

**Enhanced Water Quality Monitoring and Modeling Program for the
A.R.M. Loxahatchee National Wildlife Refuge
Quarterly Update Report – March 2014**

Prepared by:

Donatto Surratt, A.R.M. Loxahatchee National Wildlife Refuge

Overview

This update is a summary of activities since the previous status report of December 2013 on the implementation of the Refuge's Enhanced Water Quality Monitoring and Modeling Program. A project overview, and other detailed information about the program can be found at: http://sofia.usgs.gov/lox_monitor_model/. The primary objective of this overall program (Brandt et al. 2004) focuses on providing information for use in ecological management of the Refuge (e.g., USFWS 2007a, b; USFWS 2009; USFWS 2010a, b; USFWS 2012a; USFWS 2012b; USFWS 2013).

The Refuge's monitoring component of this program also addresses one of the Consent Decree Principals recommendations (17 December 2003):

B. Enhancing Monitoring of the Refuge

Design and implement an enhanced monitoring program to improve spatial and temporal understanding of factors related to phosphorus dynamics.

Information Availability

Through collaboration with USGS, information from the Refuge's Enhanced Water Quality Monitoring and Modeling Program has been made available on the USGS' SOFIA web site at: http://sofia.usgs.gov/lox_monitor_model/.

Final data for monthly samples through May 2006 are publicly posted on DBHYDRO by the SFWMD at http://my.sfwmd.gov/dbhydroplsqli/show_dbkey_info.main_page. Data for June 2006-March 2014 are posted on the Technical Oversight Committee's web site at <http://www.sfwmd.gov/toc/>. This report includes information from samples collected through March 2014.

Water Quality Data Analyses Update

Primary efforts for this quarter involved exploring mechanisms to continue translating information from the program to aid in Refuge management decisions, and working on the program's Annual Report.

Monitoring Update (January – March 2014)

Sampling of the enhanced water quality monitoring network (**Figure 1**) occurred at 35 stations in January, 37 in February, and 33 in March 2014 (**Table 1**).

Total phosphorus data available to date for April 2013 through March 2014 are presented in **Table 1**. Maps of stations where samples were collected for the months from for January through March 2014 are presented in **Figures 2-4**.

Conductivity sonde deployment information for April 2013 through March 2014 is presented in **Table 2**.

Next Steps

The next steps for this program include additional efforts on the Annual Report, and additional model development and application.

References

- Brandt, L.A., Harwell, M., Waldon, M. (2004) Work Plan: Water Quality Monitoring and Modeling for the A.R.M. Loxahatchee National Wildlife Refuge: 2004-2006. Prepared for the A.R.M. Loxahatchee National Wildlife Refuge. April, 2004. 33 pp.
- USFWS. (2007a) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Monitoring and Modeling Program – 2nd Annual Report – February 2007. LOXA06-008, U.S. Fish and Wildlife Service, Boynton Beach, FL. 183 pp.
- USFWS. (2007b) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 3rd Annual Report – October 2007. LOXA07-005, U.S. Fish and Wildlife Service, Boynton Beach, FL. 116 pp.
- USFWS. (2009) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 4th Annual Report – July 2009. LOXA09-007, U.S. Fish and Wildlife Service, Boynton Beach, FL. 106 pp.
- USFWS. (2010a) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 5th Annual Report – September 2010. LOXA08-007, U.S. Fish and Wildlife Service, Boynton Beach, FL. 43 pp.
- USFWS. (2010b) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 6th Annual Report – October 2010. LOXA09-011, U.S. Fish and Wildlife Service, Boynton Beach, FL. 42 pp.
- USFWS. (2012a) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 7th Annual Report – February 2012. LOXA12-001, U.S. Fish and Wildlife Service, Boynton Beach, FL. 115 pp.
- USFWS. (2012b) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 8th Annual Report – October 2012. LOXA12-004, U.S. Fish and Wildlife Service, Boynton Beach, FL. 68 pp.
- USFWS. (2013) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 8th Annual Report – June 2013. LOXA13-001, U.S. Fish and Wildlife Service, Boynton Beach, FL. 71 pp.

