

**Enhanced Water Quality Monitoring and Modeling Program for the
A.R.M. Loxahatchee National Wildlife Refuge
Quarterly Update Report – January 2011**

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Overview

This update is a summary of activities since the previous status report of October 2010 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).

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.

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

C. Modeling of the Refuge

- 1. Develop a water quality/hydraulic model for the Refuge with a phosphorus cycling component.*
- 2. Evaluate issues associated with phosphorus loads and transports within the L-40 and L-7 canals.*
- 3. Develop and track a simple phosphorus mass-balance model for the Refuge.*

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-December 2010 are posted on the Technical Oversight Committee's web site at https://my.sfwmd.gov/portal/page/portal/pg_grp_sfwmd_era/pg_sfwmd_era_techovercommittee. This report includes information from samples collected through December 2010.

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 (October 2010 – December 2010)

Sampling of the enhanced water quality monitoring network (**Figure 1**) occurred at 37 stations in October, 36 stations in November, and all 35 stations in December 2010 (**Table 1**).

Total phosphorus data available to date for January 2010 through December 2010 are presented in **Table 1**. Maps of stations where samples were collected for October 2010 through December 2010 are presented in **Figures 2-4**.

Conductivity sonde deployment information for January 2010 through December 2010 is presented in **Table 2**.

Modeling Update

During the fourth quarter of 2010, the Refuge modeling team investigated improvements in model calibration of the compartmental models. Efforts continued on documentation of models, and publication in journals. Continued develop of hydrologic performance measures was undertaken, including proposing a stage reversal performance measure to address Refuge ecological impacts.

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.

Table 1. Total phosphorus data (ppb) available for January 2010 – December 2010 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	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10
LOXA101	10	7	13	9	-	14	-	32	22	16	14	20
LOXA102	5	4	4	-	-	-	-	-	16	12	8	-
LOXA103	7	12	-	-	-	-	-	-	20	12	10	10
LOXA105	11	10	U	8	-	20	19	24	26	21	16	8
LOXA106	5	U	U	5	-	11	15	14	15	16	9	3
LOXA107	4	U	-	-	-	-	-	-	19	13	9	-
LOXA108	7	8	10	U	-	6	7	-	9	8	5	9
LOXA109	7	6	U	4	10	11	9	10	11	11	7	3
LOXA110	8	5	4	7	10	10	10	10	7	10	8	6
LOXA111	5	U	U	3	8	5	6	8	7	9	6	U
LOXA112	6	5	U	U	6	11	17	11	10	10	7	5
LOXA113	5	U	U	U	6	U	5	8	5	10	5	6
LOXA114	4	U	U	U	7	6	8	6	5	12	U	U
LOXA117	12	5	4	5	10	14	28	17	33	22	15	9
LOXA118	5	4	U	2	10	10	10	11	11	13	9	6
LOXA119	5	U	U	4	8	8	9	9	7	12	7	5
LOXA120	3	U	U	3	6	7	7	7	4	8	7	5
LOXA122	6	5	U	6	15	19	18	17	21	19	13	9
LOXA124	7	9	19	9	9	18	16	13	18	13	10	14
LOXA126	6	5	14	3	12	14	18	18	20	13	12	16
LOXA127	4	U	U	U	7	-	18	12	9	7	8	11
LOXA128	9	U	U	2	5	U	6	7	4	9	4	U
LOXA130	6	7	3	3	11	13	14	8	26	15	11	14
LOXA131	8	6	U	U	8	8	13	12	11	9	7	9
LOXA133	26	28	14	14	-	30	-	17	46	20	15	28
LOXA134	8	8	19	5	9	11	13	11	21	16	11	11
LOXA136	13	8	17	7	22	18	-	-	33	23	-	21
LOXA137	9	9	5	6	12	9	8	8	18	17	11	12
LOXA138	9	4	U	U	7	10	7	8	9	17	6	8
LOXA139	3	7	U	4	11	6	9	6	7	7	8	9
LOXA140	9	5	U	10	9	11	-	10	18	12	11	16
LOXA141	14	10	U	10	15	10	12	13	13	20	15	10
MAX	26	28	19	14	22	30	28	32	46	23	16	28
MIN	3	4	3	2	5	5	5	6	4	7	4	3

