Appendix 3-1: Annual Permit Report for the Everglades Stormwater Treatment Areas

Permit Report (May 1, 2011–April 30, 2012)

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SUMMARY

As part of Everglades restoration, the construction and operation of large freshwater treatment wetlands are mandated by the Everglades Forever Act (EFA) (Chapter 373.4592, Florida Statutes). These wetlands, known as the Everglades Stormwater Treatment Areas (STAs), have been constructed as part of the Everglades water quality restoration efforts (www.sfwmd.gov/sta). The total area of the STAs including infrastructure components is around 65,000 acres, with approximately 45,000 acres of effective treatment area currently operational. An additional 12,000 acres of treatment area have been completed in Compartments B and C. For this reporting period, the South Florida Water Management District (SFWMD or District) was not able to operate these expansion areas until the issuance of operating permits by the Florida Department of Environmental Protection (FDEP). Collectively, the STAs have been constructed south of Lake Okeechobee to remove excess total phosphorus (TP) from surface waters prior to entering the Everglades Protection Area (EPA) (**Figure 1**).

The Everglades STAs [STA-1 East (STA-1E), STA-1 West (STA-1W), STA-2, STA-3/4, STA-5, and STA-6] (**Figure 2**) operate pursuant to EFA and National Pollutant Discharge Elimination System (NPDES) permits and their associated Administrative Orders (AOs). This appendix serves as the reporting mechanism for requirements contained in those permits and AOs for the STAs during Water Year 2012 (WY2012) (May 1, 2011–April 30, 2012). The detailed annual report for the Everglades STAs is presented in this appendix and Volume I, Chapter 5.

Based on FDEP permit reporting guidelines, **Tables 1** through **6** list key permit-related information associated with this report for the Everglades STAs. **Table 7** lists the attachments included with this report. In Attachment A, Tables A-1 through A-4 list the specific pages, tables, graphs, and attachments where project status and annual reporting requirements are addressed in Volumes I and III for the permit-specific conditions of each STA.

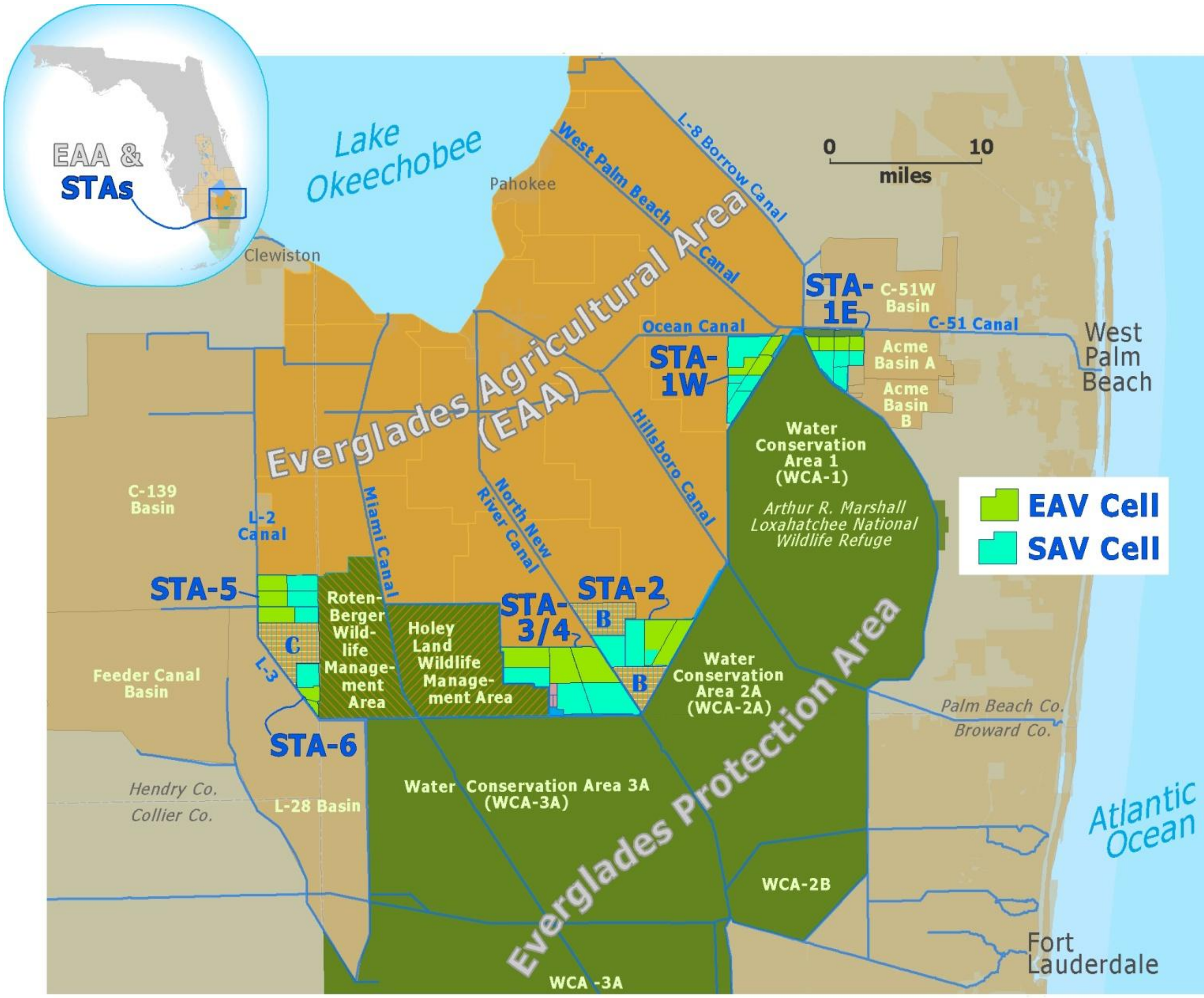

Figure 1. Location of the Everglades Stormwater Treatment Areas (STAs) and the dominant vegetation community for each STA treatment cell [i.e., emergent aquatic vegetation (EAV) or submerged aquatic vegetation (SAV)] [Note: “STA-1E” = STA-1 East; “STA-1W” = STA-1 West].

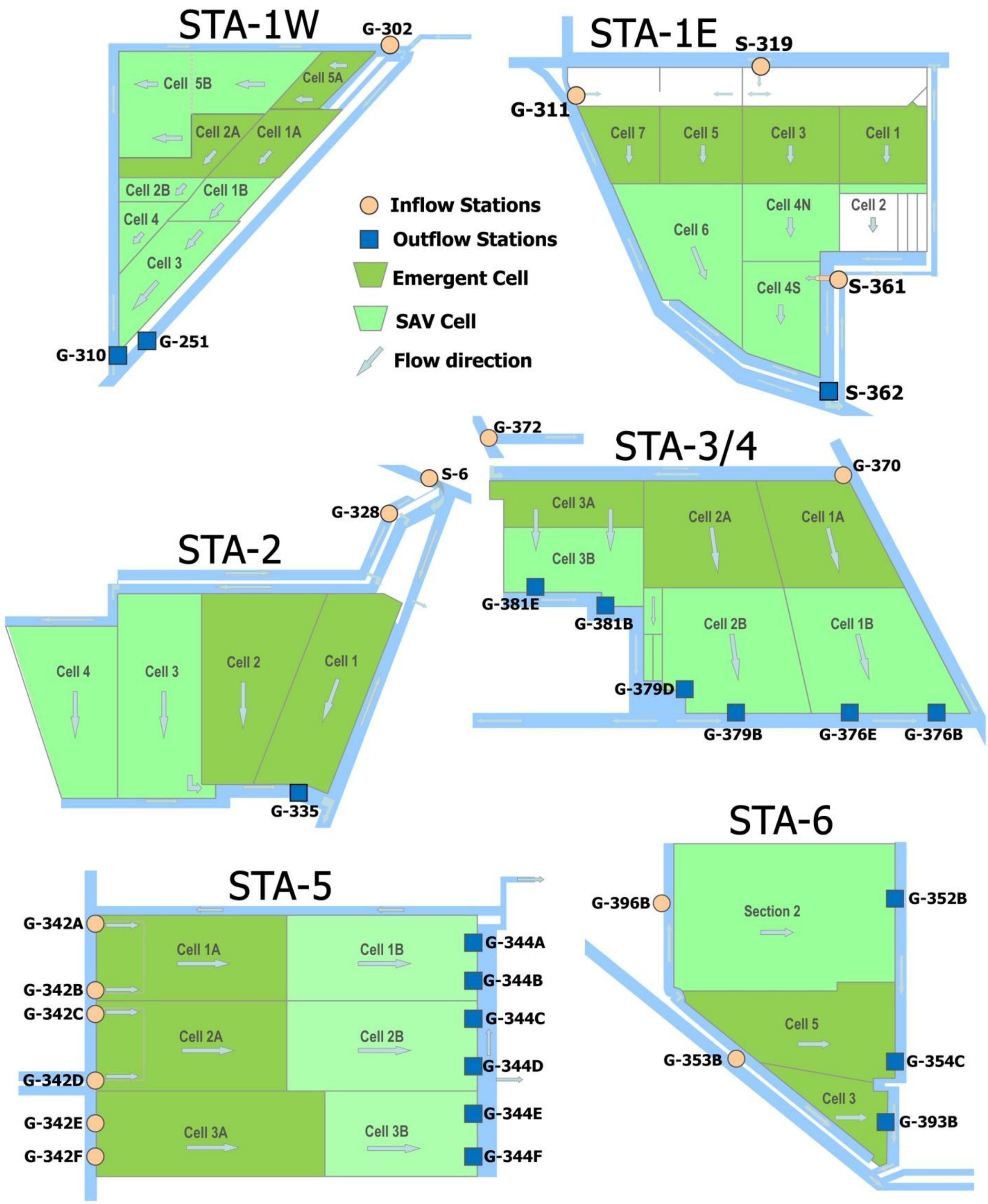

Figure 2. STA schematics showing configurations of the treatment cells, flow direction, dominant vegetation type, and locations of permitted inflow and outflow stations.

Table 1. Key permit-related information for Stormwater Treatment Area (STA) 1 East (STA-1E) [Note: EFA – Everglades Forever Act; NPDES – National Pollution Discharge Elimination System].

Project Name	STA-1E
Permit Numbers	0279449 (EFA) FL0304549 (NPDES) Administrative Order-009 (NPDES)
Issue and Expiration Date	Issue: November 16, 2007 Expiration: November 15, 2012 (EFA) Issue: August 30, 2005 Expiration: August 30, 2010 (NPDES); NPDES permit is administratively extended
Project Phase	Stabilization
Permit Condition Requiring Annual Monitoring Report	Specific Condition 30 A-E
Relevant Period of Record	May 1, 2011–April 30, 2012
Report Generator	Guy Germain ggermain@sfwmd.gov 561-682-6732
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Table 2. Key permit-related information for STA-1 West (STA-1W).

Project Name	STA-1W
Permit Numbers	0279499 (EFA) FL0177962 (NPDES) Administrative Order-001(NPDES)
Issue and Expiration Date	Issue: November 16, 2007 Expiration: November 15, 2012 (EFA) Issue: May 11, 1999 Expiration: May 10, 2004 (NPDES); NPDES permit is administratively extended
Project Phase	Stabilization
Permit Condition Requiring Annual Monitoring Report	Specific Condition 30 A-E
Relevant Period of Record	May 1, 2011–April 30, 2012
Report Generator	Guy Germain ggermain@sfwmd.gov 561-682-6732
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Table 3. Key permit-related information for STA-2.

Project Name	STA-2
Permit Numbers	0126704 (EFA) FL0177946 (NPDES) Administrative Order-010 (EFA & NPDES)
Issue and Expiration Date	Issue: March 17, 2009 Expiration: March 17, 2014 (EFA) Issue: September 4, 2007 Expiration: September 4, 2012 (NPDES)
Project Phase	Stabilization
Permit Condition Requiring Annual Monitoring Report	Specific Condition 28 A-E
Relevant Period of Record	May 1, 2011–April 30, 2012
Report Generator	Guy Germain ggermain@sfwmd.gov 561-682-6732
Permit Coordinator	Holly Andreotta handreot@sfwmd.gov 561-682-6432

Table 4. Key permit-related information for STA-3/4.

Project Name	STA-3/4
Permit Numbers	0192895 (EFA) Administrative Order-008 (EFA) FL0300195 (NPDES) Administrative Order-007 (NPDES)
Issue and Expiration Date	Issue: January 9, 2004 Expiration: January 9, 2009 (EFA) Issue: January 9, 2004 Expiration: January 9, 2009 (NPDES); NPDES permit is administratively extended
Project Phase	Post-stabilization
Permit Condition Requiring Annual Monitoring Report	Specific Condition 30 A-F
Relevant Period of Record	May 1, 2011–April 30, 2012
Report Generator	Guy Germain ggermain@sfwmd.gov 561-682-6732
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Table 5. Key permit-related information for STA-5.

Project Name	STA-5
Permit Numbers	0131842 (EFA) FL0177954 (NPDES) Administrative Order-011 (EFA & NPDES)
Issue and Expiration Date	Issue: January 29, 2009 Expiration: January 29, 2014 (EFA) Issue: September 4, 2007 Expiration: September 4, 2012 (NPDES)
Project Phase	Stabilization
Permit Condition Requiring Annual Monitoring Report	Specific Condition 28 A-E
Relevant Period of Record	May 1, 2011–April 30, 2012
Report Generator	Guy Germain ggermain@sfwmd.gov 561-682-6732
Permit Coordinator	Holly Andreotta handreot@sfwmd.gov 561-682-6432

Table 6. Key permit-related information for STA-6.

Project Name	STA-6
Permit Numbers	0131842 (EFA) FL0473804 (NPDES) Administrative Order-011 (EFA) Administrative Order-012 (NPDES)
Issue and Expiration Date	Issue: January 29, 2009 Expiration: January 29, 2014 (EFA) Issue: September 4, 2007 Expiration: September 4, 2012 (NPDES)
Project Phase	Stabilization
Permit Condition Requiring Annual Monitoring Report	Specific Condition 28 A-E
Relevant Period of Record	May 1, 2011–April 30, 2012
Report Generator	Guy Germain ggermain@sfwmd.gov 561-682-6732
Permit Coordinator	Holly Andreotta handreot@sfwmd.gov 561-682-6432

Table 7. Attachments included with this report.

Attachment	Title
A	Specific Conditions and Cross-References
B	Supporting Information on Water Quality Data for the Everglades STAs and Downstream Transects for Water Year 2012
C	Annual Permit Compliance Monitoring Report for Mercury in the STAs
D	Rotenberger Wildlife Management Area Restoration and STA Downstream Transect Monitoring
E	STA Herbicide Application Summary for Water Year 2012

INTRODUCTION

In 1994 the Everglades Forever Act (EFA) authorized the Everglades Agricultural Area (EAA) Best Management Practices (BMPs) and the Everglades Stormwater Treatment Areas (STAs). As a major component of Everglades restoration, the STAs are intended to remove excess total phosphorus (TP) from surface waters prior to those waters entering the Everglades Protection Area (EPA). STAs are constructed wetlands that retain nutrients through several mechanisms including plant growth, accumulation of dead plant material in a layer of peat, settling and sorption, precipitation, and microbial activities.

This appendix reports on the permit compliance aspect of the Everglades STAs: STA-1 East (STA-1E), STA-1 West (STA-1W), STA-2, STA-3/4, STA-5, and STA-6 (see **Figures 1** and **2**). The STAs operate under EFA and National Pollutant Discharge Elimination System (NPDES) permits and Administrative Orders (AOs). AOs, issued with each of the STA permits, establish a schedule for achieving compliance with the permit interim effluent limits (IELs). Varying in size, configuration, and period of operation, the STAs are shallow freshwater marshes divided into treatment cells by interior levees. Water flows through these systems via water control structures, such as pump stations, gates, or culverts. The dominant plant communities in the treatment cells are broadly classified as emergent aquatic vegetation (EAV), submerged aquatic vegetation (SAV), and floating aquatic vegetation (FAV). Both native and nonnative vegetation play a role in phosphorus removal in the STAs. Vegetation management activities include control of undesirable species that impact hydraulics.

This appendix summarizes STA performance during Water Year 2012 (WY2012) (May 1, 2011–April 30, 2012) to fulfill various permit reporting mandates and provides an evaluation of TP compliance with the IEL and other water quality parameters, including dissolved oxygen (DO), mercury (Hg), and other nutrients and major ions. Attachments A through E provide supplementary information for this report (**Table 7**).

It should be noted that new EFA and NPDES permits (Permit Nos. 0311207 and FL0778451, respectively) were issued for all the Everglades STAs on September 10, 2012. It is anticipated that associated changes and new requirements will be incorporated in the 2014 SFER.

STA PERFORMANCE

This section presents the annual data required by STA operating permits, AOs, and downstream monitoring. It also includes STA discharge monitoring in the downstream areas. A cross-reference listing for the permit reporting requirements is presented in Attachment A.

PERMIT STATUS AND REPORTING REQUIREMENTS

Permit Compliance for Phosphorus

The STAs operate under EFA and NPDES permits and AOs issued over a phased implementation schedule (**Table 8**). As part of the permit compliance for phosphorus, annual STA performance is evaluated in comparison to interim effluent limits and operational envelopes. The derivation of the IELs is found in the permit technical support documents, which also identify factors that may impact flows and TP loads associated with the treatment system. IELs are different concentrations for each STA, as defined by their respective operating permits, and are adjusted based on the amount of effective treatment area in operation for each STA (the effective treatment area of an STA may be temporarily reduced due to flow-ways being taken offline for rehabilitation or construction activities) (see Table 5-2 in Volume I, Chapter 5 for more information about the flow-way operational status of the STAs). Several factors are taken into account when determining the IEL compliance status of an STA. These factors include (1) the operational phase of the STA, (2) rainfall conditions, and (3) rehabilitation or major construction activities. The operating permits also take into consideration that natural systems undergo maturity changes by categorizing STA operations into phases that depend on development and performance (**Table 9**). The permits for STA-1E, STA-1W, STA-2, STA-5, and STA-6 describe three operational phases: start-up, stabilization, and routine operations. The three phases for STA-3/4 are the same except that routine operation is referred to as post-stabilization. During the initial start-up phase of a new treatment cell or new flow-way, phosphorus concentrations within the facility are monitored to demonstrate that the project is achieving a net reduction in phosphorus. Start-up phase operation and monitoring within the treatment area consists of the following criteria: (1) manage water depths in the treatment cells to facilitate the recruitment of marsh vegetation in accordance with the operations plan, (2) monitor TP weekly at the upstream side of a flow-way's inflow and outflow structures, (3) demonstrate that an individual flow-way or treatment cell, over a four-week period, is reducing TP[1], and (4) discharge operations. Discharge operations, from an individual flow-way or treatment cell that has passed the phosphorus start-up test described in item 3, may commence once initial start-up phase documentation and all supporting data and analyses are submitted to the Florida Department of Environmental Protection (FDEP). For flow-ways or treatment cells that have not passed this test within six months after issuance of the permit, status updates regarding progress toward achieving and identifying strategies and timelines to achieve this requirement are necessary. The fifth criterion for start-up phase operations is referred to as initiation of individual flow-way (stabilization and routine operation) discharges and monitoring. Once flow-through discharges from a flow-way begin, routine water quality monitoring is initiated consistent with the monitoring program described in the permit.

[1] This net reduction is deemed to occur when the four-week geometric mean TP water column concentration from samples collected at the applicable outflow structures is less than the four-week geometric mean TP water column concentration collected at the applicable inflow structure(s).

Table 8. Current permit/Administrative Order (AO) reporting requirements used during Water Year 2012 (WY2012) (May 1, 2011–April 30, 2012) to assess STA phosphorus removal performance for EFA and NPDES permits and AOs.[1]

STA Permit /AO Reporting Requirements	
STA-1E Permit Phase: All Treatment Cells are in Stabilization Phase	
EFA permit 0279449-001-EM (issued November 16, 2007) is in effect.	The interim effluent limit (IEL) is applied as the annual phosphorus limitation for discharges under the current permit.
NPDES permit FL0304549 and AO-009-EV are in effect. Both were issued August 30, 2005.	These permits have the annual limit of 68 parts per billion (ppb) for each water year and a not-to-exceed limit of 50 ppb for three or more consecutive water years.
STA-1W Permit Phase: All Treatment Cells are in Stabilization Phase	
EFA permit 0279449-001-EM (issued November 16, 2007) is in effect.	The IEL is applied as the annual phosphorus limitation for discharges under the current permit.
NPDES permit FL0177962-001 and AO-001-EV are in effect. Both were issued May 11, 1999	The NPDES and AO permits have an annual limit of 76 ppb for each water year and a not-to-exceed limit of 50 ppb for three or more consecutive water years.
STA-2 Permit Phase: Cells 1–3 are in Stabilization Phase	
EFA permit 0126704-008-EM (issued March 17, 2009), NPDES permit FL0177946 (issued September 4, 2007), and AO-010-EV (issued March 17, 2009) are in effect. Note: AO authorizes conditional operations of the existing facility (Cells 1–3) and construction of Compartment B.	The IEL is applied as the annual phosphorus limitation for discharges under the current permit.
STA-3/4 Permit Phase: Post-Stabilization Phase (according to 2004-Issued Permit)	
EFA permit 0192895. NPDES permit FL0300195 and AO are in effect. All were issued on January 9, 2004.	These permits have the annual limit of 76 ppb for each water year and a not-to-exceed limit of 50 ppb for three or more consecutive water years.
STA-5 Permit Phase: North, Central, and Southern flow-ways are in Stabilization Phase	
EFA permit 0131842-009-EM (issued January 29, 2009), NPDES permit FL0177954 (issued September 4, 2007), and AO-011-EV (issued January 29, 2009) are in effect. Note: AO authorizes continued operation of the existing facility and conditional authorization of the construction of Compartment C.	The IEL is applied as the annual phosphorus limitation for discharges under the current permit.
STA-6 Permit Phase: Stabilization Phase	
EFA permit 0131842-009-EM and AO-011-EV (issued January 29, 2009) and NPDES permit FL0473804-001 and AO-012-EV (issued September 4, 2007) are in effect. Note: AO authorizes conditional operations of the existing facility (Sections 1 and 2) and construction of Compartment C.	The IEL is applied as the annual phosphorus limitation for discharges under the current permit.

[1] Refer to **Table 10** for the EFA and NPDES/AO outflow limits and status of applicability or compliance with the three-part test.

Table 9. Phases of each STA based on the conditions outlined in the EFA permits.[1]

STA Permit Phase	Date Phase Entered	Factors/Activities Impacting STA Treatment Capabilities			
		Long-Term Plan Enhancements	Recovery	Maintenance	Outside of Agency Control
STA-1E Stabilization Phase	WY2006		Recovery of submerged aquatic vegetation in Cell 6 continued into WY2012 following vegetation uprooting and loss that occurred in WY2010.	Cells 3, 4S, 5, 6, 7: Bulrush plantings Cells 1, 3, 4N, 4S, 5, 6, and 7: Vegetation received herbicide application Cell 5: Berm Degradation Elimination of short circuits using cattail bails Pilot Project to eradicate primrose willow Cell 6: Drawdown Inoculations Cell 7: Pilot project to eliminate floating cattail tussocks and establish rooted emergent vegetation (bulrush) Cell 4N and 6: Temporary Pumps	The eastern flow-way remains in restricted flow conditions due to the United States Army Corps of Engineers' Periphyton-Based Stormwater Treatment Area (PSTA) Demonstration Project, and numerous culvert Repairs throughout the STA, and S-375 structure repairs. Until the Comprehensive Everglades Restoration Plan (CERP) Loxahatchee River Watershed Project (L-8 Diversion Project) is complete, the status is expected to remain in the current phase. Performance of the western flow way of STA-1E has been impacted by topographic deficiencies and deep water conditions in Cells 5 and 7 and a major uprooting/loss of Hydrilla in Cell 6.
STA-1W Stabilization Phase	WY2000			Cells1B, 2B, 5A, and 5B: Bulrush plantings Cells 1A, 1B, 2A, 2B, 3, 4, 5A, 5B: Vegetation received herbicide application Cell 2A: Lime rock plugs Cell 3: G-259 Plug	Presence of stilt nests limited the operations of Cell 2B by holding the water level below 11.4 ft from 5/15/12 to 5/23/12.
STA-2 Stabilization Phase	WY2008	Cell 2 vegetation conversion was initiated in WY2010 in and continued in WY2012. Compartment B construction		Cells 1, 2, 3, 4, 5, and 6: Vegetation received herbicide application Cell 2: Vegetation conversions, cattail treatment, inoculations Cell 4: Vegetation received herbicide application to treat cattail overgrowth	
STA-3/4 Post-stabilization Phase	WY2005	Vegetation conversion continued in Cell 1B. Inoculations, Cattail vegetation treatment for conversions	Temporary drawdown of Cell 1A was performed beginning in May 2010, and again in March 2011 to June 2011 to allow reestablishment of cattails impacted by chronic deep water conditions in the northern portion of the cell. Cell was slowly inundated to hydrate new plantings.	Cells 1A, 2A, 2B, 3A, 3B, and PSTA: Vegetation received herbicide application Cell 1A; Drawdown Bulrush plantings Cell 1B: Hydration - Installation of Temporary Pumps	Presence of stilt nests limited operations of PSTA cell by holding the water level below 11.13 ft. from May 14– June 29, 2012.
STA-5 Stabilization Phase	WY2000			Cell 1A,1B, 2B: Bulrush plantings Cell 1B: Hydration - Installation of temporary pumps Cell 2B: Hydration - Installation of temporary pumps Cells 1B, 2A, 2B, 3A, 3B, 4A, 4B, 5B: Vegetation received herbicide application	Unconfirmed Snail kite nest reported in 2B by the Hendry County Audubon Society birding tour group. Cell 2B stage was held at 13.00-ft for affected period and staff were told to stay away from potential nest site from 4/8/12 to 5/10/12. Due to low rainfall received in WY2012, Cells 1A, 2A, 3A, and 3B were declared dry in April 2012.
STA-6 Stabilization Phase	WY2008	Compartment C construction		Cells 3, 5, and 4: Vegetation received herbicide application	Due to low rainfall received in WY2012, Cells 3 and 5 were declared dry in March 2012 and have remained dry. Section 2 was taken offline in November 2010 due to Compartment C construction and will remain offline until an operating permit is obtained.

[1] The District continues to coordinate with the FDEP on the expected duration of the current phases, and plans to report the updated status in future South Florida Environmental Reports.

During the stabilization phase (flow-through operations), the treatment vegetation will be maturing and STA performance will generally be improving toward achieving the IEL. An STA or flow-way may enter the stabilization phase after one of four conditions: (1) once flow-through operations begin following the initial start-up of a new treatment cell, (2) when a treatment cell is taken offline for implementation of the Long-Term Plan for Achieving Water Quality Goals in the Everglades Protection Area (Long-Term Plan) enhancements that may have adverse impacts on STA performance, (3) when a treatment cell is taken offline for recovery activities associated with a major event that compromises structural integrity or performance, or (4) planned/unplanned maintenance activities that would cause adverse impacts to the STA's treatment capabilities (see Figure 5-7 in Volume I, Chapter 5, for more information about operational status.). Once the facility achieves the IEL, it enters the routine operations phase/post-stabilization phase and discharges from the STA must meet the related permit effluent limitations.

Compliance with the IEL is required once the facility enters flow-through operations; however, it is recognized that one or more of the aforementioned conditions may result in an observed excursion from the IEL. Such excursions do not immediately constitute noncompliance with the AO (and hence, the permit) as long as all the activities identified in the compliance schedules are being implemented, the reporting requirements are being met, any necessary recovery measures are being undertaken, and all other relevant conditions are in compliance. Annual maximum IELs for phosphorus are required by permits or AOs for all of the STAs except for STA-3/4. A two-part compliance test is required for STA-1E, STA-1W, and STA-3/4 in which the annual TP flow-weighted mean (FWM) concentration has to be less than the IEL for the reported water year or the TP FWM concentration has to be less than or equal to 50 parts per billion (ppb) for three or more consecutive years. All the STAs except for STA-6 have met all appropriate criteria and were in compliance during WY2012. STA-6 did not meet the IEL compliance criteria; however, according to Specific Conditions 18, 21A, and 32 of the EFA permit and Condition 18 of the AO, STA-6 is not required to meet the compliance criteria because of dryout conditions and section 2 being off line due to the Compartment C build-out. An action plan for STA-6 can be found in Volume I, Chapter 5 (see page 5-49). Therefore, all the STAs were in compliance with their AOs and permits for WY2012 (**Table 10** and **Figure 3**).

In addition to IELs and operational envelopes (i.e., annual STA inflow volumes and TP loads compared to the 36-year daily simulated flows and TP loads), additional permit compliance is required. Operational envelopes are adjusted based on the amount of effective treatment area in operation for each STA. The effective treatment area of an STA may be temporarily reduced due to flow-ways being taken offline for rehabilitation or construction work. The operational envelope assessment is included in permits for all of the STAs except those for STA-3/4 to account for variable inflows received and requires annual comparison of the actual volumetric and TP loading to both the average and maximum annual loadings estimated in the operational envelope. STA-2 is only required to compare the maximum value to the operational envelope. STA-3/4 is operated under permits issued in calendar year 2004 prior to the development of operational envelopes. Information regarding the amount of water diverted around the STAs and received by the STAs from Lake Okeechobee as inflows during WY2012 is presented in **Table 11**.

Table 10. STA performance for WY2012 and the period of record (POR) 1994–2012.

	STA-1E	STA-1W	STA-2	STA-3/4	STA-5	STA-6	All STAs
Effective Treatment Area in Permit (acres)	5,132	6,670	8,240	16,543	6,095	2,257	44,937
Adjusted Effective Treatment Area (acres)[a]	5,099	6,670	6,338	16,543	6,095	836	41,581
Acres of Effective Treatment Area Offline	33	0	1902	0	0	1421	3,356
Rainfall							
Total Annual Rainfall (inches)	43.3	43.3	52.2	56.3	48.5	48.5	48.7
SFWMM Simulation Rainfall Range (inches)[b]	39.8 - 77.5	36.6 - 77.4	35.4 - 71.6	32.3 - 70.7	38.6 - 61.4	46.8 - 57.6	---
Inflow							
Total Inflow Volume (ac-ft)	85,533	96,847	195,651	269,737	47,508	17,055	712,331
Total Inflow TP Load (mt)	11.520	17.117	21.044	36.327	9.160	2.624	97.792
FWM Concentration Inflow TP (ppb)	109	143	87	109	156	125	111
Hydraulic Loading Rate (HLR) (cm/d)[c]	1.40	1.21	2.58	1.36	0.65	1.70	1.43
TP Loading Rate (PLR) ($g/m^2/yr$)[c]	0.56	0.63	0.82	0.54	0.37	0.78	0.58
Outflow							
Total Outflow Volume (ac-ft)	76,208	94,011	217,570	291,838	41,779	9,061	730,468
Total Outflow TP Load (mt)	2.010	2.598	3.278	6.670	1.659	0.833	17.048
Flow-weighted Mean Outflow TP (ppb)	21	22	12	19	32	75	19
Outflow Plus Diversion Structures FWM TP (ppb)[i]	21	22	NA	NA	NA	NA	---
Hydraulic Residence Time (d)	15	41	19	31	46	3	---
TP Retained (mt)	9.509	14.519	17.766	29.657	7.501	1.791	80.744
TP Removal Rate ($g/m^2/yr$)	0.46	0.54	0.69	0.44	0.30	0.53	0.48
Load Reduction (%)	83%	85%	84%	82%	82%	68%	83%
Period of Record Performance [j]							
Start date	Sep 2004	Oct 1993	Jun 1999	Oct 2003	Oct 1999	Oct 1997	1994 - 2012
Total Inflow Volume (ac-ft)	648,071	3,256,934	2,764,250	3,719,561	1,226,542	687,681	12,303,039
Total TP Load Retained to Date (mt)	94.575	479.954	268.868	439.843	211.710	65.726	1,560.677
FWM Concentration TP Outflow to Date (ppb)	57	51	22	18	93	34	37

[a] Adjusted Effective Treatment Area (AETA) reflects treatment cells temporarily offline for plant rehabilitation, infrastructure repairs, or LTP enhancements. For information on how AETA is calculated, see Volume I, Chapter 5, pages 5-10 and 5-11, and Table 5-2.

[b] SFWMM – South Florida Water Management Model

Table 10. Continued.

Required WY2011 Permit Reporting: Everglades Forever Act (EFA), National Pollutant Discharge Elimination System (NPDES), Administrative Order (AO), Interim Effluent Limit (IEL)							
	STA-1E	**STA-1W**	**STA-2**	**STA-3/4**	**STA-5**	**STA-6**	**All STAs**
Operational permit phase[d]	Stabil.	Stabil.	Stabil.	Post-Stabil.[e]	Stabil.	Stabil.	----
In compliance with permits?	Yes	Yes	Yes	Yes	Yes	Yes	----
Within Operational Envelope?							----
Average (Flow/Load)	Yes/Yes	Yes/Yes	Yes/Yes	NA	Yes/Yes	Yes/Yes	----
Maximum (Flow/Load)	Yes/Yes	Yes/Yes	Yes/Yes	NA	Yes/Yes	Yes/Yes	----
Was EFA IEL achieved?	Yes	Yes	Yes	Yes	Yes	No[f]	----
Was NPDES/AO annual IEL achieved?[h]	Yes	Yes	Yes	Yes	Yes	No[f]	----
Was NPDES/AO 50 ppb 3-year test achieved?	Yes	Yes	NA	Yes	NA	NA	----
Was EFA 50 ppb annual diversion test achieved?	Yes	Yes	NA	NA	NA	NA	----
Were there any water quality excursions (other than phosphorus)?	No	No	No	No	No	No	----
Was dissolved oxygen (DO SSAC) achieved?[g]	Yes	Yes	Yes	Yes	Yes	No	----
Permit Limits							
Operational Envelope:[c]							----
Avg. inflow volume (ac-ft)	207,808	206,987	262,762	NA	156,643	28,772	----
Max. inflow volume (ac-ft)	304,993	329,169	412,614	NA	209,265	34,905	----
Avg. inflow TP load (mt)	33.702	44.303	33.140	NA	39.457	3.189	----
Max. inflow TP load (mt)	49.721	72.273	54.716	NA	63.929	3.968	----
Outflow EFA and NPDES/AO Limits:							----
Outflow EFA IEL TP limit (ppb)	22	26	29	76	41	28	----
Outflow NPDES/AO IEL TP limit (ppb)	68	76	29	76	41	28	----

Units: parts per billion (ppb are equivalent to micrograms per liter (µg/L)); mt – metric tons; ac-ft – acre feet; cm/d – centimeters per day; d – days; g/m^2/yr – grams per square meter per year.

[c] Inflow volume or total phosphorus (TP) load/adjusted effective treatment area
[d] See the *Permit Status and Reporting Requirements* section of this chapter. Stabil. = Stabilization, Post-Stabil. = Post Stabilization
[e] STA-3/4 is operated under permits issued in 2004 and is considered to be in the post-stabilization phase and the outflow water quality limit (IEL) is set at 76 ppb as defined in those permits. Operational envelope comparison is not applicable (NA) under present permit.
[f] Excursions to the IEL are detailed further in the *STA Performance* section of this chapter.
[g] See the *Dissolved Oxygen* section of this chapter for details regarding the dissolved oxygen site-specific alternative criteria (DO SSAC).
[h] The NPDES/AO permits for STA-1E, STA-1W, and STA-3/4 require a two-part test for phosphorus compliance. The two-part test states that the annual outflow TP FWM concentration has to be less than the IEL for the reported water year and the TP FWM.
[i] The EFA permit for STA-1W and STA-1E, limits the discharge concentrations resulting from diversion events (Specific Conditions 26A & B) to a 50 ppb maximum annual limit individually for each STA. The 50 ppb diversion limit is calculated as an annual FWMC for combined discharges from the EAA during each water year from the G-301 diversion structure and G-251 and G-310 pump stations for STA-1W, and from the G-300 diversion structure and G-362 pump station for STA-1E.
[j] The values reflect flow data correction in DBHYDRO for G372 from May 19, 2009 to June 12, 2009.

Notes: Flow-proportional auto-samplers are used to calculate TP loads and concentrations, if available. Period of record calculations include the amount of inflows and TP loads used to hydrate the STAs during start-up if those data are available. STA-1E flows and TP loads that occurred in WY2004 in response to regional flooding due to Hurricanes Francis and Jeanne are also included.

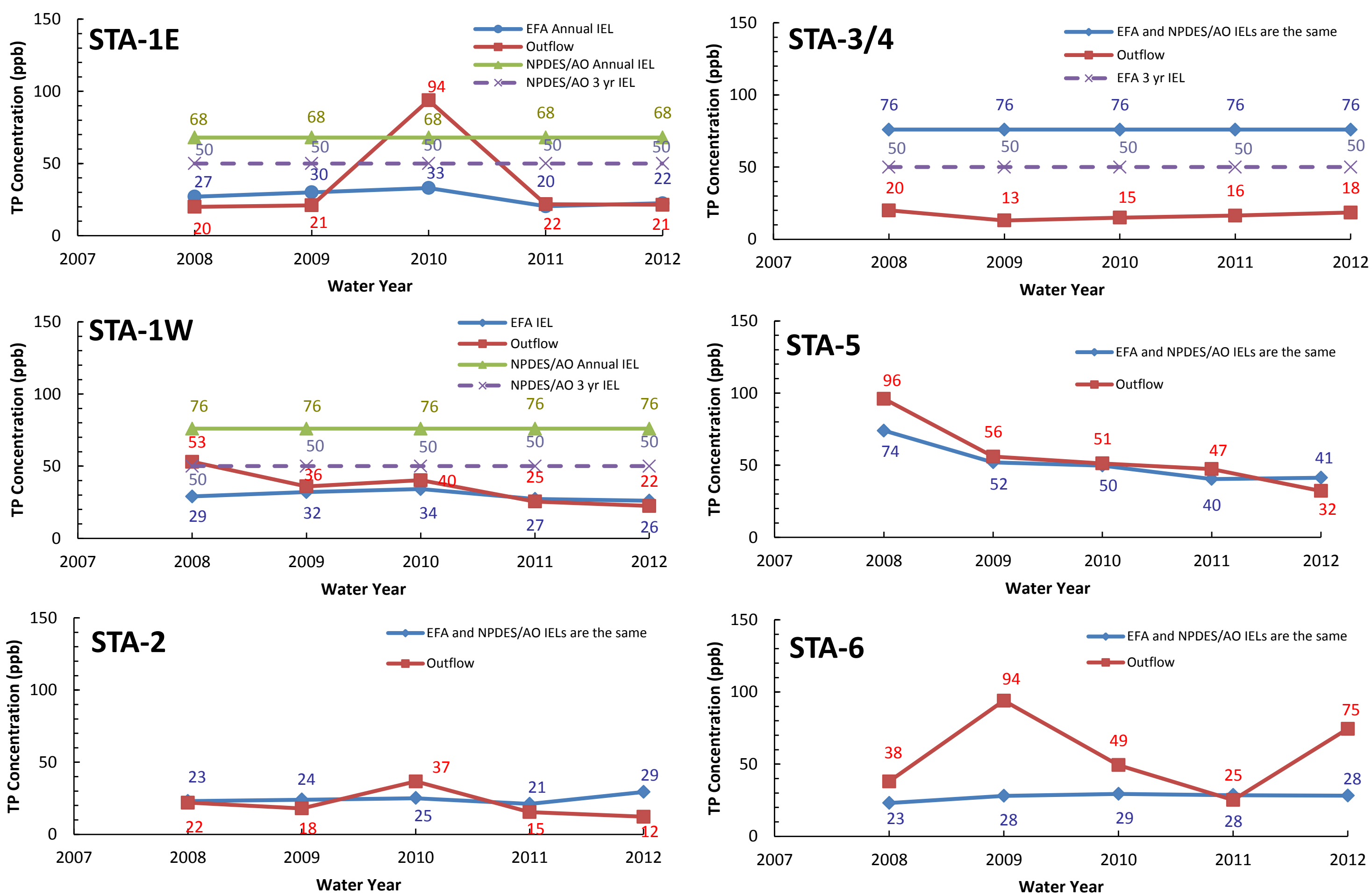

Figure 3. STA outflow total phosphorus (TP) concentrations in parts per billion (ppb) compared to Everglades Forever Act (EFA) and National Pollution Elimination System (NPDES)/ Administrative Order (AO) interim effluent limits (IELs).

Table 11. Information fulfilling the permit-related reporting requirement for the amount of water diverted around the STAs and received by the STAs from Lake Okeechobee as inflows in WY2012[a].

