5.7 Shakey Pond

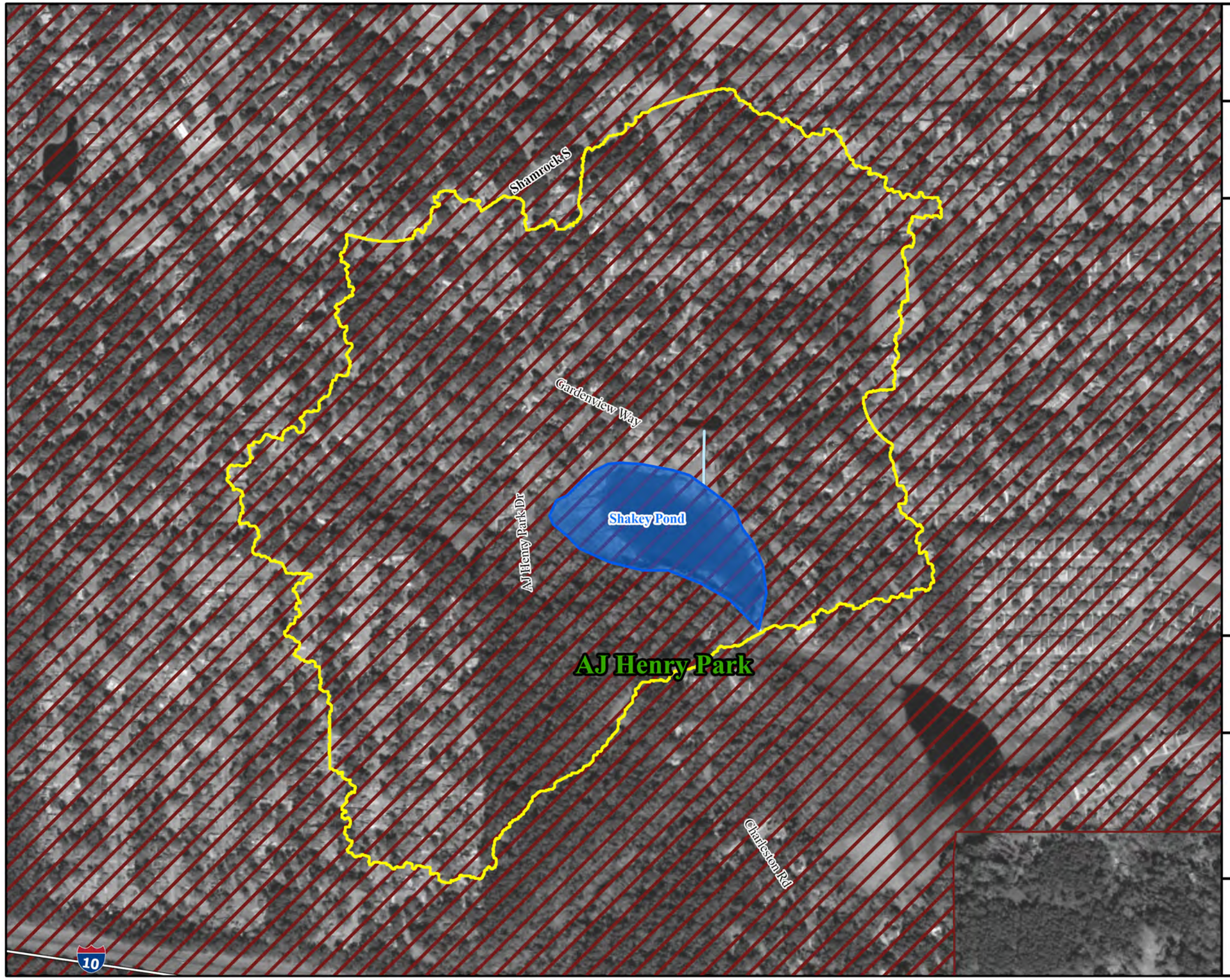
This section presents the results from Tasks 1 through 3 for Shakey Pond, including an overview and history of the pond and basin, present impairment status, an overview of available data, a qualitative assessment of potential pollutant sources, and calculation of potential pollutant loads.

5.7.1 Overview and History

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

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

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



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Legend

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

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

Figure 5-127:
Shakey Pond Basin Overview Map

Tallahassee Master Plan - Surface Water (TMaPS)

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

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

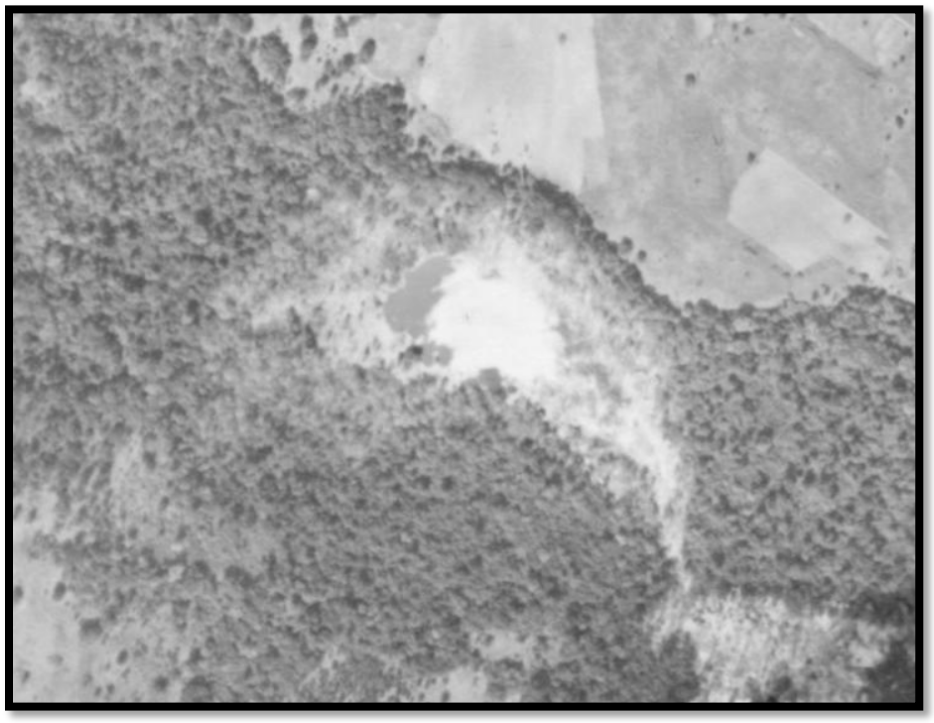

Photo 5-58: Shakey Pond Basin Area Aerial (1949)

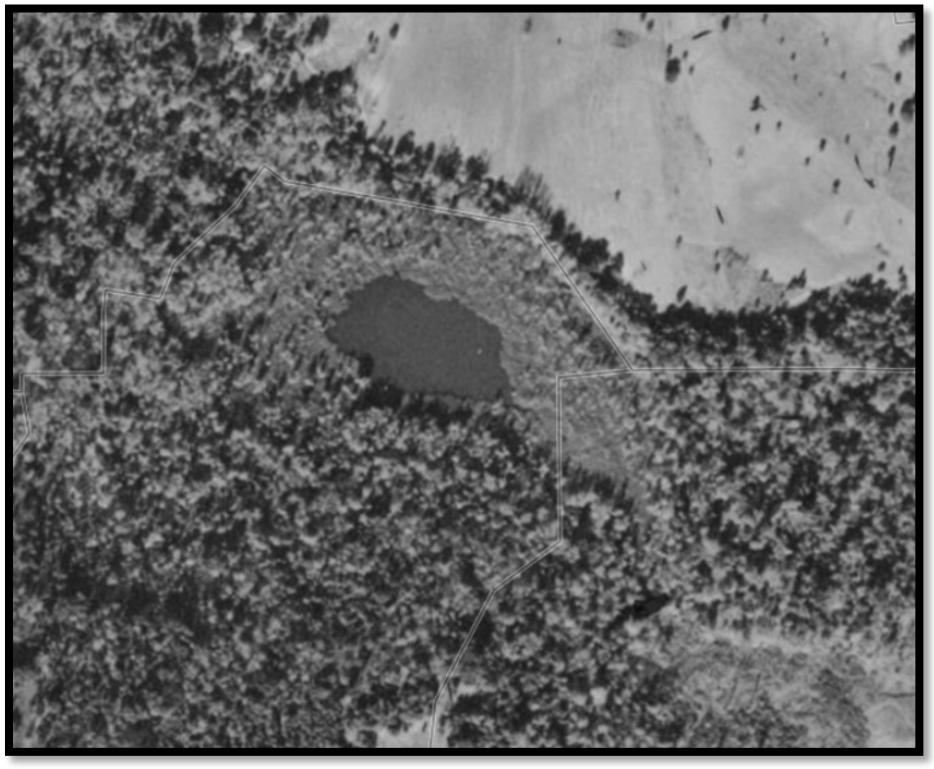

Photo 5-59: Shakey Pond Basin Area Aerial (1954)

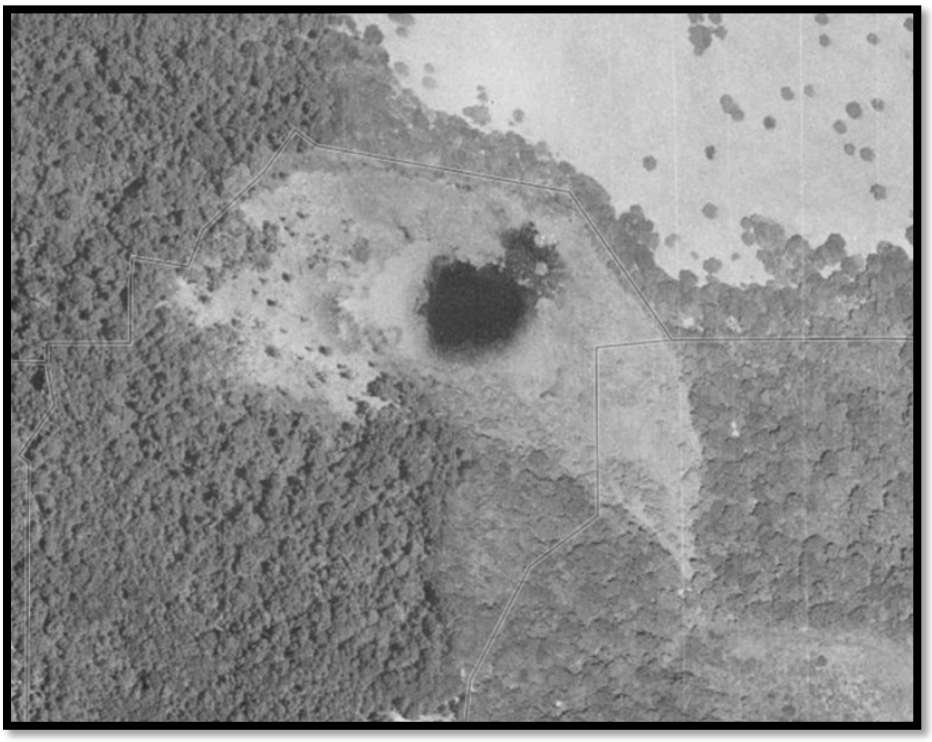

Photo 5-60: Shakey Pond Basin Area Aerial (1970)

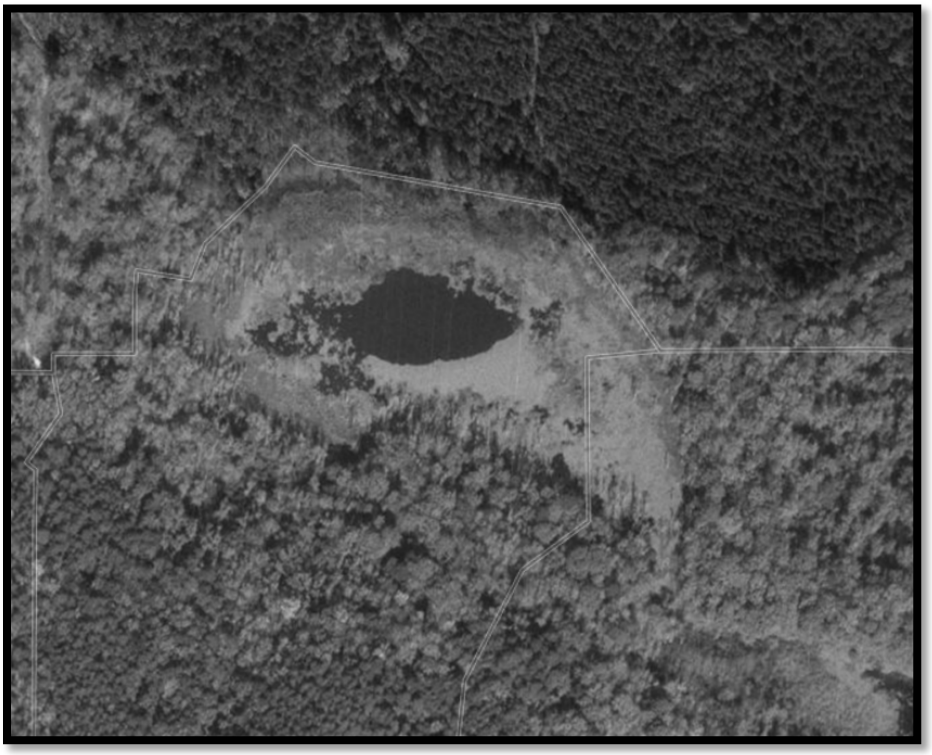

Photo 5-61: Shakey Pond Basin Area Aerial (1983)

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

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

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

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

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

5.7.2 Regulatory Status

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

5.7.3 Waterbody Data Review and Summary

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

Photo 5-65: Shakey Pond Outflow Structure in 2023

5.7.3.1 Bathymetry

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

5.7.3.2 Land Use

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

5.7.3.3 Soils

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

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Current Water Depth (ft) *

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

* Based on approximate current pond elevation of 113.2' NAVD88

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

Figure 5-128:
Shakey Pond Bathymetric Map

Tallahassee Master Plan - Surface Water (TMaPS)

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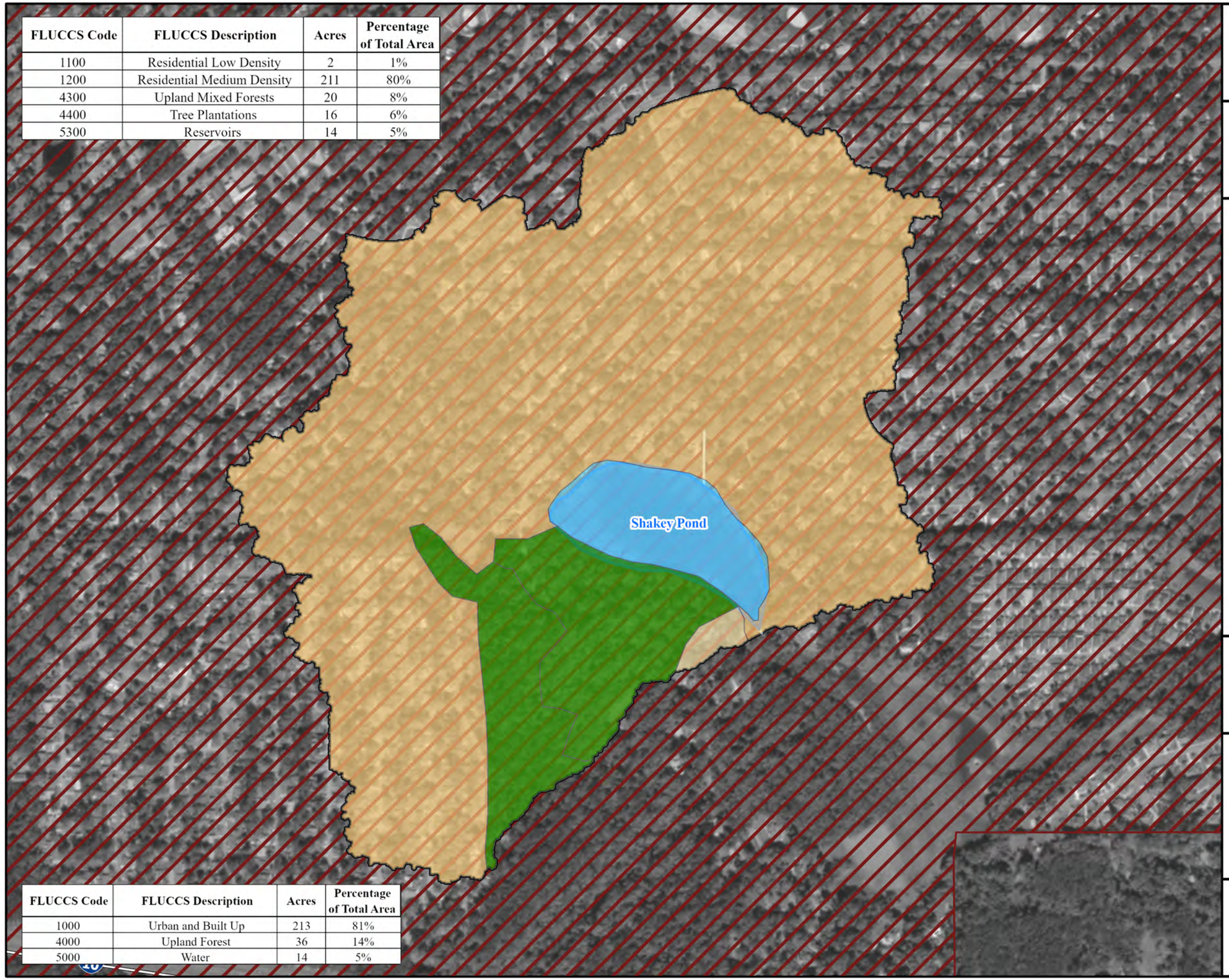
FLUCCS Code	FLUCCS Description	Acres	Percentage of Total Area
1100	Residential Low Density	2	1%
1200	Residential Medium Density	211	80%
4300	Upland Mixed Forests	20	8%
4400	Tree Plantations	16	6%
5300	Reservoirs	14	5%



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

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Legend

- Shakey Pond Drainage Basin
- Tallahassee Corporate Limits

Land Use

- 1100: Residential Low Density
- 1200: Residential Medium Density
- 4300: Upland Mixed Forests
- 4400: Tree Plantations
- 5300: Reservoirs

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

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

Tallahassee Master Plan - Surface Water (TMaPS)

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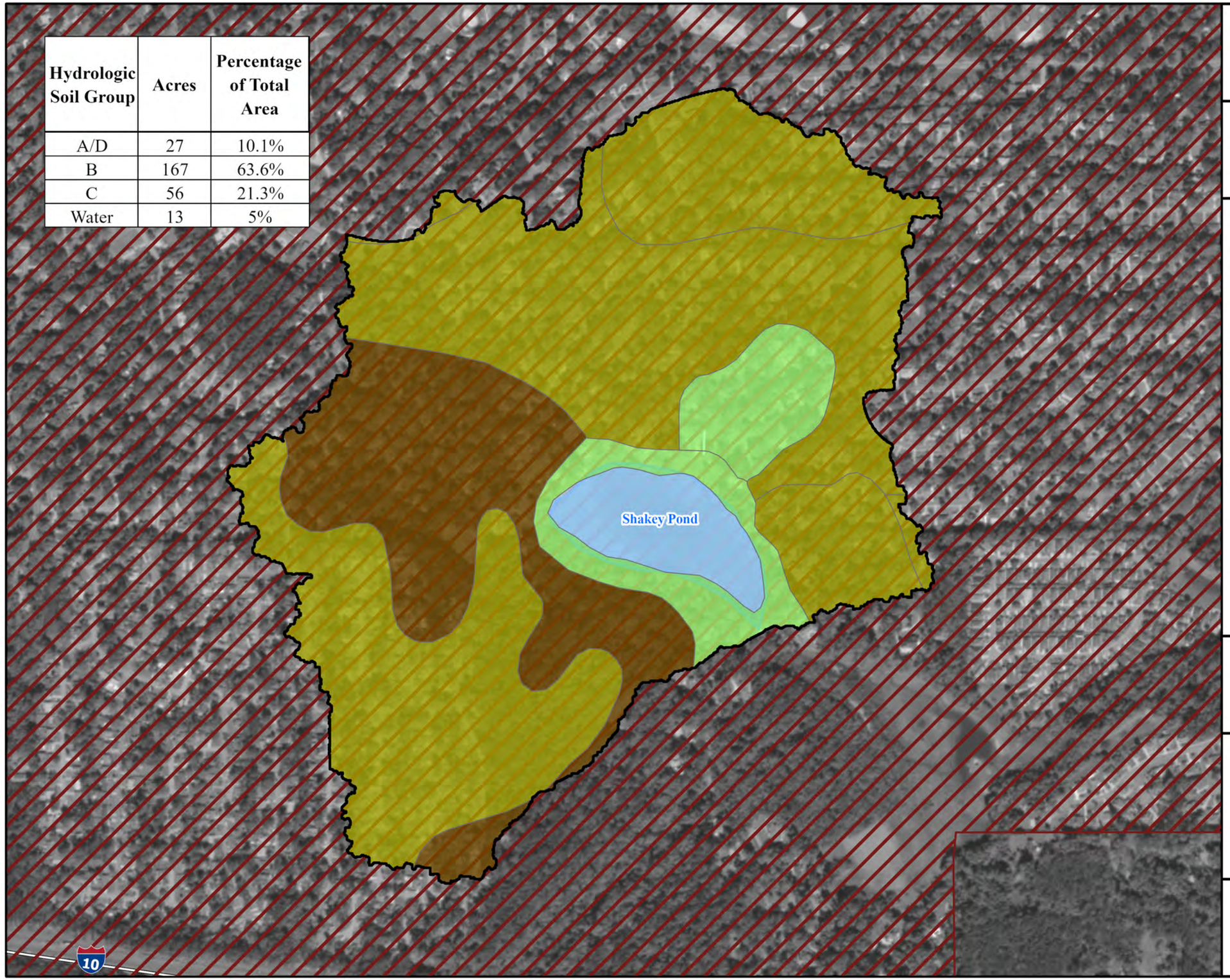
Hydrologic Soil Group	Acres	Percentage of Total Area
A/D	27	10.1%
B	167	63.6%
C	56	21.3%
Water	13	5%



CITY OF TALLAHASSEE

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Legend

- Shakey Pond Drainage Basin
- Tallahassee Corporate Limits

Hydrologic Soil Group

- A/D
- B
- C
- Water

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

Figure 5-130:
Shakey Pond Drainage Basin Soils Map

Tallahassee Master Plan - Surface Water (TMaPS)

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5.7.3.4 Septic Systems

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

5.7.3.5 Hydrologic Data

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

5.7.3.6 Surface Water Quality Data

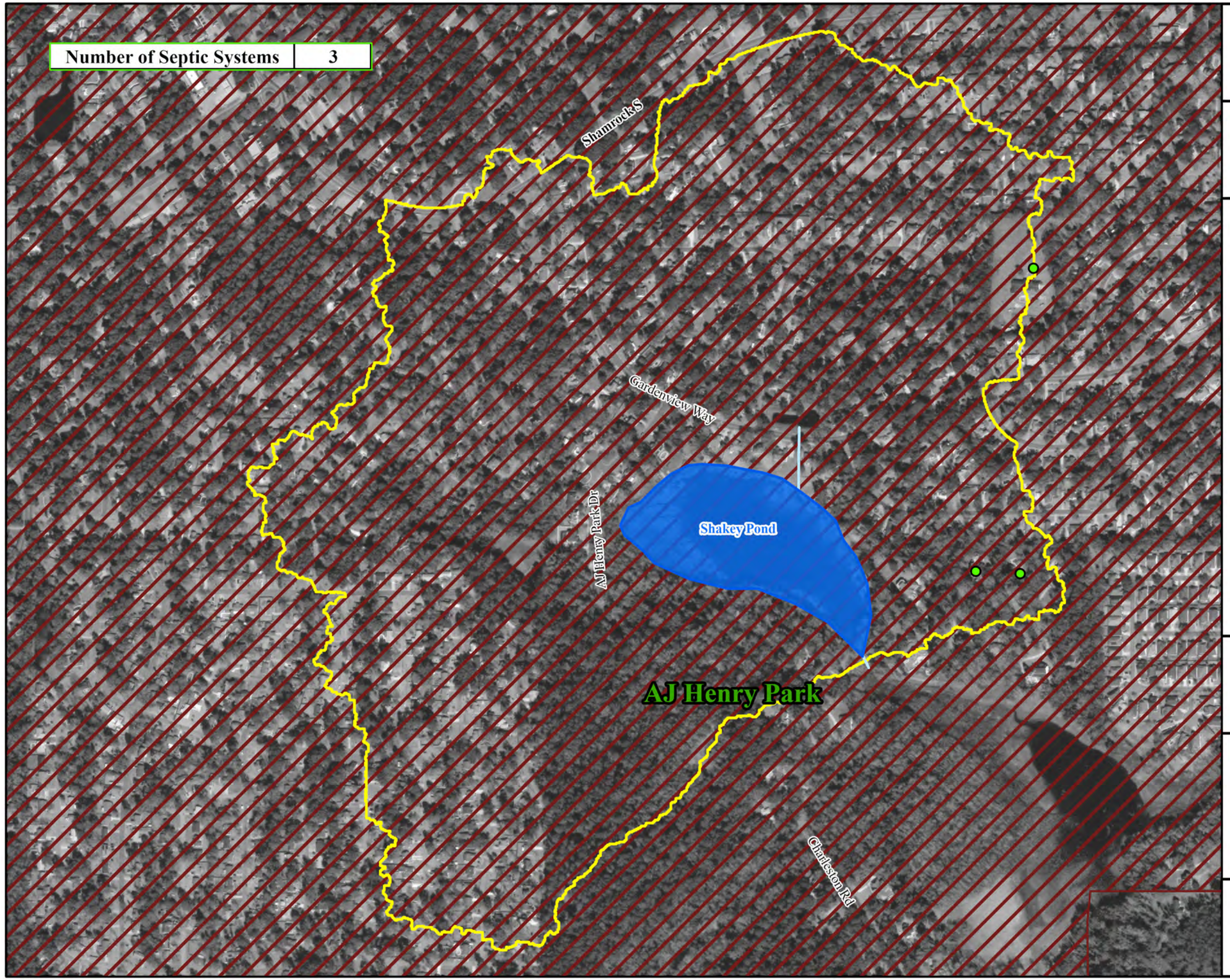
The water quality dataset for Shakey Pond (WBID 647I) spans from 1992 to 2021 and includes data from the City and FDEP. **Figure 5-133** presents the locations of in-lake water quality monitoring stations for Shakey Pond (yellow). A table is provided in **Figure 5-133** that shows the station ID, station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

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

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

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

Number of Septic Systems	3



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Legend

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

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

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

Tallahassee Master Plan - Surface Water (TMaPS)

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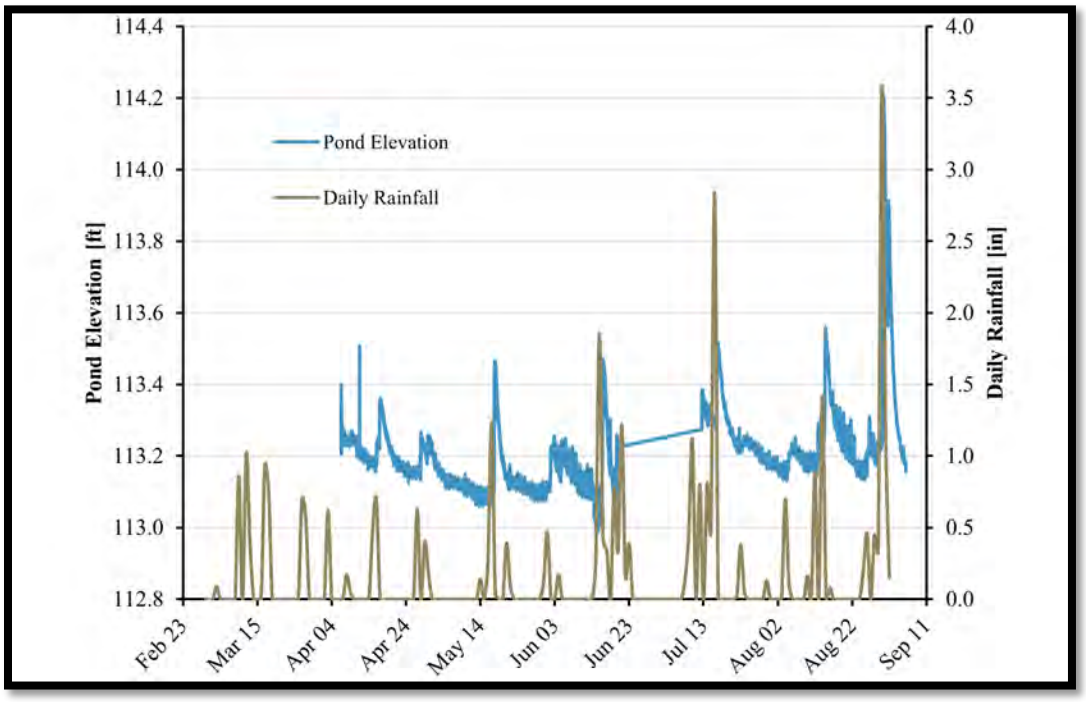


Figure 5-132: Shakey Pond Rainfall and Water Levels (February to September 2023)

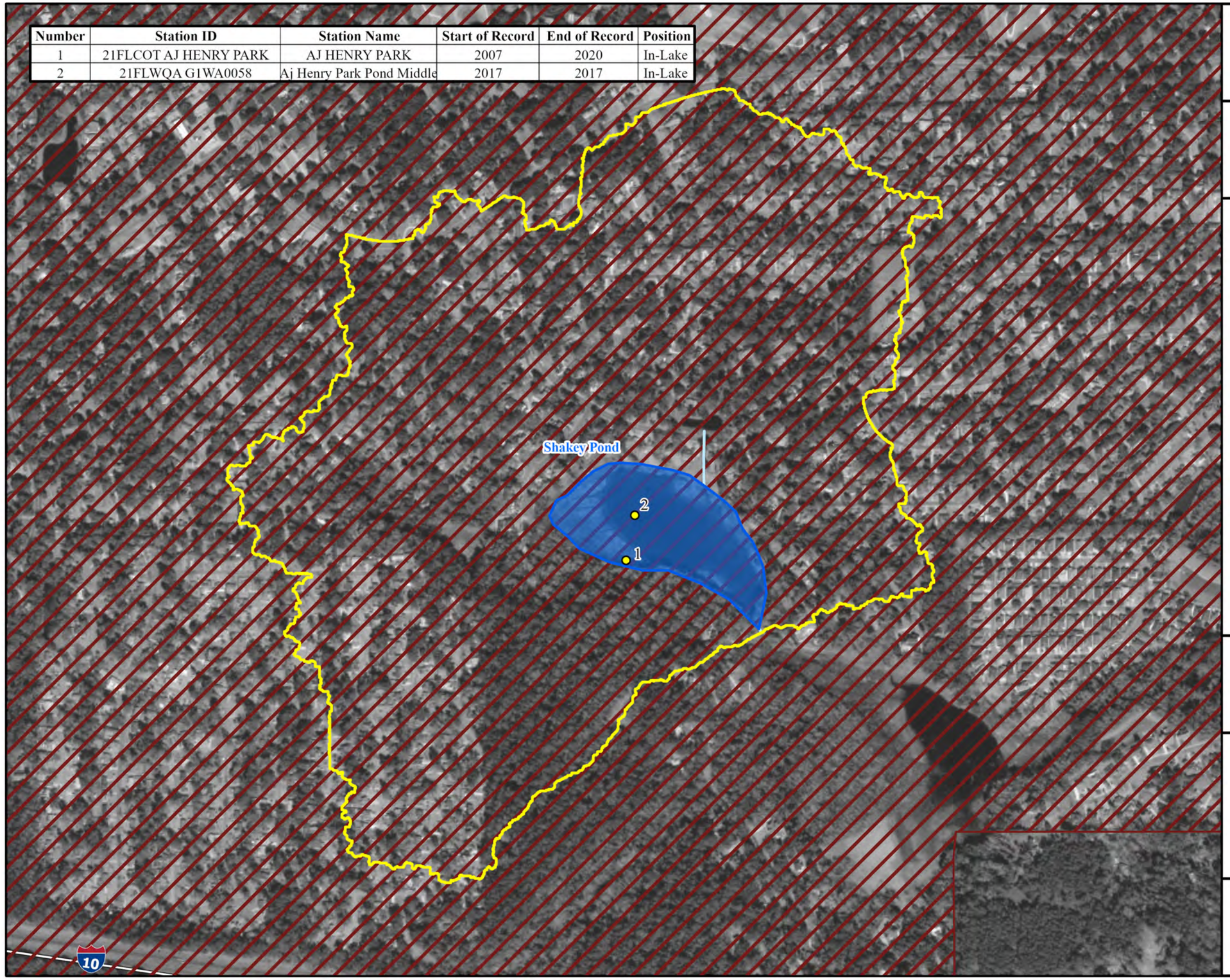
Under FDEP's NNC, Shakey Pond is defined as a low color, high alkalinity system. Based on this designation, the AGM threshold for Chl-a is 20 µg/L. For TN and TP, a range of concentrations are allowable, based on maintaining Chl-a levels in the lake below 20 µg/L. For TN, the range is 1.05 mg/L to 1.91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

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

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

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

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



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Legend

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

Water Quality Stations

Position

- In-Lake

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

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

Tallahassee Master Plan - Surface Water (TMaPS)

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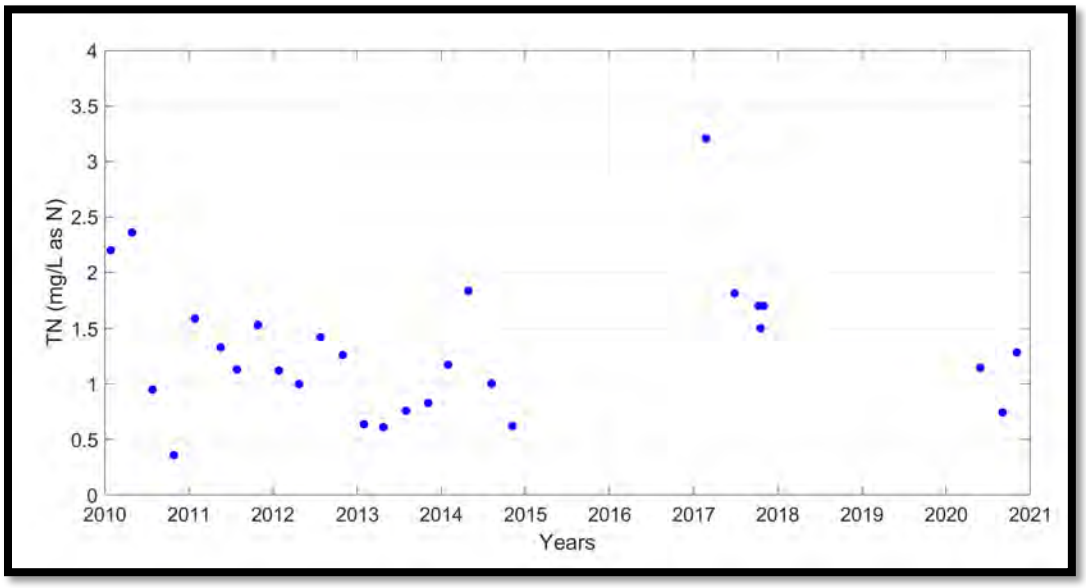


