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

## LAKE LAFAYETTE BASIN

CITY OF TALLAHASSEE

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**July 2025**

Geosyntec consultants
engineers | scientists | innovators

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# VOLUME 5

# LAKE LAFAYETTE BASIN

## CITY OF TALLAHASSEE

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Project Number: FW7714

July 2025

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# TMaPS: VOLUME 5

# LAKE LAFAYETTE BASIN

## CITY OF TALLAHASSEE

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

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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 *a* |
| City | City of Tallahassee |
| *E. coli* | *Escherichia coli* |
| 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

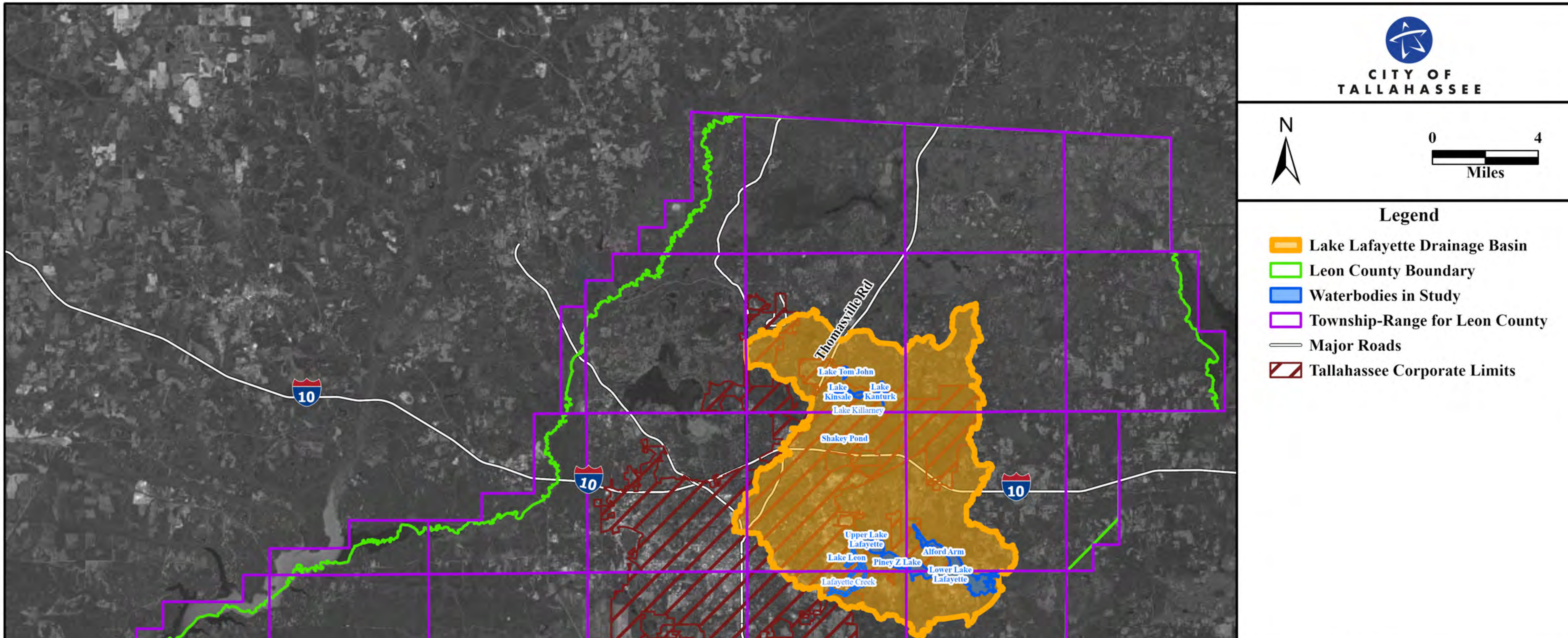
The Lake Lafayette basin is located in Leon County, FL north of Tallahassee and encompasses the township and ranges of: 002N001E, 002N002E, 001N001E, 001N002E, 001S001E, 001S002E. **Figure 5-1** shows the location of the Lake Lafayette basin in relation to the Tallahassee city limits and within the Leon 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.

CITY OF TALLAHASSEE




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)**

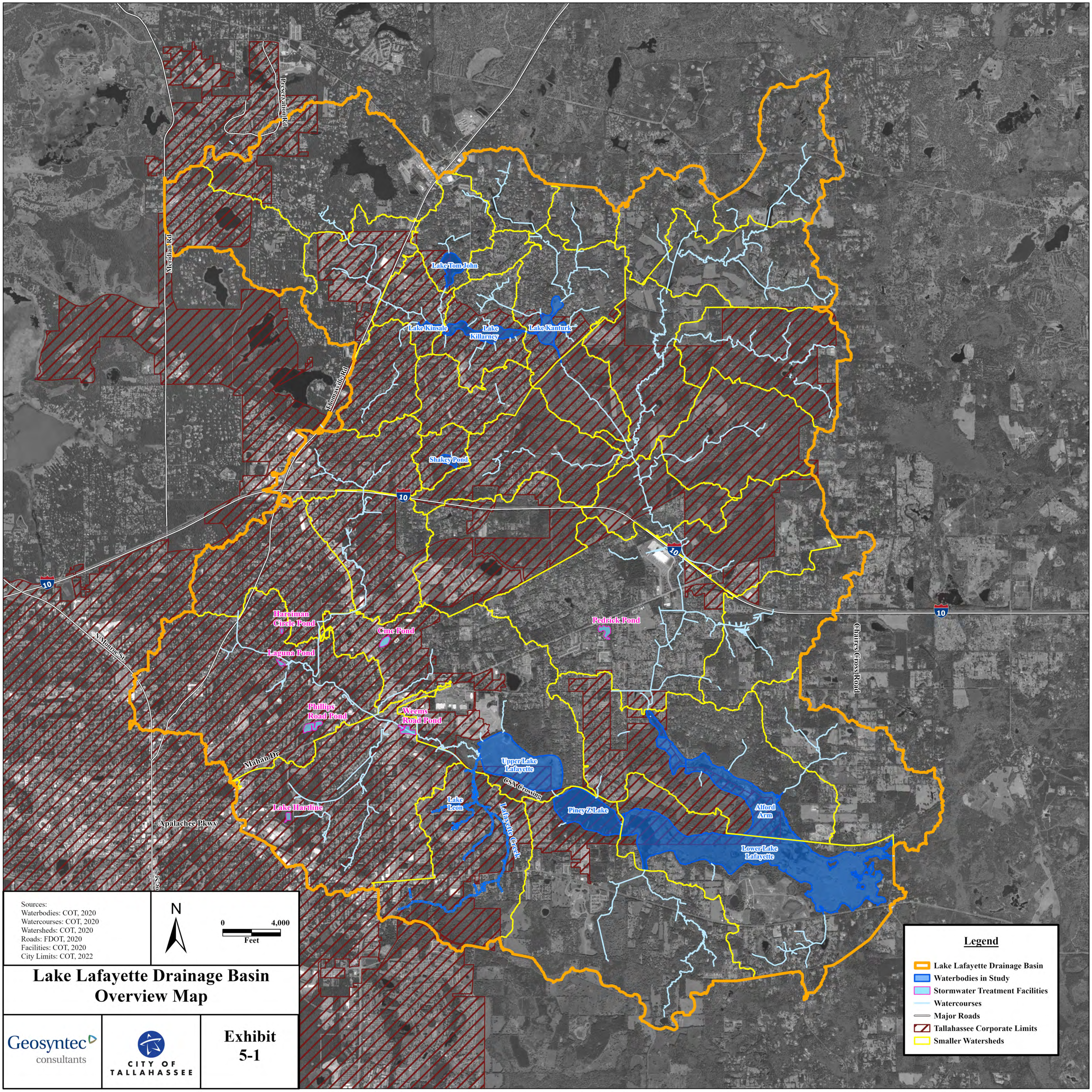
Geosyntec consultants

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.




**Lake Lafayette Drainage Basin Overview Map**

**Exhibit 5-1**

## 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 ODonnell | 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 Chairs Cross Road during a rain event in 2022 along with the Northwest Florida Water Management District (NWFWMD) 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 NWFWMD. 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 Killearn 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 Killearn 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 Killearn 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

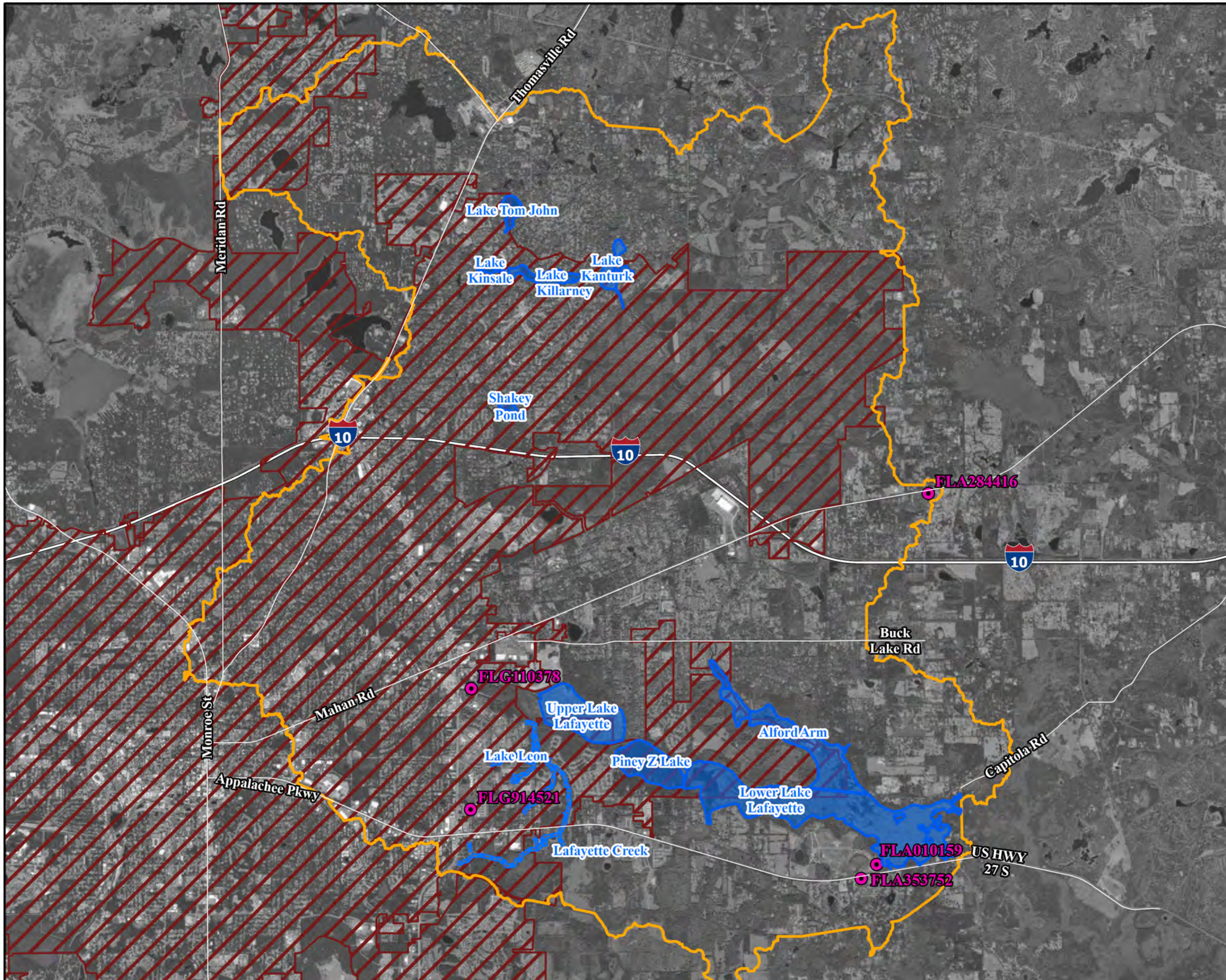
An estimated 8,378 septic tank units are within the boundaries of the Lake Lafayette basin based on the Florida Department of Health (FDOH) septic tank layer (**Exhibit 5-5**). Effluent from septic tanks that are in good condition should be comparable to secondarily treated wastewater from sewage treatment 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.

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**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)**

Geosyntec consultants

**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 NWFWMD. 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.

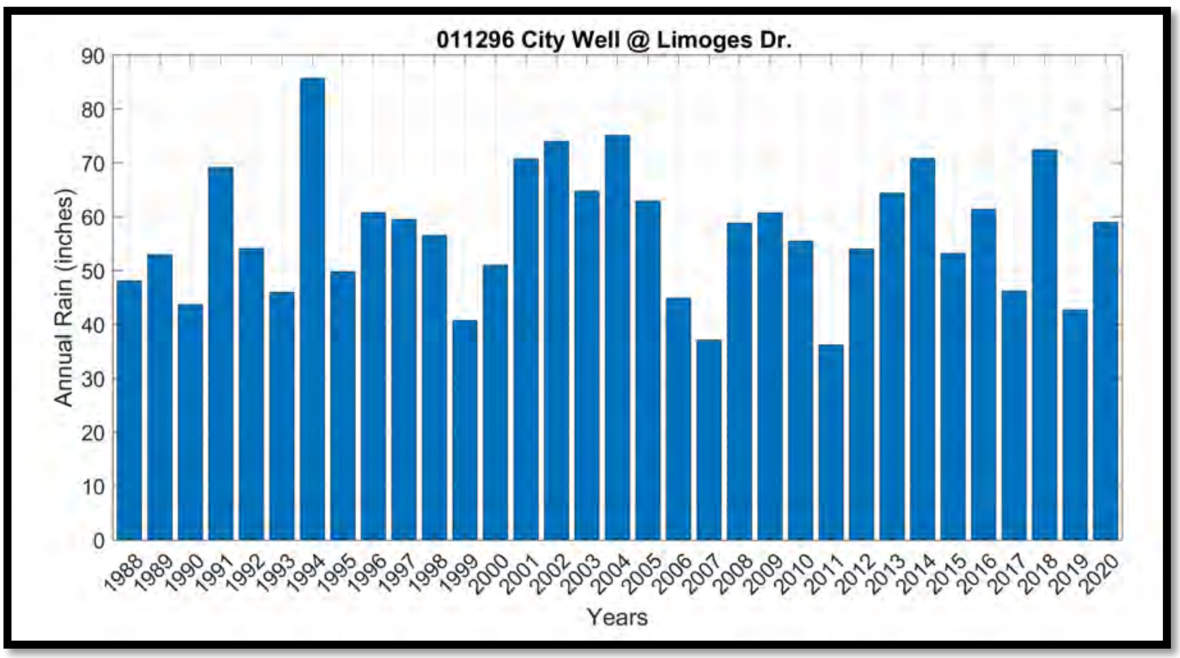



**Figure 5-3: Annual Rainfall in the Lake Lafayette Basin (1987 to 2020)**

Lake stage data were retrieved from NWFWMD 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**.

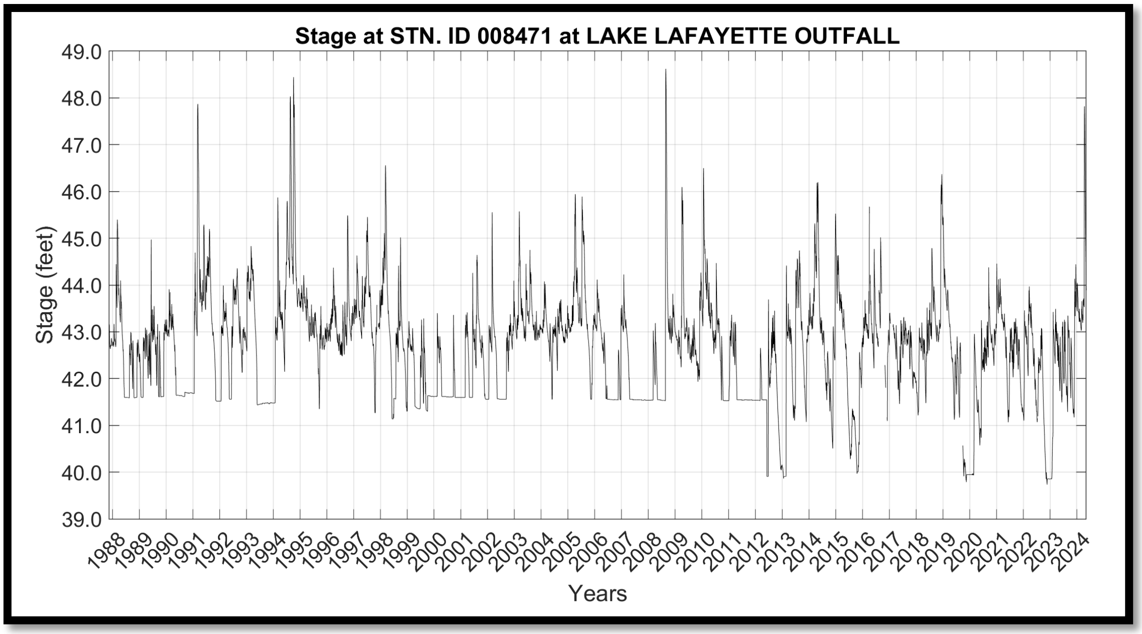



**Figure 5-4: Water Level at Lower Lake Lafayette Outfall Station 008471 (1988 to 2020)**

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.