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

Table 1 cont.

b) Canal stations

Canal Station	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10
LOXA104	27	31	27	56	42	26	26	34	31	27	28	20
LOXA115	26	22	20	37	36	29	23	34	33	30	27	23
LOXA129	32	38	54	70	49	59	39	37	32	28	28	25
LOXA132	36	37	38	71	51	53	60	36	38	29	30	26
LOXA135	28	30	32	72	46	51	62	32	20	21	27	28
MAX	36	38	54	72	51	59	62	37	38	30	30	28
MIN	26	22	20	37	36	26	23	32	20	21	27	20

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

Table 2. January 2010 – December 2010 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.

2010												
Site ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
LOXA104	X	X	X	X	X	X	X	X	X	X	X	X
LOXA105	X		X		X	X	X		X		X	
LOXA106	X		X		X	X	X		X		X	
LOXA107	X		X		X	X	X		X		X	
LOXA108	X		X		X	X	X		X		X	
LOXA111		X		X		X		X		X		X
LOXA112		X		X		X		X		X		X
LOXA113		X		X		X		X		X		X
LOXA114		X		X		X		X		X		X
LOXA115	X	X	X		X	X	X	X	X	X	X	X
LOXA116			X		X	X	X		X	X		X
LOXA117			X		X	X	X		X	X		X
LOXA118					X	X	X		X	X		X
LOXA119			X		X	X	X		X	X		X
LOXA120			X		X	X	X		X	X		X
LOXA126		X		X		X		X		X		X
LOXA127		X		X		X		X		X		X
LOXA128		X		X		X		X		X		X
LOXA129	X	X	X		X	X	X	X	X	X	X	X
LOXA130	X		X		X	X			X		X	
LOXA131	X		X		X	X			X		X	
LOXA132	X	X	X		X	X	X	X	X	X	X	X
LOXA133	X		X		X	X			X		X	
LOXA135	X	X	X		X	X	X	X	X	X	X	X
LOXA136	X		X		X	X			X		X	
LOXA137	X		X		X	X			X		X	
LOXA138	X		X		X	X			X		X	
LOXA139	X		X		X	X			X		X	
LOXA142		X	X		X		X		X		X	X
LOXA143		X		X		X		X		X		X
LOXA144		X		X		X		X		X		X
LOXA145		X		X		X		X		X		X
LOXA146		X		X		X		X		X		X
LOXA147	X		X		X		X					
LOXA148		X		X		X		X		X		X
LOXA149		X		X		X		X		X		X
LOXA150		X		X		X		X		X		X
LOXA151	X	X	X		X	X	X	X	X	X	X	X
LOXA152	X	X	X		X	X	X	X	X	X	X	X
LOXA153					X	X	X	X	X	X	X	X
I-8C	X			X		X	X	X	X		X	
LOX04	X		X		X	X			X		X	
LOX06		X		X		X		X		X		X
LOX07		X		X		X		X		X		X
LOX08		X		X		X		X		X		X
LOX09		X		X		X		X		X		X
LOX10		X		X		X		X		X		X
LOX15		X		X		X		X		X		X