Figure 5-134: Plot of Measured TN

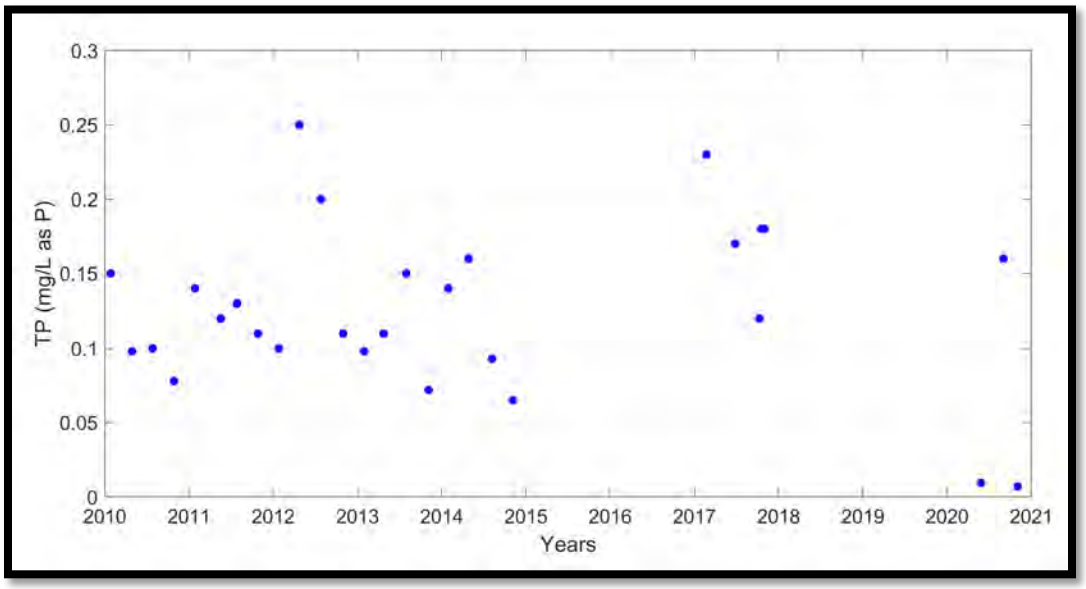


Figure 5-135: Plot of Measured TP

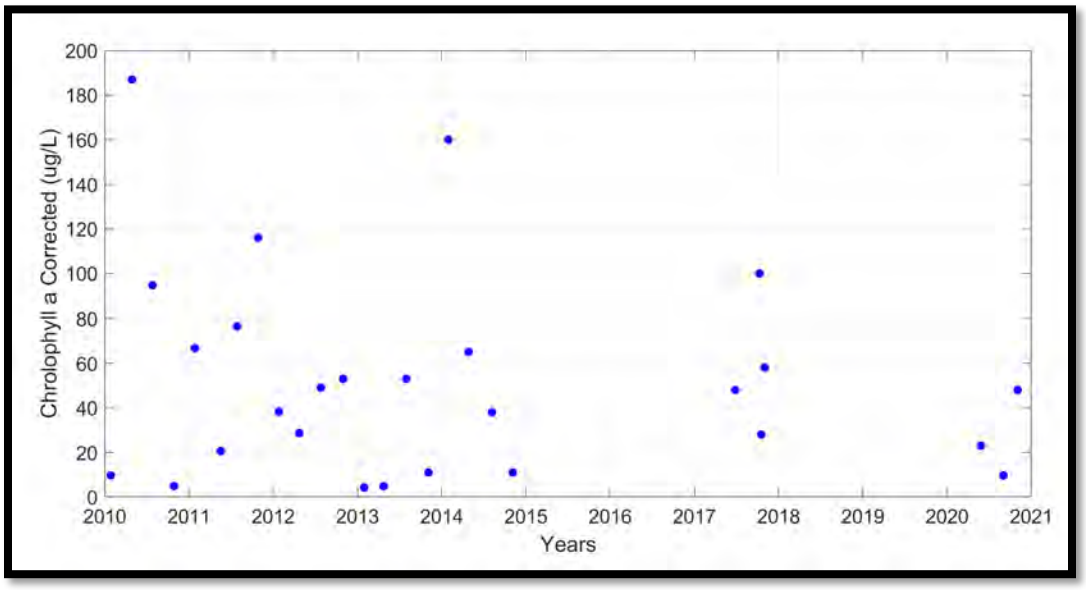


Figure 5-136: Plot of Measured Chl-a

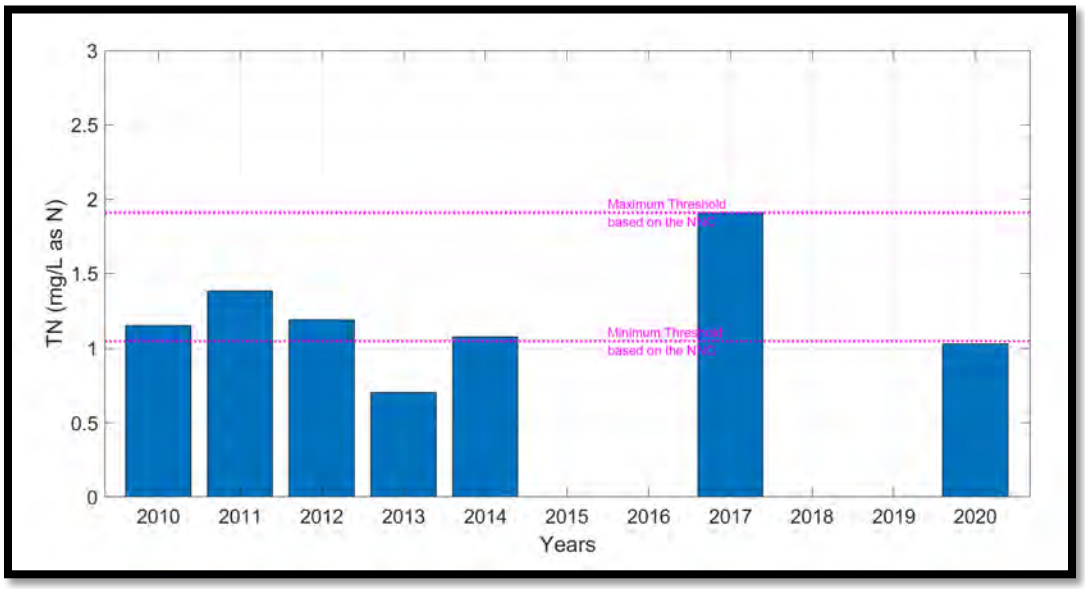


Figure 5-137: Plot of Annual Geometric Means for TN with NNC Criteria for Shakey Pond

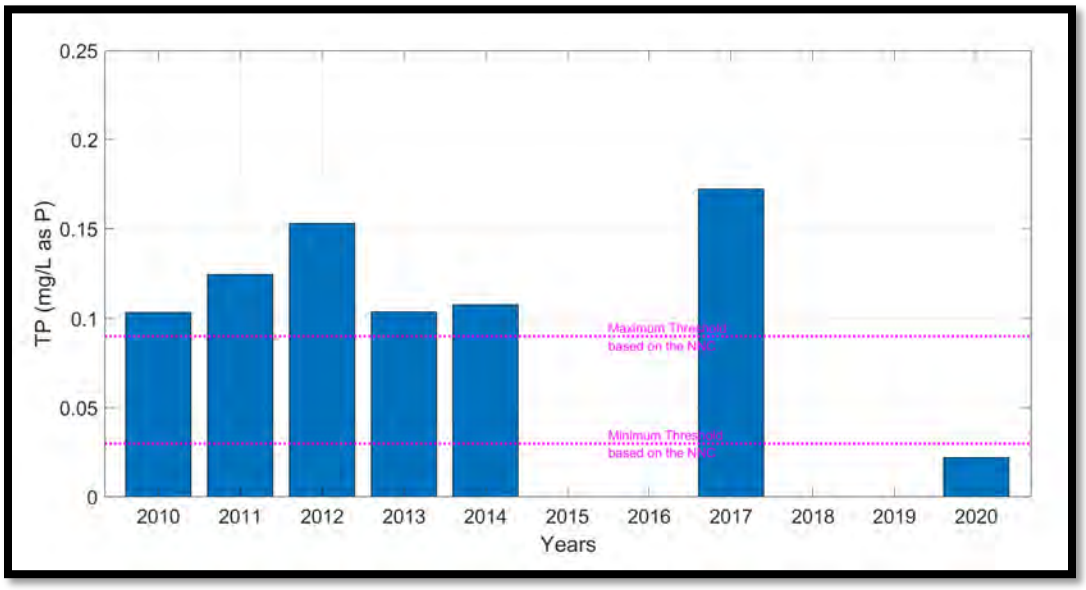


Figure 5-138: Plot of Annual Geometric Means for TP with NNC Criteria for Shakey Pond

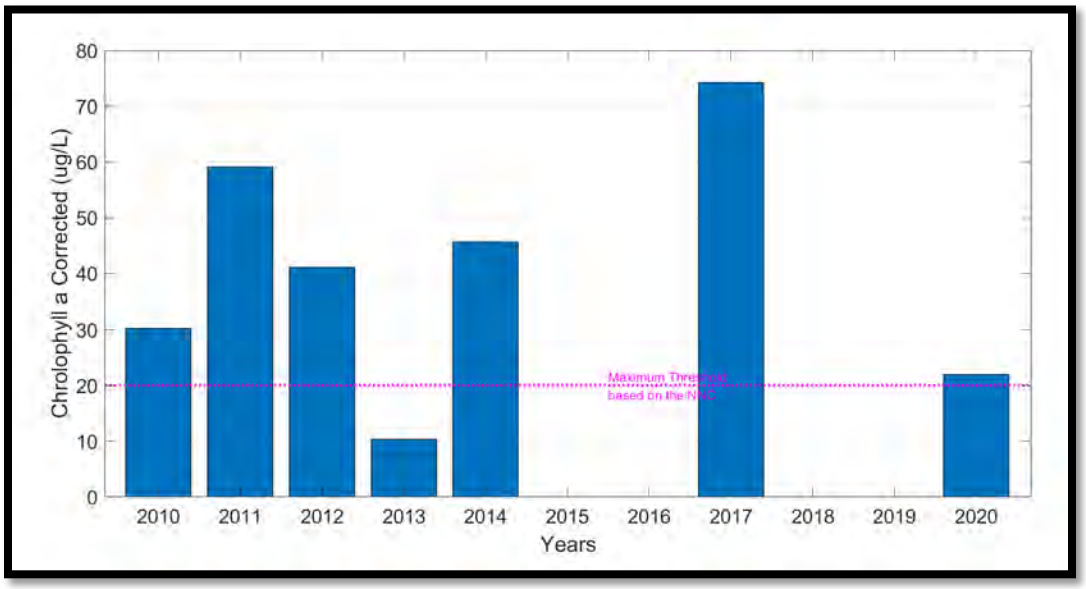


Figure 5-139: Plot of Annual Geometric Means for Chl-a with NNC Criteria for Shakey Pond

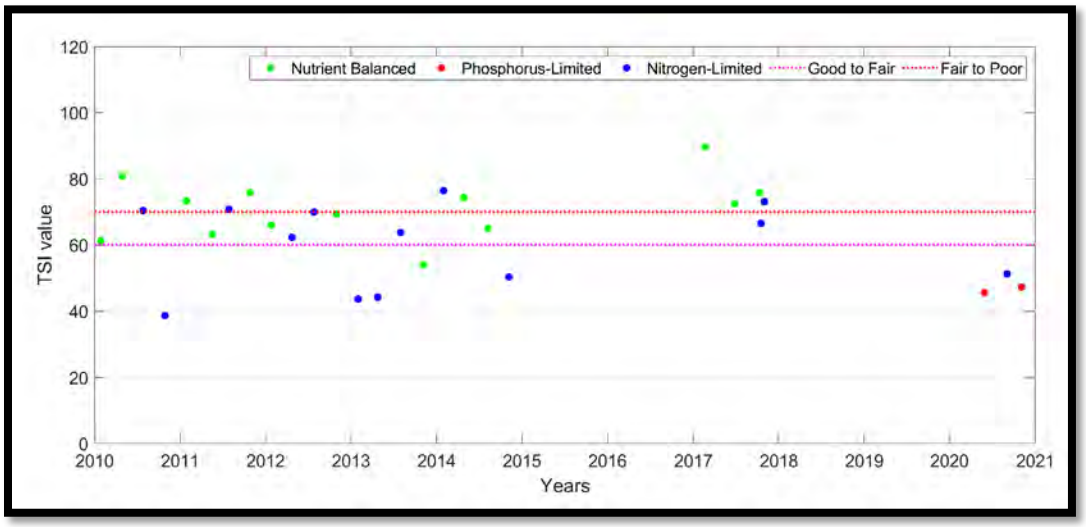


Figure 5-140: Trophic State Index for Shakey Pond

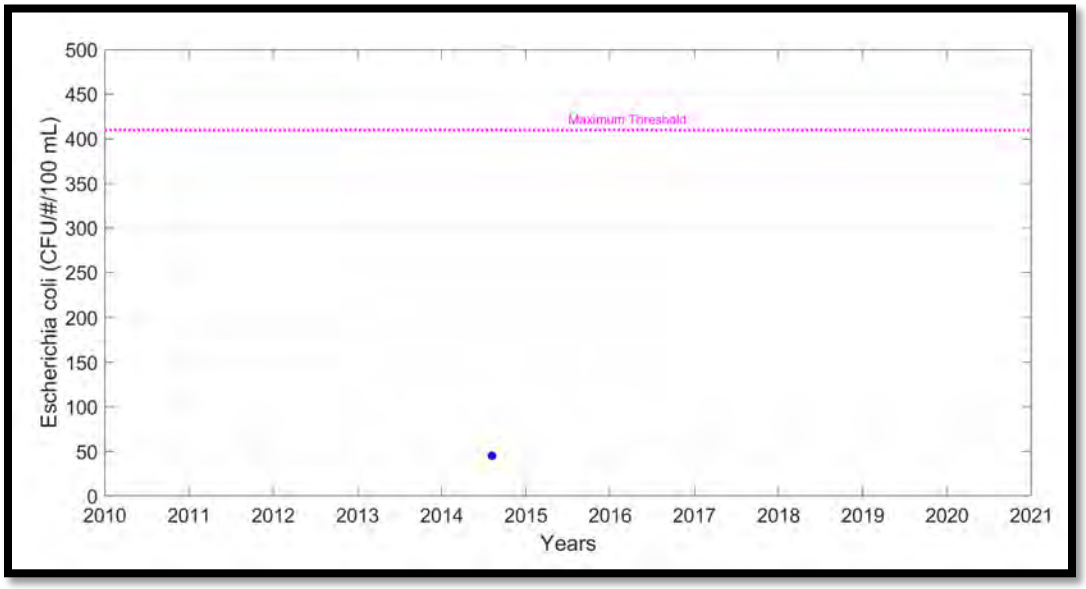


Figure 5-141: Plot of *E. coli* Measurements (2015 to 2019)

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

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

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

5.7.3.7 Groundwater Data

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

5.7.3.8 Biological Data

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

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

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

5.7.3.9 Stormwater Treatment Facilities

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

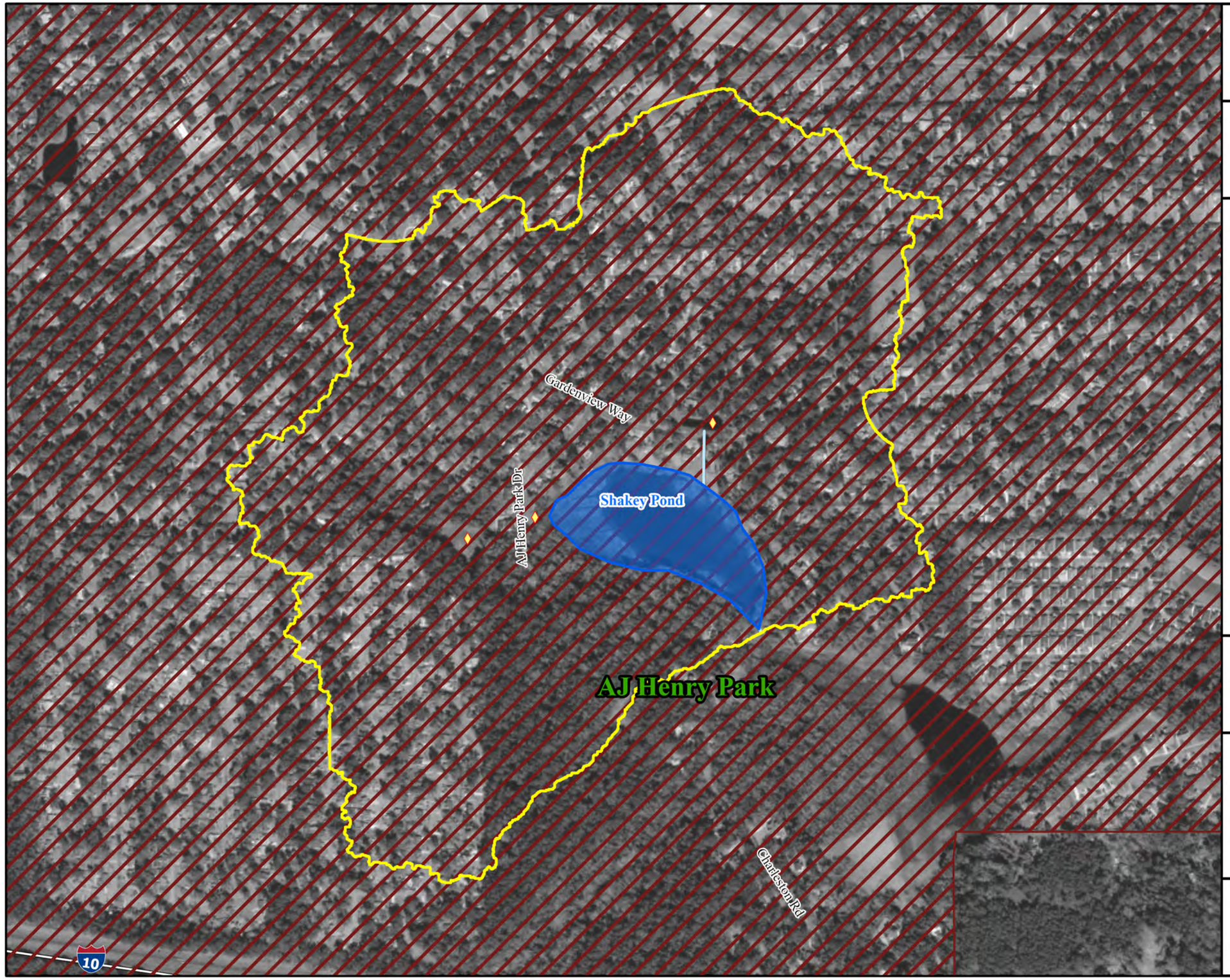
5.7.3.10 Atmospheric Deposition Data

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

5.7.3.11 Data Summary

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

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



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Legend

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

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

Figure 5-142:
Shakey Pond Basin BMP Location Map

Tallahassee Master Plan - Surface Water (TMaPS)

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- No surficial groundwater monitoring stations are located in the vicinity to determine the quality of potential seepage into Shakey Pond.
- No data are available to determine the potential for internal loading as a source.

5.7.4 Qualitative Assessment of Sources

As outlined in previous sections, prior to performing loading calculations and other analyses to quantify existing pollutant sources to Shakey Pond, it is important to analyze available data and other information to support identification of likely sources.

For Shakey Pond, the sources to be evaluated include the following:

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

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

5.7.4.1 Stormwater Runoff

To assess stormwater runoff as a potential source of pollutant loads to Shakey Pond the LDI level within the basin draining to the lake was evaluated. LDI values for the full basin draining to the Lafayette Chain of Lakes were presented on **Figure 5-45** including the Shakey Pond Basin. The map shows that for the watershed draining to Shakey Pond, LDI levels are poor. This would indicate that this area has significant potential for anthropogenic pollutant loads from stormwater runoff. No data are available for any of the discharges at outfalls flowing into Shakey Pond to support direct assessment of stormwater runoff. Additionally, as outlined in **Section 5.7.3.9**, 78 percent of the stormwater runoff from the basin passes through 3 stormwater ponds prior to discharge.

5.7.4.2 Septic Systems

Figure 5-131 presented the locations of septic systems within the Shakey Pond basin. Only 3 systems were identified. Based on the number of septic systems, septic loading is not identified as a source of loading and is not quantified in **Section 5.6.5**.

5.7.4.3 Internal Recycling and Seepage

Internal Recycling

Based on historic loading to the lake and accumulation of material, internal load was defined as a potential source to Shakey Pond. As part of the study discussed earlier, internal loads were calculated.

Seepage

As outlined in **Section 5.7.3.7**, no surficial aquifer data in the immediate vicinity of Shakey Pond were identified. Septic is the most likely source of seepage load, and septics were not identified as a source in **Section 5.7.3.4**. Additionally, soils around Shakey Pond have moderate to poor infiltration potential reducing the likelihood of seepage as a source in relation to stormwater runoff. Based on these reasons, seepage is not identified as a potential significant source.

5.7.4.4 Wastewater

Within the Shakey Pond basin, there currently are no direct wastewater discharges. Additionally, no areas in the Lake Lafayette basin presently have reuse discharges. **Figure 5-47** presented a map of the Lafayette Chain of Lakes basin boundaries in relation to sewer service areas and sewer infrastructure including the Shakey Pond basin. The entire basin has sewer infrastructure. While SSOs occur from time to time, SSOs are acute events with impacts lasting for relatively short periods of time (hours to several days), depending on magnitude and environmental conditions. The mechanism for abatement would not be treatment projects but rather any needed maintenance to sewer infrastructure. The City presently tracks, reports, and addresses these issues as they arise. No significant sewer overflow events have been identified in the Shakey Pond basin, therefore wastewater is not identified as a potential significant source.

5.7.4.5 Atmospheric Deposition

For the Shakey Pond basin, the ratio of the watershed area to lake area is around 18:1. With this ratio, and the potential attenuation of rainfall runoff, direct atmospheric deposition to the lake can play a role in overall loading, especially for nitrogen. **Section 5.5.3.10** identified the nearest atmospheric deposition station as the Quincy Station (FL14) (**Figure 5-35**).

5.7.4.6 Interconnected Flows

No lakes are located upstream of Shakey Pond, therefore interconnected loads are not a source.

5.7.4.7 Summary of Findings

Based on the discussions above, and data and information presented in **Section 5.5.3**, there are various potential sources of pollutant loads to Shakey Pond. Stormwater runoff contributing to direct inflow is identified as a potentially significant anthropogenic load and is quantified in **Section 5.6.5**. Internal loading is also identified as a potential load. Finally, atmospheric deposition is identified as a potential significant source and is quantified **Section 5.6.5**. Another key aspect of Shakey Pond is the failure of the outflow structure which has led to decreased water levels in the system.

5.7.5 Calculation of Potential Nutrient Loads

This section presents calculations of potential nutrient (TN and TP) loads to Shakey Pond for the sources identified for calculation in **Section 5.7.4.7**. These include stormwater runoff and atmospheric deposition. Where loads were not calculated, the sections provide brief discussions. The load calculations are for the purpose of comparing the potential magnitudes of each source relative to one another to support determination of sources to target for load reduction.

5.7.5.1 Stormwater Pollutant Load

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

Figure 5-143 presents the subbasins and the DEM utilized in the SIMPLE model calculations for Shakey Pond. **Figure 5-144** presents the aggregated land use. Finally, **Figure 5-145** presents the CDAs for the Shakey Pond stormwater loading to define total and per acre TN and TP loads, as well as the ranking of CDAs around the Lake.

Stormwater Nutrient Loads to Shakey Pond

Figure 5-146 presents the distribution of the ranking of the CDAs for TN along with the total load and per acre loads, see the table on **Figure 5-146**. The rankings are color coded with the highest ranked CDAs in dark green moving down to the lowest ranked in pale yellow. The calculated total stormwater TN loads from the CDAs ranged from as low as 7.4 lb/yr up to 372.4 lb/yr. The per acre loads ranged from 1.2 lb/acre/yr up to 4.6 lb/acre/yr. The highest ranked CDAs are located north of Shakey Pond in the areas with significant residential development. For the loading calculations treatment was only assumed for ponds larger than 1 acre, as such present treatment within the Shakey Pond watershed for some CDAs is not accounted for. Only one of the CDAs discharges directly to Shakey Pond without any treatment and that is #2 on **Figure 5-145** and is one of the top ranked CDAs relative to TN loading. The total potential stormwater runoff load for TN to Shakey Pond is 932 lb/yr.

Figure 5-147 presents the distribution of the ranking of the CDAs for TP along with the total load and per acre loads, see the table on **Figure 5-147**. The calculated total stormwater TP loads from the CDAs ranged from as low as 1.4 lb/yr up to 101.4 lb/yr. The per acre loads ranged from 0.2 lb/acre/yr up to 1.3 lb/acre/yr. The total potential stormwater runoff load for TP for Shakey Pond is 250 lb/yr.

5.7.5.2 Septic Load

Based on the small number of septic systems in the basin (3) septic load was not identified as a potential source. As such, no septic load was calculated.

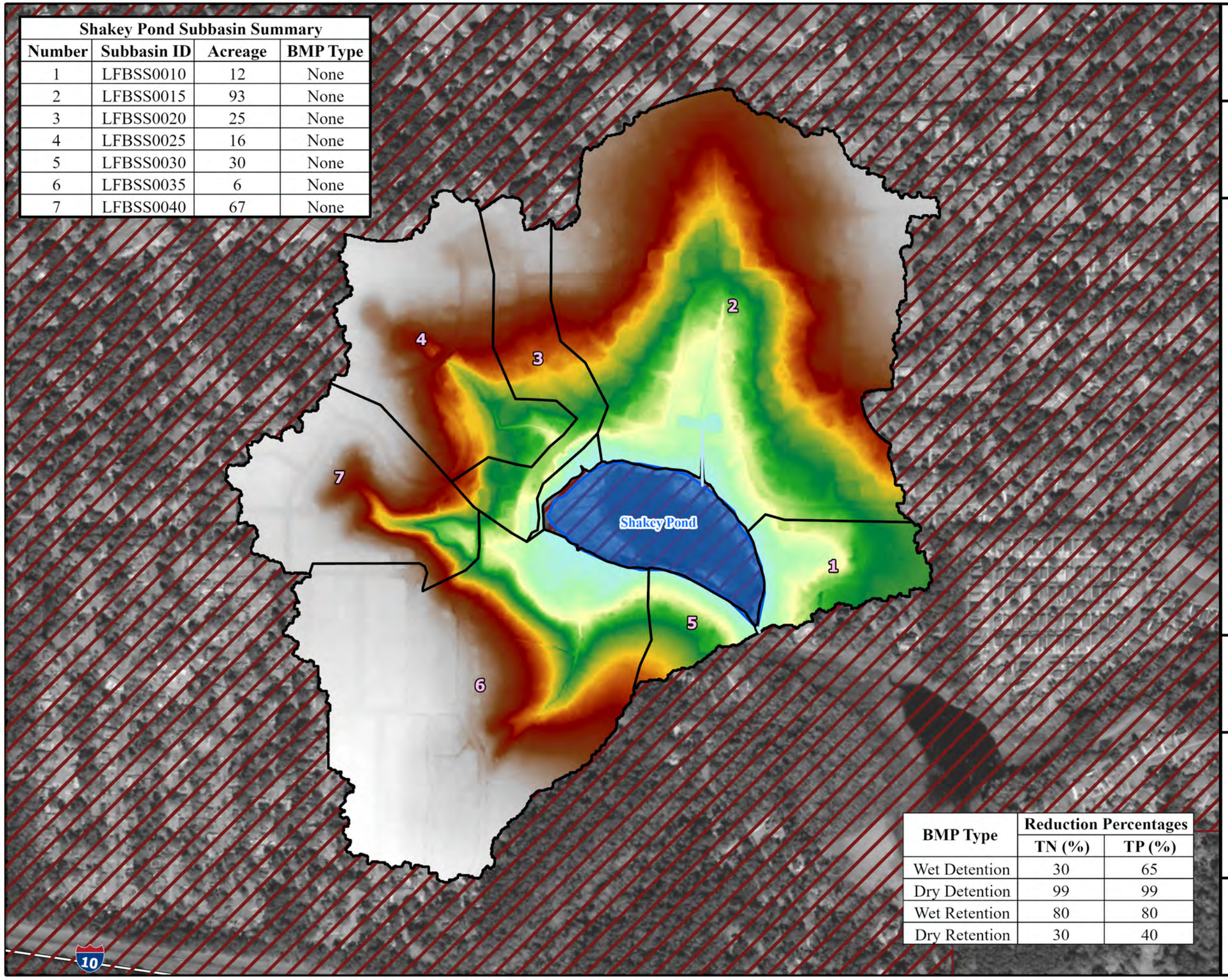
5.7.5.3 Point Source Load

No active point sources were identified within the Shakey Pond basin. Therefore, the point source loads for TN and TP are set to 0 lb/yr for Shakey Pond.

5.7.5.4 Lake Inflow Load

There are no identified lakes upstream of Shakey Pond. Therefore, the inter-lake TN and TP loads are set to 0 lb/yr.

Shakey Pond Subbasin Summary			
Number	Subbasin ID	Acreage	BMP Type
1	LFBSS0010	12	None
2	LFBSS0015	93	None
3	LFBSS0020	25	None
4	LFBSS0025	16	None
5	LFBSS0030	30	None
6	LFBSS0035	6	None
7	LFBSS0040	67	None



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

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Legend

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

Topographic Elevations
ft NAVD88

225
115

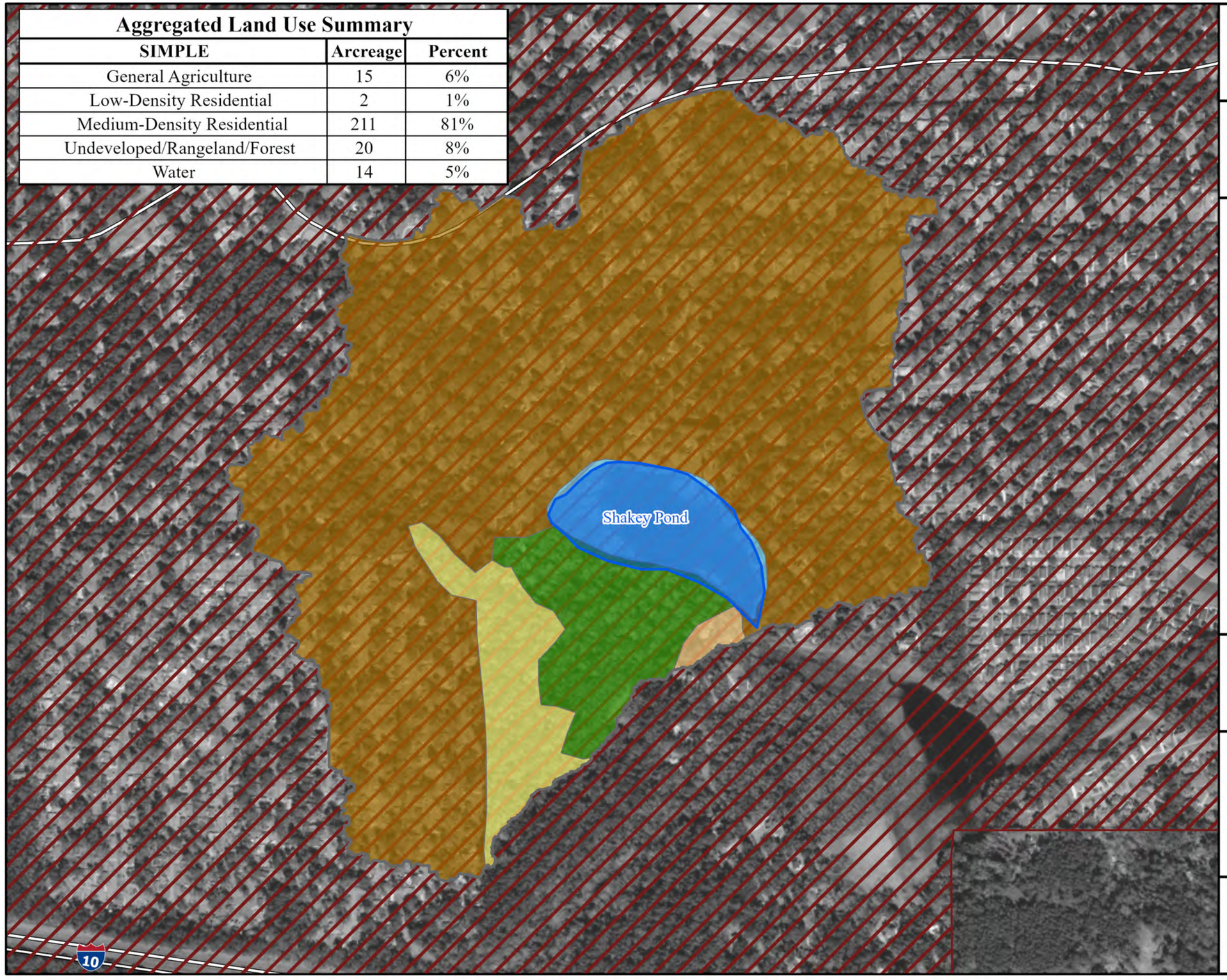
Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Subbasins: Geosyntec, 2022
Roads: COT-Leon County, 2023
City Limits: COT, 2022
BMPs: Geosyntec, 2023
Elevation: COT-Leon County, 2018

Figure 5-143:
Shakey Pond Subbasin Delineation and BMPs

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants

Aggregated Land Use Summary		
SIMPLE	Arcreage	Percent
General Agriculture	15	6%
Low-Density Residential	2	1%
Medium-Density Residential	211	81%
Undeveloped/Rangeland/Forest	20	8%
Water	14	5%



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Miles

Legend

- Shakey Pond Drainage Basin
- Waterbodies In Study
- Tallahassee Corporate Limits

Aggregated Land Use

Land Use Type

- General Agriculture
- Low-Density Residential
- Medium-Density Residential
- Undeveloped/Rangeland/Forest
- Water

