Settlement Agreement Report

First Quarter
January – March 2011

Prepared for the
Technical Oversight Committee
May 23, 2011
(Revised on July 15, 2011, November 15, 2011)
See Appendix E: Document Revisions for specific revisions.

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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 2011 (January - March 2011). 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, 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 2011.
- **Shark River Slough:** The 12-month flow-weighted mean TP concentration was below the 12-month moving long-term limit during the first quarter.
- **Taylor Slough and Coastal Basins:** The 12-month flow-weighted mean TP concentration was below the 12-month moving long-term limit during the first quarter

Table 1. Total phosphorus compliance, first quarter 2011.

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-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*

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 2011	730.5	9.1	9.3	48.3	48.0
Feb 2011	695.2	9.1 9.5		49.3	45.8
Mar 2011	645.6	9.2	9.7	50.7	54.2[a]
Everglades National Park – Taylor Slough and Coastal Basins					
Jan 2011	273.0	5.4	11.0	53.1	0.0
Feb 2011	253.5	5.4 11.0		53.1	0.0
Mar 2011	246.6	5.3	11.0	53.1	0.0

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.

* Revised from the original May 23, 2011, report to reflect the removal of data qualifier for the March 3, 2011, sampling trip TP concentration data (LOX7 and LOX8).

** Revised to include March 3, 2011 stages in the average stage calculation and long-term level calculation.

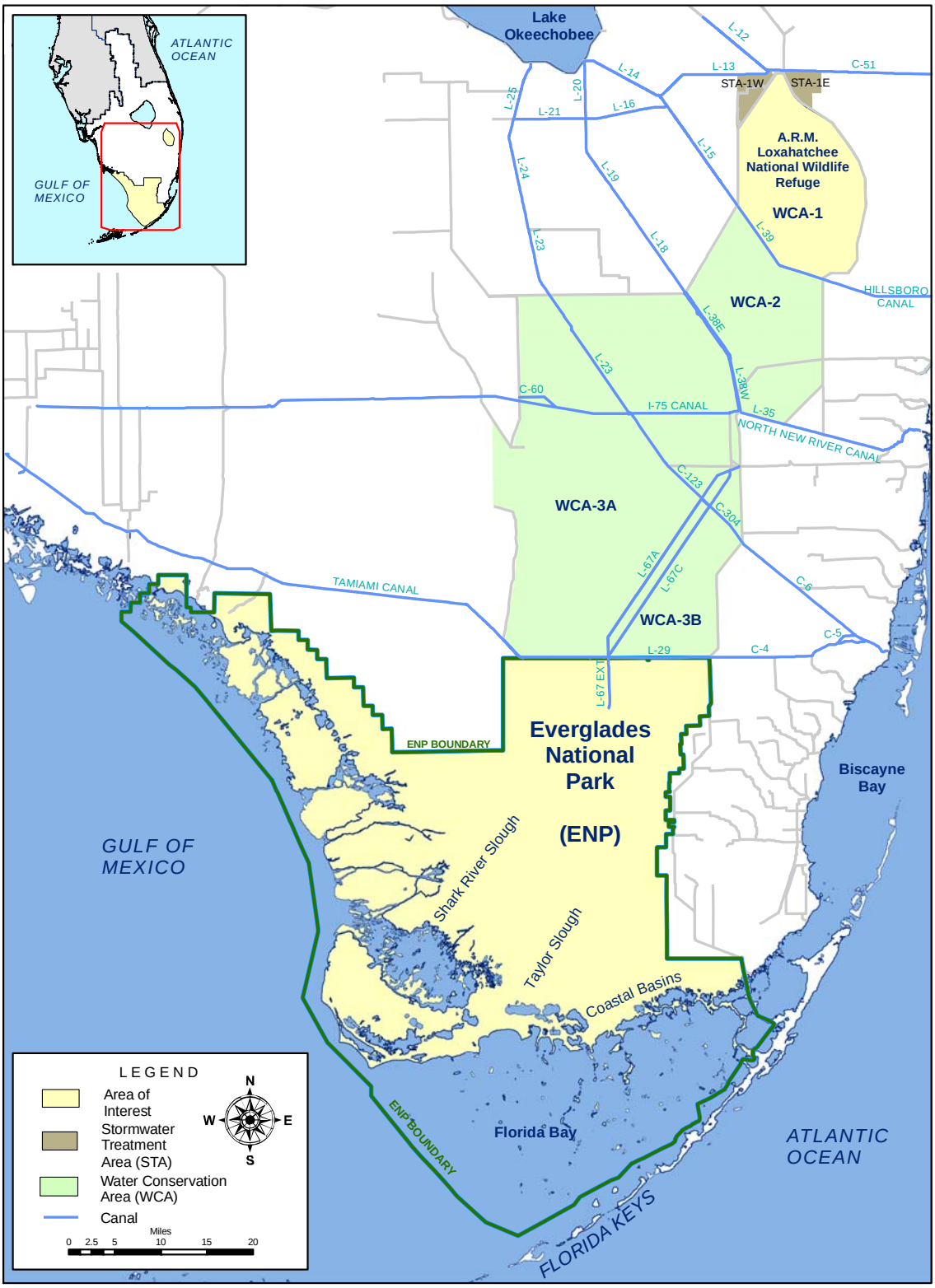

Figure 1. Areas of interest.

