4/19/05

A.R.M Loxahatchee National Wildlife Refuge
Enhanced Water Quality Monitoring and Modeling

Interim Report

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Executive Summary

Congress appropriated funds to the U.S. Fish and Wildlife Service in 2004 to develop an enhanced water quality monitoring network and hydrodynamic and water quality models to improve the scientific understanding of water quality in the Arthur R. Marshall Loxahatchee National Wildlife Refuge and provides information that can be utilized in management decisions to better protect Refuge resources[2]. The enhanced water quality monitoring network complements the existing water quality compliance network created under the 1992 Federal Consent Decree by characterizing the water quality of a larger Refuge area, particularly the fringe area potentially impacted by canal water intrusions. The expanded monitoring network, initiated in June, 2004, consists of monthly grab samples collected at 39 canal and marsh stations, and continuous measurements of conductivity along 7 transects from the canal to the interior. This Interim Report covers the period of June 2004, through February 2005.

Data collected as part of this report show that intrusion of rim canal water into the Refuge interior is occurring. Intrusion of nutrient-rich and high conductivity water from the canal has the potential to negatively impact Refuge plants and animals. Therefore, analysis of these and future data from the Enhanced Monitoring Network will be important to recommend management practices that minimize such intrusion.

In general, conductivity values decrease with distance from canal stations toward the marsh interior, with the most interior marsh stations having values ten times lower than the canal. Sulfate values also decrease with distance toward the marsh interior, but total phosphorus values did not always show such a pattern.

Canal water intrusion probably is influenced by the relative water levels in the canal and adjacent marsh. When water levels in the canal are higher than in the marsh, intrusion of canal water is encouraged. The reverse also may be true – canal water levels lower than the marsh water levels probably discourages intrusion, although the results show that

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[1] Other contributors include: Nick Aumen, Joffre Castro, Bob Kadlec, Kevin Kotun, Leslie MacGregor, Ehab Meselhe, Sara O'Connell, Paul Teague
[2] Public Law 108-108; see House Report No. 108-195, p. 39-41 (2004)

some intrusion may occur even under these conditions. The period of record for this *Interim Report* was characterized by unusually dry conditions, except for the two hurricanes and their associated rainfall in September 2004. Intrusion occurred in August, September and October; the latter two were presumably related to the hurricanes.

Data collected thus far is in agreement with previous studies that have suggested intrusion. Conductivity values collected nearly simultaneously at numerous stations within the Refuge in March and September, 2004 suggest intrusion is occurring, particularly along the west side of the Refuge. Sediment total phosphorus data collected from the Refuge interior in 1991 illustrate elevated sediment total phosphorus concentrations that generally coincide with the location of canal water intrusion.

Model selection is underway for the hydrodynamic and water quality modeling effort, with final model selection and initial model development to begin this summer, 2005. The models will predict water movement and water quality within the Refuge, in support of management decision. Characterization of the rim canal around the Refuge will continue with initiation of the canal water quality monitoring and further canal profile work.

Future reports will be produced on an annual basis, analyzing data from the previous water year (May 1 through April 30). The next report will be produced in August, 2006, in order to shift to the water year reporting period. Data from the monthly grab samples will be continually updated on DBHYDRO. The Refuge will continue to make quarterly updates to the Technical Oversight Committee.

1. Introduction

Developing a sound technical understanding of the biological, chemical, and environmental characteristics of the Refuge is critical for management and protection of Refuge resources. At over 140,000 acres, the Refuge is a unique portion of the remnant Everglades ecosystem. This report presents information and results from new studies designed to improve the understanding of water quality characteristics of the Refuge, focusing particularly on the period from March 2004 to February 2005.

Section 1 provides background information on the program. **Section 2** provides a summary of the implementation of the program, including the water quality monitoring program, the hydrodynamic and water quality monitoring effort, and canal sediment and water quality characterization research. **Section 3** provides a descriptive summary of environmental data for the Refuge covering the period of March 2004 – February 2005. Characterization of water quality data from both the Refuge's Enhanced Water Quality Monitoring and Consent Decree compliance network programs are presented in this section. This summary also includes information about rainfall, hydrology and structure operations and some research by other agencies on synoptic surface water conductivity mapping, sediment soil phosphorus, and new topography information. Finally, this section also identifies other sources of relevant information that was not incorporated into this report. More data characterization is reported in the Appendices. **Section 4** presents information from conductivity sondes deployed along transects in the Refuge interior to increase our understanding of water movement. **Section 5** discusses several events that occurred during this reporting period: the 2004 hurricanes, and wildland and prescribed fires in the Refuge interior. **Section 6** provides a brief synthesis of the materials presented in this report and outlines the next steps in the program, including program implementation, data analyses, and future reporting.

Background

The Everglades, including the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge), developed as a rainfall-driven system with surface waters low in nutrients and inorganic ions such as chloride, sodium, and calcium, and, therefore, low in conductivity. Areas of pristine marsh throughout the Everglades have been impacted to various degrees by intrusion of water with high nutrients and other constituents. Information from the Refuge and other wetlands indicates that changes in phosphorus and major ions cause undesirable ecological changes in flora and fauna. A large amount of research conducted by state, federal, and private entities has demonstrated the impacts of small increases in concentration of total phosphorus. Changes in Everglades flora and fauna begin to occur at total phosphorus concentrations slightly higher than 10 ppb. In addition to elevated phosphorus concentrations, canal water has high conductivity compared to the naturally low conductivity marsh interior. Conductivity is a simple field measurement that provides a surrogate for concentration of major ions. Therefore, there are concerns that increases in canal water intrusion into the Refuge interior may cause negative ecological consequences because canal water is higher in nutrients. For example, Childers et al. (2003) documented changes in vegetation and soil phosphorus patterns in the Refuge.

In FY 04, Congress appropriated funds specifically to the Refuge for development of an enhanced water quality monitoring network and hydrodynamic and water quality modeling tools. The appropriation was intended, in part, to improve the scientific understanding of water quality issues in the Refuge and provide information that can be incorporated into water management decisions to better protect Refuge resources. The Refuge's existing water quality monitoring network used for Federal Consent Decree compliance characterized the central region of the interior marsh, leaving a relatively large region uncharacterized, predominantly in the outer, impacted fringe of the wetland. If a line is drawn to connect all the outer-most compliance stations, approximately 60% of the Refuge marsh is inside that region. The additional monthly sampling as part of the enhanced water quality monitoring program, thus, focuses on these uncharacterized areas. Further, as phosphorus, and other water quality parameters, are affected by water depth and other environmental factors, more information, such as data from this program, is needed to make valid comparisons with existing information to best characterize the entire marsh.

A work plan was developed by Refuge staff outlining studies in three areas: (1) increased numbers of monthly water quality sampling sites; (2) monitoring of canal water intrusion using surface water conductivity transects into the interior marsh; and, (3) development of hydrodynamic and water quality modeling. These areas are consistent with long-term goals identified in the Refuge's 15-year Comprehensive Conservation Plan (USFWS 2000) and recommendations made by the Technical Oversight Committee for addressing exceedances observed in interim phosphorus levels within the Refuge (http://www.sfwmd.gov/org/ema/toc/archives_mtgs.html#2004):

> <u>TOC Recommendation B. Enhancing Monitoring of the Refuge</u>
> *Design and implement an enhanced monitoring program to improve spatial and temporal understanding of factors related to phosphorus dynamics.*
>
> <u>TOC Recommendation C. Modeling of the Refuge</u>
> 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 for the Refuge.*

Additional funding provided by the Department of Interior in 2004 allowed for extending the duration of the program and for adding one additional component to the program: characterization of sediment and water quality in the perimeter canals of the Refuge.

Grab samples for water chemistry analysis were collected monthly by the Refuge beginning in June 2004, although many stations had insufficient water depths in June, July, and August from which to collect samples. Some of the conductivity instruments were deployed as early as March 2004. This report contains data through February 2005, and also includes data collected as part of the Refuge Consent Decree compliance network.

Report Objectives

1. To report the status of the enhanced monitoring and modeling projects.
2. To report and characterize water quality data collected over the project's period of record, especially for total phosphorus, sulfate, and conductivity.
3. To report and describe patterns of canal water intrusion into the Refuge interior, including initial patterns of conductivity, phosphorus and sulfate along transects from canal to interior.

As the grab sampling effort has not yet encompassed a full wet season/dry season cycle, this report is considered an interim report. Subsequent reports will be produced on an annual basis, coinciding with the Water Year reporting cycle (May 1 – April 30) used by the South Florida Water Management District and others. The next annual report will be produced by August 1, 2006.

Because of the limited period of observations, this report focuses on the description of data patterns and does not attempt to explain observed patterns. The initial Work Plan (Brandt et al. 2004) did not envision data interpretation until after more than one year of data collection because of environmental variability. It is expected that a longer period of record available in subsequent reports will increase the ability to develop causal relationships between water quality patterns, trends, and other factors such as water management practices.

2. Program Implementation Update *(Report Objective 1)*

The Refuge's Enhanced Water Quality monitoring program (referred to as LOXA), an expanded water quality monitoring network of 39 stations (a combination of transects and individual sites), has been designed and established (Fig. 1). This program network involves a combination of monthly water quality grab samples at all locations and a series of continuous monitoring of conductivity along transects. Specific details about the Work Plan are presented in Brandt et al. (2004). Water quality stations along seven transects (two in cooperation with the USGS) have been equipped with water conductivity data loggers to continuously collect conductivity and temperature data.

Monthly water quality grab sampling for LOXA is designed to be as similar as possible as the Consent Decree compliance monitoring program (e.g., same collection protocols, collection staff, laboratory analyses by SFWMD, data QA/QC, data availability, etc.). The parameters analyzed for the monthly grab samples of the LOXA program are the same that are analyzed for the Consent Decree compliance network (Appendix A). The Refuge has adopted a *Field Sampling Quality Manual* for both programs. This manual adopts, by citation, the South Florida Water Management District's *Field Sampling Quality Manual* (SFWMD; Version 2.0; 01/03/05) and includes other information specific to the Refuge. The Refuge's manual incorporates the current 4-page training checklist for water quality projects.

Final data for monthly grab samples for LOXA are posted on DBHYDRO by the SFWMD (http://www.sfwmd.gov/org/ema/dbhydro/index.html), the same location where data are available from the Consent Decree monitoring network. Both raw and summarized data from March 2004 – February 2005 are presented in this report in tables, figures, and maps. Field notes and laboratory "header sheets", archived electronically on a regular basis, are maintained by the Refuge, and are available.

Additionally, Dr. Samira Daroub (UF – IFAS) is under a cooperative agreement with the Refuge and is conducting a series of canal hydrographic surveys and synoptic water quality surveys in the perimeter canals of the Refuge to better understand the potential impact of pollutant-rich sediments being entrained into surface water. The first sediment survey field effort is complete, and these data are undergoing initial review. The first canal water quality survey component will completed by summer 2005.

Dr. Ehab Meselhe (University of Louisiana – Lafayette) is under a cooperative agreement with the Refuge and is finalizing efforts related to model selection, which will be completed by the end of spring 2005. Additionally, he is working on collecting relevant environmental data for hydrodynamic and water quality model development. Dr. Vince Neary (Tennessee Technological University), also under cooperative agreement with the Refuge, has established and convened an external technical panel to provide review of the model selection process and review of the development of the modeling tool(s) over time. This panel's model selection review report will be completed by the end of spring 2005. Refuge staff have worked with USGS to post current information on the review panel at: http://sofia.usgs.gov/advisorypanel/.

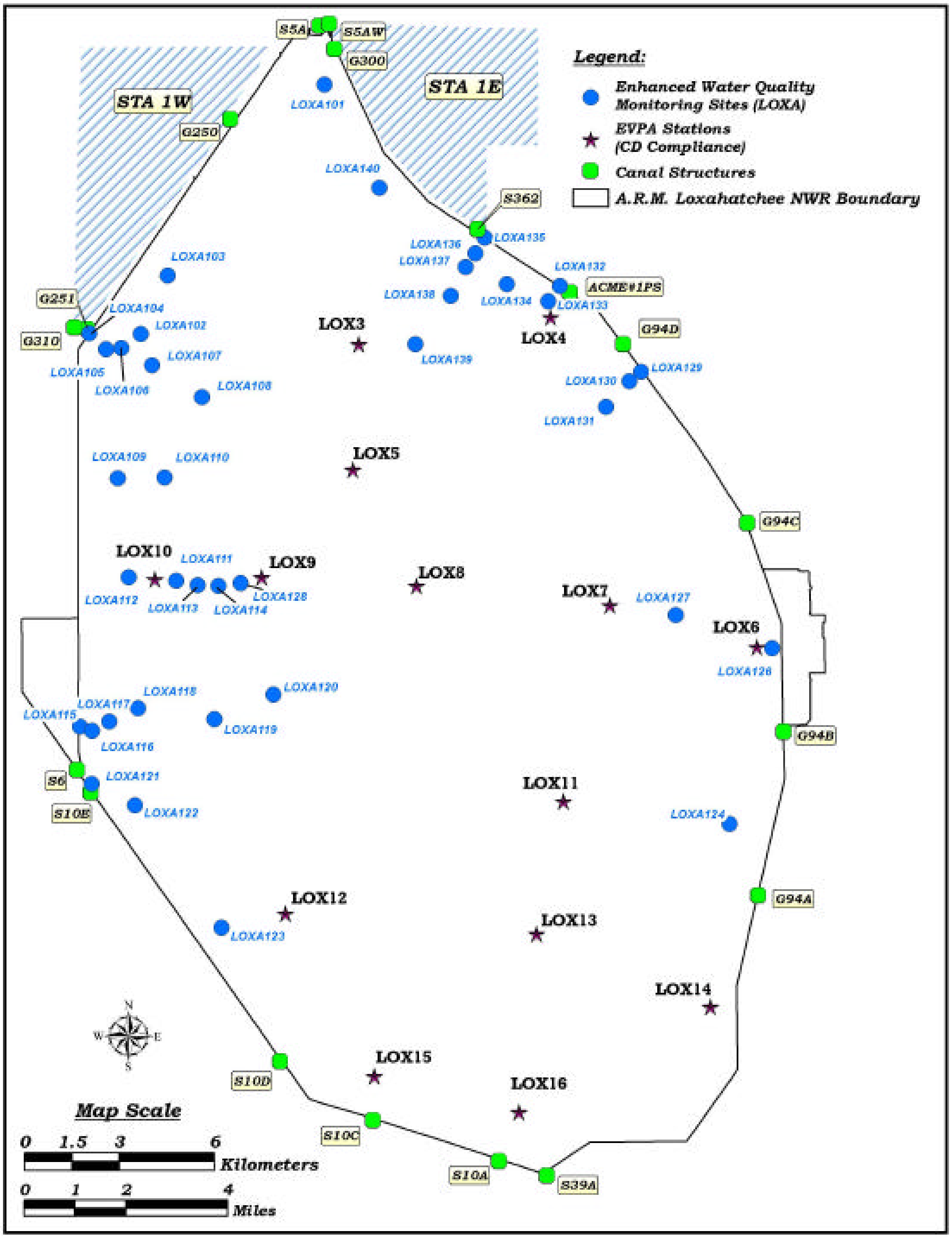


Figure 1. Location of Refuge's Enhanced Water Quality Monitoring network stations (blue circles, labeled LOXA###) and Consent Decree compliance stations (red stars, labeled LOX##). Location of conductivity sondes (not shown here) are presented in Table 2.

3. Environmental and Water Quality Data Overview *(Report Objective 2)*

Rainfall monitoring

Rainfall and other meterological parameters are monitored by the South Florida Water Management District and others. As an annual average, rainfall and potential evapotranspiration in the Refuge area are very similar (Abtew et al. 2005).

The period of this report was characterized by a dryer-than-average dry season, a delayed onset of the wet season, and several tropical storms. An empirical frequency curve of annual total rain at the S-5A structure (north end of the Refuge) shows that total rainfall in 2004 was well below average (Fig. 2).

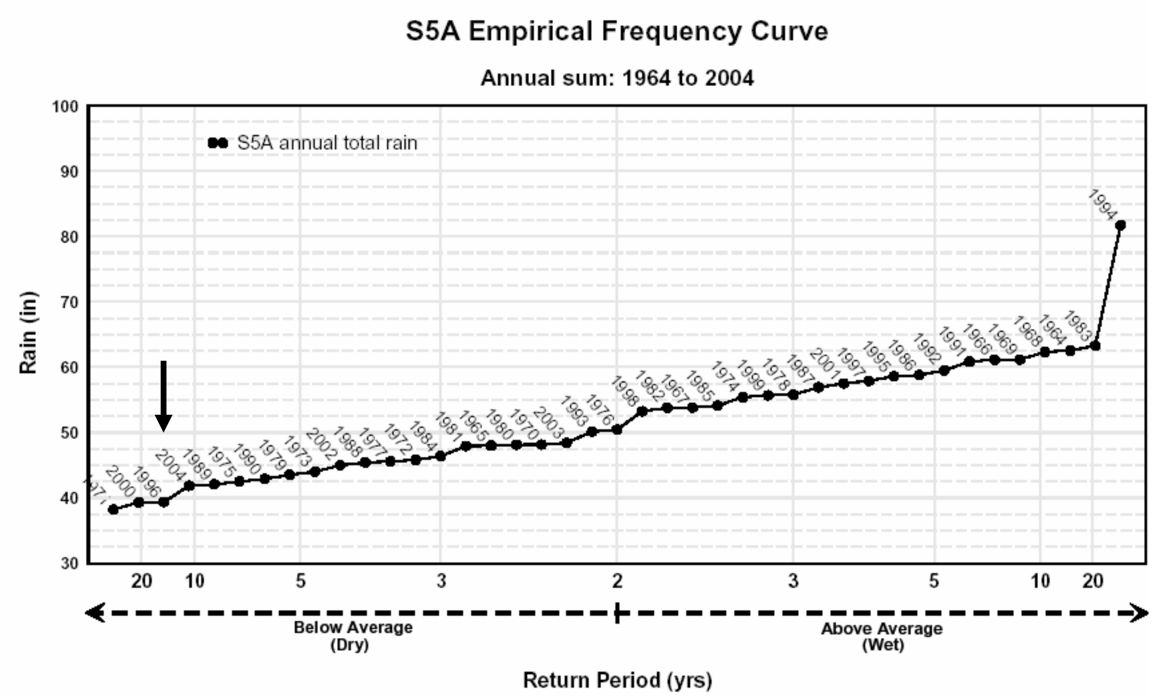


Figure 2. S-5A annual total rainfall for 2004 (arrow) relative to other years from 1964-2004 (SFNRC 2005).

Rainfall in the Refuge also is spatially heterogeneous, with higher mean rainfall typically occurring on the eastern side of the Refuge (Fig. 3).

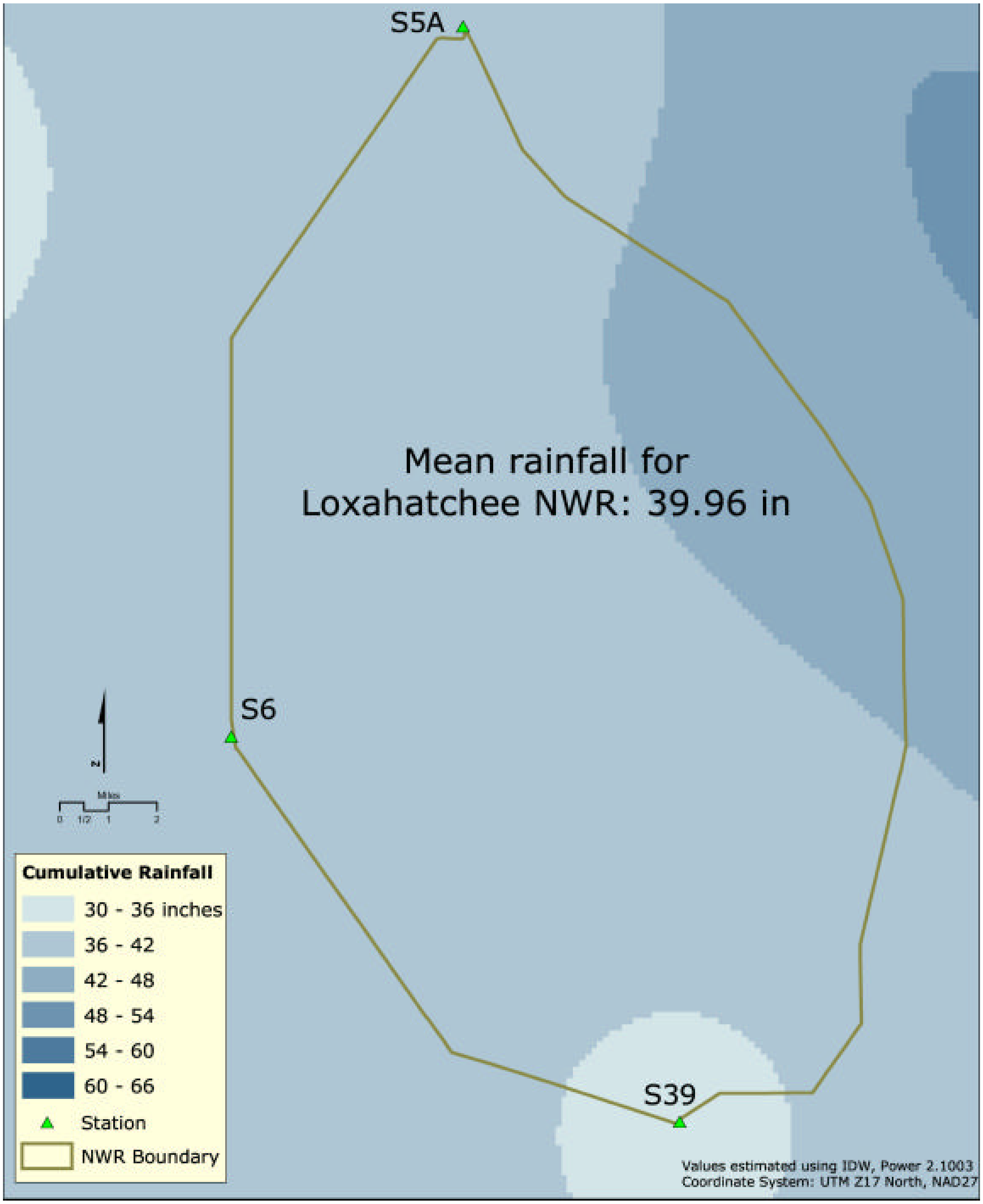


Figure 3. Estimated cumulative rainfall for the Refuge from March 1, 2004 – February 28, 2005 based on rainfall station data (stations outside the boundary not shown). (SFNRC 2005)

Hydrology
From June 2004 – February 2005, daily stage in the Refuge ranged from just below 15 feet to just above 17 feet (Fig. 4). Inflows into the rim canal around the Refuge ranged from zero to more than 4500 cfs (Fig. 5-a). Timing of water quality sampling events relative to rim canal inflows is presented in Fig. 5-a; Fig. 5-b shows the sampling events relative to net inflows to the Refuge (rim canal inflow – rim canal outflow).

Hydraulic gradients between the rim canal and the interior marsh, examined by comparison of structure tailwater stage to marsh stage, are useful to estimate the potential for canal water intrusion into the interior marsh (Walker 2004). Examples of this are presented in Figure 6, and illustrate the likelihood of canal water intrusion during certain time periods. Periods of net inflows to the Refuge often correspond to periods of positive hydraulic gradients into the marsh.

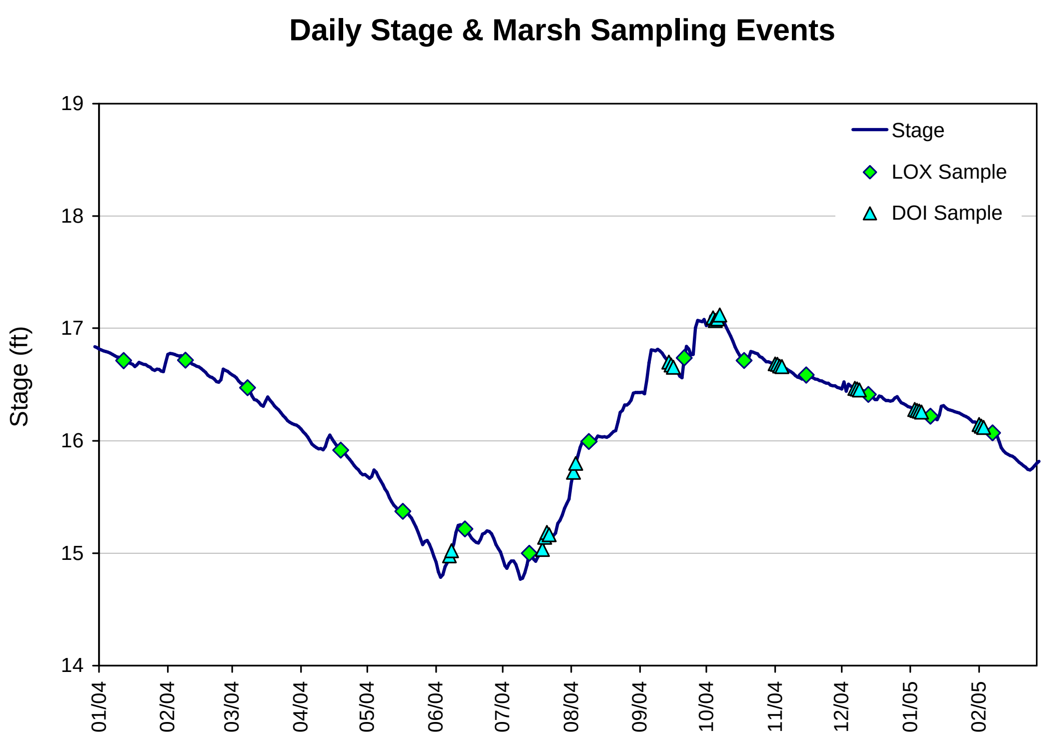
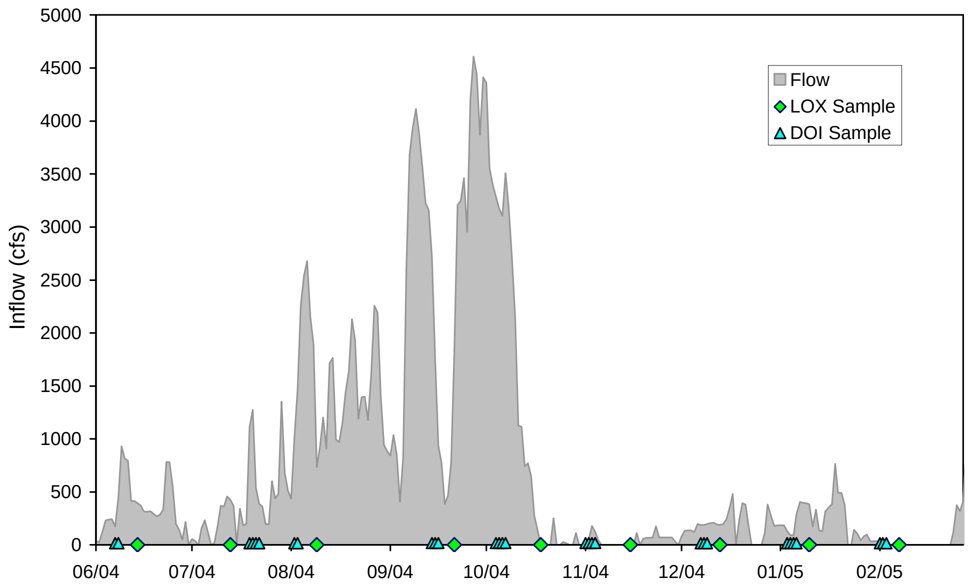
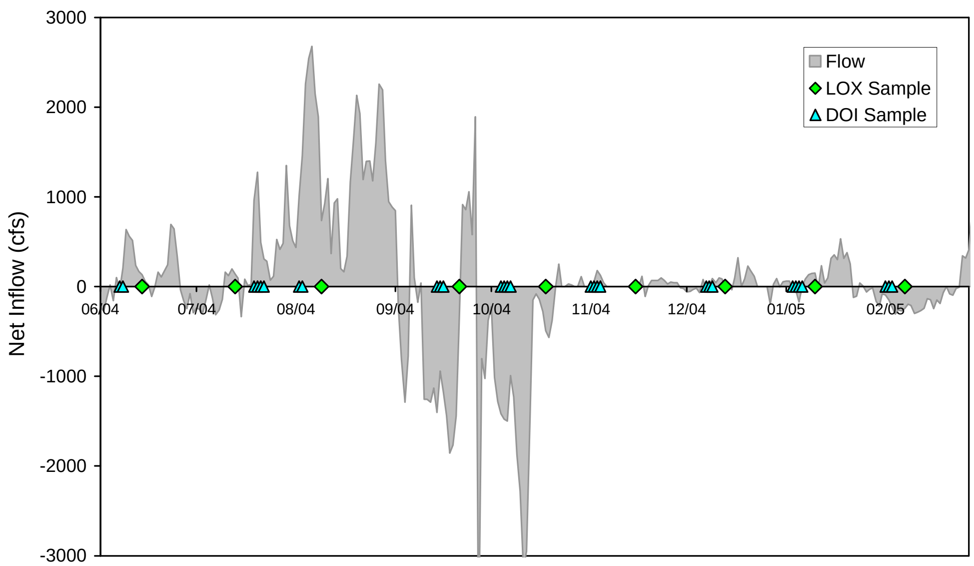


Figure 4. Water quality sampling events as they relate to daily stage (defined as the average of the 8C, 7, 9 stations). Consent Decree compliance sampling events are shown by the green diamonds (“LOX Sample”). The LOXA sampling events are shown by the blue triangles (“DOI Sample”).

a) **Rim Canal Daily Inflow & Sampling Events**



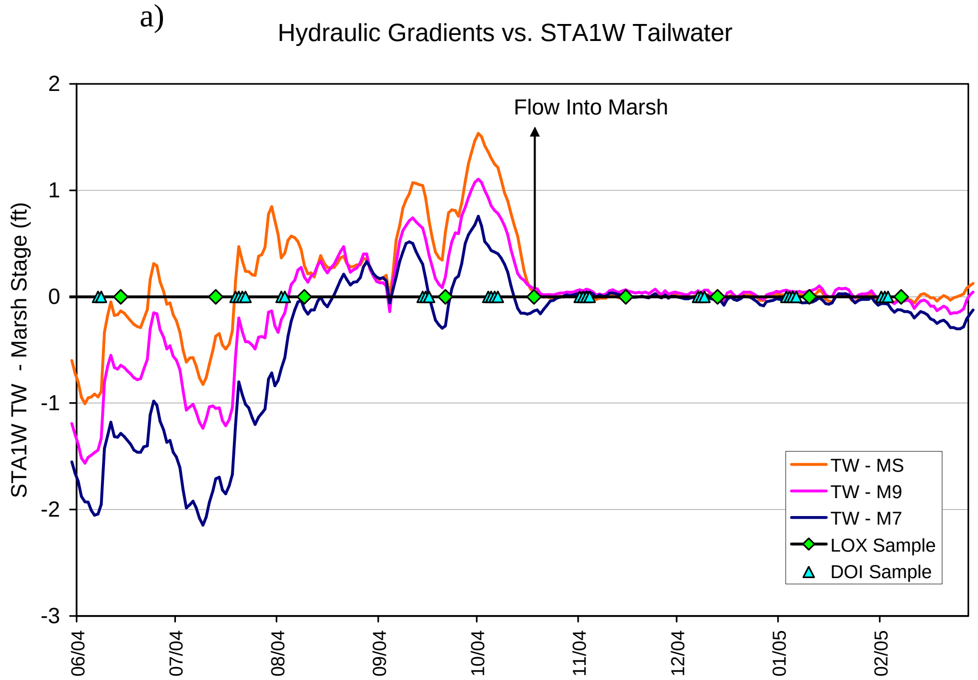
b) **Rim Canal Daily Net Inflow & Sampling Events**



Net Inflow = Total Inflows - Total Outflows from Rim Canal

Figure 5. Timing of water quality sampling events relative to water movement in the rim canals of the Refuge: a) daily inflows; b) net inflows (rim canal inflow – rim canal outflow) reported in cubic feet per second (cfs). Consent Decree compliance sampling events are shown by the green diamonds (labeled “LOX Sample”). The Refuge’s Enhanced Water Quality Monitoring sampling events are shown by the blue triangles (labeled “DOI Sample”).

a)



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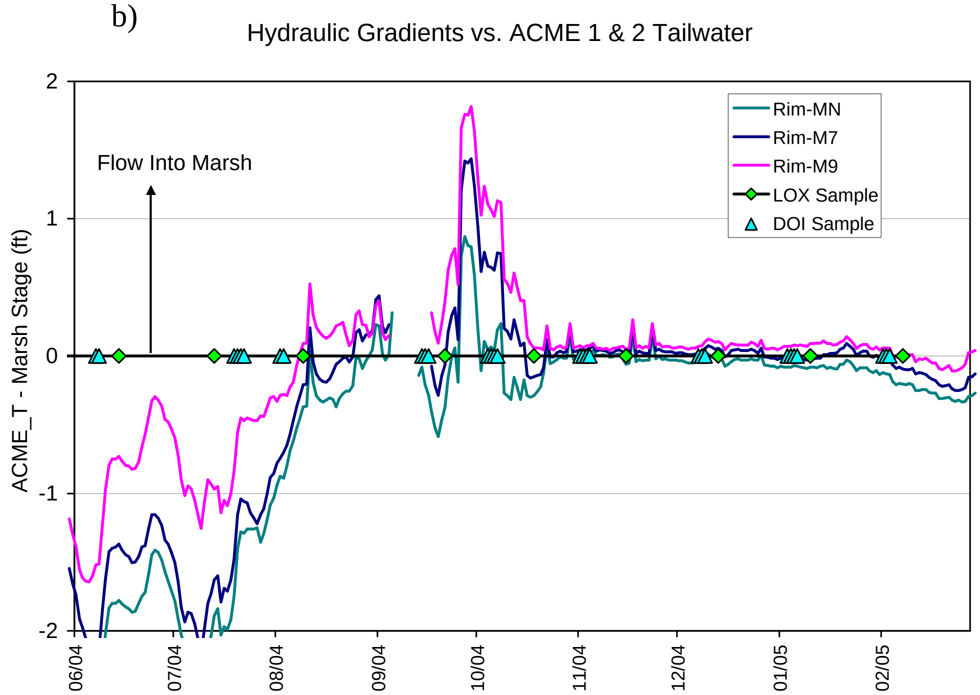


Fig. 6a. Hydraulic gradients on the western side of the Refuge near STA-1W. **Fig. 6b**. Hydraulic gradients on the eastern side of the Refuge near Acme discharge structures. Consent Decree compliance sampling events are shown by the green diamonds (labeled "LOX Sample"). The Refuge's Enhanced Water Quality Monitoring sampling events are shown by the blue triangles (labeled "DOI Sample").

Water Quality Sampling

Monthly water quality grab samples have been collected at the 39-station network of the Refuge's Enhanced Water Quality Monitoring program (Fig. 1) from June 2004 to present. For this report, data were analyzed through February 2005. Because of staff and helicopter logistical constraints, the samples collected for the Refuge's Enhanced Water Quality Program cannot be collected on the same dates as the 14-station Consent Decree compliance monitoring samples. However, samples for the two programs are collected with as little temporal separation as possible. As for the compliance monitoring program, a large suite of water quality parameters (Appendix A) are analyzed when there is a clear water column depth of 20 cm or greater. When the depth of the clear water column is between 10 and 20 cm, samples are collected for total phosphorus only using a smaller bottle. For the Refuge's Enhanced Water Quality Monitoring program, starting in December 2004, additional water was collected (in a second bottle) for sulfate and chloride for stations where water depths were between 10 and 20 cm.

Continuous-recording data sondes (also referred to as minisondes) have been deployed across multiple transects to monitor specific conductivity in surface water of the Refuge interior. Sondes have been deployed along a series of transects in different areas of the Refuge interior (deployment history is presented in Appendix A).

Water Quality Data – Descriptive Summary

Twenty-seven water quality parameters were measured for each grab sample from the Refuge's Enhanced Water Quality Monitoring network (Appendix A). All of these parameters also are analyzed as part of the Consent Decree compliance network. In addition to total phosphorus, this *Interim Report* focuses on spatial and temporal patterns of temperature-compensated electrical specific conductance (conductivity) and sulfate (SO_4) concentration. Both parameters provide insight into water movement and mixing between canal water and water originating as rainfall in the central part of the Refuge. Both sulfate concentration and conductivity are much higher in canal water than in interior marsh surface water. Conductivity is highly correlated with concentration of major inorganic ions and is often used as a surrogate for total dissolved solids concentration (TDS). Conductivity acts as a "conservative tracer" of canal water; that is, there are no biological or chemical processes in the surface water that significantly alter conductivity. Sulfate concentration also provides a tracer for canal water, but is not conservative; there are significant biochemical reactions in wetlands that reduce sulfate. Thus, presence of elevated conductivity at a Refuge marsh site is evidence of canal water intrusion, while elevated sulfate concentration is evidence of recent canal water intrusion. Understanding gained in future modeling efforts will better quantify these qualitative assessments.

General descriptive statistics on most of the other water quality parameters are presented in Appendix A. Raw grab sample data are available on DBHYDRO, and raw sonde data are now available upon request from Refuge staff. Water quality data for total phosphorus, specific conductivity, and sulfate in the Refuge interior are presented in Appendix C, and Refuge maps illustrating parameter values graphically along transects are presented in Appendices D and E. Water quality data at Refuge inflow and outflow structures are collected by the South Florida Water Management District. Summary data for the reporting period are presented Appendix B.

Sampling network design focused on characterizing potential water quality gradients from the perimeter canal inward to the marsh interior. Many of the stations were located along transects from the canal inward. For data evaluation purposes, distances between the rim canal and each station are presented in Table 1. Future annual reports may explore additional parameters in greater detail.

Table 1. Distance between stations and the nearest point in the rim canal (provisional data) in different regions of the Refuge. LOXA### = Refuge's Enhanced Water Quality Monitoring network; LOX# = Consent Decree compliance network.

Region	Station ID	**Distance from canal (m)**	**Region**	Station ID	**Distance from canal (m)**
STA-1W Transect	LOXA104	Canal	S-5A area	LOXA101	785
	LOXA105	726		LOXA140	853
	LOXA106	1,102			
	LOXA107	2,211	STA-1E Transect	LOXA135	Canal
	LOXA108	3,911		LOXA136	561
	LOX5	8,144		LOXA137	1,086
				LOXA138	2,108
STA-1W Other	LOXA102	1,357		LOXA139	4,011
	LOXA103	1,004		LOX5	8,144
	LOXA109	1,228			
	LOXA110	2,704	STA-1E Other	LOXA140	853
	LOX3	4,566		LOXA134	838
				LOX3	4,566
S-6 Transect	LOXA115	Canal			
	LOXA116	338	Acme 1	LOXA132	Canal
	LOXA117	899		LOXA133	578
	LOXA118	1,807		LOX4	1152
	LOXA119	4,226			
	LOXA120	6,098	Acme 2	LOXA129	Canal
	LOX11	6,566		LOXA130	464
				LOXA131	1,532
S-6 area	LOXA121	103			
	LOXA122	830	Central Transect	LOXA112	1,546
				LOX10	1,189
South Area	LOXA123	843		LOXA111	3,054
	LOXA124	1,359		LOXA113	3,732
	LOX11	6,566		LOXA114	4,383
	LOX12	2,702		LOXA128	5,079
	LOX13	6,637		LOX9	5,507
	LOX14	1,233		LOX8	9,688
	LOX15	1,249		LOX7	5,489
	LOX16	2,013		LOXA127	3,060
				LOX6	1,054
				LOXA126	292

Water Quality in the Marsh
One of the primary suites of Refuge management questions relating to water quality include: How do conductivity, phosphorus, and sulfate change as you move from canal to the interior marsh over the period of record? Are patterns related to rainfall, canal stages, marsh elevation, water management activities such as bypass, or others? Are these patterns different in different parts of the Refuge, and to the change seasonally? The data presented here provides the groundwork for more detailed analyses with data from a longer time period to help address some of these questions.

Total Phosphorus data

Table 2. Total phosphorus data (ppb) from the Consent Decree compliance network (a) and canal (b) and marsh (c) stations from the Refuge's Enhanced Water Quality Monitoring network (LOXA). The samples from these two programs are not collected on the same dates, but are collected with as few days as logistically possible between them.

a) Consent Decree compliance network - total phosphorus (ppb)

Canal Stations	June 2004	July 2004	Aug 2004	Sep 2004	Oct 2004	Nov 2004	Dec 2004	Jan 2005	Feb 2005
LOX3				8		24	38		
LOX4			54	12	11	10	13	8	26
LOX5				14	12	10			
LOX6			17	7	7	5	5	6	6
LOX7			16	8	8	8	14	9	12
LOX8			26	6	8	7	11	7	9
LOX9			10	7	7	10	18	11	
LOX10			13	12	10	8	13	9	14
LOX11			15	9	9	8	9	8	10
LOX12	47	21	33	9	9	7	7	8	6
LOX13			13	9	10	8	10	10	9
LOX14			13	8	8	6	7	6	7
LOX15	34		10	6	8	8	9	7	7
LOX16			20	8	10	6	5	7	8
Max	47	21	54	14	12	24	38	11	26
Min	34	21	10	6	7	5	5	6	6

b) Canal stations from LOXA- total phosphorus (ppb)

Canal Stations	June 2004	July 2004	Aug 2004	Sep 2004	Oct 2004	Nov 2004	Dec 2004	Jan 2005	Feb 2005
LOXA104	40	23	22	210	237	98	93	93	100
LOXA115	55	26	29	181	200	73	53	51	100
LOXA129	82	80	76	246	499	66	58	60	81
LOXA132	86	77	64	256	574	76	60	61	88
LOXA135	81	95	53	257	649*	96	84	66	79
Max	86	95	76	257	649	98	93	93	100
Min	40	23	22	181	200	66	53	51	79

* = this value is the average of 2 readings of the sample (645 ppb; 653 ppb).

c) Marsh stations from LOXA- total phosphorus (ppb)

Marsh Stations	June 2004	July 2004	Aug 2004	Sep 2004	Oct 2004	Nov 2004	Dec 2004	Jan 2005	Feb 2005
LOXA101				22	53	18	14	11	11
LOXA102				15	15	10	12	11	
LOXA103				19	12	9	12	15	42
LOXA105				58	232	25	23	17	23
LOXA106				14	48	11	7	10	14
LOXA107			16	10	9	7	12		
LOXA108			17	10	12	8	6		
LOXA109			22	14	8	10	8	9	8
LOXA110			15	9	7	11	17	24	
LOXA111			8	9	9	6	13	22	12
LOXA112				15	13	8	9	10	12
LOXA113	14		10	7	8	7	8	9	17
LOXA114	33	18	13	8	9	6	10	15	
LOXA116			74	47	199	38	67	47	32
LOXA117			19	22	15	13	18	8	12
LOXA118	18		6	8	6	6	9	6	6
LOXA119	19	10	8	6	6	9	13	12	5
LOXA120	16		8	7	6	8	9	12	7
LOXA121			80		136	32	179	91	117
LOXA122			17	14	10	11	10	9	12
LOXA123			25	14	8	14	14	9	9
LOXA124				69	151	15	15	9	15
LOXA126			33	11	8	9	6	7	10
LOXA127			27	15	6	8	9	6	7
LOXA128			16	10	7	8	21	11	
LOXA130				52	212	19	11	15	16
LOXA131				10	10	5	6	6	7
LOXA133				177	322	65	98	265	
LOXA134				23	216	24	26	34	16
LOXA136				91	238	64	40	154	77
LOXA137				28	57	23	14	12	31
LOXA138				14	10	10	18	12	10
LOXA139				13	8	13	14		
LOXA140				30	31	13	13	12	26
MAX	33	18	80	177	322	65	179	265	117
MIN	14	10	6	6	6	5	6	6	5

Transect analyses

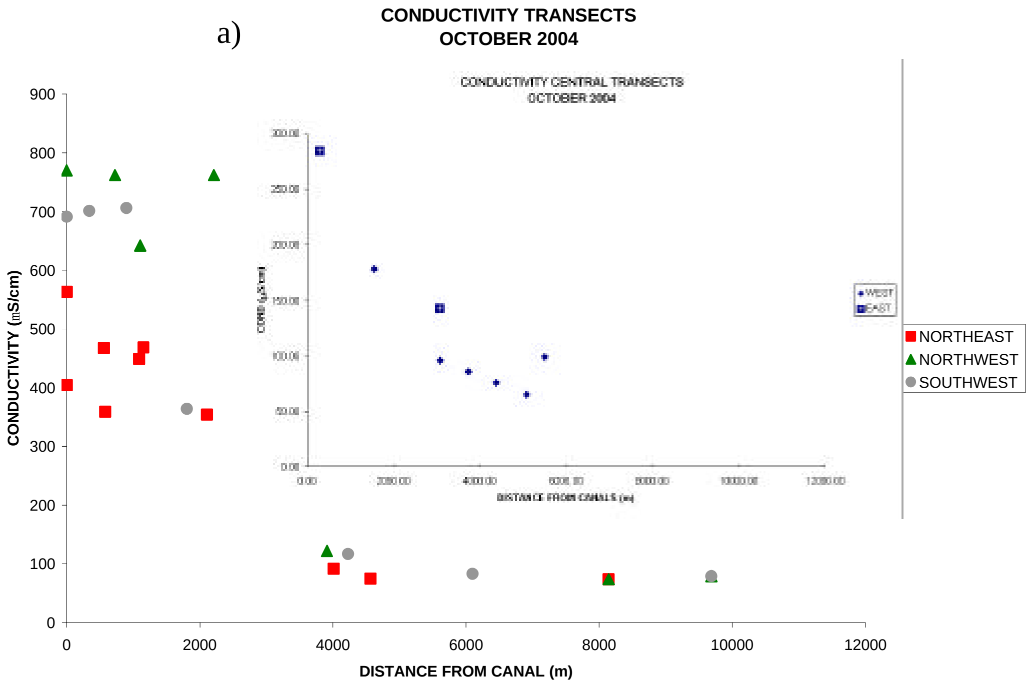
As the presence of elevated conductivity at a Refuge marsh site is evidence of canal water intrusion, the first step to analyze water quality data along a transect from the canal towards the marsh interior begins with examining conductivity data. With this frame of reference, examining total phosphorus, or other parameters, follows.

Northwest (STA-1W) and southwest (S-6) Refuge conductivity transects in October 2004 and January 2005 have the highest conductivity values near the canals, whereas the northeast (STA-1E) and central transects have lower conductivity values near the canals (Fig. 7). Patterns of conductivity versus distance from canals shows that there is greater marsh intrusion of high conductivity on the west side of the Refuge than on the east side. Conductivity along all transects generally are higher than 300-400 μS/cm until several kilometers into the interior marsh. This range, based on recent research (SFWMD 2005), is considered the general range dividing un-impacted areas by lower ionic concentrations from more impacted areas by higher concentration. Conductivity data from the interior-most stations consistently are below 200 μS/cm.

These general conductivity patterns illustrated here for October 2004 and January 2005 are similar to those that occur throughout the year (Appendices D, E, and F), with a greater intrusion of conductivity into the interior marsh observed in August 2004, and in September and October 2004 as a result of the 2004 hurricanes and associated structure discharges. These conductivity transect data reveal similar patterns to those illustrated in the Refuge-wide synoptic conductivity maps from March and September 2004 (see below). The relative balance of Refuge outflows and inflows (Fig. 5) and lack of hydraulic gradients (Fig. 6) after October 2004 were not conducive for extensive transport from the rim canal to Refuge interior.