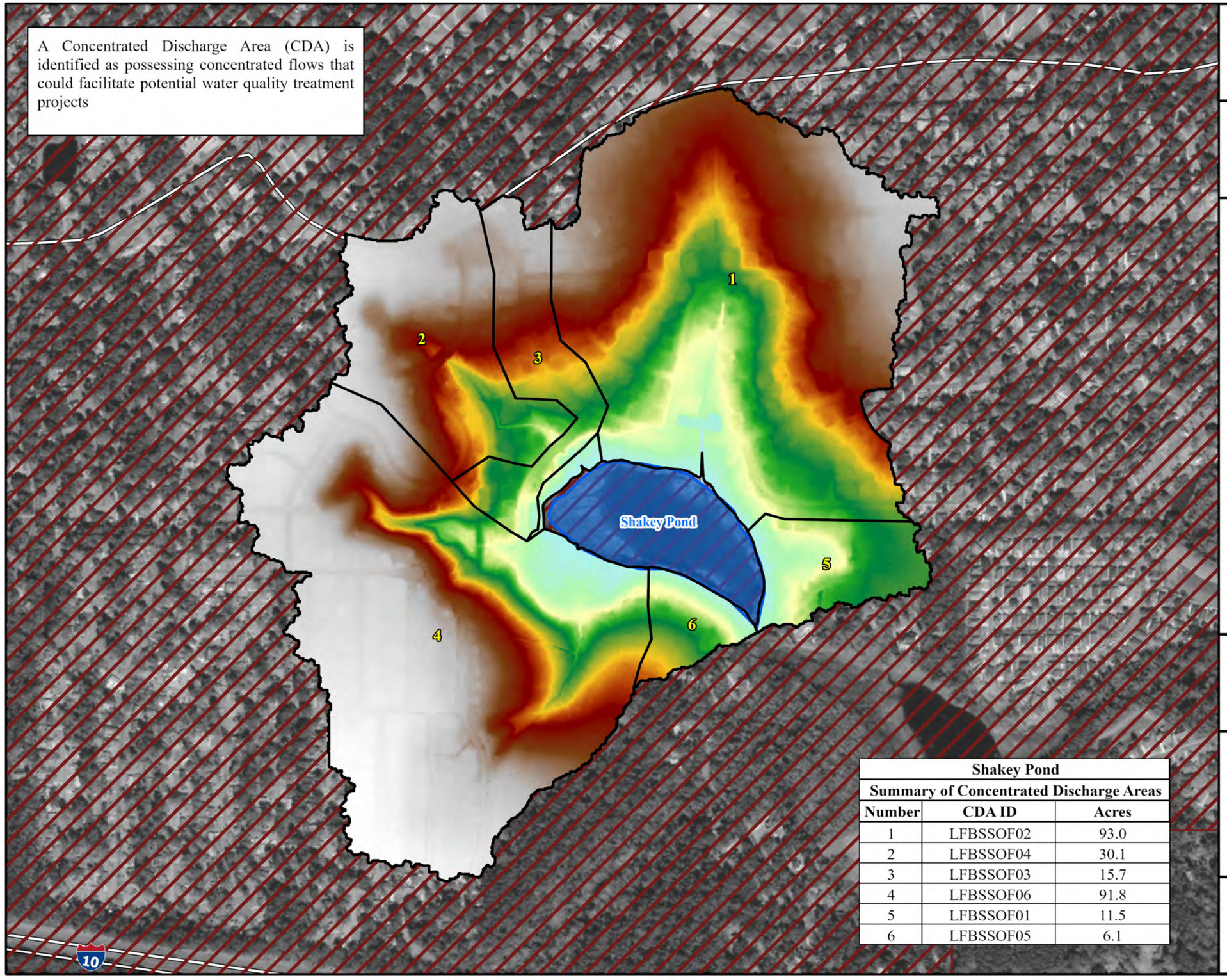
Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Land Use: Geosyntec, 2023
Roads: FDOT, 2020
City Limits: COT, 2020

Figure 5-144:
Shakey Pond Aggregated Land Use

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants

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



CITY OF TALLAHASSEE

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Miles

Legend

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

Topographic Elevations
ft NAVD88

225
115

Shakey Pond		
Summary of Concentrated Discharge Areas		
Number	CDA ID	Acres
1	LFBSSOF02	93.0
2	LFBSSOF04	30.1
3	LFBSSOF03	15.7
4	LFBSSOF06	91.8
5	LFBSSOF01	11.5
6	LFBSSOF05	6.1

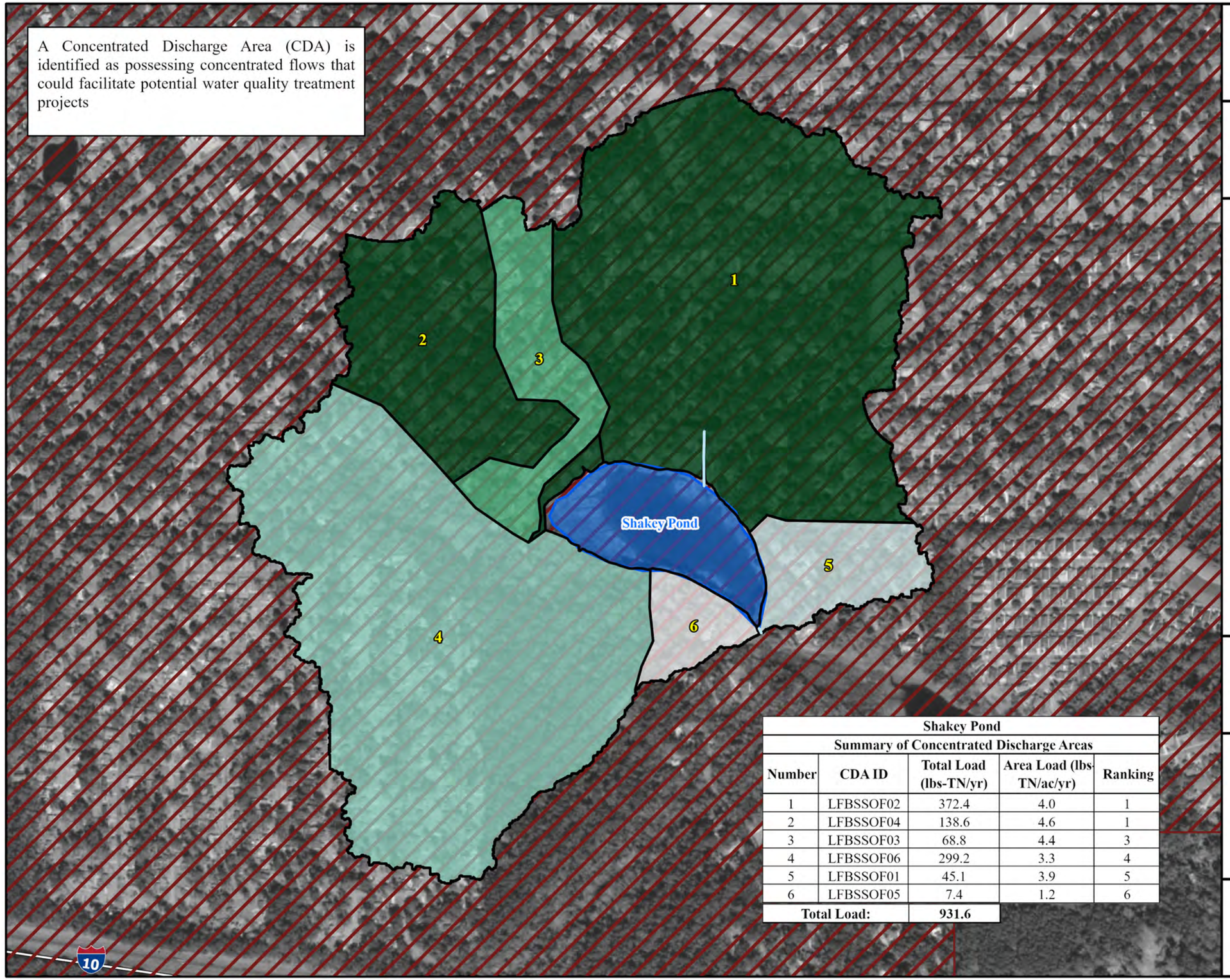
Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
CDAs: Geosyntec, 2022
Roads: COT-Leon County, 2023
City Limits: COT, 2022
Elevation: COT-Leon County, 2018

Figure 5-145:
Shakey Pond Concentrated Discharge Areas

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants

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



CITY OF TALLAHASSEE

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Miles

Legend

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

Ranking

- High (1)
- Low (6)

Shakey Pond				
Summary of Concentrated Discharge Areas				
Number	CDA ID	Total Load (lbs-TN/yr)	Area Load (lbs-TN/ac/yr)	Ranking
1	LFBSSOF02	372.4	4.0	1
2	LFBSSOF04	138.6	4.6	1
3	LFBSSOF03	68.8	4.4	3
4	LFBSSOF06	299.2	3.3	4
5	LFBSSOF01	45.1	3.9	5
6	LFBSSOF05	7.4	1.2	6
Total Load:		931.6		

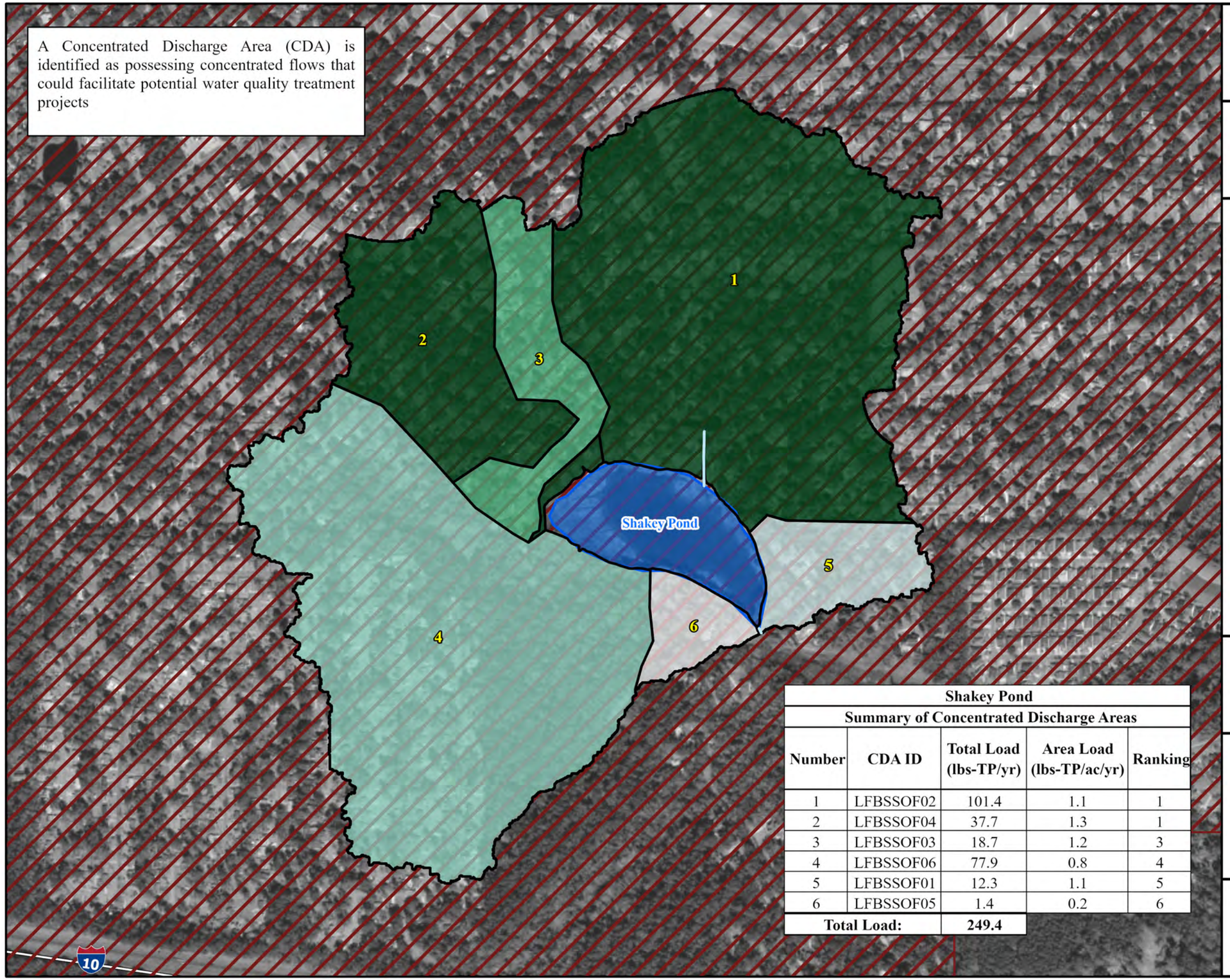
Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
CDAs: Geosyntec, 2022
Roads: COT-Leon County, 2023
City Limits: COT, 2022

Figure 5-146:
Shakey Pond Concentrated Discharge Areas-Total Nitrogen

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants

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



CITY OF TALLAHASSEE

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Legend

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

Ranking

- High (1)
- Low (6)

Shakey Pond				
Summary of Concentrated Discharge Areas				
Number	CDA ID	Total Load (lbs-TP/yr)	Area Load (lbs-TP/ac/yr)	Ranking
1	LFBSSOF02	101.4	1.1	1
2	LFBSSOF04	37.7	1.3	1
3	LFBSSOF03	18.7	1.2	3
4	LFBSSOF06	77.9	0.8	4
5	LFBSSOF01	12.3	1.1	5
6	LFBSSOF05	1.4	0.2	6
Total Load:		249.4		

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

Figure 5-147:
Shakey Pond Concentrated Discharge Areas-Total Phosphorus

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants

5.7.5.5 Internal Lake Load

As discussed previously, a study was completed in Shakey Pond. As part of that study the average annual internal load for TN and TP was calculated. The fluxes were 985 lb/yr and 29 lb/yr respectively for TN and TP.

5.7.5.6 Atmospheric Deposition

As presented and discussed in **Section 5.4.5.6** the annual average atmospheric TN load per acre was calculated from the Quincy NADP station (F14) at 2.56 lb/acre/yr. Multiplying this by the acreage of Shakey Pond (14 acres) gives a total TN load of 35.8 lb/yr. No data are available for TP therefore only the nitrogen load is provided.

5.7.5.7 Summary of Calculated Loads

Nutrient loads to Shakey Pond were calculated for stormwater runoff, septic systems, and atmospheric deposition. **Table 5-23** presents the calculated total loads to the lake for TN and TP. For atmospheric deposition only TN loads were calculated.

Table 5-23: Summary of Calculated Loads to Shakey Pond

Source	TN (lb/year)	TP (lb/year)
Stormwater Runoff	932	249
Septic Load	0	NC
Internal Load	985	29
Atmospheric Deposition	36	NC

NC – Not calculated.

5.8 Lafayette Creek and Lake Leon

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

5.8.1 Overview and History

Lafayette Creek is an ephemeral urban stream that flows from its headwaters in commercial areas around the intersection of Capital Circle and Apalachee Parkway, through a mixture of wooded areas and commercial/residential development both south and north of Apalachee Parkway and ultimately discharges to the southeast end of Upper Lake Lafayette just north of the CSX railroad crossing (**Figure 5-148**). **Photo 5-66** shows the stream upstream of the CSX crossing and the ephemeral nature of the creek. **Photo 5-67** shows the stream at the CSX crossing. Neighborhoods contained within the drainage basin include Twin Lakes, Copper Creek, and Chase Ridge along with Lincoln High School and Tom Brown Park. The Lafayette Creek basin covers an area of 180 acres with the bulk of the basin within the City's incorporated area. The only unincorporated areas of the basin are along the western side (**Figure 5-148**).

Photo 5-66: Lafayette Creek Upstream of CSX Crossing

CSX Crossing
Upper Lake Lafayette
Tom Brown Park
Lake Leon
Connor Blvd
Pincy Z Lake
Lafayette Creek
Capital Circle SE
Apalachee Pkwy SR20
US Hwy 27 S
Old St Augustine Rd

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Miles

Legend

- Lafayette Creek and Lake Leon Drainage Basin
- Waterbodies in Study
- Tallahassee Corporate Limits

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

Figure 5-148:
Lafayette Creek and Lake Leon Basin Overview Map

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants

Photo 5-67: Lafayette Creek at CSX Crossing

Lake Leon is a 6-acre impounded waterbody located within Tom Brown Park. **Photo 5-68** shows the lake in January 2021**.** According to FDEP, the lake was excavated out of wetlands in the 1960s. Drainage to Lake Leon includes adjacent recreational areas and ball parks within Tom Brown Park, the Florida Agricultural Museum, and the Federal Correctional Institution through wetland areas located to the west of the lake. Inflows come from two channels that drain into the western side into the downstream end of Lafayette Creek. Outflow is via a spillway located on the eastern side of the lake. **Photo 5-69** shows the spillway.

Photo 5-70 through **Photo 5-77** present aerials of the area around Lake Leon from 1937 to 1920. The aerial photos identify a number of important aspects of the Lake's history. First, examination of the aerial photos from 1937 through 1970 show that, as discussed above, prior to the 1960s Lake Leon did not exist. Prior to the excavation of the lake, the area where it is presently located was a wooded area with no visible open water. The lake outline is clear in the 1970 photo (**Photo 5-73**) and remains relatively consistent through present conditions. One aspect visible in the 2020 aerial is the expansion of aquatic vegetation cover on the lake which is not seen in any of the other photos (**Photo 5-77**).

Photo 5-68: Lake Leon (January 2021)

Photo 5-69: Lake Leon Spillway (January 2021)

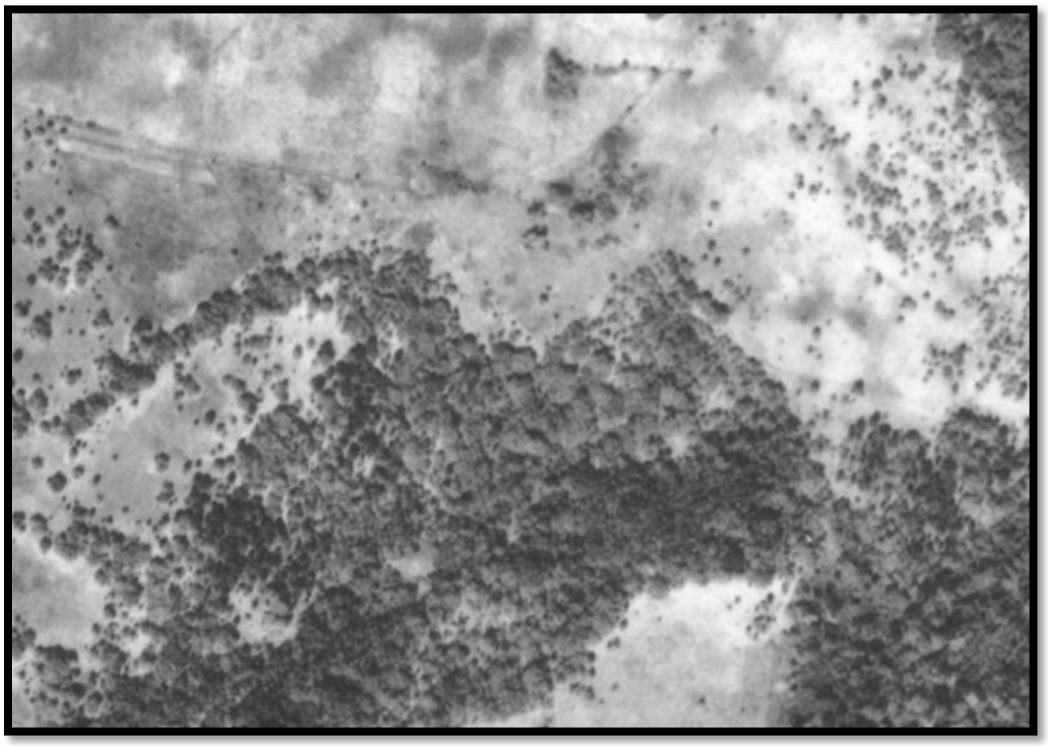


Photo 5-70: Lake Leon Aerial (1937)

Photo 5-71: Lake Leon Aerial (1949)

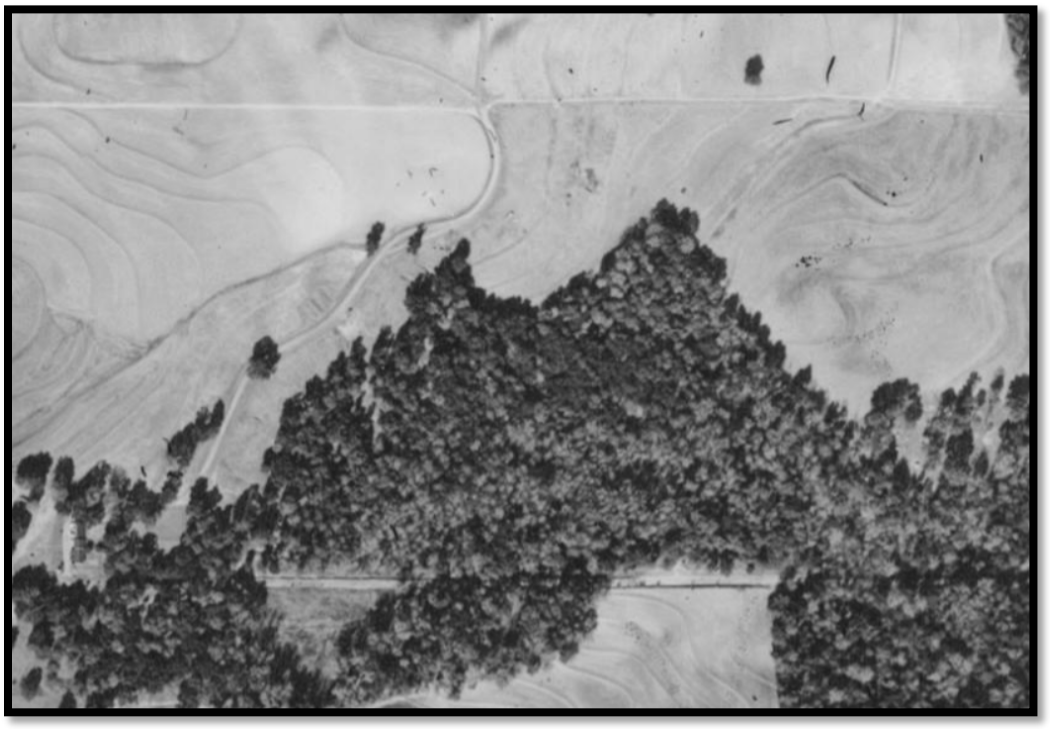


Photo 5-72: Lake Leon Aerial (1954)

Photo 5-73: Lake Leon Aerial (1970)

Photo 5-74: Lake Leon Aerial (1983)

Photo 5-75: Lake Leon Aerial (1990)

Photo 5-76: Lake Leon Aerial (2007)

Photo 5-77: Lake Leon Aerial (2020)

In 2009 a pilot project by the City was completed on Lake Leon to evaluate the efficacy of using floating vegetation mats to reduce nutrient concentrations. Nine floating mats were installed in the lake and the plant biomass and resulting inflowing and outflowing nutrient concentrations monitored. The findings of the study were that while some uptake of TKN was documented along with increases in plant biomass, overall nitrogen and phosphorus uptake by the mats was insufficient to provide measurable improvements in lake water quality.

The lake has undergone a number of drawdowns in recent years. **Photo 5-78** shows a drawdown in 2011 as part of a shoreline restoration project. In 2017 the lake was drawn down in order to do lake bottom modifications and repairs to an aerator pump. Increases in littoral vegetation including water hyacinths was noted following the 2017 draw down. **Photo 5-68** shows the extensive water hyacinth coverage in 2021.

Photo 5-78: Lake Leon during 2011 Drawdown for Shoreline Restoration

Presently Lake Leon is classified as a lake and is assessed against lake NNC despite its being a constructed and impounded waterbody built primarily to serve as stormwater retention. FDEP has identified that Lake Leon is not eligible for exemption under 62-340.700, F.A.C. based on it meeting the criteria for non-exempt status as a "*works, impoundments, reservoirs, or other watercourses that, are currently wetlands which existed before construction of the stormwater treatment system and were incorporated in it.*" Additionally, FDEP has identified that Lake Leon is not operated solely as a stormwater facility but is utilized as a recreational fishery and therefore should be protected as a Class III waterbody.

5.8.2 Regulatory Status

Exhibit 5-2 presented the verified impaired waters within the overall Lake Lafayette basin. Presently, neither Lafayette Creek nor Lake Leon are verified impaired for any parameter.

5.8.3 Waterbody Data Review and Summary

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

5.8.3.1 Land Use

Figure 5-149 presents a map of the Level 2 land uses within the Lafayette Creek basin. A table is provided to show the overall acreages and percent cover. Tables are provided for both the Level 2 and grouped Level 1 land uses. The largest land use within the Lafayette Creek basin per the grouped Level 1 categories is Urban and Built Up (44 percent), which is made up of a mixture of medium and high density residential. The second largest land use is Upland Forest (34 percent). The Upland Forest land uses are located as a large area in the headwater of the basin along the creek, and in and around Lake Leon and Tom Brown Park near the discharge to Upper Lake Lafayette. Commercial areas are located along Apalachee Parkway and around Lincoln High School.

5.8.3.2 Soils

The most prevalent soil group in the Lafayette Creek and Lake Leon basin is Group B (45.9 percent) (**Figure 5-150**) followed closely by Group C (38.0 percent). Group B soils are considered to have moderate rates of infiltration while Group C soils have slow rates of infiltration. The remaining soils in the area are A/D and B/D soils (located primarily around the creek and Lake Leon) which have low rates of infiltration due to a high-water table. Based on the distribution of soil groups in the basin, infiltration is limited resulting in higher runoff potential.

5.8.3.3 Septic Systems

An estimated 197 septic systems are within the boundaries of the Lafayette Creek basin (**Figure 5-151**). The systems are located as sparse clusters in the headwaters along the western side of the basin and within a somewhat dense cluster directly adjacent to the creek just upstream of the crossing of Apalachee Parkway. There are no septic systems in the downstream areas of the basin or near Lake Leon.

5.8.3.4 Hydrologic Data

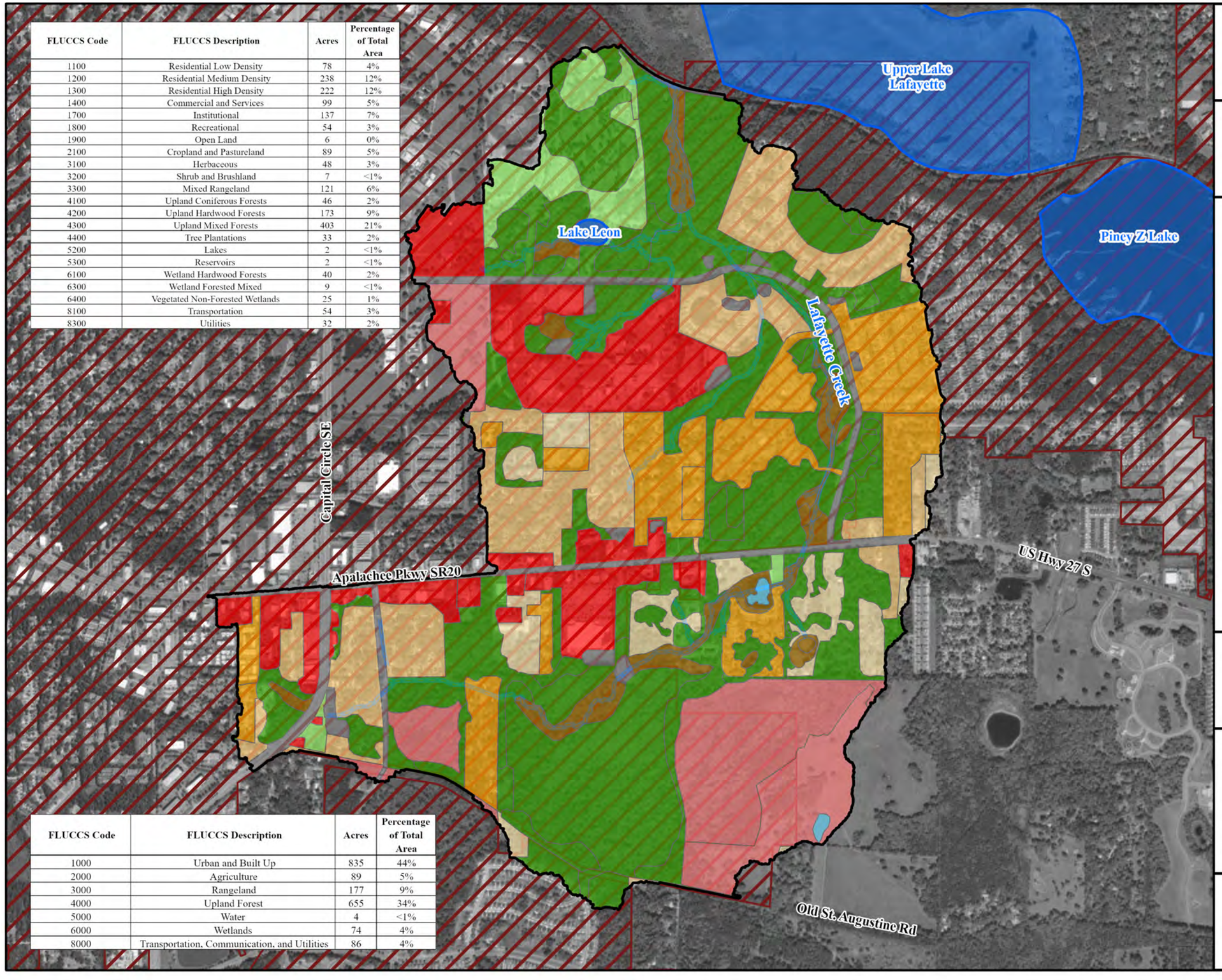
Exhibit 5-6 presented the locations of hydrologic monitoring stations throughout the Lafayette Chain of Lakes basin. There are no hydrologic stations located in the Lafayette Creek basin or in Lake Leon.

5.8.3.5 Surface Water Quality Data

The IWR dataset for Lafayette Creek and Lake Leon spans from 1996 to 2020 and includes data collected by the City, USGS, FDEP and Leon County (**Figure 5-152**). A table is provided in **Figure 5-152** that shows the ID, station name, period of record, and if the stations are within Lake Leon or Lafayette Creek. Based on the number of stations and the length of the station IDs, station IDs were not included on the figure, rather each of the stations is given a number and the numbers correspond to stations in the table.

FLUCCS Code	FLUCCS Description	Acres	Percentage of Total Area
1100	Residential Low Density	78	4%
1200	Residential Medium Density	238	12%
1300	Residential High Density	222	12%
1400	Commercial and Services	99	5%
1700	Institutional	137	7%
1800	Recreational	54	3%
1900	Open Land	6	0%
2100	Cropland and Pastureland	89	5%
3100	Herbaceous	48	3%
3200	Shrub and Brushland	7	<1%
3300	Mixed Rangeland	121	6%
4100	Upland Coniferous Forests	46	2%
4200	Upland Hardwood Forests	173	9%
4300	Upland Mixed Forests	403	21%
4400	Tree Plantations	33	2%
5200	Lakes	2	<1%
5300	Reservoirs	2	<1%
6100	Wetland Hardwood Forests	40	2%
6300	Wetland Forested Mixed	9	<1%
6400	Vegetated Non-Forested Wetlands	25	1%
8100	Transportation	54	3%
8300	Utilities	32	2%

FLUCCS Code	FLUCCS Description	Acres	Percentage of Total Area
1000	Urban and Built Up	835	44%
2000	Agriculture	89	5%
3000	Rangeland	177	9%
4000	Upland Forest	655	34%
5000	Water	4	<1%
6000	Wetlands	74	4%
8000	Transportation, Communication, and Utilities	86	4%



CITY OF TALLAHASSEE

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Legend

- Lafayette Creek and Lake Leon Drainage Basin
- Tallahassee Corporate Limits

Land Use

- 1100: Residential Low Density
- 1200: Residential Medium Density
- 1300: Residential High Density
- 1400: Commercial and Services
- 1500: Industrial
- 1600: Extractive
- 1900: Open Land
- 2100: Cropland and Pastureland
- 2400: Nurseries and Vineyards
- 3200: Shrub and Brushland
- 3300: Mixed Rangeland
- 4100: Upland Coniferous Forests
- 4200: Upland Hardwood Forests
- 4300: Upland Mixed Forests
- 3300: Mixed Rangeland
- 5200: Lakes
- 5300: Reservoirs
- 6100: Wetland Hardwood Forests
- 6300: Wetland Forested Mixed
- 6400: Vegetated Non-Forested Wetlands
- 8100: Transportation
- 6500: Non-Vegetated

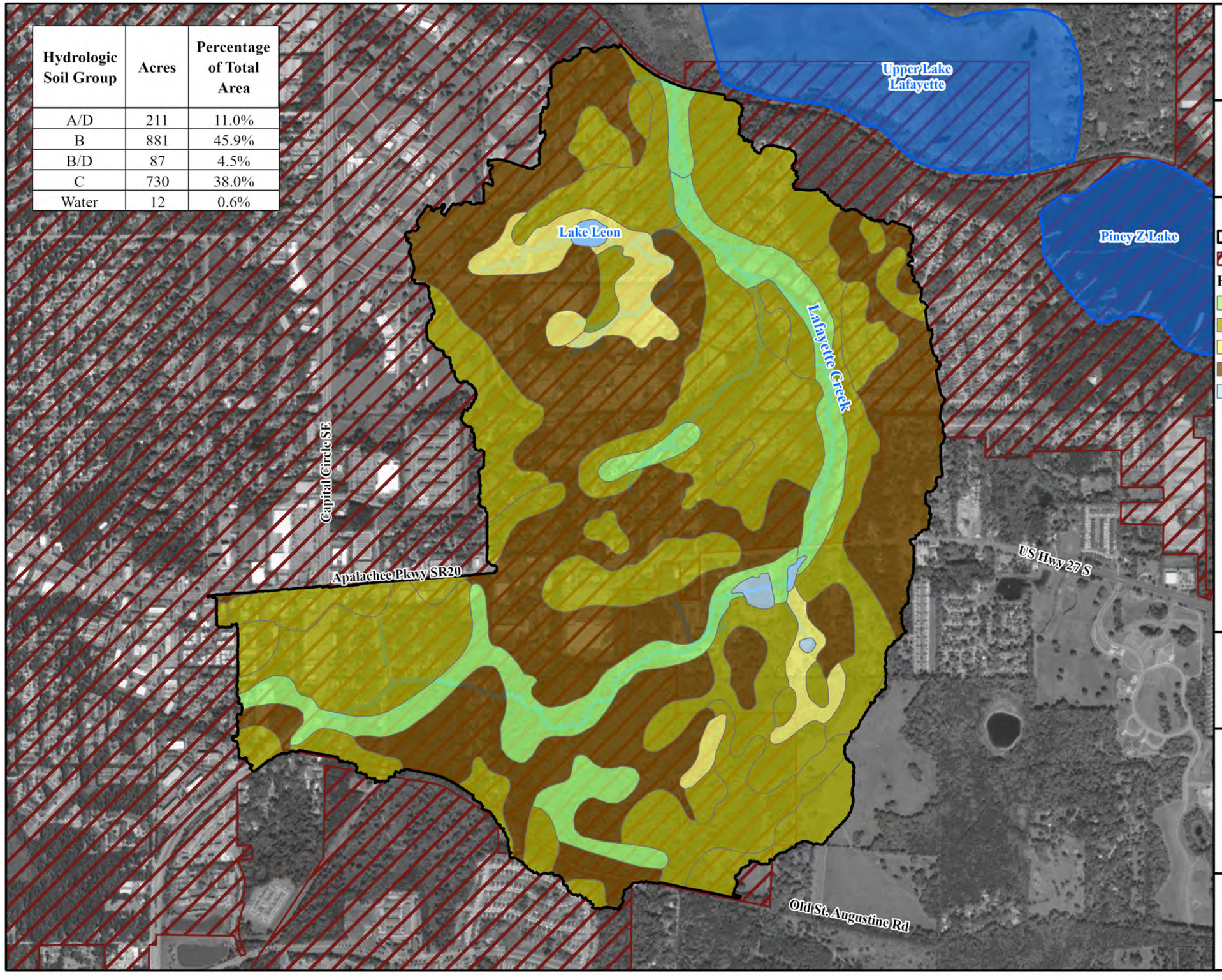
Sources:
Waterbodies: COT, 2020
Watersheds: COT, 2020
Roads: FDOT, 2020
Land Use: NWFWMD, 2019
City Limits: COT, 2022

Figure 5-149:
Lafayette Creek and Lake Leon Land Use Map

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants

Hydrologic Soil Group	Acres	Percentage of Total Area
A/D	211	11.0%
B	881	45.9%
B/D	87	4.5%
C	730	38.0%
Water	12	0.6%



