Appendix 4-1: Water Year 2013 Supplemental Evaluations for Regulatory Source Control Programs in the Northern Everglades Watersheds

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INTRODUCTION

The South Florida Water Management District (District or SFWMD) is required under the Northern Everglades and Estuaries Protection Program [Subsection 373.4595(6), Florida Statutes] to provide an annual progress report on water quality and other conditions. Annual reporting on the progress and effectiveness of the source control programs for the Northern Everglades watersheds is a component of the overall strategy for meeting water quality requirements. Other source control reporting requirements are presented in Chapter 4 of this volume.

The Northern Everglades Source Control Programs consist of a combination of distinct and coordinated efforts, including the SFWMD Works of the District (WOD) Phosphorus Control Program, the SFWMD Environmental Resource Permitting (ERP)/Surface Water Management Permitting (SW) Program, the Florida Department of Agriculture and Consumer Services (FDACS) Notice of Intent Best Management Practices (BMP) Program, and the Florida Department of Environmental Protection (FDEP) programs. The WOD program is a mandated nonpoint source control program focusing on nutrient discharges from new and existing agricultural and nonagricultural land uses. The ERP/SW permits apply to agricultural and nonagricultural projects (new or modifications to existing) that alter surface water flows and have the potential to affect water management and resource protection. The FDACS program is an incentive-based BMP program targeting pollutants from agricultural land uses. The FDEP source control programs are primarily for point source nonagricultural areas.

As source control programs are not yet fully developed and implemented in the Northern Everglades watersheds, it is essential to accurately track their implementation rates. These implementation rates are key to evaluating effectiveness with regard to improving downstream water quality. Once water quality monitoring networks are finalized, it is anticipated that the data

[1] Contributed as SFWMD staff during the draft SFER production cycle.

will be used in conjunction with implementation rates to evaluate progress toward achieving water quality goals.

The implementation of source control programs in the Lake Okeechobee, St. Lucie River, and Caloosahatchee River watersheds is provided in this appendix for Water Year 2013 (WY2013) (May 1, 2012–April 30, 2013). The following pages provide a brief description of the existing flow and monitoring networks, water quality data, and geospatial coverage of source control programs in the three watersheds, including lands that have SFWMD WOD and ERP/SW permits, and agricultural lands that are enrolled in the FDACS BMP Program based on documentation of a landowner's intent to implement BMPs as of June 2013 for the Lake Okeechobee and Caloosahatchee River watersheds and July 2013 for the St. Lucie River Watershed.

LAKE OKEECHOBEE WATERSHED

The existing monitoring network provides nutrient and flow data to capture nutrient loading from the following basins: Upper Kissimmee, Lower Kissimmee, S-133, S-135, S-154, S-154C, S-191, Lake Istokpoga, Indian Prairie, Fisheating Creek, Nicodemus Slough, East Caloosahatchee, S-4/Industrial Canal, C-44, L-8, and South Lake Okeechobee. The East Caloosahatchee and S-4/Industrial Canal basins can discharge into either Lake Okeechobee or the Caloosahatchee River, and the C-44 Basin can discharge into either Lake Okeechobee or the St. Lucie River. The L-8 Basin can also discharge into either Lake Okeechobee or outside of the watershed into the S-5A Basin, West Pam Beach Canal, or C-51W Basin. Additionally, there are two tributaries in the Upper Kissimmee Sub-watershed (Boggy Creek and Shingle Creek) and two tributaries in the Lake Istokpoga Sub-watershed (Arbuckle Creek and Josphine Creek) where total phosphorus (TP) flow data are available upstream of Lake Kissimmee and Lake Istokopga.

Figures 1 and **2** provide flow schematics of the Lake Okeechobee Watershed, depicting the sub-watersheds located northern and southern part of Lake Okeechobee, respectively, flow transfers between sub-watersheds, and existing structures associated with the water quality and flow data used for nutrient calculations. **Figures 3** through **17** provide the geospatial coverage of the source control programs in each of the sub-watersheds and basins located within the Lake Okeechobee Watershed. This includes lands that have WOD and ERP/SW permits, and agricultural lands that are enrolled in the FDACS BMP Program based on Notice of Intent (NOI) to Implement documentation as of June 2013.

Table 1 provides a summary of the 2013 load and flow-weighted mean (FWM) concentration data for the basins within the Lake Okeechobee Watershed; **Figures 18** through **33** provideTP load and FWM concentration data from WY2002–WY2013 for each basin. These load and concentration data represent total runoff from the basins regardless of receiving water body. Total runoff load is presented because reductions in discharges to one water body may be due to diversions to other water bodies and not to reductions at the source. It should also be noted that these data may differ from the data presented in Chapter 8 because that chapter focuses solely on TP loads entering Lake Okeechobee.

LAKE OKEECHOBEE WATERSHED ASSESSMENT MONITORING NETWORK DATA

In addition to the water quality monitoring at the Lake Okeechobee sub-watershed and basin-level structures, monitoring is conducted within each sub-watershed and basin under several different projects. The District's ambient monitoring network and the United States Geological Survey monitoring network are described in Chapter 8 of this volume. Lake Okeechobee Watershed Assessment (LOWA) monitoring, along with other ambient monitoring network data (TP concentration only) are used by the coordinating agencies to direct resources to areas of water quality concern. Site data collected under the LOWA monitoring program, along with data collected from the District's ambient monitoring network and Lake Okeechobee inflow sites, are used to identify, prioritize, and direct resources to areas of water quality concern within the sub-watershed. The District, FDACS, and FDEP meet routinely to discuss areas with water quality concerns.

An overview of TP concentrations from the LOWA monitoring network and ambient TP sites from other monitoring projects is presented in **Figures 34** through **44.** These sites include WY2013 mean TP concentrations for all samples taken during a flow event. Note that for the Lake Okeechobee structure stations, the mean TP concentrations include concentration data for samples collected when there was reverse flow. Also, the concentrations presented in **Figures 34** through **44** are not flow-weighted as flow measurements were not available at most stations. Sites that are depicted with a square, in general, represent larger conveyances or canals.

Water quality data were collected in the Upper Kissimmee, Lower Kissimmee, S-133, S-154, S-191, Lake Istokpoga, Indian Prairie, Fisheating Creek, S-135, S-154C, and Nicodemus Slough hydrologic areas under the various District monitoring projects mentioned above. In the Upper Kissimmee (thirty-seven sites), S-135 (one site), and Nicodemus Slough (one site) basins, the mean concentrations at all sites collected were less that 180 ppb, which was the Surface Water Improvement Management plan tributary inflow target for Lake Okeechobee (SFWMD, 2002[2]). Lower Kissimmee, which includes the S-65D and S-65E priority basins, the S-154 priority basin, the S-191 priority basin, Lake Istokpoga, and Indian Prairie basins, all had upstream sites with concentrations greater than 1,000 ppb.

Table 2 presents the TP annual means and medians of all the samples collected in each basin. The Chapter 40E-61, Florida Administrative Code (F.A.C.), lake inflow concentration limitation for each basin is also presented. The basin means are typically greater than the medians because sites with higher concentrations will skew the data higher. The S-154C, S-191, and S-154 basins had the highest mean and median TP concentrations.

During this past water year, the District partnered with the FDACS and FDEP to conduct a water quality survey downstream of two LOWA monitoring sites with relatively high concentrations (1,755 ppb and 693 ppb annual average TP) that flow often (16 and 25 flow samples out of 26 possible, respectively). These LOWA monitoring sites receive runoff from a vegetable field and dairy and are located in the Lake Istokpoga Basin. Results of the one-day sampling survey were inconclusive in determining a specific source of the high TP concentrations. However, continual high concentrations at the LOWA monitoring stations did move a nearby farm up on the priority list, and the FDACS was able to cost-share the implementation of riser culverts to try to reduce runoff from the area.

SUB-WATERSHED OBSERVED ANNUAL TOTAL PHOSPHORUS LOAD BREAKDOWN

Figure 45 provides a box-and-whisker plot for the 16 sub-watersheds. The data used to construct this figure included loading information from the most recent twelve-year period (WY2002 to WY2013), except for S-154C and Nicodemus Slough where WY2009 to WY2013 were used as measured flow data was not available until WY2009 for these two particular basins. It should also be noted that the TP loads presented in this table may differ from the loads

[2] SFWMD. 2002 Surface Water Improvement and Management (SWIM) Plan, Update for Lake Okeechobee 2002. South Florida Water Management District, West Palm Beach, FL.

presented in Chapter 8 of this volume because that chapter focuses solely on TP loads entering Lake Okeechobee.

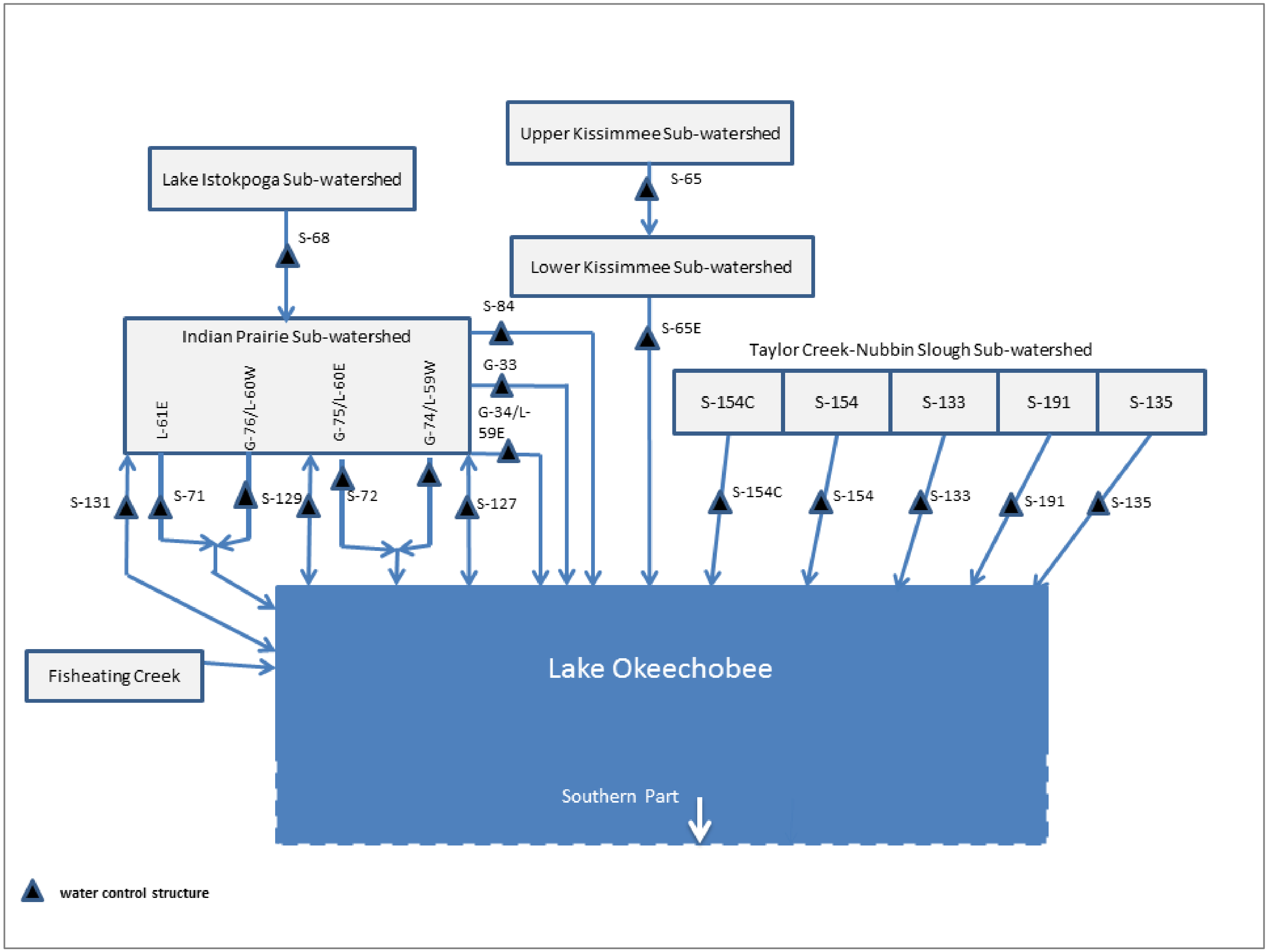


Figure 1. Lake Okeechobee Watershed (northern part of Lake Okeechobee) flow schematic.

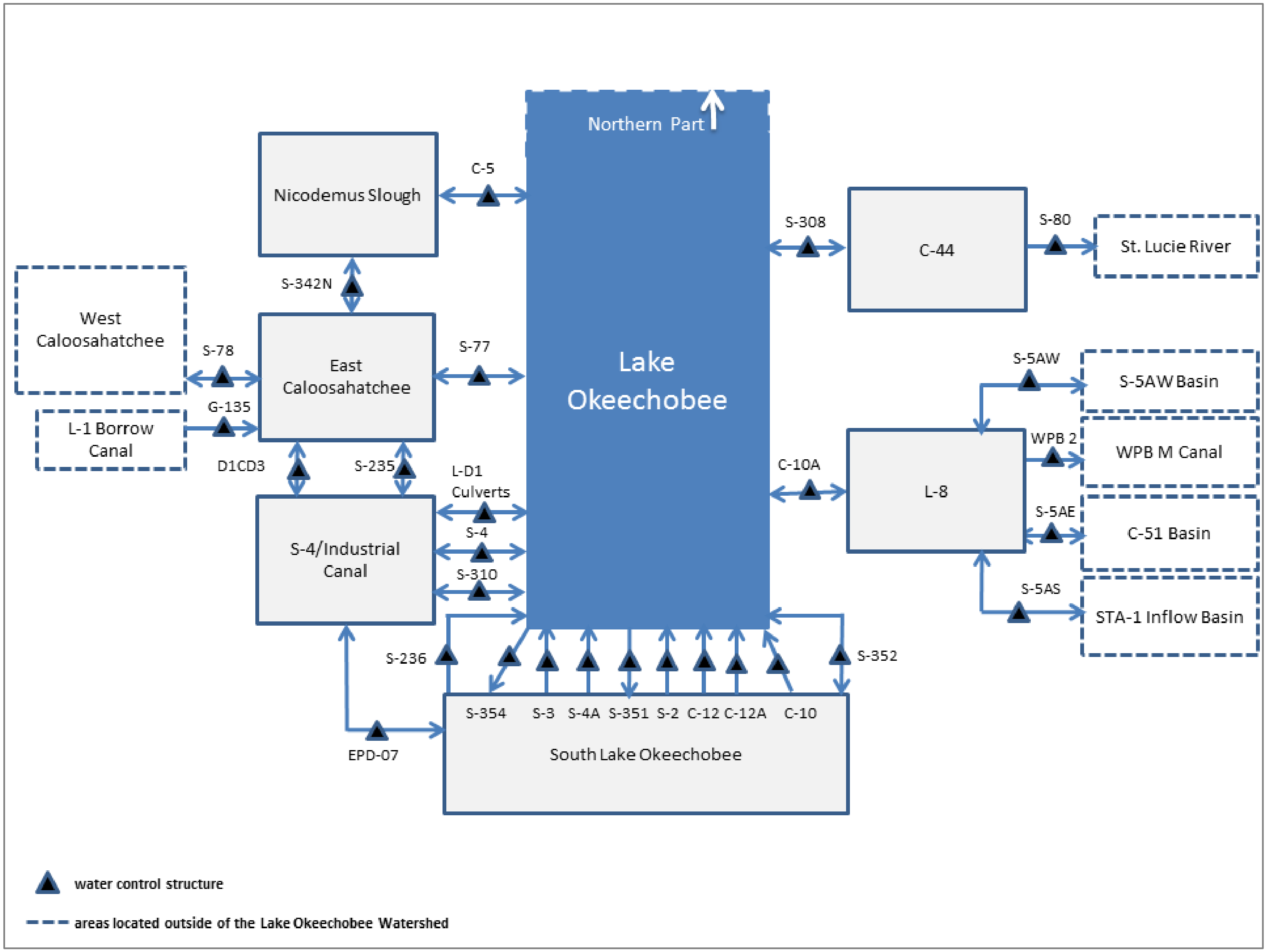


Figure 2. Lake Okeechobee Watershed (southern part of Lake Okeechobee) flow schematic.

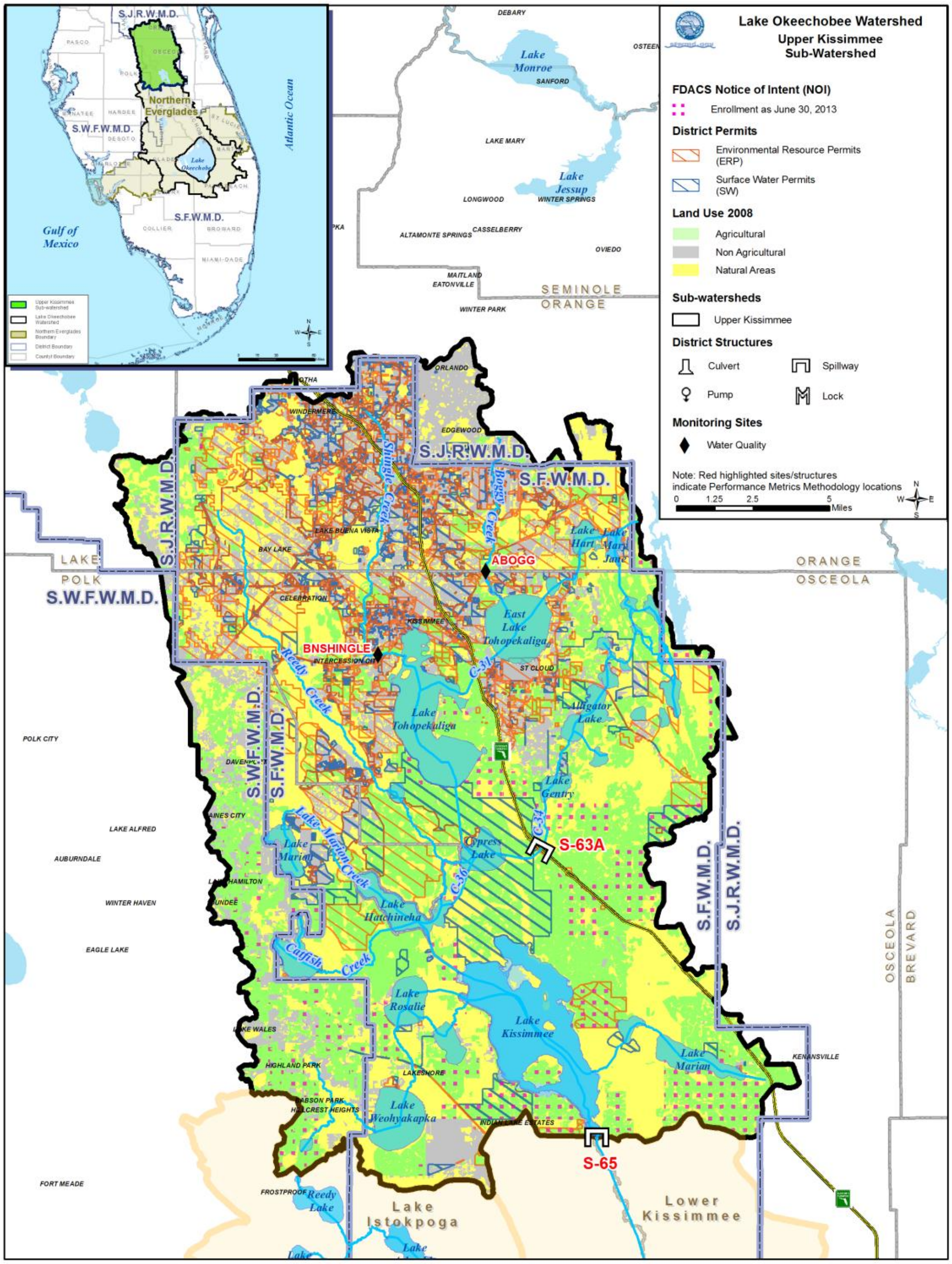


Figure 3. Source control program coverage in the Upper Kissimmee Sub-watershed. [Note: Co – County, FDACS – Florida Department of Agriculture and Consumer Services, S.F.W.M.D. – South Florida Water Management District, S.J.R.W.M.D. – St. Johns Water Management District, S.W.F.W.M.D. – Southwest Florida Water Management District.]

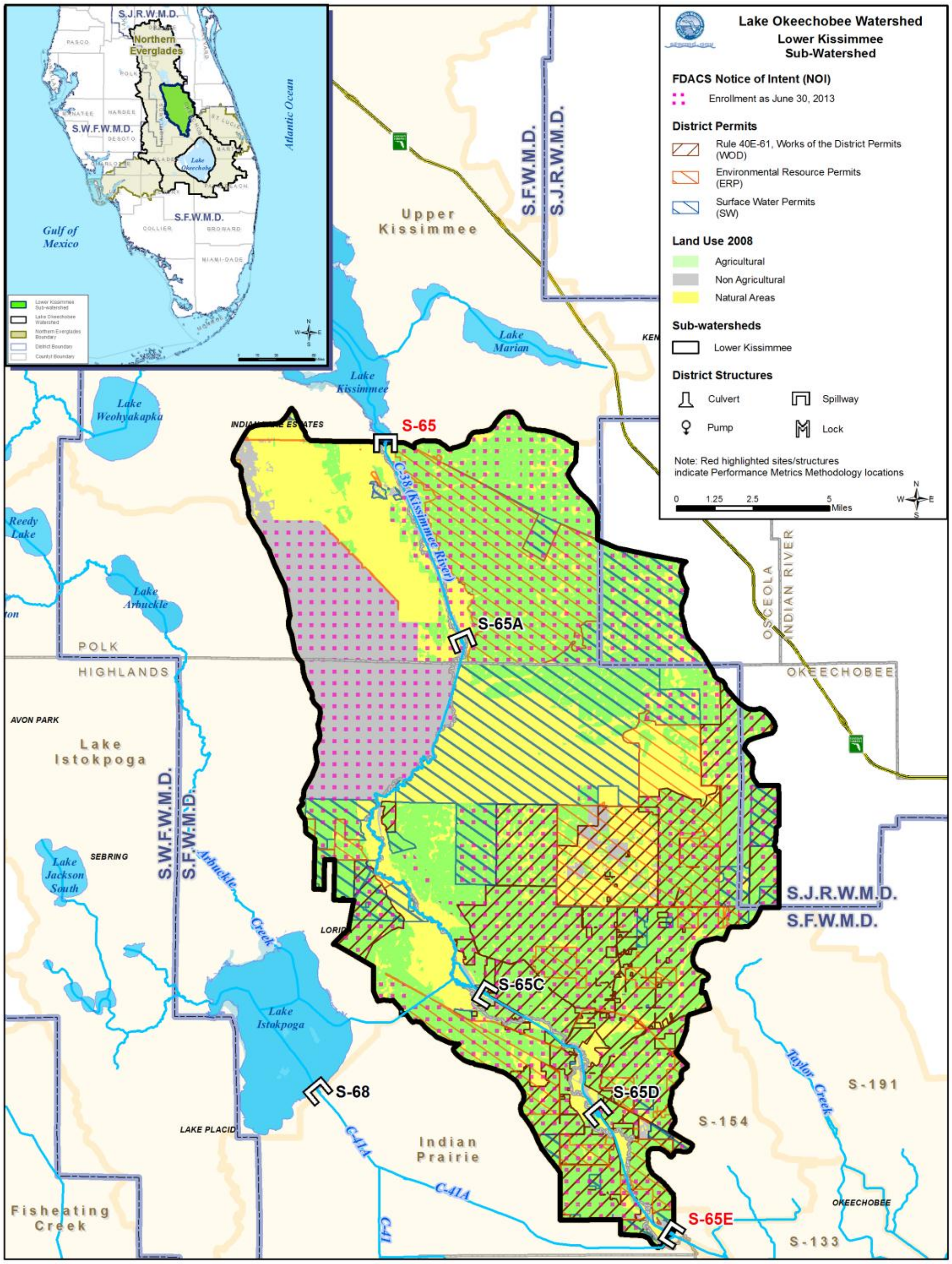


Figure 4. Source control program coverage in the Lower Kissimmee Sub-watershed.

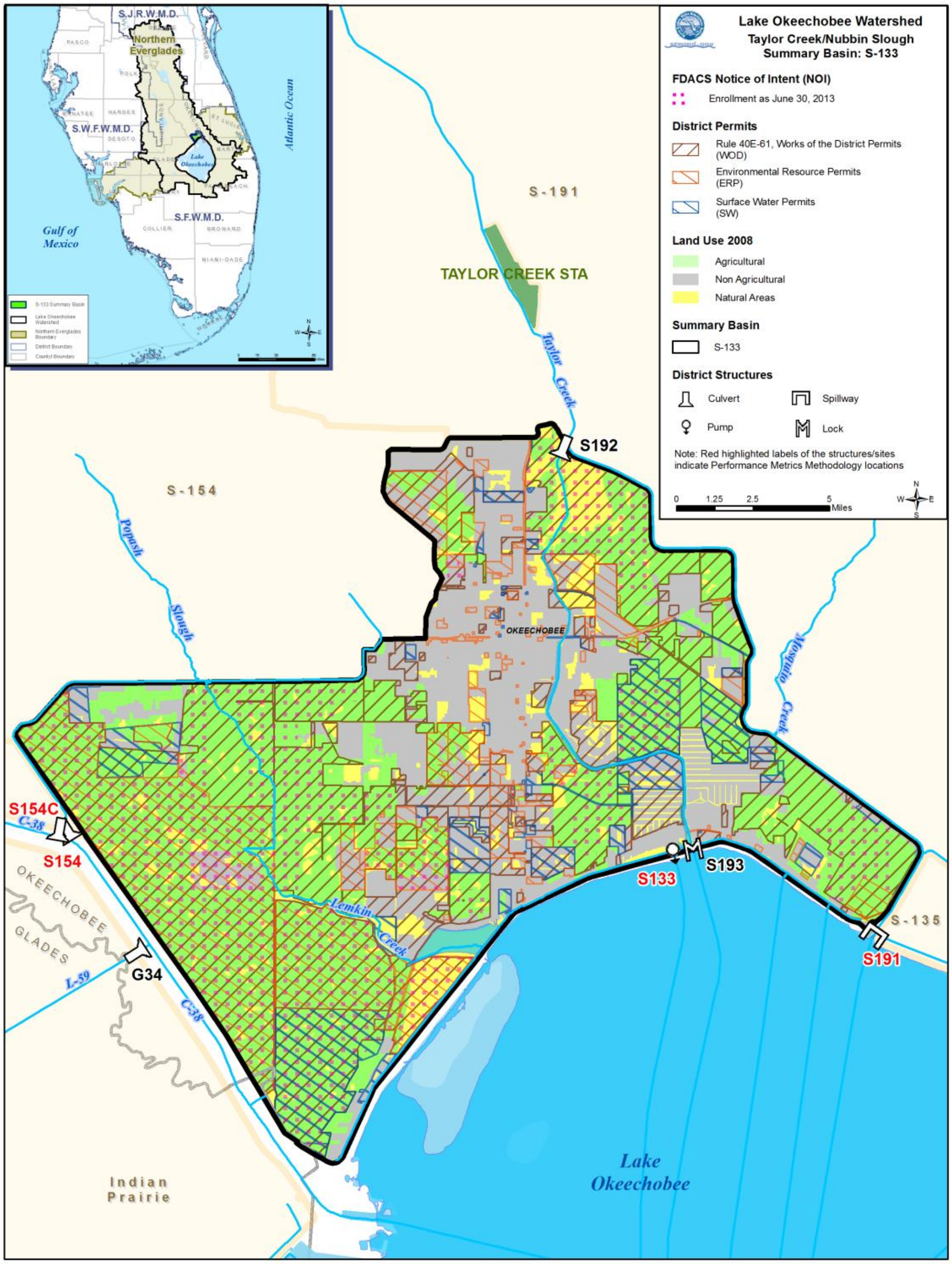


Figure 5. Source control program coverage in the Taylor Creek/Nubbin Slough Sub-watershed, S-133 Basin.

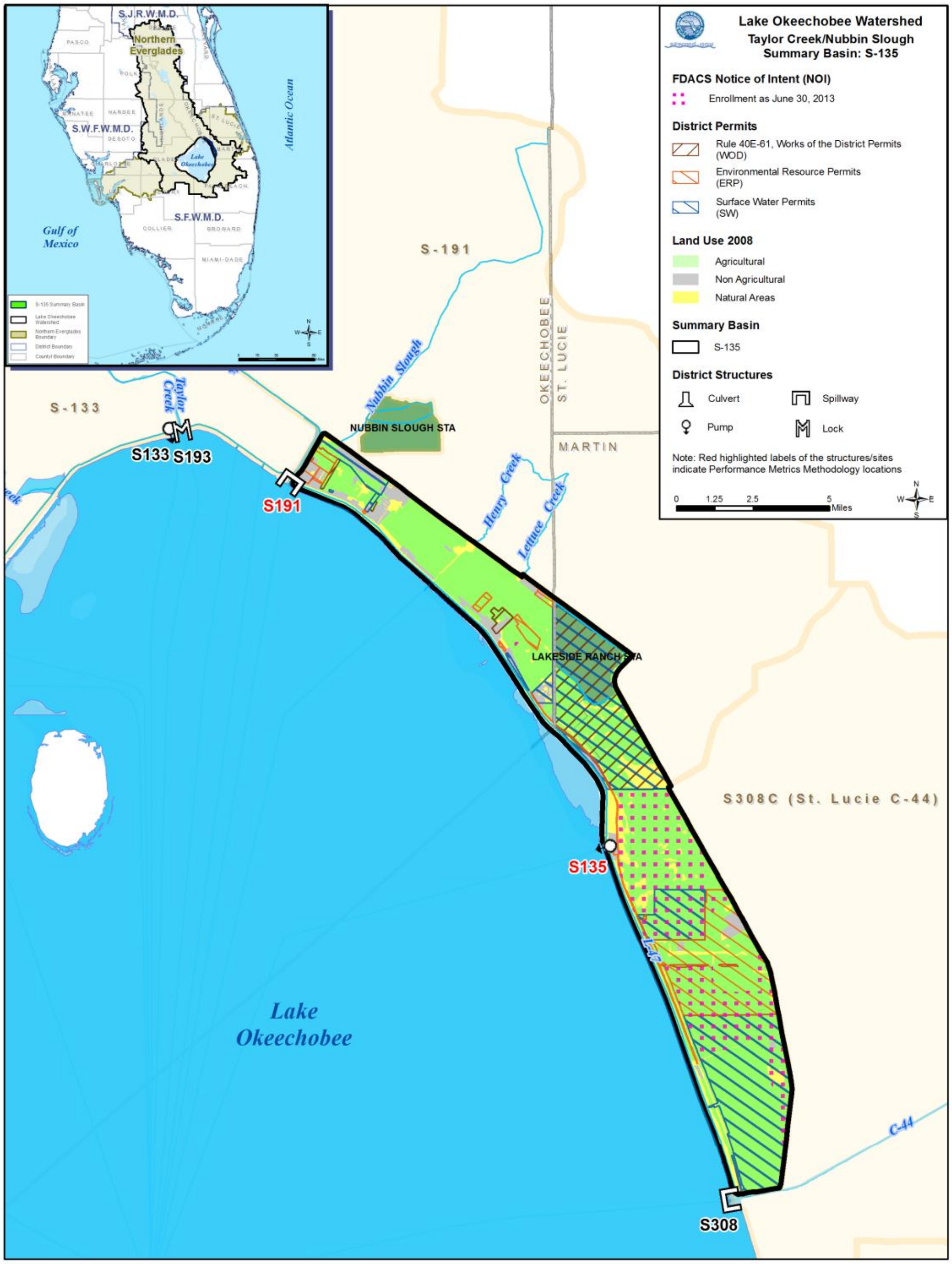


Figure 6. Source control program coverage in the Taylor Creek/Nubbin Slough Sub-watershed, S-135 Basin.

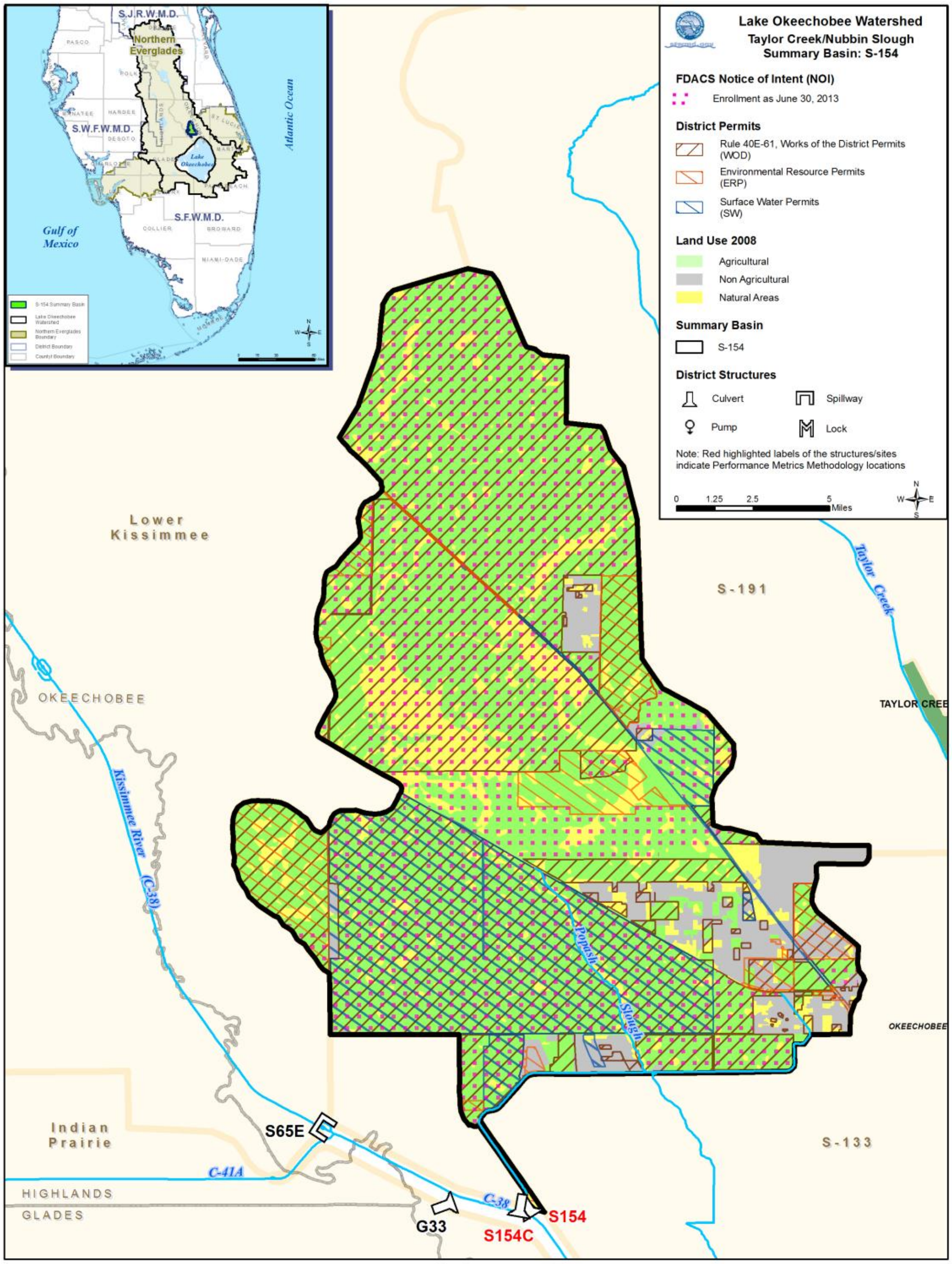


Figure 7. Source control program coverage in the Taylor Creek/Nubbin Slough Sub-watershed, S-154 Basin.

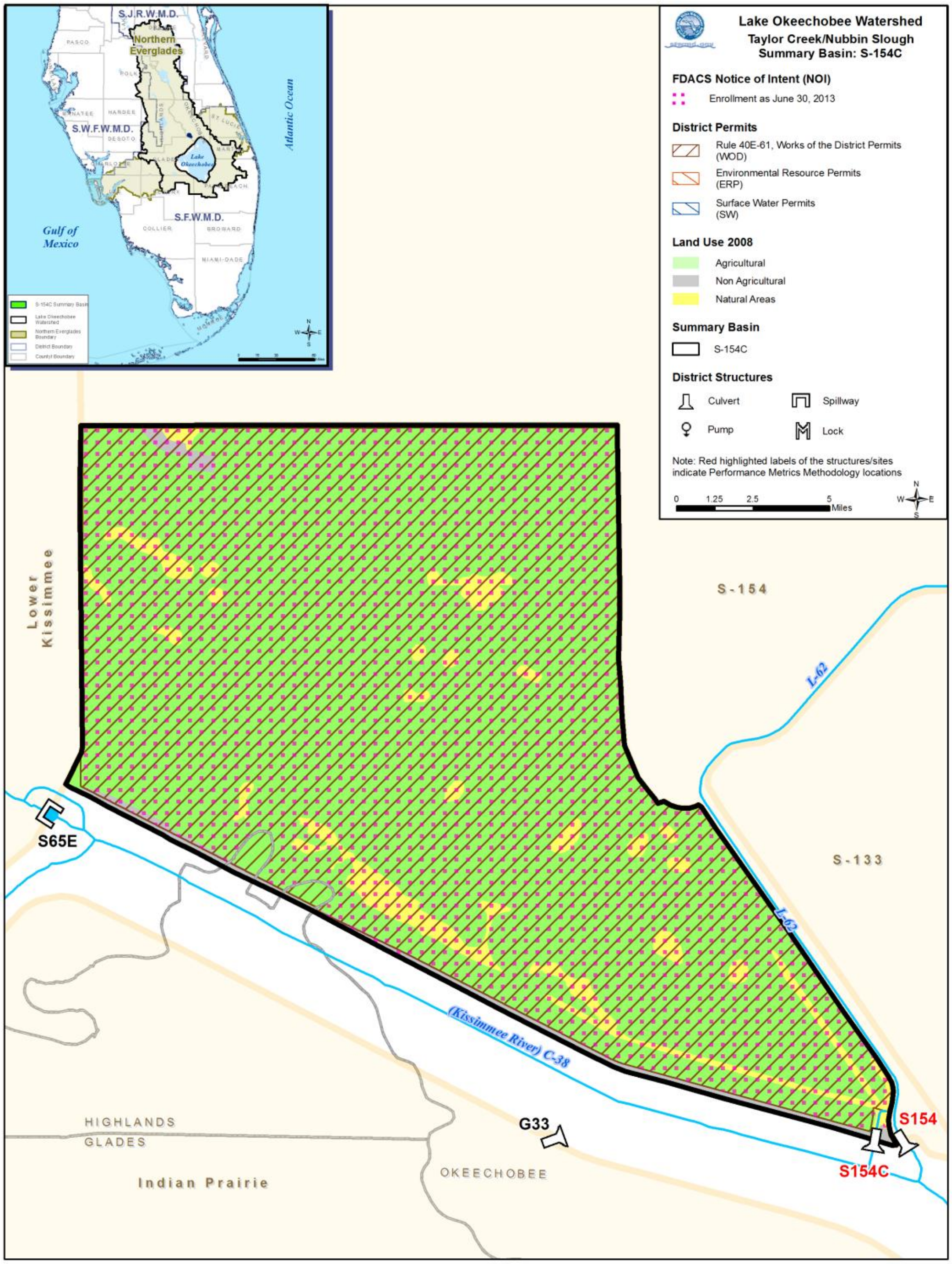


Figure 8. Source control program coverage in the Taylor Creek/Nubbin Slough Sub-watershed, S-154C Basin.

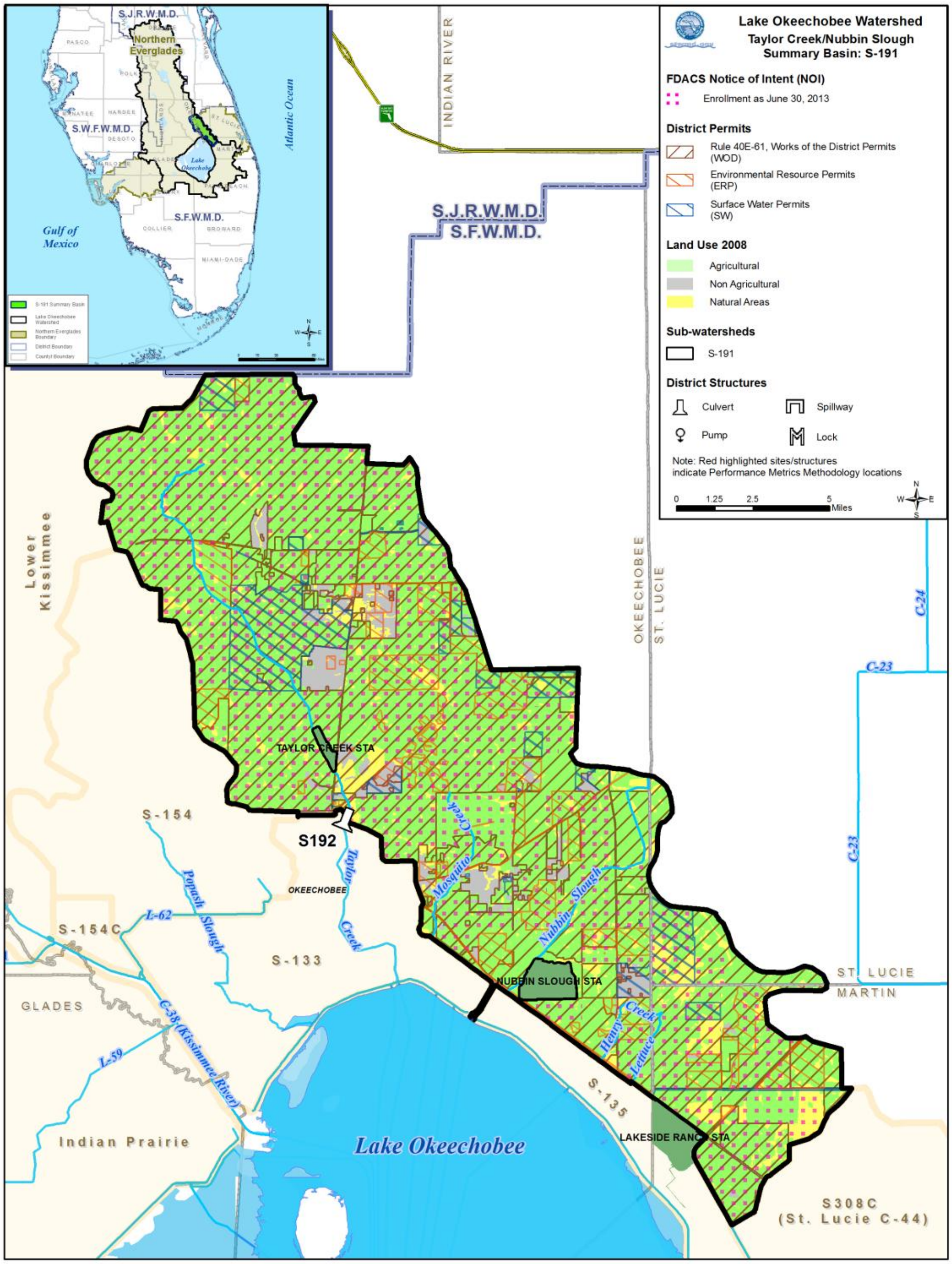


Figure 9. Source control program coverage in the Taylor Creek/Nubbin Slough Sub-watershed, S-191 Basin.

