

Enhanced Water Quality Monitoring and Modeling Program for the A.R.M. Loxahatchee National Wildlife Refuge Quarterly Update Report – April 2007

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Overview

This update is a summary of activities since the previous status report of January 2007 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 focuses on providing information for use in ecological management of the Refuge (Brandt et al. 2004; Harwell et al. 2005; USFWS 2007).

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://www.sfwmd.gov/org/ema/dbhydro/index.html>. Data for June 2006-March 2007 are posted on the Technical Oversight Committee's web site at <http://www.sfwmd.gov/org/ema/toc/index.html>. This report includes information from samples collected through March 2007.

Water Quality Data Analyses Update

Primary efforts from this quarter focused on finalizing and releasing the Second Annual Report. This report, available on our SOFIA site (http://sofia.usgs.gov/lox_monitor_model/), is composed of three sections. The first section of the Annual Report provides a general introductory overview of the Refuge and the Enhanced Water Quality Monitoring and Modeling Program. The second section is comprised of three technical chapters that present extensive analyses of water quality data generally covering the period from June 2004 (the initiation of this program) through December 2005. The second section also contains a chapter on the status of the model efforts through April 2006, and presents a list of the types of management questions/scenarios that are anticipated for modeling tools application. Finally, the report contains a synthesis of the information presented in report in the context of the support for management decisions. In addition, the report discusses what additional information is necessary to continue to improve our scientific understanding of water quality issues in the Refuge.

Monitoring Update (January 2007 – March 2007)

Sampling of the enhanced water quality monitoring network (**Figure 1**) occurred at 34 stations in January 2007, 29 stations in February 2007, and 7 stations in March 2007 (**Table 1**).

Total phosphorus data available to date for July 2006 to March 2007 are presented in **Table 1**. Maps of stations where samples were collected for January 2007 through March 2007 are presented in **Figures 2-4**.

Conductivity sonde deployment information for July 2006 to March 2007 is presented in **Table 2**.

Modeling Update

Model development continues with intensive effort by the modeling team. The modeling chapter of the 2nd annual report focused on data availability and compilation, and on model selection. The chapter also described the beginning of our modeling process.

These bullets describe progress to date since that report was written:

- A first version of the simplified 2-box model is complete.
- An option has been added to control outflow in the simple model to follow the regulation schedule (as opposed to using historic flows) has been added and tested.
- A first version of a 4-box constituent transport model for chloride is complete.
- A first version of a 4-box total phosphorus model is complete
- Each of these simplified models is in the process of being documentation. Documentation will include development, calibration, and user instructions.
- The MIKE FLOOD 2-dimensional model has been calibrated to stage data.
- The MIKE FLOOD model is in the process of being calibrated for chloride.
- The modeling technical advisory panel met for a second time in October 2006. Their report on this meeting should soon be available.

Next Steps

The next steps for this program include exploring mechanisms to present information from the Annual Report – in particular the modeling efforts – to a larger audience, continuation of data collection and analysis, additional model development and implementation. Presentations are planned to contribute to a special session on water quality issues in the Everglades for the 2007 annual meeting of the North American Benthological Society being held in June 2007 in Columbia, SC (see: <http://www.benthos.org/Meeting/>). Finally, as funding for this program ends in September 2007 (end of FY07), efforts are underway to examine potential mechanisms to continue program funding.

References

http://sofia.usgs.gov/lox_monitor_model/

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.

Harwell, M. Surratt, D., Waldon, M., Walker, B., Brandt, L. (2005) A.R.M. Loxahatchee National Wildlife Refuge Enhanced Water Quality Monitoring and Modeling Interim Report. April, 2005. 106 pp.

USFWS. (2007) 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.