Table 1. Total phosphorus data (ppb) available for April 2013 – March 2014 from the Enhanced Water Quality Monitoring Program for: (a) marsh, and (b) canal stations for the A.R.M. Loxahatchee National Wildlife Refuge. Graphical representation of station locations are shown in Figure 1.

a) Marsh stations

Marsh Station	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13	Jan-14	Feb-14	Mar-14
LOXA101	-	14	179	21	18	15	-	9	31	13	14	14
LOXA102	-	-	16	-	-	15	-	5	15	7	9	-
LOXA103	-	-	21	-	-	11	-	7	12	7	11	3
LOXA105	-	9	153	15	-	21	14	14	36	14	15	22
LOXA106	-	-	19	6	-	23	11	7	28	11	9	5
LOXA107	-	-	12	-	-	-	9	U	4	5	7	-
LOXA108	-	-	10	5	7	7	2	2	11	9	6	-
LOXA109	8	7	13	6	10	15	-	7	25	11	9	7
LOXA110	7	5	8	5	6	6	-	2	6	8	5	3
LOXA111	7	4	8	5	6	6	-	2	5	6	5	2
LOXA112	5	6	17	6	9	9	-	6	16	8	5	5
LOXA113	10	5	7	4	6	5	-	U	7	6	4	6
LOXA114	8	6	24	4	7	6	-	U	6	7	6	4
LOXA117	12	7	16	10	10	14	16	17	16	13	17	8
LOXA118	6	6	9	5	7	8	8	8	9	8	10	5
LOXA119	9	8	7	5	8	9	6	8	7	7	6	5
LOXA120	4	5	6	5	8	8	4	4	5	7	6	4
LOXA122	13	8	11	7	10	13	-	13	17	13	15	11
LOXA124	-	7	185	10	13	25	-	10	26	20	23	14
LOXA126	U	4	13	14	10	7	-	13	10	7	7	5
LOXA127	6	5	3	5	10	7	-	7	7	7	5	3
LOXA128	-	4	6	5	7	5	-	U	7	6	5	3
LOXA130	5	5	22	6	8	10	-	6	16	11	17	5
LOXA131	4	7	9	6	8	10	-	3	11	U	3	9
LOXA133	-	-	29	11	-	23	-	15	27	13	21	8
LOXA134	4	7	14	6	7	10	-	8	20	7	9	4
LOXA136	-	14	21	10	12	14	18	14	31	16	19	13
LOXA137	7	8	14	5	8	11	9	8	15	8	11	4
LOXA138	4	7	12	4	7	9	3	U	6	5	3	3
LOXA139	-	6	9	5	6	5	3	U	11	-	3	6
LOXA140	-	5	27	6	8	10	-	6	12	13	5	5
LOXA141	11	11	9	7	12	10	-	10	13	16	11	11
MAX	13	14	185	21	18	25	18	17	36	20	23	22
MIN	4	4	3	4	6	5	2	2	4	5	3	2

U indicates that compound was analyzed, but the concentration was below the minimum detection limit.

Table 1 cont.

b) Canal stations

Canal Station	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13	Jan-14	Feb-14	Mar-14
LOXA104	28	38	270	32	32	36	28	19	35	28	38	25
LOXA115	20	47	83	26	25	32	23	17	36	22	36	-
LOXA129	31	45	54	27	32	40	-	24	32	39	45	28
LOXA132	26	41	55	26	34	40	-	26	32	45	41	30
LOXA135	26	60	58	29	38	39	37	29	40	47	38	33
MAX	31	60	270	32	38	40	37	29	40	47	45	33
MIN	20	38	54	26	25	32	23	17	32	22	36	25

U indicates that compound was analyzed, but the concentration was below the minimum detection limit.

Table 2. April 2013 – March 2014 conductivity sonde deployment information, separated by transect, for the A.R.M. Loxahatchee National Wildlife Refuge. X = data collected from sonde deployment during that month. Graphical representation of station locations are shown in Figure 1. Stations labeled DECOM were decommissioned.