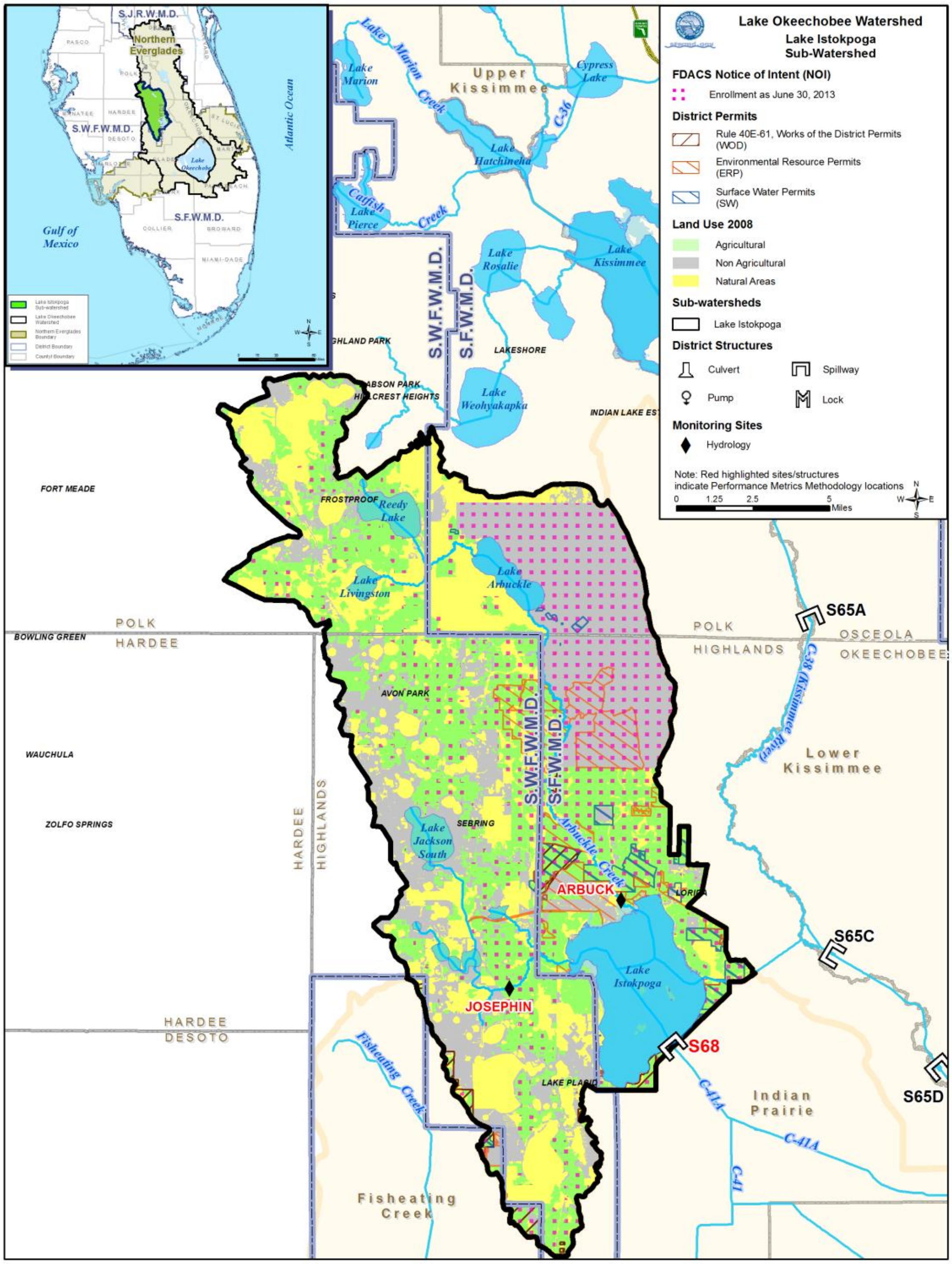


Figure 10. Source control program coverage in the Lake Istokpoga Sub-watershed.

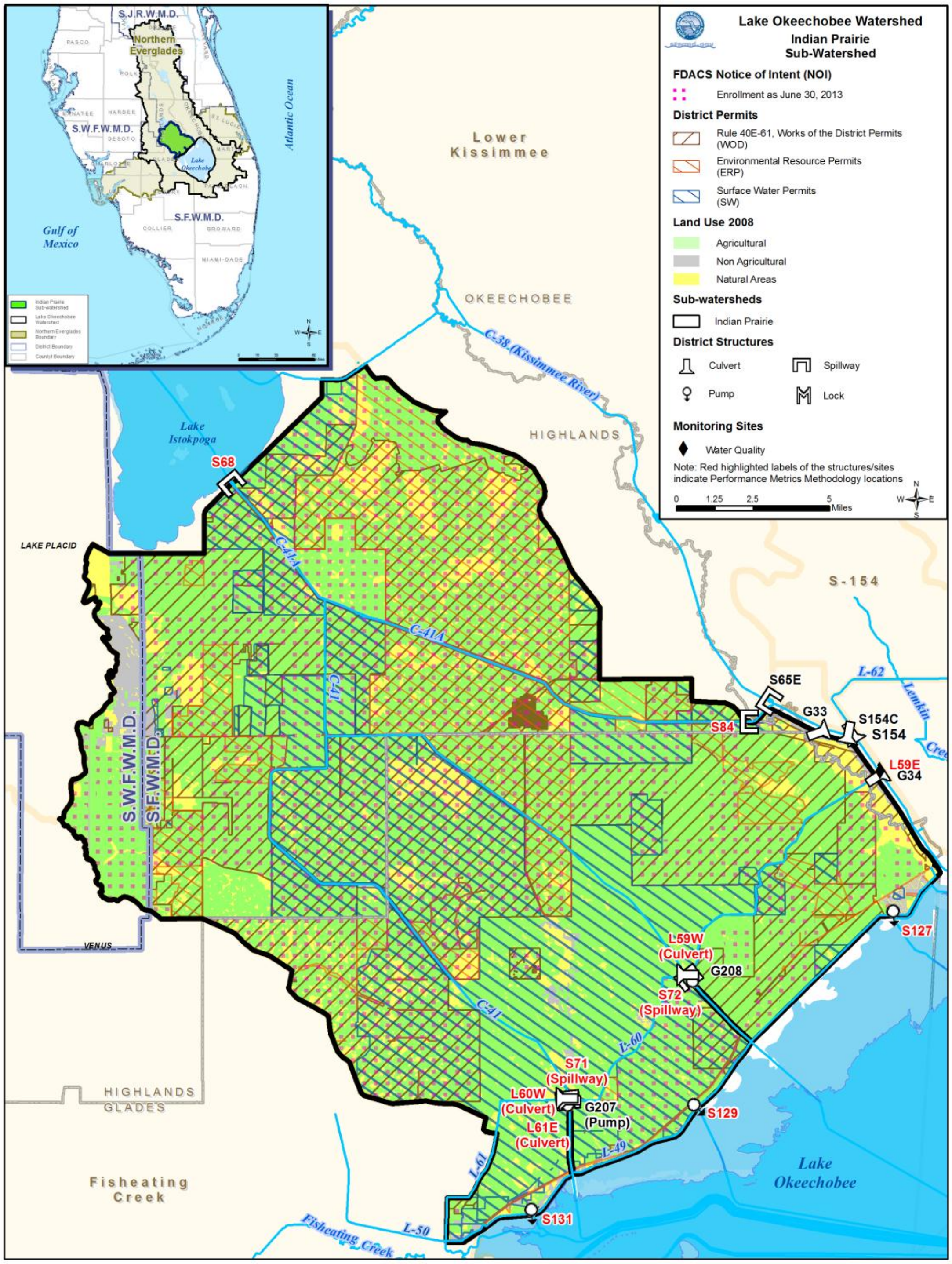


Figure 11. Source control program coverage in the Indian Prairie Sub-watershed.

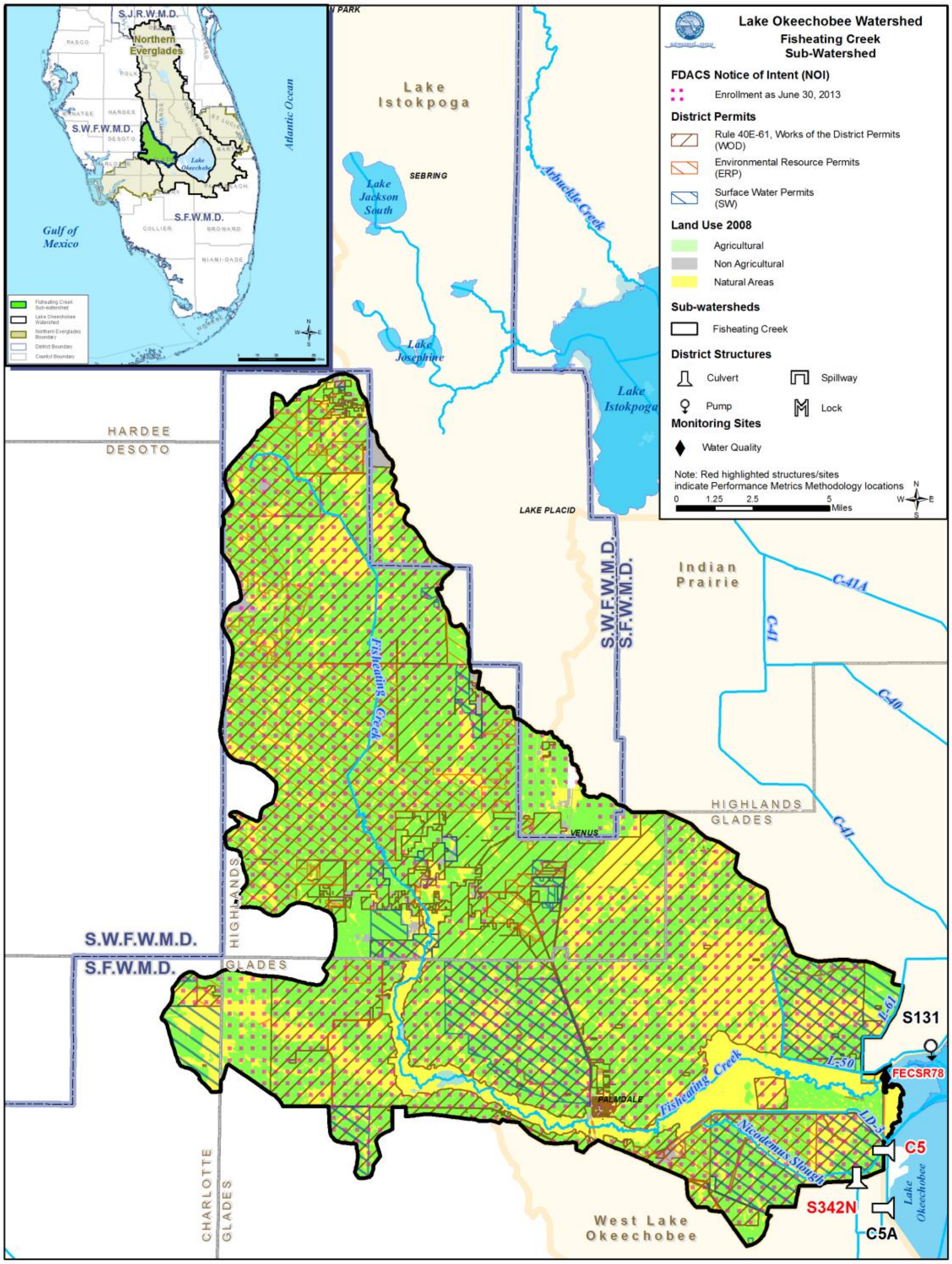


Figure 12. Source control program coverage in the Fisheating Creek/Nicodemus Slough Sub-watershed.

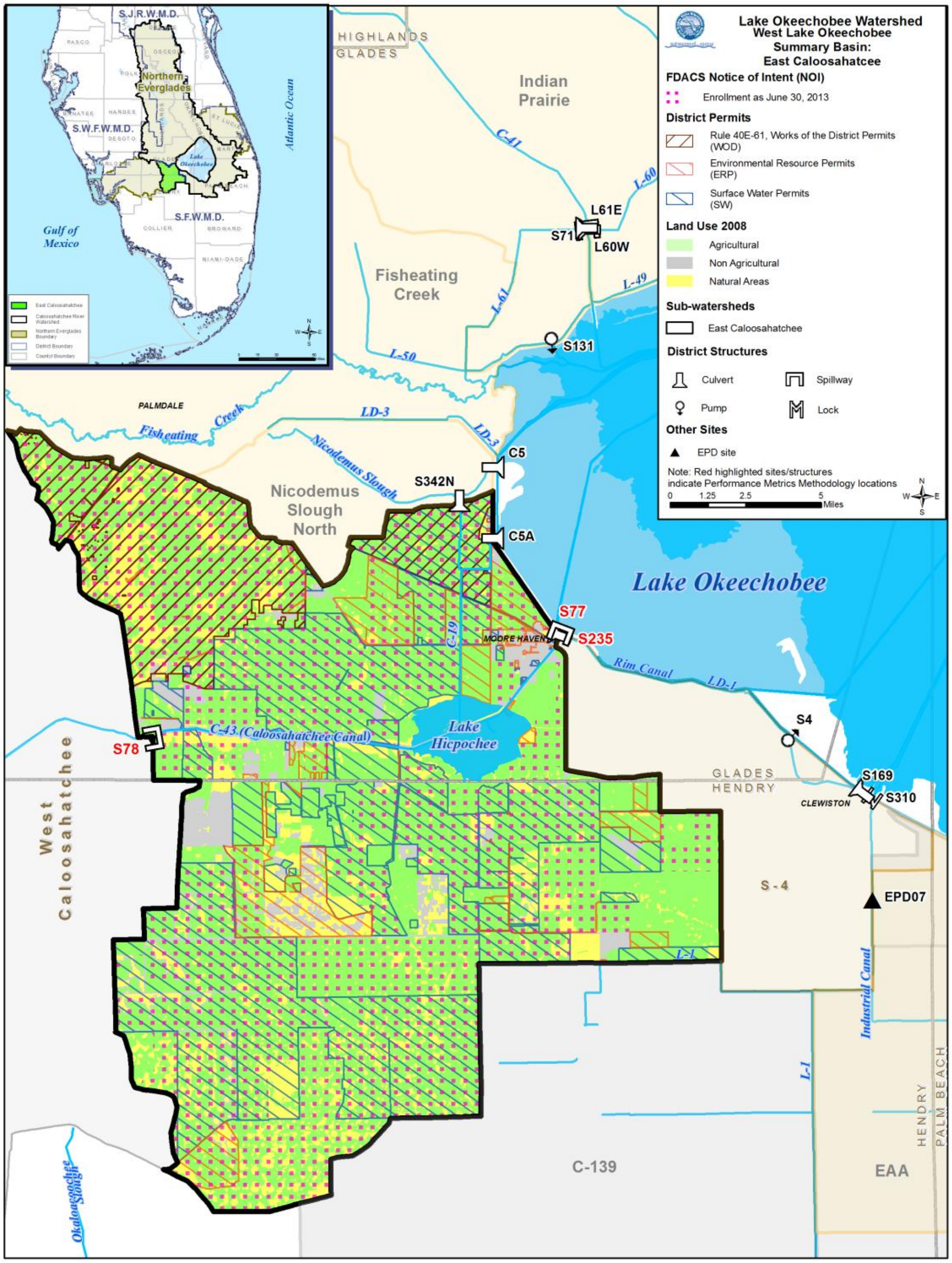


Figure 13. Source control program coverage in the West Lake Okeechobee Sub-watershed, East Caloosahatchee Basin.

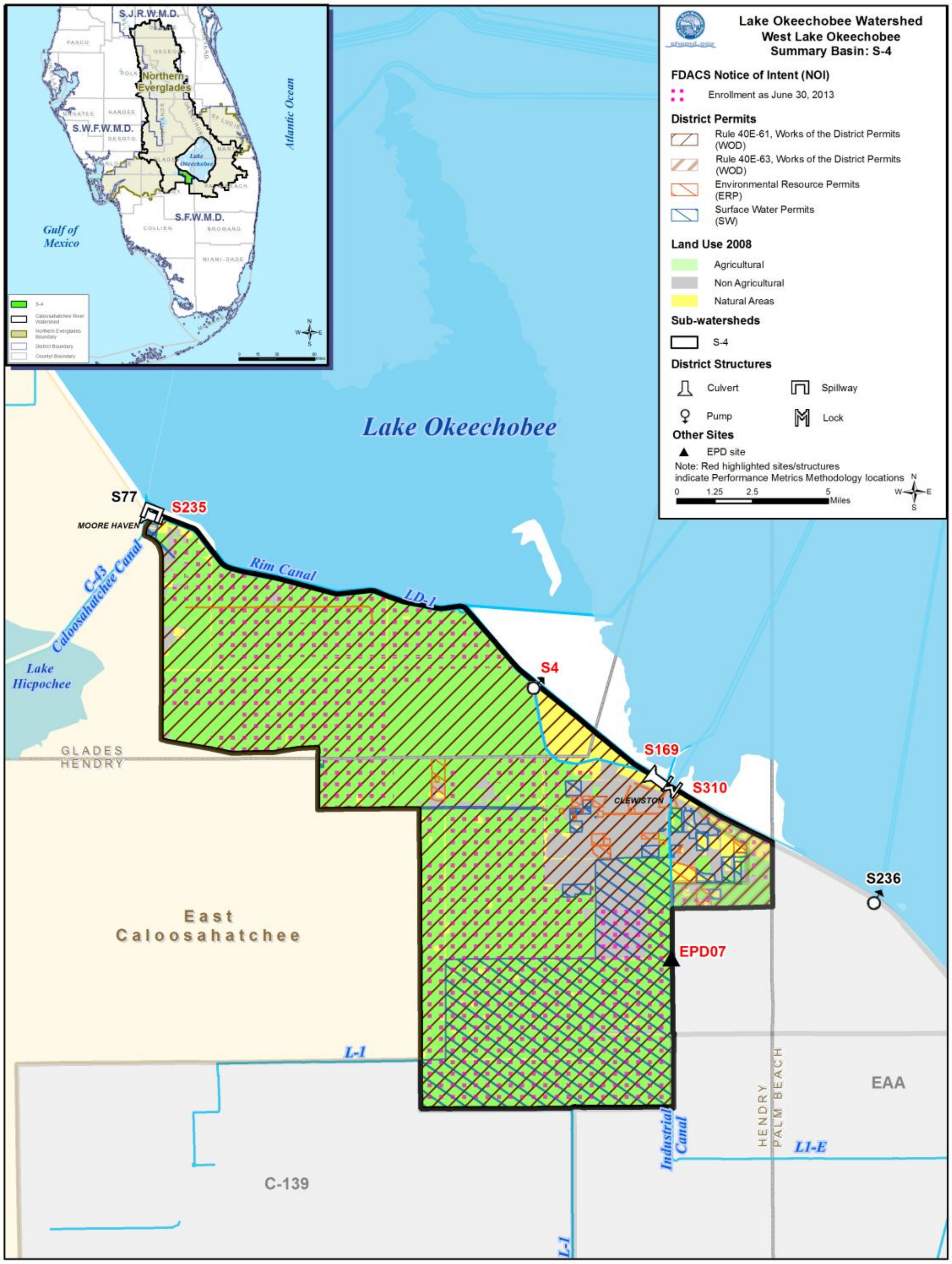


Figure 14. Source control program coverage in the West Lake Okeechobee Sub-watershed, S-4 Basin.

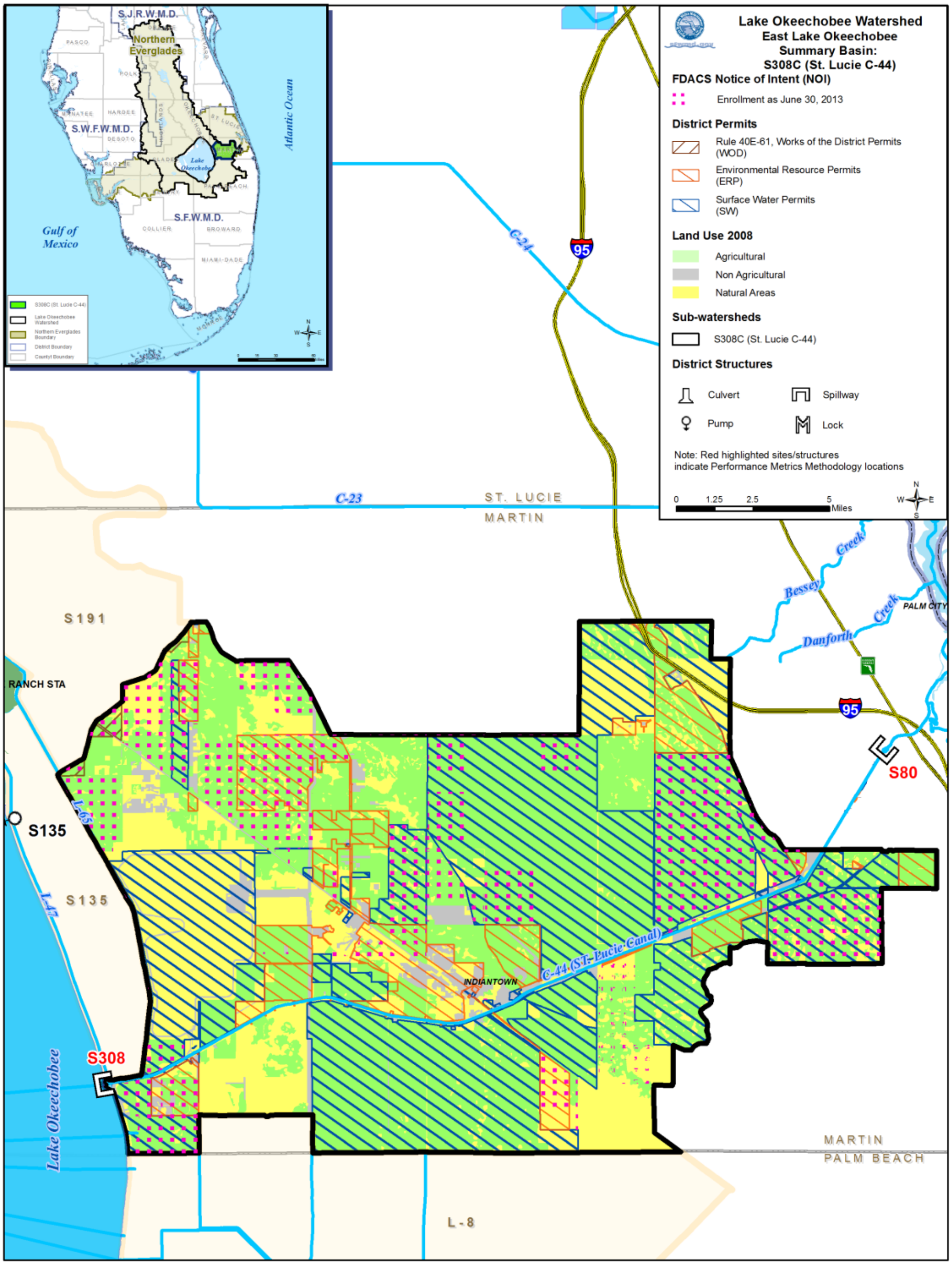


Figure 15. Source control program coverage in the East Lake Okeechobee Sub-watershed, C-44 Basin.

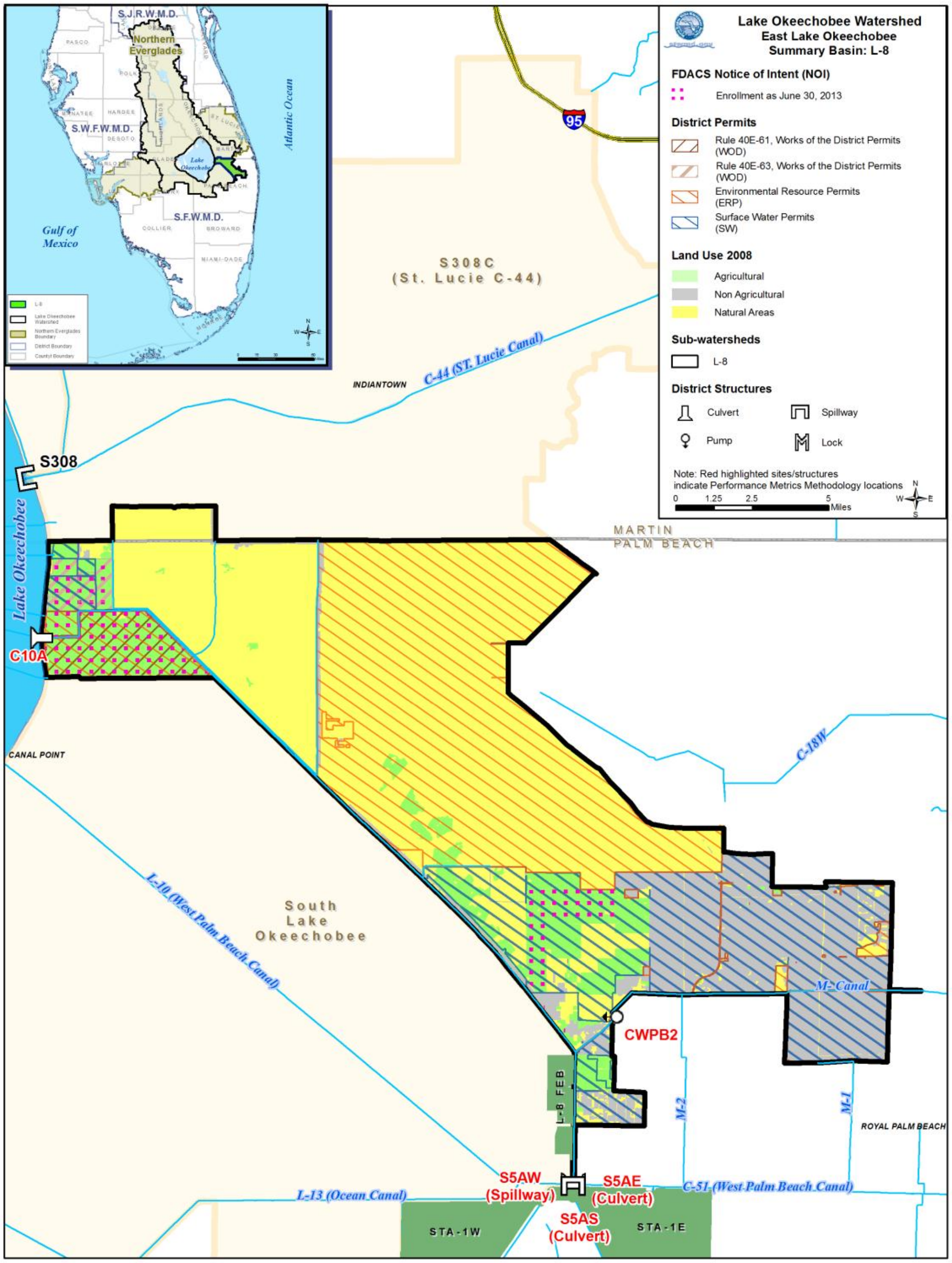


Figure 16. Source control program coverage in the East Lake Okeechobee Sub-watershed, L-8 Basin. [Note: STA-1E – Stormwater Treatment Area 1 East, STA-1W – Stormwater Treatment Area 1 West.]

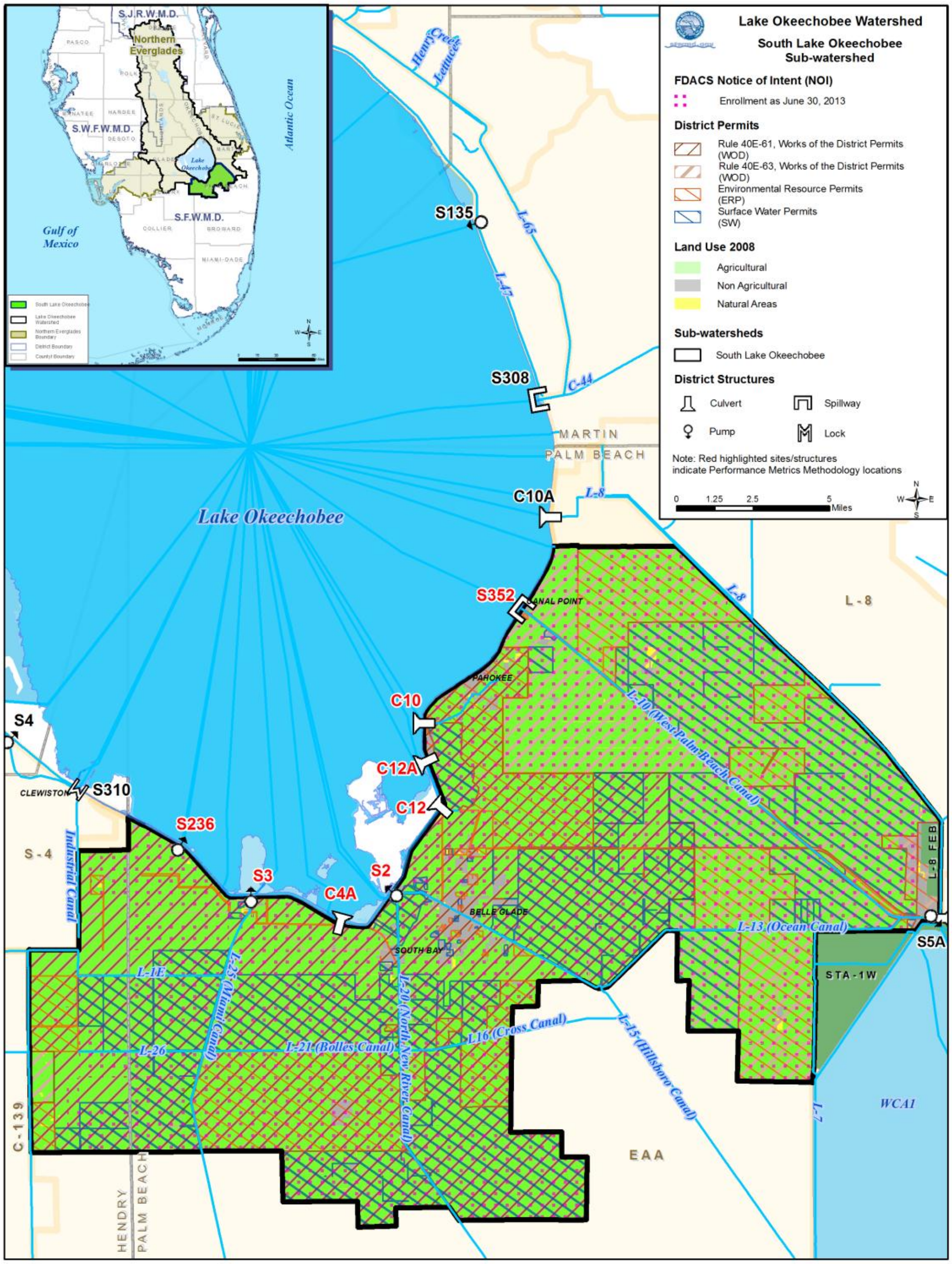


Figure 17. Source control program coverage in the South Lake Okeechobee Sub-watershed.

Table 1. Water Year 2013 (WY2013) (May 1, 2012–April 30, 2013) total phosphorus (TP) loads in metric tons (mt) and flow-weighted mean (FWM) concentrations in parts per billion (ppb).

Basin	WY2013 Flow[1] (ac-ft)	WY2013 Observed TP Load[1] (mt)	WY2013 TP FWM Conc.[1] (ppb)
Upper Kissimmee (S-65)[2]	439,646	49	90
Boggy Creek	36,720	1	25
Shingle Creek	97,549	7	55
Lower Kissimmee[3]	464,959	101	175
S-133	23,227	10	338
S-135	16,046	2	95
S-154	52,305	43	660
S-154C	2,820	4	1,063
S-191	113,711	79	565
Lake Istokpoga (S-68)[4]	280,540	32	92
Arbuckle Creek	179,514	30	136
Josephine Creek	47,448	3	60
Indian Prairie[5]	259,513	102	318
Fisheating Creek	204,551	48	189
Nicodemus Slough[6]	9	0	383
S-4/Industrial Canal[7]	63,994	14	174
East Caloosahatchee[8]	164,644	42	209
C-44[9]	156,437	59	306
L-8[10]	158,796	19	97
South Lake Okeechobee[11]	67,668	24	288

[1] Data presented in this table may have more than one receiving body and may differ from Chapter 8, where there is overlap, since Chapter 8 focuses solely on TP loads entering Lake Okeechobee.

[2] Because most of the stormwater from the Upper Kissimmee flows directly into the multiple lakes and not through the primary canal system, the majority of runoff is not monitored. Monitoring sites on two major tributaries (Boggy Creek and Shingle Creek) were identified as locations that may be used to characterize the effectiveness of the source control programs.

[3] The observed annual TP loads for the Lower Kissimmee Sub-watershed are based on the difference in loads and flows measured at the S-65E and S-65 structures.

[4] The TP load measured at the S-68 structure includes the attenuation effect of Lake Istokpoga. To characterize the effectiveness of the source control programs for the entire sub-watershed, the tributaries (Arbuckle Creek and Josephine Creek) will continued to be monitored.

[5] The observed annual TP loads for the Indian Prairie Sub-watershed are based on samples collected and flows measured at the G-33, G-34, G-74, G-75, G-76, L-61E, S-71, S-72, S-84, S-127, S-129, and S-131 structures. The loads that are flowing through the Indian Prairie Sub-watershed from the Lake Istokpoga Sub-watershed through the S-68 structure are accounted for in the Indian Prairie Sub-watershed load calculation.

[6] The observed annual TP loads for the Nicodemus Slough basin are based on samples and flows measured at the C-5 and S-342N structures.

[7] In the S-4/Industrial Canal Basin, the observed TP loads are based on samples and flows measured at the S-235, S-4, S-310, and EPD-07 structures. Additionally, observed flows and TP loads at the S-169 structure is used to determine the load passing through the basin.

[8] In the East Caloosahatchee Basin, the observed TP loads are based on samples and flows measured at the S-235, S-77, and S-78 structures. Flows and loads passing through this basin are also accounted for at these structures.

[9] East Lake Okeechobee Sub-watershed observed annual TP loads are based on samples and flows measured at S-308C and S-80.

[10] The L-8 Basin observed annual TP loads are based on samples and flows measured at the C-10A, S-5AS, S-5AE, S-5AW, and WPB2 structures

[11] The South Lake Okeechobee Sub-watershed consists of the Everglades Agricultural Area (EAA) basins S-2, S-3, and S-5A, as well as EAA diversion basins. The EAA's existing source control performance measures are defined by Chapter 40E-63, F.A.C., and reported within Chapter 4 and Appendix 4-2 of this volume, but exclude the EAA diversion basins. The combined observed annual TP loads from the EAA diversion basins both to Lake Okeechobee and to the EAA canals are presented in this appendix.

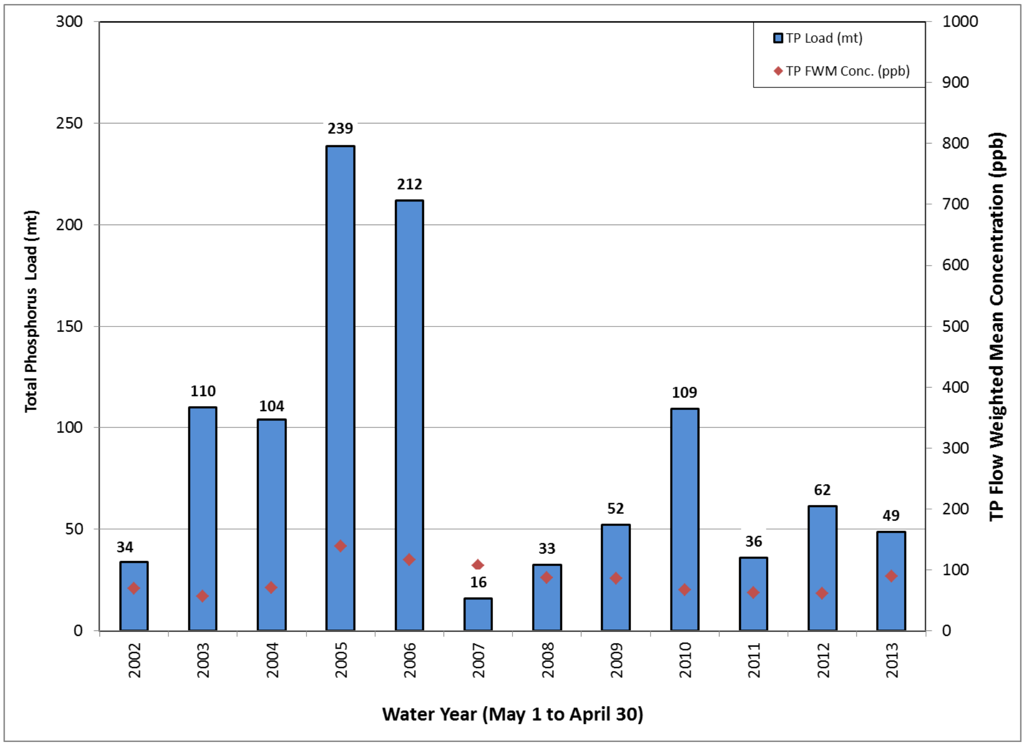


Figure 18. Upper Kissimmee Sub-watershed observed total phosphorus (TP) loads in metric tons (mt) and flow-weighted mean (FWM) concentrations in parts per billion (ppb) for Water Years 2002 through 2013 (WY2002–WY2013).

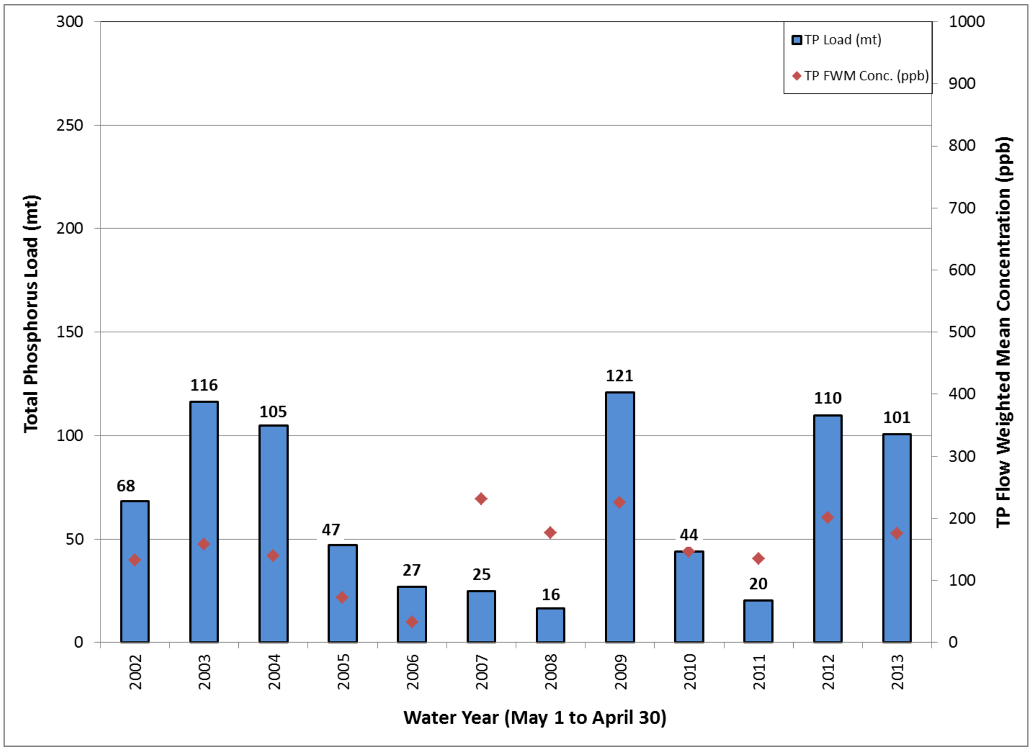


Figure 19. Lower Kissimmee Sub-watershed observed TP loads and FWM concentrations (WY2002–WY2013).

