DRAFT

2023 5-Year Review of the St. Lucie River and Estuary Basin Management Action Plan

Division of Environmental Assessment and Restoration
Water Quality Restoration Program
Florida Department of Environmental Protection

with participation from the
St. Lucie River and Estuary Stakeholders

May 2023

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Acknowledgments

The *St. Lucie River and Estuary Basin Management Action Plan*, originally adopted in June 2013 with an update in January 2020, was prepared as part of a statewide watershed management approach to restore and protect Florida's water quality. This *2023 5-Year Review of the St. Lucie River and Estuary Basin Management Action Plan* was prepared by the Florida Department of Environmental Protection in partial fulfillment of section 373.4595(4)(b), Florida Statutes, with participation from the St. Lucie River and Estuary stakeholders identified below.

Type of Governmental or Private Entity	Participant
Local Governments	Martin County Okeechobee County St. Lucie County City of Fort Pierce City of Port St. Lucie City of Stuart Town of Sewall's Point
Community Development Districts	Copper Creek Creekside Portofino Isles River Place St. Lucie West Services District Tesoro Tradition Veranda Verano Villa Vizcaya
Special Districts	Hobe St. Lucie Conservancy District North St. Lucie River Water Control District Pal Mar Water Control District Troup-Indiantown Water Control District
Agencies	Florida Department of Agriculture and Consumer Services Florida Department of Environmental Protection Florida Department of Transportation District 1 Florida Department of Transportation District 4 Florida Turnpike Enterprise South Florida Water Management District

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List of Acronyms and Abbreviations

ac-ft/yr	acre-feet per year
BMAP	Basin Management Action Plan
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
CDD	Community Development District
DEP	Florida Department of Environmental Protection
DO	Dissolved Oxygen
DWM	Dispersed Water Management
EPA	U.S. Environmental Protection Agency
F.A.C.	Florida Administrative Code
FDACS	Florida Department of Agriculture and Consumer Services
FDOT	Florida Department of Transportation
F.S.	Florida Statutes
FSAID9	Florida Statewide Agricultural Irrigation Demand Version 9 (Geodatabase)
lbs	Pounds
lbs/yr	Pounds Per Year
MDL	Minimum Detection Level
mg/L	Milligrams per Liter
MS4	Municipal Separate Storm Sewer System
N/A	Not Applicable
NPDES	National Pollutant Discharge Elimination System
O&M	Operations and Maintenance
OSTDS	Onsite Sewage Treatment and Disposal System
POR	Period of Record
SFWMD	South Florida Water Management District
STA	Stormwater Treatment Area
STAR	Statewide Annual Report
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TRA	Targeted Restoration Area
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
WaSh	Watershed Water Quality Simulation (Model)
WBID	Waterbody Identification (Number)
WCD	Water Control District
WIN	Watershed Information Network (Database)
WWTF	Wastewater Treatment Facility
WY	Water Year

Executive Summary

Background

The St. Lucie River and Estuary Watershed is located in southeast Florida in Martin, St. Lucie, and Okeechobee counties. The St. Lucie Estuary is a major tributary to the southern Indian River Lagoon, and the watershed is an economically important area.

The St. Lucie River and Estuary and its associated watershed have been subjected to hydrologic, land use, and other anthropogenic modifications over the past century that have degraded its water quality. To help address the nutrient impairment, the Florida Department of Environmental Protection (DEP) adopted total maximum daily loads (TMDLs) for total nitrogen (TN) and total phosphorus (TP) to the estuary. This BMAP represents the joint efforts of multiple stakeholders to identify where TN and TP can be reduced through regulatory and non-regulatory programs, incentive-based programs, and implementation of projects that will ultimately achieve the TN and TP TMDLs in the estuary.

Summary of Load Reductions

DEP asked the stakeholders to provide information on management actions, including projects, programs, and activities, that would reduce nutrient loads from the St. Lucie River and Estuary Watershed. Management actions were required by the original BMAP and 2020 BMAP update to address nutrient loads to the estuary and had to meet several criteria to be considered eligible for credit. Through December 31, 2022, 229 projects were completed, and an additional 36 projects were underway or planned. Based on the load estimation shapefile developed from the Watershed Water Quality Simulation (WaSh) model, the completed activities in the St. Lucie River and Estuary Watershed are estimated to achieve total reductions of 839,854 lbs/yr of TN, which is 67% of the reductions needed to meet the TN TMDL, and 203,836 lbs/yr of TP, which is 50% of the reductions needed to meet the TP TMDL.

To achieve the TMDL in 15 years, stakeholders must identify and submit additional local projects and the Coordinating Agencies (DEP, Florida Department of Agriculture and Consumer Services [FDACS], and South Florida Water Management District [SFWMD]) must identify additional regional projects as well as determine sources for the significant funding that will be necessary. Enhancements to programs addressing basinwide sources will also be required.

Recommendations for Future Implementation

The BMAP implements phased TN and TP reductions, according to section 403.067(7)(a)1., Florida Statutes (F.S.), for the portion of loading generated in the St. Lucie River and Estuary Watershed. The purpose of this 2023 5-Year Review is to evaluate implementation activities that have taken place during the second 5-year BMAP phase and make recommendations for future implementation activities that may be incorporated into a revised BMAP.

The first and second BMAP phases included significant restoration efforts by stakeholders, and the implementation will continue to help meet the TMDL. This 2023 5-Year Review

recommends milestones be adjusted to fit a 20-year timeline in the next BMAP update, as the previous BMAP update increased load reduction requirements, and many stakeholder projects will need more time for implementation to meet the TMDL. Allocations may need to be updated to reflect land use changes. In addition, small modifications to the water quality monitoring network are recommended to fill in gaps and enable complete analyses. Finally, the next BMAP update will include actions from the wastewater and onsite sewage treatment and disposal system (OSTDS) remediation plans being prepared by local governments. The update will be completed no later than July 1, 2025, in accordance with the Clean Waterways Act, Chapter 2020-150, Laws of Florida.

Chapter 1. Background Information

1.1 Water Quality Standards and Total Maximum Daily Loads (TMDLs)

Florida's water quality standards are designed to ensure that surface waters fully support their designated uses, such as drinking water, aquatic life, recreation, and agriculture. Currently, most surface waters in Florida, including those in the St. Lucie River and Estuary Watershed, are categorized as Class III waters, meaning they must be suitable for recreation and must support fish consumption and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife. **Table 1** lists all designated use classifications for Florida surface waters.

Table 1. Designated use attainment categories for Florida surface waters

[1] Class I, I-Treated, and II waters additionally include all Class III uses.
* Class I-Treated waters designation is not yet approved by the U.S. Environmental Protection Agency (EPA).

Classification	Description
Class I[1]	Potable water supplies
Class I-Treated[1*]	Treated potable water supplies
Class II[1]	**Shellfish propagation or harvesting**
Class III	**Fish consumption; recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife**
Class III-Limited	Fish consumption; recreation or limited recreation, and/or propagation and maintenance of a limited population of fish and wildlife
Class IV	Agricultural water supplies
Class V	Navigation, utility, and industrial use (*no current Class V designations*)

Section 303(d) of the federal Clean Water Act requires that each state must identify its impaired waters every two years, including estuaries, lakes, rivers, and streams, that do not meet their designated uses. Florida Department of Environmental Protection (DEP), Division of Environmental Assessment and Restoration is responsible for assessing Florida's waters for inclusion on the Verified List of Impaired Waters (when a causative pollutant for the impairment has been identified) and Study List (when a causative pollutant for the impairment has not been identified and additional study is needed). These lists are then provided to EPA as an update to the state's 303(d) list. In 2004, DEP identified the St. Lucie River and Estuary as impaired for dissolved oxygen (DO) and nutrients.

1.1.1 St. Lucie River and Estuary TMDLs

DEP develops and adopts TMDLs for the waterbody segments it identifies as impaired. A TMDL is the maximum amount of a specific pollutant that a waterbody can assimilate while maintaining its designated uses. In March 2009, DEP adopted the St. Lucie River and Estuary TMDLs for total nitrogen (TN) and total phosphorus (TP), which are linked to high chlorophyll-*a* concentrations in portions of the St. Lucie River and Estuary. The TMDLs include segments with waterbody identification (WBID) numbers 3193 (St. Lucie Estuary), 3194 (North Fork St. Lucie River), 3194B (North Fork St. Lucie Estuary), 3197 (C-24 Canal), 3200 (C-23 Canal),

3210 (South Fork St. Lucie Estuary), 3210A (South Fork St. Lucie River), 3211 (Bessey Creek), and 3218 (C-44 Canal).

Table 2 lists the TMDLs and pollutant load allocations implemented by rule (Rule 62-304.705, Florida Administrative Code [F.A.C.], effective March 26, 2009) for the St. Lucie River and Estuary Watershed (based on updates to the watershed loading effective May 14, 2012). These TMDLs are for TN, TP, and biochemical oxygen demand (BOD). TMDL loads in upstream WBIDs were calculated based on achieving the same target concentrations (0.72 milligrams per liter [mg/L] for TN and 0.081 mg/L for TP) as in the St. Lucie Estuary. The TMDLs were used as the basis for the basin management action plan (BMAP) targets and allocation calculations. **Figure 1** shows the locations of the estuary and tributary WBIDs with nutrient TMDLs.

Table 2. St. Lucie River and Estuary TMDLs

NPDES = National Pollutant Discharge Elimination System.
[1]The TMDL represents a 7-year rolling average of annual loads, not to be exceeded, including loads from upstream basins. Dividing by 365 yields daily TMDL loads.
[2]The required percent reductions listed in this table represent the reduction from all sources.

WBID	Waterbody	Parameter	Annual TMDL Target	NPDES Stormwater (% Reduction)	Load Allocation (% Reduction)
3193	St. Lucie Estuary	TN	0.720 mg/L	21.4	21.4
3193	St. Lucie Estuary	TP	0.081 mg/L	41.3	41.3
3194	North Fork	TN	140,134 lbs	25.0	25.0
3194	North Fork	TP	15,765 lbs	42.2	42.2
3194	North Fork	BOD	2.0 mg/L	74.0	74.0
3194B	North Fork	TN	103,747 lbs	28.8	28.8
3194B	North Fork	TP	11,672 lbs	58.1	58.1
3197	C-24 Canal	TN	348,957 lbs	51.8	51.8
3197	C-24 Canal	TP	39,258 lbs	72.2	72.2
3197	C-24 Canal	BOD	2.0 mg/L	33.3	33.3
3200	C-23 Canal	TN	242,202 lbs	51.7	51.7
3200	C-23 Canal	TP	27,248 lbs	78.6	78.6
3210	South Fork	TN	24,463 lbs	38.4	38.4
3210	South Fork	TP	2,752 lbs	57.2	57.2
3210A	South Fork	TN	90,471 lbs	47.1	47.1
3210A	South Fork	TP	10,178 lbs	61.8	61.8
3211	Bessey Creek	TN	29,981 lbs	23.9	23.9
3211	Bessey Creek	TP	3,373 lbs	51.2	51.2
3218	C-44 Canal	TN	242,929 lbs	51.2	51.2
3218	C-44 Canal	TP	27,330 lbs	55.0	55.0
3218	C-44 Canal	BOD	2.0 mg/L	69.7	69.7

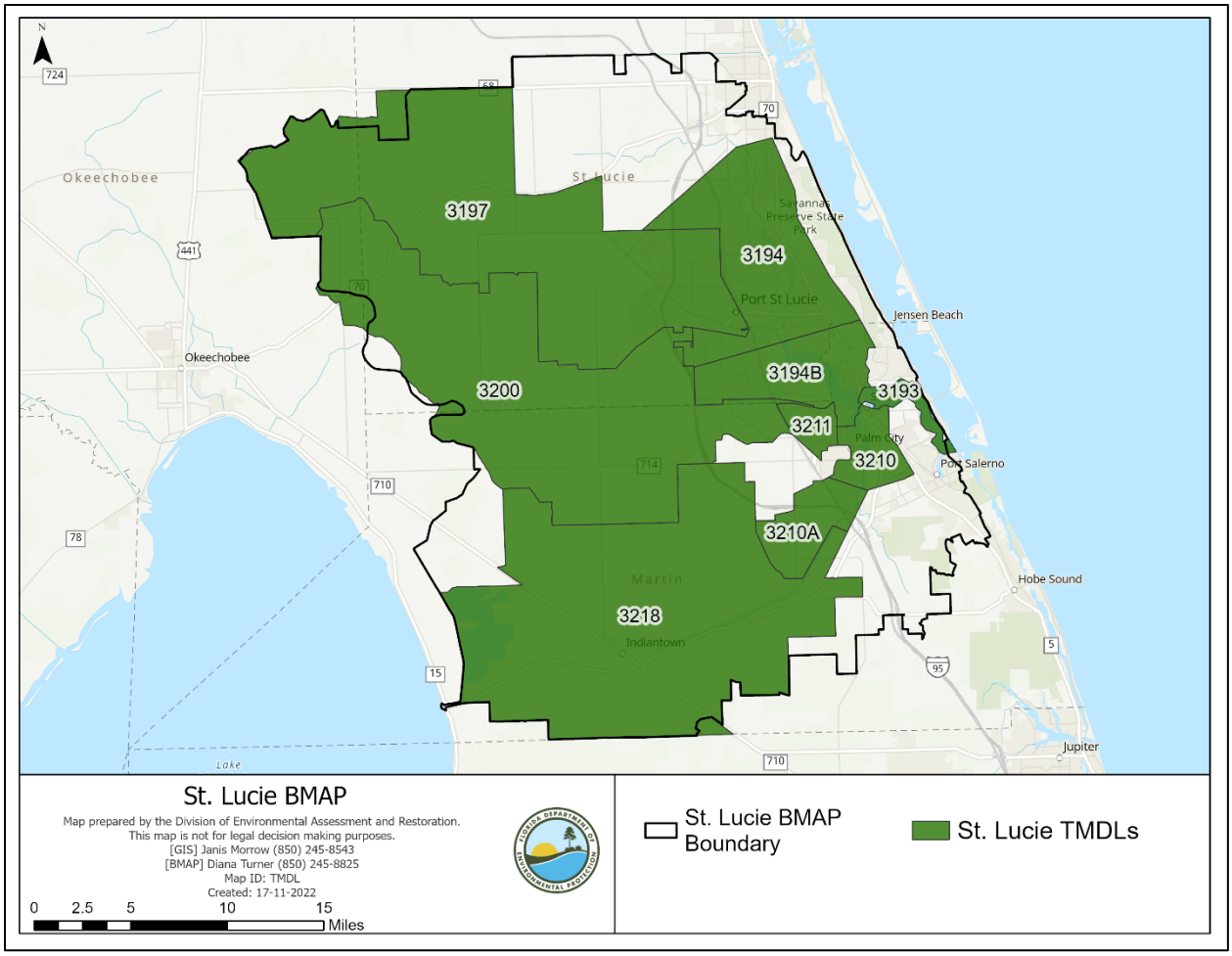

Figure 1. St. Lucie watershed TMDL boundaries

1.2 St. Lucie River and Estuary BMAP

DEP implements TMDLs through permits and BMAPs; the latter contain strategies to reduce and prevent pollutant discharges through various cost-effective means. During the watershed restoration process, DEP and the affected stakeholders jointly develop BMAPs or other implementation approaches. Stakeholder involvement is critical to the success of the watershed restoration program and varies with each phase of implementation to achieve different purposes. The BMAP development process is structured to achieve cooperation and consensus among a broad range of interested parties, including the South Florida Water Management District (SFWMD), Florida Department of Agriculture and Consumer Services (FDACS), and stakeholders representing other agencies, governments, and interested parties.