Representative transect data for total phosphorus and sulfate are presented in Figures 8 and 9, and full data appear in Appendices F. Spatial patterns in total phosphorus concentration data along the transects are less clear than for sulfate or conductivity data. This difference is expected due to the non-reactive (conservative) nature of conductivity as compared to the highly reactive nature of total phosphorus, particularly in the phosphorus-limited Everglades ecosystem. Sulfate may be more conservative than total phosphorus, but is non-conservative and displays decreasing gradients from the canal inward.

a)



b)

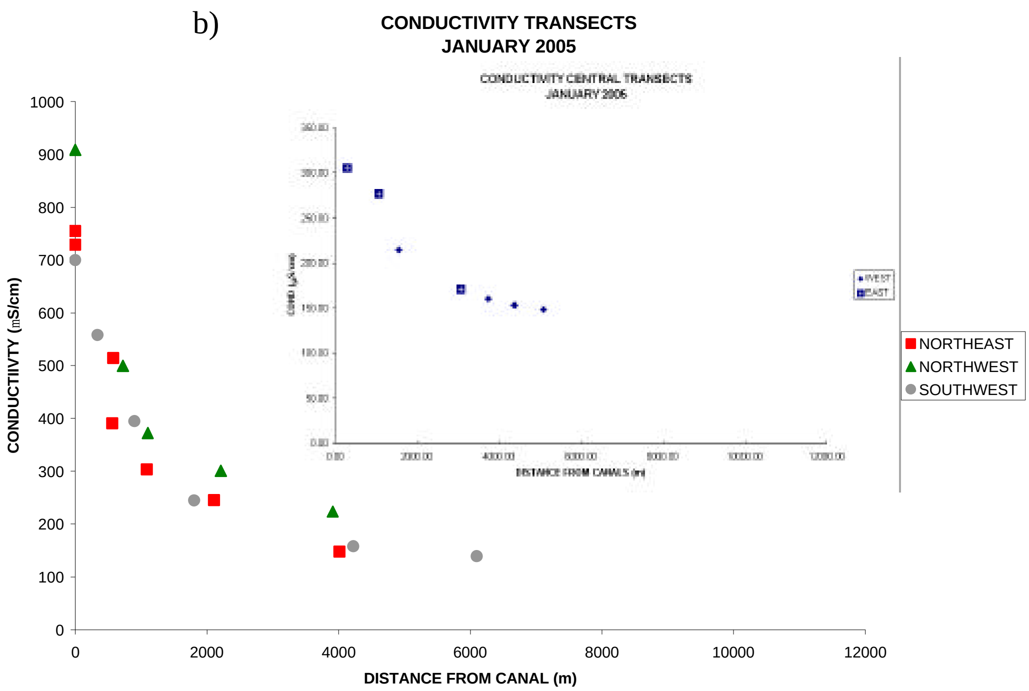


Figure 7: Conductivity versus distance from the canal along a series of transects during: (a) wet season (October 2004) when the canal stage is greater than the interior marsh, and (b) dry season (January 2005) when the canal stage is lower than that of the interior marsh. Inset graphs show the central transect: West starts at the L-7 canal and goes to LOX8; East starts at the L-40 canal and goes to LOX8. Stations and distances from Table 1.

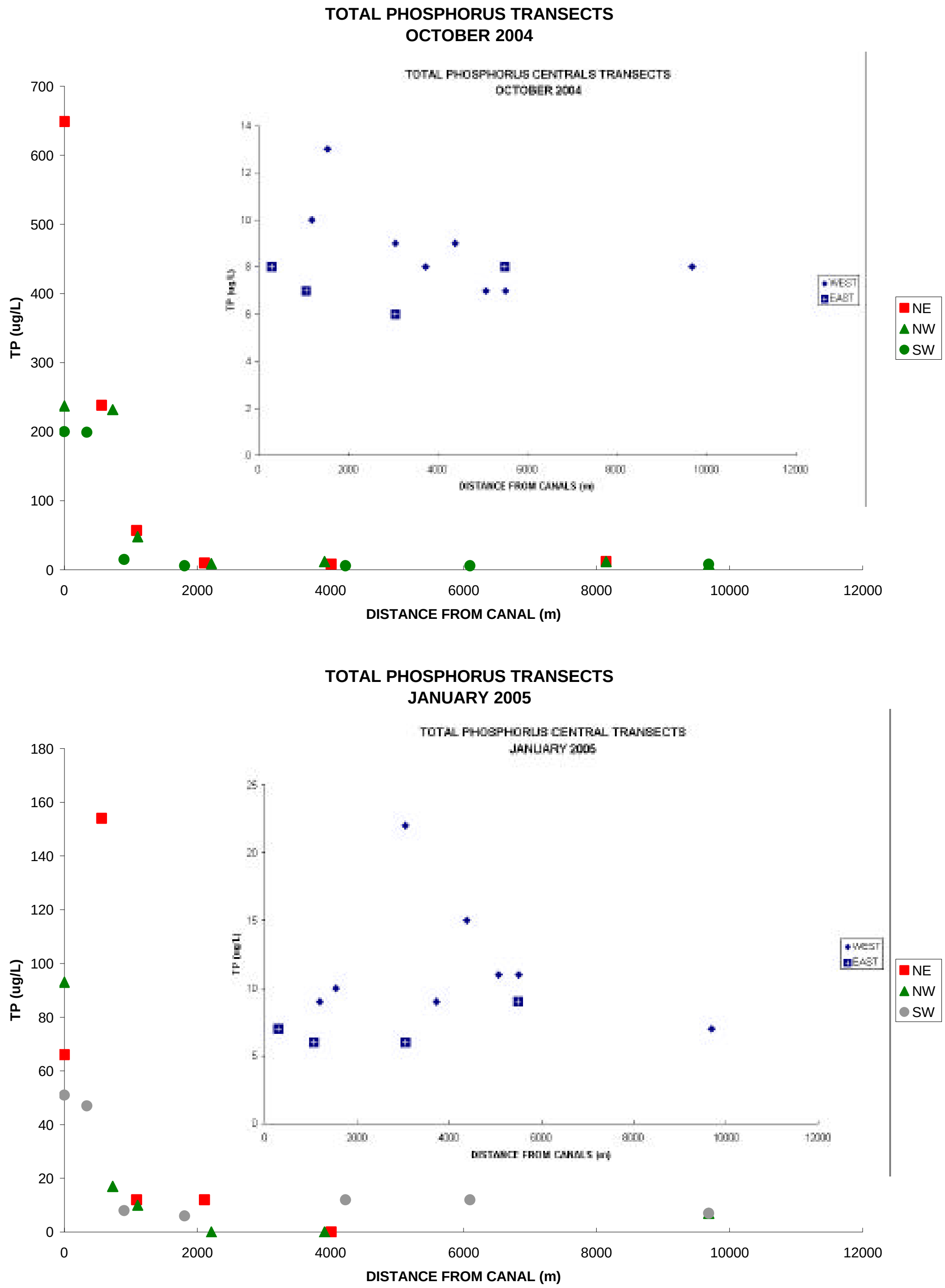
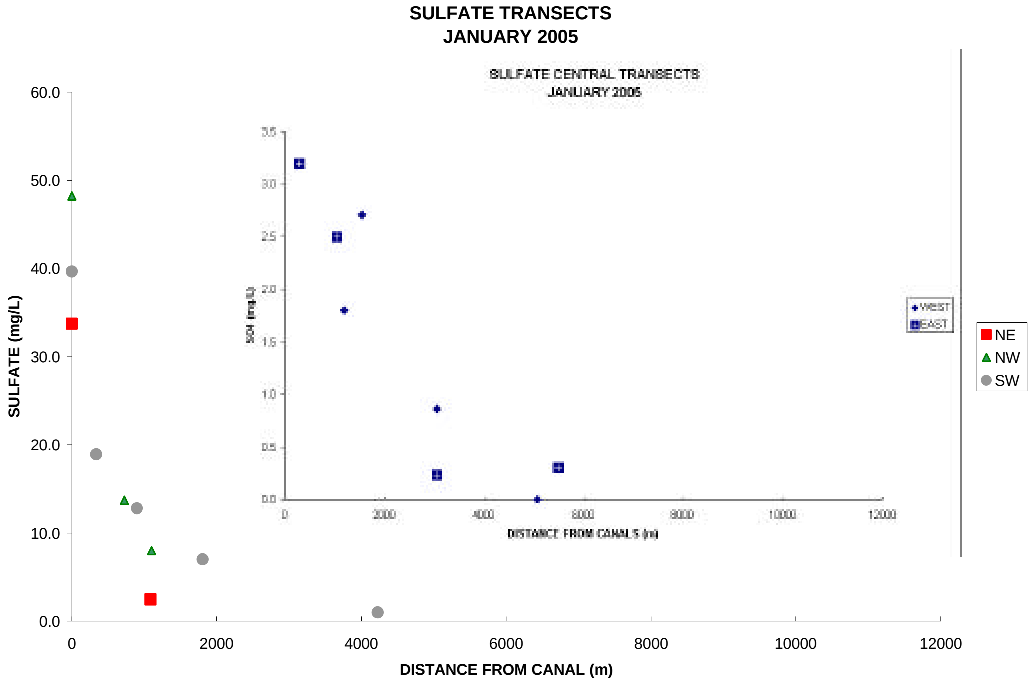


Figure 8: Total phosphorus versus distance from the canal along a series of transects during: (a) wet season (October 2004) when the canal stage is greater than the interior marsh, and (b) dry season (January 2005) when the canal stage is lower than that of the interior marsh. Inset graphs show the central transect: West starts at the L-7 canal and goes to LOX8; East starts at the L-40 canal and goes to LOX8. Stations and distances from Table 1.



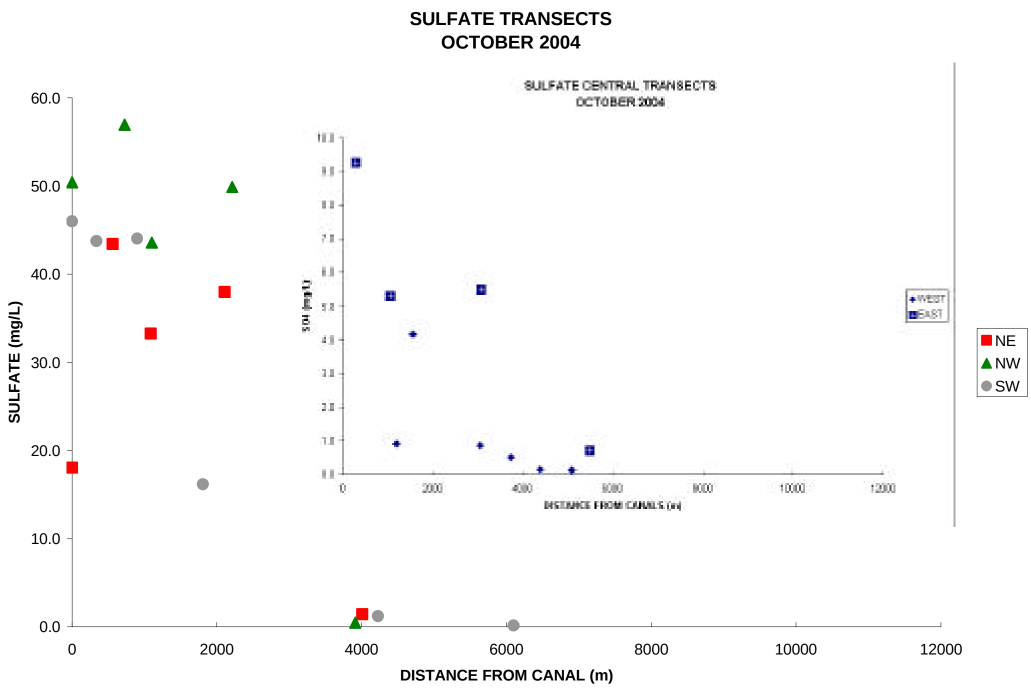


Figure 9: Sulfate versus distance from the canal along a series of transects during: (a) wet season (October 2004) when the canal stage is greater than the interior marsh, and (b) dry season (January 2005) when the canal stage is lower than that of the interior marsh. Inset graphs show the central transect: West starts at the L-7 canal and goes to LOX8; East starts at the L-40 canal and goes to LOX8. Stations and distances from Table 1.

Related studies and data

The potential for canal water intrusion into the marsh (Fig. 7) has been demonstrated by other studies. In 2004, South Florida Water Management District staff, along with Refuge personnel, conducted two synoptic surveys of surface water conductivity throughout the Refuge and adjoining rim canal (Fig. 10). The first survey was conducted in March 2004, during the dry season when canal stages were lower than stages in the interior marsh. Higher conductivities can be observed on the western side of the Refuge, both in the canal and in the marsh, relative to the eastern side. Evidence of intrusion of canal water is present, especially along the western marsh. In September 2004, this survey was repeated during the wet season, between Hurricanes Frances and Jeanne. Canal stages were higher than those of the interior marsh and there were positive hydraulic gradients into the marsh (Fig. 6). The same general patterns were observed, along with a greater penetration of high conductivity water into the marsh fringe along the eastern side of the Refuge. The penetration of high conductivity water into the Refuge interior shown in Figure 10 has been previously reported (Richardson et al. 1990, Scheidt et al. 2000, Stober et al. 2001, and others) and mirrors existing data on soil phosphorus levels discussed below.

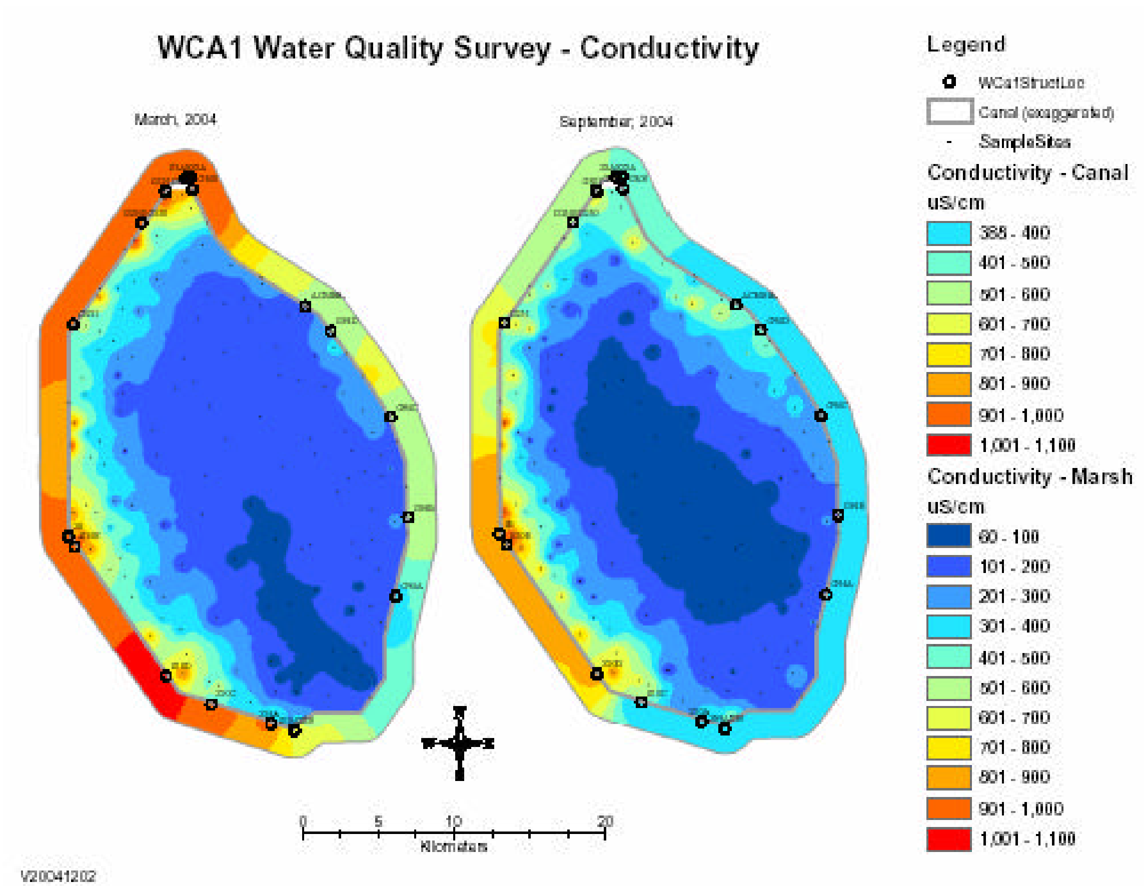


Figure 10: Surface water specific conductivity synoptic maps from March 2004 (dry season) and September 2004 (wet season). Data from South Florida Water Management District and Refuge staff. (SFWMD 2005).

Sediment total phosphorus data collected in 1991 (Newman et al. 1997) also are available for the Refuge (Fig. 11). Spatial locations of elevated soil phosphorus concentrations indicative of enrichment (> 500 mg TP/kg soil) generally coincide with areas of the marsh that have been subjected to canal water intrusion (Fig. 10). This pattern has also been reported by others (e.g., Childers et al. 2003).

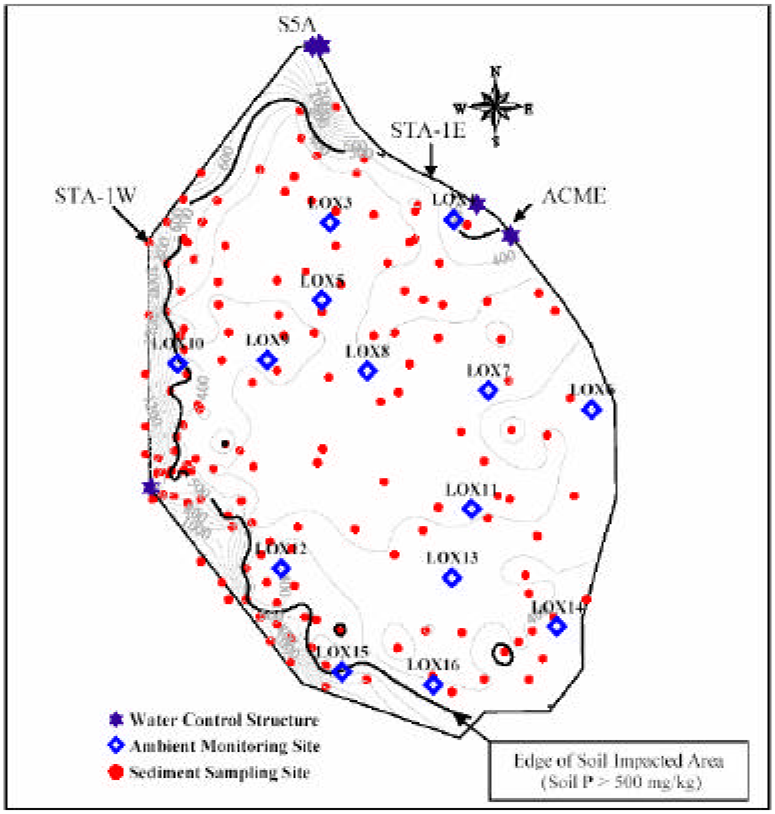


Figure 11. Sediment phosphorus concentrations in the Refuge. Refuge marsh area between the canals and the solid line has sediment TP concentrations >500 mg/kg. Map produced by Florida Department of Environmental Protection from 1991 data (Newman et al. 1997).

This sediment total phosphorus survey was repeated in 2004 as part of a multi-agency effort (including University of Florida and the South Florida Water Management District). At the time of this report, those data were not available.

Additionally, in 2003, USGS conducted a topographic survey of the Refuge by helicopter at a spatial resolution of approximately 400 meters, utilizing a grid pattern. This new topography data will be incorporated into updates of existing water management models as well as the new hydrological/water quality models being developed for the Refuge.

There are other sources of historical and existing water quality data related to the Refuge that are not included in this report. Of most relevance is the South Florida Water Management District's X, Y, Z transects in the southwest corner of the Refuge. Data have been collected at these stations since 1996 (McCormick et al. 2000) and the Florida Department of Environmental Protection has used these data to better understand potential water quality impacts on Everglades wetlands. It is anticipated that continued collaboration with the principal investigators of that project will result in mutual data analysis, interpretation, and presentation/publication.

4. Canal Water Intrusion and Water Management *(Report Objective 3)*
Data presented in this report and from other sources show that intrusion of water from the canal into the Refuge interior is occurring. Intrusion of nutrient-rich and high conductivity water from the canal has the potential to negatively impact Refuge plants and animals. Therefore, analysis of these and future data from the Enhanced Monitoring Network will be important to recommend water management practices that minimize such intrusion. The nine months of data in this *Interim Report* are not sufficient to demonstrate relationships between specific environmental conditions, water management activities, and the degree of intrusion, but these data lay the foundation for further work. A particularly useful indicator of canal water intrusion is conductivity – a general water quality parameter that is relatively conservative in its behavior.

Deployment of conductivity sondes along fixed transects allow the documentation of the spatial and temporal extent of intrusion of high conductivity canal water into the Refuge under different hydrologic conditions, with emphasis on areas directly interior from STA-1E and STA-1W. Continuous collection of conductivity data results in much greater detail about water movement on a time scale shorter than the typical monthly grab samples. Conductivity sondes placed in the canal show both high conductivity values and high temporal variability in conductivity values on a time scale much shorter than one month (Fig. 12).

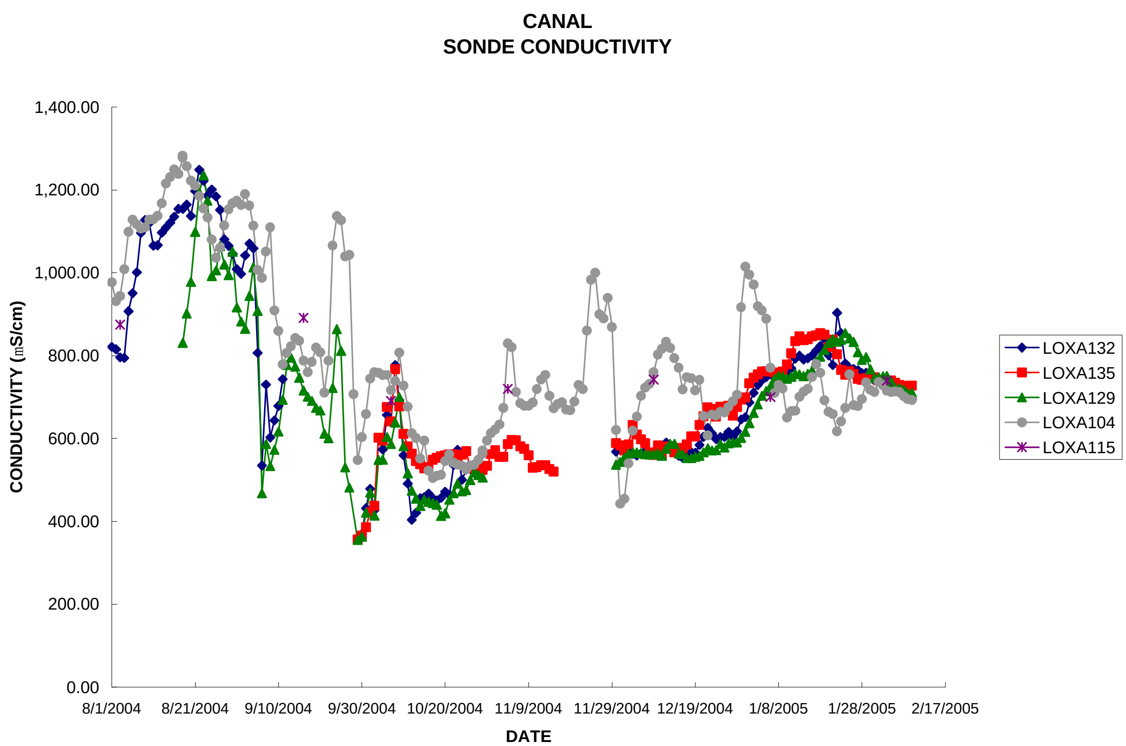


Figure 12. Time series of continuous conductivity data for canal stations.

Continuous conductivity data along the STA-1W transect (Fig. 13) indicates high conductivity values from LOXA104 (canal) to LOXA106, with values dropping below 300 µS/cm by LOXA107 (2,211 m from the canal). The variability within the conductivity readings decreases as a function of increasing distance from the canal, with variability in the signal all but lost by LOXA106 (1,102 m from the canal). In general, there was an increase in conductivity values in the interior marsh from November 2004 through February 2005.

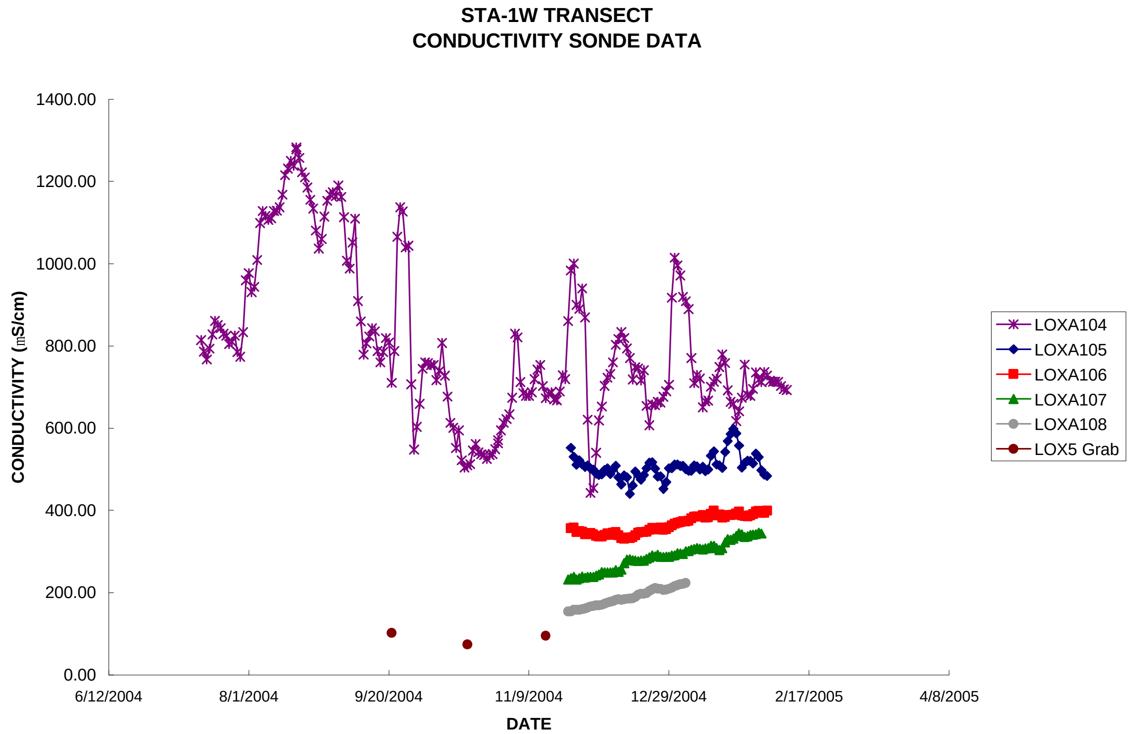


Figure 13. Time series of continuous conductivity data along the STA-1W transect (as defined in Table 1).

Continuous conductivity data along the STA-1E transect (Fig. 14) indicates high conductivity values from LOXA135 (canal) to LOXA137, with values dropping below 300 µS/cm by LOXA138 (2,108 m from the canal). Under normal meterological conditions, the variability within the conductivity values seems to drop as a function of increasing distance from the canal, with variability in the signal all but lost between LOXA136 and LOXA137 (561 – 1,086 m from the canal). This drop in variability occurs closer to the canal than observed on the west side of the Refuge. However, during the hurricanes in September 2004, the values and variability in the conductivity values were high through LOXA138 (see also Fig. 17 in Section 5 below). In general, there was an increase in conductivity values in the interior marsh from November 2004 through February 2005.

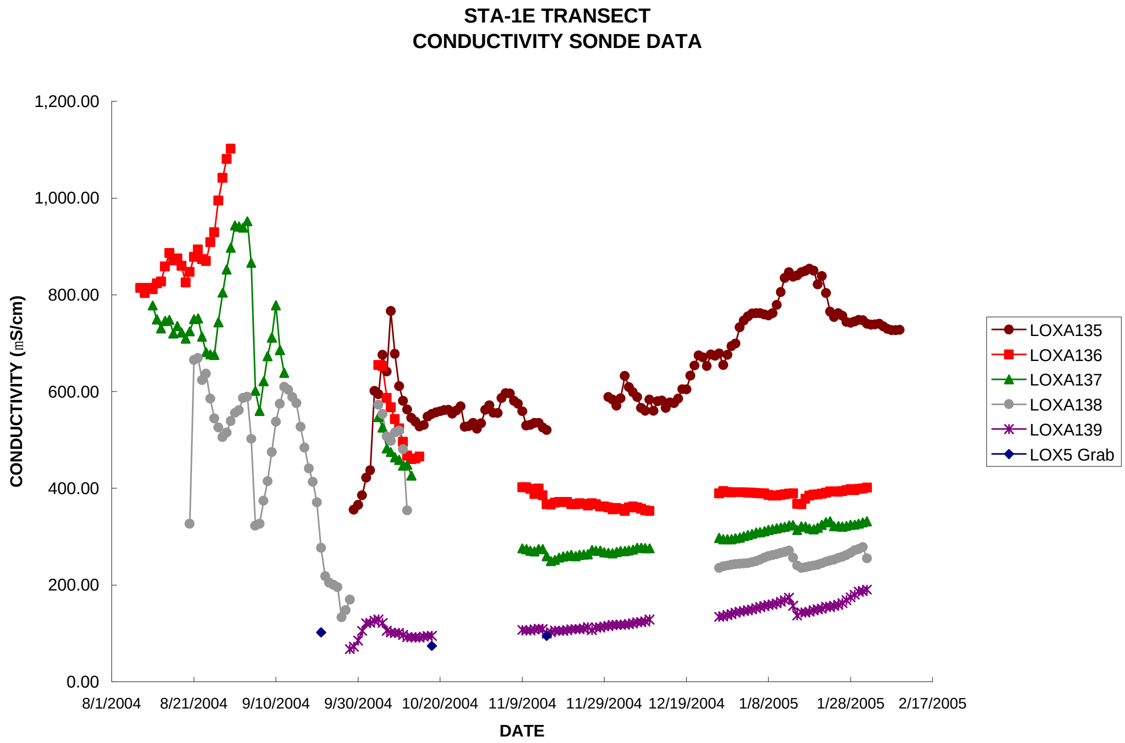


Figure 14. Time series of continuous conductivity data along the STA-1E transect (as defined in Table 1).

In general, data from the deployment of conductivity sondes is already beginning to provide some insights into the relationship between environmental conditions, water management activities, and intrusion of high conductivity water into the soft-water interior marsh. However, because this *Interim Report* spans an unusually dry year in 2004, but with the occurrence of two hurricanes in the 2004 wet season, it is not possible to develop explicit conclusions and management recommendations from the data collected so far.

5. Events during the Sampling Period

2004 Hurricanes

In 2004, two hurricanes passed within the vicinity of the Refuge – Hurricane Frances (September 4, 2005) and Hurricane Jeanne (September 25, 2005). Both hurricanes passed north of the Refuge, impacting the interior with westerly winds, causing defoliation, tree limb damage, and uprooted trees on the western side of tree islands in the Refuge interior. The Refuge interior received 15.59 inches of rain (Figure 15) from both hurricanes in addition to runoff from rainfall occurring in basins to the north. Rainfall was spatially heterogeneous, with most of the rainfall to the Refuge interior occurred in the northeast.

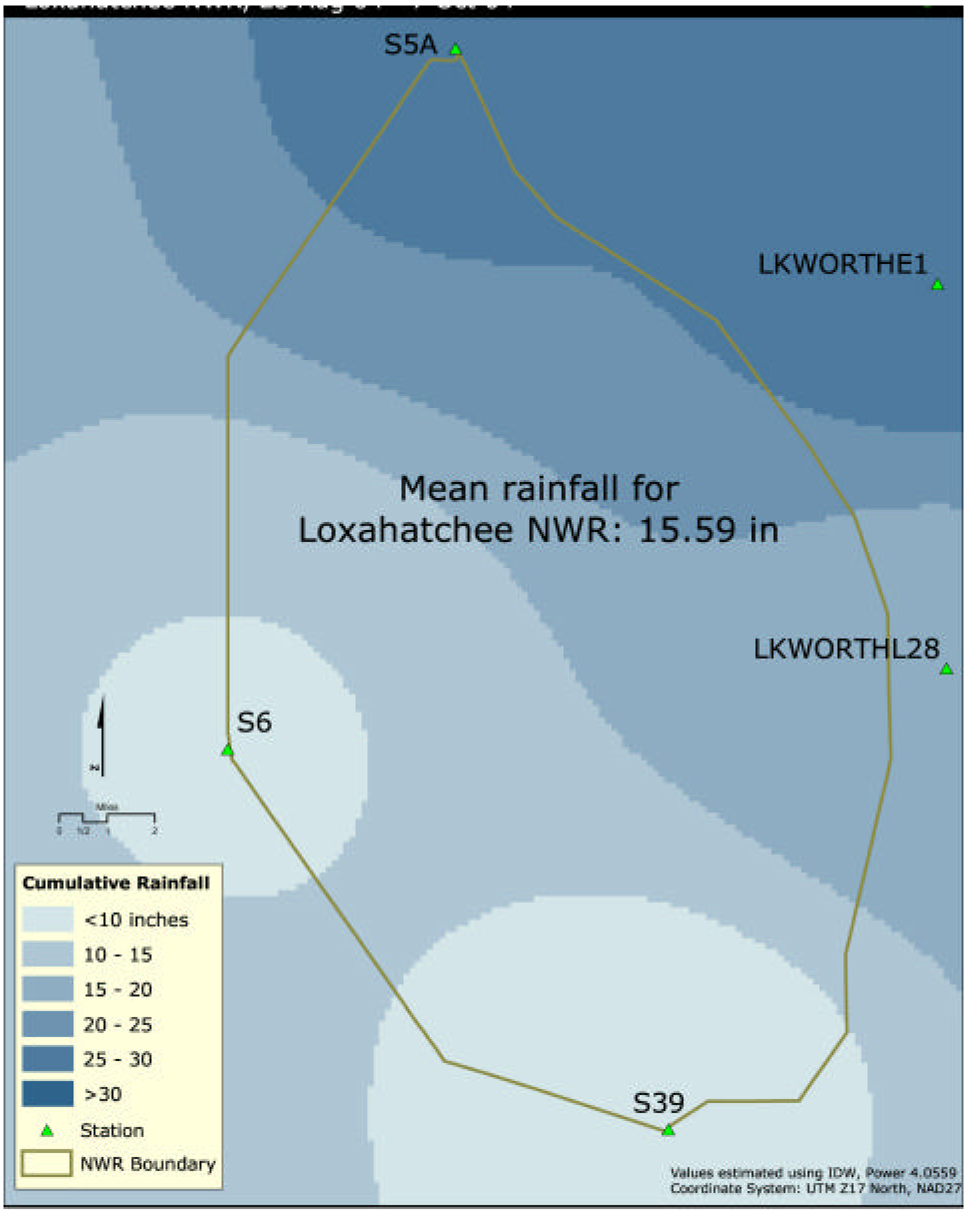


Figure 15. Estimated cumulative rainfall from the 2004 hurricanes for the Refuge (August 23 – October 7, 2004) based on rainfall station data (stations outside the boundary not shown). (SFNRC 2005)

A rainfall frequency curve for data from the Palm Beach International Airport shows that none of the 2004 hurricanes should be considered extreme natural events. Hurricane Frances, the largest of the rainfall events, was approximately a 1-in-5 year precipitation event (Fig. 16).

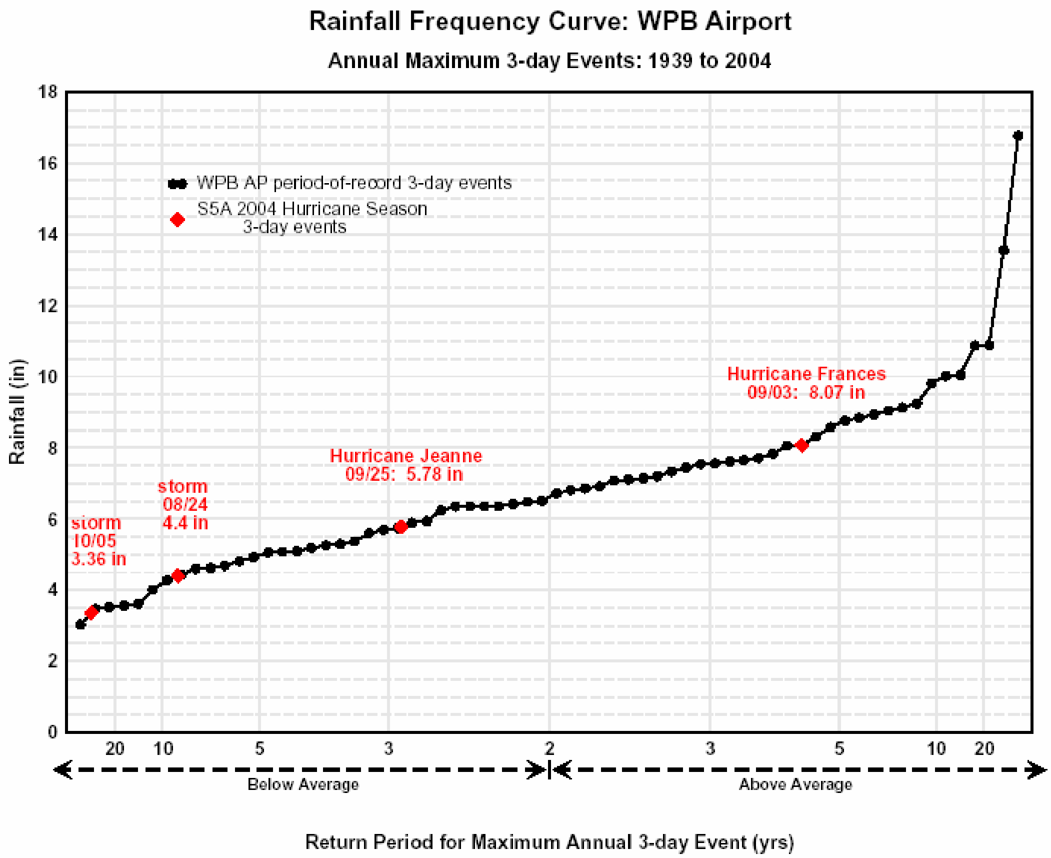


Figure 16. Rainfall frequency curve (3-day event window shown here) for WPB airport data covering the period of 1939-2004. (SFNRC 2005)

There were three major hurricane-related discharges to the Refuge: September 6-12, 2004 and September 21 – October 7, 2004 discharges of untreated water, by-passing STA-1W through the G-300 structure; and September 26 - October 4 emergency discharges from the non-operational STA-1E at S-362.

Hurricane Frances and Jeanne resulted in enough stormwater runoff from the northern basins that pump stations were at or near capacity for some time. After Hurricane Jeanne, the Refuge's inflow and outflow pumps and gates were operating full capacity and the Army Corps of Engineers and the South Florida Water Management District moved water through the Refuge as quickly as possible.

Table 3 is a synopsis of water quality data related to the one STA-1E discharge event of S-362 (26 Sept – 4 October) for Hurricane Jeanne.

Table 3. STA-1E discharges and water quality (from S-362) related to Hurricane Jeanne.

Date	S-362 discharge (acre-feet/day)[1]	S-362 discharge (cfs)[2]	S-362 Total Phosphorus (ppb)[1]
9/21/2004	0	0	264 (grab); 274 (auto)
9/22/2004	0	0	
9/23/2002	0	0	
9/24/2004	0	0	
9/25/2004	0	0	
9/26/2004	388	196	
9/27/2004	1967	992	
9/28/2004	1937	977	
9/29/2004	1871	943	
9/30/2004	1664	839	455 (grab)
10/1/2004	4055	2044	
10/2/2004	1099	554	
10/3/2004	1372	692	
10/4/2004	1160	585	
10/5/2004	0	0	
10/6/2004	0	0	562 (grab); 433 (auto)
TOTAL discharge	**16,612**		

[1] Data are from South Florida Water Management District (not available in DBHYDRO).
[2] Daily discharge rates (in cubic feet per second) were calculated using 43,560 ft^2/acre, and 86400 sec/day.

Refuge interior water quality was sampled on several occasions:

- September 14-16, 2004 Refuge's Enhanced Water Quality Network
- September 21-23, 20904 Consent Decree compliance monitoring
- October 4-7, 2004 Refuge's Enhanced Water Quality Network
- October 18-19, 2004 Consent Decree compliance network
- November 1-4, 2004 Refuge's Enhanced Water Quality Network

Significant canal water penetration past LOXA 138 is evident (Table 4) from the specific conductivity and sulfate data, but not reflected as much in the total phosphorus data, possibly for the reasons described previously (*Water Quality in the Marsh* in **Section 3**).

Table 4. Refuge water quality data from monthly grab samples along the STA-1E transect (LOXA### = Refuge's Enhanced Water Quality program; LOX# = Consent Decree Compliance Network station).

Specific Conductivity (mS)				
Station	Distance	Sep-04	Oct-04	Nov-04
LOXA 135	Canal	790	555	558
LOXA 136	561	676	648	412.2
LOXA 137	1,086	682	544	271.2
LOXA 138	2,108	597	570	176.8
LOXA 139	4,011	184	135	100.5
LOX5	8,144	102	73.9	95

Total Phosphorus (ppb)				
Station	Distance	Sep-04	Oct-04	Nov-04
LOXA 135	Canal	257	649	96
LOXA 136	561	91	238	64
LOXA 137	1,086	28	57	23
LOXA 138	2,108	14	10	10
LOXA 139	4,011	13	8	13
LOX5	8,144	14	12	10

Sulfate (mg/L)				
Station	Distance	Sep-04	Oct-04	Nov-04
LOXA 135	Canal	44.33	18.08	12.52
LOXA 136	561	47.98	43.42	6.47
LOXA 137	1,086	47.3	33.28	3.39
LOXA 138	2,108	17.45	38	1.92
LOXA 139	4,011	5.44	1.44	0.2
LOX5	8,144	0.1	BDL	-

BDL = Below Detection Limit

Conductivity sondes deployed in the area of the STA-1E discharge structure tracked intrusion of the canal water during the September 26 – October 4, 2004 discharge event (Fig. 17).

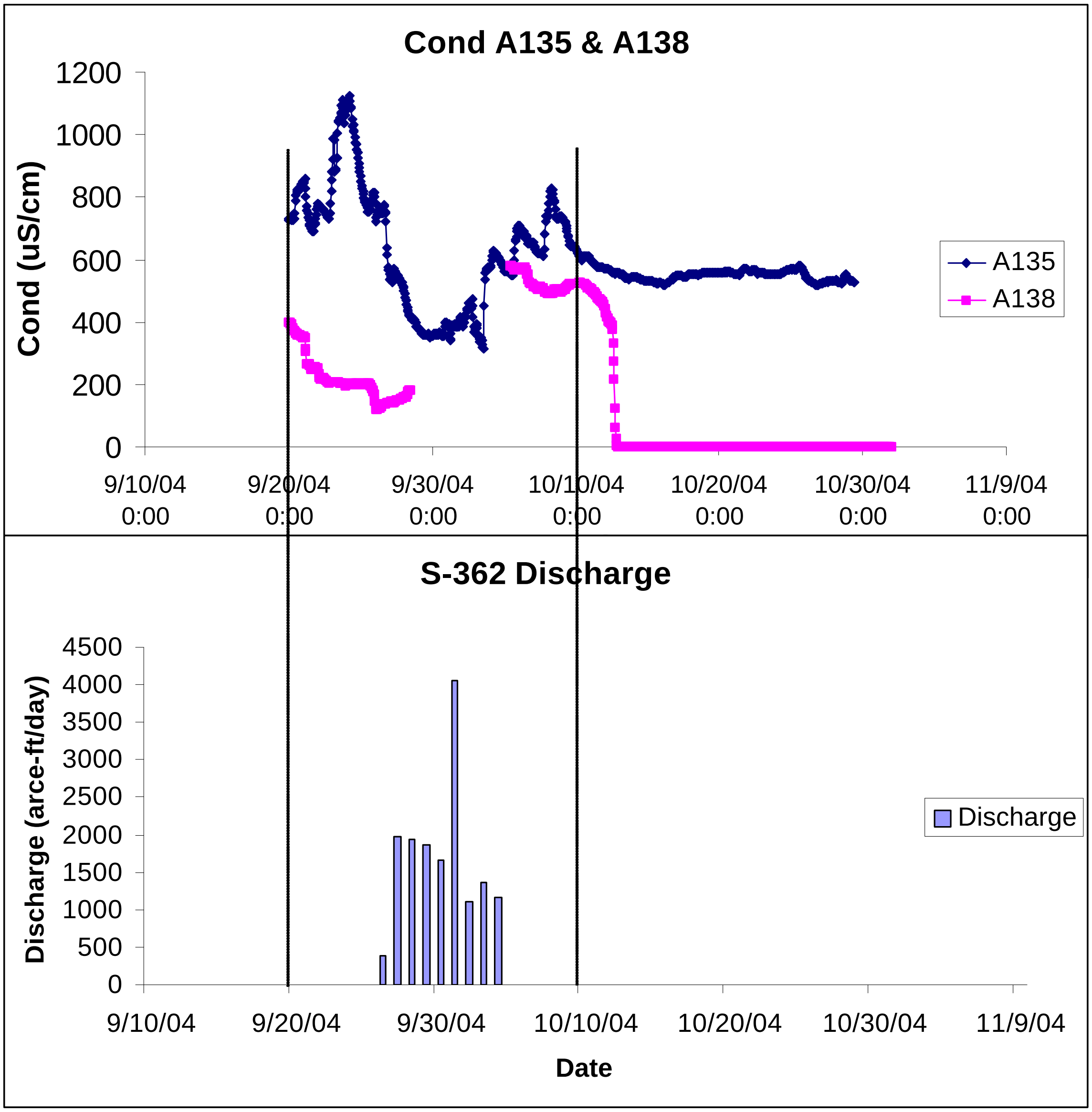


Figure 17. Conductivity data for LOXA 135 and LOXA 138 (upper panel) covering the period of STA-1E discharges (lower panel). These are the only available sonde data along the STA-1E transect for this period. Missing data for LOXA 138 occurred during a period when the sonde was not deployed. Zero values reflect water levels being below the sonde's sensor.

Fire

Fire is natural component of the Everglades ecosystem, but its role in altering the ecosystem has changed with compartmentalization of the system. Beginning in 2004, prescribed fire in the Refuge interior is used as a management tool to aid in the control of exotics, as well as a mechanism to help re-establish some of the role that fire played historically.

There were a number of wildland and prescribed fires in the Refuge during the 2004 dry season (Figure 18). Fire type, date, and size information are presented in Table 5.

Table 5. Details about fires in the Refuge interior during 2004.

Type	Date (Name)	Size (acres)
Wildland	June 2, 2004 (Fuzz Fire)	441
	July 12-13, 2004 (Hillsboro C. Lightning Fire)	81 (+5217 in WCA-2)
	July 19, 2004 (Thirty Minute Fire)	11
	July 26, 2004 (Sun shower Fire)	approx. 100
Prescribed	April 7, 2004 (Cattail Fire)	1016
	June 3-4, 2004 (SW Burn Unit Fire)	5247
	June 29, 2004 (SW_Burn Unit Fire)	1306

The Refuge also is interested in possible effects of fire on water quality. In 2004, with limited resources, an attempt was made to establish transects across a theoretical burn front where water quality samples were to be collected pre- and post-burn. This effort was unsuccessful as the unpredictable burn mosaic did not coincide with a transect-sampling approach and many *a priori* selected stations had less than 10 cm of water when visited.