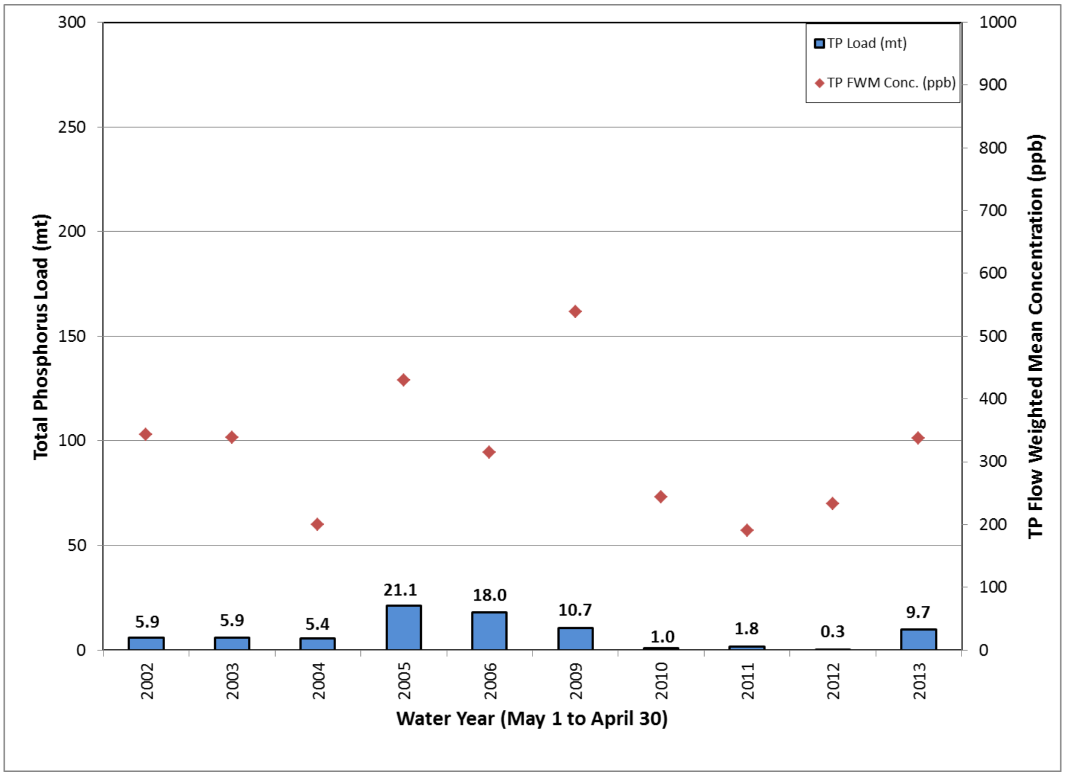


Figure 20. Taylor Creek/Nubbin Slough Sub-watershed, S-133 Basin observed TP loads and FWM concentrations (WY2002–WY2013).

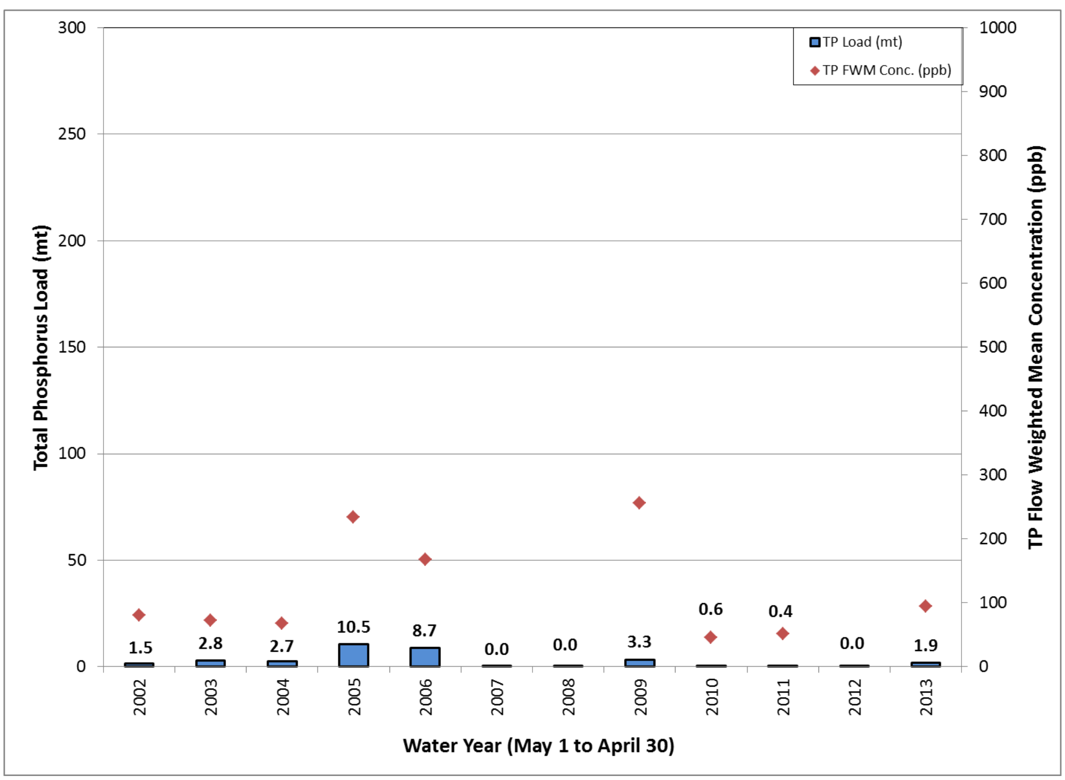


Figure 21. Taylor Creek/Nubbin Slough Sub-watershed, S-135 Basin observed TP loads and FWM concentrations (WY2002–WY2013).

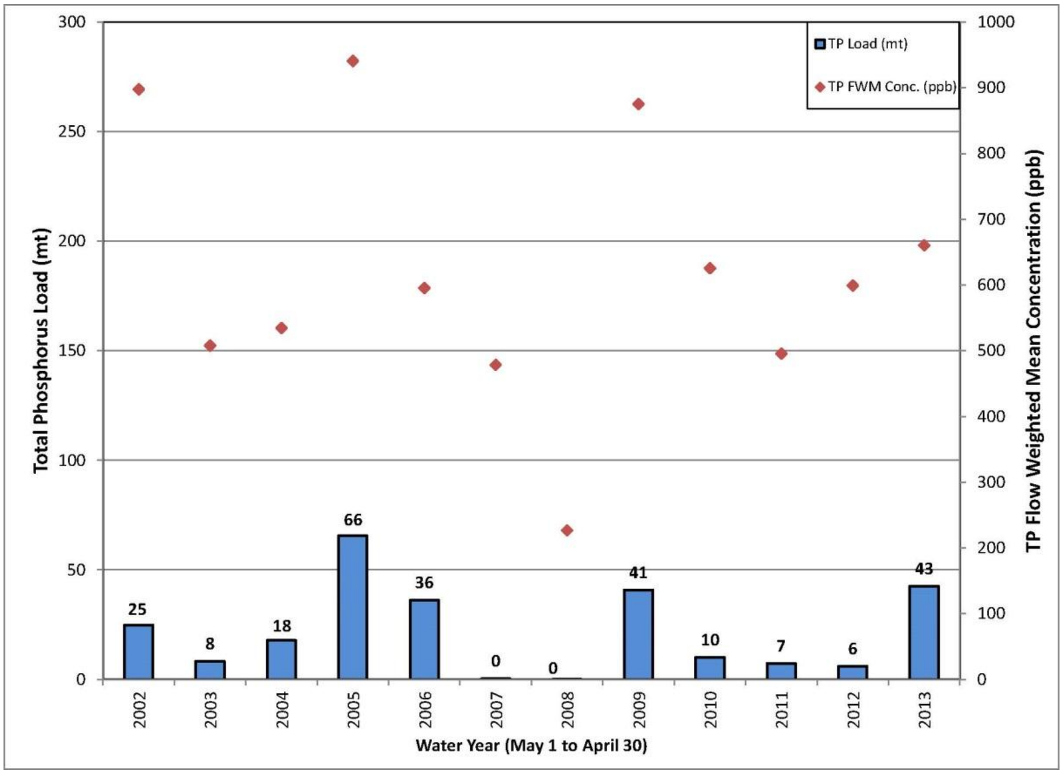


Figure 22. Taylor Creek/Nubbin Slough Sub-watershed, S-154 Basin observed TP loads and FWM concentrations (WY2002–WY2013).

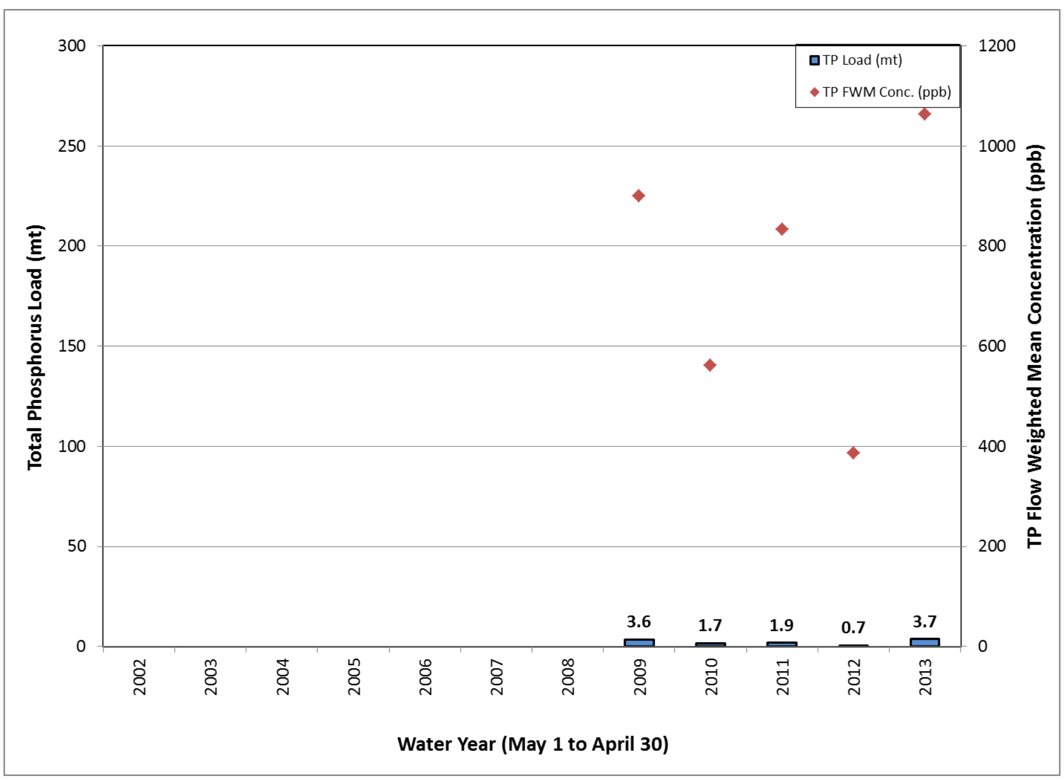


Figure 23. Taylor Creek/Nubbin Slough Sub-watershed, S-154C Basin observed TP loads and FWM concentrations (WY2002–WY2013).

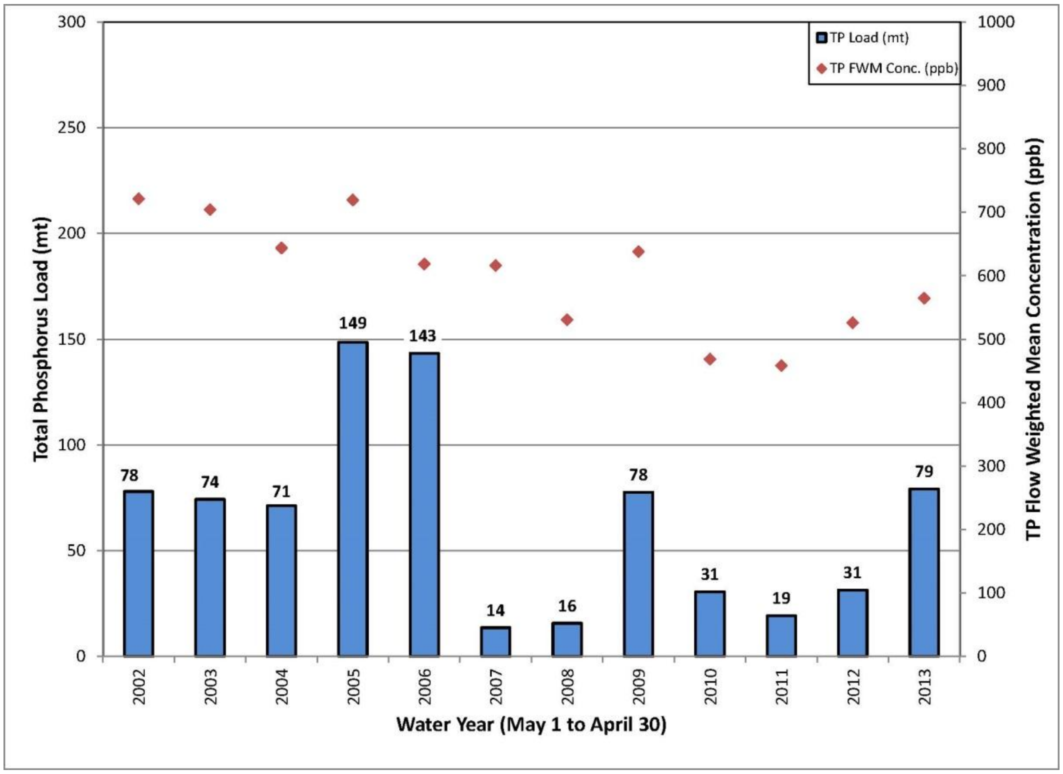


Figure 24. Taylor Creek/Nubbin Slough Sub-watershed, S-191 Basin observed TP loads and FWM concentrations (WY2002–WY2013).

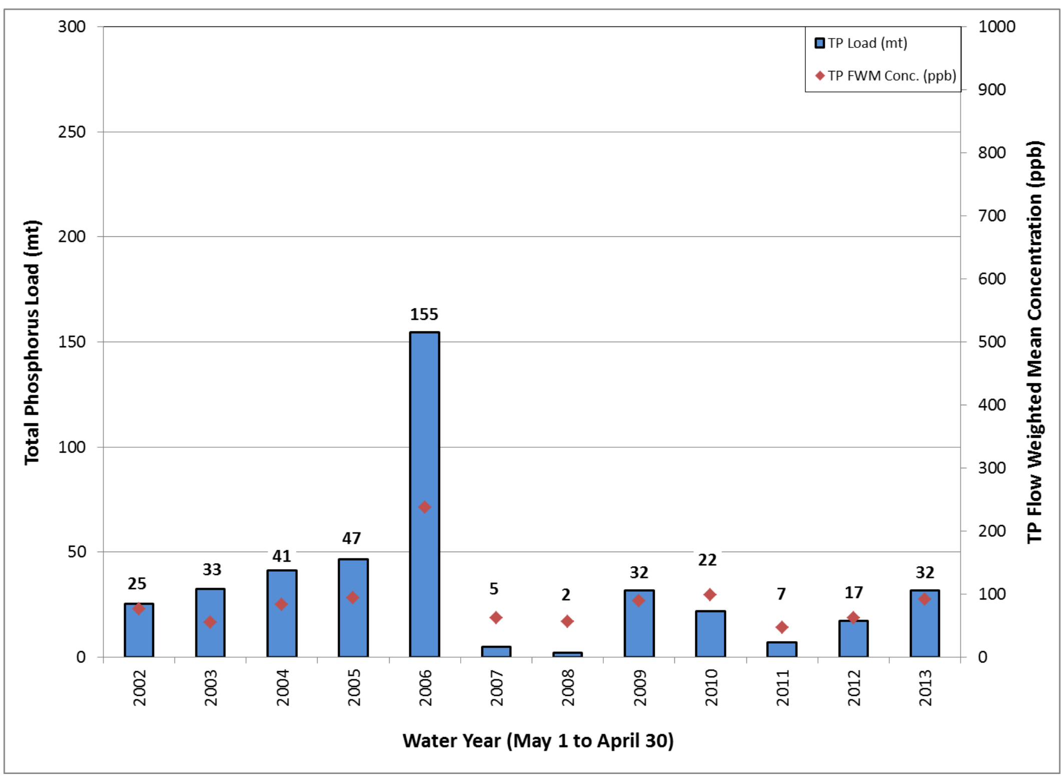


Figure 25. Lake Istokpoga Sub-watershed observed TP loads and FWM concentrations (WY2002–WY2013).

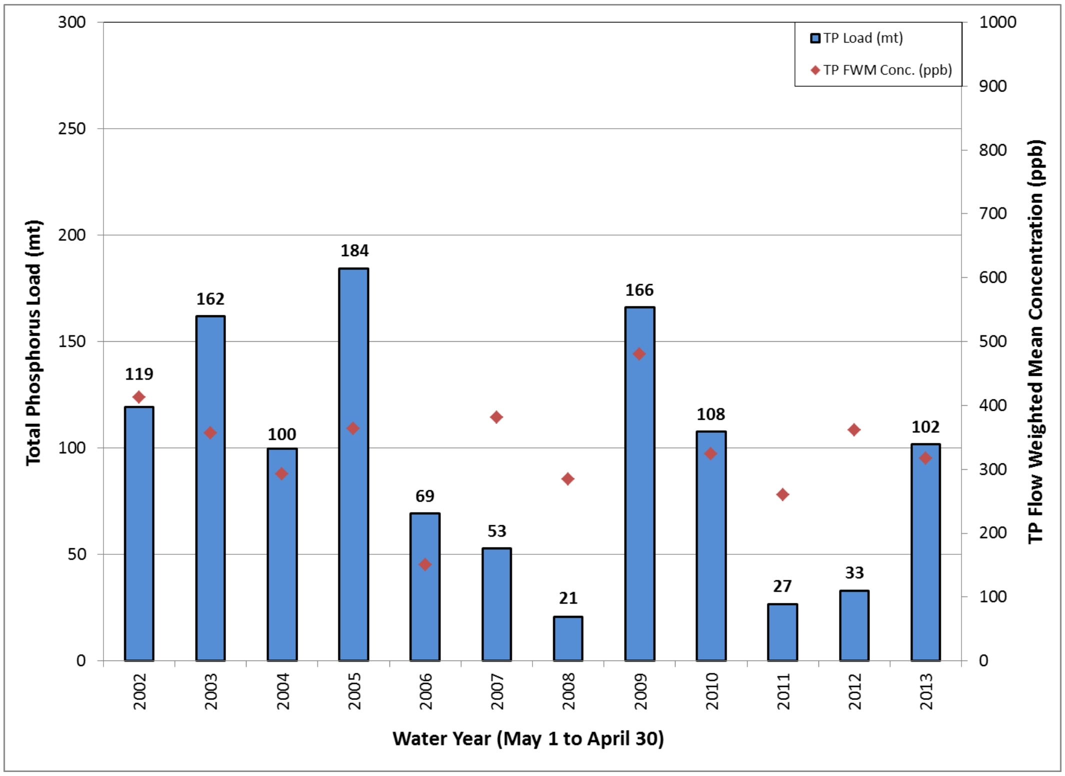


Figure 26. Indian Prairie Sub-watershed observed TP loads and FWM concentrations (WY2002–WY2013).

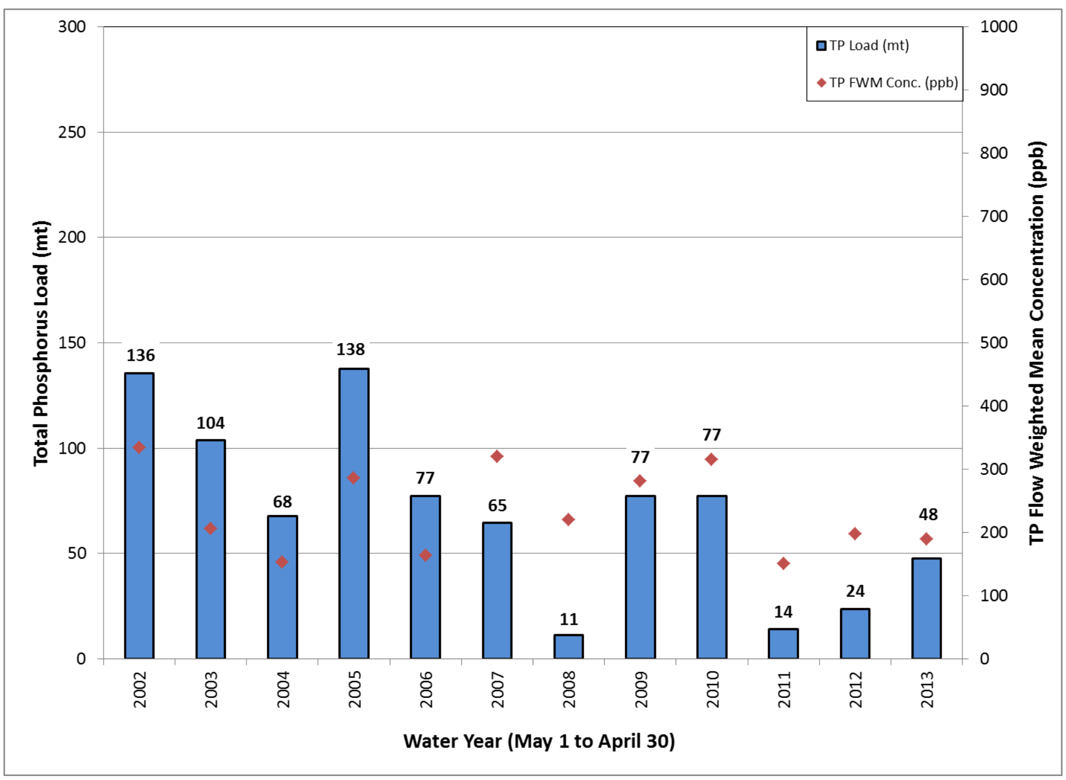


Figure 27. Fisheating Creek/Nicodemus Slough Sub-watershed, Fisheating Creek Basin observed TP loads and FWM concentrations (WY2002–WY2013).

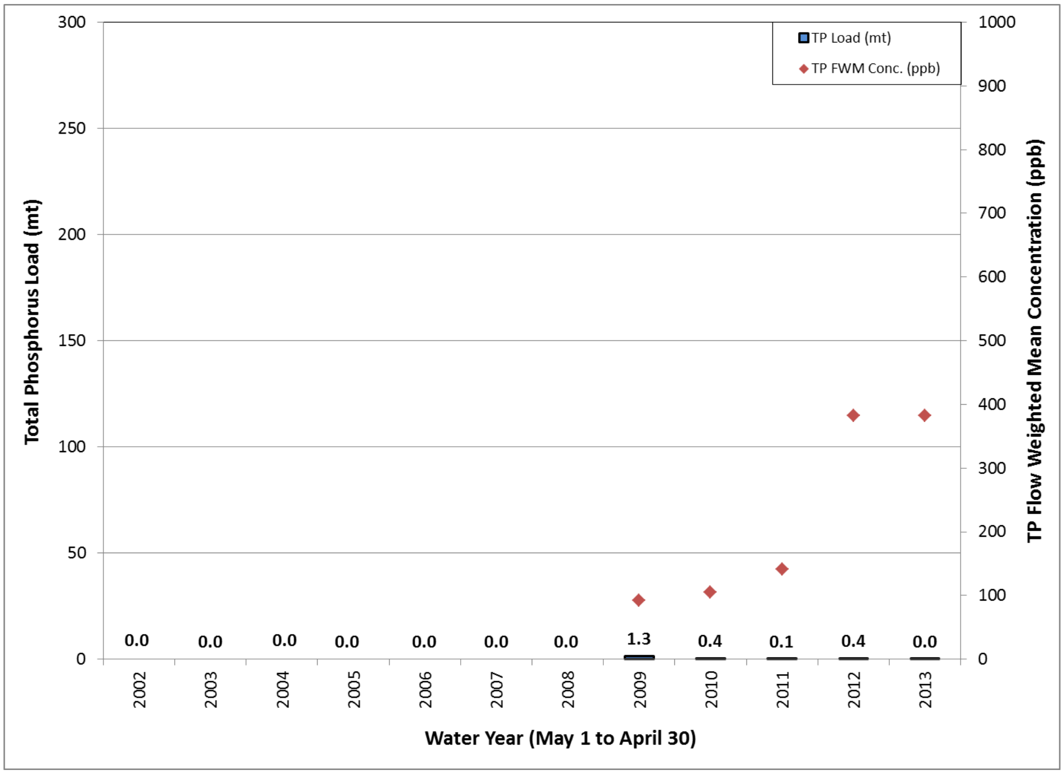


Figure 28. Fisheating Creek/Nicodemus Slough Sub-watershed, Nicodemus Slough Basin observed TP loads and FWM concentrations (WY2002–WY2013).

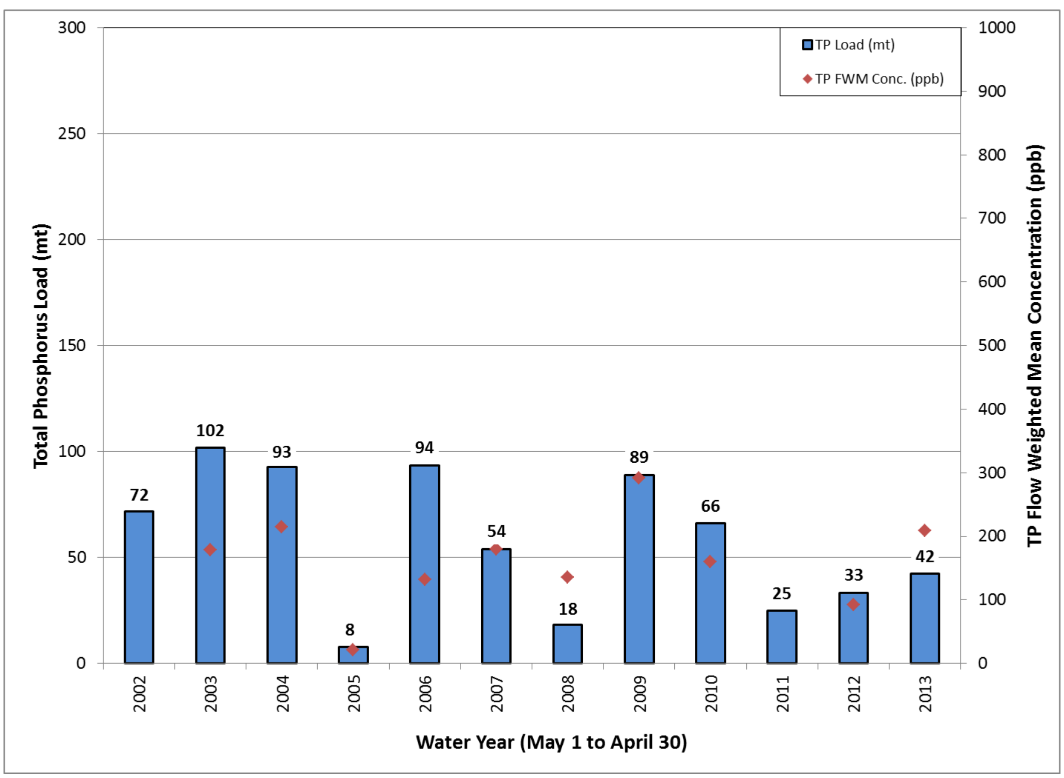


Figure 29. West Lake Okeechobee Sub-watershed, East Caloosahatchee Basin observed TP loads and FWM concentrations (WY2002–WY2013).

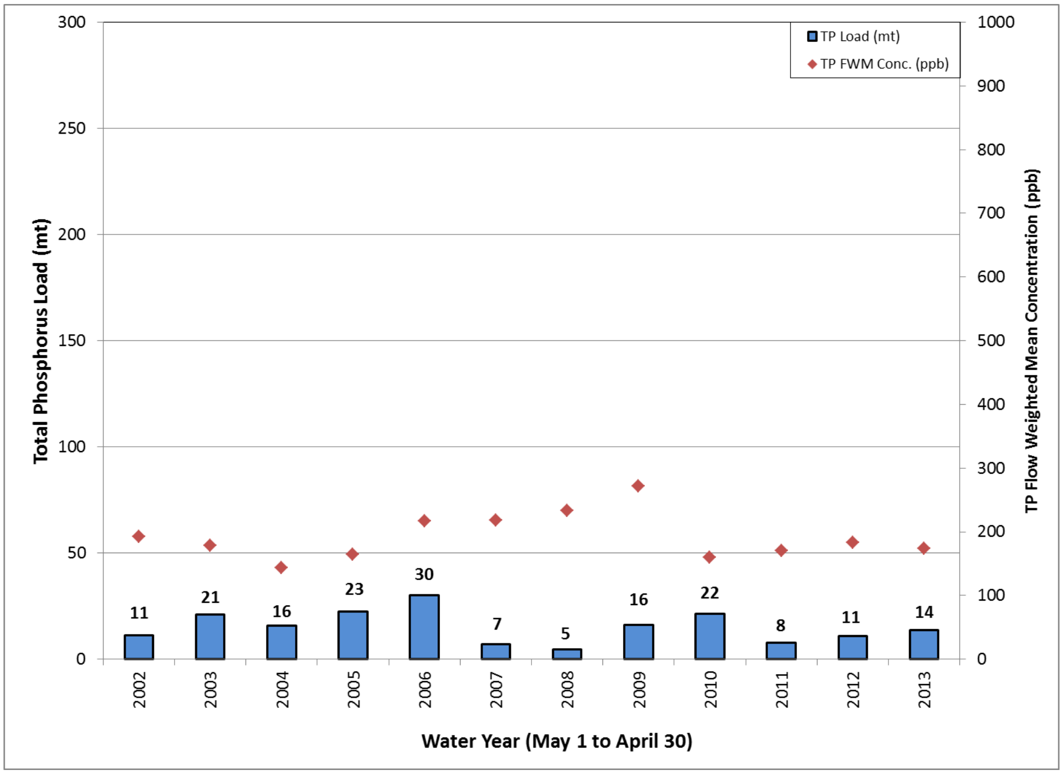


Figure 30. West Lake Okeechobee Sub-watershed, S-4/Industrial Canal Basin observed TP loads and FWM concentrations (WY2002–WY2013).

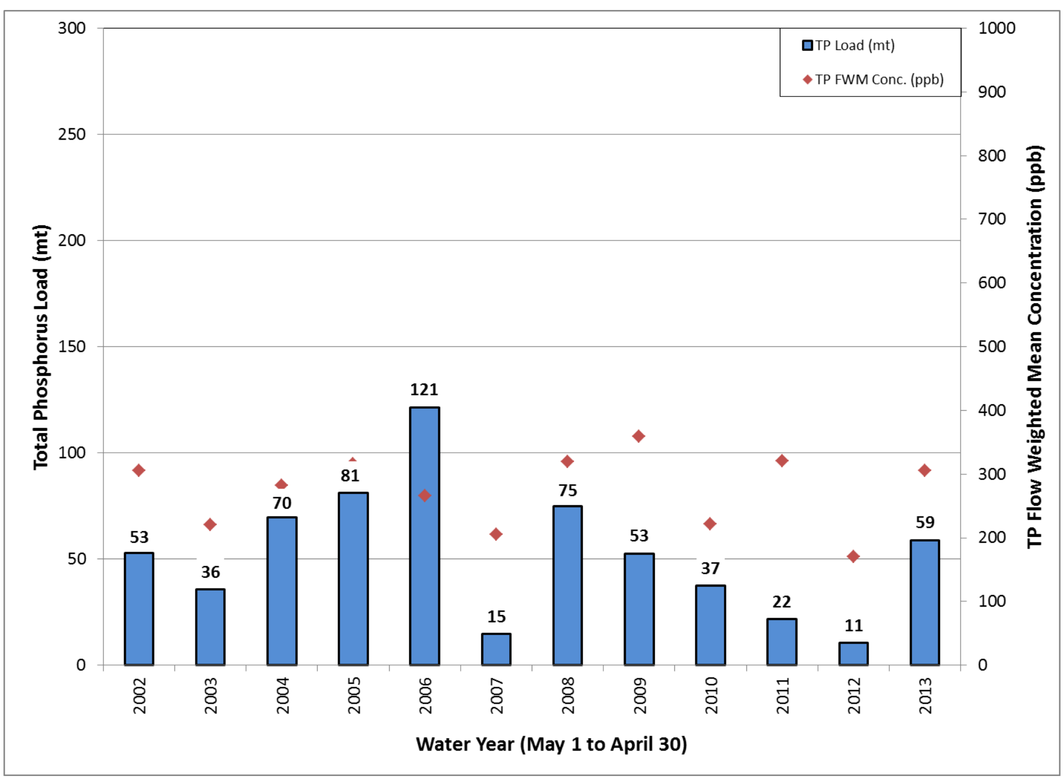


Figure 31. East Lake Okeechobee Sub-watershed, C-44 Basin observed TP loads and FWM concentrations (WY2002–WY2013).

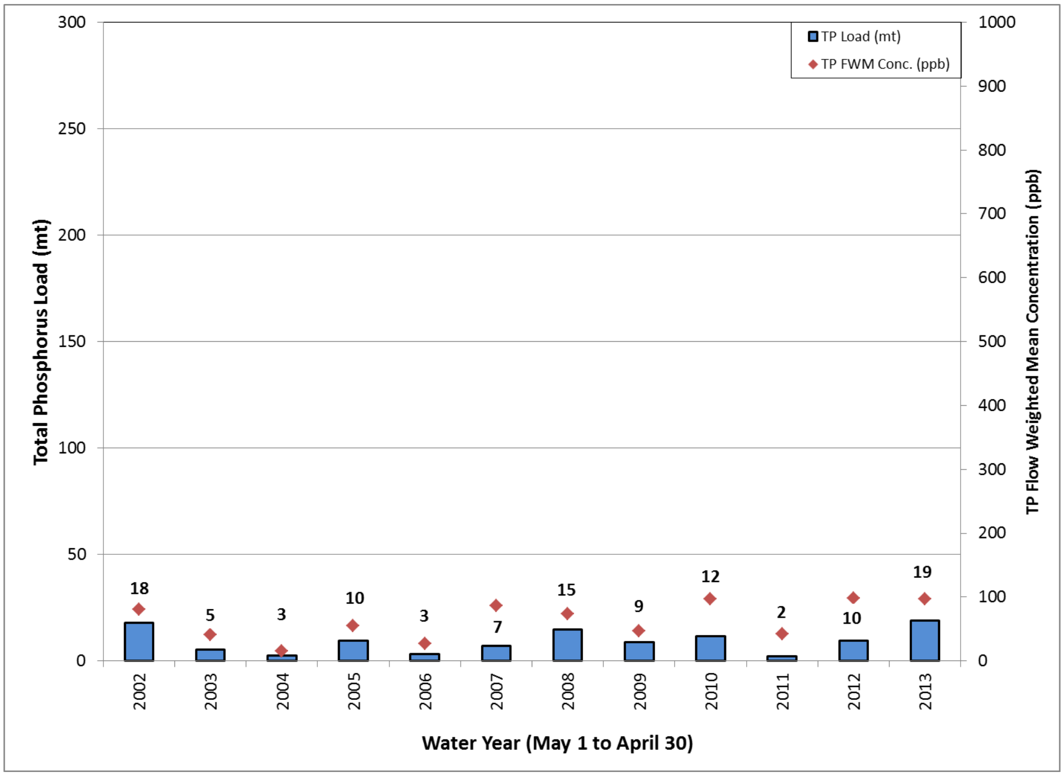


Figure 32. East Lake Okeechobee Sub-watershed, L-8 Basin observed TP loads and FWM concentrations (WY2002–WY2013).

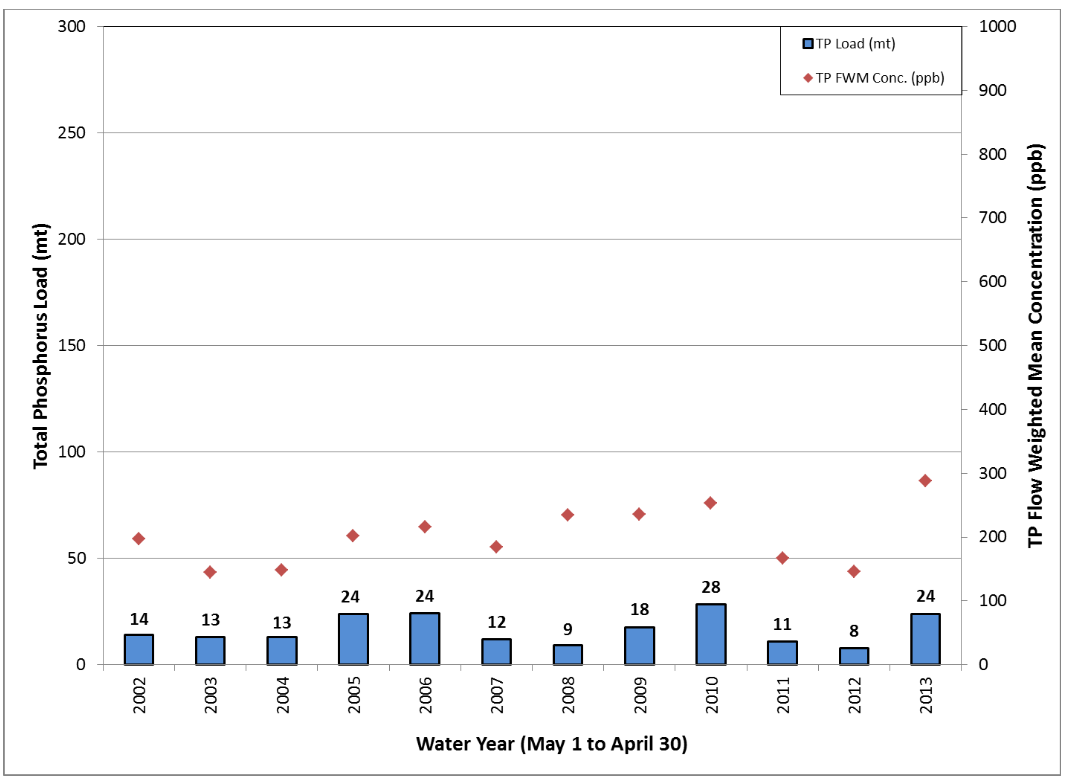


Figure 33. South Lake Okeechobee Sub-watershed observed TP loads (into Lake Okeechobee only) and FWM concentrations (WY2002–WY2013).

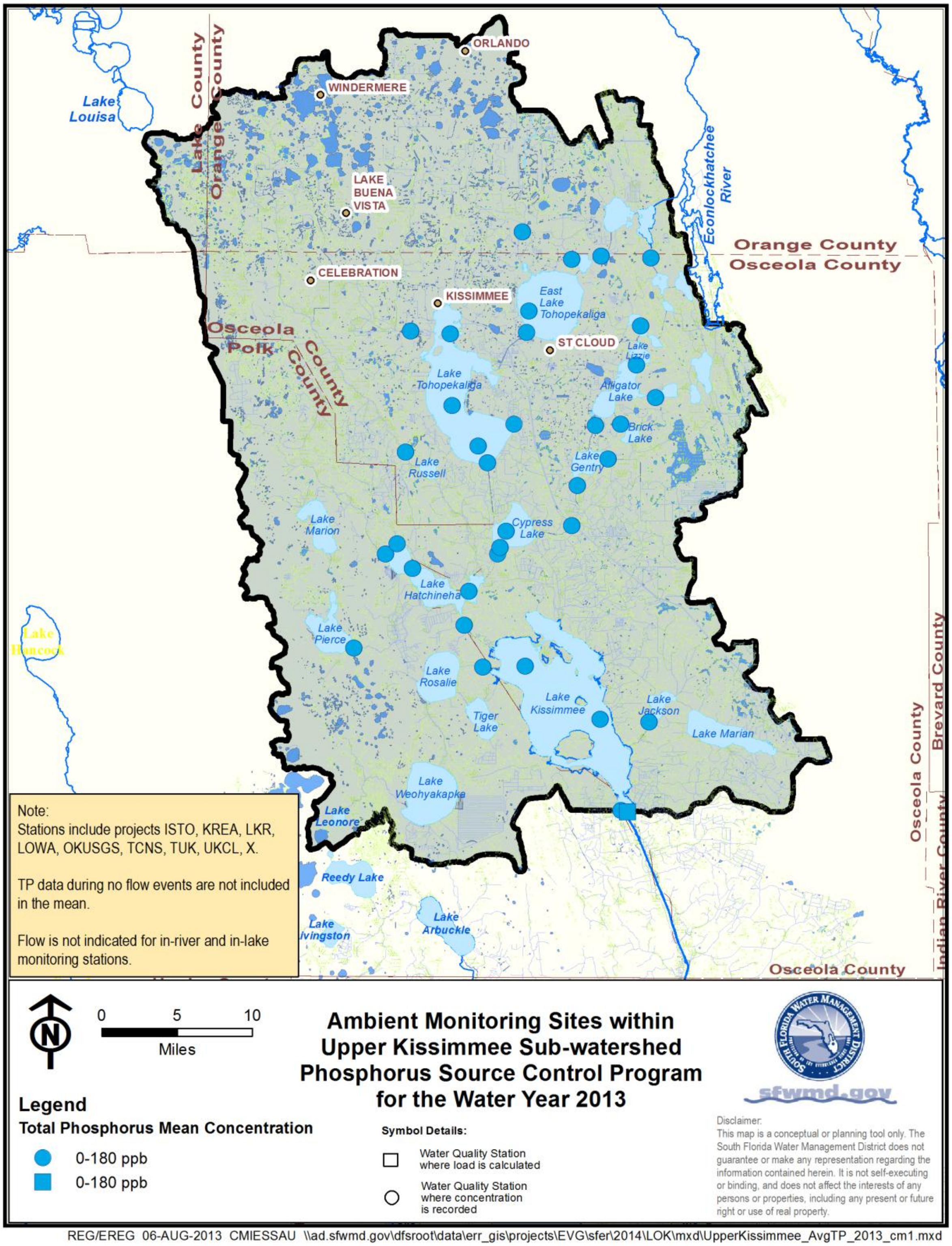


Figure 34. Upper Kissimmee Sub-watershed average TP concentrations in ppb for WY2013.