Site ID	2013					2014						
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
LOXA 104	X	X		X	X	X	X	X		X	X	X
LOXA 105	X		X		X		X		X		X	
LOXA 106	X		X		X		X		X		X	
LOXA 107	X		X		X		X		X		X	
LOXA 108	X		X		X		X		X		X	
LOXA 111		X	DECOM-->									
LOXA 112		X	DECOM-->									
LOXA 113		X	DECOM-->									
LOXA 114		X	DECOM-->									
LOXA 115	X	X		X	X	X	X	X		X	X	X
LOXA 116	X		X		X		X		X		X	X
LOXA 117	X		X		X		X		X		X	
LOXA 118	X		X		X		X		X		X	
LOXA 119	X		X		X		X		X		X	
LOXA 120	X		X		X		X		X		X	
LOXA 126		X	DECOM-->									
LOXA 127		X	DECOM-->									
LOXA 128			DECOM-->									
LOXA 129	X	X		X	X	X	X	X		X	X	X
LOXA 130	X		X		X		X		X		X	
LOXA 131	X		X		X		X		X		X	
LOXA 132	X	X		X	X	X	X	X		X	X	X
LOXA 133	X		X		X		X		X		X	
LOXA 135	X	X		X	X	X	X		X		X	X
LOXA 136	X		X		X		X		X		X	
LOXA 137	X		X		X		X		X		X	
LOXA 138	X		X		X		X		X		X	
LOXA 139	X		X		X		X		X		X	
LOXA 142	X	X		X	X	X	X		X		X	X
LOXA 143	X		X		X		X		X		X	X
LOXA 144	X		X		X		X		X		X	X
LOXA 145	X		X		X		X		X		X	X
LOXA 146	X		X		X		X		X		X	X
LOXA 147	X	X	X	X	X	X	X	X	X	X	X	X
LOXA 148	X		X		X		X		X		X	X
LOXA 149	X		X		X		X		X		X	
LOXA 150	X		X		X		X		X		X	
LOXA 151	X	X		X	X	X	X		X		X	X
LOXA 152	X	X		X	X	X	X		X		X	X
LOXA 153	X	X		X	X	X	X		X		X	X
I-8C	X	X	X	X	X	X	X	X	X	X	X	X
LOX04	X		X		X		X		X		X	
LOX06		X	DECOM-->									
LOX07		X	DECOM-->									
LOX08		X	DECOM-->									
LOX09		X	DECOM-->									
LOX10		X	DECOM-->									
LOX15	X		X		X		X		X		X	X

