Settlement Agreement Report

First Quarter
January – March 2012

Prepared for the
Technical Oversight Committee

May 21, 2012

Prepared by:

Cheol Mo, Violeta Ciuca, and Stuart Van Horn

Compliance Assessment and Reporting Section
Water Quality Bureau
South Florida Water Management District
3301 Gun Club Road
West Palm Beach, FL 33406

PURPOSE

The South Florida Water Management District has prepared this report to provide a quarterly update to the Technical Oversight Committee on the compliance status with total phosphorus levels or limits defined in the 1991 Settlement Agreement entered as a Consent Decree in 1992 and modified in 1995. The areas of interest in this report include the interior marsh stations in Arthur R. Marshall Loxahatchee National Wildlife Refuge and two discharges to Everglades National Park: inflows to Shark River Slough and inflows to Taylor Slough and Coastal Basins.

CONTENTS

APPENDICES

TABLES

FIGURES

ACRONYMS AND ABBREVIATIONS

ENP	Everglades National Park
kac-ft	thousand acre feet
NGVD 29	National Geodetic Vertical Datum of 1929
OFW	Outstanding Florida Waters
ppb	parts per billion
Refuge	Arthur R. Marshall Loxahatchee National Wildlife Refuge
SFWMD	South Florida Water Management District
TOC	Technical Oversight Committee
TP	total phosphorus
µg/L	micrograms per liter
USACE	United States Army Corps of Engineers
WCA	Water Conservation Area

EXECUTIVE SUMMARY

This report fulfills the South Florida Water Management District's reporting requirements under the 1991 Settlement Agreement, entered as a Consent Decree in 1992 and modified in 1995, for the first quarter of 2012 (January – March 2012). Total phosphorus (TP) compliance highlights for this period are summarized below for the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge) and Everglades National Park, including Shark River Slough, and Taylor Slough and Coastal Basins (**Table 1** and **Figure 1**):

- **Refuge:** The geometric mean TP concentrations were below the long-term levels in January, February, and March 2012.
- **Shark River Slough:** The 12-month flow-weighted mean TP concentrations were below the 12-month moving long-term limits during the first quarter.
- **Taylor Slough and Coastal Basins:** The 12-month flow-weighted mean TP concentrations were below the 12-month moving long-term limits during the first quarter.

Table 1. Total phosphorus compliance, first quarter 2012.

Month	Geometric Mean TP Concentration (ppb)	Long-term Level (ppb)	Mean Stage (ft NGVD 29)	Number of Samples
Arthur R. Marshall Loxahatchee National Wildlife Refuge				
Jan 2012	6.0	10.0	16.43	14
Feb 2012	7.5	11.1	16.23	13
Mar 2012	6.3	12.8	15.96	10

12-Month Period Ending	Total Flow (kac-ft)	12-Month Flow-weighted Mean TP Concentration (ppb)	Long-term Limit (ppb)	Percent of Sampling Events Greater than 10 ppb	
				Guideline	Observed
Everglades National Park – Shark River Slough					
Jan 2012	488.4	9.3 (9.5*)	10.6	55.6	61.9[a] (61.9[a,]*)
Feb 2012	495.5	9.4 (9.5*)	10.6	55.4	63.6[a] (63.6[a,]*)
Mar 2012	485.8	9.4 (9.5*)	10.6	55.7	57.1[a] (57.1[a,]*)
Everglades National Park – Taylor Slough and Coastal Basins					
Jan 2012	169.5	6.4 (6.3**)	11.0	53.1	10.0 (13.2**)
Feb 2012	170.2	6.4 (6.3**)	11.0	53.1	9.3 (13.5**)
Mar 2012	169.5	6.4 (6.3**)	11.0	53.1	9.5 (14.7**)

Notes:
- ppb = parts per billion. Values are actually in µg/L (micrograms per liter), which, for the purposes of this report, is equivalent to ppb.
- ft NGVD 29 = elevation in feet related to the National Geodetic Vertical Datum of 1929.
- kac-ft = thousand acre feet.
- Compliance for inflows to Everglades National Park (Shark River Slough, Taylor Slough and Coastal Basins) is evaluated annually based on the 12-month flow-weighted mean TP concentration for the federal water year ending on September 30.

[a] Value exceeded the guideline percentage.
* Excluding the re-sampled datum (7 ppb) at S12D on December 8, 2011.
** Including the five qualified sample data collected in Water Year 2011 (see Appendix C, Table C-1).

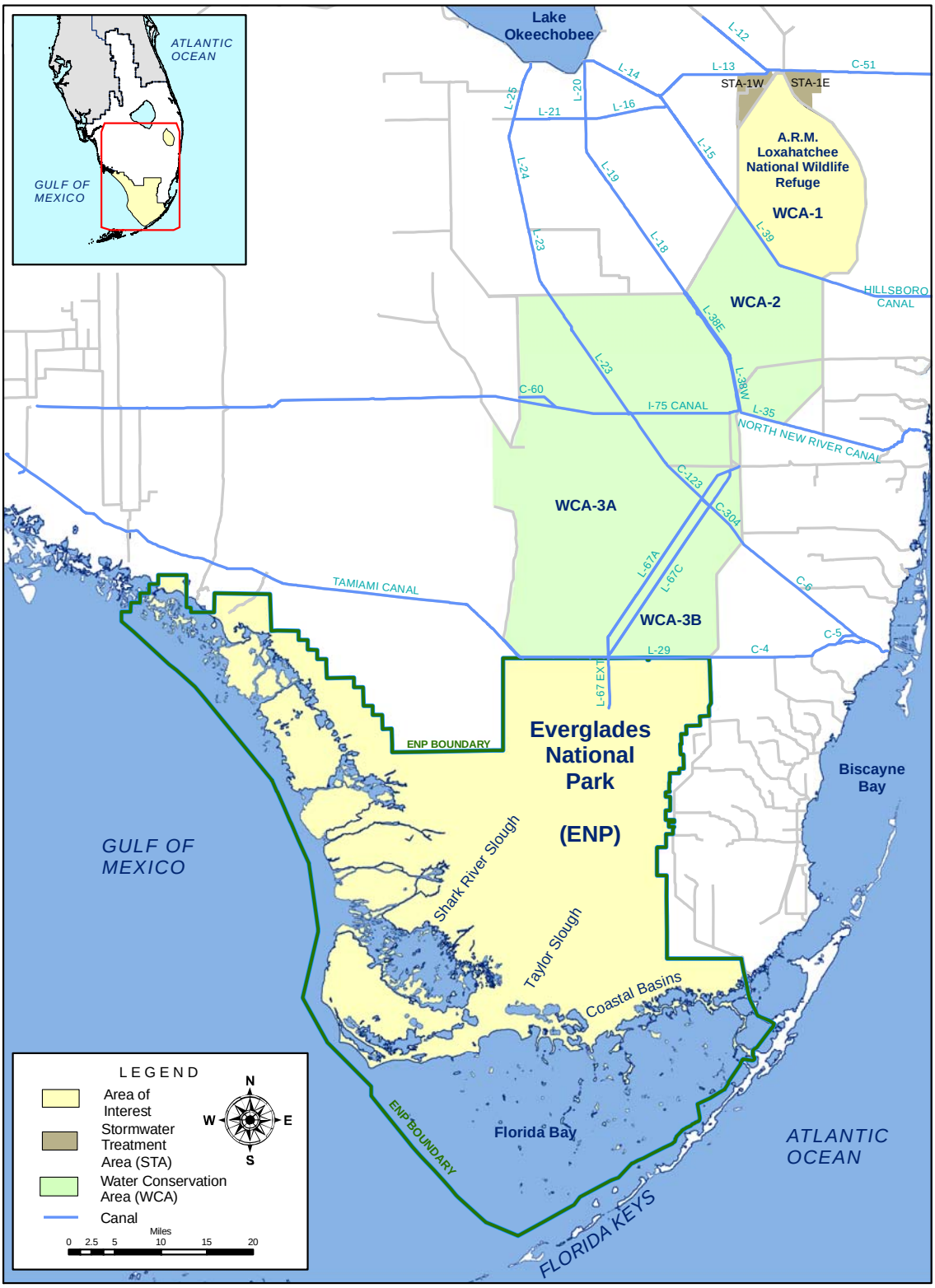

Figure 1. Areas of interest.

ARTHUR R. MARSHALL LOXAHATCHEE NATIONAL WILDLIFE REFUGE

Background

The 1991 Settlement Agreement ended the Everglades lawsuit and was entered into by the federal government, the State of Florida, and the South Florida Water Management District. The subsequent Consent Decree, as modified in 1995, specified that interim and long-term total phosphorus (TP) concentration levels for the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge) must be met by February 1, 1999, and December 31, 2006, respectively. Both the interim and long-term concentration levels vary monthly because they are calculated as a function of water stage measured at gauging stations 1-7, 1-8C, and 1-9 within the Refuge. The stage range within which the interim and long-term concentration levels are applicable is 15.42 to 17.14 feet relative to the National Geodetic Vertical Datum of 1929 (NGVD 29). The monthly TP concentrations are determined from water samples collected at 14 interior marsh stations, LOX3 through LOX16 (**Figure 2**). As required in the Consent Decree, the concentrations are converted to a geometric mean, which is compared to the interim and long-term concentration levels. Monthly TP data for each station for the past 36 months are provided in **Appendix A**. The calculation methods specified in the Consent Decree are provided in **Appendix D**.

Reporting Period Update

Average sampling day stages in the Refuge were 16.43, 16.23, and 15.96 feet in January, February, and March 2012, respectively (**Figure 3** and **Table 2**). The geometric mean, calculated from TP concentrations measured in water samples collected in January, February, and March 2012, were 6.0, 7.5, and 6.3 parts per billion (ppb), respectively. The geometric mean TP concentrations were below the long-term level for the months of January, February, and March 2012.

TP samples were not collected at station LOX3 for the months of February and March 2012, and at stations LOX 5, LOX 9, and LOX 10 during March 2012, because the water depths were less than 0.1 meter at the sites.