The Florida Watershed Restoration Act, subparagraph 403.067(7)(a)1., Florida Statutes (F.S.) establishes an adaptive management process for BMAPs that continues until the TMDLs are met. This approach allows for incrementally reducing loadings through the implementation of projects and programs, while simultaneously monitoring and conducting studies to better understand water quality dynamics (sources and response variables) in each impaired waterbody. The

original St. Lucie River and Estuary BMAP was adopted in June 2013, and the first 5-Year Review was completed in June 2018. Section 373.4595, F.S., calls for a review of the BMAP to be completed and submitted to the Legislature and Governor every 5 years. This adaptive management process will continue until the TMDLs are met.

In January 2019, Executive Order 19-12, section 1,C included a requirement to update and secure all restoration plans, within one year, for waterbodies impacting south Florida communities, including the St. Lucie River and Estuary BMAP. The 2020 BMAP update fulfilled those requirements and implemented many recommendations from the 2018 5-Year Review. The BMAP update refined the BMAP boundary to include the South Coastal Basin and other areas draining to the St. Lucie Estuary, revised allocations and estimated reductions based on model updates, incorporated both the targeted restoration area (TRA) evaluation and basinwide sources approach, and set limitations to nutrient discharges from domestic wastewater treatment facilities (WWTFs), among other policy decisions. The current BMAP boundary and the basins within the BMAP are shown in **Figure 2**.

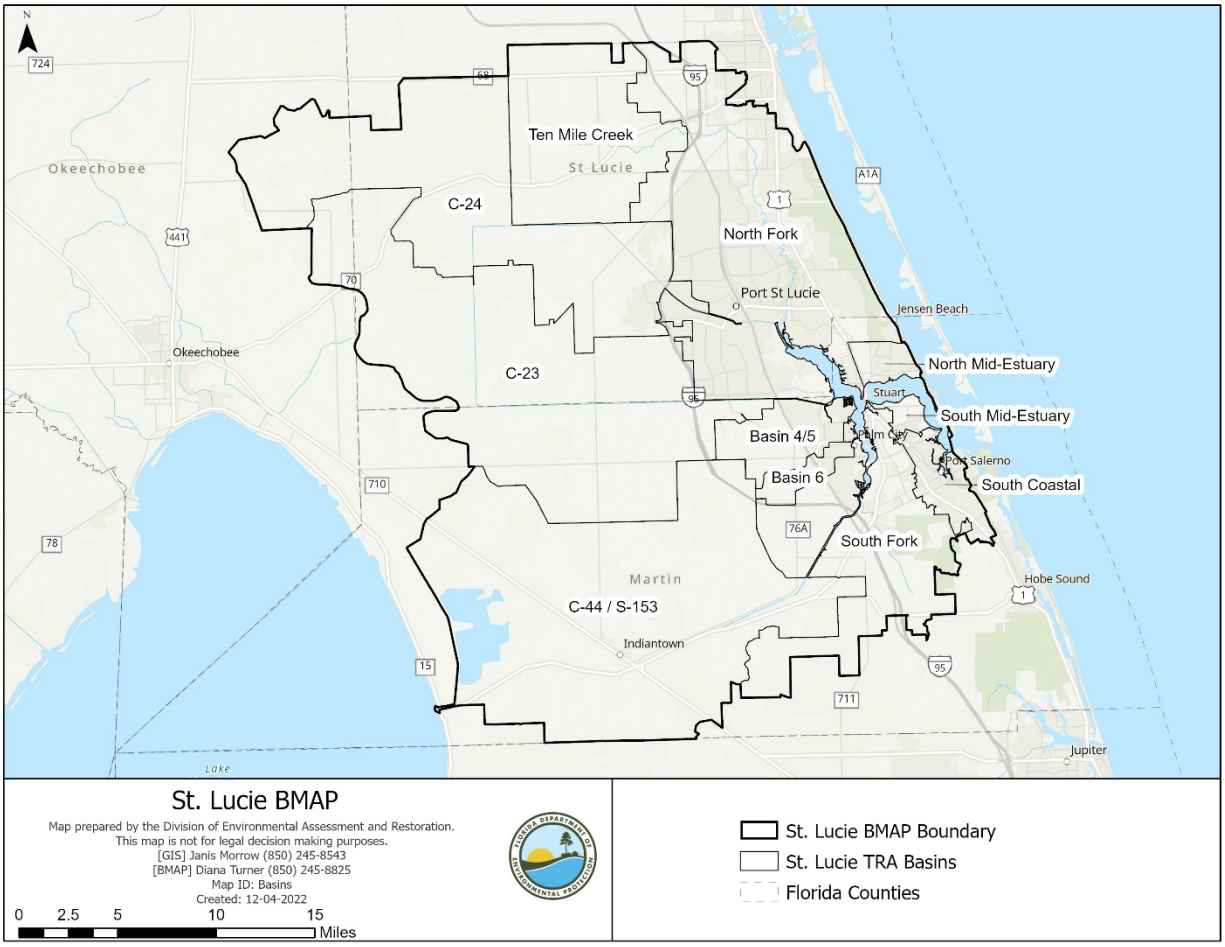

Figure 2. St. Lucie River and Estuary BMAP boundary and basins

1.2.1 BMAP Pollutant Reductions and Discharge Allocations

As part of Executive Order 19-12, recommendations from the 2018 5-Year Review were included in the 2020 St. Lucie River and Estuary BMAP update. The BMAP update also included revised reductions and allocations to achieve the TMDLs.

The revised Watershed Water Quality Simulation (WaSh) model was used to calculate the stakeholder allocations. The starting TN and TP loads in pounds per year (lbs/yr) for each entity within their respective basins were calculated using the WaSh model. The required load reduction needed to meet the TMDLs was then calculated by multiplying the TN and TP starting loads for each entity in each basin by the percent required reduction for TN and TP by basin. If a stakeholder is located in more than one basin, the required load reductions by basin were summed to determine one total load reduction for TN and TP. **Table 3** and **Table 4** show the TN and TP load required reductions by entity, respectively.

There are various sources of pollution in the St. Lucie River and Estuary watershed. Nonpoint (i.e., diffuse) sources in the watershed contribute the majority of TN and TP loads and include urban and agricultural stormwater runoff. The BMAP included an assessment of basinwide sources that also considers nutrient input from onsite sewage treatment disposal systems (OSTDS) and WWTFs.

Table 3. TN load required reductions by entity

Note: Gray shaded rows denote entities meeting classification requirements for low priority.
* The Village of Indiantown's starting loads are grouped with Martin County's loads but may be separated in a future phase of the BMAP.

Entity	Basins 4,5,6	C-23	C-24	C-44, S-153	North Fork	North Mid-Estuary	South Fork	South Mid-Estuary/ South Coastal	Ten Mile Creek	Total
Agriculture	3,789	344,034	285,331	128,760	17,171	0	45,088	0	60,529	884,700
City of Fort Pierce	0	0	0	0	16,204	0	0	0	2	16,205
City of Port St. Lucie	0	4,576	10,181	0	125,318	0	0	0	163	140,239
City of Stuart	0	0	0	0	304	617	5,082	0	0	6,003
Copper Creek Community Development District (CDD)	0	0	1,500	0	0	0	0	0	0	1,500
Creekside CDD	0	0	0	0	0	0	0	0	475	475
Florida Department of Transportation (FDOT) District 4	293	4,791	2,185	1,480	4,514	101	1,883	0	660	15,907
FDOT District 1	0	594	0	0	0	0	0	0	0	594
Martin County*	14,397	7,047	0	10,127	8,475	5,459	33,326	0	0	78,831
Okeechobee County	0	4,515	3,435	0	0	0	0	0	0	7,950
Portofino Isles CDD	0	1,256	0	0	15	0	0	0	0	1,271
River Place CDD	0	0	0	0	389	0	0	0	0	389
St. Lucie County	0	3,773	18,001	0	36,672	0	0	0	9,234	67,679
St. Lucie West Services District	0	0	0	0	13,469	0	0	0	0	13,469
Tesoro CDD	0	0	0	0	2,585	0	0	0	0	2,585
Town of Sewall's Point	0	0	0	0	0	417	0	0	0	417
Tradition CDD	0	1	8,302	0	93	0	0	0	0	8,396
Turnpike	294	11	0	0	3,198	0	650	0	10	4,163
Veranda CDD	0	0	0	0	186	0	0	0	0	186
Verano CDD	0	0	1,030	0	0	0	0	0	0	1,030
Villa Vizcaya CDD	0	0	0	0	119	0	0	0	0	119
Total	**18,772**	**370,598**	**329,964**	**140,367**	**228,710**	**6,594**	**86,029**	**0**	**71,072**	**1,252,107**

Table 4. TP load required reductions by entity

Note: Gray shaded rows denote entities meeting classification requirements for low priority.
* The Village of Indiantown's starting loads are grouped with Martin County's loads but may be separated in a future phase of the BMAP.

Entity	Basins 4,5,6	C-23	C-24	C-44, S-153	North Fork	North Mid-Estuary	South Fork	South Mid-Estuary/ South Coastal	Ten Mile Creek	Total
Agriculture	2,734	122,410	77,500	28,910	7,073	0	18,482	20	27,156	284,285
City of Fort Pierce	0	0	0	0	5,265	0	0	0	1	5,266
City of Port St. Lucie	0	1,024	2,181	0	41,551	0	0	0	55	44,812
City of Stuart	0	0	0	0	98	245	1,617	739	0	2,700
Copper Creek CDD	0	0	306	0	0	0	0	0	0	306
Creekside CDD	0	0	0	0	0	0	0	0	175	175
FDOT District 4	169	1,485	507	335	1,415	39	544	29	278	4,801
FDOT District 1	0	218	0	0	0	0	0	0	0	218
Martin County*	8,305	1,810	0	2,150	2,667	2,287	10,851	4,468	0	32,537
Okeechobee County	0	1,279	687	0	0	0	0	0	0	1,966
Portofino Isles CDD	0	280	0	0	5	0	0	0	0	285
River Place CDD	0	0	0	0	127	0	0	0	0	127
St. Lucie County	0	1,041	3,905	0	12,667	0	0	0	3,785	21,398
St. Lucie West Services District	0	0	0	0	4,545	0	0	0	0	4,545
Tesoro CDD	0	0	0	0	829	0	0	0	0	829
Town of Sewall's Point	0	0	0	0	0	174	0	0	0	174
Tradition CDD	0	0	1,786	0	29	0	0	0	0	1,815
Turnpike	168	3	0	0	1,020	0	205	0	5	1,402
Veranda CDD	0	0	0	0	41	0	0	0	0	41
Verano CDD	0	0	260	0	0	0	0	0	0	260
Villa Vizcaya CDD	0	0	0	0	39	0	0	0	0	39
Total	**11,376**	**129,551**	**87,131**	**31,395**	**77,372**	**2,745**	**31,699**	**5,256**	**31,455**	**407,980**

Chapter 2. Assessing Progress

2.1 Projects to Achieve the TMDL

DEP annually reviews each entity's progress toward completing projects listed in the BMAP and achieving the assigned allocations based on the details described in the current TMDLs and BMAP. Detailed project information can be found in the Statewide Annual Report (STAR), published online (DEP 2023).

2.1.1 Nutrient Removal Projects

Table 5 outlines the number of projects that each entity has committed to in the BMAP and annual reports, along with the status of those projects as of December 31, 2022.

Table 5. Projects submitted to achieve the TMDLs

Entity	Completed	Ongoing	Planned	Underway	Total
Agriculture	12	8	0	0	20
City of Fort Pierce	9	4	0	0	13
City of Port St. Lucie	25	4	0	4	33
City of Stuart	20	3	0	1	24
FDOT District 4	59	2	0	2	63
Fort Pierce Utilities Authority	0	0	1	5	6
Hobe St. Lucie Conservancy District	1	0	1	0	2
Martin County	39	3	1	4	47
North St. Lucie River Water Control District (WCD)	10	0	0	1	11
Okeechobee County	0	0	0	0	0
SFWMD - Coordinating Agency	9	0	1	1	11
St. Lucie County	9	9	2	2	22
St. Lucie West Services District	2	3	0	0	5
Town of Sewall's Point	29	2	3	5	39
Tradition CDD	0	0	0	0	0
Troup-Indiantown WCD	2	0	0	2	4
Turnpike Enterprise	3	2	0	0	5
Total	**229**	**40**	**9**	**27**	**305**

Table 6 summarizes the required reductions for each entity within the BMAP and the total reductions associated with projects completed by each entity as of December 31, 2022. **Figure 3** and **Figure 4** show the progress made towards the TN and TP reduction targets, respectively, as of December 31, 2022.

Table 6. Reductions toward the TMDLs

* Reductions to date include estimated TN and TP reductions associated with projects completed and ongoing as of December 31, 2022.

Entity	Required TN Reductions (lbs/yr)	Estimated TN Reductions (lbs/yr)	TN Percent Complete	Required TP Reductions (lbs/yr)	Estimated TP Reductions (lbs/yr)	TP Percent Complete
Agriculture	884,700	461,419	52%	284,286	112,919	40%
City of Fort Pierce	16,205	3,889	24%	5,266	1,639	31%
City of Port St. Lucie	140,239	61,336	44%	44,812	17,380	39%
City of Stuart	6,003	11,429	190%	2,700	3,100	115%
FDOT District 4	15,907	26,645	168%	4,801	7,201	150%
Hobe St. Lucie Conservancy District	-	2,915	-	-	718	-
Martin County	78,831	70,572	90%	32,537	15,163	47%
North St. Lucie River WCD	-	3,799	-	-	370	-
Okeechobee County	7,950	-	0%	1,966	-	0%
SFWMD - Coordinating Agency	-	150,134	-	-	31,717	-
St. Lucie County	67,679	19,813	29%	21,398	5,055	24%
St. Lucie West Services District	13,469	1,925	14%	4,545	966	21%
Town of Sewall's Point	-	2,313	-	-	49	-
Tradition CDD	8,396	-	0%	1,815	-	0%
Troup-Indiantown WCD	-	23,199	-	-	7,497	-
Turnpike Enterprise	4,163	466	11%	1,402	62	4%
Total	**1,243,959**	**839,854**	**68%**	**405,701**	**203,836**	**50%**

