



**CITY OF
TALLAHASSEE**

TALLAHASSEE MASTER PLAN – SURFACE WATER (TMaPS): VOLUME 5

LAKE LAFAYETTE BASIN



Submitted by:
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July 2025

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VOLUME 5

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CITY OF TALLAHASSEE

Prepared for

City of Tallahassee

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Tallahassee, Florida 32301

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Project Number: FW7714

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The engineering material and data contained within the enclosed report was prepared by Geosyntec Consultants, Inc. for sole use by the City of Tallahassee. This report was prepared under the supervision and direction of the respective undersigned, whose seal as a registered professional engineer is affixed below.

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Tallahassee Master Plan – Surface Water (TMaPS)

Volume 1: Executive Summary

Volume 2: Background & Approach

Volume 3: Lake Munson Basin

Volume 4: Lake Jackson Basin

Volume 5: Lake Lafayette Basin

Volume 6: Wakulla Spring and Lake Talquin

Volume 7: Non-Structural and Structural Project Development

Volume 8: Regulatory Review

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ACRONYMS AND ABBREVIATIONS

AGM	annual geometric mean
BMAP	basin management action plan
BMP	best management practice
BRA	Biological Research Associates
CDA	Concentrated Discharge Area
cfs	cubic feet per second
Chl-a	chlorophyll <i>a</i>
City	City of Tallahassee
<i>E. coli</i>	<i>Escherichia coli</i>
EMC	event mean concentration
EPA	U.S. Environmental Protection Agency
F.A.C.	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FDOH	Florida Department of Health
FDOT	Florida Department of Transportation
FLUCCS	Florida Land Use Cover Classification System
ft	feet
FWC	Florida Fish and Wildlife Conservation Commission
GIS	geographic information system
ID	identification
IWR	Impaired Waters Rule
LDI	Landscape Development Intensity
LVI	Lake Vegetation Index
mg/L	milligrams per liter
mL	milliliter
MPN	Most Probable Number
NAVD88	North American Vertical Datum of 1988
NHD	National Hydrological Dataset
NNC	Numeric Nutrient Criteria
NRCS	Natural Resource Conservation Service

NWFWMD	Northwest Florida Water Management District
OSTDS	onsite sewage treatment and disposal systems
PCU	platinum-cobalt units
RAP	Reasonable Assurance Plan
SCI	Stream Condition Index
SSAC	Site-Specific Alternative Criteria
SSO	sanitary sewer overflow
SWIM	Surface Water Improvement and Management
TMaPS	Tallahassee Master Plan - Surface Water
TMDL	total maximum daily load
TN	total nitrogen
TP	total phosphorus
TSI	Trophic State Index
TSS	total suspended solids
µg/L	micrograms per liter
ULL-NRF	Upper Lake Lafayette Nutrient Reduction Facility
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
WBID	waterbody identification

5 Lake Lafayette Basin

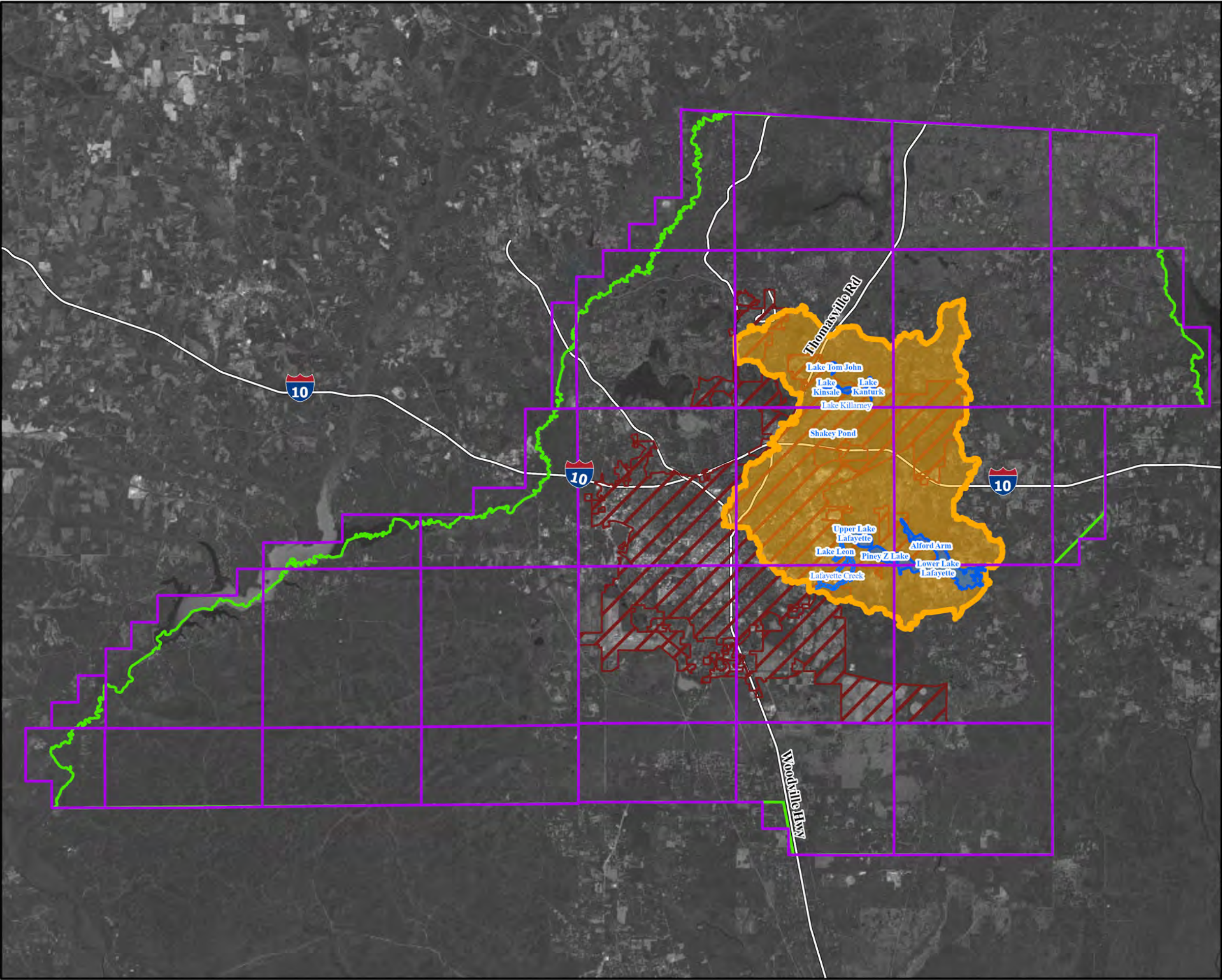
5.1 Basin Overview and Project Waterbodies

The Lake Lafayette basin is located in Leon County, FL north of Tallahassee and encompasses the township and ranges of: 002N001E, 002N002E, 001N001E, 001N002E, 001S001E, 001S002E. **Figure 5-1** shows the location of the Lake Lafayette basin in relation to the Tallahassee city limits and within the Leon County boundary. The basin covers 55,170 acres (84.6 square miles), of which 92.7 percent (51,212 acres) is land cover and the remaining 7.3 percent (3,958 acres) is surface water. **Exhibit 5-1** presents a map showing basin boundaries, waterbodies that are part of this study (termed primary waterbodies), tributary inputs, the extents of the City of Tallahassee (City) incorporated area, and smaller watershed areas that drain to the Lake Lafayette system, which are the primary receiving waterbodies in the basin.

Historical manmade alterations to the Lake Lafayette system created four distinct waterbodies (Upper Lake Lafayette, Piney Z Lake, Lower Lake Lafayette, and Alford Arm). These are shown on **Exhibit 5-1**, and for this report, these are termed the Lafayette Chain of Lakes. The historical alterations are discussed in greater detail in **Section 5.4.1**.

Looking at drainage to the various lake segments (**Exhibit 5-1**), drainage to Upper Lake Lafayette comes in through two primary subbasins as well as from direct discharge to Upper Lake Lafayette from the Upper Lake Lafayette watershed as shown in **Exhibit 5-1**. The first primary subbasin is the northeast drainage ditch (NEDD) which includes the Park Avenue drainage ditch. The NEDD drains a highly urbanized area (around 10,000 acres) and discharges to the Weems Pond Regional Stormwater Treatment Facility which includes alum treatment to primarily remove phosphorus. The watersheds that drain to the NEDD, as shown in **Exhibit 5-1**, include Eastgate, Goose Pond, Evening Rose, and the northern parts of Weems Pond watershed. The Park Avenue drainage ditch comes out of the southern portions of the Weems Pond watershed. Flow out of Weems Pond travels along a channelized creek approximately 0.8 miles prior to discharging to the western side of Upper Lake Lafayette. The second primary input comes from Lafayette Creek which flows in along the southwestern side of Upper Lake Lafayette. Lafayette Creek and Lake Leon (which drains to Lafayette Creek) are target waterbodies in this study. A key hydrologic feature of Upper Lake Lafayette are numerous sinks, the largest of which is Lafayette Sink located on the north side of the lake. Flows into Upper Lake Lafayette ultimately discharge into the groundwater system through the sinks and the porous lake bottom.

Piney Z Lake is an impounded waterbody to the east of Upper Lake Lafayette with a very limited drainage area and no primary tributary inflows (**Exhibit 5-1**). Only the Piney Z watershed drains directly to the lake under normal conditions. An overflow drop structure along the eastern side of Piney Z Lake discharges to Upper Lake Lafayette during higher rainfall periods. The structure has a gate that can be closed. Flows between Lower Lake Lafayette and Piney Z Lake are through a drop structure located to the east of the berm separating the two waterbodies. Based upon water levels in Piney Z Lake relative to Lower Lake Lafayette, flow may occur in either direction.



Legend

- Lake Lafayette Drainage Basin
- Leon County Boundary
- Waterbodies in Study
- Township-Range for Leon County
- Major Roads
- Tallahassee Corporate Limits

Sources:
Waterbodies: COT, 2020
Watersheds: COT, 2020
Roads: FDOT, 2020
BMPs: Geosyntec, 2022
City Limits: COT, 2022

**Figure 5-1:
Lake Lafayette Basin Location Map**

**Tallahassee Master Plan - Surface
Water (TMaPS)**

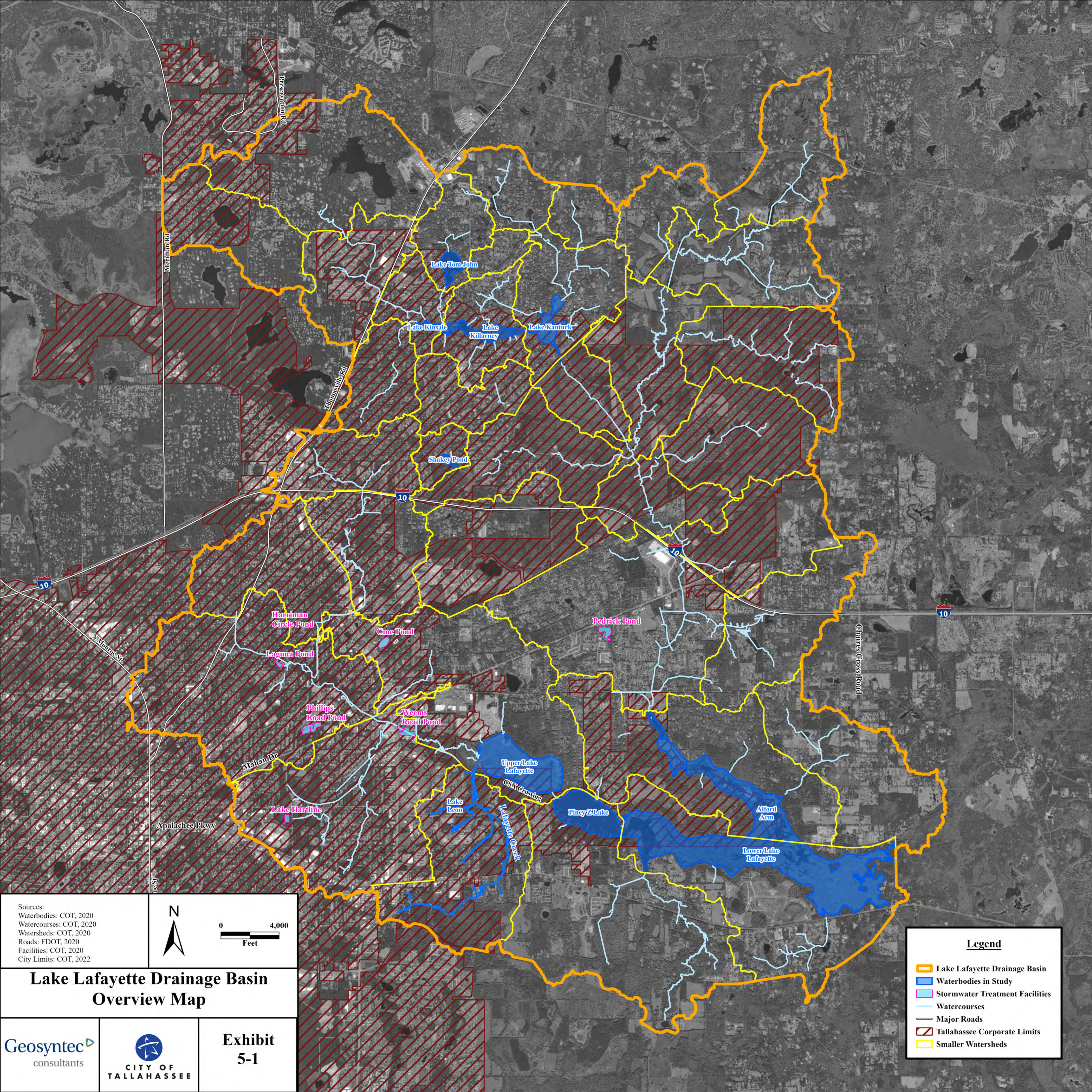


The majority of the remaining watershed, 28,891 acres to the north of the Lake Lafayette system and north of I-10, drains through Alford Arm into Lower Lake Lafayette. Lower Lake Lafayette ultimately discharges through a channel that passes under a short bridge section along Chairs Cross Road and then into wetlands that feed the upper St. Marks River. The inflow to Alford Arm includes discharges from the Killearn Chain of Lakes (Lake Kinsale, Lake Killarney, and Lake Kanturk) which are waterbodies in this study. Upstream of the Killearn Chain of Lakes is Lake Tom John, also a waterbody in this study, and Lake McBride which is the most upstream waterbody on the northwest side of the basin. Other discharges to Alford Arm come from the Desoto Lake and Roberts Pond watersheds at the northeast upper end of the basin and other smaller watersheds along the western side of the basin.

As mentioned above, for the Lake Lafayette basin, 11 primary waterbodies were identified for assessment of water quality conditions, evaluation of potential pollutant loads, and development of structural and non-structural projects to improve water quality (as needed), these are:

- Lafayette Chain of Lakes (Upper Lake Lafayette, Piney Z Lake, Lower Lake Lafayette, Alford Arm)
- Killearn Chain of Lakes (Lake Kinsale, Lake Killarney, Lake Kanturk)
- Lake Tom John
- Shakey Pond
- Lafayette Creek and Lake Leon

These waterbodies are highlighted in **Exhibit 5-1** (lakes in dark blue and creeks as dark blue lines) and are the focus of the analyses in the sections following this introduction.



Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Watersheds: COT, 2020
Roads: FDOT, 2020
Facilities: COT, 2020
City Limits: COT, 2022

Lake Lafayette Drainage Basin Overview Map

5.2 Report Review Summary

For the Lake Lafayette basin, a series of reports were reviewed that provided the history and background of the basin and its waterbodies, along with data and other information to support the identification of potential sources and structural and non-structural projects to improve water quality. **Table 5-1** presents a list of the reports reviewed.

The reports range in time from the 1970s through the present and include studies on the various waterbodies throughout the basin, analyses of measured hydrologic, water quality, and biological data, evaluations of appropriate water quality targets for various waterbodies, waterbody ecosummaries, and management plans targeted to restoration and land acquisition.

Table 5-1: Lake Lafayette Basin Reference List

Report Name	Author	Year
2023 Lakes Monitoring Annual Report: Lake Tom John	City	2023
Project #6: Lafayette Greenway	City	2021
Habitat Conservation Plan, Upper Lake Lafayette	City	2020
Comprehensive Wastewater Treatment Facilities Plan-- Task 1: Nitrogen Reduction Performance Criteria Alternative Wastewater Treatment Systems	JSA, ATM, Balmoral, Magnolia Engineering, and Tetra Tech	2020
Shakey Pond Statement of Work - Phase I (Study and Recommendations)	City	2020
Shakey Pond - Stormwater Contribution	City	2020
Waterbody Summary: Lake Lafayette	Leon County	2019
Waterbody Summary: Northeast Drainage Ditch	Leon County	2019
Lake Ecosummary: Piney Z	City	2019
FDEP Response Letter to Jodie on comments on 2018 list	FDEP	2019
Waterbody Assessment: Unnamed Stream at Chaires Crossroad. Lake Lafayette Basin	Leon County	2019
Waterbody Summary, Alford Arm Creek	Leon County	2019
Waterbody Summary: Apalachee Creek	City	2019
FDEP's Responses to the City of Tallahassee Comments on the 2018 Draft Verified List of Impaired Waters in the Ochlockonee-St. Marks Basin	FDEP- Kevin O'Donnell	2019
Lake Ecosummary - Lake Killarney	City	2019
Lake Ecosummary - Lake Kanturk	City	2019
Lake Ecosummary - Tom Brown Park (Lake Leon)	City	2019
Waterbody Summary, Lafayette Creek	City	2019
Comment Letter from the City to FDEP from Jodie to Kevin O'Donnell	City	2018
Alford Arm Tributary Draft Impairment	City	2018
Emails, between Mark Heidecker and Kevin O'Donnell	City	2018

Table 5-1: Lake Lafayette Basin Reference List

Report Name	Author	Year
DEP Sampling Site Alford Arm Tributary Map	City	2018
City of Tallahassee Comments on the 2018 Draft Verified List of Impaired Waters in the Ochlockonee-St. Marks Basin	City - Jodie Cahoon	2018
Conflicting Elevation Information for Historic KCOL Control Elevations	City - Jason Icerman	2018
The Lakes of Killearn - A report to the Killearn Homes Association evaluating the factors influencing and the management options for enhancing the water levels and health of the lakes in Killearn	Thomas Singleton for KHA	2018
Summary pages on the need for pumping.	City	2017
An Evaluation of a Minimum Equilibration Period Prior to Sampling Previously Desiccated Lakes	Frydenborg Ecologic	2017
Identification of Hydrologic Conditions for Inclusion of Ambient Monitoring Data from IWR Assessment. Findings Memorandum Development of Criteria for the Collection of Acceptable Water Quality Samples.	ATM	2016
The Effects of Water Level Fluctuation on the Killarney Chain of Lakes	Frydenborg Ecologic	2016
Documentation in Support of Category 4e for WBIDs 647C and 647F: Killarney and Kanturk	City	2016
Eastgate Way Stormwater Improvements As-Built Survey	Moore Bass Consulting	2015
Letter from Rowe Drilling Company to the Killearn Homes Association	Rowe Drilling Company	2015
Monitoring Plan Review and Data Analysis Relative to Listing Assessment	ATM	2015
Upper Lake Lafayette Aquifer Protection Florida Forever Proposal, Evaluation Report	City Provided Document	2014
Evaluation of Sediment Impacts on Water Quality in the Killearn Lakes	ERD	2014
The Killearn Waterbodies: An Assessment of the Upland Drainage Basin Soils	City/UF	2014
Results and Conclusions -- Killearn Chain of Lakes Hydrologic Investigation	CH2MHill	2014
Final Total Maximum Daily Load for Nutrients, Upper Lake Lafayette WBID 756F	EPA Region 4	2012
An Assessment of Floating Vegetated Mats to Reduce Nutrients in an Urban Lake	City	2011
St. Marks River Watershed SWIM Plan Update	NWFWMD	2009
Native American Heritage Site: The Block-Sterns Site (8le148) in the Lake Lafayette Drainage Basin, Leon County, Florida	Louis D. Tesar	2007
Weems Pond Regional Stormwater Treatment Facility Improvements Feasibility Study Final Report	PBSJ	2007
TMDL for Fecal and Total Coliform NEDD (WBID 756)	EPA Region 4	2006

Table 5-1: Lake Lafayette Basin Reference List

Report Name	Author	Year
Wildlife Surveys and Potential for Occurrence of Listed Species Falls Chase, Leon County, FL	Breedlove Dennise and Associates	2006
Total Maximum Daily Load (TMDL) for Fecal and Total Coliforms Northeast Drainage Ditch (WBID 756) Leon County, Florida	EPA Region 4	2006
Existing Status and Management Plan for Lake Lafayette and the Lake Lafayette Watershed (Sections 1 and 6)	ERD	2005
Existing Status and Management Plan for Lake Lafayette and the Lake Lafayette Watershed (another version)	ERD	2005
FDEP Email, Jess Van Dyke to Harvey Harper	FDEP	2005
Existing Status (2003-2004) and Management Plan for Lake Lafayette (PowerPoint presentation)	ERD	2005
J.R. Alford Greenway, Management Plan	Leon County	2003
Lakes Killarney and Kinsale Nuisance Vegetation Investigation	BRA	2003
Triploid Carp Permit	City	2000
Lake Lafayette Management: A Report Outlining Lake Shore, In-Lake and Land Use Management Proposals	Swanson, Sloan, and Chernets	1996
Long-Term Performance Evaluation of the Alum Stormwater Treatment System at Lake Ella, Florida	FDER	1990
Permit for Dredge and Fill for Shakey Pond	FDER	1989
Dredge and Fill Permit Application for Shakey Pond	Dan Garlick and Associates	1988
Shakey Pond Discharge Structure Schematic	Brown and Associates	1985
Letter to Leon County Planning	Dick Crane, Director, Killearn Properties Inc	1971
Design Letter, Consultant to Owners of Killearn Estates	Wayne H Coloney Company - Consulting Engineers	1970

5.3 Volume Outline

The sections that follow present the results from the completion of Tasks 1 to 4 including: an overview of available data; assessment of the water quality conditions in the primary waterbodies and the tributaries that drain into them; development of potential pollutant loads; identification of “hot spot” areas, by waterbody, to target for structural and non-structural projects within the Lake Lafayette basin; and recommendations for additional data collection or studies to fill data gaps and support assessment of specific stressors to the primary waterbodies. The specific tasks, with a description of the work, include:

- Task 1 – Data Collection
 - Collection and review of data for use in project analyses.
- Task 2 – Waterbody Data Review and Summary
 - Evaluation of existing water quality conditions and general health of target waterbodies using available data and studies.
 - Qualitative assessment for each water body to identify pollutant loading sources to focus on.
- Task 3 – Water Quality Assessment
 - Calculation of pollutant load estimates to the target waterbodies (where data allow) including stormwater runoff, groundwater impacted by onsite sewage treatment and disposal systems (OSTDS), point sources, lake inflow, internal recycling, and atmospheric deposition.
 - Identification of hotspots within each drainage basin and prioritization of waterbodies to target for restoration efforts.
- Task 4 – Water Quality Study Identification and Prioritization
 - Identification of potential data collection or water quality improvement studies needed to address data gaps.

Section 5.4 through **Section 5.8** present an overview and history for each of the primary waterbodies along with the findings and results from Tasks 1 through 3. **Section 5.9** presents a basin-wide assessment of hot spot areas as outlined in Task 3 to target for structural and non-structural projects based on the data and analyses presented in **Section 5.4** through **Section 5.8**. **Section 5.10** presents recommendations on data collection or studies.

5.4 Lafayette Chain of Lakes

This section presents the results from Tasks 1 through 3 for the Lafayette Chain of Lakes, including Upper Lake Lafayette, Piney Z Lake, Lower Lake Lafayette, and Alford Arm which includes an overview and history of the lakes and basin; present impairment status of waterbodies in the basin; an overview of available data; a qualitative assessment of potential pollutant sources; and calculation of potential pollutant loads.

5.4.1 Overview and History

The Lafayette Chain of Lakes (Upper Lake Lafayette, Piney Z Lake, Lower Lake Lafayette, Alford Arm) were once a contiguous meandering wetland prairie system located in Leon County, FL covering an area of around 2,600 acres. Historically, areas of Lower Lake Lafayette flowed west toward the sinks in Upper Lake Lafayette, but the system was subdivided by railroad construction in the late 1800s. The railroad is owned by CSX today and still active. In the mid-1900s (from 1941 to 1954), the system was partitioned further through the construction of berms on the eastern and western sides of Piney Z Lake. The berms were constructed for agricultural purposes and were built using the bottom sediments and muck from Piney Z Lake. The berm between Upper Lake Lafayette and Piney Z Lake (known as the West Levee) was constructed in 1948. A similar berm was constructed on the eastern end of Piney Z Lake, completing the compartmentalization of the system. The final significant hydrologic modification was the construction of a channel connecting Lower Lake Lafayette to the St. Marks River in the area of Chaires Cross Road, which was constructed following record flooding in 1948, which was the highest flood of record. Due to the partitioning of the system each component is now recognized as a separate and distinct waterbody. The overall drainage basin to the Lafayette Chain of Lakes covers an area of 54,170 acres (**Exhibit 5-1**).

Photo 5-1 through **Photo 5-8** present aerial photographs of the system from 1941 to 2020. The railroad can be seen in the 1941 aerial photograph (**Photo 5-1**) passing south of Upper Lake Lafayette, crossing between Upper Lake Lafayette and Piney Z Lake, running along the northern side of Piney Z Lake and Lower Lake Lafayette, and crossing the lower end of Alford Arm. The railroad crossing of Alford Arm created a significant reduction in the connectivity between Alford Arm and Lower Lake Lafayette. Numerous sinks are also visible within the Upper Lake Lafayette and Piney-Z Lake segments. The 1949 aerial photograph (**Photo 5-2**) shows conditions during a wetter period with Upper Lake Lafayette full and showing extensive open water area. The 1954 aerial (**Photo 5-3**) shows the compartmentalized system with the open dry areas and sinks within Upper Lake Lafayette, the impounded open waters of Piney Z Lake, and the mixed wetland/open water areas of Lower Lake Lafayette and Alford Arm. **Photo 5-4** through **Photo 5-8** present aerial images of the compartmentalized system under varying water level conditions and showing changes from relatively undeveloped in the 1970s to highly developed conditions by the early 2000s up to 2020.



Photo 5-1: Lafayette Chain of Lakes Aerial – 1941



Photo 5-2: Lafayette Chain of Lakes Aerial – 1949



Photo 5-3: Lafayette Chain of Lakes Aerial – 1954



Photo 5-4: Lafayette Chain of Lakes Aerial – 1970



Photo 5-5: Lafayette Chain of Lakes Aerial – 1983

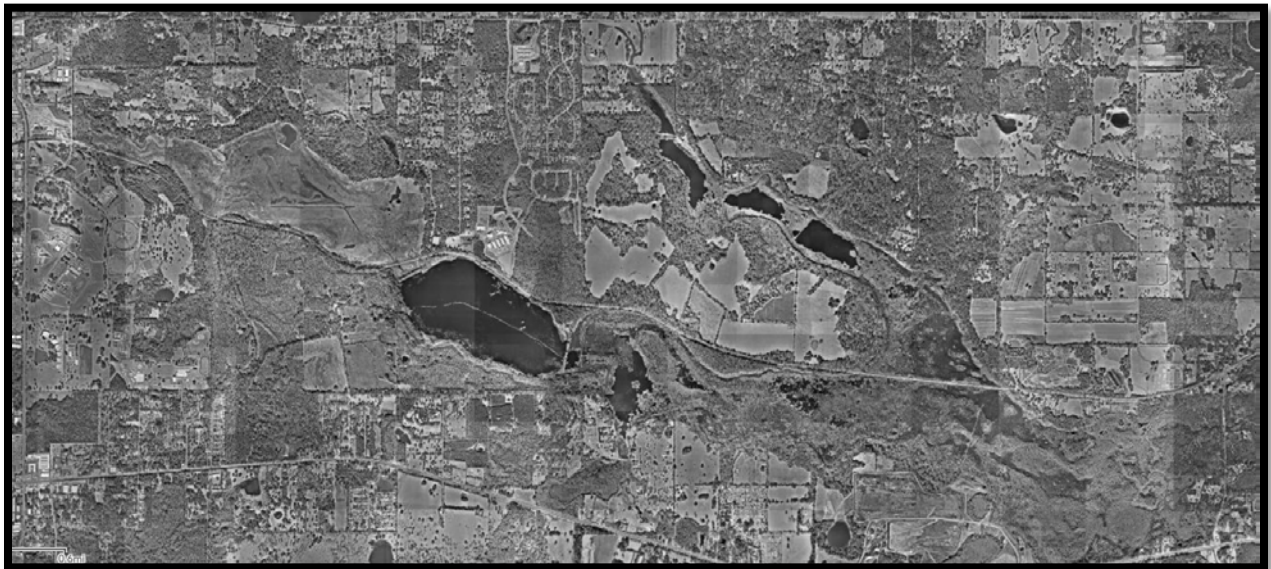


Photo 5-6: Lafayette Chain of Lakes Aerial – 1996



Photo 5-7: Lafayette Chain of Lakes Aerial – 2007



Photo 5-8: Lafayette Chain of Lakes Aerial – 2020

The following provides more detailed discussions of the history and hydrologic characteristics of each of the four waterbodies in the chain.

Upper Lake Lafayette

Upper Lake Lafayette is the western-most waterbody in the Lafayette Chain of Lakes (**Exhibit 5-1**). The most dominant features of Upper Lake Lafayette are the multiple sinkholes that drain to the Florida Aquifer, and the largest is Lafayette Sink which is shown in **Photo 5-9** during a period of low water. Due to the sinks and the highly permeable bottom, the lake drains very quickly and only fills for relatively short periods of time following large rainfall events. When full, the lake is around 370 acres in size at an elevation of around 40 feet (ft). Standing water (other than around the sink) is typically present only for short periods, though sometimes for months or longer during extended rainfall conditions. **Photo 5-10** shows the lake during a higher water condition in 2014. The bottom of Upper Lake Lafayette has vegetation and channelized inflows that move water to the sink during normal to dry periods. **Photo 5-11** shows the lake during a low water condition in 2012. **Photo 5-12** shows a close up of the vegetation on the lake bottom and the channel that carries inflows to the sink during normal to low water conditions. Ownership of the lake bottom is split between Leon County, the City, and private landowners. An east-west running berm with a ditch was constructed in the early 1950s. The berm can first be seen in the 1954 aerial (**Photo 5-3**). The berm divides the Leon County and City portions of the lake bottom with the County owning the land north of the berm.



Photo 5-9: Lafayette Sink During Low Water Period (2011)



Photo 5-10: Upper Lake Lafayette During Higher Water Period (2014)



Photo 5-11: Upper Lake Lafayette During Low Water Period (2012)



Photo 5-12: Channels within Upper Lake Lafayette Lake Bottom to Lafayette Sink (2011)

There are two primary inflows to Upper Lake Lafayette: the NEDD and Lafayette Creek. Lafayette Creek, which is one of the primary waterbodies in this study, is discussed in detail in **Section 5.8**. The NEDD (including the Park Avenue Ditch) drains the Eastgate, Goose Pond, Evening Rose, and the Weems Pond watersheds as outlined in **Exhibit 5-1**. The total drainage area for the NEDD (including the Park Avenue Ditch) is approximately 10,200 acres. The NEDD and Park Avenue Ditch drain highly developed urbanized watersheds. **Photo 5-13** shows the NEDD where it crosses Mahan Drive immediately upstream of Weems Pond. **Photo 5-14** shows a project completed in 2015 to stabilize a portion of the upper reaches of the ditch in the Eastgate watershed.

Although not a significant inflow in relation to the NEDD and Lafayette Creek, Piney Z Lake at times discharges into Upper Lake Lafayette through a creek that flows under the CSX railroad crossing. **Photo 5-15** shows the CSX bridge across the connection. On very rare occasions, Upper Lake Lafayette will discharge to Piney Z Lake, but only during very extreme high-water conditions and dependent upon operation of a gate valve-controlled structure that passes through the berm, which is discussed further as related to Piney Z Lake.

Numerous studies have documented degraded water quality in Upper Lake Lafayette due to pollutant loading from the NEDD and Lafayette Creek. The 1996 Lake Lafayette Management Plan identified significant degradation due to urban stormwater runoff including adverse impacts to groundwater due to discharges to the Floridan Aquifer through the multiple sinks. The 2005 Existing Status and Lake Management Plan by ERD identified that the stormwater load to Upper Lake Lafayette is very high in inorganic and organic constituents which go directly into the aquifer through the sinks and the porous bottom. The study also identified that both baseflow and stormwater have poor water quality.



Photo 5-13: Northeast Drainage Ditch (NEDD) at Mahan Drive



Photo 5-14: NEDD Stabilized Project in East Gate Watershed (2021)



Photo 5-15: CSX Railroad Bridge over Upper Lake Lafayette Connection to Piney Z Lake

Numerous stormwater treatment facilities have been constructed in the NEDD drainage basin, with many of the larger facilities shown on **Exhibit 5-1** including the Capital Medical Center (CMC) Pond, Harriman Circle Pond, Laguna Pond, Phillips Road Pond, and Weems Pond. Weems Pond was a permitted wet detention pond located immediately upstream of the discharge to Upper Lake Lafayette which receives the full inflow from the NEDD. In 2015, Weems Pond was enhanced to include alum injection upstream of the pond to improve the pollutant removal efficiencies of the system, potentially upwards of 90 percent treatment of phosphorus prior to entering Upper Lake Lafayette. Following enhancement, Weems Pond was renamed the Upper Lake Lafayette Nutrient Reduction Facility (ULL-NRF). **Photo 5-16** shows the ULL-NRF in 2021. **Photo 5-17** shows the alum treatment mixing chambers.

Various studies have provided additional recommendations for the restoration of Upper Lake Lafayette and mitigation of pollutant discharges to the Floridan Aquifer along with habitat restoration. The 2005 Existing Status and Management Plan by ERD identified the following.

- Construction of vegetative flow paths for inflows between Weems Pond and the sink.
- Redirection of the flows to Piney Z Lake instead of the sink. This solution would have required pumping due to the impounded nature of Piney Z Lake.
- Construction of earthen berms around the various sinks to hold water levels at a set elevation and provide for a more permanent open water volume. This solution presented issues relative to holding water given the permeable nature of the lake bottom and the potential for formation of other sinks.
- Additional stormwater treatment facilities in the Lafayette Creek watershed.



Photo 5-16: Weems Pond Regional Treatment Facility (2021)



Photo 5-17: Weems Pond Regional Treatment Facility Alum Mixing Chambers

The 2014 Upper Lake Lafayette Aquifer Protection Report identified the creation of a contiguous system of conservation lands around the Lafayette Chain of Lakes including the Falls Chase Greenway, Lafayette Heritage Trail Park, the J.R. Alford Greenway, and the L. Kirk Wildlife and Environmental Area. In 2020, the City developed a Habitat Conservation Plan for Upper Lake Lafayette. The Plan recognized the unique nature of the lake bottom due to the repeated inundation and drying. The objective of the Conservation Plan was to outline management practices that could be implemented by the City to control invasive vegetation and enhance the native plant communities.

Piney Z Lake

Piney Z Lake is an impounded waterbody that sits between Upper Lake Lafayette and Lower Lake Lafayette (**Exhibit 5-1**). Due to the impoundment by the eastern and western levees, and unlike the other waterbodies within the Lafayette Chain of Lakes, the lake maintains a relatively constant area of open water around 230 acres at an elevation around 46.5 ft. **Photo 5-18** shows the lake in 2022 with areas of submergent and emergent aquatic vegetation.



Photo 5-18: Piney Z Lake in 2022

Piney Z Lake has no significant tributary inflows. The drainage basin to the lake is outlined in **Exhibit 5-1** and identified as the Piney Z Watershed. A large part of the southern end of the Piney Z Watershed is a closed basin which further reduces the direct drainage area. The total direct drainage area to Piney Z Lake is around 520 acres.

Piney Z Lake has limited interaction with the other waterbodies in the Lafayette Chain and resembles a closed system. Discharge structures are located at each of the two berms providing some connectivity. **Photo 5-19** shows the berm on the eastern side separating Piney Z from Lower Lake Lafayette and the discharge structure, which is a drop structure within Lower Lake Lafayette with pipes through the berm. The drop structure has a fixed elevation weir on the Lower Lake Lafayette side and depending upon overall stage and the differences in water levels between Piney Z Lake and Lower Lake Lafayette will allow flow in either direction. Based on anecdotal information from visits to the site and discussions with City staff, Lower Lake Lafayette generally stages up higher than Piney Z Lake such that the flow direction is from Lower Lake Lafayette to Piney Z Lake. Direct observation of the structure during this effort has shown discharges in both directions. **Photo 5-20** shows the drop inlet structure at the berm on the western side of Piney Z Lake. **Photo 5-21** shows a view of the structure during a significant low water period in 2020. The structure on the western berm has a gate that can be closed. Generally, flows are from Piney Z Lake through the structure, across the bridge on the CSX railroad (**Photo 5-15**) and to the sink via channels in the Upper Lake Lafayette bottom. However, flow can occur in either direction depending on operation of the gate.



Photo 5-19: Berm along Eastern Side of Piney Z Lake with Control Structure in Lower Lake Lafayette



Photo 5-20: Drop Inlet Structure along Western Side of Piney Z Lake



Photo 5-21: Drop Inlet Structure along Western Side of Piney Z Lake Exposed During Low Water in 2020

Piney Z Lake and the immediate areas around the lake are owned by the City and the lake is managed as a fishery by the Florida Fish and Wildlife Conservation Commission (FWC). In 1997 the lake bottom was dredged and sediments placed to create fishing fingers that extend out from the southern shoreline. The fingers can be seen in the 2007 aerial (**Photo 5-7**). While the lake has water quality issues relative to meeting its targets for nutrients and Chlorophyll a (Chl-a), as well as periods of low dissolved oxygen, the issues are generally associated with vegetation management. In the early 2000s sterile Carp were introduced into the lake for the purpose of controlling hydrilla. The stocking of Carp (along with Tropical Storm Fay in 2008) resulted in the loss of much of the lake's macrophyte community, which, in turn, led to higher nutrient and Chl-a concentrations. Based on correspondence with the Florida Department of Environmental Protection (FDEP), the sterile Carp that were introduced in the early 2000s should be reaching the end of their life, which should lead to re-establishment of the macrophyte community and a return to better water quality conditions.

Lower Lake Lafayette

Lower Lake Lafayette is the largest of the four waterbody segments in the Lafayette Chain of Lakes, covering an area of around 1,000 acres (**Exhibit 5-1**), and the most ecologically valuable portion of the Lafayette Chain of Lakes as it supports a wood stork rookery. While classified as a lake, the waterbody actually functions more as a wetland prairie system with pockets of open water. The vast majority of its area is covered by dense emergent vegetation.

Lower Lake Lafayette is bordered on the west by the Piney Z Lake eastern berm, on the north by Alford Arm (separated by the CSX railroad), and the St. Marks River on the west at Chaires Cross Road. **Photo 5-22** shows Lower Lake Lafayette as seen from the Piney Z Lake eastern berm. **Photo 5-23** shows the waterbody as seen from the CSX railroad along the northern side. **Photo 5-24** shows the CSX railroad berm that crosses between Lower Lake Lafayette and Alford Arm.



Photo 5-22: Lower Lake Lafayette from the Piney Z Berm



Photo 5-23: Lower Lake Lafayette from the CSX Railroad Berm



Photo 5-24: CSX Railroad Crossing between Alford Arm and Lower Lake Lafayette

The primary inflow to Lower Lake Lafayette comes from Alford Arm through culverts in the CSX berm. The culverts, overall drainage area, and connections are discussed in more detail as related to Alford Arm. Additional direct discharge to the waterbody comes from the Windwood Hills and Lower Lake Lafayette watersheds as shown in **Exhibit 5-1**. As discussed previously, a drop structure is located along the western side of Lower Lake Lafayette which discharges to or receives discharge from Piney Z Lake depending upon water level conditions (**Photo 5-19**). Outflow from Lower Lake Lafayette occurs through a channel that passes underneath Chaires Cross Road and connects to wetlands adjacent to the upper portions of the St. Marks River. **Photo 5-25** shows the discharge channel at Chaires Cross Road during a rain event in 2022 along with the Northwest Florida Water Management District (NFWMD) gaging station. The St. Marks wetlands can, at times, backwater into Lower Lake Lafayette.



Photo 5-25: Lower Lake Lafayette Outflow Channel at Chaires Cross Road during Rain Event in 2022

The 1996 Lake Lafayette Management study identified that Lower Lake Lafayette has experienced significant degradation due to urban stormwater runoff and point source discharges to the system and was identified as “on the edge of collapse”. Similar determinations were made based on the 2005 Existing Status and Management Plan and the 2009 St. Marks SWIM plan by NFWMD. Pollutant sources identified include non-point source loading to Alford Arm which flows into Lower Lake Lafayette, a 600-acre solid waste facility operated by Leon County, and seepage from a 70,000 gallon per day package treatment plan operated by Talquin Electric. The solid waste facility is presently closed. The former solid waste facility and the treatment plant are located on the southern side of the waterbody in the Lower Lake Lafayette watershed (**Exhibit 5-1**).

Alford Arm

Alford Arm is a 370-acre waterbody separated from Lower Lake Lafayette by the CSX Railroad berm which runs directly across the lower end of Alford Arm (**Exhibit 5-1**). As with Lower Lake Lafayette, Alford Arm contains pockets of open water, but the vast majority of the area is covered by dense stands of submergent and emergent wetland vegetation. **Photo 5-26** shows the lower portions of Alford Arm taken from the CSX Railroad berm. **Photo 5-27** shows open water areas in the upper portions of Alford Arm near Buck Lake Road. Parts of Alford Arm have been extensively bermed in the past to create standing water areas for agricultural purposes, which means parts have characteristics of a lake (open water with permanent pools) with other parts wetland. Ownership of the land in Alford Arm is divided between the State of Florida and private individuals.

Flows into Alford Arm come from an extensive basin area that includes the Alford Arm, Maybin, Deer Point, Lake Cassie, Mike Johnson Road, Welaka Trail, Upper Miles, Cascade Lake, Shakey Pond, Martinez, Gutsch, Roberts Pond, Wiregrass Way, Lower Lake Kanturk, Lake Kanturk, Sams Lane, Gilbert Pond, Lake Killarney, Lake Kinsale, Royal Oaks Creek, Lake Tom John, Bull Run North, and Lake McBride watersheds (**Exhibit 5-1**). The total drainage area to Alford Arm is 28,891 acres. This collection of watersheds all drain into the upper end of Alford Arm immediately south of Buck Lake Road.



Photo 5-26: Lower Portions of Alford Arm from CSX Railroad Berm in 2022



Photo 5-27: Open Water Area in Upper Alford Arm in 2021

The drainage to Alford Arm includes a number of the other target waterbodies in this study including the Killlearn Chain of Lakes, Shakey Pond, and Lake Tom John. Alford Arm discharges into Lower Lake Lafayette across the CSX railroad berm, discussed earlier. Connections between Alford Arm and Lower Lake Lafayette include lower elevation culverts at various crossing points as well as higher elevation culverts designed to handle higher flow conditions. **Photo 5-28** shows the inflow channel at Buck Lake Road during a rain event. **Photo 5-29** shows a photo of two of the higher elevation culverts, at the time of the photo these culverts were completely blocked.



Photo 5-28: Discharge to Upper End of Alford Arm at Buck Lake Road During a Rain Event in 2023



Photo 5-29: High Flow Culverts through CSX Railroad Berm in 2023

5.4.2 Regulatory Status

The U.S. Environmental Protection Agency (EPA) is authorized under Section 303(d) of the Clean Water Act to assist states in the identification of impaired waterbodies and the calculation of total maximum daily loads (TMDLs) to these waterbodies. FDEP administers the 303(d) program in Florida. A waterbody on the FDEP's 303(d) list falls into one of several categories:

Category 4a – The waterbody is impaired but does not require TMDL development because a TMDL has already been completed.

Category 4b – The waterbody is impaired but will not require a TMDL to be developed because the waterbody will attain standards due to existing or proposed measures.

Category 4c – The waterbody is impaired, but the impairment is not caused by a pollutant and therefore does not require a TMDL.

Category 4d – The waterbody is impaired but the pollutant causing impairment is not known. A TMDL cannot be calculated until the pollutant is identified.

Category 4e – The waterbody is impaired, but ongoing or recently completed restoration activities are underway to restore designated uses, so a TMDL calculation is not necessary.

Category 5 – The waterbody is impaired, and a TMDL will be calculated.

Waterbodies in Florida on FDEP's 303(d) list are impaired. Waterbodies classified in Category 5 are placed on FDEP's comprehensive Verified List. When a waterbody is placed on the Verified List, FDEP is required by law to develop a TMDL. Waterbodies classified in Categories 4a through 4e are not on the comprehensive Verified List but are considered impaired. Generally, this means that more study is needed (4d) or FDEP has identified that local efforts are expected to restore the waterbody (4b and 4e).

FDEP has the option to develop basin management action plans (BMAPs) for waterbodies that have adopted TMDLs. A BMAP is a framework for water quality restoration in various forms containing commitments at local and state levels. These broad-based plans are developed with local stakeholders, including cities and counties. Once these plans are adopted by FDEP Secretarial Order, they are legally enforceable. FDEP also has a process by which local entities can initiate restoration activities in lieu of development of a TMDL. This type of activity fits under the 4e and 4b categories. These are locally driven restoration efforts with a goal to meet water quality standards. This process is often favored because it puts control in the hands of the local stakeholders to determine what is needed to restore their waterbodies rather than FDEP dictating the terms of a load reduction and is also much faster than the traditional TMDL/BMAP pathway, which can take more than a decade.

Presently, five verified impaired waterbodies are within the Lake Lafayette Drainage Basin.

Exhibit 5-2 displays the five verified impaired waterbody identification segments (WBIDs) along with a table listing the WBID, waterbody name, parameters assessed, and thresholds for each parameter. These are as follows.

- Lake Tom John (WBID 647A), which flows into Lake Kinsale within the Killearn Chain of Lakes is verified for nutrients with exceedances of the Chl-a, total nitrogen (TN), and total phosphorus (TP) thresholds. Lake Tom John is one of the target waterbodies for this study and the impairments are discussed further in **Section 5.6.2**.
- Lake McBride (WBID 647E) is verified for nutrients with exceedances of the Chl-a and TP thresholds. The verified listing is based upon data from 2017 and 2019 where Chl-a annual geometric means (AGMs) exceeded the target and TP AGMs were above the minimum threshold. Lake McBride is the most upstream waterbody in the Lake Lafayette Basin. Flow out of Lake McBride travels approximately 2 miles prior to entering a large treatment pond to the west of Thomasville Road. Discharge from the treatment pond crosses Thomasville Road and flows into the upper end of Lake Kinsale.
- Shakey Pond (WBID 647I), which at times discharges into creeks above Alford Arm, is verified for nutrients with exceedances of the Chl-a and TP thresholds. Shakey Pond is one of the target waterbodies for this study and the impairment and ongoing restoration efforts are discussed further in **Section 5.7.2**.
- Piney Z Lake (WBID 756B), which is part of the Lafayette Chain of Lakes, is verified impaired for nutrients with exceedances of the Chl-a, TN, and TP thresholds. The impairment is based on the waterbody not meeting the criteria for its designation as a clear acidic lake for numerous years in the verified period from 2015 to 2022. In 2018 the City requested that FDEP modify the impairment to 4C (impairment not caused by a pollutant). The City identified that the lake needs a healthy macrophyte community in order to maintain good water quality. However, based on fishery management by FWC and the release of Carp (as discussed previously) the macrophyte community was lost. FDEP did not modify the listing but agreed with the City that the sterile Carp should reach their life span in the early 2020s and therefore the macrophyte community should recover, thus naturally improving water quality.

- Virginia Tributary (WBID 883B) which includes the Park Avenue Ditch is impaired for fecal coliform. However, fecal coliform is no longer the applicable bacteria parameter for its waterbody classification. In addition to the verified impairments listed above, four waterbodies in the Lake Lafayette Basin have alternative restoration plans. These include the Lake Kinsale (WBID 647K), Lake Killarney (WBID 647J), Lake Kanturk (WBID 647F) and Upper Lake Lafayette (WBID 756F). Lakes Kinsale, Killarney, and Kanturk are target waterbodies for this study and the alternative restoration plan is discussed further in **Section 5.5.2**.

Upper Lake Lafayette (WBID 756F) is presently in category 4e (ongoing restoration plans). The City initially submitted documentation in support of a 4e determination for Upper Lake Lafayette in 2012, which outlined plans for the retrofit of Weems Pond into the ULL-NRF, which provides chemically enhanced treatment of flow from the NEDD. The 4e designation was accepted based on determinations that the facility would provide treatment levels for nutrients, total suspended solids (TSS), biochemical oxygen demand (BOD), and bacteria greater than that identified in an EPA TMDL. The ULL-NRF went into operation in October of 2015, and in 2017, the final status update was provided on the 4e designation. For the status update, measured reductions in nutrients, TSS, BOD, and bacteria were provided based on monitoring of the facility performance at inflow and discharge, which demonstrated that the ULL-NRF is performing as designed and as documented in the 2012 4e submittal. In fact, the update showed that discharges are exceeding load reductions required in the original TMDL. The update also noted that Upper Lake Lafayette samples are generally measured in the sink and may not reflect true lake conditions since other stressors, outside of surface water inputs, are contributing to the conditions in the sink.

5.4.3 Waterbody Data Review and Summary

This section presents an overview of available data and data sources for the Lafayette Chain of Lakes and the Lake Lafayette Basin including bathymetry, land use, soils, septic systems, hydrologic measurements, surface water quality, groundwater quality, biological, stormwater treatment facilities, and atmospheric deposition.

5.4.3.1 Bathymetry

Bathymetric data were developed for the four waterbodies in the Lafayette Chain of Lakes as part of this study. As part of the 2005 Existing Status and Management Plan by ERD contour plots for the four waterbodies were developed. The following provides an overview of the depths in each segment based on the 2005 study.

The typical water surface elevation of Piney Z Lake is around 46 ft, with the lowest bottom elevations around 37 ft, which means the maximum depth during typical conditions is around 9 ft, with average depths throughout the lake around 5 ft.

Lower Lake Lafayette water surface elevation is around 45 ft, with the lowest bottom elevation in a hole along the southern side at 37 ft, which means the maximum depth is on the order of 7 to 8 ft in the one deeper hole. Average depths are around 3 to 4 ft.

Alford Arm water surface elevation is around 45 ft. The lowest bottom elevations are around 40 ft, resulting in maximum depths around 5 ft. Average depths in the waterbody are around 3 ft.

As discussed previously, the water levels in Upper Lake Lafayette fluctuate significantly depending upon rainfall. In the area of the sink, during dry periods, the lake surface elevation is on the order of 24 ft. When the lake is near full, the area of the lake is 373 acres and has a surface elevation of around 40 ft. When the lake is full, depths average around 7 to 8 ft throughout most of the lake area with depths in the sink around 16 ft.

5.4.3.2 Land Use

Land use is the term used to describe the general purpose or function of a given area of land. It can represent economic and cultural activities, or it can depict the physical nature of the land (known as land cover). Land use categorization is used for planning and regulation purposes and assists agencies in keeping track of geographic areas for their respective organization purposes, such as zoning or environmental management. Impacts to waterbodies from watershed loading are evaluated, in part, as a function of land use. Event mean concentrations (EMCs) are utilized for simulating water quality concentrations in stormwater runoff. Pollutant loads are a function of pollutant concentration and volume of runoff. Land use types are used to determine appropriate EMCs when assessing water quality impacts from stormwater.

For the purpose of this study, the Level 2 Florida Land Use Cover Classification System (FLUCCS) codes were used to be consistent with classifications used to generate EMC values, which dictate pollutant loading with respect to precipitation and land use types. **Exhibit 5-3** presents a map of the Level 2 land uses within the Lake Lafayette basin. A table is provided to show the overall acreages and percent cover for the various levels. Tables are provided for both the Level 2 and grouped Level 1 land uses. The largest land use types within the Lake Lafayette basin per the grouped Level 1 categories are Urban and Built Up (46 percent, **Exhibit 5-3**) and Upland Forest (30 percent, **Exhibit 5-3**). Within the Urban Built-Up category, Medium Density and Low Density Residential take up the largest portions (19 percent and 15 percent respectively). The highest concentration of anthropogenic land use categories are clustered around the southern and western sides of the basin that drain directly to Upper Lake Lafayette. The northern areas of the basin are split between residential areas upstream of the Killlearn Chain of Lakes and forested areas in the northeastern areas that drain to Alford Arm. Wetland areas make up around 9 percent of the basin, agriculture around 7 percent and water around 2 percent. Approximately 49 percent of the basin is categorized as developed (combining level 1 FLUCCS for Urban and Built Up with Transportation, Communication, and Utilities) mainly located upstream of Upper Lake Lafayette and the Killlearn Chain of Lakes.

5.4.3.3 Soils

Soil classifications for the study were determined from the area's hydrological soil group category. Hydrologic soil groups are based on estimates of runoff and infiltration potential. The Natural Resource Conservation Service (NRCS), an agency of the U.S. Department of Agriculture (USDA), delineates four primary soil groups (A, B, C, and D) as well as three dual classes (A/D, B/D, and C/D). Group A soils are characterized as having high infiltration rates with low runoff potential, and each subsequent group is characterized by an iteratively lower infiltration rate and higher runoff potential, ending with Group D soils being designated as having very low infiltration rates with high runoff potential. The dual classes represent

conditions where infiltration rates under dry conditions would be per the primary soil type, but due to high groundwater levels in these areas, infiltration is low.

The most prevalent soil group in the Lake Lafayette Drainage Basin is Group B (47.4 percent per **Exhibit 5-4**). Group B soils are considered to have a moderate rate of infiltration. The Group B soils are spread throughout the basin. The second highest percentage soil group is Group C (26.9 percent). Group C soils are considered to have slow rates of infiltration (**Exhibit 5-4**). These too are dispersed throughout the basin other than in the northwestern areas of the basin to the west of Lake McBride, and in areas immediately surrounding the Lafayette Chain of Lakes where Group C soils are dominant. Group A/D and B/D soils are located near the open waterbodies and tributaries. These are considered to have high to moderate infiltration potential, but due to elevated groundwater table conditions, act more similarly to soils with low infiltration potential.

5.4.3.4 Septic Systems

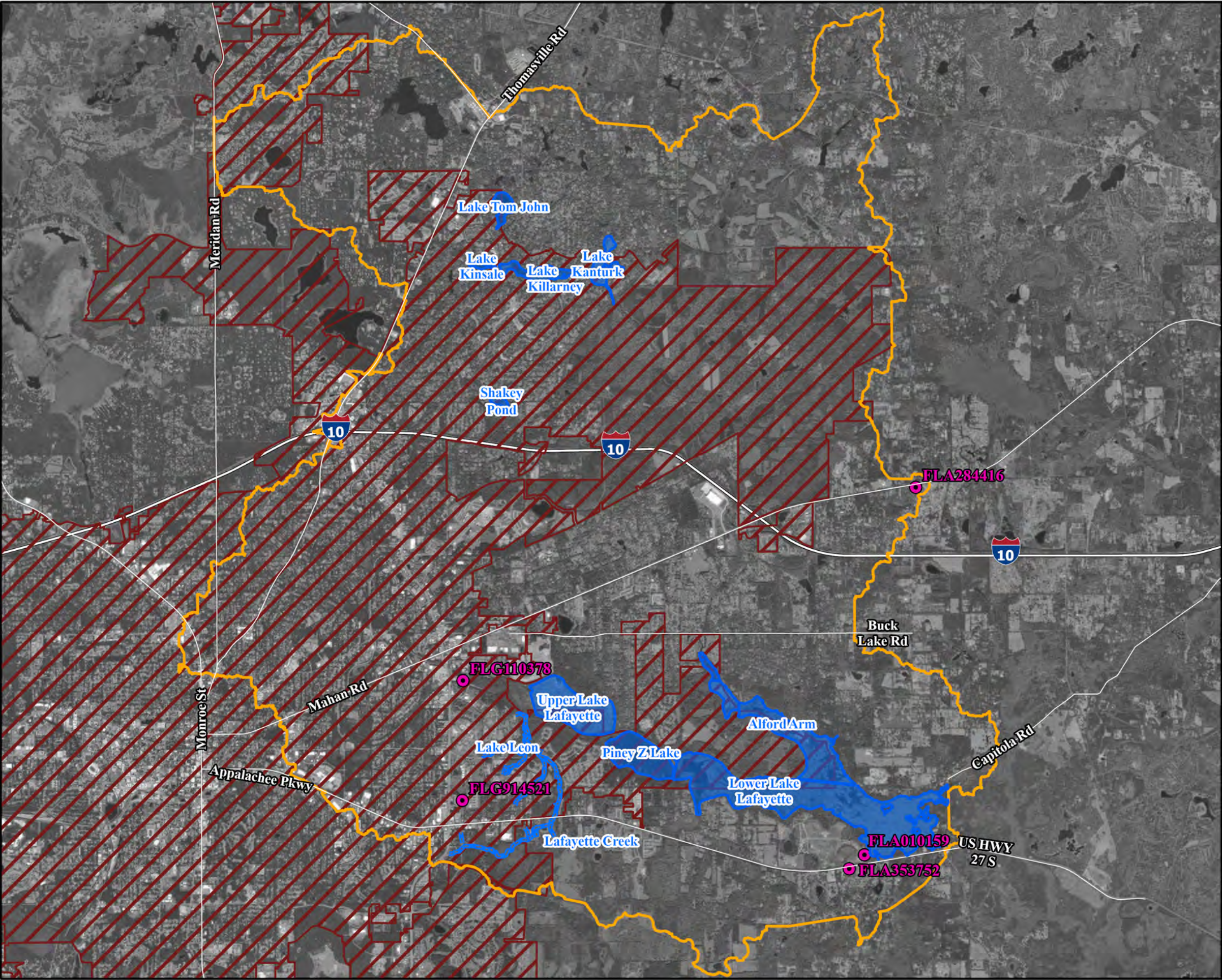
An estimated 8,378 septic tank units are within the boundaries of the Lake Lafayette basin based on the Florida Department of Health (FDOH) septic tank layer (**Exhibit 5-5**). Effluent from septic tanks that are in good condition should be comparable to secondarily treated wastewater from sewage treatment plants. However, septic systems can be a source of pollutants, pathogens, and nutrients and are identified by FDEP as a potential source of bacteria and nutrients to waterbodies in its assessment processes.

For recent TMDL analyses, FDEP uses a radius of 200 meters to analyze direct contribution of nutrient loads from septic systems to a waterbody. Within that buffer, the Lafayette Chain of Lakes is in proximity to almost 127 septic systems. Accounting for tributaries that directly drain into the Lafayette Chain of Lakes, that number rises to over 750 septic systems. Septic nutrient loads to a waterbody are a function of the number of septic units, the number of people per household, the soil conditions in the area, groundwater table conditions, and if the systems are working properly. As discussed in **Section 5.4.3.3**, there are extensive areas around the Lafayette Chain of Lakes with Group B and C soils which have moderate to low infiltration potential, respectively. The Lafayette Chain of Lakes has large clusters of septic systems on the southern side and along tributaries that drain directly to Alford Arm, with many of the units within the 200-meter buffer (of the lake or directly draining tributaries) dwelling on Group B and C soils.

5.4.3.5 Point Sources

Permitted facilities within the Lake Lafayette basin were identified based on a facilities list provided by the City and information from FDEP's Oculus platform. **Figure 5-2** presents the locations of active permitted facilities identified within the Lake Lafayette basin. **Table 5-2** outlines the key facility attributes including facility name, permit number, and the type of discharge (point discharge or land application).

The two point source discharges, Ready Mix USA and Sams Club, are located in the NEDD and Park Avenue Ditches upstream of Weems Pond. The Pan Food Store Number 2 car wash is located on a tributary that drains to Alford Arm and consists of land application. The remaining two facilities, Meadow at Woodrun WWTF and the Pan Food Store Number 1 car wash are located to the north and south of US Highway 27 respectively south of the eastern end of Lower Lake Lafayette, these are both land application types.



Legend

- Lake Lafayette Drainage Basin
- Waterbodies in Study
- Tallahassee Corporate Limits
- Point Source Facilities

Sources:
Waterbodies: COT, 2020
Drainage Basins: COT, 2020
Roads: FDOT, 2020
City Limits: COT, 2022
Point Source Facilities: COT, 2020

Figure 5-2:
Active Point Source Facilities within the
Lafayette Chain of Lakes Basin

Tallahassee Master Plan - Surface
Water (TMaPS)



Table 5-2: Summary Table of Active Point Source Facilities within the Lake Lafayette Basin

Site Name	Permit Number	Discharge Type
Meadow at Woodrun WWTF	FLA010159	Land Application
Pan Food Store No 1 Car Wash	FLA353752	Land Application
Pan Food Store No 2 Car Wash	FLA284416	Land Application
Ready Mix USA Weems Road Plant	FLG110378	Point Source
Sams Club 8120	FLG914521	Point Source

5.4.3.6 Hydrologic Data

Rainfall station locations and data were retrieved from NFWMD. There are six stations located throughout the Lake Lafayette basin (**Exhibit 5-6**). Five of the six stations have records from the late 1980s through the present. **Figure 5-3** presents the annual precipitation from station 011296, which is located in the center of the basin. While other stations showed differences for individual rain events, the annual totals and patterns are similar. Overall, the data show that rainfall levels range from less than 40 inches in various years to a maximum of more than 85 inches in 1994.

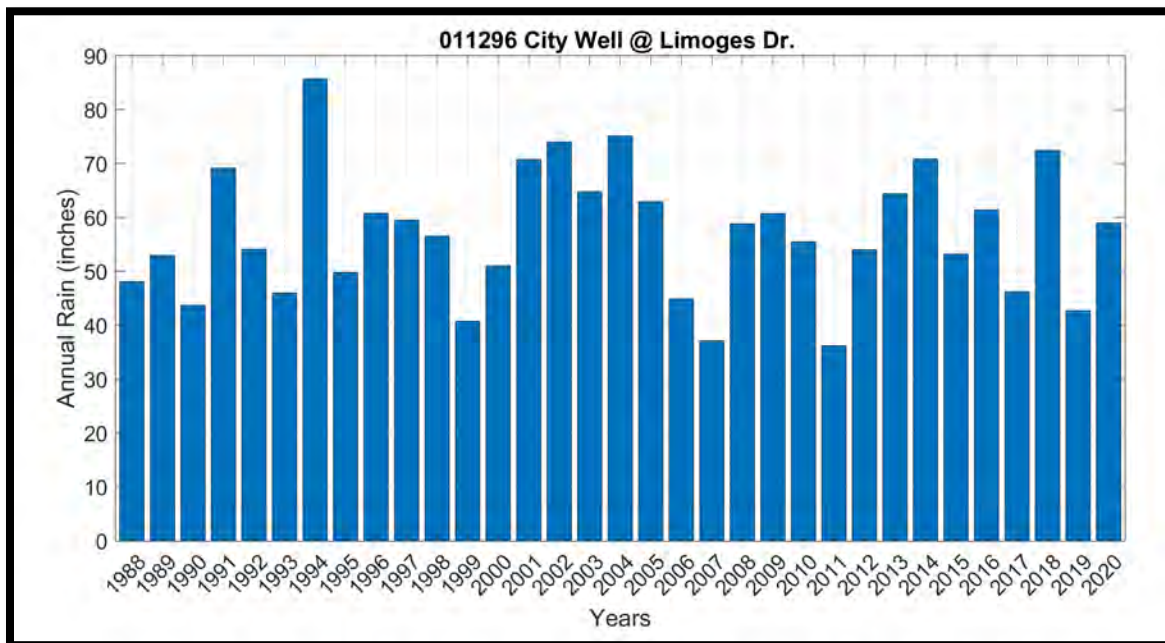


Figure 5-3: Annual Rainfall in the Lake Lafayette Basin (1987 to 2020)

Lake stage data were retrieved from NFWMD with the locations shown on **Exhibit 5-6**. Four stations were downloaded within open waterbodies: Lake Lafayette Outfall at Chaires Cross Road (008471), Lake Kinsale (012547), Lake Killarney (012548) and Lake Kanturk (012549). The other stations identified with stage data are along tributaries. Only the lake levels are plotted.

Figure 5-4 presents the measured water levels in Lower Lake Lafayette in the outfall channel (008471). The stages at the downstream end of Lower Lake Lafayette range over around 8.0 ft. Prior to 2012, it appears there was a limitation on the stage gage that it did not record lower levels below 41.5 ft referenced to the North American Vertical Datum of 1988 (ft-NAVD88). After 2012, the data show levels as low as 40.0 ft-NAVD88. The measured water levels in the Killearn Chain of Lakes are presented and discussed in **Section 5.5.3.5**.

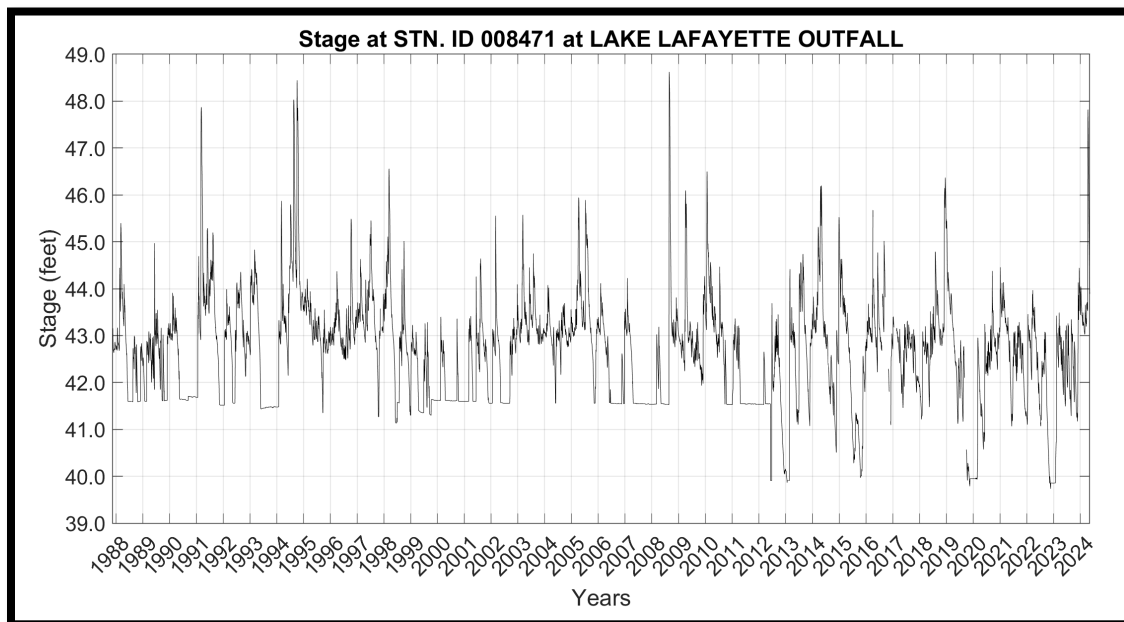


Figure 5-4: Water Level at Lower Lake Lafayette Outfall Station 008471 (1988 to 2020)

Continuous direct discharge data are available at five stations throughout the Lake Lafayette Basin (**Exhibit 5-6**), including a station on the Park Avenue Ditch (008479), a station on the NEDD upstream of the confluence with the Park Avenue Ditch (008474), a station immediately upstream of the inflow to Alford Arm (008460), a station along the tributary to Alford Arm upstream of I-10 (008459), a station immediately downstream of the discharge from Lake Kanturk (008469), and a station at the outfall from Lower Lake Lafayette where it crosses Chaires Road. Data for these stations span from the 1980s and 1990s through the present. The discharge from Lake Kanturk is presented in **Section 5.5.3.5**.

Figure 5-5 and **Figure 5-6** present plots of the measured daily average flows along the NEDD. The measured daily average flows along the Park Avenue Ditch (**Figure 5-5**) generally ranged between 0 cubic feet per second (cfs) and 30 cfs with peak flows ranging between 100 cfs and 500 cfs. The measured flows along the NEDD upstream of the confluence with the Park Avenue Ditch (**Figure 5-6**) ranged between 0 cfs and 100 cfs with peak flows between 200 cfs and 800 cfs. One value over 1,600 cfs was measured in 2001.

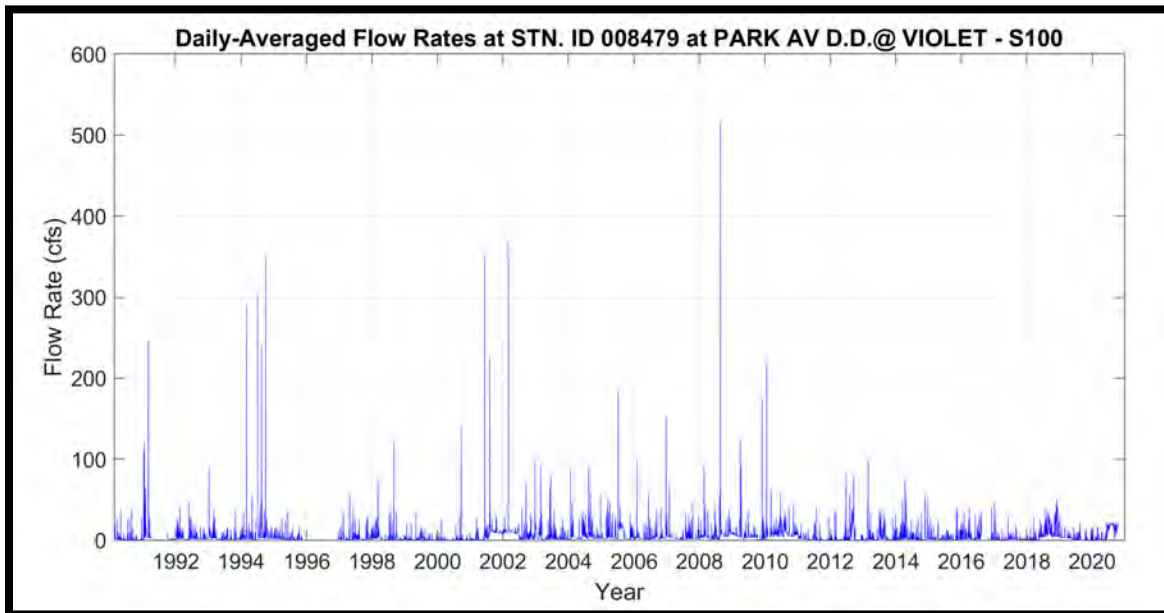


Figure 5-5: Flows on Park Avenue Ditch Station 008479 (1990 to 2020)

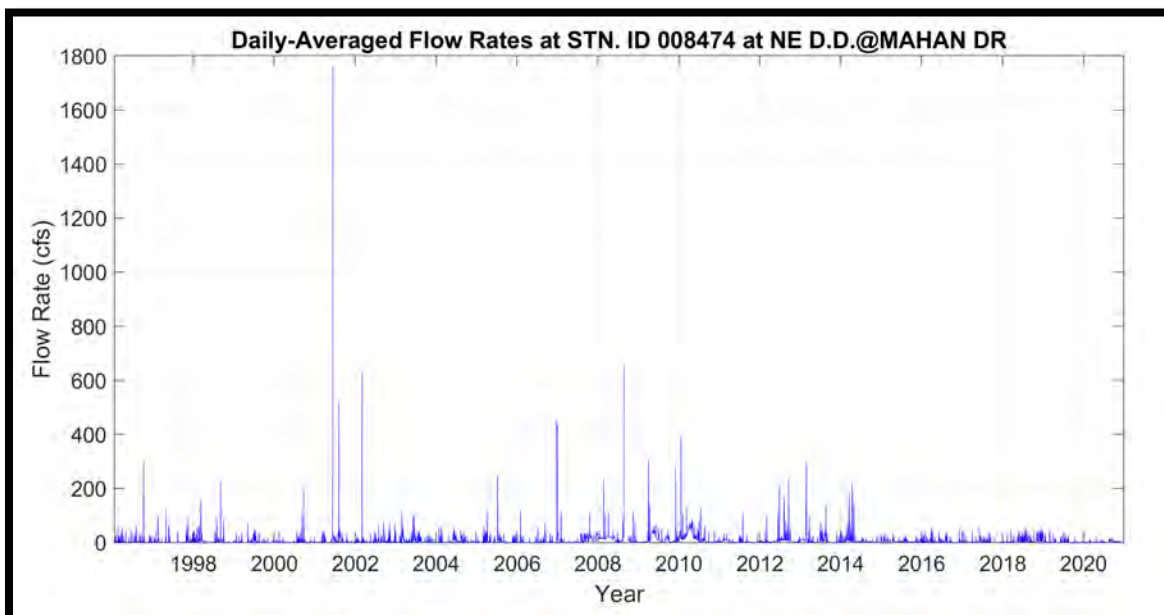


Figure 5-6: Flows on NEDD Station 008474 (1996 to 2020)

Figure 5-7 and **Figure 5-8** present the daily average flows along the tributary to Alford Arm. The upstream station just north of I-10 (008459) has flow rates generally between 0 and 100 cfs with some periods of continuous flow. The highest measured flows are on the order of 500 to 600 cfs. The downstream station at Buck Lake Road (008460) has slightly higher flows with similar characteristics. The highest measured flows at this station are between 600 and 700 cfs, indicating somewhat limited pickup of additional flow between the stations.

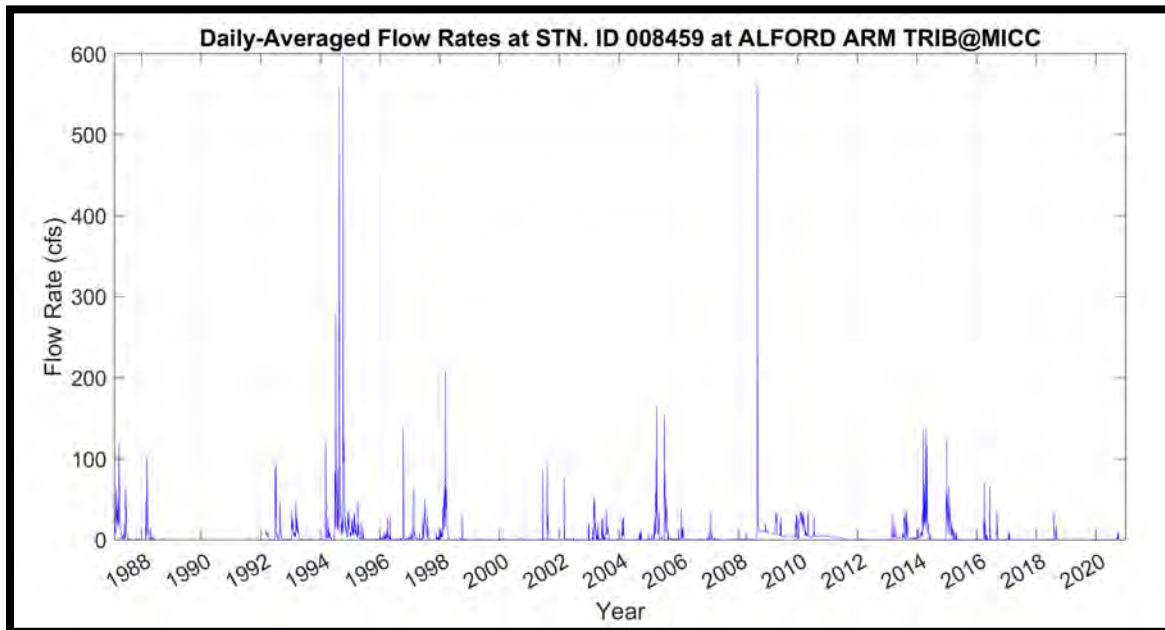


Figure 5-7: Flows on Alford Arm Upstream of I-10 Station 008459 (1987 to 2020)

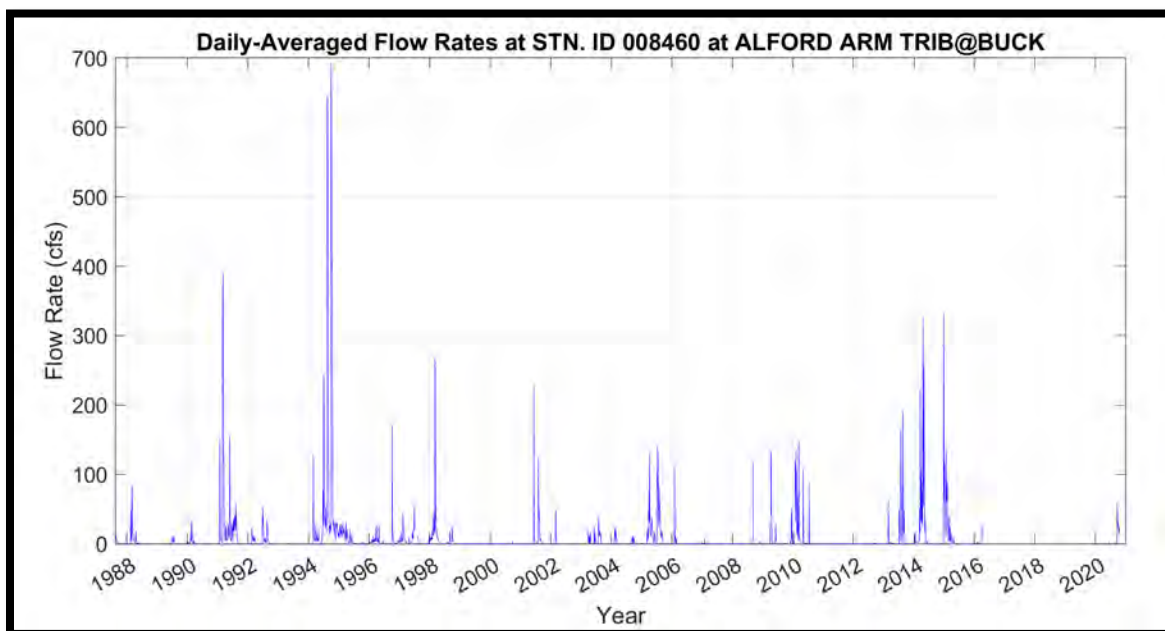


Figure 5-8: Flows on Alford Arm at Buck Lake Road Station 008460 (1987 to 2020)

Figure 5-9 presents the daily average flows out of Lower Lake Lafayette. The data are only available for a 2-year period from late 2014 through 2016, with the highest flows between 140 and 180 cfs.

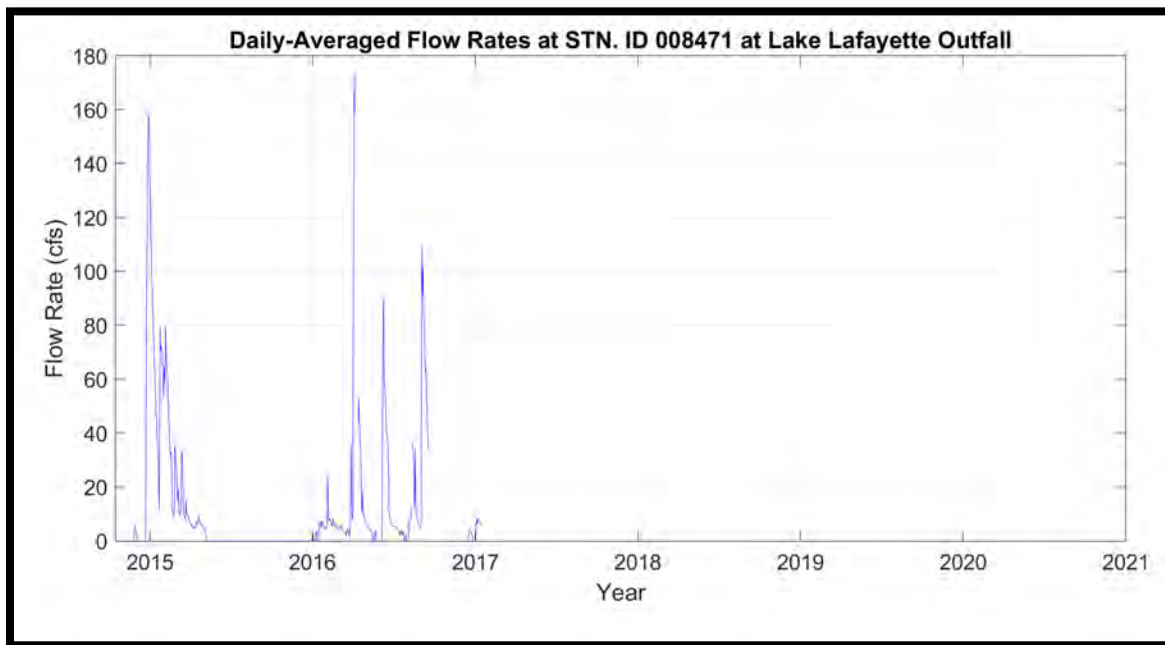


Figure 5-9: Flows at Lower Lake Lafayette Outfall Station 008471 (2014 to 2017)

5.4.3.7 Surface Water Quality Data

Water quality data were retrieved from the FDEP Impaired Waters Rule (IWR) and City databases. The IWR outlines FDEP’s methodology to identify waters that will be included in the 303(d) list. The IWR database is a collection of stations that are used to assess ambient water quality of surface waterbodies. The stations are not necessarily managed by FDEP, but any relevant data from various agencies are included for the purpose of collecting pertinent information for a given body of water.

The water quality dataset for the Lafayette Chain of Lakes and the tributaries discharging to the lakes spans from 1974 to 2020 and includes contributions from local, state, and national agencies [City, Leon County, NFWMD, FDEP, FWC, FL LAKEWATCH, and the U.S. Geological Survey (USGS)], as well as private sector firms [Biological Research Associates (BRA), McGlynn Lab]. The IWR contains multiple parameters that are monitored, for our purposes the primary parameters are nutrients (and nutrient related parameters) and bacteria. **Figure 5-10** presents the locations of in-lake water quality monitoring stations for the Lafayette Chain of Lakes (yellow) along with stations that provide water quality data along tributaries that flow directly into the Lafayette Chain of Lakes (red). A table is provided in **Figure 5-10** that shows the station identification (ID), station name, period of record, and if the station represents in-lake or inflowing tributary data (upstream of the lakes).

Based on the number of stations and the length of the station IDs, station IDs were not provided directly onto the figure, rather each of the stations is given a number and the numbers correspond to stations in the table. Stations upstream of the outfall from Lake Kanturk (within the Killearn Chain of Lakes watershed) along with stations on Lafayette Creek are not shown in this figure. These stations are part of other target waterbody sections presented later in this document.

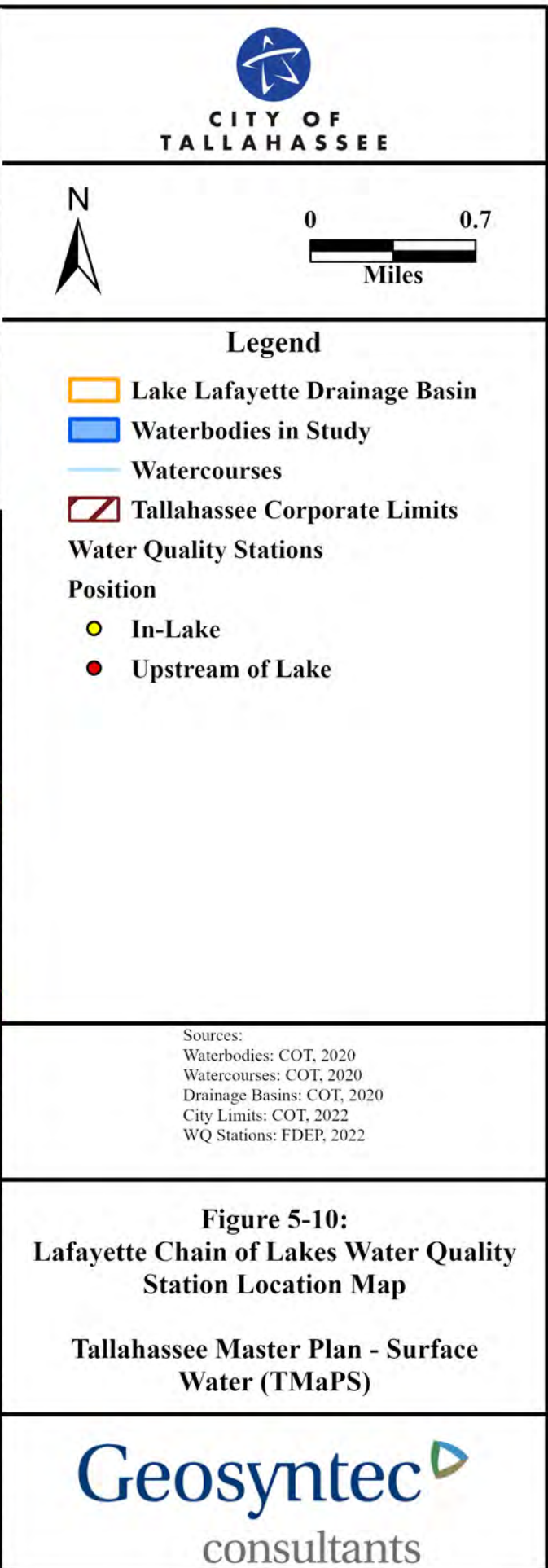


Figure 5-10 shows that there are stations located throughout each of the lakes within the chain as well as along the various tributaries that drain to the lakes. The tributary data support the qualitative assessment of potential sources in **Section 5.4.4**.

Some initial plots of the available data in the lake are provided in this section, including plots of the data and analyses of AGMs against numeric nutrient criteria (NNC). As nutrients are the primary constituent of interest relative to water quality conditions in the Lafayette Chain of Lakes, plots are provided for the key parameters related to potential nutrient impairment which include TN, TP, Chl-a, and Trophic State Index (TSI). Additionally, based on interest in the area relative to septic systems and other sources, bacteria, specifically *Escherichia coli* (*E. coli*) are included. Additional data plots and analyses are provided as part of the qualitative assessment of sources in **Section 5.4.4**. For the data plots and analyses, only data after 2010 are presented or analyzed since the goal of this study is to assess present conditions. Some discussions of the historic measurements are provided in the text that follows where significant changes have occurred.

Through the analysis of the TN data for the Lafayette Chain of Lakes and other waterbodies in the Lake Lafayette basin, issues were identified relative to how certain TKN data were used in the calculation of TN. **Appendix A** presents a short write up of the issues encountered and how they were rectified to get the TN levels utilized in the analyses below.

Figure 5-11 through **Figure 5-19** presents plots of the measured TN, TP, and Chl-a data from 2010 to 2020 for Upper Lake Lafayette, Piney Z Lake, and Lower Lake Lafayette. No samples were available within Alford Arm after 2010 due to issues with sample collection.

Upper Lake Lafayette TN concentrations range between 0.2 milligrams per liter (mg/L) up to near 3.0 mg/L (**Figure 5-11**). TP concentrations range between 0.05 mg/L and 0.2 mg/L with some higher values upwards of 0.3 mg/L (**Figure 5-12**). Chl-a concentrations range up to 40 µg/L between 2010 and 2015 with higher values after 2015 upwards of 100 µg/L (**Figure 5-13**).

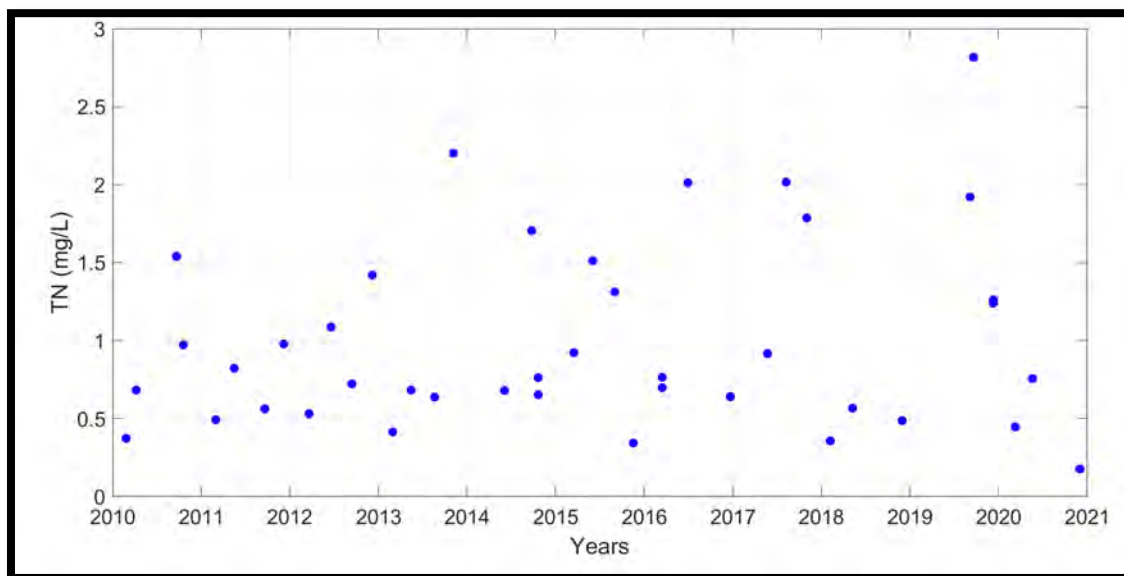


Figure 5-11: Plot of Measured TN Concentrations in Upper Lake Lafayette (2010 to 2020)

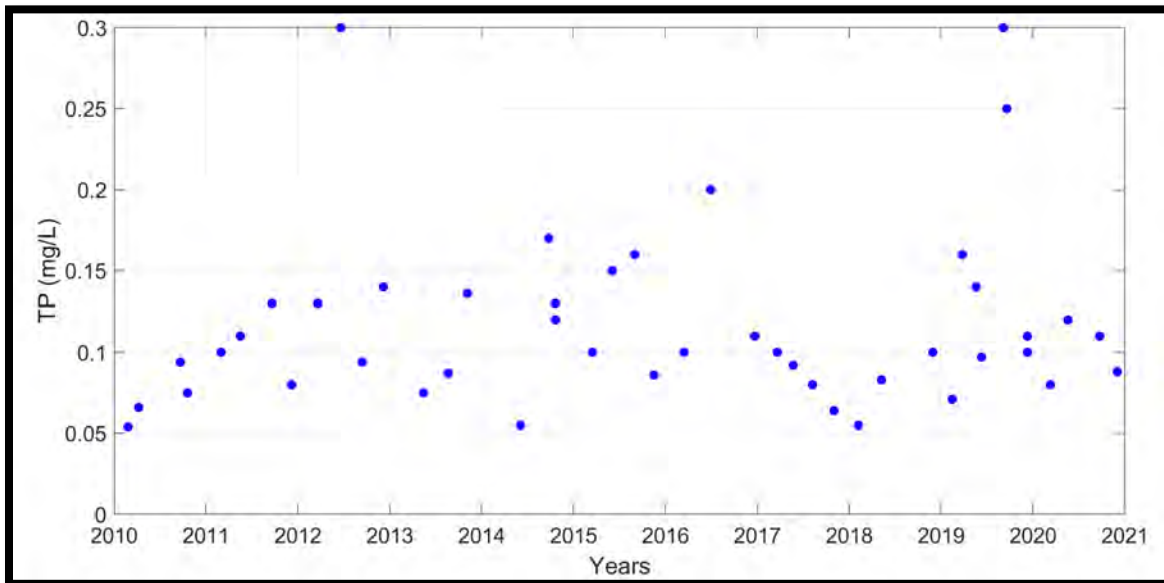


Figure 5-12: Plot of Measured TP Concentrations in Upper Lake Lafayette (2010 to 2020)

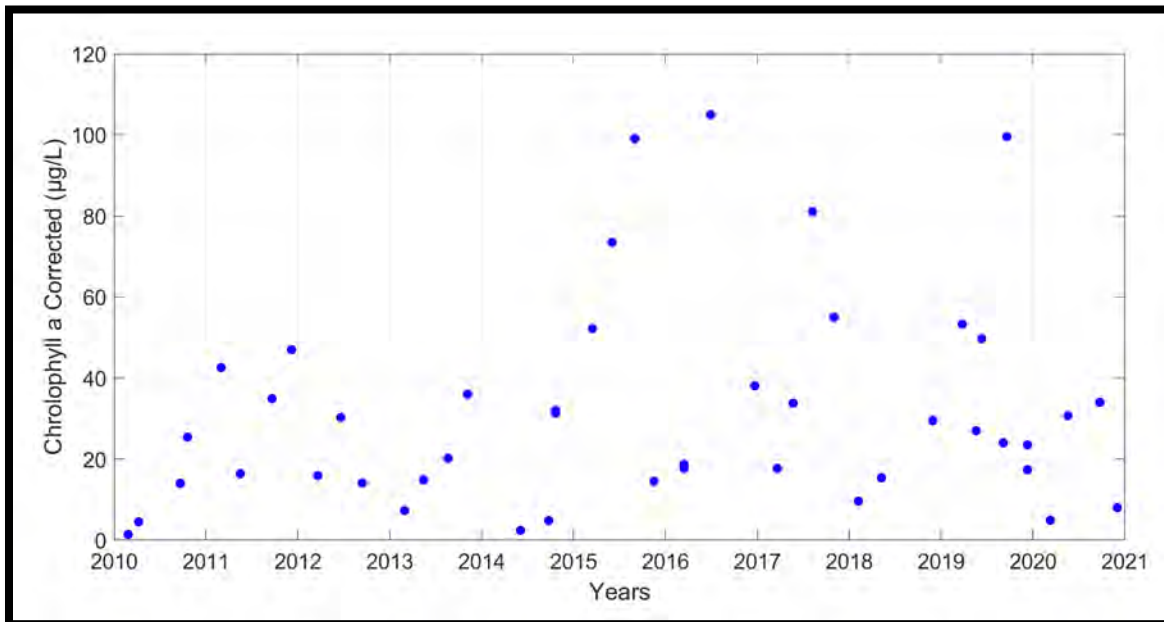


Figure 5-13: Plot of Measured Chl-a Concentrations in Upper Lake Lafayette (2010 to 2020)

Piney Z Lake TN concentrations ranged between less than 0.5 mg/L up to around 2.0 mg/L with a significant downward shift in the concentrations after 2015 (**Figure 5-14**). TP concentrations range between near 0.0 mg/L and 0.1 mg/L with a downward trend overall (**Figure 5-15**). Chl-a concentrations range up to around 80 µg/L with a general downward trend and a drop off after 2014 (**Figure 5-16**).

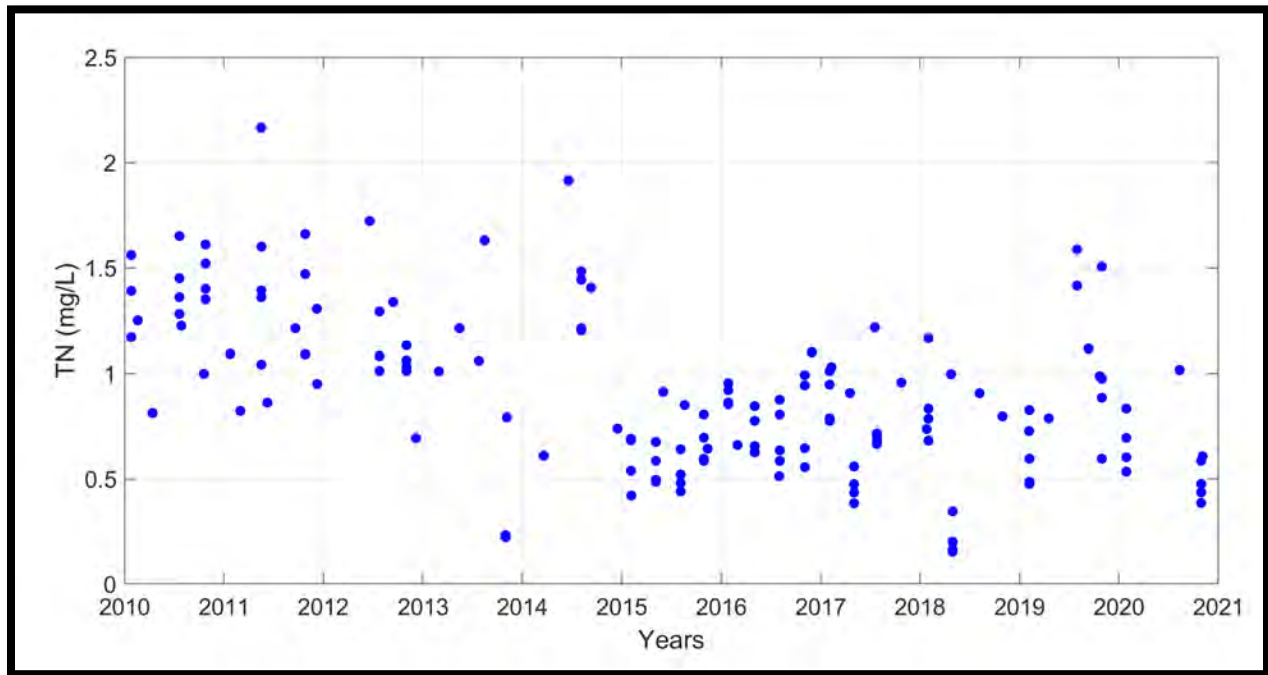


Figure 5-14: Plot of Measured TN Concentrations in Piney Z Lake (2010 to 2020)

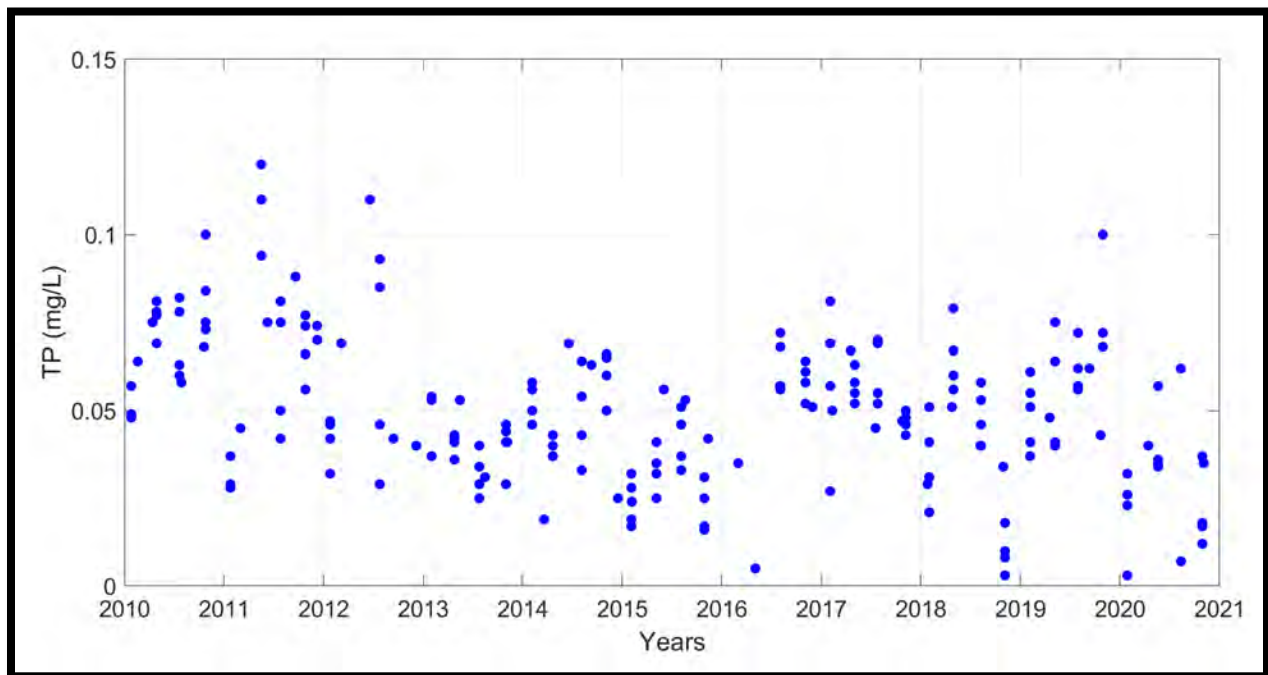


Figure 5-15: Plot of Measured TP Concentrations in Piney Z Lake (2010 to 2020)

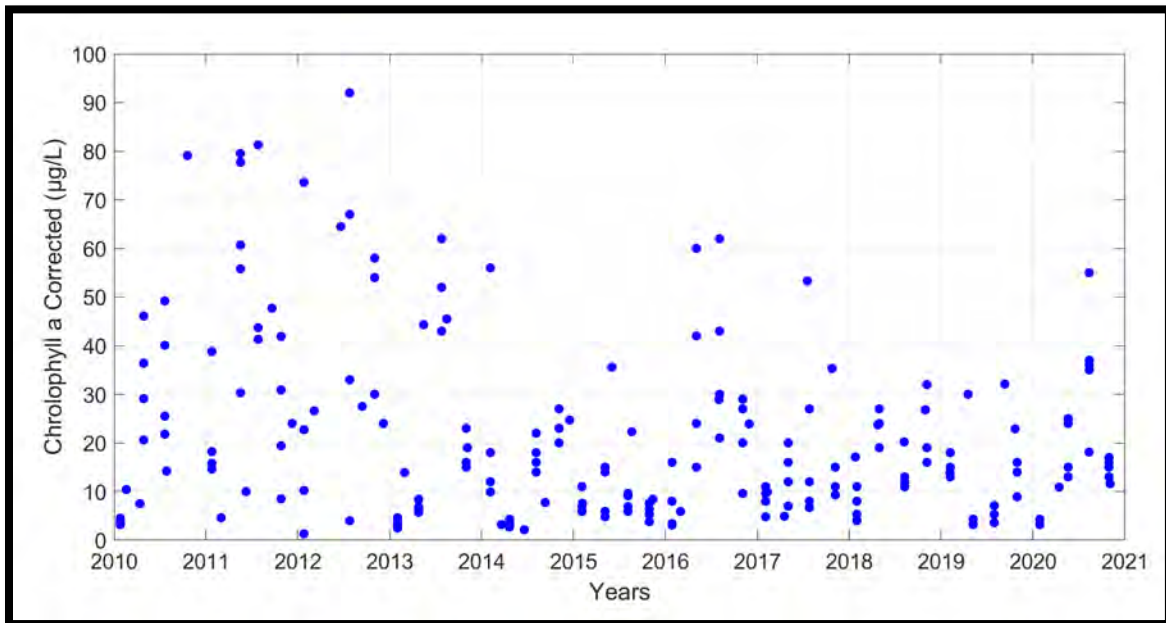


Figure 5-16: Plot of Measured Chl-a Concentrations in Piney Z Lake (2010 to 2020)

While data were more limited, Lower Lake Lafayette had the lowest nutrient and Chl-a concentrations of the three waterbodies. TN concentrations ranged between less than 0.5 mg/L up to around 1.0 mg/L with no significant visual trend (**Figure 5-17**). TP concentrations were generally less than 0.05 mg/L again with no visible trend (**Figure 5-18**). Chl-a concentrations were mostly less than 20 µg/L with no visible trend (**Figure 5-19**).

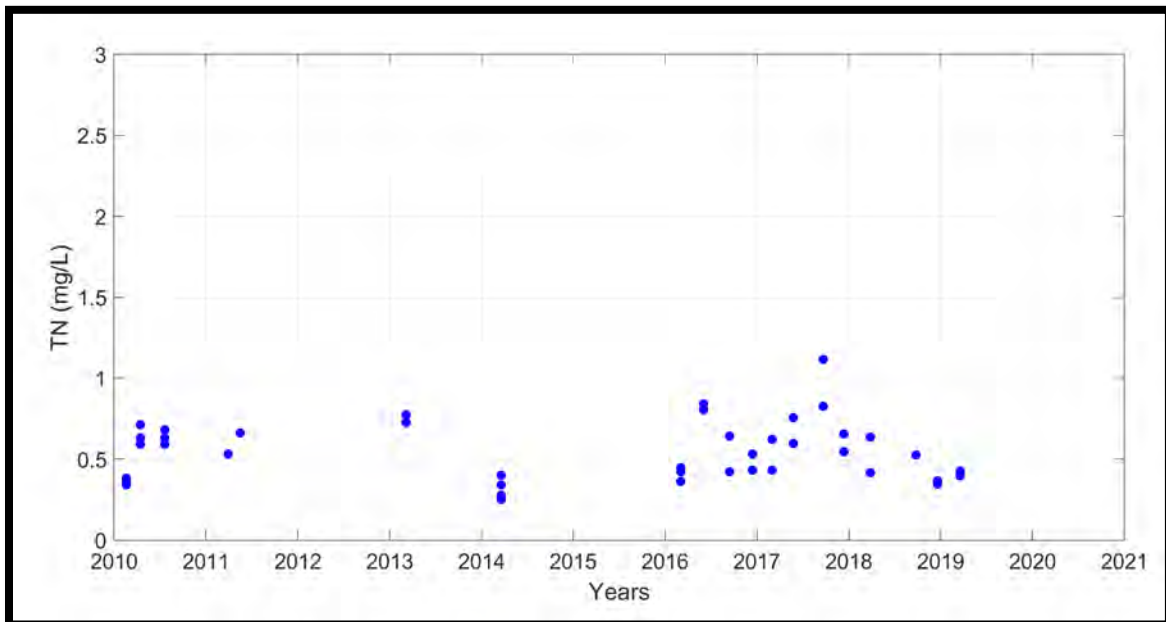


Figure 5-17: Plot of Measured TN Concentrations in Lower Lake Lafayette (2010 to 2020)

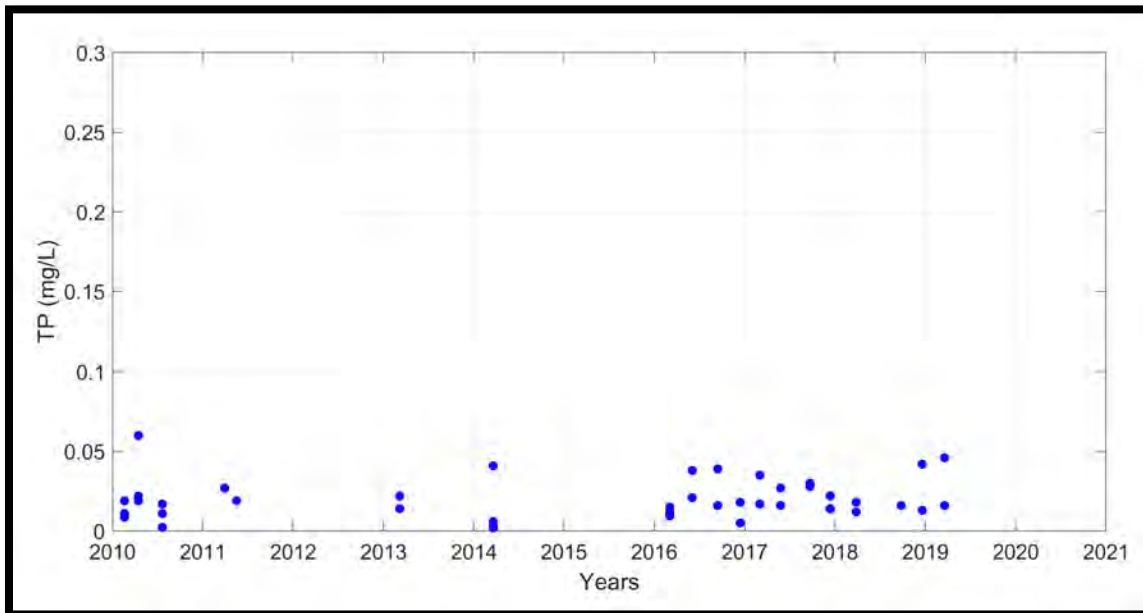


Figure 5-18: Plot of Measured TP Concentrations in Lower Lake Lafayette (2010 to 2020)

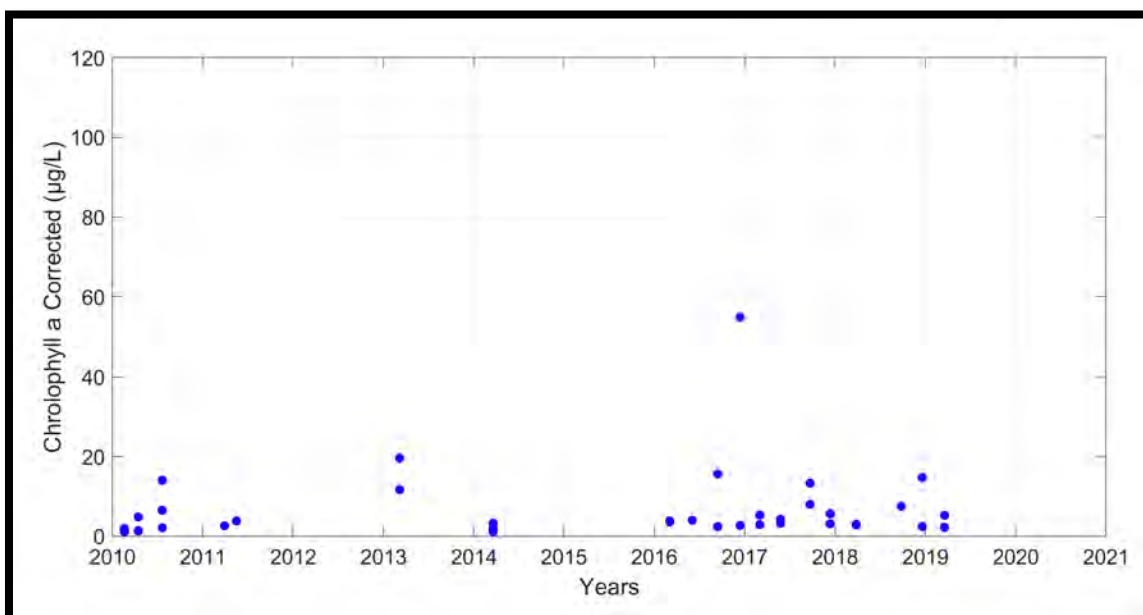


Figure 5-19: Plot of Measured Chl-a Concentrations in Lower Lake Lafayette (2010 to 2020)

Under FDEP's NNC, each of the four waterbodies have different requirements due to their unique characteristics. Upper Lake Lafayette is defined as a low color high alkalinity system. Based on this designation, the AGM threshold for Chl-a is 20 µg/L. For TN and TP, a range of concentrations are allowed, based on maintaining Chl-a concentrations below 20 µg/L. For TN, the range is 1.05 mg/L to 1.91 mg/L. For TP, the range is 0.03 mg/L to 0.09 mg/L. TN or TP levels below the minimum indicate the system is not impaired for either parameter, levels above the maximum would indicate impairment, measurements in between are allowable so long as the Chl-a levels that coincide with

the nutrient concentrations are below the 20 µg/L threshold. Piney Z Lake is defined as a low color, low alkalinity system. The AGM threshold for Chl-a is 6 µg/L. The TN range is 0.51 mg/L to 0.93 mg/L. The TP range is 0.01 mg/L to 0.03 mg/L. Lower Lake Lafayette and Alford Arm are defined as high color, low alkalinity systems. The AGM threshold for Chl-a is 20 µg/L. The TN range is 1.27 mg/L to 2.23 mg/L. The TP range is 0.05 mg/L to 0.16 mg/L.

Historically, FDEP utilized TSI as a metric for determination of surface waterbody impairment due to nutrients. TSI is a classification system designed to “rate” lakes based on the amount of biological productivity occurring in the waterbody, with higher TSI values indicative of more productive lakes. The calculations are based on a scale from 1 to 100. Lakes with TSI values less than 60 were considered good, lakes with values between 60 and 69 were considered fair, and lakes with values greater than 70 were considered poor. While no longer utilized for assessment of impairment, the TSI index remains a tool for evaluating potential nutrient enrichment and biological productivity. Therefore, data on TSI are presented against the thresholds listed above.

For *E. coli*, the criteria are monthly geometric means below 126 colonies per 100 milliliters (mL) of water and less than 10 percent of samples above 410 colonies per 100 mL of water in any 30-day period. Generally, insufficient samples are available to assess the monthly geometric means, therefore, the criteria most used for assessing *E. coli* is the 410 colonies per 100 mL. For the purposes of this report, the *E. coli* are presented against the 410 threshold to see if more than 10 percent of the available data are above it.

TN, TP, and Chl-a AGMs are plotted in **Figure 5-20** through **Figure 5-28** for the three waterbodies with data. Where sufficient data are available (based generally on the IWR rule requirements) to assess the AGMs, the levels are provided from 2010 through 2020. The Chl-a threshold and the minimum and maximum thresholds for TN and TP relative to the NNC are provided on each of the graphs as pink dashed lines.