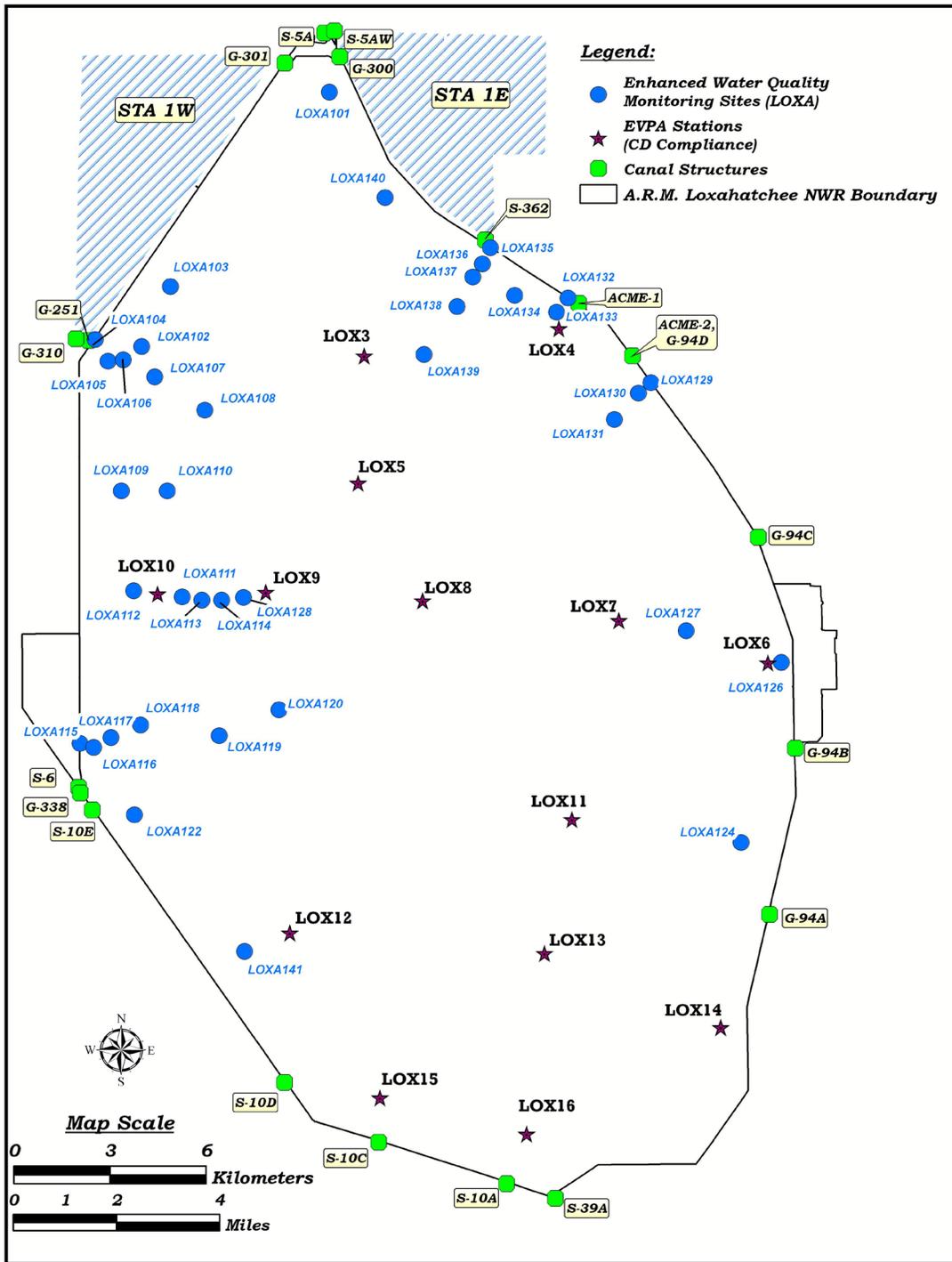


Figure 1. Location of Enhanced Water Quality Monitoring network stations (LOXA###), in relation to Consent Decree compliance stations (LOX##), for the A.R.M. Loxahatchee National Wildlife Refuge.