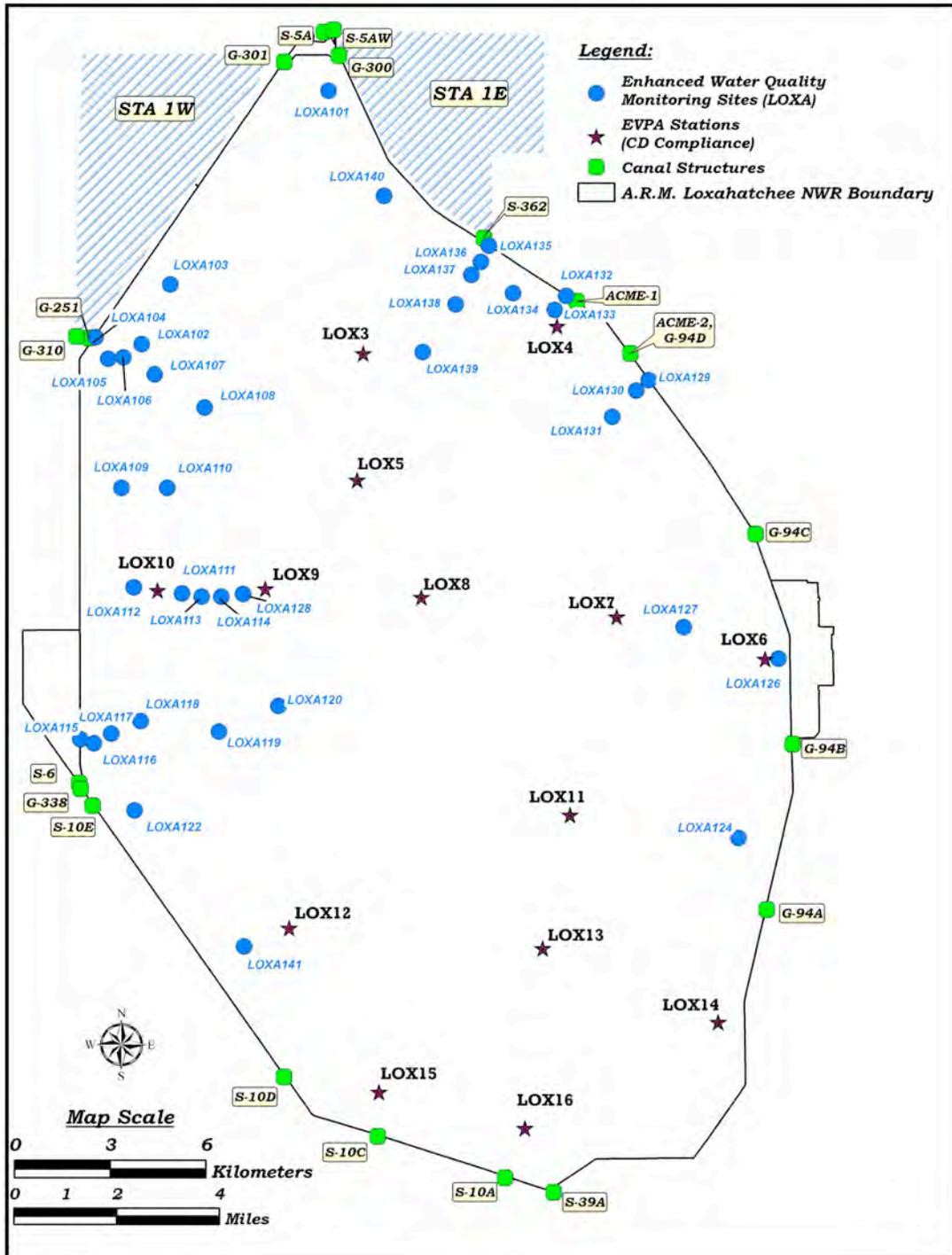


Figure 1. Location of Enhanced Water Quality Monitoring network stations (LOXA###), in relation to Consent Decree compliance stations (LOX##), for the A.R.M. Loxahatchee National Wildlife Refuge.