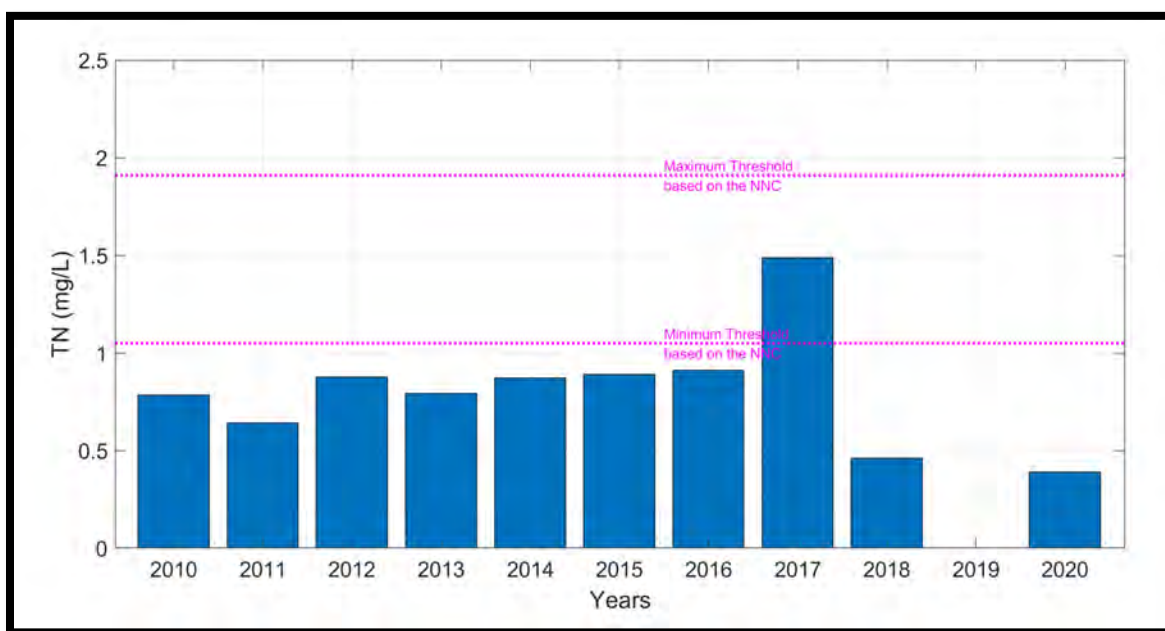


Figure 5-20: Plot of AGM for TN with NNC Criteria for Upper Lake Lafayette

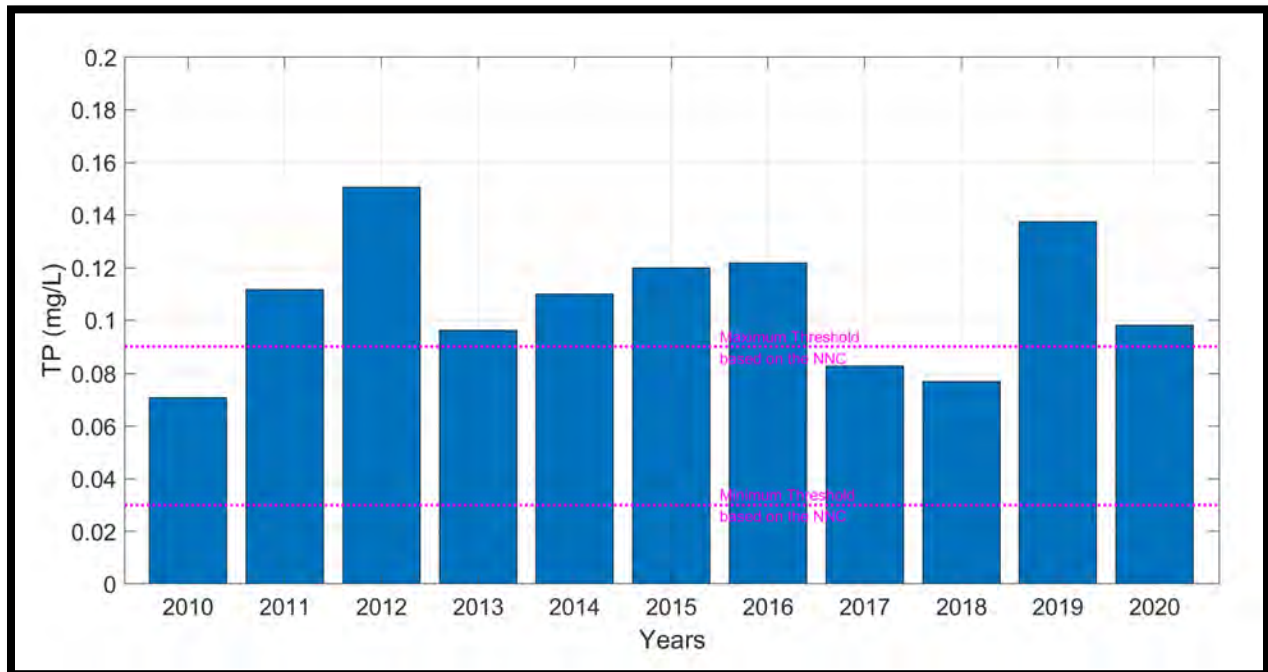


Figure 5-21: Plot of AGM for TP with NNC Criteria for Upper Lake Lafayette

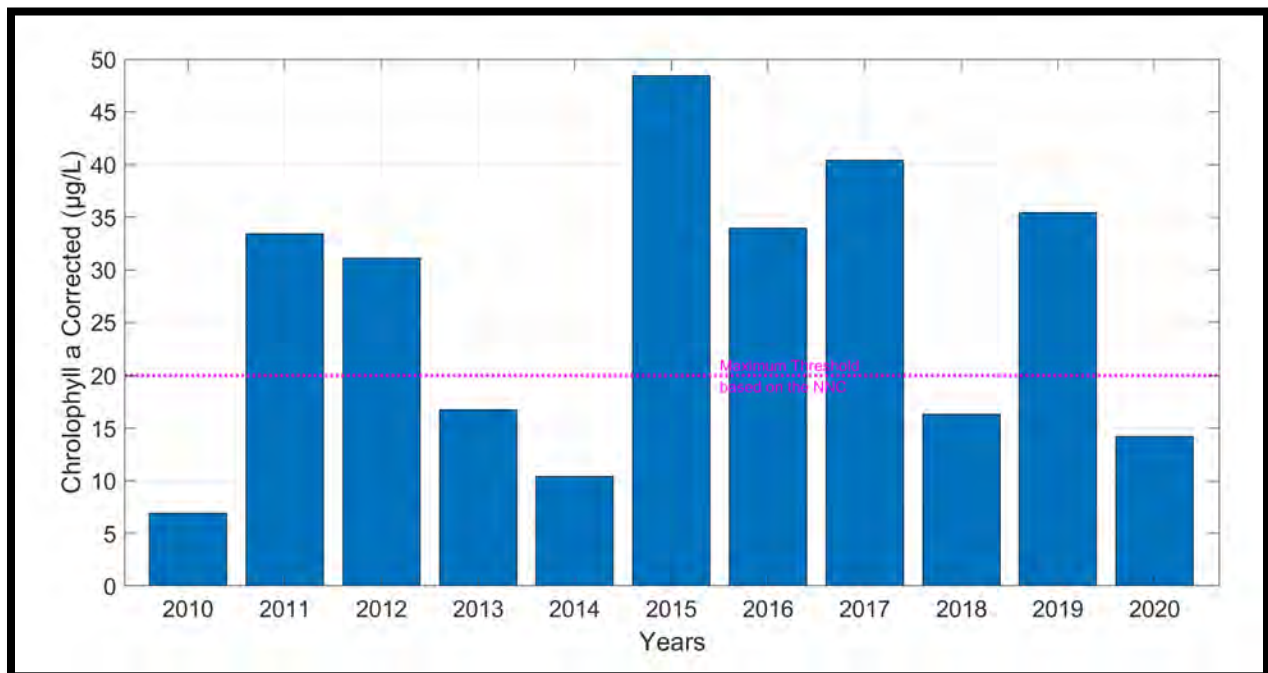


Figure 5-22: Plot of AGM for Chl-a with NNC Criteria for Upper Lake Lafayette

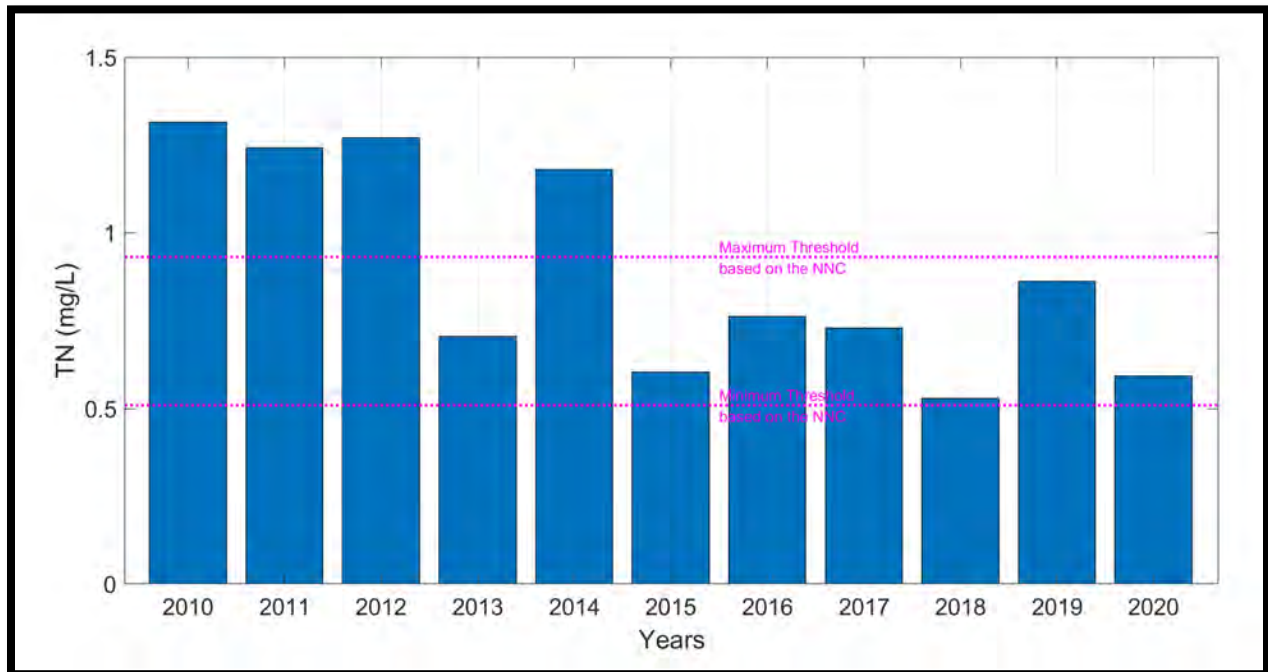


Figure 5-23: Plot of AGM for TN with NNC Criteria for Piney Z Lake

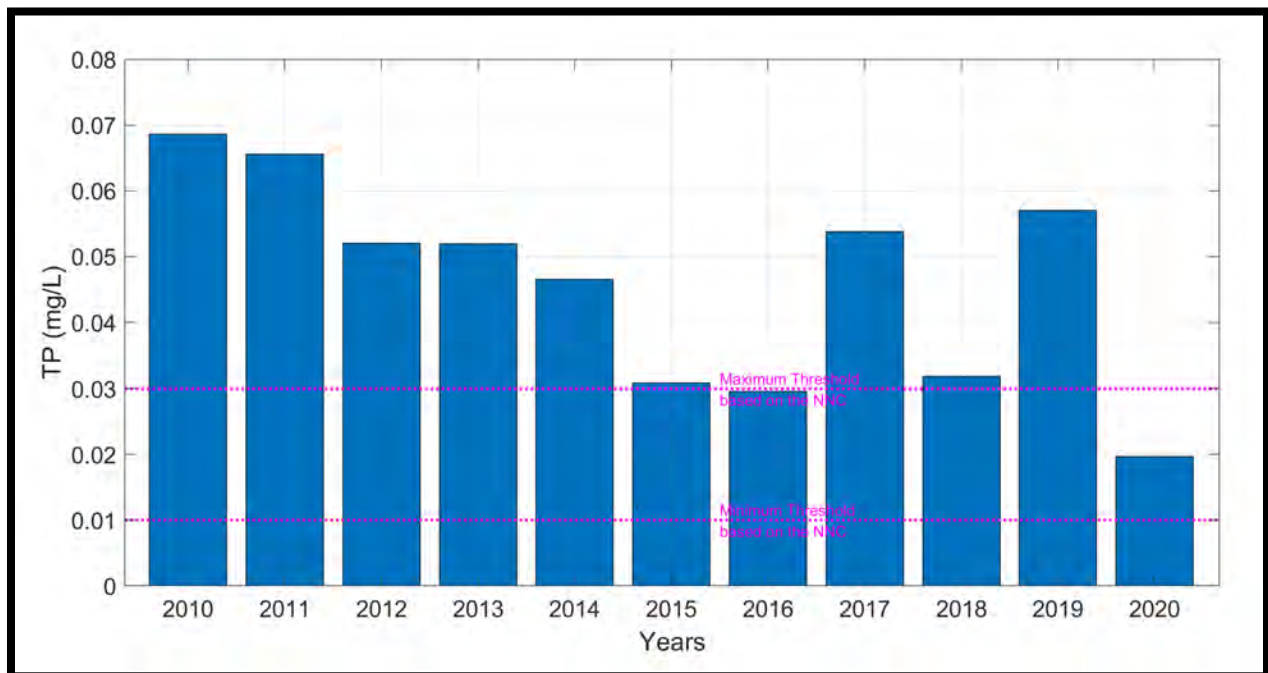


Figure 5-24: Plot of AGM for TP with NNC Criteria for Piney Z Lake

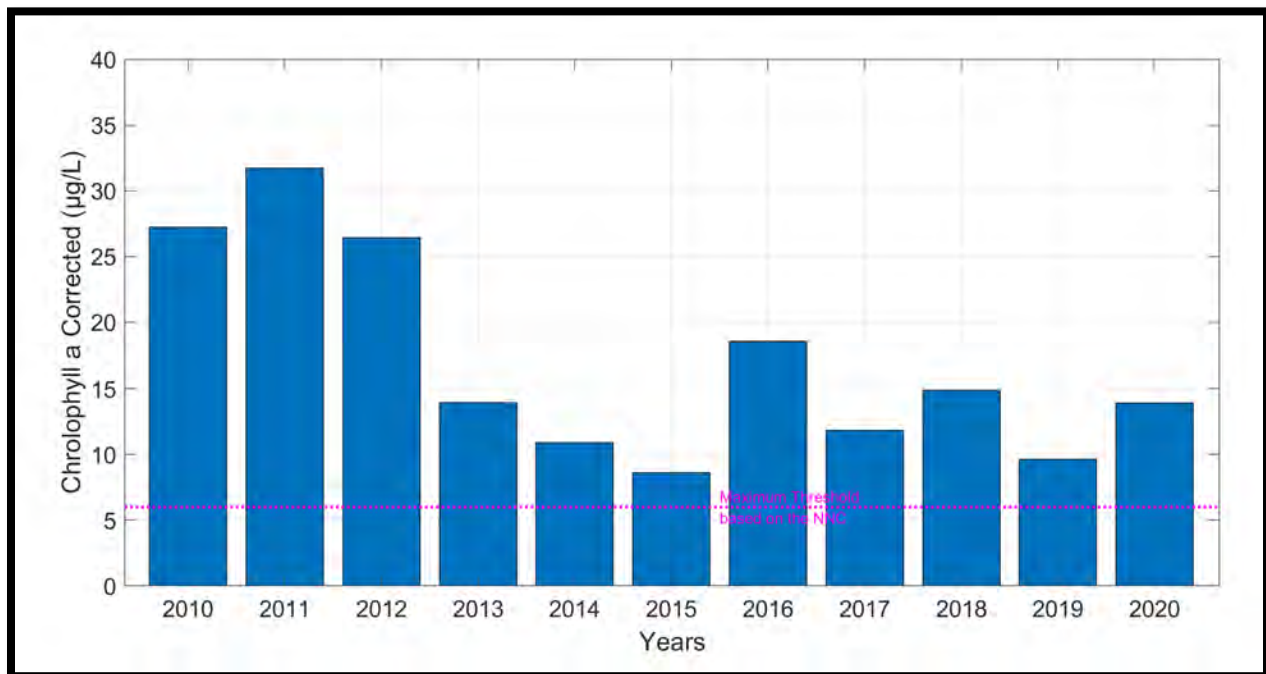


Figure 5-25: Plot of AGM for Chl-a with NNC Criteria for Piney Z Lake

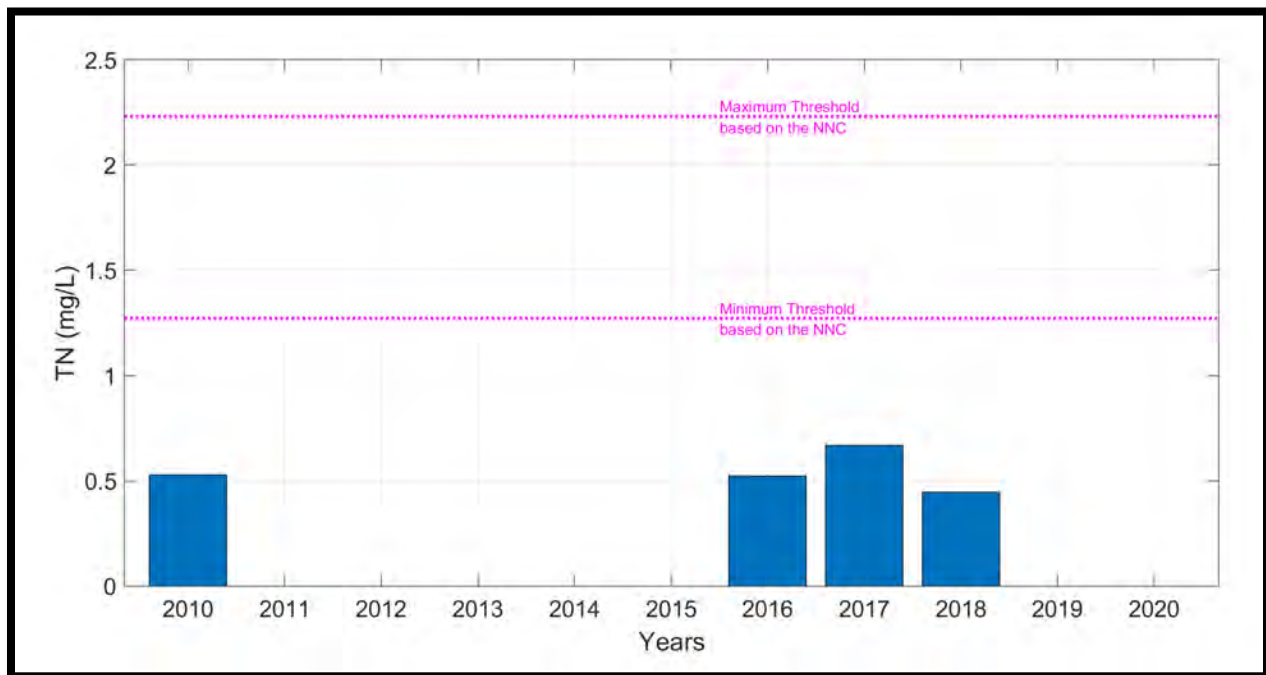


Figure 5-26: Plot of AGM for TN with NNC Criteria for Lower Lake Lafayette

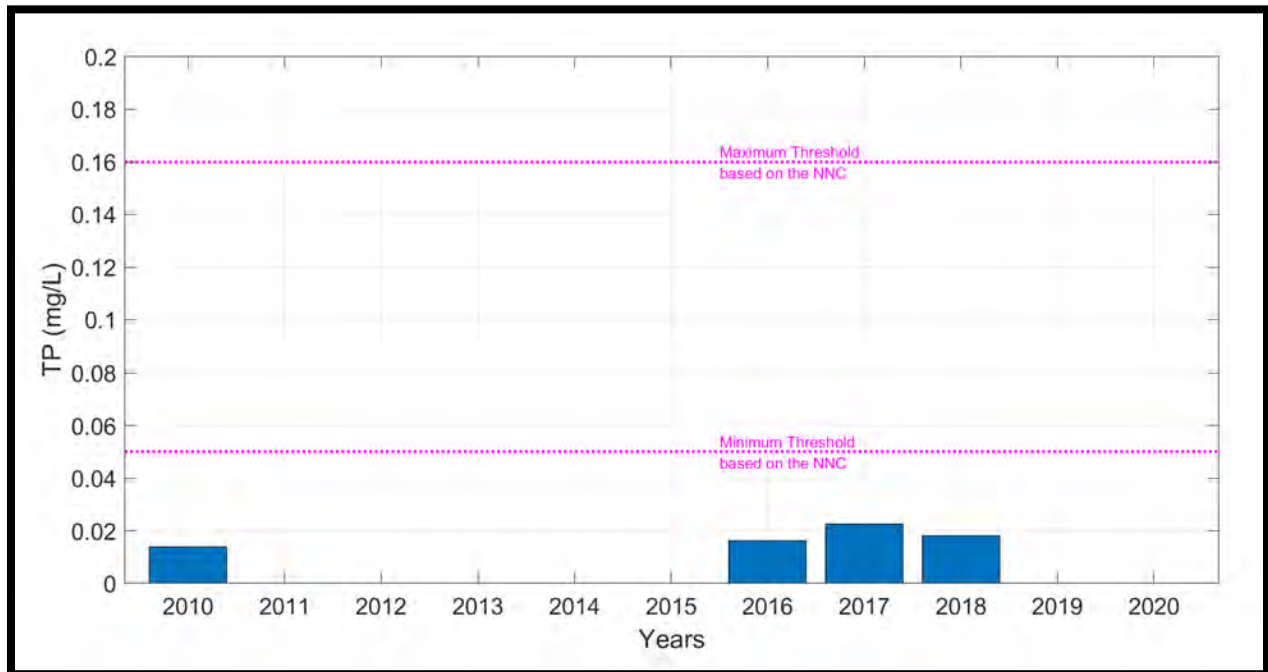


Figure 5-27: Plot of AGM for TP with NNC Criteria for Lower Lake Lafayette

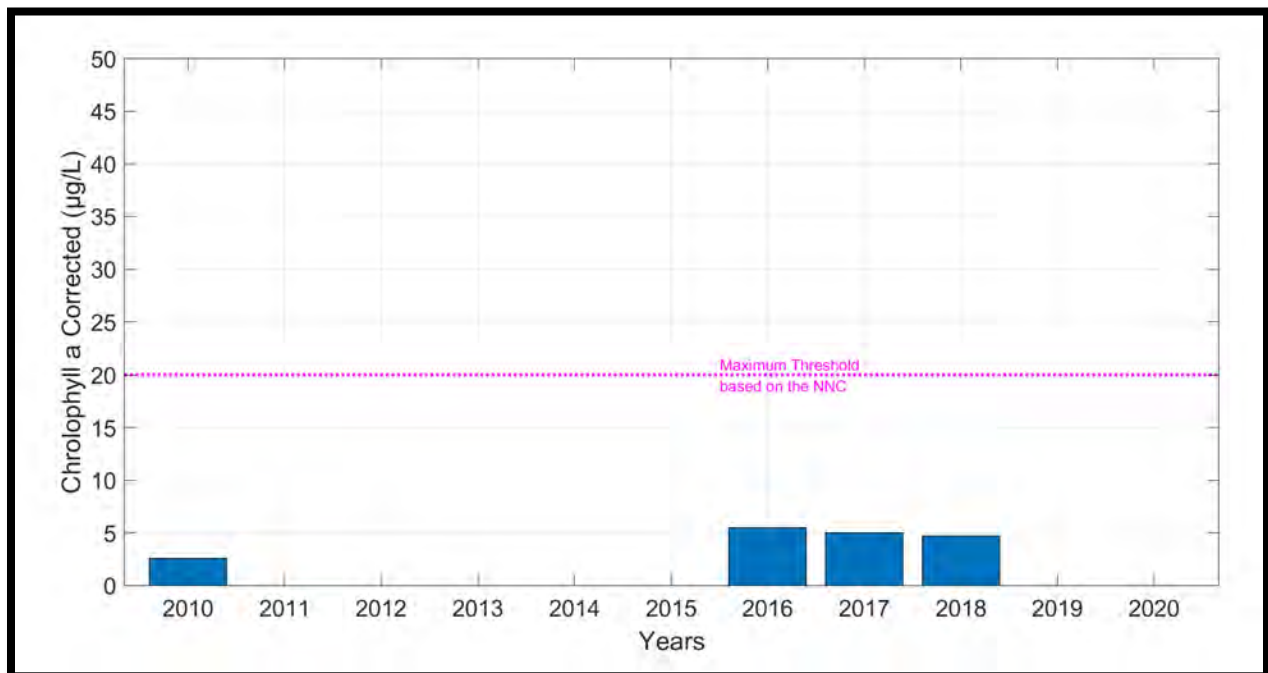


Figure 5-28: Plot of AGM for Chl-a with NNC Criteria for Lower Lake Lafayette

Examination of the TN plots shows that between 2010 and 2020 Upper Lake Lafayette TN AGM values (**Figure 5-20**) were generally between 0.5 mg/L and 1.0 mg/L and below the minimum threshold (1.05 mg/L) in all years except 2017. Piney Z Lake TN AGM values (**Figure 5-23**) ranged between 0.5 mg/L up to around 1.3 mg/L with values prior to 2015 above the maximum threshold (0.93 mg/L) and values from 2015 on between the minimum (0.51 mg/L) and maximum threshold. Lower Lake Lafayette TN AGM values (**Figure 5-26**), for the years where sufficient data were available to calculate the AGM, were all around 0.5 mg/L and well below the minimum threshold (1.27 mg/L).

Examination of the TP plots shows that between 2010 and 2020 Upper Lake Lafayette TP AGM values (**Figure 5-21**) were between 0.07 mg/L and 0.15 mg/L with all but three years above the maximum threshold of 0.09 mg/L. Piney Z Lake TP AGM values (**Figure 5-24**) ranged between 0.02 mg/L up to as around 1.3 mg/L with values prior to 2015 above the maximum threshold (0.93 mg/L) and values from 2015 on between the minimum (0.51 mg/L) and maximum threshold. Lower Lake Lafayette TP AGM values (**Figure 5-27**), for the years where sufficient data were available to calculate the AGM, were around or below 0.02 mg/L and well below the minimum threshold (0.05 mg/L).

Examination of the Chl-a plots shows that between 2010 and 2020 Upper Lake Lafayette Chl-a AGM values (**Figure 5-22**) were above the 20 µg/L threshold for 6 of the 11 years with the latest year above in 2019. Piney Z Lake Chl-a AGM values (**Figure 5-25**) were above the 6 µg/L threshold for all of the years with a drop off after 2012 to values generally between 8 and 15 µg/L. Lower Lake Lafayette Chl-a AGM values (**Figure 5-28**) were all at or below 5 µg/L and well below the threshold of 20 µg/L.

Examination of the TSI plot for Upper Lake Lafayette (**Figure 5-29**) shows values in all three categories (good, fair, and poor) throughout the time period. For the calculated TSI values, the nutrient limitations are presented by color based on the method for calculation of TSI. For Upper Lake Lafayette the system fluctuates between balanced and nitrogen limited which is consistent with the high TP concentrations presented earlier. Piney Z Lake TSI values (**Figure 5-30**) show a downward trend with levels prior to 2013 in the poor range transitioning to fair then primarily good in the latter years. The dominant limitation status is nutrient balanced with time periods of nitrogen and phosphorus limitation. TSI levels in Lower Lake Lafayette (**Figure 5-31**) are all in the good range. One difference seen in Lower Lake Lafayette is the higher frequency of phosphorus limitation compared to the other waterbodies.

Examination of the *E. coli* plots (**Figure 5-32 through Figure 5-34**) shows that no measurements exceeded the (ten percent) 410 colonies per 100 mL criteria for Class III freshwaters in any of the lakes. Upper Lake Lafayette has higher values overall than in Piney Z Lake or Lower Lake Lafayette.

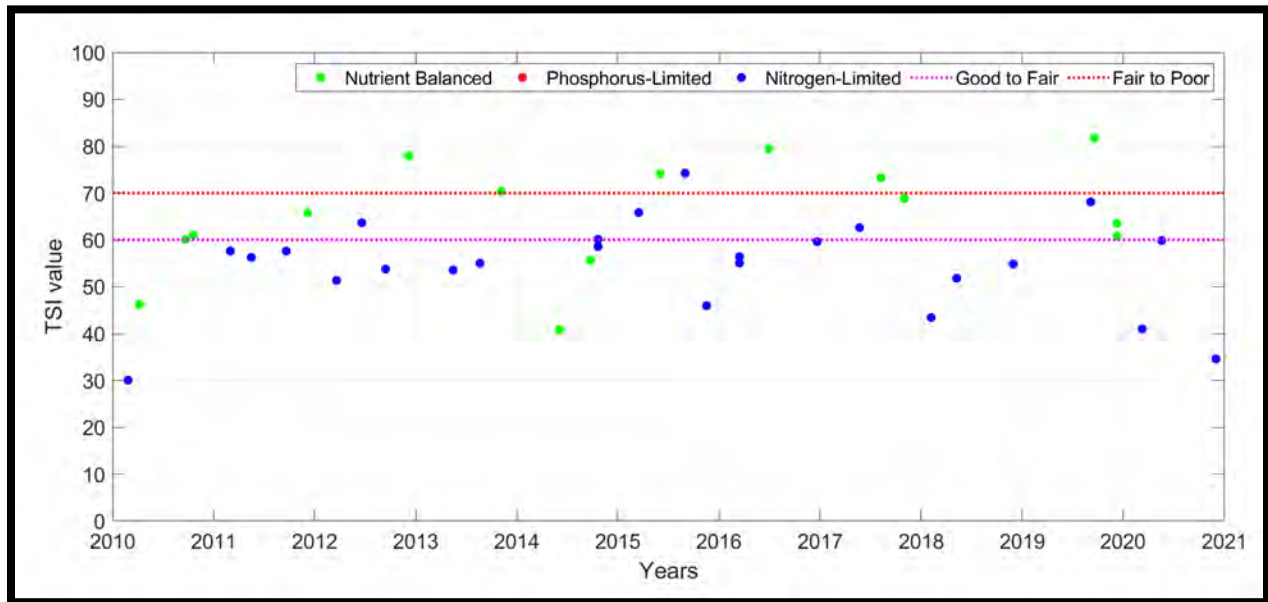


Figure 5-29: Plot of TSI for Upper Lake Lafayette

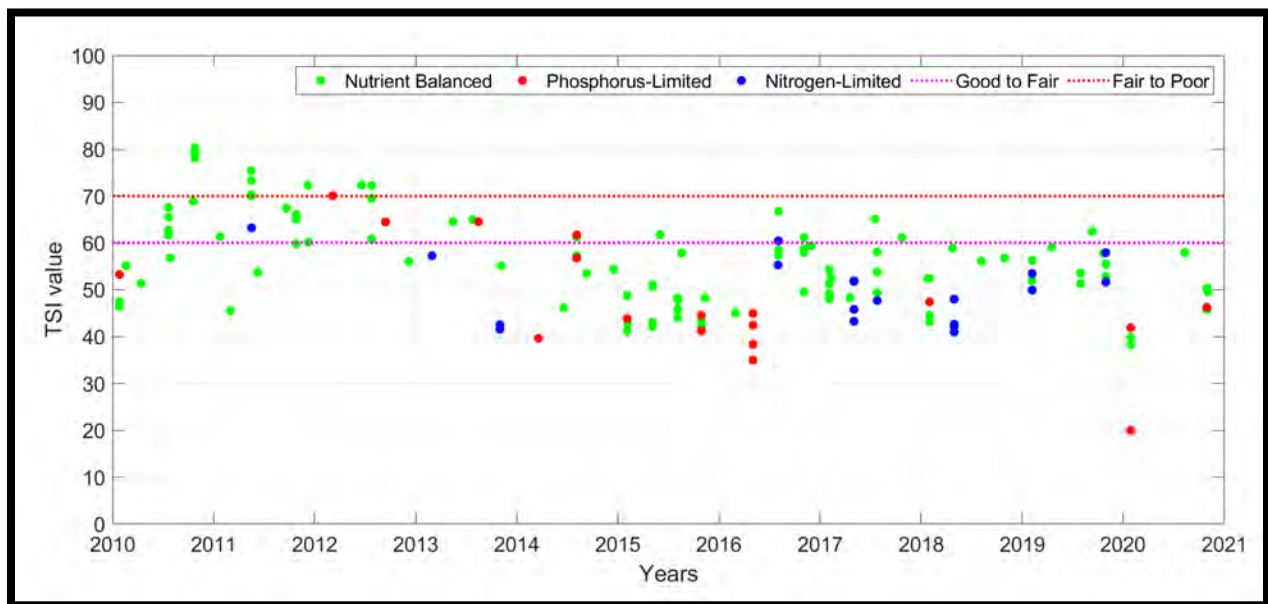


Figure 5-30: Plot of TSI for Piney Z Lake

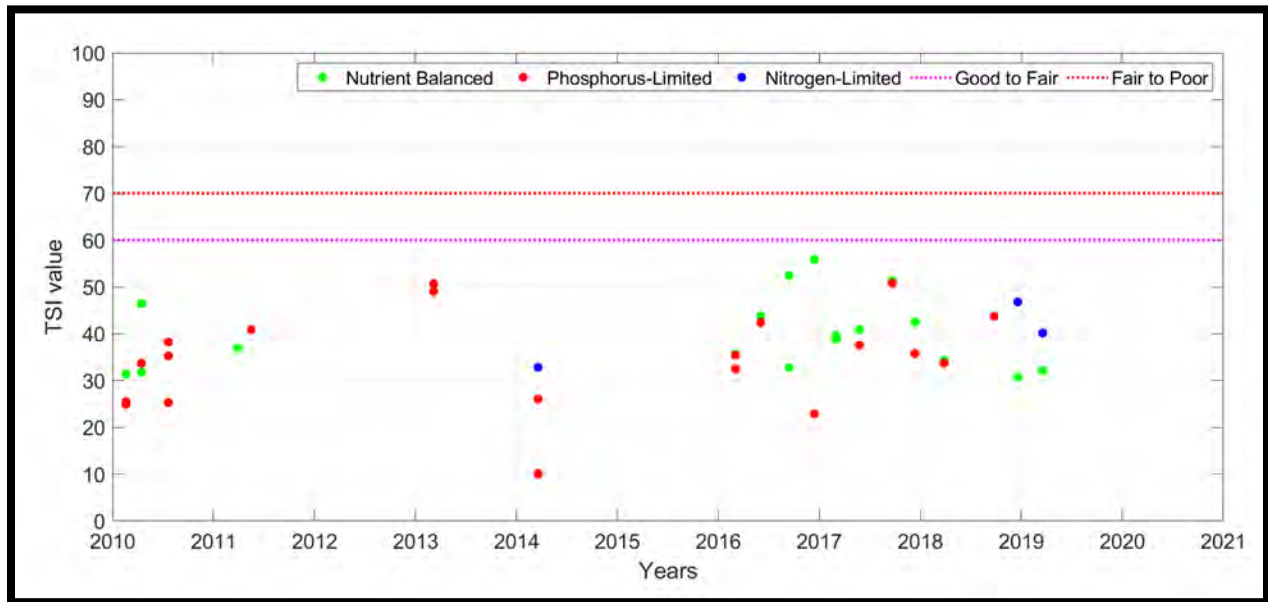


Figure 5-31: Plot of TSI for Lower Lake Lafayette

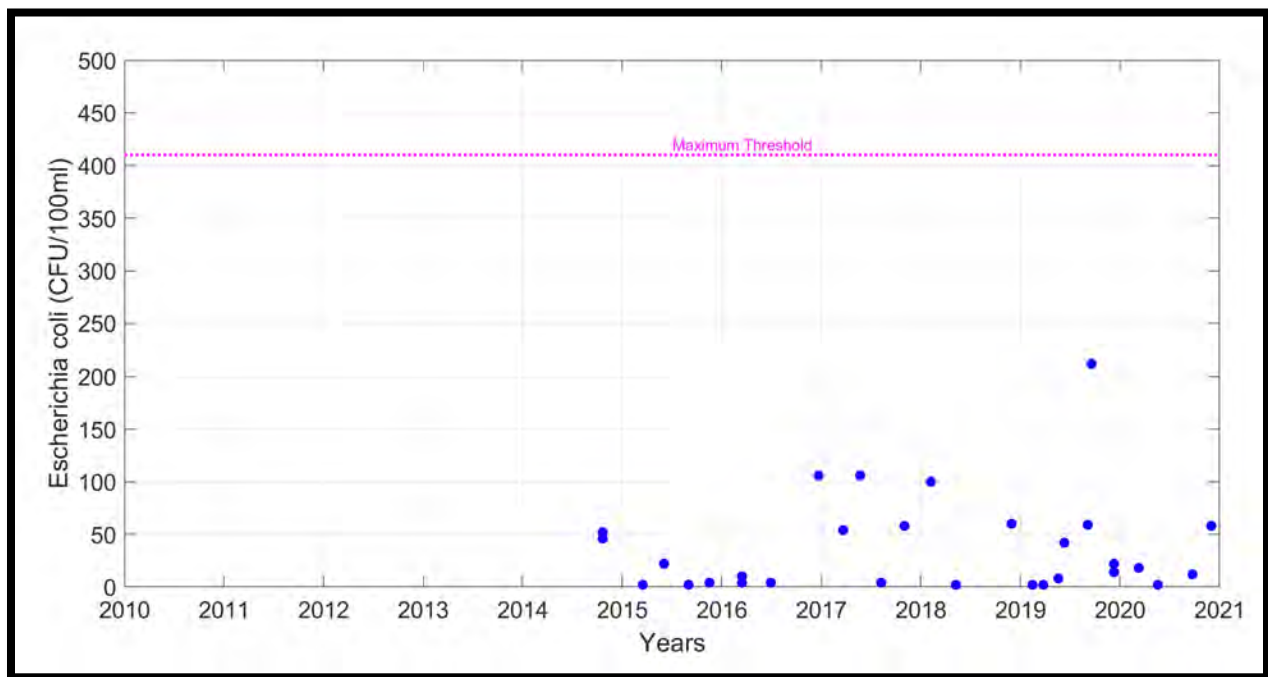


Figure 5-32: Plot of *E. coli* for Upper Lake Lafayette

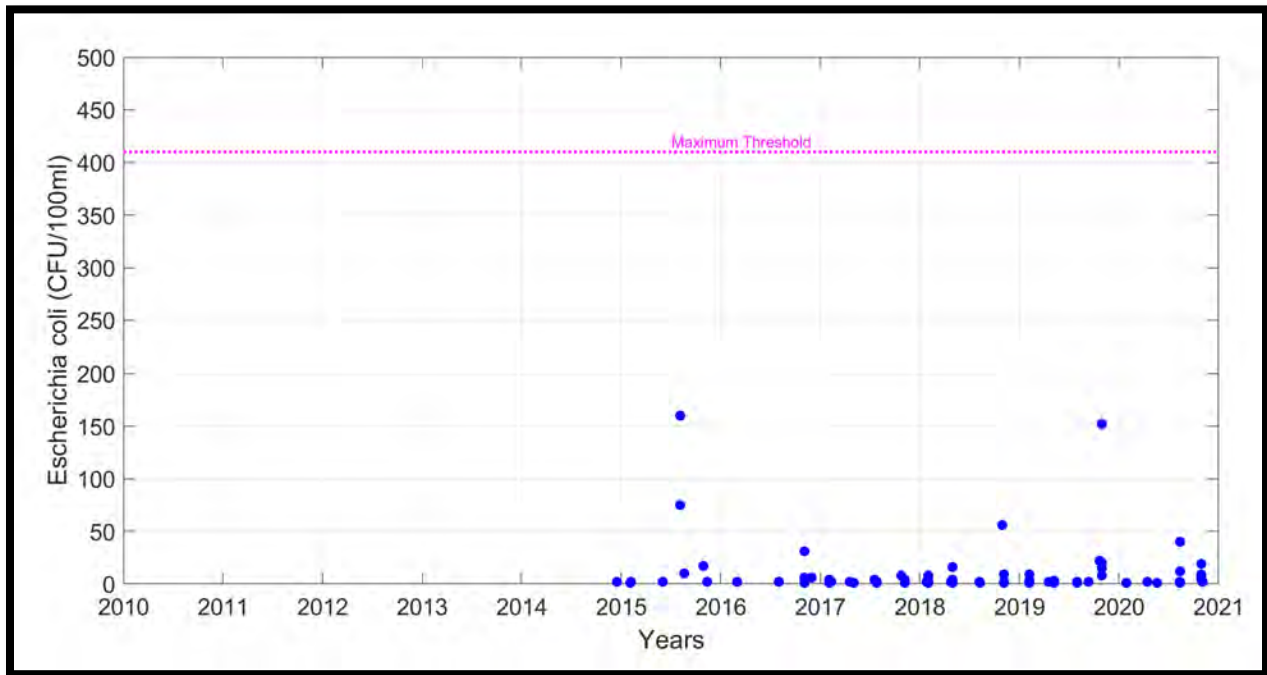


Figure 5-33: Plot of *E. coli* for Piney Z Lake

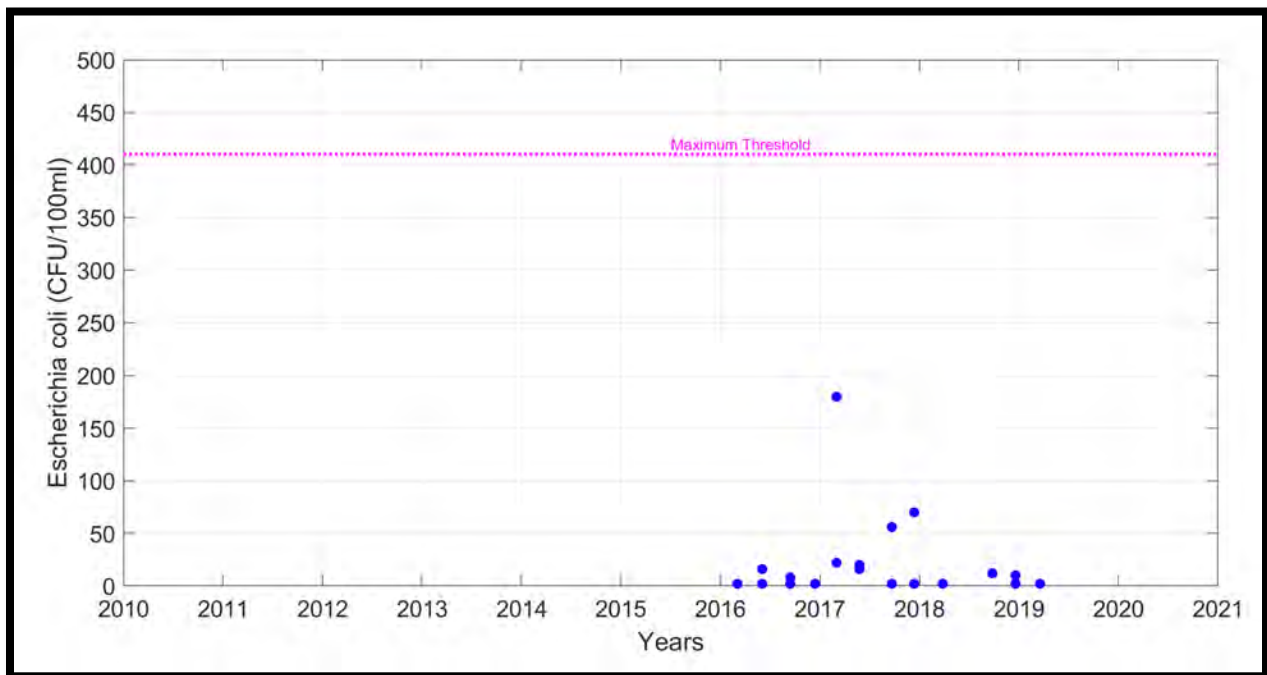


Figure 5-34: Plot of *E. coli* for Lower Lake Lafayette

5.4.3.8 Groundwater Data

Groundwater is water that has infiltrated to fill spaces between sediments and cracks in rock. Groundwater is fed by precipitation and eventually resurfaces to replenish surface water, including lakes through seepage from the surficial aquifer and, at times, from inputs from the Floridan Aquifer. For the Lafayette Chain of Lakes, flows to the Floridan Aquifer are through Lafayette Sink and other smaller sinks in the western end of the chain as well as through the porous bottom of Upper Lake Lafayette. The surficial aquifer, on the other hand, could be a source of water and/or nutrients through direct seepage into the lakes. Surficial groundwater flow into waterbodies may bring with it any contaminants or pollutants that it contacts on its way to a lake or surface water. Therefore, analysis of surficial groundwater data can be beneficial in evaluating potential seepage into the lake and its impacts on water quality. However, no surficial aquifer groundwater sampling wells were identified within the Lake Lafayette basin.

5.4.3.9 Biological Data

The Lake Vegetation Index (LVI) is a bioassessment procedure that analyzes the health of the plant community in freshwater surface waterbodies. FDEP performs sampling and calculations for waterbodies to interpret LVI values with respect to how closely they resemble the levels of a lake under conditions of minimal human disturbance. The LVI methodology was developed in 2005 in the pursuit of relating plant metrics to human disturbance. The LVI assesses factors such as the presence of exotic species and their ratio to native plant species, lakeshore alterations, and chemical disturbances such as excessive nutrients from surrounding land uses.

For lakes in Florida, an LVI range of 79 to 100 is considered Exceptional, a range of 43 to 78 is considered Healthy, and any values below 42 are deemed Impaired. **Table 5-3** presents LVI data for Piney Z Lake. No LVI data are available for the other three waterbodies. Between 2010 to 2019 all LVI evaluations showed Piney Z Lake to be in the healthy category.

Table 5-3: Summary of LVI Results from Piney Z Lake

Date	Station ID	LVI	Aquatic Life Use Category
6/22/2010	21FLCOT COTLVI007	58	Healthy
8/27/2010	21FLLEONLEONLVI011	63	Healthy
7/20/2011	21FLLEONLEONLVI011	56	Healthy
7/21/2011	21FLPNS 22030127	54	Healthy
9/14/2012	21FLCOT COTLVI007	49	Healthy
7/24/2013	21FLLEONLEONLVI011	47	Healthy
10/14/2013	21FLCOT COTLVI007	58	Healthy
9/10/2014	21FLLEONLEONLVI011	52	Healthy
8/20/2015	21FLLEONLEONLVI011	55	Healthy
9/24/2015	21FLCOT COTLVI007	57	Healthy
8/2/2016	21FLLEONLEONLVI011	50	Healthy
7/24/2018	21FLLEONLEONLVI011	57	Healthy
7/23/2019	21FLLEONLEONLVI011	60	Healthy

5.4.3.10 Stormwater Treatment Facilities

In assessing potential sources of pollutants to the Lafayette Chain of Lakes and other lakes within the basin, and ultimately for targeting nutrient reduction projects, it is important to identify existing treatment facilities adjacent to and along tributaries flowing into the downstream waterbodies. In earlier sections, discussions were provided on stormwater treatment facilities that were constructed in the area of the NEDD and Park Avenue Ditch to deal with specific inputs to Upper Lake Lafayette. **Exhibit 5-7** presents locations of stormwater treatment facilities and treatment best management practices (BMPs) within the Lake Lafayette basin boundaries, which include stormwater ponds maintained by the City as well as other entities such as Leon County and the Florida Department of Transportation (FDOT) (private or other agencies).

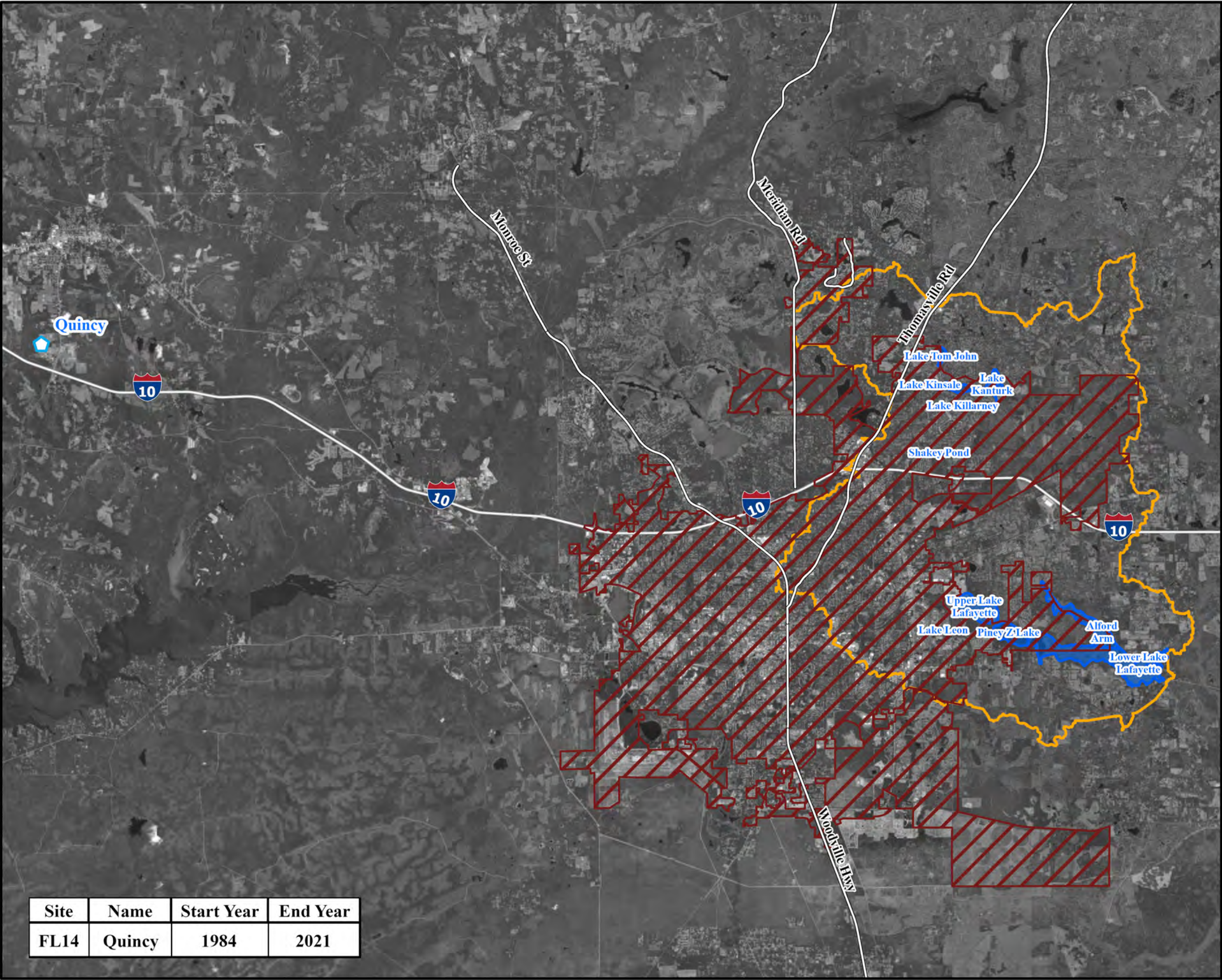
5.4.3.11 Atmospheric Deposition Data

Atmospheric deposition is the loading that falls directly onto the open water lake surface contained in rainfall or that falls onto the surface as dry deposition. Stations are maintained throughout Florida that collect atmospheric deposition data. **Figure 5-35** shows the location of the nearest atmospheric deposition station to the Lafayette Basin. The station is in Quincy (FL14) and has been collecting data since 1984.

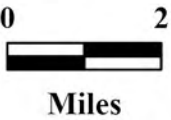
5.4.3.12 Data Summary

For the purposes of the qualitative analysis of sources of pollutants to the Lafayette Chain of Lakes (**Section 5.4.4**) the available data are reasonable. Other than Alford Arm, there are sufficient active surface water quality stations within the waterbodies to support the qualitative assessment. The following outlines limitations in the available data. Specific recommendations on additional data collection efforts are provided in **Section 5.10**.

- There is no water level data within Upper Lake Lafayette, Piney Z Lake and the western side of Lower Lake Lafayette.
- There is no recent water quality data within the lake portion of Alford Arm.
- Information on the hydrologic connections between the different waterbodies is limited to qualitative information. The connections include the structure passing through the berm between Upper Lake Lafayette and Piney Z Lake, the structure passing through the berm between Piney Z Lake and Lower Lake Lafayette, and the various structures beneath the CSX railroad that connect Alford Arm to Lower Lake Lafayette.
- There is no flow data available for Lafayette Creek.
- There are no data to evaluate the potential for seepage of pollutants to the lake from the surficial aquifer, i.e., surficial groundwater sampling stations around the Chain of Lakes.



Site	Name	Start Year	End Year
FL14	Quincy	1984	2021



Legend

- Lake Lafayette Drainage Basin
- Waterbodies in Study
- Major Roads
- Tallahassee Corporate Limits
- Atmospheric Deposition Station

Sources:
Waterbodies: COT, 2020
Station: NADP, 2022
Drainage Basins: COT, 2020
Roads: COT-Leon County, 2023
City Limits: COT, 2020

Figure 5-35:
Locations of Atmospheric Deposition
Stations Relative to Lafayette Chain of
Lakes

Tallahassee Master Plan - Surface



5.4.4 Qualitative Assessment of Sources

Prior to performing loading calculations and other analyses to quantify existing pollutant sources to the Lafayette Chain of Lakes, it is important to analyze available data and summarize findings from historical studies to support identification of the pathway and magnitude of potential sources, which provides a more complete understanding of the waterbodies water quality response and (where data and historical studies are available) highlights those tributaries and other inputs that are potential sources. Additionally, the determination of potential sources must take into account existing water quality treatment infrastructure and how their location and function mitigate conditions prior to discharge to the waterbodies.

For the Lafayette Chain of Lakes, the sources that were evaluated include the following:

- Stormwater runoff
- Septic systems
- Interconnected flows
- Internal recycling and seepage
- Wastewater
- Atmospheric deposition

An overview of the analyses and findings for each of the sources listed above is provided in the following sections. Prior to the discussions of each of the potential sources, in-lake and tributary analyses examining the spatial variation of the parameters of interest are provided to support determination of key focus areas throughout the system. Following the discussions for each source type, a summary of findings for the qualitative assessment is provided.

5.4.4.1 In-Lake and Tributary Water Quality

Spatial variation throughout the Lafayette Chain of Lakes was evaluated for the following parameters:

- Color
- Alkalinity
- Total Phosphorus
- Total Nitrogen
- Chl-a
- Trophic State Index
- *E. coli*

Spatial variation within tributaries flowing directly into the Lafayette Chain of Lakes was evaluated for the following parameters:

- Total Nitrogen
- Total Phosphorus

- TSS
- *E. coli*

To maximize available data for use in the spatial analyses, data stations were clustered to represent general areas of the waterbodies and tributaries throughout the system. Analyses were then performed on the collective data for that general location. **Figure 5-36** presents the data clustering locations and the specific water quality stations where data were pulled for that specific cluster.

For the Lafayette Chain of Lakes, a total of five clusters were identified for the waterbodies and five clusters along the directly inflowing tributaries. Within the waterbodies there is one cluster in Upper Lake Lafayette (LU) in the area of the sink, two on either end of Piney Z Lake (PW, PE), and two at either end of Lower Lake Lafayette (LW, LE). Along the tributaries there are two along the ditches flowing to Upper Lake Lafayette, one in the Park Avenue Ditch (UL1) and one representing stations downstream of Weems Pond (UL2), one along the tributary to Alford Arm at Buck Lake Road (UA3), one along the tributary from the Windwood Hills watershed which drains to the western end of Lower Lake Lafayette (DL1), and one at the base of Lafayette Creek prior to discharge to Upper Lake Lafayette (LEU).

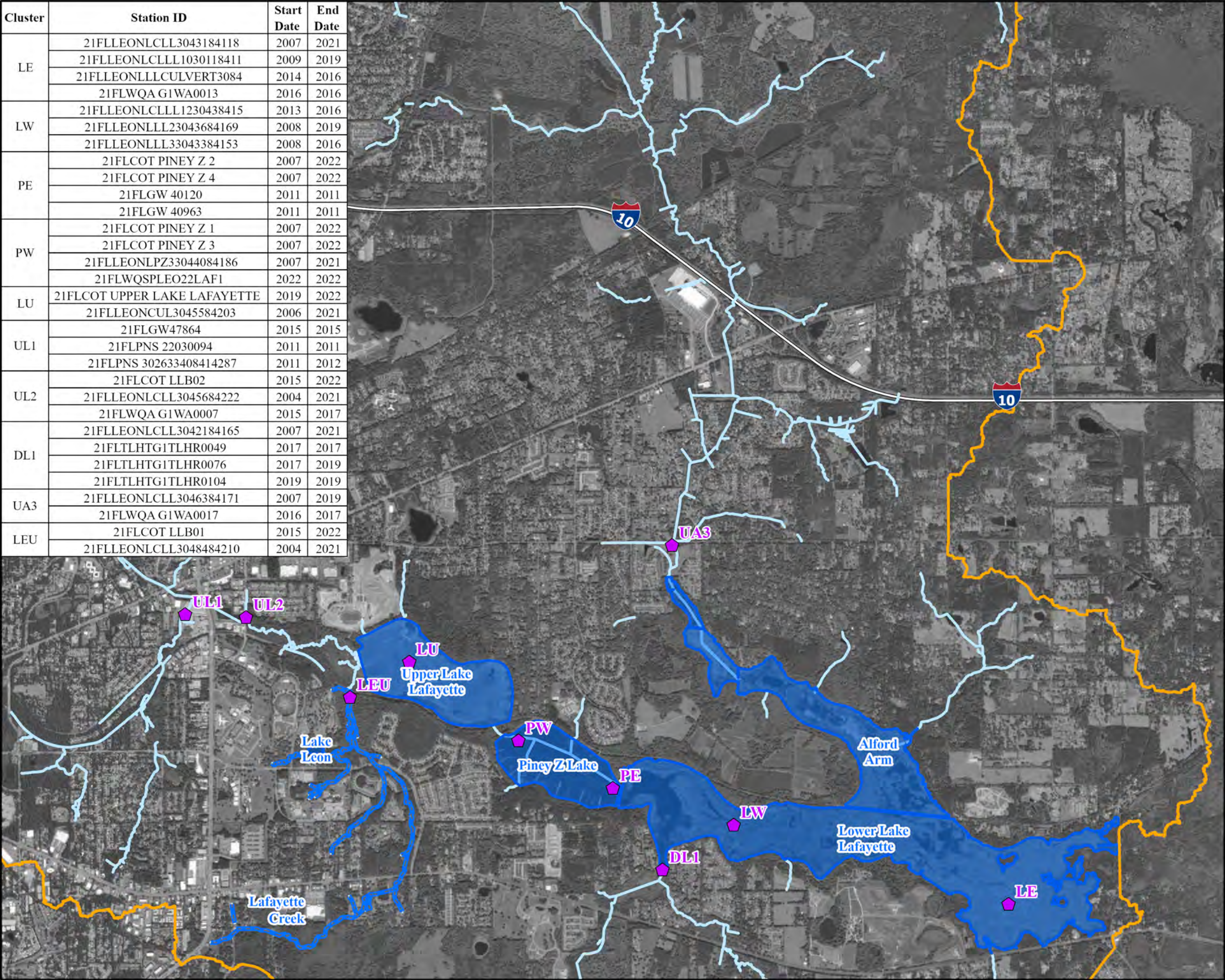
The spatial analyses were only performed using data after 2010 to represent recent conditions. Any station that had data after 2010 was assigned one of the cluster locations and a collective data set developed for that cluster. As such, all data available within the waterbodies and tributaries after 2010 were utilized in the spatial analyses. The only cluster which did not have a full period of record from 2010 to the present is UL1.

Figure 5-37 through **Figure 5-44** present the spatial analyses. For all parameters (other than *E. coli*), the annual geomeans for the period of record from 2010 to 2020 were averaged to calculate the cluster values. For *E. coli* the 90th percentile of the data was used as the cluster value.

The results at each cluster are presented as colored symbols representing ranges of calculated values. For nutrients and Chl-a the NNC criteria/thresholds were used to define breakpoints for the color transitions. For color and alkalinity in the lakes, the NNC thresholds defining each of the lake types were utilized. As discussed earlier, each of the three waterbodies analyzed (Upper Lake Lafayette, Piney Z Lake, and Lower Lake Lafayette) fall under a different classification under the NNC criteria. For *E. coli* the stream and lake criteria were utilized. The following outlines the choices made in the cutoff and ranges.

- For all three waterbodies, the alkalinity cutoff from orange into red was set to 20 mg/L based on the NNC threshold for high versus low alkalinity.
- For color, the cutoff from blue to green was set at 40 platinum-cobalt units (PCUs) based on the NNC threshold for lake type.
- For TN and TP in the lake segments, cutoffs were set for blue as below the minimum threshold, red as above the maximum threshold, and green to orange based on even spacing between the minimum and maximum. As stated earlier, each of the lake segments had different ranges, therefore for the lake segments three different scales are provided.

Cluster	Station ID	Start Date	End Date
LE	21FLEONLCLL3043184118	2007	2021
	21FLEONLCLL1030118411	2009	2019
	21FLEONLLLCULVERT3084	2014	2016
	21FLWQA G1WA0013	2016	2016
LW	21FLEONLCLL1230438415	2013	2016
	21FLEONLL23043684169	2008	2019
	21FLEONLL33043384153	2008	2016
PE	21FLCOT PINEY Z 2	2007	2022
	21FLCOT PINEY Z 4	2007	2022
	21FLGW 40120	2011	2011
	21FLGW 40963	2011	2011
PW	21FLCOT PINEY Z 1	2007	2022
	21FLCOT PINEY Z 3	2007	2022
	21FLEONLPZ33044084186	2007	2021
	21FLWQSPLEO22LAF1	2022	2022
LU	21FLCOT UPPER LAKE LAFAYETTE	2019	2022
	21FLEONCUL3045584203	2006	2021
UL1	21FLGW47864	2015	2015
	21FLPNS 22030094	2011	2011
	21FLPNS 302633408414287	2011	2012
UL2	21FLCOT LLB02	2015	2022
	21FLEONLCLL3045684222	2004	2021
DL1	21FLWQA G1WA0007	2015	2017
	21FLEONLCLL3042184165	2007	2021
	21FLTLHTG1TLHR0049	2017	2017
	21FLTLHTG1TLHR0076	2017	2019
	21FLTLHTG1TLHR0104	2019	2019
UA3	21FLEONLCLL3046384171	2007	2019
	21FLWQA G1WA0017	2016	2017
LEU	21FLCOT LLB01	2015	2022
	21FLEONLCLL3048484210	2004	2021





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0 0.7
Miles

Legend

- Lake Lafayette Drainage Basin
- Waterbodies in Study
- Watercourses
- Station Clusters

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Drainage Basins: COT, 2020
Roads: COT-Leon County, 2023

Figure 5-36:
Station Clustering for Spatial Analyses of
Lafayette Chain of Lakes

Tallahassee Master Plan - Surface
Water (TMaPS)

Geosyntec
consultants

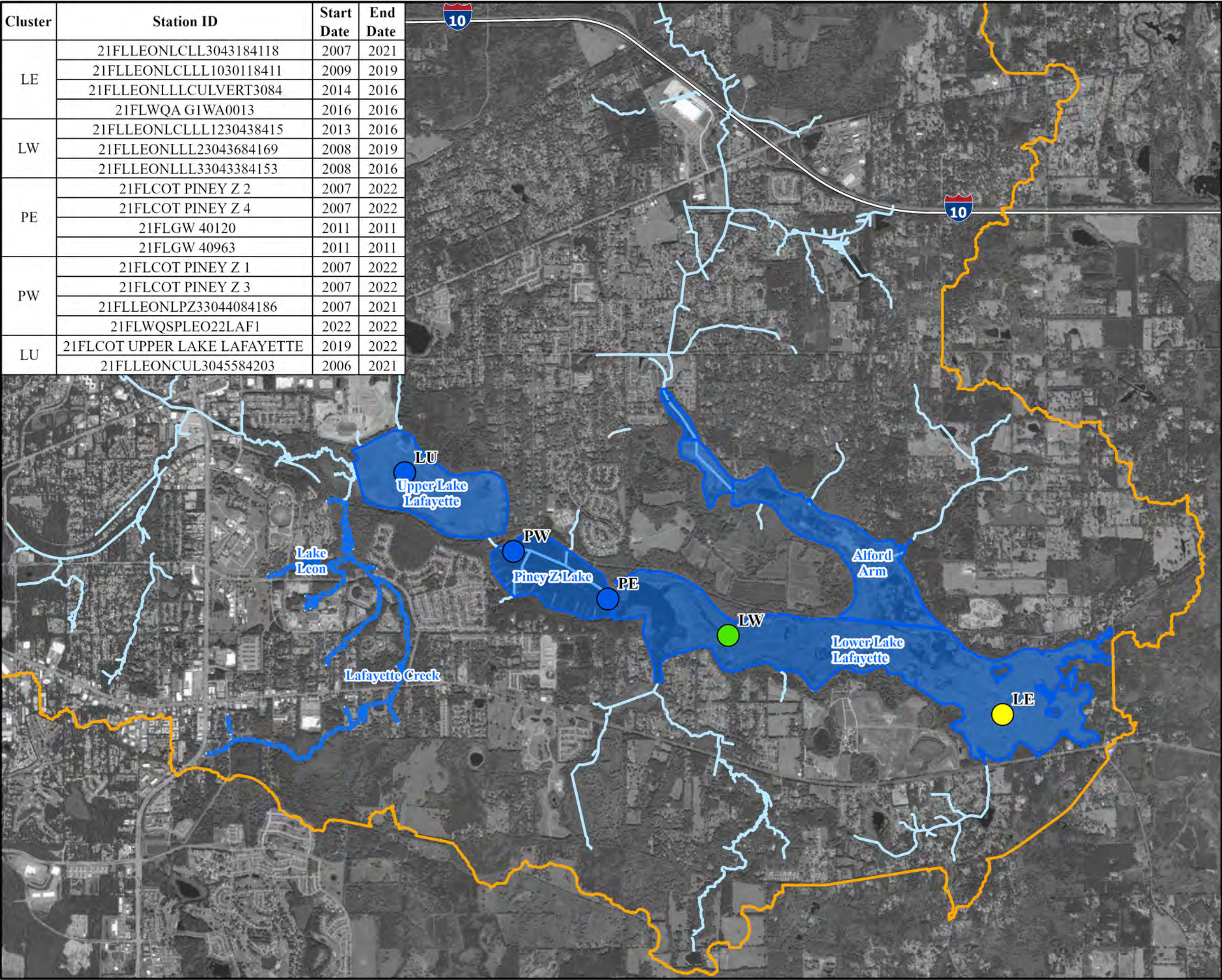
- For the tributary TN and TP, cutoffs were set at orange to red at the NNC thresholds of 1.03 mg/L and 0.18 mg/L respectively.
- For Chl-a, the cutoff from orange to red was set at the applicable NNC threshold, i.e., Upper Lake Lafayette and Lower Lake Lafayette (20 µg/L) and Piney Z Lake (6 µg/L).
- For TSI, the cutoff was set to 60 from orange to red, based on the transition from mesotrophic to eutrophic conditions.
- For *E. coli*, the transition from orange to red was set at the threshold of 410 Most Probable Number (MPN)/100 mL for the 90th percentile of the data.

It is important to note that the analyses presented herein are not meant to indicate conditions of impairment or non-impairment per FDEP rules and criteria. The criteria/thresholds are to aid in assessing general conditions in the lake segments and inflowing tributaries, and the thresholds provide baselines to evaluate against and to aid in defining potential target areas for water quality improvement. Additionally, the analyses represent average conditions from 2010 through 2020 and do not account for trends or changes during that time period.

Figure 5-37 and **Figure 5-38** present the variations in color and alkalinity through the system. The color map shows a transition from low color in Upper Lake Lafayette and Piney Z Lake to higher color moving into Lower Lake Lafayette with the highest color in the area of the discharge from Lower Lake Lafayette (LU=17.3 PCU, PW=23.8 PCU, PE=23.9 PCU, LW=59.4 PCU, LE=105.0 PCU). Insufficient data were available in lake portions of Alford Arm. The alkalinity map shows a transition from higher levels (greater than 20 mg/L) in Upper Lake Lafayette to significantly lower levels throughout Piney Z Lake and Lower Lake Lafayette (LU=27.4 mg/L, PW=6.8 mg/L, PE=6.8 mg/L, LW=4.9 mg/L, LE=6.1 mg/L). These values reflect the classifications for each of the lake segments with Upper Lake Lafayette as a low color, high alkaline system, Piney Z Lake as a low color, low alkaline system, and Lower Lake Lafayette as a high color, low alkaline system.

Figure 5-39 and **Figure 5-40** present the spatial variation of TN and TP in the lake segments and tributaries. The lake segments show TN values below the minimum threshold in Upper Lake Lafayette and Lower Lake Lafayette (LU=1.01 mg/L, PW=0.73 mg/L, PE=0.81 mg/L, LW=0.39 mg/L, LE=0.26 mg/L). Piney Z Lake shows TN levels between the minimum and maximum threshold with somewhat higher levels along the eastern end. All the inflow tributary clusters show low TN levels (UL1=0.50 mg/L, UL2=0.25 mg/L, LEU=0.23 mg/L, UA3=0.44 mg/L, DL1=0.52 mg/L), i.e., well below the stream threshold, with somewhat elevated levels (in relation to the others) at DL1 discharging from the Windwood Hills watershed into Lower Lake Lafayette. The lake segments show TP values above the maximum threshold in Upper Lake Lafayette and Piney Z Lake (LU=0.119 mg/L, PW=0.047 mg/L, PE=0.057 mg/L, LW=0.019 mg/L, LE=0.010 mg/L). Lower Lake Lafayette shows TP levels below the minimum threshold. All the inflowing tributary clusters show low TP levels (UL1=0.105 mg/L, UL2=0.041 mg/L, LEU=0.071 mg/L, UA3=0.074 mg/L, DL1=0.104 mg/L), i.e., below the stream threshold, with somewhat elevated levels (in relation to the others) at DL1 discharging from the Windwood Hills watershed into Lower Lake Lafayette. TP levels in the cluster upstream of the Weems Pond Regional Treatment Facility are significantly higher than measured downstream from the facility, demonstrating the impacts of the alum treatment.

Cluster	Station ID	Start Date	End Date
LE	21FLLEONLCLL3043184118	2007	2021
	21FLLEONLCLLL1030118411	2009	2019
	21FLLEONLLLCULVERT3084	2014	2016
	21FLWQA G1WA0013	2016	2016
LW	21FLLEONLCLLL1230438415	2013	2016
	21FLLEONLLL23043684169	2008	2019
	21FLLEONLLL33043384153	2008	2016
PE	21FLCOT PINEY Z 2	2007	2022
	21FLCOT PINEY Z 4	2007	2022
	21FLGW 40120	2011	2011
	21FLGW 40963	2011	2011
PW	21FLCOT PINEY Z 1	2007	2022
	21FLCOT PINEY Z 3	2007	2022
	21FLLEONLPZ33044084186	2007	2021
	21FLWQSPLEO22LAF1	2022	2022
LU	21FLCOT UPPER LAKE LAFAYETTE	2019	2022
	21FLLEONCUL3045584203	2006	2021





**CITY OF
TALLAHASSEE**




Legend

 Lake Lafayette Drainage Basin

 Waterbodies in Study

 Watercourses

Color Average 2010-2020

PCU

 0-40

 40-80

 80-120

 120-160

 >160

Sources:

Waterbodies: COT, 2020

Watercourses: COT, 2020

Drainage Basins: COT, 2020

Roads: COT-Leon County, 2023

Station Data: FDEP, 2021

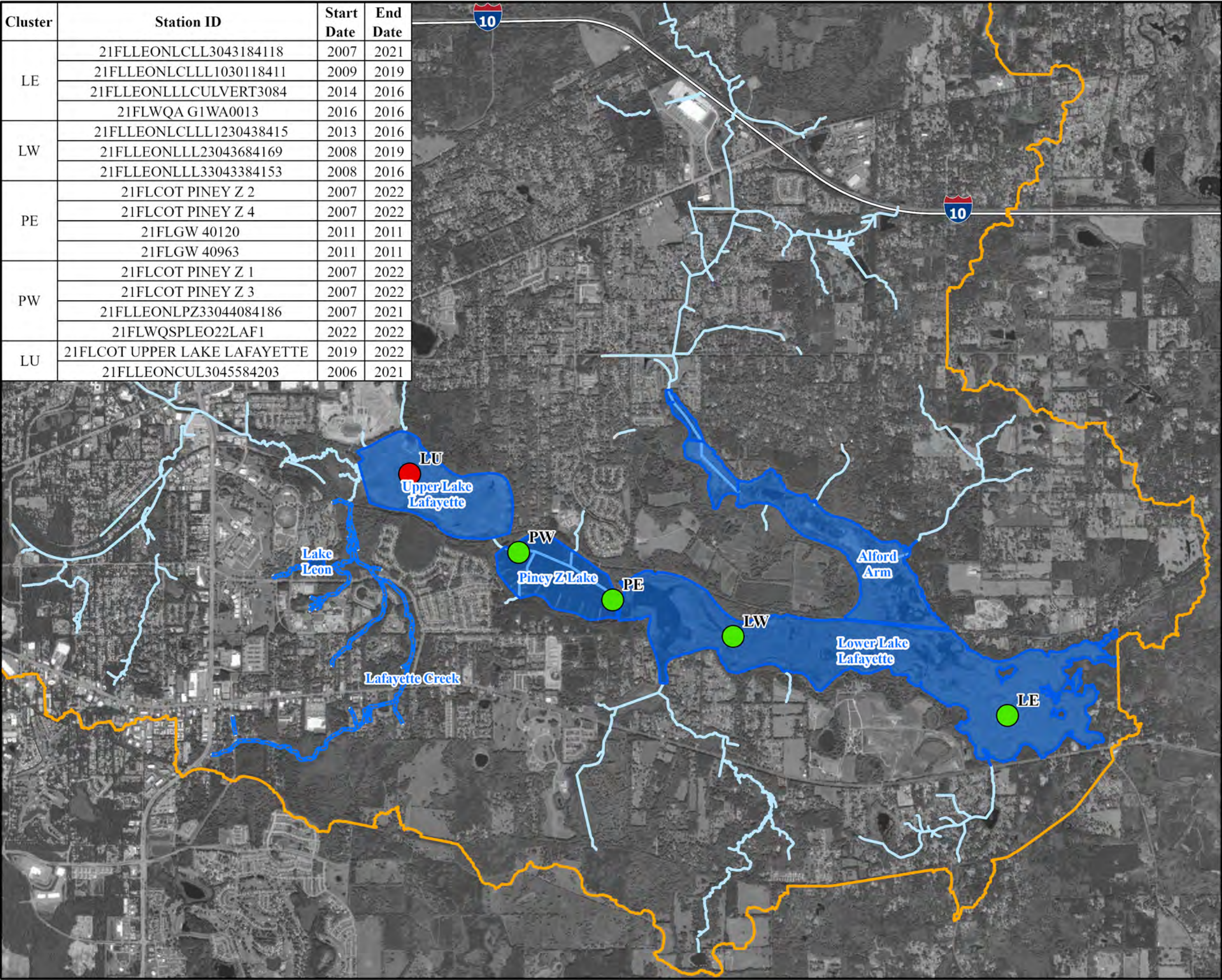
Figure 5-37:

Spatial Assessment of Color in Lafayette Chain of Lakes

Tallahassee Master Plan - Surface Water (TMaPS)



Cluster	Station ID	Start Date	End Date
LE	21FLLEONLCLL3043184118	2007	2021
	21FLLEONLCLLL1030118411	2009	2019
	21FLLEONLLLCULVERT3084	2014	2016
LW	21FLWQA G1WA0013	2016	2016
	21FLLEONLCLLL1230438415	2013	2016
	21FLLEONLLL23043684169	2008	2019
PE	21FLLEONLLL33043384153	2008	2016
	21FLCOT PINEY Z 2	2007	2022
	21FLCOT PINEY Z 4	2007	2022
PW	21FLGW 40120	2011	2011
	21FLGW 40963	2011	2011
	21FLCOT PINEY Z 1	2007	2022
LU	21FLCOT PINEY Z 3	2007	2022
	21FLLEONLPZ33044084186	2007	2021
	21FLWQSPLEO22LAF1	2022	2022
LU	21FLCOT UPPER LAKE LAFAYETTE	2019	2022
	21FLLEONCUL3045584203	2006	2021



Legend

- Lake Lafayette Drainage Basin
- Waterbodies in Study
- Watercourses
- Alkalinity Average 2010-2020
mg/L
 - 0-5
 - 5-10
 - 10-15
 - 15-20
 - >20

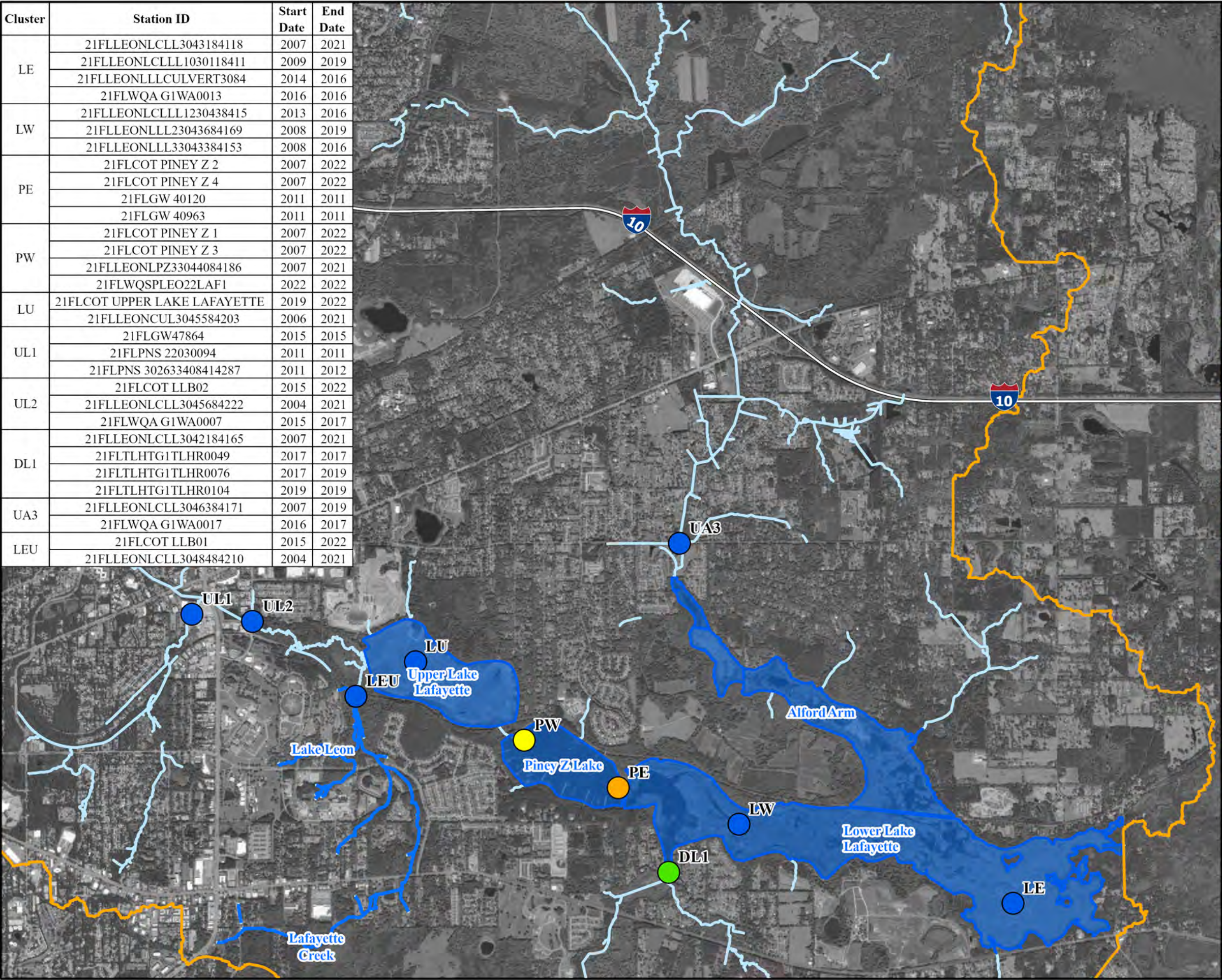
Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Drainage Basins: COT, 2020
Roads: COT-Leon County, 2023
Station Data: FDEP, 2021

Figure 5-38:
Spatial Assessment of Alkalinity in
Lafayette Chain of Lakes

Tallahassee Master Plan - Surface
Water (TMaPS)



Cluster	Station ID	Start Date	End Date
LE	21FLLEONLCLL3043184118	2007	2021
	21FLLEONLCLL1030118411	2009	2019
	21FLLEONLLLCULVERT3084	2014	2016
	21FLWQA G1WA0013	2016	2016
LW	21FLLEONLCLL1230438415	2013	2016
	21FLLEONLL23043684169	2008	2019
	21FLLEONLL33043384153	2008	2016
PE	21FLCOT PINEY Z 2	2007	2022
	21FLCOT PINEY Z 4	2007	2022
	21FLGW 40120	2011	2011
	21FLGW 40963	2011	2011
PW	21FLCOT PINEY Z 1	2007	2022
	21FLCOT PINEY Z 3	2007	2022
	21FLLEONLPZ33044084186	2007	2021
	21FLWQSPLEO22LAF1	2022	2022
LU	21FLCOT UPPER LAKE LAFAYETTE	2019	2022
	21FLLEONCUL3045584203	2006	2021
UL1	21FLGW47864	2015	2015
	21FLPNS 22030094	2011	2011
	21FLPNS 302633408414287	2011	2012
	21FLCOT LLB02	2015	2022
UL2	21FLLEONLCLL3045684222	2004	2021
	21FLWQA G1WA0007	2015	2017
DL1	21FLLEONLCLL3042184165	2007	2021
	21FLTLHTG1TLHR0049	2017	2017
	21FLTLHTG1TLHR0076	2017	2019
	21FLTLHTG1TLHR0104	2019	2019
UA3	21FLLEONLCLL3046384171	2007	2019
	21FLWQA G1WA0017	2016	2017
LEU	21FLCOT LLB01	2015	2022
	21FLLEONLCLL3048484210	2004	2021





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0 0.7
Miles

Legend

— Lake Lafayette Drainage Basin

— Waterbodies in Study

— Watercourses

Upper Lake Lafayette TN Average 2010-2020
mg/L

0-1.05

1.05-1.34

1.34-1.63

1.63-1.91

>1.91

Piney Z Lake TN Average 2010-2020
mg/L

0-0.51

0.51-0.65

0.65-0.79

0.79-0.93

>0.93

Lower Lake Lafayette TN Average 2010-2020
mg/L

0-1.27

1.27-1.59

1.59-1.91

1.91-2.23

>2.23

Stream TN Average 2010-2020
mg/L

0-0.51

0.51-0.65

0.65-0.79

0.79-1.03

>1.03

Sources:

Waterbodies: COT, 2020

Watercourses: COT, 2020

Drainage Basins: COT, 2020

Roads: COT-Leon County, 2023

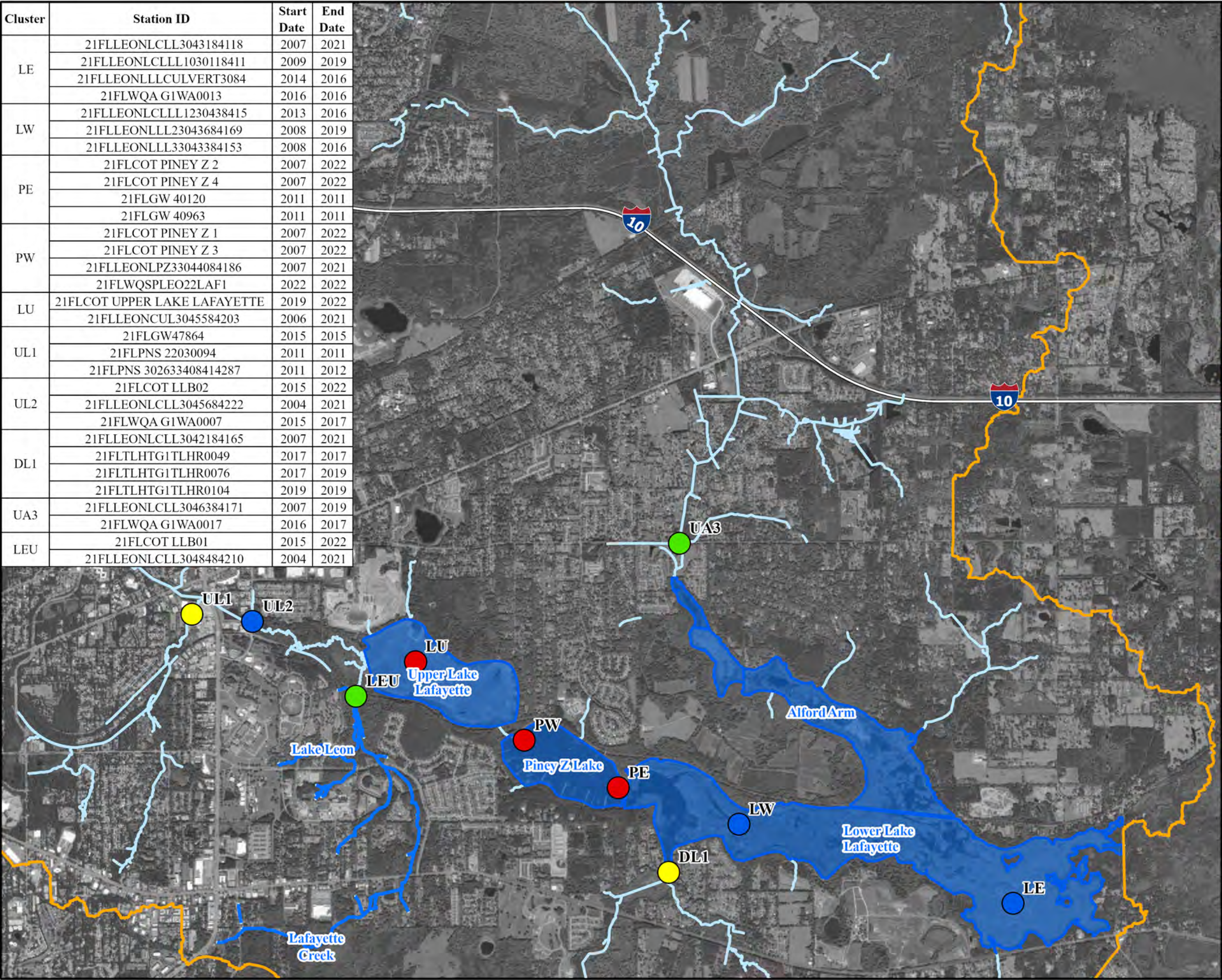
Station Data: FDEP, 2021

Figure 5-39:
Spatial Assessment of TN in Lafayette
Chain of Lakes

Tallahassee Master Plan - Surface
Water (TMaPS)

Geosyntec
consultants

Cluster	Station ID	Start Date	End Date
LE	21FLLEONLCLL3043184118	2007	2021
	21FLLEONLCLL1030118411	2009	2019
	21FLLEONLLLCULVERT3084	2014	2016
	21FLWQA G1WA0013	2016	2016
LW	21FLLEONLCLL1230438415	2013	2016
	21FLLEONLL23043684169	2008	2019
	21FLLEONLL33043384153	2008	2016
PE	21FLCOT PINEY Z 2	2007	2022
	21FLCOT PINEY Z 4	2007	2022
	21FLGW 40120	2011	2011
PW	21FLGW 40963	2011	2011
	21FLCOT PINEY Z 1	2007	2022
	21FLCOT PINEY Z 3	2007	2022
	21FLLEONLPZ33044084186	2007	2021
LU	21FLWQSPLEO22LAF1	2022	2022
	21FLCOT UPPER LAKE LAFAYETTE	2019	2022
	21FLLEONCUL3045584203	2006	2021
UL1	21FLGW47864	2015	2015
	21FLPNS 22030094	2011	2011
UL2	21FLPNS 302633408414287	2011	2012
	21FLCOT LLB02	2015	2022
	21FLLEONLCLL3045684222	2004	2021
DL1	21FLWQA G1WA0007	2015	2017
	21FLLEONLCLL3042184165	2007	2021
	21FLTLHTG1TLHR0049	2017	2017
	21FLTLHTG1TLHR0076	2017	2019
UA3	21FLTLHTG1TLHR0104	2019	2019
	21FLLEONLCLL3046384171	2007	2019
	21FLWQA G1WA0017	2016	2017
LEU	21FLCOT LLB01	2015	2022
	21FLLEONLCLL3048484210	2004	2021





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N

0 0.7
Miles

Legend

Orange outline: Lake Lafayette Drainage Basin

Blue outline: Waterbodies in Study

Light blue line: Watercourses

Upper Lake Lafayette TP Average 2010-2020 mg/L

- Blue circle: 0-0.03
- Green circle: 0.03-0.05
- Yellow circle: 0.05-0.07
- Orange circle: 0.07-0.09
- Red circle: >0.09

Lower Lake Lafayette TP Average 2010-2020 mg/L

- Blue circle: 0-0.05
- Green circle: 0.05-0.09
- Yellow circle: 0.09-0.13
- Orange circle: 0.13-0.19
- Red circle: >0.19

Stream TP Average 2010-2020 mg/L

- Blue circle: 0-0.045
- Green circle: 0.045-0.09
- Yellow circle: 0.09-0.135
- Orange circle: 0.135-0.18
- Red circle: >0.18

Piney Z Lake TP Average 2010-2020 mg/L

- Blue circle: 0-0.01
- Green circle: 0.01-0.017
- Yellow circle: 0.017-0.024
- Orange circle: 0.024-0.03
- Red circle: >0.03

Sources:

Waterbodies: COT, 2020

Watercourses: COT, 2020

Drainage Basins: COT, 2020

Roads: COT-Leon County, 2023

Station Data: FDEP, 2021

Figure 5-40:
Spatial Assessment of TP in Lafayette Chain of Lakes

Tallahassee Master Plan - Surface Water (TMaPS)



Figure 5-41 and **Figure 5-42** present maps of the spatial variation in Chl-a and TSI. These parameters represent the biological response of the systems to nutrient loading. **Figure 5-41** presents the Chl-a values (LU=14.9 µg/L, PW=17.2 µg/L, PE=15.8 µg/L, LW=4.4 µg/L, LE=2.8 µg/L). Comparing the lake segment values against their individual thresholds, Piney Z Lake shows levels at both clusters above the threshold. Lower Lake Lafayette shows low values well below its threshold. Upper Lake Lafayette values are below the threshold, but in relation to Lower Lake Lafayette the values are elevated. For Chl-a, Piney Z Lake has the highest average values. **Figure 5-42** presents the TSI values in the lake segments (LU=57.1, PW=54.3, PE=52.5, LW=37.0, LE=34.1). As all of these are at the same scale they are intercomparable.

Figure 5-43 presents the map for *E. coli*. The lake segment clusters all show very low values (LU=13.1 MPN/100 mL, PW=3.0 MPN/100 mL, PE=2.0 MPN/100 mL, LW=5.3 MPN/100 mL, LE=16.2 MPN/100 mL). For the tributaries the values are low for the cluster downstream of Weems Pond and at the inflow point for Alford Arm (UL1=155.3 MPN/100 mL, UL2=42.3 MPN/100 mL, LEU=290.1 MPN/100 mL, UA3=27.2 MPN/100 mL, DL1=425.5 MPN/100 mL). Higher levels are seen for the Lafayette Creek inflow (LEU) and the Windwood Hills inflow (DL1). As was seen for TP the bacteria levels in the Park Avenue Ditch (UL1) are higher than seen downstream of Weems Pond.

Figure 5-44 presents the map for TSS for the tributaries. All of the inflows show relatively low average TSS levels with slightly elevated levels at DL1 compared to the others.

5.4.4.2 Stormwater Runoff

To assess stormwater runoff as a potential source of pollutant loads to the Lafayette Chain of Lakes, a number of analyses were conducted. First, calculations of Landscape Development Intensity (LDI) Index by sub-watershed were performed to estimate the intensity of human land use based on nonrenewable energy flow. The LDI is calculated as the percentage area within a catchment of particular types of land use, multiplied by the coefficient of energy associated with that land use, summed over all land use types in the catchment (Brown and Vivas, 2005).

$$LDI = \sum (LDI_i * \%LU_i)$$

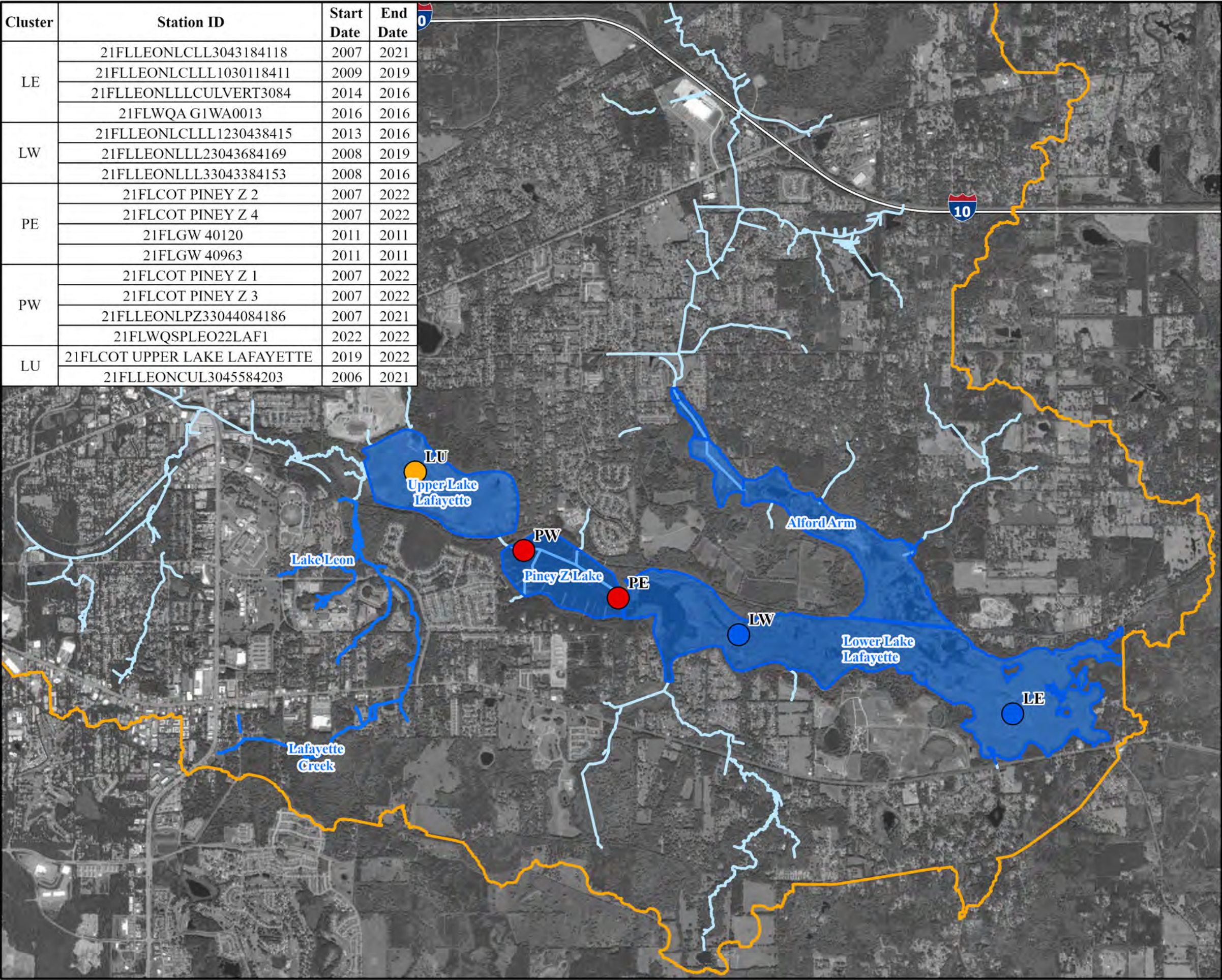
Where:

LDI_i = the nonrenewable energy land use for land use i, and

%LU_i = the percentage of land area in the catchment with land use i.

The LDI coefficients are provided in **Table 5-4**.

Cluster	Station ID	Start Date	End Date
LE	21FLLEONLCLL3043184118	2007	2021
	21FLLEONLCLLL1030118411	2009	2019
	21FLLEONLLL3043384153	2008	2016
LW	21FLWQA G1WA0013	2016	2016
	21FLLEONLCLLL1230438415	2013	2016
	21FLLEONLLL23043684169	2008	2019
PE	21FLCOT PINEY Z 2	2007	2022
	21FLCOT PINEY Z 4	2007	2022
	21FLGW 40120	2011	2011
PW	21FLCOT PINEY Z 1	2007	2022
	21FLCOT PINEY Z 3	2007	2022
	21FLWQSPLEO22LAF1	2022	2022
LU	21FLCOT UPPER LAKE LAFAYETTE	2019	2022
	21FLLEONCUL3045584203	2006	2021





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TALLAHASSEE

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0 0.7
Miles

Legend

Lake Lafayette Drainage Basin

Waterbodies in Study

Watercourses

Upper and Lower Lake Lafayette Chl a Average 2010-2020
µg/L

0-5

5-10

10-15

15-20

>20

Piney Z Lake Chl a Average 2010-2020
µg/L

0-1.5

1.5-3

3-4.5

4.5-6

>6

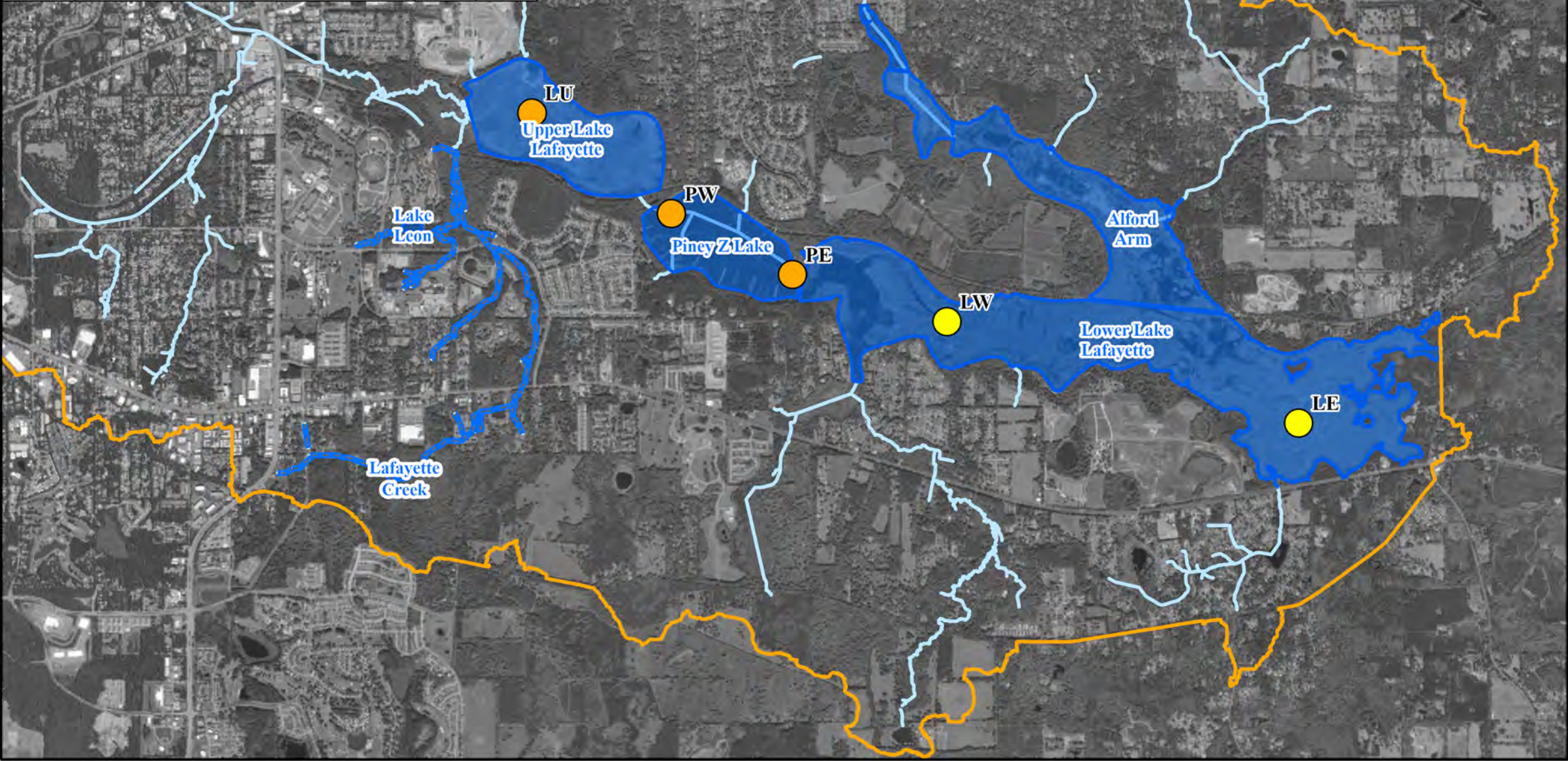
Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Drainage Basins: COT, 2020
Roads: COT-Leon County, 2023
Station Data: FDEP, 2021

Figure 5-41:
Spatial Assessment for Chl a in Lafayette
Chain of Lakes

Tallahassee Master Plan - Surface
Water (TMaPS)

Geosyntec
consultants

Cluster	Station ID	Start Date	End Date
LE	21FLLEONLCLL3043184118	2007	2021
	21FLLEONLCLLL1030118411	2009	2019
	21FLLEONLLLCULVERT3084	2014	2016
LW	21FLWQA G1WA0013	2016	2016
	21FLLEONLCLLL1230438415	2013	2016
	21FLLEONLLL23043684169	2008	2019
PE	21FLLEONLLL33043384153	2008	2016
	21FLCOT PINEY Z 2	2007	2022
	21FLCOT PINEY Z 4	2007	2022
PW	21FLGW 40120	2011	2011
	21FLGW 40963	2011	2011
	21FLCOT PINEY Z 1	2007	2022
LU	21FLCOT PINEY Z 3	2007	2022
	21FLLEONLPZ33044084186	2007	2021
	21FLWQSPLEO22LAF1	2022	2022
LU	21FLCOT UPPER LAKE LAFAYETTE	2019	2022
	21FLLEONCUL3045584203	2006	2021





CITY OF
TALLAHASSEE

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0 0.7
Miles



Legend

 Lake Lafayette Drainage Basin

 Waterbodies in Study

 Watercourses

TSI Average 2010-2020

TSI Score

 0-15

 15-30

 30-45

 45-60

 >60

Sources:

Waterbodies: COT, 2020

Watercourses: COT, 2020

Drainage Basins: COT, 2020

Roads: COT-Leon County, 2023

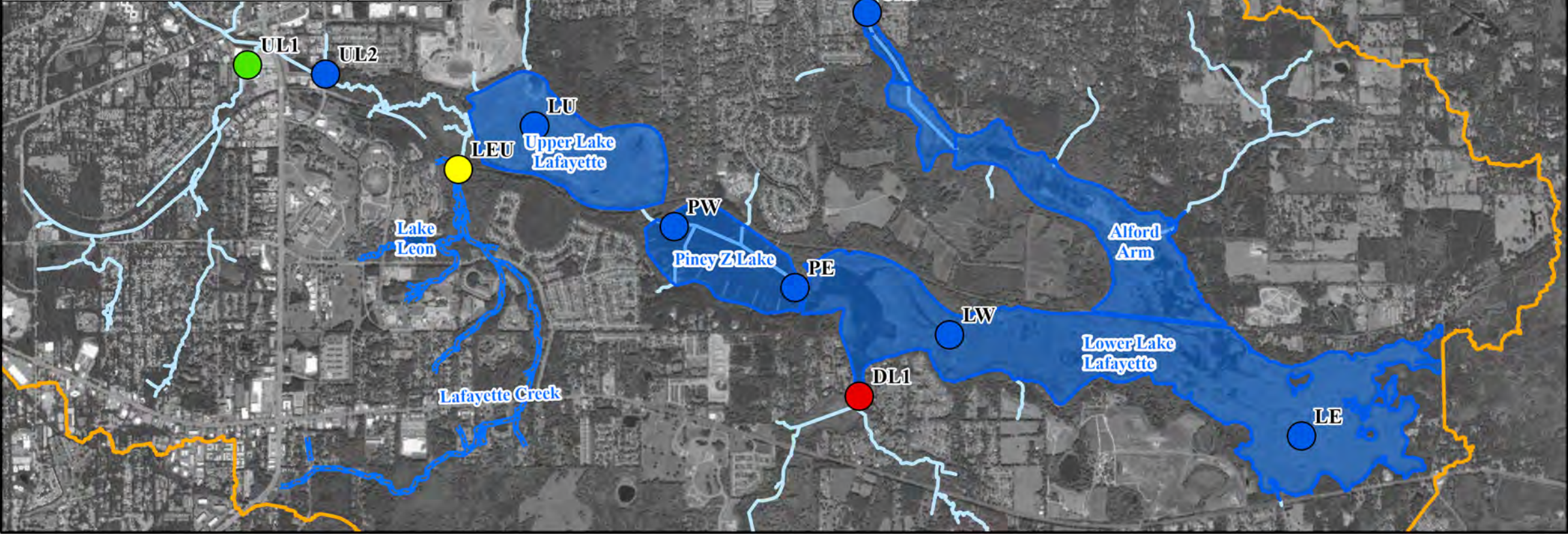
Station Data: FDEP, 2021

Figure 5-42:
Spatial Assessment of TSI in Lafayette
Chain of Lakes

Tallahassee Master Plan - Surface
Water (TMaPS)

Geosyntec 
consultants

Cluster	Station ID	Start Date	End Date
LE	21FLLEONLCLL3043184118	2007	2021
	21FLLEONLCLL1030118411	2009	2019
	21FLLEONLLLCULVERT3084	2014	2016
	21FLWQA G1WA0013	2016	2016
LW	21FLLEONLCLL1230438415	2013	2016
	21FLLEONLL23043684169	2008	2019
	21FLLEONLL33043384153	2008	2016
PE	21FLCOT PINEY Z 2	2007	2022
	21FLCOT PINEY Z 4	2007	2022
	21FLGW 40120	2011	2011
PW	21FLGW 40963	2011	2011
	21FLCOT PINEY Z 1	2007	2022
	21FLCOT PINEY Z 3	2007	2022
	21FLLEONLPZ33044084186	2007	2021
LU	21FLWQSPLEO22LAF1	2022	2022
	21FLCOT UPPER LAKE LAFAYETTE	2019	2022
UL1	21FLLEONCUL3045584203	2006	2021
	21FLGW47864	2015	2015
	21FLPNS 22030094	2011	2011
UL2	21FLPNS 302633408414287	2011	2012
	21FLCOT LLB02	2015	2022
	21FLLEONLCLL3045684222	2004	2021
DL1	21FLWQA G1WA0007	2015	2017
	21FLLEONLCLL3042184165	2007	2021
	21FLTLHTG1TLHR0049	2017	2017
	21FLTLHTG1TLHR0076	2017	2019
UA3	21FLTLHTG1TLHR0104	2019	2019
	21FLLEONLCLL3046384171	2007	2019
	21FLWQA G1WA0017	2016	2017
LEU	21FLCOT LLB01	2015	2022
	21FLLEONLCLL3048484210	2004	2021



Legend

- Lake Lafayette Drainage Basin
- Waterbodies in Study
- E. coli 90th Percentile 2010-2020**
MPN/100mL
 - 0-100
 - 100-200
 - 200-300
 - 300-410
 - >410

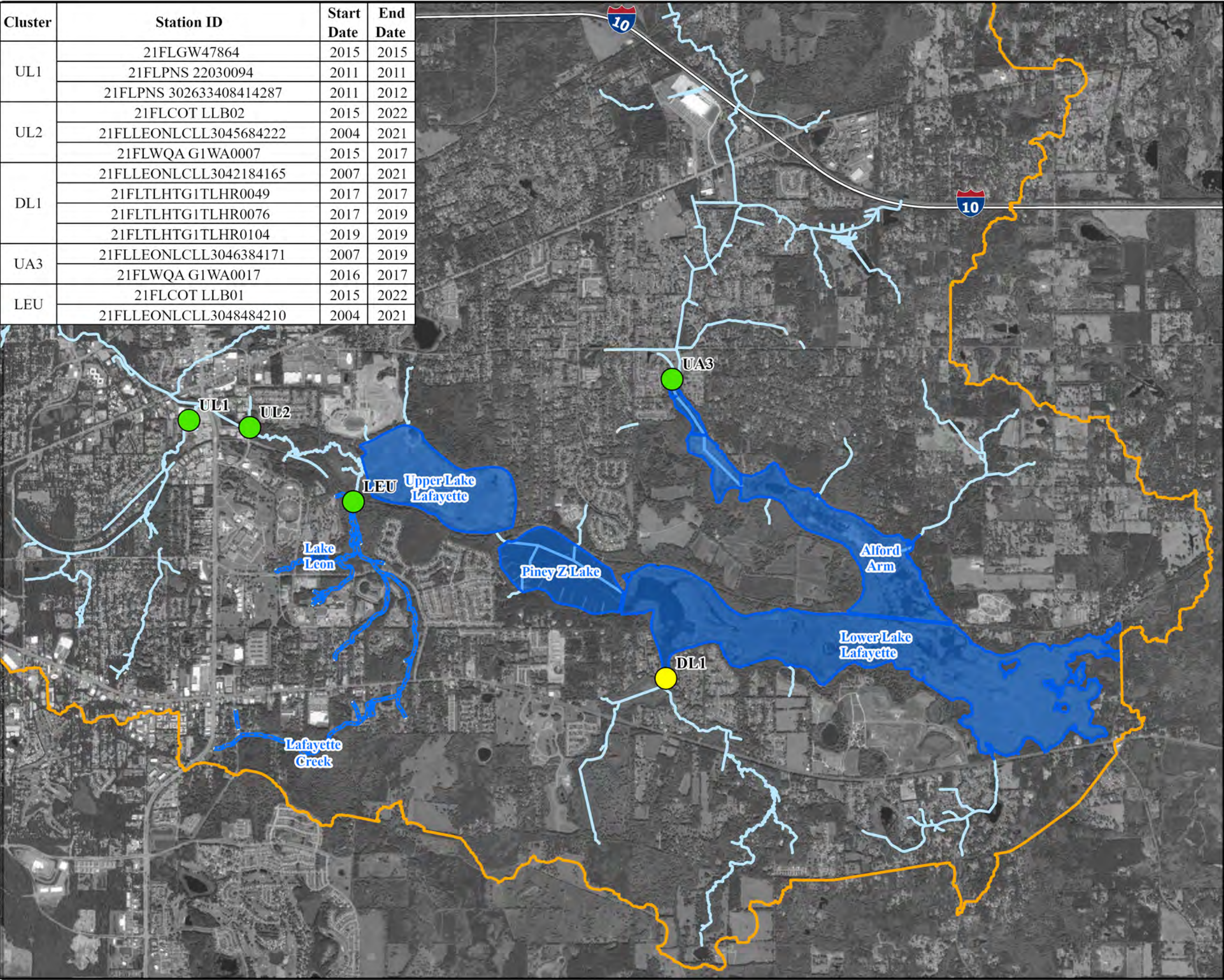
Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Drainage Basins: COT, 2020
Roads: COT-Leon County, 2023
Station Data: FDEP, 2021

Figure 5-43:
Spatial Assessment of E. coli in Lafayette
Chain of Lakes and Tributaries

Tallahassee Master Plan - Surface
Water (TMaPS)



Cluster	Station ID	Start Date	End Date
UL1	21FLGW47864	2015	2015
	21FLPNS 22030094	2011	2011
	21FLPNS 302633408414287	2011	2012
UL2	21FLCOT LLB02	2015	2022
	21FLLEONLCLL3045684222	2004	2021
	21FLWQA G1WA0007	2015	2017
DL1	21FLLEONLCLL3042184165	2007	2021
	21FLTLHTG1TLHR0049	2017	2017
	21FLTLHTG1TLHR0076	2017	2019
	21FLTLHTG1TLHR0104	2019	2019
UA3	21FLLEONLCLL3046384171	2007	2019
	21FLWQA G1WA0017	2016	2017
LEU	21FLCOT LLB01	2015	2022
	21FLLEONLCLL3048484210	2004	2021





CITY OF
TALLAHASSEE




Legend

Lake Lafayette Drainage Basin

Waterbodies in Study

Watercourses

TSS Average 2010-2020
mg/L

- 0-2.5
- 2.5-5.0
- 5.0-7.5
- 7.5-10.0
- >10.0

Sources:
 Waterbodies: COT, 2020
 Watercourses: COT, 2020
 Drainage Basins: COT, 2020
 Roads: COT-Leon County, 2023
 Station Data: FDEP, 2021

Figure 5-44:
 Spatial Assessment of TSS in Lafayette
 Chain of Lakes Tributaries

Tallahassee Master Plan - Surface
 Water (TMaPS)



Table 5-4: Landscape Development Intensity Index Coefficients

Category	Coefficient
Natural System	1
Pine Plantation	1.6
Pasture	3.4
Row Crops	4.5
Residential (low)	6.8
Residential (high)	7.6
Commercial	8.0
Industrial	8.3
Commercial (high)	9.2
Business District	10.0

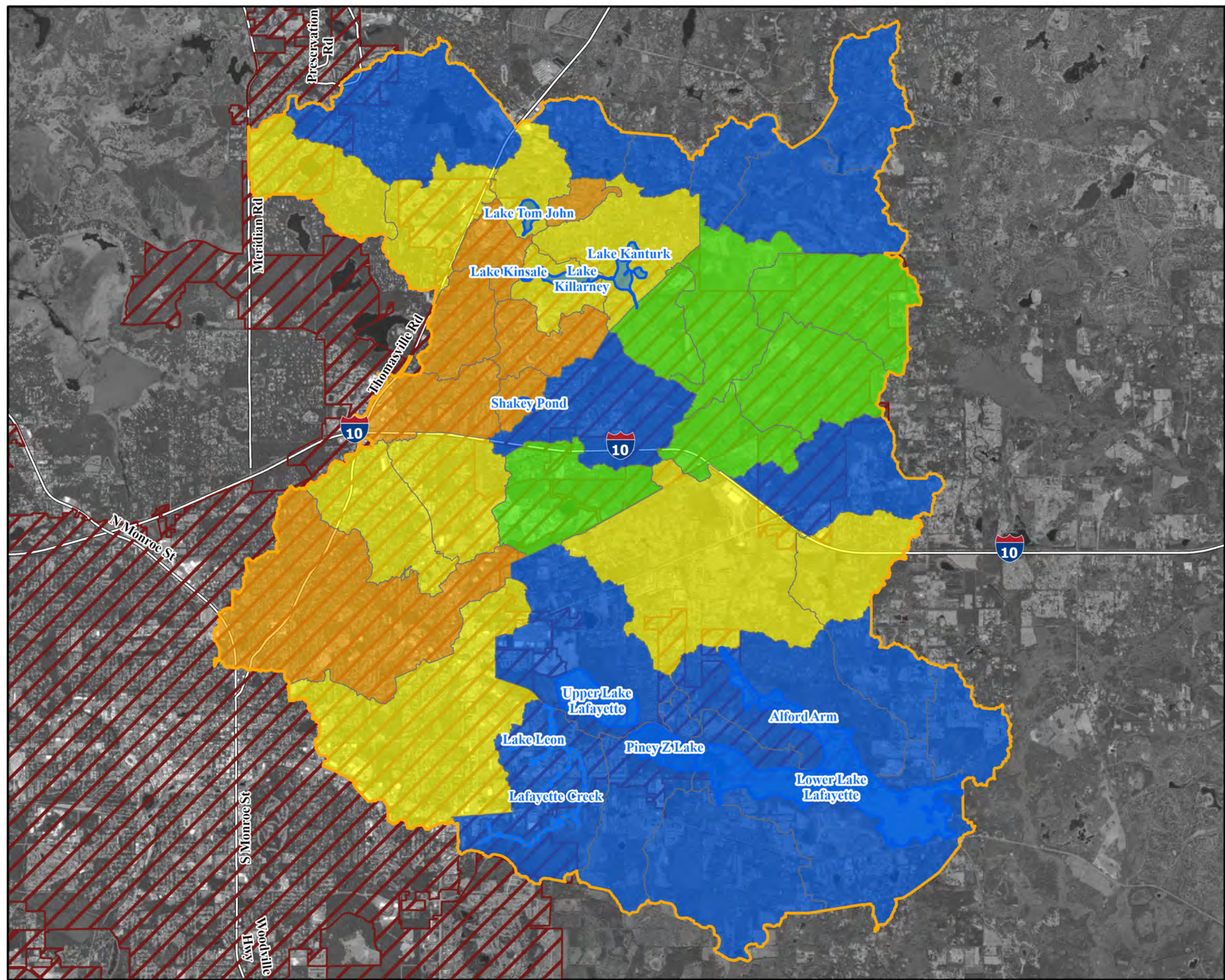
FDEP uses the LDI as a tool to estimate potential adverse human effects from various land uses on adjacent waterbodies, such as streams, lakes, and wetlands. Based on the LDI score, the catchment area is rated as excellent (1 to 2), good (3 to 4), moderate (5 to 6), poor (7 to 8), or very poor (9 to 10) in relation to its potential for adverse impacts or loadings to waterbodies that receive runoff (FDEP, 2020).

Figure 5-45 presents the calculated LDIs by sub-watershed throughout the Lake Lafayette basin. The boundaries of the watersheds evaluated are thin grey lines in the figure. The results show the distinct spatial differences in land use and runoff loading potential in the basin. The LDI analyses do not account for treatment that occurs within the various watersheds but rather reflect the potential for pollutant load in stormwater runoff from the various land uses.

For the drainage to the Lafayette Chain of Lakes, LDIs in the subwatersheds draining to Upper Lake Lafayette range from Excellent to Poor with the LDIs along the bulk of the NEDD ranging from moderate to poor. All subwatersheds draining to Upper Lake Lafayette have Good LDI values. Similarly, the subwatersheds that drain directly to Lower Lake Lafayette and Alford have Good LDI values. Upstream of Alford Arm the subwatersheds range from Excellent to Poor with the subwatersheds upstream of I-10 (below the Killearn Chain of Lakes and into the upstream areas of the watershed to the Northeast) LDI values ranging from Excellent to Good.

The second analysis was based on data presented in **Section 5.4.4.1** which quantified the concentrations coming into the Chain of Lakes from various tributaries. These included the NEDD, Lafayette Creek, the Windwood Hills neighborhood, and the tributary flowing into Alford Arm. Examination of the tributary analyses showed that, due to the Weems Pond Stormwater Treatment Facility, concentrations of nutrients and bacteria from the NEDD are well below the NNC and bacteria criteria (**Figure 5-39, Figure 5-40, Figure 5-41**).

Lafayette Creek discharges to Upper Lake Lafayette are also well below the NNC and bacteria criteria with slightly higher TP concentrations. Similar conditions are found for the inflow to Alford Arm. The Windwood Hills neighborhood inflows also are all below the NNC but with more elevated values. The Windwood Hills neighborhood did have bacteria levels above the 410 MPN/100 mL criteria, indicating a potentially significant bacteria source in that subwatershed.



Legend

- Waterbodies in Study
- Tallahassee Corporate Limits
- Land Development Index**
- Excellent
- Good
- Moderate
- Poor
- Very Poor

Sources:
Waterbodies: COT, 2020
Drainage Basins: COT, 2020
Roads: Leon County, 2023
City Limits: COT, 2022

Figure 5-45:
Land Development Index by Sub-
Watershed within Lafayette Chain of Lakes
Drainage Basin

Tallahassee Master Plan - Surface
Water (TMaPS)



5.4.4.3 Septic Systems

Figure 5-46 presents a map showing the septic tank densities by subwatershed to aid in identifying the areas more likely to be sources of loading to the lakes. Examination of the figure shows that septic densities in the areas draining to the Lafayette Chain of Lakes are low (less than 1 per 5 acres). The only area with somewhat elevated densities, i.e., between 1 per 2 or 3 acres, are the areas just upstream of Alford Arm. The distribution of septic systems can be seen in **Exhibit 5-5**. The highest densities in the basin are upstream of the Killlearn Chain of Lakes, the densities in this area are discussed in later sections.