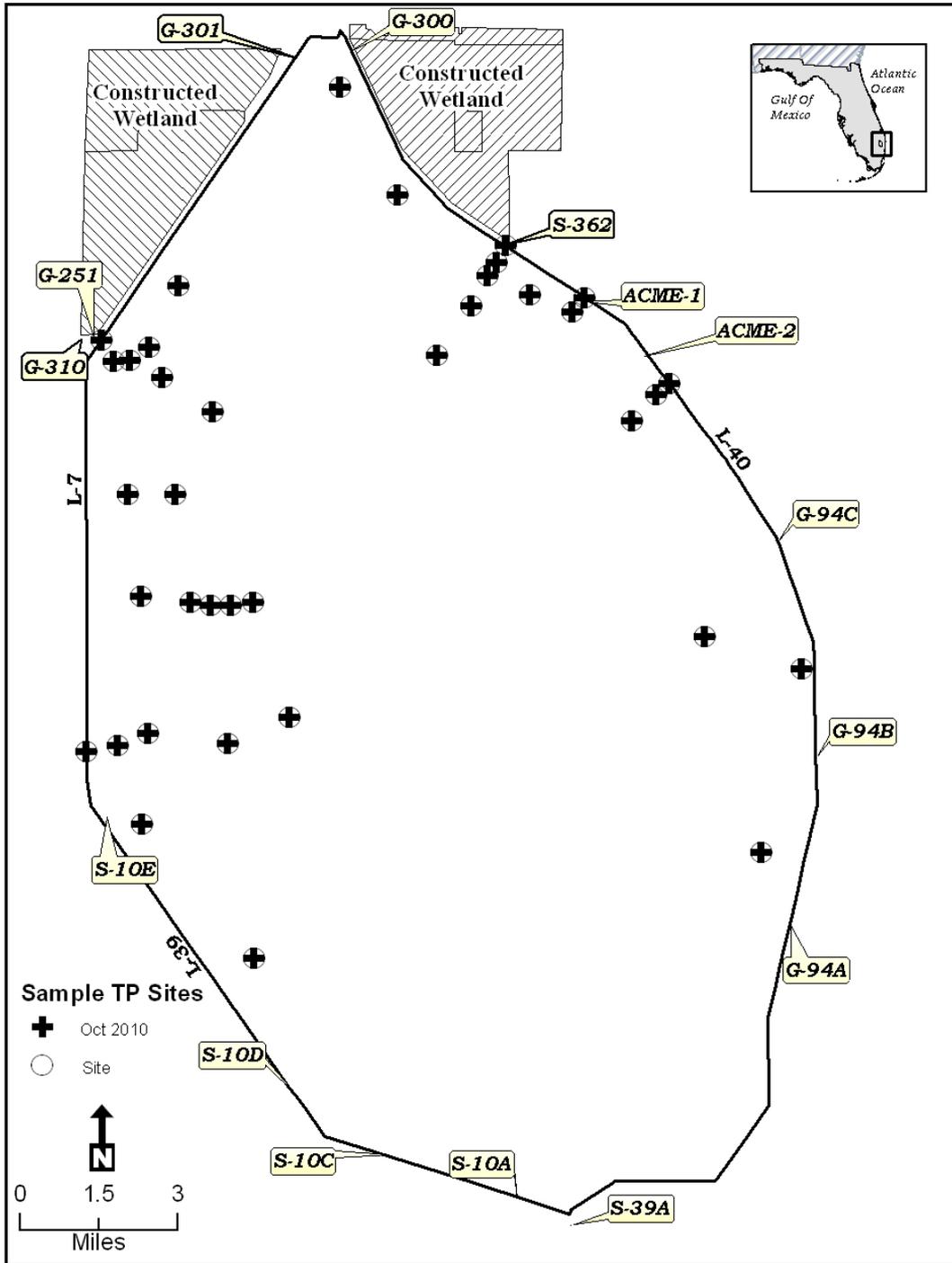


Figure 2. October 2010 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.

