Appendix 4-1: Water Year 2014 Supplemental Evaluations for Regulatory Source Control Programs in the Northern Everglades Watersheds

Jodie Hansing, Ximena Pernett, Hiram Raulerson[1] and Chad Rucks[1]

Contributors: Carmela Bedregal, Randy McCafferty,
Steffany Olson, Cheol Mo, Lucia Baldwin,
Cordella Miessau and Lacramioara Ursu

INTRODUCTION

The South Florida Water Management District's (District or SFWMD) Regulatory Nutrient Source Control Program in the Northern Everglades is administered under Chapter 40E-61, Florida Administrative Code (F.A.C.), and is also known as the Works of the District (WOD) program. The District anticipates adoption of WOD rule amendments in 2015.

The WOD program established in 1989 requires controlling nutrients in discharges through BMPs and specifies discharge limitations for the sub-watersheds and basins within the rule boundary. The program focuses on reducing nutrient discharges from both agricultural and nonagricutltural land uses. One component of this longstanding regulatory program is water quality monitoring to highlight potential areas of water quality concern within the watersheds. The water quality monitoring data, including the upstream and ambient monitoring for the Lake Okeechobee, St. Lucie River, and Caloosahatchee River watersheds is provided in this appendix for Water Year 2014 (WY2014) (May 1, 2013–April 30, 2014). The following pages provide a brief description of the existing monitoring networks, water quality data, and the 2008–2009 land use coverage.

LAKE OKEECHOBEE WATERSHED

There are hydrologic overlaps between the northern and southern Lake Okeechobee watershed as well as between the Lake Okeechobee Watershed and the St. Lucie and Caloosahatchee River Watersheds. **Figures 1** and **2** provide flow schematics of the Lake Okeechobee Watershed, depicting the sub-watersheds located in the 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.

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

The existing monitoring network provides phosphorus concentration and flow data to capture representative discharges 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, C-44, L-8, S-4/Industrial Canal, and South Lake Okeechobee EAA Diversion Basins. 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 discharge into either Lake Okeechobee or outside of the watershed into the West Pam Beach M Canal, the West Palm Beach Canal (S-5A Basin or C-51W Basin), and the L-8 Flow Equalization Basin (FEB). It should be noted the L-8 FEB, formerly a reservoir, has been in construction since early 2013, and flows into and out of the reservoir have occurred since September 2004 through temporary structures. The lower segment of the L-8 Canal has been used to move water into the reservoir from other basins (and vice versa) and it will be used in the future to move water into the FEB from other basins (and vice versa). The South Lake Okeechobee basins can discharge into either Lake Okeechobee or outside of the watershed into the southern EAA. 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 Josephine Creek) where total phosphorus (TP) and flow data are available upstream of Lake Kissimmee and Lake Istokpoga respectively.

Figures 3 through **11** provide the 2008-2009 land use data for the Lake Okeechobee Watershed by sub-watershed. Agricultural, nonagricultural and natural areas are presented. The existing WOD program is implemented on both agricultural and nonagricultural lands. Additional details on the land use breakdown in the Lake Okeechobee Watershed can be found in Chapter 8 of this volume.

Figures 12 through **22** depict the TP flow-weighted mean concentration (FWMC) data for the period of record and five-year moving averages to track trends over time. Similar to the data presented in Chapter 4 of this volume, trend analyses are not presented for S-135, S-154C, Nicodemus Slough, and portions of both the Upper Kissimmee and Lake Istokpoga Sub-watersheds. There were not sufficient flow data to develop this information. The WY2014 FWMC for these areas are presented in Tables 4-1 and 4-2 of this volume. The FWMC plot for the C-44 Basin is provided in the *St. Lucie River Watershed* section and the East Caloosahatchee and S-4/Industrial Canal basins are included in the *Caloosahatchee River Watershed* section.

Chapter 40E-61, F.A.C., adopted in 1989, provides concentration limitations for permittees in the Lake Okeechobee Watershed. It was expected that the concentrations could be achieved through the implementation of permitted phosphorus control plans utilizing BMPs. These concentration limitations were developed based on the Surface Water and Improvement Management (SWIM) Plan target phosphorus loading rate of 360 mt/year for Lake Okeechobee. According to the technical support document for the rule (SFWMD, 1989b), the load contributions from rainfall, Lake Istokpoga, and Lake Kissimmee were subtracted from the target loading rate and the remaining load was divided by the average annual discharge from the 34 SWIM plan basins and converted to a concentration target. Based on this implementation strategy, it was hypothesized that a 180 micrograms per liter (µg/L) annual average TP concentration at all inflows to the lake would result in the long-term average annual target load of 360 mt. The 19 SWIM basins which had concentrations below 180 µg/L (based on average flow-weighted concentrations from 1973–1987; SFWMD, 1989a) had lake inflow concentration limitations that maintained their existing water quality. These limitations ranged from 60 to 180 µg/L. The remaining 15 SWIM basins in which historical water quality exceeded 180 µg/L had their lake inflow concentration limitation set at 180 µg/L. Unfortunately, this strategy was not fully implemented as a result of changes in legislative directives. In presenting the data, the discharge limitations set by rule may be used as an annual point of reference in WY2014, where Fisheating Creek, S-133, S-154, and S-191 basins all had TP discharge concentrations greater

than 180 µg/L. The Indian Prairie Sub-watershed, which is made up of multiple SWIM plan basins, also had a mean discharge concentration greater than 180 µg/L. The data are presented below in terms of trends.

LAKE OKEECHOBEE WATERSHED ASSESSMENT MONITORING NETWORK DATA

In addition to the water quality monitoring at the Lake Okeechobee basin level, monitoring is conducted within each sub-watershed and basin at upstream locations under several different projects. Site data collected under the Lake Okeechobee Watershed Assessment (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, Florida Department of Agriculture and Consumer Services, and Florida Department of Environmental Protection meet routinely to discuss areas with water quality concerns and develop agency action plans. The District's ambient monitoring network and United States Geological Survey monitoring network are described further in Chapter 8 of this volume.

An overview of TP concentrations from the upstream sites is presented in **Figures 23** through **32.** These sites include WY2014 mean TP concentrations for all samples taken during flow conditions. Also, the concentrations presented in **Figures 23** through **32** are not flow-weighted as flow measurements are not available at most stations. Sites that are depicted with a square, in general, represent larger conveyances or canals.

As discussed above, Chapter 40E-61, F.A.C., provides concentration limitations for basins in the Lake Okeechobee Watershed that are within the jurisdiction of the rule. These limitations have been in place since the rule was adopted in 1989. The Chapter 40E-61, F.A.C., parcel level monitoring limitations were based on achieving the 180 µg/L at the lake inflow taking into account assimilation within the watershed as described in the Technical Document in Support of Chapter 40E-61 Works of the District within the Lake Okeechobee Basin (SFWMD, 1989b). The parcel level limitation for improved pasture is 350 µg/L and was based on an evaluation of long-term water quality monitoring data for pasture runoff. For all other land uses the range of the parcel level water quality limitations is between maintaining existing water quality and 1200 µg/L.

Water quality data were collected in the Upper Kissimmee, Lower Kissimmee, S-133, S-154, S-191, S-135, S-154C, Lake Istokpoga, Indian Prairie, and Fisheating Creek/Nicodemus Slough, hydrologic areas under the various District monitoring projects mentioned above. For the Upper Kissimmee (thirty-six sites) and S-133 (three sites) basins, all of the sites had average annual TP concentrations less than 350 µg/L. The Lower Kissimmee, which includes the S-65D and S-65E priority basins, the S-154 priority basin, the S-191 priority basin, and Lake Istokpoga basin all had one or more upstream sites with TP average concentrations greater than 1,200 µg/L.

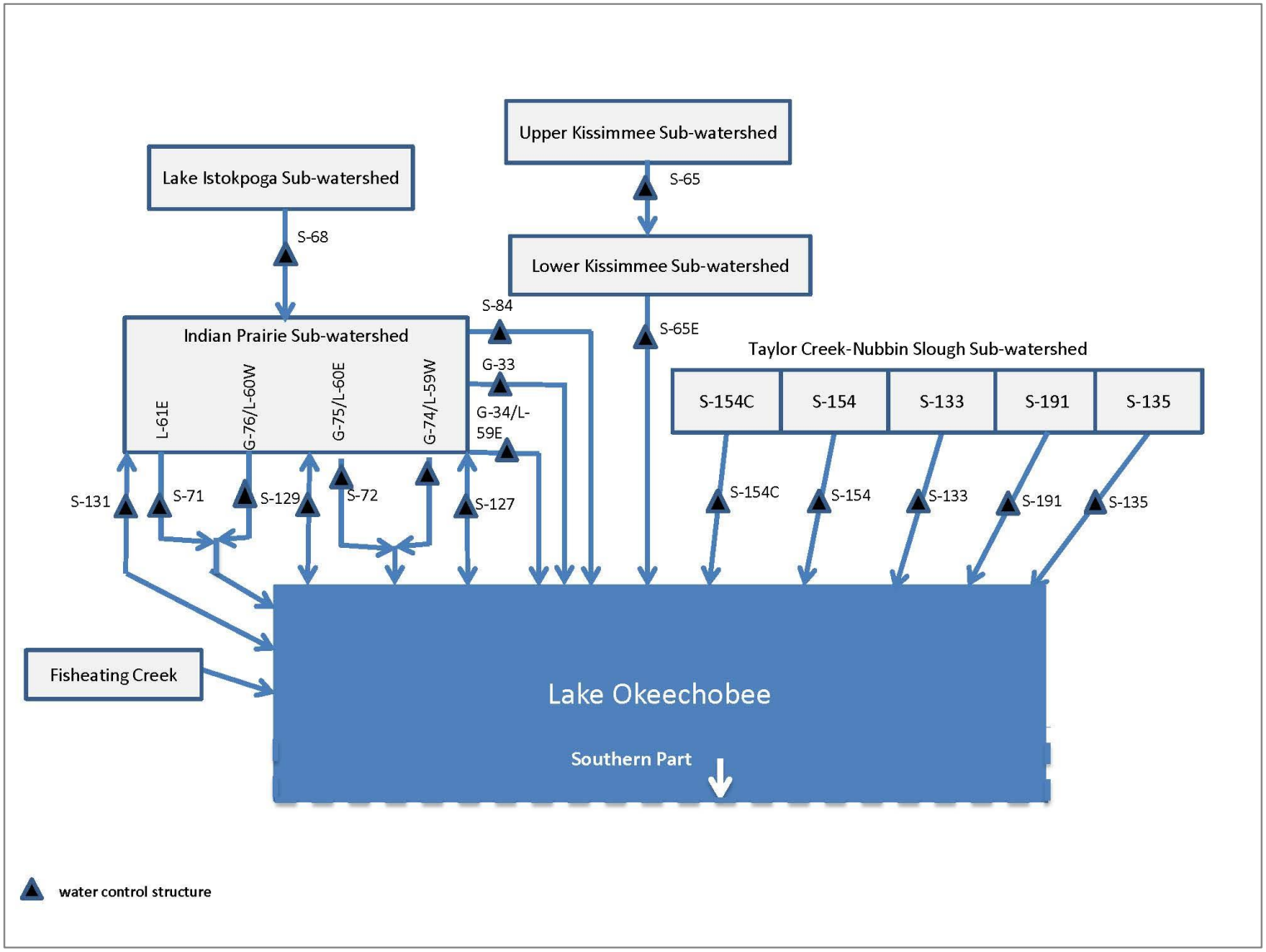


Figure 1. Lake Okeechobee Watershed (northern part of Lake Okeechobee) flow schematic.

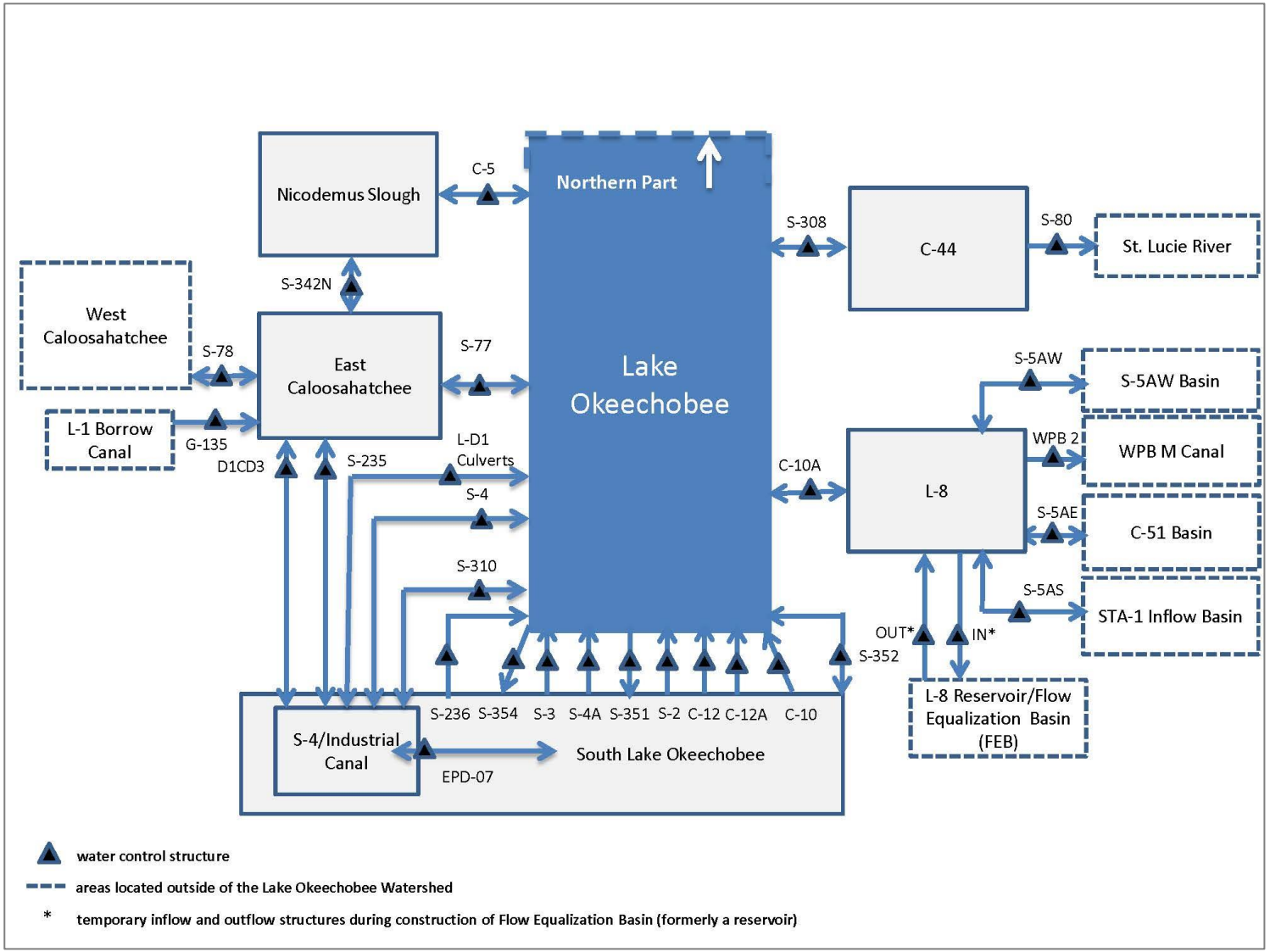


Figure 2. Lake Okeechobee Watershed (southern part of Lake Okeechobee) flow schematic.

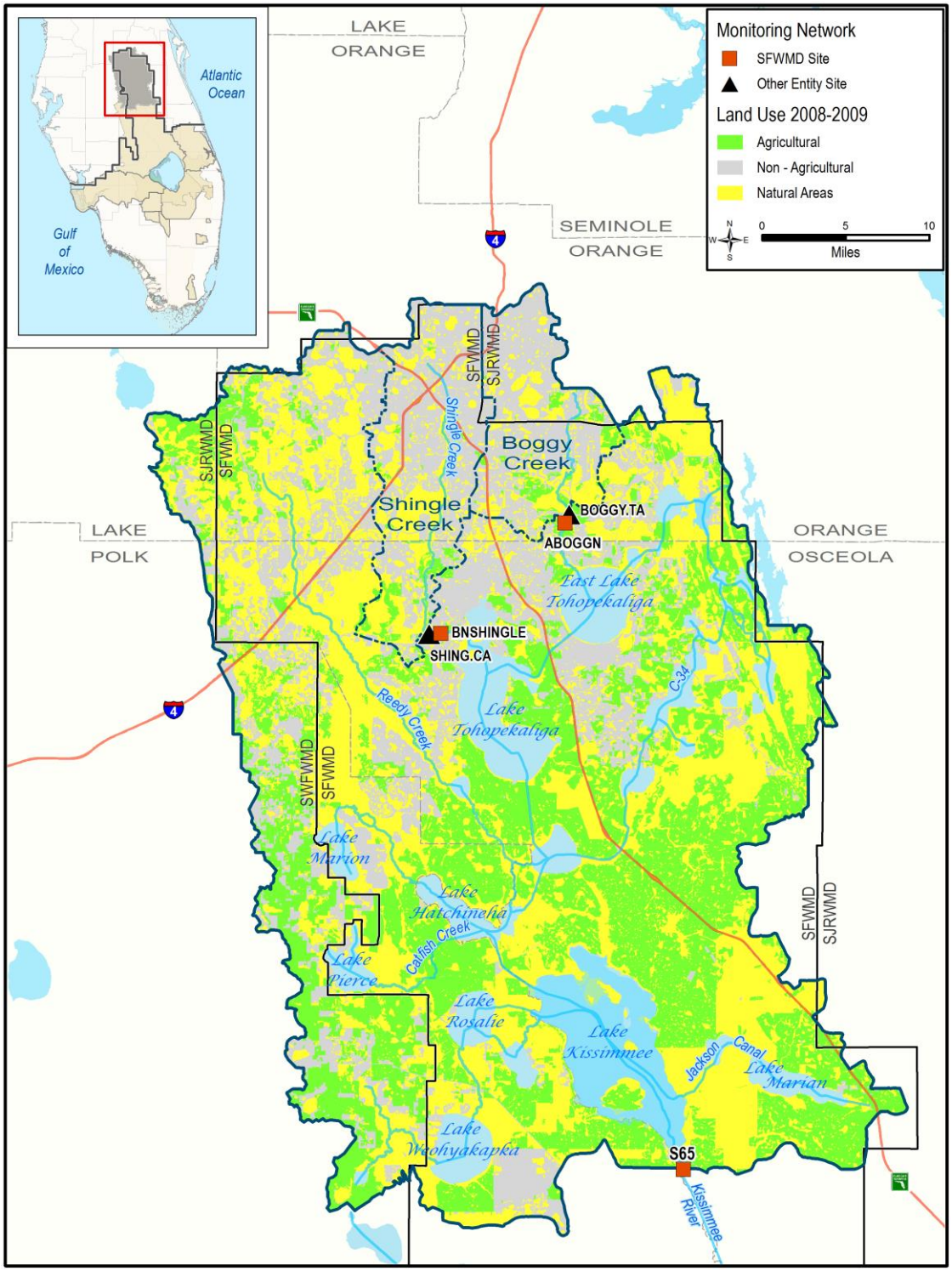


Figure 3. Lake Okeechobee Watershed, Upper Kissimmee Sub-watershed.

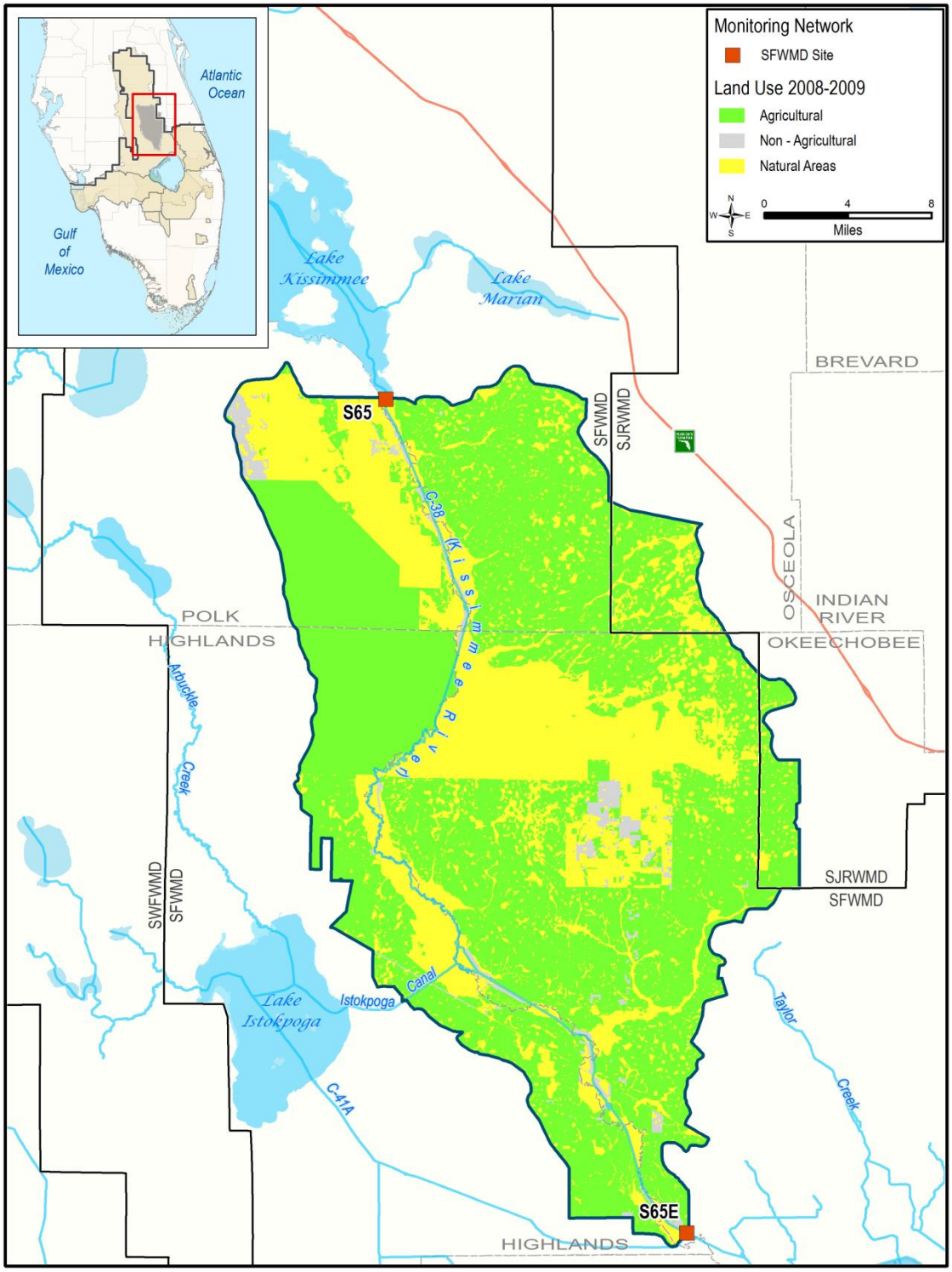


Figure 4. Lake Okeechobee Watershed, Lower Kissimmee Sub-watershed.

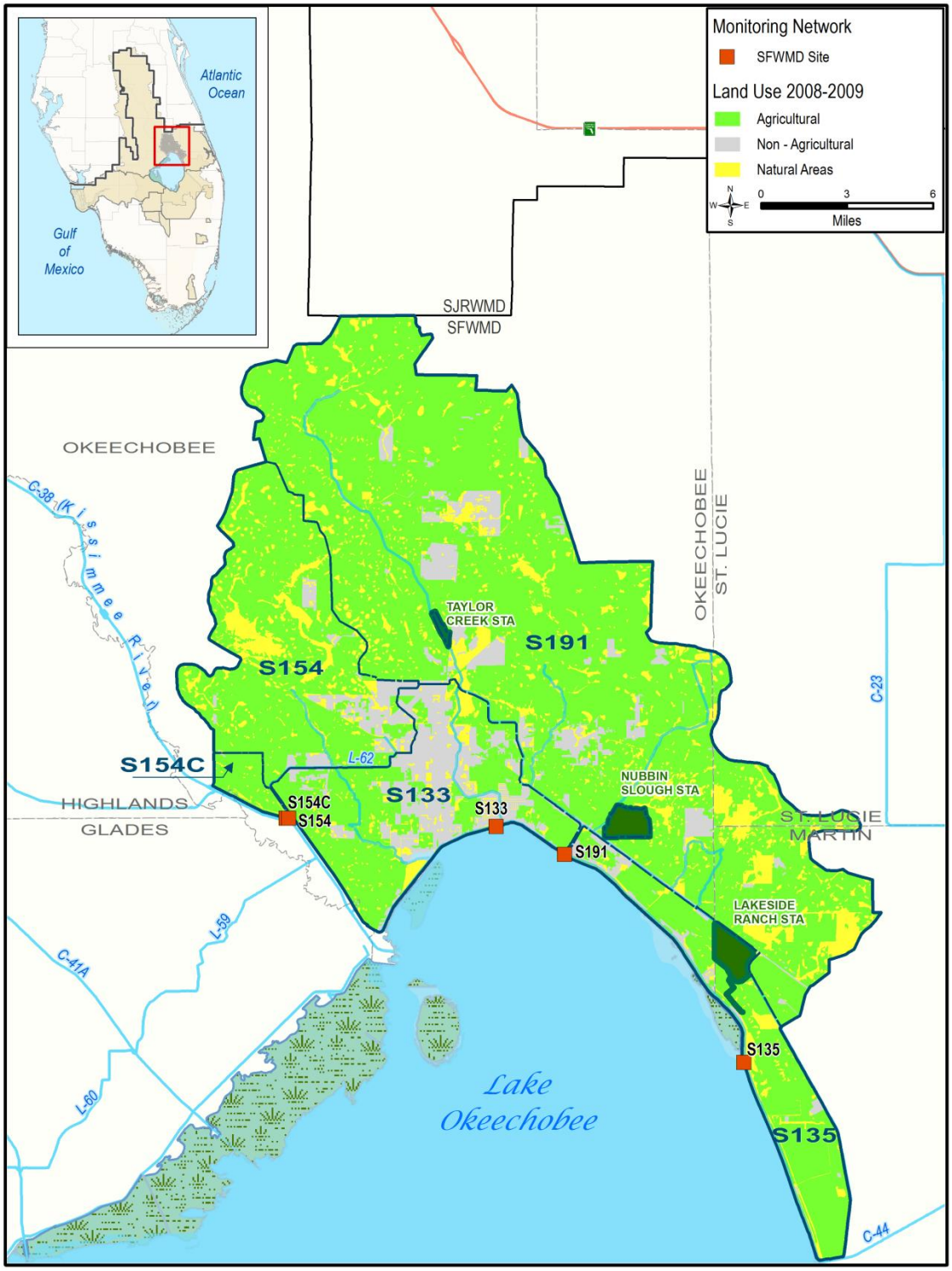


Figure 5. Lake Okeechobee Watershed,
Taylor Creek/Nubbin Slough Sub-watershed.

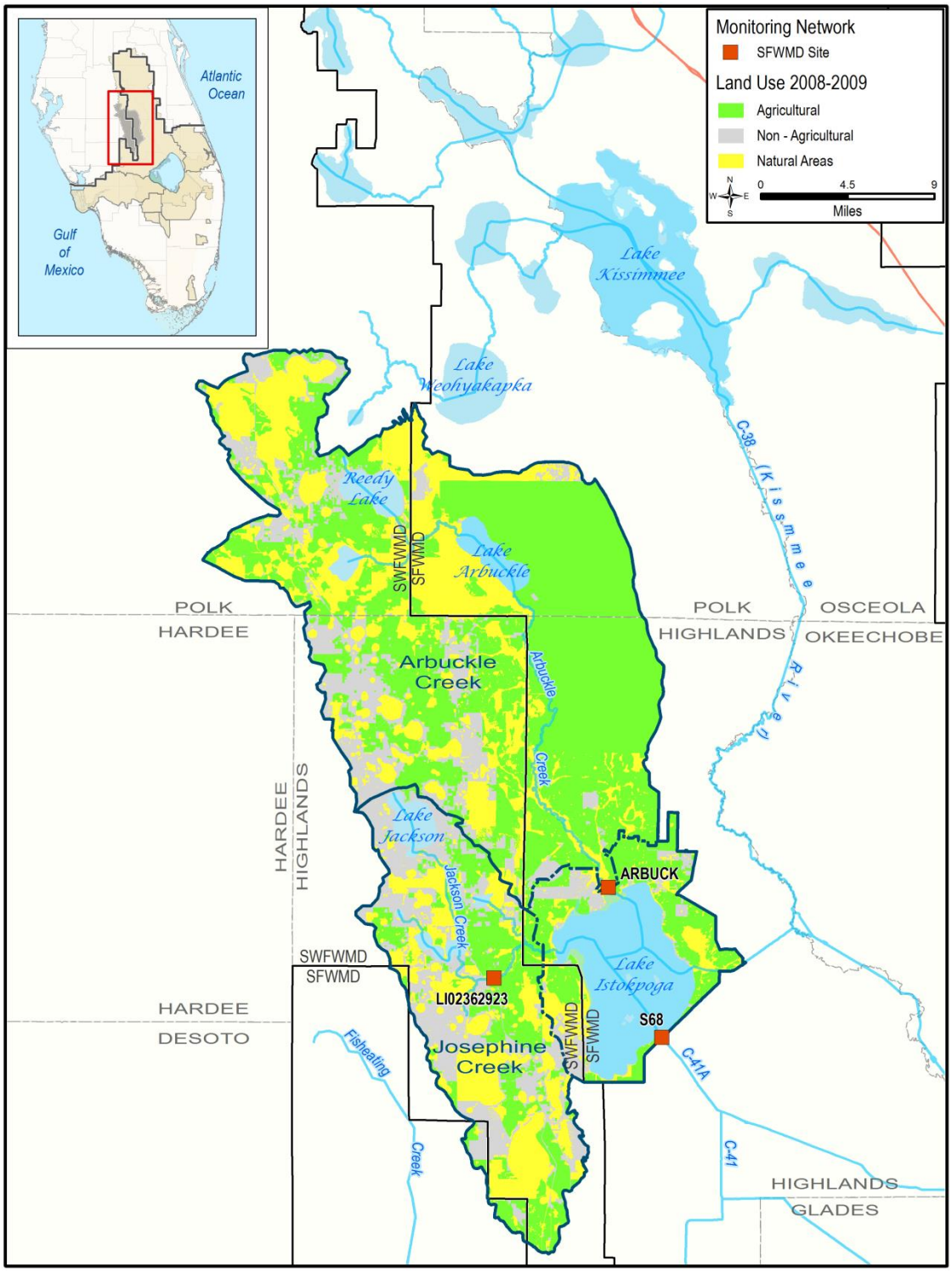


Figure 6. Lake Okeechobee Watershed, Lake Istokpoga Sub-watershed.

