Northeast District • Lower St. Johns Basin

Draft Report

Dissolved Oxygen TMDL for Haw Creek above Crescent Lake (WBID 2622A)

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Executive Summary

This report presents the total maximum daily loads (TMDLs) developed to address the dissolved oxygen (DO) impairment of Haw Creek above Crescent Lake, located in the Lower St. Johns River Basin.

Haw Creek above Crescent Lake (the segment with waterbody identification [WBID] number 2622A) was identified as impaired (Category 5) for DO based on DO concentration (in milligrams per liter [mg/L]) and was added to the 303(d) list by Secretarial Order in May 2004 and May 2009. Nutrients have been identified as the causative pollutant. TMDLs for nitrogen and phosphorus to improve DO have been developed in accordance with Section 303(d) of the federal Clean Water Act and guidance developed by the U.S. Environmental Protection Agency. These nutrient TMDLs are not considered site specific interpretations of the numeric nutrient criterion (H1) because they were not developed to address imbalances of flora and fauna (paragraph 62-302.530(48)(b), F.A.C.) because there are no biological impairments in Haw Creek and paragraph 62-302.531(2)(a), F.A.C. limits H1 expressions to numeric interpretations of paragraph 62-302.530(48)(b), F.A.C. The TMDLs were developed to only address 62-302.530(48)(a), F.A.C. **Table EX-1** lists supporting information for the TMDLs.

Table EX-1. Summary of TMDL supporting information for Haw Creek above Lake Crescent

Type of Information	Description
Waterbody name (WBID)	Haw Creek above Crescent Lake (2622A)
Hydrologic Unit Code (HUC) 8	03080103
Use classification/ Waterbody designation	Class III freshwater stream
Targeted beneficial uses	Fish consumption, recreation, and propagation and maintenance of a healthy, well-balanced population of fish and wildlife.
303(d) listing status	Verified List of Impaired Waters for the Group 2 basins (Lower St. Johns), adopted via Secretarial Order dated May 2004 and May 2009.
TMDL pollutants	TN and TP
TMDLs	**Haw Creek above Crescent Lake (WBID 2622A):** **TN:** 504,043 pounds per year (lbs/yr), expressed as a 7-year rolling average load not to be exceeded. **TP:** 21,880 lbs/yr, expressed as a 7-year rolling average load not to be exceeded.
Load reductions required to meet the TMDLs	**WBID 2622A:** A 28 % total nitrogen (TN) reduction and a 62 % total phosphorus (TP) reduction to achieve the applicable DO criterion in the creek
Concentration-based lake restoration targets	**WBID 2622A:** To improve DO the loading-based criteria are a TN annual geometric mean (AGM) of 1.16 mg/L and a TP AGM of 0.05 mg/L, not to be exceeded more than once in any consecutive 3-year period.

Acknowledgments

This analysis was accomplished thanks to significant contributions from staff in the Florida Department of Environmental Protection (DEP) Division of Environmental Assessment and Restoration, specifically, the Office of Watershed Services, Watershed Assessment Section, Standards Development Section, Water Quality Restoration Program, and Watershed Evaluation and TMDL Section. DEP also recognizes the U.S. Army Corps of Engineers, especially Russ Weeks, for providing the Hydrological Simulation Program – Fortran (HSPF) Model in the Lower St. Johns River Basin.

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List of Acronyms and Abbreviations

µg/L	Micrograms Per Liter
ac-ft/yr	Acre-Feet Per Year
AGM	Annual Geometric Mean
BMAP	Basin Management Action Plan
BMP	Best Management Practice
CBP	Concrete Batch Plant
CFR	Code of Federal Regulations
Chla	Chlorophyll *a*
CWA	Clean Water Act
° F.	Degrees Fahrenheit
DEP	Florida Department of Environmental Protection
DO	Dissolved Oxygen
DOsat	Dissolved Oxygen Percent Saturation
EPA	U.S. Environmental Protection Agency
F.A.C.	Florida Administrative Code
FDOH	Florida Department of Health
FDOT	Florida Department of Transportation
FL	Florida
F.S.	Florida Statutes
FWRA	Florida Watershed Restoration Act
FWS	U.S. Fish and Wildlife Service
HSPF	Hydrological Simulation Program – Fortran
GIS	Geographic Information System
HUC	Hydrologic Unit Code
in/yr	Inches Per Year
IWR	Impaired Surface Waters Rule
LA	Load Allocation
lbs	Pounds
lbs/yr	Pounds Per Year
mg/L	Milligrams Per Liter
mgd	Million Gallons Per Day
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer System
NA	Not Applicable
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
OSTDS	Onsite Sewage Treatment and Disposal System
PLRG	Pollutant Load Reduction Goal
SJRWMD	St. Johns River Water Management District
SWIM	Surface Water Improvement and Management
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
U.S.	United States

USACE	U.S. Army Corps of Engineers
WBID	Waterbody Identification
WLA	Wasteload Allocation
WQS	Water Quality Standards
WWTF	Wastewater Treatment Facility
WWTP	Wastewater Treatment Plant

Chapter 1: Introduction

1.1 Purpose of Report

This report presents the total maximum daily loads (TMDLs) developed to address the dissolved oxygen (DO) impairment of Haw Creek above Crescent Lake, located in the Lower St. Johns Basin. The creek is one of the tributaries to Crescent Lake. The waterbody was verified as impaired for DO, with nutrients as the causative pollutants, using the methodology in the Identification of Impaired Surface Waters Rule (IWR) (Chapter 62-303, Florida Administrative Code [F.A.C.]) and was included on the Verified List of Impaired Waters for the Lower St. Johns Basin adopted by Secretarial Order in May 2004 and May 2009.

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody so that it can still meet water quality standards, identifies the sources of the pollutant, and provides water quality targets needed to comply with applicable water quality criteria based on the relationship between pollutant sources and water quality in the receiving waterbody. The TMDLs establish the allowable loadings to Haw Creek above Crescent Lake that would restore the waterbody so that it meets the applicable water quality criterion for DO.

1.2 Identification of Waterbody

For assessment purposes, the Florida Department of Environmental Protection (DEP) divided the Lower St. Johns Basin (Hydrologic Unit Code [HUC] 8 – 03080103) into watershed assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or surface water segment. Haw Creek above Crescent Lake is WBID 2622A. **Figure 1.1** shows the location of the waterbody in the basin and major geopolitical and hydrologic features in the region, and **Figure 1.2** contains more detailed map of the waterbody.

The Haw Creek above Crescent Lake segment is 4 miles long and located in Flagler County. Main Haw Creek flows southwest and receives discharges from Little Haw Creek and Middle Haw Creek (these waterbodies are not impaired for nutrients or DO), which flow north, and several smaller creeks arranged in a dendritic pattern. Other smaller first-order streams and artificial channels draining roads and agricultural areas discharge directly into the creek.

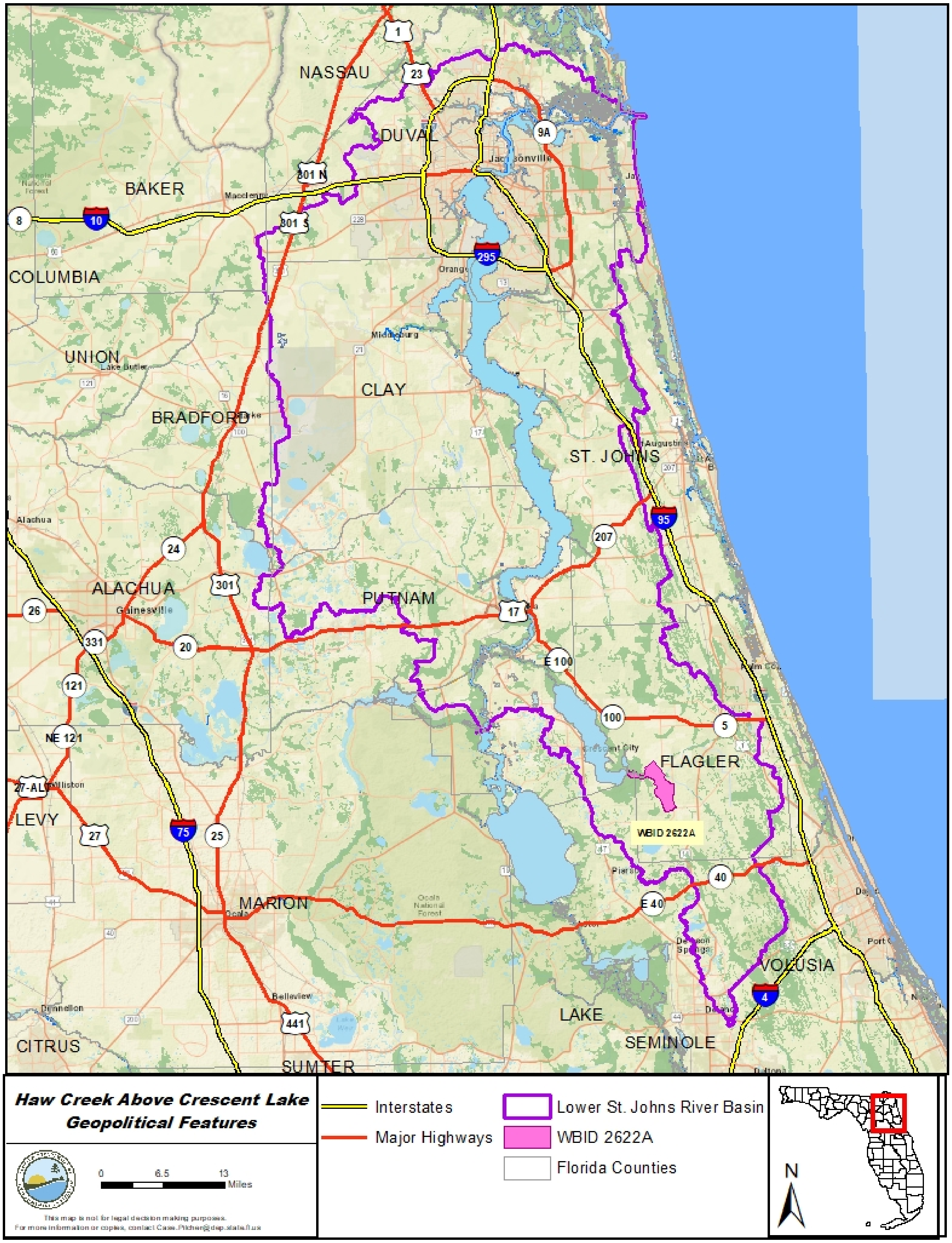


Figure 1.1. Location of Haw Creek above Crescent Lake (WBID 2622A) in the Lower St. Johns River Basin and major hydrologic and geopolitical features in the area

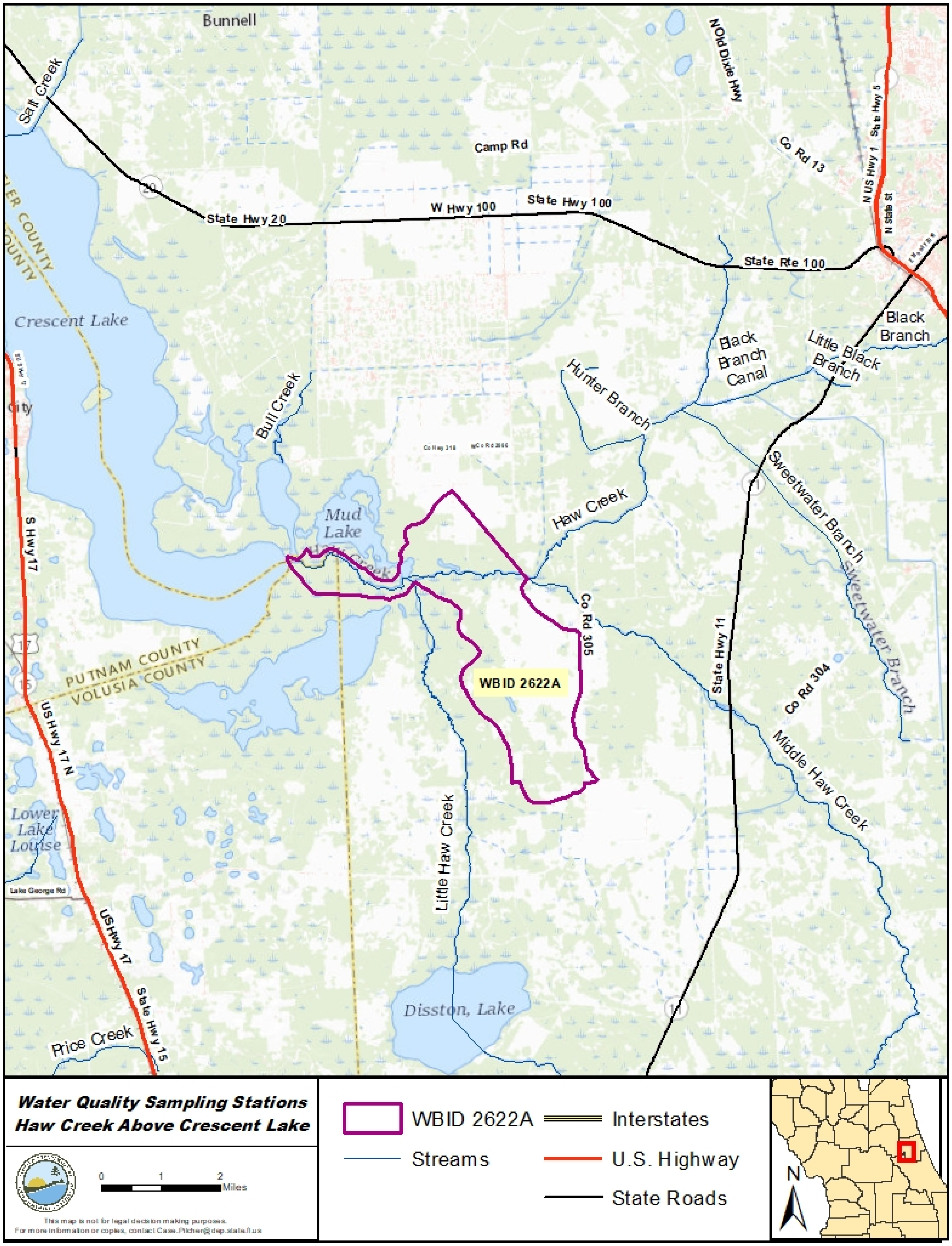


Figure 1.2. Location of Haw Creek above Crescent Lake (WBID 2622A) in large scale

1.3 Watershed Information

1.3.1 Population and Geopolitical Setting

The Haw Creek Watershed covers an area of 220,000 acres. The watershed is located in Flagler County in the north and in Volusia County in the south. The City of Bunnell is situated in the northeast and the City of Deland in the south of the watershed. In 2018, Flagler and Volusia Counties had a population of 112,067 and 547,538, respectively (U.S. Census Bureau 2018). The majority of the Haw Creek Watershed is composed of upland forest, along with wetland and agricultural land uses. There are also residential developments in the outer fringes of the watershed.