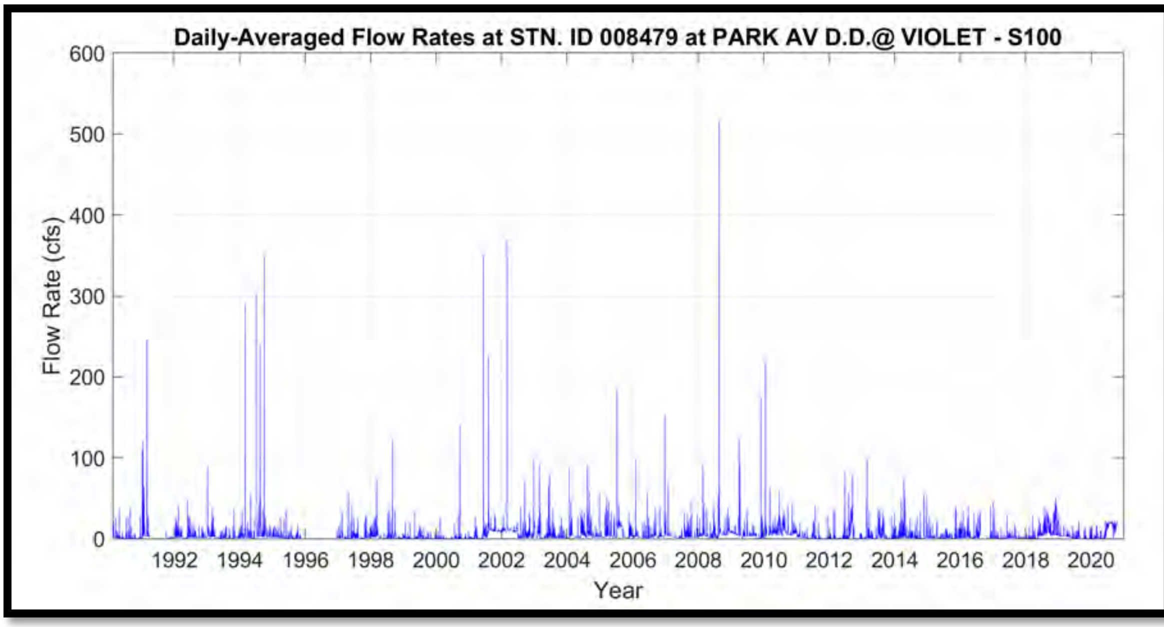



**Figure 5-5: Flows on Park Avenue Ditch Station 008479 (1990 to 2020)**

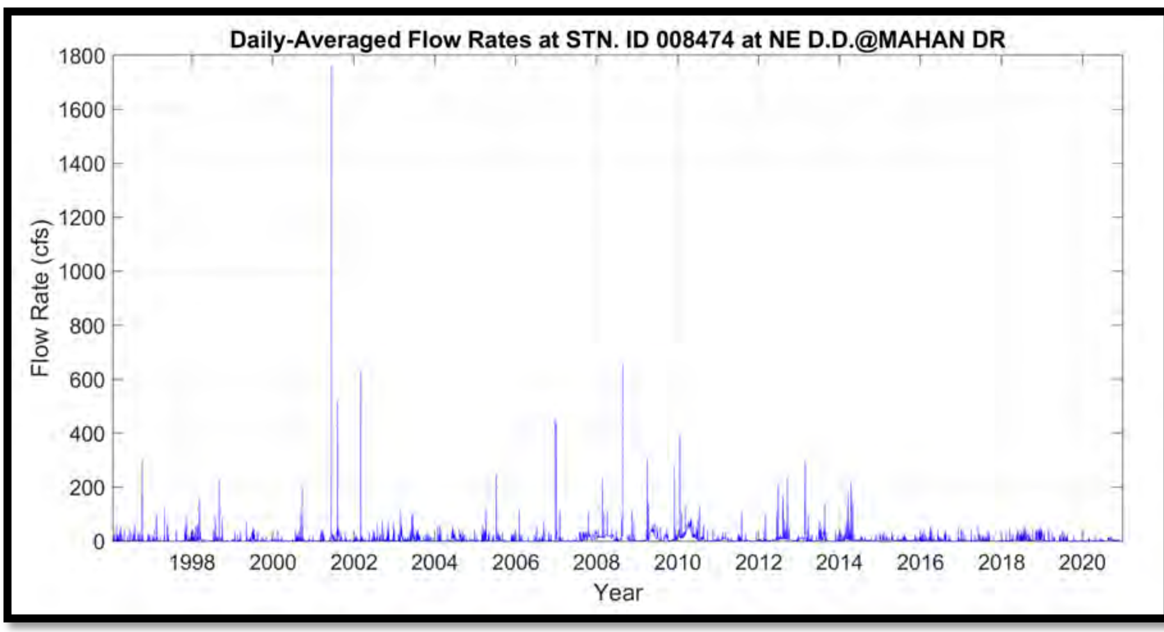



**Figure 5-6: Flows on NEDD Station 008474 (1996 to 2020)**

**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.

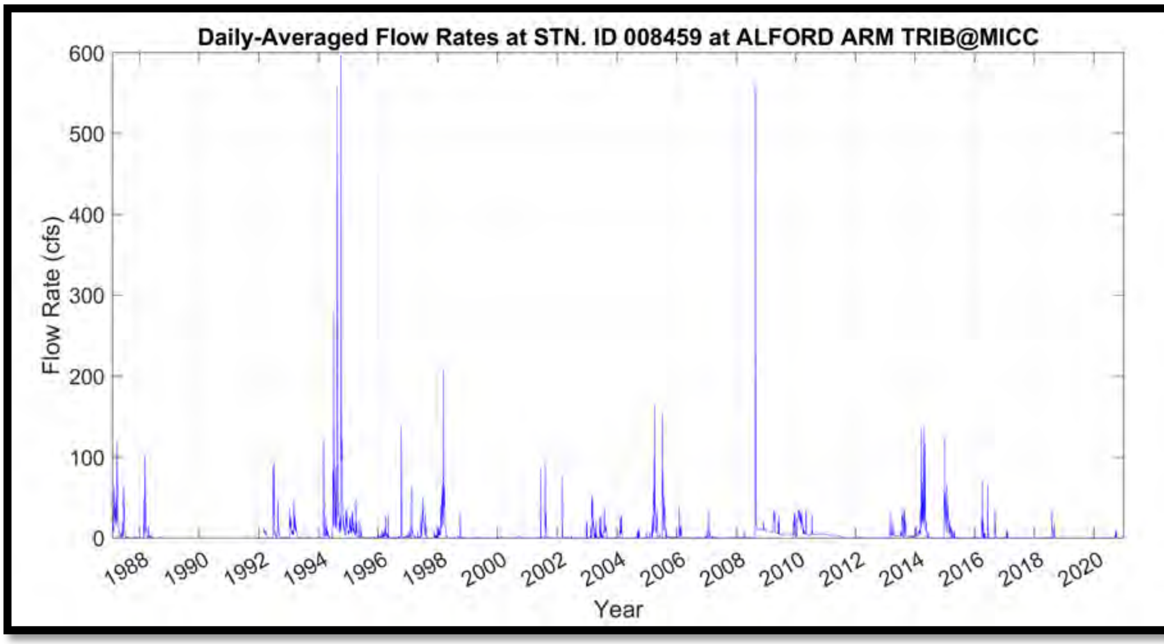



**Figure 5-7: Flows on Alford Arm Upstream of I-10 Station 008459 (1987 to 2020)**

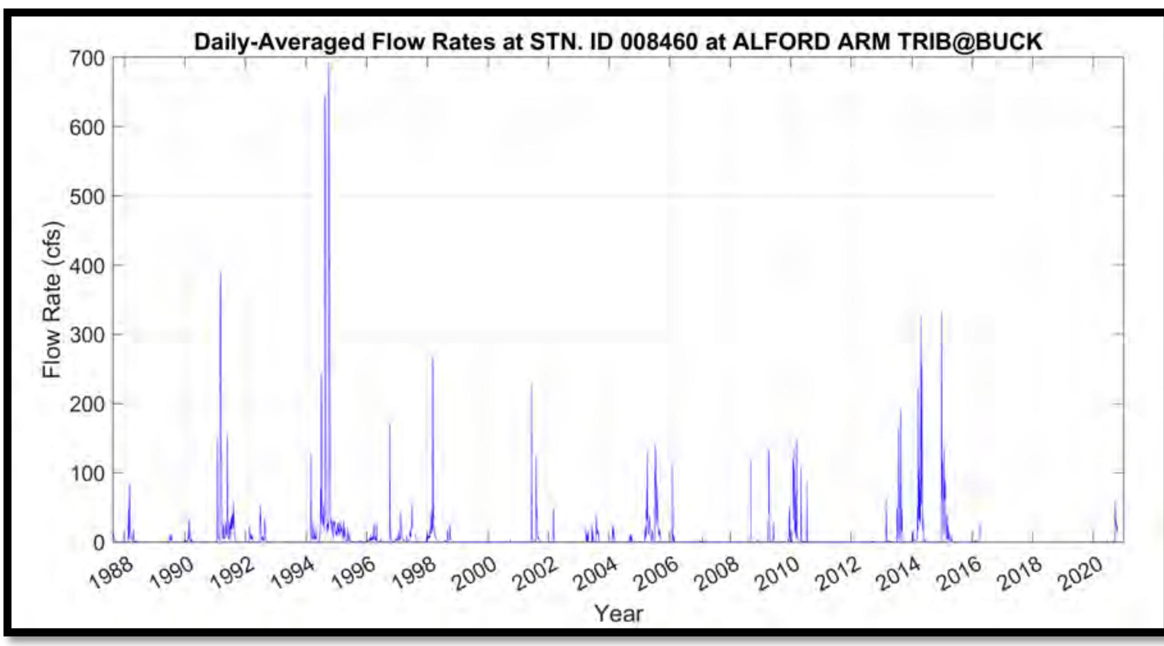



**Figure 5-8: Flows on Alford Arm at Buck Lake Road Station 008460 (1987 to 2020)**

**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.

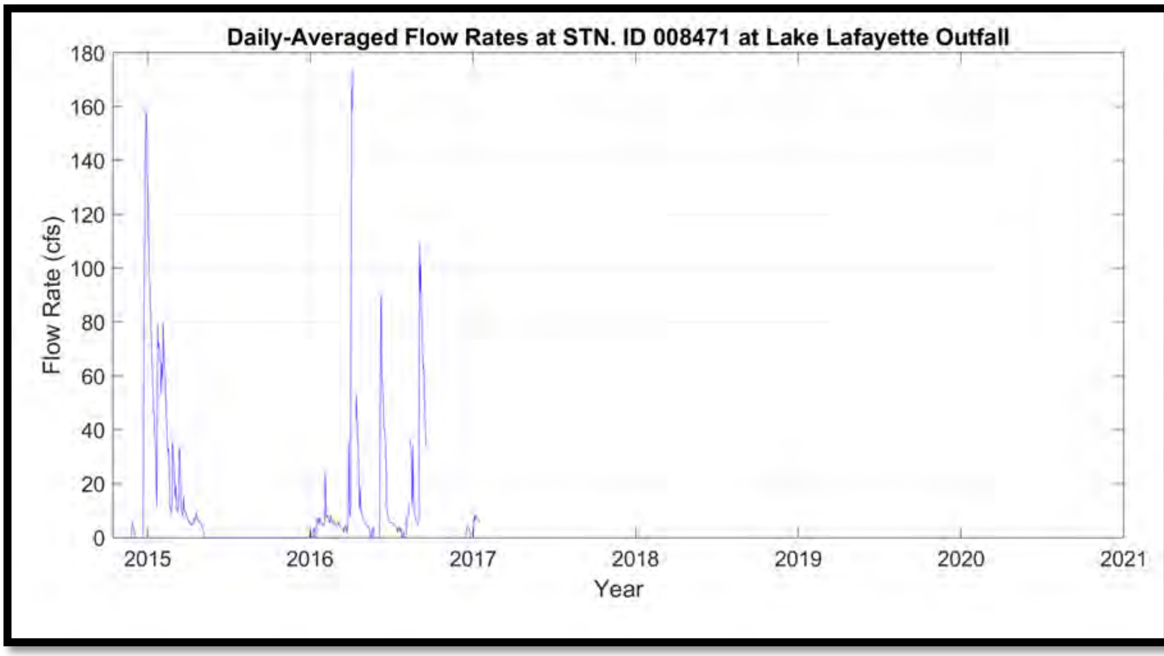



**Figure 5-9: Flows at Lower Lake Lafayette Outfall Station 008471 (2014 to 2017)**

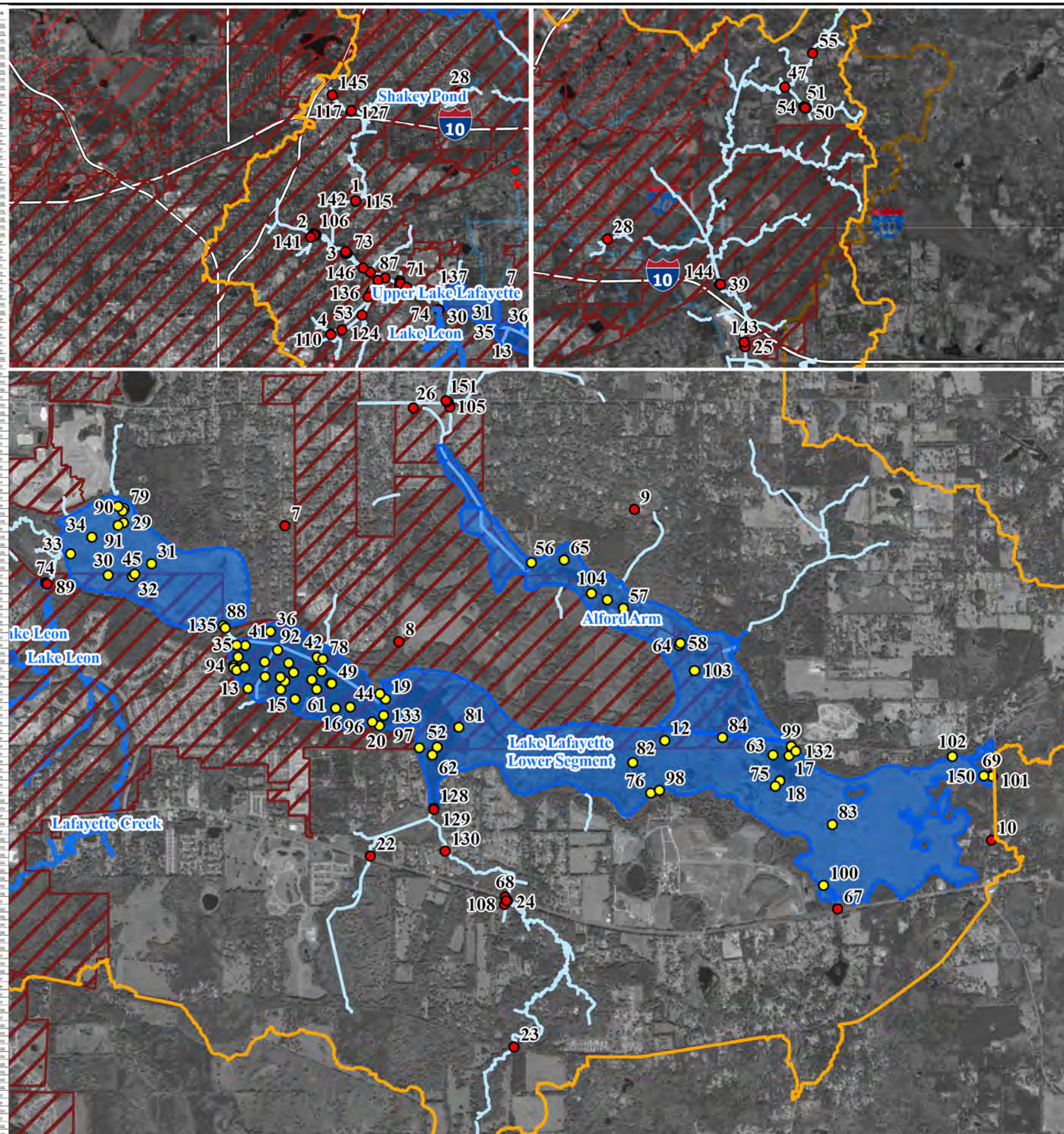
#### 5.4.3.7 Surface Water Quality Data

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, NWFWMD, 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.

| Number | Station ID | Station Name | Start of Record | End of Record | Position |
|---|---|---|---|---|---|
| 1 | 112WRD 02326828 | NORTHEAST DD AT CAPITAL CIR TALLAHASSEE FL | 1980 | 1980 | Upstream |
| 2 | 112WRD 02326836 | MCCORD PK POND DD AT CNTVL RD TALLAHASSEE FLA | 1980 | 1980 | Upstream |
| 3 | 112WRD 02326838 | LAFAYETTE CREEK MICCOSUKEE RD (NO 28) TLH , FL | 1980 | 1996 | Upstream |
| 4 | 112WRD 02326842 | GOVERNORS SQ MALL DD AT PARK AV TALLAHASSEE FLA | 1980 | 1980 | Upstream |
| 5 | 112WRD 02326845 | LAFAYETTE CRK AT WEEMS RD TALLAHASSEE FL | 1980 | 1996 | Upstream |
| 6 | 21FLA 22030045 | LK LAFAYETTE E SIDE SR 261 | 1974 | 1975 | Upstream |
| 7 | 21FLA 22030046 | SINK HOLE FLOW FROM LK LAFAYETTE | 1974 | 1974 | Upstream |
| 8 | 21FLA 22030047 | LAKE LAFAYATTE #3 WEST DIKE PINE | 1974 | 1975 | Upstream |
| 9 | 21FLA 22030048 | LAKE LAFAYATTE #4 N DIKE ALFORD | 1974 | 1975 | Upstream |
| 10 | 21FLA 22030049 | LAKE LAFAYETTE #5 CHAIRES ROAD C | 1974 | 1975 | Upstream |
| 11 | 21FLA 22030127 | PINEY Z LAKE (LAFAYETTE) CENTER | 1996 | 1996 | In-Lake |
| 12 | 21FLA 22030128 | LAKE LAFAYETTE NEAR MOUTH OF ALFORD ARM | 1996 | 1996 | In-Lake |
| 13 | 21FLBRA 756B-C | 756B - Lake Piney Z - at boatramp S of playground | 2006 | 2007 | In-Lake |
| 14 | 21FLBRA 756B-D | 756B - Lake Piney Z - near Cypress Rookery | 2006 | 2007 | In-Lake |
| 15 | 21FLBRA 756B-E | 756B - Lake Piney Z - Fishing Finger 4 | 2007 | 2007 | In-Lake |
| 16 | 21FLBRA 756B-F | 756B - Lake Piney Z - end of Fishing Finger 6 | 2007 | 2007 | In-Lake |
| 17 | 21FLBRA 756C-A | 756C - Lower Lake Lafayette - 100m S of Road to Lake Rd. boa | 2006 | 2006 | In-Lake |
| 18 | 21FLBRA 756C-B | 756C - Lower Lake Lafayette - 350m SW of Road to Lake Rd. bo | 2006 | 2006 | In-Lake |
| 19 | 21FLBRA 756C-C | 756C - Lower Lake Lafayette - N end of dam below Piney Z | 2006 | 2007 | In-Lake |
| 20 | 21FLBRA 756C-D | 756C - Lower Lake Lafayette - S end of dam below Piney Z | 2006 | 2007 | In-Lake |
| 21 | 21FLBRA 756C-E | 756C - Lower Lake Lafayette - at Rd to Lake boatramp | 2006 | 2006 | In-Lake |
| 22 | 21FLBRA 919-A | 919 - Unnamed Slough / Tribs. @ Hwy 27 - At US 27 | 2006 | 2006 | Upstream |
| 23 | 21FLBRA 919-D | 919 - Unnamed Slough / Tribs. @ Hwy 27 - At Old St. Augustin | 2006 | 2006 | Upstream |
| 24 | 21FLBRA 919-E | 919 - Unnamed Slough / Tribs. @ Hwy 27 - Unnamed Trib @ US 2 | 2006 | 2006 | Upstream |
| 25 | 21FLBRA 647-A | 647 - Alford Arm - at US 90 W of I-10 | 2006 | 2007 | Upstream |
| 26 | 21FLBRA 647-B | 647 - Alford Arm - pond below Peyton Ct. cul de sac | 2006 | 2007 | Upstream |
| 27 | 21FLBRA 647-D | 647 - Alford Arm - Bucklake Rd | 2006 | 2007 | Upstream |
| 28 | 21FLBRA 647-E | 647 - Alford Arm - at Gardenview Way | 2006 | 2006 | Upstream |
| 29 | 21FLBRA 756A-A | 756A - Upper Lake Lafayette - northern section | 2006 | 2006 | In-Lake |
| 30 | 21FLBRA 756A-C | 756A - Upper Lake Lafayette - 240m E of 756A-G | 2006 | 2006 | In-Lake |
| 31 | 21FLBRA 756A-D | 756A - Upper Lake Lafayette - 240m from 756A-G at end of ber | 2006 | 2006 | In-Lake |
| 32 | 21FLBRA 756A-G | 756A - Upper Lake Lafayette - South of Berm | 2006 | 2006 | In-Lake |
| 33 | 21FLBRA 756A-I | 756A - Upper Lake Lafayette - Western Trib | 2006 | 2006 | In-Lake |
| 34 | 21FLBRA 756A-J | 756A - Upper Lake Lafayette - 250m dwnstrm from 756A-I | 2006 | 2006 | In-Lake |
| 35 | 21FLBRA 756B-A | 756B - Lake Piney Z - At end of second berm from north | 2006 | 2007 | In-Lake |
| 36 | 21FLBRA 756B-B | 756B - Lake Piney Z - 250 m from 3rd berm from N | 2006 | 2007 | In-Lake |
| 38 | 21FLCOT LLB02 | LLB02 | 2015 | 2022 | Upstream |
| 39 | 21FLCOT LLB03 | LLB03 | 2015 | 2022 | Upstream |
| 41 | 21FLCOT PINEY Z 1 | PINEY Z 1 | 2007 | 2022 | In-Lake |
| 42 | 21FLCOT PINEY Z 2 | PINEY Z 2 | 2007 | 2022 | In-Lake |
| 43 | 21FLCOT PINEY Z 3 | PINEY Z 3 | 2007 | 2022 | In-Lake |
| 44 | 21FLCOT PINEY Z 4 | PINEY Z 4 | 2007 | 2022 | In-Lake |
| 45 | FLCOT UPPER LAKE LAFAYET | Upper Lake Lafayette | 2019 | 2022 | In-Lake |
| 47 | 21FLGW 46206 | Z1-SS-8014 UNKNOWN | 2014 | 2014 | Upstream |
| 48 | 21FLGW 40120 | Z1-LL-5001 PINEY Z LAKE | 2011 | 2011 | In-Lake |
| 49 | 21FLGW 40963 | Z1-LL-5001R PINEY Z LAKE | 2011 | 2011 | In-Lake |
| 50 | 21FLGW 44484 | Z1-SL-7012 LITTLE ROBERTS POND | 2013 | 2013 | Upstream |
| 51 | 21FLGW 50028 | Z1-SL-10033 UNKNOWN | 2016 | 2016 | Upstream |
| 52 | 21FLGW 7093 | NWA-SL-1027 LAKE LAFAYETTE | 2000 | 2000 | In-Lake |
| 53 | 21FLGW 47864 | Z1-SS-9016 UNKNOWN | 2015 | 2015 | Upstream |
| 54 | 21FLGW 48192 | Z1-SL-9030 LITTLE ROBERTS POND | 2015 | 2015 | Upstream |
| 55 | 21FLGW 8705 | NWA-SL-1034 UNKNOWN | 2000 | 2000 | Upstream |
| 56 | 21FLKWATLEO-ALFORDAR-1 | LEO-ALFORDAR-1 | 1999 | 2000 | In-Lake |
| 57 | 21FLKWATLEO-ALFORDAR-2 | LEO-ALFORDAR-2 | 1999 | 2000 | In-Lake |
| 58 | 21FLKWATLEO-ALFORDAR-3 | LEO-ALFORDAR-3 | 1999 | 2000 | In-Lake |
| 59 | 21FLKWATLEO-PINEYZ-1 | LEO-PINEYZ-1 | 1999 | 2003 | In-Lake |
| 60 | 21FLKWATLEO-PINEYZ-2 | LEO-PINEYZ-2 | 1999 | 2003 | In-Lake |
| 61 | 21FLKWATLEO-PINEYZ-3 | LEO-PINEYZ-3 | 1999 | 2003 | In-Lake |
| 62 | 21FLLEONLCL13043484173 | Windham Hills | 2006 | 2007 | In-Lake |
| 63 | 21FLLEONLCL213043484139 | Chairs | 2006 | 2007 | In-Lake |
| 64 | 21FLLEONLCL263044384148 | Lower Alford's Arm | 2006 | 2009 | In-Lake |
| 65 | 21FLLEONLCL273045084160 | Mid Alford's Arm | 2007 | 2007 | In-Lake |
| 66 | 21FLLEONLCL303044684155 | Alford Arm across from Greenway Ramp | 2009 | 2010 | In-Lake |
| 67 | 21FLLEONLCLL3042084133 | Unnamed Creek 2 @ 27 West | 2007 | 2007 | Upstream |
| 68 | 21FLLEONLCLL3042184165 | Unnamed Creek 3 @ 27 West | 2007 | 2021 | Upstream |
| 69 | 21FLLEONLCLL3043184118 | Unnamed Creek @ Chaires Road | 2007 | 2021 | In-Lake |
| 70 | 21FLLEONLCLL3045384231 | Park Ave/Violet Trib | 2004 | 2007 | Upstream |
| 71 | 21FLLEONLCLL3045684222 | NE Ditch/Weems Rd | 2004 | 2021 | Upstream |
| 72 | 21FLLEONLCLL3046384171 | Lower Lake Lafayette, Alford Arm @ Bucklake | 2007 | 2019 | Upstream |
| 73 | 21FLLEONLCLL3046484239 | NE Ditch at Mice RD | 2004 | 2005 | Upstream |
| 74 | 21FLLEONLCLL3048484210 | Lafayette Crk at RR | 2004 | 2021 | Upstream |
| 75 | 21FLLEONLCLLL1030118411 | Lower Lake Lafayette near Road to the Lakes Landing | 2009 | 2019 | In-Lake |
| 76 | 21FLLEONLCLLL1230438415 | Lower Lake Lafayette South Side | 2013 | 2016 | In-Lake |
| 77 | 21FLLEONLCPZ3043884186 | Lake Piney-Z, South of berm | 2007 | 2008 | In-Lake |
| 78 | 21FLLEONLCPZ3044284183 | Lake Piney-Z, North of berm | 2007 | 2008 | In-Lake |
| 79 | 21FLLEONLCUL3045584203 | Lafayette Sinkhole | 2006 | 2021 | In-Lake |
| 81 | 21FLLEONLLL23043684169 | Lower Lake Lafayette 2 | 2008 | 2019 | In-Lake |
| 82 | 21FLLEONLLL33043384153 | Lower Lake Lafayette 3 | 2008 | 2016 | In-Lake |
| 83 | 21FLLEONLLL43042784133 | Lower Lake Lafayette 4 | 2009 | 2009 | In-Lake |
| 84 | 21FLLEONLLLCULVERT3084 | Lower Lake Lafayette @ Culvert | 2014 | 2016 | In-Lake |
| 85 | 21FLLEONLPZ33044084186 | Lake Piney-Z, Center of Lake | 2007 | 2021 | In-Lake |
| 86 | 21FLMCGLL00A | Weems Pond - outflow | 1999 | 2000 | Upstream |
| 87 | 21FLMCGLL00B | Weems Pond - inflow | 1999 | 2000 | Upstream |
| 88 | 21FLMCGLL00C | Weems Pond - outflow from Lake Piney Z to Upper Lake Lafayette | 1999 | 2000 | In-Lake |
| 89 | 21FLMCGLL00D | Lafayette Creek and Tom Brown Park | 1999 | 2000 | Upstream |
| 90 | 21FLMCGLL02 | Upper Lake Lafayette, Lafayette Sink (sinkhole) | 1991 | 2006 | In-Lake |
| 91 | 21FLMCGLL02A | Upper Lake Lafayette, Lafayette Sink | 1999 | 2000 | In-Lake |
| 92 | 21FLMCGLL03 | Piney Z, northern Lake | 2001 | 2001 | In-Lake |
| 93 | 21FLMCGLL05 | Lake Piney Z | 1991 | 1999 | In-Lake |
| 94 | 21FLMCGLL07 | Lake Piney Z | 1991 | 1999 | In-Lake |
| 95 | 21FLMCGLL09 | Lake Piney Z | 1991 | 1997 | In-Lake |
| 96 | 21FLMCGLL11 | Lake Piney Z | 1991 | 1998 | In-Lake |
| 97 | 21FLMCGLL15 | Lower Lake Lafayette, Windham Hills | 1991 | 2006 | In-Lake |
| 98 | 21FLMCGLL20 | Lower Lake Lafayette, Leon County Landfill | 1991 | 2006 | In-Lake |
| 99 | 21FLMCGLL21 | Lower Lake Lafayette, Chaires | 1991 | 2006 | In-Lake |
| 100 | 21FLMCGLL22 | Lower Lake Lafayette, Tallgum STP | 1991 | 2006 | In-Lake |
| 101 | 21FLMCGLL24 | Lower Lake Lafayette, Mosquito Canal to St. Marks River | 1991 | 1996 | In-Lake |
| 102 | 21FLMCGLL25 | Lower Lake Lafayette, on RR at Chaires | 1991 | 2006 | In-Lake |
| 103 | 21FLMCGLL26 | Alford Arm | 2003 | 2006 | In-Lake |
| 104 | 21FLMCGLL27 | Alford Arm | 2003 | 2004 | In-Lake |
| 105 | 21FLMCGLL28 | Lower Lake Lafayette, Alford Arm | 2003 | 2006 | Upstream |
| 106 | 21FLMCGLL00E | McCord Pond | 1999 | 2000 | Upstream |
| 107 | 21FLMCGLPZ1 | Piney Z, southern Lake | 2001 | 2006 | In-Lake |
| 108 | 21FLNWFD3023600409601 | HWY 27 AT RAYMOND TUCKER ROAD | 1988 | 1989 | Upstream |
| 109 | 21FLNWFD3026260841301 | Lake Lafayette @ Piney Z Lake | 1992 | 1992 | In-Lake |
| 110 | 21FLNWFD302629084144100 | PARK AVENUE 1 MI. WEST OF STATE HWY 261 | 1989 | 1989 | Upstream |
| 111 | 21FLNWFD302709084132100 | WEEMS ROAD NEAR HWY 90 | 1989 | 1989 | Upstream |
| 112 | 21FLNWFD302747084101501 | BUCK LAKE ROAD | 1989 | 1989 | Upstream |
| 113 | 21FLNWFD302730084143400 | RIGGINS RD AT MICCOSUKEE RD AND DOGMAN DRIVE | 1988 | 1988 | Upstream |
| 114 | 21FLNWFD302800084150000 | CENTERVILLE ROAD AT TARPON DRIVE | 1987 | 1989 | Upstream |
| 115 | 21FLNWFD302820084141200 | CENTERVILLE ROAD AT CAPITAL CIRCLE | 1989 | 1989 | Upstream |
| 116 | 21FLNWFD302905084141601 | MICCOSUKEE ROAD AT I-10 | 1987 | 1989 | Upstream |
| 117 | 21FLNWFD302902084141700 | HADLEY ROAD NEAR RAYMOND DIEHL ROAD | 1988 | 1988 | Upstream |
| 118 | 21FLNWFDS369 | Lake Lafayette | 1992 | 1992 | In-Lake |
| 122 | 21FLPNS 22030094 | Park Ave. Ditch at Fort Knox Bridge | 2011 | 2011 | Upstream |
| 124 | 21FLPNS 302654084142877 | Mall Drainage Ditch @ Victory Garden Dr. (also 21FLWQA) | 2012 | 2012 | Upstream |
| 125 | 21FLPNS 302719084132100 | NE Drainage Ditch at Weems Rd (also 21FLNWFD) | 2006 | 2006 | Upstream |
| 126 | 21FLPNS 302750084142400 | Drainage @ Riggins Road (also 21FLNWFD) | 2006 | 2006 | Upstream |
| 127 | 21FLPNS 304012084141700 | NE Drainage Ditch at Hadley Road (also 21FLNWFD) | 2006 | 2006 | Upstream |
| 128 | 21FLTLHRG/TLHR0049 | MT SINAI SLOUGH @ WEEPING WILLOW WAY | 2017 | 2019 | Upstream |
| 129 | 21FLTLHRG/TLHR0036 | Mt Sinai Slough @ Weeping Willow Way | 2017 | 2017 | Upstream |
| 130 | 21FLTLHRG/TLHR0104 | Mt Sinai Slough @ E Windwood Way | 2019 | 2019 | Upstream |
| 131 | 21FLWQA 302517084094554 | Trib at US 27 (combined) 3 ... east Capital Circle | 2006 | 2006 | Upstream |
| 132 | 21FLWQA 302602084101137 | Lower Lake Lafayette at end of road to the lake | 2006 | 2006 | In-Lake |
| 133 | 21FLWQA 302615084101033 | Lower Lake Lafayette at culvert | 2005 | 2005 | In-Lake |
| 134 | 21FLWQA 302627084112999 | Piney Z Lake SW end at wood dock near FWC gage | 2006 | 2006 | In-Lake |
| 135 | 21FLWQA 302640084111339 | Upper Lake Lafayette at RR bridge | 2006 | 2006 | In-Lake |
| 136 | 21FLWQA 302706084113500 | Park Ave Ditch D/S RR near Violet and Lupine St | 2006 | 2006 | Upstream |
| 137 | 21FLWQA 302712084113213 | Upper Lake Lafayette at N sinkhole (WAS gage) | 2005 | 2005 | In-Lake |
| 138 | 21FLWQA 302719084113203 | NE Drainage Ditch at Weems Rd | 2005 | 2006 | Upstream |
| 139 | 21FLWQA 302733084113330 | NE Drainage Ditch at Mahan Dr | 2006 | 2006 | Upstream |
| 140 | 21FLWQA 302748084105159 | Alford Arm Trib at Buck Lake Rd | 2006 | 2006 | Upstream |
| 141 | 21FLWQA 302806084135037 | McCord Park Ditch at Centerville Rd | 2006 | 2006 | Upstream |
| 142 | 21FLWQA 302834084141722 | NE Drainage Ditch at Capital Circle | 2006 | 2006 | Upstream |
| 143 | 21FLWQA 302839084095116 | Alford Arm Trib at US 90 | 2006 | 2006 | Upstream |
| 144 | 21FLWQA 302910084100166 | Alford Arm Trib at Miccosukee Rd | 2006 | 2006 | Upstream |
| 145 | 21FLWQA 303023084144484 | NE Drainage Ditch at Delaney Dr | 2006 | 2006 | Upstream |
| 146 | 21FLWQSPLEO1131US | Lafayette Crk 150 m u/s of Hwy 90 (WBID 756) | 2005 | 2005 | Upstream |
| 147 | 21FLWQSPLEO1161UL | Piney Lake SE of boat ramp (WBID 756B) | 2005 | 2005 | In-Lake |
| 148 | 21FLWQSPLEO2LAF1 | LEO2LAF1 | 2022 | 2022 | In-Lake |
| 149 | 21FLWQA G1WA0007 | Lake Lafayette Drain 250 meters downstream of Weems Rd | 2013 | 2017 | Upstream |
| 150 | 21FLWQA G1WA0013 | Lake Lafayette Drain At Chaires Cross Rd | 2016 | 2016 | Upstream |
| 151 | 21FLWQA G1WA0017 | Alford Arm Tributary at Buck Lake Rd | 2016 | 2017 | Upstream |
| 152 | 21FLWQA G1WA0066 | Alford Arm Tributary At Miccosukee Rd | 2018 | 2018 | Upstream |
| 153 | 21FLWQSP 22030127 | Lake Piney Z | 2007 | 2009 | In-Lake |




CITY OF TALLAHASSEE

N

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Miles

**Legend**

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

Water Quality Stations

Position

- In-Lake
- Upstream of Lake

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

**Figure 5-10:**
**Lafayette Chain of Lakes Water Quality Station Location Map**

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

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**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**).