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 stages in the Refuge were 16.29, 16.19, and 15.79 feet in January, February, and March 2011, respectively (**Figure 3** and **Table 2**). The geometric means, calculated from TP concentrations measured in water samples collected in January, February, and March 2011 were 5.1, 6.0, and 8.1 parts per billion (ppb), respectively. The geometric mean TP concentrations were below the long-term level for the reporting period. TP samples were not collected at stations LOX3, LOX4, LOX5, LOX6, LOX9, and LOX10 because the water depth was less than 0.1 meters at the sites.

TP data for LOX7 and LOX8 for March 2011 were originally qualified because the proper field sample collection procedure for quality control blanks was thought not to have been followed (see page 5, Table 5 of the Quality Assessment Report for Water Quality Monitoring, January – March 2011, published on May 12, 2011). After an investigation, it was determined the proper field sample collection procedure was followed, and the validity of the data was confirmed. The March 2011 geometric mean TP concentration excluding the two data was 6.8 ppb. This value was revised to include LOX7 and LOX8 data. The revised geometric mean TP concentration for March 2011 was 8.1 ppb and did not exceed the long-term level of 14.0 ppb, which was revised to include the additional sampling day stage values.

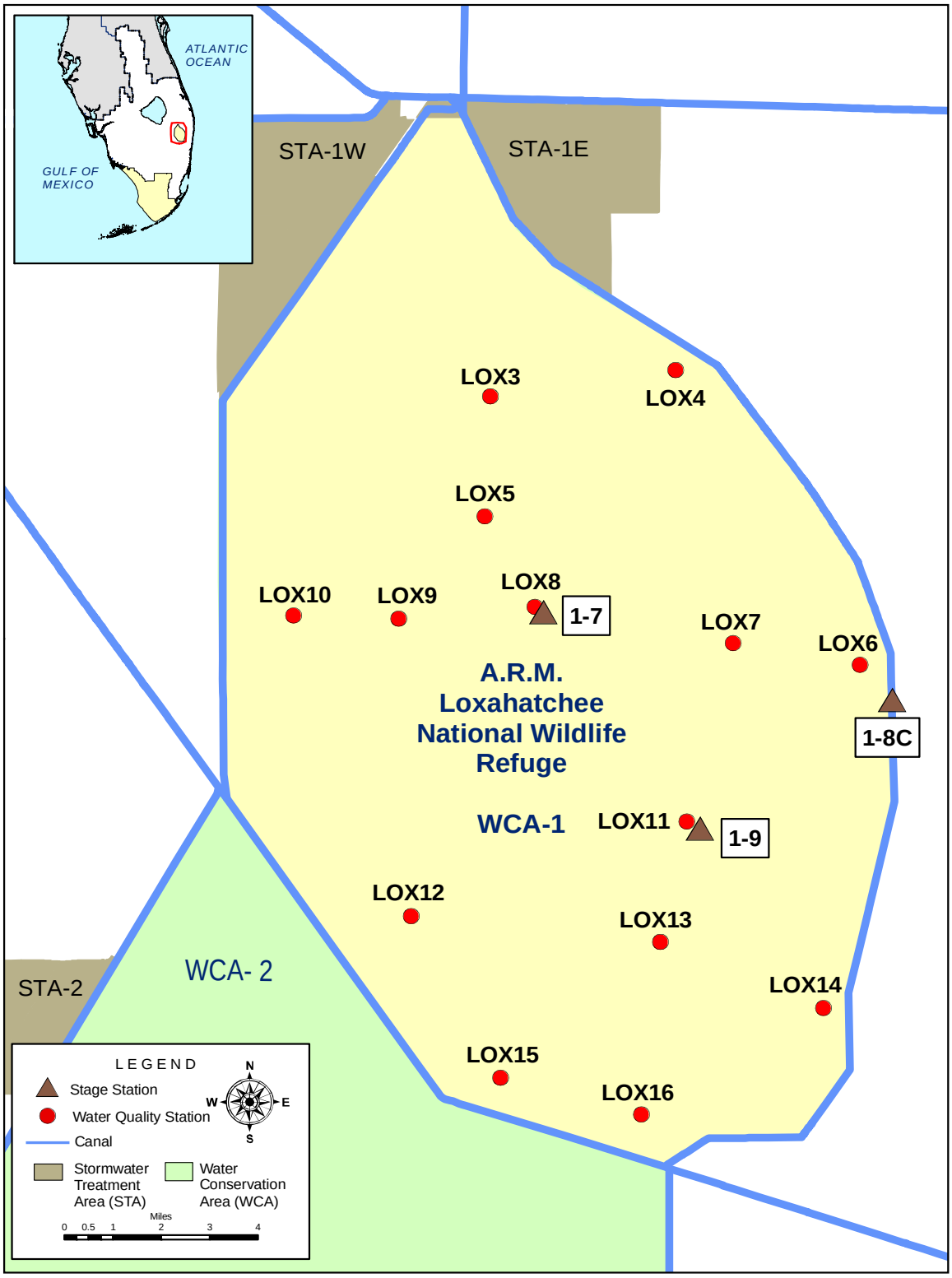

Figure 2. Arthur R. Marshall Loxahatchee National Wildlife Refuge water quality sampling and stage measurement sites.