1.3.2 Topography

Elevations in the Haw Creek Watershed range from 5 to 115 feet, with the lower elevation contours surrounding the creek itself and the higher elevations located farther away from the waterway. The 115-foot contours are found in the southwest edges of the watershed. This topography yields mostly 0 % to 6 % slopes.

Haw Creek receives discharges from Little Haw Creek, Middle Haw Creek, Sweetwater Branch, Black Branch, and several smaller streams arranged in a dendritic pattern. Haw Creek flows into Crescent Lake. The water leaving Crescent Lake flows from the outlet on the north side of Crescent Lake into Dunns Creek and eventually into the St. Johns River.

1.3.3 Hydrogeological Setting

The Haw Creek Watershed is located in a humid subtropical climate zone characterized by hot and humid summers, mild winters, and a wet season between June and September. The watershed's long-term average rainfall was 50 inches per year (in/yr) from 1973 to 2018. Rainfall data came from the National Oceanic and Atmospheric Administration (NOAA 2018) Online Weather Data Daytona International Airport weather station. The annual average temperature was 71 degrees Fahrenheit (° F.).

Soil infiltration rate is an important characteristic of soils that determines how much surface runoff is produced from a given area. The Haw Creek Watershed comprises hydrologic soil groups A, A/D, B/D, C/D, and D. These groups are based on the National Cooperative Soil Survey. Group A soils range from sandy to loamy in texture and are characterized by low runoff potential and increased infiltration rates. Soils in Group B range from silty to loamy soil textures and have moderate drainage. Group C soils have low infiltration rates when saturated and are moderately well drained to well drained. Soils in Group D contain higher amounts of clay, often 40 % or more, and have high runoff potential. When unsaturated, Group A/D, B/D, and C/D soils are characteristic of Group A, B, and C soils, respectively, and when saturated they are more characteristic of Group D soils.

Table 1.1 lists the soil hydrologic groups in the Haw Creek Watershed and their corresponding acreages. The hydrologic characteristics of soil can significantly influence the capability of a watershed to hold rainfall or produce surface runoff. Based on the percent acreage of these soil hydrologic groups, Type A soil occupied only 7 % of the basin. Dual hydrologic groups (A/D, B/D, and C/D) dominate in the basin, accounting for 88 % of the watershed. (**Table 1.1** and **Figure 1.3**). Due to the composition of soil type, the Haw Creek Watershed has high runoff potential.

Table 1.1. Acreage of hydrologic soil groups in the Haw Creek Watershed

Soil Hydrologic Group	Acreage	% Acreage
A	15,533	7
A/D	120,814	55
B/D	8,120	4
C/D	62,938	29
D	5,855	3
No Data	5,669	3
Total	**218,929**	**101**

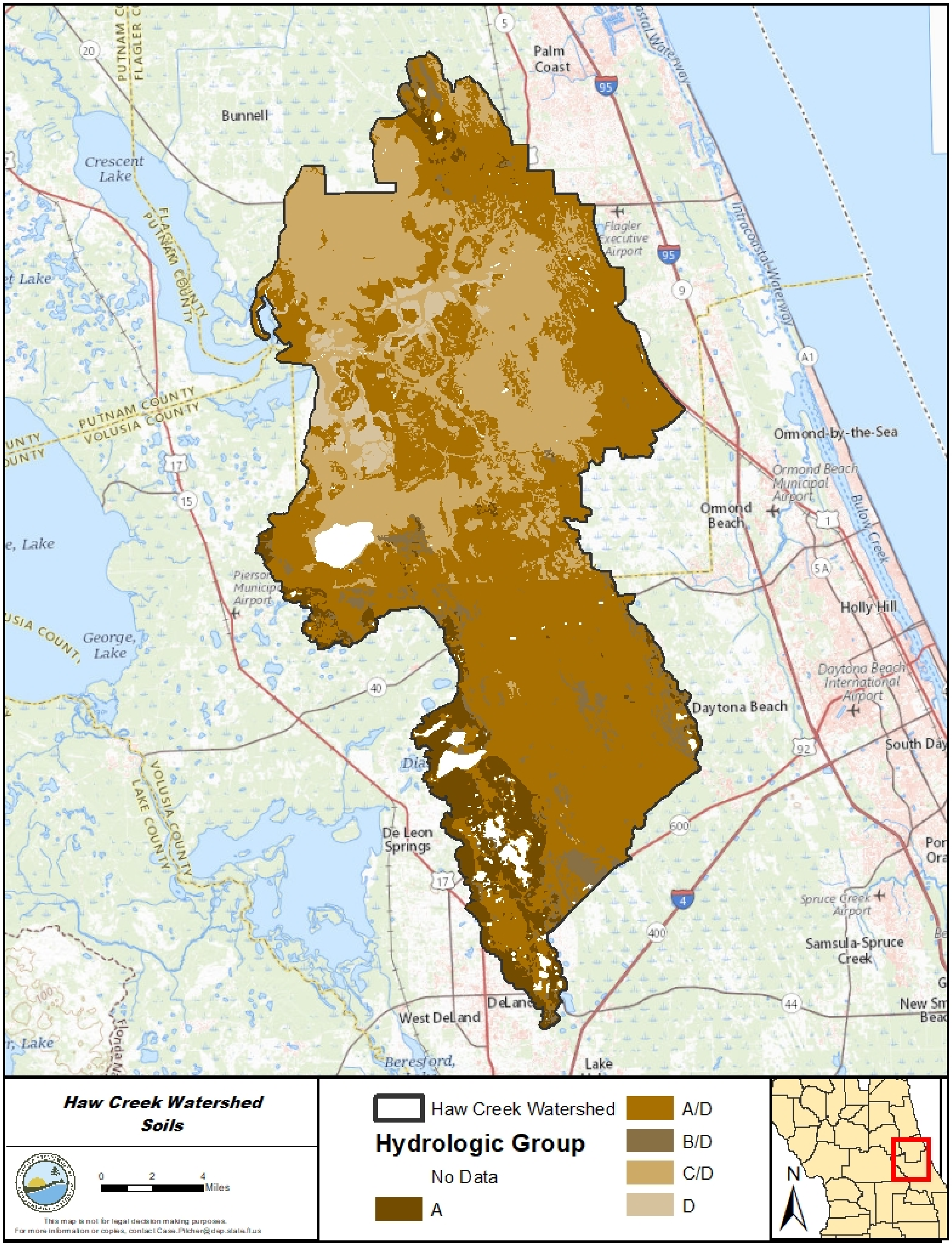


Figure 1.3. Hydrologic soil groups in the Haw Creek Watershed

Chapter 2: Water Quality Assessment and Identification of Pollutants of Concern

2.1 Statutory Requirements and Rulemaking History

Section 303(d) of the federal Clean Water Act (CWA) requires states to submit to the U.S. Environmental Protection Agency (EPA) lists of surface waters that do not meet applicable water quality standards (impaired waters) and establish a TMDL for each pollutant causing the impairment of listed waters on a schedule. DEP has developed such lists, commonly referred to as 303(d) lists, since 1992.

The Florida Watershed Restoration Act (FWRA) (Section 403.067, Florida Statutes [F.S.]) directed DEP to develop, and adopt by rule, a science-based methodology to identify impaired waters. The Environmental Regulation Commission adopted the methodology as Chapter 62-303, F.A.C. (the IWR), in 2001. The rule was amended in 2006, 2007, 2012, 2013, and 2016.

The list of impaired waters in each basin, referred to as the Verified List, is also required by the FWRA (Subsection 403.067[4], F.S.). The state's 303(d) list is amended annually to include basin updates.

2.2 Classification of the Waterbody and Applicable Water Quality Standards

Haw Creek above Crescent Lake is a Class III (fresh) waterbody, with a designated use of fish consumption, recreation, and propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The applicable Class III freshwater stream criterion for DO specifies that no more than 10 % of the daily average DO percent saturation (DOsat) values shall be below 38 % (Subparagraph 62-302.533(1)(a)2., F.A.C.), but also includes a "time-of-day-specific-translation" using the equation in Paragraph 62-303.320(4)(c)., F.A.C.

The DO criterion also includes a natural background provision, which states that if it is determined that the natural background DOsat in the waterbody (including values that are naturally low because of vertical stratification) is less than the applicable criterion stated above, then the applicable criterion shall be 0.1 milligrams per liter (mg/L) below the DO concentration associated with the natural background DOsat level.

2.3 Determination of the Pollutant of Concern

2.3.1 Data Providers

Water quality data used in the development of TMDLs for Haw Creek above Crescent Lake were provided by DEP, St. Johns River Water Management District (SJRWMD), EPA, and Volusia County. **Table 2.1** summarizes the data providers for the waterbody, including corresponding stations and monitoring beginning and ending dates. SJRWMD provided the majority of the data for the assessment. **Figure 2.1** shows the sampling locations.

The individual water quality measurements discussed in this report are available in IWR Run 58 and are available on request.

Table 2.1. Haw Creek above Crescent Lake data providers

Sampling Station	Data Provider	Activity Beginning Date	Activity Ending Date
21FLA 20030385	DEP	1979	2012
21FLA 20030415	DEP	1978	2012
21FLA 20030662	DEP	1992	2012
21FLCEN G2CE0116	DEP	2017	2018
21FLSJWM80186	SJRWMD	2016	2017
21FLSJWMHAW	SJRWMD	1984	2016
21FLSJWMHAWCK	SJRWMD	2015	2017
21FLSJWMLSJ075	SJRWMD	1992	1992
21FLVOL HAW010	Volusia County	1995	1995
11EPALES1206B1	EPA	1973	1974

2.3.2 Information on Verified Impairment

As part of the statewide waterbody assessment process, each of Florida's major river basins is placed into one of five groups. The Lower St. Johns River is a Group 2 basin. These basin groups are evaluated every five years, and each five-year evaluation is assigned a cycle number. For Group 2, assessments were completed in 2004 (Cycle 1), 2009 (Cycle 2), and 2016 (Cycle 3). The data used in each of these assessments were from the seven and a half years prior to the assessment year (**Table 2.2**).

Table 2.2. Group 2 assessment cycle and verified period

Assessment Cycle	Verified Period
Cycle 1	January 1, 1996–June 30, 2003
Cycle 2	January 1, 2001–June 30, 2008
Cycle 3	January 1, 2007–June 30, 2014
Cycle 4	January 1, 2012–June 30, 2019

The Haw Creek above Crescent Lake waterbody segment was included on the Verified List of Impaired Waters for the Lower St. Johns River Basin for DO impairment that was adopted by Secretarial Order in May 2004 for the Cycle 1 assessment and again in May 2009 for the Cycle 2 assessment.

During the Cycle 1 assessment, WBID 2622A was added to the Verified List for low DO based on the finding that DO concentrations in 47 out of 73 samples were lower than the state's DO criterion (5 mg/L) for Class III freshwater. For the Cycle 2 assessment, there were 54 exceedances out of 74 samples. During the Cycle 3 assessment, the waterbody was reassessed using the new DO criterion based on DOsat. **Table 2.3** summarizes the DOsat data used in the Cycle 3 assessment. Nutrients were identified as the causative pollutants for the DO impairment. **Table 2.4** lists the annual geometric mean (AGM) values for chlorophyll *a*, total nitrogen (TN), and total phosphorus (TP) during the 2007–14 verified period for WBID 2622A.

Table 2.3. Summary of DOsat data used in the Cycle 3 assessment (number of samples)

Note: the measurements were assessed using the time of day correction.

Waterbody (WBID)	Total Number of Samples for Verified Period	Number of Samples Below 38 %	Percentage Below 38 %
Haw Creek above Crescent Lake (2622A)	59	34	58

Table 2.4. AGM values for WBID 2622A for the 2007–14 verified period

µg/L = Micrograms per liter
ID = Insufficient data
Note: Values shown in boldface type and shaded are greater than the stream nutrient thresholds (TN = 1.54 mg/L and TP = 0.12 mg/L).

Year	Chlorophyll *a* (µg/L)	TN (mg/L)	TP (mg/L)
2007	7	**2.00**	0.11
2008	11	**1.73**	0.12
2009	4	ID	ID
2010	ID	ID	ID
2011	ID	1.29	ID
2012	14	**1.77**	**0.14**
2013	4	**1.78**	**0.17**
2014	ID	ID	ID

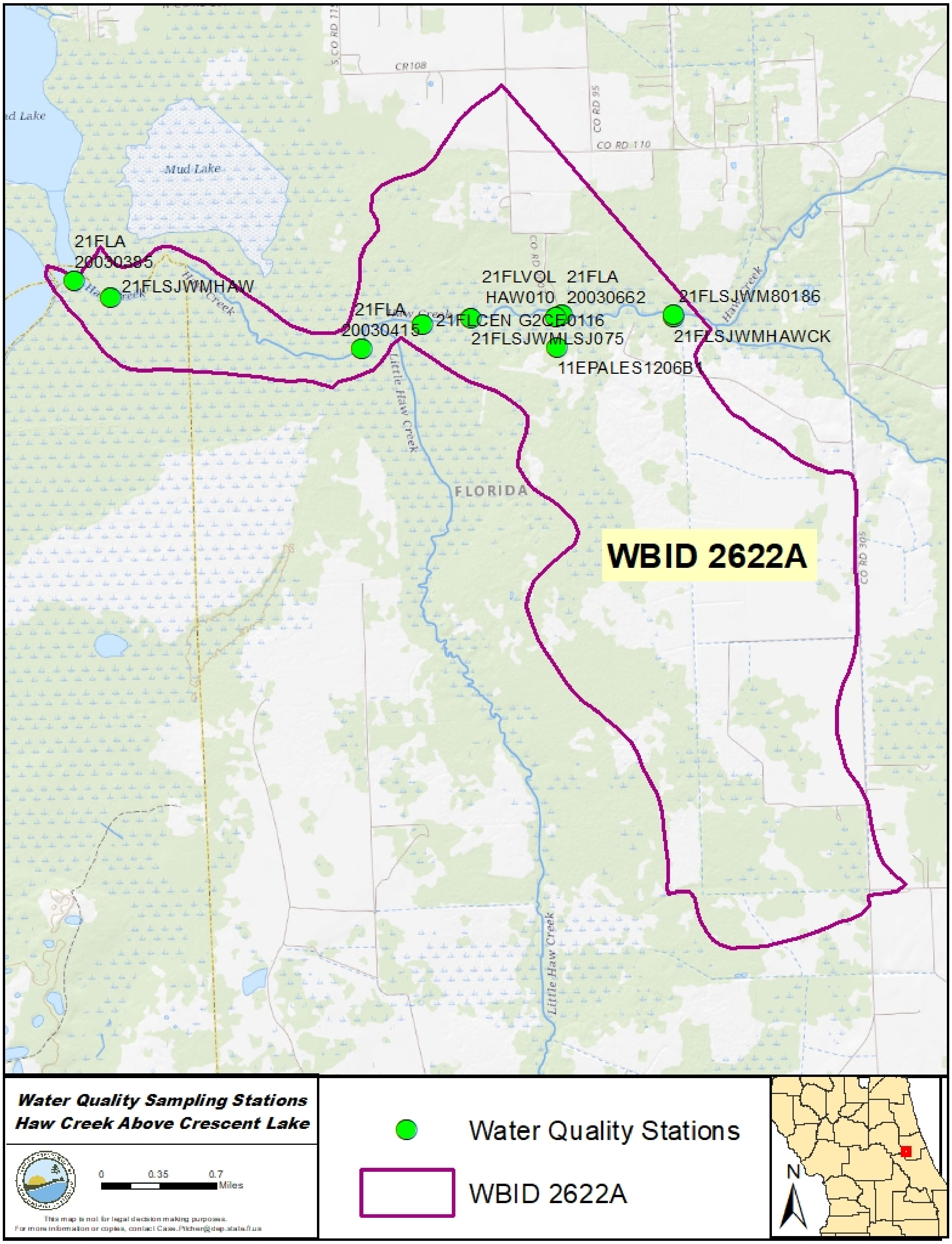
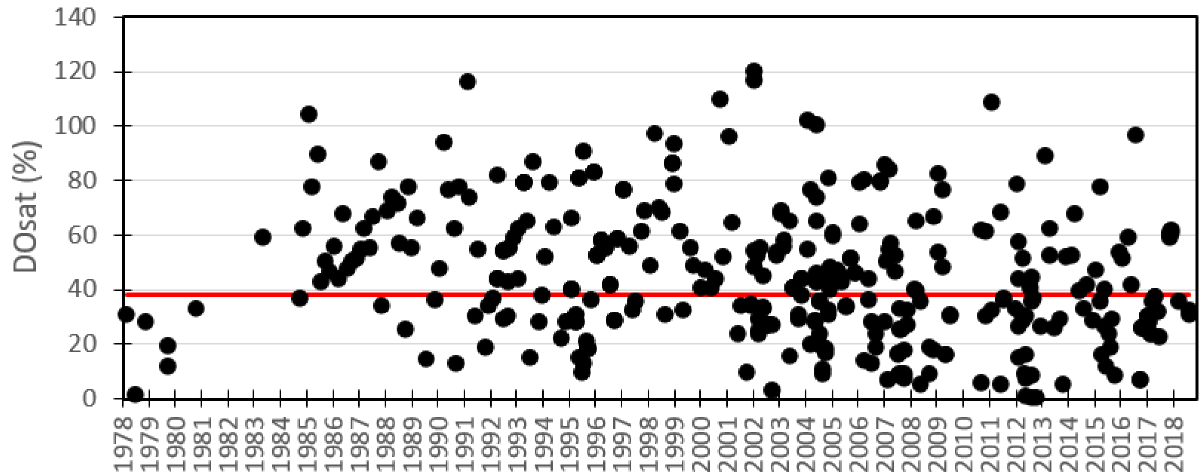