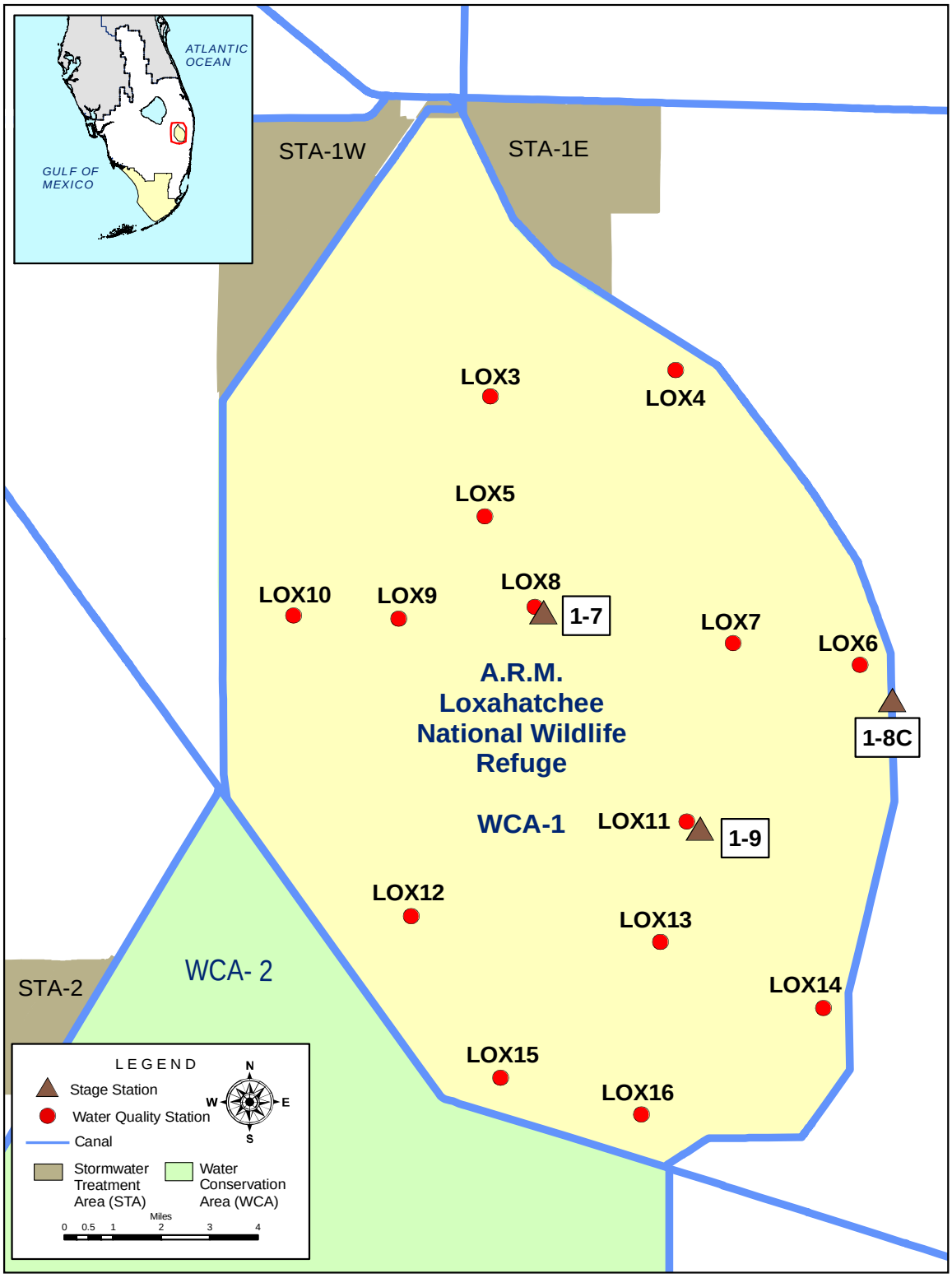

Figure 2. Arthur R. Marshall Loxahatchee National Wildlife Refuge water quality sampling and stage measurement sites.

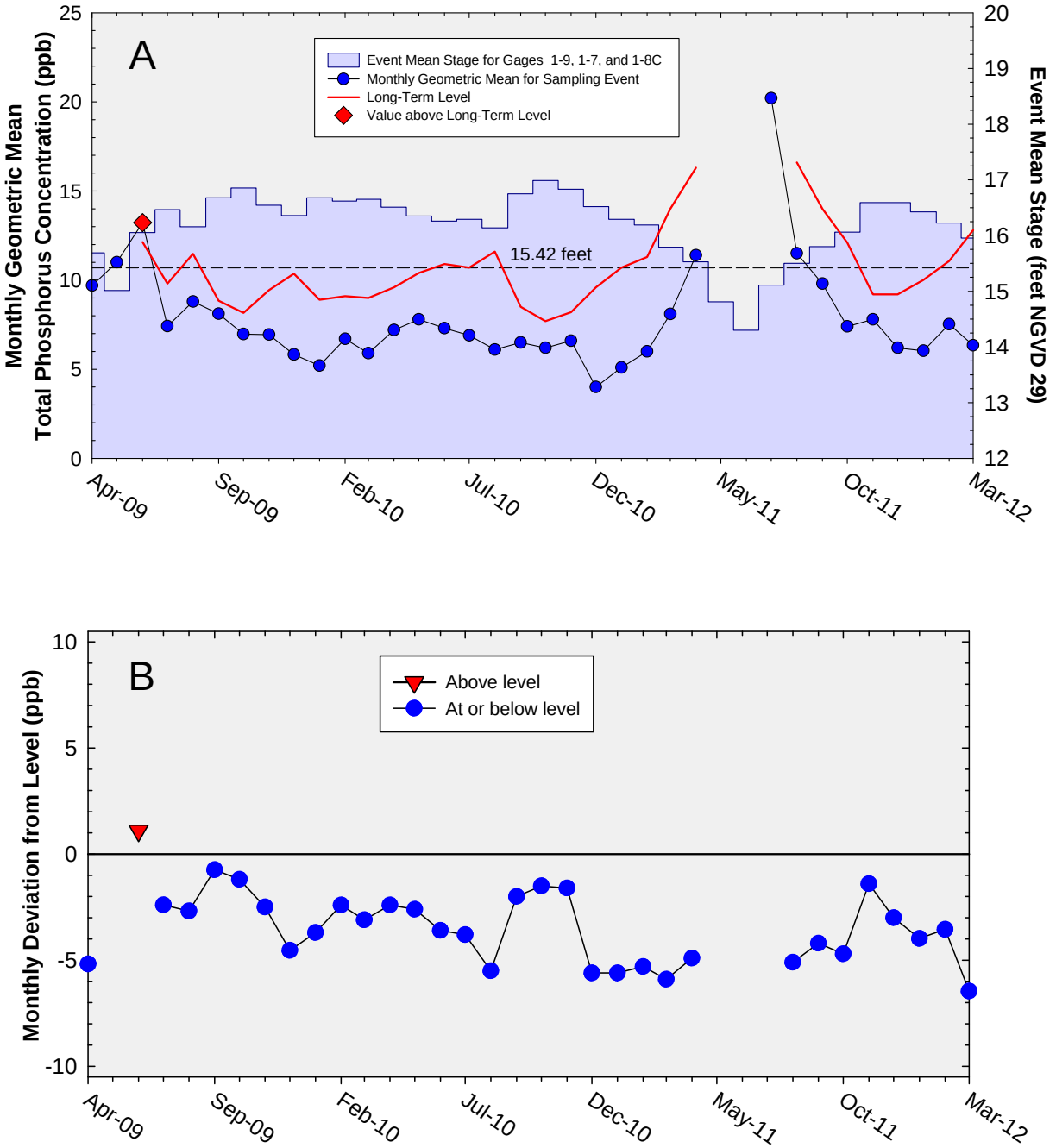

Figure 3. (A) Monthly total phosphorus geometric mean concentrations for the Arthur R. Marshall Loxahatchee National Wildlife Refuge compared to calculated long-term levels, which are adjusted for fluctuations in stage. The long-term level was not applicable for May 2009 and May through July 2011 because the average stage was less than 15.42 feet. The geometric mean was greater than the long-term level in June 2009. **(B)** Deviation of monthly geometric mean total phosphorus concentrations with calculated long-term levels. Values greater than zero indicate that the geometric mean was greater than the long-term level.

Table 2. Loxahatchee National Wildlife Refuge total phosphorus compliance tracking.

Month	Geometric Mean TP Concentration (ppb)	Long-Term Level (ppb) Effective 12/31/2006	Average Stage[a] (ft NGVD 29)	Number of Samples
Apr-2009	9.7	14.9	15.69	8
May-2009	11.0	N/A[b]	15.01	1
Jun-2009[c]	***13.2***	***12.1***	***16.05***	***12***
Jul-2009	7.4	9.8	16.47	14
Aug-2009	8.8	11.5	16.16	14
Sep-2009	8.1	8.9	16.68	14
Oct-2009	7.0	8.2	16.86	14
Nov-2009	6.9	9.4	16.55	14
Dec-2009	5.8	10.4	16.36	12
Jan-2010	5.2	8.9	16.68	14
Feb-2010	6.7	9.1	16.62	14
Mar-2010	5.9	9.0	16.65	14
Apr-2010	7.2	9.6	16.51	14
May-2010	7.8	10.4	16.35	14
Jun-2010	7.3	10.9	16.26	14
Jul-2010	6.9	10.7	16.29	14
Aug-2010	6.1	11.6	16.14	10
Sep-2010	6.5	8.5	16.76	14
Oct-2010	6.2	7.7	16.99	14
Nov-2010	6.6	8.2	16.83	14
Dec-2010	4.0	9.6	16.52	13
Jan-2011	5.1	10.7	16.29	10
Feb-2011	6.0	11.3	16.19	10
Mar-2011	8.1	14.0	15.79	8
Apr-2011	11.4	16.3	15.53	7
May-2011	no data	N/A[b]	14.87	0
Jun-2011	no data	N/A[b]	14.30	0
Jul-2011	20.2	N/A[b]	15.11	4
Aug-2011	11.5	16.6	15.50	8
Sep-2011	9.8	14.0	15.80	11
Oct-2011	7.4	12.1	16.06	11
Nov-2011	7.8	9.2	16.59	14
Dec-2011	6.2 (7.0*)	9.2	16.59 (16.59*)	7 (14*)
Jan-2012	6.0	10.0	16.43	14
Feb-2012	7.5	11.1	16.23	13
Mar-2012	6.3	12.8	15.96	10

Notes:
- ppb = parts per billion. Values are actually in µg/L (micrograms per liter), which, for the purposes of this report, is equivalent to ppb.
- ft NGVD 29 = elevation in feet related to the National Geodetic Vertical Datum of 1929.
- Highlighted rows with bold, italicized text indicate when an excursion over the long-term level occurred.

[a] Average stage is calculated using stage elevations at stations 1-7, 1-8C, and 1-9 for a given sampling date.
[b] N/A denotes that the level was not applicable because the average stage was less than 15.42 feet.
[c] June 1 and 2, 2009 compliance sampling data only.
[*] Including the seven qualified data. TP concentration data for the samples collected on December 13, 2011, were qualified with "J" flags because the analyte was detected in the field equipment blank (EB) taken for the sampling trip.

