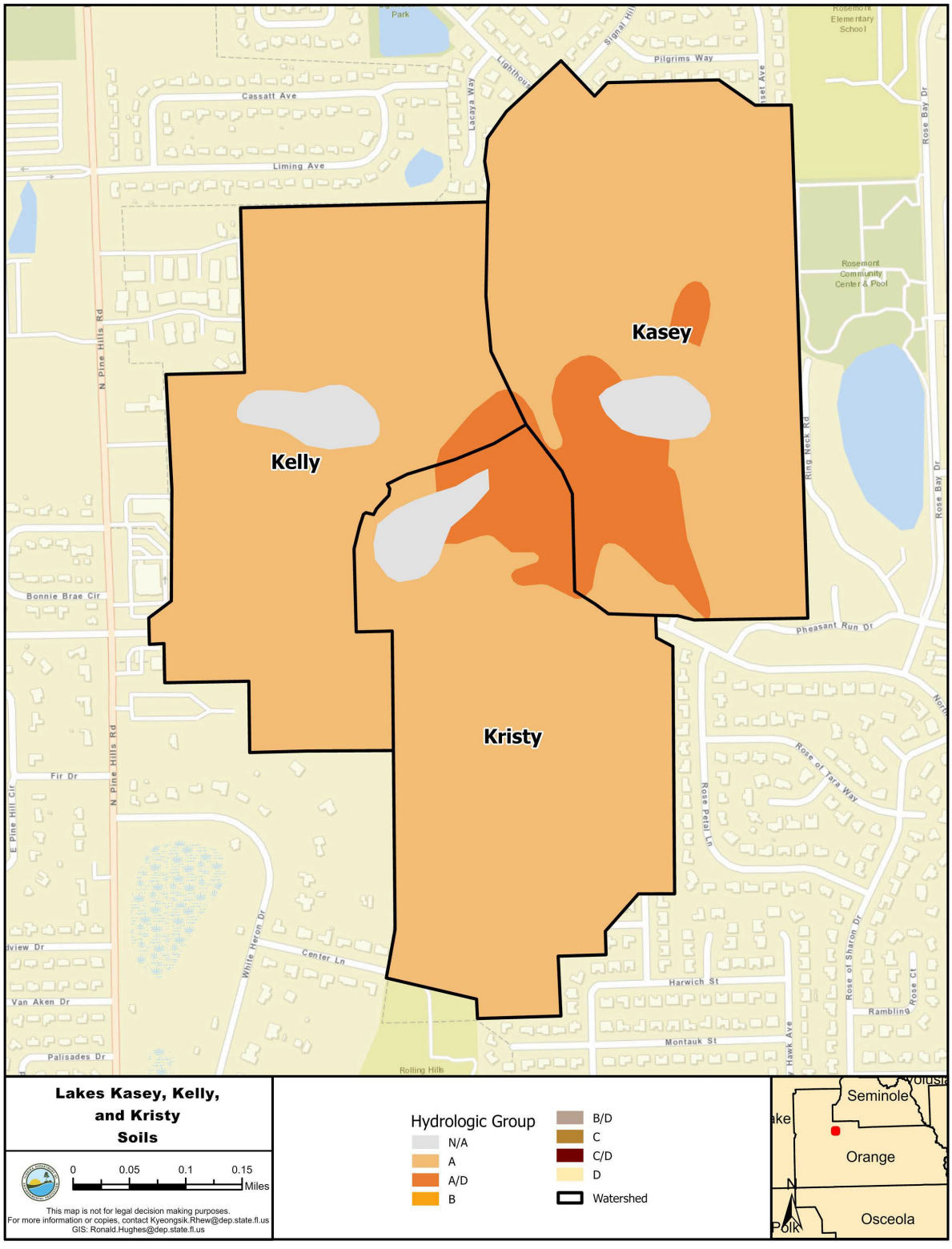


Figure 1.5. Hydrologic soil groups in the Kasey-Kelly-Kristy Lake Group Watershed.

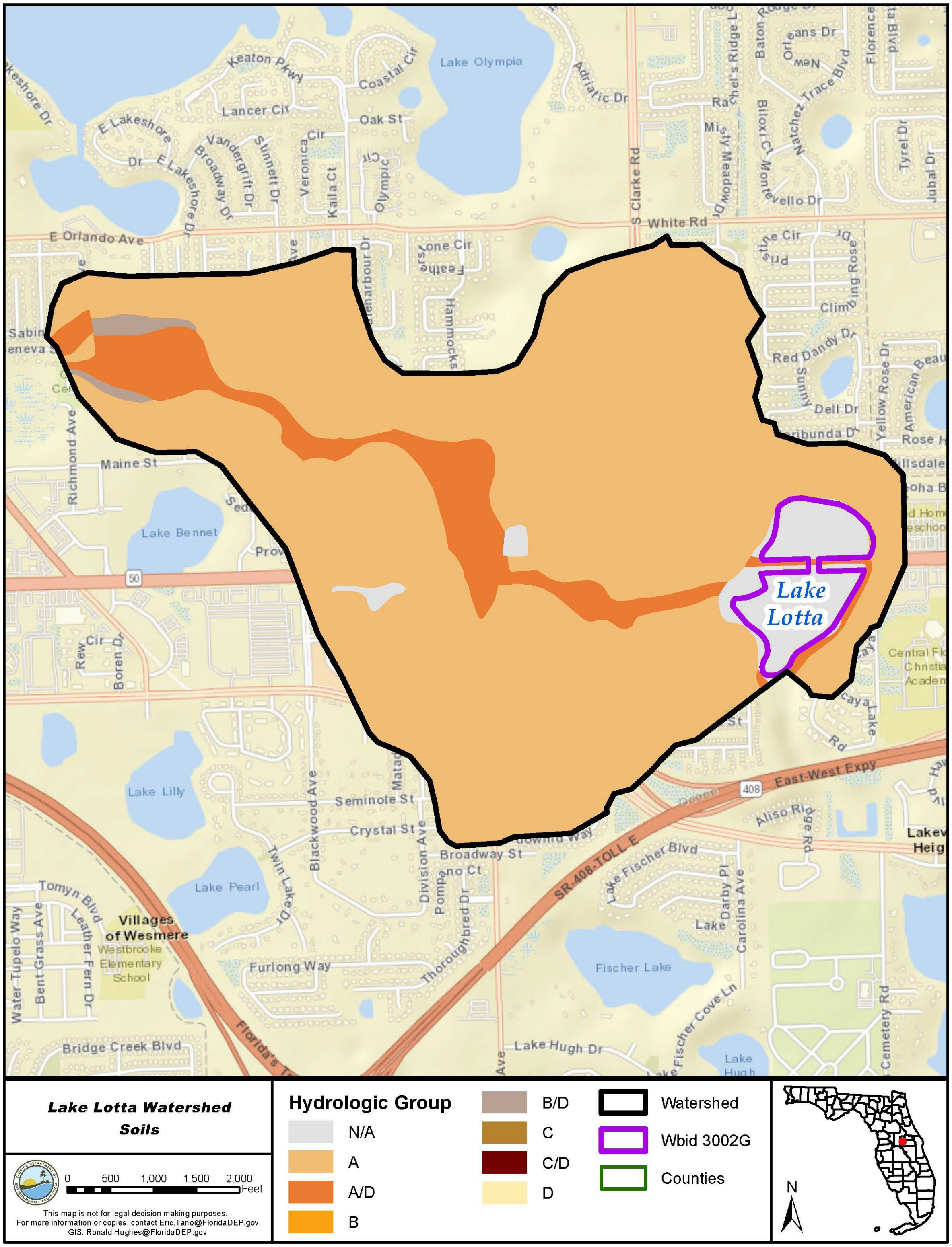


Figure 1.6. Hydrologic soil groups in the Lake Lotta Watershed.

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 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.).

2.2 Classification of the Waterbody and Applicable Water Quality Standards

Kasey Lake, Kelly Lake and Lake Lotta are Class III (fresh) waterbodies, with a designated use of fish consumption, recreation, and propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The Class III water quality criterion applicable to the verified impairment (nutrients) for these waterbodies is Florida's nutrient criterion in paragraph 62-302.530(48)(b), F.A.C. Florida adopted NNC for lakes, spring vents, and streams in 2011.

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 geometric means (**Table 2.1**). The long-term averages of geometric means for alkalinity in Kasey Lake, Kelly Lake, and Lake Lotta are 27, 32, and 56 mg/L $CaCO_3$, respectively. The long-term averages of geometric means for color in Kasey Lake, Kelly Lake and Lake Lotta are 31, 16, and 49 PCU, respectively. The geometric means were calculated based on the results in the IWR Run 65 Database. Using this methodology, Lake Kasey and Kelly Lake are both classified as low color, high alkalinity (≤40 PCU and >20 mg/L $CaCO_3$) lakes, while Lake Lotta is classified as high color (> 40 PCU) lake.

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

If there are sufficient data to calculate an AGM for chlorophyll *a* and the AGM does not exceed the chlorophyll *a* criterion for the lake type in **Table 2.1**, then the TN and TP numeric interpretations for the calendar year are the AGMs for lake TN and TP samples, subject to minimum and maximum limits.

If there are insufficient data to calculate the AGM for chlorophyll *a* for a given year, or the AGM for chlorophyll *a* exceeds the values in the table for the lake type, then the applicable nutrient interpretations for TN and TP are the minimum values. These values are listed in **Table 2.1**, as specified in subparagraph 62-302.531(2)(b)1., F.A.C.

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

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

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

2.3 Determination of the Pollutant of Concern

2.3.1 Data Providers

The lake nutrient data used in the most recent assessment period for Kasey Lake came from stations sampled and monitored by the DEP Central District (21FLCEN…) and the City of Orlando (21FLORL…). All Kelly Lake nutrient data were collected by the City of Orlando. For Lake Lotta, most of the lake nutrient data used in the most recent assessment period came from stations sampled and monitored primarily by the DEP (21FLCEN... and 21FLGW…) and Orange County Environmental Protection Division (21FLORAN…). **Table 2.2** summarizes the sampling stations and associated data providers. chlorophyll *a*, TN, and TP data from 1992 to 2022 for Kasey Lake and Kelly Lake, and from 2005 to 2022 for Lake Lotta collected by these providers were used for TMDL development. **Figures 2.1** and **2.2** show the lake sampling locations in the three WBIDs, respectively.

Table 2.2. Monitoring stations for Kasey Lake, Kelly Lake, and Lake Lotta in the Middle St. Johns River Basin.

Lake	WBID	Station Identification
Kasey	3002Q	21FLCEN20011235 21FLCENG2CE0011 21FLORL KASEY
Kelly	3002R	21FLORL KELLY
Lotta	3002G	21FLORANBW38 21FLORANBW38N 21FLORANBW38S 21FLCEN G2CE0093 21FLCEN 20010673 21FLCEN HABCE0001 21FLGW 42423 21FLGW 49029

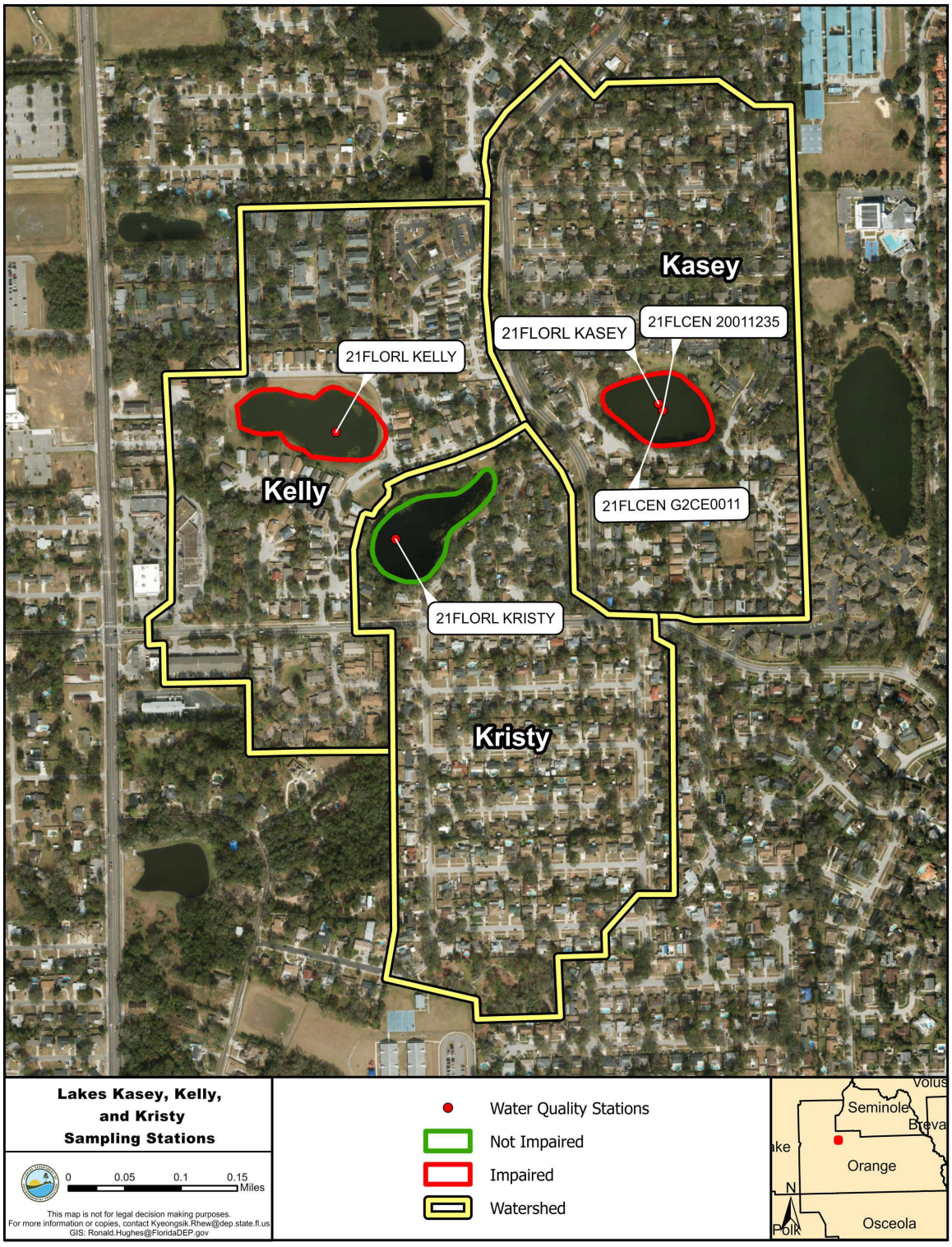


Figure 2.1. Monitoring stations in Kasey Lake (WBID 3002Q), Kelly Lake (WBID 3002R) and Kristy Lake (WBID 3002S).