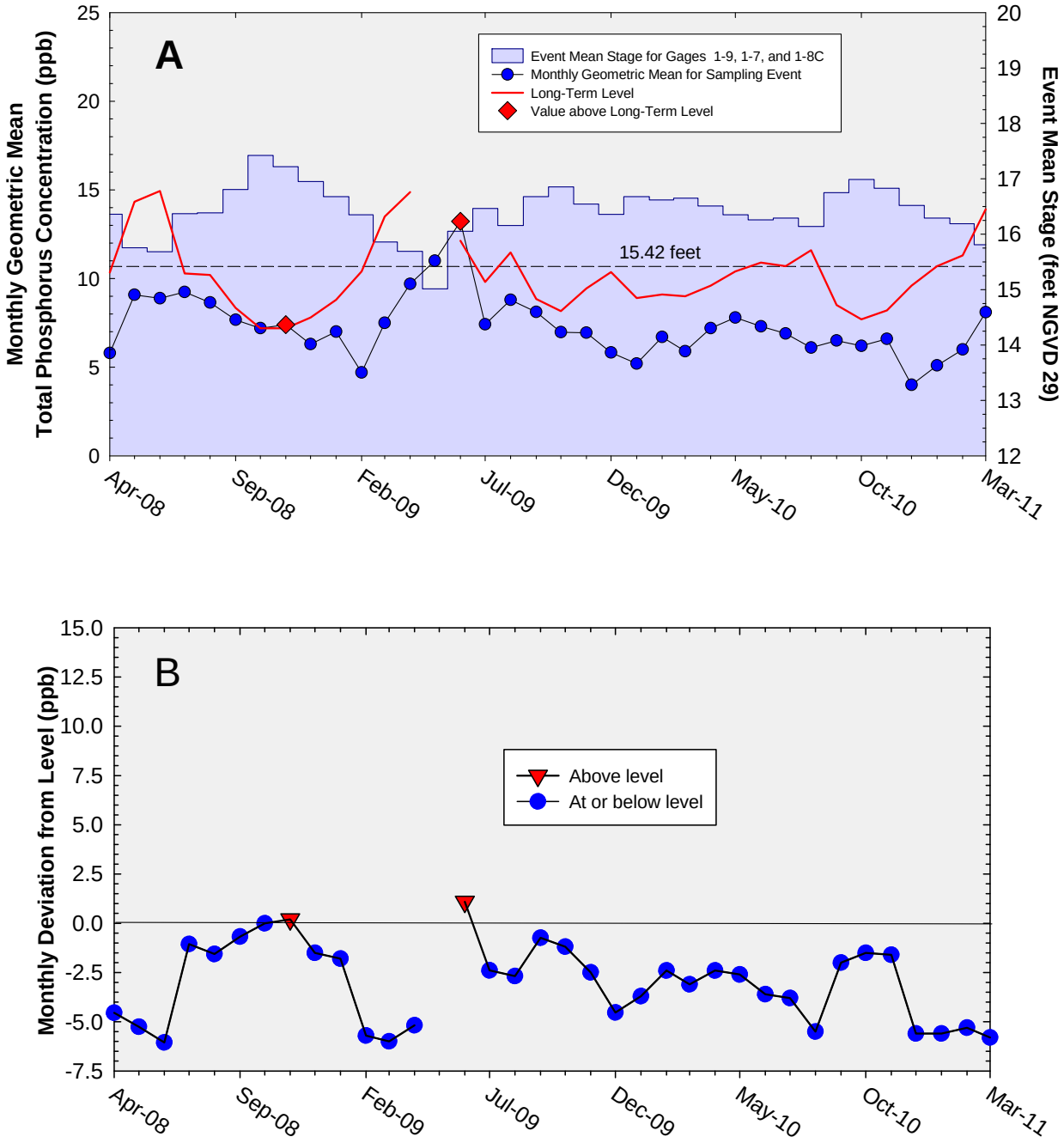

Figure 3. (A) Monthly total phosphorus geometric mean concentrations for the Arthur R. Marshall Loxahatchee National Wildlife Refuge compared to calculated long-term levels. These calculated long-term total phosphorus levels are adjusted for fluctuations in stage. The long-term level was not applicable for May 2009 because the average stage was less than 15.42 feet. The geometric mean was greater than the long-term level in November 2008 and June 2009.
(**B)** Deviation of monthly geometric mean total phosphorus concentrations with calculated long-term levels. Values greater than zero suggest 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-2008	5.8	10.3	16.36	14
May-2008	9.1	14.3	15.76	9
Jun-2008	8.9	14.9	15.68	8
Jul-2008	9.2	10.3	16.37	14
Aug-2008	8.6	10.2	16.39	14
Sep-2008	7.7	8.3	16.81	14
Oct-2008	7.2	7.2	17.42	14
Nov-2008	***7.4***	***7.2***	***17.22***	***14***
Dec-2008	6.3	7.8	16.95	14
Jan-2009	7.0	8.8	16.68	14
Feb-2009	4.7	10.4	16.35	12
Mar-2009	7.5	13.5	15.86	9
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	16.75	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*

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.
* Revised from the original May 23, 2011, report to reflect the removal of data qualifier for the March 3, 2011, sampling trip TP concentration data (LOX7 and LOX8).
** Revised to include March 3, 2011 stages in the average stage calculation and long-term level calculation.