EVERGLADES NATIONAL PARK

Shark River Slough

Background

The Settlement Agreement/Consent Decree (1995) specified that interim and long-term TP concentration limits for discharges into the Everglades National Park (ENP) (**Figure 4**) through Shark River Slough be met by October 1, 2003, and December 31, 2006, respectively. It was specified that the TP concentrations be presented as 12-month flow-weighted means. Only the TP concentrations for the water year ending September 30 are evaluated for compliance with the Consent Decree limits (**Appendix D**). The long-term TP concentration limit for inflows to Shark River Slough through structures S12A, S12B, S12C, S12D, and S333 represents the concentrations delivered during the Outstanding Florida Waters baseline period of March 1, 1978, to March 1, 1979, and is adjusted for variations in flow. Inflow concentrations of TP through Shark River Slough are compared to the interim and long-term limits at the end of each water year (October 1 through September 30) from 1991 to 2011 (**Figure 5**). The flow-weighted mean TP concentration was below the long-term limit of 12.0 ppb for the 12-month period ending on September 30, 2011. Therefore, Shark River Slough TP concentration was in compliance for federal water year 2011.

Reporting Period Update

Table 3 presents the 12-month flow-weighted mean concentrations for each month with the corresponding long-term TP concentration limits calculated using the 12-month period flow. Routine monitoring was changed to weekly for all Shark River Slough sites beginning in August 2007. In accordance with Appendix A of the Consent Decree, only the every-other-week grab concentration data were used for the flow-weighted mean calculations from October 2007 forward[1]. Weekly TP data for each station for the past 12 months are provided in **Appendix B**. For the 12-month periods ending in January, February, and March 2012, the 12-month flow-weighted mean TP concentrations were 9.3 (9.5), 9.4 (9.5), and 9.4 (9.5) ppb, respectively[2]. The long-term limits were 10.6, 10.6, and 10.6 ppb, respectively for the periods.

The Consent Decree stipulates that the percentage of flow-weighted mean TP concentrations greater than 10 ppb from each sampling event in any 12-month period must not exceed a guideline value based on flow into Shark River Slough for the same 12-month period. For the 12-month periods ending January, February, and March 2012, the sampling event TP

[1] S12A and S333 are sampled weekly if flowing, otherwise monthly. S12B, S12C, and S12D are sampled weekly if flowing.

[2] Values in parentheses are the 12-month flow-weighted mean concentrations calculated excluding the re-sampled datum (7 ppb) at S12D on December 8, 2011.

concentration greater than 10 ppb was 61.9 (61.9), 63.6 (63.6), and 57.1 (57.1) percent, respectively[3].

The observed percentages of the sampling event flow-weighted mean TP concentrations greater than 10 ppb were higher than the guideline for the 12-month period ending in January, February, and March 2012 (**Table 3**). The 12-month flow-weighted mean TP concentrations and the flow-weighted mean TP concentrations for individual sampling events are presented in **Figure 6**.

The daily flows through the individual Shark River Slough structures from April 2009 through March 2012 are presented in **Figures 7** and **9**. The stage in Water Conservation Area 3A (WCA-3A) declined continuously during the quarter. It was in Zone E of the Regulation Schedule in January 2012 and in Zone E1 in February and March 2012. S12A and S12B were closed during the quarter. S12C was closed on January 5, 2012, and remained closed for the duration of the quarter. S12D remained open during the quarter.

A combined total of 25,250 acre-feet of water was discharged through the S12 structures. A total of 27,753 acre-feet of water was discharged through S333. Only about 9 percent (2,383 acre-feet) of this water through S333 was discharged through S334 during the quarter, mostly at the end of March 2012 (**Figure 8**).

For additional information on the WCA-3A regulation schedule, please refer to the U.S. Army Corps of Engineers (USACE) – Jacksonville District's website[4].

The relationship between the sum of the daily flows at Shark River Slough structures and corresponding flow-weighted mean TP concentrations for individual sampling events is presented in **Figure 10**. The flow-weighted mean TP concentrations during the quarter were low, averaging 10.2 ppb (**Figure 10**).

[3] Values in parentheses are percentages calculated excluding the re-sampled datum.
[4] http://www.saj.usace.army.mil/h2o/plots/wca3ahp.pdf

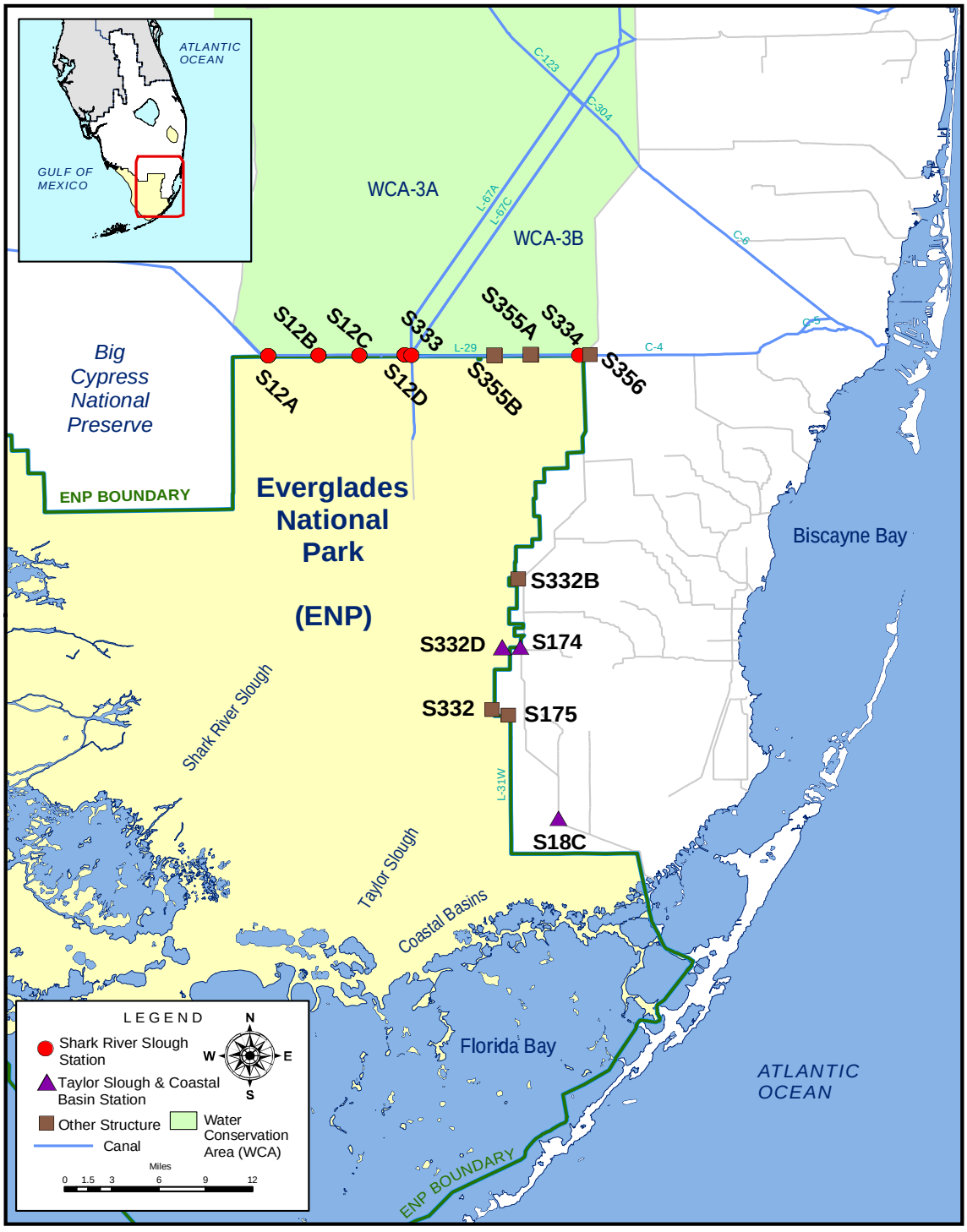

Figure 4. Everglades National Park flow structures.

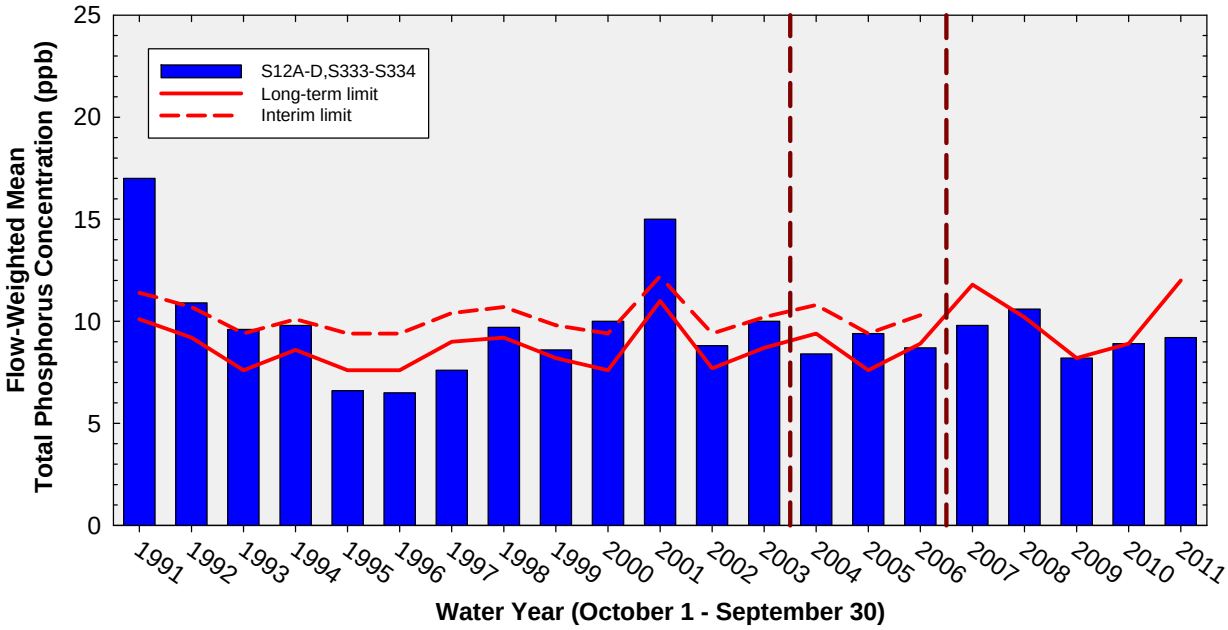

Figure 5. The 12-month flow-weighted mean total phosphorus concentrations at inflows to the Everglades National Park through Shark River Slough at the end of each water year compared to the interim and long-term total phosphorus limits. The Water Year 2011 concentration was below the long-term limit. The Water Year 2008 concentration exceeded the long-term limit but the TOC at the March 1, 2011, quarterly meeting determined substantial evidence indicates this exceedance was due to error.

Table 3. Shark River Slough total phosphorus compliance tracking.