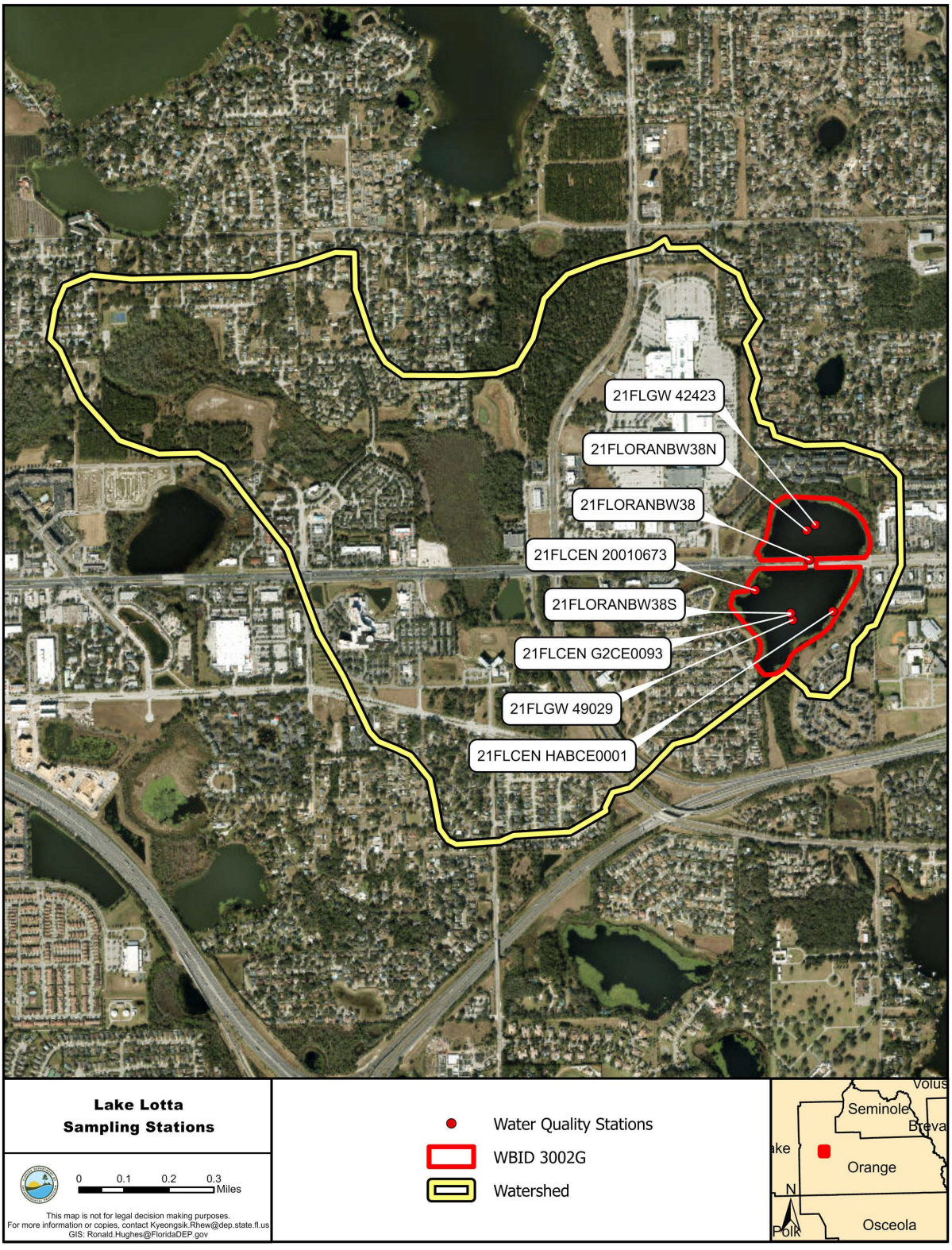


Figure 2.2. Monitoring stations in Lake Lotta.

2.3.2 Information on Verified Impairment

For the Cycle 4 basin assessment completed in 2020, the NNC were used to assess the lakes for the verified period (January 1, 2012–June 30, 2019) during the Group 2, Cycle 4 assessment based on data from the IWR Run 58 Database. Kasey Lake was assessed as impaired (Category 5) for chlorophyll *a*, TN and TP. Lake Lotta was assessed as impaired (Category 5) for chlorophyll *a* and was added to the Verified List. Kelly Lake was assessed as impaired (Category 5) for TP, and the chlorophyll *a* impairment was added to the Verified List during the statewide Biennial Assessment 2020-2022 (the verified period: January 1, 2013-June 30, 2020), based on data from the IWR Run 60 Database

Tables 2.3, **2.4**, and **2.5** list the chlorophyll *a*, TN, and TP AGMs, respectively, for Kasey Lake, Kelly Lake and Lake Lotta calculated using the data from 2012 to 2022 in the IWR Run 65 Database.

Table 2.3. Kasey Lake (WBID 3002Q) AGM values for the 2012–2022 period.

ID = Insufficient data.
µg/L = Micrograms per liter; mg/L = Milligrams per liter.
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)
2012	**57**	**1.41**	**0.08**
2013	ID	**1.17**	**0.07**
2014	**29**	1.02	**0.07**
2015	**55**	**1.17**	**0.07**
2016	**33**	**1.09**	**0.05**
2017	ID	0.78	**0.06**
2018	**34**	1.00	**0.06**
2019	**45**	0.90	**0.07**
2020	**43**	**1.10**	**0.07**
2021	**70**	ID	ID
2022	ID	ID	ID

Table 2.4. Kelly Lake (WBID 3002R) AGM values for the 2012–2022 period.

Year	Chlorophyll a (µg/L)	TN (mg/L)	TP (mg/L)
2012	ID	0.64	0.04
2013	ID	ID	ID
2014	ID	0.94	0.06
2015	**33**	1.05	**0.07**
2016	18	1.10	0.05
2017	ID	0.73	**0.07**
2018	12	0.74	0.06
2019	15	0.62	0.05
2020	**27**	0.81	0.05
2021	**40**	ID	ID
2022	ID	ID	ID

Table 2.5. Lake Lotta (WBID 3002G) AGM values for the 2012–2022 period.

Year	Chlorophyll a (µg/L)	TN (mg/L)	TP (mg/L)
2012	**32**	1.15	0.05
2013	**32**	1.26	0.05
2014	ID	ID	ID
2015	ID	0.74	0.04
2016	15	0.93	0.03
2017	ID	ID	ID
2018	**29**	0.84	0.05
2019	**36**	0.92	**0.06**
2020	**31**	0.77	**0.06**
2021	**29**	0.97	0.05
2022	**37**	1.02	**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 Kasey Lake, Kelly Lake and Lake Lotta 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 impairments, 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 geometric mean chlorophyll *a* of 20 µg/L in both low color, high-alkalinity lakes and high color 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), and low color (<40 PCU), high alkalinity lakes (≥ 20 mg CaCO3/L) are considered mesotrophic.

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 (e.g., a significant increasing trend in color and/or alkalinity). Long-term datasets of color, alkalinity, and nutrients in this TMDL 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 and high color lakes is appropriate for the lakes in question, will serve as the TMDL water quality 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 or TP), using the AGM values from Kasey Lake, Kelly Lake, and Lake Lotta were applied in the TMDL development approach, explained in detail in **Chapter 5.**

For Kasey Lake (WBID 3002Q) and Kelly Lake (WBID 3002R), TN and TP targets derived from the simple linear regression equations using the combined multi-lake AGM values from these two lakes (nutrient impaired) and Kristy Lake (WBID 3002S, not impaired). These three lakes (so-called Kasey-Kelly-Kristy Lake group) are all low-color, high alkalinity lakes, hydrologically interconnected, and located in the same lake region (Apopka Upland). The nutrient targets were determined the TN and TP concentrations, respectively needed to achieve the chlorophyll *a* restoration target of 20 µg/L. The TN and TP target values were then applied in the multiple linear regression equation for the Kasey-Kelly-Kristy Lake group, to confirm the nutrient interactions effect on chlorophyll.

In the case of Lake Lotta, only the total phosphorus (TP) target was determined using simple linear regression. This method calculated the TP concentrations required to reach the chlorophyll *a* restoration goal of 20 µg/L. Total nitrogen (TN) was not considered because its levels were already within the Numeric Nutrient Criteria (NNC) for the lake. 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.

The site-specific numeric interpretations of the narrative nutrient criterion for TN in both Kasey Lake and Kelly Lake are 0.91 mg/L, and Lake Lotta is 1.27 mg/L, (**Table 3.1**), expressed as an AGM lake concentration not to be exceeded in any year. The site-specific numeric interpretations of the narrative nutrient criterion for TP in both Kasey Lake and Kelly Lake are

0.05 mg/L, and Lake Lotta is 0.03 mg/L (**Table 3.1**), expressed as an AGM lake concentration not to be exceeded in any year.

Tables 3.1 summarize the TMDL target values, and more information on the mathematical relationships and percent reductions is shown in **Chapter 5.**

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
Kasey Lake/ 3002Q	20	Once in a three-year period	0.91	No exceedance	0.05	No exceedance
Kelly Lake/ 3002R	20	Once in a three-year period	0.91	No exceedance	0.05	No exceedance
Lake Lotta/ 3002G	20	Once in a three-year period	1.27	No exceedance	0.03	No exceedance

3.4 Downstream Protection

Kasey Lake is connected to Kristy Lake and then to Kelly Lake which flows to Lake Orlando through a pipe (**Figure 1.4**). Lake Orlando is an impaired high color lake, and the proposed TN TMDL of 0.91 mg/L is less than the applicable minimum TN NNC of 1.27 mg/L for high color lakes. The proposed TP TMDL of 0.05 mg/L for Kasey Lake and Kelly Lake is equal to the minimum TP NNC for the high color lakes. Therefore, the proposed target concentrations of TN and TP for Kasey Lake and Kelly Lake associated with the lake restoration should improve the water quality in Lake Orlando.

Lake Lotta, a high-color lake, is upstream of Lake Rose, a low-color, high-alkalinity lake that is impaired for chlorophyll a. However, two pieces of evidence suggest that Lake Lotta has minimal impact on Lake Rose.

First, the lakes are indirectly connected through dry ponds and wetlands. According to the hydrologic and nutrient budget and water quality management plan for Lake Rose (ERD 2020), Lake Rose receives no significant hydrologic or nutrient input from Lake Lotta, indicating hydrologic isolation between the lakes.

Second, the department conducted simple regression analyses of the relationships between the TN and TP AGMs in Lake Lotta and Lake Rose (**Figures 3.1** and **3.2**). The low R^2 values and statistically insignificant P-values of these analyses suggest that Lake Lotta's flow has little to no influence on the water quality of Lake Rose, further supporting the idea of hydrologic isolation.