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 2010 (**Figure 5**). The flow-weighted mean TP concentration was equal to the long-term limit of 8.9 ppb for the 12-month period ending on September 30, 2010. Therefore, Shark River Slough TP concentration was in compliance for federal water year 2010.

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 October 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]. For the 12-month periods ending in January, February, and March 2011, the 12-month flow-weighted mean TP concentrations were 9.1, 9.1, and 9.2 ppb. The long-term limits were 9.3, 9.5, and 9.7 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 2011, the sampling event TP concentrations greater than 10 ppb were 48.0, 45.8, 54.2 percent, respectively.

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

The observed percentages of the sampling event flow-weighted mean TP concentrations greater than 10 ppb were higher than the guidelines for the 12-month period ending in March 2011 (**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 2008 through March 2011 are presented in **Figures 7** and **9**. The stage at the Water Conservation Area 3A (WCA-3A) was very low and remained in Zone E of the Regulation Schedule during the quarter. There was no flow through the S12 structures during the quarter. A total of 30,152 acre-feet of water was discharged through S333; 28,564 acre-feet (95%) of the water was diverted to S334 during the quarter (**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:
http://www.saj.usace.army.mil/h2o/plots/wca3ahp.pdf**.**

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**. Flow and TP concentrations for waters entering the ENP through Shark River Slough have been following an inverse relationship (**Figure 10**).