As the Enhanced Water Quality Monitoring program had just begun and water levels were very low during this period of the fires, there was very few water quality samples collected in burn areas to aid in our understanding any interactions between fire and water quality. It is anticipated that information from the Refuge's Enhanced Water Quality Monitoring program will provide some valuable information for future fires.

During 2005, the Refuge will be updating its *Fire Management Plan* and is working on future plans for pre- and post-burn monitoring for both water quality and vegetation.

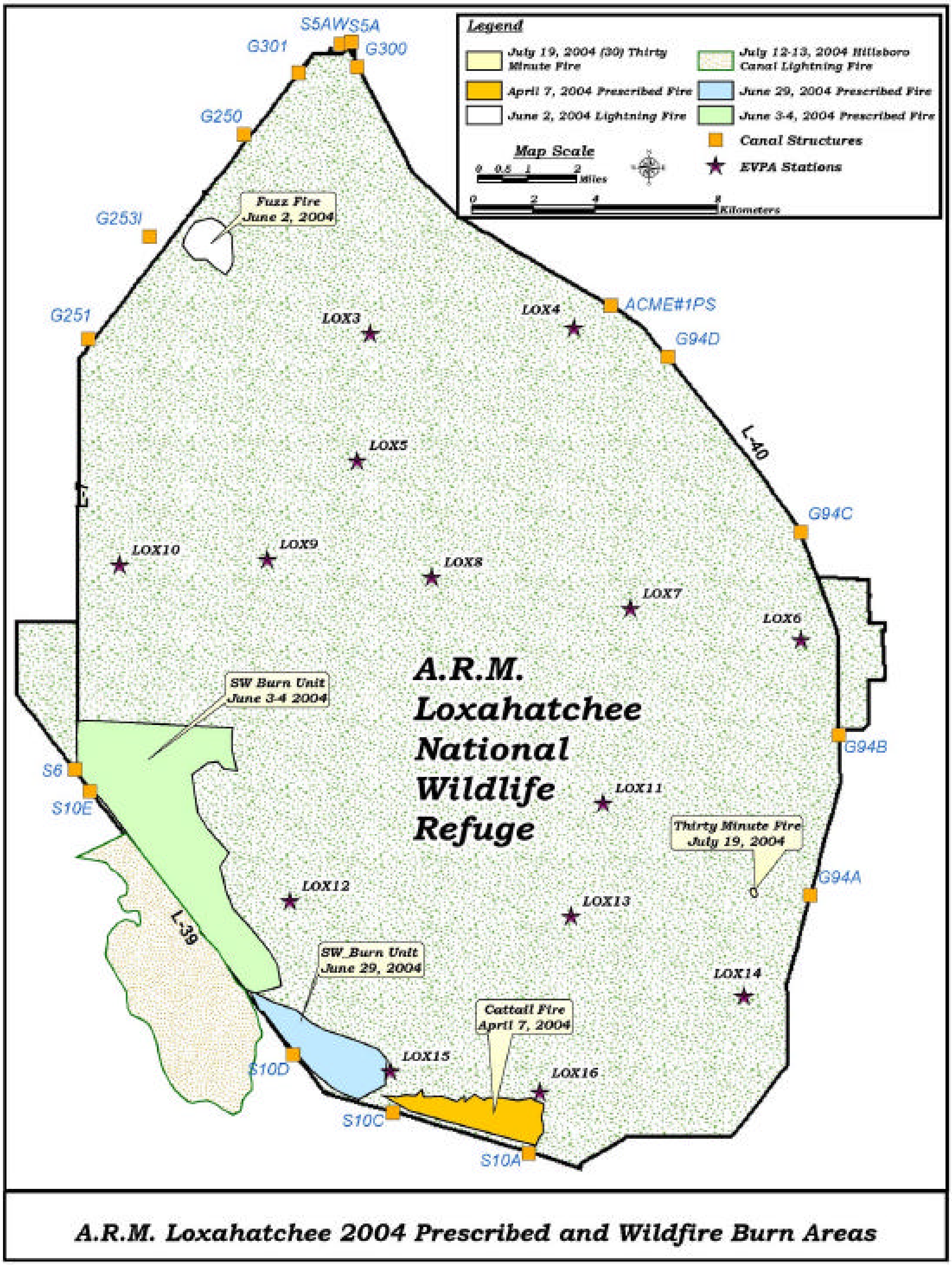


Figure 18. Location of prescribed and natural (wildland) burn areas in the Refuge during 2004. Consent Decree compliance stations are shown for reference.

6. Data Summary and Next Steps

Data Summary

Data collected as part of the Enhanced Water Quality Monitoring Program show that intrusion of rim canal water into the Refuge interior is occurring. In general, conductivity values decrease with distance from canal stations toward the marsh interior, with the most interior marsh stations having values ten times lower than the canal. Sulfate values also decrease with distance toward the marsh interior.

Canal water intrusion probably is influenced by the relative water levels in the canal and adjacent marsh. When water levels in the canal are higher than in the marsh, intrusion of canal water is encouraged. The reverse also may be true – canal water levels lower than the marsh water levels probably discourages intrusion, although the results show that some intrusion may occur even under these conditions. The period of record for this *Interim Report* was characterized by unusually dry conditions, except for the two hurricanes and their associated rainfall in September 2004. Intrusion occurred in September and October, presumably related to the hurricanes.

The data collected thus far is in agreement with previous studies that have suggested intrusion. Conductivity values collected nearly simultaneously at numerous stations within the Refuge in March and September, 2004 suggest intrusion is occurring, particularly along the west side of the Refuge. Sediment total phosphorus data collected from the Refuge interior in 1991 illustrate elevated sediment total phosphorus concentrations that generally coincide with the location of canal water intrusion.

Next Steps

While this *Interim Report* has provided additional data for areas of the Refuge that were not previously monitored and improved our understanding of the relationship between environmental conditions, management activities, and canal water intrusion**,** it also reveals the limitations of analyzing and interpreting water quality data for a period shorter than one year. Multiple years of water quality data, encompassing a series of wet and dry seasons is critical for the ability to understand water quality issues in the Refuge. Future data analysis will consist of, among others, continuing trend analyses, multi-parameter data analyses, and spatial analyses. Further examination of the full suite of parameters may result in the technical conclusion that some parameters can be eliminated without decreasing our understanding of the system. As we further refine our analysis of the data, we will review location of our sampling stations to ensure that water quality throughout the entire marsh is adequately characterized.

The water quality modeling component of this project will enter into the next phases, final model selection and initial model development. Characterization of the rim canal around the Refuge will continue with initiation of the canal water quality monitoring and further canal profile work.

Future reports will be produced on an annual basis, analyzing data from the previous water year (May 1 through April 30). The next report will be produced in August, 2006, in order to shift to the water year reporting period. Data from the monthly grab samples will be continually updated on DBHYDRO. The Refuge will continue to make quarterly updates to the Technical Oversight Committee.

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8. Appendices

Appendix A: Summary Statistics of Water Quality Data

Appendix B: Water Quality Data for Refuge Structures

Appendix C: Water Quality Data for Refuge Interior

Appendix D: Maps of Water Quality Data over Time

Appendix E: Monthly Maps of Water Quality Data

Appendix F: Water Quality Data - Distance from Canal

Appendix A: Summary Statistics of Water Quality Data

Table A-1: Water quality parameters for the Refuge's Enhanced Water Quality Monitoring Program. All constituents are part of the suite of parameters analyzed for the Consent Decree compliance monitoring network.

Table A-2: Conductivity sonde deployment information.

Table A-3: Summary statistics of virtually all water quality data for the Refuge's Enhanced Water Quality Monitoring and Consent Decree compliance monitoring programs. (NO3, NO2, TDPO4, and TDKN are the only parameters not included in this table). Data from DBHYDRO.

Table A-1. Water quality parameters measured for the Refuge's Enhanced Water Quality Monitoring program. These analyses are conducted by the chemistry lab at South Florida Water Management District and match most of those analyzed monthly for the Consent Decree compliance monitoring program. Method citations are available from the South Florida Water Management District.

Test Name	Units	MDL	Method	SFWMD Test Number	EPA Storet Code
ALKALINE PHOSPHATASE	nM/minmL	1	SFWMD 3160.1	168	49548
CARBON, DISSOLVED ORGANIC	mg/L	1	EPA 415.1	89	681
TOTAL DISSOLVED SOLIDS	MG/L	22	SM2540C	97	70300
DEPTH, TOTAL	METERS		FIELD	99	
CARBON, TOTAL ORGANIC	mg/L	1	EPA 415.1	100	680
TEMP	Deg C		FIELD	7	
PHOSPHATE, DISSOLVED AS P	mg/L	0.002	SM4500PF	26	666
PHOSPHATE, TOTAL AS P	mg/L	0.002	SM4500PF	25	665
PHOSPHATE, ORTHO AS P	mg/L	0.004	SM4500PF	23	671
KJELDAHL NITROGEN, DIS	mg/L	0.05	EPA 351.2	22	623
KJELDAHL NITROGEN, TOTAL	mg/L	0.05	EPA 351.2-MOD	21	625
NITRITE-N	mg/L	0.004	SM4500NO3F	19	615
NITRATE+NITRITE-N	mg/L	0.004	SM4500NO3F	18	630
TOTAL SUSPENDED SOLIDS	mg/L	3	EPA 160.2	16	530
COLOR	PCU	1	SM2120B (MODIFIED)	13	80
ALKALINITY, TOT, CACO3	mg/L	1	EPA 310.1	67	410
HARDNESS AS CACO3	mg/L	0.1	SM3120B	35	
SULFATE	mg/L	0.1	EPA 300.0	33	946
CHLORIDE	mg/L	0.1	EPA 300.0	32	941
MAGNESIUM	mg/L	0.1	SM3120B	31	925
CALCIUM	mg/L	0.2	SM3120B	30	915
POTASSIUM	mg/L	0.1	SM3120B	29	935
SODIUM	mg/L	0.2	SM3120B	28	930
SILICA	mg/L	0.05	SM4500SID (MODIFIED)	27	955
TURBIDITY	NTU	0.1	SM2130B	12	76
PH, FIELD	UNITS		FIELD	10	
SP CONDUCTIVITY, FIELD	µS/cm		FIELD	9	
DISSOLVED OXYGEN	mg/L		FIELD	8	
NITRATE-N	mg/L	0.004	SM4500NO3F	78	620
AMMONIA-N	mg/L	0.009	SM4500-NH3H	20	608
NITRATE+NITRITE-N	mg/L	0.006	SM4500NO3F	18	630

Table A-2. Conductivity sonde deployment information. X = sonde deployed for part or all of the month.

		2004					Month					2005	
Site ID	Description	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
LOXA104	STA-1W Transect (canal)				X	X	X	X	X	X		X	X
LOXA105	STA-1W Transect										X	X	X
LOXA106	STA-1W Transect										X	X	X
LOXA107	STA-1W Transect										X	X	X
LOXA108	STA-1W Transect	X									X	X	X
LOXA111	Central Transect												
LOXA112	Central Transect											X	X
LOXA113	Central Transect											X	X
LOXA114	Central Transect												
LOXA115	S-6 Transect (canal)	X	X	X	X				X	X	X	X	X
LOXA116	S-6 Transect	X	X	X	X	X	X	X	X	X	X	X	X
LOXA117	S-6 Transect	X	X	X	X	X	X	X	X	X	X	X	X
LOXA118	S-6 Transect	X	X	X	X	X	X	X	X	X	X	X	X
LOXA119	S-6 Transect	X	X	X	X	X	X	X	X	X	X	X	X
LOXA120	S-6 Transect												X
LOXA126	Central Transect										X	X	X
LOXA127	Central Transect										X	X	X
LOXA128	Central Transect												
LOXA129	Acme 2 Transect (canal)				X	X	X	X	X	X	X	X	X
LOXA130	Acme 2 Transect											X	X
LOXA131	Acme 2 Transect											X	X
LOXA132	Acme 1 Transect (canal)				X	X	X	X	X	X	X	X	X
LOXA133	Acme 1 Transect				X	X	X	X	X	X	X	X	X
LOXA134	STA-1E Other												
LOXA135	STA-1E Transect (canal)	X	X		X	X	X	X	X	X	X	X	X
LOXA136	STA-1E Transect	X	X		X	X	X		X	X	X	X	X
LOXA137	STA-1E Transect	X	X		X	X	X	X	X	X	X	X	X
LOXA138	STA-1E Transect	X	X		X	X	X	X	X	X		X	X
LOXA139	STA-1E Transect	X	X		X	X			X	X	X	X	X
LOX4	EVPA site/Acme 1 Transect				X	X				X	X	X	X
LOX6	EVPA site/Central Transect										X	X	X
LOX7	EVPA site/Central Transect										X	X	X
LOX8	EVPA site/Central Transect											X	X
LOX9	EVPA site/Central Transect											X	X
LOX10	EVPA site/Central Transect										X	X	X

Table A-3

ID	STAT	ALK	APA	Ca	Cl	COLOR	D_O2	DOC	HARD	K	Mg	Na	NH4	N02	N03	NOX	OPO4	Ph_F	SiO2	SO4	SpC	TDKN	TD_PO4	TDS	TEMP	TKN	TOC	T_PO4	TSS	TURB
		mg/L	nM/minmL	mg/L	mg/L	PCU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	units	mg/L	mg/L	uS/cm	mg/L	mg/L	mg/L	Deg.C	mg/L	mg/L	mg/L	mg/L	mg/L
	SIZE	2	1	2	2	2	3	2	2	2	2	2	2	2	2	2	2	4	2	2	4	2	2	2	4	1	1	3	2	2
	AVG	8	40.0	4.3	14.9	156.5	4.0	22.0	20	0.8	1.4	9.1	0.021	0.008	0.006	0.014	0.009	5.6	2.4	0.1	95	1.22	0.006	83	20.7	1.3	24.0	0.023	3.8	1.0
LOX3	STD						1.3											0.7			26				5.1			0.015		
	MIN	7		4.2	14.1	151.0	3.1	22.0	20	0.8	1.4	9.0	0.020	0.007	0.002	0.010	0.009	5.1	2.1	0.1	75	1.14	0.005	81	14.0			0.008	1.5	0.8
	MAX	8		4.3	15.7	162.0	5.5	22.0	20	0.8	1.4	9.2	0.021	0.008	0.010	0.017	0.009	6.8	2.8	0.2	132	1.30	0.006	84	25.4			0.038	6.0	1.1
	SIZE	6	4	6	6	6	5	6	6	6	6	6	6	6	4	6	6	7	6	6	6	6	6	6	7	6	6	7	6	6
	AVG	120	9.3	37.2	74.8	124.0	3.3	28.2	129	6.4	10.5	48.3	0.013	0.005	0.003	0.005	0.005	6.5	14.1	6.5	574	1.42	0.007	347	21.3	1.5	29.0	0.019	3.9	0.8
LOX4	STD	7	4.6	2.2	11.1	21.6	0.8	4.4	39	0.4	1.1	6.9	0.009	0.001	0.001	0.002	0.002	0.4	6.6	5.0	199	0.20	0.001	36	5.0	0.3	5.0	0.016	4.1	0.3
	MIN	113	4.0	34.4	60.7	108.0	2.2	22.0	100	5.9	9.3	39.4	0.005	0.004	0.002	0.002	0.002	6.0	5.1	2.7	448	1.11	0.005	302	15.1	1.2	22.0	0.008	1.5	0.5
	MAX	131	14.0	39.9	89.0	167.0	4.4	33.0	200	6.9	12.4	55.2	0.030	0.006	0.004	0.008	0.008	7.2	22.8	15.4	970	1.62	0.009	408	29.3	2.0	34.0	0.054	12.0	1.2
	SIZE	2	1	2	2	2	3	2	2	2	2	2	2	2	2	2	2	3	2	2	3	2	2	2	3	2	2	3	2	2
	AVG	8	45.0	4.4	18.4	135.0	3.6	22.0	20	0.8	1.5	11.0	0.015	0.006	0.006	0.012	0.009	5.4	3.1	0.1	90	1.27	0.009	90	23.0	1.4	23.0	0.012	5.0	2.2
LOX5	STD						1.2											0.6			15				2.8			0.002		
	MIN	7		4.0	15.0	129.0	2.8	21.0	20	0.7	1.4	9.4	0.014	0.006	0.005	0.011	0.008	5.0	2.7	0.1	74	1.27	0.008	83	19.9	1.4	22.0	0.010	4.0	0.9
	MAX	8		4.8	21.7	141.0	5.0	23.0	20	0.9	1.6	12.6	0.016	0.006	0.006	0.012	0.010	6.2	3.5	0.1	102	1.27	0.010	96	25.5	1.5	24.0	0.014	6.0	3.4
	SIZE	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	6	7	7	7	7	7	7	7
	AVG	53	26.3	21.4	44.6	110.3	4.0	22.4	72	2.4	5.7	29.3	0.214	0.004	0.006	0.013	0.003	6.8	6.0	16.9	301	1.61	0.006	209	21.7	1.7	22.3	0.008	1.5	0.5
LOX6	STD	9	8.4	6.6	3.8	51.7	1.6	7.6	13	0.5	1.3	2.5	0.528	0.002	0.014	0.014	0.002	0.3	4.7	30.1	66	1.31	0.004	60	4.9	1.3	7.3	0.004	0.0	0.1
	MIN	35	14.0	17.8	40.0	74.0	1.3	17.0	60	2.0	4.9	26.3	0.005	0.002	0.000	0.005	0.002	6.4	0.2	2.3	252	0.98	0.003	160	16.4	1.0	17.0	0.005	1.5	0.4
	MAX	60	36.0	36.2	50.9	224.0	6.0	39.0	100	3.4	8.5	33.4	1.410	0.008	0.039	0.043	0.007	7.3	11.9	84.3	444	4.58	0.014	342	29.1	4.7	38.0	0.017	1.5	0.7
	SIZE	5	3	5	6	5	5	5	5	5	5	5	5	5	5	5	5	7	5	6	6	5	5	5	7	5	5	7	5	5
	AVG	13	29.3	7.3	29.5	116.2	3.7	22.8	26	1.0	2.0	15.6	0.014	0.004	0.001	0.007	0.005	5.9	5.5	0.4	131	1.00	0.005	122	22.1	1.4	23.2	0.011	5.8	1.2
LOX7	STD	1	1.5	0.9	7.3	21.9	1.8	2.9	6	0.2	0.3	3.2	0.009	0.002	0.003	0.004	0.002	0.3	1.7	0.2	29	0.55	0.001	21	5.0	0.3	2.8	0.003	9.6	0.8
	MIN	12	28.0	6.1	18.4	94.0	1.7	19.0	20	0.8	1.5	10.6	0.005	0.002	0.000	0.003	0.002	5.3	3.0	0.3	97	0.03	0.004	98	16.3	1.2	20.0	0.008	1.5	0.6
	MAX	14	31.0	8.5	39.9	149.0	5.6	27.0	31	1.3	2.4	19.2	0.023	0.006	0.007	0.011	0.007	6.4	7.5	0.7	179	1.32	0.007	155	30.5	1.8	27.0	0.016	23.0	2.5
	SIZE	7	5	7	7	7	5	7	7	7	7	7	7	7	7	7	7	7	7	7	6	7	7	7	7	7	7	7	7	7
	AVG	10	46.6	5.7	22.6	91.4	4.6	22.7	23	0.7	1.8	13.1	0.018	0.004	0.003	0.007	0.004	5.7	3.2	0.1	108	1.31	0.006	102	21.7	1.6	23.1	0.011	4.2	1.1
LOX8	STD	3	6.9	1.2	6.2	22.6	1.1	3.3	4	0.2	0.3	3.4	0.021	0.001	0.004	0.005	0.002	0.3	1.2	0.0	29	0.19	0.001	22	5.2	0.5	3.0	0.007	6.1	0.7
	MIN	8	36.0	4.4	15.5	72.0	3.1	18.0	20	0.5	1.4	9.6	0.005	0.002	0.000	0.002	0.002	5.2	1.7	0.1	79	1.02	0.005	77	14.8	1.2	19.0	0.006	1.5	0.5
	MAX	16	55.0	7.6	32.7	135.0	5.6	27.0	30	1.0	2.3	18.9	0.064	0.005	0.012	0.016	0.006	6.3	5.5	0.1	146	1.58	0.008	141	30.3	2.7	27.0	0.026	18.0	2.5
	SIZE	2	1	2	3	2	4	2	2	2	2	2	2	2	2	2	2	6	2	3	5	2	2	2	6	2	2	6	3	2
	AVG	11	62.0	4.1	20.2	76.5	3.4	16.0	20	0.8	1.6	9.7	0.012	0.003	0.001	0.006	0.007	5.8	5.0	0.1	117	0.96	0.005	83	22.3	1.1	16.5	0.011	1.0	0.6
LOX9	STD				9.1		0.9											0.6		0.0	49				6.0			0.004	0.9	
	MIN	9		3.8	14.3	72.0	2.6	16.0	20	0.6	1.4	9.0	0.010	0.002	0.000	0.005	0.006	5.2	3.0	0.1	76	0.89	0.005	59	14.6	1.1	16.0	0.007	0.0	0.5
	MAX	13		4.4	30.7	81.0	4.7	16.0	20	1.0	1.7	10.3	0.014	0.004	0.002	0.007	0.007	6.9	6.9	0.1	200	1.02	0.005	107	31.7	1.1	17.0	0.018	1.5	0.6
	SIZE	3	2	3	5	3	5	3	3	3	3	3	3	3	3	3	3	7	3	5	6	3	3	3	7	3	3	7	3	3
	AVG	37	22.0	10.9	27.2	95.7	3.1	17.0	43	2.1	3.7	16.7	0.010	0.004	0.002	0.006	0.004	6.2	9.5	3.1	221	0.87	0.005	142	20.7	0.9	17.3	0.011	3.3	0.7
LOX10	STD	10		3.8	9.2	10.7	0.4	2.6	15	1.1	1.4	7.9	0.005	0.001	0.002	0.003	0.002	0.5	3.6	3.5	121	0.11	0.000	47	5.3	0.2	3.2	0.002	3.2	0.3
	MIN	29	13.0	8.0	16.3	84.0	2.4	15.0	30	1.3	2.6	11.1	0.005	0.004	0.000	0.002	0.002	5.5	7.2	0.9	112	0.79	0.005	95	14.5	0.8	15.0	0.008	1.5	0.5
	MAX	48	31.0	15.2	36.7	105.0	3.5	20.0	60	3.4	5.2	25.7	0.013	0.005	0.004	0.008	0.005	7.2	13.6	9.3	443	1.00	0.005	189	28.2	1.1	21.0	0.014	7.0	1.0
	SIZE	6	5	6	6	6	7	6	6	6	6	6	6	6	2	6	6	7	6	6	6	6	5	6	7	6	6	7	6	6
	AVG	11	42.2	6.4	18.5	88.2	3.7	19.0	22	0.3	1.3	10.7	0.031	0.003	0.005	0.010	0.004	6.2	1.1	0.1	91	1.03	0.006	81	22.1	1.3	19.3	0.010	2.5	0.9
LOX11	STD	3	8.2	1.6	5.7	25.0	1.8	3.0	4	0.1	0.3	3.1	0.031	0.002		0.007	0.001	0.2	0.7	0.0	23	0.18	0.001	18	4.6	0.2	2.9	0.002	1.8	0.2
	MIN	8	32.0	4.7	11.9	62.0	0.9	15.0	20	0.2	1.0	7.1	0.005	0.002	0.002	0.002	0.002	6.0	0.3	0.1	67	0.78	0.004	58	16.9	1.0	15.0	0.008	1.5	0.6
	MAX	14	52.0	8.1	25.9	128.0	6.2	23.0	27	0.4	1.7	14.7	0.088	0.005	0.007	0.023	0.005	6.5	1.9	0.1	123	1.26	0.008	103	29.3	1.5	23.0	0.015	6.0	1.0
	SIZE	9	9	9	9	9	9	9	9	9	9	9	9	9	1	9	9	9	9	9	8	9	8	9	9	9	9	9	9	9
	AVG	55	14.1	15.5	32.4	69.7	4.4	17.4	60	1.8	5.1	22.3	0.028	0.002	0.002	0.007	0.003	7.0	9.4	1.6	232	1.01	0.006	154	24.1	1.6	17.4	0.016	13.7	3.6
LOX12	STD	10	7.2	3.0	10.6	13.8	2.1	3.3	11	0.5	1.0	6.5	0.023	0.001		0.004	0.001	0.4	2.9	0.8	60	0.25	0.001	48	4.7	1.1	3.0	0.015	29.7	8.2
	MIN	45	6.0	12.5	19.9	48.0	2.0	14.0	50	1.3	4.0	14.5	0.005	0.002		0.002	0.002	6.7	4.6	1.0	158	0.81	0.005	65	17.4	0.9	14.0	0.006	1.5	0.3
	MAX	74	32.0	21.2	50.0	91.0	7.5	24.0	80	2.6	6.9	33.7	0.079	0.004		0.015	0.005	8.0	14.9	3.3	327	1.48	0.008	234	30.2	4.2	23.0	0.047	92.0	25.5
	SIZE	7	7	7	7	7	7	7	7	7	7	7	7	7	3	7	7	7	7	7	6	7	6	7	7	7	7	7	7	7
	AVG	15	45.3	7.8	20.8	88.7	4.0	21.1	25	0.6	1.5	11.7	0.305	0.004	0.005	0.008	0.004	6.3	2.3	0.1	112	1.51	0.006	102	22.2	1.7	21.6	0.010	1.5	0.8
LOX13	STD	5	11.1	2.1	6.6	23.4	2.3	7.2	7	0.5	0.4	3.0	0.518	0.002	0.001	0.003	0.002	0.2	3.2	0.1	38	0.96	0.0004	35	4.1	0.9	7.1	0.002	0.0	0.1
	MIN	12	28.0	5.8	14.0	59.0	1.3	16.0	20	0.3	1.1	8.3	0.011	0.002	0.004	0.002	0.002	6.1	0.2	0.1	80	0.95	0.006	73	17.7	1.2	16.0	0.008	1.5	0.7
	MAX	26	60.0	12.1	34.3	121.0	7.1	37.0	40	1.7	2.2	17.7	1.440	0.006	0.006	0.011	0.006	6.5	8.5	0.2	186	3.67	0.007	179	28.7	3.9	37.0	0.013	1.5	1.0
	SIZE	7	7	7	7	7	7	7	7	7	7	7	7	7	4	7	7	7	7	7	7	7	6	7	7	7	7	7	7	7
	AVG	50	12.7	18.4	38.7	92.3	3.9	19.4	72	1.9	5.0	25.0	0.021	0.004	0.005	0.009	0.003	6.6	4.3	8.1	249	0.98	0.006	174	22.2	1.1	19.6	0.008	1.5	0.6
LOX14	STD	29	2.5	11.7	23.2	16.4	1.8	3.6	57	2.1	3.8	16.3	0.030	0.001	0.003	0.004	0.001	0.2	4.7	15.8	169	0.29	0.002	97	4.4	0.3	3.5	0.002	0.0	0.2
	MIN	32	8.0	11.4	21.3	72.0	1.7	16.0	40	0.8	2.7	13.0	0.005	0.002	0.002	0.004	0.002	6.3	1.7	1.4	140	0.79	0.004	114	17.4	0.8	17.0	0.006	1.5	0.4
	MAX	116	15.0	44.8	89.8	115.0	5.5	27.0	200	6.5	13.6	61.2	0.087	0.005	0.010	0.015	0.005	7.0	14.9	44.0	628	1.63	0.010	391	28.8	1.7	27.0	0.013	1.5	1.1

ID	STAT	ALK	APA	Ca	Cl	COLOR	D_O2	DOC	HARD	K	Mg	Na	NH4	N02	N03	NOX	OPO4	Ph_F	SiO2	SO4	SpC	TDKN	TD_PO4	TDS	TEMP	TKN	TOC	T_PO4	TSS	TURB
		mg/L	nM/minmL	mg/L	mg/L	PCU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	units	mg/L	mg/L	uS/cm	mg/L	mg/L	mg/L	Deg.C	mg/L	mg/L	mg/L	mg/L	mg/L
	SIZE	7	7	7	7	7	8	7	7	7	7	7	7	7	4	7	7	8	7	7	8	7	6	7	8	7	7	8	7	7
	AVG	91	12.4	27.7	50.7	69.6	4.4	19.3	100	3.2	9.5	36.1	0.040	0.003	0.008	0.012	0.003	7.2	10.1	15.9	406	1.16	0.006	253	23.8	1.3	19.7	0.011	1.5	0.6
LOX15	STD	34	4.2	11.8	28.6	11.3	1.7	4.2	47	1.9	5.0	19.4	0.020	0.001	0.006	0.003	0.002	0.2	5.6	17.0	191	0.24	0.001	121	4.6	0.2	4.3	0.009	0.0	0.1
	MIN	58	8.0	17.2	27.9	54.0	2.2	16.0	60	1.8	5.4	21.1	0.020	0.002	0.000	0.007	0.002	7.0	4.6	5.8	223	0.96	0.005	171	18.1	1.1	16.0	0.006	1.5	0.4
	MAX	152	21.0	49.0	107.0	82.0	7.3	27.0	200	7.2	19.3	74.4	0.070	0.004	0.014	0.018	0.006	7.5	19.3	51.7	761	1.63	0.007	480	30.1	1.8	27.0	0.034	1.5	0.8
	SIZE	7	7	7	7	7	7	7	7	7	7	7	7	7	2	7	7	7	7	7	7	7	6	7	7	7	7	7	7	7
	AVG	51	13.5	17.5	43.1	104.3	1.6	20.7	73	2.4	5.6	28.0	0.012	0.004	0.005	0.006	0.003	6.5	6.9	8.5	270	1.02	0.006	191	23.0	1.1	21.0	0.009	1.9	0.7
LOX16	STD	31	4.7	10.5	25.2	25.2	1.4	3.6	58	2.1	4.7	18.6	0.008	0.001		0.004	0.001	0.2	5.1	15.4	178	0.28	0.001	107	4.4	0.3	3.5	0.005	0.9	0.3
	MIN	27	8.0	10.3	24.0	73.0	0.6	18.0	40	0.9	2.7	14.4	0.000	0.002	0.002	0.002	0.002	6.3	1.8	0.8	141	0.82	0.005	103	17.3	0.9	18.0	0.005	1.5	0.4
	MAX	118	20.0	40.2	97.2	134.0	4.8	28.0	200	6.8	15.8	68.2	0.024	0.005	0.008	0.012	0.005	7.0	16.9	42.3	654	1.62	0.008	415	29.0	1.8	28.0	0.020	4.0	1.3
	SIZE	4	4	4	7	4	6	4	4	4	4	4	4	4	2	4	4	6	4	7	6	4	4	4	6	4	4	6	4	4
	AVG	174	3.8	54.6	75.1	165	1.8	29.8	200	8.1	15.4	51.0	0.016	0.006	0.007	0.010	0.012	7.1	27.4	17.4	672	1.70	0.017	428	21.4	1.8	33.0	0.022	1.3	0.9
LOXA101	STD	18	2.6	3.3	38.4	42	1.6	2.7	16	0.8	2.3	10.7	0.005	0.002		0.005	0.009	0.1	6.9	10.7	94	0.15	0.013	70	4.8	0.1	7.8	0.016	1.4	0.5
	MIN	152	1.5	50.6	5.7	122	0.6	27.1	188	7.3	12.7	35.6	0.009	0.004	0.004	0.004	0.006	7.0	17.5	1.8	525	1.53	0.006	332	15.8	1.6	28.8	0.011	0.3	0.6
	MAX	196	7.5	58.7	124.9	204	4.9	33.6	222	8.9	18.3	59.4	0.020	0.008	0.009	0.015	0.025	7.2	33.1	29.6	794	1.87	0.036	499	27.4	1.9	44.7	0.053	3.3	1.6
	SIZE	3	3	3	5	3	5	3	3	3	3	3	3	3	2	3	3	5	3	5	5	3	3	3	5	3	3	5	3	3
	AVG	151	7.9	48.3	61.6	159	2.1	28.9	183	6.8	15.1	52.2	0.017	0.006	0.005	0.009	0.006	6.9	26.5	21.8	488	1.64	0.009	400	22.0	1.7	34.5	0.013	1.2	1.4
LOXA102	STD	78	2.2	26.6	38.2	35	1.4	10.2	101	3.0	8.7	32.2	0.010	0.001		0.005	0.002	0.2	13.0	23.8	292	0.66	0.003	245	5.1	0.7	17.8	0.002	0.5	1.1
	MIN	67	6.1	18.4	32.7	119	0.4	19.4	71	3.4	6.1	24.4	0.009	0.005	0.001	0.005	0.004	6.6	15.9	4.5	255	0.94	0.006	146	15.6	1.0	19.4	0.010	0.9	0.7
	MAX	221	10.3	69.1	127.3	187	3.7	39.7	269	9.0	23.5	87.5	0.028	0.006	0.009	0.014	0.008	7.1	41.0	54.5	952	2.26	0.011	633	27.1	2.3	54.1	0.015	1.7	2.6
	SIZE	4	4	4	6	4	6	4	4	4	4	4	4	4	4	4	4	6	4	6	6	4	4	4	6	4	4	6	4	4
	AVG	128	6.1	40.0	67.6	150	2.3	29.0	154	6.1	13.2	50.0	0.014	0.006	0.004	0.009	0.007	7.0	22.8	18.4	484	1.54	0.009	391	20.6	1.6	33.0	0.018	1.0	1.1
LOXA103	STD	70	3.2	24.4	28.9	37	1.8	7.8	93	3.0	7.8	24.7	0.002	0.001	0.003	0.003	0.002	0.2	13.7	21.8	246	0.55	0.003	194	5.4	0.5	15.0	0.012	0.3	0.3
	MIN	62	3.1	17.4	37.1	111	0.5	21.8	68	3.6	6.0	27.3	0.011	0.004	0.001	0.006	0.005	6.7	8.9	3.4	257	0.99	0.006	227	14.2	1.1	21.5	0.009	0.8	0.8
	MAX	200	10.5	61.1	118.1	194	5.7	39.9	240	9.4	21.3	81.2	0.016	0.007	0.007	0.013	0.009	7.3	39.8	49.5	873	2.22	0.012	619	27.2	2.2	54.5	0.042	1.2	1.5
	SIZE	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	8	9	9	9	9	9	9	9	9	9	9	9
	AVG	196	1.2	63.1	112.0	126	4.3	31.8	243	9.0	20.8	78.5	0.121	0.023	0.140	0.163	0.073	7.6	18.2	52.4	843	2.00	0.082	552	25.0	2.1	31.8	0.102	2.7	3.5
LOXA104	STD	18	0.2	10.7	29.5	56	2.1	6.2	26	2.1	2.4	19.9	0.096	0.023	0.138	0.157	0.079	0.3	5.3	11.2	96	0.39	0.073	57	4.1	0.4	5.8	0.076	1.6	2.5
	MIN	161	1.0	42.7	80.1	75	0.3	22.9	202	7.3	16.8	58.8	0.013	0.005	0.002	0.010	0.008	7.3	8.5	34.5	713	1.39	0.015	464	17.7	1.6	22.7	0.022	0.8	1.5
	MAX	216	1.6	77.8	174.7	218	7.2	45.6	281	13.3	23.7	121.5	0.325	0.068	0.401	0.469	0.224	8.0	22.6	68.2	1018	2.57	0.223	639	29.1	2.7	44.0	0.237	5.6	7.9
	SIZE	6	6	6	6	6	6	6	6	6	6	6	6	6	4	6	6	6	5	6	6	6	6	6	6	6	6	6	6	6
	AVG	157	2.0	51.4	73.2	160	1.2	28.6	189	7.1	14.6	51.7	0.021	0.006	0.003	0.007	0.036	6.8	21.7	31.3	602	1.57	0.040	409	21.0	1.9	28.5	0.063	3.0	2.1
LOXA105	STD	37	0.9	17.6	7.7	44	1.0	4.3	61	1.8	4.1	5.1	0.013	0.002	0.002	0.003	0.068	0.4	6.0	22.0	140	0.48	0.070	116	5.4	0.6	4.0	0.084	1.2	1.5
	MIN	122	0.7	35.3	65.2	130	0.2	24.6	132	5.5	10.7	46.0	0.009	0.004	0.001	0.004	0.005	6.1	15.7	12.0	476	1.11	0.009	299	14.7	1.3	24.8	0.017	1.7	0.9
	MAX	201	3.2	73.8	84.0	227	2.5	34.4	265	9.9	19.5	57.7	0.042	0.008	0.006	0.011	0.175	7.2	31.5	58.4	763	2.17	0.182	551	27.6	2.6	33.7	0.232	5.3	4.8
	SIZE	3	3	3	6	3	6	3	3	3	3	3	3	3	2	3	3	6	3	6	6	3	3	3	6	3	3	6	3	3
	AVG	160	4.5	53.9	60.7	178	2.3	29.3	200	7.4	15.9	50.7	0.017	0.007	0.005	0.009	0.014	6.7	25.9	22.6	494	1.65	0.018	450	20.5	1.7	29.1	0.017	1.3	1.3
LOXA106	STD	51	2.8	21.8	18.9	45	2.2	6.6	81	2.2	6.7	18.5	0.002	0.002		0.003	0.012	0.4	5.7	23.4	193	0.45	0.016	134	5.4	0.5	6.4	0.015	0.9	0.6
	MIN	102	1.3	28.8	44.9	133	0.3	22.1	108	4.9	8.9	36.2	0.015	0.005	0.004	0.006	0.006	5.9	21.3	6.6	345	1.13	0.007	299	13.8	1.1	21.9	0.007	0.6	0.8
	MAX	200	6.5	68.0	97.5	223	5.7	35.0	261	8.9	22.2	71.6	0.019	0.008	0.005	0.012	0.028	7.0	32.3	60.5	819	1.94	0.036	557	27.0	2.0	34.2	0.048	2.3	2.0
	SIZE	2	2	2	3	2	5	2	2	2	2	2	2	2	1	2	2	5	2	3	5	2	2	2	5	2	2	5		2
	AVG	162	20.1	52.5	75.5	140	1.6	32.4	204	7.8	17.7	65.5	0.013	0.006	0.007	0.009	0.007	6.6	34.9	25.3	435	1.76	0.008	523	23.9	1.8	32.7	0.011		0.5
LOXA107	STD				33.5		1.3											0.3		23.8	252				4.3			0.003		
	MIN	151	13.7	45.8	36.8	127	0.2	31.8	179	7.7	15.7	63.2	0.009	0.005		0.005	0.006	6.1	33.9	2.5	216	1.74	0.007	492	17.9	1.8	32.0	0.007		0.5
	MAX	172	26.6	59.3	95.9	152	3.2	33.1	229	7.8	19.7	67.8	0.016	0.006		0.013	0.007	7.0	35.9	49.9	762	1.78	0.009	554	28.0	1.8	33.5	0.016		0.6
	SIZE	3	3	3	4	3	5	3	3	3	3	3	3	3	2	3	3	5	3	4	5	3	3	3	5	3	3	5	3	3
	AVG	28	37.4	6.9	25.8	129	3.5	20.5	28	1.9	2.7	17.2	0.009	0.005	0.002	0.007	0.005	6.5	8.5	0.3	173	1.09	0.006	116	26.9	1.2	21.1	0.011	2.0	1.7
LOXA108	STD	7	11.2	1.7	6.7	19	2.6	2.9	7	0.3	0.6	3.3	0.003	0.001		0.002	0.001	0.2	2.8	0.3	62	0.19	0.002	21	4.2	0.2	1.7	0.004	0.5	1.1
	MIN	21	26.4	5.6	19.2	108	1.8	17.5	23	1.6	2.2	15.0	0.006	0.005	0.001	0.005	0.004	6.3	5.5	0.1	121	0.87	0.005	102	21.3	1.0	20.0	0.006	1.7	0.9
	MAX	35	48.8	8.8	33.4	142	8.2	23.2	36	2.1	3.4	20.9	0.011	0.006	0.003	0.009	0.006	6.8	11.2	0.7	274	1.21	0.008	141	32.5	1.3	23.0	0.017	2.6	3.0
	SIZE	6	6	6	6	6	7	6	6	6	6	6	6	6	1	6	6	7	5	6	7	6	6	6	7	6	6	7	6	6
	AVG	65	10.2	18.4	39.5	111	1.9	20.6	73	3.2	6.5	27.8	0.010	0.004	0.010	0.008	0.007	6.5	16.3	6.7	291	0.99	0.006	203	22.8	1.1	20.5	0.011	1.7	0.6
LOXA109	STD	40	4.5	12.6	25.2	43	0.9	6.3	49	2.5	4.2	16.2	0.007	0.002		0.004	0.002	0.4	9.7	8.9	174	0.35	0.002	126	4.7	0.4	6.2	0.005	0.8	0.1
	MIN	39	6.2	10.2	20.1	79	0.7	16.2	40	1.8	3.6	15.4	0.003	0.003		0.004	0.005	5.8	7.4	1.3	153	0.81	0.004	122	16.0	0.8	16.2	0.008	0.8	0.4
	MAX	144	17.9	43.5	88.7	192	3.3	33.2	170	8.0	14.8	59.6	0.021	0.007		0.014	0.009	7.0	31.0	24.3	656	1.70	0.010	448	27.9	1.8	32.9	0.022	2.9	0.7