Table 1. 2006 Total phosphorus data (ppb) available for January – December 2006 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 Figures 1-3.

a) Marsh stations

Marsh Station	Jul-06	Aug-06	Sept-06	Oct-06	Nov-06	Dec-06	Jan-07	Feb-07	Mar-07
LOXA101	23	U	36	9	13	5	13	12	-
LOXA102	17	-	11	6	6	U	-	-	-
LOXA103	17	-	13	8	-	2	4	-	-
LOXA105	48	-	12	-	14	-	16	10	-
LOXA106	17	3	8	8	7	-	5	-	-
LOXA107	-	-	7	7	5	-	-	-	-
LOXA108	-	-	10	5	3	-	-	-	-
LOXA109	8	5	4	8	5	U	5	-	-
LOXA110	U	-	3	11	4	-	U	-	-
LOXA111	21	-	5	4	6	-	7	U	-
LOXA112	4	U	5	6	8	-	6	5	-
LOXA113	14	-	6	4	6	-	U	U	-
LOXA114	4	U	6	6	4	-	U	5	-
LOXA116	90	24	25	86	-	8	20	-	-
LOXA117	20	8	9	19	11	13	7	5	-
LOXA118	5	U	6	8	4	6	10	4	-
LOXA119	20	U	3	U	4	U	8	9	-
LOXA120	10	U	3	6	5	6	6	U	12
LOXA121	-	-	-	-	X	X	X	X	X
LOXA122	10	16	8	7	7	9	12	6	-
LOXA123	-	-	-	-	X	X	X	X	X
LOXA124	5	U	47	3	14	8	6	7	-
LOXA126	5	U	9	U	5	8	6	6	-
LOXA127	U	U	9	U	13	7	6	U	-
LOXA128	3	U	5	5	3	2	4	U	-
LOXA130	23	U	12	U	18	6	9	5	-
LOXA131	10	U	7	U	3	9	6	5	-
LOXA133	-	28	-	-	20	-	17	55	-
LOXA134	7	36	13	12	9	11	7	6	-
LOXA136	-	28	28	18	15	13	37	21	-
LOXA137	10	27	10	5	9	6	5	6	-
LOXA138	8	U	9	4	4	-	3	U	-
LOXA139	5	-	6	4	4	-	-	-	-
LOXA140	15	-	13	6	9	-	6	U	-
LOXA141					8	3	13	6	8
MAX	90	36	47	86	20	13	37	55	12
MIN	4	3	3	3	3	3	3	4	8

U indicates that compound was analyzed but not detected.
X indicates station no longer sampled.

Table 1 cont.

b) Canal stations

Canal Station	Jul-06	Aug-06	Sep-06	Oct-06	Nov-06	Dec-06	Jan-07	Feb-07	Mar-07
LOXA104	110	75	150	43	60	37	24	27	100
LOXA115	120	71	120	60	34	25	23	47	25
LOXA129	68	34	110	19	51	35	36	36	84
LOXA132	80	41	93	43	43	41	39	36	54
LOXA135	100	42	150	46	48	34	35	46	48
MAX	120	75	150	60	60	41	39	47	100
MIN	68	34	93	19	34	25	23	27	25

U indicates that compound was analyzed but not detected.

Table 2. July 2006 - January 2007 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 Figures 1-3.

Site ID	Description	2006					2007				
		Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	
LOXA104	NW Transect 0 (canal)		X		X		X				
LOXA105	NW Transect 0.5	X		X		X		X		X	
LOXA106	NW Transect 1	X		X		X		X		X	
LOXA107	NW Transect 2	X		X		X		X		X	
LOXA108	NW Transect 4	X		X		X		X		X	
LOXA111			X		X		X		X		
LOXA112			X		X		X		X		
LOXA113			X		X		X		X		
LOXA114			X		X		X		X		
LOXA115	SW Transect 0 (canal)		X		X		X			X	
LOXA116	SW Transect 0.5	X		X		X				X	
LOXA117	SW Transect 1	X		X		X				X	
LOXA118	SW Transect 2	X		X		X			X		
LOXA119	SW Transect 4	X		X		X			X		
LOXA120	SW Transect- X5	X		X		X			X		
LOXA126			X		X	X	X		X		
LOXA127			X	X	X	X	X		X		
LOXA128			X		X	X			X		
LOXA129	NE Transect S 0 (canal)	X	X	X		X			X	X	
LOXA130	NE Transect S	X		X		X					
LOXA131	NE Transect S	X		X		X					
LOXA132	NE Transect N 0 (canal)	X	X	X		X			X	X	
LOXA133	NE Transect N		X	X		X					
LOXA135	NE Transect STA1E 0 (canal)	X	X	X		X			X	X	
LOXA136	NE Transect STA1E 0.5		X	X		X		X		X	
LOXA137	NE Transect STA1E 1	X		X		X		X		X	
LOXA138	NE Transect STA1E 2	X		X		X		X		X	
LOXA139	NE Transect STA1E 4	X		X		X				X	
LOX6	EVPA site		X		X	X	X		X		
LOX7	EVPA site		X			X	X		X		
LOX8	EVPA site		X		X	X	X				
LOX9	EVPA site		X		X	X	X		X		
LOX10	EVPA site		X		X		X		X		