CITY OF TALLAHASSEE

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Miles

Legend

- Lafayette Creek and Lake Leon Drainage Basin
- Tallahassee Corporate Limits

Hydrologic Soil Group

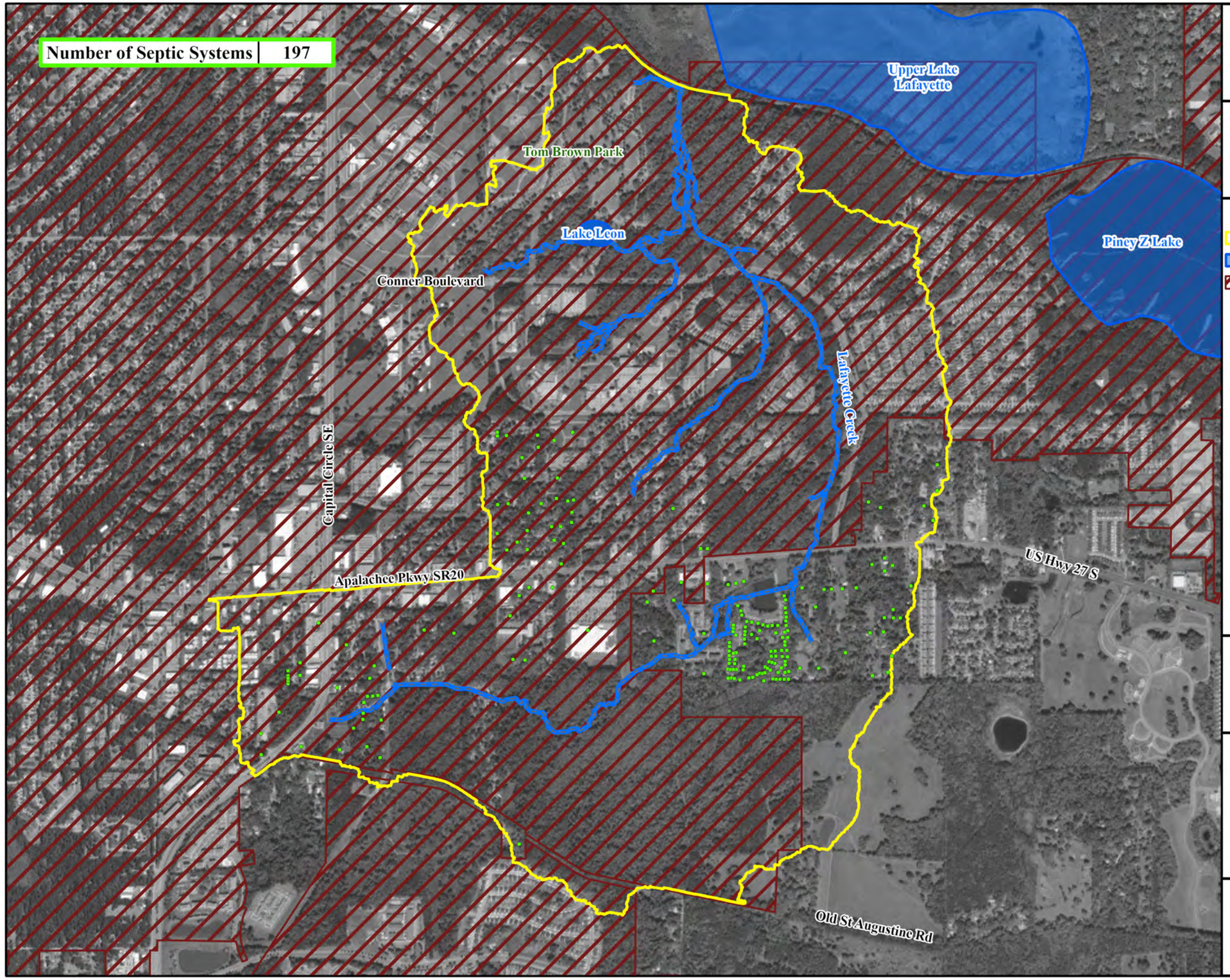
- A/D
- B
- B/D
- C
- Water

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

Figure 5-150:
Lafayette Creek and Lake Leon Soils Map

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants



CITY OF TALLAHASSEE

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Legend

- Lafayette Creek and Lake Leon Drainage Basin
- Waterbodies in Study
- Tallahassee Corporate Limits
- Septic Systems

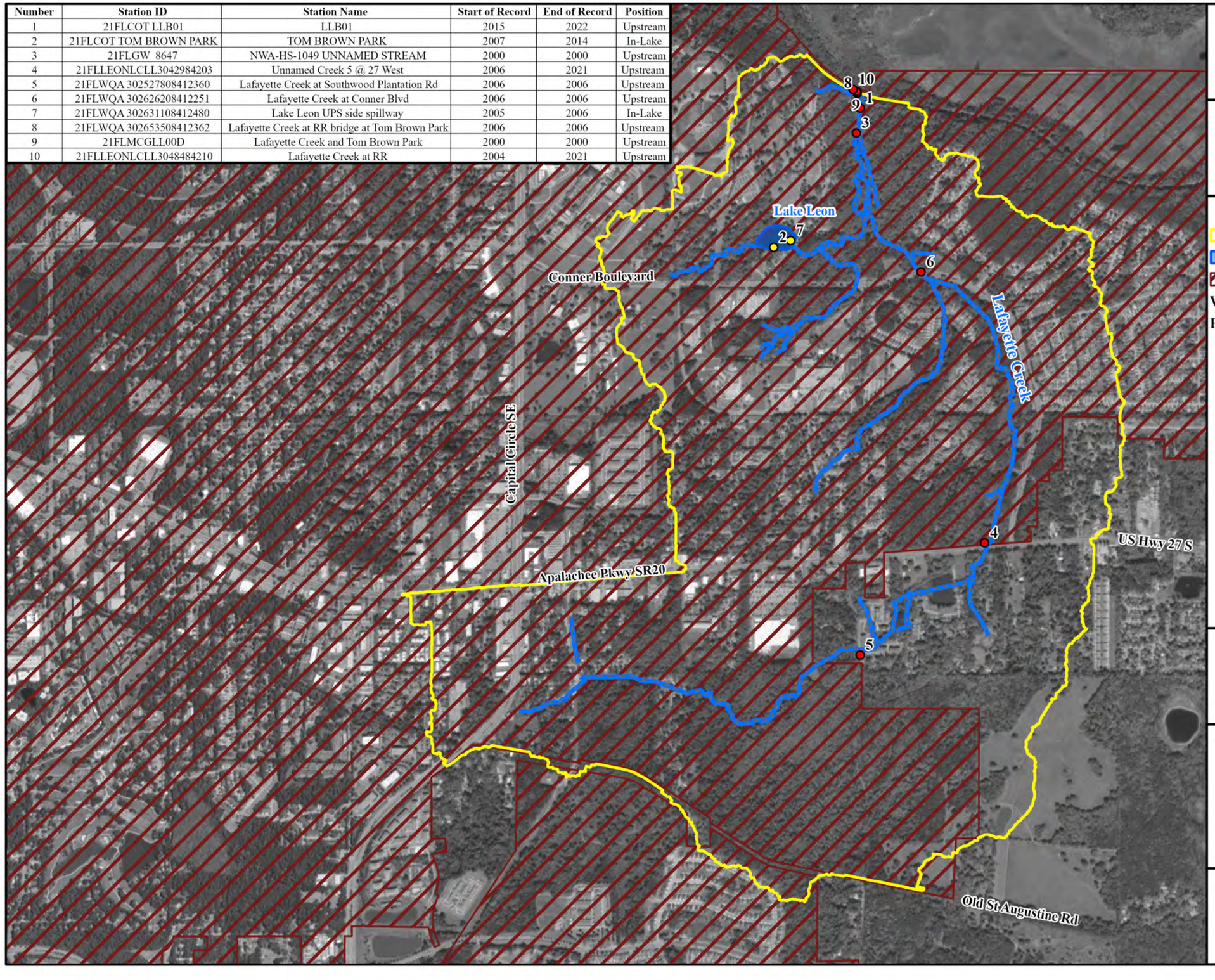
Sources:
Waterbodies: COT, 2020
Watersheds: COT, 2020
Roads: FDOT, 2020
Septic Systems: COT, 2020
City Limits: COT, 2022

Figure 5-151:
Lafayette Creek and Lake Leon Septic Systems Map

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants

Number	Station ID	Station Name	Start of Record	End of Record	Position
1	21FLCOT LLB01	LLB01	2015	2022	Upstream
2	21FLCOT TOM BROWN PARK	TOM BROWN PARK	2007	2014	In-Lake
3	21FLGW 8647	NWA-HS-1049 UNNAMED STREAM	2000	2000	Upstream
4	21FLLEONLCLL3042984203	Unnamed Creek 5 @ 27 West	2006	2021	Upstream
5	21FLWQA 302527808412360	Lafayette Creek at Southwood Plantation Rd	2006	2006	Upstream
6	21FLWQA 302626208412251	Lafayette Creek at Conner Blvd	2006	2006	Upstream
7	21FLWQA 302631108412480	Lake Leon UPS side spillway	2005	2006	In-Lake
8	21FLWQA 302653508412362	Lafayette Creek at RR bridge at Tom Brown Park	2006	2006	Upstream
9	21FLMCGLL00D	Lafayette Creek and Tom Brown Park	2000	2000	Upstream
10	21FLLEONLCLL3048484210	Lafayette Creek at RR	2004	2021	Upstream



CITY OF TALLAHASSEE

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Legend

- Lafayette Creek and Lake Leon Drainage Basin
- Waterbodies in Study
- Tallahassee Corporate Limits

Water Quality Stations

Position

- Lake Leon Stations
- Lafayette Creek Stations

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

Figure 5-152:
Lafayette Creek and Lake Leon Water Quality Station Location Map

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants

Longer term data, i.e., data for more than a single year, exists at three locations within the basin. These are also the stations that have data after 2010. The first is at the downstream end just prior to discharge into Upper Lake Lafayette (Station 1 on **Figure 5-152**). Data are available at this station from 2015 to 2020. The second station is where the creek crosses Apalachee Parkway (Station 4). Data are available at this station from 2006 to 2020. Finally, data are available in Lake Leon from 2006 to 2020.

Some initial plots of the available data in Lake Leon and Lafayette Creek are provided in this section, which includes plots of the raw data along with AGMs against the NNC criteria. Nutrients are the primary constituent of interest relative to water quality conditions in Lafayette Creek and Lake Leon, therefore, plots are provided for the key parameters related to potential nutrient impairment. These include TN, TP, Chl-a, and TSI for Lake Leon and TN and TP for Lafayette Creek. As discussed earlier, where available, data are plotted from 2010 to 2020 to represent present conditions. Additionally, based on interest in the area relative to septic systems and other sources, bacteria, specifically *E. coli* are included. Additional data plots and analyses are provided as part of the qualitative assessment of sources in **Section 5.8.4**.

Figure 5-153 through **Figure 5-155** present plots of the measured TN, TP and Chl-a respectively from 2010 to 2020 for Lake Leon. The TN concentrations (**Figure 5-153**) are relatively consistent from 2010 through 2020 with nearly all values below 1.0 mg/L. TP concentrations (**Figure 5-154**) are relatively constant with higher values between 2017 to 2019 then dropping off significantly in 2020. The majority of measured TP concentrations are below 0.05 mg/L. Chl-a concentrations (**Figure 5-155**) are generally below 40 µg/L with some higher values in 2011 and 2017. It is noted that those were the years of the drawdowns as discussed in **Section 5.8.1**.

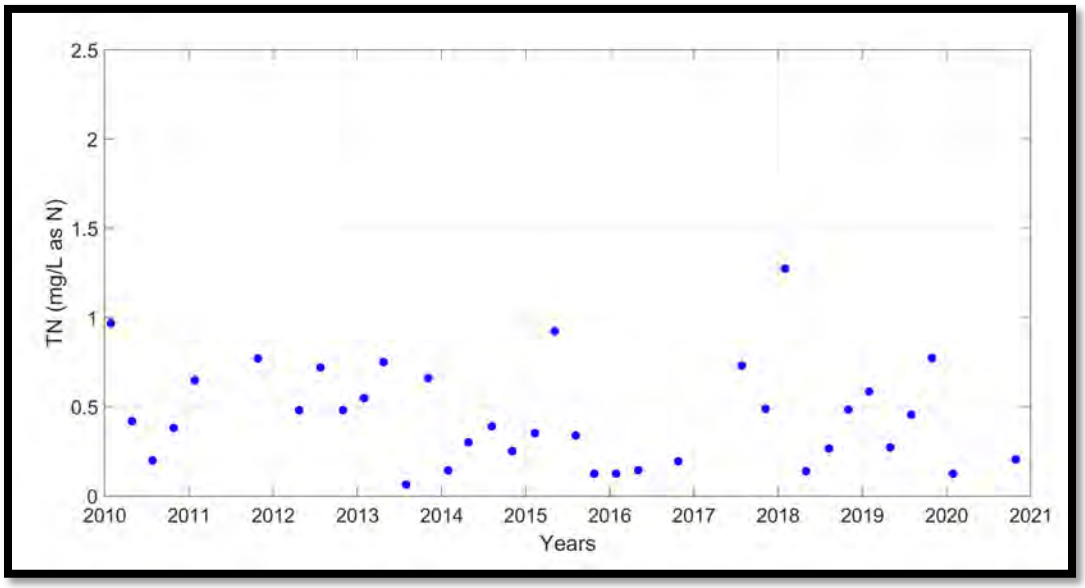

Figure 5-153: Plot of Measured TN in Lake Leon

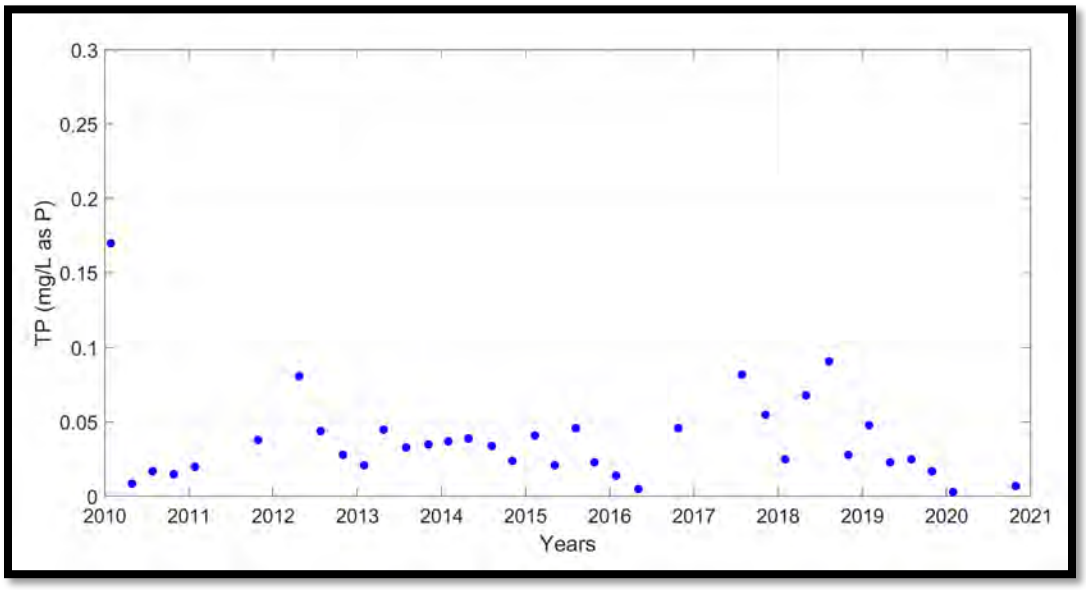

Figure 5-154: Plot of Measured TP in Lake Leon

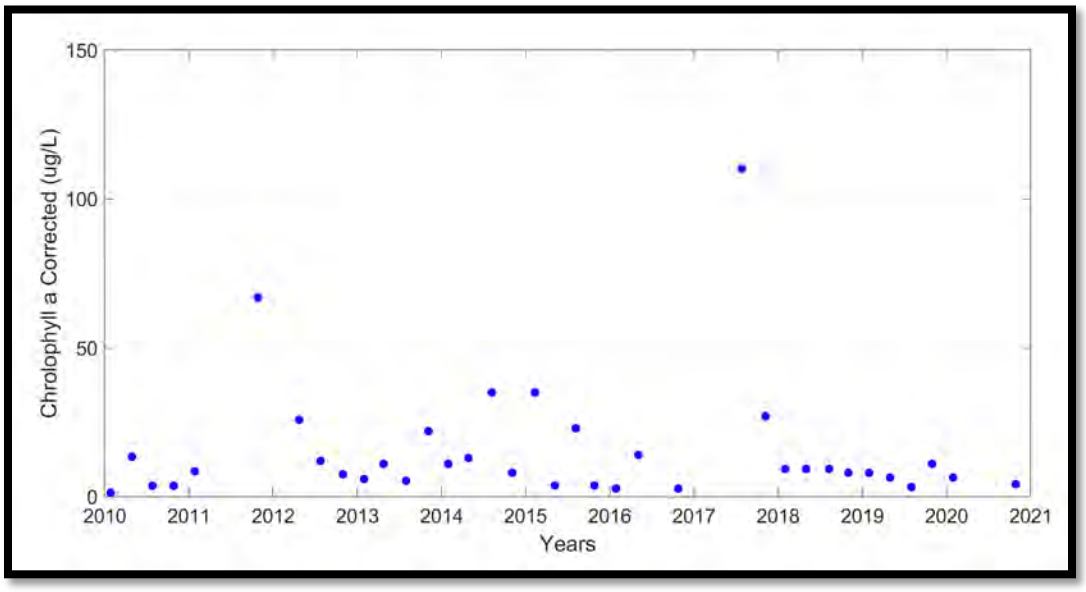

Figure 5-155: Plot of Measured Chl-a in Lake Leon

Figure 5-156 and **Figure 5-157** present plots of the TN and TP data in Lafayette Creek, respectively, from 2010 to 2020. The data prior to 2015 include only data from the upstream station (Station 4 in **Figure 5-152**) while the data after 2015 includes data on the creek from both the upstream and downstream (Station 1) stations. Examination of the data shows somewhat elevated TN and TP levels in the earlier years in relation to later years.

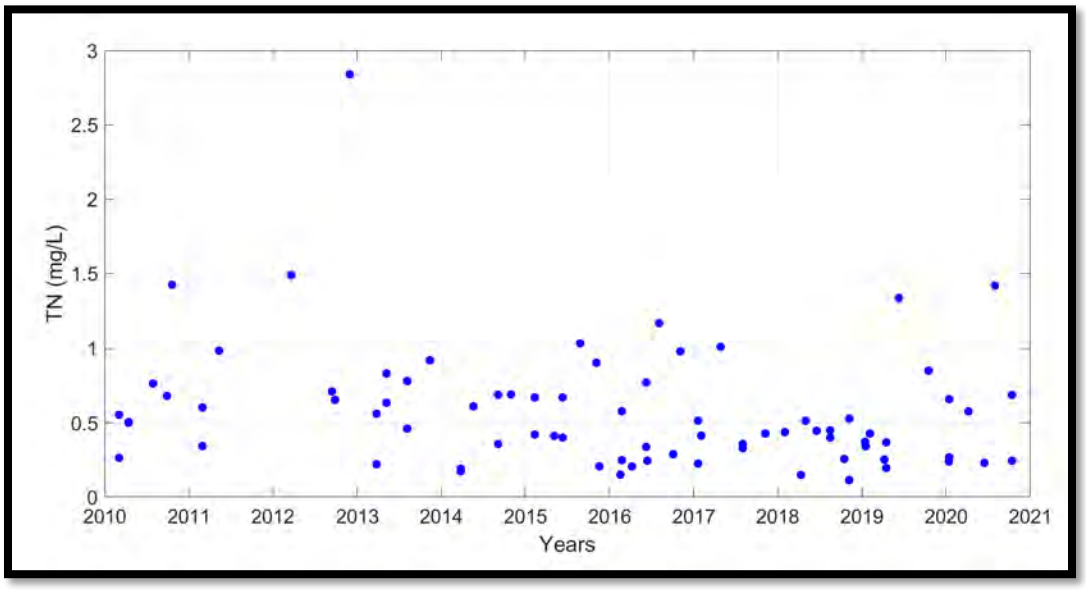

Figure 5-156: Plot of Measured TN in Lafayette Creek

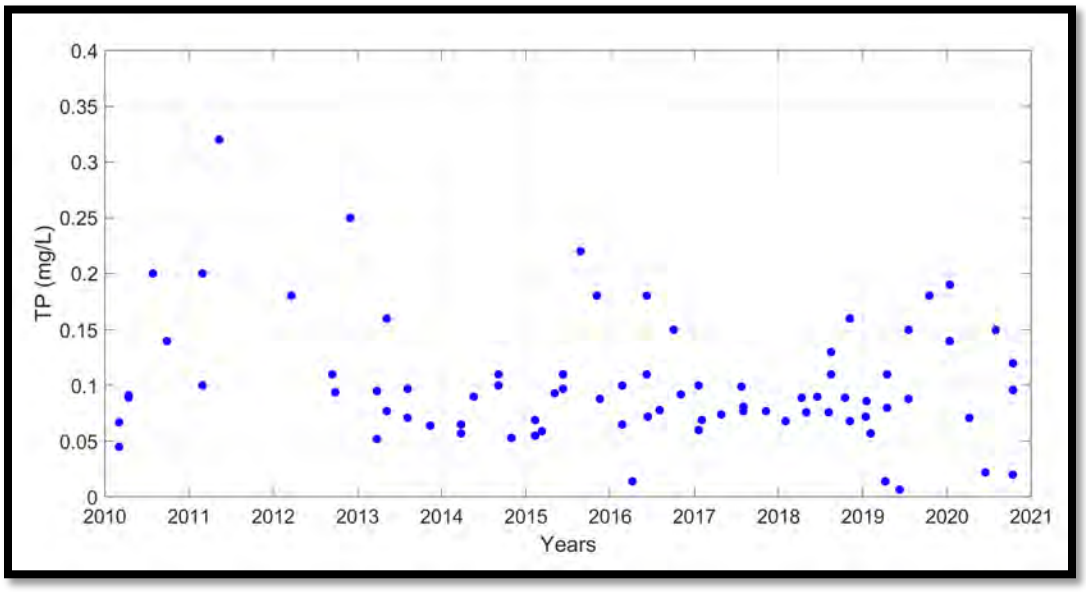

Figure 5-157: Plot of Measured TP in Lafayette Creek

Under FDEP's NNC, Lake Leon is defined as a low color, high alkalinity system. The designation is based on long-term average color lower than 40 PCU and long-term alkalinity levels greater than 20 mg/L. Based on this designation, the AGM threshold for Chl-a is 20 µg/L. For TN and TP, a range of concentrations are allowable, based on maintaining Chl-a levels in the lake below 20 µg/L. For TN, the range is 1.05 mg/L to 1.91 mg/L. For TP, the range is 0.03 mg/L to 0.09 mg/L.

Under FDEP's NNC, the freshwater stream thresholds applicable in Lafayette Creek are 0.18 mg/L for TP and 1.03 mg/L for TN as AGMs. For *E. coli*, the freshwater stream and lake criteria are monthly geometric means below 126 colonies per 100 mL of water and less than 10 percent

of samples above 410 colonies per 100 mL of water in any 30-day period. For the purpose of determining bacteria impairments where data are collected monthly, per 62-303 F.A.C., FDEP assesses all the samples collected through the verified period to determine the number of samples that are above the threshold. If the number of samples (based on the sample size) is greater than or equal to numbers provided in the tables within 62-303 (to provide 90 percent confidence), the waterbody is deemed impaired. The FDEP threshold for this analysis is 410 MPN/100 mL.

TN, TP, and Chl-a, AGMs are plotted in **Figure 5-158** through **Figure 5-160** as these define the status of the lake relative to nutrient impairments. **Figure 5-161** and **Figure 5-162** present the calculated annual AGMs within Lafayette Creek for TN and TP respectively. Where sufficient data are available to assess the AGMs, the levels are provided from 2010 through 2020. The Chl-a threshold and the minimum (where applicable) and maximum thresholds for TN and TP relative to the NNC are on each of the graphs as pink dashed lines. **Figure 5-163** presents a plot of calculated TSI values in the lake. While TSI is no longer utilized for the determination of impairment, it does serve as an indicator of lake health. Based on TSI definitions, levels below 60 are deemed good condition, levels between 60 and 70 indicate fair condition, while levels above 70 indicate poor condition. **Figure 5-164** and **Figure 5-165** presents plots of *E. coli* data for the available period of record for Lake Leon and Lafayette Creek respectively.

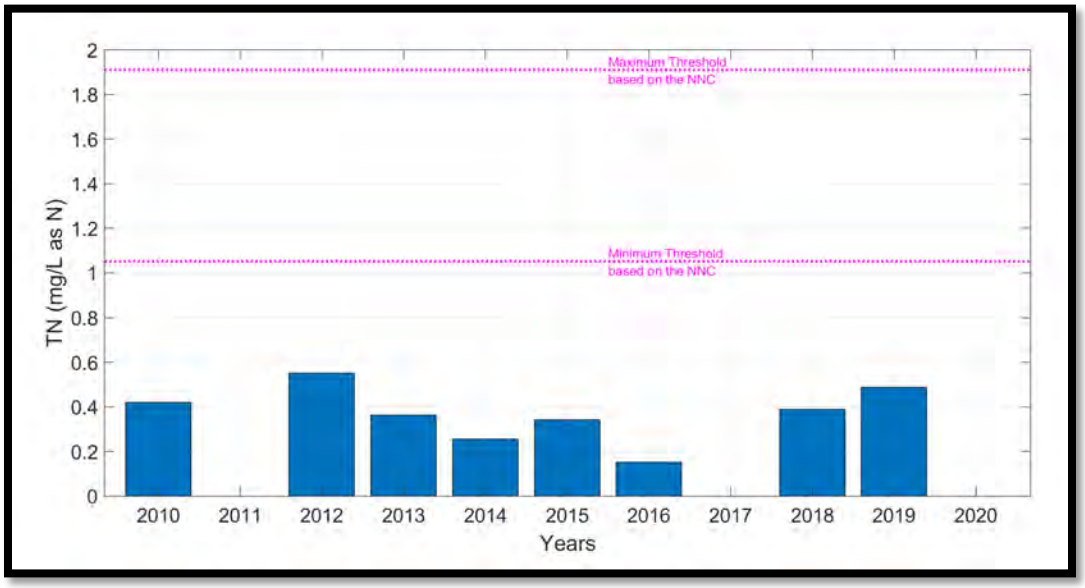

Figure 5-158: Plot of Annual Geometric Means for TN with NNC Criteria for Lake Leon

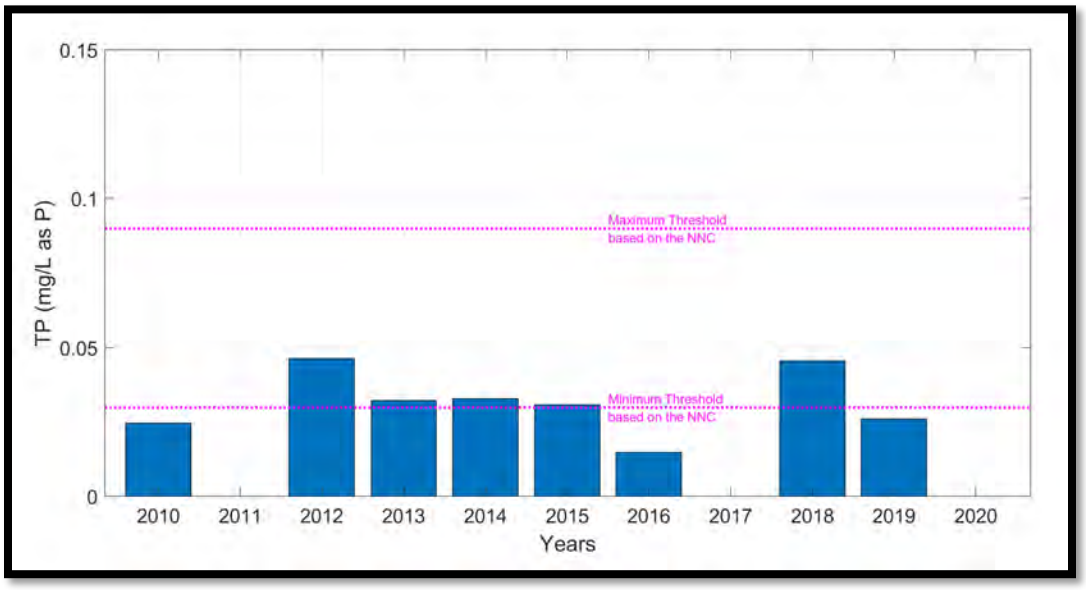

Figure 5-159: Plot of Annual Geometric Means for TP with NNC Criteria for Lake Leon

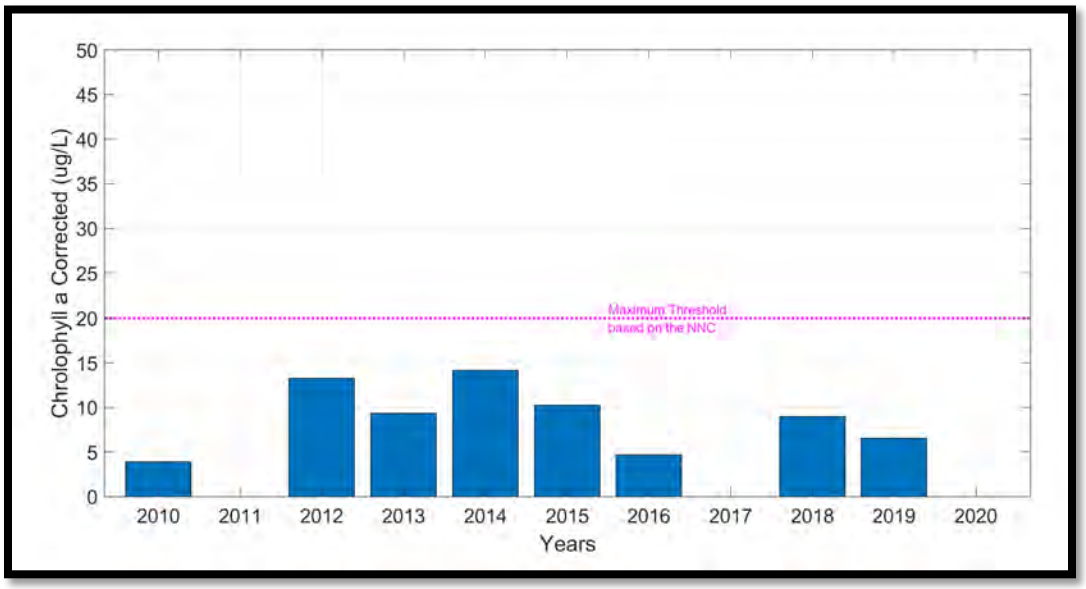

Figure 5-160: Plot of Annual Geometric Means for Chl-a with NNC Criteria for Lake Leon

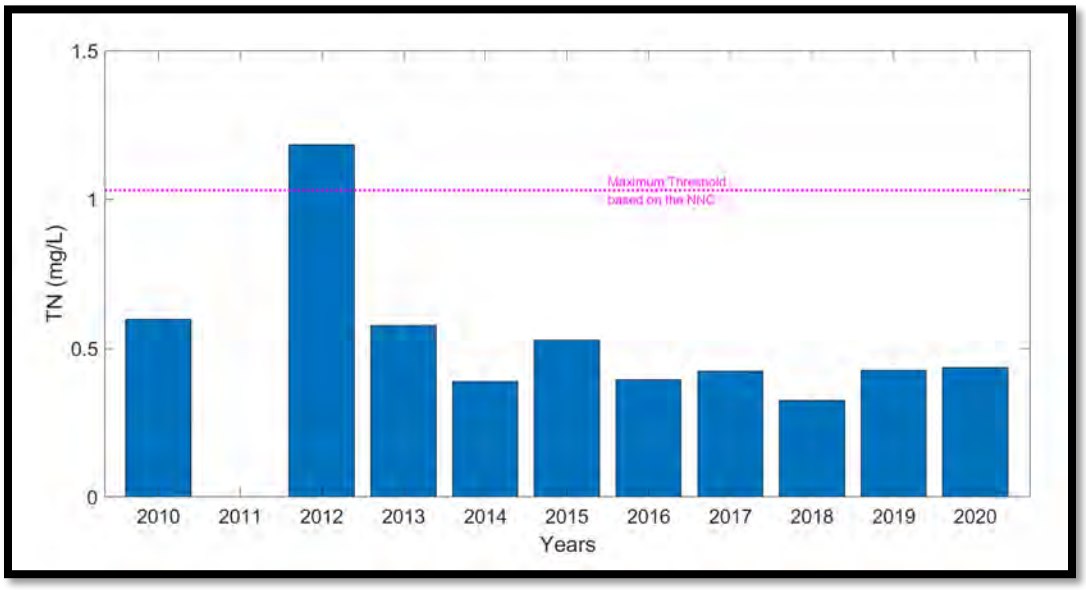

Figure 5-161: Plot of Annual Geometric Means for TN with NNC Criteria for Lafayette Creek

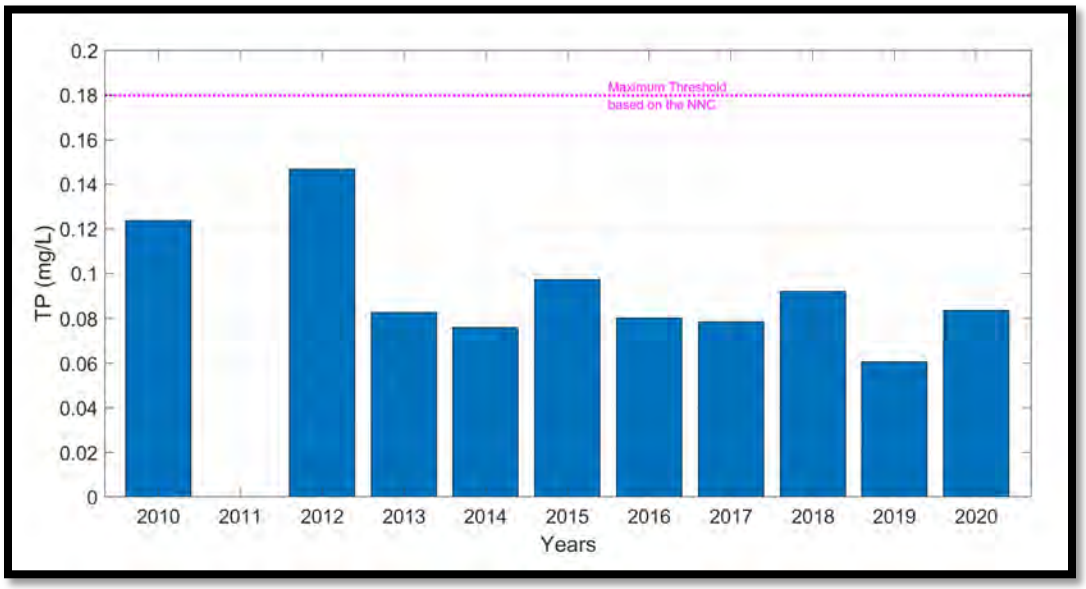

Figure 5-162: Plot of Annual Geometric Means for TP with NNC Criteria for Lafayette Creek