ID	STAT	ALK	APA	Ca	Cl	COLOR	D_O2	DOC	HARD	K	Mg	Na	NH4	N02	N03	NOX	OPO4	Ph_F	SiO2	SO4	SpC	TDKN	TD_PO4	TDS	TEMP	TKN	TOC	T_PO4	TSS	TURB
		mg/L	nM/minmL	mg/L	mg/L	PCU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	units	mg/L	mg/L	uS/cm	mg/L	mg/L	mg/L	Deg.C	mg/L	mg/L	mg/L	mg/L	mg/L
	SIZE	4	4	4	5	4	7	4	4	4	4	4	4	4	1	4	4	7	4	5	7	4	4	4	7	4	4	6	4	4
	AVG	29	43.1	8.0	24.0	111	2.8	18.5	32	1.7	2.9	15.9	0.009	0.004	0.004	0.009	0.005	6.4	8.5	0.9	151	0.98	0.006	137	23.1	1.1	19.2	0.014	4.3	0.9
LOXA110	STD	7	24.6	2.4	6.4	37	1.2	4.0	10	0.6	0.9	4.2	0.005	0.002		0.004	0.002	0.3	3.9	0.8	34	0.18	0.001	33	4.6	0.2	3.3	0.006	3.6	0.4
	MIN	23	17.7	6.2	16.6	75	1.5	13.9	25	1.3	2.2	12.8	0.005	0.003		0.004	0.004	5.8	4.3	0.4	112	0.71	0.005	111	17.0	0.7	16.1	0.007	0.9	0.6
	MAX	39	74.3	11.4	31.8	159	5.2	23.7	46	2.5	4.2	21.8	0.016	0.007		0.012	0.007	6.6	12.8	2.3	202	1.12	0.008	186	28.1	1.3	23.8	0.024	8.3	1.3
	SIZE	5	5	5	6	5	7	5	5	5	5	5	5	5	1	5	5	7	5	6	7	5	5	5	7	5	5	7	5	5
	AVG	37	29.1	12.1	28.2	92	3.0	17.9	47	1.9	4.2	18.1	0.013	0.003	0.004	0.008	0.005	6.5	7.7	4.0	199	0.93	0.006	138	22.5	1.2	18.5	0.011	7.5	2.2
LOXA111	STD	17	14.6	6.4	17.0	28	1.3	5.1	25	1.7	2.3	12.0	0.009	0.001		0.003	0.001	0.2	6.7	7.7	101	0.27	0.001	84	5.0	0.4	4.6	0.005	11.3	3.0
	MIN	23	11.3	6.7	12.7	63	1.2	12.4	26	1.1	2.2	9.1	0.007	0.002		0.004	0.003	6.3	2.2	0.5	96	0.68	0.005	59	15.9	0.7	14.5	0.006	0.6	0.6
	MAX	65	45.4	23.0	59.4	125	4.4	26.0	91	4.9	8.1	38.7	0.028	0.005		0.012	0.006	6.9	19.2	19.7	382	1.39	0.007	281	27.8	1.8	26.1	0.022	27.2	7.6
	SIZE	6	6	6	6	6	6	6	6	6	6	6	6	6	2	6	6	6	5	6	6	7	6	6	6	7	6	6	6	6
	AVG	62	19.1	18.6	37.8	92	2.3	20.0	72	3.0	6.3	26.3	0.008	0.004	0.010	0.009	0.005	6.6	11.6	7.1	272	1.17	0.006	195	22.3	1.2	20.6	0.011	4.0	1.0
LOXA112	STD	39	13.9	12.2	27.3	33	1.5	5.8	49	2.4	4.4	18.6	0.003	0.002		0.005	0.003	0.3	9.0	10.8	195	0.41	0.002	127	5.0	0.4	5.5	0.003	2.5	0.2
	MIN	36	4.1	10.5	19.3	66	0.2	16.2	40	1.5	3.4	14.0	0.003	0.002	0.009	0.005	0.002	6.0	5.1	1.6	147	0.80	0.004	125	16.2	0.8	16.1	0.008	1.1	0.8
	MAX	140	41.2	43.0	92.1	155	4.3	31.5	170	7.8	15.2	63.4	0.011	0.006	0.010	0.015	0.009	7.0	27.4	29.1	664	1.77	0.009	454	27.9	1.7	31.6	0.015	6.3	1.2
	SIZE	4	4	4	6	4	8	4	4	4	4	4	4	4	1	4	4	8	4	6	8	5	4	4	8	4	4	8	4	4
	AVG	31	59.2	9.2	24.9	86	3.2	17.5	36	1.6	3.2	14.8	0.011	0.004	0.007	0.012	0.005	6.5	7.4	1.3	181	0.77	0.006	113	23.4	1.1	18.1	0.010	2.9	1.1
LOXA113	STD	13	46.2	4.4	11.4	24	1.4	4.9	18	1.0	1.6	8.5	0.004	0.001		0.007	0.002	0.3	5.4	2.1	72	0.47	0.001	29	4.0	0.3	4.3	0.004	3.1	0.6
	MIN	22	27.0	5.8	11.5	61	1.2	13.4	23	1.1	2.0	8.2	0.007	0.002		0.004	0.003	5.9	3.7	0.2	86	0.02	0.005	89	17.6	0.7	15.4	0.007	0.3	0.5
	MAX	51	127.6	15.5	40.6	118	5.4	24.6	62	3.0	5.5	27.0	0.016	0.005		0.020	0.007	6.9	15.3	5.7	271	1.25	0.007	153	27.7	1.3	24.5	0.017	7.0	1.7
	SIZE	4	4	4	5	4	9	4	4	4	4	4	4	4	1	4	4	9	4	5	9	4	4	4	9	4	4	8	4	4
	AVG	24	51.7	7.1	19.5	96	3.2	18.0	28	1.3	2.6	12.2	0.009	0.004	0.030	0.018	0.004	6.4	6.0	0.2	166	0.94	0.006	115	23.9	1.0	18.4	0.014	2.5	0.8
LOXA114	STD	9	17.2	2.5	6.8	32	1.5	4.5	10	0.6	0.9	4.4	0.004	0.001		0.014	0.001	0.2	3.3	0.1	65	0.19	0.001	18	4.1	0.3	4.0	0.009	2.3	0.4
	MIN	16	38.1	5.0	10.8	75	1.0	13.3	20	0.9	1.7	7.7	0.004	0.003		0.004	0.003	6.2	3.8	0.1	76	0.67	0.005	99	17.0	0.7	14.9	0.006	0.9	0.5
	MAX	36	76.6	10.5	26.2	143	5.6	23.8	42	2.2	3.8	17.8	0.012	0.006		0.036	0.005	6.8	10.8	0.4	277	1.09	0.006	135	28.1	1.3	23.7	0.033	5.7	1.4
	SIZE	9	9	8	9	9	9	9	8	8	8	8	9	9	9	9	9	9	8	9	9	9	9	9	9	9	9	9	9	9
	AVG	187	1.6	61.9	102.7	122	4.6	29.9	236	8.1	19.9	73.4	0.072	0.017	0.089	0.107	0.056	7.6	18.8	50.3	799	1.81	0.064	510	25.4	2.0	29.9	0.085	4.8	4.6
LOXA115	STD	18	0.8	7.8	24.6	52	2.2	4.9	21	1.2	2.5	17.9	0.050	0.015	0.081	0.094	0.063	0.3	3.7	11.4	100	0.31	0.061	72	3.5	0.3	4.4	0.064	3.6	3.1
	MIN	160	1.0	53.3	71.4	76	2.3	23.3	218	7.0	17.1	51.5	0.007	0.007	0.014	0.021	0.006	7.0	12.0	38.7	691	1.41	0.014	422	19.6	1.6	23.7	0.026	0.8	1.2
	MAX	227	3.1	78.4	148.4	214	9.1	37.3	285	10.5	22.3	103.9	0.173	0.046	0.229	0.275	0.172	7.9	23.0	65.0	962	2.37	0.180	600	28.5	2.5	36.2	0.200	12.1	10.4
	SIZE	7	7	6	7	7	7	7	6	6	6	6	7	7	5	7	7	7	6	7	7	7	7	7	7	7	7	7	7	7
	AVG	180	3.7	60.5	81.4	129	1.0	28.7	220	7.0	16.8	59.1	0.051	0.005	0.006	0.009	0.030	7.1	15.1	35.2	761	1.64	0.037	456	22.9	2.0	29.1	0.072	6.6	2.7
LOXA116	STD	31	3.5	12.8	26.3	33	0.7	4.4	54	2.1	5.4	19.6	0.051	0.001	0.004	0.005	0.057	0.2	7.2	22.9	207	0.34	0.055	132	3.6	0.3	3.9	0.058	4.9	0.8
	MIN	142	0.7	45.4	57.0	96	0.3	25.4	158	4.1	10.7	42.6	0.011	0.003	0.001	0.005	0.006	6.7	5.8	18.4	558	1.33	0.012	354	17.4	1.6	25.8	0.032	2.0	1.3
	MAX	238	11.2	80.9	135.4	183	2.1	36.9	309	9.5	25.9	96.1	0.161	0.007	0.012	0.018	0.159	7.3	24.6	81.0	1063	2.21	0.162	707	26.6	2.4	36.1	0.199	15.7	3.4
	SIZE	5	5	5	6	5	7	5	5	5	5	5	5	5	3	5	5	7	5	6	7	5	5	5	7	5	5	7	5	5
	AVG	136	6.0	44.3	69.9	139	2.2	27.1	169	5.8	14.2	51.0	0.016	0.006	0.004	0.008	0.007	6.9	18.8	28.4	520	1.39	0.009	381	22.4	1.4	27.2	0.015	1.3	0.8
LOXA117	STD	46	2.6	17.3	30.2	24	2.4	7.0	69	2.1	6.4	22.5	0.011	0.001	0.003	0.002	0.002	0.3	7.3	22.9	218	0.53	0.003	170	4.1	0.5	6.8	0.005	1.5	0.2
	MIN	101	1.7	30.3	49.9	104	0.5	21.8	115	3.9	9.6	34.7	0.002	0.004	0.001	0.006	0.003	6.4	9.8	12.8	367	0.98	0.005	248	16.8	1.0	22.4	0.008	0.2	0.5
	MAX	205	8.1	69.3	123.3	162	7.3	38.1	271	8.3	23.7	85.7	0.033	0.007	0.006	0.010	0.009	7.3	29.1	68.2	939	2.21	0.012	628	27.1	2.1	37.4	0.022	3.9	1.0
	SIZE	5	5	5	6	5	8	5	5	5	5	5	5	5	2	5	5	8	5	6	8	6	5	5	8	6	5	8	5	5
	AVG	83	18.4	25.6	42.4	104	2.5	20.7	98	3.4	8.3	31.0	0.014	0.005	0.002	0.007	0.005	6.8	12.3	12.0	329	1.15	0.006	209	24.0	1.2	20.6	0.008	0.8	0.5
LOXA118	STD	38	8.9	12.1	23.2	18	1.4	5.0	47	2.3	4.1	16.1	0.012	0.001		0.003	0.002	0.2	7.7	9.7	140	0.32	0.001	101	4.1	0.2	4.7	0.004	0.6	0.2
	MIN	59	8.9	17.1	26.2	81	0.8	17.8	65	2.0	5.4	19.6	0.001	0.003	0.001	0.005	0.003	6.4	3.1	5.7	221	0.85	0.005	124	17.2	1.0	17.9	0.006	0.2	0.4
	MAX	150	27.9	46.4	87.1	129	4.7	29.6	179	7.4	15.3	58.0	0.034	0.006	0.002	0.012	0.008	7.2	22.4	30.0	647	1.59	0.007	364	28.5	1.6	28.8	0.018	1.4	0.8
	SIZE	7	8	7	8	7	9	7	7	7	7	7	7	7	3	7	7	9	7	8	9	7	7	7	9	7	7	9	7	7
	AVG	38	43.1	10.4	21.8	73	3.5	15.8	41	1.5	3.6	15.0	0.046	0.005	0.043	0.024	0.004	6.6	7.0	1.5	199	0.84	0.005	122	24.4	1.0	16.5	0.010	1.6	0.7
LOXA119	STD	5	24.7	1.4	4.9	7	1.8	2.3	6	0.4	0.5	3.4	0.100	0.003	0.064	0.046	0.001	0.3	3.0	1.4	100	0.20	0.001	19	4.3	0.4	2.5	0.004	1.3	0.3
	MIN	28	25.3	7.8	15.9	63	0.2	13.0	30	1.2	2.6	11.6	0.001	0.003	0.001	0.002	0.003	6.1	3.2	0.6	117	0.68	0.004	104	17.1	0.6	13.3	0.005	0.2	0.3
	MAX	41	101.6	12.0	30.6	86	5.7	20.0	48	2.3	4.3	21.8	0.272	0.012	0.117	0.129	0.006	7.1	11.6	4.9	401	1.27	0.007	157	30.0	1.7	20.2	0.019	3.4	1.1
	SIZE	6	7	6	7	6	8	6	6	6	6	6	6	6		6	6	8	6	7	8	6	6	6	8	6	6	8	6	6
	AVG	22	66.2	6.6	21.0	65	4.1	16.8	27	1.1	2.4	12.6	0.014	0.003		0.007	0.004	6.5	5.4	0.1	164	1.07	0.005	97	24.9	1.2	17.0	0.009	3.4	0.9
LOXA120	STD	5	48.4	1.2	6.0	14	2.1	1.8	5	0.3	0.4	2.7	0.009	0.001		0.004	0.001	0.2	4.1	0.1	111	0.13	0.001	24	2.7	0.3	1.6	0.003	4.8	0.4
	MIN	15	32.5	4.6	11.8	50	0.8	14.1	18	0.8	1.7	8.6	0.001	0.002		0.002	0.003	6.1	1.3	0.0	83	0.84	0.004	61	20.4	0.9	15.0	0.006	0.3	0.4
	MAX	29	172.1	8.1	30.1	84	6.6	19.7	32	1.6	2.8	15.8	0.029	0.004		0.014	0.006	6.6	11.5	0.3	430	1.23	0.006	128	27.9	1.7	19.8	0.016	11.9	1.5
	SIZE	5	5	5	6	5	6	5	5	5	5	5	5	5	4	5	5	6	5	6	6	5	5	5	6	5	5	6	5	5
	AVG	204	1.7	67.1	88.0	133	0.7	30.7	246	8.3	19.0	60.7	0.035	0.005	0.008	0.011	0.039	7.0	16.3	42.3	761	1.78	0.046	496	21.7	2.5	31.2	0.106	13.6	4.7
LOXA121	STD	23	0.9	9.2	12.8	24	0.2	1.5	35	0.7	2.9	7.8	0.028	0.001	0.003	0.005	0.040	0.2	4.7	9.4	87	0.15	0.040	45	4.5	1.0	1.6	0.050	18.8	5.4
	MIN	175	0.9	52.5	70.8	100	0.5	28.9	191	7.5	14.6	52.1	0.007	0.004	0.004	0.004	0.010	6.6	8.8	24.0	622	1.58	0.016	435	15.5	1.8	29.9	0.032	0.6	1.3
	MAX	236	3.1	76.4	101.6	166	1.0	33.1	282	9.2	22.1	71.1	0.080	0.006	0.011	0.017	0.108	7.3	20.6	48.7	852	1.96	0.113	559	26.9	4.1	33.9	0.179	43.1	14.2

ID	STAT	ALK	APA	Ca	Cl	COLOR	D_O2	DOC	HARD	K	Mg	Na	NH4	N02	N03	NOX	OPO4	Ph_F	SiO2	SO4	SpC	TDKN	TD_PO4	TDS	TEMP	TKN	TOC	T_PO4	TSS	TURB
		mg/L	nM/minmL	mg/L	mg/L	PCU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	units	mg/L	mg/L	uS/cm	mg/L	mg/L	mg/L	Deg.C	mg/L	mg/L	mg/L	mg/L	mg/L
	SIZE	5	5	5	5	5	7	5	5	5	5	5	5	5	3	5	5	7	5	5	7	5	5	5	7	5	5	7	5	5
	AVG	186	11.1	60.7	95.7	129	1.8	31.3	230	6.9	19.0	67.6	0.019	0.005	0.005	0.007	0.006	7.1	20.8	41.3	721	1.69	0.007	499	23.5	1.8	31.9	0.012	1.4	0.8
LOXA122	STD	21	5.1	10.4	17.8	9	1.4	3.6	43	0.7	4.2	13.4	0.011	0.001	0.003	0.004	0.001	0.2	2.6	24.6	144	0.33	0.002	94	3.5	0.3	3.4	0.003	0.9	0.2
	MIN	161	5.4	51.7	78.7	118	0.5	28.1	192	6.1	15.2	54.5	0.009	0.004	0.002	0.001	0.005	6.6	17.0	20.2	527	1.42	0.004	426	18.4	1.5	28.4	0.009	0.3	0.7
	MAX	208	19.2	73.8	122.8	137	4.6	36.7	280	7.7	23.9	86.9	0.037	0.006	0.007	0.011	0.007	7.3	23.9	69.0	940	2.13	0.008	608	27.7	2.3	36.7	0.017	2.5	1.1
	SIZE	7	6	5	6	6	7	6	5	5	5	5	6	6	2	6	6	7	5	6	7	7	6	6	7	7	6	7	6	6
	AVG	137	14.9	35.4	63.5	80	2.4	22.5	134	4.3	11.1	44.0	0.026	0.004	0.005	0.009	0.004	7.1	14.7	15.7	477	1.27	0.006	302	23.8	1.3	22.5	0.013	1.5	0.7
LOXA123	STD	52	5.0	2.5	3.3	6	1.4	1.5	9	0.1	0.8	2.5	0.019	0.001		0.005	0.001	0.2	1.0	2.6	21	0.07	0.002	22	3.3	0.2	1.7	0.006	0.7	0.2
	MIN	101	5.3	32.4	59.6	72	0.8	19.8	123	4.1	10.1	41.3	0.008	0.003	0.005	0.003	0.003	6.9	13.2	13.3	440	1.13	0.005	278	18.8	0.8	19.7	0.008	0.6	0.5
	MAX	253	18.7	39.2	66.7	91	4.3	23.9	147	4.5	11.9	47.0	0.057	0.005	0.005	0.016	0.005	7.4	15.7	19.5	499	1.35	0.010	337	27.6	1.4	24.3	0.025	2.5	1.1
	SIZE	6	6	6	6	6	6	6	6	6	6	6	6	6	1	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	AVG	28	13.2	10.9	24.8	98	2.5	18.5	36	0.9	2.3	14.9	0.009	0.004	0.021	0.008	0.030	6.4	3.4	1.0	147	0.98	0.034	99	22.1	1.1	18.9	0.046	3.1	0.7
LOXA124	STD	5	12.8	1.6	7.2	24	2.2	1.3	6	0.5	0.5	4.1	0.006	0.001		0.009	0.057	0.3	3.4	1.2	37	0.08	0.057	37	4.9	0.3	1.4	0.056	1.8	0.2
	MIN	23	2.2	9.3	17.7	67	0.4	17.1	31	0.6	1.8	10.7	0.001	0.003		0.003	0.003	6.1	0.9	0.5	115	0.89	0.006	44	15.4	1.0	17.2	0.009	2.1	0.6
	MAX	37	36.4	13.8	37.8	126	6.3	20.7	47	2.0	3.2	22.2	0.016	0.005		0.025	0.146	6.9	9.7	3.6	215	1.10	0.149	148	27.3	1.7	20.7	0.151	5.7	1.1
	SIZE	6	6	6	6	6	7	6	6	6	6	6	6	6	2	6	6	7	6	6	7	6	6	6	7	6	6	7	6	6
	AVG	79	19.6	25.4	52.6	97	4.1	20.9	93	2.9	7.2	35.4	0.009	0.004	0.003	0.004	0.004	6.7	8.2	9.3	326	1.15	0.006	243	23.4	1.2	21.2	0.012	1.1	0.8
LOXA126	STD	31	9.6	10.6	17.1	24	2.6	4.3	39	1.2	3.1	12.9	0.007	0.001		0.003	0.002	0.3	8.0	10.7	134	0.25	0.003	102	4.6	0.3	4.0	0.009	0.9	0.3
	MIN	61	6.5	19.3	40.9	71	1.7	17.5	70	2.2	5.4	27.4	0.001	0.002	0.001	0.002	0.002	6.2	0.5	3.2	191	0.91	0.004	176	16.5	0.9	17.6	0.006	0.3	0.4
	MAX	141	30.3	46.9	86.5	134	9.5	29.2	173	5.4	13.6	61.4	0.018	0.005	0.005	0.009	0.007	7.2	22.2	30.7	616	1.60	0.011	448	27.7	1.7	28.8	0.033	2.8	1.1
	SIZE	6	6	6	6	6	7	6	6	6	6	6	6	6	2	6	6	7	6	6	7	7	6	6	7	7	6	7	6	6
	AVG	24	48.2	9.8	31.8	106	4.1	22.3	35	1.3	2.7	18.9	0.009	0.004	0.001	0.005	0.006	6.4	5.7	1.8	168	1.19	0.006	138	23.9	1.3	22.3	0.011	1.4	0.7
LOXA127	STD	1	9.6	0.8	5.9	44	3.2	4.8	3	0.3	0.2	3.2	0.005	0.002		0.002	0.002	0.2	2.7	2.2	19	0.22	0.002	10	4.8	0.4	4.4	0.008	0.6	0.1
	MIN	21	32.5	8.7	25.1	73	0.8	15.7	32	1.0	2.5	15.9	0.001	0.002	0.001	0.001	0.003	6.2	1.5	0.2	143	0.91	0.005	125	16.6	0.8	16.9	0.006	0.6	0.5
	MAX	25	58.1	11.0	40.4	193	11.0	28.7	39	1.7	2.9	23.8	0.016	0.007	0.001	0.007	0.008	6.6	8.3	5.5	191	1.45	0.009	152	27.8	1.8	27.9	0.027	2.3	0.9
	SIZE	5	4	4	5	4	7	4	4	4	4	4	4	4	1	4	4	7	4	5	7	4	4	4	7	4	4	6	4	4
	AVG	28	99.6	5.7	19.1	80	3.5	17.6	23	1.1	2.1	10.8	0.009	0.004	0.001	0.007	0.005	6.3	4.7	0.1	129	0.97	0.006	99	24.2	1.4	18.1	0.012	4.1	1.6
LOXA128	STD	24	50.2	1.5	6.7	19	1.0	3.2	6	0.4	0.6	3.0	0.008	0.001		0.003	0.001	0.2	3.2	0.0	43	0.17	0.001	15	3.6	0.6	2.9	0.005	5.0	1.7
	MIN	10	48.6	3.8	10.6	60	2.4	13.5	15	0.7	1.4	7.1	0.001	0.003		0.004	0.004	6.1	2.6	0.1	65	0.72	0.005	79	18.6	0.9	14.3	0.007	0.8	0.6
	MAX	69	167.6	7.0	28.2	105	5.0	20.8	29	1.7	2.7	13.5	0.019	0.004		0.009	0.006	6.6	9.4	0.1	190	1.07	0.008	112	28.1	2.2	21.0	0.021	11.5	4.2
	SIZE	9	9	9	9	9	9	9	9	9	9	9	9	9	7	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
	AVG	169	3.5	57.0	84.2	116	4.6	25.3	201	7.1	14.3	56.9	0.091	0.010	0.033	0.037	0.084	7.5	13.4	31.3	662	1.56	0.095	436	25.5	1.9	26.6	0.139	8.4	7.1
LOXA129	STD	25	2.0	8.0	27.1	46	4.4	5.0	31	1.4	4.8	18.9	0.096	0.006	0.032	0.032	0.141	0.3	3.5	17.7	139	0.32	0.142	88	4.7	0.4	6.4	0.147	5.4	4.4
	MIN	120	1.6	43.5	54.0	45	0.4	16.7	161	5.2	7.9	35.3	0.011	0.002	0.001	0.008	0.007	7.2	8.8	6.6	497	0.99	0.016	329	18.3	1.4	16.9	0.058	1.4	1.8
	MAX	194	7.8	72.3	130.3	193	14.7	32.4	237	8.9	20.7	87.5	0.306	0.019	0.093	0.102	0.432	8.0	19.9	59.0	874	2.10	0.446	563	30.6	2.4	37.2	0.499	17.5	15.6
	SIZE	6	6	6	6	6	6	6	6	6	6	6	6	6	3	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	AVG	138	10.2	44.6	63.5	125	2.2	25.5	154	6.1	10.4	41.9	0.012	0.004	0.001	0.005	0.035	6.9	8.5	11.7	499	1.41	0.041	325	22.7	1.6	26.1	0.054	1.0	0.9
LOXA130	STD	23	12.0	9.4	18.2	38	2.5	6.0	34	1.4	2.8	11.4	0.007	0.001	0.001	0.002	0.072	0.2	6.5	15.3	100	0.35	0.073	76	4.6	0.4	6.4	0.079	0.5	0.4
	MIN	112	0.8	39.5	30.7	98	0.6	16.0	128	5.2	6.5	21.4	0.002	0.003	0.001	0.001	0.003	6.7	1.2	2.6	348	0.95	0.007	217	16.4	1.1	16.5	0.011	0.5	0.6
	MAX	179	34.0	63.4	86.5	202	7.3	31.7	221	8.9	15.1	55.7	0.022	0.006	0.002	0.006	0.181	7.1	17.0	42.0	647	1.92	0.190	454	28.2	2.2	33.8	0.212	1.4	1.7
	SIZE	6	6	6	6	6	6	6	6	6	6	6	6	6	4	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	AVG	91	28.8	27.9	62.8	129	4.9	27.9	104	4.7	8.4	41.0	0.012	0.005	0.003	0.006	0.005	6.9	10.7	7.9	408	1.52	0.006	293	23.0	1.6	27.6	0.007	0.7	0.7
LOXA131	STD	33	11.4	10.1	14.6	21	4.8	4.3	38	1.4	3.0	9.9	0.005	0.001	0.003	0.004	0.002	0.1	10.0	9.0	123	0.23	0.002	80	4.6	0.3	3.9	0.002	0.2	0.2
	MIN	67	8.4	19.4	45.3	101	1.2	22.2	73	3.4	6.0	30.3	0.004	0.003	0.001	0.001	0.001	6.7	0.5	1.5	293	1.23	0.004	228	16.3	1.2	22.6	0.005	0.6	0.4
	MAX	139	41.4	42.3	87.5	163	14.1	31.9	158	6.6	12.8	58.6	0.017	0.006	0.007	0.012	0.008	7.1	25.1	21.5	612	1.78	0.008	429	27.8	1.9	32.2	0.010	1.1	0.9
	SIZE	8	8	9	9	9	9	9	9	9	9	9	9	9	6	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
	AVG	176	3.6	58.7	88.1	122	4.9	26.4	209	7.3	15.1	59.4	0.106	0.010	0.054	0.045	0.097	7.5	13.9	33.5	690	1.62	0.107	456	25.7	2.0	27.3	0.149	7.4	6.7
LOXA132	STD	24	2.3	7.5	23.5	56	4.8	5.0	27	1.8	4.6	16.5	0.115	0.005	0.046	0.046	0.163	0.4	3.3	16.6	121	0.38	0.158	77	4.9	0.5	7.2	0.171	5.5	3.8
	MIN	130	1.5	46.0	50.0	50	0.2	18.4	171	5.0	7.7	32.5	0.007	0.003	0.005	0.005	0.007	7.0	10.4	8.4	520	1.07	0.015	368	18.1	1.3	18.3	0.060	1.4	1.5
	MAX	203	8.0	71.7	123.9	220	15.3	33.0	252	10.0	20.5	82.9	0.334	0.019	0.112	0.121	0.506	8.3	19.5	56.7	853	2.33	0.500	563	31.7	2.9	43.2	0.574	17.9	13.9
	SIZE	4	4	4	5	4	6	4	4	4	4	4	4	4	2	4	4	6	4	5	6	4	4	4	6	4	4	5	4	4
	AVG	140	2.8	46.5	61.9	142	2.0	25.3	161	6.6	10.8	38.7	0.014	0.005	0.004	0.007	0.078	7.0	13.3	15.4	510	1.53	0.085	346	22.4	2.6	28.0	0.185	9.2	2.2
LOXA133	STD	34	1.8	14.2	17.0	51	2.3	6.2	52	1.9	4.4	11.2	0.009	0.002		0.004	0.118	0.2	5.7	17.5	99	0.44	0.116	113	4.8	0.9	10.7	0.109	4.4	0.6
	MIN	120	1.3	36.7	33.2	106	0.3	18.5	132	5.4	6.9	22.4	0.002	0.003	0.003	0.002	0.008	6.6	6.5	4.4	384	1.18	0.010	245	17.0	1.7	19.6	0.065	5.1	1.6
	MAX	191	5.4	67.2	77.7	215	6.3	32.9	238	9.5	17.1	46.7	0.021	0.008	0.004	0.011	0.254	7.2	19.2	46.0	680	2.17	0.256	506	28.0	3.6	43.6	0.322	15.4	2.9
	SIZE	6	6	6	6	6	6	6	6	6	6	6	6	6	4	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	AVG	115	6.1	37.1	56.0	123	2.5	25.3	132	5.9	9.6	38.0	0.015	0.005	0.003	0.006	0.037	7.0	11.1	14.3	441	1.44	0.041	298	22.4	1.6	26.9	0.057	3.2	1.1
LOXA134	STD	26	4.1	11.6	12.1	29	2.1	4.4	40	1.0	3.2	8.6	0.006	0.001	0.002	0.004	0.073	0.2	7.2	16.9	104	0.25	0.076	82	4.9	0.3	6.8	0.078	3.1	0.4
	MIN	94	0.9	28.3	32.1	104	0.2	17.0	105	5.2	6.9	21.7	0.009	0.004	0.002	0.001	0.003	6.7	2.8	3.9	368	1.01	0.007	230	16.3	1.1	18.0	0.016	0.3	0.6
	MAX	165	10.7	58.1	65.3	180	5.5	29.3	210	7.9	15.8	46.9	0.025	0.007	0.006	0.010	0.186	7.3	20.2	47.9	647	1.78	0.196	447	27.8	1.9	38.7	0.216	8.5	1.6

ID	STAT	ALK	APA	Ca	Cl	COLOR	D_O2	DOC	HARD	K	Mg	Na	NH4	N02	N03	NOX	OPO4	Ph_F	SiO2	SO4	SpC	TDKN	TD_PO4	TDS	TEMP	TKN	TOC	T_PO4	TSS	TURB
		mg/L	nM/minmL	mg/L	mg/L	PCU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	units	mg/L	mg/L	uS/cm	mg/L	mg/L	mg/L	Deg.C	mg/L	mg/L	mg/L	mg/L	mg/L
	SIZE	9	9	9	9	9	9	9	9	9	9	9	9	9	8	9	10	9	8	9	9	9	9	9	9	9	9	11	9	9
	AVG	170	2.5	58.0	87.9	116	3.7	24.9	205	7.3	14.7	59.5	0.076	0.011	0.045	0.052	0.142	7.5	13.4	32.1	685	1.57	0.117	444	25.5	1.9	26.6	0.197	8.4	7.9
LOXA135	STD	23	1.6	7.3	23.1	46	2.6	4.5	29	1.6	4.9	16.5	0.079	0.010	0.046	0.048	0.213	0.3	3.6	16.0	128	0.31	0.182	75	4.4	0.4	6.2	0.230	5.7	4.7
	MIN	126	1.1	44.8	59.6	48	0.1	17.7	166	5.3	7.6	39.6	0.010	0.003	0.003	0.004	0.005	7.1	8.2	8.3	544	1.03	0.013	350	18.4	1.5	17.9	0.053	1.7	1.8
	MAX	201	5.8	68.0	122.3	190	7.4	30.6	237	9.9	20.6	82.9	0.263	0.034	0.115	0.123	0.544	8.0	19.7	56.2	847	2.18	0.580	541	29.9	2.6	39.9	0.653	17.6	17.2
	SIZE	4	4	4	6	4	6	4	4	4	4	4	4	4	3	4	4	6	4	5	6	4	4	4	6	4	4	6	4	4
	AVG	143	3.0	48.1	58.0	182	0.7	29.1	172	6.4	12.5	40.2	0.037	0.006	0.003	0.008	0.062	6.8	14.2	21.0	484	1.80	0.072	388	21.9	2.2	32.8	0.111	3.8	2.0
LOXA136	STD	45	3.2	19.0	6.5	38	0.3	3.1	66	2.5	4.6	6.0	0.032	0.001	0.002	0.002	0.088	0.3	6.0	22.6	139	0.31	0.089	117	5.0	0.3	7.9	0.073	1.9	0.8
	MIN	102	0.6	30.6	48.3	149	0.3	26.0	110	3.8	8.2	33.9	0.016	0.005	0.001	0.006	0.008	6.5	5.5	3.1	364	1.52	0.013	280	16.0	1.9	26.4	0.040	2.0	1.1
	MAX	188	7.5	65.2	64.4	215	1.2	33.4	233	9.5	17.1	45.7	0.085	0.007	0.004	0.010	0.193	7.2	19.0	48.0	676	2.14	0.202	506	27.4	2.5	44.1	0.238	5.7	3.0
	SIZE	5	5	5	6	5	6	5	5	5	5	5	5	5	4	5	5	6	5	6	6	5	5	5	6	5	5	6	5	5
	AVG	109	6.0	36.2	49.4	155	1.2	27.0	131	5.4	9.9	34.2	0.017	0.005	0.006	0.009	0.011	6.8	10.0	15.2	402	1.61	0.016	290	22.3	1.7	29.8	0.028	1.0	1.1
LOXA137	STD	51	3.7	19.0	13.2	39	0.7	2.7	67	2.2	4.8	11.7	0.004	0.001	0.004	0.004	0.009	0.2	9.5	19.9	170	0.24	0.012	117	4.7	0.3	6.3	0.016	0.2	0.6
	MIN	70	1.4	21.4	35.5	112	0.2	23.6	79	3.5	6.2	24.9	0.011	0.004	0.002	0.006	0.003	6.5	1.0	2.3	271	1.28	0.007	190	16.7	1.4	23.8	0.012	0.6	0.6
	MAX	171	10.3	57.4	72.8	200	2.1	30.3	212	8.1	16.6	53.3	0.022	0.007	0.010	0.014	0.026	7.1	23.1	47.3	682	1.90	0.035	446	27.6	2.0	40.1	0.057	1.2	2.1
	SIZE	4	4	4	6	4	6	4	4	4	4	4	4	4	4	4	4	6	4	6	6	4	4	4	6	4	4	6	4	4
	AVG	90	38.8	28.7	49.2	147	2.5	27.0	108	4.9	8.8	35.9	0.018	0.005	0.004	0.009	0.007	6.8	13.3	10.4	346	1.49	0.008	290	22.3	1.8	31.2	0.012	5.0	1.2
LOXA138	STD	54	20.3	17.2	21.9	29	1.0	4.4	64	2.9	5.3	20.2	0.001	0.002	0.000	0.001	0.001	0.3	11.4	14.9	188	0.16	0.002	152	5.0	0.3	8.7	0.003	6.8	0.8
	MIN	41	17.6	13.1	26.2	117	1.0	23.4	49	2.2	4.0	17.1	0.017	0.004	0.004	0.008	0.006	6.5	2.7	1.5	177	1.32	0.006	155	16.6	1.5	23.7	0.010	0.8	0.7
	MAX	137	64.6	47.7	84.9	187	3.5	33.3	177	8.1	14.0	58.3	0.020	0.007	0.004	0.011	0.008	7.1	26.3	38.0	597	1.69	0.011	438	27.9	2.1	43.6	0.018	15.1	2.4
	SIZE	3	3	3	4	3	5	3	3	3	3	3	3	3	2	3	3	5	3	4	5	4	3	3	5	4	3	4	3	3
	AVG	20	66.9	8.7	24.1	169	2.0	26.1	33	1.6	2.8	14.6	0.015	0.006	0.003	0.007	0.007	6.2	7.0	2.3	148	1.55	0.007	144	23.6	1.7	26.2	0.012	2.9	1.6
LOXA139	STD	4	47.7	2.2	5.7	38	0.9	6.2	8	0.4	0.6	3.6	0.003	0.002		0.003	0.003	0.2	1.8	2.7	36	0.39	0.001	37	4.9	0.4	4.7	0.003	2.7	1.6
	MIN	15	36.1	6.8	17.7	144	0.8	20.9	26	1.1	2.2	10.8	0.011	0.005	0.001	0.005	0.005	6.0	5.1	0.2	101	1.04	0.006	120	16.8	1.2	22.9	0.008	0.9	0.7
	MAX	23	121.8	11.1	31.5	212	3.4	33.0	42	1.9	3.4	18.1	0.017	0.008	0.004	0.010	0.010	6.4	8.7	5.4	184	1.91	0.008	186	28.0	2.1	31.6	0.014	6.0	3.4
	SIZE	4	4	4	6	4	6	4	4	4	4	4	4	4	4	4	4	6	4	6	6	4	4	4	6	4	4	6	4	4
	AVG	97	15.7	30.3	54.9	201	1.6	31.5	112	5.4	8.8	37.4	0.017	0.007	0.006	0.013	0.010	6.8	13.4	8.8	378	1.74	0.011	305	22.1	1.8	33.2	0.021	1.6	1.2
LOXA140	STD	48	14.8	15.1	22.8	41	1.1	6.3	56	3.1	4.6	19.0	0.002	0.002	0.004	0.004	0.003	0.2	14.1	11.8	166	0.36	0.004	134	4.8	0.5	5.9	0.009	0.7	0.4
	MIN	52	5.2	15.9	30.2	156	0.2	25.8	58	2.7	4.4	21.7	0.014	0.005	0.003	0.008	0.007	6.7	1.9	1.7	218	1.40	0.006	170	16.1	1.3	28.2	0.012	0.6	0.8
	MAX	144	37.3	45.7	96.3	255	3.2	40.0	164	9.0	13.4	64.7	0.020	0.009	0.012	0.017	0.014	7.2	32.1	30.7	657	2.24	0.015	467	27.6	2.5	40.5	0.031	2.3	1.6

NOTES:

1. The statistics presented above are for a sampling period between 7/6/04 and 3/2/05 and may not be indicative of the long-term water quality at these stations.
2. For values less than the MDL (Minimum Detection Level), a 1/2 of the MDL was used.
3. For pH, the average was estimated from the antilog of its value.

CONSTITUENT	ID	UNITS	CONSTITUENT	ID	UNITS	CONSTITUENT	ID	UNITS
ALKALINITY TOTAL as CaCO3	ALKA	mg/L	MAGNESSIUM	Mg	mg/L	Sp CONDUCTIVITY, FIELD	SpC	uS/cm
ALKALINE PHOSPHATASE	APA	nM/minmL	SODIUM	Na	mg/L	KJELDAHL NITROGEN, DISSOLVED	TDKN	mg/L
CALCIUM	Ca	mg/L	AMMONIUM	NH4	mg/L	PHOSPHATE, DISSOLVED as P	TD_PO4	mg/L
CHLORIDE	Cl	mg/L	NITRATE	NO3	mg/L	TOTAL DISSOLVED SOLIDS	TDS	mg/L
COLOR	COLOR	PCU	NITRITE	NO2	mg/L	TEMPERATURE	TEMP	Deg. C
DISSOLVED OXYGEN	DIS_O2	mg/L	NITRATES and NITRITES as N	NOX	mg/L	KJELDAHL NITROGEN, TOTAL	TKN	mg/L
DISSOLVED ORGANIC CARBON	DOC	mg/L	PHOSPHATE, ORTHO as P	OPO4	mg/L	CARBON, TOTAL ORGANIC	TOC	mg/L
HARDNESS as CaCO3	HARD	mg/L	pH, FIELD	pH_F	UNITS	PHOSPHATE, TOTAL as P	T_PO4	mg/L
POTASSIUM	K	mg/L	SILICA	SiO2	mg/L	TOTAL SUSPENDED SOLIDS	TSS	mg/L
			SULFATE	SO4	mg/L	TURBIDITY	TURB	NTU

Appendix B: Water Quality Data for Refuge Structures

Table B-1: Water quality data (total phosphorus, sulfate, specific conductivity) for Refuge inflow structures.

Table B-2: Water quality data (total phosphorus, sulfate) for Refuge outflow structures.

Figure B-1: Total phosphorus over time at Refuge inflow structures.

Figure B-2: Total phosphorus over time at Refuge outflow structures.

Figure B-3: Sulfate over time at Refuge inflow structures.

Figure B-4: Sulfate over time at Refuge outflow structures.

Figure B-5: Flow-weighted mean concentrations of total phosphorus and sulfate from STA-1W discharges.

Table B-1. Examples of water quality data at Refuge inflow structures. A) Total Phosphorus; B) Sulfate; C) Specific conductivity.

A) Total Phosphorus (ppb)

Total Phosphorus Inflow Structure Data

Sample Collection Dates	G310	G251	S362	ACME 1DS
4/7/2004	48.5	32		
4/13/2004	24	31		46
4/20/2004	42.5	31		
4/27/2004	31	27		
5/5/2004	30	24		
5/11/2004	27	29		
5/18/2004	23	34		
5/24/2004				42
5/25/2004	32.5	29		
6/3/2004	36	34		
6/8/2004	30.5	42.5		
6/15/2004	32.5	33		
6/21/2004				41
6/22/2004	27	30.5		
6/30/2004	39.5	40.5		
7/6/2004	31.5	50		43
7/13/2004	31.5	38		
7/20/2004	29	42		
7/28/2004	27.5	35		
8/3/2004	24.5	25.5	26	
8/10/2004	40.5	45.5	27.5	
8/17/2004	32	77.5	18	
8/24/2004			19	
8/25/2004	40.5	77.5		
8/31/2004	43	59	22	
9/9/2004	86.5	36	29	
9/14/2004	156	62	296	
9/21/2004	161	105	269	
9/28/2004	127	41		135
9/30/2004			455	
10/5/2004	211.5	237.5		

Sample Collection Dates	G310	G251	S362	ACME 1DS
10/6/2004			497.5	
10/12/2004	18.3	217.5	451	
10/19/2004	180.5	159	350	
10/25/2004				90
10/26/2004	155	65	262.5	
11/2/2004	129	41		
11/3/2004			180	
11/9/2004	111.5	41	159	
11/16/2004	102	33		
11/17/2004			117.5	
11/22/2004				91
11/23/2004	96	81	93.5	
11/30/2004	80	101		
12/1/2004			89.5	
12/7/2004	73	89	59.5	
12/14/2004	64	99		
12/15/2004			53.5	
12/21/2004	64.5	80.5	46	
12/22/2004				54
12/28/2004	79.5	75		
12/29/2004			43	
1/4/2005	94	49	39	
1/11/2005			55	
1/13/2005	121	99		
1/18/2005				49
1/20/2005	170.5	92	43	
1/26/2005			41	
1/27/2005	155	71.5	45	
2/3/2005	113.5	65	35	
2/10/2005	96	45	34	
2/17/2005	73	54		
Max	211.5	237.5	497.5	135
Min	18.3	24	18	41

B) Sulfate (mg/L)

Total Sulfate Inflow Structure Data

Sample Collection Dates	G310 (mg L^{-1})	G251 (mg L^{-1})	ACME1DS (mg L^{-1})
4/7/2004	67.4	52.9	
4/13/2004			43.1
4/20/2004	63.5	58.3	
5/5/2004	65.2	47.6	
5/18/2004	62.8	52.5	
6/3/2004	64.9	33.1	
6/15/2004	42.9	52.1	
6/30/2004	68.3	68.9	
7/6/2004			56.2
7/13/2004	69.4	65.1	
7/28/2004	53.6	51.6	
8/10/2004	94.2	93.2	
8/25/2004	83.9	88	
9/9/2004	88.7	67.2	
9/21/2004	62.7	40.1	
10/5/2004	54.9	51.5	
10/19/2004	78.6	44.9	
10/25/2004			15.8
11/2/2004	60.4	24.2	
11/16/2004	51.8	30.5	
11/30/2004	52.4	58.4	
12/14/2004	51.4	44.6	
12/28/2004	53.3	41.8	
1/13/2005	40.6	39.6	
1/18/2005			36.6
1/27/2005	39.7	45.8	
2/10/2005	41.6	48.2	
Min	39.7	24.2	15.8
Max	94.2	93.2	56.2

C) Specific Conductivity (μS/cm)

Conductivity

Sample Collection Dates	S362 (μS cm^{-1})
8/10/2004	1,007
8/12/2004	1,022
8/17/2004	1,015
8/24/2004	1,027
8/31/2004	1,028
9/9/2004	935
9/14/2004	752
9/21/2004	858
9/22/2004	868
9/28/2004	395
9/30/2004	340
10/6/2004	517
10/12/2004	541
10/19/2004	661
10/26/2004	518
11/3/2004	692
11/9/2004	730
11/17/2004	781
11/23/2004	812
12/1/2004	819
12/7/2004	896
12/15/2004	950
12/21/2004	1,016
12/29/2004	1,046
1/4/2005	1,075
1/11/2005	1,114
1/20/2005	1,122
1/26/2005	1,139
2/3/2005	1,208
2/10/2005	1,236
2/17/2005	1,284
Min	340
Max	1284

Table B-2. Examples of water quality data at Refuge outflow structures. A) Total Phosphorus; B) Sulfate. There is no specific conductivity in DBHydro for these structures.

A) Total Phosphorus (ppb)

Total Phosphorus Outflow Structure Data

Sample Collection Dates	G94B	S10A	S10C	S10D	S10E
4/13/2004	25				
4/26/2004		13	15	22	22
5/24/2004	360			32	32
6/21/2004	56			35	36
7/6/2004	60				
7/19/2004		34	36	43	47
8/16/2004			22	38	
9/13/2004		166	11	196	
9/28/2004	246	151	12	177	171
10/11/2004	149	107	11	149	
10/25/2004					75
11/22/2004	52			33	44
12/22/2004	33			51	64
1/18/2005	515	16	19	40	109
Max	515.00	166.00	36.00	196.00	171.00
Min	25.00	13.00	11.00	22.00	22.00

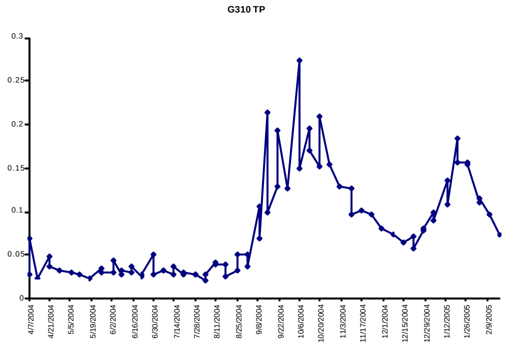
B) Sulfate (mg/L)

Sulfate Outflow Structure Data

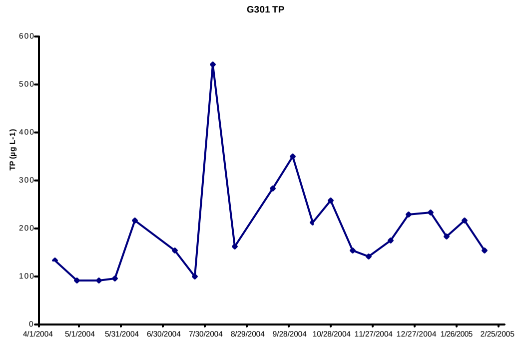
Sample Collection Dates	G94B (mg L^{-1})	S10A (mg L^{-1})	S10C (mg L^{-1})	S10D (mg L^{-1})	S10E (mg L^{-1})
4/13/2004	8.2				
4/26/2004		14.9	22.6	32.7	36.8
7/6/2004	59.9				
7/19/2004		49.9	64.2	66.2	68.7
10/11/2004	24.1	20.8	4	57.5	
10/25/2004					39.6
1/18/2005	17	28.2	35.9	45.1	40.6
Min	8.2	14.9	4	32.7	36.8
Max	59.9	49.9	64.2	66.2	68.7

Figure B-1. Refuge inflow structure water quality – total phosphorus (ppb).

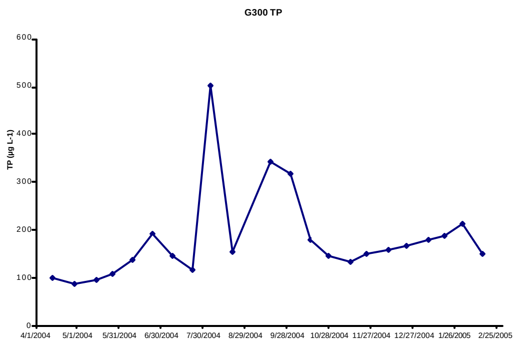
A) G-310



B) G-301



C) G-300



D) Acme PS #1

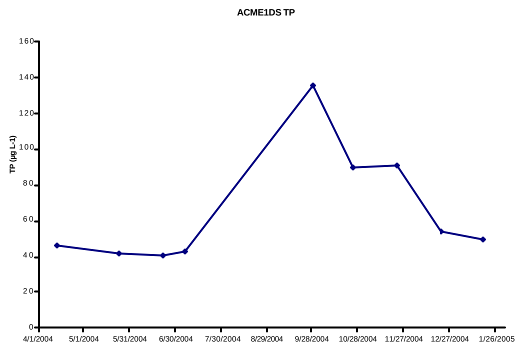
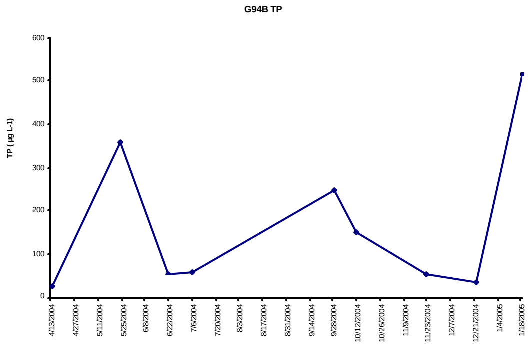
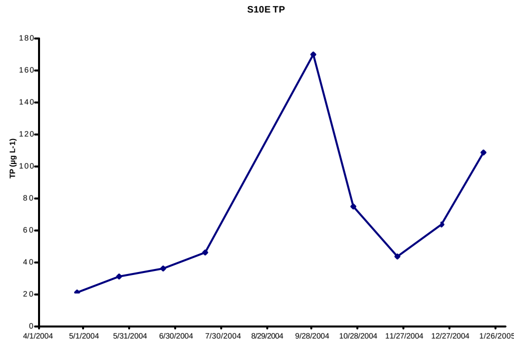


Figure B-2. Refuge outflow structure water quality – total phosphorus (ppb).

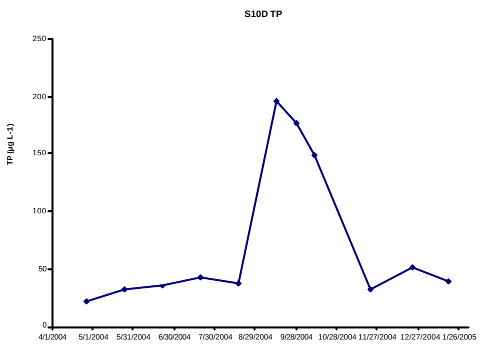
A) G-94B



B) S-10E



C) S-10 D



D) S-10 C

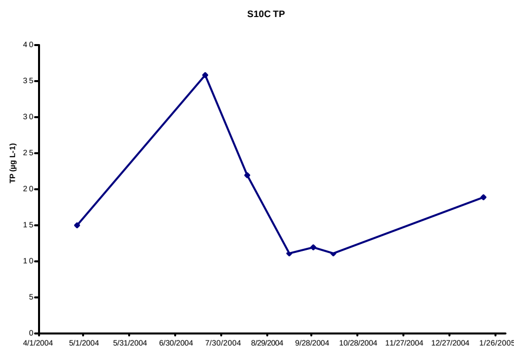
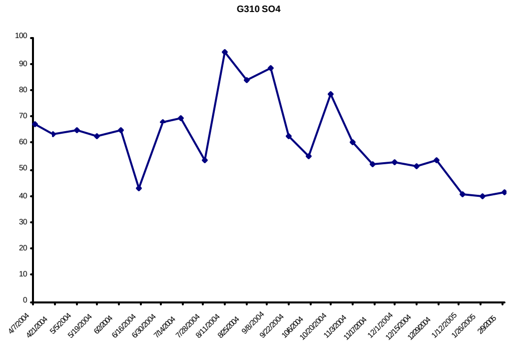


Figure B-3. Refuge inflow structure water quality – sulfate (mg/L)

A) G-310



B) Acme PS #1

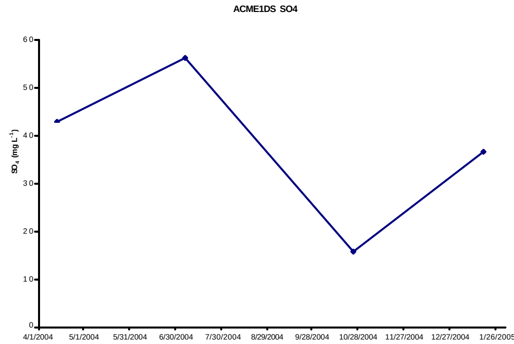
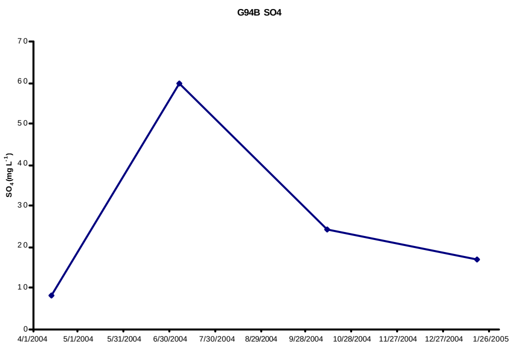
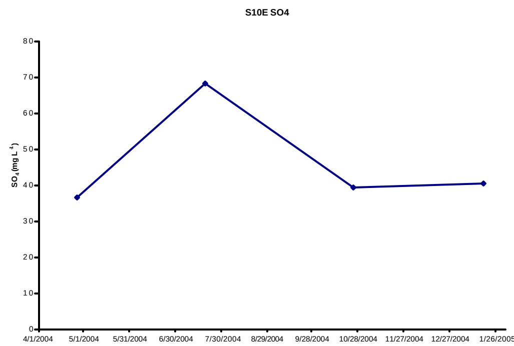


Figure B-4. Refuge outflow structure water quality – sulfate (mg/L).