12-Month Period	Total Flow (kac-ft)	Flow-Weighted Mean TP Concentration (ppb)	Long-Term Limit (ppb) *Effective 12/31/2006*	Percent of Sampling Events Greater than 10 ppb	
				Guideline	Observed
May 2008 - Apr 2009	1024.2	7.4	7.8	40.9	34.8
Jun 2008 - May 2009	992.8	7.3	8.0	41.6	33.3
Jul 2008 - Jun 2009	1035.1	8.4	7.7	40.7	38.1
Aug 2008 - Jul 2009	1045.1	8.4	7.7	40.4	38.1
Sep 2008 - Aug 2009	1019.4	8.1	7.8	41.0	28.6
Oct 2008 - Sep 2009	***945.3***	***8.2***	***8.2***	***42.7***	***26.1***
Nov 2008 - Oct 2009	847.5	9.1	8.7	45.1	27.3
Dec 2008 - Nov 2009	708.3	9.7	9.4	48.9	31.8
Jan 2009 - Dec 2009	647.6	9.9	9.7	50.7	30.4
Feb 2009 - Jan 2010	656.3	9.9	9.7	50.4	30.4
Mar 2009 - Feb 2010	682.1	9.8	9.5	49.6	34.8
Apr 2009 - Mar 2010	733.9	9.7	9.3	48.2	34.8
May 2009 - Apr 2010	790.9	9.9	9.0	46.6	37.5
Jun 2009 - May 2010	869.0	9.9	8.6	44.6	42.3
Jul 2009 - Jun 2010	861.2	9.0	8.6	44.8	42.3
Aug 2009 - July 2010	859.2	8.8	8.6	44.8	42.3
Sep 2009 - Aug 2010	842.5	8.8	8.7	45.3	48.1[a]
Oct 2009 - Sep 2010	***809.9***	***8.9***	***8.9***	***46.1***	***50.0***[a]
Nov 2009 - Oct 2010	757.3	9.0	9.1	47.5	50.0[a]
Dec 2009 - Nov 2010	742.5	9.0	9.2	47.9	46.2
Jan 2010 - Dec 2010	739.1	9.0	9.2	48.0	46.2
Feb 2010 - Jan 2011	730.5	9.1	9.3	48.3	48.0
Mar 2010 - Feb 2011	695.2	9.1	9.5	49.3	45.8
Apr 2010 - Mar 2011	645.6	9.2	9.7	50.7	54.2[a]
May 2010 - Apr 2011	585.0	9.0	10.1	52.5	54.2[a]
Jun 2010 - May 2011	526.0	8.8	10.4	54.4	54.2
Jul 2010 - Jun 2011	484.1	8.6	10.6	55.8	52.2
Aug 2010 - Jul 2011	399.7	8.0	11.1	58.6	47.6
Sep 2010 - Aug 2011	311.9	7.4	11.6	61.7	47.4
Oct 2010 - Sep 2011	***247.0***	***9.2***	***12.0***	***64.1***	***57.9***
Nov 2010 - Oct 2011	228.4	11.7	12.2	64.8	68.4[a]
Dec 2010 - Nov 2011	362.0	10.4	11.3	59.9	68.4[a]
Jan 2011 - Dec 2011	463.0	9.5 (9.6*)	10.8	56.5	68.4[a] (68.4[a,]*)
Feb 2011 - Jan 2012	488.4	9.3 (9.5*)	10.6	55.6	61.9[a] (61.9[a,]*)
Mar 2011 - Feb 2012	495.5	9.4 (9.5*)	10.6	55.4	63.6[a] (63.6[a,]*)
Apr 2011 - Mar 2012	485.8	9.4 (9.5*)	10.6	55.7	57.1[a] (57.1[a,]*)

Notes:
- kac-ft = thousand acre feet.
- ppb = parts per billion. Values are actually in µg/L (micrograms per liter), which, for the purposes of this report, is equivalent to ppb.
- Compliance is evaluated annually based on the 12-month flow-weighted mean TP concentration for the federal water year ending on September 30. The compliance periods are shown as highlighted rows with bold, italicized text.

[a] Value exceeded the guideline percentage.

* Excluding the re-sampled datum (7 ppb) at S12D on December 8, 2011.

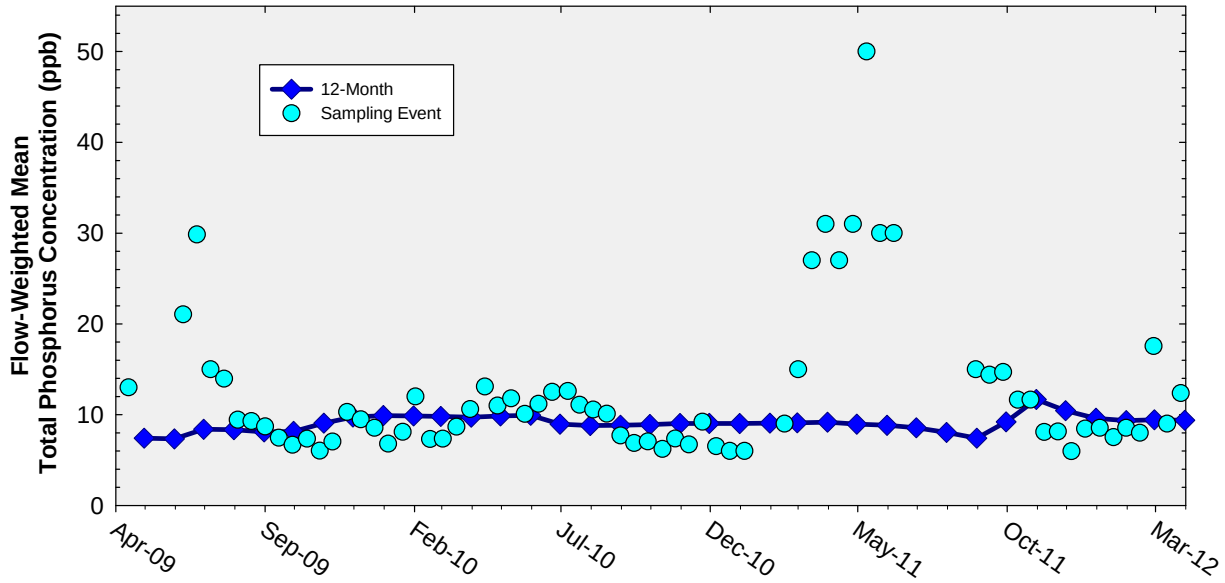

Figure 6. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Shark River Slough at the end of each month and the flow-weighted mean concentration for each sampling event. There are no sampling event values for some months because there was little or no flow in those periods.

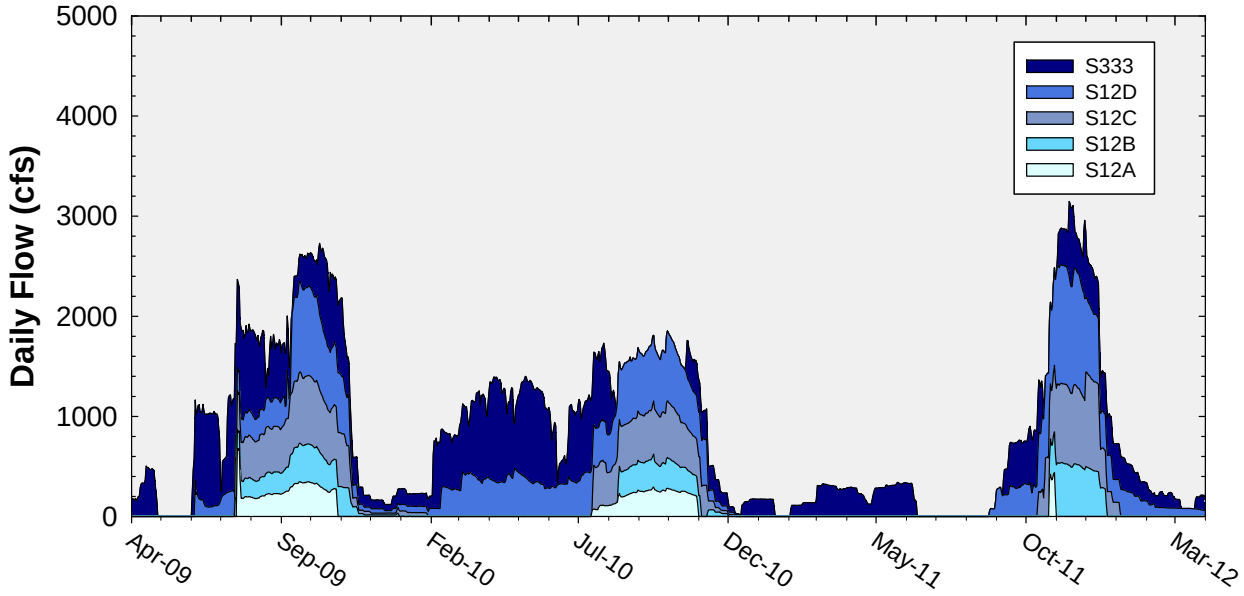

Figure 7. Daily flows at Shark River Slough structures as a stacked sum of five inflows.

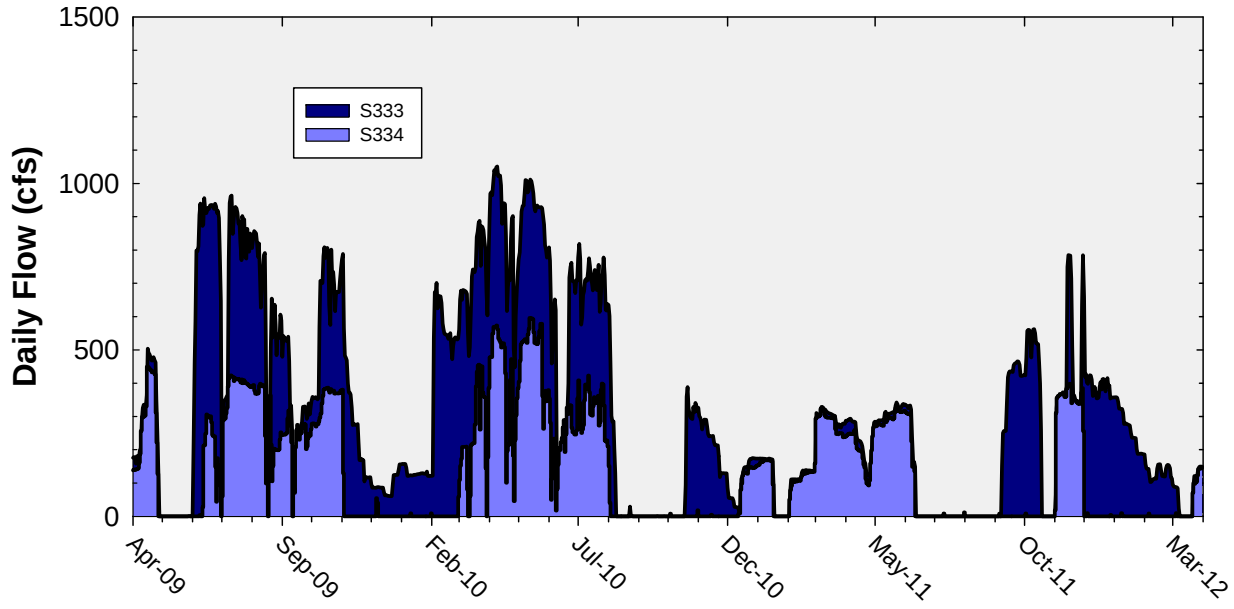

Figure 8. Daily flows at structures S333 and S334.