STA	STA Diversion Structure Flow							Inflows from Lake Okeechobee						
	Structure	*STA Diversion*			*Water Supply, Gate Maintenance, etc.*			Structure	*Lake Flow-Through*[c]			*Supplemental Water to Maintain Vegetation*[e]		
		Volume (ac-ft)	TP Load (mt)	FWM TP (ppb)	Volume (ac-ft)	TP Load (mt)	FWM TP (ppb)		Volume (ac-ft)	TP Load (mt)	FWM TP (ppb)	Volume (ac-ft)	TP Load (mt)	FWM TP (ppb)
STA-1E	G-300	----	----	----	1	<0.001	87	G-311	5,470	0.682	101	3,562	0.384	87
								S-319	858	0.114	108	549	0.077	113
	Total	**----**	**----**	**----**	**1**	**<0.001**	**87**	**Total**	**6,328**	**0.796**	**102**	**4,111**	**0.461**	**91**
STA-1W	G-301	----	----	----	1	<0.001	83	G-302	8,871	1.013	93	3,368	0.361	87
	Total	**----**	**----**	**----**	**1**	**<0.001**	**83**	**Total**	**8,871**	**1**	**93**	**3,368**	**0.361**	**87**
STA-2	G-338	----	----	----	0	<0.001	49	S-6[b]	11,598	0.436	30	10,992	0.412	30
	G-339	----	----	----	63	0.003	35							
	Total	**----**	**----**	**----**	**63**	**0.003**	**35**	**Total**	**11,598**	**0.436**	**30**	**10,992**	**0.412**	**30**
STA-3/4	G-371	19,139	2.189	93	12,704	0.822	52	G-370	7,159	0.325	37	6,485	0.262	33
	G-373	36,058	3.720	84	18,231	0.740	33	G-372	11,815	0.524	36	11,375	0.503	36
	Total	**55,197**	**5.909**	**87**	**30,936**	**1.562**	**41**	**Total**	**18,974**	**0.849**	**36**	**17,860**	**0.765**	**35**
STA-5	N/A	----	----	----	----	----	----	G-507[d]	4,530	0.120	21	4,530	0.120	21
								G-349B[d]	16	0.000	18	16	0.000	18
								G-350B[d]	5,281	0.132	20	5,281	0.132	20
	Total	**----**	**----**	**----**	**----**	**----**	**----**	**Total**	**9,827**	**0.252**	**21**	**9,827**	**0.252**	**21**
STA-6	G-407	----	----	----	63	0.003	35	----	----	----	----	----	----	----
	Total	**----**	**----**	**----**	**63**	**0.003**	**35**	**Total**	**----**	**----**	**----**	**----**	**----**	**----**
All STAs	***Total***	***55,197***	***5.909***	***87***	***31,064***	***1.567***	***41***	***Total***	***55,598***	***3.347***	***49***	***46,158***	***2.250***	***40***

Units: ac-ft – acre-feet; mt – metric tons; ppb – parts per billion (ppb are equivalent to micrograms per liter (μg/L)

[a] Some numbers reported are estimated using Everglades Agricultural Area (EAA) model output; see also Volume I, Appendix 3A-5.

[b] Some lake flow-through water at S-6 was for agricultural irrigation and was not routed to the STA-2 for supplemental water.

[c] Lake flow-through: A balance of Lake Okeechobee outflow into EAA basins and discharges from EAA basins.

[d] Water was delivered via the G507, G349B and G350B structure for STA-5 rehydration was from mixed sources of Lake Okeechobee, STA-3/4 discharges and STA-5 seepage return. TP loads and flow weighted mean TP concentrations were calculated based on G-507 monitoring data. The data presented here are from Lake Okeechobee only.

[e] Supplemental water was delivered to STA-1E, STA-2 and STA-3/4 from May 1 to June 25, 2011 and from January 17 to April 18, 2012, to STA-1W from January 17 to April 18, 2012, and to STA-5 throughout the water year.

In WY2012, all the STAs removed a significant amount of the inflow TP loads, ranging from 68 to 85 percent load reduction (**Table 10**). About 80.8 metric tons (mt) of TP that would have entered the EPA was instead retained in the STAs. Since 1994, the total amount of TP retained in the STAs is about 1,550 mt.

Comparison of the outflow TP FWM concentration to the IEL shows that the 75 ppb outflow concentration measured at STA-6 did not meet the EFA or NPDES permit IEL of 28 ppb. STA-1E, STA-1W, STA-2, STA-3/4, and STA-5 met both the EFA and NPDES/AO IELs. Performance of all the STAs was compared to the EFA and NPDES/AO IELs for three or more consecutive water years, WY2008–WY2012, illustrating that STA-5 was the only STA not to be below the IEL for WY 2009–WY2011, although it was below for WY2012 (**Figure 3**). Even though STA-6 did not meet the EFA or NPDES/AO criteria, all STAs were considered to be in compliance in WY2012 as previously noted (see explanation on page App. 3-1-11).

Other Water Quality Permit Requirements

Water quality parameters with Florida Class III standards are identified in **Table 12**. Compliance with EFA permits is determined based on the following three-part assessment:

1. If the annual average outflow concentration does not cause or contribute to violations of applicable Class III water quality standards, then the STA shall be deemed in compliance.
2. If the annual average concentration at the outflow causes or contributes to violations of applicable Class III water quality standards, but does not exceed or is equal to the annual average concentration at the inflow stations, then the STA shall be deemed in compliance.
3. If the annual average concentration at the outflow causes or contributes to violations of applicable Class III water quality standards and also exceeds the annual average concentration at the inflow station, then the STA shall be deemed out of compliance.

The determination as to whether an STA is contributing to a violation for a specific parameter is a comparison of the average annual inflow concentration to the average annual outflow concentration relative to the three-part assessment. The South Florida Water Management District (District or SFWMD) has performed all sampling and analysis in compliance with Chapter 62-160, Florida Administrative Code (F.A.C.), and the District's Laboratory Quality Manual (SFWMD, 2011a) and Field Sampling Quality Manual (SFWMD, 2011b). The annual permit compliance monitoring report for mercury in the STAs is presented in Attachment C. Each STA has different permit reporting requirements for annual water quality constituents.

Compliance with the specific conductance (or conductivity) criteria for Class III fresh waters is described in Section 62-302.530, F.A.C., as measured values that are not more than 50 percent above background or do not exceed 1,275 microsiemens per centimeter (µS/cm), whichever is greater. Because the samples are collected in freshwater systems, conductivities at STA inflows and outflows are typically lower than 1,275 µS/cm.

The Class III criterion for turbidity, as specified under Section 62-302.530, F.A.C., states that measured values shall not be more than 29 nephelometric turbidity units (NTUs) above natural background conditions. Under Chapter 62-303, F.A.C., natural background is defined as:

> …the condition of waters in the absence of man-induced alterations based on the best scientific information available to the Department. The establishment of natural background for an altered water body may be based upon a similar unaltered water body or on historical pre-alteration data...

Because the FDEP has not compiled any information on what it considers natural background, the District has determined that any measured value that is greater than 29 NTUs exceeds the turbidity criterion.

Table 12. Water quality parameters with Florida Class III criteria specified in Section 62-302.530, Florida Administrative Code.

Parameter	Units	Florida Class III Criteria[a]
Dissolved Oxygen[2]	mg/L	≥ 5.0 mg/L
Specific Conductance	µS/cm	Not > 50 percent of background or > 1,275 µS/cm, whichever is greater
pH	SU	Not < 6.0 or > 8.5
Turbidity	NTU	≤ 29 NTUs above background conditions
Un-ionized Ammonia	mg/L	≤ 0.02 mg/L
Alkalinity	mg $CaCO_3$/L	Not < 20 mg/L

mg/L – milligrams per liter; µS/cm – microsiemens per centimeter; SU – standard units; NTU – nephelometric turbidity units; mg CaCO3/L – milligrams calcium carbonate per liter

[a] Because the STAs are freshwater systems, the background concentration for specific conductance is assumed to be less than 1,275 µS/cm, and the background concentration for turbidity cannot exceed 29 NTUs.

[b] Permits for all STAs, except STA-3/4, require compliance with the site-specific alternative criteria (SSAC) for dissolved oxygen (Weaver, 2004).

Water Year 2012 Performance for Other Water Quality Parameters

For water quality parameters that do not have a Florida Class III standard, excursions are noted when the annual outflow FWM concentrations are higher than the annual inflow FWM concentrations. An STA may have individual excursions yet be in overall compliance if it meets the remaining components of the EFA three-part assessment.

WY2012 monitoring data for permitted water quality parameters other than TP and DO at the STA inflows and outflows are presented in Attachment B. Annual FWM concentrations at inflows and outflows of the STAs, including excursion analysis, are summarized in **Tables 12** and **13**. During WY2012, no excursions occurred at any of the STAs. Also, none of the annual FWM concentrations measured at the outflows of each STA exceeded the Class III criteria and were lower than annual FWM concentrations at the inflows to the STAs.

Pursuant to the EFA permits for each of the STAs (except STA-3/4), a statistical analysis is used to compare DO levels within the STA as set forth in the Everglades marsh DO site-specific alternative criteria (SSAC) to evaluate compliance annually. Additional details regarding the DO SSAC are presented in the *Dissolved Oxygen* section of this appendix.

Inflow and outflow FWM concentrations were compared statistically with a significance level (α) of 0.05. The Shapiro-Wilk test of normality was used to determine if datasets deviated significantly from normality. Those datasets that did not deviate significantly from a normal distribution (i.e., $p > 0.05$) were analyzed using the Student's t-test. Datasets that deviated significantly from normality ($p < 0.05$) were tested using the Mann-Whitney U test (a non-parametric equivalent of the Student's t-test).

During WY2012, 12 datasets did not deviate from normal distribution and 11 datasets did show deviation. Therefore, both the Mann-Whitney U and Student's t-test were used to compare the inflow and outflow FWM concentrations. These statistical comparisons are summarized in **Table 14** by parameter and STA. Of the 23 datasets evaluated, nine comparisons exhibited statistically significant differences between inflow and outflow FWM concentrations. For eight of the nine datasets, inflow FWM concentrations were significantly higher than outflow FWM concentrations.

Table 13. Summary of annual FWM concentrations of parameters other than TP for inflow and outflow of the STAs during WY2012. [Note: n – sample size; Conc. – concentration]

Parameter	Annual Flow-Weighted Means[a]			
	Total Inflow		Total Outflow	
	n[b]	Conc.	n[b]	Conc.
STA-1E				
Sulfate (mg/L)	38 (75)	47.9	15 (27)	43.1
Alkalinity (mg $CaCO_3$/L)	39 (81)	200	15 (27)	178
Total Nitrogen (mg/L)	36 (78)	2.48	14 (26)	1.68
Nitrate + Nitrite as N (mg/L)	36 (78)	0.728	14 (26)	0.043
STA-1W				
Sulfate (mg/L)	4 (21)	88.9	24 (54)	59.4
Alkalinity (mg $CaCO_3$/L)	5 (27)	259	24 (54)	169
Total Nitrogen (mg/L)	5 (27)	6.2	22 (52)	1.93
Nitrate + Nitrite as N (mg/L)	5 (27)	2.859	22 (52)	0.045
STA-2				
Sulfate (mg/L)	24 (70)	69.4	18 (26)	59.1
Total Nitrogen (mg/L)	25 (77)	4.36	17 (25)	2.36
Nitrate + Nitrite as N (mg/L)	25 (77)	1.561	17 (25)	0.305
STA-3/4				
Turbidity (NTU)	9 (22)	5.1	37 (66)	1
Soluble Reactive Phosphorus (mg/L)	27 (76)	0.035	101 (228)	0.002
Sulfate (mg/L)	18 (52)	79	63 (156)	58.3
Total Nitrogen (mg/L)	18 (52)	112	63 (156)	105
Nitrate + Nitrite as N (mg/L)	18 (51)	3.7	63 (154)	2.01
STA-5				
Sulfate (mg/L)	35 (113)	12.4	27 (130)	5
Total Nitrogen (mg/L)	31 (105)	1.71	24 (125)	1.47
Nitrate + Nitrite as N (mg/L)	31 (105)	0.075	24 (125)	0.006
STA-6				
Sulfate (mg/L)	10 (20)	13.5	20 (38)	5.7
Total Nitrogen (mg/L)	10 (20)	1.5	20 (38)	1.41
Nitrate + Nitrite as N (mg/L)	10 (20)	0.032	20 (38)	0.006

[a] Annual flow-weighted means are computed for inflows and outflows by combining the data from individual stations

[b] n: total number of samples collected with flow (total number of samples collected regardless of flow)

Table 14. Statistical comparison of monthly FWM concentrations at inflows and outflows of the STAs for other water quality parameters for WY2012.

Parameter Name	Variable	Storm Water Treatment Areas					
		STA-1E	STA-1W	STA-2	STA-3/4	STA-5	STA-6
Specific Conductivity	p-Value[a]	***0.016***	0.248	0.330	0.471	1.000	0.901
	Structure[b]	***Outflow***	Outflow	Inflow	Outflow	Inflow	Inflow
	Statistical Test[c]	***t Test***	Mann-Whitney	t Test	t Test	Mann-Whitney	t Test
Turbidity	p-Value[a]	NA	NA	NA	NC	NA	NA
	Structure[b]	NA	NA	NA	NC	NA	NA
	Statistical Test[c]	NA	NA	NA	NC	NA	NA
Alkalinity	p-Value[a]	0.390	NC	NA	NA	NA	NA
	Structure[b]	Both	NC	NA	NA	NA	NA
	Statistical Test[c]	t Test	NC	NA	NA	NA	NA
Sulfate	p-Value[a]	0.583	NC	0.477	0.599	***0.001***	***<0.001***
	Structure[b]	Outflow	NC	Outflow	Inflow	***Inflow***	***Inflow***
	Statistical Test[c]	t Test	NC	Mann-Whitney	t Test	***t Test***	***t Test***
Soluble Reactive Phosphorus	p-Value[a]	NA	NA	NA	***0.001***	NA	NA
	Structure[b]	NA	NA	NA	***Inflow***	NA	NA
	Statistical Test[c]	NA	NA	NA	***Mann-Whitney***	NA	NA
Nitrate + Nitrite	p-Value[a]	***0.032***	NC	***0.001***	***0.004***	***<0.001***	***0.004***
	Structure[b]	***Inflow***	NC	***Inflow***	***Inflow***	***Inflow***	***Inflow***
	Statistical Test[c]	***Mann-Whitney***	NC	***Mann-Whitney***	***Mann-Whitney***	***t Test***	***Mann-Whitney***
Total Nitrogen	p-Value[a]	0.591	NC	0.201	0.643	0.622	0.895
	Structure[b]	Outflow	NC	Inflow	Inflow	Inflow	Inflow
	Statistical Test[c]	Mann-Whitney	NC	Mann-Whitney	Mann-Whitney	t Test	t Test

Note: NA - data was not collected; and NC - insufficient data to perform the statistical analyses.

[a] Probability level (p-value) computed using appropriate comparison test. A significance level (α) of 0.05 was used. When p-value was less than 0.05, the parameter concentrations were significantly different between the inflow and outflow. Significant p-values are identified by shading and are presented in the table as italicized and bolded values.

[b] STA structure group (pooled inflow or pooled outflow) exhibiting higher parameter concentrations during the water year.

[c] Statistical test used to compare inflow and outflow water quality data. Choice of test was based on distributional assumptions. If the distribution of data did not significantly deviate from normality, the Student t test (t Test) was used. When the distribution of data deviated significantly from normality, the Mann-Whitney test (non-parametric equivalent) was used.

Dissolved Oxygen

DO concentrations below 5.0 milligrams per liter (mg/L) occur commonly throughout the Everglades Protection Area (EPA), including interior marsh sites minimally impacted by nutrient enrichment or cattail invasion. Frequent DO levels below 5.0 mg/L are typical in macrophyte-dominated wetlands where photosynthesis and respiration result in wide diel swings in DO levels. Because low DO concentrations often measured in the EPA represent natural variability in this type of ecosystem, the FDEP, pursuant to Chapter 62-302.800(1), F.A.C., has promulgated a SSAC for DO in the Everglades. This SSAC addresses the natural fluctuations that influence background DO levels. Weaver et al. (2008) explains the SSAC and its development and application in assessing DO excursions. The specific methods for determining compliance are set forth in the DO SSAC (Weaver and Payne, 2004), which was adopted by Secretarial Order on January 26, 2004, and approved by the U.S. Environmental Protection Agency (USEPA) as a revision to the State of Florida's water quality standards on June 16, 2004.

Previous reports (Jorge et al., 2002; Goforth et al., 2003, 2004, 2005; Pietro et al., 2006 and 2007) provided monitoring results, comparisons, and evaluations for diel DO in the STAs. These reports were used to assess the impact of STA discharges on the downstream Everglades ecological system or downstream water quality with respect to DO and pursuant to EFA permits and associated AOs for STA-1E, STA-1W, STA-2, STA-3/4, and STA-5. These reports also provided data to the FDEP for developing the DO SSAC. DO SSAC comparisons have been used to assess the STAs (except STA-6) since WY2007 (Pietro et al., 2008). STA-6 did not have a diel DO permit requirement when the DO SSAC was adopted.

The SSAC is now included in EFA permits and associated AOs of STA-1E, STA-1W, STA-2, STA-5, and STA-6 as a permit compliance criterion. The DO SSAC is also expected to be included in future STA permits for STA-3/4; the NPDES permit issued on January 9, 2004, for this STA stipulates that the permit shall be revised in the event that the State of Florida establishes a DO SSAC in the EPA.

EFA Permits and AOs issued for the Everglades STAs require that the District provide the FDEP with an annual report consisting of an analysis demonstrating that DO levels in STA discharges do not adversely change the downstream Everglades ecology or the downstream water quality. As the DO SSAC has been adopted by the FDEP and formally approved by the USEPA, assessment on possible downstream impacts by the outflows from STAs during WY2012 was performed by applying the DO SSAC at the outflow stations.

Biweekly DO concentrations measured at STA discharge points during WY2012 are provided in Attachment B. A summary of annual DO levels at these permitted outflows and calculated DO SSAC for each STA are provided in **Table 15**. A comparison of the measured mean annual DO for an outflow station with the calculated mean annual SSAC determines compliance. When mean annual DO concentrations measured at the outflow stations are greater than the calculated mean annual concentration utilizing the SSAC equation, then the outflow values are in compliance with the permit.

During WY2012, two outflow stations at STA-5 (G344E and G344F) and STA-6 (G354C and G393B) had mean annual DO levels lower than the SSAC (**Table 15**). Low DO concentrations (<2.40 mg/L) measured at the two outflow stations for STA-5 reflected stagnant conditions. Flow at these two stations was recorded less than 2 percent of the time during 2012 (6 out of 366 days). The total flow recorded at these two structures was less than 4 acre-feet or less than 0.01 percent of the total annual flow for STA-5. Therefore, it is highly unlikely that low DO measured at these two monitoring stations would have any impact on DO concentrations downstream of the STA.

Only two outflow stations (G354C and G393B) at STA-6 were monitored during WY2012. Both stations had annual average DO concentrations below the calculated SSAC limit (**Table 15**). As previously noted, Section 2 of STA-6 (outflow station G352) was offline in during WY2012 due to the Compartment C build-out construction. No flow was recorded at G354C and G393B for the periods from May 1–July 13, 2011, and December 15, 2011–April 30, 2012.

Table 15. Summary of WY2012 annual dissolved oxygen (DO) levels at outflow stations for each STA compared to the site-specific alternative criteria (SSAC).

STA	Outflow Station	No. of Samples	Mean ± SD[1]	Minimum	Maximum	Mean Annual SSAC Limit[2]	SSAC Limit Classification[3]
STA-1E	S362	52	6.26 ± 1.26	3.41	10.20	2.85	Above
STA-1W	G251	52	2.27 ± 1.50	0.33	6.48	2.25	Above
	G310	52	5.31 ± 1.41	2.42	8.43	2.06	Above
STA-2	G335	52	4.76 ± 1.32	2.39	8.54	2.25	Above
STA-3/4	G376B	53	5.24 ± 1.56	2.47	8.49	2.46	Above
	G376E	53	5.65 ± 1.70	2.90	9.24	2.54	Above
	G379B	53	4.71 ± 1.45	1.80	8.72	2.69	Above
	G379D	53	5.37 ± 1.64	1.71	8.93	2.82	Above
	G381B	53	5.33 ± 1.74	1.37	8.77	3.04	Above
	G381E	53	5.49 ± 1.79	2.17	9.26	3.17	Above
STA-5	G344A	52	3.94 ± 2.37	0.65	8.61	2.22	Above
	G344B	52	3.74 ± 2.25	0.85	9.15	2.40	Above
	G344C	44	3.99 ± 2.55	0.63	9.56	2.48	Above
	G344D	44	3.63 ± 2.26	0.65	9.04	2.64	Above
	G344E	***37***	***1.42 ± .85***	***0.33***	***4.16***	***2.52***	***Below***
	G344F	***37***	***1.51 ± .70***	***0.50***	***3.16***	***2.57***	***Below***
STA-6	***G354C***	***36***	***2.46 ± 2.04***	***0.15***	***7.74***	***2.78***	***Below***
	G393B	***36***	***2.43 ± 1.76***	***0.43***	***7.26***	***2.94***	***Below***

Note: [1] Arithmetic mean ± standard deviation (SD)

[2] SSAC limit derived using the equation derived by Weaver (2004) which calculates the limit using water temperature and time of day data recorded at each monitoring location during each monitoring event.

[3] SSAC limit indicates whether the mean annual DO level measured at an outflow station was above or below the SSAC limit. To be above the SSAC limit, mean annual DO must be equal to or greater than the mean annual SSAC limit. Note: In this table, data below the limit are denoted in **bold**.

STA-1E and STA-1W EFA Permit No. 0279499-001-EM; STA-2 EFA Permit No. 0126704-005-EM; STA-3/4 EFA Permit No. 0192895 and NPDES Permit No. FL0300195; STA-5 EFA Permit No. 0131842-006-GL; and STA-6 EFA Permit No. 0236905-001 (PATS No. 262918309).

Approximately 50 percent of the DO measurements at these two monitored stations were collected during no flow conditions (i.e., stagnant conditions). DO levels measured at the two outflow stations of STA-6 from July–October 2011 are considered to be representative of the wet season when surface water temperatures are higher and solubility of oxygen is lower. During this period, productivity is also higher in the STA as more nutrients are introduced through rainfall and runoff. After October 2011, DO concentrations increased as expected as water temperatures decreased and inflows to the STA decreased. During WY2012, average annual DO levels for stations G354C and G393B were 2.46 and 2.43 mg/L, respectively. These annual concentrations were 0.3 to 0.5 mg/L lower than the SSAC (**Table 15**). Overall, the average DO concentrations reported for these two outflow stations were higher than in the previous year by more than 1 mg/L. It is important to note that DO levels reported for STA-6 outflows during WY2012 are not representative of a typical year of operation at this STA.

In addition to assessing STA performance in WY2012 relative to the DO SSAC, a comparison of STA performance with the SSAC for the past five water years was also performed. **Figure 4** presents the mean annual residual DO levels for STA outflow for WY2007–WY2012. When mean annual DO levels are greater than the SSAC, the mean annual residuals (or difference between mean annual DO levels and SSAC) are positive (or greater than zero). All outflow stations at STA-1E, STA-2, and STA-3/4 and one outflow stations at STA-1W (e.g., G310) had positive residuals and exhibited continued improvement in DO levels since WY2007. In addition, outflow stations at STA-1W, three stations in STA-5, and two stations in STA-6 exhibited improved DO levels.

Compliance with the DO SSAC at marsh stations is analyzed in Volume I, Chapter 3A. A summary table for individual marsh stations in the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge), Water Conservation Areas (WCAs) 2 and 3, and Everglades National Park (ENP or Park) is provided in Volume I, Appendix 3A-3. Based on the results of the SSAC analysis, 10 marsh stations did not pass the DO SSAC assessment in WY2012. These stations are LOX16, LOXA105, LOXA124, LOXA136, X1, and Z1 (Refuge); F1and F2 (WCA-2); and CA316 and CA38 (WCA-3). All marsh stations in the ENP exceeded calculated SSAC limits.

As discussed in Volume I, Chapter 3A, three stations in the Refuge (LOXA124, X1, and X4) that did not pass compliance with the DO SSAC were only sampled one time during the reporting period (January 5, 2012). However, it should be noted that data comparison of these stations (i.e., single measurement per location) to the DO SSAC may not be appropriate to affirm DO compliance. Another station in the Refuge that did not meet the SSAC limit is marsh station LOX16, located in the southern portion of the Refuge close to the S-10A structure and 28 kilometers (km) from STA-1W and STA-1E discharges. The annual average DO concentrations for this station (mean = 2.14 mg/L) was lower than the annual SSAC limit by approximately 0.4 mg/L. Based on the DO levels of neighboring stations (LOX15 = 3.96 mg/L and S10C = 7.03) and its proximity to the STA-1W and STA-1E discharges (see Figure 3A-1 in Volume I, Chapter 3A), it is not likely that the discharge from either STA resulted in the depressed DO levels observed at LOX16.

Two marsh stations (LOXA105 and LOXA136), located along downstream transects from STA-1W and STA-1E, respectively, did not meet the DO SSAC during WY2012. These two stations are located approximately 1.0 km from the STA outflows and approximately 0.7 km from the rim canal (see Figure 3A-1 of Volume I, Chapter 3A). Water quality sampling at these two stations did not start until mid-September 2011 due to dry conditions or water depths less than 10 cm. Most of the DO measurements were made during the period from November 2011–April 2012. **Figure 5** compares the DO concentrations for stations along the two STA downstream transects. It is evident from the plots that LOXA105 and LOXA136, which are located under 1 km from the rim canal, exhibited the lowest average DO concentrations of all transect stations.

DO concentrations at these two stations averaged 2.92 mg/L at LOXA105 and 2.68 mg/L at LOXA136 (see Volume I, Appendix 3A-3). Rim canal DO concentrations averaged approximately 5.6 mg/L, which are comparable to mean annual DO from STA-1E and STA-1W. Transect stations located more than 1 km from the rim canal exhibited higher DO concentrations and were in compliance with the DO SSAC.

Marsh stations F1 and F2 in WCA-2 had a mean annual DO level of 3.0 mg/L and 2.3 mg/L (or 0.4 and 0.9 mg/L below the SSAC limit; see Volume I, Appendix 3A-3), respectively. These marsh stations are located 2 km and 4 km downstream of the S-10C structure, respectively, and approximately 14 km east of the STA-2 discharge canal, L-6 (see Figure 3A-2 of Volume I, Chapter 3A). Based on the location of both stations, it unlikely that DO levels measured at these stations were influenced by discharges from STA-2. The two marsh stations in WCA-3 (CA316 and CA38) are also not believed to have been influence by STA discharges. Both stations are approximately 20 km from the nearest STA discharge (see Figure 3A-2 of Volume I, Chapter 3A). In addition, all other marsh stations located around these two marsh stations exhibited mean annual DO levels above the SSAC limit. The depressed DO levels may reflect natural processes as well as localized effects.

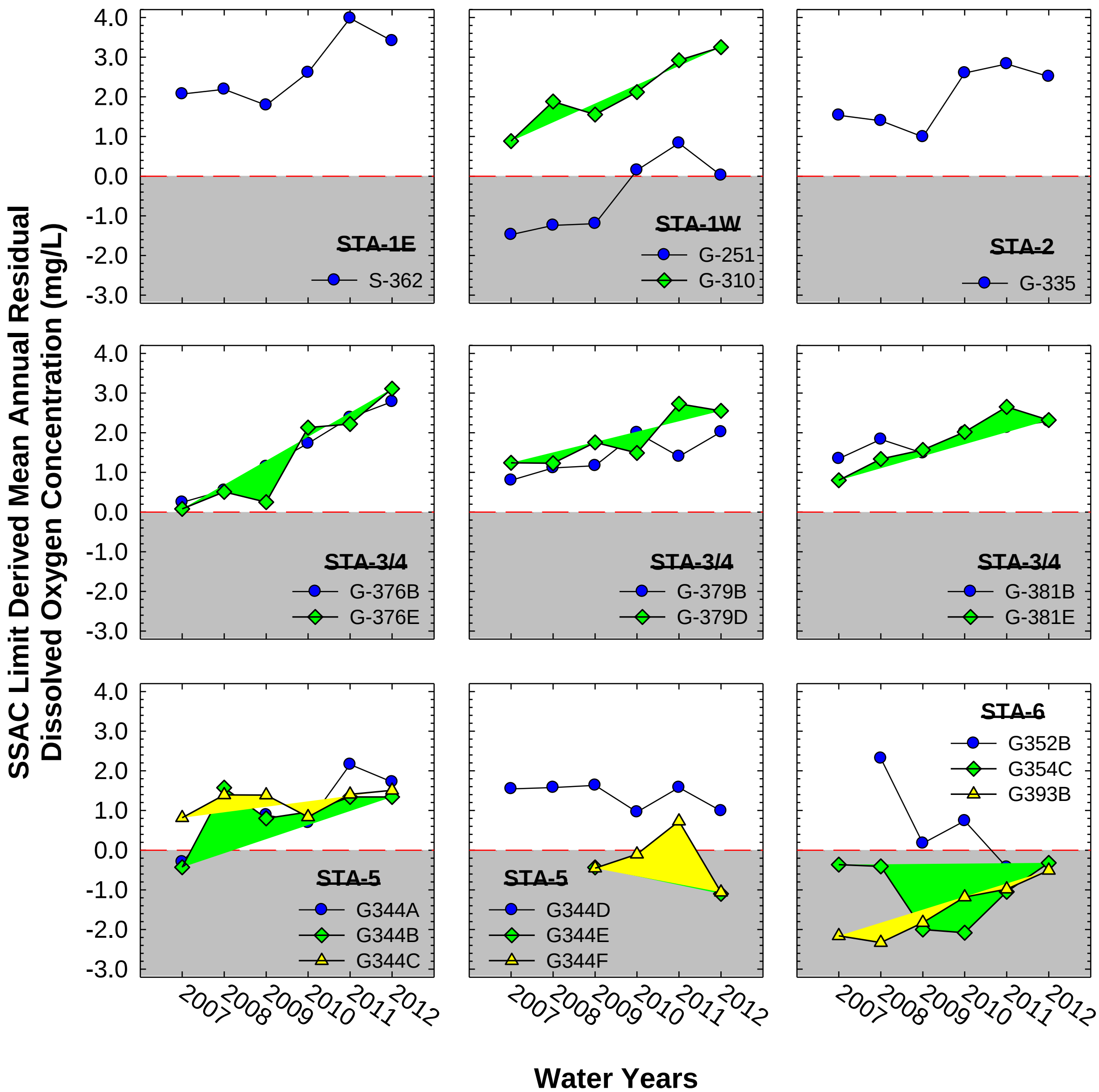

Figure 4. The mean annual residual DO plots at STA outflow stations from WY2007–WY2012. Mean annual residuals were computed as the difference between the mean annual DO and mean annual SSAC. Negative residuals indicate that an outflow station was below the SSAC limit, while positive residuals indicate that an outflow station was above the SSAC limit.

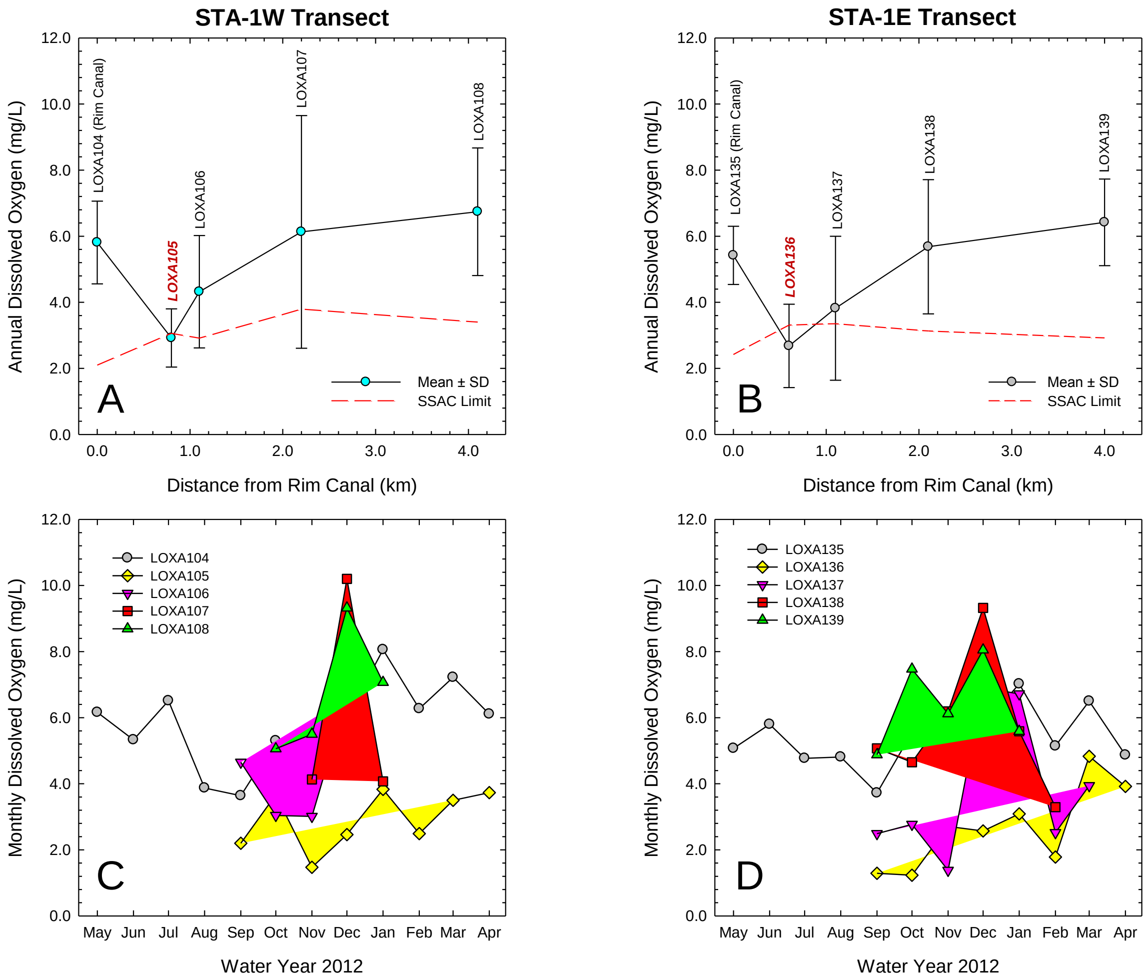

Figure 5. DO concentrations at monitoring stations located along transects downstream from STA-1W and STA-1E during WY2012. The two top graphs show annual mean DO concentrations (± SD) plotted with distance from the rim canal for the STA-1W (A) and STA-1E (B) transects. The two graphs on the bottom show monthly DO concentrations at each station along the STA-1W (C) and STA-1E (D) transects.

Mercury

During WY2012, there were no violations of the Florida Class III numerical water quality standard of 12 nanograms (ng) of total mercury per liter (THg/L) at any STA. The total outflow mercury load was lower than the inflow load. Surface water samples are collected in STA-1E, STA-2, and STA-5 for total mercury (THg) and methylmercury (MeHg) analysis; no water samples were collected in STA-6 due to the Compartment C build-out construction. Surface water mercury monitoring within STA-1W and STA-3/4 was terminated in accordance with the guidelines listed in the Protocol for Monitoring Mercury and Other Toxicants (SFWMD and FDEP, 2011) (see Attachment C). Currently, mercury monitoring in STA-1E is in Phase 2, Tier 1 (note that a request to move to Phase 3, Tier 1 was submitted to the FDEP for their approval), and STA-1W is in Phase 3, Tier 3. STA-2 is currently in Phase 2, Tier 1 (note that request to move to

Phase 3, Tier 3 for Flow-ways 1, 2, and 3 and for Cell 4 was submitted to the FDEP for their approval). STA-3/4 is in Phase 3, Tier 2; STA-5 northern and central flow-ways are in Phase 3, Tier 3; STA-5 Southern Flow-way is in Phase 2, Tier 1; STA-6, Cells 3 and 5, are in Phase 3, Tier 3; and STA-6 Section 2 is in Phase 2, Tier 1.

During WY2012, the annual average mercury concentrations in mosquitofish (*Gambusia affinis*) and sunfish (*Lepomis* spp.) from all interior STA locations were similar to those in 2011. The lowest THg concentration in mosquitofish was found in STA-3/4 and STA-5 while the highest was found in STA-6. For sunfish, the lowest THg concentration was found in STA-3/4 and the highest was found in STA-1E. For largemouth bass (LMB, *Micropterus salmoides*), sample collection was unsuccessful in STA-5 and STA-6. The lowest THg concentration was found in STA-2 and the highest was found in STA-3/4. Based on U.S. Fish and Wildlife Service (USFWS) and USEPA predator protection criteria, fish-eating wildlife foraging within all STAs appear to be at an overall moderate risk to mercury exposure. STA mercury performance criteria are evaluated on an annual basis. If respective action levels are exceeded, then corrective measures are taken in accordance with the FDEP-approved monitoring plans. Additional information on fish mercury concentrations, including spatial and temporal trends within and downstream of each STA, are presented in Attachment C.

Rotenberger Wildlife Management Area Restoration and STA Transect Monitoring

The District monitors adjacent wetland areas that receive discharges from the STAs, which include the Refuge (adjacent to STA-1E and STA-1W), WCA-2A (adjacent to STA-2), and the Rotenberger Wildlife Management Area (adjacent to STA-5) (**Figure 1**). Water and sediment quality, flow, stage and vegetation data are collected at inflow points and along prescribed transects to assess changes in conditions as water moves south. In accordance with the annual reporting requirements of related permits, these WY2012 data are provided in Attachment D.

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Attachment A: Specific Conditions and Cross-References

Tables A-1 through **A-4** provide specific conditions, actions taken, and cross-references for Stormwater Treatment Areas (STAs) constructed under the Everglades Forever Act (EFA). **Table A-1** provides this information for both STA-1 West (STA-1W) and STA-1 East (STA-1E), operation of which is authorized by Florida Department of Environmental Protection (FDEP) permit number 0279499-001-EM. STA-2 (FDEP permit 0126704-008-EM) and STA-3/4 (FDEP permit 0192895) information is provided in **Tables A-2** and **A-3**, respectively. **Table A-4** provides this information for both STA-5 and STA-6, which are authorized by FDEP permit 0131842-009-EM.

Table A-1. Specific conditions, actions taken, and cross-references presented for the Stormwater Treatment Area 1 West (STA-1W) and Stormwater Treatment Area 1 East (STA-1E) projects (EFA permit 0279499-001-EM) in this report.

Specific Condition	Description	Applicable Phase	Action Taken	Reported in the 2013 SFER in: (Note: "V1" = Volume I, Chapter 5; "V3" = Volume III, Appendix 3-1)			
				Table	**Narrative** (page #'s)	**Figure**	**Attachment**
6	Operational Improvements and Enhancements	Stabilization	Repairs to multiple existing water control structures in STA-1E; removed 500 feet berm in Eastern Flow-way PSTA Project; vegetation enhancements in STA-1E and STA-1W		V1:2,16-20, 24	V1: 7,13	
8	STA Operation Plan and Modifications	Stabilization	No modifications made in WY2012				
8A	Minimum Water Level Targets to Avoid Dryout	Stabilization	Implemented drought contingency strategies		V1: 11		
8B	Responding to Dryout Conditions	Stabilization	Drought contingency water levels implemented; supplemental water delivery from Lake Okeechobee	V3: Table B-1	V3: 11, V1: 11, 18, 24	V1: 8	V3: B
8C	Maximum Water Level Targets	ALL	Water levels monitored daily under inflow conditions			V1: 8, 9	
8D	Operational Envelope	Stabilization		V3: 10	V3: 11		
8E	Phosphorus Uptake Optimization	Stabilization	Flows and loads and outflow concentrations for each flow-way are evaluated weekly and if feasible, adjustments are made to the flow-way loadings.		4		
8F	Hydropattern Restoration	Stabilization	On-going				V3: D
10A	Source Control Programs Implementation	Stabilization	Implementation of source control programs continued as required	V1: Ch.4 & App.4-2	V1: Ch.4 & App.4-2	V1: Ch.4 & App.4-2	
10B	Source Control Programs Performance	Stabilization	Annual performance evaluation has been conducted and reported	V1: Ch.4 & App.4-2	V1: Ch.4 & App.4-2	V1: Ch.4 & App.4-2	
10C	Source Control Programs Improvements	Stabilization	Complied with, as required	V1: Ch.4 & App.4-2	V1: Ch.4 & App.4-2	V1: Ch.4 & App.4-2	
11	Water Quantity and Flooding Impacts	Stabilization	NA; no adverse impacts on adjacent lands.				
12	Phosphorus Standard	Stabilization	In progress		V1: 99		

Table A-1. Continued.

Specific Condition	Description	Applicable Phase	Action Taken	Reported in the 2013 SFER in: (Note: "V1" = Volume I, Chapter 5; "V3" = Volume III, Appendix 3-1)			
				Table	Narrative (page #'s)	Figure	Attachment
13	Start-Up Phase	Start-Up	NA – STAs are in Stabilization Phase		V3: 8,11		
13A	Establishment of Marsh Vegetation	Start-Up	NA – STAs are in Stabilization Phase				
13B	Start-Up Monitoring	Start-Up	NA – STAs are in Stabilization Phase				
13C	Phosphorus Start-Up Test	Start-Up	NA – STAs are in Stabilization Phase				
13D	Discharge Operation	Start-Up	NA – STAs are in Stabilization Phase				
13E	Initiation of Flow-Way (Stabilization and Routine Operation) and Discharge and Monitoring	Stabilization	Ongoing	V1: 1; V3: 10, 13	V1: 15, 22	V1: 6,12	
14	Stabilization Phase	Stabilization	Submit strategies and timelines for corrective actions, as needed. Assess total phosphorus (TP) trends, annually. Remedial measures for no positive trend annually.	V3: 9,10	V1: 15, 22	V1: 6, 12	
15	Routine Operation Phase	Routine	NA - STAs currently are in Stabilization Phase				
16	Application of Interim Effluent Limit (IEL)	Stabilization		V3: 8,9, 10	V3: 8,11,16	V3: 3	
16A	Test compliance versus flow above specified minimum stages	Stabilization	NA				
16B	IEL shall not apply during years with rain in excess of maximums	Stabilization	NA – annual rainfall total was found to be below the maximum				
16C	Deemed in compliance unless exceeds IEL as flow-weighted annual average	Stabilization	Complied with in this report	V3: 10			

Table A-1. Continued.