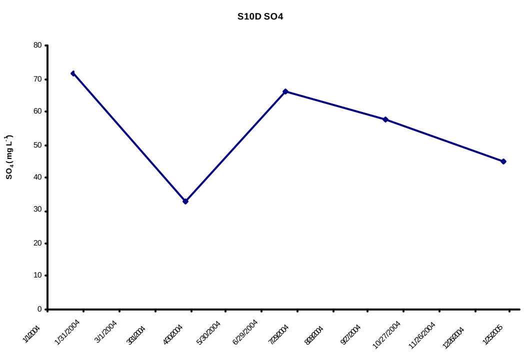
A) G-94B



B) S-10E



C) S-10 D



D) S-10 C

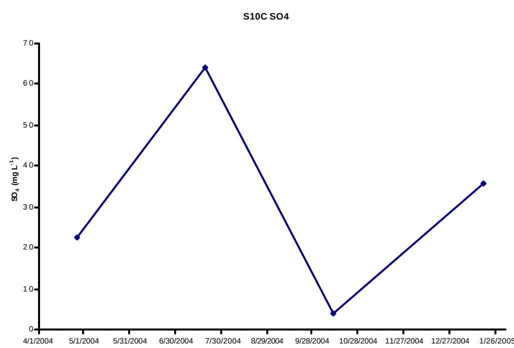
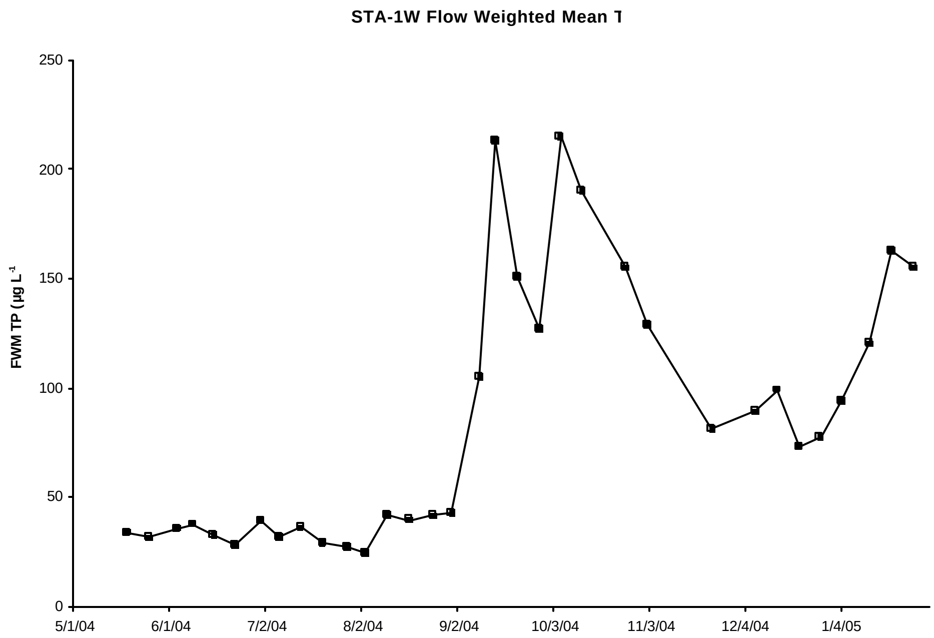
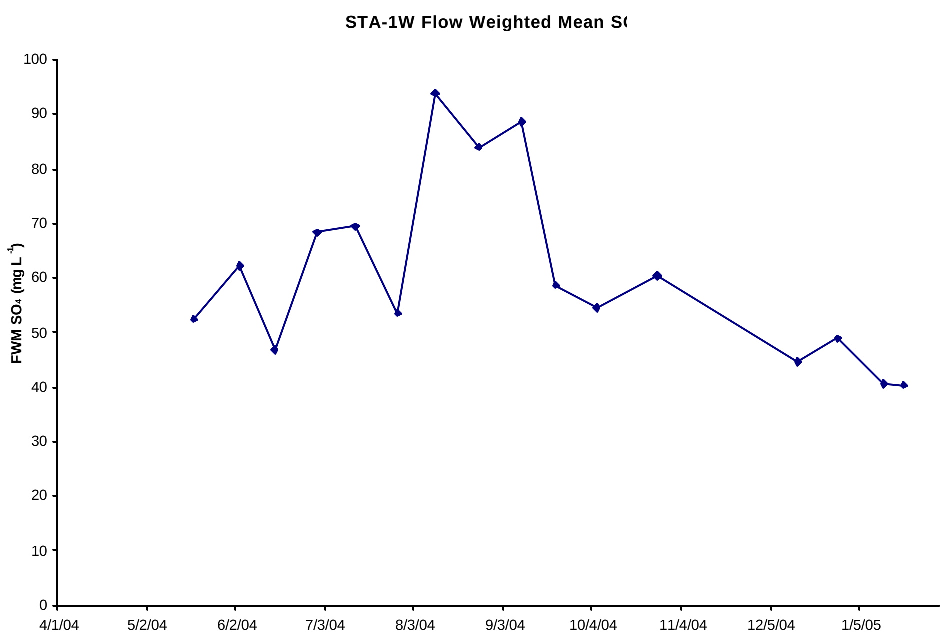


Figure B-5. Total phosphorus (ppb) and sulfate (mg/L) from STA-1W discharges at the G-310:

a) Flow-weighted mean total phosphorus (ppb)



b) Flow-weighted mean sulfate (mg/L)



Appendix C: Water Quality Data for Refuge Interior

Table C-1: Total phosphorus at canal stations.

Table C-2: Total phosphorus at marsh stations from Refuge's Enhanced Water Quality Monitoring Program.

Table C-3: Total phosphorus at marsh stations from Consent Decree compliance monitoring program.

Table C-4: Sulfate at canal stations.

Table C-5: Sulfate at marsh stations from Refuge's Enhanced Water Quality Monitoring Program.

Table C-6: Sulfate at marsh stations from Consent Decree compliance monitoring program.

Table C-7: Specific conductivity at canal stations.

Table C-8: Specific conductivity at marsh stations from Refuge's Enhanced Water Quality Monitoring Program.

Table C-9: Specific conductivity at marsh stations from Consent Decree compliance monitoring program.

Table C-1: Total Phosphorus (ppb) data at **canal stations** from monthly grab samples at the Refuge's Enhanced Water Quality Program (labeled LOXA###).

Canal Stations	June 2004	July 2004	Aug 2004	Sep 2004	Oct 2004	Nov 2004	Dec 2004	Jan 2005	Feb 2005
LOXA104	40	23	22	210	237	98	93	93	100
LOXA115	55	26	29	181	200	73	53	51	100
LOXA129	82	80	76	246	499	66	58	60	81
LOXA132	86	77	64	256	574	76	60	61	88
LOXA135	81	95	53	257	649*	96	84	66	79
Max	86	95	76	257	649	98	93	93	100
Min	40	23	22	181	200	66	53	51	79

* = this value is the average of 2 readings of the sample (645 ppb; 653 ppb).

Note: The samples collected for the Refuge's Enhanced Water Quality Program are not collected on the same dates as the EVPA samples, but are collected with as few days as logistically possible between the two.

Table C-2: Total Phosphorus (ppb) data at **marsh (interior) stations** from monthly grab samples at the Refuge's Enhanced Water Quality Program (labeled LOXA###).

Marsh Stations	June 2004	July 2004	Aug 2004	Sep 2004	Oct 2004	Nov 2004	Dec 2004	Jan 2005	Feb 2005
LOXA101				22	53	18	14	11	11
LOXA102				15	15	10	12	11	
LOXA103				19	12	9	12	15	42
LOXA105				58	232	25	23	17	23
LOXA106				14	48	11	7	10	14
LOXA107			16	10	9	7	12		
LOXA108			17	10	12	8	6		
LOXA109			22	14	8	10	8	9	8
LOXA110			15	9	7	11	17	24	
LOXA111			8	9	9	6	13	22	12
LOXA112				15	13	8	9	10	12
LOXA113	14		10	7	8	7	8	9	17
LOXA114	33	18	13	8	9	6	10	15	
LOXA116			74	47	199	38	67	47	32
LOXA117			19	22	15	13	18	8	12
LOXA118	18		6	8	6	6	9	6	6
LOXA119	19	10	8	6	6	9	13	12	5
LOXA120	16		8	7	6	8	9	12	7
LOXA121			80		136	32	179	91	117
LOXA122			17	14	10	11	10	9	12
LOXA123			25	14	8	14	14	9	9
LOXA124				69	151	15	15	9	15
LOXA126			33	11	8	9	6	7	10
LOXA127			27	15	6	8	9	6	7
LOXA128			16	10	7	8	21	11	
LOXA130				52	212	19	11	15	16
LOXA131				10	10	5	6	6	7
LOXA133				177	322	65	98	265	
LOXA134				23	216	24	26	34	16
LOXA136				91	238	64	40	154	77
LOXA137				28	57	23	14	12	31
LOXA138				14	10	10	18	12	10
LOXA139				13	8	13	14		
LOXA140				30	31	13	13	12	26
MAX	33	18	80	177	322	65	179	265	117
MIN	14	10	6	6	6	5	6	6	5

Note: The samples collected for the Refuge's Enhanced Water Quality Program are not collected on the same dates as the EVPA samples, but are collected with as few days as logistically possible between the two.

Table C-3: Total Phosphorus (ppb) data at stations from monthly grab samples at the EVPA (**Consent Decree compliance stations**) 14 station network (labeled LOX##).

Canal Stations	June 2004	July 2004	Aug 2004	Sep 2004	Oct 2004	Nov 2004	Dec 2004	Jan 2005	Feb 2005
LOX3				8		24	38		
LOX4			54	12	11	10	13	8	26
LOX5				14	12	10			
LOX6			17	7	7	5	5	6	6
LOX7			16	8	8	8	14	9	12
LOX8			26	6	8	7	11	7	9
LOX9			10	7	7	10	18	11	
LOX10			13	12	10	8	13	9	14
LOX11			15	9	9	8	9	8	10
LOX12	47	21	33	9	9	7	7	8	6
LOX13			13	9	10	8	10	10	9
LOX14			13	8	8	6	7	6	7
LOX15	34		10	6	8	8	9	7	7
LOX16			20	8	10	6	5	7	8
Max	47	21	54	14	12	24	38	11	26
Min	34	21	10	6	7	5	5	6	6

Note: The samples collected for the Refuge's Enhanced Water Quality Program are not collected on the same dates as the EVPA samples, but are collected with as few days as logistically possible between the two.

Table C-4: Sulfate (mg/L) data at **canal stations** from monthly grab samples at the Refuge's Enhanced Water Quality Program (labeled LOXA###).

CANAL STATIONS	DISTANCE FROM CANAL (m)	JUNE 2004	JULY 2004	AUG 2004	SEP 2004	OCT 2004	NOV 2004	DEC 2004	JAN 2004	FEB 2004
LOXA104	0	58	62	68	63	50	35	47	48	41
LOXA115	0	52	65	64	65	46	42	39	40	41
LOXA129	0	46	35	59	46	21	10	7	22	36
LOXA132	0	45	37	57	52	28	11	8	28	36
LOXA135	0	45	36	56	44	18	13	8	34	36
MAX		58	65	68	65	50	42	47	48	41
MIN		45	35	56	44	18	10	7	22	36

Note: The samples collected for the Refuge's Enhanced Water Quality Program are not collected on the same dates as the EVPA samples, but are collected with as few days as logistically possible between the two.

Table C-5: Sulfate (mg/L) data at **marsh (interior) stations** from monthly grab samples at the Refuge's Enhanced Water Quality Program (labeled LOXA###).

MARSH STATIONS	DISTANCE FROM CANAL (m)	JUNE 2004	JULY 2004	AUG 2004	SEP 2004	OCT 2004	NOV 2004	DEC 2004	JAN 2004	FEB 2004
LOXA101	785				29.5	29.6	24.4*	14.6	10.3	11.5
LOXA102	1357				54.5	39.9	4.5	4.5	5.4	
LOXA103	1004				43.4	49.5	3.6	3.4	4.6	6.1
LOXA105	726				58.4	56.9	33.7	12.0	13.7	12.9
LOXA106	1102				60.5	43.6	7.7	6.6	8.0	9.3
LOXA107	2211				23.5	49.9		2.5		
LOXA108	3911				0.7	0.5		0.1		
LOXA109	1228				24.3	7.2	1.3	1.9	2.6	3.0
LOXA110	2704				2.3	0.8	0.4	0.4	0.5	
LOXA111	3054				19.7	0.9	0.5	0.8	0.9	1.3
LOXA112	1546				29.1	4.2	1.6	2.1	2.7	3.0
LOXA113	3732				5.7	0.5	0.2	0.4		0.5
LOXA114	4383				0.4	0.2	0.1	0.1		
LOXA116	338			18.4	81.0	43.8	41.4	23.2	18.9	19.8
LOXA117	899				68.2	44.0	17.2	13.6	12.8	14.4
LOXA118	1807				30.0	16.2	5.7	5.9	7.0	7.3
LOXA119	4226	4.9		1.3	1.4	1.2	0.6	0.7	1.0	1.2
LOXA120	6098			0.3	0.1	0.2				0.1
LOXA121	103			24.0		48.7	43.1	42.6	48.2	47.4
LOXA122	830				66.9	69.0	29.4	21.1	20.2	
LOXA123	843				19.5	18.1	15.1	13.8	14.1	13.3
LOXA124	1359				3.6	0.7	0.5	0.5	0.5	0.5
LOXA126	292				30.7	9.3	5.0	4.2	3.2	3.2
LOXA127	3060				3.6	5.5	1.0	0.4	0.2	0.3
LOXA128	5079				0.1	0.1	0.0	0.1	0.0	
LOXA130	464				42.0	12.5	6.0	3.4	2.6	3.6
LOXA131	1532				21.5	17.2	3.0	2.2	1.5	1.9
LOXA133	578				46.0	14.0	7.6	4.4	5.0	
LOXA134	838				47.9	12.2	11.7	5.1	4.7	3.9
LOXA136	561				48.0	43.4	6.5	3.1		4.1
LOXA137	1086				47.3	33.3	3.4	2.8	2.5	2.3
LOXA138	2108				17.5	38.0	1.9	1.5		1.7
LOXA139	4011				5.4	1.4	0.2			
LOXA140	853				14.3	30.7	2.2	1.7		2.0

MAX		4.9	0.0	24.0	81.0	69.0	43.1	42.6	48.2	47.4
MIN		4.9	0.0	24.0	81.0	69.0	43.1	42.6	48.2	47.4

* This station had two different values reported for this sample (1.38; 24.38).

Note: The samples collected for the Refuge's Enhanced Water Quality Program are not collected on the same dates as the EVPA samples, but are collected with as few days as logistically possible between the two.

Table C-6: Sulfate (mg/L) data at stations from monthly grab samples at the EVPA (**Consent Decree compliance stations**) 14 station network (labeled LOX##).

EVPA STATIONS	DISTANCE FROM CANAL (m)	JUNE 2004	JULY 2004	AUG 2004	SEP 2004	OCT 2004	NOV 2004	DEC 2004	JAN 2004	FEB 2004
LOX3	4566				0.2					
LOX4	1152				15.4	9.3	4.8	3.8	2.7	3.2
LOX5	8144				0.1					
LOX6	1054			84.3	16.7	5.3	3.8	3.4	2.5	2.3
LOX7	5489				0.3	0.7	0.4	0.3	0.3	0.4
LOX8	9688			0.1	0.1		0.1			
LOX9	5507				0.1					
LOX10	1189				9.3	0.9	1.8	-	1.8	1.8
LOX11	6566				0.1					
LOX12	2702	1.4	1.4	3.3	2.8	1.3	1.4	1.1	1.0	1.0
LOX13	6637			0.2	0.2		0.1			
LOX14	1233			44.0	4.3	1.5	2.1	2.0	1.7	1.4
LOX15	1249			51.7	23.6	8.4	5.8	5.9	8.6	7.1
LOX16	2013			42.3	3.1	1.2	1.7	1.4	1.2	0.8
MAX		1.4	1.4	84.3	23.6	9.3	5.8	5.9	8.6	7.1
MIN		1.4	1.4	0.1	0.1	0.7	0.1	0.3	0.3	0.4

Note: The samples collected for the Refuge's Enhanced Water Quality Program are not collected on the same dates as the EVPA samples, but are collected with as few days as logistically possible between the two.

Table C-7: Specific conductivity (μS/cm) data at **canal stations** from monthly grab samples at the Refuge's Enhanced Water Quality Program (labeled LOXA###).

CANAL STATIONS	DISTANCE FROM CANAL (m)	JUNE 2004	JULY 2004	AUG 2004	SEP 2004	OCT 2004	NOV 2004	DEC 2004	JAN 2004	FEB 2004
LOXA104	0	1018	838	927	845	770	713	859	883	733
LOXA115	0	962	867	875	891	691	720	742	700	740
LOXA129	0	874	532	831	704	527	497	564	679	751
LOXA132	0	853	574	814	792	612	520	576	730	737
LOXA135	0	847	544	811	790	555	558	555	762	739
MAX		1018	867	927	891	770	720	859	883	751
MIN		847	532	811	704	527	497	555	679	733

Note: The samples collected for the Refuge's Enhanced Water Quality Program are not collected on the same dates as the EVPA samples, but are collected with as few days as logistically possible between the two.

Table C-8: Specific conductivity (µS/cm) data at **marsh (interior) stations** from monthly grab samples at the Refuge's Enhanced Water Quality Program (labeled LOXA###).

MARSH STATIONS	DISTANCE FROM CANAL (m)	JUNE 2004	JULY 2004	AUG 2004	SEP 2004	OCT 2004	NOV 2004	DEC 2004	JAN 2004	FEB 2004
LOXA101	785				724	525	643	624	719	794
LOXA102	1357				952	597	254.5	288	347	
LOXA103	1004				873	700	257.2	309	346	417
LOXA105	726				763	762	642.5	481	485	476
LOXA106	1102				819	642	390.8	345	372	393
LOXA107	2211			296	651	762	216.3	250		
LOXA108	3911			274	177	122	121	170		
LOXA109	1228			342	656	283	152.8	168	213	219
LOXA110	2704			143	202	113	112.1	141	162	185
LOXA111	3054			281	382	96	115.5	150	169	198
LOXA112	1546				664	178	147	183	215	245
LOXA113	3732	271		237	263	86	99.3	133	160	199
LOXA114	4383	277	235	194	166	76	90.3	124	153	181
LOXA116	338			1031	1063	701	764.2	609	558	601
LOXA117	899			367	939	706	405.2	416	395	411
LOXA118	1807	368		279	647	364	220.8	237	245	275
LOXA119	4226	401	343	159	165	117	131.8	146	158	173
LOXA120	6098	430		161	117	83	99.5	123	139	158
LOXA121	103			622		709	750.4	852	791	843
LOXA122	830			527	940	879	639.9	645	688	727
LOXA123	843			491	499	440	455.4	483	486	486
LOXA124	1359				215	115	115.3	138	149	149
LOXA126	292			191	616	285	270.3	300	306	314
LOXA127	3060			191	160	143	146.5	174	171	188
LOXA128	5079			163	124	65	90.5	120	148	190
LOXA130	464				647	348	466	487	482	562
LOXA131	1532				612	499	293.3	326	332	383
LOXA133	578				680	384	468.8	472	510	546
LOXA134	838				647	368	449.4	392	394	396
LOXA136	561				676	648	412.2	364	398	407
LOXA137	1086				682	544	271.2	276	307	334
LOXA138	2108				597	570	176.8	206	243	283
LOXA139	4011				184	135	100.5	136		183
LOXA140	853				657	495	218.1	266	296	338
MAX		430	343	1031	1063	879	764	852	791	843
MIN		271	235	143	117	65	90	120	139	149

Note: The samples collected for the Refuge's Enhanced Water Quality Program are not collected on the same dates as the EVPA samples, but are collected with as few days as logistically possible between the two.

Table C-9: Specific conductivity (µS/cm) data at stations from monthly grab samples at the EVPA (**Consent Decree compliance stations**) 14 station network (labeled LOX##).

EVPA STATIONS	DISTANCE FROM CANAL (m)	JUNE 2004	JULY 2004	AUG 2004	SEP 2004	OCT 2004	NOV 2004	DEC 2004	JAN 2004	FEB 2004
LOX3	4566				79	75	95	132		
LOX4	1152			970	565	469	448	469		525
LOX5	8144				102	74	95			
LOX6	1054			444	315	252	265	271	277	279
LOX7	5489			107	97	133	127	146		179
LOX8	9688			140	86	79	89	109		146
LOX9	5507			200	90	76	99	120		
LOX10	1189			443	250	112	133	163		223
LOX11	6566			103	67	68	81	104		123
LOX12	2702	308	327	257	213	158		188	200	201
LOX13	6637			186	106	80	86	103		111
LOX14	1233			628	225	140	167	196	204	186
LOX15	1249	558		761	532	272	223	237	340	324
LOX16	2013			654	240	141	186	198	201	169
MAX		558	327	970	565	469	448	469	340	525
MIN		308	327	103	67	68	81	103	200	111

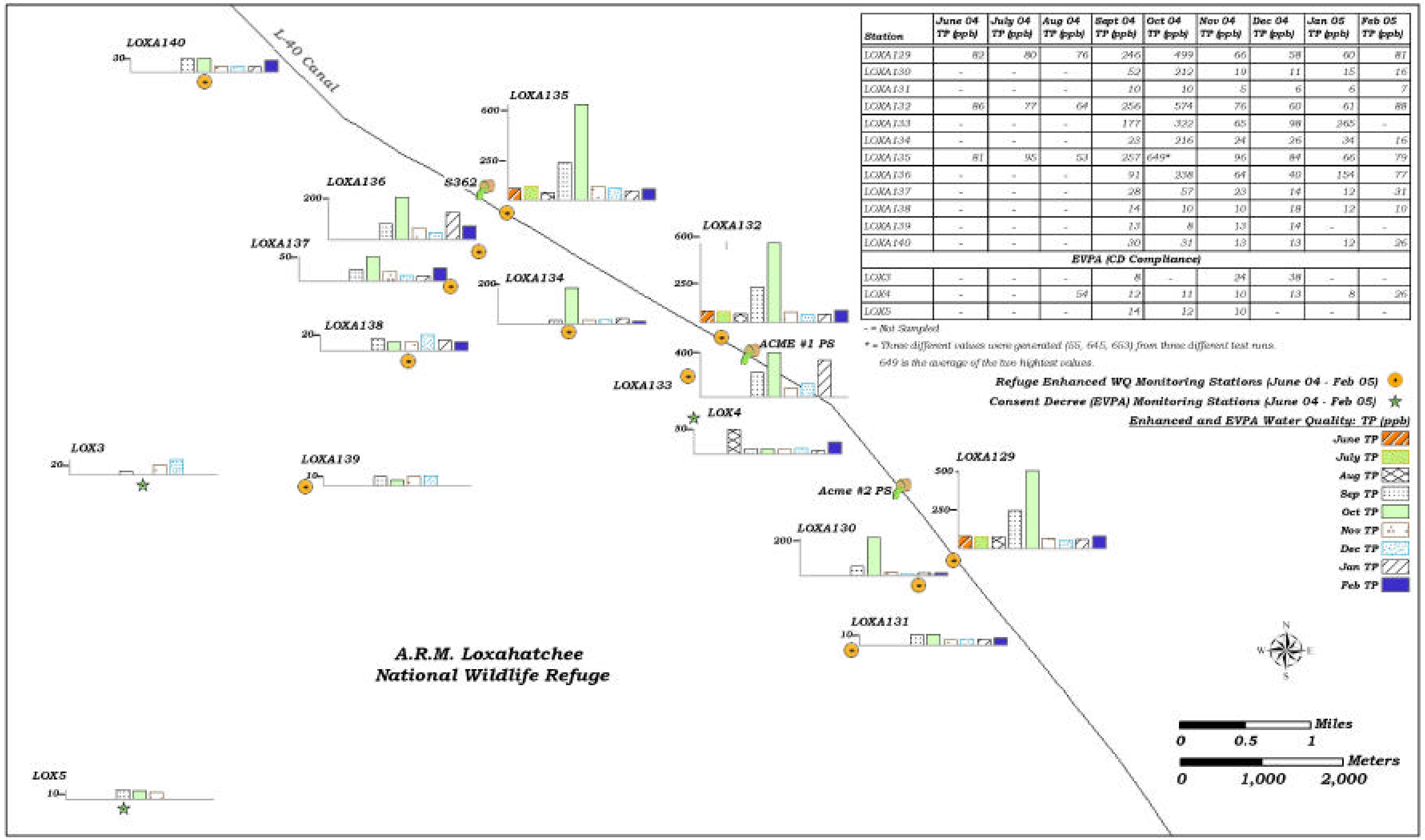
Note: The samples collected for the Refuge's Enhanced Water Quality Program are not collected on the same dates as the EVPA samples, but are collected with as few days as logistically possible between the two.

Appendix D: Maps of Water Quality Data over Time

Figures D-1 – D-5: Maps of total phosphorus over time for different regions of Refuge.

Figures D-6 – D-10: Maps of specific conductivity over time for different regions of Refuge.

Figures D-11 – D-15: Maps of sulfate over time for different regions of Refuge.



Station	June 04 TP (ppb)	July 04 TP (ppb)	Aug 04 TP (ppb)	Sept 04 TP (ppb)	Oct 04 TP (ppb)	Nov 04 TP (ppb)	Dec 04 TP (ppb)	Jan 05 TP (ppb)	Feb 05 TP (ppb)
LOXA129	82	80	76	246	499	66	58	60	81
LOXA130	-	-	-	52	212	19	11	15	16
LOXA131	-	-	-	10	10	5	6	6	7
LOXA132	86	77	64	256	574	76	60	61	88
LOXA133	-	-	-	177	322	65	98	265	-
LOXA134	-	-	-	23	216	24	26	34	16
LOXA135	81	95	53	257	649*	96	84	66	79
LOXA136	-	-	-	91	338	64	40	154	77
LOXA137	-	-	-	28	57	23	14	12	31
LOXA138	-	-	-	14	10	10	18	12	10
LOXA139	-	-	-	13	8	13	14	-	-
LOXA140	-	-	-	30	31	13	13	12	26
EVPA (CD Compliance)									
LOX3	-	-	-	8	-	24	38	-	-
LOX4	-	-	54	12	11	10	13	8	26
LOX5	-	-	-	14	12	10	-	-	-

- = Not Sampled

* = Three different values were generated (55, 645, 653) from three different test runs.
649 is the average of the two highest values.

Figure D-1

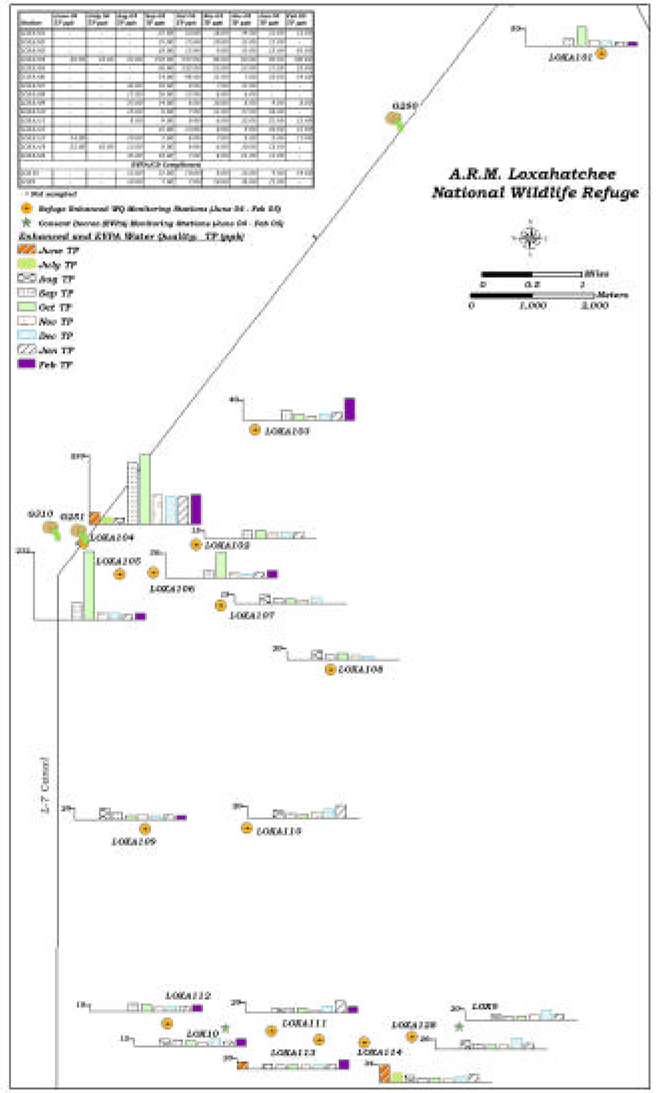
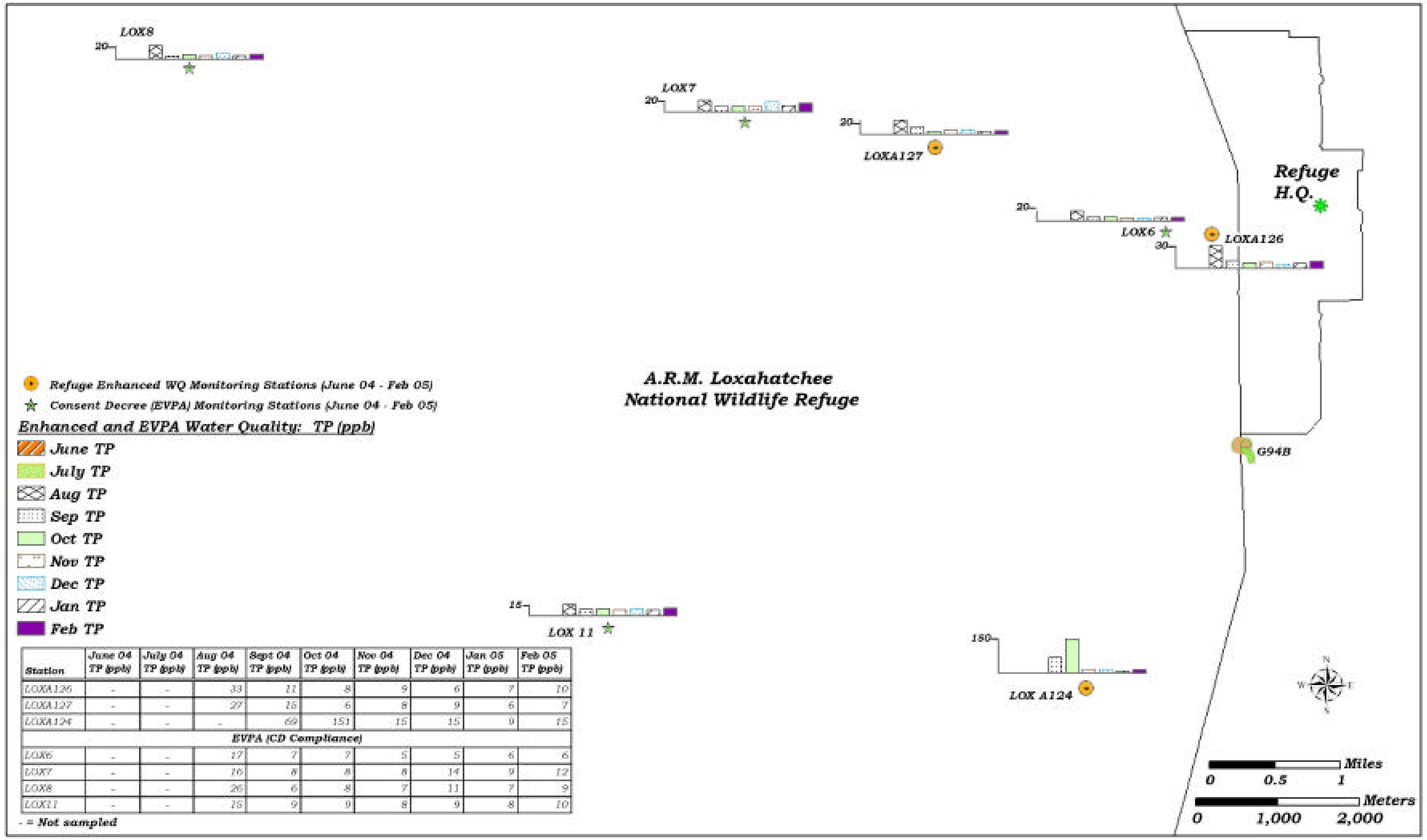

A.R.M. Loxahatchee
National Wildlife Refuge
June TP
July TP
Aug TP
Sep TP
Oct TP
Nov TP
Dec TP
Jan TP
Feb TP
L-7 Canal

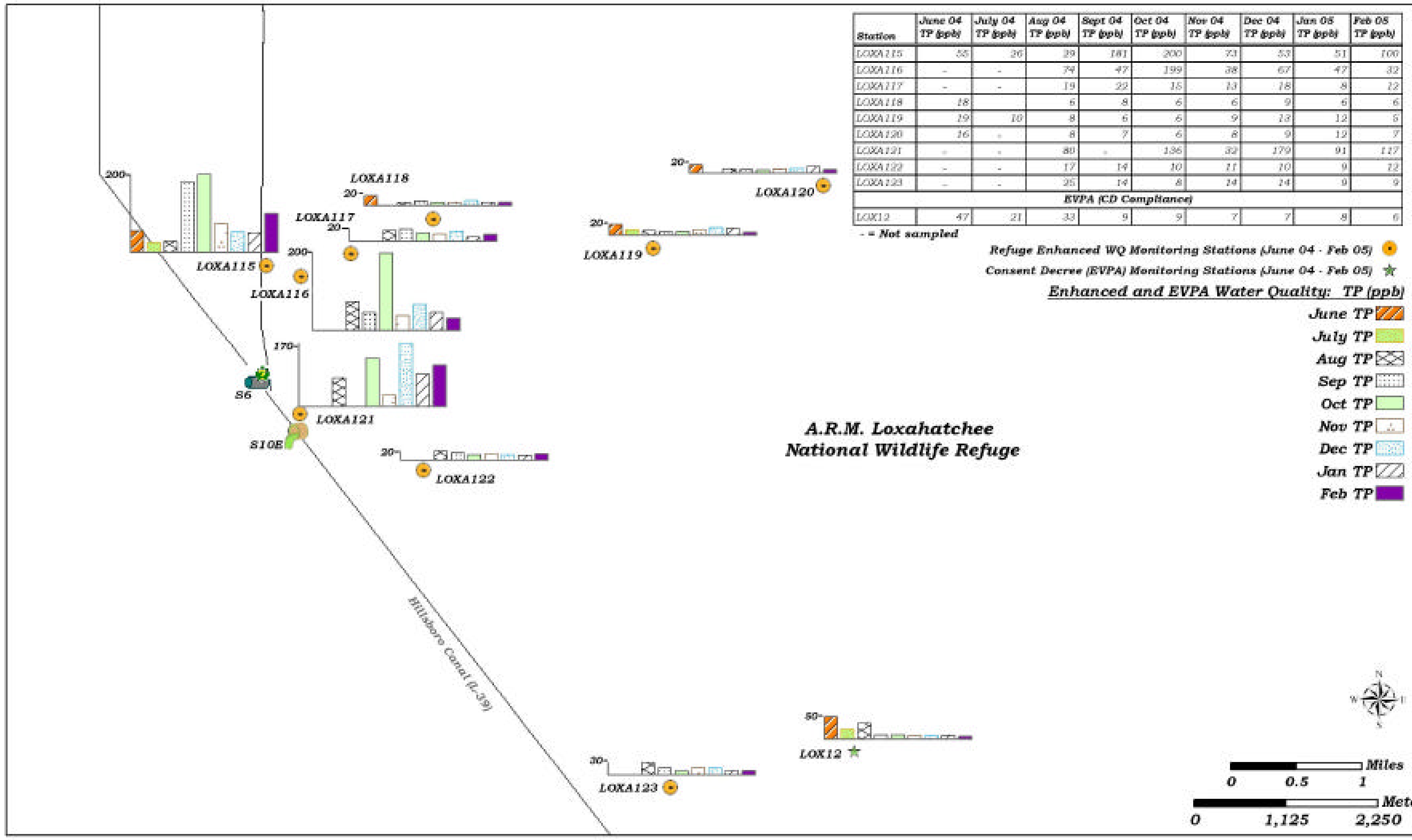
Figure D-2



Station	June 04 TP (ppb)	July 04 TP (ppb)	Aug 04 TP (ppb)	Sept 04 TP (ppb)	Oct 04 TP (ppb)	Nov 04 TP (ppb)	Dec 04 TP (ppb)	Jan 05 TP (ppb)	Feb 05 TP (ppb)
LOXA126	-	-	33	11	8	9	6	7	10
LOXA127	-	-	27	15	6	8	9	6	7
LOXA124	-	-	-	69	151	15	15	9	15
EVPA (CD Compliance)									
LOX6	-	-	17	7	7	5	5	6	6
LOX7	-	-	16	8	8	8	14	9	12
LOX8	-	-	26	6	8	7	11	7	9
LOX11	-	-	15	9	9	8	9	8	10

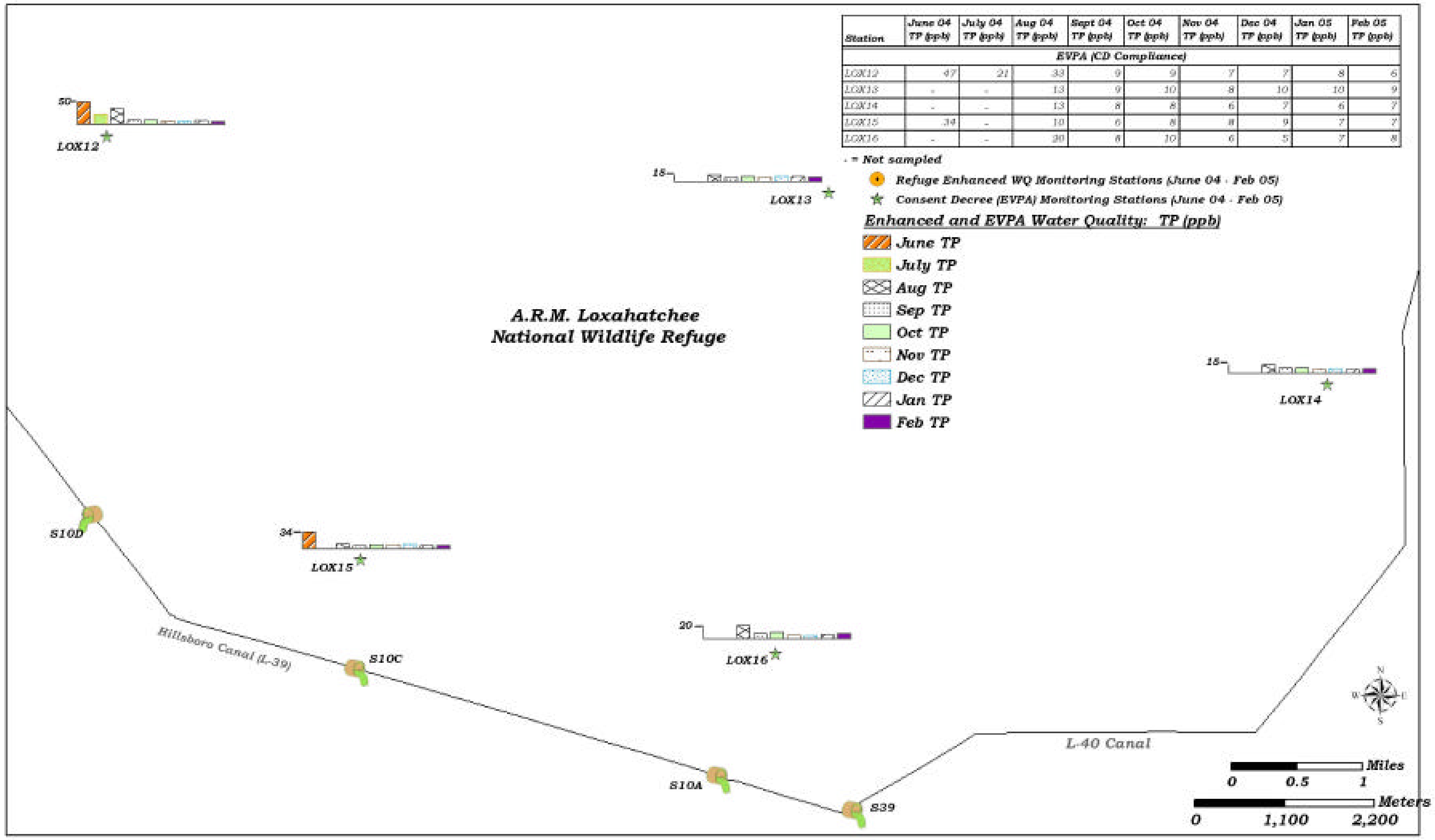
- = Not sampled

Figure D-3



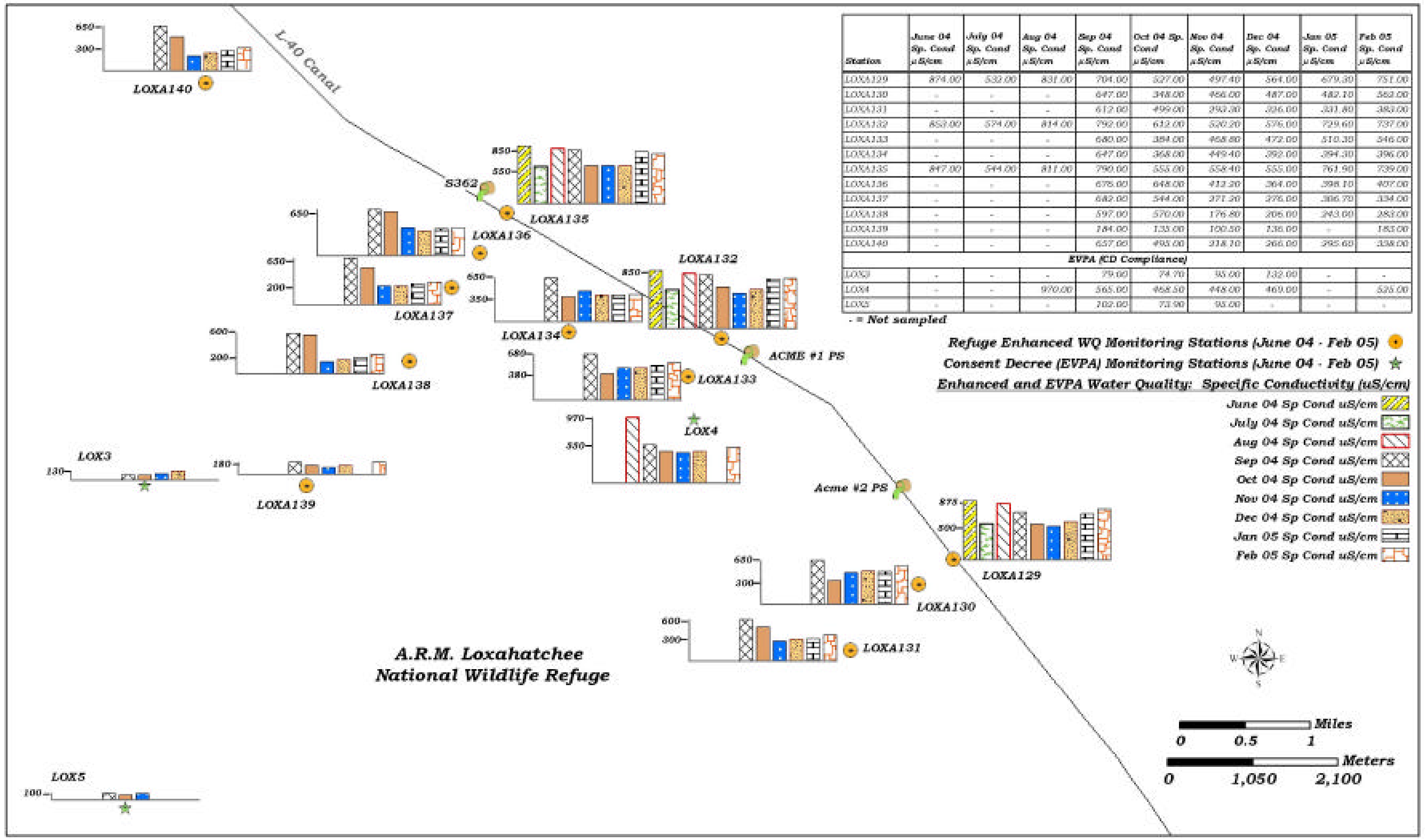
Station	June 04 TP (ppb)	July 04 TP (ppb)	Aug 04 TP (ppb)	Sept 04 TP (ppb)	Oct 04 TP (ppb)	Nov 04 TP (ppb)	Dec 04 TP (ppb)	Jan 05 TP (ppb)	Feb 05 TP (ppb)
LOXA115	55	26	29	181	200	73	53	51	100
LOXA116	-	-	74	47	199	38	67	47	32
LOXA117	-	-	19	22	15	13	18	8	12
LOXA118	18		6	8	6	6	9	6	6
LOXA119	19	10	8	6	6	9	13	12	5
LOXA120	16	-	8	7	6	8	9	12	7
LOXA121	-	-	80	-	136	32	179	91	117
LOXA122	-	-	17	14	10	11	10	9	12
LOXA123	-	-	25	14	8	14	14	9	9
EVPA (CD Compliance)									
LOX12	47	21	33	9	9	7	7	8	6

Figure D-4



Station	June 04 TP (ppb)	July 04 TP (ppb)	Aug 04 TP (ppb)	Sept 04 TP (ppb)	Oct 04 TP (ppb)	Nov 04 TP (ppb)	Dec 04 TP (ppb)	Jan 05 TP (ppb)	Feb 05 TP (ppb)
EVPA (CD Compliance)									
LOX12	47	21	33	9	9	7	7	8	6
LOX13	-	-	13	9	10	8	10	10	9
LOX14	-	-	13	8	8	6	7	6	7
LOX15	34	-	10	6	8	8	9	7	7
LOX16	-	-	20	8	10	6	5	7	8

