TALLAHASSEE MASTER PLAN – SURFACE WATER (TMaPS): VOLUME 6

CITY OF TALLAHASSEE

WAKULLA SPRING AND LAKE TALQUIN

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July 2025

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engineers | scientists | innovators

TMaPS: VOLUME 6

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CITY OF TALLAHASSEE

Prepared for

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Project Number: FW7714

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

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Tallahassee Master Plan – Surface Water (TMaPS)

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ACRONYMS AND ABBREVIATIONS

AGM	annual geometric mean
AWT	advanced wastewater treatment
BMAP	basin management action plan
BMP	best management practice
cfs	cubic feet per second
Chl-a	chlorophyll a
City	City of Tallahassee
EPA	U.S. Environmental Protection Agency
F.A.C.	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FDOT	Florida Department of Transportation
FSAPA	Florida Springs and Aquifer Protection Act
FSQAH	Florida Stormwater Quality Applicants Handbook
ft	feet
ID	identification
in/yr	inches per year
IWR	Impaired Waters Rule
lb/yr	pounds per year
mg/L	milligrams per liter
MGD	million gallons per day
NNC	numeric nutrient criteria
NPDES	National Pollutant Discharge Elimination System
NSILT	Nitrogen Source Inventory Loading Tool
NWFWMD	Northwest Florida Water Management District
PFA	priority focus areas
RPS	Rapid Periphyton Survey
SCI	Stream Condition Index
STAR	Statewide Annual Report
TMaPS	Tallahassee Master Plan - Surface Water
TMDL	total maximum daily load
TN	total nitrogen

TP	total phosphorus
TPSWRF	Thomas P. Smith Water Reclamation Facility
TSI	Trophic State Index
TSS	total suspended solids
UFA	Upper Floridan Aquifer
μg/L	micrograms per liter
WBID	waterbody identification

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6.1 Wakulla Spring

6.1.1 Overview and History

Wakulla Spring in Wakulla County is an Outstanding Florida Spring and the primary source of inflow to the Wakulla River. The Northwest Florida Water Management District (NWFWMD) estimates the average discharge of Wakulla Spring is about 623 cubic feet per second (cfs), roughly 400 million gallons per day, making it a major point of discharge from the Upper Floridan Aquifer (UFA).

The Wakulla Spring springshed includes portions of south Georgia and Leon, Wakulla, Gadsden, and Jefferson Counties in Florida (**Figure 6-1**). Total springshed area is about 1,738 square miles (mi^2), with 1,325 mi^2 in Florida. The springshed is characterized by two main geomorphic zones, with a line of delineation known as the Cody Scarp. The primary differentiating feature between the area north of the Cody Scarp and the region south of the Cody Scarp is the degree of aquifer confinement which affects both the rate of recharge to groundwater and the amount of nutrient attenuation between the surface and groundwater. The UFA south of the scarp is unconfined (**Figure 6-1**), meaning that the aquifer is very close to the surface, or the overlying sediments are sandy, thin, or missing. Areas north of the scarp are classified as either semi-confined or confined. Semi-confined regions of the UFA have confining layers less than 100 feet (ft) thick, and sinkholes are present. The confined UFA includes areas where the confining layer is more than 100 ft thick. The unconfined UFA south of the scarp is the most vulnerable to groundwater contamination due to higher rates of recharge and lower rates of nutrient attenuation. Recharge to the UFA is primarily via rainfall, with recharge rates ranging from 0 to 2 inches per year (in/yr) in the confined aquifer to 9 to 20 in/yr in the unconfined aquifer. Estimated recharge in the semi-confined aquifer ranges from 3 to 8 in/yr. The general flow of groundwater in the springshed is north/northeast to south/southwest.

The Upper Wakulla River in Wakulla County is a spring fed stream originating at Indian Spring and terminating at Wakulla County Road (CR) 365, often referred to as the "Upper Bridge." **Figure 6-2** shows the river and its associated watershed. Added flow is provided to the Upper Wakulla River by Sally Ward Spring, Wakulla Spring, and numerous smaller springs between Wakulla Spring and CR 365. Downstream of CR 365, the Middle Wakulla River extends to the "Lower Bridge" at U.S. Highway 98, and the Lower Wakulla River includes the portion between the Lower Bridge and the point at which the river joins the St. Marks River at the southern end of the town of St. Marks.

Although Wakulla Spring is located in Wakulla County, its groundwater recharge area encompasses the entire jurisdictional boundary of the City of Tallahassee (City) (**Figure 6-1**). Nearly 78 percent of the City land area is located in the semi-confined aquifer north of the Cody Scarp, with about 22 percent located in the unconfined aquifer south of the scarp. City-owned facilities south of the Cody Scarp include the Thomas P. Smith Water Reclamation Facility (TPSWRF) and associated southeast and southwest sprayfields, and Tallahassee International Airport (**Figure 6-3**).

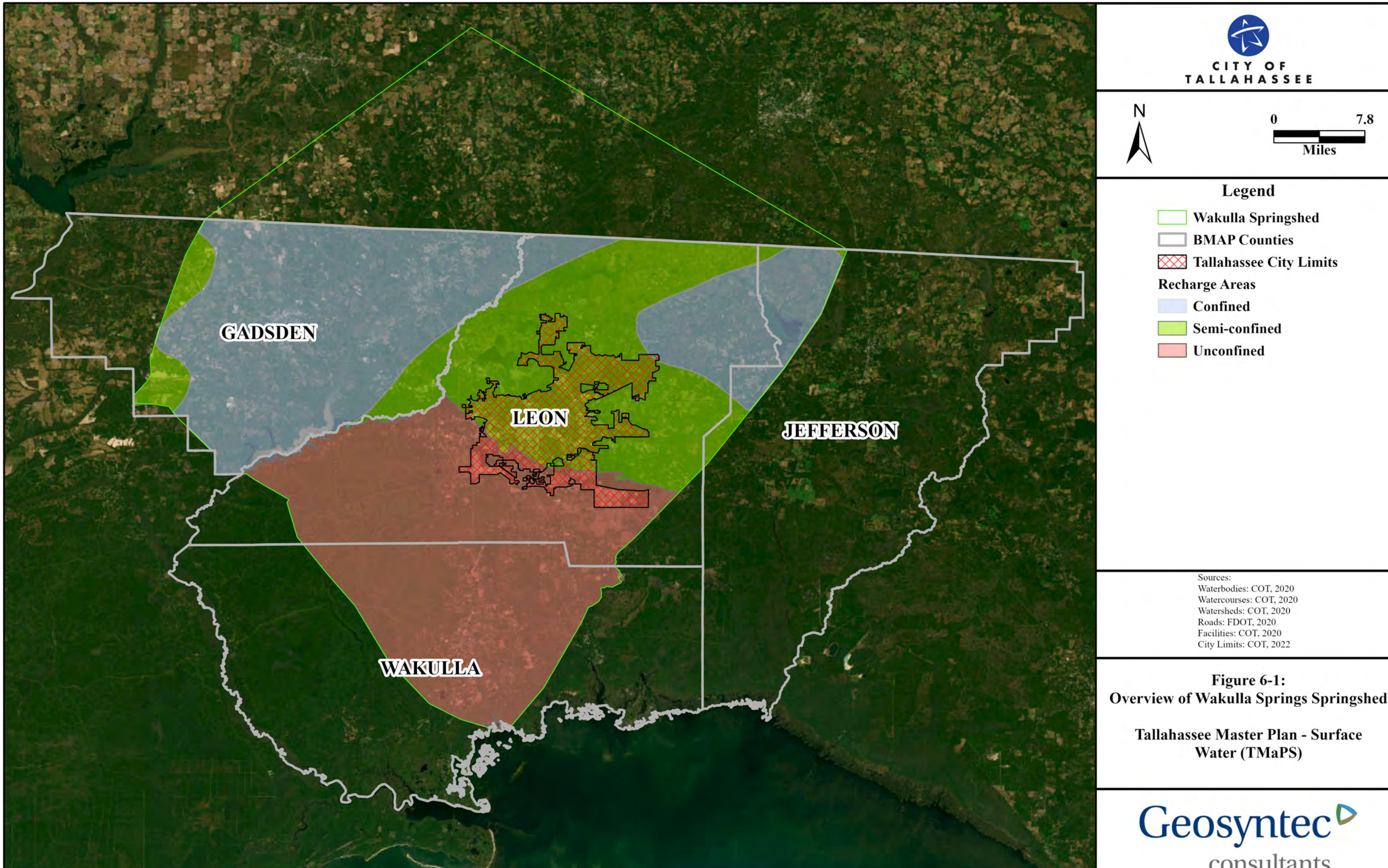

Figure 6-1:
Overview of Wakulla Springs Springshed

Tallahassee Master Plan - Surface Water (TMaPS)

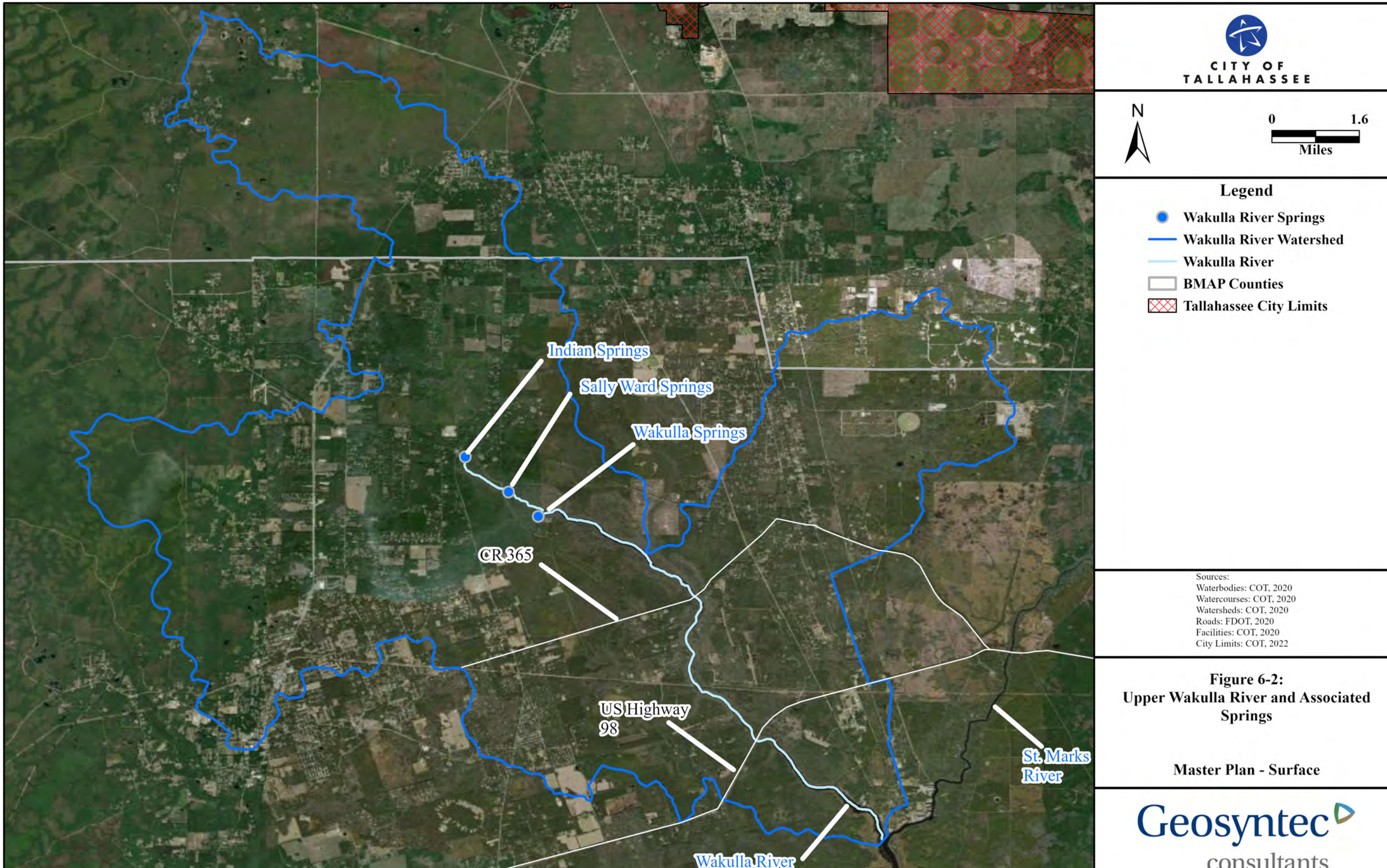

Figure 6-2: Upper Wakulla River and Associated Springs

Master Plan - Surface

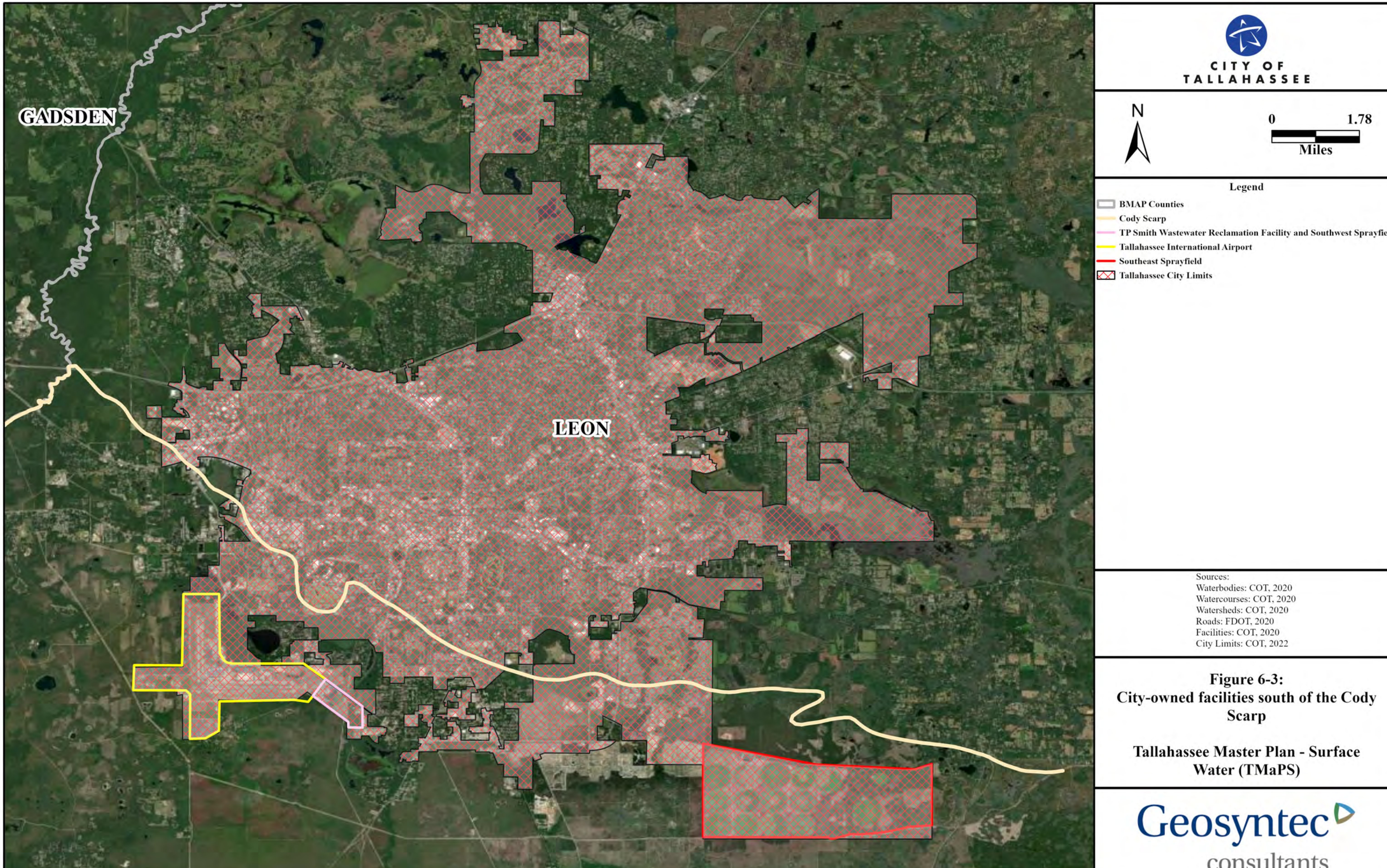

Figure 6-3: City-owned facilities south of the Cody Scarp

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The TPSWRF began operation in 1966 as the Springhill Road Sewage Treatment Facility. Its initial capacity was 2.5 million gallons per day (MGD). Capacity was expanded in the 1970s, at which time the facility was renamed to the TPSWRF. Additional expansions in the 1980s and 1990s increased the facility's capacity to 27.5 MGD. The facility upgraded to advanced wastewater treatment (AWT) between 2008 and 2016, which resulted in a decrease in plant capacity to the current permitted limit of 26.5 MGD and a significant reduction in the nitrogen concentration in the effluent. Under current conditions, effluent discharged from the facility typically has total nitrogen (TN) concentrations near 1.0 milligrams per liter (mg/L), which is well below the AWT standard for TN (3 mg/L).