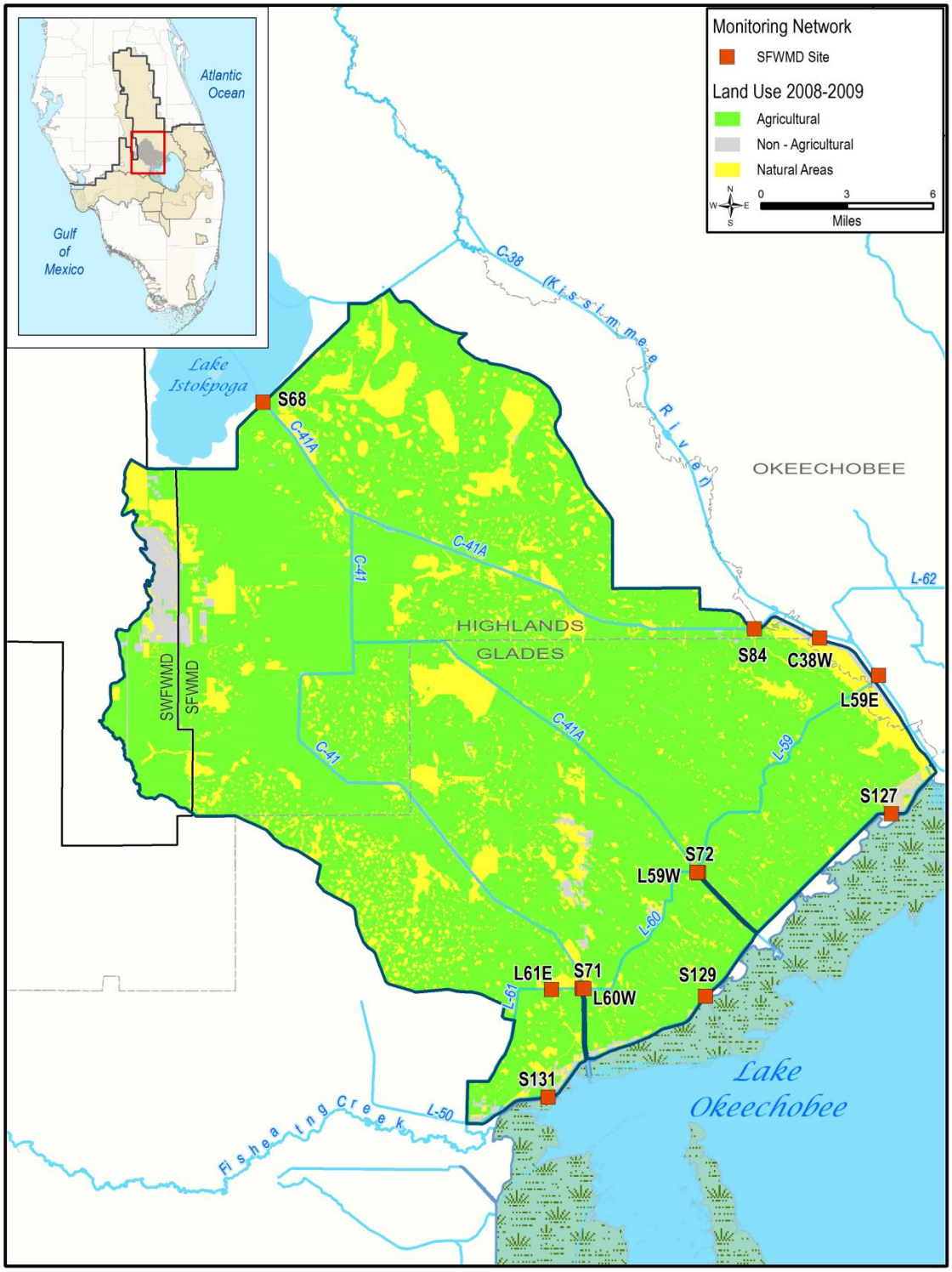


Figure 7. Lake Okeechobee Watershed,
Indian Prairie Sub-watershed.

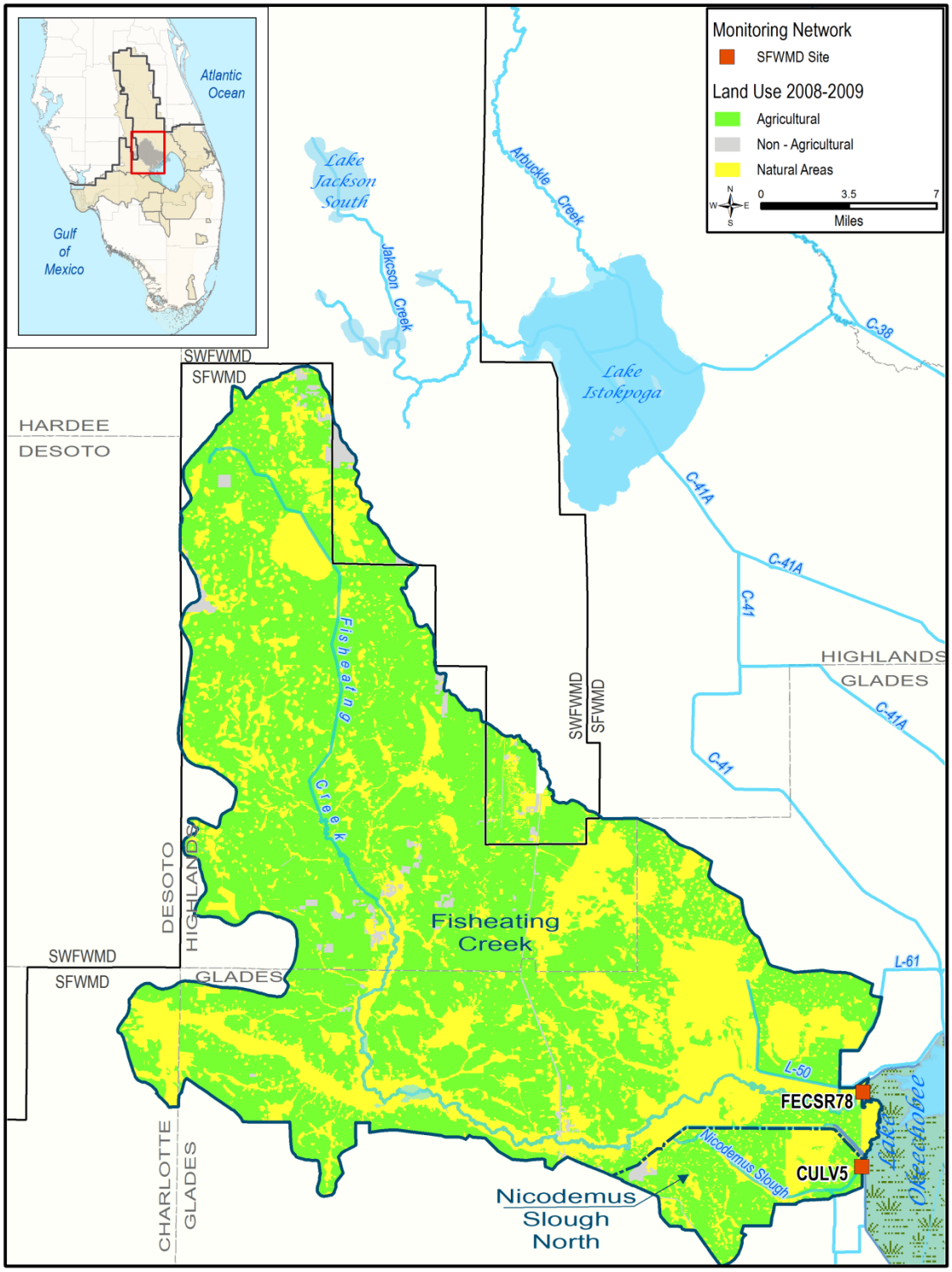


Figure 8. Lake Okeechobee Watershed,
Fisheating Creek/Nicodemus Slough Sub-watershed.

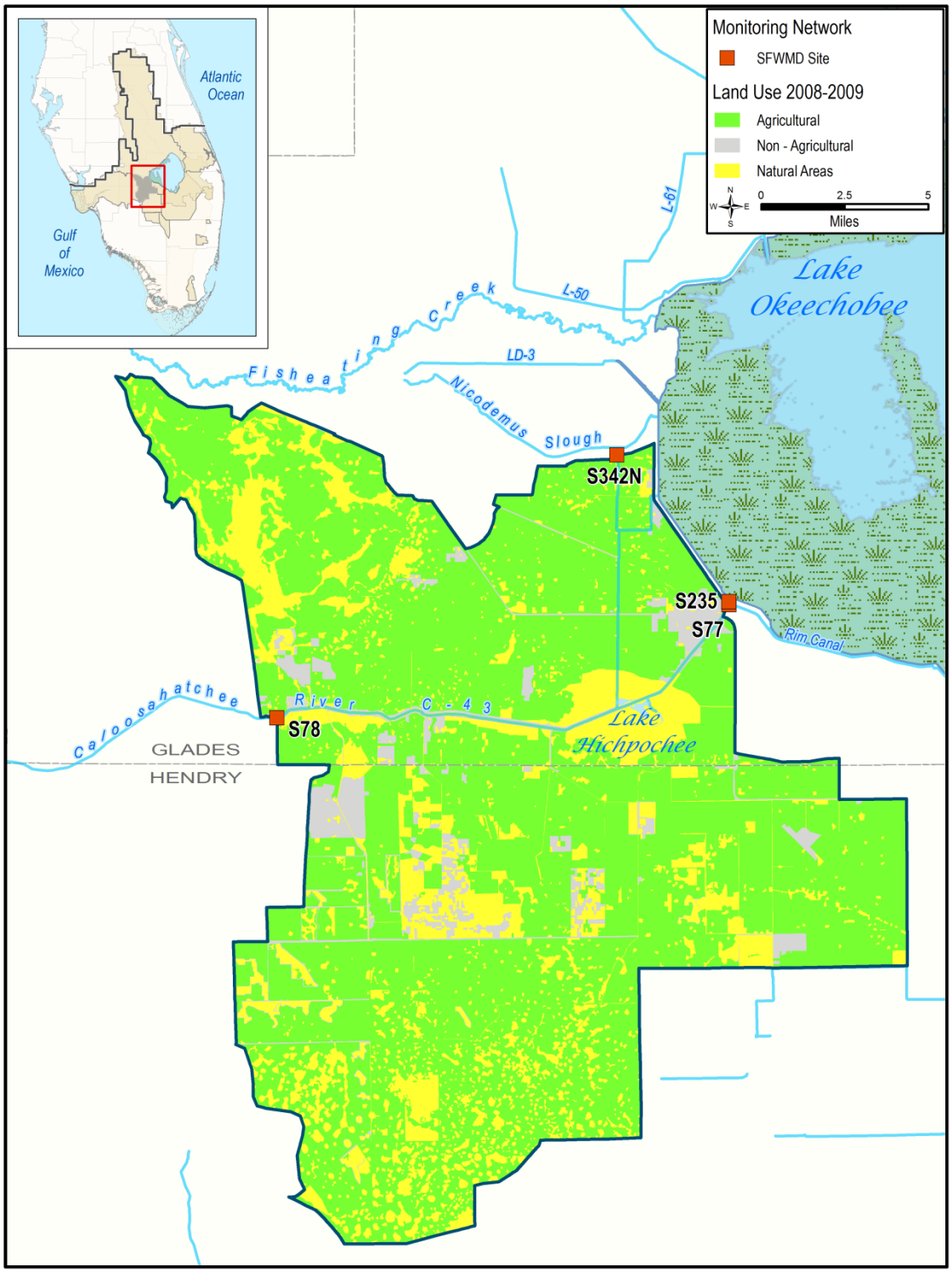


Figure 9. Lake Okeechobee Watershed, West Lake Okeechobee Sub-watershed.

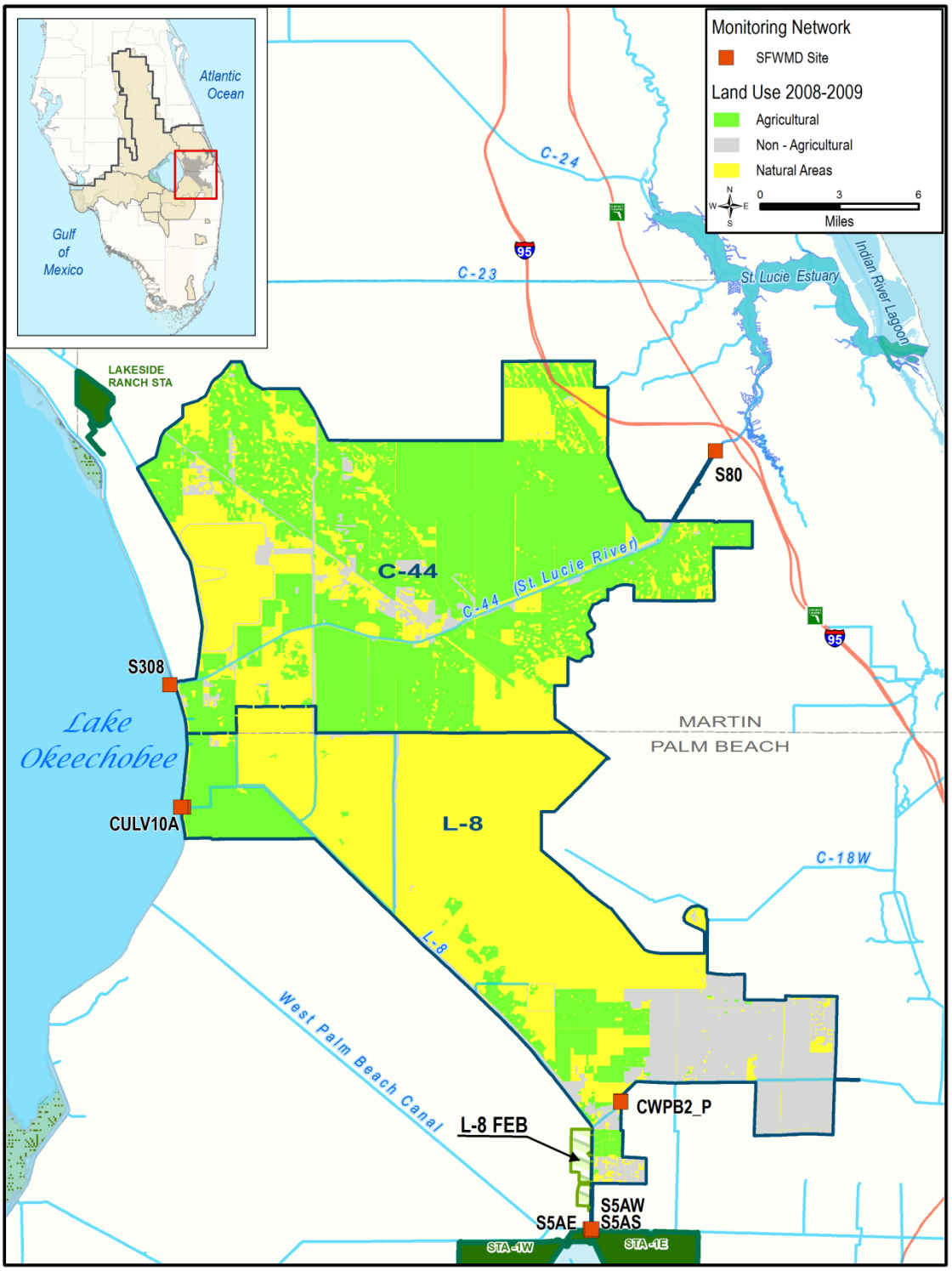


Figure 10. Lake Okeechobee Watershed, East Lake Okeechobee Sub-watershed.

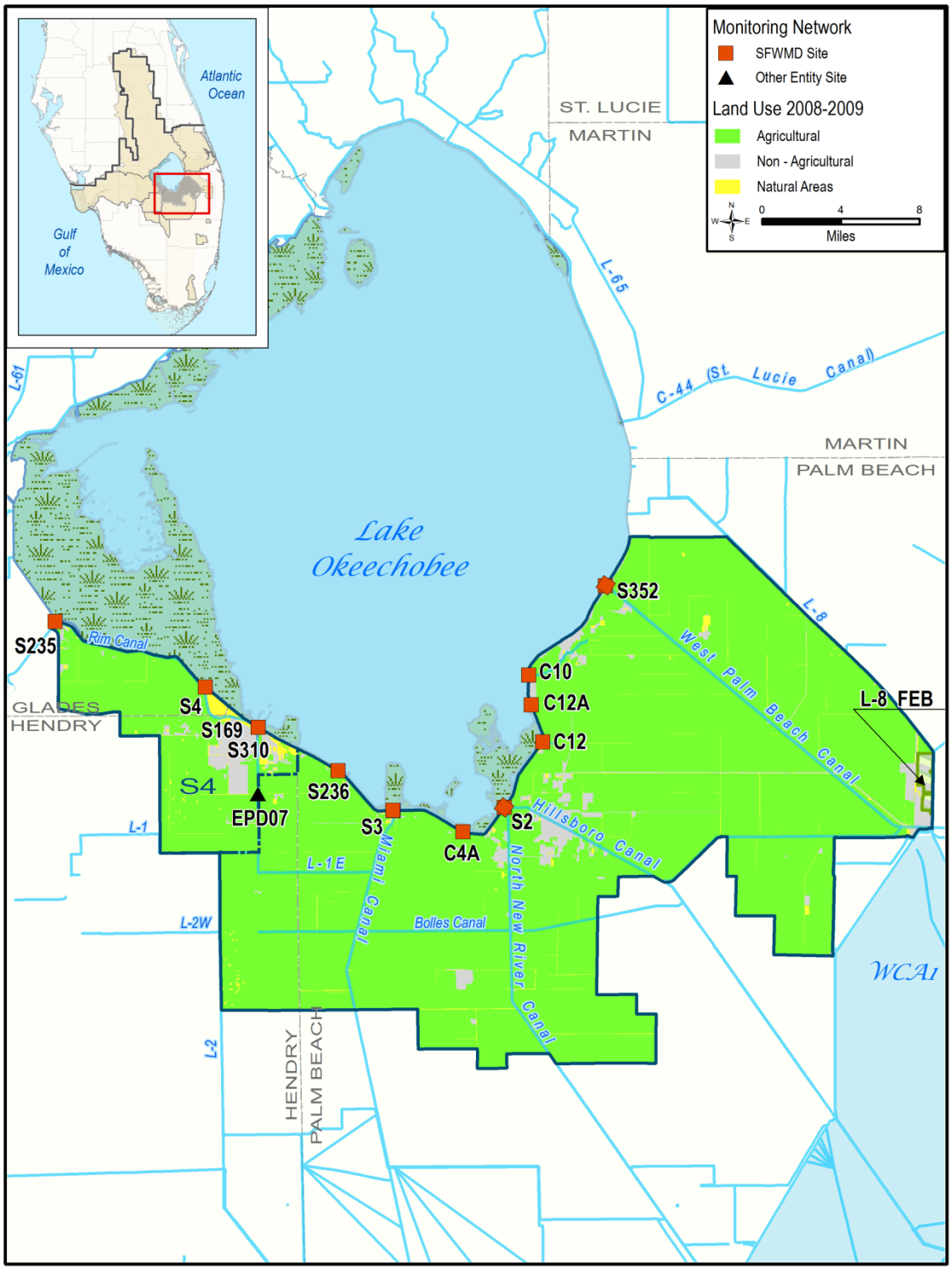


Figure 11. Lake Okeechobee Watershed, South Lake Okeechobee Sub-watershed.

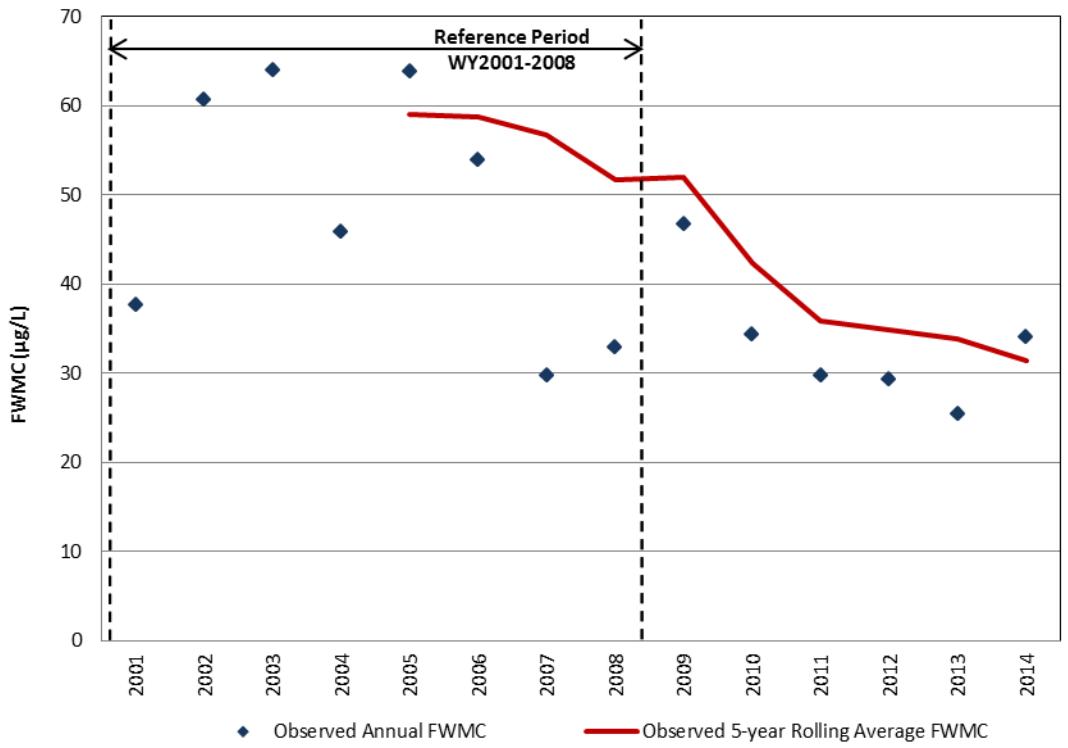


Figure 12. Boggy Creek: Total phosphorus (TP) observed annual flow-weighted mean concentration (FWMC) and five-year rolling averages.

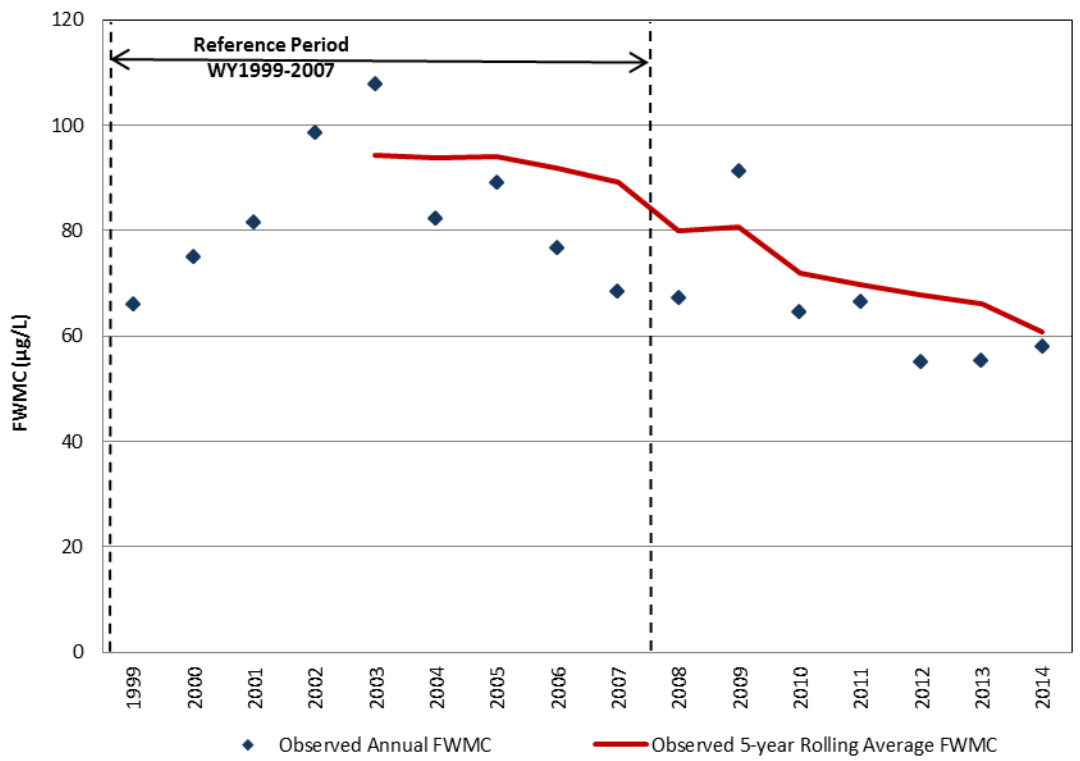


Figure 13. Shingle Creek: TP observed annual FWMC and five-year rolling averages.

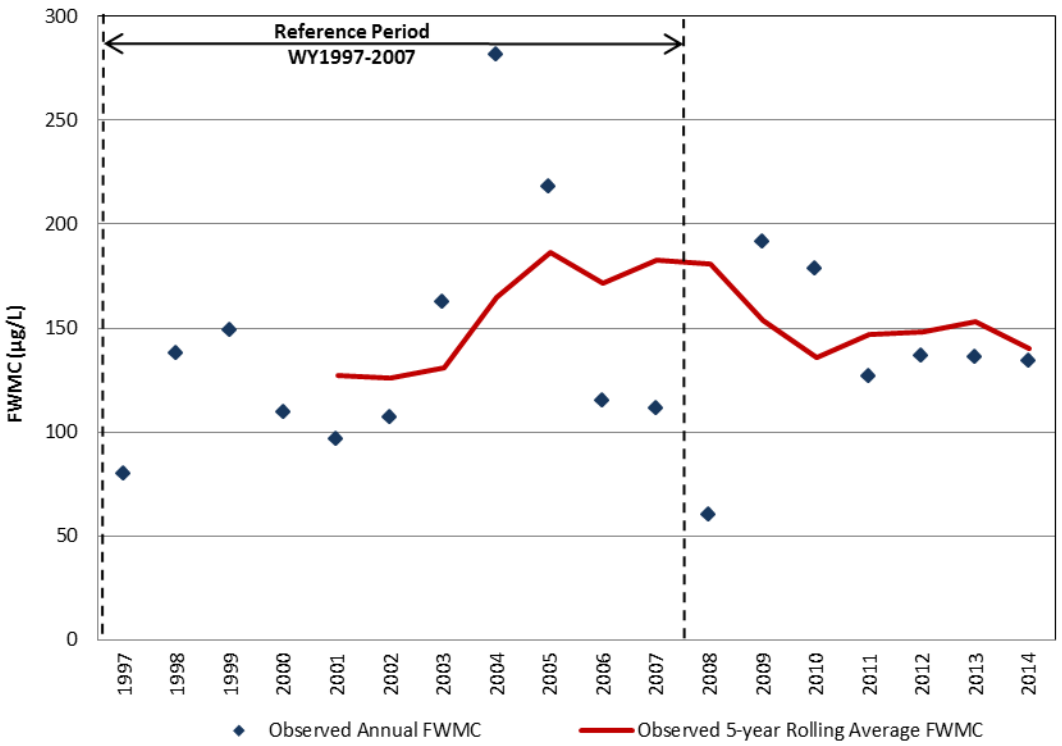


Figure 14. Arbuckle Creek: TP observed annual FWMC and five-year rolling averages.

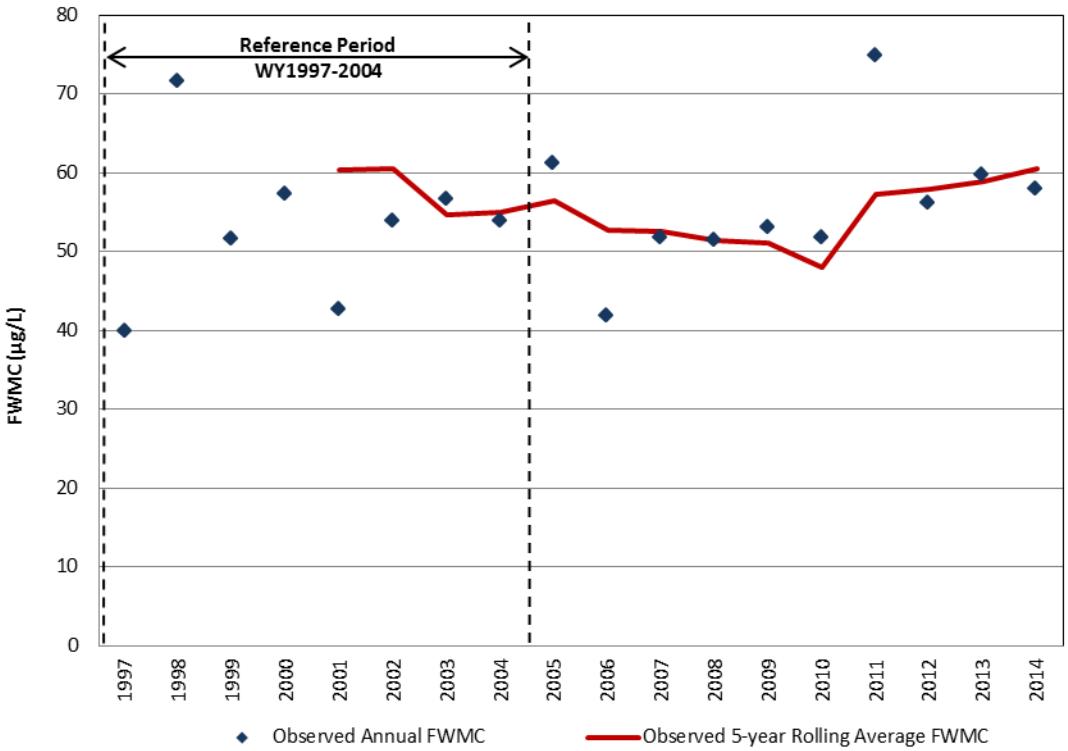


Figure 15. Josephine Creek: TP observed annual FWMC and five-year rolling averages.

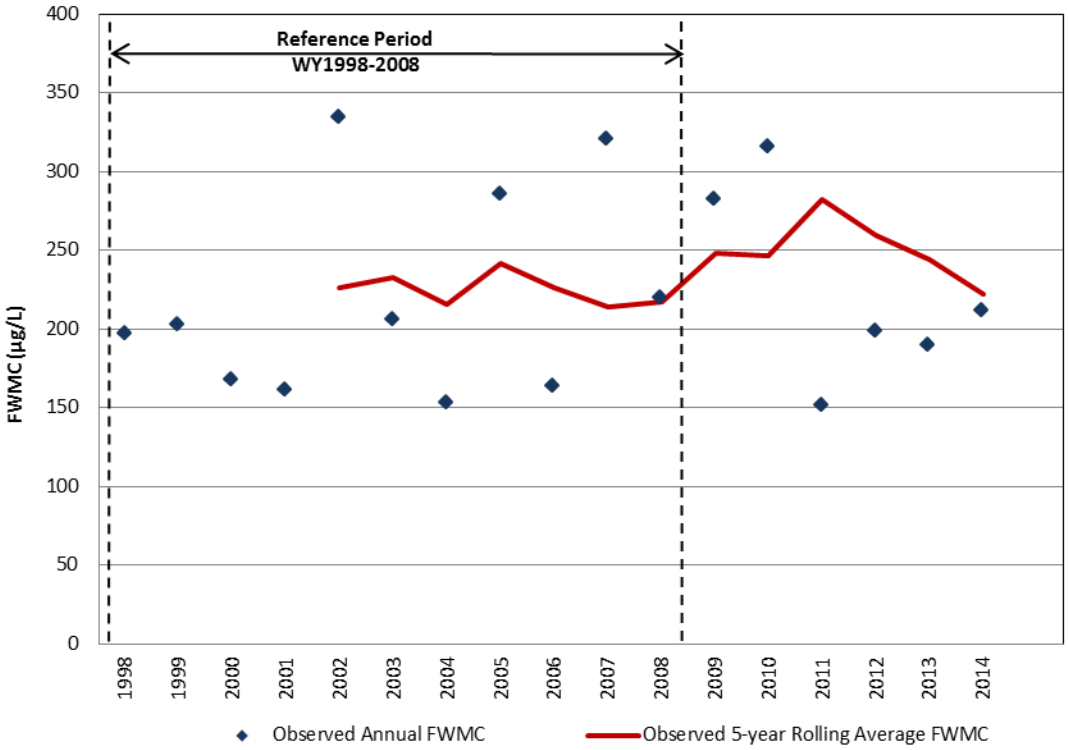


Figure 16. Fisheating Creek: TP observed annual FWMC and five-year rolling averages.