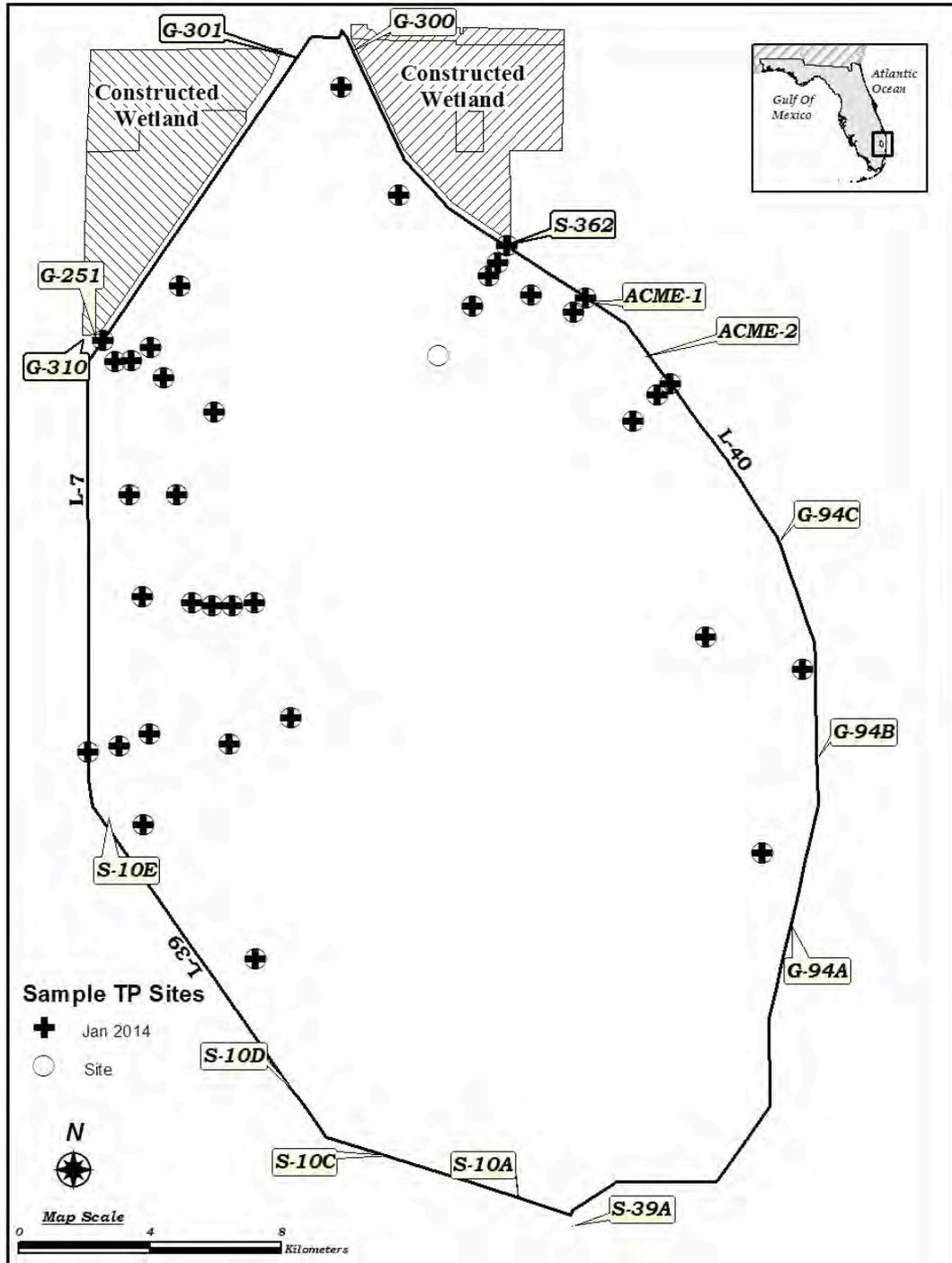


Figure 2. January 2014 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.

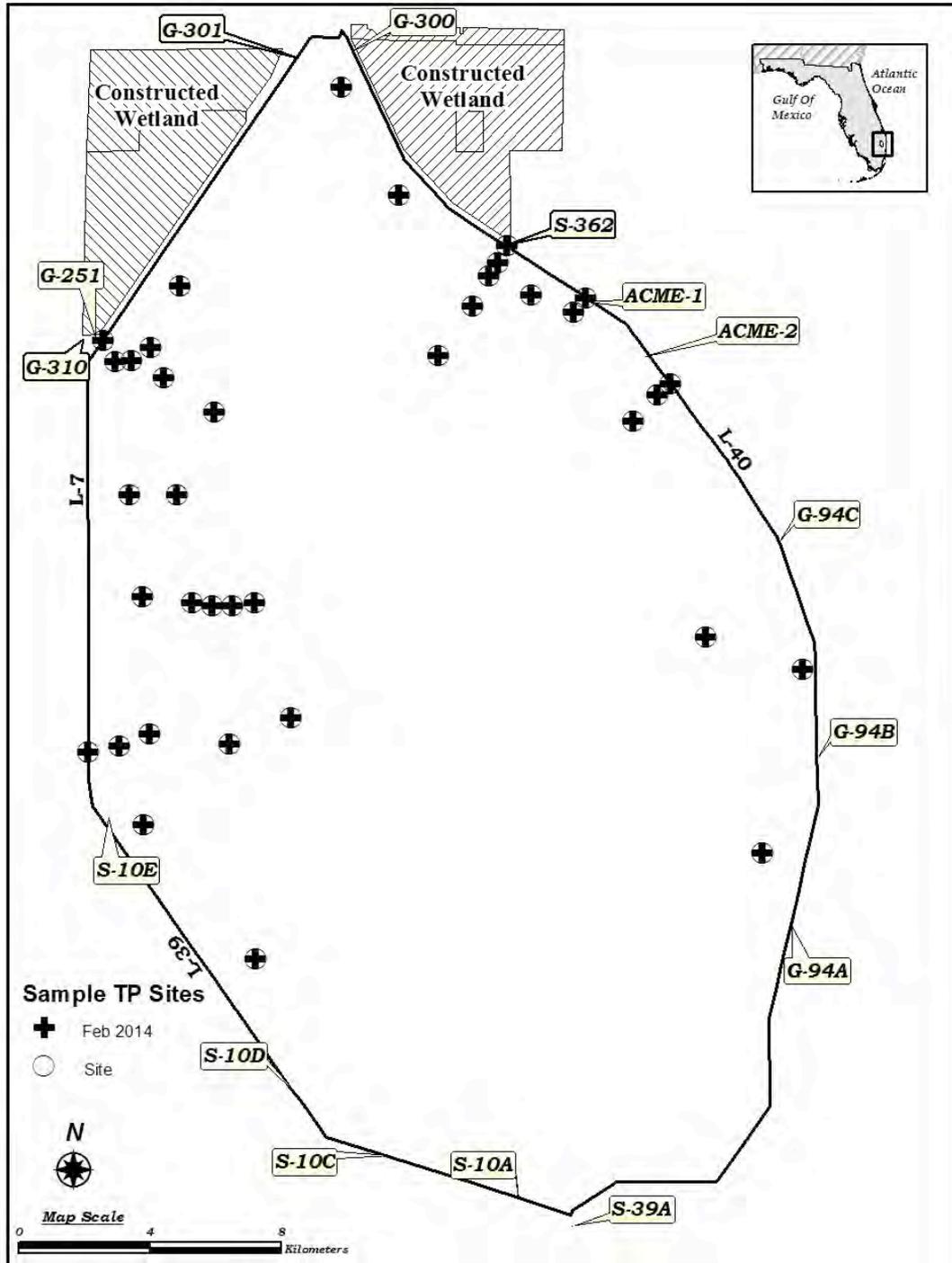


Figure 3. February 2014 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.