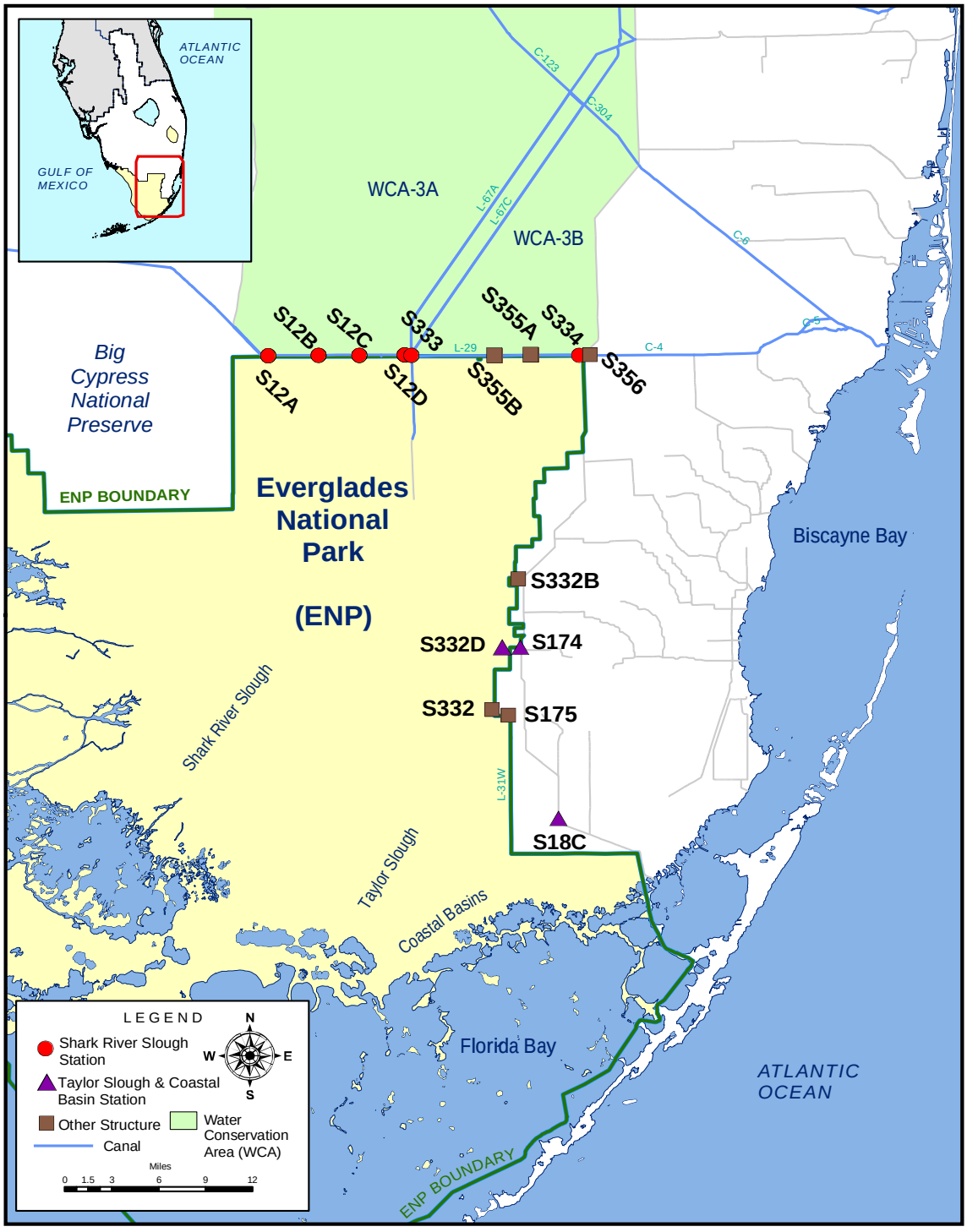

Figure 4. Everglades National Park flow structures.

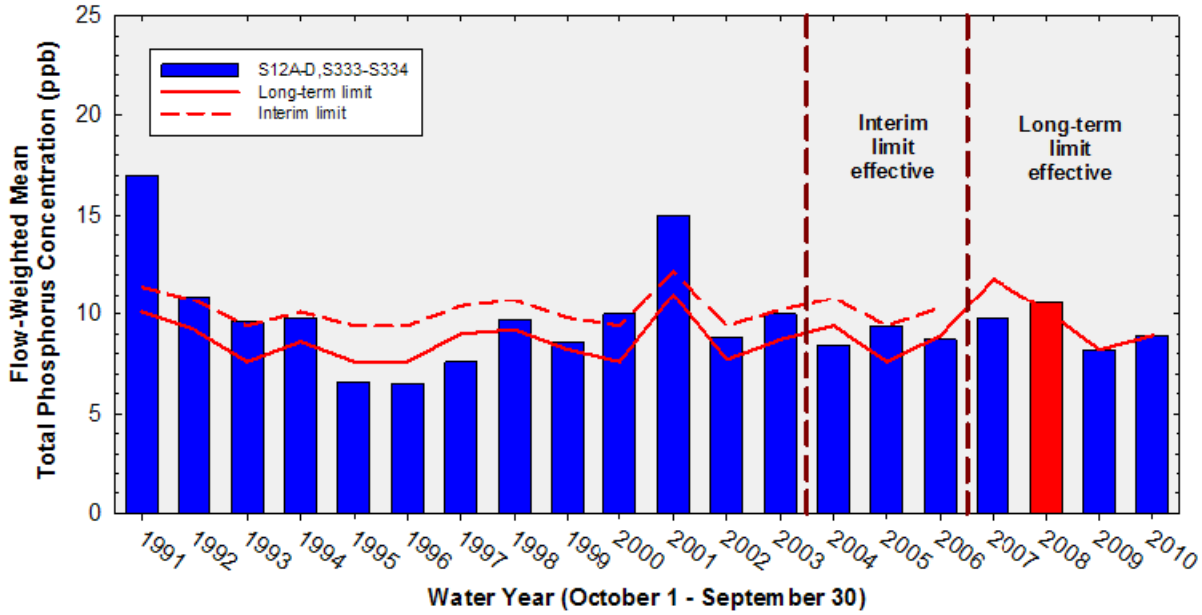

Figure 5. The 12-month flow-weighted mean total phosphorus concentrations at inflows to the Everglades National Park through Shark River Slough at the end of each water year compared to the interim and long-term total phosphorus limits. The 12-month flow-weighted mean TP concentration for the compliance year through September 30, 2008 exceeded the long-term limit.

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 2007 - Apr 2008	110.9	12.4	12.9	69.4	78.6[b]
Jun 2007 - May 2008	142.3	12.2	12.7	68.1	75.0[b]
Jul 2007 - Jun 2008	153.6	11.8	12.6	67.7	70.6[b]
Aug 2007 - Jul 2008	227.4	12.4	12.2	64.9	76.5[b]
Sep 2007 - Aug 2008	356.8	12.0	11.4	60.1	77.8[b]
Oct 2007 - Sep 2008	***562.0***	***10.6***[a]	***10.2***	***53.3***	***73.7***[a,b]
Nov 2007 - Oct 2008	775.9	8.0	9.0	47.0	57.9[b]
Dec 2007 - Nov 2008	935.4	7.6	8.2	43.0	47.4[b]
Jan 2008 - Dec 2008	1003.1	7.5	7.9	41.4	45.0[b]
Feb 2008 - Jan 2009	1007.1	7.5	7.9	41.3	42.9[b]
Mar 2008 - Feb 2009	1021.5	7.5	7.8	41.0	39.1
Apr 2008 - Mar 2009	1030.3	7.5	7.8	40.8	37.5
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[b]
Oct 2009 - Sep 2010	***809.9***	***8.9***	***8.9***	***46.1***	***50.0***[b]
Nov 2009 - Oct 2010	757.3	9.0	9.1	47.5	50.0[b]
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[b]

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] Values for the Water Year 2008 (October 2007 – September 2008) were revised on March 28, 2011, based on the recommendation to exclude "qualified" data by the Special Master in his January 4, 2011 report. The 12-month flow weighted mean was revised from 10.2 ppb to 10.6 ppb and the observed percent of sampling events greater than 10 ppb was revised from 70.0 to 73.7. The revised value was published in the Settlement Agreement Report, October – December 2010. At the March 1, 2011 quarterly meeting, the TOC determined substantial evidence indicates this exceedance was due to error as described on page A-4 of Appendix A of the 1995 Amended Consent Decree.