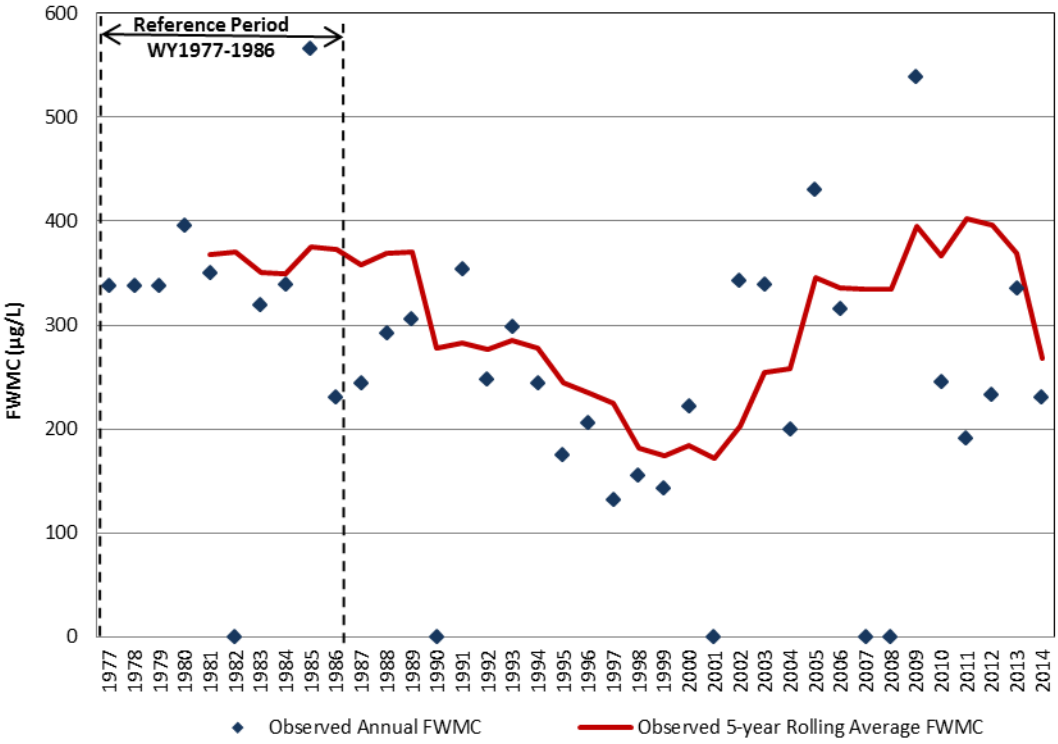


Figure 17. S-133 Basin: TP observed annual FWMC and five-year rolling averages.

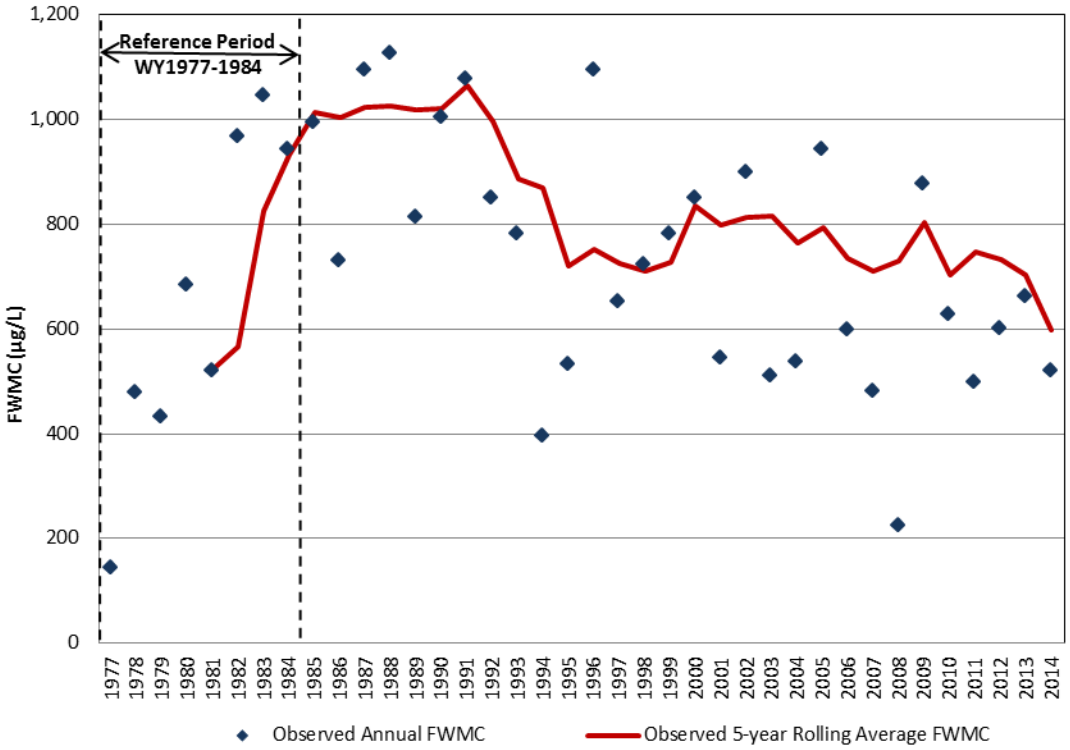


Figure 18. S-154 Basin: TP observed annual FWMC and five-year rolling averages.

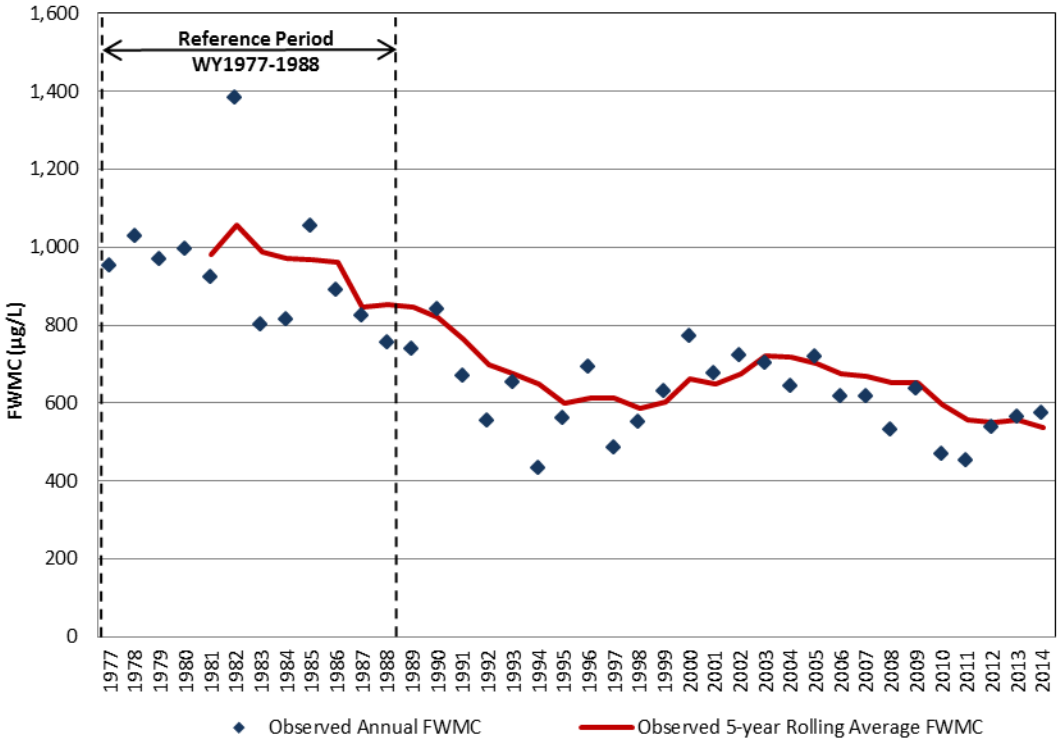


Figure 19. S-191 Basin: TP observed annual FWMC and five-year rolling averages.

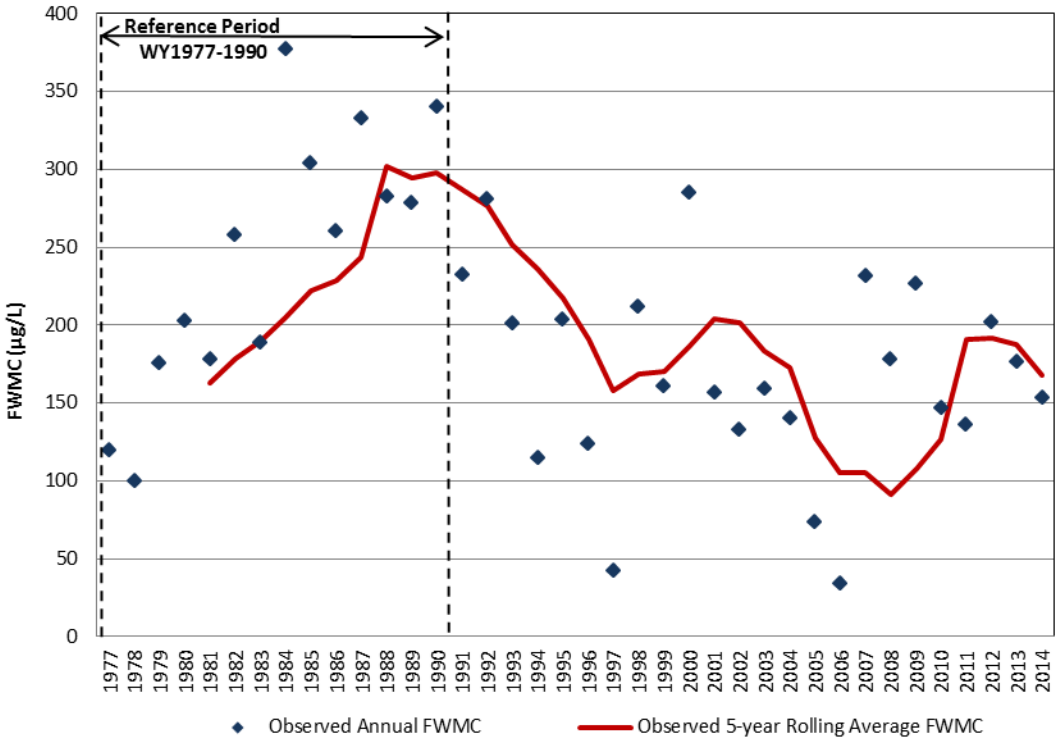


Figure 20. Lower Kissimmee Basin: TP observed annual FWMC and five-year rolling averages.

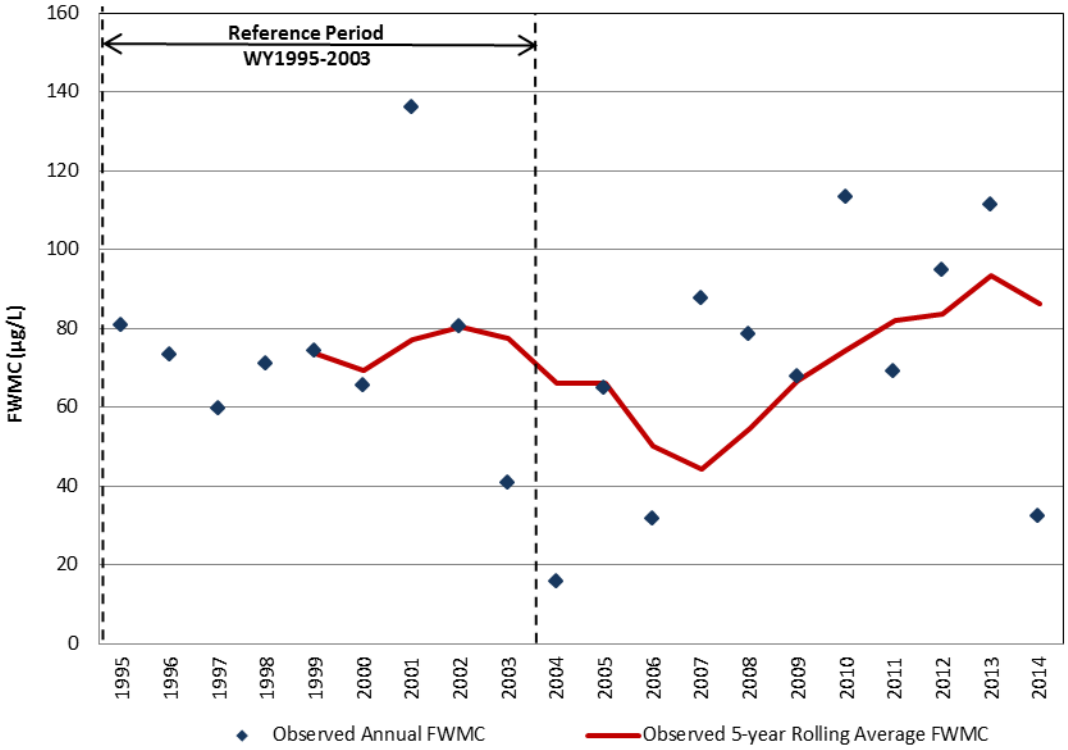


Figure 21. L-8 Basin: TP observed annual FWMC and five-year rolling averages.

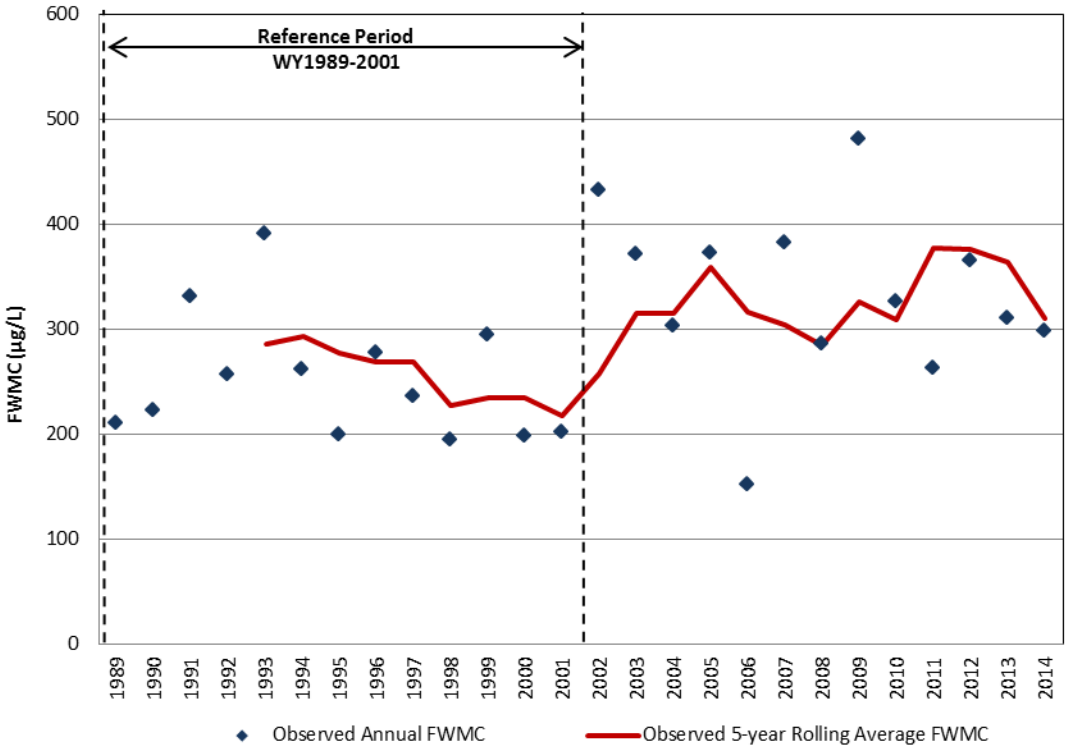
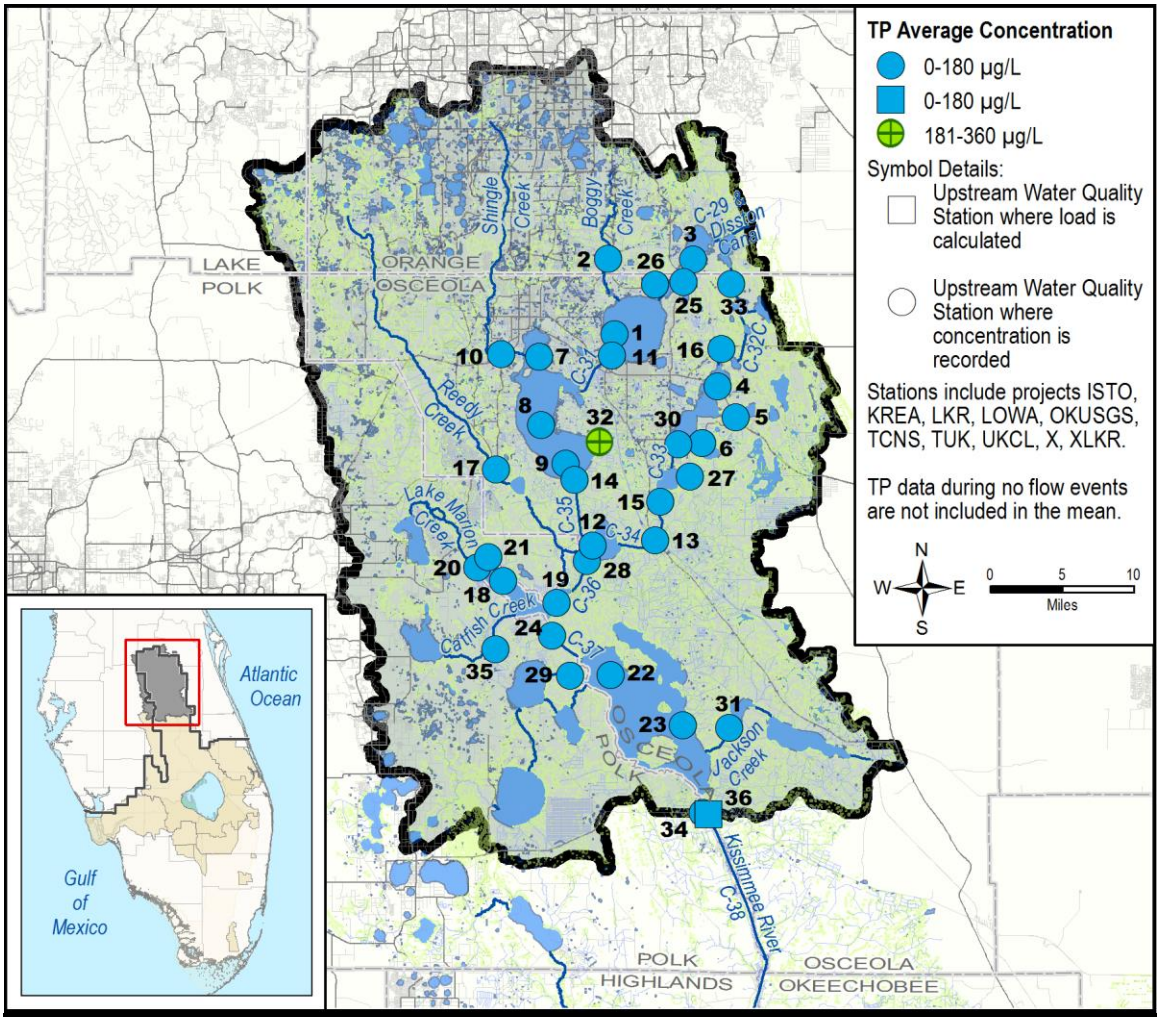
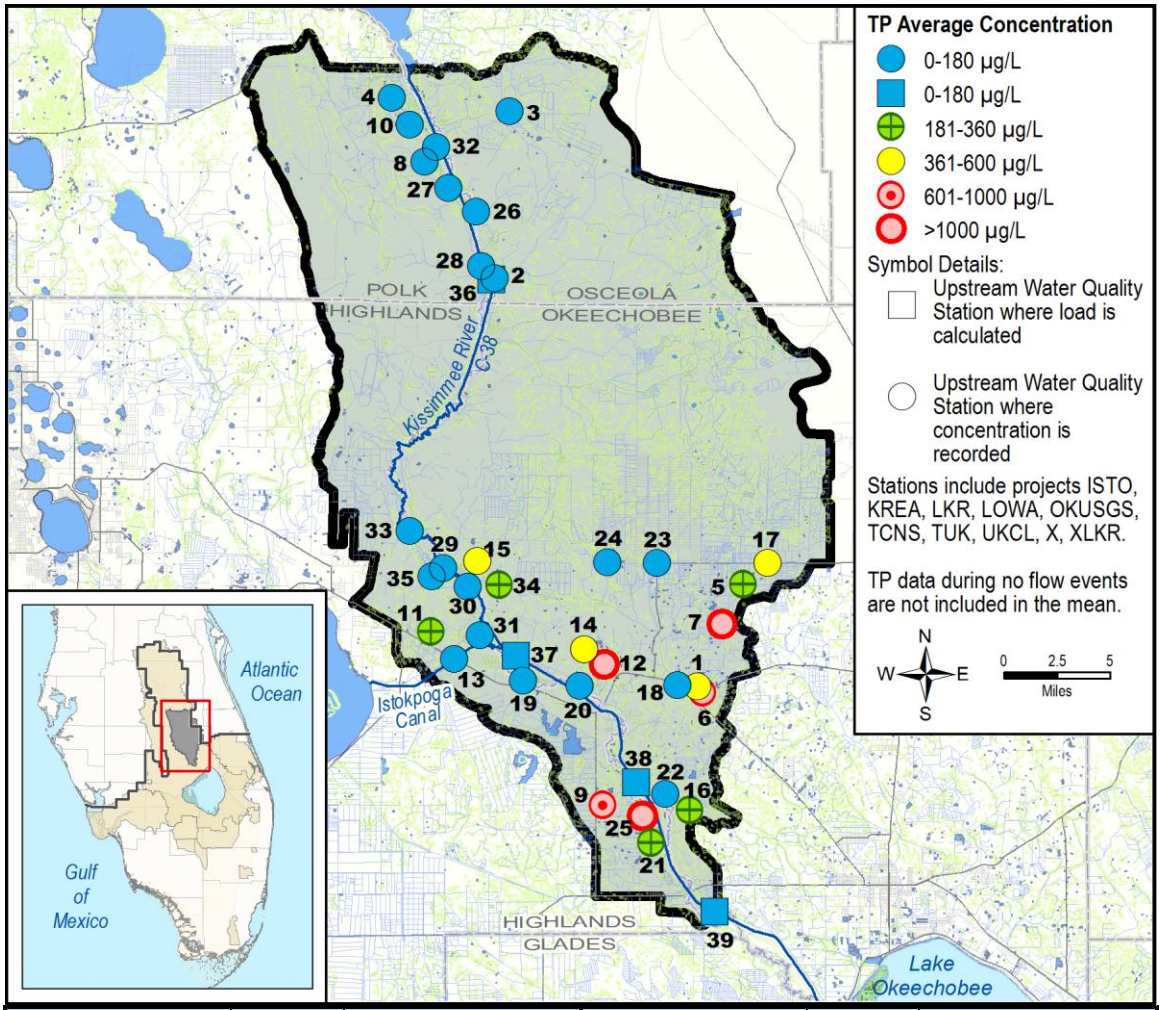


Figure 22. Indian Prairie Basin: TP observed annual FWMC and five-year rolling averages.



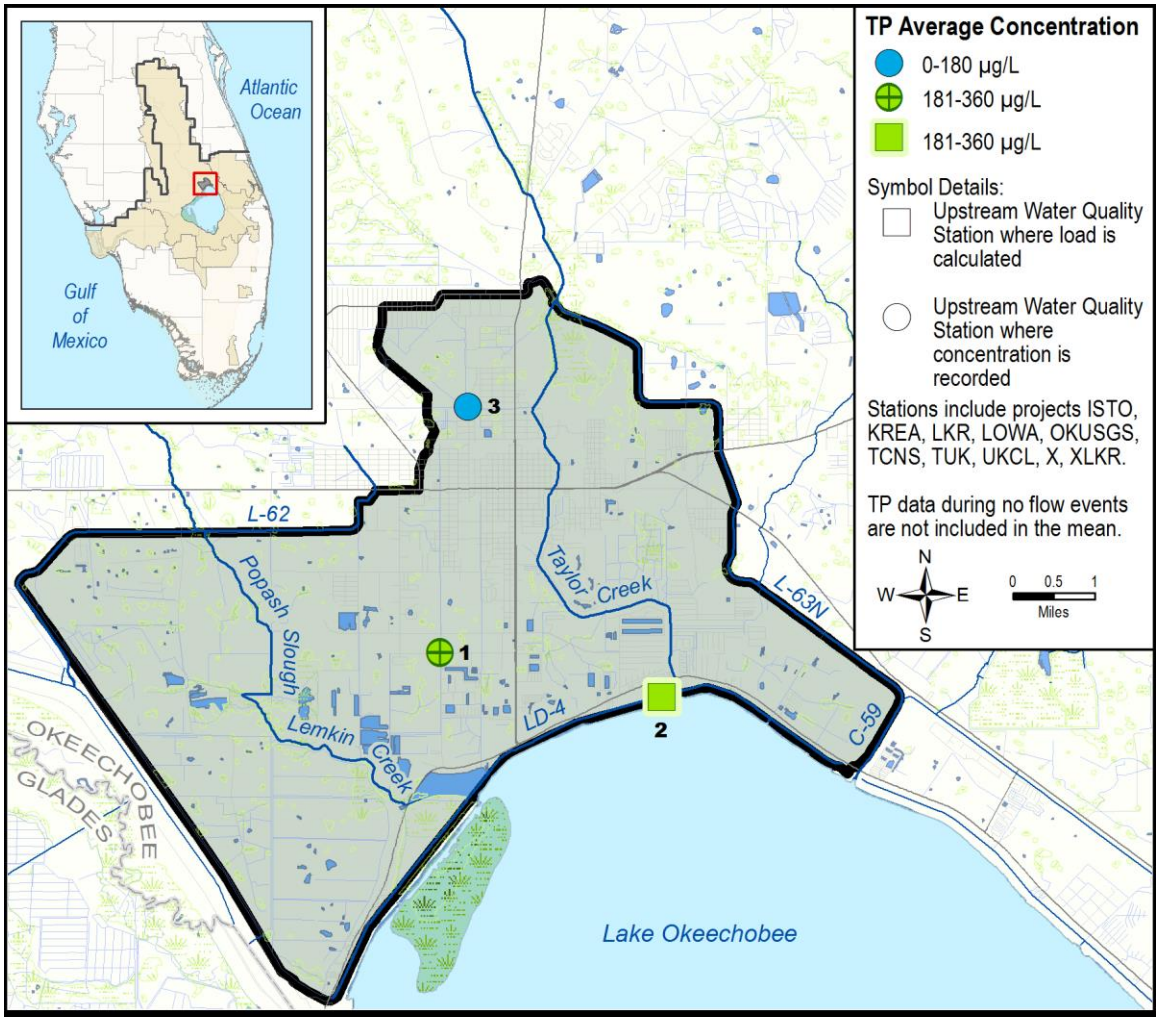
Upper Kissimmee		# of Samples	TP Concentration (µg/L)			Upper Kissimmee		# of Samples	TP Concentration (µg/L)		
Map ID	Station		Avg.	Min	Max	Map ID	Station		Avg.	Min	Max
1	A03	8	15	13	18	19	D03	8	52	42	71
2	ABOGGN	12	25	14	43	20	DLMARNCR	26	63	38	101
3	AJ33243122	3	31	30	33	21	DLONDNCR	9	112	63	136
4	AL11263113	11	15	12	18	22	E02	8	49	36	72
5	AL24263113	23	52	20	660	23	E04	8	41	31	59
6	AL34263113	18	22	18	27	24	EC-37	22	55	39	92
7	B02	7	50	34	81	25	ET05253114	10	39	28	59
8	B06	7	35	27	55	26	ET06253113	26	102	42	642
9	B09	8	37	28	61	27	GENTRYDTCH	7	69	17	207
10	BNSHINGLE	12	49	27	77	28	HL08283014	14	63	45	96
11	BS-59	8	14	13	18	29	KUB009	8	95	69	170
12	C03	8	43	34	69	30	LG32263124	11	20	16	27
13	CL06283111	15	103	22	396	31	LJACKDSCH	16	71	41	124
14	CL18273011	16	46	33	76	32	LT32263013	7	297	153	410
15	CL19273123	13	32	23	43	33	MJ01253123	8	18	16	24
16	CO35253112	9	49	46	54	34	PA10313112	11	107	32	298
17	CREEDYBR	6	69	45	102	35	ROMIN	15	48	25	88
18	D02	8	57	43	111	36	S65	77	62	23	165

Figure 23. Upper Kissimmee Sub-watershed average TP concentrations for WY2014.



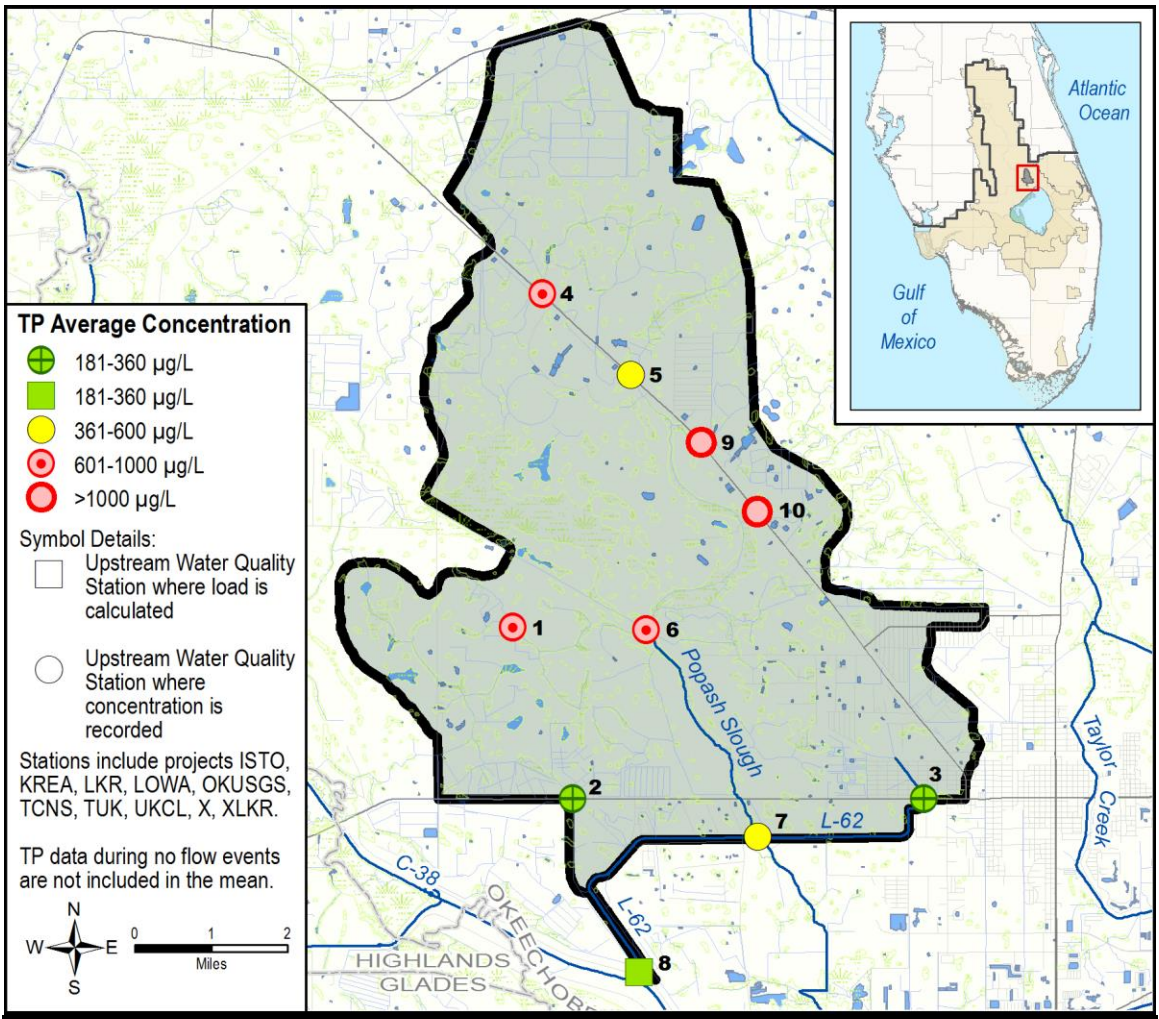
Lower Kissimmee		# of Samples	TP Concentration (µg/L)			Lower Kissimmee		# of Samples	TP Concentration (µg/L)		
Map ID	Station		Avg.	Min	Max	Map ID	Station		Avg.	Min	Max
1	02272676	11	431	211	548	21	KREA 14	16	356	36	939
2	AM28323233	5	102	78	133	22	KREA 17A	18	159	73	291
3	BB16313214	1	106	106	106	23	KREA 22	17	94	49	145
4	BM15313111	7	24	15	47	24	KREA 23	20	81	43	208
5	CY05353444	17	223	42	1302	25	KREA 41A	12	1166	62	2623
6	CY06363411	7	720	328	1473	26	KREA 79	2	155	74	237
7	CY17353413	3	3831	3396	4612	27	KREA 91	12	71	25	143
8	IC35313112	11	61	23	213	28	KREA 92	10	51	27	87
9	KR05373311	12	764	269	1683	29	KREA 93	12	67	40	116
10	KR23313113	5	69	54	77	30	KREA 94	12	68	47	125
11	KR24353114	15	201	81	398	31	KREA 95	2	82	69	96
12	KR29353334	9	1893	779	8545	32	KREA 97	12	83	55	135
13	KR30353214	2	67	60	75	33	KREA 98	12	62	43	104
14	KR30353312	2	488	398	578	34	OK09353212	15	200	94	430
15	KR32343214	5	397	203	609	35	PC45	2	43	39	47
16	KR36363312	5	269	165	489	36	S65A	78	50	26	112
17	KREA 01	12	421	138	721	37	S65C	78	61	23	161
18	KREA 04	13	177	111	581	38	S65D	75	70	35	196
19	KREA 101	9	90	33	404	39	S65E	82	80	35	225
20	KREA 102	8	95	43	147						

Figure 24. Lower Kissimmee Sub-watershed average TP concentrations for WY2014.