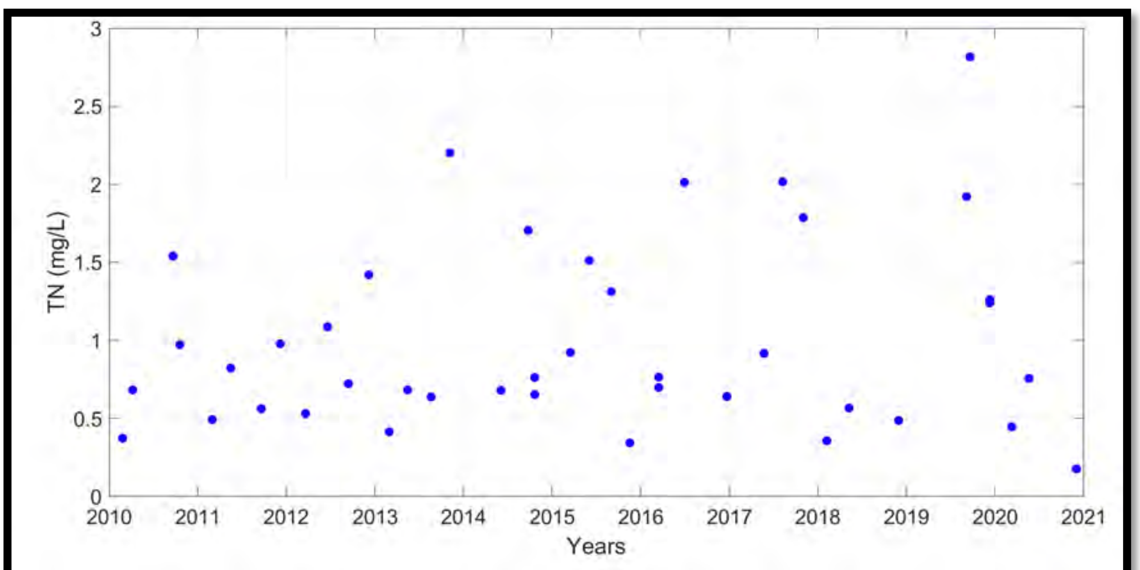


**Figure 5-11: Plot of Measured TN Concentrations in Upper Lake Lafayette (2010 to 2020)**

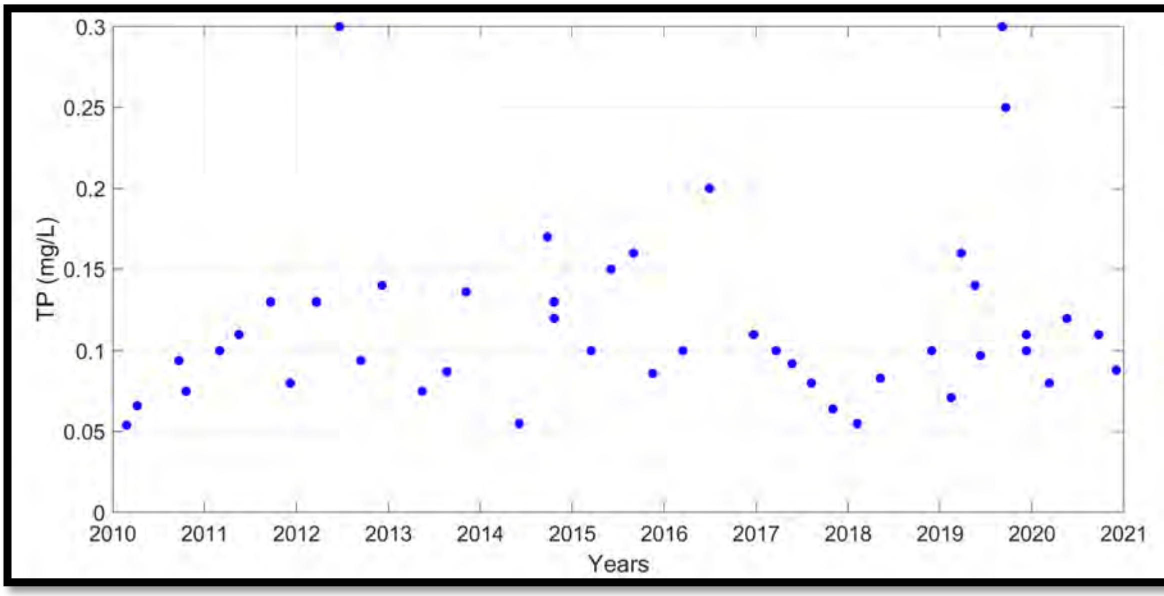


**Figure 5-12: Plot of Measured TP Concentrations in Upper Lake Lafayette (2010 to 2020)**

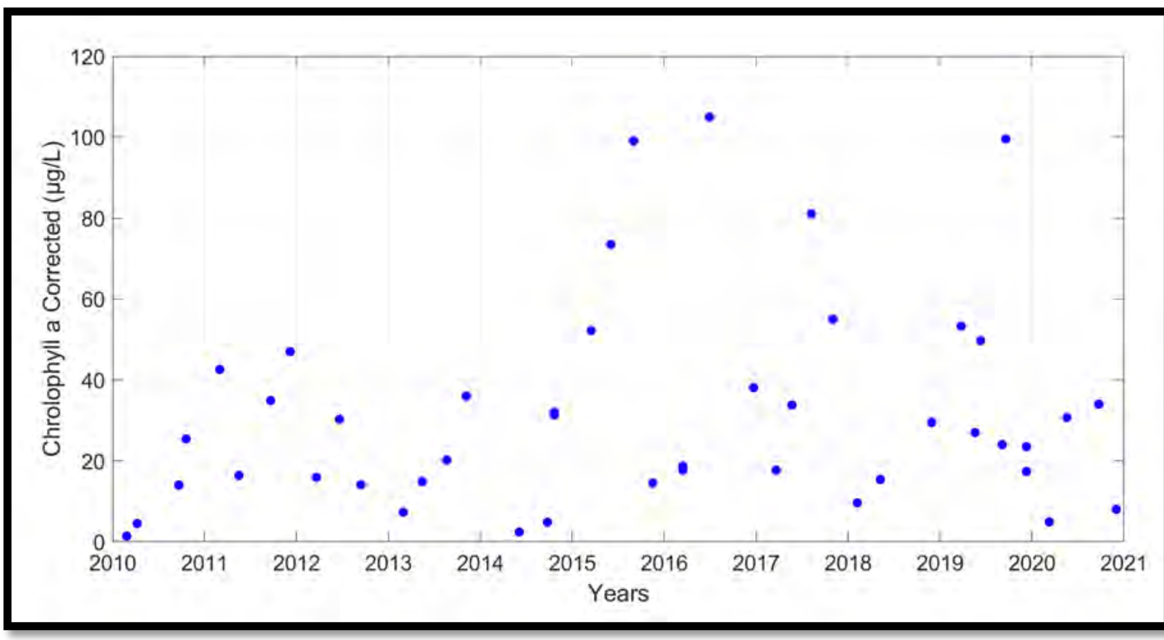


**Figure 5-13: Plot of Measured Chl-a Concentrations in Upper Lake Lafayette (2010 to 2020)**

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**).

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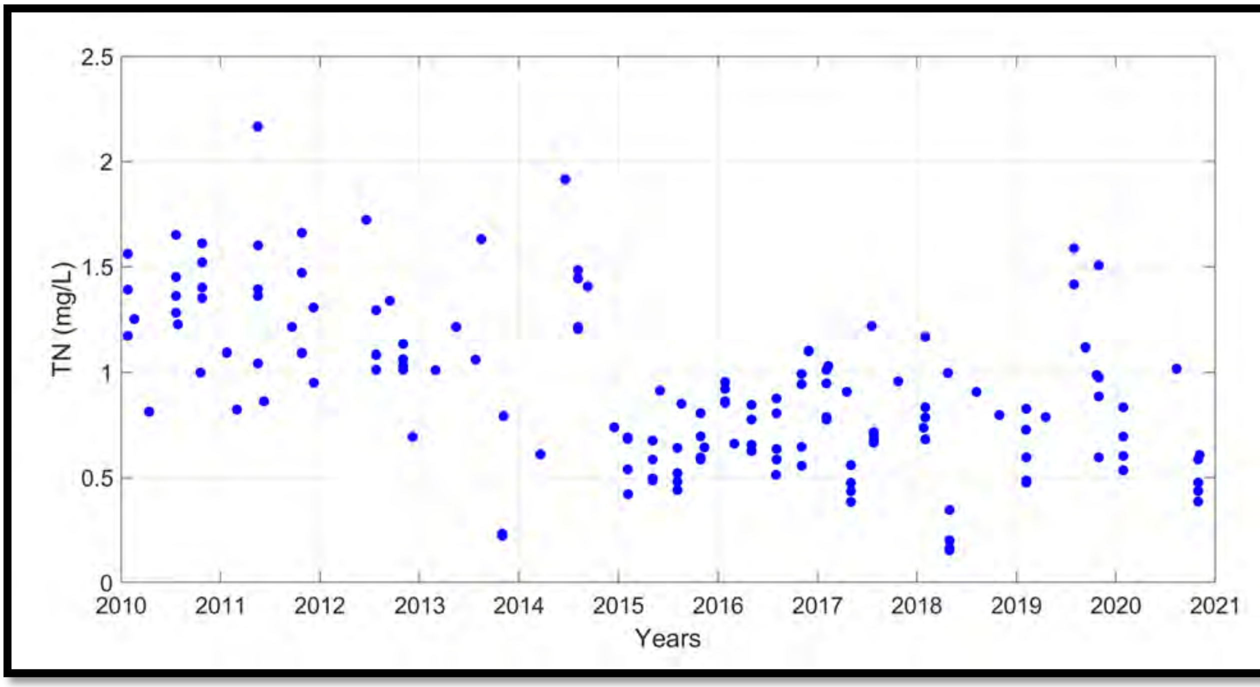



**Figure 5-14: Plot of Measured TN Concentrations in Piney Z Lake (2010 to 2020)**

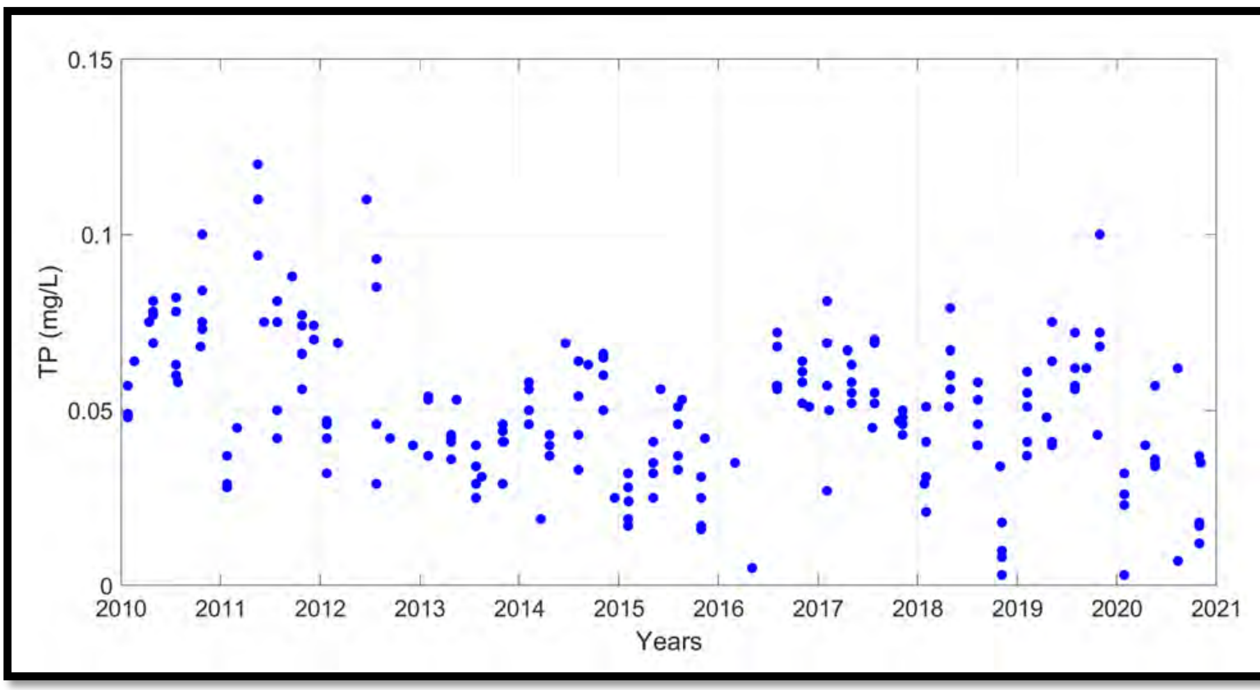



**Figure 5-15: Plot of Measured TP Concentrations in Piney Z Lake (2010 to 2020)**

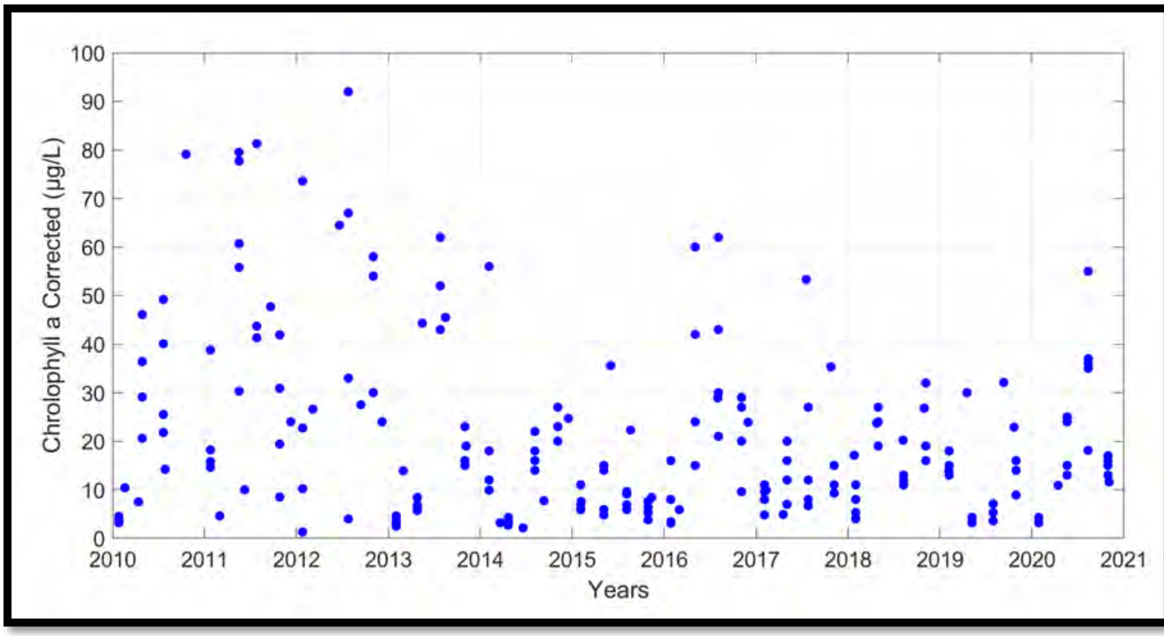



**Figure 5-16: Plot of Measured Chl-a Concentrations in Piney Z Lake (2010 to 2020)**

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**).

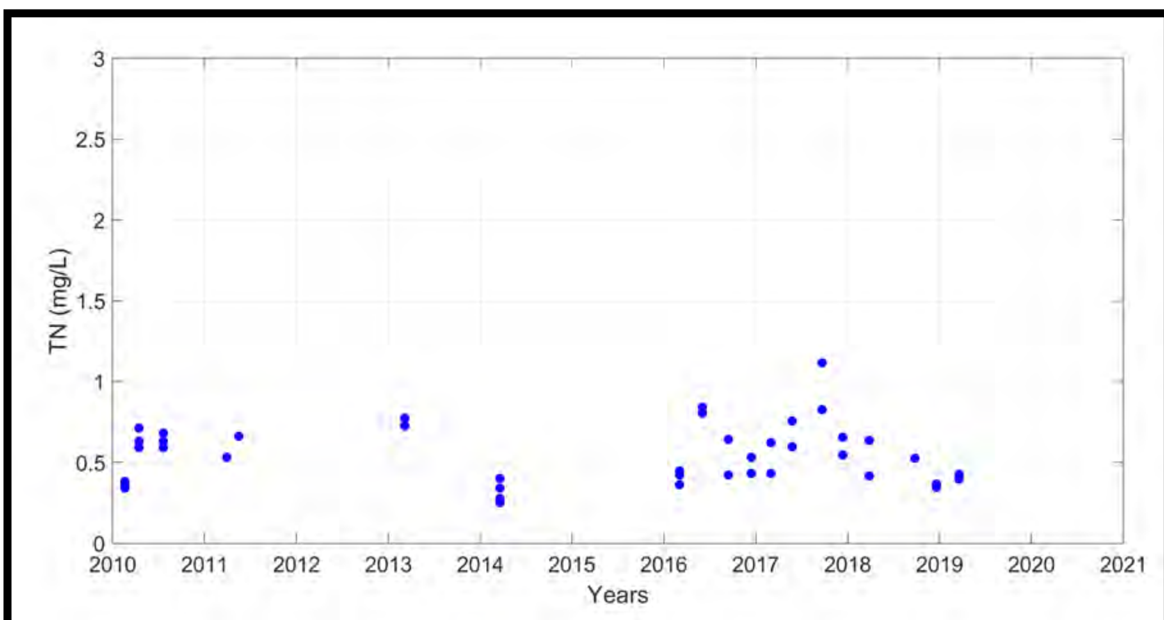



**Figure 5-17: Plot of Measured TN Concentrations in Lower Lake Lafayette (2010 to 2020)**

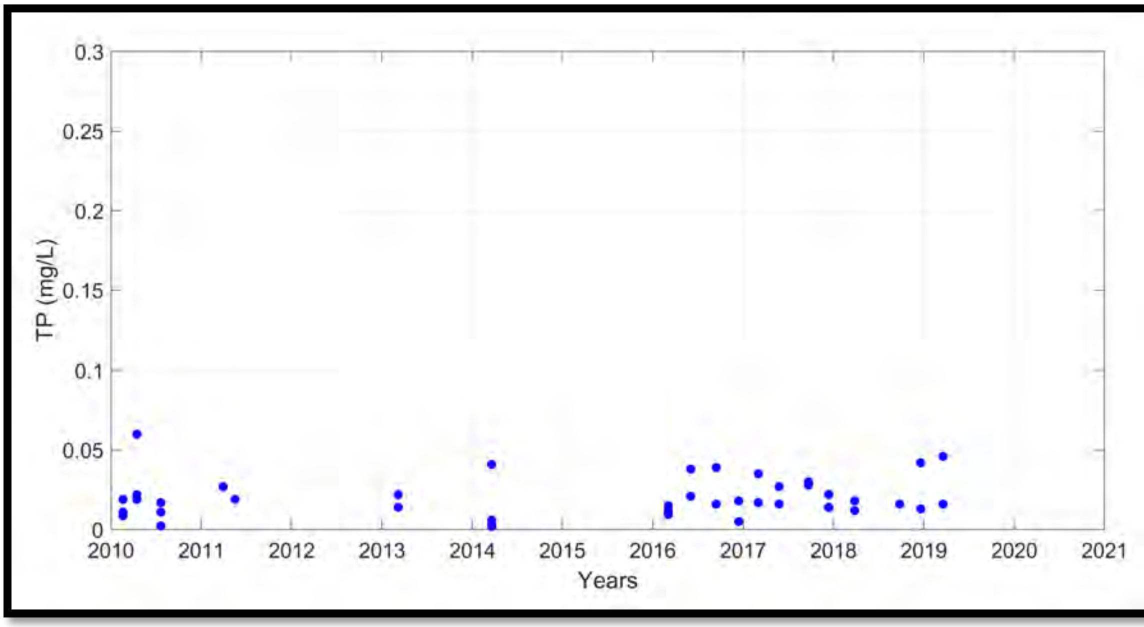



**Figure 5-18: Plot of Measured TP Concentrations in Lower Lake Lafayette (2010 to 2020)**

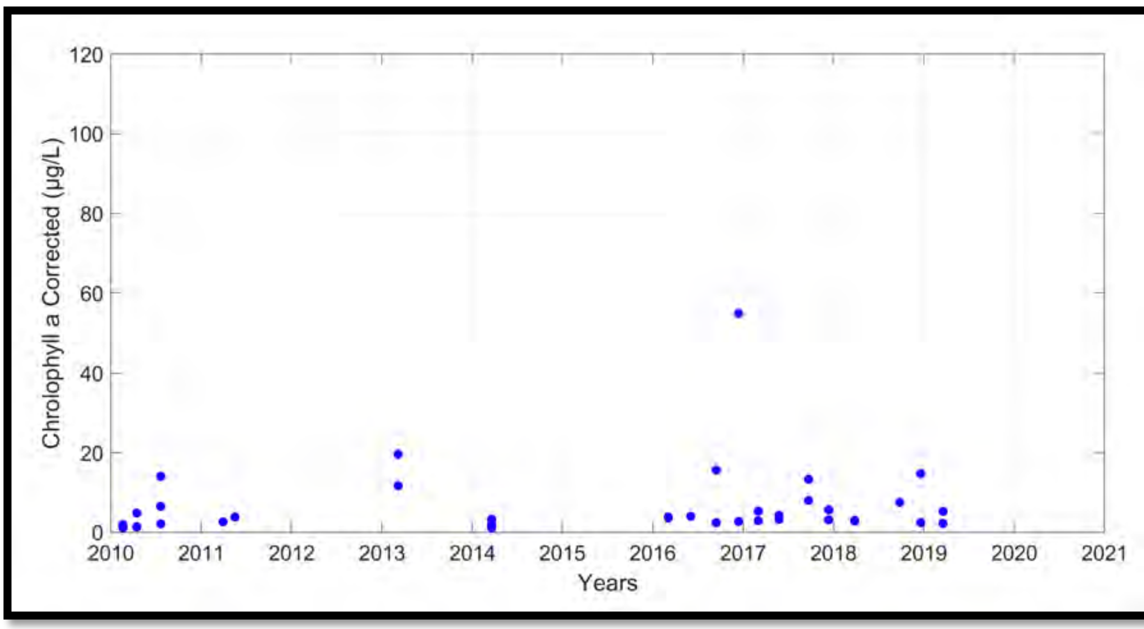



**Figure 5-19: Plot of Measured Chl-a Concentrations in Lower Lake Lafayette (2010 to 2020)**

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.