Figure D-5



Station	June 04 Sp. Cond µS/cm	July 04 Sp. Cond µS/cm	Aug 04 Sp. Cond µS/cm	Sep 04 Sp. Cond µS/cm	Oct 04 Sp. Cond µS/cm	Nov 04 Sp. Cond µS/cm	Dec 04 Sp. Cond µS/cm	Jan 05 Sp. Cond µS/cm	Feb 05 Sp. Cond µS/cm
LOXA129	874.00	532.00	831.00	704.00	527.00	497.40	564.00	679.30	751.00
LOXA130	-	-	-	647.00	348.00	466.00	487.00	482.10	562.00
LOXA131	-	-	-	612.00	499.00	293.30	326.00	331.80	383.00
LOXA132	853.00	574.00	814.00	792.00	612.00	520.20	576.00	729.60	737.00
LOXA133	-	-	-	680.00	384.00	468.80	472.00	510.30	546.00
LOXA134	-	-	-	647.00	368.00	449.40	392.00	394.30	396.00
LOXA135	847.00	544.00	811.00	790.00	555.00	558.40	555.00	761.90	739.00
LOXA136	-	-	-	676.00	648.00	412.20	364.00	398.10	407.00
LOXA137	-	-	-	682.00	544.00	371.20	376.00	386.70	334.00
LOXA138	-	-	-	597.00	570.00	176.80	206.00	243.00	283.00
LOXA139	-	-	-	184.00	135.00	100.50	136.00	-	183.00
LOXA140	-	-	-	657.00	495.00	218.10	266.00	395.60	338.00
EVPA (CD Compliance)									
LOX3	-	-	-	79.00	74.70	95.00	132.00	-	-
LOX4	-	-	970.00	565.00	468.50	448.00	469.00	-	525.00
LOX5	-	-	-	102.00	73.90	95.00	-	-	-

- = Not sampled

Figure D-6

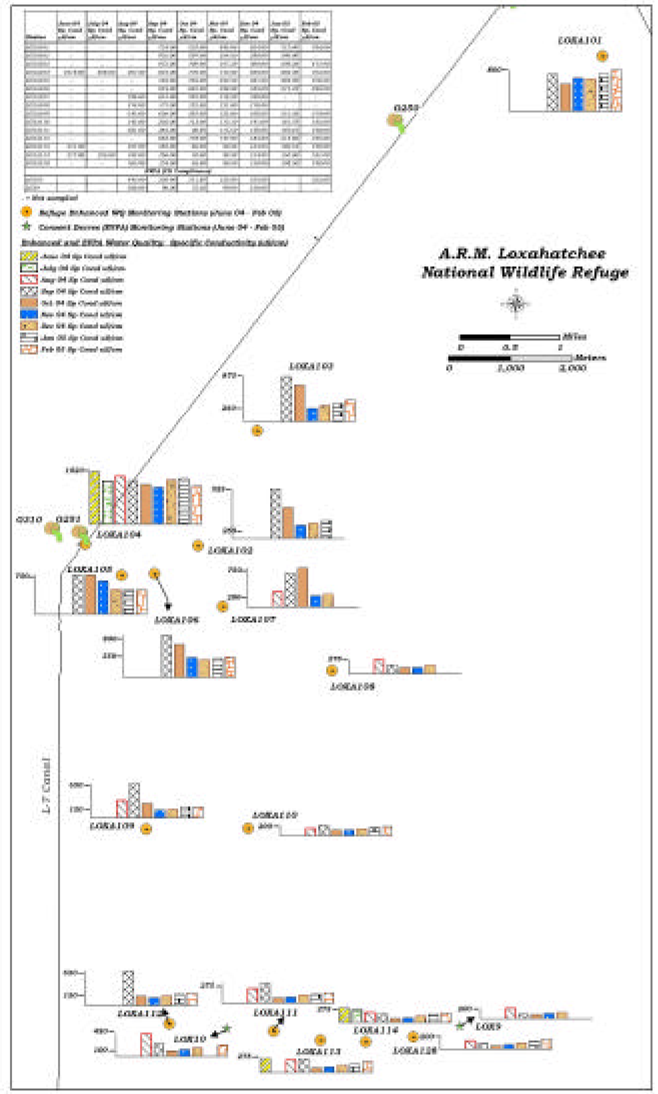
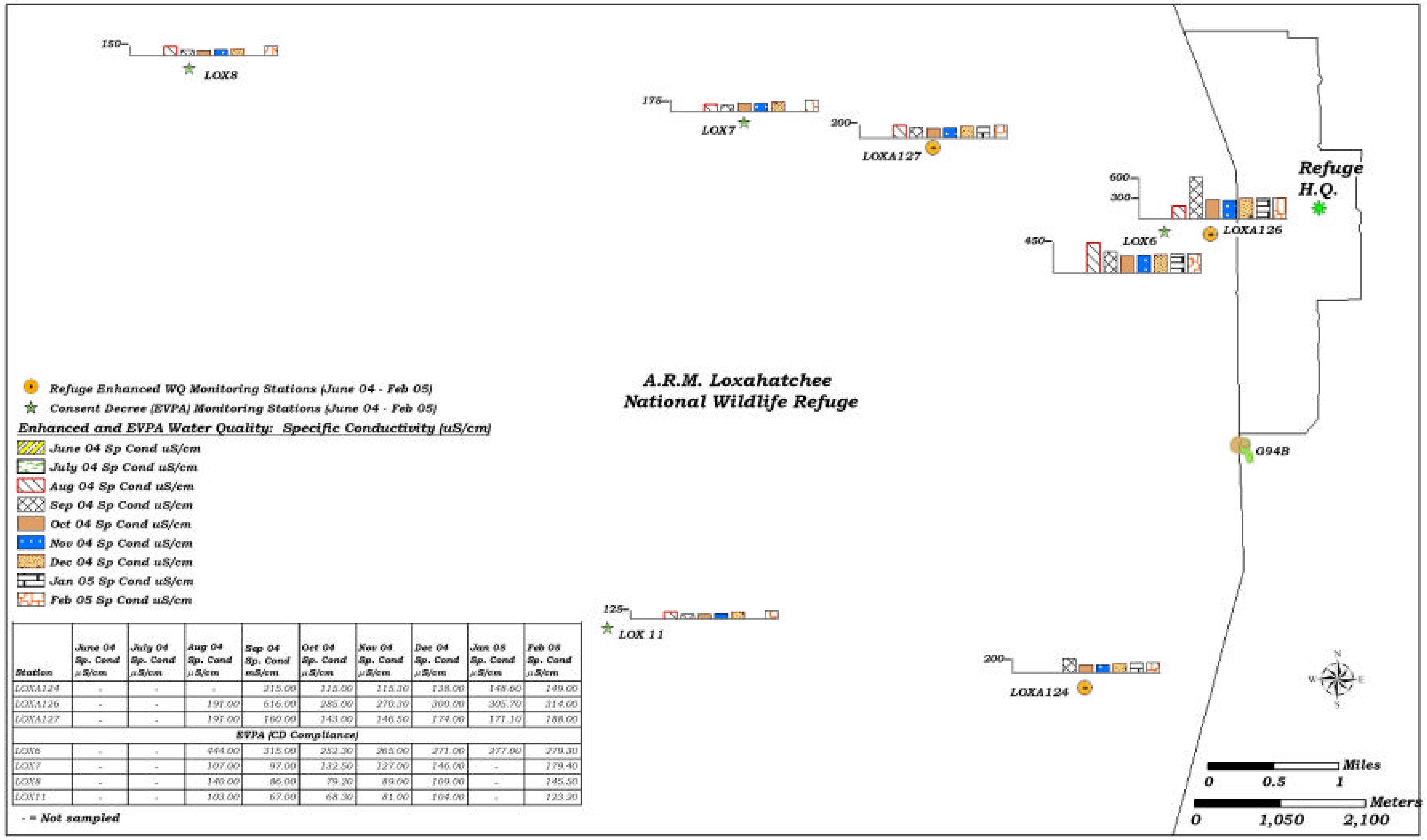

A.R.M. Loxahatchee
National Wildlife Refuge
LOXA101
LOXA103
LOXA104
LOXA102
LOXA105
LOXA106
LOXA107
LOXA108
LOXA109
LOXA110
LOXA111
LOXA113
LOX10
LOX9
L-7 Canal

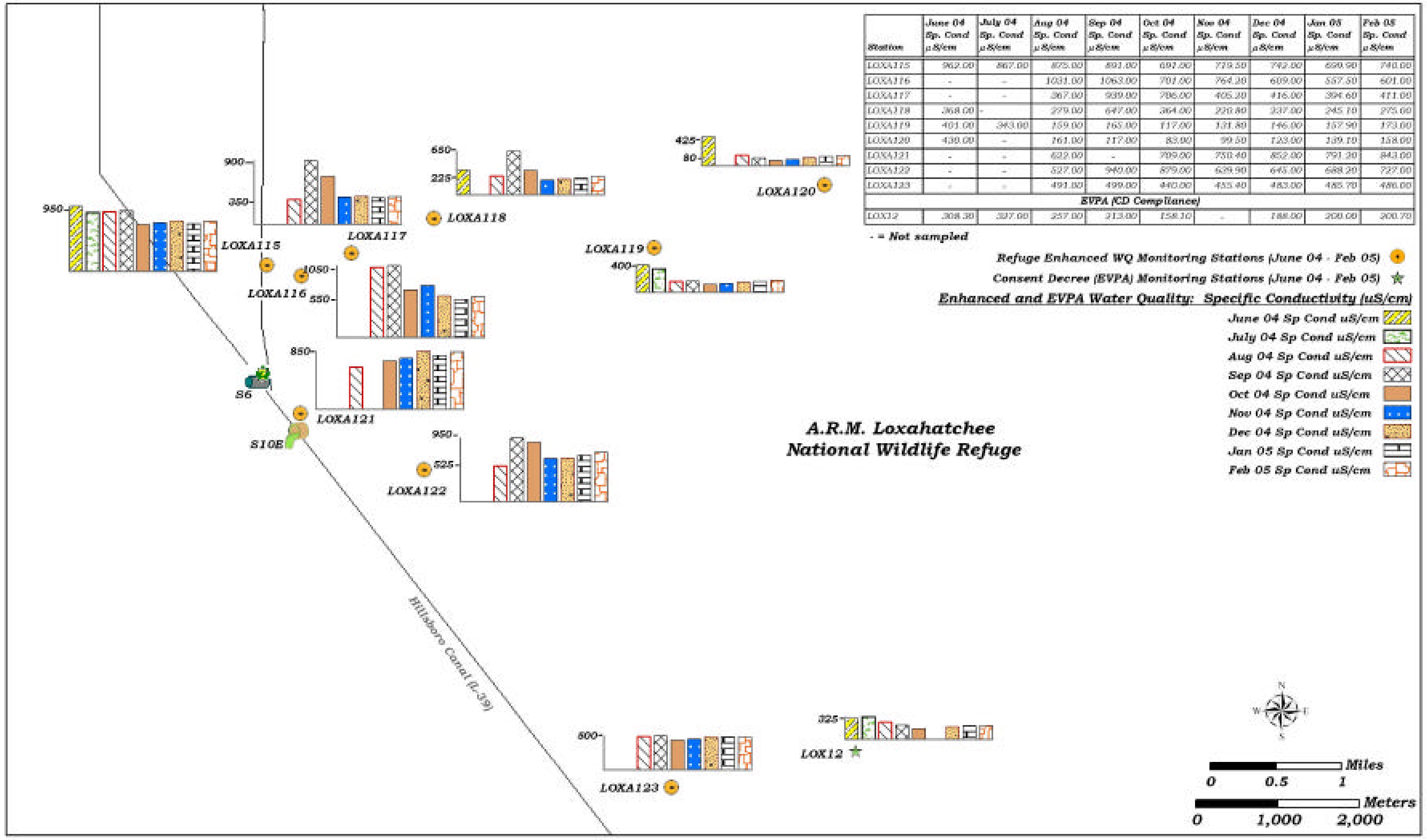
Figure D-7



Station	June 04 Sp. Cond µS/cm	July 04 Sp. Cond µS/cm	Aug 04 Sp. Cond µS/cm	Sep 04 Sp. Cond mS/cm	Oct 04 Sp. Cond µS/cm	Nov 04 Sp. Cond µS/cm	Dec 04 Sp. Cond µS/cm	Jan 05 Sp. Cond µS/cm	Feb 05 Sp. Cond µS/cm
LOXA124	-	-	-	215.00	115.00	115.30	138.00	148.60	249.00
LOXA126	-	-	191.00	616.00	285.00	270.30	300.00	305.70	314.00
LOXA127	-	-	191.00	160.00	143.00	146.50	174.00	171.10	188.00
EVPA (CD Compliance)									
LOX6	-	-	444.00	315.00	252.30	265.00	271.00	277.00	279.30
LOX7	-	-	107.00	97.00	132.50	127.00	146.00	-	179.40
LOX8	-	-	140.00	86.00	79.20	89.00	109.00	-	145.50
LOX11	-	-	103.00	67.00	68.30	81.00	104.00	-	123.30

- = Not sampled

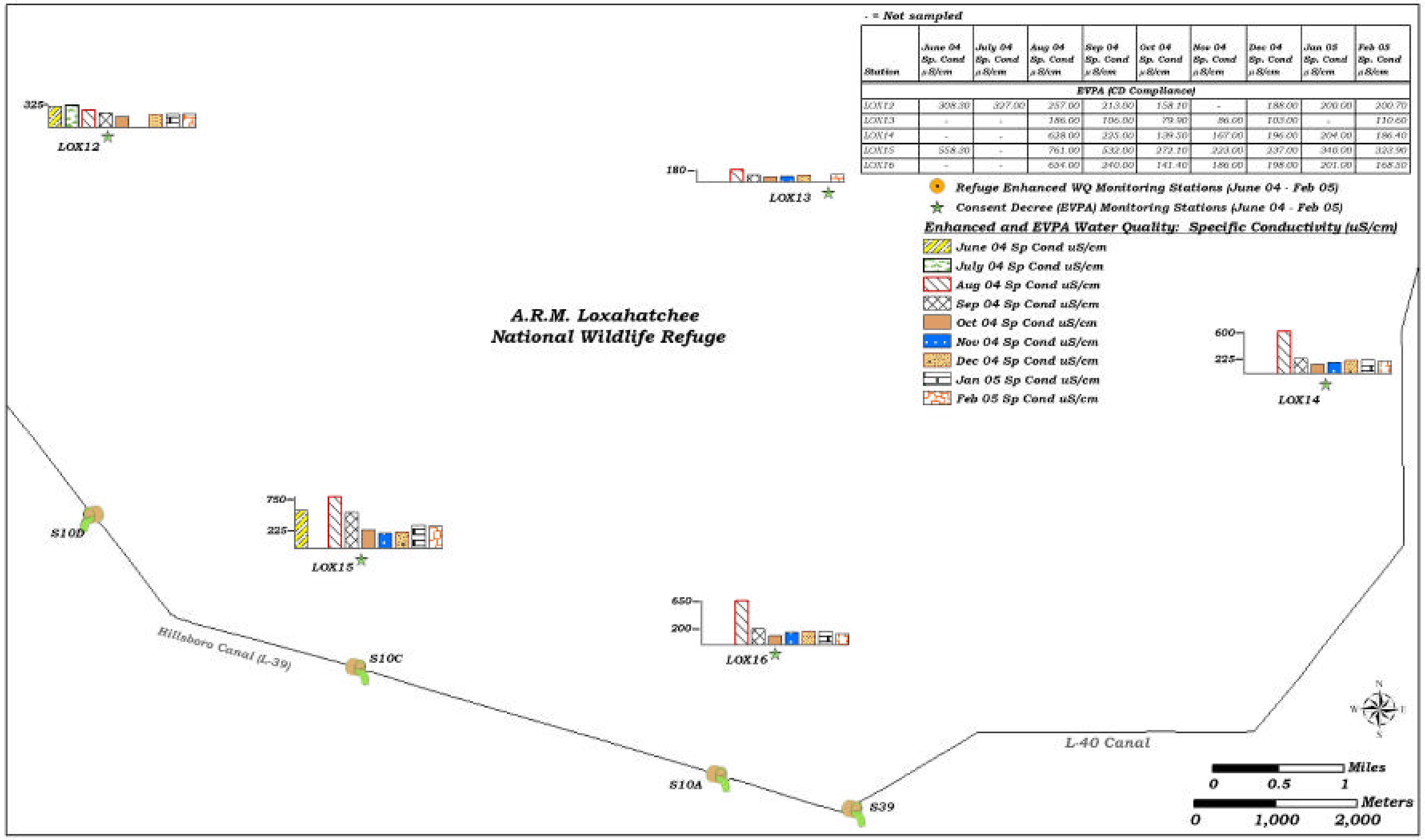
Figure D-8



Station	June 04 Sp. Cond µS/cm	July 04 Sp. Cond µS/cm	Aug 04 Sp. Cond µS/cm	Sep 04 Sp. Cond µS/cm	Oct 04 Sp. Cond µS/cm	Nov 04 Sp. Cond µS/cm	Dec 04 Sp. Cond µS/cm	Jan 05 Sp. Cond µS/cm	Feb 05 Sp. Cond µS/cm
LOXA115	962.00	867.00	875.00	891.00	697.00	779.50	742.00	690.90	740.00
LOXA116	-	-	1031.00	1063.00	701.00	764.20	609.00	557.50	601.00
LOXA117	-	-	367.00	939.00	706.00	405.20	416.00	394.60	411.00
LOXA118	368.00	-	279.00	647.00	364.00	220.80	337.00	245.10	275.00
LOXA119	401.00	343.00	159.00	165.00	117.00	131.80	146.00	157.90	173.00
LOXA120	430.00	-	161.00	117.00	83.00	99.50	123.00	139.10	158.00
LOXA121	-	-	622.00	-	709.00	750.40	852.00	791.20	843.00
LOXA122	-	-	527.00	940.00	879.00	639.90	645.00	688.20	727.00
LOXA123	-	-	491.00	499.00	440.00	455.40	483.00	485.70	486.00
EVPA (CD Compliance)									
LOX12	308.30	327.00	257.00	213.00	158.10	-	188.00	200.00	200.70

- = Not sampled

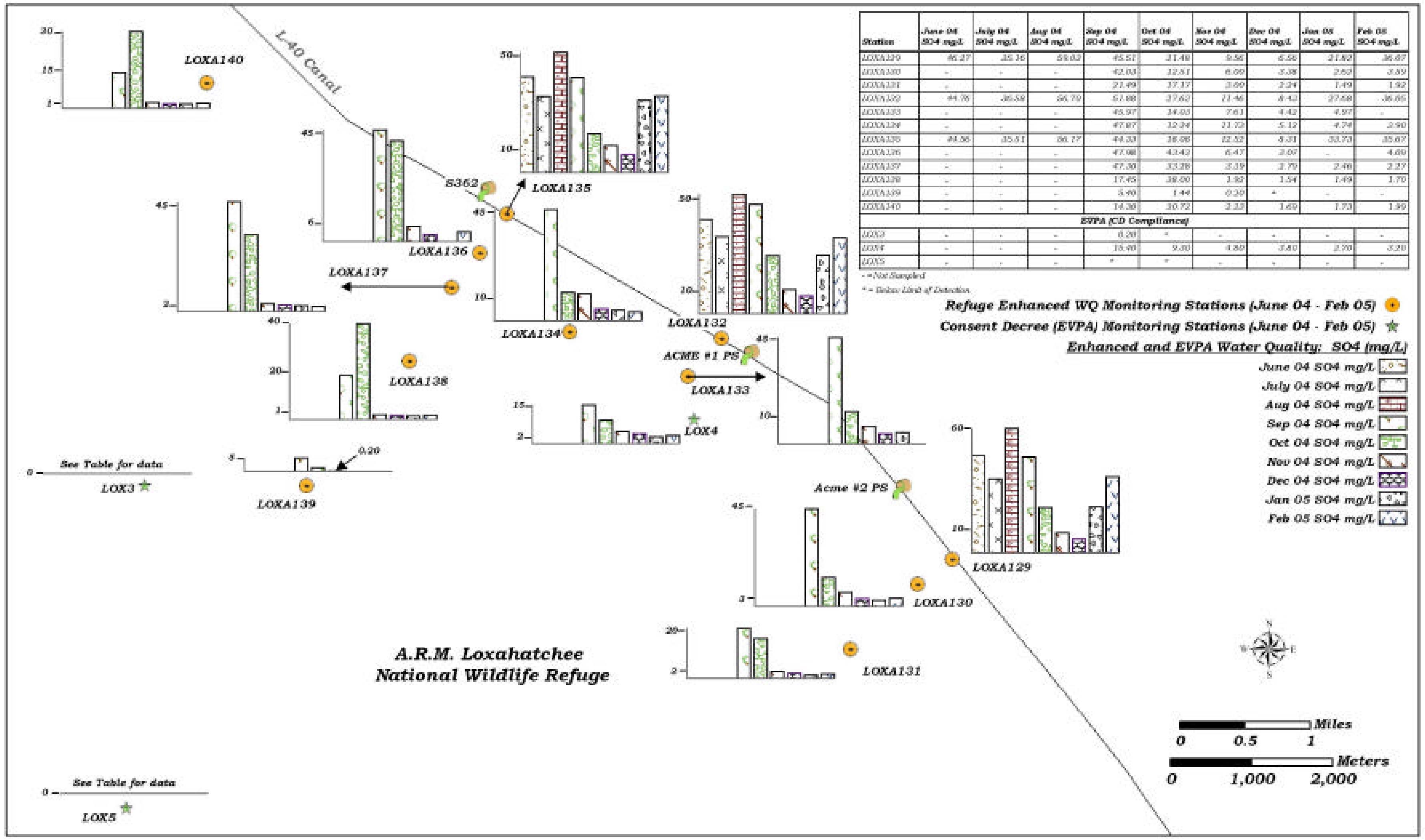
Figure D-9



- = Not sampled

Station	June 04 Sp. Cond µS/cm	July 04 Sp. Cond µS/cm	Aug 04 Sp. Cond µS/cm	Sep 04 Sp. Cond µS/cm	Oct 04 Sp. Cond µS/cm	Nov 04 Sp. Cond µS/cm	Dec 04 Sp. Cond µS/cm	Jan 05 Sp. Cond µS/cm	Feb 05 Sp. Cond µS/cm
EVPA (CD Compliance)									
LOX12	308.30	327.00	257.00	213.00	158.10	-	188.00	200.00	200.70
LOX13	-	-	186.00	106.00	79.90	86.00	103.00	-	110.60
LOX14	-	-	628.00	225.00	139.50	167.00	196.00	204.00	186.40
LOX15	558.30	-	761.00	532.00	272.10	223.00	237.00	340.00	322.90
LOX16	-	-	654.00	240.00	141.40	186.00	198.00	201.00	168.50

Figure D-10



Station	June 04 SO4 mg/L	July 04 SO4 mg/L	Aug 04 SO4 mg/L	Sep 04 SO4 mg/L	Oct 04 SO4 mg/L	Nov 04 SO4 mg/L	Dec 04 SO4 mg/L	Jan 05 SO4 mg/L	Feb 05 SO4 mg/L
LOXA129	46.27	35.16	59.02	45.51	21.48	9.56	6.56	21.82	36.67
LOXA130	-	-	-	42.03	12.51	6.09	3.38	2.62	3.59
LOXA131	-	-	-	21.49	37.17	3.00	2.24	1.49	1.92
LOXA132	44.76	36.58	56.79	51.88	27.62	11.46	8.42	27.68	36.65
LOXA133	-	-	-	45.97	14.93	7.61	4.42	4.97	-
LOXA134	-	-	-	47.87	12.24	11.73	5.12	4.74	2.90
LOXA135	44.56	35.51	56.17	44.33	18.06	12.52	8.31	33.73	35.67
LOXA136	-	-	-	47.98	43.42	6.47	2.07	-	4.69
LOXA137	-	-	-	47.30	33.28	3.39	2.79	2.46	2.27
LOXA138	-	-	-	17.45	38.00	1.92	1.54	1.49	1.70
LOXA139	-	-	-	5.40	1.44	0.20	*	-	-
LOXA140	-	-	-	14.30	30.72	2.33	1.69	1.73	1.99
EVPA (CD Compliance)									
LOX3	-	-	-	0.20	*	-	-	-	-
LOX4	-	-	-	15.40	9.30	4.80	3.80	2.70	3.20
LOX5	-	-	-	*	*	-	-	-	-

Figure D-11

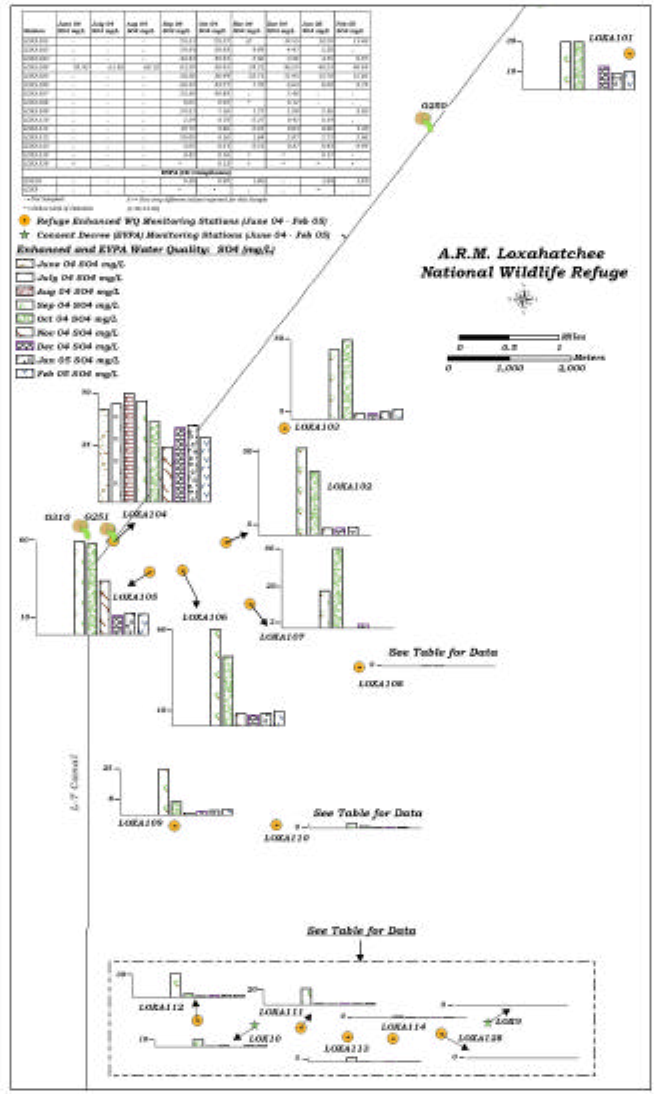
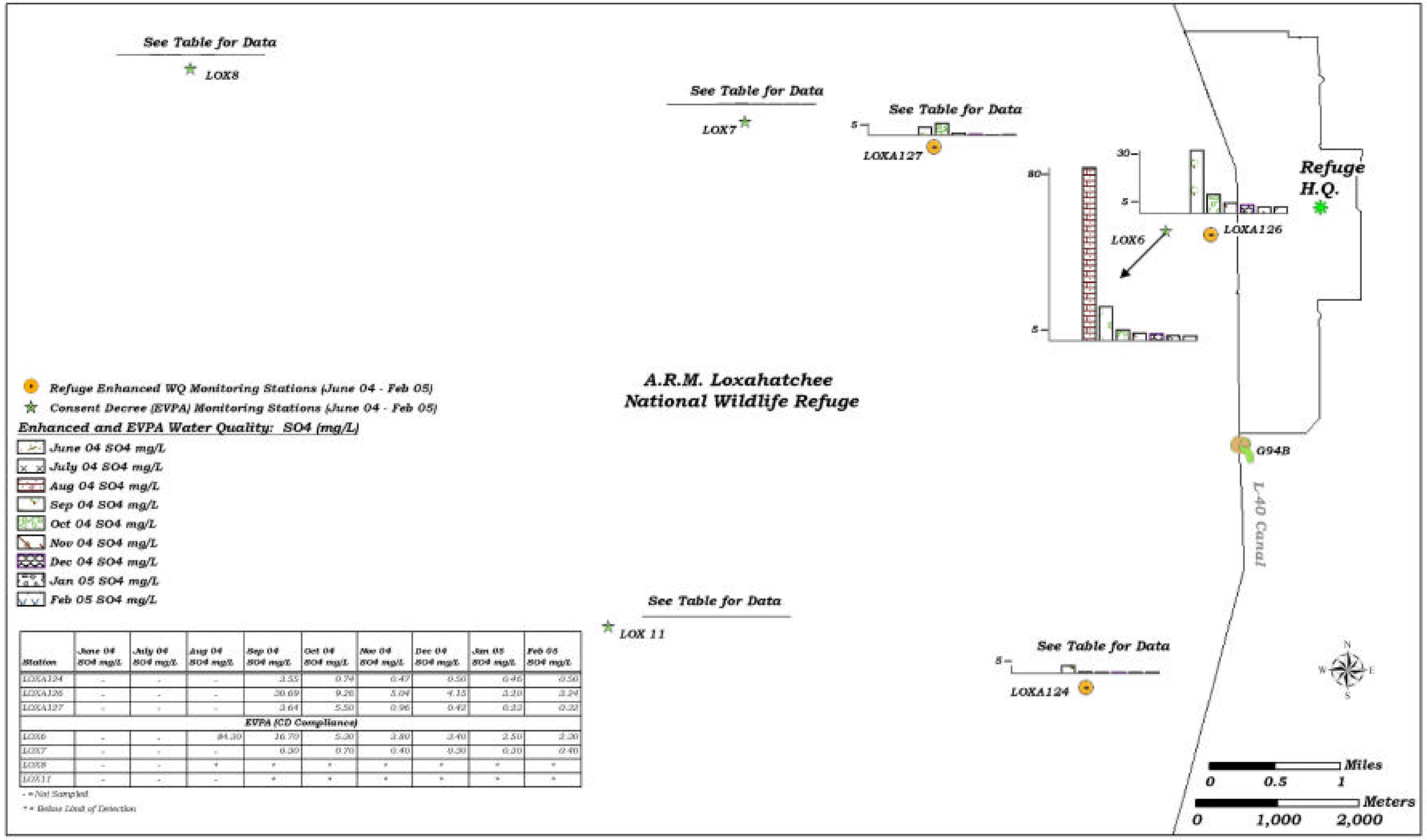

A.R.M. Loxahatchee
National Wildlife Refuge
Refuge Enhanced WQ Monitoring Stations (June 04 - Feb 05)
Consent Decree (EVPA) Monitoring Stations (June 04 - Feb 05)
Enhanced and EVPA Water Quality: SO4 (mg/L)
June 04 SO4 mg/L
July 04 SO4 mg/L
Aug 04 SO4 mg/L
Sep 04 SO4 mg/L
Oct 04 SO4 mg/L
Nov 04 SO4 mg/L
Dec 04 SO4 mg/L
Jan 05 SO4 mg/L
Feb 05 SO4 mg/L
LOXA101
G250
LOXA102
LOXA103
LOXA104
LOXA105
LOXA106
LOXA107
LOXA108
LOXA109
LOXA110
LOXA111
LOXA112
LOXA113
LOXA114
LOXA138
LOX10
LOX9
G310
G251
See Table for Data
See Table for Data
See Table for Data
L-7 Canal

Figure D-12

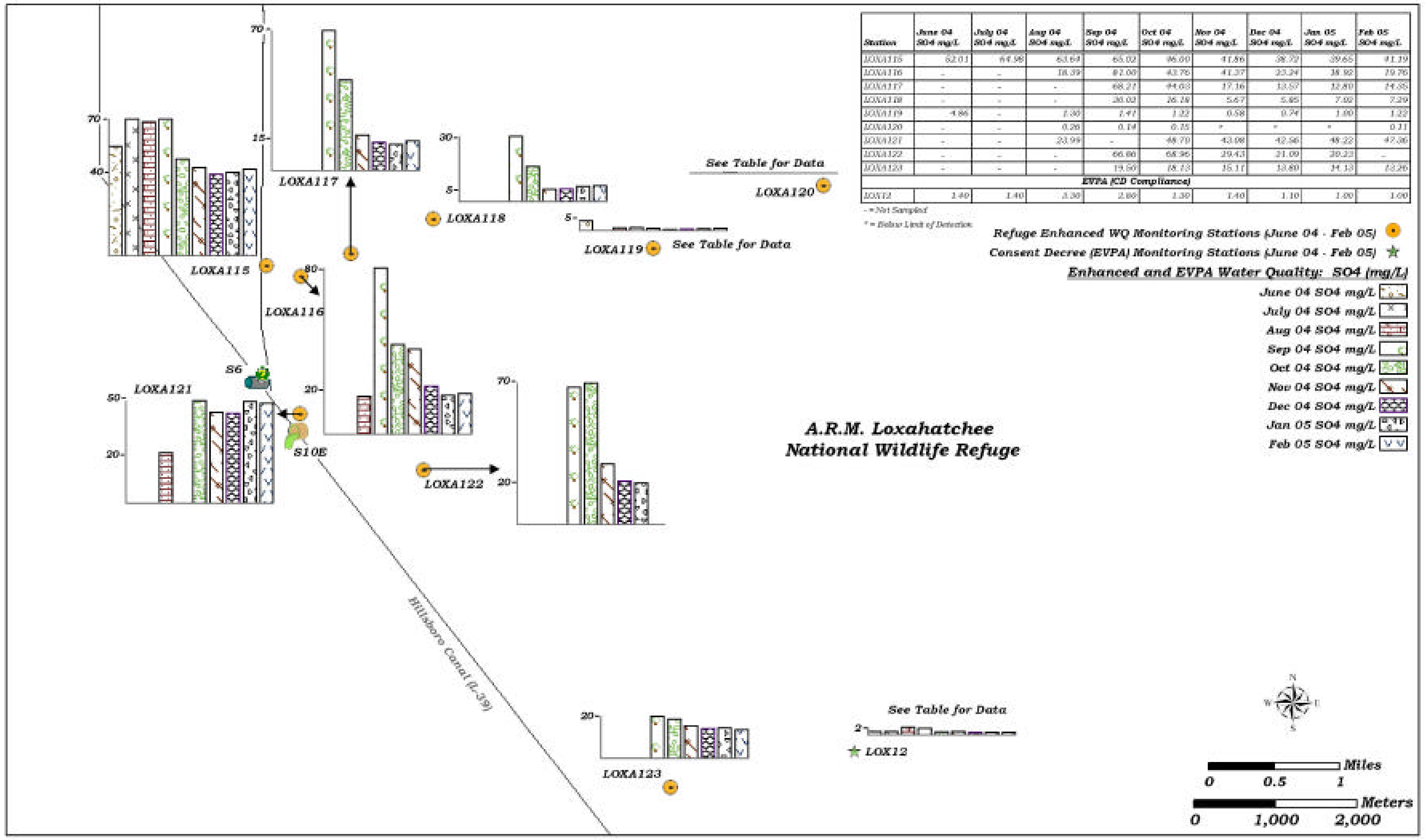


Station	June 04 SO4 mg/L	July 04 SO4 mg/L	Aug 04 SO4 mg/L	Sep 04 SO4 mg/L	Oct 04 SO4 mg/L	Nov 04 SO4 mg/L	Dec 04 SO4 mg/L	Jan 05 SO4 mg/L	Feb 05 SO4 mg/L
LOXA124	-	-	-	3.55	0.74	0.47	0.50	0.46	0.50
LOXA126	-	-	-	30.69	9.26	5.04	4.15	3.20	3.24
LOXA127	-	-	-	3.64	5.50	0.96	0.42	0.22	0.22
EVPA (CD Compliance)									
LOX6	-	-	84.30	16.70	5.30	3.80	3.40	2.50	2.30
LOX7	-	-	-	0.30	0.70	0.40	0.30	0.20	0.40
LOX8	-	-	*	*	*	*	*	*	*
LOX11	-	-	-	*	*	*	*	*	*

- = Not Sampled

* = Below Limit of Detection

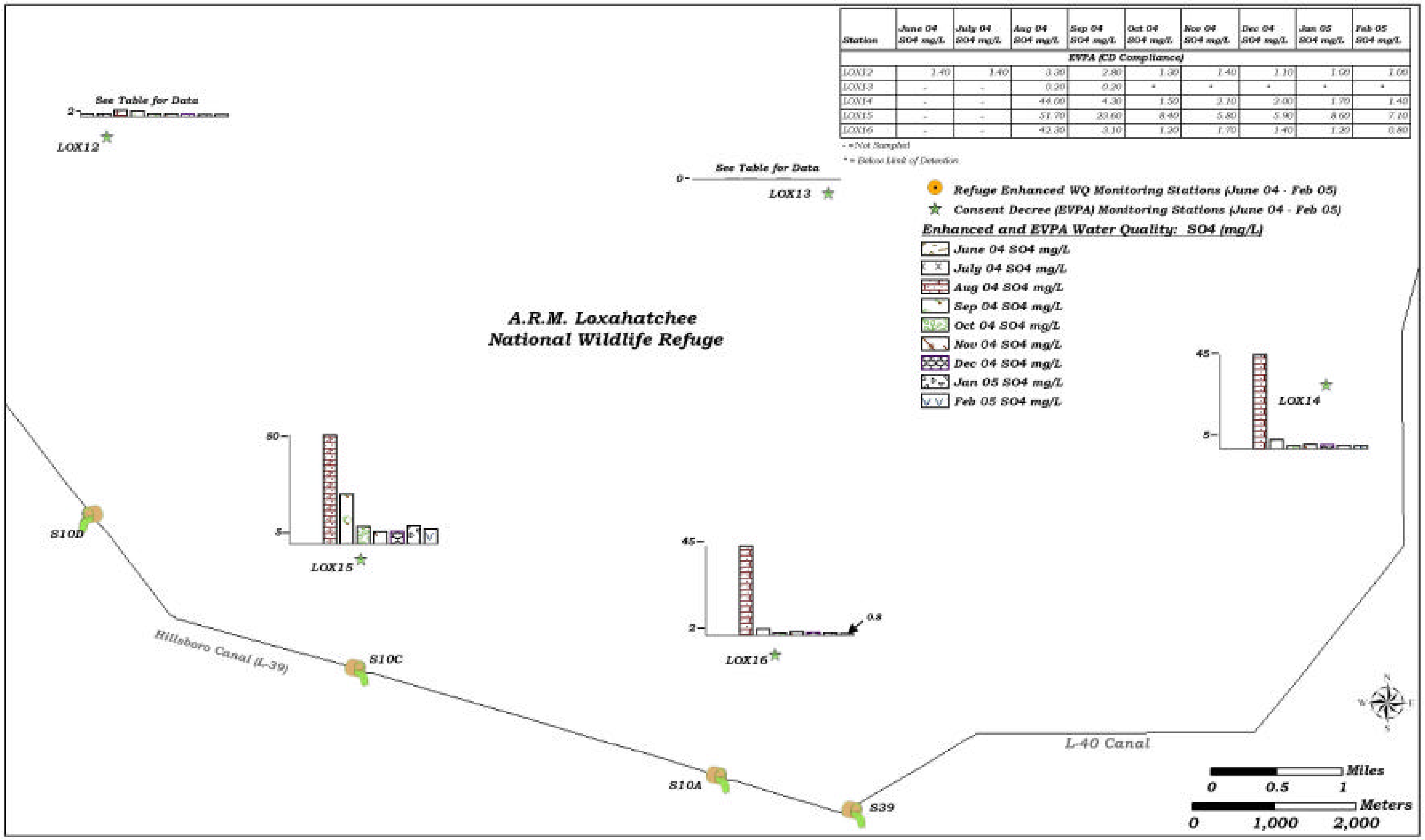
Figure D-13



Station	June 04 SO4 mg/L	July 04 SO4 mg/L	Aug 04 SO4 mg/L	Sep 04 SO4 mg/L	Oct 04 SO4 mg/L	Nov 04 SO4 mg/L	Dec 04 SO4 mg/L	Jan 05 SO4 mg/L	Feb 05 SO4 mg/L
LOXA115	52.01	64.98	63.64	65.02	46.00	41.86	38.72	39.65	41.19
LOXA116	-	-	18.39	82.08	43.76	41.37	23.24	18.92	19.76
LOXA117	-	-	-	68.27	44.03	17.16	13.57	12.80	14.35
LOXA118	-	-	-	30.02	26.18	5.67	5.85	7.02	7.29
LOXA119	4.86	-	1.30	1.47	1.22	0.58	0.74	1.00	1.22
LOXA120	-	-	0.26	0.14	0.15	*	*	*	0.11
LOXA121	-	-	23.99	-	48.70	43.08	42.56	48.22	47.36
LOXA122	-	-	-	66.86	68.96	29.43	21.09	20.23	-
LOXA123	-	-	-	19.50	18.13	15.11	13.80	14.13	13.26
EVPA (CD Compliance)									
LOX12	1.40	1.40	3.30	2.80	1.30	1.40	1.10	1.00	1.00

- = Not Sampled
* = Below Limit of Detection

Figure D-14



Station	June 04 SO4 mg/L	July 04 SO4 mg/L	Aug 04 SO4 mg/L	Sep 04 SO4 mg/L	Oct 04 SO4 mg/L	Nov 04 SO4 mg/L	Dec 04 SO4 mg/L	Jan 05 SO4 mg/L	Feb 05 SO4 mg/L
EVPA (CD Compliance)									
LOX12	1.40	1.40	3.30	2.80	1.30	1.40	1.10	1.00	1.00
LOX13	-	-	0.20	0.20	*	*	*	*	*
LOX14	-	-	44.00	4.30	1.50	2.10	2.00	1.70	1.40
LOX15	-	-	51.70	23.60	8.40	5.80	5.90	8.60	7.10
LOX16	-	-	42.30	3.10	1.20	1.70	1.40	1.20	0.80

- = Not Sampled

* = Below Limit of Detection

Figure D-15

Appendix E: Monthly Maps of Water Quality Data

Note: Scale legend is shown for each map; all maps are on same scale. Depths are linear. Concentrations are square root transformations.

Figure E-1: June 2004 map of depth, total phosphorus, specific conductivity, and sulfate.

Figure E-2: July 2004 map of depth, total phosphorus, specific conductivity, and sulfate.

Figure E-3: August 2004 map of depth, total phosphorus, specific conductivity, and sulfate.

Figure E-4: September 2004 map of depth, total phosphorus, specific conductivity, and sulfate.

Figure E-5: October 2004 map of depth, total phosphorus, specific conductivity, and sulfate.

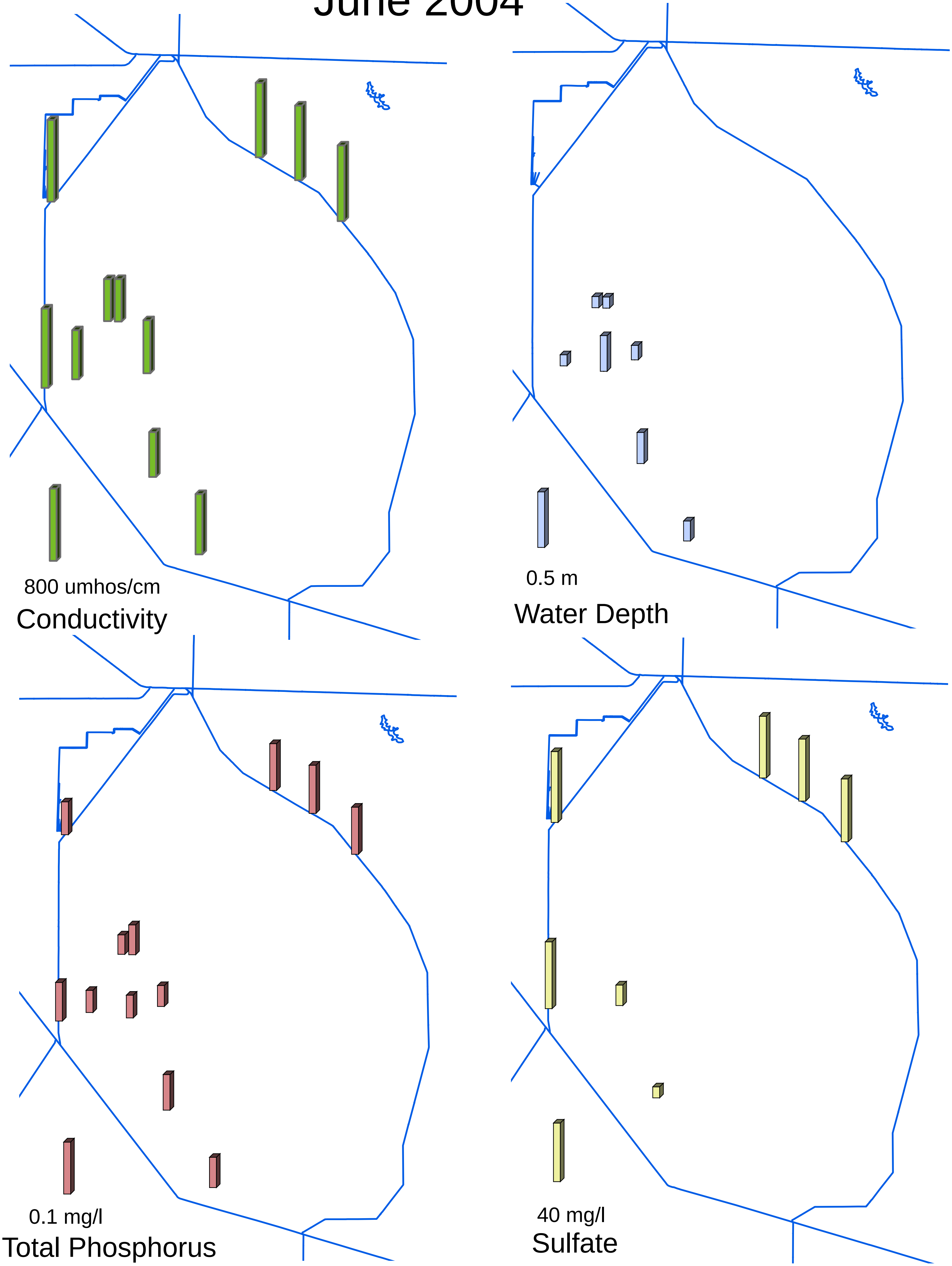
Figure E-6: November 2004 map of depth, total phosphorus, specific conductivity, and sulfate.

Figure E-7: December 2004 map of depth, total phosphorus, specific conductivity, and sulfate.