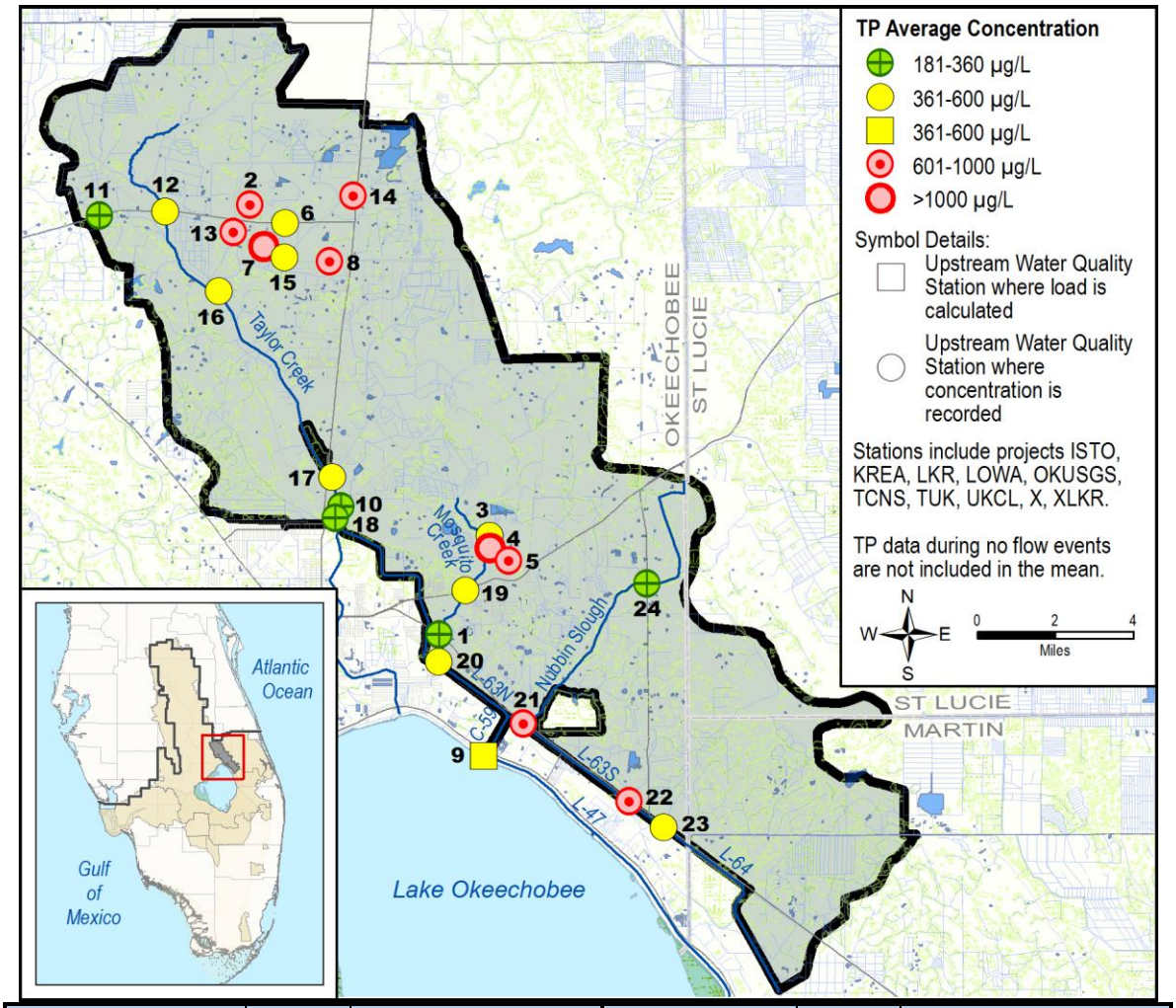
S133		# of Samples	TP Concentration (µg/L)		
Map ID	Station		Average	Min	Max
1	LM29373514	22	214	94	860
2	S133	2	244	216	272
3	TC09373513	20	104	45	302

Figure 25. Taylor Creek/Nubbin Slough Sub-watershed, S-133 Basin average TP concentrations for WY2014.



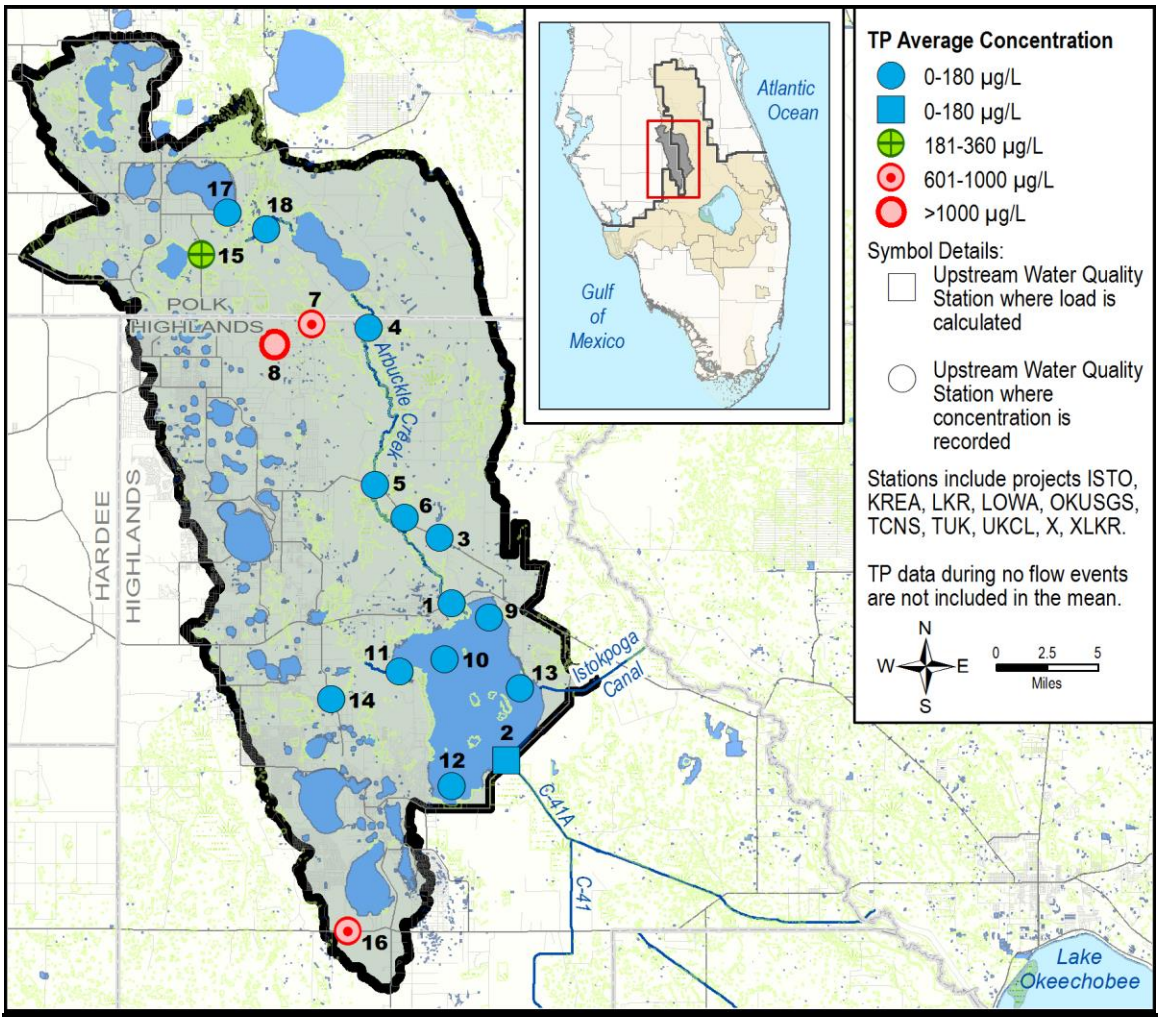
S154		# of Samples	TP Concentration (µg/L)		
Map ID	Station		Average	Min	Max
1	KR05373414	1	943	943	943
2	KR16373414	12	336	45	923
3	KR17373513	14	222	46	473
4	KREA 20	8	718	510	953
5	KREA 25	7	593	326	957
6	KREA 28	9	611	276	1230
7	KREA 30A	5	568	281	877
8	S154	55	257	71	779
9	TS26363411	5	1577	1149	2052
10	TS36363411	5	3810	2696	5397

Figure 26. Taylor Creek/Nubbin Slough Sub-watershed, S-154 Basin average TP concentrations for WY2014.



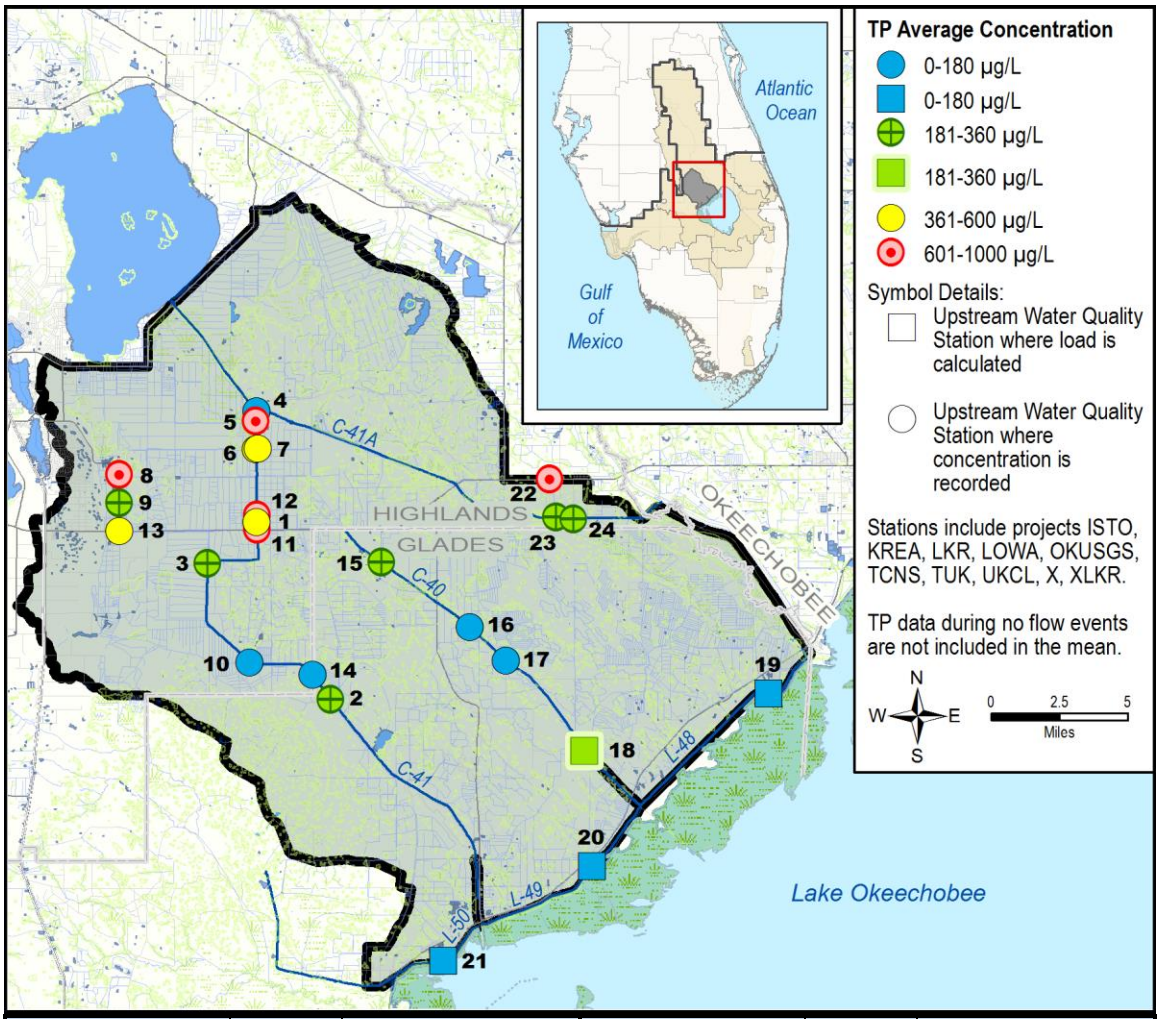
S191		# of Samples	TP Concentration (µg/L)			S191		# of Samples	TP Concentration (µg/L)		
Map ID	Station		Avg.	Min	Max	Map ID	Station		Avg.	Min	Max
1	02275197	18	330	111	654	13	TCNS 204	13	962	478	1737
2	LB29353513	12	747	398	1903	14	TCNS 207	13	659	309	1537
3	MS05373613	2	583	451	715	15	TCNS 209	8	578	236	890
4	MS08373611	8	1402	489	2825	16	TCNS 213	10	449	131	899
5	MS08373614	2	961	958	965	17	TCNS 214	13	523	288	948
6	OT29353514	14	393	182	733	18	TCNS 217	23	277	112	548
7	OT32353511	8	2962	2088	3729	19	TCNS 220	12	409	121	686
8	OT34353513	8	931	181	2171	20	TCNS 222	16	369	200	665
9	S191	26	509	133	826	21	TCNS 228	4	612	532	758
10	TC03373511	6	295	191	519	22	TCNS 230	5	612	375	806
11	TC27353413	6	332	188	538	23	TCNS 233	11	599	302	958
12	TCNS 201	6	533	241	790	24	TCNS 249	4	206	114	277

Figure 27. Taylor Creek/Nubbin Slough Sub-watershed, S-191 Basin average TP concentrations for WY2014.



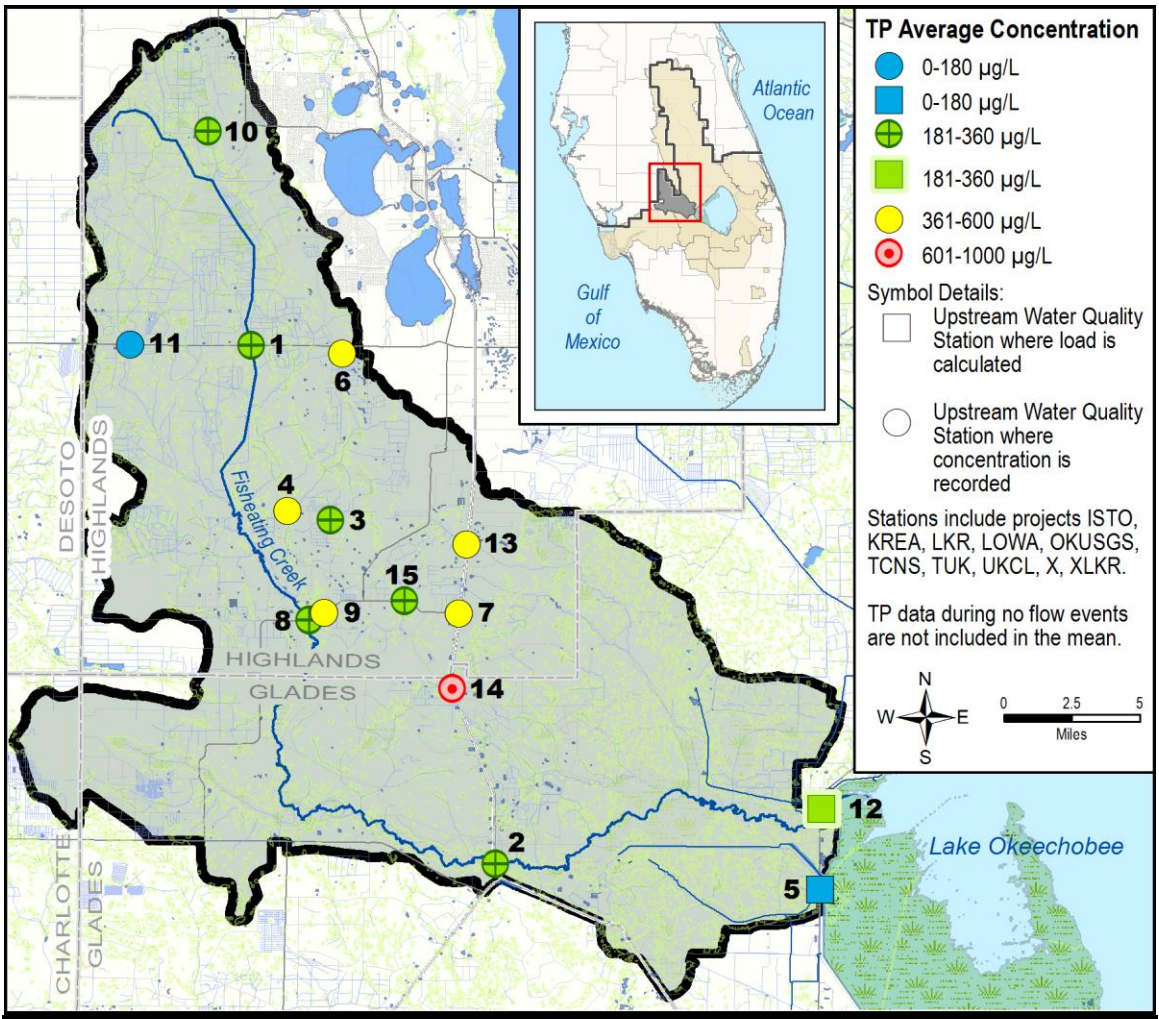
Lake Istokpoga		# of Samples	TP Concentration (µg/L)		
Map ID	Station		Average	Min	Max
1	02270500	96	119	52	360
2	02273198	78	79	21	133
3	AB27343014	19	178	22	653
4	AR06333013	26	48	35	68
5	AR18343012	15	124	74	224
6	AR21343013	7	169	69	288
7	BN03332911	26	811	515	1224
8	BN08332912	23	1983	812	5489
9	ISTK1	6	83	64	119
10	ISTK2S	6	79	57	117
11	ISTK3W	6	59	39	102
12	ISTK5N	5	72	53	104
13	ISTK6	6	95	66	166
14	LI02362923	26	57	33	95
15	LV14322813	12	223	158	495
16	PL01382911	21	931	682	1356
17	RD01322813	26	25	16	46
18	RD08322913	26	78	29	117

Figure 28. Lake Istokpoga Sub-watershed average TP concentrations for WY2014.



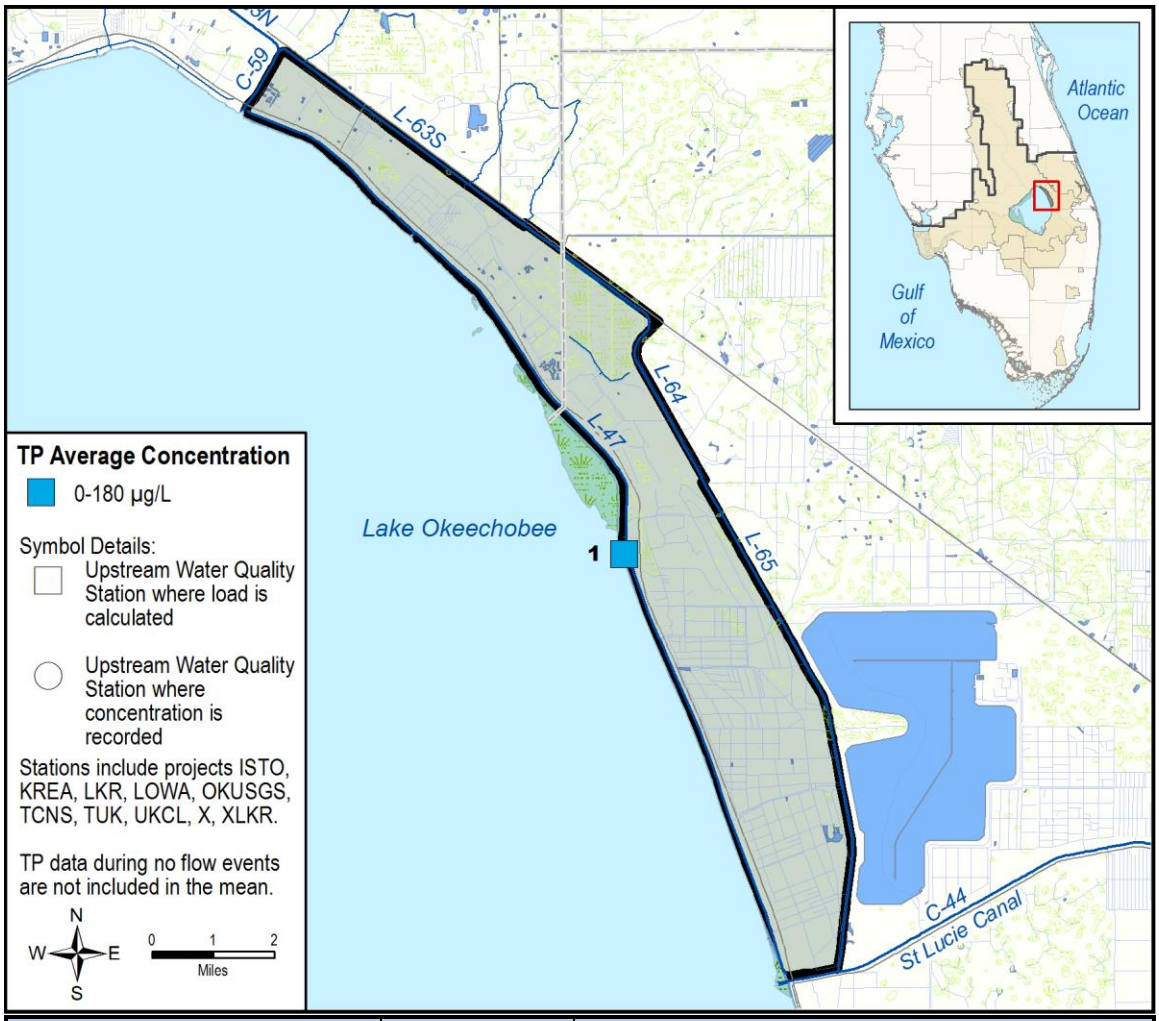
Indian Prairie		# of Samples	TP Concentration (µg/L)			Indian Prairie		# of Samples	TP Concentration (µg/L)		
Map ID	Station		Avg.	Min	Max	Map ID	Station		Avg.	Min	Max
1	02273230	12	415	81	1010	13	HP36373013	9	450	135	845
2	HP06393242	16	227	55	480	14	HP36383112	3	140	85	194
3	HP09383151	14	294	50	673	15	IP09383232	16	197	81	562
4	HP11373132	12	63	46	77	16	IP24383214	5	88	49	145
5	HP15373112	8	786	377	1171	17	IP29383313	9	180	94	279
6	HP22373112	11	479	267	996	18	L60E	2	197	178	217
7	HP23373111	4	406	127	702	19	S127	3	125	71	164
8	HP24373013	14	949	655	1435	20	S129	5	44	28	67
9	HP25373013	24	264	120	654	21	S131	7	75	41	114
10	HP27383124	10	162	105	214	22	SD28373312	7	696	449	1493
11	HP34373124	7	663	128	989	23	SD33373314	8	316	64	534
12	HP35373113	1	681	681	681	24	SD34373313	4	218	82	530

Figure 29. Indian Prairie Sub-watershed average TP concentrations for WY2014.



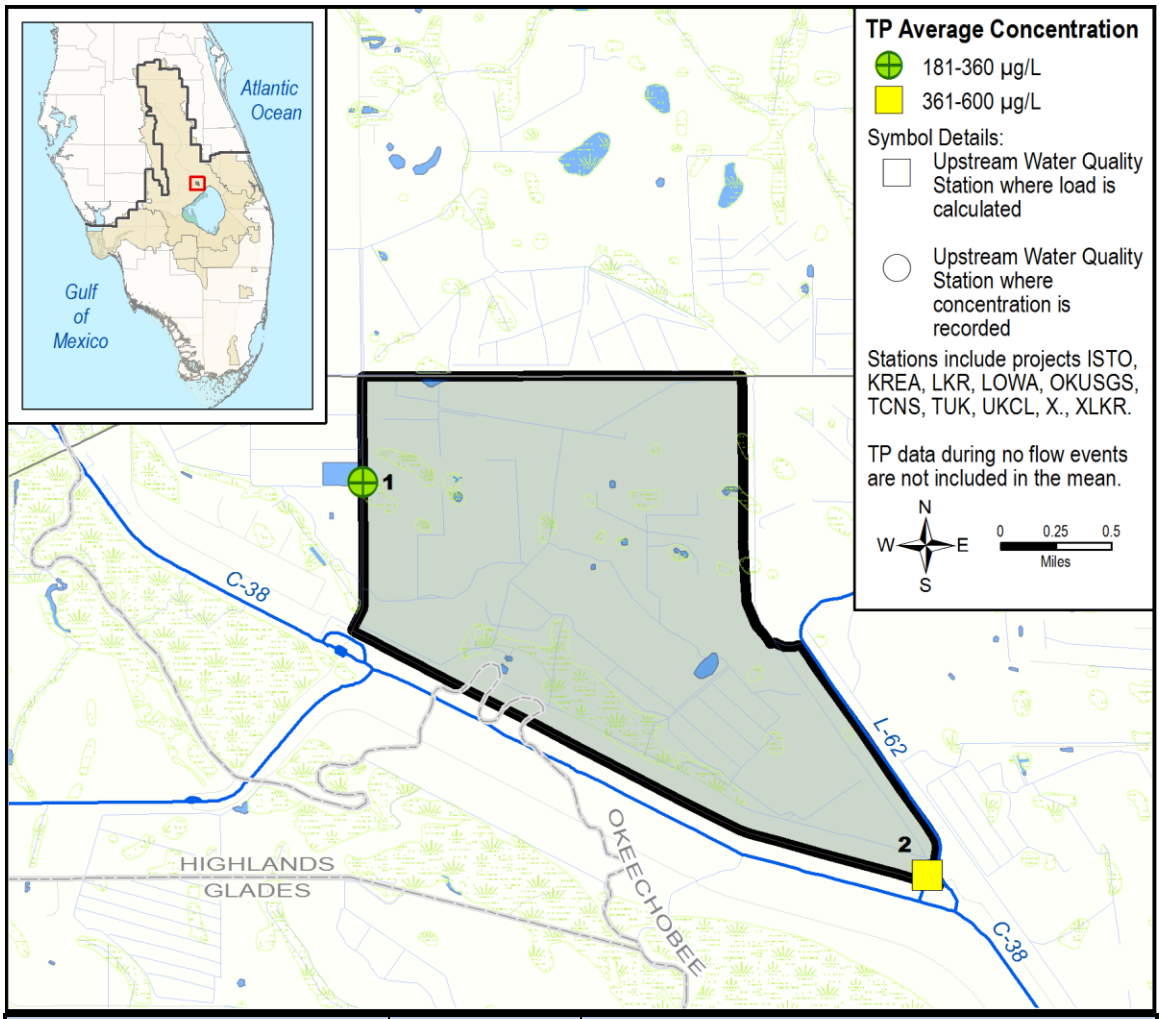
Fisheating Creek		# of Samples	TP Concentration (µg/L)		
Map ID	Station		Average	Min	Max
1	02255600	11	231	131	364
2	02256500	9	206	138	322
3	BH04392912	11	287	177	794
4	BH32382914	7	571	454	852
5	CULV5	2	35	33	37
6	FE03382911	2	555	441	669
7	FE20393013	10	406	270	541
8	FE21392913	10	329	168	676
9	FE21392914	8	395	123	565
10	FE26362812	17	330	78	1038
11	FE32372814	11	142	49	395
12	FECSR78	12	182	90	607
13	GA09393011	22	401	189	933
14	GG05403011	8	971	642	1578
15	PB24392912	24	312	135	570

Figure 30. Fisheating Creek/Nicodemus Slough Sub-watershed, Fisheating Creek Basin average TP concentrations for WY2014.



S135		# of Samples	TP Concentration (µg/L)		
Map ID	Station		Average	Min	Max
1	S135	4	72	27	111

Figure 31. Taylor Creek/Nubbin Slough Sub-watershed, S-135 Basin average TP concentrations for WY2014.



S154C		# of Samples	TP Concentration (µg/L)		
Map ID	Station		Average	Min	Max
1	KR20373413	4	305	65	519
2	S154C	23	505	279	1085

Figure 32. Taylor Creek/Nubbin Slough Sub-watershed, S-154C Basin average TP concentrations for WY2014.

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 33 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.

Figures 34 through **38** provide the 2008-2009 land use data for the Caloosahatchee River sub-watersheds. Agricultural, nonagricultural and natural areas are presented.