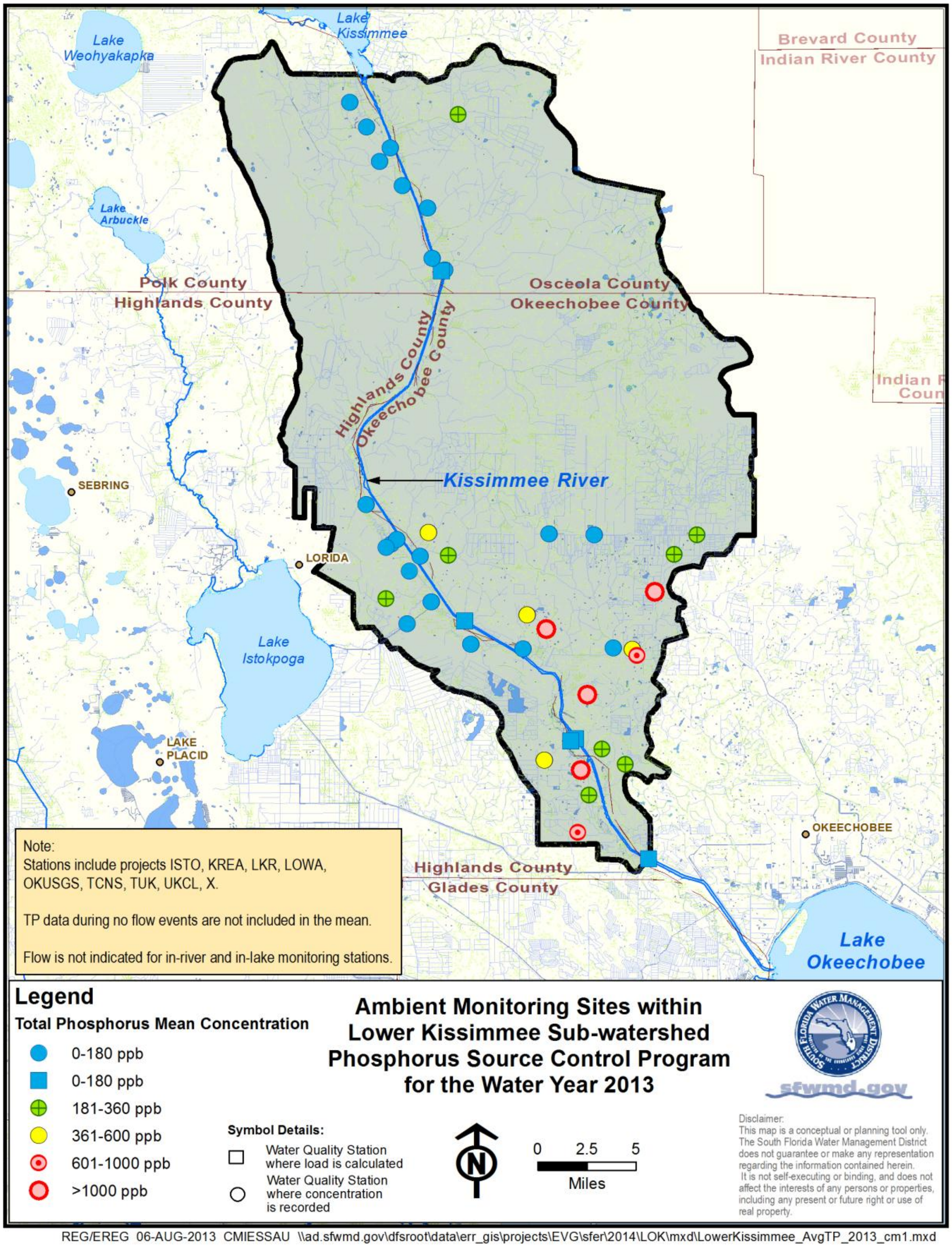


Figure 35. Lower Kissimmee Sub-watershed average TP concentrations in ppb for WY2013.

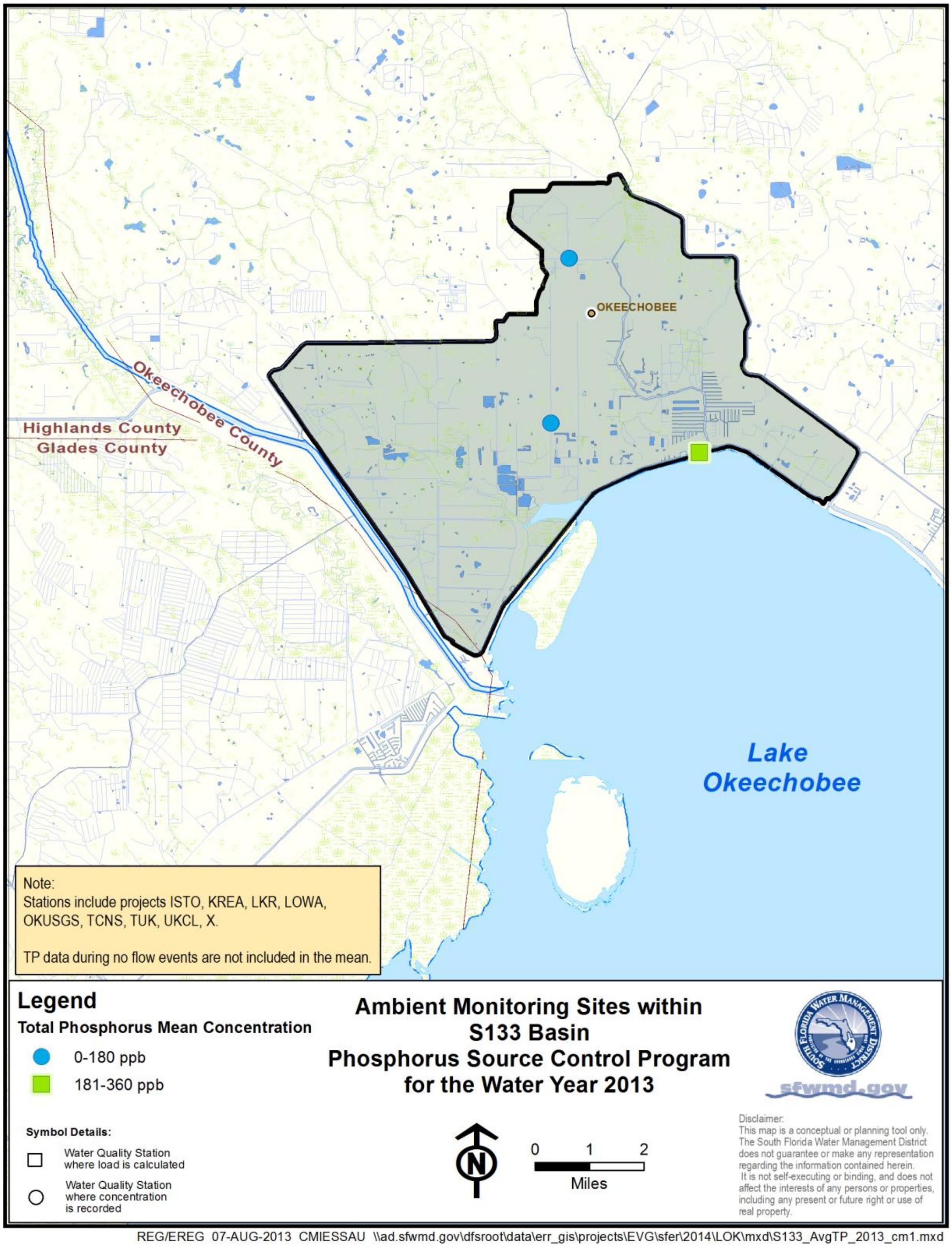
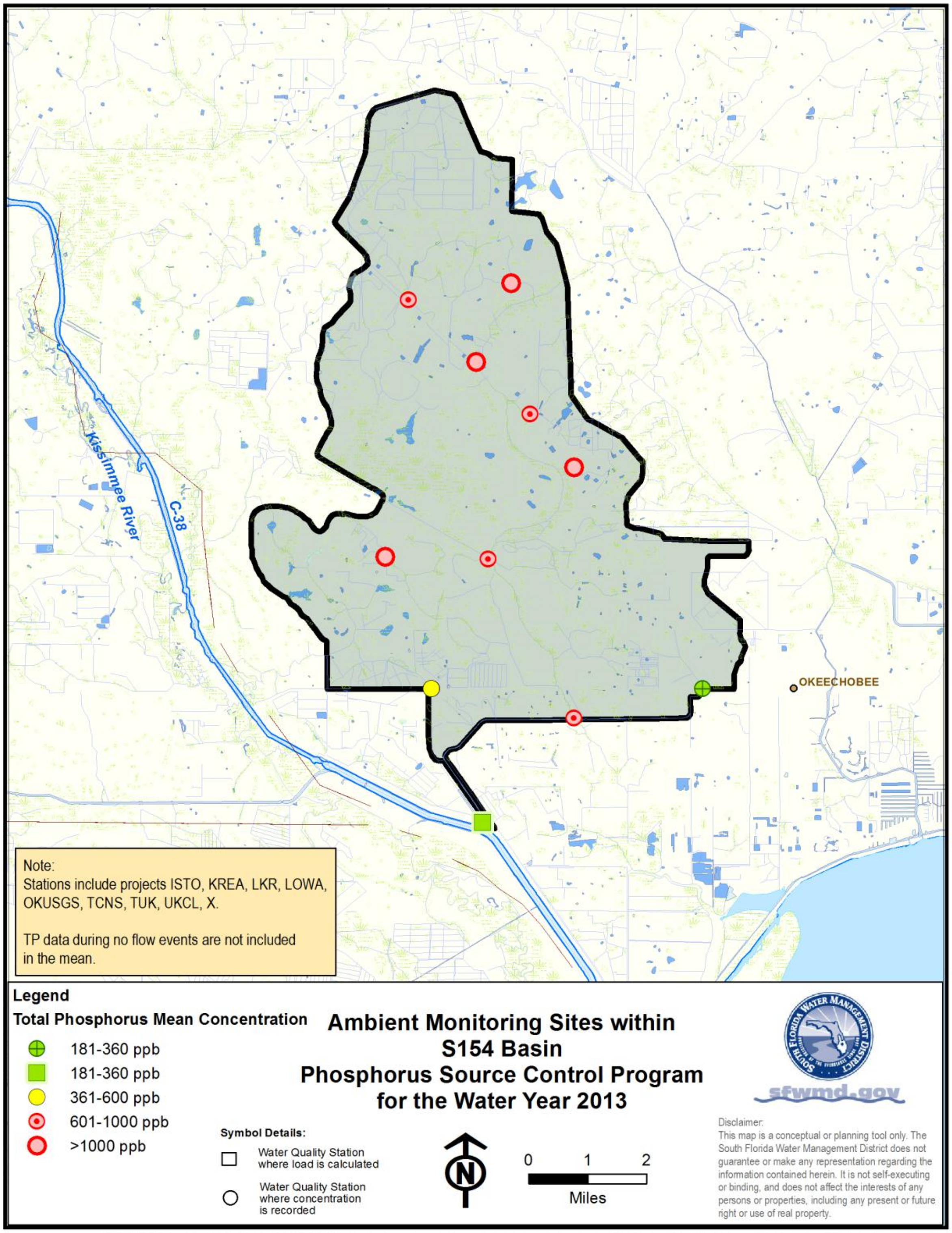


Figure 36. Taylor Creek/Nubbin Slough Sub-watershed, S-133 Basin average TP concentrations in ppb for WY2013.



REG/EREG 09-AUG-2013 CMIESSAU \\ad.sfwmd.gov\dfsroot\data\err_gis\projects\EVG\sfer\2014\LOK\mxd\S154_AvgTP_2013_cm1.mxd

Figure 37. Taylor Creek/Nubbin Slough Sub-watershed, S-154 Basin average TP concentrations in ppb for WY2013.

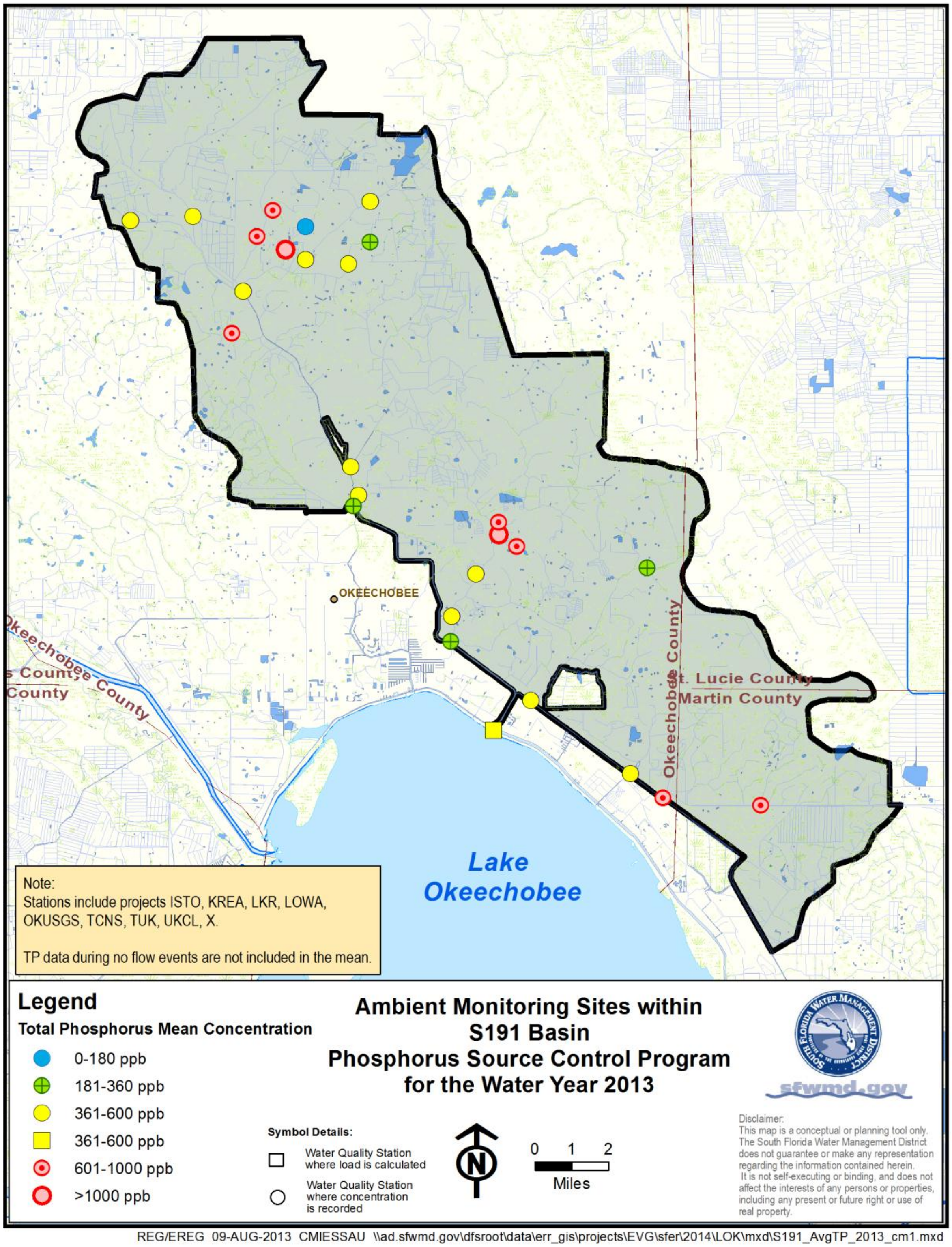


Figure 38. Taylor Creek/Nubbin Slough Sub-watershed, S-191 Basin average TP concentrations in ppb for WY2013.

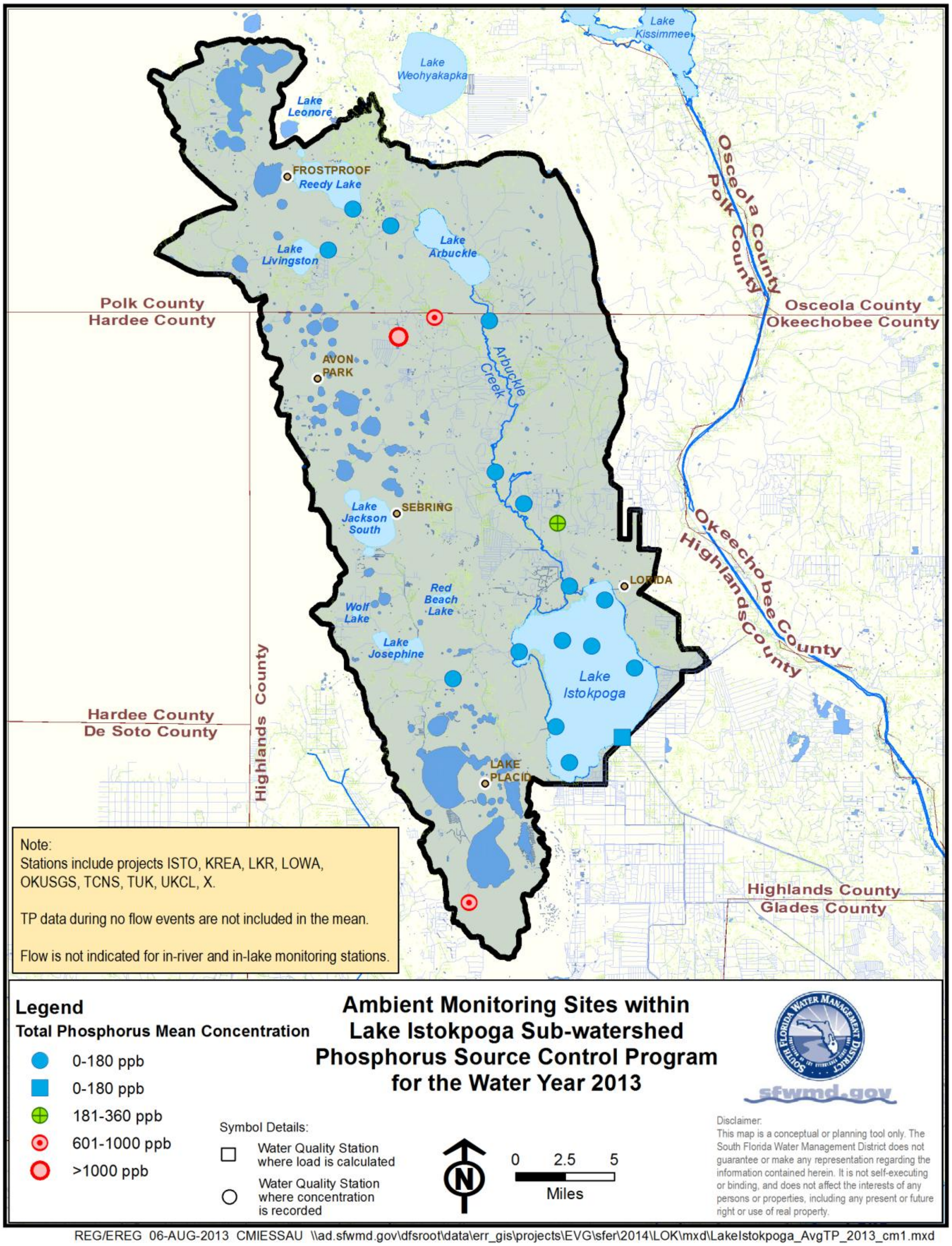


Figure 39. Lake Istokpoga Sub-watershed average TP concentrations in ppb for WY2013.

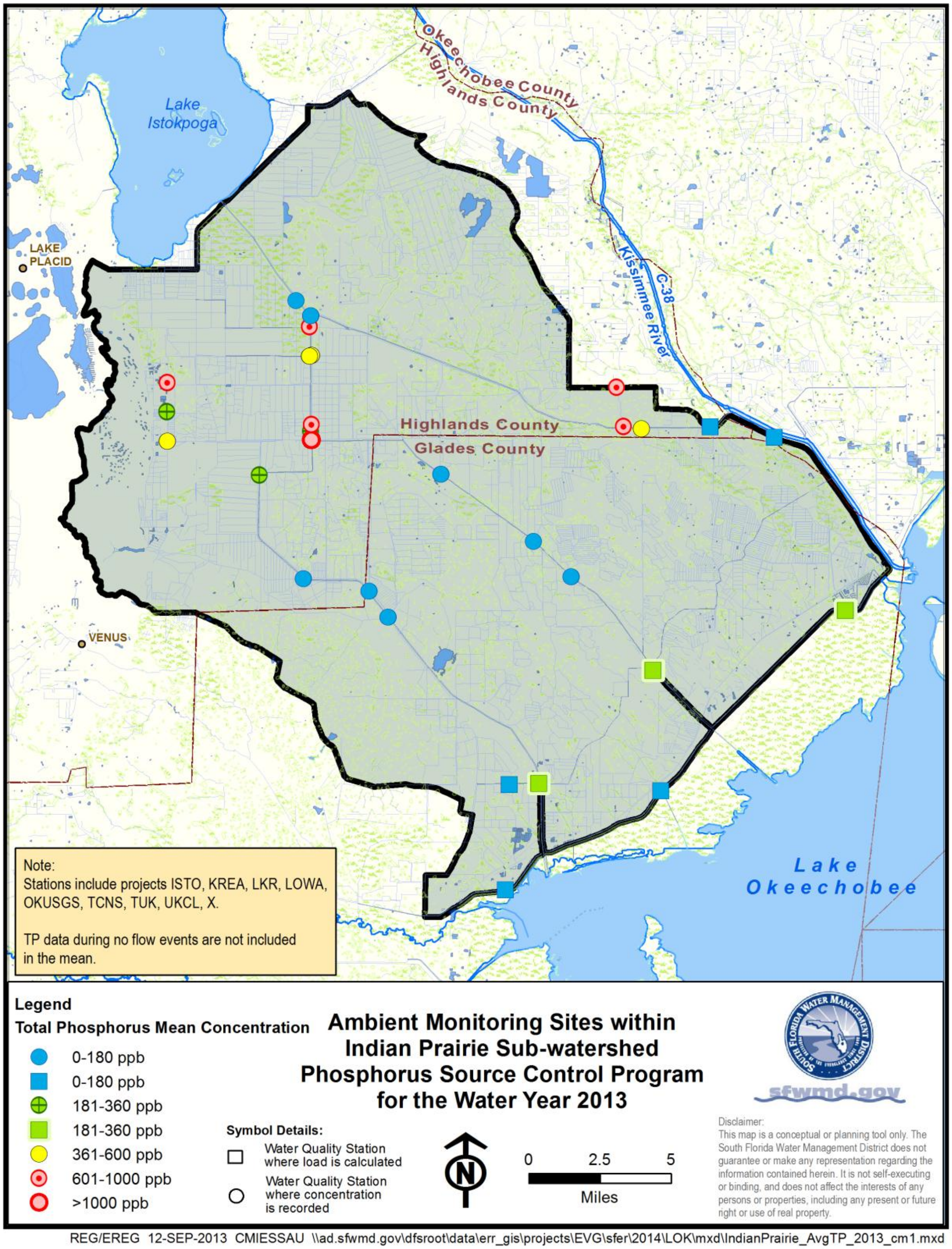


Figure 40. Indian Prairie Sub-watershed average TP concentrations in ppb for WY2013.

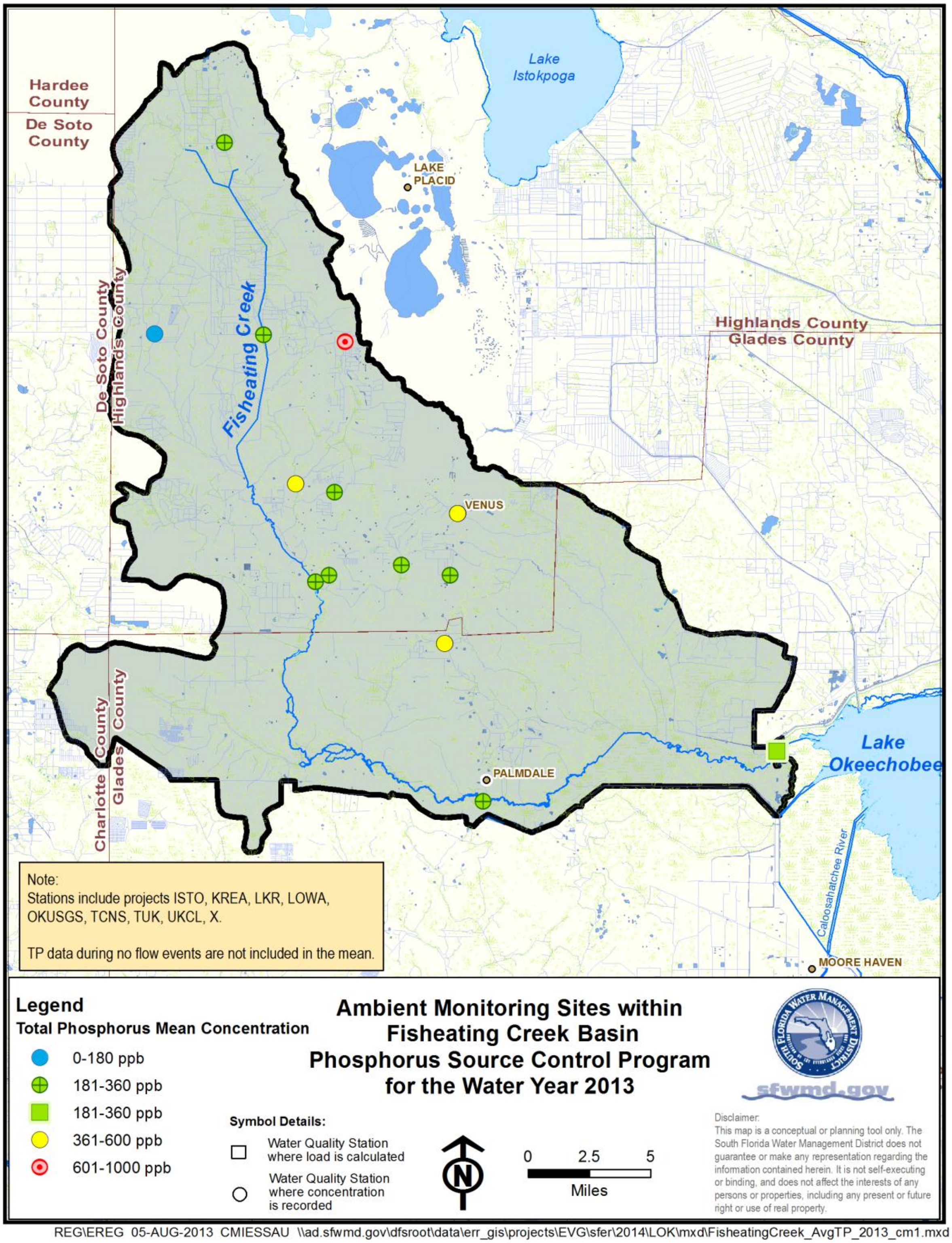


Figure 41. Fisheating Creek/Nicodemus Slough Sub-watershed, Fisheating Creek Basin average TP concentrations in ppb for WY2013.

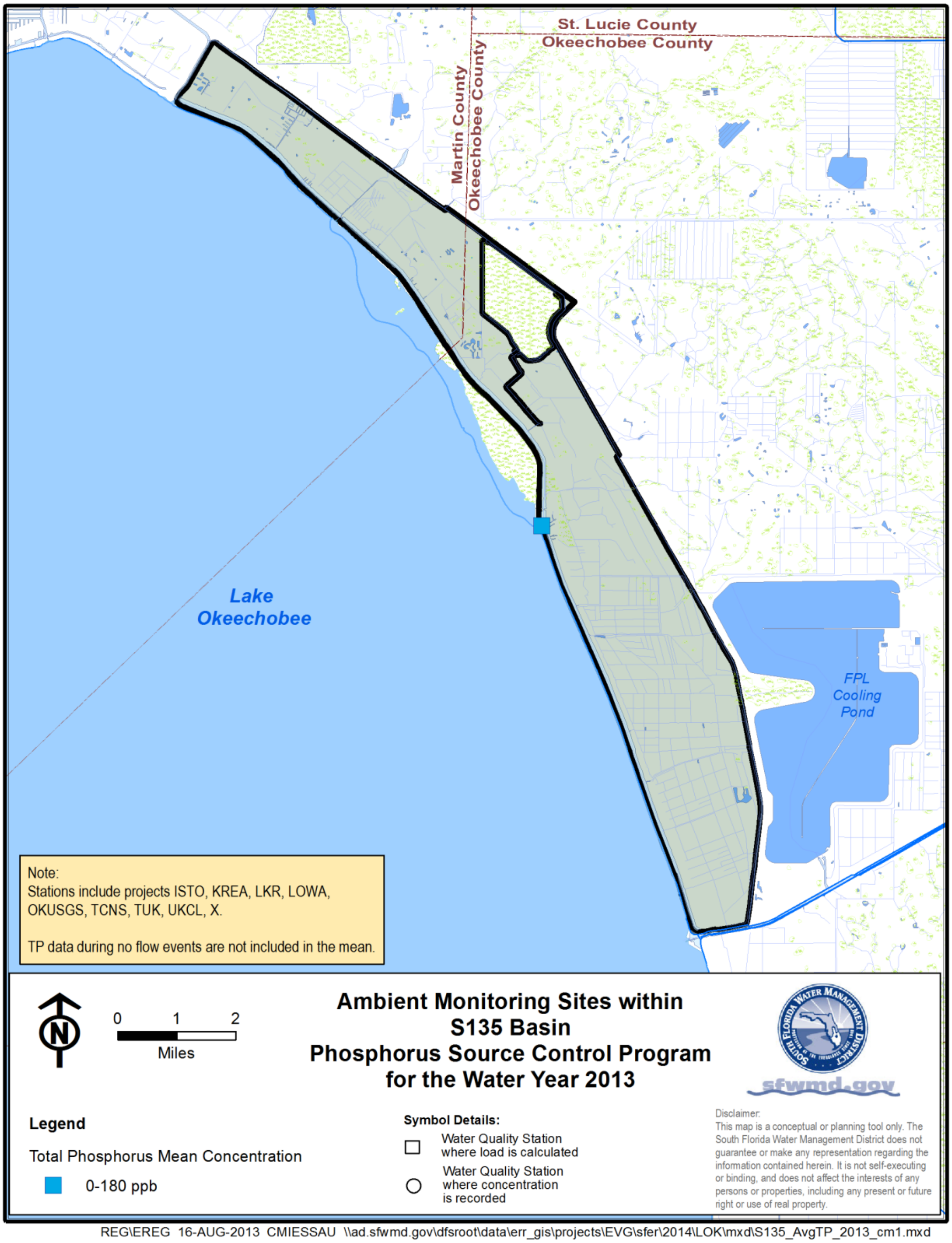


Figure 42. Taylor Creek/Nubbin Slough Sub-watershed, S-135 Basin.

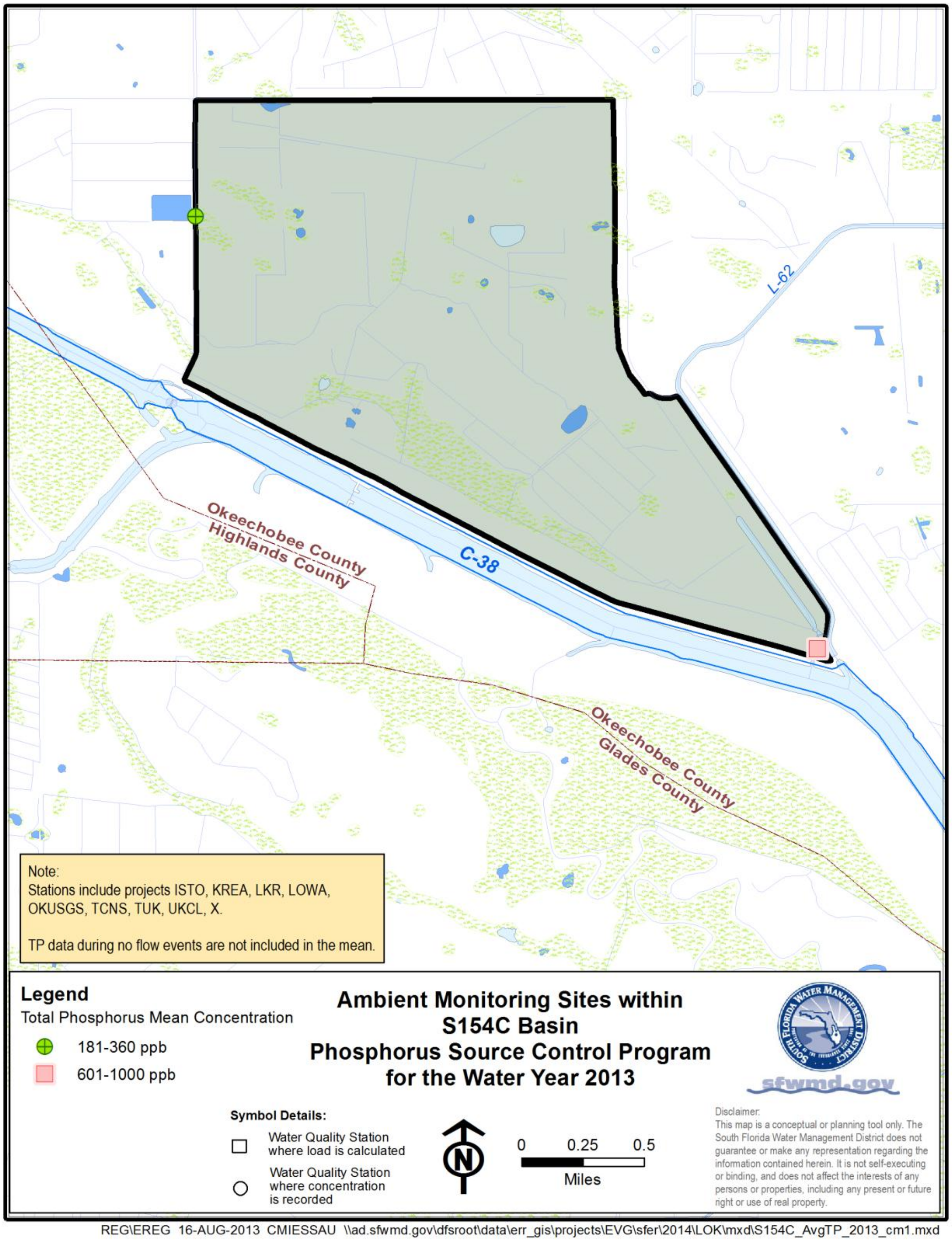


Figure 43. Taylor Creek/Nubbin Slough Sub-watershed, S-154C Basin average TP concentrations in ppb for WY2013.

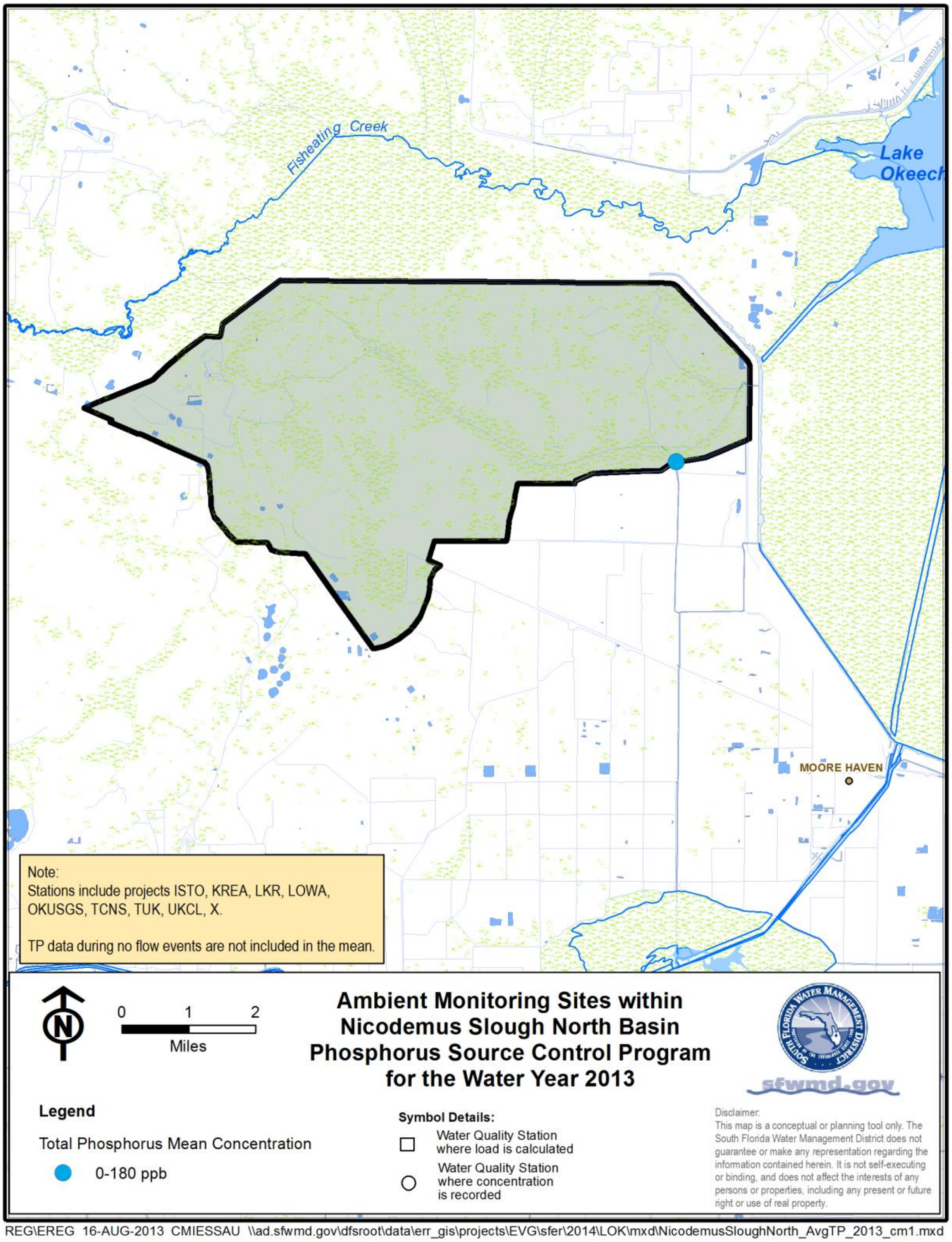


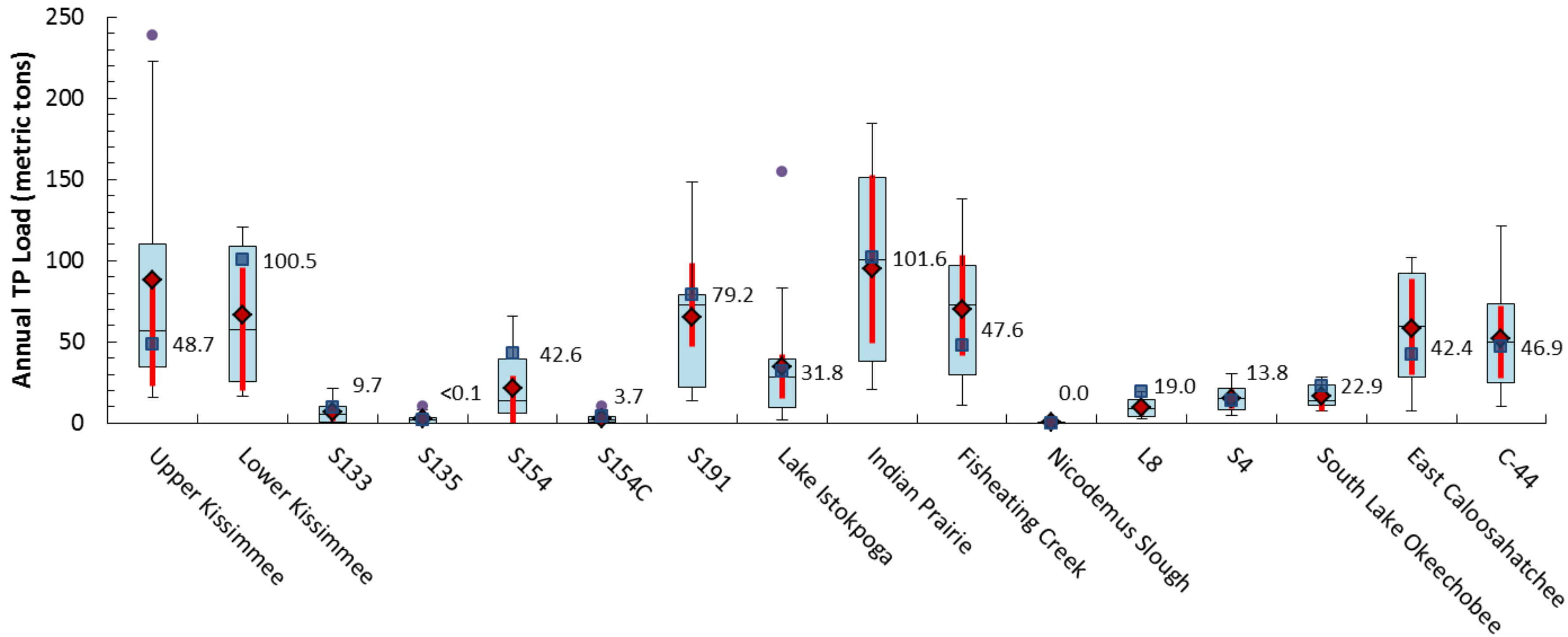
Figure 44. Fisheating Creek/Nicodemus Slough Sub-watershed, Nicodemus Slough Basin.

Table 2. WY2013 TP mean and median concentrations (ppb) of samples collected in the Lake Okeechobee Basins.

Basin	WY2013 Mean Concentration (ppb)	WY2013 Median Concentration (ppb)	Chapter 40E-61 F.A.C. Lake Inflow Concentration Limitation (ppb)
Upper Kissimmee (S-65)	56	49	Not Assigned[1]
Lower Kissimmee	203	67	Not Assigned[2]
S-133	158	123	180
S-135	95	95	110
S-154	539	365	180
S-154C	655	546	180
S-191	578	460	180
Nicodemus Slough	64	62	60
Lake Istokpoga	227	74	Not Assigned[1]
Indian Prairie	282	172	Not Assigned[2]
Fisheating Creek	281	255	180

[1]Chapter 40E-61, F.A.C. does not have limitations for the Upper Kissimmee and Lake Istokpoga Sub-watersheds since these areas are outside of the rule boundary.

[2]Chapter 40E-61, F.A.C does not have limitations for the Lower Kissimmee and Indian Prairie Sub-watersheds. However, there are limitations set for the smaller basins within those sub-watersheds.



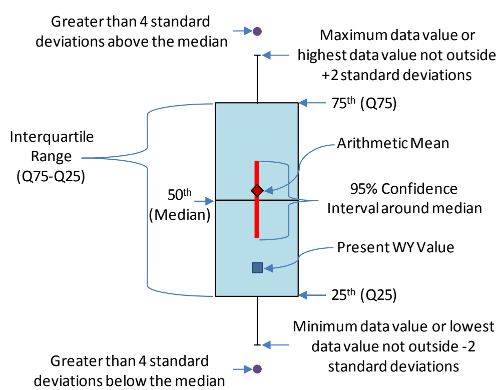


Figure 45. Comparison of TP loads for each sub-watershed and basin within the Lake Okeechobee Watershed as a box-and-whisker plot (based on WY2002–WY2013 data, except for S-154C and Nicodemus Slough where WY2009–WY2013 was used because WY2009 was the first year with measured flow data for these two basins).

CALOOSAHATCHEE RIVER WATERSHED

The existing monitoring network provides nutrient and flow data to capture representative discharges from the East Caloosahatchee, West Caloosahatchee, and S-4/Industrial Canal sub-watersheds. The East Caloosahatchee and the S-4/Industrial Canal sub-watersheds can discharge to either the Caloosahatchee River or Lake Okeechobee. The Coastal and Tidal sub-watersheds of the Caloosahatchee River Watershed are characterized by numerous tributary flows into the estuary. While many of these tributaries are actively monitored for water quality, the monitoring network does not currently capture all of the sub-watershed loads for these areas.