[b] Value exceeded the guideline percentage.

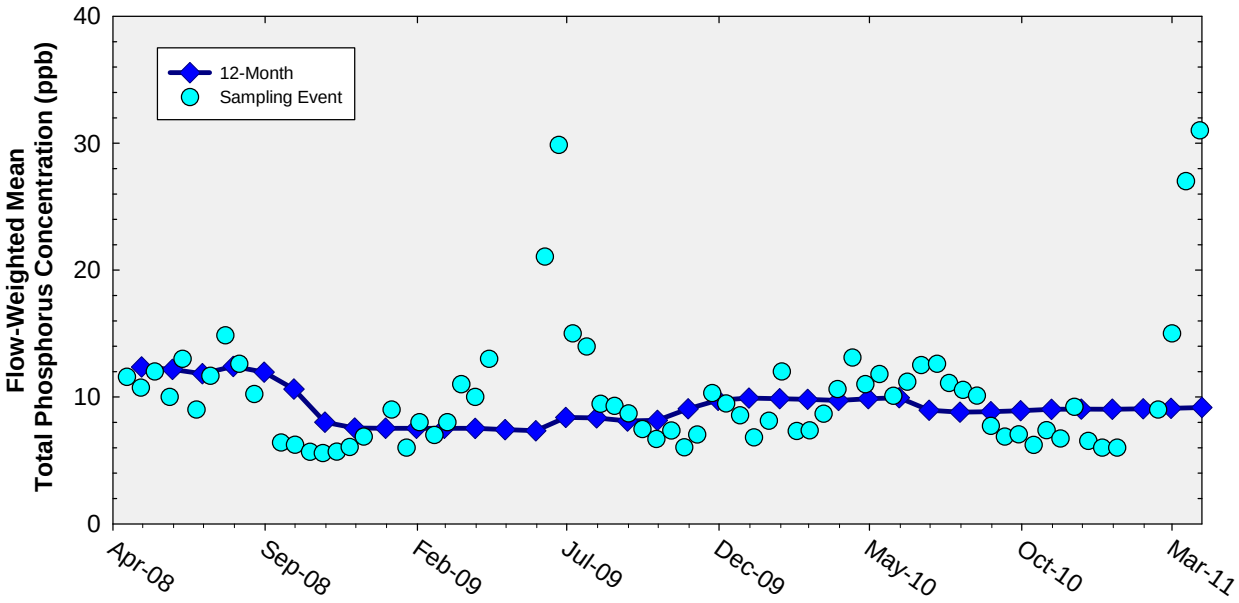

Figure 6. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Shark River Slough at the end of each month and the flow-weighted mean concentration for each sampling event. There are no sampling event values for some months because there was little or no flow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

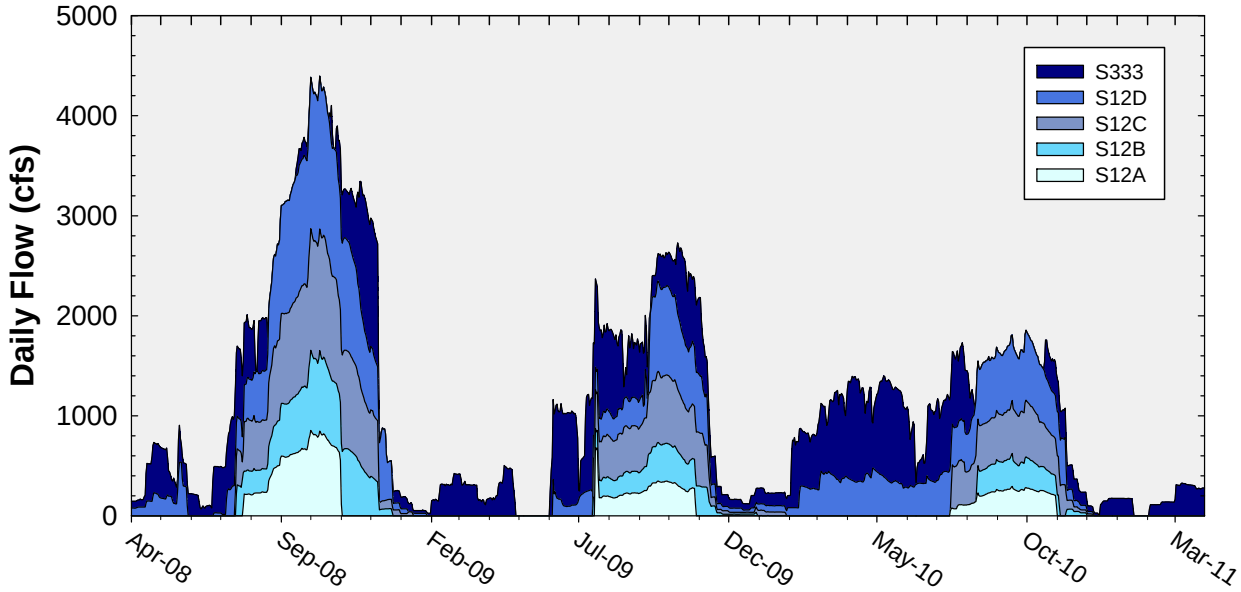

Figure 7. Daily flows at Shark River Slough structures as a stacked sum of five inflows.