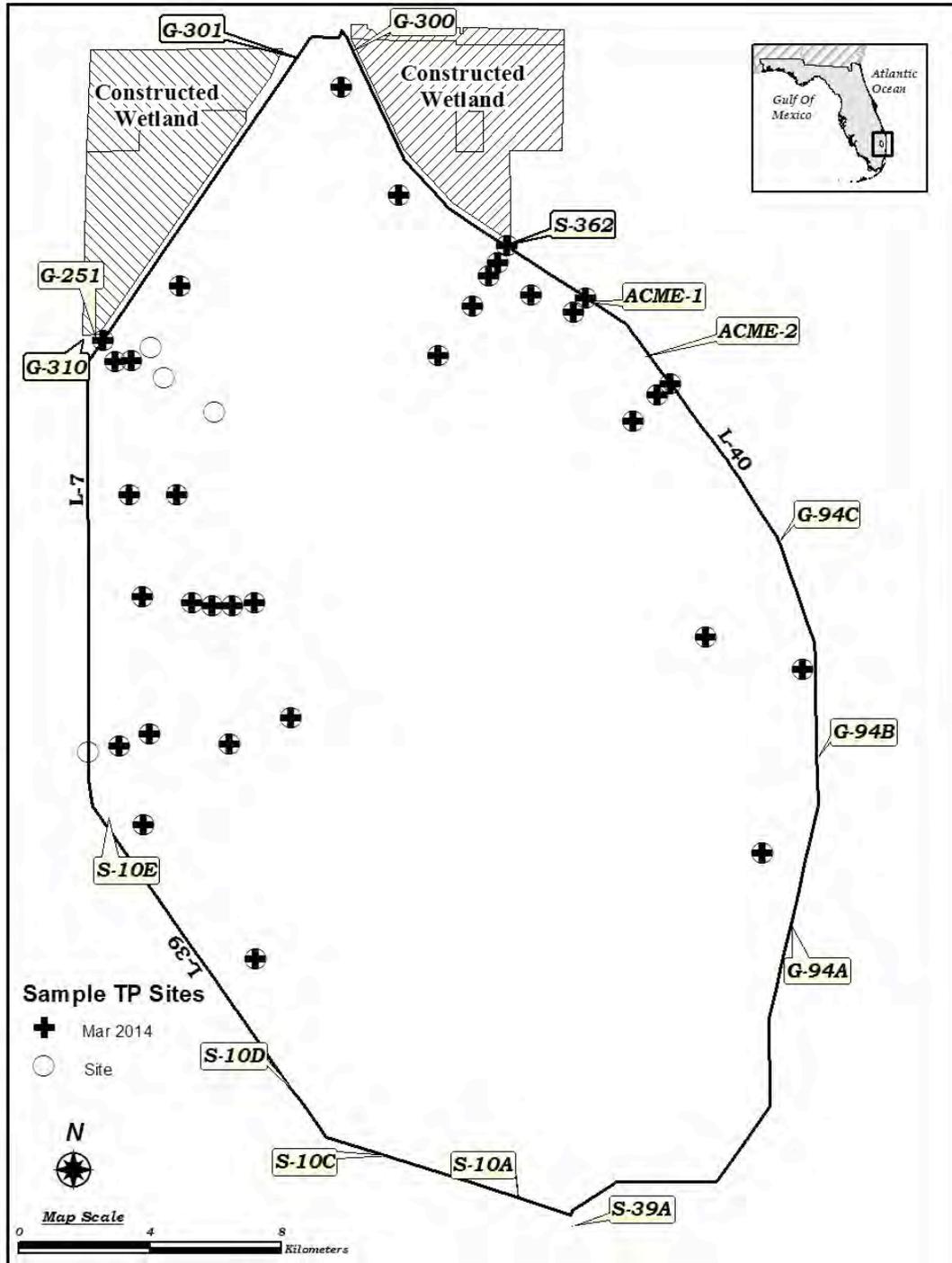


Figure 4. March 2014 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.