Table 2 provides a summary of the WY2014 flow, rainfall and concentration data for the Caloosahatchee sub-watersheds. **Figures 39** through **41** depict the FWMC 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 five to ten years are presented in **Figures 42** through **45** based on availability**.**

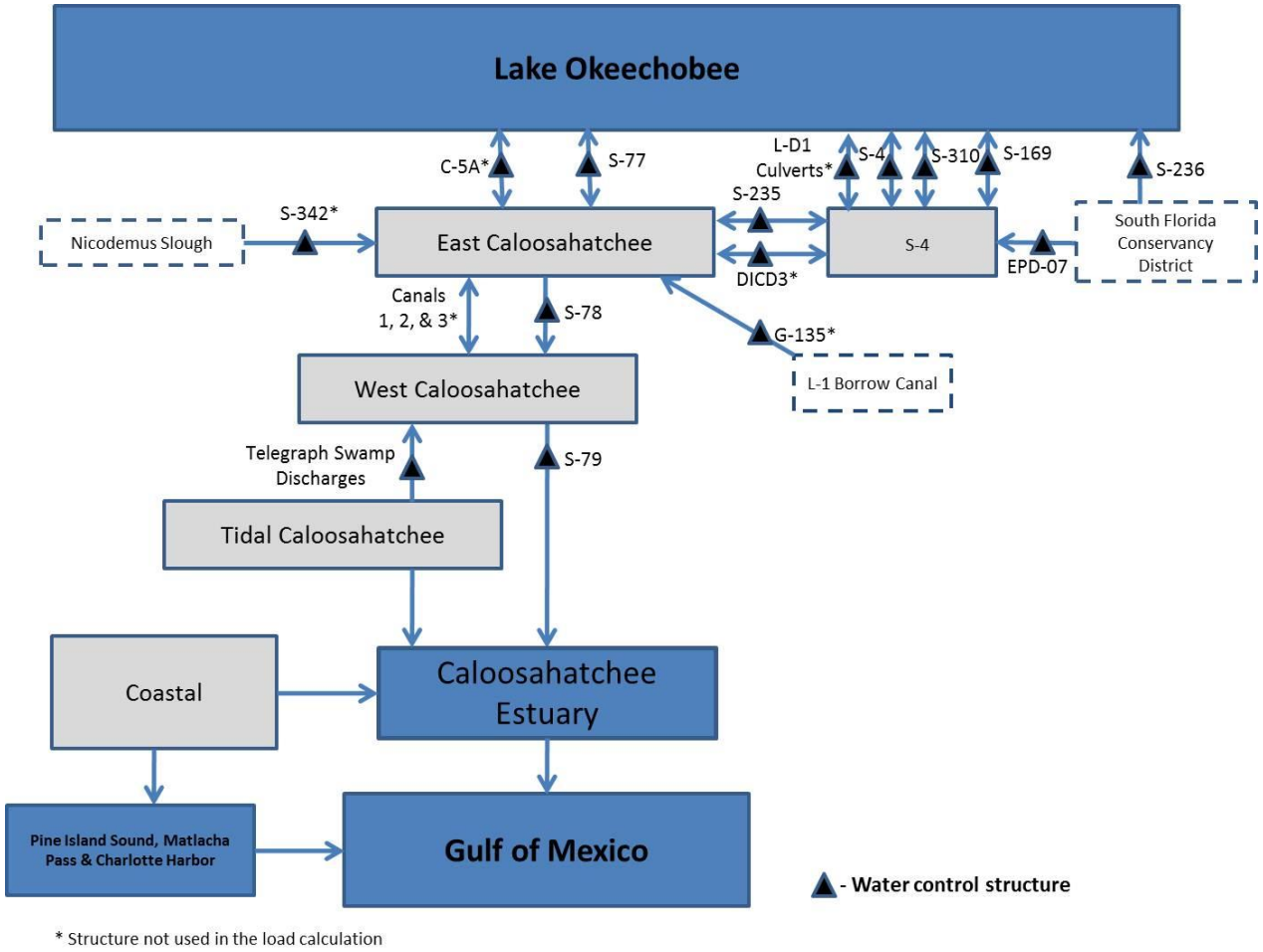


Figure 33. Caloosahatchee River Watershed flow schematic (HDR, 2011[2]).

[2] 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.

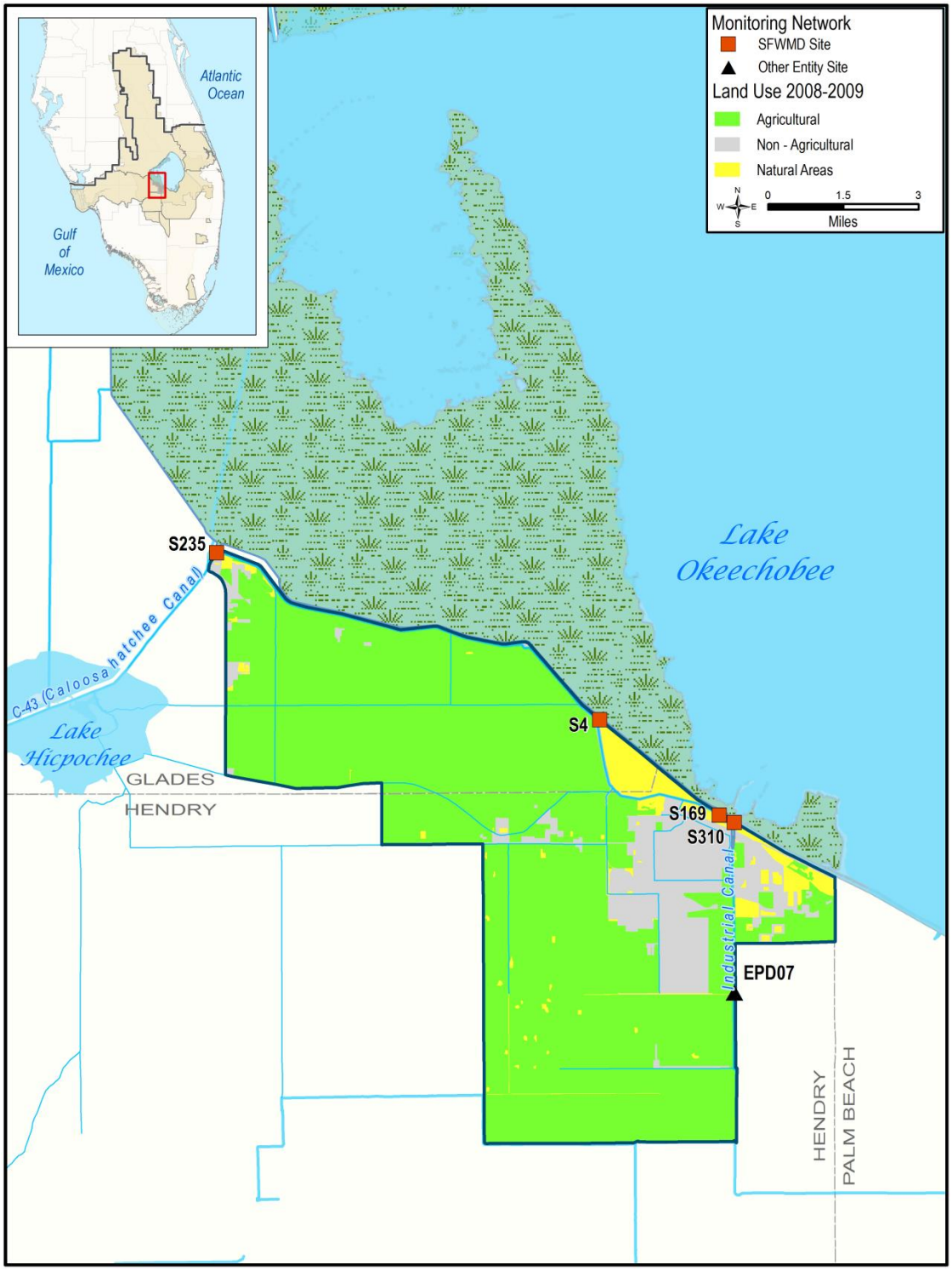


Figure 34. Caloosahatchee River Watershed, S-4 Sub-watershed.

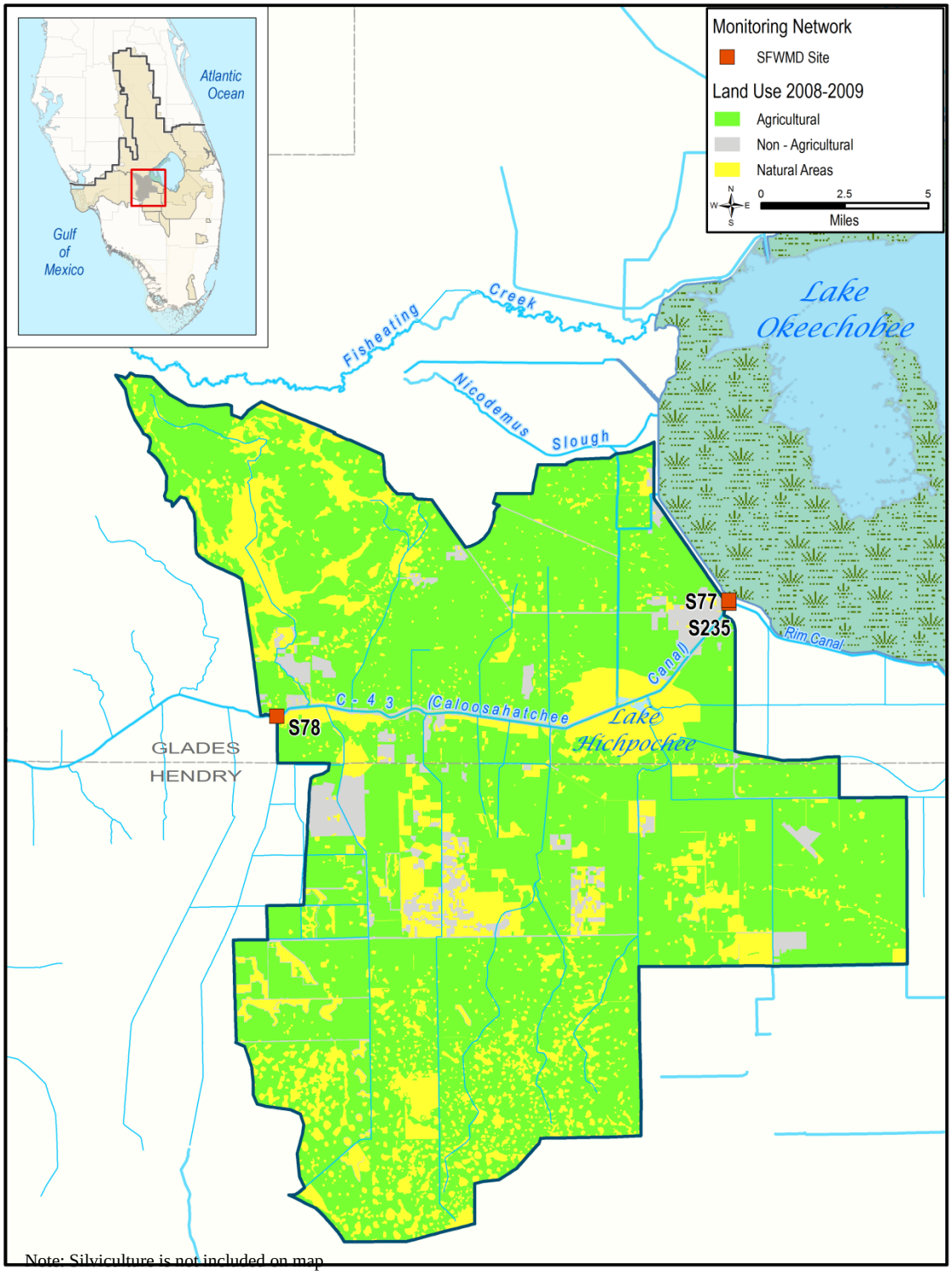


Figure 35. Caloosahatchee River Watershed, East Caloosahatchee Sub-watershed.

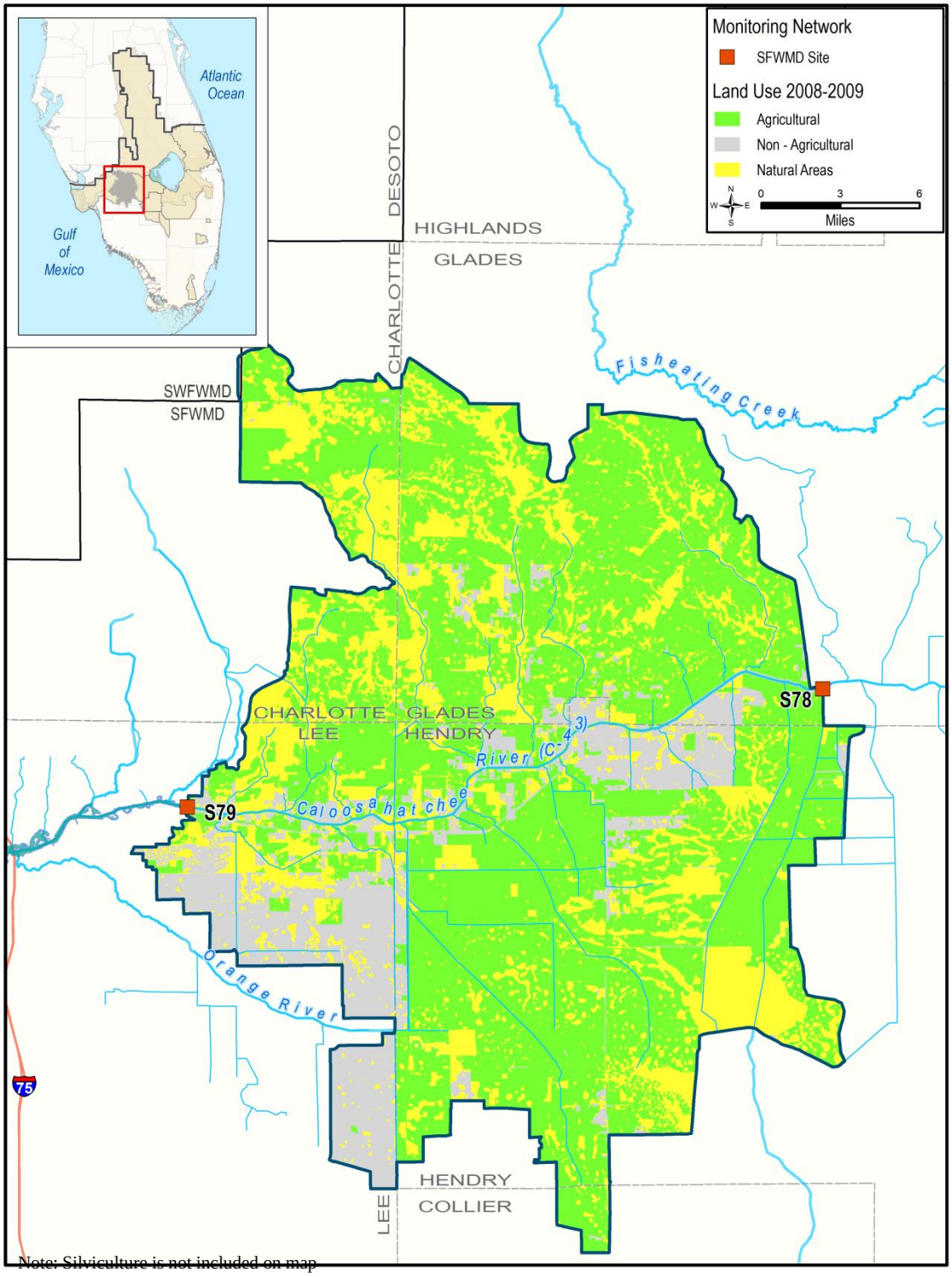


Figure 36. Caloosahatchee River Watershed, West Caloosahatchee Sub-watershed.

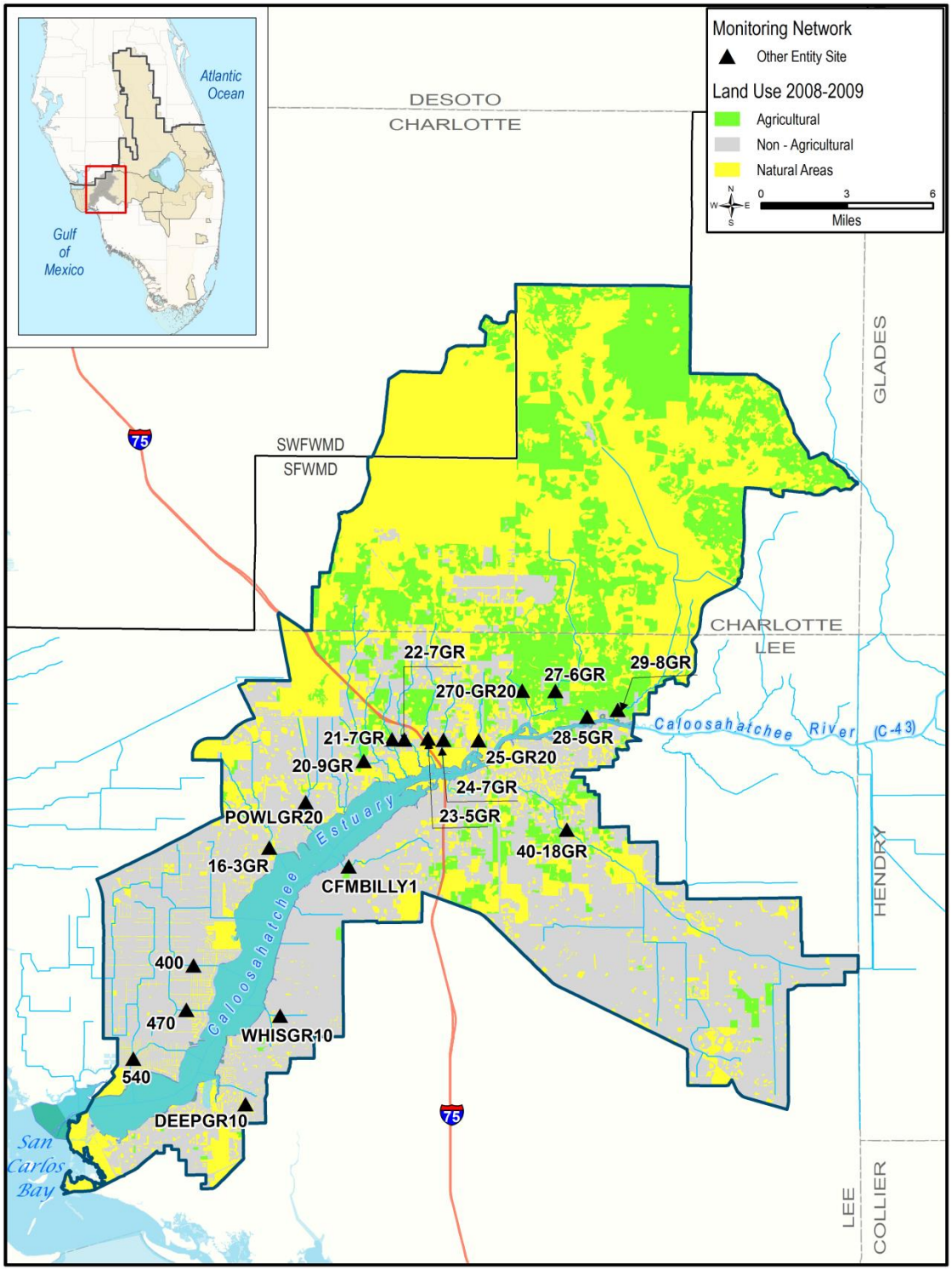


Figure 37. Caloosahatchee River Watershed, Tidal Caloosahatchee Sub-watershed.

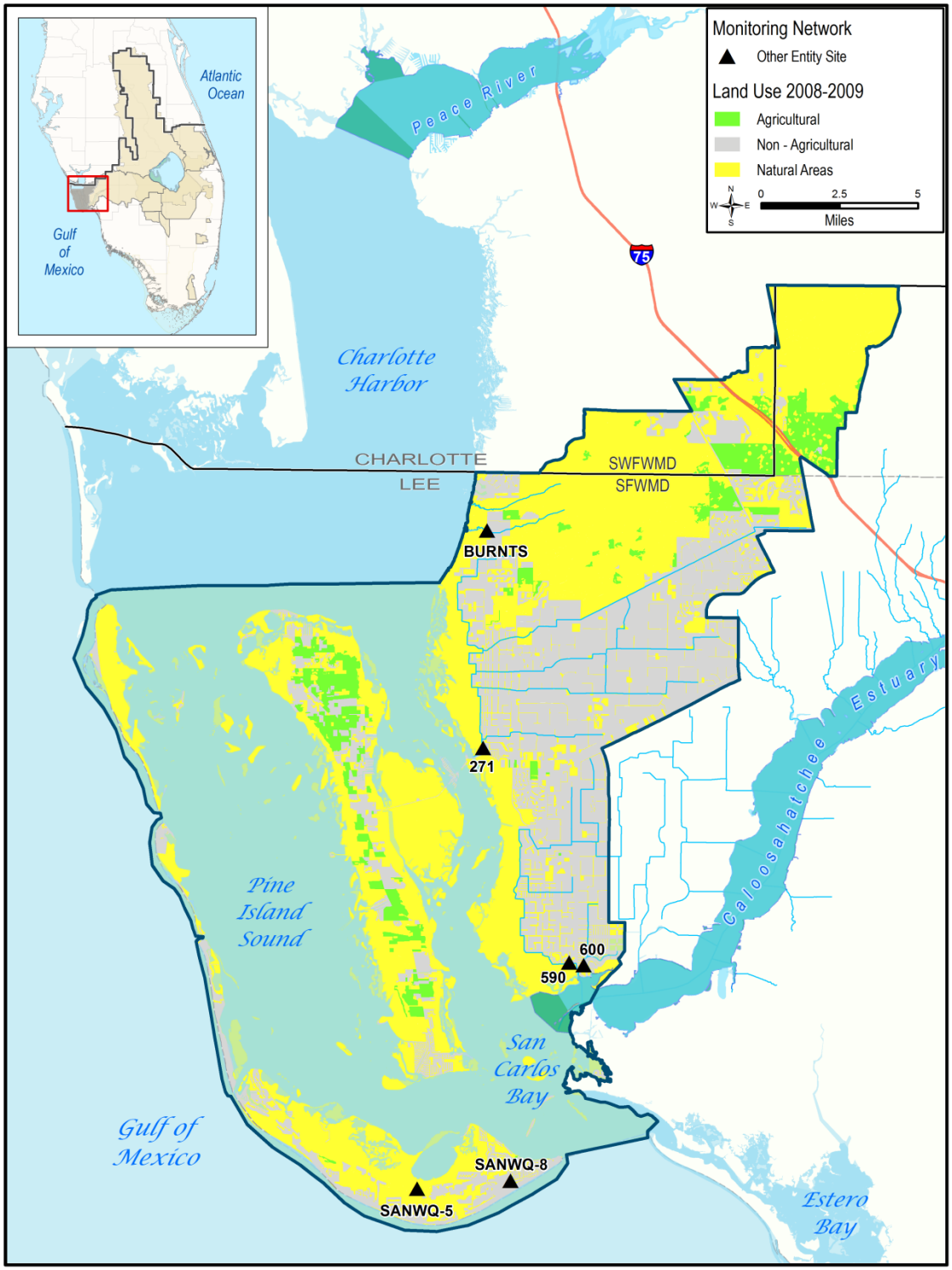


Figure 38. Caloosahatchee River Watershed, Coastal Caloosahatchee Sub-watershed.

Table 2. WY2014 flow (acre-feet, or ac-ft), rainfall (inches, or in), and TP and total nitrogen (TN) concentrations (µg/L, respectively).

Sub-Watershed	Annual Flow (ac-ft)	Annual Rainfall (in)	WY2014 TP Concentration (µg/L)[1]	WY2014 TN Concentration (µg/L)[1]
East Caloosahatchee	361,090	48.58	267	1,948
West Caloosahatchee	1,874,036	59.40	65	633
S-4/Industrial Canal	72,129	37.11	254	2,435
Tidal Caloosahatchee [2]		55.66	60	1,163
Bayshore Creek			91	1,471
Billy Creek[3]			NA	NA
Chapel Branch			75	1,590
Daughtrey Creek[4]			75	1,263
Deep Lagoon			95	1,281
Hancock Creek[4]			125	1,405
Lower Orange River[4]			14	960
Marsh Point			130	1,310
Otter Creek			150	1,117
Owl Creek			65	1,493
Palm Creek			60	1,493
Popash Creek			160	1,432
Powell Creek			145	1,028
Southeast Cape Coral[4]			69	1,056
Stroud Creek			50	1,227
Telegraph Creek[4]			45	1,410
Trout Creek			51	1,092
Whiskey Creek			27	870
Coastal Caloosahatchee[2]		55.09	58	1,041
Durden Creek			11	1,170
Northwest Cape Coral[4]			50	904
Sanibel Island[4]			82	2,139
Southwest Cape Coral[4]			53	812

[1] 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

[2] 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.

[3] Water quality monitoring was not conducted or reported at this site during WY2014.

[4] Tributaries were combined into larger hydrologic units using the most downstream station as follows: Daughtrey Creek with East Daughtrey Creek; Hancock Creek with Yellow Fever and East Yellow Fever; Lower Orange River with Upper Orange River and Blackstone; Telegraph Creek with Telegraph Swamp and Babcock; Northwest Cape Coral with Upper Yucca Pens, Lower Yucca Pens, and Northcentral Cape Coral; or stations within the same tributary were averaged in Southeast Cape Coral, Sanibel Island, and Southwest Cape Coral.

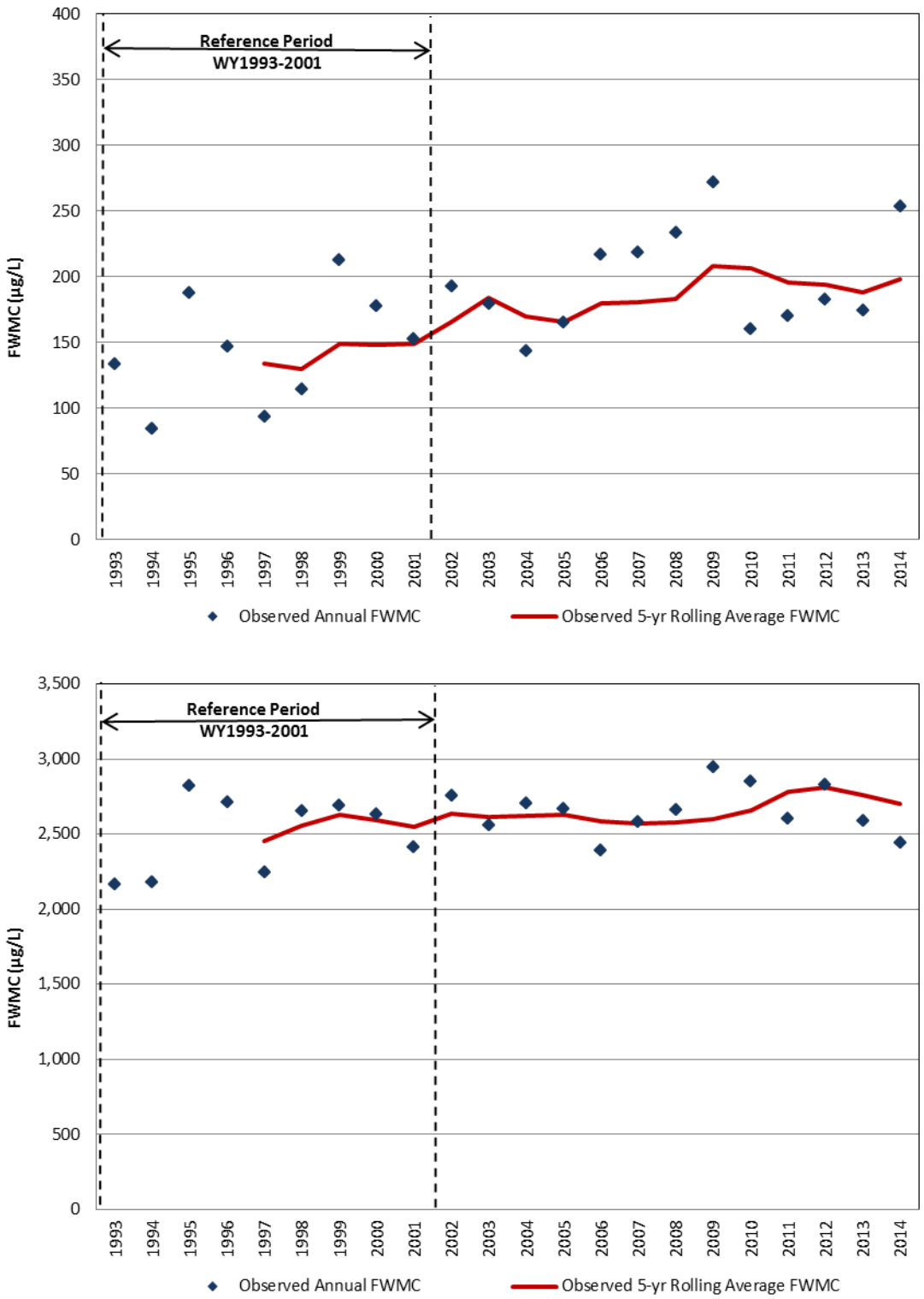


Figure 39. S4 – Industrial Canal Basin: TP (top) and total nitrogen (TN) (bottom) observed annual FWMC and five-year rolling averages.

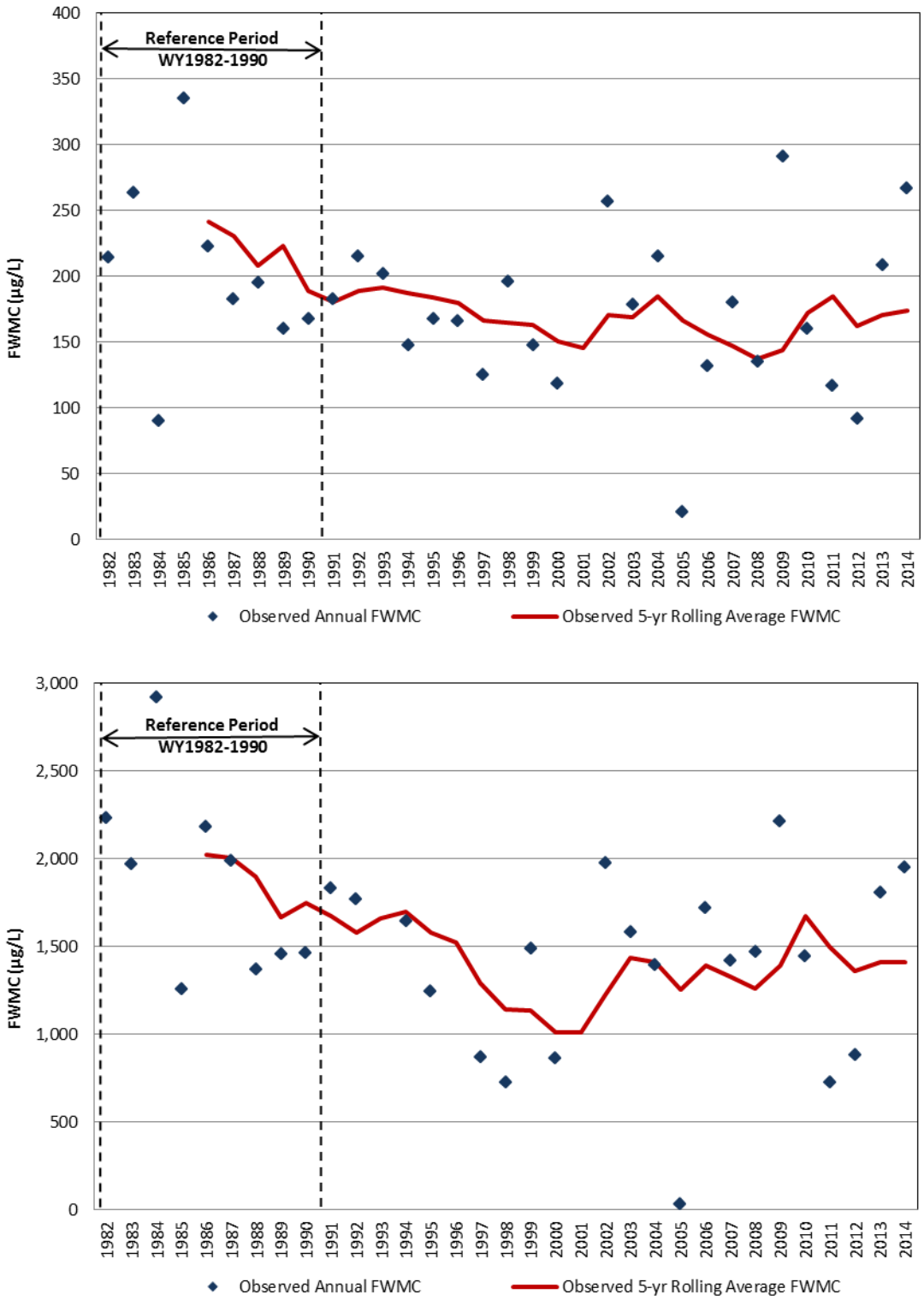


Figure 40. East Caloosahatchee Basin: TP (top) and TN (bottom) observed annual FWMC and five-year rolling averages.