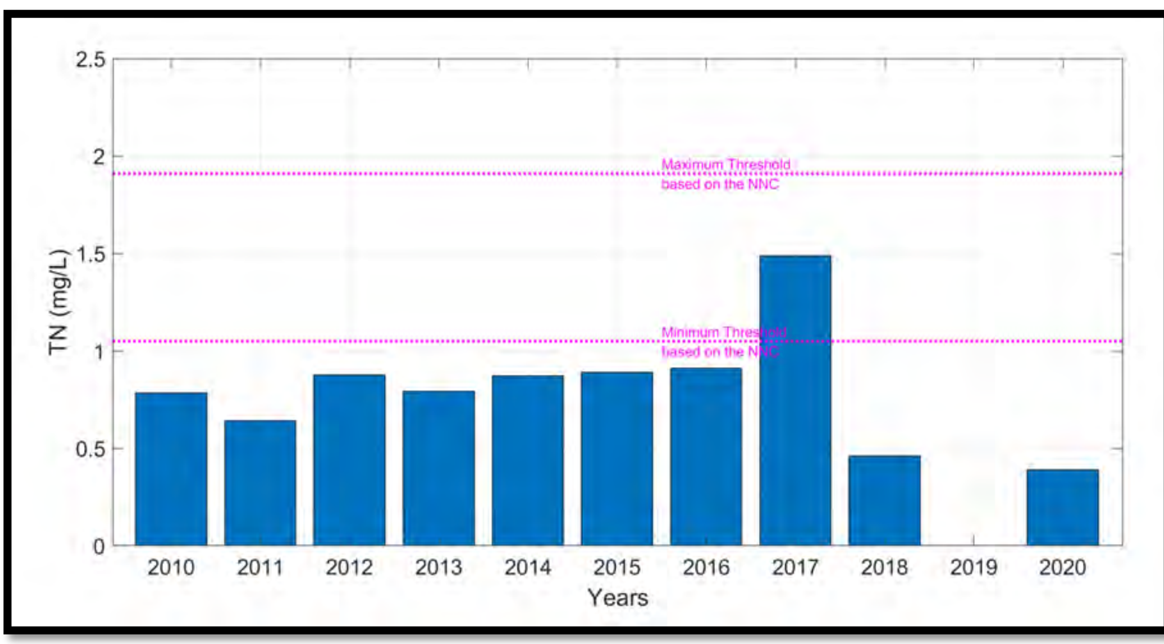



**Figure 5-20: Plot of AGM for TN with NNC Criteria for Upper Lake Lafayette**

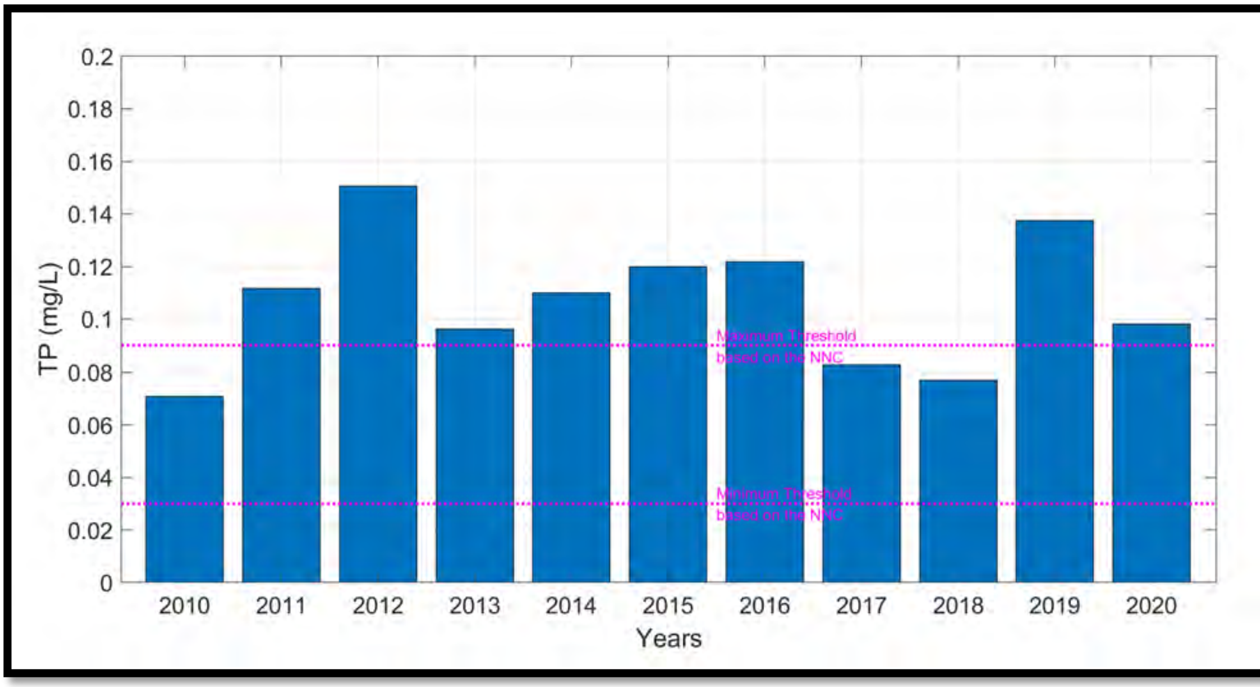



**Figure 5-21: Plot of AGM for TP with NNC Criteria for Upper Lake Lafayette**

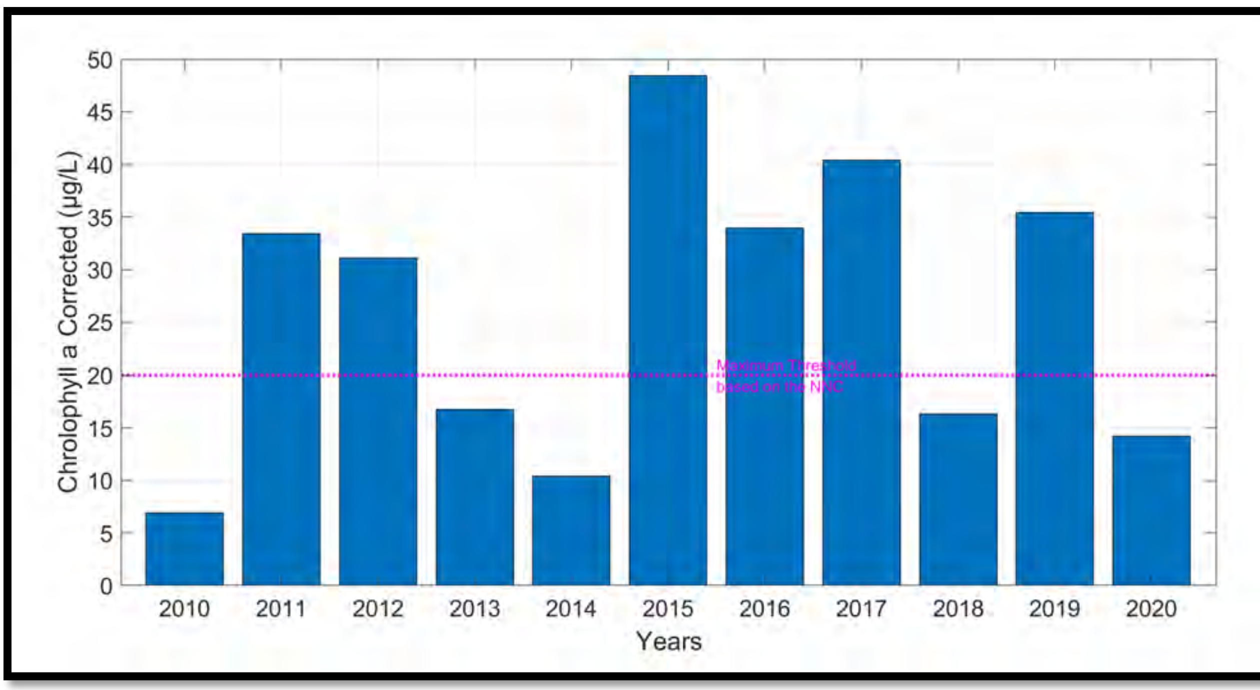



**Figure 5-22: Plot of AGM for Chl-a with NNC Criteria for Upper Lake Lafayette**

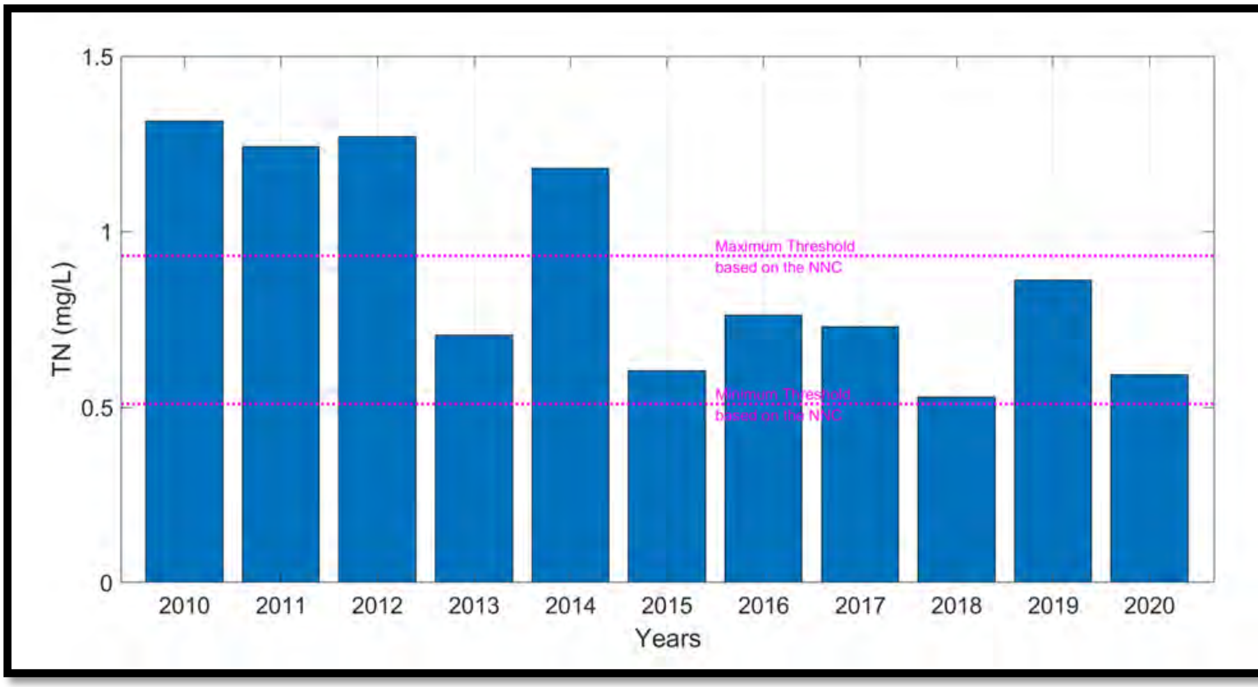



**Figure 5-23: Plot of AGM for TN with NNC Criteria for Piney Z Lake**

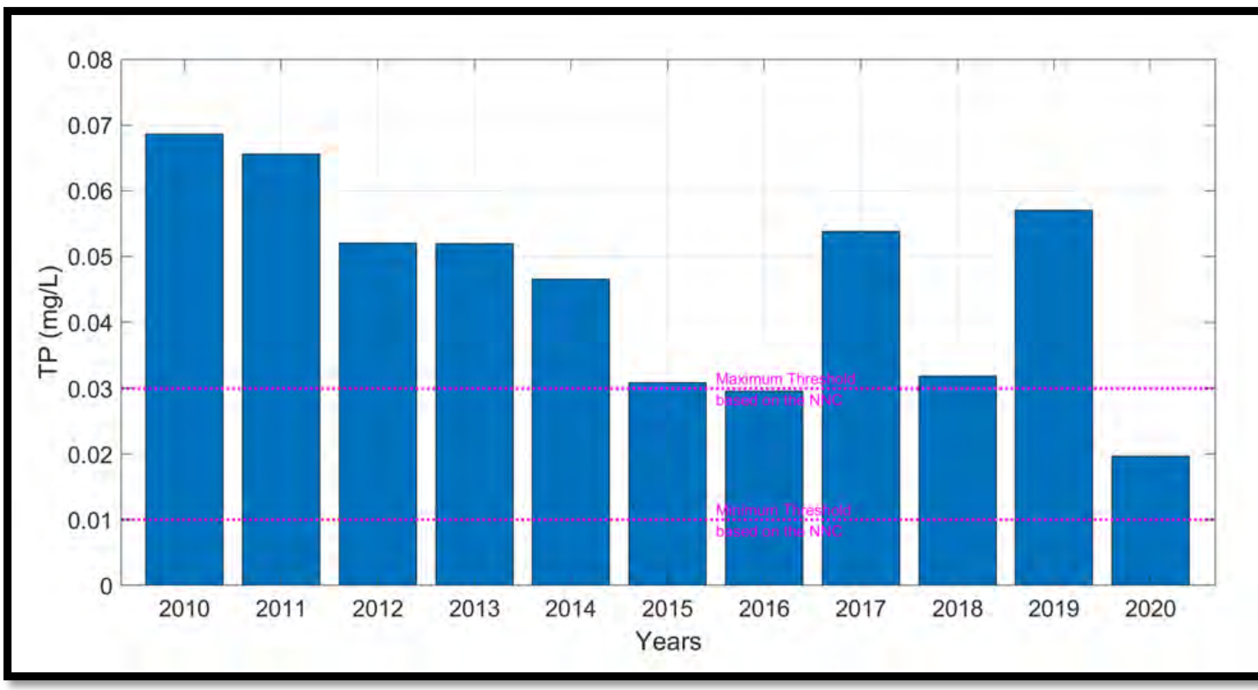



**Figure 5-24: Plot of AGM for TP with NNC Criteria for Piney Z Lake**

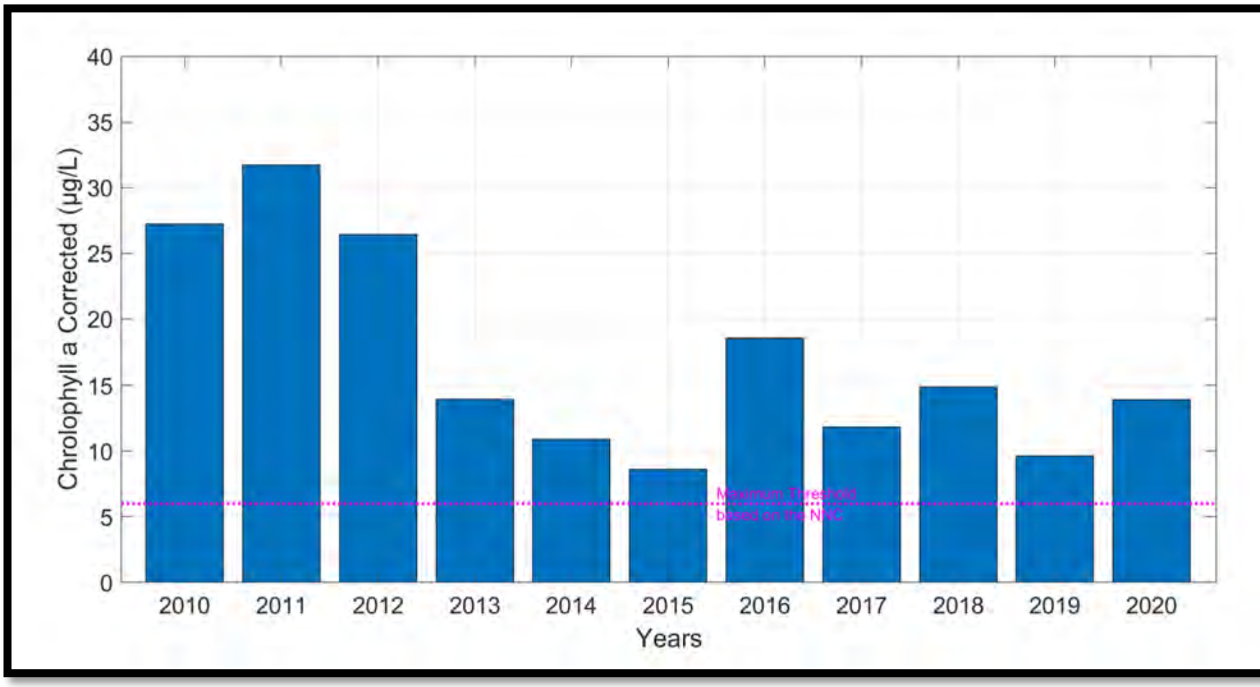



**Figure 5-25: Plot of AGM for Chl-a with NNC Criteria for Piney Z Lake**

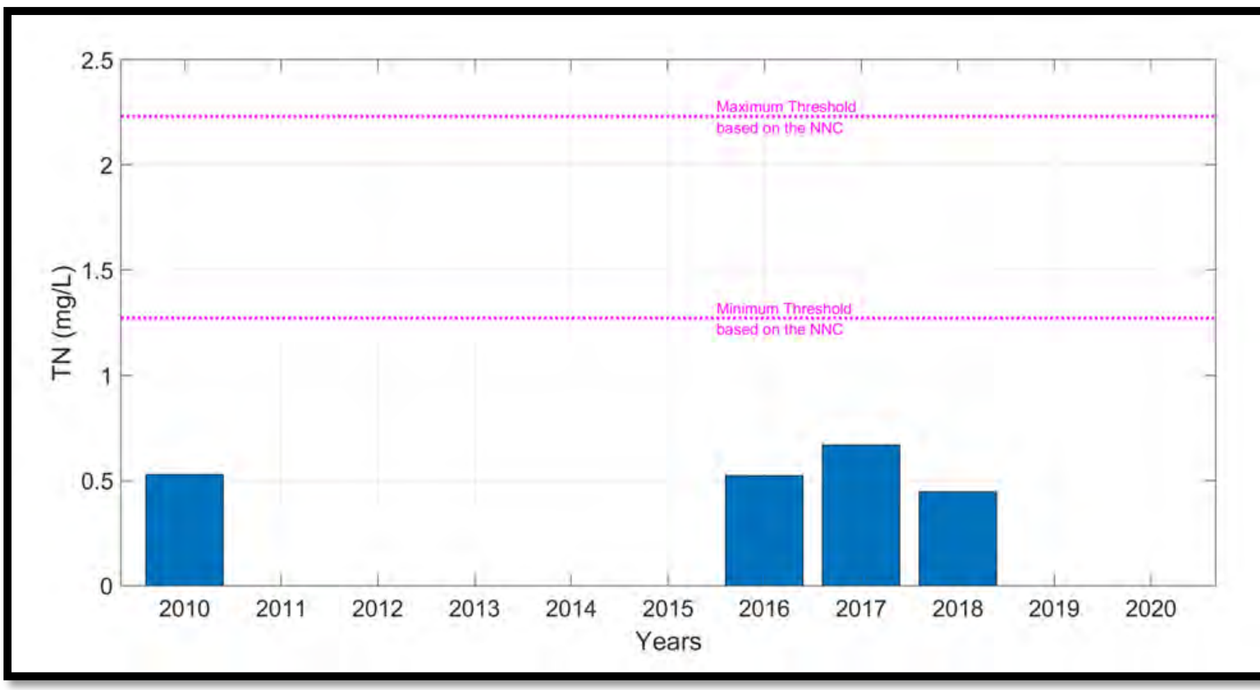



**Figure 5-26: Plot of AGM for TN with NNC Criteria for Lower Lake Lafayette**

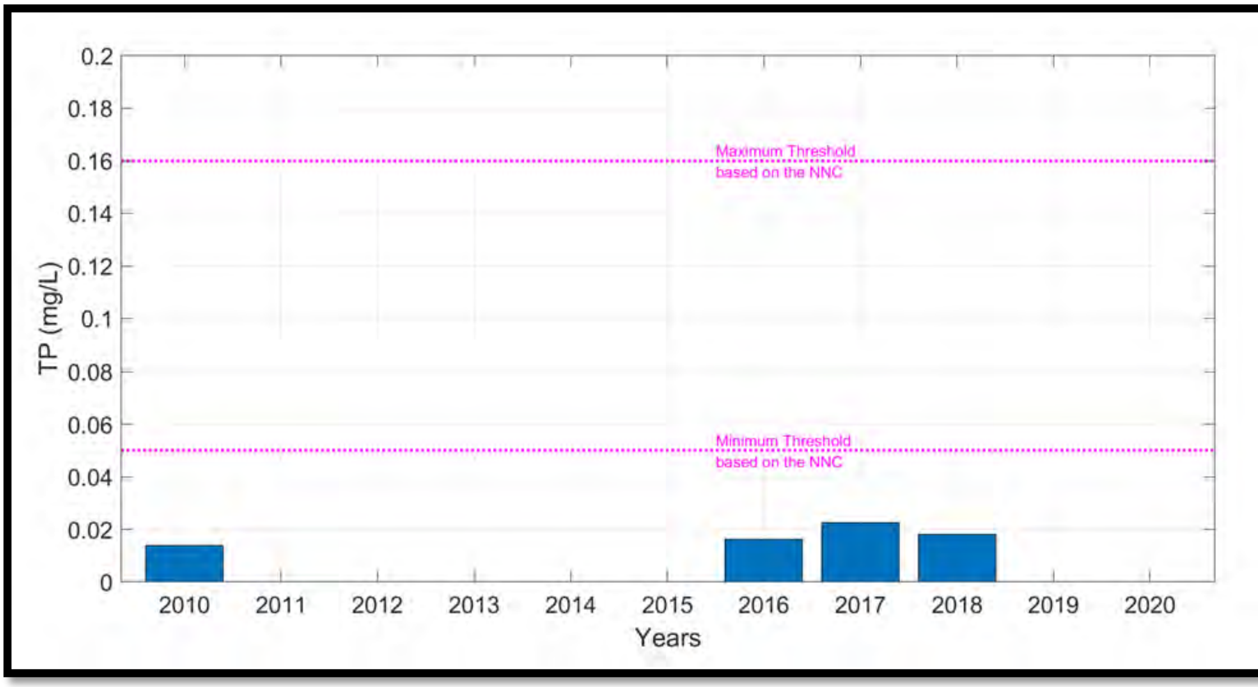



**Figure 5-27: Plot of AGM for TP with NNC Criteria for Lower Lake Lafayette**

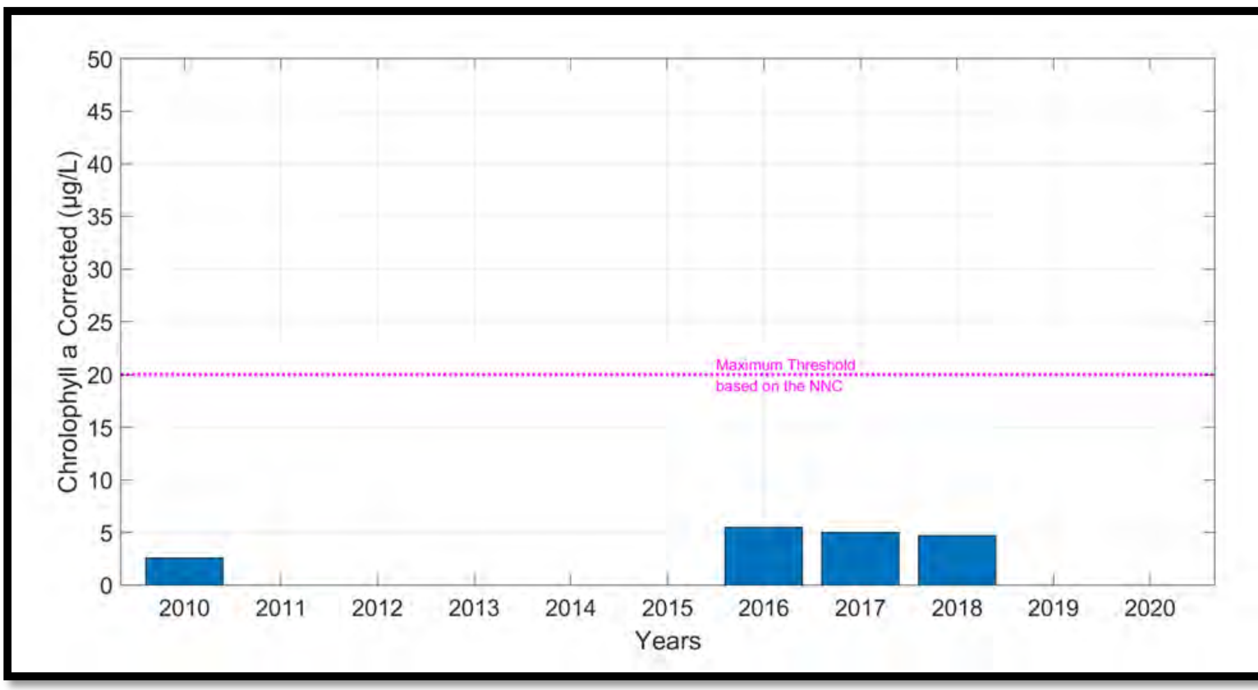



**Figure 5-28: Plot of AGM for Chl-a with NNC Criteria for Lower Lake Lafayette**

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.