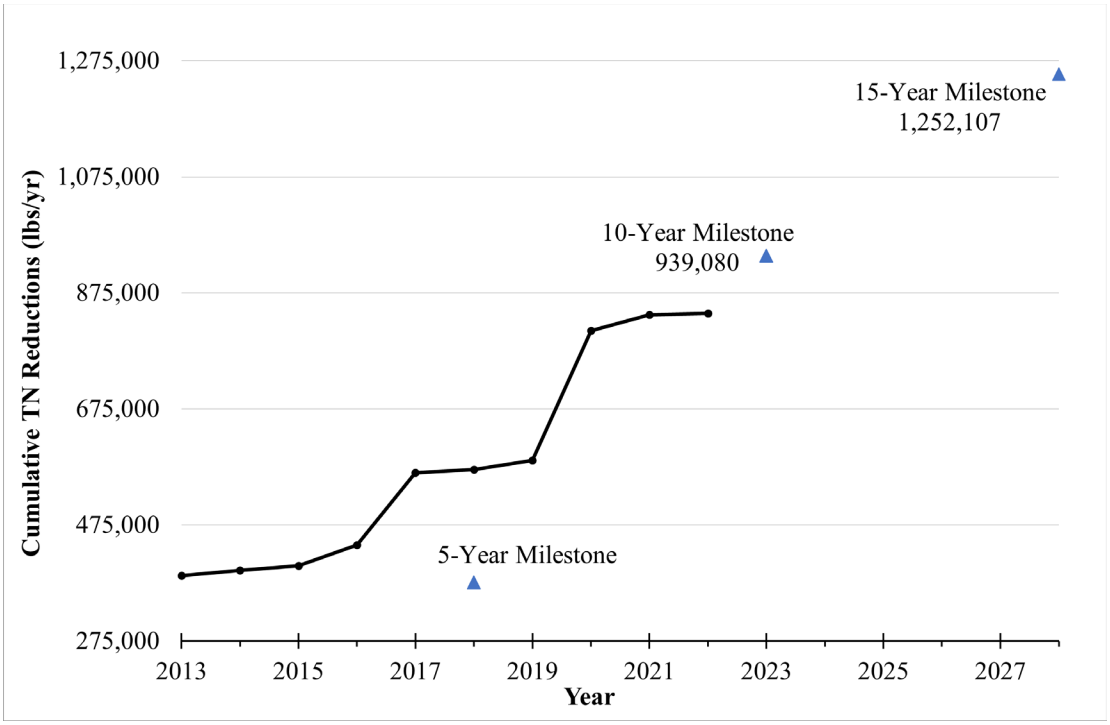

Figure 3. Progress towards TN reduction milestones

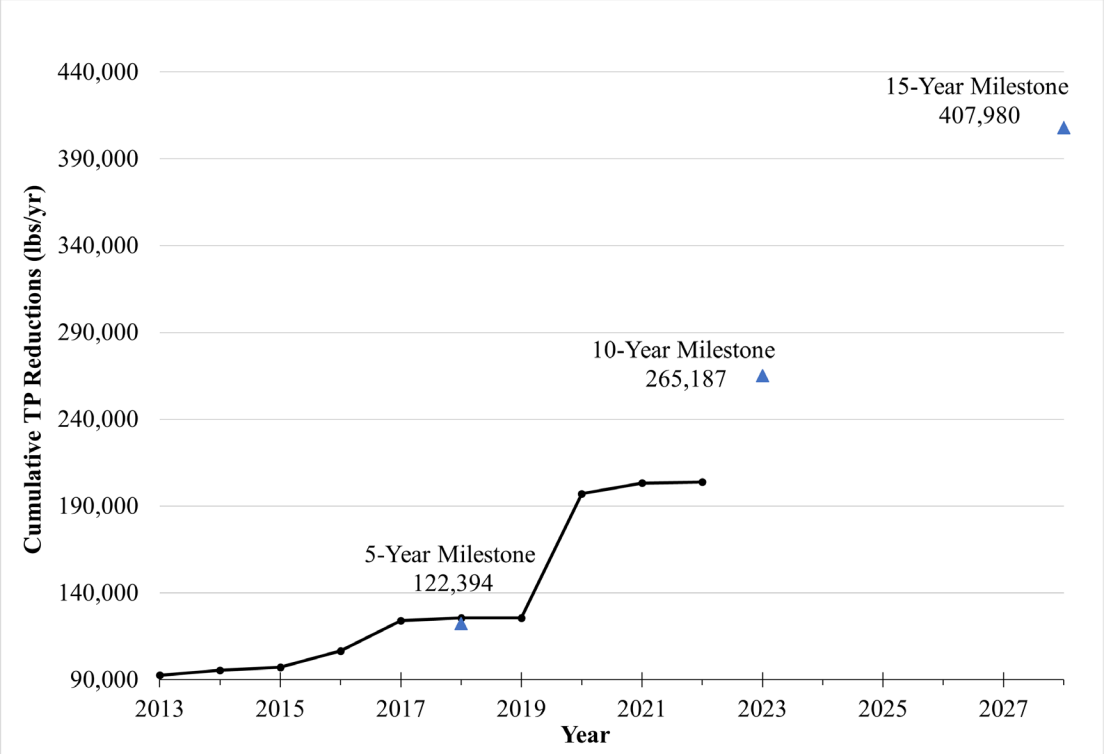

Figure 4. Progress towards TP reduction milestones

2.2 Other Coordinating Agency Efforts

FDACS and SFWMD are coordinating with DEP to focus their efforts on achieving the TMDLs and maintaining compliance with state water quality standards. These efforts are briefly summarized below.

2.2.1 Agriculture/FDACS' Office of Agricultural Water Policy

All agricultural nonpoint sources in the St. Lucie River and Estuary BMAP area are statutorily required either to implement FDACS-adopted best management practices (BMPs) or conduct water quality monitoring prescribed by DEP or the applicable water management district. Paragraph 403.067(7)(c), F.S., provides a presumption of compliance with water quality standards for the pollutants addressed by the BMP to producers that implement FDACS-adopted, DEP-verified BMPs, in accordance with FDACS rules.

FDACS used the Florida Statewide Agricultural Irrigation Demand (Version 9) (FSAID9) data set to identify the agricultural lands. As of December 31, 2022, 234,812 agricultural acres are enrolled in the BMP program, which is 81% of the total 288,739 agricultural acres within the St. Lucie River and Estuary Watershed. The types of agriculture enrolled include Citrus, Cow/Calf, Dairy, Equine, Fruit/Nut, Nursery, Poultry, Row/Field Crop, and Sod. The acreages for the Conservation Plan are counted in the enrolled acres.

Beyond enrolling producers in the BMP program, FDACS is working with DEP to improve the data used to estimate agricultural lands. FDACS performs an "unenrolled agricultural lands" characterization analysis, which provides an indication of areas that are more likely to have enrollable agricultural activities occurring on them. Of the remaining 53,884 acres categorized as agricultural land in FSAID9, 15,006 acres are unlikely enrollable due to entity ownership (e.g., not a commercial agricultural entity) or agricultural type (e.g., aquaculture or silviculture). An additional 8,492 acres are within state-owned properties and/or surface water project areas that are initially deemed low priority with the presumption that they are not agricultural lands. Using this adjusted agricultural acreage, 89% of agricultural acres within the St. Lucie River and Estuary Watershed have been enrolled. FDACS will continue to characterize the land uses with agricultural production that are consistent with FDACS' BMP Program and provide this information to DEP.

As part of the implementation of the Clean Waterways Act, Chapter 2020-150, Laws of Florida, FDACS must undertake implementation verification site visits on properties enrolled in the BMP program at least every two years and review the required records that producers must maintain to demonstrate compliance with the BMPs. The addition of section 403.067(7)(d)3., F.S., also requires FDACS to retain records related to the application of nitrogen and phosphorus fertilizers by enrolled landowners and producers. FDACS developed and implemented the Nutrient Application Record Form to standardize and collect this information. The act identifies the St. Lucie River and Estuary BMAP as one of the priority areas for FDACS to conduct implementation verification site visits. Thus, FDACS focused its efforts in the first two years of the new law on implementation verification site visits in this BMAP and two others.

FDACS' Office of Agricultural Water Policy also works with producers to identify and implement a suite of agricultural projects and research agricultural technologies on properties where they are deemed technically feasible and where funding can be made available. The implementation of these projects requires funding as well as more detailed design based on site-specific information, such as applicable acreages and willing landowners. Since June 2018, FDACS has provided $5,002,454 in cost-share assistance to enrolled producers in the St. Lucie River and Estuary Watershed. A total of 64 projects were completed in areas of nutrient and irrigation management, and water resource protection.

Further details on these updates and BMP implementation and verification can be found in the FDACS report *Status of Implementation of Agricultural Nonpoint Source Best Management Practices* (FDACS 2023), which is available on the FDACS Office of Agricultural Water Policy's web page.

2.2.2 SFWMD

State-appropriated funds coupled with SFWMD resources were used to advance numerous restoration activities in the St. Lucie River and Estuary Watershed during the BMAP reporting period. Local and regional projects with both water storage and water quality benefits progressed, as spotlighted below. Key highlights of SFWMD-led projects in the St. Lucie River and Estuary Watershed through December 31, 2022, are summarized in **Table 7** and shown in **Figure 5**.

Priority work advanced on the Comprehensive Everglades Restoration Plan Indian River Lagoon – South projects, in partnership with the U.S. Army Corps of Engineers (USACE). The C-44 Reservoir and stormwater treatment area (STA) construction was completed in mid-2021; operational testing and monitoring is underway until full operations are transferred from USACE to SFWMD in 2024. In October 2021, construction began on the C-23/C-24 STA, with completion planned in 2025. Construction of the Estuary Discharge Diversion Canal (C-23 to C-44 Interconnect) began in October 2022 and is scheduled for completion in 2025. In December 2021, 1,583 acres of land were acquired in St. Lucie County for the C-25 Reservoir and STA, and design is underway. Design efforts also progressed on the C-23/C-24 North and South Reservoir projects.

In 2020, nine new water quality improvement projects by local governments in the St. Lucie River and Estuary Watershed were awarded state grant funds, which are being administered under the Indian River Lagoon Water Quality Improvement Projects Grant Program via a memorandum of understanding between SFWMD and St. Johns River Water Management District (see **Figure 6**).

In 2021, operations began for two Northern Everglades Public-Private Partnership projects—Bluefield Grove Water Farm in the C-23 Basin and Scott Water Farm in the C-25 Basin, immediately upstream of the St. Lucie River and Estuary BMAP area.
In 2022, SFWMD Governing Board authorized agency staff to negotiate up to 14 water retention and nutrient load reduction projects across the Northern Everglades. To date, SFWMD has

executed 10-year contract renewals for two existing Dispersed Water Management (DWM) projects in the St. Lucie River Watershed—Alderman-Deloney Ranch and Spur Land and Cattle—with additional project negotiations in progress.

Further details on these projects can be found in Chapter 8C of the *Final 2023 South Florida Environmental Report – Volume I* (Taylor et al. 2023).

Table 7. Current SFWMD-led projects in the St. Lucie River and Estuary Watershed

Project Name	BMAP Project Number	Lead Entity	Project Type	Project Benefits	Project Area (acres)	Description	Basin	2022 Project Status	Construction Completion Date
Ten Mile Creek Water Preserve Area	CA-01	SFWMD - Coordinating Agency	Hydrologic Restoration	Water Quality	658	Control the quantity and timing of water delivery to the North Fork of the St. Lucie River by capturing and storing stormwater flows that originated in the Ten Mile Creek Basin.	Ten Mile Creek	Completed (Operations and Maintenance [O&M])	2009
Indian River Lagoon-South - Phase 1 & 2	CA-02	SFWMD - Coordinating Agency	Regional Stormwater Treatment	Water Quality and Water Storage	Not Provided	Phase 1: C-44 Reservoir and STA, C-23 to C-44 Interconnect, C-23/24 North and South Reservoirs and STA, C-25 Reservoir and STA; Phase 2: 3 Natural Storage and Water Treatment Areas, North Fork St. Lucie Floodplain Restoration and dredging muck from St. Lucie Estuary.	Multi-Basin (C-23/C-24/ C-44/C-25/South Fork/North Fork)	Underway	2030
Adams-Russakis Ranch WMA	CA-03	SFWMD - Coordinating Agency	DWM	Water Storage	1,000	1,000-acre project area, which has an estimated water storage benefit of 536 acre-feet per year (ac-ft/yr).	C-24	Completed (O&M)	2020
C-23/24 Interim Storage Section C Water Farm	CA-04	SFWMD - Coordinating Agency	DWM	Water Storage	297	297-acre project area, which has an estimated water storage benefit of 2,958 ac-ft/yr.	C-23/C-24	Completed (O&M)	2017

Project Name	BMAP Project Number	Lead Entity	Project Type	Project Benefits	Project Area (acres)	Description	Basin	2022 Project Status	Construction Completion Date
Bluefield Grove Water Farm	CA-05	SFWMD - Coordinating Agency	DWM	Water Quality and Water Storage	6,100	A public-private partnership project actively stores local stormwater runoff on 6,100 acres in the C-23 watershed in St. Lucie County. The project is estimated to provide a net annual average water storage benefit of 28,360 ac-ft/yr.	C-23	Completed (O&M)	2021
Bull Hammock Ranch WMA	CA-06	SFWMD - Coordinating Agency	DWM	Water Storage	608	608-acre project area, which has an estimated water storage benefit of 285 ac-ft/yr.	C-23	Completed (O&M)	2015
Spur Land and Cattle	CA-07	SFWMD - Coordinating Agency	DWM	Water Storage	210	210-acre project area, which has an estimated water storage benefit of 1,500 ac-ft/yr.	C-23	Completed (O&M)	2014
Caulkins Water Farm	CA-08	SFWMD - Coordinating Agency	DWM	Water Quality and Water Storage	3,275	This Northern Everglades Public-Private Partnership project actively stores local stormwater runoff and water from Lake Okeechobee regulatory releases on 3,275 acres of private land along C-44 Canal. Project is estimated to provide a net annual average water storage benefit of 60,000 ac-ft/yr.	C-44	Completed (O&M)	2017
Alderman-Deloney Ranch	CA-09	SFWMD - Coordinating Agency	DWM	Water Storage	170	170-acre project area, which has an estimated water storage benefit of 147 ac-ft/yr.	C-25 (Upstream BMAP Area)	Completed (O&M)	2012

Project Name	BMAP Project Number	Lead Entity	Project Type	Project Benefits	Project Area (acres)	Description	Basin	2022 Project Status	Construction Completion Date
C-23/24 Section A/B Restoration	CA-10	SFWMD - Coordinating Agency	Wetland Restoration	Water Quality and Water Storage	650	Restoration of approximately 650 acres to provide wildlife habitat as well as ancillary water quantity and quality benefits.	C-23/C-24	Planned	2026
Scott Water Farm	---	SFWMD - Coordinating Agency	DWM	Water Quality and Water Storage	7,444	A public-private partnership project actively stores local stormwater runoff on more than 7,400 acres in the C-25 watershed in St. Lucie County. The project is estimated to provide a net annual average water storage benefit of 11,000 ac-ft/yr.	C-25 (Upstream BMAP Area)	Completed (O&M)	2021