Specific Condition	Description	Applicable Phase	Action Taken	Reported in the 2013 SFER in: (Note: "V1" = Volume I, Chapter 5; "V3" = Volume III, Appendix 3-1)			
				Table	Narrative (page #'s)	Figure	Attachment
17A	Internal Improvements and Enhancements	Stabilization	See 17A(1) and 17A(2) below				
17A(1)	STA-1W Enhancements	Stabilization	Conducted vegetation management activities		V1: 24	13	
17A(2)	STA-1E Enhancements	Stabilization	Conducted vegetation management activities		V1: 16-17, 19	V1:7	
17B(1)	Convert STA1E to Flow-Through Operations	Stabilization	Eastern Flow-way PSTA partial berm removal		V1: 16	V1: 7	
17B(2)	L-8 Diversion	Stabilization	NA at this time				
17B(3)	Additional Treatment Area	Stabilization	NA at this time				
17B(4)	Conveyance Improvements	Stabilization	STA-1E Eastern Flow-way PSTA partial berm removal		V1: 16	V1: 7	
18	Water Quality-Based Effluent Limits (WQBEL)	Stabilization	Evaluated relationship between effluent load and Arthur R. Marshall Loxahatchee National Wildlife Refuge TP (separate submittal), one-time				
19	Operational Envelope	Stabilization	Compared actual to design inflow loads to evaluate effect on performance (see 8D, above)	V3: 10	V3: 8,11		
20	Conditions for Parameters other than Total Phosphorus: Comparison of Outflows to Inflows	Stabilization		V3: 12-14	V3: 16-18, 51, 55, 62, 69, 74, 78	V3: 4	
20A	If annual average outflow concentration does not cause Refuge > water quality standard (WQS), deemed in compliance	Stabilization			V3: 11,16		
20B	If not A but outflow < inflow, deemed in compliance	Stabilization		V3: 13,14	V3: 11,16		

Table A-1. Continued.

Specific Condition	Description	Applicable Phase	Action Taken	Reported in the 2013 SFER in: (Note: "V1" = Volume I, Chapter 5; "V3" = Volume III, Appendix 3-1)			
				Table	Narrative (page #'s)	Figure	Attachment
20C	If not A or B, then deemed in non-compliance	Stabilization		V3: 13,14	V3: 11,16		
21	Dissolved Oxygen, evaluate compliance with site-specific alternative criteria on annual basis using statistics	Stabilization		V3: 15	V3: 20–23	V3: 4	
22	Public Health, Safety or Welfare	Stabilization	On-going				
23	Factors Outside of Permittee's Control	Stabilization	See 23A, 23B, 23C, & 23D below.				
23A	Anomalous Rainfall	Stabilization	Dryout conditions occurred although rainfall not considered anomalous (see 8A and 8C)	V3: Table B-1	V1: 11,18, 24		V3: B
23B	Random Variation	Stabilization	None during WY2012				
23C	Other Factors	Stabilization	Lake Okeechobee and Water Conservation Area 3A were below regulation schedule				
23D	Emergency Conditions	Stabilization	NA; no emergency conditions experienced				
24	Turbidity Monitoring	Stabilization	Monitoring for Best Management Practices and WQS compliance (separate submittal), quarterly				
25	Monitoring Program	Stabilization	Monitoring complied with				
25A	Long-Term Plan	Stabilization			V1:97-99		V1: App. 5-7
25A(1)	Aerial Vegetation Photographs and Mapping	Stabilization		V1: 4, 6	V1: 19-21, 25-27,	V1: 10,15-16	V1: App. 5-5
25A(2)	Mercury	Stabilization			V3: 26-27		V3: Att. C
25A(3)	Routine Monitoring and Research	Stabilization		V1: 1, 3, 5 V3: 10, 13-15	Entire Ch 5; Research V1: 57-95 Monitoring V3: 7-27	V1: 2-3, 6, 12; V3: 3-5	
26	Diversions	Stabilization	NA; None occurred during WY2012				
26A	STA-1W Diversion Limit	Stabilization	NA; None occurred during WY2012	V3: 11			

Table A-1. Continued.

Specific Condition	Description	Applicable Phase	Action Taken	Reported in the 2013 SFER in: *(Note: "V1" = Volume I, Chapter 5; "V3" = Volume III, Appendix 3-1)*			
				Table	**Narrative** (page #'s)	**Figure**	**Attachment**
26B	STA-1E Diversion Limit	Stabilization	NA; None occurred during WY2012	V3: 11			
27	Transects 1W	Stabilization			V3: 24		V3: D
28	Transects 1E	Stabilization			V3: 24		V3: D
29	Inspection Reports	Stabilization	Dike and pump inspections reports (semiannually). Levee and structure reports (annually). These reports are submitted under separate cover. The WY2012 annual levee and structure inspection reports were received by the FDEP in July 2012.				
30	Annual Monitoring Reports	Stabilization	All requirements were complied with.	V1: Ch5, V3: App.3-1	V1: Ch5, V3: App.3-1	V1: Ch5, V3: App.3-1	V1: Ch5, V3: App.3-1
30A	Quality Assurance/Quality Control	Stabilization	All QA/QC requirements were complied with.				V3: B, C
30B	Water Quality Data	Stabilization					V3: B
30C	Performance Evaluation	Stabilization		V3: 10,13,14 V1: 1, 3, 5	V3: 8,11,16–18,20-23 V1: 5, 13, 22	V1: 2-4, 6, 12	
30D	Herbicide and Pesticide Tracking	Stabilization	All herbicide and pesticide applications were recorded.				V3: E
30E	Implementation Schedules	Stabilization	NA				
31	Removal of Parameters	Stabilization	NA; No parameters were removed during WY2012				
32	Addition of Parameters	Stabilization	NA; No parameters were added during WY2012				
34	Emergency Suspension of Sampling	Stabilization	Suspended sampling for Cell 1A due to dryout conditions from March 17–August 18, 2011	V3: Table B-1			V3: B
35	Permit Renewal	Stabilization	NA for WY2012				
36	Permit Modification for STA Optimization	Stabilization	NA; No permit modifications occurred during WY2012				

Table A-2. Specific conditions, actions taken, and cross-references presented for the Stormwater Treatment Area 2 (STA-2) project (EFA permit 0126704-008-EM) in this report.

Specific Condition	Description	Applicable Phase	Action Taken	Reported in the 2013 SFER in: (Note: "V1" = Volume I, Chapter 5; "V3" = Volume III, Appendix 3-1)			
				Table	**Narrative** (page #'s)	**Figure**	**Attachment**
3	Public Use	Stabilization			V1: 96-97		
5	Project Construction – Compartment B Build-Out	Stabilization	Currently under way		V1: 3, 30		
6	Operation and Maintenance	Stabilization		V1: 2	V1:29, 32		
9	Vegetation and Operational Enhancements	Stabilization		V1: 8, V3: 9	V1: 32	V1: 21-23	
11	STA Operation Plan and Modifications	Stabilization	Operations Plan incorporating Compartment B build-out completed August 2012				
11A	Minimum Water Level Targets to Avoid Dryout	Stabilization	Drought contingency strategies were implemented		V1: 11, 30	V1: 19, 20	
11B	Responding to Dryout Conditions	Stabilization	Drought contingency strategies were implemented	V3: Table B-1	V1: 11, 30		V3: B
11C	Maximum Water Level Targets	Stabilization	Water levels monitored daily under inflow conditions				
11D	Operational Envelope	Stabilization		V3: 10	V3: 11		
11E	Phosphorus Uptake Optimization	Stabilization	Flows, loads, and outflow concentrations for each flow-way were evaluated weekly and, when feasible, adjustments were made to the flow-way loadings		V1: 29, 32		
11F	Operational Plan Modification	Stabilization	Complied with as required				
12	Hydropattern Restoration	Stabilization					V3: D
13A	Source Control Programs Implementation	Stabilization	Implementation of source control programs continued as required	V1: Ch.4 & App.4-2	V1: Ch.4 & App.4-2	V1: Ch.4 & App.4-2	
13B	Source Control Programs Performance	Stabilization	Annual performance evaluation has been conducted and reported	V1: Ch.4 & App.4-2	V1: Ch.4 & App.4-2	V1: Ch.4 & App.4-2	

Table A-2. Continued.

Specific Condition	Description	Applicable Phase	Action Taken	Reported in the 2013 SFER in: *(Note: "V1" = Volume I, Chapter 5; "V3" = Volume III, Appendix 3-1)*			
				Table	**Narrative** (page #'s)	**Figure**	**Attachment**
13C	Source Control Programs Improvements	Stabilization	Complied with as required	V1: Ch.4 & App.4-2	V1: Ch.4 & App.4-2	V1: Ch.4 & App.4-2	
14	Minimize Wetland Impacts	Stabilization	Ongoing				V3: D
15	Water Quantity and Flooding Impacts	Stabilization	NA: No adverse impacts on adjacent lands				
16	Phosphorus Standard	Stabilization	In progress				
17	Start-Up Phase	Start-Up	NA – Compartment B cells hydrated; no water quality sampling in WY2012.				
17A	Establishment of Marsh Vegetation	Start-Up	Ongoing: Comp. B vegetation control and grow-in of desired wetland vegetation	V1: 8	V1: 30-33	V1: 21-23	V1: App. 5-5
17B	Start-Up Monitoring	Start-Up	NA – Compartment B cells hydrated; no water quality sampling in WY2012.				
17C	Phosphorus Start-Up Test	Start-Up	NA – Compartment B cells hydrated; no water quality sampling in WY2012.		V3: 8		
17D	Discharge Operation	Start-Up	NA – Compartment B cells hydrated; no water quality sampling in WY2012.		V3: 8		
17E	Initiation of Flow-Way (Stabilization and Routine Operation) and Discharge and Monitoring	Stabilization	NA – Compartment B cells hydrated; no water quality sampling in WY2012.				
18	Stabilization Phase	Stabilization	Submit strategies and timelines for corrective actions as needed. Assess total phosphorus (TP) trends annually. Remedial measures for no positive trend annually	V3: 9,10			
19	Routine Operation Phase	Routine	NA – STA currently is in Stabilization Phase				
20	Operational Envelope	Stabilization	Compare actual to design inflow loads to evaluate effect on performance	V3: 10	V3: 11		
21	Factors Outside of Permittee's Control	Stabilization	See 21A, 21B, 21C, & 21D below				
21A	Anomalous Rainfall	Stabilization	Dryout conditions occurred, although rainfall was not considered anomalous (see 11A and 11B, above)		V1: 30	V1: 19	

Table A-2. Continued.

Specific Condition	Description	Applicable Phase	Action Taken	Reported in the 2013 SFER in: (Note: "V1" = Volume I, Chapter 5; "V3" = Volume III, Appendix 3-1)			
				Table	**Narrative** (page #'s)	**Figure**	**Attachment**
21B	Random Variation	Stabilization	NA; None during WY2012				
21C	Other Factors	Stabilization	Lake Okeechobee and Water Conservation Area 3A were below regulation schedule				
21D	Emergency Conditions	Stabilization	NA: no emergency conditions experienced				
22	Conditions for Parameters other than Total Phosphorus: Comparison of Outflows to Inflows	Stabilization		V3: 13-14	V3: 16-18, 51,55,62,69,74,78	V3: 4	V3: C,D
22A	If annual average outflow concentration does not cause Arthur R. Marshall Loxahatchee National Wildlife Refuge > water quality standards (WQS), deemed in compliance	Stabilization			V3: 11,16		V3: D
22B	If not A but outflow < inflow, deemed in compliance	Stabilization		V3: 13,14	V3: 11,16		
22C	If not A or B, then deemed in non-compliance	Stabilization		V3: 13,14	V3: 11,16		
23	Dissolved Oxygen	Stabilization		V3: 15	V3: 21-24		
24	Turbidity Monitoring	Stabilization	Monitoring for Best Management Practice and WQS compliance (separate submittal) quarterly				
25	Monitoring Program	Stabilization	Monitoring complied with				
25A	Long-Term Plan	Stabilization	Compartment B construction, continued vegetation conversion in Cell 1B	V3: 9	V1: 30, 97-99		V1: App. 5-7
25A(1)	Aerial Vegetation Photographs and Mapping	Stabilization		V1: 8	V1: 32	V1: 21-23	V1: App. 5-5
25A(2)	Mercury Monitoring Program	Stabilization			V3: 26-27		V3: C

Table A-2. Continued.

Specific Condition	Description	Applicable Phase	Action Taken	Reported in the 2013 SFER in: *(Note: "V1" = Volume I, Chapter 5; "V3" = Volume III, Appendix 3-1)*			
				Table	**Narrative** (page #'s)	**Figure**	**Attachment**
25A(3)	Routine Monitoring and Research Program	Stabilization		V1: 7, 13	Ch. 5., Research: V1:57-95; Monitoring V3: 7-27	V1: 2-3, 18	
26	Diversions	Stabilization	No diversions occurred during WY2012				
27	Inspection Reports	Stabilization	Dike and pump inspections reports (semiannually). Levee and structure reports (annually). These reports are submitted under separate cover. The WY2012 annual levee and structure inspection reports were received by the FDEP in July 2012				
28	Annual Monitoring Reports	Stabilization	All requirements for reporting were complied with	V1: Ch5, V3: App3-1	V1: Ch5, V3: App3-1	V1: Ch5, V3: App3-1	V1: Ch5, V3: App3-1
28A	Quality Assurance/ Quality Control	Stabilization	All QA/QC requirements were complied with				V3: B
28B	Water Quality Data	Stabilization		V1: 1, 7 V3: 10, 13-15	V1: 28-29	V1: 2-4	V3: B
28C	Performance Evaluation	Stabilization		V3: 10,13,14 V1: 1, 7	V3: 8,11,16–18,20-23 V1: 28-29	V1: 18 V3: 4	
28D	Herbicide and Pesticide Tracking	Stabilization					V3: E
28E	Implementation Schedules	Stabilization	NA				
29	Removal of Parameters	Stabilization	No parameters were removed during WY2012				
30	Addition of Parameters	Stabilization	No parameters were added during WY2012				
32	Emergency Suspension of Sampling	Stabilization	Suspended monitoring in Cell 1 due to dryout conditions from December 12, 2010 to June 29, 2011	V3: Table B-1			V3: B
33	Permit Renewal	Stabilization	NA for WY2012				
34	Permit Modification for STA Optimization	Stabilization	No permit modifications occurred during WY2012				

Table A-3. Specific conditions, actions taken, and cross-references presented for the Stormwater Treatment Area 3/4 (STA-3/4) projects (EFA permit 0192895) in this report.

Specific Condition	Description	Applicable Phase	Action Taken	Reported in the 2013 SFER in: *(Note: "V1" = Volume I, Chapter 5; "V3" = Volume III, Appendix 3-1)*			
				Table	**Narrative** (page #'s)	**Figure**	**Attachment**
10	STA Operation Plan and Modifications	Post Stabilization	No modification in WY2012				
10A	Minimum Water Level Targets to Avoid Dryout	Post Stabilization	Implemented drought contingency strategies		V1: 11	V1: 26-27	
10B	Responding to Dryout Conditions	Post Stabilization	Drought contingency water levels implemented; supplemental water delivery from Lake Okeechobee	V3: Table B-1	V1: 38-39, V3: 11	V1: 26-27	V3: B
10C	Maximum Water Level Targets	Post Stabilization	Water levels monitored daily under inflow conditions			V1: 26	
10D	Phosphorus Uptake Optimization	Post Stabilization			V1: 4, 36-39, 61-68		
10E	Hydropattern Restoration	Post Stabilization	NA				
10F	Operations Plan Modification	Post Stabilization	NA: No modifications made in WY2012				
11	Hydropattern Restoration	Post Stabilization	NA				
12A	Best Management Practices (BMP) Implementation and Monitoring	Post Stabilization		V1: Ch.4 & App.4-2	V1: Ch.4 & App.4-2	V1: Ch.4 & App.4-2	
12B	BMP Fluctuations	Post Stabilization		V1: Ch.4 & App.4-2	V1: Ch.4 & App.4-2	V1: Ch.4 & App.4-2	
12C	BMP Performance	Post Stabilization		V1: Ch.4 & App.4-2	V1: Ch.4 & App.4-2	V1: Ch.4 & App.4-2	

Table A-3. Continued.

Specific Condition	Description	Applicable Phase	Action Taken	**Reported in the 2013 SFER in:** *(Note: "V1" = Volume I, Chapter 5; "V3" = Volume III, Appendix 3-1)*			
				Table	**Narrative** (page #'s)	**Figure**	**Attachment**
13	Minimization of Wetland Impacts	Post Stabilization	NA: No adverse impacts on adjacent lands				
14	Water Quantity and Flooding Impacts	Post Stabilization	Diversion occurred in late June/early July 2012 to prevent vegetation damage		V1: 39		
15	Structure Inspection Plan	Post Stabilization	Dike and pump inspections reports (semiannually). Levee and structure reports (annually). These reports are submitted under separate cover. The WY2012 annual levee and structure inspection reports were received by the FDEP in July 2012.				
16	Start-Up Phase	Start-Up	NA – STA is in Post-Stabilization Phase				
17	Stabilization Phase	Stabilization Phase	NA – STA is in Post-Stabilization Phase				
18	Post-Stabilization/Normal Flow-Through Operation	Post-Stabilization	Criteria met for WY2012				
19	Conditions for Parameters other than Total Phosphorus: Comparison of Outflows to Inflows	Post Stabilization		V3: 13,14	V3: 16-18, 51, 55, 62, 69, 74, 78	V3: 4	V3: C,D
19A	If annual average outflow concentration does not cause or contribute to violations of applicable Class III water quality standards, deemed in compliance	Post Stabilization		V3: 13,14	V3: 16,18		
19B	If not A but outflow < inflow, deemed in compliance	Post Stabilization		V3: 13,14	V3: 16,18		
19C	If not A or B, then deemed in non-compliance	Post Stabilization		V3: 13,14	V3: 16,18		
20	Dissolved Oxygen, evaluate compliance with site-specific alternative criteria on annual basis using statistics	Post Stabilization		V3: 15	V3: 21-24	V3: 4,5	
22	Factors Outside of Permittee's Control	Post Stabilization	See 22A, 22B, 22C, 22D, & 22E, below.				

Table A-3. Continued.

Specific Condition	Description	Applicable Phase	Action Taken	Reported in the 2013 SFER in: *(Note: "V1" = Volume I, Chapter 5; "V3" = Volume III, Appendix 3-1)*			
				Table	**Narrative** (page #'s)	**Figure**	**Attachment**
22A	Anomalous Rainfall	Post Stabilization	Dryout conditions occurred although rainfall not considered anomalous (see 10A and 10B, above)		V1: 38-39		
22B	Natural Background	Post Stabilization	NA				
22C	Random Variation	Post Stabilization	NA; None during WY2012				
22D	Vegetation Conditions	Post Stabilization			V1: 38-40	V1: 27-30	V1: App. 5-5
22E	Other Factors	Post Stabilization	NA: no unavoidable legal barriers or restraints in WY2012				
23	Emergency Conditions	Post Stabilization	Diversion occurred in WY2012	V3: 11	V1: 2, 39		
25	Permit Modifications for Technological Advances	Post Stabilization	NA - No permit modifications occurred during WY2012				
26	Permit Modifications for Design Changes	Post Stabilization	NA - No permit modifications occurred during WY2012				
27	Permit Modifications for Long-Term Compliance	Post Stabilization	NA - No permit modifications occurred during WY2012				
29	Monitoring Program	Post Stabilization	Monitoring complied with				
29A	Aerial Vegetation Photographs and Mapping	Post Stabilization		V1:10	V1:40	V1: 29, 30	V1:App. 5-6
29B	Research and Monitoring Program	Post Stabilization		V1: 13	V1: 57-95		
30	Annual Monitoring Reports	Post Stabilization	All requirements complied with	V1: Ch5, V3: App3-1	V1: Ch5, V3: App3-1	V1: Ch5, V3: App3-1	V1: Ch5, V3: App3-1
30A	Quality Assurance/Quality Control	Post Stabilization	All QA/QC requirements were met	V3: 7			V3: B
30B	Water Quality Data	Post Stabilization		V1: 1	V1: 5-13, 36-38	V1:2, 3.4, 25	V3: B
30C	Hydraulic Retention Time	Post Stabilization		V1: 1 V3: 10			
30D	Performance Evaluation	Post Stabilization		V1: 1, 9, V3: 10,13,14	V1: 5-13, 36-39 V3: 8,11,16–27	V1:2, 3.4,8 25 V3: 3, 4	
30E	Herbicide and Pesticide Tracking	Post Stabilization					V3: E

Table A-3. Continued.

Specific Condition	Description	Applicable Phase	Action Taken	Reported in the 2013 SFER in: *(Note: "V1" = Volume I, Chapter 5; "V3" = Volume III, Appendix 3-1)*			
				Table	**Narrative** (page #'s)	**Figure**	**Attachment**
30F	Implementation Schedules	Post Stabilization	NA				
31	Removal of Parameters	Post Stabilization	NA - No parameters were removed during WY2012				
32	Addition of Parameters	Post Stabilization	NA - No parameters were added during WY2012				
34	Emergency Suspension of Sampling	Post Stabilization	Suspension of sampling at Cell 1A due to dryout from March 21–June 28, 2011	V3: Table B-1			V3: B

Table A-4. Specific conditions, actions taken, and cross-references presented for the Stormwater Treatment Area 5/6 (STA-5/6) projects (EFA permit 0131842-009-EM) in this report.

Specific Condition	Description	Applicable Phase	Action Taken	Reported in the 2013 SFER in: *(Note: "V1" = Volume I, Chapter 5; "V3" = Volume III, Appendix 3-1)*			
				Table	**Narrative** (page #'s)	**Figure**	**Attachment**
3	Public Use	Stabilization			V1: 96-97		
4	Project Construction - Compartment C	Stabilization	Currently under way		V1:52-53	V1: 37	
5	Operation and Maintenance	Stabilization			V1: 49-50, 54		
8	Vegetation and Operational Enhancements	Stabilization		V3: 9	V1: 2, 54	V1: 38, 39	
10	STA Operation Plan and Modifications	Stabilization	NA: Integrated Operations Plan was written 10/2008				
10A	Minimum Water Level Targets to Avoid Dryout	Stabilization			V1: 11, 49-50, 52	V1: 34	
10B	Responding to Dryout Conditions	Stabilization		V3: 9, B-1	V3: 11, V1: 52	V1: 36	V3: B
10C	Maximum Water Level Targets	Stabilization	Water levels monitored daily under inflow conditions		V1: 49-50	V1: 34	
10D	Operational Envelope	Stabilization		V3: 10	V3: 11		
10E	Phosphorus Uptake Optimization	Stabilization			V1:45-54, 87-88	V1:32-33, 63-66	
10F	Operations Plan Modifications	Stabilization	NA – no modifications in WY2012				
11	Hydropattern Restoration	Stabilization			V3: 27		V3: D
12	Rotenberger Wildlife Management Area Restoration	Stabilization		V3: 7	V3: 27		V3: D
13	Implementation of Source Control Programs	Stabilization	See 13A, B, C, below.				
13A	Source Control Programs Implementation	Stabilization	Implementation of source control programs continued as required	V1: Ch.4 & App.4-2	V1: Ch.4 & App.4-2	V1: Ch.4 & App.4-2	

Table A-4. Continued.

Specific Condition	Description	Applicable Phase	Action Taken	Reported in the 2013 SFER in: *(Note: "V1" = Volume I, Chapter 5; "V3" = Volume III, Appendix 3-1)*			
				Table	**Narrative** (page #'s)	**Figure**	**Attachment**
13B	Source Control Programs Performance	Stabilization	Annual performance evaluation has been conducted and reported	V1: Ch.4 & App.4-2	V1: Ch.4 & App.4-2	V1: Ch.4 & App.4-2	
13C	Source Control Programs Improvements	Stabilization	Complied with as required	V1: Ch.4 & App.4-2	V1: Ch.4 & App.4-2	V1: Ch.4 & App.4-2	
14	Minimization of Wetlands Impacts	Stabilization	Environmentally sensitive areas in Compartment C		V1: 53		
15	Water Quantity and Flooding Impacts	Stabilization	NA – no adverse impacts on adjacent lands				
16	Phosphorus Standard	Stabilization			V1: 49	V1: 33	
17	Start-Up Phase	Start-Up	NA – some of the Compartment C cells hydrated; no water quality sampling in WY2012.		V1: 3, 52-53		
17A	Establishment of Marsh Vegetation	Start-Up	On-going: Compartment C vegetation control and grow-in of desired wetland vegetation		V1: 3, 52-53		
17B	Start-Up Monitoring	Start-Up	NA – some Compartment C cells hydrated; no water quality sampling in WY2012.		V3: 8		
17C	Phosphorus Start-Up Test	Start-Up	NA – some Compartment C cells hydrated; no water quality sampling in WY2012.		V3: 8		
17D	Discharge Operation		NA – some Compartment C cells hydrated; no water quality sampling in WY2012.		V3: 8		
17E	Initiation of Flow-Way (Stabilization and Routine Operation) and Discharge and Monitoring	Stabilization	NA – some Compartment C cells hydrated; no water quality sampling in WY2012.				
18	Stabilization Phase	Stabilization Phase	Submit strategies and timelines for corrective actions, as needed. Assess total phosphorus (TP) trends annually. Remedial measures for no positive trend annually	V3: 9	V1: 49	V1: 32, 33	
19	Routine Operation Phase	Routine Phase	NA - STA is in Stabilization Phase				
20	Operational Envelope	Stabilization	Compare actual to design inflow loads to evaluate effect on performance annually	V3: 10	V3: 11		

Table A-4. Continued.

Specific Condition	Description	Applicable Phase	Action Taken	Reported in the 2013 SFER in: *(Note: "V1" = Volume I, Chapter 5; "V3" = Volume III, Appendix 3-1)*			
				Table	**Narrative** (page #'s)	**Figure**	**Attachment**
21	Factors Outside of Permittee's Control	Stabilization	See 21A, 21B, 21C, 21D below				
21A	Anomalous Rainfall	Stabilization	Dryout conditions occurred although rainfall not considered anomalous (see 10A and 10B, above)		V1: 49-50, 52	V1: 34	
21B	Random Variation	Stabilization	NA - None during WY2012				
21C	Other Factors	Stabilization	Culturally sensitive areas in Compartment C; no operation until issuance Compartment C operating permit		V1: 52-53		
21D	Emergency Conditions	Stabilization	NA – there were no discharges through G-407 in WY2012	V3: 11			
22	Conditions for Parameters other than Total Phosphorus: Comparison of Outflows to Inflows	Stabilization		V3: 13,14	V3: 16-18, 51, 55, 62, 69, 74, 78	V3: 4	V3: C, D
22A	If annual average outflow concentration does not cause or contribute to violations of applicable Class III water quality standards, deemed in compliance	Stabilization		V3: 13, 14	V3: 11, 16, 18		
22B	If not A but outflow < inflow, deemed in compliance	Stabilization		V3: 13, 14	V3: 11,16,18		
22C	If not A or B, then deemed in non-compliance	Stabilization		V3: 13, 14	V3: 11,16,18		
23	Dissolved Oxygen	Stabilization		V3: 15	V3: 20–24		
24	Turbidity Monitoring	Stabilization	Monitoring for Best Management Practice and WQS compliance (separate submittal) quarterly				
25	Monitoring Program	Stabilization	Monitoring complied with				
25A	Long-Term Plan	Stabilization	Compartment C Build-out; vegetation management activities	V3: 9	V1: 52-53, 97-99		V1: App. 5-7
25A(1)	Aerial Vegetation Photographs and Mapping	Stabilization		V1:12	V1:55	V1: 39	V1: App. 5-5
25A(2)	Mercury Monitoring Program	Stabilization			V3: 26-27		V3: C

Table A-4. Continued.

Specific Condition	Description	Applicable Phase	Action Taken	Reported in the 2013 SFER in: *(Note: "V1" = Volume I, Chapter 5; "V3" = Volume III, Appendix 3-1)*			
				Table	**Narrative** (page #'s)	**Figure**	**Attachment**
25A(3)	Routine Monitoring and Research Program	Stabilization		V1: 1, 3, 5	Research: V1: 57-97 Monitoring V3: 7-27	V1: 2-3, 32-33	
26	Diversions	Stabilization	NA – there were no diversions in WY2012				
27	Inspection Reports	Stabilization	Dike and pump inspections reports (semiannually). Levee and structure reports (annually). These reports are submitted under separate cover. The WY2012 annual levee and structure inspection reports were received by the FDEP in July 2012				
28	Annual Monitoring Reports	Stabilization	All reporting requirements were complied with				
28A	Quality Assurance/Quality Control	Stabilization	All QA/QC requirements were met	V3: 7			V3: B
28B	Water Quality Data	Stabilization			V1: 6,7,26	V1: 16,17	V3: B
28C	Performance Evaluation	Stabilization		V1: 1, 11 V3: 10,13,14	V1: 45-52; 87-88 V3: 8,11,16–18, 20-23	V1: 2-4, 32-33, 62-66	
28D	Herbicide and Pesticide Tracking	Stabilization		V3: 7			V3: E
28E	Implementation Schedules	Stabilization			V1:49, 52-54,		
29	Removal of Parameters	Stabilization	NA - No parameters were removed during WY2012				
30	Addition of Parameters	Stabilization	NA - No parameters were added during WY2012				
32	Emergency Suspension of Sampling	Stabilization	Suspension of sampling for STA-5 for Cells 1A, 2A, 2B, 3A and 3B and STA-6 Cells 3 and 5 due to dryout. STA-6 offline due to construction of Compartment C.	V3: Table B-1			V3: B
33	Permit Renewal	Stabilization	NA for WY2012				
34	Permit Modification for STA Optimization	Stabilization	NA - No permit modifications occurred during WY2012				

Attachment B: Supporting Information on Water Quality Data for the Everglades STAs and Downstream Transects for Water Year 2012

This project information is required by Specific Conditions 27, 28, 30(b), and 34 of the EFA permits for STA-1W, STA-1E, and STA-3/4, and by Specific Conditions 25(b)3, 28(b), and 32 of the EFA permits for STA-2, STA-5, and STA-6. This information is also required by the Administrative Order for STA-5 and STA-6, and under Findings of Fact Number 20 for each of the above-mentioned STAs, and is available upon request. All sampling and monitoring data referenced in this attachment were collected, analyzed, reported, and retained in accordance with Chapter 62-160, F.A.C. Information on suspension and resumption of sampling in the STAs due to dryout or construction during WY2012 is provided in this attachment in **Table B-1**.

Table B-1. STA suspension and resumption of sampling due to dryout or construction during WY2012 (EFA specific condition 34 for STA-1W, STA-1E, and STA-3/4, and specific condition 32 for STA-2, STA-5, and STA-6)

STA	Cell	Date FDEP Notified of Anticipated Dryout	Inflow							Outflow						
			Structure	Grab Samples			Composite Samples			Structure	Grab Samples			Composite Samples		
				Sampling Suspended	Date Suspended	Date Resumed	Sampling Suspended	Date Suspended	Date Resumed		Sampling Suspended	Date Suspended	Date Resumed	Sampling Suspended	Date Suspended	Date Resumed
STA-1E	1	3/9/2011	S363C	Yes	3/17/2011	7/18/2011	No	-	-	S364A	Yes	3/17/2011	7/18/2011	No	-	-
STA-1E	1	1/27/2012	S363C	Yes	2/6/2012		No	-	-	S364A	Yes	2/6/2012		No	-	-
STA-1E	2	1/27/2012	S364A	Yes	2/6/2012		No	-	-	S365A S365B	Yes	2/6/2012		No	-	-
STA-2	1	12/8/2010	G329B	Yes	12/22/2010	6/29/2011	No	-	-	G330D	Yes	12/22/2010	6/29/2011	No	-	-
STA-2	4	12/1/2010	G337A	Yes	11/23/2010		No	-	-	G368	Yes	11/23/2010		No	-	-
STA-3/4	1A	3/10/2011	G374B G374E	Yes	3/21/2011	6/28/2011	No	-	-	G375B G375E	Yes	3/21/2011	6/28/2011	No	-	-
STA-5	1A	12/8/2010	G342A* G342B*	Yes	12/29/2010	6/29/2011	No	-	-	-	No	-	-	No	-	-
STA-5	2A	12/8/2010	G342C* G342D*	Yes	12/29/2010	6/29/2011	No	-	-	G343F G343G	Yes	12/29/2010	6/29/2011	No	-	-
STA-5	2B	3/16/2011	G343F G343G	Yes	12/29/2010	6/29/2011	No	-	-	G344C* G344D*	Yes	3/23/2011	6/29/2011	No	-	-
STA-5	3A	12/8/2010	G342E* G342F*	Yes	12/29/2010	7/13/2011	No	-	-	G343I G343J	Yes	12/29/2010	7/13/2011	No	-	-
STA-5	3B	12/8/2010	G343I G343J	Yes	12/29/2010	7/13/2011	No	-	-	G344E G344F*	Yes	12/29/2010	7/13/2011	No	-	-

Table B-1. (Continued)

STA	Cell	Date FDEP Notified of Anticipated Dryout	Inflow							Outflow						
			Structure	Grabs Samples			Composite Samples			Structure	Grab Samples			Composite Samples		
				Sampling Suspended	Date Suspended	Date Resumed	Sampling Suspended	Date Suspended	Date Resumed		Sampling Suspended	Date Suspended	Date Resumed	Sampling Suspended	Date Suspended	Date Resumed
STA-5	1A	3/28/2012	G342A* G342B*	Yes	4/3/2012	6/13/2012	No	-	-	G343B G343C	Yes	4/3/2012	6/13/2012	No	-	-
STA-5	2A	3/28/2012	G342C* G342D*	Yes	4/3/2012	6/13/2012	No	-	-	G343F G343G	Yes	4/3/2012	6/13/2012	No	-	-
STA-5	3A	3/28/2012	G342E* G342F*	Yes	4/3/2012		No	-	-	G343I G343J	Yes	4/3/2012		N/A No	-	-
STA-5	3B	3/28/2012	G343I G343J	Yes	4/3/2012		N/A No	-	-	G344E* G344F*	Yes	4/3/2012		Yes	4/3/2012	
STA-6	2	12/1/2010	G396B*	Yes	11/23/2010		Yes	11/23/2010	-	G352B*	Yes	11/23/2010		No	-	-
STA-6	3	12/8/2010	G353C	Yes	12/29/2010	6/30/2011	No	-	-	G393B*	Yes	12/29/2010	6/30/2011	No	-	-
STA-6	5	12/8/2010	G353A G353B*	Yes	12/29/2010	6/30/2011	No	-	-	G354C*	Yes	12/29/2010	6/30/2011	No	-	-
STA-6	5	3/13/2012	G353C	Yes	3/28/2012		No	-	-	G393B*	Yes	3/28/2012		Yes	3/28/2012	
STA-6	3	3/13/2012	G353A G353B*	Yes	3/28/2012		No	-	-	G354C*	Yes	3/28/2012		Yes	3/28/2012	

* = Permit compliance site

☐ = Suspension due to construction of the Compartment C build-out

= Hg Monitoring has also been suspended at these structures

Attachment C: Annual Permit Compliance Monitoring Report for Mercury in the STAs

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In addition to the information provided in this attachment, additional supplemental information is required by Specific Conditions 27, 28, and 30(b) of the EFA permits for STA-1W, STA-1E, and STA-3/4, and by Specific Conditions 25(b)3 and 28(b) of the EFA permits for STA-2, STA-5, and STA-6. This information is also required by the Administrative Order for STA-5 and STA-6, and under Findings of Fact Number 20 for each of the above-mentioned STAs, and is available upon request.

KEY FINDINGS AND OVERALL ASSESSMENT

This report summarizes data from compliance monitoring of mercury (Hg) storage, reduction, release, and biomagnification in the Stormwater Treatment Areas (STAs) for Water Year 2012 (WY2012) (May 1, 2011–April 30, 2012). Key findings are as follows:

1. **All STAs:** There were no violations of the Florida Class III numerical water quality standard of 12 nanograms (ng) of total mercury per liter (THg/L) during the reporting year at any of the STAs and the projects have met all action level requirements listed in the Protocol for Monitoring Mercury and Other Toxicants (SFWMD and FDEP, 2011). With the exception of one out of range largemouth bass in STA-3/4, total mercury concentrations in mosquitofish, sunfish, and largemouth bass in STA interior stations for WY2012 did not exceed U.S. Fish and Wildlife Service (USFWS) and U.S. Environmental Protection Agency (USEPA) predator protection criteria.
2. **STA-1W:** Since its start as the Everglades Nutrient Removal Project in 1994, methylmercury (MeHg) biomagnification in resident large-bodied fish such as sunfish (*Lepomis* spp.) and largemouth bass (*Micropterus salmoides*) in STA-1W has remained relatively constant over the monitoring period at levels almost an order of magnitude lower than those observed in fish from downstream Everglades sites and lower than the other STAs. Mercury levels in STA-1W in fish across trophic levels did not pose a threat to fish-eating wildlife based on USFWS and USEPA predator protection criteria. Consistent with the Protocol for Monitoring Mercury and Other Toxicants (SFWMD and FDEP, 2011), all mercury monitoring was terminated in STA-1W in 2009 (see the *Phase 3: Operational Monitoring* section of this attachment).

3. **STA-1E:** During WY2012, surface water total mercury (THg) and MeHg inflow and outflow concentrations were comparatively moderate in STA-1E. THg and MeHg loads in outflow were less than inflow. Mercury levels in mosquitofish (*Gambusia holbrooki*) and sunfish (*Lepomis* spp.) from the interior marshes were the third lowest of all STAs. Mercury levels in largemouth bass in STA-1E interior were the lowest among STAs. Regarding risks to fish-eating wildlife, mosquitofish and sunfish (trophic level 2 or 3) from the interior locations did not exceed the USEPA's 77 nanograms per gram (ng/g) predator protection criterion; however, mosquitofish and sunfish from the downstream location did exceed the criterion. All sunfish from the interior marsh of STA-1E had mercury concentrations below both USFWS (100 ng/g) and most sunfish were below USEPA (77 ng/g) criteria for trophic level (TL) 3 fish. However, nearly all downstream sunfish assayed had concentrations greater than 77 ng/g. All largemouth bass from the interior marsh did not exceed the USEPA criterion (346 ng/g) for TL 4 fish species. No largemouth bass were collected from the downstream site due to lack of fish under drought conditions.

4. **STA-2:** During WY2012 in STA-2, both THg and MeHg were among the lowest concentrations in both inflow and outflow relative to other STAs. Although THg and MeHg were at the highest loading rates among STAs, STA-2 displayed the highest MeHg load reduction. The THg level in mosquitofish from STA-2 marsh interior was the lowest among actively monitored STAs. Sunfish and largemouth bass THg concentrations from interior cells were also the lowest. All mosquitofish within and downstream of STA-2 contained mercury levels less than both the USFWS and USEPA predator protection criteria for TL 3 species. THg levels in all sunfish from the interior and downstream locations were below the USFWS criterion of 100 ng/g for TL 2 or TL 3 species. Largemouth bass from the STA interior contained THg level lower than EPA criterion (346 ng/g) for TL 4 fish species while at downstream, largemouth bass contained THg level greater than the EPA criterion.

5. **STA-3/4:** Consistent with the Protocol for Monitoring Mercury and Other Toxicants (SFWMD and FDEP, 2011), THg and MeHg surface water sampling is no longer conducted in STA-3/4, mosquitofish was sampled on a semiannual frequency and sunfish and LMB sampling is on a triennial frequency. The average Hg level in mosquitofish from STA-3/4 was the lowest among STAs and lower than the USEPA criterion (77 ng/g). Sunfish in the STA interior was one of the lowest compared to other STAs and below USEPA criterion. Sunfish in the downstream site was below USEPA criterion. Largemouth bass in both interior and downstream exceeded USEPA criterion (346 ng/g) but were below 90 percent POR all STA basin and downstream fish THg levels.

6. **STA-5:** Water-column concentrations of both THg and MeHg were comparatively moderate for the inflows and outflows of STA-5 during WY2012 and well below USEPA surface water criterion for THg (12 ng/L). At the outflow, there was a net reduction of THg but not for MeHg due to a single high MeHg concentration. Mosquitofish collected from STA-5 in WY2012 contained moderate annual mean mercury levels, compared to the other STAs. The average annual mosquitofish composite for WY2012 and each individual mosquitofish composite for all locations within STA-5 did not exceed the POR 75th percentile for all downstream Everglades sampling locations. Mosquitofish THg level at outflow was the lowest among all STA outflow/downstream stations. Sunfish collected from the interior marsh contained one of the lowest THg level among STAs. Sunfish from downstream in WY2012 contained considerably lower THg level than WY2011 and was below FWC criterion (100 ng/g). Similar to WY2010 and WY2011, despite a concerted collection effort, no largemouth bass were caught.

7. **STA-6:** No surface water samples were taken for THg and MeHg analysis due to STA-6 Compartment C construction. Levels of mercury in mosquitofish from the interior of STA-6

for WY2012 remained the highest of all STAs, but together with mosquitofish in the downstream location, were well below the 77 ng/g USEPA criterion. Sunfish from the interior marsh did not exceed the USEPA criterion and sunfish from the downstream site exceeded the USFWS 100 ng/g criterion, but was below the 75 percent POR for downstream monitoring sites. No largemouth bass samples were available from the interior STA-6 for WY2012. Largemouth bass THg level collected at the downstream site were below both USEPA Trophic Level 4 criterion and the 75 percent POR for all downstream locations.