Figure 46 provides a flow schematic of the Caloosahatchee River Watershed depicting the sub-watershed divisions, flow transfers between sub-watersheds, and the existing structures associated with the water quality and flow data used for nutrient calculations.

As of June 2013, approximately 474,866 acres of the agricultural and nonagricultural acreage within the Caloosahatchee River Watershed are included in ERP/SW permits issued by the District (44 percent of the watershed acreage), and 393,308 acres of the agricultural lands (71 percent) are reported to be enrolled in the FDACS BMP Program. The specific coverage for each of its five sub-watersheds is shown in **Figures 47** through **51**.

Table 3 provides a summary of the WY2013 load and concentration data for the Caloosahatchee sub-watersheds. **Figures 52** through **63** depict the Unit Area Load (UAL) and FWM concentration data for the period of record and five-year moving averages to track trends over time. For the tributaries within the Tidal and Coastal sub-watersheds, median concentration data for the past four to ten years are presented in **Figures 64** through **67** based on availability**.**

WY2013 nutrient loads and concentrations for the eastern sub-watersheds (S4/Industrial Canal, East, and West) were generally lower than the median levels observed during the period of record, except for the nutrient concentrations in the East Caloosahatchee which were approximately 20 percent higher. Also, as nutrient loads are highly sensitive to rainfall and flow, these data were also examined. Annual rainfall and flows in all three sub-watersheds were generally lower than the median levels, except for the rainfall in the S-4/Industrial Canal Sub-watershed which was slightly higher (approximately 4 inches).

WY2013 TP concentrations in the Tidal Sub-watershed were lower in 14 out of the 18 tributaries, while total nitrogen (TN) concentrations in all tributaries exceeded the median levels observed during the period of record. In the Coastal Sub-watershed, most of the WY2013 nutrient concentrations exceeded the period of record medians except in one tributary.

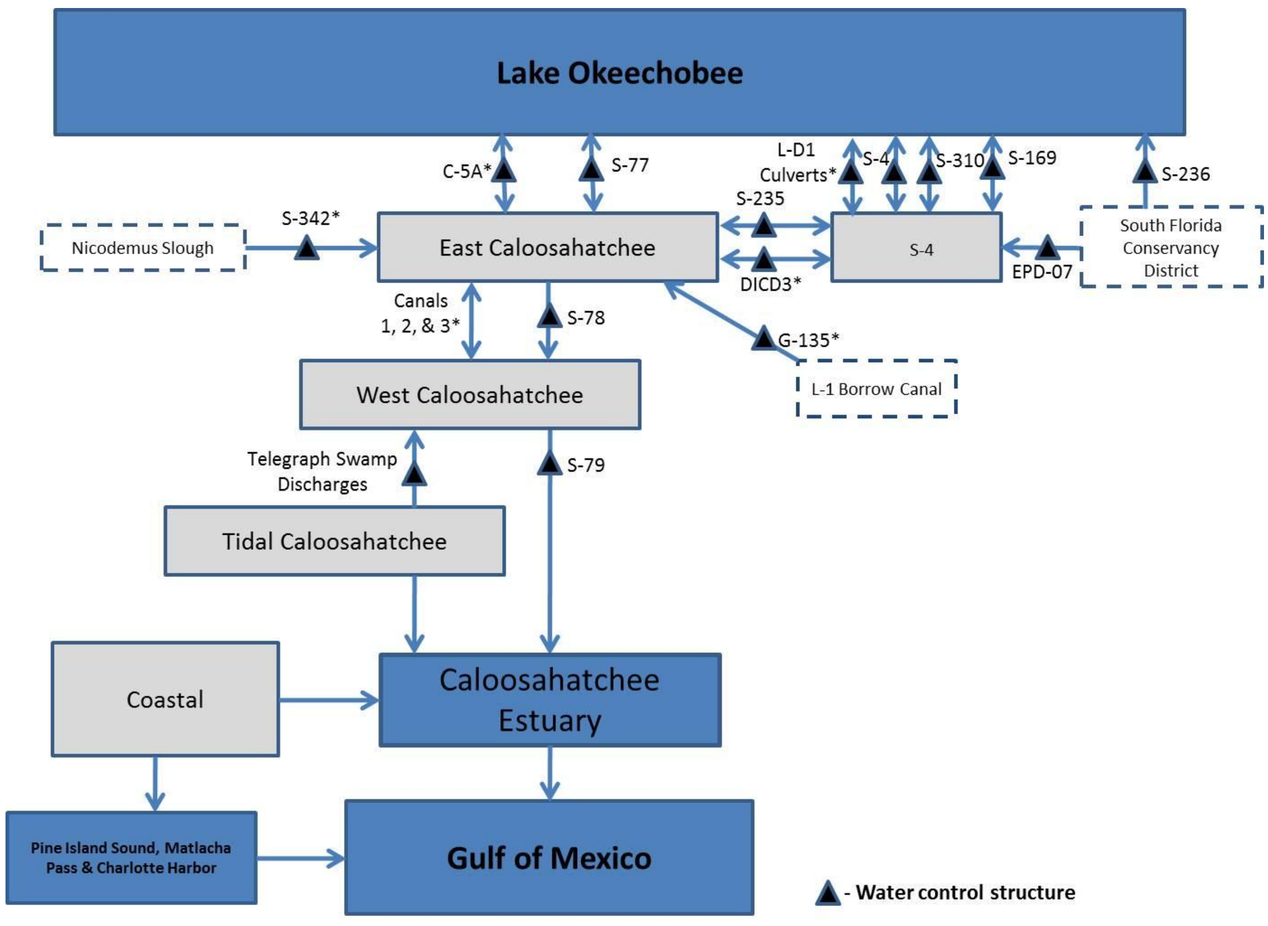


Figure 46. Caloosahatchee River Watershed flow schematic (HDR, 2011[3]).

[3] HDR Engineering, Inc. 2011. Data Analysis and Performance Measure Development for the Caloosahatchee River Watershed Source Control Programs, Deliverable 5.6, Final Analysis of Historical Data Report. Submitted to the South Florida Water Management District, West Palm Beach, FL.

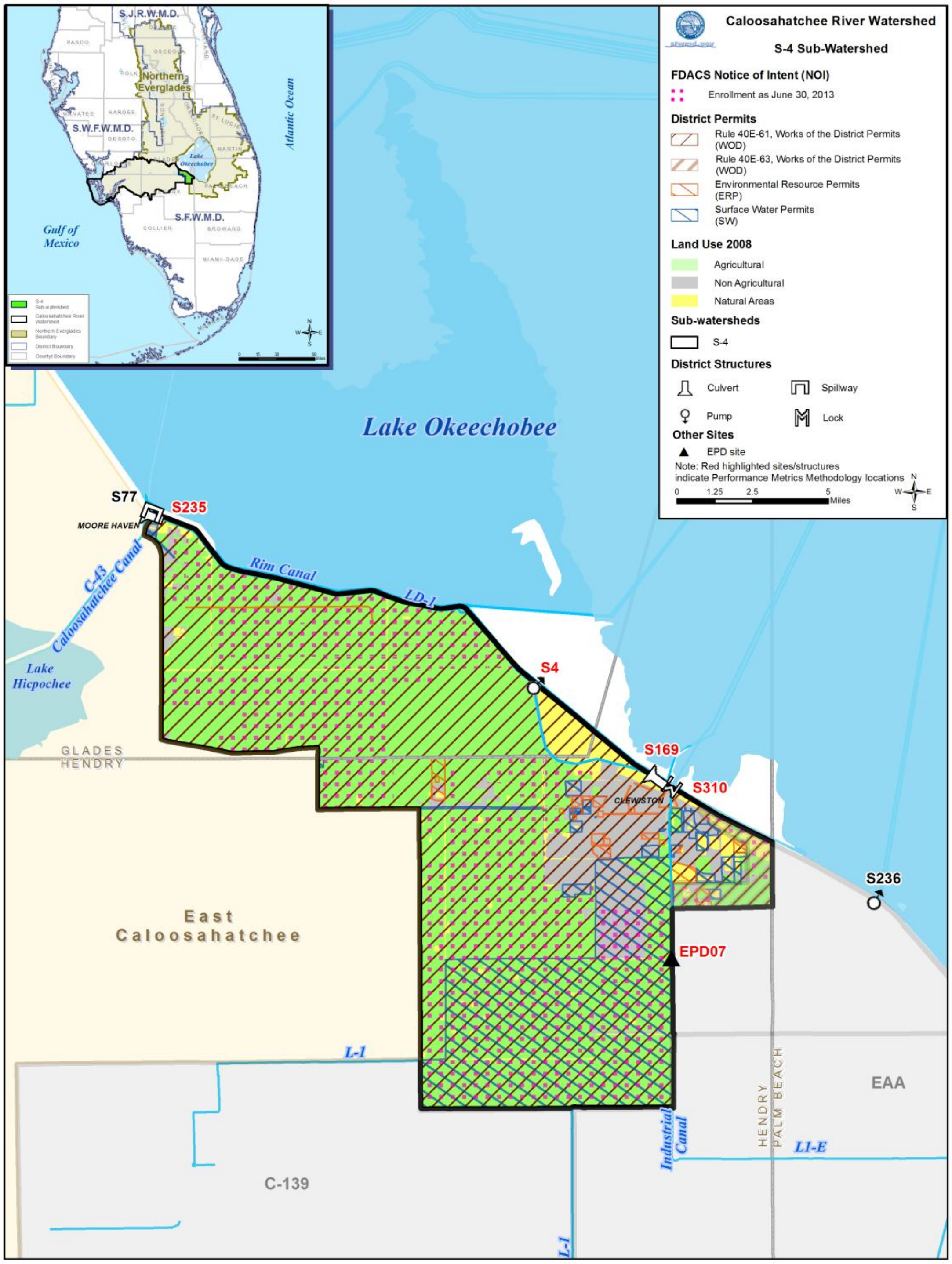
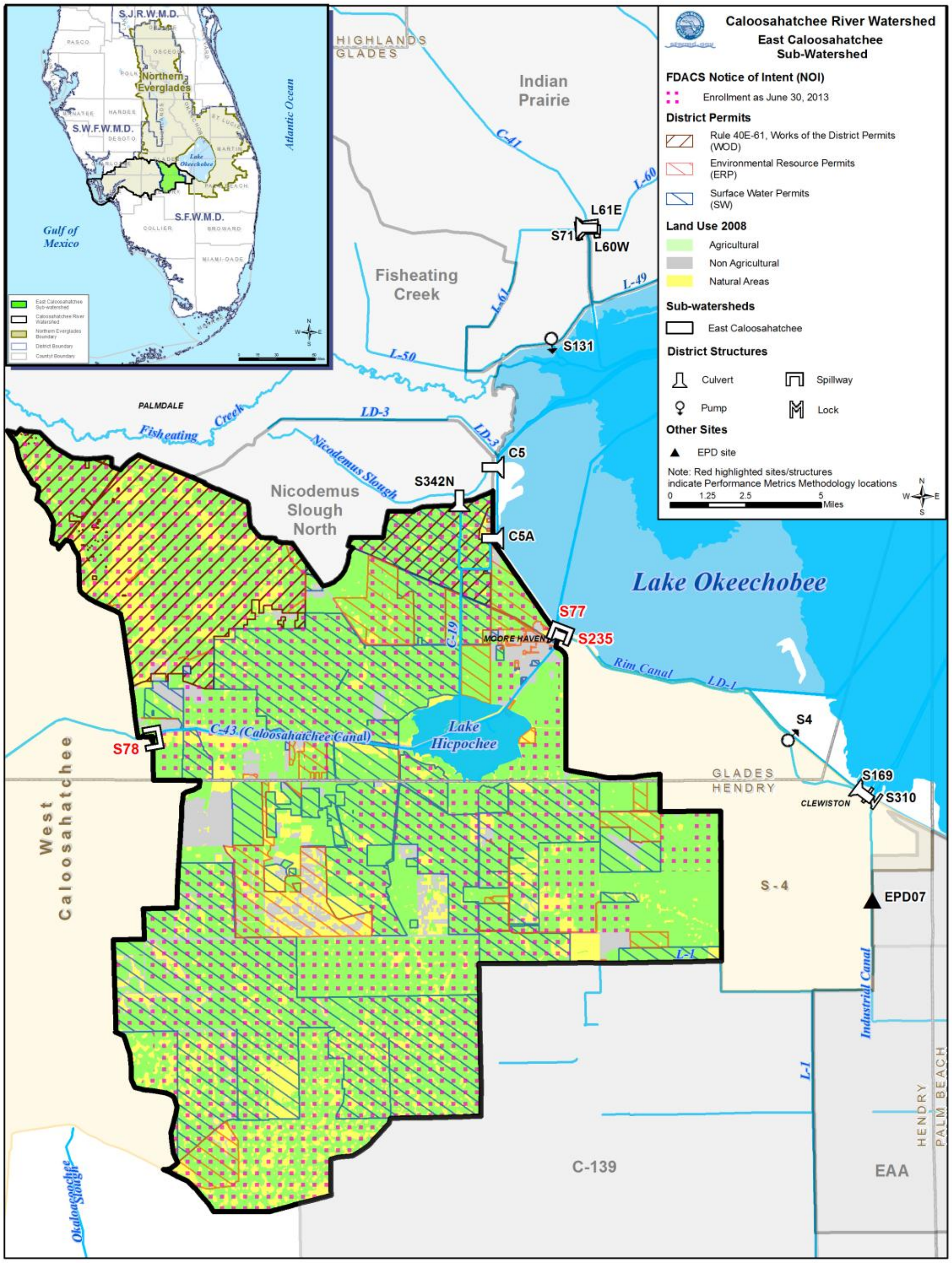
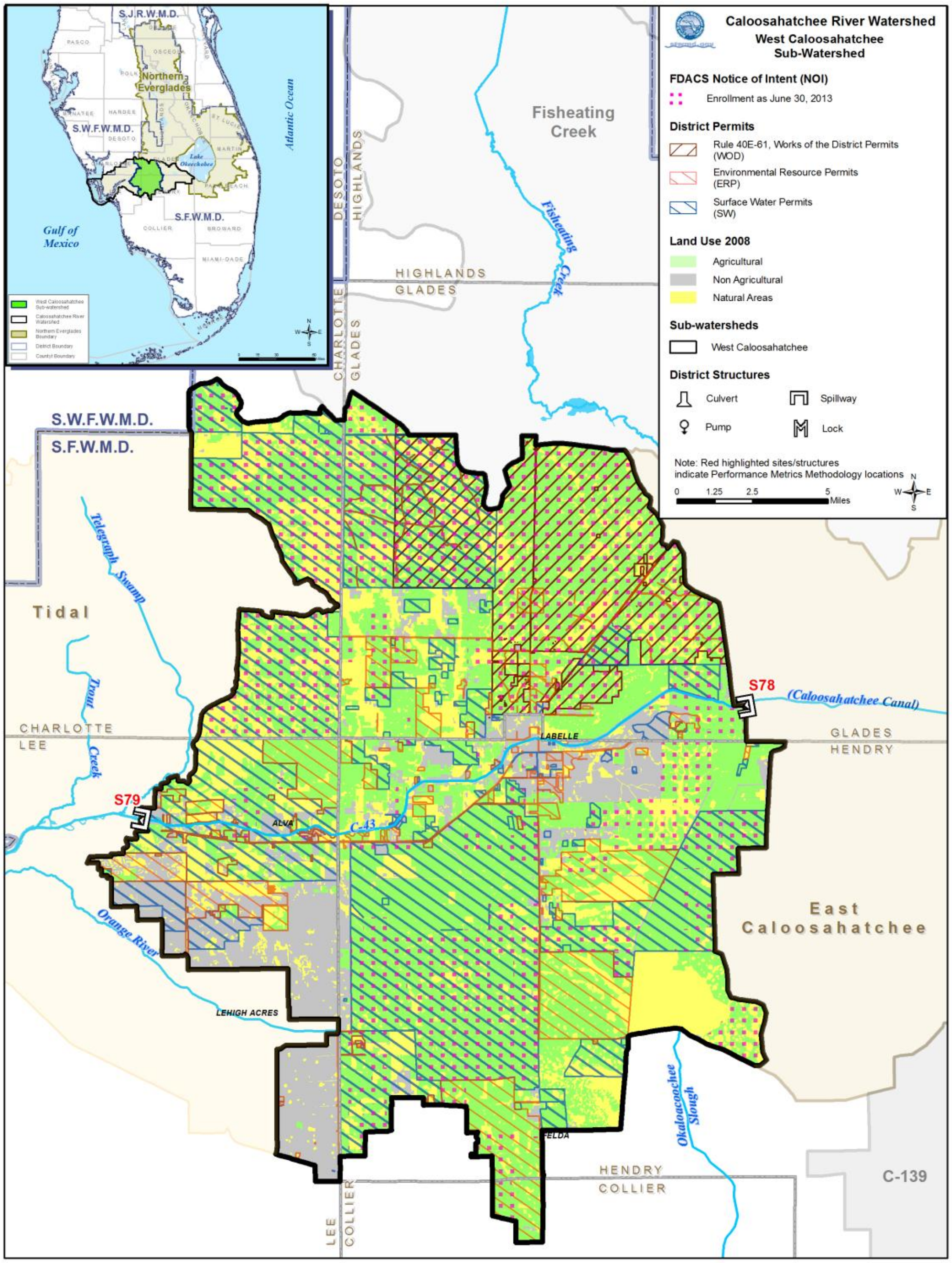


Figure 47. Caloosahatchee River Watershed, S-4 Sub-watershed.



Note: Silviculture is not included on map

Figure 48. Caloosahatchee River Watershed, East Caloosahatchee Sub-watershed.



Note: Silviculture is not included on map

Figure 49. Caloosahatchee River Watershed, West Caloosahatchee Sub-watershed.

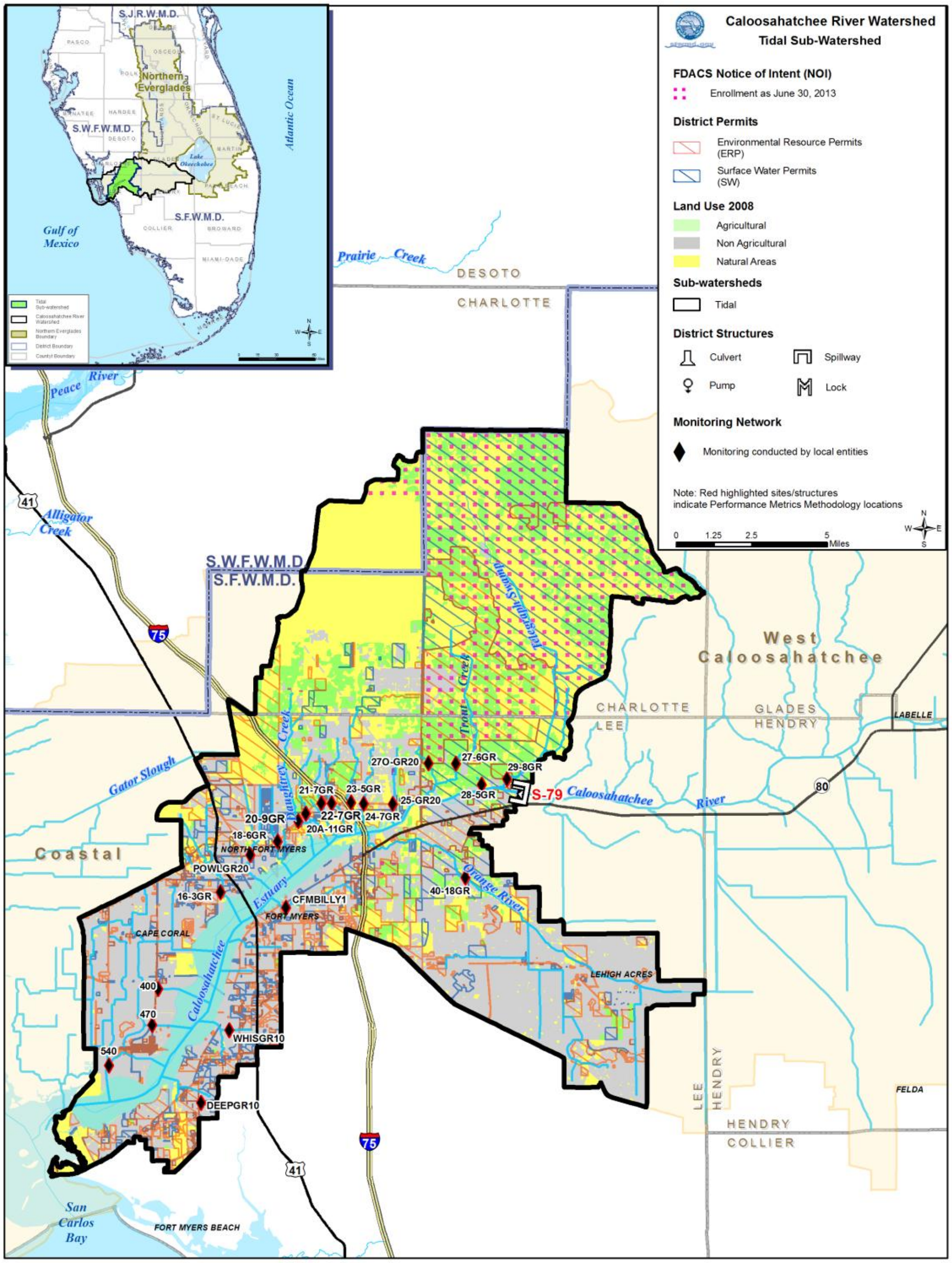


Figure 50. Caloosahatchee River Watershed, Tidal Caloosahatchee Sub-watershed.

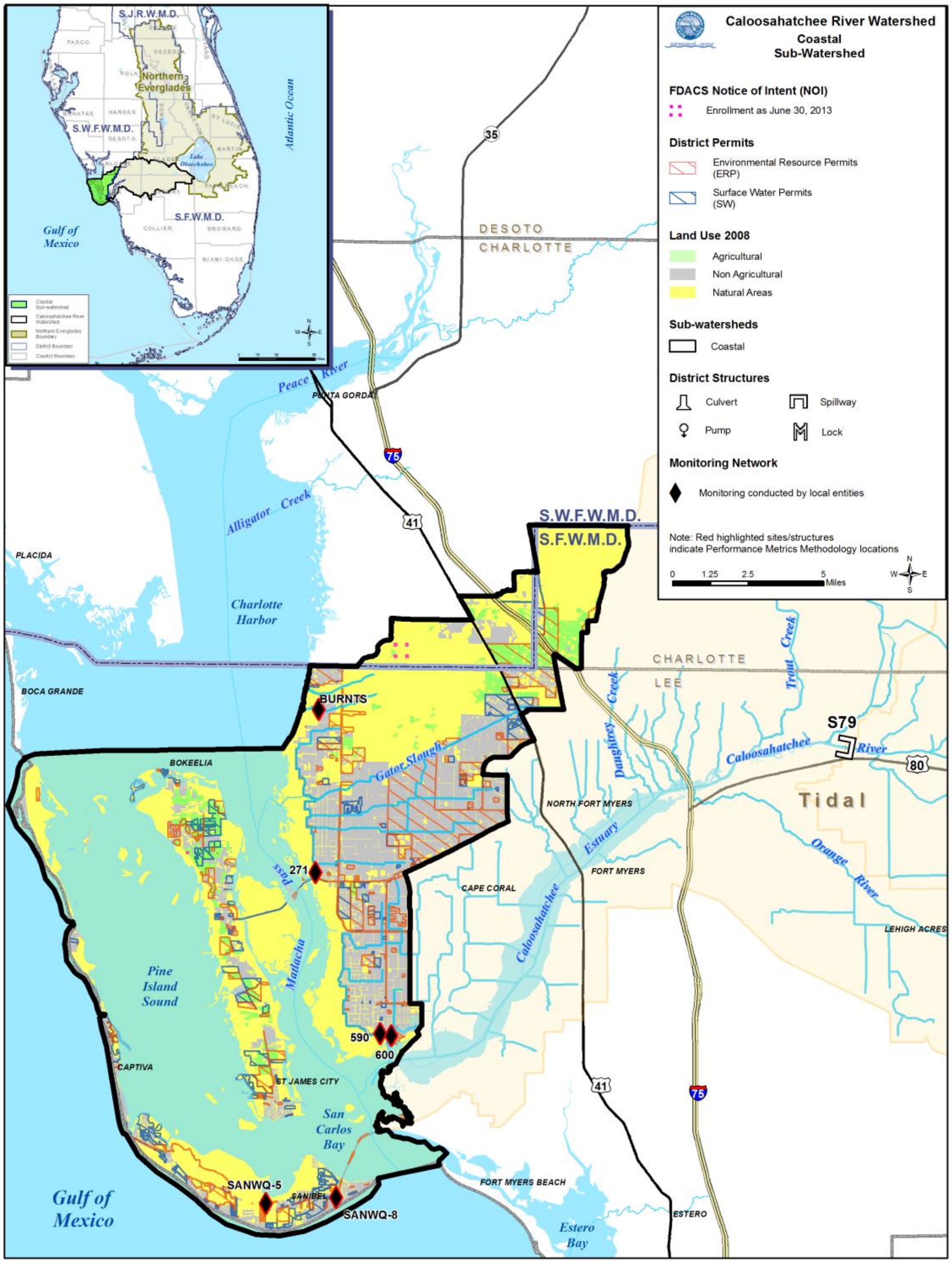


Figure 51. Caloosahatchee River Watershed, Coastal Caloosahatchee Sub-watershed.

Table 3. WY2013 rainfall and total phosphorus (TP) and total nitrogen (TN) loads (mt), Unit Area Loads (UAL; lbs/ac), and concentrations (ppb).

Sub-Watershed	Annual Rainfall (in)	WY2013 Flow (ac-ft)[1]	WY2013 Observed TP Load (mt)	WY2013 Observed TP UAL (lb/ac)	WY2013 Observed TN Load (mt)	WY2013 Observed TN UAL (lb/ac)	WY2013 TP Concentration (ppb)[2]	WY2013 TN Concentration (ppb)[2]
East Caloosahatchee[3]	46.99	164,644	42	0.45	367	3.96	209	1,805
West Caloosahatchee	46.33	507,630	87	0.55	887	5.58	139	1,417
S-4/Industrial Canal [3]	42.93	63,994	14	0.73	204	10.67	174	2,582
Tidal Caloosahatchee [4]	43.81	-	-	-	-	-	65	1,206
Bayshore Creek		-	-	-	-	-	91	1,661
Billy Creek[5]		-	-	-	-	-	NA	NA
Chapel Branch		-	-	-	-	-	63	1,704
Daughtrey Creek[6]		-	-	-	-	-	74	1,208
Deep Lagoon		-	-	-	-	-	100	1,413
Hancock Creek[6]		-	-	-	-	-	130	1,410
Lower Orange River[6]		-	-	-	-	-	26	1,025
Marsh Point		-	-	-	-	-	110	1,310
Otter Creek		-	-	-	-	-	150	1,779
Owl Creek		-	-	-	-	-	63	1,310
Palm Creek		-	-	-	-	-	70	1,377
Popash Creek		-	-	-	-	-	195	1,730
Powell Creek		-	-	-	-	-	170	1,410
Southeast Cape Coral[6]		-	-	-	-	-	53	963
Stroud Creek		-	-	-	-	-	78	1,516
Telegraph Creek[6]		-	-	-	-	-	40	1,538
Trout Creek		-	-	-	-	-	55	1,054
Whiskey Creek		-	-	-	-	-	26	850
Coastal Caloosahatchee[4]	50.38	-	-	-	-	-	44	1,026
Durden Creek		-	-	-	-	-	12	1,217
Northwest Cape Coral[6]		-	-	-	-	-	40	850
Sanibel Island[6]		-	-	-	-	-	87	1,819
Southwest Cape Coral[6]		-	-	-	-	-	50	838

[1] Tributaries with blank data are currently not monitored for flow.
[2] Concentrations are flow-weighted means for S4/Industrial Canal, East, and West Caloosahatchee sub-watersheds. Concentrations for tributary sites are monthly medians based on grab samples collected by local water quality programs
[3] Loads from the East Caloosahatchee and S-4 Sub-watersheds can discharge to both the Caloosahatchee River Watershed and Lake Okeechobee.
[4] Composite sub-watershed nutrient concentrations were calculated by flow-weighting the individual tributary concentrations, using the unit area runoff coefficients and areas for the basins developed for the 2012 Caloosahatchee River Watershed Protection Plan update.
[5] Water quality monitoring was not conducted and/or reported at this site during WY2013.
[6] Tributaries were combined into larger hydrologic units using the most downstream station or averaging stations as follow: Daughtrey Creek with East Daughtrey Creek; Hancock Creek with Yellow Fever and East Yellow Fever; Lower Orange River with Upper Orange River and Blackstone; Southeast Cape Coral; Telegraph Creek with Telegraph Swamp and Babcock; Northwest Cape Coral with Upper Yucca Pens, Lower Yucca Pens and Northcentral Cape Coral; Sanibel Island; Southwest Cape Coral.

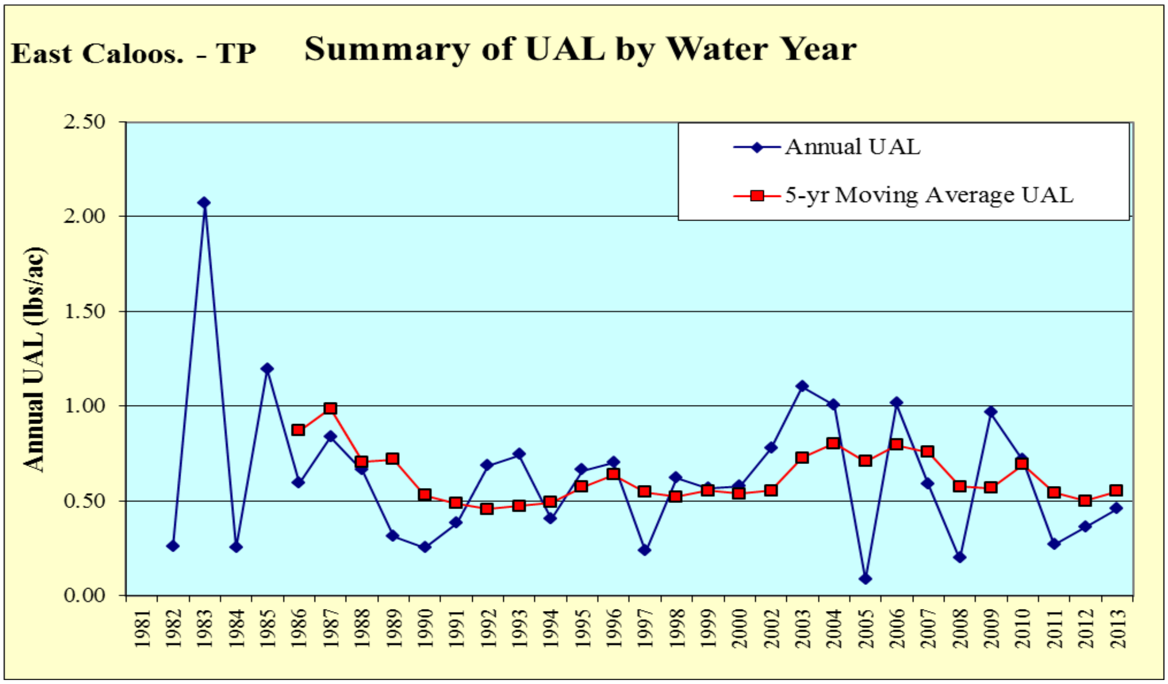


Figure 52. East Caloosahatchee Sub-watershed observed TP Unit Area Load (UAL).

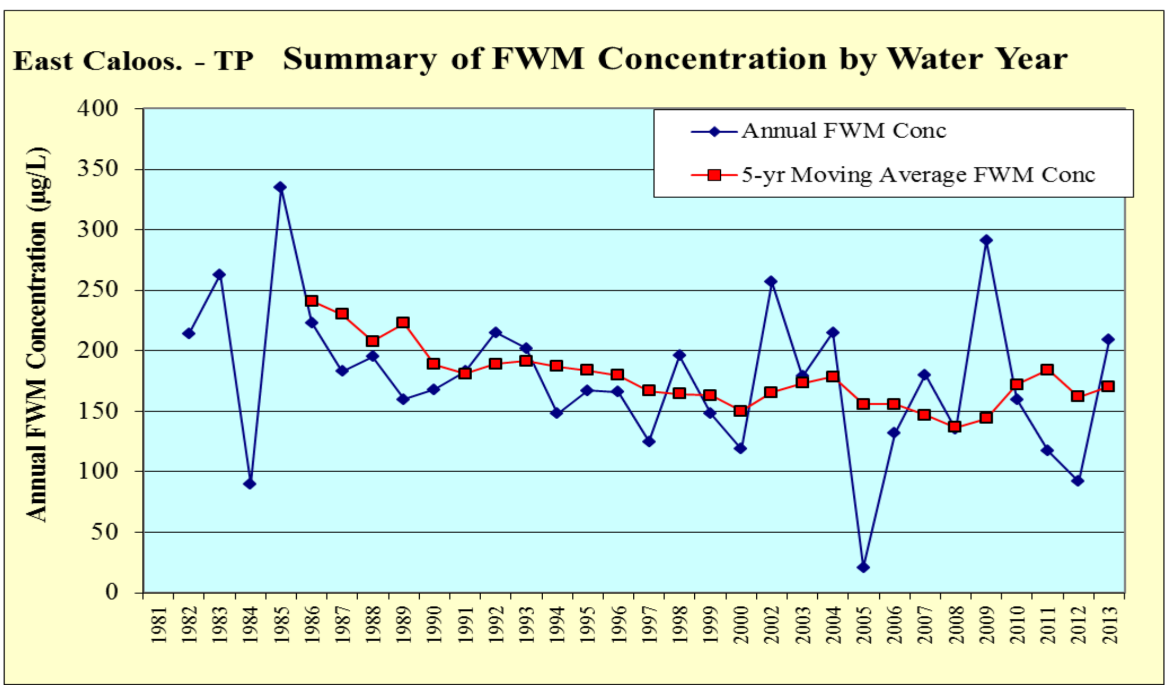


Figure 53. East Caloosahatchee Sub-watershed observed TP FWM concentrations.

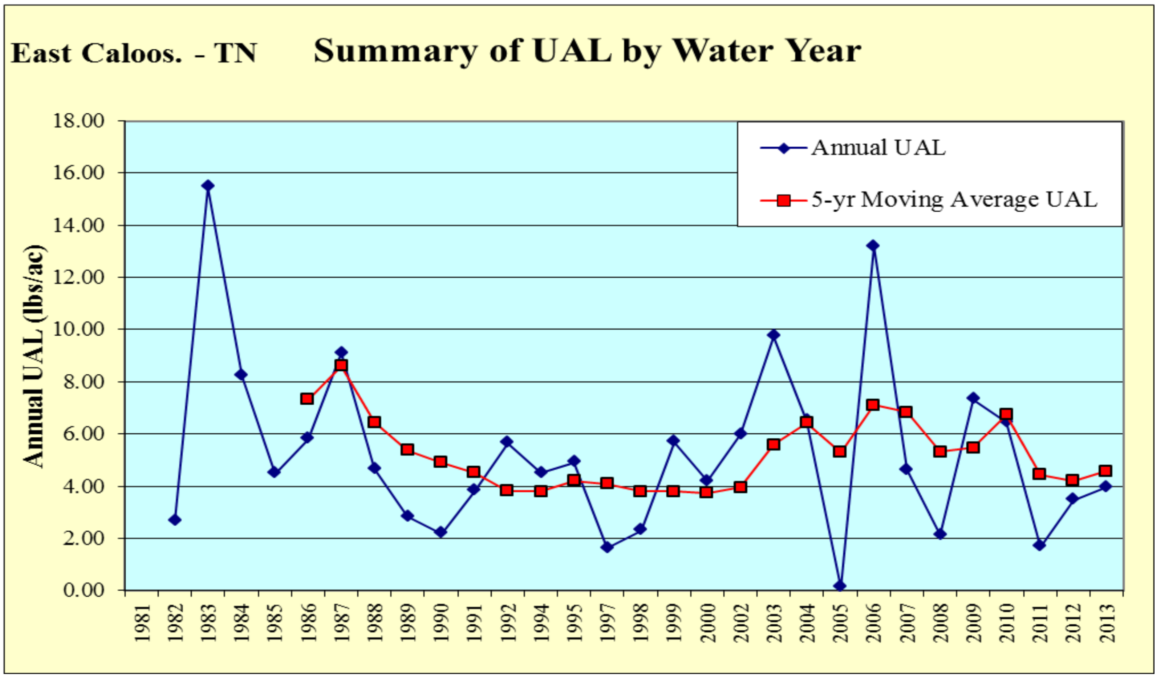


Figure 54. East Caloosahatchee Sub-watershed observed TP UAL.

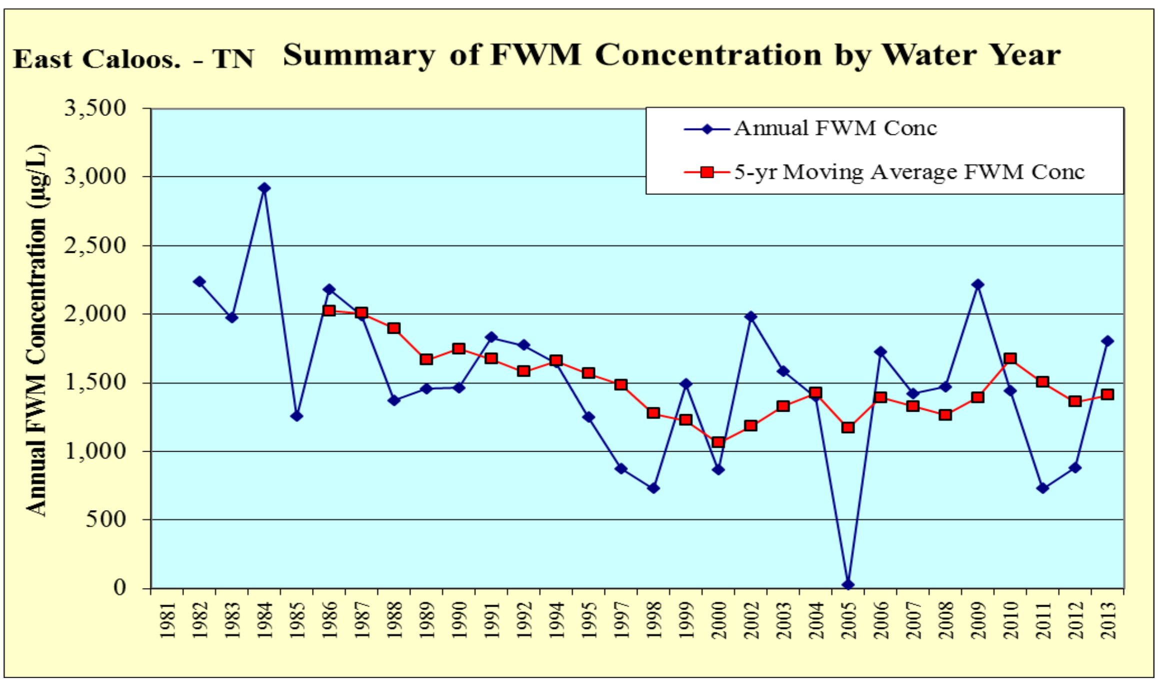


Figure 55. East Caloosahatchee Sub-watershed observed TP FWM concentrations.

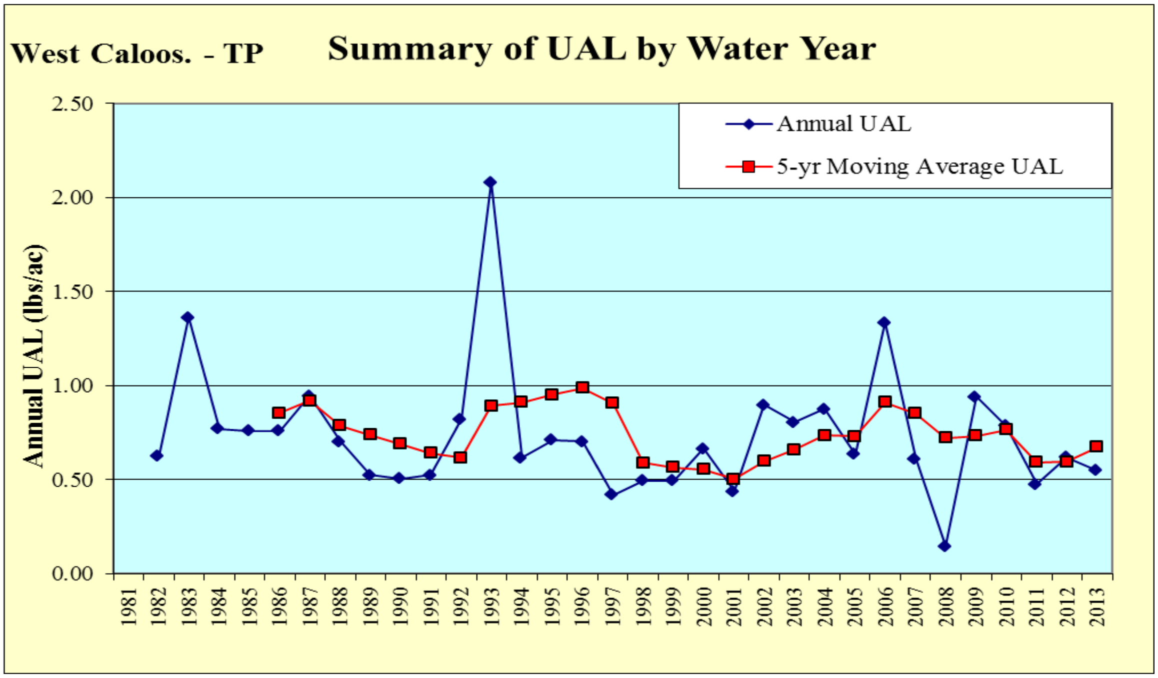


Figure 56. West Caloosahatchee Sub-watershed observed TP UAL.