Figure 41. West Caloosahatchee Basin: TP (top) and TN (bottom) observed annual FWMC and five-year rolling averages.

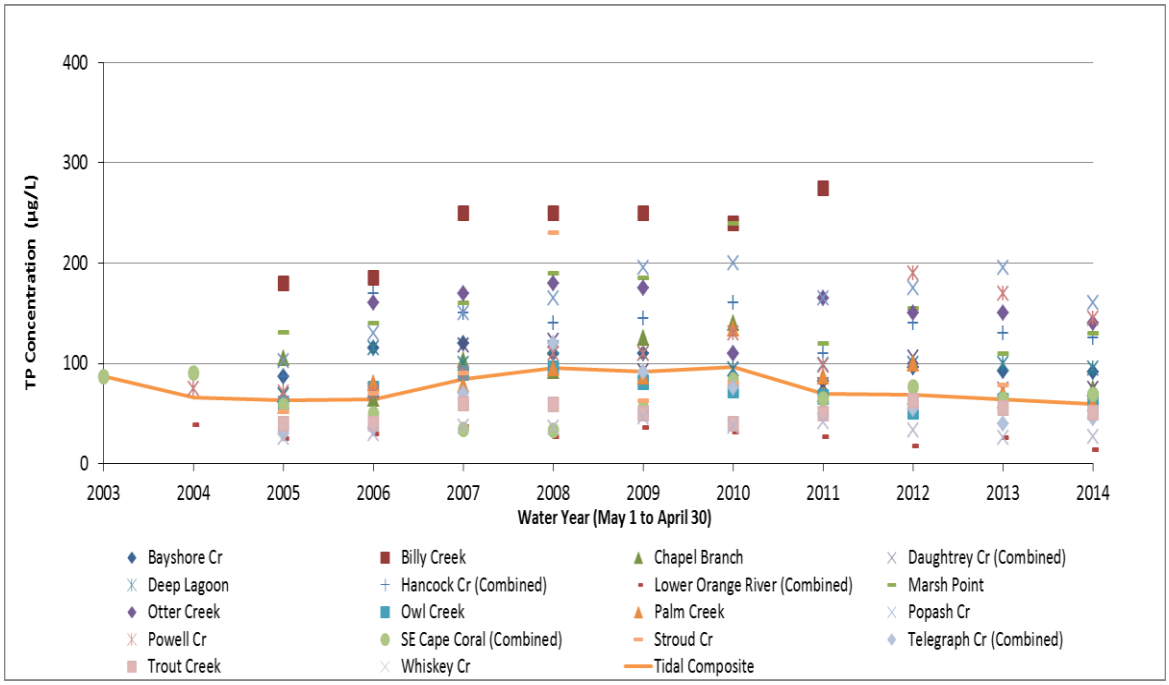


Figure 42. Tidal Caloosahatchee Sub-watershed observed TP concentrations.

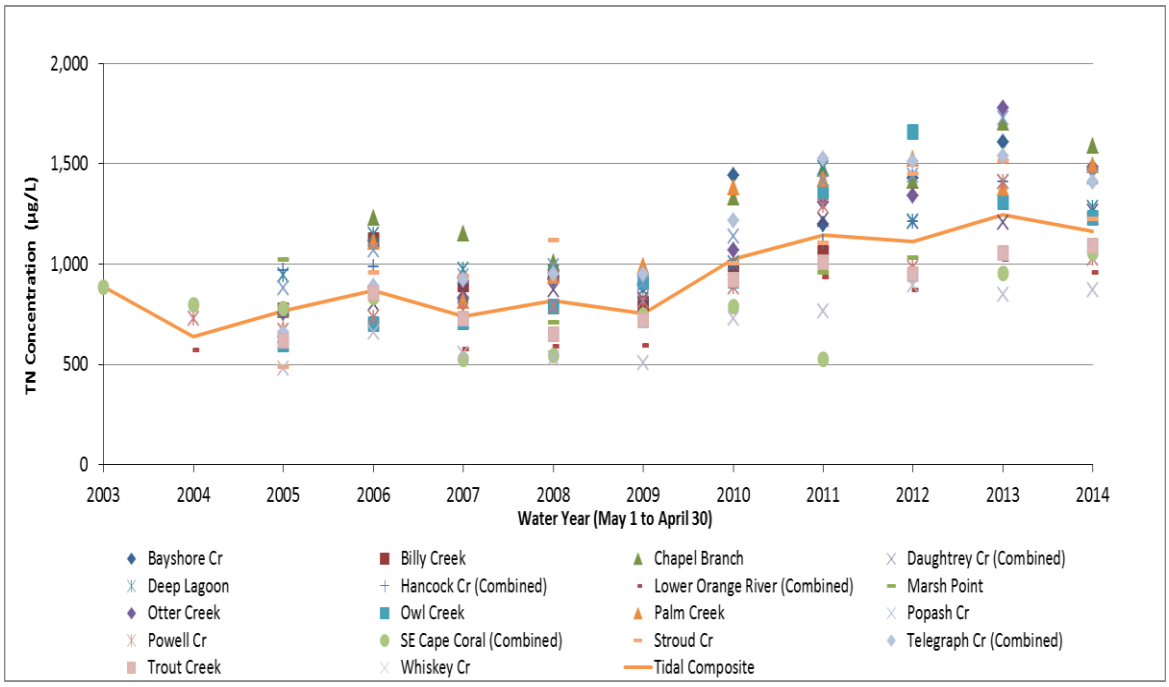


Figure 43. Tidal Caloosahatchee Sub-watershed observed TN concentrations.

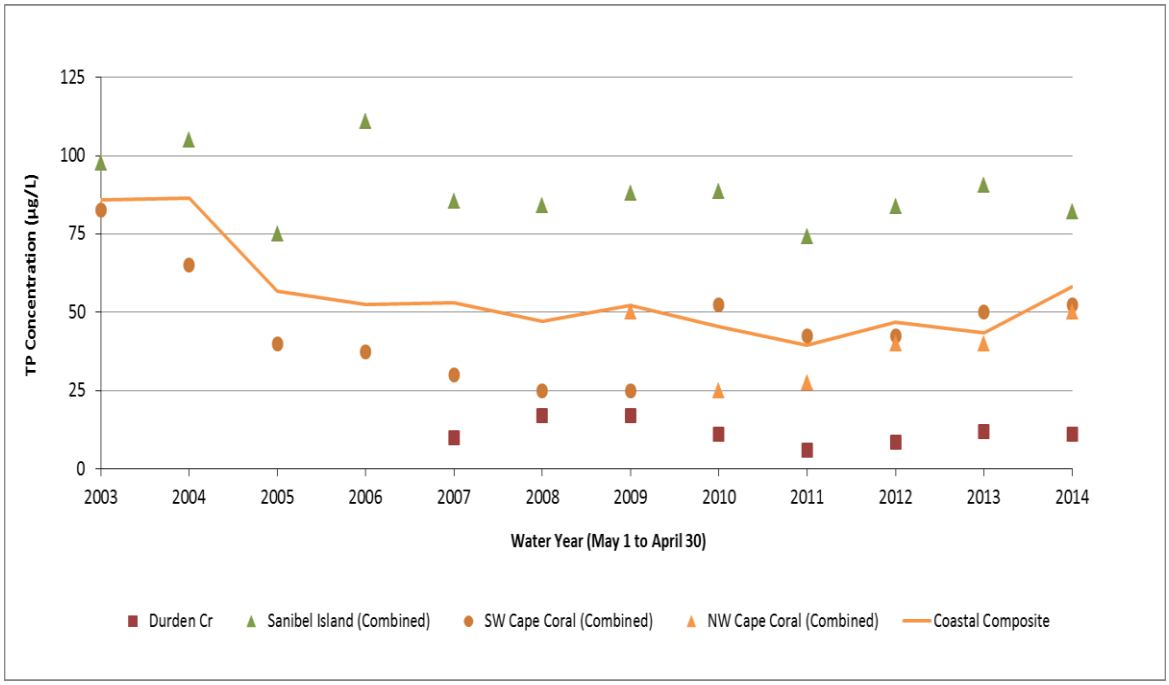


Figure 44. Coastal Caloosahatchee Sub-watershed observed TP concentrations.

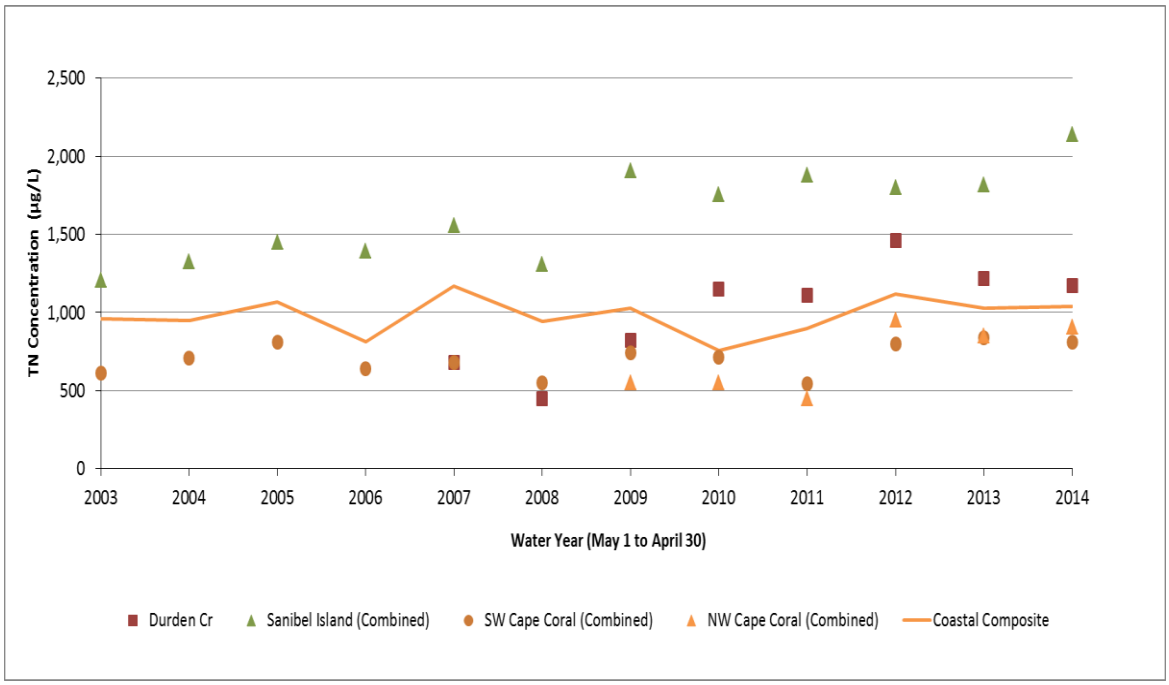


Figure 45. Coastal Caloosahatchee Sub-watershed observed TN concentrations.

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-25, 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 46** 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.

Figures 47 through **56** provide the 2008–2009 land use data for the St. Lucie River sub-watersheds. Agricultural, nonagricultural and natural areas are presented.

Table 3A and **3B** provides a summary of the WY2014 rainfall and concentration data for the St. Lucie basins and tributaries, respectively. **Figures 57** through **61** depict the annual FWM (Flow Weighted Mean) concentration data for the period of record and five-year rolling averages to track trends over time. For the tributary stations, flow data is not monitored; therefore, the median concentration data for the available data period is depicted in **Figures 62** through **67**.

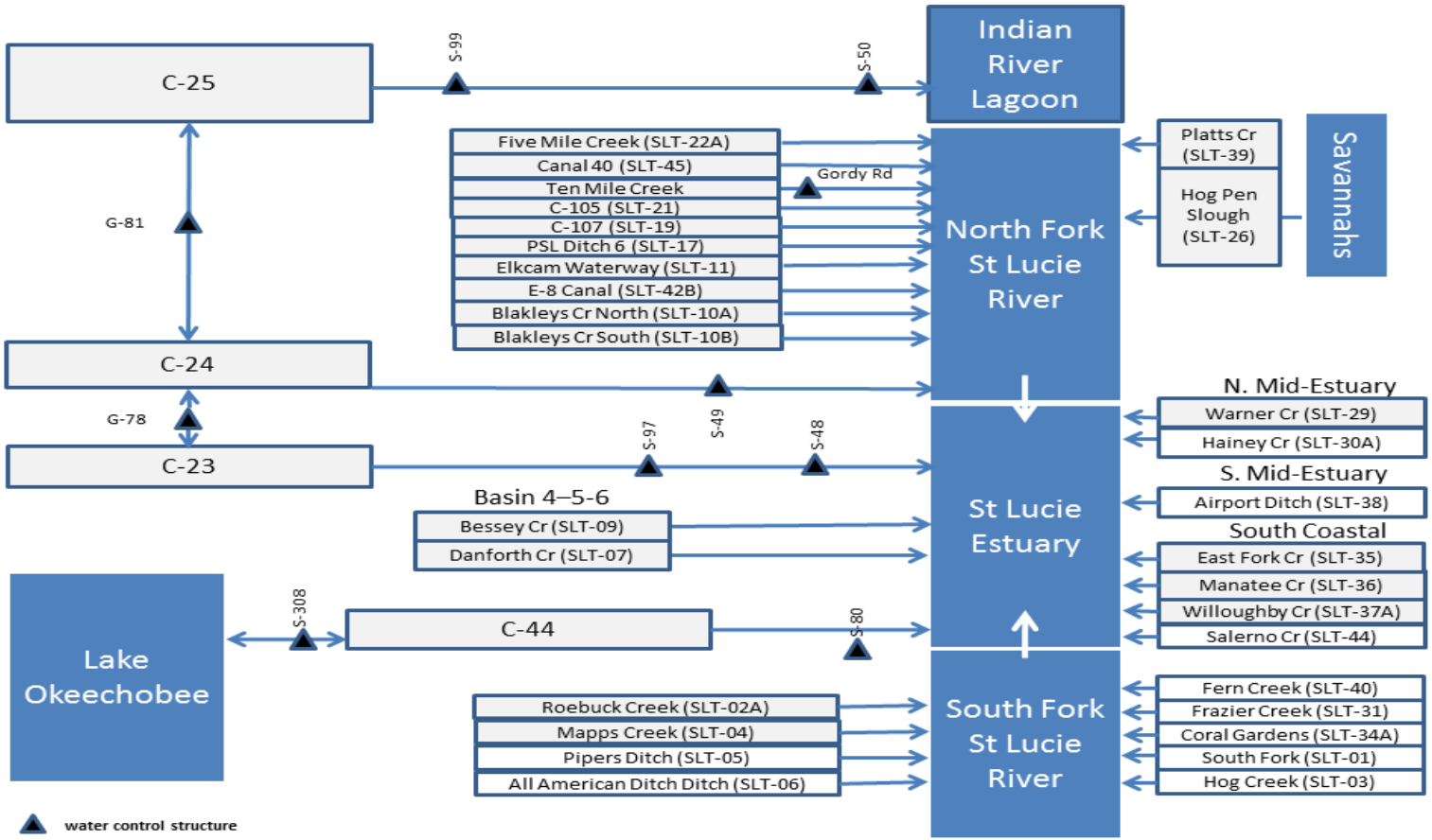


Figure 46. St. Lucie River Watershed flow schematic (HDR, 2011[3]).

[3] HDR Engineering, Inc. 2011. Data Analysis and Performance Measure Development for the St. Lucie River Watershed Source Control Program, Deliverable 6.1, Collective Source Control Performance Measures for C-23, C-24, C-25/25E, and C-44 Sub-watersheds Technical Report. Submitted to the South Florida Water Management District, West Palm Beach, FL.

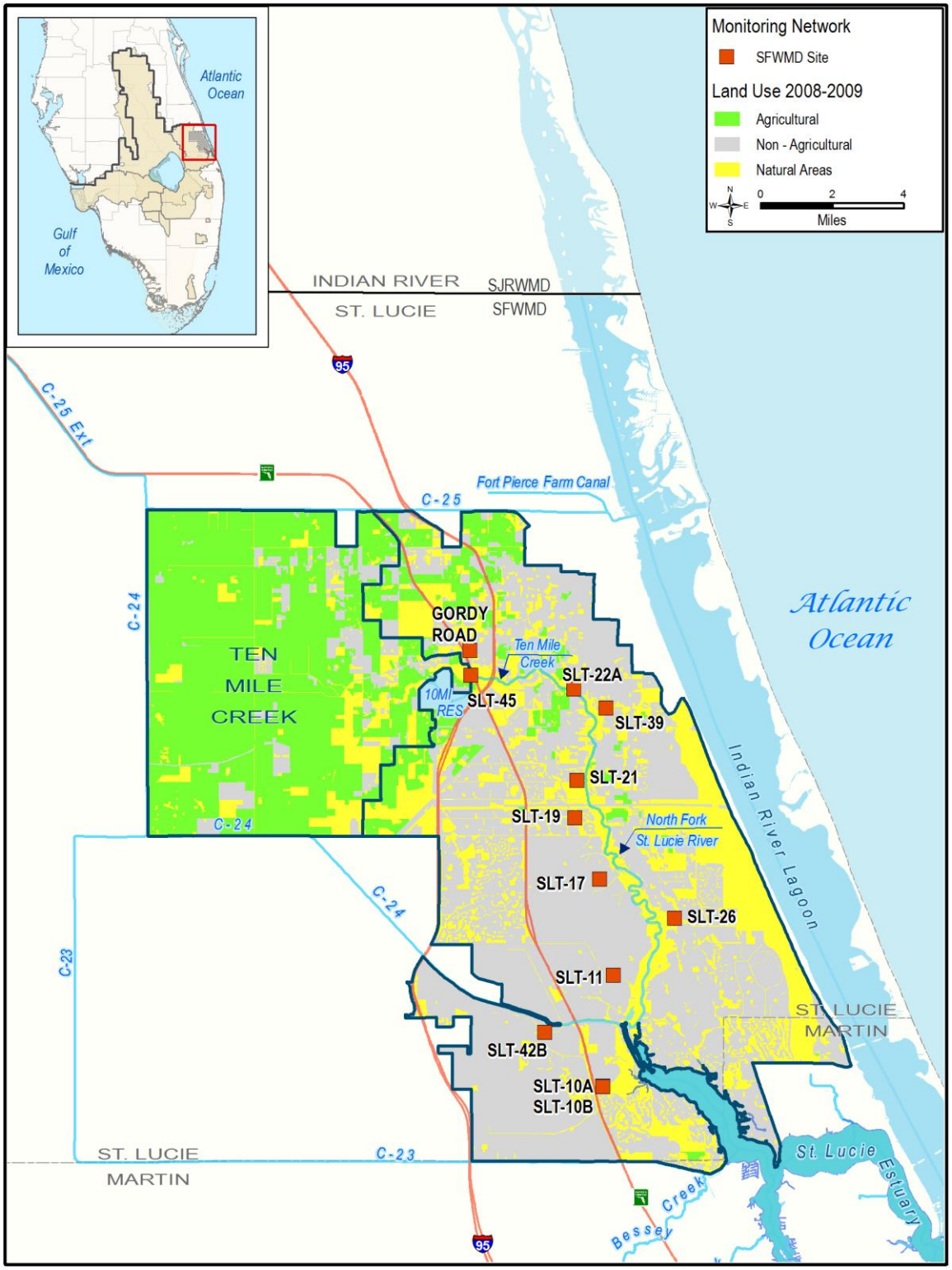


Figure 47. St. Lucie River Watershed, North Fork Sub-watershed.

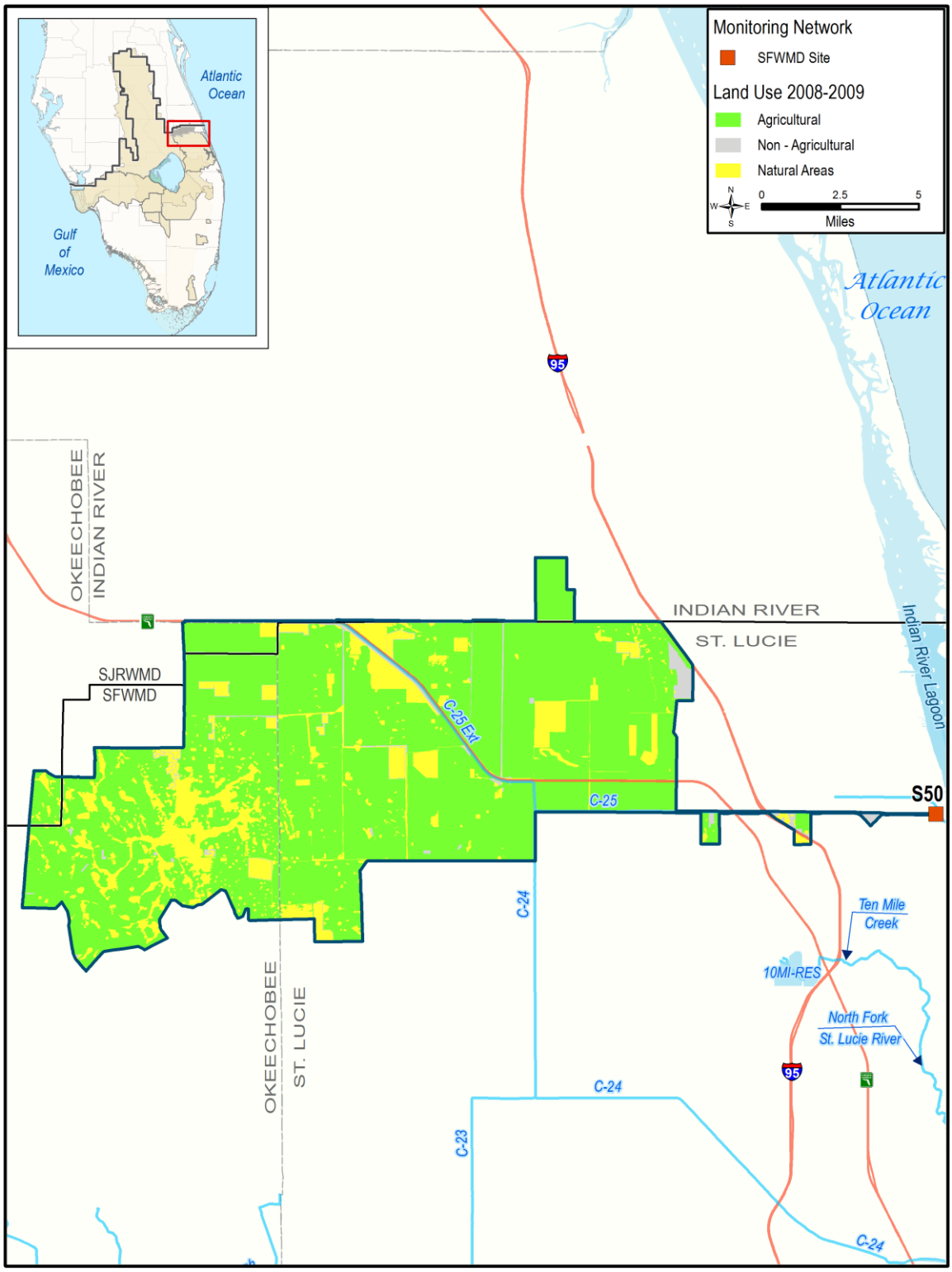


Figure 48. St. Lucie River Watershed, C-25 Sub-watershed.

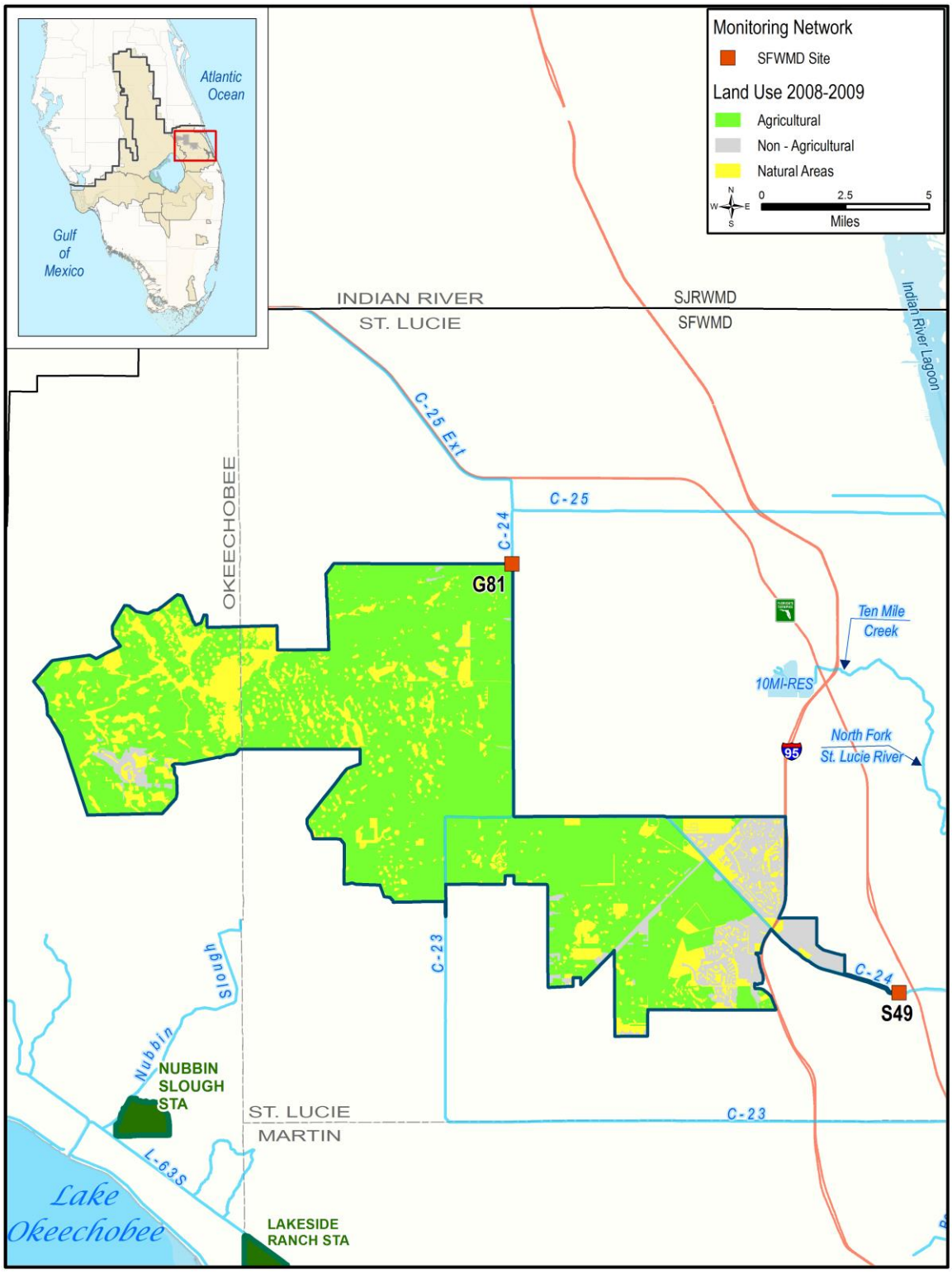


Figure 49. St. Lucie River Watershed, C-24 Sub-watershed.

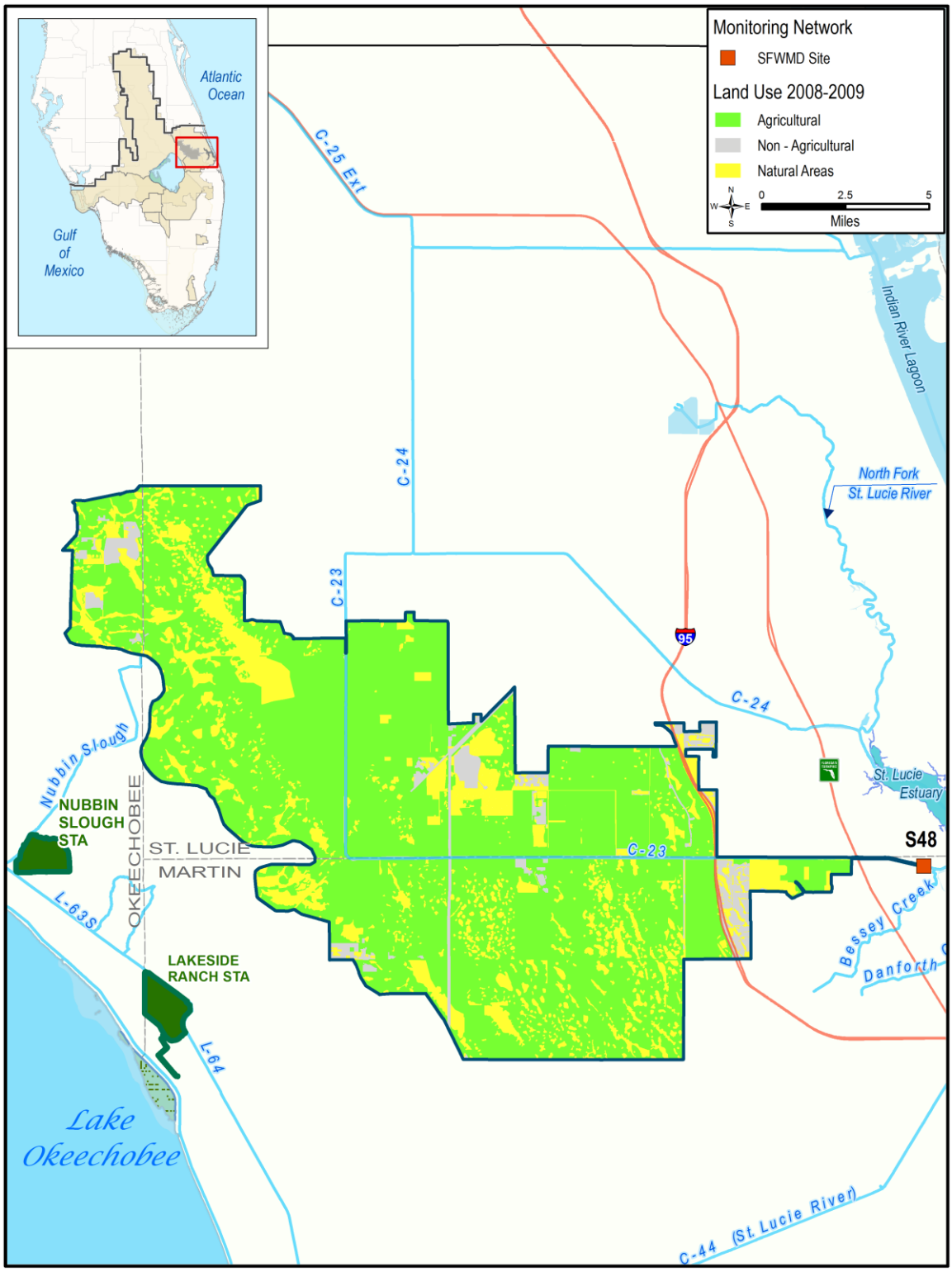


Figure 50. St. Lucie River Watershed, C-23 Sub-watershed.