INTRODUCTION

This attachment contains the annual permit compliance monitoring report for mercury (Hg) in the Everglades Stormwater Treatment Areas (STAs) by the South Florida Water Management District (District or SFWMD) and summarizes the mercury-related reporting requirements of Florida Department of Environmental Protection (FDEP) permit number 0279499-001-EM [STA 1 West (STA-1W) and STA 1 East (STA-1E)], 0126704-008-EM (STA-2), 192895 (STA-3/4) and 0131842-009-EM (STA-5/6 and Compartment C) under the Everglades Forever Act (EFA) [Chapter 373.4592, Florida Statutes (F.S.)].

This report summarizes the results of monitoring in Water Year 2012 (WY2012) (May 1, 2011–April 30, 2012) for surface water and fish in STA-1E, STA-2, STA-3/4, STA-5, and STA-6. The results of mercury monitoring at far-field sites downstream of the STAs in accordance with these permits, as well as non-Everglades Construction Project (non-ECP) discharge structures (permit number 06.502590709), are reported separately in Appendix 3-2, Attachment F of this volume.

This report consists of key findings and overall assessment, an introduction and background, a summary of the Mercury Monitoring and Assessment Program (MMAP), and monitoring results. The background section briefly summarizes previously identified and published concerns regarding possible impact of STA operations on South Florida's mercury problem. The following sections summarize MMAP, quality assurance/quality control (QA/QC), and statistical applications, followed by a summary and discussion of monitoring results. The monitoring results section comprises the bulk of new discussion. The last section of this attachment provides updates on mercury monitoring network optimization in each STA.

BACKGROUND

STAs are constructed wetlands designed to remove total phosphorus (TP) from stormwater runoff originating from upstream agricultural areas and other areas, including Lake Okeechobee releases. The original Everglades STAs, totaling over 65,000 acres and approximately 45,000 acres of effective treatment area, were built as part of the Everglades Construction Project (ECP) authorized under the EFA (Chapter 373.4592, F.S.).

Even before passage of the EFA in 1994, concerns were being raised that attempts to reduce downstream eutrophication could inadvertently aggravate the mercury problem known to be present in the Everglades (Ware et al., 1990; Mercury Technical Committee, 1991). These concerns stemmed from studies in other areas that showed flooded soils in new impoundments were sources of inorganic mercury (Cox et al., 1979). Of greater concern, studies also showed wetlands to be a significant site of mercury methylation.

Methylmercury (MeHg) is more bioaccumulative and toxic than the inorganic or elemental form of mercury (St. Louis et al., 1994; Rudd, 1995). Decomposition of flooded terrestrial vegetation and soil carbon in new reservoirs was reported to stimulate the sulfate-reducing bacteria that methylate inorganic mercury (Kelly et al., 1997; Paterson et al., 1998).

Environments that favor methylation also drive bioaccumulation. For example, Paterson et al. (1998) found that annual fluxes of MeHg increased 10 to 100 times through a zooplankton community after impoundment.

Newly created reservoirs were also found to contain fish with elevated mercury levels (Abernathy and Cumbie, 1977; Bodaly et al., 1984; Bodaly and Fudge, 1999). This so-called "reservoir effect" can persist for several decades after initial soil flooding (Bodaly et al., 1984; Verdon et al., 1991; Fink et al., 1999). For instance, Verdon et al. (1991) reported that total mercury levels in northern pike (*Esox lucius*) increased from 0.61 to 2.99 parts per million (ppm or milligrams per liter) and continued to increase nine years after the initial soil flooding. Given these observations, Kelly et al. (1997) recently recommended that in siting a new reservoir, total land area flooded should be minimized, and flooding of wetlands, which contain more organic carbon than uplands, should be avoided.

However, applying these recommendations directly to the Everglades is problematic because most of the observations were made in deepwater lakes or reservoirs in temperate regions. In a report to the SFWMD on the potential impact of nutrient removal on the Everglades mercury problem, Watras (1993) stated that "the boreal and temperate watersheds, wetlands and reservoirs studied to date are very different geologically, hydrologically, meteorologically and ecologically from the subtropical systems in the Everglades." Watras recommended monitoring and integrating mass balance and process-oriented studies to understand how this subtropical system would behave. Such studies were initiated in 1994 with the start-up of the prototype STA, the Everglades Nutrient Removal (ENR) Project (later incorporated within Stormwater Treatment Area 1 West). Baseline collections at the ENR Project found no evidence of MeHg spikes in either surface water (PTI, 1994 attributed to KBN, 1994a; Watras, 1993 and 1994) or resident fish [mosquitofish (*Gambusia holbrooki*) and largemouth bass (*Micropterus salmoides*)] (PTI, 1994 attributed to KBN, 1994b].

During the first two years of operation, median concentrations of total mercury (THg) and MeHg in unfiltered surface water were reported to be 0.81 and 0.074 nanograms per liter (ng/L), respectively (Miles and Fink, 1998). These low levels persisted in later years: from January 1998 through April 1999, median water-column concentrations in the interior marsh (i.e., excluding inflows and outflows) were 0.81 ng THg/L and 0.04 ng MeHg/L (Rumbold and Fink, 2002b). Resident fish also continued to have only low mercury levels: 8–75 nanograms per gram (ng/g) in mosquitofish, and 100–172 ng/g largemouth bass age-standardized to three years (age-3) (Miles and Fink, 1998; SFWMD, 1999a; Lange et al., 1999). Finally, a mass balance assessment found the ENR Project to be a net sink for both THg and MeHg, removing approximately 70 percent of the inflow mass (Miles and Fink, 1998). Nonetheless, to provide continuing assurance that EFA implementation does not exacerbate the mercury problem, the FDEP construction and operating permits issued for the STAs require the SFWMD to monitor levels of THg and MeHg in various abiotic (e.g., surface water and sediment) and biotic (e.g., fish and bird tissues) media, both within STAs and the downstream receiving waters (see also Appendix 3-2, Attachment F of this volume).

Results from monitoring programs at STAs constructed and operated since 1999 (after the ENR Project) have revealed transitory spikes in MeHg production (see previous reports published by the SFWMD, including Rumbold and Fink, 2002b). Combined with the results of a 1999 field study on the effect that drought and muck fires had on mercury cycling in the Everglades (Krabbenhoft and Fink, 2001), these monitoring results demonstrated that spikes can sometimes occur following dryout and rewetting. Accumulating evidence suggests that oxidation of sulfide pools in the sediments (e.g., organic sulfide, disulfides, acid volatile sulfides) during dryout can lead to increased methylation upon rewetting of the marsh either by providing free sulfate, which stimulates sulfate-reducing bacteria or, in highly sulfidic areas, by reducing porewater sulfide, which can inhibit methylation (Benoit et al., 1999a and b).

OVERVIEW OF THE MERCURY MONITORING AND ASSESSMENT PROGRAM

The following section provides information on current monitoring and reporting activities used for the District's Mercury Monitoring and Assessment Program (MMAP) (SFWMD, 1999c). The MMAP was initially developed for the Everglades Construction Project, the Central and Southern Florida Project, and the Everglades Protection Area (EPA). The SFWMD developed and submitted a plan to the FDEP, the U.S. Environmental Protection Agency (USEPA), and the U.S. Army Corps of Engineers (USACE) in compliance with the permit requirements (SFWMD, 1999b) and was later approved. Details on the procedures for ensuring the quality of and accountability for data generated under this monitoring program were set forth in the SFWMD's Quality Assurance Project Plan (QAPP) for the Mercury Monitoring and Assessment Program (SFWMD, 1999c), which was also approved on issuance of the FDEP permit. QAPP revisions were approved by the FDEP on June 7, 1999.

On February 13, 2006, a revised sampling protocol was approved by the FDEP and the District which was entitled A Protocol for Monitoring Mercury and Other Toxicants (Protocol). Adapted from Rumbold and Pfeuffer (2005), this new plan was developed to replace the initial plan developed under the MMAP. The primary drivers of the Protocol are to (1) streamline sampling procedures, (2) eliminate the need for extended, open-ended sampling activities, and (3) phase out surface water sampling. The Protocol continues to use the QAPP modified in 1999. As of May 16, 2008, all mercury monitoring within each STA follows the Protocol. On September 29, 2009, additional modifications to the Protocol were approved by FDEP that involved altering the fish collection length for largemouth bass to the current range of 307–385 millimeters (mm). The Protocol was formally updated in April 2011 (SFWMD and FDEP, 2011) to reflect the agreed-upon change in the size of fish collected for analysis and is in agreement with CERP Guidance Memorandum 42 on the same subject. The change in size reflects a more appropriate age for evaluating contaminant concentrations.

PROTOCOL FOR MONITORING MERCURY AND OTHER TOXICANTS

Phase 1: Baseline Collection and Assessment

Phase 1 baseline collection and assessment is meant to provide information regarding the likelihood that a constructed facility under an EFA project may exacerbate or create a mercury (or other toxicant) problem. Identifying problematic areas will allow managers to avoid sites or areas that may present risk. Phase 1 is operated under three levels: Tier 1 (Compilation and Review of Available Data), Tier 2 (Field Sampling), and Tier 3 (Bioaccumulation Tests and Dynamic Modeling). Under Tier 1, the Environmental Site Assessment (ESA) is evaluated to determine (1) if any corrective actions were taken during the ESA, (2) there was potential for contamination, or (3) the time interval between the ESA and project construction. If information data gaps exist, or where the preponderance of baseline data demonstrates a potential problem, then Phase 1, Tier 2 or Tier 3 is initiated. Under Phase 1, Tier 2, three representative soil/sediment cores are collected and analyzed from five locations within each operable unit [i.e., Operating Unit (OU) - each independently operated treatment train] or each 1,000 acre parcel, whichever is smaller, At each location, three cores from the 0-to-4 cm horizon are collected and composited as a single soil sample and analyzed for several constituents that help evaluate MeHg production and mercury bioaccumulation.

Phase 1, Tier 3 is initiated if at least one of the following occurs: (1) absolute concentrations of MeHg or average percent MeHg in sediments/soils from an OU exceeds the 90 percent upper confidence level of the basin average or, if not available, the 75th percentile concentration (percent MeHg) for all basins; or (2) ambient fish collected with the project boundary demonstrate excessive bioaccumulation that exceeds the 90 percent upper confidence level of the basin-wide average or, if that value is not available, the 75th percentile concentration for all basins. Phase 1, Tier 3 is used to evaluate extending uncertainties surrounding mercury bioaccumulation. This is accomplished through the use of bioaccumulation testing and modeling.

Phase 2: Monitoring During Three-Year Stabilization Period

If Phase 1 monitoring is not necessary, then Phase 2, Tier 2 monitoring can occur following OU flow-through. Under Phase 2, Tier 1, one surface water sample is collected and analyzed for THg and MeHg on a quarterly basis at inflow and outflow structures. Additionally, at least 100 mosquitofish are collected quarterly from multiple locations within each OU to be composited and analyzed for THg. Sunfish (*Lepomis* spp.) and largemouth bass (LMB) ($n \geq 5$) are collected and analyzed for THg annually.

Six criteria are used to evaluate the performance of each OU with respect to mercury bioaccumulation and enhancement (SFWMD and FDEP, 2011). These criteria are related to long-term trends in fish tissue concentrations, surface water THg/MeHg loading, and water quality standards. If any of the action criteria is exceeded, then Phase 2, Tier 2 is triggered. Tier 2 sequentially involves (1) notifying the permitting authority, (2) resampling the media that triggered Tier 2 monitoring, (3) evaluating the spatial and temporal extent of the mercury bioaccumulation/enhancement accompanied with bioaccumulation modeling, and (4) developing an adaptive management plan.

Phase 3: Operational Monitoring

If after the first three years of monitoring, neither downstream loading nor residue levels in fish have exceeded action levels in the two years prior, then the project can move into Phase 3, Tier 1. Under Phase 3, Tier 1, (1) surface water sampling is discontinued, (2) the frequency of mosquitofish collection is reduced to semiannually, and (3) the frequency of large-bodied fish collection is reduced to one collection every three years. If the conditions are not met within the first three years, then criteria can be reevaluated annually based on the preceding two-year period.

Phase 3, Tier 2 is triggered if (1) the annual average THg levels in mosquitofish progressively increase over time, (2) any semiannual mosquitofish composite exceeds the 90 percent upper confidence level of the basin-wide annual average (or, if basin-specific data are lacking, exceeds the 75th percentile concentration for the period of record for all basins), or (3) if triennial monitoring of large-bodied fish (i.e., in years 6–9) reveal tissue mercury levels have statistically increased over time (i.e., over two or more years) or have become elevated to the point of exceeding the 90 percent upper confidence level of the basinwide annual average (or if basin-specific data are lacking, exceeds the 75th percentile for the period of record for all basins).

If fish under Phase 3 operational monitoring have not exceeded action levels by the ninth year, project-specific mercury monitoring can be moved into Phase 3, Tier 3. Under Phase 3, Tier 3, all of the project's mercury-related monitoring is discontinued; however, project managers are cautioned that action levels may be revised in the future.

QUALITY ASSURANCE MEASURES

Quality assurance and quality control (QA/QC) are integral to all monitoring programs. A stringent QA/QC program is especially critical when dealing with ultra-trace concentrations of analytes in natural and human-impacted environments. Quality assurance includes design, planning, and management activities conducted prior to implementing the project to ensure that the appropriate types and quantities of data will be collected with the required representativeness, accuracy, precision, reliability, and completeness. The goals of QA are to ensure (1) standard collection, processing, and analysis techniques will be applied consistently and correctly, (2) the number of lost, damaged, and uncollected samples will be minimized, (3) the integrity of the data will be maintained and documented from sample collection to entry into the data record, and (4) data are usable based on project objectives.

QA measures are incorporated during the sample collection and laboratory analysis to evaluate the quality of the data. These measures give an indication of measurement error and bias (or accuracy and precision). Aside from using these results to indicate data quality, an effective QA program must utilize QC results to determine areas of improvement and implement corrective measures. QC measures include both internal and external checks. Typical internal QC checks include replicate measurements, internal test samples, method validation, blanks, and the use of standard reference materials. Typical external QC checks include split and blind studies, independent performance audits, and periodic proficiency examinations. Data comparability is a primary concern because mercury-related degradation of water quality is defined here as relative to baseline data generated by one or more laboratories. It is important to establish and maintain comparability of the performance and results among participating laboratories assessing the reporting units and calculations, database management processes, and interpretative procedures. Comparability of laboratory performance must be ensured if the overall goals of the monitoring program are to be realized.

Laboratory Quality Control

Data for this program was generated by the District and the FDEP, both of which are certified by the Florida Department of Health under the National Environmental Laboratory Accreditation Program. The following methods were utilized when analyzing samples for THg and MeHg during WY2012: FDEP–USEPA Method 1631E (Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry); USEPA Draft Method 1630 (Methylmercury in Water and Tissues by Distillation, Extraction, Aqueous Phase Ethylation, Purge and Trap, Isothermal GC Separation, Cold Vapor Atomic Fluorescence Spectrometry); USEPA Method 245.6 [Mercury in Tissues by Cold Vapor AAS (uses liquid digestion)]; EPA 7471A [Mercury in Solids by Cold Vapor AAS (uses liquid digestion)]; District–EPA 7473 [Mercury in Solids and Tissues by Direct Thermal Decomposition, Amalgamation and AA (does not incorporate liquid digestion)]. All of these methods use performance-based standards employing the appropriate levels of QA/QC required by the National Environmental Laboratory Accreditation Conference (NELAC), the specific reference method, and the Protocol.

Field Quality Control Samples

For WY2012, 24 field QC samples, including field kit prep blanks (FKPB), equipment blanks [both laboratory-cleaned equipment blanks (EB) and field-cleaned equipment blanks (FCEB)], and replicate samples (RS) were collected for both THg and MeHg surface water samples at STA-1E, STA-2, STA-3/4, STA-5, and STA-6. These field QC check samples represented approximately 38 percent of the 96 water samples collected during this reporting period. The results of the field QC blanks are summarized in **Table C-1**. An FKPB is a sample of the de-ionized distilled water (DDW) for field QC that remains at the lab to monitor low-level background inorganic mercury contamination of the laboratory DDW system, which can vary over time. FKPB were discontinued effective 6/16/12 according to the Water Quality Monitoring Division Quality Assurance Team Investigation (QATI) Report QATI 110616-1. An EB is collected at the beginning of every sampling event, and an FCEB is collected at the end of the event. A TB is a blank sample (DDW) that is used to identify potential contamination during field transport. For this field collection blank, DDW is carried through the

Table C-1. Field quality control (QC) blanks from Stormwater Treatment Area STA 1 East (STA-1E), STA-2 and STA-5 for Water Year 2012 (WY2012) (May 1, 2011–April 30, 2012). Method detection limits (MDLs) are 0.1 nanograms per liter (ng/L) for total mercury (THg) and 0.022 ng/L for methylmercury (MeHg).

Field QC[a]	THg						MeHg					
	Sample Size (n)[b]	Collection Frequency (%)	Mean (ng/L)[c]	n>MDL	n Flagged	% Flagged[d]	Sample Size (n)[b]	Collection Frequency (%)	Mean (ng/L)[c]	n>MDL	n Flagged	% Flagged[d]
FKPB	1	1.0	-0.10	0	0	0	1	1.0	-0.022	0	0	0
EB	3	3.1	-0.10	0	0	0	3	3.1	-0.022	0	0	0
FCEB	8	8.3	-0.10	0	0	0	4	8.3	-0.022	0	0	0

[a] FKPB – field kit preparation blank; EB – lab-cleaned equipment blank; FCEB – field-cleaned equipment blank.

[b] Total number (n) of respective quality assurance/quality control (QA/QC) samples

[c] Mean concentration of quality control (QC) samples

[d] Percentage of all (QA/QC+ monitoring) samples collected for WY2012 (n = 48 for THg and n = 48 for MeHg)

field collection trip, remains sealed in a container, and is then analyzed with all other samples at the FDEP laboratory. TBs were discontinued effective 6/16/12 according to the Water Quality Monitoring Division Quality Assurance Team Investigation (QATI) Report QATI 033111-1. For WY2012, there were no flagged QA/QC samples for THg and MeHg samples.

The sample corrective action criterion for FCEBs and EBs is currently 10x the FCEB/EB level. All routine samples associated with an FCEB or EB are flagged if its value is less than 10x the method detection limit of 0.1 ng/L for THg, or 0.022 ng/L for MeHg.

Analytical and Field Sampling Precision

Field replicates samples (RS) are collected from the same source as the routine sample using the same sampling equipment. The resulting data are compared to the results of routine samples to evaluate sampling precision.

Laboratory replicates are aliquots of the same sample that are prepared and analyzed within the same run. The results from duplicate analyses are used to evaluate analytical precision.

WATER SAMPLES

To assess the precision of field collection and analysis, 12 replicate, unfiltered surface water samples (6 THg and 6 MeHg) collected at STA-1E, STA-2, and STA-5 were processed during WY2012. **Table C-2** reflects the results of sample analyses. Two replicate samples were matched with one surface water sample. For WY2012, all the THg and MeHg relative standard deviations were below the required 20 percent QA/QC precision level.

Table C-2. Relative standard deviations (RSD) for samples with two replicates (RS) collected within STA-1E, STA-2, and STA-5 during WY2012.

Media	Sample Size (n)	% Relative Standard Deviation*		
		Minimum	Maximum	Mean
Surface Water THg	6	3	8.1	5.2
Surface Water MeHg	6	0	4.6	2.8
Mosquitofish THg	10	4.3	21.5	9

* RSD = standard deviation/average x 100. RSD is calculated for each sampling event with sample replicates separately (1 sample value + two RS)

MOSQUITOFISH COMPOSITE SAMPLES

To monitor spatial and temporal patterns in mercury residues in small-bodied fish, mosquitofish (at least 100 individuals) are collected at various locations in the STAs, ECP, and non-ECP marshes. These individuals are then composited for each site. Composite sampling can increase sensitivity by increasing the amount of material available for analysis, reduce inter-sample variance effects, and dramatically reduce analytical costs. However, subsampling from a composite introduces uncertainty if homogenization is incomplete. Since 1999, the District has used a Polytron® homogenizer to homogenate composited mosquitofish. Until late 2001, the homogenate was subsampled in quintuplicate and each subsample analyzed for THg. Based on the apparent degree of homogenization as evidenced by the low relative standard deviation (RSD) among aliquots reported in the *2002 Everglades Consolidated Report*, the District revised its standard operating procedure after consultation with and approval by the FDEP, reducing subsampling of the homogenate from five to three. In 2007, replicates were further reduced from three to one homogenate [Note: This reduction was approved by the FDEP in 2007 and documented in the *2009 South Florida Environmental Report (SFER) – Volume I*, Appendix 5-4, under the *Prey Fish* sub-section]. Laboratory replicates of mosquitofish were processed by the SFWMD and analyzed for THg. For WY2012, the mean percent RSD between replicate and routine samples for the 10 aliquots was 9 percent (**Table C-1**) which is lower than WY2011 (mean of 12 percent).

SEDIMENT COMPOSITE SAMPLES

For WY2012, sediment samples were collected for THg/MeHg analysis from Compartments B and C.

Inter-laboratory Comparability Studies

To ensure further reproducibility between ongoing mercury sampling initiatives and to evaluate the performance of contract laboratories used for mercury analysis, round-robin studies for water, fish, and sediment are routinely initiated. These studies are performed by the District and contracted laboratories (Battelle et al., 2011; Wageningen Evaluating Programmes for Analytical Laboratories, 2011).

SURFACE WATER AND FISH

As in previous years, inter-laboratory studies were initiated by the FDEP to assess the comparability of THg and MeHg analysis in water for several laboratories. Participating laboratories receive nine samples of ambient water from the Everglades for analysis of THg and/or MeHg. In WY2012, the District participated in the Quality Assurance of Information for Marine Environmental Monitoring in Europe (QUASIMEME) study to assess their performance in quantifying mercury in fish and improve the laboratory’s data quality.

SEDIMENT

In WY2012, the District participated in ERA’s Soil-74, Soil-76 and Soil-78 Proficiency Testing (PT) studies to assess the ability of the District’s laboratory to generate acceptable analytical data for THg in sediment/soil. NELAC certification requires participation in PT studies every six months.

SELECTION OF FISH SPECIES AND SIZE RANGE

The proper interpretation of residue levels in tissues can sometimes prove problematic due to the confounding influences of age or species of collected animals. For comparison, special procedures are used to normalize the data (Wren and MacCrimmon, 1986; Hakanson, 1980). To be consistent with the reporting protocol used by the Florida Fish and Wildlife Conservation Commission (FWC) (Lange et al., 1998 and 1999), mercury concentrations in LMB were standardized to an expected mean concentration in three-year-old fish at a given site by regressing mercury against age (EHg3). Currently, the FWC targets LMB between lengths of 307–385 mm, which includes age-3 fish. This length range is targeted to eliminate the need for fish aging. Sunfish were not aged. Instead, arithmetic means were reported. Additionally, the distribution of the different species of sunfish [warmouth (*Lepomis gulosus*), spotted sunfish (*L. punctatus*), bluegill (*L. macrochirus*), and redear sunfish (*L. microlophus*)] that were collected during electroshocking was also qualitatively considered as a potential confounding influence on mercury concentrations prior to each comparison. The target sunfish species is bluegill.

SITE DESCRIPTIONS

Site descriptions and operational plans for STA-1W, STA-1E, STA-2, STA-3/4, STA-5, and STA-6 are published elsewhere (SFWMD, 2007a-d; 2009). Maps of selected monitoring locations are given with the data for each STA in the *Monitoring Results* section of this Attachment.

MONITORING RESULTS

Table C-3. Concentration of THg [nanograms per grams (ng/g), wet weight] in mosquitofish (*Gambusia holbrooki*) composite samples from STAs during WY2012. NA: Not available.

STA	Quarterly Collection	Interior Fish	Outflow/ Downstream Fish
STA-1W	*No results; Monitoring terminated in 2009*		
STA-1E	Jul-11	17	130
	Oct-11	19	129
	Jan-12	19	109
	WY2012 mean	18	123
STA-2	May-11	9	42
	Aug-11	14	25
	Sep-11	24	NA
	Oct-11	10	37
	Jan-12	9	24
	WY2012 mean	13	32
STA-3/4	Sep-11	10	41
	Apr-12	11	41
	WY2012 mean	11	41
STA-5	Jul-11	43	19
	Sep-11	41	NA
	Nov-11	10	8
	Feb-12	12	22
	WY2012 mean	26	16
STA-6	Jul-11	28	54
	Sep-11	56	NA
	Nov-11	12	25
	Feb-12	28	26
	WY2012 mean	31	35

STA-1W

[Note: Monitoring was terminated in 2009.]

STA-1E

Monitoring water-column concentrations of THg and MeHg began in January 2005 at STA-1E (**Figure C-1**). Both the central flow-way (Cells 3, 4N, and 4S) and the westernmost flow-way (Cells 5–7) met the start-up criteria, as specified in EFA permit number 0195030-001-GL. The USACE constructed a Periphyton-Based Stormwater Treatment Area (PSTA) Demonstration Project in the easternmost flow-way (Cells 1 and 2) of STA-1E. The most recent eastern flow-way passed start-up in 2007. February 29, 2012 the Florida Department of Environmental Protection (Department) approved transfer of STA-1E mercury monitoring from Phase 2 – Tier 1: Routine Monitoring during Stabilization Period to Phase 3 – Tier 1: Routine Operational Monitoring from Year 4 to Year 9 for all flow ways (Western, Central and Eastern) which include cells 1, 2, 3, 4N, 4S, 5, 6 and 7 of STA-1E.

In WY2012, STA-1E displayed moderate surface water THg and MeHg concentrations at inflow and outflow locations (**Figures C-2**). All THg levels were below the Florida Class III numerical water quality standard of 12 ng/L. Both THg and MeHg loads at the outflow were less than inflow (**Table C-4**).

Quarterly collection of mosquitofish from STA-1E sites at interior marshes (in each cell) and the single downstream site (ST1ELX) at the WCA-1 marsh began during the third quarter of 2005. As shown in **Table C-3**, annual mean mercury level in mosquitofish from the interior marsh in WY2012 was 18ng/g. Average annual mosquitofish composites for the interior of STA-1E, including all mosquitofish composites, did not exceed the POR 75th percentile for all Everglades downstream sampling locations during WY2012. However, the downstream mosquitofish contained an annual average level (123 ng/g) that exceeded the USEPA trophic level (TL) 3 criterion (77 ng/g). THg concentration in the interior site was 4 ng/g higher than WY2011, while the downstream site averaged 34 ng/g higher than WY2011. Surface water sulfate, water level, and rainfall for STA-1E are presented in **Figure C-3**. Water levels within the cells of this STA typically do not fall below mean cell bottom elevation (**Figure C-3**). Sulfate levels at the inflow and outflow locations are comparable to other STAs and there does not appear to be any seasonal trend in sulfate concentration (**Figure C-3**). It has been speculated that seasonal dryout/reflooding which leads to the release of inorganic Hg from sediment and high Hg methylation rate is likely the reason of high THg in fish in the Everglades marsh. Since high THg levels were also observed in sunfish (see **Table C-5**), future research is needed to assess major environmental factors that promote high THg levels in fish at the downstream site within WCA-1.

The average THg levels in sunfish collected in the marsh interior in WY2012 were 44 ng/g compared to 109 ng/g in WY2011 which represents 40 percent reduction (**Table C-5**). This level is below USFWS TL 3 criterion (100 ng/g). The downstream sunfish THg level in WY2012 (173 ng/g) was higher than that (120 ng/ng) and exceeded USFWS TL 3 criterion. Overall, sunfish THg level in the STA interior remained low compared the initial years (WY2006 and 2007). The THg level at the downstream site has exceeded USFWS TL criterion for all years but did not display a trend of increase or decrease (**Figure C-4**).

For WY2012, 10 largemouth bass (LMB) were collected from two STA-1E interior sites (Cell 4 and Cell 6). All but one LMB were within the 307–385 mm target range. The average annual LMB THg concentration for interior was 69 ng/g (**Table C-6**) which was below EPA Trophic Level 4 fish criterion (346 ng/g) and did not exceed the POR 75th percentile (290 ng/g). There was a significant trend of decrease in LMB THg level in the interior site (r = -0.94,

$p < 0.0001$, n =7 years). No LMB sample in the downstream site was collected for WY2010, only one fish was caught in WY2011 and again no LMB was caught in WY2012.

The elevated THg concentrations in mosquitofish and sunfish at the downstream site may be related enhanced mercury methylation at the downstream marsh in the ARM Loxahatchee National Wildlife Refuge where the high sulfate concentration is likely diluted by marsh water to reach the optimal range for methylation.

Regarding risks to fish-eating wildlife, interior mosquitofish (TL 2 or 3) did not exceed the USEPA's 77 ng/g criterion; however, the mosquitofish from the downstream location did exceed this criterion for all three quarters. In WY2011, all resident interior and downstream sunfish within STA-1E were above the USFWS criterion of 100 ng/g for TL 2 or 3 fish. In WY2012, the sunfish in the STA interior was below USFWS criterion while the sunfish in the downstream site remained above the USFWS criterion. The individual and average THg level for LMB STA-1E interior did not exceed the USEPA criterion of 346 ng/g for TL 4 fish species.

Table C-4. THg and MeHg inflow and outflow loadings in grams for WY2012

STA	Inflow Load		Outflow Load		% Difference[a]	
	THg	MeHg	THg	MeHg	THg	MeHg
STA-1E[b]	107.9	21.6	61.2	9.9	-43.3	-54.1
STA-2[c]	209.9	42.2	244.2	31.6	16.3	-33.5
STA-5[d]	71.0	7.2	44.7	12.0	-58.8	40
STA-6[e]	NS	NS	NS	NS	NS	NS

[a] (outflow–inflow/inflow)*100
[b] S-319 (inflow), S-361 (outflow), S-362 (outflow)
[c] Includes stations S6, G328 (inflow) and G335 (outflow)
[d] Includes stations G342E, G342F (inflow, Flow-way 3) and G344E, G344F (outflow, Flow-way 3)
[e] Includes stations G600, G396B (inflow) and stations G354, G393, G354C, G393B, and G352B (outflow)
Note: surface water THg/MeHg monitoring was terminated in STA-3/4 and STA-1W. NS: No samples for WY12 due to Compartment C construction

Table C-5. Concentration of THg (ng/g, wet weight) in sunfish collected from STAs in WY2012 (sample size in parentheses).

STA	Interior Fish	Outflow/Downstream Fish
STA-1W	*No Results; Monitoring terminated in 2009*	
STA-1E	44±27 (15[a])	173±101 (5)
Cumulative mean	68	165
STA-2	40±14 (10)	99±83(20)
Cumulative mean	89	110
STA-3/4	34±15 (5)	68±21 (5)
Cumulative mean	66	95
STA-5	34±22 (5)	96±28 (4)
Cumulative mean	87	80
STA-6	41±6 (5)	113±31 (5)
Cumulative mean	69	106

[a] Where n > 5, multiple sites were sampled and pooled, i.e., multiple interior or outflows (see the *Protocol for Monitoring Mercury and Other Toxicants* section of this appendix).

Table C-6. Largemouth bass THg concentrations (ng/g, wet weight) collected in the STAs between lengths 307–385 millimeters (mm) for WY2012. In parentheses all data is presented, which includes data within and outside of the 307–385 mm range. Cumulative mean includes all fish within and outside the 307–385 mm range for the period of record. All data show arithmetic mean±1 standard deviation (SD).

STA	Interior Fish	Outflow/Downstream Fish
STA-1W	*No Results Monitoring terminated in 2009*	
STA-1E	69± 33, 8 (73±31, 10)	ND
Cumulative mean	149	350
STA-2	83±20, 4 (82±18, 5)	440±179, 8 (451±222,20)
Cumulative mean	238	416
STA-3/4	353±245, 4 (222±116, 5)	446±258, 2 (354±159, 5)
Cumulative mean	350	418
STA-5	ND	ND
Cumulative mean	350	362
STA-6	ND (284±336,5)	302,1 (375±99, 5)
Cumulative mean	333	452

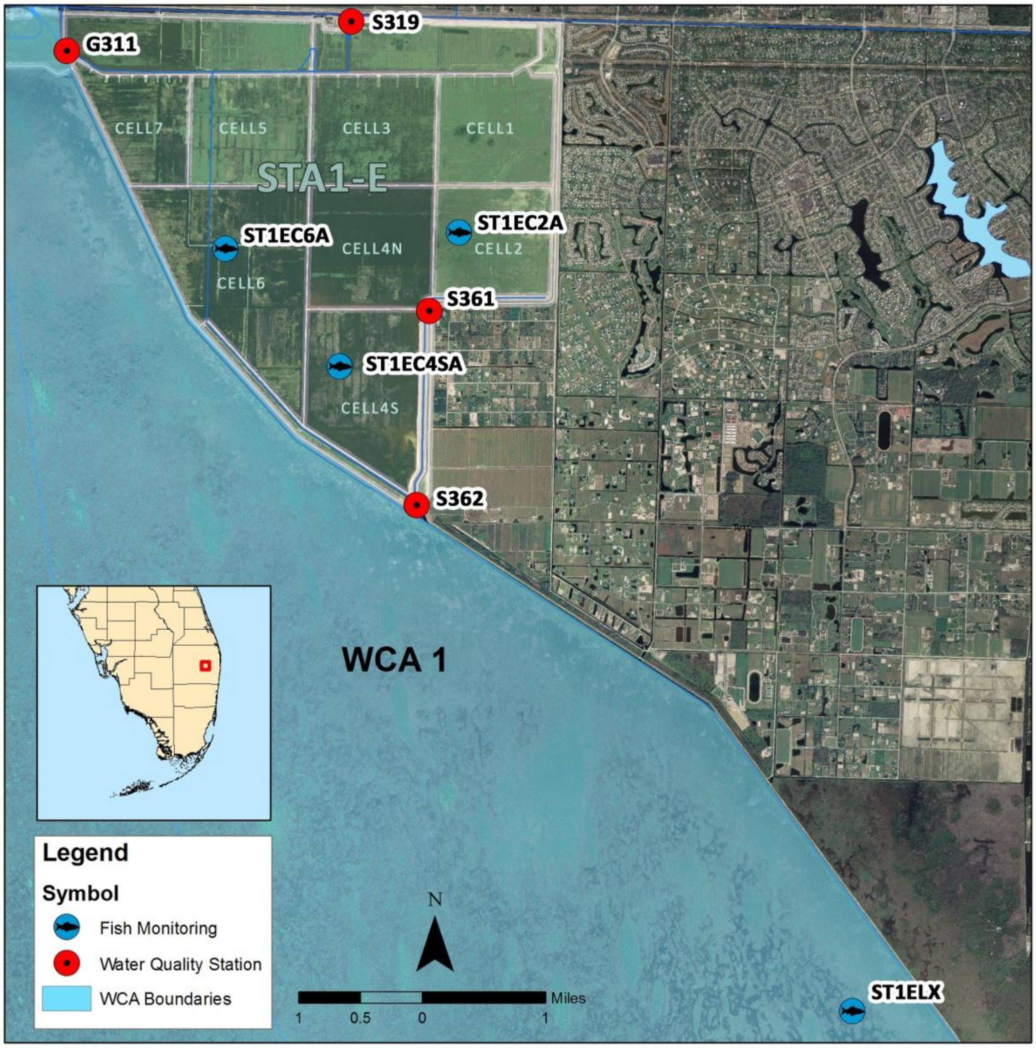


Figure C-1. Selected mercury monitoring sites at STA-1 East (STA-1E). Mosquitofish are collected downstream of STA-1E at ST1ELX and within each cell of the STA, and submitted as one composite sample per flow-way.

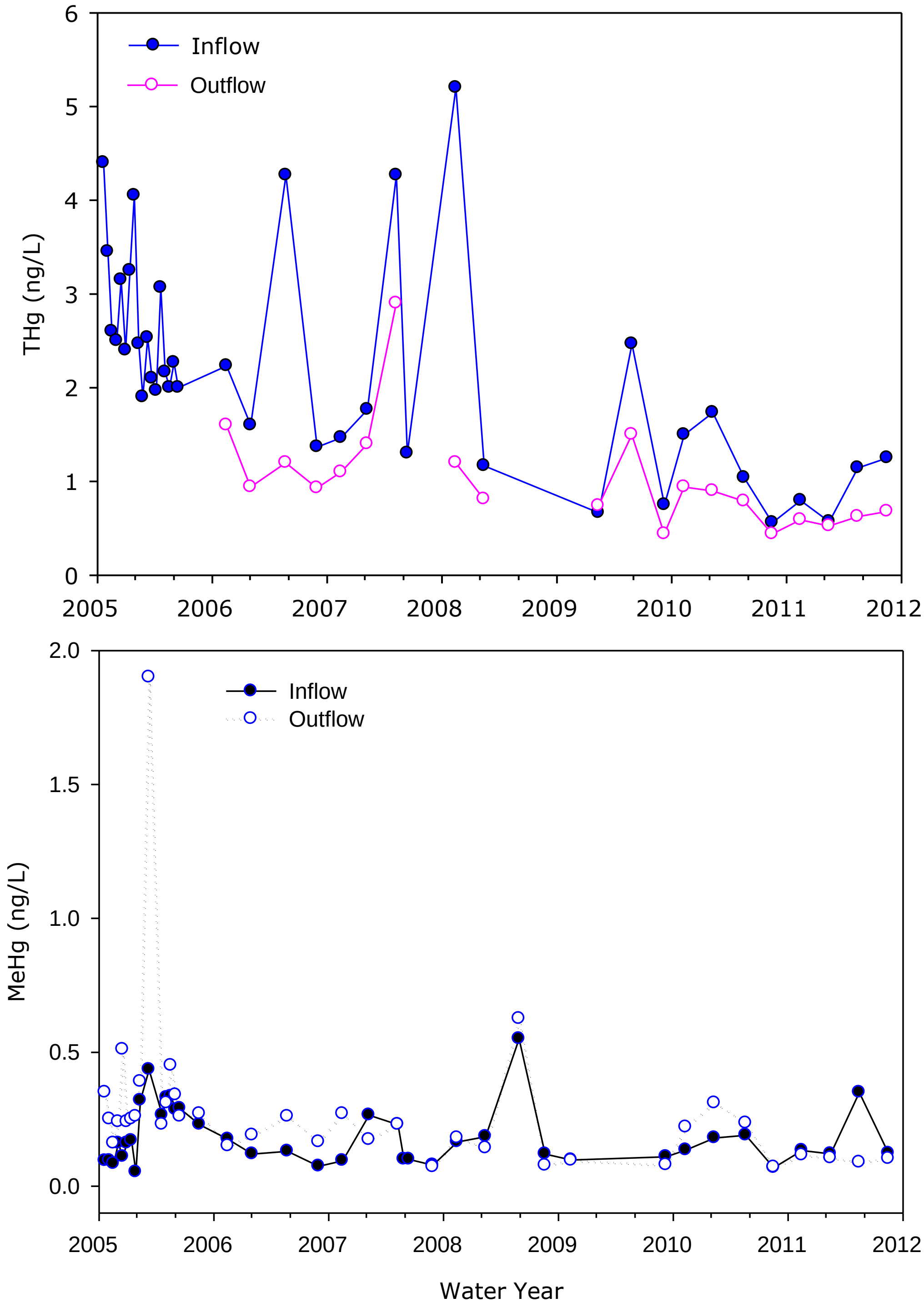


Figure C-2. Concentrations of THg (top) and MeHg (bottom) in unfiltered surface water collected at STA-1E.