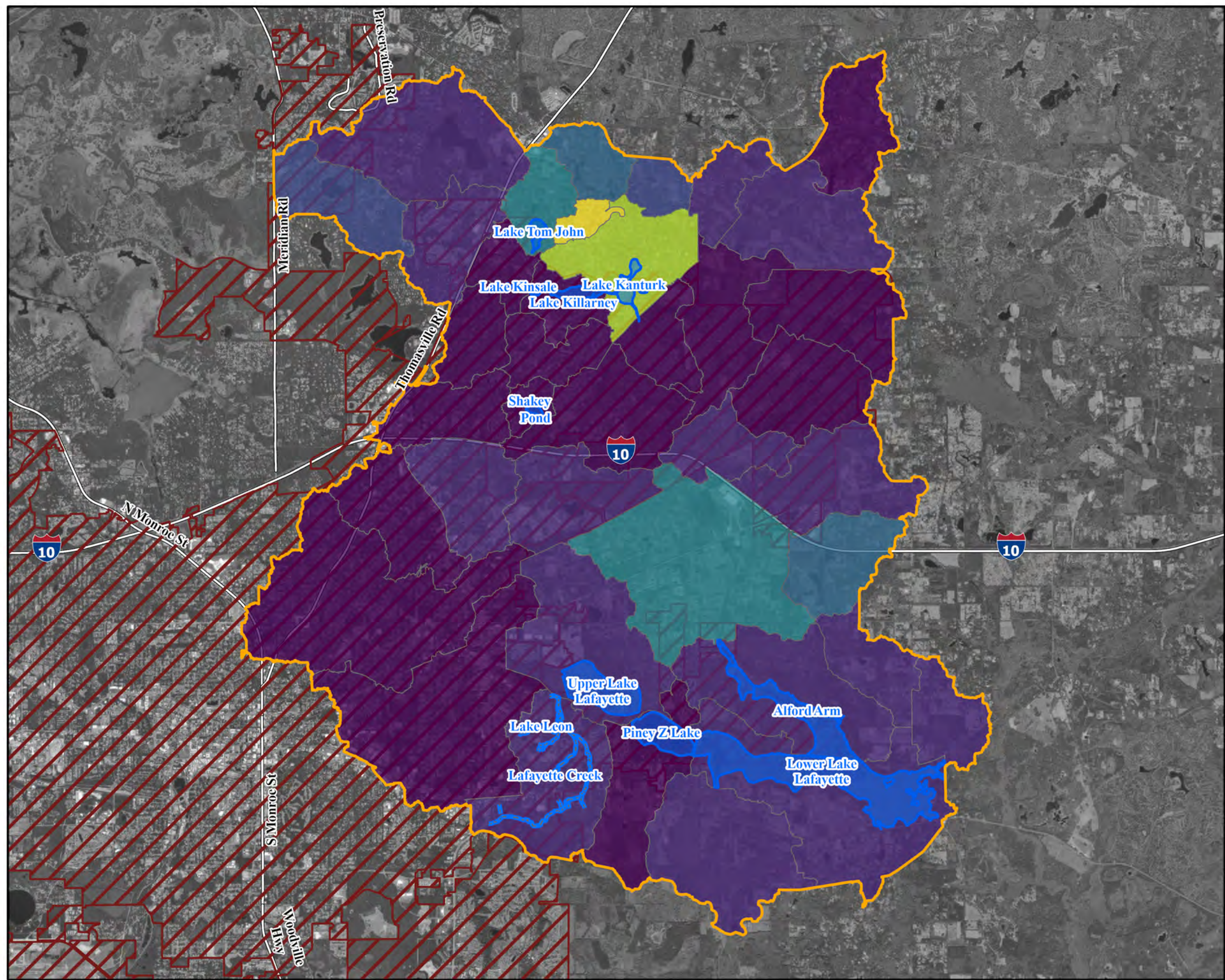
5.4.4.4 Internal Recycling and Seepage

Internal Recycling

As discussed in **Section 5.4.1**, in 2005, the Existing Status and Management Plan was completed on the Lafayette Chain of Lakes. The study developed management options for water quality restoration. As part of this study, sediment cores were collected at 34 sites located throughout all four waterbodies. Analyses of the sediments identified that the lakes have a mixture of highly organic and sandy sediments with a higher percentage of organics in Piney Z, Alford Arm, and Lower Lake Lafayette. The study also identified that organic matter likely does not accumulate as much in Upper Lake Lafayette due to the periods of time where bottom conditions are dry. The study identified elevated levels of TN and TP in the sediments in Upper Lake Lafayette and Alford Arm with lower levels observed in Piney Z Lake and Lower Lake Lafayette. The data from this study reflects discharge conditions prior to 2004. For Upper Lake Lafayette the sediment results are prior to the construction of the ULL-NRF.

Direct measurements of internal loading have not been performed for any of the waterbodies. As such, quantification of the internal TN and TP loads cannot be done. Historic measurements identified that sediments within Lower Lake Lafayette and Piney Z Lake did not have elevated nutrient levels. Given the nature of Lower Lake Lafayette, with extensive vegetative cover, pockets of open water, and overall good water quality as outlined in **Section 5.4.3.7** and **Section 5.4.4.1** internal nutrient loads are not identified as a significant source. For Piney Z Lake, historic measurements did not show elevated nutrients within the surface organic sediments, based on this, internal nutrient loading is not identified as a significant source.

Historic sediment measurements in Alford Arm show elevated nutrient levels. Those data were collected in 2004. Due to issues of available sampling locations, no recent data on water quality is available within the lake portions of Alford Arm (**Section 5.4.3.7**). Inflow water quality data immediately upstream of Alford Arm did not show elevated nutrients or bacteria (**Figure 5-39**, **Figure 5-40**, and **Figure 5-43**). Given the inflow data, along with the impounded and wetland nature of the system (similar to Lower Lake Lafayette) internal loading is identified as a potential source.



Legend

- Lake Lafayette Drainage Basin
- Waterbodies in Study
- Tallahassee Corporate Limits
- Septic Tank Density
- Density
- 0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
- 0.9 - 1

Sources:
 Waterbodies: COT, 2020
 Drainage Basins: COT, 2020
 Roads: Leon County, 2023
 City Limits: COT, 2022
 Septic Tanks: COT, 2020

Figure 5-46:
 Septic Tank Density by Sub-Basin within
 Lafayette Chain of Lakes Drainage Basin

Tallahassee Master Plan - Surface
 Water (TMaPS)



Upper Lake Lafayette's unique hydrology has direct impacts upon the potential for internal lake sediment/recycling as a source of loading. The natural dry-out of the lake bottom creates conditions where a significant portion of the bottom sediments are periodically desiccated. Additionally, while historic measurements show elevated nutrient levels in the sediments, these measurements were made prior to the construction of the ULL-NRF. This facility significantly reduced nutrient loads from the primary drainage to Upper Lake Lafayette, the NEDD. Additionally, the other primary drainage into Upper Lake Lafayette (Lafayette Creek) did not show elevated nutrient levels. Based on the inflows and the hydrology of the lake, internal nutrient loads are not identified as a significant source.

Seepage

As outlined in the data summary (**Section 5.4.3.12**), there are no surficial sampling wells in the vicinity of the Lafayette Chain of Lakes that might provide direct data on the potential for seepage as a source. For Upper Lake Lafayette, given the intermittent nature of the system and the frequent and extended periods of dry down, seepage is not identified as a significant potential source. For the remaining lakes, the primary potential source of pollutants to the surficial aquifer in the areas surrounding the lakes are septic systems. **Section 5.4.4.3** provided an assessment of septic systems as a source and, therefore, addresses their source potential.

5.4.4.5 Wastewater

A source of pollution that is discretely identifiable and from which pollutants are discharged is known as a point source. Common types of point sources include wastewater generating facilities like factories, paper/pulp mills, and water treatment plants. Effluent from these facilities can be discharged either directly to a waterbody or via land application on designated spray fields. In either case, these discharges pose the potential to be a source of pollutants to waterbodies in the basin. This section of the report focuses on known wastewater point sources within the Lake Lafayette basin and reviews their potential for impacting water quality within the study waterbodies as a function of loading with a focus on TN and TP.

Figure 5-2 and **Table 5-2** in **Section 5.4.3.5** identified active permitted point source discharges in the Lake Lafayette basin. A total of five facilities are located within the basin boundaries. Of these five facilities, two are located upstream of the ULL-NRF. These are the Ready Mix USA Weems Road Plant and Sams Club 8120. Neither facility monitors nutrients, so a calculation of load is not possible. Based on their location upstream of the Weems Pond SWMF these discharges are not identified as significant loads to Upper Lake Lafayette. Two other facilities are car washes located along Highway 27 and Buck Lake Road (numbers 1 and 2 in **Table 5-2**). These facilities also do not monitor nutrients. Based on the nature of the facilities they are not identified as potential significant sources.

The final facility is the Meadow at Woodrun WWTF operated by Talquin. This facility is a land application site and is located in close proximity to wetland portions of Lower Lake Lafayette along the southeastern side. Annual average discharge volumes for the facility are 30,000 gallons per day. The 1996 Lake Lafayette Management study identified that contributions from the treatment facility at that time, along with potential seepage from the landfill located immediately adjacent to the treatment plant led to water quality degradation in Lower Lake Lafayette. The

landfill has subsequently been closed. Presently, based on available data, Lower Lake Lafayette is meeting NNC and bacteria criteria. Therefore, the Meadow at Woodrun WWTP is not identified as a potential significant source of loading to Lower Lake Lafayette.

Figure 5-47 presents a map of the Lake Lafayette basin boundaries in relation to sewer service areas. Sewer infrastructure within the basin is located primarily on the western side of the basin in the watersheds draining to Upper Lake Lafayette and Piney Z Lake. There is limited wastewater infrastructure in the direct and tributary drainage to Lower Lake Lafayette and Alford Arm.

None of the three waterbodies in the Lafayette Chain of Lakes (Upper Lake Lafayette, Piney Z Lake, and Lower Lake Lafayette) had significantly elevated bacteria levels, i.e., *E. coli* levels above the 410 MPN/100 mL threshold (**Figure 5-32** through **Figure 5-34**). Some higher levels of bacteria were found along the inflow from Lafayette Creek, but these were below the 410 MPN/100 mL threshold. The Windwood Hills neighborhood inflow had bacteria levels above the 410 MPN/100 mL threshold (**Figure 5-43**) but that neighborhood is not presently on central sewer. Therefore, other sources are likely contributing to those higher bacteria levels. While sanitary sewer overflows (SSOs) occur from time to time, SSOs are acute events with impacts lasting for relatively short periods of time (hours to several days), depending on magnitude and environmental conditions. The mechanism for abatement would not be treatment projects but rather any needed maintenance to sewer infrastructure. The City presently tracks, reports, and addresses these issues as they arise.

5.4.4.6 Atmospheric Deposition

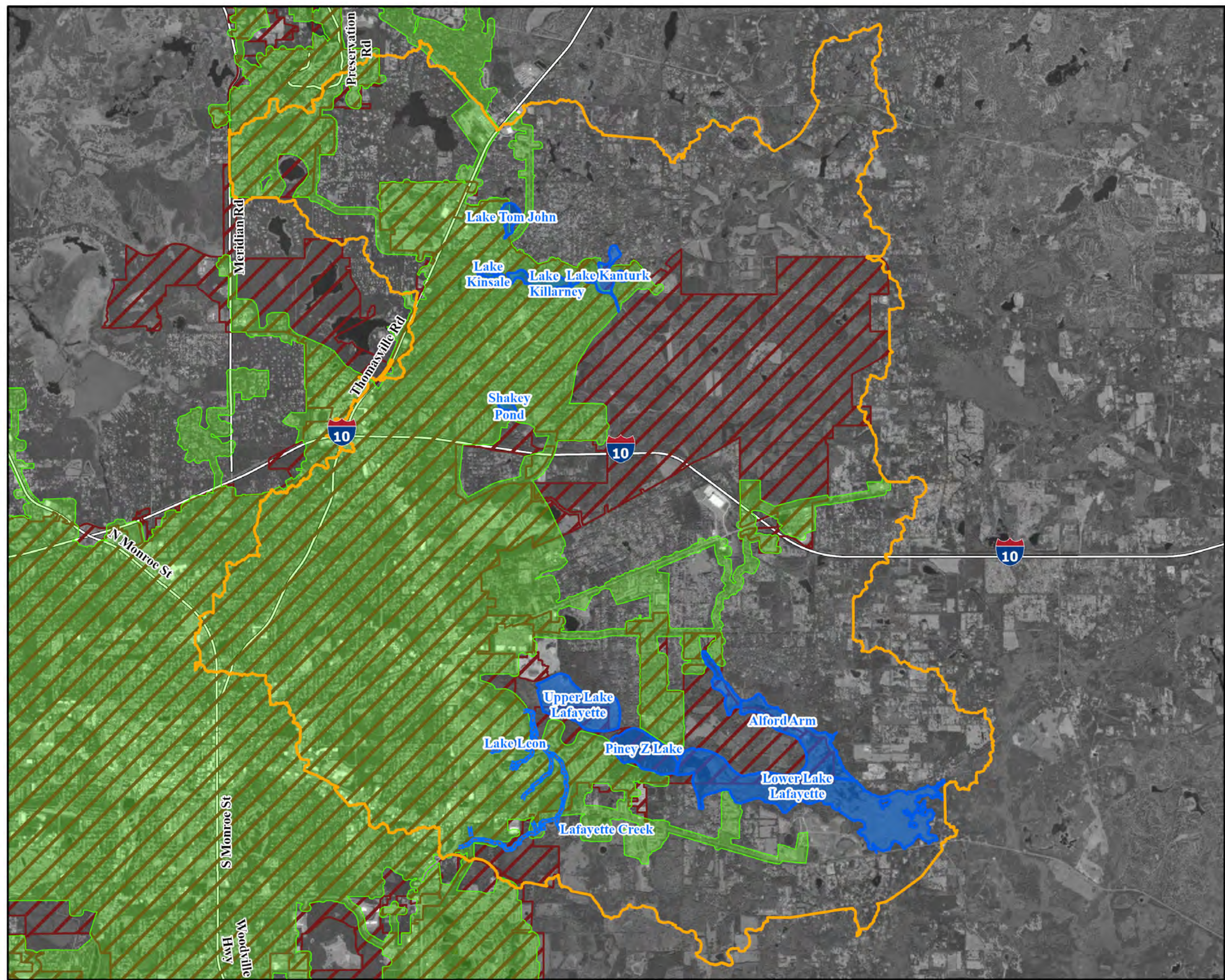
Atmospheric deposition is the load that falls directly onto the earth's surface. For this and future analyses, atmospheric deposition is accounted for both indirectly within stormwater runoff and directly as a load to the lake surface. In watersheds with a large watershed-to-lake area ratio (such as Upper Lake Lafayette and Lower Lake Lafayette) atmospheric deposition will play a lesser role. Where that value is larger (Piney Z Lake) atmospheric deposition may play a larger role. As such, it should be considered in the assessment of loads to the lakes. It is important to note that project-specific recommendations made within this report will not address direct deposition on the waterbody surfaces as a source, but its quantification relative to other sources is important.

As outlined in **Section 5.4.3.11**, there is an atmospheric deposition station in the vicinity of Tallahassee. This station is the Quincy station (FL14) (**Figure 5-35**). Data from this station was utilized to calculate the atmospheric deposition to each of the Lakes in the Lafayette Chain.

Atmospheric deposition is a function of air quality that is able to be improved through regulation and public outreach. Analysis of atmospheric deposition and impacts from it was outside of the project scope and, therefore, will not be assessed in this report.

5.4.4.7 Interconnected Lakes

There are six lakes (outside of the chain) identified with surface connections and the potential to flow into the waterbodies in the Lafayette Chain of Lakes. These are Buck Lake and Lake Leon which drain to Upper Lake Lafayette, Lake Windermere that drains to a tributary of Lower Lake Lafayette, Mill Pond that drains to a tributary of Alford Arm, Lake Cassie that discharges to tributaries upstream of Alford Arm, and Lake Kanturk that flow out of the Killlearn Chain into tributaries upstream of Alford Arm.



Legend

- Lake Lafayette Drainage Basin
- Waterbodies in Study
- Tallahassee Corporate Limits
- Sewer Service Areas

Sources:
Waterbodies: COT, 2020
Drainage Basins: COT, 2020
Roads: FDOT, 2020
City Limits: COT, 2022
Waste Water: COT, 2020

Figure 5-47:
City of Tallahassee Wastewater Service
Areas within Lafayette Chain of Lakes
Basin

Tallahassee Master Plan - Surface
Water (TMaPS)



Buck Lake has a surface area of 11.4 acres and is mainly surrounded by residential land use. It connects to Upper Lake Lafayette through a tributary that crosses Buck Lake Road and flows into the area of the sink. There is no current water quality data for Buck Lake so potential impacts from the connection cannot be assessed. Observations provided by City staff indicate that Buck Lake has a good vegetative community with no observed algal blooms, therefore it is not deemed a potential source of loading.

Lake Leon, which is a target waterbody in this study, has a surface area of 6 acres and is located in Tom Brown Park. It connects to Upper Lake Lafayette through a Lafayette Creek which discharges on the southern side of lake. Water quality data are available for Lake Leon, so the potential load is calculated in **Section 5.4.5.4**. Lake Leon has the potential to be a source of loading to Upper Lake Lafayette.

Lake Windermere has a surface area of 8.7 acres and is mainly surrounded by residential land use. It connects to the eastern end of Lower Lake Lafayette through a tributary that discharges on the southern side of the lake. There is no current water quality data for Lake Windermere so potential impacts from the connection cannot be assessed. Lake Windermere, based on adjacent land use and proximity to Lower Lake Lafayette has the potential to be a source of loading.

Mill Pond has a surface area of 8.9 acres and is mainly surrounded by residential land use. It connects to tributaries that drain into Alford Arm. There is no current water quality data for Mill Pond so potential impacts from the connection cannot be assessed. Based on adjacent land use and its size Mill Pond would not be considered a significant source to Alford Arm.

Lake Cassie has a surface area of 9 acres and is mainly surrounded by low density residential development. It connects to the tributaries that drain into Alford Arm. There is no current water quality data for Lake Cassie so potential impacts from the connection cannot be assessed. Lake Cassie, based on adjacent land use, would not be considered a significant source to Alford Arm.

In addition to the lakes described above, the lakes within the chain can contribute loads to each other. Piney Z Lake drains to Upper Lake Lafayette through a drop structure along its western side and a pipe passing through the berm between the two lakes. This discharge can be turned on and off by valves in the pipe. While Piney Z Lake contributes flow to Upper Lake Lafayette, based on lower TN and TP concentrations within Piney Z Lake, it would not be considered a significant source of loads.

Piney Z Lake and Lower Lake Lafayette exchange flows based on their differences in elevation through a drop structure located along the western side of Lower Lake Lafayette and pipes that pass through the berm between the two waterbodies. Flows through this structure can go in either direction so loads are deemed net zero between the two waterbodies.

Finally, Alford Arm discharges to Lower Lake Lafayette through pipes that pass beneath the CSX railroad berm. This load is considered a potential source of nutrients to Lower Lake Lafayette.

5.4.4.8 Summary of Findings

Based on the discussions above, and data and information presented in **Section 5.5.3**, there are various potential sources of pollutant loads to the Lafayette Chain of Lakes that should be

targeted for further evaluation. As discussed earlier, Upper Lake Lafayette is presently impaired but the lakes present hydrology and extensive periods of dry down with standing water only in the area of Lafayette Sink make assessment as a typical lake unreasonable. Piney Z Lake is presently impaired based upon its classification as a low color low alkalinity system which may not represent an appropriate designated use. Lower Lake Lafayette and Alford Arm are presently not impaired. The spatial analyses presented in **Section 5.4.4.1** did not show elevated nutrient concentrations within any of the primary tributaries flowing directly into any of the four waterbodies with very low levels coming out of the ULL-NRF. Piney Z has no significant tributary inflows. The following outlines the findings for each of the potential pollutant sources discussed above.

- Stormwater Runoff – Stormwater runoff, contributing to tributary inflow loads, is not identified as a potential significant source of pollutants to the Lafayette Chain of Lakes based on water quality data, in place treatment, and watershed conditions.
- Septic Systems – Loads from septic system are not identified as a potential source of pollutants to Upper Lake Lafayette, Piney Z Lake, and Lower Lake Lafayette. Alford Arm is identified as having septic loading as a source based upon the number and density of systems upstream.
- Interconnected Flows – The only interconnected flow identified as a potential source is the flow from Alford Arm into Lake Lafayette but, based on the water quality conditions measured at the inflow to Alford Arm, and present water quality in Lower Lake Lafayette, this loading is likely not a significant source of pollutants.
- Internal Recycling – Internal recycling is not identified as a potential significant load to the Lafayette Chain of Lakes. Some historic sediment data within Alford Arm did show elevated TN and TP levels.
- Seepage – While no data on seepage into the lakes is available, it is assumed that the primary source of seepage loads would be septic systems, which are assessed separately.
- Wastewater – The only wastewater load identified as a potential concern was potential seepage associated with the Meadow at Woodrun WWTF operated by Talquin Electric. Historic studies identified this facility as a potential source of degraded water quality in Lower Lake Lafayette. Based on present water quality conditions, and cluster analyses of data in the area of Lower Lake Lafayette near the facility, it is not considered a potential significant source.
- Atmospheric Deposition – Based on the relatively low watershed to lake area ratio for Piney Z Lake and its isolated nature, atmospheric deposition is identified as a potentially significant load. While this load is quantified for comparison to other loads, no recommendations will be made relative to potential reductions. Atmospheric deposition is not a potential significant source for the other lakes within the chain.

5.4.5 Calculation of Potential Nutrient Loads

This section presents calculations of potential nutrient (TN and TP) loads to the Lafayette Chain of Lakes for the sources identified for calculation in **Section 5.4.4.8**. These include stormwater runoff, septic systems, point source load, lake inflow and atmospheric deposition. Where loads were not calculated, the sections below provide brief discussions. The load calculations are for the purpose of comparing the potential magnitudes of each source relative to one another.

5.4.5.1 Stormwater Pollutant Load

In order to calculate the potential stormwater TN and TP loads to the Lafayette Chain of Lakes, and other waterbodies within the Lake Lafayette basin, average annual pollutant load modeling was performed. The goal was to identify areas that are contributing higher TN and TP loads relative to others within the drainage area to the waterbody and estimate a potential total load for comparison to other loading sources. TN and TP loads were calculated using the Spatially Integrated Model for Pollutant Loading Estimates (SIMPLE-Seasonal) model. The approach described below was used for all project waterbodies within the Lake Lafayette basin. Pollutant load models, such as the SIMPLE model, calculate loads by determining a volume of runoff from a specified area and then multiplying the runoff volume by EMCs. EMCs are concentrations of constituents (TN and TP in this case) that are found in runoff based on specified land uses.

SIMPLE-Seasonal Model Methodology

Pollutant loads from direct runoff for each subbasin are calculated using the SIMPLE-Seasonal model, originally developed by Jones Edmunds and Associates (Jones Edmunds) for Sarasota County and the Southwest Florida Water Management District (SWFWMD). The complete model development is documented in *Sarasota County County-Wide Non-Point Source Pollutant Loading Model* prepared by Jones Edmunds in August 2005. The model operates within a geographic information system (GIS) framework and calculates pollutant loading over large areas with spatially variable characteristics, leveraging the runoff excess estimation methods described by Harper and Baker, 2007.

For the purposes of this project, the model was set up following the procedure outlined in the Hernando County guidance document developed by Jones Edmunds (Hernando County, 2013). It should be noted that when running the SIMPLE-Seasonal model, Geosyntec utilized default model values to account for seasonal variability of rainfall. The model includes BMP, EMC, runoff, basins, septic, and point source feature classes. For the purposes of this project, the septic and point source feature classes were not utilized as those loads are quantified separately. TN and TP reductions due to the different types of BMPs are assigned in the BMP shapefile. The EMC shapefile includes the TN and TP EMCs based on the land use types. The runoff shapefile includes the land use, hydrologic soil group (HSG), and the average annual runoff coefficient, defined as the fraction of average annual rainfall volume converted to runoff. Finally, the basin shapefile includes the total acreages of each subbasin. Note that no base flow was assigned for this analysis. The calculation of the pollutant load associated with the runoff was based on the Harper and Baker (2007) method of rainfall excess determination and pollutant loading. This method uses an average annual rainfall volume, which is multiplied by an average annual runoff coefficient to determine the average annual runoff volume. The average annual runoff coefficient

is based on the percent directly connected impervious area (DCIA) and the non-DCIA curve number (CN), which are determined based on the land use and soil conditions. The average annual loading is determined by multiplying the average annual volume of runoff and the pollutant EMC.

The average annual rainfall depth for this watershed was estimated to be 59 inches using the *Florida State University – Office of Institutional Research Tallahassee/Leon County, Florida*.

The topography for the study area was analyzed via a Digital Elevation Model (DEM) from Leon County (2018). The elevations within the watershed range from approximately 255 ft down to approximately 17 ft. All elevation data presented in this report are expressed in feet referenced to NAVD88 (**Figure 5-48**). The highest elevations appear in the southwest side of the basin, with the lowest values around the eastern end of Lower Lake Lafayette where the basin discharges to the St. Marks watershed.

Subbasins were initially provided by the City within the Lake Lafayette basin. For modeling purposes, subbasins were delineated to the BMP and the outfall level to define where stormwater is generated and where it accumulates. For the purposes of this study, BMPs under 1-acre in size were not accounted for in the load calculations based on the scale of the overall project. The runoff volumes are estimated along with the associated pollutant loads. A total of 69 subbasins were delineated throughout the Lake Lafayette basin using the 2018 Leon County DEM and the flowlines from the USGS National Hydrological Dataset (NHD) (2020). The NHD represents the water drainage network within the study area, such as conduits, inlets, and junctions, and is used to delineate the watershed in a manner appropriate for the level of detail required for this study. The final contributing drainage area, based on the delineations, is presented in **Figure 5-48**. Additionally, the treatment percentages utilized for each BMP type are presented. For the purposes of the Lafayette Chain of Lakes stormwater load calculations, the subbasins within the Killearn Chain of Lakes and those upstream are not presented. Their loads are presented in later sections.

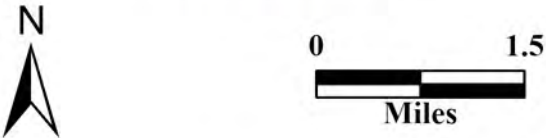
The land use data used for this modeling effort referenced the 2019 NFWFMD feature class presented in **Section 5.4.3.2**. The data were manipulated for the purposes of this analysis as described below. First, the NFWFMD land use data were aggregated into simplified land use categories as presented in the SIMPLE guidance document (Hernando County, 2013), which was done to generalize the watershed's land uses into 11 land use categories (**Figure 5-49**), which corresponded to available EMC data. A summary of how the land uses were aggregated is presented in **Table 5-5**.

As previously mentioned, the SIMPLE-Seasonal model uses the Harper and Baker (2007) method to determine stormwater pollutant loads. Specifically, a mean annual runoff coefficient (MARC) and the average annual rainfall depth are used to estimate average annual runoff volumes. The MARCs for all land use categories were developed based on the annual runoff coefficients for Meteorological Zone 1 in the draft *Florida Stormwater Quality Applicants Handbook* (FSQAH) (FDEP, 2010). The MARCs are assigned based on the DCIA and the non-DCIA CN. Impervious areas within representative areas for each simplified land use type were digitized to estimate representative DCIA and impervious percentages. The representative percentages were used for each land use with the values used provided in **Table 5-6**.

Lake Lafayette Chain Subbasin Summary			
Number	Subbasin ID	Acreage	BMP Type
1	LFBULL0070	653	Wet Detention
2	LFBULL0090	202	Wet Detention
3	LFBULL0030	60	Dry Detention
4	LFBULL0050	26	Dry Detention
5	LFBULL0040	56	Wet Detention
6	LFBULL0080	55	Dry Retention
7	LFBULL0060	17	Wet Detention
8	LFBULL0010	562	None
9	LFBULL0020	403	None
10	LFBULL0015	422	None
11	LFBWEEM01	10,353	Wet Detention
12	LFBPZL0020	163	Dry Detention
13	LFBPZL0030	265	None
14	LFBPZL0010	165	None
15	LFBLLL0100	90	Dry Detention
16	LFBLLL0020	2,083	None
17	LFBLLL0015	57	Dry Retention
18	LFBLLL0025	30	Dry Detention
19	LFBLLL0023	51	Dry Retention
20	LFBLLL0050	68	Wet Detention
21	LFBLLL0120	22	Dry Retention
22	LFBLLL0110	536	Wet Detention
23	LFBLLL0130	802	None
24	LFBLLL0090	16	Dry Retention
25	LFBLLL0080	6	Dry Retention
26	LFBLLL0030	72	Wet Detention
27	LFBLLL0040	8	Dry Detention
28	LFBLLL0060	38	Wet Detention
29	LFBLLL0070	19	Dry Detention
30	LFBLLL0010	833	None
31	LFBLLL0140	293	None
32	LFBLLL0013	103	None
33	LFBLLL0145	53	Dry Detention
34	LFBA00050	463	Dry Detention
35	LFBA00070	287	Wet Detention
36	LFBA00130	99	Wet Detention
37	LFBA00060	1,462	Wet Detention
38	LFBA00090	68	Dry Detention
39	LFBA00020	15,553	None
40	LFBA00040	476	Wet Detention
41	LFBA00120	96	Wet Detention
42	LFBA00015	53	Dry Detention
43	LFBA00030	25	Wet Detention
44	LFBA00080	16	Dry Detention
45	LFBA00110	20	Dry Detention
46	LFBA00010	1,806	None
47	LFBA00100	282	Dry Detention
48	LFBLC0030	30	Dry Detention
49	LFBLC0020	92	Dry Detention
50	LFBLC0040	18	Dry Detention
51	LFBLC0010	129	None
52	LFBLC0050	208	None
53	LFBLC0060	50	None
54	LFBLC0070	638	None
55	LFBLC0051	111	None
56	LFBLC0052	34	None
57	LFBLC0053	39	None
58	LFBLC0015	90	None
59	LFBLC0075	95	None
60	LFBLC0080	212	None
61	LFBLC0061	58	None
62	LFBLC0062	12	None
63	LFBL0010	12	None
64	LFBL0015	14	None
65	LFBL0020	10	None
66	LFBL0025	20	None
67	LFBL0030	3	None
68	LFBL0035	32	None
69	LFBL0040	14	None

LFBWEEM01 represents the contributing area to Weems Pond. The nutrient loading from this Facility was determined based on the average of the most recent 3 years of annual geomean water quality data collected after 2017 multiplied by the average annual stormwater runoff volume (based on the SIMPLE Seasonal modeling).

BMP Type	Reduction Percentages	
	TN (%)	TP (%)
Wet Detention	30	65
Dry Detention	99	99
Wet Retention	80	80
Dry Retention	30	40



Legend

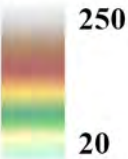
- Subbasins
- Waterbodies in Study
- Watercourses
- Tallahassee Corporate Limits
- Weems Pond

BMP Type

- Dry Detention
- Dry Retention
- Wet Detention

Topographic Elevations

ft NAVD88

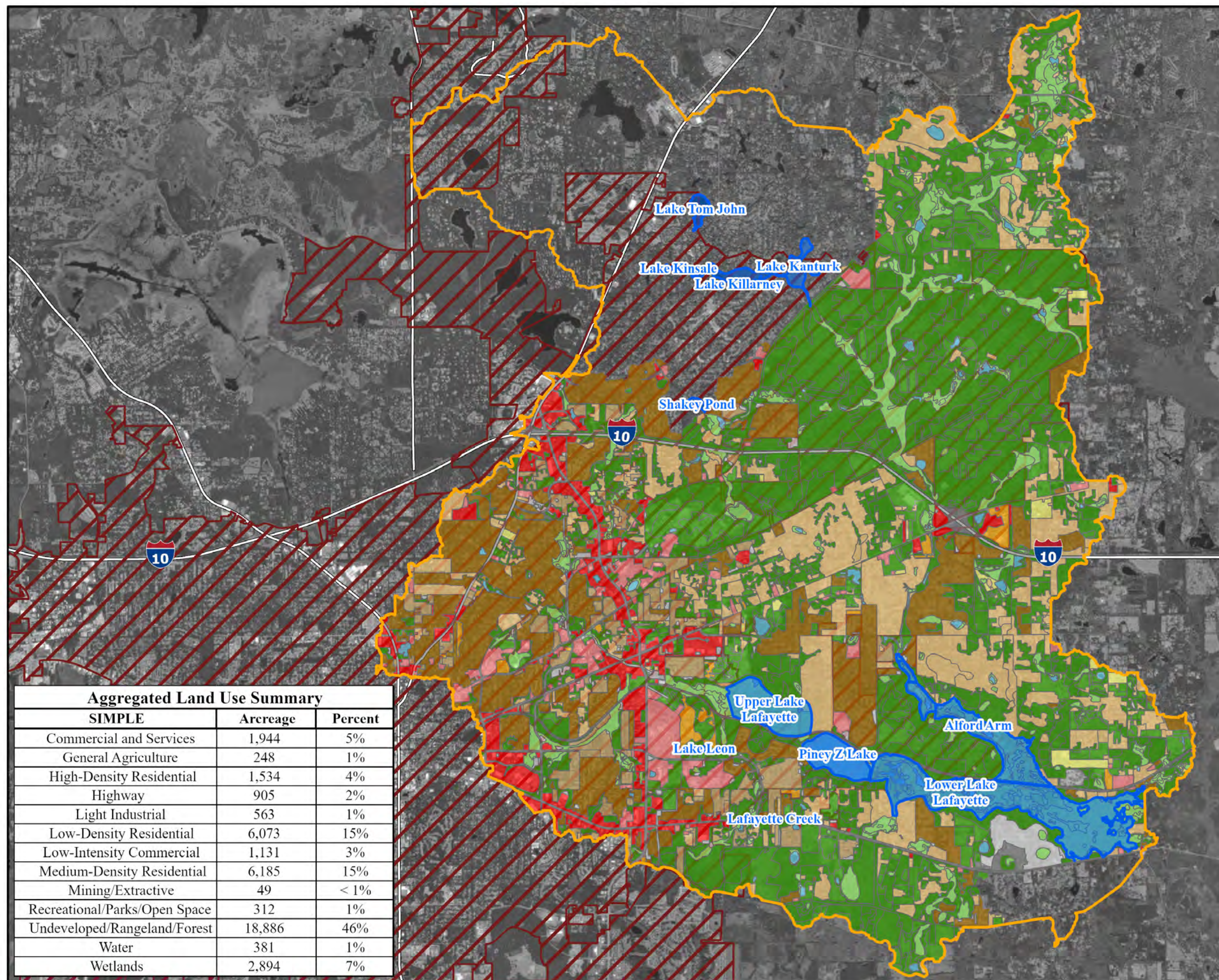


Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Subbasins: Geosyntec, 2022
Roads: COT-Leon County, 2023
City Limits: COT, 2022
BMPs: Geosyntec, 2023
Elevation: COT-Leon County

Figure 5-48:
Lafayette Chain of Lakes Subbasin
Delineation and BMPs

Tallahassee Master Plan - Surface
Water (TMaPS)





0 1.3
Miles

Legend

-  Lake Lafayette Drainage Basin
-  Waterbodies in Study
-  Tallahassee Corporate Limits
- Land Use Type**
-  Commercial and Services
-  General Agriculture
-  High-Density Residential
-  Highway
-  Light Industrial
-  Low-Density Residential
-  Low-Intensity Commercial
-  Medium-Density Residential
-  Recreational/Parks/Open Space
-  Undeveloped/Rangeland/Forest
-  Water
-  Wetlands

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Land Use: Geosyntec, 2023
Roads: FDOT, 2020
City Limits: COT, 2020

Figure 5-49:
Lafayette Chain of Lakes Aggregated Land Use

Tallahassee Master Plan - Surface Water (TMaPS)

Aggregated Land Use Summary

SIMPLE	Acres	Percent
Commercial and Services	1,944	5%
General Agriculture	248	1%
High-Density Residential	1,534	4%
Highway	905	2%
Light Industrial	563	1%
Low-Density Residential	6,073	15%
Low-Intensity Commercial	1,131	3%
Medium-Density Residential	6,185	15%
Mining/Extractive	49	< 1%
Recreational/Parks/Open Space	312	1%
Undeveloped/Rangeland/Forest	18,886	46%
Water	381	1%
Wetlands	2,894	7%

Table 5-5: Aggregated Land Use

FLUCCS Code	FLUCCS Description	SIMPLE-Seasonal Aggregated Description
1100	Low-Density Residential	Low-Density Residential
1200	Medium-Density Residential	Medium-Density Residential
1300	High-Density Residential	High-Density Residential
1400	Commercial and Services	Commercial and Services
1500	Other Light Industrial	Light Industrial
1600	Reclaimed Lands	Mining/Extractive
1700	Institutional	Low-Intensity Commercial
1800	Community Recreational Facilities	Recreational/Parks/Open Space
1900	Open Land	Recreational/Parks/Open Space
2100	Cropland and Pastureland	Undeveloped/Rangeland/Forest
2400	Nurseries and Vineyards	General Agriculture
2600	Other Open Lands (Rural)	Undeveloped/Rangeland/Forest
3100	Range Land, Herbaceous (Dry Prairie)	Undeveloped/Rangeland/Forest
3200	Shrub and Brushland	Undeveloped/Rangeland/Forest
3300	Mixed Rangeland	Undeveloped/Rangeland/Forest
4100	Upland Coniferous Forests	Undeveloped/Rangeland/Forest
4200	Upland Hardwood Forests	Undeveloped/Rangeland/Forest
4300	Hardwood Coniferous - Mixed	Undeveloped/Rangeland/Forest
4400	Forest Regeneration Areas	Undeveloped/Rangeland/Forest
5100	Streams and Waterways	Water
5200	Lakes	Water
5300	Reservoirs	Water
5600	Slough Waters	Water
6100	Wetland Hardwood Forests	Wetlands
6200	Wetland Coniferous Forests	Wetlands
6300	Wetland Forested Mixed	Wetlands
6400	Vegetated Non-Forested Wetlands	Wetlands
6500	Non-Vegetated Wetlands	Wetlands
7400	Disturbed Lands	Undeveloped/Rangeland/Forest
8100	Transportation	Highway
8200	Communications	Light Industrial
8300	Utilities	Light Industrial

Note:

1. The aggregated descriptions are based on guidance from the SIMPLE-Seasonal model guidance document.

Table 5-6: Land Use DCIA and Non-DCIA Percentages

FLUCCS Code	FLUCCS Description	% Impervious	% DCIA	% Pervious
1100	Low-Density Residential	11	3	89
1200	Medium-Density Residential	37	12	63
1300	High-Density Residential	38	18	62
1400	Commercial and Services	58	58	42
1700	Institutional	44	38	56
1800	Community Recreational Facilities	29	18	71
1900	Open Land	0	0	100
2100	Cropland and Pastureland	0	0	100
2200	Tree Crops	0	0	100
2500	Specialty Farms	0	0	100
3100	Range Land, Herbaceous (Dry Prairie)	0	0	100
3200	Shrub and Brushland	0	0	100
3300	Mixed Rangeland	0	0	100
4100	Upland Coniferous Forests	0	0	100
4200	Upland Hardwood Forests	0	0	100
4300	Hardwood Coniferous – Mixed	0	0	100
4400	Forest Regeneration Areas	0	0	100
5200	Lakes	100	100	0
5300	Reservoirs	100	100	0
6100	Wetland Hardwood Forests	100	100	0
6200	Wetland Coniferous Forests	100	100	0
6300	Wetland Forested Mixed	100	100	0
6400	Vegetated Non-Forested Wetlands	100	100	0
6500	Non-Vegetated Wetlands	100	100	0
7400	Disturbed Lands	4	0	96
8100	Transportation	72	38	28
8200	Communications	12	1	88
8300	Utilities	22	22	78

The non-DCIA CNs were calculated based on the percent impervious, minus the DCIA percentage, and the pervious fractions, which were based on open space in good condition and the soil hydraulic group. The impervious areas were assigned a CN value of 98. A lookup table was developed to relate soil hydrologic group to pervious area CNs [see **Table 5-7**, which were referenced from the USDA Urban Hydrology for Small Watersheds (TR-55) (June 1986)]. The overall non-DCIA CNs were then determined by taking an area weighted average of the impervious and pervious fractions of the non-DCIA CNs.

Table 5-7: Curve Number Lookup Table

Land Use	A	B	C	D	W
Open Space in Good Condition (Grass Cover > 75%)	39	61	74	80	100
Water	100	100	100	100	100
Wetlands	100	100	100	100	100

The soils data used for this modeling effort were presented in **Section 5.4.3.3**. Stormwater runoff is generated when the rate of rainfall exceeds the infiltration capacity of the site soils, resulting in water flow along the land surface. For pits and urban land, soil types were assumed to be HSG D soil group. When dual HSGs were found, an average value was assigned (i.e., soils A/D were assigned a B runoff potential, soils B/D were assigned a C runoff potential, soils C/D were assigned a D runoff potential). This assumption is appropriate because the SIMPLE-Seasonal model is based on an average annual analysis and dual classed soils will sometimes behave as one hydrologic group and other times behave as the other. If the worst-case hydrologic group is taken, as is done for event-based floodplain modeling, it would result in an over estimation of volume of stormwater generated and thus pollutant loading.

Pollutant loads for direct runoff are determined by multiplying the average annual runoff volumes by the appropriate EMCs. The EMC values used for this study were a combination of values determined by the City (2015) and those reported by Harper and Baker (2007). Water and wetland land use types were assigned a value of zero (0) as they are assumed in this analysis to not contribute pollutants but act as a pollutant sink. **Table 5-8** shows the EMC values used for the SIMPLE-Seasonal model. Mean annual runoff coefficients were calculated for each polygon resulting from the intersection of the land use layer and the soils layer, based on the FSQAH (FDEP, 2010).

Table 5-8: Event Mean Concentration by Land Use

SIMPLE-Seasonal Aggregated Description	TP (mg/L)	TN (mg/L)	Reference
General Agriculture	0.94	1.32	City, 2015
High-Density Residential	0.43	1.58	City, 2015
Commercial and Services	0.22	1.05	City, 2015
Highway	0.22	1.64	Harper, 2007
Light Industrial	0.13	1.22	City, 2015
Low-Density Residential	0.27	1.18	City, 2015
Low-Intensity Commercial ¹	0.18	1.18	Harper, 2007
Medium-Density Residential	0.43	1.58	City, 2015
Water ²	0.0	0.0	-
Wetlands ²	0.0	0.0	-
Undeveloped/Rangeland/Forest	0.11	0.79	City, 2015
Recreational/Parks/Open Space	1.13	2.33	City, 2015

Note:

1. Low-intensity commercial land use type was used for institutional land use type.
2. EMCs assumed to be zero (0) since water bodies and wetlands are typically assumed to be sinks and not sources of pollutant loads within a watershed.

Water quality treatment provided by existing BMPs within the subbasins was considered in this analysis. Runoff BMPs were identified and classified as wet detention, wet retention, dry retention, or dry detention. Aerial imagery, 2018 Leon County DEM, and BMP shapefiles from the City, Leon County, and FDOT were reviewed to identify BMPs within the subbasins draining to the Lafayette Chain of Lakes greater than 1 acre. **Figure 5-48** shows the BMPs by subbasin. The BMPs were assigned a removal efficiency based on the type of practice. The removal efficiencies for BMPs are provided in **Table 5-9**, and also on **Figure 5-48**, the values were based on the study conducted by Harper and Baker (2007) and based on the draft Environmental Resource Permit (ERP) Applicant's Handbook Volume I Section 8 from FDEP (2022). Based on guidance from the City, all the dry detention ponds were assumed to have sand filters due to local land development regulations.

Table 5-9: Direct Runoff BMP Removal Efficiencies

BMP Type	TN (%)	TP (%)
Wet Detention ¹	30	65
Wet Retention ²	80	80
Dry Retention ¹	99	99
Dry Detention ¹	30	40

Note:

1. The values were from H. Harper and D. Baker, *Evaluation of current Stormwater Design Criteria within the State of Florida* (June 2007).
2. Stormwater quality nutrient permitting requirements (FDEP 2022)

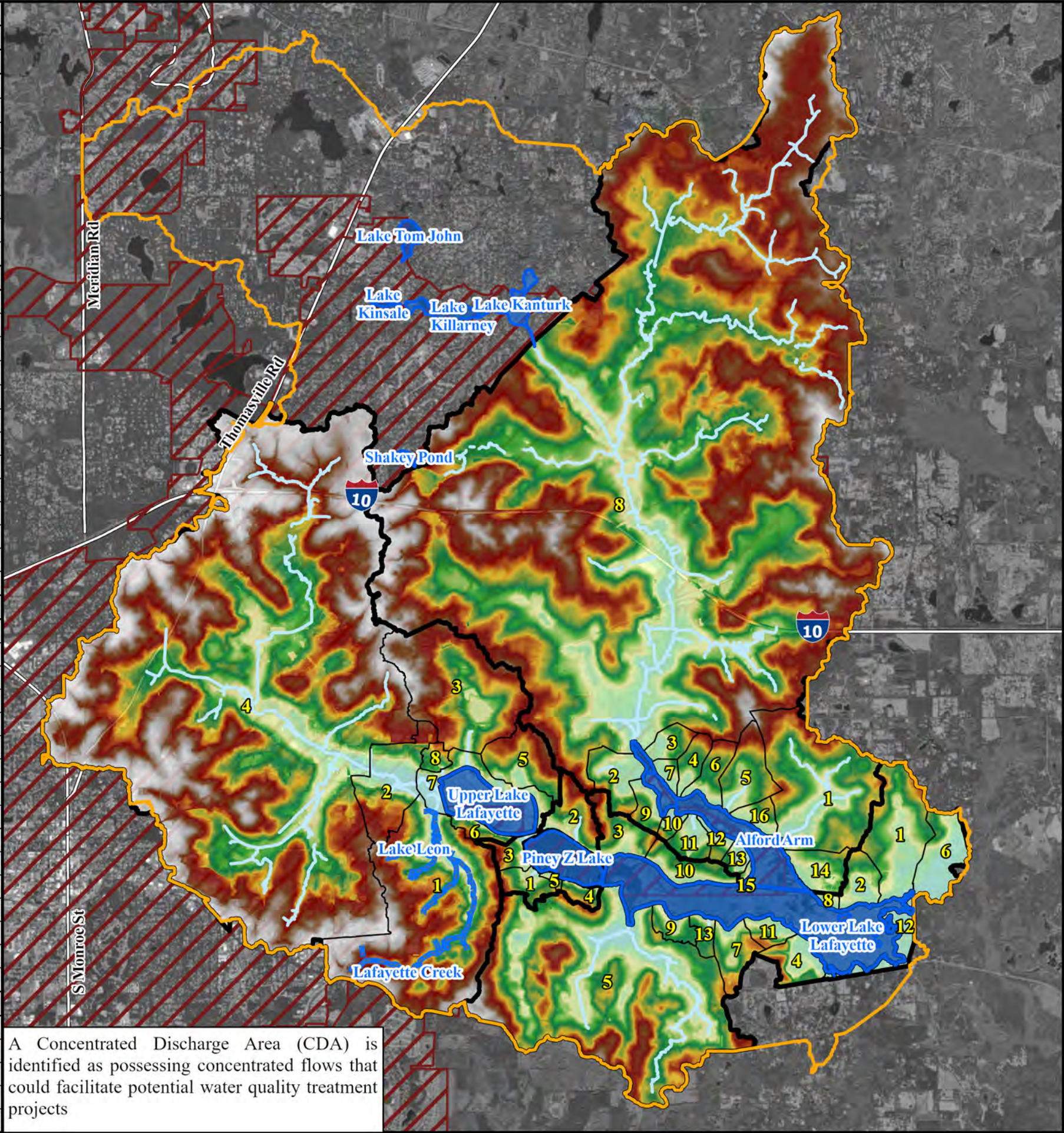
Natural depressions, wetlands, and natural water bodies were not included as BMPs since removal efficiencies are based on retaining a certain design volume from engineered systems. Additionally, as outlined previously, any BMP less than 1 acre was not considered due to the scale of this study. Based on the assumptions outlined above, the SIMPLE modeling presented for the Lafayette Chain of Lakes and subsequent waterbodies, has the potential to calculate high load values due to not considering removal associated with natural features and small local BMPs as well as other processes. As such, the purpose of the SIMPLE model is to provide total loads and per acre loading for comparison between contributing areas around the waterbody, and total loads for comparison to other loading sources to the waterbody.

For the purposes of the loading calculations, the subbasins were grouped into Concentrated Discharge Areas (CDA) which represent discrete areas of loading to Lake Munson and Munson Slough downstream of Lake Henrietta SWMF. The loads from the subbasins were then summed for each of the CDAs. **Figure 5-50** presents the CDAs along with their associated acreage. The CDAs represent the discrete areas upon which evaluations of total loading and per acre loading are presented below.

Utilizing the calculated total loads and the per acre loads, the various CDAs were ranked. The approach for the ranking was to order the total loads and the per acre load from lowest to highest and assign a numeric order number for each waterbody where the highest load would receive the higher numeric order number and the lowest load would receive the lower. The ranks represent a score that can be used to identify CDAs of interest. The two scores were then added together (total load rank and per acre load rank) to get a total score. These were then ordered from highest to lowest value to define the ranking.

Summary of Concentrated Discharge Areas		
Number	CDA ID	Acres
Upper Lake Lafayette		
1	LFBULLOF08	1,926.8
2	LFBULLOF02	435.6
3	LFBULLOF04	1,003.0
4	LFBWEEM01	10,442.5
5	LFBULLOF03	309.9
6	LFBULLOF05	67.8
7	LFBULLOF01	241.5
8	LFBULLOF06	56.0
Lower Lake Lafayette		
1	LFBLLLOF10	530.7
2	LFBLLLOF11	154.0
3	LFBLLLOF03	210.5
4	LFBLLLOF04	183.2
5	LFBLLLOF07	3,019.3
6	LFBLLLOF12	287.6
7	LFBLLLOF08	184.3
8	LFBLLLOF05	29.4
9	LFBLLLOF06	97.7
10	LFBLLLOF13	181.6
11	LFBLLLOF09	94.5
12	LFBLLLOF01	139.7
13	LFBLLLOF02	66.5
Alford Arm		
1	LFBAAOF15	1,052.0
2	LFBAAOF01	219.3
3	LFBAAOF02	103.3
4	LFBAAOF03	102.0
5	LFBAAOF14	263.1
6	LFBAAOF16	142.8
7	LFBAAOF04	54.7
8	LFBAAOF05	18,038.6
9	LFBAAOF06	100.3
10	LFBAAOF07	50.2
11	LFBAAOF08	116.4
12	LFBAAOF09	56.4
13	LFBAAOF10	57.5
14	LFBAAOF11	185.6
15	LFBAAOF12	19.1
16	LFBAAOF13	91.4
Piney Z Lake		
1	LFBPZLOF05	122.9
2	LFBPZLOF02	220.2
3	LFBPZLOF03	94.4
4	LFBPZLOF01	68.0
5	LFBPZLOF04	19.0

A Concentrated Discharge Area (CDA) is identified as possessing concentrated flows that could facilitate potential water quality treatment projects





CITY OF
TALLAHASSEE

N

0 1.3
Miles

Legend

- Lake Lafayette Drainage Basin
- Waterbodies in Study
- Concentrated Discharge Areas
- Watercourses
- Tallahassee Corporate Limits

Topographic Elevations
ft NAVD88

250
20

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
CDAs: Geosyntec, 2022
Roads: COT-Leon County, 2023
City Limits: COT, 2022
Elevation: COT-Leon County, 2018

Figure 5-50:
Lafayette Chain of Lakes Concentrated
Discharge Areas

Tallahassee Master Plan - Surface
Water (TMaPS)

Geosyntec
consultants

The goal was for the ranking to consider both the total load from an area (which allows focus on areas with significant load) along with the per acre loading (which allows focus on areas with high discharge concentrations or greater anthropogenic impact). The combining of the two allows focus on both available load for reduction and targeted higher concentration areas which represent greater opportunity for treatment.

Stormwater Nutrient Loads to Upper Lake Lafayette

For the load leaving the ULL-NRF, measured water quality data from downstream of the facility was used for the load calculation out of CDA LFBWEEM01 (#4 on **Figure 5-51**). The data were collected at Station LLB02 and were part of the data sets presented in earlier sections. The runoff volume calculated from the SIMPLE-Seasonal Model was used as the volume discharged from the system. The TN and TP loads were calculated by multiplying the volume by the measured average TN and TP concentrations (**Table 5-10**). The average value of the most recent 3 years of geometric mean TN and TP data were used for the load calculations. It is noted that no data earlier than 2017 were used for this analysis as it is not considered representative of current conditions. This approach is different than the SIMPLE modeling approach presented earlier as it accounts for the removal processes that occur upstream and within the ULL-NRF, which was done because of the nature of the ULL-NRF as a significant and unique regional treatment system, along with the availability of sufficient water quality data to perform the calculation.

Table 5-10: Concentration Data, Volumes, and Calculated Loads Representing the Discharge from Weems Pond

Station ID LLB02	Concentration (mg/L)	Year of data	Volume (ac-ft/yr) ¹	Loads (lb/yr)
Total N	0.262	2020-2022	13,644	9,708
Total P	0.020	2020-2022	13,644	742

Note:

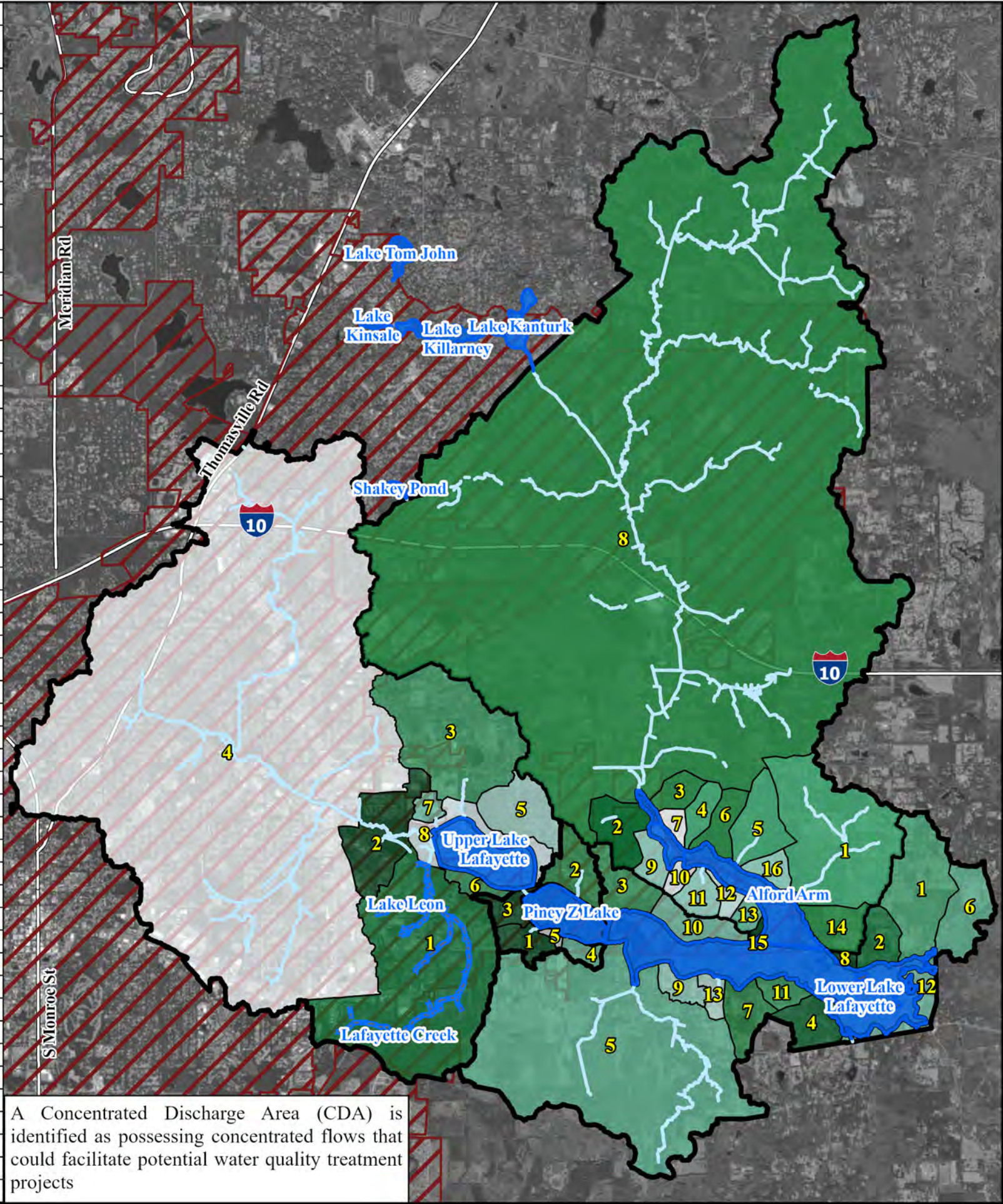
1. The value was calculated in SIMPLE-Seasonal Model.

Figure 5-51 presents the distribution of the ranking of the CDAs for TN along with the total load and per acre loads, see the table on **Figure 5-51**. The rankings are color coded with the highest ranked CDAs in dark green moving down to the lowest ranked in pale yellow. For all of the lake segments, the calculated total stormwater TN loads from the CDAs ranged from as low as 19.6 lb/year up to 23,457 lb/year. The per acre loads ranged from 0.6 lb/acre/year up to 3.8 lb/acre/yr.

Figure 5-52 presents the distribution of the ranking of the CDAs for TP along with the total load and per acre loads, see the table on **Figure 5-52**. For all of the lake segments, the calculated total stormwater TP loads from the CDAs ranged from as low as 3.1 lb/year up to 4,578 lb/year. The per acre loads ranged from 0.1 lb/acre/year up to 0.9 lb/acre/yr.

For Upper Lake Lafayette, impacts of the treatment from the ULL-NRF can be seen in the low ranking for the TN and TP loads coming out of the NEDD (#4). The treatment results in the lowest per acre TN and TP loading to Upper Lake Lafayette. The highest ranked CDAs to Upper Lake Lafayette are the localized direct discharge watersheds containing neighborhoods and other commercial land uses just downstream of the ULL-NRF and Lafayette Creek. The total potential stormwater runoff TN and TP loads to Upper Lake Lafayette are 19,863 lb/yr and 2,843 lb/yr respectively.

Summary of Concentrated Discharge Areas				
Number	CDA ID	Total Load (lbs-TN/yr)	Area Load (lbs-TN/ac/yr)	Ranking
Upper Lake Lafayette				
1	LFBULLOF08	5,706.4	3.0	2
2	LFBULLOF02	1,668.8	3.8	1
3	LFBULLOF04	1,771.6	1.8	3
4	LFBWEEM01	9,707.8	0.9	7
5	LFBULLOF03	464.9	1.5	5
6	LFBULLOF05	119.8	1.8	3
7	LFBULLOF01	325.7	1.3	6
8	LFBULLOF06	97.8	1.7	4
	Total Load:	19,862.8		
Lower Lake Lafayette				
1	LFBLLLOF10	912.1	1.7	6
2	LFBLLLOF11	385.2	2.5	3
3	LFBLLLOF03	463.3	2.2	5
4	LFBLLLOF04	591	3.2	2
5	LFBLLLOF07	4,757.5	1.6	7
6	LFBLLLOF12	450.8	1.6	7
7	LFBLLLOF08	425.4	2.3	4
8	LFBLLLOF05	106.7	3.6	1
9	LFBLLLOF06	139.1	1.4	9
10	LFBLLLOF13	278.5	1.5	8
11	LFBLLLOF09	209.9	2.2	5
12	LFBLLLOF01	213.5	1.5	8
13	LFBLLLOF02	86.2	1.3	10
	Total Load:	9,019.2		
Alford Arm				
1	LFBAAOF15	1,312.2	1.2	4
2	LFBAAOF01	532.8	2.4	2
3	LFBAAOF02	132.7	1.3	3
4	LFBAAOF03	119.0	1.2	4
5	LFBAAOF14	304.4	1.2	4
6	LFBAAOF16	186.4	1.3	3
7	LFBAAOF04	32.3	0.6	9
8	LFBAAOF05	23,456.6	1.3	3
9	LFBAAOF06	91.6	0.9	6
10	LFBAAOF07	36.0	0.7	8
11	LFBAAOF08	99.8	0.9	6
12	LFBAAOF09	46.4	0.8	7
13	LFBAAOF10	57.5	1.0	5
14	LFBAAOF11	248.0	1.3	3
15	LFBAAOF12	57.7	3.0	1
16	LFBAAOF13	80.0	0.9	6
	Total Load:	26,793.4		
Piney Z Lake				
1	LFBPZLOF05	453.0	3.7	1
2	LFBPZLOF02	733.4	3.3	2
3	LFBPZLOF03	345.5	3.7	1
4	LFBPZLOF01	74.8	1.1	3
5	LFBPZLOF04	19.6	1.0	4
	Total Load:	1,626.3		



CITY OF
TALLAHASSEE

Legend

- Concentrated Discharge Areas
- Waterbodies in Study
- Watercourses
- Tallahassee Corporate Limits

CDA - Lafayette Chain of Lakes - TN

Rank

High
Low

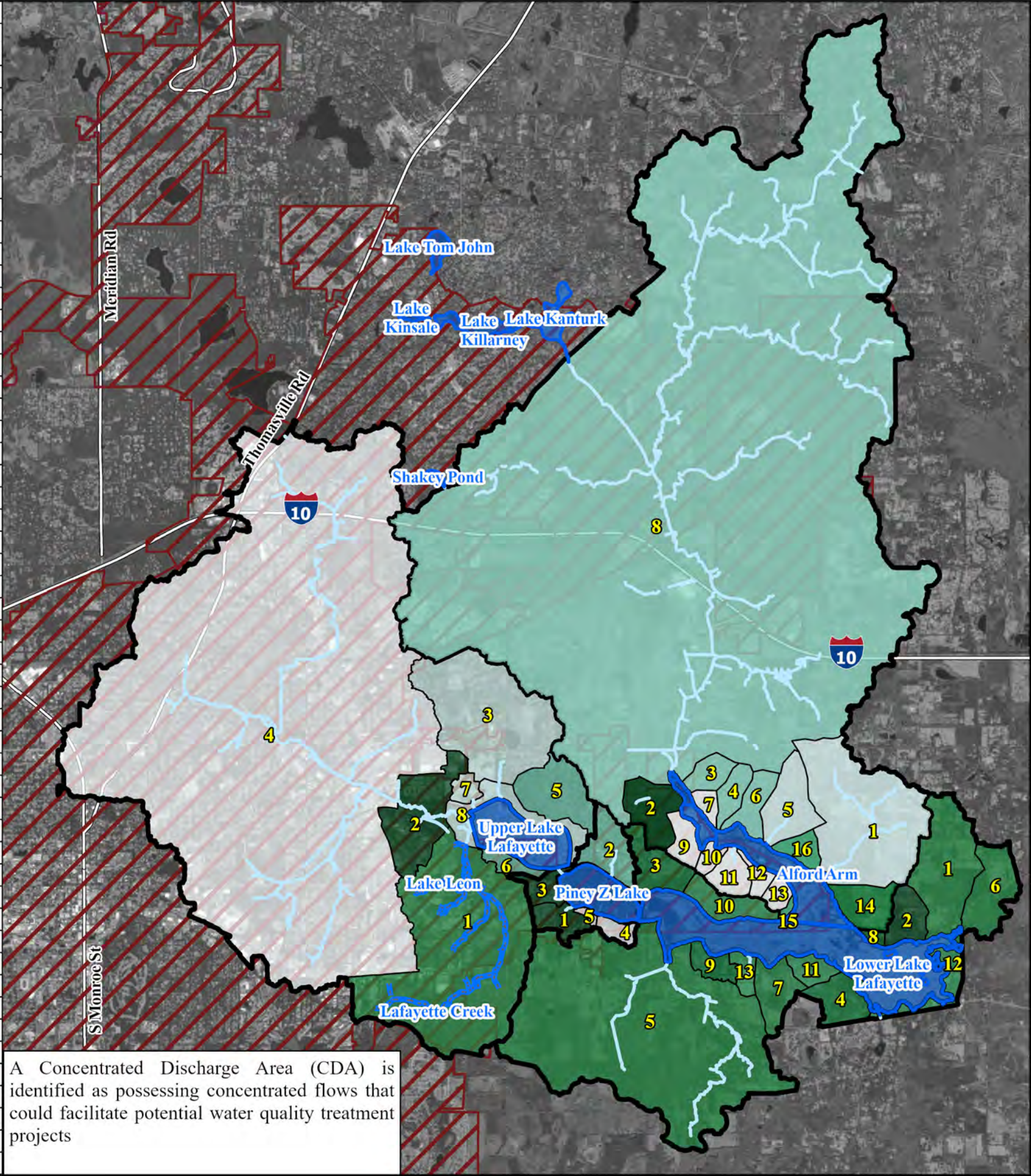
Sources:
 Waterbodies: COT, 2020
 Watercourses: COT, 2020
 CDAs: Geosyntec, 2022
 Roads: COT-Leon County, 2023
 City Limits: COT, 2022

Figure 5-51:
 Lafayette Chain of Lakes Concentrated
 Discharge Areas-Total Nitrogen

Tallahassee Master Plan - Surface
 Water (TMaPS)

Summary of Concentrated Discharge Areas				
Number	CDA ID	Total Load (lbs-TP/yr)	Area Load (lbs-TP/ac/yr)	Ranking
Upper Lake Lafayette				
1	LFBULLOF08	1,297.4	0.7	2
2	LFBULLOF02	407.6	0.9	1
3	LFBULLOF04	213.4	0.2	4
4	LFBWEEM01	742.4	0.1	5
5	LFBULLOF03	98.9	0.3	3
6	LFBULLOF05	20.7	0.3	3
7	LFBULLOF01	53.2	0.2	4
8	LFBULLOF06	8.9	0.2	4
	Total Load:	2,842.5		
Lower Lake Lafayette				
1	LFBLLLOF10	180.8	0.3	4
2	LFBLLLOF11	122.8	0.8	1
3	LFBLLLOF03	88.5	0.4	3
4	LFBLLLOF04	64.4	0.4	3
5	LFBLLLOF07	812.3	0.3	4
6	LFBLLLOF12	90.5	0.3	4
7	LFBLLLOF08	51.4	0.3	4
8	LFBLLLOF05	19.0	0.6	2
9	LFBLLLOF06	34.7	0.4	3
10	LFBLLLOF13	38.0	0.2	5
11	LFBLLLOF09	23.6	0.2	5
12	LFBLLLOF01	32.00	0.2	5
13	LFBLLLOF02	13.4	0.2	5
	Total Load:	1,571.4		
Alford Arm				
1	LFBAAOF15	261.0	0.2	5
2	LFBAAOF01	130.2	0.6	1
3	LFBAAOF02	31.2	0.3	4
4	LFBAAOF03	26.4	0.3	4
5	LFBAAOF14	64.5	0.2	5
6	LFBAAOF16	39.2	0.3	4
7	LFBAAOF04	6.4	0.1	6
8	LFBAAOF05	4,578.2	0.3	4
9	LFBAAOF06	12.7	0.1	6
10	LFBAAOF07	5.0	0.1	6
11	LFBAAOF08	13.9	0.1	6
12	LFBAAOF09	6.5	0.1	6
13	LFBAAOF10	8.0	0.1	6
14	LFBAAOF11	84.6	0.5	2
15	LFBAAOF12	7.8	0.4	3
16	LFBAAOF13	15.9	0.2	5
	Total Load:	5,291.5		
Piney Z Lake				
1	LFBPZLOF05	114.2	0.9	1
2	LFBPZLOF02	142.6	0.6	2
3	LFBPZLOF03	87.9	0.9	1
4	LFBPZLOF01	12.7	0.2	3
5	LFBPZLOF04	3.1	0.2	3
	Total Load:	360.5		

A Concentrated Discharge Area (CDA) is identified as possessing concentrated flows that could facilitate potential water quality treatment projects





CITY OF
TALLAHASSEE

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Miles

Legend

- Concentrated Discharge Areas
- Waterbodies in Study
- Watercourses
- Tallahassee Corporate Limits
- CDA - Lafayette Chain of Lakes - TP
- Rank
- High
- Low

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
CDAs: Geosyntec, 2022
Roads: COT-Leon County, 2023
City Limits: COT, 2022

Figure 5-52:
Lafayette Chain of Lakes Concentrated
Discharge Areas-Total Phosphorus

Tallahassee Master Plan - Surface
Water (TMaPS)

Geosyntec
consultants

For Piney Z Lake the highest ranked CDAs for TN and TP load, with the highest per acre loads, contain the neighborhoods that drain into the southwest side of the lake. The total potential stormwater runoff TN and TP loads to Piney Z Lake are 1,626 lb/yr and 361 lb/yr respectively.

For Lower Lake Lafayette the highest ranked CDAs for TN and TP load, with the highest per acre loads, are along the western end of the lake due to drainage from development along Highway 27 and Chaires Cross Road. The total potential stormwater runoff TN and TP loads to Lower Lake Lafayette are 9,019 lb/yr and 1,571 lb/yr respectively.

For Alford Arm Lower the highest ranked CDA for TN and TP load is in the neighborhoods off Buck Lake Road. The greatest overall load comes from the large watershed area that drains into the upper end of Alford Arm. The total potential stormwater runoff TN and TP loads to Alford Arm are 26,793 lb/yr and 5,292 lb/yr respectively.

5.4.5.2 Septic Load

Methodology

In order to quantify the potential nutrient load from septic tank units to the Lafayette Chain of Lakes and other waterbodies within the Lake Lafayette basin, the SPIL method, as adopted by FDEP, was utilized. The SPIL method calculates the TN load based on the number of septic tanks within a specified distance to the waterbody and an assumed loading of 9.012 lb of TN per person per year. Additionally, per the SPIL method, a percent loss of 50 percent is assumed as septic tank effluent moves through the unsaturated zone to groundwater.

The equation for estimating potential loading is:

$$S * P * I * L = \text{Total TN (lb) per year}$$

Where:

- **S** = Number of known septic tanks within 200 meters of a waterbody (default)
- **P** = Average number of people per household (2.4, default)
- **I** = Constituent annual load (pounds per person per septic tank – 9.012 lb/yr, default)
- **L** = Percentage of nutrient loss during seepage (50 percent, default)

The latest available census data was utilized to calculate the 2.4 persons per household within Leon County. The buffer zone for selecting septic tanks was also applied to tributaries discharging to the waterbody of interest, as delineated by the City. The inclusion of the tributaries in the loading calculation deviates from the approach utilized by FDEP, but based on internal project team discussion, was felt to be a reasonable addition as these represent a direct connection to the waterbody.

The FDEP method only calculates TN load since the majority of phosphorous in septic tank effluent is assumed to be adsorbed onto soil particles before reaching the groundwater table. Published studies on phosphorus attenuation in groundwater show that phosphorus plumes from septic units typically do not extend beyond 50 meters, with approximately 96 percent of phosphorus removal occurring within the first 10 meters (Corbett et al., 2002; Robertson et al., 2019). Therefore, FDEP's decision to not include TP was followed in this study.

The literature review also indicated that the 200-meter buffer around waterways that FDEP uses to capture septic tank TN contributions is a conservative approach. The literature suggests that most of the TN attenuation takes place within the first 10 meters (Corbett et al., 2022; Robertson et al., 2019; Van Stempvoort et al., 2021). For the purpose of identifying potential problem areas and based on general soil characteristics in and around tributaries and the waterbodies (higher water table conditions), the 200-meter buffer (as defined by FDEP) for TN contributions was maintained. The watercourse layer provided by the City was used to assess the 200-meter buffer.

Based on the available literature on septic movement, it is understood that the approach presented herein may overpredict the nitrogen load to the waterbodies and therefore potentially represents a conservative potential load. Presently, further study is needed to better quantify septic loading to the lakes and other waterbodies in the basin.

Results

Figure 5-53 shows the septic systems utilized in this analysis, with green representing those associated with direct loading to the waterbody and pink representing those associated with loading to tributaries. A table provided on the figure summarizes the calculated nutrient loads to each of the waterbodies in Lafayette Chain of Lakes. Upper Lake Lafayette has an estimated annual TN load of 1,168 lb/yr. Direct septic loading to Upper Lake Lafayette is 184 lb/yr. Piney Z Lake has an estimated annual TN load of 65 lb/yr. With all the load coming from septic systems located along the lake boundary. Lower Lake Lafayette has an estimated annual TN load of 2,011 lb/yr with 746 lb/yr of that coming from septic systems located along the boundary. Alford Arm has an estimated annual TN load of 6,327 lb/yr with nearly all of that coming from loading to tributaries upstream of the inflow to Alford Arm at Buck Lake Road.

5.4.5.3 Point Source Load

As no significant point source loads were identified in the qualitative assessment, no load calculations are provided.

5.4.5.4 Lake Inflow Load

Methodology

Surface water connections between waterbodies are inherently potential sources of pollutants to a downstream waterbody. This section, and others to follow, focuses on the interconnectivity of lakes within the Lake Lafayette basin and their potential for impacting water quality as a function of loading from one waterbody to another. Estimation of this loading requires having flow and water quality data. When assessing the potential for inter-lake loading to the Lafayette Chain of Lakes and other waterbodies within the basin, the analyses will focus on nutrient loading (TN and TP) and considerations of impairment and nutrient concentrations in the upstream and downstream lakes.

Summary of Nutrient Loading from Septic			
Waterbody	TN Loading Direct to Lake (Lbs/yr)	TN Loading From Tributaries (Ibs/yr)	TN Load (Ibs/yr)
Upper Lake Lafayette	184	984	1,168
Waterbody	TN Loading Direct to Lake (Lbs/yr)	TN Loading From Tributaries (Ibs/yr)	TN Load (Ibs/yr)
Piney Z Lake	65	0	65
Waterbody	TN Loading Direct to Lake (Lbs/yr)	TN Loading From Tributaries (Ibs/yr)	TN Load (Ibs/yr)
Lower Lake Lafayette	746	1,265	2,011
Waterbody	TN Loading Direct to Lake (Lbs/yr)	TN Loading From Tributaries (Ibs/yr)	TN Load (Ibs/yr)
Alford Arm	379	5,948	6,327

Only septic systems within 200 meters of the waterbody or its tributaries were selected and shown on this map as they are the source of the calculated nutrient loads, the remainder of septic units that were not selected are not shown on this map



- Legend**
- Lafayette Drainage Basin
 - Waterbodies in Study
 - Watercourses
 - Tallahassee Corporate Limits
 - Relevant Septic Sites
 - Lake
 - Tributaries

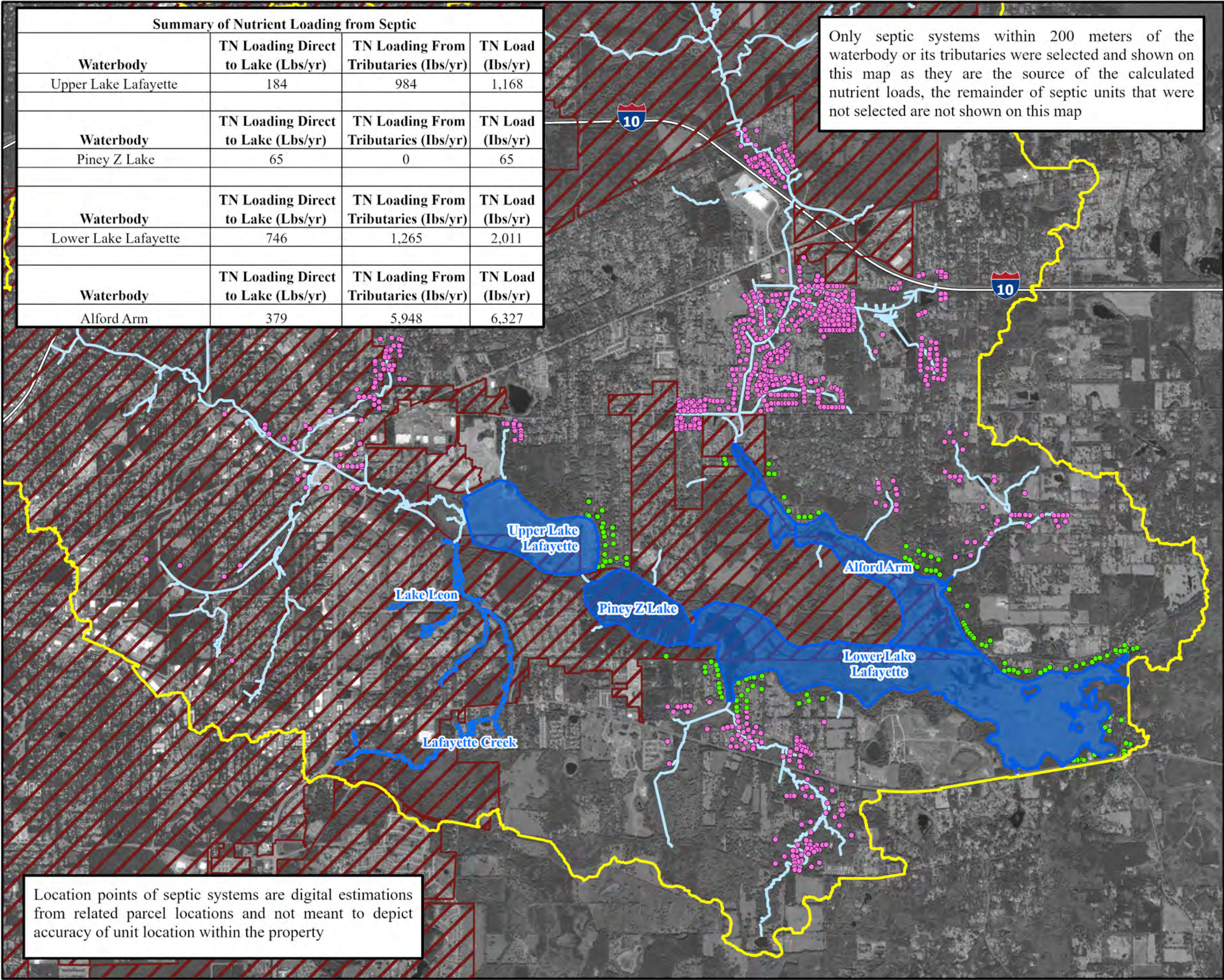
Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Septic Systems: COT, 2020
Watershed: COT, 2020
Roads: COT-Leon County, 2023

Figure 5-53:
Septic Loading to Lafayette Chain of Lakes

Tallahassee Master Plan - Surface Water (TMaPS)



Location points of septic systems are digital estimations from related parcel locations and not meant to depict accuracy of unit location within the property



At present there are no direct flow measurements immediately downstream of the majority of the lakes discussed as sources in this, and subsequent sections. Therefore, in order to calculate annual nutrient loads out of the lakes (where nutrient concentration data are available), an average annual flow volume out must be calculated. To this end, the results from the SIMPLE Seasonal modeling performed as part of the analysis presented in **Section 5.4.5.1** were used to estimate the annual average flows into the upstream lakes. The average annual flow into the lakes were then assumed to be equivalent to the average annual flow out (rainfall and evaporation generally being equivalent on an average annual basis). The calculated flows were then multiplied by TN and TP concentrations in the upstream lake. The TN and TP concentrations represent averages of the latest 3-years of geomeans with no data prior to 2017 utilized. This approach was utilized for all the lake loading calculations within the Lake Lafayette basin where recent lake nutrient concentration data are available and direct inflows have been calculated using the SIMPLE Seasonal model. Where measured flows are available these are utilized for the calculations based on the average flows for the period of record after 2010.

Results

For the Lafayette Chain of Lakes there were various lakes identified as having potential loads going into the Lafayette Chain. Additionally, the interconnections between the lakes within the Chain create loads. **Figure 5-54** shows the interconnectivity.

For Upper Lake Lafayette three lakes are identified as providing inflow, these are Buck Lake, Lake Leon, and Piney Z Lake. Of these three lakes, Lake Leon and Piney Z Lake have data to support calculation of the loading to Upper Lake Lafayette. The tables on **Figure 5-54** present the calculated TN and TP loads.

For Piney Z Lake, flows out of the lake are proportionally toward Upper Lake Lafayette through the structure on the western side. Discussions in **Section 5.4.1** outlined that the structure that passes through the berm between Lower Lake Lafayette and Piney Z Lake flows in both directions depending upon the water level conditions between the two lakes. As such, the assumption was made that the net flow is 0 and therefore no load is defined as going from Lower Lake Lafayette into Piney Z Lake. As such, the interconnected lake load is assumed to be zero.

For Lower Lake Lafayette, inflows were defined as coming from Lake Windermere and Alford Arm. As no water quality or flow information were available from Lake Windermere, the loading was not calculated. Additionally, as no recent data are available for Alford Arm, no load was calculated for that inflow.

For Alford Arm three lake inflows were identified, Mill Pond, Lake Cassie and Lake Kanturk. Only Lake Kanturk had data for the load calculation. The table on **Figure 5-54** shows the load from Lake Kanturk. The loading shown for Lake Kanturk is significant and represents the loading for all the basin area upstream of the Killlearn Chain of Lakes.

Receiving Lake	Receiving Lake Impaired?	Receiving Lake Concentrations (3-year average of Annual Geomeans)	Upstream Lake(s)	Upstream Lake(s) Impaired?	Simulated Annual Average Lake Outflow (cubic feet)	Upstream Lake WQ Concentrations (most recent 3-year average of Annual Geomeans)	Calculated Annual Average TN load (lb/year)	Calculated Annual Average TP load (lb/year)
Alford Arm	No	ND	Lake Kanturk	No	8,890	CHLA: 16 µg/L TN: 0.85 mg/L TP: 0.086 mg/L	20549	2079
			Lake Cassie	Unknown	ND	CHLA: ND TN: ND TP: ND	ND	ND
			Mill Pond	Unknown	ND	CHLA: ND TN: ND TP: ND	ND	ND

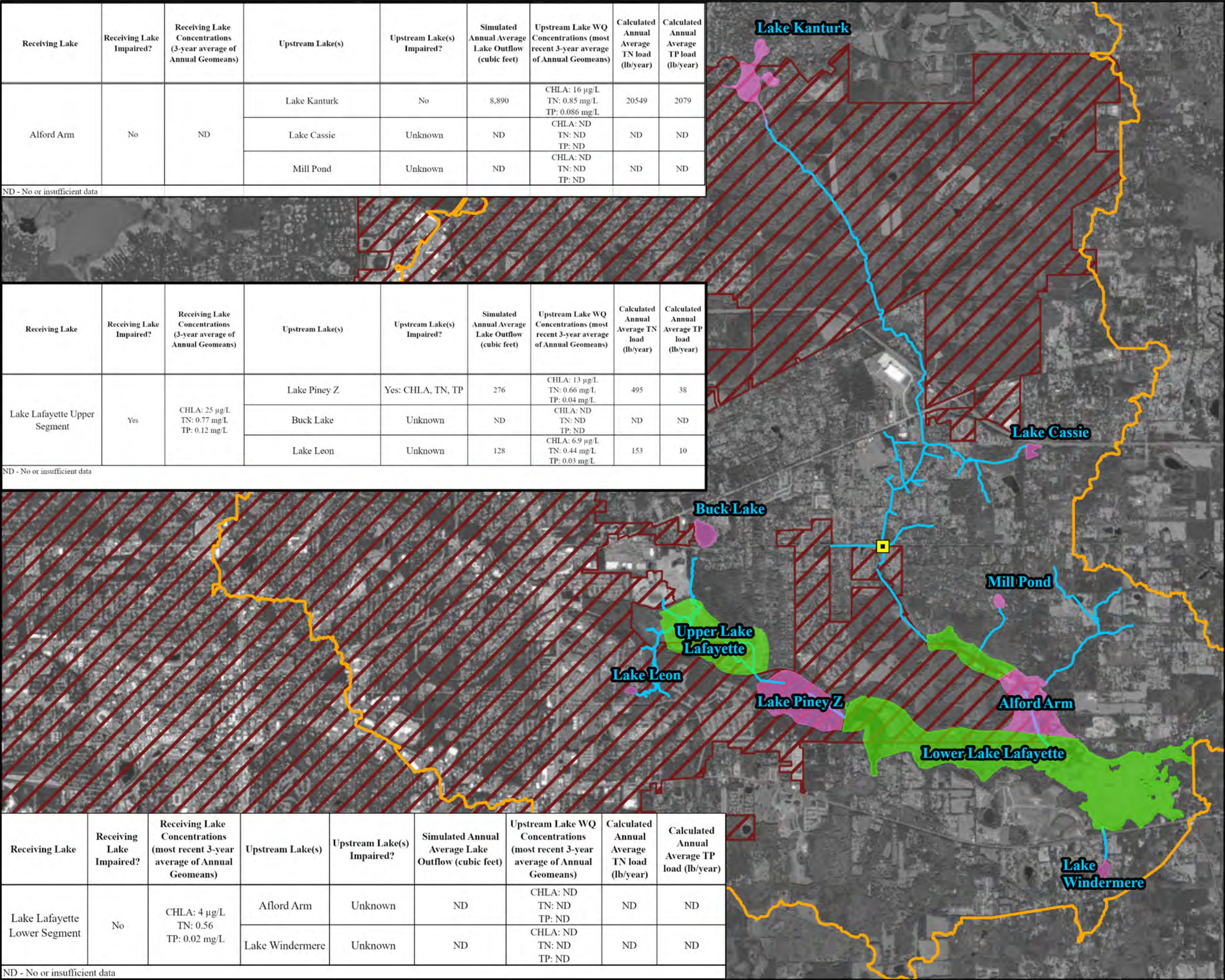
ND - No or insufficient data

Receiving Lake	Receiving Lake Impaired?	Receiving Lake Concentrations (3-year average of Annual Geomeans)	Upstream Lake(s)	Upstream Lake(s) Impaired?	Simulated Annual Average Lake Outflow (cubic feet)	Upstream Lake WQ Concentrations (most recent 3-year average of Annual Geomeans)	Calculated Annual Average TN load (lb/year)	Calculated Annual Average TP load (lb/year)
Lake Lafayette Upper Segment	Yes	CHLA: 25 µg/L TN: 0.77 mg/L TP: 0.12 mg/L	Lake Piney Z	Yes: CHLA, TN, TP	276	CHLA: 13 µg/L TN: 0.66 mg/L TP: 0.04 mg/L	495	38
			Buck Lake	Unknown	ND	CHLA: ND TN: ND TP: ND	ND	ND
			Lake Leon	Unknown	128	CHLA: 6.9 µg/L TN: 0.44 mg/L TP: 0.03 mg/L	153	10

ND - No or insufficient data

Receiving Lake	Receiving Lake Impaired?	Receiving Lake Concentrations (most recent 3-year average of Annual Geomeans)	Upstream Lake(s)	Upstream Lake(s) Impaired?	Simulated Annual Average Lake Outflow (cubic feet)	Upstream Lake WQ Concentrations (most recent 3-year average of Annual Geomeans)	Calculated Annual Average TN load (lb/year)	Calculated Annual Average TP load (lb/year)
Lake Lafayette Lower Segment	No	CHLA: 4 µg/L TN: 0.56 TP: 0.02 mg/L	Aflord Arm	Unknown	ND	CHLA: ND TN: ND TP: ND	ND	ND
			Lake Windermere	Unknown	ND	CHLA: ND TN: ND TP: ND	ND	ND

ND - No or insufficient data



Legend

- Lake Lafayette Drainage Basin
- Recieving Lakes
- Inflowing Lakes
- Flowlines
- Discharge Station
- Tallahassee Corporate Limits

Sources:
Waterbodies: COT, 2020
Flowlines: USGS, 2020
Watershed: COT, 2020
Roads: COT-Leon County, 2023
City Limits: COT, 2020

Figure 5-54:
Inflow Loading to Lafayette Chain of Lakes

Tallahassee Master Plan - Surface
Water (TMaPS)



5.4.5.5 Internal Lake Load

Internal recycling loads represent fluxes from benthic substrate that build up from the deposition of ongoing or legacy loads coming into a waterbody. Additionally, build up can also occur through the accumulation of organic material which settles following algal blooms. These algal blooms occur due to excess nutrient loading to the water column which results in a positive feedback loop of benthic nutrient releases followed by algal blooms. Nutrients are bound into the benthic substrate and, under different conditions (depending upon the nature of the nutrients in the sediments), can be released into the water column. In many lakes within Florida, benthic flux, or internal recycling, can be a significant portion of the nutrient budget. While naturally occurring flux does occur, it is the portion caused by the excessive historic and/or ongoing anthropogenic impacts that would require remediation.

In the qualitative assessment of potential pollutant loads to the Lafayette Chain of Lakes (**Section 5.4.4.4**) an assessment was made relative to the potential for anthropogenically driven internal loading to play a significant role in the nutrient balance of each of the waterbodies within the Lafayette Chain of Lakes. The determination was made that internal loading was not a significant nutrient load to any of the lakes.

5.4.5.6 Atmospheric Deposition

In order to calculate the atmospheric deposition loading for nutrients to the Lafayette Chain of Lakes, the data from the Quincy Station (FL14), identified in earlier sections and shown on **Figure 5-35**, were utilized. The National Atmospheric Deposition Program (NADP) provides a clearinghouse for deposition data. The NADP sites collect nitrogen data but not phosphorus, as such, only TN is available. **Table 5-11** presents the annual TN loads per acre from 2010 to 2020. No data were available at the Quincy station for 2020 so the value from the next nearest station (Sumatra – FL23) was utilized. Averaging the annual load per acre over the 10-year period gives a value of 2.56 lb/acre/yr. Multiplying the 2.56 lb/acre/yr TN load by the acreages for Upper Lake Lafayette, Piney Z Lake, Lower Lake Lafayette, and Alford Arm gives the TN atmospheric loads. **Table 5-12** presents the calculated loads for each of the lakes in the chain.

Table 5-11: Annual Atmospheric Total Nitrogen Load per Acre from Quincy Station

Year	TN (lb/acre)
2010	2.19
2011	2.31
2012	2.20
2013	2.57
2014	4.95
2015	2.57
2016	2.47
2017	2.31
2018	2.40
2019	1.97
2020*	2.16*

*Data from NADP Website Sumatra Station

Table 5-12: Atmospheric Total Nitrogen Loads to Lafayette Chain of Lakes

Waterbody	Acreage	TN Load (lb/yr)
Upper Lake Lafayette	373	955
Piney Z Lake	238	609
Lower Lake Lafayette	1067	2,732
Alford Arm	367	940

5.4.5.7 Summary of Calculated Loads

Nutrient loads to the Lafayette Chain of Lakes were calculated for stormwater runoff, septic systems, interconnected flow (where data allowed), and atmospheric deposition. **Table 5-13** presents the calculated total loads to the lake for TN and TP. For septic systems and atmospheric deposition only TN loads were calculated (see **Section 5.4.5.2** and **Section 5.4.5.6** respectively for explanation). A significant load that was not able to be calculated is the load from Alford Arm into Lower Lake Lafayette, which is due to a lack of recent data in Alford Arm.

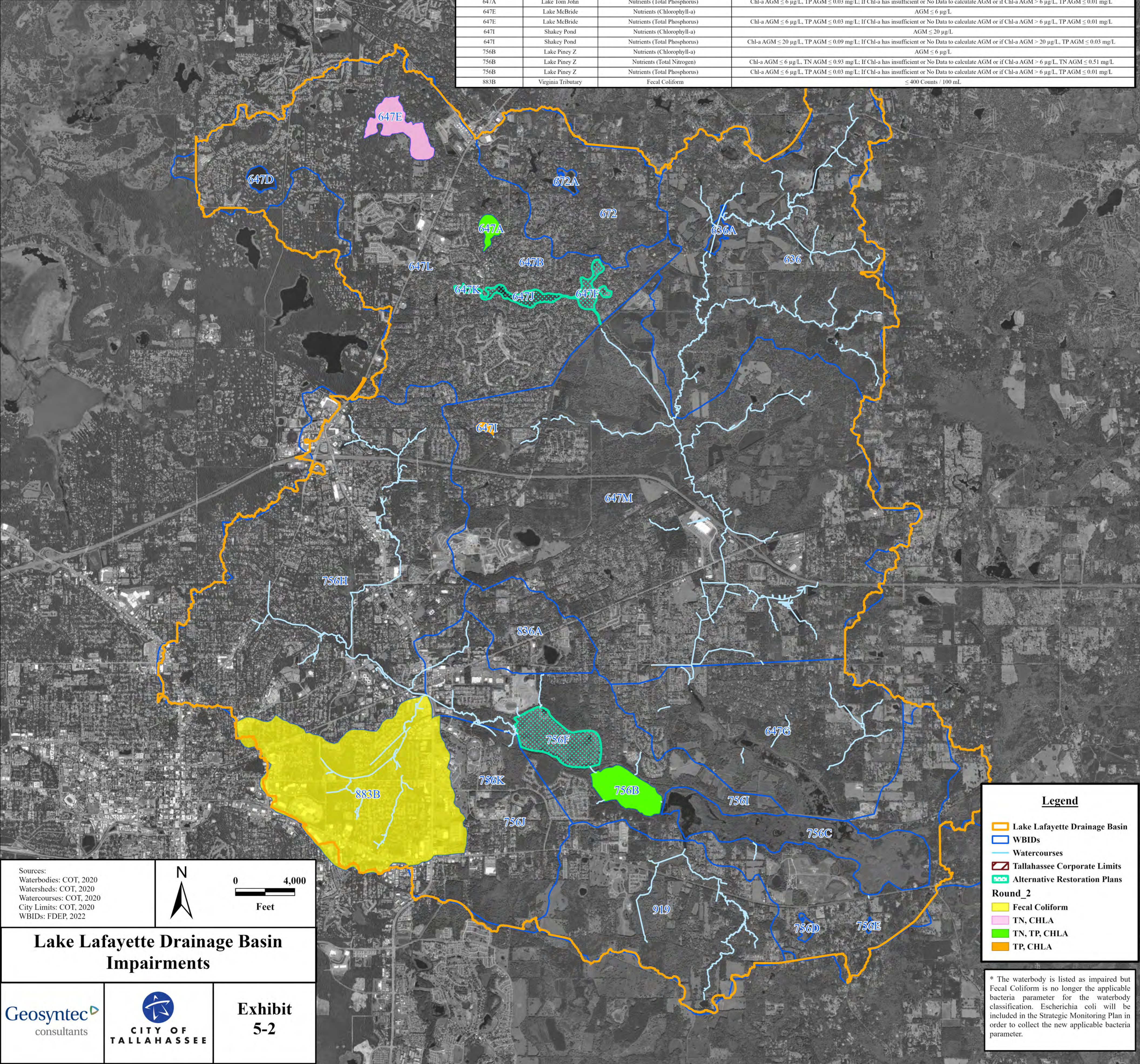
Table 5-13: Summary of Calculated Loads to the Lafayette Chain of Lakes

Source	Upper Lake Lafayette		Piney Z Lake		Lower Lake Lafayette		Alford Arm	
	TN (lb/yr)	TP (lb/yr)	TN (lb/yr)	TP (lb/yr)	TN (lb/yr)	TP (lb/yr)	TN (lb/yr)	TP (lb/yr)
Stormwater Runoff	19,863	2,843	1,626	361	9,019	1,571	26,793	5,292
Septic Systems	1,168	ND	65	ND	2,011	ND	6,327	ND
Lake Inflow	648	48	0	0	ND	ND	20,549	2,079
Atmospheric Deposition	955	ND	609	ND	2,732	ND	940	ND

ND – No data available to calculate, NA – Load calculation not applicable

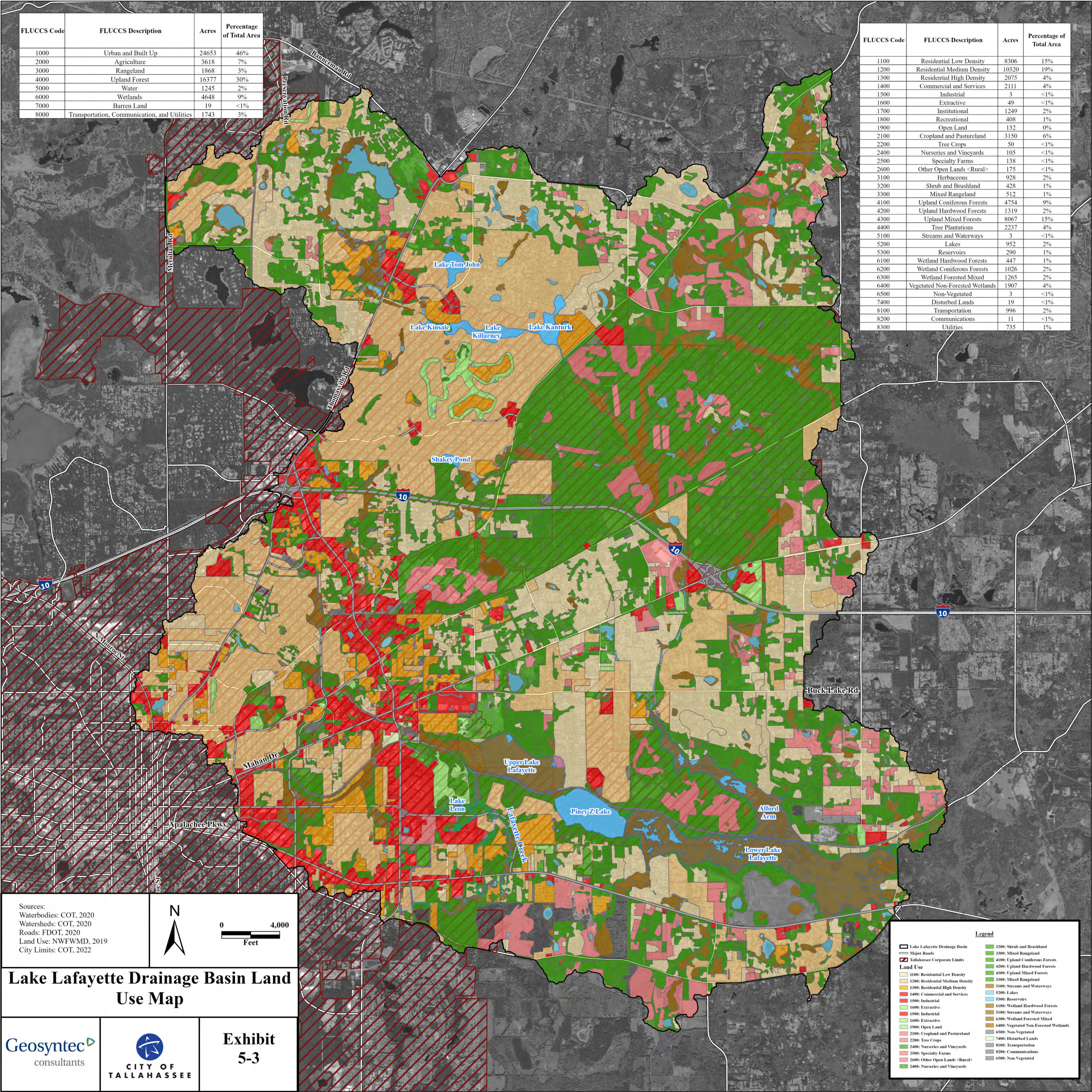
Alternative Restoration Plans			
WBID	Waterbody Name	Parameters Assessed Using the Impaired Surface Waters Rule (IWR)	Year of Adoption
647K	Lake Kinsale	CHLA, TN, TP	2019
647F	Lake Kanturk	CHLA, TN, TP	2016
647J	Lake Killamey	CHLA, TP, un-ionized Ammonia	2016
756F	Upper Lake Lafayette	CHLA, TP, DO, Fecal Coliform	2013

Impaired Waterbodies			
WBID	Waterbody Name	Parameters Assessed Using the Impaired Surface Waters Rule (IWR)	Criterion Concentration or Threshold Not Met
647A	Lake Tom John	Nutrients (Chlorophyll-a)	AGM $\leq$ 6 μ g/L
647A	Lake Tom John	Nutrients (Total Nitrogen)	Chl-a AGM $\leq$ 6 μ g/L, TN AGM $\leq$ 0.93 mg/L; If Chl-a has insufficient or No Data to calculate AGM or if Chl-a AGM $>$ 6 μ g/L, TN AGM $\leq$ 0.51 mg/L
647A	Lake Tom John	Nutrients (Total Phosphorus)	Chl-a AGM $\leq$ 6 μ g/L, TP AGM $\leq$ 0.03 mg/L; If Chl-a has insufficient or No Data to calculate AGM or if Chl-a AGM $>$ 6 μ g/L, TP AGM $\leq$ 0.01 mg/L
647E	Lake McBride	Nutrients (Chlorophyll-a)	AGM $\leq$ 6 μ g/L
647E	Lake McBride	Nutrients (Total Phosphorus)	Chl-a AGM $\leq$ 6 μ g/L, TP AGM $\leq$ 0.03 mg/L; If Chl-a has insufficient or No Data to calculate AGM or if Chl-a AGM $>$ 6 μ g/L, TP AGM $\leq$ 0.01 mg/L
647I	Shakey Pond	Nutrients (Chlorophyll-a)	AGM $\leq$ 20 μ g/L
647I	Shakey Pond	Nutrients (Total Phosphorus)	Chl-a AGM $\leq$ 20 μ g/L, TP AGM $\leq$ 0.09 mg/L; If Chl-a has insufficient or No Data to calculate AGM or if Chl-a AGM $>$ 20 μ g/L, TP AGM $\leq$ 0.03 mg/L
756B	Lake Piney Z	Nutrients (Chlorophyll-a)	AGM $\leq$ 6 μ g/L
756B	Lake Piney Z	Nutrients (Total Nitrogen)	Chl-a AGM $\leq$ 6 μ g/L, TN AGM $\leq$ 0.93 mg/L; If Chl-a has insufficient or No Data to calculate AGM or if Chl-a AGM $>$ 6 μ g/L, TN AGM $\leq$ 0.51 mg/L
756B	Lake Piney Z	Nutrients (Total Phosphorus)	Chl-a AGM $\leq$ 6 μ g/L, TP AGM $\leq$ 0.03 mg/L; If Chl-a has insufficient or No Data to calculate AGM or if Chl-a AGM $>$ 6 μ g/L, TP AGM $\leq$ 0.01 mg/L
883B	Virginia Tributary	Fecal Coliform	$\leq$ 400 Counts / 100 mL

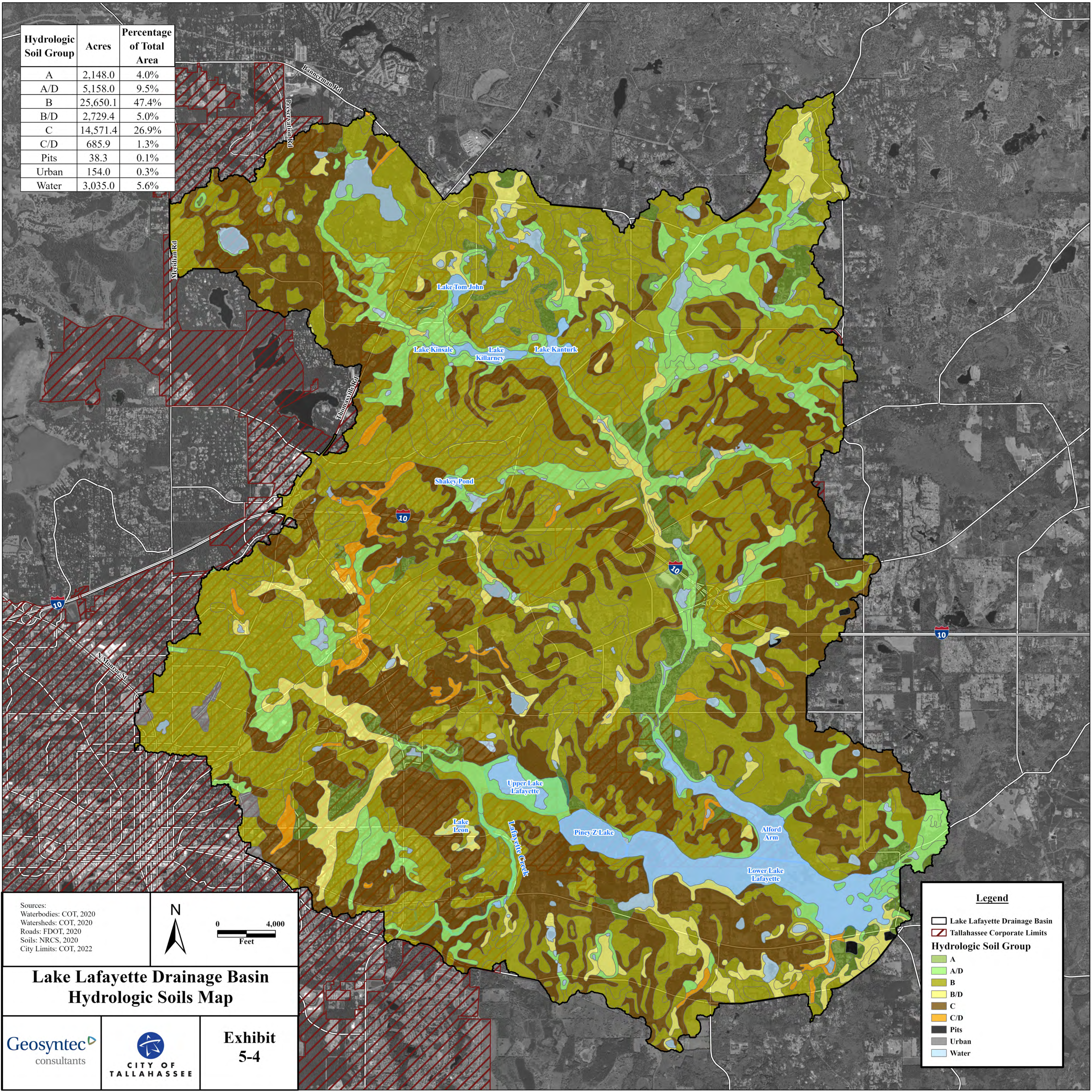


FLUCCS Code	FLUCCS Description	Acres	Percentage of Total Area
1000	Urban and Built Up	24653	46%
2000	Agriculture	3618	7%
3000	Rangeland	1868	3%
4000	Upland Forest	16377	30%
5000	Water	1245	2%
6000	Wetlands	4648	9%
7000	Barren Land	19	<1%
8000	Transportation, Communication, and Utilities	1743	3%

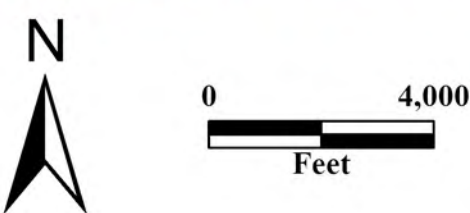
FLUCCS Code	FLUCCS Description	Acres	Percentage of Total Area
1100	Residential Low Density	8306	15%
1200	Residential Medium Density	10320	19%
1300	Residential High Density	2075	4%
1400	Commercial and Services	2111	4%
1500	Industrial	3	<1%
1600	Extractive	49	<1%
1700	Institutional	1249	2%
1800	Recreational	408	1%
1900	Open Land	132	0%
2100	Cropland and Pastureland	3150	6%
2200	Tree Crops	50	<1%
2400	Nurseries and Vineyards	105	<1%
2500	Specialty Farms	138	<1%
2600	Other Open Lands <Rural>	175	<1%
3100	Herbaceous	928	2%
3200	Shrub and Brushland	428	1%
3300	Mixed Rangeland	512	1%
4100	Upland Coniferous Forests	4754	9%
4200	Upland Hardwood Forests	1319	2%
4300	Upland Mixed Forests	8067	15%
4400	Tree Plantations	2237	4%
5100	Streams and Waterways	3	<1%
5200	Lakes	952	2%
5300	Reservoirs	290	1%
6100	Wetland Hardwood Forests	447	1%
6200	Wetland Coniferous Forests	1026	2%
6300	Wetland Forested Mixed	1265	2%
6400	Vegetated Non-Forested Wetlands	1907	4%
6500	Non-Vegetated	3	<1%
7400	Disturbed Lands	19	<1%
8100	Transportation	996	2%
8200	Communications	11	<1%
8300	Utilities	735	1%



Hydrologic Soil Group	Acres	Percentage of Total Area
A	2,148.0	4.0%
A/D	5,158.0	9.5%
B	25,650.1	47.4%
B/D	2,729.4	5.0%
C	14,571.4	26.9%
C/D	685.9	1.3%
Pits	38.3	0.1%
Urban	154.0	0.3%
Water	3,035.0	5.6%



Sources:
Waterbodies: COT, 2020
Watersheds: COT, 2020
Roads: FDOT, 2020
Soils: NRCS, 2020
City Limits: COT, 2022



**Lake Lafayette Drainage Basin
Hydrologic Soils Map**

Geosyntec
consultants



**Exhibit
5-4**

Legend

Lake Lafayette Drainage Basin

Tallahassee Corporate Limits

Hydrologic Soil Group

A

A/D

B

B/D

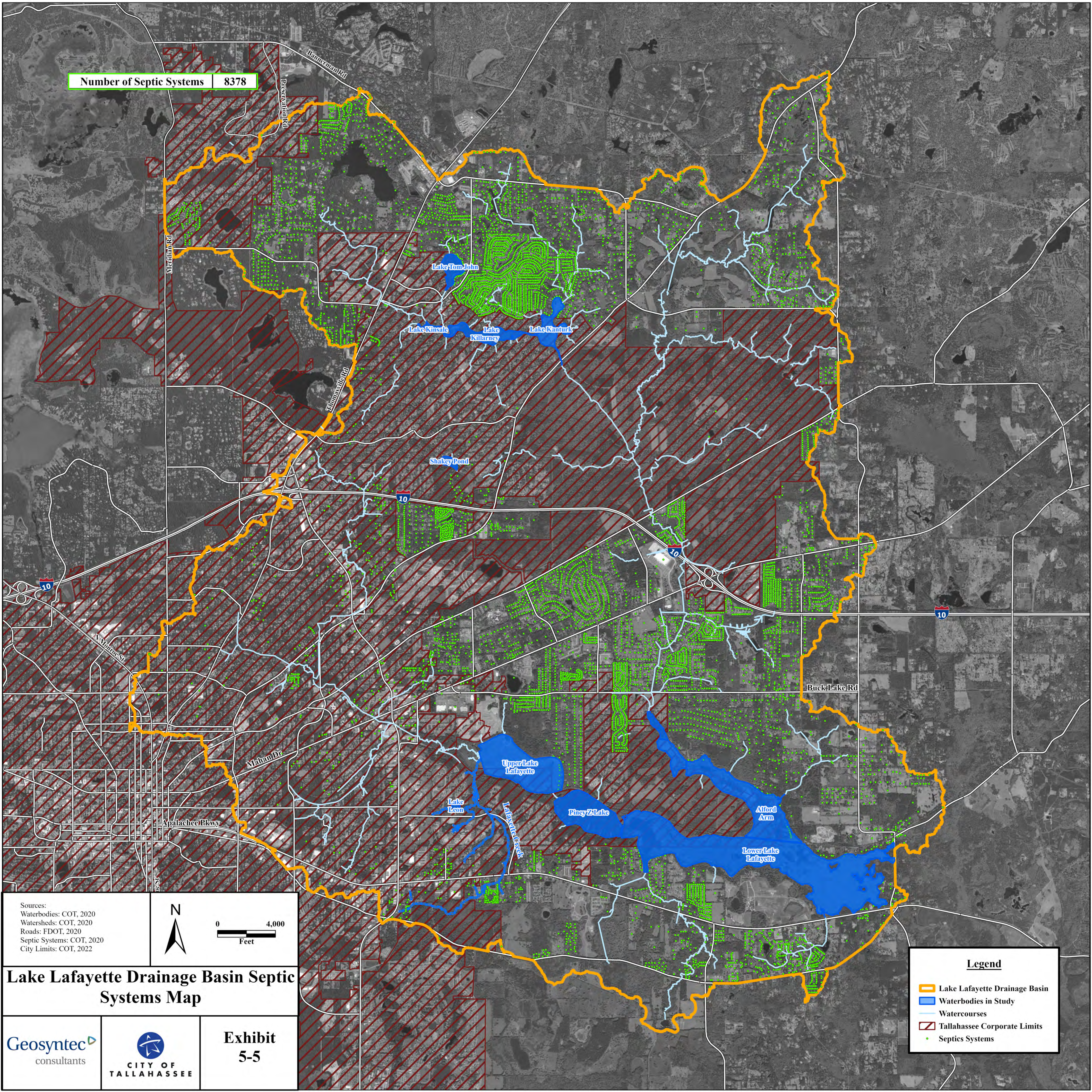
C

C/D

Pits

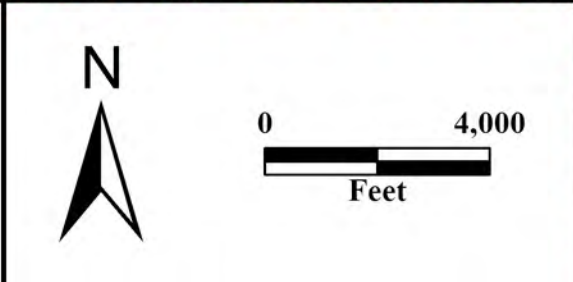
Urban

Water



Number of Septic Systems 8378

Sources:
Waterbodies: COT, 2020
Watersheds: COT, 2020
Roads: FDOT, 2020
Septic Systems: COT, 2020
City Limits: COT, 2022



Lake Lafayette Drainage Basin Septic Systems Map

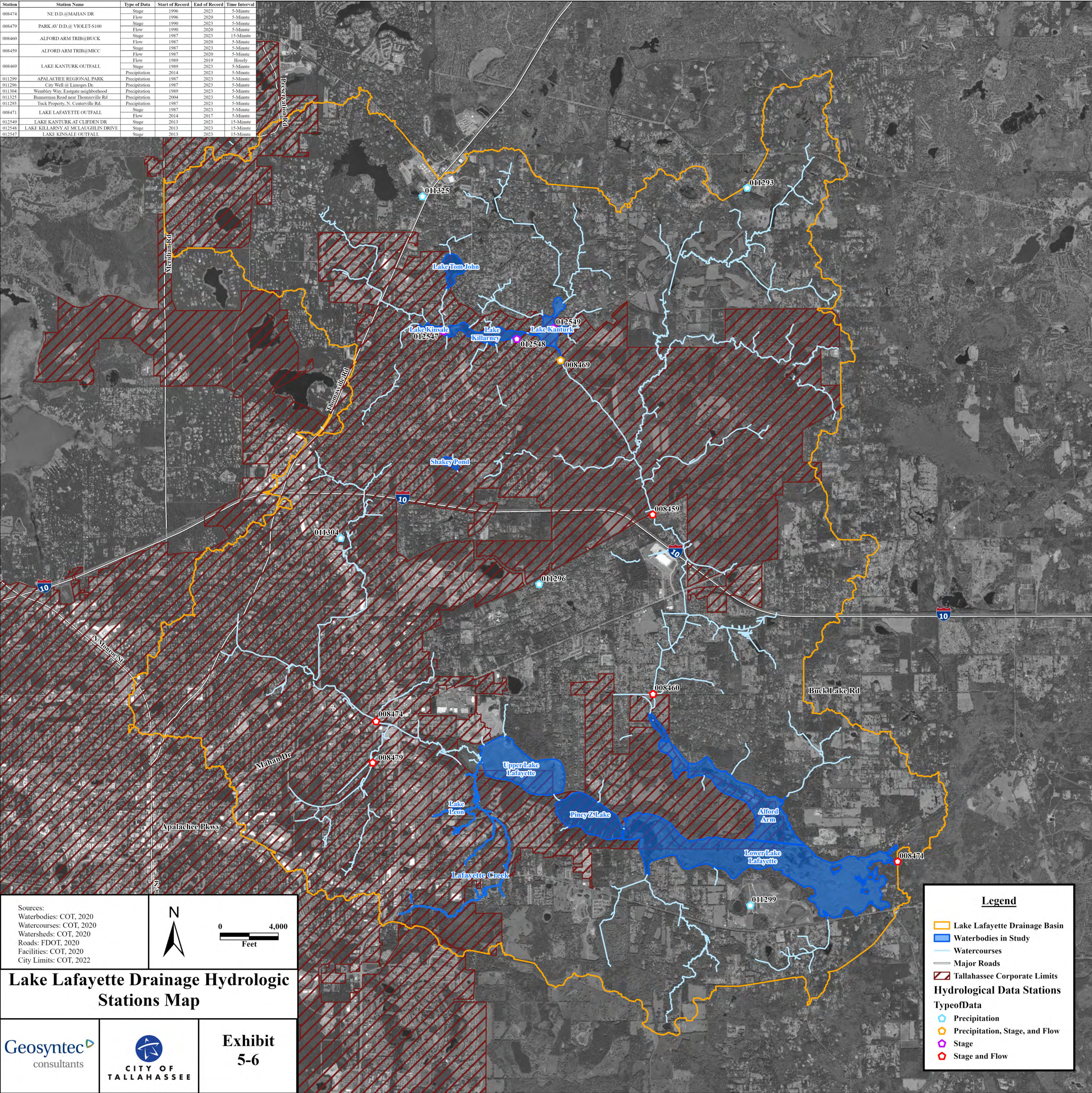


**Exhibit
5-5**

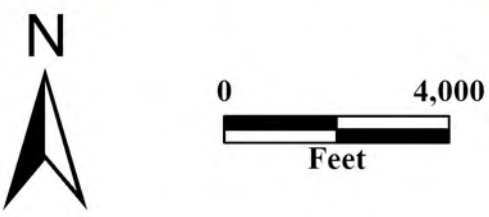
Legend

- Lake Lafayette Drainage Basin
- Waterbodies in Study
- Watercourses
- Tallahassee Corporate Limits
- Septic Systems

Station	Station Name	Type of Data	Start of Record	End of Record	Time Interval
008474	NE D.D.@MAHAN DR	Stage	1996	2023	5-Minute
		Flow	1996	2020	5-Minute
		Stage	1990	2023	5-Minute
008479	PARK AV D.D.@ VIOLET-S100	Flow	1990	2020	5-Minute
		Stage	1987	2023	15-Minute
		Flow	1987	2020	5-Minute
008459	ALFORD ARM TRIB@MICC	Stage	1987	2023	5-Minute
		Flow	1987	2020	5-Minute
		Stage	1989	2019	Hourly
008469	LAKE KANTURK OUTFALL	Stage	1989	2023	5-Minute
		Precipitation	2014	2023	5-Minute
		Precipitation	1987	2023	5-Minute
011299	APALACHEE REGIONAL PARK	Precipitation	1987	2023	5-Minute
011296	City Well @ Limoges Dr.	Precipitation	1987	2023	5-Minute
011304	Wembley Way, Eastgate neighborhood	Precipitation	1989	2023	5-Minute
011325	Bannerman Road near Thomassville Rd	Precipitation	2004	2023	5-Minute
011293	Tuck Property, N. Centerville Rd.	Precipitation	1987	2023	5-Minute
008471	LAKE LAFAYETTE OUTFALL	Stage	1987	2023	5-Minute
		Flow	2014	2017	5-Minute
		Stage	2013	2023	15-Minute
012549	LAKE KANTURK AT CLIFDEN DR	Stage	2013	2023	15-Minute
012548	LAKE KILLARNY AT MCLAUGHLIN DRIVE	Stage	2013	2023	15-Minute
012547	LAKE KINSALE OUTFALL	Stage	2013	2023	15-Minute



Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Watersheds: COT, 2020
Roads: FDOT, 2020
Facilities: COT, 2020
City Limits: COT, 2022

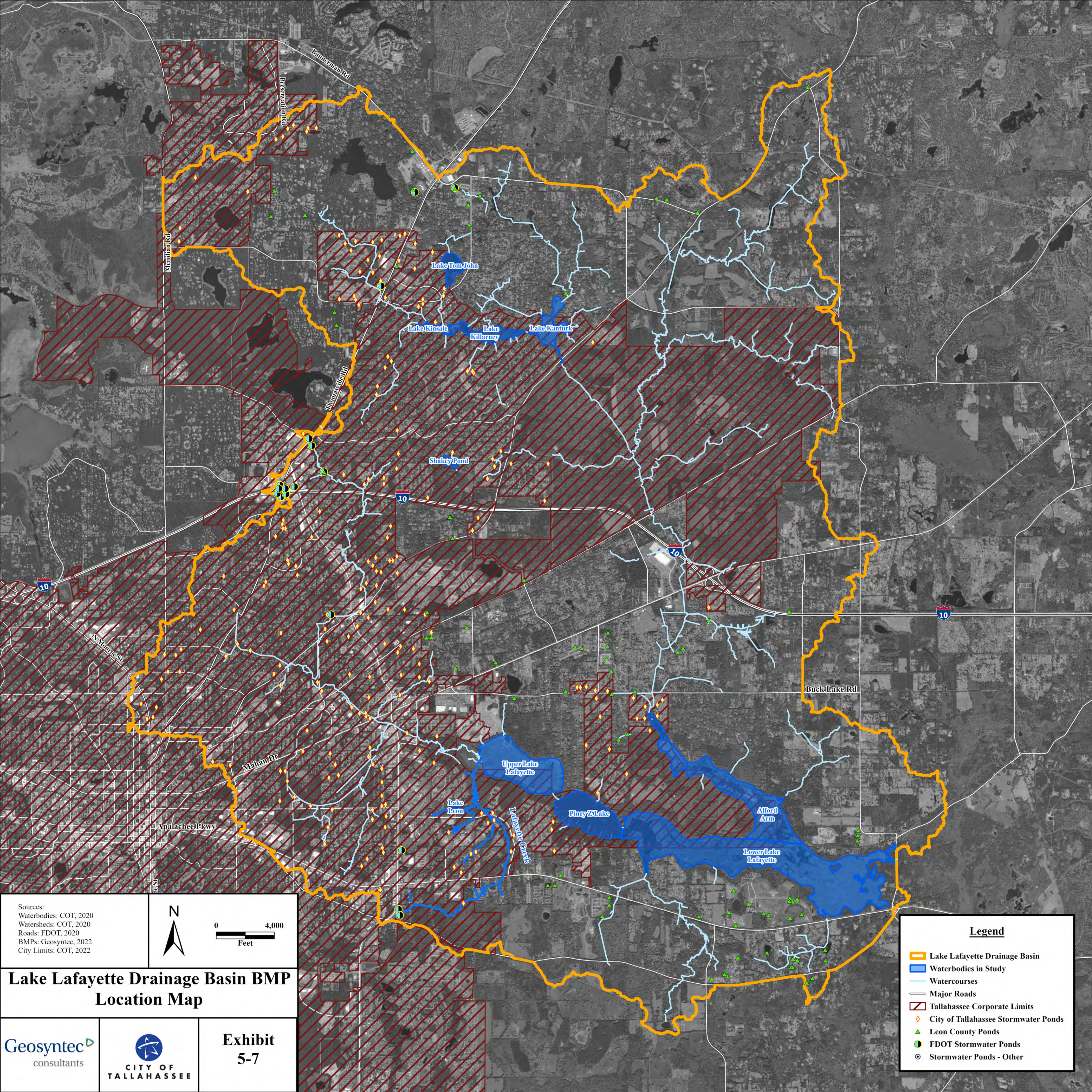


Lake Lafayette Drainage Hydrologic Stations Map

Geosyntec
consultants



Exhibit
5-6



5.5 Killearn Chain of Lakes

This section presents the results from Tasks 1 through 3 for the Killearn Chain of Lakes (Lake Kinsale, Lake Killarney, and Lake Kanturk), which includes an overview and history of the lakes and basin; present impairment status; an overview of available data; a qualitative assessment of potential pollutant sources; and calculation of potential pollutant loads.