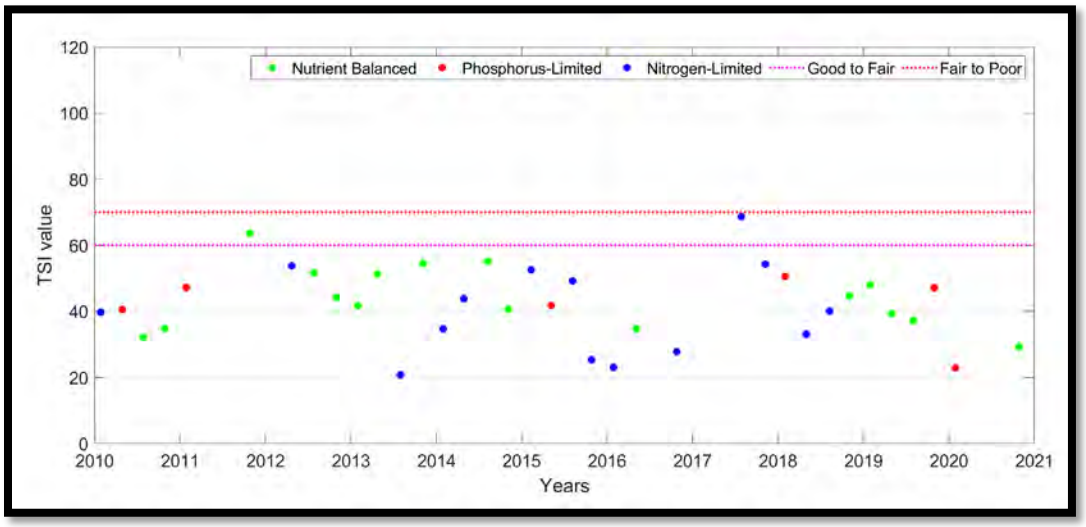

Figure 5-163: Trophic State Index for Lake Leon (2010 to 2020)

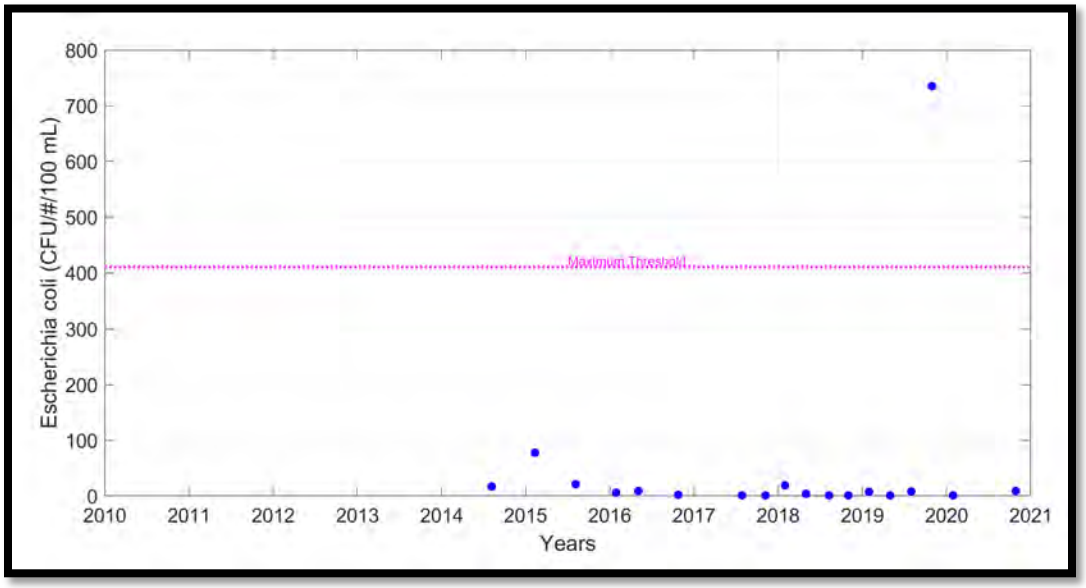

Figure 5-164: Plot of *E. coli* Measurements for Lake Leon (2010 to 2020)

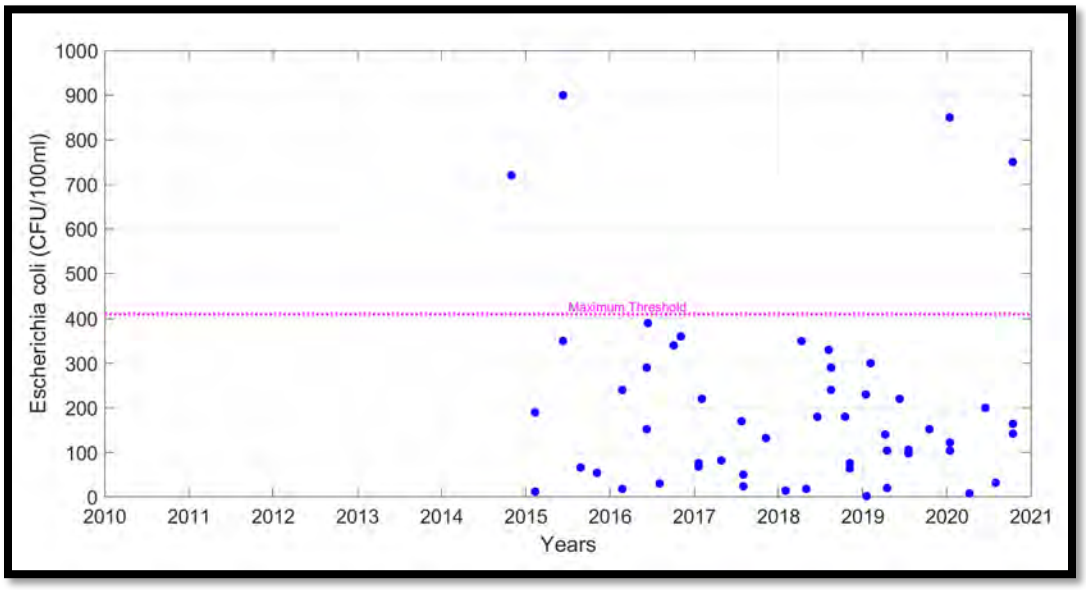

Figure 5-165: Plot of *E. coli* Measurements for Lafayette Creek (2010 to 2020)

Examination of the TN plot for Lake Leon **(Figure 5-158)** shows that from 2010 to 2020, where sufficient data were available TN AGM levels have been well below the minimum threshold. TP AGM levels **(Figure 5-159)** were below, at or just above the minimum threshold. The Chl-a AGMs from 2010 through 2020 (**Figure 5-160**) were all below the 20 µg/L threshold. Insufficient data were available in 2011 and 2017, the years when drawdowns occurred.

Examination of the TN plot for Lafayette Creek **(Figure 5-161)** shows a general downward trend with some higher values prior to 2015 and one year where measured values were above the NNC threshold. TP AGM levels **(Figure 5-162)** are all below the stream threshold with a similar downward trend in the later years. The lower values in the later years may be due to the addition of the downstream data after 2015. The spatial differences along the creek will be further examined in **Section 5.8.4.1**.

Examination of the TSI plot **(Figure 5-163**) shows all but two measurements in the good range with generally nutrient-balanced to nitrogen-limited conditions. No values went above the 70 threshold from 2010 to 2020.

Figure 5-164 presents a plot of measured *E. coli* levels in Lake Leon from 2014 through 2020. The data (other than one high value) show very low values, with most at below detection limits. **Figure 5-165** presents a plot of measured *E. coli* levels in Lafayette Creek from 2014 through 2020. There are elevated levels measured in the creek but most (other than 4 measurements) at or below the 410 MPN/100 mL threshold. Again, this data represents both upstream and downstream samples. The spatial differences will be examined further in **Section 5.8.4.1**.

5.8.3.6 Groundwater Data

Presently there are no surficial groundwater monitoring wells identified within the Lafayette Creek basin.

5.8.3.7 Biological Data

Table 5-24 presents LVI data for Lake Leon. The LVI sampling showed the lake to be impaired for 3 of the 4 years sampled, with one year (2010) just into the healthy range.

Table 5-24: Summary of LVI Results from Lake Leon

Date	Station ID	LVI	Aquatic Life Use Category
06/22/2010	Lake Leon	39	Healthy
09/27/2012	Lake Leon	31	Impaired
10/14/2013	Lake Leon	11	Impaired
10/01/2015	Lake Leon	16	Impaired

5.8.3.8 Stormwater Treatment Facilities

Figure 5-166 presents a map showing the locations of stormwater treatment facilities throughout the Lafayette Creek basin. The City maintains multiple treatment ponds distributed throughout the basin serving various developments and other facilities. FDOT maintains two ponds in the headwaters of the basin associated with Capital Circle.

5.8.3.9 Atmospheric Deposition Data

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

5.8.3.10 Data Summary

For the purposes of the qualitative analysis of sources of pollutants to Lafayette Creek and Lake Leon (**Section 5.8.4**), the available data are reasonable. There are sufficient active surface water quality stations at key locations within the creek to support the qualitative assessment. The following outlines some limitations in the available data. Specific recommendations on additional data collection efforts are provided in **Section 5.10**.

- No hydrologic data (level or inflow/outflow) data has been collected in Lake Leon (level) or within Lafayette Creek (flow).
- No surficial groundwater monitoring stations are located in the vicinity to determine the quality of potential seepage into the lake or creek segments.
- No data are available to determine the potential for internal loading as a source to Lake Leon.

5.8.4 Qualitative Assessment of Sources

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

CITY OF TALLAHASSEE

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Lake Leon

Capital Circle SE

Apalachee Pkwy SR20

Lafayette Creek

US Hwy 27 S

Legend

- Lafayette Creek and Lake Leon Drainage Basin
- Waterbodies in Study
- Tallahassee Corporate Limits
- City of Tallahassee Stormwater Ponds
- FDOT Stormwater Ponds

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

Figure 5-166:
Lafayette Creek and Lake Leon Basin BMP Location Map

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants

For Lafayette Creek and Lake Leon, the sources to be evaluated include the following:

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

An overview of analyses and findings for each source listed above is provided in the following sections. Prior to the discussions of each of the potential sources, additional analyses of the data collected along Lafayette Creek and Lake Leon are provided to build on the information presented in **Section 5.8.3.5**. Following the discussions for each source type, a summary of findings for the qualitative assessment is provided.

5.8.4.1 In-Stream and Lake Water Quality

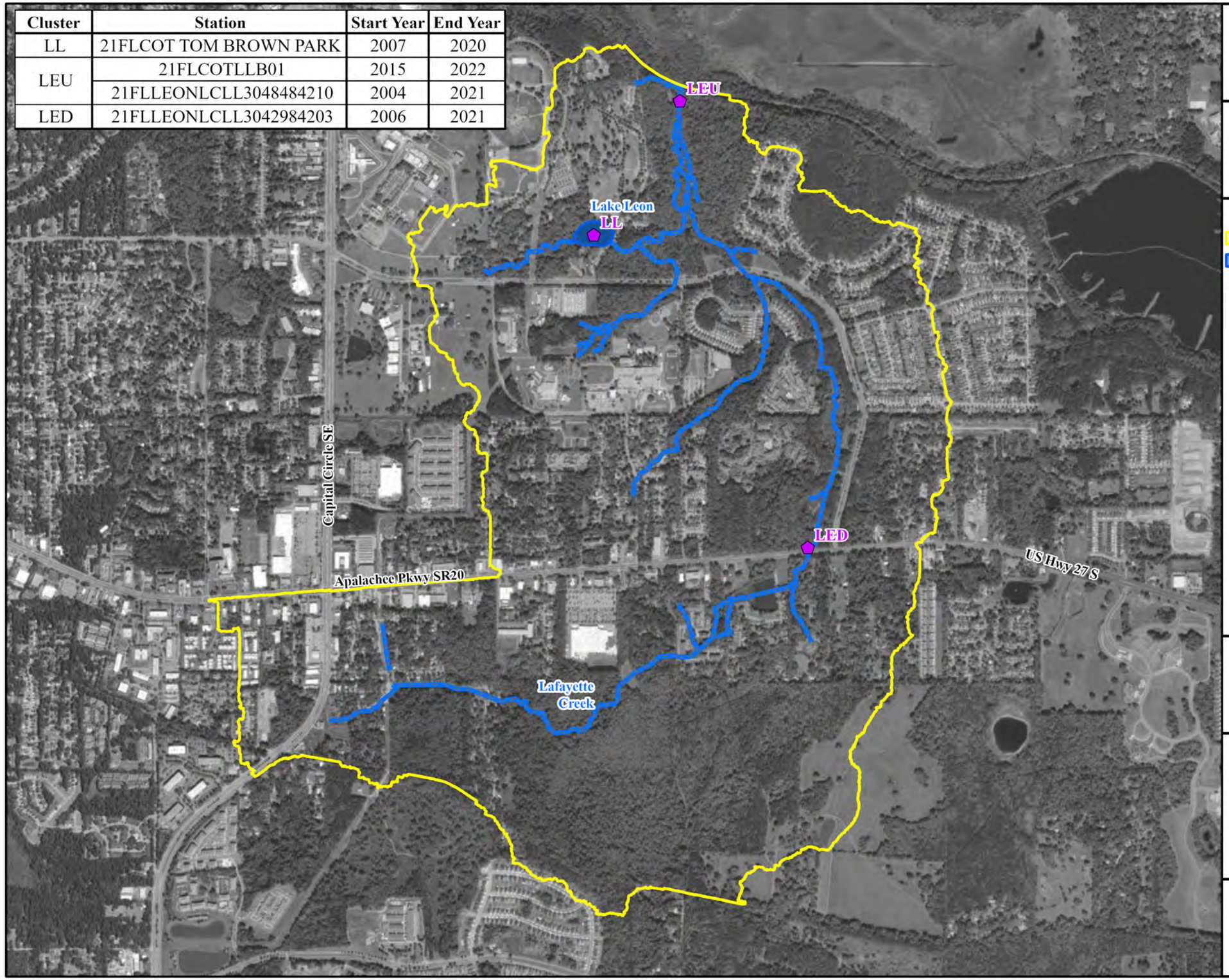
Following the methodology utilized for other basins, analyses were conducted on the available stream data and lake data from 2010 to the present. The primary purpose of this analysis is to evaluate the baseline water quality and the spatial differences along the creek and relative to Lake Leon. The parameters analyzed include TP, TN, TSS, and *E. coli*.

Water quality stations were clustered where they represent conditions within a specific area along the creek or representing the lake. The clustered data from 2010 to 2020 were analyzed to provide the average of the annual geomeans or the 90th percentile, depending upon the parameter. The results are then presented on a map with colors representing the results. The levels associated with the colors are reflective of water quality thresholds as outlined in 62-302 F.A.C. for the lake or stream. As only one location is representative of the lake, parameters that reflect both lake and stream conditions are presented (TN, TP, *E. coli*) to provide comparisons. The color transitions for the clusters within Lake Leon and Lafayette Creek were set in a similar manner to the other lakes and creeks presented and described earlier. Additionally, based on having two stations along the creek, TSS values are also presented.

Figure 5-167 presents the data clustering used for the analyses and associated stations. For Lafayette Creek and Lake Leon, data from 2010 through 2020 were available at three locations. One cluster represents conditions in Lake Leon (LL). A second is located along the main stem of Lafayette Creek where it crosses Apalachee Parkway (LED). The third is located along the main stem of Lafayette Creek where it crosses the CSX railroad just prior to discharge to Upper Lake Lafayette. All three clusters had complete data sets from 2010 to 2020.

Figure 5-168 and **Figure 5-169** present the TN and TP results. Looking first at the TN values (LED=0.44 mg/L, LEU=0.23 mg/L, LL=0.05 mg/L) shows that TN levels within the lake and stream are low in relation to the thresholds. Additionally, along the creek there does not appear to be significant differences between the upstream and downstream stations. While TP levels are higher in relation to the thresholds (LED=0.113 mg/L, LEU=0.071 mg/L, LL=0.033 mg/L), the values are below the thresholds at all locations, with upstream TP levels on average higher than the downstream values.

Cluster	Station	Start Year	End Year
LL	21FLCOT TOM BROWN PARK	2007	2020
LEU	21FLCOTLLB01	2015	2022
	21FLLEONLCLL3048484210	2004	2021
LED	21FLLEONLCLL3042984203	2006	2021



CITY OF TALLAHASSEE

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Legend

- Lafayette Creek and Lake Leon Drainage Basin
- Waterbodies in Study
- Staion Clusters

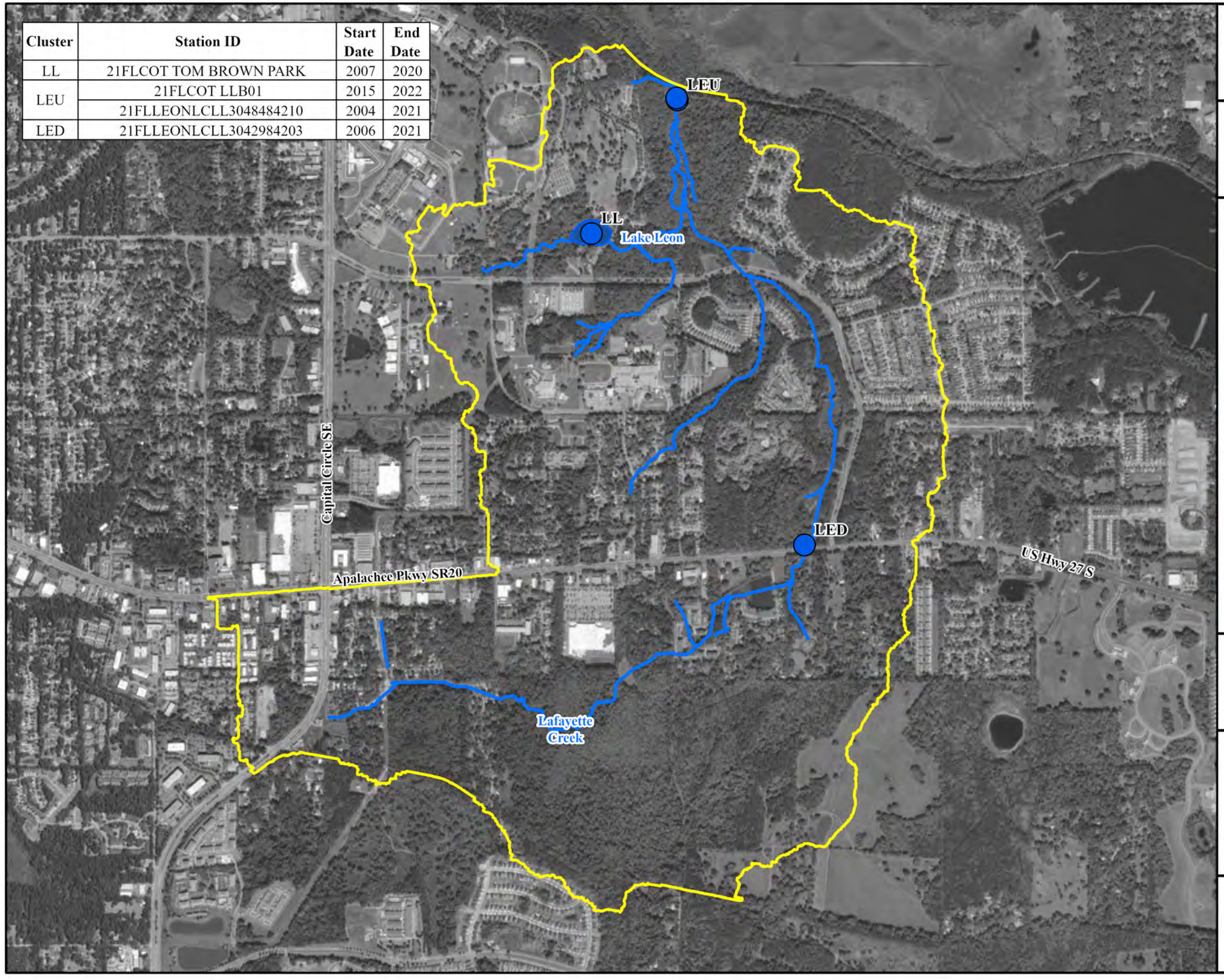
Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Drainage Basins: COT, 2020
Roads: COT-Leon County, 2023

Figure 5-167:
Station Clustering for Spatial Analyses of Lafayette Creek and Lake Leon

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants

Cluster	Station ID	Start Date	End Date
LL	21FLCOT TOM BROWN PARK	2007	2020
LEU	21FLCOT LLB01	2015	2022
	21FLLEONLCLL3048484210	2004	2021
LED	21FLLEONLCLL3042984203	2006	2021



CITY OF TALLAHASSEE

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Legend

- Lafayette Creek and Lake Leon Drainage Basin
- Waterbodies in Study

Lake Leon TN Average 2010-2020
mg/L
- 0-1.05
- 1.05-1.34
- 1.34-1.63
- 1.63-1.91
- >1.91

Stream TN Average 2010-2020
mg/L
- 0-0.51
- 0.51-0.65
- 0.65-0.79
- 0.79-1.03
- >1.03

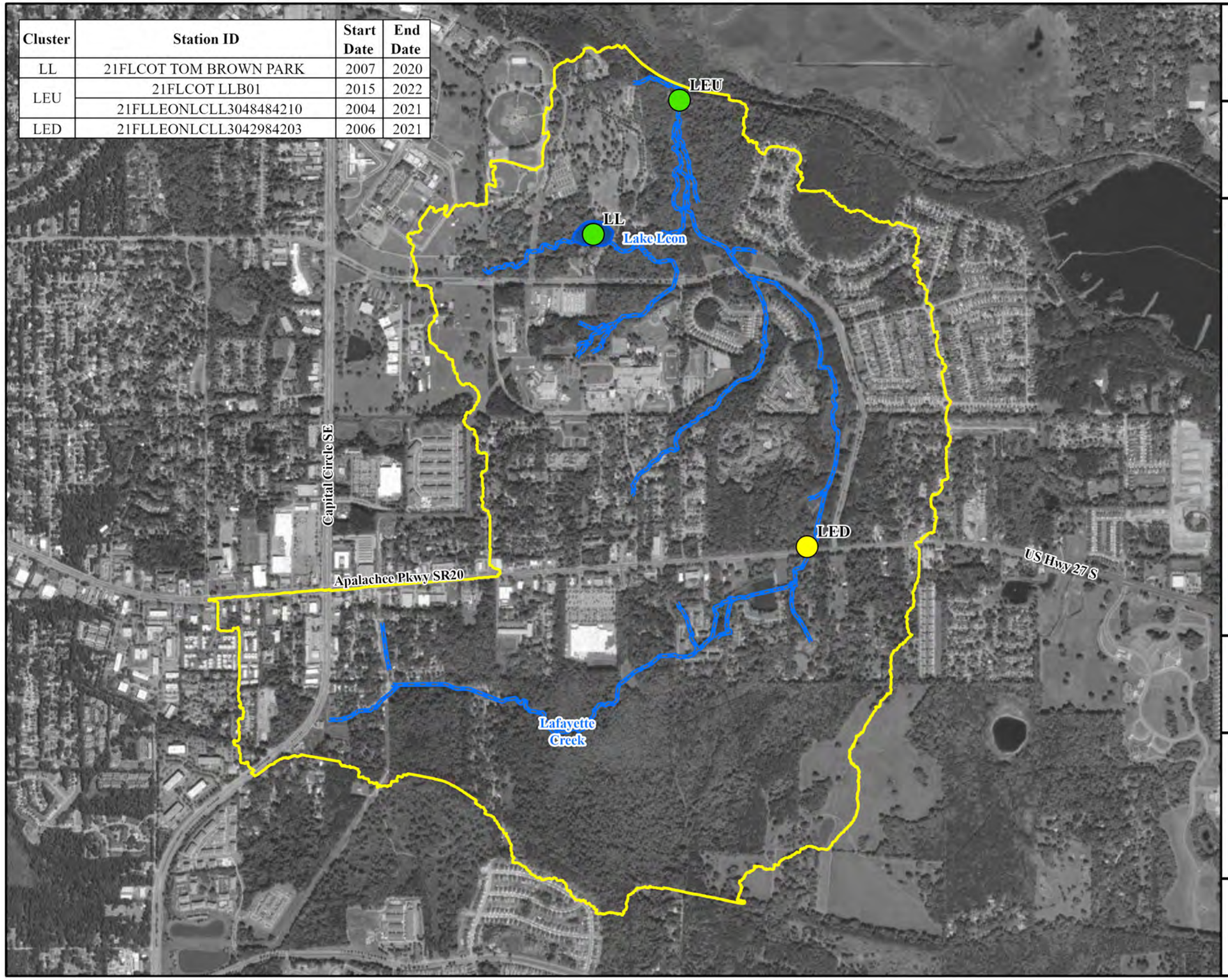
Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Drainage Basins: COT, 2020
Roads: COT-Leon County, 2023
Station Data: FDEP, 2021

Figure 5-168:
Spatial Assessment of TN in Lafayette Creek and Lake Leon

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants

Cluster	Station ID	Start Date	End Date
LL	21FLCOT TOM BROWN PARK	2007	2020
LEU	21FLCOT LLB01	2015	2022
	21FLLEONLCLL3048484210	2004	2021
LED	21FLLEONLCLL3042984203	2006	2021



CITY OF TALLAHASSEE

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Legend

- Lafayette Creek and Lake Leon Drainage Basin
- Waterbodies in Study

In Lake TP Average 2010-2020
mg/L
- 0-0.03
- 0.03-0.05
- 0.05-0.07
- 0.07-0.09
- >0.09

Stream TP Average 2010-2020
mg/L
- 0-0.045
- 0.045-0.09
- 0.09-0.135
- 0.135-0.18
- >0.18

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

Figure 5-169:
Spatial Assessment of TP in Lafayette Creek and Lake Leon

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants

Figure 5-170 presents a map of the TSS levels. The calculated TSS averages (LED=10.1 mg/L, LEU=4.4 mg/L) in the creek are higher at the upstream station than the downstream station. The upstream station had the highest TSS levels of any of the tributaries analyzed in previous sections within the Lake Lafayette Chain basin.

Figure 5-171 presents a map of the *E. coli* levels. The data analyzed are from 2014 through 2020 and the data were analyzed to provide the 90th percentile to compare against the 410 MPN/100 mL criteria per the FDEP approach in the IWR analyses. The analyses show that none of the stations have 90th percentiles above the threshold with the 90th percentiles in Lake Leon and the upstream station (LEU) low (LED=56.7 MPN/100 mL, LEU=227.7 MPN/100 mL, LL=21.1 MPN/100 mL). The higher concentrations plotted earlier in **Figure 5-165**, are associated with the downstream station just prior to the discharge to Upper Lake Lafayette.

5.8.4.2 Stormwater Runoff

To assess stormwater runoff as a potential source of pollutant loads to Lafayette Creek and Lake Leon the LDI level within the basin was evaluated. **Figure 5-172** presents the calculated LDI. The map shows that for the watershed draining to Lake Lafayette Creek and Lake Leon the levels are moderate, which indicates that this area does not have a high potential for anthropogenic pollutant loads from stormwater runoff. The available data analyzed and presented earlier support this.

5.8.4.3 Septic Systems

Figure 5-151 presented the locations of septic systems within the Lafayette Creek basin. **Figure 5-173** presents a map showing the septic tank density for the Lafayette Creek basin. The septic tank density in the Lafayette Creek basin is low with, on average, 1 system per acre. Early analyses identified the highest *E. coli* levels at the downstream end of Lafayette Creek at the CSX crossing. The upstream station (at the crossing of Apalachee Parkway) had some elevated values, but values were lower than the downstream. Lake Leon concentrations were the lowest.

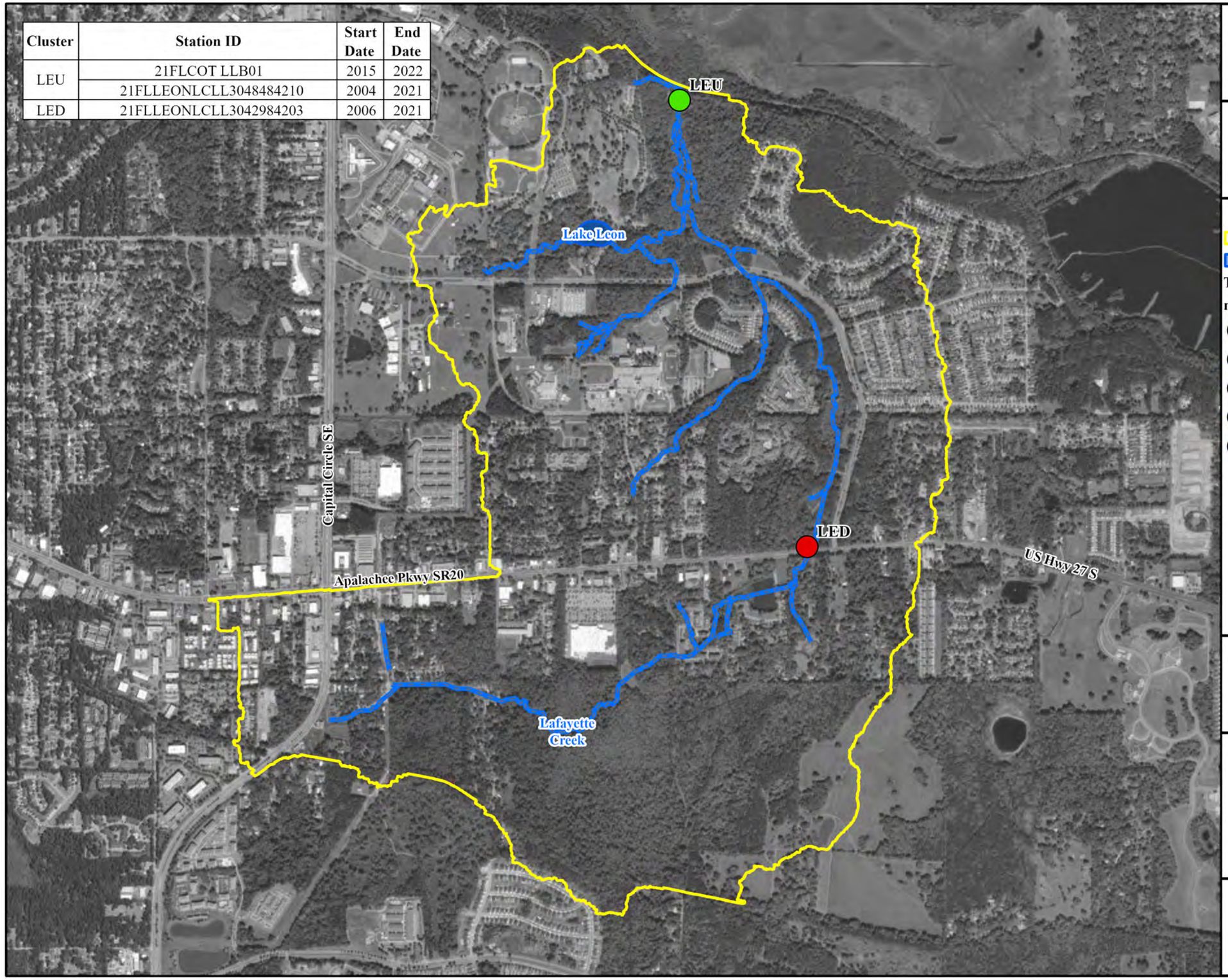
Examination of the location of the septic systems along the creek (**Figure 5-151**) shows the largest number of systems immediately upstream of the crossing at Apalachee Parkway. Per the discussion above, while some elevated values were measured at the crossing, they were lower than seen in the downstream station, and not high enough to exceed the threshold, i.e., 10 percent greater than 410 MPN/100 mL, which, along with the nutrient analyses, indicates that septic systems are not a significant anthropogenic source to the creek. A septic load will be calculated based on available information and presented in **Section 5.8.5.2**.

5.8.4.4 Internal Recycling and Seepage

Internal Recycling

To date, no studies or data collection efforts have been undertaken to assess the potential for loading from sediments in Lake Leon. Analyses of the available data in Lake Leon do not show significantly elevated levels in relation to NNC thresholds. As such, internal recycling is not identified as a potential significant anthropogenic source of loads to the lake.