Figure 2.1. Monitoring stations in Haw Creek above Crescent Lake

2.3.3 Historical Variation in Water Quality Variables

For WBID 2622A, water quality data have been collected at the ten sampling stations since 1973 (**Table 2.1** and **Figure 2.1**). **Figures 2.2** through **2.5** show the DOsat, chlorophyll *a*, TN, and TP data collected at all the stations in the waterbody using (A) daily samples and (B) AGMs in the period of record from the IWR Database (IWR Run 58).

(A)



(B)

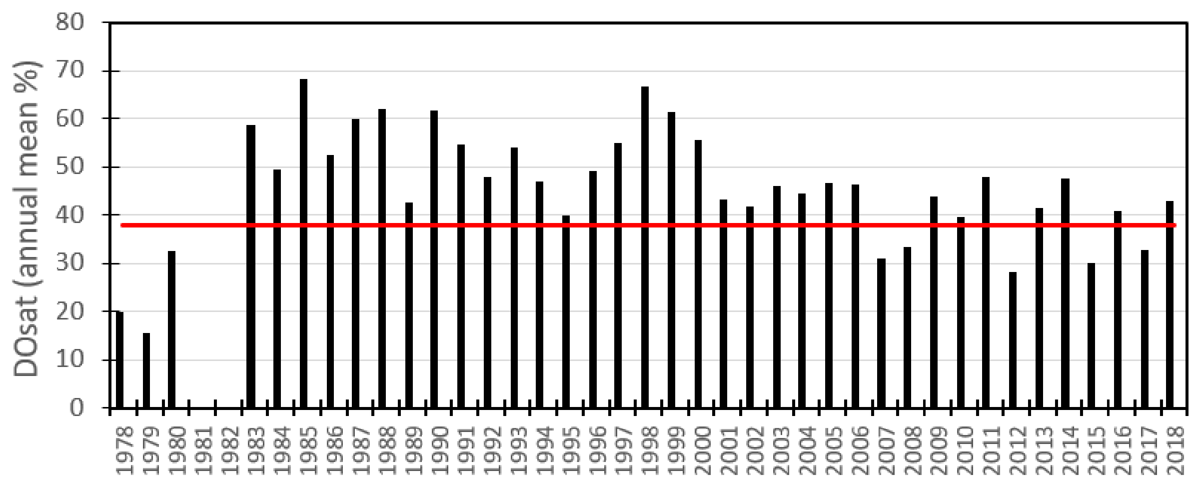
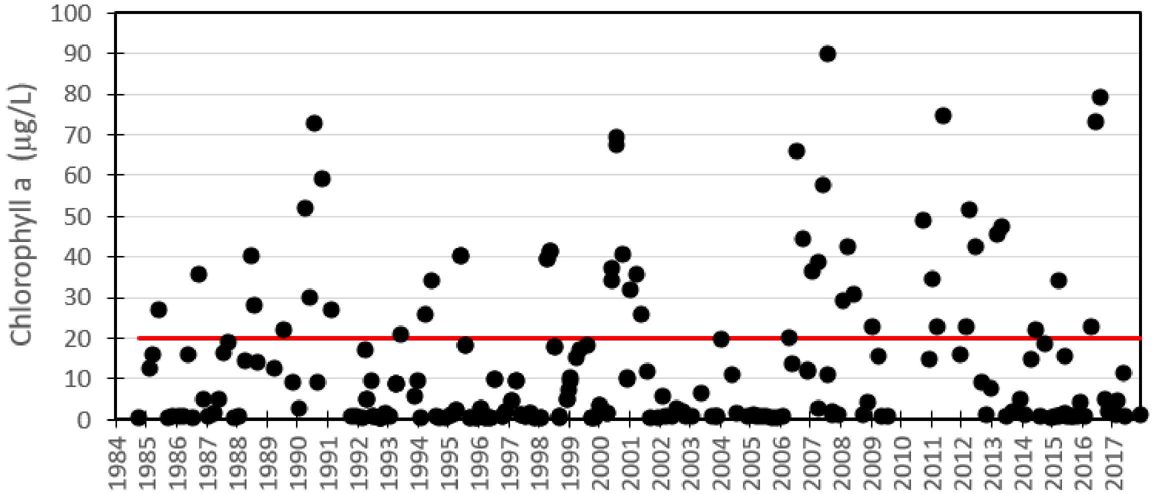


Figure 2.2. DOsat measured in WBID 2622A: (A) sampling dates, (B) annual means in the period of record: red line indicates DOsat criterion (38 %; the line is provided for informational purposes)

(A)



(B)

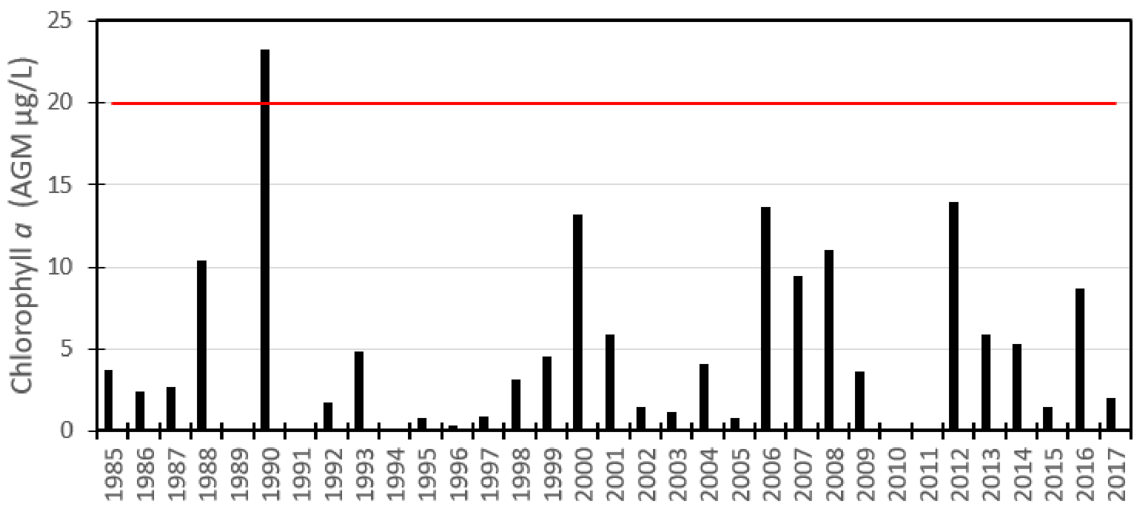
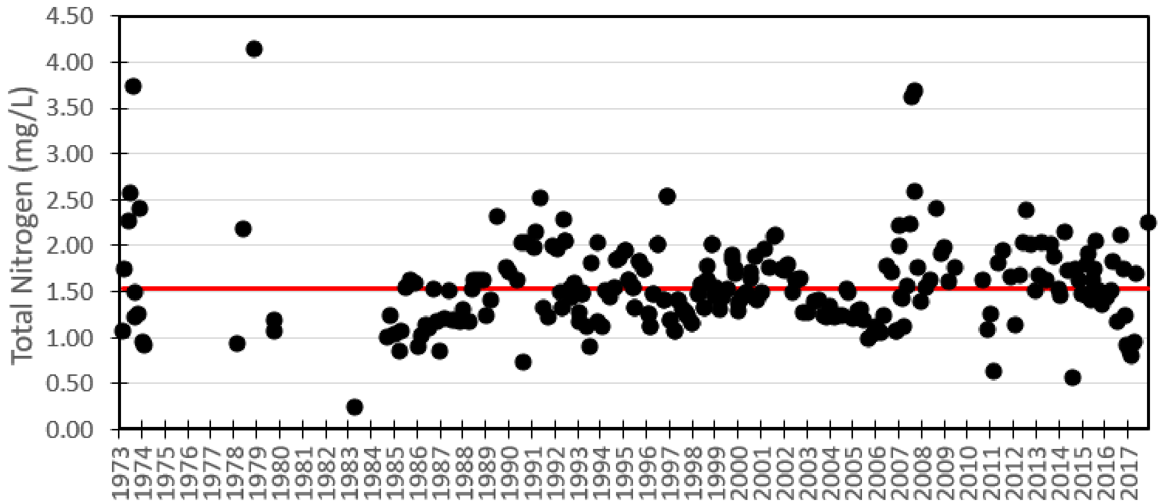


Figure 2.3. Chlorophyll *a* corrected measured in WBID 2622A: (A) sampling dates, (B) AGMs in the period of record: red line indicates chlorophyll *a* threshold (20 µg/L), expressed as an AGM; the line is provided for informational purposes)

(A)



(B)

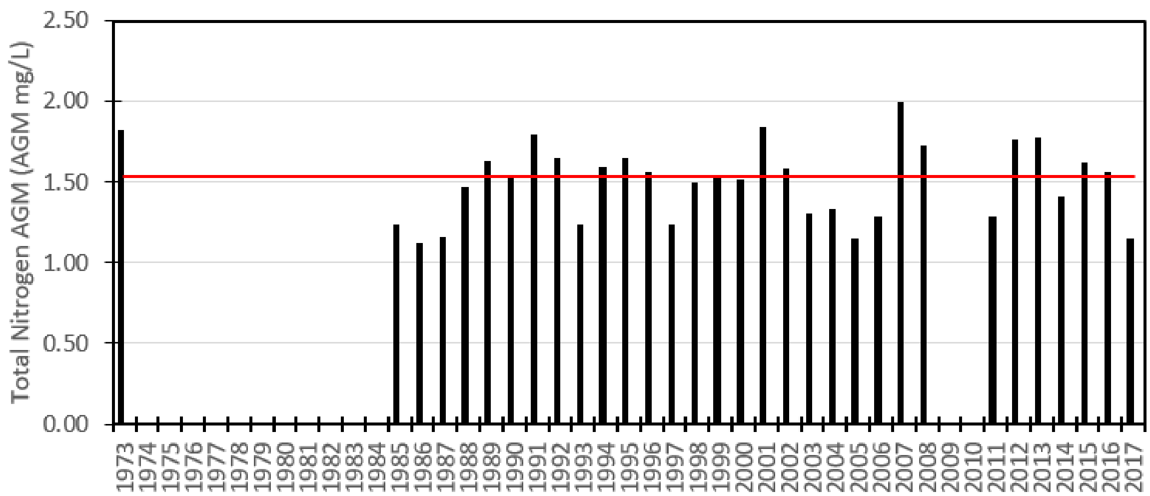


Figure 2.4. TN measured in WBID 2622A: (A) sampling dates, (B) AGMs in the period of record: red line indicates TN threshold (1.54 mg/L, expressed as an AGM; the line is provided for informational purposes)

(A)

(B)