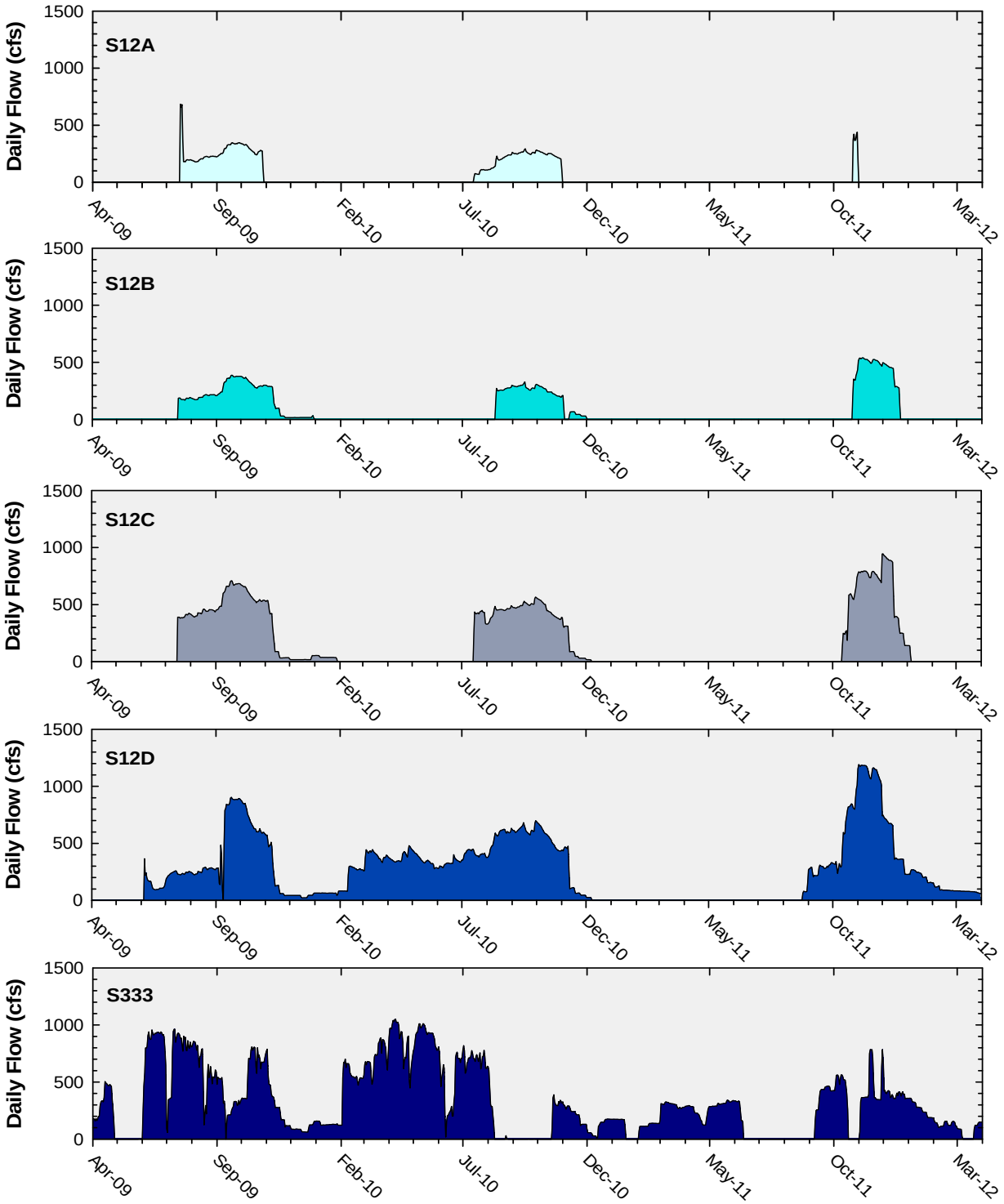

Figure 9. Daily flows at individual inflow structures to Shark River Slough. This figure includes most of the data illustrated in **Figures 7** and **8**.

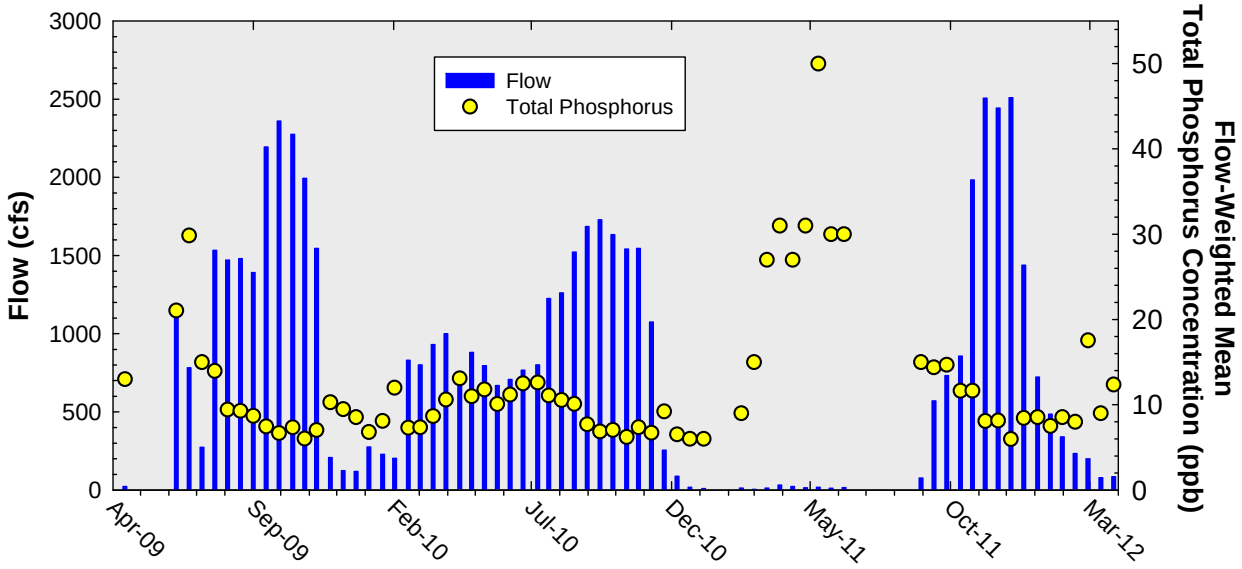

Figure 10. Flow at Shark River Slough structures on the day of sampling and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

Taylor Slough and Coastal Basins

Background

Under the Consent Decree, a single TP long-term limit of 11 ppb, to be met by December 31, 2006, was set for the two points of inflow to Taylor Slough (S332 and S175) and the inflow point to the Coastal Basins (S18C) (see **Appendix C**). The 12-month flow-weighted mean concentrations have consistently been lower than the long-term limit of 11 ppb.

Inflow TP concentrations to the ENP through Taylor Slough and Coastal Basins are compared to the 11 ppb limit at the end of each water year using data from both the old (S175, S332, S18C) and new (S174, S332D, S18C) combinations of structures (**Figure 11**). The narrow bars in **Figure 11** represent the 12-month flow-weighted mean TP concentrations from S332, S175, and S18C for water years 1991 through 2002. The wider bars for water years 1999 through 2011 represent the new combination of structures.

TP and flow data from both sets of structures presented in prior editions of this report through December 2001 (April 2002 report) showed that, beginning in October 2000, the 12-month moving total flow for S332D, S174, and S18C was consistently greater than flow at S332, S175, and S18C. There was also a shift in flow-weighted mean TP concentration data whereby S332D, S174, and S18C concentrations became equal to and then consistently lower than the concentrations at S332, S175, and S18C. These changes reflected the switch from S332 to S332D for water delivery to Taylor Slough between July 3 and July 5, 2000. Consequently, as of the July 2002 report, only S332D, S174, and S18C data are presented for monthly tracking of data in **Figure 11**. However, almost no flow passed through S174 from March 2006 to September 2007. The site was plugged in September 2007, preventing any additional flow.

The flow-weighted mean TP concentration was below the long-term limit for the 12-month period ending on September 30, 2011. Therefore, Taylor Slough and Coastal Basins TP concentration was in compliance for the federal water year 2011.

Reporting Period Update

Figure 12 presents the 12-month and individual sampling event flow-weighted mean TP concentrations at the S332D and S18C structures. All TP grab sample concentrations taken on positive flow days reported for surface water monitoring at the sites were used for the compliance calculations.

The daily flows into ENP through S332D, S174, and S18C are presented in **Figures 13** and **14**.

For the combined flow through S332D and S18C, the 12-month flow-weighted mean TP concentrations for the periods ending in January, February, and March 2012 were 6.4 (6.3), 6.4 (6.3), and 6.4 (6.3) ppb, respectively[5] (**Table 4**).

The Consent Decree stipulates that the percent of flow-weighted mean TP concentrations greater than 10 ppb from each sampling event in any 12-month period must not exceed a fixed guideline of 53.1 percent. For the 12-month periods ending January, February, and March 2012, the sampling event TP concentrations greater than 10 ppb were 10.0 (13.2), 9.3 (13.5), and 9.5 (14.7) percent, respectively[6].

Figure 15 shows the relationship between the daily inflows and the corresponding flow-weighted mean TP concentrations for each sampling event. The sampling event flow-weighted mean concentrations generally remained very low. The average of the flow-weighted mean TP concentrations was 4.3 ppb in the first quarter.

The USACE authorized the C-111 project in 1995 to restore more natural hydrologic conditions in Taylor Slough and to maintain flood protection to the east of the L31N and C-111 canals.

The original project facilities consisted of pump stations (S332B, S332C, and S332D), detention cells (Cell 1 through Cell 5), a connector cell between Cell 2 and Cell 3, a flow-way cell originating at Berm 3 of Cell 5, and four diversion structures (DS1 through DS4). Upon completion of a USACE construction project in 2009, an interconnected detention system now exists, starting at S332B west discharge and continuing to the S332D high head cell.