Cluster	Station ID	Start Date	End Date
LEU	21FLCOT LLB01	2015	2022
	21FLLEONLCLL3048484210	2004	2021
LED	21FLLEONLCLL3042984203	2006	2021



CITY OF TALLAHASSEE

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Legend

- Lafayette Creek and Lake Leon Drainage Basin
- Waterbodies in Study

TSS Average 2010-2020

mg/L

- 0-2.5
- 2.5-5.0
- 5.0-7.5
- 7.5-10
- >10.0

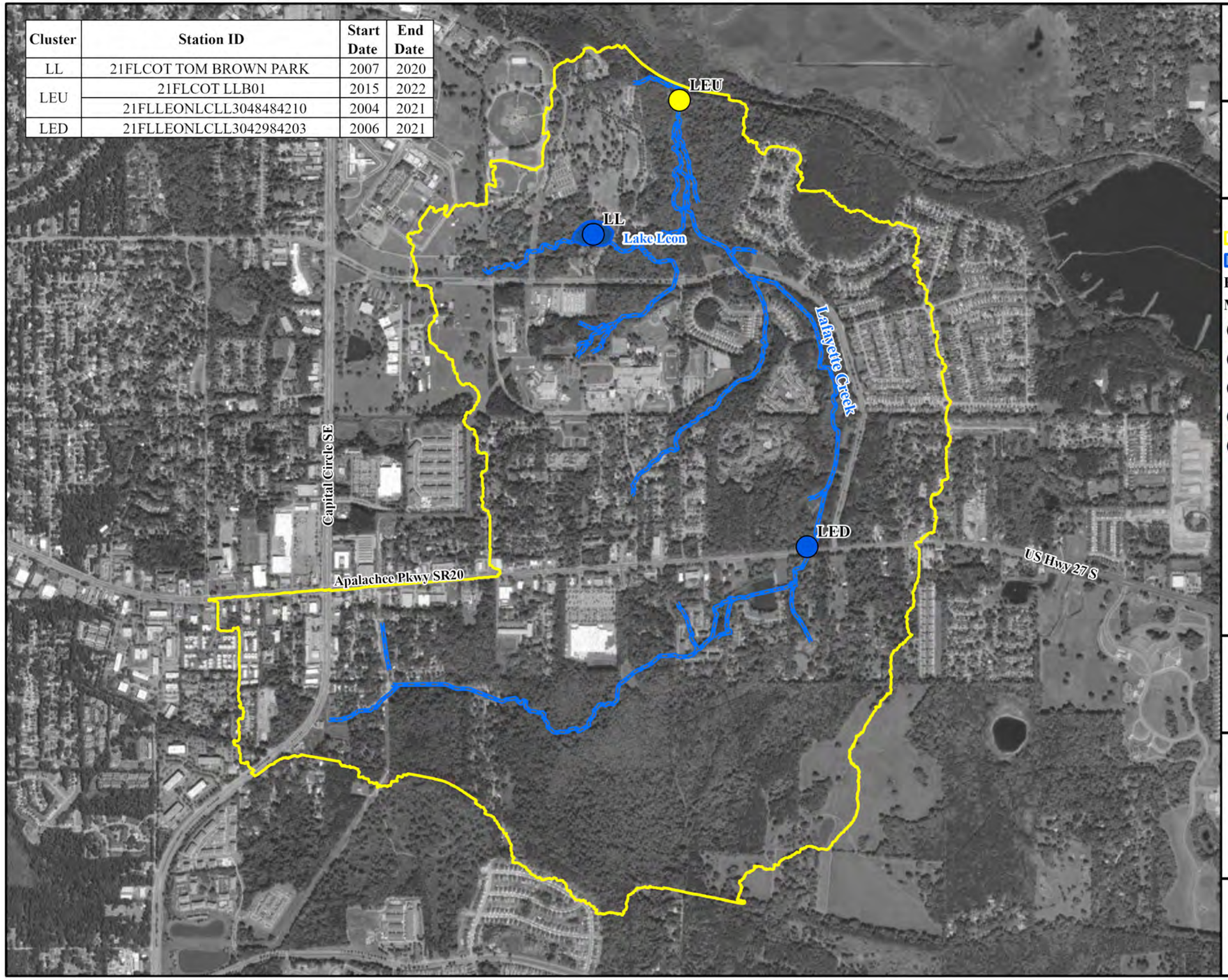
Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Drainage Basins: COT, 2020
Roads: COT-Leon County, 2023
Station Data: FDEP, 2021

Figure 5-170:
Spatial Assessment of TSS in Lafayette Creek

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants

Cluster	Station ID	Start Date	End Date
LL	21FLCOT TOM BROWN PARK	2007	2020
LEU	21FLCOT LLB01	2015	2022
	21FLLEONLCLL3048484210	2004	2021
LED	21FLLEONLCLL3042984203	2006	2021



CITY OF TALLAHASSEE

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Miles

Legend

- Lafayette Creek and Lake Leon Drainage Basin
- Waterbodies in Study

E. coli 90th Percentile 2010-2020

MPN/100mL

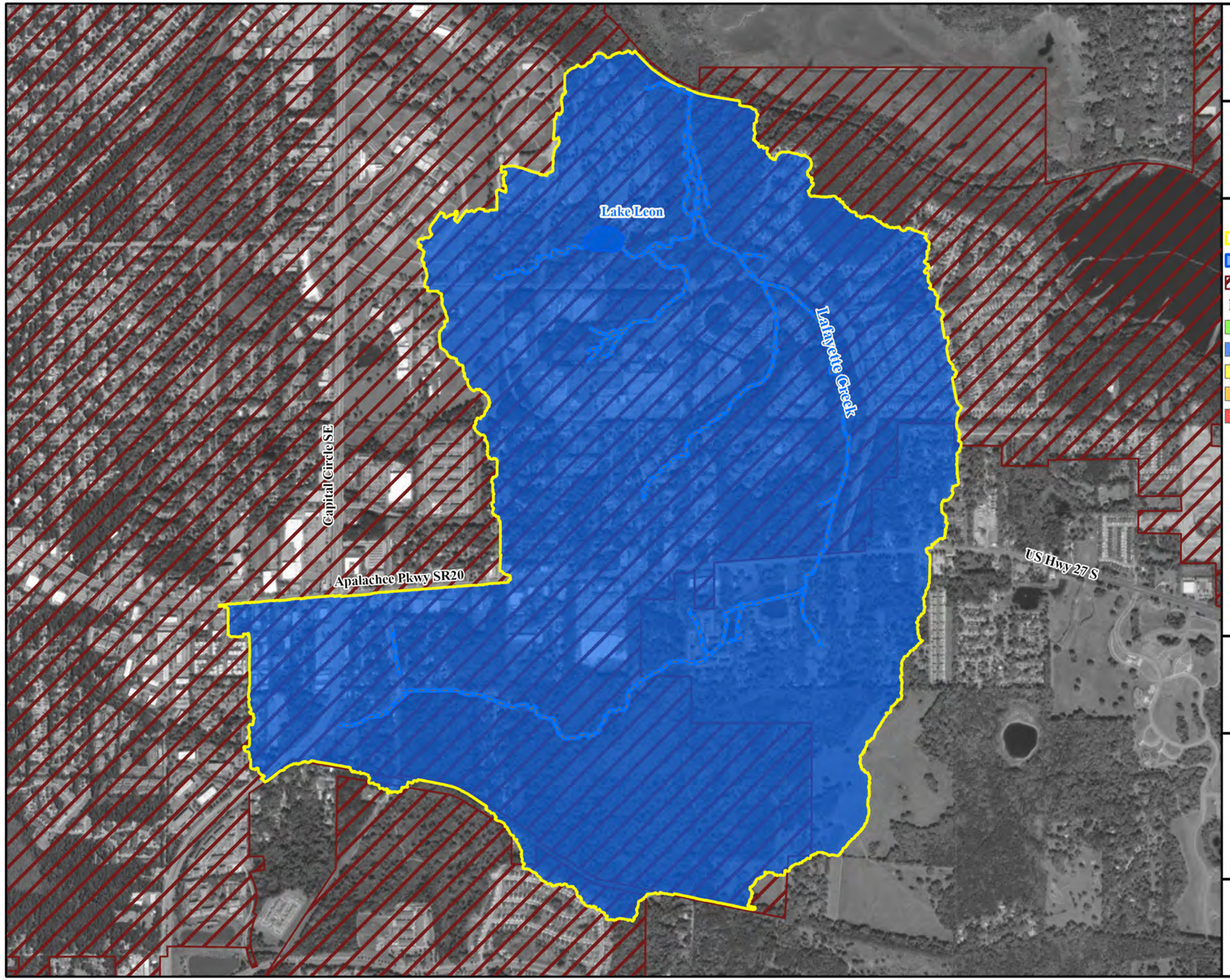
- 0-100
- 100-200
- 200-300
- 300-410
- >410

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

Figure 5-171:
Spatial Assessment of E. coli in Lafayette Creek and Lake Leon

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants



CITY OF TALLAHASSEE

N

0 0.2
Miles

Legend

- Lafayette Creek and Lake Leon Drainage Basin
- Waterbodies in Study
- Tallahassee Corporate Limits

Land Development Index

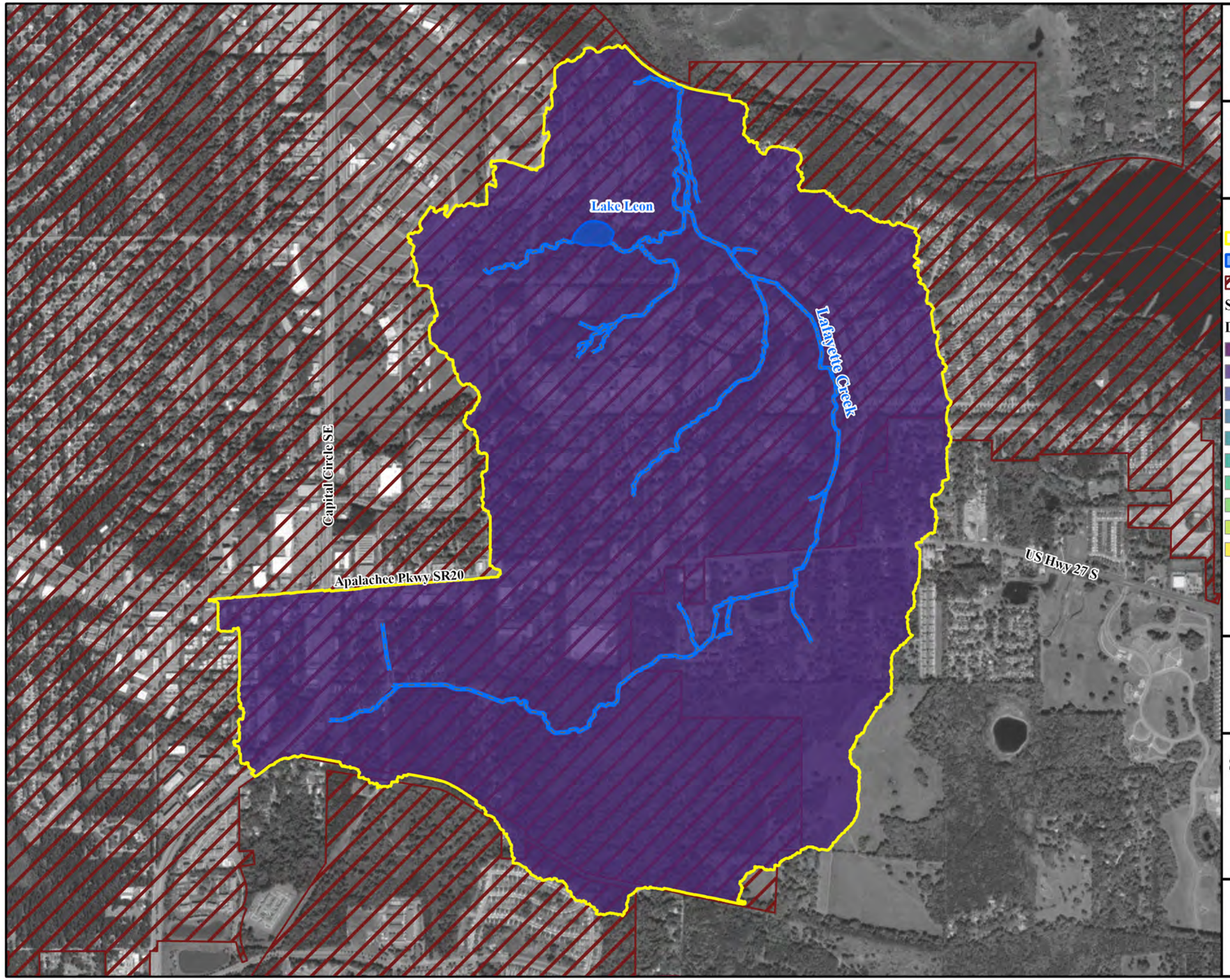
- Excellent
- Good
- Moderate
- Poor
- Very Poor

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

Figure 5-172:
Land Development Index in Lafayette Creek and Lake Leon Basin

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants



CITY OF TALLAHASSEE

N

0 0.2
Miles

Legend

- Lafayette Creek and Lake Leon 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 5-173:
Septic Tank Density in Lafayette Creek and Lake Leon Basin

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants

Seepage

As outlined in **Section 5.8.3.6**, no surficial aquifer data in the immediate vicinity of the lake and creek were identified. As was outlined for internal recycling, based on present water quality conditions in the lake, seepage is not identified as a potential significant anthropogenic source to the lake. Based on the soil types in this basin discussed in **Section 5.8.3.2**, subsurface transmissivity levels are expected to be low impeding transport of pollutants through seepage.

5.8.4.5 Wastewater

Within the Lafayette Creek basin, there currently are no direct wastewater discharges. Additionally, no areas in the Lake Lafayette Chain of Lakes basin presently have reuse discharges. **Figure 5-174** presents a map of the Lafayette Creek basin boundaries in relation to sewer service areas and sewer infrastructure. Presently, 68 percent of the Lafayette Creek basin has sewer infrastructure, and some of this infrastructure is located adjacent to the creek. Earlier analyses of *E. coli* data showed elevated concentrations in the downstream reaches where the creek crosses the CSX railroad. Based on these data and the wastewater infrastructure coverage areas, wastewater may be a source to the creek and will need to be evaluated as part of an overall assessment of bacteria conditions in the Lafayette Creek basin.

5.8.4.6 Atmospheric Deposition

For Lake Leon, the ratio of the drainage area to lake area is around 18:1. With this ratio, and the potential attenuation of rainfall runoff, direct atmospheric deposition to the lake is not expected to play a role in overall loading, especially for phosphorus. **Section 5.8.3.9** identified the nearest atmospheric deposition station as the Quincy Station (FL14) (**Figure 5-35**).

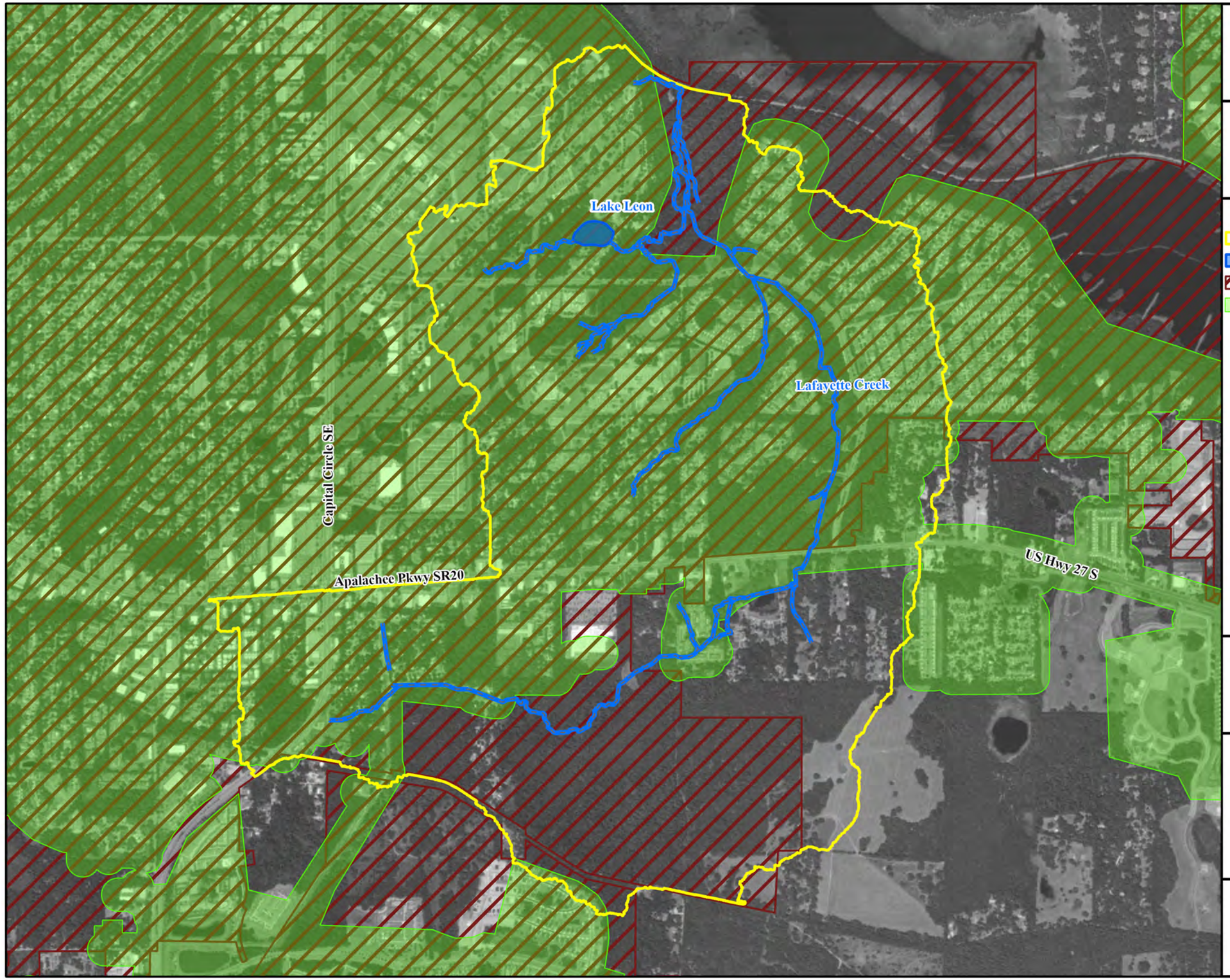
5.8.4.7 Interconnected Flows

Lake Leon discharges over a weir structure to the lower end of Lafayette Creek. As such, it has the potential to be a source to Lafayette Creek. Examination of the TN and TP AGMs within Lake Leon (**Figure 5-158** and **Figure 5-159**) in relation to Lafayette Creek (**Figure 5-161** and **Figure 5-162**), shows that concentrations in Lake Leon are at or lower than the levels in Lafayette Creek. Additionally, the values in Lake Leon (as well as Lafayette Creek) are well below the stream thresholds for TN and TP. Based on this, the load from Lake Leon is not identified as a significant anthropogenic source to Lafayette Creek.

5.8.4.8 Summary of Findings

Based on the discussions above, and data and information presented in **Section 5.8.3,** the only potential anthropogenic sources identified for Lake Leon and Lafayette Creek are septics and wastewater associated with bacteria. The sources of elevated bacteria levels in the creek should be identified and a study recommendation is provided in **Section 5.10**.

Though the sources do not appear significant for TN and TP load, stormwater runoff, septic, interconnected flows (out of Lake Leon), and atmospheric deposition are quantified for comparative purposes as part of this study based on available data. Internal recycling and seepage do not appear to be significant sources and were not quantified as part of this study based on limited data.



CITY OF TALLAHASSEE

N

0 0.2
Miles

Legend

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

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

Figure 5-174:
City of Tallahassee Wastewater Service Areas within Lafayette Creek and Lake Leon Basin

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants

5.8.5 Calculation of Potential Nutrient Loads

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

5.8.5.1 Stormwater Pollutant Load

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

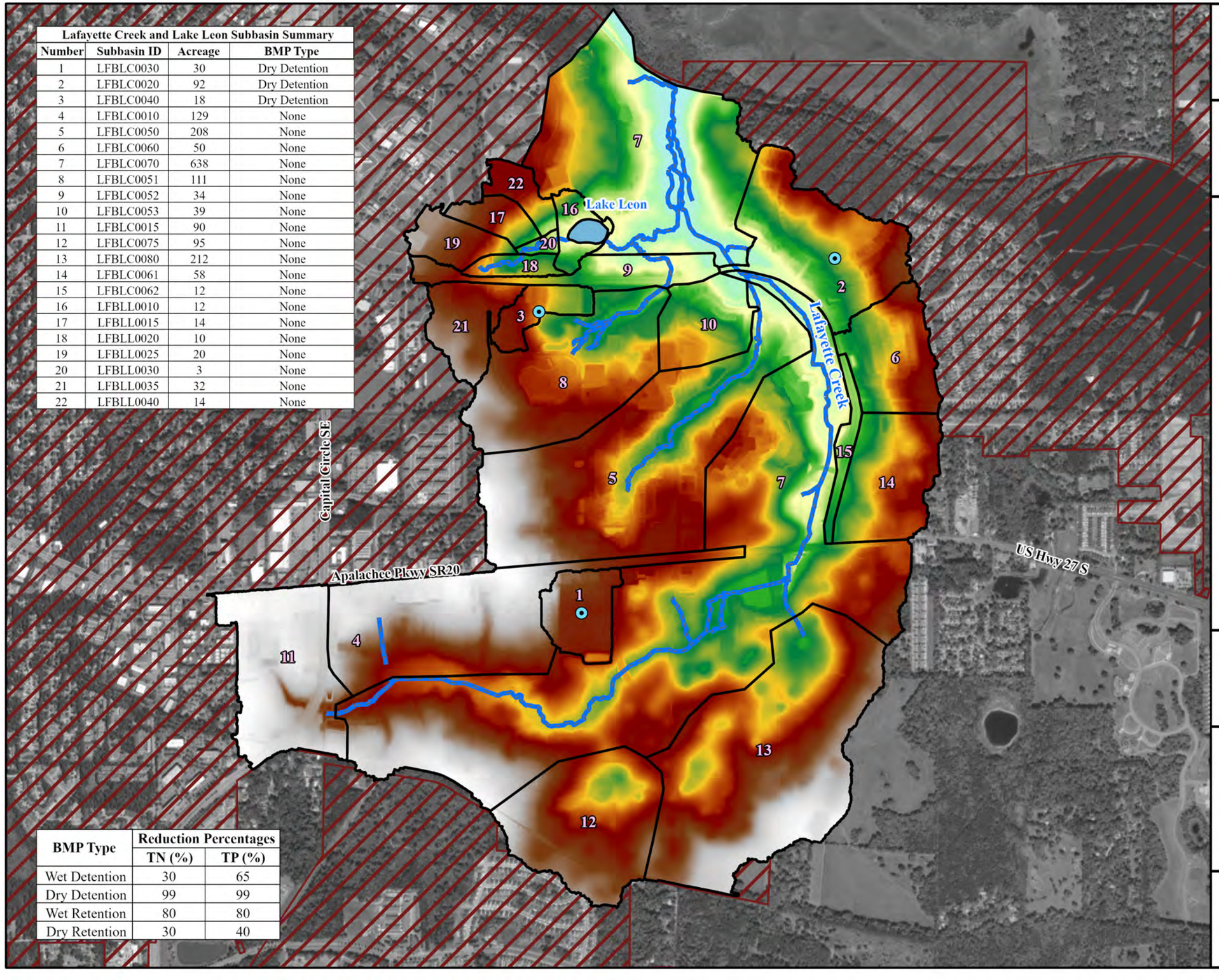
Figure 5-175 presents the subbasins and the DEM utilized in the SIMPLE model calculations for Lafayette Creek and Lake Leon. **Figure 5-176** presents the aggregated land use. Finally, **Figure 5-177** presents the CDAs for the Lafayette Creek and Lake Leon stormwater loading to define total and per acre TN and TP loads, as well as the ranking of CDAs throughout the basin. A series of subbasins were defined in **Figure 5-175** that drain to Lake Leon (subbasins 16, 17, 18, 19, 20 and 22). These are joined into a single CDA draining to Lake Leon (CDA 13). The remaining subbasins make up the CDAs discharging to Lafeyette Creek.

Stormwater Nutrient Loads to Lexington Creek

Figure 5-178 presents the distribution of the ranking of the CDAs for TN along with the total load and per acre loads for Lake Leon and Lafayette Creek, see the tables on **Figure 5-178**. The rankings are color coded, with the highest ranked CDAs in dark green moving down to the lowest ranked in pale yellow. As discussed earlier, a single CDA represents the load to Lake Leon. The total potential stormwater TN load to Lake Leon is 371.5 lb/year, with a per acre load of 3.5 lb/acre/year. For the remaining CDAs that drain to Lafayette Creek, the total TN loads range from as low as 87.3 lb/year up to 1,352.8 lb/year. The per acre loads range from 0.8 lb/acre/year up to 5.3 lb/acre/yr. The highest ranked CDAs are primarily located on the western two tributaries draining to Lafayette Creek and in the most upstream areas, where there is considerable commercial land use. In relation to the other CDAs draining to Lafayette Creek, the CDA draining to Lake Leon is ranked relatively low. Presently, based on the cutoff of 1 acre as the stormwater pond area to account for treatment (see discussion in **Section 5.4.5.1**), treatment that occurs in some of the subbasins is not accounted for in the load calculations. The total potential stormwater runoff load for TN for Lafayette Creek and Lake Leon is 5,335 lb/year.

Lafayette Creek and Lake Leon Subbasin Summary			
Number	Subbasin ID	Acreage	BMP Type
1	LFBLC0030	30	Dry Detention
2	LFBLC0020	92	Dry Detention
3	LFBLC0040	18	Dry Detention
4	LFBLC0010	129	None
5	LFBLC0050	208	None
6	LFBLC0060	50	None
7	LFBLC0070	638	None
8	LFBLC0051	111	None
9	LFBLC0052	34	None
10	LFBLC0053	39	None
11	LFBLC0015	90	None
12	LFBLC0075	95	None
13	LFBLC0080	212	None
14	LFBLC0061	58	None
15	LFBLC0062	12	None
16	LFBLL0010	12	None
17	LFBLL0015	14	None
18	LFBLL0020	10	None
19	LFBLL0025	20	None
20	LFBLL0030	3	None
21	LFBLL0035	32	None
22	LFBLL0040	14	None

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



CITY OF TALLAHASSEE

N

0 0.2
Miles

Legend

- Subbasins
- Waterbodies in Study
- Tallahassee Corporate Limits

BMP Type

- Dry Detention

Topographic Elevations

ft NAVD88

225

35

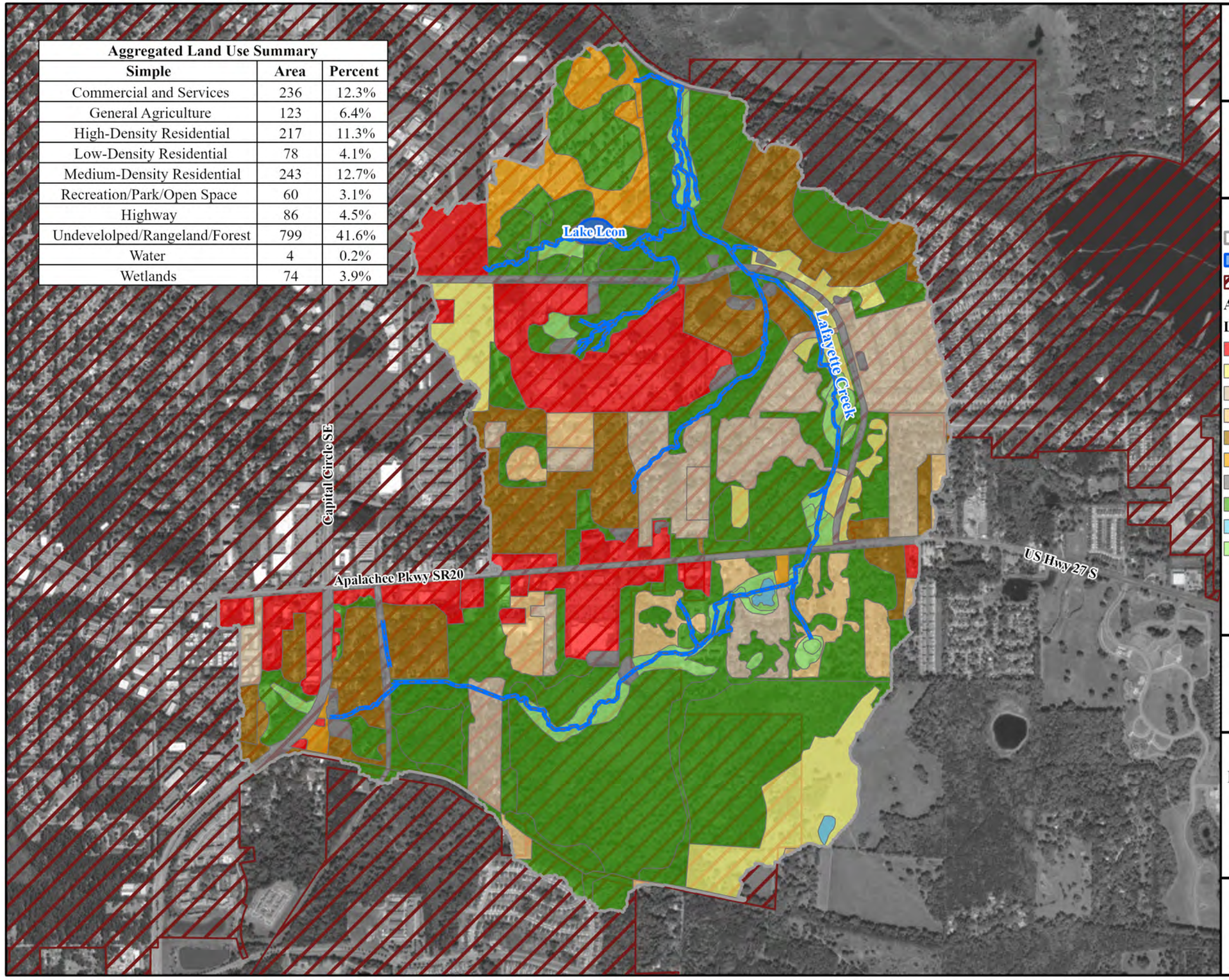
Sources:
Waterbodies: COT, 2020
Watercourses: COT, 2020
Subbasins: Geosyntec, 2022
Roads: COT-Leon County, 2023
City Limits: COT, 2022
BMPs: Geosyntec, 2023
Elevation: COT-Leon County, 2018

Figure 5-175:
Lafayette Creek and Lake Leon Subbasin Delineation and BMPs

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants

Aggregated Land Use Summary		
Simple	**Area**	**Percent**
Commercial and Services	236	12.3%
General Agriculture	123	6.4%
High-Density Residential	217	11.3%
Low-Density Residential	78	4.1%
Medium-Density Residential	243	12.7%
Recreation/Park/Open Space	60	3.1%
Highway	86	4.5%
Undevelolped/Rangeland/Forest	799	41.6%
Water	4	0.2%
Wetlands	74	3.9%



CITY OF TALLAHASSEE

N

0 0.2
Miles

Legend

- Lafayette Creek and Lake Leon Drainage Basin
- Waterbodies in Study
- Tallahassee Corporate Limits

Aggregated Land Use

Land Use Type

- Commercial and Services
- General Agriculture
- High-Density Residential
- Low-Density Residential
- Medium-Density Residential
- Recreation/Park/Open Space
- Highway
- Undeveloped/Rangeland/Forest
- Water
- Wetlands

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

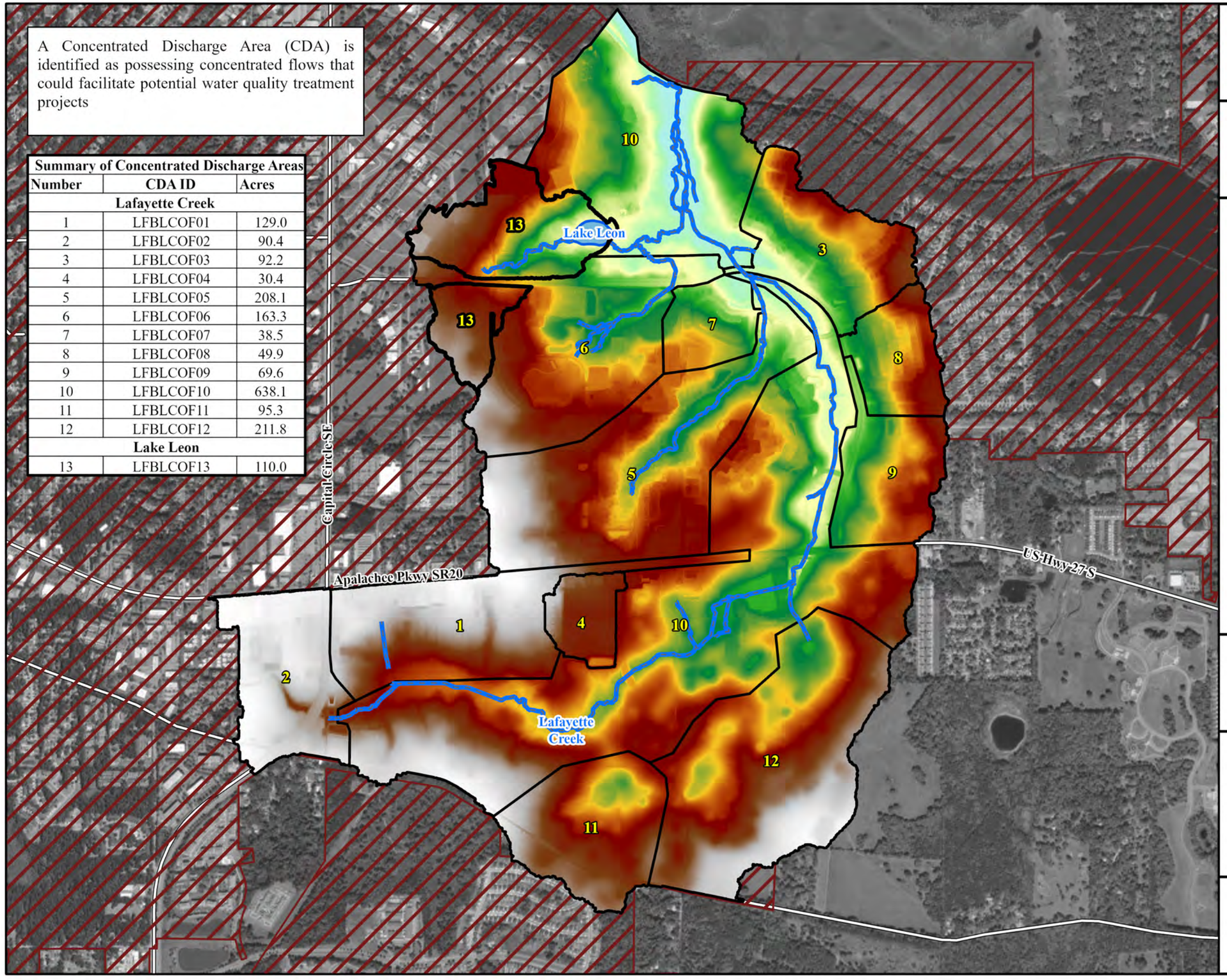
Figure 5-176:
Lafayette Creek and Lake Leon Aggregated Land Use

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants

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

Summary of Concentrated Discharge Areas		
Number	CDA ID	Acres
Lafayette Creek		
1	LFBLCOF01	129.0
2	LFBLCOF02	90.4
3	LFBLCOF03	92.2
4	LFBLCOF04	30.4
5	LFBLCOF05	208.1
6	LFBLCOF06	163.3
7	LFBLCOF07	38.5
8	LFBLCOF08	49.9
9	LFBLCOF09	69.6
10	LFBLCOF10	638.1
11	LFBLCOF11	95.3
12	LFBLCOF12	211.8
Lake Leon		
13	LFBLCOF13	110.0



CITY OF TALLAHASSEE

N

0 0.2 Miles

Legend

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

Topographic Elevations
ft NAVD88

225
35

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

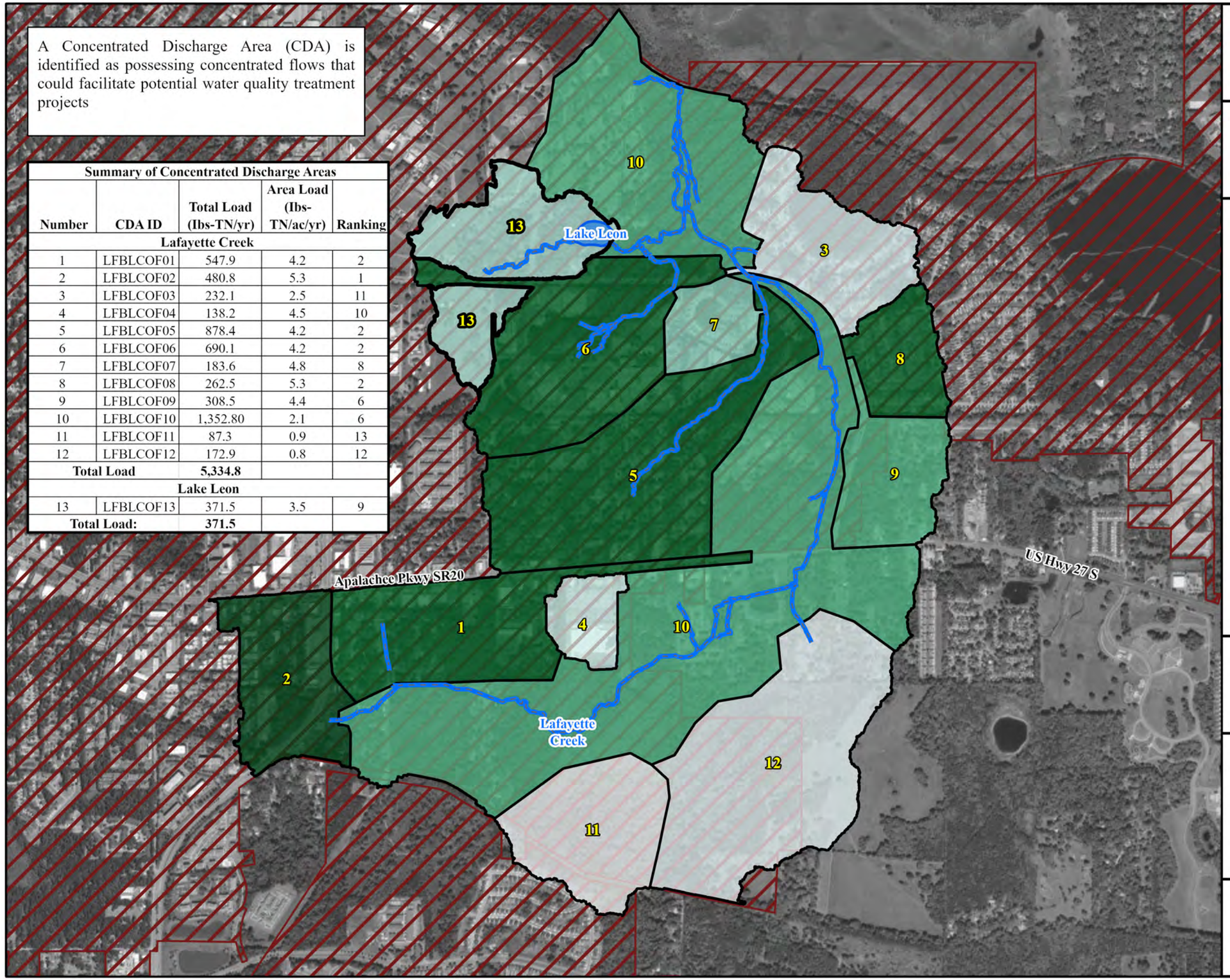
Figure 5-177:
Lafayette Creek and Lake Leon Concentrated Discharge Areas

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants

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

Summary of Concentrated Discharge Areas				
Number	CDA ID	Total Load (lbs-TN/yr)	Area Load (lbs-TN/ac/yr)	Ranking
Lafayette Creek				
1	LFBLCOF01	547.9	4.2	2
2	LFBLCOF02	480.8	5.3	1
3	LFBLCOF03	232.1	2.5	11
4	LFBLCOF04	138.2	4.5	10
5	LFBLCOF05	878.4	4.2	2
6	LFBLCOF06	690.1	4.2	2
7	LFBLCOF07	183.6	4.8	8
8	LFBLCOF08	262.5	5.3	2
9	LFBLCOF09	308.5	4.4	6
10	LFBLCOF10	1,352.80	2.1	6
11	LFBLCOF11	87.3	0.9	13
12	LFBLCOF12	172.9	0.8	12
Total Load		**5,334.8**		
Lake Leon				
13	LFBLCOF13	371.5	3.5	9
Total Load:		**371.5**		



CITY OF TALLAHASSEE

N

0 0.2 Miles

Legend

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

Ranking

- High (1)
- Low (13)

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

Figure 5-178:
Lafayette Creek and Lake Leon Concentrated Discharge Areas-Total Nitrogen

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants

Figure 5-179 presents the distribution of the ranking of the CDAs for TP along with the total load and per acre loads, see the table on **Figure 5-179**. The total potential stormwater TP load to Lake Leon is 94.9 lb/year with a per acre load of 0.9 lb/acre/year. For the remaining CDAs draining to Lafayette Creek the calculated total stormwater TP loads ranged from as low as 12.9 lb/yr up to 372 lb/yr. The per acre loads ranged from 0.1 lb/acre/yr up to 1.0 lb/acre/yr. The TP shows similar results to those seen for TN with a higher ranked CDA in the upper reach of the creek and higher ranked CDAs along the western side. As was seen for TN, the CDA for Lake Leon is ranked lower than others draining to Lafayette Creek. The total potential stormwater runoff load for TP for Lafayette Creek is 1202.5 lb/year.