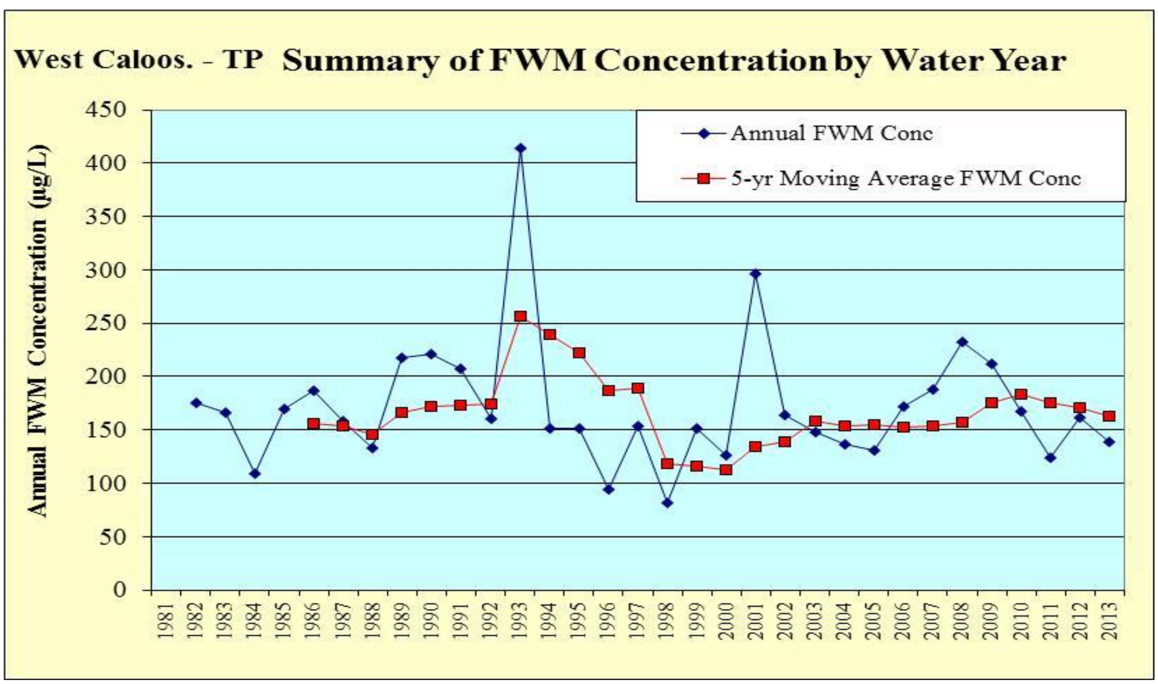


Figure 57. West Caloosahatchee Sub-watershed observed TP FWM concentrations.

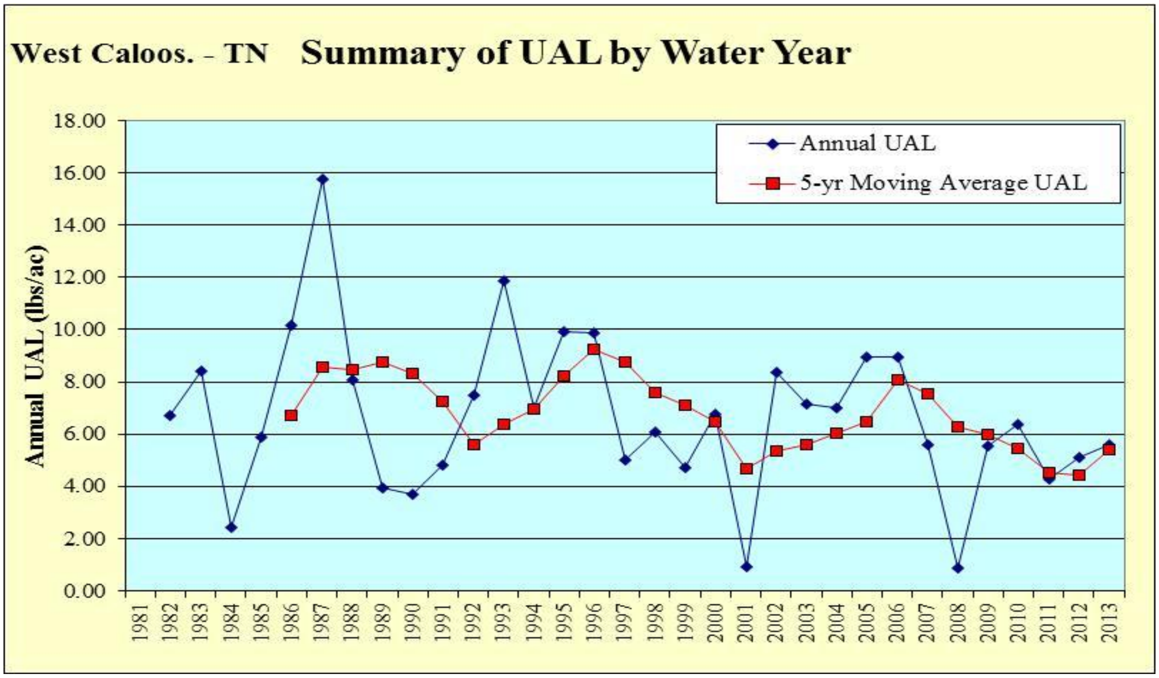


Figure 58. West Caloosahatchee Sub-watershed observed total nitrogen (TN) UAL.

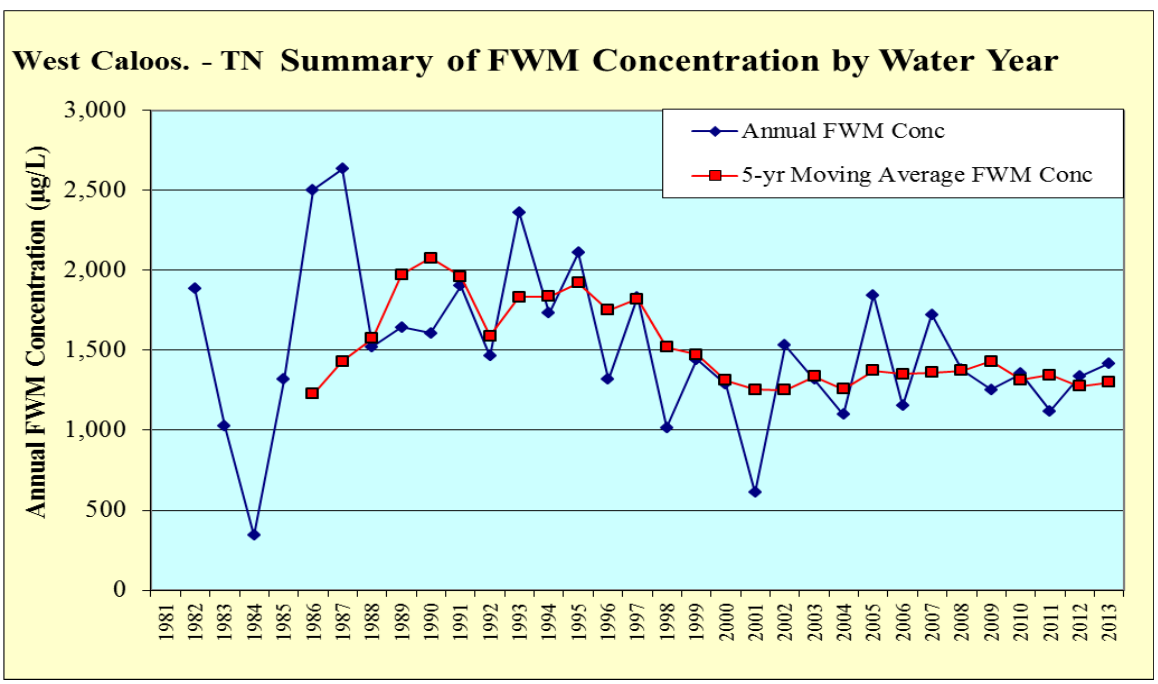


Figure 59. West Caloosahatchee Sub-watershed observed TN observed TP FWM concentrations.

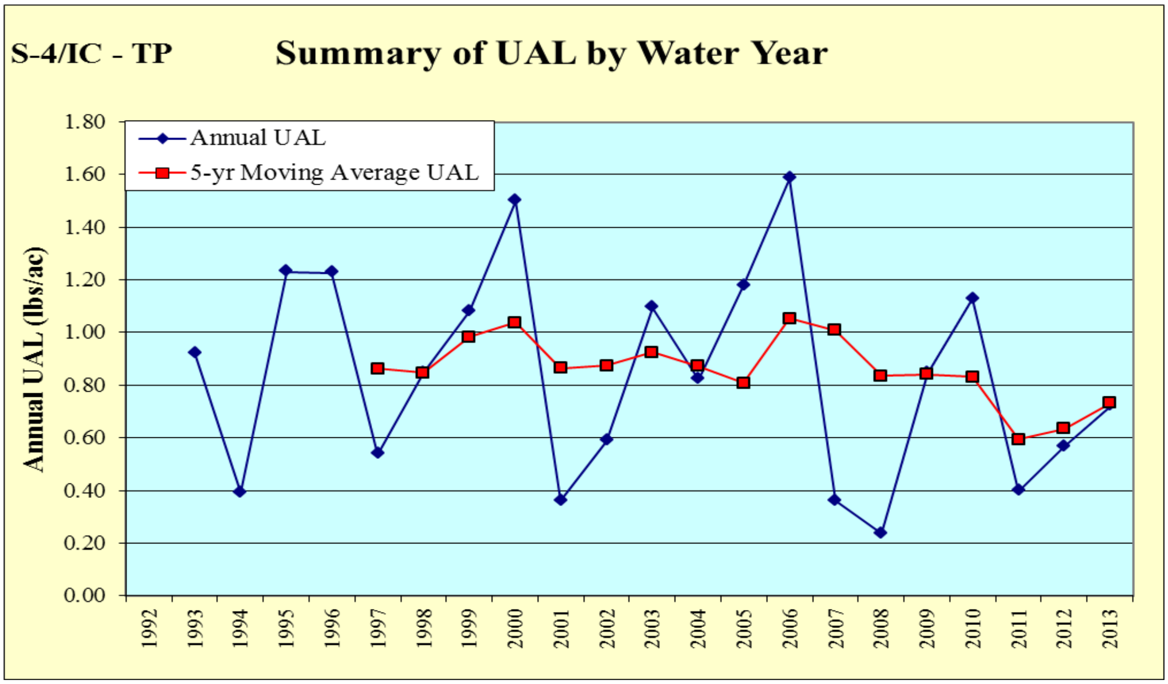


Figure 60. S-4/Industrial Canal Sub-watershed observed TP UAL.

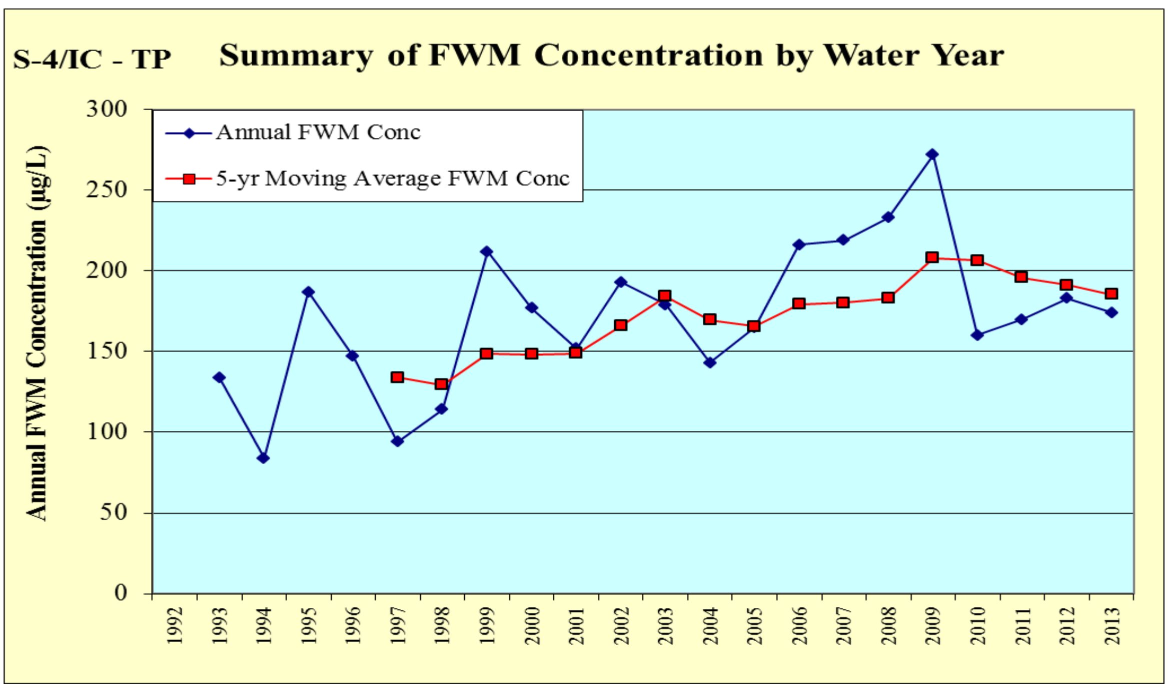


Figure 61. S-4/Industrial Canal Sub-watershed observed TP FWM concentrations.

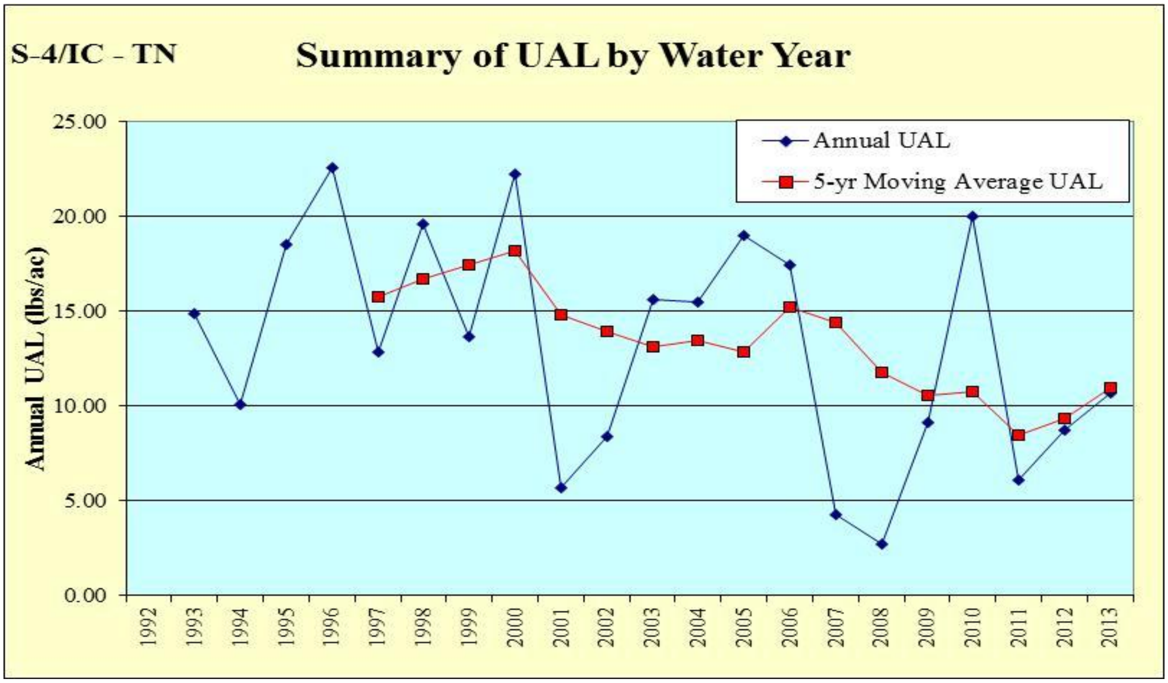


Figure 62. S-4/Industrial Canal Sub-watershed observed TN UAL.

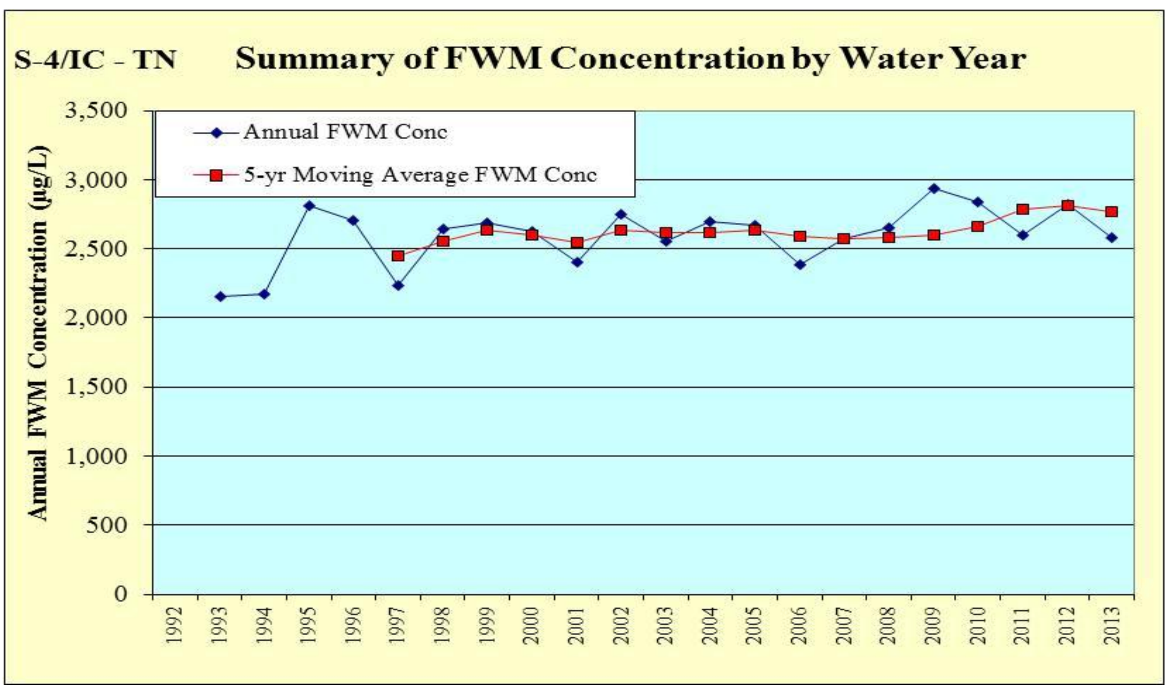


Figure 63. S-4/Industrial Canal Sub-watershed observed TN FWM concentrations.

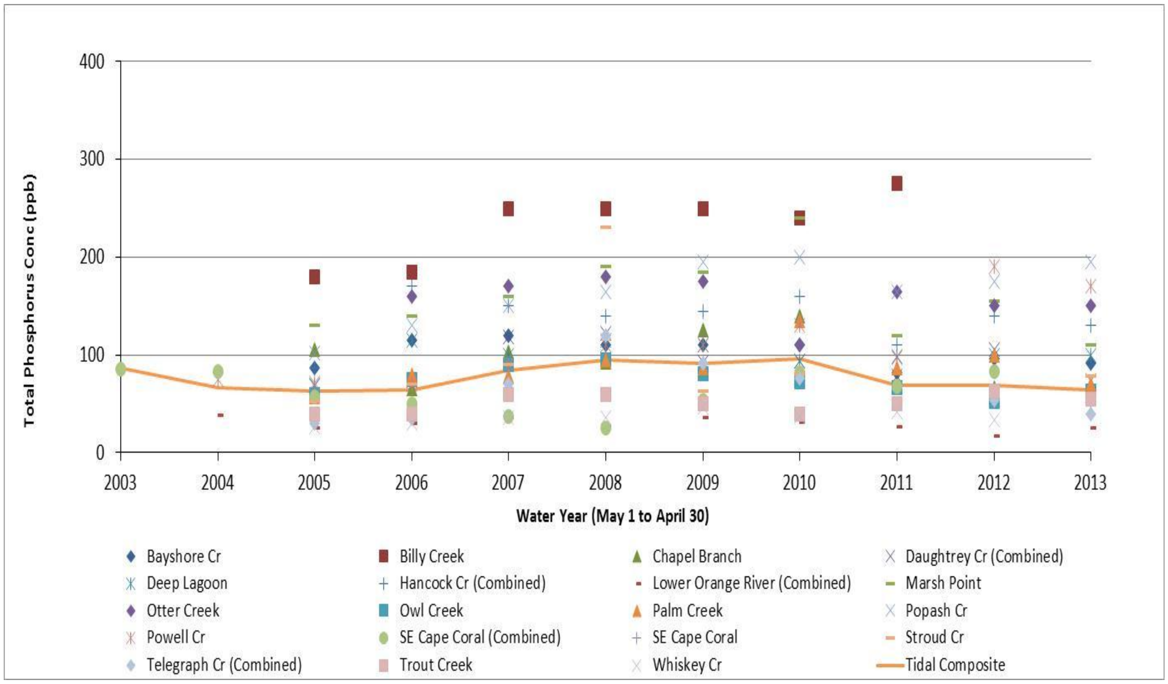


Figure 64. Tidal Caloosahatchee Sub-watershed observed TP concentrations.

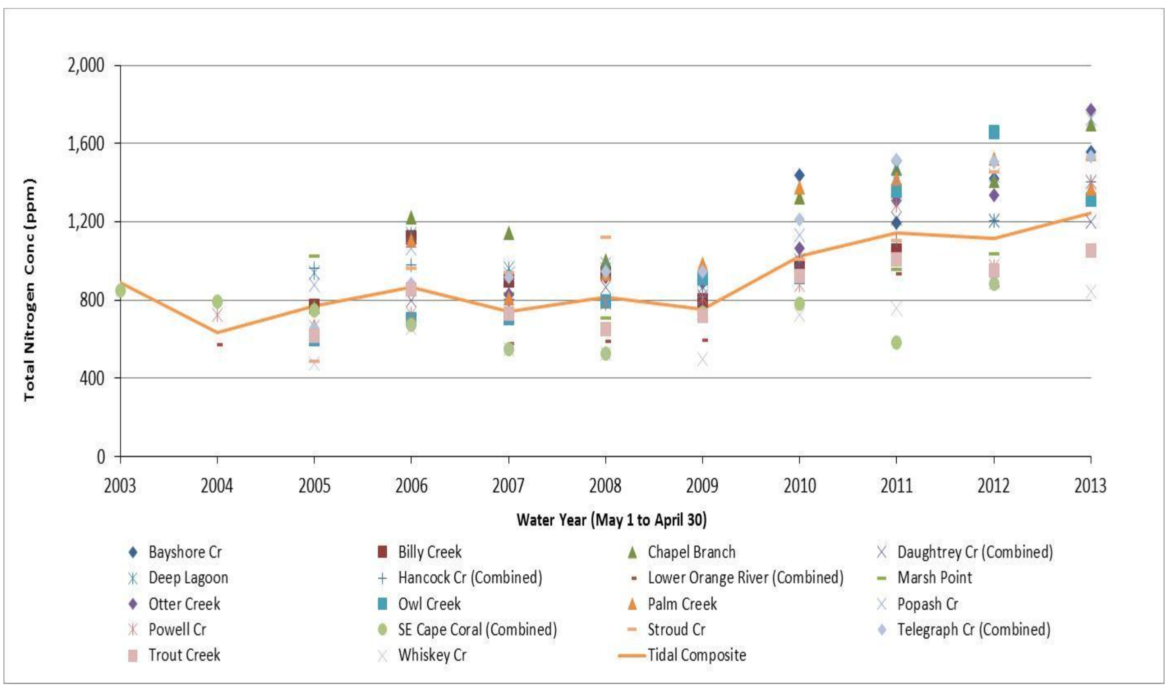


Figure 65. Tidal Caloosahatchee Sub-watershed observed TN concentrations.

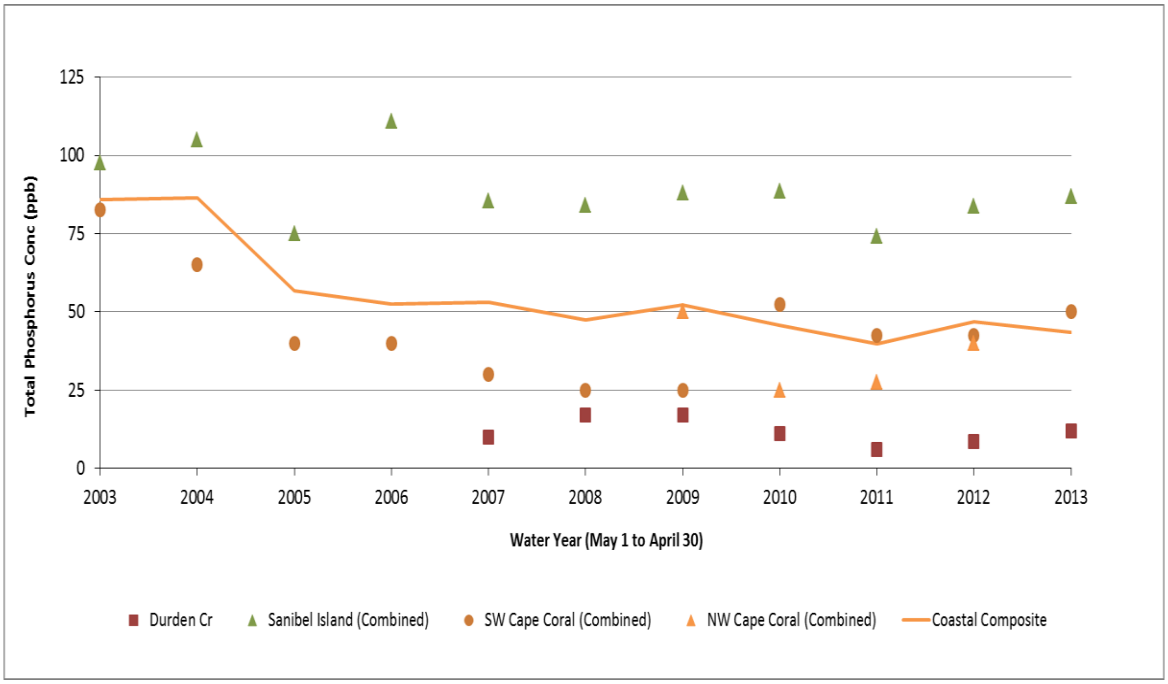


Figure 66. Coastal Caloosahatchee Sub-watershed observed TP concentrations.

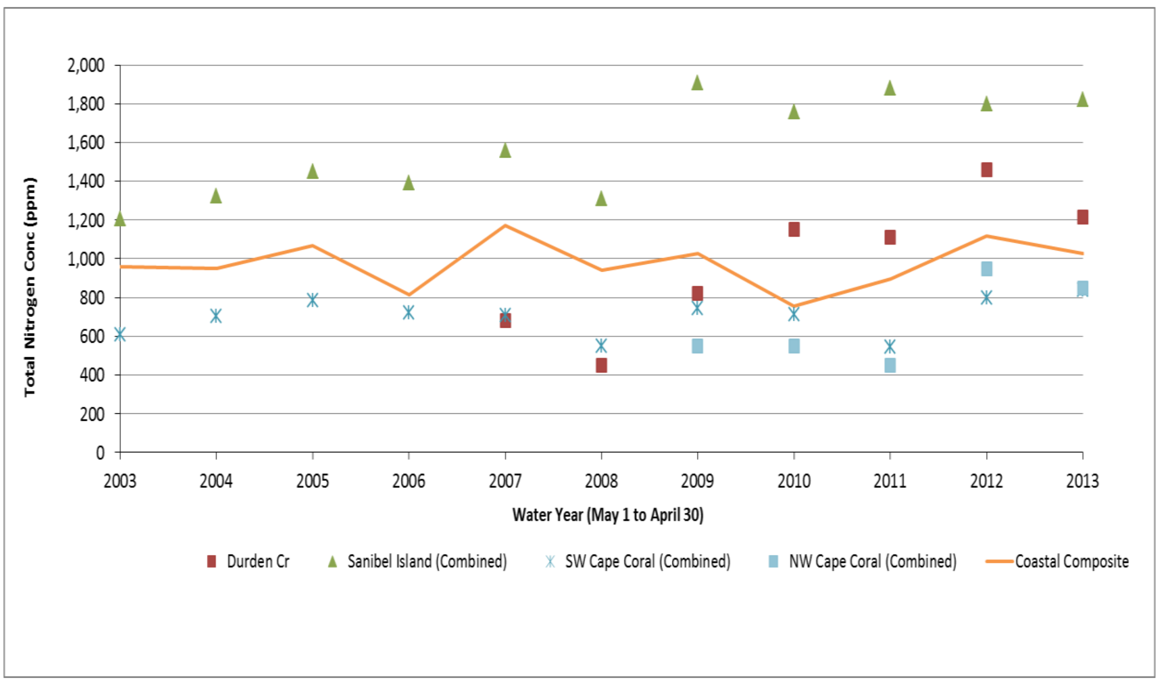


Figure 67. Coastal Caloosahatchee Sub-watershed observed TN concentrations.

ST. LUCIE RIVER WATERSHED

The existing monitoring network provides nutrient and flow data to capture nutrient loading for approximately 73 percent of the St. Lucie River Watershed (SLRW). Nutrient loading is monitored in the C-23, C-24, C-44, and Ten Mile Creek basins. The North Fork, South Fork, North Mid-Estuary, South Mid-Estuary, Basin 4-5-6, and South Coastal basins are characterized by numerous tributary flows into the estuary. While a number of these tributaries are actively monitored for water quality, the monitoring network does not currently capture loading for these areas. The data will be used to track progress towards achieving water quality goals. **Figure 68** provides a flow schematic of the SLRW depicting the basin divisions, flow transfers between sub-watersheds, and existing structures associated with the water quality and flow data used for nutrient calculations.

As of July 2013, approximately 448,822 acres of the agricultural and non-agricultural acreage within the SLRW are covered by ERP/SW permits (70 percent) and 204,457 acres of the agricultural lands (51 percent) are reported as enrolled in the FDACS BMP Program. The specific coverage for each of the sub-watersheds is presented in **Figures 69** through **76**.

Table 4 provides a summary of the WY2013 UAL and concentration data for the St. Lucie sub-watersheds and tributaries. **Figures 77** through **92** depict the UAL and FWM concentration data for the period of record and five-year moving averages to track trends over time. For the tributary stations, flow data is not monitored; therefore, the average concentration data for the past 10 years is depicted in **Figures 93** through **98.**

WY2013 nutrient loading for the C-23 basin in TN, the C-24 basin in TP, and the Ten Mile Creek basin in TP and in TN were lower than their medians during the period of record. The C-23, C-44, and Ten Mile Creek basins had generally lower rainfall and flow during WY2013, while the C-24 basin flow and rainfall was slightly greater compared to the historical record. However, nutrient loading for the C-44 basin in TP and TN, the C-23 basin in TP, and the C-24 basin in TN were higher than their medians during the period of record. Note that the C-44 loading calculation is based on the runoff generated within the basin and excludes Lake Okeechobee pass-through flows. Nutrient concentrations had similar trends as the loads, except for TN in the C-23 and C-24 basins. For C-23 TN, the load was lower than the median of the period of record, while the concentration was higher; for C-24 TN, the load was higher than the median of the period of record, while the concentration was lower. For the 17 tributary stations, TN and TP concentration data were below the median of the period of record.

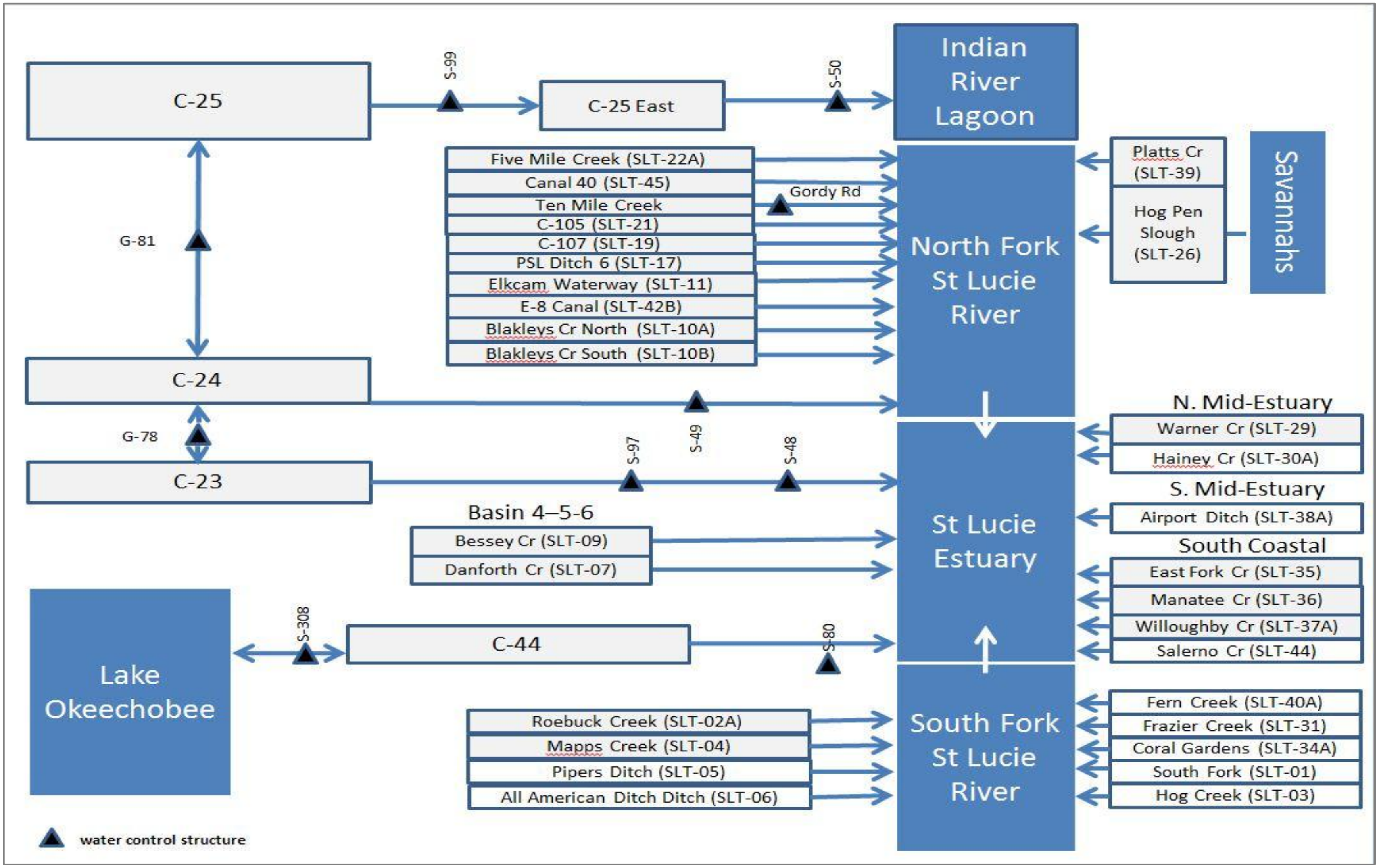


Figure 68. St. Lucie River Watershed flow schematic.

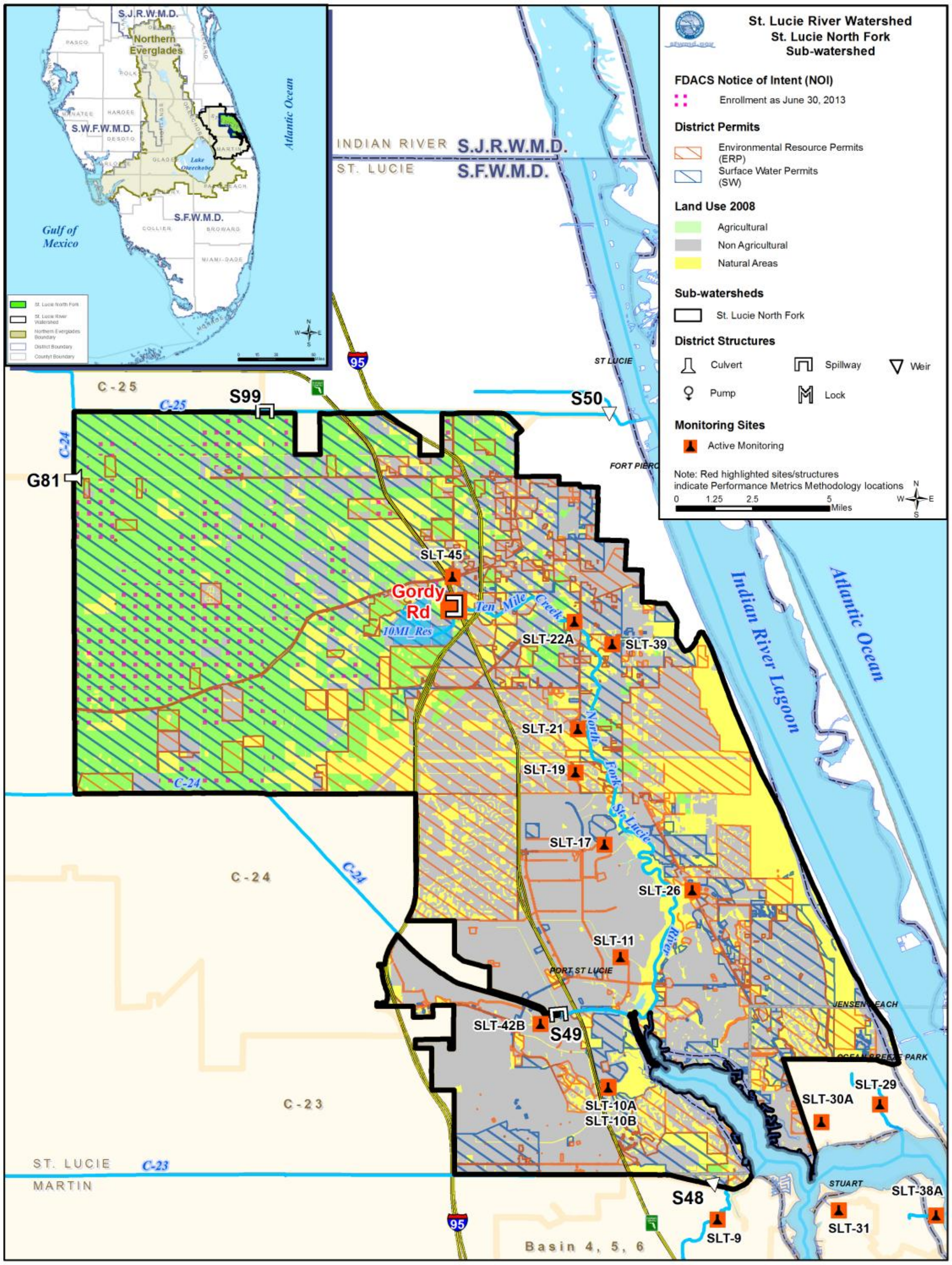


Figure 69. St. Lucie River Watershed, North Fork Sub-watershed.

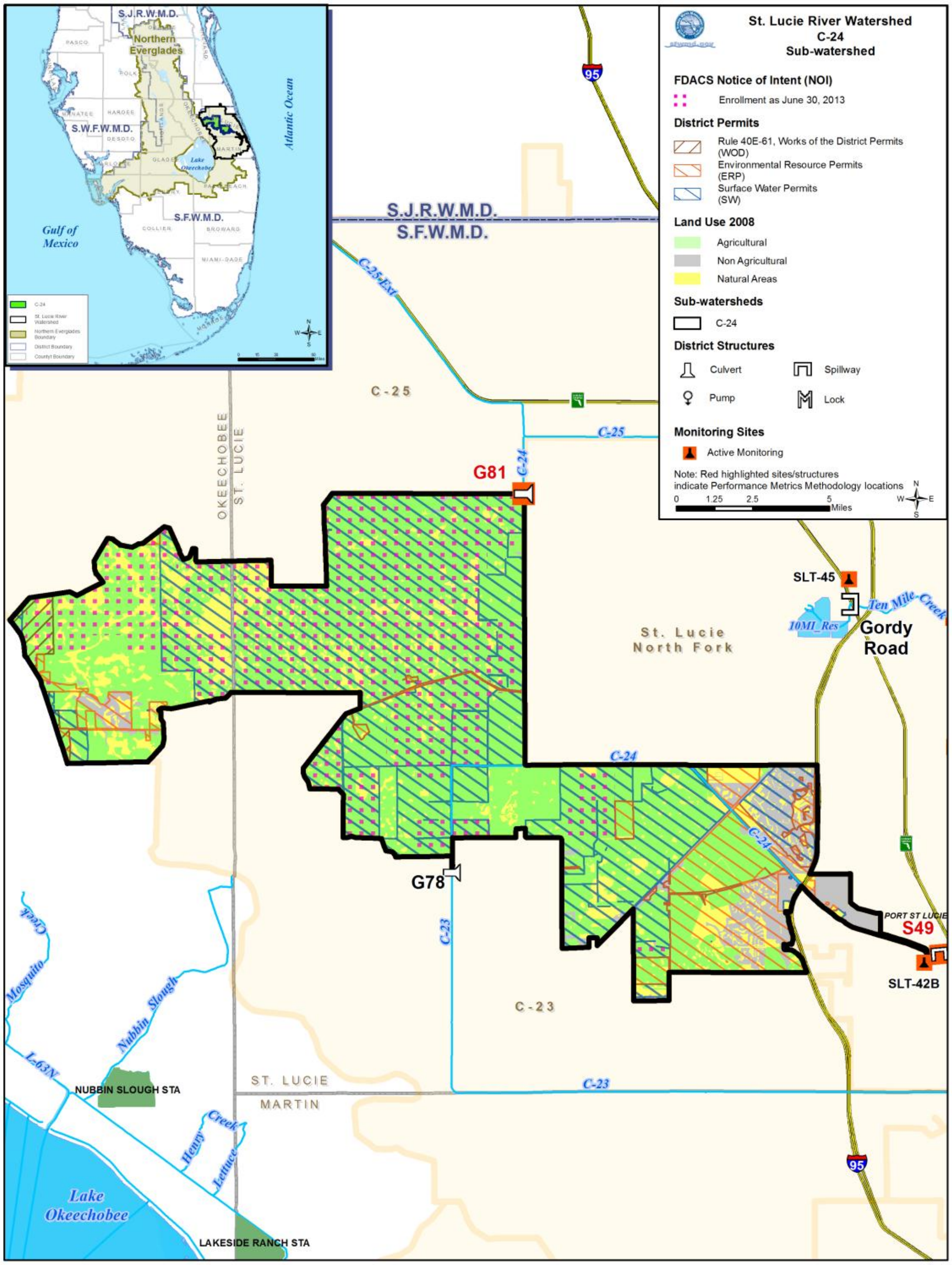


Figure 70. St. Lucie River Watershed, C-24 Sub-watershed.