[5] Values in parentheses are 12-months flow-weighted mean concentrations calculated including the five qualified sample data collected in Water Year 2011 (see Appendix C, Table C-1).
[6] Values in parentheses are percentages calculated including the qualified data.

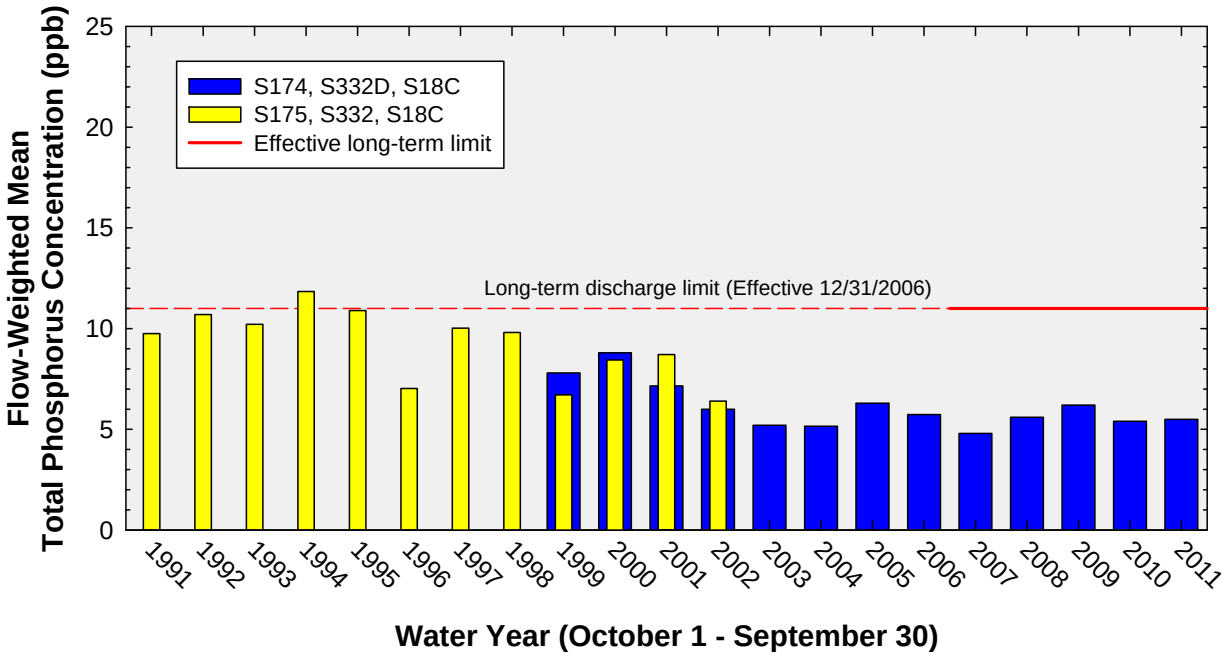

Figure 11. The 12-month flow-weighted mean total phosphorus concentrations in inflows to Everglades National Park through Taylor Slough and Coastal Basins at the end of each water year compared to the 11 ppb long-term total phosphorus limit.

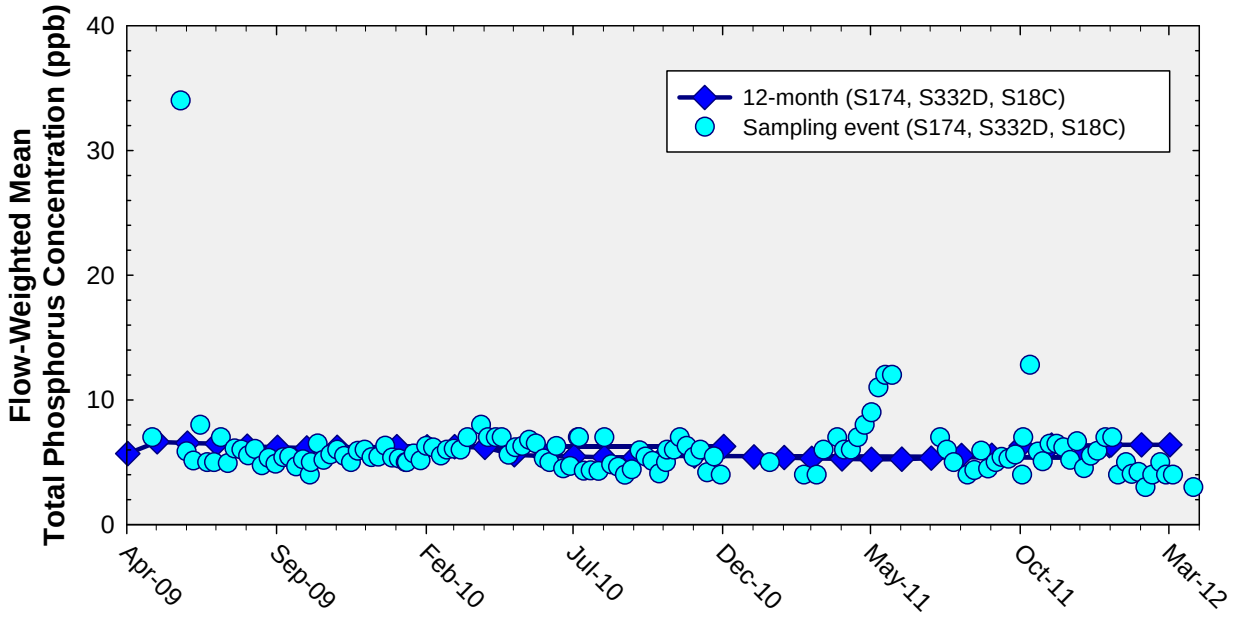

Figure 12. The 12-month flow-weighted mean total phosphorus concentrations in inflows to Everglades National Park through Taylor Slough and Coastal Basins at the end of each month and the flow-weighted mean total phosphorus concentration for each sampling event.

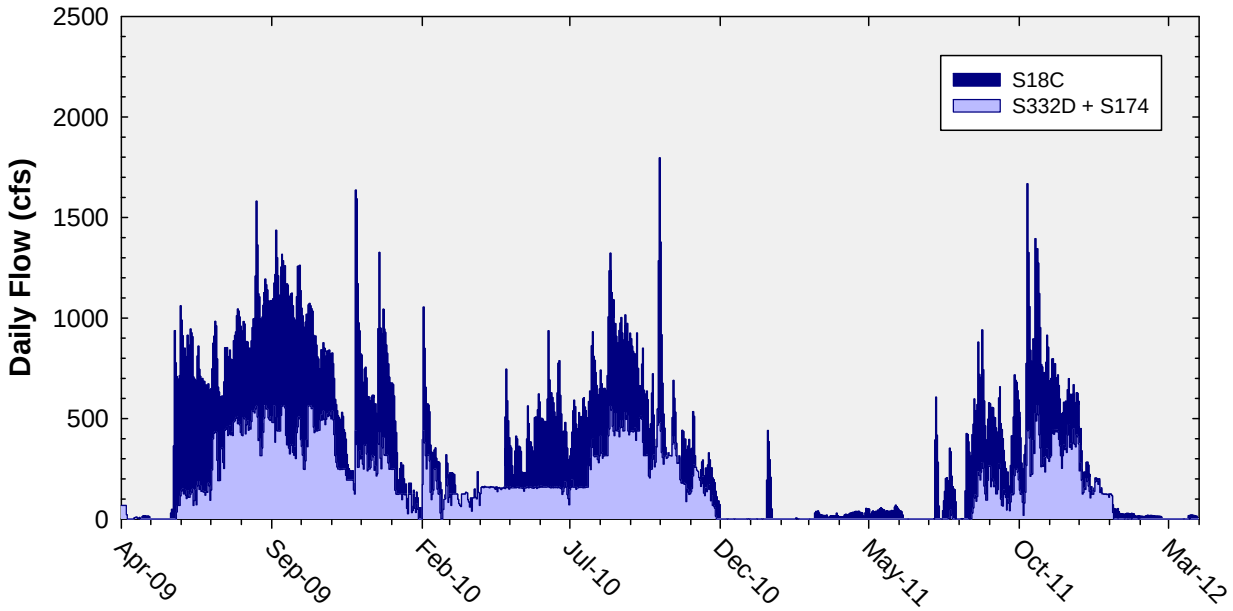

Figure 13. Daily flows into Everglades National Park as a stacked sum of Taylor Slough (structures S332D + S174) and Coastal Basins (structure S18C). Structure S174 was plugged in September 2007, and is no longer used.

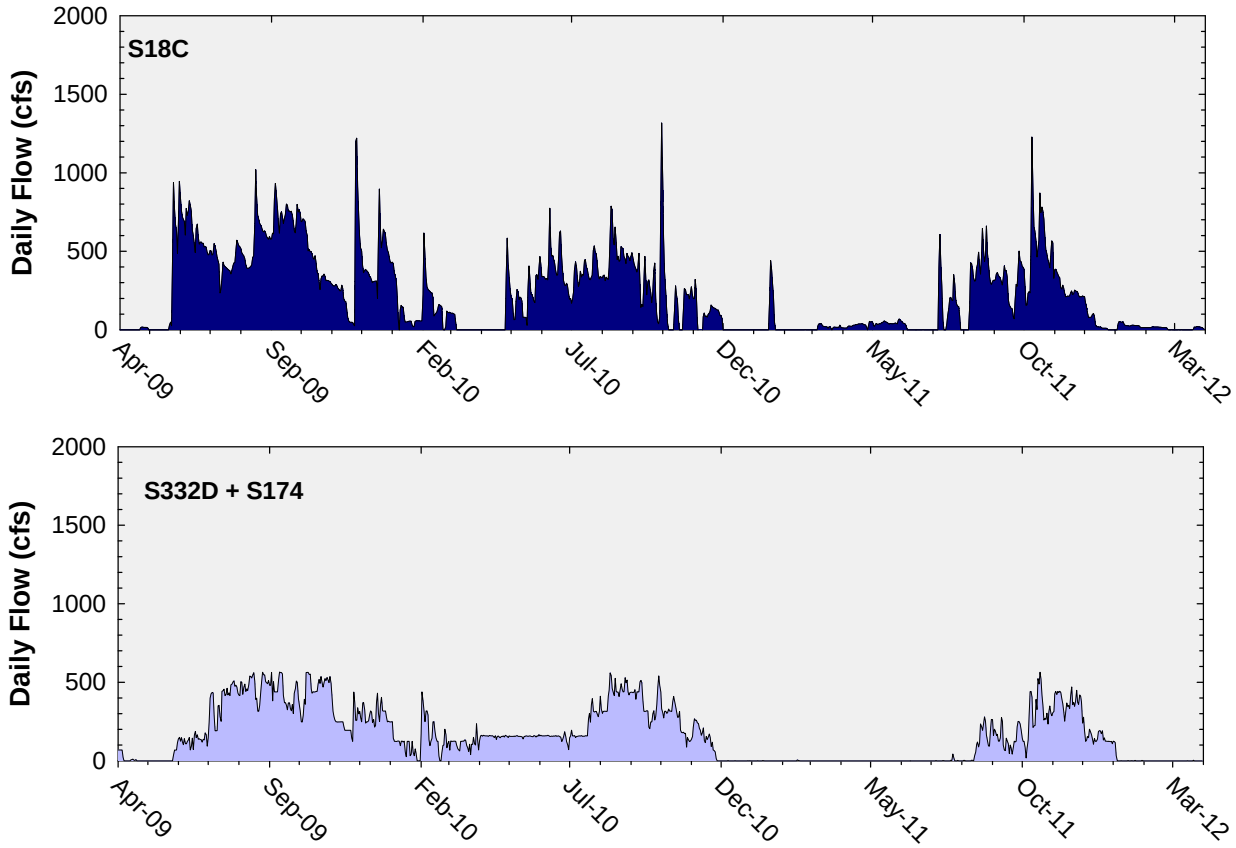

Figure 14. Daily flows at individual Coastal Basins (S18C) and Taylor Slough (S332D + S174) structures into the Everglades National Park.