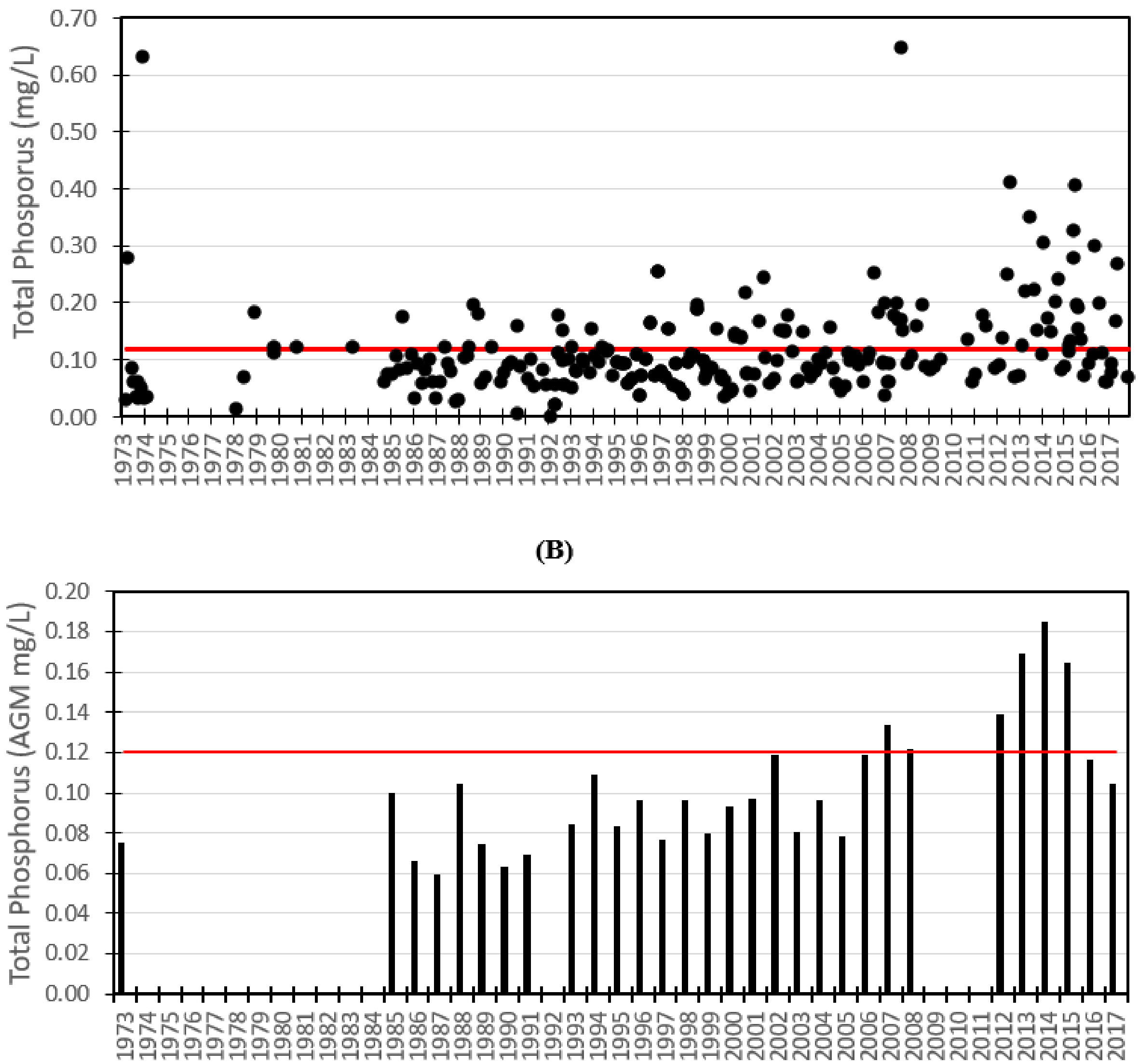


Figure 2.5. TP measured in WBID 2622A: (A) sampling dates, (B) AGMs in the period of record: red line indicates TP threshold (0.12 mg/L, expressed as an AGM; the line is provided for informational purposes)

2.3.4 Seasonal Variation in Water Quality Variables

Seasonally, DOsat levels in summer (June, July, and August) and fall (September, October, and November) were lower than in winter (December, January, and February) and spring (March, April, and May) in Haw Creek above Crescent Lake (**Figure 2.6 [A]**). Low DOsat appears more often in high-temperature conditions, which decrease the solubility of DO in the water. Higher temperature lowers DO solubility and is one of the factors contributing to the low DOsat in Haw Creek.

However, seasonal nutrient concentrations showed opposite trends with DOsat; TN and TP concentrations were higher in summer and fall than in winter and spring (**Figures 2.6 [B]** and **2.6 [C]**). As TMDLs primarily address impairments caused by pollutants, this report focuses on the effect of nutrients on DOsat in Haw Creek. It should be noted that, while temperature and other physical factors could have an important influence on DO concentration, nutrients could also play a significant role because those can directly and indirectly influence the oxygen consumption rate in the water. In cold months, low organismal metabolic rates in addition to low nutrient concentrations—especially the low oxygen consumption rate of bacteria in a heterotrophic ecosystem—could be a major factor in causing the relatively high DO concentration. In contrast, when the temperature increases, higher nutrient concentrations would support a higher oxygen consumption rate by bacteria and result in low DO if the consumption rate were not compensated for by the reaeration rate.

2.4 Downstream Protection

Haw Creek above Crescent Lake discharges directly to Crescent Lake (WBID 2606B). TN and TP target concentrations for Haw Creek above Crescent Lake were matched with those in Crescent Lake (1.16 mg/L for TN and 0.05 mg/L for TP) for downstream protection. These target concentrations were based on the natural background condition. Therefore, nutrient load reductions for Haw Creek will protect the downstream waterbody by decreasing algal biomass (such as *Microcystis* bloom) and will maintain recreational uses (such as fishing and duck hunting).

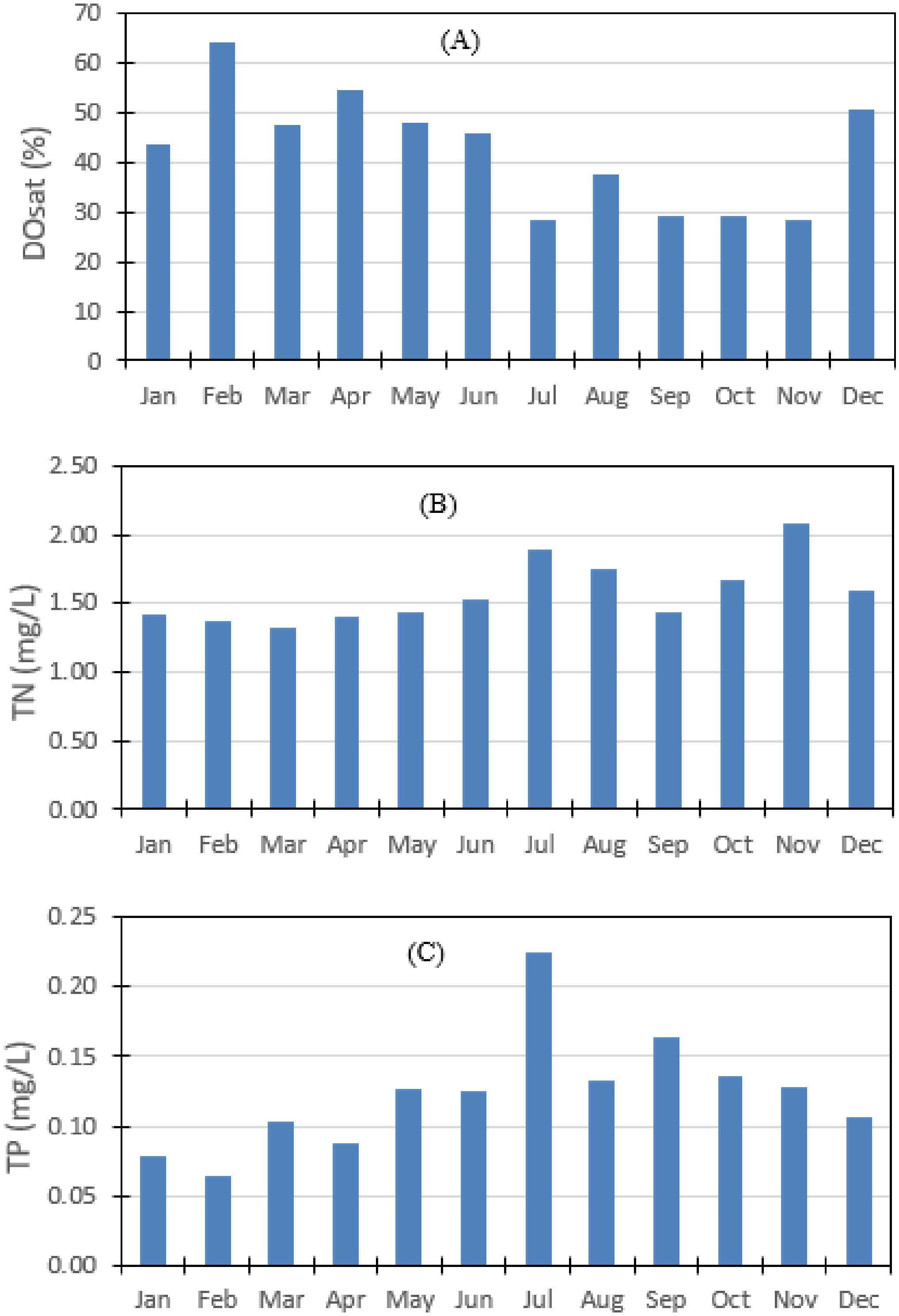


Figure 2.6. Seasonal variation in water quality variation in Haw Creek above Crescent Lake: (A) DOsat, (B) TN, and (C) TP

Chapter 3: Assessment of Sources

3.1 Types of Sources

An important part of the TMDL analysis is the identification of pollutant source categories, source subcategories, or individual sources of the pollutant of concern in the target watershed and the amount of pollutant loading contributed by each of these sources. Sources are broadly classified as either point sources or nonpoint sources. Historically, the term "point sources" has meant discharges to surface waters that typically have a continuous flow via a discernable, confined, and discrete conveyance, such as a pipe. Domestic and industrial wastewater treatment facilities (WWTFs) are examples of traditional point sources. In contrast, the term "nonpoint sources" was used to describe intermittent, rainfall-driven, diffuse sources of pollution associated with everyday human activities, including runoff from urban land uses, agriculture, silviculture, and mining; discharges from septic systems; and atmospheric deposition.

However, the 1987 amendments to the CWA redefined certain nonpoint sources of pollution as point sources subject to regulation under the EPA's National Pollutant Discharge Elimination System (NPDES) Program. These nonpoint sources included certain urban stormwater discharges, such as those from local government master drainage systems, construction sites over five acres, and a wide variety of industries (see **Appendix A** for background information on the federal and state stormwater programs).

To be consistent with CWA definitions, the term "point source" is used to describe traditional point sources (such as domestic and industrial wastewater discharges) and stormwater systems requiring an NPDES stormwater permit when allocating pollutant load reductions required by a TMDL (see **Section 5.1** on **Expression and Allocation of the TMDL**). However, the methodologies used to estimate nonpoint source loads do not distinguish between NPDES and non-NPDES stormwater discharges, and as such, this source assessment section does not make any distinction between the two types of stormwater.

3.2 Point Sources

3.2.1 Wastewater Point Sources

There are one permitted domestic wastewater facility and three industrial wastewater facilities in the Haw Creek Watershed (**Figure 3.1**). The domestic wastewater facility, the City of Bunnell WWTF (**Table 3.1**), treats wastewater from the town and therefore has low outlet flow of 0.3 million gallons per day (mgd). The facility discharges water to Haw Creek through Black Branch. All industrial wastewater discharges (**Table 3.2**) are from concrete batch mixers and therefore are not expected to contribute significant amounts of nutrients into Haw Creek given the requirements for best management practices (BMPs) contained in the generic permit language (Paragraph 62-621.300[2][a], F.A.C.). The industrial wastewater sources are excluded from load reductions because their permits and activities result in minimal nutrient loadings.

Table 3.1. Domestic wastewater facility in the Haw Creek Watershed

Facility ID	Name	NPDES	Facility Type	Treatment Process Summary	Permitted Capacity (mgd)	Domestic Waste Class
FL0020907	City of Bunnell WWTF	Yes	Domestic Wastewater Treatment Plant (WWTP)	Activated Sludge Treatment Plant with Effluent to Polishing Pond	0.3	IIC

Table 3.2. Industrial wastewater facilities in the Haw Creek Watershed

Facility ID	Name	NPDES	Major/Minor Discharge	Facility Type	City	State	Ownership Type
FLG110625	Argos Ready Mix Bunnell Terminal Concrete Batch Plant (CBP)	Yes	Minor	Concrete Batch General Permit (GP)	Bunnell	FL	Private
FLG110637	Cemex LLC North Bunnell CBP	Yes	Minor	Concrete Batch GP	Bunnell	FL	Private
FLG110867	Titan Florida LLC Bunnell Ready Mix	Yes	Minor	Concrete Batch GP	Bunnell	FL	Private

3.2.2 Municipal Separate Storm Sewer System (MS4) Permittees

There are 5 MS4 point source discharge permits in the Haw Creek Watershed (**Figure 3.2**): City of Bunnell Phase II (FLR04E143), City of Palm Coast Phase II (FLR04E145), City of DeLand Phase II (FLR04E078), City of Daytona Beach Phase II (FLR04E011), and Volusia County Phase II-C (FLR04E033). Loadings from these sources are currently unknown because the quality of water discharged from these sources has not been tested, and the true extent of the stormwater systems is unknown.

For more information on MS4s in the watershed, send an email to: NPDES-stormwater@dep.state.fl.us. **Table 3.3** lists the permittees and their MS4 permit numbers.

Table 3.3. NPDES MS4 permittees with jurisdiction in the Haw Creek Watershed

Permittee	Permit ID	Phase	County
City of Bunnell	FLR04E143	II	Flagler
City of Palm Coast	FLR04E145	II	Flagler
Volusia County	FLR04E033	II-C	Volusia
City of Daytona Beach	FLR04E011	II	Volusia
City of Deland	FLR04E078	II	Volusia

3.3 Nonpoint Sources

The watershed supplying Haw Creek is primarily rural, with few point source and stormwater areas contributing to nutrient loading. Therefore, the major source of nutrient loading to Haw Creek is distributed nonpoint source land uses. Based on SJRWMD 2009 land use coverage, agriculture and silviculture are the most common nonnatural land uses in the watershed (**Figure 3.3**; **Table 3.4**).

Silviculture likely has a relatively low loading rate and may already be implementing BMPs if these operations are certified by the Sustainable Forestry Institute or Forest Stewardship Council. Agricultural operations contribute significantly to the nutrient loads reaching Haw Creek. The loadings depend on hydrology and on the type and extent of BMPs currently being used. Because point sources are unlikely to be the main contributor to nutrient loading in the creek, the major nutrient contributors are probably nonpoint sources, including surface runoff based on land use, onsite sewage treatment and disposal systems (OSTDS), and MS4s.