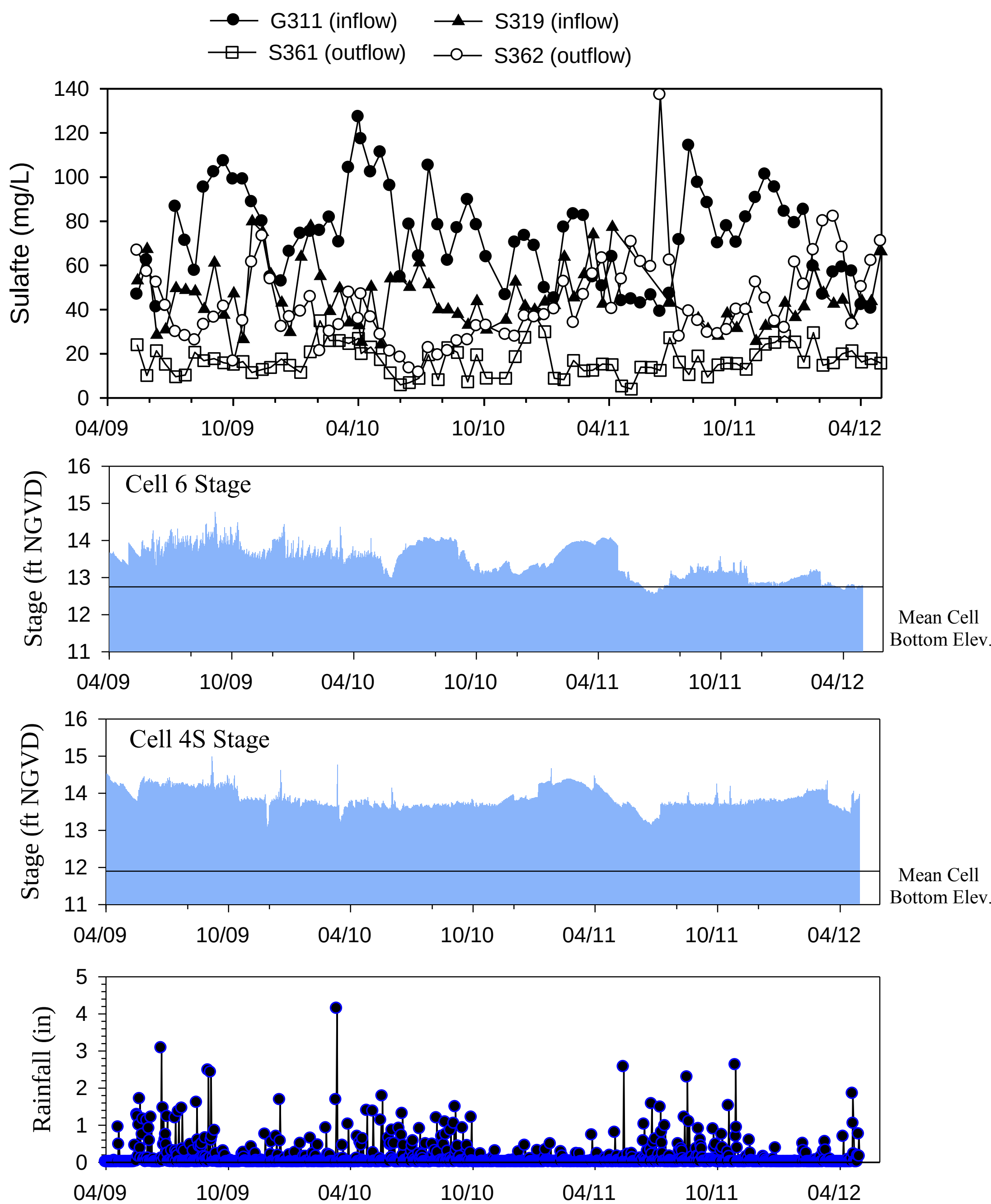


Figure C-3. Water-column sulfate, stage (recorded immediately upstream of outflow culvert of cell), and rainfall at STA-1E. [Note: mg/L – milligrams per liter; ft NGVD – feet National Geodetic Vertical Datum; in – inches; Elev – elevation]

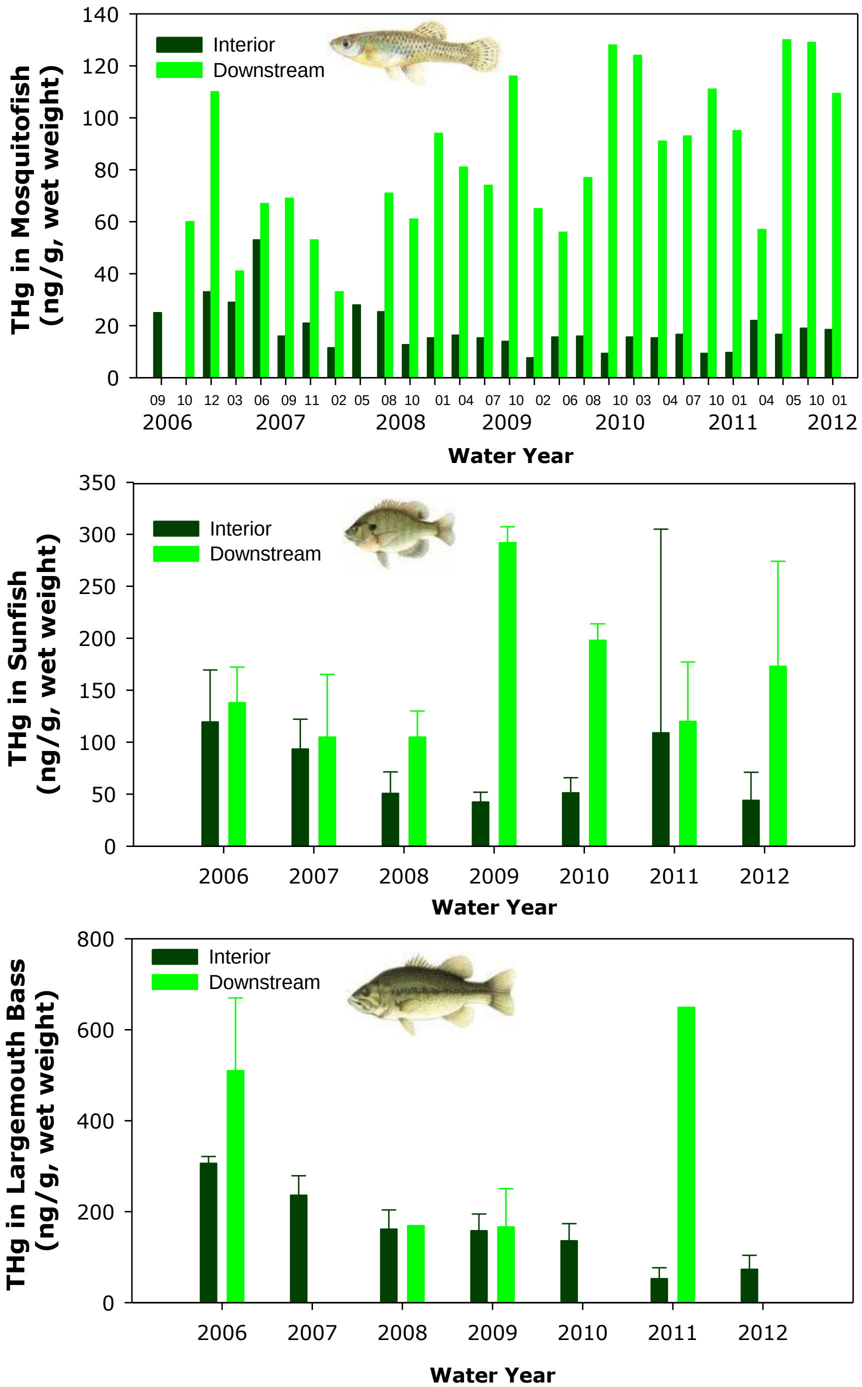


Figure C-4. Total mercury concentrations (ng/g, wet weight) in mosquitofish composites (± SD) (top), whole sunfish (arithmetic mean ± SD) (middle), and fillets of largemouth bass (arithmetic mean ± SD) (bottom) collected at STA-1E.

STA-2

STA-2, Cells 2 and 3, met mercury start-up criteria in September 2000 and November 2000, respectively. In August 2001, flow-though operation of Cell 1 was approved under a permit modification. Cell 1 met start-up criteria in November 26, 2002. Operational monitoring for mercury at STA-2 began during the third quarter of 2001 after completion of the S-6 connection (Rumbold and Fink, 2002b, 2003b; Rumbold 2004, 2005; Rumbold et al., 2006). The most recently developed area, Cell 4, passed mercury start-up criteria and flow-through began in 2007. February 29, 2012, the Florida Department of Environmental Protection Department approved transfer of STA-2 mercury monitoring from Phase 2 - Tier 1: Routine Monitoring during Stabilization Period for STA-2 Cells 1, 2 and 3 to Phase 3 – Tier 3: Routine Operational Monitoring After Year 9 and Phase 3 – Tier 1: Routine Operational Monitoring From Year 4 to Year 9 for STA-2 Cell 4. Phase 3 – Tier 3 implemented the termination of all site specific mercury monitoring at STA-2 Cells 1, 2, and 3 (**Figure C-5**).

Only two sampling events for surface water mercury were taken in WY2012. Results show that THg concentration in inflow and outflow did not exceed the Florida Class III numerical water quality standard of 12 ng/L (**Figure C-6**). A high value of THg (12 ng/L) was observed at the outflow site on December 2001. The high THg level was associated with the dryout and reflooding events that occurred in STA-2 Cell 1 and has been reported by Rumbold and Fink (2005). The average THg concentration from the two inflow sites (G328 and S6) in WY2012 was slightly higher than the average outflow concentration (G335). As a result of this and more importantly as a result of higher outflow water load than inflow water load, outflow load of THg exceeded inflow THg load while the outflow MeHg load remained lower than the inflow load (**Table C-4**). A drop in water level below mean cell bottom elevation is a common occurrence in this STA. In WY2011, the drop in water level for Cell 1 (**Figure C-7**) may have triggered increased THg levels that hampered the load reduction.

Table C-3 and **Figure C-8** summarize results from operational monitoring of mercury concentrations in STA-2 mosquitofish for WY2012. The THg level in mosquitofish from the STA-2 marsh interior remained the lowest among actively monitored STAs. In WY2012, the average mosquitofish composite and each individual mosquitofish composite for the interior were higher than those in WY2011, but remained well below EPA or FWS Trophic Level 2/3 fish criterion and the POR 75th percentile for the STAs (35 ng/g). The average mosquitofish composite was also elevated relative to WY11, but again well below or FWS Trophic Level 2/3 fish criterion and the POR 75th percentile for the downstream Everglades sampling locations.

The THg level of sunfish from STA-2 interior sampling locations (STA2C4A and STA2C1X) remained low (40 ng/g) in WY2012 (**Table C-5** and **Figure C-8**). The downstream site (CA2NF) displayed slightly higher THg level (99 ng/g) than WY2011. In WY2012, the average annual sunfish concentration for all STA-2 interior locations and downstream did not exceed the POR 75th percentile for all downstream Everglades sampling locations.

Concentrations of THg in fillets of resident largemouth bass from STA-2 (**Table C-6** and **Figure C-8**) in the length range of 307–385 mm reflect an overall average of 83 ± 20 ng/g collected across Cell 4. Historically, fish THg levels within this STA have been high compared with the other STAs, which may be related to the previous land use within this area. Annual LMB concentration for all STA-2 locations did not exceed the POR 75th percentile for all Everglades downstream receiving water sampling locations (see Appendix 3-2, Attachment F).

Regarding risk to fish-eating wildlife, in WY2012 no mosquitofish composite or sunfish from the interior and downstream site contained mercury levels greater than the USEPA predator protector criteria of 77 ng/g for TL 3 species or the USFWS criteria of 100 ng/g. There was no exceedance of the USEPA criterion of 346 ng/g for TL 4 fish species in LMB within STA-2 interior although THg level in the downstream site exceeded USEPA criterion of 346 ng/g for TL 4 fish, but did not exceed 75 percent POR LMB mercury level for the downstream Everglades. Overall, fish-eating wildlife foraging preferentially within and downstream of STA-2 continue to appear to have an overall moderate risk of mercury exposure.

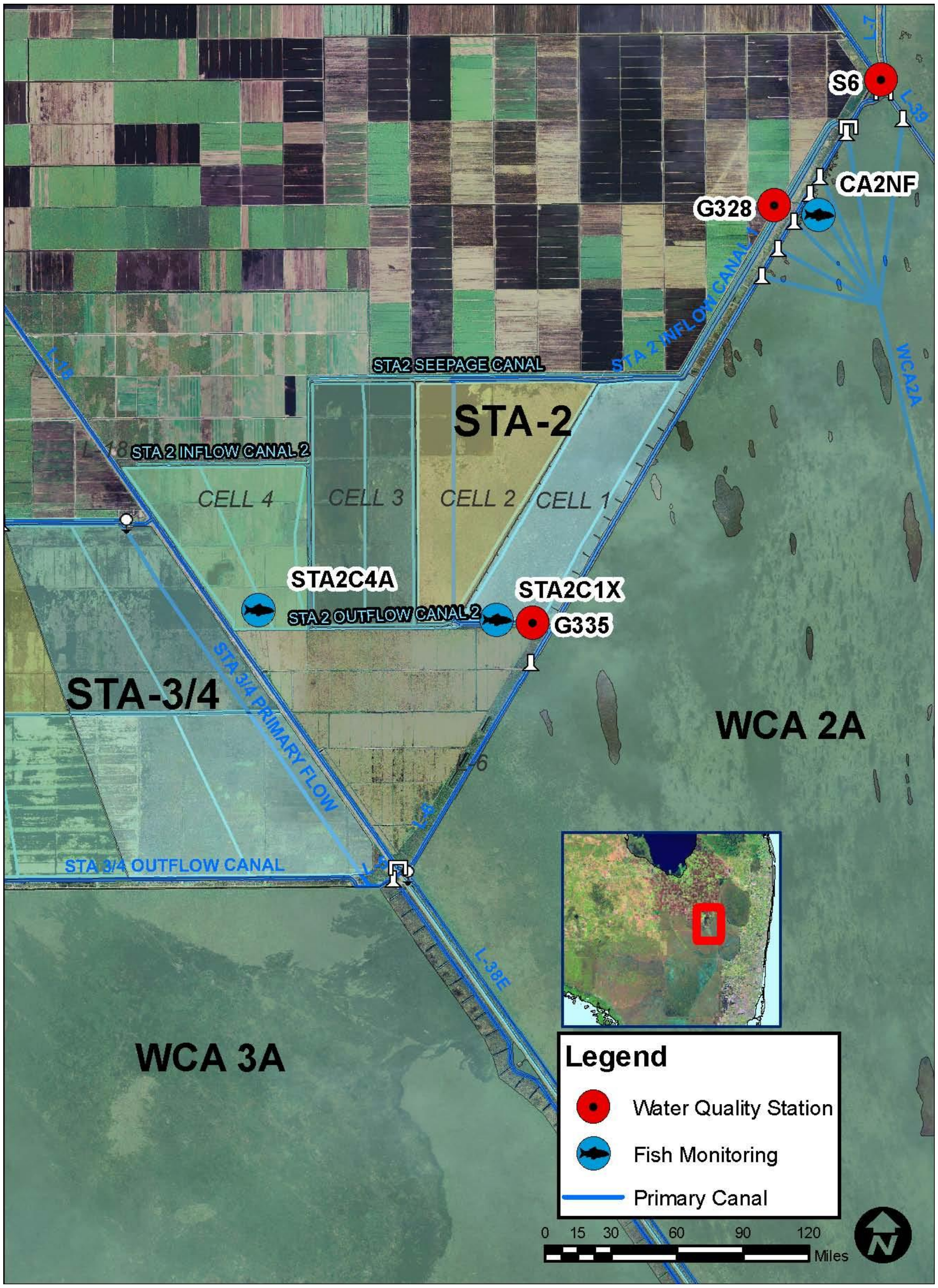
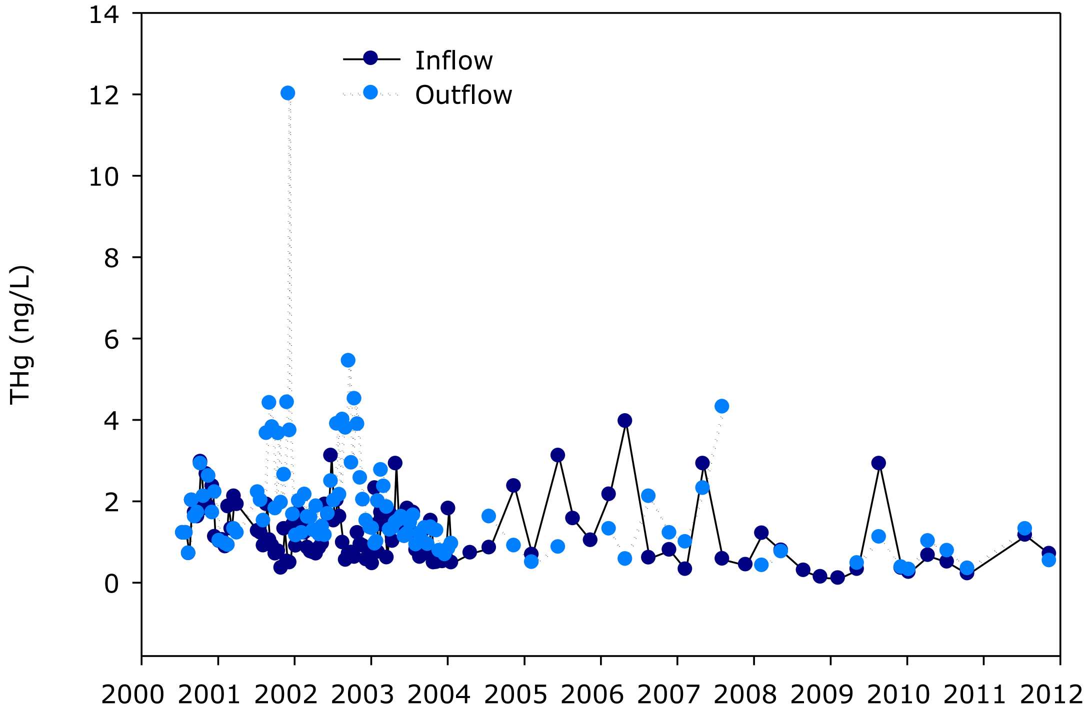


Figure C-5. Current mercury monitoring sites at STA-2. Mosquitofish samples are collected from downstream station CA2NF and in each cell, and then submitted as a composite for each flow-way.



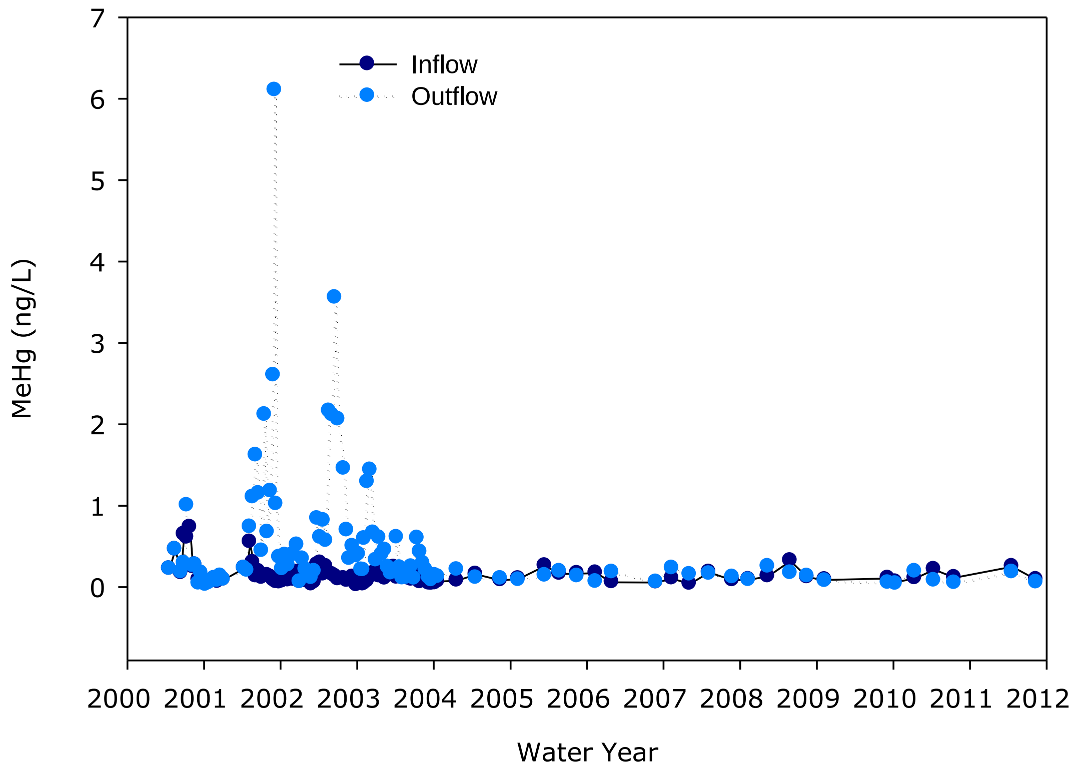


Figure C-6. Concentrations of THg (top) and MeHg (bottom) in unfiltered surface water collected at STA-2.

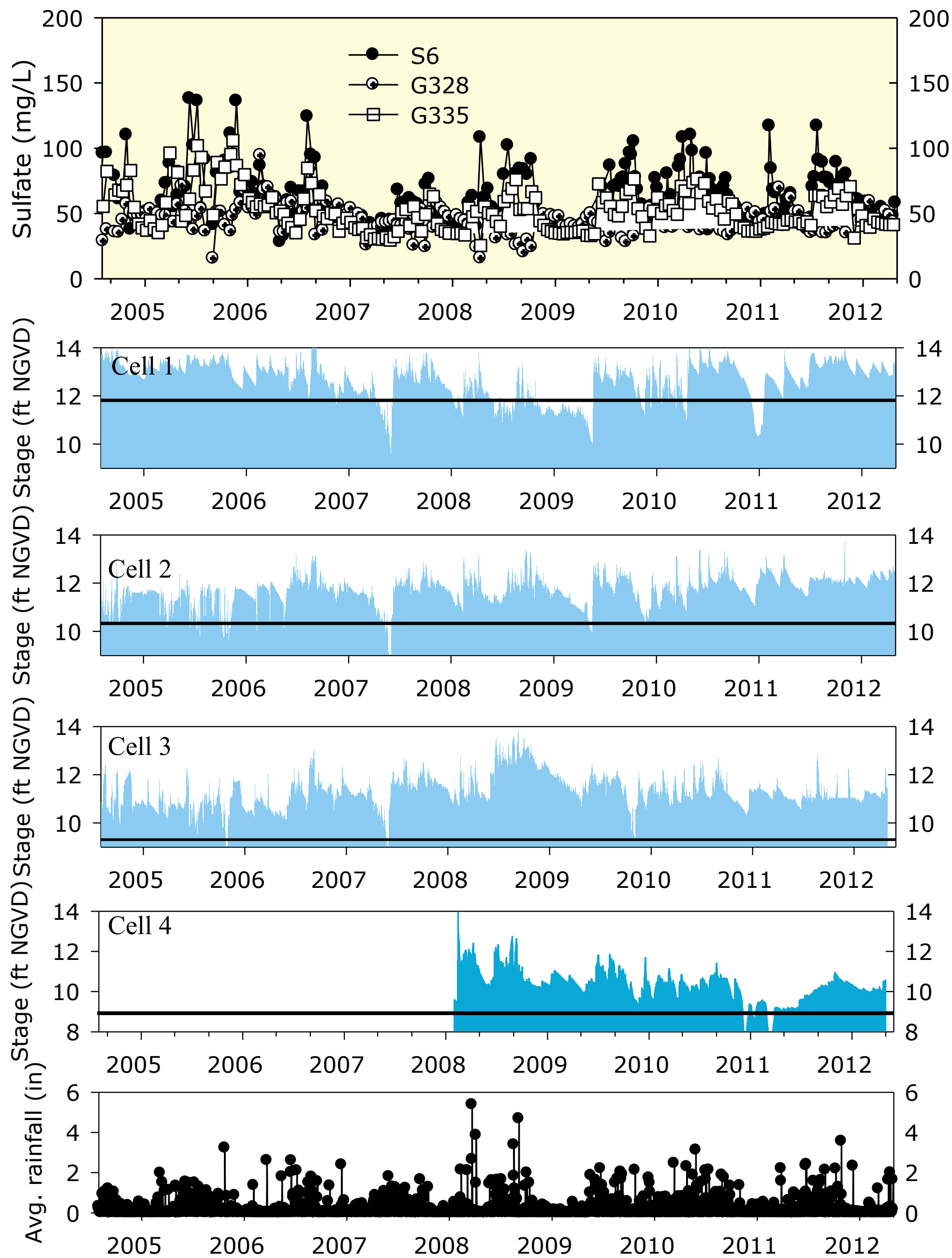


Figure C-7. Water-column sulfate, stage (recorded immediately upstream of outflow culvert of cell), and rainfall totals at STA-2.

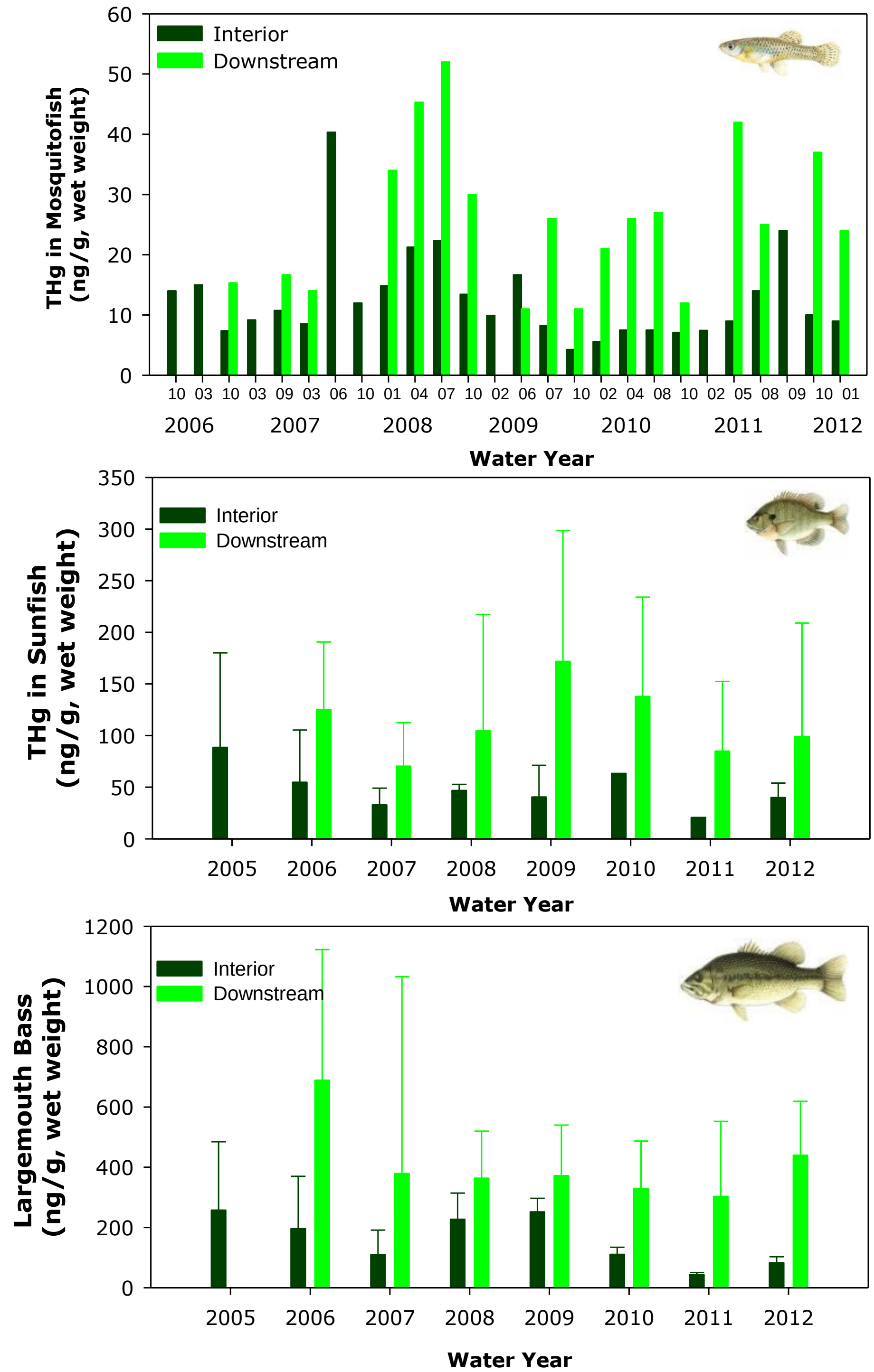


Figure C-8. Mercury concentrations (ng/g, wet weight) in mosquitofish composites (± SD) (STA2C4A and STA2C1X) (top), whole sunfish (±SD) (middle), and fillets of largemouth bass (arithmetic mean, ± SD) (bottom) collected at STA-2. An asterisk indicates an arithmetic mean of all available largemouth bass.

STA-3/4

STA-3/4, Cell 1, satisfied start-up criteria for mercury in January 2004; the first discharges of treated water from this STA were in February 2004. Accordingly, routine operational monitoring of this flow-way began during the first quarter of 2004. STA-3/4, Cell 3, satisfied start-up criteria for mercury in June 2004 and Cell 2 passed in August 2004; with consensus from the FDEP in September 2004, discharges began (for discussion of results observed prior to 2005, see Rumbold et al., 2006). In 2007, all mercury monitoring was moved into Phase 3, Tier 1 of the Protocol (SFWMD and FDEP, 2011). Therefore, surface water monitoring for THg and MeHg was terminated and the last surface water dataset was collected in March 2008. Information on THg and MeHg for STA-3/4 is presented in previous SFERs. **Figure C-10** shows current mercury monitoring locations for concentrations in resident fish. Concentrations of THg in mosquitofish are summarized in **Table C-3** and **Figure C-9**. For WY2012, mosquitofish from STA-3/4 had the lowest THg level (11 ng/g) among the STAs, which is consistent with past years. The average annual composite for WY2012 and each individual mosquitofish composite within STA-3/4 did not exceed the POR 75th percentile for all downstream receiving water sampling Everglades locations during the year.

Surface water sulfate, water level, and precipitation for STA-3/4 are presented in **Figure C-11**. Water levels within the cells of this STA typically do not fall below mean cell bottom elevation. Sulfate levels at the inflow and outflow locations are comparable to other STAs and there does not appear to be any seasonal trend in sulfate concentration.

Sunfish in the STA interior was one of the lowest compared to other STAs and below USEPA criterion. Sunfish in the downstream site contained THg level above USEPA criterion, but below FWC TL3 fish criterion (100 ng/g). Largemouth bass in both interior and downstream exceeded USEPA criterion (346 ng/g), but were below 75 percent POR all STA basin and downstream fish THg levels (**Tables C-5** and **C-6**).

Regarding the risk to fish-eating wildlife, all resident mosquitofish within the marsh of STA-3/4 contain mercury levels below the USEPA criterion of 77 ng/g for TL 3 fish species. Based on the available mosquitofish data, fish-eating wildlife foraging preferentially within the interior marsh and downstream of STA-3/4 appear to be at low risk from mercury exposure.

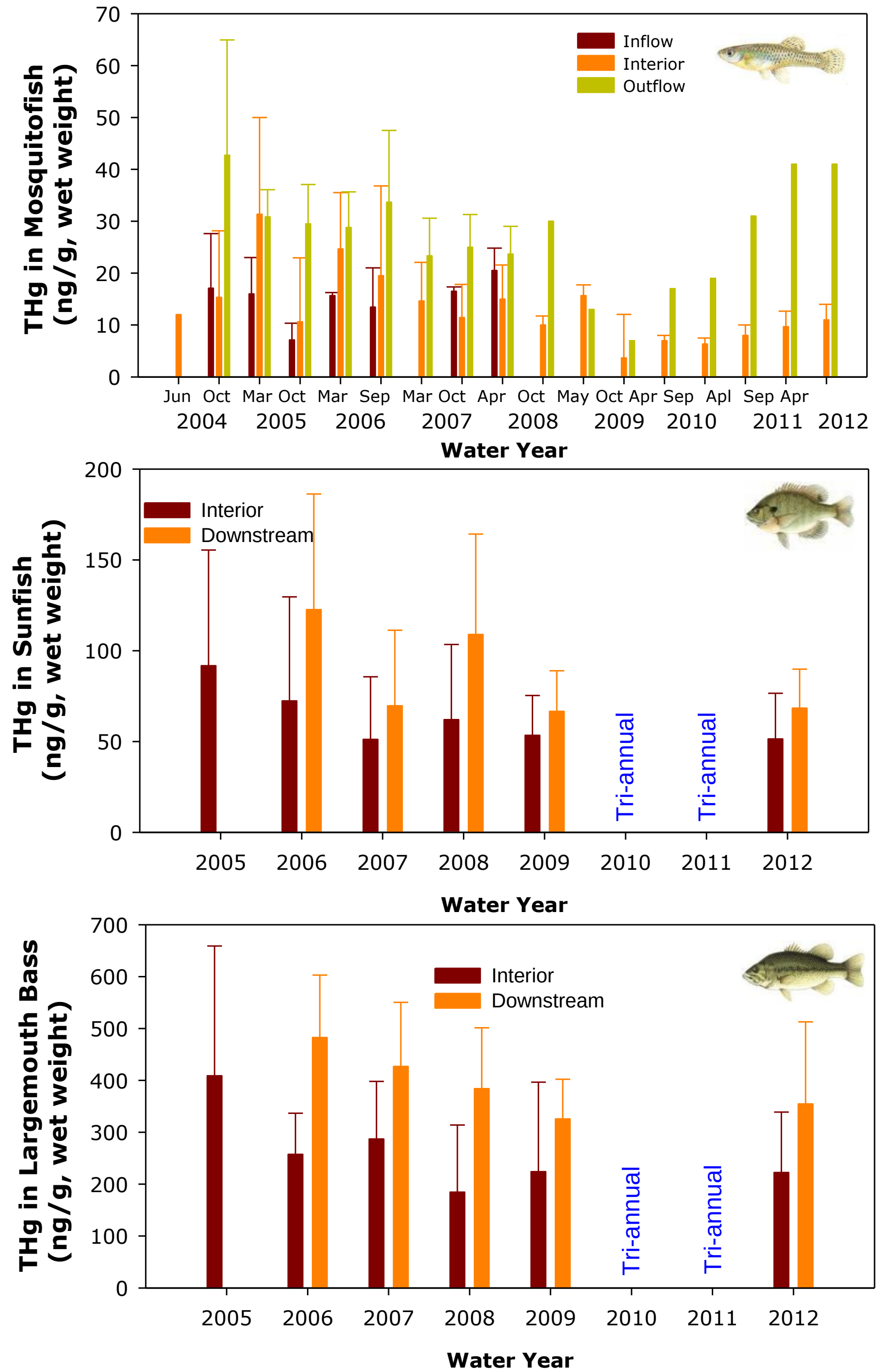


Figure C-9. Mercury concentrations (ng/g, wet weight) in mosquitofish composites (± SD) whole sunfish (±SD) (middle), and fillets of largemouth bass (arithmetic mean, ± SD) (bottom) collected at STA-3/4.

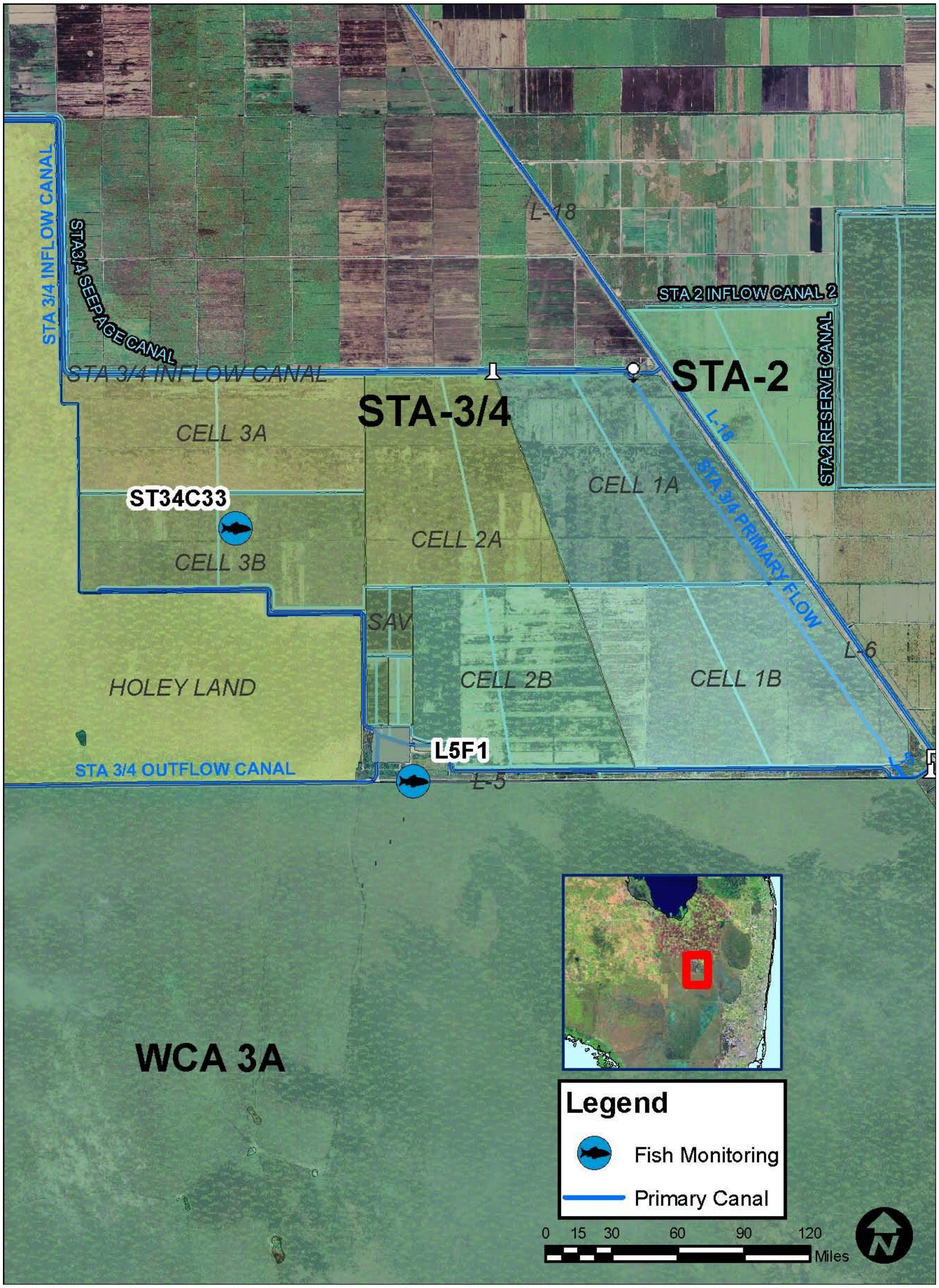


Figure C-10. Current mercury monitoring sites at STA-3/4.

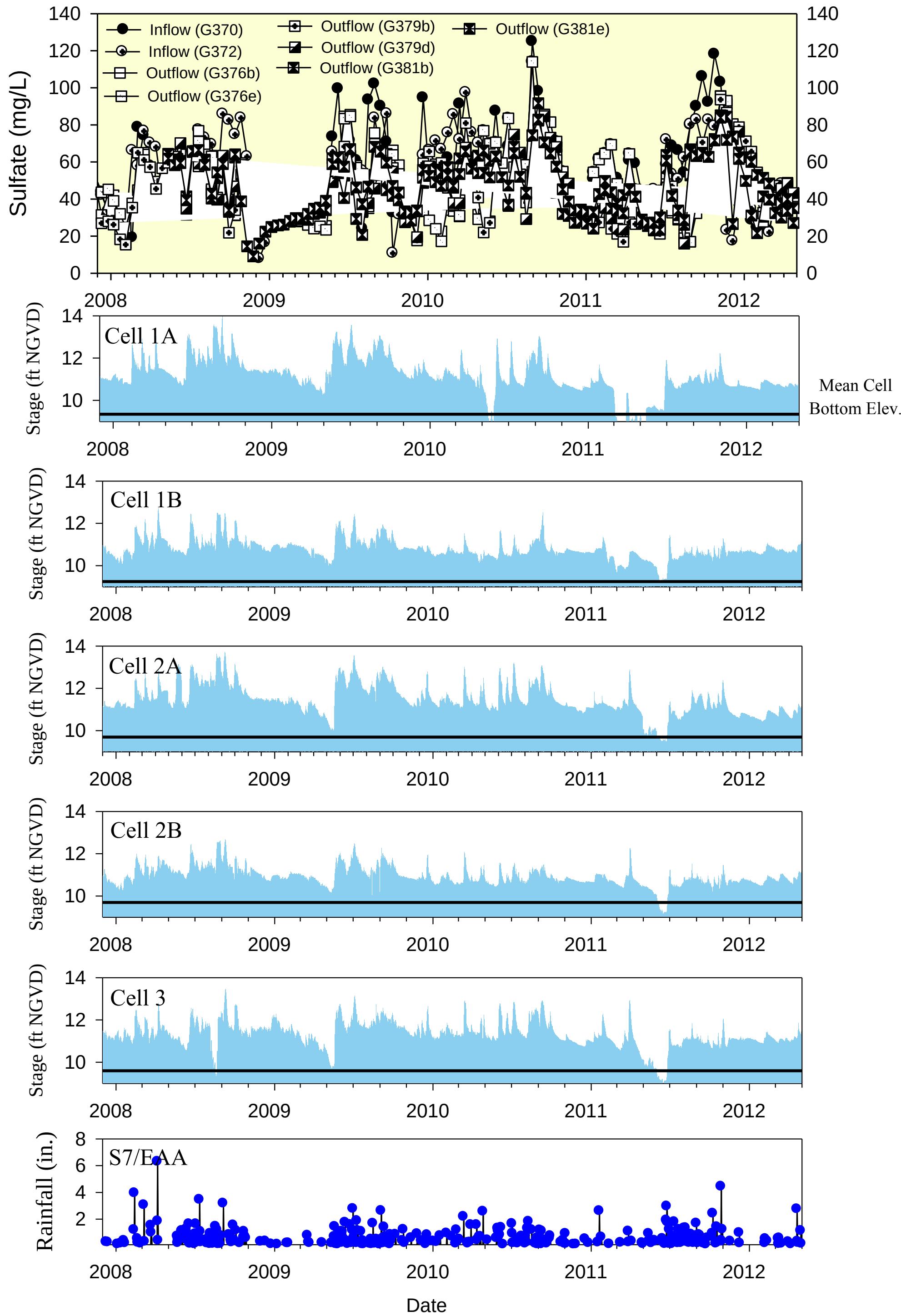


Figure C-11. Water-column sulfate, stage (recorded immediately upstream of outflow culvert of cell), and rainfall at STA-3/4.