Table 4. Taylor Slough and Coastal Basins total phosphorus compliance tracking.

12-Month Period	Total Flow (kac-ft)	Flow-Weighted Mean TP Concentration (ppb)	Long-Term Limit (ppb) *Effective 12/31/2006*	Percent of Sampling Events Greater than 10 ppb	
				Guideline	Observed
May 2008 - Apr 2009	317.6	5.7	11.0	53.1	1.9
Jun 2008 - May 2009	329.2	6.6	11.0	53.1	3.7
Jul 2008 - Jun 2009	358.3	6.5	11.0	53.1	3.5
Aug 2008 - Jul 2009	388.8	6.5	11.0	53.1	1.9
Sep 2008 - Aug 2009	398.6	6.3	11.0	53.1	1.9
Oct 2008 - Sep 2009	***411.4***	***6.2***	***11.0***	***53.1***	***2.2***
Nov 2008 - Oct 2009	399.3	6.1	11.0	53.1	2.3
Dec 2008 - Nov 2009	383.5	6.2	11.0	53.1	2.3
Jan 2009 - Dec 2009	391.5	6.3	11.0	53.1	2.4
Feb 2009 - Jan 2010	395.0	6.2	11.0	53.1	2.3
Mar 2009 - Feb 2010	414.5	6.2	11.0	53.1	2.1
Apr 2009 - Mar 2010	418.5	6.2	11.0	53.1	2.1
May 2009 - Apr 2010	430.6	6.2	11.0	53.1	2.0
Jun 2009 - May 2010	441.7	5.6	11.0	53.1	0.0
Jul 2009 - Jun 2010	428.2	5.5	11.0	53.1	0.0
Aug 2009 - Jul 2010	413.2	5.5	11.0	53.1	0.0
Sep 2009 - Aug 2010	404.8	5.4	11.0	53.1	0.0
Oct 2009 - Sep 2010	***377.5***	***5.4***	***11.0***	***53.1***	***0.0***
Nov 2009 - Oct 2010	349.1	5.5	11.0	53.1	0.0
Dec 2009 - Nov 2010	328.9	5.5	11.0	53.1	0.0
Jan 2010 - Dec 2010	283.3	5.4	11.0	53.1	0.0
Feb 2010 - Jan 2011	273.0	5.4	11.0	53.1	0.0
Mar 2010 - Feb 2011	253.5	5.4	11.0	53.1	0.0
Apr 2010 - Mar 2011	246.6	5.3	11.0	53.1	0.0
May 2010 - Apr 2011	235.2	5.3	11.0	53.1	0.0
Jun 2010 - May 2011	215.0	5.2	11.0	53.1	7.1
Jul 2010 - Jun 2011	183.4	5.2	11.0	53.1	8.1
Aug 2010 - Jul 2011	156.3	5.3	11.0	53.1	8.8
Sep 2010 - Aug 2011	126.4	5.5	11.0	53.1	9.4
Oct 2010 - Sep 2011	***111.4***	***5.6 (5.5*)***	***11.0***	***53.1***	***9.4 (11.4*)***
Nov 2010 - Oct 2011	134.6	6.3 (6.2*)	11.0	53.1	12.1 (13.9*)
Dec 2010 - Nov 2011	157.9	6.4 (6.3*)	11.0	53.1	12.5 (14.3*)
Jan 2011 - Dec 2011	170.2	6.3 (6.3*)	11.0	53.1	11.1 (12.8*)
Feb 2011 - Jan 2012	169.5	6.4 (6.3*)	11.0	53.1	10.0 (13.2*)
Mar 2011 - Feb 2012	170.2	6.4 (6.3*)	11.0	53.1	9.3 (13.5*)
Apr 2011 - Mar 2012	169.5	6.4 (6.3*)	11.0	53.1	9.5 (14.7*)

Notes:

- kac-ft = thousand acre feet.
- ppb = parts per billion. Values are actually in µg/L (micrograms per liter), which, for the purposes of this report, is equivalent to ppb.
- Compliance is evaluated annually based on the 12-month flow-weighted mean TP concentration for the federal water year ending on September 30. The compliance periods are shown as highlighted rows with bold, italicized text.

* Including the 5 qualified sample data collected in Water Year 2011 (see Appendix C, Table C-1).

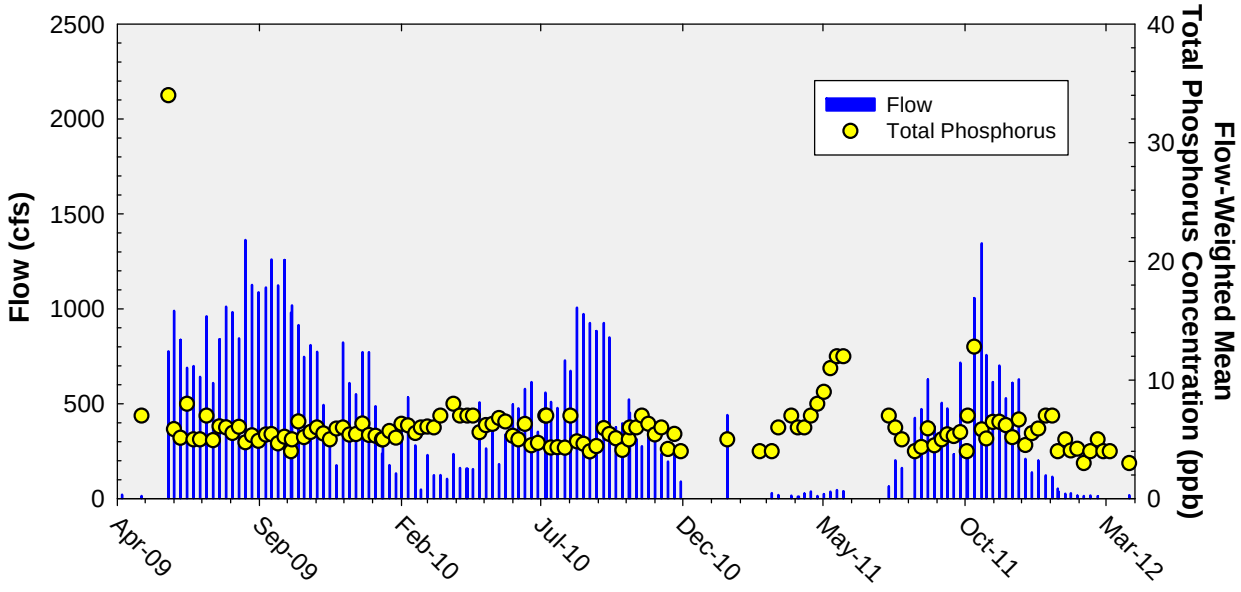

Figure 15. Flow from Taylor Slough and Coastal Basins structures (S332D + S174 and S18C) on the day of sampling and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

APPENDIX A

MONTHLY TOTAL PHOSPHORUS CONCENTRATION DATA FOR THE ARTHUR R. MARSHALL LOXAHATCHEE NATIONAL WILDLIFE REFUGE

Table A-1. Refuge monthly TP data (ppb).

Month-Year	LOX3	LOX4	LOX5	LOX6	LOX7	LOX8	LOX9	LOX10	LOX11	LOX12	LOX13	LOX14	LOX15	LOX16
Apr-2009	---	---	---	---	18	18	---	---	7	7	7	8	8	11
May-2009	---	---	---	---	---	---	---	---	---	11	---	---	---	---
Jun-2009[a]	---	25	---	14	10	20	8	15	14	14	12	12	11	11
Jul-2009	6	11	6	6	8	10	7	5	6	17	5	8	7	8
Aug-2009	9	8	7	8	8	12	10	11	7	11	7	10	8	9
Sep-2009	8	20	7	7	8	9	7	7	8	8	8	6	7	9
Oct-2009	7	10	7	4	8	9	7	7	7	9	6	7	5	7
Nov-2009	7	16	6	5	6	9	6	5	7	9	6	6	7	7
Dec-2009	---	8	---	4	7	9	6	5	4	5	7	5	6	6
Jan-2010	7	5	7	4	5	8	5	5	5	5	5	4	5	4
Feb-2010	10	8	11	5	8	8	6	7	5	6	5	6	6	6
Mar-2010	11	7	10	2	7	8	6	6	4	6	5	5	6	6
Apr-2010	9	8	10	5	9	10	6	6	6	6	6	7	6	9
May-2010	9	7	14	7	8	8	6	5	9	8	7	8	7	10
Jun-2010	8	8	7	9	7	7	5	5	7	7	6	7	10	12
Jul-2010	9	9	9	8	7	6	5	7	5	6	6	6	7	8
Aug-2010	---	---	---	6	7	6	5	6	6	6	---	5	7	7
Sep-2010	6	10	6	5	6	6	6	6	6	8	6	6	7	8
Oct-2010	5	17	5	6	5	7	5	7	6	7	5	5	6	7
Nov-2010	5	11	6	6	7	9	5	6	7	7	7	7	5	6
Dec-2010	4	7 (J)	5	3	4	5	4	4	3	5	4	4	4	4
Jan-2011	---	8	---	5	6	8	---	---	4	5	4	4	4	5
Feb-2011	---	9	---	5	7	8	---	---	5	6	6	5	4	7
Mar-2011	---	---	---	---	12	15	---	---	7	6	7	7	7	7
Apr-2011	---	---	---	---	---	48	---	---	10	7	7	12	8	11
May-2011	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Jun-2011	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Jul-2011	---	30	---	---	12	---	---	---	---	20	---	---	23	---
Aug-2011	---	---	---	12	13	17	---	---	8	11	---	14	8	12
Sep-2011	---	13	---	10	6	10	12	10	8	11	---	9	8	13
Oct-2011	---	11	---	6	5	8	6	10	7	8	---	7	7	8
Nov-2011	7	18	7	6	7	10	7	8	9	7	9	6	6	7
Dec-2011	7 (J)	10 (J)	6 (J)	5	7 (J)	9 (J)	8 (J)	8 (J)	7	6	8	6	5	7
Jan-2012	5	9	6	5	6	8	3	8	7	6	6	6	6	6
Feb-2012	---	10	9	5	9	10	9	11	7	6	6	7	5	7
Mar-2012	---	6	---	5	8	10	---	---	6	5	7	6	5	7

June 17 and 19, 2009 values are as follows:

Month-Year	LOX3	LOX4	LOX5	LOX6	LOX7	LOX8	LOX9	LOX10	LOX11	LOX12	LOX13	LOX14	LOX15	LOX16
Jun-2009	11	12	13	10	9	14	9	9	11	6	7	11	7	10

Notes:

--- Indicates sample was not collected due to insufficient water depth.