Most of the effluent from the TPSWRF is used for crop irrigation at the City's 2,500-acre Southeast Farm Reuse Facility (Southeast Sprayfield) and 60-acre Southwest Sprayfield. Up to 1.2 MGD of effluent is diverted for irrigation of public areas after undergoing additional treatment at the Tram Road Reuse Facility.

Water quality of groundwater recharge throughout the springshed influences water quality at the spring vent, but two areas in particular have a direct connection to Wakulla Spring: Ames Sink and the southeast sprayfield.

Ames Sink is located in the Lake Munson basin (see Volume 3). Ames Sink receives inflow from Lake Munson via lower Munson Slough and Eightmile Pond and ultimately emerges at Wakulla Spring. Dye trace studies have confirmed a direct connection between Ames Sink and Wakulla Spring (Stevenson, 2016).

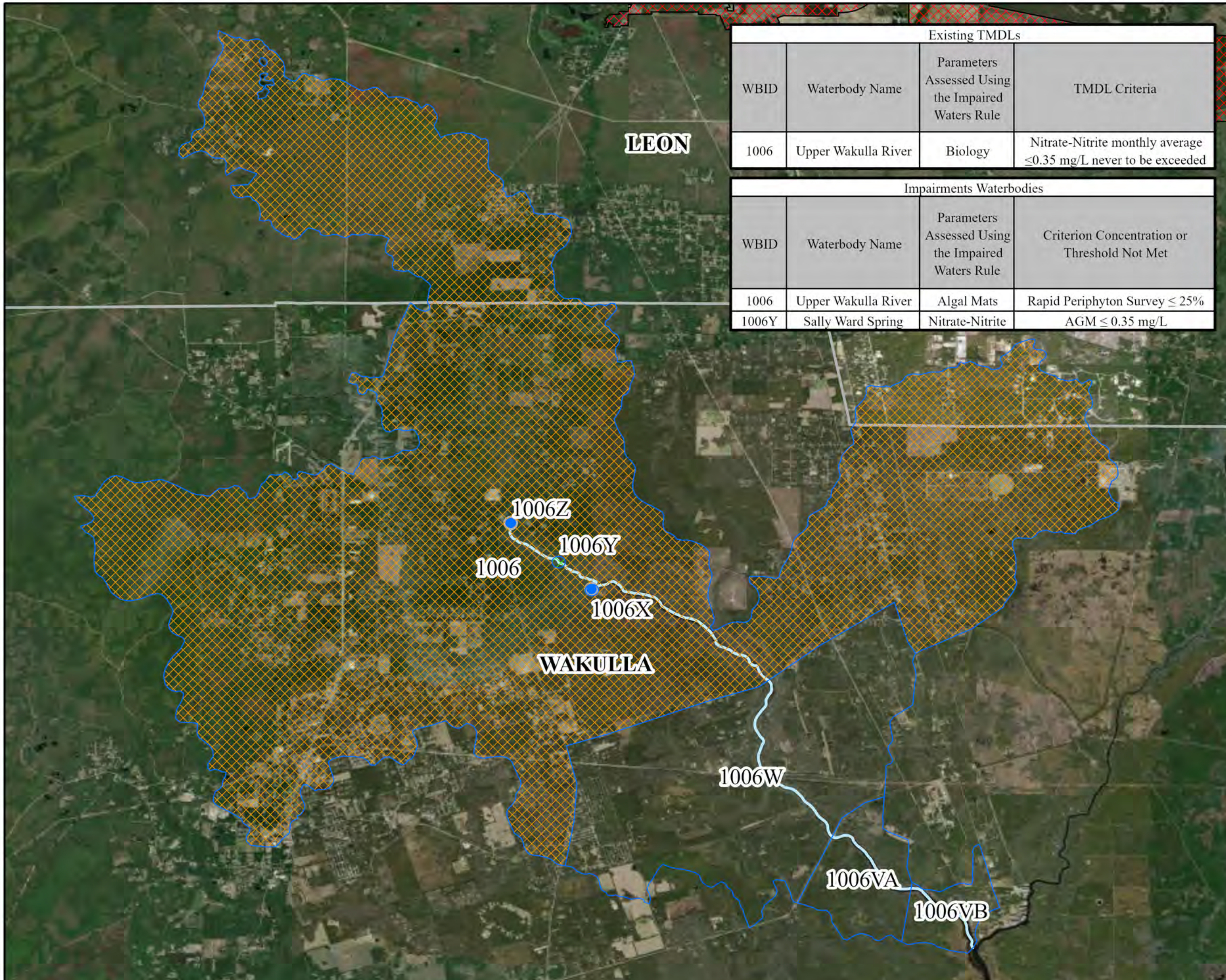
At the Southeast Sprayfield the City uses treated wastewater effluent for beneficial reuse. A 2005 tracer study [Kincaid et al. (2012)] demonstrated that treated wastewater from the Southeast Sprayfield reaches Wakulla Spring in 60 to 65 days.

Management activities affecting the quality of water discharged to Ames Sink are discussed in Volume 3 - Lake Munson Basin. With respect to the Southeast Sprayfield, there are no other management options available to the City for further improvement of the quality in the wastewater effluent. Therefore, unlike other volumes in the master plan, the primary purpose of this section is to document current conditions of the Upper Wakulla River and associated springs, including Wakulla Spring, and to outline the City's efforts to improve water quality of these waterbodies.

6.1.2 Regulatory Status

The adopted 2020-2022 and 2022-2024 biennial assessment master lists for northwest Florida and Impaired Waters Rule (IWR) Run 65 were reviewed for the four Wakulla River segments and three associated springs (**Figure 6-4**), with a primary focus on nutrient-related parameters. However, all parameters were reviewed for impairment or potential impairment. The 2020-2022 lists are based on IWR Run 60 (effective date July 7, 2020), and the 2022-2024 lists are based on IWR Run 64 (effective date July 13, 2022). IWR Run 65 was reviewed to capture potential updates to the assessments that may occur with the 2024-2026 biennial assessment. The definitions of relevant assessment categories are summarized in **Table 6-1**. Verified Impairments and total maximum daily loads (TMDLs) are shown in **Figure 6-4**.

CITY OF TALLAHASSEE



Existing TMDLs			
WBID	Waterbody Name	Parameters Assessed Using the Impaired Waters Rule	TMDL Criteria
1006	Upper Wakulla River	Biology	Nitrate-Nitrite monthly average ≤0.35 mg/L never to be exceeded

Impairments Waterbodies			
WBID	Waterbody Name	Parameters Assessed Using the Impaired Waters Rule	Criterion Concentration or Threshold Not Met
1006	Upper Wakulla River	Algal Mats	Rapid Periphyton Survey ≤ 25%
1006Y	Sally Ward Spring	Nitrate-Nitrite	AGM ≤ 0.35 mg/L

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

Figure 6-4: Wakulla River and Springs Impairments Map

Tallahassee Master Plan - Surface Water (TMaPS)

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Table 6-1: Description of Assessment Categories used by FDEP

Category	Description
2	Waterbody is not impaired
2e	Waterbody is not impaired and an alternative restoration plan is in place.
2t	Waterbody has an adopted TMDL and is not impaired for the TMDL parameter.
3c	There are enough data to determine that the waterbody may be impaired and further investigation is needed.
4a	The waterbody is impaired and a TMDL has been adopted.
4c	The waterbody is impaired but the impairment is caused by a pollutant, i.e., natural condition and a TMDL is not needed.
4d	The waterbody is impaired but a causative pollutant has not been identified; or there are potentially adverse trends in nutrients; or nutrient thresholds are exceeded but there is not enough information to fully assess non-attainment of the nutrient standard.
4e	Waterbody is impaired and restoration activities are in progress or planned.
5	Waterbody is impaired and a TMDL is needed.

The Upper Wakulla River presently passes for Stream Condition Index (SCI) but does not pass the Rapid Periphyton Survey (RPS). This section of the river still exceeds the TMDL nitrate target of 0.35 mg/L (monthly average, never to be exceeded) and is impaired for excessive algal mats, with nutrients as the causative pollutant. The low dissolved oxygen (percent saturation) was determined to be a natural condition. The algal mat impairment was first added to the verified list in October 2019 with adoption of the Cycle 4 Ochlockonee-St. Marks Basin assessment lists. The nitrate impairment for Sally Ward Spring was added at the same time.

Of note in these assessments is that Wakulla Spring, the major inflow to the Upper Wakulla River, was not impaired for nitrate in either the 2020-2022 or 2022-2024 biennial assessments, however, additional data included in IWR Run 65 indicate that the spring will be impaired during the 2024-2026 assessment cycle. **Section 6.1.3** identifies potential issues associated with the previous assessments discussed above, and the ramifications relative to the impairment of the spring.

6.1.3 Water Quality Data Review

As the main source of inflow to the Upper Wakulla River, the associated springs, Wakulla Spring in particular, have a substantial impact on the water quality of the river. The primary water quality concern for both the springs and the river is excessive nutrients in the form of nitrate-nitrite (nitrate). **Figure 6-5** and **Figure 6-6** show the period of record data available in IWR 65 for nitrate concentration in Wakulla Spring and the Upper Wakulla River, respectively.

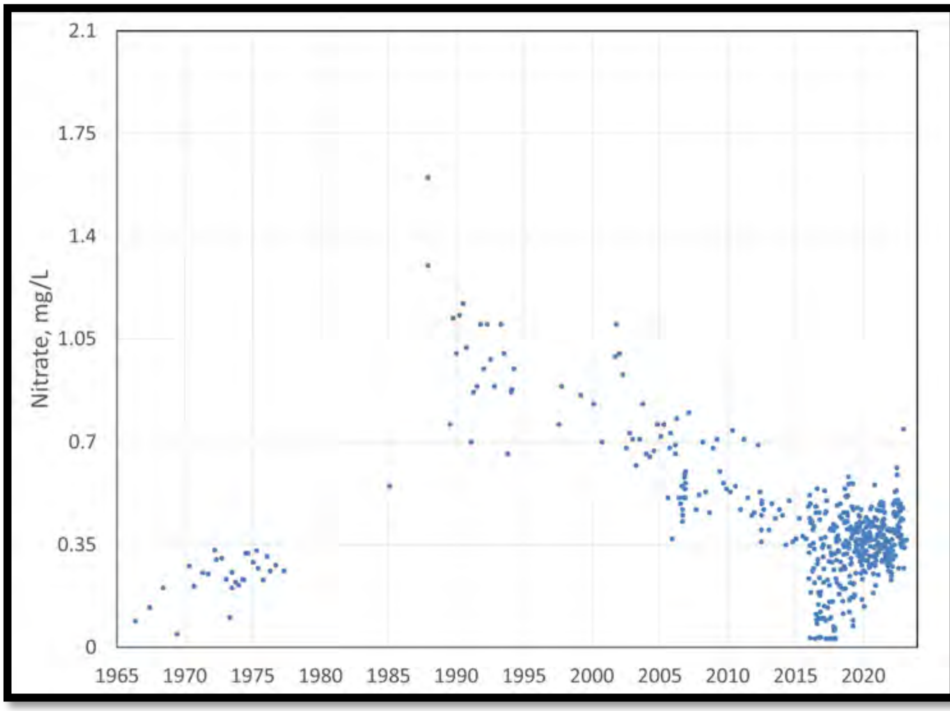


Figure 6-5: Nitrate Concentration in Wakulla Spring, 1965-2023 (Outliers have been removed.)

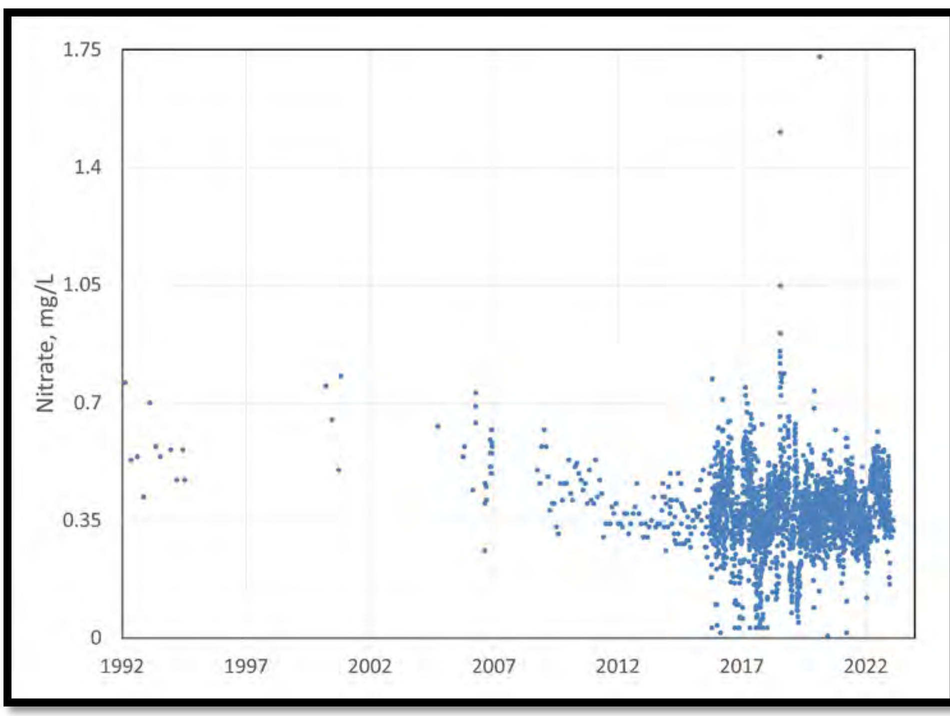


Figure 6-6: Nitrate Concentration in the Upper Wakulla River, 1992-2023

Figure 6-5 shows that prior to about 1978, Wakulla Spring was consistently below the nitrate criterion of 0.35 mg/L. Data in IWR Run 65 for the Upper Wakulla River only go back to 1992. However, the Upper Wakulla River TMDL presents data for the river that date back to 1951, and these data show that the river was also below 0.35 mg/L between 1951 and 1978.