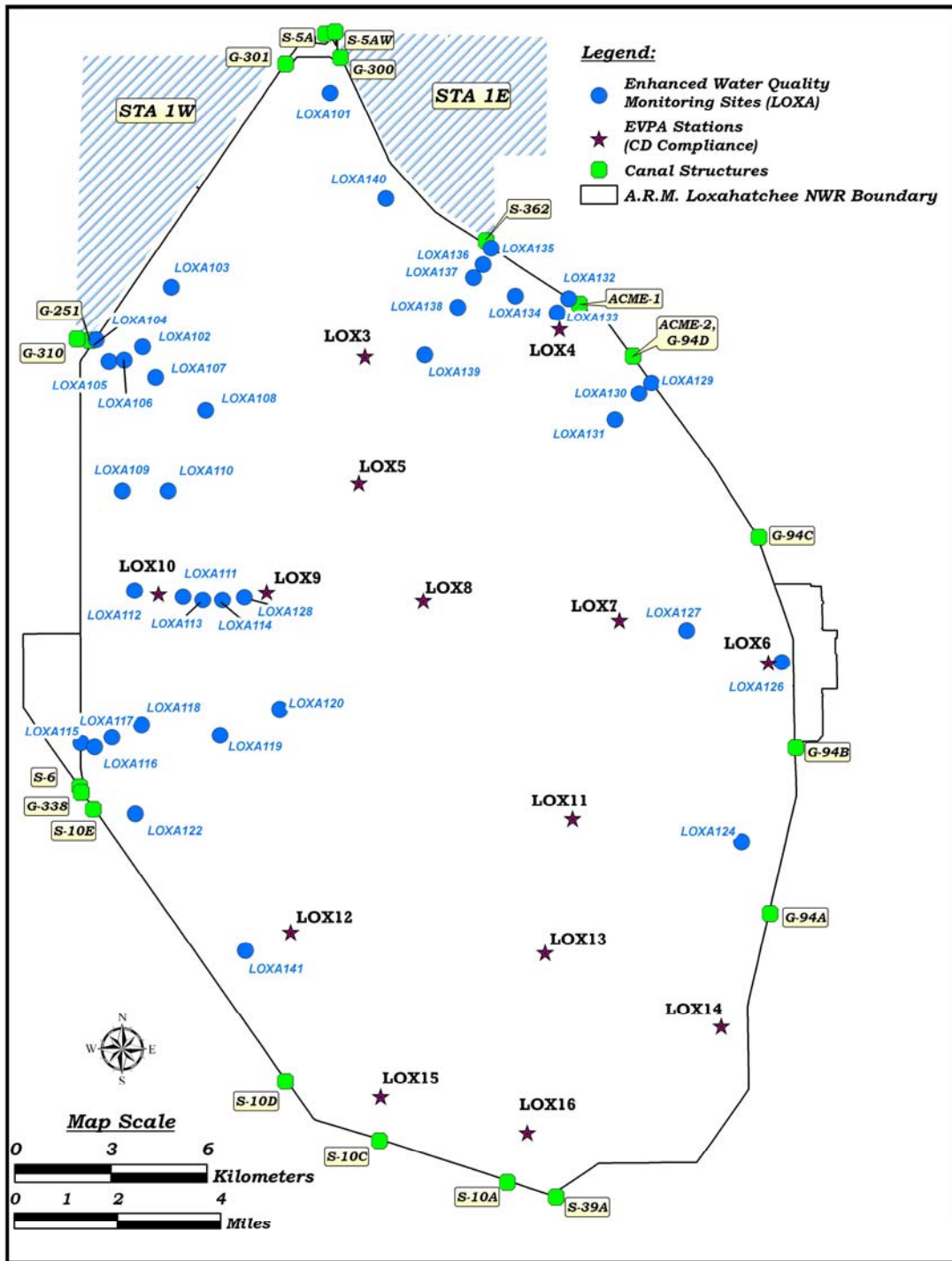


Figure 1. Location of Enhanced Water Quality Monitoring network stations (LOXA###), in relation to Consent Decree compliance stations (LOX##), for the A.R.M. Loxahatchee National Wildlife Refuge.