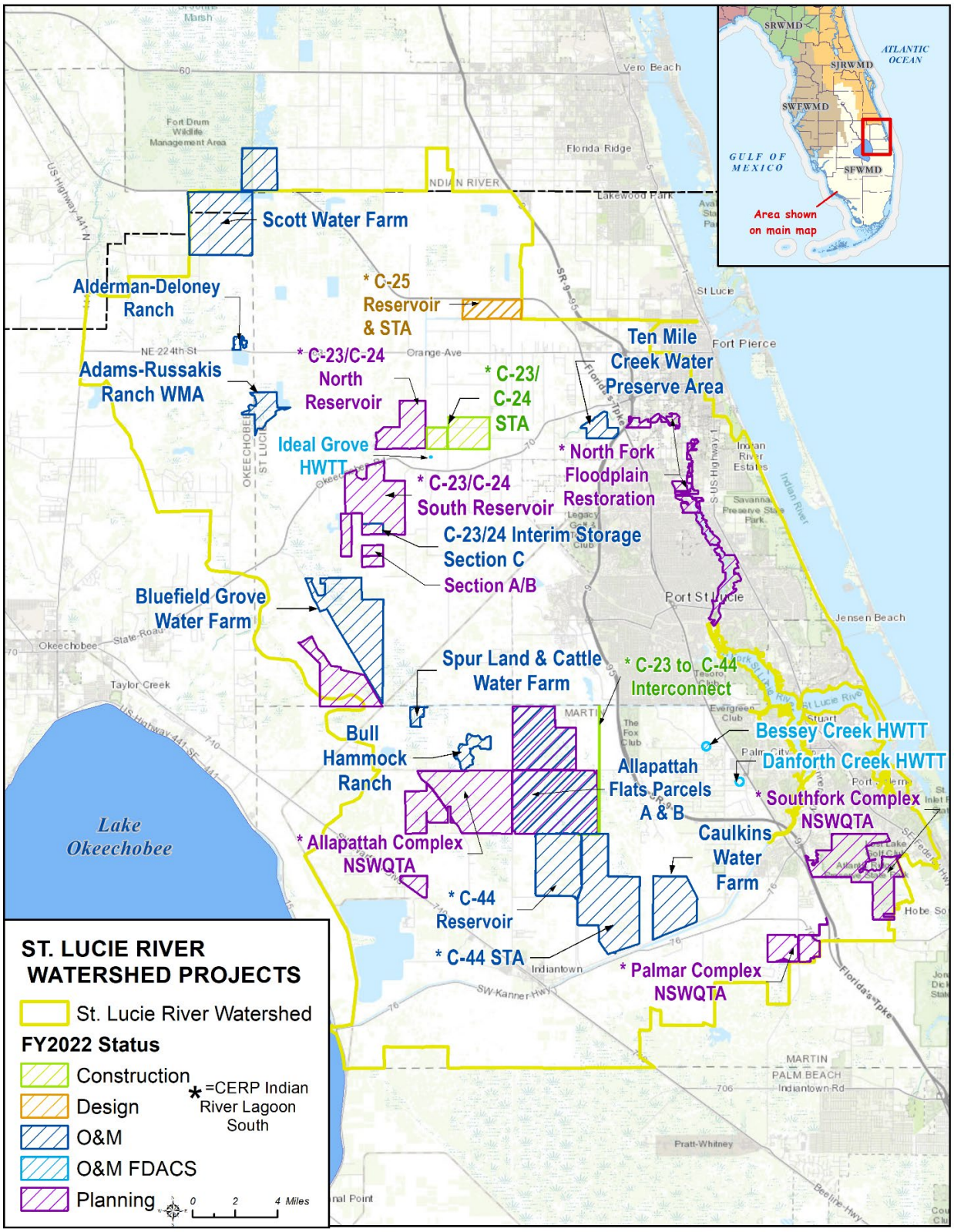

Figure 5. SFWMD-led projects in the St. Lucie River and Estuary Watershed

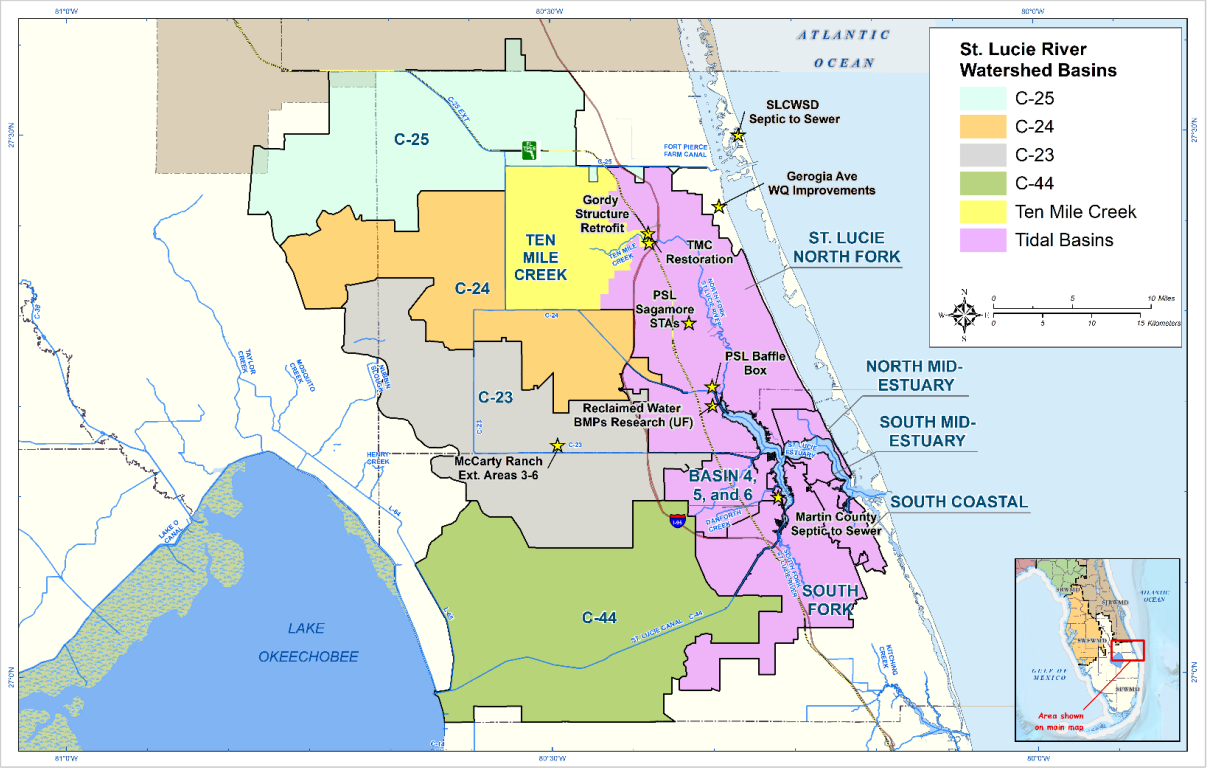

Figure 6. New local projects in the St. Lucie River and Estuary Watershed, under the Indian River Lagoon Water Quality Grant Program

2.2.3 DEP

As part of the 2020 BMAP update, DEP implemented a basinwide sources approach. To support this approach, DEP has taken several actions to address the basinwide sources since the BMAP update was adopted.

The Clean Waterways Act, Chapter 2020-150, Laws of Florida, which was passed by the Florida Legislature in 2020, includes a requirement for local governments to develop master wastewater treatment feasibility analyses to address loads from existing and new septic systems. These plans are also required by the BMAP. DEP has been developing tools and templates to assist local governments in developing these plans, which will be incorporated into the next BMAP update (see **Section 3.4** for additional details).

The 2020 BMAP update also includes WWTF TN and TP effluent limits, based on the facility size and effluent discharge method. As the WWTF permits in the St. Lucie River and Estuary Watershed come up for renewal, DEP is comparing the current effluent concentrations to the BMAP requirements. DEP is modifying the WWTF permits, as needed, during renewal to revise effluent limits to meet BMAP requirements.

To address stormwater sources, DEP and the water management districts initiated rulemaking, as directed by Section 5 of the Clean Waterways Act, to update the stormwater design and

operation regulations for environmental resource permitting. These rulemaking efforts are currently underway and public workshops were held. In addition, using the 2020 Census data, DEP is coordinating with EPA on whether additional local governments throughout the state meet the thresholds for a NPDES Municipal Separate Storm Sewer System (MS4). DEP is currently evaluating whether any potential new MS4 permittees will be designated. If any are identified in the St. Lucie River and Estuary Watershed, those new MS4 permittees will be identified as part of the next BMAP update.

DEP also has several funding sources available to implement innovative technologies to help achieve nutrient load reduction goals. The Innovative Technologies Grant Program is available to local governments for projects that evaluate and implement innovative technologies and short-term solutions to combat algal blooms and nutrient enrichment, restore and preserve Florida waterbodies, and implement certain water quality treatment technologies. Eligible projects will prevent, mitigate, or clean-up harmful algal blooms, with an emphasis on projects that prevent blooms through nutrient reductions. Projects that improve the ability to predict and monitor harmful algal blooms are also considered for funding. In addition, the Resilient Florida Program includes a selection of grants that are available to counties, municipalities, water management districts, flood control districts, and regional resilience entities. The grants may be used to analyze and plan for vulnerabilities and implement projects for adaptation and mitigation to address the impacts of flooding and sea level rise that the state faces.

2.3 Water Quality Monitoring and Evaluation

The St. Lucie River and Estuary BMAP monitoring plan was designed to enhance the understanding of basin loads, identify areas with high nutrient concentrations, and track water quality trends. The information gathered through the monitoring plan measures progress toward achieving the TMDLs and provides a better understanding of watershed loading. The BMAP monitoring plan consists of ambient water quality sampling, sampling at discharge structures, and flow monitoring, with stations organized into a two-tier system to prioritize which stations are used to track water quality trends in the BMAP. In addition, SFWMD conducts biological sampling for eastern oysters (*Crassostrea virginica*) and submerged aquatic vegetation including seagrass.

2.3.1 Ambient Water Quality Monitoring

Focused objectives are critical for a monitoring strategy to provide the information needed to evaluate implementation success. The primary objective of the monitoring strategy for the St. Lucie River and Estuary Watershed, described below, is to evaluate the success of the BMAP, help interpret the data collected, and provide information for potential future refinements of the BMAP.

Primary Objective

- To track trends in TN and TP loads in the major canals and tributaries, as well as the St. Lucie River and Estuary.

To achieve these objectives, the monitoring strategy focuses on the following parameters:

- Alkalinity.
- Ammonia as Nitrogen.
- BOD.
- Carbon – Organic.
- Carbon – Total.
- Chlorophyll *a.*
- Color.
- DO.
- DO Saturation.
- Flow.
- Nitrate + Nitrite as Nitrogen.
- Nitrogen – Total Kjeldahl.
- Nitrogen – Total.
- Orthophosphate as Phosphorus.
- pH.
- Phosphorus – Total.
- Specific Conductance.
- Salinity.
- Temperature, Water.
- Total Suspended Solids.
- Turbidity.

The stakeholders responsible for monitoring continue to sample their sites and uploaded the data to the Watershed Information Network (WIN) database.

2.3.2 Water Quality Evaluation

To help track implementation progress for the St. Lucie River and Estuary Watershed BMAP, a water quality evaluation was completed using data available as of May 31, 2022. Trend analyses were conducted as part of the 2018 5-Year Review and updated for this 2023 5-Year Review to track changes in nutrient concentrations in the impaired St. Lucie River and Estuary WBIDs. The results from the water quality trend analyses for St. Lucie River and Estuary basins are described below. **Appendix A** describes the methods used to retrieve, process, and analyze the data.

2.3.2.1 Data Management and Processing

Data were collated from the previous 5-year trend analysis and new data retrieved from the WIN database. The analysis was conducted using five water years (WYs) of data from before BMAP adoption and ten WYs of data from after BMAP adoption, for a period of record (POR) extending from May 1, 2001, through April 30, 2022. The evaluation used data from the Tier 1 and Tier 2 BMAP monitoring stations. Concentrations, rather than nutrient loads, are analyzed as few locations have adequate flow data to calculate loads for a trend analysis. The TN and TP analyses are comprised of 14,759 records, an increase of 4,539 records for TN and 4,365 records for TP from the previous 5-year trend analysis. This large jump in records is both due to automatic samplers at important structures that collect a large number of samples and a large increase in the number of stations analyzed to provide by-basin data. The previous analysis was focused on 15 stations, while this analysis uses data from 63 stations throughout the BMAP. Available data were used to calculate TN from its constituents, if necessary, where TN was not reported (described in **Appendix A**). Monthly medians were calculated for TN and TP where multiple, non-duplicated samples were reported in a month. The analysis used the Seasonal Kendall test, which is robust in respect to missing data; therefore, a 50% cut-off was used to select basins with adequate data for the trend analysis. The requirement for five years of continuous data was maintained from the 2018 5-Year Review to ensure a robust analysis.

2.3.2.2 Statistical Analyses

Autocorrelation was tested using the '*acf*' function in R v.4.0.4 on monthly median values (see **Table A-2** in **Appendix A**). Trends were analyzed using the U.S. Geological Survey (USGS) Seasonal Kendall formula, provided as a Window's executable program (Helsel et al. 2006). For basins with multiple stations, trends were also analyzed by station if the station followed the data requirements.

2.3.2.3 Seasonal Kendall Trend Results for Basins

The South Coastal and Ten Mile Creek basins showed a significant decrease in TN (**Table 8**, **Figure 7**), while the C-24 and Ten Mile Creek basins showed a significant decrease in TP. The South Mid-Estuary basin showed a significant increase in TP (**Table 9**, **Figure 8**). However, it is worth noting that average TP concentrations for the C-24 and Ten Mile Creek basins are more than twice the TMDL requirement of 0.081 mg/L, while the South Mid-Estuary basin has an average TP concentration of 0.036 mg/L (**Table A-3**). For TN, those basins without significant trends did have negative or zero slopes, except for the South Mid-Estuary basin, while TP slopes were generally close to zero. Overall, the slope of change for TN and TP in all basins was fairly small, suggesting very slow change in any direction.

Averaged TN concentrations are above the TMDL of 0.72 mg/L in every basin but the South Mid-Estuary basin. Average TP concentrations below the TMDL can be found in the North Fork, North Mid-Estuary, South Coastal, and South Mid-Estuary basins. Those small slopes suggest that even for basins with decreasing trends, achieving the TMDL values may take more work to increase water quality at a faster pace.

Insufficient results in Basin 4/5 and Basin 6 are from lack of consistent monthly samples during the 2018, 2020, and 2022 WYs. The primary station for C-23 basin was down for most of WY 2018 due to construction, thus there was not a full recent five years of data for that basin.

Table 8. Results of the Seasonal Kendall test for TN

Note: Cells marked with a – indicate insufficient data. See **Appendix A** for details on data sufficiency requirements.

Basin	Tau	Kendall S	Slope	p-value	Trend
Basin 4/5	—	—	—	—	—
Basin 6	—	—	—	—	—
C-23	—	—	—	—	—
C-24	-0.09	-205	-0.004	0.182	No Significant Trend
C-44	-0.116	-270	-0.007	0.103	No Significant Trend
Roosevelt Bridge Compliance Station	-0.047	-8	-0.004	0.694	No Significant Trend
North Fork	0.001	1	0.000	1.000	No Significant Trend
North Mid-Estuary	-0.133	-47	-0.009	0.113	No Significant Trend
South Coastal	-0.252	-473	-0.011	**0.004**	**Significantly Decreasing**
South Fork	0.019	34	0.000	0.770	No Significant Trend
South Mid-Estuary	-0.06	-27	0.002	0.448	No Significant Trend
Ten Mile Creek	-0.218	-512	-0.012	**0.005**	**Significantly Decreasing**

Table 9. Results of the Seasonal Kendall test for TP

Note: Cells marked with a – indicate insufficient data. See **Appendix A** for details on data sufficiency requirements.