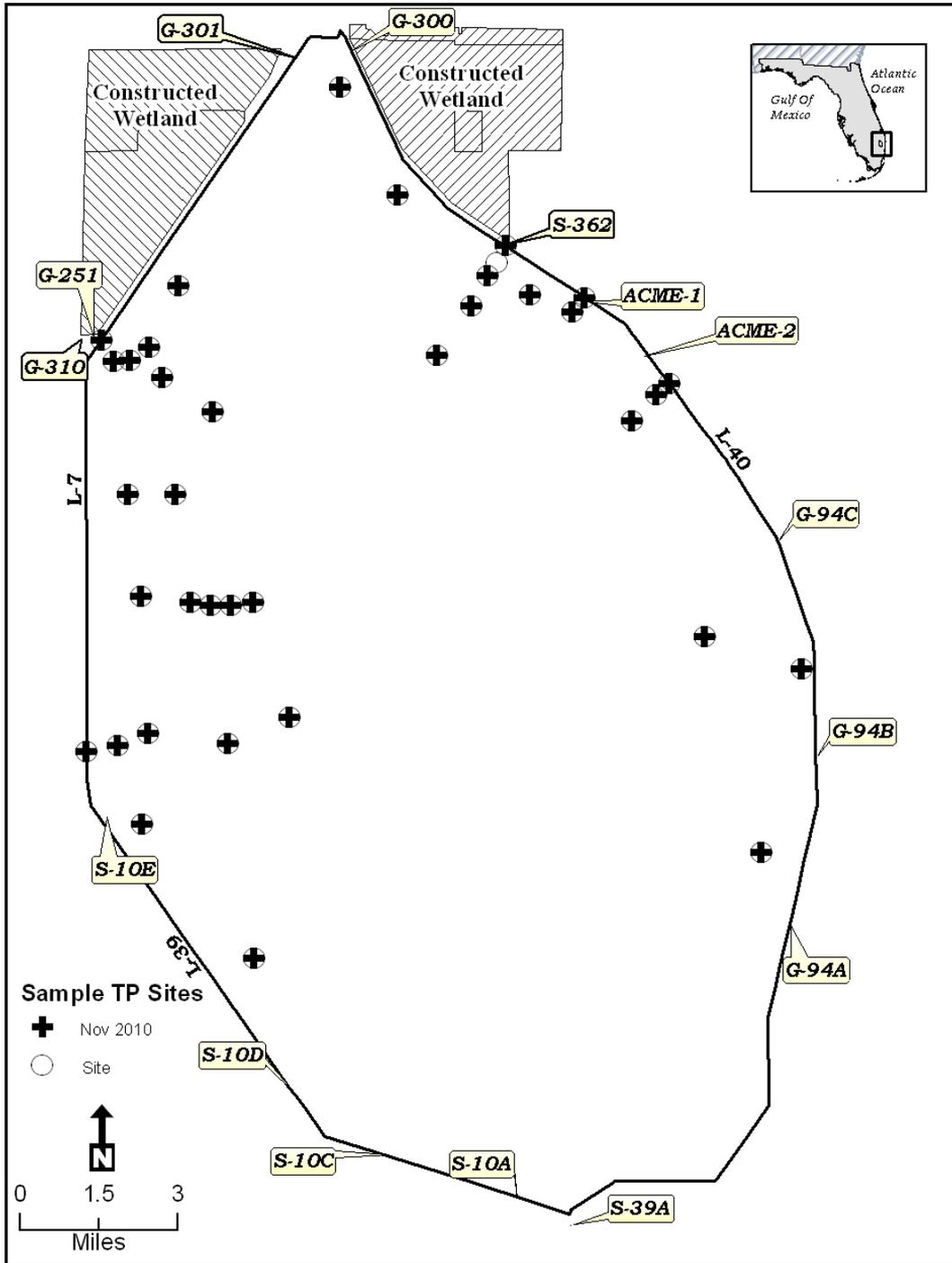


Figure 3. November 2010 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.