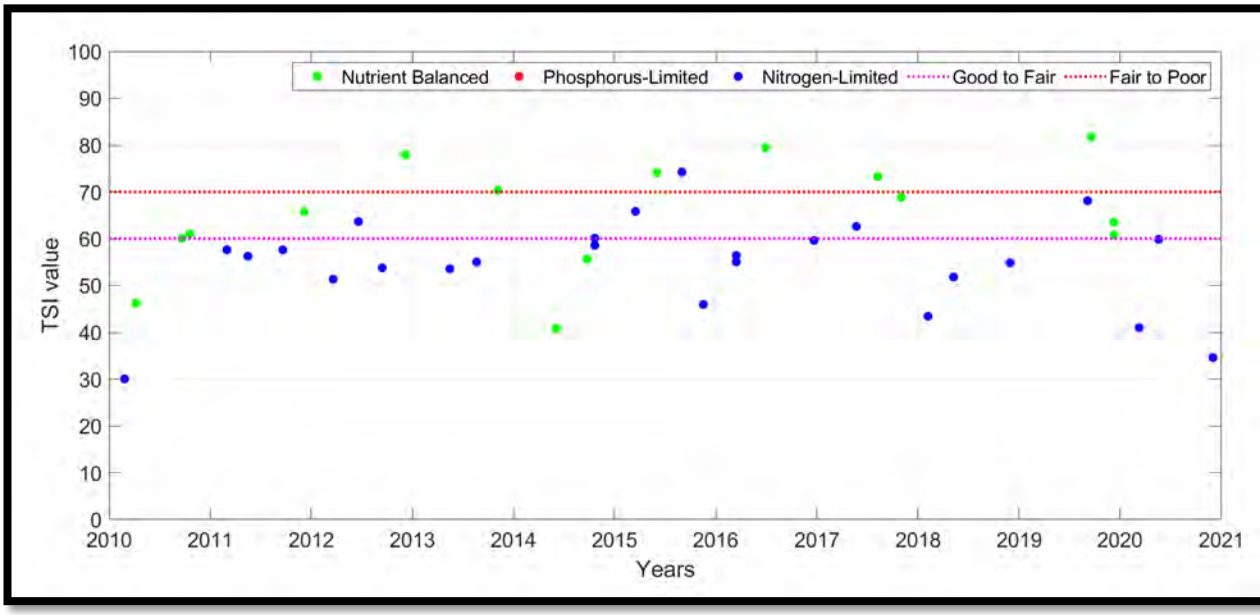



**Figure 5-29: Plot of TSI for Upper Lake Lafayette**

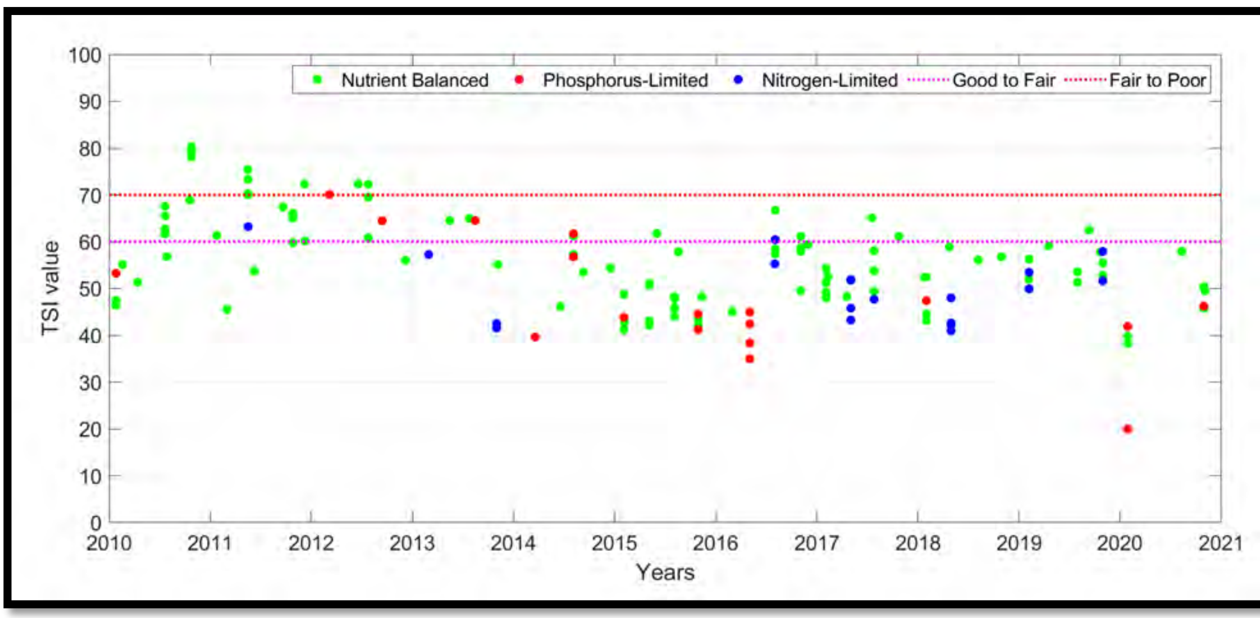



**Figure 5-30: Plot of TSI for Piney Z Lake**

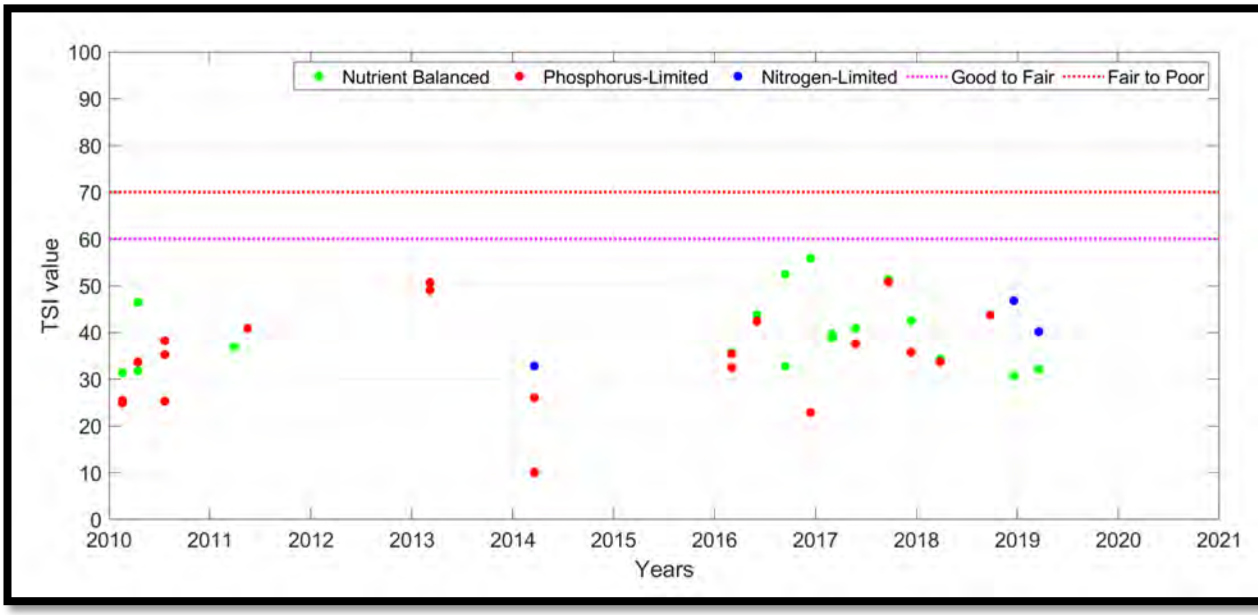



**Figure 5-31: Plot of TSI for Lower Lake Lafayette**

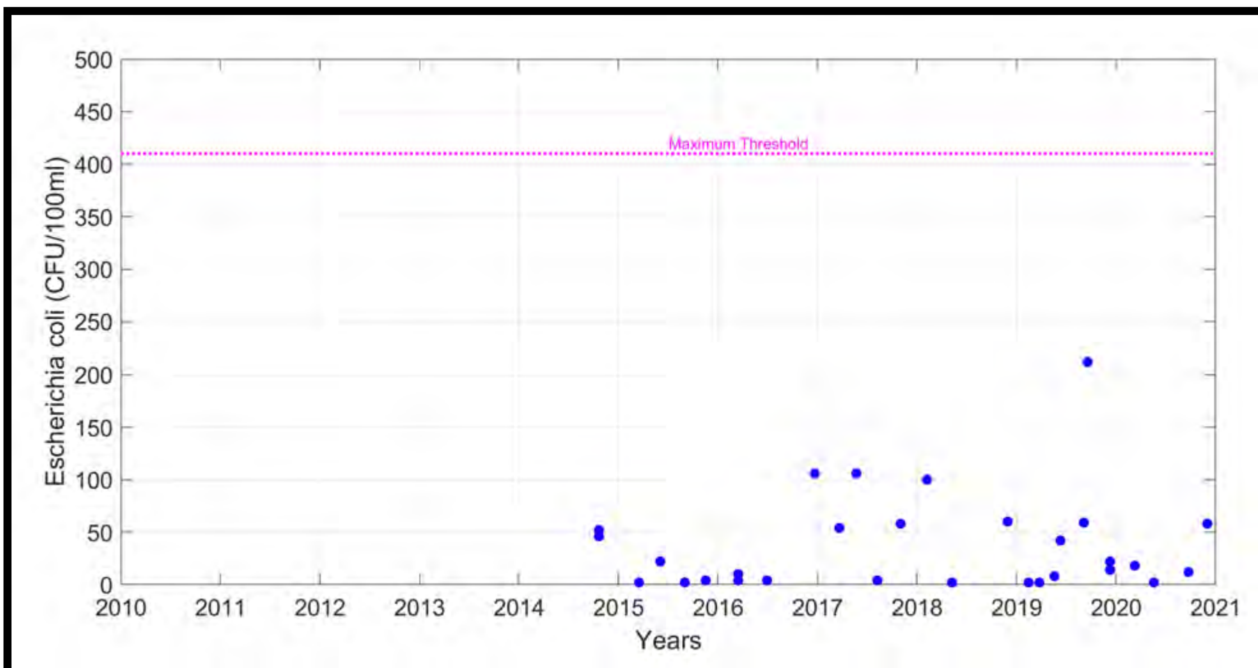



**Figure 5-32: Plot of *E. coli* for Upper Lake Lafayette**

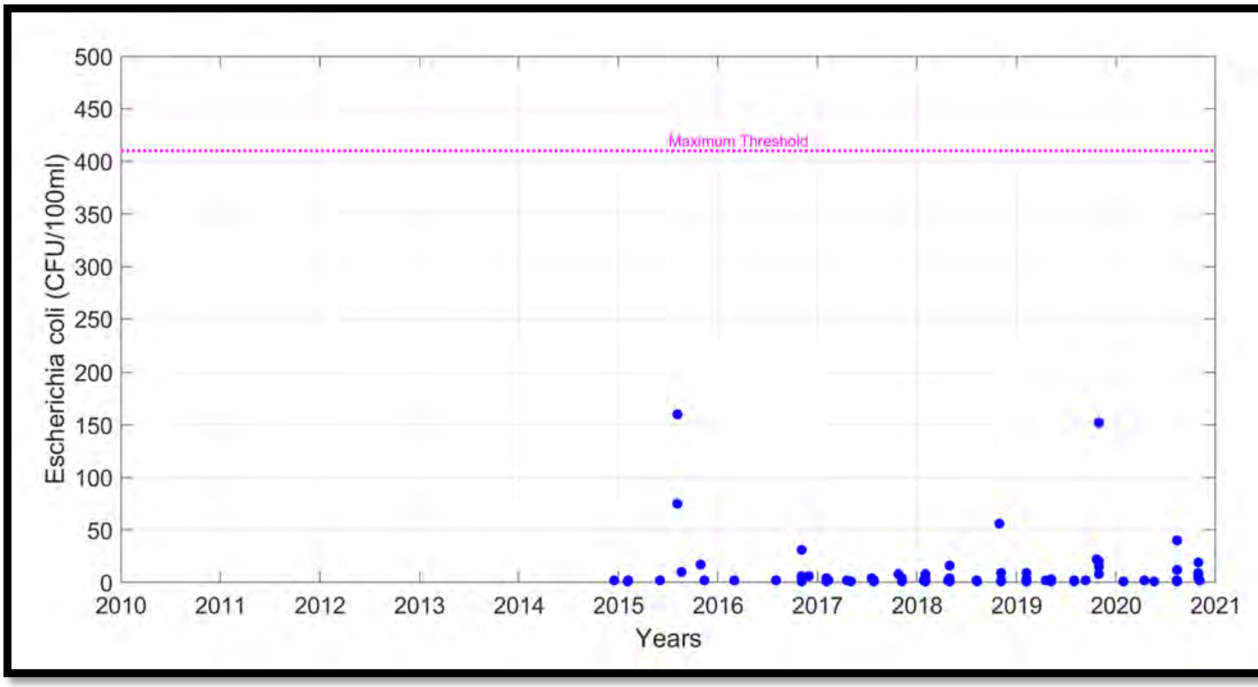



**Figure 5-33: Plot of *E. coli* for Piney Z Lake**

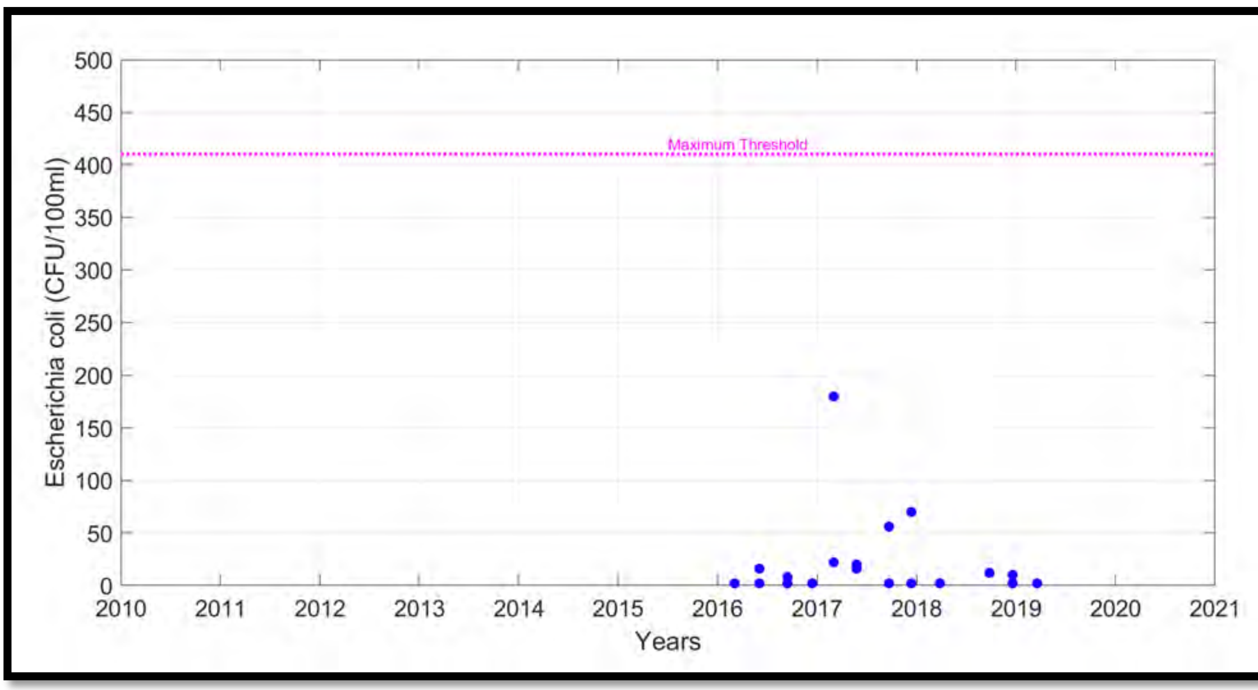



**Figure 5-34: Plot of *E. coli* for Lower Lake Lafayette**

#### 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).

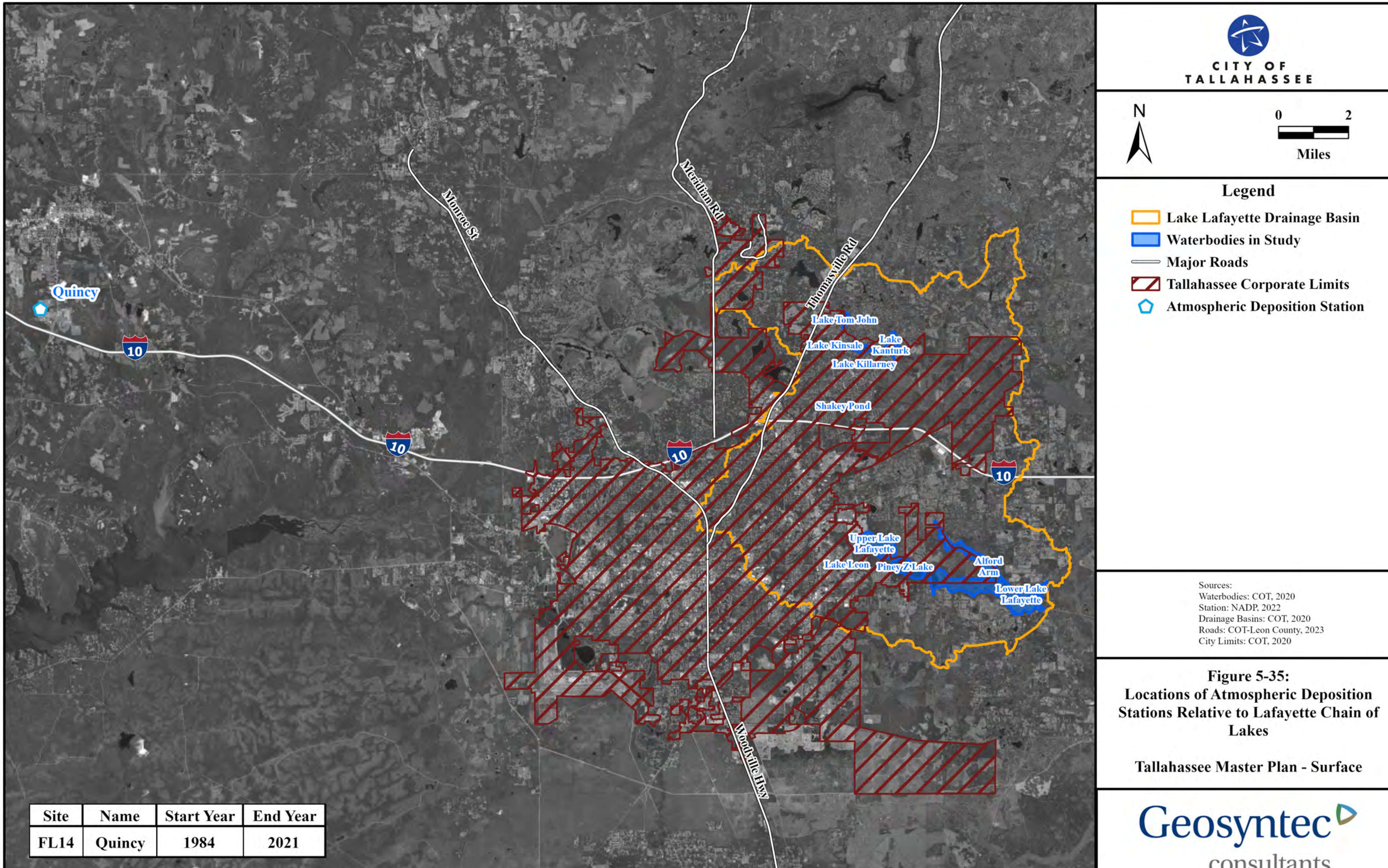
#### 5.4.3.11 Atmospheric Deposition Data

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 |

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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**

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### 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).

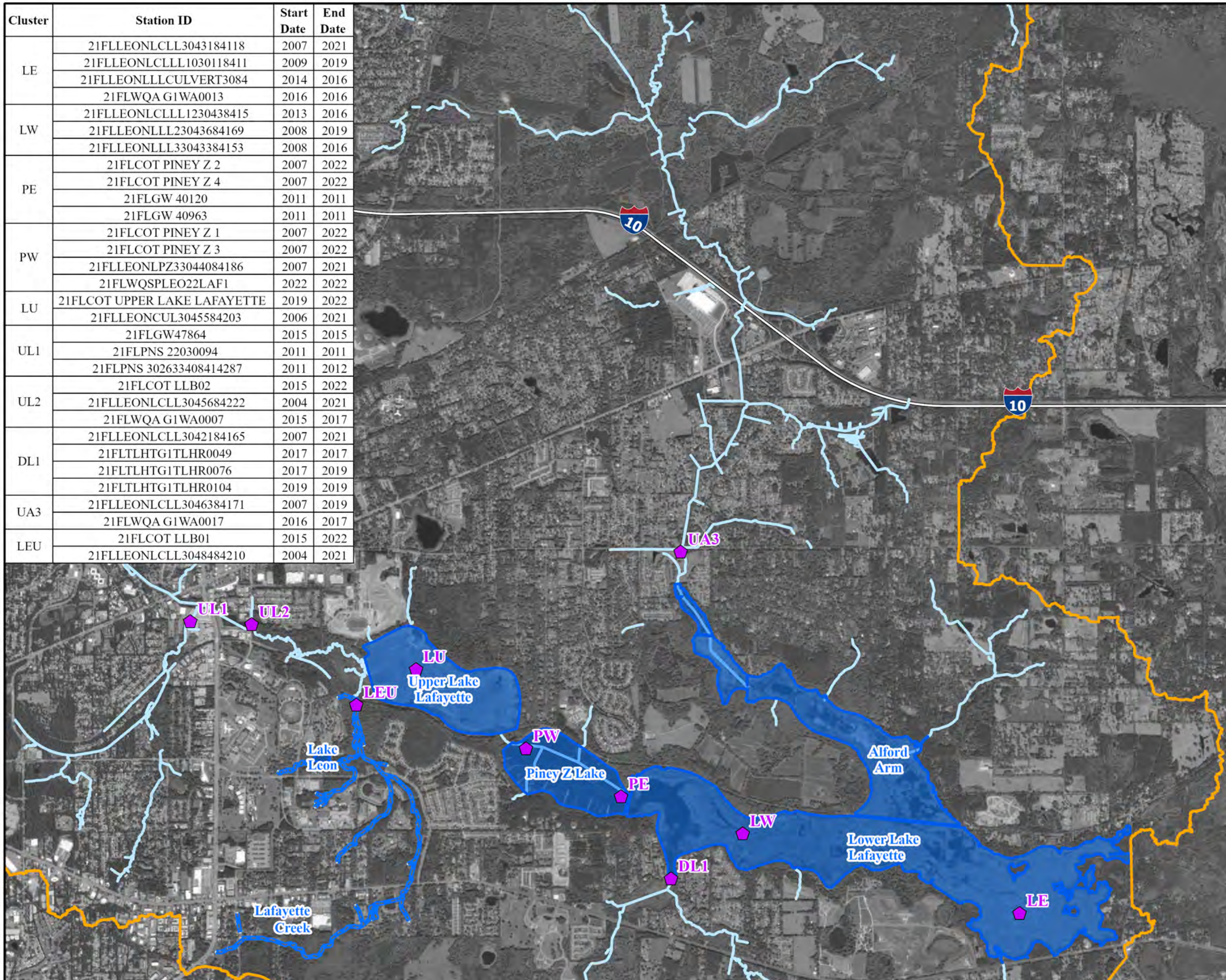
The spatial analyses were only performed using data after 2010 to represent recent conditions. Any station that had data after 2010 was assigned one of the cluster locations and a collective data set developed for that cluster. As such, all data available within the waterbodies and tributaries after 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 90$^{th}$ 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 | 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 |
| 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