Basin	Tau	Kendall S	Slope	p-value	Trend
Basin 4/5	—	—	—	—	—
Basin 6	—	—	—	—	—
C-23	—	—	—	—	—
C-24	-0.167	-410	-0.002	**0.015**	**Significantly Decreasing**
C-44	-0.027	-68	0.000	0.698	No Significant Trend
Roosevelt Bridge Compliance Station	-0.153	-26	-0.003	0.156	No Significant Trend
North Fork	0.166	340	0.001	0.051	No Significant Trend
North Mid-Estuary	0.083	30	0.000	0.323	No Significant Trend
South Coastal	0.012	25	0.000	0.894	No Significant Trend
South Fork	-0.071	-140	0.001	0.381	No Significant Trend
South Mid-Estuary	0.159	79	0.001	**0.034**	**Significantly Increasing**
Ten Mile Creek	-0.376	-955	-0.007	**0.000**	**Significantly Decreasing**

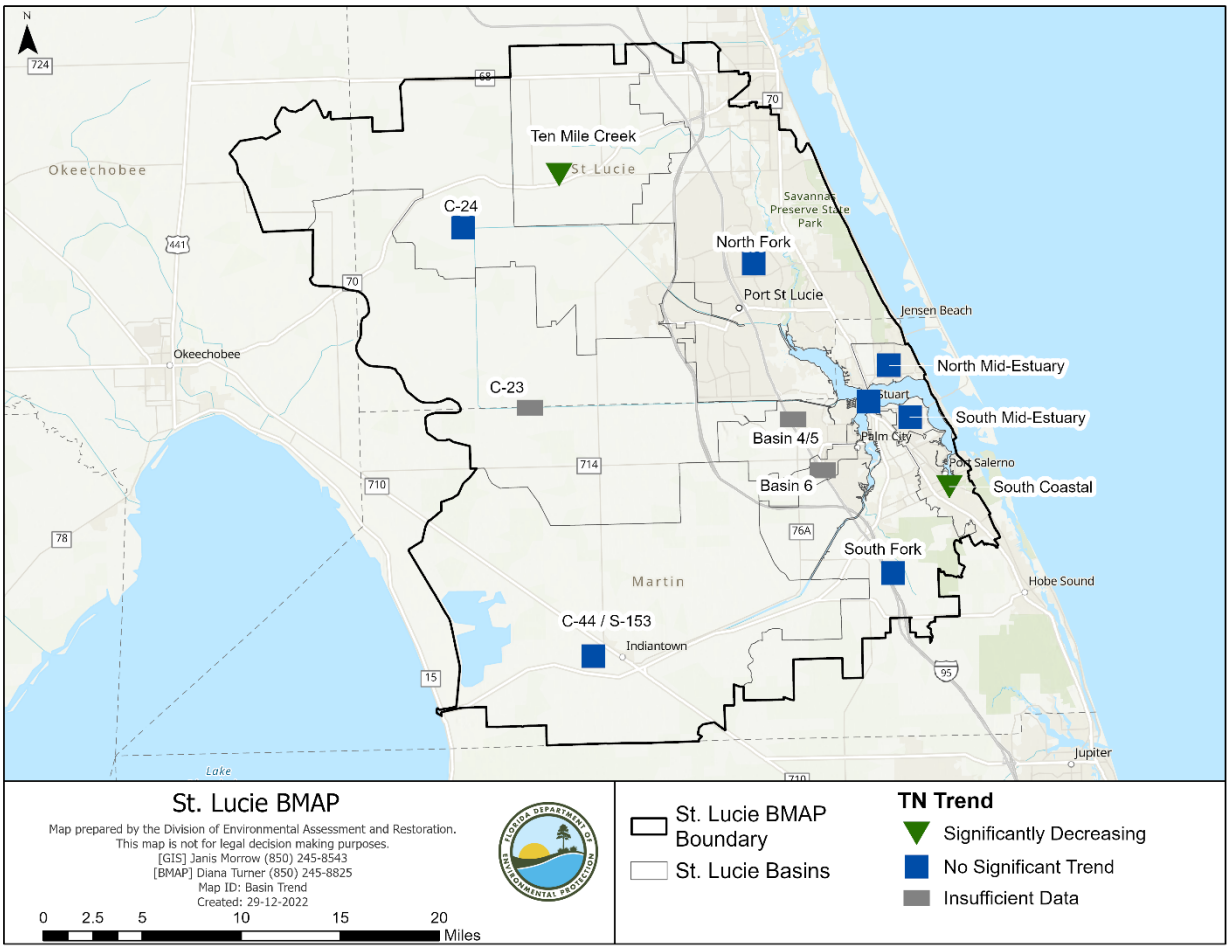

Figure 7. Map of Seasonal Kendall test for TN

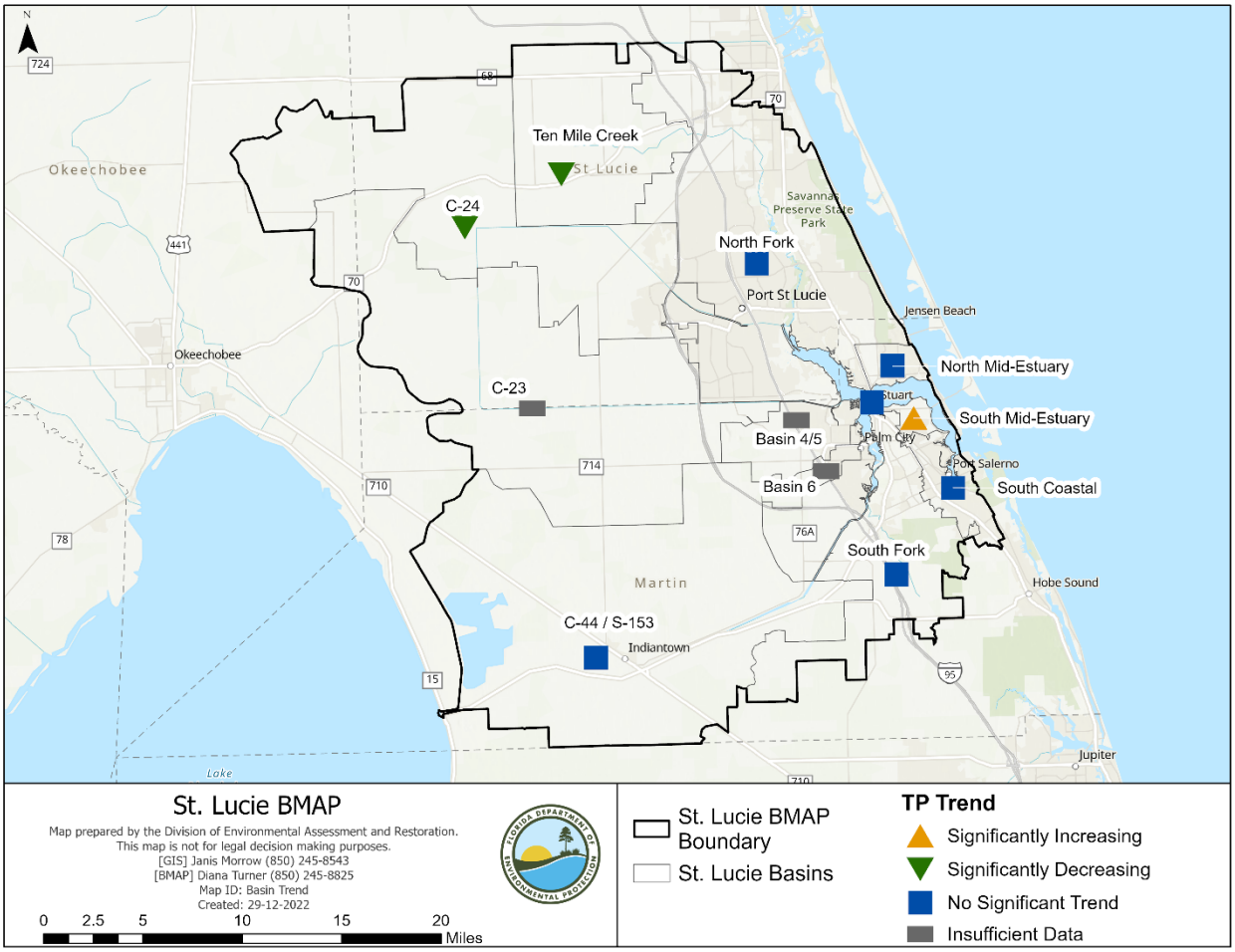

Figure 8. Map of Seasonal Kendall test for TP

Trend analysis results for 30 stations with sufficient data can be seen in **Appendix A**. Stations had more variability in results, where one South Fork and two South Coastal stations showed a significantly increasing trend in TN, and one North Fork, one South Coastal, two South Fork, and two C-44 stations showed a significant decrease in TN concentrations (**Table A-4**, **Figure A-1**). One South Fork station and three South Coastal stations show significant increases in TP, while eight stations showed a significant decreasing trend in TP: four in the North Fork basin, two in the South Fork basin, and one each in the C-24 and North Mid-Estuary basins (**Table A-5**, **Figure A-2**).

For those stations used in the 2018 5-Year Review, stations that showed decreasing trends in the previous analysis (DEP 2018) no longer show any significant trend in either TN or TP. Instead, C44S80, GORDYRD, and S308C show decreasing trends in TN and C24S49, GORDYRD, and HR1 show decreasing trends in TP. These sites showed no trend for either constituent in the previous analysis.

It is worth noting that, while decreasing trends are being seen, the average concentrations for TN and TP for most sites are above TMDL required concentrations. This also includes HR1 for TN and SE 06 and SE 12 for both TN and TP, which had decreasing trends previously but no longer show a trend for those constituents. Decreasing slopes seen for those stations with significant trends are still not strong enough to cause a rapid decrease in either TN or TP concentrations over the next few years when the needed decrease in concentrations levels is considered.

2.4 TRA Approach

To better prioritize and focus resources to achieve restoration most efficiently in the St. Lucie River and Estuary Watershed, DEP developed the TRA approach, which is described in full in the 2020 BMAP document (DEP 2020). This approach uses measured data collected throughout the watershed to evaluate TN and TP concentrations in each of the basins. In conjunction with concentration, the approach looks at flows, past trends, and unit area loading targets across the watershed to prioritize where resources are most needed. Priorities were set with 1 as the highest priority, 2 the next highest priority, and 3 a priority as resources allow. The TRA allows for DEP and stakeholders to prioritize water quality restoration projects based on areas that show the greatest need from monitoring data. **Table 10** provides the TRA evaluation results based on data from WY2018 through WY2022, and **Figure 9** show these results on a map.

Table 10. TRA evaluation results for St. Lucie River and Estuary basins

Note: The numbers highlighted in green and marked with an * have moved down in priority since the BMAP update. The numbers highlighted in orange and marked with an ** increased in priority since the BMAP update.

Basin	Final TN Priority	Final TP Priority
Basin 4/5	2	2*
Basin 6	2	2
C-23	1**	1**
C-24	1	2*
C-44/S-153	3	2
North Fork	2**	2**
North Mid-Estuary	3	3
South Coastal	3*	2
South Fork	2	2
South Mid-Estuary	2	2**
Ten Mile Creek	3*	2*

Results of the TRA analysis show quite a few changes in priority levels for most of the basins compared to the 2020 TRA. For increasing TN priorities, the C-23 basin showed an increase in the unit area load while the North Fork basin no longer showed the decreasing trend from the 2018 5-Year Review. The Ten Mile Creek and South Coastal basins had a decrease in TN priority. This was due to a decrease in the unit area load for the Ten Mile Creek basin and a decreasing trend in TN concentrations in the trend analysis presented in this review for both basins.

Basin 4/5 showed a decrease in TP priority due to a decrease in average TP concentration, while the Ten Mile Creek and C-24 basins decreased in priority due to the decreasing trend in TP in the current trend analysis. C-23 had a change in the unit area load that resulted in the higher priority for TP. The North Fork basin increased in TP priority due to the change from a decreasing trend result in the 2018 5-Year Review to no trend in the current analysis. The South Mid-Estuary basin increased in priority for TP due to an increasing trend result in the most current analysis.

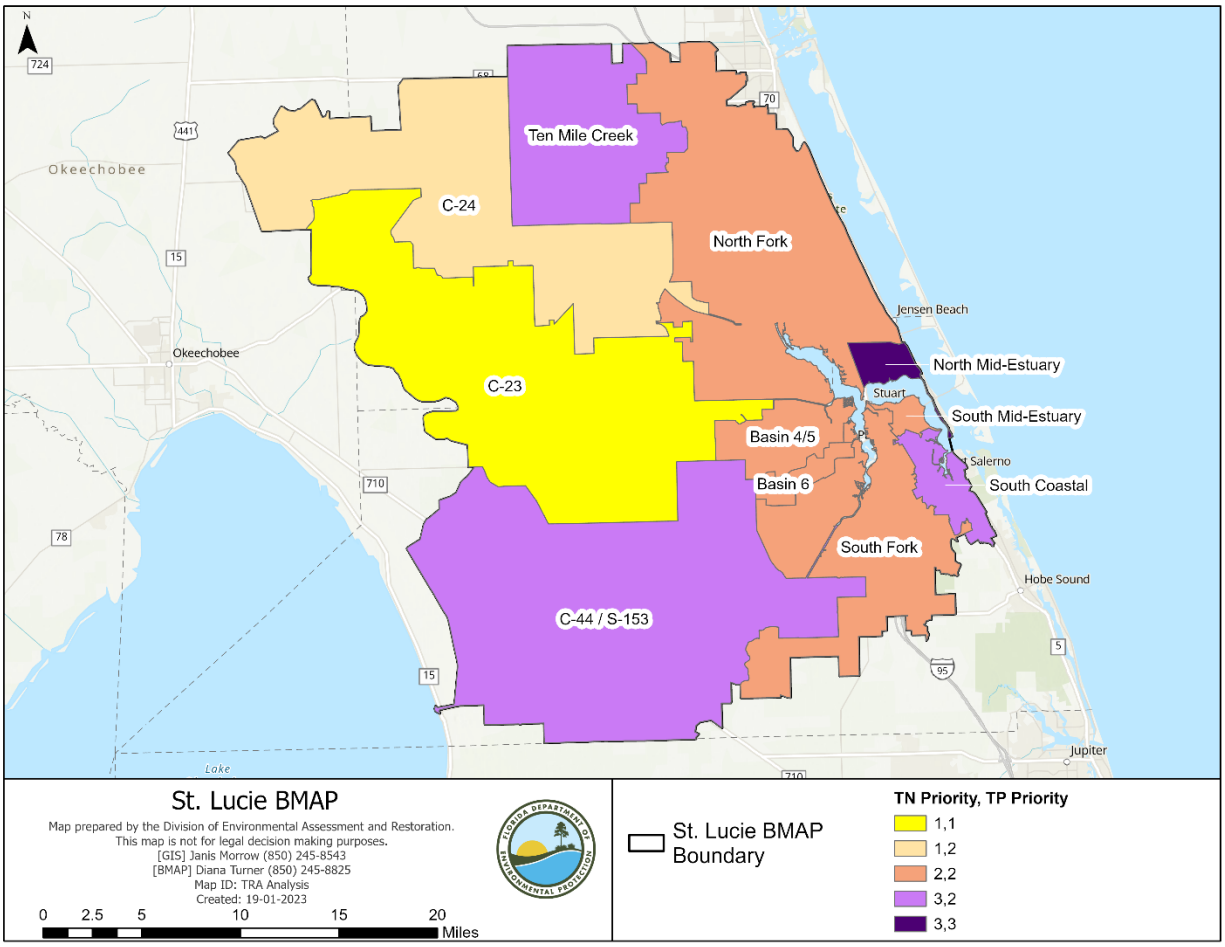

Figure 9. Map of TRA results for basins in the St. Lucie River and Estuary BMAP

Chapter 3. Recommendations

The BMAP implements phased TN and TP reductions according to section 403.067(7)(a)1., F.S. The purpose of this 2023 5-Year Review is to evaluate implementation activities that have taken place during the first and second five-year phases. The recommendations included here are for future implementation activities that may be incorporated into a revised BMAP and adopted by Secretarial Order.