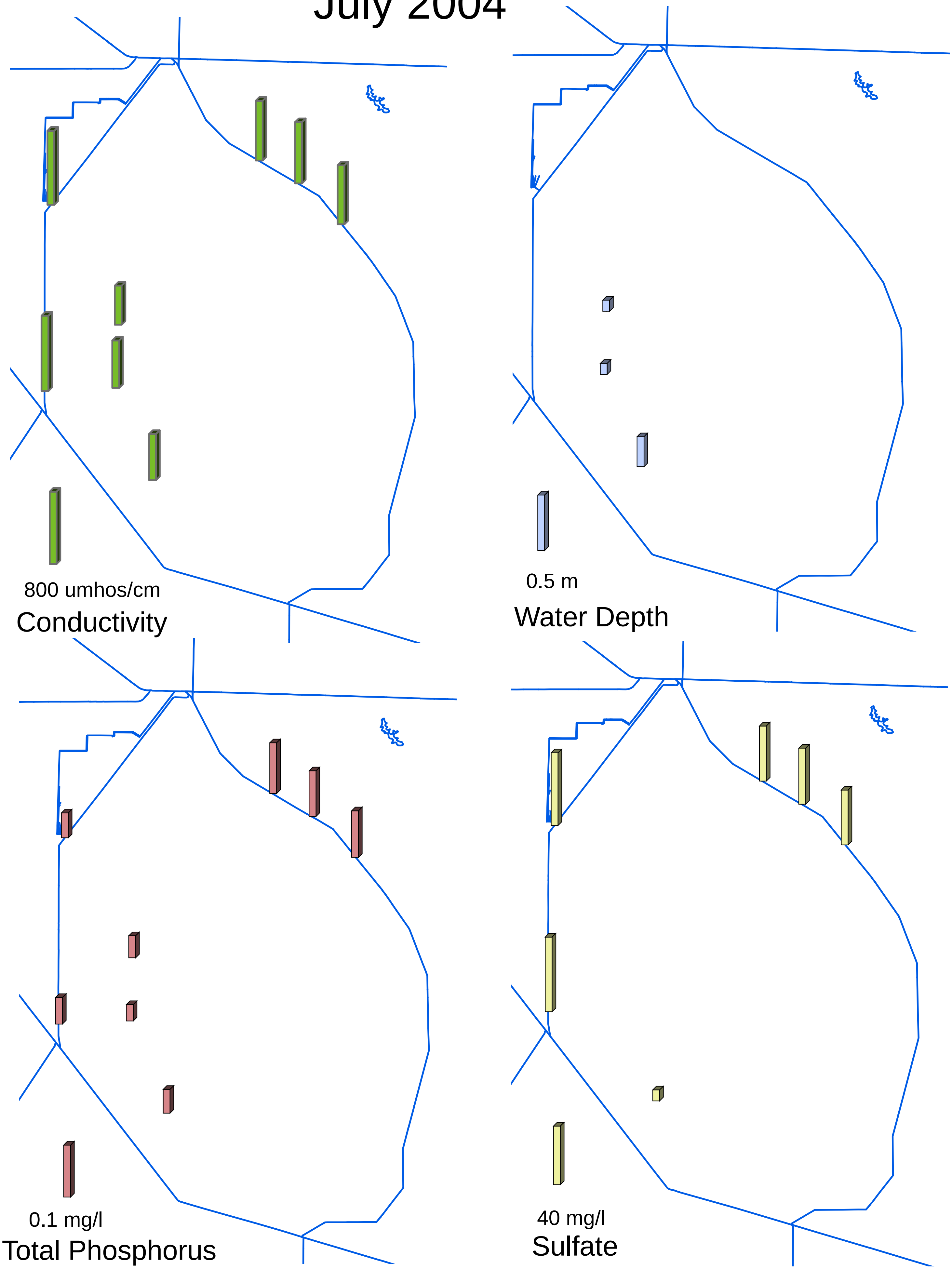
Figure E-8: January 2005 map of depth, total phosphorus, specific conductivity, and sulfate.

Figure E-9: February 2005 map of depth, total phosphorus, specific conductivity, and sulfate.

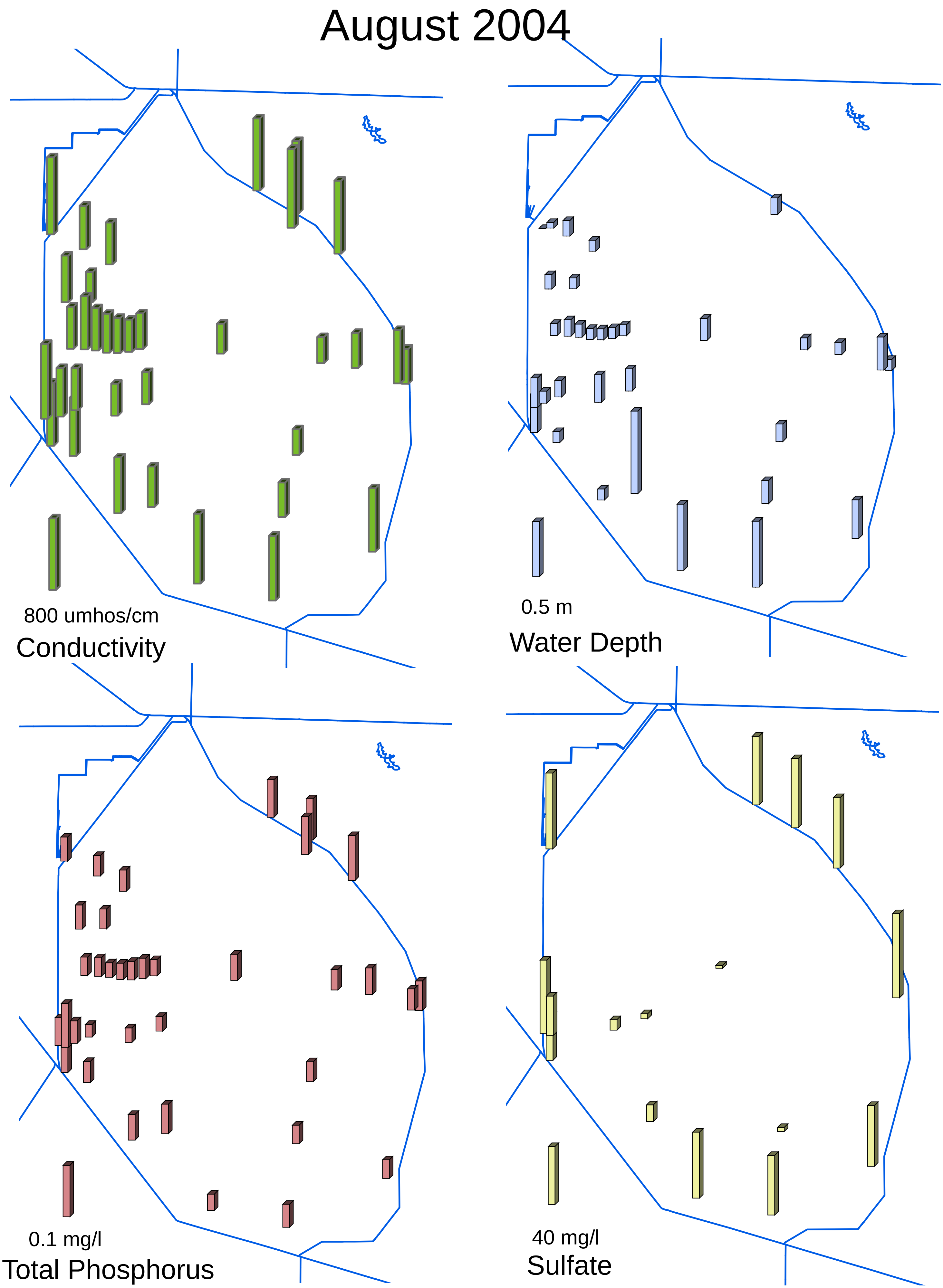
June 2004


800 umhos/cm
Conductivity
0.5 m
Water Depth
0.1 mg/l
Total Phosphorus
40 mg/l
Sulfate

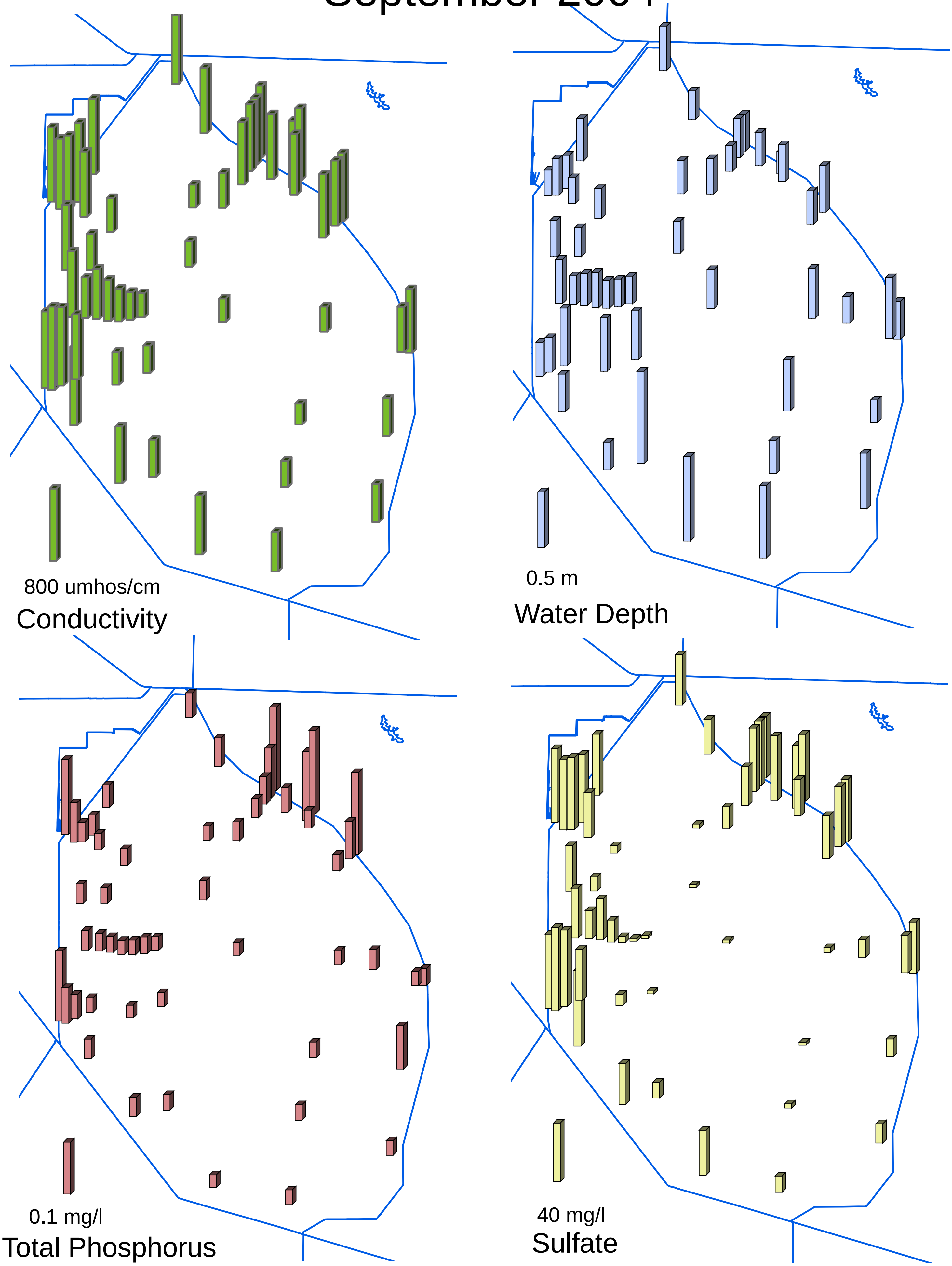
July 2004



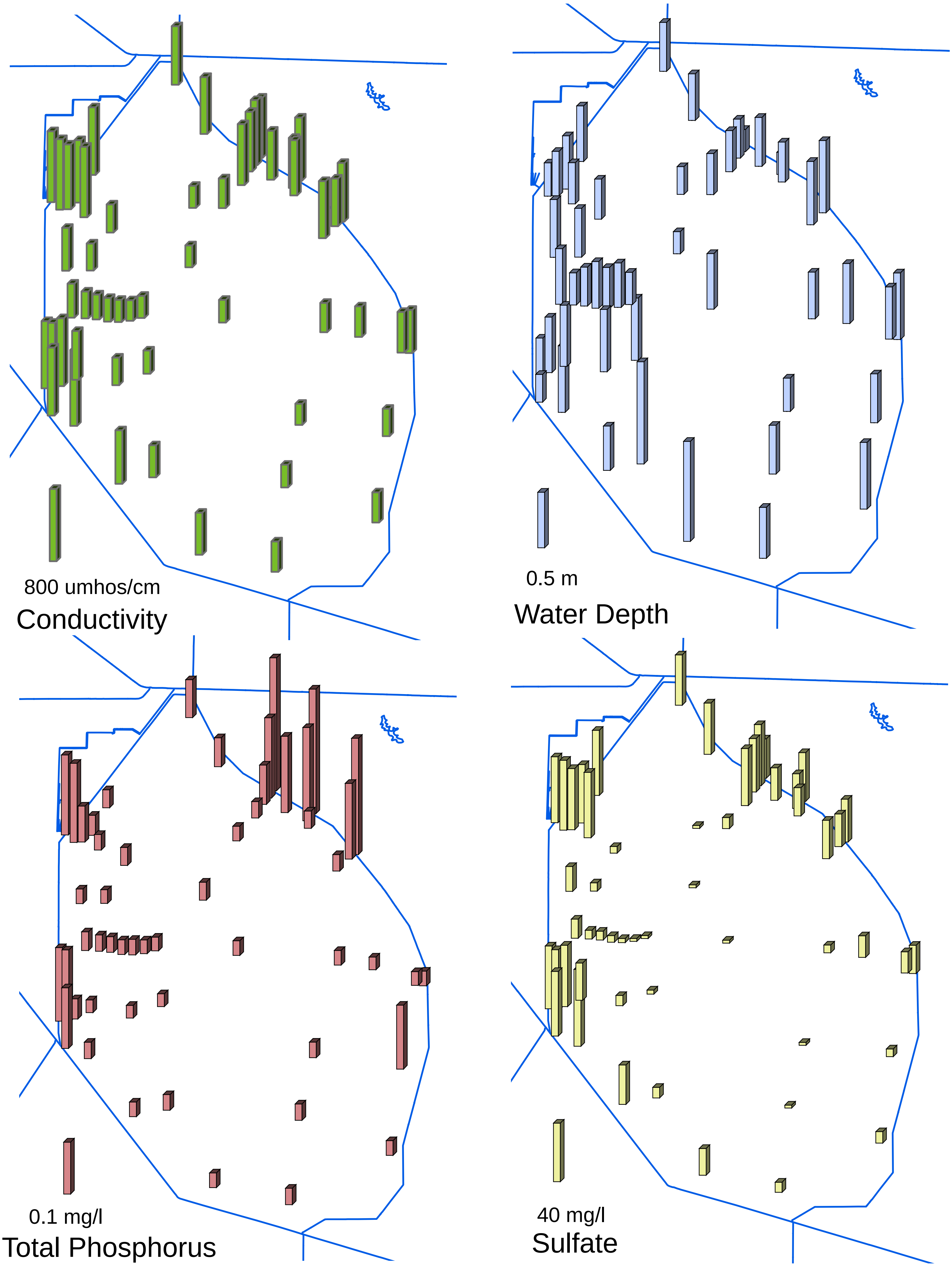
800 umhos/cm
Conductivity
0.5 m
Water Depth
0.1 mg/l
Total Phosphorus
40 mg/l
Sulfate


August 2004
800 umhos/cm
Conductivity
0.5 m
Water Depth
0.1 mg/l
Total Phosphorus
40 mg/l
Sulfate

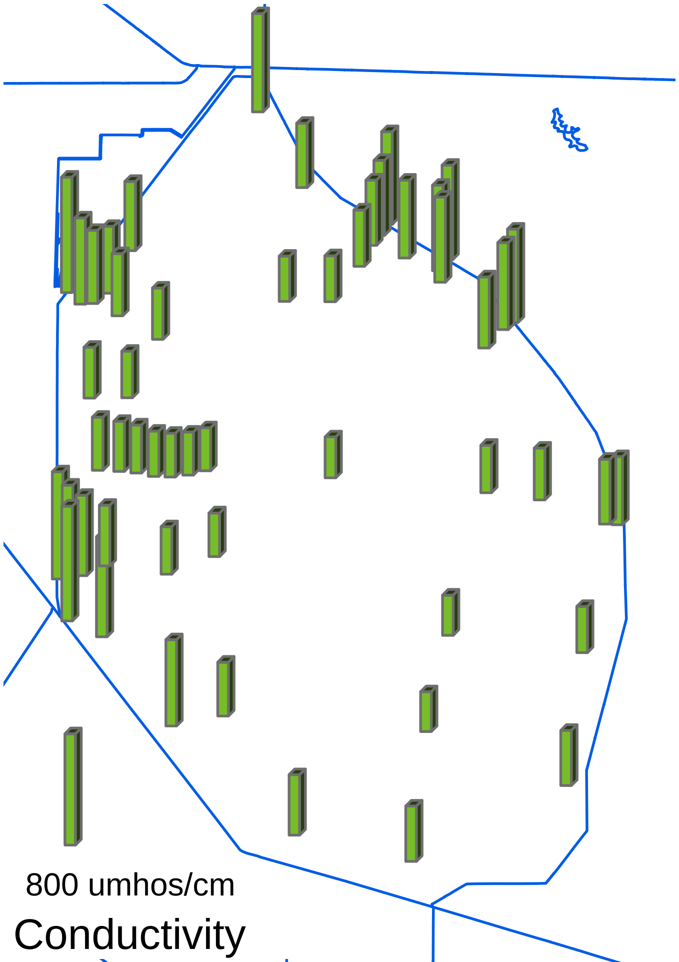
September 2004

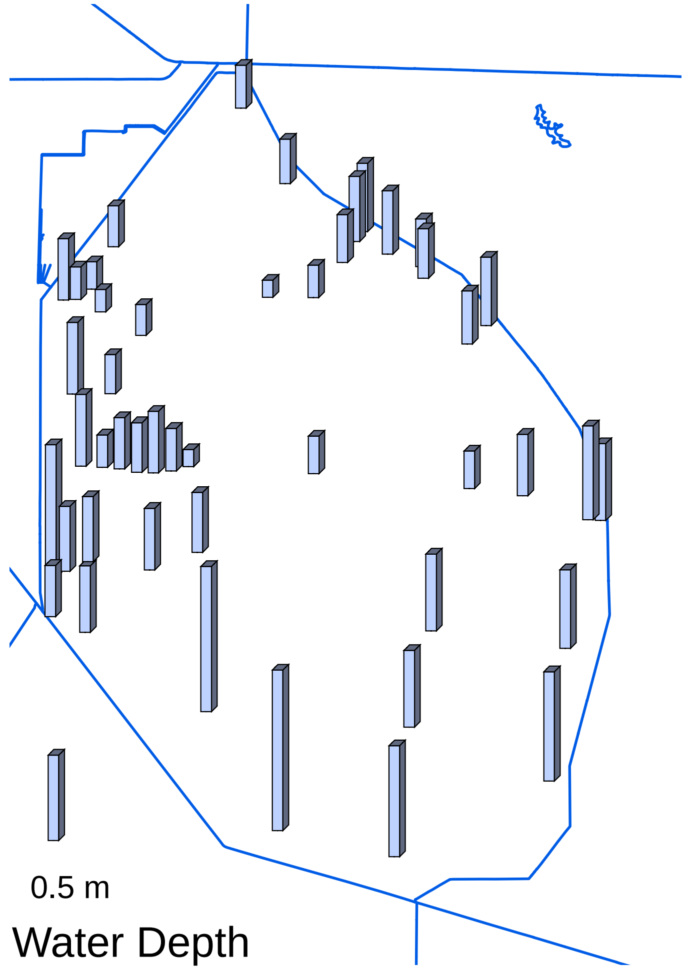


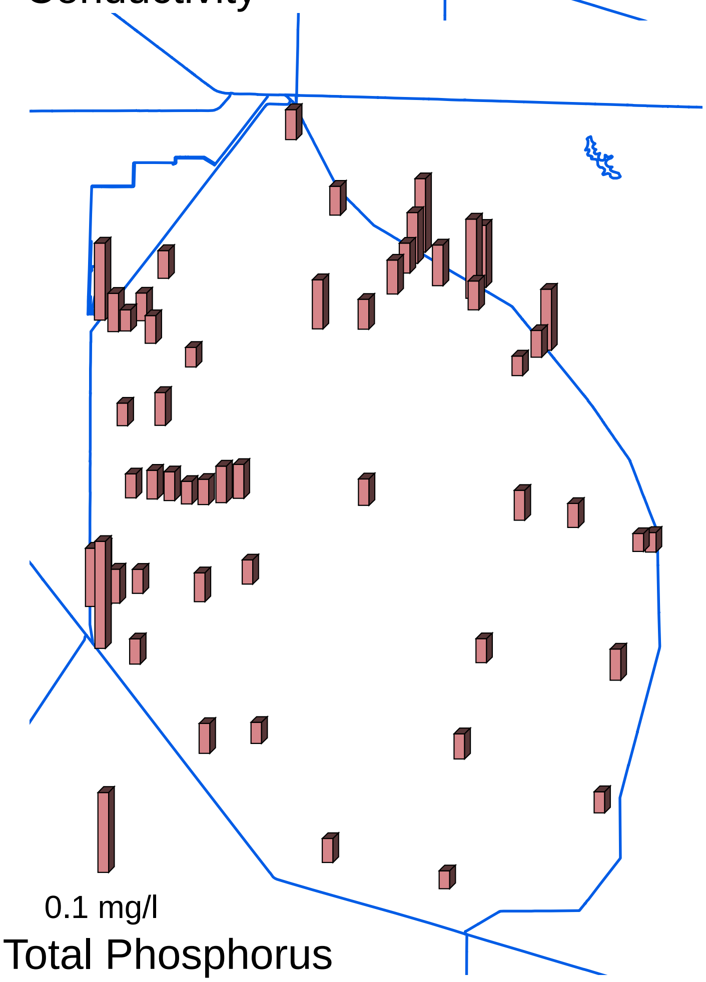
October 2004

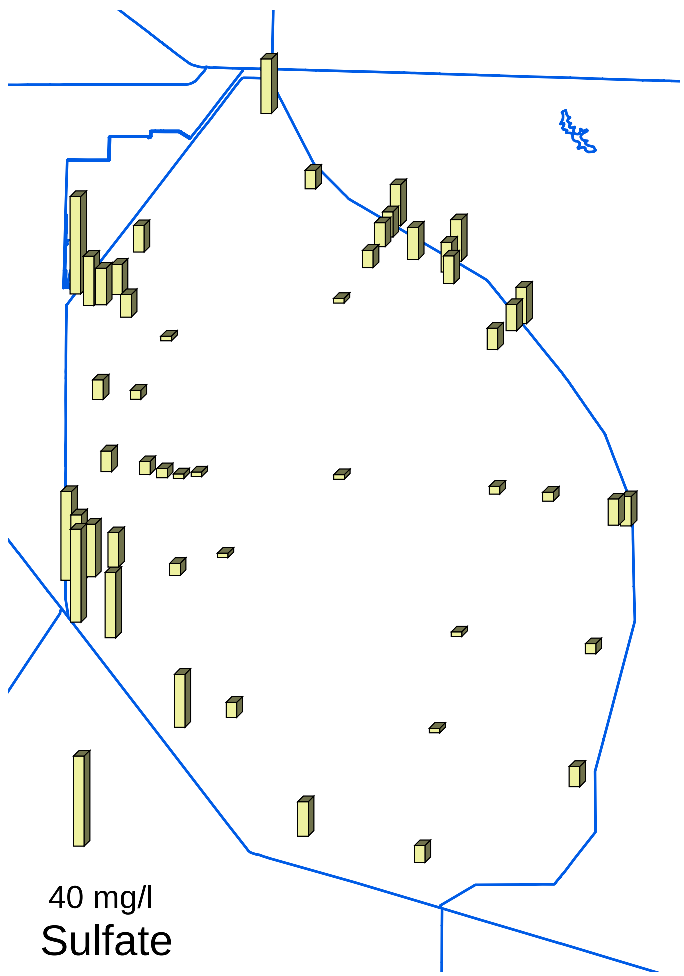


December 2004

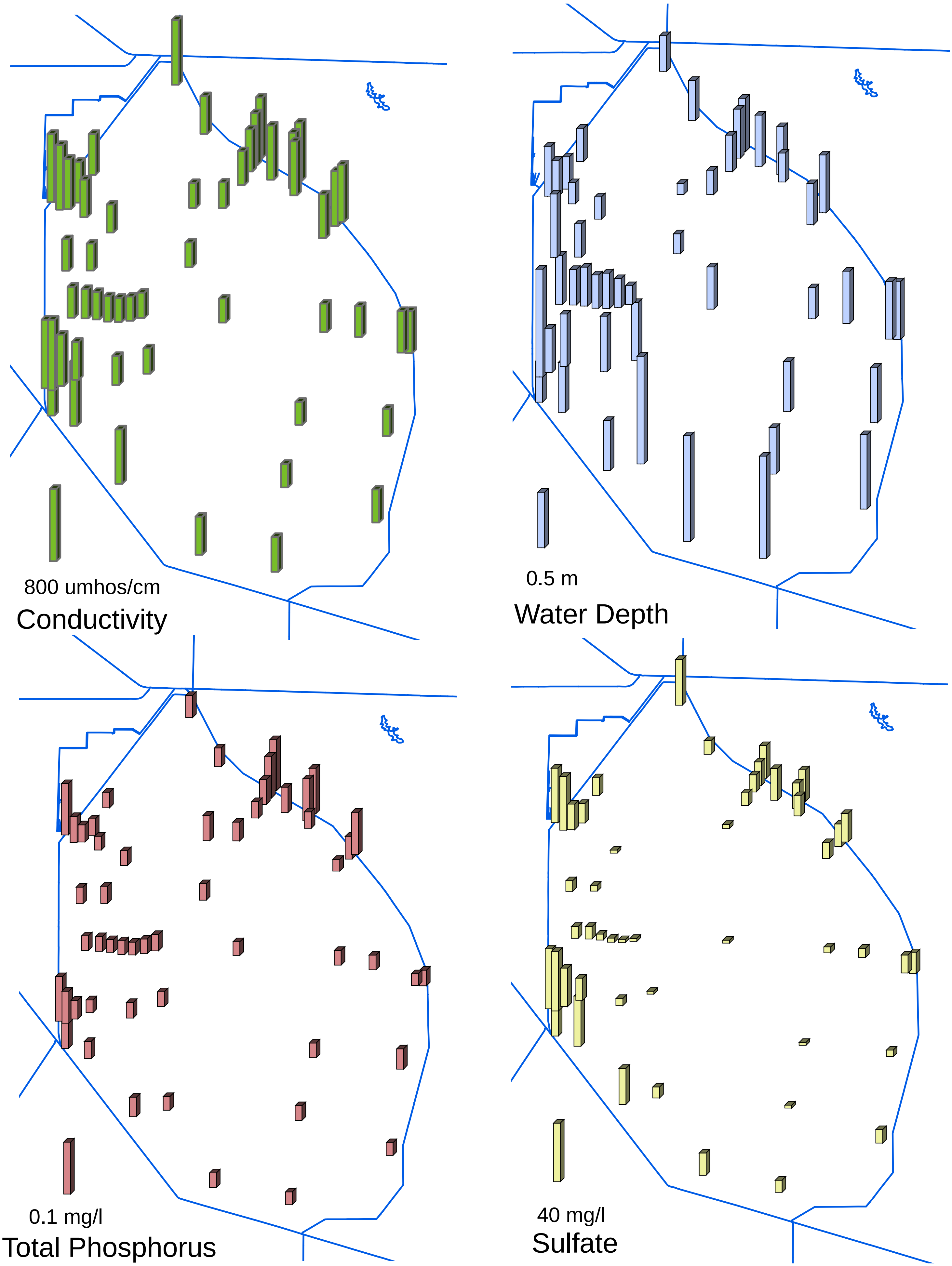




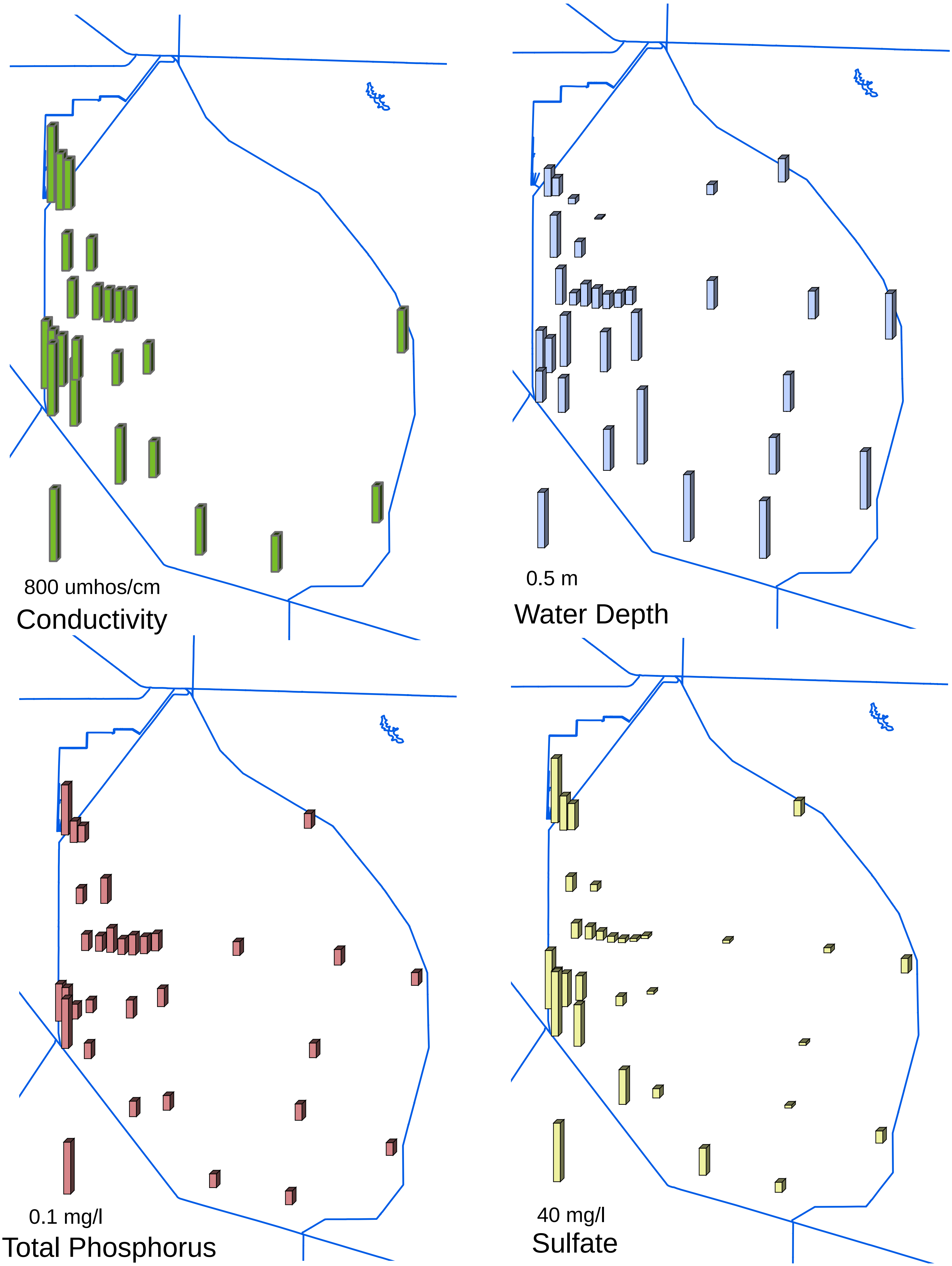




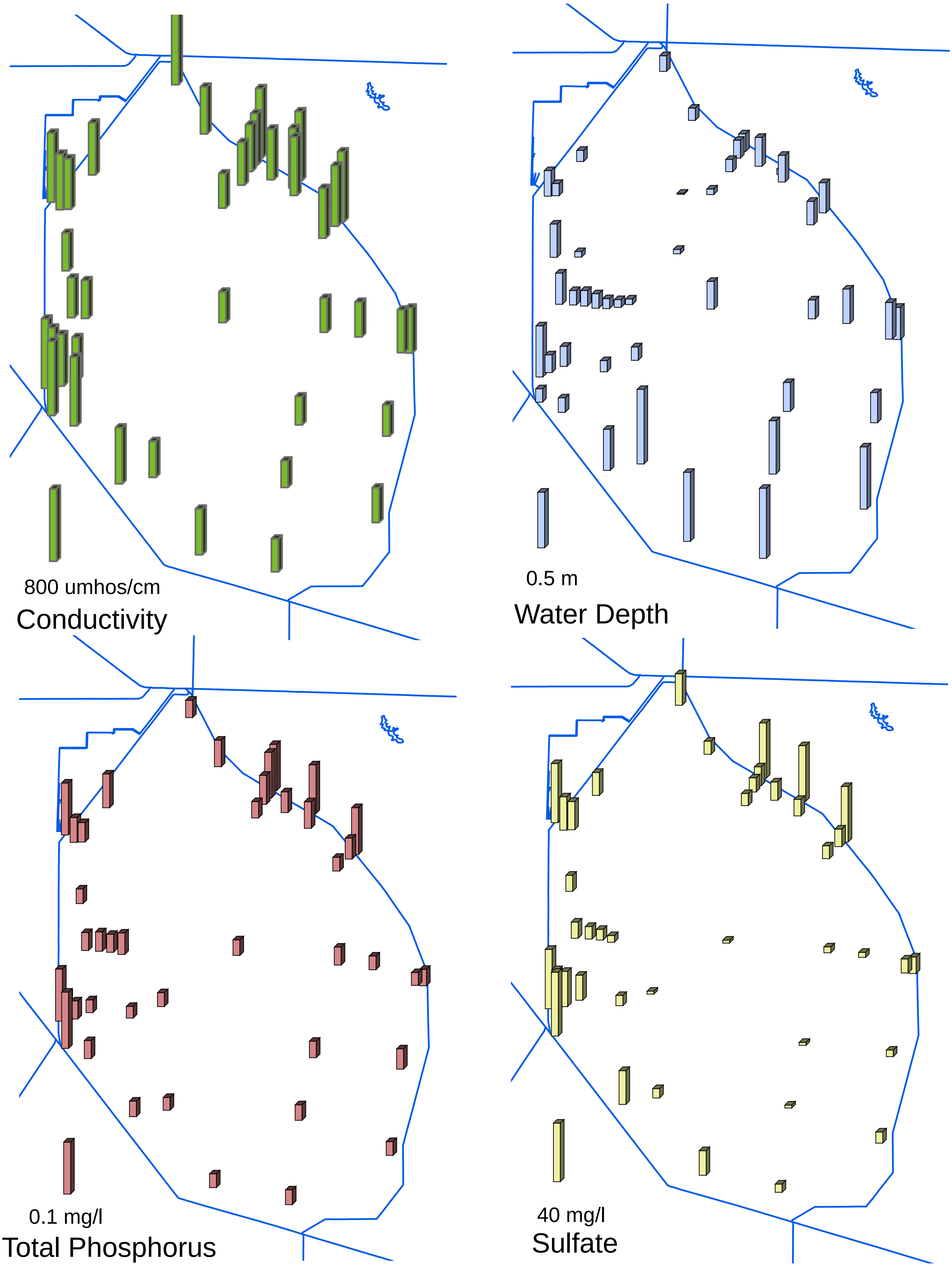
November 2004



January 2005



February 2005



Appendix F: Water Quality Data - Distance from Canal

Figure F-1: August 2004 plot of total phosphorus over distance along transects. Inset map is “central” transect. Stations and distances used for transects from Table 3.

Figure F-2: August 2004 plot of specific conductivity (top panel) and sulfate (bottom panel) over distance along transects. Inset map is “central” transect. Stations and distances used for transects from Table 3.

Figure F-3: September 2004 plot of total phosphorus over distance along transects. Inset map is “central” transect. Stations and distances used for transects from Table 3.

Figure F-4: September 2004 plot of specific conductivity (top panel) and sulfate (bottom panel) over distance along transects. Inset map is “central” transect. Stations and distances used for transects from Table 3.

Figure F-5: October 2004 plot of total phosphorus over distance along transects. Inset map is “central” transect. Stations and distances used for transects from Table 3.

Figure F-6: October 2004 plot of specific conductivity (top panel) and sulfate (bottom panel) over distance along transects. Inset map is “central” transect. Stations and distances used for transects from Table 3.

Figure F-7: November 2004 plot of total phosphorus over distance along transects. Inset map is “central” transect. Stations and distances used for transects from Table 3.

Figure F-8: November 2004 plot of specific conductivity (top panel) and sulfate (bottom panel) over distance along transects. Inset map is “central” transect. Stations and distances used for transects from Table 3.

Figure F-9: December 2004 plot of total phosphorus over distance along transects. Inset map is “central” transect. Stations and distances used for transects from Table 3.

Figure F-10: December 2004 plot of specific conductivity (top panel) and sulfate (bottom panel) over distance along transects. Inset map is “central” transect. Stations and distances used for transects from Table 3.

Figure F-11: January 2005 plot of total phosphorus over distance along transects. Inset map is “central” transect. Stations and distances used for transects from Table 3.

Figure F-12: January 2005 plot of specific conductivity (top panel) and sulfate (bottom panel) over distance along transects. Inset map is “central” transect. Stations and distances used for transects from Table 3.

Figure F-13: February 2005 plot of total phosphorus over distance along transects. Inset map is "central" transect. Stations and distances used for transects from Table 3.

Figure F-14: February 2005 plot of specific conductivity (top panel) and sulfate (bottom panel) over distance along transects. Inset map is "central" transect. Stations and distances used for transects from Table 3.

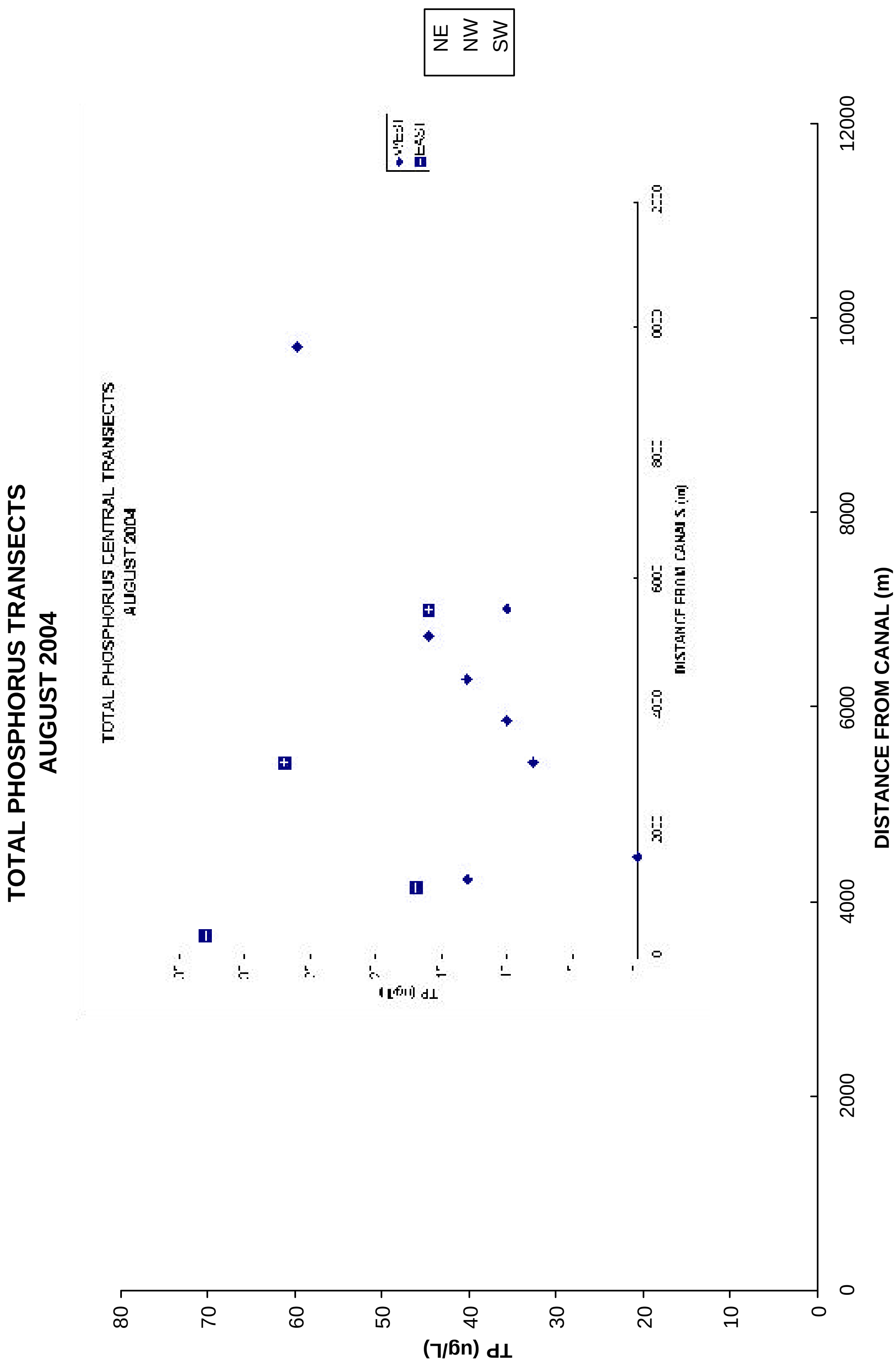
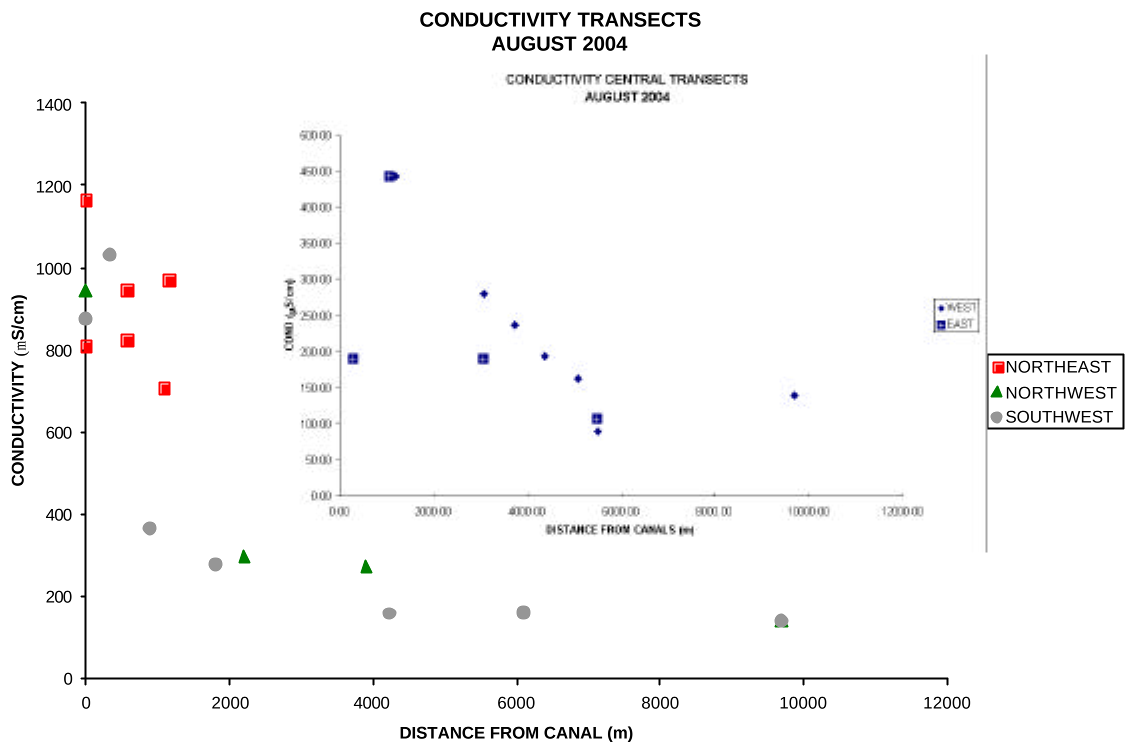


Figure F-1: August 2004 Total Phosphorus.



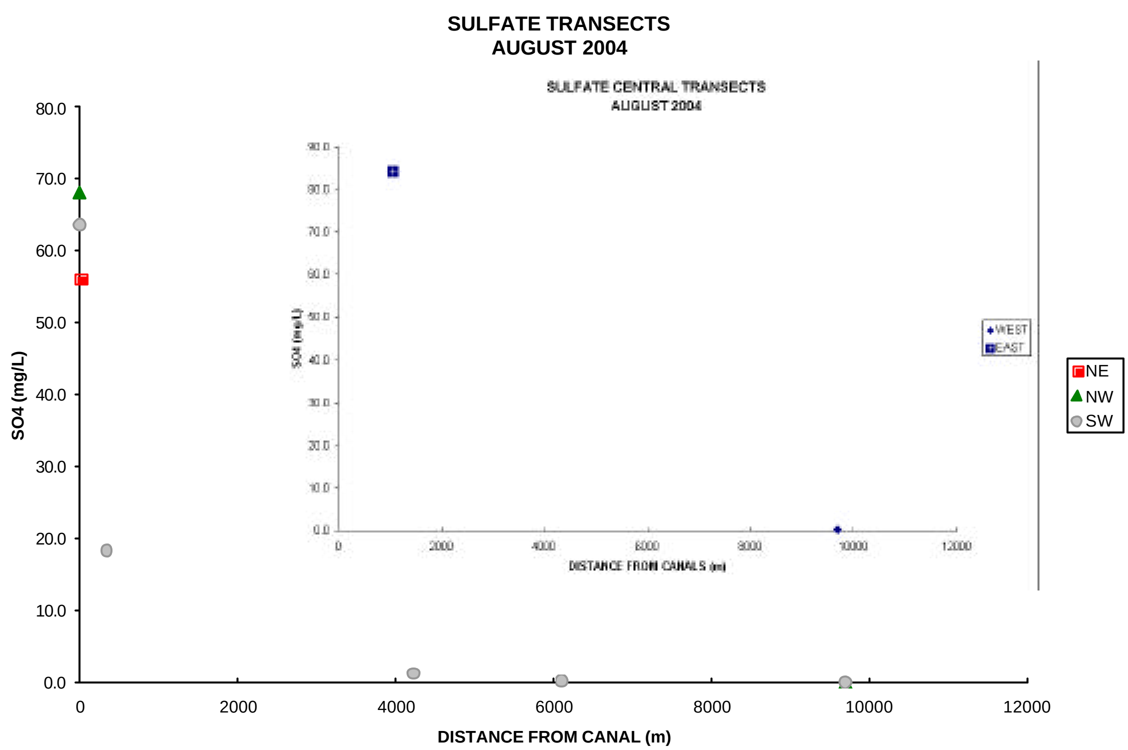


Figure F-2: August 2004. Top panel – specific conductivity. Bottom panel – sulfate.