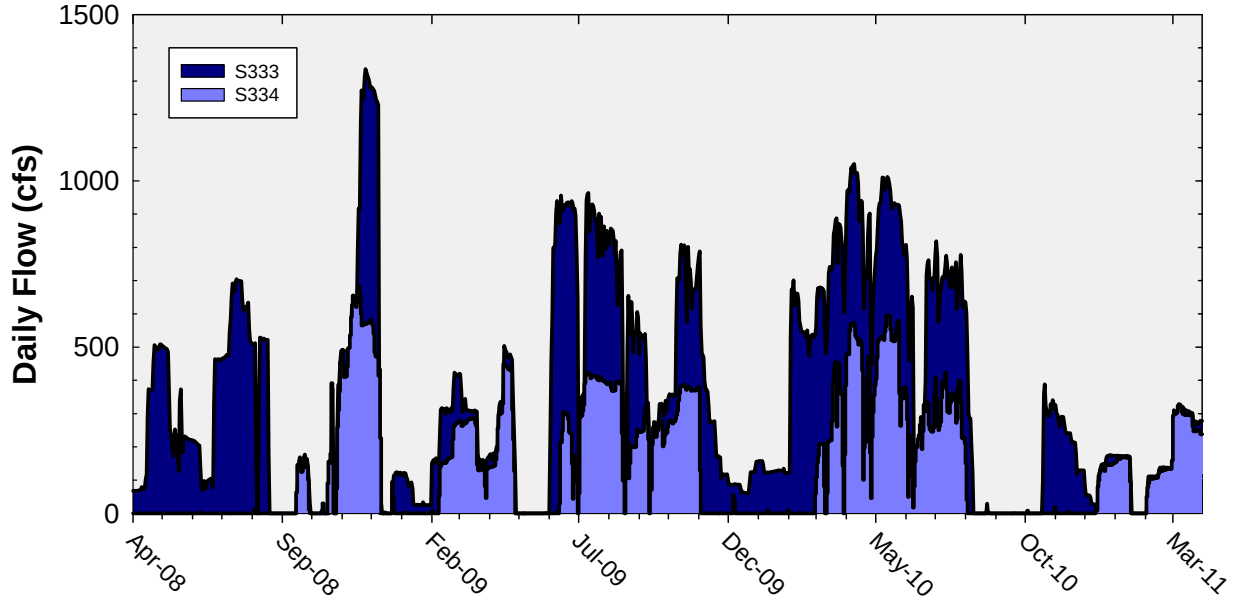

Figure 8. Daily flows at structures S333 and S334.