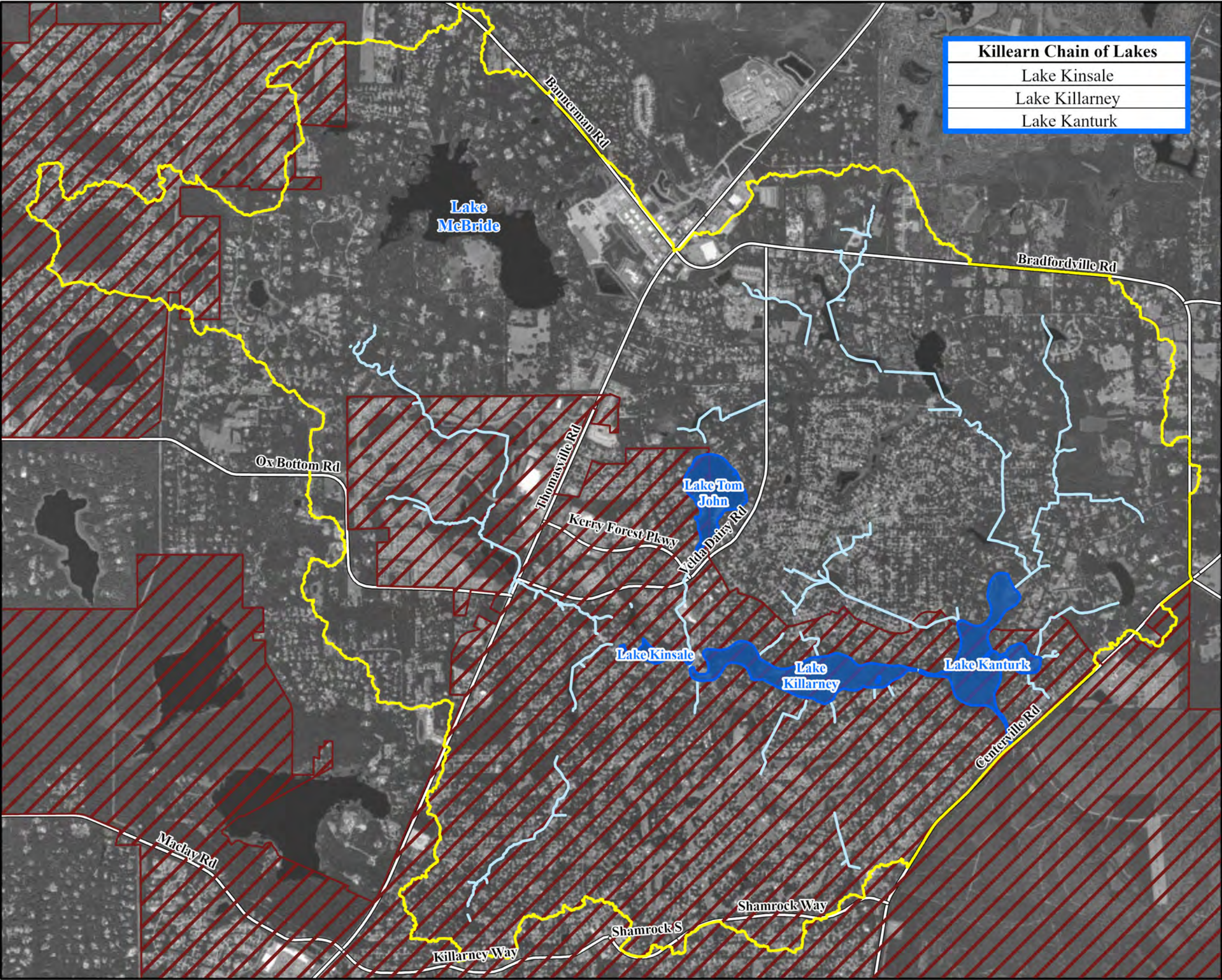
5.5.1 Overview and History

The Killearn Chain of Lakes include Lake Kinsale, Lake Killarney and Lake Kanturk located in the upstream portion of the Lake Lafayette Drainage Basin (**Figure 5-55**). Flows from the upstream most waterbody in the system (Lake McBride) flow south to a crossing at Thomasville Road and then into the western end of Lake Kinsale. Additional flows from Lake Tom John (another target waterbody in this study) enter Lake Kinsale at its eastern end. Flows then proceed through Lake Killarney and Lake Kanturk, discharge across Centerville Road, and eventually to Alford Arm and Lower Lake Lafayette.

Based on early maps from the 1800s, the area where Lake Killarney is located was called Long Pond. This area appears to be best described as a wetland prairie system that was also a floodplain for the drainage out of Lake McBride as it flowed down to Lake Lafayette. **Photo 5-30** through **Photo 5-37** present aerial views of the system from 1937 through 2020. In the early photos (**Photo 5-30** and **Photo 5-31**) the general shapes of the lakes can be seen as open water floodplain areas. Agricultural activities from the 1940s to the 1960s resulted in excavation of drainage ditches and a pond in the area of Lake Killarney. In the 1970s permits were obtained for development of the area into lots for residential housing including a golf course located to the south of the lakes. The three lakes, as they exist today, were constructed in the historic floodplain primarily as aesthetic features for the development. **Photo 5-32** through **Photo 5-34** show the transition from the agricultural area in the 1950s to the developed condition in the 1980s. By 1996 (**Photo 5-35**) the area around the lakes is almost completely built-out residential development.

The drainage basin for the Killearn Chain of Lakes covers an area of 8,843 acres and includes Lake McBride in the upstream reaches and Lake Tom John that drains across Velda Dairy Road into Lake Kinsale (**Figure 5-55**). The Killearn Chain receives discharge from multiple neighborhoods including Killearn Acres, Killearn Estates, Royal Oaks, Foxcroft, Lake Carolyn Estates, Highlands and portions of Ox Bottom Manor and Summerbrooke. Additionally, the basin includes numerous commercial areas along Thomasville Road and Kerry Forest Parkway.

Water levels in each of the lakes are controlled by structures that provide interconnection between the waterbodies. A weir structure is located at the downstream end of Lake Kinsale (**Photo 5-38**) at an elevation of 74.8 ft-NAVD88. A culvert with an invert elevation of 70.5 ft-NAVD88 connects Lake Killarney with Lake Kanturk. Finally, a sump with an overflow elevation of 73.9 ft-NAVD88 at Centerville Road controls outflow from Lake Kanturk (**Photo 5-39**). The outflow from Lake Kanturk has been significantly stabilized to prevent erosion (**Photo 5-40**).



Killearn Chain of Lakes	
	Lake Kinsale
	Lake Killarney
	Lake Kanturk



Legend

- Killearn Chain of Lakes Drainage Basin
- Waterbodies in Study
- Watercourses
- Tallahassee Corporate Limits

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Watersheds: COT, 2020
Roads: FDOT, 2020
Facilities: COT, 2020
City Limits: COT, 2022

Figure 5-55:
Killearn Chain of Lakes Basin Overview
Map

Tallahassee Master Plan - Surface
Water (TMaPS)





Photo 5-30: Killlearn Chain of Lakes Basin Area Aerial (1937)



Photo 5-31: Killlearn Chain of Lakes Basin Area Aerial (1949)

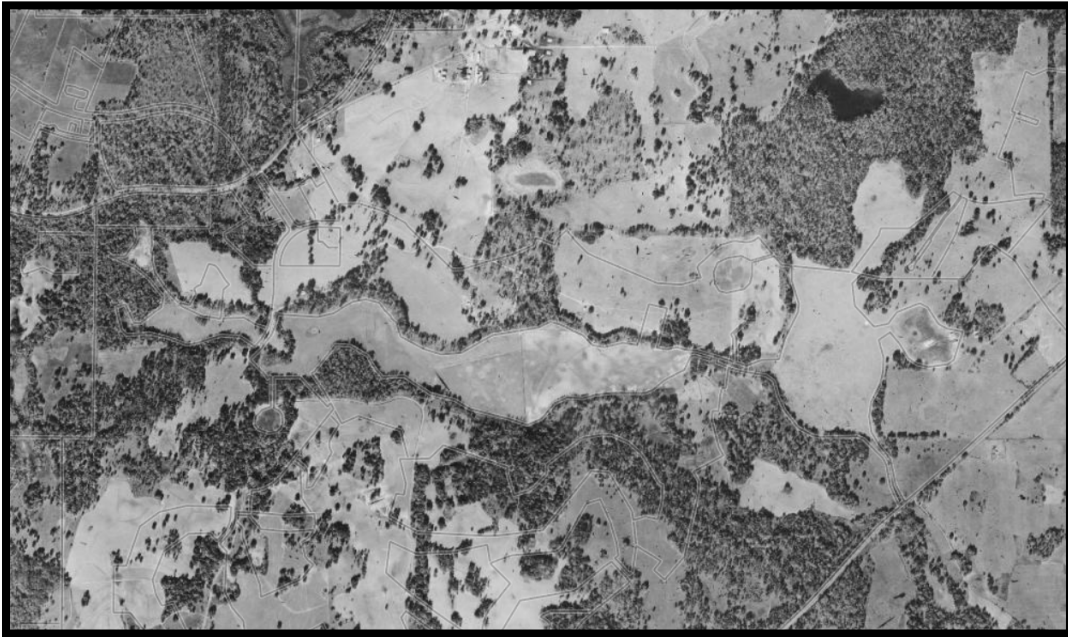


Photo 5-32: Killlearn Chain of Lakes Basin Area Aerial (1954)



Photo 5-33: Killlearn Chain of Lakes Basin Area Aerial (1970)



Photo 5-34: Killlearn Chain of Lakes Basin Area Aerial (1983)

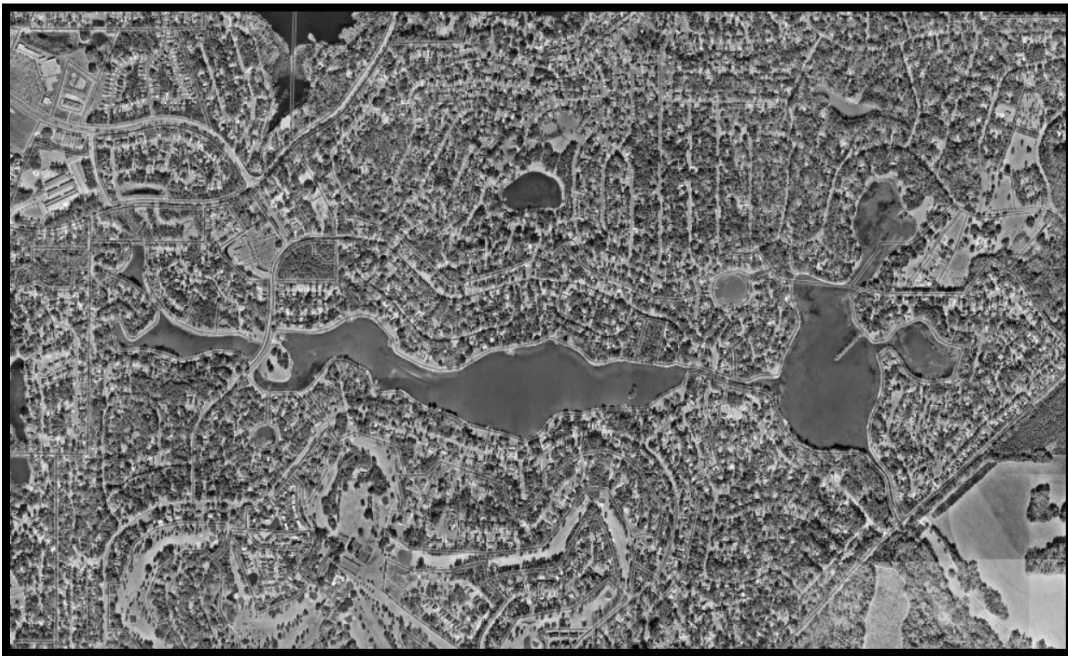


Photo 5-35: Killlearn Chain of Lakes Basin Area Aerial (1996)



Photo 5-36: Killlearn Chain of Lakes Basin Area Aerial (2007)



Photo 5-37: Killlearn Chain of Lakes Basin Area Aerial (2020)



Photo 5-38: Weir Structure on Lake Kinsale



Photo 5-39: Sump Wall Overflow on Eastern End of Lake Kanturk



Photo 5-40: Outflow Channel from Killlearn Chain of Lakes at Centerville Road

When the lakes were constructed in the 1970s, in order to maintain water levels, groundwater pumping was required due to insufficient hydrologic inputs. This pumping supplemented inflows and helped to maintain water levels throughout the system. Due to costs, pumping was discontinued circa 1990. Following the elimination of pumping, the lakes experienced significant fluctuation in water levels with periods of dry-down which exposed the lake bottom for extended periods of time.

Examination of the aerial photos shows these fluctuations. In the 1983 aerial (**Photo 5-34**) all three lakes are clearly full. In the 1996 aerial (**Photo 5-35**) some bottom exposure can be seen. In the 2007 and 2020 aerial photos (**Photo 5-36** and **Photo 5-37**) extensive exposed bottom can be seen in both Lake Killarney and Lake Kanturk. Due to the weir at the downstream end of Lake Kinsale, along with the larger watershed which drains directly to Lake Kinsale, water levels remain higher in comparison to the other two lakes. To illustrate the impacts of the variations in water level, photos of Lake Killarney are provided under different conditions. **Photo 5-41** presents a near full condition following extended rainfall. **Photo 5-42** presents a more average condition. **Photo 5-43** presents a low water condition during winter. **Photo 5-44** presents a low water condition after an extended dry period to allow vegetative growth. As these photos illustrate, the impacts to the lakes from the exposure of the lake bottom (and associated vegetation) to frequent dry spells creates conditions where upon refilling, decomposing material leads to an influx of nutrients to the system with resulting algal response.



Photo 5-41: Western End of Lake Killarney High Condition (April 2017)



Photo 5-42: Western End of Lake Killarney Average Condition (May 2011)



Photo 5-43: Western End of Lake Low Condition (January 2020)



Photo 5-44: Western End of Lake Low Condition (July 2011)

Between 2014 to 2018 numerous studies were undertaken by the City and others to evaluate conditions in the lakes and identify an appropriate path forward for the waterbody designations and restoration. The studies included,

- A 2014 Evaluation of Sediment Impacts on Water Quality by ERD that evaluated sediments in the lake and their potential contribution to nutrient loading,
- A 2014 study by the City and the University of Florida that provided an assessment of the soil characteristics in the basin and their impacts on water quality,
- A 2015 study by Applied Technology and Management (ATM) that provided an assessment of storm event loading data and other data relative to the waterbody designations, and
- Studies by ATM and Frydenborg Ecologic in 2016 and 2017 that evaluated the effects of the water level fluctuations on water quality and guidance for performing sampling within the three lakes.

The lake sediment study (conducted in 2014) calculated the internal nutrient loads under typical conditions and under conditions following rewetting of the lake bottoms. Analyses were performed on cores taken from two sites in Lake Kinsale, three sites in Lake Killarney, and three sites in Lake Kanturk. The calculated loads are presented in **Section 5.5.4.4**. The study concluded that nutrient recycling from bottom sediments is minimal and that nutrient release from sediments following reflooding is not a significant source.

The overriding finding from the other studies is that the water level fluctuations create extended periods where conditions are not appropriate for assessment against criteria established for lakes under the NNC and lakes in general. As such, management recommendations need to center around solutions to maintain water levels in the lakes or provide for management as a more standard wetland prairie system. The study findings are discussed in greater detail in sections to follow.

5.5.2 Regulatory Status

Exhibit 5-2 presented the verified impaired waters within the overall Lake Lafayette basin. In the Cycle 3/Group 1 assessment, Lakes Killarney/Kinsale (WBID 647C) were verified impaired for nutrients (TSI) and un-ionized ammonia based on data from 2007 to 2014. During that same cycle Lake Kanturk (WBID 647F) was verified impaired for nutrients (TSI) based on data from 2008 to 2014. In 2016, the City submitted a document entitled *Documentation in Support of Category 4e for WBIDs 647C and 647F: Killarney and Kanturk* requesting the two WBIDs (containing all three lakes) be moved into Category 4e. Category 4e (as outlined in **Section 5.4.2**) indicates that *the waterbody is impaired, but ongoing or recently completed restoration activities are underway to restore designated uses, so a TMDL calculation is not necessary*. In 2019 WBID 647C was subdivided so that in the present IWR database there are two WBIDs, one for Lake Kinsale (WBID 647K) and one for Lake Killarney (WBID 647J). The 4e designation carried forward to the two new WBIDs. Presently all three lakes remain in the 4e category. A key finding as part of the 4e assessment was that without supplemental hydraulic augmentation the waterbodies will continue to be impaired.

5.5.3 Waterbody Data Review and Summary

This section presents an overview of available data and data sources for the Killlearn Chain of Lakes including bathymetry, land use, soils, septic systems, hydrologic measurements, surface water quality, groundwater quality, biological, stormwater treatment facilities, and atmospheric deposition.

5.5.3.1 Bathymetry

No bathymetric data was available. Based on available reports and other information the average depths in the lakes (when full) are approximately 4 ft, 6 ft, and 5 ft for Lake Kinsale, Lake Killarney, and Lake Kanturk, respectively.

5.5.3.2 Land Use

Figure 5-56 presents a map of the Level 2 land uses within the Killlearn Chain of Lakes basin. A table is provided to show the overall acreages and percent cover for the various levels. Tables are provided for both the Level 2 and grouped Level 1 land uses. The largest land use type by far within the Killlearn Chain of Lakes drainage basin per the grouped Level 1 categories is Urban and Built Up (67 percent) with the bulk of that being Medium Density Residential. The areas are spread throughout the basin. The next highest category is Upland Forest (20 percent) located primarily in the northwestern most upstream reaches of the basin.

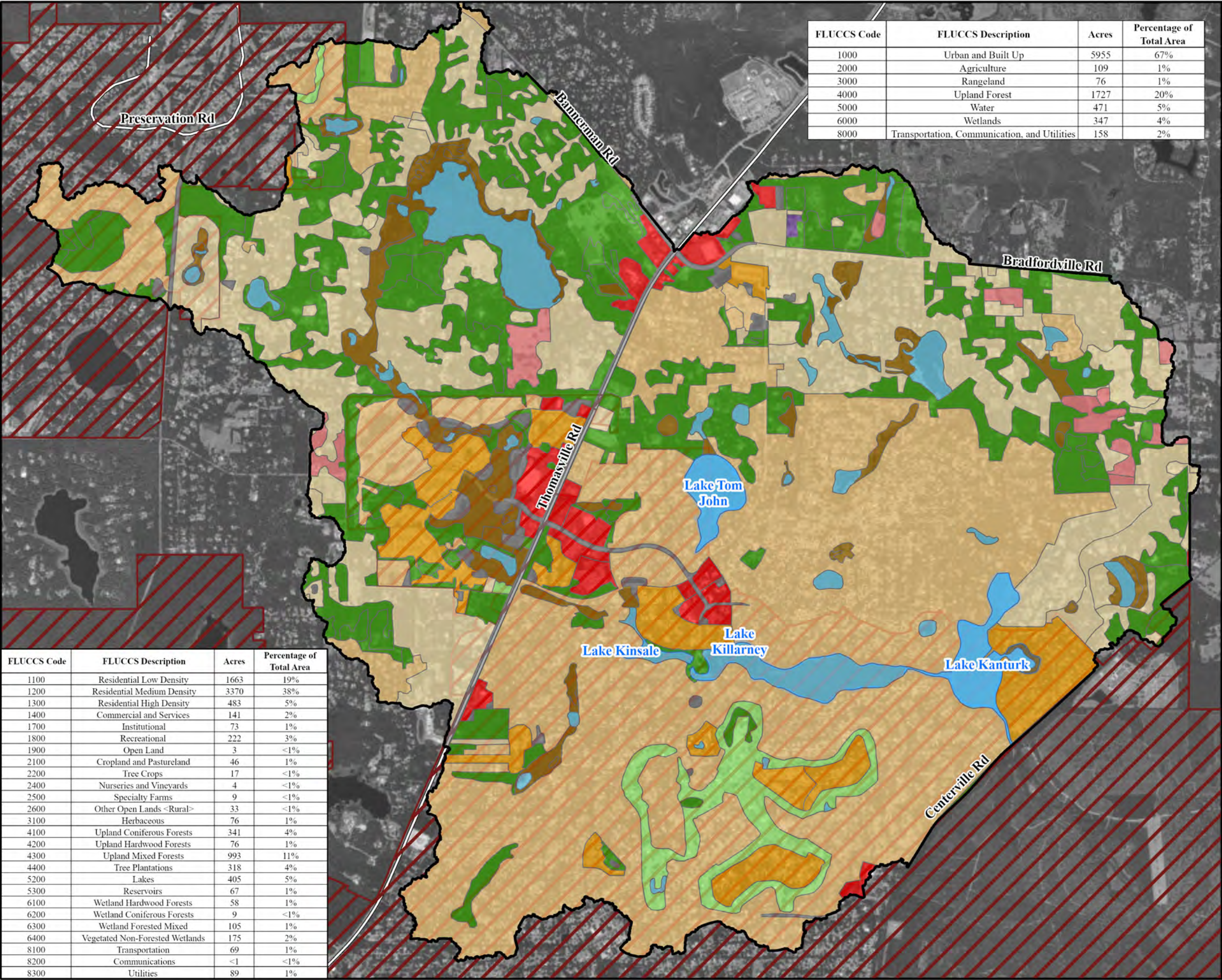
5.5.3.3 Soils

The most prevalent soil group in the Killlearn Chain of Lakes basin is Group B (56 percent) (**Figure 5-57**). Group B soils are considered to have moderate rates of infiltration. The second highest soil group coverage is Group C (20 percent), which has low rates of infiltration and high runoff potential. The majority of the remaining soil groups (B/D and A/D) throughout the basin are generally in areas with high water tables so they also would not drain well and have large runoff potentials.

5.5.3.4 Septic Systems

An estimated 2,675 septic systems are within the boundaries of the Killlearn Chain of Lakes drainage basin, based on the FDOH septic tank layer (**Figure 5-58**). The systems are located throughout the northern and upstream portions of the basin. The highest density is in neighborhoods to the north of the Killlearn Chain of Lakes along tributaries that drain to Lake Kanturk.

Effluent from septic tanks that are in good condition should be comparable to secondarily treated wastewater effluent from sewage treatment plants. However, septic systems can be a source of pollutants, pathogens, and nutrients and are identified by FDEP as a potential source of bacteria and nutrients to waterbodies in its assessment processes.



FLUCCS Code	FLUCCS Description	Acres	Percentage of Total Area
1100	Residential Low Density	1663	19%
1200	Residential Medium Density	3370	38%
1300	Residential High Density	483	5%
1400	Commercial and Services	141	2%
1700	Institutional	73	1%
1800	Recreational	222	3%
1900	Open Land	3	<1%
2100	Cropland and Pastureland	46	1%
2200	Tree Crops	17	<1%
2400	Nurseries and Vineyards	4	<1%
2500	Specialty Farms	9	<1%
2600	Other Open Lands <Rural>	33	<1%
3100	Herbaceous	76	1%
4100	Upland Coniferous Forests	341	4%
4200	Upland Hardwood Forests	76	1%
4300	Upland Mixed Forests	993	11%
4400	Tree Plantations	318	4%
5200	Lakes	405	5%
5300	Reservoirs	67	1%
6100	Wetland Hardwood Forests	58	1%
6200	Wetland Coniferous Forests	9	<1%
6300	Wetland Forested Mixed	105	1%
6400	Vegetated Non-Forested Wetlands	175	2%
8100	Transportation	69	1%
8200	Communications	<1	<1%
8300	Utilities	89	1%



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Legend

 Killlearn Chain of Lakes Drainage Basin

 Tallahassee Corporate Limits

Land Use

Land Use Type

- 1100: Residential Low Density
- 1200: Residential Medium Density
- 1300: Residential High Density
- 1400: Commercial and Services
- 1500: Industrial
- 1600: Extractive
- 1900: Open Land
- 2100: Cropland and Pastureland
- 2200: Tree Crops
- 2400: Nurseries and Vineyards
- 2500: Specialty Farms
- 2600: Other Open Lands <Rural>
- 2400: Nurseries and Vineyards
- 4100: Upland Coniferous Forests
- 4200: Upland Hardwood Forests
- 4300: Upland Mixed Forests
- 3300: Mixed Rangeland
- 5200: Lakes
- 5300: Reservoirs
- 6100: Wetland Hardwood Forests
- 5100: Streams and Waterways
- 6300: Wetland Forested Mixed
- 6400: Vegetated Non-Forested Wetlands
- 8100: Transportation
- 8200: Communications
- 6500: Non-Vegetated

Sources:

Waterbodies: COT, 2020

Watersheds: COT, 2020

Roads: FDOT, 2020

Land Use: NWFWM, 2019

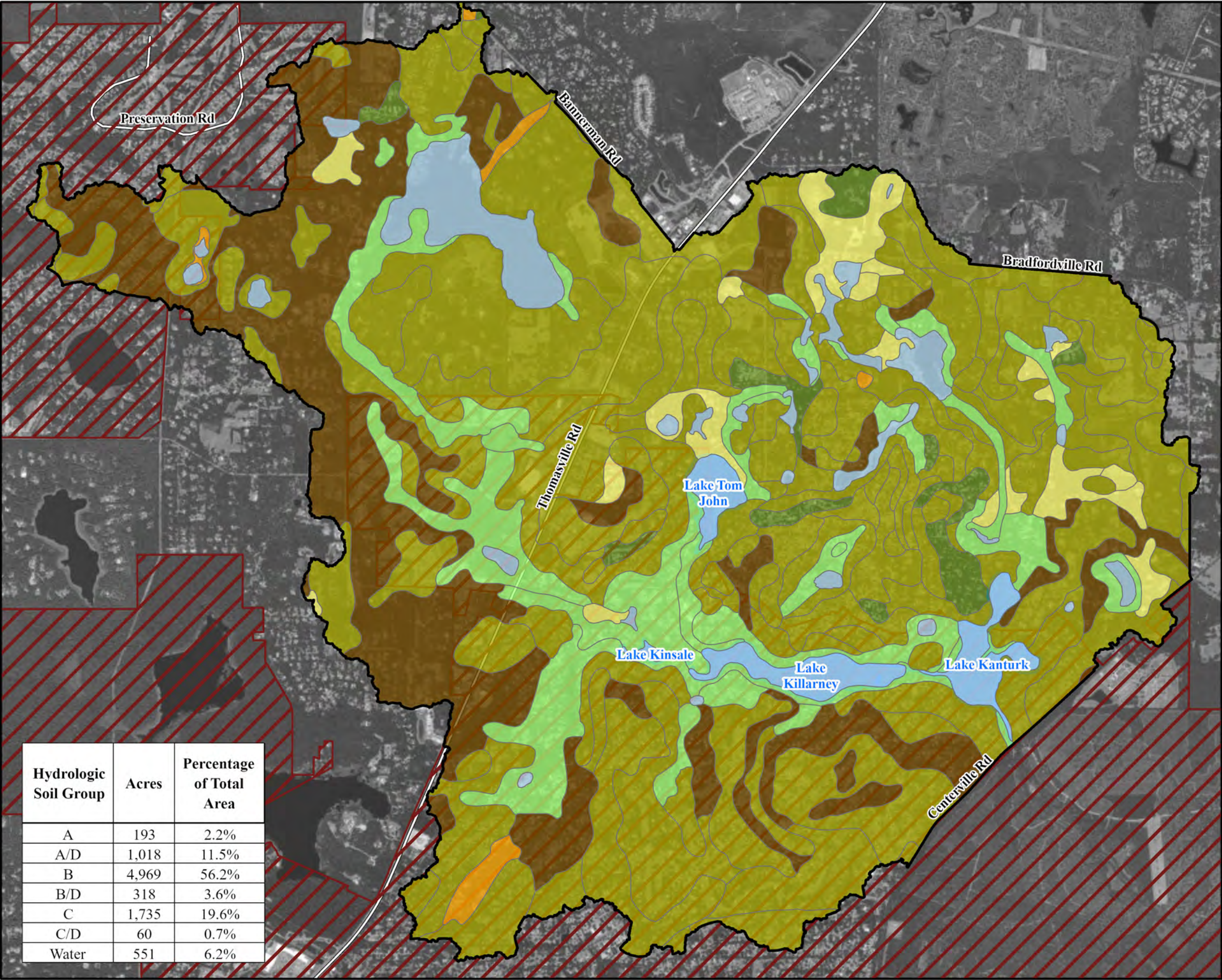
City Limits: COT, 2022

Figure 5-56:
Killlearn Chain of Lakes Drainage Basin
Land Use Map

Tallahassee Master Plan - Surface
Water (TMaPS)



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Legend

- Killlearn Chain of Lakes Drainage Basin
- Tallahassee Corporate Limits
- Hydrologic Soil Group
 - A
 - A/D
 - B
 - B/D
 - C
 - C/D
 - Water

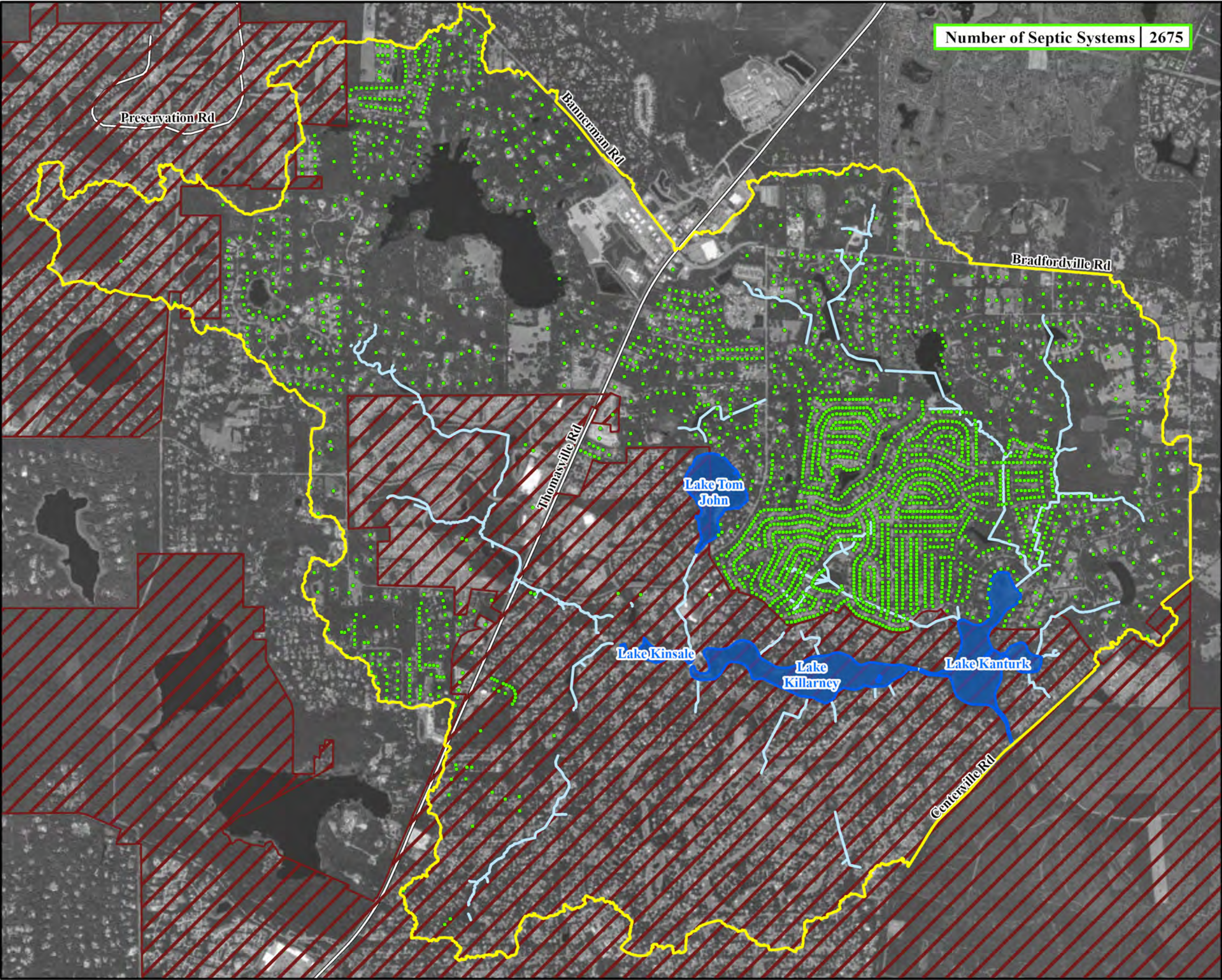
Sources:
Waterbodies: COT, 2020
Watersheds: COT, 2020
Roads: FDOT, 2020
Soils: NRCS, 2020
City Limits: COT, 2022

Hydrologic Soil Group	Acres	Percentage of Total Area
A	193	2.2%
A/D	1,018	11.5%
B	4,969	56.2%
B/D	318	3.6%
C	1,735	19.6%
C/D	60	0.7%
Water	551	6.2%

Figure 5-57:
Killlearn Chain of Lakes Drainage Basin
Soils Map

Tallahassee Master Plan - Surface
Water (TMaPS)





Number of Septic Systems | 2675



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Legend

- Waterbodies in Study
- Watercourses
- Tallahassee Corporate Limits
- Septic Systems

Sources:
Waterbodies: COT, 2020
Watersheds: COT, 2020
Roads: FDOT, 2020
Septic Systems: COT, 2020
City Limits: COT, 2022

Figure 5-58:
Killarn Chain of Lakes Drainage Basin
Septic Systems Map

Tallahassee Master Plan - Surface
Water (TMaPS)

Geosyntec
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5.5.3.5 Hydrologic Data

Exhibit 5-6 presented the locations of hydrologic data stations within the Lake Lafayette basin. As the map shows, there are water level stations located in each of the three lakes (Stations 012547, 012548, and 012549). Data from these stations was obtained from 2013 to 2021. **Figure 5-59** presents a plot of the measured water levels relative to NAVD88 for the period of the available data. The data for each of the lakes are plotted together to show how the lake levels vary relative to one another. The data show the variations between the lakes. The stage in Kinsale stays higher for longer periods and does not drop down to the levels seen in the other waterbodies. Killarney and Kanturk drop to levels around 4 ft lower than Kinsale for extended periods representing dry out conditions.

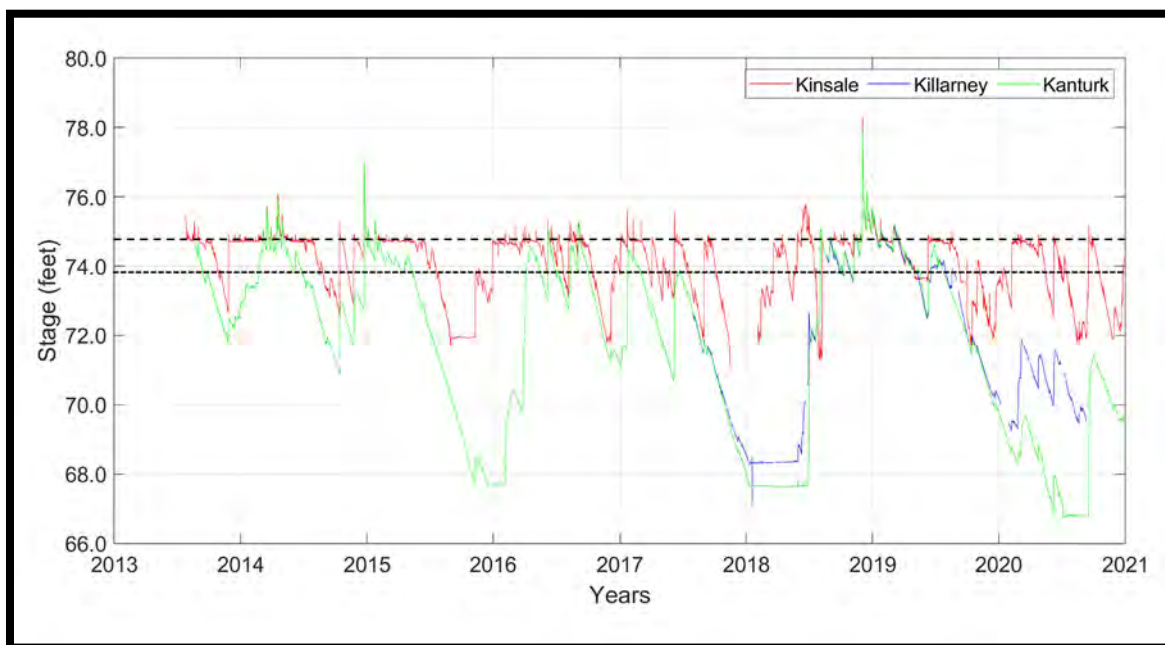


Figure 5-59: Water Levels in Lake Kinsale, Lake Killarney, and Lake Kanturk with Control Elevations (Kinsale/Killarney – long dash, Killarney/Kanturk – short dash)

A flow measurement station is located downstream of Lake Kanturk where the discharge channel crosses Centerville Road (**Exhibit 5-6**). These data reflect the flow out of the system. **Figure 5-60** presents a plot of the daily average flows from 1990 through 2020. The flow rates vary from 0 up to over 200 cfs. Discharge out of the Killarney Chain of Lakes is highly intermittent with long periods when discharge is at 0.

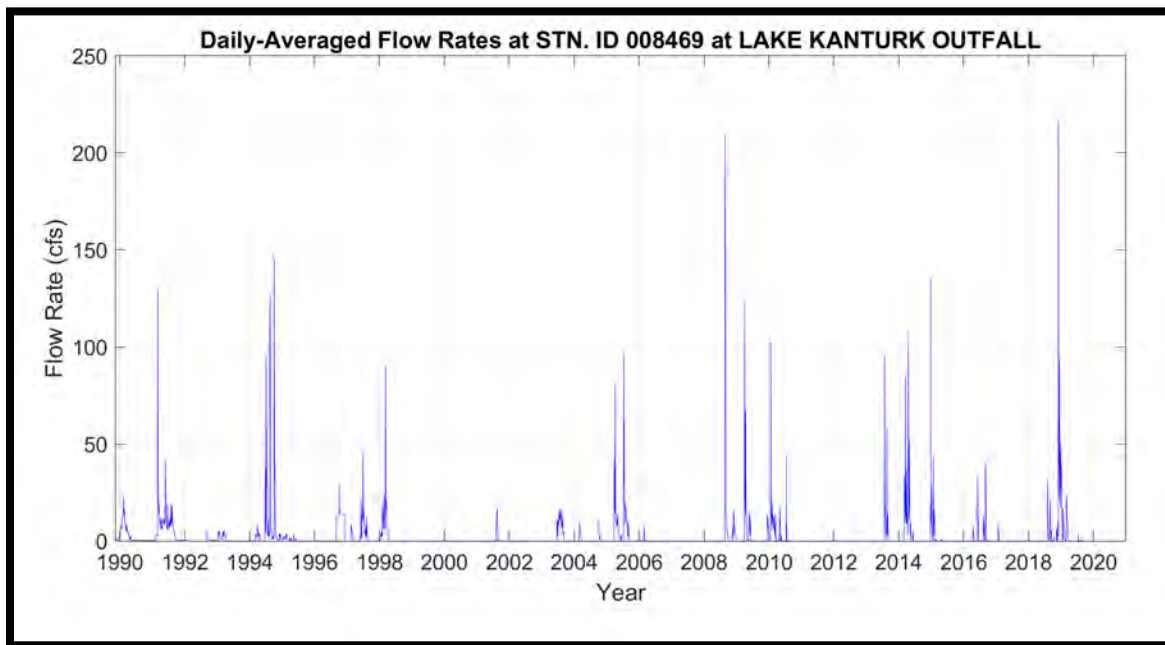


Figure 5-60: Flow Out of Lake Kanturk

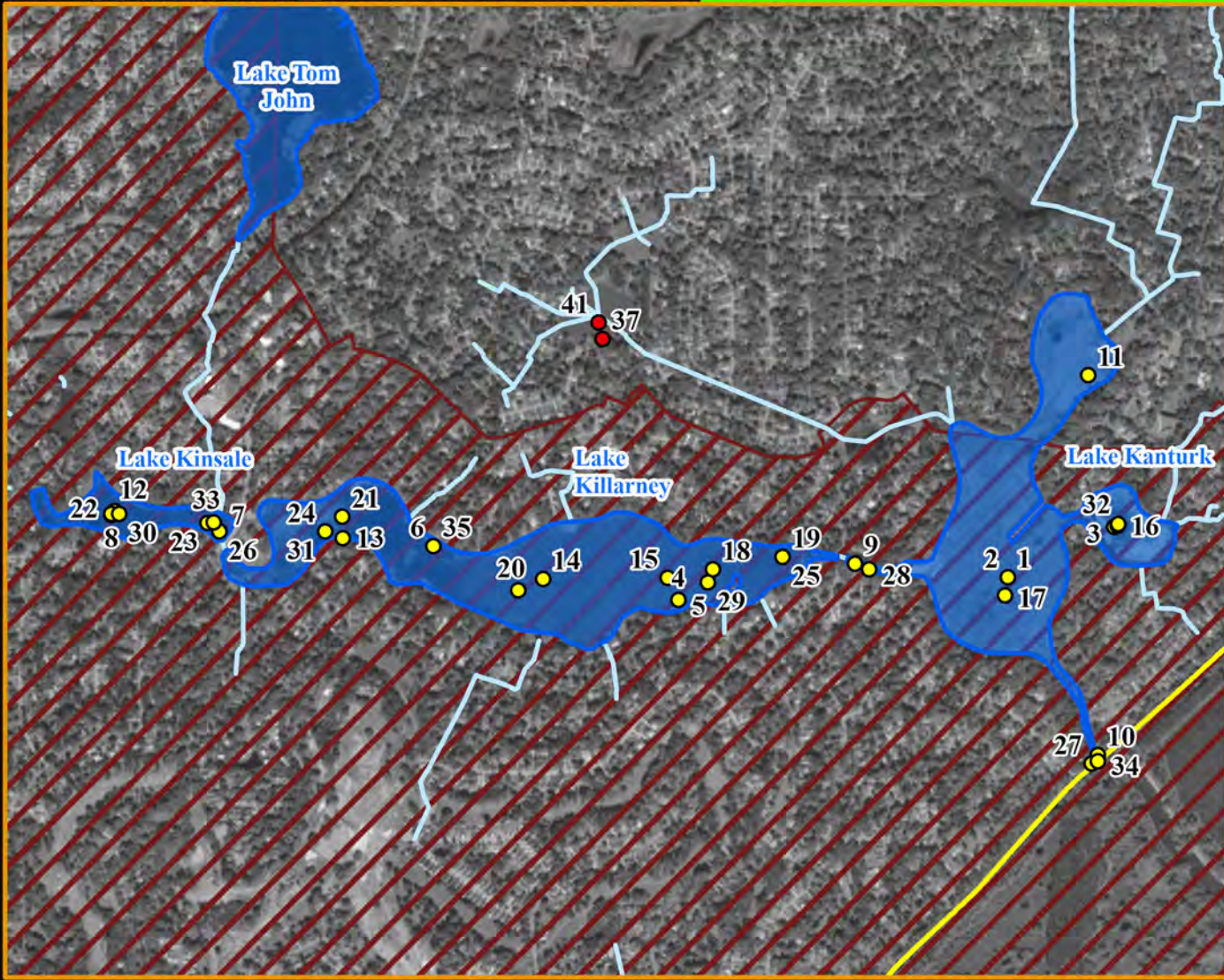
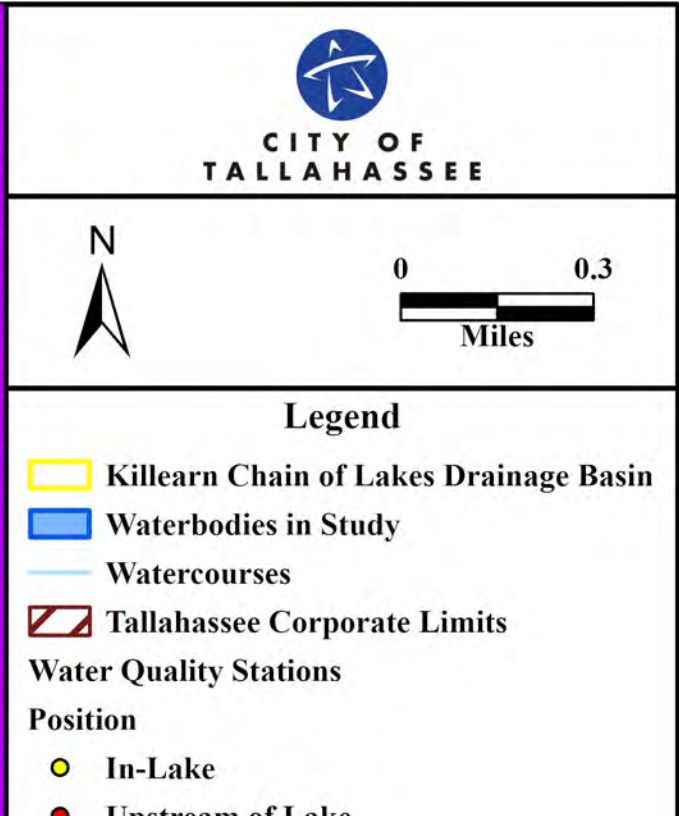
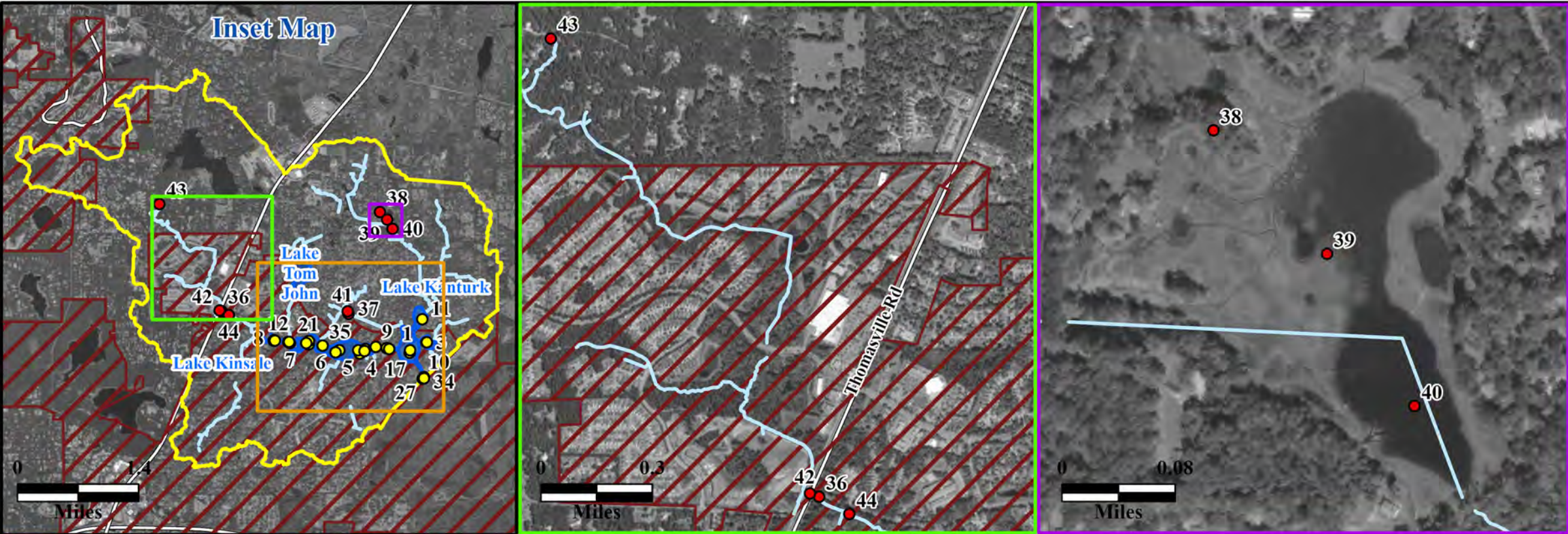
5.5.3.6 Surface Water Quality Data

The available data from the Killearn Chain of Lakes span from 1999 to the present. Data were provided by local and state agencies (City, Leon County, FDEP, and USGS) as well as private sector firms (McGlynn Lab).

Figure 5-61 presents the locations of in-lake water quality monitoring stations for the Killearn Chain of Lakes (yellow) along with stations that provide water quality data within tributaries that drain into Lake Kinsale and Lake Kanturk (red). A table is provided in **Figure 5-61** that shows the station ID, station name, period of record, and if the station represents in-lake or inflowing tributary data. Based on the number of stations and the length of the station IDs, station IDs were not included on the figure, rather each of the stations is given a number and the numbers correspond to stations in the table.

Figure 5-61 shows that water quality monitoring stations have been spread throughout the three lakes for the period of record. Relative to more recent data (after 2010) there are numerous stations throughout the system.

Some initial plots of the available data in the lakes are provided in this section. As nutrients are the primary constituent of interest relative to water quality conditions in the Killearn Chain of Lakes, plots are provided for the key parameters related to potential nutrient impairment. These include TN, TP, Chl-a, and TSI. Additionally, based on interest relative to septic systems and other sources, FIB, specifically *E. coli* are included. Additional data plots and analyses are provided as part of the qualitative assessment of sources in **Section 5.5.4**.



Number	Station ID	Station Name	Start of Record	End of Record	Position
1	21FLCOT KANTURK	KANTURK	2008	2022	In-Lake
2	21FLCOT KANTURK - SUPPL	Kanturk - Supplemental	2013	2014	In-Lake
3	21FLCOT KANTURK N - SUP	Kanturk North - Supplemental	2013	2014	In-Lake
4	21FLCOT KILLARN E - SUP	Killamey East - Supplemental	2013	2014	In-Lake
5	21FLCOT KILLARNEY EAST	KILLARNEY EAST	2007	2022	In-Lake
6	21FLCOT KILLARNEY WEST	KILLARNEY WEST	2008	2022	In-Lake
7	21FLCOT KINSALE	Kinsale	2017	2022	In-Lake
8	21FLCOT KINSALE - SUPPL	Kinsale - Supplemental	2013	2014	In-Lake
9	21FLCOT STA - 16	STA - 16	2014	2014	In-Lake
10	21FLCOT STA-12	STA-12	2014	2014	In-Lake
11	21FLGW 45419	Z1-LL-8003 UNNAMED LARGE LAKE	2014	2014	In-Lake
12	21FLGW 54310	Z1-SL-12030 LAKE KINSALE	2018	2018	In-Lake
13	21FLKWATLEO-KILLARNEY-1	LEO-KILLARNEY-1	1999	2009	In-Lake
14	21FLKWATLEO-KILLARNEY-2	LEO-KILLARNEY-2	1999	2009	In-Lake
15	21FLKWATLEO-KILLARNEY-3	LEO-KILLARNEY-3	1999	2009	In-Lake
16	21FLMCGLKANTURK1	Lake Kanturk, first station	2008	2019	In-Lake
17	21FLMCGLKANTURK3	Lake Kanturk, third station	2008	2021	In-Lake
18	21FLMCGLKILLEARNY1	Lake Killearny, station 1	2008	2021	In-Lake
19	21FLMCGLKILLEARNY1A	Lake Killearny, station 1A	2009	2009	In-Lake
20	21FLMCGLKILLEARNY2	Lake Killearny, station 2	2008	2021	In-Lake
21	21FLMCGLKILLEARNY3	Lake Killearny, station 3	2008	2021	In-Lake
22	21FLMCGLKINSAIL1	Lake Kinsail, station 1	2008	2021	In-Lake
23	21FLMCGLKINSAIL2	Lake Kinsail, station 2	2008	2021	In-Lake
24	21FLPNS 132UL	Lake Killearny Near Center (also 21FLWQSP)	2011	2011	In-Lake
25	21FLPNS KILLEARNY1A	Lake Killearny East (also 21FLMCGL)	2011	2011	In-Lake
26	21FLTLHRG1TLHR0148	Lake Kinsale	2021	2022	In-Lake
27	21FLWQA 303135908411272	Alford Arm Trib at Centerville Rd (Lake Kanturk outlet)	2006	2006	In-Lake
28	21FLWQA BLOOM515	Canal Between Kanturk and Killarney	2017	2017	In-Lake
29	21FLWQA BLOOM516	Killarney Mid	2017	2017	In-Lake
30	21FLWQA BLOOM517	Kinsail Mid	2017	2017	In-Lake
31	21FLWQSPLEO132UL	Lake Killarney near center (WBID 647C)	2005	2005	In-Lake
32	21FLWQSPLEO136UL	Lake Kanturk near center (WBID 647)	2005	2005	In-Lake
33	21FLWQA G1WA0079	Lake Kinsail	2017	2017	In-Lake
34	21FLCOT LLB04	LLB04	2015	2019	In-Lake
35	21FLCOT KILLARN W - SUP	Killarney West - Supplemental	2013	2014	Upstream
36	21FLCOT STA-11	STA-11	2013	2014	Upstream
37	21FLGW 7045	NWA-SL-1005 LAKE SHEELIN	2000	2000	Upstream
38	21FLKWATLEO-JEAN-1	LEO-JEAN-1	1999	1999	Upstream
39	21FLKWATLEO-JEAN-2	LEO-JEAN-2	1999	1999	Upstream
40	21FLKWATLEO-JEAN-3	LEO-JEAN-3	1999	1999	Upstream
41	21FLKWATLEO-SHEELIN-2	LEO-SHEELIN-2	1999	1999	Upstream
42	21FLWQA 303217408413489	Alford Arm Trib at Thomasville Rd	2006	2006	Upstream
43	21FLWQA 303321508414309	Alford Arm Trib at Rd north Two Pond Lane	2006	2006	Upstream
44	21FLWQA G1WA0015	Killeam Chain of Lake Outlet at Velda Dairy Rd. across from	2016	2017	Upstream

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Drainage Basins: COT, 2020
City Limits: COT, 2022
WQ Stations: FDEP, 2022

Figure 5-61:
Killarn Chain of Lakes Basin Water Quality Station Location Map

Tallahassee Master Plan - Surface Water (TMaPS)

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Below are plots of the measured TN, TP, and Chl-a data from 2010 to 2020 for Lake Kinsale, Lake Killarney, and Lake Kanturk. For Lake Kinsale (**Figure 5-62** through **Figure 5-64**) all three constituents show significant variation with TN and Chl-a showing slight upward trends, while TP concentrations appear consistent over the 10-year period. Three concentrations higher than 120 $\mu\text{g/L}$ (not shown on the graph) were measured in Lake Kinsale in 2017 between May and August, with one measurement at 380 $\mu\text{g/L}$. For Lake Killarney (**Figure 5-65** through **Figure 5-67**), all three parameters show significant variation with lower overall concentrations after 2015. Finally, Lake Kanturk (**Figure 5-68** through **Figure 5-70**) shows similar concentration ranges to those seen in the other lakes but with more bunched data at lower concentrations with fewer higher values.

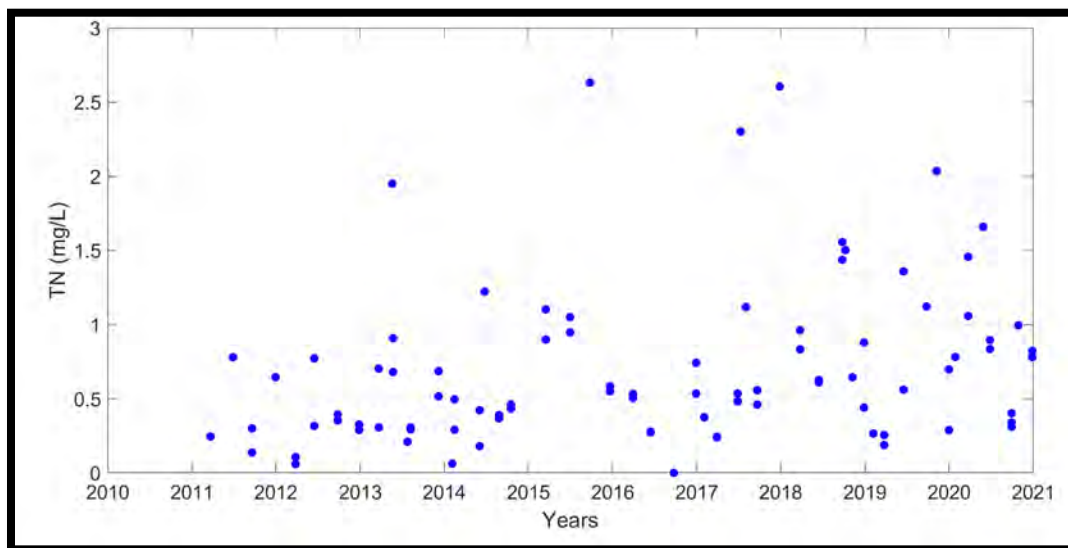


Figure 5-62: Plot of Measured TN Concentrations in Lake Kinsale (2010 to 2020)

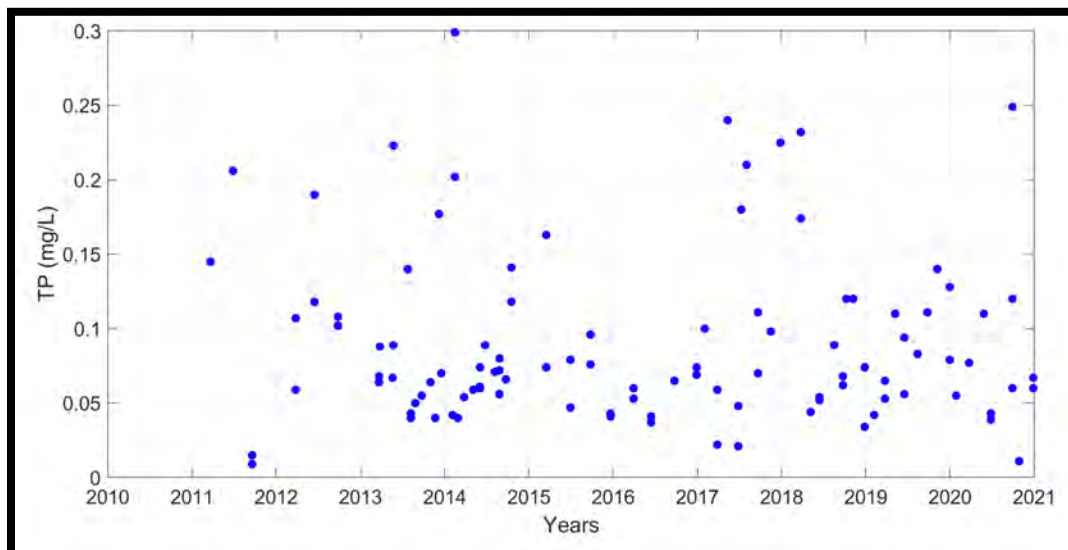


Figure 5-63: Plot of Measured TP Concentrations in Lake Kinsale (2010 to 2020)

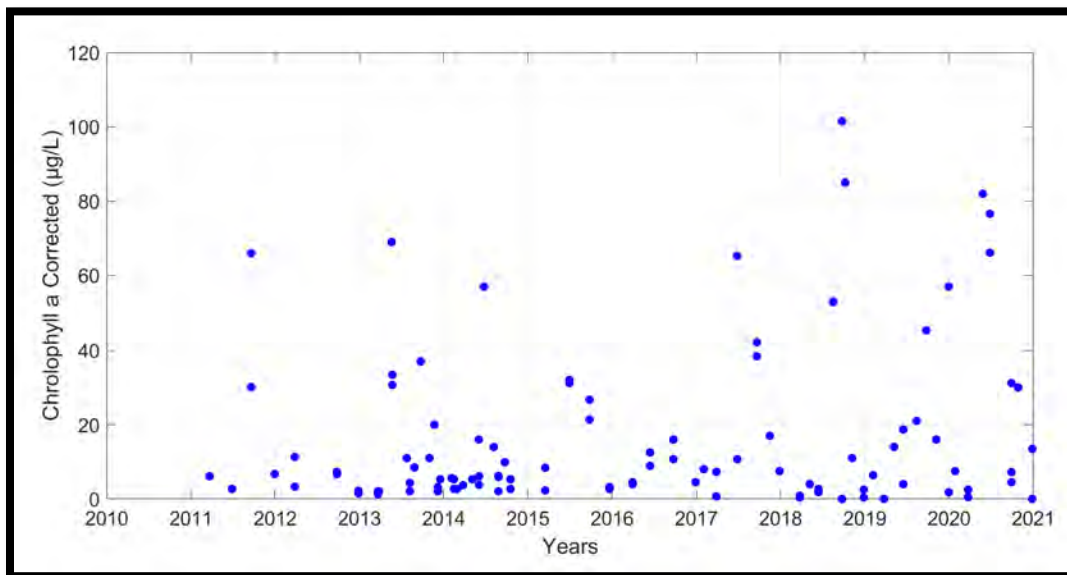


Figure 5-64: Plot of Measured Chl-a Concentrations in Lake Kinsale (2010 to 2020)

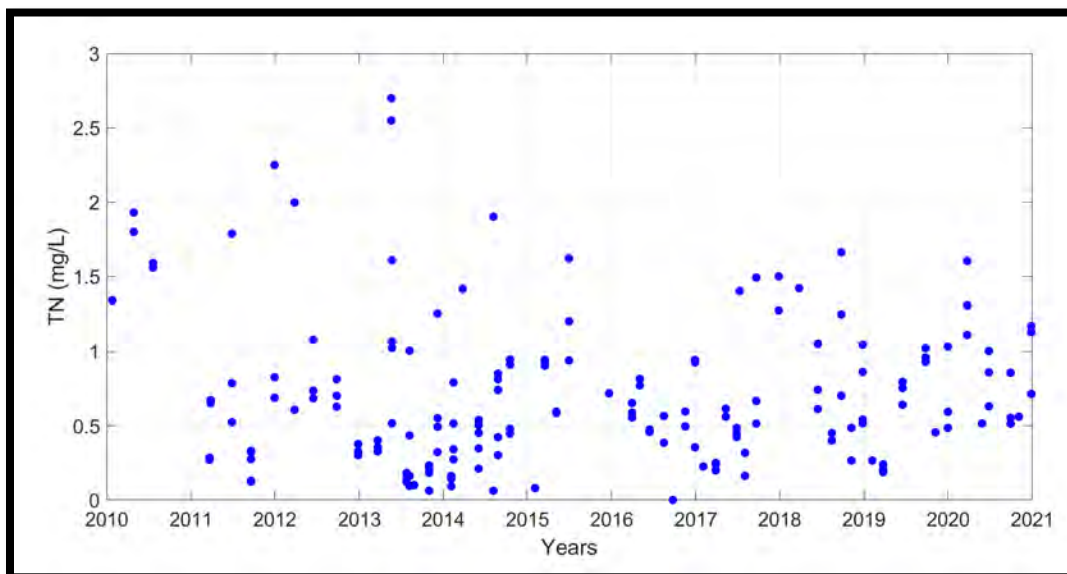


Figure 5-65: Plot of Measured TN Concentrations in Lake Killarney (2010 to 2020)

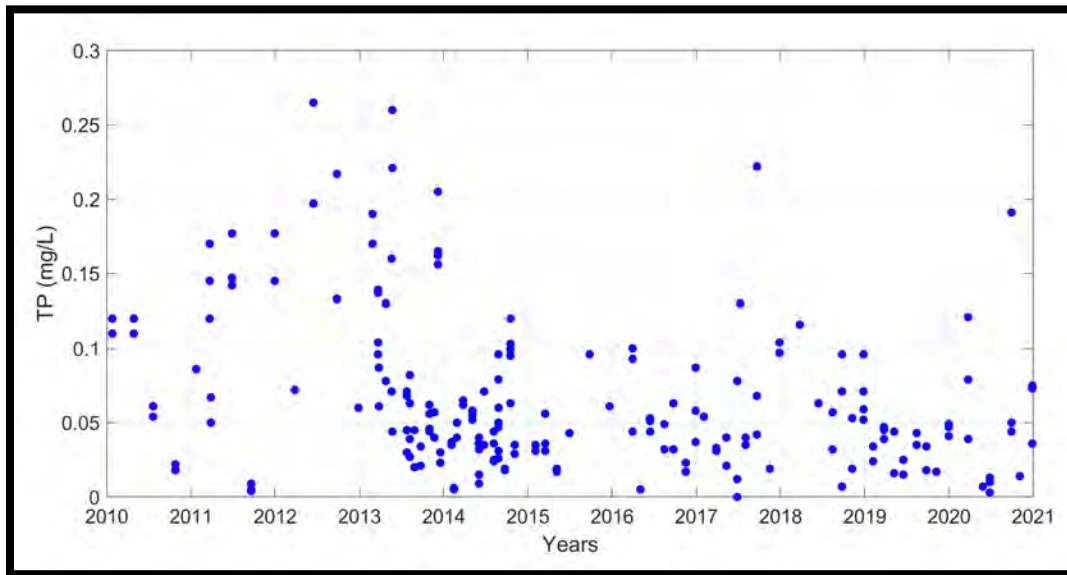


Figure 5-66: Plot of Measured TP Concentrations in Lake Killarney (2010 to 2020)

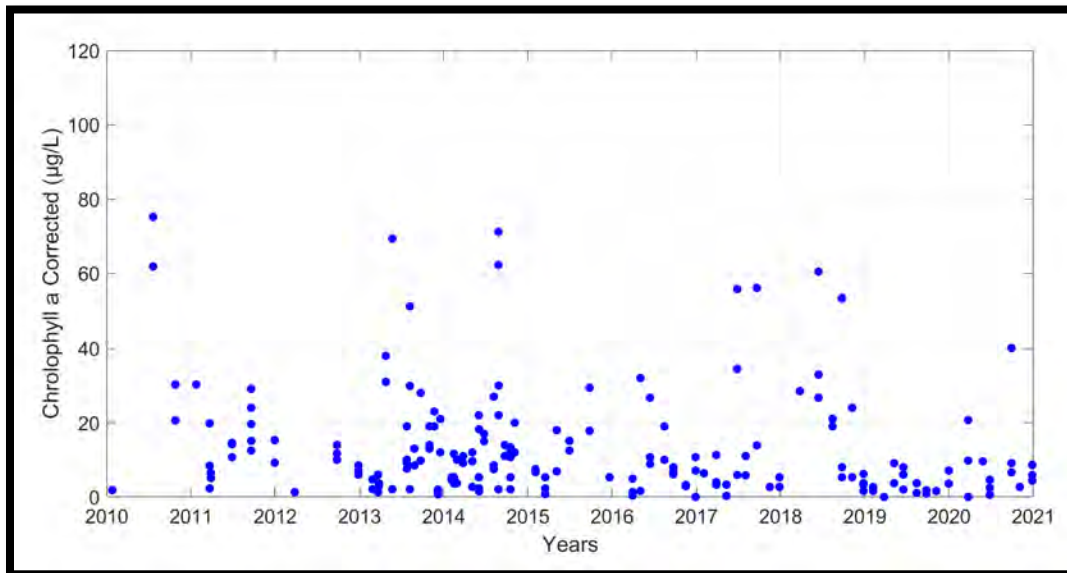


Figure 5-67: Plot of Measured Chl-a Concentrations in Lake Killarney (2010 to 2020)

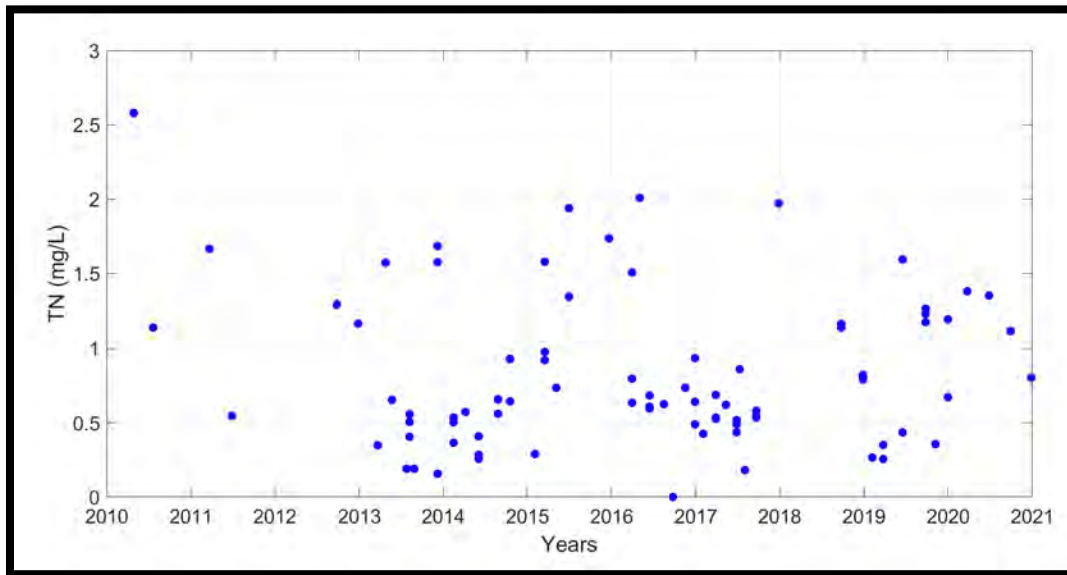


Figure 5-68: Plot of Measured TN Concentrations in Lake Kanturk (2010 to 2020)

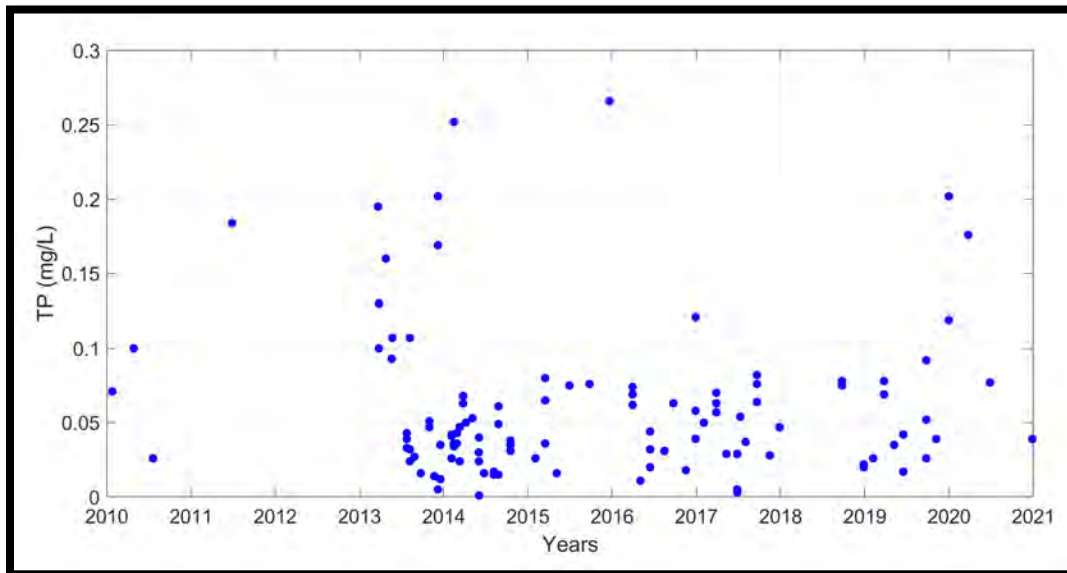


Figure 5-69: Plot of Measured TP Concentrations in Lake Kanturk (2010 to 2020)

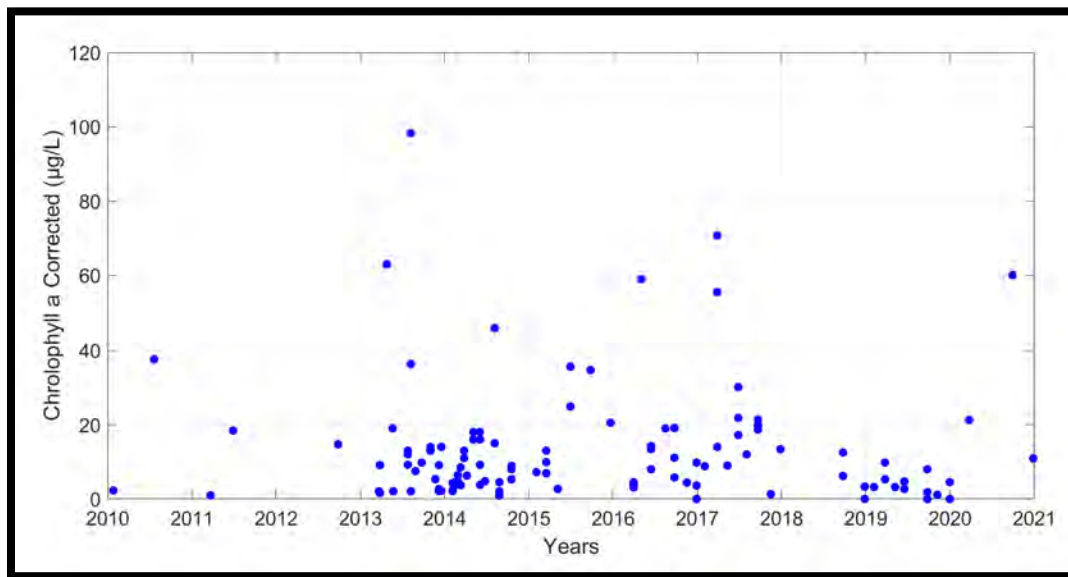


Figure 5-70: Plot of Measured Chl-a Concentrations in Lake Kanturk (2010 to 2020)

Under FDEP's NNC, the Killarney Chain of Lakes are all defined as low color, low alkalinity waterbodies. Based on this designation, the AGM threshold for Chl-a is 6 µg/L. For TN and TP, a range of concentrations are allowable, based on maintaining Chl-a levels in the lake below 6 µg/L. For TN, the range is 0.51 mg/L to 0.93 mg/L. For TP, the range is 0.01 mg/L to 0.03 mg/L. Based on the constructed nature and use of these waterbodies (as stormwater facilities) the City has identified through numerous studies that the targets outlined above may not be appropriate. For *E. coli*, the criteria are monthly geometric means below 126 colonies per 100 mL of water and less than 10 percent of samples above 410 colonies per 100 mL of water in any 30-day period.

TN, TP, and Chl-a AGMs are plotted below for each of the lakes as these define the status relative to nutrient impairments. Where sufficient data are available to assess the AGMs, the levels are provided from 2010 through 2020. For Chl-a, only data with corrected Chl-a are provided. The Chl-a threshold and the minimum and maximum thresholds for TN and TP relative to the NNC are provided on each of the graphs as pink dashed lines. Plots of calculated TSI values in the lake are also provided. While TSI is no longer utilized for the determination of impairment, it does serve as an indicator of lake health. Based on TSI definitions, levels below 60 are deemed good condition, levels between 60 and 70 indicate fair condition, while levels above 70 indicate poor condition. Finally, *E. coli* data for each of the lakes, for the available period of record, are presented against the 410 colonies per 100 mL threshold.

Examination of the TN plots (**Figure 5-71**, **Figure 5-74**, and **Figure 5-77**) shows that between 2010 and 2020 the TN AGMs for the three lakes varied significantly with some values below the minimum, some between the minimum and maximum and some above the maximum. Only Lake Kanturk did not have values below the minimum and overall had higher TN AGMs. TP AGM levels (**Figure 5-72**, **Figure 5-75**, and **Figure 5-78**) for the three lakes were all at or above the maximum threshold with Lake Kinsale having the highest values, and Lake Killarney and Lake Kanturk having similar values. **Figure 5-73**, **Figure 5-76**, and **Figure 5-79**, present the Chl-a

AGMs from 2010 through 2020. The majority of the Chl-a AGMs for the three lakes were above the 6 $\mu\text{g/L}$ threshold with Lake Kanturk having the highest overall values and Lake Killarney showing a downward trend.

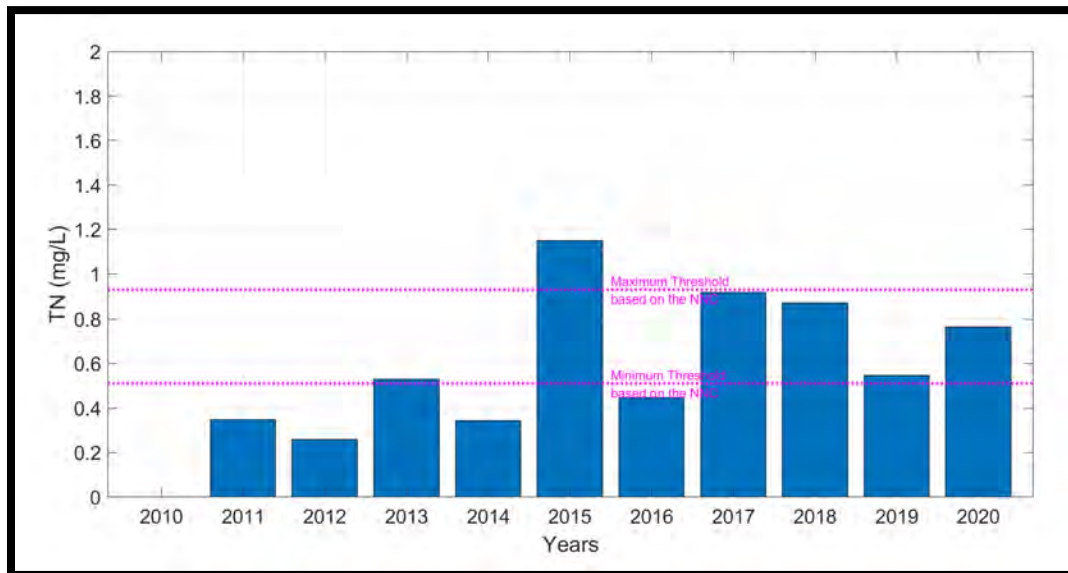


Figure 5-71: Plot of AGM for TN with NNC Criteria for Lake Kinsale

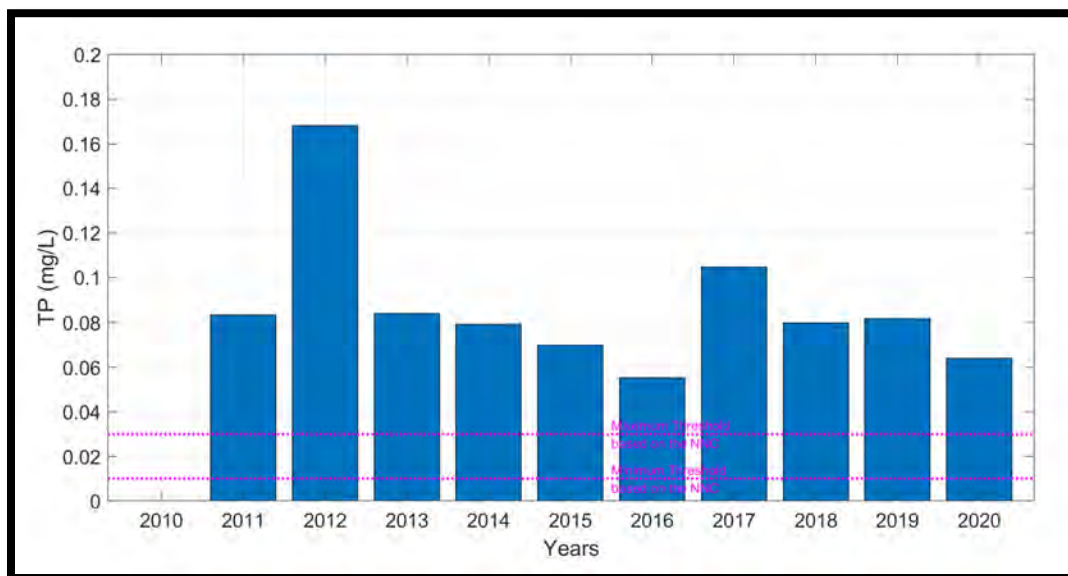


Figure 5-72: Plot of AGM for TP with NNC Criteria for Lake Kinsale

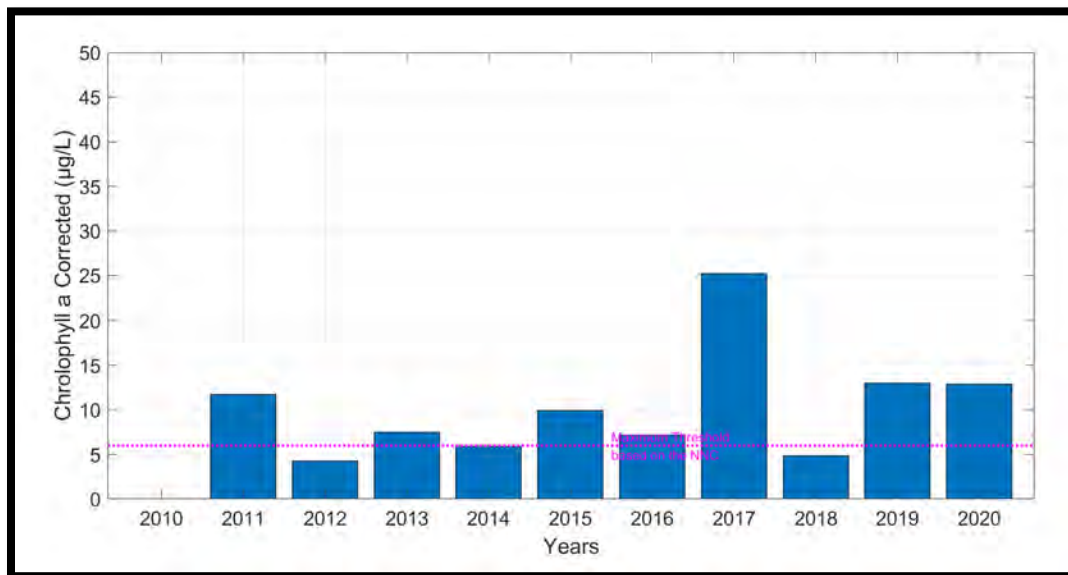


Figure 5-73: Plot of AGM for Chl-a with NNC Criteria for Lake Kinsale

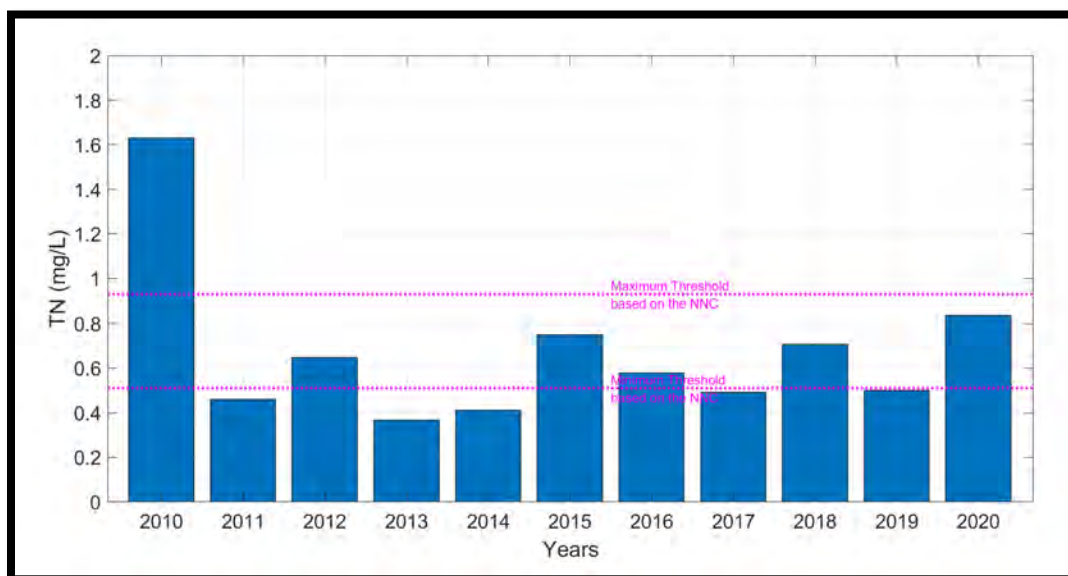


Figure 5-74: Plot of AGM for TN with NNC Criteria for Lake Killarney

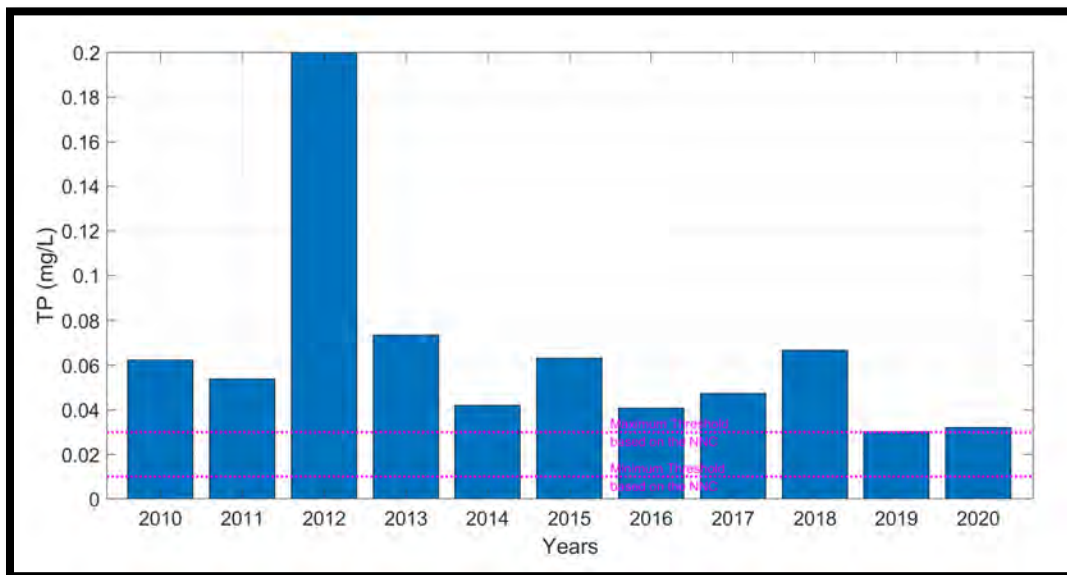


Figure 5-75: Plot of AGM for TP with NNC Criteria for Lake Killarney

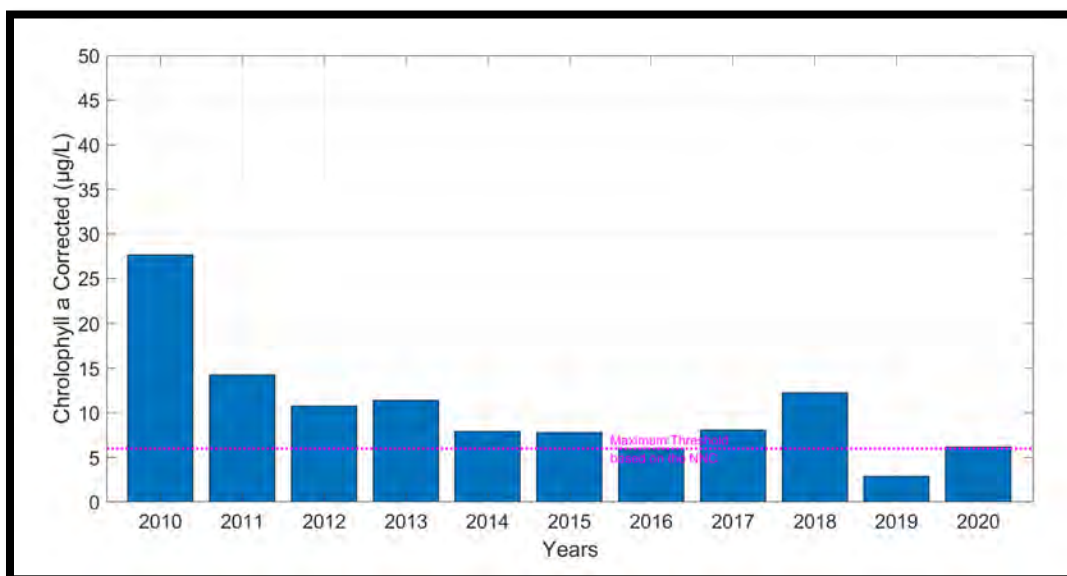


Figure 5-76: Plot of AGM for Chl-a with NNC Criteria for Lake Killarney

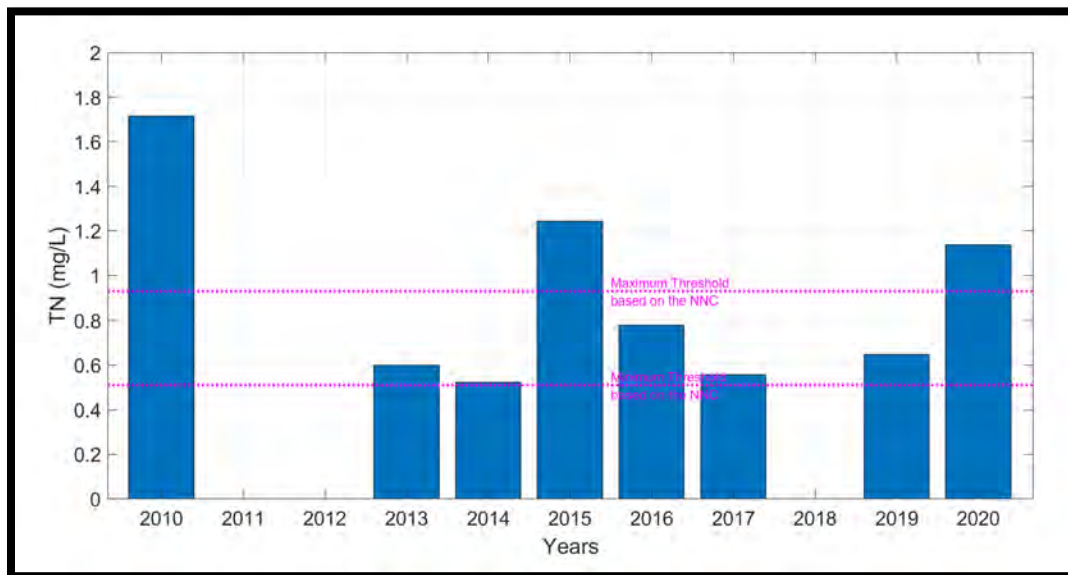


Figure 5-77: Plot of AGM for TN with NNC Criteria for Lake Kanturk

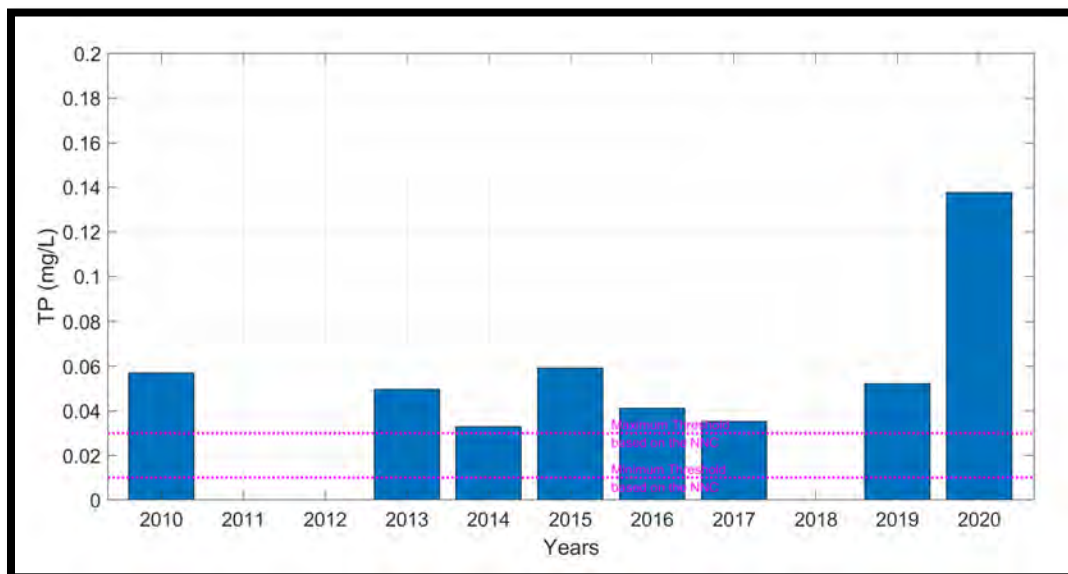


Figure 5-78: Plot of AGM for TP with NNC Criteria for Lake Kanturk

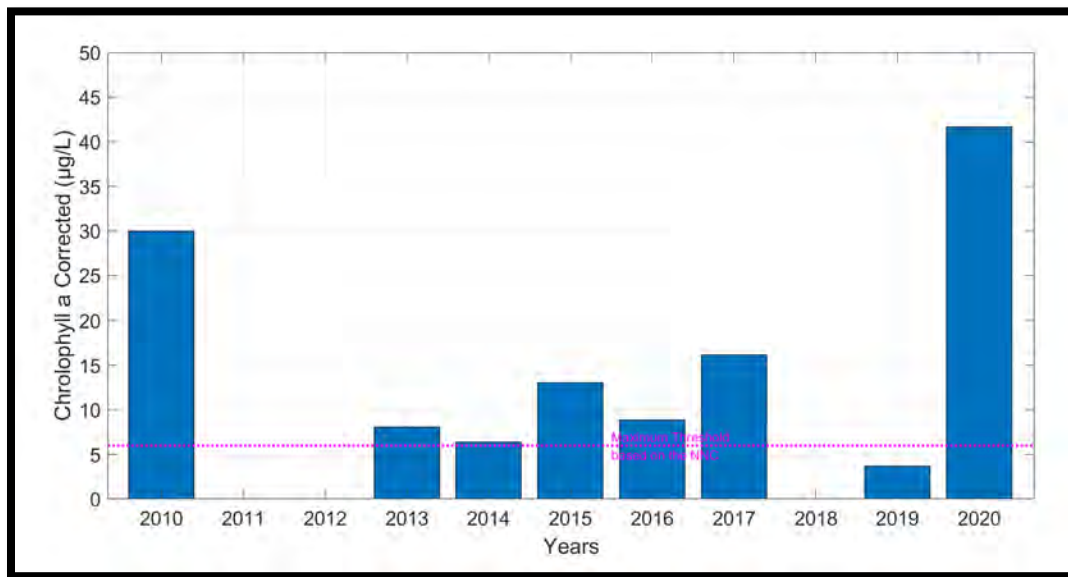


Figure 5-79: Plot of AGM for Chl-a with NNC Criteria for Lake Kanturk

Examination of the TSI plots **Figure 5-80**, **Figure 5-81**, and **Figure 5-82**) show that each of the lakes has values in the good range (below 60), the fair range and values in the poor range (above 70). The bulk of the values are in the good range for each of the lakes. All three lakes switch between nitrogen limited to nutrient balanced with some periods of time showing phosphorus limitation.

Figure 5-83, **Figure 5-84**, and **Figure 5-85** present plots of measured *E. coli* levels in the lakes from 2016 through 2020. The concentrations are generally low with no measurements showing values above the 410 MPN/100 mL threshold.

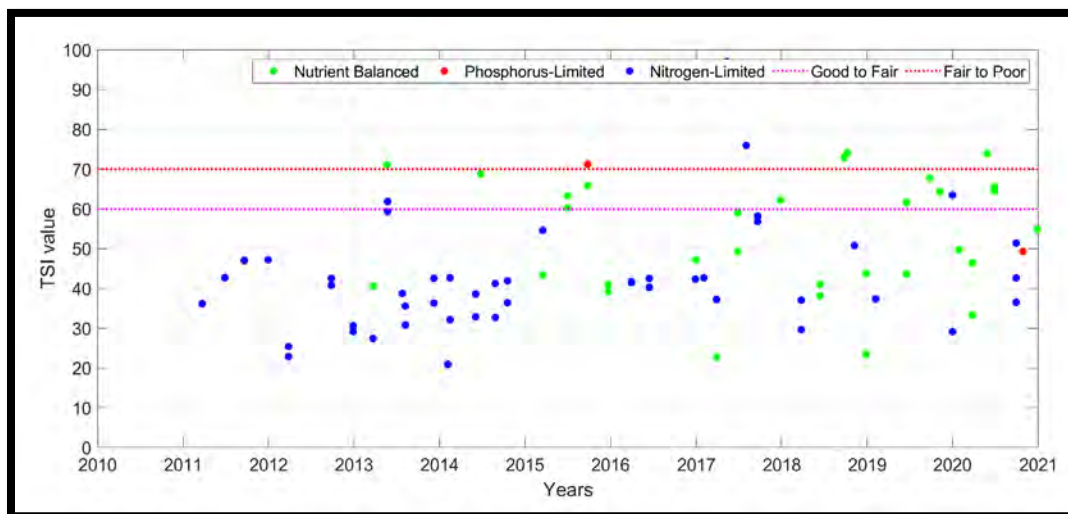


Figure 5-80: Plot of TSI for Lake Kinsale

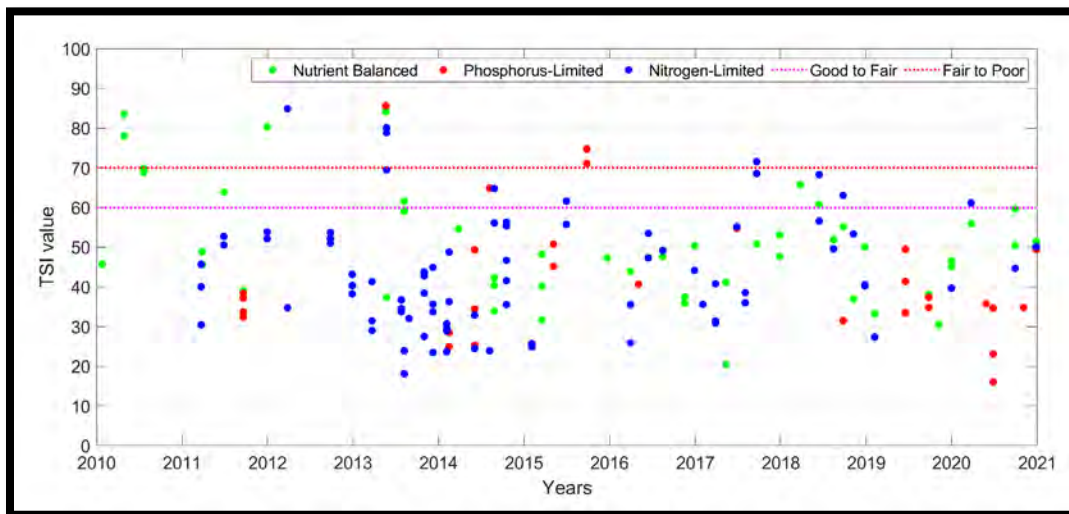


Figure 5-81: Plot of TSI for Lake Killarney

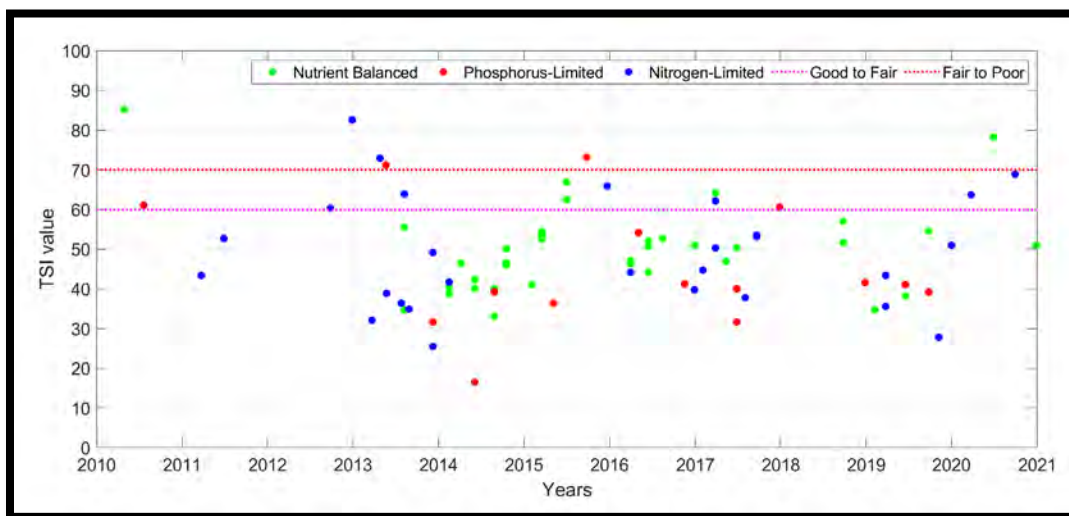


Figure 5-82: Plot of TSI for Lake Kanturk

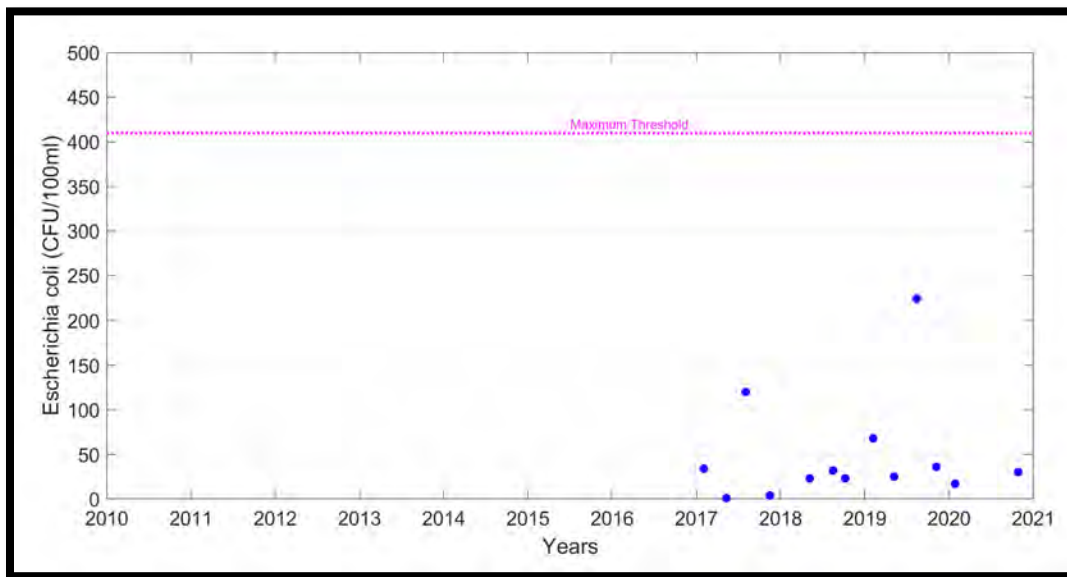


Figure 5-83: Plot of *E. coli* for Lake Kinsale

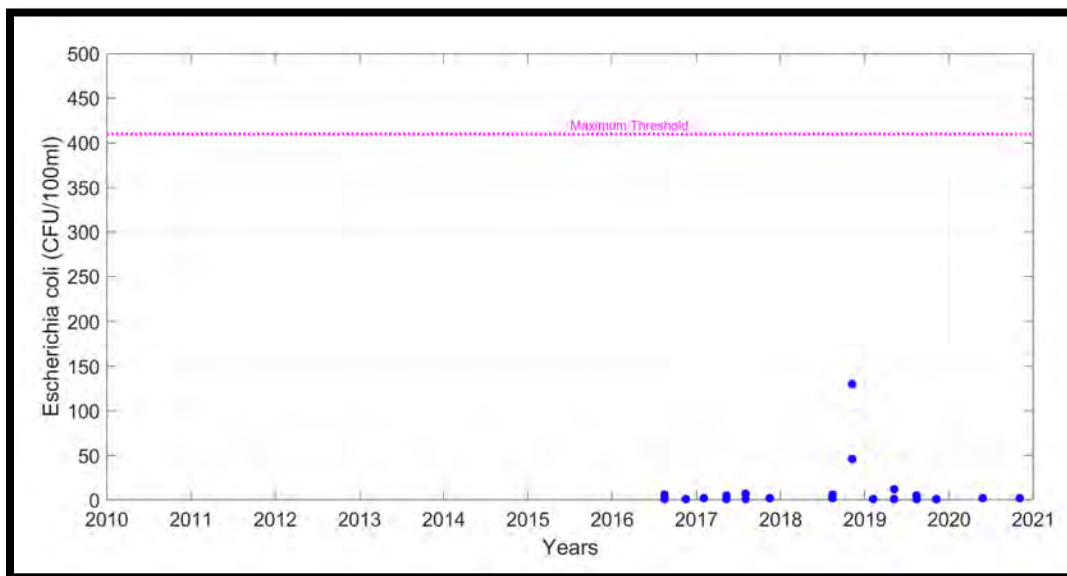


Figure 5-84: Plot of *E. coli* for Lake Killarney

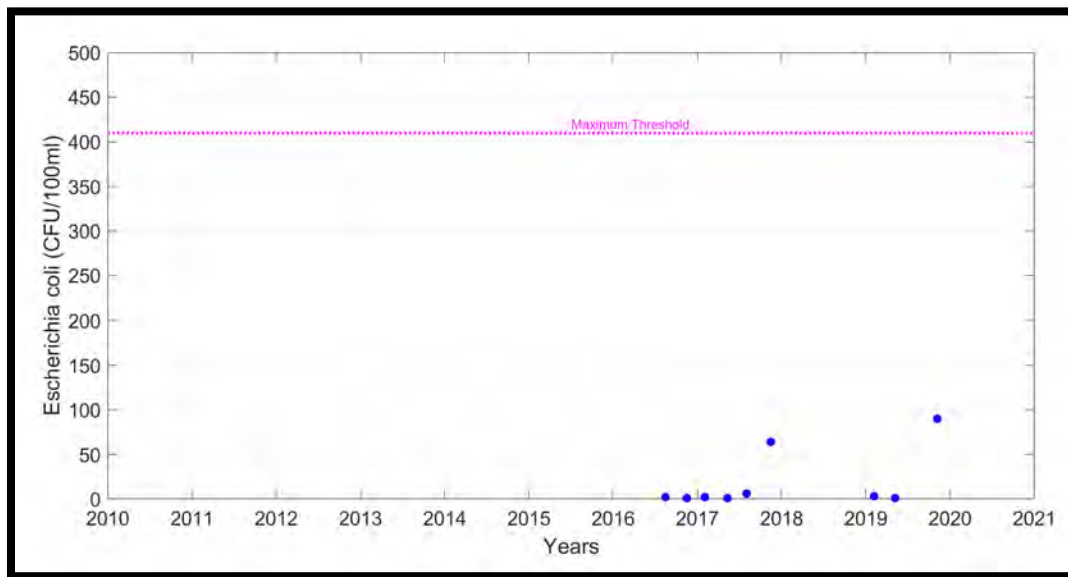


Figure 5-85: Plot of *E. coli* for Lake Kanturk

5.5.3.7 Groundwater Data

Presently, there are no surficial groundwater monitoring wells within the Killlearn Chain of Lakes basin.

5.5.3.8 Biological Data

Table 5-14 and **Table 5-15** present LVI data collected by the City in Lake Killarney and Lake Kanturk since 2010. Data are only available for two years in that timeframe, 2010 and 2013. The data for both lakes showed impaired conditions relative to biology. No data during that same time period was available for Lake Kinsale. A 2009 sampling had a value of 35 which also indicates impaired conditions relative to the biology. The primary factor limiting the ability to perform LVI determinations are the low water levels and the repeated wetting and drying of the lake beds.

Table 5-14: Summary of LVI Data for Lake Killarney

Date	Station ID	LVI	Aquatic Life Use Category
6/10/2010	21FLCOT COTLVI005	28	Impaired
10/21/2013	21FLCOT COTLVI005	32	Impaired

Table 5-15: Summary of LVI Data for Lake Kanturk

Date	Station ID	LVI	Aquatic Life Use Category
6/10/2010	21FLCOT COTLVI004	24	Impaired
10/21/2013	21FLCOT COTLVI004	38	Impaired

5.5.3.9 Stormwater Treatment Facilities

In assessing potential sources of pollutants to the Killearn Chain of Lakes, and ultimately for targeting loads and reductions, it is important to identify treatment facilities adjacent to and along tributaries flowing into the three lakes. **Figure 5-86** presents a map showing the locations of stormwater treatment facilities throughout the Killearn Chain of Lakes basin. Multiple City ponds are located in the tributaries that drain into Lake Kinsale across Thomasville Road and downstream of Lake Tom John as well as the smaller tributary that drains to Lake Killarney. Leon County facilities are located in the tributaries that drain into the northern side of Lake Kanturk and scattered throughout the unincorporated areas that drain to Lake Kinsale.

5.5.3.10 Atmospheric Deposition Data

Section 5.4.3.11 presented the location of the nearest atmospheric deposition station to the Lake Lafayette basin. The data from this station will be utilized to calculate atmospheric deposition to the Killearn Chain of Lakes.

5.5.3.11 Data Summary

For the purposes of the qualitative analysis of sources of pollutants to the Killearn Chain of Lakes (**Section 5.5.4**) the available data are sufficient. There are sufficient active surface water quality stations within the lakes and within key tributaries entering the lakes. There are continuous water level measurements in each of the three lakes along with continuous flow at the outfall. Additionally, measured internal nutrient flux data are available for each of the lakes based on conditions in 2014. The following outlines limitations in the available data. Specific recommendations on additional data collection efforts are provided in **Section 5.10**.

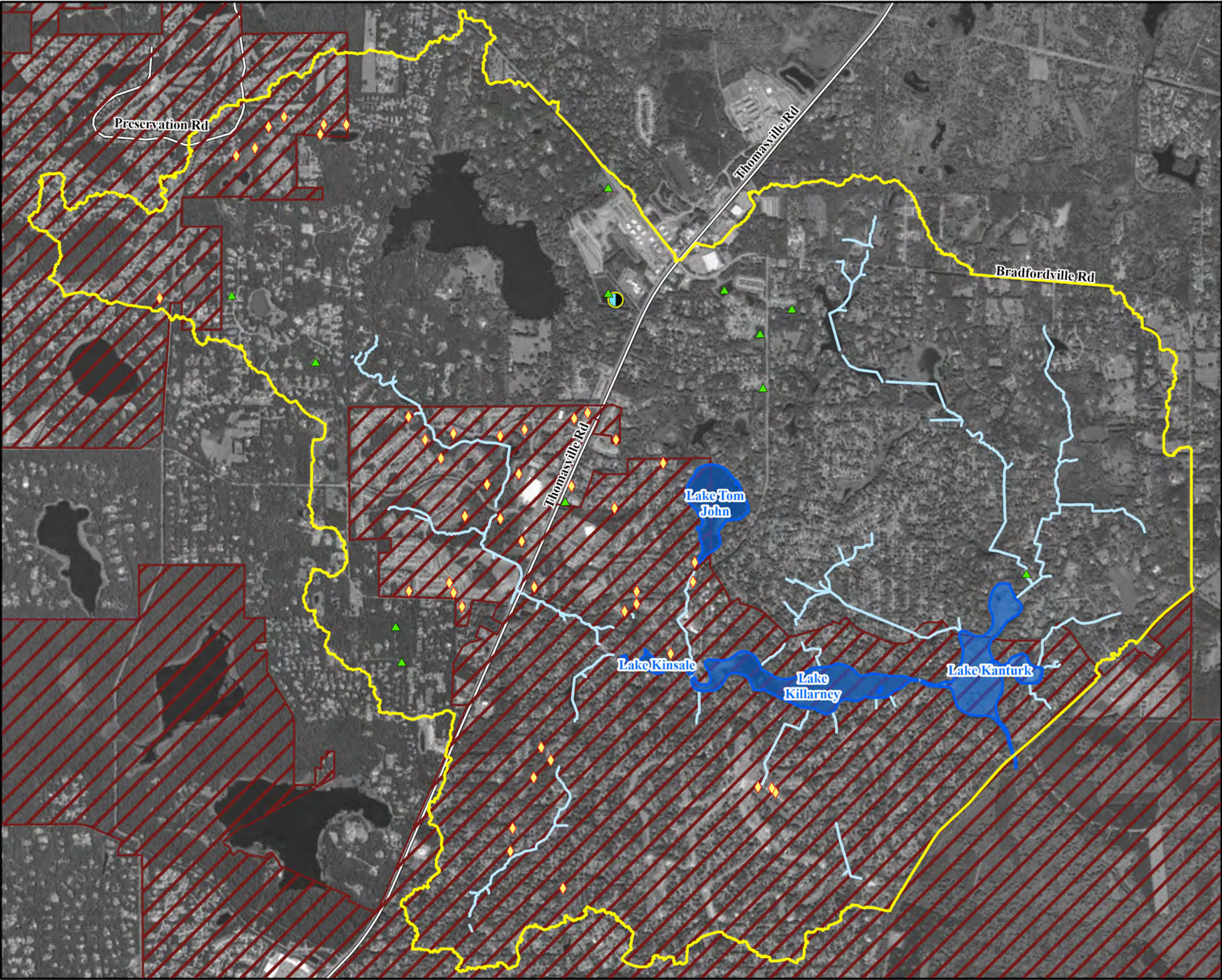
- There is no flow data for the tributaries flowing into Lake Kinsale.
- There are limited water quality data at the inflow points to Lake Kinsale from the upstream tributaries. Only two years of data are available along the creek crossing Thomasville Road.
- There are limited data to evaluate the potential for seepage of pollutants to the lake from the surficial aquifer, i.e., surficial groundwater sampling stations around the lakes.

5.5.4 Qualitative Assessment of Sources

As outlined in previous sections, prior to performing loading calculations and other analyses to quantify existing pollutant sources to the Killearn Chain of Lakes, it is important to analyze available data and summarize findings from historical studies to support identification and magnitude of likely sources.