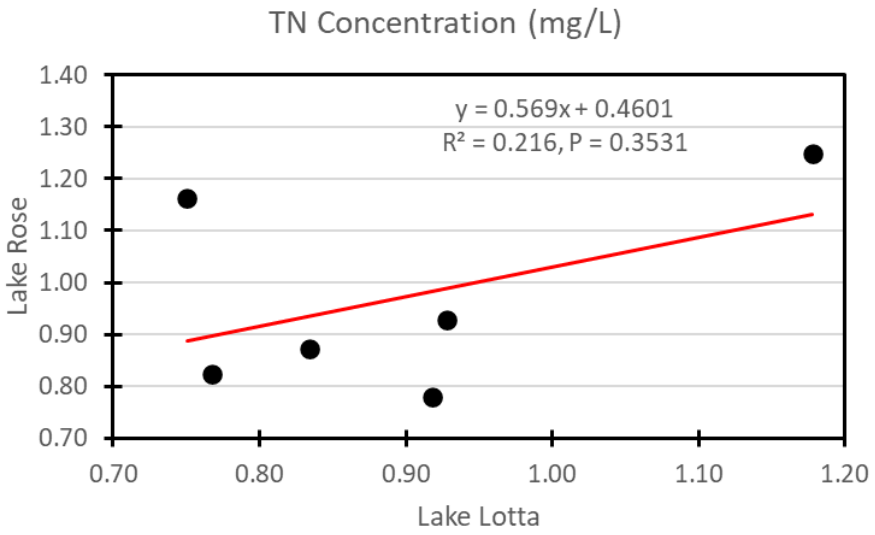


Figure 3.1. Relationship of AGMs (2010 - 2022) for TN concentration between Lake Lotta and Lake Rose

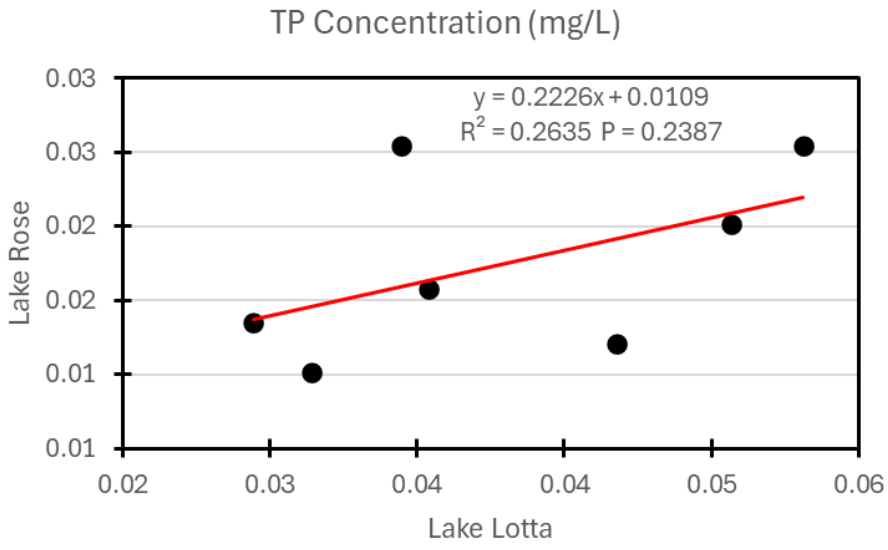


Figure 3.2. Relationship of AGMs (2010 - 2022) for TP concentration between Lake Lotta and Lake Rose

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. There are no aquatic endangered species within the TMDL watersheds, indicating no adverse effects because of the TMDLs.

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 (see **Section 6.1** on **Expression and Allocation of the TMDL**). However, the methodologies used to estimate nonpoint source loads do not distinguish between NPDES and non-NPDES stormwater discharges, and as such, this source assessment section does not make any distinction between the two types of stormwater.

4.2 Point Sources

4.2.1 Wastewater Point Sources

There are no NPDES-permitted wastewater facilities that discharge to Kasey Lake, Kelly Lake or Lake Lotta, or that discharge to surface waters in the three watersheds.

4.2.2 Municipal Separate Storm Sewer System (MS4) Permittees

The Kasey Lake Watershed is covered by the City of Orlando's NPDES MS4 Phase I permit (FLS000014). The Kelly Lake Watersheds is covered by City of Orlando's NPDES MS4 Phase I permit and Orange County's NPDES MS4 Phase I permit (FLS000011). The Lake Lotta Watershed is also covered by the Florida Department of Transportation (DOT) District 5 Phase I co-permit (FLS000011) and the City of Ocoee's Phase I co-permit (FLS000011) on Orange County's permit. For more information on MS4 facilities in both watersheds, send an email to: npdes-stormwater@dep.state.fl.us. **Table 4.1** lists the MS4 permittees/co-permittees and their MS4 permit numbers.

Table 4.1. NPDES MS4 permits with jurisdiction in the Kasey Lake, Kelly Lake, and Lake Lotta Watersheds.

Permit Number	Permittee/ Co-permittee	Phase	Lake
FLS000014	City of Orlando	I	Kasey and Kelly
FLS000011	Orange County	I	Kelly and Lotta
FLS000011	City of Ocoee	I	Lotta
FLS000011	DOT	I	Lotta

4.3 Nonpoint Sources

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

4.3.1 Land Use

Land use is one of the most important factors in determining nutrient loadings from a watershed. Nutrients can be flushed into a receiving water through surface runoff and stormwater conveyance systems during stormwater events. Both human land use areas and natural land areas generate nutrients. However, human land uses typically generate more nutrient loads per unit of land surface area than natural lands produce. **Tables 4.2**, and **4.3** list 2016 land use for the Kasey-Kelly-Kristy Lake group and Lake Lotta Watersheds based on data from the St. Johns River Water Management District (SJRWMD). **Figures 4.1, and 4.2,** show the land use information graphically for each watershed.

The Kasey-Kelly-Kristy Lake group Watershed is predominated by residential land uses including low, medium, and high density residentials, occupying 95 %, 86 %, and 95 % in Kasey Lake, Kelly Lake and Kristy Lake watersheds, respectively (**Table 4.2**). Natural land uses including water and wetland, occupy only 5 % in each individual watershed.

The Lake Lotta Watershed covers an area of 908.3 acres. Commercial represents 18 % of the watershed, medium-density residential 17 %, and communication and transportation 13 %. Natural land uses including water, wetland, and forest/rural open occupy 27 % of the watershed (**Table 4.3**).

Table 4.2. SJRWMD land use in the Kasey-Kelly-Kristy Lake group Watershed, 2016.

Land Use Classification	Kasey Lake Acres	Kasey Lake Percent	Kelly Lake Acres	Kelly Lake Percent	Kristy Lake Acres	Kristy Lake Percent
Low-Density Residential	24.3	32	-	-	-	-
Medium-Density Residential	22.3	30	23.4	37	62.8	94
High-Density Residential	24.3	33	31.5	49	0.7	1
Commercial	-	-	4.9	8	-	-
Institutional	-	-	0.8	1	-	-
Water	3.6	5	3.3	5	2.9	4
Wetlands	-	-	-	-	0.8	1
Total	**74.5**	**100**	**63.9**	**100**	**67.2**	**100**

Table 4.3. SJRWMD land use in the Lake Lotta Watershed, 2016.

Land Use Classification	Acres	% of Watershed
Low-Density Residential	17.5	2
Medium-Density Residential	152.5	17
High-Density Residential	81.3	9
Commercial	162.0	18
Institutional	70.9	8
Recreational	8.1	1
Open Land	18.0	2
Agriculture	20.9	2
Rangeland	7.4	1
Forest/Rural Open	87.2	10
Water	45.5	5
Wetlands	112.3	12
Rangeland	3.8	0
Communication and Transportation	120.9	13
	908.3	**100**

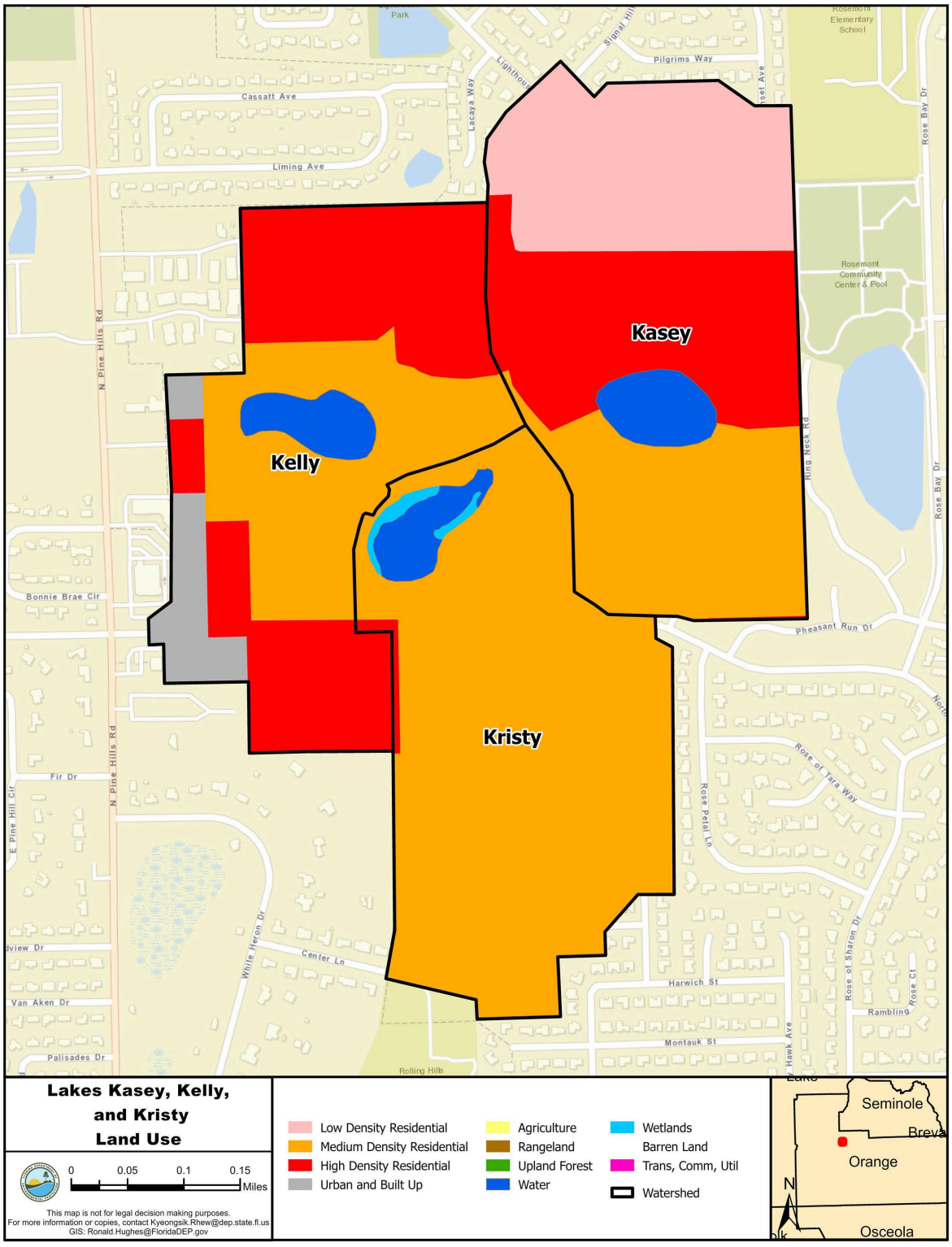


Figure 4.1. Land use in the Kasey-Kelly-Kristy Lake group Watersheds, 2016.

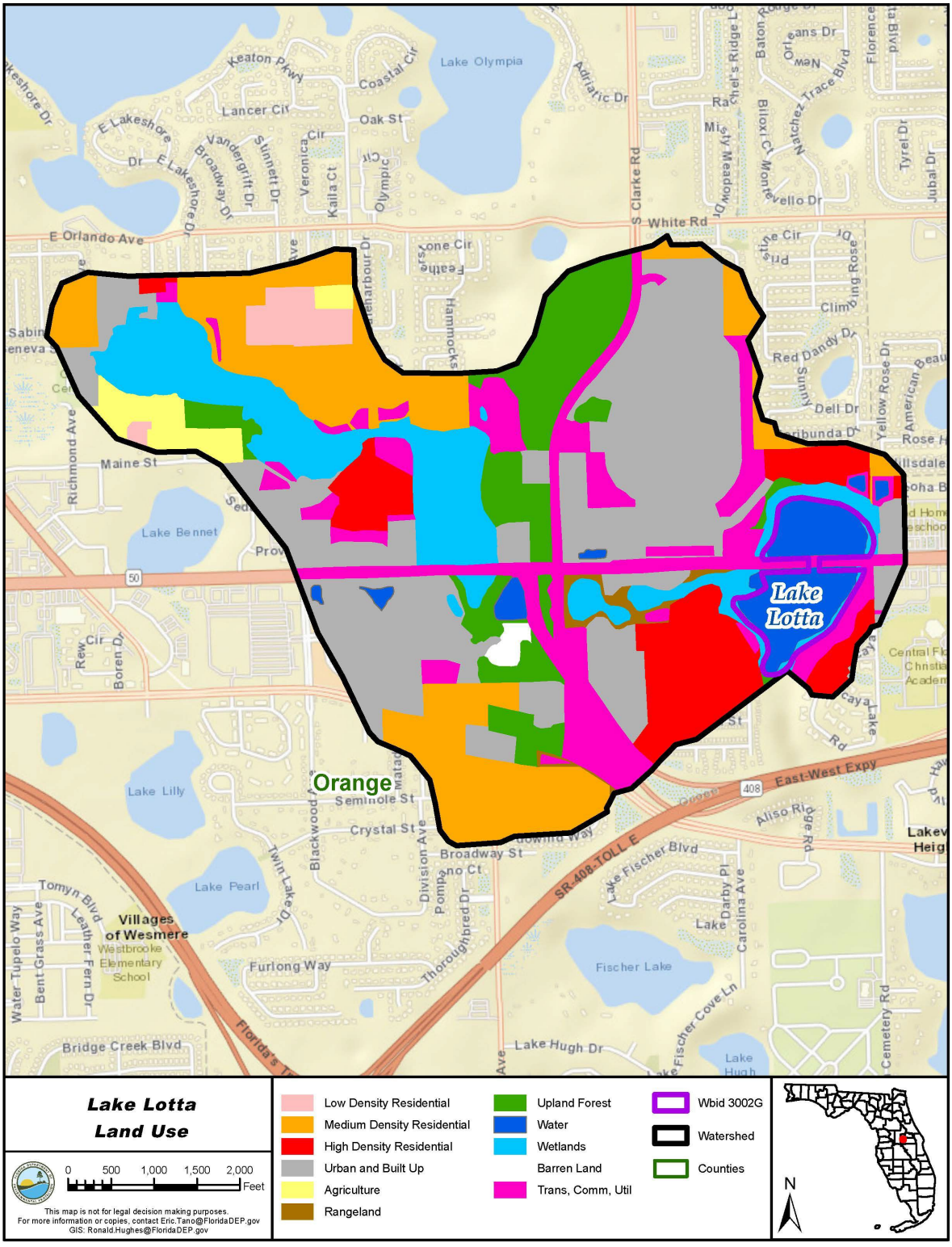


Figure 4.2. Land use in the Lake Lotta Watershed, 2016.