To better understand naturally occurring concentrations, Leseman (2011) compiled and summarized a groundwater nitrate database from groundwater wells in Leon County. Most of the data were collected from regulated public or community water system wells, from 1980-2011. The data provides a comparison of historic water quality data collected nearby in the UFA to the proposed TMDL nitrate target for the Upper Wakulla River. Based on these available data, Leseman (2011) concludes that "…nitrate concentrations in the Floridan aquifer beneath Leon County, Florida often exceed the proposed 0.35 mg/L TMDL concentration for the Wakulla River. Long-term trend data indicate that, in many cases, this is the ambient background condition." He further notes that nitrate concentrations exceeding 0.35 mg/L have been present for more than 28 years and may be a natural condition. Leseman's observations and conclusions highlight the potential difficulty in meeting the current TMDL target.

In reviewing the IWR data, anomalies and inconsistencies were observed with data collected and/or analyzed by McGlynn Laboratories compared with data analyzed by other providers. McGlynn began collecting and analyzing water samples from the spring in December 2015 and from the river in September 2015. **Figure 6-7** shows springs and river nitrate values reported by McGlynn compared with results reported by other laboratories. Of note is the large number of very low springs and river nitrate concentrations reported by McGlynn, e.g., 0.03 mg/L, compared with other labs, particularly in 2016 and 2017. Also, in general, the envelope of variation in measurements is much greater for McGlynn's lab samples than for data reported by the other labs. As shown in **Figure 6-8**, however, the result envelope without the McGlynn data is fairly narrow and consistent.

The data review also considered how same-day spring and river samples compared with one another for the different labs. In general, for other labs, the nitrate concentrations in the spring and river were fairly close and the same order of magnitude. It also appeared that, in most cases, the spring nitrate concentration was higher than the same-day nitrate concentration in the river, which makes sense, because some level of denitrification is expected. For the samples analyzed by McGlynn, however, spring nitrate was often much lower than river nitrate. For example, on June 1, 2017, McGlynn Labs reported a spring nitrate concentration of 0.03 mg/L and a river nitrate concentration of 0.504 mg/L. For reasons noted above, samples analyzed by McGlynn Labs were excluded from data analyses included in this report.

Over the period of record nitrate concentrations in the river have decreased substantially (**Figure 6-6**). In recent years, the monthly average nitrate concentration has fluctuated around the TMDL concentration target of 0.35 mg/L (**Figure 6-9**), but because there are exceedances, the TMDL has not been achieved.

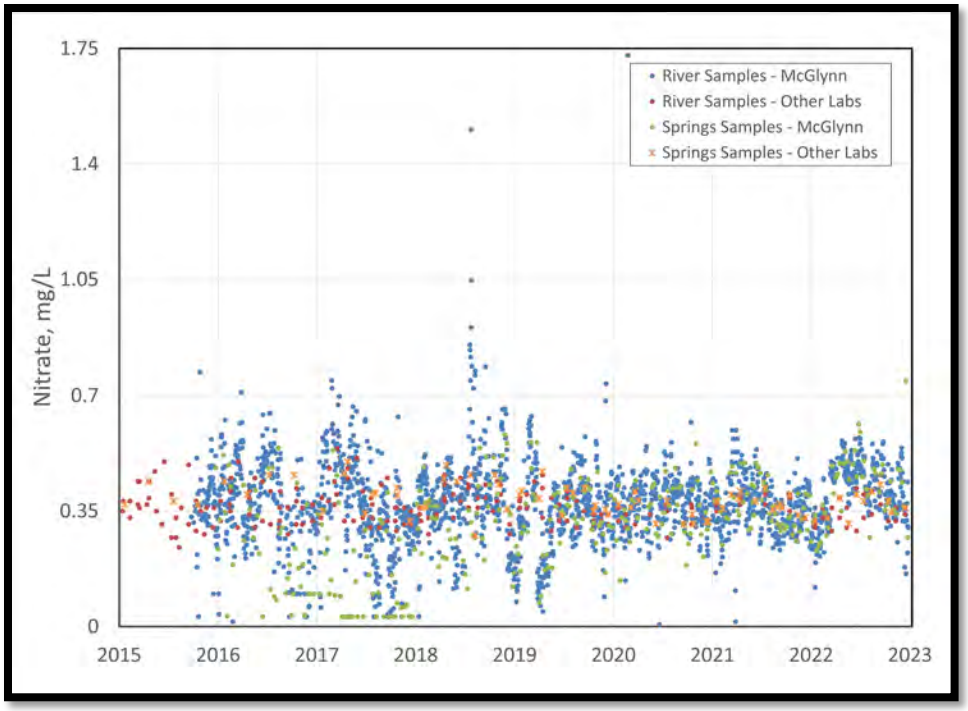


Figure 6-7: Springs and River Nitrate Data Reported by Different Analyzing Laboratories

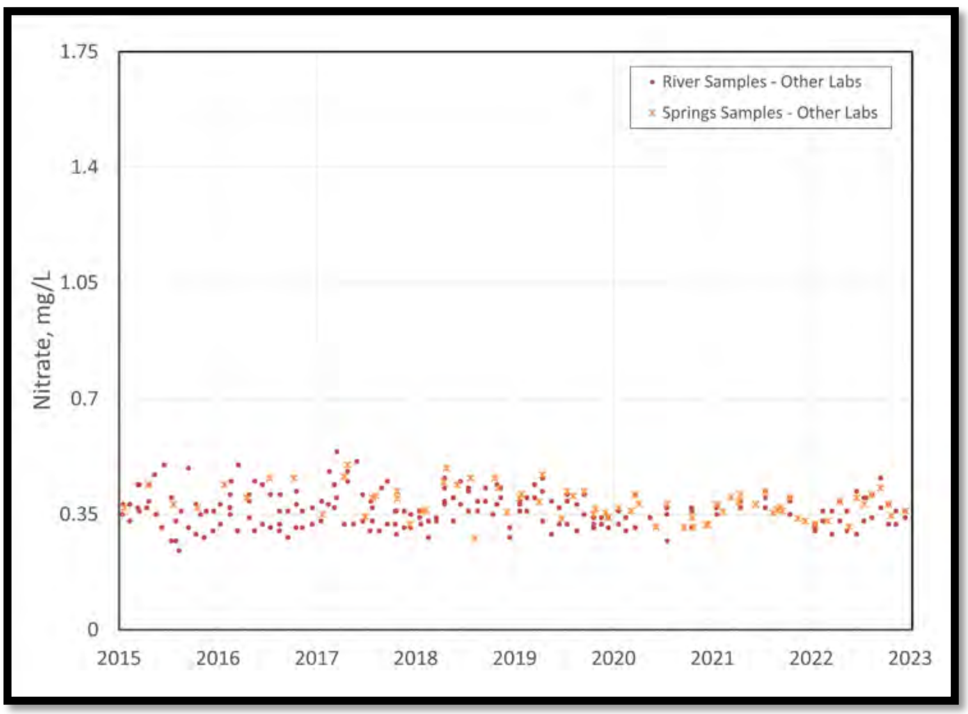


Figure 6-8: Springs and River Nitrate Data with McGlynn Laboratory Excluded

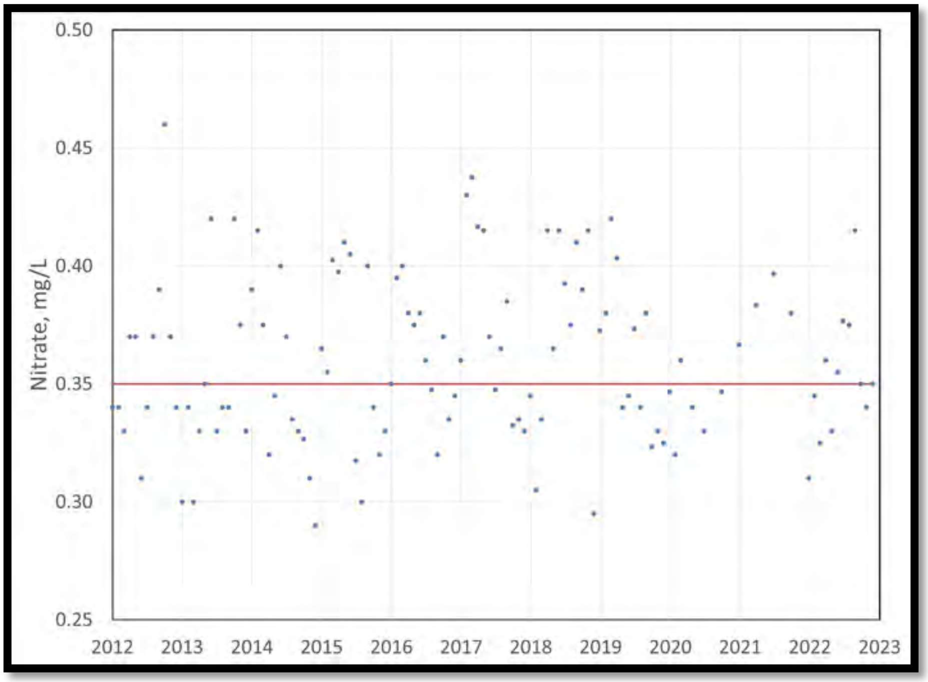


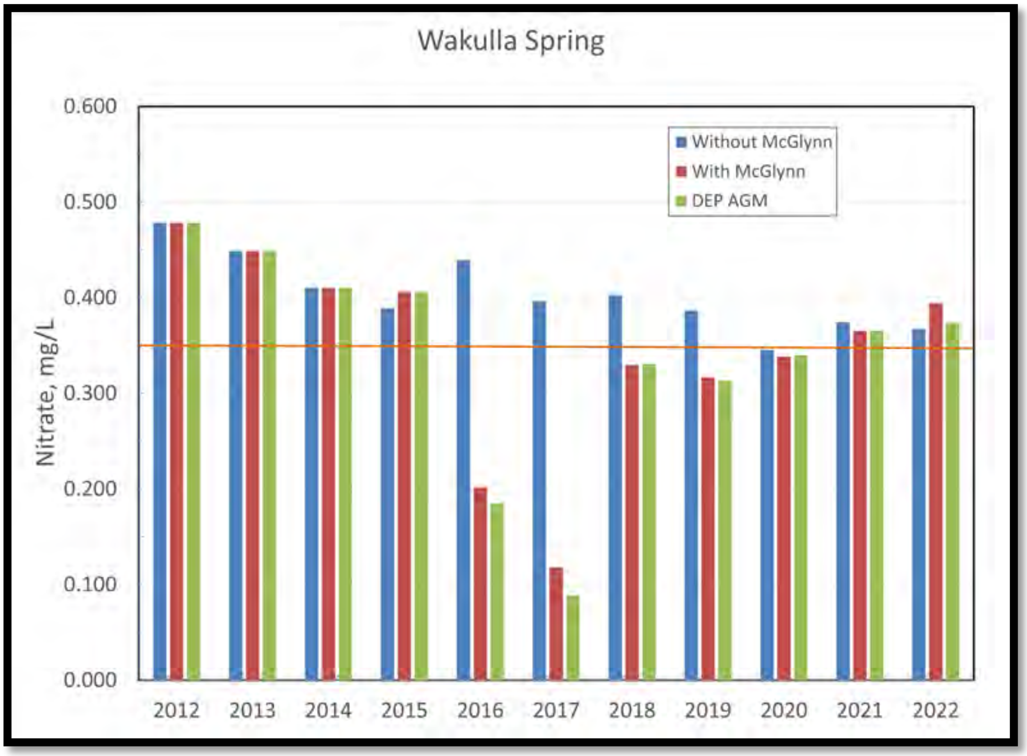
Figure 6-9: Monthly Average Nitrate Concentration in the Upper Wakulla River Compared with the TMDL Target of 0.35 mg/L

Figure 6-10 (top) shows the nitrate annual geometric mean (AGM) for Wakulla Spring. The plot shows that when the questionable lab data are excluded, the spring met its numeric nutrient criteria (NNC) target in 2020 only.

The nitrate AGMs for Sally Ward Spring since data collection began in 2006 are shown in **Figure 6-10** (bottom). Even though the data are limited, there is an apparent downward trend in nitrate since 2006, which is consistent with the downward trend in nitrate for both the Upper Wakulla River and Wakulla Spring.

6.1.4 TMDL Summary and Load Reductions

The Upper Wakulla River was placed on the verified impaired list for biology in August 2002 based on five failing SCI surveys. The river was affirmed impaired for biology in June 2008 due to continuing SCI failures. In 2008, nitrate was identified as the causative pollutant, with a median concentration of 0.51 mg/L over the verified period. The Florida Department of Environmental Protection (FDEP) adopted a TMDL for the Upper Wakulla River in March 2012 to address the biology impairment. The TMDL targets nitrate-nitrite (nitrate) and requires that the monthly average of nitrate in the river be at or below 0.35 mg/L, with no allowable exceedances. The TMDL is expressed as a nitrate concentration reduction of 56.2 percent to achieve the monthly nitrate target.