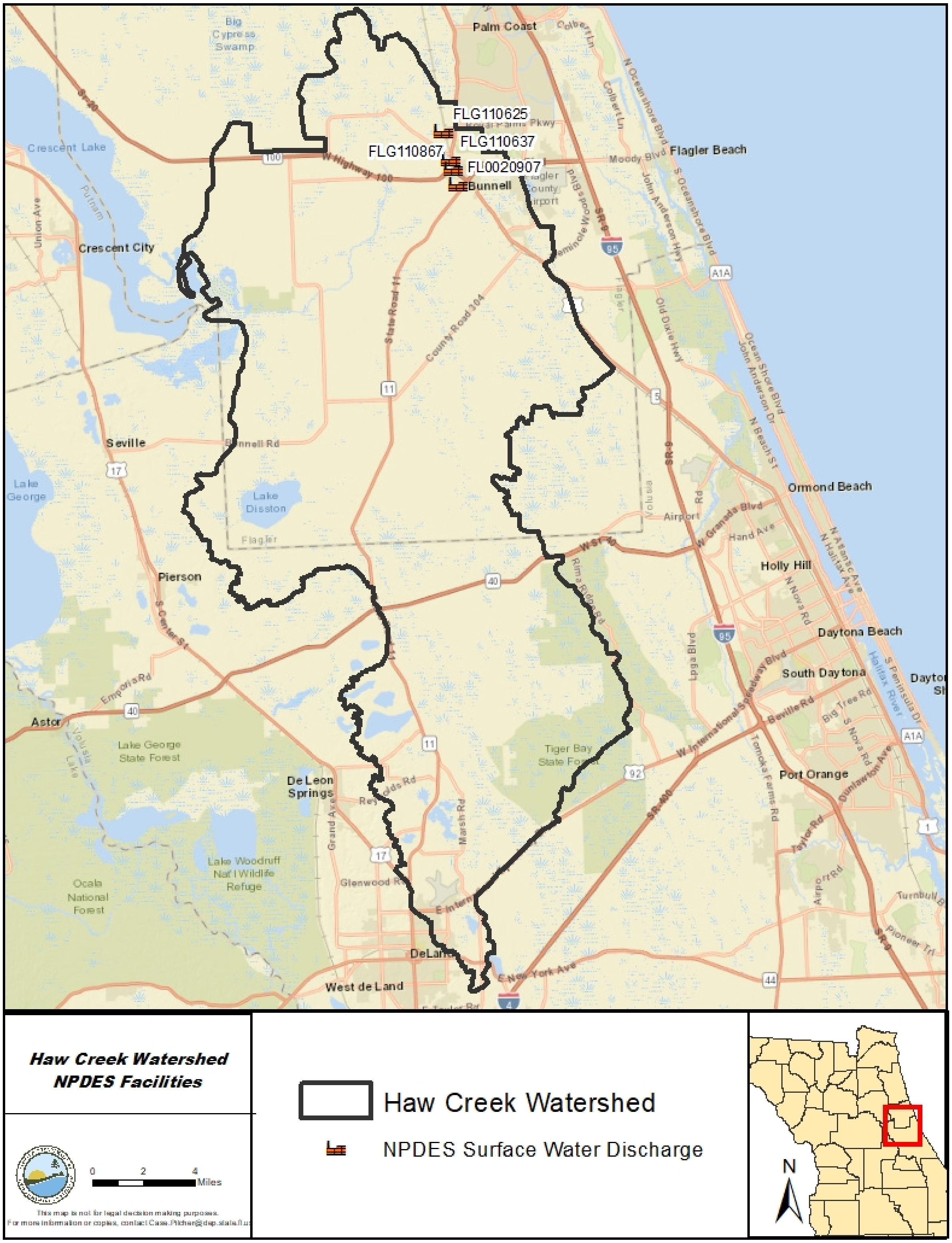


Figure 3.1. Location of wastewater facilities in the Haw Creek Watershed

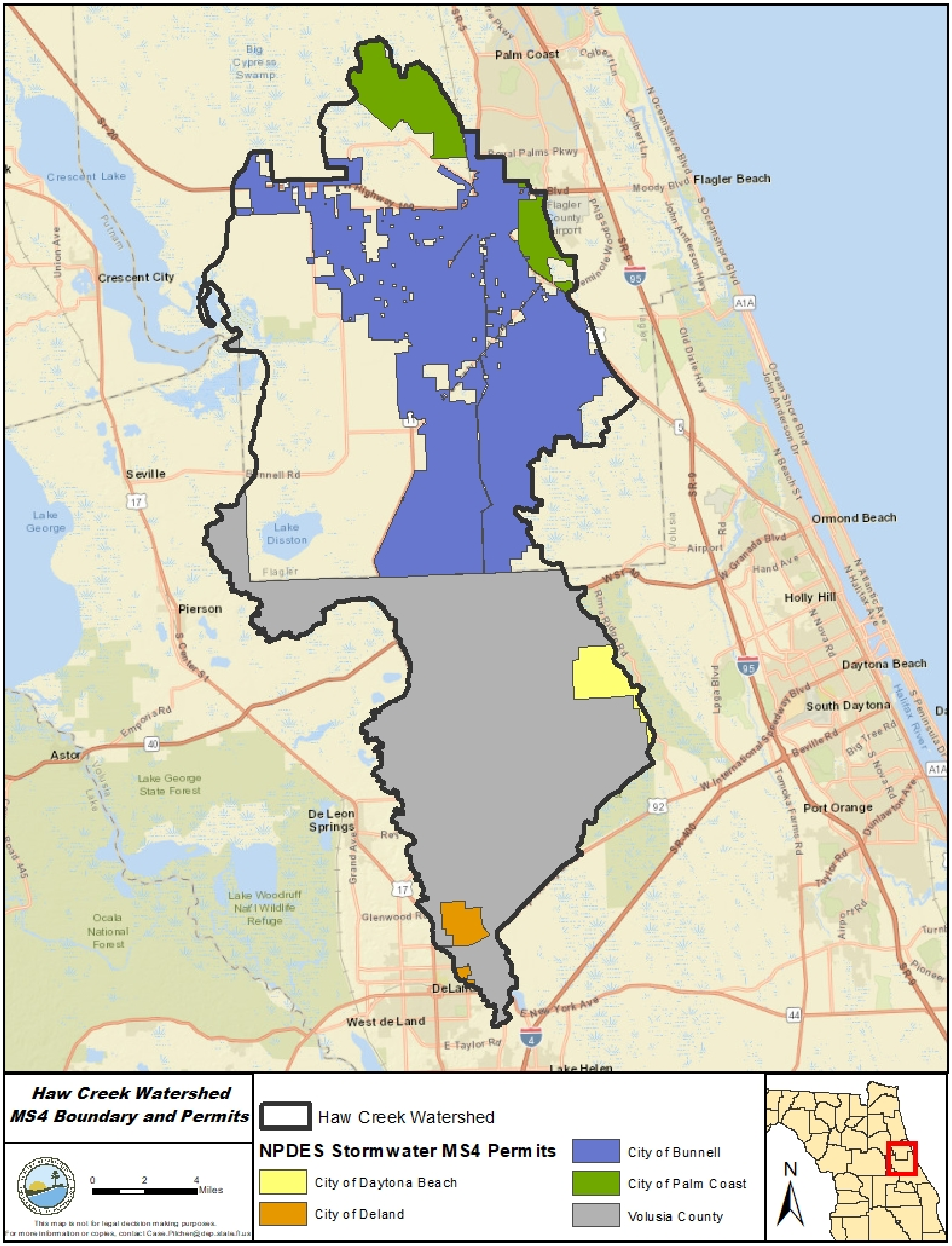


Figure 3.2. Location of MS4 permittees in the Haw Creek Watershed

3.3.1 Land Uses

Land use is one of the most important factors in determining nutrient loadings from the Haw Creek Watershed. Nutrients can be flushed into a receiving water through surface runoff and stormwater conveyance systems during stormwater events. Both human land use areas and natural land areas generate nutrients. However, human land uses typically generate more nutrient loads per unit of land surface area than natural lands can produce. **Table 3.4** lists land uses in the watershed, and **Figure 3.3** shows the information graphically.

Land use information for the Haw Creek Watershed area was obtained from the 2009 SJRWMD Land Use Database's geographic information system (GIS) coverage based on the HSPF model. **Table 3.4** and **Figure 3.3** show the breakdown of the various land use categories in the Haw Creek Watershed. Upland forest and wetlands are the predominant land uses, covering 41 % and 32 % of the watershed, respectively. Agriculture and tree crops follow, with 13 %. Urban land uses—including low-, medium-, and high-density residential and industrial and commercial—account for 8 % of all land use in the watershed.

Table 3.4. SJRWMD land use in the Haw Creek Watershed, 2009

Land Use Classification	Acres	% of Watershed
Low-Density Residential	9,977	5
Medium-Density Residential	2,021	1
High-Density Residential	339	0
Industrial and Commercial	4,267	2
Mining	101	0
Open and Barren Land	784	0
Pasture	16,775	8
Agriculture General	11,204	5
Agriculture Tree Crops	923	0
Rangeland	7,795	4
Upland Forest	89,612	41
Water	4,866	2
Wetlands	70,265	32
Total	**218,929**	**100**

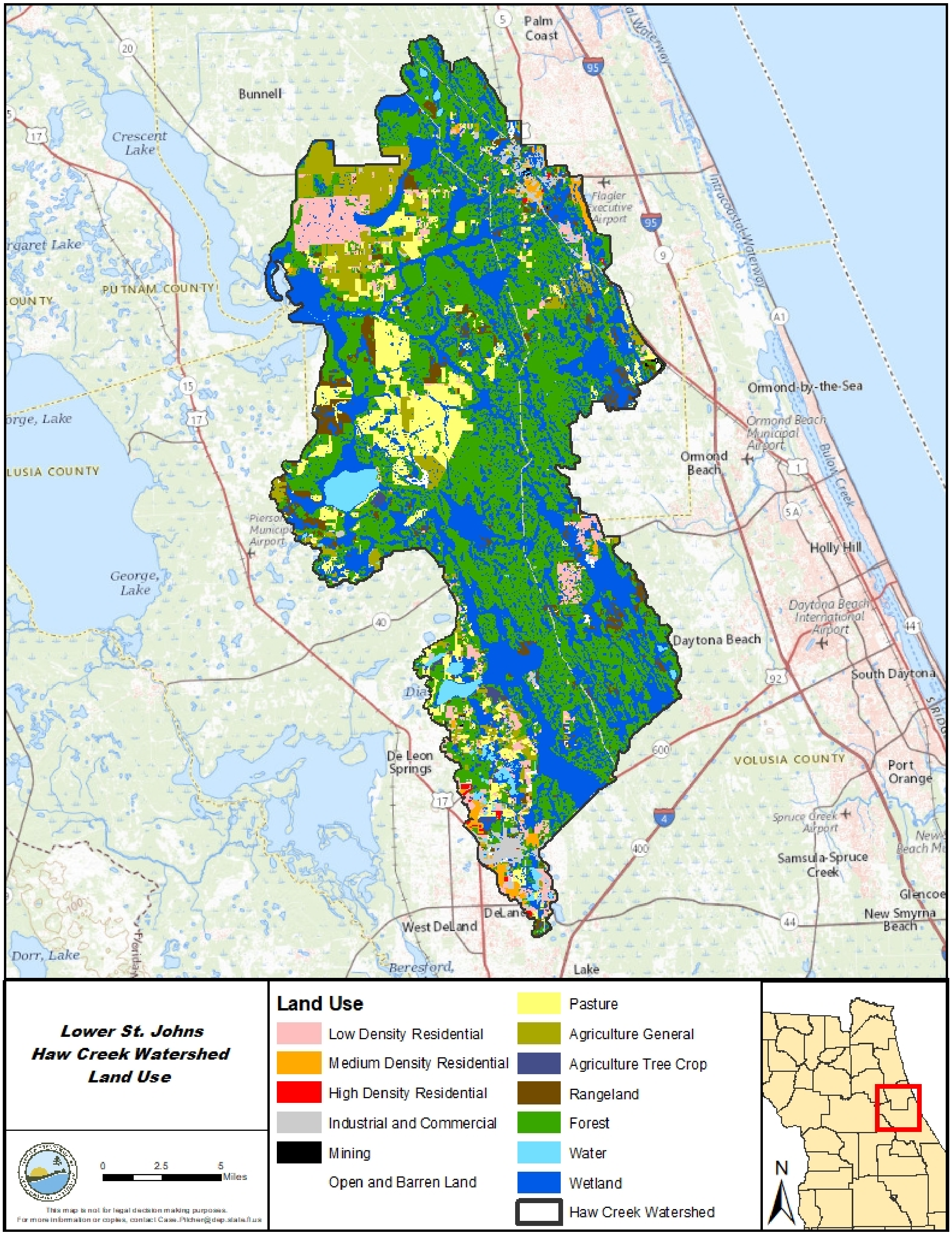


Figure 3.3. Land use in the Haw Creek Watershed, 2009

3.3.2 OSTDS

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

The Florida Department of Health (FDOH) maintains a list of septic tanks by county. The Flagler and Volusia Counties 2018 Database was used to determine the number of septic tanks in the Haw Creek Watershed. There are 5,925 known septic tanks in the watershed. **Figure 3.4** shows the OSTDS locations in the watershed.

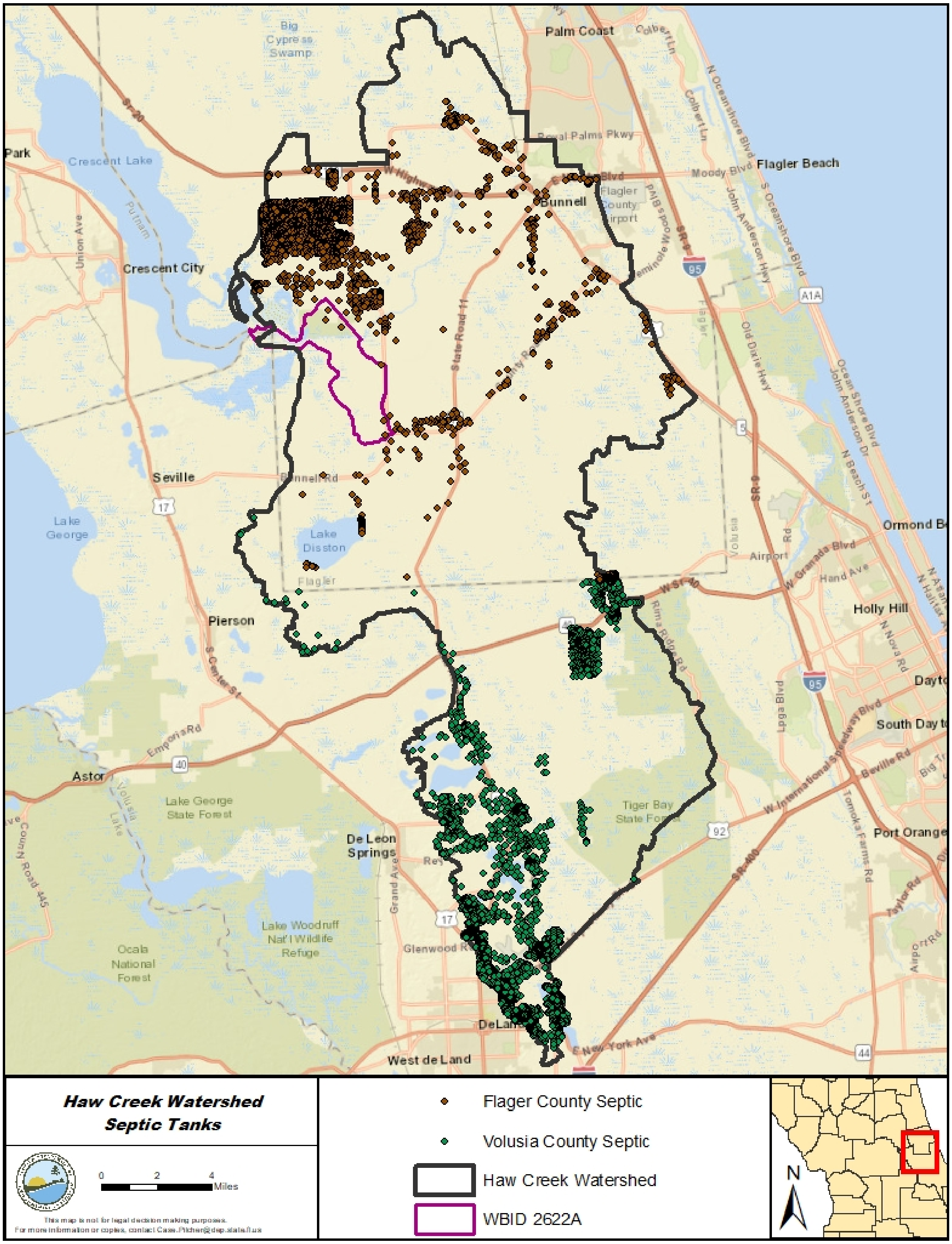


Figure 3.4. OSTDS in the Haw Creek Watershed

3.4 Estimating Water Flow from the Haw Creek Watershed Using the HSPF Model

To simulate hydrology in the Haw Creek Watershed, the HSPF Model was used. The model uses a series of algorithms to simulate hydrologic processes and water quality. Continuous rainfall and other meteorological records are used to simulate land surface processes (e.g., evaporation, water withdrawals, irrigation, diversion, wastewater discharges, infiltration, and active and deep groundwater reservoir storage), and the runoff and associated water quality are then integrated with instream hydraulic and sediment-chemical interactions (Bicknell et al. 2014).