4.3.2 Onsite Sewage Treatment and Disposal Systems (OSTDS)

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

The Florida Department of Health (DOH) maintains a list of septic systems by county, and the DOH Florida Water Management Inventory dataset was used to determine the number of septic systems in the watersheds. **Figures 4.3** and **4.4** show the locations of OSTDS in the watershed in 2024 based on centroids of parcels with known, likely, or somewhat likely septic systems. Currently, there are no septic systems in the Kasey Lake and Kristy Lake Watersheds, six septic systems in the Kelly Lake Watershed, and 583 septic systems in the Lake Lotta Watershed.

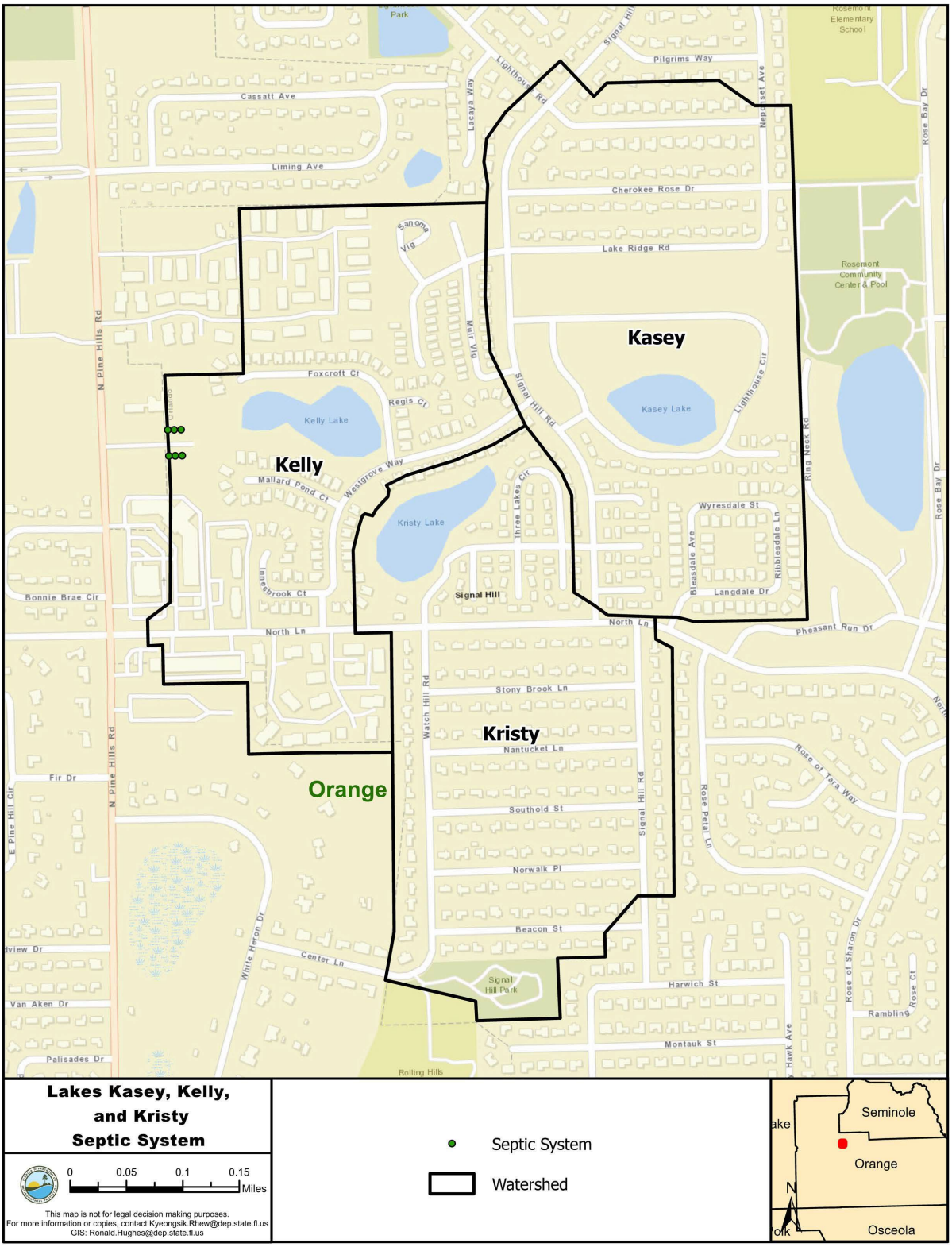


Figure 4.3. OSTDS in the Kasey Lake (WBID 3002Q), Kelly Lake (WBID 3002R), and Kristy Lake (WBID 3002S) Watersheds.

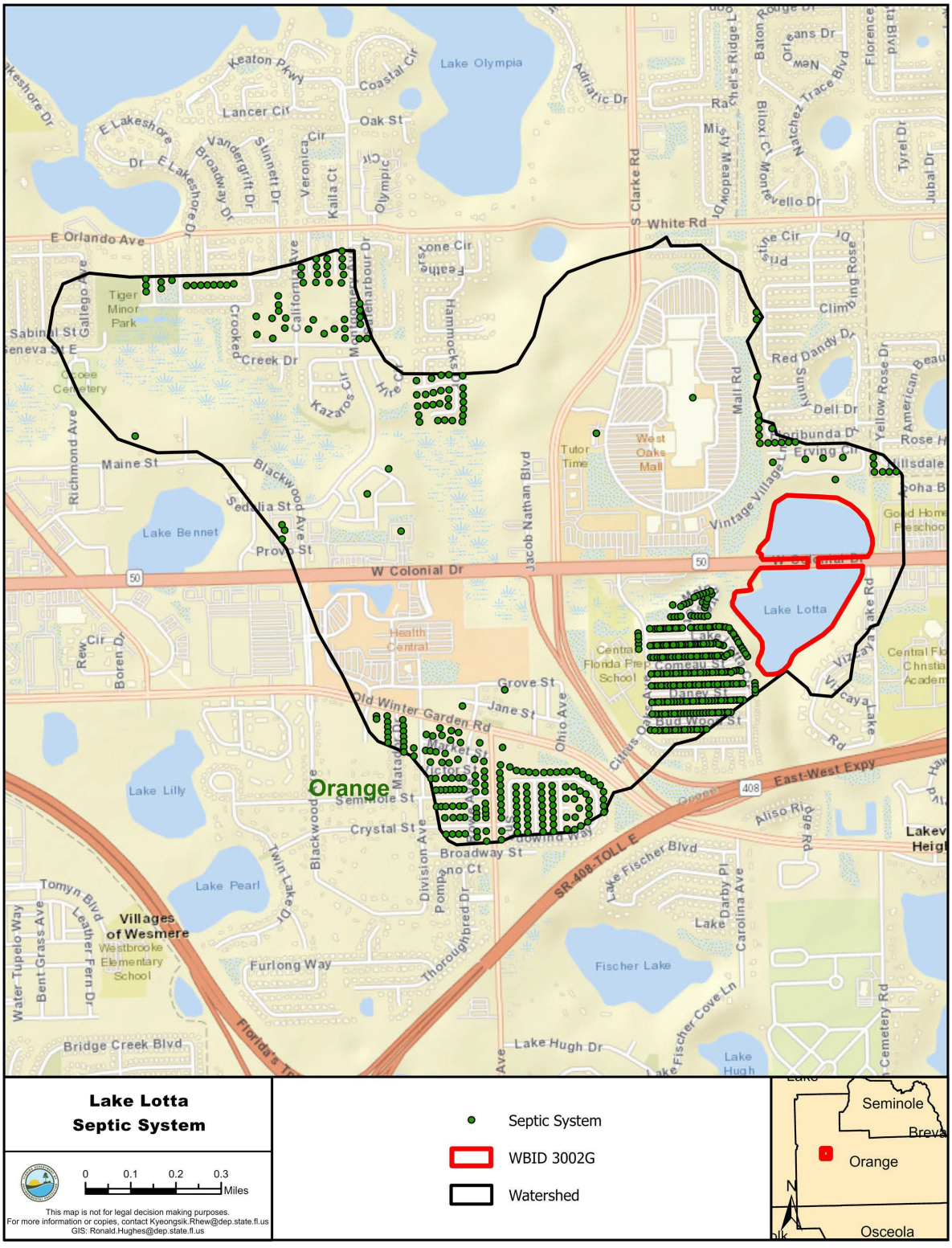


Figure 4.4. OSTDS in the Lake Lotta (WBID 3002G) Watershed.

Chapter 5: Determination of Assimilative Capacity

5.1 Determination of Loading Capacity

Nutrient enrichment and the resulting problems related to eutrophication tend to be widespread and are frequently manifested far (in both time and space) from their sources. Addressing eutrophication involves relating water quality and biological effects such as photosynthesis, decomposition, and nutrient recycling as acted on by environmental factors (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 Kasey Lake and Kelly Lake and to identify the maximum allowable lake TN and TP concentrations and the associated nutrient source reductions, 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 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 - 2.5** in **Chapter 2** may not exactly match the AGMs used for TMDL development.

5.2.2 Relationships Between Water Quality Variables

Water quality monitoring for nutrients in the lakes was conducted primarily by City of Orlando, Orange County and DEP. **Figure 5.1** shows the chlorophyll *a* AGM values from 1992 to 2022 for the Kasey-Kelly-Kristy Lake group. During the sampling period, Kasey Lake had the highest chlorophyll *a* results in the three lakes, ranging from 19 µg/L to 58 µg/L. Chlorophyll *a* AGMs exceeded NNC during all years except for 2002 and 2005. For Kelly Lake, Chlorophyll *a* ranged from 2 to 33 µg/L and started to exceed NNC from 2015. Kristy Lake had the lowest chlorophyll *a* results, ranging between 3 and 21 µg/L and exceeded NNC only in 2009. Chlorophyll *a* AGMs in these lakes showed increasing trends, with the strongest trends in Kasey Lake and Kelly Lake.

Figure 5.2 shows the TN AGM values from 1992 to 2022 for the Kasey-Kelly-Kristy Lake group. Kasey Lake had the highest TN results in the three lakes during the sampling period, ranging from 0.78 to 1.47 mg/L. For Kelly Lake, TN ranged from 0.41 to 1.10 mg/L, for Kristy Lake, from 0.51 to 1.09 mg/L. In general, the three lakes exhibited decreases in TN AGMs in recent years.

Figure 5.3 shows the TP AGM values from 1992 to 2022 for the Kasey-Kelly-Kristy Lake group., Kasey Lake had the highest TP results most of time in the three lakes during the sampling period, ranging from 0.05 to 0.09 mg/L. For Kelly Lake, TP ranged from 0.03 to 0.07 mg/L, for Kristy Lake, from 0.02 to 0.05 mg/L. Kasey Lake and Kelly Lake exhibited increasing trends in TP AGMs over the sampling period but Kristy Lake did not display a trend.

Figure 5.4 shows the chlorophyll *a* AGM values from 2005 to 2022 for Lake Lotta. During the sampling period, Lake Lotta chlorophyll *a* ranged from 17 µg/L to 36 µg/L. In all sampled year with sufficient data, chlorophyll *a* AGMs exceeded NNC (20 µg/L) for high color lakes, except for 2002 and 2005. The lake exhibited increasing trends in chlorophyll *a* AGMs over the sampling period, but statistically not significant.

Figure 5.5 shows the TN AGM values from 2005 to 2022 for Lake Lotta. Lake Lotta TN ranged from 0.75 mg/L to 1.17 mg/L.