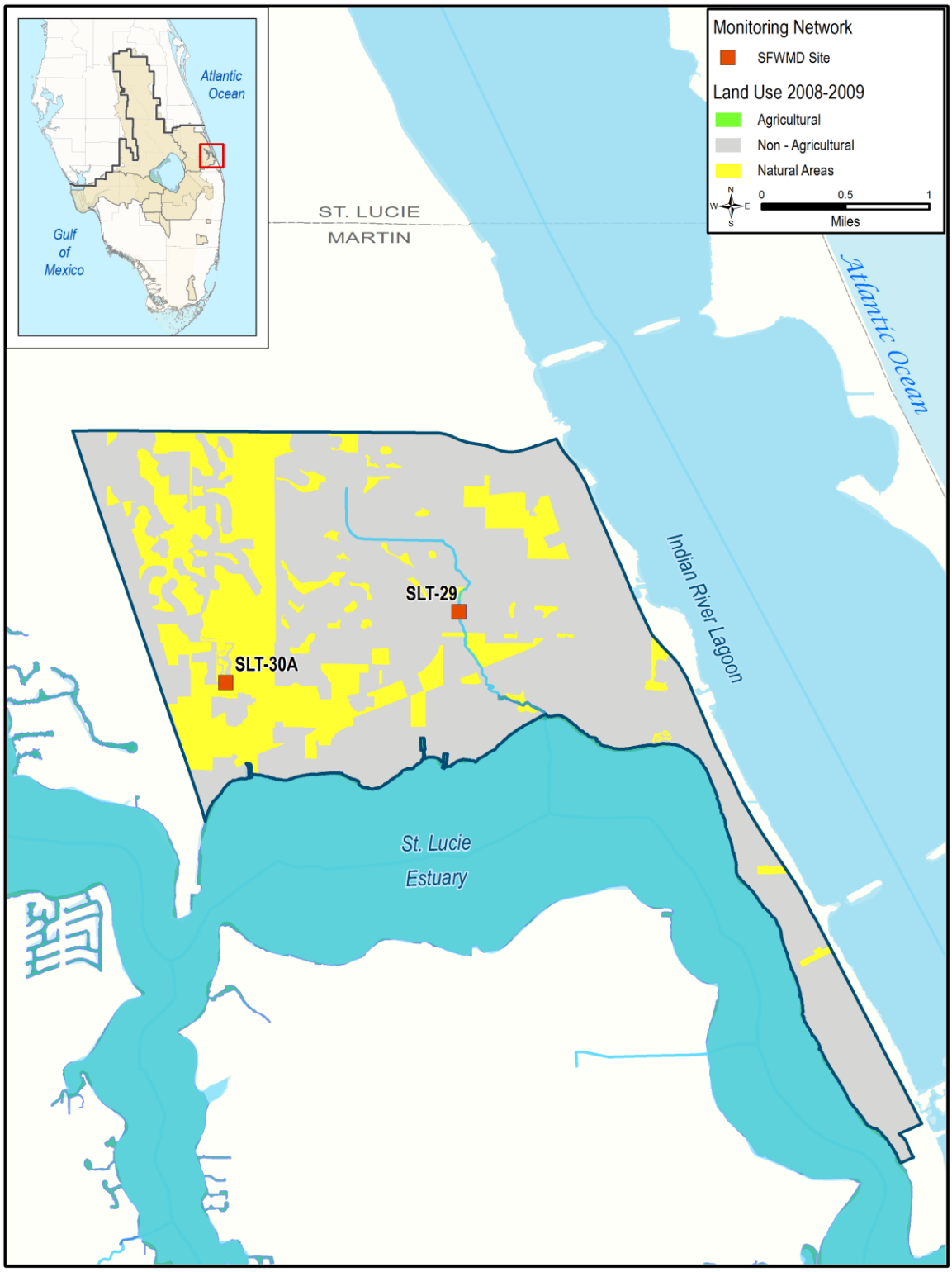


Figure 51. St. Lucie River Watershed, North Mid-Estuary sub-watershed.

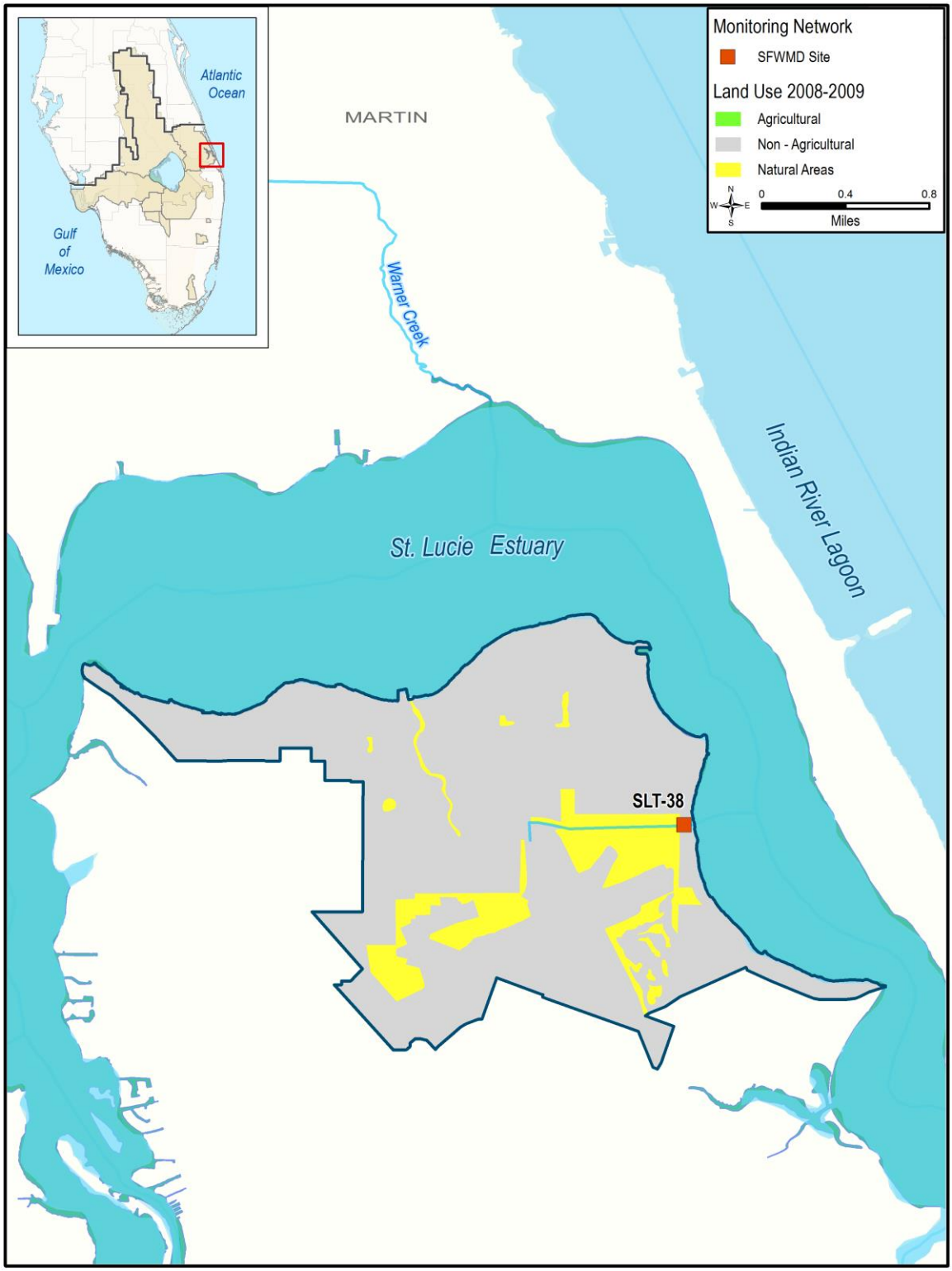


Figure 52. St. Lucie River Watershed, South Mid-Estuary sub-watershed.

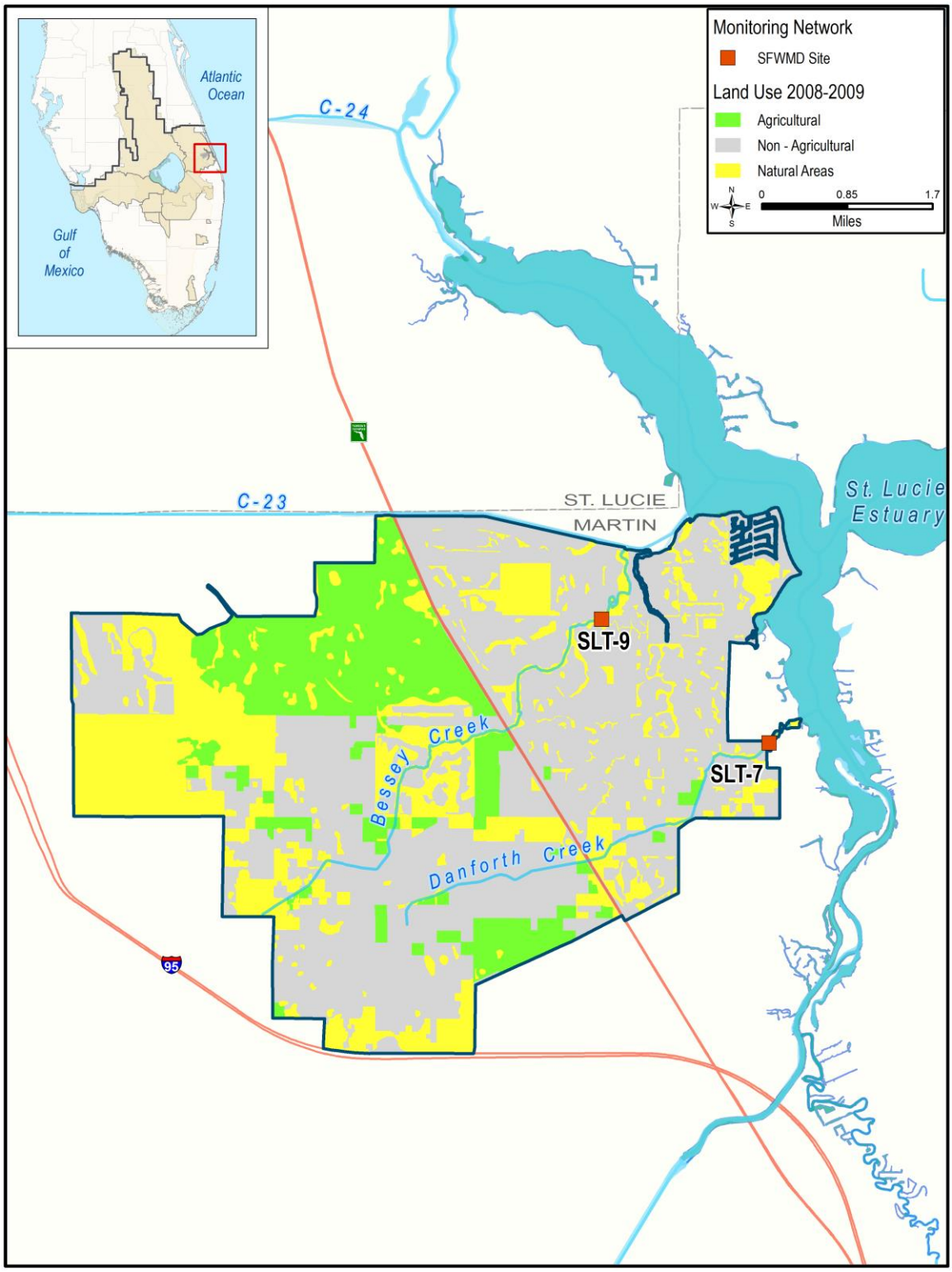


Figure 53. St. Lucie River Watershed, Basin 4-5-6 Sub-watershed.

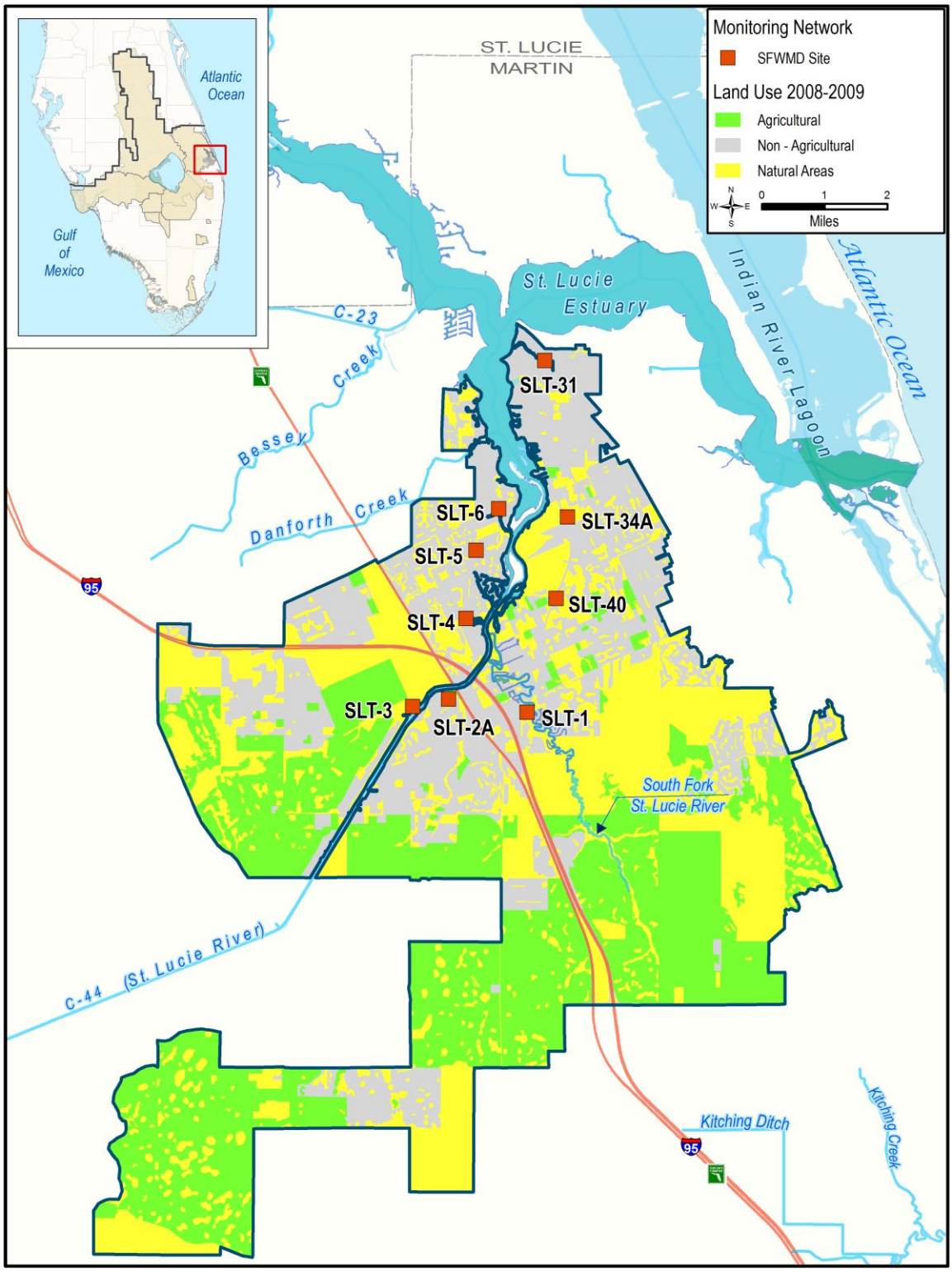


Figure 54. St. Lucie River Watershed, South Fork Sub-watershed.

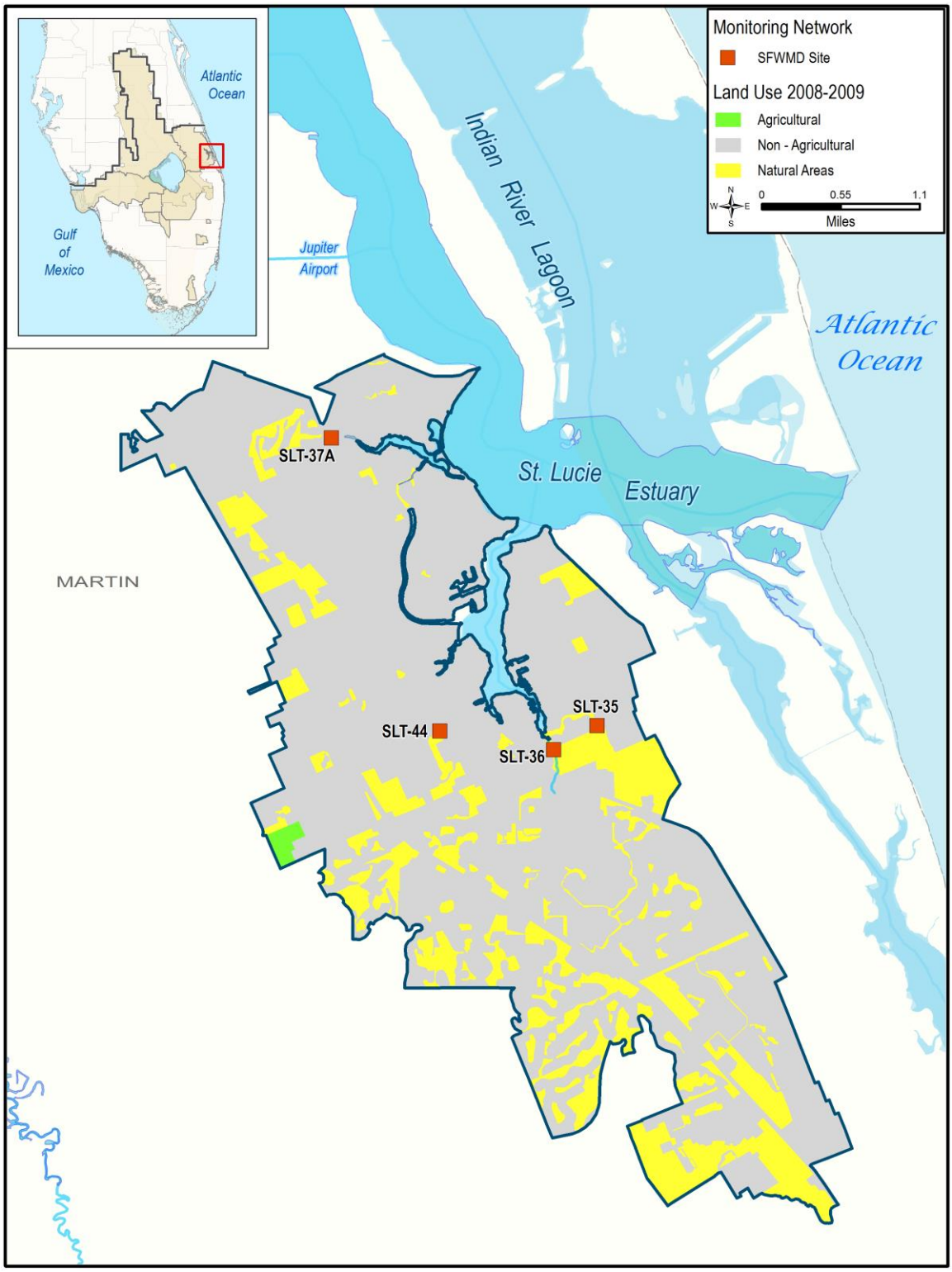


Figure 55. St. Lucie River Watershed, South Coastal Sub-watershed.

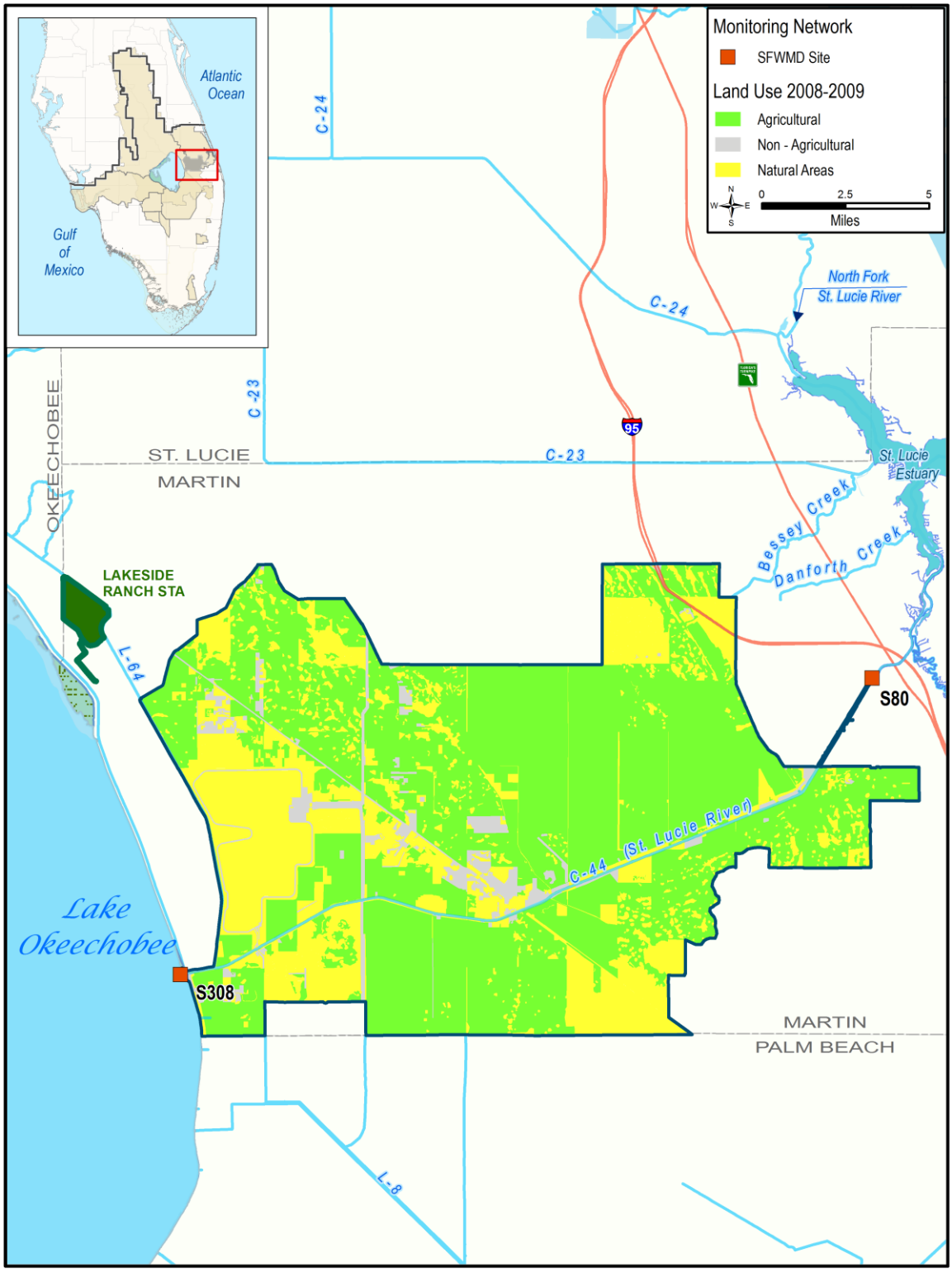


Figure 56. St. Lucie River Watershed, C-44 Sub-watershed.

Table 3A. WY2014 flow (ac-ft), rainfall (in), and TP and TN concentrations (µg/L).

Basin	Annual Flow (ac-ft)	Annual Rainfall (in)	WY2014 TP Concentration (µg/L)[1]	WY2014 TN Concentration (µg/L)[1]
C-23	169,434	62.65	446	1,725
C-24	137,683	57.52	330	1,503
C-25	195,923	56.78	203	1,449
C-44[2]	285,394	51.62	319	3,542
Ten Mile Creek (Gordy Road)[3]	84,325	59.72	226	981
Composite Area[4]	n/a[4]	53.97	98	903

[1] Concentrations are flow-weighted means for C-24, C-25, C-23, C-44, and Ten Mile Creek. Concentrations for the composite area are calculated by flow-weighting the individual tributary concentrations, using the unit area runoff coefficients and areas of the tributary basins where data is available during the reference period and only using samples collected when flow is observed and are not tidally influenced.

[2] The C-44 Basin calculation is based on the runoff generated within the basin and excludes Lake Okeechobee pass-through flows in the FWMC presented.

[3] 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.

[4] The Composite Area is made up of tributaries representing the North Fork (excluding Ten Mile Creek), the South Fork, South Coastal, Basin 4-5-6, North Mid Estuary, and South Mid Estuary. Flow data is not collected for the composite area.

Table 3B. WY2014 rainfall (in) and TP and TN concentrations (µg/L).

Basin/Tributary	Annual Rainfall (in)[2]	WY2014 TP Concentration (µg/L)[1]	WY2014 TN Concentration (µg/L)[1]
North Fork	58.01	74	862
Canal 40 (SLT-45)[3]		69	855
Five Mile Creek (SLT-22A)		144	979
Platts Creek (SLT-39)		149	911
Hog Pen Slough (SLT-26)		50	862
C-105 (SLT-21)		45	813
C-107 (SLT-19)		28	692
PSL Ditch 6 (SLT-17)		84	838
Elkham Waterway (SLT-11)		65	831
E-8 Canal (SLT-42B)[3]		111	909
Blakleys Creek North (SLT-10A)[3]		86	918
Blakleys Creek South (SLT-10B)[3]		74	953
South Fork	48.04	118	1,017
Frazier Creek (SLT-31)		74	1,047
Coral Gardens Ditch (SLT-34A)		118	1,017
Fern Creek (SLT-40)		93	1,179
South Fork (SLT-1)[3]		106	1,011
Roebuck Creek (SLT-2A)[3]		24	827
Hog Creek (SLT-3)[3]		307	974
Mapps Creek (SLT-4)[3]		132	996
Pipers Ditch (SLT-5)[3]		123	1,297
All American Ditch (SLT-6)[3]		220	1,492
Basin 4-5-6	55.88	199	1,146
Danforth Creek (SLT-07)		198	1,166
Bessey Creek (SLT-09)		199	1,126
North Mid-Estuary	57.61	24	1,038
Warner Creek (SLT-29)		22	1,141
Hainey Creek (SLT-30A)[3]		25	935
South Mid-Estuary	50.04	64	754
Airport Ditch (SLT-38)		64	754
South Coastal	47.88	68	976
East Fork Creek (SLT-35)[3]		82	1,006
Manatee Creek (SLT-36)		175	1,293
Willoughby Creek (SLT-37A)		17	682
Salerno Creek (SLT-44)		53	946

[1] Concentrations are monthly medians and are calculated based on samples collected when flow is observed and are not tidally influenced.
[2] Rainfall is only calucated at the basin level and is not reported for the individual tributaries.
[3] Data collection either began or was brought back online in WY2014 for these stations.

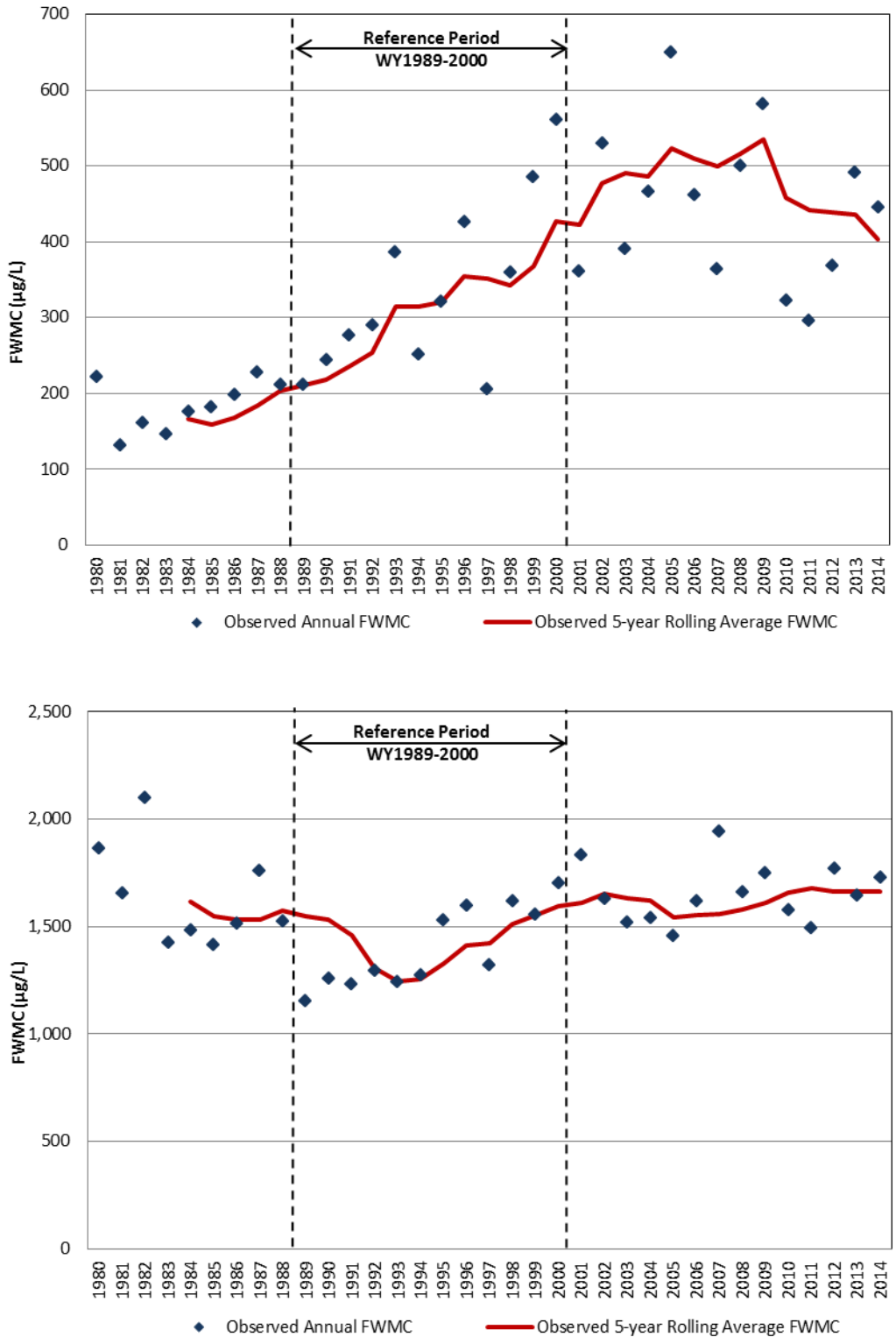


Figure 57. C-23 Basin: TP (top) and TN (bottom) observed annual FWMC and five-year rolling averages.