The model is capable of simulating the hydrologic and associated water quality processes on pervious and impervious land surfaces and in streams and well-mixed impoundments, and it can simulate one or more pervious or impervious unit areas discharging into one or more reaches. The HSPF Model simulates watershed hydrology and nonpoint source loads for organic matter, sediments, and nutrients in a watershed network of delineated subbasins.

The model was developed and calibrated only for hydrology and not for water quality (modeling period from 2004 to 2015) by the U.S. Army Corps of Engineers (USACE) to assist in evaluating salinity for the Jacksonville Harbor Navigation Project (Taylor Engineering Inc. 2017). In the project, SJRWMD and USACE applied HSPF to develop a comprehensive hydrologic model of the entire St. Johns River Watershed. However, DEP used only the simulation of the Crescent Lake Subwatershed for the development of these TMDLs. The five reaches belong to the subwatershed (**Figure 3.5**), and only three of them (3A1, 3A2, and 3A3) receive water from the Haw Creek Watershed in the model.

To calibrate the modeled hydrology, model outputs were compared with measured data from two gauging stations operated by SJRWMD. **Figure 3.6** shows the location of the gauging stations—SJRWMD 08711974 in Little Haw Creek and SJRWMD 08701972 in Middle Haw Creek—used in the calibration of the HSPF Model. Plots were created to compare the observed flows with the model predictions for total daily flows (**Figures 3.7** and **3.8**). Various goodness-of-fit statistics were calculated, including correlation coefficients, coefficient of determination R^2, and Nash-Sutcliffe model efficiency coefficients. The modeling report (Taylor Engineering Inc. 2017) describes the calculated statistics. DEP also ran the model and confirmed the calibration. The modeling report (Taylor Engineering Inc. 2017) also provides additional details about the HSPF Model in the Crescent Lake Subwatershed.

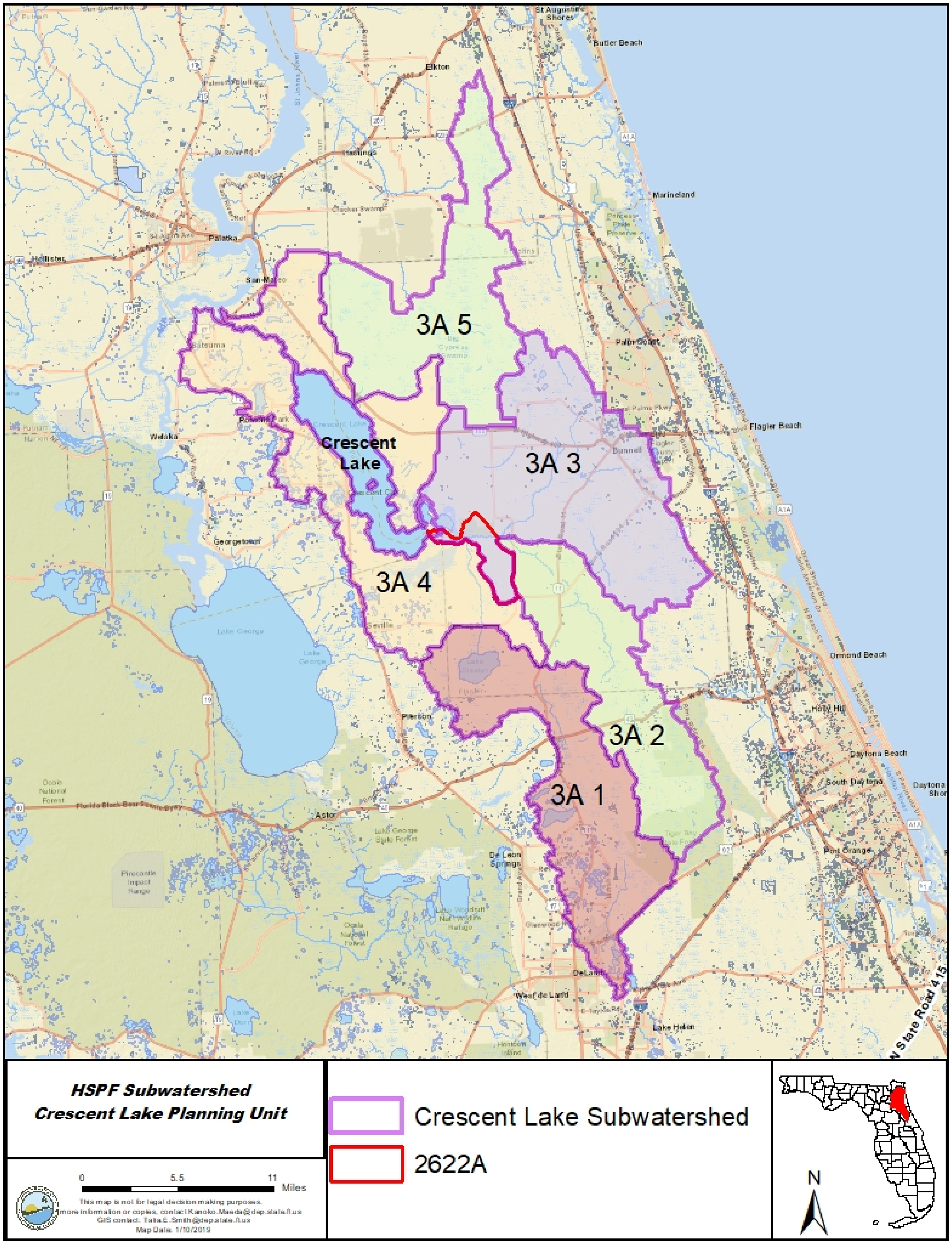


Figure 3.5. Crescent Lake Subwatershed in the HSPF Model

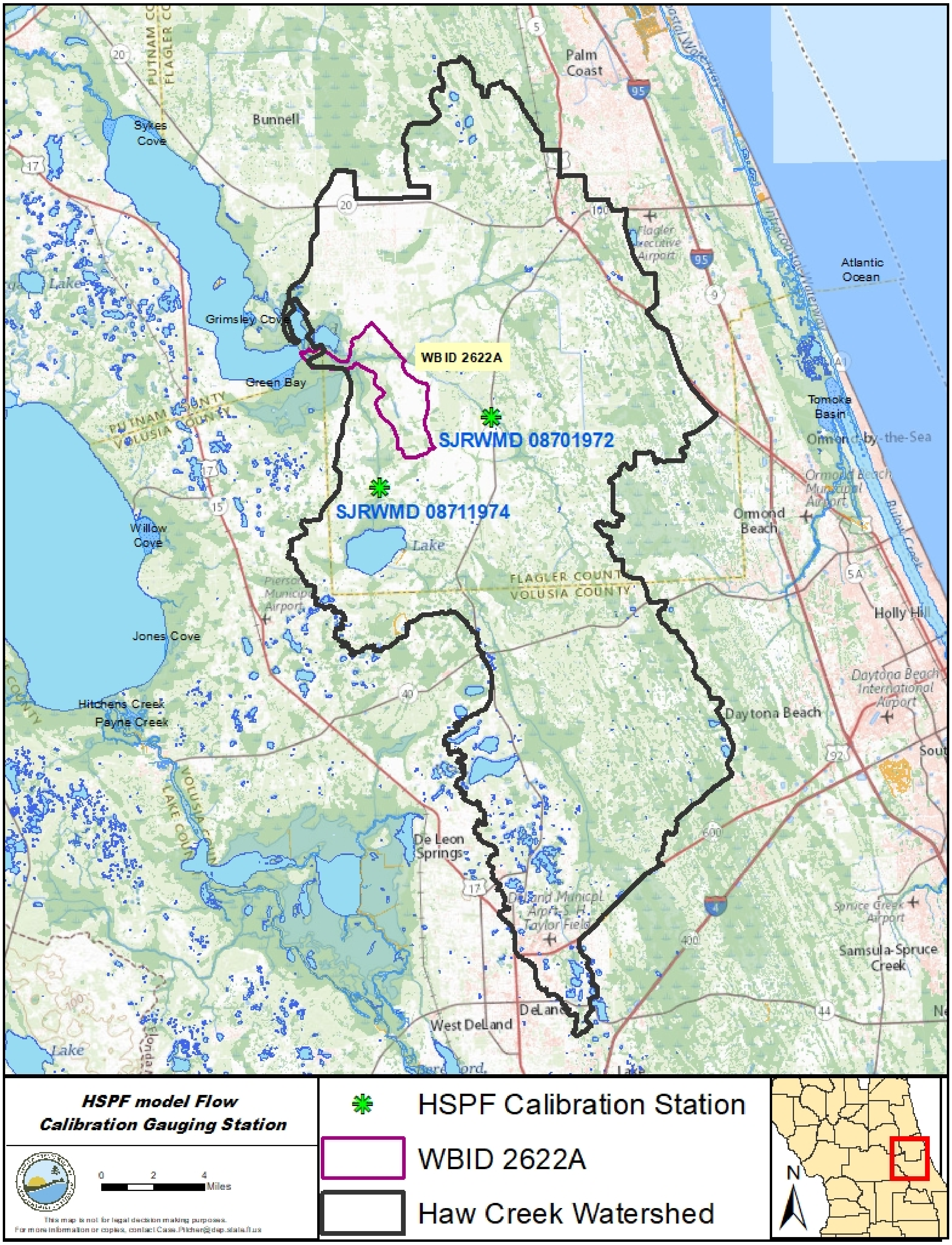


Figure 3.6. Location of HSPF hydrology calibration stations

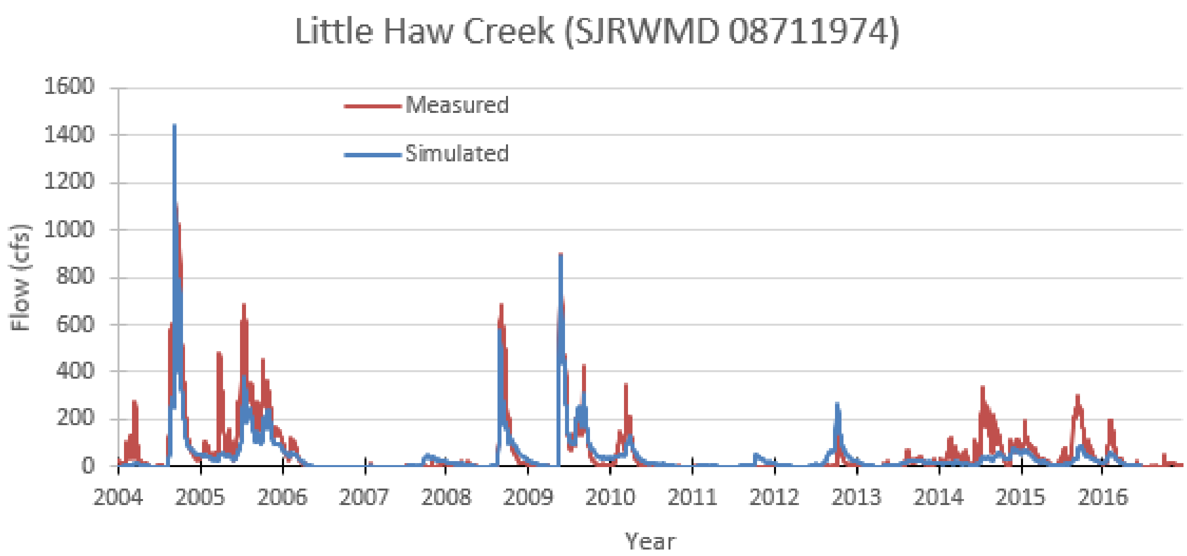


Figure 3.7. Flow time series simulation and measured (SJRWMD 08711974) data for Little Haw Creek

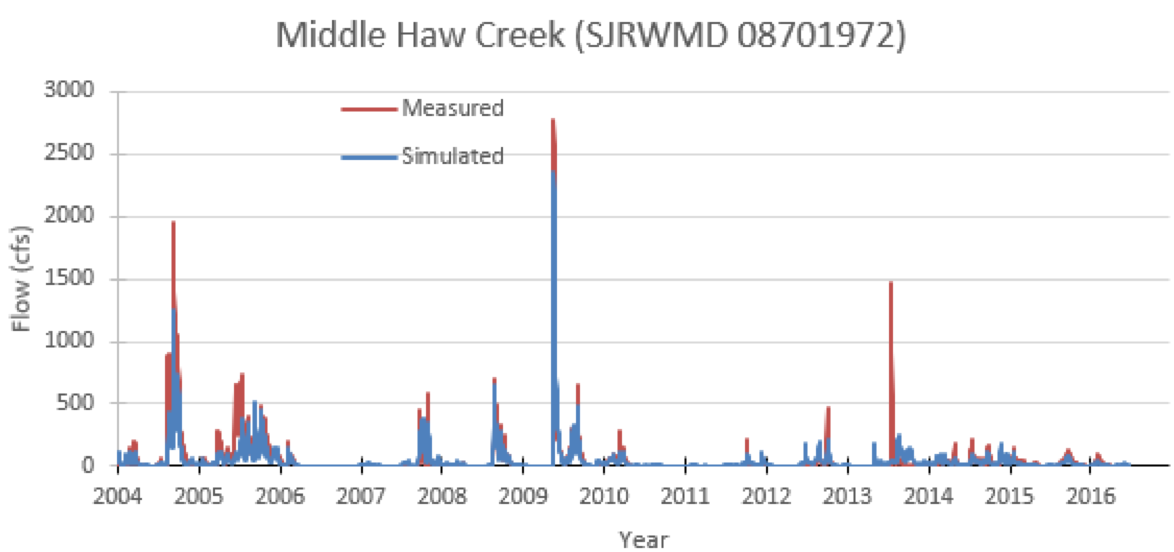


Figure 3.8. Flow time series simulation and measured (SJRWMD 08701972) data for Middle Haw Creek

Chapter 4: Determination of Assimilative Capacity

4.1 Determination of Loading Capacity

The goal of this TMDL analysis is to determine the assimilative capacity of Haw Creek above Crescent Lake and to identify the maximum allowable TN and TP loadings from the watershed, so that the waterbody will meet the TMDL targets and thus maintain its function and designated uses as Class III waters. Depressed DO caused by nutrient enrichment, and the resulting problems related to eutrophication, tend to be widespread and are frequently manifested far (in both time and space) from their sources. Addressing low DO tied to eutrophication involves relating water quality and biological effects such as photosynthesis, decomposition, and nutrient recycling as acted on by environmental factors (rainfall, point source discharge, etc.) to the timing and magnitude of constituent loads supplied from various categories of pollution sources.