STA-5

STA-5 met start-up criteria for mercury in September 1999. However, because of drought conditions and the detection of high phosphorus concentrations at the outflows, STA-5 did not begin flow-through until July 2000 (for discussion of results observed prior to 2005, see Rumbold and Rawlik, 2000; Rumbold et al., 2001 and 2006; Rumbold and Fink, 2002a and 2003a; Rumbold, 2004 and 2005). The new section, Flow-way 3, is under Phase 2, Tier 1 monitoring and Flow-ways 1 and 2 are under Phase 3, Tier 3 monitoring (**Figure C-12**). On December 31, 2009, the FDEP approved the District's request to move mercury monitoring in Flow-ways 1 and 2 from Phase 3, Tier 1 to Phase 3, Tier 3. This implemented termination of all site-specific mercury monitoring in those flow-ways.

As shown in **Figure C-13**, water-column concentrations of THg and MeHg in WY2012 remained low in STA-5. No THg sample was above the 12 ng/L water quality standard. On January 1, 2009, surface water sampling was temporarily suspended due to dryout conditions. The consistent dryout and rewetting has likely created the elevated surface water sulfate concentrations (**Figure C-14**). An increasing/decreasing trend in surface water sulfate occurred, which, likely also results from the frequent dryout and rewet processes (**Figure C-14**). For WY2012, there was a net reduction of nearly 60 percent of THg. However, outflow loading of MeHg was about 40 percent greater than the inflow (**Table C-6**). There was 20 percent negative reduction in WY2011 (Gu and Nicole 2012). The negative reduction on MeHg was due to a spike of MeHg (2.05 ng/L) at the inflow on August 17, 2011.

Mosquitofish collected from STA-5 in WY2012 contained moderate annual mean mercury levels (**Figure C-15**), compared to other STAs (**Table C-3**). The average annual mosquitofish composite for WY2012 (26 ng/g) and each individual mosquitofish composite (10-43 ng/g) for all locations within STA-5 did not exceed the POR 75th percentile for all downstream Everglades sampling locations. Since 2009, mosquitofish THg level at outflow decreased steadily while THg at the interior marsh fluctuated at a moderately low level.

Compared to WY2011, WY2012 sunfish collected from the interior marsh contained slightly higher THg level. Sunfish from downstream in WY2012 contained lower THg level than WY2011 and remained the lowest levels of mercury among all STAs (**Table C-5**).

As in previous years, the FWC (under contract to the District to collect large-bodied fish for mercury monitoring) encountered difficulties in filling sample quotas for STA-5. As shown in **Table C-6**, no LMB were available. Please refer to **Figure C-15** for mercury level in LMB within STA-5 in previous years (WY2006-2009).

Regarding the risk to fish-eating wildlife, the resident mosquitofish and sunfish within and downstream from STA-5 contained average mercury levels below the USEPA criterion of 77 ng/g for TL 3 fish species and all fish were below the USFWS criterion of 100 ng/g. Three individual bluegill at the downstream site contained THg level exceeding USFWS criterion of 100 ng/g, but was below 75 percent POR for the downstream sunfish THg level. Largemouth bass samples collected between WY2006 and WY2009 did not exceed the USEPA criterion of 346 ng/g for TL 4 fish species. Therefore, based on the available mosquitofish and sunfish data, fish-eating wildlife foraging preferentially from the interior marsh of STA-5 appears to be at low to moderate risk from mercury exposure.

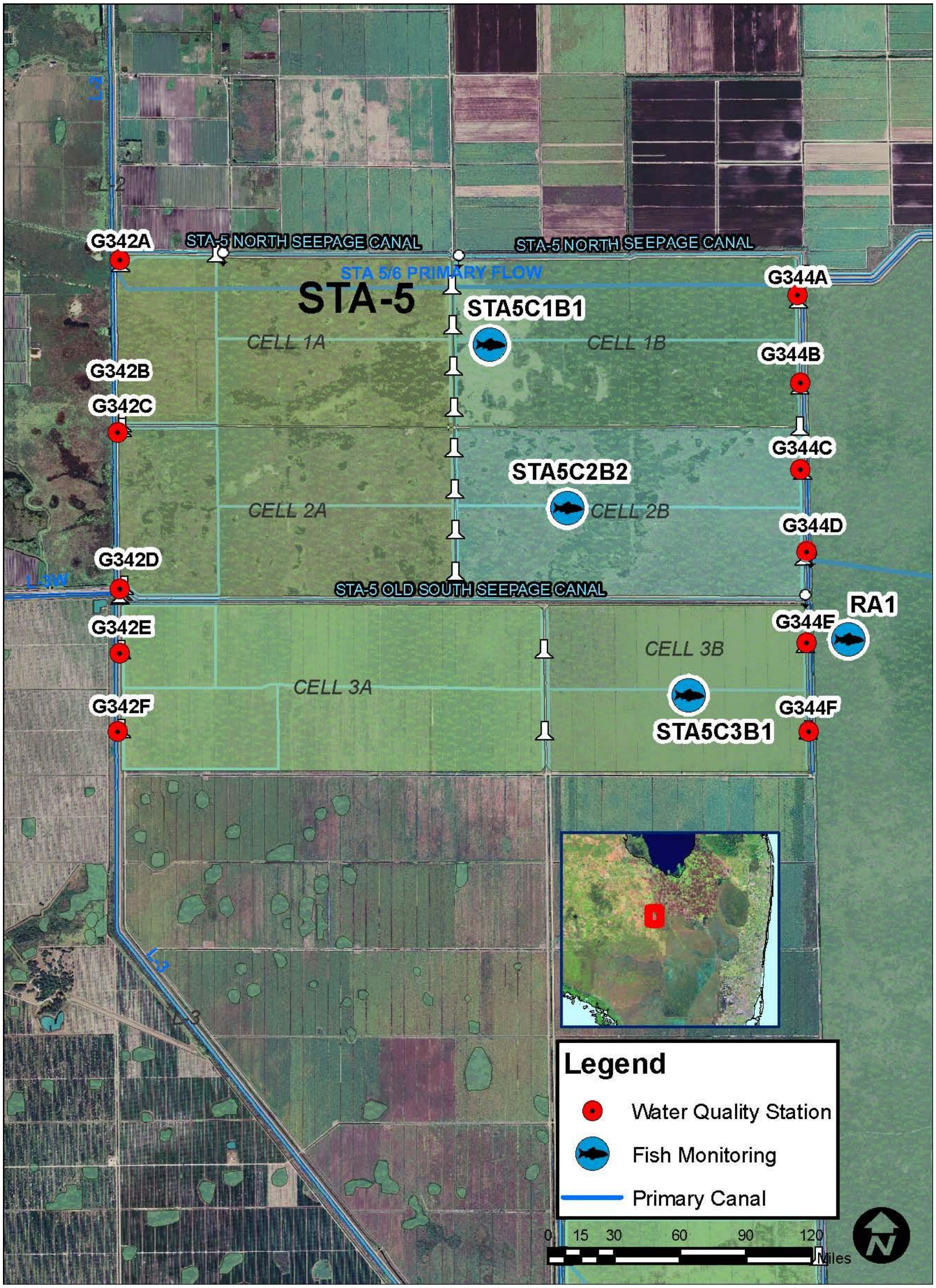


Figure C-12. Current and historical mercury monitoring sites at STA-5. Mosquitofish composite samples are collected for each flow-way and composited, and one mosquitofish sample is collected downstream (RA1). Currently, only Flow-way 3 is being monitored for fish collection.

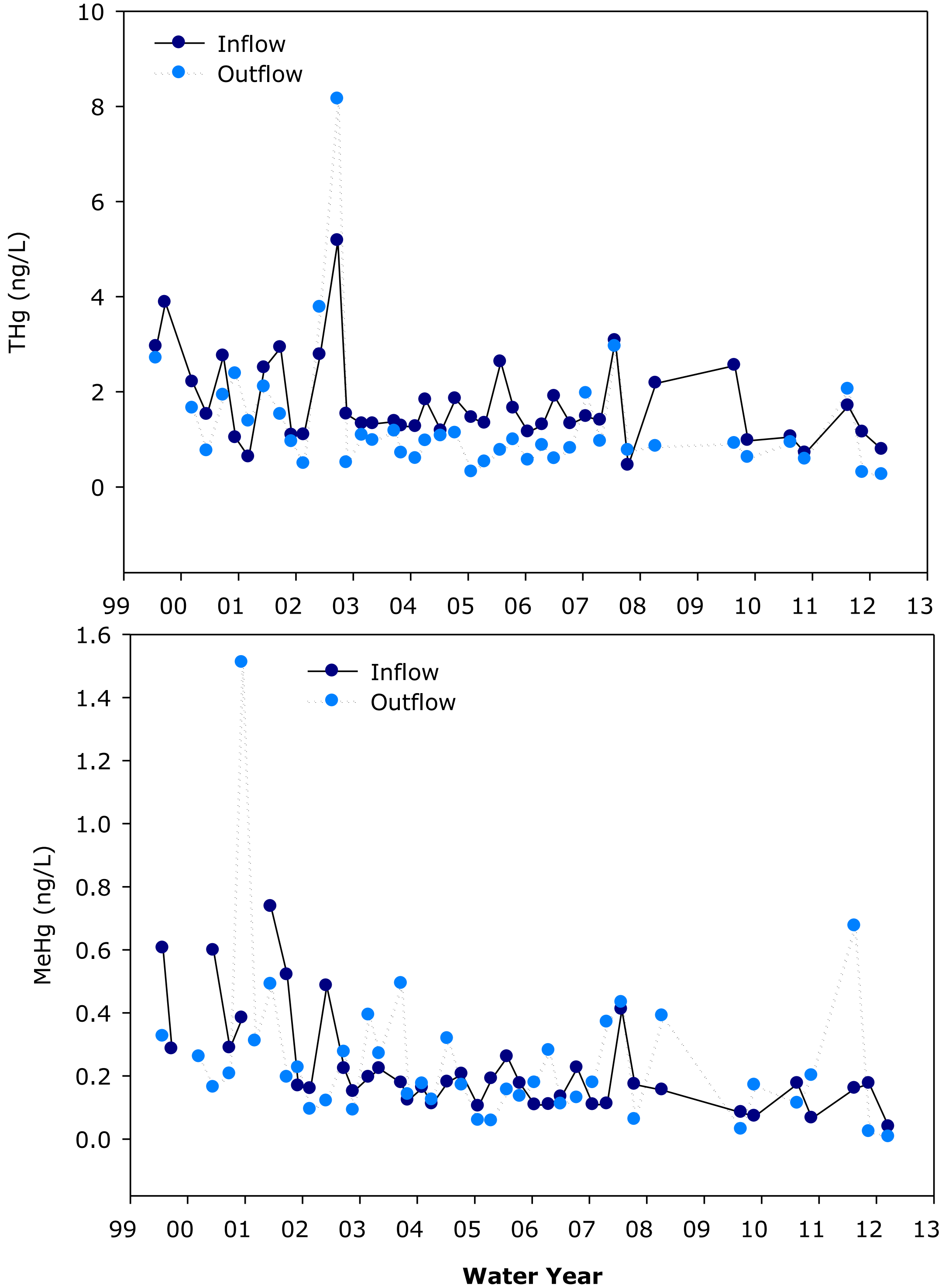


Figure C-13. Concentrations of THg (top) and MeHg (bottom) in unfiltered surface water collected at STA-5.

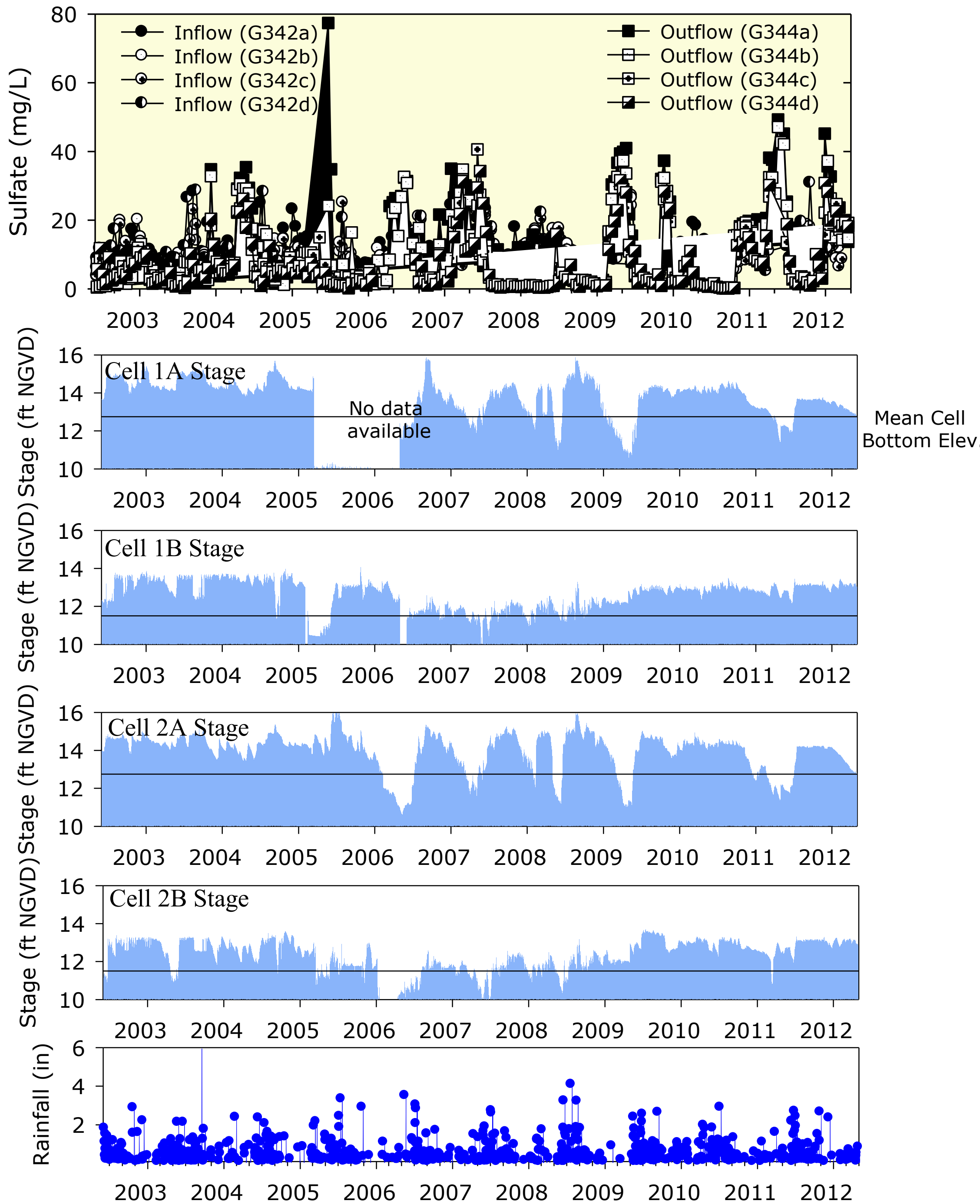


Figure C-14. Concentrations of sulfate, stage in the two cells (recorded immediately upstream of the outflow culvert), and rainfall at STA-5.

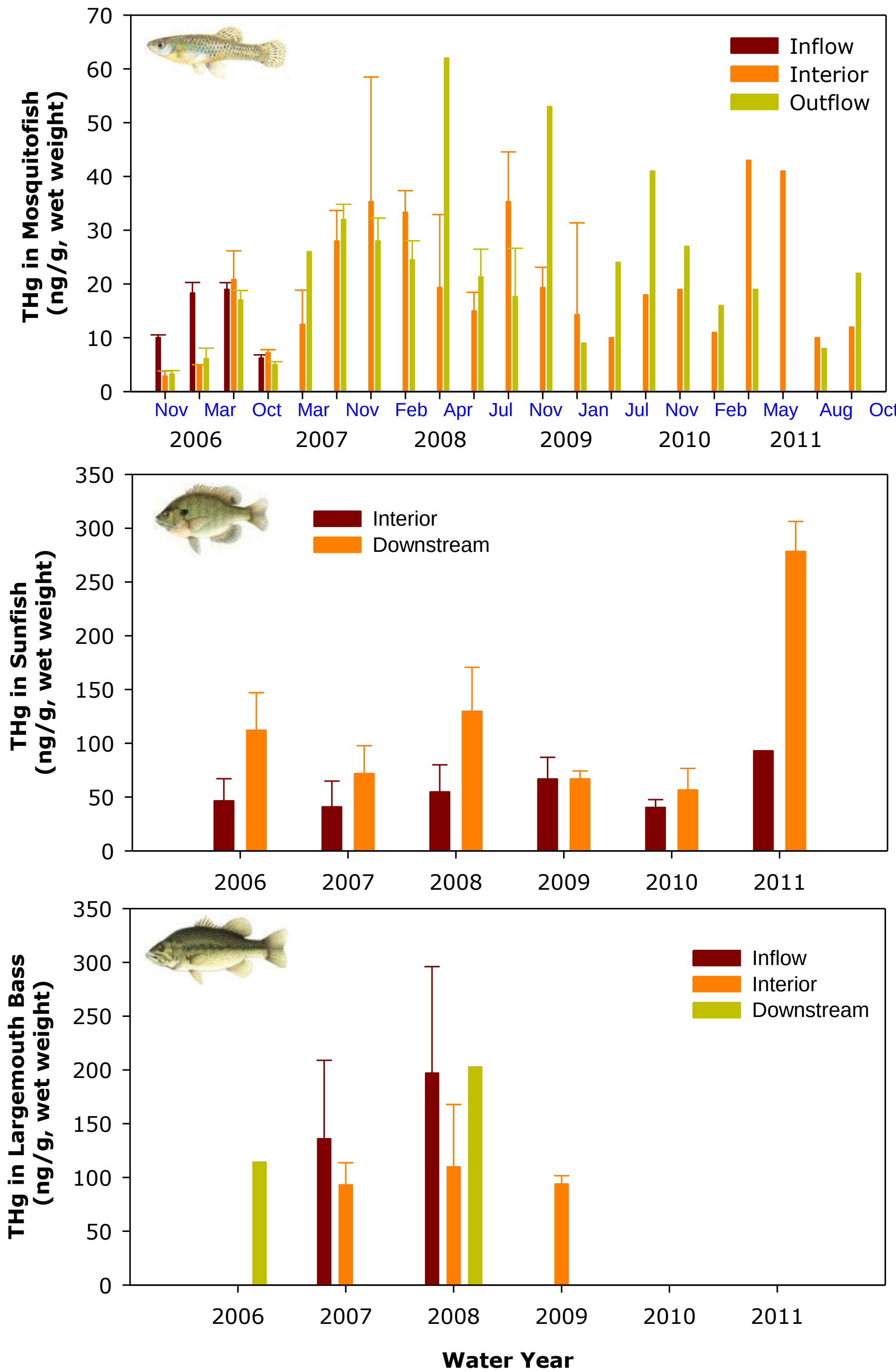


Figure C-15. Mercury concentrations (ng/g, wet weight) in mosquitofish composites (± SD) (top), whole sunfish (± SD) (middle), and fillets of largemouth bass (arithmetic mean, ± SD) (bottom) collected at STA-5. Samples of largemouth bass were not available from WY2010 to WY2012 due to drought condition.

STA-6

Start-up mercury monitoring occurred in the new part of STA-6, Section 2, on July 25, 2007. Currently, STA-6, Section 2, is under Phase 2, Tier 1 monitoring (**Figure C-16**) as reported in this section. The Florida Department of Environmental Protection issued minor permit modification 0236905-001 June 6, 2008, approving transfer of mercury monitoring from Phase 2 – Tier 1: Routine Monitoring during Stabilization Period to Phase 3 – Tier 3: Routine Operational Monitoring from Year 4 to Year 9 for STA-6 Section 1 (STA-6 Cells 3 and 5). Phase 3 – Tier 3 implemented the termination of all site specific mercury monitoring at STA-6 Section 1. Monitoring results prior to May 2004 are reported elsewhere (SFWMD, 1998 and 1999d; Rumbold and Rawlik, 2000; Rumbold et al., 2001; Rumbold and Fink, 2002a; Rumbold and Fink, 2003a; Rumbold, 2004 and 2005; Rumbold et al., 2006).

Due to STA-6 Section 2 Compartment C build-out construction, surface water sampling sites were offline and, therefore, no surface water samples were collected for WY2012 (see **Figure C-17**, which shows THg and MeHg surface water concentrations from WY1998–WY2011). **Figure C-18** shows updates of sulfate concentration, stage, and rainfall from WY2001–WY2012.

Concentrations of THg in mosquitofish are summarized in **Table C-3** and **Figure C-19**. Levels of mercury in mosquitofish from the interior of STA-6 for WY2012 remained the highest of all STAs. The persistent high levels in STA-6 are inconsistent with the historically low surface water percent MeHg levels, leading to the speculation that food chain dynamics enhance mercury bioaccumulation in STA-6. However, potential changes in porewater MeHg may also be a factor. The average annual composite for WY2012 and each individual mosquitofish composite for all locations within STA-6 did not exceed EPA TL 3 fish THg criterion and the POR 75th percentile for all downstream Everglades sampling locations.

As shown in **Table C-3** and **Figure C-19**, the average sunfish THg level in STA-6 from the interior marsh decreased from 72 ng/g in WY2011 to 41 ng/g in WY2012. There was a three year trend of decreases in THg level in the STA-6 interior. However, the average THg in the downstream increased by 12 ng/g to 113 ng/g. This has been the scenario since STA-6 started operations. The average annual sunfish Hg concentration for the interior marsh of STA-6 did not exceed the75th percentile for the POR for all receiving waters sampled in downstream Everglades locations during WY2012.

No largemouth bass sample between the standard length range of 307 and 385 mm was collected from STA interior and downstream during WY2012 (**Table C-6**). The average THg level for the 5 LMB in the interior STA was 284 ng/g with one individual (SL=389 mm) containing THg level of 896 ng/g (**Table C-6**). The downstream LMB contained an average THg level of 375 ng/g which was substantially lower than the average (467 ng/g) in WY2011. In all WYs, the downstream THg levels were consistently greater than the levels form the STA interior (**Figure C-19**). The average annual LMB collected for WY2012 in STA-6 did not exceed the POR 75th percentile for all downstream Everglades sampling locations.

Regarding risks to fish-eating wildlife, mosquitofish from the interior and downstream locations did not exceed the 77 ng/g TL 3 USEPA criterion in WY2011. Contrast to WY2011 when 80 percent of the catch from the interior marsh exceeded the USEPA TL 3 criterion and 40 percent exceeded the USFWS 100 ng/g criterion, no sunfish in WY2012 exceeded either criterion. Similar to WY2011, all sunfish THG level from the downstream site equaled or exceeded the USFWS criterion. Ten percent from the interior marsh and 60 percent from downstream were above the USEPA criterion of TL 4 species (346 ng/g). Therefore, the risk of mercury exposure to fish-eating wildlife foraging preferentially at interior and downstream locations within STA-6 remains moderate to high.

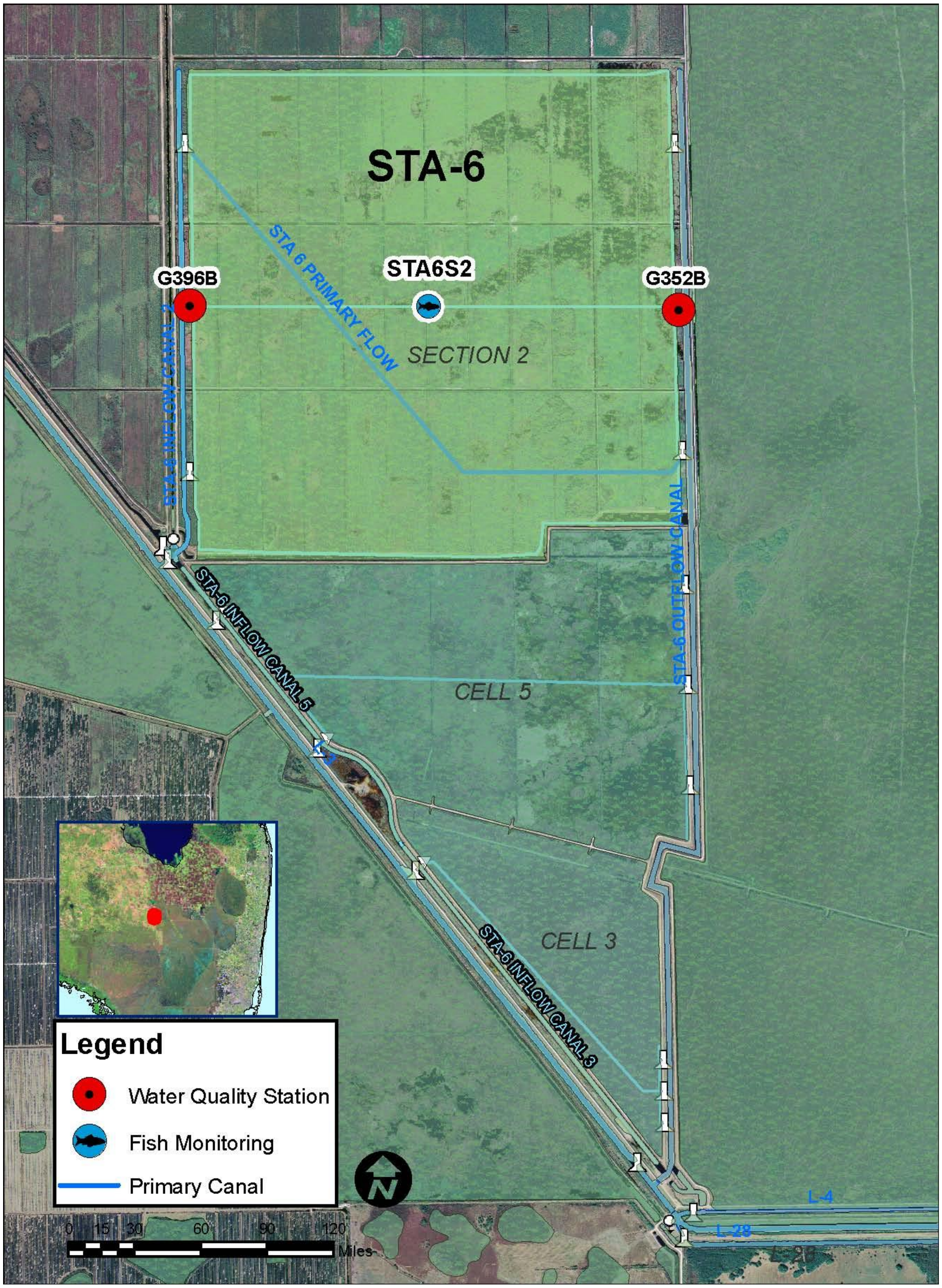


Figure C-16. Current mercury monitoring sites at STA-6.
A mosquitofish composite sample is collected for STA-6, Section 2, and a single mosquitofish sample is collected downstream (STA6DC).

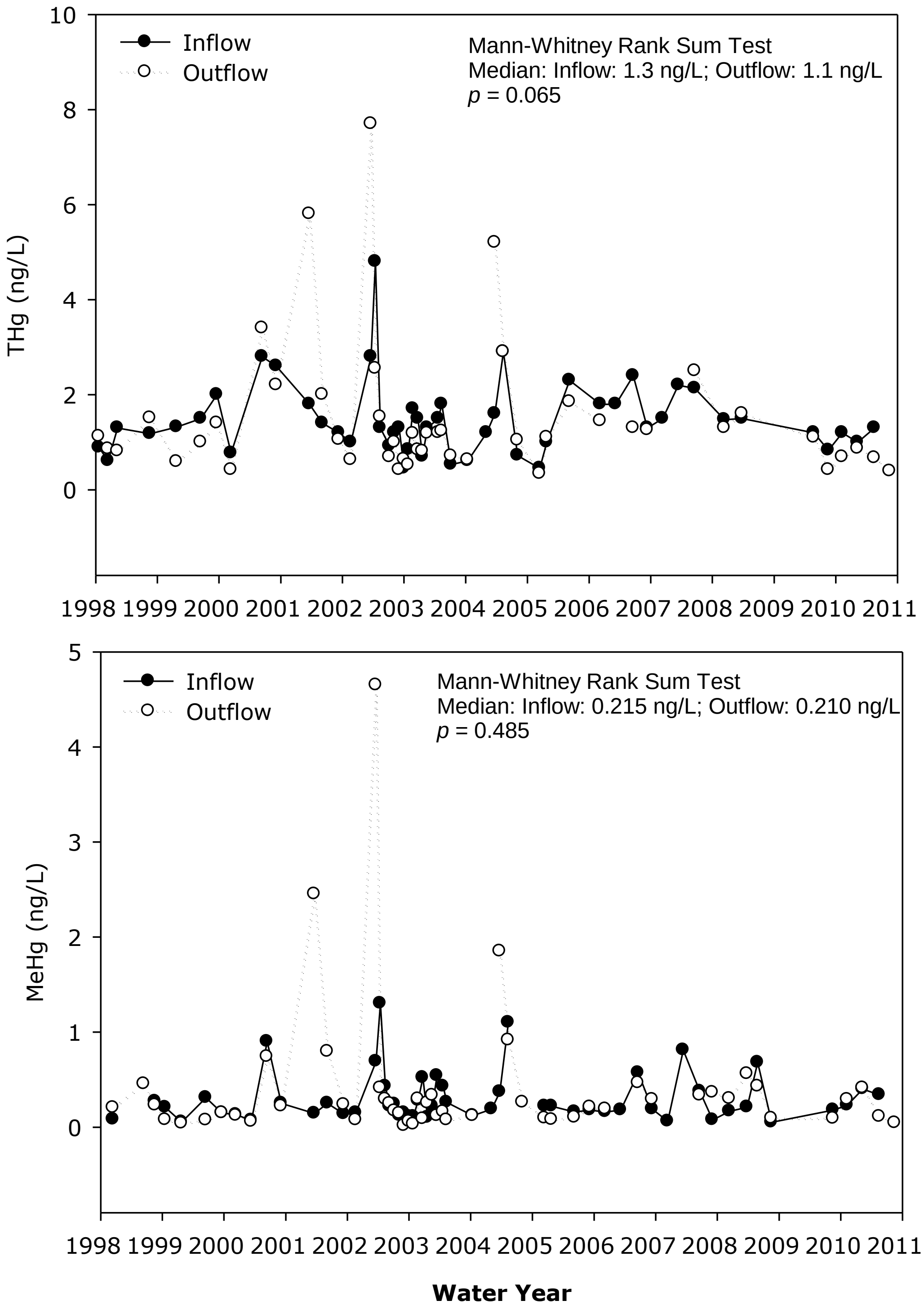


Figure C-17. Concentrations of (A) THg and (B) MeHg (ng/L) in unfiltered surface water collected at STA-6.

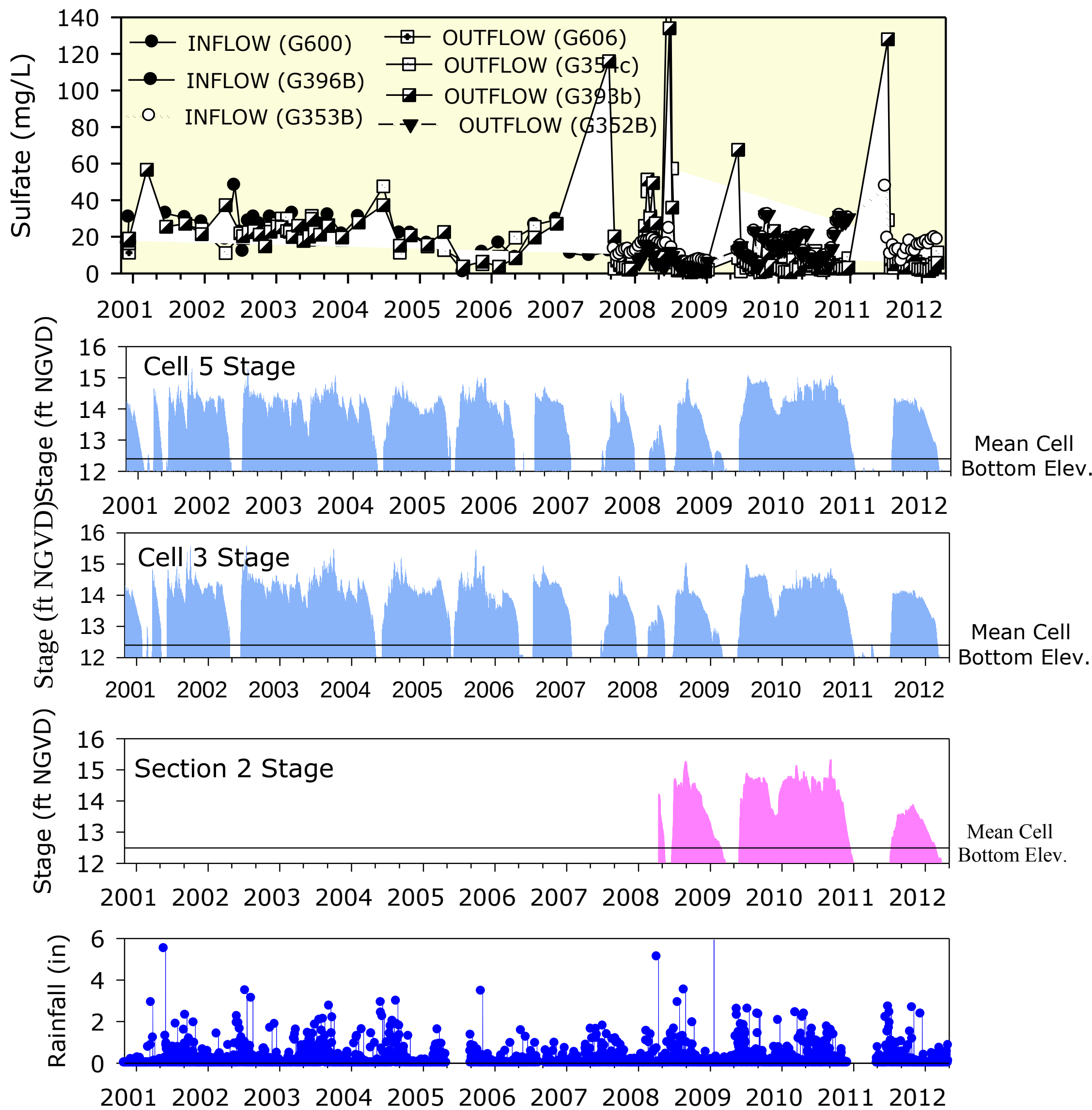


Figure C-18. Concentrations of sulfate, stage, and rainfall for STA-6.

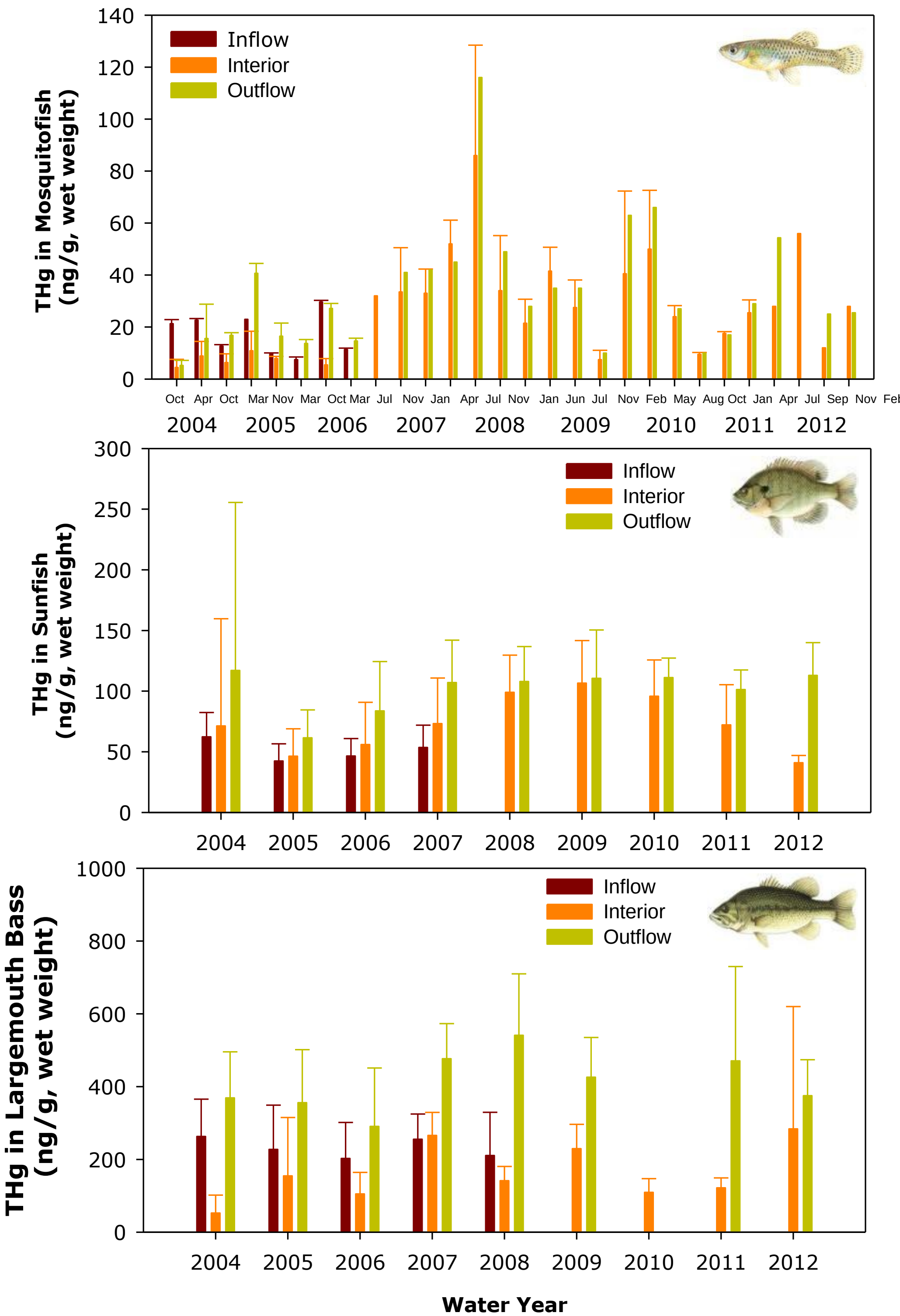


Figure C-19. Mercury concentrations (ng/g, wet weight) in mosquitofish composites (± SD)(top), whole sunfish (± SD)(middle), and fillets of largemouth bass (arithmetic mean, ± SD)(bottom) collected at STA-6.

MERCURY MONITORING NETWORK OPTIMIZATIONS

The summaries below provide information on the current mercury monitoring phase for each STA. These phases are concurrent with guidance contained in the MMAP.

STA-1W

The permit modification for moving from Phase 3 - Tier 1 to Phase 3, Tier 3 was issued August 21, 2009. Phase 3 – Tier 3 terminates all mercury monitoring in STA-1W (mosquitofish stations ST1W13COM, ST1W24COM, ST1WC5COM, ENR012, G310, and ST1WLX; bass and sunfish stations ST1W51, ENR012, G310, and ST1WLX).

STA-1E

Mercury monitoring in STA-1E is currently in Phase 3 – Tier 1. February 29, 2012 the Florida Department of Environmental Protection (Department) approved transfer of STA-1E mercury monitoring from Phase 2 – Tier 1: Routine Monitoring during Stabilization Period to Phase 3 – Tier 1: Routine Operational Monitoring from Year 4 to Year 9 for all flow-ways (Western, Central and Eastern), which include cells 1, 2, 3, 4N, 4S, 5, 6 and 7 of STA-1E. Phase 3 – Tier 1 terminated all mercury surface water monitoring at STA-1E (stations G-311, S-362, S-361, and S-319), reduced the mosquitofish monitoring frequency from quarterly to semiannually, bass and sunfish monitoring frequency from annually to triennially, and reduced the number of bass and sunfish monitoring stations from all flow-ways to one flow-way with the historically highest mercury concentrations (station ST1EC2A in Cell 2 of the eastern flow-way) and one downstream station (ST1ELX). Bass and sunfish monitoring was terminated in the Central (station ST1EC4SA in Cell 4S) and Western (station ST1EC6A in Cell 6) flow-ways.

STA-2

Mercury monitoring in STA-2 is currently in Phase 1 – Tier 2: Field Sampling for Initial Startup Monitoring Prior to Discharge for Cell 4 and Phase 3 – Tier 3: Routine Operational Monitoring After Year 9 for Cells 1, 2, and 3. February 29, 2012, the Department approved transfer of STA-2 mercury monitoring from Phase 2 - Tier 1: Routine Monitoring during Stabilization Period for Cells 1, 2 and 3 of STA-2 to Phase 3 – Tier 3: Routine Operational Monitoring After Year 9 and Phase 3 – Tier 1: Routine Operational Monitoring From Year 4 to Year 9 for Cell 4 of STA-2. Phase 3 – Tier 3 implemented the termination of all site specific mercury monitoring at STA-2 Cells 1, 2, and 3 (mosquitofish stations ST2C1COM, ST2C2COM, ST2C3COM).

STA-3/4

Mercury monitoring in STA-3/4 is currently in Phase 3, Tier 1. A permit modification issued June 6, 2008, moved monitoring from Phase 2. Under this modification, Hg monitoring through mosquitofish was terminated at G383, G370, ST34C1B1, ST34C2B4, G376B, G376E, G379B, G379D, G381B, and G381E; largemouth bass and sunfish monitoring was ended at G383, G370, ST34C1B1, and ST34C2B4. Mosquitofish monitoring continues semiannually at cell flow-ways and downstream station L5F1. Largemouth bass and sunfish collections are on triennial basis.