Figure 5.6 shows the TP AGM values from 2005 to 2022 for Lake Lotta. Lake Lotta TP ranged from 0.03 mg/L to 0.06 mg/L. The lake exhibited increases in TP AGMS in recent years (2018-2022)

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 water quality sampling started from the 1992 to the present for the Kasey-Kelly-Kristy Lake group and this period includes years with both above- and below-average precipitation. Long-term average

rainfall (48.97 inches) was calculated from the Orange County (Orlando Internation Airport) data from 1953 to 2023.

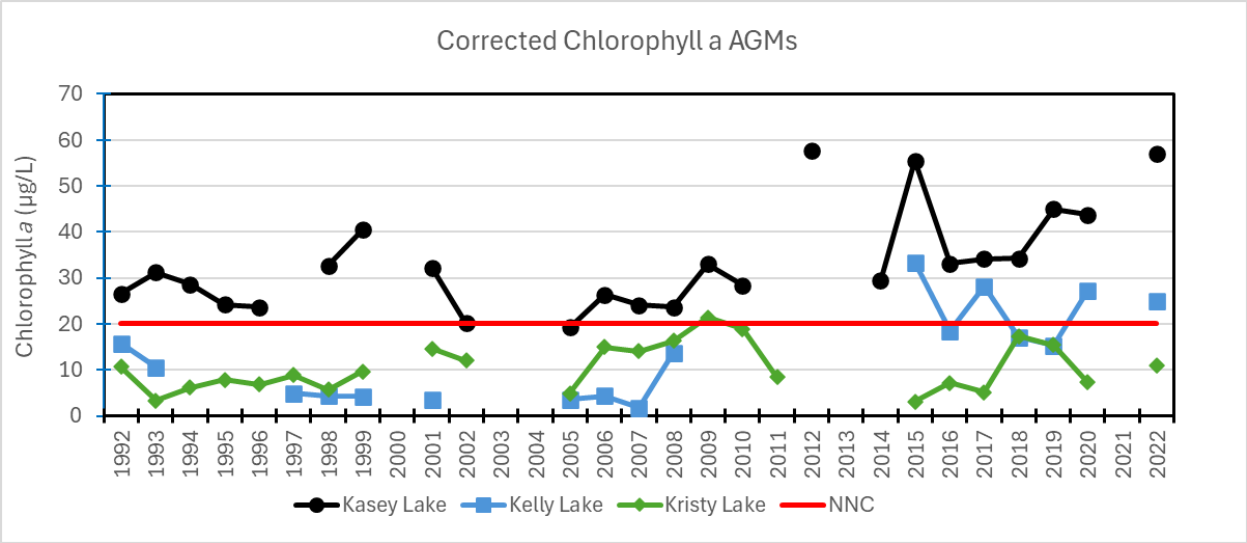


Figure 5.1. Chlorophyll *a* AGMs in the Kasey-Kelly-Kristy Lake group for the period, 1992–2022.

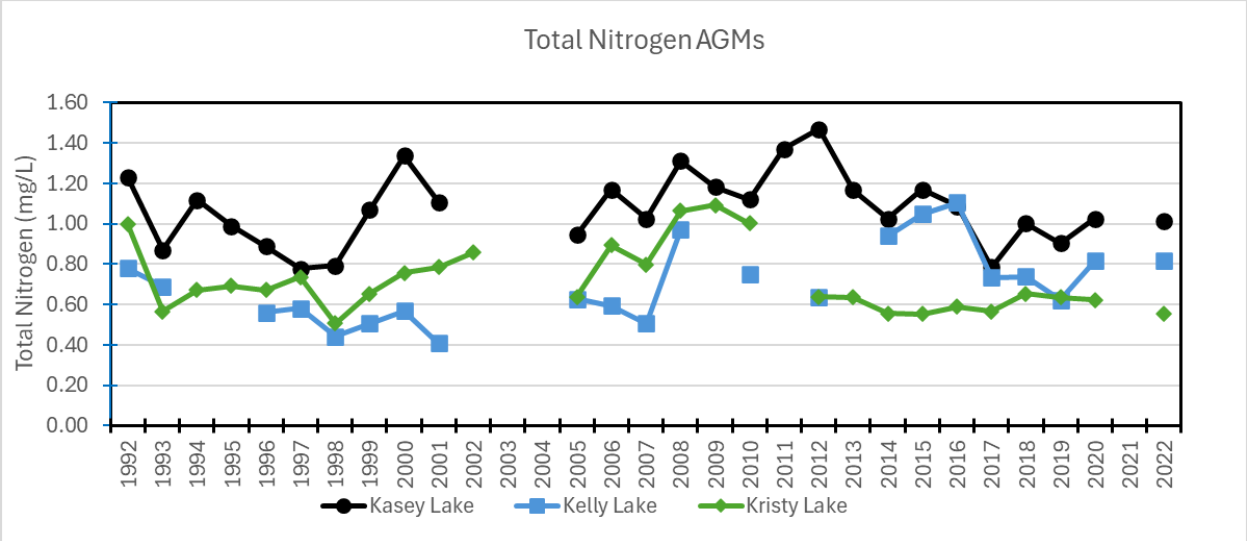


Figure 5.2. Total Nitrogen AGMs in the Kasey-Kelly-Kristy Lake group for the period, 1992–2022.

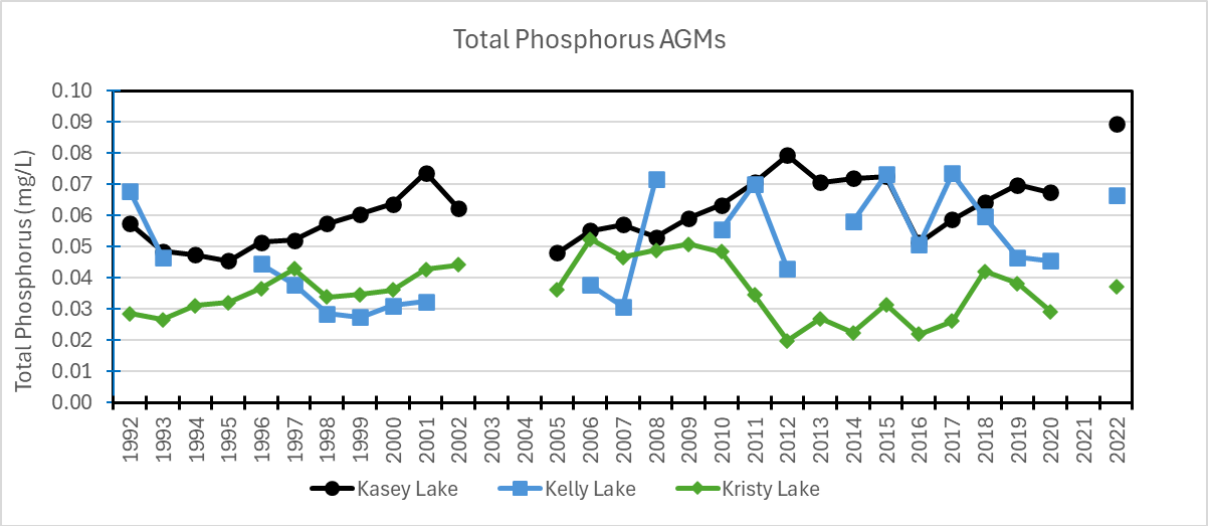


Figure 5.3. Total Phosphorus AGMs in the Kasey-Kelly-Kristy Lake group for the period, 1992–2022.

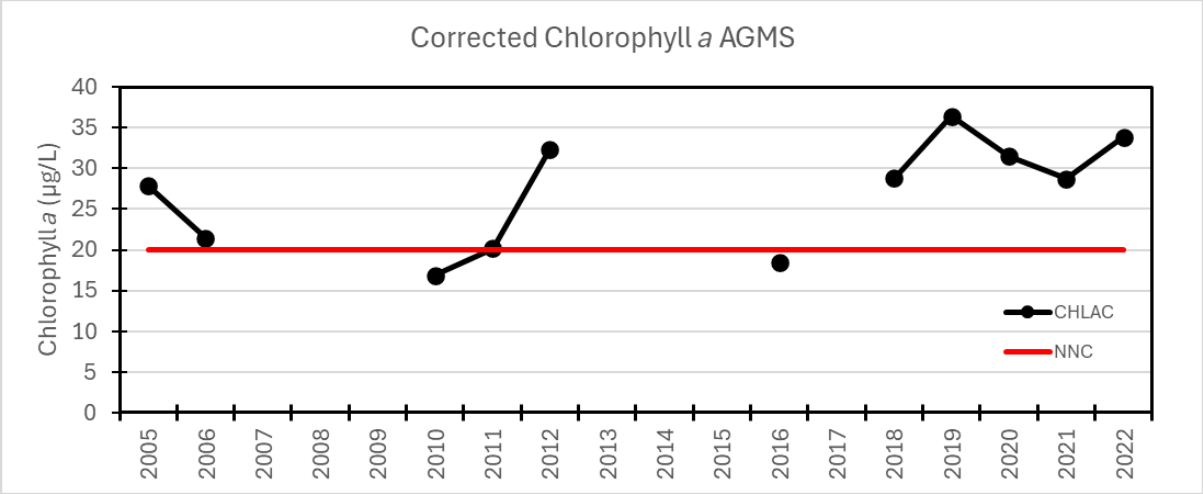


Figure 5.4. Chlorophyll *a* AGMs in Lake Lotta for the period, 2005–2022.

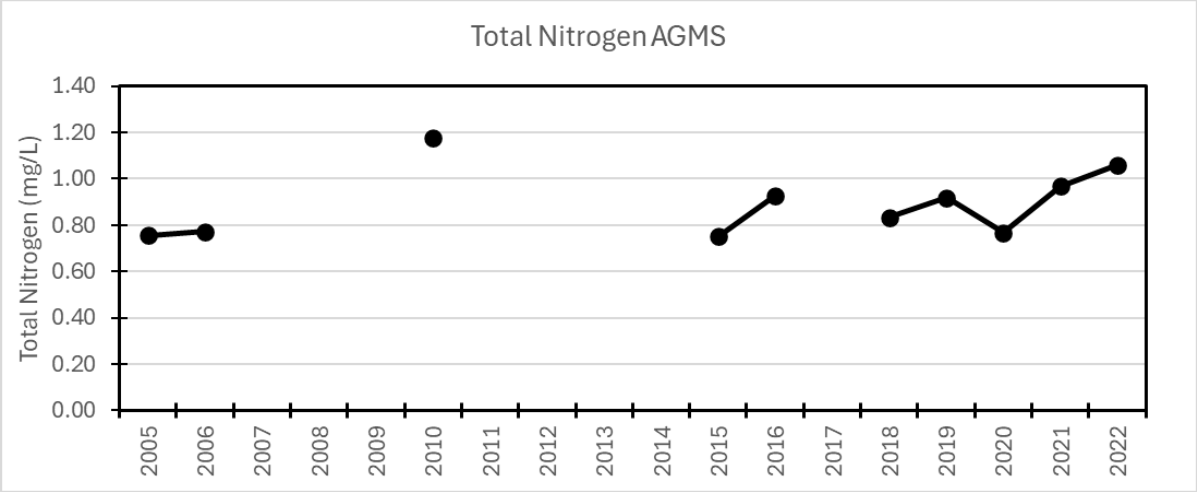


Figure 5.5. Total Nitrogen AGMs in Lake Lotta for the period, 2005–2022.

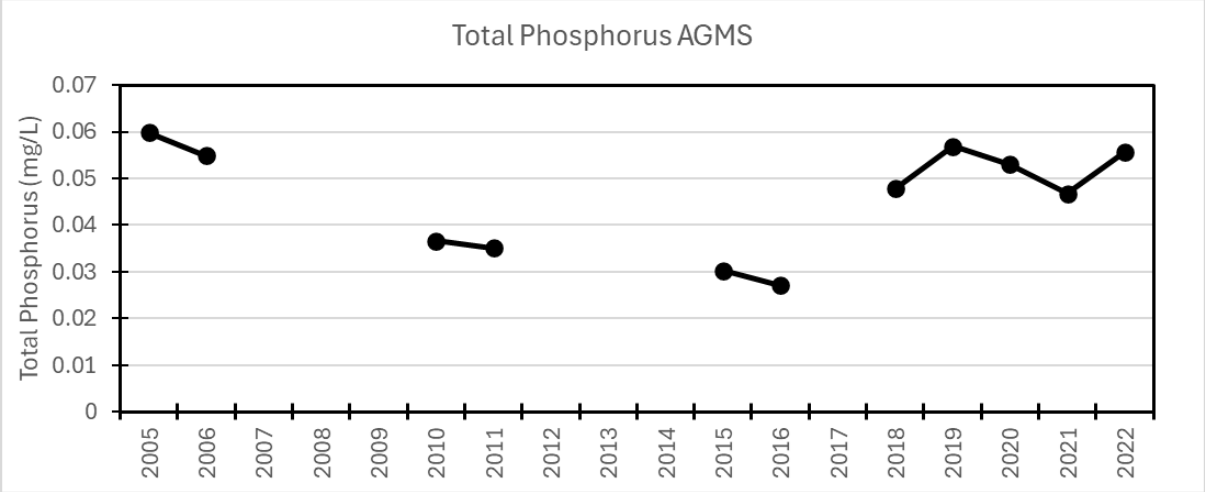


Figure 5.6. Total Phosphorus AGMs in Lake Lotta for the period, 2005–2022.