5.8.5.2 Septic Load

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

An estimated 89 septic tank units were identified within 200 meters of Lafayette Creek. No septic tanks were located within 200 meters of Lake Leon or the tributaries that drain to Lake Leon. **Figure 5-180** shows the septic systems utilized in the analyses. A table provided on the figure summarizes the calculated TN load from septic units. The total load is 1,157 lb/year.

5.8.5.3 Point Source Load

No active point sources were identified within the Lafayette Creek basin. Therefore, the point source loads for TN and TP are set to 0 lb/yr for Lafayette Creek and Lake Leon.

5.8.5.4 Lake Inflow Load

There are no identified lakes upstream of Lake Leon. Therefore, the lake load for TN and TP are set to 0 lb/yr.

5.8.5.5 Internal Lake Load

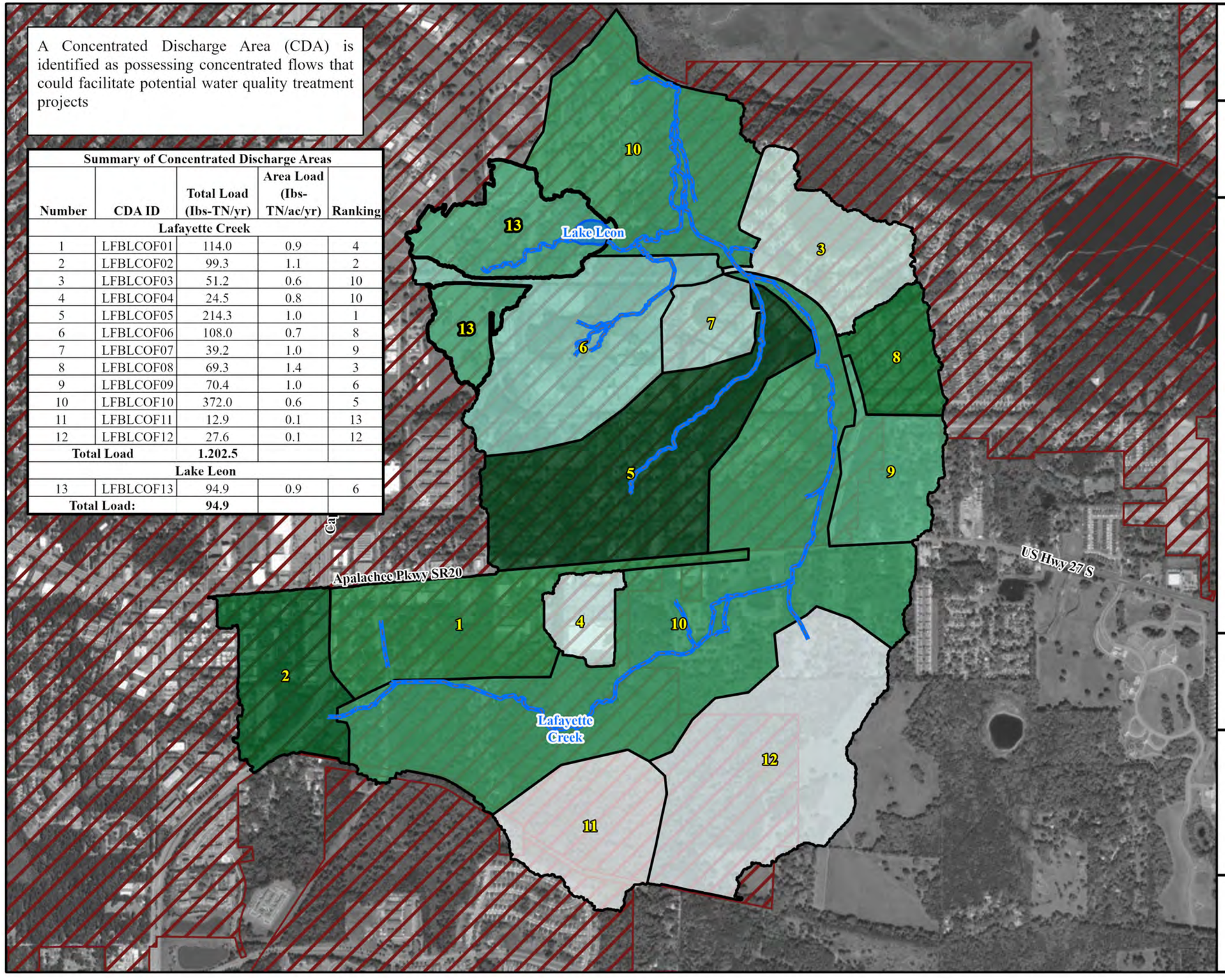
The source assessment determined that internal loading is likely not a significant anthropogenic source to Lake Leon due to the present water quality conditions. At present no measurements have been completed to allow quantification of this load so it is not calculated.

5.8.5.6 Atmospheric Deposition

As presented and discussed in **Section 5.4.5.6** the annual average atmospheric TN load per acre was calculated from the Quincy NADP station (F14) at 2.56 lb/acre/year. Multiplying this by the acreage of Lake Leon (6 acres) gives a total TN load of 15.4 lb/year. No data are available for TP therefore only the nitrogen load is provided.

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

Summary of Concentrated Discharge Areas				
Number	CDA ID	Total Load (lbs-TN/yr)	Area Load (lbs-TN/ac/yr)	Ranking
Lafayette Creek				
1	LFBLCOF01	114.0	0.9	4
2	LFBLCOF02	99.3	1.1	2
3	LFBLCOF03	51.2	0.6	10
4	LFBLCOF04	24.5	0.8	10
5	LFBLCOF05	214.3	1.0	1
6	LFBLCOF06	108.0	0.7	8
7	LFBLCOF07	39.2	1.0	9
8	LFBLCOF08	69.3	1.4	3
9	LFBLCOF09	70.4	1.0	6
10	LFBLCOF10	372.0	0.6	5
11	LFBLCOF11	12.9	0.1	13
12	LFBLCOF12	27.6	0.1	12
Total Load		**1,202.5**		
Lake Leon				
13	LFBLCOF13	94.9	0.9	6
Total Load:		**94.9**		



CITY OF TALLAHASSEE

N

0 0.2 Miles

Legend

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

Ranking

- High (1)
- Low (13)

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

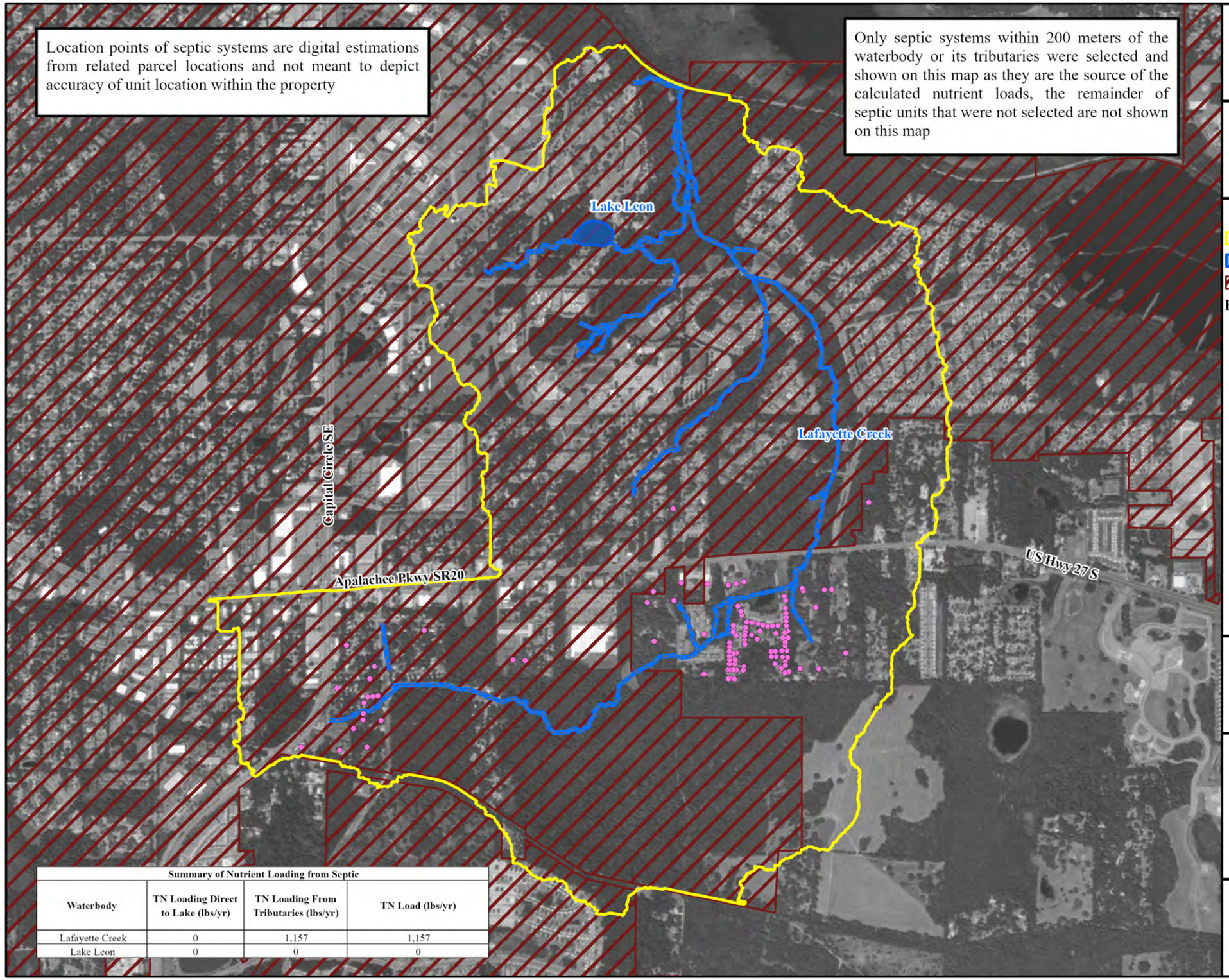
Figure 5-179:
Lafayette Creek and Lake Leon Concentrated Discharge Areas-Total Phosphorus

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants

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

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



Summary of Nutrient Loading from Septic			
Waterbody	TN Loading Direct to Lake (lbs/yr)	TN Loading From Tributaries (lbs/yr)	TN Load (lbs/yr)
Lafayette Creek	0	1,157	1,157
Lake Leon	0	0	0

CITY OF TALLAHASSEE

N

0 0.2
Miles

Legend

- Lafayette Creek and Lake Leon Drainage Basin
- Waterbodies in Study
- Tallahassee Corporate Limits

Relevant Septic Sites

- Tributaries

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

Figure 5-180:
Septic Loading to Lafayette Creek and Lake Leon

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants

5.8.5.7 Summary of Calculated Loads

Nutrient loads to Lafayette Creek were calculated for stormwater runoff, septic systems and interconnected flow out of Lake Leon. Nutrient loads to Lake Leon were calculated for stormwater runoff, septic systems and atmospheric deposition. **Table 5-25** presents the calculated total loads to Lafayette Creek for TN and TP. **Table 5-26** presents the calculated total loads to Lake Leon. For septic systems and atmospheric deposition only TN loads were calculated.

Table 5-25: Summary of Calculated Loads to Lafayette Creek

Source	TN (lb/year)	TP (lb/year)
Stormwater Runoff	5,335	1203
Septic Systems	1,157	NC

NC – Not calculated.

Table 5-26: Summary of Calculated Loads to Lake Leon

Source	TN (lb/year)	TP (lb/year)
Stormwater Runoff	372	95
Septic Systems	0	NC
Atmospheric Deposition	15.4	NC

NC – Not calculated.

5.9 Lafayette Chain of Lakes Basin Hot Spot Analysis

Using the information presented and discussed in **Section 5.4** through **Section 5.8**, qualitative and quantitative rankings were performed in order to identify target areas (hot spots) within the Lafayette Chain of Lakes basin for development of structural and non-structural projects to reduce loads and improve water quality.

The hot spot analysis was completed in three steps. The first step was to collate information presented for each of the waterbodies to support their ranking from highest to lowest based on need for water quality restoration. The second step was to utilize the load calculations presented for each of the waterbodies to rank the sources (by waterbody) from lowest to highest using normalized loads. The final step was to provide spatial ranking of CDAs (as defined in the TN and TP load calculations) by waterbody for use in the identification of structural and non-structural projects. The higher ranked CDAs within a highly ranked waterbody are hot spots and will be targeted for potential pollutant load reduction projects.

For the rankings, nutrients were the primary driver with bacteria data used to support some of the determinations. All rankings using actual loading data were based on nutrients. The following discusses the data utilized, the methodology, and the results of each step of the hot spot analysis culminating in stormwater runoff and septic hot spot maps for the Lafayette Chain of Lakes basin.

5.9.1 Waterbody Ranking

The waterbodies within the Lafayette Chain of Lakes basin were ranked with respect to water quality or factors that could negatively affect water quality, using a qualitative approach. The ranking identified those waterbodies most in need of restoration. The waterbodies evaluated in this analysis include:

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

The information utilized in the development of the waterbody ranking included:

- Verified impairment status,
- Waterbody and tributary water quality analyses,
- Biological data [LVI or Stream Condition Index (SCI)],
- Land-development indices (LDI), and
- Septic densities.

Table 5-27 presents a summary of the information by waterbody for each of the categories listed above. For each of the five categories the waterbodies were ranked based on the summary information provided. The rankings were qualitative for some categories and quantitative in others. The five rankings were then averaged. Using the average ranking, the waterbodies were ranked from highest to lowest based on need for water quality restoration.

For impairment status, the rankings were based on if the waterbodies were verified impaired for nutrients or FIB, their present status relative to TMDL or alternative restoration plan development, and if the waterbody is meeting its TMDL. Waterbodies that were impaired for nutrients were given the higher ranking. Presently, three waterbodies are verified impaired for nutrients with no TMDL or reasonable assurance plan (RAP) completed. These are Piney Z Lake, Lake Tom John, and Shakey Pond. These waterbodies were ranked highest. Four waterbodies were verified impaired but have had TMDLs and/or RAPs completed. These are, Upper Lake Lafayette, Lake Kinsale, Lake Killarney, and Lake Kanturk. In **Section 5.5** discussions were provided on the applicability of the criteria within the Killearn Chain of Lakes, noting that due to their intermittent and man-made nature the NNC for clear/low alkalinity lakes may not be appropriate, thus bringing into question their present impaired status. Based on this, Upper Lake Lafayette was ranked higher than the Killearn Chain based on impairment status. Finally, four waterbodies have no verified impairments, these are Lower Lake Lafayette, Alford Arm, Lake Leon, and Lafayette Creek, these had the lowest ranking.

Analyses of water quality data presented earlier, which included evaluations of the data against the NNC for the waterbodies themselves and primary inflowing tributaries, were utilized for the waterbody water quality ranking. The highest ranked waterbody was Shakey Pond due to the percentage of exceedances of the Chl-a AGM threshold coinciding with high TP AGMs and TSI values in the fair to poor range. The second ranked waterbody was Upper Lake Lafayette based on Chl-a exceedances along with a significant number of TP AGMs above the NNC maximum. TSI values were predominantly in the poor range. The third ranked waterbody was Piney Z Lake, which is based upon Chl-a exceedances along with a significant number of TP AGMs above the maximum. The Killearn Chain of Lakes were all ranked fourth based upon similar levels of exceedances of the Chl-a and TP criteria. The remaining waterbodies (Alford Arm, Lafayette Creek, Lower Lake Lafayette and Lake Leon) were not impaired and were ranked according to their Chl-a and nutrient levels.

As discussed in **Section 5.5** and summarized above, the low color, low alkalinity NNC thresholds are not appropriate for the Killearn Chain of Lakes. **Section 5.5** also identified concerns relative to the applicability of the proposed criteria due to the nature of the waterbodies (former wetlands) and that the alkalinity levels are close to those that would shift them into an alternate category.

For the biological assessment, the waterbody rankings used the Exceptional, Healthy, and Impaired determinations. Based on this assessment (outlined in **Table 5-27**) the top ranked waterbodies were the Killearn Chain of Lakes and Lake Leon which had Impaired determinations or a preponderance of Impaired. Shakey Pond, Upper Lake Lafayette, Alford Arm, Lafayette Creek, and Lower Lake Lafayette were ranked second based on lack of data or some impairment with mostly healthy (Shakey Pond). Lake Tom John was ranked third based on a single healthy determination and Piney Z Lake ranked fourth based on consistent healthy determinations.

Table 5-27: Waterbody Ranking

Waterbody	Impairment Status	Rank	Waterbody and Tributary WQ Analyses	Rank	Biological Data (LVI or SCI)	Rank	LDI	Rank	Septic Density	Rank	Average Rank	Waterbody Rank
Shakey Pond	Impaired	1	Six of seven Chl-a AGMs between 2010-2020 above NNC criteria of 20 µg/L. Five TN AGMs between the minimum and maximum NNC targets, two below the minimum NNC target. Six TP AGMs from 2010 to 2020 above the maximum NNC target and one below the minimum. Most TSI values in the poor and fair ranges with a few in the good range between 2010 and 2020.	1	2 Healthy, 1 Impaired	2	Poor	1	The Shakey drainage area has very few septic tanks.	6	2.20	**1**
Upper Lake Lafayette	Impaired (Chl-a, TN, TP) but TMDL Completed and RAP (4e) Completed	2	Six out of ten Chl-a AGMs between 2010-2020 above NNC criteria of 20 µg/L. All but one TN AGM below the NNC minimum, one between minimum and maximum since 2010. Eight of ten TP AGMs from 2010 to 2020 above the NNC maximum target, remaining TP AGMs are between the minimum and maximum targets. Numerous TSI values in the poor range between 2010 and 2020.	2	No data	2	Mixture of Moderate and Poor, with more areas Poor.	2	Drainage has densities between 0.0 to 0.2 units per acre.	5	2.60	**2**
Lake Kanturk	Impaired (TN, TP, Chl–a) but RAP (4e) Completed	3	Six of eight Chl-a AGMs between 2010-2020 above NNC criteria of 6 µg/L. Three TN AGM between the maximum NNC target and 5 between the minimum and maximum NNC targets. All eight TP AGMs from 2010 to 2020 above the maximum NNC target. Some TSI values in the poor and fair ranges but most in the good range between 2010 and 2020.	4	2 Impaired	1	Mixture of Moderate and Poor in immediate area, moderate and good in upper drainage area.	4	Drainage has densities greater than 0.9 units per acre.	1	2.60	**2**
Lake Tom John	Impaired (TP, Chl-a)	1	Three of four Chl-a AGMs between 2015-2020 above NNC criteria of 6 µg/L. Three TN AGMs between the minimum and maximum and one below the minimum. All four TP AGMs from 2015 to 2020 between the minimum and maximum NNC targets. All TSI values in the good range between 2015 and 2020.	5	1 Healthy	3	Moderate	5	Drainage has densities between 0.4 to 0.5 units per acre.	2	3.20	**4**
Lake Kinsale	Impaired (TN, TP, Chl–a) but RAP (4e) Completed	3	Seven out of ten Chl-a AGMs between 2010-2020 above NNC criteria of 6 µg/L. One TN AGM above the NNC maximum, five between the minimum and maximum, and four below the minimum NNC target. All ten TP AGMs from 2010 to 2020 above the NNC maximum target. Some TSI values in the poor and fair ranges but most in the good range between 2010 and 2020.	4	No data after 2010, 2009 Impaired	1	Immediate drainage Poor with upper reaches of the watershed draining Moderate to Good.	3	Drainage has densities between 0.0 to 0.2 units per acre.	5	3.20	**4**
Lake Killarney	Impaired (TN, TP, Chl–a) but RAP (4e) Completed	3	Eight of ten Chl-a AGMs between 2010-2020 above NNC criteria of 6 µg/L. One TN AGM above the NNC maximum, five between the minimum and maximum, and four below the minimum NNC target. Eight of ten TP AGMs from 2010 to 2020 above the NNC maximum target, remaining two are just below the maximum. Some TSI values in the poor and fair ranges but most in the good range between 2010 and 2020. There is a general improving trend in the lake.	4	2 Impaired	1	Mixture of Moderate and Poor in immediate area, moderate and good in upper drainage area.	4	No septics within the immediate drainage	7	3.80	**6**
Lake Piney Z	Impaired (TN, TP, Chl–a)	1	All Chl-a AGMs between 2010-2020 above NNC criteria of 6 µg/L, but lower values after 2012. Four out of ten TN AGMs above the maximum, all prior to 2015. From 2015 to 2020 all TN AGMs between the minimum and maximum NNC criteria. Seven of ten TP AGMs from 2010 to 2020 above the NNC maximum with remaining between the minimum and maximum TP targets. Five of the seven were prior to 2015. Other values between the minimum and maximum NNC targets. Some TSI values in the poor range prior to 2013, after 2013 some in the fair range but most in the good range. Ranking accounts for concerns on reasonableness of NNC targets.	3	12 Healthy	4	Good	7	Drainage has densities between 0.0 to 0.1 units per acre.	6	4.20	**7**

Waterbody	Impairment Status	Rank	Waterbody and Tributary WQ Analyses	Rank	Biological Data (LVI or SCI)	Rank	LDI	Rank	Septic Density	Rank	Average Rank	Waterbody Rank
Alford Arm	Not Impaired	4	Insufficient data between 2010 and 2020 to calculate the AGM values in any year for TN, TP or Chl-a. Only year with any data was 2010.	7	No data	2	Immediate drainage good, lower drainage basin areas Moderate with upper reaches a mixture of Good and Excellent	6	Drainage has densities between 0.1 and 0.6 units per acre.	3	4.40	**8**
Lafayette Creek	Not Impaired	4	One TN AGM between 2010-2020 above the East Panhandle Stream threshold (2012) with all remaining TN AGMs well below the threshold. All TP AGMs below the Panhandle East Stream NNC threshold. Has high bacteria at the lower station.	6	No Data	2	Good	7	Septic densities generally near zero other than one area in upper watershed with densities between 0.06 and 0.4 but overall basin is below 0.1 units per acre	6	5.00	**9**
Lower Lake Lafayette	Not Impaired	4	TN and TP AGMs were below the NNC minimum thresholds for all years between 2010 and 2020. Chl-a AGMs were below the NNC threshold of 20 µg/L for all years with AGM values down near 6 µg/L where sufficient data were available. Nearly all TSI values were in the good range with only a few data points in the fair range.	9	No data	2	Good in immediate drainage, moderate, good and excellent in larger drainage area.	8	Drainage has densities between 0.1 and 0.2 units per acre.	4	5.40	**10**
Lake Leon	Not Impaired	4	All Chl-a AGMs between 2010-2020 below NNC criteria of 20 µg/L. All TN AGMs below the minimum NNC target. Four out of five TP AGMs at or below the minimum NNC target with one between the minimum and maximum NNC targets.	8	1 Healthy, 3 Impaired	1	Good	7	Near zero septics in drainage area	7	5.40	**10**

Using the LDI scores presented earlier, the individual waterbodies were ranked based upon where they fell overall in the potential for anthropogenic loading resulting from the watershed that drains to it **(Table 5-27**). For LDI, the highest ranked waterbody was Shakey Pond. Upper Lake Lafayette was ranked second due to extensive urban areas draining to it. The Killearn Chain of Lakes were ranked next with Lake Kinsale having a slightly higher ranking (third) than Killarney and Kanturk (tied for fourth). Lake Tom John was ranked fifth because of the extensive residential areas draining to it. Alford Arm was ranked sixth due to some moderate areas immediately upstream with overall being good to excellent. Lafayette Creek and Lake Leon were tied for seventh with Lower Lake Lafayette having the lowest ranking resulting from the extensive natural areas in its immediate drainage basin.

The final waterbody ranking criteria was Septic Density within the immediate drainage area. Based on the results presented earlier and summarized in **Table 5-27**, the waterbodies were ranked. The top ranked waterbody was Lake Kanturk which had overall septic densities upwards of 1 unit per acre, the highest in the drainage basin. Lake Tom John was ranked second with densities around 1 unit per 2 acres. Alford Arm was ranked third with a range of septic densities in the immediate area with the highest having around 1 unit per 2 acres. The remaining waterbodies all had relatively low septic densities with the rankings from highest to lowest being Lower Lake Lafayette, Upper Lake Lafayette, Lake Kinsale, Lafayette Creek, Piney Z Lake, Shakey Pond, Lake Killarney, and Lake Leon.

Table 5-27 provides an average ranking for each of the waterbodies and then a final ranking based on the average ranking. The final ranking by waterbody, with respect to the need for restoration activities, are presented from most pressing (1) to least pressing (6) in the order shown below. Where waterbodies are tied in ranking, they are presented together.

1. Shakey Pond
2. Upper Lake Lafayette, Lake Kanturk
4. Lake Tom John
5. Lake Kinsale
6. Lake Killarney
7. Piney Z Lake, Alford Arm
9. Lafayette Creek, Lower Lake Lafayette, Lake Leon

Based on their overall water quality and potential for loading (as summarized above and in **Table 5-28)**, Piney Z Lake, Alford Arm, Lafayette Creek, Lower Lake Lafayette, and Lake Leon were removed from further ranking, and not considered priority targets for load reduction projects at this time. Additional study recommendations are provided for both the priority and non-priority waterbodies in **Section 5.10** depending on data needs and water quality conditions.

5.9.2 Pollutant Source Ranking

The pollutant source ranking utilizes load calculations presented in the **Calculation of Potential Nutrient Loads** sections for each waterbody. The specific loads quantified (where data allowed) include:

- Stormwater pollutant load,
- Septic load,
- Point source load,
- Lake inflow load,
- Internal lake load, and shallow groundwater seepage,
- Atmospheric deposition.

Using the calculated total loads for nutrients the load sources are ranked for each individual waterbody to identify which type of loading to prioritize. The ranking (by waterbody) is based upon the total loads with the highest rank (the top source to target) assigned to the largest load. Where insufficient data are available, the load sources are not considered in the ranking but are discussed where appropriate.

Table 5-28 presents the results of the source ranking by waterbody. As some of the load types only had TN data, TN became the driving load for the ranking in general. Almost across the board, stormwater loads are identified as the top ranked source.

For Upper Lake Lafayette, stormwater loads are significantly higher than any other source. This is mainly due to the size of the watershed. Based on treatment received through the Weems Pond Regional Treatment Facility, while the loads are high, the concentrations are low. Therefore, stormwater loads are not deemed a significant pollutant source to Upper Lake Lafayette. The second highest load was septic followed closely by atmospheric deposition.

For Piney Z Lake, due to the size of the watershed and the isolated nature of the waterbody, while stormwater is the highest overall load, in comparison to other lakes of similar size, the stormwater load is not large. The second highest load is atmospheric deposition due to the relatively small watershed to receiving waterbody area ratio.

For Lower Lake Lafayette, while stormwater loads are the highest of the calculated sources, the likely actual largest load would be Lake Inflow from Alford Arm. This value was not calculated due to the lack of recent water quality data for the lake portion of Alford Arm, which is due to the significant watershed area draining to Alford Arm and the direct connection into Lower Lake Lafayette. The second highest load to Lower Lake Lafayette for those calculated is atmospheric deposition, which is due to the relatively low direct watershed area to receiving waterbody area ratio.

Table 5-28: Load Source Ranking

Waterbody	Lake Area	Stormwater Pollutant Load			Septic Load			Lake Inflow Load			Internal Load			Atmospheric Deposition		
		Total		Rank	Total		Rank	Total		Rank	Total		Rank	Total		Rank
		TN (lb/yr)	TP (lb/yr)		TN (lb/yr)	TP (lb/yr)		TN (lb/yr)	TP (lb/yr)		TN (lb/yr)	TP (lb/yr)		TN (lb/yr)	TP (lb/yr)	
Upper Lake Lafayette	**373**	19,863	2,843	1	1,168	ND	2	495	38	4	ND	ND	ND	955	ND	3
Lake Piney Z	**238**	1,626	361	1	65	ND	3	NA	NA	NA	ND	ND	ND	609	ND	2
Lower Lake Lafayette	**1067**	9,019	1,571	1	2,011	ND	3	ND	ND	ND	ND	ND	ND	2,732	ND	2
Alford Arm	**367**	26,793	5,292	1	6,327	ND	3	20,549	2,079	2	ND	ND	ND	940	ND	4
Lake Kinsale	**13**	10,244	2,248	1	346	ND	4	584	21	3	975	64	2	32	ND	5
Lake Killarney	**80**	5,153	1,497	1	0	0	4	11,148	1,055	1	4,105	187	2	205	ND	3
Lake Kanturk	**70**	6,209	1,568	1	9,852	ND	2	12,131	551	1	5,199	238	3	179	ND	4
Lake Tom John	**40**	2,194	438	1	1,125	ND	2	ND	ND	ND	ND	ND	ND	102	ND	3
Shakey Pond	**14**	932	249	1	0	0	3	NA	NA	NA	ND	ND	ND	36	ND	2
Lake Leon	**6**	372	95	1	0	ND	3	NA	NA	NA	ND	ND	ND	15	ND	2
Lafayette Creek	**NA**	5,335	1,203	1	1,157	ND	2	240	10	3	NA	NA	NA	NA	NA	NA

For Alford Arm, the stormwater loads as well as the lake inflow (mainly from Killearn Chain) are significant with the direct stormwater load higher. The significant volume of lake inflow load comes out of the Killearn Chain of Lakes which drains a large area of the upper watershed and has somewhat elevated TN and TP levels. The third highest load to Alford Arm is septic load due primarily to a significant cluster of units directly upstream.

For the Killearn Chain of Lakes the largest loads (based on TN) are stormwater and (for the downstream lakes) lake inflow loads, due to the pass through of incoming stormwater loads to Lake Kinsale. Direct stormwater runoff and lake inflow loads were ranked tied for Lake Killarney and Lake Kanturk based on nitrogen and phosphorus loads being higher for each of the two sources. Internal loads were the second highest loads for Lake Kinsale and Lake Killarney. The second highest load for Lake Kanturk was septics, due to the extensive cluster of units in the watershed areas draining to the northern side.

For Lake Tom John, stormwater was the highest load with septics being ranked number 2. For Shakey Pond and Lake Leon stormwater loads were by far the highest, the same was seen for Lafayette Creek. Additionally, for Shakey Pond internal loads were high.

Based on this analysis, the top load source to target for the waterbodies within the Lake Lafayette Chain of Lakes basin would be stormwater loads. The next target would be septic loading. Other loading sources are generally either at zero, are low compared to the stormwater or septic, are not addressable through projects (atmospheric deposition), or have insufficient data at this time and therefore would not be targeted for structural or non-structural projects as part of this study.

5.9.3 Identification of Hot Spot Areas

Section 5.9.1 ranked the waterbodies in the Lake Lafayette Chain of Lakes basin based on their need for water quality restoration. The next step in the evaluation of the waterbodies was to determine if each one should be prioritized and therefore be a primary target for development of projects, which is a qualitative assessment that accounts for the present conditions and the potential for future degradation. For the Lake Lafayette basin, it was determined that the watershed draining to Shakey Pond, Lake Tom John and the Killearn Chain of Lakes, and the portion of the watershed draining to Upper Lake Lafayette (below Weems Pond) could be targeted for projects relative to stormwater loads. Lake Kanturk was targeted for potential projects to reduce septic loads.

The next step was to present the stormwater and septic load rankings for each of the chosen waterbodies presented on a basin-wide map. The stormwater load rankings were presented by waterbody drainage area in the **Calculation of Potential Nutrient Loads** sections. The highest to lowest ranked CDAs were highlighted from dark green to pale yellow, with the dark green representing the top rank areas to target for load reduction activities.

For septic loads, the total loads (calculated and presented in earlier sections) were subdivided into the CDAs based upon the location of septic systems which were determined to load the waterbodies or tributaries draining to the waterbodies. The total septic load for each of the CDAs were calculated and then ranked (by waterbody drainage area) as largest to smallest based on total load with the highest ranked having the largest total load. The septic load CDA rankings are

presented separately as their loads will be different and the potential project types also different, i.e., septic to sewer conversions.

Although Piney Z Lake was not identified in the hot spot areas as a priority target for projects, the waterbody remains impaired and therefore some determination of future actions is necessary. Piney Z Lake is identified as a target waterbody in **Section 5.10** which identifies potential additional studies to address waterbody issues.

Exhibit 5-8 and **Exhibit 5-9** present the CDA rankings for the stormwater and septic loads, respectively, for each of the chosen waterbodies, with the drainage areas for the waterbodies not identified for projects (Upper Lake Lafayette above Weems Pond, Piney Z Lake, Lower Lake Lafayette, Alford Arm, Lafayette Creek and Lake Leon for stormwater and all areas other than Lake Kanturk and Lafayette Creek for septic) greyed out. The rankings are by waterbody drainage area and are shown as green for the highest ranked areas and pale yellow for the lowest ranked areas. These two maps provide the basis for project targeting for the two primary sources identified, stormwater and septic loads. While Lafayette Creek was not identified as a priority waterbody, it is included in the septic map (**Exhibit 5-9**) based on elevated *E. coli* levels and study recommendations provided in **Section 5.10**.