DO in ambient waters can also be controlled by many other factors, including DO solubility, which is controlled by temperature. DO enrichment processes are influenced by reaeration, which is controlled by flow velocity and the photosynthesis of phytoplankton, periphyton, and other aquatic plants. DO consumption occurs from the oxidation of some reductants such as ammonia and metals, respiration by aquatic organisms, and the degradation of biochemical oxygen demand (BOD, organic materials) in the water column and sediment. In Haw Creek, BOD concentration was not high (average: 2.0 mg/L and median 2.0 mg/L) in the period of record (**Appendix B-1**). Currently, Florida does not use BOD as a causative pollutant to list for DO impairment anymore, but previously, the screening value was 2.0 mg/L for streams. A regression analysis showed that BOD reduction would not improve dissolved oxygen (**Appendix B-1**).

DOsat may be reduced by contributions of water that are naturally low in DO from wetlands and groundwater input. When tested wetland effects on DOsat using the water-color parameter, it showed negative relationship ($p < 0.0005$, $R^2 = 0.05$) (**Appendix B-2**). This result indicates that the low DO in Haw Creek would be partly originated from the wetlands such as cypress swamps.

4.2 Water Quality Target Setting

4.2.1 Relationships Between DOsat and Nutrients in Haw Creek above Crescent Lake

Nutrients were identified as causative pollutants for DO impairment in Haw Creek above Crescent Lake. Therefore, regression analyses were performed to see the relationships between DOsat versus TN and TP (**Figures 4.1** and **4.2**). AGMs for TN and TP and annual means for DOsat (from 1985 to 2017) were used for the analyses. Although these relationships are statistically significant ($p < 0.05$), the R square values are relatively low: 0.17 for TN and 0.28 for TP. When sampling date data (from 1978 to 2017, not normally distributed and square root-transformed) were used for the regression (**Figures 4.3** and **4.4**), the R square values were even lower—0.04 for TN and 0.05 for TP—although the relationships are still statistically significant ($p < 0.05$).

The potential targets calculated by the regression equations were 2.01 mg/L for TN and 0.16 mg/L for TP, respectively, when using the AGM for nutrients and the annual mean for DOsat (**Figures 4.1** and **4.2**). When data were used from all sampling dates for nutrients and DOsat, the potential targets were 2.52 mg/L for TN and 0.24 mg/L for TP, respectively (**Figures 4.3** and **4.4**). Although there are statistically significant relationships (i.e., measure and predictable) between DOsat and nutrient concentrations in Haw Creek above Crescent Lake, the site-specific numeric interpretations of the narrative nutrient criteria were not pursued in this TMDL development for two reasons. First, the low DOsat levels in Haw Creek are not causing biologically impairment; therefore, the nutrient TMDL only addresses paragraph 62-302.530(48)(a), F.A.C., and not imbalances of flora or fauna. Second, the potential targets from the regressions will not protect the downstream water, which is Crescent Lake. Based on the TMDL report (DEP 2017), the nutrient target concentrations for Crescent Lake are 1.16 mg/L for TN and 0.05 mg/L for TP, respectively, to achieve the chlorophyll *a* criterion of 15 µg/L as an AGM not to be exceeded more than once in any consecutive 3-year period.

Because of these two reasons, the correlation between DO and nutrients established in this analysis is not used for quantitative purposes to establish the TN and TP targets. Instead, it is used qualitatively to show the general negative correlation between DOsat and nutrients in Haw Creek. This suggests that by reducing the TN and TP concentrations in the creek's waters, DOsat in the water will improve.

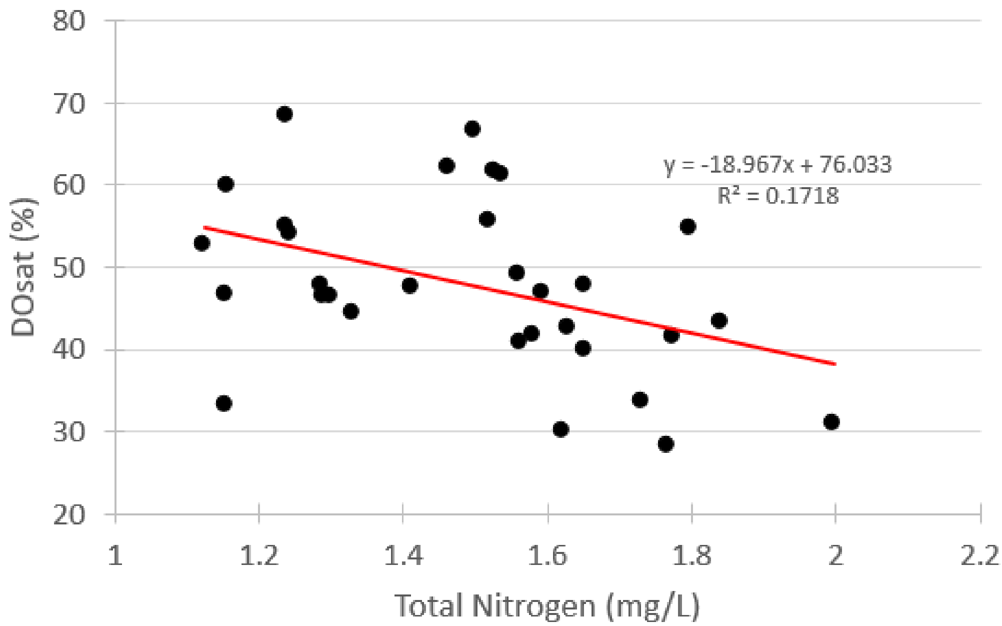


Figure 4.1. Relationship between DOsat (annual mean) and TN concentration (AGM), 1985–2017

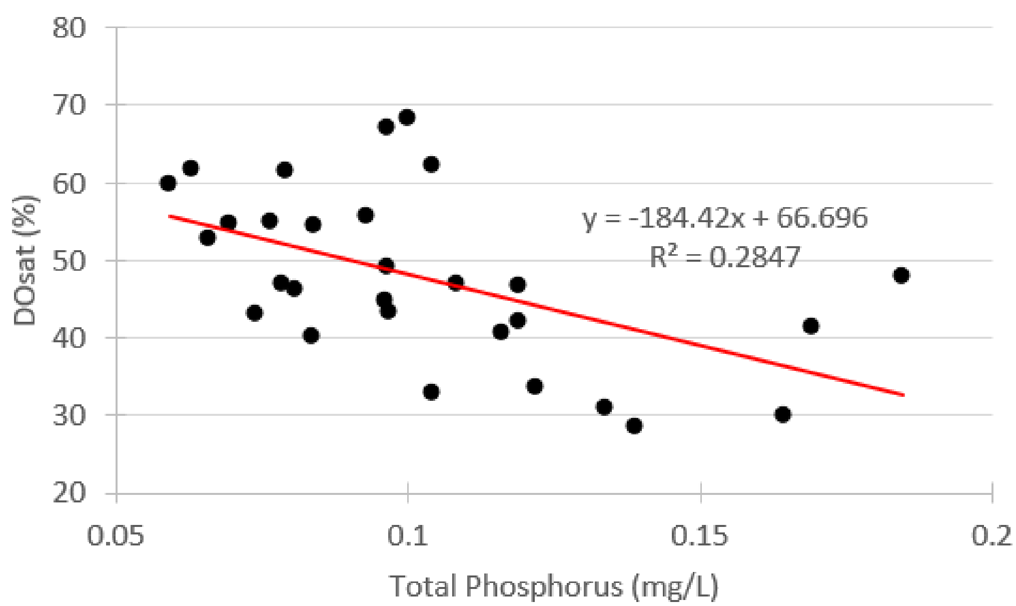


Figure 4.2. Relationship between DOsat (annual mean) and TP concentration (AGM), 1985–2017

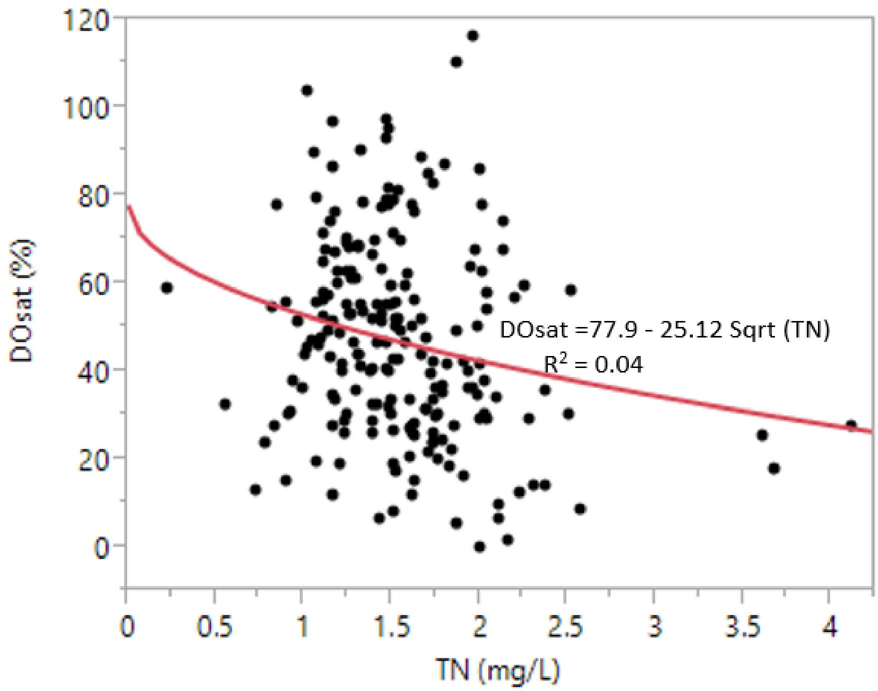


Figure 4.3. Relationship between DOsat (sampling dates) and TN concentration (sampling dates), 1978–2017

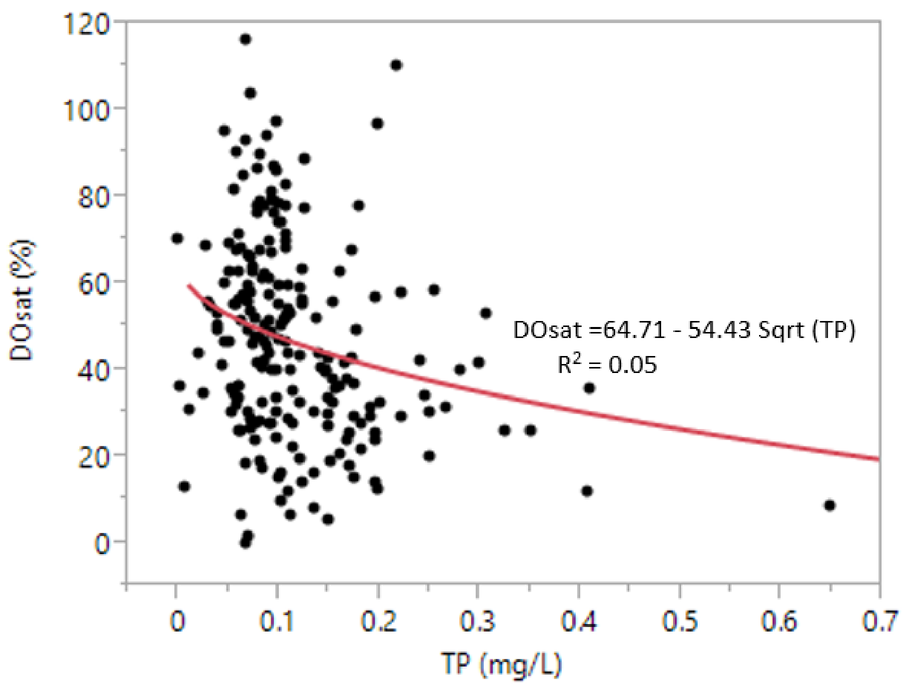


Figure 4.4. Relationship between DOsat (sampling dates) and TP concentration (sampling dates), 1978–2017

4.2.2 Nutrient Target Selection

For the reasons described in **Section 4.2.1**, TN and TP target concentrations for Haw Creek were determined based on downstream protection (Crescent Lake): 1.16 mg/L for TN and 0.05 mg/L for TP, respectively (DEP 2017). The nutrient target concentrations for Crescent Lake were based on the natural background condition which inherently results in natural dissolved oxygen condition. Therefore, the target concentrations will improve DOsat in Haw Creek.

4.3 Critical Conditions and Seasonal Variation

Assimilative capacity should be related to some specific hydrometeorological condition during a selected period or to some range of expected variation in these conditions. The estimated assimilative capacity in this report is based on annual conditions, rather than critical/seasonal conditions, because the net change in overall primary productivity in the waterbody segments is a critical factor and is better addressed on an annual basis. Seasonal variability is captured in the model, which is calibrated to a range of meteorological conditions as shown in **Section 3.4** through the hydrology calibration. The model calibrates well against observed data. Furthermore, the loading can be expressed as daily equivalents but will be implemented in practice over a longer period.

To account for interannual variability, the TMDL was based on the maximum seven-year rolling average loading from the entire modeled period from 2004 to 2015 that attained the DO criterion in every year. A single year can vary significantly entirely because of stochastic effects that overwhelm the central tendency for the system, and this would adversely weight the TMDL towards extreme values. An average will reduce the impact of outlier years, and the period of seven years was selected because this should capture both drought and wet years.

Because nutrient loading to a waterbody is predominantly influenced by precipitation in each year and, in these agricultural basins, by several other variables that vary from year to year and season to season (e.g., irrigation requirements, specific crop coverage and harvest time), a daily or annual load assignment or measurement is not particularly useful. Taking a long-term or rolling average also has the advantage of removing the precipitation effect in favor of better capturing the impact of the watershed loadings. A simple rolling average is an average of the last N values (in this case seven years of annual averages) in a dataset, applied row by row to obtain a series of averages.

4.4 Determination of Assimilative Capacity

To calculate existing nutrient loads from the Haw Creek Watershed, annual mean water flows were simulated by the HSPF Model and were multiplied by the AGMs of TN and TP concentrations (**Table 4.1**). For the TMDL nutrient loads, the target concentrations of 1.16 mg/L for TN and 0.05 mg/L for TP, respectively, were used for downstream protection, Crescent Lake (**Table 4.1**).

Table 4.1. Model-simulated annual flow from the Haw Creek Watershed and TN and TP existing and target concentrations

ac=ft/yr = Acre-feet per year
Note: Values shown in boldface type and shaded cells represent the maximum AGM used because there were insufficient data to calculate the AGM in that year.