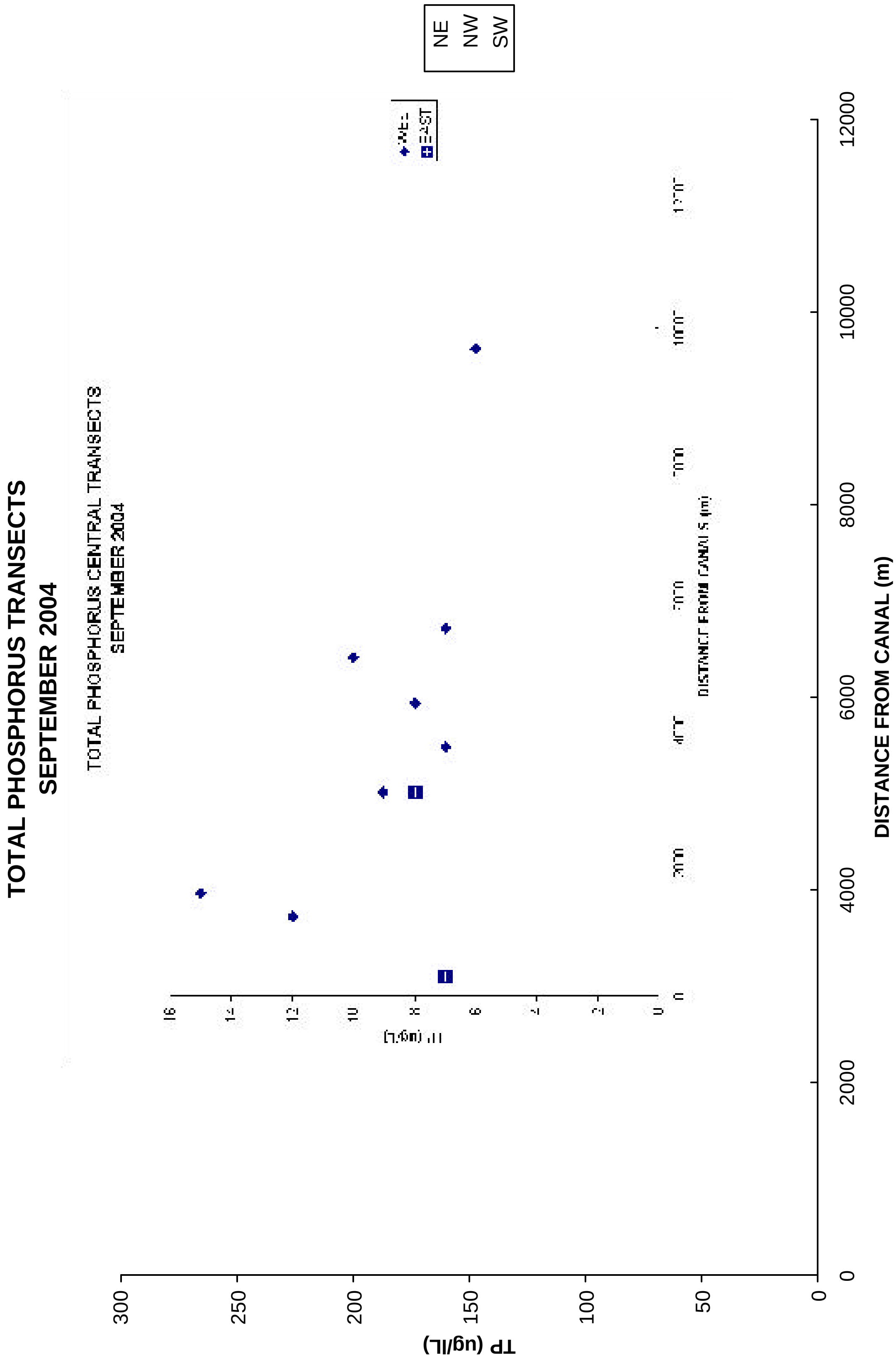


Figure F-3: September 2004 Total Phosphorus.

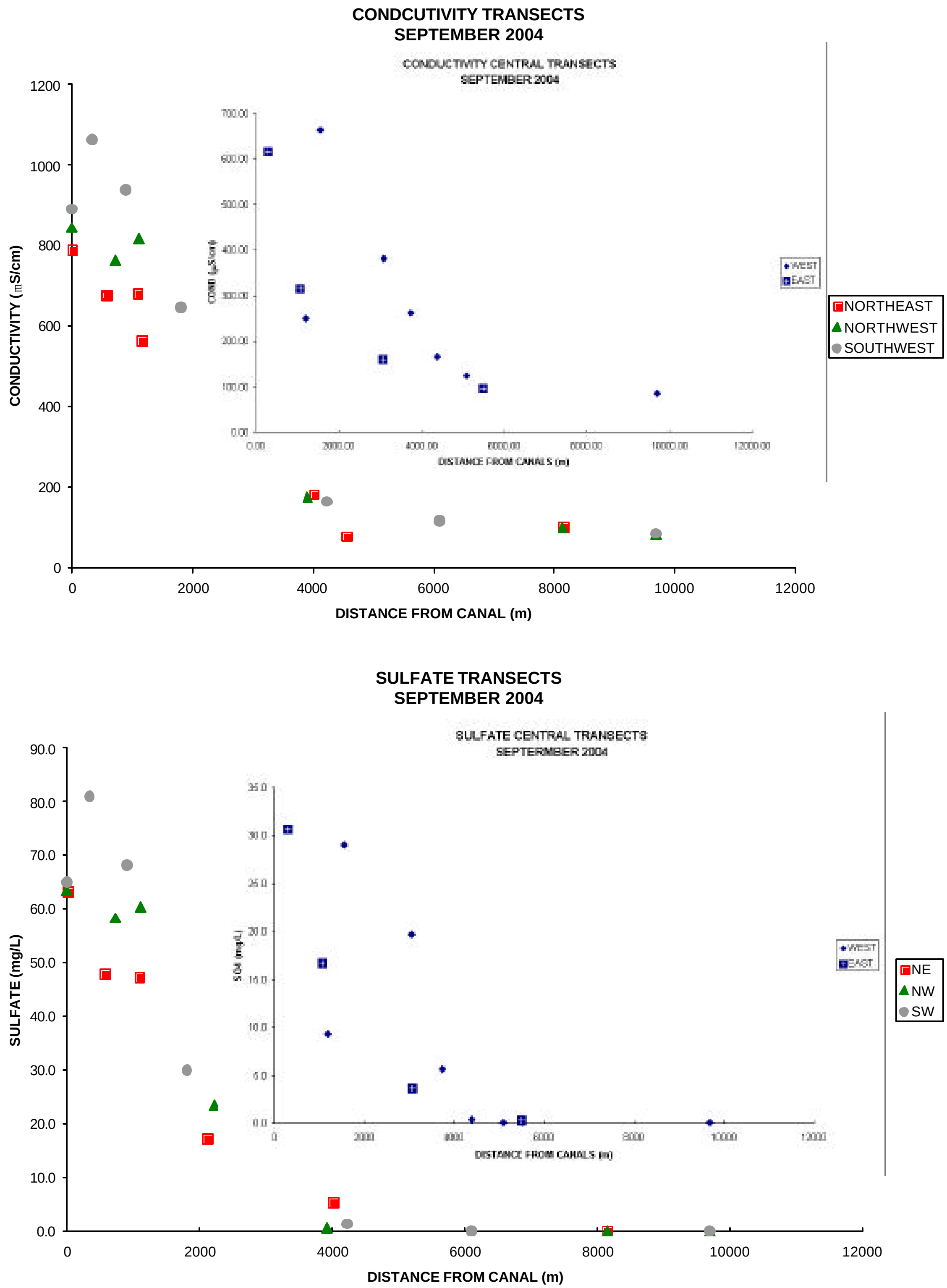


Figure F-4: September 2004. Top panel – specific conductivity. Bottom panel – sulfate.

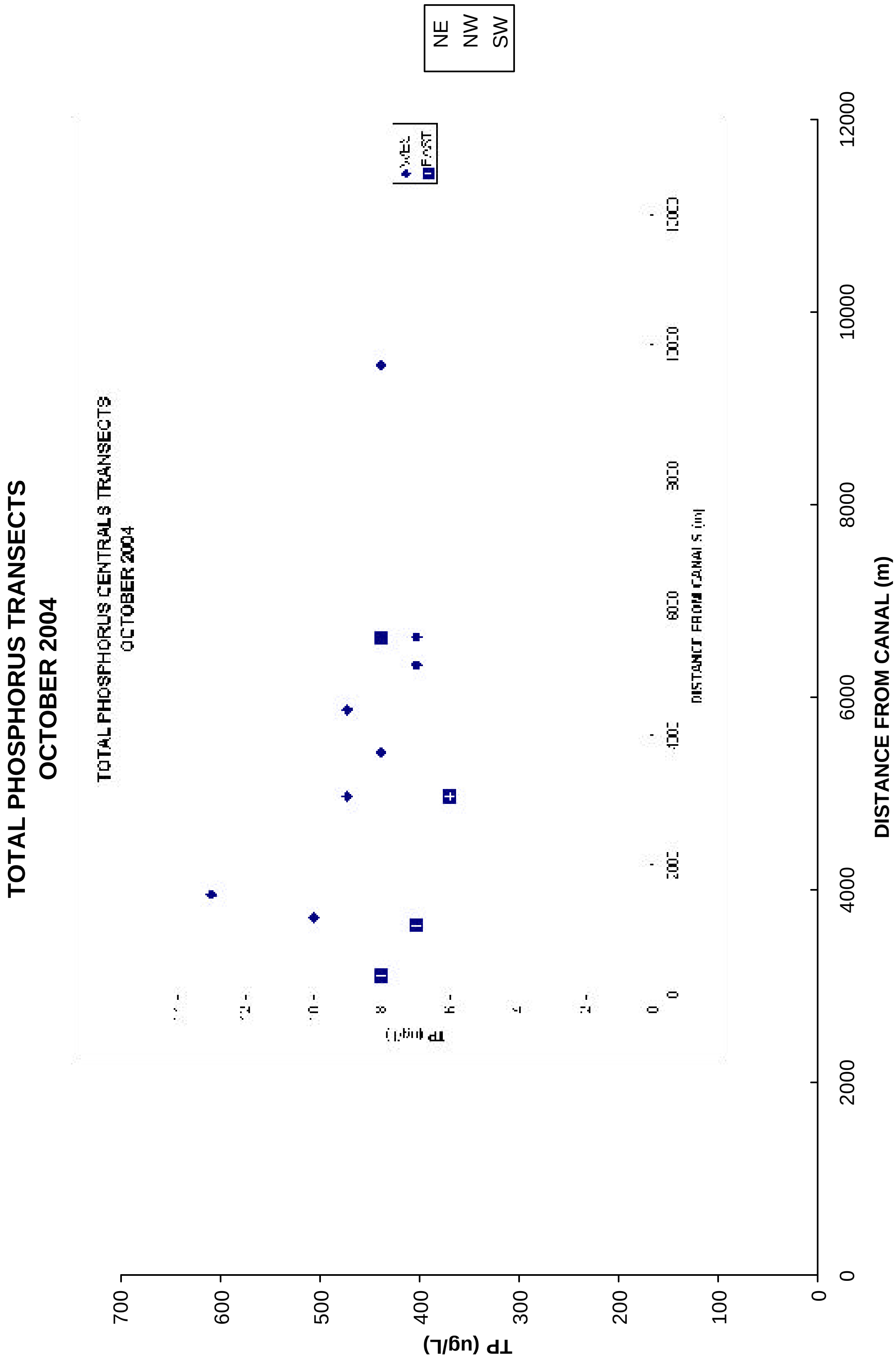


Figure F-13: October 2004 Total Phosphorus.

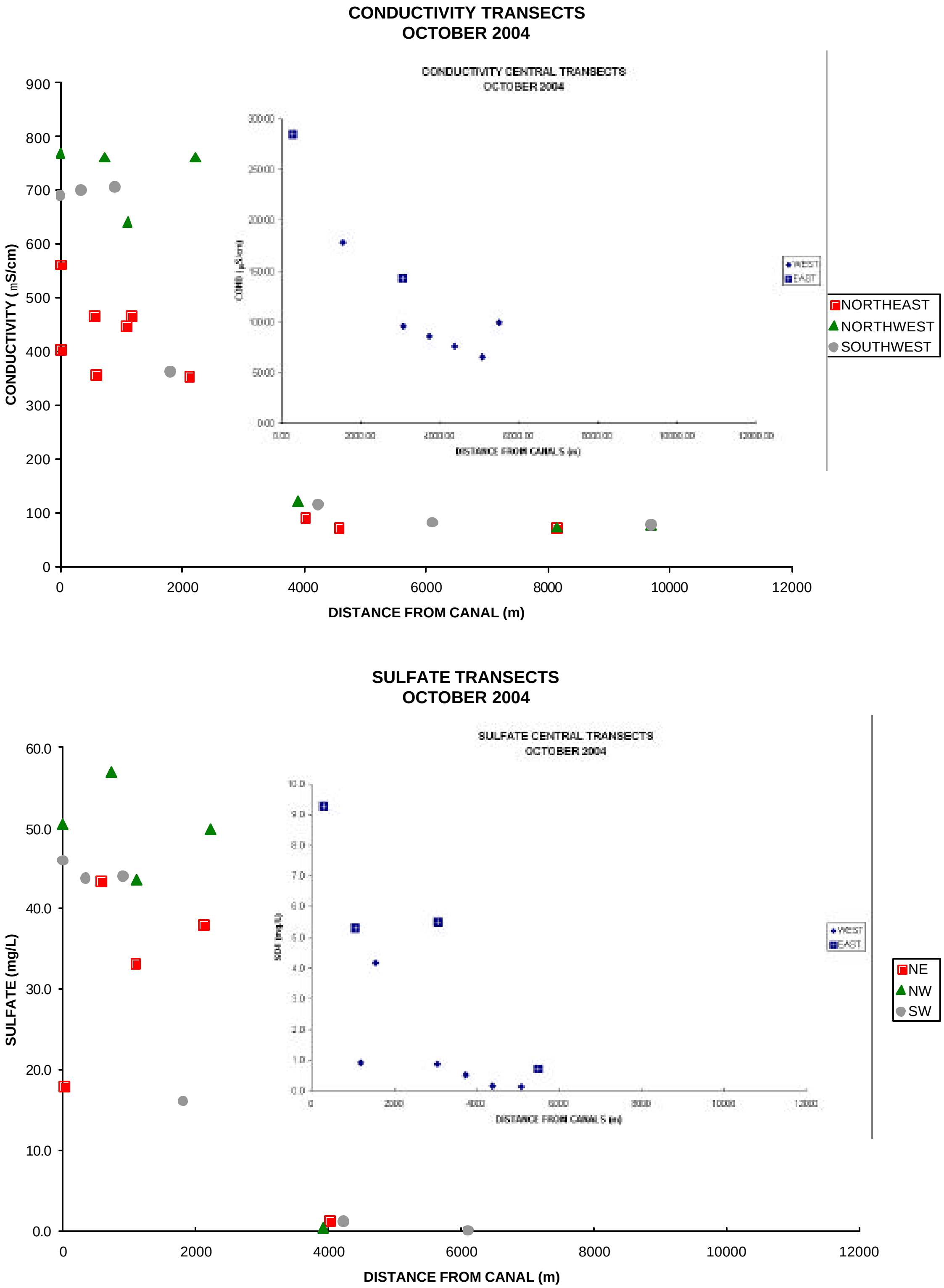


Figure F-6: October 2004. Top panel – specific conductivity. Bottom panel – sulfate.

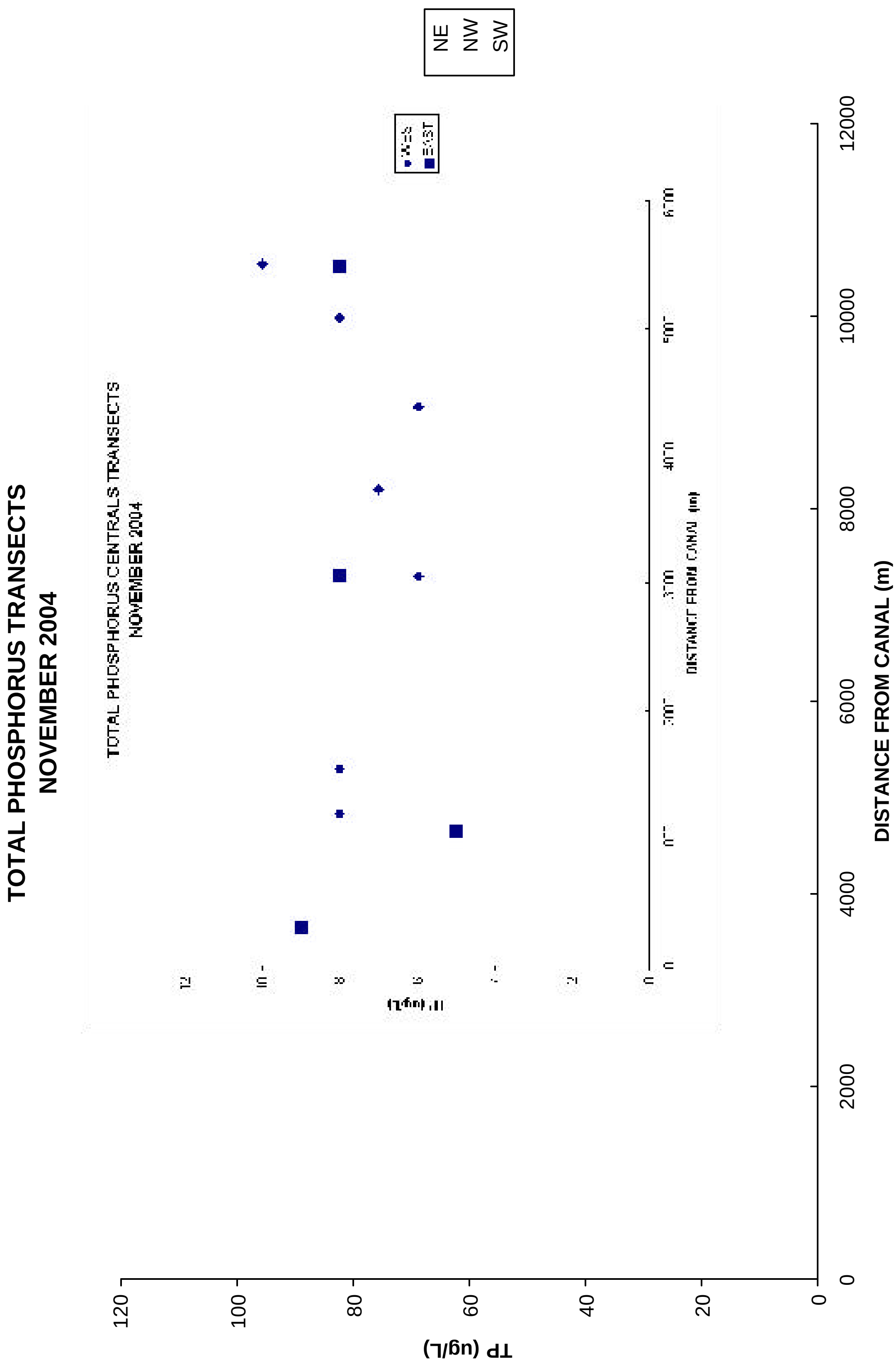
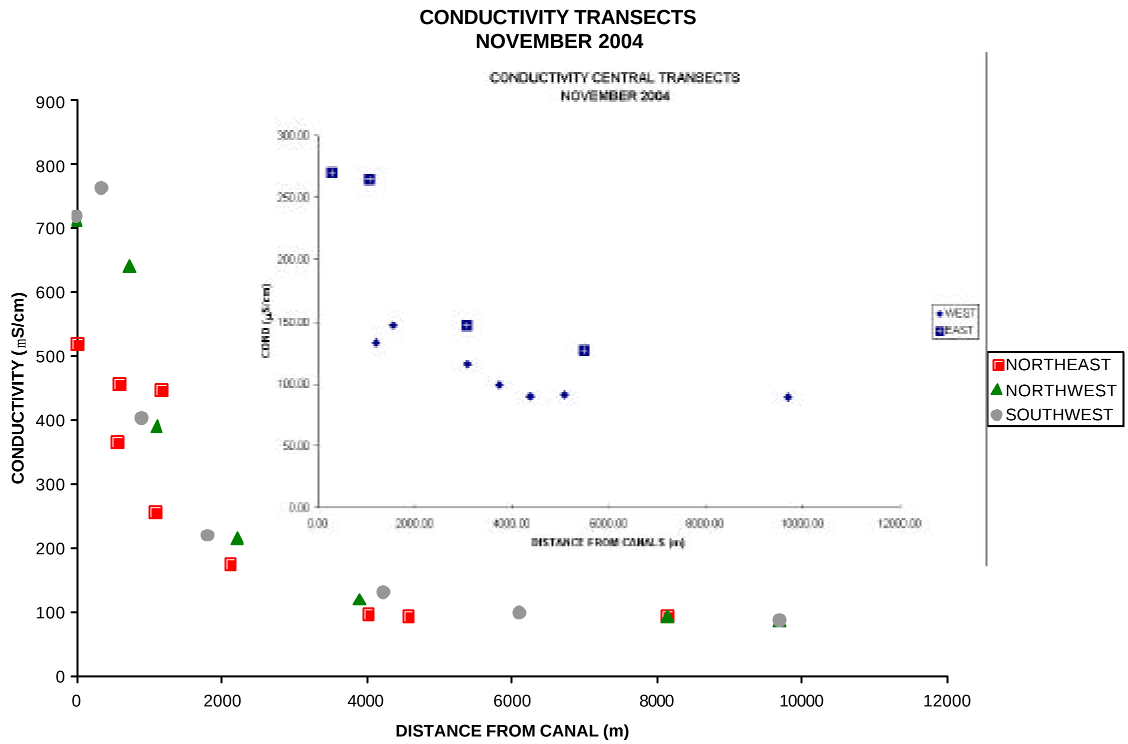


Figure F-7: November 2004 Total Phosphorus.



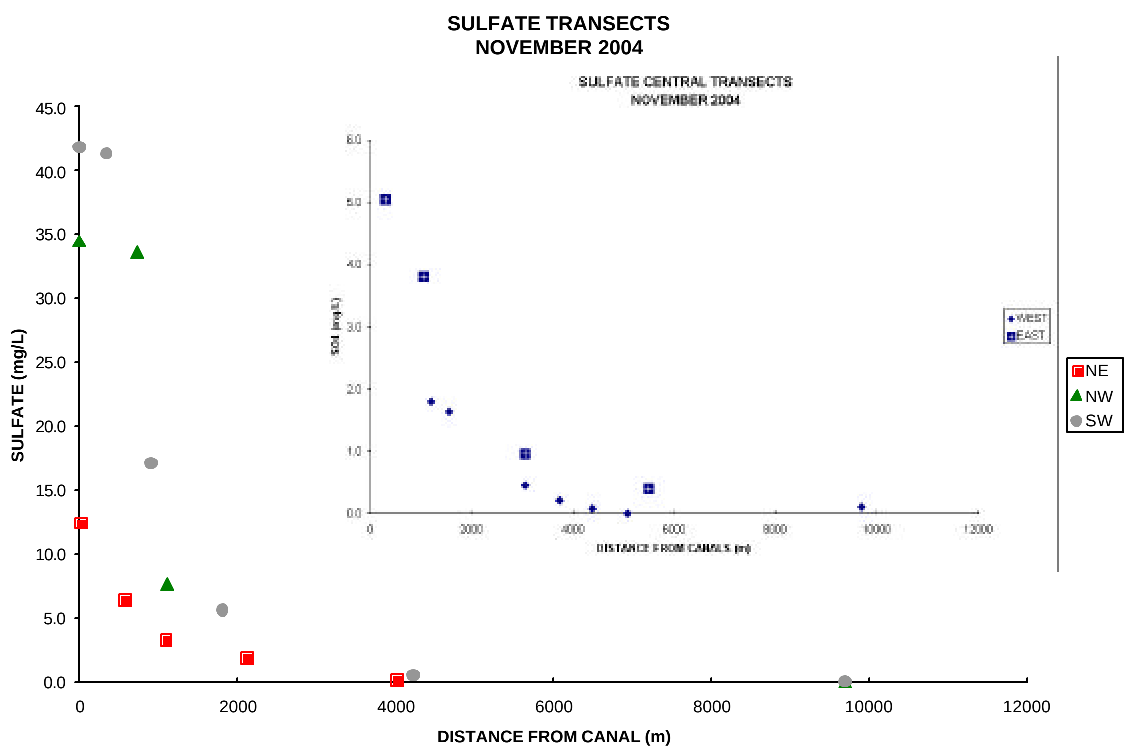


Figure F-8: November 2004. Top panel – specific conductivity. Bottom panel – sulfate.

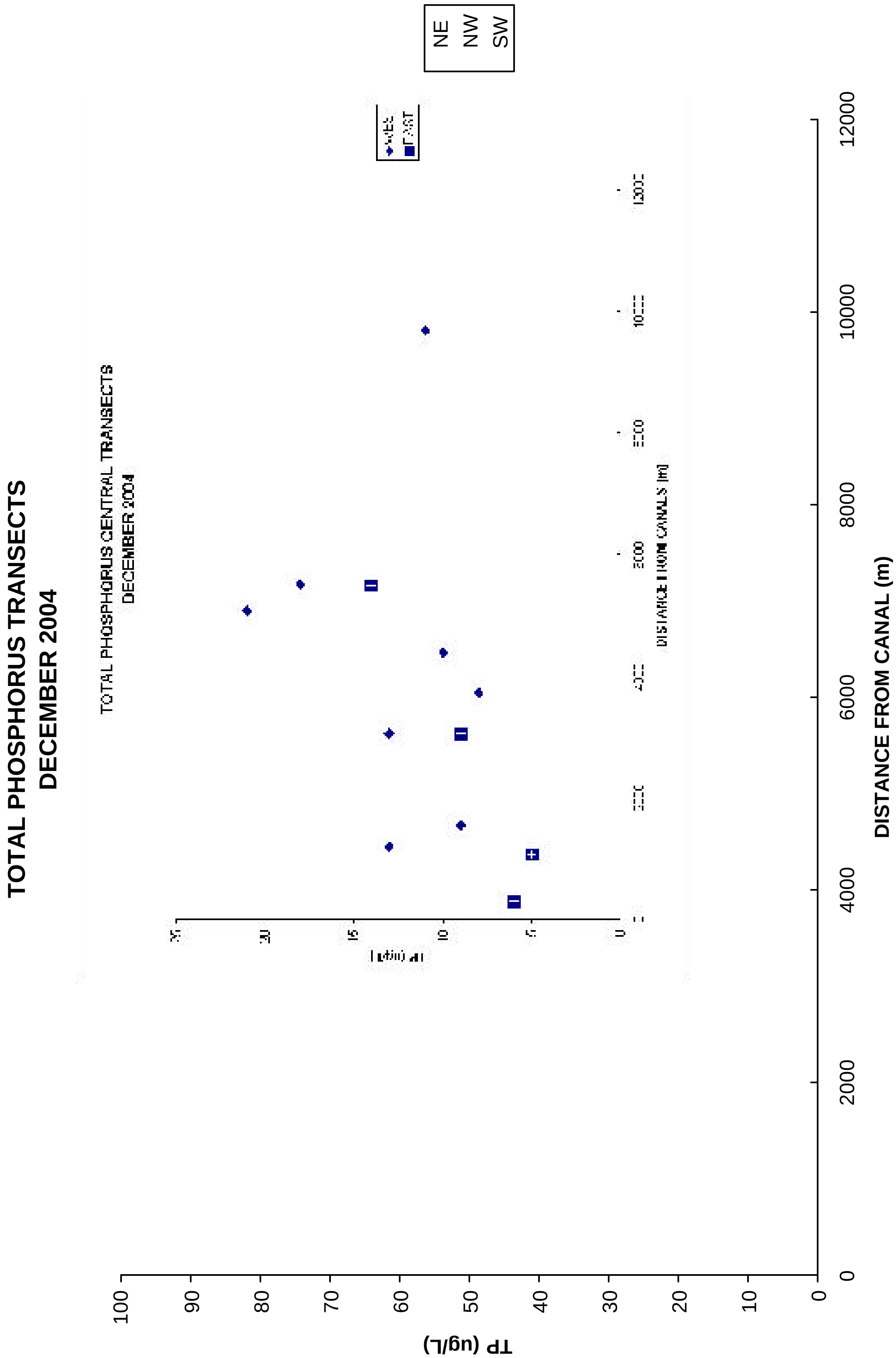


Figure F-9: December 2004 Total Phosphorus.

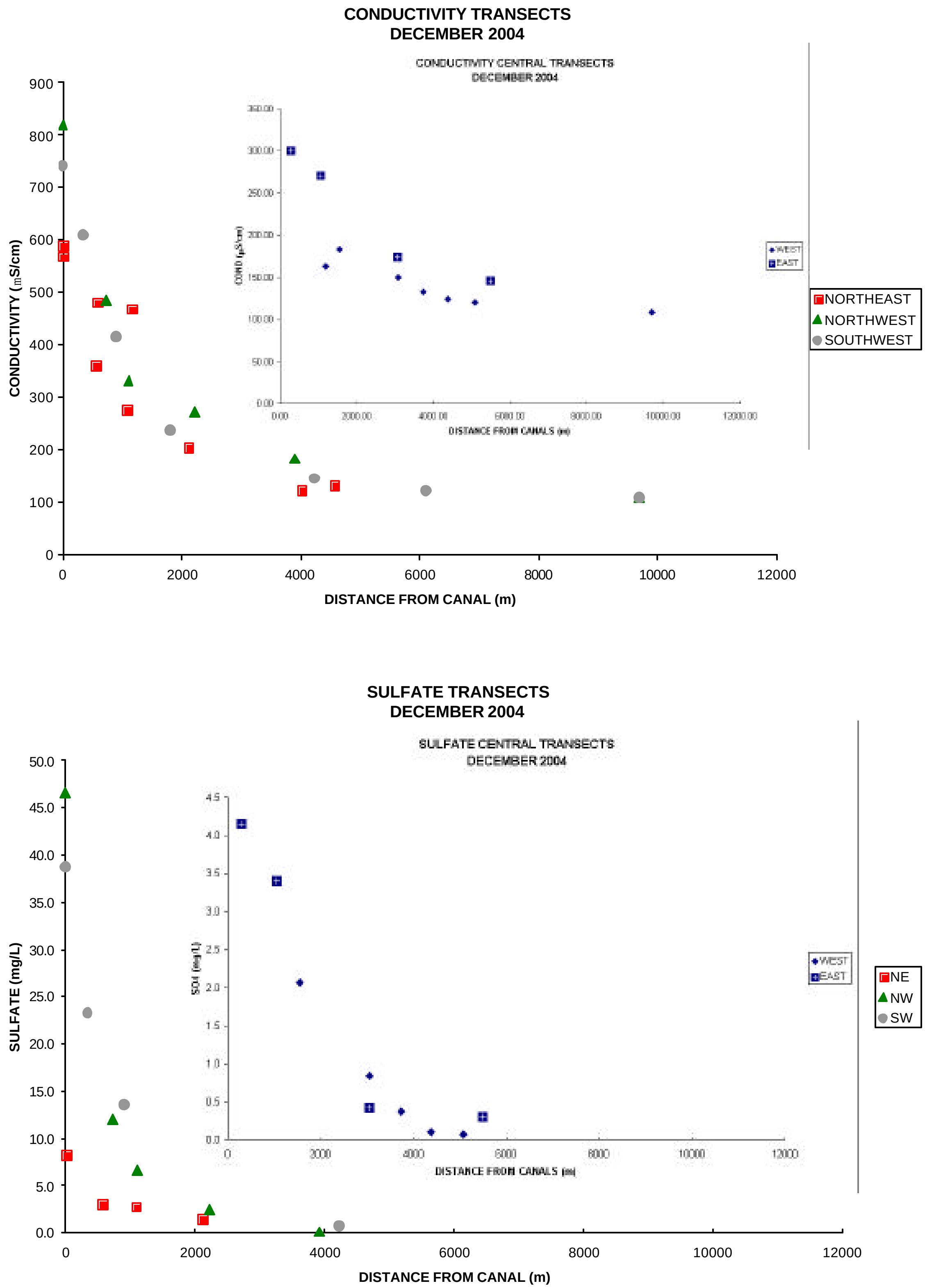


Figure F-10: December 2004. Top panel – specific conductivity. Bottom panel – sulfate.

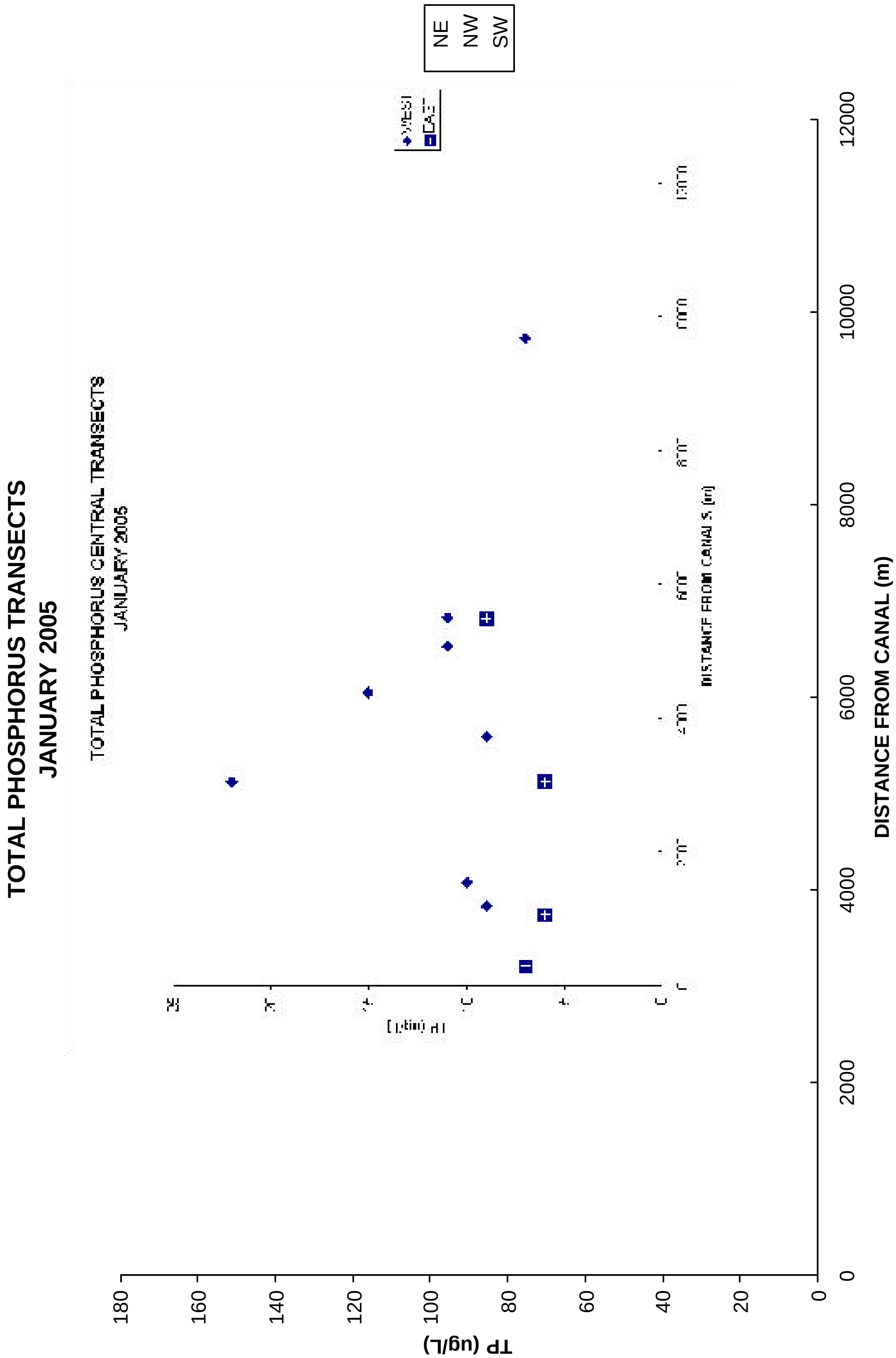
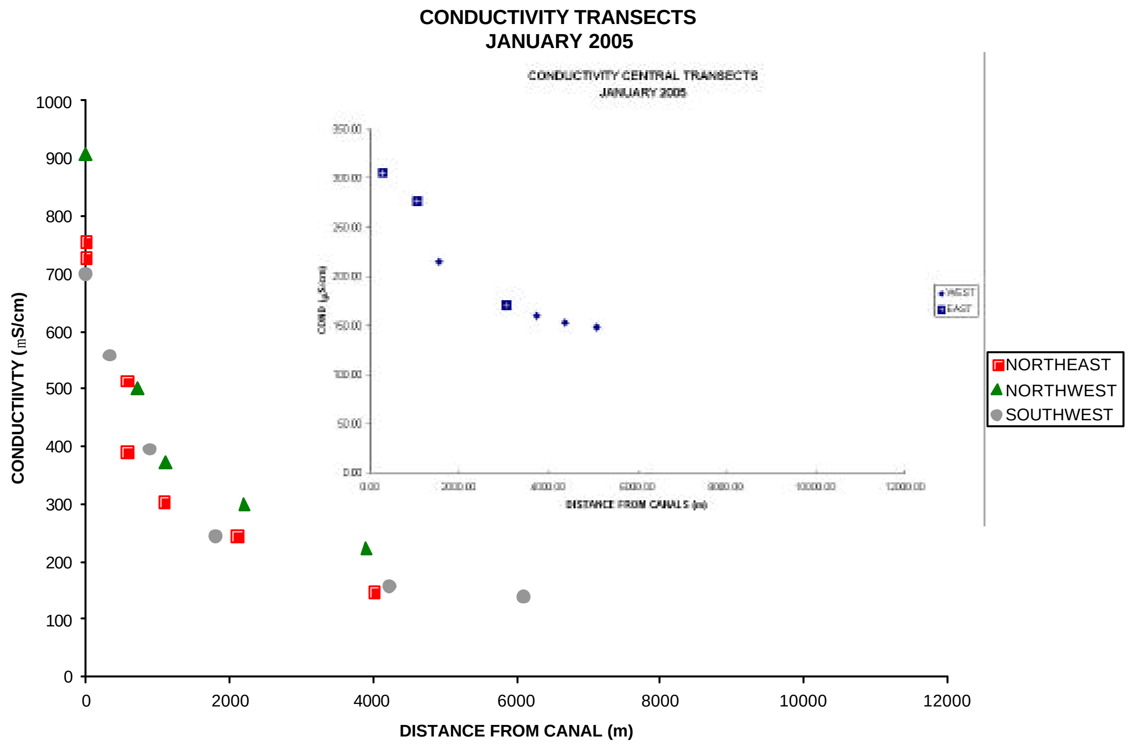


Figure F-11: January 2005 Total Phosphorus.



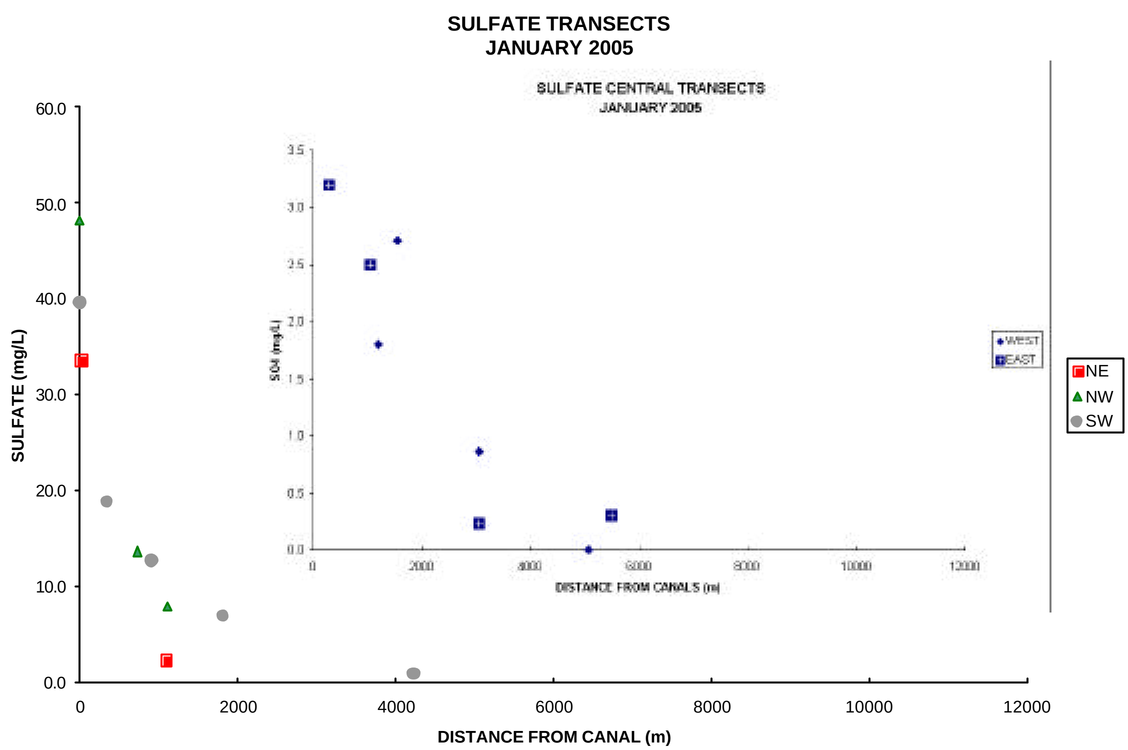


Figure F-12: January 2005. Top panel – specific conductivity. Bottom panel – sulfate.

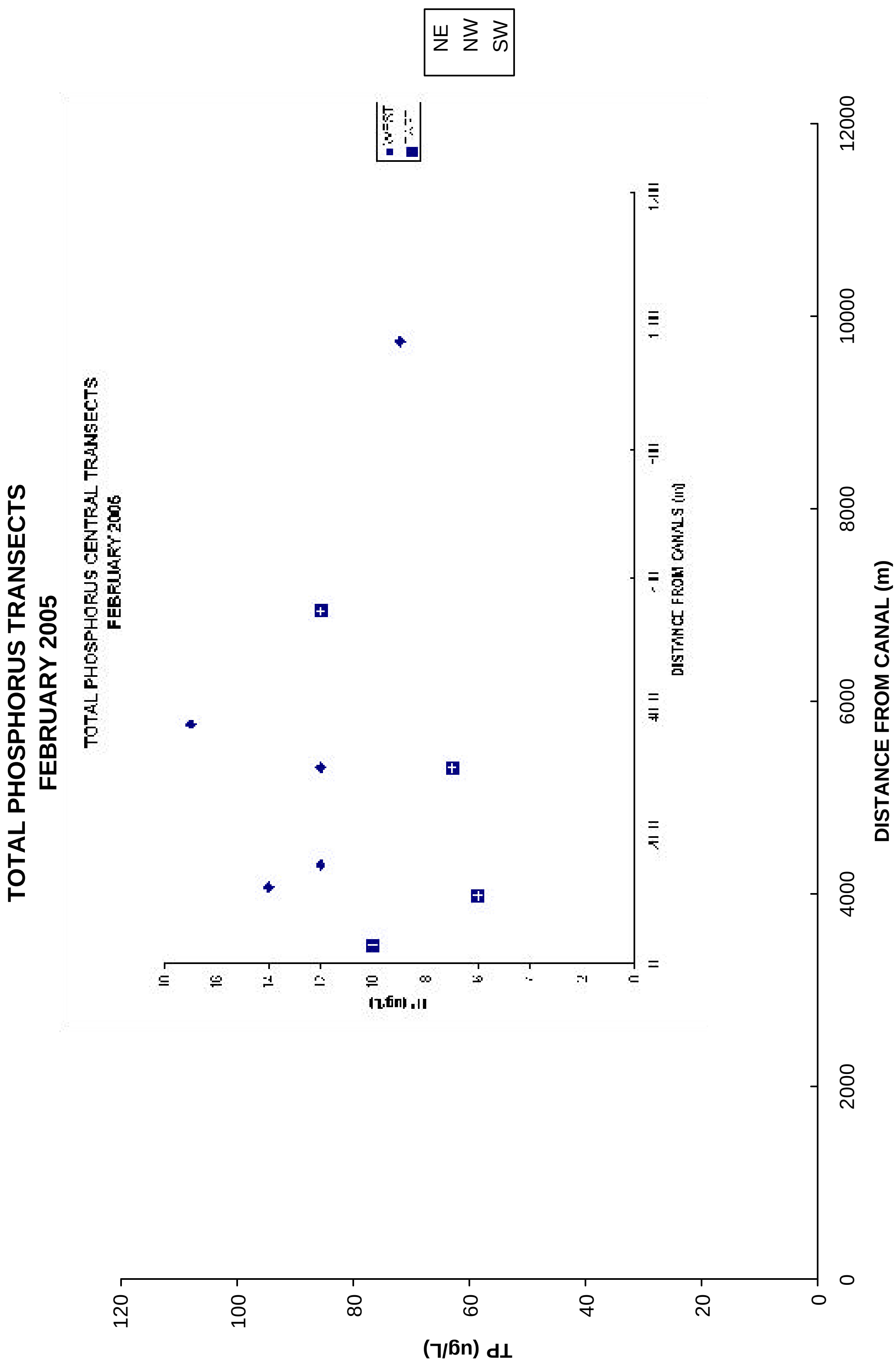


Figure F-13: February 2005 Total Phosphorus.

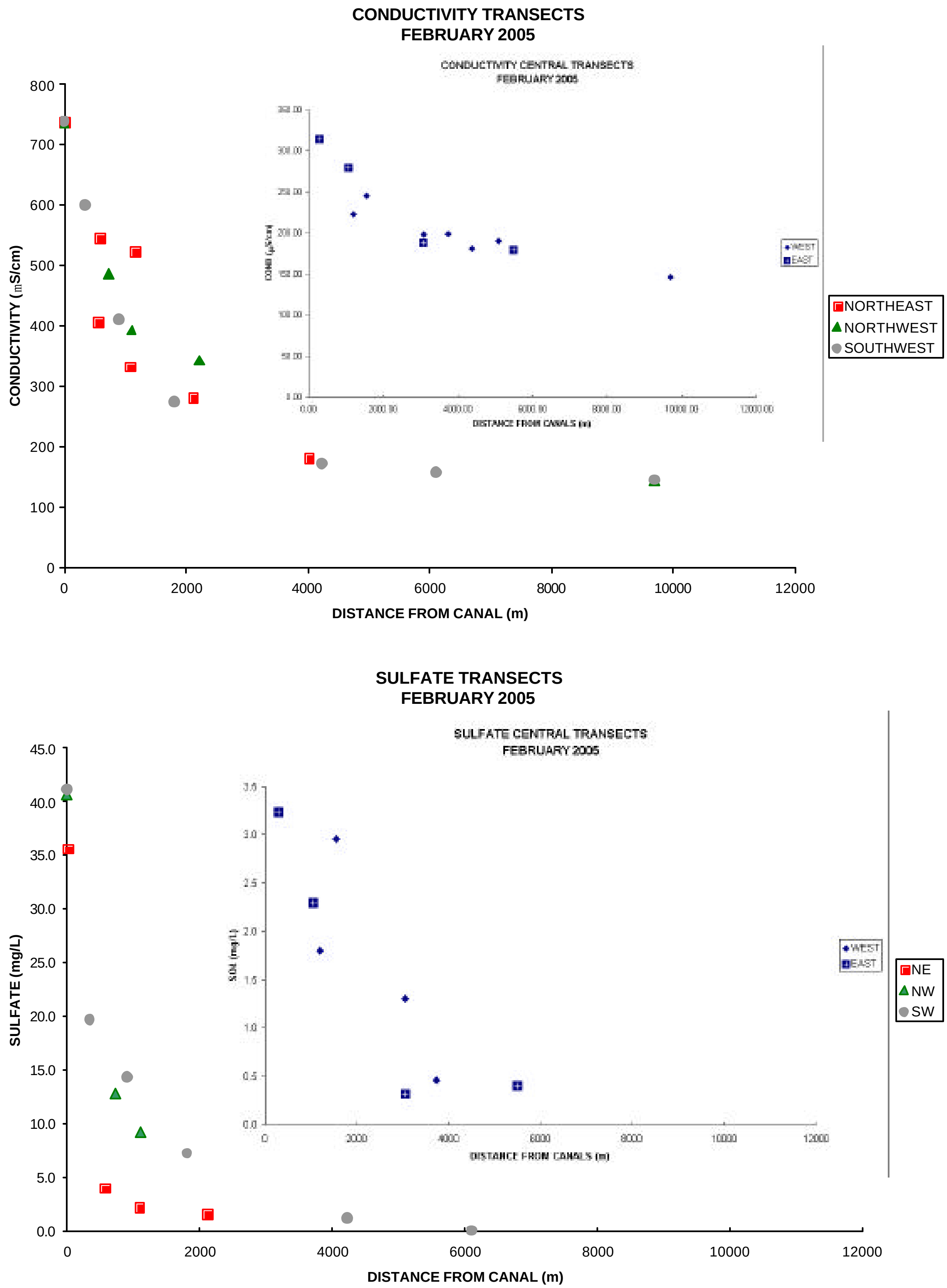


Figure F-14: February 2005. Top panel – specific conductivity. Bottom panel – sulfate.