The first and second BMAP phases included significant restoration efforts by stakeholders, and the implementation process will continue to help meet the TMDLs. Through December 31, 2022, 229 projects were completed, and an additional 36 projects were underway or planned. Based on the load estimation shapefile developed from the WaSh model, the completed activities in the St. Lucie River and Estuary Watershed are estimated to achieve total reductions of 839,854 lbs/yr of TN, which is 67% of the reductions needed to meet the TN TMDL, and 203,836 lbs/yr of TP, which is 50% of the reductions needed to meet the TP TMDL.

Recommendations for consideration in the next BMAP update are summarized in the sections below.

3.1 Milestones

Milestones with percent reduction goals were established by the 2020 BMAP as follows:

TN Milestones:

- 5-year milestone (Years 1 to 5): 50%
- 10-year milestone (Years 6 to 10): 75%
- 15-year milestone (Years 11 to 15): 100%

TP Milestones:

- 5-year milestone (Years 1 to 5): 50%
- 10-year milestone (Years 6 to 10): 65%
- 15-year milestone (Years 11 to 15): 100%

The 2013 BMAP was established with a 15-year deadline, thus the current BMAP has 100% of required reductions to be completed by 2028. The updated modeling completed for the 2020 BMAP resulted in increased load reduction requirements for the stakeholders. In addition, based on the water quality trend evaluation (see **Section 2.3.2**), TN and TP concentrations are still significantly higher than the TMDL concentrations. To allow the time necessary to plan and construct projects to meet the TMDL targets, it is recommended that the milestones be adjusted for a 20-year

completion plan, which is consistent with the other Northern Everglades BMAPs for the Caloosahatchee River and Estuary and Lake Okeechobee.

3.2 Water Quality Monitoring

Monitoring locations proposed in the previous BMAP update have been successfully implemented and will provide important data for better defining basin-wide nutrient sources in the St. Lucie River and Estuary BMAP for inland basins within the watershed.

Monitoring for Basin 4/5 and Basin 6 is conducted through a single location for each basin, and sample collection appears to be less consistent than other basins in the St. Lucie River and Estuary Watershed. DEP and SFWMD will collaborate to determine whether new locations are needed for long-term monitoring of these basins, or if additional sites would instead provide supplementary data for the basins.

3.3 Compliance

Extensive land use changes have occurred in areas of the St. Lucie BMAP, and allocations may need to be adjusted in the upcoming BMAP update to better reflect the changes in sources of nutrient loading, including consideration of FDACS unenrolled agricultural lands characterization analysis, along with other appropriate data sets. BMAP requirements may also need to be updated to correspond with pending rule changes regarding stormwater infrastructure.

3.4 Wastewater and OSTDS Plans

Subparagraph 403.067(7)(a)9, F.S., states that in BMAP watersheds with at least 20% of the nutrient loading from WWTF or OSTDS, local governments must develop a plan to address any necessary construction, expansion, or upgrades to address these sources. The plans are to be developed with cooperation from DEP, water management districts, and adjacent stakeholders. The plan must name responsible parties and include permitted capacity, average nutrient load, projected timeline for improvements, and projected cost for improvements. These plans must be incorporated into the revised BMAP no later than July 1, 2025. DEP has begun to provide information and resources to local governments to help them in preparing these plans.

DEP recommends including a new OSTDS requirement in the next BMAP update that prohibits new conventional systems on lots of one acre or less within the BMAP area unless certain other requirements are met. DEP will work with stakeholders on refining OSTDS requirements in BMAP areas.

Chapter 4. References

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Appendices

Appendix A. Water Quality Data Processing and Analysis Methods

For this 2023 5-Year Review, trend analyses were conducted on available data from Tier 1 and Tier 2 stations in the St. Lucie River and Estuary BMAP network from an overall POR of May 1, 2001, to April 30, 2022 (six years before BMAP adoption through the first ten years of BMAP implementation). WIN data for nutrient concentrations were processed using the methods described below, and only data that meet quality control objectives were used in the analyses. Nonparametric statistical techniques were used to identify monotonic trend analyses in a statistically rigorous way with the Seasonal Kendall trend test. Data are not required to conform to a particular distribution for nonparametric analyses. Nonparametric tests are also robust against outliers and large data gaps. **Section 2.3** in the main report summarizes the analyses and results; additional details on the methods are provided below.

Data Download

- Stations used for each basin to collect TN and TP data from WIN and the 2017 5-Year Review are summarized in **Table A-1**.

Table A-1. List of stations selected for processing

Basin	Station Name	WIN ID	Basin	Station Name	WIN ID
Basin 4/5	SLT-9	18971	**North Fork**	SLT-17	18935
Basin 6	SLT-7	18969	**North Fork**	SLT-19	18937
C-23	ACRA1	1920	**North Fork**	SLT-21	18940
C-23	PC32C23	39863	**North Fork**	SLT-22A	35317
C-23	PC49C23	39861	**North Fork**	SLT-26	18945
C-23	C23S48	4199	**North Fork**	SLT-39	18960
C-24	G79	39860	**North Fork**	SLT-41	18963
C-24	PC38C24	39865	**North Fork**	SLT-42B	36691
C-24	PC39C24	49025	**North Fork**	SLT-45	36692
C-24	PC54C23	41460	**North Fork**	U16-D016/CS-1 (Structure)	VETERANS MEMORIAL
C-24	C24S49	4203	**North Mid-Estuary**	SE 02	18443
C-44	C44S80	4329	**North Mid-Estuary**	SLT-29	18948
C-44	C44SC14	39857	**North Mid-Estuary**	SLT-30A	36690
C-44	C44SC19	49022	**South Coastal**	SE 11	18453
C-44	C44SC2	49020	**South Coastal**	SLT-35	18955
C-44	C44SC23	49023	**South Coastal**	SLT-36	18956
C-44	C44SC24	49024	**South Coastal**	SLT-37A	18958

Basin	Station Name	WIN ID	Basin	Station Name	WIN ID
C-44	C44SC5	49021	**South Coastal**	SLT-44	18966
C-44	S153	17331	**South Fork**	SE 08B	18450
C-44	S308C	17625	**South Fork**	SE 09	18451
Compliance Station	SE 03	18444	**South Fork**	SLT-1	18926
North Fork	A18	HORSESHOE CANAL	**South Fork**	SLT-2A	36689
North Fork	A22	SOUTHBEND_HORSESHOE	**South Fork**	SLT-3	18949
North Fork	C-107/ 7-01 (Structure)	C-107 WW	**South Fork**	SLT-31	18951
North Fork	E8/B-2 (Structure)	E-8 WW	**South Fork**	SLT-34A	28220
North Fork	Elcam Spillway	ELKCAM WW	**South Fork**	SLT-4	18961
North Fork	H-16/H-60 (Structure)	HOGPEN SLOUGH	**South Fork**	SLT-40	18962
North Fork	HR1	9552	**South Fork**	SLT-40A	35326
North Fork	Kingsway WW	KINGSWAY WW	**South Fork**	SLT-5	18967
North Fork	Monterey WW	MONTERREY WW	**South Fork**	SLT-6	18968
North Fork	SE 06	18447	**South Mid-Estuary**	SE 01	18442
North Fork	SE 12	18454	**South Mid-Estuary**	SLT-38	18959
North Fork	SLT-10A	18927	**South Mid-Estuary**	SLT-38A	35318
North Fork	SLT-10B	18928	**Ten Mile Creek**	GORDYRD	8879
North Fork	SLT-11	18929	-	-	-

- Station concentration data were retrieved from WIN for the designated POR of May 1, 2001, through April 30, 2022, for Tier 1 and 2 basin stations.

Data Processing (in order of operation)

- Nutrient Characteristic Selection:
  - TP: Phosphorus.
  - TN: TN or Total Kjeldahl Nitrogen + (Nitrate + Nitrite), whichever was available.
- Sample Depth:
    - Samples were not filtered by sample depth as only surface water samples were used in this analysis.
- Data Qualifiers:
  - Data with result qualifiers of "A," "F," "G," "H," "K," "L," "N," "O," "T," "V," "Y," or "?" were not used in the analysis, as per Table 1, Data Qualifier Codes, in Rule 62-160.700, F.A.C., Quality Assurance.

  - Data with a result qualifier of "I" were only used if a corresponding minimum detection level (MDL) was listed:
    - Data with qualifier of "I" with corresponding comment "*Present<QL" were not used in the analysis.
  - Data with a result qualifier of "U" were reviewed:
    - If not already present, a result qualifier of "U" was assigned to any data with a result value of "*Non-Detect."
    - Data with a result value of "*Not Reported" were deleted unless they also had a value qualifier of "U."
    - Data with a result value or qualifier that indicated values were below the MDL were reviewed within the dataset's POR. If it was determined that the analytical methods were changed during the POR resulting in differences in the MDL, the highest MDL value was used as the uniform MDL for the entire POR.
    - Data with a result qualifier of "U" were processed in accordance with subsection 62-303.320(12), F.A.C., Aquatic Life-Based Water Quality Criteria Assessment. Results reported by a laboratory with the "U" data qualifier code were assessed as half the reported result or half the criterion (whichever was lower).

- Basin Data:
  - Station data were combined by basin (parameters kept separate) for processing and analysis.
    - Additional analyses were run on stations with more than 50% data coverage and five continuous years of data.

- Temporal Processing:
  - Monthly time series: If multiple data points existed within a month, the monthly median was calculated for each month.

- Processing for Statistical Tests:
  - Data were processed according to the needs of each statistical test and formatted for use in the R statistical program or USGS Fortran executable.
  - Sampling Frequency:
    - Monthly data series were used for analysis.
    - Missing data entries were removed.
  - Data Gap Filling:
    - If a series did not have at least five years of continuous data with 50% coverage, it was not used for trend analysis.

Statistical Analyses

- Trend Analysis:
    - Autocorrelation Function:
        - Autocorrelation was conducted to evaluate seasonal patterns and/or serial correlation (monthly seasons).
            - Autocorrelation was conducted on monthly, non-gap-filled series to determine seasonality.
            - For purposes of Seasonal Kendall analysis, statistically significant correlation on the 12-month lag was considered representative of serial correlation.
    - Seasonal Kendall Tau Test:
        - Statistical Test Description: A nonparametric statistical test that does not require data to conform to a specific distribution and is not sensitive to outliers or data gaps:
            - Identifies monotonic trends in the datasets.
            - Yields statistical significance value and direction of trend (increasing or decreasing).
            - Accounts for seasonal data patterns (using months as seasons).
        - Use in Trend Analysis:
            - Serial correlation was identified with autocorrelations prior to trend analysis.
            - USGS Fortran code for Seasonal Kendall Tau Test was used to produce tau, p-value, adjusted p-value, and Sen slope.
                - Raw p-value < 0.05 used for series with no serial correlation detected.
                - Adjusted p-value < 0.05 used if serial correlation was identified for time series with at least 10 years of data.

Table A-2. Summary of POR and data availability for basins

N/A = Not applicable.

Basin	Stations	Station Tier	WY Range	TN Serial Correlation	TN Number of Samples	TN Percent Complete	TP Serial Correlation	TP Number of Samples	TP Percent Complete
Basin 4/5	SLT-9	2	N/A (gaps)	—	—	—	—	—	—
Basin 6	SLT-7	2	N/A (gaps)	—	—	—	—	—	—
C-23	ACRA1, PC32C23, PC49C23, C23S48	2,2,2,1	N/A (gaps)	—	—	—	—	—	—
C-24	G79, PC38C24, PC39C24, PC54C23, C24S49	2,2,2,2, 1	2001–2022	Yes	237	90%	Y	248	94%
C-44	C44S80, C44SC14, C44SC19, C44SC2, C44SC23, C44SC24, C44SC5, S153, S308C	1,2,2,2, 2,2,2,2, 1	2001–2022	Yes	237	90%	Y	251	95%
Compliance Station	SE 03	1	2017–2022	Yes	70	97%	Y	70	97%
North Fork	A18, A22, C-107/ 7-01(Structure), E8/B-2 (Structure), Elcam Spillway, H-16/H-60 (Structure), HR1, Kingsway WW, Monterey WW, SE 06, SE 12, SLT-10A, SLT-10B, SLT-11, SLT-17, SLT-19, SLT-21, SLT-22A, SLT-26, SLT-39, SLT-41, SLT-42B, SLT-45, U16-D016/CS-1 (Structure)	2,2,2,2, 2,2,1,2, 2,1,1,2, 2,2,2,2, 2,2,2,2, 2,2,2,2	2003–2022	No	213	93%	Y	228	100%
North Mid-Estuary	SE 02, SLT-29, SLT-30A	1,2,2	2013–2022	No	98	82%	N	99	83%
South Coastal	SE 11, SLT-35, SLT-36, SLT-37A, SLT-44	1,2,2,2, 2	2003–2022	Yes	216	90%	Y	229	95%

Basin	Stations	Station Tier	WY Range	TN Serial Correlation	TN Number of Samples	TN Percent Complete	TP Serial Correlation	TP Number of Samples	TP Percent Complete
South Fork	SE 08B, SE 09, SLT-1, SLT-2A, SLT-3, SLT-31, SLT-34A, SLT-4, SLT-40, SLT-40A, SLT-5, SLT-6	1,1,2,2, 2,2,2,2, 2,2,2,2	2003–2022	Yes	204	85%	Y	224	93%
South Mid-Estuary	SE 01, SLT-38, SLT-38A	1,2,2	2013–2022	No	110	92%	N	113	94%
Ten Mile Creek	GORDYRD	1	2001–2022	Yes	239	91%	Y	253	96%

Table A-3. Summary statistics for nutrient concentrations by basin

Note: All values in mg/L.
Basins with * do not have consistent data, which could affect descriptive statistics.
N/A = Not applicable.

Basin	TN Average	TN Standard Deviation	TN Minimum	TN Maximum	TP Average	TP Standard Deviation	TP Minimum	TP Maximum
Basin 4/5*	0.925	0.227	0.488	1.708	0.184	0.066	0.063	0.489
Basin 6*	0.998	0.260	0.565	2.140	0.163	0.068	0.041	0.477
C-23*	1.322	0.384	0.252	3.020	0.295	0.178	0.065	1.089
C-24	1.269	0.325	0.713	2.685	0.211	0.143	0.037	0.839
C-44	1.222	0.292	0.767	2.572	0.160	0.075	0.043	0.516
Compliance Station	0.828	0.352	0.397	1.780	0.157	0.061	0.068	0.369
North Fork	0.822	0.120	0.605	1.358	0.077	0.038	0.026	0.364
North Mid-Estuary	0.835	0.191	0.303	1.212	0.030	0.020	0.012	0.101
South Coastal	0.931	0.278	0.123	2.155	0.059	0.045	0.013	0.308
South Fork	0.984	0.152	0.501	1.430	0.119	0.031	0.047	0.233
South Mid-Estuary	0.609	0.114	0.409	0.919	0.036	0.017	0.017	0.102
Ten Mile Creek	0.954	0.341	0.385	2.094	0.238	0.149	0.044	1.068

Table A-4. Trend analysis results by station for TN

Note: Cells marked with a – indicate insufficient data. See **Appendix A** for details on data sufficiency requirements.
N/A = Not applicable.