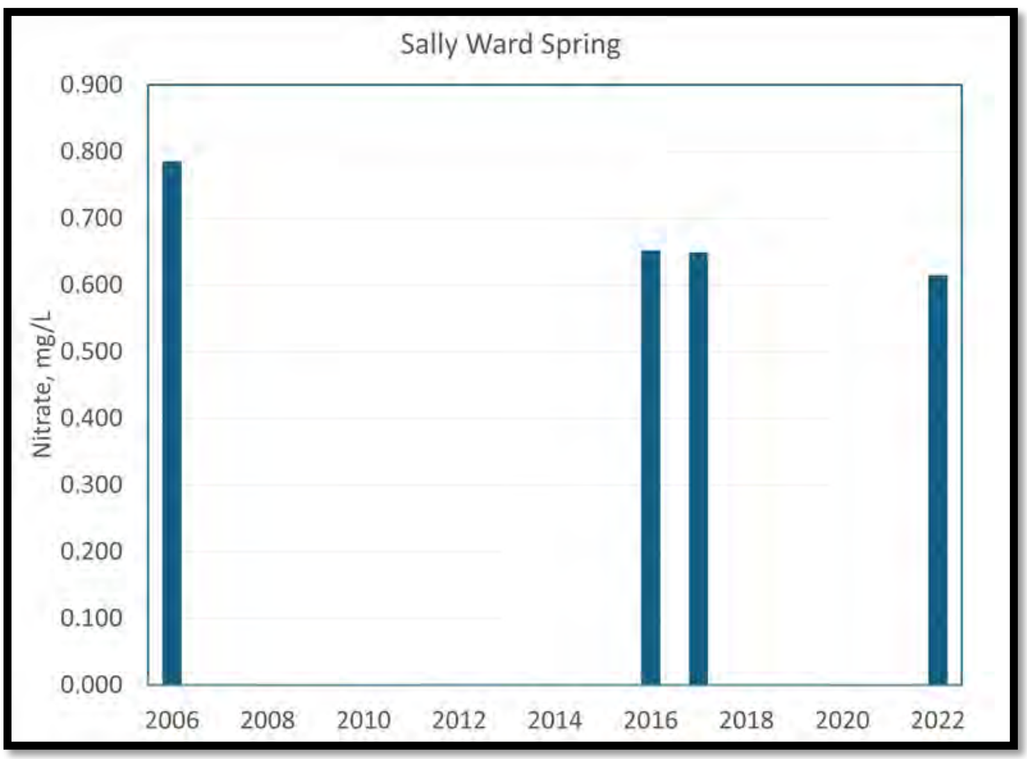


Figure 6-10: Nitrate AGMs for Wakulla Spring, 2012 – 2022 (top) and Nitrate AGMs for Sally Ward Spring, 2006 – 2022 (bottom)

As noted previously, the Upper Wakulla River is meeting the SCI thresholds, but it is impaired due to excessive algal mats, with nutrients identified as the causative pollutant. The TMDL target to address the biology impairment in the Upper Wakulla River is based on a study that identified the nitrate level needed to trigger excessive growth of periphytons, including algae, so the existing target is assumed to be applicable to the current algae impairment. The TMDL target concentration is also the same as the numeric nutrient concentration used to assess the impairment status of Wakulla Spring and other springs that discharge to the Upper Wakulla River, although the numeric nutrient and TMDL temporal criteria are different, i.e., numeric nutrient criteria allows one exceedance in three consecutive years, while the TMDL does not allow any exceedances of the average monthly nitrate in the river. As shown in **Figure 6-9**, the Upper Wakulla has not achieved its TMDL, however, monthly concentrations are often below the target of 0.35 mg/L and rarely exceed 0.45 mg/L.

6.1.5 Basin Management Action Plan Summary and Allocations

FDEP initiated development of a basin management action plan (BMAP) for the Upper Wakulla River and Wakulla Spring in January 2013 to implement the Upper Wakulla River TMDL, and the final BMAP was adopted in October 2015. The Florida legislature passed the Florida Springs and Aquifer Protection Act (FSAPA) in 2016. The Act provides for the protection and restoration of Florida's 30 Outstanding Florida Springs, which includes Wakulla Spring. To meet the additional requirements of the Act, FDEP initiated an update to the BMAP in 2017, and the update was adopted in June 2018. FDEP is expected to revise the BMAP again in 2025, which is discussed further below.

The BMAP area includes the portion of the Wakulla Spring springshed located in Florida and two priority focus areas (PFAs) within the springshed boundary (**Figure 6-11**). The PFAs delineate areas within the springshed/BMAP area that are the most vulnerable to groundwater pollution and provide guidance on where projects are likely to be most effective. The northernmost PFA (PFA1) spans both Leon and Wakulla Counties. Approximately 22 percent of the City lies within PFA1, including the Thomas P. Smith (Trac Road) sprayfields. PFA2 to the south is entirely within Wakulla County.

The 2015 BMAP was based on a "sufficiency of effort" approach, which means that the projects and management strategies listed in the BMAP are expected to significantly reduce nitrate concentrations and make substantial progress towards meeting the TMDL target. The TMDL allocation was made to the springshed as a whole and not to individual entities. In addition, the 2015 BMAP did not specify the load reduction required to achieve the TMDL.

The 2015 BMAP introduced the Nitrogen Source Inventory Loading Tool (NSILT) which is used to estimate nitrogen load to the UFA based on the estimated load to the land surface. Surface loads are reduced by both an environmental factor and a recharge factor depending upon the nitrogen source (environmental factor) and level of confinement of the UFA (attenuation factor). The environmental attenuation factor ranges from 25 percent to 90 percent, and the recharge rate ranges from 10 percent to 90 percent. The NSILT analysis calculated the existing load to the UFA (also known as the groundwater load) as 753,643 pounds per year (lb/yr).

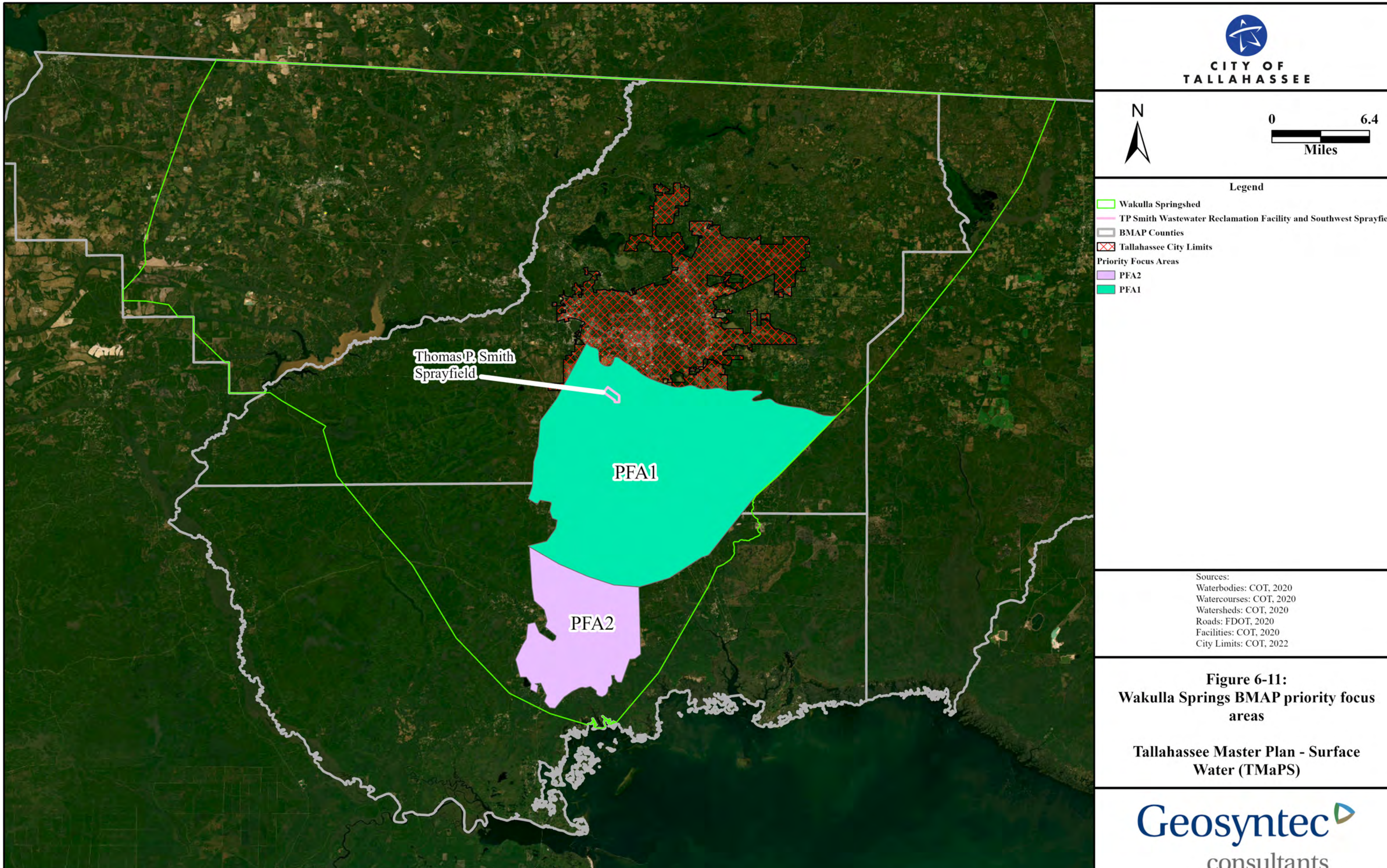


Figure 6-11: Wakulla Springs BMAP priority focus areas

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Although a discussion of the NSILT was included in the 2015 BMAP, load reductions from stakeholders' management strategies were expressed as reductions to the land surface and not as reductions to groundwater. Projects were tracked by whether they were inside or outside of the PFAs. The 2015 BMAP documented total springshed reductions of 1,344,419 lb-N/yr to the land surface, with 1,341,645 lb-N/yr occurring inside the PFAs, and 2,774 lb/yr outside of the PFAs. Projects submitted by the City included reductions of 983,272 lb-N/yr inside PFA1 and 2,077 lb-N/yr outside the PFAs, or 73.3 percent of documented reductions. Leon County and FDOT District 3 accounted for 25.9 percent and 0.8 percent of total reductions, respectively. Nitrogen reductions were not included for all projects either because they were not relevant to the management strategy, e.g., research studies, or because they were yet to be determined.

Like the 2015 BMAP, the 2018 BMAP update allocated load reductions to the entire springshed. In addition, the 2018 BMAP included an analysis of the required nitrate load reduction at the spring vent to achieve the nitrate numeric nutrient criterion of 0.35 mg/L. Using concentration and flow data from 2014 to 2017, the estimated required reduction was calculated by subtracting the spring vent load at the TMDL concentration of 0.35 mg/L from current nitrate load. The 2018 estimated required nitrogen reduction at the spring vent to achieve the 0.35 mg/L target was 139,564 pounds of nitrate per year.

Unlike the 2015 BMAP, 2018 project credits were adjusted by the NSILT environmental and attenuation factors to estimate reduction in load to groundwater instead of reduction in load to the land surface. This provides a more realistic expectation of the load reductions that might be seen at the spring vent due to implementation of management strategies. Also, because the spring vent load reduction analysis starts in 2014, only projects completed after January 1, 2013, were given nitrogen reduction credit. It is assumed that benefits from projects completed before that date are already reflected in the water quality data, or, in the case of wastewater upgrades, that the reductions in load to surface are reflected in the starting load analyses. FDEP calculated potential credits from management actions to reduce loads from existing source categories to range from 134,107 – 234,567 lb-N/yr, with the greatest potential reductions from septic system remediation and agricultural best management practices. The BMAP does not differentiate between project location relative to the PFAs, although this information is included in the Statewide Annual Report (STAR) submitted to the legislature each year.

The 2018 BMAP documented reductions to groundwater from post-2013 projects of 46,893 lb-N/yr for the entire springshed, including projects that were underway or planned. Reductions for completed and ongoing post-2013 projects were estimated to be 8,850 lb-N/yr. Post 2013 project credits for the City's completed and ongoing projects were 892 lb-N/yr, with a septic connection project expected to provide an additional credit of 1,177 lb-N/yr. In contrast, the City's pre-2013 projects resulted in an estimated load reduction to groundwater of almost 234,000 lb-N/yr. In accordance with the FSAPA of 2016, the 2018 BMAP sets a 20-year milestone from BMAP adoption to achieve the TMDL, i.e., the TMDL will be achieved by 2038.

FDEP is in the process of updating the 2018 BMAP by July 1, 2025 to comply with House Bill (HB) 1379 passed in 2023. As part of this update, FDEP will assign allocations to individual stakeholders instead of to the springshed as a whole. Entities with allocations are required to provide sufficient projects to meet 5-year milestones to achieve the TMDL within 20 years from

BMAP adoption. In addition, projects must include an estimate of the nutrient reduction that is reasonably expected to be achieved based on the best scientific information available.

6.1.6 Summary of Efforts by City

The City has undertaken projects that considerably reduce nitrogen loading in the Wakulla Spring springshed. Projects resulting in the most significant reductions in nitrate load to groundwater occurred prior to 2013 and are estimated to be about 233,942 lb-N/yr (**Table 6-2**). Efforts began in 2001 with the with elimination of biosolids application in the springshed. By far, however, the most important project undertaken by the City was the upgrade of the TPSWRF to AWT. The 2015 BMAP estimated that this single project reduced nitrate load to groundwater by 170,323 lb-N/yr. Similarly, the City estimates that since 2000 it has reduced its nitrate load to groundwater by 75 percent or 241,750 lb-N/yr (City, 2024), which far exceeds the 56.2 percent reduction required by the TMDL.

Importantly, FDEP has decided to exclude projects completed prior to 2013 from eligibility for credit and this philosophy is expected to be repeated in the 2025 BMAP update. As such, FDEP's approach ignores the considerable progress made prior to 2014, largely due to the City's efforts, and redistributes credit that should be attributable to the City to other stakeholders instead, regardless of whether they have implemented any management strategies. **Figure 6-12** shows the annual required reductions in load since 2005 and clearly demonstrates the benefits of reduction efforts prior to 2014.

Since the City has already contributed more than its fair share to the reduction efforts needed, well exceeding the 56.2 percent threshold, assignment of further load reduction requirements to the City is not equitable and is contrary to the requirements of the Watershed Restoration Act. It is unknown at this time how FDEP will handle this contradiction in requirement versus approach moving forward.

6.1.7 Study Identification

In expectation of FDEP assigning it additional load reduction requirements in the 2025 BMAP update, the City prepared a detailed evaluation of its past, present, and future nitrogen load to groundwater (City, 2024). The analyses demonstrate that the City has exceeded its TMDL obligation to reduce nitrogen load to groundwater, even under the future (2038) increased load scenario. The City points out that it is inherently inequitable to use an adaptive management approach that resets the load reduction requirements and uniformly allocates reduction requirements to all stakeholders, because this method does not recognize the significant contributions already made by the City towards reducing nitrogen load to groundwater.

In addition, the City will be accepting additional nitrogen load at its wastewater treatment plants as septic systems outside its jurisdiction are connected to its system in the future. However, despite the overall benefit to the springshed of these septic conversions, the City receives no nitrogen credits for its role in facilitating the connections. The City also does not receive credit when its wastewater effluent is below the BMAP requirement of 3 mg/L nitrogen. The nitrogen concentration in effluent from the TPSWRF is typically below 1.5 mg/L.