N

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

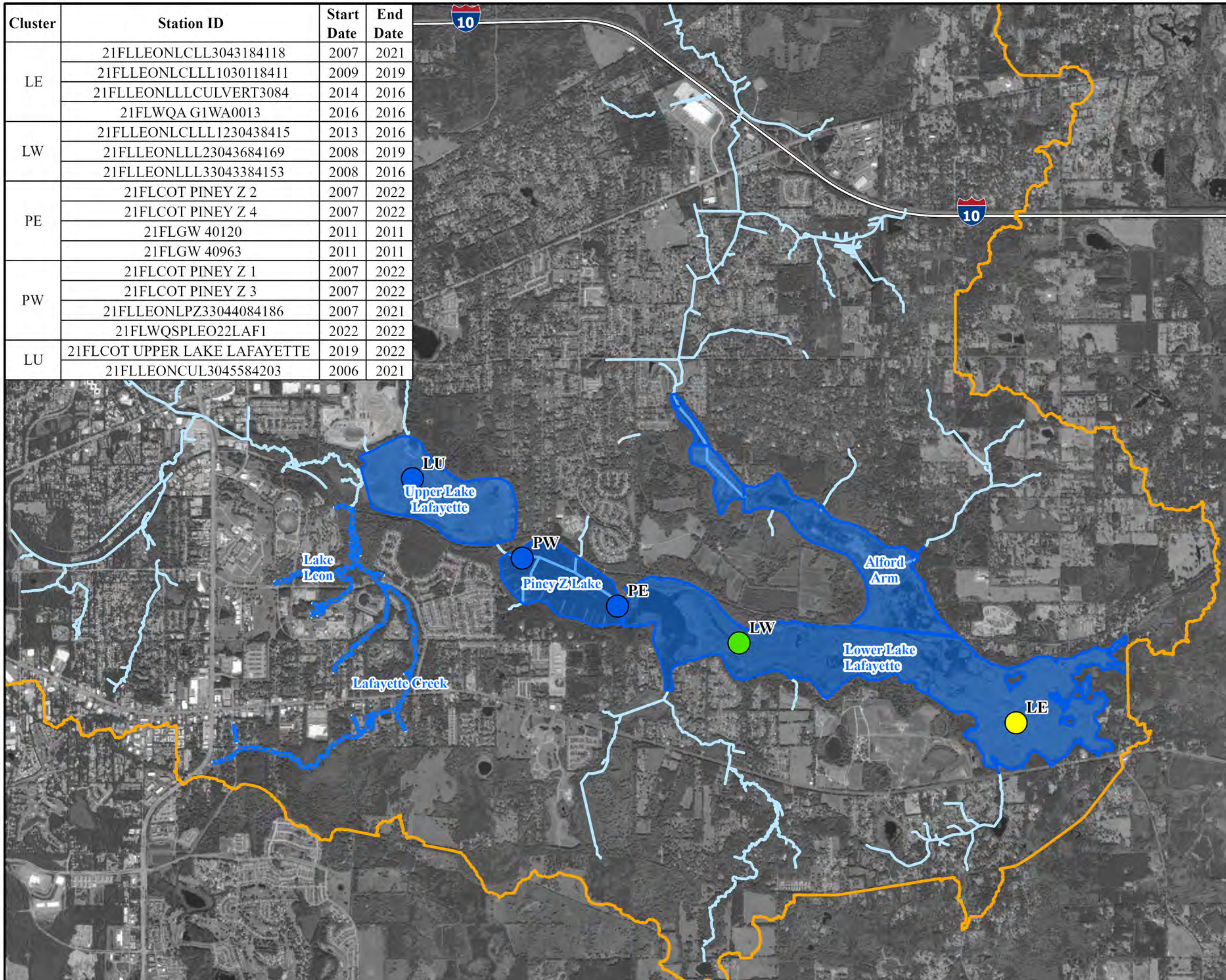
- For the tributary TN and TP, cutoffs were set at orange to red at the NNC thresholds of 1.03 mg/L and 0.18 mg/L respectively.
- For Chl-a, the cutoff from orange to red was set at the applicable NNC threshold, i.e., Upper Lake Lafayette and Lower Lake Lafayette (20 µg/L) and Piney Z Lake (6 µg/L).
- 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 $90^{th}$ 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 |

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N

0 0.7

Miles

**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)**

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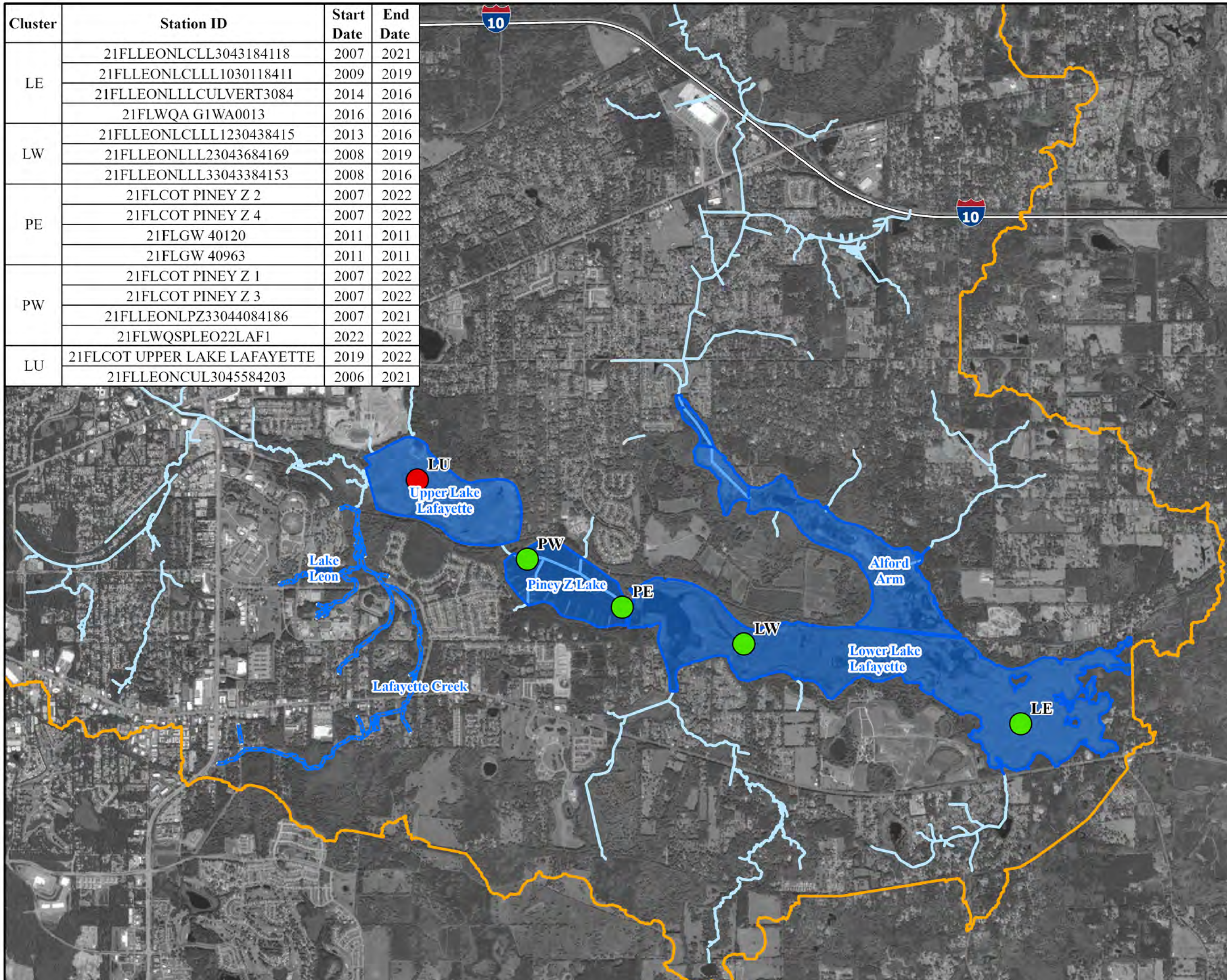
| Cluster | Station ID | Start Date | End Date |
|---|---|---|---|
| LE | 21FLLEONLCLL3043184118 | 2007 | 2021 |
| | 21FLLEONLCLLL1030118411 | 2009 | 2019 |
| | 21FLLEONLLLCULVERT3084 | 2014 | 2016 |
| | 21FLWQA G1WA0013 | 2016 | 2016 |
| LW | 21FLLEONLCLLL1230438415 | 2013 | 2016 |
| | 21FLLEONLLL23043684169 | 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 |

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N

0 0.7

Miles

**Legend**

Lake Lafayette Drainage Basin

Waterbodies in Study

Watercourses

Alkalinity Average 2010-2020

mg/L

0-5

5-10

10-15

15-20

>20

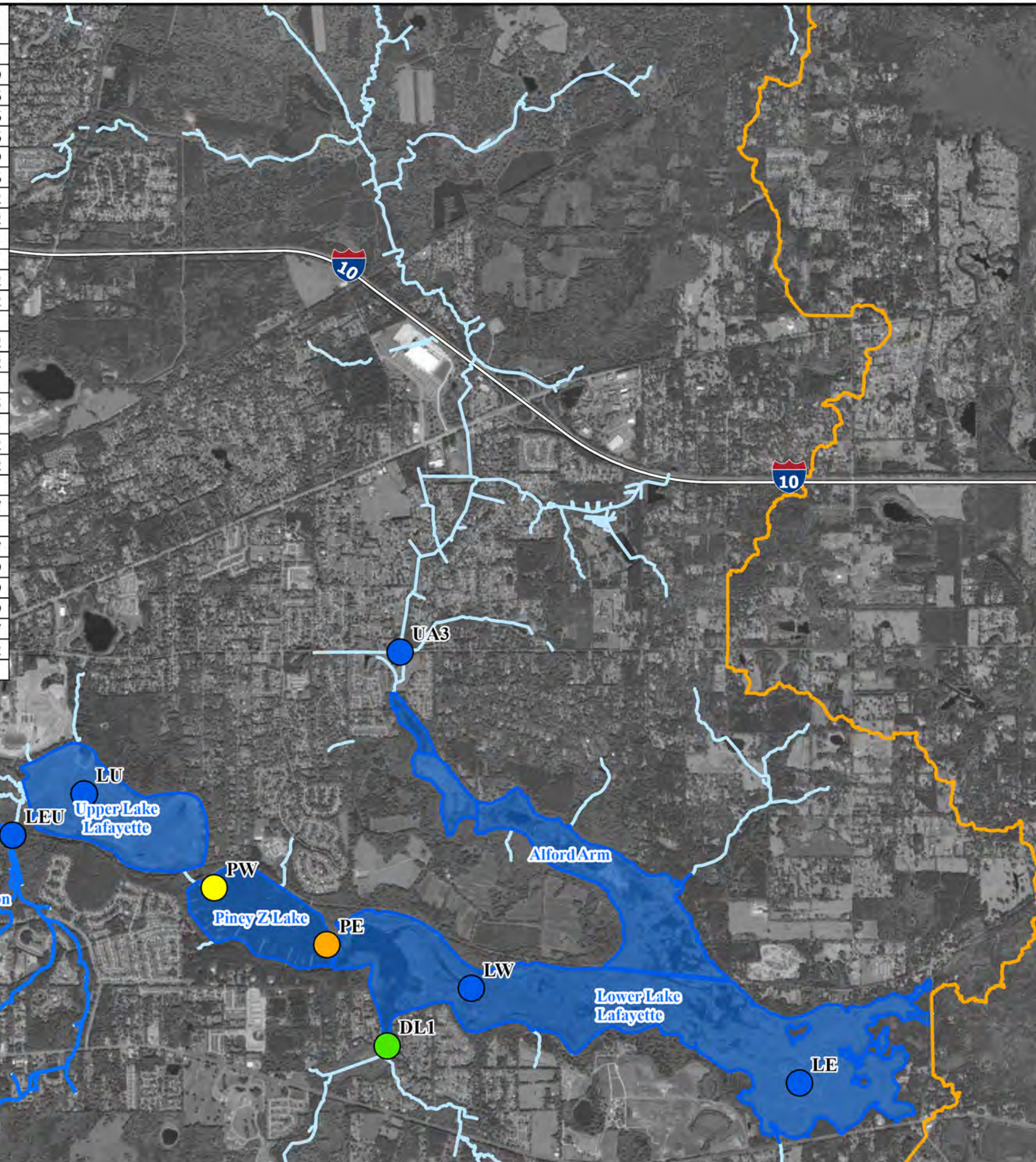
Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Drainage Basins: COT, 2020
Roads: COT-Leon County, 2023
Station Data: FDEP, 2021

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

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

Geosyntec consultants

| 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 |
| 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

N

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

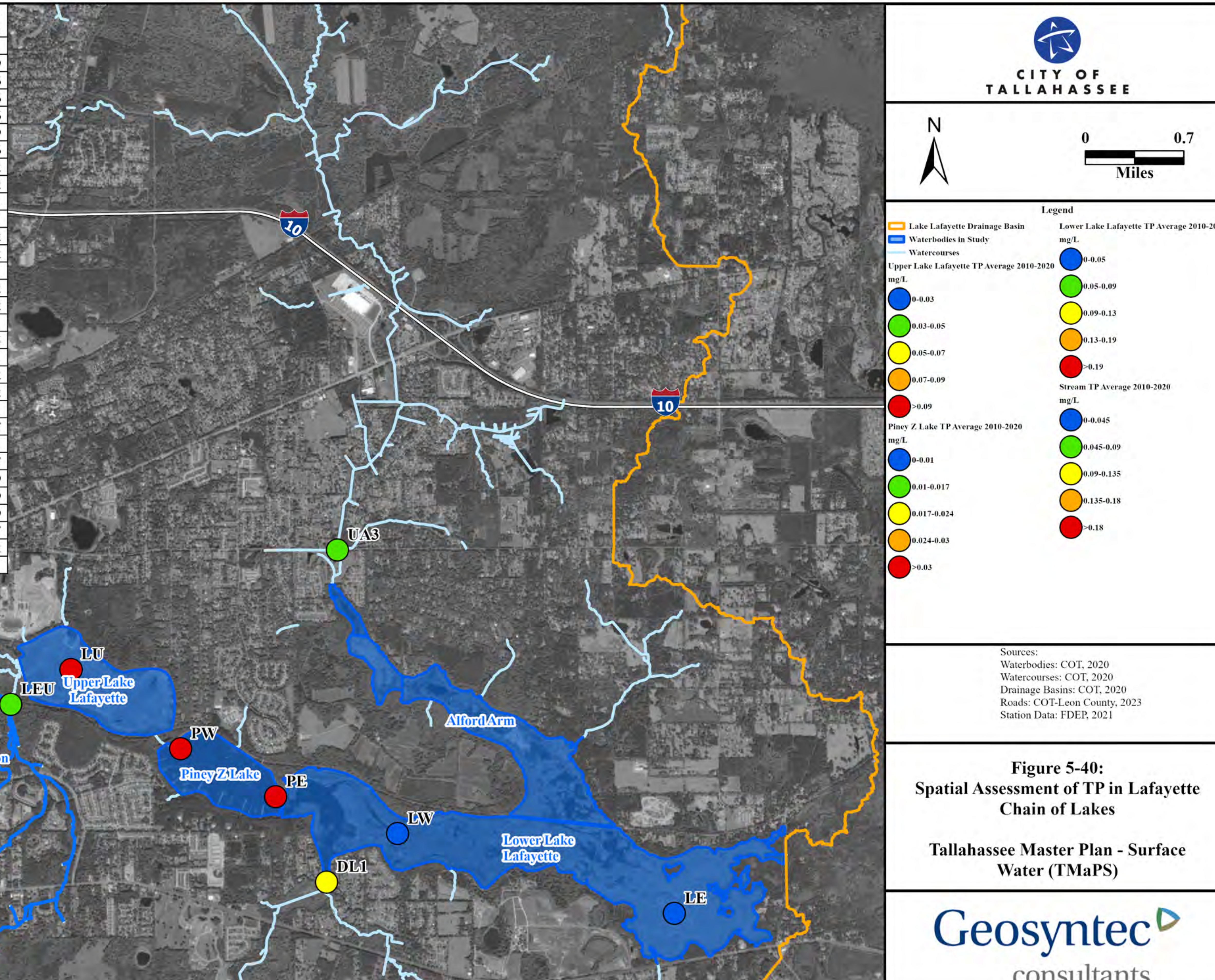
Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Drainage Basins: COT, 2020
Roads: COT-Leon County, 2023
Station Data: FDEP, 2021

**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 |
| | 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 |
| 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

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)**

Geosyntec consultants

**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).

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

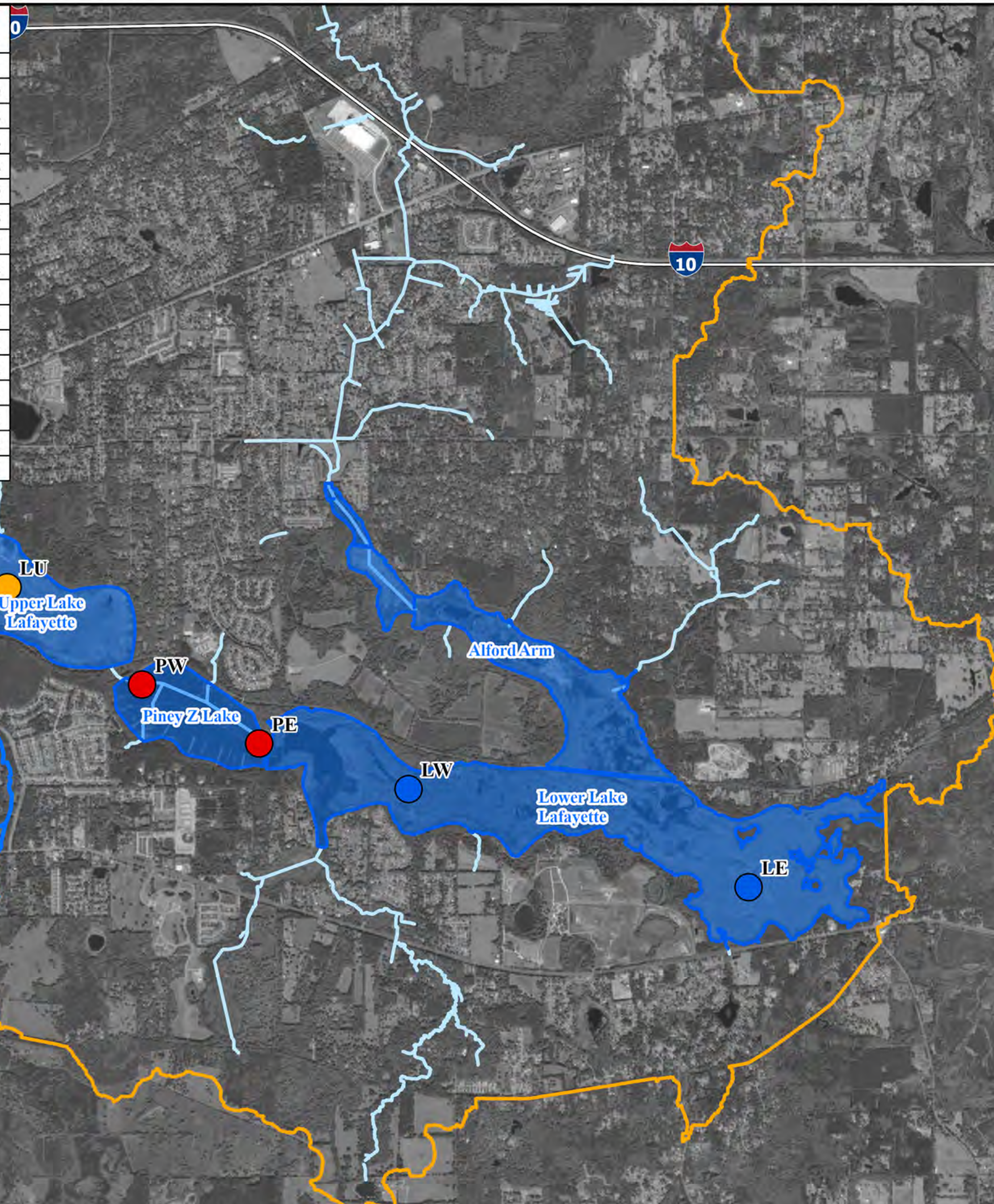
Where:

$LDI_i$ = 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 |
| | 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

N

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

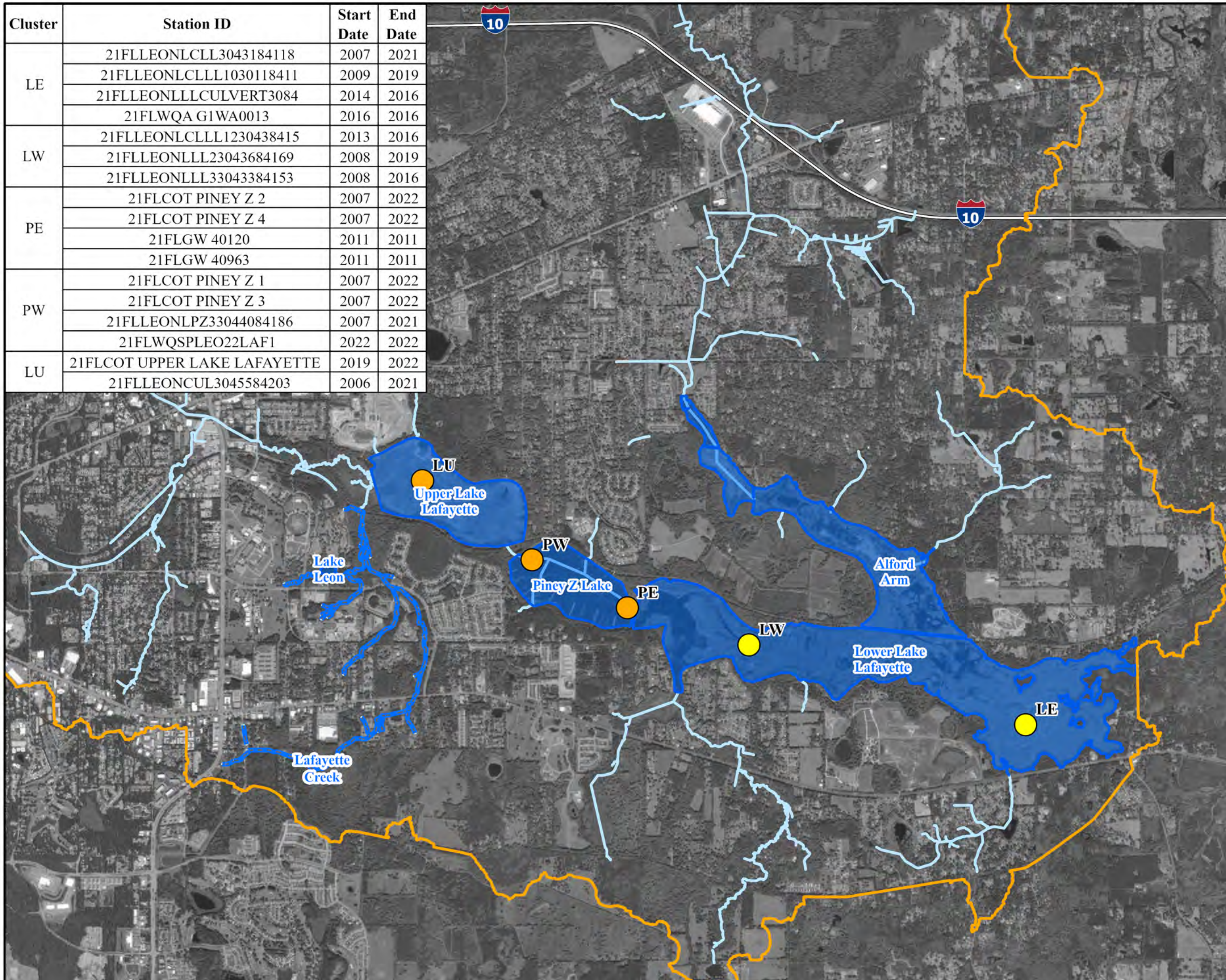
Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Drainage Basins: COT, 2020
Roads: COT-Leon County, 2023
Station Data: FDEP, 2021

**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 |
| | 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

N

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 |
| | 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 |
| 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 |