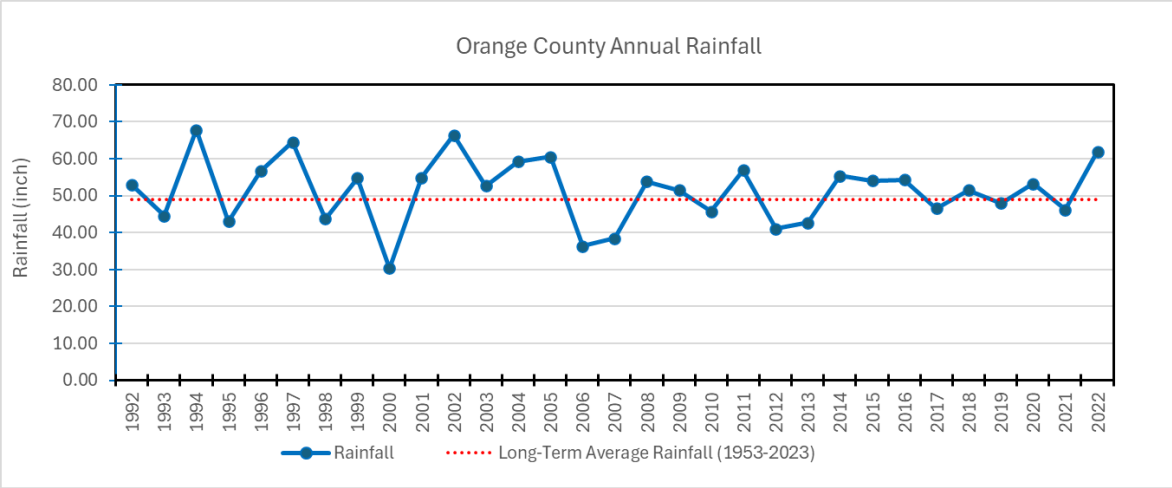


Figure 5.7. Annual rainfall in Orange County (Orlando International Airport), 1992–2022.

Relationships between nutrients and chlorophyll *a*, were evaluated by grouping the AGM values for the three lakes located in the contributing area of Lake Kelly. These lakes are characterized as the same lake type (low-color, high alkalinity lakes) and hydrologic connection. 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 three lakes, indicate a strong positive response of chlorophyll *a* to nutrient concentrations. The relationships are based on data in the 1992–2022 period. During this time frame there were the most complete long-term sets of AGM values for evaluating surface water quality for the Kasey-Kelly-Kristy Lake group. The AGMs are natural log ln transformed in the figures as the chlorophyll *a*, TN, and TP values are not normally distributed. The simple linear regression results indicate that 68 percent of the variation in chlorophyll a is explained by TN concentrations and 72 percent of chlorophyll a variation is explained by TP concentrations.

The relationship between chlorophyll *a* and TP AGMs (**Figure 5.10**) for Lake Lotta indicates a significant positive response of chlorophyll *a* to TP concentrations. The relationships are based on data in the 2005–2022 period. For Lake Lotta, 60 percent of the variation in chlorophyll *a* is explained by TP concentrations.

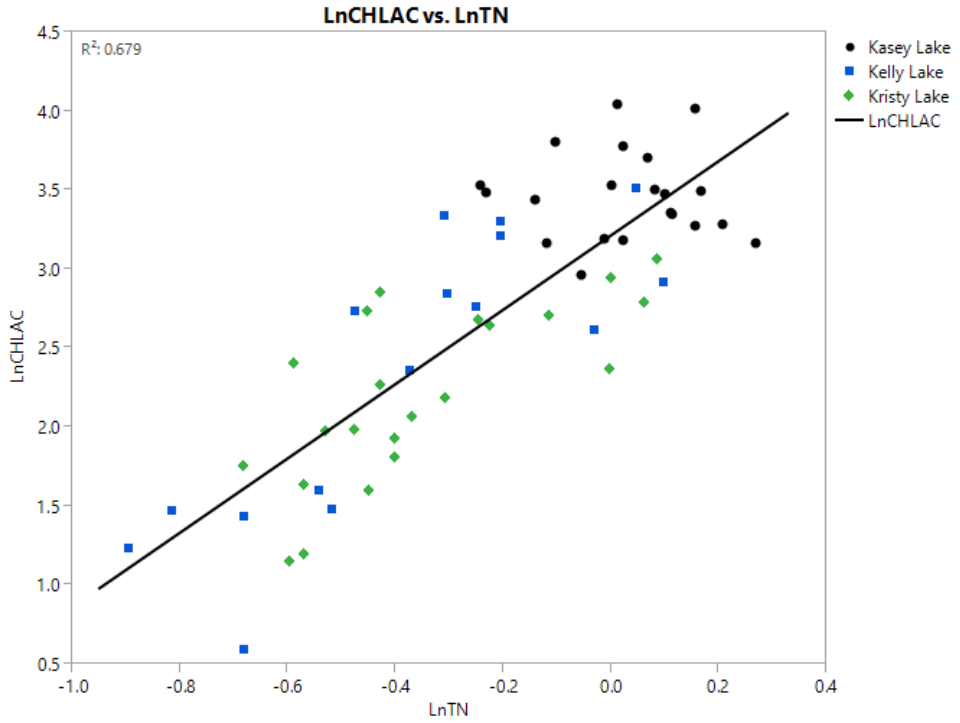


Figure 5.8. Relationship between chlorophyll *a* and TN, along with a regression line, for the lakes in the Kasey-Kelly-Kristy Lake group using AGMs from 1992-2022.

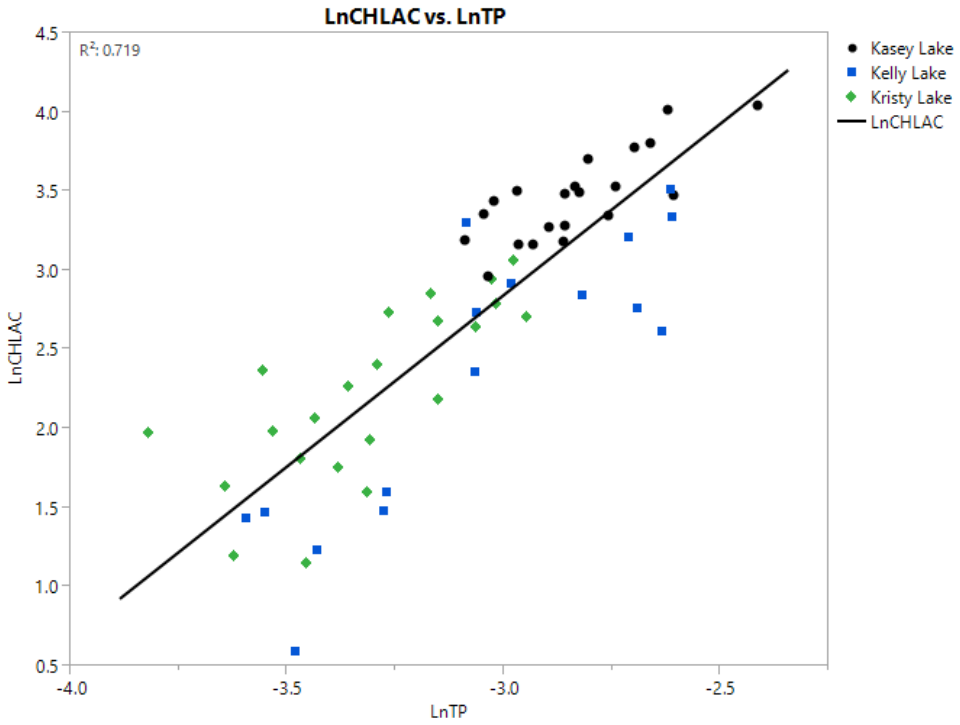


Figure 5.9. Relationship between chlorophyll *a* and TP, along with a regression line, for the lakes in the Kasey-Kelly-Kristy Lake group using AGMs from 1992-2022.

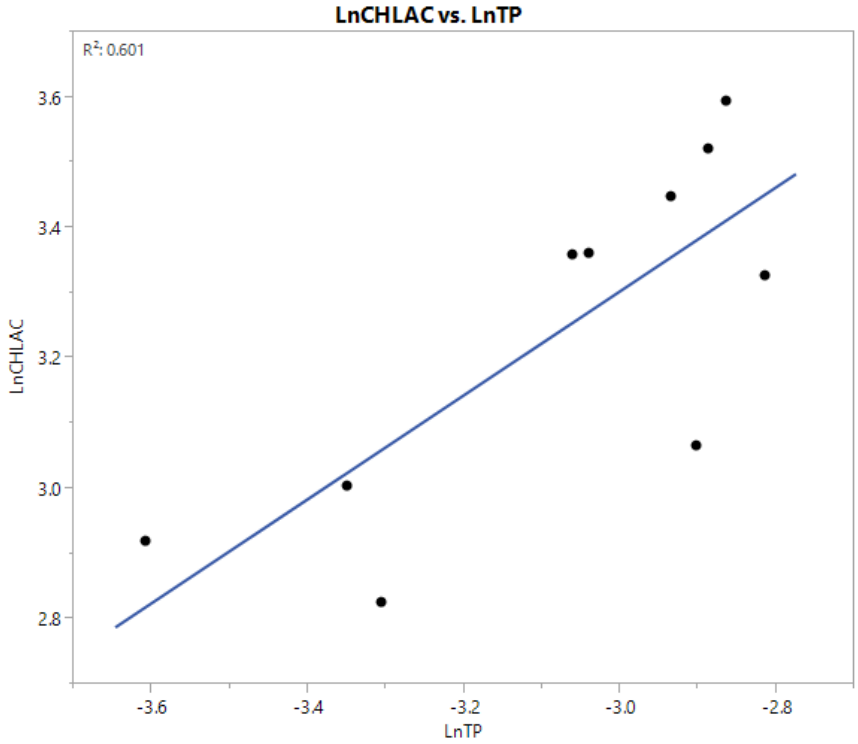


Figure 5.10. Relationship between chlorophyll *a* and TP, along with a regression line, for Lake Lotta using AGMs from 2005-2022.

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 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 target is expressed as an AGM.

5.4 Water Quality Analysis to Determine Assimilative Capacity

For the Kasey-Kelly-Kristy Lake group, the strong positive 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 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 1992-2022, which represents the most complete set of AGM values for the three lakes in the lake group. The 1992–2022 period,

included years with both above- and below-average precipitation. Rainfall measured at the Orlando International Airport indicate that 12 years had below-average precipitation, while 19 years had above-average precipitation during the period (**Figure 5.7**).

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 81% of the variation in chlorophyll *a* is attributed to TN and TP concentrations (r square = 0.81, *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**.

For Lake Lotta, the significant positive relationships (p values < 0.0084) of chlorophyll *a* to in-lake TP concentration as shown in **Figure 5.10**, but no significant relationship between chlorophyll *a* and in-lake TN concentration. **Appendix E** 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 2005-2022. This period included years with both above- and below-average precipitation. Rainfall measured at the Orlando International Airport indicate that 2006, 2007, 2012 and 2013 were years with below-average precipitation, while 2005, 2008, 2011, 2014-16, and 2022 were years with above-average precipitation (**Figure 5.7**).

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, to set the water quality targets for the Kasey-Kelly-Kristy Lake group, empirical relationships between chlorophyll *a* and TN and TP concentrations were developed using data from the three lakes characterized as low-color (≤ 40 PCU), high-alkalinity (> 20 mg/L $CaCO_3$). The regression equations representing the relationships between corrected chlorophyll *a* AGMs and TN and TP AGMs are as follows:

Ln (Chlorophyll *a* AGM) = 3.21911 + 2.35161* Ln (TN AGM)

Ln (Chlorophyll *a* AGM) = 9.34702 + 2.16530* Ln (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 Kasey-Kelly-Kristy Lake group and will serve as the water quality restoration target. The available information suggests that designated use attainment for the three lakes would be protected at the chlorophyll *a* criterion.

The TN and TP limits necessary to achieve the chlorophyll *a* restoration target were derived using the Kasey-Kelly-Kristy Lake group 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 a 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 0.91 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 corrected chlorophyll a concentrations

Ln (Chlorophyll *a* AGM) = 7.12136 + 1.25988 * Ln (TN AGM) + 1.34928 * Ln (TP AGM)

Applying the nutrient concentrations, derived using the simple linear regression models, in the MLR equation results in a chlorophyll *a* AGM of 19 µg/L, which confirms the restoration target is attainable accounting for the interaction of in-lake TN and TP conditions.