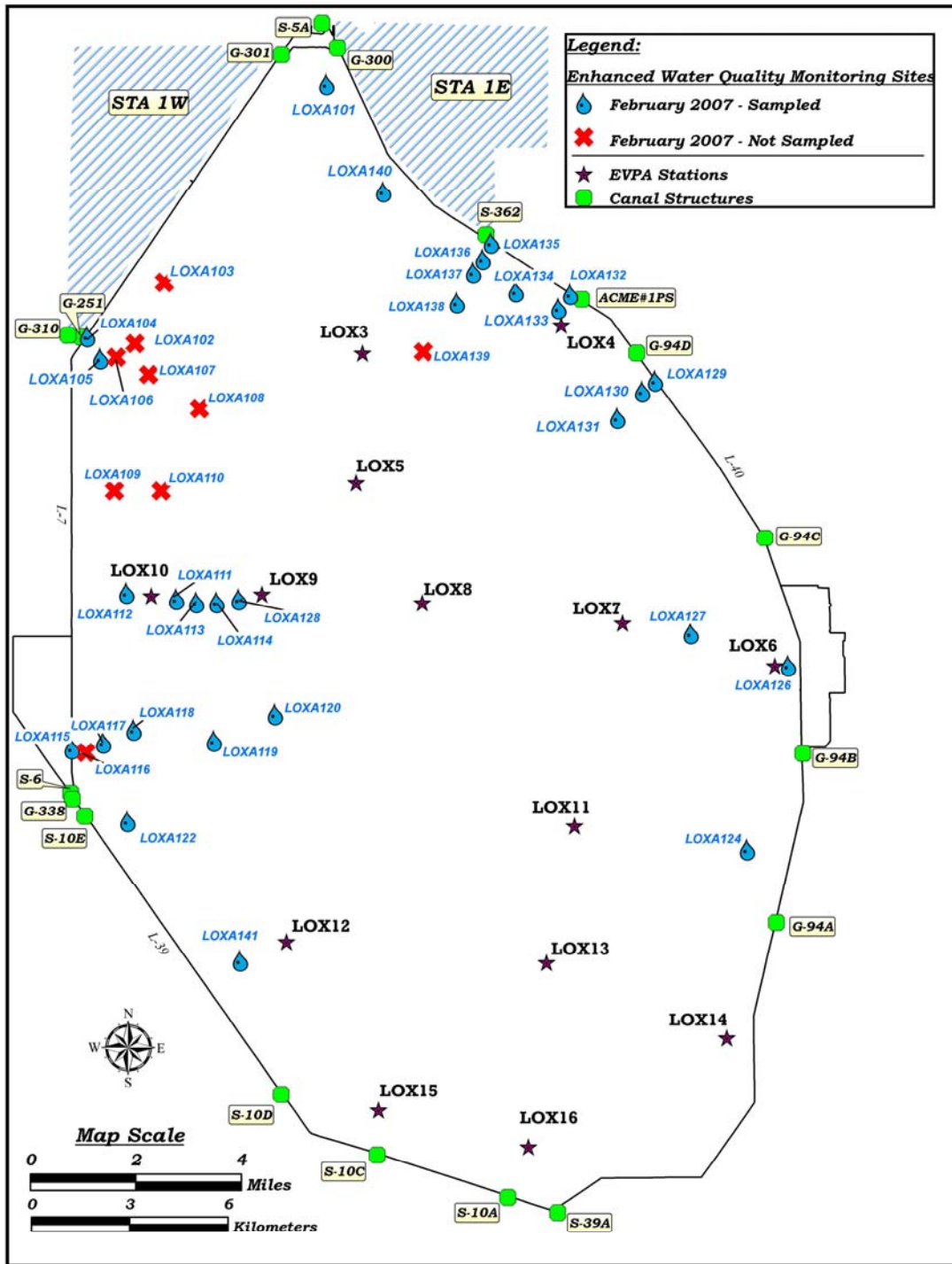


Figure 3. February 2007 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.