Table 6-2: City of Tallahassee Pre-2013 Wakulla BMAP Projects

Project #	Project Description	2015 BMAP Load to Surface Reduction (lb)	Recharge Factor (assumed)	Biological Attenuation Factor (assumed)	Reduction in Load to Groundwater (lb)	Year Project Completed
COT-001	Wastewater Treatment Facility Upgrade to AWT	473,859	0.90	0.60	170,323	2012
COT-002	Biosolids Application Elimination	372,563	0.40	0.90	14,903	2006
COT-006	Spray Field Fertilizer Application	135,584	0.90	0.60	48,708	2007
COT-008	Stormwater Improvement Projects	31	0.90	0.70	8	2012
Total					233,942	

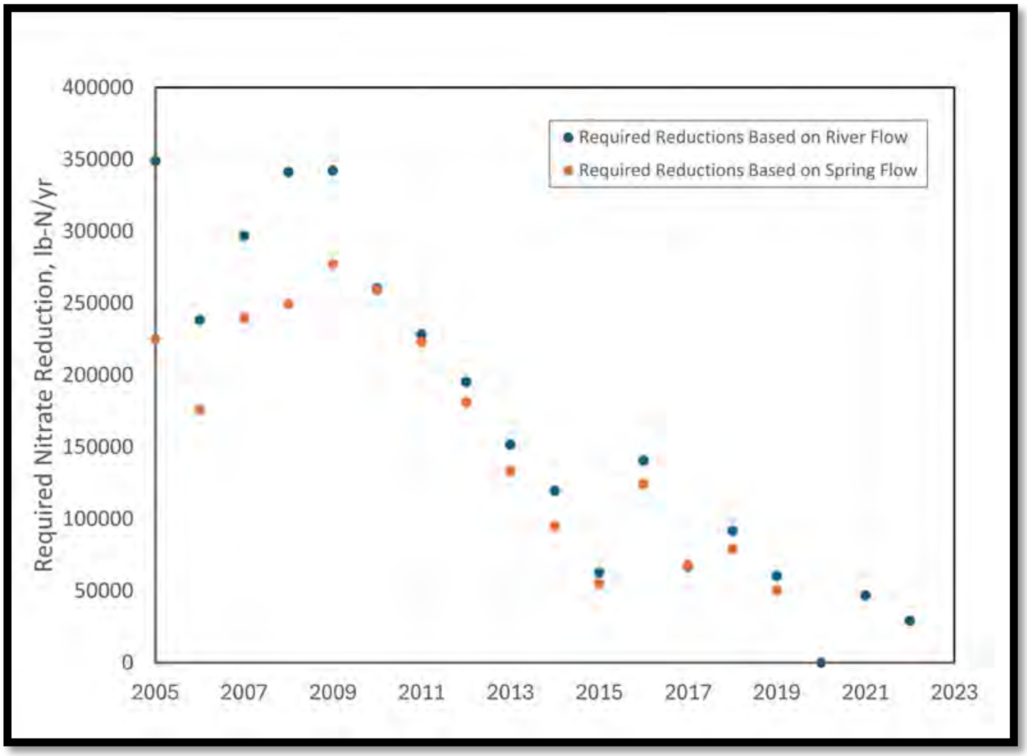


Figure 6-12: Required Reductions in Nitrate Load at the Spring Vent to Meet the Upper Wakulla River TMDL

Overall, the City's opportunities for additional nitrogen reductions are very limited and the City "…finds itself in a near impossible position where N-loading to groundwater allocated to the City is expected to increase with each future BMAP update regardless of successfully implemented past and future control measures."

6.2 Lake Talquin

6.2.1 Overview and History

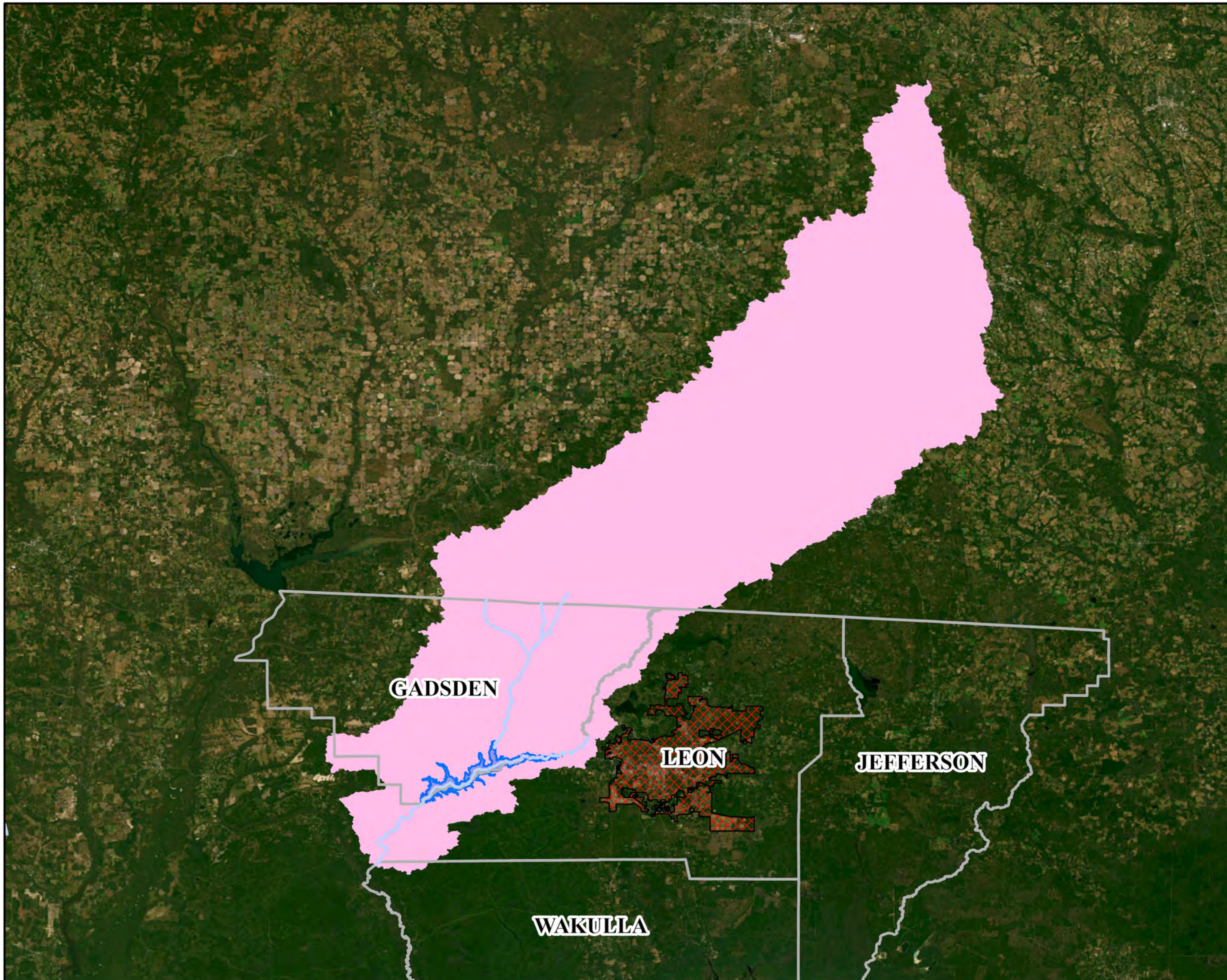
Lake Talquin is located in western Leon County/eastern Gadsden County and encompasses 7,782 acres at the southern end of a 1,569-mi^2 watershed that begins in southern Georgia and extends into Florida. Roughly 73 percent of the watershed is in Georgia, with the remaining 27 percent located in Leon and Gadsden Counties in Florida (**Figure 6-13**). The lake is designated an Outstanding Florida Water [62-302.700(9)(c)(50), Florida Administrative Code (F.A.C.]. Several small- to medium-sized towns are distributed throughout the watershed and include Tifton, Moultrie, Thomasville, and Cairo in Georgia and Gretna, Havana, and Quincy in Florida.

The lake was formed in 1929 when the West Florida Power Company (later Florida Power Corporation) built Jackson Bluff Dam on the Ochlockonee River to produce hydroelectric power. The West Florida Power Company abandoned operation of the power plant in 1970 when it turned the facility over to the State of Florida and donated the land that is now Lake Talquin State Park along the southern shoreline of the lake. The Florida Department of Natural Resources, predecessor to FDEP, managed the dam until 1981, but did not produce power during this time. The City restarted power production at the facility in August 1985, operating as the C. H. Corn Hydroelectric Power Generating Plant. In 2017, the City notified the state it would not renew its lease on the facility and submitted application to the Federal Energy Regulation Commission to surrender its license when it expired in 2022.

The Ochlockonee River originates south of the Town of Sylvester in southwest Georgia and flows approximately 241 miles before emptying into Lake Talquin (206 miles in Georgia and 35 miles in Florida). The river contributes more than one-half of the inflow to Lake Talquin. Little River is the second largest source of water to Lake Talquin. Three tributaries originating in Georgia - Attapulgus Creek, Swamp Creek, and Willacoochee Creek – merge in Florida approximately 21 miles upstream of Lake Talquin to form Little River. Downstream discharges from the lake into the Ochlockonee River flow 61 miles to Ochlockonee Bay and, ultimately, into the Gulf of Mexico. Maximum lake depth occurs along the original Ochlockonee River channel and is estimated to be about 30 ft. Estimates of average depth range from 13 to 15 ft.

The City lies entirely outside of the Lake Talquin watershed, however, the City-operated Arvah B. Hopkins Power Generating Station straddles the eastern boundary of the Lake Talquin watershed and discharges into Beaver Creek, and ultimately into the Ochlockonee River upstream of Lake Talquin. The station operates under National Pollutant Discharge Elimination System (NPDES) permit FL0025518, which limits downstream loads.

Other than management of the Hopkins discharge, the City's activities have no potential impact on water quality in Lake Talquin. This section is included to ensure the master plan provides a comprehensive evaluation of the condition of waterbodies connected to the City's activities, however remote. Unlike other volumes in the master plan, the primary purpose of this section is to document current conditions of Lake Talquin and to describe the character of the City's discharge into the lake.



CITY OF TALLAHASSEE

N

0 10.4
Miles

Legend

- Major Drainage Basin Talquin
- Lake Talquin Waterbody
- Watercourses
- BMAP Counties
- Tallahassee City Limits

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

Figure 6-13:
Overview of Talquin Major Drainage Basin

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants

6.2.2 Regulatory Status

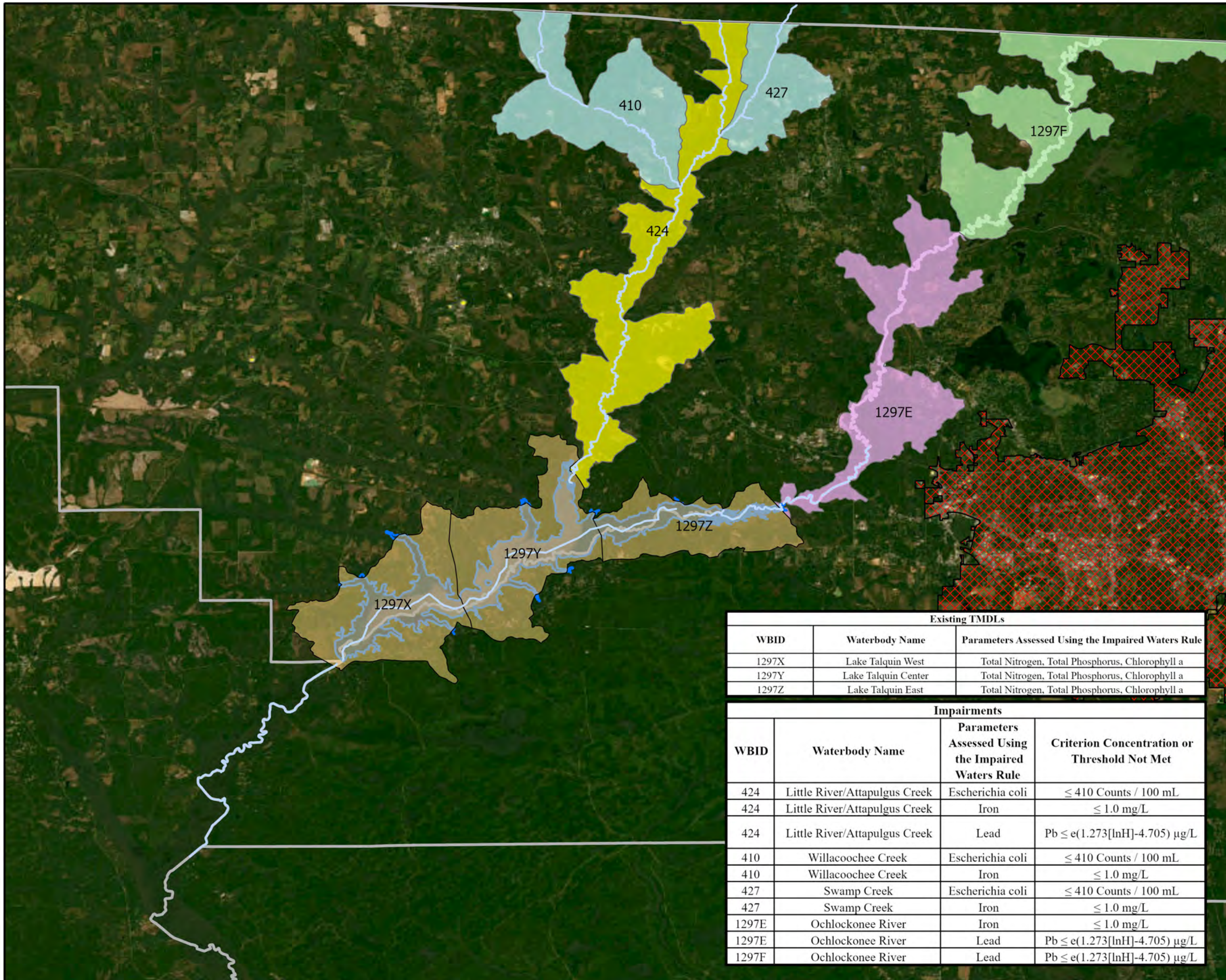
For purposes of impairment assessment, FDEP divided Lake Talquin into 3 WBIDs. They are Lake Talquin West (1297X), Lake Talquin Center (1297Y), and Lake Talquin East (1297Z). In addition to the three lake WBIDs, the impairment status of 5 upstream tributary WBIDs was reviewed. The assessment status of the lake and its tributaries was reviewed using the methodology described in **Section 6.1.2**. Results are summarized in **Figure 6-14** with a table provided to summarize the impairments. Of note is that four of the five upstream waterbodies, both Ocklockonee River WBIDs, Little River/Attapulgus Creek, and Willacoochee Creek, are identified as impaired for TN, but are on the study list because there are insufficient supporting biological data.

6.2.3 Water Quality Data Review

Figure 6-15 through **Figure 6-17** present plots of the AGMs for TN, total phosphorus (TP), and chlorophyll a (Chl-a) for Lake Talquin West (WBID 1297X). **Figure 6-18** through **Figure 6-20** present plots of the AGMs for TN, TP, and Chl-a for Lake Talquin Center (WBID 1297Y). **Figure 6-21** through **Figure 6-23** present plots of the AGMs for TN, TP, and Chl-a for Lake Talquin East (WBID 1297Z). The TN and TP thresholds shown are the concentration thresholds, never to be exceeded, in each lake segment for the lake to achieve its TMDL target of 20 micrograms per liter (µg/L) Chl-a with no allowable exceedances. The TMDL is discussed in more detail in **Section 6.2.4**.