For Lake Lotta, based on an assessment of the lake results listed in **Table 2.5**, the TN AGMs did not exceed the applicable target of 1.27 mg/L in any year. The available data indicate that the lake TN results are meeting the applicable target which suggests that the existing lake nitrogen concentrations and loads to the lakes are not having a detrimental effect on surface water quality. The TN water quality target is the same as the lower end of the range of NNC values, which is 1.27 mg/L for high color lakes.

To set the TP water quality target, empirical relationships between chlorophyll *a* and TP concentrations were developed using data from Lake Lotta. The regression equations representing the relationships between corrected chlorophyll *a* AGMs and TP AGMs are as follows:

Ln(Chlorophyll *a* AGM) = 5.69609 + 0.79726* Ln (TP AGM)

Application of the equations indicate the TP AGM concentration necessary to meet the chlorophyll *a* criterion of 20 µg/L is 0.03 mg/L.

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:

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

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

Table 5.1 lists the percent reductions in the maximum AGMs needed to achieve the TN AGM target of 0.91 mg/L and the TP AGM target of 0.05 mg/L for Kasey Lake and Kelly Lake, and the TN AGM target of 1.27 mg/L and TP AGM target of 0.03 mg/L for Lake Lotta. The TN percent reductions are 22 % in Kasey Lake, 17 % in Kelly Lake, and 0 % in Lake Lotta. The TP percent reductions are 44 % in Kasey Lake, 17 % in Kelly Lake, and 50% in Lake Lotta. 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 in Kasey Lake, Kelly Lake, and Lake Lotta.

ID = Insufficient Data

Year	Kasey Lake TN AGMs (mg/L)	Kasey Lake TP AGMs (mg/L)	Kelly Lake TN AGMs (mg/L)	Kelly Lake TP AGMs (mg/L)	Lake Lotta TN AGMs (mg/L)	Lake Lotta TP AGMs (mg/L)
2013	1.17	0.07	ID	ID	ID	ID
2014	1.02	0.07	0.94	0.06	ID	ID
2015	1.17	0.07	1.05	0.07	0.75	0.03
2016	1.09	0.05	1.10	0.05	0.93	0.03
2017	0.78	0.06	0.73	0.07	ID	ID
2018	1.00	0.06	0.74	0.06	0.83	0.05
2019	0.90	0.07	0.62	0.05	0.92	0.06
2020	1.02	0.07	0.81	0.05	0.77	0.05
2021	ID	ID	ID	ID	0.97	0.05
2022	1.01	0.09	0.81	0.07	1.06	0.06
Maximum	**1.17**	**0.09**	**1.10**	**0.07**	**1.18**	**0.06**
TMDL Target	**0.91**	**0.05**	**0.91**	**0.05**	**1.27**	**0.03**
% Reduction to Meet Target	**22**	**44**	**17**	**29**	**0**	**50**

Chapter 6: Determination of Loading Allocations

6.1 Expression and Allocation of the TMDLs

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

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

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

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

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

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

This approach is consistent with federal regulations (40 Code of Federal Regulations [CFR] § 130.2(I)), which state that TMDLs can be expressed in terms of mass per time (e.g., pounds per day), toxicity, or other appropriate measure. The TMDLs for Kasey Lake, Kelly Lake and Lake Lotta are expressed in terms of in-lake nutrient concentration targets and the percent reductions in existing 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**). The restoration goal is to achieve the generally applicable chlorophyll *a*

criterion of 20 µg/L, which is expressed as an AGM not to be exceeded more than once in any consecutive 3-year period. This threshold protects each lake's designated use.

Table 6.1 lists the TMDLs for Kasey Lake, Kelly Lake, and Lake Lotta. These 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 waters.

Table 6.1. TMDL components for nutrients in Kasey Lake (3002Q), Kelly Lake (3002R), and Lake Lotta (3002G).

Note: Margin of safety is implicit.
The TMDL represents the AGM lake concentration (mg/L) not to be exceeded.
NA = Not applicable.
The required percent reductions listed in this table represent the reductions of in-lake concentrations and do not directly reflect reductions in source loading.

Waterbody Name/WBID	Parameter	TMDL (mg/L)	WLA Wastewater (% reduction)	WLA NPDES Stormwater (% reduction)	LA (% reduction)
Kasey Lake/ 3002Q	TN	0.91	NA	22	22
Kasey Lake/ 3002Q	TP	0.05	NA	44	44
Kelly Lake/ 3002R	TN	0.91	NA	17	17
Kelly Lake/ 3002R	TP	0.05	NA	29	29
Lake Lotta/ 3002G	TN	1.27	NA	0	0
Lake Lotta/ 3002G	TP	0.03	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 facilities in the Kasey Lake, Kelly Lake, or Lake Lotta Watersheds discharge either into the waterbodies or their watersheds. Therefore, a WLA for wastewater discharges is not applicable.

6.3.2 NPDES Stormwater Discharges

Orange County, the City of Orlando, and the City of Ocoee have a Phase I NPDES MS4 permit (FLS000011 and FLS000014). Areas within this jurisdiction in the Kasey Lake Watershed are responsible for a 22 % reduction in TN and a 44 % reduction in TP from the current anthropogenic loading. Areas in the Kelly Lake Watershed are responsible for a 17 % reduction in TN and a 29 % reduction in TP from the current anthropogenic loading. Areas in the Lake Lotta Watershed are responsible for a 0 % reduction in TN and a 50 % reduction in TP from the current anthropogenic loading.

Any MS4 permittee is only responsible for reducing the anthropogenic loads associated with stormwater outfalls that it owns or otherwise has responsible control over, and it is not responsible for reducing other nonpoint source loads in its jurisdiction.

6.4 Margin of Safety

The MOS can either be implicitly accounted for by choosing conservative assumptions about loading or water quality response, or explicitly accounted for during the allocation of loadings. 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: 1) The reductions were calculated from the highest measured AGM TN and TP values to calculate the percent reductions. 2) Require that the TMDL nutrient targets are not to be exceeded in any one year and, 3) Applying the TMDL nutrient concentrations in the MLR model equation, to account for the effects of nutrient interactions on chlorophyll *a* concentrations, results in a chlorophyll *a* AGM of 19 µg/L, which is less than the restoration target of 20 µg/L for Kasey Lake and Kelly Lake.

Chapter 7: Implementation Plan Development and Beyond

7.1 Implementation Mechanisms

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

Facilities with NPDES permits that discharge to the TMDL waterbody must implement the permit conditions that reflect target concentrations, reductions or wasteload allocations identified in the TMDL. NPDES permits are required for Phase I and Phase II MS4s and 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 TMDL are already defined in a BMAP. MS4 Phase II permit holders must also implement the responsibilities defined in a BMAP or other form of restoration plan (e.g., a reasonable assurance plan).

7.2 BMAPs

Information on the development and implementation of BMAPs can be found in Section 403.067, F.S. (the FWRA). DEP or a local entity may initiate and develop a BMAP that addresses some or all 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 Kasey Lake, Kelly, and Lake Lotta Watersheds are in the Wekiwa Spring and Rock Springs BMAP area. The BMAP was adopted in June 2018 to implement protections for Outstanding Florida Springs as provided by the 2016 Florida Springs and Aquifer Protection Act. This BMAP will be implemented in addition to the Wekiva River, Rock Springs and Little Wekiva Canal surface water BMAP (adopted in 2015).

Management strategies in the Kasey Lake and Kelly Lake Watersheds will also address nutrient impairments for these lakes and will likely benefit the lakes at a different level than reported in the Wekiva River, Rock Springs Run and Little Wekiva Canal BMAP. Additional information about BMAPs is available on DEP's website.

7.3 Implementation Considerations for the Waterbodies

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

The goal of this TMDL is achieve the generally applicable NNC. Stakeholders should focus on nutrient concentration targets that help reduce nutrient and chlorophyll levels. Once the lake is consistently meeting the NNC over the assessment period, it can be assumed that the TMDL is being met.

References

Brooks, H.K. 1981. *Physiographic divisions.* Scale 1:500,000. Gainesville, FL: Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida.

———. 1982. *Guide to the physiographic divisions of Florida.* Gainesville, FL: Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida.

CDM. 2005. Little Wekiva River Watershed Management Plan Phase II Engineering Analysis. Prepared for the St. Johns River Water Management District in cooperation with Orange County, Seminole County, the City of Orlando and the City of Altamonte Springs.

City of Orlando Public Works Department, Streets and Stormwater Division, Stormwater Compliance Section. 2016. *Lake water quality report 2016*.

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

Environmental Research and Design. 2020. Lake Rose hydrologic/nutrient budget and water quality management plan. Prepared for Orange County.

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

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

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

U.S. Census Bureau. July 2019. *Annual estimates of the resident population: April 1, 2010, to July 1, 2019.* Washington, DC: Population Division. Accessed December 2020.

U.S. Geological Survey. 1996. *Hydrogeologic conditions and simulation of ground-water flow in the greater Orlando metropolitan area, east-central Florida*. Tallahassee, FL.

Appendices

Appendix A: Background Information on Federal and State Stormwater Programs

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

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

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

However, because the master drainage systems of most local governments in Florida are physically interconnected, the EPA implemented Phase I of the MS4 permitting program on a countywide basis, which brought in all cities (incorporated areas), Chapter 298 special districts; community development districts, water control districts, and FDPT 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	Kasey Lake, Kelly Lake, and Lake Lotta
Waterbody type(s)	Lake
WBID	3002Q, 3002R, and 3002G (see **Figure 1.2** of this report)
Description	Kasey Lake and Kelly Lake are in the City of Orlando in Orange County. Lake Lotta is situated in unincorporated Orange County, near the City of Ocoee. According to data available from the U.S. Census Bureau (2023), the population of Orange County is 1,471,416 and the City of Orlando has a population of 320,742. **Chapter 1** of this report provides more detail on the system.
Specific location (latitude/longitude or river miles)	The center of Kasey Lake - Latitude N: 28°35'56", Longitude W: -81°26'35", the center of Kelly Lake - Latitude N: 28°35'56", Longitude W: -81°26'54", and the center of Lake Lotta - Latitude N: 28°33'4", Longitude W: -81°30'41" The site-specific criteria apply as a spatial average for the lake, as defined by WBIDs 3002Q, 3002R and 3002G.
Map	**Figure 1.1** shows the general location of the lakes and their watersheds, and **Figure 4.1** shows the land uses in the watersheds.
Classification(s)	Class III Freshwater
Basin name (HUC 8)	Middle St. Johns River Basin (03080101)

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	Kasey Lake and Kelly Lake 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. Lake Lotta is classified as high-color (<40 PCU), 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 1.27 to 2.23 mg/L, and TP of 0.05 to 0.16 mg/L
Proposed TN, TP, chlorophyll a, and/or nitrate + nitrite concentrations (magnitude, duration, and frequency)	Numeric interpretations of the narrative nutrient criterion: **Kasey Lake and Kelly Lake** **TN:** 0.91 mg/L, expressed as an AGM not to be exceeded. **TP:** 0.05 mg/L, expressed as an AGM not to be exceeded. **Lake Lotta** **TN:** 1.27 mg/L, expressed as an AGM not to be exceeded. **TP:** 0.03 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	For Kasey Lake and Kelly Lake, combined AGM values for Kasey-Kelly-Kristy Lake group from 1992 to 2022 were used to develop the empirical relationship used to set the TN and TP criteria. For Lake Lotta, AGM values from 2005 to 2022 were used to develop the empirical relationship used to set the TP criterion.
How the criteria developed are spatially and temporally representative of the waterbody or critical condition	The water quality results applied in the regression analyses were from the 1992–2022 period for Kasey-Kelly-Kristy Lake group and from 2005-2022 period for Lake Lotta, which included years with both above- and below-average precipitation. Long-term average Rainfall (48.97 inches) was calculated from the Orange County (Orlando Internation Airport) data from 1953 to 2023. The rainfall results indicate that 12 years had below-average precipitation, while 19 years had above-average precipitation during 1992-2022 period **Figures 2.1** and **2.2** show the sampling stations in the TMDL lakes. Monitoring stations were located across the spatial extent and represent the spatial distribution of nutrient dynamics in the lakes. **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	For the Cycle 4 basin assessment completed in 2020, the NNC were used to assess the lakes for the verified period (January 1, 2012–June 30, 2019) during the Group 2, Cycle 4 assessment based on data from the IWR Run 58 Database. Kasey Lake was assessed as impaired (Category 5) for chlorophyll *a*, TN and TP. Lake Lotta was assessed as impaired (Category 5) for chlorophyll *a* and was added to the Verified List. Kelly Lake was assessed as impaired (Category 5) for TP, and chlorophyll *a* impairment was added to the Verified List during the statewide Biennial Assessment 2020-2022 (the verified period: January 1, 2013-June 30, 2020), based on data from the IWR Run 60 Database
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 address the nutrient impairment was the development of a regression equation that relates the lake TN and TP concentrations to the AGM chlorophyll *a* levels, 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 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	Kasey Lake is connected to Kristy Lake and then to Kelly Lake which flows to Lake Orlando through a pipe (**Figure 1.4**). Lake Orlando is an impaired high color lake, and the proposed TN TMDL of 0.91 mg/L is less than the applicable minimum TN NNC of 1.27 mg/L for high color lakes. The proposed TP TMDL of 0.05 mg/L for Kasey Lake and Kelly Lake is equal to the minimum TP NNC for the high color lakes. Therefore, the proposed target concentrations of TN and TP for Kasey Lake and Kelly Lake associated with the lake restoration should improve the water quality in Lake Orlando. Lake Lotta, a high-color lake, is upstream of Lake Rose, a low-color, high-alkalinity lake that is impaired for chlorophyll a. However, two pieces of evidence suggest that Lake Lotta has minimal impact on Lake Rose. First, the lakes are indirectly connected through dry ponds and wetlands. According to the hydrologic and nutrient budget and water quality management plan for Lake Rose (ERD 2020), Lake Rose receives no significant hydrologic or nutrient input from Lake Lotta, indicating hydrologic isolation between the lakes. Second, the department conducted simple regression analyses of the relationships between the TN and TP AGMs in Lake Lotta and Lake Rose (**Figures 3.1** and **3.2**). The low R^2 values and statistically insignificant P-values of these analyses suggest that Lake Lotta's flow has little to no influence on the water quality of Lake Rose, further supporting the idea of hydrologic isolation.
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, Orange County, and DEP conduct routine monitoring of these lakes. 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