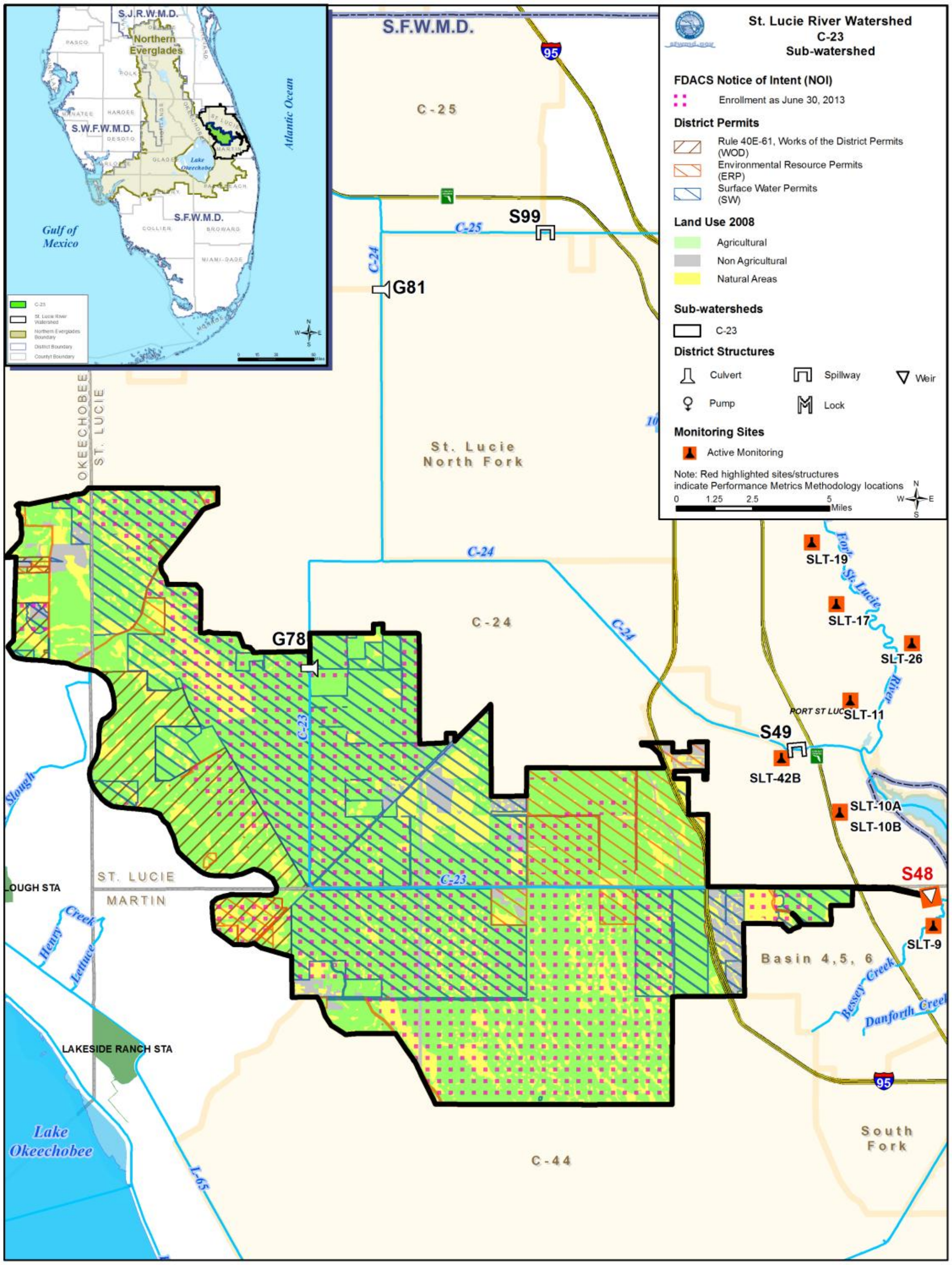


Figure 71. St. Lucie River Watershed, C-23 Sub-watershed.

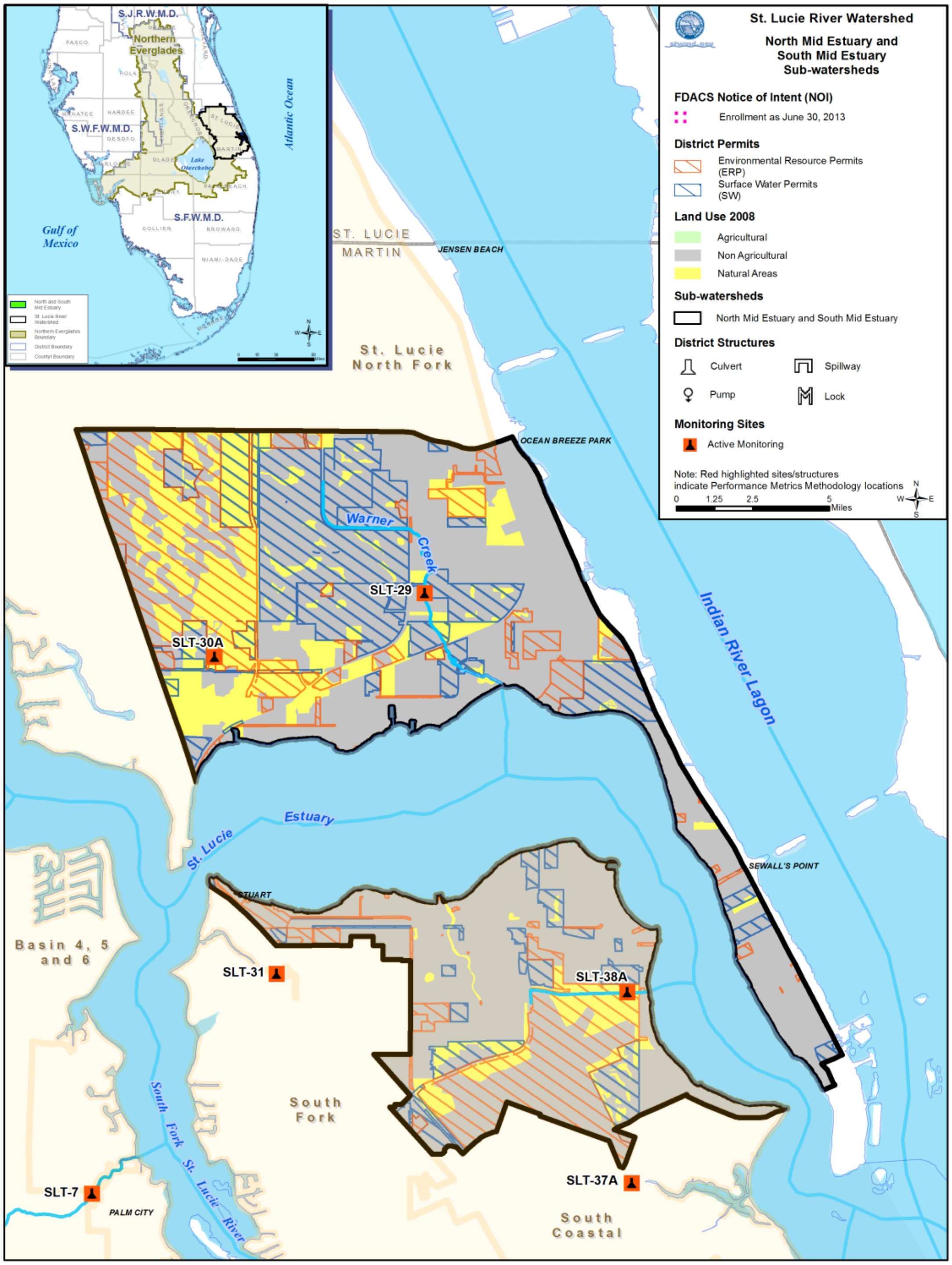


Figure 72. St. Lucie River Watershed, North Mid-Estuary and South Mid-Estuary sub-watersheds.

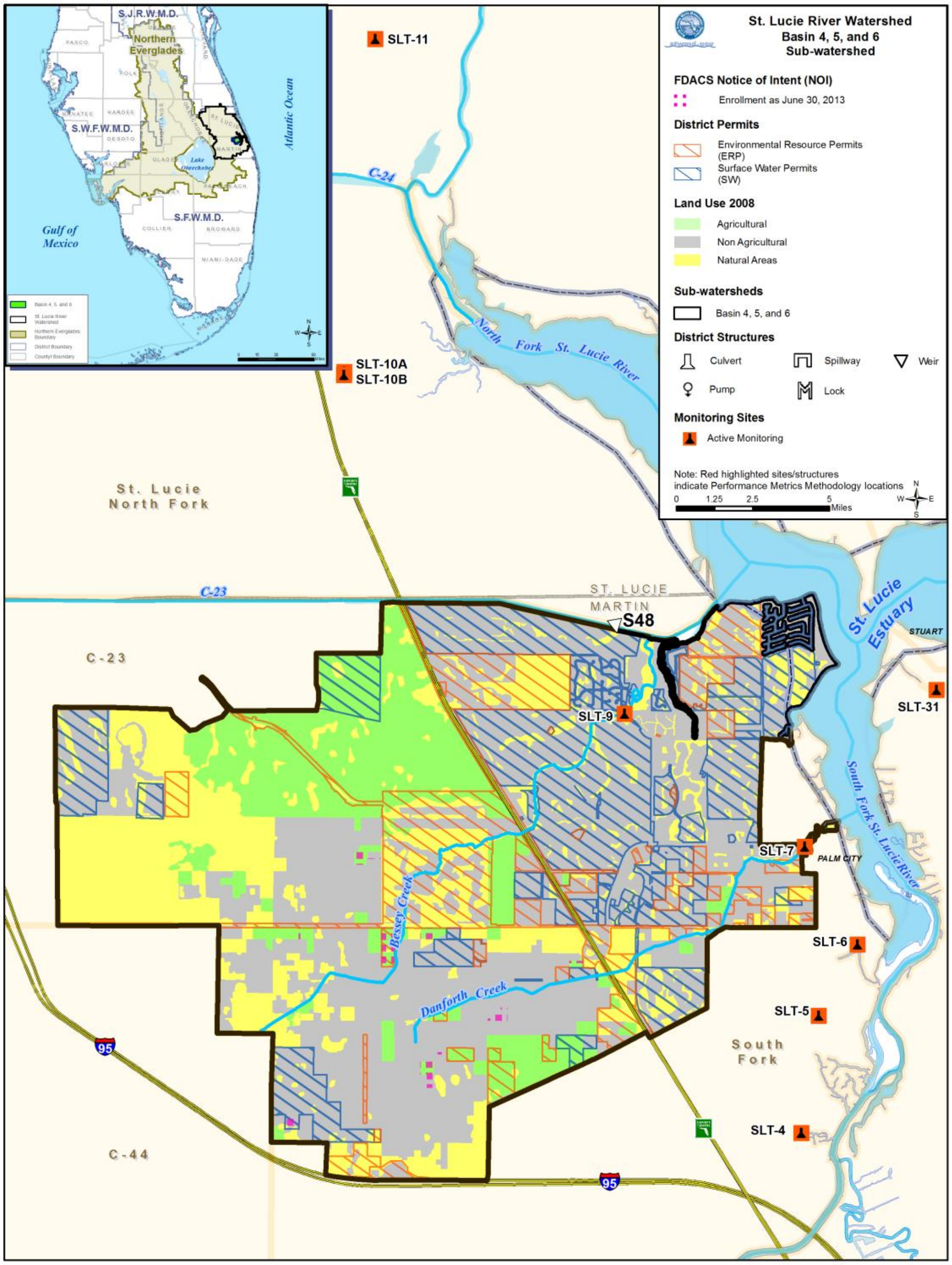


Figure 73. St. Lucie River Watershed, Basin 4-5-6 Sub-watershed.

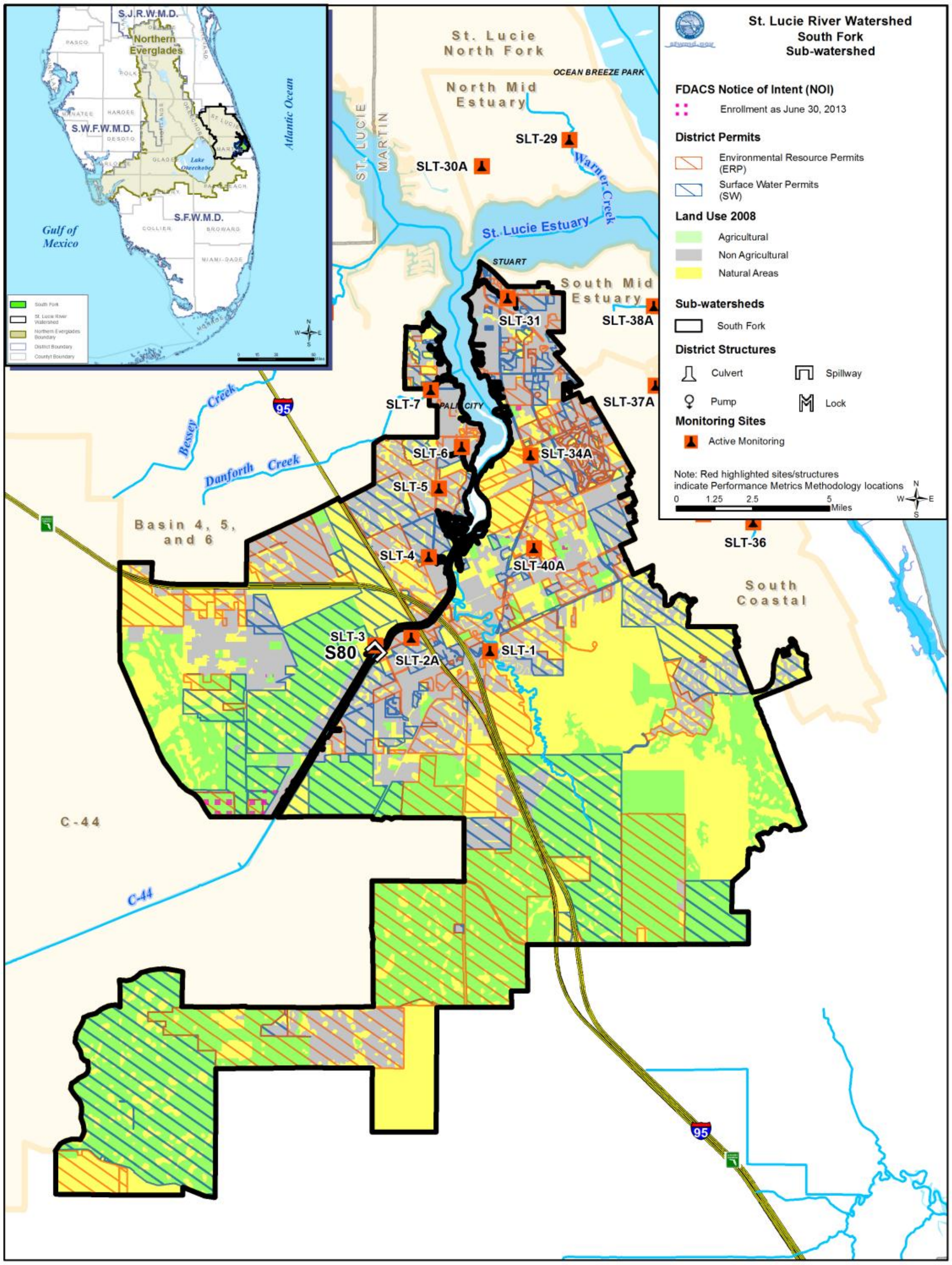


Figure 74. St. Lucie River Watershed, South Fork Sub-watershed.

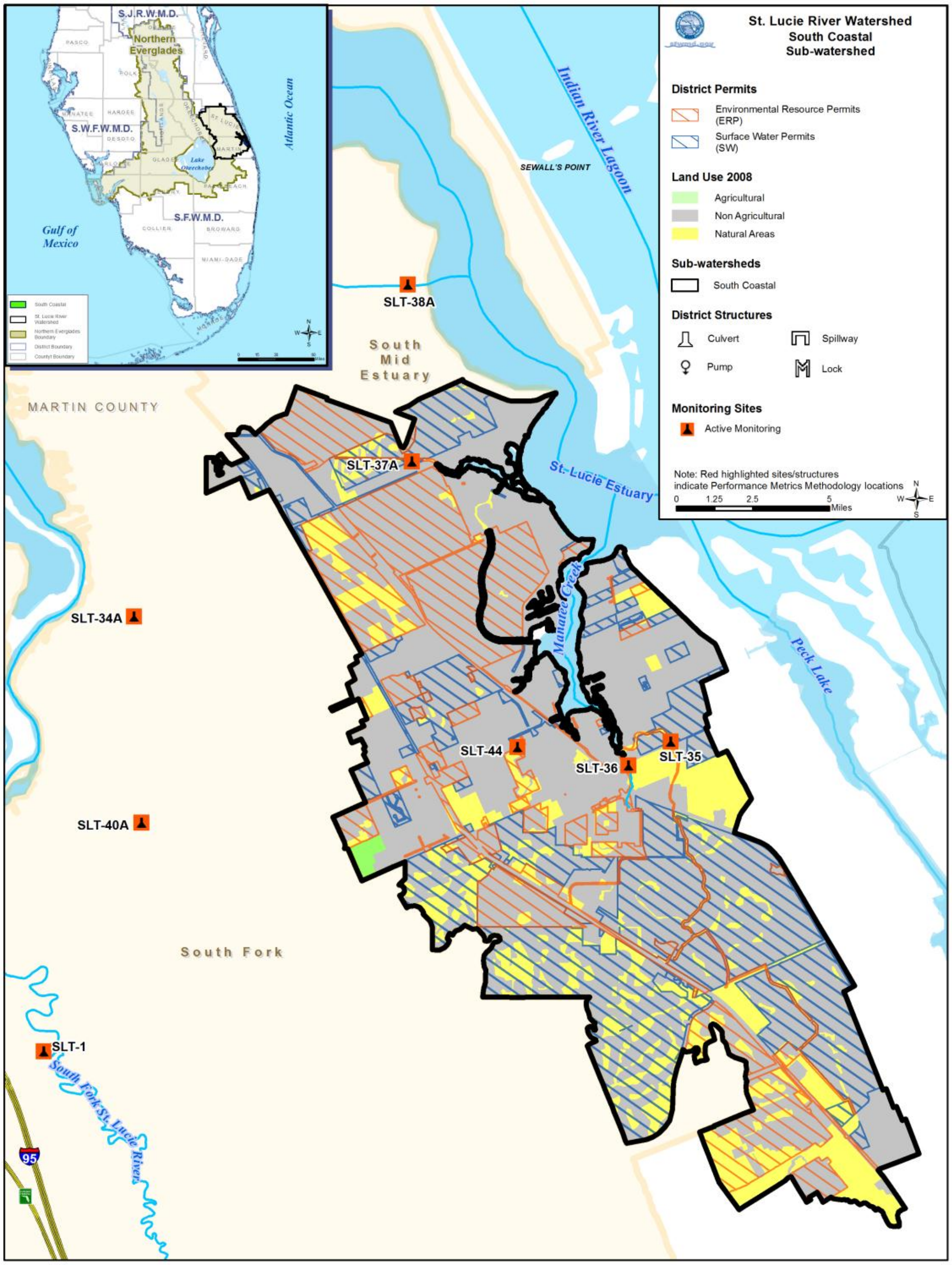


Figure 75. St. Lucie River Watershed, South Coastal Sub-watershed.

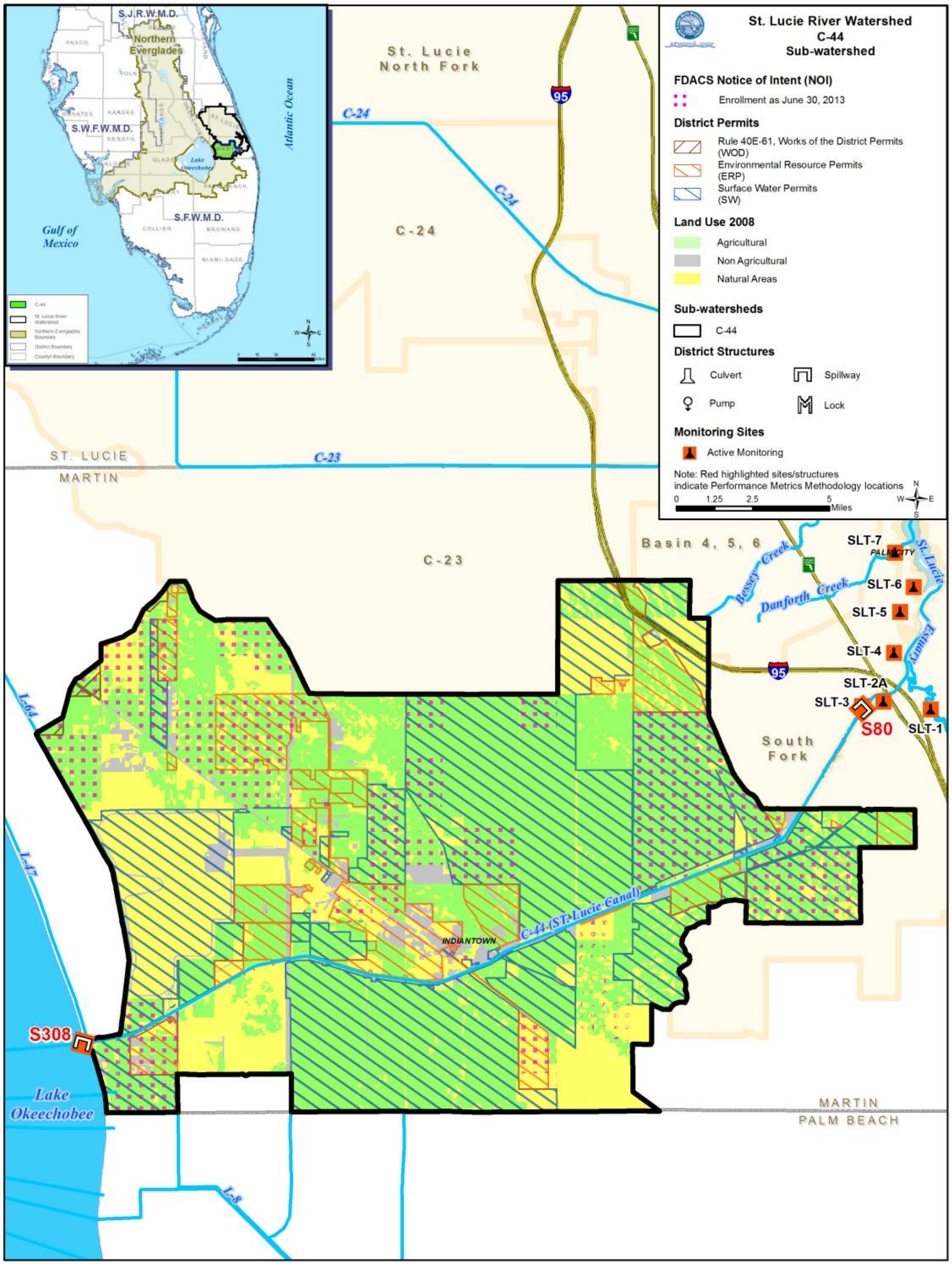


Figure 76. St. Lucie River Watershed, C-44 Sub-watershed.

Table 4. WY2013 rainfall and TP and TN loads (mt) and concentrations (ppb).

Sub-Watershed	Annual Rainfall (in)	WY2013 Flow (ac-ft)[1]	WY2013 Observed TP Load (mt)[1]	WY2013 Observed TP UAL (lb/ac)[1]	WY2013 Observed TN Load (mt)[1]	WY2013 Observed TN UAL (lb/ac)[1]	WY2013 TP Concentration (ppb)[2]	WY2013 TN Concentration (ppb)[2]
C-24	51.68	153,652	56	1.49	306	8.11	297	1,617
C-23	46.69	85,776	52	1.03	174	3.46	492	1,643
C-44[3]	40.77	156,437	59	0.98	306	5.08	306	1,584
North Fork	49.11	-	-	-	-	-	160	918
Ten Mile Creek(Gordy)[4]	48.95	81,339	24	1.33	103	5.71	239	1,022
Five Mile Creek (SLT-22)		-	-	-	-	-	131	764
Elkham Waterway (SLT-11)		-	-	-	-	-	58	790
PSL Ditch 6 (SLT-17)		-	-	-	-	-	62	710
C-105 (SLT-21)		-	-	-	-	-	27	753
C-107 (SLT-19)		-	-	-	-	-	46	770
Hog Pen Slough (SLT-26)		-	-	-	-	-	54	880
Platts Creek (SLT-39)		-	-	-	-	-	163	885
South Fork	39.89	-	-	-	-	-	106	1,015
Frazier Creek (SLT-31)		-	-	-	-	-	60	641
Coral Gardens Ditch (SLT-34A)		-	-	-	-	-	118	1082
Fern Creek (SLT-40)		-	-	-	-	-	94	1055
Basin 4-5	45.01	-	-		-			
Bessey Creek (SLT-09)		-	-	-	-	-	180	820
Basin 6	40.08	-	-	-	-	-		
Danforth Creek (SLT-07)		-	-	-	-	-	170	980
North Mid-Estuary	49.11	-	-	-	-	-		
Warner Creek (SLT-29)		-	-	-	-	-	24	1026
South Mid-Estuary	39.81	-	-	-	-	-		
Airport Ditch (SLT-38)		-	-	-	-	-	84	744
South Coastal	39.81	-	-	-	-	-	102	1,018
Manatee Creek (SLT-36)		-	-	-	-	-	218	1373
Willoughby Creek (SLT-37A)		-	-	-	-	-	22	731
Salerno Creek (SLT-44)		-	-	-	-	-	50	887

[1] Tributaries with blank data are currently not monitored for flow.
[2] Concentrations are flow-weighted means for C-24, C-23, C-44, and Gordy Rd. Concentrations for tributary sites are straight averages based on grab samples taken only when flow is observed.
[3] Loads from C-44 can discharge to both the St. Lucie River Watershed and Lake Okeechobee.
[4] In previous SFERs, nutrient loading from Ten Mile Creek (Gordy Road) was not reported. For WY2013, the flow data and basin boundary for Gordy Road was improved and, therefore, nutrient loading from this basin is now estimated.

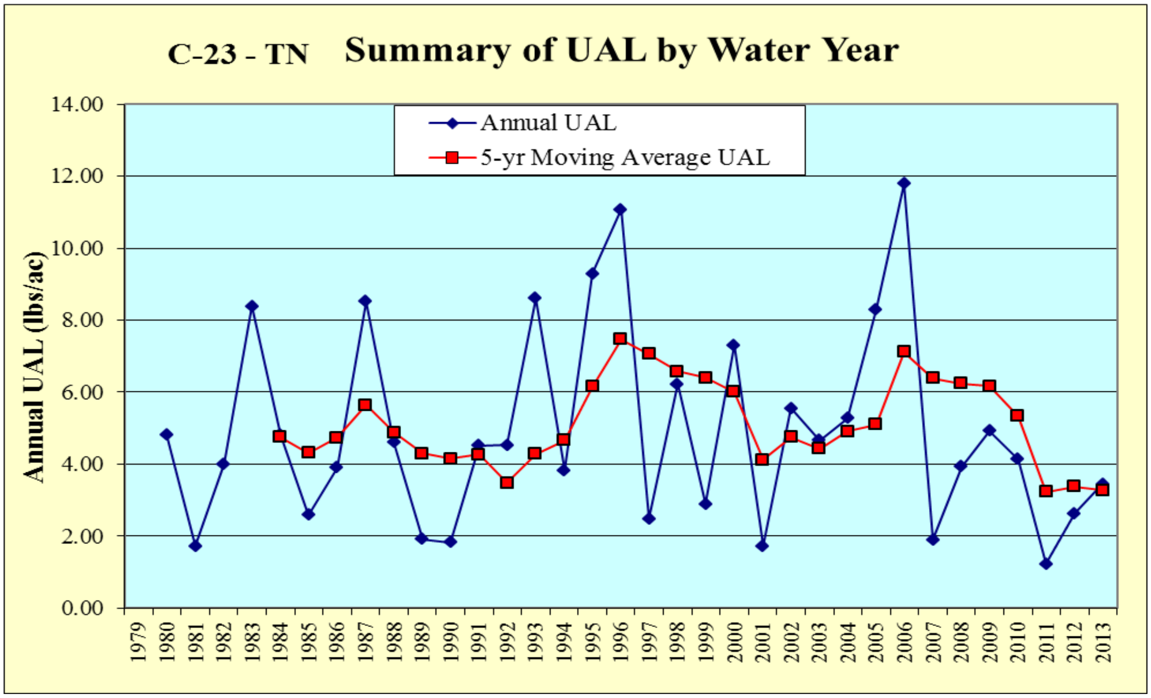


Figure 77. C-23 Sub-watershed observed TN UAL.

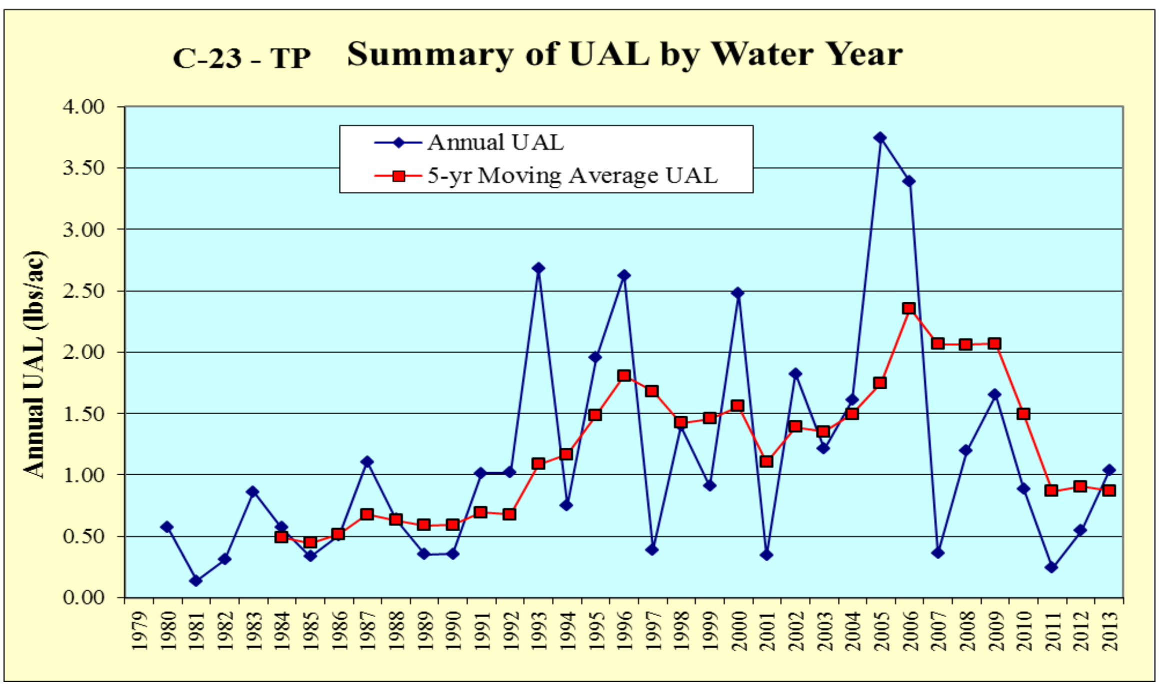


Figure 78. C-23 Sub-watershed observed TP UAL.

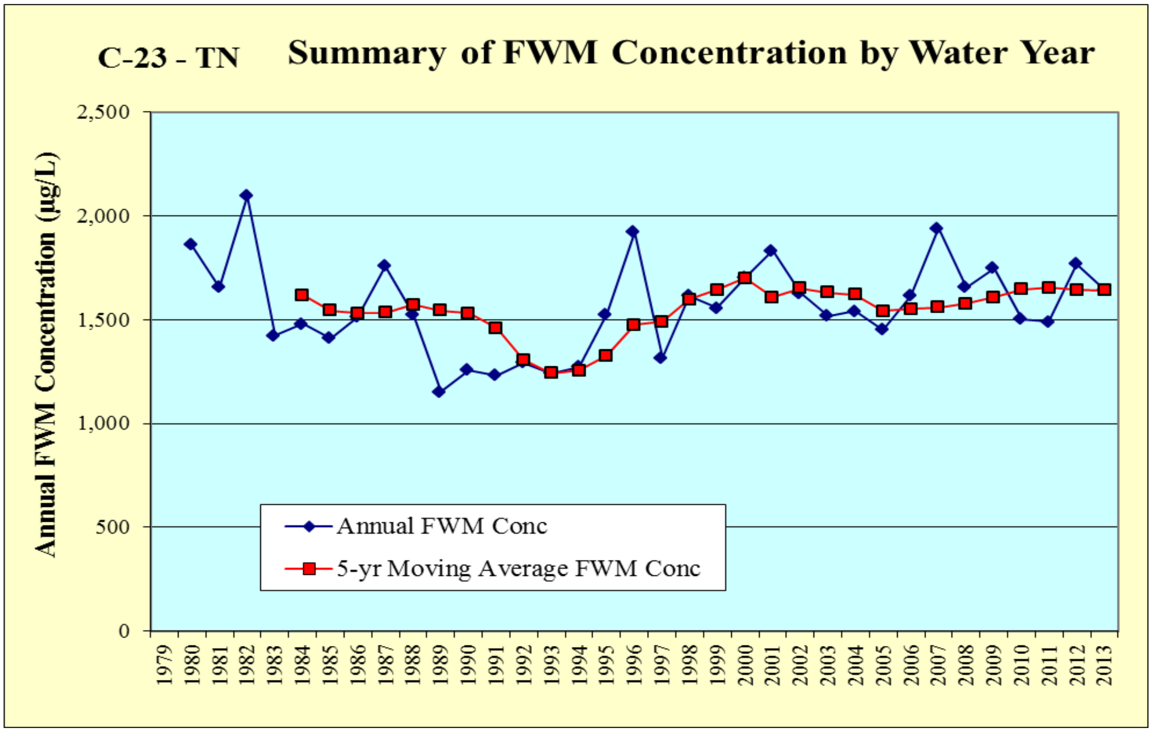


Figure 79. C-23 Sub-watershed observed TN FWM concentrations.

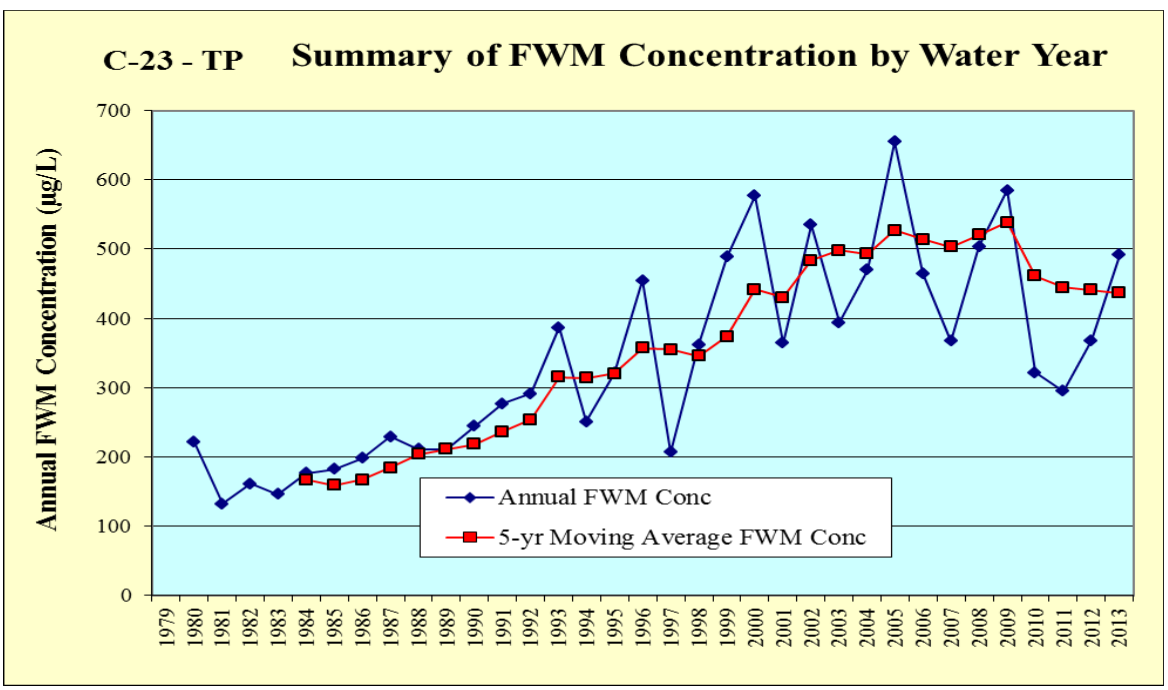


Figure 80. C-23 Sub-watershed observed TP FWM concentrations.

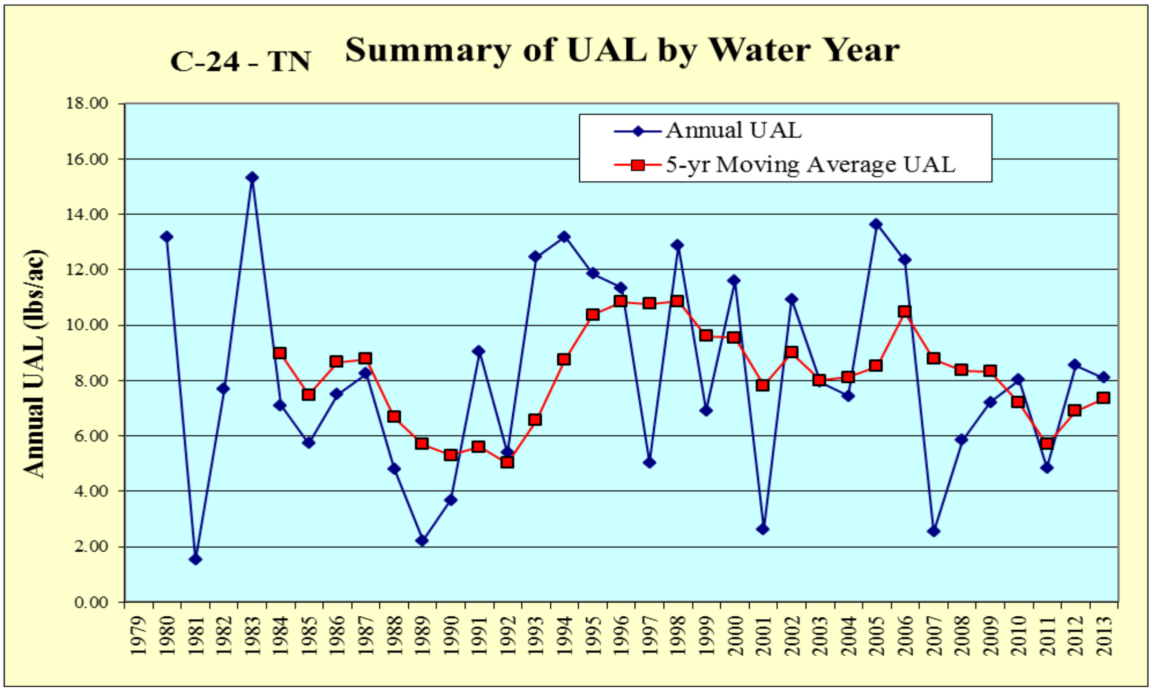


Figure 81. C-24 Sub-watershed observed TN UAL.

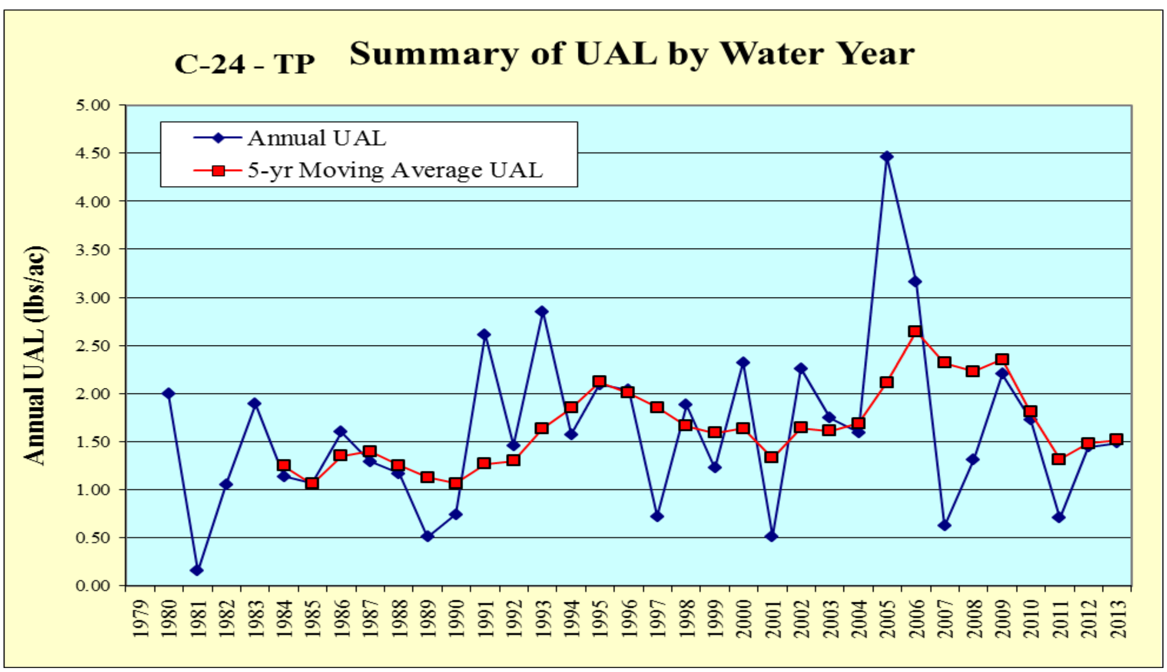


Figure 82. C-24 Sub-watershed observed TP UAL.