Figure 6-24 through **Figure 6-26** present the TN AGMs for Little River and the two Ochlockonee River segments. Together, these rivers contribute most of the flow and nutrient load into Lake Talquin. As noted previously, the segments have been identified as impaired for TN, but the biological condition, i.e., impaired or healthy, has not been confirmed, so they are on the study list for now. Of these three segments, only Little River is notable for the magnitude of TN exceedance, with the AGM frequently more than twice the numeric nutrient criterion (NNC). Even if Little River is ultimately found to be biologically healthy, the magnitude of load from the river is concerning with respect to protection of a downstream impaired water, i.e., Lake Talquin.

The primary upstream source of nitrogen into Little River is the BASF – Attapulgus processing facility in Decatur County, Georgia. Operating under NPDES permit number GA0001678, BASF discharges to Little Attapulgus Creek which empties into Attapulgus Creek about just north of the Florida-Georgia line. Attapulgus Creek joins Little River about 21 miles north of Lake Talquin. The BASF facility effluent is characterized by very high concentrations of nitrogen, primarily nitrite-nitrate (nitrate) [Applied Technology and Management (ATM), 2008]. Discharge monitoring reports from 2004 through 2006 show average nitrate concentrations ranging from 140 mg/L to 167 mg/L. BASF discharges account for 37 percent to 87 percent of the nitrate load to the Little River Watershed and a large percentage of the TN load to Lake Talquin (ATM, 2008). The AGMs for nitrate in Little River are shown in **Figure 6-27**, confirming that a large portion of the nitrogen load to the lake is attributable to nitrate.



Existing TMDLs

WBID	Waterbody Name	Parameters Assessed Using the Impaired Waters Rule
1297X	Lake Talquin West	Total Nitrogen, Total Phosphorus, Chlorophyll a
1297Y	Lake Talquin Center	Total Nitrogen, Total Phosphorus, Chlorophyll a
1297Z	Lake Talquin East	Total Nitrogen, Total Phosphorus, Chlorophyll a

Impairments

WBID	Waterbody Name	Parameters Assessed Using the Impaired Waters Rule	Criterion Concentration or Threshold Not Met
424	Little River/Attapulgus Creek	Escherichia coli	$\leq$ 410 Counts / 100 mL
424	Little River/Attapulgus Creek	Iron	$\leq$ 1.0 mg/L
424	Little River/Attapulgus Creek	Lead	$\text{Pb} \leq e(1.273[\ln H]-4.705)$ µg/L
410	Willacoochee Creek	Escherichia coli	$\leq$ 410 Counts / 100 mL
410	Willacoochee Creek	Iron	$\leq$ 1.0 mg/L
427	Swamp Creek	Escherichia coli	$\leq$ 410 Counts / 100 mL
427	Swamp Creek	Iron	$\leq$ 1.0 mg/L
1297E	Ochlockonee River	Iron	$\leq$ 1.0 mg/L
1297E	Ochlockonee River	Lead	$\text{Pb} \leq e(1.273[\ln H]-4.705)$ µg/L
1297F	Ochlockonee River	Lead	$\text{Pb} \leq e(1.273[\ln H]-4.705)$ µg/L

CITY OF TALLAHASSEE

N

0 3.4

Miles

Legend

- Lake Talquin Waterbody
- Watercourses
- BMAP Counties
- Tallahassee City Limits

Existing TMDLs

- Layer

Impairments

- Iron, E.Coli
- Iron, Lead
- Iron, Lead, E.Coli
- Lead

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

Figure 6-14:
Lake Talquin Watershed Impairments Map

Tallahassee Master Plan - Surface Water (TMaPS)