Basin	Station Name	Period of Record (WY)	Serial Correlation	Tau	Kendall S	Slope	p-value	TN Trend
C-24	**C24S49**	2001–2022	Yes	-0.103	-234	-0.00479	0.123	No Significant Trend
C-44	**C44S80**	2001–2022	Yes	-0.149	-348	-0.00929	**0.0356**	**Significantly Decreasing**
Ten Mile Creek	**GORDYRD**	2001–2022	No	-0.218	-512	-0.01175	**0.0045**	**Significantly Decreasing**
North Fork	**SLT-11**	2003–2022	Yes	-0.114	-207	-0.00397	0.1324	No Significant Trend
North Fork	**SLT-17**	2003–2022	No	-0.01	-17	-0.00056	0.8579	No Significant Trend
North Fork	**SLT-19**	2003–2022	Yes	0.004	7	8.57E-05	0.9655	No Significant Trend
North Fork	**SLT-21**	2003–2022	Yes	-0.113	-171	-0.0035	0.1054	No Significant Trend
North Fork	**SLT-26**	2003–2022	No	-0.001	-3	-3.1E-05	0.9836	No Significant Trend
North Mid-Estuary	**SLT-29**	20032022	No	0.008	13	0.0005	0.889	No Significant Trend
South Fork	**SLT-31**	2003–2022	Yes	0.061	102	0.003297	0.3546	No Significant Trend
South Coastal	**SLT-37A**	2005–2022	Yes	0.373	133	0.02571	**0.0486**	**Significantly Increasing**
South Fork	**SE 08B**	2005–2022	Yes	-0.126	-186	-0.00764	0.0815	No Significant Trend
South Coastal	**SLT-44**	2008–2022	No	0.15	154	0.006682	**0.0118**	**Significantly Increasing**
South Fork	**SLT-34A**	2008–2022	No	-0.182	-183	-0.00828	**0.0023**	**Significantly Decreasing**
South Fork	**SE 09**	2012–2022	No	0.042	22	0.003	0.5815	No Significant Trend
South Fork	**SLT-40A**	2013–2021	Yes	-0.43	-133	-0.03371	**0.0126**	**Significantly Decreasing**
South Mid-Estuary	**SLT-38A**	2013–2022	No	0.043	20	0.001646	0.5889	No Significant Trend
North Fork	**SLT-10A**	2014–2022	No	-0.061	-22	-0.00156	0.4773	No Significant Trend
North Fork	**SLT-42B**	2014–2022	No	-0.46	-125	-0.0276	**0**	**Significantly Decreasing**
South Coastal	**SLT-35**	2014–2022	No	-0.341	-472	-0.01347	**0**	**Significantly Decreasing**
South Fork	**SLT-2A**	2014–2022	Yes	0.269	79	0.01671	**0.0034**	**Significantly Increasing**
South Fork	**SLT-3**	2014–2022	No	0.067	24	0.008708	0.4329	No Significant Trend
North Fork	**SE 06**	2016–2022	No	0.113	25	0.01	0.2584	No Significant Trend
North Fork	**SE 12**	2016–2022	No	0.093	20	0.007125	0.3629	No Significant Trend
C-44	**S308C**	2017–2022	No	-0.211	-37	-0.04425	**0.0469**	**Significantly Decreasing**

Basin	Station Name	Period of Record (WY)	Serial Correlation	Tau	Kendall S	Slope	p-value	TN Trend
Compliance Station	**SE 03**	2017–2022	Yes	-0.047	-8	-0.0035	0.694	No Significant Trend
North Fork	**HR1**	2017–2022	Yes	0	0	-0.001	1	No Significant Trend
North Mid-Estuary	**SE 02**	2017–2022	No	-0.044	-7	-0.00417	0.7256	No Significant Trend
South Coastal	**SE 11**	2017–2022	No	-0.188	-30	-0.013	0.0904	No Significant Trend
South Mid-Estuary	**SE 01**	2017–2022	No	-0.056	-9	-0.00675	0.6399	No Significant Trend
Basin 4/5	**SLT-9**	N/A (gaps)	—	—	—	—	—	—
Basin 6	**SLT-7**	N/A (gaps)	—	—	—	—	—	—
C-23	**C23S48**	N/A (gaps)	—	—	—	—	—	—
C-23	**ACRA1**	N/A (gaps)	—	—	—	—	—	—
C-23	**PC32C23**	N/A (new)	—	—	—	—	—	—
C-23	**PC49C23**	N/A (new)	—	—	—	—	—	—
C-24	**G79**	N/A (new)	—	—	—	—	—	—
C-24	**PC38C24**	N/A (gaps)	—	—	—	—	—	—
C-24	**PC39C24**	N/A (gaps)	—	—	—	—	—	—
C-24	**PC54C23**	N/A (gaps)	—	—	—	—	—	—
C-44	**C44SC14**	N/A (gaps)	—	—	—	—	—	—
C-44	**C44SC19**	N/A (new)	—	—	—	—	—	—
C-44	**C44SC2**	N/A (gaps)	—	—	—	—	—	—
C-44	**C44SC23**	N/A (gaps)	—	—	—	—	—	—
C-44	**C44SC24**	N/A (new)	—	—	—	—	—	—
C-44	**C44SC5**	N/A (new)	—	—	—	—	—	—
C-44	**S153**	N/A (gaps)	—	—	—	—	—	—
North Fork	**A18**	N/A (new)	—	—	—	—	—	—
North Fork	**A22**	N/A (new)	—	—	—	—	—	—
North Fork	**C-107/ 7-01 (Structure)**	N/A (new)	—	—	—	—	—	—
North Fork	**E8/B-2 (Structure)**	N/A (new)	—	—	—	—	—	—

Basin	Station Name	Period of Record (WY)	Serial Correlation	Tau	Kendall S	Slope	p-value	TN Trend
North Fork	**Elcam Spillway**	N/A (new)	—	—	—	—	—	—
North Fork	**H-16/H-60 (Structure)**	N/A (new)	—	—	—	—	—	—
North Fork	**Kingsway WW**	N/A (new)	—	—	—	—	—	—
North Fork	**Monterey WW**	N/A (new)	—	—	—	—	—	—
North Fork	**SLT-10B**	N/A (gaps)	—	—	—	—	—	—
North Fork	**SLT-22A**	N/A (gaps)	—	—	—	—	—	—
North Fork	**SLT-39**	N/A (gaps)	—	—	—	—	—	—
North Fork	**SLT-41**	N/A (new)	—	—	—	—	—	—
North Fork	**SLT-45**	N/A (gaps)	—	—	—	—	—	—
North Fork	**U16-D016/CS-1 (Structure)**	N/A (new)	—	—	—	—	—	—
North Mid-Estuary	**SLT-30A**	N/A (gaps)	—	—	—	—	—	—
South Coastal	**SLT-36**	N/A (gaps)	—	—	—	—	—	—
South Fork	**SLT-1**	N/A (gaps)	—	—	—	—	—	—
South Fork	**SLT-4**	N/A (gaps)	—	—	—	—	—	—
South Fork	**SLT-40**	N/A (gaps)	—	—	—	—	—	—
South Fork	**SLT-5**	N/A (gaps)	—	—	—	—	—	—
South Fork	**SLT-6**	N/A (gaps)	—	—	—	—	—	—
South Mid-Estuary	**SLT-38**	N/A (gaps)	—	—	—	—	—	—

Table A-5. Trend analysis results by station for TP

Note: Cells marked with a – indicate insufficient data. See **Appendix A** for details on data sufficiency requirements.
POR does not change between TN and TP samples.

Basin	Station Name	Serial Correlation	Tau	Kendall S	Slope	p-value	Trend
C-24	**C24S49**	Yes	-0.165	-406	-0.00238	**0.0164**	**Significantly Decreasing**

Basin	Station Name	Serial Correlation	Tau	Kendall S	Slope	p-value	Trend
C-44	**C44S80**	No	-0.061	-152	-0.00056	0.1857	No Significant Trend
Ten Mile Creek	**GORDYRD**	No	-0.376	-955	-0.00691	**0.0001**	**Significantly Decreasing**
North Fork	**SLT-11**	Yes	-0.035	-66	-0.00019	0.6664	No Significant Trend
North Fork	**SLT-17**	Yes	-0.199	-363	-0.00191	**0.047**	**Significantly Decreasing**
North Fork	**SLT-19**	Yes	0.079	149	0.00033	0.4415	No Significant Trend
North Fork	**SLT-21**	Yes	0.073	119	0.00025	0.3226	No Significant Trend
North Fork	**SLT-26**	No	-0.171	-342	-0.00053	**0.0005**	**Significantly Decreasing**
North Mid-Estuary	**SLT-29**	No	-0.279	-488	-0.0006	**0**	**Significantly Decreasing**
South Fork	**SLT-31**	Yes	0.02	35	0.000206	0.869	No Significant Trend
South Coastal	**SLT-37A**	No	0.127	186	0.00025	**0.0176**	**Significantly Increasing**
South Fork	**SE 08B**	Yes	-0.036	-52	-0.0005	0.6884	No Significant Trend
South Coastal	**SLT-44**	No	0.183	198	0.000977	**0.0017**	**Significantly Increasing**
South Fork	**SLT-34A**	Yes	-0.285	-308	-0.00212	**0.0051**	**Significantly Decreasing**
South Fork	**SE 09**	Yes	0.109	57	0.00133	0.3405	No Significant Trend
South Fork	**SLT-40A**	Yes	-0.524	-166	-0.0055	**0.0038**	**Significantly Decreasing**
South Mid-Estuary	**SLT-38A**	No	0.105	50	0.00025	0.1167	No Significant Trend
North Fork	**SLT-10A**	No	-0.11	-38	-0.0011	0.1969	No Significant Trend
North Fork	**SLT-42B**	No	-0.322	-88	0.0044	**0.0005**	**Significantly Decreasing**
South Coastal	**SLT-35**	No	0.229	83	0.0035	**0.0057**	**Significantly Increasing**
South Fork	**SLT-2A**	Yes	0.297	84	0.003167	**0.0012**	**Significantly Increasing**
South Fork	**SLT-3**	No	-0.022	-8	-0.00131	0.8113	No Significant Trend
North Fork	**SE 06**	No	-0.105	-24	-0.00288	0.2877	No Significant Trend
North Fork	**SE 12**	No	-0.135	-30	-0.0035	0.1716	No Significant Trend
C-44	**S308C**	No	-0.109	-19	-0.00413	0.3205	No Significant Trend
Compliance Station	**SE 03**	Yes	-0.153	-26	-0.003	0.1556	No Significant Trend
North Fork	**HR1**	Yes	-0.253	-43	-0.005	**0.0181**	**Significantly Decreasing**

Basin	Station Name	Serial Correlation	Tau	Kendall S	Slope	p-value	Trend
North Mid-Estuary	**SE 02**	Yes	-0.153	-26	-0.003	0.1587	No Significant Trend
South Coastal	**SE 11**	No	-0.194	-33	-0.002	0.0717	No Significant Trend
South Mid-Estuary	**SE 01**	No	-0.106	-18	-0.003	0.3379	No Significant Trend
Basin 4/5	**SLT-9**	—	—	—	—	—	—
Basin 6	**SLT-7**	—	—	—	—	—	—
C-23	**C23S48**	—	—	—	—	—	—
C-23	**ACRA1**	—	—	—	—	—	—
C-23	**PC32C23**	—	—	—	—	—	—
C-23	**PC49C23**	—	—	—	—	—	—
C-24	**G79**	—	—	—	—	—	—
C-24	**PC38C24**	—	—	—	—	—	—
C-24	**PC39C24**	—	—	—	—	—	—
C-24	**PC54C23**	—	—	—	—	—	—
C-44	**C44SC14**	—	—	—	—	—	—
C-44	**C44SC19**	—	—	—	—	—	—
C-44	**C44SC2**	—	—	—	—	—	—
C-44	**C44SC23**	—	—	—	—	—	—
C-44	**C44SC24**	—	—	—	—	—	—
C-44	**C44SC5**	—	—	—	—	—	—
C-44	**S153**	—	—	—	—	—	—
North Fork	**A18**	—	—	—	—	—	—
North Fork	**A22**	—	—	—	—	—	—
North Fork	**C-107/ 7-01(Structure)**	—	—	—	—	—	—
North Fork	**E8/B-2 (Structure)**	—	—	—	—	—	—
North Fork	**Elcam Spillway**	—	—	—	—	—	—
North Fork	**H-16/H-60 (Structure)**	—	—	—	—	—	—

Basin	Station Name	Serial Correlation	Tau	Kendall S	Slope	p-value	Trend
North Fork	**Kingsway WW**	—	—	—	—	—	—
North Fork	**Monterey WW**	—	—	—	—	—	—
North Fork	**SLT-10B**	—	—	—	—	—	—
North Fork	**SLT-22A**	—	—	—	—	—	—
North Fork	**SLT-39**	—	—	—	—	—	—
North Fork	**SLT-41**	—	—	—	—	—	—
North Fork	**SLT-45**	—	—	—	—	—	—
North Fork	**U16-D016/CS-1 (Structure)**	—	—	—	—	—	—
North Mid-Estuary	**SLT-30A**	—	—	—	—	—	—
South Coastal	**SLT-36**	—	—	—	—	—	—
South Fork	**SLT-1**	—	—	—	—	—	—
South Fork	**SLT-4**	—	—	—	—	—	—
South Fork	**SLT-40**	—	—	—	—	—	—
South Fork	**SLT-5**	—	—	—	—	—	—
South Fork	**SLT-6**	—	—	—	—	—	—
South Mid-Estuary	**SLT-38**	—	—	—	—	—	—