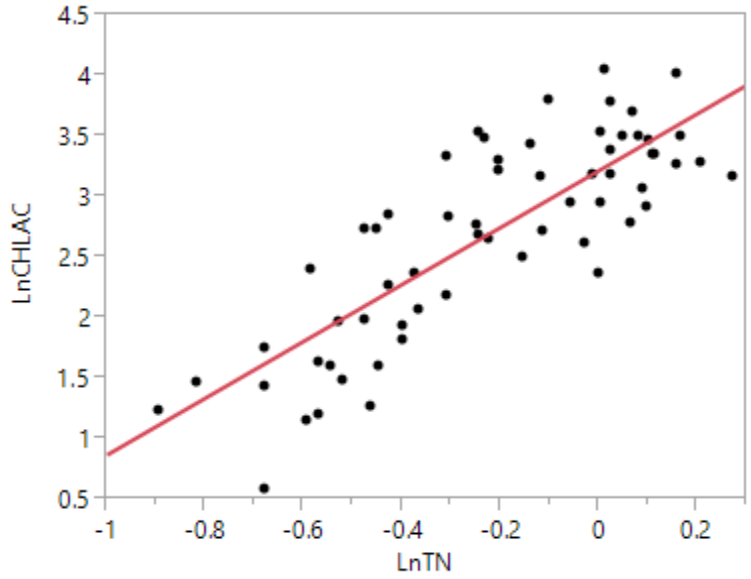
Administrative Requirements	Information for Administrative Requirements
Endangered species consideration	DEP is not aware of any endangered aquatic species present in the TMDL area. Furthermore, it is expected that improvements in water quality resulting from these restoration efforts will positively 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. 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 Regression Model Results for the Kasey-Kelly-Kristy Lake group.

Response CHLAC AGM: Kasey-Kelly-Kristy Lake group 1992–2022.



Summary of Fit

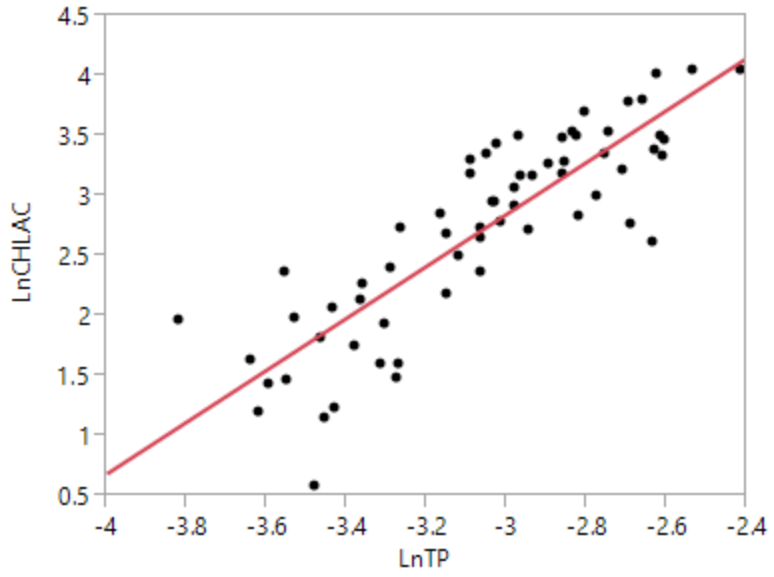
Calculation	Result
Equation	LnCHLAC = 3.2191123 + 2.3516126*LnTN
RSquare	0.679139
RSquare Adj	0.67351
Root Mean Square Error	0.472969
Mean of Response	2.692193
Observations (or Sum Wgts)	59

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	26.9887	26.9887	120.6469
Error	57	12.75089	0.2237	Prob > F
C. Total	58	39.73959		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	3.219112	0.078057	41.24	<.0001
LnTN	2.351613	0.214096	10.98	<.0001



Summary of Fit

Calculation	Result
Equation	LnCHLAC = 9.3470225 + 2.1652961*LnTP
RSquare	0.719292
RSquare Adj	0.714367
Root Mean Square Error	0.442386
Mean of Response	2.692193
Observations (or Sum Wgts)	59

Analysis of Variance

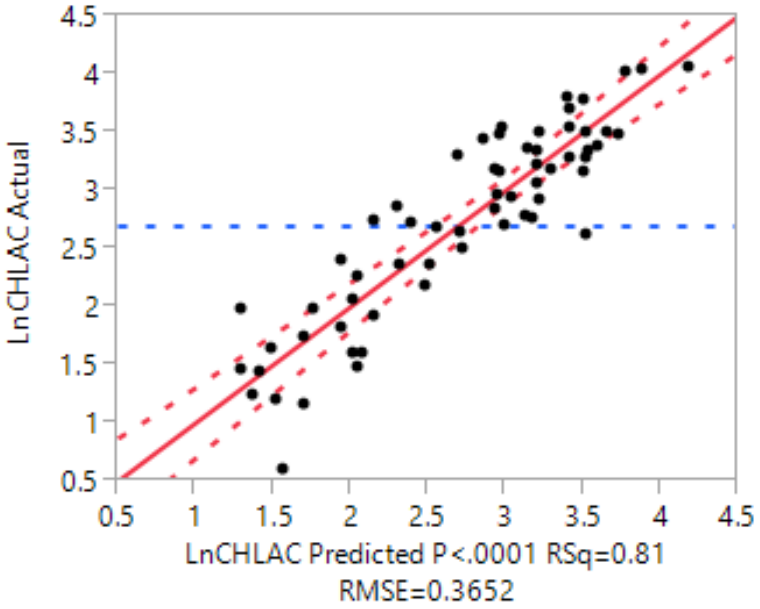
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	28.58436	28.5844	146.0579
Error	57	11.15523	0.1957	Prob > F
C. Total	58	39.73959		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	9.347023	0.553652	16.88	<.0001
LnTN	2.165296	0.179166	12.09	<.0001

Appendix D: Multiple Regression Model Results for the Kasey-Kelly-Kristy Lake group.

Response CHLAC AGM: Kasey-Kelly-Kristy Lake group 1992–2022.



Summary of Fit

Calculation	Result
RSquare	0.812067
RSquare Adj	0.805355
Root Mean Square Error	0.36519
Mean of Response	2.692193
Observations (or Sum Wgts)	59

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	32.27121	16.1356	120.9894
Error	56	7.468372	0.1334	Prob > F
C. Total	58	39.73959		<.0001

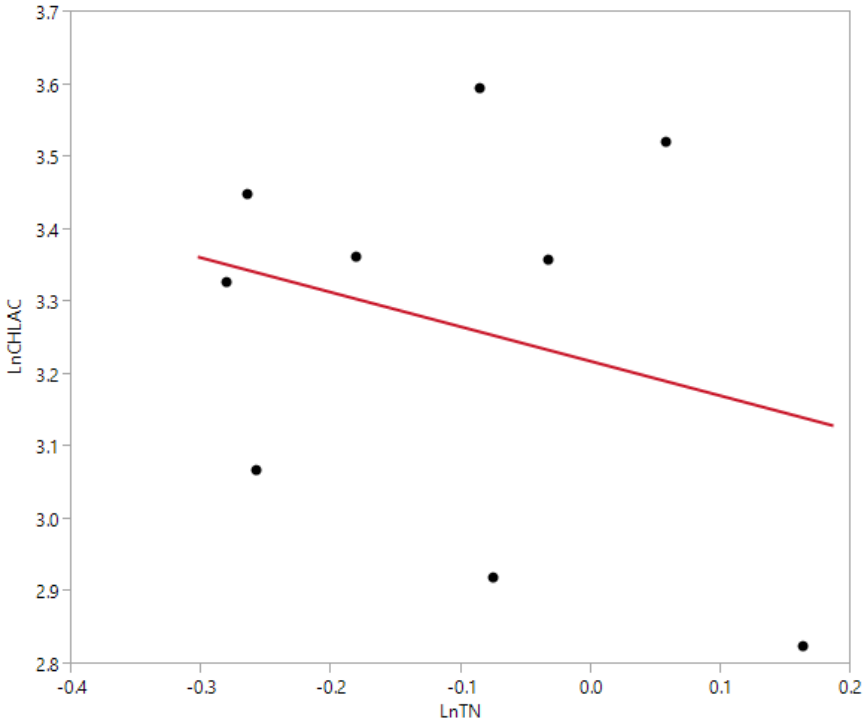
Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	VIF
Intercept	7.1213589	0.622953	11.43	<.0001	.
LnTN	1.2598817	0.239619	5.26	<.0001	2.101135
LnTP	1.3492751	0.214387	6.29	<.0001	2.101135

Prediction Expression	7.1213588659935 + 1.25988171709116*LnTN + 1.34927514990475*LnTP

Appendix E: Simple Regression Model Results for Lake Lotta.

Response CHLAC AGM: Lake Lotta 2005–2022.



Summary of Fit

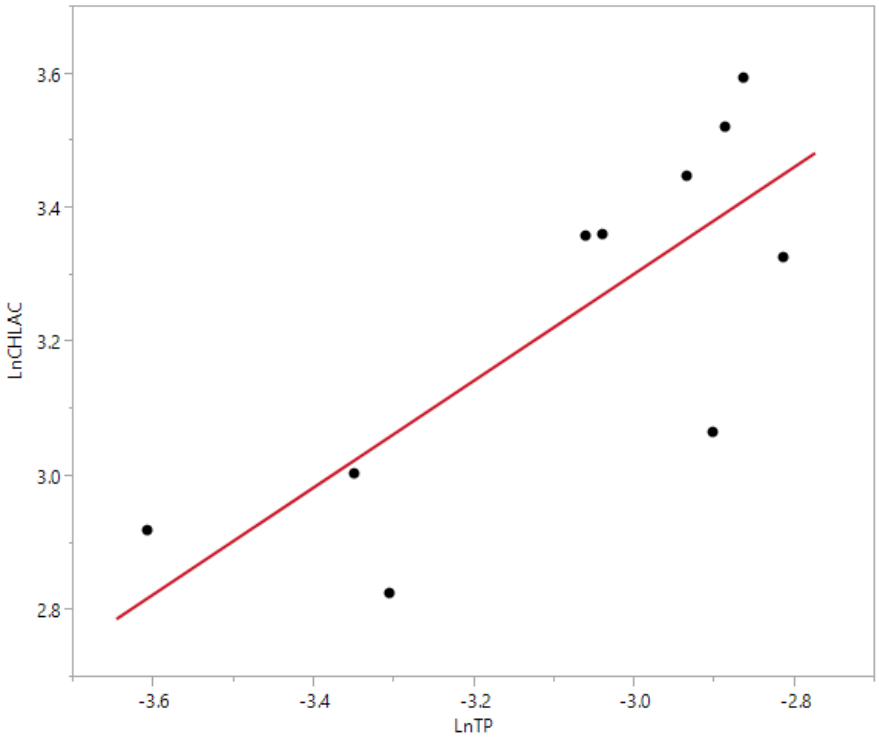
Calculation	Result
Equation	LnChla = 3.2185259 - 0.4762103*LnTN
RSquare	0.074344
RSquare Adj	-0.05789
Root Mean Square Error	0.277439
Mean of Response	3.26919
Observations (or Sum Wgts)	9

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.043274	0.043274	0.5622
Error	7	0.538807	0.076972	Prob > F
C. Total	8	0.582081		0.4778

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	3.218526	0.114535	28.1	<.0001
LnTN	-0.47621	0.635114	-0.75	0.4778



Summary of Fit

Calculation	Result
Equation	LnChla = 5.6960865 + 0.7972615*LnTP
RSquare	0.600781
RSquare Adj	0.550878
Root Mean Square Error	0.179468
Mean of Response	3.242658
Observations (or Sum Wgts)	10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.387767	0.387767	12.0391
Error	8	0.257672	0.032209	Prob > F
C. Total	9	0.645438		0.0084

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	5.696087	0.709366	8.03	<.0001
LnTN	0.797262	0.229775	3.47	0.0084