J indicates analyte detected in field blank and/or associated sample.

[a] June 1 and 2, 2009, compliance sampling data values.

APPENDIX B

WEEKLY GRAB TOTAL PHOSPHORUS CONCENTRATION DATA FOR SHARK RIVER SLOUGH

Table B-1. Weekly Grab TP Concentration Data for Shark River Slough (ppb).

Date	S12A	S12B	S12C	S12D	S333	Remarks
04/06/2011	45	---	---	---	31	N/A
04/12/2011	67	---	---	---	27	Compliance data
04/19/2011	53	---	---	---	26	N/A
04/26/2011	64	---	---	---	31	Compliance data
05/03/2011	56	---	---	---	43	N/A
05/10/2011	44	---	---	---	50	Compliance data
05/17/2011	43	---	---	---	29	N/A
05/24/2011	59	---	---	---	30	Compliance data
06/01/2011	74	---	---	---	39	N/A
06/07/2011	78	---	---	---	30	Compliance data
06/14/2011	62	---	---	---	49	N/A
06/21/2011	78	---	---	---	35	Compliance data
06/28/2011	83	---	---	---	30	N/A
07/06/2011	52	---	---	---	25	Compliance data
07/13/2011	53	---	---	---	20	N/A
07/19/2011	93	---	---	---	20	Compliance data
07/26/2011	47	---	---	---	19	N/A
08/02/2011	28	---	---	---	17	Compliance data
08/09/2011	29	---	---	---	24	N/A
08/16/2011	21	---	---	---	18	Compliance data
08/23/2011	56	---	---	---	25	N/A
08/30/2011	19	---	---	15	17	Compliance data
09/07/2011	16	---	---	15	13	N/A
09/13/2011	28	---	---	15	14	Compliance data
09/20/2011	20	---	---	14	13	N/A
09/27/2011	25	---	---	17	13	Compliance data
10/05/2011	32	---	---	11	13	N/A
10/12/2011	14	---	---	11	12	Compliance data
10/18/2011	27	---	9	13	14	N/A
10/25/2011	20	12	7	11	9	Compliance data
11/01/2011	12	8	6	15	11	N/A
11/08/2011	13	7	6	10	11	Compliance data
11/15/2011	12	8	5	7	14	N/A
11/22/2011	13	8	7	9	8	Compliance data
11/29/2011	12	---	6	8	12	N/A
12/06/2011	16	8	4	*	8	Compliance data
12/08/2011	---	---	---	7	---	Compliance data
12/13/2011	11	8	6	8	9	N/A
12/20/2011	18	13	7	7	8	Compliance data
12/28/2011	18	---	10	8	8	N/A
01/04/2012	11	0	5	10	9	Compliance data
01/11/2012	10	0	0	8	8	N/A
01/18/2012	12	0	0	7	8	Compliance data
01/24/2012	8	0	0	7	8	N/A
01/31/2012	14	0	0	8	9	Compliance data
02/07/2012	14	0	0	7	11	N/A
02/14/2012	11	0	0	8	8	Compliance data
02/22/2012	12	0	0	9	9	N/A
02/28/2012	14	0	0	28	10	Compliance data
03/06/2012	12	0	0	9	11	N/A
03/13/2012	18	0	0	9	11	Compliance data
03/20/2012	18	0	0	10	8	N/A
03/27/2012	22	0	0	13	10	Compliance data

Notes:

--- indicates water sample was not collected because the spillway gates were closed at the time of the site visit.

"Compliance data" indicates bi-weekly sampling data used for consent decree calculation.

"N/A" indicates bi-weekly sampling data presented for informational purposes only and not used for consent decree calculation.

*Water sample taken at S12D on December 6, 2011 was not properly preserved, thus not analyzed. The site was re-sampled on December 8, 2011.

APPENDIX C

WEEKLY GRAB TOTAL PHOSPHORUS CONCENTRATION DATA FOR TAYLOR SLOUGH AND COASTAL BASINS

Table C-1. Weekly Grab TP Concentration Data for Taylor Slough and Coastal Basins (ppb).

Date	S332DX	S18C
04/04/2011	--	6
04/05/2011	12	--
04/11/2011	12	6
04/18/2011	12	7
04/25/2011	21	8
05/02/2011	12	9
05/09/2011	19	11
05/16/2011	17	12
05/23/2011	14	12
05/31/2011	15 (J)	11 (J)
06/06/2011	16	12
06/13/2011	16	13
06/20/2011	18	10
06/27/2011	14	9
07/05/2011	9	7
07/11/2011	--	7 (J)
07/12/2011	8	--
07/18/2011	6	6
07/25/2011	5	5
08/01/2011	11	4
08/08/2011	7 (J)	4 (J)
08/15/2011	7	4
08/22/2011	8	5
08/29/2011	6	4
09/06/2011	7	4
09/12/2011	7	5
09/19/2011	7	4
09/26/2011	7	5
09/06/2011	7	4
09/12/2011	7	5
09/19/2011	7	4
09/26/2011	7	5

Date	S332DX	S18C
10/03/2011	--	4
10/04/2011	7	--
10/11/2011	6	17
10/19/2011	7	5
10/24/2011	7	4
10/31/2011	7	6
11/07/2011	8	4
11/14/2011	7	5
11/21/2011	6	4
11/28/2011	8	4
12/05/2011	6	2
12/12/2011	6	4
12/19/2011	6	4
12/27/2011	7	3
01/03/2012	7	6
01/09/2012	--	4
01/10/2012	5	--
01/17/2012	6	5
01/23/2012	5	4
01/30/2012	6	4
02/06/2012	6	3
02/13/2012	5	4
02/21/2012	6	5
02/27/2012	5	4
03/05/2012	7	4
03/12/2012	5	3
03/19/2012	6	4
03/26/2012	6	3

Note: -- indicates water sample was not collected.
J indicates analyte detected in field blank and/or associated sample.

APPENDIX D

CALCULATION METHODS

Long Term Marsh Concentration Levels for Loxahatchee National Wildlife Refuge

Long Term Marsh Concentration Levels:

$$C = 10.7172 - 0.541156S + 1.372\sqrt{7.5819 - 0.9310S + 0.02902216S^2}$$

Terms:

C = the natural log of the geometric mean total phosphorus concentration across 14 marsh stations.

S = average stage measured at gauges CA1-9, CA1-7, and CA1-8C on sampling date (feet).

This equation is applicable over a stage range of 15.42 to 17.14 feet. If the stage on any sampling date exceeds 17.14 feet, a stage of 17.14 feet should be used in calculating the long term concentration levels. The equation shall not apply to dates when the average stage is less than 15.42 feet.

(*1991 Settlement Agreement entered as a Consent Decree in 1992 and modified in 1995, Exhibit B, Appendix B, Attachment II, page B-7*)

Discharge Limits and OFW Standards for Shark River Slough

Interim Discharge Limit:

$$C = 11.16 - 0.00465Q + 1.397\sqrt{6.377 - 0.00591Q + 0.00000436\,Q^2}$$

Long-Term Discharge Limit & OFW Standard:

$$C = 11.38 - 0.00538Q + 1.397\sqrt{2.493 - 0.00231Q + 0.00000170\,Q^2}$$

Frequency Exceedance:

$$F = 48.411 - 0.02896Q + 1.397\sqrt{330.1 - 0.3071Q + 0.0002254\,Q^2}$$

Terms:

Water Year = October through September

Q = total inflow to Shark River Slough for water year, S-12s + S-333 + any additional inflow from the WCAs established in the future, thousand acre-ft/yr (Kac-ft/yr).

C = limit on maximum flow-weighted-mean inflow concentration for any Water Year, composite of all inflows to Shark Slough (ppb).

F = exceedance for maximum frequency (percent) of inflow concentrations exceeding 10 ppb, computed from the time series of concentrations composited across all inflow structures on each sampling date with positive flow in a given Water Year.

The range of flow (Q) used in deriving the limits is 117 to 1061 Kac-ft/yr. If the total flow for any water year exceeds 1061 Kac-ft/yr, a flow of 1061 Kac-ft/yr should be used in calculating the discharge limits.

(*1991 Settlement Agreement entered as a Consent Decree in 1992 and modified in 1995, Exhibit B, Appendix A, Attachment I, page A-5*)

Note: Additional inflows, currently, comprises the discharges through S334, S355A and S335B, and S356. The latest TOC approved methodology to incorporate these additional inflows was documented in the Shark River Slough section of the Settlement Agreement July – September 2006 Report (dated November 9, 2011).

Discharge Limits and OFW Standards for Taylor Slough and Coastal Basins

Long-Term Flow-Weighted Discharge Limit & OFW Standard = 11.0 ppb

Frequency Exceedance:

Frequency of values > 10 ppb must be less than 53.1%.

Terms:

Limits are defined on a Water Year basis, October through September.

Basin flow is the total flow through structures S-332, S-175, S-18C, plus any new release points from this basin established in the future, thousand acre-ft/yr (Kac-ft/yr).

Limits apply to the flow-weighted-mean concentration for any Water Year, composite of all inflows to Taylor Slough (S-332) and Coastal Basin (S-18C).

Frequency exceedance is the exceedance for maximum frequency (percent) of inflow concentrations exceeding 10 ppb, computed from the time series of concentrations composited across all inflow structures on each sampling date with positive flow in a given Water Year.

(*1991 Settlement Agreement entered as a Consent Decree in 1992 and modified in 1995, Exhibit B, Appendix A, Attachment II, page A-6*)

APPENDIX E
DOCUMENT REVISIONS

Table E-1. Revisions to this report since initial publication.

Page/Date	Original	Revision
None		None