STA-5

Mercury monitoring in STA-5, Flow-ways 1 and 2, is currently in Phase 3, Tier 3. The recently constructed Flow-way 3 is in Phase 2, Tier 1. The permit modification issued June 6, 2008, made these phase adjustments, terminating mosquitofish monitoring at G344B and G344D, largemouth bass and sunfish monitoring at G344D, and added mosquitofish station ST5C3COM and largemouth bass and sunfish collection station STA5C3B1.

STA-6

STA-6 (Cells 3 and 5) is in Phase 3, Tier 3 and mercury monitoring has been terminated in these areas. The relatively new Section 2 of STA-6 is in Phase 2, Tier 1 monitoring, which includes surface water and fish data. The permit modification issued June 6, 2008, made these phase adjustments, terminated mosquitofish monitoring at STA6C3COM and STA6C5COM, and terminated largemouth bass and sunfish monitoring at STA6C32.

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Attachment D: Rotenberger Wildlife Management Area Restoration and STA Downstream Transect Monitoring

Tom Dreschel

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In addition to the information provided in this attachment, additional supplemental information is required by Specific Conditions 27, 28, and 30(b) of the EFA permits for STA-1W, STA-1E, and STA-3/4, and by Specific Conditions 25(b)3 and 28(b) of the EFA permits for STA-2, STA-5, and STA-6. This information is also required by the Administrative Order for STA-5 and STA-6, and under Findings of Fact Number 20 for each of the above-mentioned STAs, and is available upon request.

HYDROPATTERN RESTORATION AND STA DISCHARGE MONITORING ON THE DOWNSTREAM AREAS

This section presents results from monitoring conducted in the areas downstream of the Stormwater Treatment Areas (STAs), including the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge), Water Conservation Area (WCA) 2A, and the Rotenberger Wildlife Management Area (RWMA). Everglades Forever Act (EFA) permit 0279449 for STA 1 West (STA-1W) and STA 1 East (STA-1E) and Administrative Order (AO) AO-010-EV for STA-2 and AO-011-EV for STA-5 requires the characterization of the effects of STA discharges on adjacent marsh areas. This characterization is based on monthly samples collected for specific conductance (conductivity) and total phosphorus (TP). Water quality monitoring stations in the marsh areas have been chosen along a transect from the discharge points and are categorized as "impacted" or "unimpacted" based on sediment TP levels. Those transect stations in areas where sediment TP levels are greater than 500 milligrams per kilogram (mg/kg) are identified as impacted. Monitoring data for each transect is available upon request as part of Attachment B. A summary of specific conductance and TP collected for these transects is provided in **Tables D-1** and **D-2**, respectively. These water quality data are also graphically presented as notched box-and-whisker plots along with the results of the monitoring conducted as part of the hydropattern restoration monitoring, which includes vegetation and water level.

[2] Florida Fish and Wildlife Conservation Commission, FL.

Table D-1. Summary statistics for specific conductance (in microsiemens per centimeter, µS/cm) measurements collected during Water Year 2012 (WY2012) (May 1, 2011–April 30, 2012) at transect stations downstream from STA outflows. Note: distances reported in kilometers (km).

STA Transect	Station Information		Distance from Canal (km)	Number of Samples	Mean ± SD[2]	Min	Percentiles[3]			Max
	Name	Category[1]					25th	50th	75th	
STA-1W	LOXA104	Rim Canal	0.0	12	848 ± 131	681	734	843	922	1,083
	LOXA104.5	Impacted	0.4	8	782 ± 189	409	694	831	907	983
	LOXA105	Impacted	0.8	8	715 ± 201	336	604	779	837	942
	LOXA106	Impacted	1.1	3	488 ± 125	356	393	504	580	605
	LOXA107	Impacted	2.2	3	191 ± 9	182	184	190	198	200
	LOXA107U	Unimpacted	3.4	4	150 ± 21	126	135	149	165	175
	LOXA108	Unimpacted	4.1	4	153 ± 39	114	123	148	184	204
STA-1E	LOXA135	Rim Canal	0.0	12	938 ± 207	615	803	857	1,097	1,350
	LOXA136	Impacted	0.6	8	581 ± 186	269	462	658	694	752
	LOXA137	Impacted	1.1	6	460 ± 164	174	425	478	531	674
	LOXA138	Unimpacted	2.1	5	249 ± 84	127	213	247	292	363
	LOXA139	Unimpacted	4.0	4	131 ± 18	111	118	130	145	153
STA-2 (Transect 1)	N0.25	Impacted	0.2	10	1,161 ± 133	914	1,044	1,216	1,243	1,314
	N1.0	Impacted	0.9	10	1,170 ± 146	853	1,118	1,218	1,282	1,339
	N2.0	Impacted	1.9	7	1,110 ± 150	819	1,044	1,153	1,210	1,258
	N4.0	Impacted	3.7	7	1,084 ± 140	805	1,058	1,073	1,195	1,222
	C4.0	Unimpacted	6.8	6	1,007 ± 142	797	904	1,025	1,092	1,197
STA-2 (Transect 2)	FS0.25	Impacted	0.4	8	1,145 ± 102	965	1,074	1,166	1,225	1,262
	FS1.0	Impacted	1.0	7	1,077 ± 117	937	983	1,069	1,169	1,259
	FS3.0	Impacted	3.1	9	936 ± 280	351	801	994	1,117	1,249
	CA29	Unimpacted	5.6	10	921 ± 208	550	820	900	1,060	1,321
STA-5	RC1	Impacted	0.2	10	686 ± 168	433	505	705	830	937
	RC2	Impacted	2.3	9	533 ± 261	260	290	545	791	886
	RC3	Impacted	4.2	9	403 ± 282	186	205	236	740	822

Note:

1 Categories of "impacted" and "unimpacted" refer to station identification based on sediment phosphorus concentrations. Impacted stations have sediment TP concentration ≥500 mg/Kg.

2 Arithmetic mean ± one standard deviation

3 Median = 50th Percentile.

Table D-2. Summary statistics for total phosphorus (TP in micrograms per liter, µg/L) measurements in water quality samples collected during Water Year 2012 (WY2012, May 1, 2011 – April 30, 2012) at transect stations downstream from STA outflows. Note: distances reported in kilometers (km).

STA Transect	Station Information		Distance from Canal (km)	Number of Samples	Mean ± SD[2]	Min	Percentiles[3]			Max
	Name	Category[1]					25th	50th	75th	
STA-1W	LOXA104	Rim Canal	0.0	11	23.5 ± 3.9	19	20	22	27	30
	LOXA104.5	Impacted	0.4	7	37.1 ± 14.5	21	25	37	46	62
	LOXA105	Impacted	0.8	7	18.1 ± 5.5	12	14	16	24	26
	LOXA106	Impacted	1.1	5	14.2 ± 3.9	10	12	13	17	20
	LOXA107	Impacted	2.2	2	13.5 ± 3.5	11	11	14	16	16
	LOXA107U	Unimpacted	3.4	4	6.8 ± 1.3	5	6	7	8	8
	LOXA108	Unimpacted	4.1	4	8.5 ± 5.0	6	6	6	11	16
STA-1E	LOXA135	Rim Canal	0.0	12	32.2 ± 17.3	14	20	29	38	71
	LOXA136	Impacted	0.6	7	23.0 ± 14.9	10	14	17	30	52
	LOXA137	Impacted	1.1	6	15.8 ± 6.7	8	11	15	21	26
	LOXA138	Unimpacted	2.1	5	7.8 ± 1.3	6	7	8	9	9
	LOXA139	Unimpacted	4.0	5	9.0 ± 4.6	6	6	8	10	17
STA-2 (Transect 1)	N0.25	Impacted	0.2	10	15.6 ± 5.1	9	11	16	19	26
	N1.0	Impacted	0.9	10	14.7 ± 7.3	9	11	13	16	34
	N2.0	Impacted	1.9	7	11.9 ± 3.5	9	9	10	15	17
	N4.0	Impacted	3.7	7	6.7 ± 0.8	6	6	7	7	8
	C4.0	Unimpacted	6.8	6	5.5 ± 0.8	5	5	5	6	7
STA-2 (Transect 2)	FS0.25	Impacted	0.4	8	19.5 ± 9.4	11	13	16	25	39
	FS1.0	Impacted	1.0	7	16.7 ± 8.2	10	12	14	18	34
	FS3.0	Impacted	3.1	9	7.8 ± 2.2	5	6	8	10	11
	CA29	Unimpacted	5.6	10	5.8 ± 2.2	3	4	5	8	10
STA-5	RC1	Impacted	0.2	10	22.2 ± 9.9	11	15	20	27	44
	RC2	Impacted	2.3	9	10.6 ± 3.0	7	8	11	13	15
	RC3	Impacted	4.2	9	12.0 ± 4.8	7	9	10	14	22

Note:

1 Categories of "impacted" and "unimpacted" refer to station identification based on sediment phosphorus concentrations. Impacted stations have sediment TP concentration ≥500 mg/Kg.

2 Arithmetic mean ± one standard deviation

3 Median = 50th Percentile.

Transects in the Refuge exhibited a substantial decrease in both specific conductance and TP concentrations within 1 km of the rim canal (**Figure D-2**). Specific conductance measured in the western transect (downstream of STA-1W outflows) decreased, on average, by 42 percent or 340 microsiemens per centimeter (μS/cm) and TP concentrations decreased by approximately 39 percent or 9 micrograms per liter [(μg/L) or parts per billion (ppb)] within 1 km from the rim canal station. The eastern transect (downstream of the STA-1E outflow) exhibited a decrease of approximately 51 percent or 478 μS/cm in specific conductance and 51 percent or 16 ppb in TP within 1 km of the rim canal. Stations on both transects more than 1 km from the rim canal had mean TP concentrations ranging from 7 to 16 ppb and mean specific conductance values ranging from 130 to 250 μS/cm (**Tables D1** and **D2**). On March 8, 2012, a specific conductance value of 1,350 μS/cm was measured at LOXA135. All other specific conductance levels measured at Refuge transect stations were below the Class III criterion of 1,275 μS/cm.

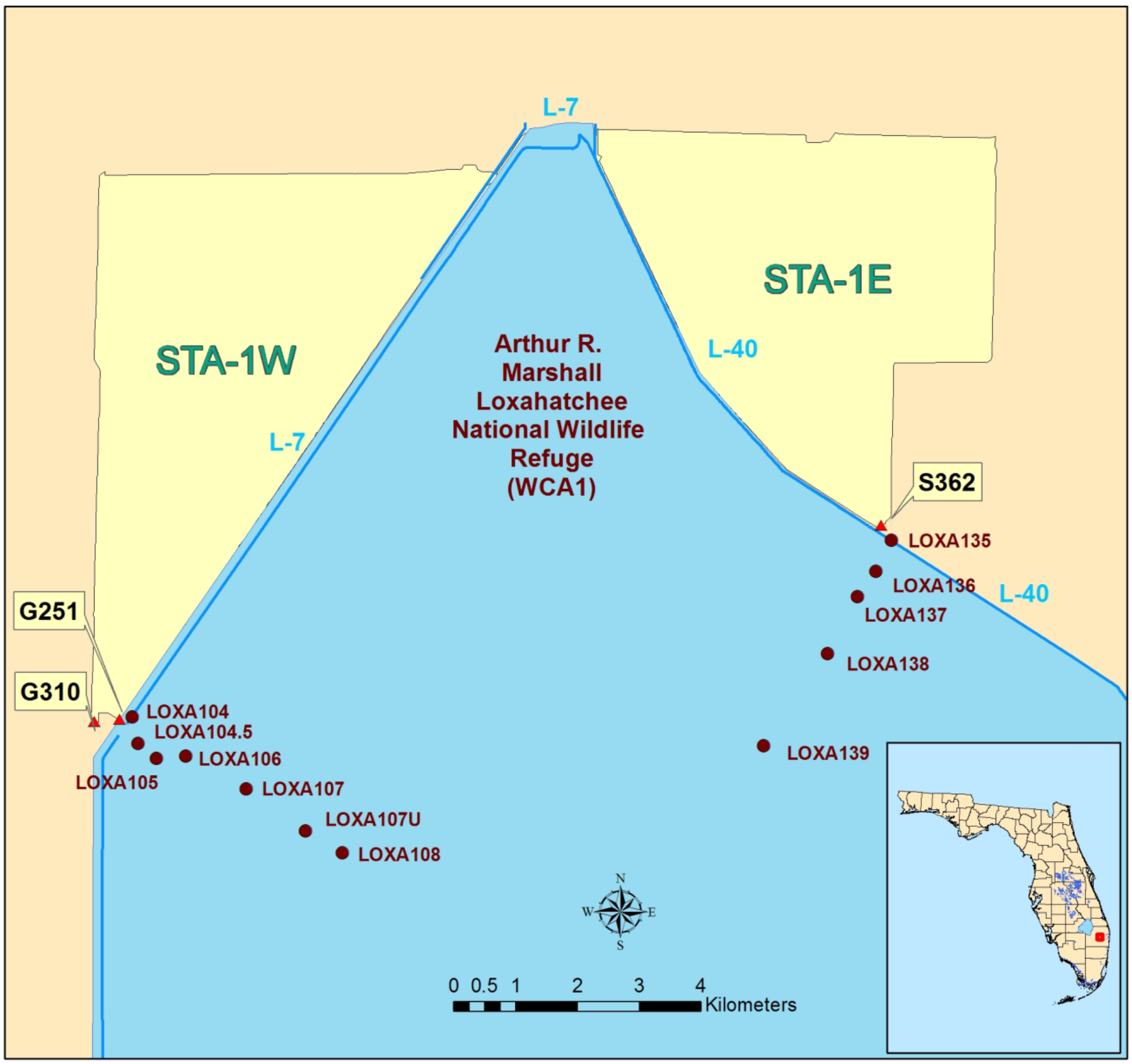


Figure D-1. Locations of marsh transect stations in the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge) and outflow structures from Stormwater Treatment Area (STA) 1 West (STA-1W) and STA 1 East (STA-1E).

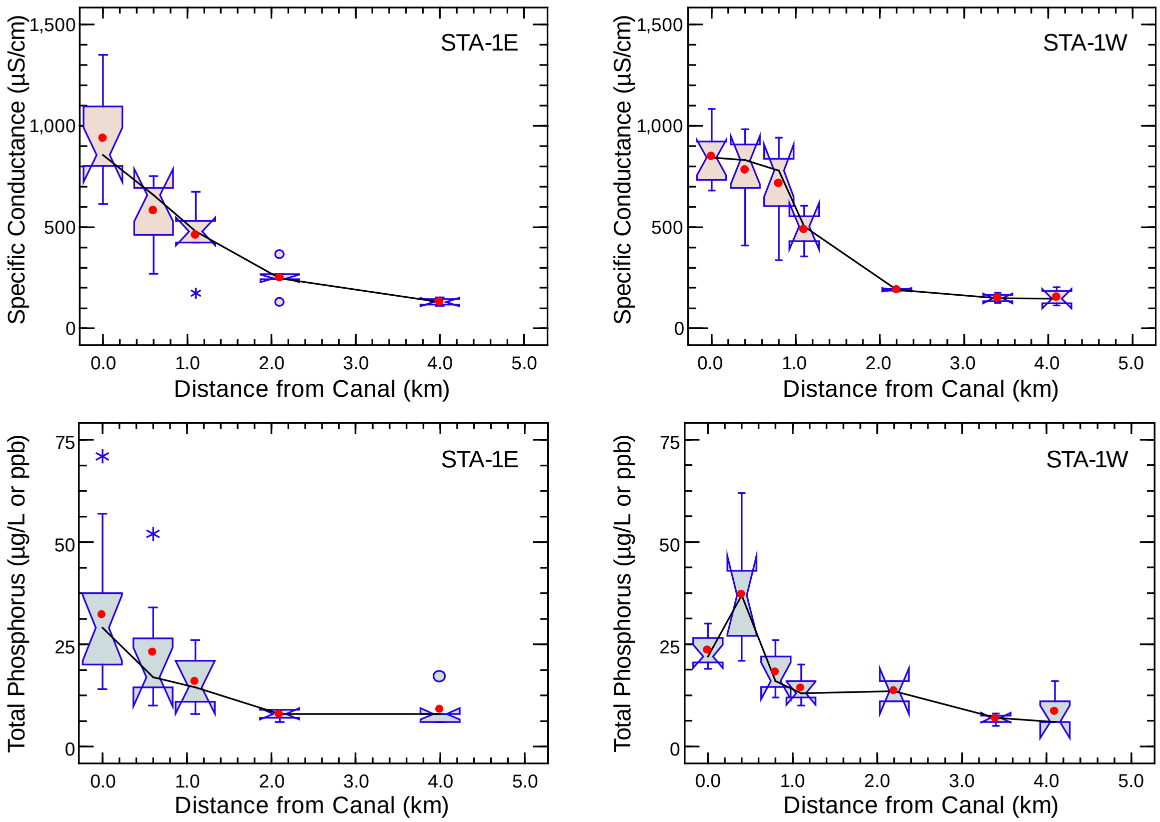


Figure D-2. Notched box-and-whisker plots of specific conductance and total phosphorus (TP) measured at transect stations downstream of STA-1W and STA-1E during Water Year 2012 (WY2012) (May 1, 2011 – April 30, 2012). The notch on a box plot represents the 95 percent confidence interval (C.I.) about the median, which is represented by the narrowest part of the notch. The top and bottom of the box represent the 75th and 25th percentiles, respectively. The whiskers represent the highest and lowest data values that are within two standard deviations (SD) of the median. Values above and below the whiskers are greater than two SD from the median. Notches that do not overlap indicate that the data represented by the boxes being compared are significantly different at the 95 percent C.I. [Note: km – kilometers)]

The average specific conductance levels for STA-1W and STA-1E transects were 446 ± 317 µS/cm (median = 382) and 592 ± 322 µS/cm (median = 664) for Water Year 2011 (WY2011) (May 1, 2010–April 30, 2011) and WY2012, respectively. The average transect TP concentration during WY2011 was 16 ± 13 µg/L (median = 12) and 20 ± 14 µg/L (median = 17) for WY2012. A Mann-Whitney test was used to statistically compare specific conductance and TP levels for WY2011 and WY2012. The test indicated that specific conductance levels measured in WY2012 were statistically higher than in WY2011 (p-value = 0.002, n = 176). Total P concentrations were also statistically higher in WY2012 compared to WY2011 (Mann-Whitney test, p-value = 0.004, n = 174). However, TP concentrations at the rim canal stations adjacent to both STA-1E andSTA-1W discharges were higher in WY2012 compared to WY2011. Additional statistical summaries for these two transects are provided in **Table D-3**. Higher specific conductance and TP levels measured during WY2012 may be attributed to dry conditions that prevailed during WY2012.

While rim canal stations were sampled 12 times during the water year, sampling at marsh stations along these transects did not start until September 2011 with some stations not sampled until December 2012.

At the vegetation line transect (**Tables D-4A and B**), cattail was present only at LOXA104.5 where it was dominant. At all other transect sites, only sawgrass was present or no plants were documented.

Table D-3. Comparison of surface water specific conductance and TP concentrations collected at permit compliance stations in Water Conservation Area 1 (WCA-1) during WY2011 and WY2012.

STA Transect	Station	Specific Conductance (µS/cm)						Total Phosphorus (µg/L or ppb)					
		WY2011			WY2012			WY2011			WY2012		
		No. of Samples	Mean ± SD	Median	No. of Samples	Mean ± SD	Median	No. of Samples	Mean ± SD	Median	No. of Samples	Mean ± SD	Median
STA-1E	LOXA135	12	768 ± 123	761	12	938 ± 207	857	12	38.5 ± 18.7	30.0	12	32.2 ± 17.3	29.0
	LOXA136	8	384 ± 197	444	8	581 ± 186	658	8	16.9 ± 6.4	17.0	7	23.0 ± 14.9	17.0
	LOXA137	10	248 ± 106	258	6	460 ± 164	478	10	12.0 ± 6.7	11.0	6	15.8 ± 6.7	14.5
	LOXA138	8	141 ± 24	140	5	249 ± 84	247	8	6.8 ± 2.1	7.5	5	7.8 ± 1.3	8.0
	LOXA139	8	98 ± 30	93	4	131 ± 18	130	8	6.8 ± 1.8	6.5	5	9.0 ± 4.6	8.0
STA-1W	LOXA104	12	879 ± 175	879	12	848 ± 131	843	12	25.9 ± 9.4	23.5	11	23.5 ± 3.9	22.0
	LOXA104.5	9	767 ± 218	792	8	782 ± 189	831	9	17.6 ± 5.8	18.0	7	37.1 ± 14.5	37.0
	LOXA105	9	530 ± 223	557	8	715 ± 201	779	9	13.9 ± 4.9	14.0	7	18.1 ± 5.5	16.0
	LOXA106	7	401 ± 175	393	3	488 ± 125	504	7	8.9 ± 2.7	9.0	5	14.2 ± 3.9	13.0
	LOXA107	4	198 ± 30	201	3	191 ± 9	190	4	8.3 ± 5.5	7.0	2	13.5 ± 3.5	13.5
	LOXA107U	5	144 ± 11	139	4	150 ± 21	149	5	6.6 ± 1.8	6.0	4	6.8 ± 1.3	7.0
	LOXA108	7	140 ± 20	141	4	153 ± 39	148	7	6.9 ± 2.7	8.0	4	8.5 ± 5.0	6.0

Note: ppb = parts per billion
Mean ± SD = arithmetic mean ± one standard deviation.

Table D-4A. Number of points (out of 10 possible points at 1 meter intervals along each line transect) of WCA-1 at monitoring locations where sawgrass or cattail was present. Survey was conducted during the dry season.

Date	LOXA104.5		LOXA105		LOXA106		LOXA107		LOXA107U		LOXA108	
	Saw	Cat	Saw	Cat	Saw	Cat	Saw	Cat	Saw	Cat	Saw	Cat
Mar 2012	0	10	9	0	10	0	10	0	10	0	7	0

Table D-4B. Number of points (out of 10 possible points at 1 meter intervals along each line transect) of WCA-1 at monitoring locations where sawgrass or cattail was present. Survey was conducted during the dry season.

Date	LOXA136		LOXA137		LOXA138		LOXA139	
	Saw	Cat	Saw	Cat	Saw	Cat	Saw	Cat
Mar 2012	0	0	1	0	3	0	3	0

NORTHWESTERN WATER CONSERVATION AREA 2A

WCA-2A Monitoring Objectives

In accordance with the EFA, the South Florida Water Management District (District or SFWMD) has been monitoring the effect of water discharged from STA-2 into the northwestern region of WCA-2A. These releases are intended to restore the hydropattern and ecological functionality of the marshes downstream of STA-2. The STA-2 EFA permit requires that the District implement a monitoring and assessment program to monitor and evaluate ecological changes associated with STA-2 discharges into the area. This annual report addresses the (1) beneficial environmental effects, including changes in water quality, soil, vegetative conditions, inundation, and timing of discharges, and (2) any adverse environmental effects, including imbalances in natural populations of flora or fauna, changes in periphyton communities, or other undesirable consequences of the hydropattern restoration.

WCA-2A Configuration

STA-2 primarily discharges into WCA-2A through six culverts (G-336A–F structures) (**Figure D-3**). STA-2 discharges are also released through G-336G into the discharge canal south of STA-2. Approximately 1 km northeast of the S-7 pump station, the levee separating this discharge canal from WCA-2A is degraded, allowing discharge passing through G-336G to passively enter WCA-2A. Three transects (N-, C-, and S-transects) were established in 1998 to monitor environmental and ecological changes in the area. In 2005, a new transect (FS-transect) was established to monitor the STA-2 discharges through the degraded levee northeast of S-7. The FS-transect includes locations at 0.25, 1, 2, and 3 km from the degraded levee. In 2010 the transects were reengineered to better monitor better monitor ecological changes; the (S-transect) was eliminated and additional stations were added to the N-, C-, and FS- transects. There are two EFA permit compliance monitoring transects that consist of selected stations from the N-, C-, and FS-transects and also include station CA29.

WCA-2A Hydropattern Restoration

Hydropattern improvements resulting from STA-2 discharges are presented in Pietro et al. (2009) and Garrett and Ivanoff (2008). Permanent stage recorders were installed at WC2AN1 and WC2AS1 (**Figure D-3**) stations in WY2009 and both gauges began recording data in June 2009. Stage data were available for WY2010, WY2011 and WY2012 for sites WC2AN1 and WC2AS. Water depths were determined by subtracting estimated ground elevation from the stages. Results showed that in WY2012, the north and south stations were inundated 86 and 59 percent of the time, respectively (**Figure D-4**). Mean water depth when water level was above ground ranged from 14.4 inches (in) at WC2AN1 to 4.6 in at WC2AS1. Compared to WY2011, depths and number of inundation days were higher but the average depth was lower in WY2012. In May and June of 2011, water levels at both sites were below ground reflecting the drought conditions at the time. Water depths at the north station fluctuated widely between 15 inches and 40 inches during the wet season and part of the dry season. Water depths at the south station fluctuated between 5 and 20 inches during the wet season and part of the dry season. At the south site, water levels went below ground from January 2012 to the end of the water year.

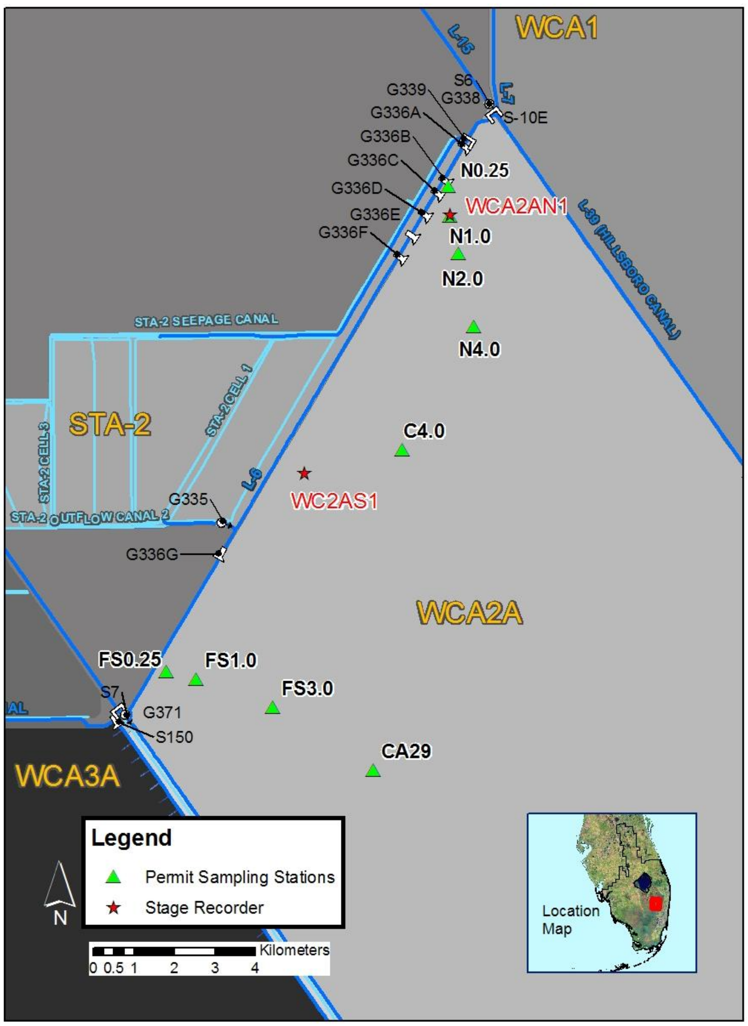


Figure D-3. Location of STA-2 discharge structures, including the G-336A–G discharge culverts in relation to sampling stations along transects in the northwestern section of Water Conservation Area (WCA) 2A.

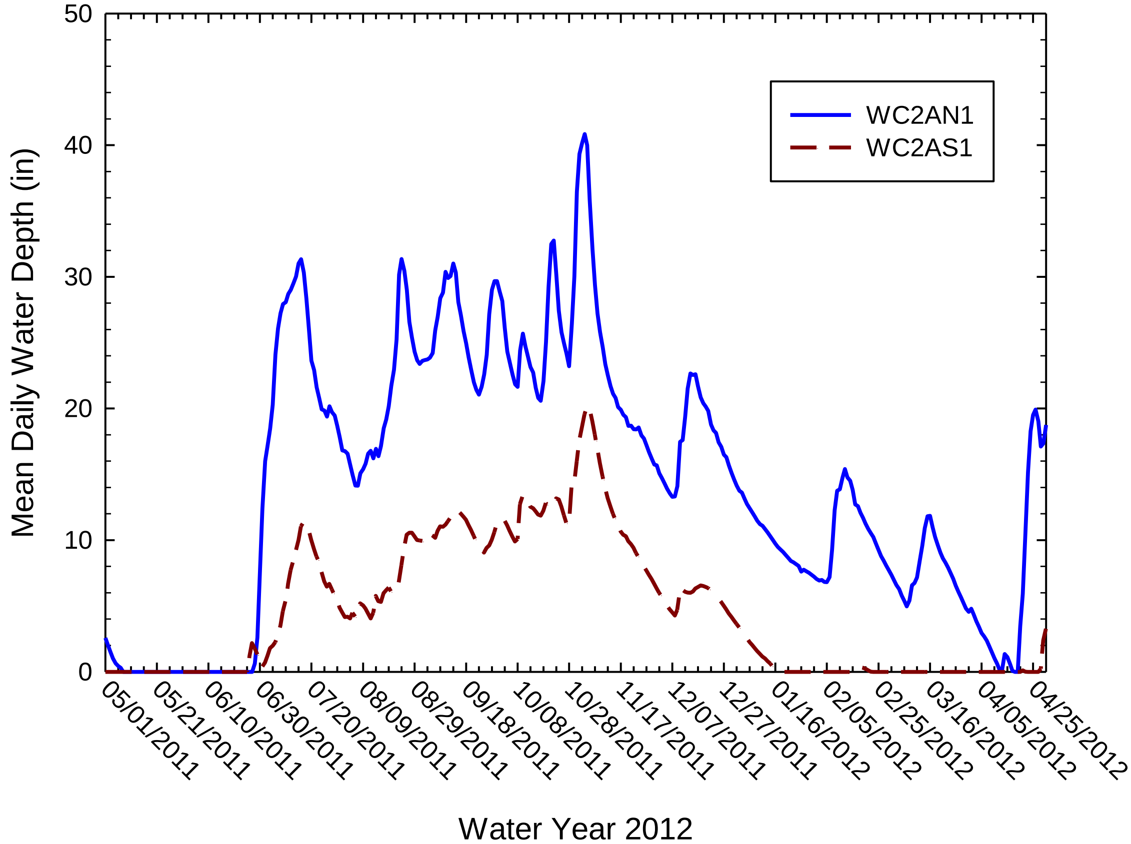


Figure D-4. Mean daily water depths for WY2012 derived from two stage recorders deployed along the northwest region of WCA-2A. See Figure D-3 for the location of these stations.

EFA Permit Compliance Transect Total Phosphorus and Specific Conductance at STA-2 Downstream Area (WCA-2A)

Two EFA permit compliance transects are downstream of the STA-2 discharge. These transects are monitored to characterize the effects of STA-2 discharges on the marsh. They are in the western part of the WCA, with Transect 1 in the northern portion and Transect 2 in the southern portion (**Figure D-3**). Transect 1 is near the G-336A-G structure and consists of five marsh monitoring stations (N0.25, N1.0, N2.0, N4.0, and C4.0) extending approximately 7 km into the WCA. Transect 2 is downstream of the G-336G structure and consists of four marsh monitoring stations (FS0.25, FS1.0, FS3.0, and CA29) extending approximately 6 km into WCA-2A.

Mean specific conductance during WY2012 ranged from 921 to 1,170 µS/cm for both transects (**Table D-5**). Specific conductance levels at stations located between 0.25 and 4 km from L-6 Canal along the northern transect ranged from 1,084 to 1,170 µS/cm and decreased to 1,007 µS/cm at 7 km into the marsh (**Figure D-5**). Average specific conductance levels changed by approximately 220 µS/cm along the southern transect during WY2012, ranging from 921 to 1,145 µS/cm (**Table D-5**). One measurement along the southern transect and five measurements along the northern transect exceeded the Class III criterion of 1,275 µS/cm. Specific conductance values exceeding the Class III criterion were measured at stations of CA29, N0.25 and N1.0 and ranged from 1,282 to 1,339 µS/cm. These values were all measured between February and April 2012 during the peak of the dry season and probably resulted from evaporative processes. No statistically significant difference was observed between specific conductance measure in WY2011 and WY2012 (Mann-Whitney p-value = 0.80, n = 137).

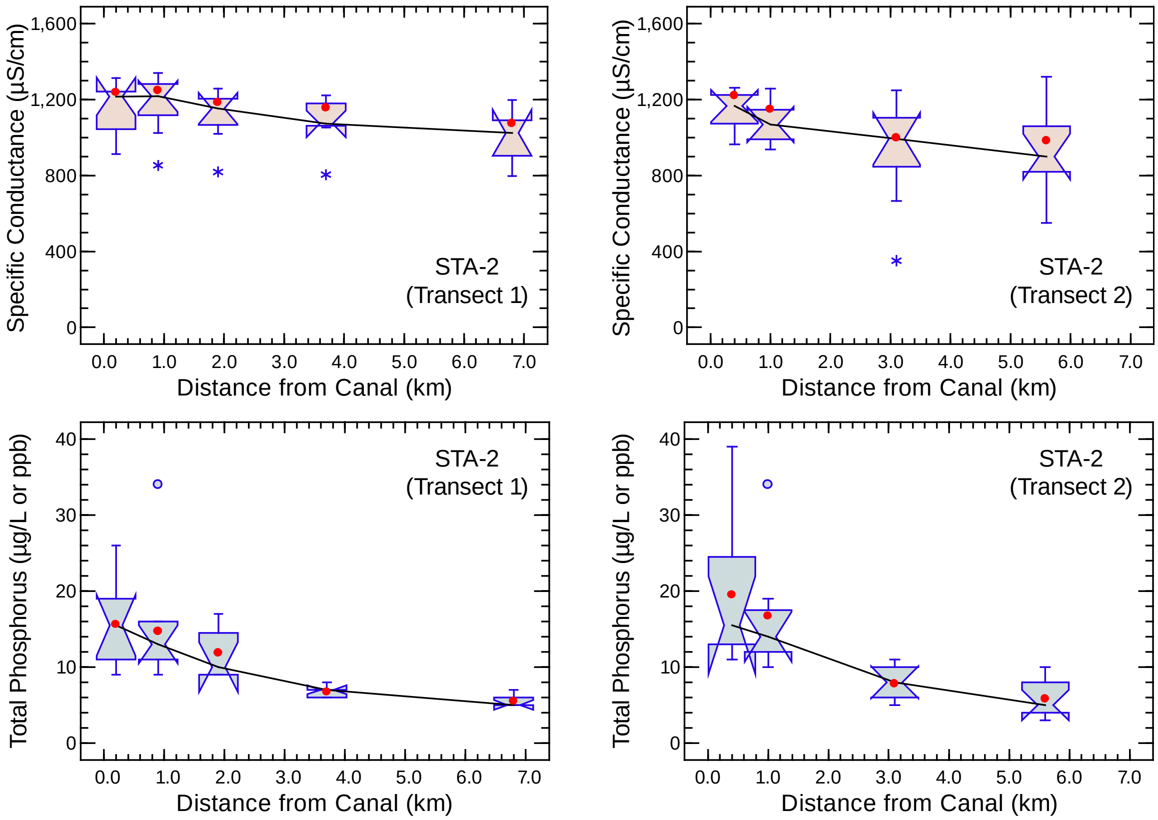


Figure D-5. Notched box-and-whisker plots of specific conductance and TP levels measured at transect stations downstream of STA-2 during WY2012. See Figure D-2 for information on notched box-and-whisker plots.

Mean TP concentrations in WY2012 ranged from 6 to 20 µg/L for both transects with stations located closer to the canal exhibiting higher TP concentrations (**Table D-5**). By 4 km from the canal, TP concentrations for both transects were below 10 µg/L (**Figure D-5**). TP concentrations in the northern transect decreased from a mean concentration of 16 µg/L at N0.25 to 6 ppb at 7 km from the discharge point. Along the southern transect, the mean TP concentration near the inflow averaged 20 µg/L and decreased to 6 ppb approximately 6 km into the marsh. Both transects exhibited a reduction in TP concentrations at 1 to 2 km from the inflow.

A Mann-Whitney test was used to determine if a statistically significant difference existed for TP data between WY2011 and WY2012. Based on the analysis, a statistically significant difference (p-value = 0.01, n = 138) was observed for TP data with the WY2012 data (median = 12 µg/L) being higher than the WY2011 data (median = 10 µg/L). Drought conditions during WY2012 may have contributed to the observed differences.

Sediments sampled in WCA-2A in May 2012 (early WY2013), are compared to concentrations obtained in March–April 2010 (during WY2010), in **Table D-6**. Sediment TP measured in WY2012 generally appear to be higher than those measured in WY2010. A statistical comparison was performed for each monitoring station using a 2-sample t-test. The results of the test indicate that while sediment TP content changed at each monitoring station between the two water years, the changes were not statistically significant ($p > 0.05$). The only exception was FS3.0 which exhibited a statistically significant decrease in sediment TP content ($p = 0.008$).

Table D-5. Comparison of surface water specific conductance and TP concentrations collected at permit compliance stations in Water Conservation Area 2 (WCA-2) during the WY2011 and WY2012.

STA Transect	Station	Specific Conductance (µS/cm)						Total Phosphorus (µg/L or ppb)					
		WY2011			WY2012			WY2011			WY2012		
		No. of Samples	Mean ± SD	Median	No. of Samples	Mean ± SD	Median	No. of Samples	Mean ± SD	Median	No. of Samples	Mean ± SD	Median
STA-2 (Transect 1)	N0.25	9	1,102 ± 154	1,139	10	1,161 ± 133	1216	8	18.8 ± 6.8	16.5	10	15.6 ± 5.1	15.5
	N1.0	7	1,020 ± 204	1,055	10	1,170 ± 146	1218	7	17.6 ± 5.7	16.0	10	14.7 ± 7.3	13.0
	N2.0	5	1,033 ± 124	1,034	7	1,110 ± 150	1153	5	14.0 ± 3.2	14.0	7	11.9 ± 3.5	10.0
	N4.0	6	1,036 ± 152	1,071	7	1,084 ± 140	1073	6	7.0 ± 0.9	7.0	7	6.7 ± 0.8	7.0
	C4.0	5	963 ± 198	983	6	1,007 ± 142	1025	5	5.6 ± 1.1	6.0	6	5.5 ± 0.8	5.0
STA-2 (Transect 2)	FS0.25	8	1,024 ± 136	991	8	1,145 ± 102	1166	8	22.9 ± 19.0	17.5	8	19.5 ± 9.4	15.5
	FS1.0	7	1,007 ± 99	995	7	1,077 ± 117	1069	7	14.4 ± 3.2	15.0	7	16.7 ± 8.2	14.0
	FS3.0	8	912 ± 255	1,003	9	936 ± 280	994	8	6.1 ± 1.0	6.0	9	7.8 ± 2.2	8.0
	CA29	9	921 ± 132	920	10	921 ± 208	900	9	5.0 ± 1.1	5.0	10	5.8 ± 2.2	5.0

Note:
ppb = parts per billion
Mean ± SD = arithmetic mean ± one standard deviation.

Table D-6. Mean soil TP concentrations (± Standard Deviation) measured in March-April 2010 (during WY2010) and in May 2012 (early WY2013). Each value is the mean of three soil cores collected to a depth of 10 cm. Soil TP concentrations above 500 mg/kg are considered impacted.

Station	2010 Mean Soil TP (March-April) (mg/kg)	2012 Mean Soil TP (May) (mg/kg)	Two-Sample t-Test p-value[1]
C4.0	444 ± 40	491 ± 26	0.174
CA29	363 ± 48	431 ± 50	0.163
FS0.25	1,241 ± 15	1,016 ± 208	0.134
FS1.0	992 ± 102	1,164 ± 32	0.090
FS3.0	***611 ± 8***	***554 ± 14***	***0.008***
N0.25	854 ± 52	977 ± 116	0.199
N1.0	802 ± 96	882 ± 110	0.399
N2.0	681 ± 57	748 ± 22	0.168
N4.0	475 ± 47	530 ± 22	0.170

[1] Probability level (p-value) computed using a two-sample t-test. A significance level (α) of 0.05 was used. When p-value was less than 0.05, the soil TP contents were significantly different between the two water years. Significant p-values are shown in bold, italics.

WCA-2A Macrophyte Composition along the Permit Compliance Transects

The areal coverage of several dominant macrophyte species was measured along fixed transects each year from 2005 through 2012. Using point-intercept survey methodology, the presence of sawgrass (*Cladium jamaicense*) and cattail (*Typha* spp.) at one-meter intervals along 10 m transects was recorded. Only data from the permit compliance sites are presented in this report. **Tables D-7** and **D-8** show the frequency of occurrence of cattail and sawgrass along each transect. At the northern transect, site N0.25 (0.25 km from the nearest G-336 discharge point), was dominated by cattail with little sawgrass present. Sawgrass has been the dominant vegetation at 1 to 4 km from the inflow over the survey period except for site N1.0 (**Table D-7**). Little change has occurred since the 2010 surveys.