The stormwater load ranking by CDA for the upstream drainage to Piney Z Lake, Lower Lake Lafayette, Alford Arm, and Lafayette Creek are not provided as these waterbodies were not targeted for septic load reduction projects based on the qualitative assessment presented in previous sections.

Lake Tom John
Lake Kinsale
Lake Killarney
Lake Kanturk
Shakey Pond
Upper Lake Lafayette
Lake Leon
Alford Arm
Piney Z Lake
Lower Lake Lafayette
Lafayette Creek

Sources:
Waterbodies: COT, 2020
Watersheds: COT, 2020
Watercourses: COT, 2020
City Limits: COT, 2020

N

0 4,000
Feet

Legend

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

Stormwater Load Ranking

- High
- Low

Lake Lafayette Drainage Basin Stormwater Loading Hotspots

Geosyntec consultants

CITY OF TALLAHASSEE

Exhibit 5-8

The septic load ranking by CDA for the upstream drainage to Upper Lake Lafayette, Piney Z Lake, Lower Lake Lafayette, and Alford Arm are not provided as these waterbodies were not targeted for septic load reduction projects based on the qualitative assessment presented in previous sections.

Lake Tom John
Lake Kinsale
Lake Killarney
Lake Kanturk
Shakey Pond
Upper Lake Lafayette
Lake Leon
Piney Z Lake
Alford Arm
Lower Lake Lafayette
Lafayette Creek

Sources:
Waterbodies: COT, 2020
Watersheds: COT, 2020
Watercourses: COT, 2020
City Limits: COT, 2020
Septic Units: COT, 2020

N

0 4,000
Feet

Legend

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

Septic Load Ranking
High
Low

Lake Lafayette Drainage Basin Septic Loading Hotspots

Geosyntec consultants

CITY OF TALLAHASSEE

Exhibit 5-9

5.10 Water Quality Study Identification and Prioritization

As part of the data review and summary provided for each of the target waterbodies (**Section 5.4** through **Section 5.8**), limitations in available hydrologic, water quality (groundwater and surface water), and benthic sediment data were identified. Additionally, as part of the qualitative assessment of sources for each waterbody, specific key stressors, i.e., significant potential sources of anthropogenic load or factors contributing to degraded water quality, were identified. Finally, **Section 5.9** presented a hot spot analysis for the Lake Lafayette basin that ranked the waterbodies relative to their need for evaluation or restoration and identified specific waterbodies to target for restoration projects, additional data collection, or studies.

Utilizing the information outlined above, potential studies needed to address data gaps, evaluate designated uses, and quantify key stressors were proposed and ranked. The results of the previous tasks are summarized in **Section 5.10.1**, along with an overview of key stressors for the priority waterbodies (Shakey Pond, Upper Lake Lafayette, Piney Z Lake, Lake Kinsale, Lake Killarney, Lake Kanturk, and Lake Tom John). Studies are identified that fill in data gaps, evaluate designated uses, support quantification of specific waterbody stressor(s) or support waterbody restoration (**Section 5.10.2**). The proposed studies include evaluations of present lake conditions and uses and opportunities for restoration, new water quality data collection, evaluation of potential septic loading, and bacteria source assessments.

5.10.1 Summary of Data Limitations, Waterbody Prioritization, and Key Stressors

Table 5-29 provides a summary of the data limitations presented at the end of the data review and summary sections for the priority waterbodies outlined above (**Section 5.4** through **Section 5.8**). The data limitations identified include no or limited hydrologic data, limited water quality data, no groundwater quality data in the area of the study waterbodies to allow assessment of potential seepage, and no data to quantify internal nutrient loading.

Table 5-27 presented the prioritized waterbodies for restoration within the Lake Lafayette Chain of Lakes basin. These included Shakey Pond, Upper Lake Lafayette, the Killearn Chain of Lakes, and Lake Tom John. These waterbodies are targeted for development of projects to support water quality improvement. Identified projects are discussed in **Volume 7 – Non-Structural and Structural Project Development**. The prioritized waterbodies are also targeted for studies to fill data gaps to further refine restoration strategies. As such, the proposed studies focus on these waterbodies.

A key task under the scope of work for the basin studies identification was to review and assess stressors for the priority waterbodies. The stressors were reviewed to confirm potential water quality impact and pathways of pollutant migration to the waterbodies. The intent is to identify where additional data collection and analysis of advanced analytic parameters might help better understand the expected load/contribution of the source. The following sections outline the key stressors identified in previous sections for the prioritized waterbodies within the Lake Lafayette Chain of Lakes basin (Shakey Pond, Upper Lake Lafayette, the Killearn Chain of Lakes, and Lake Tom John).

Table 5-29: Summary of Identified Data Limitations for Target Waterbodies in the Lake Lafayette Chain of Lakes Basin

Shakey Pond	Lafayette Chain	Killearn Chain of Lakes	Lake Tom John
There are no water quality monitoring stations for the inflows to Shakey Pond.	There is no water level data within Upper Lake Lafayette and Piney Z Lake.	There is no continuous flow data for the tributaries flowing into Lake Kinsale.	No hydrologic data (level or inflow/outflow) data has been collected on the lake or in the upstream discharge to the lake or the downstream discharge to the Killearn Chain of Lakes.
No surficial groundwater monitoring stations are located in the vicinity to determine the quality of potential seepage into Shakey Pond.	Information on the hydrologic connections between the different waterbodies is limited.	There are limited water quality data at the inflow points to Lake Kinsale from the upstream tributaries.	There are no water quality monitoring stations for the inflow to the lake which represents the bulk of the stormwater inflow from the drainage basin.
	No continuous flow measurements for the two primary inputs to Upper Lake Lafayette.		No surficial groundwater monitoring stations are located in the vicinity to determine the quality of potential seepage into the lake or ditch segments.
	There are no data to evaluate the potential for seepage of pollutants to the lake from the surficial aquifer, i.e., surficial groundwater sampling stations around the chain of lakes.	There are no data to evaluate the potential for seepage of pollutants to the lake from the surficial aquifer, i.e., surficial groundwater sampling stations around the chain of lakes.	No data are available to determine the potential for internal loading as a source.
	There is no recent water quality data in the lake portion of Alford Arm		

5.10.1.1 Shakey Pond Key Stressors

Water quality analyses and the qualitative assessment of sources identified that Shakey Pond is presently not meeting its NNC, and that stormwater runoff and internal load are potential key stressors. Another key aspect of Shakey Pond is the failure of the outflow structure which has led to decreased water levels in the system. Stormwater treatment is provided for all but one of the stormwater inflow points to the pond. A recent study of the pond has been completed that quantified the stormwater and internal loads to the pond.

5.10.1.2 Lafayette Chain of Lakes (Upper Lake Lafayette and Piney Z Lake) Key Stressors

Water quality analyses and the qualitative assessment of sources (**Section 5.4.3.6** and **Section 5.4.4**) identified that Upper Lake Lafayette is presently impaired but the lake's present hydrology and extensive periods of dry down with standing water only in the area of Lafayette Sink make assessment as a typical lake unreasonable. Additionally, evaluations of the tributary inflows to the lake did not identify elevated nutrient concentrations in either of the two primary inflows, NEDD below Weems Pond and Lafayette Creek (**Section 5.4.4.1**). As such, the primary stressor for Upper Lake Lafayette at this time is its hydrologic condition and associated nutrient assimilation capability.

Water quality analyses (**Section 5.4.3.6** and **Section 5.4.4.1**) identified that Piney Z Lake is presently impaired based upon its classification as a low color, low alkalinity system. Evaluation of stormwater runoff, septic, and other external sources did not show significant anthropogenic nutrient load potential. Additionally, historic sediment characterization did not identify elevated levels of nitrogen or phosphorus in the sediments, indicating that internal load is not a likely source. Based on historic alterations, Piney Z Lake is artificially isolated from the adjacent waterbodies due to berming, limited structural connections, and elevated water levels in comparison to the adjacent systems. Additionally, historic management of the lake reduced the volume of aquatic vegetation although recovery has begun to occur. Based on these determinations the key stressors associated with Piney Z Lake are likely it's isolated hydrology and limited exchange and historic ecologic management. Additionally, previous discussions raised issues with the applicability of the lakes present classification/criteria relative to use attainability.

5.10.1.3 Killearn Chain of Lakes Key Stressors

Water quality analyses and the qualitative assessment of sources identified stormwater runoff as a potential significant stressor to the Killearn Chain of Lakes. Historic measurements of internal load did not identify it as a significant potential anthropogenic source. An additional key stressor of the Killearn Chain of Lakes that was identified in earlier discussions is the hydrologic nature with significant periods of dry down due to insufficient hydrologic load to maintain adequate water levels. The hydrologic conditions present issues with collection of samples during and post dry down periods and their applicability relative to impairment designation. The constructed nature of the system along with the present hydrology raises concerns with the present waterbody designation and use attainability.

An additional stressor that was identified for Lake Kanturk is the potential for septic loading due to the extensive cluster of septic systems within the subwatersheds draining to the northern side

of the lake, which is based on calculated potential loads along with a study that identified high levels of TN (nitrate) in flows entering the lake.

5.10.1.4 Lake Tom John Key Stressors

Water quality analyses and the qualitative assessment of sources identified stormwater runoff contributing to direct inflow and interconnected flow from upstream waterbodies (Lake Bess) as potentially significant anthropogenic loads. Internal loading was also identified as a potential load but at present data are not available to quantify.

5.10.2 Study/Data Collection Recommendations

Based on the data limitations and waterbody stressors outlined in **Section 5.10.1**, additional data collection and waterbody study recommendations were developed in conjunction with City staff. The list of recommended studies includes the following:

- Shakey Pond
    - Water Quality Assessment and Restoration Study
- Upper Lake Lafayette
    - Hydrologic Study
- Killearn Chain of Lakes
    - Hydrologic Study
    - Evaluation of Site-Specific Alternative Criteria
- Lake Kanturk
    - Septic Loading Study
- Lake Tom John
    - Development of Hydrologic and Nutrient Budget
    - Evaluation of Site-Specific Alternative Criteria
- Piney Z Lake
    - Evaluation of Site-Specific Alternative Criteria
- Lafayette Creek
    - Additional Bacteria Sampling

The following outlines the justification, what stressors or data limitations are being addressed, and a general description of the work to be performed, along with initial scope items for each of the data collection/studies listed previously. It is noted that some of these studies are outside of the City's incorporated areas and, therefore, the studies would need to occur under the jurisdiction of the state or county.

5.10.2.1 Shakey Pond: Water Quality Assessment and Restoration Study

Section 5.10.1.1 identified that presently Shakey Pond is not meeting its NNC due to potential stormwater runoff and internal nutrient loading. Additionally, issues with the present condition of the outflow structure was identified. Based on this, it is recommended to initiate a study to determine potential restoration activities necessary to meet water quality criteria. The study will include the development of a hydrologic and nutrient budget/mass loading analysis for the pond. Additionally, mitigation strategies will be evaluated to help in the attainment of water quality standards, i.e., the appropriate NNC standard. The primary focus will be on the internal sediment nutrient flux while also addressing atmospheric deposition, stormwater inputs, and shallow groundwater inputs.

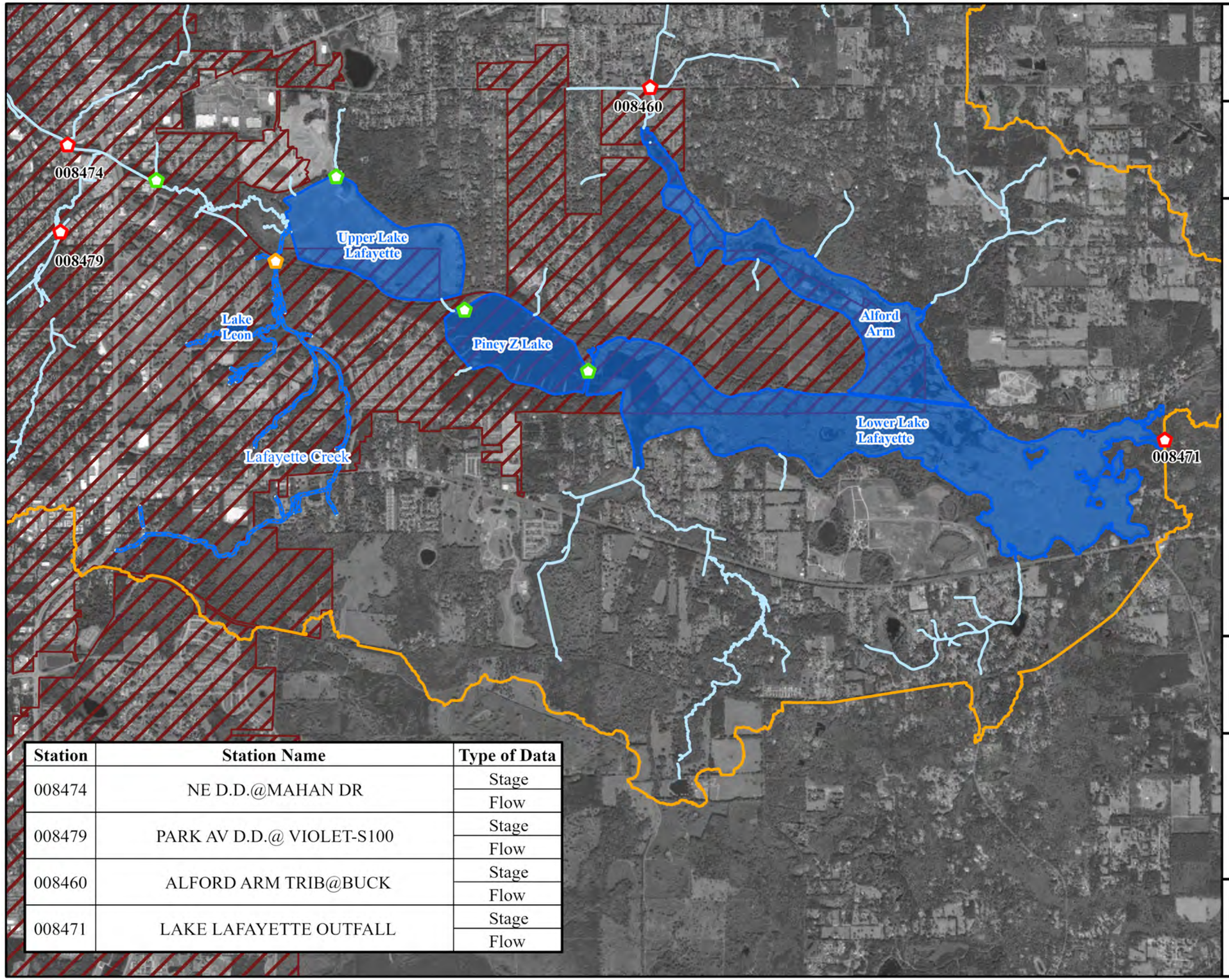
The recommended elements for the study are as follows.

- Site reconnaissance to understand the site logistics, including historical and potential future monitoring locations, as well as develop consensus with City staff on station locations and monitoring approach.
- Installation of a lake level monitor to aid in the assessment of the hydrology of the pond.
- Assessment of sediment characteristics, including muck layer thickness, nutrient content, pore water characteristics and phosphorus fractionalization.
- Development of a hydrologic model to define the system hydrologic budget. Model to be calibrated to the lake level data.
- Development of a nutrient budget.
- Identification of Restoration Options.

5.10.2.2 Upper Lake Lafayette: Hydrologic Study

Section 5.10.1.2 identified that the primary stressors for Upper Lake Lafayette come from the system's hydrology with extended periods of dry down (water limited to area of sink) with at times more extended periods of refilling, which leads to conditions that are not reflective of a true lake system, thus limiting the applicability of the State NNC. Determination of an appropriate and achievable use for the lake begins first with a full understanding of the overall system hydrology including the other lakes in the Lafayette Chain and how they interact with Upper Lake Lafayette.

Based on this, it is recommended to initiate a study to develop a complete understanding of the hydrologic budget for Upper Lake Lafayette, including conditions within the other lakes in the system as needed. The study will include collection of hydrologic data and development of a hydrologic model. The extent of the data collection and modeling (in relation to the need for inclusion of the other waterbodies in the system and their watersheds and the need for physical or hydrologic data) will be determined as a first step in the study. **Figure 5-181** presents existing hydrologic data stations and potential proposed hydrologic data collection for use in the study. As part of this study, the existing hydrologic data stations will be evaluated for accuracy and completeness. Based on Upper Lake Lafayette being under the jurisdictions of both the City and County, significant coordination with the County will be needed during this study.



Station	Station Name	Type of Data
008474	NE D.D.@MAHAN DR	Stage
		Flow
008479	PARK AV D.D.@ VIOLET-S100	Stage
		Flow
008460	ALFORD ARM TRIB@BUCK	Stage
		Flow
008471	LAKE LAFAYETTE OUTFALL	Stage
		Flow

CITY OF TALLAHASSEE

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Legend

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

Hydrological Data Stations

Type of Data

- Existing Stage and Flow
- Proposed Flow
- Proposed Stage

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

Figure 5-181:
Upper Lake Lafayette Hydrologic Study

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants

The recommended general elements are as follows.

- Site reconnaissance to understand the site logistics, including historical and potential future monitoring locations, as well as develop consensus with City staff on station locations and monitoring and modeling approach.
- Development of a Monitoring/Modeling Plan and QAPP
- Data collection as outlined in the Monitoring/Modeling Plan and QAPP including water level and flow stations. **Figure 5-181** presents potential hydrologic monitoring locations and the types of data. Additional recommended data includes water levels in Weems Pond (to support calculation of flow over the weir), Upper Lake Lafayette, Piney Z Lake, and the western portion of Lower Lake Lafayette. Additional supporting data will include surveys of key structures that provide exchange between the various waterbodies. The data collection plan, stations, and types of data would be finalized in the Monitoring and Modeling Plan.
- Development of a hydrologic model to define the system hydrologic budget. Model to be calibrated to the lake level and flow data.
- Development of the hydrologic budget for the system including all gains and losses.
- Evaluation of Restoration Options relative to the system hydrology based on the modeling of the system.

5.10.2.3 Killearn Chain of Lakes: Hydrologic Study and SSAC

Section 5.10.1.3 identified that along with stormwater loads and septic loading (for Lake Kanturk) a key stressor for the Killearn Chain of Lakes are the frequent dry downs and subsequent re-wetting of the waterbodies. As was defined for Upper Lake Lafayette, this leads to conditions that are not reflective of a true lake system, thus limiting the applicability of the State NNC. Determination of an appropriate and achievable use for the lakes begins first with a full understanding of the overall system hydrology and what could or could not be done to restore the system to be more reflective of a true system of lakes, i.e., to maintain adequate water levels to support an appropriate lake designated use.

A 2014 study by CH2MHILL performed modeling using a FEMA model to assess potential options for restoring lake levels. The study performed simulations on historic conditions back to 1982 and later conditions in 2007. Alternatives evaluated included lining all or some of the lake bottoms, increasing control elevations between the lakes and adding supplemental water from groundwater wells.

Based on this, it is recommended to initiate an updated hydrologic study to develop a complete understanding of the hydrologic budget for the Killearn Chain of Lakes under present conditions. The study will include collection of additional hydrologic data and development of a hydrologic model for the system. **Figure 5-182** presents existing hydrologic data stations. Presently there are sufficient data stations being maintained by the NWFWMD to support modeling of the Killearn Chain. As part of this study, the existing hydrologic stations will be evaluated for accuracy and completeness. One additional station that would support the modeling of the

system and provide information for another proposed study (**Section 5.10.2.5**) is the addition of water level in Lake Tom John (**Figure 5-182**). While the City is a stakeholder in the Killearn Chain of Lakes basin, the lakes are privately owned and therefore any proposed study must account for this.

The recommended general elements are as follows.

- Site reconnaissance to understand the site logistics, including historical and potential future monitoring locations, as well as develop consensus with City staff on station locations and monitoring and modeling approach.
- Development of a Monitoring/Modeling Plan and QAPP.
- Development of a hydrologic model to define the system hydrologic budget. Model to be calibrated to the lake level and flow data.
- Development of the hydrologic budget for the system including all gains and losses.
- Evaluation of Restoration Options relative to the system hydrology based on the modeling of the system.

An additional study component for the Killearn Chain of Lakes, which may be completed separately from the hydrologic study is an evaluation of the need for, and feasibility of establishing, site specific alternative nutrient criteria (SSAC). As discussed previously, the nature of the system, i.e., constructed waterbodies from a former wetland, may not support the NNC presently determined for the system of lakes. Numerous previous studies have identified this issue. The study would evaluate the appropriateness of the existing criteria and if determined to warrant development of a SSAC define appropriate Chl-a and nutrient targets for the system.

5.10.2.4 Lake Kanturk: Septic Loading Study

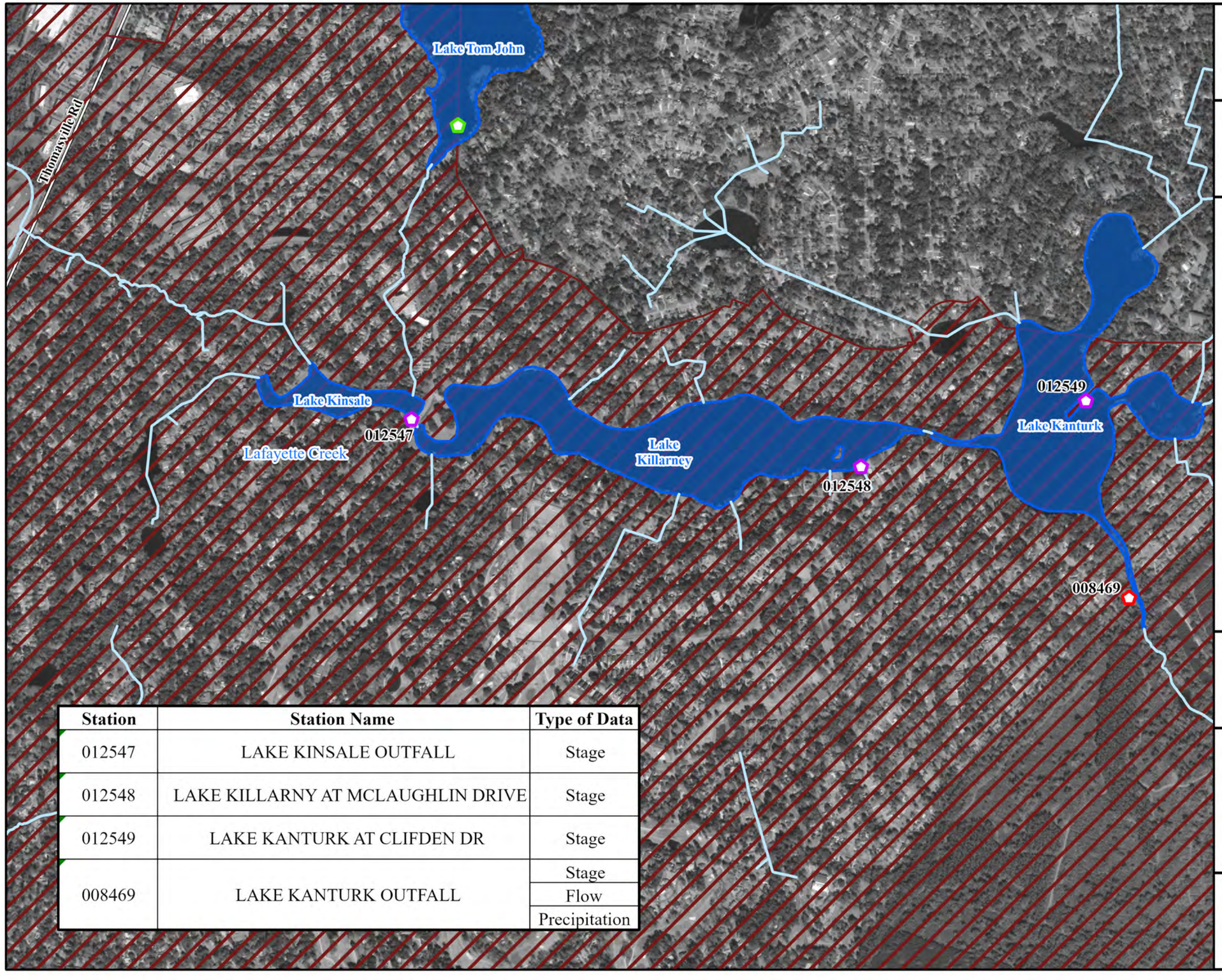
In **Section 5.10.1.3**, which outlined the stressors for the Killearn Chain of Lakes, and the qualitative assessment of sources (**Section 5.5.4**), the need for a quantitative analysis of the impact of septic loading to Lake Kanturk was identified.

Figure 5-183 shows the distribution of septic coverage within the watershed draining to Lake Kanturk. Additionally, as outlined in **Section 5.10.1.3** analyses of data from watersheds draining this area showed elevated nitrate levels.

The study approach would be to utilize targeted sampling within the subwatersheds draining to the northern end of the lake in conjunction with advanced analytic parameters such as isotopic analysis, pharmaceuticals, and microbial source tracking. Additionally, monitoring of surficial groundwater in the immediate shoreline areas of the lake would provide information on the potential for seepage from septic systems.

The recommended elements for the study described above are as follows.

- Detailed review of historical data within Lake Kanturk.



Station	Station Name	Type of Data
012547	LAKE KINSALE OUTFALL	Stage
012548	LAKE KILLARNY AT MCLAUGHLIN DRIVE	Stage
012549	LAKE KANTURK AT CLIFDEN DR	Stage
008469	LAKE KANTURK OUTFALL	Stage
		Flow
		Precipitation

CITY OF TALLAHASSEE

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Legend

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

Hydrological Data Stations

Type of Data

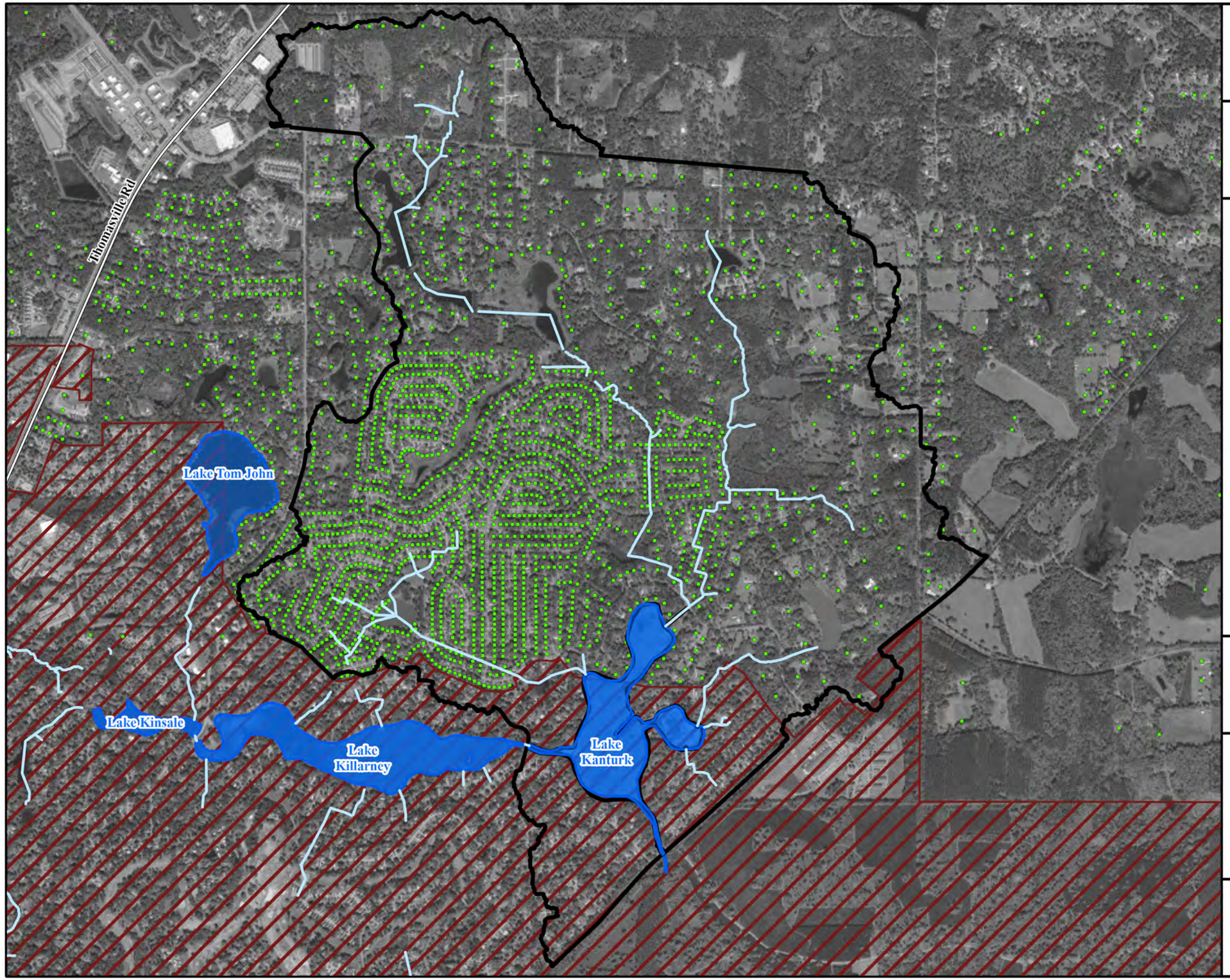
- Existing Stage and Flow
- Existing Stage
- Proposed Stage

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

Figure 5-182:
Killearn Chain of Lakes Hydrologic Study

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants



CITY OF TALLAHASSEE

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Legend

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

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

Figure 5-183:
Lake Kanturk Septic Study

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants

- Reconnaissance to understand the site logistics, including historical and potential future monitoring locations, as well as develop consensus with City staff on station locations, monitoring approach, and development of the QAPP.
- Development of a QAPP that details staff responsibilities, sampling procedure, methodology, equipment, and laboratory analytical requirements for this project.
- Field monitoring and sampling as outlined in the QAPP.
- Data analyses to evaluate results of the study and provide a determination on septic loading to the lake.
- Develop a final report summarizing the findings from the study.

5.10.2.5 Lake Tom John: Water Quality Assessment/Restoration Study and SSAC Evaluation

Section 5.10.1.4 identified that presently Lake Tom John is not meeting its NNC due to potential stormwater runoff and internal nutrient loading. Based on this, it is recommended to initiate a study to determine potential restoration activities necessary to meet water quality criteria. The study will include the development of a hydrologic and nutrient budget/mass loading analysis for the pond. Additionally, mitigation strategies will be evaluated to help in the attainment of water quality standards, i.e., the appropriate NNC standard. The primary focus will be on the loading of nutrients from the watershed and the potential for internal sediment nutrient flux while also addressing atmospheric deposition, and shallow groundwater inputs. While the City is a stakeholder in the Lake Tom John Basin, the lake is privately owned and therefore any proposed study must account for this.

The recommended elements for the study are as follows.

- Site reconnaissance to understand the site logistics, including historical and potential future monitoring locations, as well as develop consensus with City staff on station locations and monitoring approach.
- Installation of a lake level monitor to aid in the assessment of the hydrology of the pond as outlined in **Section 5.10.2.3** and shown in **Figure 5-182**.
- Assessment of sediment characteristics, including muck layer thickness, nutrient content, pore water characteristics and phosphorus fractionalization.
- Development of a hydrologic model to define the system hydrologic budget. Model to be calibrated to the lake level data.
- Development of a nutrient budget.
- Identification of Restoration Options.

An additional study component for the Lake Tom John, which may be completed separately from the restoration study is an evaluation of the need for, and feasibility of establishing, site specific alternative nutrient criteria (SSAC). Presently Lake Tom John has very low nutrient and

Chl-a targets based on color and alkalinity. The study would evaluate the appropriateness of the existing criteria and if determined to warrant development of a SSAC define appropriate Chl-a and nutrient targets for the system.

5.10.2.6 Piney Z Lake: Assessment of Site-Specific Alternative Criteria (SSAC)

Section 5.10.1.2 identified that impairments within Piney Z Lake may be associated with non-load related issues such as the isolated nature of the system and ecological management. Additionally, concerns were raised on the applicability of the present criteria. Based on these issues, a study is recommended to evaluate the appropriateness of the existing criteria in relation to the nature and management of the system, and if determined to warrant development of a SSAC, define appropriate Chl-a and nutrient targets for the system.

5.10.2.7 Other Studies

Two potential additional data collection/studies are recommended based on data and analyses presented earlier for two of the non-priority waterbodies Alford Arm and Lafayette Creek. Based on earlier discussions on the importance of vegetation in Piney Z Lake, a vegetation management study is recommended. Finally, a monitoring study to collect E Coli data within the Virginia Tributary is recommended to support removal of the legacy fecal coliform impairment. The recommendations are:

- Resumption of water quality data collection within the lake portion of Alford Arm, and
- Resumption of bacteria data collection in Lafayette Creek.
- A study on vegetation management for Piney Z Lake.
- E Coli monitoring within Virginia Tributary.

For Alford Arm, the work would include reconnaissance to define potential sampling locations and coordination with City staff on the locations. Additionally, while not impaired for *E. coli*, measured concentrations in the Lafayette Creek are elevated. As such, resumption of bacteria data collection is recommended to supplement historic data.

5.10.3 Study Prioritization

To prioritize the proposed studies, a ranking table was developed that scored each of the projects in relation to the following:

- Waterbody priority ranking **(Table 5-27**),
- Source target ranking (the overall ranking of the source addressed by the study, **Table 5-28**),
- Restoration benefits (qualitative assessment of the benefits of the study),
- Extent of missing data, and
- Relative estimated cost.

Table 5-30 presents the study rankings for each of the individual metrics, the average score based on the individual rankings, and the final study ranking. The studies are divided between those that are solely within the City's incorporated area and those within both the City's incorporated area and unincorporated Leon County. These are shown on **Table 5-30**.

Only one study was solely located within the City's incorporated area, that is the Shakey Pond Water Quality Assessment and Restoration Study, which was ranked first overall. Based on early determinations on the need for this study, it was completed prior to the completion of the development of this final report.

The remaining studies are located within both the City's incorporated area and unincorporated Leon County. For these studies the Lake Kanturk Septic Loading study was ranked highest, followed by the Lake Tom John Water Quality Assessment/Restoration Study. The Upper Lake Lafayette and Killearn Chain of Lakes Hydrologic Studies were tied based primarily on their anticipated costs. The lowest ranked study was the Lake Piney Z SSAC Evaluation.

Table 5-30: Proposed Study Ranking

Target Waterbody	Proposed Study/Data Collection	Study Location	Waterbody Priority Ranking	Source Ranking	Restoration Benefits	Extent of Missing Data	Relative Estimated Cost	Average Rank	Study Ranking
Shakey Pond	Water Quality Assessment and Restoration Study	COT Incorporated Area	1	1	3	1	3	1.80	**1**
Upper Lake Lafayette	Hydrologic Study	COT Incorporated Area and Leon County	2	3	1	4	5	3.00	**4**
Killearn Chain of Lakes	Hydrologic Study and SSAC Evaluation	COT Incorporated Area and Leon County	4	1	2	4	4	3.00	**4**
Lake Kanturk	Septic Loading Study	COT Incorporated Area and Leon County	2	2	4	1	2	2.20	**2**
Lake Tom John	Water Quality Assessment/Restoration Study and SSAC Evaluation	COT Incorporated Area and Leon County	3	1	3	2	3	2.40	**3**
Lake Piney Z	SSAC Evaluation	COT Incorporated Area and Leon County	5	4	5	3	1	3.60	**5**