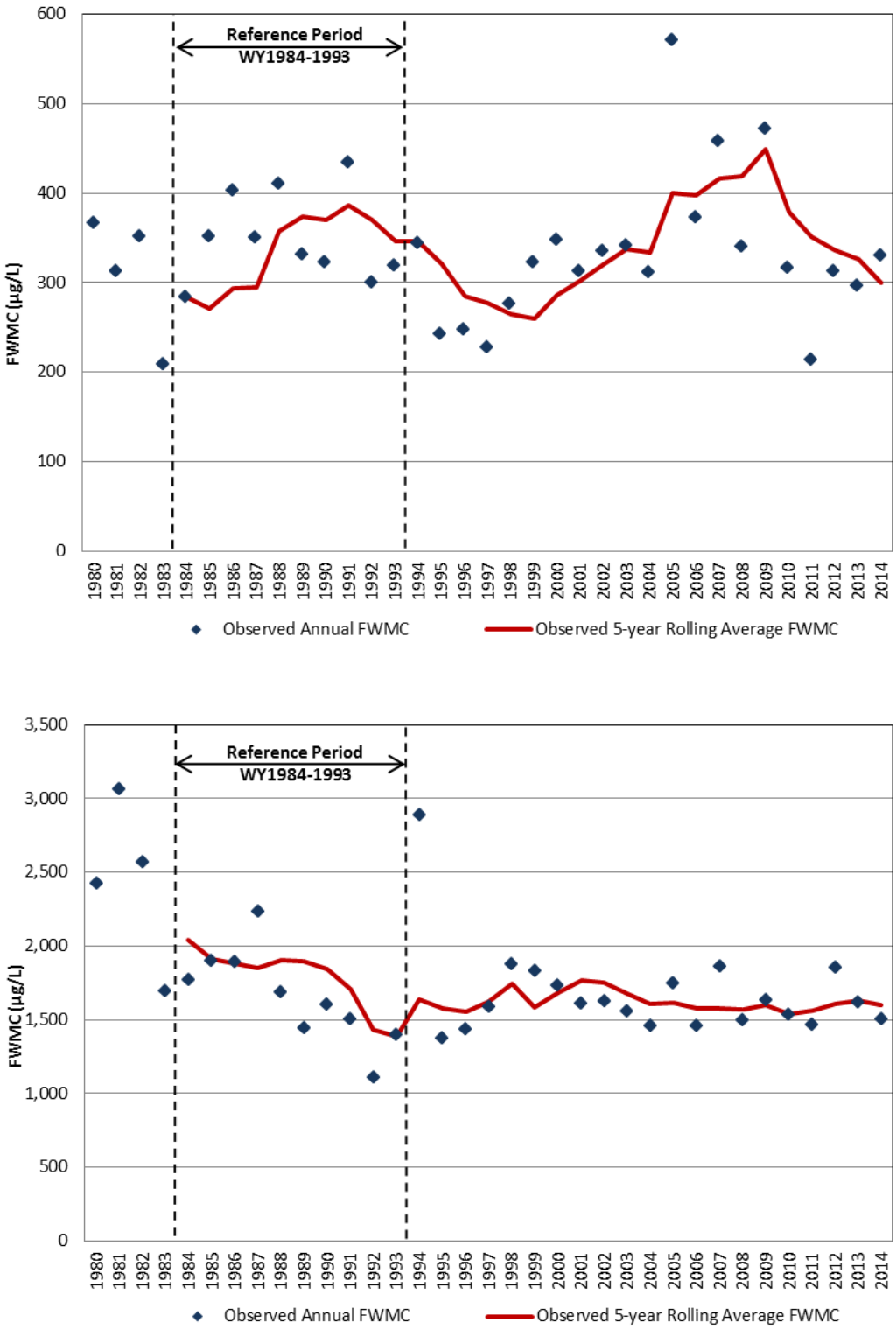
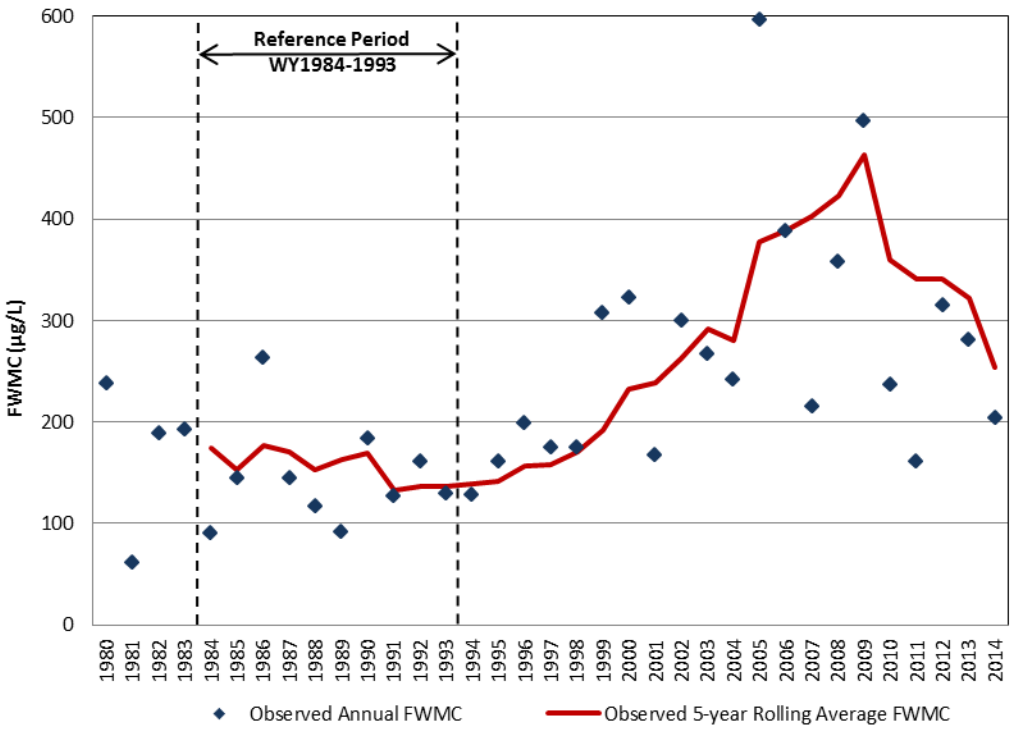


Figure 58. C-24 Basin: TP (top) and TN (bottom) observed annual FWMC and five-year rolling averages.



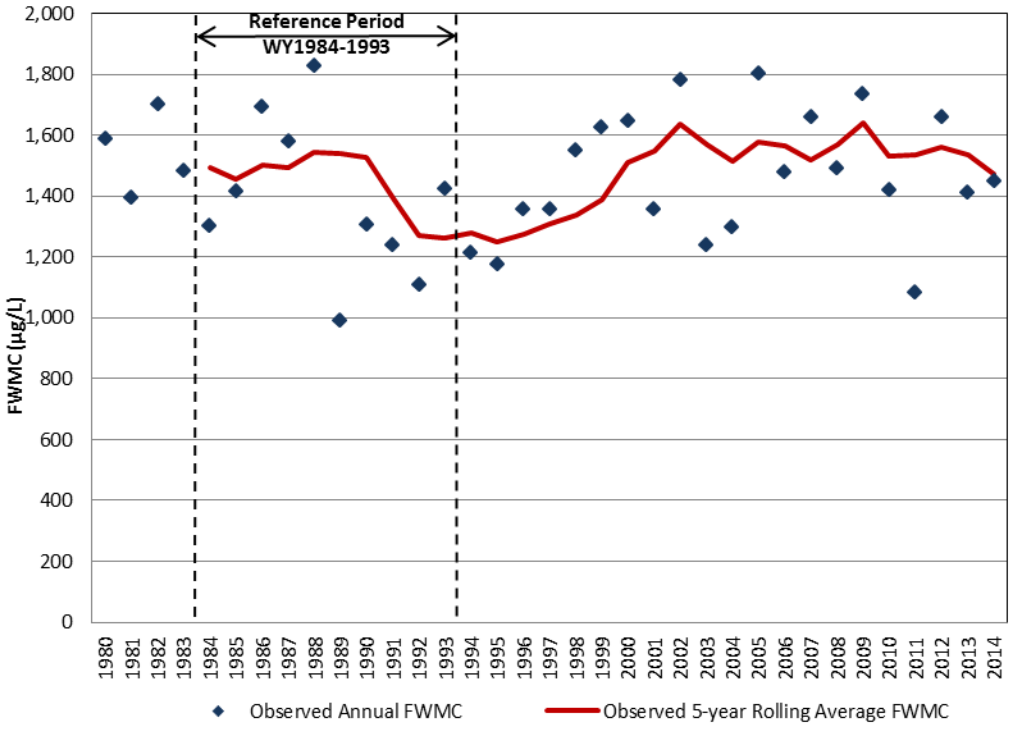


Figure 59. C-25 Basin: TP (top) and TN (bottom) observed annual FWMC and five-year rolling averages.

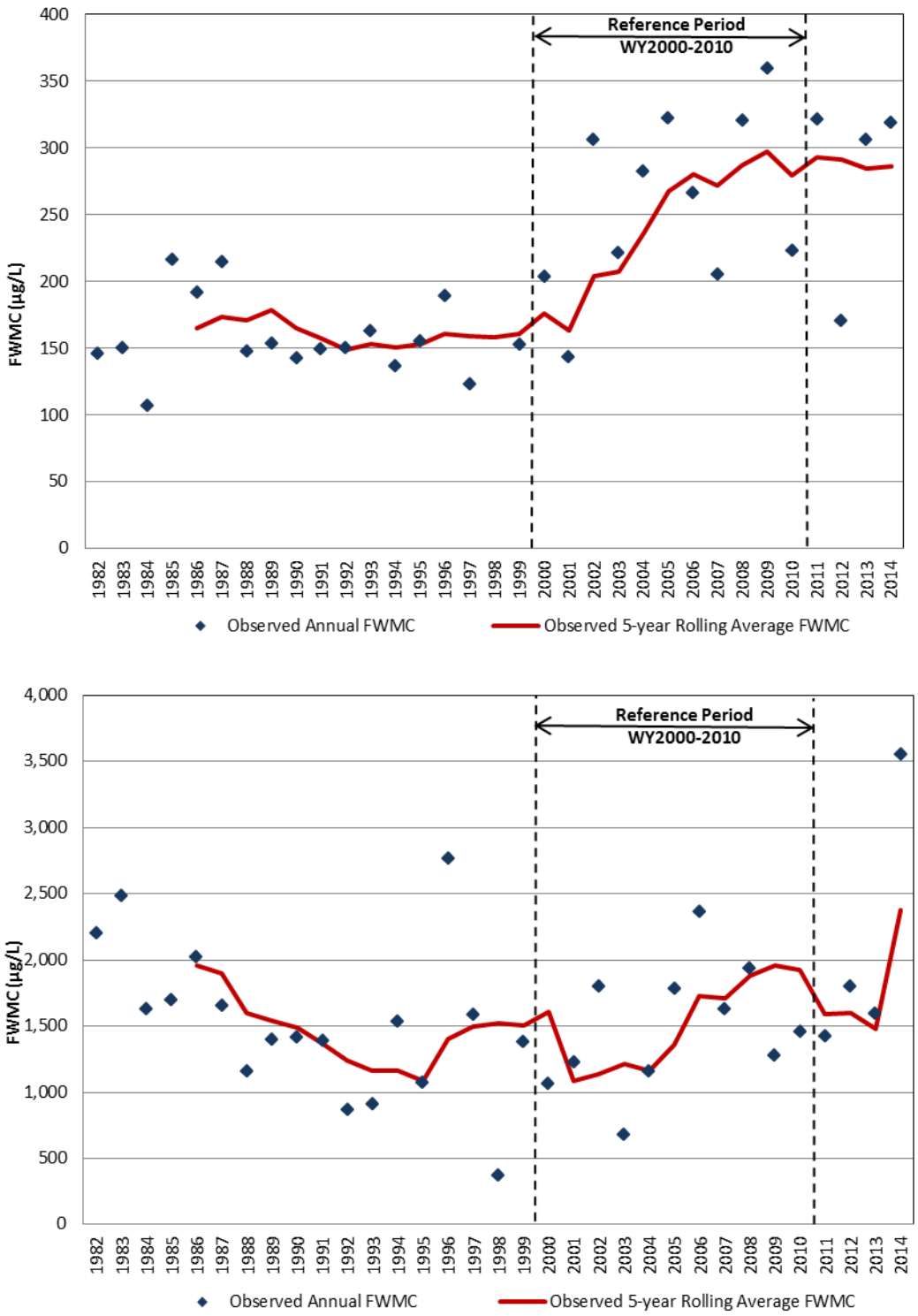
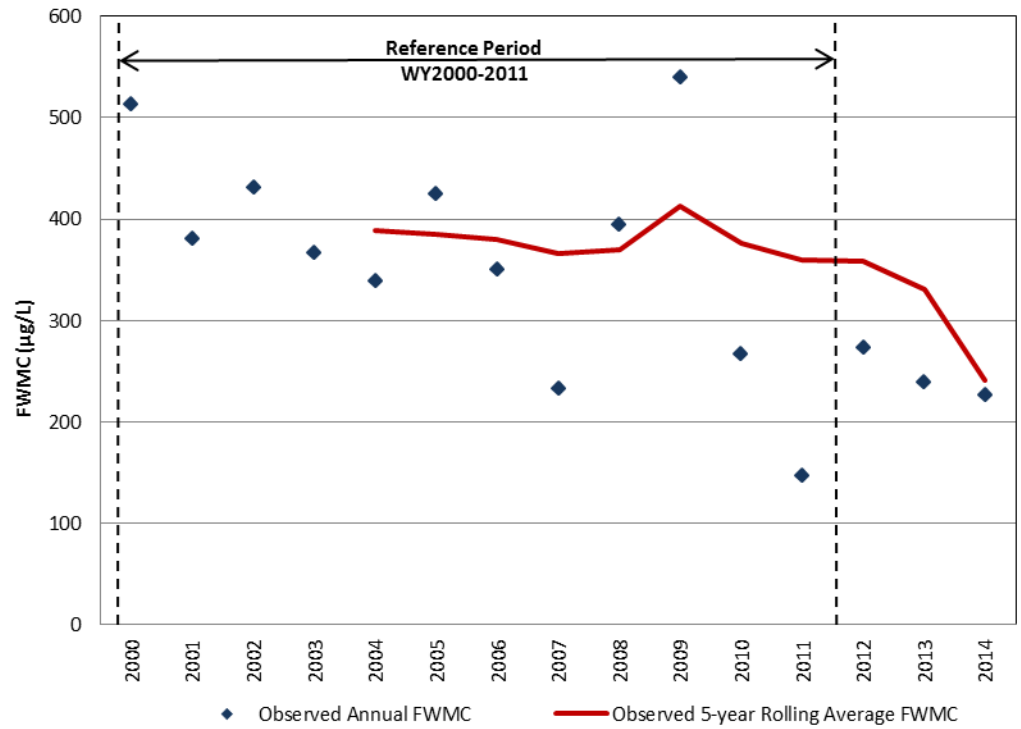


Figure 60. C-44 Basin: TP (top) and TN (bottom) observed annual FWMC and five-year rolling averages.



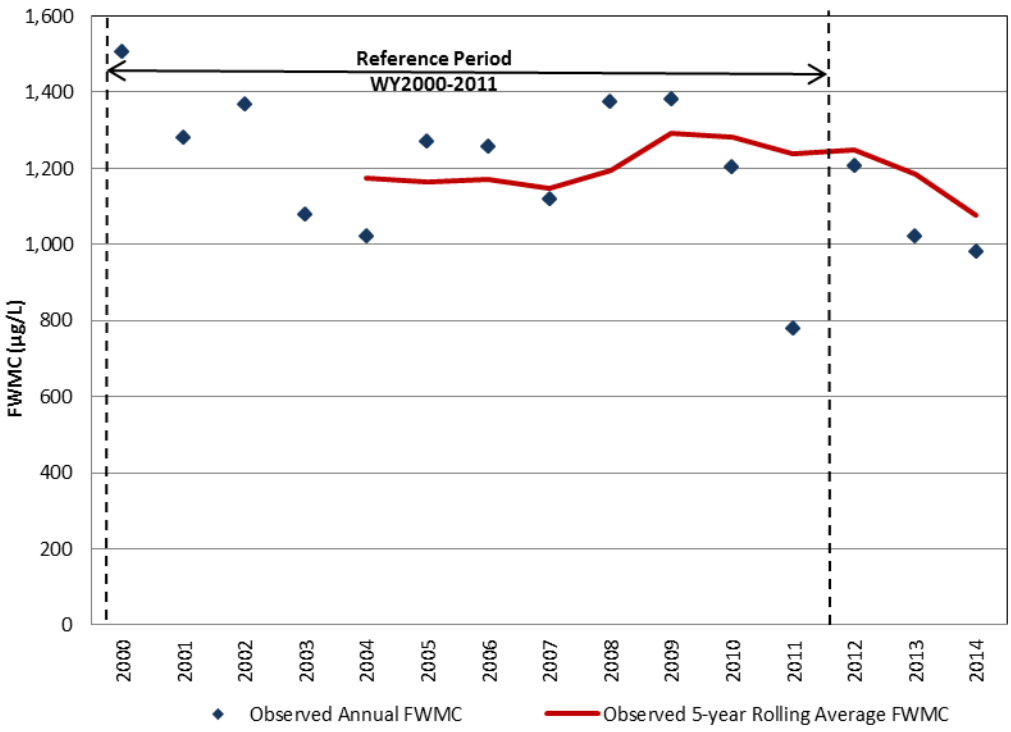


Figure 61. Ten Mile Creek Basin: TP (top) and TN (bottom) observed annual FWMC and five-year rolling averages.

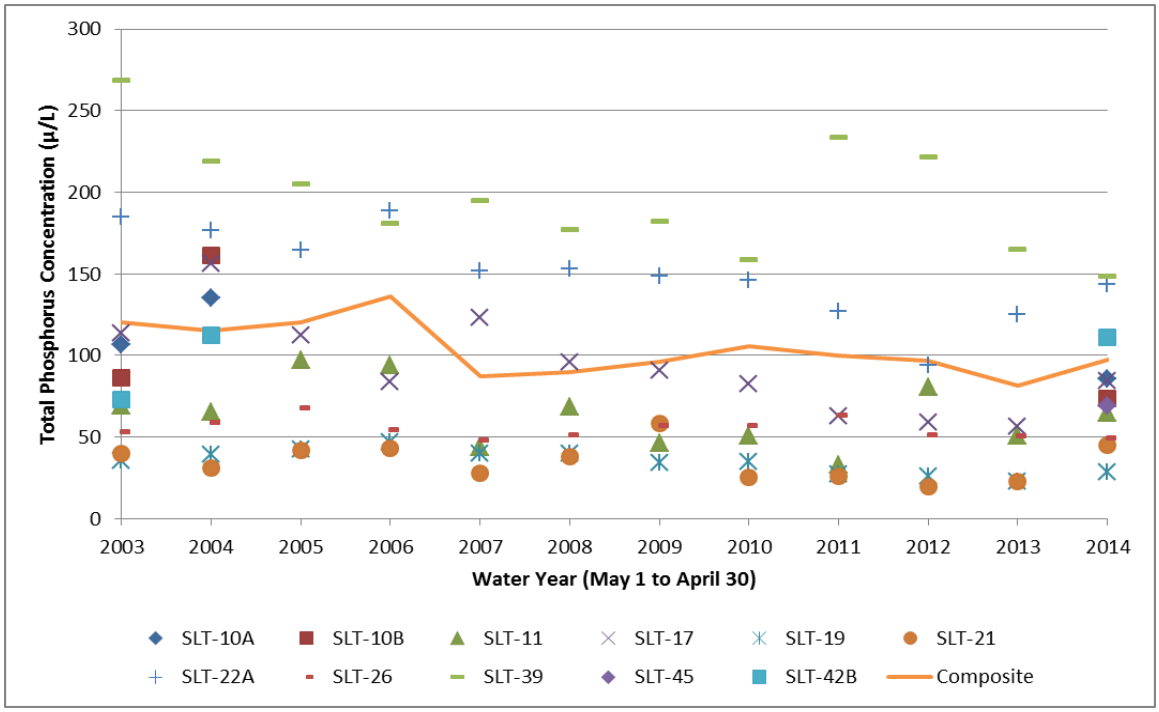


Figure 62. North Fork tributaries observed TP concentrations.

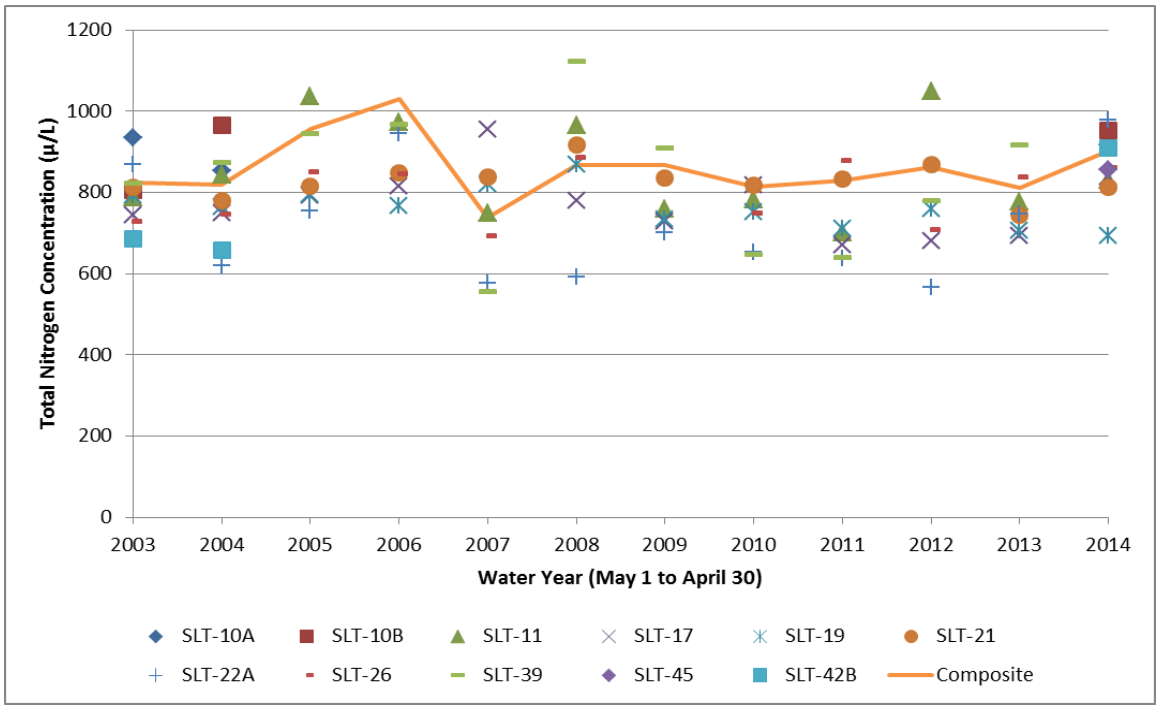


Figure 63. North Fork tributaries observed TN concentrations.

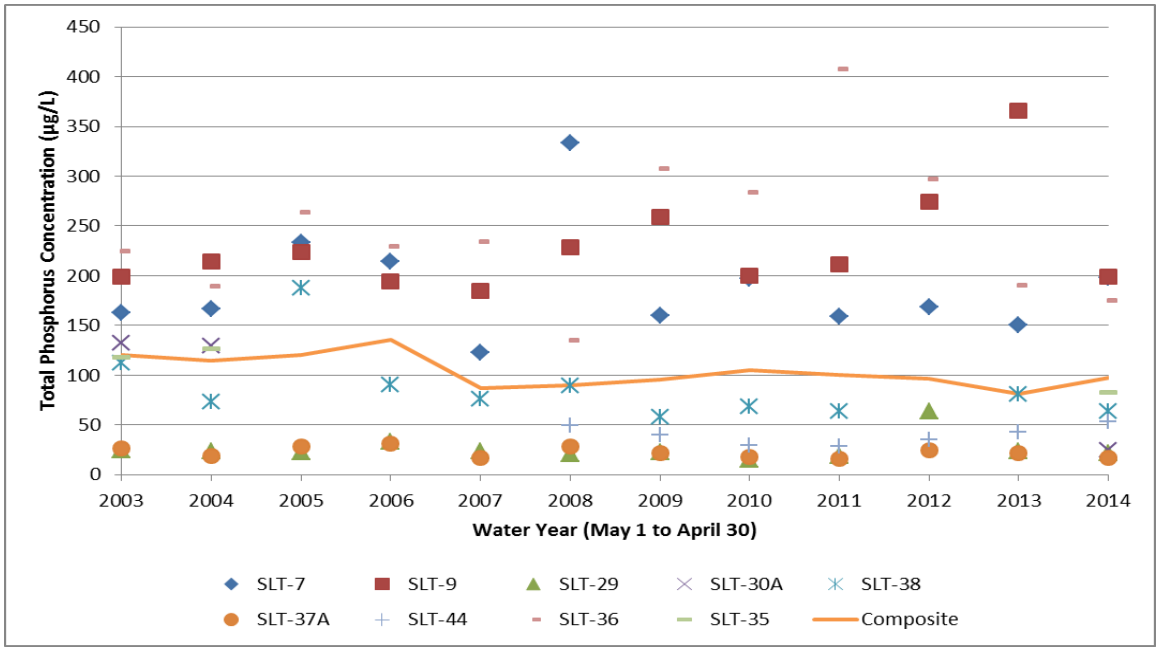


Figure 64. Basin 4-5-6, South Mid Estuary, North Mid Estuary, and South Coastal tributaries observed TP concentrations.

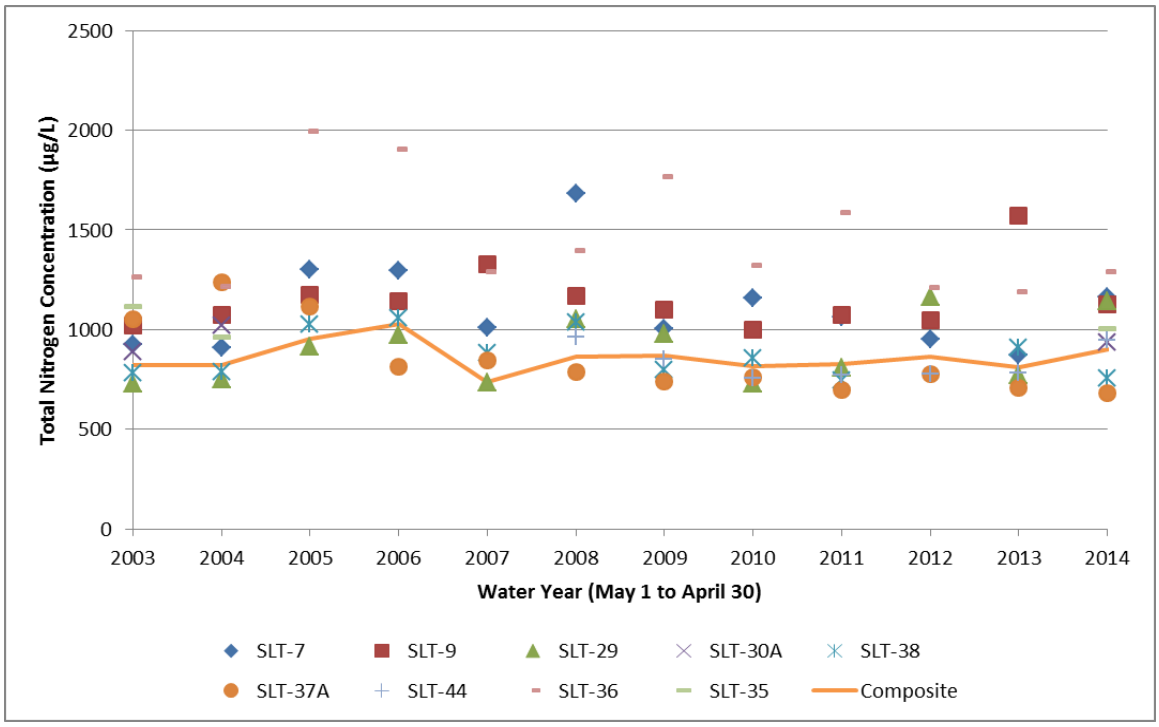


Figure 65. Basin 4-5-6, South Mid Estuary, North Mid Estuary, and South Coastal tributaries observed TN concentrations.

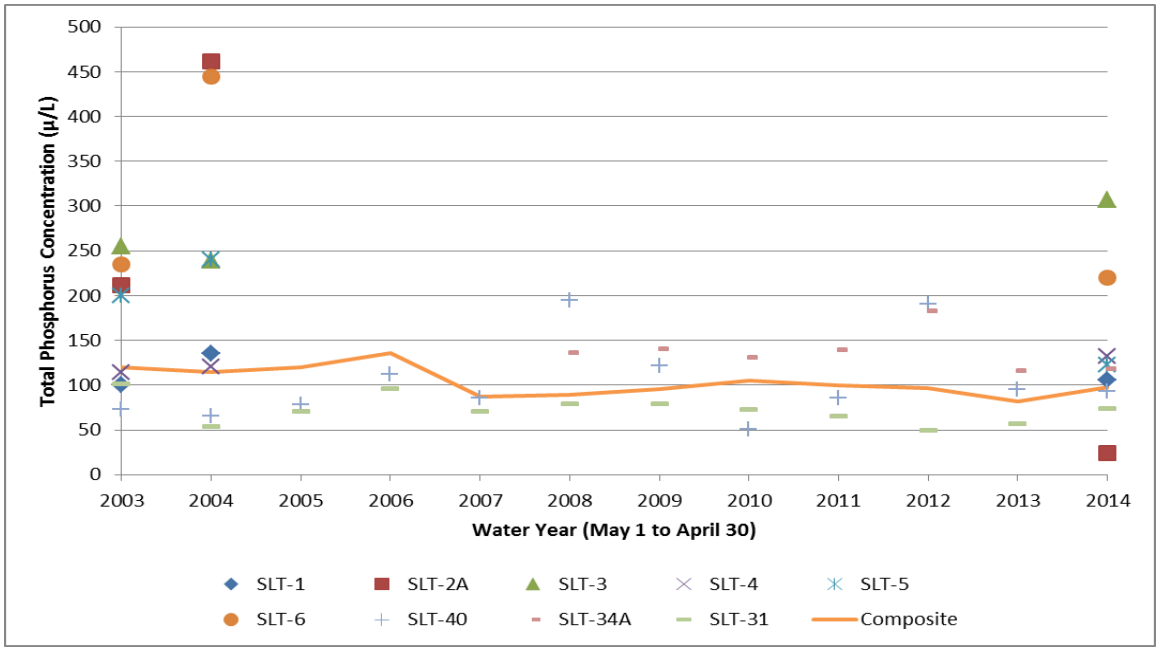


Figure 66. South Fork tributaries observed TP concentrations.

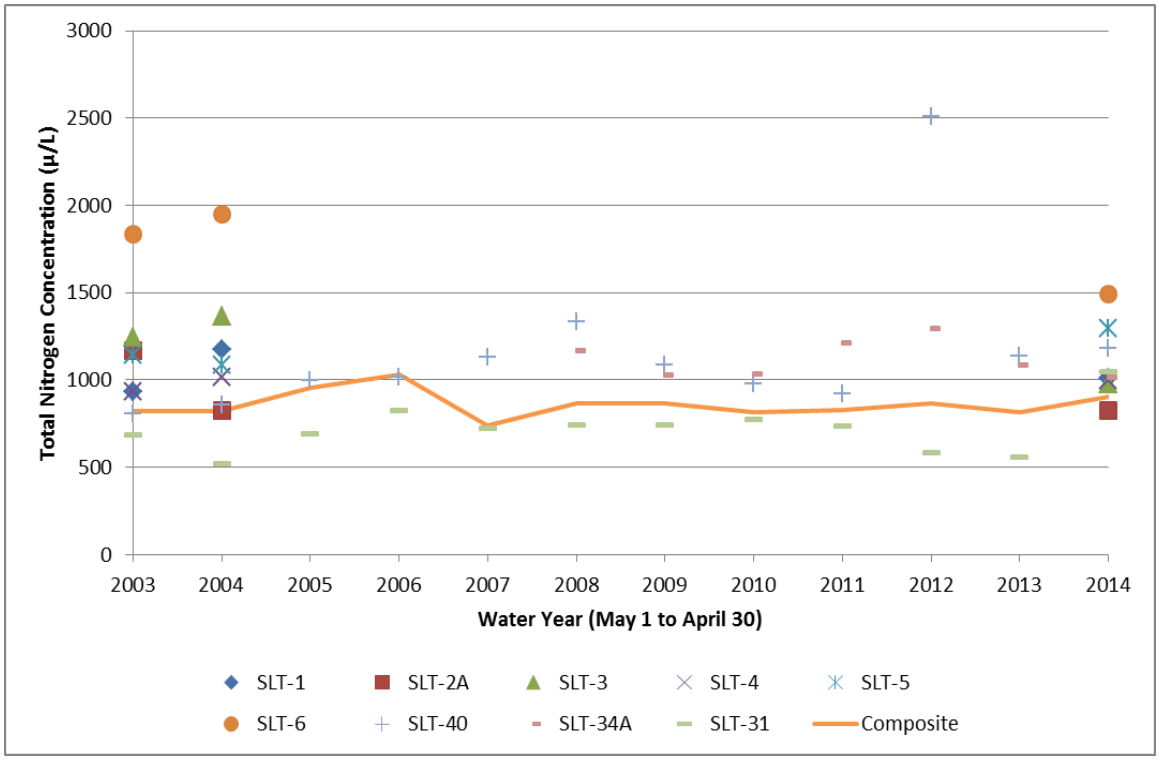


Figure 67. South Fork tributaries observed TN concentrations.