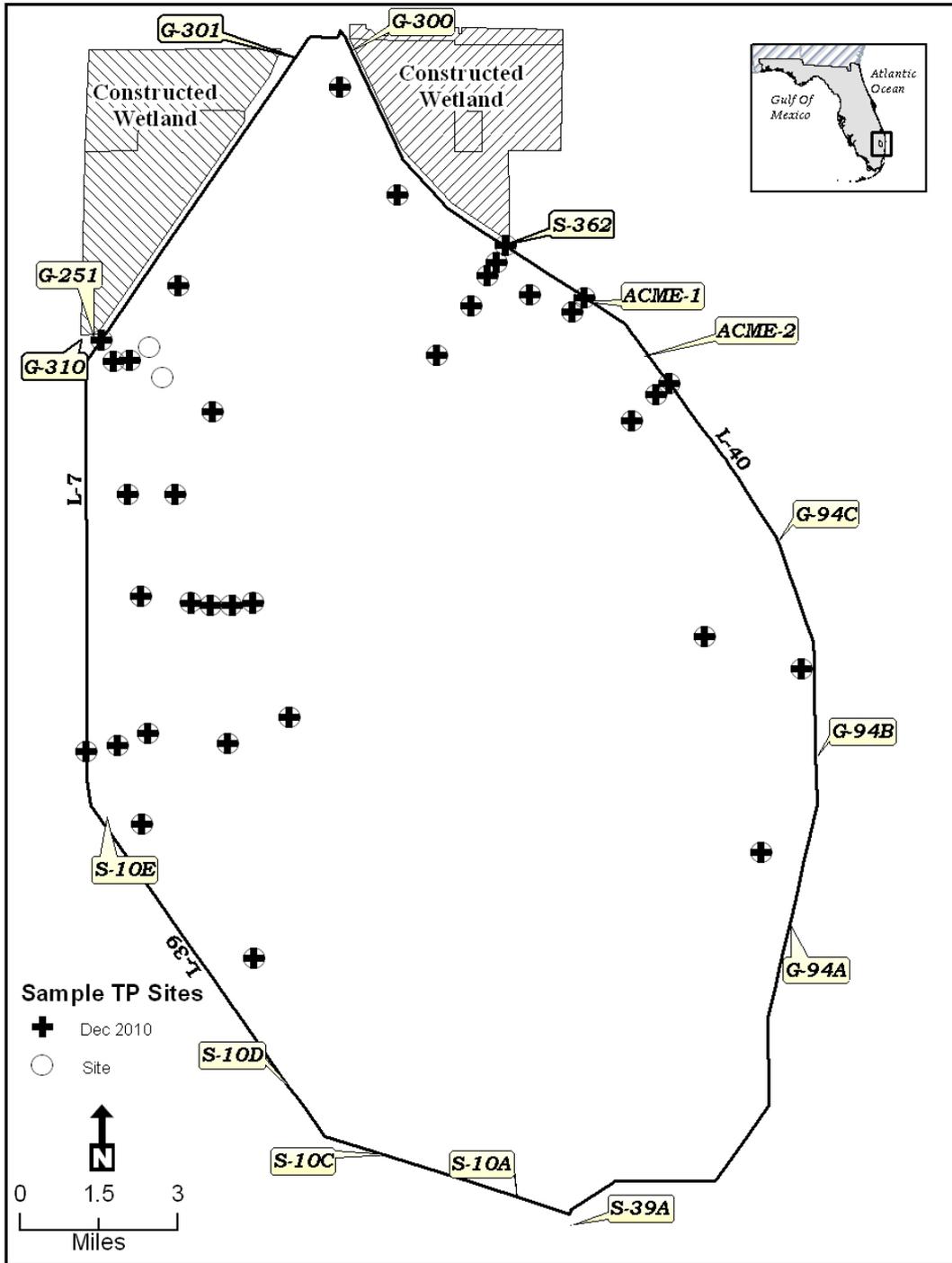


Figure 4. December 2010 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.