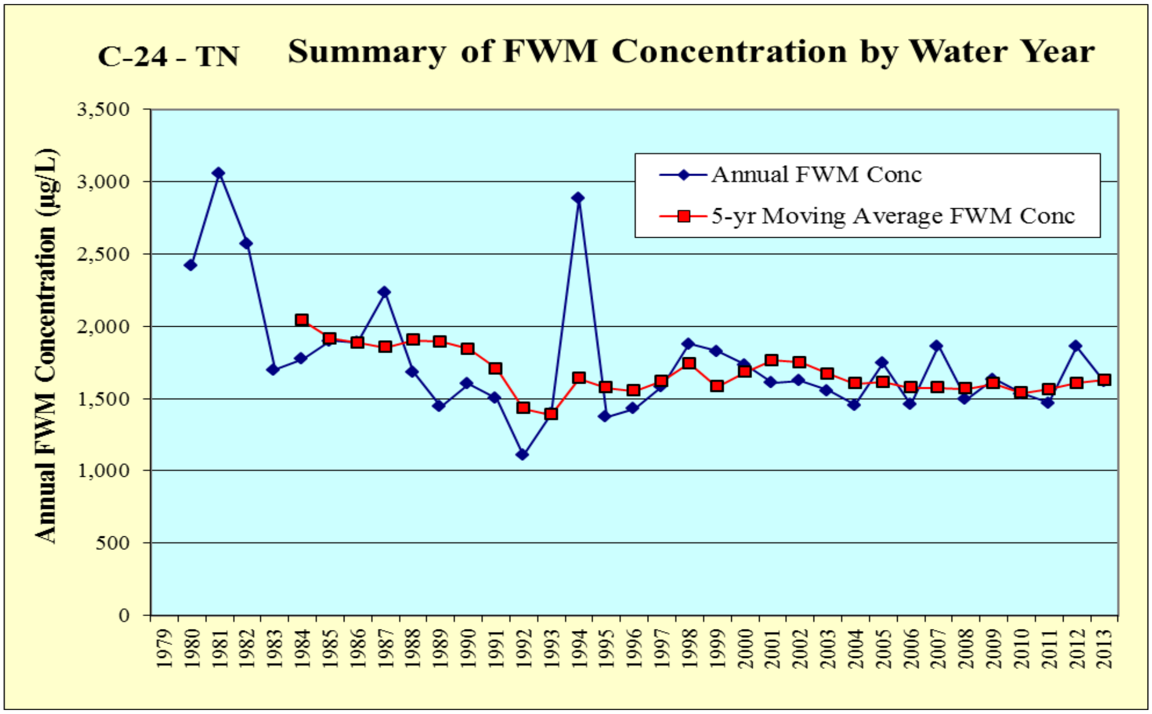


Figure 83. C-24 Sub-watershed observed TN FWM concentrations.

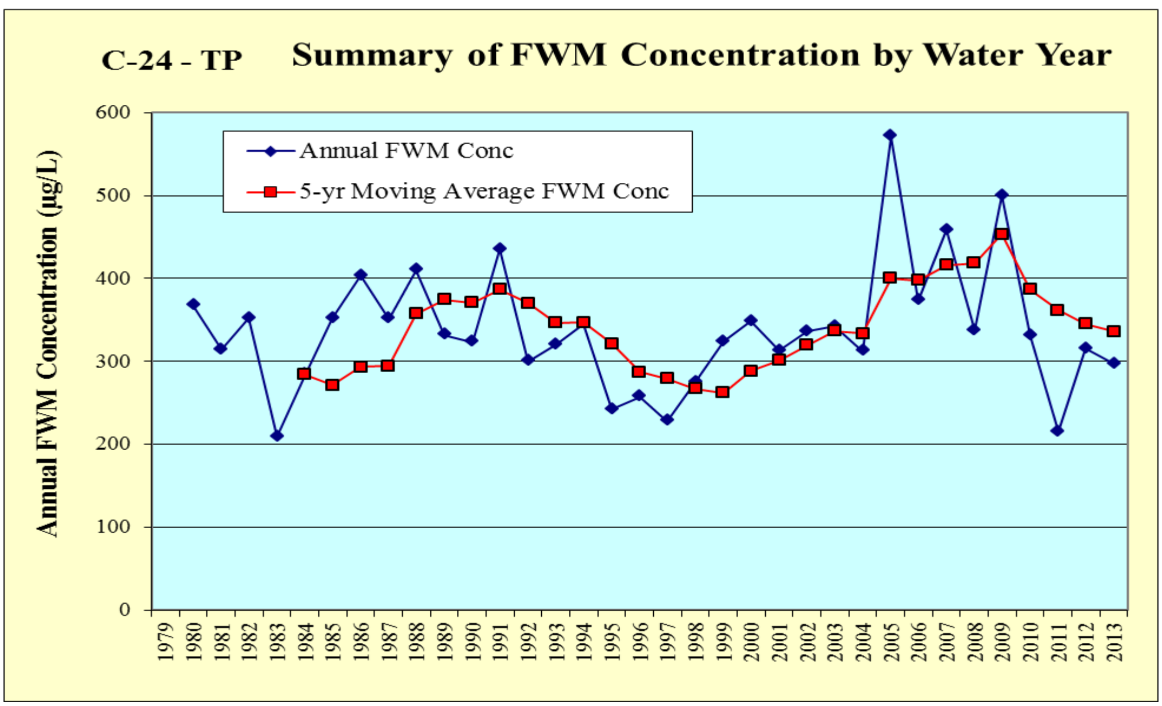


Figure 84. C-24 Sub-watershed observed TP FWM concentrations.

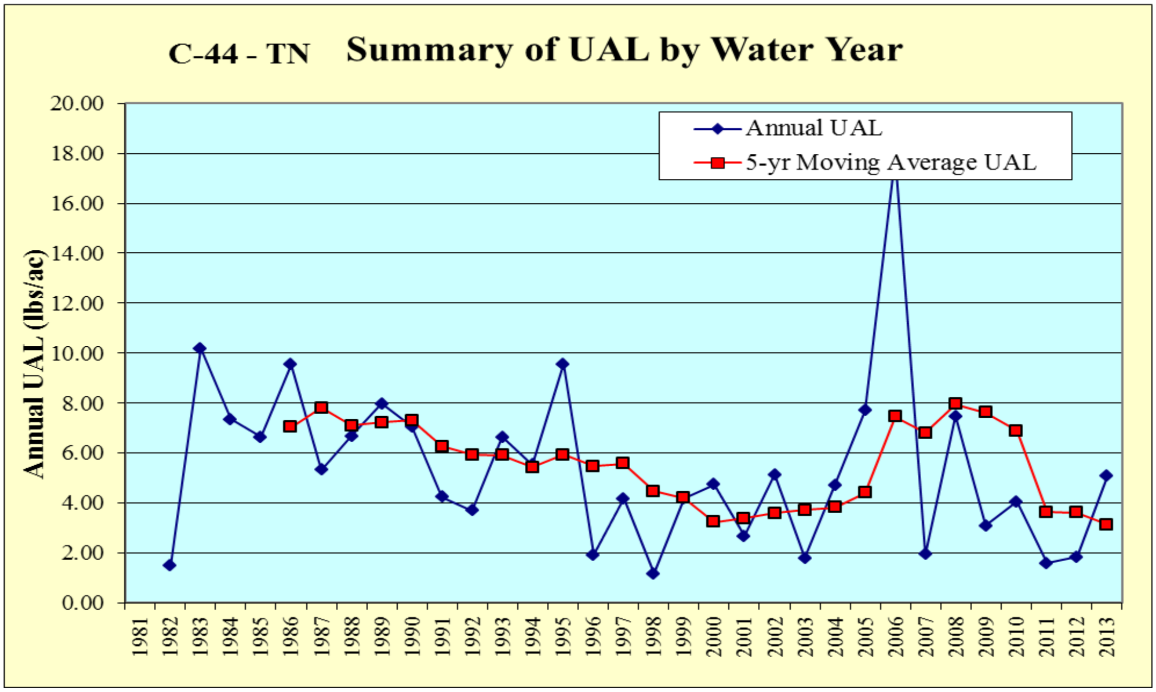


Figure 85. C-44 Sub-watershed observed TN UAL.

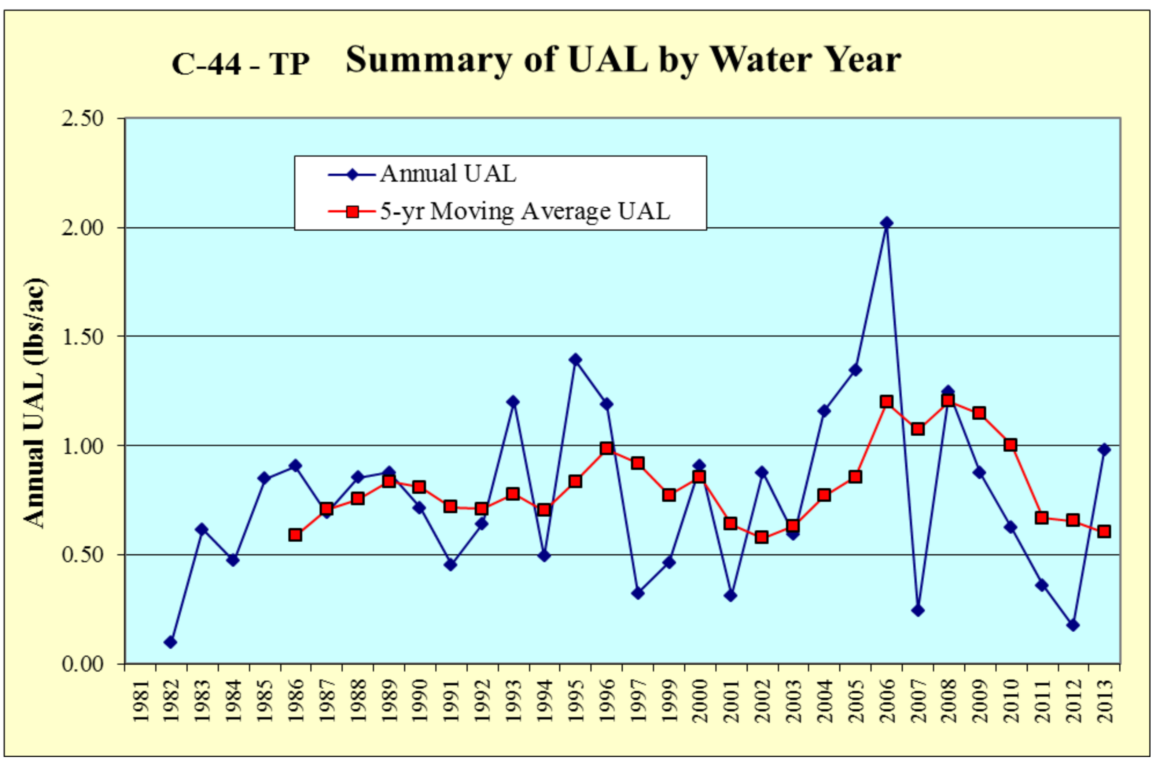


Figure 86. C-44 Sub-watershed observed TP UAL.

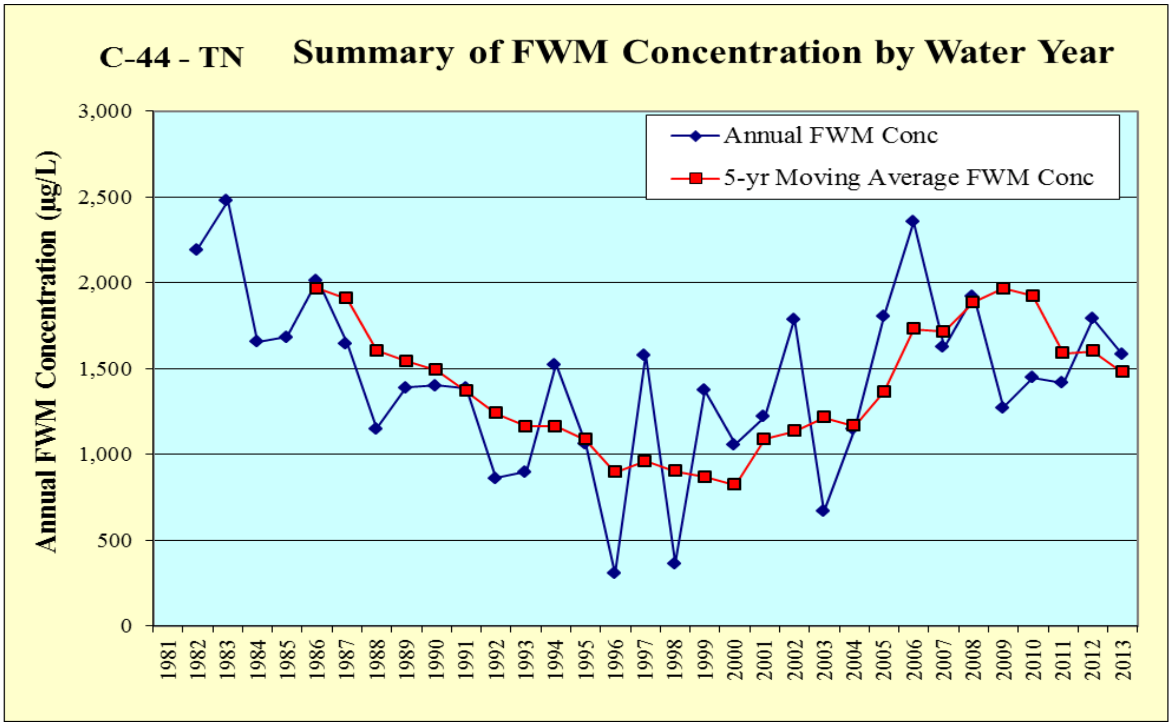


Figure 87. C-44 Sub-watershed observed TN FWM concentrations.

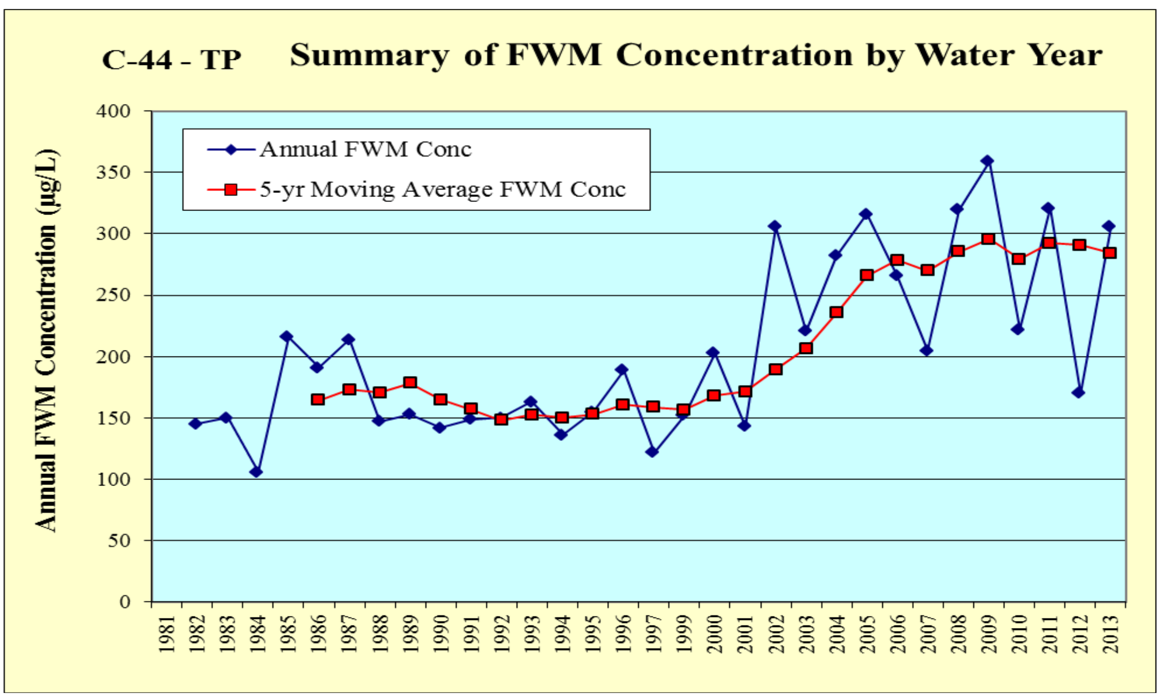


Figure 88. C-44 Sub-watershed observed TP FWM concentrations.

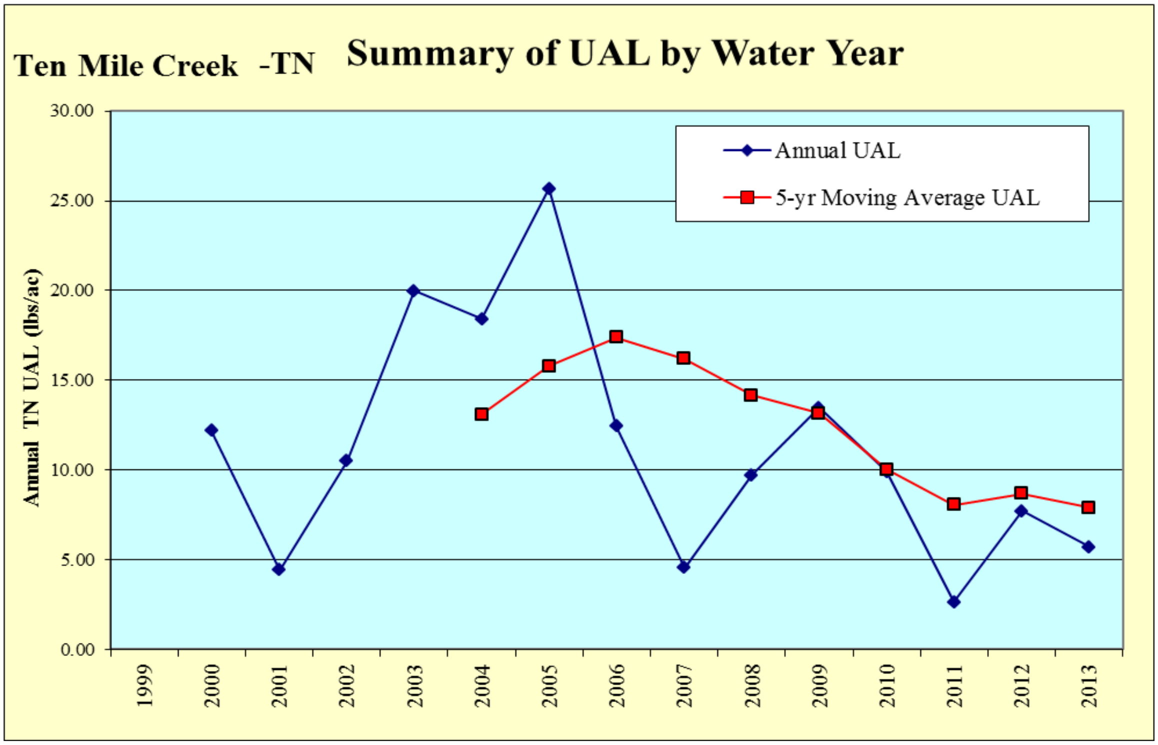


Figure 89. Ten Mile Creek Basin (Gordy Rd) observed TN UAL.

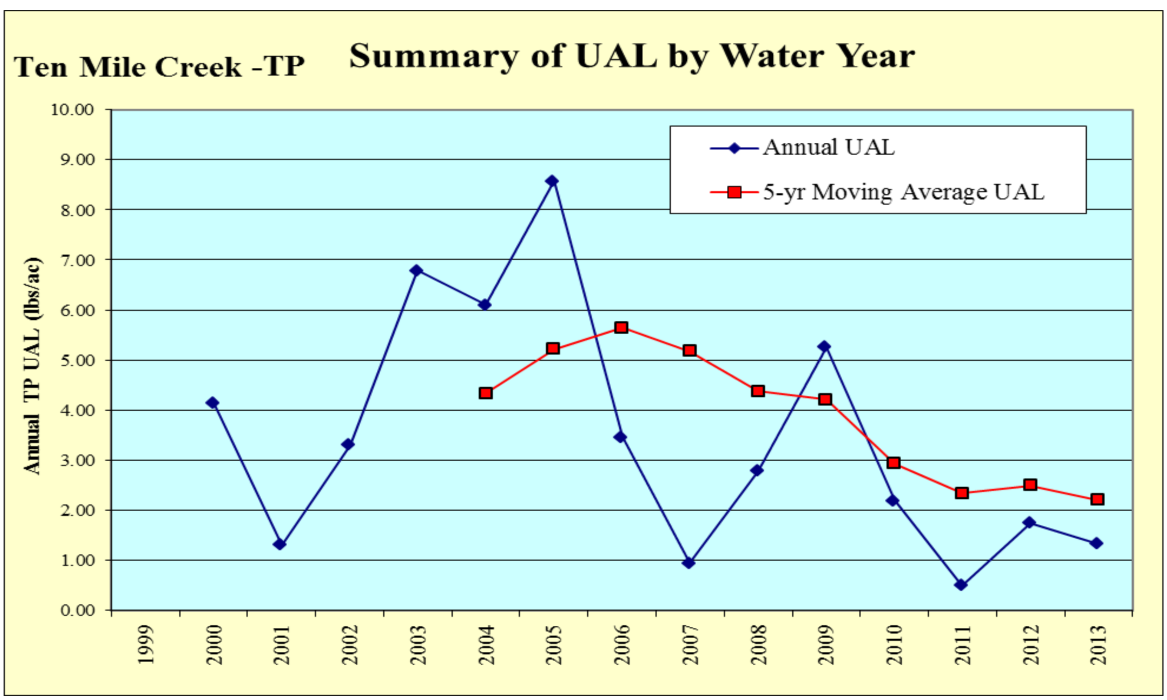


Figure 90. Ten Mile Creek Basin (Gordy Rd) observed TP UAL.

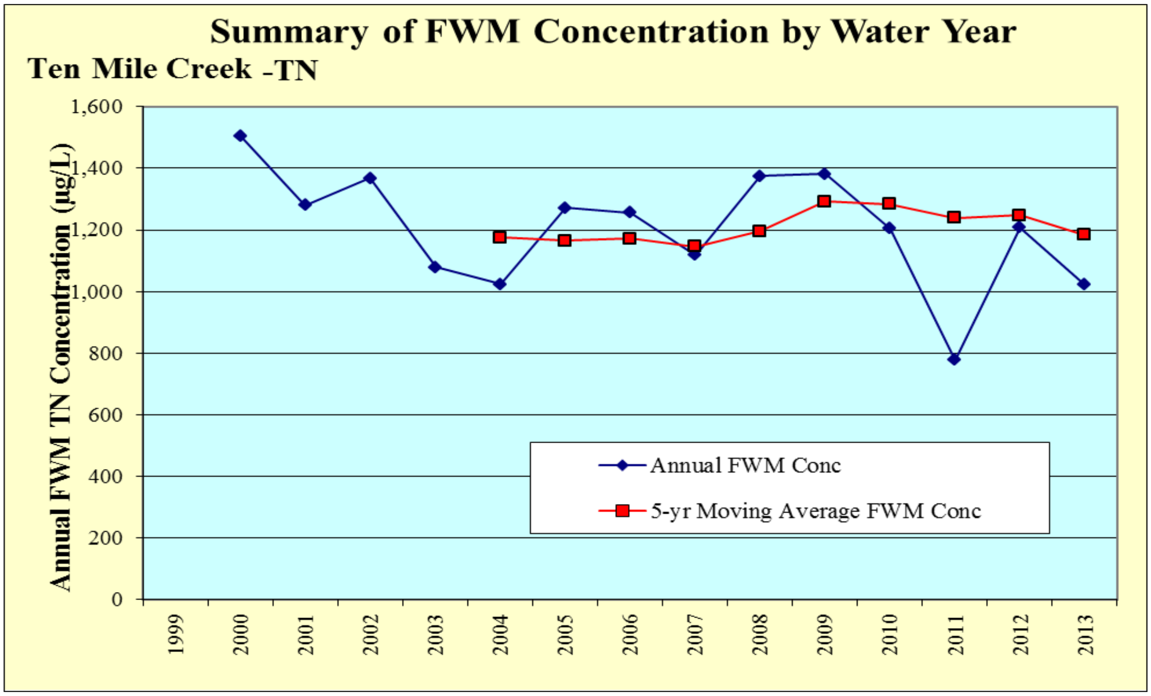


Figure 91. Ten Mile Creek Basin (Gordy Rd) observed TN FWM concentrations.

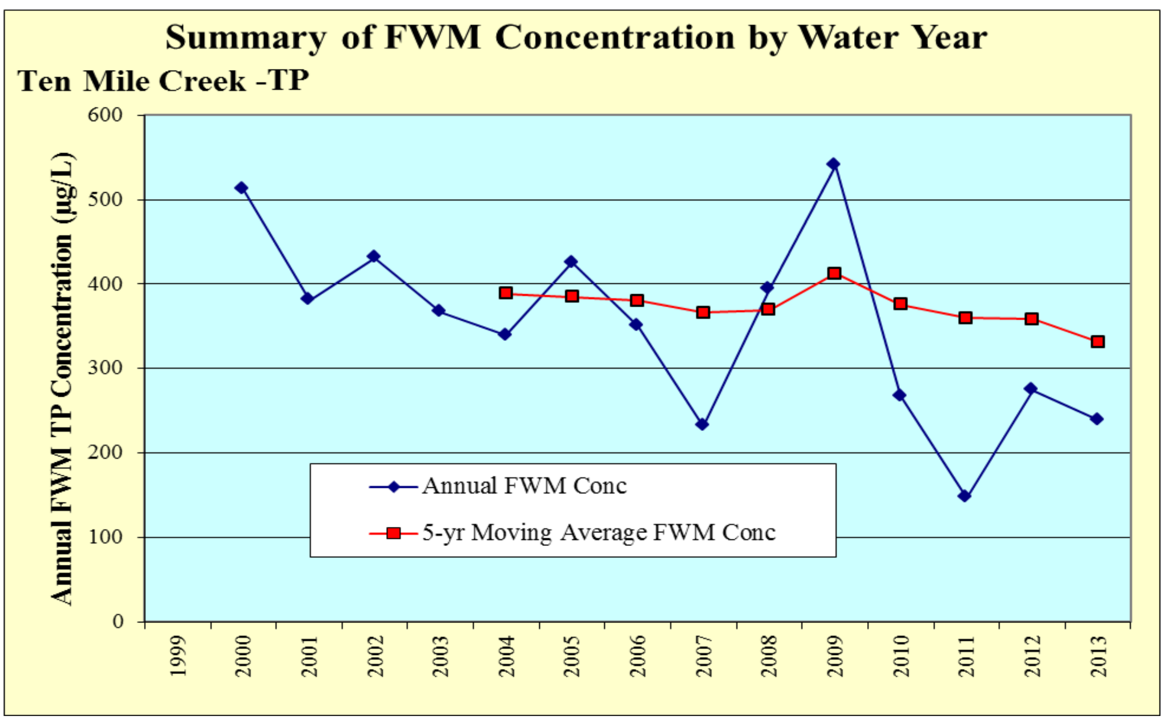


Figure 92. Ten Mile Creek Basin (Gordy Rd) observed TP FWM concentrations.

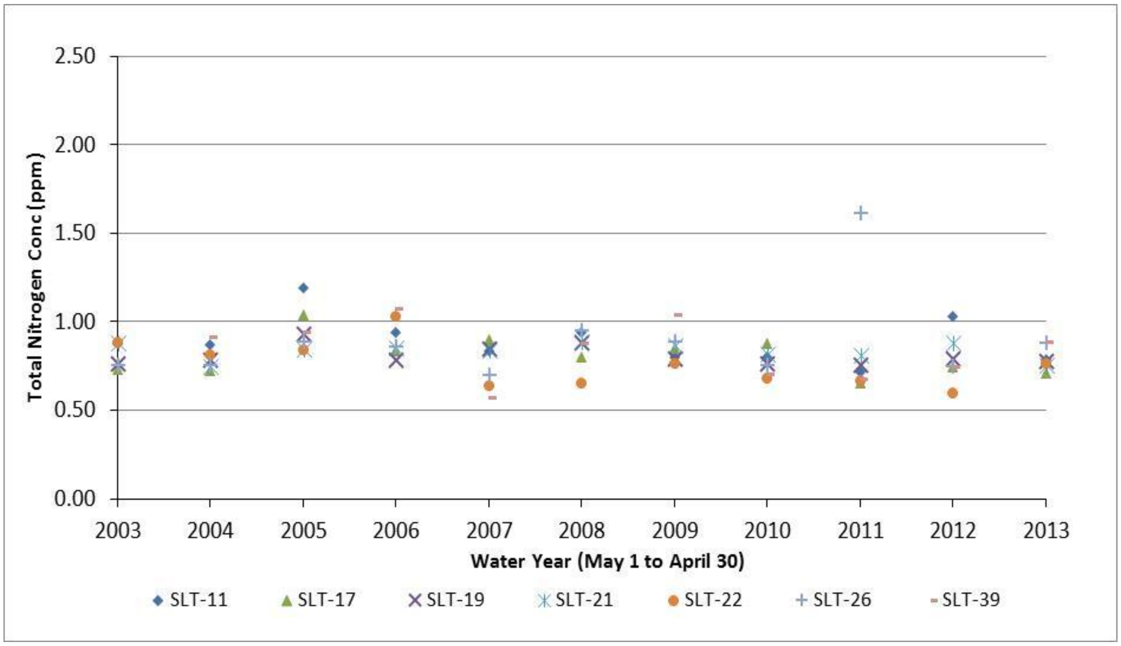


Figure 93. North Fork tributaries observed TN concentrations.

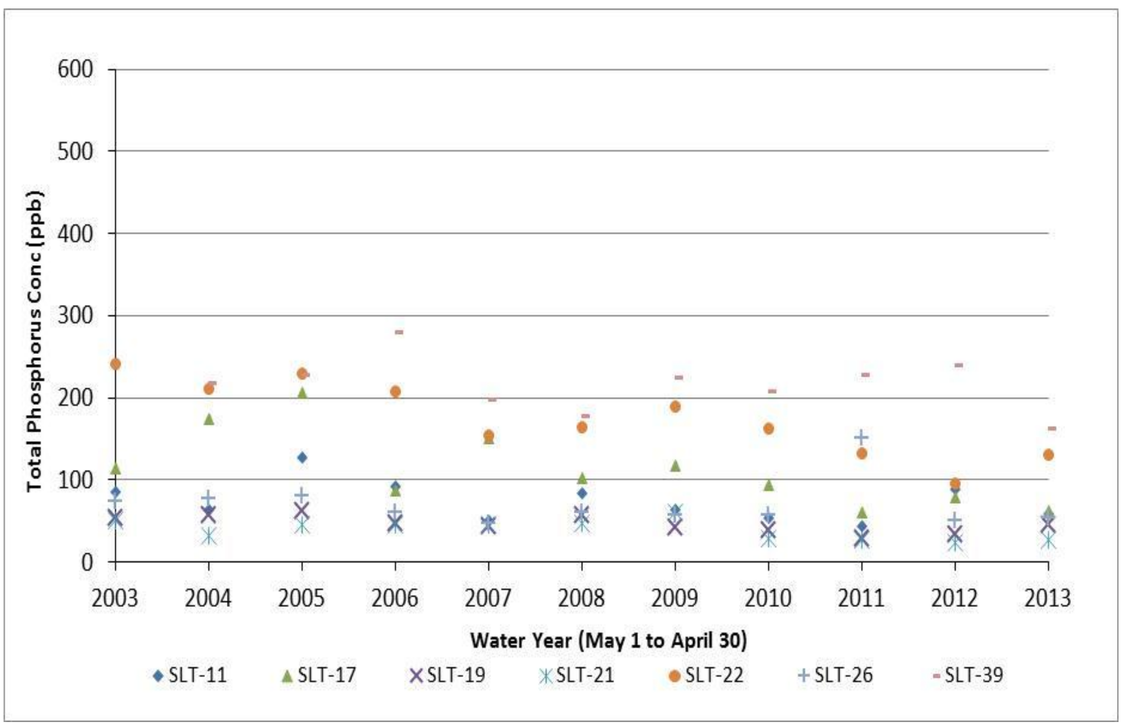


Figure 94. North Fork tributaries observed TP concentrations.

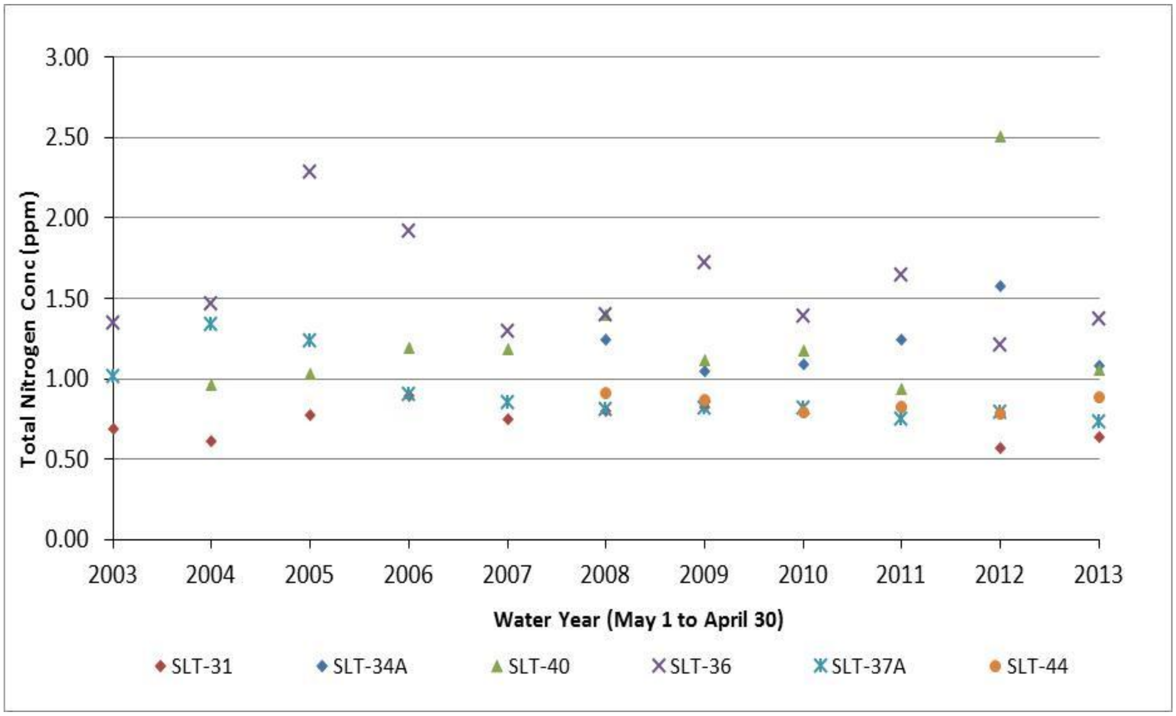


Figure 95. South Fork and South Coastal tributaries observed TN concentrations.

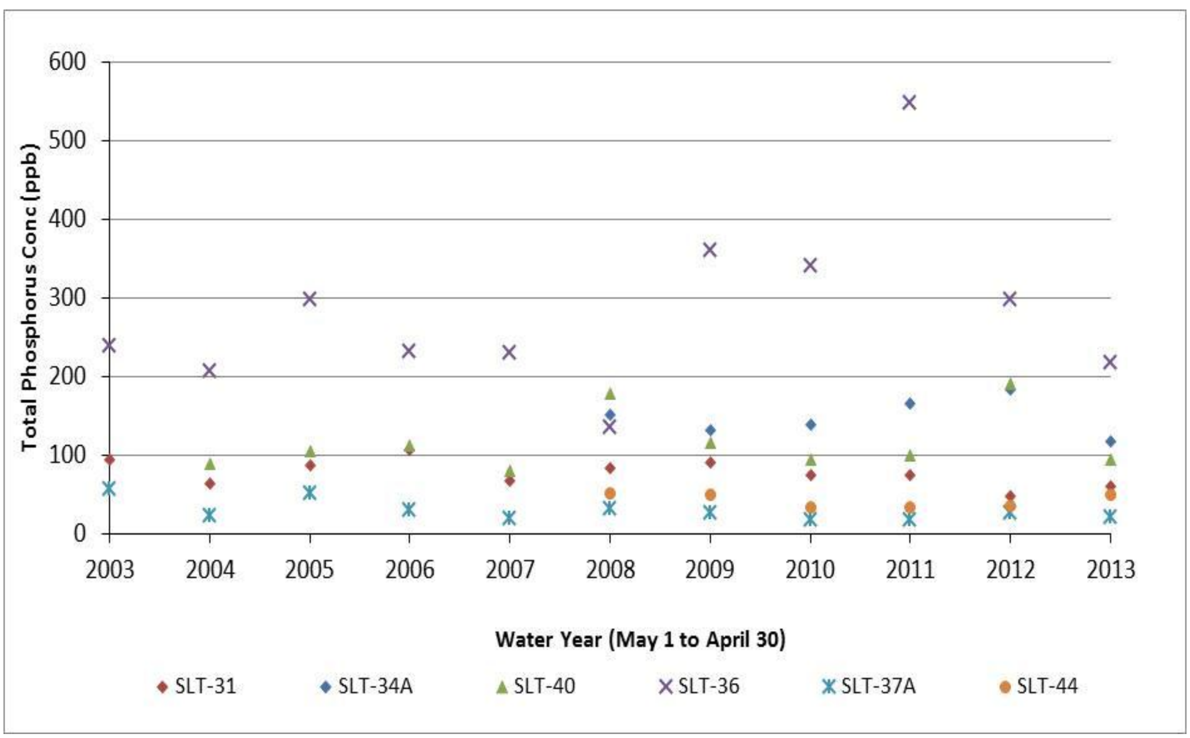


Figure 96. South Fork and South Coastal tributaries observed TP concentrations.

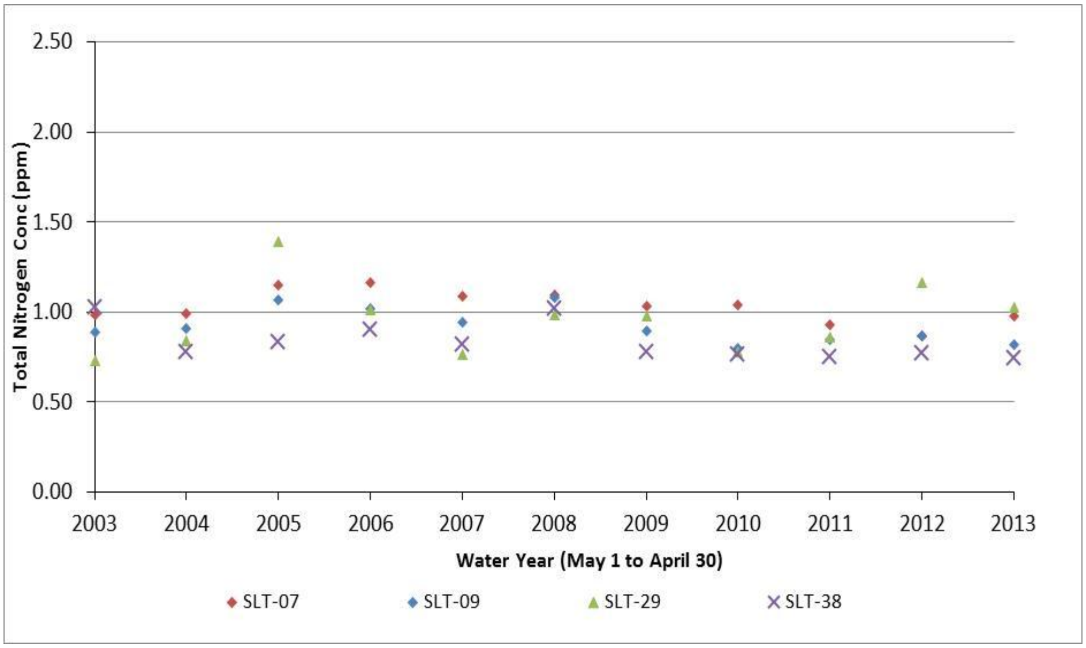


Figure 97. Basin 4-5-6, North Mid-Estuary, and South Mid-Estuary tributaries observed TN concentrations.

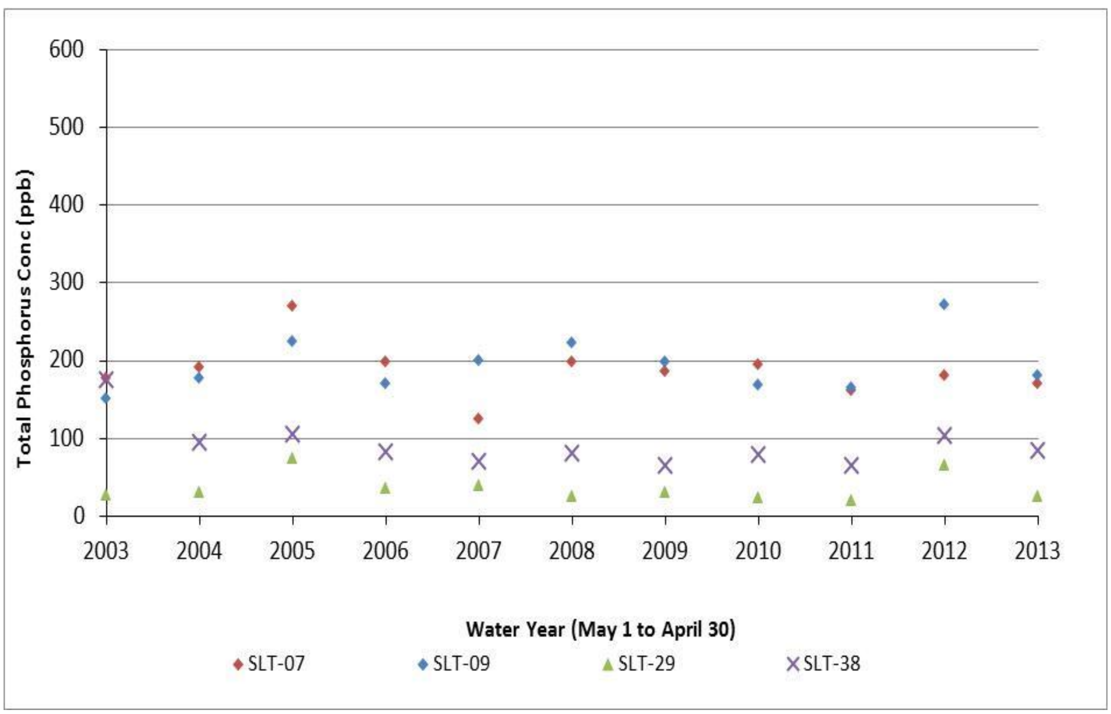


Figure 98. Basin 4-5, Basin 6, North Mid-Estuary, and South Mid-Estuary tributaries observed TP concentrations.