At the southern transect, both sawgrass and cattail were present in FS0.25 and FS1.0 while only sawgrass was present in FS3.0 (**Table D-8**). Sawgrass and cattail presence decreased at FS0.25 since 2010. However, sawgrass increased its presence at FS1.0 since the October 2010 sampling. It is important to note that transect poles had to be moved in November 2008 at several sites (N1.0, N2.0, N4.0, FS0.25, and FS1.0) was due to the impact of drift from an herbicide application to clear helicopter landing areas for safe access to sites. In addition, one transect (N2.0) was relocated in April 2006 because trails worn next to it affected the vegetation along the transect. In each of these cases, transect poles were moved to the closest possible location away from the disturbance that had the same vegetation communities. These distances varied between 15 and 30 meters from the original location.

Table D-7. Number of points (out of 10 possible points at 1 meter intervals along each line transect) at the northern transect locations of WCA-2A where sawgrass or cattail was present. Surveys were completed during the dry and wet seasons each year.

Date	N0.25		N1.0		N2.0		N4.0		C4.0	
	Saw	Cat	Saw	Cat	Saw	Cat	Saw	Cat	Saw	Cat
Apr 2005	1	10	10	0	10	0	10	0	10	0
Oct 2005	1	10	9	0	10	0	10	0	10	0
Apr 2006	1	10	9	0	10[W]	0[W]	10	0	10	0
Nov 2006	1	10	10	5	9	0	1[F]	0[F]	10	0
Apr 2007	1	10	10	9	10	0	6	0	10	0
Oct 2007	0	9	10	2	10	0	2	0	10	0
Mar 2008	0	10	10	0	10	0	4	0	10	0
Oct 2008	1	10	5	2	10	0	8	0	10	0
Apr 2009	1	10	10[S]	4[S]	10[S]	0[S]	9[S]	0[S]	10	0
Oct 2009	1	10	10	9	9	0	10	0	10	0
Apr 2010	0	9	0	9	8[A]	0[A]	10	0	9[A]	0[A]
Oct 2010	2	10	9	10	10	0	10	0	10	0
Oct 2011	1	10	10	10	10	0	10	0	10	0
Mar 2012	0	10	10	10	10	0	10	0	10	0

[S] indicates that transect was moved due to herbicide overspray
[W] indicates that transect was moved due to worn trail next to transect
[F] indicates a fire occurred at site
[A] indicates that transect was moved due to airboat damaging vegetation on transect

Table D-8. Number of points (out of 10 possible points at 1 meter intervals along each line transect) of WCA-2A at the southern transect locations where sawgrass or cattail was present. Surveys were completed during the dry and wet seasons each year.

Date	FS0.25		FS1.0		FS3.0	
	Saw	Cat	Saw	Cat	Saw	Cat
Apr 2005	7	8	7	0	10	0
Oct 2005	3	9	3	3	10	0
Apr 2006	7	4	7	6	10	0
Nov 2006	8	5	8	7	10	0
Apr 2007	8	5	8	8	9	0
Oct 2007	8	2	8	5	10	0
Mar 2008	8	4	8	8	10	0
Oct 2008	6	6	6	5	10	0
Apr 2009	8[S]	4[S]	8[S]	2[S]	10	0
Oct 2009	6	8	10	8	10	0
Apr 2010	6	10	10	9	10	0
Oct 2010	10	10	3	10	10	0
Oct 2011	7	9	7	10	---	---
Nov 2011	---	---	---	---	10	0
Mar 2012	---	---	---	---	10	0
Apr 2012	8	10	10	9	---	---

[S] indicates that transect was moved due to herbicide overspray

ROTENBERGER WILDLIFE MANAGEMENT AREA

Restoration and Monitoring Objectives

The Rotenberger Hydropattern Restoration Project is a component of the District's Everglades restoration efforts. The project goal is to slow, alter, and eventually reverse the ecosystem degradation within the RWMA (**Figure D-6**), primarily by restoring a more natural hydropattern. The degradation was caused by overly dry conditions that have resulted in repeated peat fires, soil oxidation and compaction, nutrient release from surface soils, and conversion of obligate wetland vegetative communities to upland-type communities. Anticipated benefits of the restoration efforts include the preservation and encouragement of additional desirable wetland vegetation species and the initiation of peat formation.

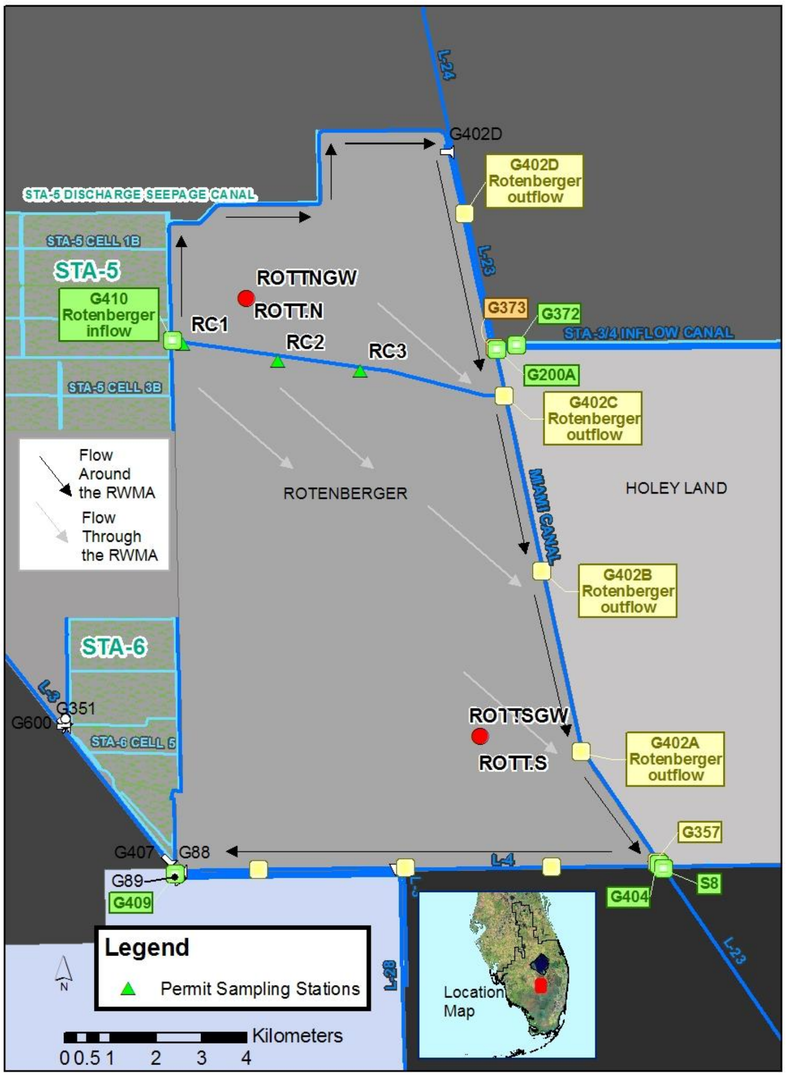


Figure D-6. Map of the Rotenberger Wildlife Management Area (RWMA) showing major structures and monitoring transect RC (permit compliance monitoring transect). Rott.N and Rott.S are the locations of the permanent stage recorders and newly installed groundwater wells.

Configuration

Project features include a 240 cubic foot per second (cfs) electric pump station (G-410) to withdraw treated water from the STA-5 discharge canal for release into the RWMA. This pump station distributes water through a 10-mile spreader canal located parallel to the west perimeter levee of the area. Surface water that is released out of the RWMA goes into the Miami Canal (L-28 canal) through four gated culverts (G-402A through G-402D) along the eastern boundary of the RWMA. There is a quarter-mile collection canal upstream of each outlet structure.

The RC1, RC2, and RC3 stations are EFA permit compliance locations within the RWMA. Monitoring data for the stations downstream of STA-5 can be located within two District databases, ERDP and DBHYDRO. Water levels have historically been monitored at the Rott.N and Rott.S stage gauges.

Water Budget

Annual water budgets from 2003–2012 are presented in **Table D-9**. Eighty percent of the inflow is attributed to rainfall and eighty-seven percent of the outflows are attributed to evapotranspiration (ET) in the water budget. Both rainfall and surface water inflow through G-410 increased significantly in WY2012 compared to WY2011. Surface water outflows decreased but ET was close to WY2011 levels reflecting continuing drought conditions. Seepage values were not accounted for in these calculations. Errors include seepage losses or gains and measurement errors. Also, due to the drought when water level receded further below ground ET will be lower than the potential ET. That could account for part of the water budget errors.

Table D-9. Water budgets calculated for WY2003–WY2012. Inflows in acre-feet (ac-ft) represent discharges into the RWMA from the G-410 structure and outflows represent water releases from the G-402A–D structures.
[Note: ET – evapotranspiration.]

Water Year	Inflow (ac-ft)	Rainfall (ac-ft)	Total Inflow (ac-ft)	Outflow (ac-ft)	ET (ac-ft)	Total Outflow (ac-ft)	Change in storage (ac-ft)	Error %
2003	54306	111179	165485	25312	125410	150722	70	-9.3
2004	16849	114620	131469	352	123546	123898	-20	-5.9
2005	44414	113868	158282	33788	123847	157635	33	-0.4
2006	29886	114605	144491	54648	124451	179099	-792	20.9
2007	16195	85538	101733	4630	123403	128033	-731	22.3
2008	11646	108725	120371	0	124900	124900	11431	13.0
2009	32297	102125	134422	25126	128177	153303	-11187	5.3
2010	40582	152423	193005	21295	125578	146873	1018	-26.5
2011	17922	116675	134597	21622	138200	159822	-13365	8.1
2012	32472	135,025	167,497	5192	137,575	142767	16,050	-5.60
Total	**296569**	**1154783**	**1451352**	**191965**	**1275087**	**1467052**	**2507**	**1.2**

Percent of Inflow			Percent of Outflow	
G-410 Inflow	20%		**G-402 Outflow**	13%
Rainfall	80%		**ET**	87%

Hydrologic and Total Phosphorus Loads

In WY2012, approximately 32,472 acre-feet (ac-ft) of water were discharged into the RWMA through the G-410 pump station (**Figure D-7**). This volume is approximately 15,000 ac-ft more than the WY2011 volume. An estimated TP load of 0.81 metric tons (mt) was exported to the RWMA during WY2012, yielding an inflow flow-weighted mean (FWM) TP concentration of 20.3 ppb. Both the TP load and FWM concentration in WY2012 were higher than those reported in WY2011 (TP load = 0.41 mt; TP FWM = 18.7 ppb). A simple regression model of inflow FWM TP concentrations with time was used to delineate any trends during WY2012. Based on the analysis, a statistically significant decrease in FWM TP concentrations was observed at inflow structures to the RWMA in WY2011 (r = -0.63, p-value = 0.02). However, TP loads entering the RWMA during WY2012 did not exhibit any trend. Although the relationship suggests a slight increase in TP loads, the slope of the line was not statistically different from zero (r = 0.24; p-value = 0.43).

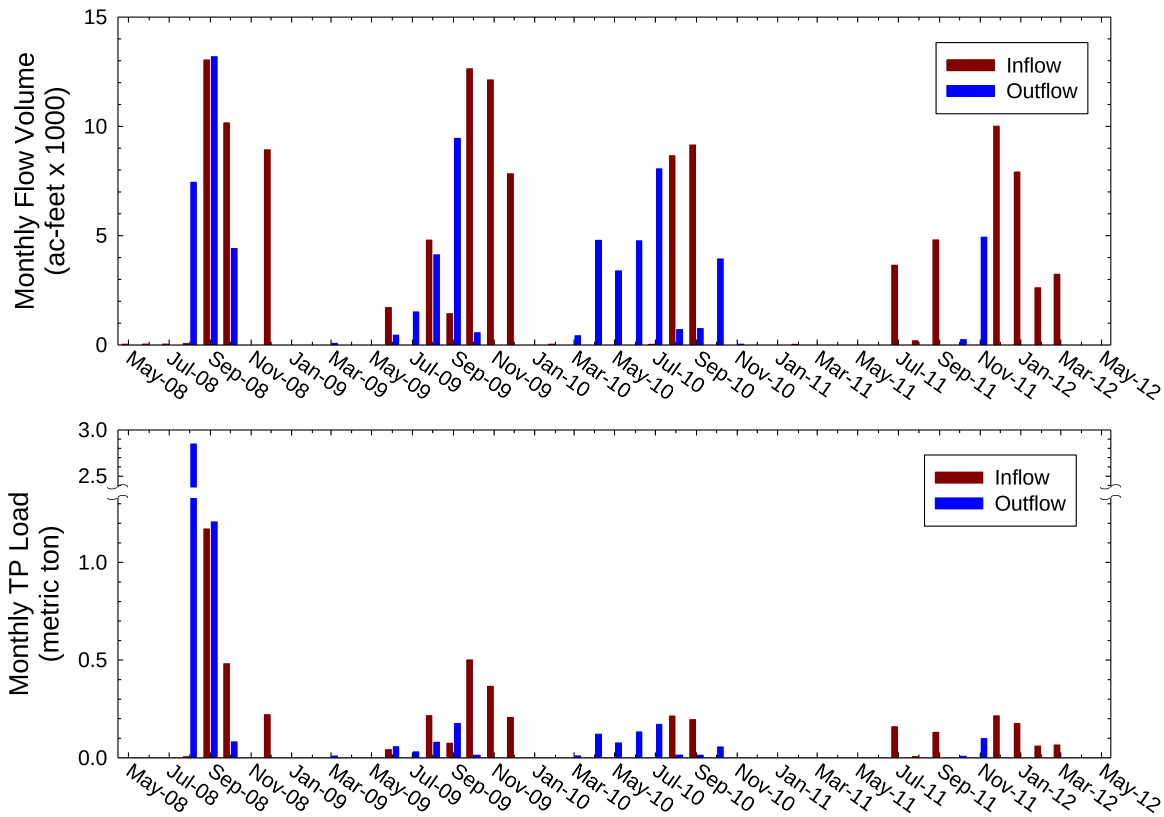


Figure D-7. Monthly flow volumes (top) and TP loads (bottom) for inflow and outflow structures at the RWMA for WY2008 through WY2011. [Note the scale break in the bottom plot.]

Approximately 5,192 ac-ft of water was released through the G-402A–C structures during WY2012, approximately 16,000 ac-ft less than in WY2011. The total load of TP released from the RWMA through the structures during WY2012 was 0.11 mt, or 0.7 mt less than discharged to the wildlife management area. The resulting annual FWM TP concentration at the RWMA outflow structures was 16.6 ppb (**Figure D-8**). Both the outflow load and FWM concentration for WY2012 were lower than WY2011 (TP Load = 0.46 mt; FWM TP = 17.3 ppb). No statistically significant trend could be identified for either TP loads or FWM TP concentrations discharged from the RWMA during WY2012 using a simple regression model. While the trend line slopes for both parameters were positive, they were not statistically different from zero (r = 0.05, p-value = 0.89 for TP load; and r = 0.63 for FWM TP; p-value = 0.26 for FWM TP).

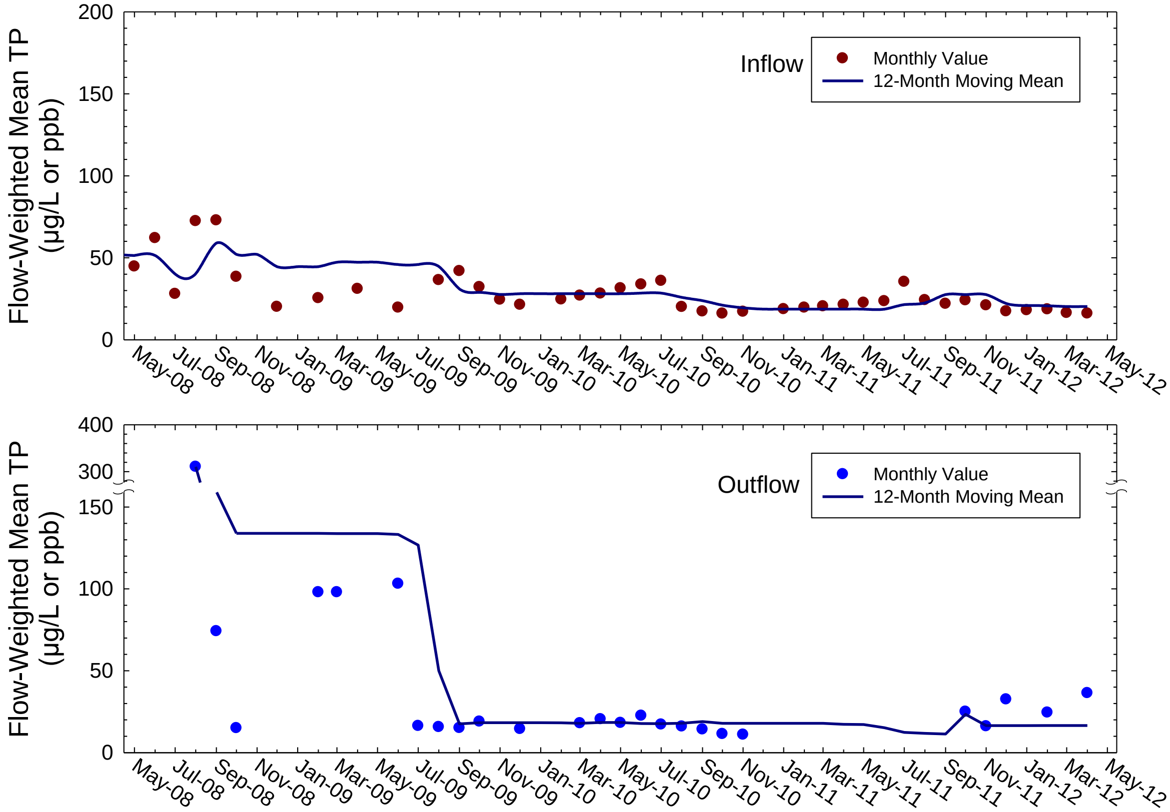


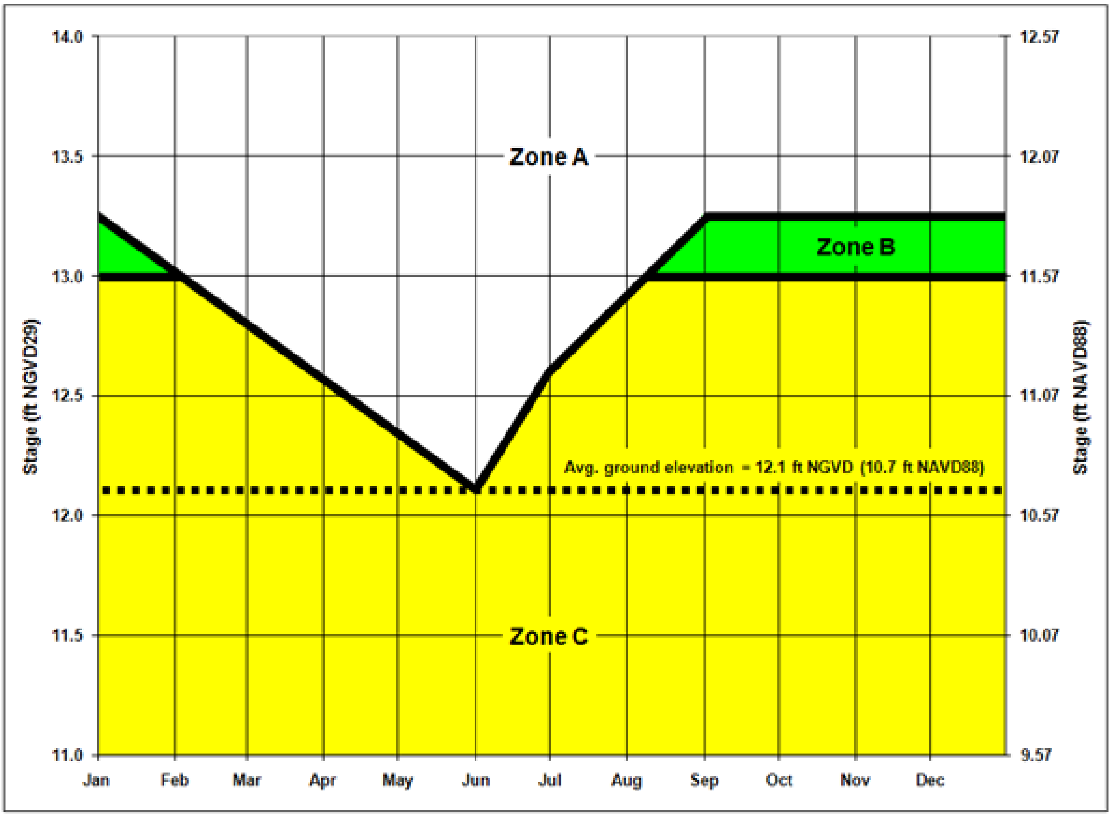
Figure D-8. Comparison of monthly flow-weighted mean TP concentrations with the 12-month moving average of the flow-weighted means for the RWMA inflow (top) and outflow (bottom) structures during WY2008 through WY2011. [Note the scale break in the bottom plot (outflow).]

Hydropattern Restoration

Starting in June 2008, the District began meeting with the Florida Fish and Wildlife Conservation Commission (FWC) and the Florida Department of Environmental Protection (FDEP) to review the RWMA Operation Plan (SFWMD, 2004) and revise and improve the interim regulation schedule in an effort to better achieve the hydropattern restoration goals for the RWMA. An initial step in the process was to obtain an updated survey of the RWMA, which was completed in December 2008. The RWMA was surveyed in 2004 and 2008. The calculated ground elevation from the 2008 survey was 12.14 feet National Geodetic Vertical Datum 1929 (ft NGVD 29).

The daily target stages for the RWMA in the previous years were set based on the District's Natural System Model (NSM) values plus 0.25 ft. The 0.25 ft was added to minimize the potential for excessive dry-out during the dry season. In April 2009, consensus was reached on a modified interim regulation schedule that attempts to maintain the hydropattern restoration goals while also addressing the diverse biological needs of the RWMA and minimizing the risk of muck and/or peat fires. The biological needs considered were those of tree islands, native open-marsh vegetation [e.g., sawgrass and maidencane (*Panicum hemitomon*)], periphyton, wading birds, aquatic macrofauna [e.g., crayfish (*Procambarus alleni*)], and upland faunal species (e.g., mammals). It is recognized that during severe droughts when no supplemental water is available, the RWMA will dry out.

In the modified regulation schedule (**Figure D-9**), when water levels are within either Zone A or Zone C and regional water conditions allow Rotenberger inflow and outflow structures will be managed in an effort to return water levels to the regulation schedule or Zone B. The District will continue to communicate all water management actions with the FWC (SFWMD, 2010).



Zone	Operational Direction
A	Manage inflows (G-410) and/or outflows (G-402A, G-402B, G-402C, and G-402D) to return to regulation schedule or Zone B.
B	Discretionary Zone: manage inflows and/or outflows to maintain water levels within Zone B if possible, based on an assessment of historical, climatic, and regional water conditions. Coordination with FWC required.
C	If regional water conditions allow, manage inflows and/or outflows to return to regulation schedule or Zone B.

Figure D-9. Modified interim regulation schedule for RWMA.

Monitoring has stopped at ROTT.N (ROTTN-L) and ROTT.S (ROTTS-L) surface water monitoring sites, but the substitute monitoring sites, ROTTNGW and ROTTSGW, are replaced respectively (**Figure 6**). WY2011 and WY2012 daily average RWMA stages, average ground elevation and the interim operation plan target stages are depicted in **Figure D-10**. Water level was below ground at the beginning of WY2012 and further dropped to over 3 ft below the ground elevation by June 13, 2011. Since then, water level continuously rose reaching the surface on July 8th, 2012. Water level stayed above ground for the rest of the water year.

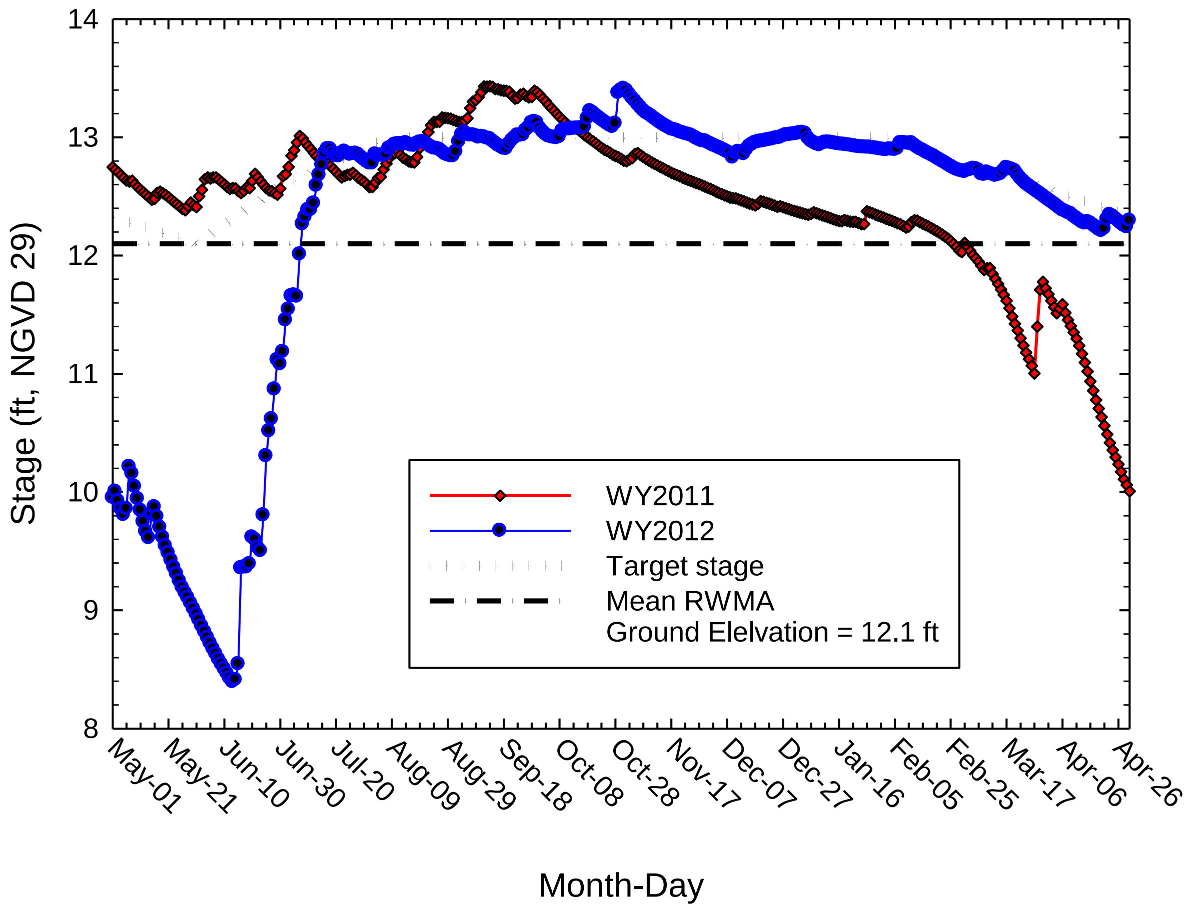


Figure D-10. Daily mean RWMA stages, average ground elevation, and interim operation plan target stages.

EFA Permit Compliance Transect Total Phosphorus and Specific Conductance at STA-5 Downstream Area

As previously mentioned, the RWMA EFA permit compliance transect comprises three monitoring stations (RC-1, RC-2, and RC-3) that extend approximately 4 km downstream of pump station G-410 (**Figure D-6**). All stations along this transect are identified as impacted.

All specific conductance levels measured during WY2012 along the RWMA transect were below the 1,275 µS/cm limit for Class III waters (**Table D-10**). Specific conductance levels in WY2011 changed by approximately 22 percent along the RWMA transect. TP concentrations exhibited a decrease of approximately 50 percent from 44 µg/L at the inflow to 22 µg/L at a distance of 4 km from the canal (**Figure D-11**).

An overall increase in specific conductance was observer during WY2012 (median = 580 µS/cm) and WY2011 (median = 490 µS/cm). This increase can be attributed to drier conditions exhibited during WY2012. In contrast, TP concentrations TP concentrations did not appear to change during the two water years (median = 13 µg/L for both years). A statistically comparison (e.g., Mann-Whitney test) was performed between the specific conductance and TP data from WY2011 and WY2012. Neither parameter exhibited a statistically significant change in levels between the two water years (specific conductance p-value = 0.12, n = 47; TP p-value = 0.54, n = 47).

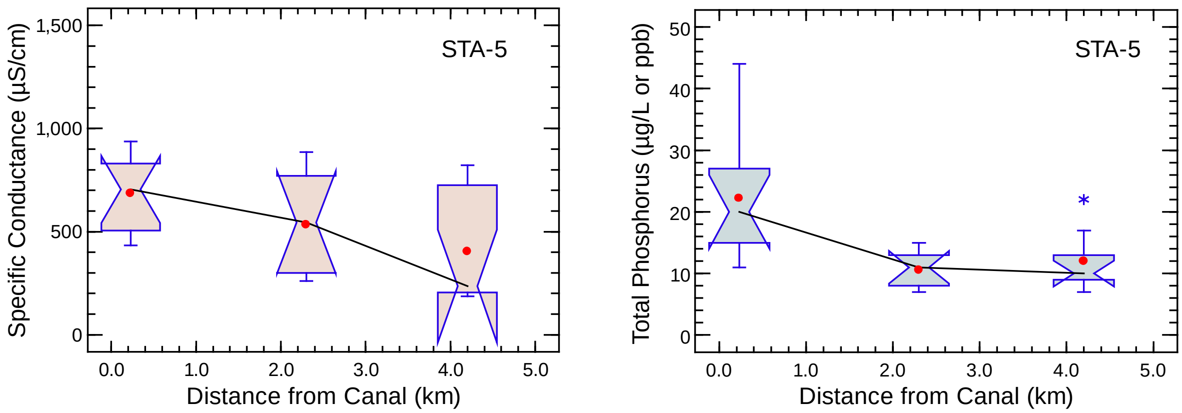


Figure D-11. Notched box-and-whisker plots of specific conductance and TP levels measured at transect stations downstream of STA-5 during WY2012. See Figure D-2 for information on notched box-and-whisker plots**.**

Table D-10. Comparison of surface water specific conductance and TP concentrations collected at permit compliance stations in Rotenberger Wildlife Management Area (RWMA) during the WY2011 and WY2012.

STA Transect	Station	Specific Conductance (µS/cm)						Total Phosphorus (µg/L or ppb)					
		WY2011			WY2012			WY2011			WY2012		
		No. of Samples	Mean ± SD	Median	No. of Samples	Mean ± SD	Median	No. of Samples	Mean ± SD	Median	No. of Samples	Mean ± SD	Median
STA-5	RC1	7	549 ± 140	557	10	686 ± 168	705	7	29.4 ± 18.1	29.0	10	22.2 ± 9.9	20.0
	RC2	6	395 ± 126	432	9	533 ± 261	545	6	12.8 ± 5.4	11.5	9	10.6 ± 3.0	11.0
	RC3	6	308 ± 106	293	9	403 ± 282	236	6	11.5 ± 4.0	11.5	9	12.0 ± 4.8	10.0

Note:
ppb = parts per billion
Mean ± SD = arithmetic mean ± one standard deviation.

MACROPHYTE COVERAGE

Using point intercept survey methodology, the areal coverage of dominant macrophyte species has been surveyed at three permit-mandated stations along fixed 10-meter transects twice a year (dry and wet seasons) since 2005. The presence of sawgrass and cattail at 1-meter intervals was recorded (**Table D-11**). Sawgrass and cattail coverage remained relatively stable since 2010. Sawgrass was the dominant macrophyte in RC2 and RC3 where surface water TP concentrations were also low (**Table D-10**).

Table D-11. Number of points along a fixed transect with three permit compliance stations where sawgrass or cattail was present, out of 10 possible points. Each point represents a distance of 1 meter. Surveys were completed twice, once during the dry and once during the wet seasons each year. Surveys were not completed at RC3 in October 2007 due to site inaccessibility.

Date	RC1		RC2		RC3	
	Saw	Cat	Saw	Cat	Saw	Cat
Apr 2005	9	4	7	6	10	0
Nov 2005	9	0	10	6	10	0
Apr 2006	9	0	10	6	10	0
Oct 2006	3	4	5	2	10	1
Apr 2007	3	3	7	4	10	4
Oct 2007	2	1	9	3	-	-
Apr 2008	4	1	9	1	10	0
Oct 2008	5	5	9	0	10	1
Apr 2009	3	7	10	0	10	1
Oct 2009	2	9	10	0	10	2
May 2010	6	7	9*	3*	10	1
Oct 2010	6	10	10	6	10	5
Mar 2011	5	10	9	3	10	0
Sep 2011	5	10	10	0	10	0
Jun 2012	4	10	9	3	10	0

Restoration Activities

In 2009, the District, in cooperation with the Florida Fish and Wildlife Conservation Commission (FWC), began restoration of 19 acres of tree islands in the southwest corner of the RWMA. Restoration began with the treatment and removal of exotic species including Brazilian pepper (*Schinus terebinthifolius*) and primrose-willow (*Ludwigia peruviana*). These tree islands were then planted with 3,000 native tree and shrub species which are protected from wildlife damage with metal exclosures. For 2011–2012, these islands were included in the 297 acres of exotic treatments conducted on tree islands by FWC. Other restoration activities conducted in RWMA include the prescribed burning of nearly 6,000 acres, cage maintenance of all planted tree islands in RWMA totaling 4,150 plants, and the additional planting of 984 more plants. Restoration of the farms located within RWMA were also completed. This multi-year project included the mechanical removal or degradation of 10.7 miles of berms and canals. These features altered surface flow throughout 1,758 acres along the eastern boundary of the area. The work was funded by the FWC's Aquatic Habitat Restoration/Enhancement Program and performed by Rio-Bak Corporation, under contract to the FWC, from May 2009–May 2011 at a cost of $109,000. Additional cooperative restoration activities are planned for the future.

Also in 2009, the District completed a major rehabilitation project within Cell 1A of STA-5 to enhance the performance of this constructed treatment wetland. Preliminary evaluations indicate that TP removal performance has improved. As a result of this rehabilitation effort and the water quality improvements anticipated with the addition of the Compartment C build-out, the need for a second Rotenberger inflow pump station was re-evaluated. The analysis indicated that the benefits to Rotenberger projected to occur with the addition of a second inflow pump station (G-708) could largely be achieved by modifying the operations of the existing inflow pump station (G-410). Consequently, on June 6, 2012 the District withdrew the application for the FDEP Environmental Resource Permit for G-708.

LITERATURE CITED

Garrett, P.B. and D. Ivanoff. 2008. Hydropattern Restoration in Water Conservation Area 2A. Prepared for the Florida Department of Environmental Protection in Fulfillment of Permit #0126704-001-GL (STA-2), by the STA Management Division, South Florida Water Management District. 113 pp.

Pietro, K., R. Bearzotti, G. Germain and N. Iricanin. 2009. Chapter 5: STA Performance, Compliance and Optimization. In: *2009 South Florida Environmental Report – Volume I*, South Florida Water Management District, West Palm Beach, FL.

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SFWMD. 2004. Rotenberger Wildlife Management Area Operational Plan, January 2004. Environmental Engineering Section, Everglades Construction Project, South Florida Water Management District, West Palm Beach, FL.

Attachment E: STA Herbicide Application Summary for Water Year 2012

Louis Toth

Table E-1 summarizes herbicide treatments (acres treated and gallons of herbicides used) in the Everglades Stormwater Treatment Areas (STAs) during Water Year 2012 (WY2012) (May 1, 2011–April 30, 2012). No pesticides were applied with the Everglades STAs during WY2012.

Herbicides were used to control four species of floating plants [water lettuce (Pistia stratiotes), water hyacinth (*Eichhornia crassipes*), frog's bit (*Limnobium spongia*), and crested floating heart (*Nymphoides cristata*)]; six species of emergents [cattail (*Typha domingensis* and *T. latifolia*), alligator weed (*Alternanthera philoxeroides*), wild taro (*Colocasia esculenta*), and pennywort (*Hydrocotyle umbellata* and *H. ranuculoides*)]; six species of grasses [torpedo grass (*Panicum repens*), paragrass (*Urochloa mutica*), West Indian marsh grass (*Hymenachne amplexicaulis*), common reed (*Phragmites australis*), napier grass (*Pennisetum purpureum*), and burmareed (*Neyraudia reynaudiana*)]; four species of shrubs [Brazilian pepper (*Schinus terebinthifolius*), primrose willow (*Ludwigia peruviana*), castorbean (*Ricinus communis*), and Carolina willow (*Salix caroliniana*)]; two tree species [melaleuca (*Melaleuca quinquenervia*) and lead tree (*Leucaena leucocephala*)]; and the submerged exotic hydrilla (*Hydrilla verticillata*). Largest herbicide treatments occurred in the newly constructed Cells 5 and 6 of STA-2, Cells 4A and 4B of STA-5, and Cell 4 of STA-6 where 3,807 acres of willow and primrose willow were treated aerially (via helicopter) to facilitate startup of Compartments B and C. Other large aerial treatments were applied to reduce cover of cattail in submerged aquatic vegetation (SAV) Cell 4 (686 acres) of STA-2 and Cell 4N (436 acres) of STA-1E, and to convert Cell 3B (392 acres) of STA-5 to SAV. Floating plants were controlled in SAV cells and at the inflows and outflows of all cells.

Application Rate: Water lettuce, water hyacinth, frog's bit, and crested floating heart were treated with either diquat dibromide (37.3 percent solution) at a rate of 1 quart per acre, 2,4D (46.3 percent) at 2 quarts per acre, or with a mix of diquat and imazapyr (28.7 percent at 2 quarts per acre or 2,4D. Aerial applications of triclopyr (44.4 percent) at a rate of 2 gallons per acre or a mix of glyphosate (53.8 percent) at 7.5 pints per acre and imazapyr (28.7 percent) at 2 quarts per acre were applied to willow, primrose willow and Brazilian pepper. Cattails were treated with glyphosate or with a mix of glyphosate and imazapyr. Glyphosate or the glyphosate/imazapyr mix also was used to treat torpedograss, paragrass, West Indian marsh grass, pennywort, and other herbaceous species. Wild taro was treated with imazamox (12.1 percent) at a rate of 2 quarts per acre.

Application Certification Statement: The South Florida Water Management District ensures that all herbicide applications are carried out in accordance with the manufacturer's guidelines.

Table E-1. Acres of vegetation treated with herbicides during WY2012.

STA/Cell	Acres	Diquat (gallons)	Imazpyr (gallons)	Glyphosate (gallons)	2,4 D (gallons)	Triclopyr (gallons)	Imazamox (gallons)
STA-1E							
1	213.45	6.25	2.5	12.63	1.5	67.5	0
2	0	0	0	0	0	0	0
3	179.84	31.76	9.5	23.2	1	0	0
4N	682.85	49.26	157.5	418	0	0	0
4S	142.94	0.5	30.93	96.55	0	0	0
5	250.27	9.25	61.08	143.21	21.52	71.13	0
6	34.42	1.25	5	15	0	0	0
7	124.5	18.75	5.5	50.63	7	0	0
STA-1W							
1A	133.43	30.75	1.25	8.44	0	0	0
1B	85.36	5.5	0	55.31	0	0	0
2A	68.41	10.25	5.94	13.88	0	0	0
2B	34.95	0.5	2.5	30.01	0	0	0
3	190.54	0	8	174.71	12	0	0
4	52.95	0	2.5	52.5	0	0	0
5A	131.44	31.75	4.25	14.06	0	0	0
5B	213.92	42.25	0	0	3.5	0	0
STA-2							
1	9.76	1	0	0.28	0	0	0
2	390.98	5.88	0	95.46	0	0	0
3	46.42	3.5	0	0	0	0	0
4	686.22	0.75	360	656.25	0	0	0
5	390.36	0	0	0.47	0	796	0
6	727.63	0	0	1.67	0.12	1436.75	0
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0
STA-3/4							
1A	453.49	106.63	1	4.23	5	0	0
1B	0	0	0	0	0	0	0
2A	89.4	21.13	0	0	0	0	0
2B	94.2	0	0	69	0	0	0
3A	25.5	5.75	0	0	0	0	0
3B	267.35	0	49.25	183.38	0	0	0
PSTA	29.48	0	3.75	28.13	0	0	0

Table E-1. Continued.

Cell	Acres	Diquat (gallons)	Imazpyr (gallons)	Glyphosate (gallons)	2,4 D (gallons)	Triclopyr (gallons)	Imazamox (gallons)
STA-5							
1A	310.91	37.5	0	0	26	18	0
1B	105.1	16.38	0.75	4.97	0	0	0
2A	85.53	10	0.5	2.25	0	13	0
2B	484.67	81.06	0	2.25	0	0	0
3A	12.4	3.5	0	0	3	0	0
3B	392	0	195	375	0	0	0
4A	1621.35	0	734	1421.25	0	0	0
4B	803.66	0	91.19	472.62	0	0	158.75
5A	0	0	0	0	0	0	0
5B	130.15	0	12.19	91.41	0	0	0
STA-6							
3	22.34	3.63	0	8.44	2.5	0	0
5	55.8	0	0	5.63	0	0	0
Section 2	0	0	0	0	0	0	0
4	264.6	0	153.66	288.15	0	0	0