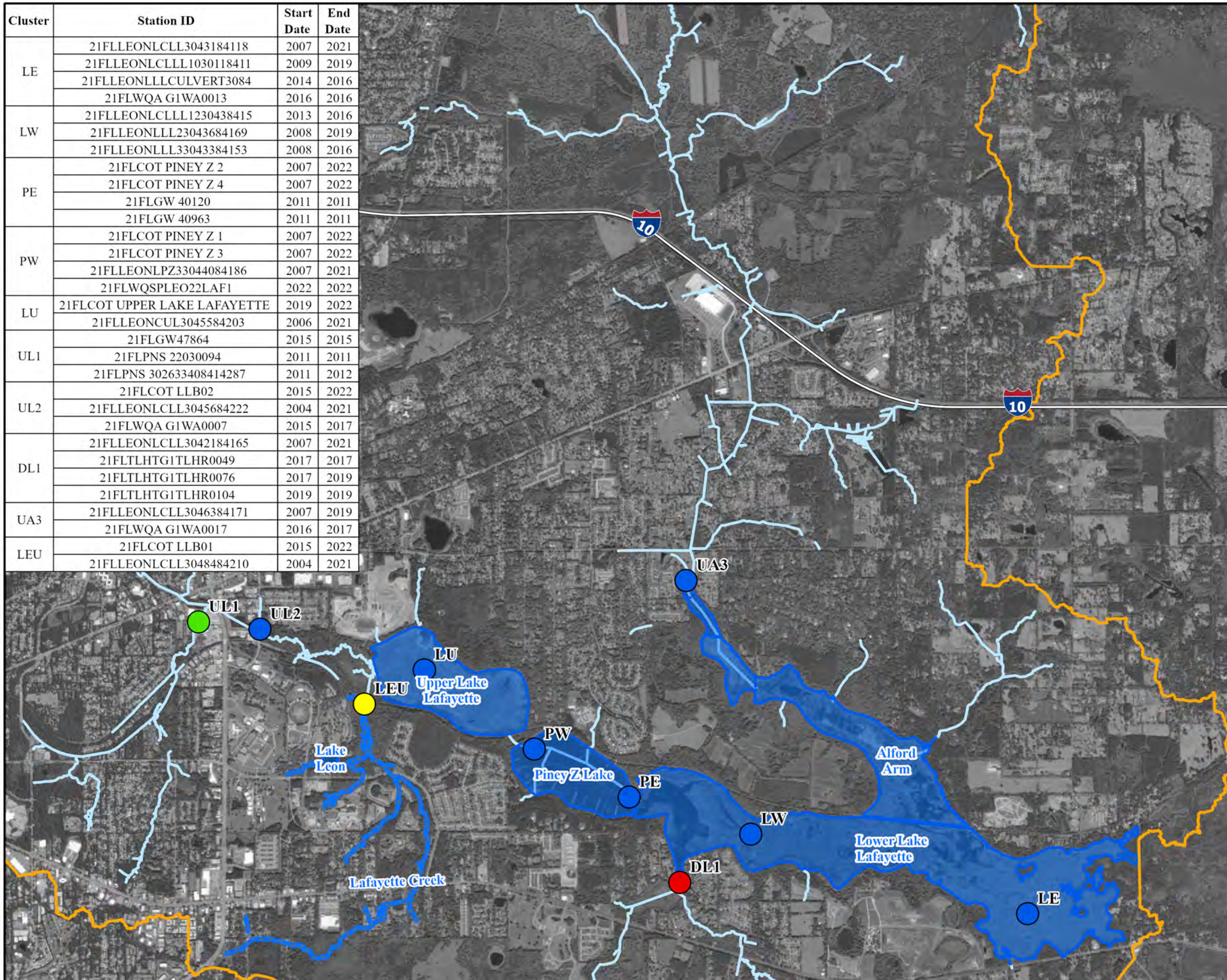



**Figure 5-43: Spatial Assessment of E. coli in Lafayette Chain of Lakes and Tributaries**

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

Geosyntec consultants

| 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 |

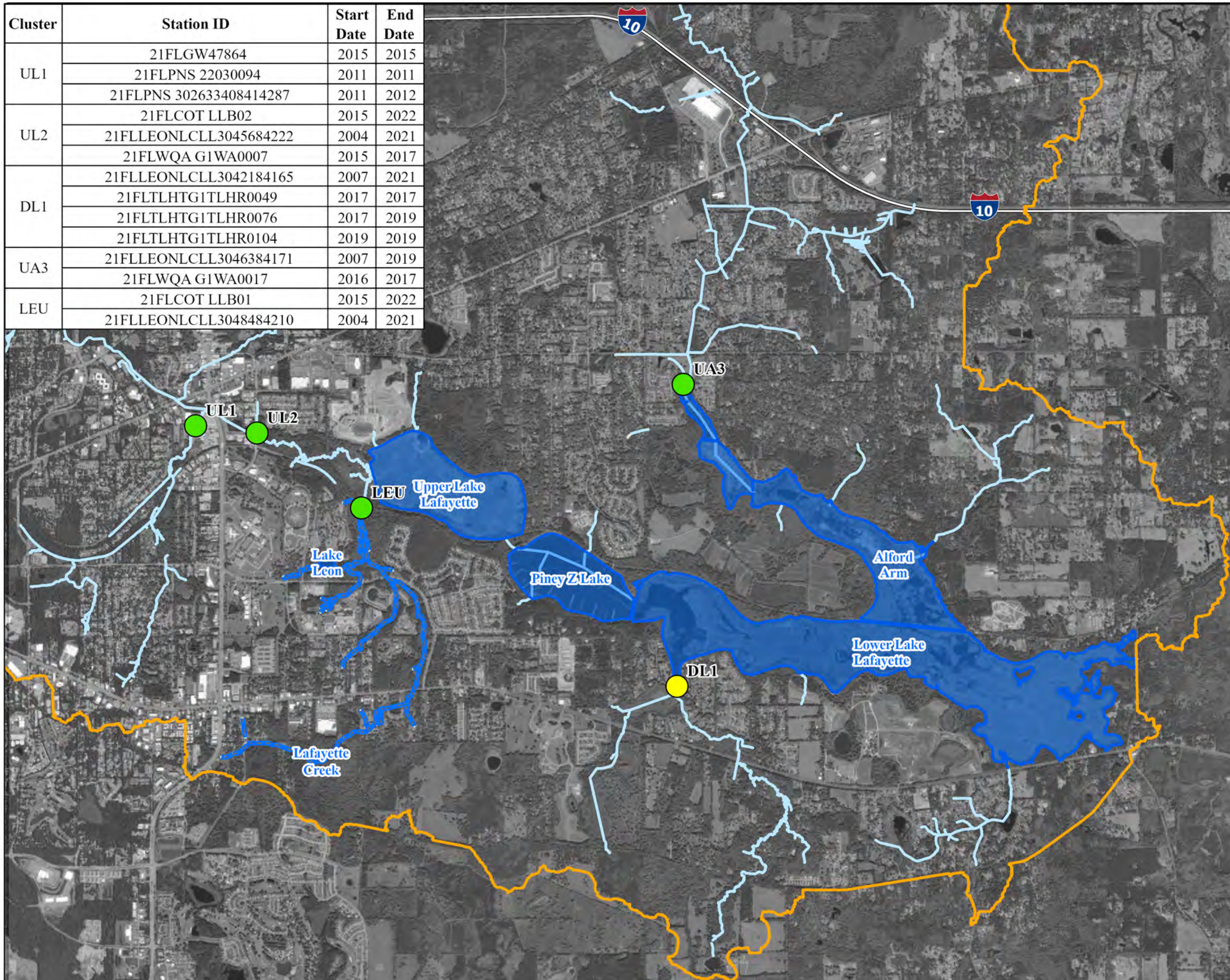



**Figure 5-44: Spatial Assessment of TSS in Lafayette Chain of Lakes Tributaries**

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

Geosyntec consultants

**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 |

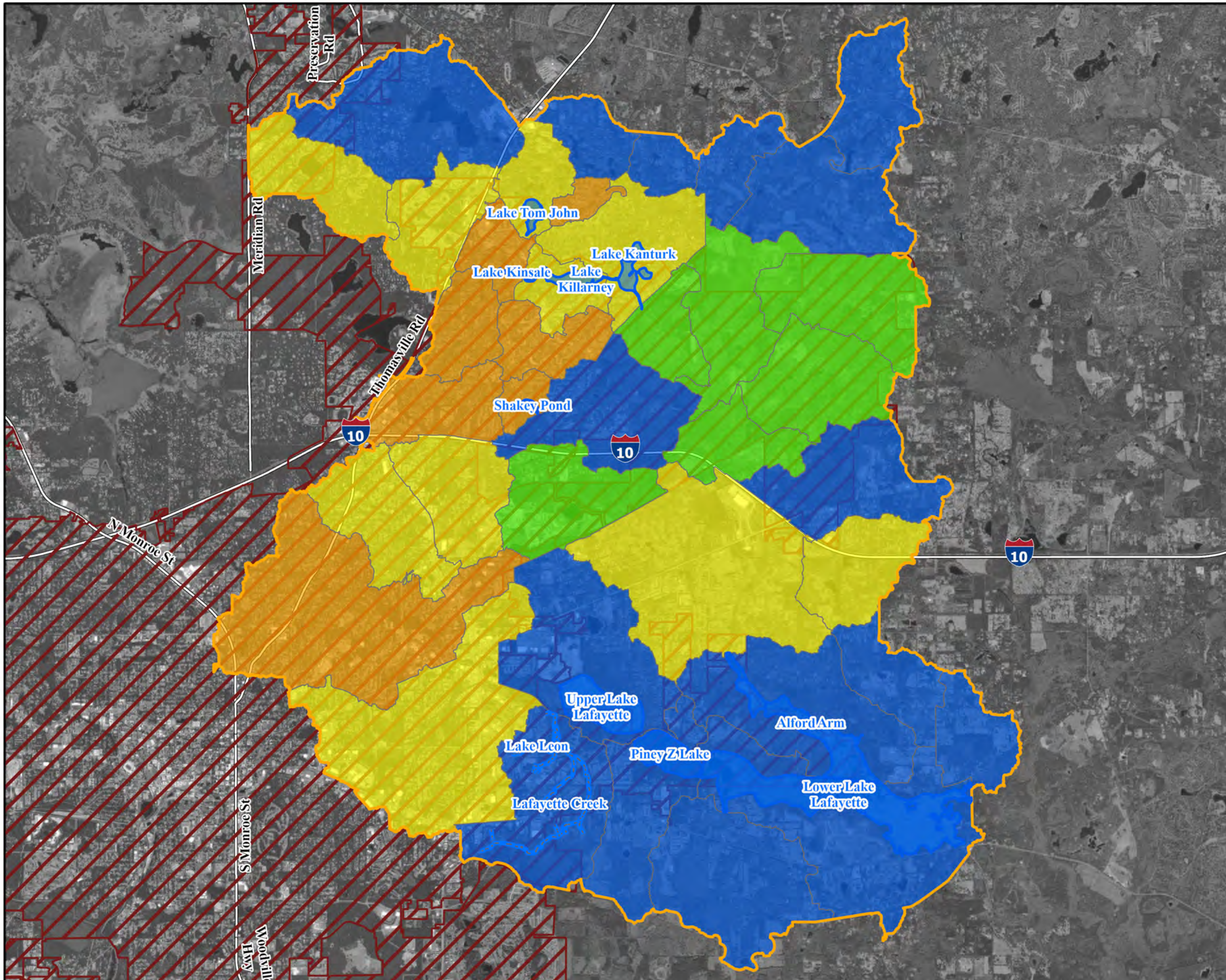
FDEP uses the LDI as a tool to estimate potential adverse human effects from various land uses on adjacent waterbodies, such as streams, lakes, and wetlands. Based on the LDI score, the catchment area is rated as excellent (1 to 2), good (3 to 4), moderate (5 to 6), poor (7 to 8), or very poor (9 to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




CITY OF TALLAHASSEE

N

0 1.3
Miles

**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)**

Geosyntec consultants

#### 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 Killearn Chain of Lakes, the densities in this area are discussed in later sections.

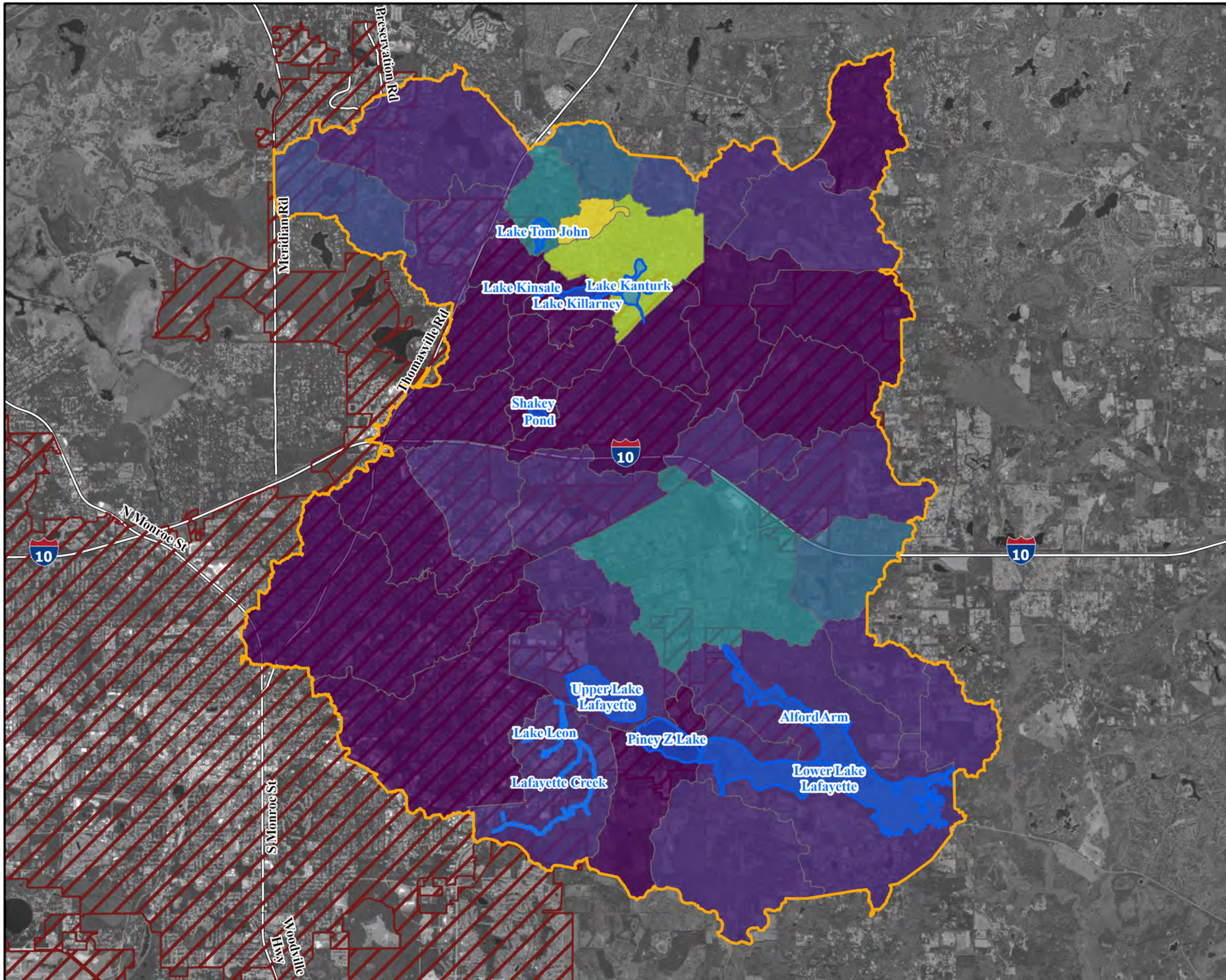
#### 5.4.4.4 Internal Recycling and Seepage

**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.




CITY OF TALLAHASSEE

N

0 1.4

Miles

**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)**

Geosyntec consultants

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

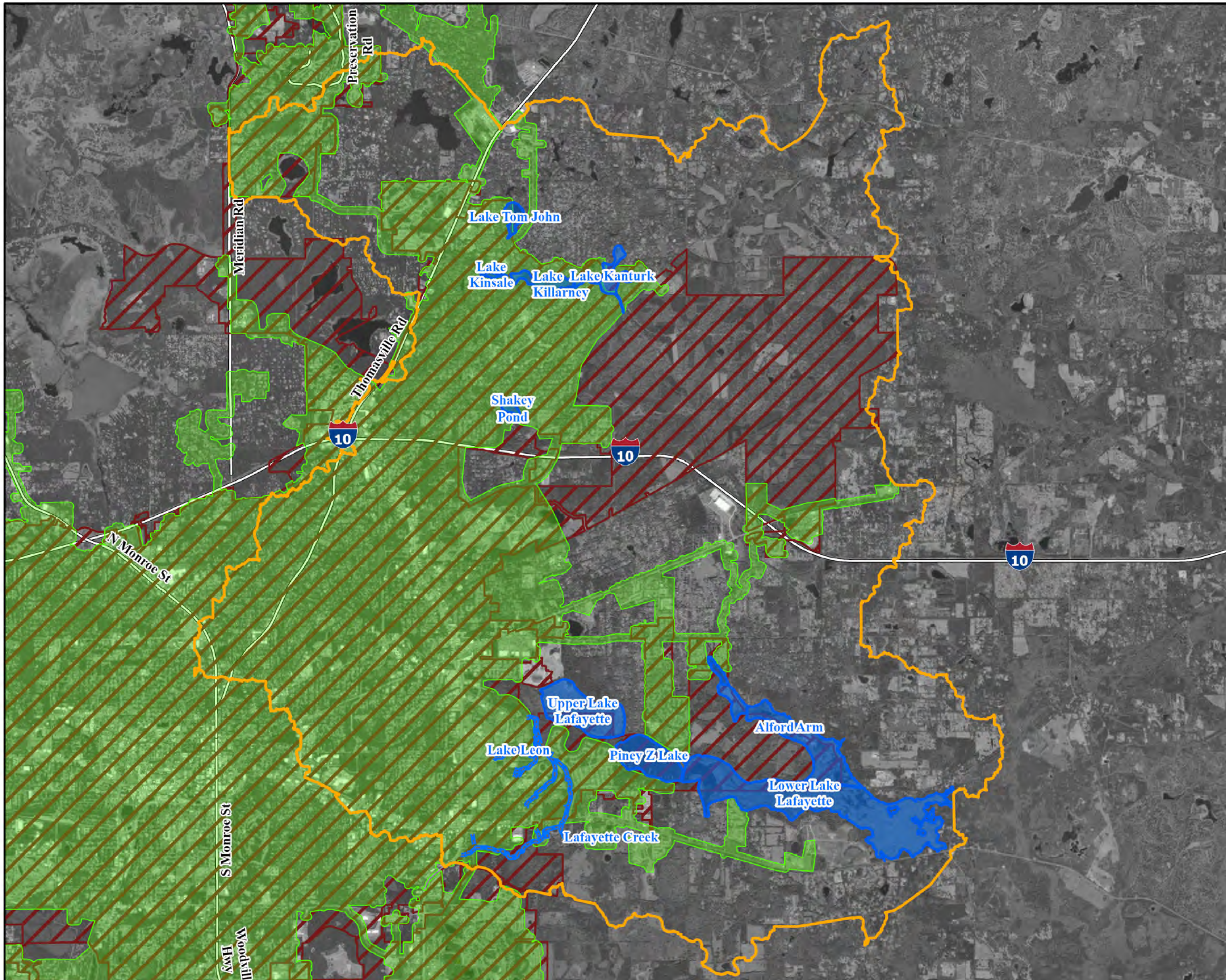
Atmospheric deposition is the load that falls directly onto the earth's surface. For this and future analyses, atmospheric deposition is accounted for both indirectly within stormwater runoff and directly as a load to the lake surface. In watersheds with a large watershed-to-lake area ratio (such as 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 Killearn Chain into tributaries upstream of Alford Arm.




CITY OF TALLAHASSEE

N

0 1.3 Miles

**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)**

Geosyntec consultants

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.

<u>SIMPLE-Seasonal Model Methodology</u>

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.

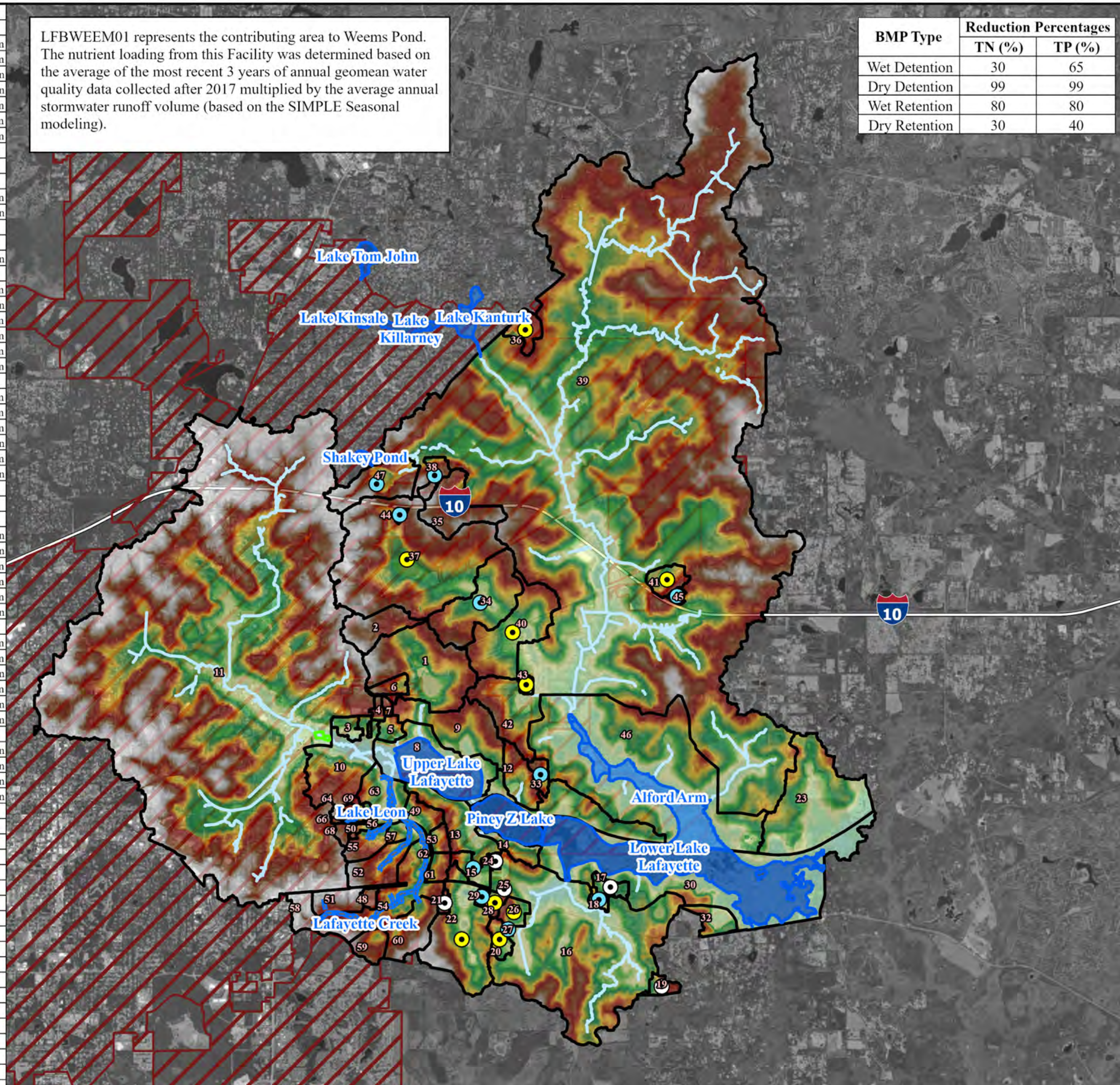
The land use data used for this modeling effort referenced the 2019 NWFWMD feature class presented in **Section 5.4.3.2**. The data were manipulated for the purposes of this analysis as described below. First, the NWFWMD land use data were aggregated into simplified land use categories as presented in 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 | LFBAA0050 | 463 | Dry Detention |
| 35 | LFBAA0070 | 287 | Wet Detention |
| 36 | LFBAA0130 | 99 | Wet Detention |
| 37 | LFBAA0060 | 1,462 | Wet Detention |
| 38 | LFBAA0090 | 68 | Dry Detention |
| 39 | LFBAA0020 | 15,553 | None |
| 40 | LFBAA0040 | 476 | Wet Detention |
| 41 | LFBAA0120 | 96 | Wet Detention |
| 42 | LFBAA0015 | 53 | Dry Detention |
| 43 | LFBAA0030 | 25 | Wet Detention |
| 44 | LFBAA0080 | 16 | Dry Detention |
| 45 | LFBAA0110 | 20 | Dry Detention |
| 46 | LFBAA0010 | 1,806 | None |
| 47 | LFBAA0100 | 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 | LFBLL0010 | 12 | None |
| 64 | LFBLL0015 | 14 | None |
| 65 | LFBLL0020 | 10 | None |
| 66 | LFBLL0025 | 20 | None |
| 67 | LFBLL0030 | 3 | None |
| 68 | LFBLL0035 | 32 | None |
| 69 | LFBLL0040 | 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 |