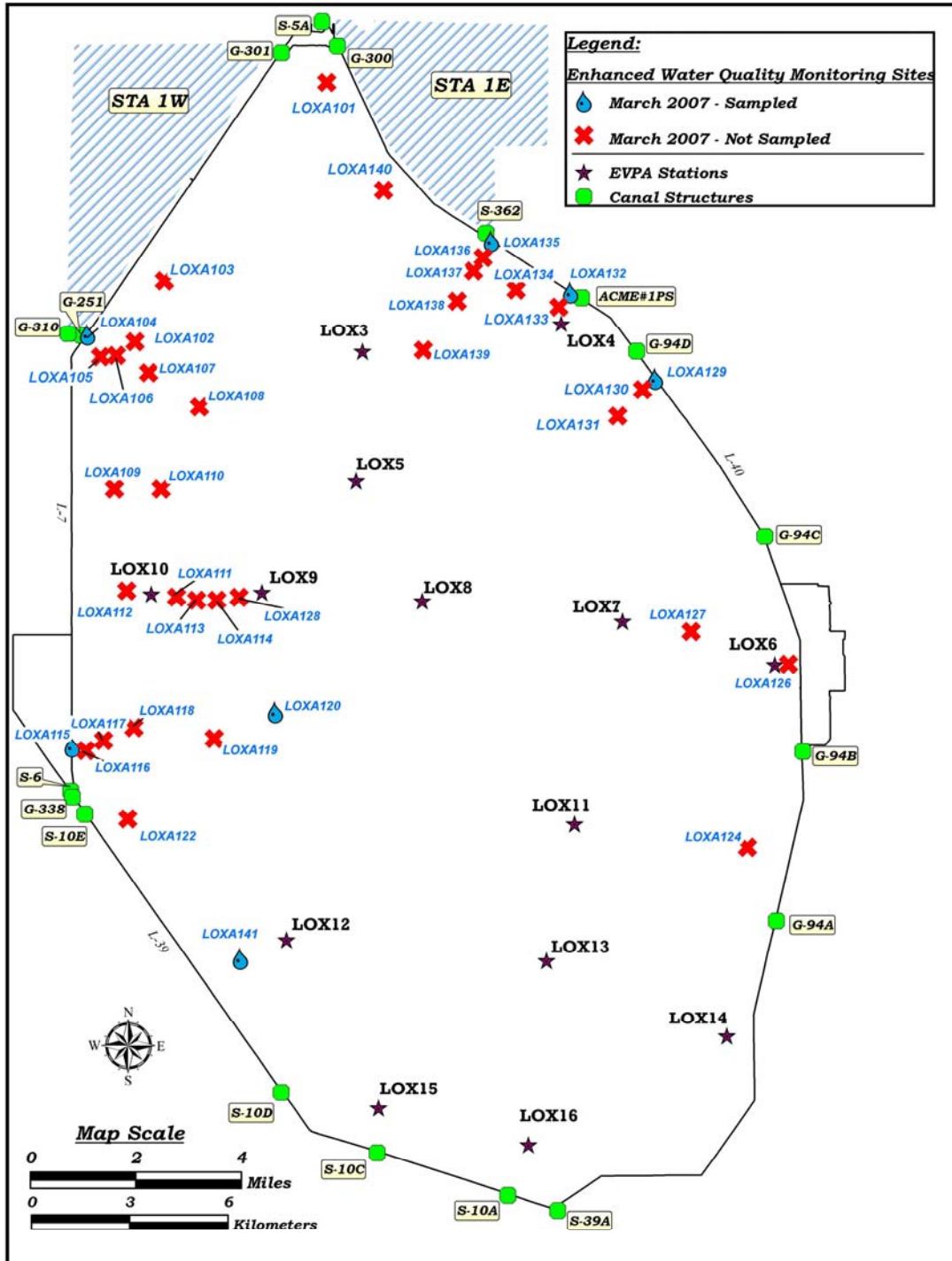


Figure 4. March 2007 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.