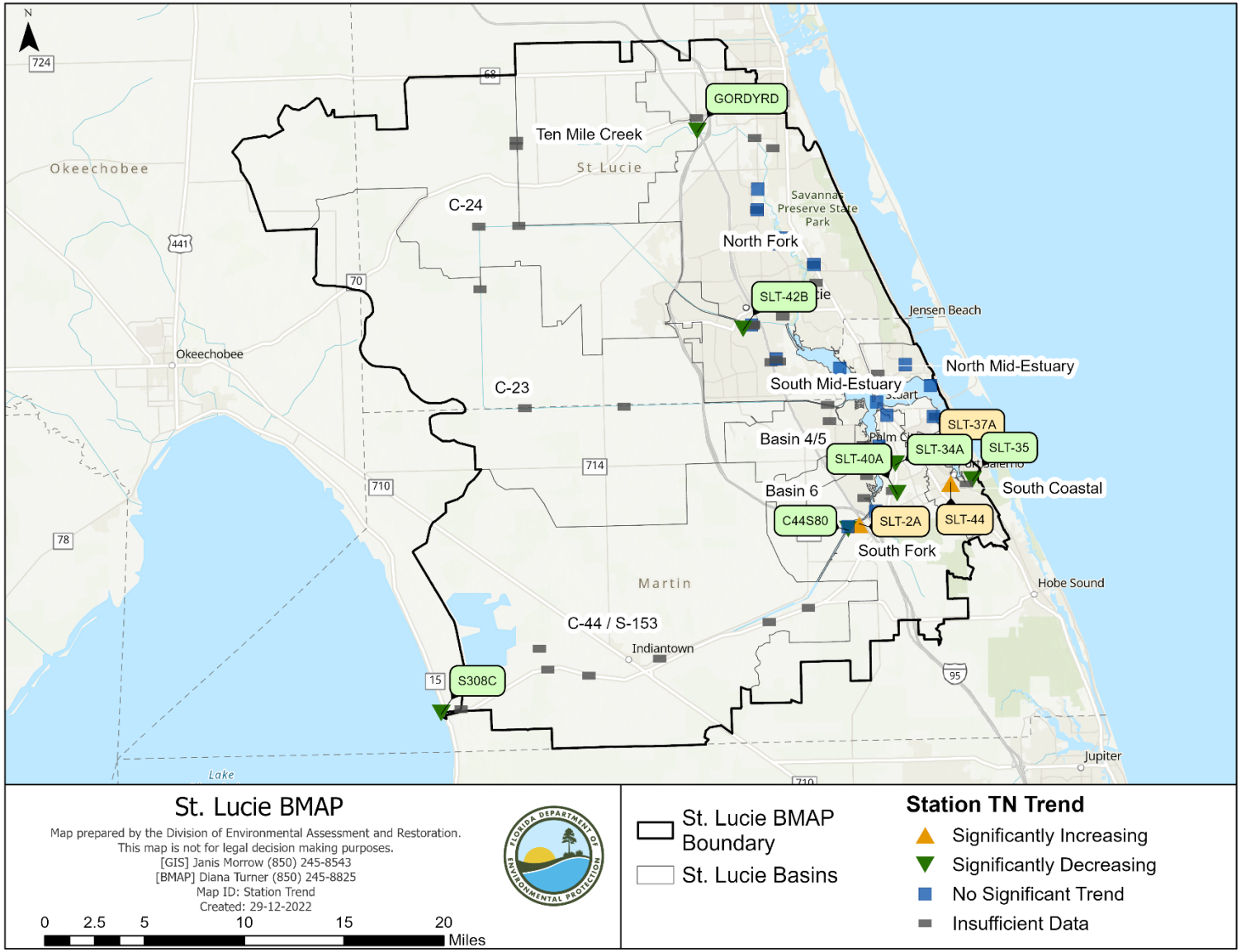

Figure A-1. Map of Seasonal Kendall test for TN by station

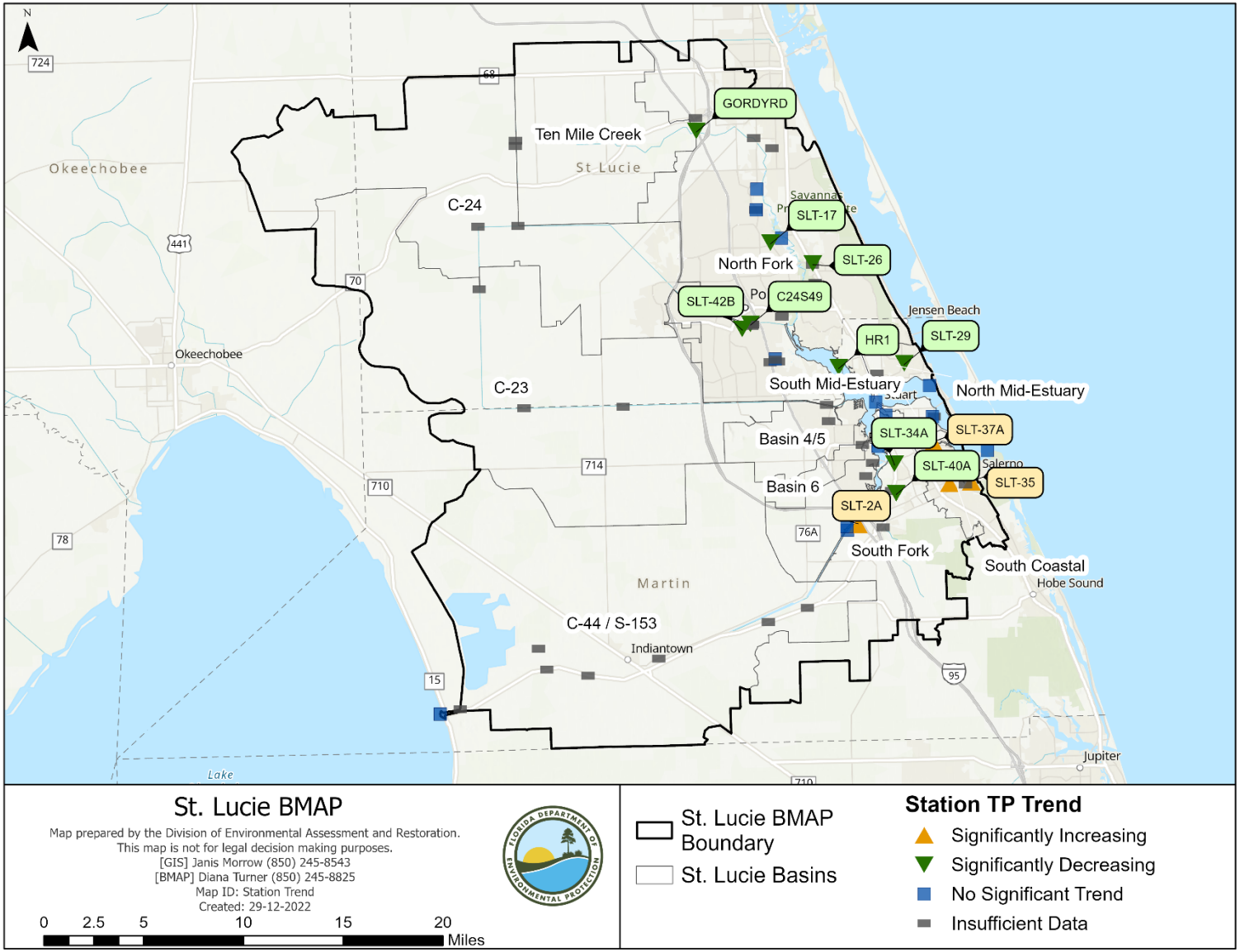

Figure A-2. Map of Seasonal Kendall test for TP by station

Table A-6. Summary statistics by station

Note: All values are in mg/L.

Basin	Station Name	Min of WY	Max of WY	Number of TN Samples	Average of TN	Standard Deviation of TN	Min of TN	Max of TN	Number of TP Samples	Average of TP	Standard Deviation of TP	Min of TP	Max of TP
Basin 4/5	SLT-9	2002	2022	260	0.925	0.227	0.488	1.708	260	0.184	0.066	0.063	0.489
Basin 6	SLT-7	2002	2022	293	0.998	0.260	0.565	2.140	293	0.163	0.068	0.041	0.477
C-23	ACRA1	2020	2022	20	1.605	0.387	1.050	2.390	20	0.470	0.338	0.078	1.089
C-23	C23S48	2001	2022	1055	1.304	0.371	0.252	3.020	1055	0.289	0.171	0.065	0.961
C-23	PC32C23	2021	2022	9	2.187	0.277	1.870	2.650	9	0.486	0.194	0.108	0.697
C-23	PC49C23	2021	2022	8	1.933	0.201	1.660	2.250	8	0.451	0.102	0.325	0.628
C-24	C24S49	2001	2022	1112	1.304	0.353	0.658	5.793	1112	0.230	0.152	0.033	1.020
C-24	G79	2020	2022	47	1.398	0.279	0.847	2.120	47	0.224	0.131	0.060	0.651
C-24	PC38C24	2021	2022	14	1.657	0.165	1.450	1.940	14	0.186	0.042	0.109	0.280
C-24	PC39C24	2021	2022	7	1.541	0.194	1.330	1.840	7	0.792	0.436	0.088	1.494
C-24	PC54C23	2021	2022	17	1.829	0.333	1.240	2.490	17	0.375	0.250	0.103	0.923
C-44	C44S80	2001	2022	1240	1.315	0.999	0.661	20.600	1240	0.183	0.280	0.033	5.443
C-44	C44SC14	2020	2022	14	1.202	0.282	0.707	1.720	14	0.161	0.081	0.084	0.358
C-44	C44SC19	2020	2022	34	1.265	0.454	0.830	2.750	34	0.324	0.268	0.081	1.381
C-44	C44SC2	2021	2021	10	1.260	0.153	1.060	1.500	10	0.116	0.045	0.061	0.200
C-44	C44SC23	2021	2022	13	1.370	0.345	0.818	2.030	13	0.270	0.156	0.059	0.542
C-44	C44SC24	2020	2022	23	1.260	0.300	0.882	2.080	23	0.204	0.139	0.052	0.551
C-44	C44SC5	2020	2022	24	1.484	0.470	0.759	2.460	24	0.125	0.074	0.035	0.262
C-44	S153	2021	2022	17	1.599	0.315	1.070	2.080	17	0.400	0.199	0.098	0.792
C-44	S308C	2017	2022	148	1.824	0.786	0.969	7.680	148	0.223	0.116	0.080	1.066
Compliance Station	SE 03	2004	2022	76	0.830	0.345	0.397	1.780	76	0.156	0.062	0.068	0.369
North Fork	A18	2018	2022	26	0.775	0.219	0.086	1.300	26	0.069	0.030	0.036	0.140
North Fork	A22	2018	2022	26	0.878	0.168	0.660	1.400	26	0.080	0.024	0.040	0.130
North Fork	C-107/7-01 (Structure)	2018	2022	26	0.771	0.194	0.500	1.500	26	0.053	0.028	0.014	0.120
North Fork	E8/B-2 (Structure)	2018	2022	26	0.608	0.135	0.470	1.100	26	0.062	0.028	0.030	0.130
North Fork	Elcam Spillway	2018	2022	26	0.778	0.207	0.530	1.400	26	0.062	0.036	0.026	0.150

Basin	Station Name	Min of WY	Max of WY	Number of TN Samples	Average of TN	Standard Deviation of TN	Min of TN	Max of TN	Number of TP Samples	Average of TP	Standard Deviation of TP	Min of TP	Max of TP
North Fork	H-16/H-60 (Structure)	2018	2022	26	0.800	0.147	0.570	1.100	26	0.053	0.020	0.035	0.130
North Fork	HR1	2001	2022	88	0.855	0.314	0.388	1.828	88	0.184	0.098	0.070	0.758
North Fork	Kingsway WW	2018	2022	25	0.830	0.261	0.470	1.500	25	0.147	0.108	0.036	0.400
North Fork	Monterey WW	2018	2022	26	0.873	0.176	0.580	1.300	26	0.112	0.032	0.052	0.170
North Fork	SE 06	2008	2022	146	0.895	0.225	0.535	1.604	146	0.192	0.090	0.089	0.643
North Fork	SE 12	2008	2022	145	0.952	0.186	0.650	1.523	145	0.200	0.088	0.094	0.588
North Fork	SLT-10A	2002	2022	259	0.942	0.167	0.587	2.150	259	0.099	0.043	0.040	0.253
North Fork	SLT-10B	2002	2022	171	0.887	0.144	0.552	1.300	171	0.080	0.035	0.039	0.321
North Fork	SLT-11	2002	2022	475	0.867	0.249	0.518	3.772	475	0.074	0.048	0.014	0.533
North Fork	SLT-17	2002	2022	428	0.792	0.225	0.393	2.898	428	0.095	0.066	0.016	0.587
North Fork	SLT-19	2002	2022	463	0.798	0.183	0.383	2.156	463	0.049	0.032	0.010	0.221
North Fork	SLT-21	2002	2022	418	0.814	0.198	0.332	3.122	418	0.043	0.028	0.009	0.298
North Fork	SLT-22A	2013	2022	114	0.862	0.221	0.537	1.660	114	0.186	0.114	0.079	0.976
North Fork	SLT-26	2002	2022	436	0.867	0.427	0.502	7.267	436	0.066	0.057	0.020	0.782
North Fork	SLT-39	2003	2022	294	0.947	0.559	0.377	8.651	294	0.207	0.113	0.056	1.460
North Fork	SLT-41	2020	2022	57	0.970	0.119	0.765	1.360	57	0.126	0.028	0.076	0.187
North Fork	SLT-42B	2014	2022	167	0.763	0.170	0.405	1.290	167	0.091	0.034	0.019	0.178
North Fork	SLT-45	2014	2019	131	0.838	1.091	0.428	12.900	131	0.113	0.380	0.024	4.357
North Fork	U16-D016/ CS-1 (Structure)	2018	2022	26	0.818	0.111	0.620	1.100	26	0.032	0.010	0.014	0.062
North Mid-Estuary	SE 02	2004	2022	87	0.707	0.321	0.286	1.600	87	0.137	0.072	0.050	0.410
North Mid-Estuary	SLT-29	2002	2022	410	0.925	0.341	0.086	5.402	410	0.026	0.022	0.005	0.316
North Mid-Estuary	SLT-30A	2014	2022	34	0.914	0.136	0.684	1.200	34	0.025	0.008	0.014	0.045
South Coastal	SE 11	2001	2022	138	0.437	0.297	0.066	1.330	138	0.062	0.057	0.009	0.341
South Coastal	SLT-35	2002	2022	240	1.050	0.445	0.329	5.918	240	0.109	0.074	0.032	0.999
South Coastal	SLT-36	2002	2022	225	1.680	0.798	0.744	5.540	225	0.284	0.176	0.070	1.277

Basin	Station Name	Min of WY	Max of WY	Number of TN Samples	Average of TN	Standard Deviation of TN	Min of TN	Max of TN	Number of TP Samples	Average of TP	Standard Deviation of TP	Min of TP	Max of TP
South Coastal	SLT-37A	2003	2022	440	0.829	0.275	0.368	2.270	440	0.026	0.022	0.008	0.321
South Coastal	SLT-44	2008	2022	348	0.889	0.210	0.593	2.393	348	0.050	0.030	0.012	0.314
South Fork	SE 08B	2004	2022	201	1.048	0.353	0.466	2.985	201	0.187	0.069	0.021	0.540
South Fork	SE 09	2001	2022	141	1.062	0.256	0.571	1.840	141	0.177	0.058	0.091	0.426
South Fork	SLT-1	2002	2022	134	1.006	0.208	0.644	1.680	134	0.118	0.043	0.055	0.299
South Fork	SLT-2A	2014	2022	159	0.883	0.122	0.550	1.220	159	0.053	0.030	0.017	0.174
South Fork	SLT-3	2014	2022	199	0.328	0.275	0.035	1.610	199	1.089	0.364	0.661	3.070
South Fork	SLT-31	2002	2022	498	0.924	0.456	0.365	6.656	498	0.132	0.131	0.015	1.207
South Fork	SLT-34A	2008	2022	345	1.086	0.255	0.653	3.453	345	0.127	0.056	0.056	0.888
South Fork	SLT-4	2002	2022	93	0.969	0.339	0.661	3.928	93	0.131	0.050	0.071	0.514
South Fork	SLT-40	2003	2021	204	1.116	0.384	0.490	3.175	204	0.104	0.062	0.029	0.526
South Fork	SLT-40A	2013	2022	168	1.084	0.195	0.677	1.740	168	0.087	0.034	0.024	0.184
South Fork	SLT-5	2002	2022	129	1.294	0.394	0.681	3.580	129	0.142	0.066	0.066	0.428
South Fork	SLT-6	2002	2022	119	1.621	0.594	0.819	5.427	119	0.269	0.154	0.058	1.122
South Mid-Estuary	SE 01	2004	2022	84	0.568	0.306	0.137	1.480	84	0.104	0.067	0.015	0.339
South Mid-Estuary	SLT-38	2002	2022	202	0.842	0.257	0.390	3.057	202	0.089	0.060	0.014	0.606
South Mid-Estuary	SLT-38A	2013	2022	236	0.607	0.126	0.366	1.490	236	0.029	0.011	0.016	0.129
Ten Mile Creek	GORDYRD	2001	2022	1459	0.960	0.375	0.028	3.318	1459	0.249	0.176	0.001	1.570