For the Killearn Chain of Lakes, the sources to be evaluated include the following:

- Stormwater runoff
- Septic systems
- Internal recycling and seepage



Legend

- Killlearn Chain of Lakes Drainage Basin
- Waterbodies in Study
- Watercourses
- Tallahassee Corporate Limits
- City of Tallahassee Stormwater Ponds
- Leon County Stormwater Ponds
- FDOT Stormwater Ponds

Sources:
Waterbodies: COT, 2020
Watersheds: COT, 2020
Roads: FDOT, 2020
BMPs: Geosyntec, 2022
City Limits: COT, 2022

Figure 5-86:
Killlearn Chain of Lakes Basin BMP
Location Map

Tallahassee Master Plan - Surface
Water (TMaPS)



- Wastewater
- Atmospheric deposition
- Interconnected flows

An overview of analyses and findings for each source listed above is provided in the following sections. Prior to the discussions of each of the potential sources, an in-lake analysis is provided to build on the information presented in **Section 5.5.3**. Following the discussions for each source type, a summary of findings for the qualitative assessment is provided.

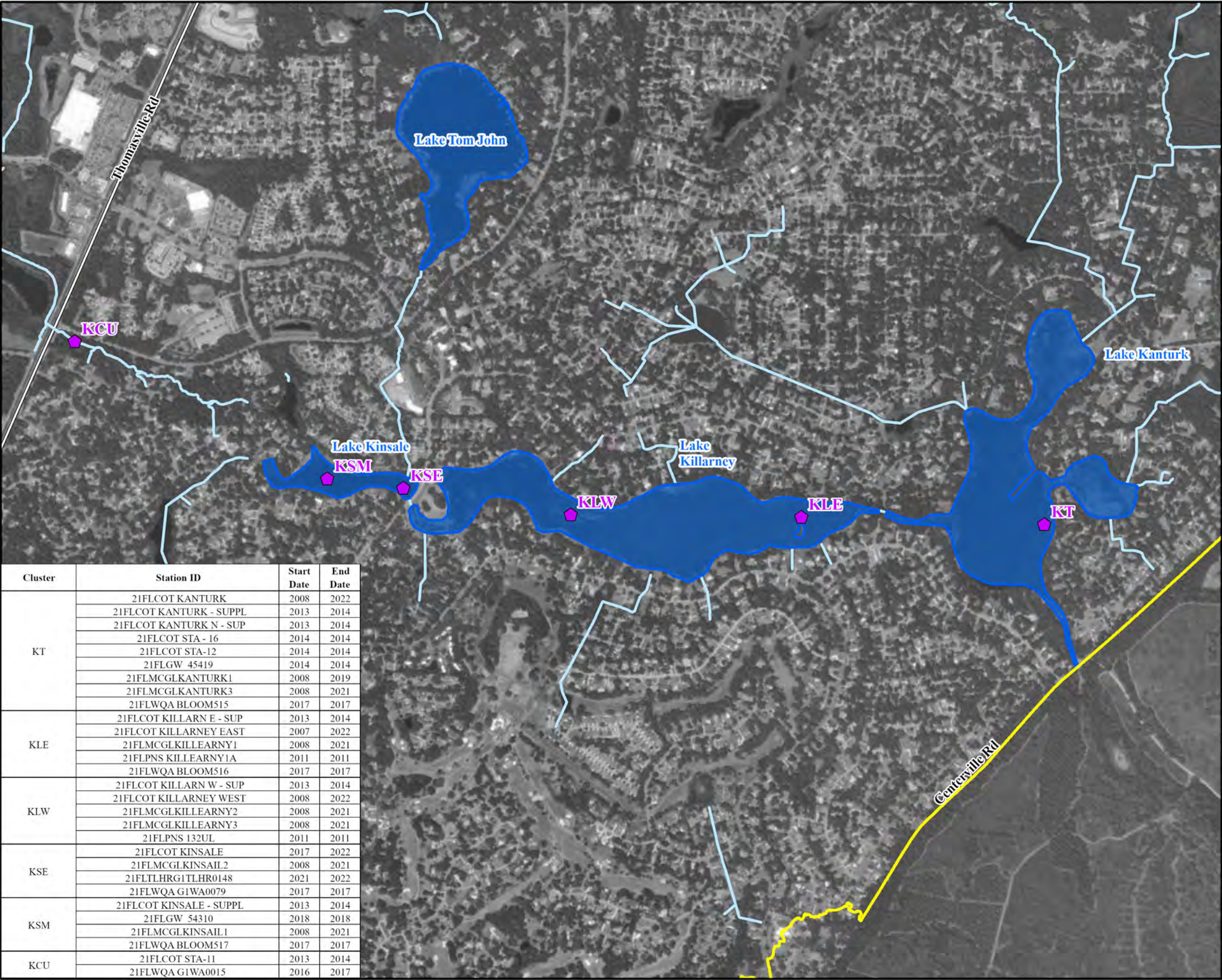
5.5.4.1 In-Stream Water Quality

Following the methodology utilized for the Lafayette Chain of Lakes in **Section 5.4.4.1**, analyses were conducted on the available in-lake data for the three lakes from 2010 to 2020, which provide an evaluation of the baseline water quality conditions as well as the spatial variation through the system of lakes. The parameters analyzed for the Killearn Chain of Lakes include color, alkalinity, TP, TN, Chl-a, TSI, and *E. coli*.

As was done for the Lafayette Chain of Lakes (**Section 5.4.4.1**) stations were clustered where they represent conditions within a specific area and all stations with data after 2010 were assigned to a specific cluster. The clustered data from 2010 to 2020 were analyzed to provide the average of the annual geomeans or the 90th percentile, depending upon the parameter. The results are presented on a map, with colors representing the results. The levels associated with the colors are reflective of water quality thresholds as outlined in 62-302 Florida Administrative Code (F.A.C) and are discussed and presented in **Section 5.4.4.1**. For the Killearn Chain of Lakes the nutrient thresholds are based on the lakes' classification as low color, low alkalinity waterbodies.

Figure 5-87 presents the data clustering used for the analyses and associated stations. For the Killearn Chain of Lakes, data since 2010 were available at multiple locations throughout the chain and at one location along the tributary draining the western portions of the basin. Within Lake Kanturk there was one cluster, near the outfall of the lake (KT). Within Lake Killarney there are two clusters one at the eastern end of the lake prior to discharging to Lake Kanturk (KLE) and one toward the western end of the lake (KLW). Finally, within Lake Kinsale there are two clusters, one at the eastern end of the lake just upstream of the weir (KSE) and the other around the middle of the lake (KSM). The final cluster is located along the tributary that drains into the western end of Lake Kinsale just downstream from the crossing at Thomasville Road (KCU). These stations, viewed together, present the spatial variation as water passes through the chain.

Figure 5-88 presents the color. For color, the scales were set such that values of 40 PCU and above were red with the remaining colors (orange down to blue) divided into 10 PCU segments, which shows how the lakes vary spatially relative to the low color threshold of 40 PCU. Moving from Lake Kinsale down to Lake Kanturk the color averages are relatively consistent with values between 10 PCU and 30 PCU. (KSM=29.2 PCU, KSE=26.1 PCU, KLW=22.5 PCU, KLE=16.8 PCU, KT=23.3 PCU).



Cluster	Station ID	Start Date	End Date
KT	21FLCOT KANTURK	2008	2022
	21FLCOT KANTURK - SUPPL	2013	2014
	21FLCOT KANTURK N - SUP	2013	2014
	21FLCOT STA - 16	2014	2014
	21FLCOT STA-12	2014	2014
	21FLGW 45419	2014	2014
	21FLMCGLKANTURK1	2008	2019
	21FLMCGLKANTURK3	2008	2021
KLE	21FLWQA BLOOM515	2017	2017
	21FLCOT KILLARN E - SUP	2013	2014
	21FLCOT KILLARNEY EAST	2007	2022
	21FLMCGLKILLEARNY1	2008	2021
	21FLPNS KILLEARNY1A	2011	2011
	21FLWQA BLOOM516	2017	2017
KLW	21FLCOT KILLARN W - SUP	2013	2014
	21FLCOT KILLARNEY WEST	2008	2022
	21FLMCGLKILLEARNY2	2008	2021
	21FLMCGLKILLEARNY3	2008	2021
	21FLPNS 132UL	2011	2011
KSE	21FLCOT KINSALE	2017	2022
	21FLMCGLKINSAIL2	2008	2021
	21FLTLHRG1TLHR0148	2021	2022
	21FLWQA G1WA0079	2017	2017
KSM	21FLCOT KINSALE - SUPPL	2013	2014
	21FLGW 54310	2018	2018
	21FLMCGLKINSAIL1	2008	2021
	21FLWQA BLOOM517	2017	2017
KCU	21FLCOT STA-11	2013	2014
	21FLWQA G1WA0015	2016	2017



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Miles



Legend

-  Killearn Chain of Lakes Drainage Basin
-  Waterbodies in Study
-  Watercourses
-  Station Clusters

Sources:

Waterbodies: COT, 2020

Watercourses: COT, 2020

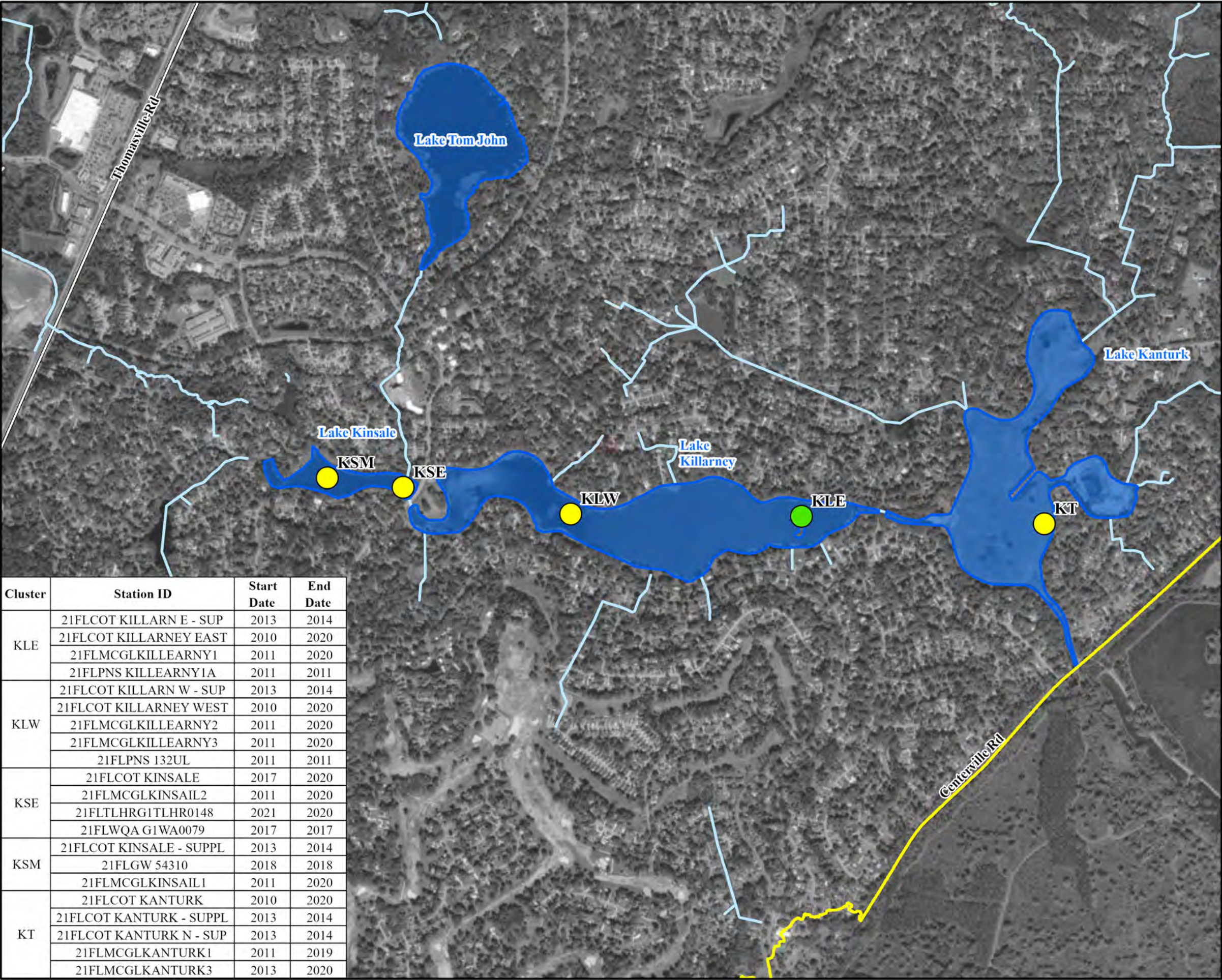
Drainage Basins: COT, 2020

Roads: COT-Leon County, 2023

Figure 5-87:
Station Clustering for Spatial Analyses of
Killearn Chain of Lakes

Tallahassee Master Plan - Surface
Water (TMaPS)

Geosyntec
consultants



Legend

- Killearn Chain of Lakes Drainage Basin
- Waterbodies in Study
- Watercourses

Color Average 2010-2020

- PCU
- 0-10
 - 10-20
 - 20-30
 - 30-40
 - >40

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Drainage Basins: COT, 2020
Roads: COT-Leon County, 2023
Station Data: FDEP, 2021

Figure 5-88:
Spatial Assessment of Color in Killearn Chain of Lakes

Tallahassee Master Plan - Surface Water (TMaPS)



Cluster	Station ID	Start Date	End Date
KLE	21FLCOT KILLARN E - SUP	2013	2014
	21FLCOT KILLARNEY EAST	2010	2020
	21FLMCGLKILLEARNY1	2011	2020
	21FLPNS KILLEARNY1A	2011	2011
KLW	21FLCOT KILLARN W - SUP	2013	2014
	21FLCOT KILLARNEY WEST	2010	2020
	21FLMCGLKILLEARNY2	2011	2020
	21FLMCGLKILLEARNY3	2011	2020
	21FLPNS 132UL	2011	2011
KSE	21FLCOT KINSALE	2017	2020
	21FLMCGLKINSAIL2	2011	2020
	21FLTLHRG1TLHR0148	2021	2020
	21FLWQA G1WA0079	2017	2017
KSM	21FLCOT KINSALE - SUPPL	2013	2014
	21FLGW 54310	2018	2018
	21FLMCGLKINSAIL1	2011	2020
KT	21FLCOT KANTURK	2010	2020
	21FLCOT KANTURK - SUPPL	2013	2014
	21FLCOT KANTURK N - SUP	2013	2014
	21FLMCGLKANTURK1	2011	2019
	21FLMCGLKANTURK3	2013	2020

Figure 5-89 presents the alkalinity. The scales were set such that values above 20 mg/L were red, based on the NNC cutoff for low alkalinity lakes, with the remaining colors (orange down to blue) in 5 mg/L segments. Moving from Lake Kinsale down to Lake Killarney, alkalinity levels are relatively constant with the clusters between 15 mg/L and 20 mg/L (KSM=17.8 mg/L, KSE=17.6 mg/L, K LW=17.9 mg/L, KLE=18.0 mg/L, KT=14.4 mg/L). The Kanturk station has lower values between 10 mg/L and 15 mg/L.

Figure 5-90 and **Figure 5-91** present the TN and TP. The ranges for the lakes were set the same way as described for the Piney Z Lake with blue lower than the minimum NNC thresholds (TN=0.51 mg/L, TP=0.01 mg/L) and red higher than the maximum (TN=0.93 mg/L, TP=0.03 mg/L). For the tributary cluster (KCU) values above the designated stream criteria (TN=1.03 mg/L, TP=0.18 mg/L) are red while the remaining colors (orange down to blue) in even segments.

The TN map (**Figure 5-90**) shows all lake cluster averages just below or just above the minimum threshold (KSM=0.59 mg/L, KSE=0.55 mg/L, K LW=0.47 mg/L, KLE=0.52 mg/L, KT=0.71 mg/L) with limited spatial variation between the lakes. The one cluster with higher TN levels was KT within Lake Kanturk. Based on the limited data cluster KCU is well below the stream threshold (KCU=0.35 mg/L).

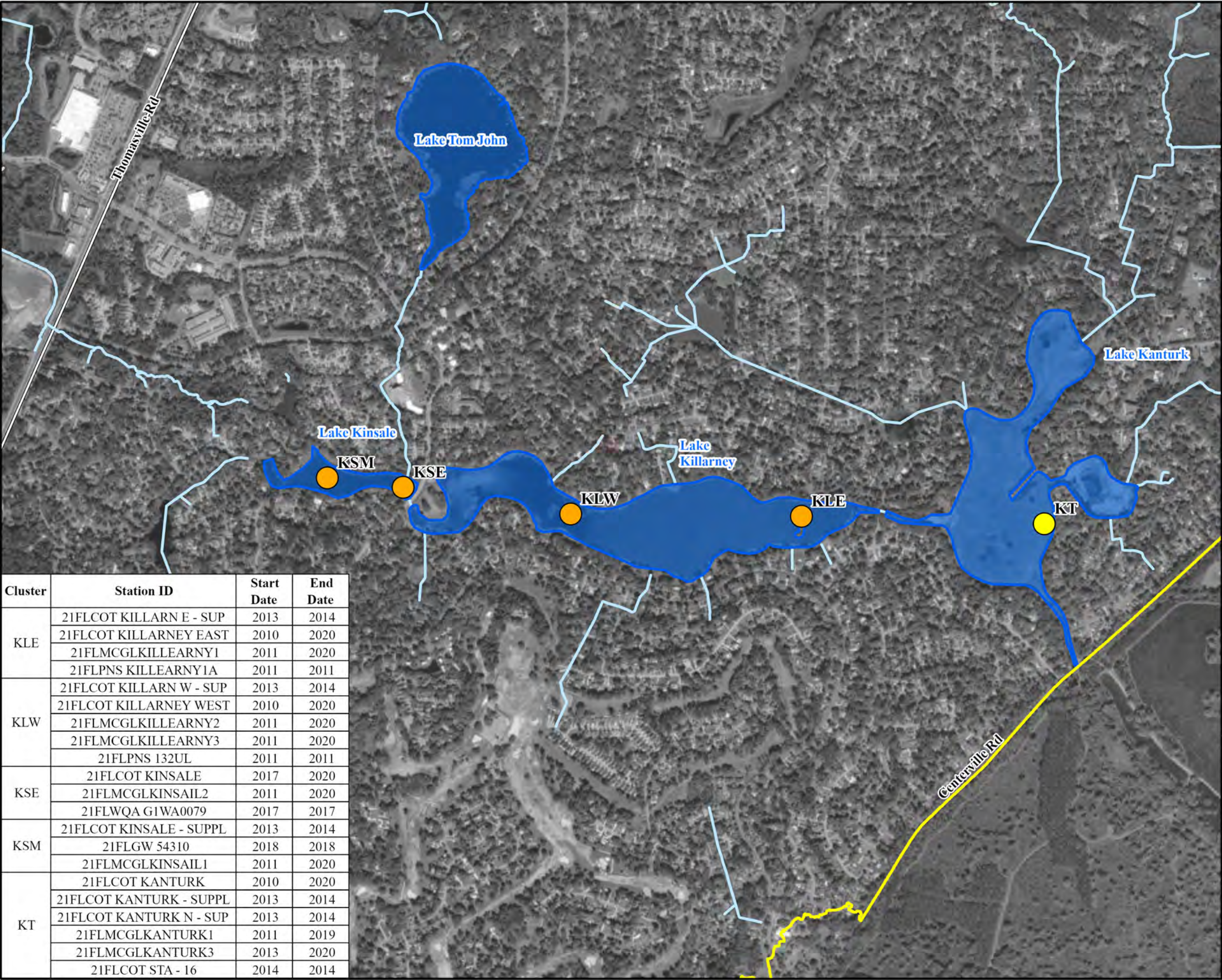
The TP map (**Figure 5-91**) shows all lake cluster averages above the maximum threshold (KSM=0.078 mg/L, KSE=0.085 mg/L, K LW=0.057 mg/L, KLE=0.050 mg/L, KT=0.043 mg/L). The tributary cluster TP level lower than the stream criteria but has levels well above the criteria within the lakes (KCU=0.088 mg/L).

Figure 5-92 and **Figure 5-93** present the Chl-a and TSI. The ranges for the lakes were set the same way as described for the Piney Z Lake with red higher than the NNC threshold of 6 µg/L for Chl-a and 60 for TSI. The Chl-a map (**Figure 5-92**) shows all lake cluster averages above the maximum threshold (KSM=11.0 µg/L, KSE=9.0 µg/L, K LW=8.4 µg/L, KLE=8.5 µg/L, KT=7.1 µg/L). The TSI map (**Figure 5-93**) shows all lake cluster averages below the 60 threshold (KSM=50.3, KSE=48.7, K LW=46.3, KLE=49.0, KT=47.4).

Figure 5-94 presents a map of the *E. coli* levels. The data analyzed are from 2016 through 2020 and the data were analyzed to provide the 90th percentile to compare against the 410 MPN/100 mL criteria per the FDEP approach in the IWR analyses. The map shows that all lake clusters have 90th percentile values well below the 410 MPN/100 mL threshold, with all stations below 100 MPN/100 mL (KSM=23 MPN/100 mL, KSE=46 MPN/100 mL, K LW=6 MPN/100 mL, KLE=2 MPN/100 mL, KT=4 MPN/100 mL).

5.5.4.2 Stormwater Runoff

Data for the tributary inflow station across Thomasville Road (which drains the upper portions of the watershed) indicate elevated TP concentrations in comparison to the in-lake TP thresholds. Average concentrations are above 0.09 mg/L compared to the in-lake range of allowable concentrations between 0.01 mg/L and 0.03 mg/L. Stormwater sampling at this same location conducted in 2013 to 2014, showed similar concentrations (average around 0.08 mg/L). While these levels are elevated in relation to the in-lake thresholds, they are well below the stream NNC for this region (0.18 mg/L).



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Miles

Legend

Killarn Chain of Lakes Drainage Basin

Waterbodies in Study

Watercourses

Alkalinity Average 2010-2020

mg/L

0-5

5-10

10-15

15-20

>20

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Drainage Basins: COT, 2020
Roads: COT-Leon County, 2023
Station Data: FDEP, 2021

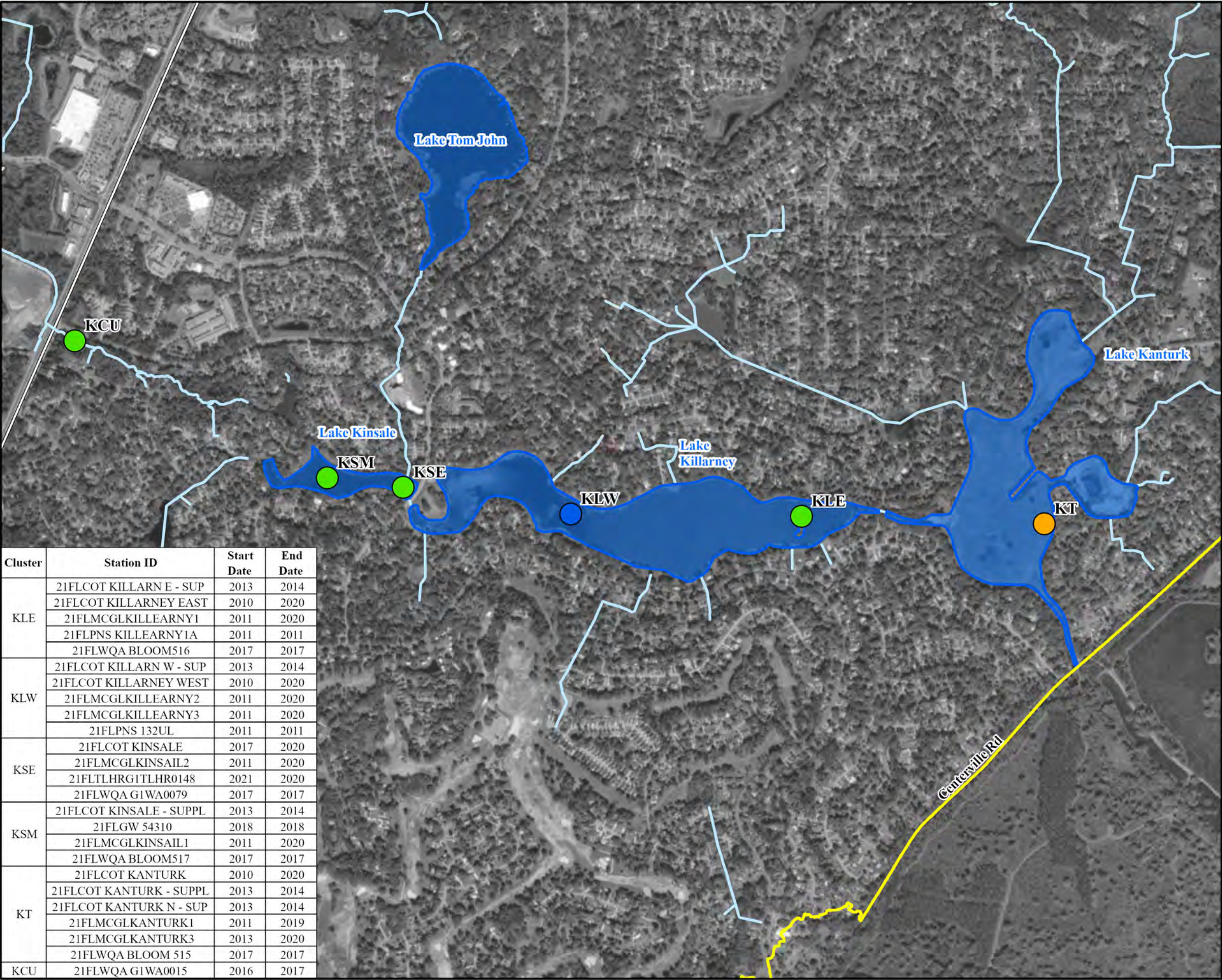
Figure 5-89:

Spatial Assessment of Alkalinity in Killarn Chain of Lakes

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec

consultants



Cluster	Station ID	Start Date	End Date
KLE	21FLCOT KILLARN E - SUP	2013	2014
	21FLCOT KILLARNEY EAST	2010	2020
	21FLMCGLKILLEARNY1	2011	2020
	21FLPNS KILLEARNY1A	2011	2011
	21FLWQA BLOOM516	2017	2017
KLW	21FLCOT KILLARN W - SUP	2013	2014
	21FLCOT KILLARNEY WEST	2010	2020
	21FLMCGLKILLEARNY2	2011	2020
	21FLMCGLKILLEARNY3	2011	2020
	21FLPNS 132UL	2011	2011
KSE	21FLCOT KINSALE	2017	2020
	21FLMCGLKINSAIL2	2011	2020
	21FLTLHRG1TLHR0148	2021	2020
	21FLWQA G1WA0079	2017	2017
KSM	21FLCOT KINSALE - SUPPL	2013	2014
	21FLGW 54310	2018	2018
	21FLMCGLKINSAIL1	2011	2020
	21FLWQA BLOOM517	2017	2017
KT	21FLCOT KANTURK	2010	2020
	21FLCOT KANTURK - SUPPL	2013	2014
	21FLCOT KANTURK N - SUP	2013	2014
	21FLMCGLKANTURK1	2011	2019
	21FLMCGLKANTURK3	2013	2020
KCU	21FLWQA G1WA0015	2016	2017



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0 0.2
Miles

Legend

 Killearn Chain of Lakes Drainage Basin

 Waterbodies in Study

 Watercourses

In-Lake TN Average 2010-2020
mg/L

 0-0.51

 0.51-0.65

 0.65-0.79

 0.79-0.93

 >0.93

Stream TN Average 2010-2020
mg/L

 0-0.25

 0.25-0.50

 0.50-0.75

 0.75-1.03

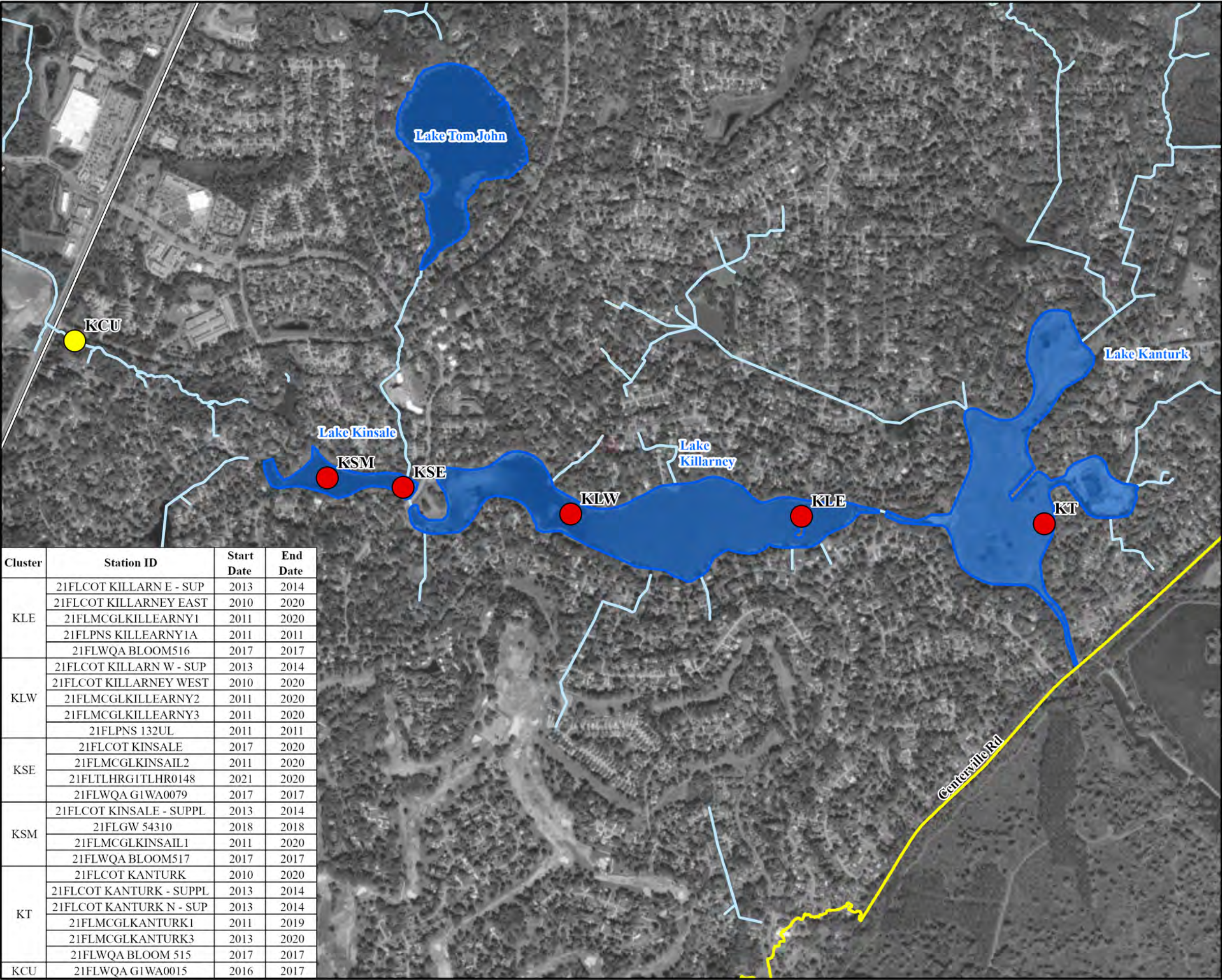
 >1.03

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Drainage Basins: COT, 2020
Roads: COT-Leon County, 2023
Station Data: FDEP, 2021

Figure 5-90:
**Spatial Assessment of TN in Killearn Chain
of Lakes and Tributaries**

**Tallahassee Master Plan - Surface
Water (TMaPS)**

Geosyntec
consultants



Cluster	Station ID	Start Date	End Date
KLE	21FLCOT KILLARN E - SUP	2013	2014
	21FLCOT KILLARNEY EAST	2010	2020
	21FLMCGLKILLEARNY1	2011	2020
	21FLPNS KILLEARNY1A	2011	2011
	21FLWQA BLOOM516	2017	2017
KLW	21FLCOT KILLARN W - SUP	2013	2014
	21FLCOT KILLARNEY WEST	2010	2020
	21FLMCGLKILLEARNY2	2011	2020
	21FLMCGLKILLEARNY3	2011	2020
	21FLPNS 132UL	2011	2011
KSE	21FLCOT KINSALE	2017	2020
	21FLMCGLKINSAIL2	2011	2020
	21FLTLHRG1TLHR0148	2021	2020
	21FLWQA G1WA0079	2017	2017
KSM	21FLCOT KINSALE - SUPPL	2013	2014
	21FLGW 54310	2018	2018
	21FLMCGLKINSAIL1	2011	2020
	21FLWQA BLOOM517	2017	2017
KT	21FLCOT KANTURK	2010	2020
	21FLCOT KANTURK - SUPPL	2013	2014
	21FLCOT KANTURK N - SUP	2013	2014
	21FLMCGLKANTURK1	2011	2019
	21FLMCGLKANTURK3	2013	2020
KCU	21FLWQA G1WA0015	2016	2017



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N



0 0.2
Miles



Legend

 Killarn Chain of Lakes Drainage Basin

 Waterbodies in Study

 Watercourses

TP Average 2010-2020
mg/L

 0-0.010

 0.010-0.017

 0.017-0.024

 0.024-0.030

 >0.03

Stream TP Average 2010-2020
mg/L

 0-0.045

 0.045-0.09

 0.09-0.135

 0.135-0.18

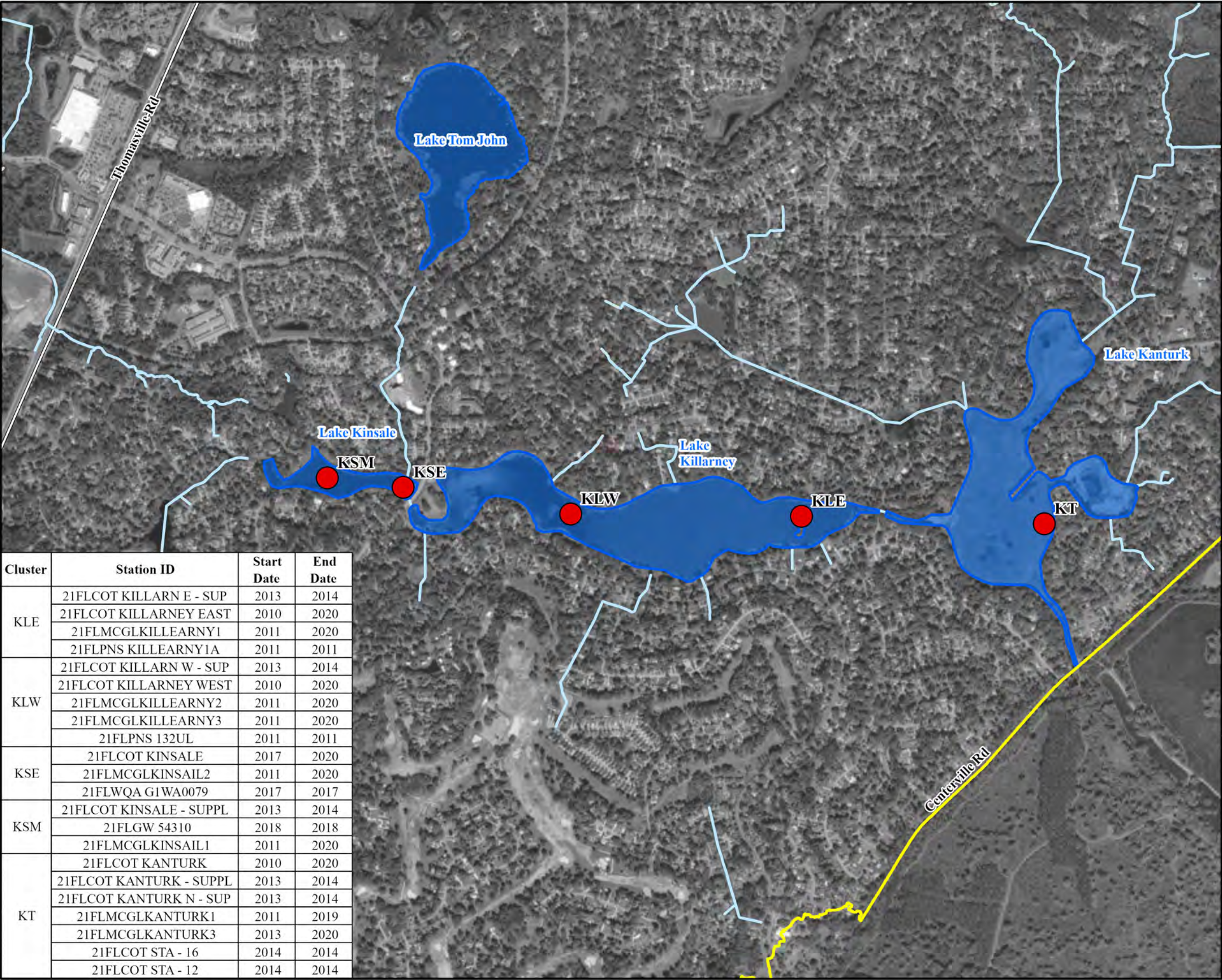
 >0.18

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Drainage Basins: COT, 2020
Roads: COT-Leon County, 2023
Station Data: FDEP, 2021

Figure 5-91:
**Spatial Assessment of TP in Killarn Chain
of Lakes and Tributaries**

**Tallahassee Master Plan - Surface
Water (TMaPS)**

Geosyntec
consultants



Cluster	Station ID	Start Date	End Date
KLE	21FLCOT KILLARN E - SUP	2013	2014
	21FLCOT KILLARNEY EAST	2010	2020
	21FLMCGLKILLEARNY1	2011	2020
	21FLPNS KILLEARNY1A	2011	2011
KLW	21FLCOT KILLARN W - SUP	2013	2014
	21FLCOT KILLARNEY WEST	2010	2020
	21FLMCGLKILLEARNY2	2011	2020
	21FLMCGLKILLEARNY3	2011	2020
KSE	21FLPNS 132UL	2011	2011
	21FLCOT KINSALE	2017	2020
	21FLMCGLKINSAIL2	2011	2020
	21FLWQA G1WA0079	2017	2017
KSM	21FLCOT KINSALE - SUPPL	2013	2014
	21FLGW 54310	2018	2018
	21FLMCGLKINSAIL1	2011	2020
KT	21FLCOT KANTURK	2010	2020
	21FLCOT KANTURK - SUPPL	2013	2014
	21FLCOT KANTURK N - SUP	2013	2014
	21FLMCGLKANTURK1	2011	2019
	21FLMCGLKANTURK3	2013	2020
	21FLCOT STA - 16	2014	2014
	21FLCOT STA - 12	2014	2014



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N



0 0.2
Miles



Legend

 Killarn Chain of Lakes Drainage Basin

 Waterbodies in Study

 Watercourses

Chl a Average 2010-2020
µg/L

 0-1.5

 1.5-3

 3-4.5

 4.5-6

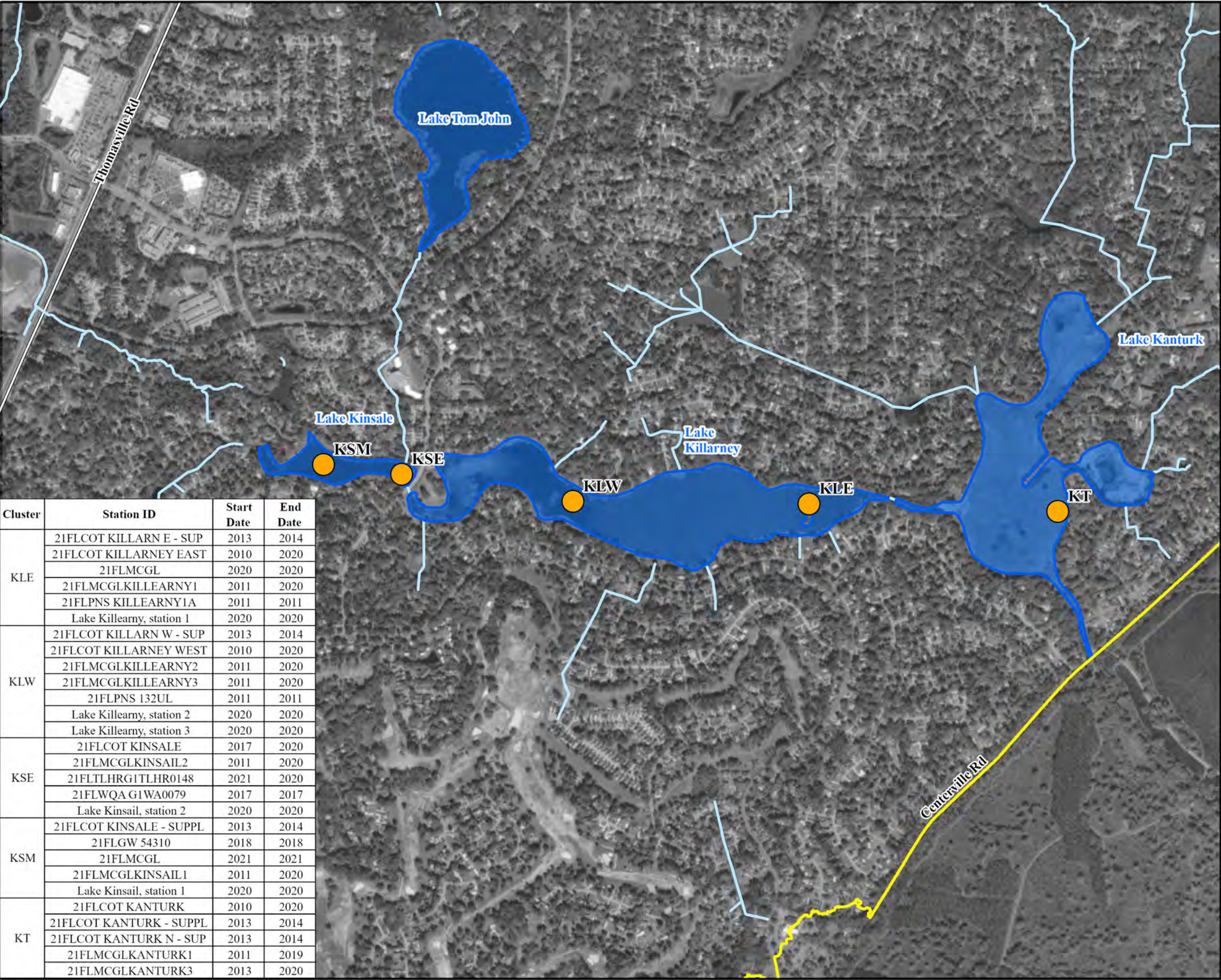
 >6

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Drainage Basins: COT, 2020
Roads: COT-Leon County, 2023
Station Data: FDEP, 2021

Figure 5-92:
Spatial Assessment for Chl a in Killarn
Chain of Lakes

Tallahassee Master Plan - Surface
Water (TMaPS)

Geosyntec
consultants



Cluster	Station ID	Start Date	End Date
KLE	21FLCOT KILLARN E - SUP	2013	2014
	21FLCOT KILLARNEY EAST	2010	2020
	21FLMCGL	2020	2020
	21FLMCGLKILLEARNY1	2011	2020
	21FLPNS KILLEARNY1A	2011	2011
	Lake Killearny, station 1	2020	2020
KLW	21FLCOT KILLARN W - SUP	2013	2014
	21FLCOT KILLARNEY WEST	2010	2020
	21FLMCGLKILLEARNY2	2011	2020
	21FLMCGLKILLEARNY3	2011	2020
	21FLPNS 132UL	2011	2011
	Lake Killearny, station 2	2020	2020
KSE	Lake Killearny, station 3	2020	2020
	21FLCOT KINSALE	2017	2020
	21FLMCGLKINSAIL2	2011	2020
	21FLTLHRG1TLHR0148	2021	2020
	21FLWQA G1WA0079	2017	2017
	Lake Kinsail, station 2	2020	2020
KSM	21FLCOT KINSALE - SUPPL	2013	2014
	21FLGW 54310	2018	2018
	21FLMCGL	2021	2021
	21FLMCGLKINSAIL1	2011	2020
	Lake Kinsail, station 1	2020	2020
	21FLCOT KANTURK	2010	2020
KT	21FLCOT KANTURK - SUPPL	2013	2014
	21FLCOT KANTURK N - SUP	2013	2014
	21FLMCGLKANTURK1	2011	2019
	21FLMCGLKANTURK3	2013	2020



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N



0 0.2
Miles



Legend

 Waterbodies in Study

 Watercourses

 Killearn Chain of Lakes Drainage Basin

TSI Average 2010-2020

TSI Score

 0-15

 15-30

 30-45

 45-60

 >60

Sources:

Waterbodies: COT, 2020

Watercourses: COT, 2020

Drainage Basins: COT, 2020

Roads: COT-Leon County, 2023

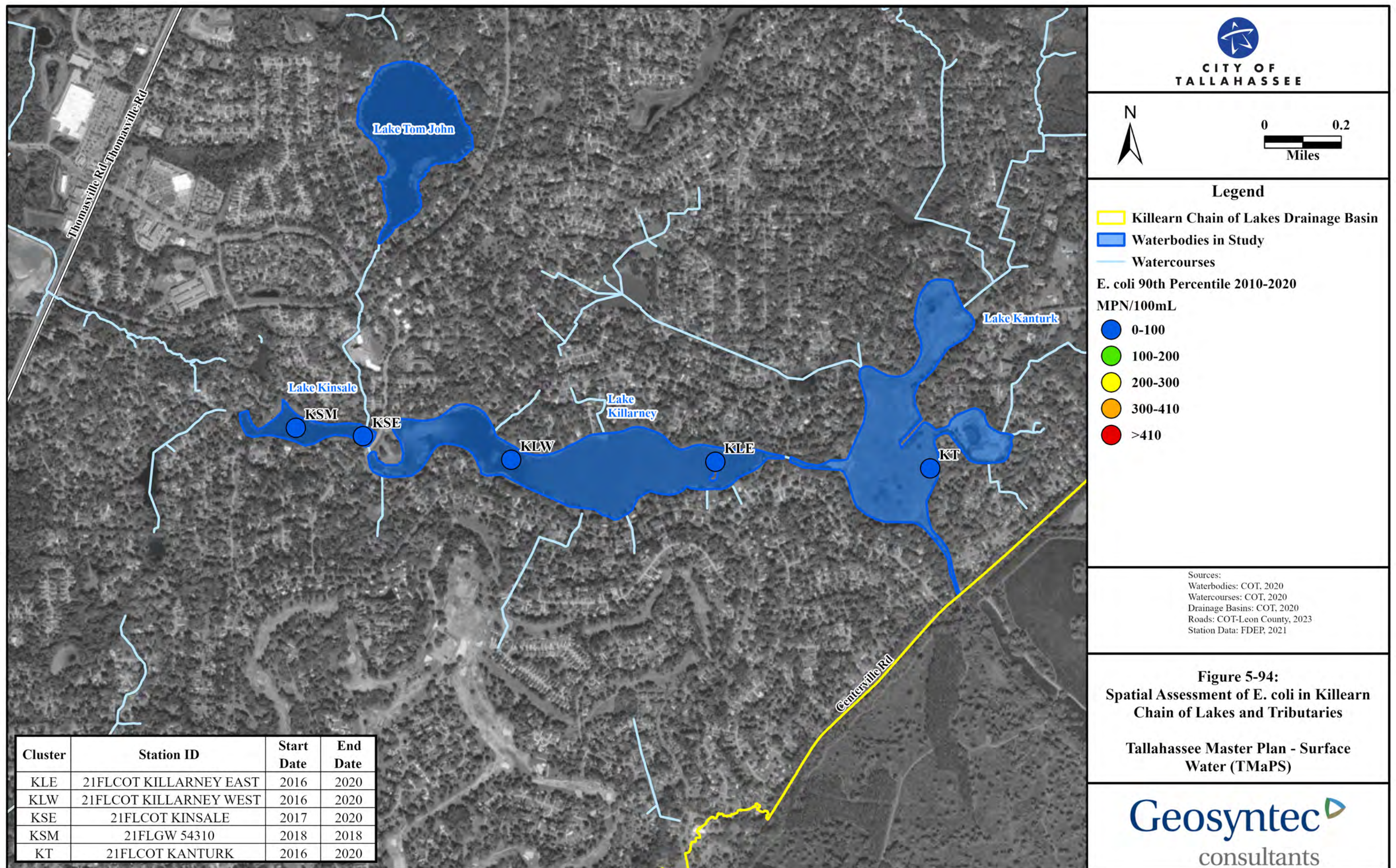
Station Data: FDEP, 2021

Figure 5-93:

Spatial Assessment of TSI in Killearn Chain of Lakes

Tallahassee Master Plan - Surface Water (TMaPS)





The 2013 to 2014, field measurements of storm event inflow concentrations discussed above were performed at all of the primary inflow points around the chain of lakes. A total of 12 stations collected between 4 and 7 samples. The results showed that for most of the drainage areas, the TN and TP concentration geomeans were at or below typical EMC values utilized by the City for medium density and high density residential areas (**Table 5-8**) but (other than the Thomasville Road crossing input discussed above, were generally at levels above the stream NNC of 0.18 mg/L. One area south of the chain of lakes that discharges to the western end of Lake Killarney had a TP value slightly above the City's EMC. Another location that drains into the northeaster lobe of Lake Kanturk showed a TP value nearly twice the City's value. Finally, an area that drains into the northwestern lobe of Lake Kanturk showed TP values twice the City's EMC and TN values 1.5 times the City's EMC.

To further assess stormwater runoff as a potential source of pollutant loads to the Killarn Chain of Lakes LDI levels within the sub-watersheds draining to the lakes were assessed. As discussed in **Section 5.4.4.2**, FDEP uses the LDI as a tool to estimate potential adverse human effects from various land uses on adjacent waterbodies with ratings from excellent to very poor in relation to the potential for adverse impacts from stormwater loads. **Figure 5-95** presents the LDI levels by sub-watershed within the Killarn Chain of Lakes drainage basin. The sub-watersheds draining directly to the lakes, and all sub-watersheds draining from the south and the immediate area to the west of Thomasville Road, range from moderate to poor. These classifications indicate potential for anthropogenic stormwater loads to the lakes. The areas along the northernmost upstream areas have good LDI values indicating limited potential for anthropogenic stormwater loads.

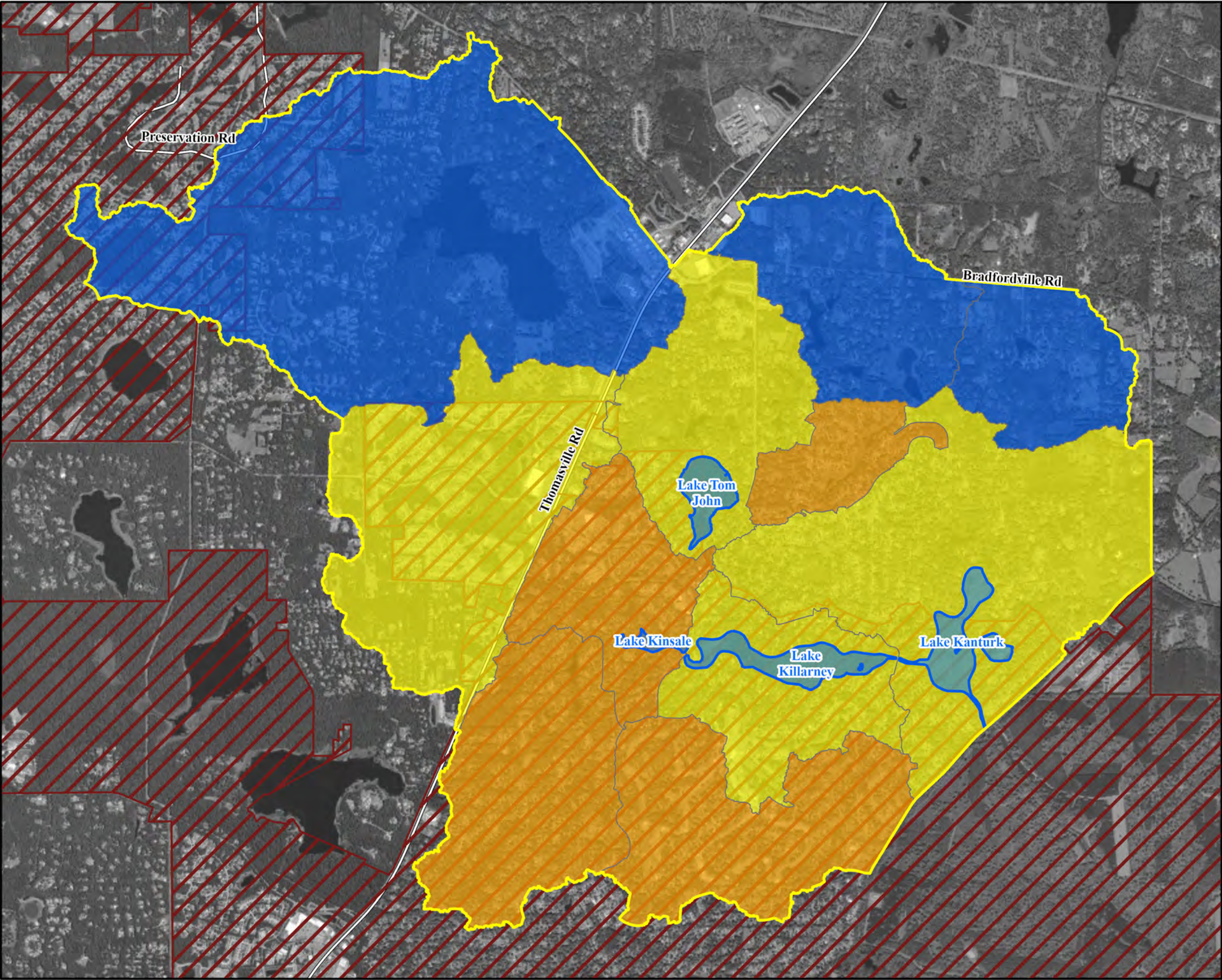
5.5.4.3 Septic Systems

Figure 5-58 presented the locations of septic systems within the Killarn Chain of Lakes basin. **Figure 5-96** presents a map showing the septic tank densities by subbasin. The septic densities for the subbasins that drain to Lake Kinsale and Lake Killarney are relatively low (less than 1 unit per 5 acres). In contrast the densities within the subbasins draining to northern end of Lake Kanturk are higher ranging near 1 unit per acre, which would indicate that septic loading may play a role in loading to the northern side of Lake Kanturk and is consistent with findings from a study conducted by ATM in 2015 that found higher inorganic nitrogen in stormwater samples from areas draining to the northern end of Lake Kanturk and concluded septic loading may be the cause. Additionally, spatial comparisons of average TN in the Killarn Chain showed elevated TN levels in Lake Kanturk compared to the other lakes (**Figure 5-90**). Septic loads to Lake Killarney and Lake Kinsale are not identified as a significant source due to the identified densities.

5.5.4.4 Internal Recycling and Seepage

Internal Recycling

ERD (2014) completed a study that evaluated the sediments and sediment flux of nutrients within the three lakes. A total of 62 cores were collected from the three lakes to characterize the sediments. Additionally, 8 large diameter (4-inch) cores were collected to support sediment benthic release experiments. Finally, sediment testing was performed to evaluate the potential release of nutrients following reflooding of desiccated areas. The following outlines the key findings from the study.



Legend

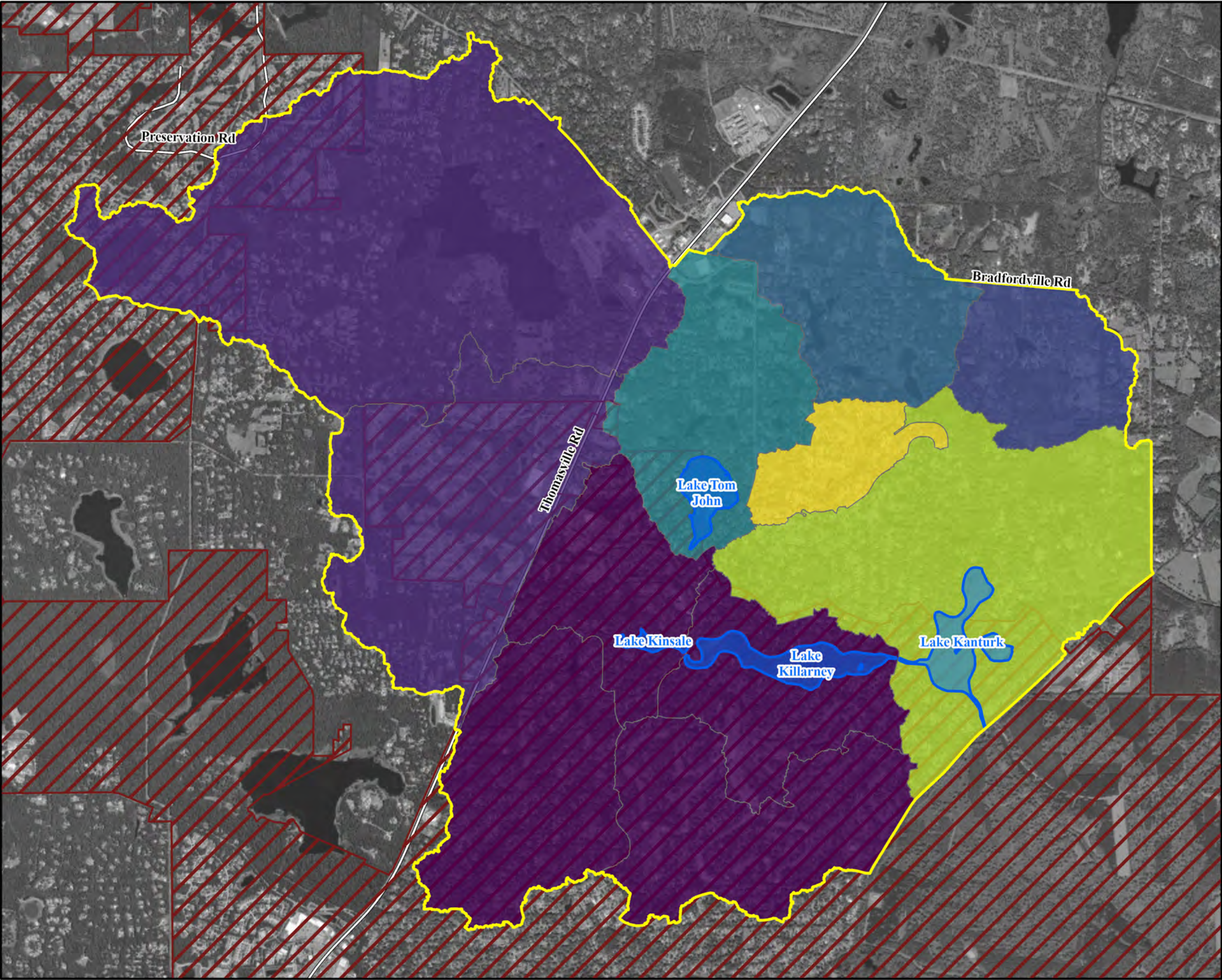
- Killearn Chain of Lakes Drainage Basin
- Waterbodies in Study
- Tallahassee Corporate Limits
- KillearnLDI**
- Land Development Index Wrong**
- Excellent
- Good
- Moderate
- Poor
- Very Poor

Sources:
Waterbodies: COT, 2020
Drainage Basins: COT, 2020
Roads: Leon County, 2023
City Limits: COT, 2022

Figure 5-95:
Land Development Index by Sub-
Watershed within Killearn Chain of Lakes
Drainage Basin

Tallahassee Master Plan - Surface
Water (TMaPS)





Legend

- Killlearn Chain of Lakes Drainage Basin
- Waterbodies in Study
- Tallahassee Corporate Limits
- Septic Tank Density
- Density
 - 0 - 0.1
 - 0.1 - 0.2
 - 0.2 - 0.3
 - 0.3 - 0.4
 - 0.4 - 0.5
 - 0.5 - 0.6
 - 0.6 - 0.7
 - 0.7 - 0.8
 - 0.8 - 0.9
 - 0.9 - 1

Sources:
Waterbodies: COT, 2020
Drainage Basins: COT, 2020
Roads: Leon County, 2023
City Limits: COT, 2022
Septic Tanks: COT, 2020

Figure 5-96:
Septic Tank Density by Sub-Basin within
Killlearn Chain of Lakes Drainage Basin

Tallahassee Master Plan - Surface
Water (TMaPS)



- The available phosphorus in the sediments for release was low in relation to values found in other urban lakes.
- The cores exhibited extremely low levels of nitrogen and phosphorus release under both aerobic and anoxic conditions.
- Nutrient loads from the reflooding were relatively minimal and equivalent to approximately 10 percent of the annual sediment release as a result of internal recycling.

Based on this study, internal recycling is not identified as a significant source of anthropogenic nutrients to the system. The internal recycling load, based on the 2014 study, will be presented in **Section 5.5.5.5** for comparison to other calculated loads.

Seepage

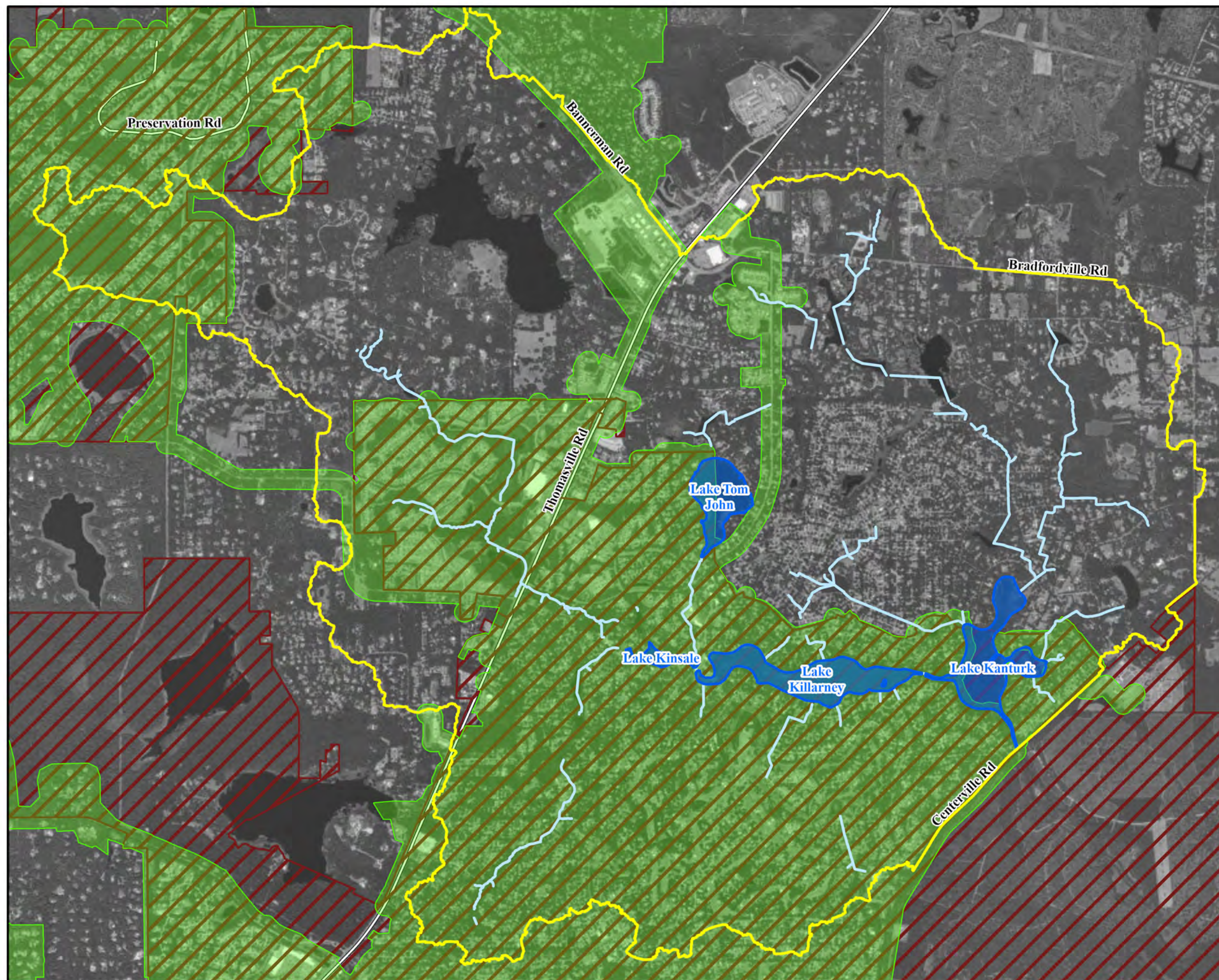
As outlined in **Section 5.5.3.7**, there are no surficial aquifer sampling sites identified within the Killearn Chain of Lakes basin to provide data on the potential for seepage to contribute to the loading to the lakes. It should be noted that based on the soil types in this basin, subsurface transmissivity levels are expected to be moderate to low, impeding transport of pollutants through seepage. Thus, seepage is not likely a significant direct source of nutrients to the Killearn Chain of Lakes. A primary potential source of seepage loads are septic systems which were evaluated in **Section 5.5.4.3** and are quantified in **Section 5.5.5.2**.

5.5.4.5 Wastewater

No direct wastewater discharges are currently within the Killearn Chain of Lakes basin. Additionally, no areas in the Killearn Chain of Lakes basin have reuse discharges. **Figure 5-97** presents a map of the Killearn Lakes basin boundaries in relation to sewer service areas. The sewer service areas are located around the direct discharge area of the three lakes, throughout the southern portions of the basin draining to the lakes, and the immediate area west of Thomasville Road that drains to Lake Kinsale. In the northern and northwestern (upstream) ends of the basin sewer infrastructure is isolated to developed areas along Velda Dairy Road and the intersection of Thomasville and Bannerman roads. Presently, 49 percent of the Killearn Chain of Lakes basin has sewer infrastructure. Based on the data analyses presented in **Section 5.5.3.6**, *E. coli* levels are generally low in the three lakes. Wastewater is not identified as a potential significant source in the Killearn Chain.

5.5.4.6 Atmospheric Deposition

For the overall surface area (combined three lakes) of the Killearn Chain of Lakes, the ratio of the watershed area to lake area is around 54:1. With this ratio, and the potential attenuation of rainfall runoff, direct atmospheric deposition to the lakes plays a minor role in overall loading to the lakes. Atmospheric deposition will be quantified in **Section 5.5.5.6** for comparison to other loads. **Section 5.5.3.10** identified the nearest atmospheric deposition station as the Quincy station (FL14). The data from this station will be utilized to calculate the atmospheric deposition to the Killearn Chain of Lakes.



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0 0.4
Miles

Legend

- Killearn Chain of Lakes Drainage Basin
- Waterbodies in Study
- Tallahassee Corporate Limits
- Sewer Service Areas

Sources:
Waterbodies: COT, 2020
Drainage Basins: COT, 2020
Roads: FDOT, 2020
City Limits: COT, 2022
Waste Water: COT, 2020

Figure 5-97:
City of Tallahassee Wastewater Service
Areas within Killearn Chain of Lakes Basin

Tallahassee Master Plan - Surface
Water (TMaPS)

Geosyntec
consultants

5.5.4.7 Interconnected Flows

Within the Killlearn Chain of Lakes, Lake Kinsale is the most upstream waterbody. Lake Kinsale discharges directly into Lake Killarney. Lake Killarney then flows into Lake Kanturk. The upstream lakes, along with other upstream waterbodies, have the potential to contribute to nutrient loading and be a source to consider for the downstream lakes.

Lake Kinsale has a surface area of about 13 acres when full and receives drainage from the western portions of the basin across Thomasville Road (including the discharge from Lake McBride) and the discharge from Lake Tom John. Presently both Lake McBride and Lake Tom John are identified as impaired. Based on this, along with the nature of land use surrounding Lake Tom John, these two lakes are considered as potential sources of anthropogenic load to Lake Kinsale. Where data are available loads from the upstream lakes (Lake Tom John and Lake McBride) are quantified in **Section 5.5.5.5**.

Lake Killarney has a surface area of about 80 acres when full and receives flows out of Lake Kinsale. Presently, Lake Kinsale is identified as impaired. Based on this, along with the nature of land use draining to Lake Kinsale, it is considered as potential sources of anthropogenic load to Lake Killarney. The loads from Lake Kinsale are quantified in **Section 5.5.5.5**.

Lake Kanturk has a surface area of about 70 acres when full and receives flows out of Lake Killarney along with two waterbodies that drain into its northern lobes (Lake Saratoga and Lake Belmont). Presently Lake Killarney is identified as impaired. Based on this, along with the nature of land use draining to Lake Killarney and the other upstream waterbodies, these are considered as potential sources of anthropogenic load to Lake Kanturk. Where data are available, loads from the upstream lakes (Lake Killarney, Lake Saratoga, and Lake Belmont) are quantified in **Section 5.5.5.5**.

5.5.4.8 Summary of Findings

Based on the discussions above, and data and information presented in **Section 5.5.3**, there are various potential sources of pollutant loads to the Killlearn Chain of Lakes. The primary constituent of concern is TP throughout the system and inorganic nitrogen for portions of Lake Kanturk.

Stormwater runoff contributing to tributary inflow and interconnected flow from upstream waterbodies along with septic load are identified as potentially significant contributors of anthropogenic load and are quantified in **Section 5.5.5**. Though not identified as potential significant sources, atmospheric deposition and internal recycling are quantified for comparative purposes in **Section 5.5.5** based on available data.

5.5.5 Calculation of Potential Nutrient Loads

This section presents calculations of potential nutrient (TN and TP) loads to the Killlearn Chain of Lakes for the sources identified for calculation in **Section 5.5.4.8**. These include stormwater runoff, septic systems, interconnected flows, internal recycling and atmospheric deposition. Where loads were not calculated the sections below provide brief discussions. The load calculations are for the purpose of comparing the potential magnitudes of each source relative to one another to support determination of sources to target for load reduction.

5.5.5.1 Stormwater Pollutant Load

In order to calculate the stormwater TN and TP loads to the Killlearn Chain of Lakes, average annual pollutant load modeling was performed. The goal was to identify outfalls that are contributing higher TN and TP loads relative to one another and to quantify the total TN and TP loads to each of the lakes (Lake Kinsale, Lake Killarney, Lake Kanturk). TN and TP loads were calculated using the Spatially Integrated Model for Pollutant Loading Estimates (SIMPLE-Seasonal) model. The model methodology was described in detail in **Section 5.4.5.1** for the stormwater loads to the Lafayette Chain of Lakes.

Figure 5-98 presents the subbasins and the DEM utilized in the SIMPLE model calculations for the Killlearn Chain of Lakes. **Figure 5-99** presents the aggregated land use. Finally, **Figure 5-100** presents the CDAs for the Chain of Lakes stormwater loading to define total and per acre TN and TP loads, as well as the ranking of CDAs around the Lakes.

Stormwater Nutrient Loads to Killlearn Chain of Lakes

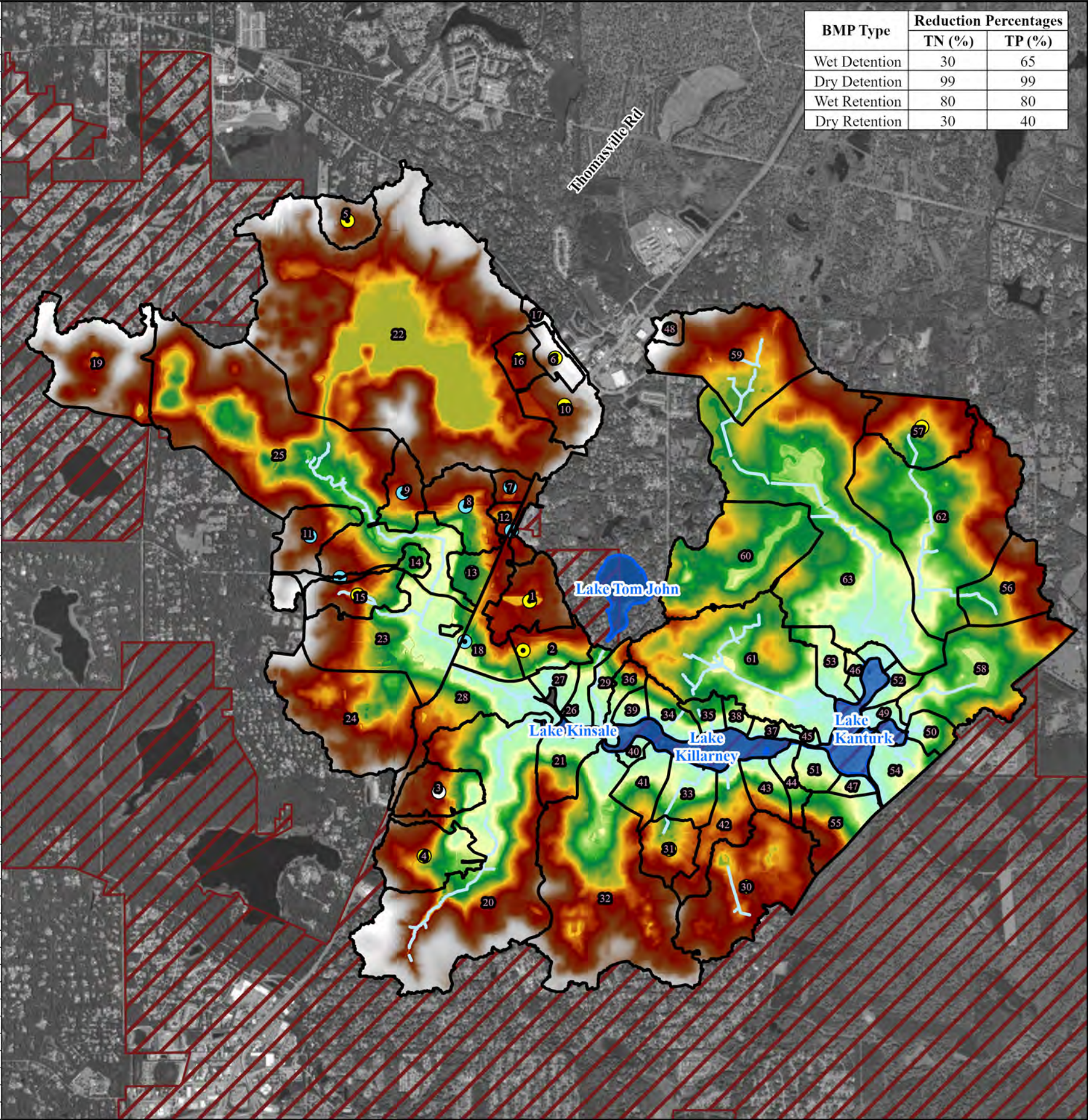
Figure 5-101 presents the distribution of the ranking of the CDAs for TN along with the total load and per acre loads, see the table on **Figure 5-101**. The rankings are color coded, with the highest ranked CDAs in dark green moving down to the lowest ranked in pale yellow. The calculated total stormwater TN loads from the CDAs ranged from as low as 41.0 lb/yr up to 6817.3 lb/yr. The per acre loads ranged from 1.7 lb/acre/yr up to 5.7 lb/acre/yr. The highest ranked CDAs were located along the southern side of the chain of lakes for the most part, which is likely a function of the land uses in conjunction with treatment considered in the model development. The total potential stormwater runoff loads for TN for Lake Kinsale, Lake Killarney, and Lake Kanturk are 10,244.9 lb/yr, 5,153.1 lb/yr, and 6,208.8 lb/yr, respectively.

Figure 5-102 presents the distribution of the ranking of the CDAs for TP along with the total load and per acre loads, see the table on **Figure 5-102**. The calculated total stormwater TP loads from the CDAs ranged from as low as 7.7 lb/yr up to 1408.0 lb/yr. The per acre loads ranged from 0.4 lb/acre/yr up to 1.9 lb/acre/yr. As was seen for the TN, the highest ranked CDAs were located along the southern side of the lakes. The total potential stormwater runoff loads for TP for Lake Kinsale, Lake Killarney, and Lake Kanturk are 2,247.8 lb/yr, 1,497.1 lb/yr, and 1,568.0 lb/yr respectively.

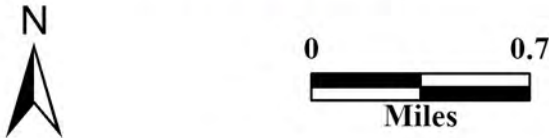
5.5.5.2 Septic Load

In order to analyze the potential impacts from septic tank units to the Killlearn Chain of Lakes, the SPIL method adopted by FDEP was utilized to quantify the potential septic load. The calculations were done for each of the three waterbodies (Lake Kinsale, Lake Killarney, and Lake Kanturk). The approach and calculations were described earlier in **Section 5.4.5.2** which presented the septic loading to the Lafayette Chain of Lakes. As outlined earlier, the calculations were only done for nitrogen (TN), and based on literature on transport and assimilation, may represent a conservative potential load.

Killearn Chain of Lakes Subbasin Summary			
Number	Subbasin ID	Acreage	BMP Type
1	LFBLKIN0080	88	Wet Detention
2	LFBLKIN0070	59	Wet Detention
3	LFBLKIN0040	71	Dry Retention
4	LFBLKIN0050	109	Wet Detention
5	LFBLKIN0210	49	Wet Detention
6	LFBLKIN0190	32	Wet Detention
7	LFBLKIN0100	20	Dry Detention
8	LFBLKIN0110	89	Dry Detention
9	LFBLKIN0120	53	Dry Detention
10	LFBLKIN0170	83	Wet Detention
11	LFBLKIN0160	90	Dry Detention
12	LFBLKIN0090	25	Dry Detention
13	LFBLKIN0130	35	Dry Detention
14	LFBLKIN0140	28	Dry Detention
15	LFBLKIN0150	68	Wet Detention
16	LFBLKIN0180	38	Wet Detention
17	LFBLKIN0200	10	Dry Detention
18	LFBLKIN0075	90	Dry Detention
19	LFBLKIN0230	197	Dry Detention
20	LFBLKIN0030	545	None
21	LFBLKIN0010	61	None
22	LFBLKIN0012	1,133	None
23	LFBLKIN0013	215	None
24	LFBLKIN0014	238	None
25	LFBLKIN0015	646	None
26	LFBLKIN0020	30	None
27	LFBLKIN0021	26	None
28	LFBLKIN0022	124	None
29	LFBLKIN0280	32	None
30	LFBLKIL0027	225	None
31	LFBLKIL0030	61	Wet Detention
32	LFBLKIL0040	458	None
33	LFBLKIL0020	61	None
34	LFBLKIL0021	38	None
35	LFBLKIL0022	22	None
36	LFBLKIL0023	26	None
37	LFBLKIL0024	15	None
38	LFBLKIL0010	14	None
39	LFBLKIL0025	18	Wet Detention
40	LFBLKIL0012	10	None
41	LFBLKIL0013	51	None
42	LFBLKIL0014	81	None
43	LFBLKIL0015	40	None
44	LFBLKIL0026	29	None
45	LFBLKAN0012	6	None
46	LFBLKAN0011	13	None
47	LFBLKAN0025	15	None
48	LFBLKAN0070	16	Wet Detention
49	LFBLKAN0014	16	None
50	LFBLKAN0036	30	None
51	LFBLKAN0013	31	None
52	LFBLKAN0015	34	None
53	LFBLKAN0055	46	None
54	LFBLKAN0010	54	None
55	LFBLKAN0020	72	None
56	LFBLKAN0035	101	None
57	LFBLKAN0060	118	Wet Detention
58	LFBLKAN0031	204	None
59	LFBLKAN0034	220	None
60	LFBLKAN0033	227	None
61	LFBLKAN0050	326	None
62	LFBLKAN0032	399	None
63	LFBLKAN0030	629	None



BMP Type	Reduction Percentages	
	TN (%)	TP (%)
Wet Detention	30	65
Dry Detention	99	99
Wet Retention	80	80
Dry Retention	30	40



Legend

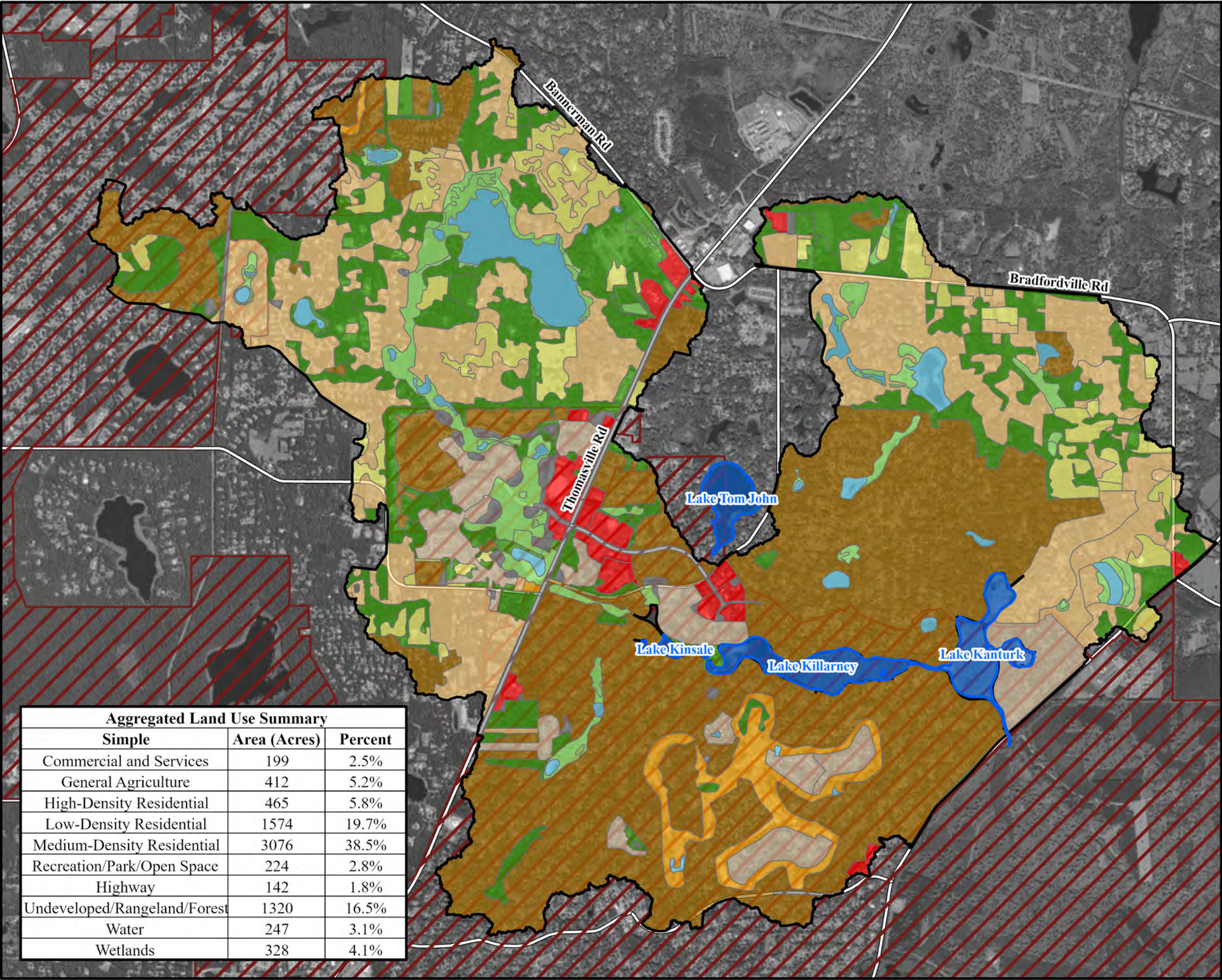
- Subbasins
- Waterbodies in Study
- Watercourses
- Tallahassee Corporate Limits
- BMP Type
 - Dry Detention
 - Dry Retention
 - Wet Detention
- Topographic Elevations
Ft. NAVD88
 - 251
 - 67

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Subbasins: Geosyntec, 2022
Roads: COT-Leon County, 2023
City Limits: COT, 2022
BMPs: Geosyntec, 2023
Elevation: COT-Leon County,

Figure 5-98:
Killearn Chain of Lakes Subbasin
Delineation and BMPs

Tallahassee Master Plan - Surface
Water (TMaPS)





Legend

-  Killearn Chain of Lakes Drainage Basin
-  Waterbodies in Study
-  Tallahassee Corporate Limits
- Aggregated Land Use
- Land Use Type
 -  Commercial and Services
 -  General Agriculture
 -  High-Density Residential
 -  Low-Density Residential
 -  Medium-Density Residential
 -  Recreation/Park/Open Space
 -  Highway
 -  Undeveloped/Rangeland/Forest
 -  Water
 -  Wetlands

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Land Use: Geosyntec, 2023
Roads: FDOT, 2020
City Limits: COT, 2020

Figure 5-99:
Killearn Chain of Lake Aggregated Land Use

Tallahassee Master Plan - Surface Water (TMaPS)

Aggregated Land Use Summary		
Simple	Area (Acres)	Percent
Commercial and Services	199	2.5%
General Agriculture	412	5.2%
High-Density Residential	465	5.8%
Low-Density Residential	1574	19.7%
Medium-Density Residential	3076	38.5%
Recreation/Park/Open Space	224	2.8%
Highway	142	1.8%
Undeveloped/Rangeland/Forest	1320	16.5%
Water	247	3.1%
Wetlands	328	4.1%

A Concentrated Discharge Area (CDA) is identified as possessing concentrated flows that could facilitate potential water quality treatment projects

Lake Killarney		
Summary of Concentrated Discharge Areas		
Number	CDA ID	Acres
1	LFBLKILOF13	458.4
2	LFBLKILOF05	39.7
3	LFBLKILOF03	51.3
4	LFBLKILOF06	122.1
5	LFBLKILOF07	38.0
6	LFBLKILOF09	26.1
7	LFBLKILOF11	18.5
8	LFBLKILOF04	305.9
9	LFBLKILOF12	28.6
10	LFBLKILOF10	15.5
11	LFBLKILOF08	22.0
12	LFBLKILOF01	14.3
13	LFBLKILOF02	10.3

Lake Kanturk		
Summary of Concentrated Discharge Areas		
Number	CDA ID	Acres
1	LFBLKANOF01	53.8
2	LFBLKANOF07	71.8
3	LFBLKANOF10	326.0
4	LFBLKANOF09	29.5
5	LFBLKANOF06	1,743.3
6	LFBLKANOF04	30.6
7	LFBLKANOF08	14.8
8	LFBLKANOF11	46.0
9	LFBLKANOF05	220.1
10	LFBLKANOF03	6.4
11	LFBLKANOF02	13.0

Lake Kinsale		
Summary of Concentrated Discharge Areas		
Number	CDA ID	Acres
1	LFBLKINOF05	724.3
2	LFBLKINOF01	61.1
3	LFBLKINOF04	3,351.3
4	LFBLKINOF06	32.2
5	LFBLKINOF02	30.3
6	LFBLKINOF03	85.5



Legend

- Concentrated Discharge Areas
- Waterbodies in Study
- Flowlines
- Tallahassee Corporate Limits
- Topographic Elevations
ft NAVD88
- 250
- 65

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
CDAs: Geosyntec, 2022
Roads: COT-Leon County, 2023
City Limits: COT, 2022
Elevation: COT-Leon County, 2018

Figure 5-100:
Killearn Chain of Lakes Concentrated
Discharge Areas

Tallahassee Master Plan - Surface
Water (TMaPS)



A Concentrated Discharge Area (CDA) is identified as possessing concentrated flows that could facilitate potential water quality treatment projects

Lake Kanturk				
Summary of Concentrated Discharge Areas				
Number	CDA ID	Total Load (lbs-TN/yr)	Area Load (lbs-TN/ac/yr)	Ranking
1	LFBLKANOF01	261.7	4.9	1
2	LFBLKANOF07	328.6	4.6	2
3	LFBLKANOF09	141.4	4.8	3
4	LFBLKANOF10	1,254.8	3.8	3
5	LFBLKANOF06	3,431.2	2.0	5
6	LFBLKANOF05	384.2	1.7	6
7	LFBLKANOF04	122.0	4.0	6
8	LFBLKANOF08	59.1	4.0	6
9	LFBLKANOF11	155.1	3.4	6
10	LFBLKANOF03	28.1	4.4	10
11	LFBLKANOF02	42.6	3.3	11
Total Load:		6,208.8		

Lake Kinsale				
Summary of Concentrated Discharge Areas				
Number	CDA ID	Total Load (lbs-TN/yr)	Area Load (lbs-TN/ac/yr)	Ranking
1	LFBLKINOF06	184.5	5.7	1
2	LFBLKINOF05	2,545.4	3.5	1
3	LFBLKINOF01	258.7	4.2	3
4	LFBLKINOF04	6,817.3	2.0	3
5	LFBLKINOF02	141.4	4.7	5
6	LFBLKINOF03	297.6	3.5	5
Total Load:		10,244.9		

Lake Killarney				
Summary of Concentrated Discharge Areas				
Number	CDA ID	Total Load (lbs-TN/yr)	Area Load (lbs-TN/ac/yr)	Ranking
1	LFBLKILOF13	2,189.4	4.8	1
2	LFBLKILOF05	195.8	4.9	2
3	LFBLKILOF09	140.4	5.4	2
4	LFBLKILOF03	244.3	4.8	4
5	LFBLKILOF06	567.8	4.6	4
6	LFBLKILOF11	93.8	5.1	6
7	LFBLKILOF07	164.6	4.3	7
8	LFBLKILOF04	1,174.9	3.8	8
9	LFBLKILOF12	121.4	4.2	9
10	LFBLKILOF10	71.4	4.6	10
11	LFBLKILOF08	90.0	4.1	11
12	LFBLKILOF01	58.3	4.1	12
13	LFBLKILOF02	41.0	4.0	13
Total Load:		5,153.1		



Legend

- Concentrated Discharge Areas
- Waterbodies in Study
- Flowlines
- Tallahassee Corporate Limits
- Ranking
 - High
 - Low

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
CDAs: Geosyntec, 2022
Roads: COT-Leon County, 2023
City Limits: COT, 2022

Figure 5-101:
Killearn Chain of Lakes Concentrated
Discharge Areas-Total Nitrogen

Tallahassee Master Plan - Surface
Water (TMaPS)



A Concentrated Discharge Area (CDA) is identified as possessing concentrated flows that could facilitate potential water quality treatment projects

Lake Kanturk				
Summary of Concentrated Discharge Areas				
Number	CDA ID	Total Load (lbs-TP/yr)	Area Load (lbs-TP/ac/yr)	Ranking
1	LFBKANO01	71.0	1.3	1
2	LFBKANO07	89.1	1.2	1
3	LFBKANO09	38.4	1.3	3
4	LFBKANO10	340.8	1.0	3
5	LFBKANO06	832.0	0.5	5
6	LFBKANO04	33.2	1.1	6
7	LFBKANO08	16.1	1.1	6
8	LFBKANO11	42.2	0.9	6
9	LFBKANO05	85.9	0.4	9
10	LFBKANO03	7.7	1.2	9
11	LFBKANO02	11.6	0.9	11
Total Load:		1,568.0		

Lake Kinsale				
Summary of Concentrated Discharge Areas				
Number	CDA ID	Total Load (lbs-TP/yr)	Area Load (lbs-TP/ac/yr)	Ranking
1	LFBLKINO01	70.4	1.2	1
2	LFBLKINO05	648.7	0.9	2
3	LFBLKINO02	35.9	1.2	3
4	LFBLKINO04	1,408.0	0.4	3
5	LFBLKINO06	37.1	1.1	5
6	LFBLKINO03	47.7	0.6	6
Total Load:		2,247.8		

Lake Killarney				
Summary of Concentrated Discharge Areas				
Number	CDA ID	Total Load (lbs-TP/yr)	Area Load (lbs-TP/ac/yr)	Ranking
1	LFBCLKIOF13	740.1	1.6	1
2	LFBCLKIOF03	95.1	1.9	2
3	LFBCLKIOF05	57.4	1.4	3
4	LFBCLKIOF06	147.6	1.2	4
5	LFBCLKIOF07	44.5	1.2	5
6	LFBCLKIOF11	24.1	1.3	6
7	LFBCLKIOF12	33.0	1.2	7
8	LFBCLKIOF04	255.2	0.8	7
9	LFBCLKIOF10	19.4	1.3	9
10	LFBCLKIOF08	24.5	1.1	10
11	LFBCLKIOF09	29.1	1.1	10
12	LFBCLKIOF01	15.9	1.1	12
13	LFBCLKIOF02	11.2	1.1	13
Total Load:		1,497.1		



Legend

- Concentrated Discharge Areas
- Waterbodies in Study
- Flowlines
- Tallahassee Corporate Limits
- Ranking
 - High
 - Low

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
CDAs: Geosyntec, 2022
Roads: COT-Leon County, 2023
City Limits: COT, 2022

Figure 5-102:
Killearn Chain of Lakes Concentrated
Discharge Areas-Total Phosphorus

Tallahassee Master Plan - Surface
Water (TMaPS)



An estimated 945 septic tank units were identified within 200 meters of the Killlearn Chain of Lakes, and associated tributaries. **Figure 5-103** shows the septic systems utilized in the analyses with those associated with direct loading to the waterbody green and those associated with loading to tributaries pink. Tables provided on the figure summarize the calculated nutrient load from septic units to each of the three waterbodies. The total TN load to Lake Kinsale is 346 lb/yr with all of that load coming from tributaries. The total TN load to Lake Killarney is 0 lb/yr as no septic units were identified within 200 meters of the lakeshore or tributaries draining to it. The potential TN load to Lake Kanturk is 9,852 lb/yr with 443 lb/yr from direct loading to the lake and the remaining from clusters of septic system along tributaries that drain to the upper parts of Lake Kanturk.

5.5.5.3 Point Source Load

No active point sources were identified within the Killlearn Chain of Lakes basin. Therefore, the point source loads for TN and TP are set to 0 lb/yr for all three lakes.

5.5.5.4 Lake Inflow Load

As discussed in **Section 5.5.4.7** upstream lakes flow to downstream receiving lakes and represents load to the downstream lake. **Figure 5-104** presents the upstream and downstream connections. Calculations of the loads are provided herein based on the availability of modeled flows and in-lake concentrations. The approach utilized in the calculation of the inter-lake loading was described in **Section 5.5.5.5** for the Lafayette Chain of Lakes. The lakes and connections are shown in **Figure 5-104**, along with a table summarizing available water quality data, flow, load calculations and impairment status. These loads represent the surface runoff and baseflow load to the downstream lakes accounting for the changes in in-lake concentrations as the water passes through. Based on available water quality data and modeled inflows, loads were calculated for Lake Kinsale from Lake Tom John, Lake Killarney from Lake Kinsale, and Lake Kanturk from Lake Killarney. The loads out of Lake McBride were not calculated based on no modeled outflow. The loads out of Lake Saratoga and Lake Belmont were not calculated based on no modeled outflow or in-lake water quality data. The loads from these three lakes are incorporated into the load calculations presented in **Section 5.5.5.1**.

5.5.5.5 Internal Lake Load

Section 5.5.4.4 outlined a study completed in 2014 that quantified the internal nutrient flux loads for the Killlearn Chain of Lakes. **Table 5-16** presents the results from the study. TN internal loads ranged from 975 lb/year in Lake Kinsale up to 5,199 lb/year in Lake Kanturk. TP internal loads showed a similar pattern ranging from 64 lb/year in Lake Kinsale up to 238 lb/year in Lake Kanturk.

Table 5-16: Internal Nutrient Load to Killlearn Chain of Lakes

Lake	TN (lb/year)	TP (lb/year)
Lake Kinsale	975	64
Lake Killarney	4,105	187
Lake Kanturk	5,199	238

Location points of septic systems are digital estimations from related parcel locations and not meant to depict accuracy of unit location within the property

Only septic systems within 200 meters of the waterbody or its tributaries were selected and shown on this map as they are the source of the calculated nutrient loads, the remainder of septic units that were not selected are not shown on this map



Legend

- Killearn Chain of Lakes Drainage Basin
- Killearn Chain of Lakes
- Waterbodies in Study
- Watercourses
- Relevant Septic Sites
 - Lake
 - Tributaries

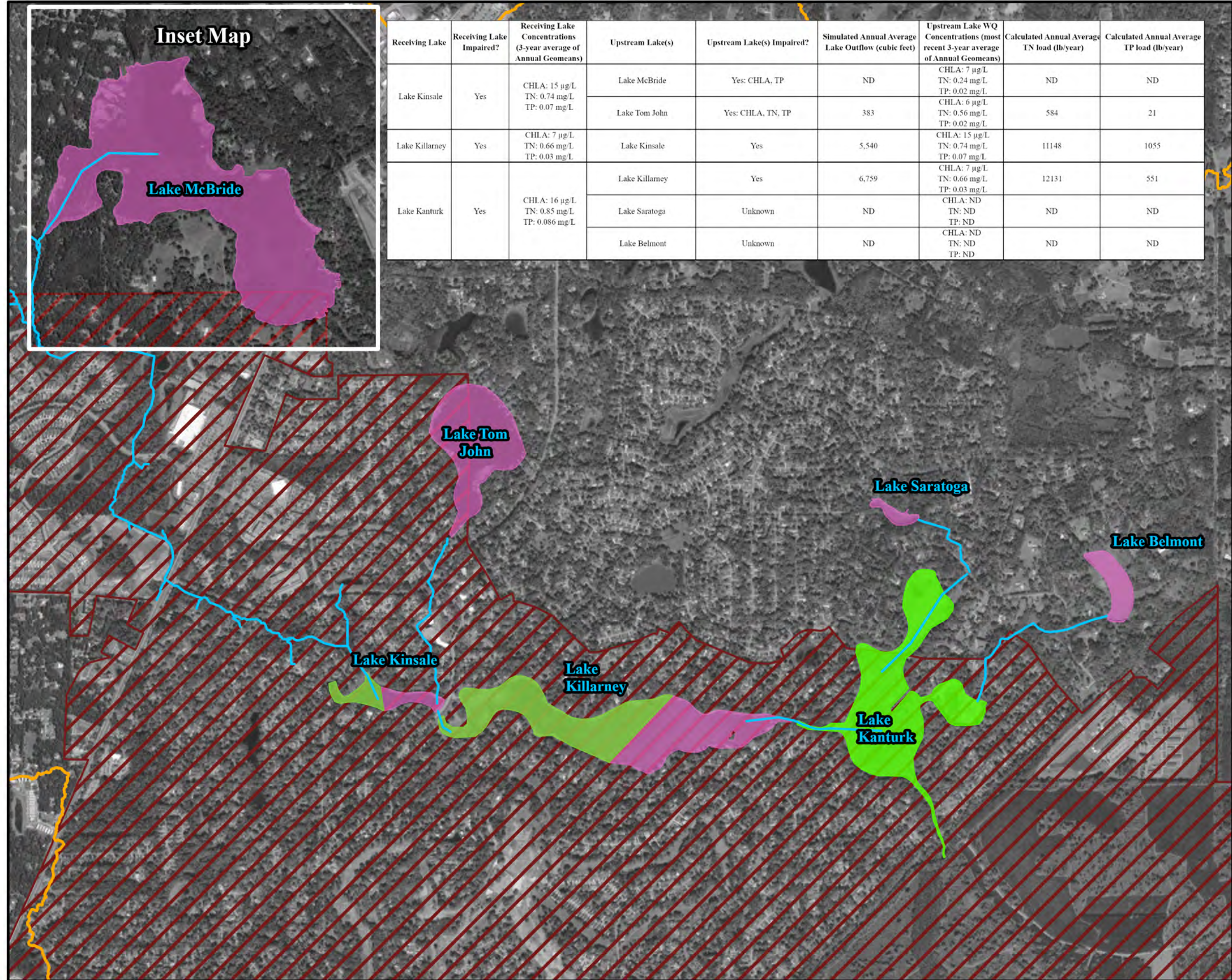
Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Septic Systems: COT, 2020
Watershed: COT, 2020
Roads: COT-Leon County, 2023

Figure 5-103:
Septic Loading to Killearn Chain of Lakes

Tallahassee Master Plan - Surface
Water (TMaPS)



Summary of Nutrient Loading from Septic			
Waterbody	TN Loading Direct to Lake (lbs/yr)	TN Loading From Tributaries (lbs/yr)	TN Load (lbs/yr)
Lake Kanturk	443	9,409	9,852
Lake Kinsale	0	346	346
Lake Killarney	0	0	0



Receiving Lake	Receiving Lake Impaired?	Receiving Lake Concentrations (3-year average of Annual Geomeans)	Upstream Lake(s)	Upstream Lake(s) Impaired?	Simulated Annual Average Lake Outflow (cubic feet)	Upstream Lake WQ Concentrations (most recent 3-year average of Annual Geomeans)	Calculated Annual Average TN load (lb/year)	Calculated Annual Average TP load (lb/year)
Lake Kinsale	Yes	CHLA: 15 µg/L TN: 0.74 mg/L TP: 0.07 mg/L	Lake McBride	Yes: CHLA, TP	ND	CHLA: 7 µg/L TN: 0.24 mg/L TP: 0.02 mg/L	ND	ND
			Lake Tom John	Yes: CHLA, TN, TP	383	CHLA: 6 µg/L TN: 0.56 mg/L TP: 0.02 mg/L	584	21
Lake Killarney	Yes	CHLA: 7 µg/L TN: 0.66 mg/L TP: 0.03 mg/L	Lake Kinsale	Yes	5,540	CHLA: 15 µg/L TN: 0.74 mg/L TP: 0.07 mg/L	11148	1055
Lake Kanturk	Yes	CHLA: 16 µg/L TN: 0.85 mg/L TP: 0.086 mg/L	Lake Killarney	Yes	6,759	CHLA: 7 µg/L TN: 0.66 mg/L TP: 0.03 mg/L	12131	551
			Lake Saratoga	Unknown	ND	CHLA: ND TN: ND TP: ND	ND	ND
			Lake Belmont	Unknown	ND	CHLA: ND TN: ND TP: ND	ND	ND



Legend

- Lake Lafayette Drainage Basin
- Receiving Lakes
- Inflowing Lakes
- Flowlines
- Tallahassee Corporate Limits

Sources:
Waterbodies: COT, 2020
Flowlines: USGS, 2020
Roads: COT-Leon County, 2023
City Limits, COT, 2020

Figure 5-104:
Inflow Loading to Killearn Chain of Lakes

Tallahassee Master Plan - Surface
Water (TMaPS)



5.5.5.6 Atmospheric Deposition

As presented and discussed in **Section 5.5.4.6** the annual average atmospheric TN load per acre was calculated from the Quincy NADP station (F14) at 2.56 lb/acre/yr. Multiplying this by the acreage of Lake Kinsale (12.6 acres), Lake Killarney (80 acres), and Lake Kanturk (70 acres) gives total TN loads of 32 lb/yr, 205 lb/yr, and 179 lb/yr respectively. No data are available for TP therefore only the nitrogen load is provided.

5.5.5.7 Summary of Calculated Loads

Nutrient loads to Lake Kinsale, Lake Killarney, and Lake Kanturk were calculated for stormwater runoff, septic systems, lake inflow, internal recycling, and atmospheric deposition. **Table 5-17** through **Table 5-19** present the calculated total loads to the lakes for TN and TP. For septic systems and atmospheric deposition only TN loads were calculated (see **Section 5.5.5.2** and **Section 5.5.5.6**, respectively, for explanation).

Table 5-17: Summary of Calculated Loads to Lake Kinsale

Source	TN (lb/year)	TP (lb/year)
Stormwater Runoff	10,245	2,248
Septic Systems	346	NC
Lake Inflow	584	21
Internal Recycling	975	64
Atmospheric Deposition	32	NC

NC – Not calculated.

Table 5-18: Summary of Calculated Loads to Lake Killarney

Source	TN (lb/year)	TP (lb/year)
Stormwater Runoff	5,153	1,497
Septic Systems	0	NC
Lake Inflow	11,148	1,055
Internal Recycling	4,105	187
Atmospheric Deposition	205	NC

NC – Not calculated.

Table 5-19: Summary of Calculated Loads to Lake Kanturk

Source	TN (lb/year)	TP (lb/year)
Stormwater Runoff	6,209	1,568
Septic Systems	9,852	NC
Lake Inflow	12,131	551
Internal Recycling	5,199	238
Atmospheric Deposition	179	NC

NC – Not calculated.

5.6 Lake Tom John

This section presents the results from Tasks 1 through 3 for Lake Tom John, which includes an overview and history of the lake and basin; present impairment status; an overview of available data; a qualitative assessment of potential pollutant sources; and calculation of potential pollutant loads.

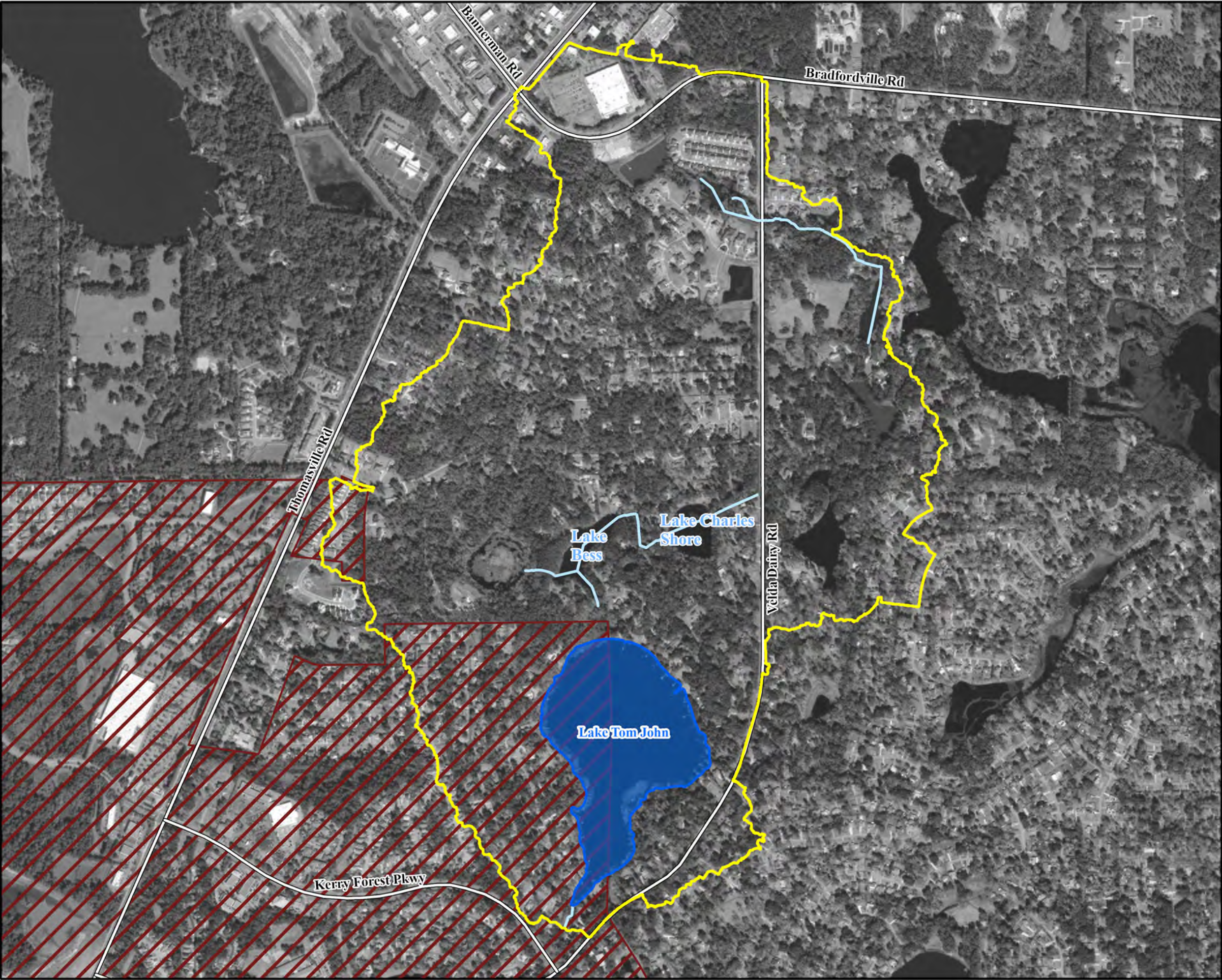
5.6.1 Overview and History

Lake Tom John is a 40-acre lake located in a residential area between Velda Dairy Road and Thomasville Road north of Kerry Forest Road (**Figure 5-105**). The lake is surrounded almost entirely by residential properties. Drainage to Lake Tom John comes from the Pembroke Place, Highlands, Quail Rise and other smaller neighborhoods. **Photo 5-45** shows the lake from a dock along the southwestern side.



Photo 5-45: Lake Tom John (August 2019)

Photo 5-46 through **Photo 5-53** present aerials of Lake Tom John in 1937, 1949, 1954, 1970, 1983, 1996, 2007, and 2020. The aerials show that while the overall footprint of the lake has remained relatively constant, in the early years the system shows wetland characteristics with extensive dry and permanent pool areas. This condition extends from 1937 through 1954 (**Photo 5-46** to **Photo 5-48**). By the 1970 aerial (**Photo 5-49**) the extent of open water area extends more out to the total footprint with what appear to be areas of extensive aquatic vegetation. The increase in the overall open water area in the lake continues from 1983 through 2020 with nearly the entire footprint as open water in 2020 (**Photo 5-50** to **Photo 5-53**).



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Legend

- Lake Tom John Drainage Basin
- Waterbodies in Study
- Watercourses
- Tallahassee Corporate Limits

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Watersheds: COT, 2020
Roads: FDOT, 2020
Facilities: COT, 2020
City Limits: COT, 2022

Figure 5-105:
Lake Tom John Basin Overview Map

**Tallahassee Master Plan - Surface
Water (TMaPS)**



Photo 5-46: Lake Tom John Basin Area Aerial (1937)



Photo 5-47: Lake Tom John Basin Area Aerial (1949)



Photo 5-48: Lake Tom John Basin Area Aerial (1954)



Photo 5-49: Lake Tom John Basin Area Aerial (1970)



Photo 5-50: Lake Tom John Basin Area Aerial (1983)



Photo 5-51: Lake Tom John Basin Area Aerial (1996)

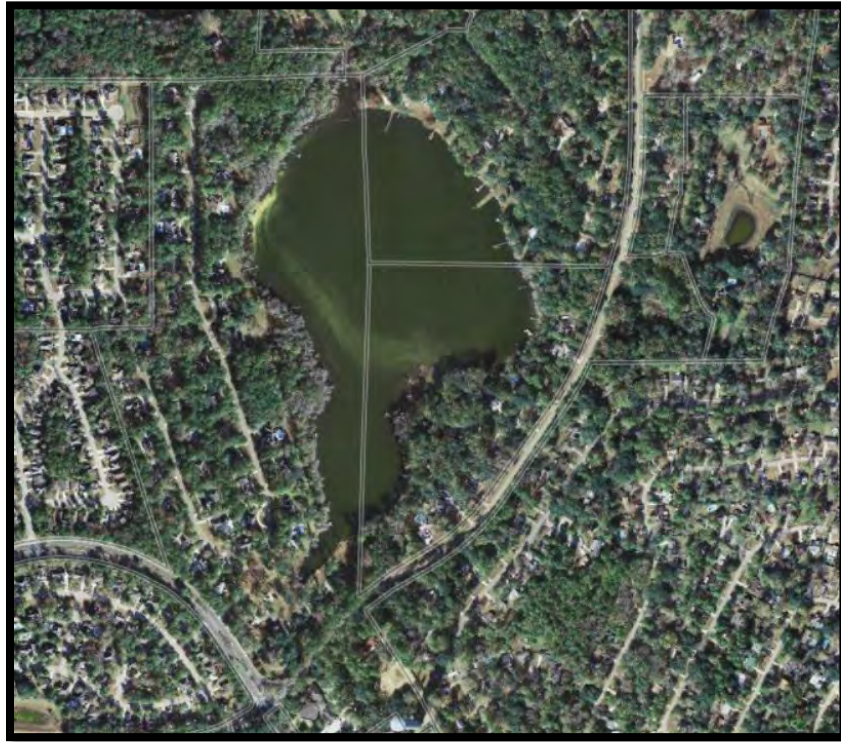


Photo 5-52: Lake Tom John Basin Area Aerial (2007)



Photo 5-53: Lake Tom John Basin Area Aerial (2020)

The drainage basin for Lake Tom John covers an area of 656 acres (**Figure 5-105**) and generally extends between Thomasville Road, Velda Dairy Road, and Bradfordville Road. The bulk of the drainage basin is within residential neighborhoods with some natural areas. The northernmost portions of the basin contain some commercial area. Most of the basin is within unincorporated Leon County with the area to the west of the lake within the City boundary. Runoff from the basin passes through a series of smaller lakes north of Lake Tom John prior to discharging into the northern end of the lake. The outflow from the lake is at the southernmost end with water levels controlled by the elevation of the outflow channel. **Photo 5-54** shows the outflow from the lake. Flows out of the lake ultimately discharge into the eastern side of Lake Kinsale in the Killearn Chain of Lakes.



Photo 5-54: Lake Tom John Outflow Channel

5.6.2 Regulatory Status

Exhibit 5-2 presented the verified impaired waters within the overall Lake Lafayette basin. The Lake Tom John WBID 647A is presently verified impaired for nutrients (Chl-a, TN and TP). This impairment is based upon not meeting the criteria for a low color, low alkalinity lake as defined under FDEPs NNC. The criteria determination and water quality results that trigger the impairment are discussed further in **Section 5.6.3.6**.

5.6.3 Waterbody Data Review and Summary

This section presents an overview of available data and data sources for Lake Tom John and the Lake Tom John basin including bathymetry, land use, soils, septic systems, hydrologic measurements, surface water quality, groundwater quality, biological, stormwater treatment facilities, and atmospheric deposition.

5.6.3.1 Bathymetry

Presently, no bathymetric maps are available for Lake Tom John. Based on review of available reports, the maximum depth in the lake is 10 ft with an average depth of 6 ft.

5.6.3.2 Land Use

Figure 5-106 presents a map of the Level 2 land uses within the Lake Tom John basin. A table is provided to show the overall acreages and percent cover for the various levels. Tables are provided for both the Level 2 and grouped Level 1 land uses. The largest land use within the Lake Tom John Drainage Basin per the grouped Level 1 categories is Urban and Built Up (60 percent). The primary Level 2 land-use within Urban and Built Up is Medium Density Residential. The second largest land use in the overall basin is Upland Forest most of which is located just north of the lake (**Figure 5-106**).

5.6.3.3 Soils

The most prevalent soil group in the Lake Tom John basin is Group B (**Figure 5-107**), accounting for 65.6 percent of the area. Group B soils are considered to have a moderate rate of infiltration. Group A/D soils (9.2 percent) and B/D (8 percent) are found along the primary tributary pathways draining to the lake. These are considered to have high to moderate infiltration potential, but due to elevated water table conditions, will act more similarly to soils with low infiltration potential.

5.6.3.4 Septic Systems

An estimated 266 septic systems are within the boundaries of the Lake Tom John basin based on the FDOH septic tank layer (**Figure 5-108**). The septic tanks are located throughout most of the unincorporated areas in the basin with limited systems at the northern end.

5.6.3.5 Hydrologic Data

No recent historic or present hydrologic monitoring stations are located within the Lake Tom John basin.

5.6.3.6 Surface Water Quality Data

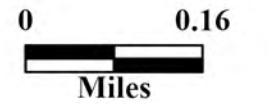
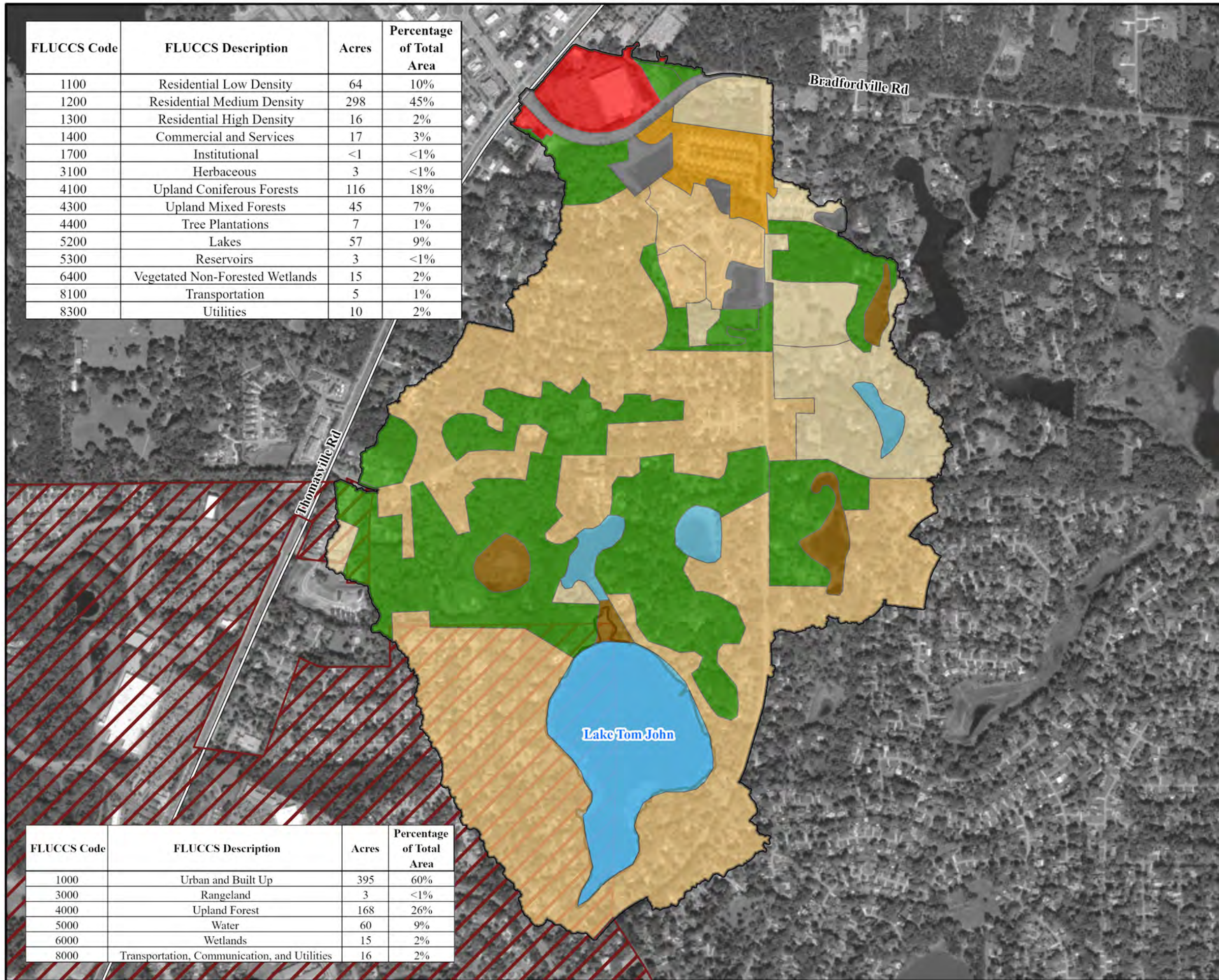
The IWR dataset for Lake Tom John (WBID 647A) spans primarily from 2016 to the present and includes contributions from local and state agencies (City, Leon County and FDEP). One year's worth of data were collected quarterly in 2005 but that is the only data prior to 2016.