Geosyntec consultants

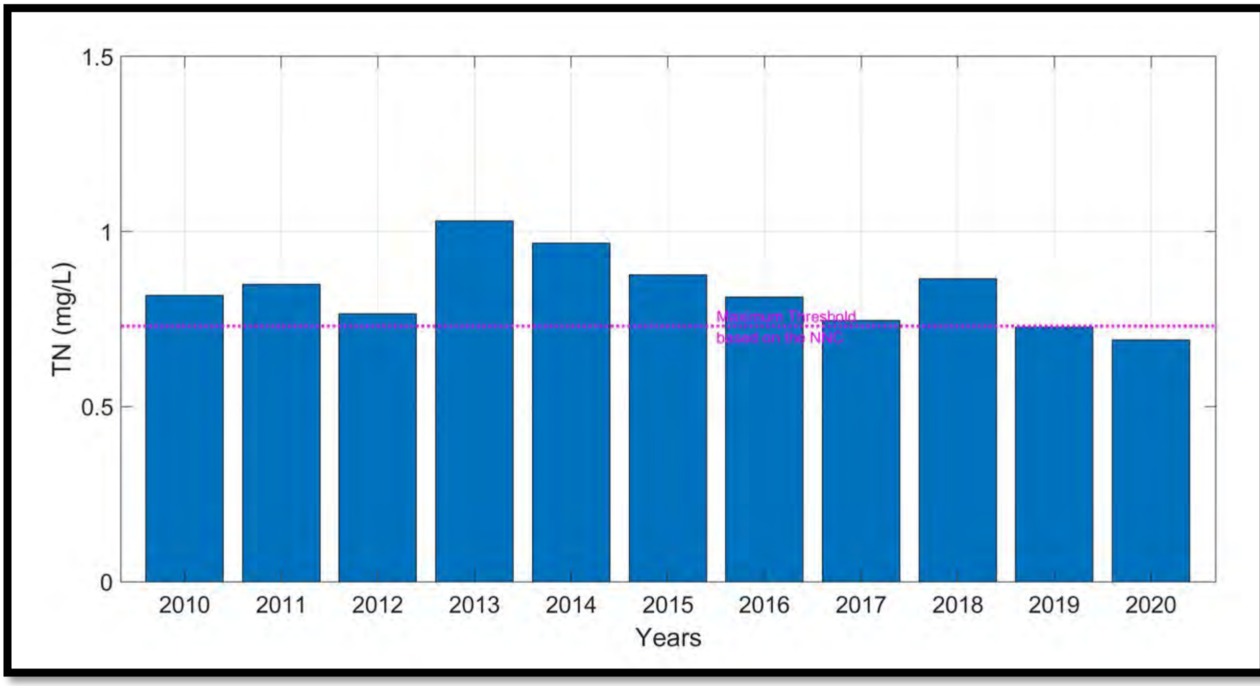


Figure 6-15: Total Nitrogen AGM for Lake Talquin West

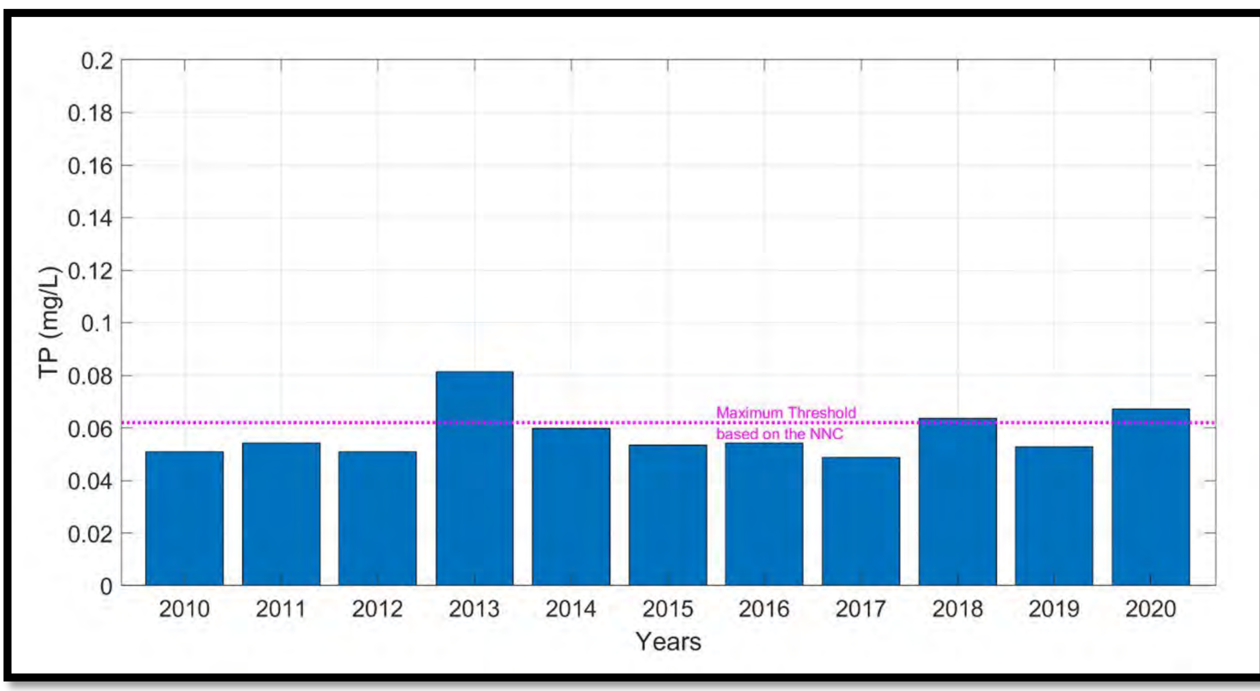


Figure 6-16: Total Phosphorus AGM for Lake Talquin West

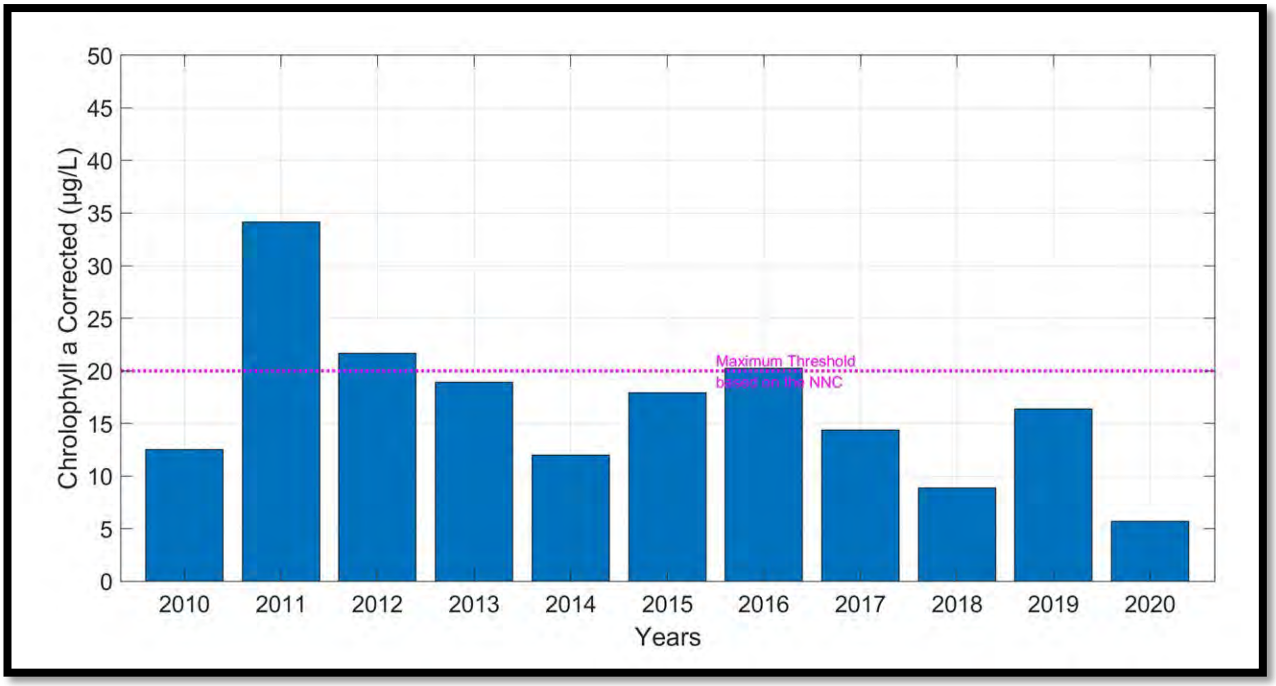


Figure 6-17: Chlorophyll a AGM for Lake Talquin West

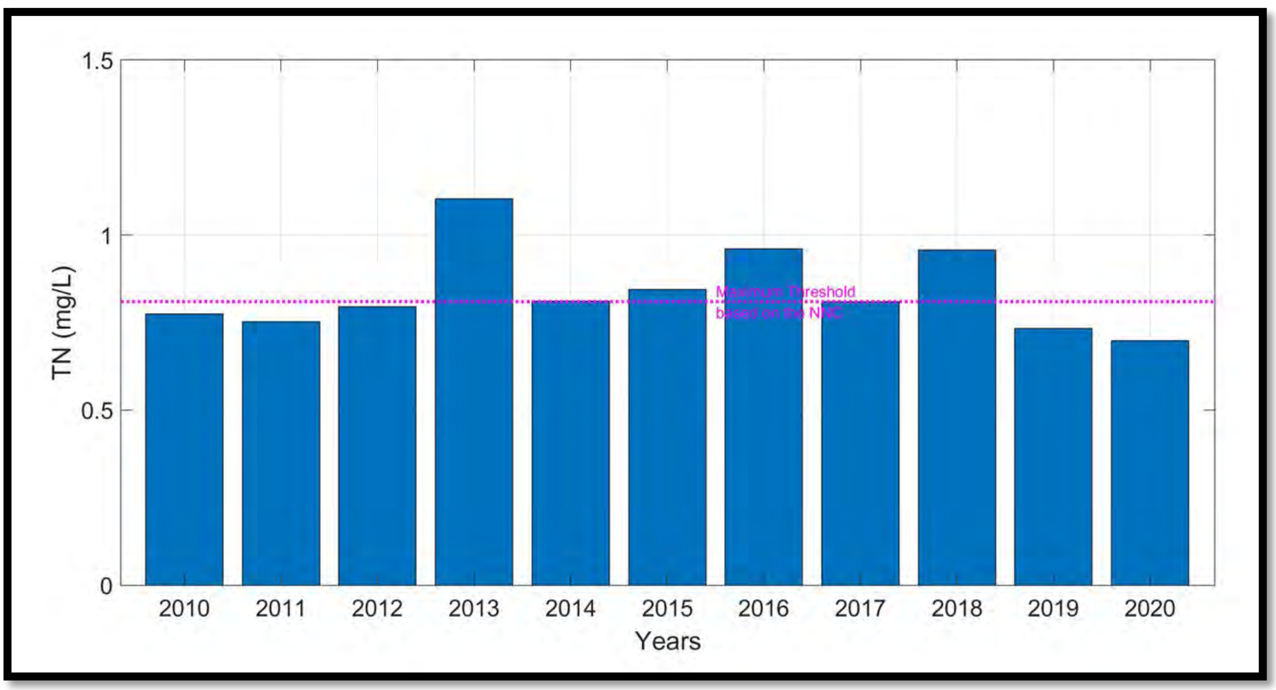


Figure 6-18: Total Nitrogen AGM for Lake Talquin Center

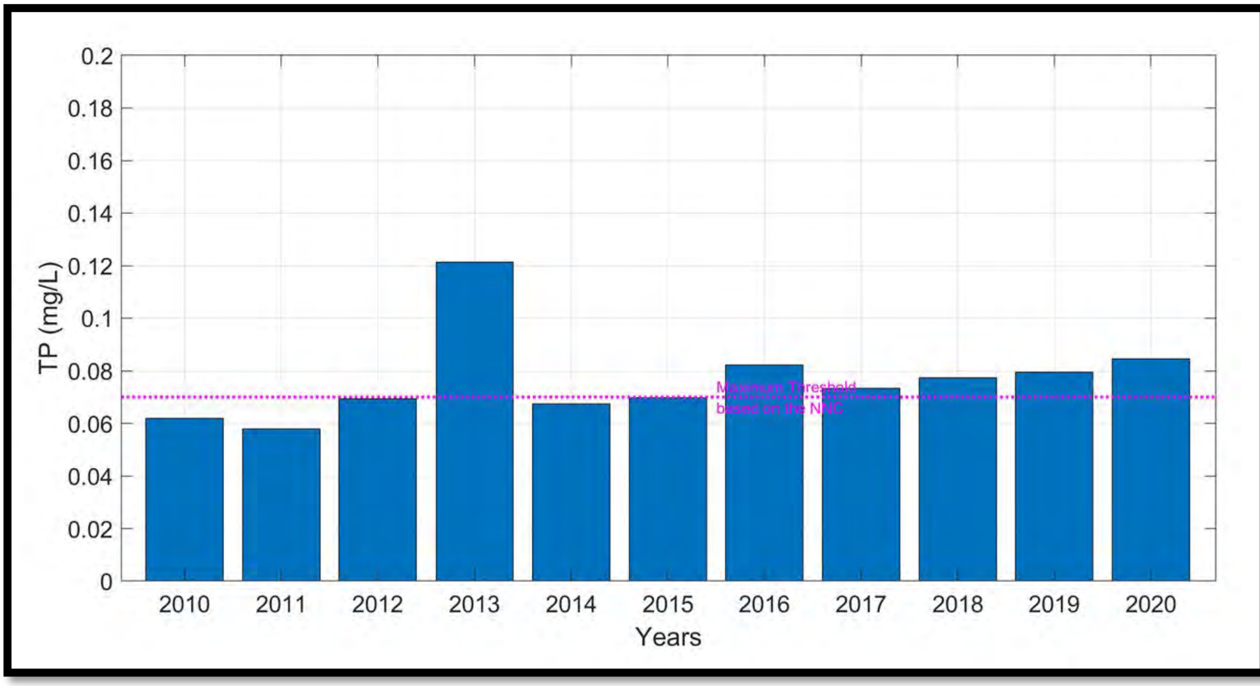


Figure 6-19: Total Phosphorus AGM for Lake Talquin Center

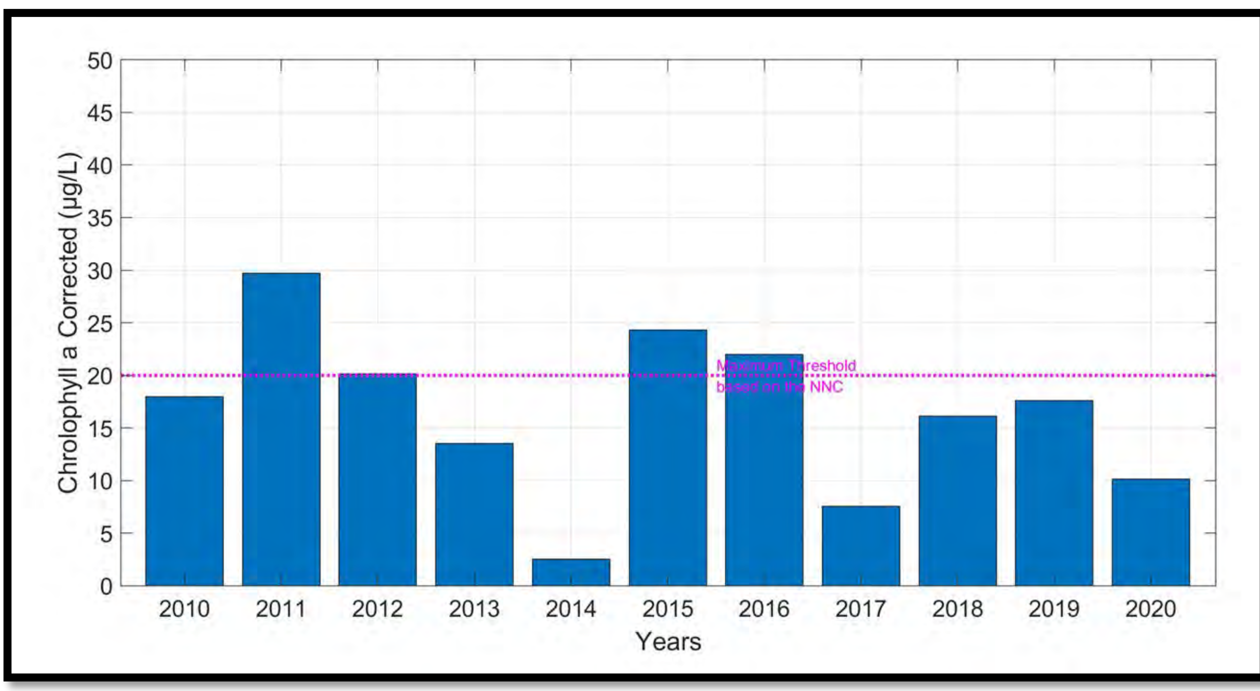


Figure 6-20: Chlorophyll a AGM for Lake Talquin Center

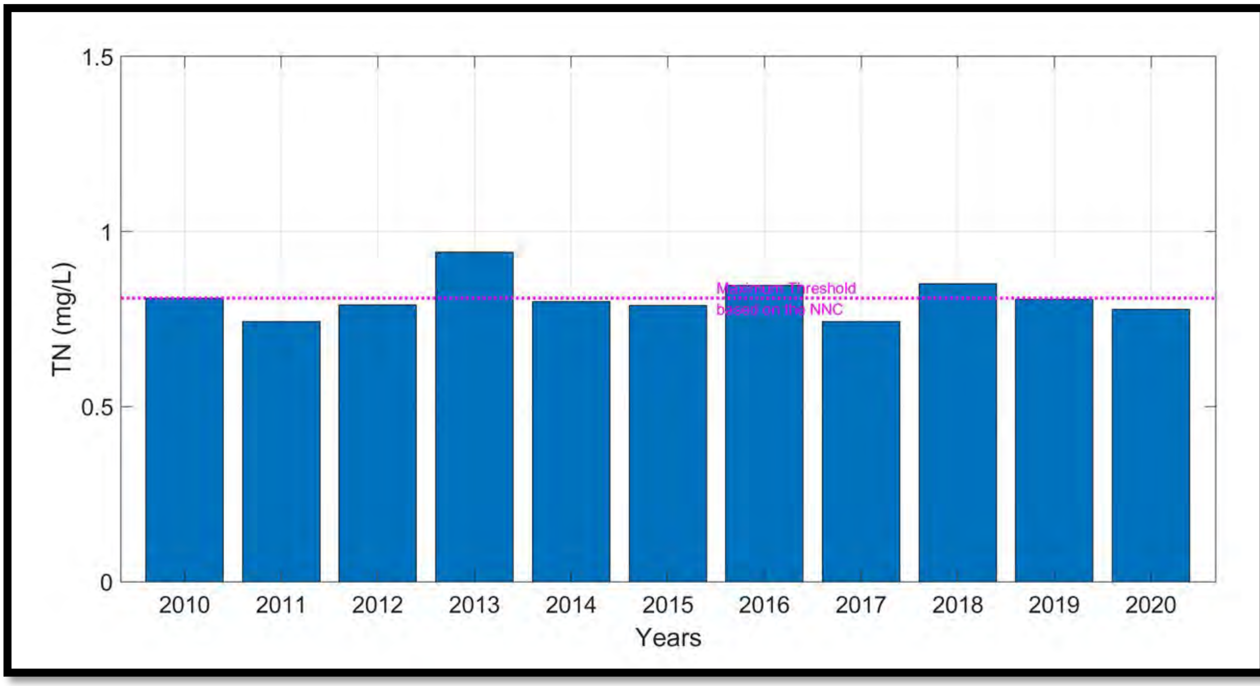


Figure 6-21: Total Nitrogen AGM for Lake Talquin East

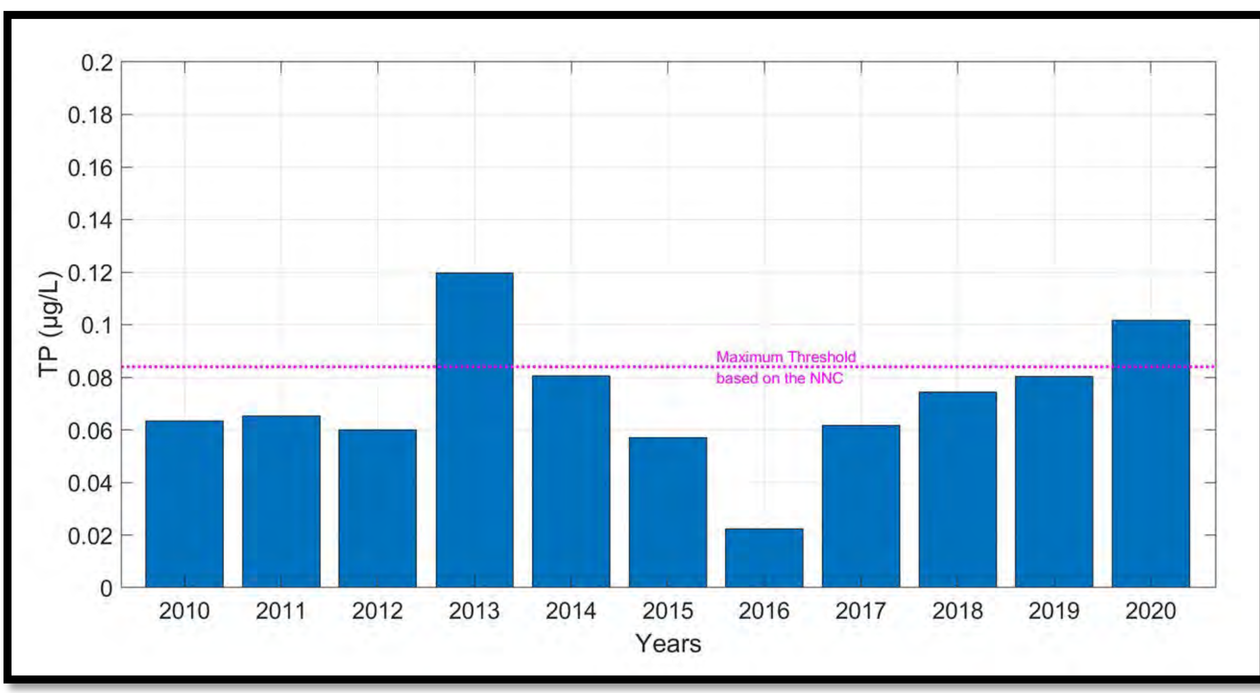


Figure 6-22: Total Phosphorus AGM for Lake Talquin East

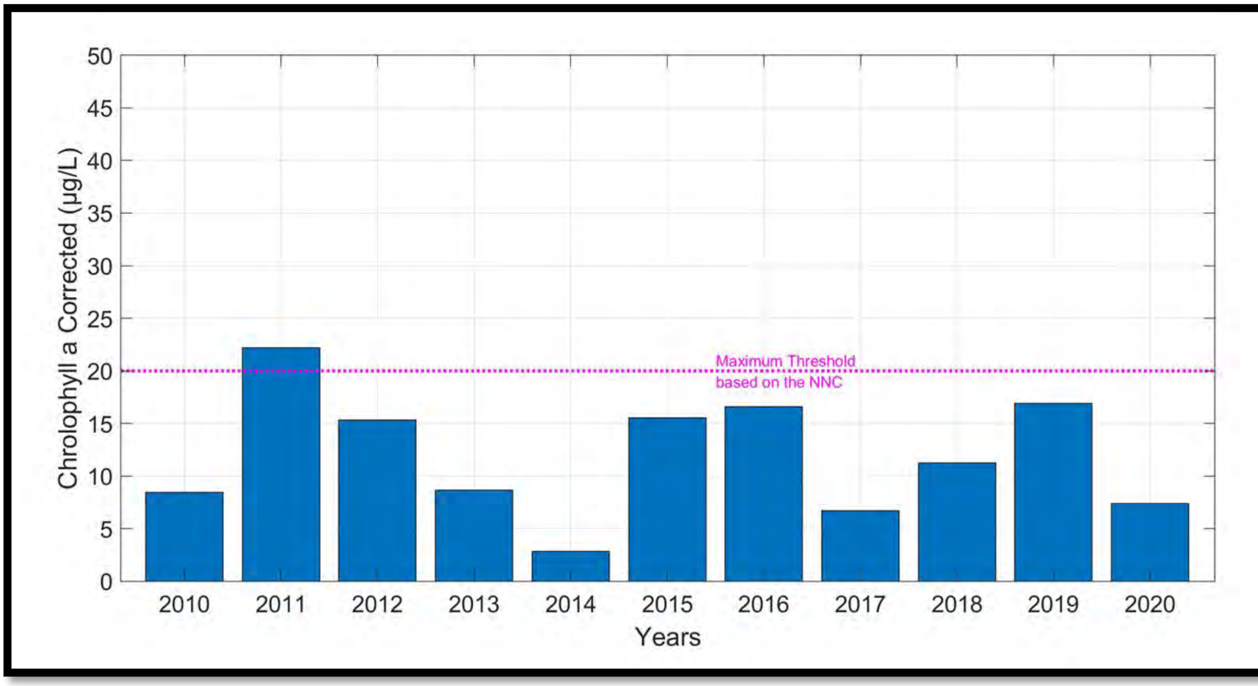


Figure 6-23: Chlorophyll a AGM for Lake Talquin East

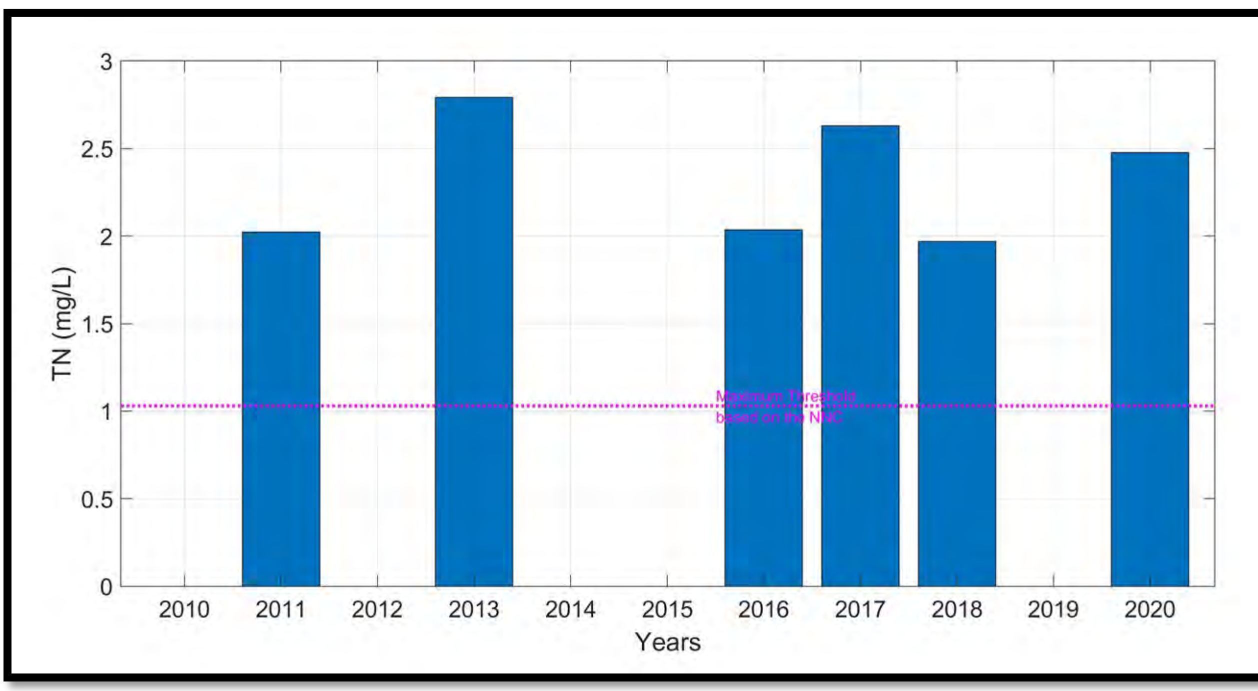


Figure 6-24: Total Nitrogen AGM for Little River

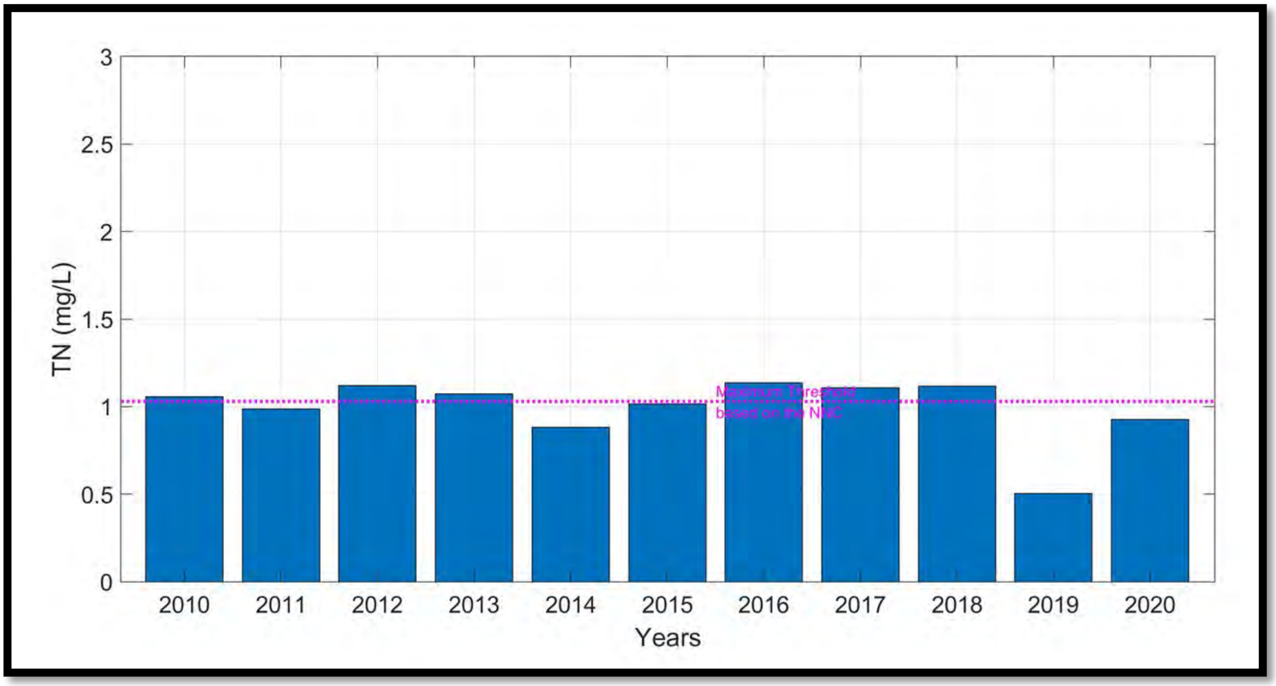


Figure 6-25: Total Nitrogen AGM for Ochlockonee River (1297E)

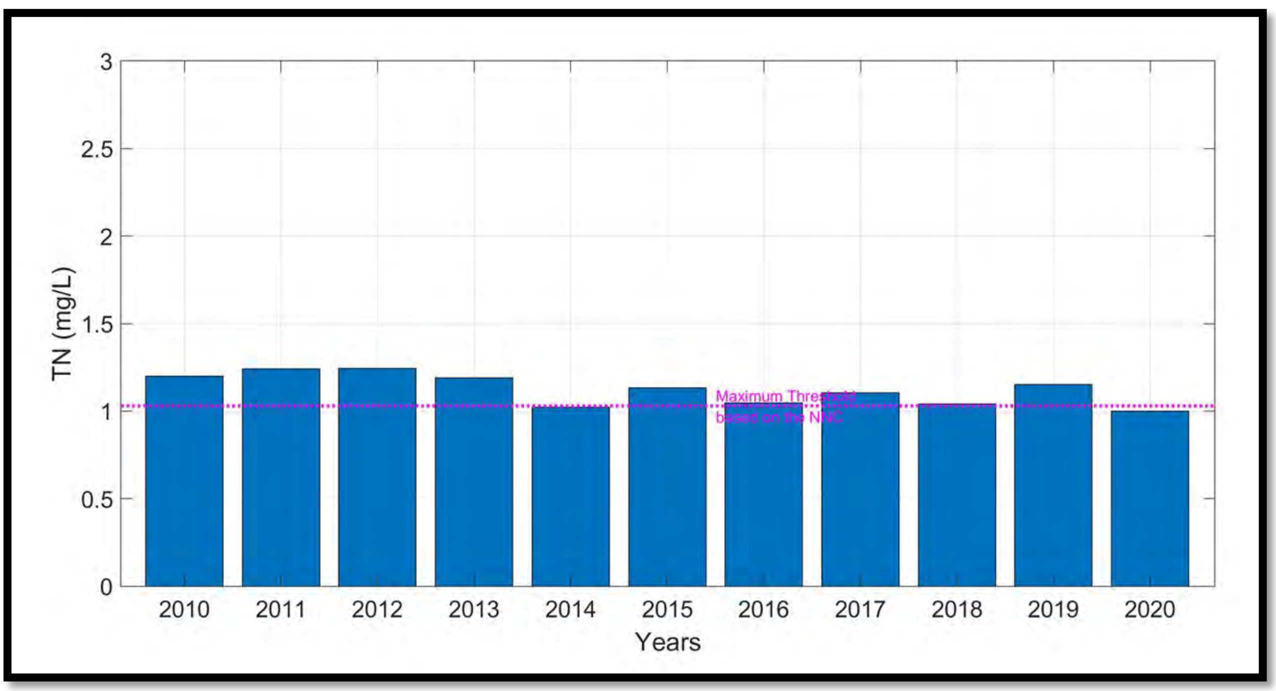


Figure 6-26: Total Nitrogen AGM for Ochlockonee River (1297F)

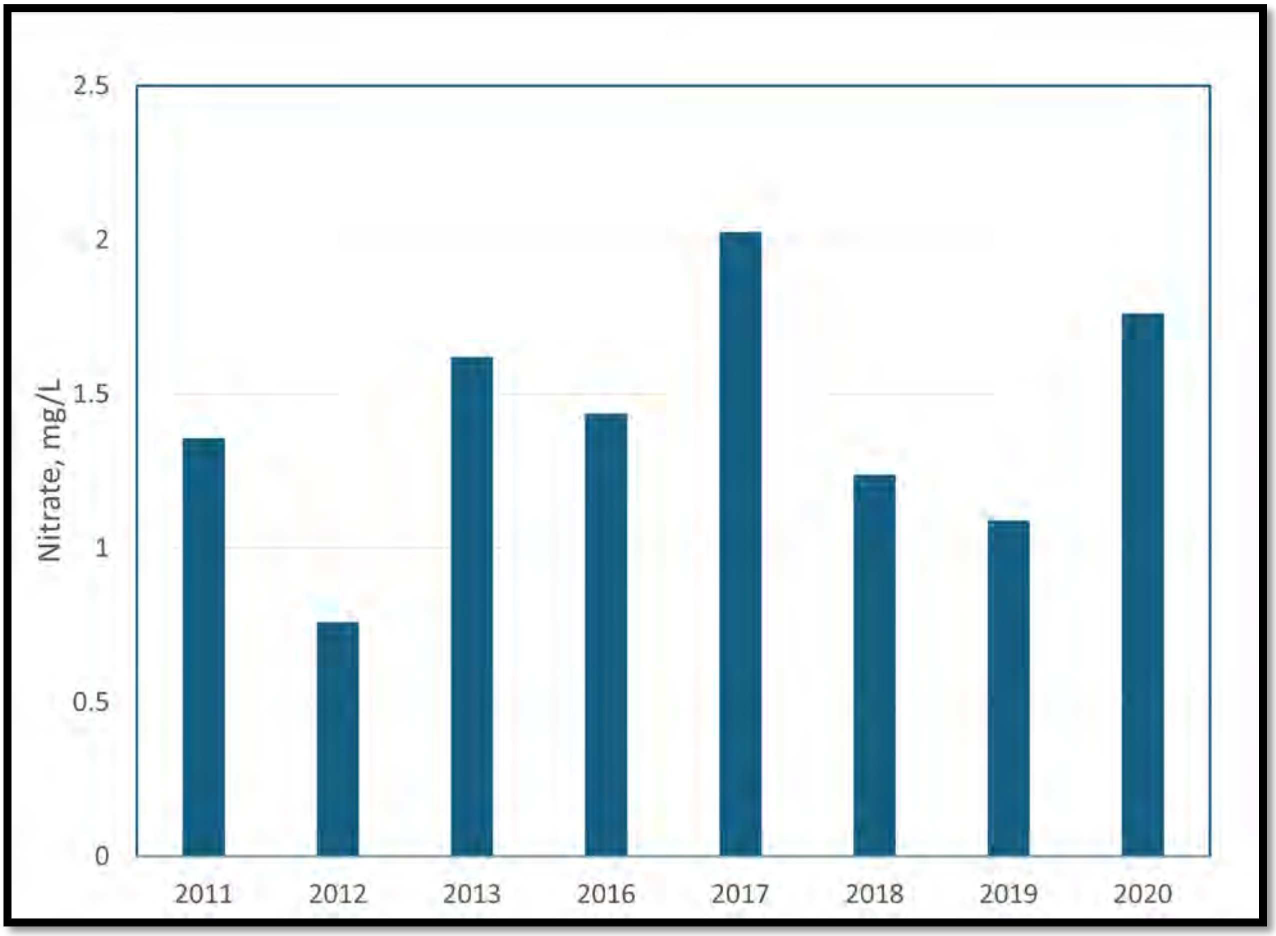


Figure 6-27: Nitrite-Nitrate AGM for Little River

6.2.4 TMDL Summary and Load Reductions

The Lake Talquin nutrient TMDL was adopted in May 2022 and is expressed as the seven-year average of annual loads of TN and TP to achieve a target Chl-a concentration of 20 µg/L, never to be exceeded. Compliance with the TMDL requires that the Chl-a AGM in each of the three lake WBIDs never exceed 20 µg/L. The TN and TP concentrations needed for each WBID to meet the Chl-a target were developed as part of the TMDL modeling, but are for information only, i.e., concentrations are not included in the TMDL rule.

At the time of TMDL development, there were 10 NPDES-permitted industrial or domestic wastewater facilities that discharge to surface waters in the Lake Talquin watershed. Two of the facilities are in Florida, the Arvah B. Hopkins Power Generating Station operated by the City and the Quincy domestic wastewater facility. These facilities are assigned wasteload allocations (WLA) in the TMDL. The wastewater WLAs were set to “hold the line” on existing discharge limits, and the allowable loads are based on the 95th percentile of discharge flow and nutrient concentrations in the effluent existing at the time of TMDL development.