Year	Flow (ac-ft/yr)	TN Existing (mg/L)	TN Target (mg/L)	TP Existing (mg/L)	TP Target (mg/L)
2004	253,170	1.33	1.16	0.096	0.05
2005	230,750	1.15	1.16	0.078	0.05
2006	32,693	1.29	1.16	0.119	0.05
2007	78,194	2.00	1.16	0.110	0.05
2008	150,350	1.73	1.16	0.122	0.05
2009	286,160	**2.00**	1.16	**0.185**	0.05
2010	59,009	**2.00**	1.16	**0.185**	0.05
2011	35,299	1.29	1.16	**0.185**	0.05
2012	91,683	1.77	1.16	0.139	0.05
2013	104,370	1.78	1.16	0.169	0.05
2014	132,750	1.41	1.16	0.185	0.05
2015	91,399	1.62	1.16	0.164	0.05

4.5 Calculation of the TMDLs

To determine the nutrient loads that improve the DOsat in Haw Creek above Crescent Lake, the anthropogenic TN and TP loads were reduced to natural background condition which was based on the Crescent Lake nutrient target concentrations (See **Section 2.4**).

For Haw Creek above Crescent Lake, 7-year rolling average loads were calculated from the yearly TN and TP loads, and the maximum 7-year averages of TN and TP loads were chosen as the TMDLs. The 7-year TN and TP target loads necessary to improve DOsat are 491,341 and 21,179 lbs/yr, respectively from nonpoint sources, for Haw Creek above Crescent Lake.

To meet the final TMDL loads, also referred to as the TMDL condition, for Haw Creek above Crescent Lake, 28 % and 62 % reductions from current nonpoint source loadings are required for TN and TP, respectively (2004–15). **Table 4.2** lists the TMDL condition nutrient loads for Haw Creek above Crescent Lake from 2004 to 2015.

Table 4.2. TMDL condition nutrient loads from the Haw Creek above Crescent Lake Watershed, 2004–16

Note: Values shown in boldface type and shaded cells represent the maximum 7-year averages, the 7-year loads used for the calculations, and percent reductions.

Year	Current Condition TN Loads (lbs/yr)	7-Year Rolling Average TN Loads (lbs/yr)	TMDL Condition TN Loads (lbs/yr)	7-Year Rolling Average TN Loads (lbs/yr)	Current Condition TP Loads (lbs/yr)	7-Year Rolling Average TP Loads (lbs/yr)	TMDL Condition TP Loads (lbs/yr)	7-Year Rolling Average TP Loads (lbs/yr)
2004	**915,652**		**798,614**		66,092		**34,423**	
2005	**721,616**		**727,891**		48,944		**31,375**	
2006	**114,686**		**103,129**		10,580		**4,445**	
2007	**425,275**		**246,660**		23,390		**10,632**	
2008	**707,320**		**474,272**		**49,880**		**20,443**	
2009	**1,556,343**		**902,679**		**143,962**		**38,909**	
2010	**320,933**	**680,261**	**186,141**	**491,341**	**29,686**	53,219	**8,023**	**21,179**
2011	123,828	567,143	111,349	393,160	**17,758**	46,314	4,800	16,947
2012	441,295	527,097	289,210	330,491	**34,655**	44,273	12,466	14,245
2013	505,199	582,885	329,231	362,792	**47,965**	49,614	14,191	15,638
2014	509,003	594,846	418,754	387,377	**66,784**	**55,813**	18,050	16,697
2015	402,646	551,321	288,314	360,811	40,762	54,510	12,427	15,552
Point Sources		12,702		12,702		701		701
Maximum 7-Year Average + Point Source		**692,963**		**504,043**		**56,514**		**21,880**
% Reduction from nonpoint sources				**28**				**62**

Chapter 5: Determination of Loading Allocations

5.1 Expression and Allocation of the TMDLs

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

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

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

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

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

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

This approach is consistent with federal regulations (40 Code of Federal Regulations [CFR] § 130.2[I]), which state that TMDLs can be expressed in terms of mass per time (e.g., pounds per day), toxicity, or other appropriate measure. The TMDLs for Haw Creek above Crescent Lake are expressed in terms of pounds per year and percent reduction of TN and TP and represent the loads of TN and TP that the waterbody can assimilate while maintaining balanced communities of aquatic flora and fauna (see **Table 5.1**). The Haw Creek above Crescent Lake TMDLs are based on 7-year rolling averages of simulated loads from 2004 to 2015. For these TMDLs, the restoration goal is to improve DOsat, thus meeting the water quality criteria and protecting the designated uses for Haw Creek above Crescent Lake.

Table 5.1 lists the TMDLs for the Haw Creek above Crescent Lake. The TN and TP loads for the creek will constitute the TMDL set forth in Paragraph 62-302.530(48)(a), F.A.C. The TMDLs for Haw Creek above Crescent Lake are expressed as a 7-year rolling annual average load not to be exceeded.

Table 5.1. TMDL components for nutrients in Haw Creek above Crescent Lake (WBID 2622A)

Note: The LA and TMDL daily load for TN is 1,381 lbs/day, and for TP 60 lbs/day.
* The required percent reductions listed in this table represent the reduction from all sources.

Waterbody (WBID)	Parameter	TMDL (lbs/yr)	WLA–NPDES Wastewater (lbs/yr)	WLA NPDES Stormwater (% reduction)*	LA (% reduction)*	MOS
2622A	TN	504,043	12,702	28	28	Implicit
2622A	TP	21,880	701	62	62	Implicit

5.2 Load Allocation

To achieve the LA for Haw Creek above Crescent Lake, 28 % and 62 % reductions in current TN and TP loads, respectively, will be required.

The TMDLs are based on the percent reduction in total watershed loading of TN and TP from all anthropogenic sources. It should be noted that the LA includes loading from stormwater discharges regulated by DEP and the water management district that are not part of the NPDES stormwater program (see **Appendix A**).

5.3 Wasteload Allocation

5.3.1 NPDES Wastewater Discharges

As noted in **Chapter 4**, there is one NPDES domestic wastewater facility in the Haw Creek Watershed. The City of Bunnell WWTF discharges water to Haw Creek through Black Branch. The TN and TP wasteload limits for the facility is set at the maximum of 701 and 12,702 lbs/yr, respectively, which are consistent with wasteload allocations for Crescent Lake TMDL (DEP 2017).

5.3.2 NPDES Stormwater Discharges

Two covered MS4 permittees in the Haw Creek Watershed are subject to load reductions. The City of DeLand Phase II MS4 (FLR04E078), Volusia County Phase II MS4 (FLR04E033), and the City of Palm Coast (FLR04E145) have urbanized areas in the watershed. Because the actual extent of their stormwater conveyance systems is not known, the general landscape load reduction requirement applies to these MS4 permit holders for the urbanized land in the Haw

Creek Watershed. The permit conditions require a 62 % reduction in TP and a 28 % reduction in TN from the existing condition.

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

5.4 MOS

The MOS can either be implicitly accounted for by choosing conservative assumptions about loading or water quality response, or explicitly accounted for during the allocation of loadings. Consistent with the recommendations of the Allocation Technical Advisory Committee (DEP 2001), an implicit MOS was used in the development of these TMDLs. The MOS is a required component of a TMDL and accounts for the uncertainty about the relationship between pollutant loads and the quality of the receiving waterbody (CWA, Section 303[d][1][c]).

The MOS was implicitly accounted for through various conservative assumptions in the derivation of the TMDLs, such as nutrient target setting based on downstream protection. In addition, the attenuation of nutrients in transport from point source outfalls and nonpoint source areas to Haw Creek above Crescent Lake was not considered in the calculation of the TMDLs, and therefore the required load reductions may lead to lower-than-anticipated nutrient concentrations by the time the loads reach the creek.

Chapter 6: Implementation Plan Development and Beyond

6.1 Implementation Mechanisms

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

Facilities with NPDES permits that discharge to the TMDL waterbody must implement the permit conditions that reflect target concentrations, reductions, or WLAs identified in the TMDL. NPDES permits are required for Phase I and Phase II MS4s as well as domestic and industrial wastewater facilities. MS4 Phase I permits require a permit holder to prioritize and act to address a TMDL unless management actions to achieve that particular TMDL are already defined in a BMAP. MS4 Phase II permit holders must also implement the responsibilities defined in a BMAP or other form of restoration plan (e.g., a reasonable assurance plan).

6.2 BMAPs

Information on the development and implementation of BMAPs is found in Section 403.067, F.S. (the FWRA). DEP or a local entity may initiate and develop a BMAP that addresses some or all of the contributing areas to the TMDL waterbody. BMAPs are adopted by the DEP Secretary and are legally enforceable.

BMAPs can describe the fair and equitable allocations of pollution reduction responsibilities to the sources in the watershed, as well as the management strategies that will be implemented to meet those responsibilities, funding strategies, mechanisms to track progress, and water quality monitoring. Local entities—such as wastewater facilities, industrial sources, agricultural producers, county and city stormwater systems, military bases, water control districts, state agencies, and individual property owners—usually implement these strategies. BMAPs can also identify mechanisms to address potential pollutant loading from future growth and development.

Additional information about BMAPs is available online.

6.3 Implementation Considerations for the Waterbody

Given the nature of the loading to Haw Creek above Crescent Lake, nonpoint source reductions are required to reach the TMDL target. In the Haw Creek Watershed, runoff from agricultural areas would be the leading non-point sources for the nutrients. The SJRWMD annually provides an Agricultural Cost-Share Program of its districtwide. The purpose of the program is to engage farmers, growers, and ranchers with SJRWMD in the shared goals of water conservation and reduction of nutrient run-off.

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Appendices

Appendix A: Background Information on Federal and State Stormwater Programs

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

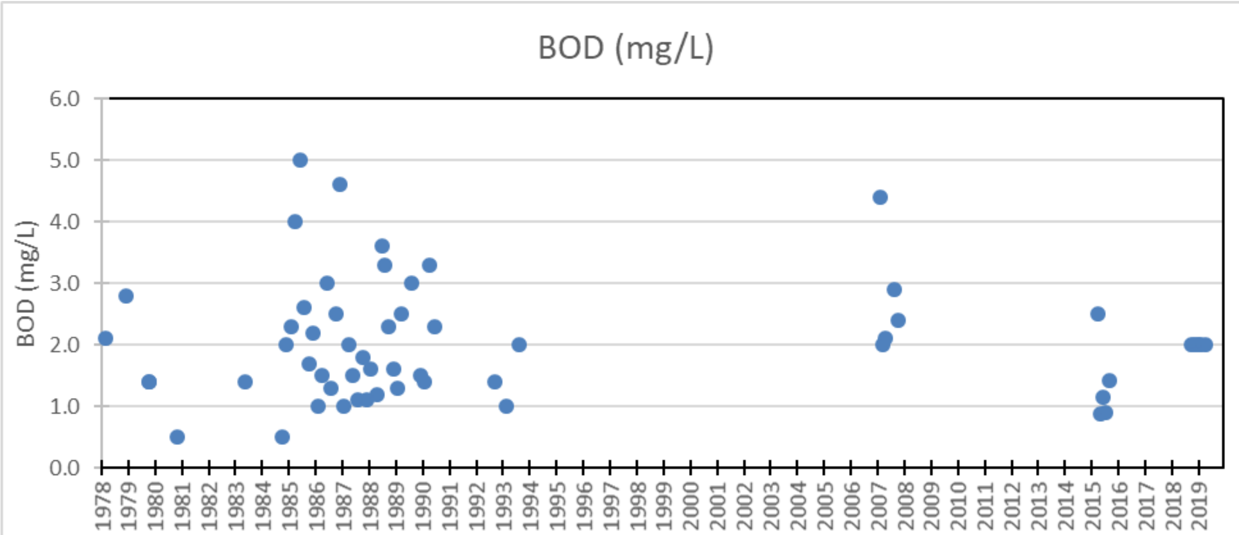
Chapter 62-40, F.A.C., also requires the state's water management districts to establish stormwater pollutant load reduction goals (PLRGs) and adopt them as part of a Surface Water Improvement and Management (SWIM) Program plan, other watershed plan, or rule. Stormwater PLRGs are a major component of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

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

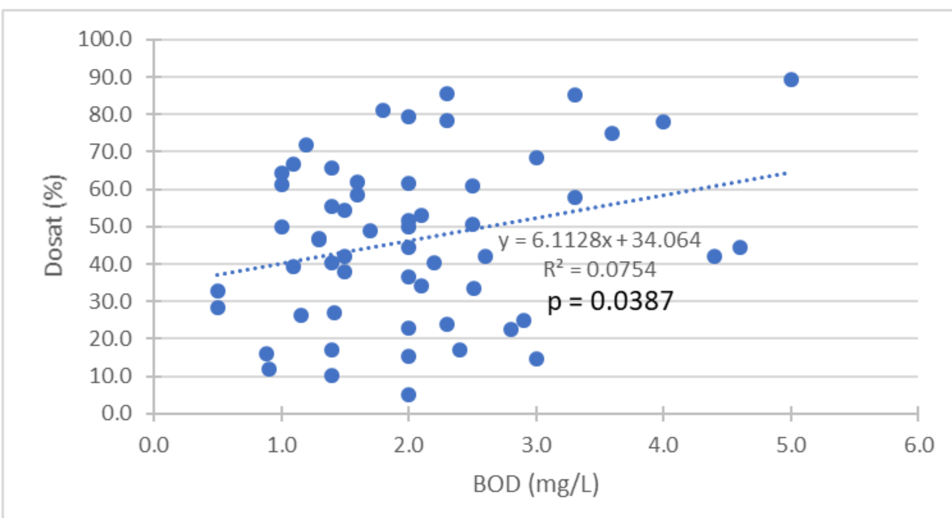
However, because the master drainage systems of most local governments in Florida are physically interconnected, the EPA implemented Phase I of the MS4 permitting program on a countywide basis, which brought in all cities (incorporated areas), Chapter 298 special districts; community development districts, water control districts, and the Florida Department of Transportation (FDOT) throughout the 15 counties meeting the population criteria. DEP received authorization to implement the NPDES stormwater program in 2000. The authority to administer the program is set forth in Section 403.0885, F.S.

The Phase II NPDES stormwater program, promulgated in 1999, addresses additional sources, including small MS4s and small construction activities disturbing between 1 and 5 acres, and urbanized areas serving a minimum resident population of at least 1,000 individuals. While these urban stormwater discharges are technically referred to as "point sources" for the purpose of regulation, they are still diffuse sources of pollution that cannot be easily collected and treated by a central treatment facility, as are other point sources of pollution such as domestic and industrial wastewater discharges. It should be noted that Phase I MS4 permits issued in Florida include a reopener clause that allows permit revisions to implement TMDLs when the implementation plan is formally adopted.

Appendix B-1: BOD data measured in WBID 2622A from 1978 to 2019 and relationship with DOsat



Statistics	BOD
Minimum	0.5 mg/L
Maximum	5.0 mg/L
Mean	2.0 mg/L
Median	2.0 mg/L



Appendix B-2: Relationship between DOsat and color