Figure 5-109 presents the locations of in-lake water quality monitoring stations for Lake Tom John (yellow). No data have been collected in the tributaries draining into or out of the lake. A table is provided in **Figure 5-109** that shows the station ID, station name, period of record, and if the station represents in-lake or tributary data. Based on the number of stations and the length of the station IDs, station IDs were not included on the figure, rather each of the stations is given a number and the numbers correspond to stations in the table.

Figure 5-109 shows that the only stations with a continuous record are the stations located in the middle of the lake. These are stations 1 and 6, which are basically at the same location.

FLUCCS Code	FLUCCS Description	Acres	Percentage of Total Area
1100	Residential Low Density	64	10%
1200	Residential Medium Density	298	45%
1300	Residential High Density	16	2%
1400	Commercial and Services	17	3%
1700	Institutional	<1	<1%
3100	Herbaceous	3	<1%
4100	Upland Coniferous Forests	116	18%
4300	Upland Mixed Forests	45	7%
4400	Tree Plantations	7	1%
5200	Lakes	57	9%
5300	Reservoirs	3	<1%
6400	Vegetated Non-Forested Wetlands	15	2%
8100	Transportation	5	1%
8300	Utilities	10	2%

FLUCCS Code	FLUCCS Description	Acres	Percentage of Total Area
1000	Urban and Built Up	395	60%
3000	Rangeland	3	<1%
4000	Upland Forest	168	26%
5000	Water	60	9%
6000	Wetlands	15	2%
8000	Transportation, Communication, and Utilities	16	2%



Legend

Lake Tom John Drainage Basin

Tallahassee Corporate Limits

Land Use

1100: Residential Low Density

1200: Residential Medium Density

1300: Residential High Density

1400: Commercial and Services

1500: Industrial

2400: Nurseries and Vineyards

4100: Upland Coniferous Forests

4300: Upland Mixed Forests

3300: Mixed Rangeland

5200: Lakes

5300: Reservoirs

6400: Vegetated Non-Forested Wetlands

8100: Transportation

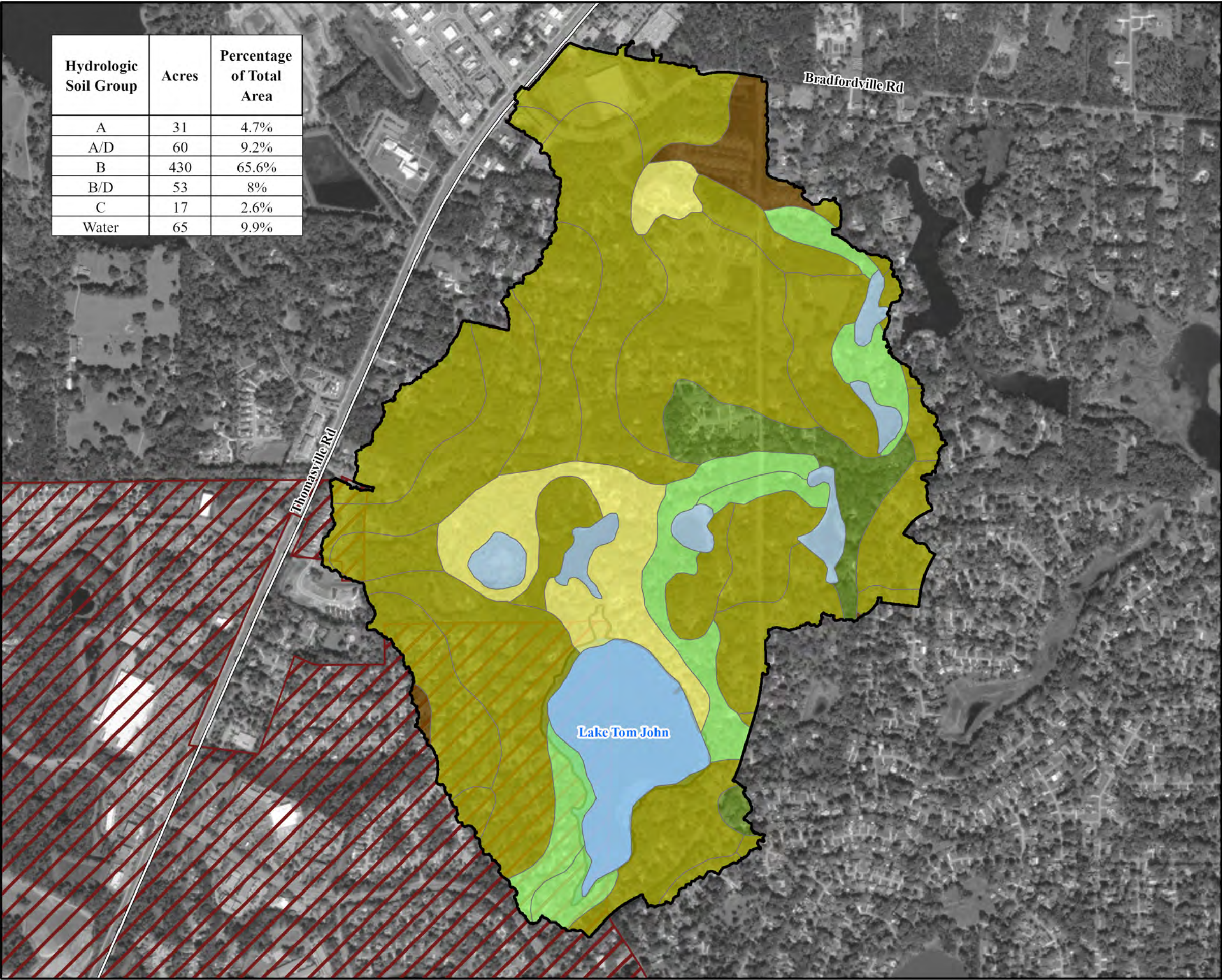
6500: Non-Vegetated

Sources:
Waterbodies: COT, 2020
Watersheds: COT, 2020
Roads: FDOT, 2020
Land Use: NWFWM, 2019
City Limits: COT, 2022

Figure 5-106:
Lake Tom John Drainage Basin Land Use
Map

Tallahassee Master Plan - Surface
Water (TMaPS)

Geosyntec
consultants



Hydrologic Soil Group	Acres	Percentage of Total Area
A	31	4.7%
A/D	60	9.2%
B	430	65.6%
B/D	53	8%
C	17	2.6%
Water	65	9.9%



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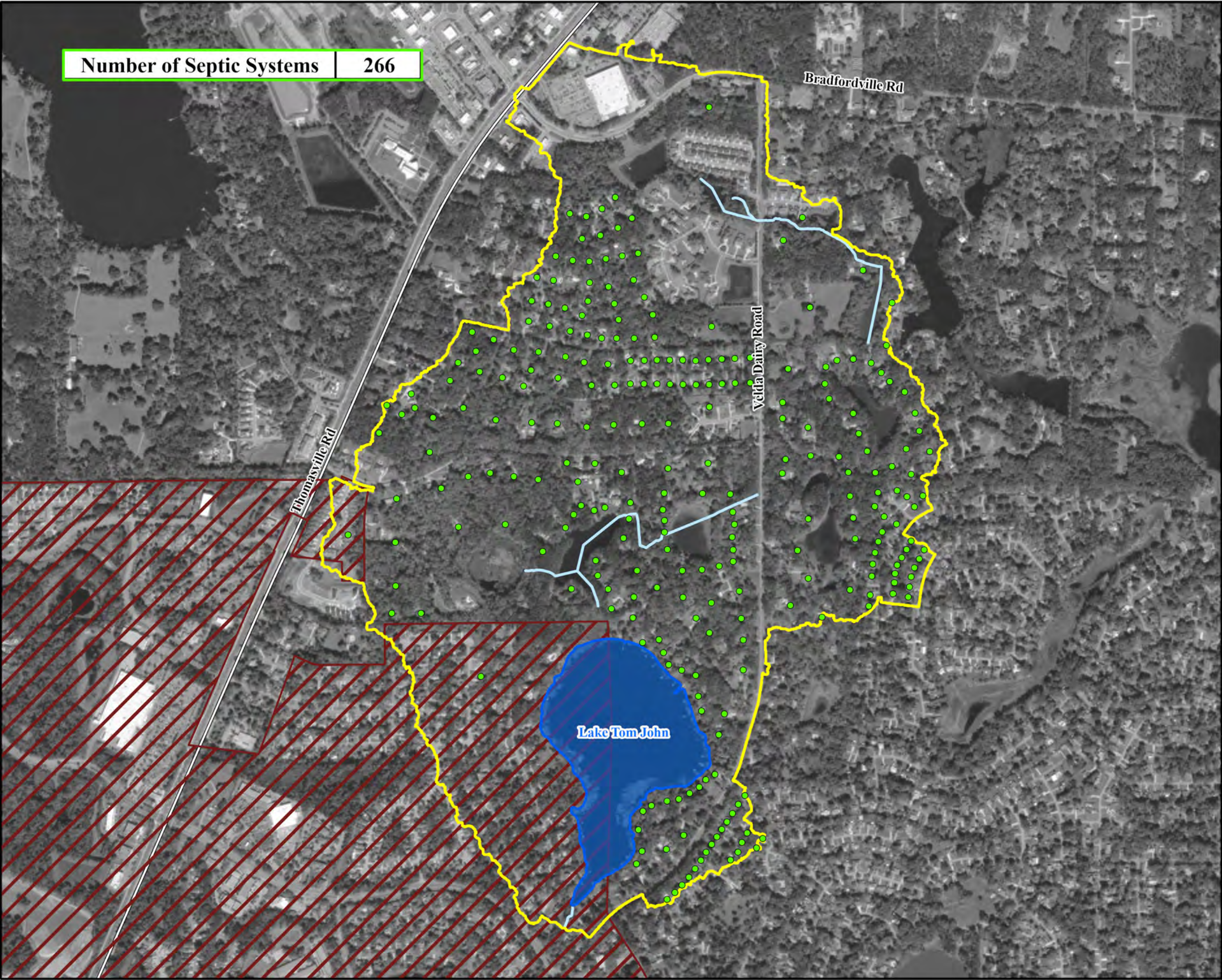
Legend

- Lake Tom John Drainage Basin
- Tallahassee Corporate Limits
- Hydrologic Soil Group
 - A
 - A/D
 - B
 - B/D
 - C
 - Water

Sources:
Waterbodies: COT, 2020
Watersheds: COT, 2020
Roads: FDOT, 2020
Soils: NRCS, 2020
City Limits: COT, 2022

Figure 5-107:
Lake Tom John Drainage Basin Soils Map

Tallahassee Master Plan - Surface
Water (TMaPS)



Legend

- Lake Tom John Drainage Basin
- Waterbodies in Study
- Watercourses
- Tallahassee Corporate Limits
- Septics Systems

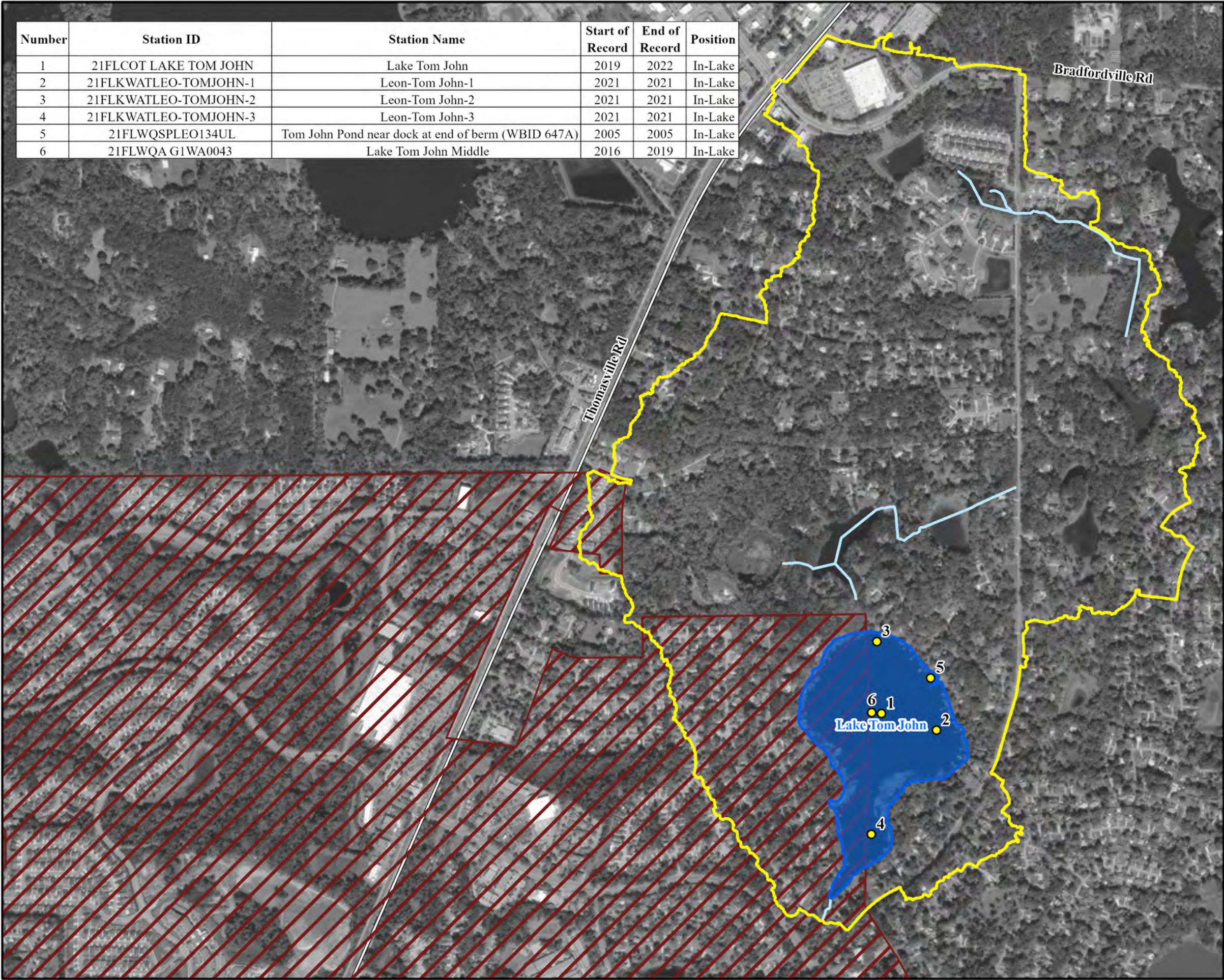
Sources:
Waterbodies: COT, 2020
Watersheds: COT, 2020
Roads: FDOT, 2020
Septic Systems: COT, 2020
City Limits: COT, 2022

Figure 5-108:
Lake Tom John Drainage Basin Septic Systems Map

Tallahassee Master Plan - Surface Water (TMaPS)



Number	Station ID	Station Name	Start of Record	End of Record	Position
1	21FLCOT LAKE TOM JOHN	Lake Tom John	2019	2022	In-Lake
2	21FLKWATLEO-TOMJOHN-1	Leon-Tom John-1	2021	2021	In-Lake
3	21FLKWATLEO-TOMJOHN-2	Leon-Tom John-2	2021	2021	In-Lake
4	21FLKWATLEO-TOMJOHN-3	Leon-Tom John-3	2021	2021	In-Lake
5	21FLWQSPLEO134UL	Tom John Pond near dock at end of berm (WBID 647A)	2005	2005	In-Lake
6	21FLWQA G1WA0043	Lake Tom John Middle	2016	2019	In-Lake



Legend

- Lake Tom John Drainage Basin
- Waterbodies in Study
- Watercourses
- Tallahassee Corporate Limits
- Water Quality Stations
- Position
 - In-Lake

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Drainage Basins: COT, 2020
City Limits: COT, 2022
WQ Stations: FDEP, 2022

Figure 5-109:
Lake Tom John Water Quality Station
Location Map

Tallahassee Master Plan - Surface
Water (TMaPS)



Some initial plots of the available data in the lake are provided in this section, which includes plots of the raw data and trends along with AGM. Nutrients are the primary constituent of interest relative to water quality conditions in Lake Tom John, therefore, plots are provided for the key parameters related to potential nutrient impairment. These include TN, TP, Chl-a, and TSI. As discussed earlier, where available, data are plotted from 2010 to 2020 to represent present conditions. For Tom John data are plotted from 2016 to 2020. Additionally, based on interest in the area relative to septic systems and other sources, bacteria, specifically *E. coli* are included. Additional data plots and analyses are provided as part of the qualitative assessment of sources in **Section 5.6.4**.

Figure 5-110 through **Figure 5-112** present plots of the measured TN, TP and Chl-a from 2016 to 2020. The TN concentrations are relatively consistent from 2016 through 2020. TP concentrations show somewhat of a downward trend. Chl-a concentrations are highly variable year to year.

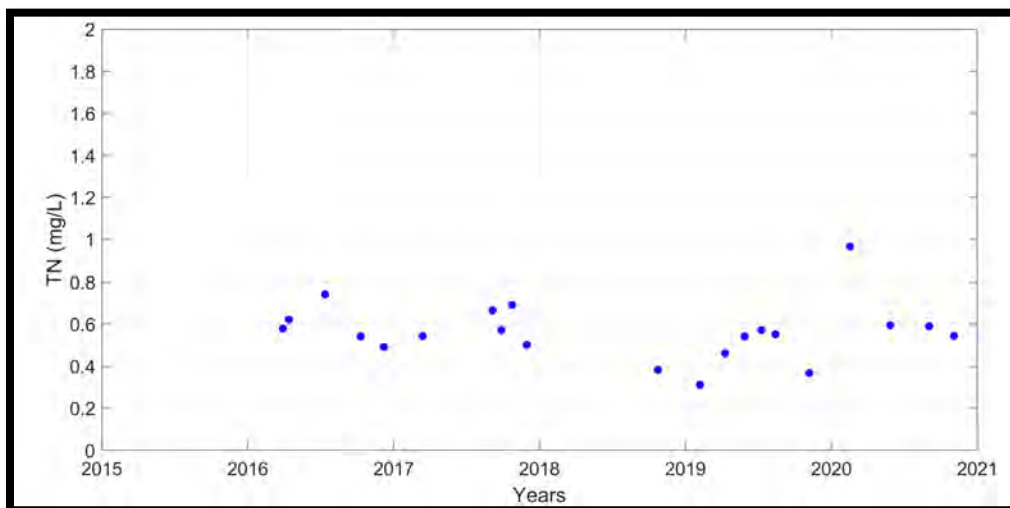


Figure 5-110: Plot of Measured TN (2016-2020)

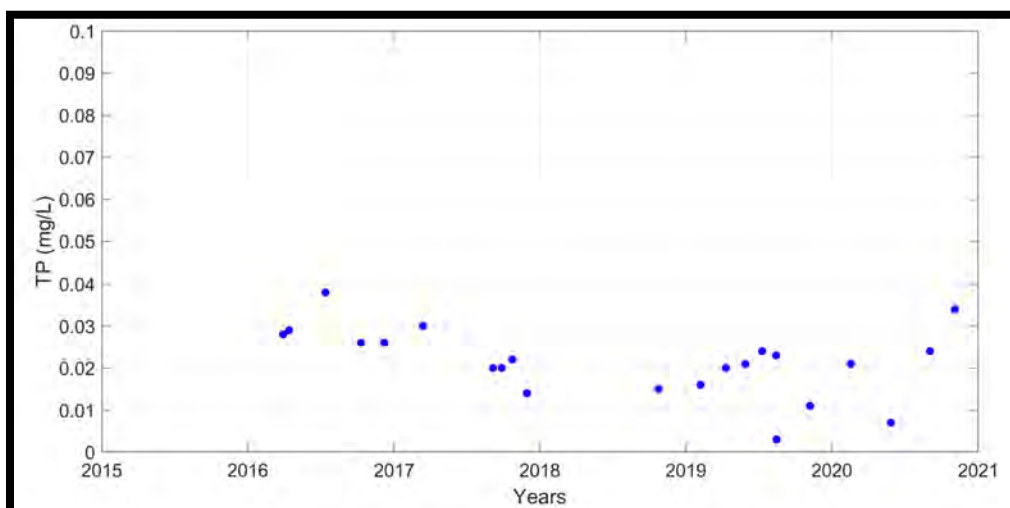


Figure 5-111: Plot of Measured TP (2016-2020)

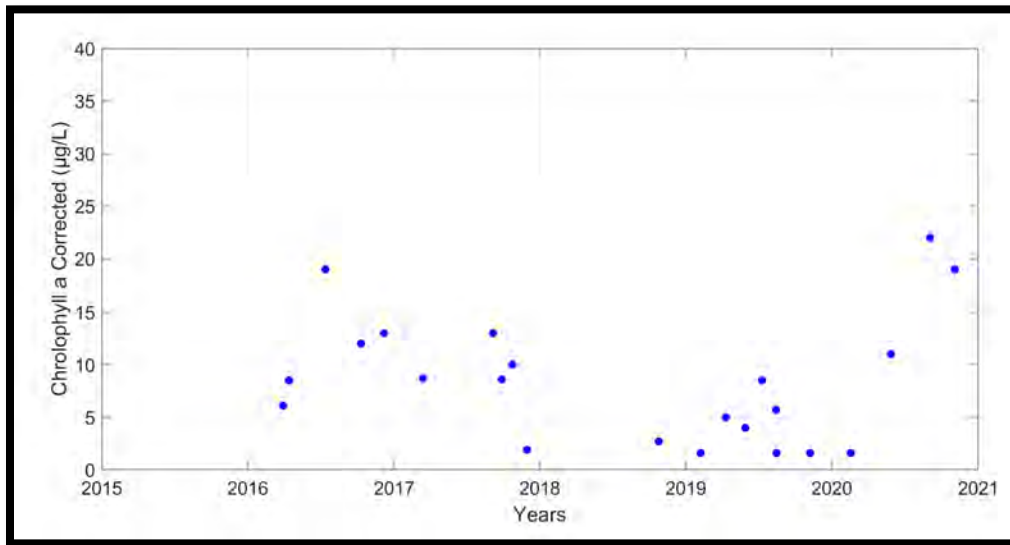


Figure 5-112: Plot of Measured Chl-a (2016-2020)

Under FDEP's NNC, Lake Tom John is defined as a low color, low alkalinity system. Based on this designation, the AGM threshold for Chl-a is 6 µg/L. For TN and TP, a range of concentrations are allowable, based on maintaining Chl-a levels in the lake below 6 µg/L. For TN, the range is 0.51 mg/L to 0.93 mg/L. For TP, the range is 0.01 mg/L to 0.03 mg/L. The designation is based on long-term average color lower than 40 PCU and long-term alkalinity levels less than 20 mg/L. Presently, the long-term average alkalinity is 18-19 mg/L which is right near the 20 mg/L. If the long-term average alkalinity were greater than 20 mg/L the lake would not be impaired. At present for *E. coli*, the criteria are monthly geometric means below 126 colonies per 100 mL of water and less than 10 percent of samples above 410 colonies per 100 mL of water in any 30-day period.

TN, TP, and Chl-a, AGMs are plotted in **Figure 5-113** through **Figure 5-115** as these define the status of the lake relative to nutrient impairments. Where sufficient data are available to assess the AGMs, the levels are provided from 2016 through 2020. The Chl-a threshold and the minimum and maximum thresholds for TN and TP relative to the NNC are on each of the graphs as pink dashed lines. **Figure 5-116** presents a plot of calculated TSI values in the lake. While TSI is no longer utilized for the determination of impairment, it does serve as an indicator of lake health. Based on TSI definitions, levels below 60 are deemed good condition, levels between 60 and 70 indicate fair condition, while levels above 70 indicate poor condition. **Figure 5-117** presents a plot of *E. coli* data for the available period of record.

Examination of the TN plot (**Figure 5-113**) shows that from 2016 to 2020 TN AGM levels have been just above or below the minimum threshold. TP AGM levels (**Figure 5-114**) have fallen between the minimum and maximum threshold values for each of the years with the later years closer to the minimum. The Chl-a AGMs from 2016 through 2020 (**Figure 5-115**) were above the 6 µg/L threshold in 3 of the 4 years with all levels generally around or below 10 µg/L. Under the case where the lake long-term average alkalinity is above 20 mg/L all Chl-a AGMs would be well below the threshold.

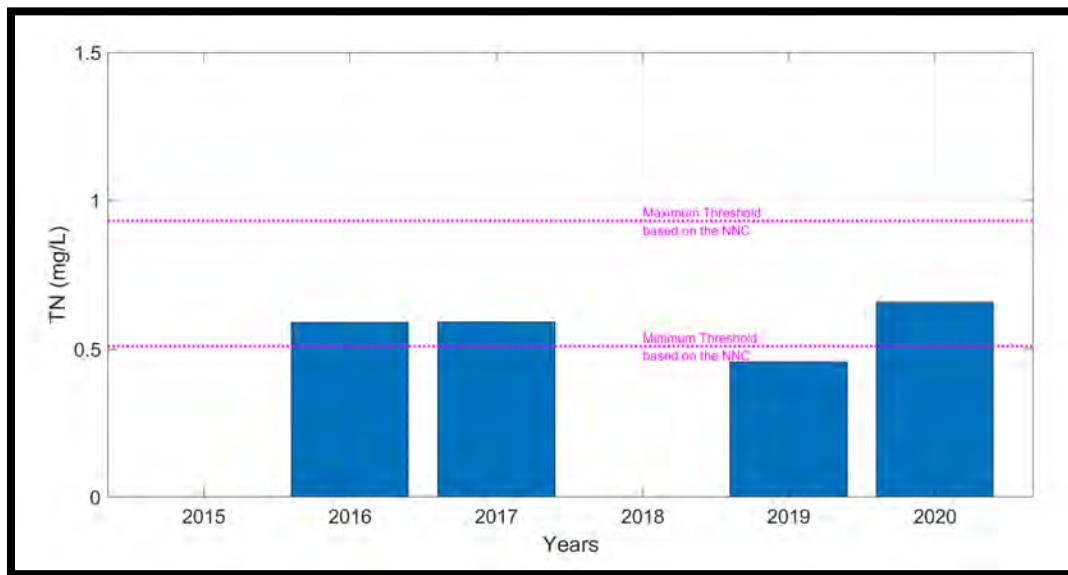


Figure 5-113: Plot of Annual Geometric Means for TN with NNC Criteria for Lake Tom John

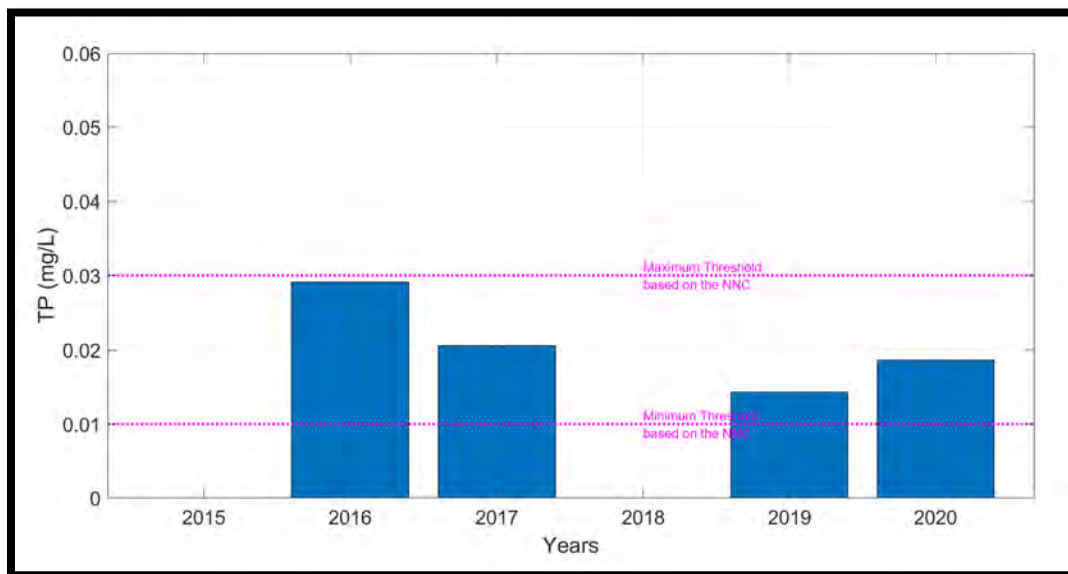


Figure 5-114: Plot of Annual Geometric Means for TP with NNC Criteria for Lake Tom John

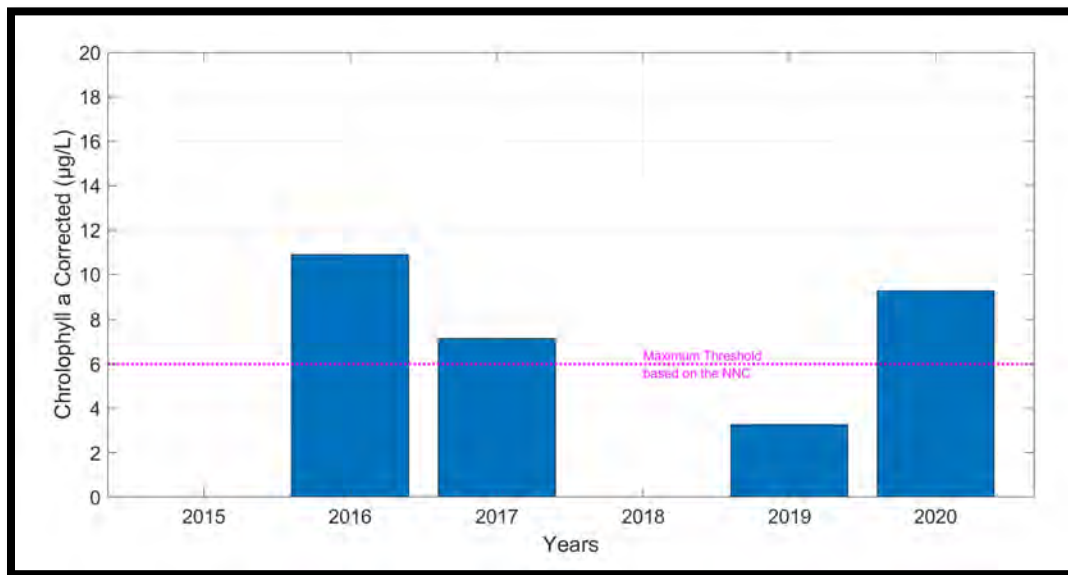


Figure 5-115: Plot of Annual Geometric Means for Chl-a with NNC Criteria for Lake Tom John

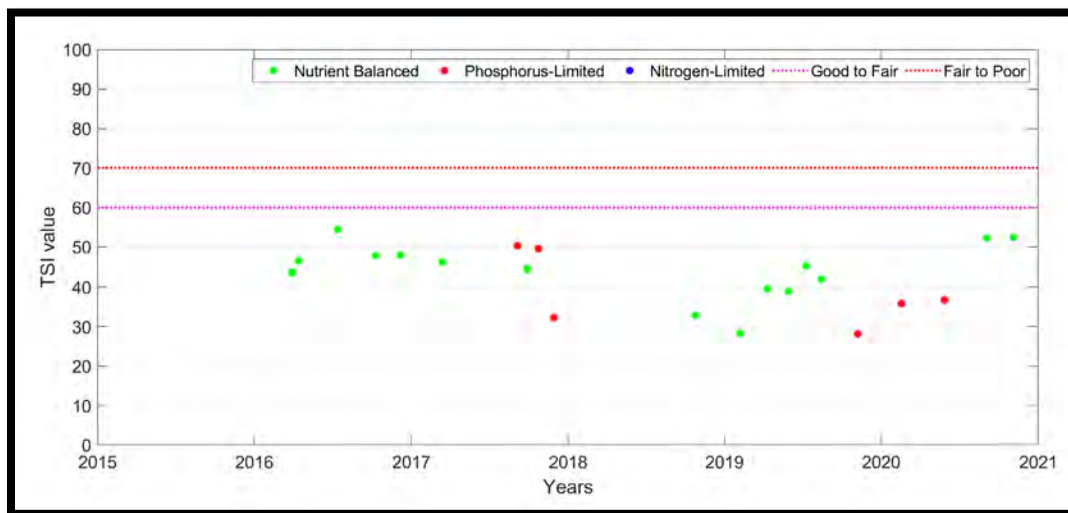


Figure 5-116: Trophic State Index for Lake Tom John (2016 to 2020)

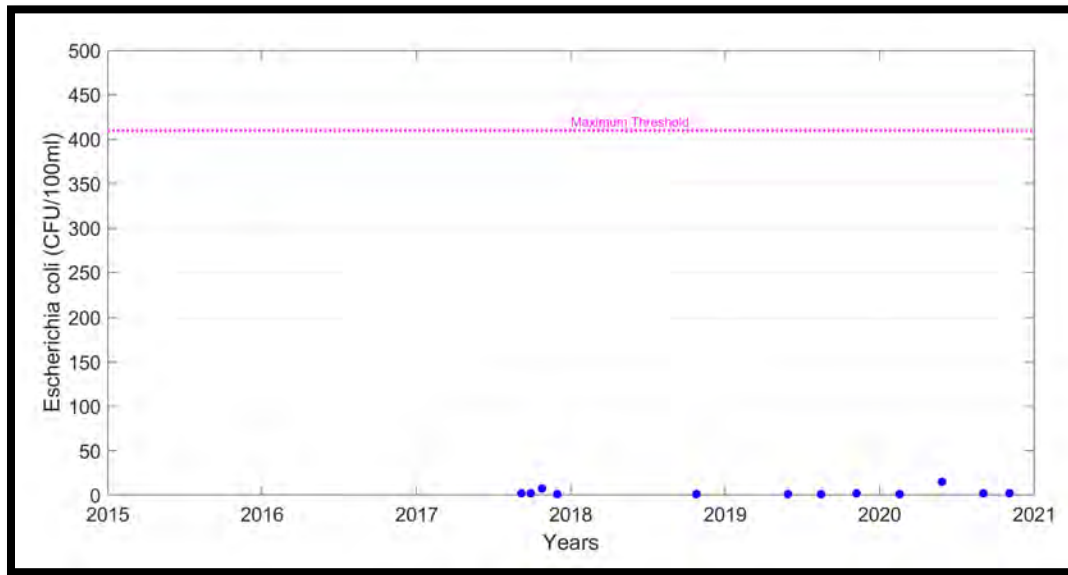


Figure 5-117: Plot of *E. coli* Measurements (2016 to 2020)

Examination of the TSI plot (**Figure 5-116**) shows all measurements in the good range with generally nutrient balanced conditions. No values went above the 60 threshold during the period of record.

Figure 5-117 presents a plot of measured *E. coli* levels in the lake from 2016 through 2020. The data all show very low values, with most at below detection limits.

5.6.3.7 Groundwater Data

Presently, there are no surficial groundwater monitoring wells within the Lake Tom John basin.

5.6.3.8 Biological Data

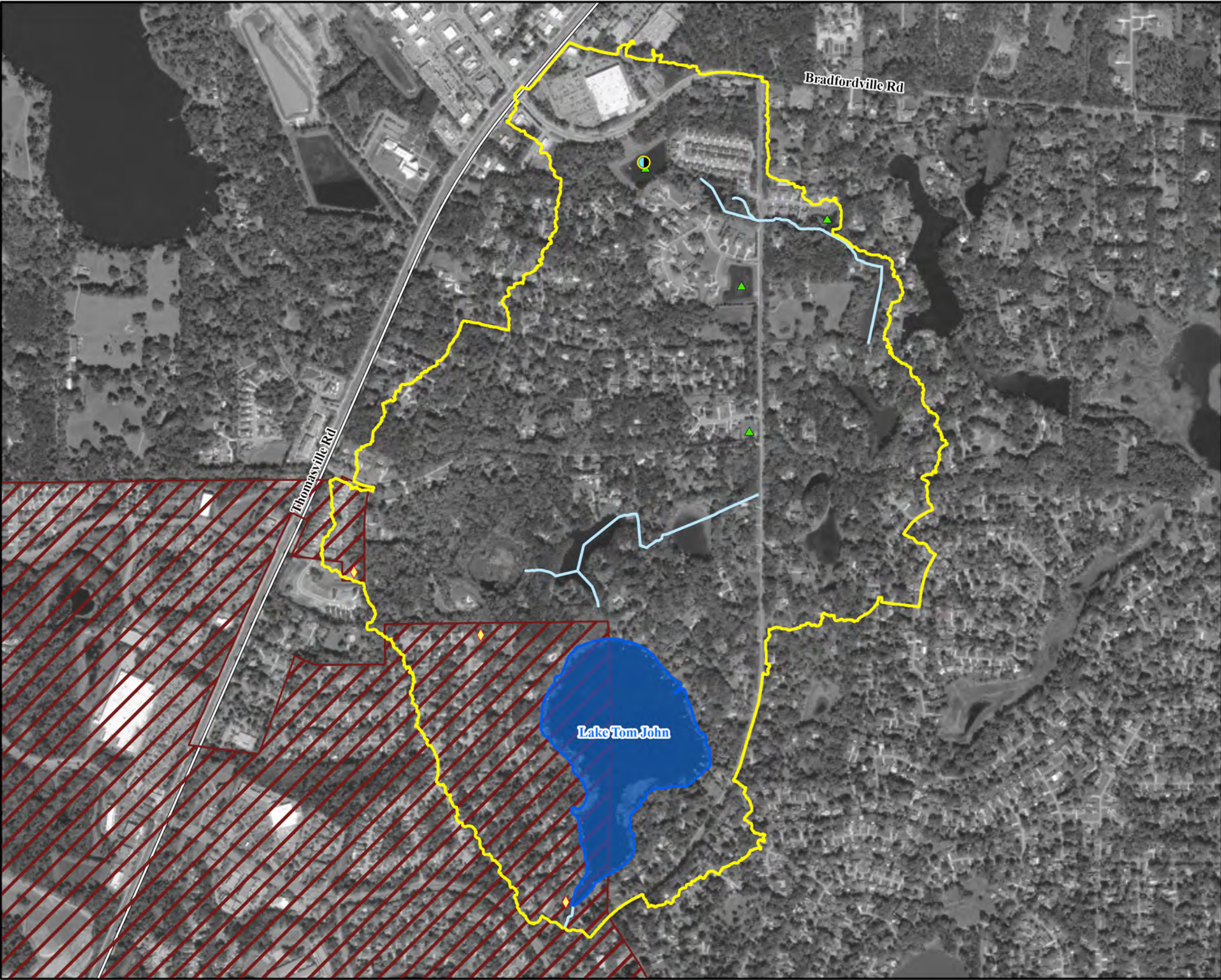
Table 5-20 presents LVI data collected in Lake Tom John. Only a single assessment is available for the lake. The LVI determination was 55, which represents a healthy condition.

Table 5-20: Summary of LVI Results from Lake Tom John

Date	Station ID	LVI	Aquatic Life Use Category
10/24/2018	21FLWQA G1WA0043	55	Healthy

5.6.3.9 Stormwater Treatment Facilities

Figure 5-118 presents a map showing the locations of stormwater treatment facilities throughout the Lake Tom John Basin. The figure shows a limited number of stormwater ponds within the basin. There are three Leon County facilities located along Velda Dairy Road, one large FDOT/Leon County facility at the upper end of the basin in the area of the commercial development, and three City facilities on the western side of the lake.



Legend

- Lake Tom John Drainage Basin
- Waterbodies in Study
- Watercourses
- Tallahassee Corporate Limits
- City of Tallahassee Stormwater Ponds
- Leon County Stormwater Ponds
- FDOT Stormwater Ponds

Sources:
Waterbodies: COT, 2020
Watersheds: COT, 2020
Roads: FDOT, 2020
BMPs: Geosyntec, 2022
City Limits: COT, 2022

Figure 5-118:
Lake Tom John Basin BMP Location Map

Tallahassee Master Plan - Surface Water (TMaPS)



5.6.3.10 Atmospheric Deposition Data

Section 5.4.3.11 presented the location of the nearest atmospheric deposition station to the Lake Lafayette basin. The data from this station will be utilized to calculate atmospheric deposition to Lake Tom John.

5.6.3.11 Data Summary

For the purposes of the qualitative analysis of sources of pollutants to Lake Tom John (**Section 5.6.4**), the available data are limited. There are sufficient active surface water quality stations within the lake to support the qualitative assessment but data in the upstream reaches that flow into the lake do not exist. Specific recommendations on additional data collection efforts are provided in **Section 5.10**. The following outlines limitations in the available data.

- No hydrologic data (level or inflow/outflow) data has been collected on the lake or in the upstream discharge to the lake or the downstream discharge to the Killlearn Chain of Lakes.
- There are no water quality monitoring stations for the inflow to the lake which represents the bulk of the stormwater inflow from the drainage basin.
- No surficial groundwater monitoring stations are located in the vicinity to determine the quality of potential seepage into the lake or ditch segments.
- No data are available to determine the potential for internal loading as a source.

5.6.4 Qualitative Assessment of Sources

As outlined in previous sections, prior to performing loading calculations and other analyses to quantify existing pollutant sources to Lake Tom John, it is important to analyze available data and summarize findings from historical studies to support identification of likely sources.

For Lake Tom John, the sources to be evaluated include the following:

- Stormwater runoff
- Septic systems
- Internal recycling and seepage
- Wastewater
- Atmospheric deposition
- Interconnected flows

An overview of analyses and findings for each source listed above is provided in the following sections.

5.6.4.1 Stormwater Runoff

To assess stormwater runoff as a potential source of pollutant loads to Lake Tom John the LDI level within the subbasin draining to the lake was evaluated. LDI values for the full basin

draining to the Killearn Chain of Lakes were presented on **Figure 5-95** including the Lake Tom John Basin. The map shows that for the watershed draining to Lake Tom John, LDI levels are moderate, which would indicate that this area has potential for anthropogenic pollutant loads from stormwater runoff. No data are available for any of the tributaries flowing into Lake Tom John to support direct assessment of stormwater runoff.

5.6.4.2 Septic Systems

Figure 5-108 presented the locations of septic systems within the Lake Tom John basin. **Figure 5-96** presented a map showing the septic tank densities by subbasin for the Killearn Chain of Lakes, including Lake Tom John. For the overall area draining to Lake Tom John (**Figure 5-96**) the septic densities are around 1 system per 2 acres. Examination of the locations of the septic systems (**Figure 5-108**) shows there are a number of systems close to the lake along the eastern shore as well as along the tributaries and smaller lakes that drain into the upper end of Lake Tom John which increases their potential as a source of pollutants to the lake and drain. Presently, based on the low *E. coli* levels measured in the lake center (**Figure 5-117**), it would not appear that septic systems are likely not a significant source, but the potential loading will be quantified in **Section 5.6.5**.

5.6.4.3 Internal Recycling and Seepage

Internal Recycling

To date, no studies or data collection efforts have been undertaken to assess the potential for loading from sediments in Lake Tom John. Presently, based on the criteria outlined and discussed in **Section 5.5.2**, the lake is impaired for nutrients. While concerns exist on the applicability of the NNC targets for the lake, the impaired status would indicate a need to further quantify potential sources to the lake including internal recycling. As such, internal recycling is identified as a potential source of loads to the lake.

Seepage

As outlined in **Section 5.6.3.7**, no surficial aquifer data in the immediate vicinity of the lake and drain were identified. As was outlined for internal recycling, seepage is identified as a potential source to the lake that has not been quantified. As septic is the most likely source of seepage load, the evaluation of septic load would address this load source. The determination for septic loading (**Section 5.6.3.4**) was that it is likely not a significant source, but it will be quantified in **Section 5.6.5**.

5.6.4.4 Wastewater

Within the Lake Tom John basin, there currently are no direct wastewater discharges. Additionally, no areas in the Lake Lafayette basin presently have reuse discharges. **Figure 5-119** presents a map of the Lake Tom John basin boundaries in relation to sewer service areas and sewer infrastructure. The sewer infrastructure within the drainage basin is located along Velda Dairy Road and the incorporated area to the west of the lake. As was defined for septic systems, bacteria data do not indicate sources of sewage to the lake. Therefore, wastewater infrastructure is not identified as a potential significant source of pollutant loads to Lake Tom John.



Legend

- Lake Tom John Drainage Basin
- Waterbodies in Study
- Tallahassee Corporate Limits
- Sewer Service Areas

Sources:
Waterbodies: COT, 2020
Drainage Basins: COT, 2020
Roads: FDOT, 2020
City Limits: COT, 2022
Waste Water: COT, 2020

Figure 5-119:
City of Tallahassee Wastewater Service
Areas within Lake Tom John Basin

Tallahassee Master Plan - Surface
Water (TMaPS)



5.6.4.5 Atmospheric Deposition

For the immediate Lake Tom John basin, the ratio of the watershed area to lake area is around 16:1. With this ratio, and the potential attenuation of rainfall runoff, direct atmospheric deposition to the lake can play a role in overall loading, especially for nitrogen. **Section 5.5.3.10** identified the nearest atmospheric deposition station as the Quincy Station (FL14) (**Figure 5-35**).

5.6.4.6 Interconnected Flows

Presently the bulk of the drainage basin flows into Lake Bess located immediately north of Lake Tom John and then discharges to Lake Tom John. As such, the interconnected flow into Lake Tom John may represent the primary loading of stormwater runoff from the basin and may be a significant source of load to Lake Tom John. As discussed earlier, presently there is no data available for Lake Bess or for the flow from Lake Bess into Lake Tom John.

5.6.4.7 Summary of Findings

Based on the discussions above, and data and information presented in **Section 5.5.3**, there are various potential sources of pollutant loads to Lake Tom John. Stormwater runoff contributing to direct inflow and interconnected flow from upstream waterbodies (Lake Bess) is identified as a potentially significant anthropogenic load and is quantified in **Section 5.6.5**. Internal loading is also identified as a potential load but at present data are not available to quantify it. Though not identified as potential significant sources, septic systems and atmospheric deposition are quantified for comparative purposes in **Section 5.6.5** based on available data.

5.6.5 Calculation of Potential Nutrient Loads

This section presents calculations of potential nutrient (TN and TP) loads to Lake Tom John for the sources identified for calculation in **Section 5.6.4.7**. These include stormwater runoff, septic systems, and atmospheric deposition. Where loads were not calculated the sections below provide brief discussions. The load calculations are for the purpose of comparing the potential magnitudes of each source relative to one another to support determination of sources to target for load reduction.

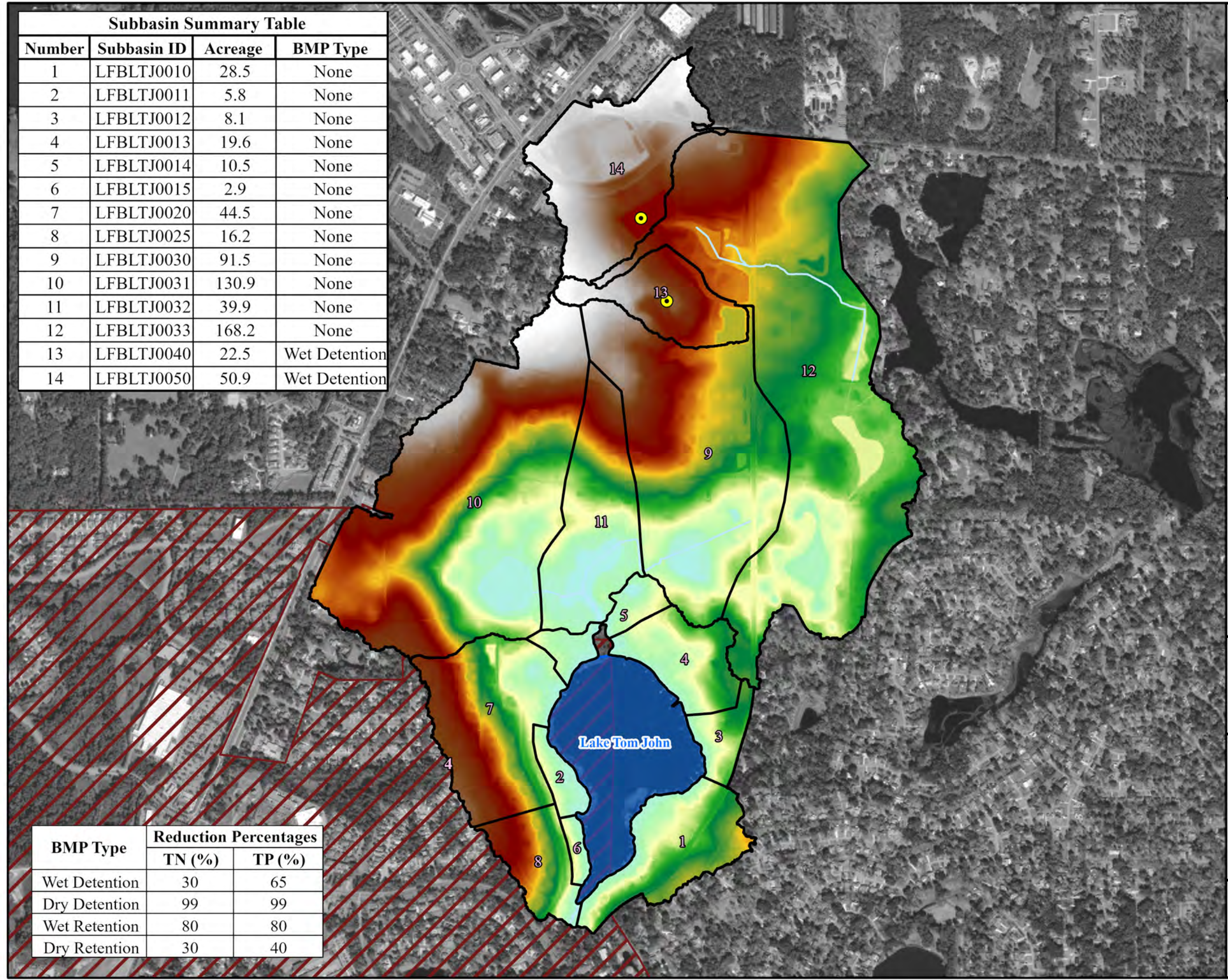
5.6.5.1 Stormwater Pollutant Load

In order to calculate the stormwater TN and TP loads to Lake Tom John, average annual pollutant load modeling was performed. The goal was to identify outfalls that are contributing higher TN and TP loads relative to one another and to quantify the total TN and TP loads to Lake Tom John. TN and TP loads were calculated using the Spatially Integrated Model for Pollutant Loading Estimates (SIMPLE-Seasonal) model. The model methodology was described in detail in **Section 5.4.5.1** for the stormwater loads to the Lake Lafayette Chain of Lakes.

Figure 5-120 presents the subbasins and the DEM utilized in the SIMPLE model calculations for Lake Tom John. **Figure 5-121** presents the aggregated land use. Finally, **Figure 5-122** presents the CDAs for the Lake Tom John stormwater loading to define total and per acre TN and TP loads, as well as the ranking of CDAs around the lake.

Subbasin Summary Table			
Number	Subbasin ID	Acreage	BMP Type
1	LFBLTJ0010	28.5	None
2	LFBLTJ0011	5.8	None
3	LFBLTJ0012	8.1	None
4	LFBLTJ0013	19.6	None
5	LFBLTJ0014	10.5	None
6	LFBLTJ0015	2.9	None
7	LFBLTJ0020	44.5	None
8	LFBLTJ0025	16.2	None
9	LFBLTJ0030	91.5	None
10	LFBLTJ0031	130.9	None
11	LFBLTJ0032	39.9	None
12	LFBLTJ0033	168.2	None
13	LFBLTJ0040	22.5	Wet Detention
14	LFBLTJ0050	50.9	Wet Detention

BMP Type	Reduction Percentages	
	TN (%)	TP (%)
Wet Detention	30	65
Dry Detention	99	99
Wet Retention	80	80
Dry Retention	30	40





CITY OF
TALLAHASSEE

N

0 0.17
Miles

Legend

Subbasins

Waterbodies in Study

Watercourses

Tallahassee Corporate Limits

BMP Type

Wet Detention

Topographic Elevations
ft NAVD88

242

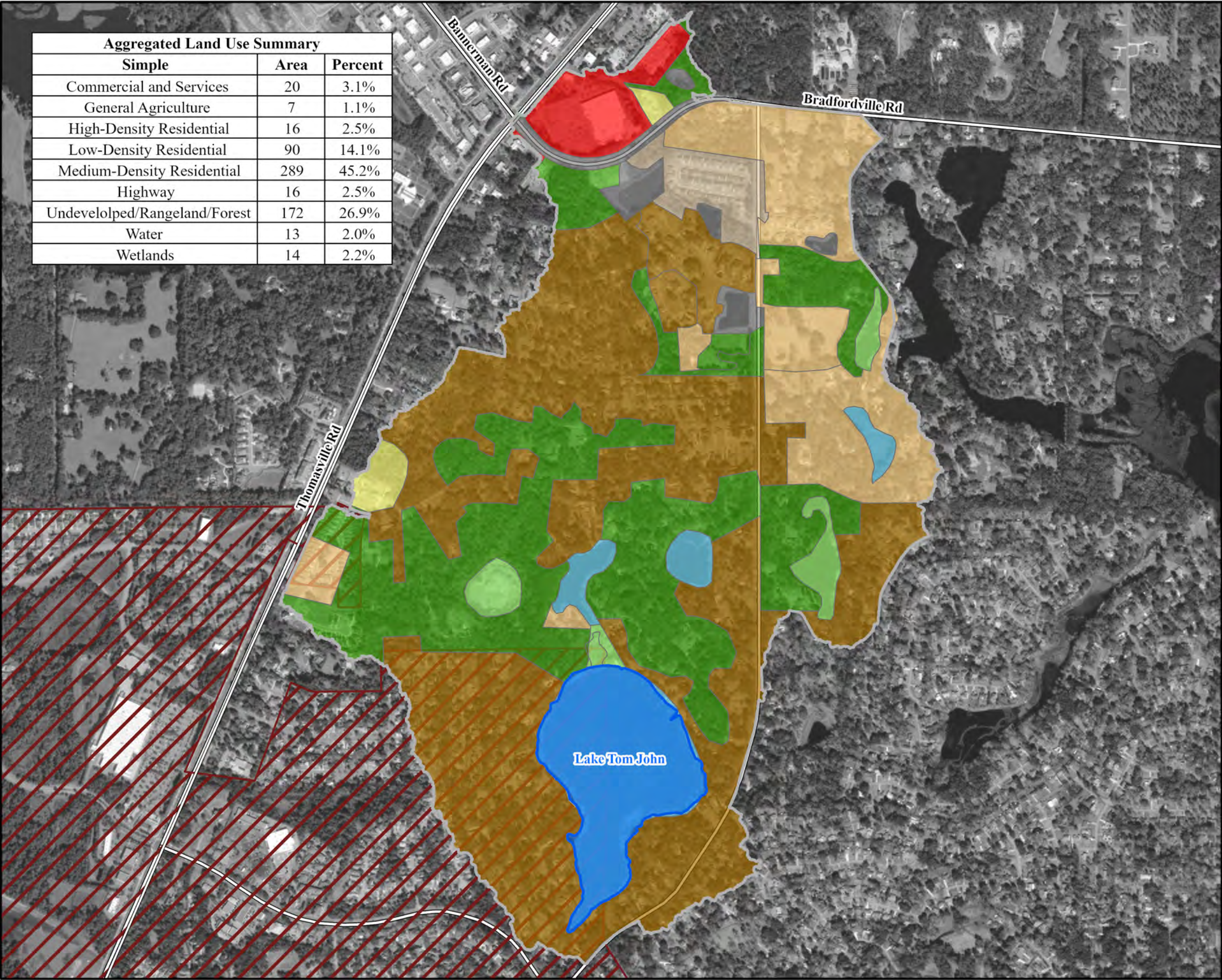
103

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Subbasins: Geosyntec, 2022
Roads: COT-Leon County, 2023
City Limits: COT, 2022
BMPs: Geosyntec, 2023
Elevation: COT-Leon County, 2018

Figure 5-120:
Lake Tom John Subbasin Delineation and
BMPs

Tallahassee Master Plan - Surface
Water (TMaPS)

Geosyntec
consultants



Aggregated Land Use Summary		
Simple	Area	Percent
Commercial and Services	20	3.1%
General Agriculture	7	1.1%
High-Density Residential	16	2.5%
Low-Density Residential	90	14.1%
Medium-Density Residential	289	45.2%
Highway	16	2.5%
Undeveloped/Rangeland/Forest	172	26.9%
Water	13	2.0%
Wetlands	14	2.2%



Legend

- Lake Tom John Drainage Basin
- Waterbodies in Study
- Tallahassee Corporate Limits
- Aggregated Land Use
- Land Use Type
 - Commercial and Services
 - General Agriculture
 - High-Density Residential
 - Low-Density Residential
 - Medium-Density Residential
 - Highway
 - Undeveloped/Rangeland/Forest
 - Water
 - Wetlands

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Land Use: Geosyntec, 2023
Roads: FDOT, 2020
City Limits: COT, 2020

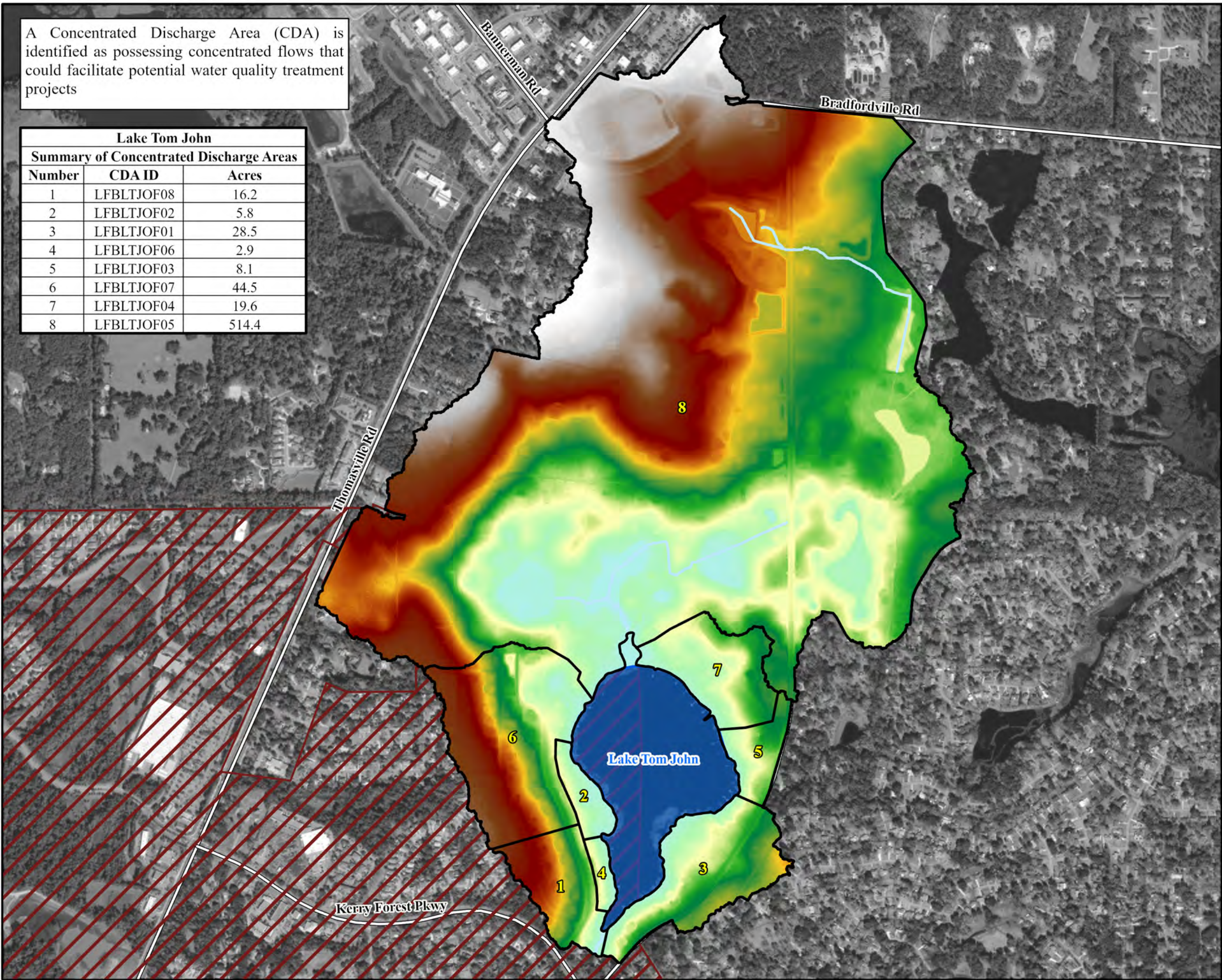
Figure 5-121:
Lake Tom John Aggregated Land Use

Tallahassee Master Plan - Surface
Water (TMaPS)



A Concentrated Discharge Area (CDA) is identified as possessing concentrated flows that could facilitate potential water quality treatment projects

Lake Tom John		
Summary of Concentrated Discharge Areas		
Number	CDA ID	Acres
1	LFBLTJOF08	16.2
2	LFBLTJOF02	5.8
3	LFBLTJOF01	28.5
4	LFBLTJOF06	2.9
5	LFBLTJOF03	8.1
6	LFBLTJOF07	44.5
7	LFBLTJOF04	19.6
8	LFBLTJOF05	514.4



- Legend**
- Waterbodies in Study
 - Watercourses
 - Tallahassee Corporate Limits
- Topographic Elevations**
ft NAVD88
-

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
CDAs: Geosyntec, 2022
Roads: COT-Leon County, 2023
City Limits: COT, 2022
Elevation: COT-Leon County, 2018

Figure 5-122:
Lake Tom John Concentrated Discharge Areas

Tallahassee Master Plan - Surface Water (TMaPS)



Stormwater Nutrient Loads to Lake Tom John

Figure 5-123 presents the distribution of the ranking of the CDAs for TN along with the total load and per acre loads, see the table on **Figure 5-123**. The rankings are color coded with the highest ranked CDAs in dark green moving down to the lowest ranked in pale yellow. The calculated total stormwater TN loads from the CDAs ranged from as low as 11.4 lb/yr up to 1741.8 lb/yr. The per acre loads ranged from 1.6 lb/acre/yr up to 4.0 lb/acre/yr. The map identifies two CDAs as ranking highest, these are on the west side of the lake within the Cities incorporated area. The total potential stormwater runoff load for TN for Lake Tom John is 2,194 lb/yr.

Figure 5-124 presents the distribution of the ranking of the CDAs for TP along with the total load and per acre loads, see the table on **Figure 5-124**. The calculated total stormwater TP loads from the CDAs ranged from as low as 3.1 lb/yr up to 316.5 lb/yr. The per acre loads ranged from 0.45 lb/acre/yr up to 1.1 lb/acre/yr. The total potential stormwater runoff load for TP for Lake Tom John is 438.2 lb/yr.

5.6.5.2 Septic Load

In order to analyze the potential impacts from septic tank units to Lake Tom John, the SPIL method adopted by the FDEP was utilized to quantify the potential septic load. The approach and calculations were described earlier in **Section 5.4.5.2** which presented the septic loading to the Lake Lafayette Chain of Lakes. As outlined earlier, the calculations were only done for nitrogen (TN), and based on literature on transport and assimilation, may represent a conservative potential load.

There were 104 septic tank units identified within 200 meters of Lake Tom John and the primary tributary (and lakes) that drain to the north end of Lake Tom John. **Figure 5-125** shows the septic systems utilized in the analyses with those associated with direct loading to the lake as green and those to the tributary and lakes upstream as pink. A table provided on the figure summarizes the calculated TN load from septic units. The calculated direct load to the lake is 627 lb/yr and the load to the tributary/lakes is 497 lb/yr.

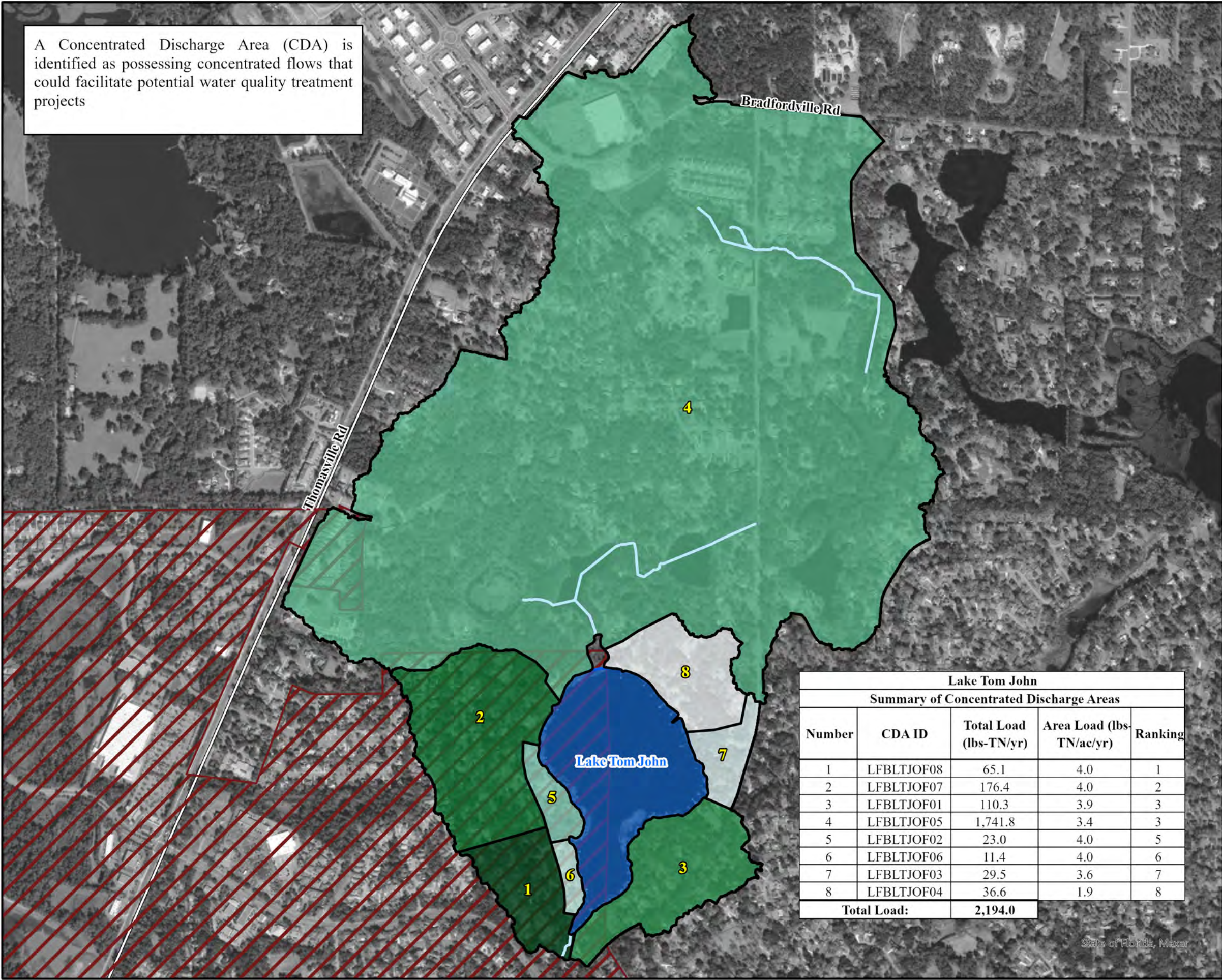
5.6.5.3 Point Source Load

No active point sources were identified within the Lake Lafayette Chain of Lakes basin. Therefore, the point source loads for TN and TP are set to 0 lb/yr for Lake Tom John.

5.6.5.4 Lake Inflow Load

As was discussed in **Section 5.6.4.6** inflows from the northern portion of the basin pass through Lake Bess prior to discharging to Lake Tom John (**Figure 5-126**). Presently, no water quality data are available for Lake Bess so calculation of the load from the lake cannot be done. Presently, the inflow load from Lake Bess is incorporated into the stormwater load calculations although any attenuation or increase in the loads as they pass through Lake Bess are not accounted for.

A Concentrated Discharge Area (CDA) is identified as possessing concentrated flows that could facilitate potential water quality treatment projects



Lake Tom John				
Summary of Concentrated Discharge Areas				
Number	CDA ID	Total Load (lbs-TN/yr)	Area Load (lbs-TN/ac/yr)	Ranking
1	LFBLTJOF08	65.1	4.0	1
2	LFBLTJOF07	176.4	4.0	2
3	LFBLTJOF01	110.3	3.9	3
4	LFBLTJOF05	1,741.8	3.4	3
5	LFBLTJOF02	23.0	4.0	5
6	LFBLTJOF06	11.4	4.0	6
7	LFBLTJOF03	29.5	3.6	7
8	LFBLTJOF04	36.6	1.9	8
Total Load:		2,194.0		



Legend

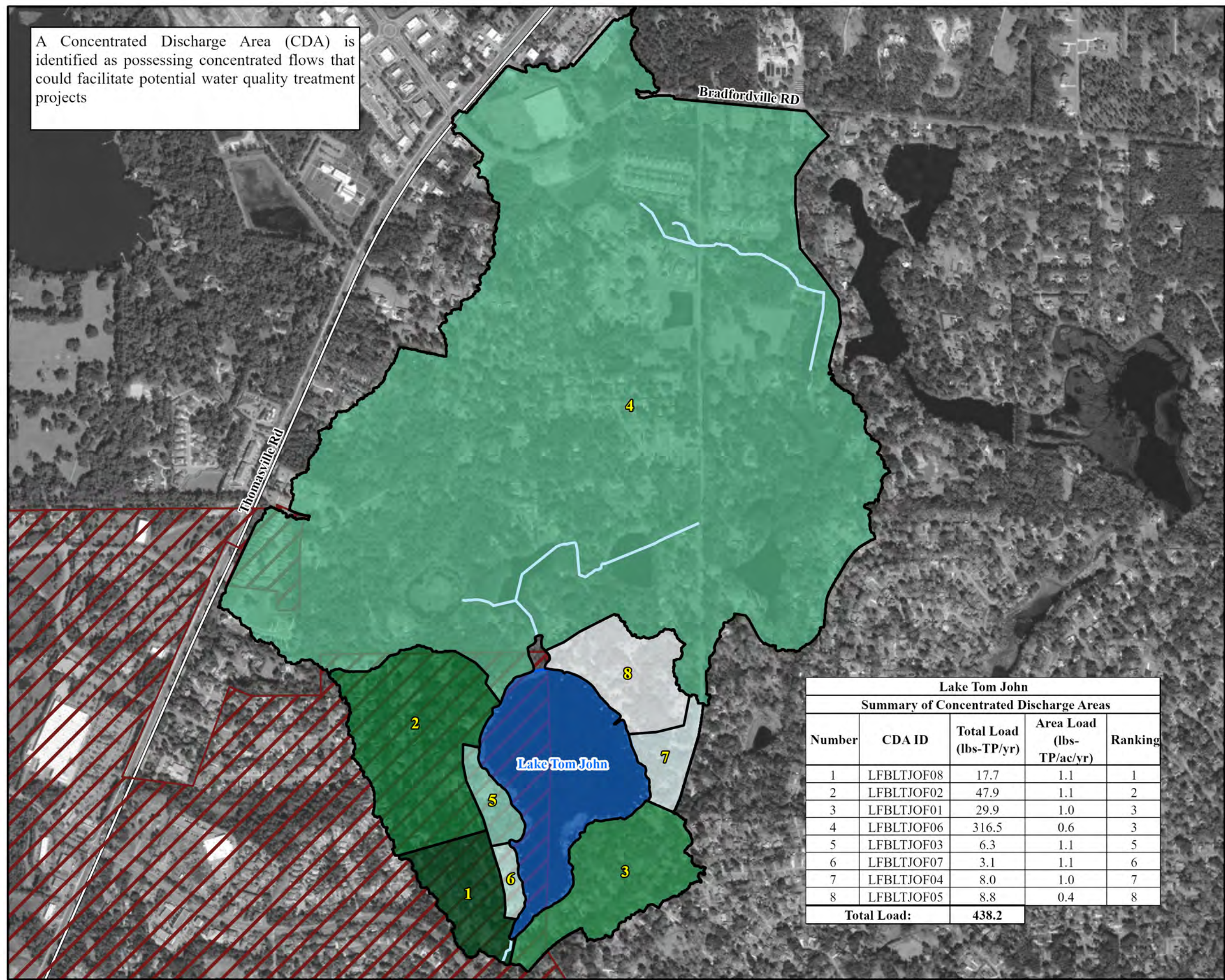
- Concentrated Discharge Areas
- Waterbodies in Study
- Watercourses
- Tallahassee Corporate Limits
- Concentrated Discharge Areas Ranking
 - High (1)
 - Low (8)

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
CDAs: Geosyntec, 2022
Roads: COT-Leon County, 2023
City Limits: COT, 2022
Elevation: COT-Leon County, 2018

Figure 5-123:
Lake Tom John Concentrated Discharge
Areas-Total Nitrogen

Tallahassee Master Plan - Surface
Water (TMaPS)

A Concentrated Discharge Area (CDA) is identified as possessing concentrated flows that could facilitate potential water quality treatment projects



Legend

- Concentrated Discharge Areas
- Waterbodies in Study
- Watercourses
- Tallahassee Corporate Limits

Concentrated Discharge Areas Ranking

High (1)
Low (8)

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
CDAs: Geosyntec, 2022
Roads: COT-Leon County, 2023
City Limits: COT, 2022

Lake Tom John				
Summary of Concentrated Discharge Areas				
Number	CDA ID	Total Load (lbs-TP/yr)	Area Load (lbs-TP/ac/yr)	Ranking
1	LFBLTJOF08	17.7	1.1	1
2	LFBLTJOF02	47.9	1.1	2
3	LFBLTJOF01	29.9	1.0	3
4	LFBLTJOF06	316.5	0.6	3
5	LFBLTJOF03	6.3	1.1	5
6	LFBLTJOF07	3.1	1.1	6
7	LFBLTJOF04	8.0	1.0	7
8	LFBLTJOF05	8.8	0.4	8
Total Load:		438.2		

Figure 5-124:
Lake Tom John Concentrated Discharge Areas-Total Phosphorus

Tallahassee Master Plan - Surface Water (TMaPS)



Location points of septic systems are digital estimations from related parcel locations and not meant to depict accuracy of unit location within the property

Only septic systems within 200 meters of the waterbody or its tributaries were selected and shown on this map as they are the source of the calculated nutrient loads, the remainder of septic units that were not selected are not shown on this map



- Legend**
- Lake Tom John Drainage Basin
 - Waterbodies in Study
 - Tallahassee Corporate Limits
 - Watercourses
 - Relevant Septic Sites**
 - Lake
 - Tributaries

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Septic Systems: COT, 2020
Watershed: COT, 2020
Roads: COT-Leon County, 2023

Figure 5-125:
Septic Loading to Lake Tom John
Tallahassee Master Plan - Surface Water (TMaPS)



Summary of Nutrient Loading from Septic			
Waterbody	TN Loading Direct to Lake (lbs/yr)	TN Loading From Tributaries (lbs/yr)	TN Load (lbs/yr)
Lake Tom John	627	497	1,125



Receiving Lake	Receiving Lake Impaired?	Receiving Lake Concentrations (most recent 3-year average of Annual Geomeans)	Upstream Lake(s)	Upstream Lake(s) Impaired?	Simulated Annual Average Lake Outflow (cubic feet)	Upstream Lake WQ Concentrations (most recent 3-year average of Annual Geomeans)	Calculated Annual Average TN load (lb/year)	Calculated Annual Average TP load (lb/year)
Lake Tom John	Yes: CHLA, TN, TP	CHLA: 6 µg/L TN: 0.56 mg/L TP: 0.02 mg/L	Lake Bess	Unknown	ND	CHLA: ND TN: ND TP: ND	ND	ND
ND - No or insufficient data								



Legend

- Receiving Lakes
- Inflowing Lakes
- Flowlines
- Tallahassee Corporate Limits

Sources:
Waterbodies: COT, 2020
Flowlines: USGS, 2020
Watershed: COT, 2020
Roads: FDOT, 2020
City Limits: COT, 2022

Figure 5-126:
Inflow Loading to Lake Tom John

Tallahassee Master Plan - Surface Water (TMaPS)



5.6.5.5 Internal Lake Load

The source assessment determined that internal loading may be a source of nutrients to the lake. At present no measurements have been completed to allow quantification of this load so it is not calculated.

5.6.5.6 Atmospheric Deposition

As presented and discussed in **Section 5.4.5.6** the annual average atmospheric TN load per acre was calculated from the Quincy NADP station (F14) at 2.56 lb/acre/yr. Multiplying this by the acreage of Lake Tom John (40 acres) gives a total TN load of 102 lb/yr. No data are available for TP therefore only the nitrogen load is provided.

5.6.5.7 Summary of Calculated Loads

Nutrient loads to Lake Tom John were calculated for stormwater runoff, septic systems, and atmospheric deposition. **Table 5-21** presents the calculated total loads to the lake for TN and TP. For septic systems and atmospheric deposition only TN loads were calculated.

Table 5-21: Summary of Calculated Loads to Lake Tom John

Source	TN (lb/year)	TP (lb/year)
Stormwater Runoff	2,194	438
Septic Systems	1,125	NC
Atmospheric Deposition	102	NC

NC – Not calculated.

5.7 Shakey Pond

This section presents the results from Tasks 1 through 3 for Shakey Pond, including an overview and history of the pond and basin, present impairment status, an overview of available data, a qualitative assessment of potential pollutant sources, and calculation of potential pollutant loads.

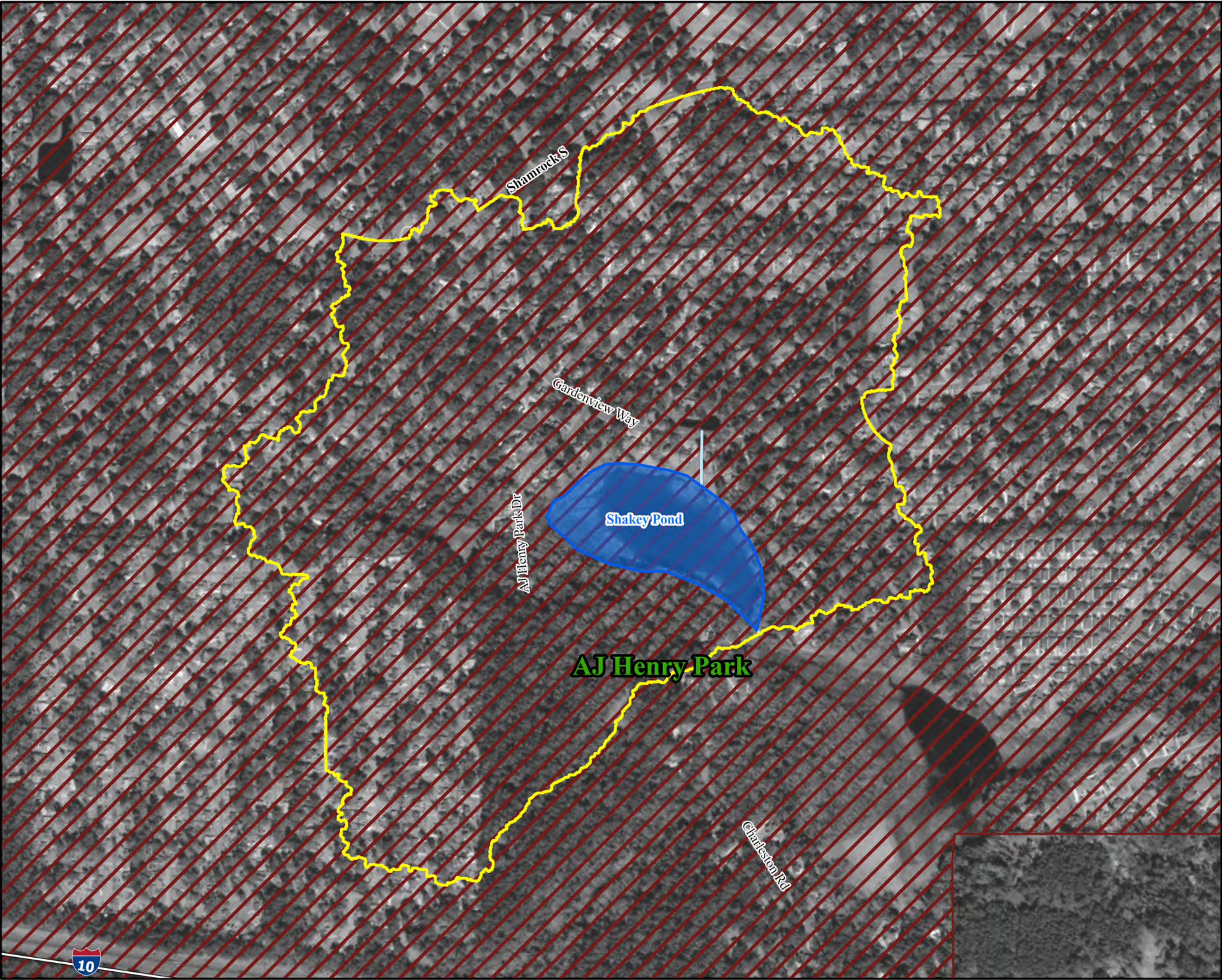
5.7.1 Overview and History

Shakey Pond is a shallow 14-acre pond located in northeast Tallahassee (**Figure 5-127**). It is bounded on its northern, eastern, and western sides by medium density residential development. The southern shore of the pond is bounded by a wooded 75-acre park (AJ Henry Park) owned and maintained by the City. **Photo 5-55** shows a view of the pond taken from the boardwalk at AJ Henry Park in February of 2021 looking northwest. **Photo 5-56** shows a view of the pond in October of 2020 looking southeast toward the outfall structure.

Originally a marsh-stream system, Shakey Pond has been significantly altered to accommodate adjacent residential development. The pond, as it exists today, was created through work completed in the 1980s and 1990s that serves the Whitfield Plantation and Killearn Estates neighborhoods. Aerial photos (**Photo 5-57** to **Photo 5-64**) present the transition of the pond from 1937 to the present. Between 1937 and 1983 the marsh area can be seen with a limited open water area. Development around the pond can be seen beginning in the 1990 aerial with the 2007 aerial showing the fully developed neighborhood and the expanded open water area based on the construction of the outfall structure.



Photo 5-55: Shakey Pond from AJ Henry Park Boardwalk Looking Northwest (February 2021)



Legend

- Shakey Pond Drainage Basin
- Waterbodies in Study
- Watercourses
- Tallahassee Corporate Limits

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Watersheds: COT, 2020
Roads: FDOT, 2020
Facilities: COT, 2020
City Limits: COT, 2022

Figure 5-127:
Shakey Pond Basin Overview Map

Tallahassee Master Plan - Surface Water (TMaPS)





Photo 5-56: Shakey Pond from AJ Henry Park Boardwalk Looking Southeast (October 2020)



Photo 5-57: Shakey Pond Basin Area Aerial (1937)

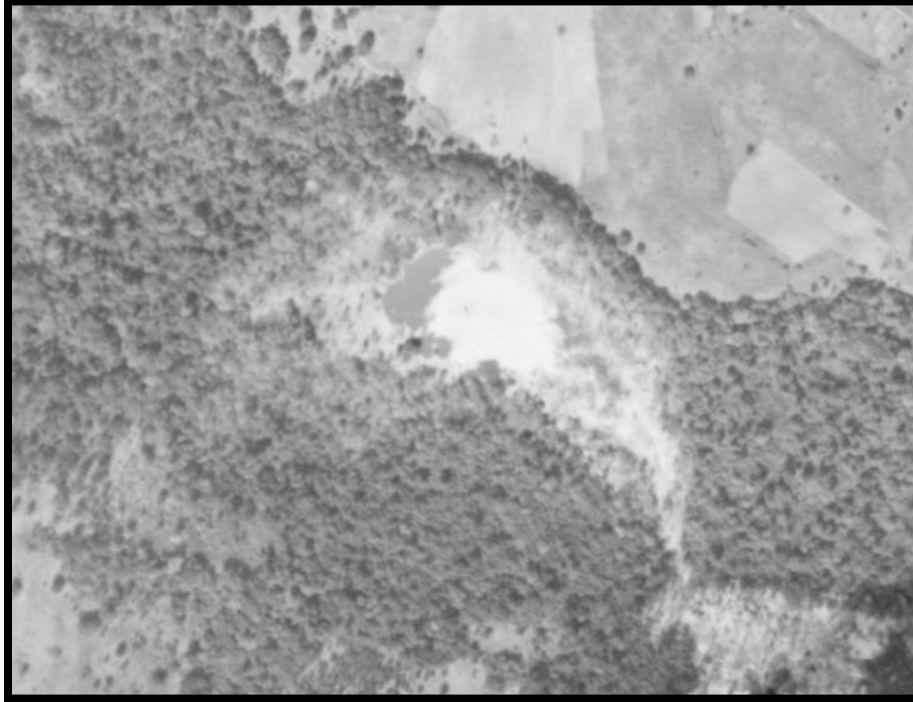


Photo 5-58: Shakey Pond Basin Area Aerial (1949)

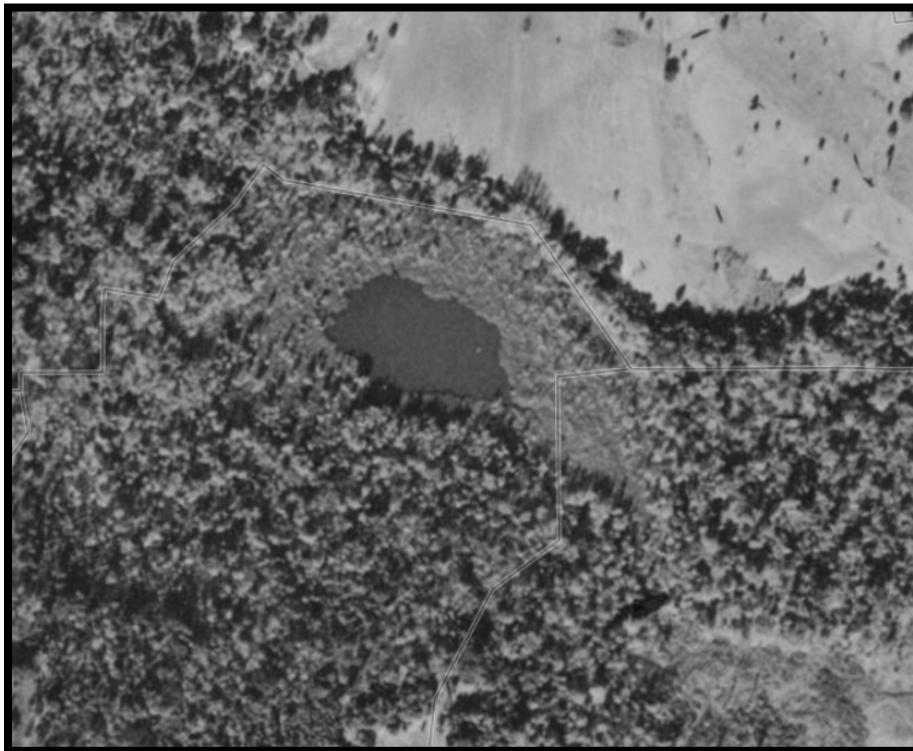


Photo 5-59: Shakey Pond Basin Area Aerial (1954)

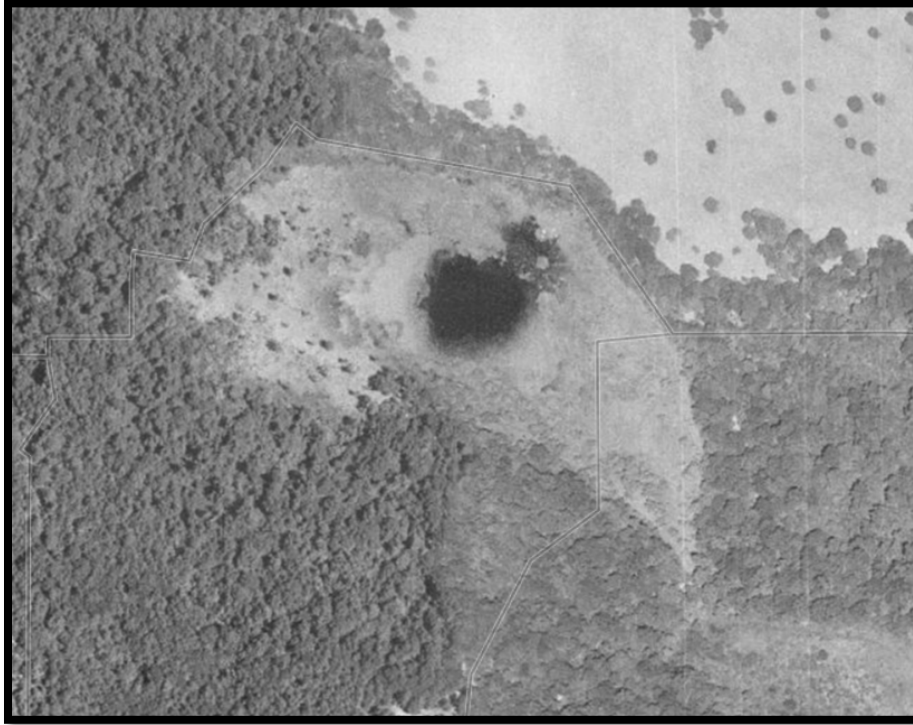


Photo 5-60: Shakey Pond Basin Area Aerial (1970)



Photo 5-61: Shakey Pond Basin Area Aerial (1983)



Photo 5-62: Shakey Pond Basin Area Aerial (1990)



Photo 5-63: Shakey Pond Basin Area Aerial (2007)



Photo 5-64: Shakey Pond Basin Area Aerial (2020)

The drainage basin for Shakey Pond covers an area of 263 acres (**Figure 5-127**). Pond inflow is primarily piped treated and untreated stormwater runoff from adjacent residential development. The pond outfalls to the east under Charleston Road, which is located within a private subdivision (Whitfield Plantation), where the outflow enters Cascade Lake and eventually flows to Alford Arm within the Lake Lafayette Drainage Basin. Pond outflow is controlled by four riser-barrels, collectively referred to as the control structure, crossing the embankment that serves Charleston Road.

Recently (circa 2018), the Shakey Pond control structure began exhibiting signs of failure due to corrosion of the corrugated metal pipes (CMPs) that comprise the riser-barrels. The pipe failures have resulted in erosion of soils near the structure and subsidence of the Charleston Road embankment. **Photo 5-65** shows a picture of the degraded control structure. The failing structure has created a consistent low-water condition within the pond, approximately 5 ft below its permitted normal-water level. In **Photo 5-55**, the shallow conditions can be seen with fine sediments just below the surface. These sediments were seen to resuspend due to the passage of swimming ducks.

5.7.2 Regulatory Status

Exhibit 5-2 presented the verified impaired waters within the overall Lake Lafayette basin. Shakey Pond (WBID 6471) was included on the 2022 verified list of impaired waters for nutrients (TP and Chl-a).

5.7.3 Waterbody Data Review and Summary

This section presents an overview of available data and data sources for Shakey Pond including bathymetry, land use, soils, septic systems, hydrologic measurements, surface water quality, groundwater quality, biological, stormwater treatment facilities, and atmospheric deposition.



Photo 5-65: Shakey Pond Outflow Structure in 2023

5.7.3.1 Bathymetry

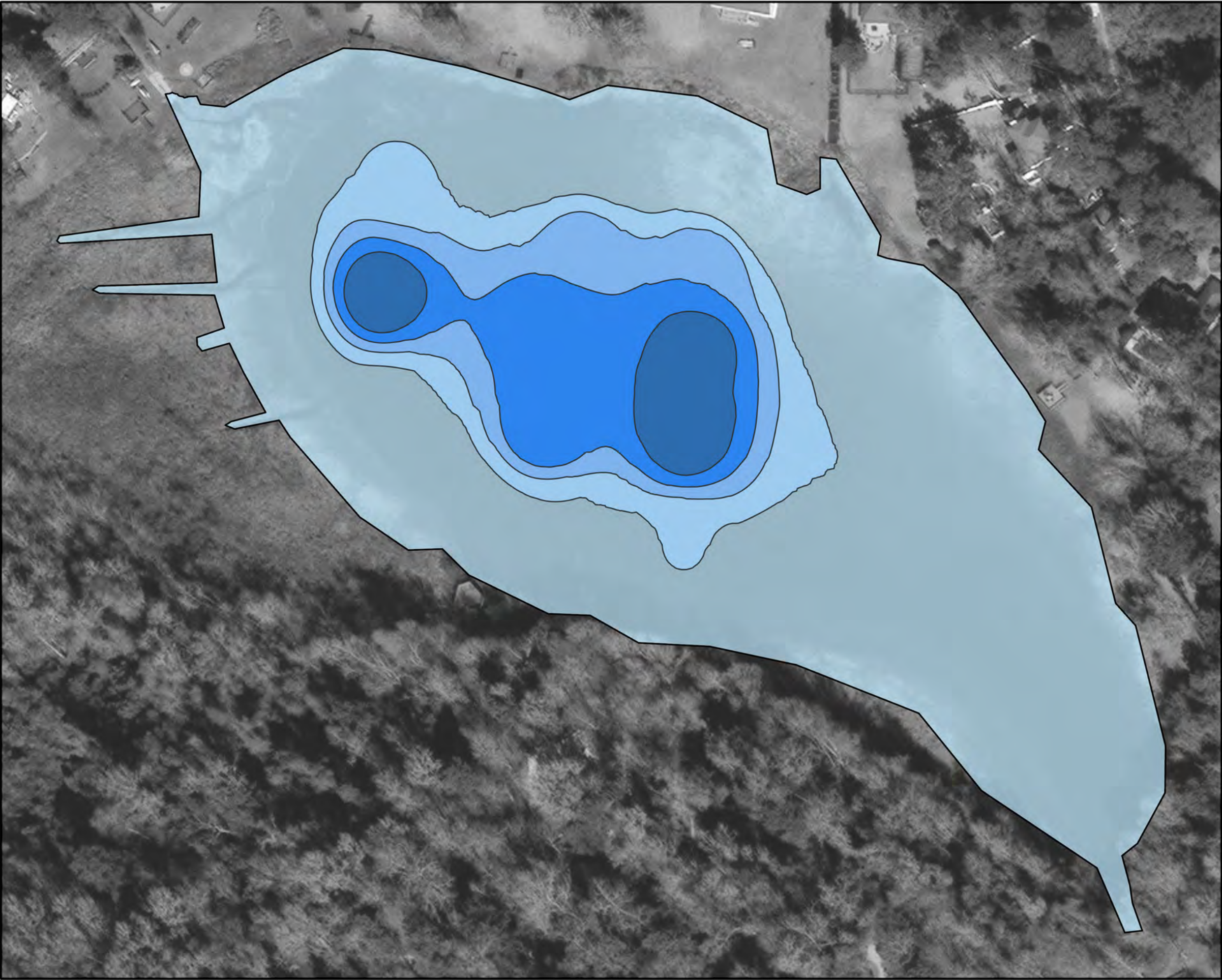
Figure 5-128 presents a bathymetric map from a survey conducted in 2023. The map shows the water depths under the present lower water level conditions due to the failure of the outflow structure. The map shows that most depths are less than 0.5 ft with some small areas just greater than 2 ft deep. The dashed line in the map shows the extent of the inundated areas at the permitted control structure outflow elevation. Depths prior to structure failure would have been around 3 ft deeper.

5.7.3.2 Land Use

Figure 5-129 presents a map of the Level 2 land uses within the Shakey Pond basin. A table is provided to show the overall acreages and percent cover for the various levels. Tables are provided for both the Level 2 and grouped Level 1 land uses. The largest land use within the Shakey Pond Drainage Basin by far is Urban and Built Up (81 percent) almost entirely Medium-Density Residential. The next highest is Upland Forest associated with AJ Henry Park.

5.7.3.3 Soils

The most prevalent soil groups in the Shakey Pond basin are Group B (**Figure 5-130**) and Group C, accounting for 63 percent and 21 percent of the area, respectively. Group B soils are considered to have a moderate rate of infiltration, whereas Group C soils are considered to have slow rates of infiltration. Group A/D soils (10 percent) are found in the areas around Shakey Pond and tributaries draining to it. These are considered to have high infiltration potential, but due to elevated water table conditions, will act more similarly to soils with low infiltration potential.



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Legend

Current Water Depth (ft) *

- >2.0
- 1.5 - 2.0
- 1.0 - 1.5
- 0.5 - 1.0
- 0.0 - 0.5

* Based on approximate current pond elevation of 113.2' NAVD88

Sources:
Waterbodies: COT, 2020
City Limits: COT, 2022
Bathymetry: Amdrill, 2023

Figure 5-128:
Shakey Pond Bathymetric Map
Tallahassee Master Plan - Surface
Water (TMaPS)

FLUCCS Code	FLUCCS Description	Acres	Percentage of Total Area
1100	Residential Low Density	2	1%
1200	Residential Medium Density	211	80%
4300	Upland Mixed Forests	20	8%
4400	Tree Plantations	16	6%
5300	Reservoirs	14	5%

FLUCCS Code	FLUCCS Description	Acres	Percentage of Total Area
1000	Urban and Built Up	213	81%
4000	Upland Forest	36	14%
5000	Water	14	5%



Legend

- Shakey Pond Drainage Basin
- Tallahassee Corporate Limits
- Land Use
 - 1100: Residential Low Density
 - 1200: Residential Medium Density
 - 4300: Upland Mixed Forests
 - 4400: Tree Plantations
 - 5300: Reservoirs

Sources:
Waterbodies: COT, 2020
Watersheds: COT, 2020
Roads: FDOT, 2020
Land Use: NWFWM, 2019
City Limits: COT, 2022

Figure 5-129:
Shakey Pond Drainage Basin Land Use Map

Tallahassee Master Plan - Surface Water (TMaPS)



Hydrologic Soil Group	Acres	Percentage of Total Area
A/D	27	10.1%
B	167	63.6%
C	56	21.3%
Water	13	5%



Legend

- Shakey Pond Drainage Basin
- Tallahassee Corporate Limits
- Hydrologic Soil Group
 - A/D
 - B
 - C
 - Water

Sources:
 Waterbodies: COT, 2020
 Watersheds: COT, 2020
 Roads: FDOT, 2020
 Soils: NRCS, 2020
 City Limits: COT, 2022

Figure 5-130:
 Shakey Pond Drainage Basin Soils Map

Tallahassee Master Plan - Surface Water (TMaPS)



5.7.3.4 Septic Systems

An estimated three septic systems are found within the boundaries of the Shakey Pond basin based on the FDOH septic tank layer (**Figure 5-131**). The systems can be seen along the eastern boundary. This low number is based on the entire basin being within the City's corporate limits so nearly all residences are on central sewer.

5.7.3.5 Hydrologic Data

No long-term hydrologic monitoring stations are located within the Shakey Pond basin. A short-term study conducted in 2023 measured rainfall and water levels in the pond for a period of around 5 months. The study collected data from approximately 8 significant storm events over a 5-month period. **Figure 5-132** presents a plot of the pond elevation and the rainfall. The collected data are indicative of a pond system that has outflow rates only slightly lower than inflow rates, meaning attenuation is minimal. Pond stages were observed to increase with rainfall events but also return to pre-rainfall levels generally within 24 to 48 hours.

5.7.3.6 Surface Water Quality Data

The water quality dataset for Shakey Pond (WBID 647I) spans from 1992 to 2021 and includes data from the City and FDEP. **Figure 5-133** presents the locations of in-lake water quality monitoring stations for Shakey Pond (yellow). A table is provided in **Figure 5-133** that shows the station ID, station name, period of record, and if the station represents in-lake or tributary data. Based on the length of the station IDs, station IDs were not included on the figure, rather each of the stations is given a number and the numbers correspond to stations in the table.

Figure 5-133 shows that the bulk of the in-lake water quality monitoring was taken from the AJ Henry Park boardwalk. The other sample collection station, located in the center of the lake was only sampled for a single year in 2017.

Some initial plots of the available data in the lake are provided in this section, which includes plots of the raw data along with AGM. Nutrients are the primary constituent of interest relative to water quality conditions in Shakey Pond, therefore, plots are provided for the key parameters related to potential nutrient impairment. These include TN, TP, Chl-a, and TSI. Data are plotted from 2010 to 2020 to represent present conditions. Additionally, based on interest relative to septic systems and other sources, bacteria, specifically *E. coli* are included.

Figure 5-134 through **Figure 5-136** present plots of the measured TN, TP and Chl-a from 2010 to 2020. The TN, TP and Chl-a concentrations are highly variable. TN concentrations do not show a visible trend with values ranging from less than 0.5 mg/L up to over 3.0 mg/L. TP concentrations also do not show a visible trend, with values as low as 0.01 mg/L up to 0.25 mg/L. Chl-a concentrations range from down below 5 µg/L up to over 180 µg/L with the bulk of the measurements above 20 µg/L.



Legend

- Shakey Pond Drainage Basin
- Waterbodies in Study
- Watercourses
- Tallahassee Corporate Limits
- Septic Systems

Sources:
Waterbodies: COT, 2020
Watersheds: COT, 2020
Roads: FDOT, 2020
Septic Systems: COT, 2020
City Limits: COT, 2022

Figure 5-131:
Shakey Pond Drainage Basin Septic
Systems Map

Tallahassee Master Plan - Surface
Water (TMaPS)



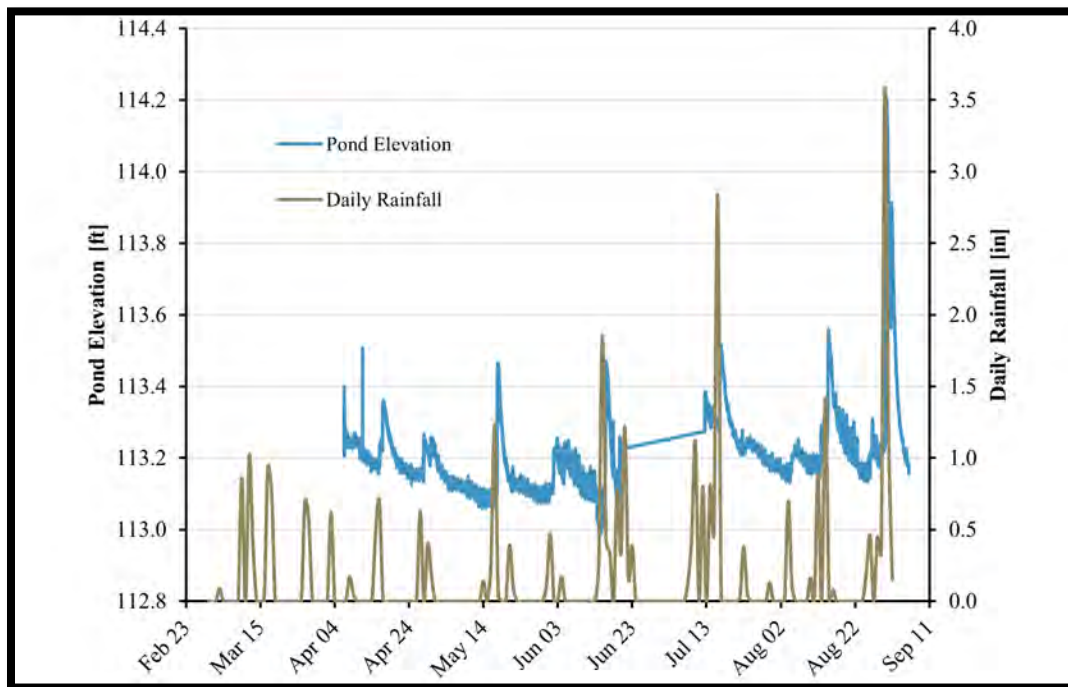


Figure 5-132: Shakey Pond Rainfall and Water Levels (February to September 2023)

Under FDEP's NNC, Shakey Pond is defined as a low color, high alkalinity system. Based on this designation, the AGM threshold for Chl-a is 20 µg/L. For TN and TP, a range of concentrations are allowable, based on maintaining Chl-a levels in the lake below 20 µg/L. For TN, the range is 1.05 mg/L to 1.91 mg/L. For TP, the range is 0.03 mg/L to 0.09 mg/L. For *E. coli*, the criteria are monthly geometric means below 126 colonies per 100 mL of water and less than 10 percent of samples above 410 colonies per 100 mL of water in any 30-day period.

TN, TP, and Chl-a, AGMs are plotted in **Figure 5-137** through **Figure 5-139** as these define the status of the lake relative to nutrient impairment. Where sufficient data are available to assess the AGMs, the levels are provided from 2010 through 2020. The Chl-a threshold and the minimum and maximum thresholds for TN and TP relative to the NNC are on each of the graphs as pink dashed lines. **Figure 5-140** presents a plot of calculated TSI values in the lake. While TSI is no longer utilized for the determination of impairment, it does serve as an indicator of lake health. Based on TSI definitions, levels below 60 are deemed good condition, levels between 60 and 70 indicate fair condition, while levels above 70 indicate poor condition. **Figure 5-141** presents a plot of *E. coli* data for the available period of record.

Examination of the TN plot (**Figure 5-137**) shows that from 2010 to 2020 TN AGM levels have been just above or below the minimum threshold. Only one year (2017) shows TN levels right at the maximum threshold.

TP AGM levels (**Figure 5-138**) are all above the maximum threshold other than 2020. In 2020 two of the three readings were very low, down at or near the detection limit. These readings were very different than were seen in all past samplings.

Number	Station ID	Station Name	Start of Record	End of Record	Position
1	21FLCOT AJ HENRY PARK	AJ HENRY PARK	2007	2020	In-Lake
2	21FLWQA G1WA0058	Aj Henry Park Pond Middle	2017	2017	In-Lake



Legend

- Shakey Pond Drainage Basin
- Waterbodies in Study
- Watercourses
- Tallahassee Corporate Limits
- Water Quality Stations
- Position
 - In-Lake

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Drainage Basins: COT, 2020
City Limits: COT, 2022
WQ Stations: FDEP, 2022

Figure 5-133:
Shakey Pond Water Quality Station
Location Map

Tallahassee Master Plan - Surface
Water (TMaPS)



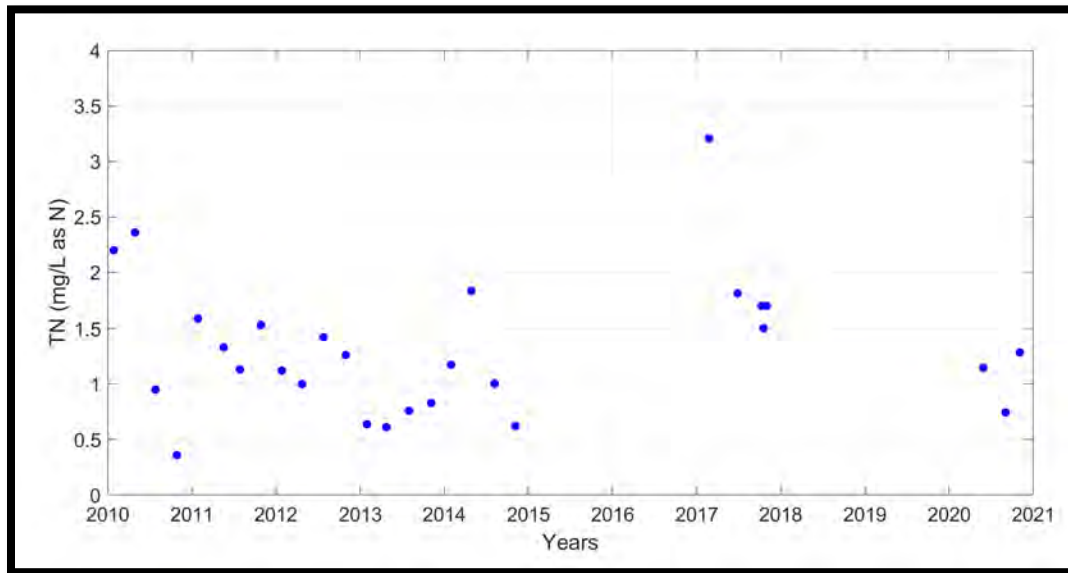


Figure 5-134: Plot of Measured TN

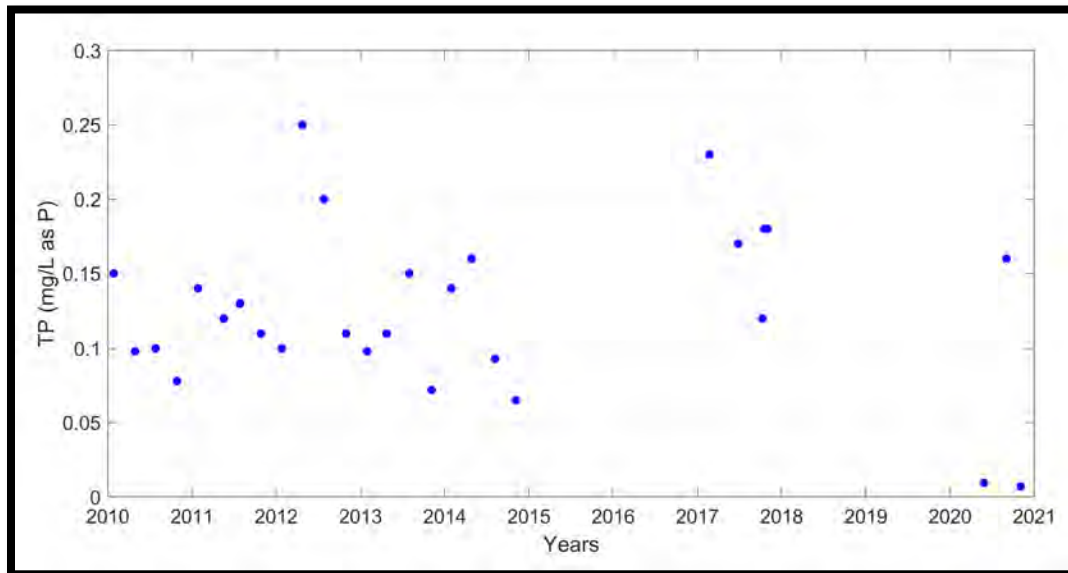


Figure 5-135: Plot of Measured TP

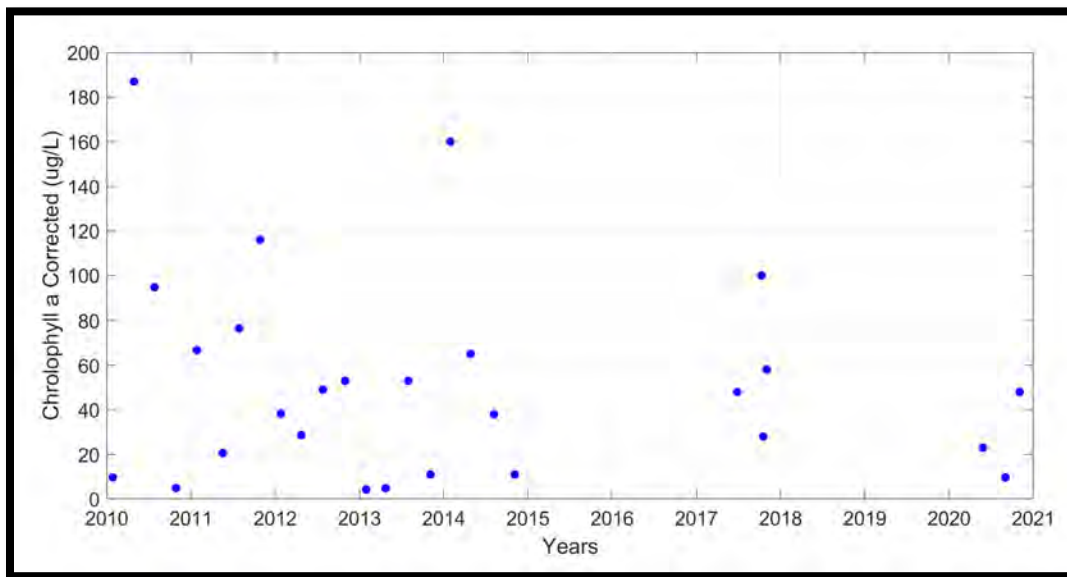


Figure 5-136: Plot of Measured Chl-a

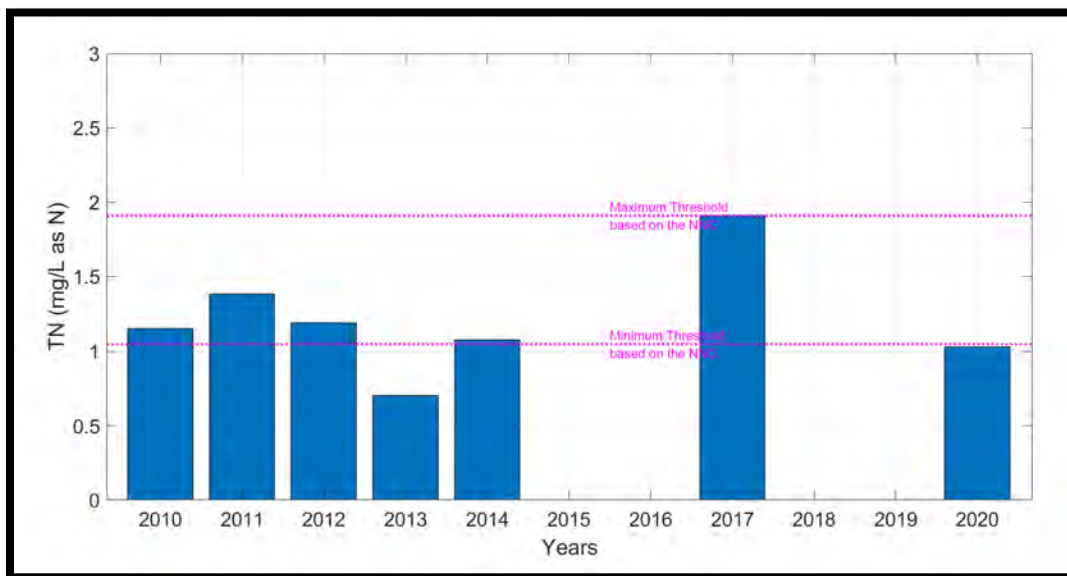


Figure 5-137: Plot of Annual Geometric Means for TN with NNC Criteria for Shakey Pond

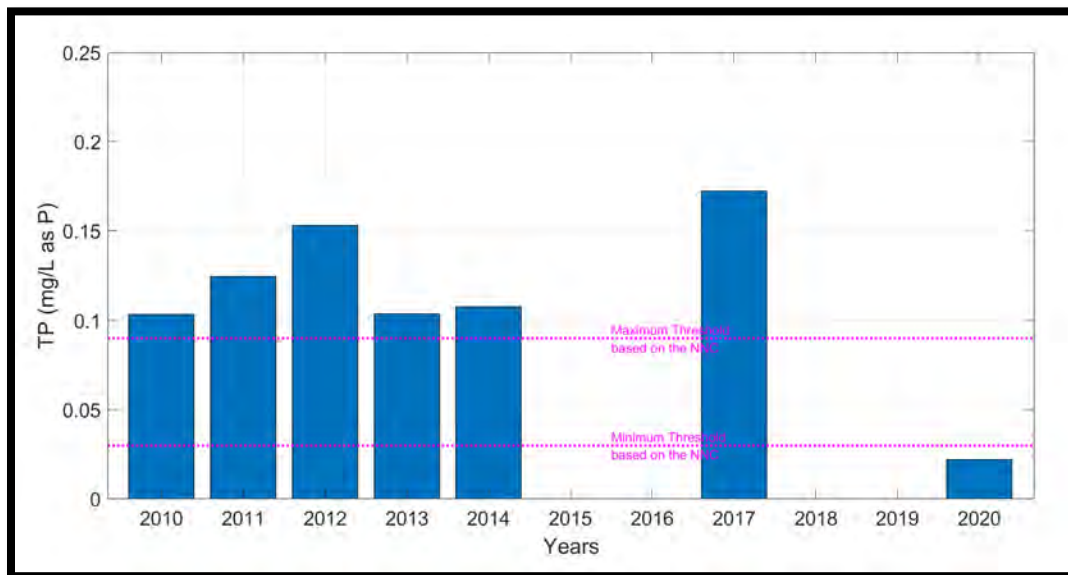


Figure 5-138: Plot of Annual Geometric Means for TP with NNC Criteria for Shakey Pond

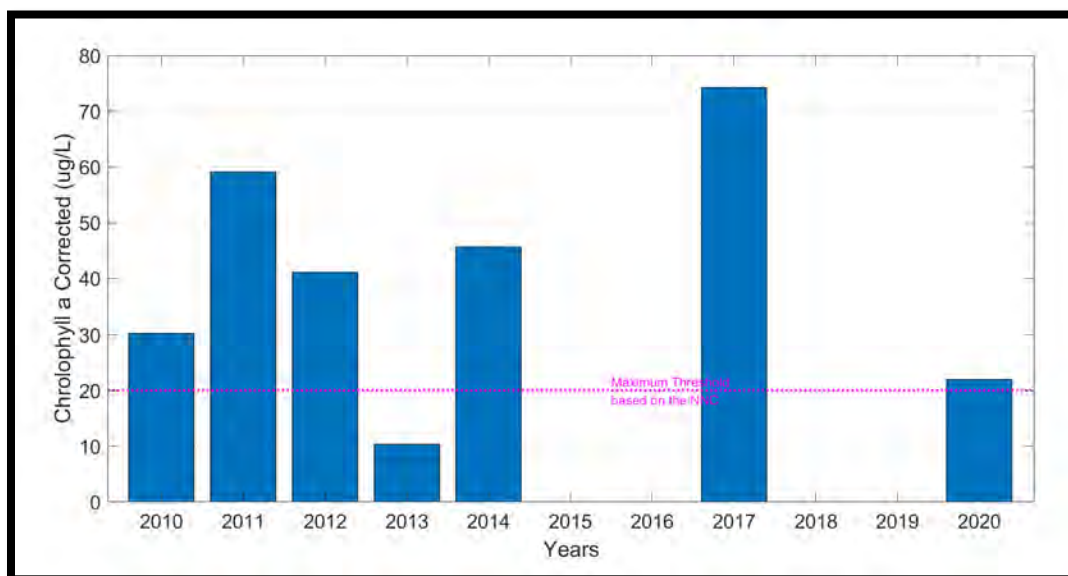


Figure 5-139: Plot of Annual Geometric Means for Chl-a with NNC Criteria for Shakey Pond

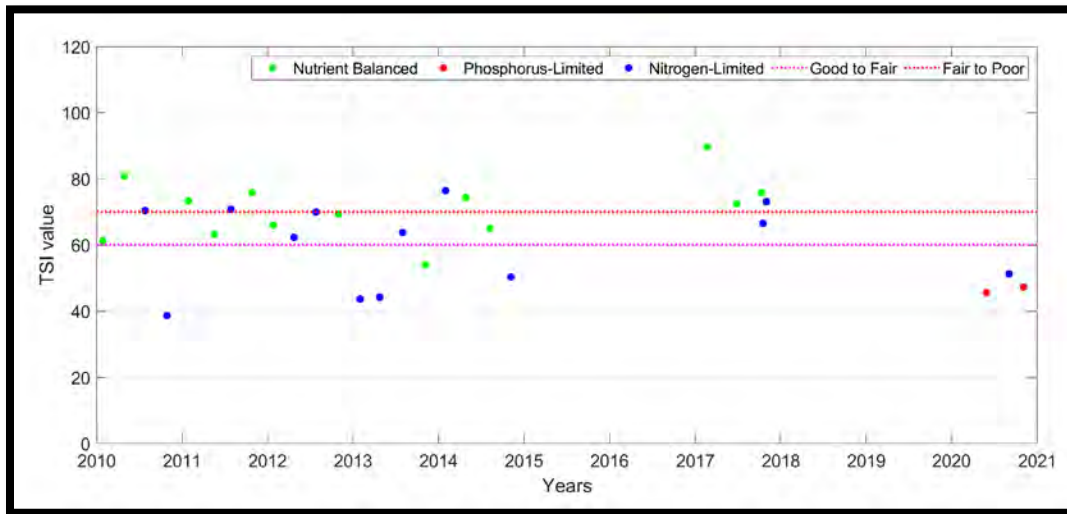


Figure 5-140: Trophic State Index for Shakey Pond

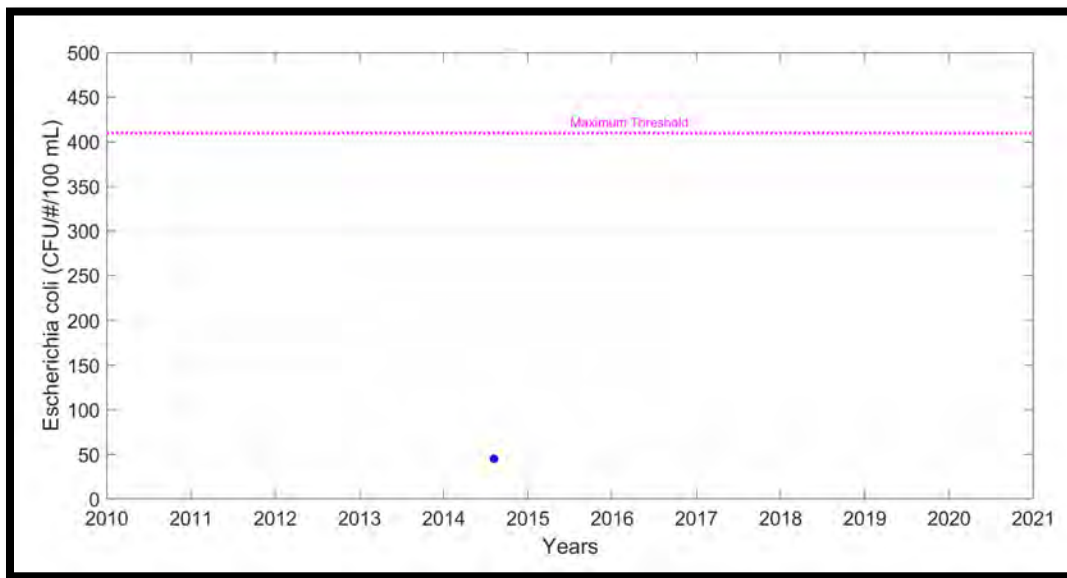


Figure 5-141: Plot of *E. coli* Measurements (2015 to 2019)

Figure 5-139 presents the Chl-a AGMs from 2010 through 2020. The Chl-a AGMs were above the threshold in all years other than 2020. The only year with Chl-a levels below the threshold was 2013.