The 95th percentile TN and TP concentrations in Hopkins discharge effluent is 0.40 mg/L and 0.97 mg/L, respectively (ATM, 2020). TN effluent concentration is well below the lake targets in the TMDL and below ambient levels in the creek downstream, so additional reductions are not needed and were not considered.

TP sampling conducted along the upper reaches of Beaver Creek, along with a study completed by Frydenborg Ecologic (2015), identify significant assimilation of the TP moving downstream through Beaver Creek prior to reaching the Ochlockonee River. Analyses by ATM (2020) and Frydenborg (2015) demonstrate that TP in the effluent is attenuated between 54 percent and 76 percent between the point of discharge and points upstream of the confluence with the Ochlockonee River. At the confluence, the TP concentration in the 2015 sampling was 0.06 mg/L, well below the NNC of 0.18 mg/L for the river and below the TMDL-derived TP targets in the lake. Results from these studies were sufficient to conclude that the contribution of TP from the Hopkins facility is de minimis, and no additional reductions in TP are required. **Table 6-3** presents the TMDL load allocations and concentration targets for the Lake Talquin TMDL.

Table 6-3: Summary of Lake Talquin TMDL

Parameter	TMDL (kg/yr)	Wasteload Allocation Wastewater		Concentration at Chl-a Target (mg/L)			Wasteload Allocation Stormwater (% Reduction)	Load Allocation (% Reduction)
		Hopkins (kg/yr)	Quincy (kg/yr)	West Lake (1297X)	Center Lake (1297Y)	East Lake (1297Z)		
TN	1,134,850	986	4,745	0.73	0.84	0.81	19	19
TP	112,326	2,409	1,460	0.062	0.070	0.084	21	21

6.2.5 Summary of Efforts by City

The Hopkins facility operates under NPDES permit FL0025518 which was most recently renewed in August 2023 and includes effluent load limits for TN and TP in accordance with the TMDL allocations. There were no load limits for TN and TP in prior permit cycles. The City is compliant with its NPDES permit, and no additional activities are planned beyond the routine operation of the Hopkins facility and continuing compliance with the permit.

6.2.6 Study Identification

No additional studies are needed or recommended.

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