CITY OF TALLAHASSEE

N

0 1.5 Miles

**Legend**

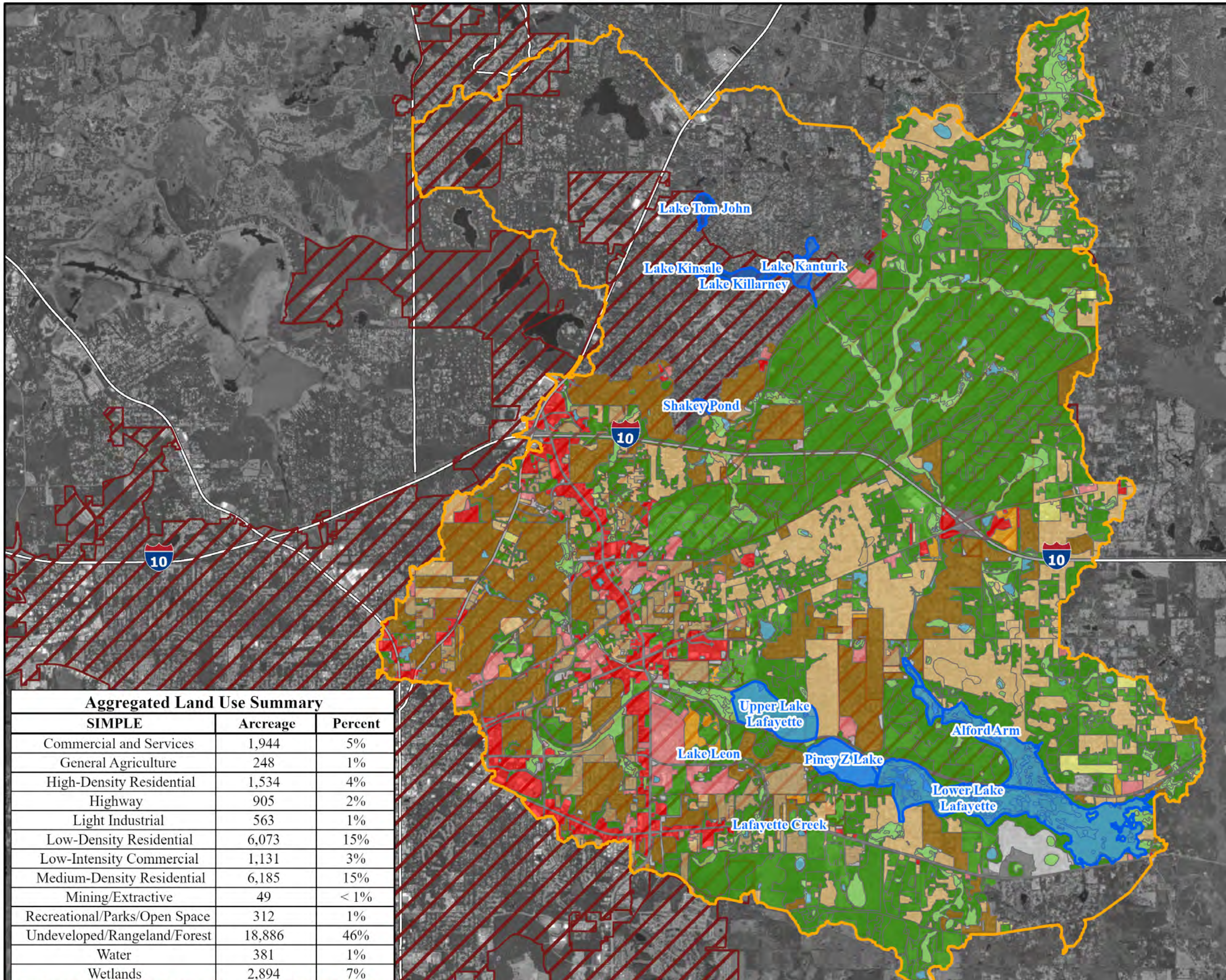
Subbasins
Waterbodies in Study
Watercourses
Tallahassee Corporate Limits
Weems Pond
BMP Type
Dry Detention
Dry Retention
Wet Detention
Topographic Elevations
ft NAVD88
250
20

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)**

Geosyntec consultants




CITY OF TALLAHASSEE

**Aggregated Land Use Summary**

| SIMPLE | Arcreage | 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% |

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)**

Geosyntec consultants

**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:**

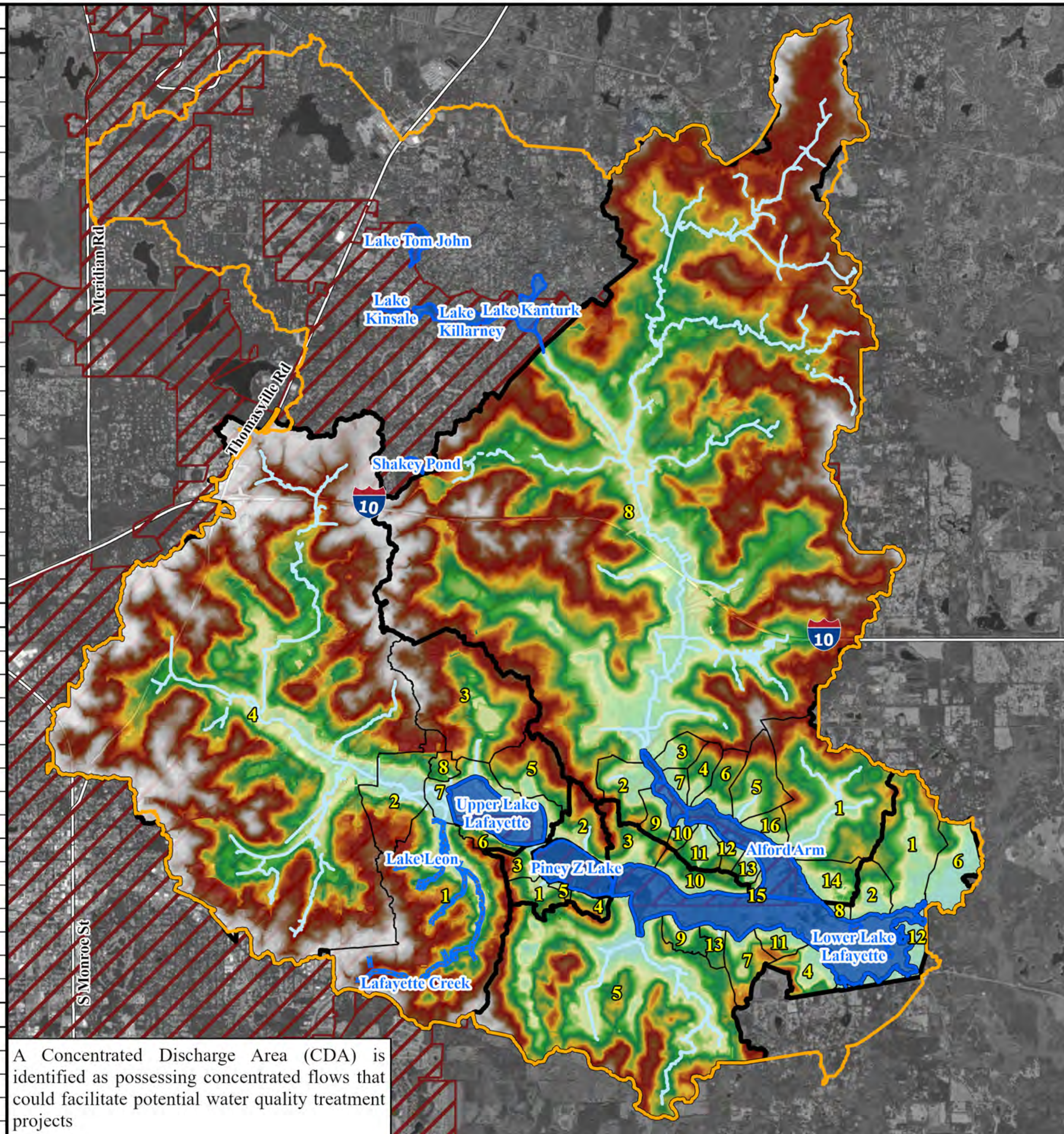
1. The values were from H. Harper and D. Baker, *Evaluation of current Stormwater Design Criteria within the State of Florida* (June 2007).
2. Stormwater quality nutrient permitting requirements (FDEP 2022)

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

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 |

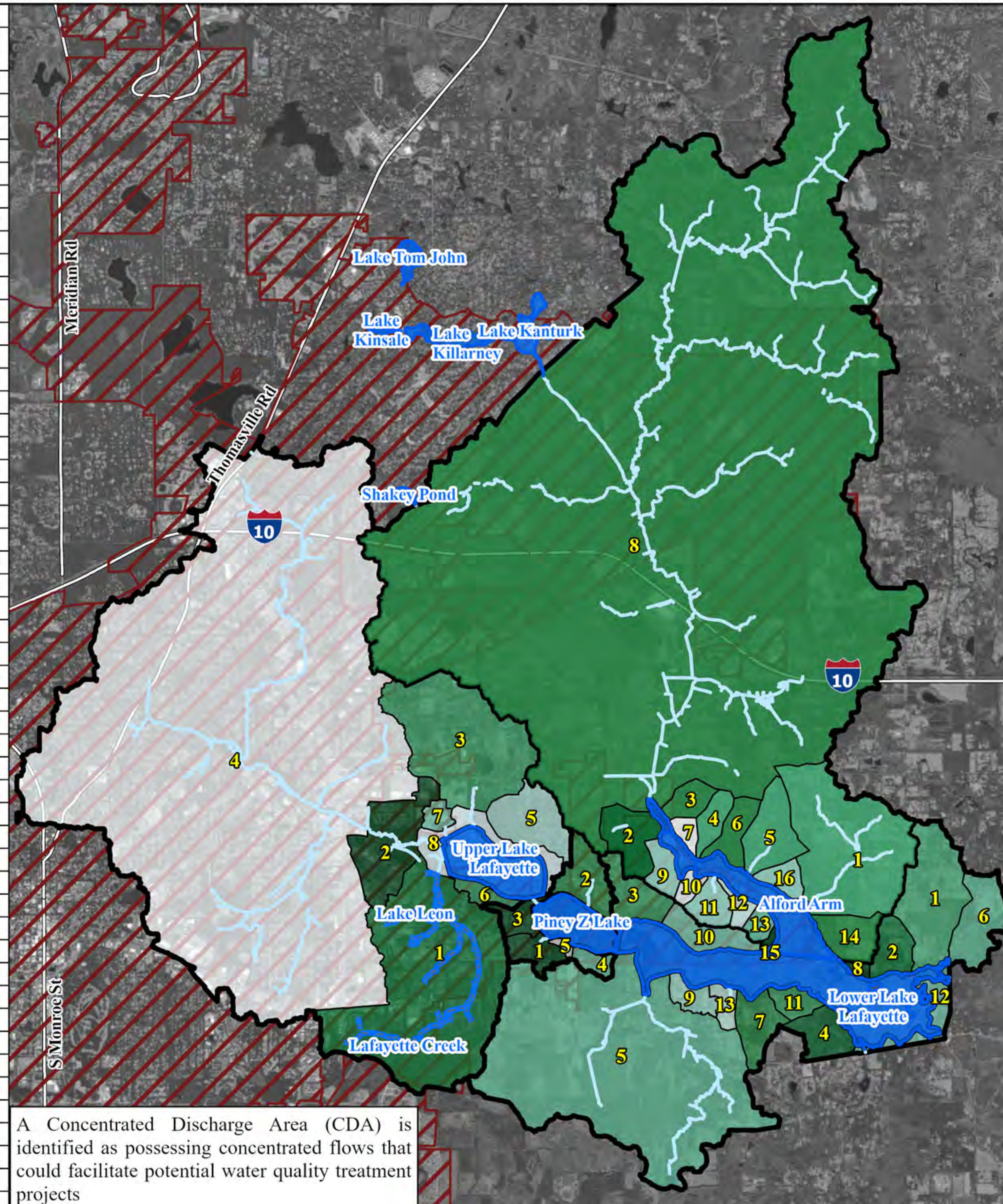
**Note:**
1. The value was calculated in SIMPLE-Seasonal Model.

**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 | | |




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**

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

CDA - Lafayette Chain of Lakes - TN Rank

High

Low

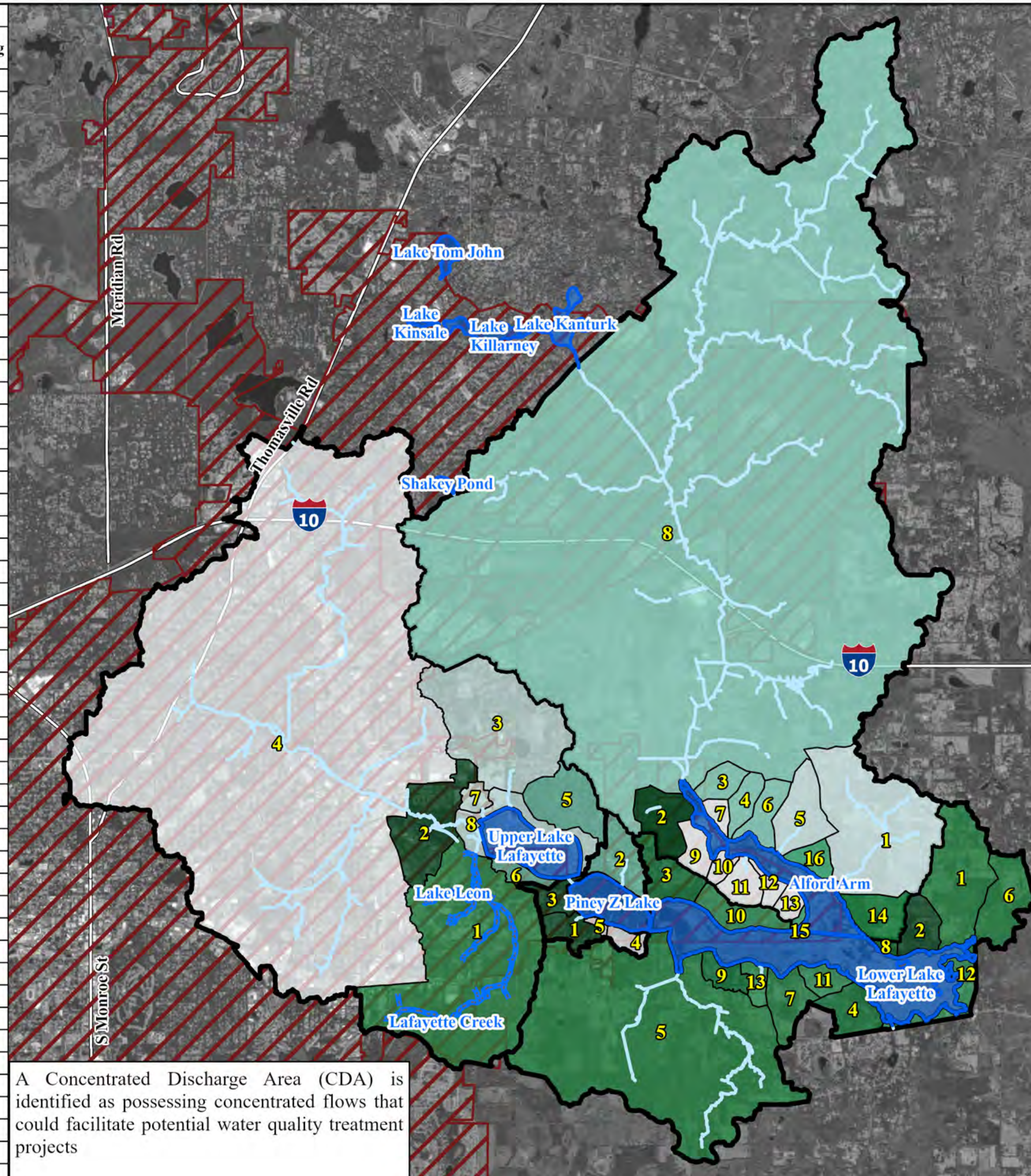
Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
CDAs: Geosyntec, 2022
Roads: COT-Leon County, 2023
City Limits: COT, 2022

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

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

Geosyntec consultants

| 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

N

0 1.3
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** = 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.

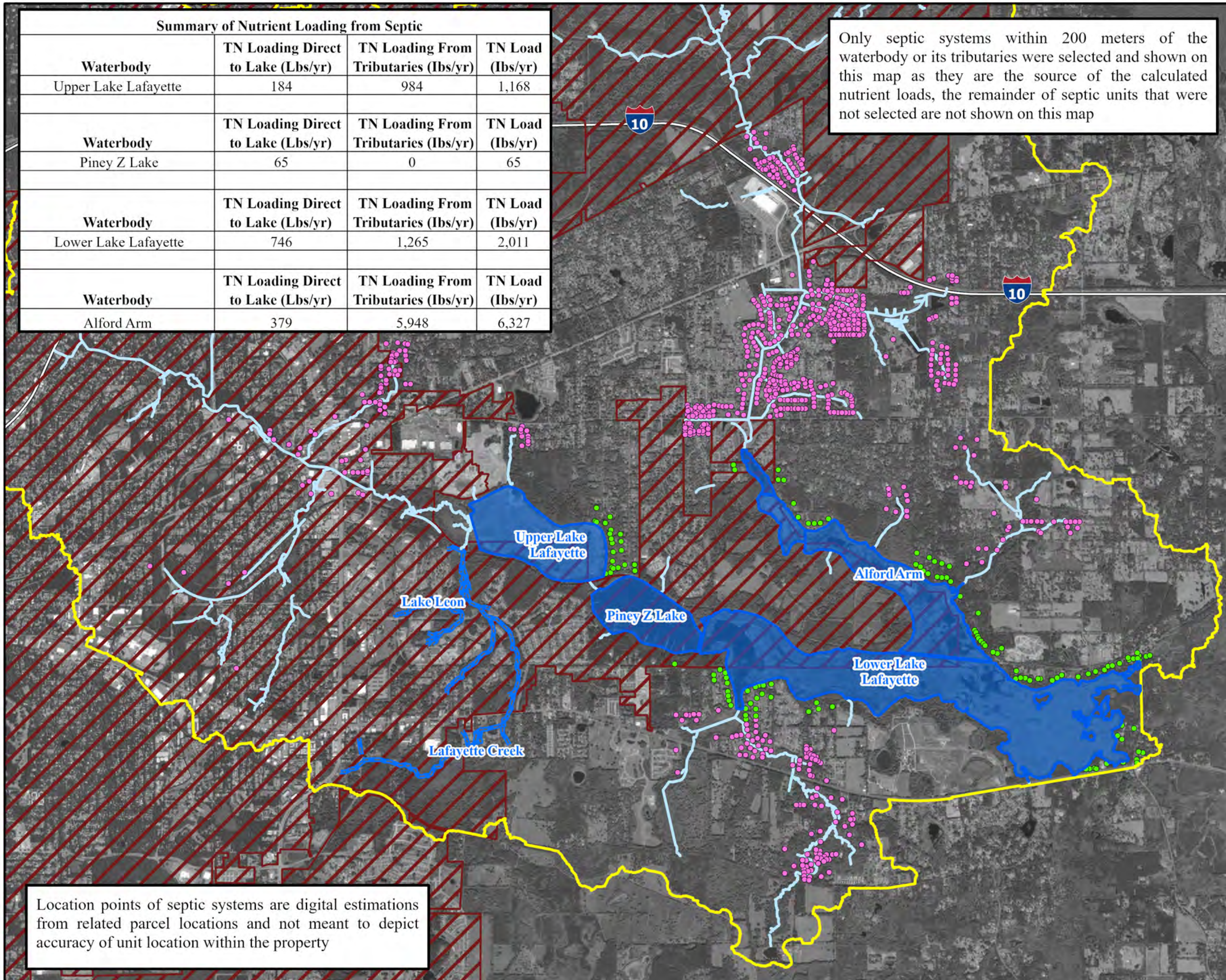
#### 5.4.5.4 Lake Inflow Load

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 (lbs/yr) | TN Load (lbs/yr) |
|---|---|---|---|
| Upper Lake Lafayette | 184 | 984 | 1,168 |
| | | | |
| **Waterbody** | **TN Loading Direct to Lake (Lbs/yr)** | **TN Loading From Tributaries (lbs/yr)** | **TN Load (lbs/yr)** |
| Piney Z Lake | 65 | 0 | 65 |
| | | | |
| **Waterbody** | **TN Loading Direct to Lake (Lbs/yr)** | **TN Loading From Tributaries (lbs/yr)** | **TN Load (lbs/yr)** |
| Lower Lake Lafayette | 746 | 1,265 | 2,011 |
| | | | |
| **Waterbody** | **TN Loading Direct to Lake (Lbs/yr)** | **TN Loading From Tributaries (lbs/yr)** | **TN Load (lbs/yr)** |
| Alford Arm | 379 | 5,948 | 6,327 |




CITY OF TALLAHASSEE

N

0 0.7
Miles

**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)**

Geosyntec consultants

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.

<u>Results</u>

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 Killearn 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<br>TN: 0.85 mg/L<br>TP: 0.086 mg/L | 20549 | 2079 |
| | | | Lake Cassie | Unknown | ND | CHLA: ND<br>TN: ND<br>TP: ND | ND | ND |
| | | | Mill Pond | Unknown | ND | CHLA: ND<br>TN: ND<br>TP: ND | ND | ND |

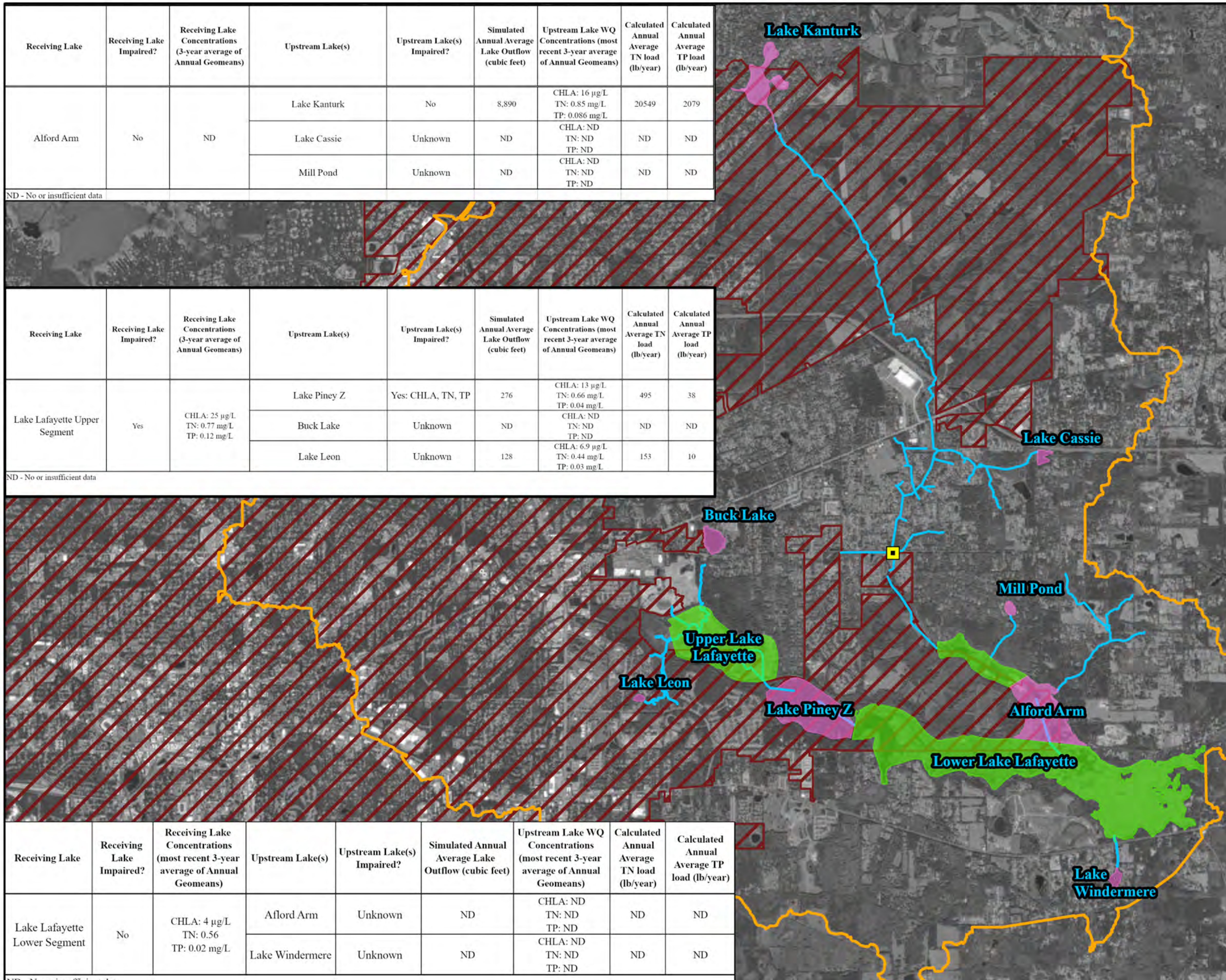
ND - No or insufficient data

| 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<br>TN: 0.77 mg/L<br>TP: 0.12 mg/L | Lake Piney Z | Yes: CHLA, TN, TP | 276 | CHLA: 13 µg/L<br>TN: 0.66 mg/L<br>TP: 0.04 mg/L | 495 | 38 |
| | | | Buck Lake | Unknown | ND | CHLA: ND<br>TN: ND<br>TP: ND | ND | ND |
| | | | Lake Leon | Unknown | 128 | CHLA: 6.9 µg/L<br>TN: 0.44 mg/L<br>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<br>TN: 0.56<br>TP: 0.02 mg/L | Aflord Arm | Unknown | ND | CHLA: ND<br>TN: ND<br>TP: ND | ND | ND |
| | | | Lake Windermere | Unknown | ND | CHLA: ND<br>TN: ND<br>TP: ND | ND | ND |

ND - No or insufficient data




CITY OF TALLAHASSEE

**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)**

Geosyntec consultants