Examination of the TSI plot (**Figure 5-140**) shows similar patterns as seen in TP and Chl-a, with levels in all years (other than 2013 and 2020) having values in the poor range. In all other years the majority of the TSI levels are in the fair range with many in the poor range. Other than 2020, the calculations show the system is nutrient balanced or nitrogen limited, reflecting the high TP concentrations.

Figure 5-141 present a plot of measured *E. coli* levels in the lake. Only one measurement was taken between 2010 and 2020 in 2014. The reading was low, near 50 MPN/100 mL.

5.7.3.7 Groundwater Data

Presently, there are no identified surficial groundwater monitoring wells within the Shakey Pond basin.

5.7.3.8 Biological Data

Table 5-22 presents the LVI data for Shakey Pond from 2010, 2011, and 2012. Data were only collected over 3 years from 2010 to 2012. Over that period the LVI generally showed healthy conditions with one year (2010) at the upper end of impaired. The limited data are based on the drop in water levels and the inability to do LVI analyses.

Table 5-22: Summary of LVI Results from Shakey Pond

Date	Station ID	LVI	Aquatic Life Use Category
07/08/2010	AJ Henry	37	Impaired
08/04/2011	AJ Henry	53	Healthy
09/27/2012	AJ Henry	47	Healthy

5.7.3.9 Stormwater Treatment Facilities

Figure 5-142 presents a map showing the locations of stormwater treatment facilities throughout the Shakey Pond Drainage Basin. The figure shows three stormwater ponds within the basin. The three ponds are maintained by the City. The stormwater ponds are located just upstream of 3 of the 5 outfalls to the lake and based upon a recent study, collectively treat approximately 78 percent of the flows coming into Shakey Pond. The remaining 22 percent of the flow comes in as untreated discharge from A.J. Henry Park, direct basin runoff to the lake, and a portion of the basin located to the northwest of the pond.

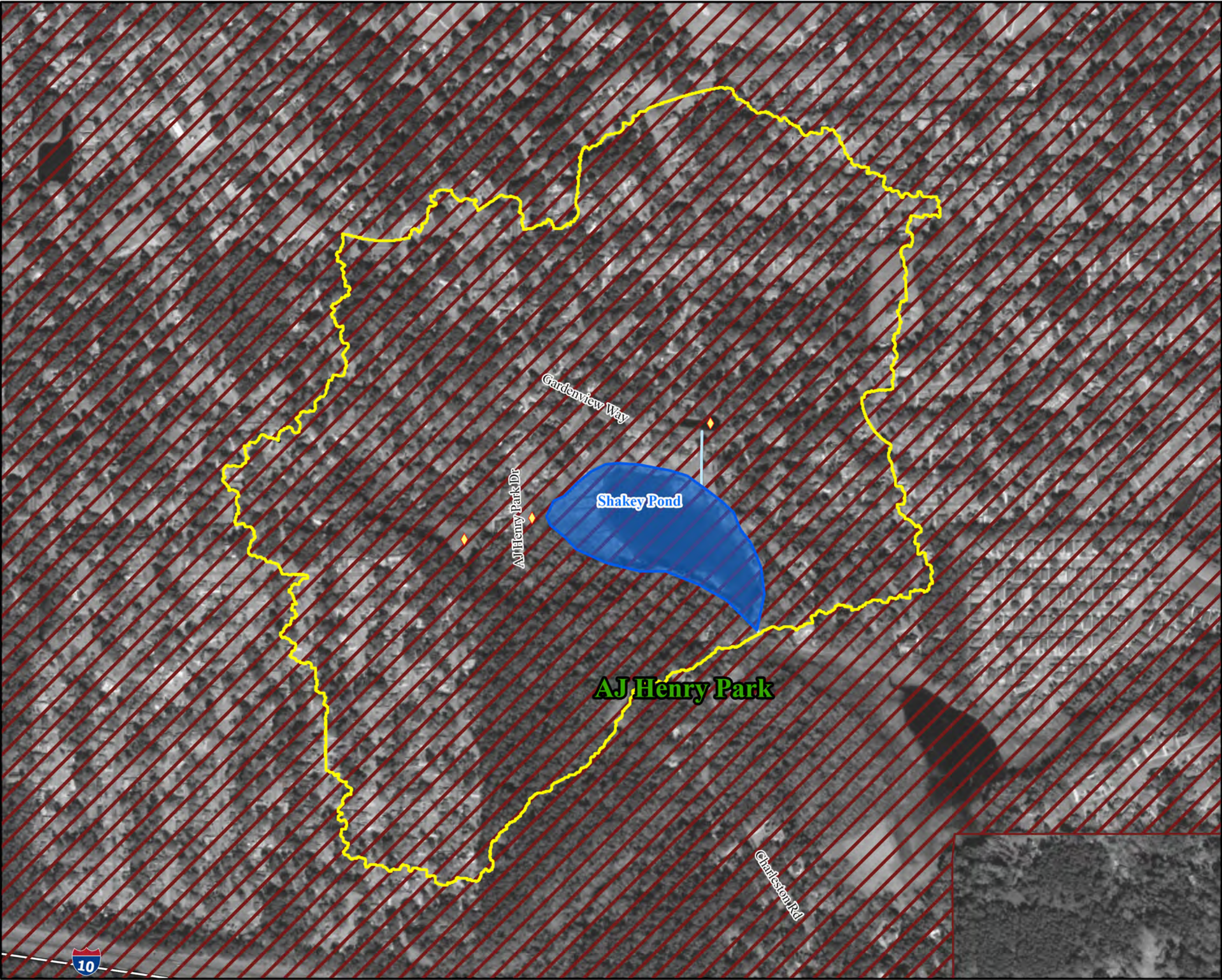
5.7.3.10 Atmospheric Deposition Data

Section 5.4.3.11 presented the location of the nearest atmospheric deposition station to the Lake Lafayette basin. The data from this station will be utilized to calculate atmospheric deposition to Shakey Pond.

5.7.3.11 Data Summary

For the purposes of the qualitative analysis of sources of pollutants to Shakey Pond (**Section 5.7.1**), the available data are somewhat limited. Recent sampling has been hindered by low water levels following the failure of the structure. Additionally, the lake, and its water quality, at present are not representative of conditions prior to failure due to the lower water levels. Additionally, no water quality data are available on inflows coming into Shakey Pond. As identified in **Section 5.7.3.9**, three of the five outfalls to the lake are immediately downstream of treatment ponds, while the remaining two discharge untreated stormwater runoff. Data limitations identified include:

- There are no water quality monitoring stations for the inflows to Shakey Pond.



Legend

- Shakey Pond Drainage Basin
- Waterbodies in Study
- Watercourses
- Tallahassee Corporate Limits
- City of Tallahassee Stormwater Ponds

Sources:
Waterbodies: COT, 2020
Watersheds: COT, 2020
Roads: FDOT, 2020
BMPs: Geosyntec, 2022
City Limits: COT, 2022

Figure 5-142:
Shakey Pond Basin BMP Location Map

**Tallahassee Master Plan - Surface
Water (TMaPS)**



- No surficial groundwater monitoring stations are located in the vicinity to determine the quality of potential seepage into Shakey Pond.
- No data are available to determine the potential for internal loading as a source.

5.7.4 Qualitative Assessment of Sources

As outlined in previous sections, prior to performing loading calculations and other analyses to quantify existing pollutant sources to Shakey Pond, it is important to analyze available data and other information to support identification of likely sources.

For Shakey Pond, the sources to be evaluated include the following:

- Stormwater runoff
- Septic systems
- Internal recycling and seepage
- Wastewater
- Atmospheric deposition
- Interconnected flows

An overview of analyses and findings for each source listed above is provided in the following sections.

5.7.4.1 Stormwater Runoff

To assess stormwater runoff as a potential source of pollutant loads to Shakey Pond the LDI level within the basin draining to the lake was evaluated. LDI values for the full basin draining to the Lafayette Chain of Lakes were presented on **Figure 5-45** including the Shakey Pond Basin. The map shows that for the watershed draining to Shakey Pond, LDI levels are poor. This would indicate that this area has significant potential for anthropogenic pollutant loads from stormwater runoff. No data are available for any of the discharges at outfalls flowing into Shakey Pond to support direct assessment of stormwater runoff. Additionally, as outlined in **Section 5.7.3.9**, 78 percent of the stormwater runoff from the basin passes through 3 stormwater ponds prior to discharge.

5.7.4.2 Septic Systems

Figure 5-131 presented the locations of septic systems within the Shakey Pond basin. Only 3 systems were identified. Based on the number of septic systems, septic loading is not identified as a source of loading and is not quantified in **Section 5.6.5**.

5.7.4.3 Internal Recycling and Seepage

Internal Recycling

Based on historic loading to the lake and accumulation of material, internal load was defined as a potential source to Shakey Pond. As part of the study discussed earlier, internal loads were calculated.

Seepage

As outlined in **Section 5.7.3.7**, no surficial aquifer data in the immediate vicinity of Shakey Pond were identified. Septic is the most likely source of seepage load, and septic systems were not identified as a source in **Section 5.7.3.4**. Additionally, soils around Shakey Pond have moderate to poor infiltration potential reducing the likelihood of seepage as a source in relation to stormwater runoff. Based on these reasons, seepage is not identified as a potential significant source.

5.7.4.4 Wastewater

Within the Shakey Pond basin, there currently are no direct wastewater discharges. Additionally, no areas in the Lake Lafayette basin presently have reuse discharges. **Figure 5-47** presented a map of the Lafayette Chain of Lakes basin boundaries in relation to sewer service areas and sewer infrastructure including the Shakey Pond basin. The entire basin has sewer infrastructure. While SSOs occur from time to time, SSOs are acute events with impacts lasting for relatively short periods of time (hours to several days), depending on magnitude and environmental conditions. The mechanism for abatement would not be treatment projects but rather any needed maintenance to sewer infrastructure. The City presently tracks, reports, and addresses these issues as they arise. No significant sewer overflow events have been identified in the Shakey Pond basin, therefore wastewater is not identified as a potential significant source.

5.7.4.5 Atmospheric Deposition

For the Shakey Pond basin, the ratio of the watershed area to lake area is around 18:1. With this ratio, and the potential attenuation of rainfall runoff, direct atmospheric deposition to the lake can play a role in overall loading, especially for nitrogen. **Section 5.5.3.10** identified the nearest atmospheric deposition station as the Quincy Station (FL14) (**Figure 5-35**).

5.7.4.6 Interconnected Flows

No lakes are located upstream of Shakey Pond, therefore interconnected loads are not a source.

5.7.4.7 Summary of Findings

Based on the discussions above, and data and information presented in **Section 5.5.3**, there are various potential sources of pollutant loads to Shakey Pond. Stormwater runoff contributing to direct inflow is identified as a potentially significant anthropogenic load and is quantified in **Section 5.6.5**. Internal loading is also identified as a potential load. Finally, atmospheric deposition is identified as a potential significant source and is quantified in **Section 5.6.5**. Another key aspect of Shakey Pond is the failure of the outflow structure which has led to decreased water levels in the system.

5.7.5 Calculation of Potential Nutrient Loads

This section presents calculations of potential nutrient (TN and TP) loads to Shakey Pond for the sources identified for calculation in **Section 5.7.4.7**. These include stormwater runoff and atmospheric deposition. Where loads were not calculated, the sections provide brief discussions. The load calculations are for the purpose of comparing the potential magnitudes of each source relative to one another to support determination of sources to target for load reduction.

5.7.5.1 Stormwater Pollutant Load

In order to calculate the stormwater TN and TP loads to Shakey Pond, average annual pollutant load modeling was performed. The goal was to identify outfalls that are contributing higher TN and TP loads relative to one another and to quantify the total TN and TP loads to Shakey Pond. TN and TP loads were calculated using the Spatially Integrated Model for Pollutant Loading Estimates (SIMPLE-Seasonal) model. The model methodology was described in detail in **Section 5.4.5.1** for the stormwater loads to the Lafayette Chain of Lakes.

Figure 5-143 presents the subbasins and the DEM utilized in the SIMPLE model calculations for Shakey Pond. **Figure 5-144** presents the aggregated land use. Finally, **Figure 5-145** presents the CDAs for the Shakey Pond stormwater loading to define total and per acre TN and TP loads, as well as the ranking of CDAs around the Lake.

Stormwater Nutrient Loads to Shakey Pond

Figure 5-146 presents the distribution of the ranking of the CDAs for TN along with the total load and per acre loads, see the table on **Figure 5-146**. The rankings are color coded with the highest ranked CDAs in dark green moving down to the lowest ranked in pale yellow. The calculated total stormwater TN loads from the CDAs ranged from as low as 7.4 lb/yr up to 372.4 lb/yr. The per acre loads ranged from 1.2 lb/acre/yr up to 4.6 lb/acre/yr. The highest ranked CDAs are located north of Shakey Pond in the areas with significant residential development. For the loading calculations treatment was only assumed for ponds larger than 1 acre, as such present treatment within the Shakey Pond watershed for some CDAs is not accounted for. Only one of the CDAs discharges directly to Shakey Pond without any treatment and that is #2 on **Figure 5-145** and is one of the top ranked CDAs relative to TN loading. The total potential stormwater runoff load for TN to Shakey Pond is 932 lb/yr.

Figure 5-147 presents the distribution of the ranking of the CDAs for TP along with the total load and per acre loads, see the table on **Figure 5-147**. The calculated total stormwater TP loads from the CDAs ranged from as low as 1.4 lb/yr up to 101.4 lb/yr. The per acre loads ranged from 0.2 lb/acre/yr up to 1.3 lb/acre/yr. The total potential stormwater runoff load for TP for Shakey Pond is 250 lb/yr.

5.7.5.2 Septic Load

Based on the small number of septic systems in the basin (3) septic load was not identified as a potential source. As such, no septic load was calculated.

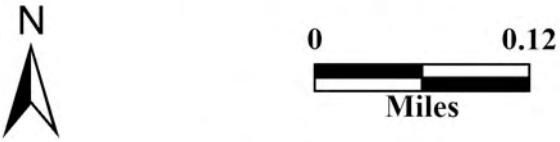
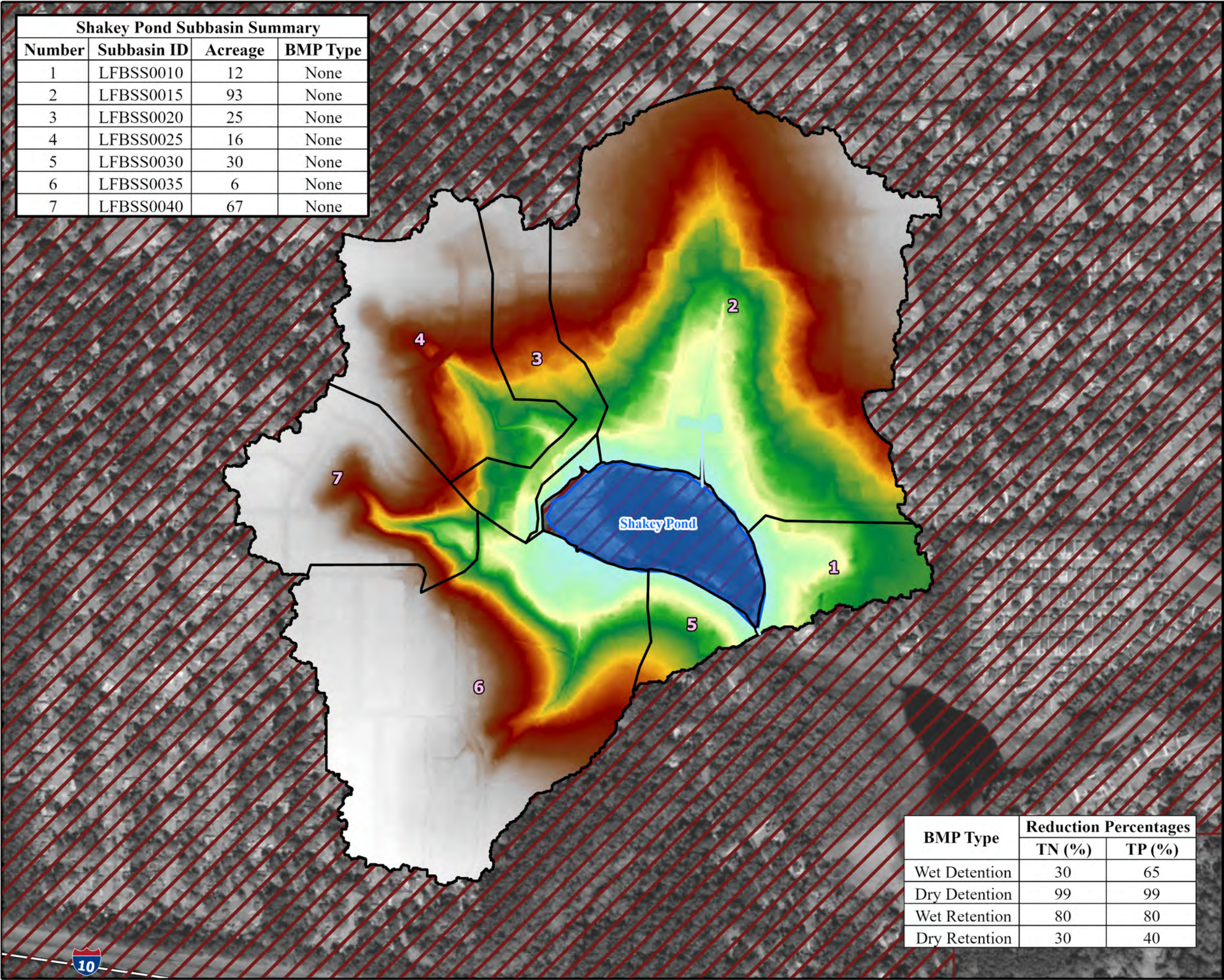
5.7.5.3 Point Source Load

No active point sources were identified within the Shakey Pond basin. Therefore, the point source loads for TN and TP are set to 0 lb/yr for Shakey Pond.

5.7.5.4 Lake Inflow Load

There are no identified lakes upstream of Shakey Pond. Therefore, the inter-lake TN and TP loads are set to 0 lb/yr.

Shakey Pond Subbasin Summary			
Number	Subbasin ID	Acreage	BMP Type
1	LFBSS0010	12	None
2	LFBSS0015	93	None
3	LFBSS0020	25	None
4	LFBSS0025	16	None
5	LFBSS0030	30	None
6	LFBSS0035	6	None
7	LFBSS0040	67	None



Legend

- Subbasins
- Waterbodies in Study
- Tallahassee Corporate Limits
- Watercourses

Topographic Elevations
ft NAVD88

225
115

Sources:
 Waterbodies: COT, 2020
 Watercourses: COT, 2020
 Subbasins: Geosyntec, 2022
 Roads: COT-Leon County, 2023
 City Limits: COT, 2022
 BMPs: Geosyntec, 2023
 Elevation: COT-Leon County, 2018

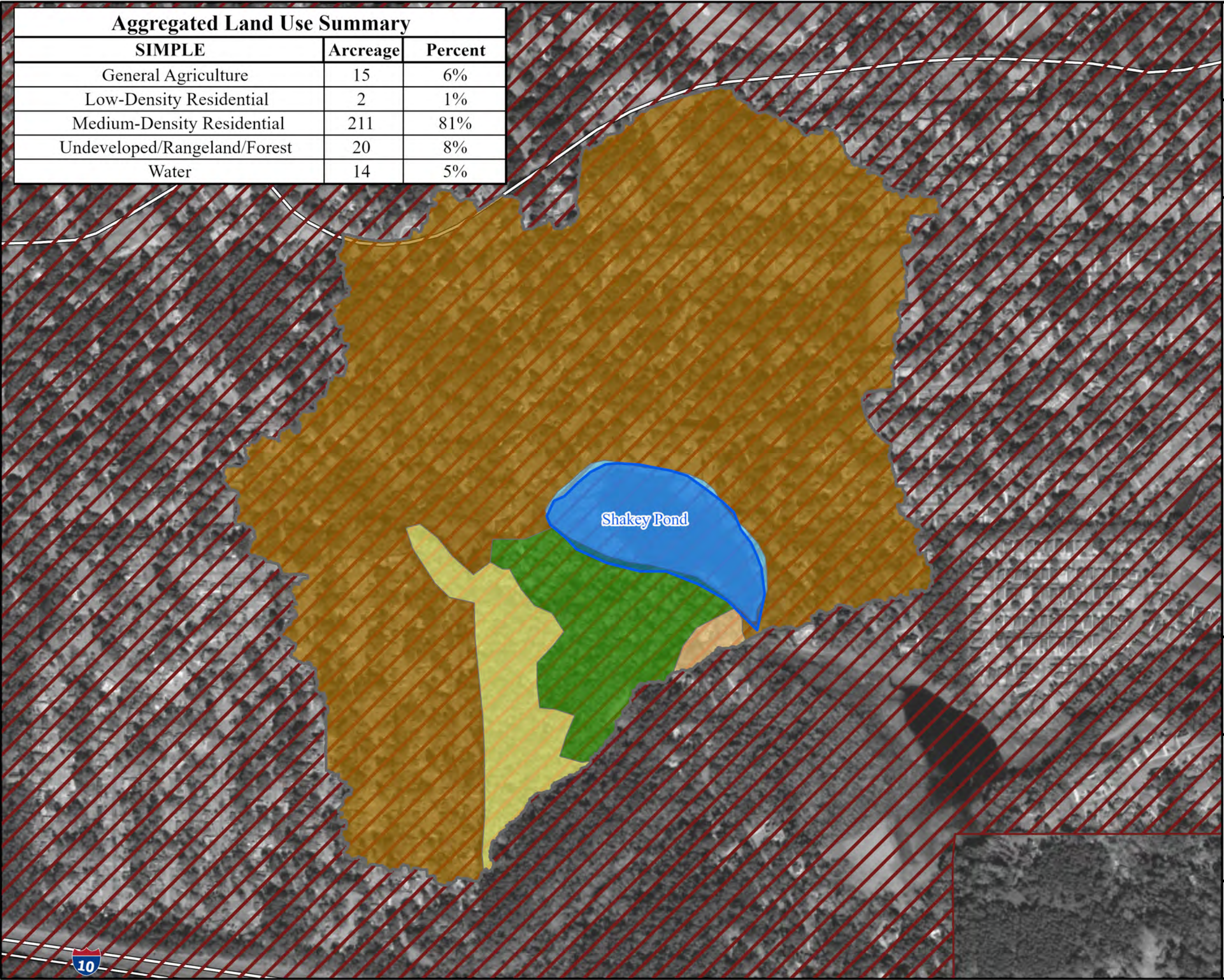
Figure 5-143:
 Shakey Pond Subbasin Delineation and
 BMPs

**Tallahassee Master Plan - Surface
 Water (TMaPS)**

BMP Type	Reduction Percentages	
	TN (%)	TP (%)
Wet Detention	30	65
Dry Detention	99	99
Wet Retention	80	80
Dry Retention	30	40



Aggregated Land Use Summary		
SIMPLE	Arcreage	Percent
General Agriculture	15	6%
Low-Density Residential	2	1%
Medium-Density Residential	211	81%
Undeveloped/Rangeland/Forest	20	8%
Water	14	5%



Legend

- Shakey Pond Drainage Basin
- Waterbodies In Study
- Tallahassee Corporate Limits
- Aggregated Land Use**
- Land Use Type**
- General Agriculture
- Low-Density Residential
- Medium-Density Residential
- Undeveloped/Rangeland/Forest
- Water

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Land Use: Geosyntec, 2023
Roads: FDOT, 2020
City Limits: COT, 2020

Figure 5-144:
Shakey Pond Aggregated Land Use

Tallahassee Master Plan - Surface
Water (TMaPS)



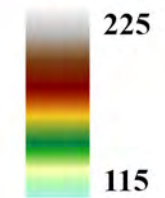
A Concentrated Discharge Area (CDA) is identified as possessing concentrated flows that could facilitate potential water quality treatment projects



Legend

- Concentrated Discharge Areas
- Waterbodies in Study
- Flowlines
- Tallahassee Corporate Limits
- Topographic Elevations

ft NAVD88



Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
CDAs: Geosyntec, 2022
Roads: COT-Leon County, 2023
City Limits: COT, 2022
Elevation: COT-Leon County, 2018

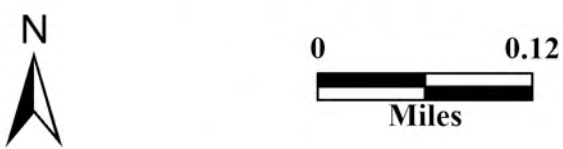
Figure 5-145:
Shakey Pond Concentrated Discharge
Areas

Tallahassee Master Plan - Surface
Water (TMaPS)



Shakey Pond		
Summary of Concentrated Discharge Areas		
Number	CDA ID	Acres
1	LFBSSOF02	93.0
2	LFBSSOF04	30.1
3	LFBSSOF03	15.7
4	LFBSSOF06	91.8
5	LFBSSOF01	11.5
6	LFBSSOF05	6.1

A Concentrated Discharge Area (CDA) is identified as possessing concentrated flows that could facilitate potential water quality treatment projects



Legend

- Concentrated Discharge Areas
- Waterbodies in Study
- Flowlines
- Tallahassee Corporate Limits
- Ranking
 - High (1)
 - Low (6)

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
CDAs: Geosyntec, 2022
Roads: COT-Leon County, 2023
City Limits: COT, 2022

Figure 5-146:
Shakey Pond Concentrated Discharge
Areas-Total Nitrogen

Tallahassee Master Plan - Surface
Water (TMaPS)

Shakey Pond				
Summary of Concentrated Discharge Areas				
Number	CDA ID	Total Load (lbs-TN/yr)	Area Load (lbs-TN/ac/yr)	Ranking
1	LFBSSOF02	372.4	4.0	1
2	LFBSSOF04	138.6	4.6	1
3	LFBSSOF03	68.8	4.4	3
4	LFBSSOF06	299.2	3.3	4
5	LFBSSOF01	45.1	3.9	5
6	LFBSSOF05	7.4	1.2	6
Total Load:		931.6		

A Concentrated Discharge Area (CDA) is identified as possessing concentrated flows that could facilitate potential water quality treatment projects



- Legend**
- Concentrated Discharge Areas
 - Waterbodies in Study
 - Flowlines
 - Tallahassee Corporate Limits
- Ranking**
- High (1)
 - Low (6)

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
CDAs: Geosyntec, 2022
Roads: COT-Leon County, 2023
City Limits: COT, 2022

Figure 5-147:
Shakey Pond Concentrated Discharge
Areas-Total Phosphorus

Tallahassee Master Plan - Surface
Water (TMaPS)



Shakey Pond				
Summary of Concentrated Discharge Areas				
Number	CDA ID	Total Load (lbs-TP/yr)	Area Load (lbs-TP/ac/yr)	Ranking
1	LFBSSOF02	101.4	1.1	1
2	LFBSSOF04	37.7	1.3	1
3	LFBSSOF03	18.7	1.2	3
4	LFBSSOF06	77.9	0.8	4
5	LFBSSOF01	12.3	1.1	5
6	LFBSSOF05	1.4	0.2	6
Total Load:		249.4		

5.7.5.5 Internal Lake Load

As discussed previously, a study was completed in Shakey Pond. As part of that study the average annual internal load for TN and TP was calculated. The fluxes were 985 lb/yr and 29 lb/yr respectively for TN and TP.

5.7.5.6 Atmospheric Deposition

As presented and discussed in **Section 5.4.5.6** the annual average atmospheric TN load per acre was calculated from the Quincy NADP station (F14) at 2.56 lb/acre/yr. Multiplying this by the acreage of Shakey Pond (14 acres) gives a total TN load of 35.8 lb/yr. No data are available for TP therefore only the nitrogen load is provided.

5.7.5.7 Summary of Calculated Loads

Nutrient loads to Shakey Pond were calculated for stormwater runoff, septic systems, and atmospheric deposition. **Table 5-23** presents the calculated total loads to the lake for TN and TP. For atmospheric deposition only TN loads were calculated.

Table 5-23: Summary of Calculated Loads to Shakey Pond

Source	TN (lb/year)	TP (lb/year)
Stormwater Runoff	932	249
Septic Load	0	NC
Internal Load	985	29
Atmospheric Deposition	36	NC

NC – Not calculated.

5.8 Lafayette Creek and Lake Leon

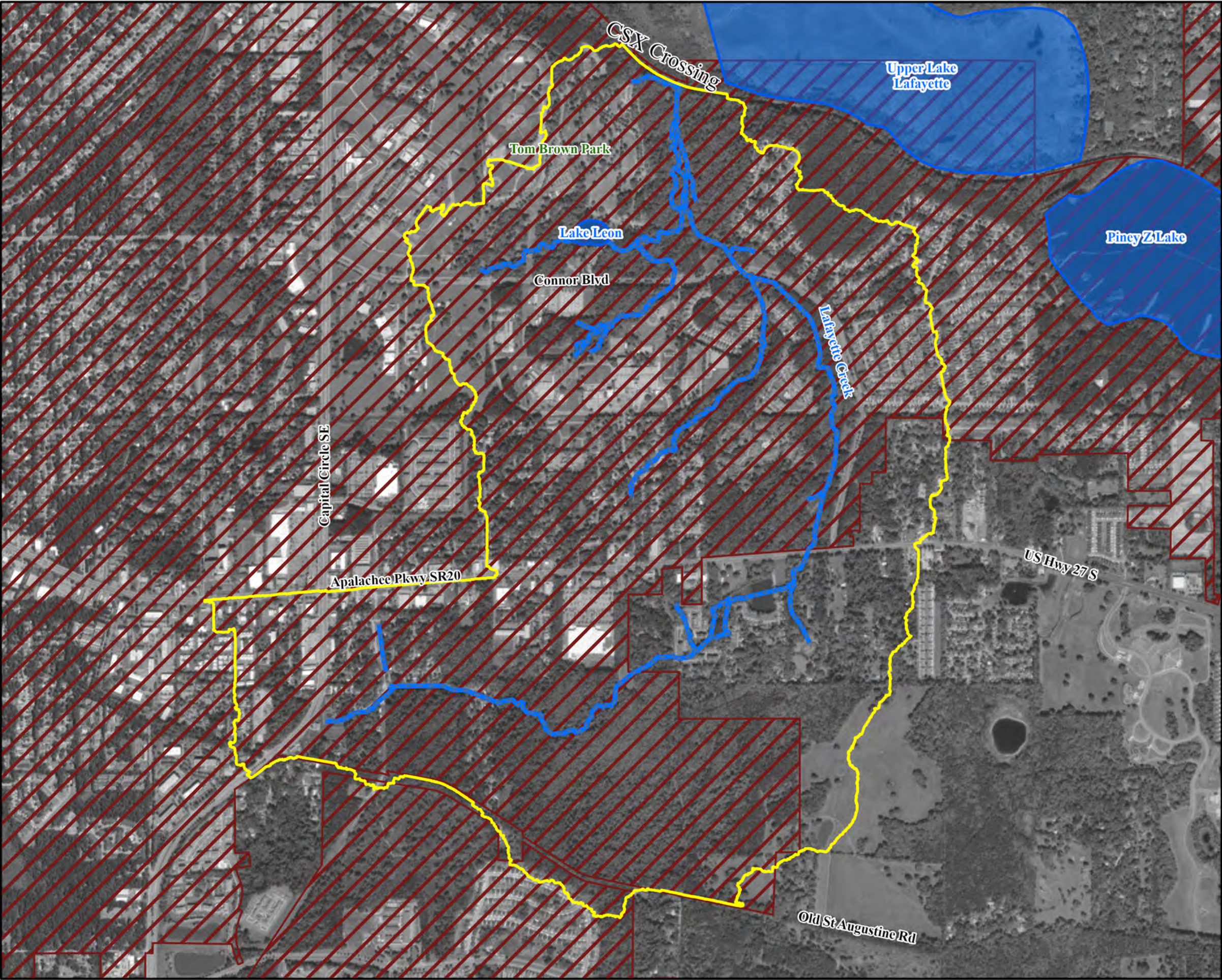
This section presents the results from Tasks 1 through 3 for Lafayette Creek and Lake Leon, which includes an overview and history of the basin; present impairment status; an overview of available data; a qualitative assessment of potential pollutant sources; and calculation of potential pollutant loads.

5.8.1 Overview and History

Lafayette Creek is an ephemeral urban stream that flows from its headwaters in commercial areas around the intersection of Capital Circle and Apalachee Parkway, through a mixture of wooded areas and commercial/residential development both south and north of Apalachee Parkway and ultimately discharges to the southeast end of Upper Lake Lafayette just north of the CSX railroad crossing (**Figure 5-148**). **Photo 5-66** shows the stream upstream of the CSX crossing and the ephemeral nature of the creek. **Photo 5-67** shows the stream at the CSX crossing. Neighborhoods contained within the drainage basin include Twin Lakes, Copper Creek, and Chase Ridge along with Lincoln High School and Tom Brown Park. The Lafayette Creek basin covers an area of 180 acres with the bulk of the basin within the City's incorporated area. The only unincorporated areas of the basin are along the western side (**Figure 5-148**).



Photo 5-66: Lafayette Creek Upstream of CSX Crossing



Legend

- Lafayette Creek and Lake Leon Drainage Basin
- Waterbodies in Study
- Tallahassee Corporate Limits

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Watersheds: COT, 2020
Roads: FDOT, 2020
Facilities: COT, 2020
City Limits: COT, 2022

Figure 5-148:
Lafayette Creek and Lake Leon Basin
Overview Map

Tallahassee Master Plan - Surface
Water (TMaPS)





Photo 5-67: Lafayette Creek at CSX Crossing

Lake Leon is a 6-acre impounded waterbody located within Tom Brown Park. **Photo 5-68** shows the lake in January 2021. According to FDEP, the lake was excavated out of wetlands in the 1960s. Drainage to Lake Leon includes adjacent recreational areas and ball parks within Tom Brown Park, the Florida Agricultural Museum, and the Federal Correctional Institution through wetland areas located to the west of the lake. Inflows come from two channels that drain into the western side into the downstream end of Lafayette Creek. Outflow is via a spillway located on the eastern side of the lake. **Photo 5-69** shows the spillway.

Photo 5-70 through **Photo 5-77** present aeries of the area around Lake Leon from 1937 to 1970. The aerial photos identify a number of important aspects of the Lake's history. First, examination of the aerial photos from 1937 through 1970 show that, as discussed above, prior to the 1960s Lake Leon did not exist. Prior to the excavation of the lake, the area where it is presently located was a wooded area with no visible open water. The lake outline is clear in the 1970 photo (**Photo 5-73**) and remains relatively consistent through present conditions. One aspect visible in the 2020 aerial is the expansion of aquatic vegetation cover on the lake which is not seen in any of the other photos (**Photo 5-77**).



Photo 5-68: Lake Leon (January 2021)



Photo 5-69: Lake Leon Spillway (January 2021)

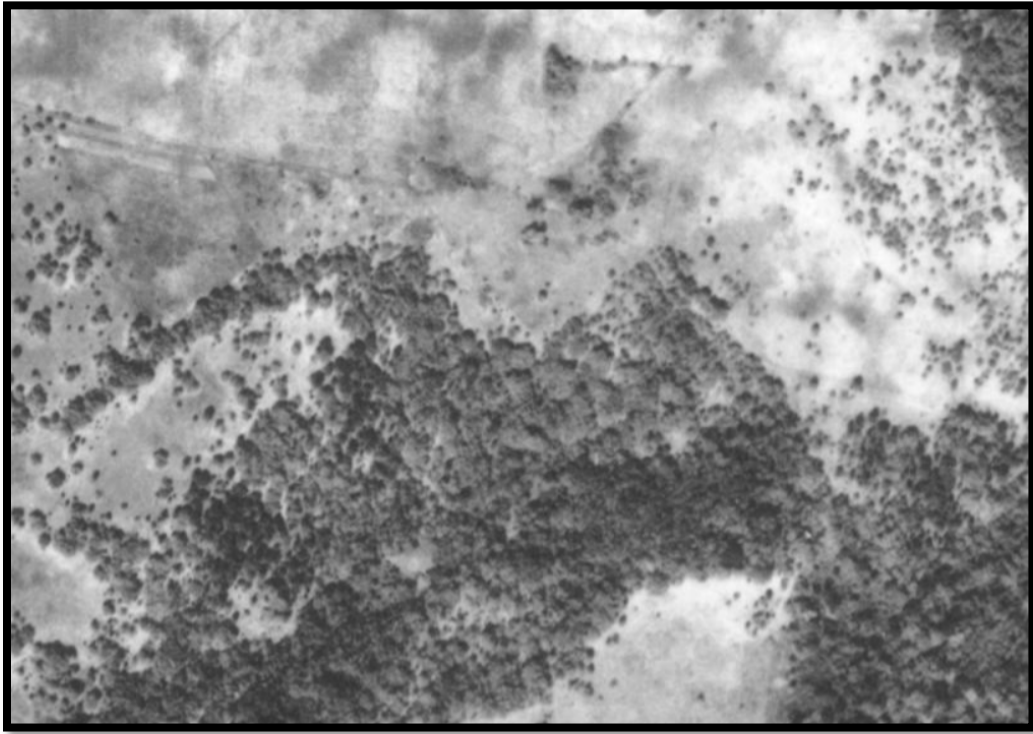


Photo 5-70: Lake Leon Aerial (1937)



Photo 5-71: Lake Leon Aerial (1949)



Photo 5-72: Lake Leon Aerial (1954)



Photo 5-73: Lake Leon Aerial (1970)



Photo 5-74: Lake Leon Aerial (1983)



Photo 5-75: Lake Leon Aerial (1990)



Photo 5-76: Lake Leon Aerial (2007)



Photo 5-77: Lake Leon Aerial (2020)

In 2009 a pilot project by the City was completed on Lake Leon to evaluate the efficacy of using floating vegetation mats to reduce nutrient concentrations. Nine floating mats were installed in the lake and the plant biomass and resulting inflowing and outflowing nutrient concentrations monitored. The findings of the study were that while some uptake of TKN was documented along with increases in plant biomass, overall nitrogen and phosphorus uptake by the mats was insufficient to provide measurable improvements in lake water quality.

The lake has undergone a number of drawdowns in recent years. **Photo 5-78** shows a drawdown in 2011 as part of a shoreline restoration project. In 2017 the lake was drawn down in order to do lake bottom modifications and repairs to an aerator pump. Increases in littoral vegetation including water hyacinths was noted following the 2017 draw down. **Photo 5-68** shows the extensive water hyacinth coverage in 2021.



Photo 5-78: Lake Leon during 2011 Drawdown for Shoreline Restoration

Presently Lake Leon is classified as a lake and is assessed against lake NNC despite its being a constructed and impounded waterbody built primarily to serve as stormwater retention. FDEP has identified that Lake Leon is not eligible for exemption under 62-340.700, F.A.C. based on it meeting the criteria for non-exempt status as a “works, impoundments, reservoirs, or other watercourses that, are currently wetlands which existed before construction of the stormwater treatment system and were incorporated in it.” Additionally, FDEP has identified that Lake Leon is not operated solely as a stormwater facility but is utilized as a recreational fishery and therefore should be protected as a Class III waterbody.

5.8.2 Regulatory Status

Exhibit 5-2 presented the verified impaired waters within the overall Lake Lafayette basin. Presently, neither Lafayette Creek nor Lake Leon are verified impaired for any parameter.

5.8.3 Waterbody Data Review and Summary

This section presents an overview of available data and data sources for Lafayette Creek and Lake Leon basin including land use, soils, septic systems, hydrologic measurements, surface water quality, groundwater quality, biological, stormwater treatment facilities, and atmospheric deposition.

5.8.3.1 Land Use

Figure 5-149 presents a map of the Level 2 land uses within the Lafayette Creek basin. A table is provided to show the overall acreages and percent cover. Tables are provided for both the Level 2 and grouped Level 1 land uses. The largest land use within the Lafayette Creek basin per the grouped Level 1 categories is Urban and Built Up (44 percent), which is made up of a mixture of medium and high density residential. The second largest land use is Upland Forest (34 percent). The Upland Forest land uses are located as a large area in the headwater of the basin along the creek, and in and around Lake Leon and Tom Brown Park near the discharge to Upper Lake Lafayette. Commercial areas are located along Apalachee Parkway and around Lincoln High School.

5.8.3.2 Soils

The most prevalent soil group in the Lafayette Creek and Lake Leon basin is Group B (45.9 percent) (**Figure 5-150**) followed closely by Group C (38.0 percent). Group B soils are considered to have moderate rates of infiltration while Group C soils have slow rates of infiltration. The remaining soils in the area are A/D and B/D soils (located primarily around the creek and Lake Leon) which have low rates of infiltration due to a high-water table. Based on the distribution of soil groups in the basin, infiltration is limited resulting in higher runoff potential.

5.8.3.3 Septic Systems

An estimated 197 septic systems are within the boundaries of the Lafayette Creek basin (**Figure 5-151**). The systems are located as sparse clusters in the headwaters along the western side of the basin and within a somewhat dense cluster directly adjacent to the creek just upstream of the crossing of Apalachee Parkway. There are no septic systems in the downstream areas of the basin or near Lake Leon.

5.8.3.4 Hydrologic Data

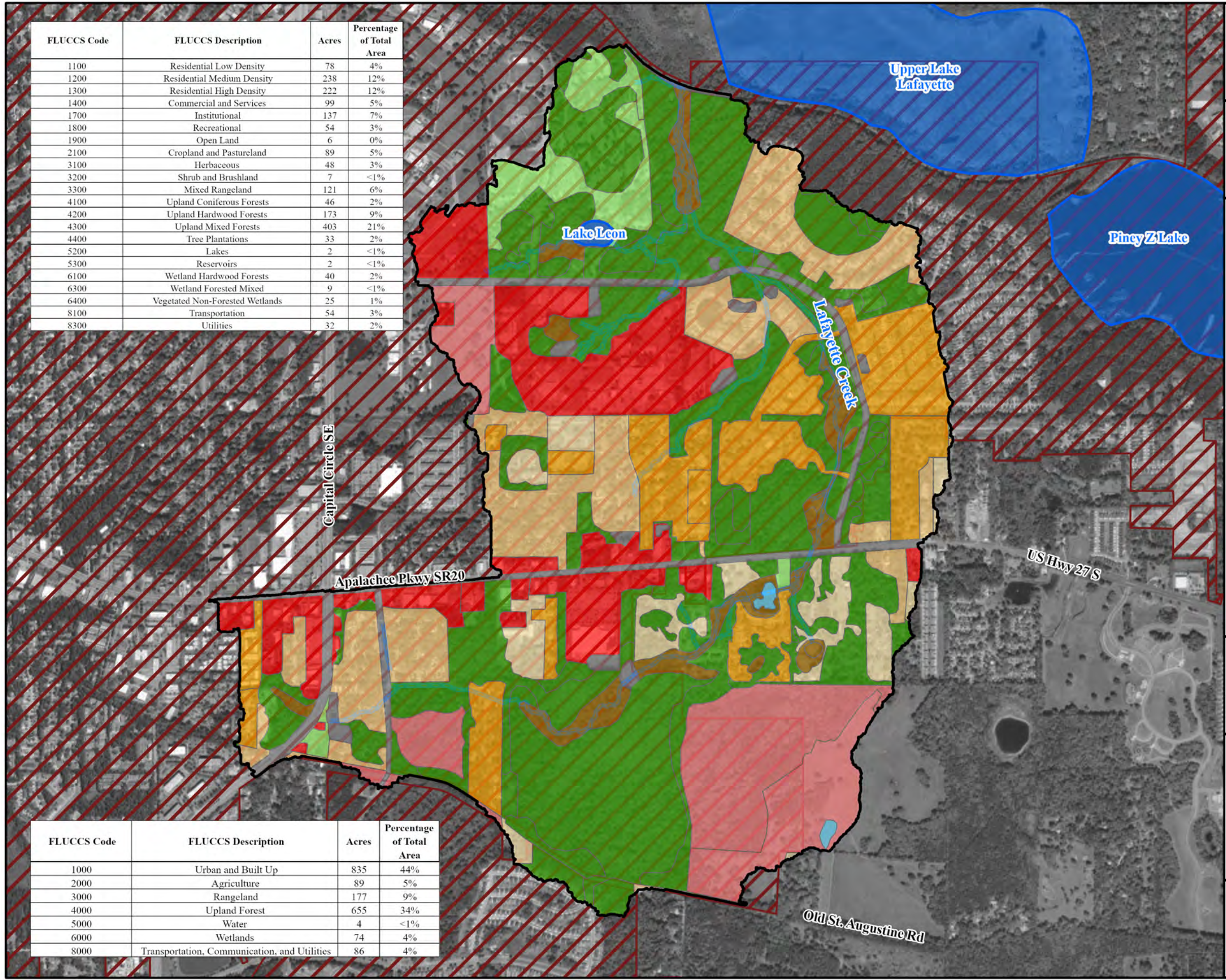
Exhibit 5-6 presented the locations of hydrologic monitoring stations throughout the Lafayette Chain of Lakes basin. There are no hydrologic stations located in the Lafayette Creek basin or in Lake Leon.

5.8.3.5 Surface Water Quality Data

The IWR dataset for Lafayette Creek and Lake Leon spans from 1996 to 2020 and includes data collected by the City, USGS, FDEP and Leon County (**Figure 5-152**). A table is provided in **Figure 5-152** that shows the ID, station name, period of record, and if the stations are within Lake Leon or Lafayette Creek. Based on the number of stations and the length of the station IDs, station IDs were not included on the figure, rather each of the stations is given a number and the numbers correspond to stations in the table.

FLUCCS Code	FLUCCS Description	Acres	Percentage of Total Area
1100	Residential Low Density	78	4%
1200	Residential Medium Density	238	12%
1300	Residential High Density	222	12%
1400	Commercial and Services	99	5%
1700	Institutional	137	7%
1800	Recreational	54	3%
1900	Open Land	6	0%
2100	Cropland and Pastureland	89	5%
3100	Herbaceous	48	3%
3200	Shrub and Brushland	7	<1%
3300	Mixed Rangeland	121	6%
4100	Upland Coniferous Forests	46	2%
4200	Upland Hardwood Forests	173	9%
4300	Upland Mixed Forests	403	21%
4400	Tree Plantations	33	2%
5200	Lakes	2	<1%
5300	Reservoirs	2	<1%
6100	Wetland Hardwood Forests	40	2%
6300	Wetland Forested Mixed	9	<1%
6400	Vegetated Non-Forested Wetlands	25	1%
8100	Transportation	54	3%
8300	Utilities	32	2%

FLUCCS Code	FLUCCS Description	Acres	Percentage of Total Area
1000	Urban and Built Up	835	44%
2000	Agriculture	89	5%
3000	Rangeland	177	9%
4000	Upland Forest	655	34%
5000	Water	4	<1%
6000	Wetlands	74	4%
8000	Transportation, Communication, and Utilities	86	4%



Legend

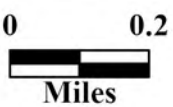
-  Lafayette Creek and Lake Leon Drainage Basin
-  Tallahassee Corporate Limits
- Land Use
-  1100: Residential Low Density
 -  1200: Residential Medium Density
 -  1300: Residential High Density
 -  1400: Commercial and Services
 -  1500: Industrial
 -  1600: Extractive
 -  1900: Open Land
 -  2100: Cropland and Pastureland
 -  2400: Nurseries and Vineyards
 -  3200: Shrub and Brushland
 -  3300: Mixed Rangeland
 -  4100: Upland Coniferous Forests
 -  4200: Upland Hardwood Forests
 -  4300: Upland Mixed Forests
 -  3300: Mixed Rangeland
 -  5200: Lakes
 -  5300: Reservoirs
 -  6100: Wetland Hardwood Forests
 -  6300: Wetland Forested Mixed
 -  6400: Vegetated Non-Forested Wetlands
 -  8100: Transportation
 -  6500: Non-Vegetated

Sources:
Waterbodies: COT, 2020
Watersheds: COT, 2020
Roads: FDOT, 2020
Land Use: NWFWMD, 2019
City Limits: COT, 2022

Figure 5-149:
Lafayette Creek and Lake Leon Land Use
Map

Tallahassee Master Plan - Surface
Water (TMaPS)

Hydrologic Soil Group	Acres	Percentage of Total Area
A/D	211	11.0%
B	881	45.9%
B/D	87	4.5%
C	730	38.0%
Water	12	0.6%



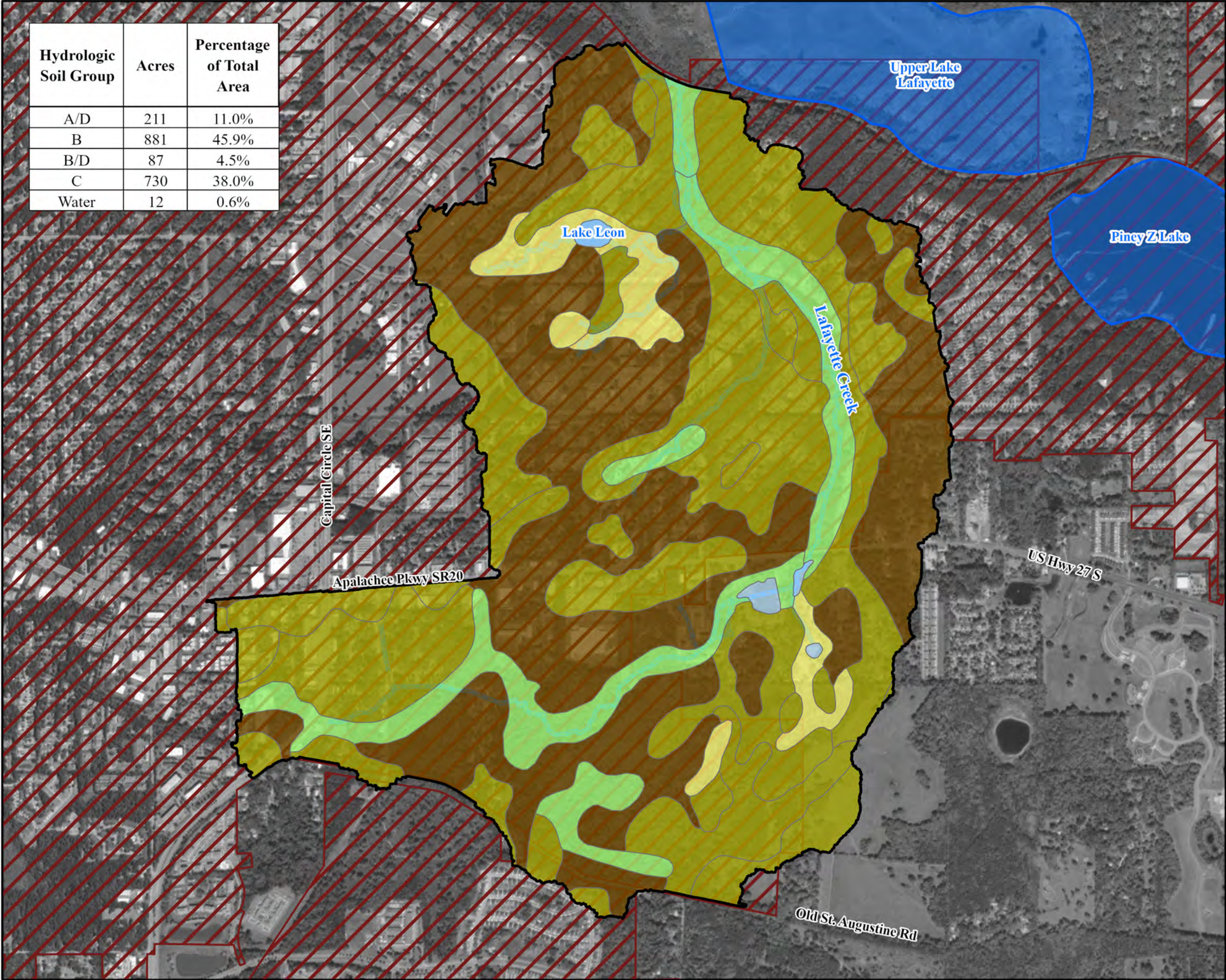
Legend

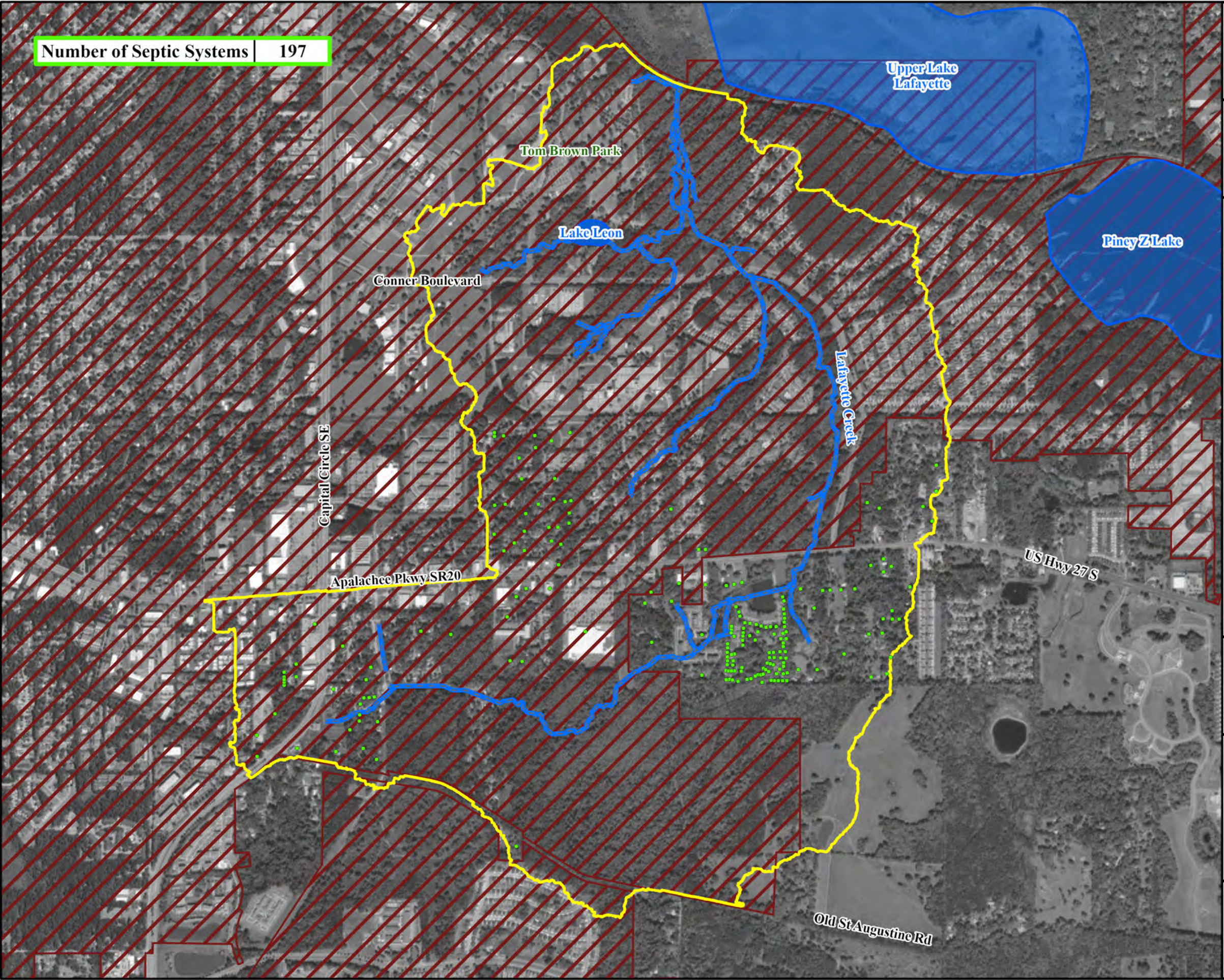
- Lafayette Creek and Lake Leon Drainage Basin
- Tallahassee Corporate Limits
- Hydrologic Soil Group
 - A/D
 - B
 - B/D
 - C
 - Water

Sources:
Waterbodies: COT, 2020
Watersheds: COT, 2020
Roads: FDOT, 2020
Soils: NRCS, 2020
City Limits: COT, 2022

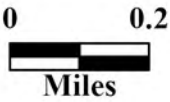
Figure 5-150:
Lafayette Creek and Lake Leon Soils Map

Tallahassee Master Plan - Surface Water (TMaPS)





Number of Septic Systems | 197



Legend

- Lafayette Creek and Lake Leon Drainage Basin
- Waterbodies in Study
- Tallahassee Corporate Limits
- Septic Systems

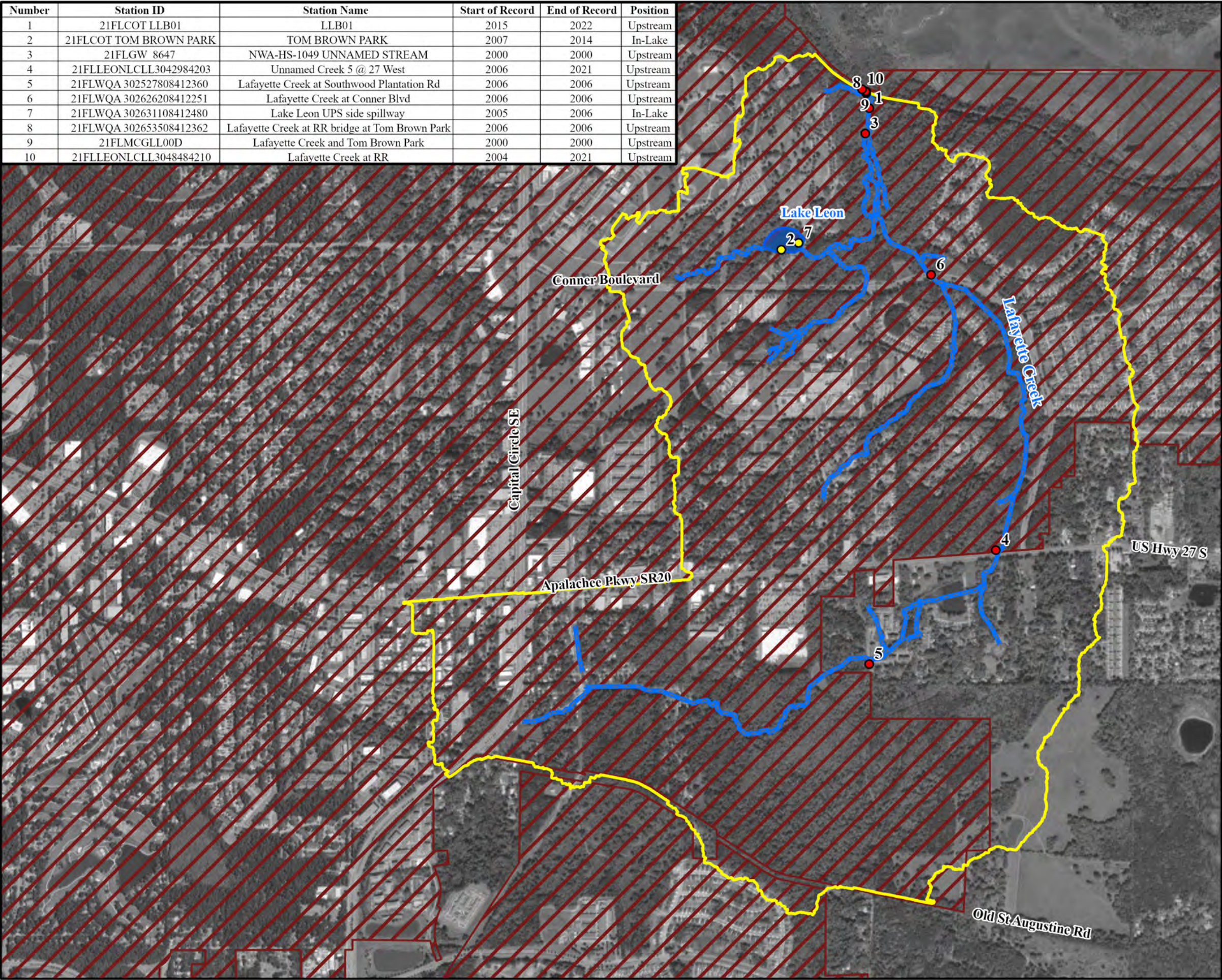
Sources:
Waterbodies: COT, 2020
Watersheds: COT, 2020
Roads: FDOT, 2020
Septic Systems: COT, 2020
City Limits: COT, 2022

Figure 5-151:
Lafayette Creek and Lake Leon Septic
Systems Map

Tallahassee Master Plan - Surface
Water (TMaPS)



Number	Station ID	Station Name	Start of Record	End of Record	Position
1	21FLCOT LLB01	LLB01	2015	2022	Upstream
2	21FLCOT TOM BROWN PARK	TOM BROWN PARK	2007	2014	In-Lake
3	21FLGW 8647	NWA-HS-1049 UNNAMED STREAM	2000	2000	Upstream
4	21FLLEONLCLL3042984203	Unnamed Creek 5 @ 27 West	2006	2021	Upstream
5	21FLWQA 302527808412360	Lafayette Creek at Southwood Plantation Rd	2006	2006	Upstream
6	21FLWQA 302626208412251	Lafayette Creek at Conner Blvd	2006	2006	Upstream
7	21FLWQA 302631108412480	Lake Leon UPS side spillway	2005	2006	In-Lake
8	21FLWQA 302653508412362	Lafayette Creek at RR bridge at Tom Brown Park	2006	2006	Upstream
9	21FLMCGLL00D	Lafayette Creek and Tom Brown Park	2000	2000	Upstream
10	21FLLEONLCLL3048484210	Lafayette Creek at RR	2004	2021	Upstream



Legend

Lafayette Creek and Lake Leon Drainage Basin

Waterbodies in Study

Tallahassee Corporate Limits

Water Quality Stations

Position

Lake Leon Stations

Lafayette Creek Stations

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Drainage Basins: COT, 2020
City Limits: COT, 2022
WQ Stations: FDEP, 2022

Figure 5-152:
Lafayette Creek and Lake Leon Water
Quality Station Location Map

Tallahassee Master Plan - Surface
Water (TMaPS)



Longer term data, i.e., data for more than a single year, exists at three locations within the basin. These are also the stations that have data after 2010. The first is at the downstream end just prior to discharge into Upper Lake Lafayette (Station 1 on **Figure 5-152**). Data are available at this station from 2015 to 2020. The second station is where the creek crosses Apalachee Parkway (Station 4). Data are available at this station from 2006 to 2020. Finally, data are available in Lake Leon from 2006 to 2020.

Some initial plots of the available data in Lake Leon and Lafayette Creek are provided in this section, which includes plots of the raw data along with AGMs against the NNC criteria. Nutrients are the primary constituent of interest relative to water quality conditions in Lafayette Creek and Lake Leon, therefore, plots are provided for the key parameters related to potential nutrient impairment. These include TN, TP, Chl-a, and TSI for Lake Leon and TN and TP for Lafayette Creek. As discussed earlier, where available, data are plotted from 2010 to 2020 to represent present conditions. Additionally, based on interest in the area relative to septic systems and other sources, bacteria, specifically *E. coli* are included. Additional data plots and analyses are provided as part of the qualitative assessment of sources in **Section 5.8.4**.

Figure 5-153 through **Figure 5-155** present plots of the measured TN, TP and Chl-a respectively from 2010 to 2020 for Lake Leon. The TN concentrations (**Figure 5-153**) are relatively consistent from 2010 through 2020 with nearly all values below 1.0 mg/L. TP concentrations (**Figure 5-154**) are relatively constant with higher values between 2017 to 2019 then dropping off significantly in 2020. The majority of measured TP concentrations are below 0.05 mg/L. Chl-a concentrations (**Figure 5-155**) are generally below 40 µg/L with some higher values in 2011 and 2017. It is noted that those were the years of the drawdowns as discussed in **Section 5.8.1**.

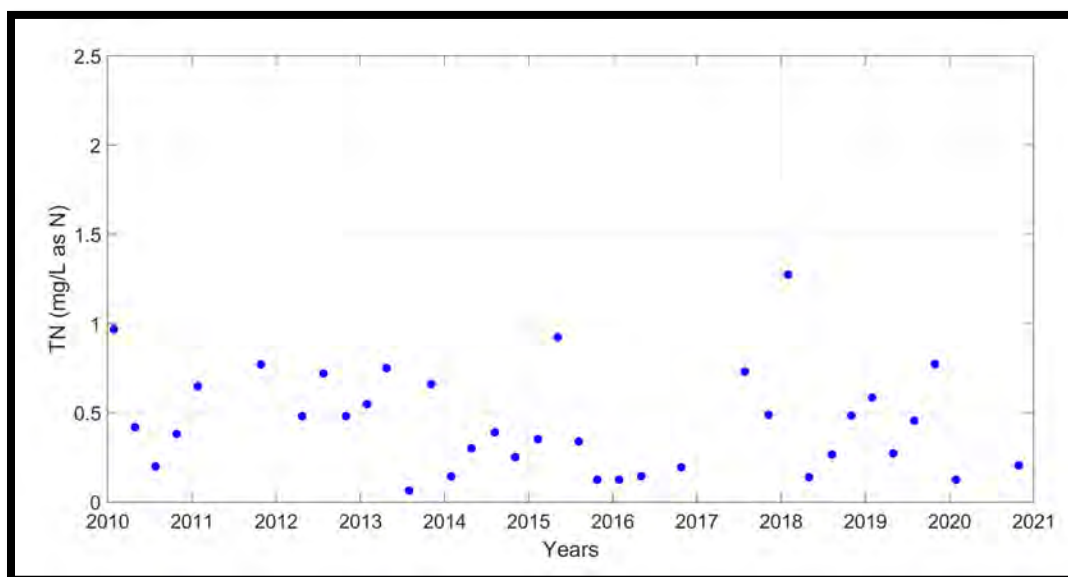


Figure 5-153: Plot of Measured TN in Lake Leon

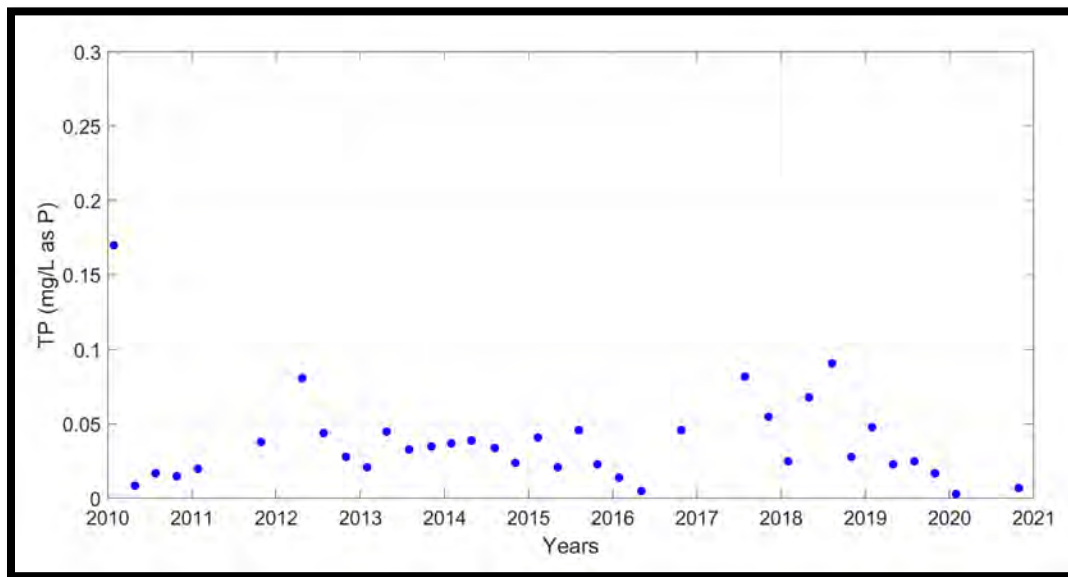


Figure 5-154: Plot of Measured TP in Lake Leon

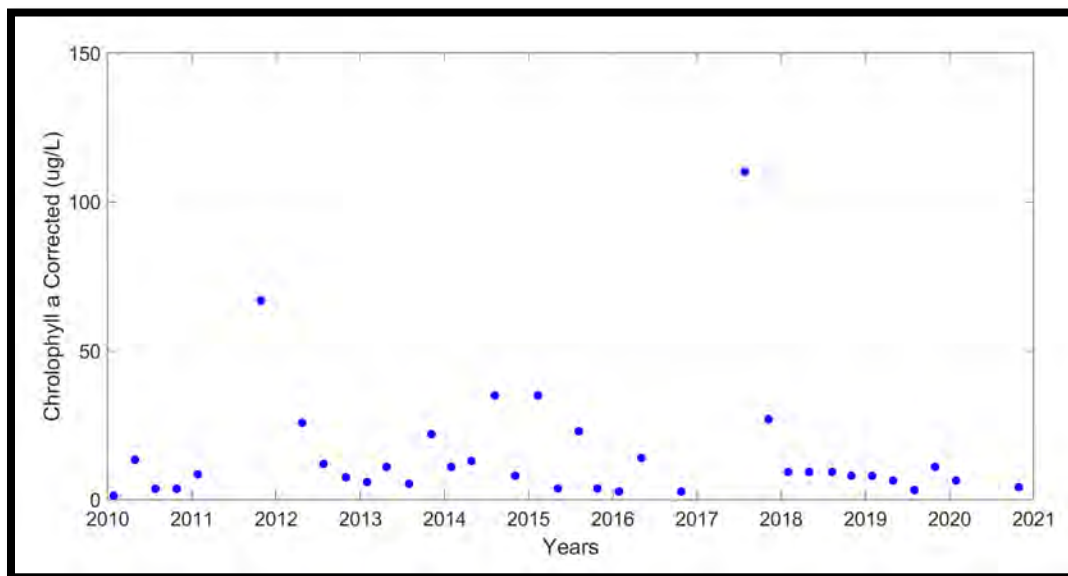


Figure 5-155: Plot of Measured Chl-a in Lake Leon

Figure 5-156 and **Figure 5-157** present plots of the TN and TP data in Lafayette Creek, respectively, from 2010 to 2020. The data prior to 2015 include only data from the upstream station (Station 4 in **Figure 5-152**) while the data after 2015 includes data on the creek from both the upstream and downstream (Station 1) stations. Examination of the data shows somewhat elevated TN and TP levels in the earlier years in relation to later years.

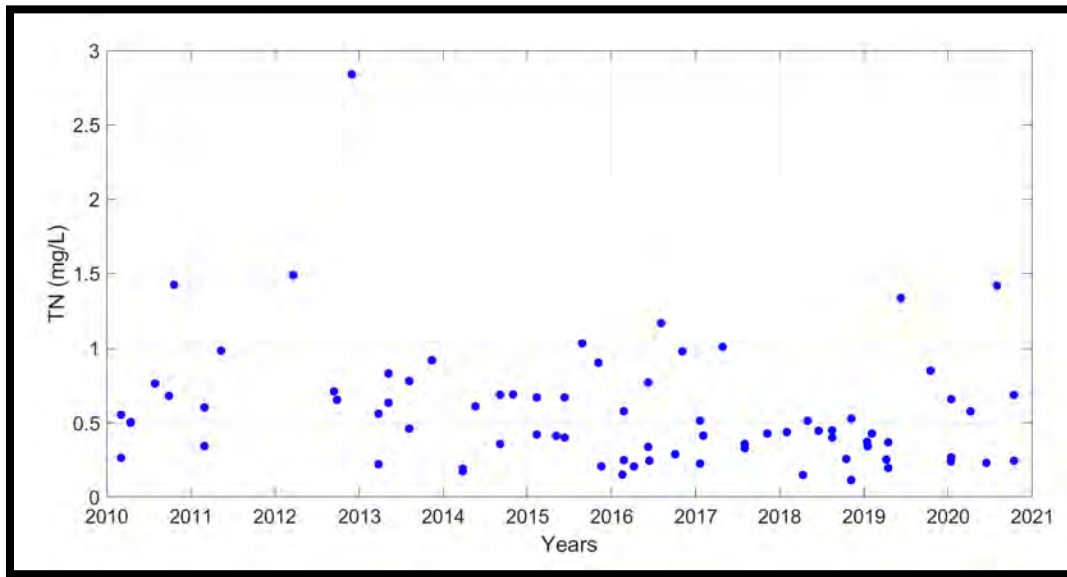


Figure 5-156: Plot of Measured TN in Lafayette Creek

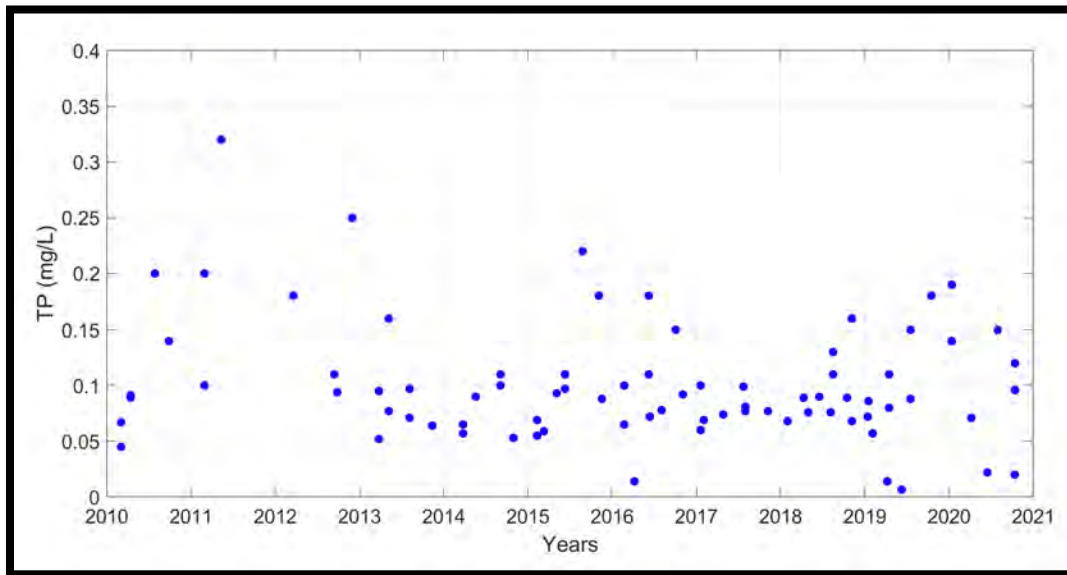


Figure 5-157: Plot of Measured TP in Lafayette Creek

Under FDEP's NNC, Lake Leon is defined as a low color, high alkalinity system. The designation is based on long-term average color lower than 40 PCU and long-term alkalinity levels greater than 20 mg/L. Based on this designation, the AGM threshold for Chl-a is 20 $\mu\text{g/L}$. For TN and TP, a range of concentrations are allowable, based on maintaining Chl-a levels in the lake below 20 $\mu\text{g/L}$. For TN, the range is 1.05 mg/L to 1.91 mg/L. For TP, the range is 0.03 mg/L to 0.09 mg/L.

Under FDEP's NNC, the freshwater stream thresholds applicable in Lafayette Creek are 0.18 mg/L for TP and 1.03 mg/L for TN as AGMs. For *E. coli*, the freshwater stream and lake criteria are monthly geometric means below 126 colonies per 100 mL of water and less than 10 percent

of samples above 410 colonies per 100 mL of water in any 30-day period. For the purpose of determining bacteria impairments where data are collected monthly, per 62-303 F.A.C., FDEP assesses all the samples collected through the verified period to determine the number of samples that are above the threshold. If the number of samples (based on the sample size) is greater than or equal to numbers provided in the tables within 62-303 (to provide 90 percent confidence), the waterbody is deemed impaired. The FDEP threshold for this analysis is 410 MPN/100 mL.

TN, TP, and Chl-a, AGMs are plotted in **Figure 5-158** through **Figure 5-160** as these define the status of the lake relative to nutrient impairments. **Figure 5-161** and **Figure 5-162** present the calculated annual AGMs within Lafayette Creek for TN and TP respectively. Where sufficient data are available to assess the AGMs, the levels are provided from 2010 through 2020. The Chl-a threshold and the minimum (where applicable) and maximum thresholds for TN and TP relative to the NNC are on each of the graphs as pink dashed lines. **Figure 5-163** presents a plot of calculated TSI values in the lake. While TSI is no longer utilized for the determination of impairment, it does serve as an indicator of lake health. Based on TSI definitions, levels below 60 are deemed good condition, levels between 60 and 70 indicate fair condition, while levels above 70 indicate poor condition. **Figure 5-164** and **Figure 5-165** presents plots of *E. coli* data for the available period of record for Lake Leon and Lafayette Creek respectively.

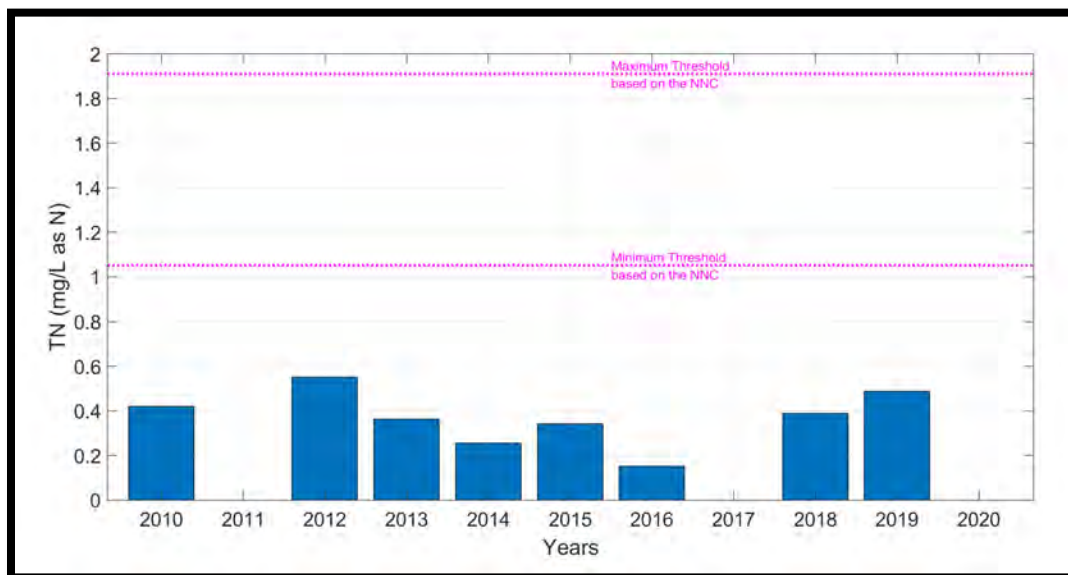


Figure 5-158: Plot of Annual Geometric Means for TN with NNC Criteria for Lake Leon

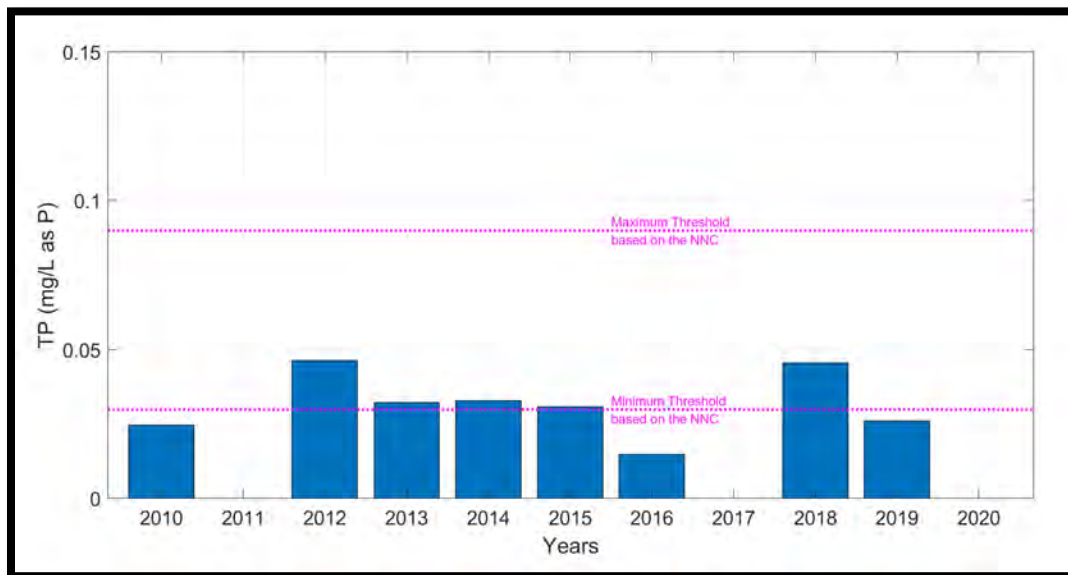


Figure 5-159: Plot of Annual Geometric Means for TP with NNC Criteria for Lake Leon

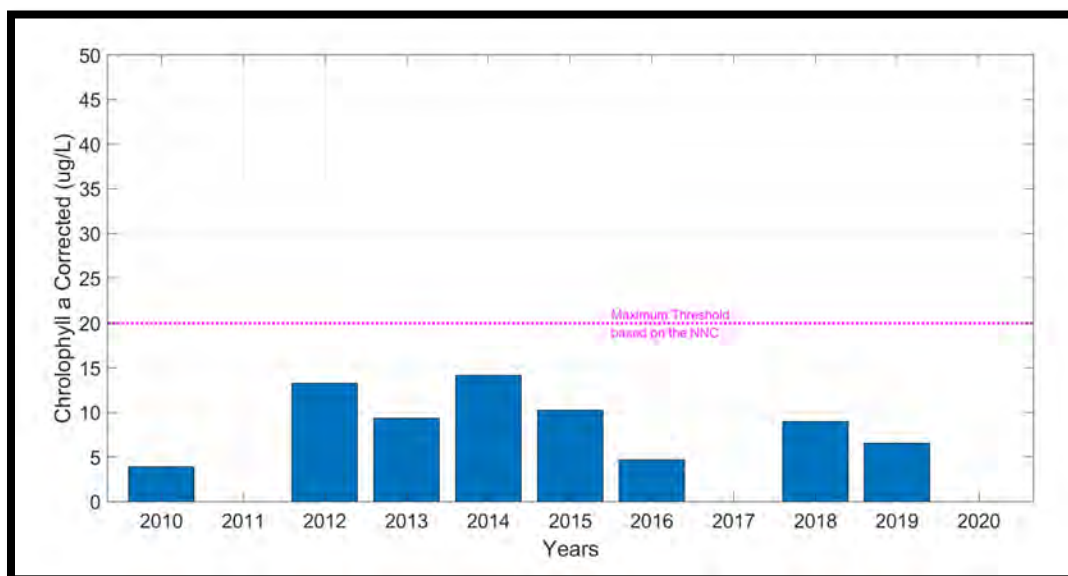


Figure 5-160: Plot of Annual Geometric Means for Chl-a with NNC Criteria for Lake Leon

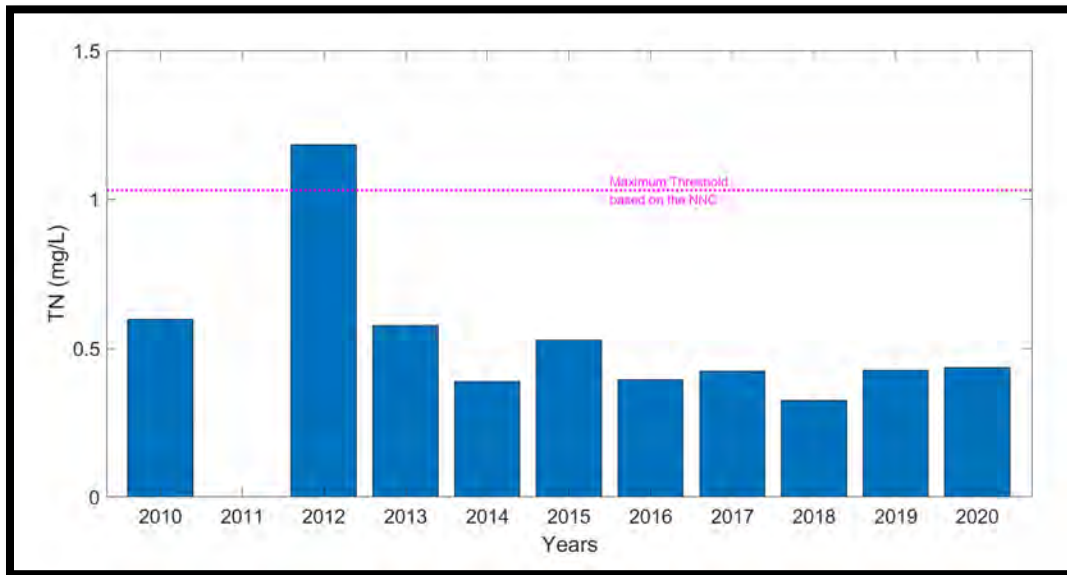


Figure 5-161: Plot of Annual Geometric Means for TN with NNC Criteria for Lafayette Creek

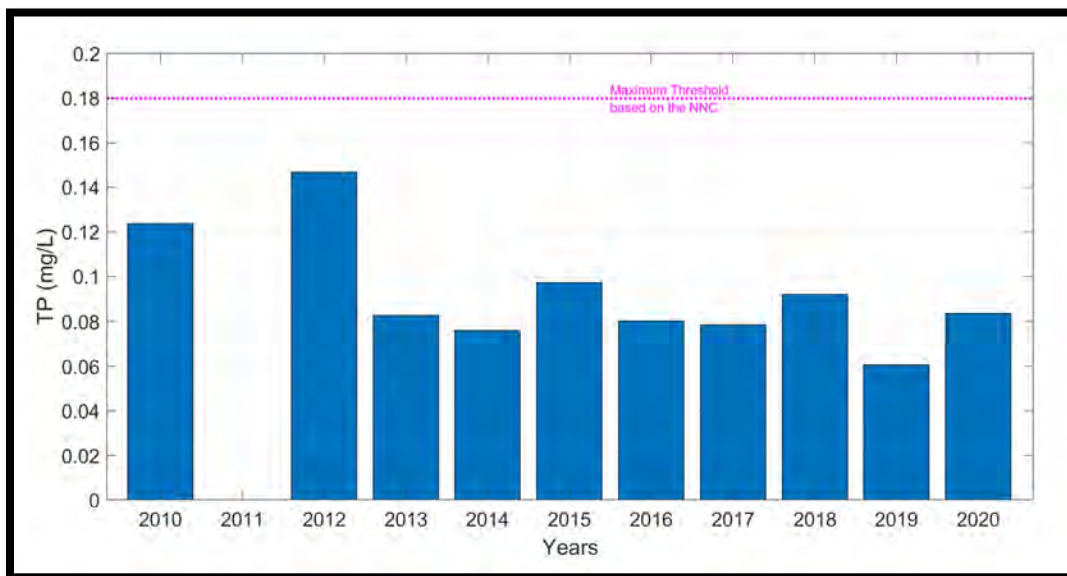


Figure 5-162: Plot of Annual Geometric Means for TP with NNC Criteria for Lafayette Creek

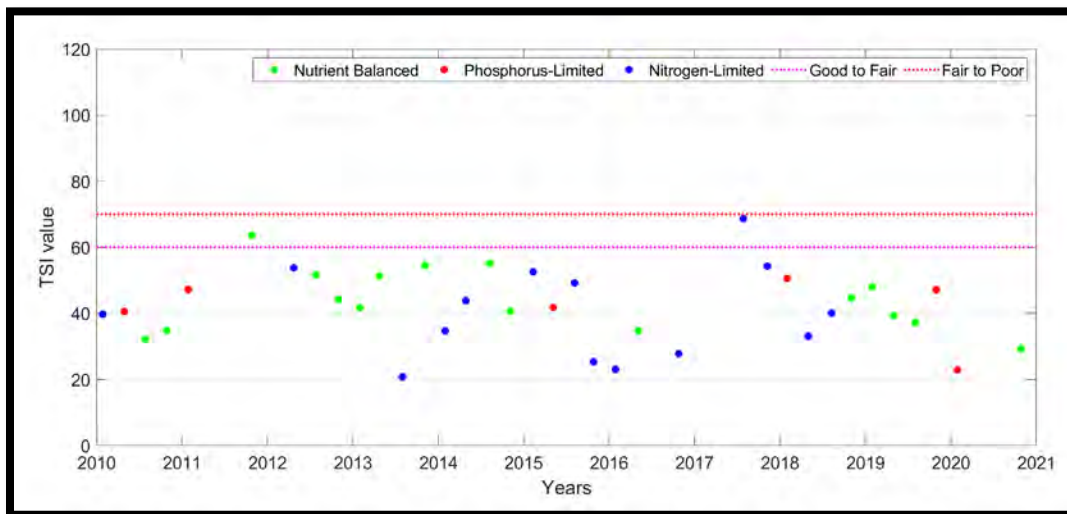


Figure 5-163: Trophic State Index for Lake Leon (2010 to 2020)

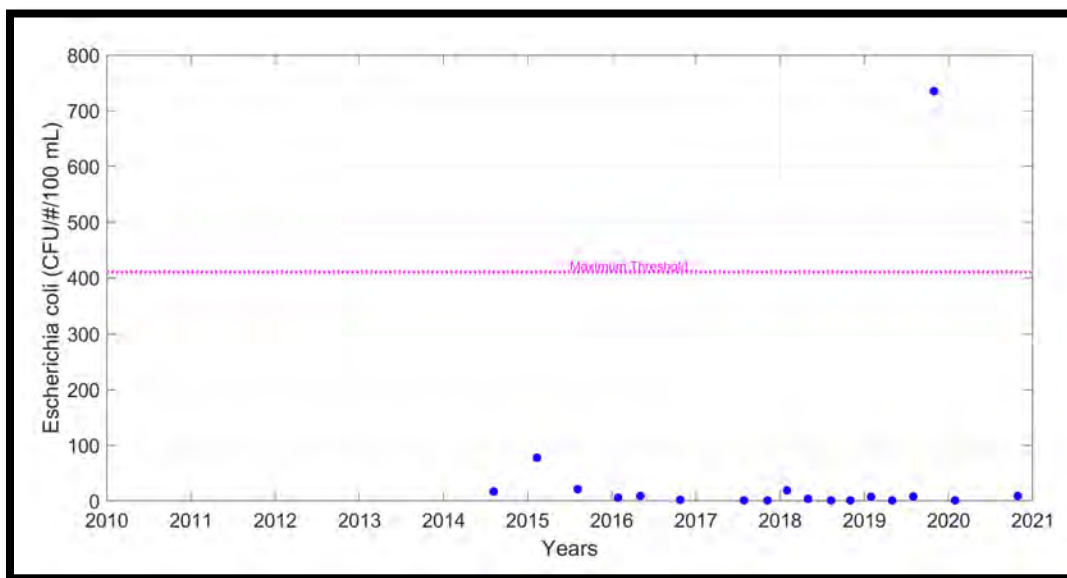


Figure 5-164: Plot of *E. coli* Measurements for Lake Leon (2010 to 2020)

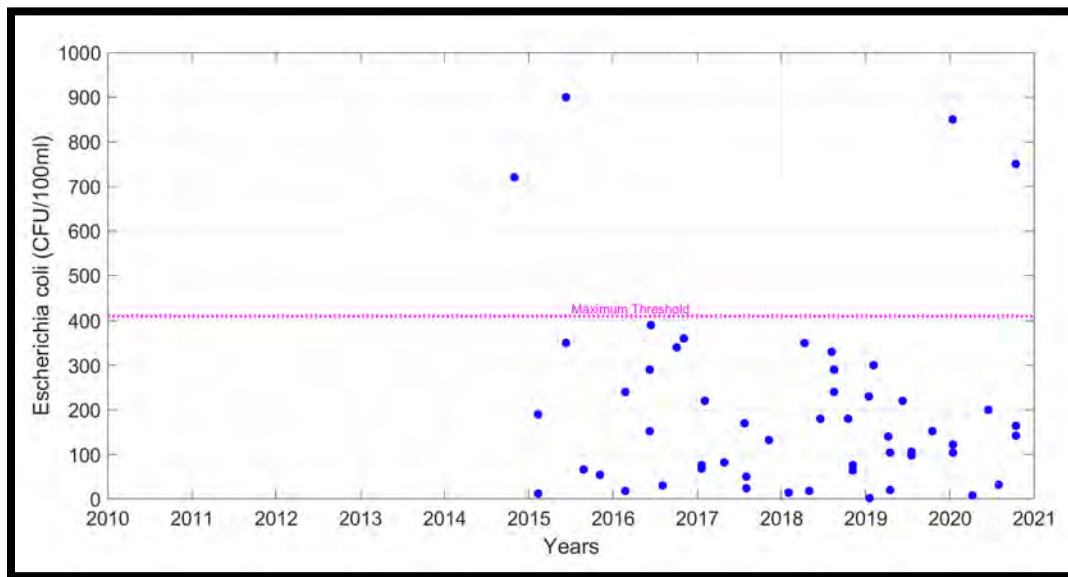


Figure 5-165: Plot of *E. coli* Measurements for Lafayette Creek (2010 to 2020)

Examination of the TN plot for Lake Leon (**Figure 5-158**) shows that from 2010 to 2020, where sufficient data were available TN AGM levels have been well below the minimum threshold. TP AGM levels (**Figure 5-159**) were below, at or just above the minimum threshold. The Chl-a AGMs from 2010 through 2020 (**Figure 5-160**) were all below the 20 $\mu\text{g/L}$ threshold. Insufficient data were available in 2011 and 2017, the years when drawdowns occurred.

Examination of the TN plot for Lafayette Creek (**Figure 5-161**) shows a general downward trend with some higher values prior to 2015 and one year where measured values were above the NNC threshold. TP AGM levels (**Figure 5-162**) are all below the stream threshold with a similar downward trend in the later years. The lower values in the later years may be due to the addition of the downstream data after 2015. The spatial differences along the creek will be further examined in **Section 5.8.4.1**.

Examination of the TSI plot (**Figure 5-163**) shows all but two measurements in the good range with generally nutrient-balanced to nitrogen-limited conditions. No values went above the 70 threshold from 2010 to 2020.

Figure 5-164 presents a plot of measured *E. coli* levels in Lake Leon from 2014 through 2020. The data (other than one high value) show very low values, with most at below detection limits. **Figure 5-165** presents a plot of measured *E. coli* levels in Lafayette Creek from 2014 through 2020. There are elevated levels measured in the creek but most (other than 4 measurements) at or below the 410 MPN/100 mL threshold. Again, this data represents both upstream and downstream samples. The spatial differences will be examined further in **Section 5.8.4.1**.

5.8.3.6 Groundwater Data

Presently there are no surficial groundwater monitoring wells identified within the Lafayette Creek basin.

5.8.3.7 Biological Data

Table 5-24 presents LVI data for Lake Leon. The LVI sampling showed the lake to be impaired for 3 of the 4 years sampled, with one year (2010) just into the healthy range.

Table 5-24: Summary of LVI Results from Lake Leon

Date	Station ID	LVI	Aquatic Life Use Category
06/22/2010	Lake Leon	39	Healthy
09/27/2012	Lake Leon	31	Impaired
10/14/2013	Lake Leon	11	Impaired
10/01/2015	Lake Leon	16	Impaired

5.8.3.8 Stormwater Treatment Facilities

Figure 5-166 presents a map showing the locations of stormwater treatment facilities throughout the Lafayette Creek basin. The City maintains multiple treatment ponds distributed throughout the basin serving various developments and other facilities. FDOT maintains two ponds in the headwaters of the basin associated with Capital Circle.

5.8.3.9 Atmospheric Deposition Data

Section 5.4.3.11 presented the location of the nearest atmospheric deposition station to the Lake Lafayette basin. The data from this station will be utilized to calculate atmospheric deposition to Lake Leon.

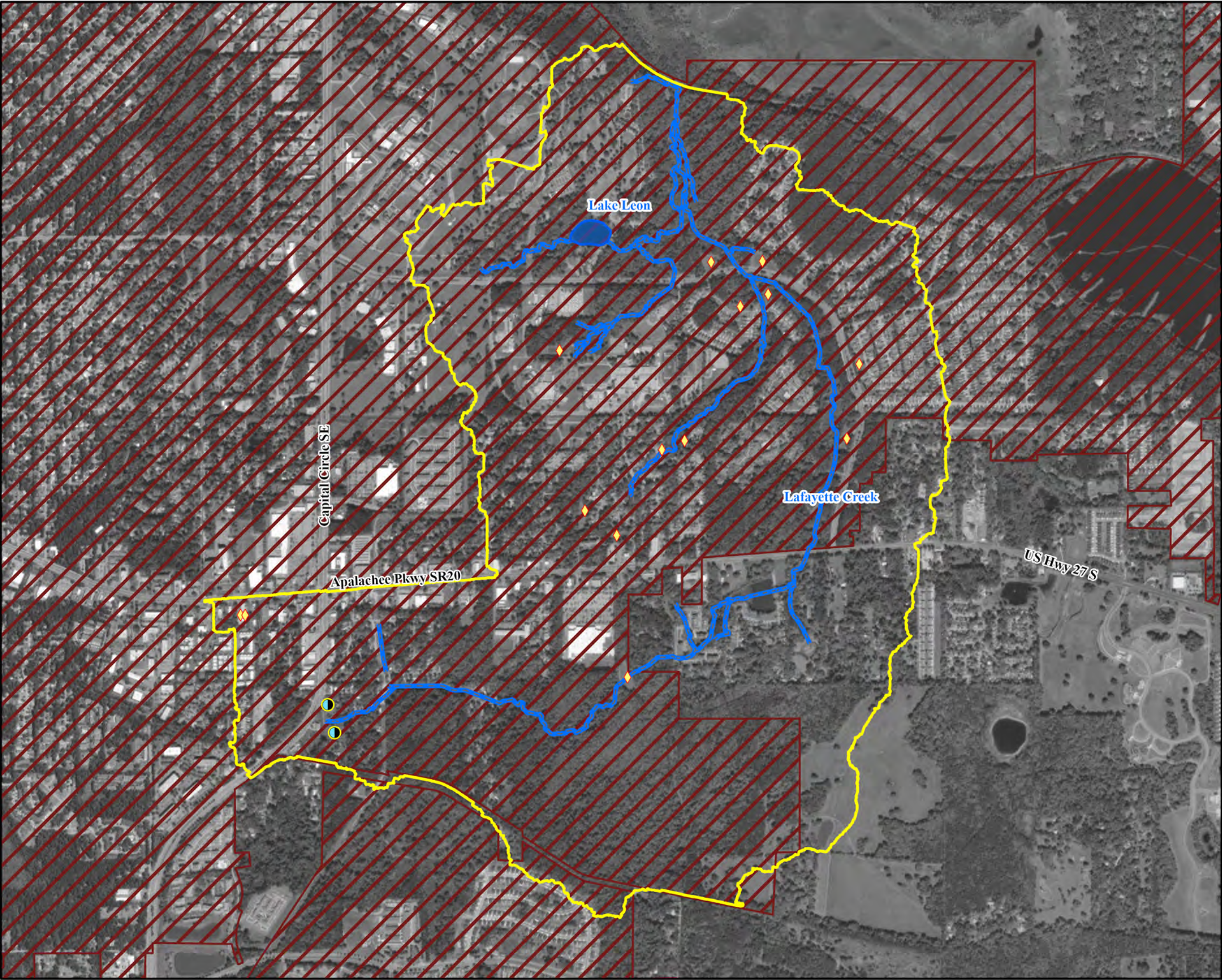
5.8.3.10 Data Summary

For the purposes of the qualitative analysis of sources of pollutants to Lafayette Creek and Lake Leon (**Section 5.8.4**), the available data are reasonable. There are sufficient active surface water quality stations at key locations within the creek to support the qualitative assessment. The following outlines some limitations in the available data. Specific recommendations on additional data collection efforts are provided in **Section 5.10**.

- No hydrologic data (level or inflow/outflow) data has been collected in Lake Leon (level) or within Lafayette Creek (flow).
- No surficial groundwater monitoring stations are located in the vicinity to determine the quality of potential seepage into the lake or creek segments.
- No data are available to determine the potential for internal loading as a source to Lake Leon.

5.8.4 Qualitative Assessment of Sources

As outlined in previous sections, prior to performing loading calculations and other analyses to quantify existing pollutant sources to Lafayette Creek and Lake Leon, it is important to analyze available data and summarize findings from historical studies to support identification of likely sources.



Legend

- Lafayette Creek and Lake Leon Drainage Basin
- Waterbodies in Study
- Tallahassee Corporate Limits
- City of Tallahassee Stormwater Ponds
- FDOT Stormwater Ponds

Sources:
Waterbodies: COT, 2020
Watersheds: COT, 2020
Roads: FDOT, 2020
BMPs: Geosyntec, 2022
City Limits: COT, 2022

Figure 5-166:
Lafayette Creek and Lake Leon Basin BMP
Location Map

Tallahassee Master Plan - Surface
Water (TMaPS)



For Lafayette Creek and Lake Leon, the sources to be evaluated include the following:

- Stormwater runoff
- Septic systems
- Internal recycling and seepage
- Wastewater
- Atmospheric deposition
- Interconnected flows

An overview of analyses and findings for each source listed above is provided in the following sections. Prior to the discussions of each of the potential sources, additional analyses of the data collected along Lafayette Creek and Lake Leon are provided to build on the information presented in **Section 5.8.3.5**. Following the discussions for each source type, a summary of findings for the qualitative assessment is provided.

5.8.4.1 In-Stream and Lake Water Quality

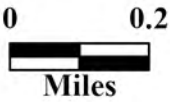
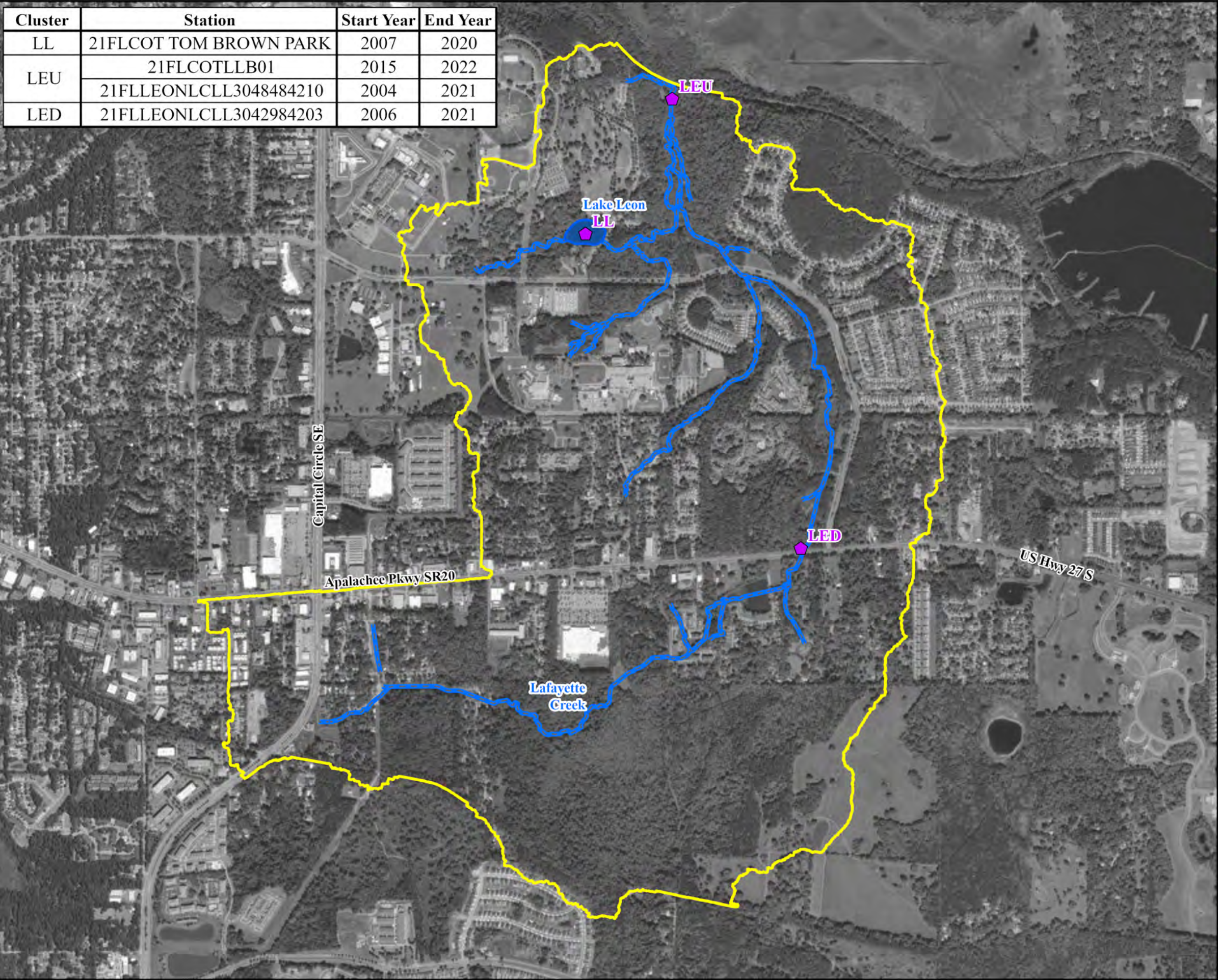
Following the methodology utilized for other basins, analyses were conducted on the available stream data and lake data from 2010 to the present. The primary purpose of this analysis is to evaluate the baseline water quality and the spatial differences along the creek and relative to Lake Leon. The parameters analyzed include TP, TN, TSS, and *E. coli*.

Water quality stations were clustered where they represent conditions within a specific area along the creek or representing the lake. The clustered data from 2010 to 2020 were analyzed to provide the average of the annual geomeans or the 90th percentile, depending upon the parameter. The results are then presented on a map with colors representing the results. The levels associated with the colors are reflective of water quality thresholds as outlined in 62-302 F.A.C. for the lake or stream. As only one location is representative of the lake, parameters that reflect both lake and stream conditions are presented (TN, TP, *E. coli*) to provide comparisons. The color transitions for the clusters within Lake Leon and Lafayette Creek were set in a similar manner to the other lakes and creeks presented and described earlier. Additionally, based on having two stations along the creek, TSS values are also presented.

Figure 5-167 presents the data clustering used for the analyses and associated stations. For Lafayette Creek and Lake Leon, data from 2010 through 2020 were available at three locations. One cluster represents conditions in Lake Leon (LL). A second is located along the main stem of Lafayette Creek where it crosses Apalachee Parkway (LED). The third is located along the main stem of Lafayette Creek where it crosses the CSX railroad just prior to discharge to Upper Lake Lafayette. All three clusters had complete data sets from 2010 to 2020.

Figure 5-168 and **Figure 5-169** present the TN and TP results. Looking first at the TN values (LED=0.44 mg/L, LEU=0.23 mg/L, LL=0.05 mg/L) shows that TN levels within the lake and stream are low in relation to the thresholds. Additionally, along the creek there does not appear to be significant differences between the upstream and downstream stations. While TP levels are higher in relation to the thresholds (LED=0.113 mg/L, LEU=0.071 mg/L, LL=0.033 mg/L), the values are below the thresholds at all locations, with upstream TP levels on average higher than the downstream values.

Cluster	Station	Start Year	End Year
LL	21FLCOT TOM BROWN PARK	2007	2020
LEU	21FLCOTLLB01	2015	2022
	21FLLEONLCLL3048484210	2004	2021
LED	21FLLEONLCLL3042984203	2006	2021



Legend

- Lafayette Creek and Lake Leon Drainage Basin
- Waterbodies in Study
- Staion Clusters

Sources:
 Waterbodies: COT, 2020
 Watercourses: COT, 2020
 Drainage Basins: COT, 2020
 Roads: COT-Leon County, 2023

Figure 5-167:
Station Clustering for Spatial Analyses of
Lafayette Creek and Lake Leon

Tallahassee Master Plan - Surface
Water (TMaPS)



Cluster	Station ID	Start Date	End Date
LL	21FLCOT TOM BROWN PARK	2007	2020
LEU	21FLCOT LLB01	2015	2022
	21FLLEONLCLL3048484210	2004	2021
LED	21FLLEONLCLL3042984203	2006	2021



Legend

Lafayette Creek and Lake Leon Drainage Basin

Waterbodies in Study

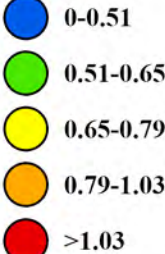
Lake Leon TN Average 2010-2020

mg/L



Stream TN Average 2010-2020

mg/L



Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Drainage Basins: COT, 2020
Roads: COT-Leon County, 2023
Station Data: FDEP, 2021

Figure 5-168:
Spatial Assessment of TN in Lafayette
Creek and Lake Leon

Tallahassee Master Plan - Surface
Water (TMaPS)



Cluster	Station ID	Start Date	End Date
LL	21FLCOT TOM BROWN PARK	2007	2020
LEU	21FLCOT LLB01	2015	2022
	21FLLEONLCLL3048484210	2004	2021
LED	21FLLEONLCLL3042984203	2006	2021



Legend

Lafayette Creek and Lake Leon Drainage Basin

Waterbodies in Study

In Lake TP Average 2010-2020

mg/L

0-0.03

0.03-0.05

0.05-0.07

0.07-0.09

>0.09

Stream TP Average 2010-2020

mg/L

0-0.045

0.045-0.09

0.09-0.135

0.135-0.18

>0.18

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Drainage Basins: COT, 2020
Roads: COT-Leon County, 2023
Station Data: FDEP, 2021

Figure 5-169:
Spatial Assessment of TP in Lafayette
Creek and Lake Leon

Tallahassee Master Plan - Surface
Water (TMaPS)



Figure 5-170 presents a map of the TSS levels. The calculated TSS averages (LED=10.1 mg/L, LEU=4.4 mg/L) in the creek are higher at the upstream station than the downstream station. The upstream station had the highest TSS levels of any of the tributaries analyzed in previous sections within the Lake Lafayette Chain basin.

Figure 5-171 presents a map of the *E. coli* levels. The data analyzed are from 2014 through 2020 and the data were analyzed to provide the 90th percentile to compare against the 410 MPN/100 mL criteria per the FDEP approach in the IWR analyses. The analyses show that none of the stations have 90th percentiles above the threshold with the 90th percentiles in Lake Leon and the upstream station (LEU) low (LED=56.7 MPN/100 mL, LEU=227.7 MPN/100 mL, LL=21.1 MPN/100 mL). The higher concentrations plotted earlier in **Figure 5-165**, are associated with the downstream station just prior to the discharge to Upper Lake Lafayette.

5.8.4.2 Stormwater Runoff

To assess stormwater runoff as a potential source of pollutant loads to Lafayette Creek and Lake Leon the LDI level within the basin was evaluated. **Figure 5-172** presents the calculated LDI. The map shows that for the watershed draining to Lake Lafayette Creek and Lake Leon the levels are moderate, which indicates that this area does not have a high potential for anthropogenic pollutant loads from stormwater runoff. The available data analyzed and presented earlier support this.

5.8.4.3 Septic Systems

Figure 5-151 presented the locations of septic systems within the Lafayette Creek basin. **Figure 5-173** presents a map showing the septic tank density for the Lafayette Creek basin. The septic tank density in the Lafayette Creek basin is low with, on average, 1 system per acre. Early analyses identified the highest *E. coli* levels at the downstream end of Lafayette Creek at the CSX crossing. The upstream station (at the crossing of Apalachee Parkway) had some elevated values, but values were lower than the downstream. Lake Leon concentrations were the lowest.

Examination of the location of the septic systems along the creek (**Figure 5-151**) shows the largest number of systems immediately upstream of the crossing at Apalachee Parkway. Per the discussion above, while some elevated values were measured at the crossing, they were lower than seen in the downstream station, and not high enough to exceed the threshold, i.e., 10 percent greater than 410 MPN/100 mL, which, along with the nutrient analyses, indicates that septic systems are not a significant anthropogenic source to the creek. A septic load will be calculated based on available information and presented in **Section 5.8.5.2**.

5.8.4.4 Internal Recycling and Seepage

Internal Recycling

To date, no studies or data collection efforts have been undertaken to assess the potential for loading from sediments in Lake Leon. Analyses of the available data in Lake Leon do not show significantly elevated levels in relation to NNC thresholds. As such, internal recycling is not identified as a potential significant anthropogenic source of loads to the lake.

Cluster	Station ID	Start Date	End Date
LEU	21FLCOT LLB01	2015	2022
	21FLLEONLCLL3048484210	2004	2021
LED	21FLLEONLCLL3042984203	2006	2021



Legend

Lafayette Creek and Lake Leon Drainage Basin

Waterbodies in Study

TSS Average 2010-2020

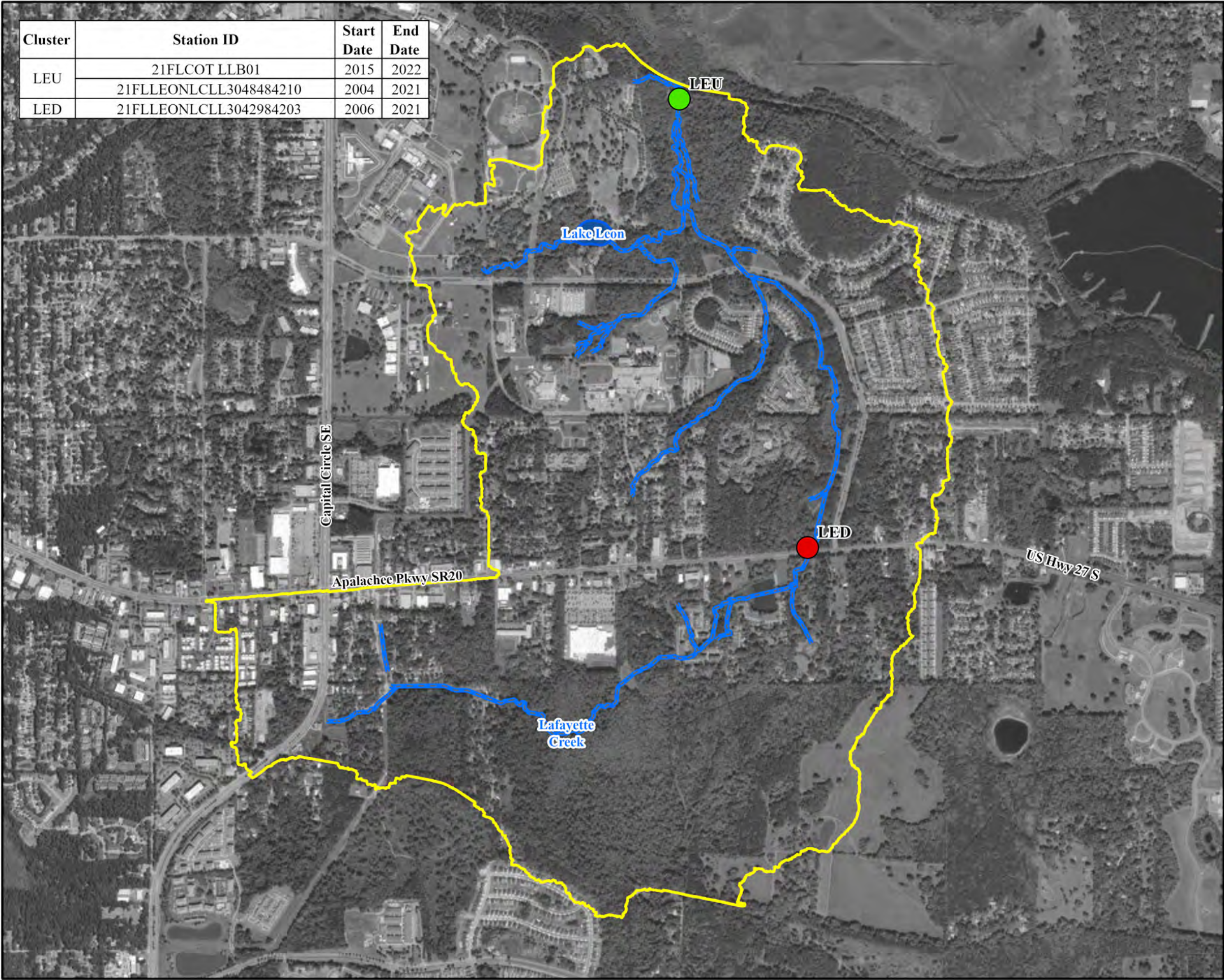
mg/L

- 0-2.5
- 2.5-5.0
- 5.0-7.5
- 7.5-10
- >10.0

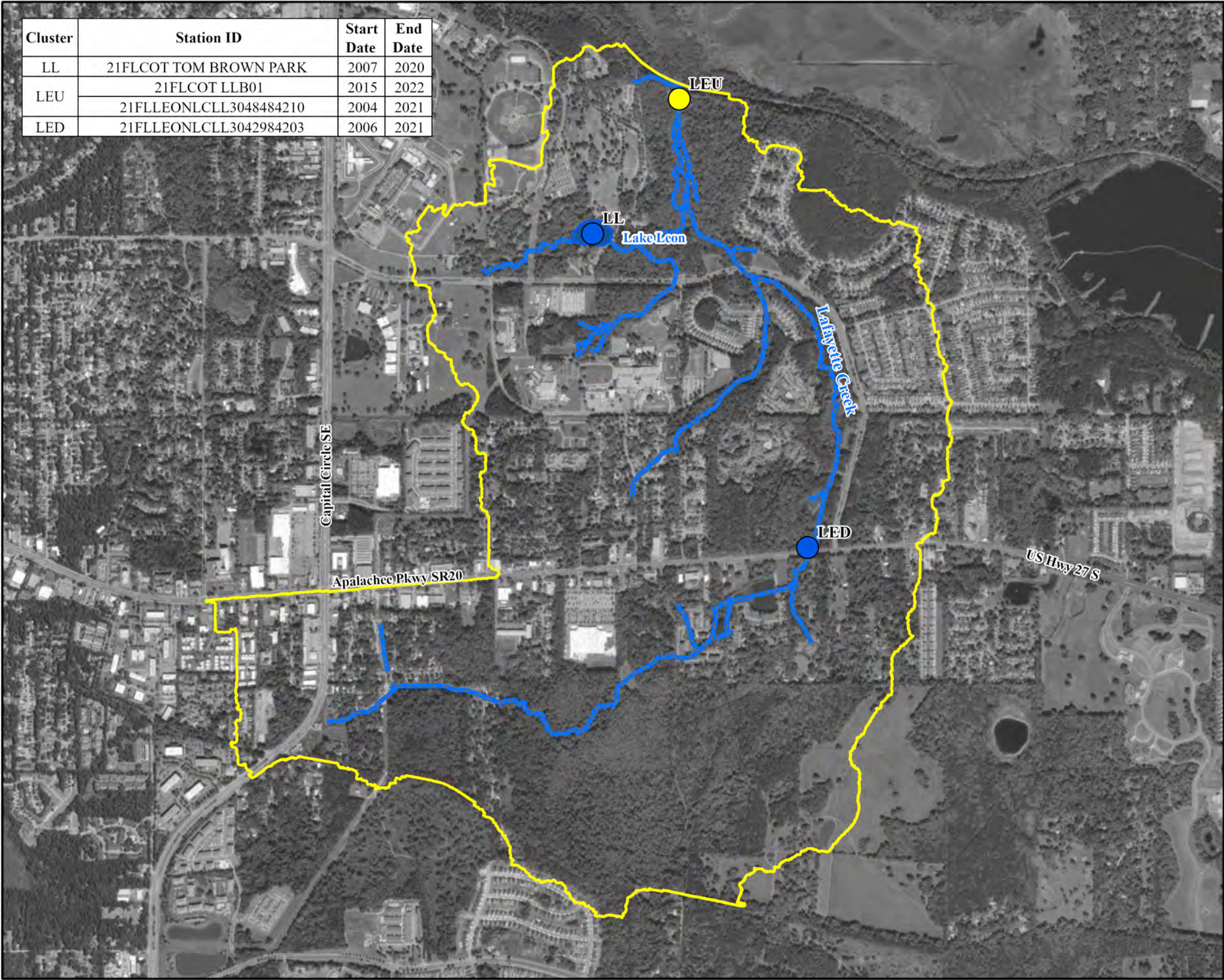
Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Drainage Basins: COT, 2020
Roads: COT-Leon County, 2023
Station Data: FDEP, 2021

Figure 5-170:
Spatial Assessment of TSS in Lafayette
Creek

Tallahassee Master Plan - Surface
Water (TMaPS)



Cluster	Station ID	Start Date	End Date
LL	21FLCOT TOM BROWN PARK	2007	2020
LEU	21FLCOT LLB01	2015	2022
	21FLLEONLCLL3048484210	2004	2021
LED	21FLLEONLCLL3042984203	2006	2021



Legend

Lafayette Creek and Lake Leon Drainage Basin

Waterbodies in Study

E. coli 90th Percentile 2010-2020

MPN/100mL

0-100

100-200

200-300

300-410

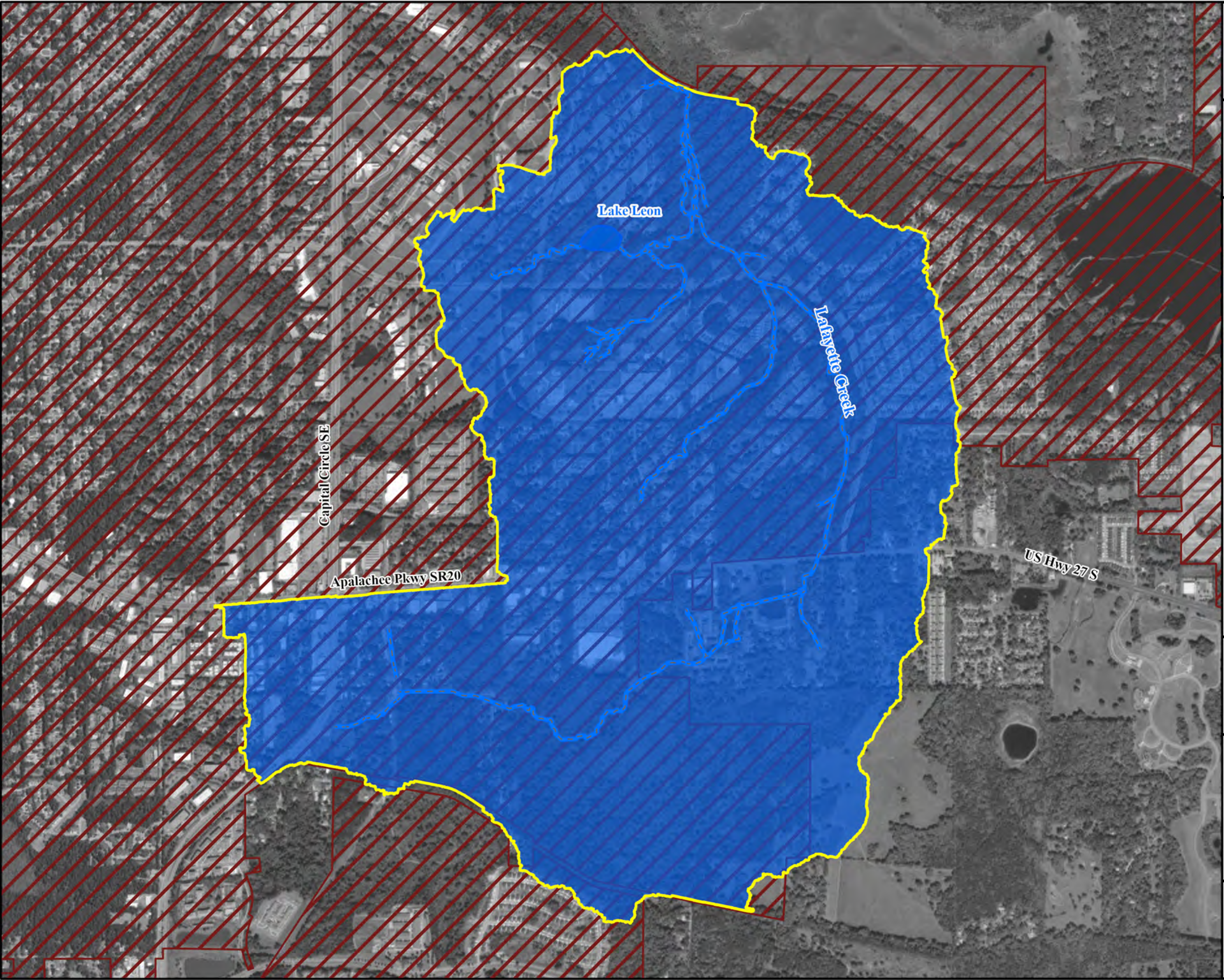
>410

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Drainage Basins: COT, 2020
Roads: COT-Leon County, 2023

Figure 5-171:
Spatial Assessment of E. coli in Lafayette
Creek and Lake Leon

Tallahassee Master Plan - Surface
Water (TMaPS)





Legend

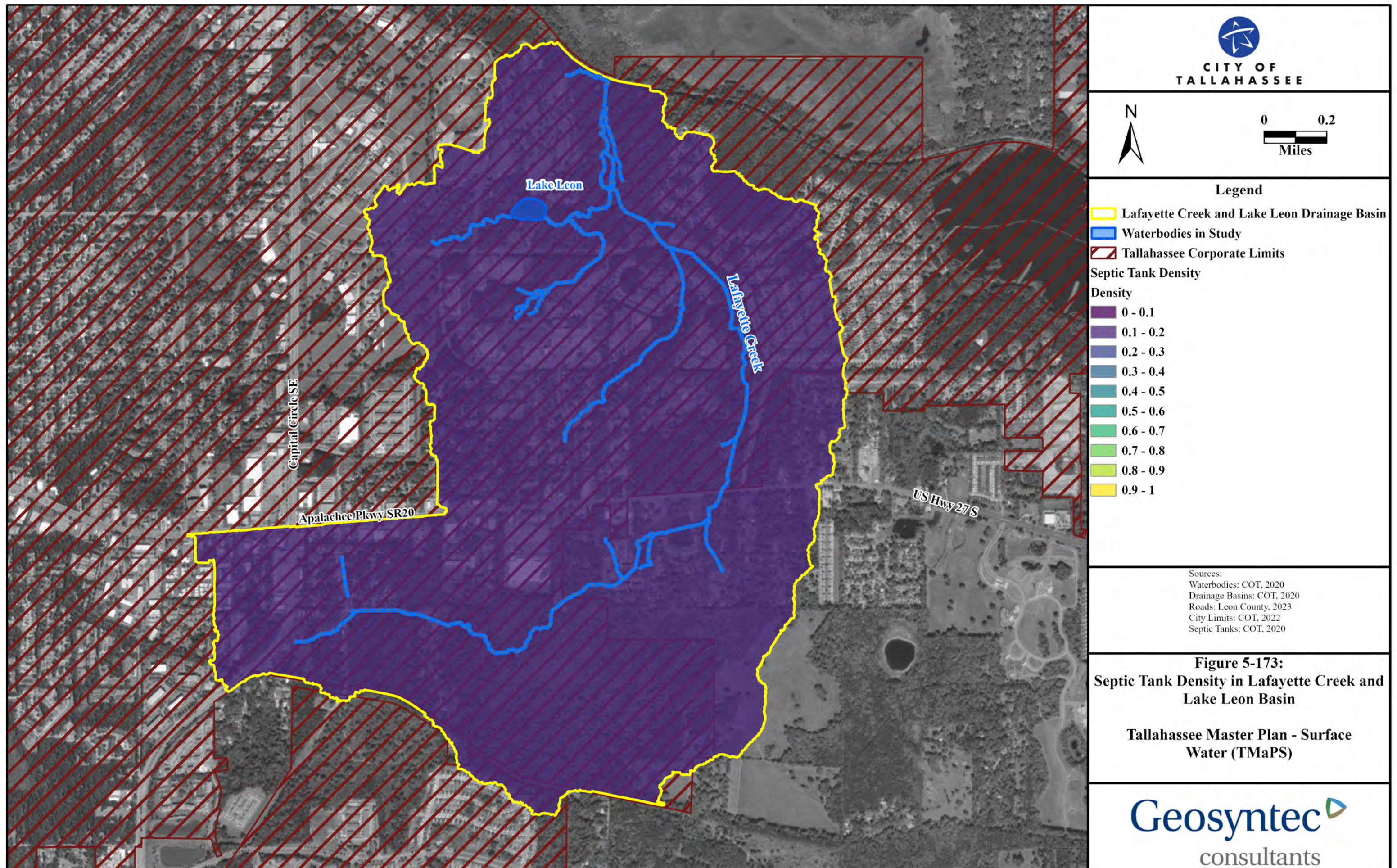
- Lafayette Creek and Lake Leon Drainage Basin
- Waterbodies in Study
- Tallahassee Corporate Limits
- Land Development Index
 - Excellent
 - Good
 - Moderate
 - Poor
 - Very Poor

Sources:
Waterbodies: COT, 2020
Drainage Basins: COT, 2020
Roads: Leon County, 2023
City Limits: COT, 2022

Figure 5-172:
Land Development Index in Lafayette
Creek and Lake Leon Basin

Tallahassee Master Plan - Surface
Water (TMaPS)





Seepage

As outlined in **Section 5.8.3.6**, no surficial aquifer data in the immediate vicinity of the lake and creek were identified. As was outlined for internal recycling, based on present water quality conditions in the lake, seepage is not identified as a potential significant anthropogenic source to the lake. Based on the soil types in this basin discussed in **Section 5.8.3.2**, subsurface transmissivity levels are expected to be low impeding transport of pollutants through seepage.

5.8.4.5 Wastewater

Within the Lafayette Creek basin, there currently are no direct wastewater discharges. Additionally, no areas in the Lake Lafayette Chain of Lakes basin presently have reuse discharges. **Figure 5-174** presents a map of the Lafayette Creek basin boundaries in relation to sewer service areas and sewer infrastructure. Presently, 68 percent of the Lafayette Creek basin has sewer infrastructure, and some of this infrastructure is located adjacent to the creek. Earlier analyses of *E. coli* data showed elevated concentrations in the downstream reaches where the creek crosses the CSX railroad. Based on these data and the wastewater infrastructure coverage areas, wastewater may be a source to the creek and will need to be evaluated as part of an overall assessment of bacteria conditions in the Lafayette Creek basin.

5.8.4.6 Atmospheric Deposition

For Lake Leon, the ratio of the drainage area to lake area is around 18:1. With this ratio, and the potential attenuation of rainfall runoff, direct atmospheric deposition to the lake is not expected to play a role in overall loading, especially for phosphorus. **Section 5.8.3.9** identified the nearest atmospheric deposition station as the Quincy Station (FL14) (**Figure 5-35**).

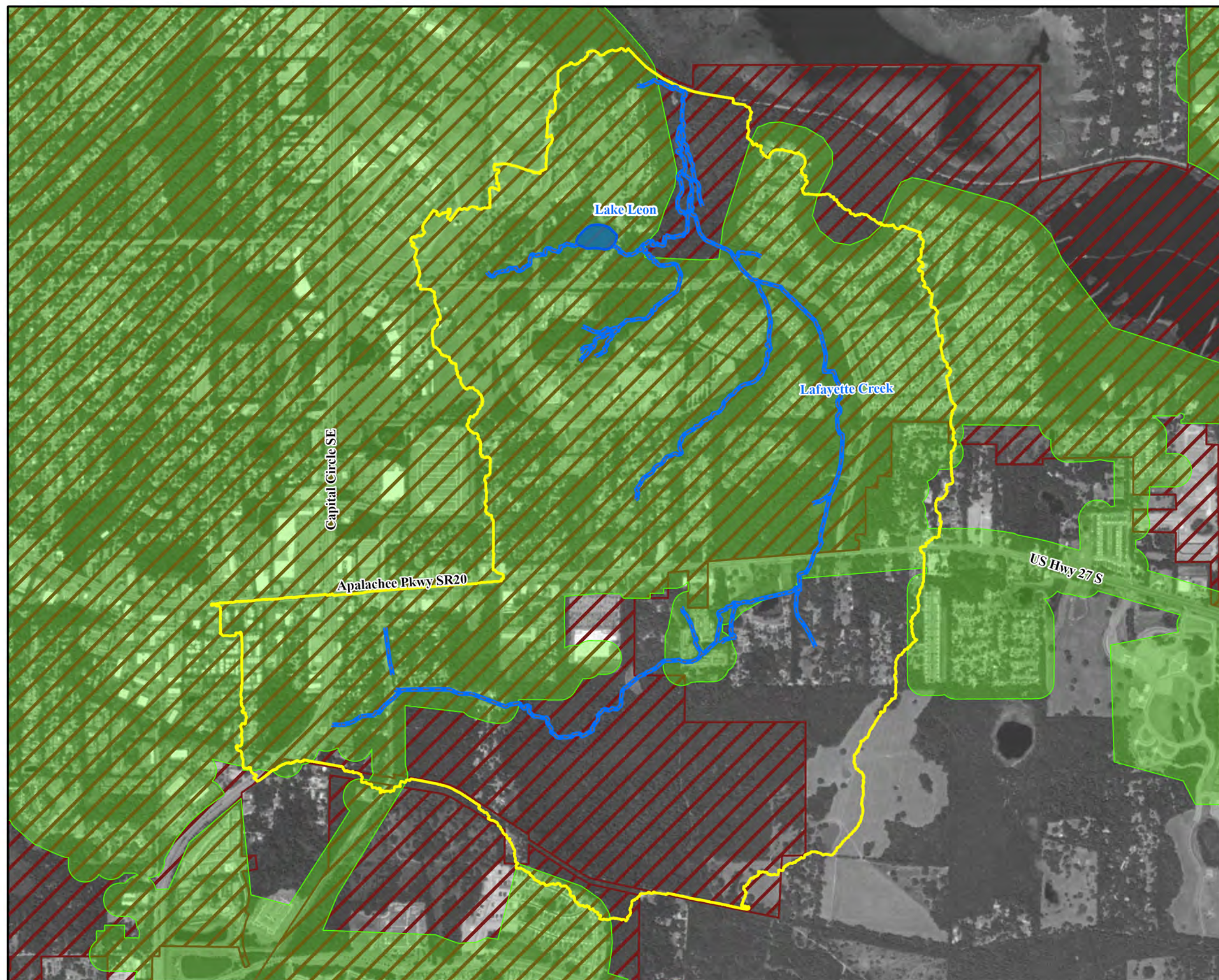
5.8.4.7 Interconnected Flows

Lake Leon discharges over a weir structure to the lower end of Lafayette Creek. As such, it has the potential to be a source to Lafayette Creek. Examination of the TN and TP AGMs within Lake Leon (**Figure 5-158** and **Figure 5-159**) in relation to Lafayette Creek (**Figure 5-161** and **Figure 5-162**), shows that concentrations in Lake Leon are at or lower than the levels in Lafayette Creek. Additionally, the values in Lake Leon (as well as Lafayette Creek) are well below the stream thresholds for TN and TP. Based on this, the load from Lake Leon is not identified as a significant anthropogenic source to Lafayette Creek.

5.8.4.8 Summary of Findings

Based on the discussions above, and data and information presented in **Section 5.8.3**, the only potential anthropogenic sources identified for Lake Leon and Lafayette Creek are septic and wastewater associated with bacteria. The sources of elevated bacteria levels in the creek should be identified and a study recommendation is provided in **Section 5.10**.

Though the sources do not appear significant for TN and TP load, stormwater runoff, septic, interconnected flows (out of Lake Leon), and atmospheric deposition are quantified for comparative purposes as part of this study based on available data. Internal recycling and seepage do not appear to be significant sources and were not quantified as part of this study based on limited data.



Legend

- Lafayette Creek and Lake Leon Drainage Basin
- Waterbodies in Study
- Tallahassee Corporate Limits
- Sewer Service Areas

Sources:
Waterbodies: COT, 2020
Drainage Basins: COT, 2020
Roads: FDOT, 2020
City Limits: COT, 2022
Waste Water: COT, 2020

Figure 5-174:
City of Tallahassee Wastewater Service
Areas within Lafayette Creek and Lake
Leon Basin

Tallahassee Master Plan - Surface
Water (TMaPS)



5.8.5 Calculation of Potential Nutrient Loads

This section presents calculations of potential nutrient (TN and TP) loads to Lafayette Creek and Lake Leon for the sources identified for calculation in **Section 5.5.4.8**. These include stormwater runoff, septic systems, interconnected flow and atmospheric deposition. Where loads were not calculated the sections below provide brief discussions. The load calculations are for the purpose of comparing the potential magnitudes of each source relative to one another to support determination of sources to target for load reduction.

5.8.5.1 Stormwater Pollutant Load

In order to calculate the stormwater TN and TP loads to Lafayette Creek and Lake Leon, average annual pollutant load modeling was performed. The goal was to identify outfalls that are contributing higher TN and TP loads relative to one another and to quantify the total TN and TP loads to Lafayette Creek and Lake Leon. TN and TP loads were calculated using the Spatially Integrated Model for Pollutant Loading Estimates (SIMPLE-Seasonal) model. The model methodology was described in detail in **Section 5.4.5.1** for the stormwater loads to the Lafayette Chain of Lakes.

Figure 5-175 presents the subbasins and the DEM utilized in the SIMPLE model calculations for Lafayette Creek and Lake Leon. **Figure 5-176** presents the aggregated land use. Finally, **Figure 5-177** presents the CDAs for the Lafayette Creek and Lake Leon stormwater loading to define total and per acre TN and TP loads, as well as the ranking of CDAs throughout the basin. A series of subbasins were defined in **Figure 5-175** that drain to Lake Leon (subbasins 16, 17, 18, 19, 20 and 22). These are joined into a single CDA draining to Lake Leon (CDA 13). The remaining subbasins make up the CDAs discharging to Lafayette Creek.

Stormwater Nutrient Loads to Lexington Creek

Figure 5-178 presents the distribution of the ranking of the CDAs for TN along with the total load and per acre loads for Lake Leon and Lafayette Creek, see the tables on **Figure 5-178**. The rankings are color coded, with the highest ranked CDAs in dark green moving down to the lowest ranked in pale yellow. As discussed earlier, a single CDA represents the load to Lake Leon. The total potential stormwater TN load to Lake Leon is 371.5 lb/year, with a per acre load of 3.5 lb/acre/year. For the remaining CDAs that drain to Lafayette Creek, the total TN loads range from as low as 87.3 lb/year up to 1,352.8 lb/year. The per acre loads range from 0.8 lb/acre/year up to 5.3 lb/acre/yr. The highest ranked CDAs are primarily located on the western two tributaries draining to Lafayette Creek and in the most upstream areas, where there is considerable commercial land use. In relation to the other CDAs draining to Lafayette Creek, the CDA draining to Lake Leon is ranked relatively low. Presently, based on the cutoff of 1 acre as the stormwater pond area to account for treatment (see discussion in **Section 5.4.5.1**), treatment that occurs in some of the subbasins is not accounted for in the load calculations. The total potential stormwater runoff load for TN for Lafayette Creek and Lake Leon is 5,335 lb/year.

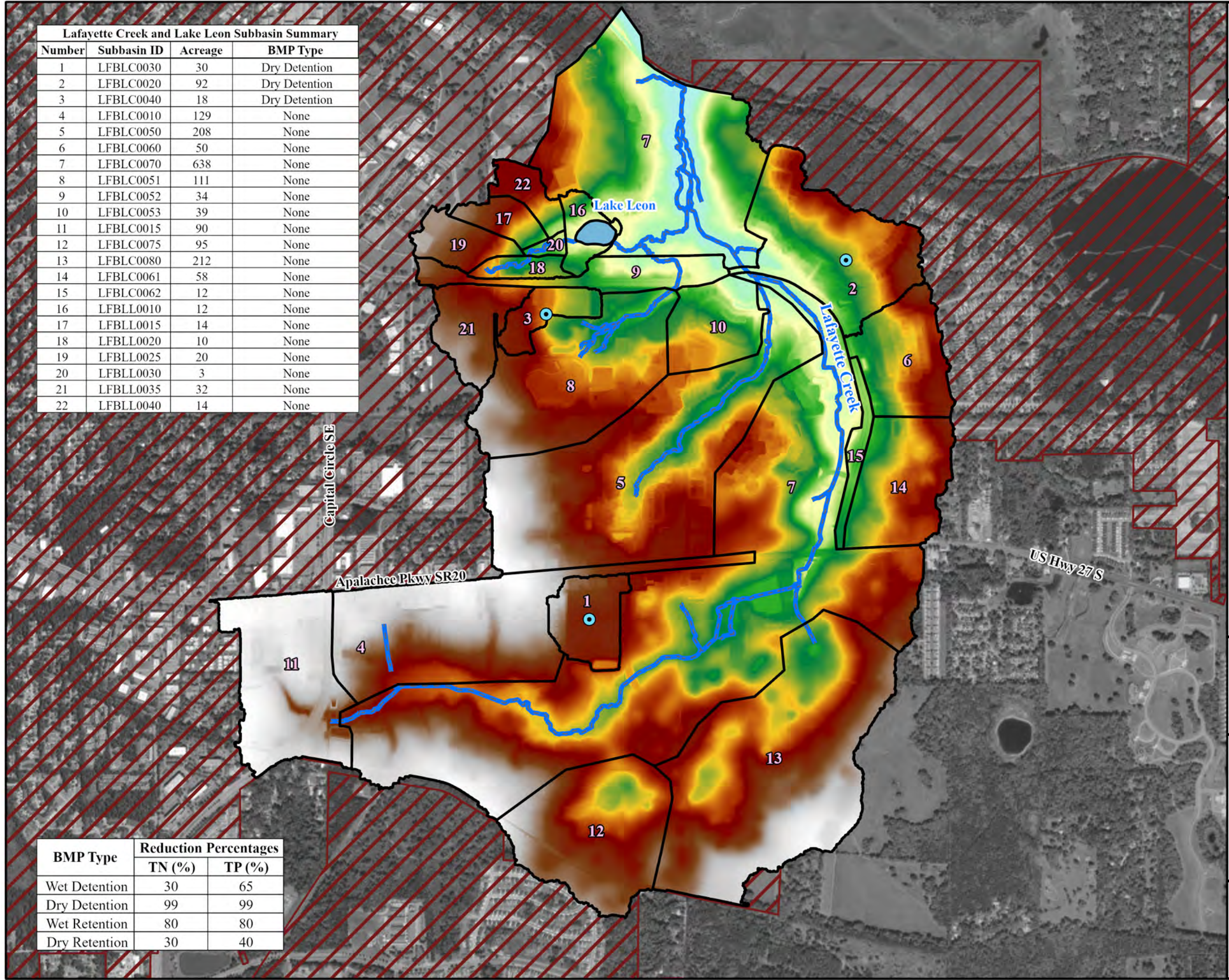
Lafayette Creek and Lake Leon Subbasin Summary			
Number	Subbasin ID	Acreage	BMP Type
1	LFBLC0030	30	Dry Detention
2	LFBLC0020	92	Dry Detention
3	LFBLC0040	18	Dry Detention
4	LFBLC0010	129	None
5	LFBLC0050	208	None
6	LFBLC0060	50	None
7	LFBLC0070	638	None
8	LFBLC0051	111	None
9	LFBLC0052	34	None
10	LFBLC0053	39	None
11	LFBLC0015	90	None
12	LFBLC0075	95	None
13	LFBLC0080	212	None
14	LFBLC0061	58	None
15	LFBLC0062	12	None
16	LFBLL0010	12	None
17	LFBLL0015	14	None
18	LFBLL0020	10	None
19	LFBLL0025	20	None
20	LFBLL0030	3	None
21	LFBLL0035	32	None
22	LFBLL0040	14	None

Capital Circle SE

Apalachee Pkwy SR20

US Hwy 27 S

BMP Type	Reduction Percentages	
	TN (%)	TP (%)
Wet Detention	30	65
Dry Detention	99	99
Wet Retention	80	80
Dry Retention	30	40



CITY OF
TALLAHASSEE



Legend

- Subbasins
- Waterbodies in Study
- Tallahassee Corporate Limits

BMP Type

- Dry Detention

Topographic Elevations

ft NAVD88

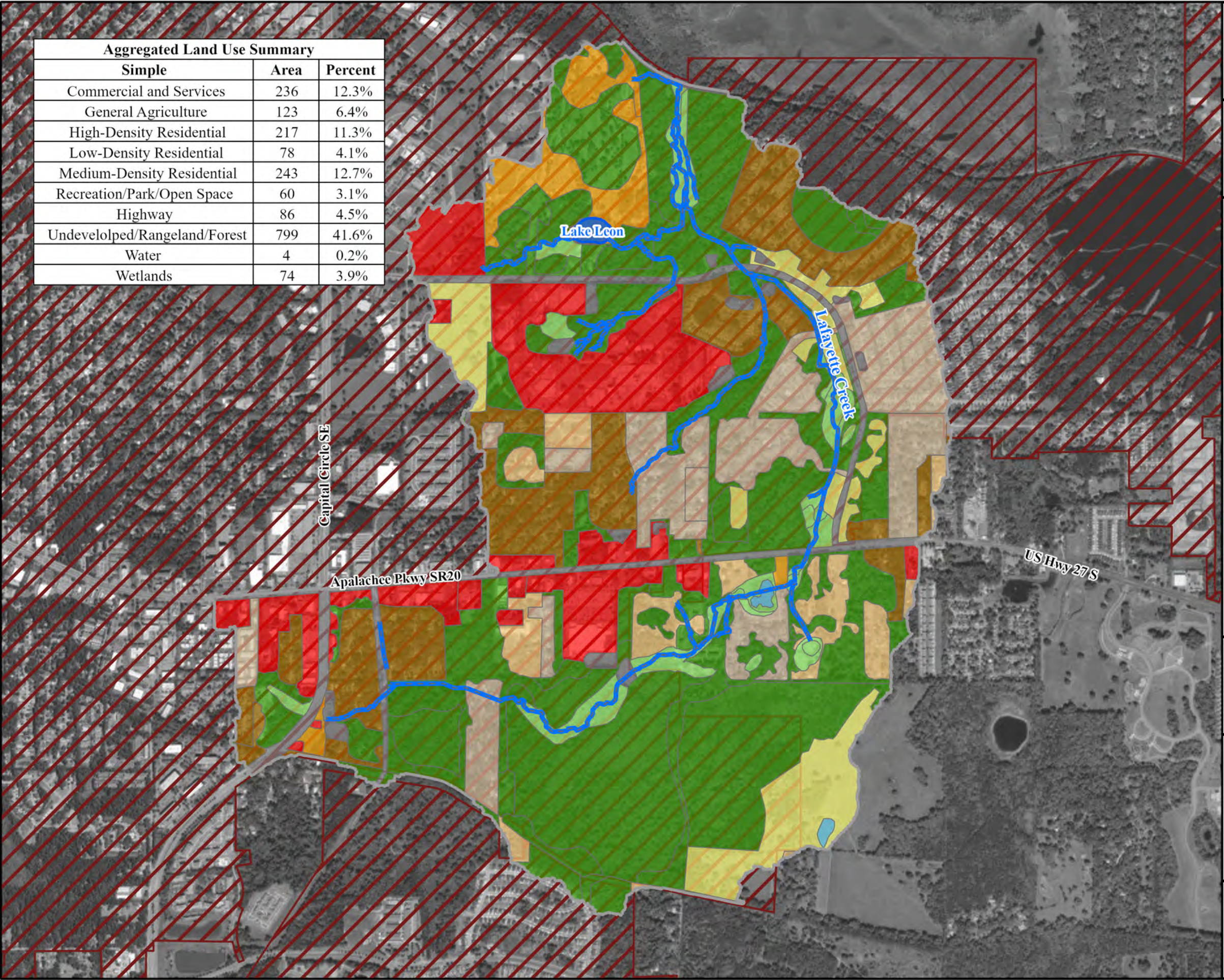


Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Subbasins: Geosyntec, 2022
Roads: COT-Leon County, 2023
City Limits: COT, 2022
BMPs: Geosyntec, 2023
Elevation: COT-Leon County, 2018

Figure 5-175:
Lafayette Creek and Lake Leon Subbasin
Delineation and BMPs

Tallahassee Master Plan - Surface
Water (TMaPS)





Aggregated Land Use Summary		
Simple	Area	Percent
Commercial and Services	236	12.3%
General Agriculture	123	6.4%
High-Density Residential	217	11.3%
Low-Density Residential	78	4.1%
Medium-Density Residential	243	12.7%
Recreation/Park/Open Space	60	3.1%
Highway	86	4.5%
Undeveloped/Rangeland/Forest	799	41.6%
Water	4	0.2%
Wetlands	74	3.9%



Legend

- Lafayette Creek and Lake Leon Drainage Basin
- Waterbodies in Study
- Tallahassee Corporate Limits
- Aggregated Land Use
- Land Use Type
 - Commercial and Services
 - General Agriculture
 - High-Density Residential
 - Low-Density Residential
 - Medium-Density Residential
 - Recreation/Park/Open Space
 - Highway
 - Undeveloped/Rangeland/Forest
 - Water
 - Wetlands

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Land Use: Geosyntec, 2023
Roads: FDOT, 2020
City Limits: COT, 2020

Figure 5-176:
Lafayette Creek and Lake Leon Aggregated
Land Use

Tallahassee Master Plan - Surface
Water (TMaPS)



A Concentrated Discharge Area (CDA) is identified as possessing concentrated flows that could facilitate potential water quality treatment projects

Summary of Concentrated Discharge Areas

Number	CDA ID	Acres
Lafayette Creek		
1	LFBLCOF01	129.0
2	LFBLCOF02	90.4
3	LFBLCOF03	92.2
4	LFBLCOF04	30.4
5	LFBLCOF05	208.1
6	LFBLCOF06	163.3
7	LFBLCOF07	38.5
8	LFBLCOF08	49.9
9	LFBLCOF09	69.6
10	LFBLCOF10	638.1
11	LFBLCOF11	95.3
12	LFBLCOF12	211.8
Lake Leon		
13	LFBLCOF13	110.0

Capital Circle SE

Apalachee Pkwy SR20

US Hwy 27 S



0 0.2
Miles

Legend

- Concentrated Discharge Areas
- Waterbodies in Study
- Tallahassee Corporate Limits

Topographic Elevations

ft NAVD88



Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
CDAs: Geosyntec, 2022
Roads: COT-Leon County, 2023
City Limits: COT, 2022
Elevation: COT-Leon County, 2018

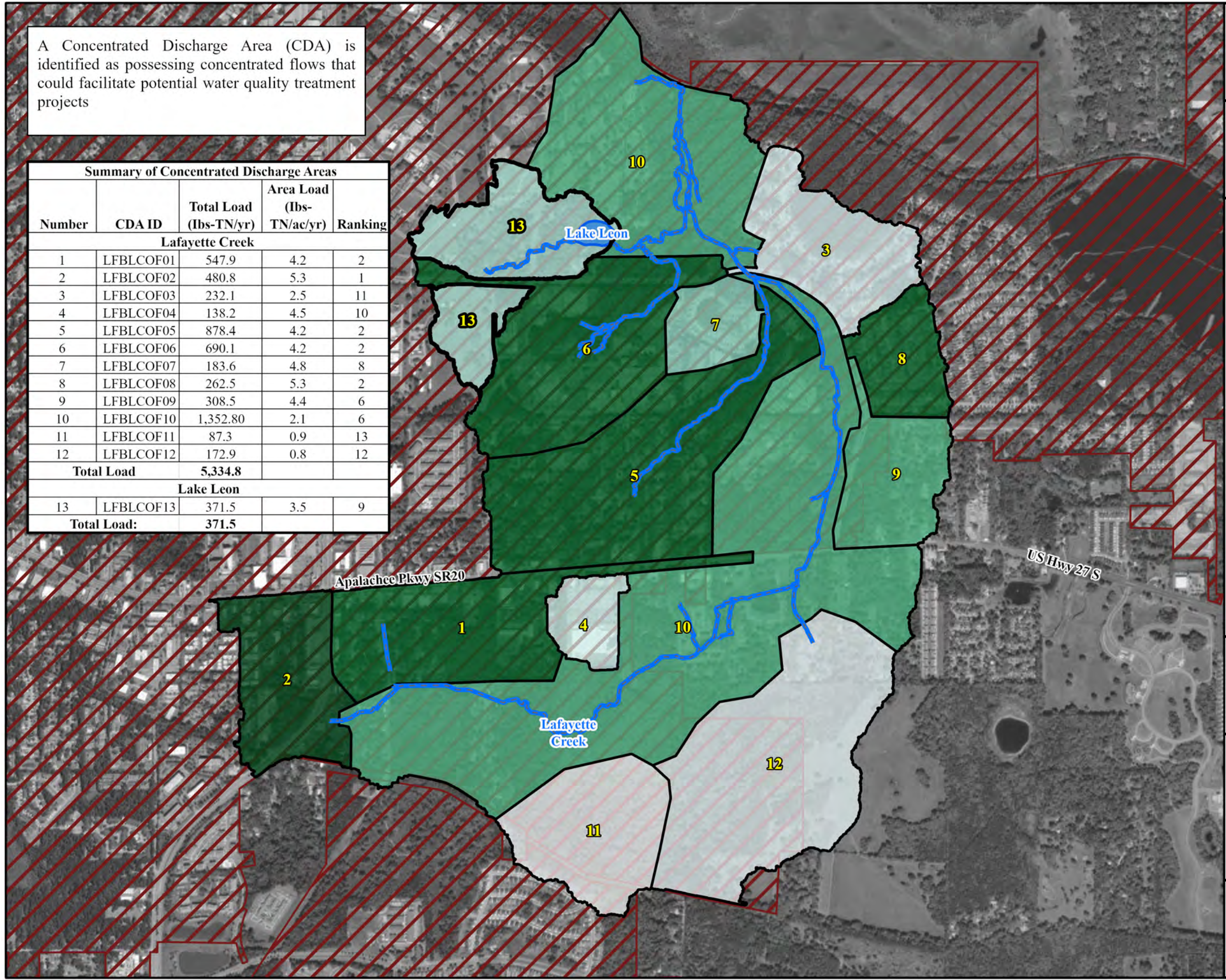
Figure 5-177:
Lafayette Creek and Lake Leon
Concentrated Discharge Areas

Tallahassee Master Plan - Surface
Water (TMaPS)



A Concentrated Discharge Area (CDA) is identified as possessing concentrated flows that could facilitate potential water quality treatment projects

Summary of Concentrated Discharge Areas				
Number	CDA ID	Total Load (lbs-TN/yr)	Area Load (lbs-TN/ac/yr)	Ranking
Lafayette Creek				
1	LFBLCOF01	547.9	4.2	2
2	LFBLCOF02	480.8	5.3	1
3	LFBLCOF03	232.1	2.5	11
4	LFBLCOF04	138.2	4.5	10
5	LFBLCOF05	878.4	4.2	2
6	LFBLCOF06	690.1	4.2	2
7	LFBLCOF07	183.6	4.8	8
8	LFBLCOF08	262.5	5.3	2
9	LFBLCOF09	308.5	4.4	6
10	LFBLCOF10	1,352.80	2.1	6
11	LFBLCOF11	87.3	0.9	13
12	LFBLCOF12	172.9	0.8	12
Total Load		5,334.8		
Lake Leon				
13	LFBLCOF13	371.5	3.5	9
Total Load:		371.5		



Legend

- Concentrated Discharge Areas
- Waterbodies in Study
- Tallahassee Corporate Limits
- Ranking
 - High (1)
 - Low (13)

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
CDAs: Geosyntec, 2022
Roads: COT-Leon County, 2023
City Limits: COT, 2022

Figure 5-178:
Lafayette Creek and Lake Leon
Concentrated Discharge Areas-Total
Nitrogen

Tallahassee Master Plan - Surface
Water (TMaPS)



Figure 5-179 presents the distribution of the ranking of the CDAs for TP along with the total load and per acre loads, see the table on **Figure 5-179**. The total potential stormwater TP load to Lake Leon is 94.9 lb/year with a per acre load of 0.9 lb/acre/year. For the remaining CDAs draining to Lafayette Creek the calculated total stormwater TP loads ranged from as low as 12.9 lb/yr up to 372 lb/yr. The per acre loads ranged from 0.1 lb/acre/yr up to 1.0 lb/acre/yr. The TP shows similar results to those seen for TN with a higher ranked CDA in the upper reach of the creek and higher ranked CDAs along the western side. As was seen for TN, the CDA for Lake Leon is ranked lower than others draining to Lafayette Creek. The total potential stormwater runoff load for TP for Lafayette Creek is 1202.5 lb/year.

5.8.5.2 Septic Load

In order to analyze the potential impacts from septic tank units to Lafayette Creek, the SPIL method adopted by FDEP was utilized to quantify the potential septic load. The approach and calculations were described earlier in **Section 5.4.5.2** which presented the septic loading to the Lafayette Chain of Lakes. As outlined earlier, the calculations were only done for nitrogen (TN), and based on literature on transport and assimilation, may represent a conservative potential load. It should be noted that the Lafayette Creek load was included within the overall Upper Lake Lafayette septic loading.

An estimated 89 septic tank units were identified within 200 meters of Lafayette Creek. No septic tanks were located within 200 meters of Lake Leon or the tributaries that drain to Lake Leon. **Figure 5-180** shows the septic systems utilized in the analyses. A table provided on the figure summarizes the calculated TN load from septic units. The total load is 1,157 lb/year.

5.8.5.3 Point Source Load

No active point sources were identified within the Lafayette Creek basin. Therefore, the point source loads for TN and TP are set to 0 lb/yr for Lafayette Creek and Lake Leon.

5.8.5.4 Lake Inflow Load

There are no identified lakes upstream of Lake Leon. Therefore, the lake load for TN and TP are set to 0 lb/yr.

5.8.5.5 Internal Lake Load

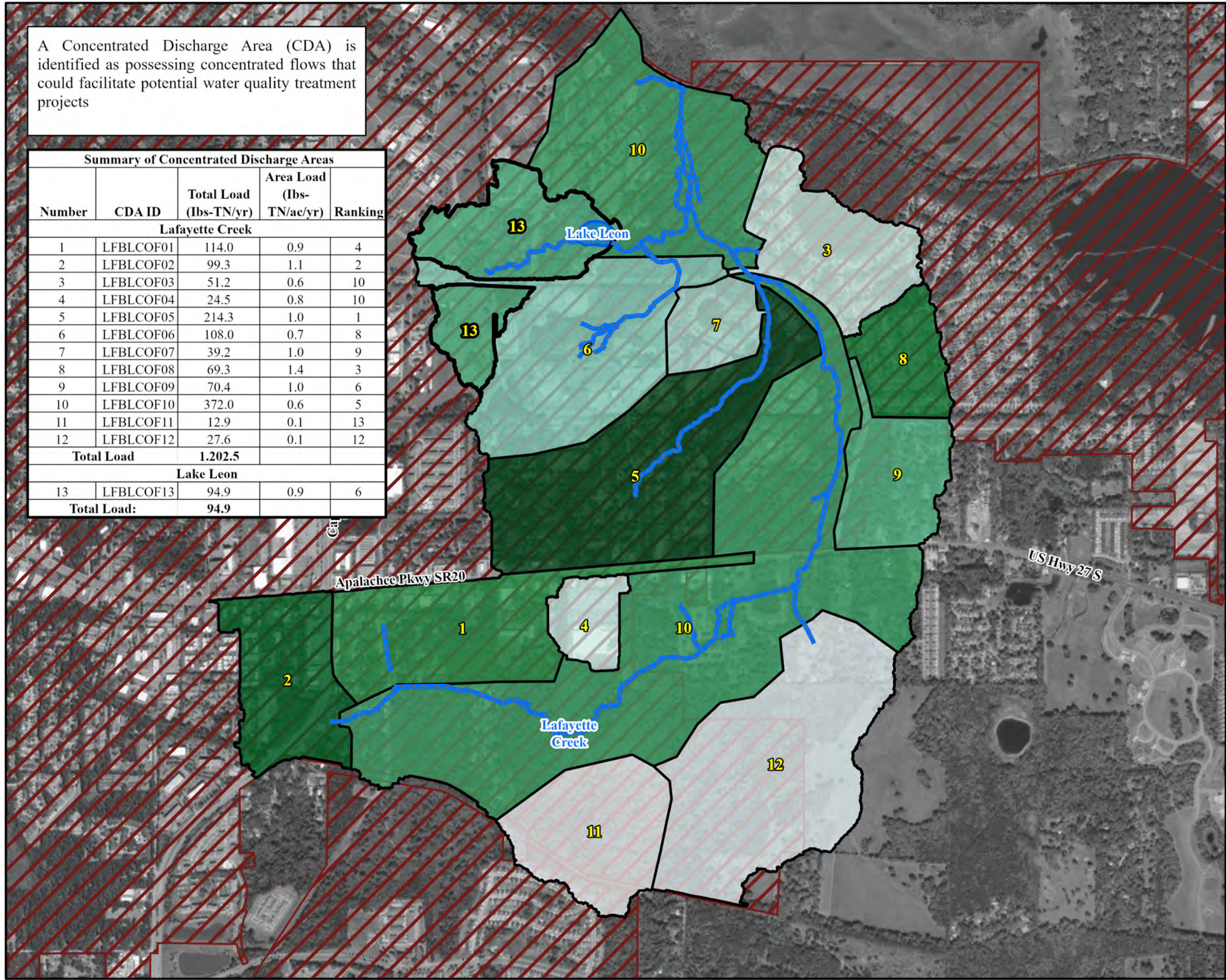
The source assessment determined that internal loading is likely not a significant anthropogenic source to Lake Leon due to the present water quality conditions. At present no measurements have been completed to allow quantification of this load so it is not calculated.

5.8.5.6 Atmospheric Deposition

As presented and discussed in **Section 5.4.5.6** the annual average atmospheric TN load per acre was calculated from the Quincy NADP station (F14) at 2.56 lb/acre/year. Multiplying this by the acreage of Lake Leon (6 acres) gives a total TN load of 15.4 lb/year. No data are available for TP therefore only the nitrogen load is provided.

A Concentrated Discharge Area (CDA) is identified as possessing concentrated flows that could facilitate potential water quality treatment projects

Summary of Concentrated Discharge Areas				
Number	CDA ID	Total Load (lbs-TN/yr)	Area Load (lbs-TN/ac/yr)	Ranking
Lafayette Creek				
1	LFBLCOF01	114.0	0.9	4
2	LFBLCOF02	99.3	1.1	2
3	LFBLCOF03	51.2	0.6	10
4	LFBLCOF04	24.5	0.8	10
5	LFBLCOF05	214.3	1.0	1
6	LFBLCOF06	108.0	0.7	8
7	LFBLCOF07	39.2	1.0	9
8	LFBLCOF08	69.3	1.4	3
9	LFBLCOF09	70.4	1.0	6
10	LFBLCOF10	372.0	0.6	5
11	LFBLCOF11	12.9	0.1	13
12	LFBLCOF12	27.6	0.1	12
Total Load		1,202.5		
Lake Leon				
13	LFBLCOF13	94.9	0.9	6
Total Load:		94.9		



Legend

- Concentrated Discharge Areas
- Waterbodies in Study
- Tallahassee Corporate Limits
- Ranking
 - High (1)
 - Low (13)

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
CDAs: Geosyntec, 2022
Roads: COT-Leon County, 2023
City Limits: COT, 2022

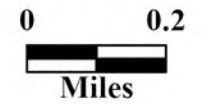
Figure 5-179:
Lafayette Creek and Lake Leon
Concentrated Discharge Areas-Total
Phosphorus

Tallahassee Master Plan - Surface
Water (TMaPS)



Location points of septic systems are digital estimations from related parcel locations and not meant to depict accuracy of unit location within the property

Only septic systems within 200 meters of the waterbody or its tributaries were selected and shown on this map as they are the source of the calculated nutrient loads, the remainder of septic units that were not selected are not shown on this map



Legend

- Lafayette Creek and Lake Leon Drainage Basin
- Waterbodies in Study
- Tallahassee Corporate Limits
- Relevant Septic Sites
 - Tributaries

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Septic Systems: COT, 2020
Watershed: COT, 2020
Roads: COT-Leon County, 2023

Figure 5-180:
Septic Loading to Lafayette Creek and Lake Leon

Tallahassee Master Plan - Surface Water (TMaPS)



Summary of Nutrient Loading from Septic			
Waterbody	TN Loading Direct to Lake (lbs/yr)	TN Loading From Tributaries (lbs/yr)	TN Load (lbs/yr)
Lafayette Creek	0	1,157	1,157
Lake Leon	0	0	0

5.8.5.7 Summary of Calculated Loads

Nutrient loads to Lafayette Creek were calculated for stormwater runoff, septic systems and interconnected flow out of Lake Leon. Nutrient loads to Lake Leon were calculated for stormwater runoff, septic systems and atmospheric deposition. **Table 5-25** presents the calculated total loads to Lafayette Creek for TN and TP. **Table 5-26** presents the calculated total loads to Lake Leon. For septic systems and atmospheric deposition only TN loads were calculated.

Table 5-25: Summary of Calculated Loads to Lafayette Creek

Source	TN (lb/year)	TP (lb/year)
Stormwater Runoff	5,335	1203
Septic Systems	1,157	NC

NC – Not calculated.

Table 5-26: Summary of Calculated Loads to Lake Leon

Source	TN (lb/year)	TP (lb/year)
Stormwater Runoff	372	95
Septic Systems	0	NC
Atmospheric Deposition	15.4	NC

NC – Not calculated.

5.9 Lafayette Chain of Lakes Basin Hot Spot Analysis

Using the information presented and discussed in **Section 5.4** through **Section 5.8**, qualitative and quantitative rankings were performed in order to identify target areas (hot spots) within the Lafayette Chain of Lakes basin for development of structural and non-structural projects to reduce loads and improve water quality.

The hot spot analysis was completed in three steps. The first step was to collate information presented for each of the waterbodies to support their ranking from highest to lowest based on need for water quality restoration. The second step was to utilize the load calculations presented for each of the waterbodies to rank the sources (by waterbody) from lowest to highest using normalized loads. The final step was to provide spatial ranking of CDAs (as defined in the TN and TP load calculations) by waterbody for use in the identification of structural and non-structural projects. The higher ranked CDAs within a highly ranked waterbody are hot spots and will be targeted for potential pollutant load reduction projects.

For the rankings, nutrients were the primary driver with bacteria data used to support some of the determinations. All rankings using actual loading data were based on nutrients. The following discusses the data utilized, the methodology, and the results of each step of the hot spot analysis culminating in stormwater runoff and septic hot spot maps for the Lafayette Chain of Lakes basin.

5.9.1 Waterbody Ranking

The waterbodies within the Lafayette Chain of Lakes basin were ranked with respect to water quality or factors that could negatively affect water quality, using a qualitative approach. The ranking identified those waterbodies most in need of restoration. The waterbodies evaluated in this analysis include:

- Lafayette Chain (Upper Lake Lafayette, Piney Z Lake, Lower Lake Lafayette, and Alford Arm)
- Killlearn Chain of Lakes (Lake Kinsale, Lake Killarney, and Lake Kanturk)
- Lake Tom John
- Shakey Pond
- Lafayette Creek and Lake Leon

The information utilized in the development of the waterbody ranking included:

- Verified impairment status,
- Waterbody and tributary water quality analyses,
- Biological data [LVI or Stream Condition Index (SCI)],
- Land-development indices (LDI), and
- Septic densities.

Table 5-27 presents a summary of the information by waterbody for each of the categories listed above. For each of the five categories the waterbodies were ranked based on the summary information provided. The rankings were qualitative for some categories and quantitative in others. The five rankings were then averaged. Using the average ranking, the waterbodies were ranked from highest to lowest based on need for water quality restoration.

For impairment status, the rankings were based on if the waterbodies were verified impaired for nutrients or FIB, their present status relative to TMDL or alternative restoration plan development, and if the waterbody is meeting its TMDL. Waterbodies that were impaired for nutrients were given the higher ranking. Presently, three waterbodies are verified impaired for nutrients with no TMDL or reasonable assurance plan (RAP) completed. These are Piney Z Lake, Lake Tom John, and Shakey Pond. These waterbodies were ranked highest. Four waterbodies were verified impaired but have had TMDLs and/or RAPs completed. These are, Upper Lake Lafayette, Lake Kinsale, Lake Killarney, and Lake Kanturk. In **Section 5.5** discussions were provided on the applicability of the criteria within the Killearn Chain of Lakes, noting that due to their intermittent and man-made nature the NNC for clear/low alkalinity lakes may not be appropriate, thus bringing into question their present impaired status. Based on this, Upper Lake Lafayette was ranked higher than the Killearn Chain based on impairment status. Finally, four waterbodies have no verified impairments, these are Lower Lake Lafayette, Alford Arm, Lake Leon, and Lafayette Creek, these had the lowest ranking.

Analyses of water quality data presented earlier, which included evaluations of the data against the NNC for the waterbodies themselves and primary inflowing tributaries, were utilized for the waterbody water quality ranking. The highest ranked waterbody was Shakey Pond due to the percentage of exceedances of the Chl-a AGM threshold coinciding with high TP AGMs and TSI values in the fair to poor range. The second ranked waterbody was Upper Lake Lafayette based on Chl-a exceedances along with a significant number of TP AGMs above the NNC maximum. TSI values were predominantly in the poor range. The third ranked waterbody was Piney Z Lake, which is based upon Chl-a exceedances along with a significant number of TP AGMs above the maximum. The Killearn Chain of Lakes were all ranked fourth based upon similar levels of exceedances of the Chl-a and TP criteria. The remaining waterbodies (Alford Arm, Lafayette Creek, Lower Lake Lafayette and Lake Leon) were not impaired and were ranked according to their Chl-a and nutrient levels.

As discussed in **Section 5.5** and summarized above, the low color, low alkalinity NNC thresholds are not appropriate for the Killearn Chain of Lakes. **Section 5.5** also identified concerns relative to the applicability of the proposed criteria due to the nature of the waterbodies (former wetlands) and that the alkalinity levels are close to those that would shift them into an alternate category.

For the biological assessment, the waterbody rankings used the Exceptional, Healthy, and Impaired determinations. Based on this assessment (outlined in **Table 5-27**) the top ranked waterbodies were the Killearn Chain of Lakes and Lake Leon which had Impaired determinations or a preponderance of Impaired. Shakey Pond, Upper Lake Lafayette, Alford Arm, Lafayette Creek, and Lower Lake Lafayette were ranked second based on lack of data or some impairment with mostly healthy (Shakey Pond). Lake Tom John was ranked third based on a single healthy determination and Piney Z Lake ranked fourth based on consistent healthy determinations.

Table 5-27: Waterbody Ranking

Waterbody	Impairment Status	Rank	Waterbody and Tributary WQ Analyses	Rank	Biological Data (LVI or SCI)	Rank	LDI	Rank	Septic Density	Rank	Average Rank	Waterbody Rank
Shakey Pond	Impaired	1	Six of seven Chl-a AGMs between 2010-2020 above NNC criteria of 20 µg/L. Five TN AGMs between the minimum and maximum NNC targets, two below the minimum NNC target. Six TP AGMs from 2010 to 2020 above the maximum NNC target and one below the minimum. Most TSI values in the poor and fair ranges with a few in the good range between 2010 and 2020.	1	2 Healthy, 1 Impaired	2	Poor	1	The Shakey drainage area has very few septic tanks.	6	2.20	1
Upper Lake Lafayette	Impaired (Chl-a, TN, TP) but TMDL Completed and RAP (4e) Completed	2	Six out of ten Chl-a AGMs between 2010-2020 above NNC criteria of 20 µg/L. All but one TN AGM below the NNC minimum, one between minimum and maximum since 2010. Eight of ten TP AGMs from 2010 to 2020 above the NNC maximum target, remaining TP AGMs are between the minimum and maximum targets. Numerous TSI values in the poor range between 2010 and 2020.	2	No data	2	Mixture of Moderate and Poor, with more areas Poor.	2	Drainage has densities between 0.0 to 0.2 units per acre.	5	2.60	2
Lake Kanturk	Impaired (TN, TP, Chl-a) but RAP (4e) Completed	3	Six of eight Chl-a AGMs between 2010-2020 above NNC criteria of 6 µg/L. Three TN AGM between the maximum NNC target and 5 between the minimum and maximum NNC targets. All eight TP AGMs from 2010 to 2020 above the maximum NNC target. Some TSI values in the poor and fair ranges but most in the good range between 2010 and 2020.	4	2 Impaired	1	Mixture of Moderate and Poor in immediate area, moderate and good in upper drainage area.	4	Drainage has densities greater than 0.9 units per acre.	1	2.60	2
Lake Tom John	Impaired (TP, Chl-a)	1	Three of four Chl-a AGMs between 2015-2020 above NNC criteria of 6 µg/L. Three TN AGMs between the minimum and maximum and one below the minimum. All four TP AGMs from 2015 to 2020 between the minimum and maximum NNC targets. All TSI values in the good range between 2015 and 2020.	5	1 Healthy	3	Moderate	5	Drainage has densities between 0.4 to 0.5 units per acre.	2	3.20	4
Lake Kinsale	Impaired (TN, TP, Chl-a) but RAP (4e) Completed	3	Seven out of ten Chl-a AGMs between 2010-2020 above NNC criteria of 6 µg/L. One TN AGM above the NNC maximum, five between the minimum and maximum, and four below the minimum NNC target. All ten TP AGMs from 2010 to 2020 above the NNC maximum target. Some TSI values in the poor and fair ranges but most in the good range between 2010 and 2020.	4	No data after 2010, 2009 Impaired	1	Immediate drainage Poor with upper reaches of the watershed draining Moderate to Good.	3	Drainage has densities between 0.0 to 0.2 units per acre.	5	3.20	4
Lake Killarney	Impaired (TN, TP, Chl-a) but RAP (4e) Completed	3	Eight of ten Chl-a AGMs between 2010-2020 above NNC criteria of 6 µg/L. One TN AGM above the NNC maximum, five between the minimum and maximum, and four below the minimum NNC target. Eight of ten TP AGMs from 2010 to 2020 above the NNC maximum target, remaining two are just below the maximum. Some TSI values in the poor and fair ranges but most in the good range between 2010 and 2020. There is a general improving trend in the lake.	4	2 Impaired	1	Mixture of Moderate and Poor in immediate area, moderate and good in upper drainage area.	4	No septics within the immediate drainage	7	3.80	6
Lake Piney Z	Impaired (TN, TP, Chl-a)	1	All Chl-a AGMs between 2010-2020 above NNC criteria of 6 µg/L, but lower values after 2012. Four out of ten TN AGMs above the maximum, all prior to 2015. From 2015 to 2020 all TN AGMs between the minimum and maximum NNC criteria. Seven of ten TP AGMs from 2010 to 2020 above the NNC maximum with remaining between the minimum and maximum TP targets. Five of the seven were prior to 2015. Other values between the minimum and maximum NNC targets. Some TSI values in the poor range prior to 2013, after 2013 some in the fair range but most in the good range. Ranking accounts for concerns on reasonableness of NNC targets.	3	12 Healthy	4	Good	7	Drainage has densities between 0.0 to 0.1 units per acre.	6	4.20	7

Waterbody	Impairment Status	Rank	Waterbody and Tributary WQ Analyses	Rank	Biological Data (LVI or SCI)	Rank	LDI	Rank	Septic Density	Rank	Average Rank	Waterbody Rank
Alford Arm	Not Impaired	4	Insufficient data between 2010 and 2020 to calculate the AGM values in any year for TN, TP or Chl-a. Only year with any data was 2010.	7	No data	2	Immediate drainage good, lower drainage basin areas Moderate with upper reaches a mixture of Good and Excellent	6	Drainage has densities between 0.1 and 0.6 units per acre.	3	4.40	8
Lafayette Creek	Not Impaired	4	One TN AGM between 2010-2020 above the East Panhandle Stream threshold (2012) with all remaining TN AGMs well below the threshold. All TP AGMs below the Panhandle East Stream NNC threshold. Has high bacteria at the lower station.	6	No Data	2	Good	7	Septic densities generally near zero other than one area in upper watershed with densities between 0.06 and 0.4 but overall basin is below 0.1 units per acre	6	5.00	9
Lower Lake Lafayette	Not Impaired	4	TN and TP AGMs were below the NNC minimum thresholds for all years between 2010 and 2020. Chl-a AGMs were below the NNC threshold of 20 µg/L for all years with AGM values down near 6 µg/L where sufficient data were available. Nearly all TSI values were in the good range with only a few data points in the fair range.	9	No data	2	Good in immediate drainage, moderate, good and excellent in larger drainage area.	8	Drainage has densities between 0.1 and 0.2 units per acre.	4	5.40	10
Lake Leon	Not Impaired	4	All Chl-a AGMs between 2010-2020 below NNC criteria of 20 µg/L. All TN AGMs below the minimum NNC target. Four out of five TP AGMs at or below the minimum NNC target with one between the minimum and maximum NNC targets.	8	1 Healthy, 3 Impaired	1	Good	7	Near zero septics in drainage area	7	5.40	10

Using the LDI scores presented earlier, the individual waterbodies were ranked based upon where they fell overall in the potential for anthropogenic loading resulting from the watershed that drains to it (**Table 5-27**). For LDI, the highest ranked waterbody was Shakey Pond. Upper Lake Lafayette was ranked second due to extensive urban areas draining to it. The Killarney Chain of Lakes were ranked next with Lake Kinsale having a slightly higher ranking (third) than Killarney and Kanturk (tied for fourth). Lake Tom John was ranked fifth because of the extensive residential areas draining to it. Alford Arm was ranked sixth due to some moderate areas immediately upstream with overall being good to excellent. Lafayette Creek and Lake Leon were tied for seventh with Lower Lake Lafayette having the lowest ranking resulting from the extensive natural areas in its immediate drainage basin.

The final waterbody ranking criteria was Septic Density within the immediate drainage area. Based on the results presented earlier and summarized in **Table 5-27**, the waterbodies were ranked. The top ranked waterbody was Lake Kanturk which had overall septic densities upwards of 1 unit per acre, the highest in the drainage basin. Lake Tom John was ranked second with densities around 1 unit per 2 acres. Alford Arm was ranked third with a range of septic densities in the immediate area with the highest having around 1 unit per 2 acres. The remaining waterbodies all had relatively low septic densities with the rankings from highest to lowest being Lower Lake Lafayette, Upper Lake Lafayette, Lake Kinsale, Lafayette Creek, Piney Z Lake, Shakey Pond, Lake Killarney, and Lake Leon.

Table 5-27 provides an average ranking for each of the waterbodies and then a final ranking based on the average ranking. The final ranking by waterbody, with respect to the need for restoration activities, are presented from most pressing (1) to least pressing (6) in the order shown below. Where waterbodies are tied in ranking, they are presented together.

1. Shakey Pond
2. Upper Lake Lafayette, Lake Kanturk
4. Lake Tom John
5. Lake Kinsale
6. Lake Killarney
7. Piney Z Lake, Alford Arm
9. Lafayette Creek, Lower Lake Lafayette, Lake Leon

Based on their overall water quality and potential for loading (as summarized above and in **Table 5-28**), Piney Z Lake, Alford Arm, Lafayette Creek, Lower Lake Lafayette, and Lake Leon were removed from further ranking, and not considered priority targets for load reduction projects at this time. Additional study recommendations are provided for both the priority and non-priority waterbodies in **Section 5.10** depending on data needs and water quality conditions.

5.9.2 Pollutant Source Ranking

The pollutant source ranking utilizes load calculations presented in the **Calculation of Potential Nutrient Loads** sections for each waterbody. The specific loads quantified (where data allowed) include:

- Stormwater pollutant load,
- Septic load,
- Point source load,
- Lake inflow load,
- Internal lake load, and shallow groundwater seepage,
- Atmospheric deposition.

Using the calculated total loads for nutrients the load sources are ranked for each individual waterbody to identify which type of loading to prioritize. The ranking (by waterbody) is based upon the total loads with the highest rank (the top source to target) assigned to the largest load. Where insufficient data are available, the load sources are not considered in the ranking but are discussed where appropriate.

Table 5-28 presents the results of the source ranking by waterbody. As some of the load types only had TN data, TN became the driving load for the ranking in general. Almost across the board, stormwater loads are identified as the top ranked source.

For Upper Lake Lafayette, stormwater loads are significantly higher than any other source. This is mainly due to the size of the watershed. Based on treatment received through the Weems Pond Regional Treatment Facility, while the loads are high, the concentrations are low. Therefore, stormwater loads are not deemed a significant pollutant source to Upper Lake Lafayette. The second highest load was septic followed closely by atmospheric deposition.

For Piney Z Lake, due to the size of the watershed and the isolated nature of the waterbody, while stormwater is the highest overall load, in comparison to other lakes of similar size, the stormwater load is not large. The second highest load is atmospheric deposition due to the relatively small watershed to receiving waterbody area ratio.

For Lower Lake Lafayette, while stormwater loads are the highest of the calculated sources, the likely actual largest load would be Lake Inflow from Alford Arm. This value was not calculated due to the lack of recent water quality data for the lake portion of Alford Arm, which is due to the significant watershed area draining to Alford Arm and the direct connection into Lower Lake Lafayette. The second highest load to Lower Lake Lafayette for those calculated is atmospheric deposition, which is due to the relatively low direct watershed area to receiving waterbody area ratio.

Table 5-28: Load Source Ranking

Waterbody	Lake Area	Stormwater Pollutant Load			Septic Load			Lake Inflow Load			Internal Load			Atmospheric Deposition		
		Total		Rank	Total		Rank	Total		Rank	Total		Rank	Total		Rank
		TN (lb/yr)	TP (lb/yr)		TN (lb/yr)	TP (lb/yr)		TN (lb/yr)	TP (lb/yr)		TN (lb/yr)	TP (lb/yr)		TN (lb/yr)	TP (lb/yr)	
Upper Lake Lafayette	373	19,863	2,843	1	1,168	ND	2	495	38	4	ND	ND	ND	955	ND	3
Lake Piney Z	238	1,626	361	1	65	ND	3	NA	NA	NA	ND	ND	ND	609	ND	2
Lower Lake Lafayette	1067	9,019	1,571	1	2,011	ND	3	ND	ND	ND	ND	ND	ND	2,732	ND	2
Alford Arm	367	26,793	5,292	1	6,327	ND	3	20,549	2,079	2	ND	ND	ND	940	ND	4
Lake Kinsale	13	10,244	2,248	1	346	ND	4	584	21	3	975	64	2	32	ND	5
Lake Killarney	80	5,153	1,497	1	0	0	4	11,148	1,055	1	4,105	187	2	205	ND	3
Lake Kanturk	70	6,209	1,568	1	9,852	ND	2	12,131	551	1	5,199	238	3	179	ND	4
Lake Tom John	40	2,194	438	1	1,125	ND	2	ND	ND	ND	ND	ND	ND	102	ND	3
Shakey Pond	14	932	249	1	0	0	3	NA	NA	NA	ND	ND	ND	36	ND	2
Lake Leon	6	372	95	1	0	ND	3	NA	NA	NA	ND	ND	ND	15	ND	2
Lafayette Creek	NA	5,335	1,203	1	1,157	ND	2	240	10	3	NA	NA	NA	NA	NA	NA

For Alford Arm, the stormwater loads as well as the lake inflow (mainly from Killearn Chain) are significant with the direct stormwater load higher. The significant volume of lake inflow load comes out of the Killearn Chain of Lakes which drains a large area of the upper watershed and has somewhat elevated TN and TP levels. The third highest load to Alford Arm is septic load due primarily to a significant cluster of units directly upstream.

For the Killearn Chain of Lakes the largest loads (based on TN) are stormwater and (for the downstream lakes) lake inflow loads, due to the pass through of incoming stormwater loads to Lake Kinsale. Direct stormwater runoff and lake inflow loads were ranked tied for Lake Killarney and Lake Kanturk based on nitrogen and phosphorus loads being higher for each of the two sources. Internal loads were the second highest loads for Lake Kinsale and Lake Killarney. The second highest load for Lake Kanturk was septic, due to the extensive cluster of units in the watershed areas draining to the northern side.

For Lake Tom John, stormwater was the highest load with septic being ranked number 2. For Shakey Pond and Lake Leon stormwater loads were by far the highest, the same was seen for Lafayette Creek. Additionally, for Shakey Pond internal loads were high.

Based on this analysis, the top load source to target for the waterbodies within the Lake Lafayette Chain of Lakes basin would be stormwater loads. The next target would be septic loading. Other loading sources are generally either at zero, are low compared to the stormwater or septic, are not addressable through projects (atmospheric deposition), or have insufficient data at this time and therefore would not be targeted for structural or non-structural projects as part of this study.

5.9.3 Identification of Hot Spot Areas

Section 5.9.1 ranked the waterbodies in the Lake Lafayette Chain of Lakes basin based on their need for water quality restoration. The next step in the evaluation of the waterbodies was to determine if each one should be prioritized and therefore be a primary target for development of projects, which is a qualitative assessment that accounts for the present conditions and the potential for future degradation. For the Lake Lafayette basin, it was determined that the watershed draining to Shakey Pond, Lake Tom John and the Killearn Chain of Lakes, and the portion of the watershed draining to Upper Lake Lafayette (below Weems Pond) could be targeted for projects relative to stormwater loads. Lake Kanturk was targeted for potential projects to reduce septic loads.

The next step was to present the stormwater and septic load rankings for each of the chosen waterbodies presented on a basin-wide map. The stormwater load rankings were presented by waterbody drainage area in the **Calculation of Potential Nutrient Loads** sections. The highest to lowest ranked CDAs were highlighted from dark green to pale yellow, with the dark green representing the top rank areas to target for load reduction activities.

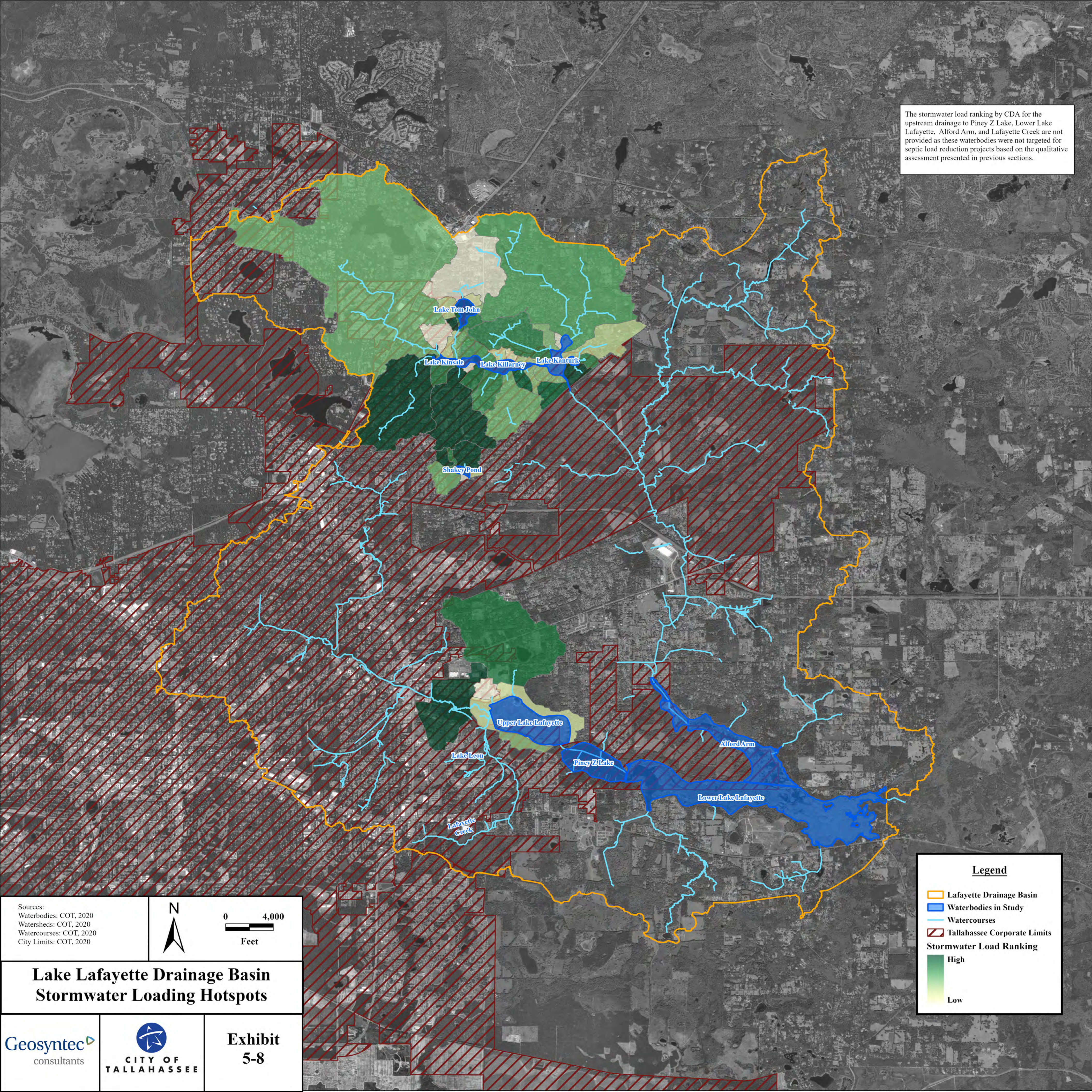
For septic loads, the total loads (calculated and presented in earlier sections) were subdivided into the CDAs based upon the location of septic systems which were determined to load the waterbodies or tributaries draining to the waterbodies. The total septic load for each of the CDAs were calculated and then ranked (by waterbody drainage area) as largest to smallest based on total load with the highest ranked having the largest total load. The septic load CDA rankings are

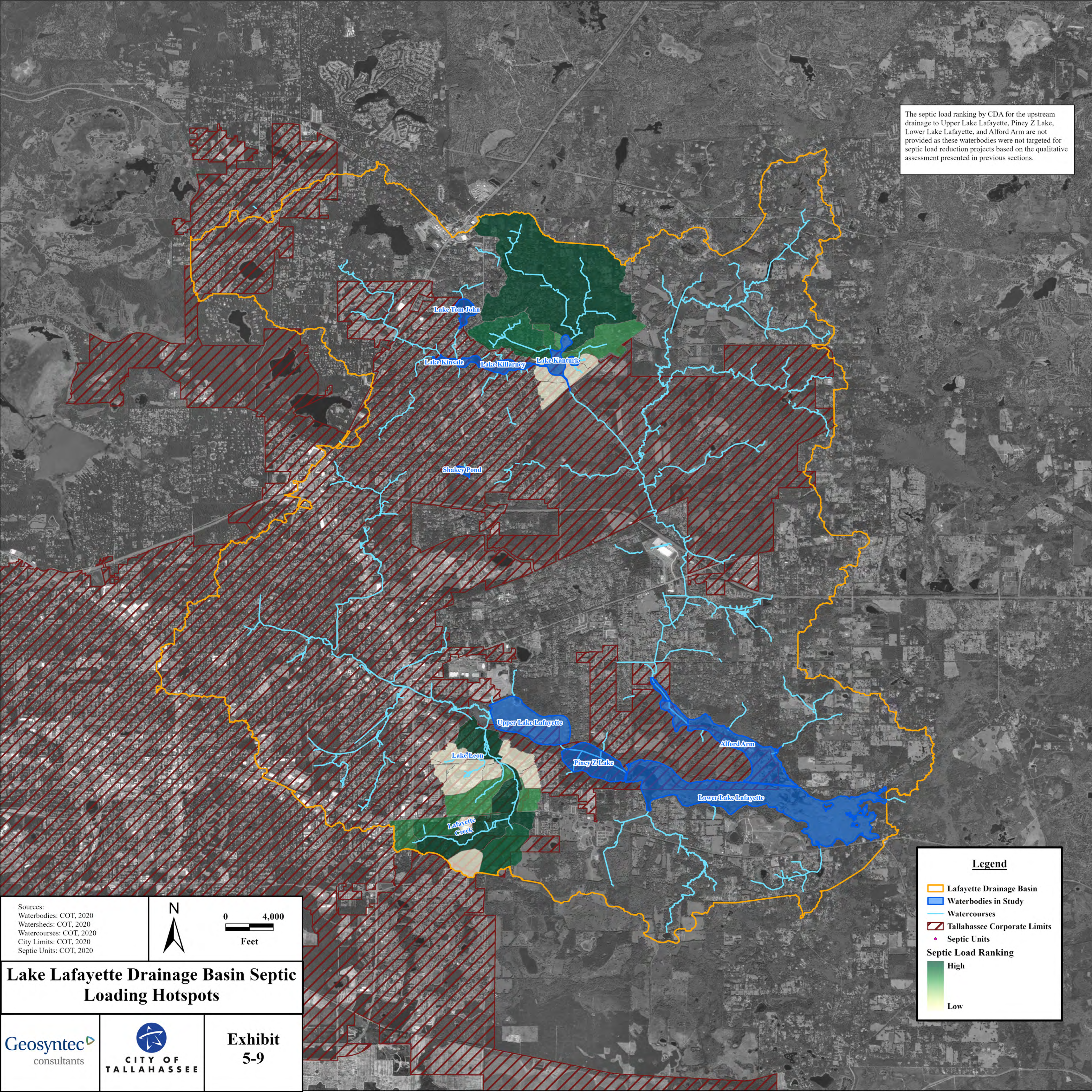
presented separately as their loads will be different and the potential project types also different, i.e., septic to sewer conversions.

Although Piney Z Lake was not identified in the hot spot areas as a priority target for projects, the waterbody remains impaired and therefore some determination of future actions is necessary. Piney Z Lake is identified as a target waterbody in **Section 5.10** which identifies potential additional studies to address waterbody issues.

Exhibit 5-8 and **Exhibit 5-9** present the CDA rankings for the stormwater and septic loads, respectively, for each of the chosen waterbodies, with the drainage areas for the waterbodies not identified for projects (Upper Lake Lafayette above Weems Pond, Piney Z Lake, Lower Lake Lafayette, Alford Arm, Lafayette Creek and Lake Leon for stormwater and all areas other than Lake Kanturk and Lafayette Creek for septic) greyed out. The rankings are by waterbody drainage area and are shown as green for the highest ranked areas and pale yellow for the lowest ranked areas. These two maps provide the basis for project targeting for the two primary sources identified, stormwater and septic loads. While Lafayette Creek was not identified as a priority waterbody, it is included in the septic map (**Exhibit 5-9**) based on elevated *E. coli* levels and study recommendations provided in **Section 5.10**.

The stormwater load ranking by CDA for the upstream drainage to Piney Z Lake, Lower Lake Lafayette, Alford Arm, and Lafayette Creek are not provided as these waterbodies were not targeted for septic load reduction projects based on the qualitative assessment presented in previous sections.





The septic load ranking by CDA for the upstream drainage to Upper Lake Lafayette, Piney Z Lake, Lower Lake Lafayette, and Alford Arm are not provided as these waterbodies were not targeted for septic load reduction projects based on the qualitative assessment presented in previous sections.

Sources:
Waterbodies: COT, 2020
Watersheds: COT, 2020
Watercourses: COT, 2020
City Limits: COT, 2020
Septic Units: COT, 2020



Lake Lafayette Drainage Basin Septic Loading Hotspots

Legend

- Lafayette Drainage Basin
- Waterbodies in Study
- Watercourses
- Tallahassee Corporate Limits
- Septic Units

Septic Load Ranking

High

Low

5.10 Water Quality Study Identification and Prioritization

As part of the data review and summary provided for each of the target waterbodies (**Section 5.4** through **Section 5.8**), limitations in available hydrologic, water quality (groundwater and surface water), and benthic sediment data were identified. Additionally, as part of the qualitative assessment of sources for each waterbody, specific key stressors, i.e., significant potential sources of anthropogenic load or factors contributing to degraded water quality, were identified. Finally, **Section 5.9** presented a hot spot analysis for the Lake Lafayette basin that ranked the waterbodies relative to their need for evaluation or restoration and identified specific waterbodies to target for restoration projects, additional data collection, or studies.

Utilizing the information outlined above, potential studies needed to address data gaps, evaluate designated uses, and quantify key stressors were proposed and ranked. The results of the previous tasks are summarized in **Section 5.10.1**, along with an overview of key stressors for the priority waterbodies (Shakey Pond, Upper Lake Lafayette, Piney Z Lake, Lake Kinsale, Lake Killarney, Lake Kanturk, and Lake Tom John). Studies are identified that fill in data gaps, evaluate designated uses, support quantification of specific waterbody stressor(s) or support waterbody restoration (**Section 5.10.2**). The proposed studies include evaluations of present lake conditions and uses and opportunities for restoration, new water quality data collection, evaluation of potential septic loading, and bacteria source assessments.

5.10.1 Summary of Data Limitations, Waterbody Prioritization, and Key Stressors

Table 5-29 provides a summary of the data limitations presented at the end of the data review and summary sections for the priority waterbodies outlined above (**Section 5.4** through **Section 5.8**). The data limitations identified include no or limited hydrologic data, limited water quality data, no groundwater quality data in the area of the study waterbodies to allow assessment of potential seepage, and no data to quantify internal nutrient loading.

Table 5-27 presented the prioritized waterbodies for restoration within the Lake Lafayette Chain of Lakes basin. These included Shakey Pond, Upper Lake Lafayette, the Killarney Chain of Lakes, and Lake Tom John. These waterbodies are targeted for development of projects to support water quality improvement. Identified projects are discussed in **Volume 7 – Non-Structural and Structural Project Development**. The prioritized waterbodies are also targeted for studies to fill data gaps to further refine restoration strategies. As such, the proposed studies focus on these waterbodies.

A key task under the scope of work for the basin studies identification was to review and assess stressors for the priority waterbodies. The stressors were reviewed to confirm potential water quality impact and pathways of pollutant migration to the waterbodies. The intent is to identify where additional data collection and analysis of advanced analytic parameters might help better understand the expected load/contribution of the source. The following sections outline the key stressors identified in previous sections for the prioritized waterbodies within the Lake Lafayette Chain of Lakes basin (Shakey Pond, Upper Lake Lafayette, the Killarney Chain of Lakes, and Lake Tom John).

Table 5-29: Summary of Identified Data Limitations for Target Waterbodies in the Lake Lafayette Chain of Lakes Basin

Shakey Pond	Lafayette Chain	Killearn Chain of Lakes	Lake Tom John
There are no water quality monitoring stations for the inflows to Shakey Pond.	There is no water level data within Upper Lake Lafayette and Piney Z Lake.	There is no continuous flow data for the tributaries flowing into Lake Kinsale.	No hydrologic data (level or inflow/outflow) data has been collected on the lake or in the upstream discharge to the lake or the downstream discharge to the Killearn Chain of Lakes.
No surficial groundwater monitoring stations are located in the vicinity to determine the quality of potential seepage into Shakey Pond.	Information on the hydrologic connections between the different waterbodies is limited.	There are limited water quality data at the inflow points to Lake Kinsale from the upstream tributaries.	There are no water quality monitoring stations for the inflow to the lake which represents the bulk of the stormwater inflow from the drainage basin.
	No continuous flow measurements for the two primary inputs to Upper Lake Lafayette.		No surficial groundwater monitoring stations are located in the vicinity to determine the quality of potential seepage into the lake or ditch segments.
	There are no data to evaluate the potential for seepage of pollutants to the lake from the surficial aquifer, i.e., surficial groundwater sampling stations around the chain of lakes.	There are no data to evaluate the potential for seepage of pollutants to the lake from the surficial aquifer, i.e., surficial groundwater sampling stations around the chain of lakes.	No data are available to determine the potential for internal loading as a source.
	There is no recent water quality data in the lake portion of Alford Arm		

5.10.1.1 Shakey Pond Key Stressors

Water quality analyses and the qualitative assessment of sources identified that Shakey Pond is presently not meeting its NNC, and that stormwater runoff and internal load are potential key stressors. Another key aspect of Shakey Pond is the failure of the outflow structure which has led to decreased water levels in the system. Stormwater treatment is provided for all but one of the stormwater inflow points to the pond. A recent study of the pond has been completed that quantified the stormwater and internal loads to the pond.

5.10.1.2 Lafayette Chain of Lakes (Upper Lake Lafayette and Piney Z Lake) Key Stressors

Water quality analyses and the qualitative assessment of sources (**Section 5.4.3.6** and **Section 5.4.4**) identified that Upper Lake Lafayette is presently impaired but the lake's present hydrology and extensive periods of dry down with standing water only in the area of Lafayette Sink make assessment as a typical lake unreasonable. Additionally, evaluations of the tributary inflows to the lake did not identify elevated nutrient concentrations in either of the two primary inflows, NEDD below Weems Pond and Lafayette Creek (**Section 5.4.4.1**). As such, the primary stressor for Upper Lake Lafayette at this time is its hydrologic condition and associated nutrient assimilation capability.

Water quality analyses (**Section 5.4.3.6** and **Section 5.4.4.1**) identified that Piney Z Lake is presently impaired based upon its classification as a low color, low alkalinity system. Evaluation of stormwater runoff, septic, and other external sources did not show significant anthropogenic nutrient load potential. Additionally, historic sediment characterization did not identify elevated levels of nitrogen or phosphorus in the sediments, indicating that internal load is not a likely source. Based on historic alterations, Piney Z Lake is artificially isolated from the adjacent waterbodies due to berming, limited structural connections, and elevated water levels in comparison to the adjacent systems. Additionally, historic management of the lake reduced the volume of aquatic vegetation although recovery has begun to occur. Based on these determinations the key stressors associated with Piney Z Lake are likely its isolated hydrology and limited exchange and historic ecologic management. Additionally, previous discussions raised issues with the applicability of the lakes present classification/criteria relative to use attainability.

5.10.1.3 Killbuck Chain of Lakes Key Stressors

Water quality analyses and the qualitative assessment of sources identified stormwater runoff as a potential significant stressor to the Killbuck Chain of Lakes. Historic measurements of internal load did not identify it as a significant potential anthropogenic source. An additional key stressor of the Killbuck Chain of Lakes that was identified in earlier discussions is the hydrologic nature with significant periods of dry down due to insufficient hydrologic load to maintain adequate water levels. The hydrologic conditions present issues with collection of samples during and post dry down periods and their applicability relative to impairment designation. The constructed nature of the system along with the present hydrology raises concerns with the present waterbody designation and use attainability.

An additional stressor that was identified for Lake Kankakee is the potential for septic loading due to the extensive cluster of septic systems within the subwatersheds draining to the northern side

of the lake, which is based on calculated potential loads along with a study that identified high levels of TN (nitrate) in flows entering the lake.

5.10.1.4 Lake Tom John Key Stressors

Water quality analyses and the qualitative assessment of sources identified stormwater runoff contributing to direct inflow and interconnected flow from upstream waterbodies (Lake Bess) as potentially significant anthropogenic loads. Internal loading was also identified as a potential load but at present data are not available to quantify.

5.10.2 Study/Data Collection Recommendations

Based on the data limitations and waterbody stressors outlined in **Section 5.10.1**, additional data collection and waterbody study recommendations were developed in conjunction with City staff. The list of recommended studies includes the following:

- Shakey Pond
 - Water Quality Assessment and Restoration Study
- Upper Lake Lafayette
 - Hydrologic Study
- Killearn Chain of Lakes
 - Hydrologic Study
 - Evaluation of Site-Specific Alternative Criteria
- Lake Kanturk
 - Septic Loading Study
- Lake Tom John
 - Development of Hydrologic and Nutrient Budget
 - Evaluation of Site-Specific Alternative Criteria
- Piney Z Lake
 - Evaluation of Site-Specific Alternative Criteria
- Lafayette Creek
 - Additional Bacteria Sampling

The following outlines the justification, what stressors or data limitations are being addressed, and a general description of the work to be performed, along with initial scope items for each of the data collection/studies listed previously. It is noted that some of these studies are outside of the City's incorporated areas and, therefore, the studies would need to occur under the jurisdiction of the state or county.

5.10.2.1 Shakey Pond: Water Quality Assessment and Restoration Study

Section 5.10.1.1 identified that presently Shakey Pond is not meeting its NNC due to potential stormwater runoff and internal nutrient loading. Additionally, issues with the present condition of the outflow structure was identified. Based on this, it is recommended to initiate a study to determine potential restoration activities necessary to meet water quality criteria. The study will include the development of a hydrologic and nutrient budget/mass loading analysis for the pond. Additionally, mitigation strategies will be evaluated to help in the attainment of water quality standards, i.e., the appropriate NNC standard. The primary focus will be on the internal sediment nutrient flux while also addressing atmospheric deposition, stormwater inputs, and shallow groundwater inputs.

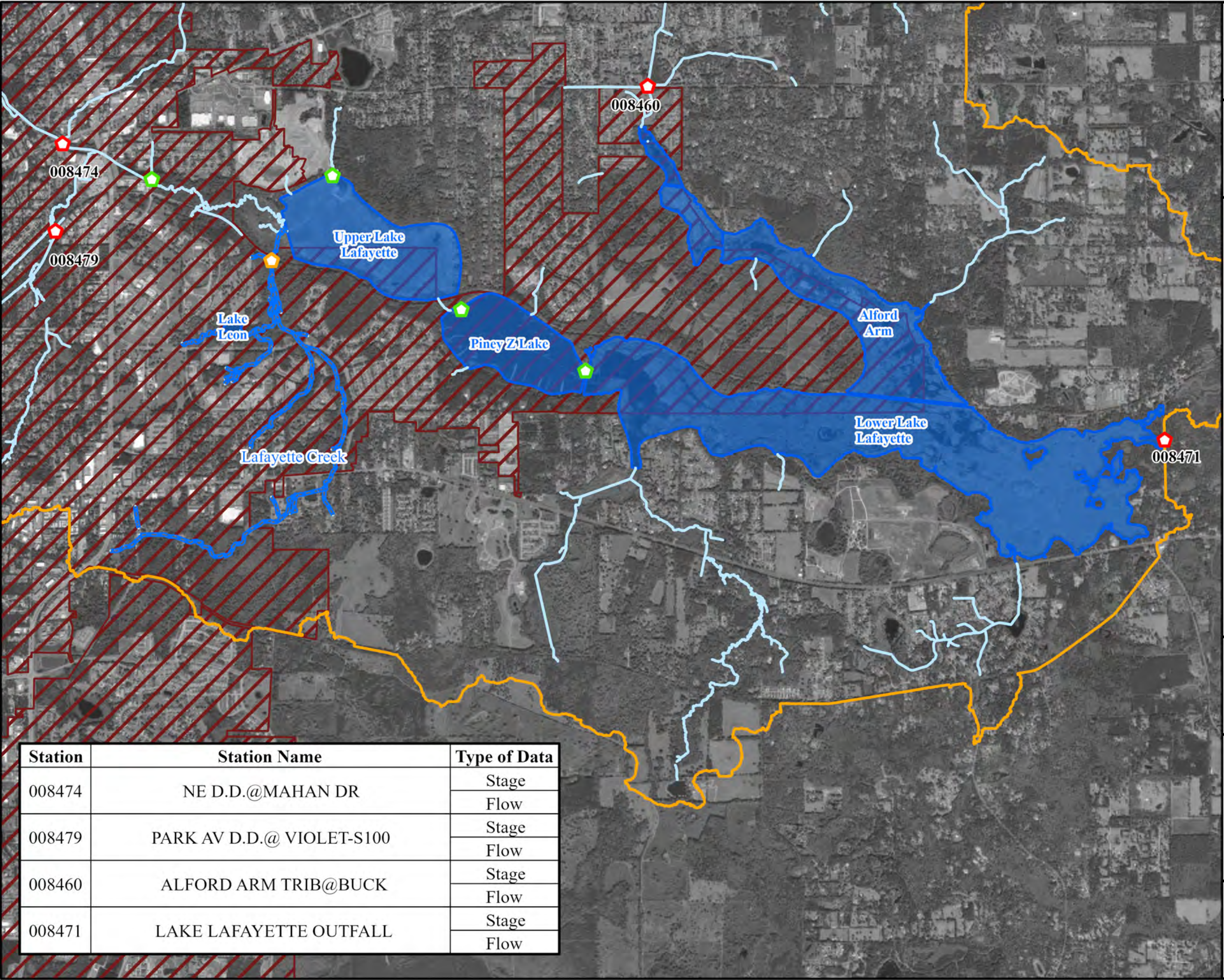
The recommended elements for the study are as follows.

- Site reconnaissance to understand the site logistics, including historical and potential future monitoring locations, as well as develop consensus with City staff on station locations and monitoring approach.
- Installation of a lake level monitor to aid in the assessment of the hydrology of the pond.
- Assessment of sediment characteristics, including muck layer thickness, nutrient content, pore water characteristics and phosphorus fractionalization.
- Development of a hydrologic model to define the system hydrologic budget. Model to be calibrated to the lake level data.
- Development of a nutrient budget.
- Identification of Restoration Options.

5.10.2.2 Upper Lake Lafayette: Hydrologic Study

Section 5.10.1.2 identified that the primary stressors for Upper Lake Lafayette come from the system's hydrology with extended periods of dry down (water limited to area of sink) with at times more extended periods of refilling, which leads to conditions that are not reflective of a true lake system, thus limiting the applicability of the State NNC. Determination of an appropriate and achievable use for the lake begins first with a full understanding of the overall system hydrology including the other lakes in the Lafayette Chain and how they interact with Upper Lake Lafayette.

Based on this, it is recommended to initiate a study to develop a complete understanding of the hydrologic budget for Upper Lake Lafayette, including conditions within the other lakes in the system as needed. The study will include collection of hydrologic data and development of a hydrologic model. The extent of the data collection and modeling (in relation to the need for inclusion of the other waterbodies in the system and their watersheds and the need for physical or hydrologic data) will be determined as a first step in the study. **Figure 5-181** presents existing hydrologic data stations and potential proposed hydrologic data collection for use in the study. As part of this study, the existing hydrologic data stations will be evaluated for accuracy and completeness. Based on Upper Lake Lafayette being under the jurisdictions of both the City and County, significant coordination with the County will be needed during this study.



Legend

- Lake Lafayette Drainage Basin
- Waterbodies in Study
- Watercourses
- Tallahassee Corporate Limits

Hydrological Data Stations

Type of Data

- Existing Stage and Flow
- Proposed Flow
- Proposed Stage

Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Watersheds: COT, 2020
Roads: FDOT, 2020
Facilities: COT, 2020
City Limits: COT, 2022

Figure 5-181:
Upper Lake Lafayette Hydrologic Study

Tallahassee Master Plan - Surface Water (TMaPS)



Station	Station Name	Type of Data
008474	NE D.D.@MAHAN DR	Stage
		Flow
008479	PARK AV D.D.@ VIOLET-S100	Stage
		Flow
008460	ALFORD ARM TRIB@BUCK	Stage
		Flow
008471	LAKE LAFAYETTE OUTFALL	Stage
		Flow

The recommended general elements are as follows.

- Site reconnaissance to understand the site logistics, including historical and potential future monitoring locations, as well as develop consensus with City staff on station locations and monitoring and modeling approach.
- Development of a Monitoring/Modeling Plan and QAPP
- Data collection as outlined in the Monitoring/Modeling Plan and QAPP including water level and flow stations. **Figure 5-181** presents potential hydrologic monitoring locations and the types of data. Additional recommended data includes water levels in Weems Pond (to support calculation of flow over the weir), Upper Lake Lafayette, Piney Z Lake, and the western portion of Lower Lake Lafayette. Additional supporting data will include surveys of key structures that provide exchange between the various waterbodies. The data collection plan, stations, and types of data would be finalized in the Monitoring and Modeling Plan.
- Development of a hydrologic model to define the system hydrologic budget. Model to be calibrated to the lake level and flow data.
- Development of the hydrologic budget for the system including all gains and losses.
- Evaluation of Restoration Options relative to the system hydrology based on the modeling of the system.

5.10.2.3 Killearn Chain of Lakes: Hydrologic Study and SSAC

Section 5.10.1.3 identified that along with stormwater loads and septic loading (for Lake Kanturk) a key stressor for the Killearn Chain of Lakes are the frequent dry downs and subsequent re-wetting of the waterbodies. As was defined for Upper Lake Lafayette, this leads to conditions that are not reflective of a true lake system, thus limiting the applicability of the State NNC. Determination of an appropriate and achievable use for the lakes begins first with a full understanding of the overall system hydrology and what could or could not be done to restore the system to be more reflective of a true system of lakes, i.e., to maintain adequate water levels to support an appropriate lake designated use.

A 2014 study by CH2MHILL performed modeling using a FEMA model to assess potential options for restoring lake levels. The study performed simulations on historic conditions back to 1982 and later conditions in 2007. Alternatives evaluated included lining all or some of the lake bottoms, increasing control elevations between the lakes and adding supplemental water from groundwater wells.

Based on this, it is recommended to initiate an updated hydrologic study to develop a complete understanding of the hydrologic budget for the Killearn Chain of Lakes under present conditions. The study will include collection of additional hydrologic data and development of a hydrologic model for the system. **Figure 5-182** presents existing hydrologic data stations. Presently there are sufficient data stations being maintained by the NFWFMD to support modeling of the Killearn Chain. As part of this study, the existing hydrologic stations will be evaluated for accuracy and completeness. One additional station that would support the modeling of the

system and provide information for another proposed study (**Section 5.10.2.5**) is the addition of water level in Lake Tom John (**Figure 5-182**). While the City is a stakeholder in the Killlearn Chain of Lakes basin, the lakes are privately owned and therefore any proposed study must account for this.

The recommended general elements are as follows.

- Site reconnaissance to understand the site logistics, including historical and potential future monitoring locations, as well as develop consensus with City staff on station locations and monitoring and modeling approach.
- Development of a Monitoring/Modeling Plan and QAPP.
- Development of a hydrologic model to define the system hydrologic budget. Model to be calibrated to the lake level and flow data.
- Development of the hydrologic budget for the system including all gains and losses.
- Evaluation of Restoration Options relative to the system hydrology based on the modeling of the system.

An additional study component for the Killlearn Chain of Lakes, which may be completed separately from the hydrologic study is an evaluation of the need for, and feasibility of establishing, site specific alternative nutrient criteria (SSAC). As discussed previously, the nature of the system, i.e., constructed waterbodies from a former wetland, may not support the NNC presently determined for the system of lakes. Numerous previous studies have identified this issue. The study would evaluate the appropriateness of the existing criteria and if determined to warrant development of a SSAC define appropriate Chl-a and nutrient targets for the system.

5.10.2.4 Lake Kanturk: Septic Loading Study

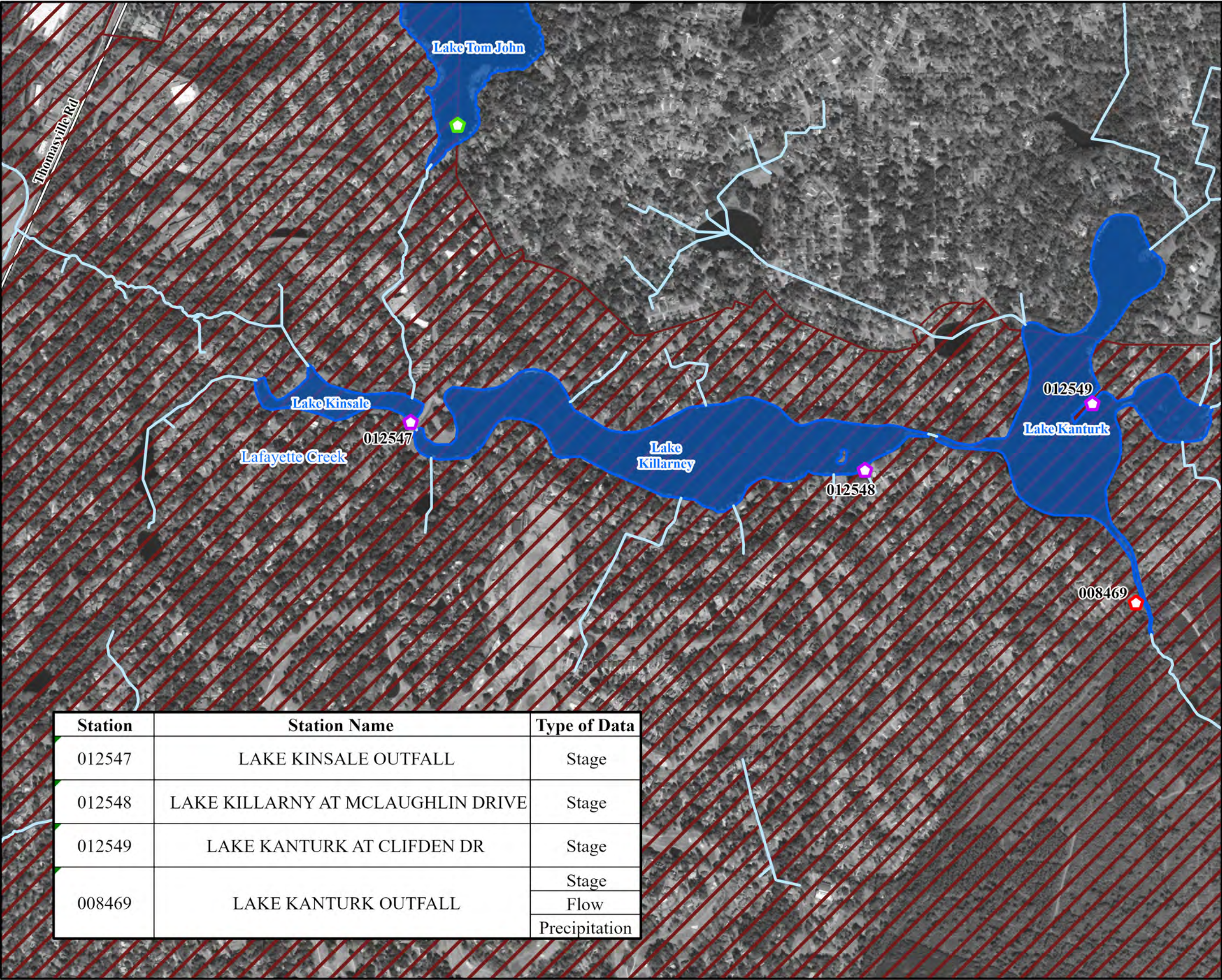
In **Section 5.10.1.3**, which outlined the stressors for the Killlearn Chain of Lakes, and the qualitative assessment of sources (**Section 5.5.4**), the need for a quantitative analysis of the impact of septic loading to Lake Kanturk was identified.

Figure 5-183 shows the distribution of septic coverage within the watershed draining to Lake Kanturk. Additionally, as outlined in **Section 5.10.1.3** analyses of data from watersheds draining this area showed elevated nitrate levels.

The study approach would be to utilize targeted sampling within the subwatersheds draining to the northern end of the lake in conjunction with advanced analytic parameters such as isotopic analysis, pharmaceuticals, and microbial source tracking. Additionally, monitoring of surficial groundwater in the immediate shoreline areas of the lake would provide information on the potential for seepage from septic systems.

The recommended elements for the study described above are as follows.

- Detailed review of historical data within Lake Kanturk.



Legend

- Lake Lafayette Drainage Basin
- Waterbodies in Study
- Major Roads
- Watercourses
- Tallahassee Corporate Limits
- Hydrological Data Stations**
- Type of Data**
- Existing Stage and Flow
- Existing Stage
- Proposed Stage

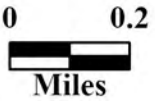
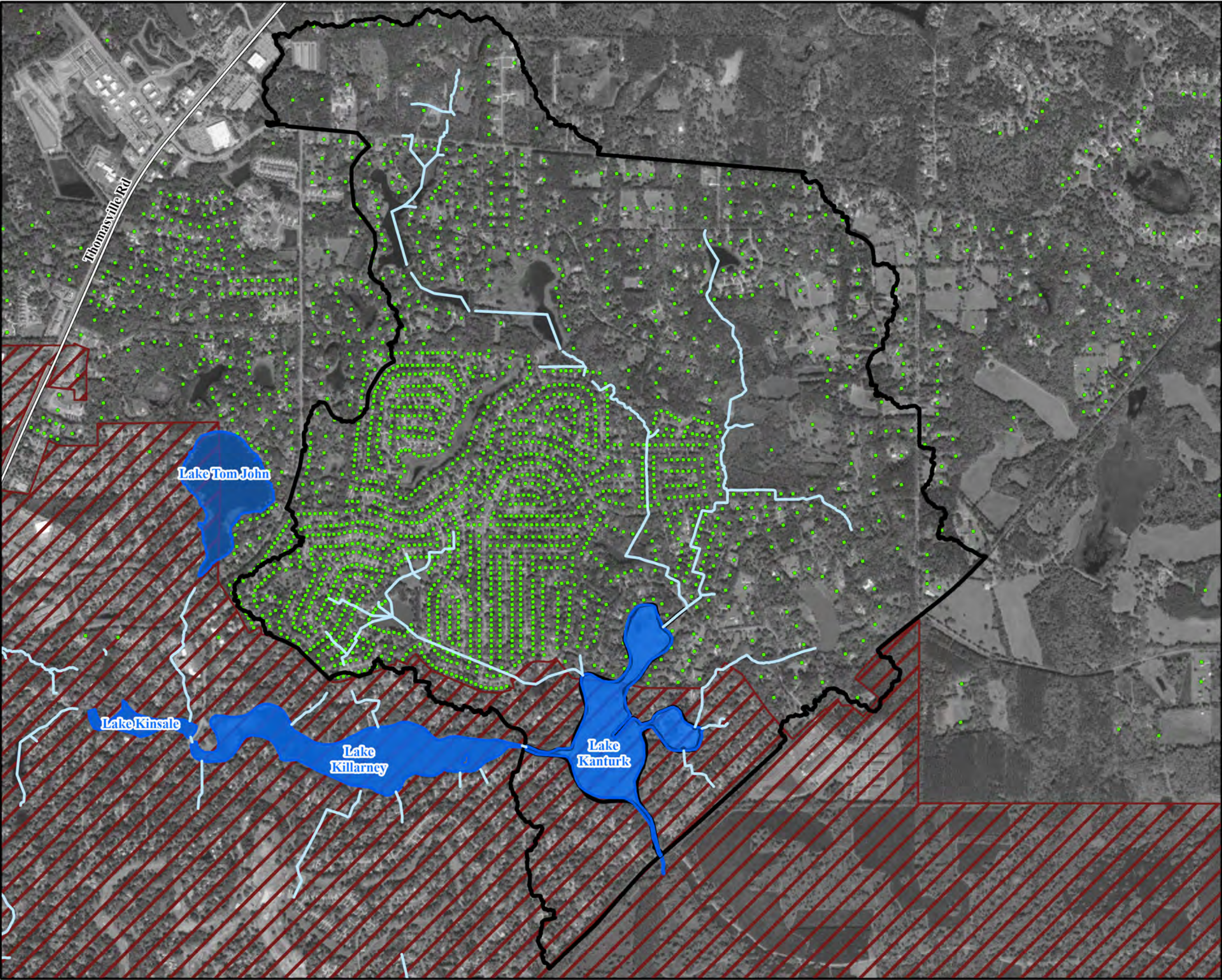
Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Watersheds: COT, 2020
Roads: FDOT, 2020
Facilities: COT, 2020
City Limits: COT, 2022

Figure 5-182:
Killarn Chain of Lakes Hydrologic Study

Tallahassee Master Plan - Surface Water (TMaPS)



Station	Station Name	Type of Data
012547	LAKE KINSALE OUTFALL	Stage
012548	LAKE KILLARNY AT MCLAUGHLIN DRIVE	Stage
012549	LAKE KANTURK AT CLIFDEN DR	Stage
008469	LAKE KANTURK OUTFALL	Stage
		Flow
		Precipitation



Legend

- Lake Kanturk Drainage Basin
- Waterbodies in Study
- Watercourses
- Tallahassee Corporate Limits
- Septics Systems

Sources:
Waterbodies: COT, 2020
Watersheds: COT, 2020
Roads: FDOT, 2020
Septic Systems: COT, 2020
City Limits: COT, 2022

**Figure 5-183:
Lake Kanturk Septic Study**

**Tallahassee Master Plan - Surface
Water (TMaPS)**



- Reconnaissance to understand the site logistics, including historical and potential future monitoring locations, as well as develop consensus with City staff on station locations, monitoring approach, and development of the QAPP.
- Development of a QAPP that details staff responsibilities, sampling procedure, methodology, equipment, and laboratory analytical requirements for this project.
- Field monitoring and sampling as outlined in the QAPP.
- Data analyses to evaluate results of the study and provide a determination on septic loading to the lake.
- Develop a final report summarizing the findings from the study.

5.10.2.5 Lake Tom John: Water Quality Assessment/Restoration Study and SSAC Evaluation

Section 5.10.1.4 identified that presently Lake Tom John is not meeting its NNC due to potential stormwater runoff and internal nutrient loading. Based on this, it is recommended to initiate a study to determine potential restoration activities necessary to meet water quality criteria. The study will include the development of a hydrologic and nutrient budget/mass loading analysis for the pond. Additionally, mitigation strategies will be evaluated to help in the attainment of water quality standards, i.e., the appropriate NNC standard. The primary focus will be on the loading of nutrients from the watershed and the potential for internal sediment nutrient flux while also addressing atmospheric deposition, and shallow groundwater inputs. While the City is a stakeholder in the Lake Tom John Basin, the lake is privately owned and therefore any proposed study must account for this.

The recommended elements for the study are as follows.

- Site reconnaissance to understand the site logistics, including historical and potential future monitoring locations, as well as develop consensus with City staff on station locations and monitoring approach.
- Installation of a lake level monitor to aid in the assessment of the hydrology of the pond as outlined in **Section 5.10.2.3** and shown in **Figure 5-182**.
- Assessment of sediment characteristics, including muck layer thickness, nutrient content, pore water characteristics and phosphorus fractionalization.
- Development of a hydrologic model to define the system hydrologic budget. Model to be calibrated to the lake level data.
- Development of a nutrient budget.
- Identification of Restoration Options.

An additional study component for the Lake Tom John, which may be completed separately from the restoration study is an evaluation of the need for, and feasibility of establishing, site specific alternative nutrient criteria (SSAC). Presently Lake Tom John has very low nutrient and

Chl-a targets based on color and alkalinity. The study would evaluate the appropriateness of the existing criteria and if determined to warrant development of a SSAC define appropriate Chl-a and nutrient targets for the system.

5.10.2.6 Piney Z Lake: Assessment of Site-Specific Alternative Criteria (SSAC)

Section 5.10.1.2 identified that impairments within Piney Z Lake may be associated with non-load related issues such as the isolated nature of the system and ecological management. Additionally, concerns were raised on the applicability of the present criteria. Based on these issues, a study is recommended to evaluate the appropriateness of the existing criteria in relation to the nature and management of the system, and if determined to warrant development of a SSAC, define appropriate Chl-a and nutrient targets for the system.

5.10.2.7 Other Studies

Two potential additional data collection/studies are recommended based on data and analyses presented earlier for two of the non-priority waterbodies Alford Arm and Lafayette Creek. Based on earlier discussions on the importance of vegetation in Piney Z Lake, a vegetation management study is recommended. Finally, a monitoring study to collect E Coli data within the Virginia Tributary is recommended to support removal of the legacy fecal coliform impairment. The recommendations are:

- Resumption of water quality data collection within the lake portion of Alford Arm, and
- Resumption of bacteria data collection in Lafayette Creek.
- A study on vegetation management for Piney Z Lake.
- E Coli monitoring within Virginia Tributary.

For Alford Arm, the work would include reconnaissance to define potential sampling locations and coordination with City staff on the locations. Additionally, while not impaired for *E. coli*, measured concentrations in the Lafayette Creek are elevated. As such, resumption of bacteria data collection is recommended to supplement historic data.

5.10.3 Study Prioritization

To prioritize the proposed studies, a ranking table was developed that scored each of the projects in relation to the following:

- Waterbody priority ranking (**Table 5-27**),
- Source target ranking (the overall ranking of the source addressed by the study, **Table 5-28**),
- Restoration benefits (qualitative assessment of the benefits of the study),
- Extent of missing data, and
- Relative estimated cost.

Table 5-30 presents the study rankings for each of the individual metrics, the average score based on the individual rankings, and the final study ranking. The studies are divided between those that are solely within the City’s incorporated area and those within both the City’s incorporated area and unincorporated Leon County. These are shown on **Table 5-30**.

Only one study was solely located within the City’s incorporated area, that is the Shakey Pond Water Quality Assessment and Restoration Study, which was ranked first overall. Based on early determinations on the need for this study, it was completed prior to the completion of the development of this final report.

The remaining studies are located within both the City’s incorporated area and unincorporated Leon County. For these studies the Lake Kanturk Septic Loading study was ranked highest, followed by the Lake Tom John Water Quality Assessment/Restoration Study. The Upper Lake Lafayette and Killlearn Chain of Lakes Hydrologic Studies were tied based primarily on their anticipated costs. The lowest ranked study was the Lake Piney Z SSAC Evaluation.

Table 5-30: Proposed Study Ranking

Target Waterbody	Proposed Study/Data Collection	Study Location	Waterbody Priority Ranking	Source Ranking	Restoration Benefits	Extent of Missing Data	Relative Estimated Cost	Average Rank	Study Ranking
Shakey Pond	Water Quality Assessment and Restoration Study	COT Incorporated Area	1	1	3	1	3	1.80	1
Upper Lake Lafayette	Hydrologic Study	COT Incorporated Area and Leon County	2	3	1	4	5	3.00	4
Killearn Chain of Lakes	Hydrologic Study and SSAC Evaluation	COT Incorporated Area and Leon County	4	1	2	4	4	3.00	4
Lake Kanturk	Septic Loading Study	COT Incorporated Area and Leon County	2	2	4	1	2	2.20	2
Lake Tom John	Water Quality Assessment/Restoration Study and SSAC Evaluation	COT Incorporated Area and Leon County	3	1	3	2	3	2.40	3
Lake Piney Z	SSAC Evaluation	COT Incorporated Area and Leon County	5	4	5	3	1	3.60	5

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