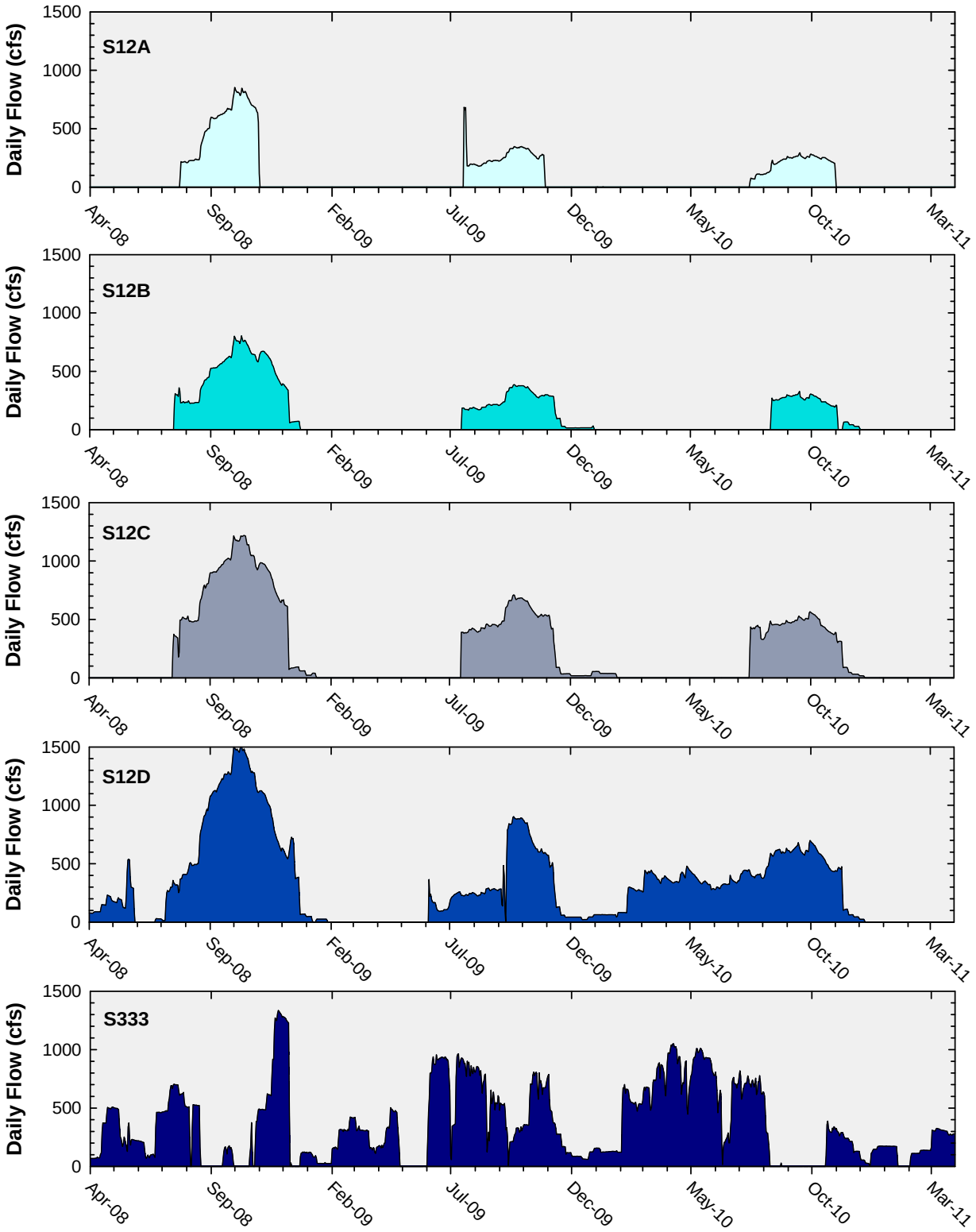

Figure 9. Daily flows at individual inflow structures to Shark River Slough. This figure includes most of the data illustrated in **Figures 7** and **8**.

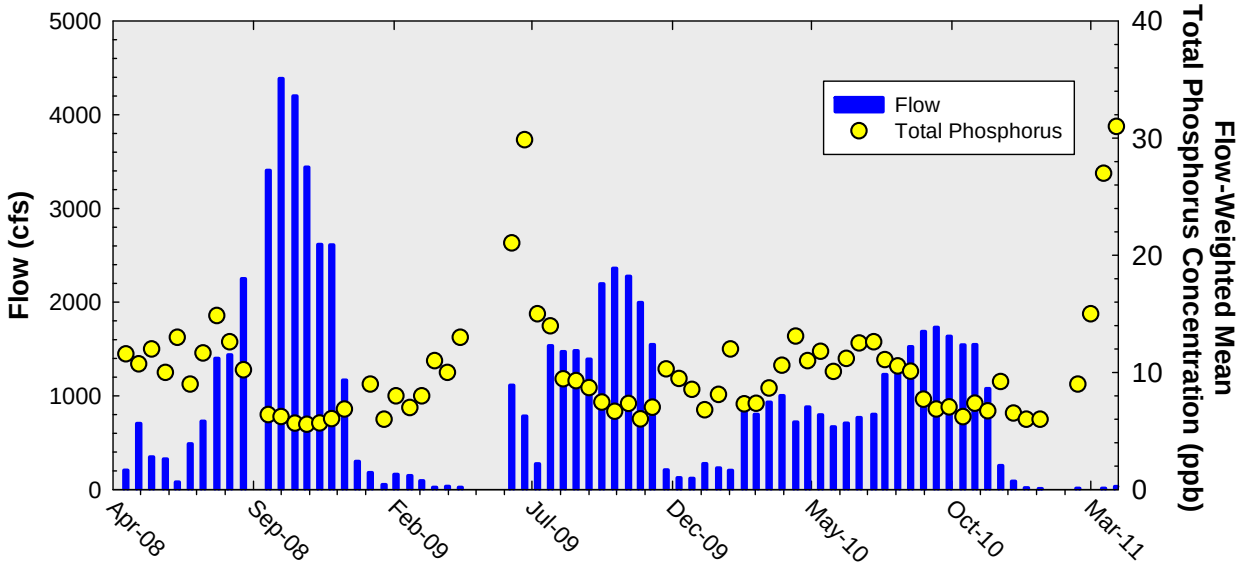

Figure 10. Flow at Shark River Slough structures on the day of sampling and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

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 2010 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, 2010. Therefore, Taylor Slough and Coastal Basins TP concentration was in compliance for the federal water year 2010.

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 concentration for the periods ending in January, February, and March 2011 was 5.4, 5.4, and 5.3 ppb respectively (**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. The sampling event flow-weighted mean concentrations generally remained very low. There was no sampling event flow-weighted mean TP concentration greater than 11 ppb since December 2006 except 23 ppb on July 14, 2008, and 34 ppb on May 26, 2009, at S18C. **Figure 15** shows the relationship between the daily inflows and the corresponding flow-weighted mean TP concentrations for each sampling event.

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.

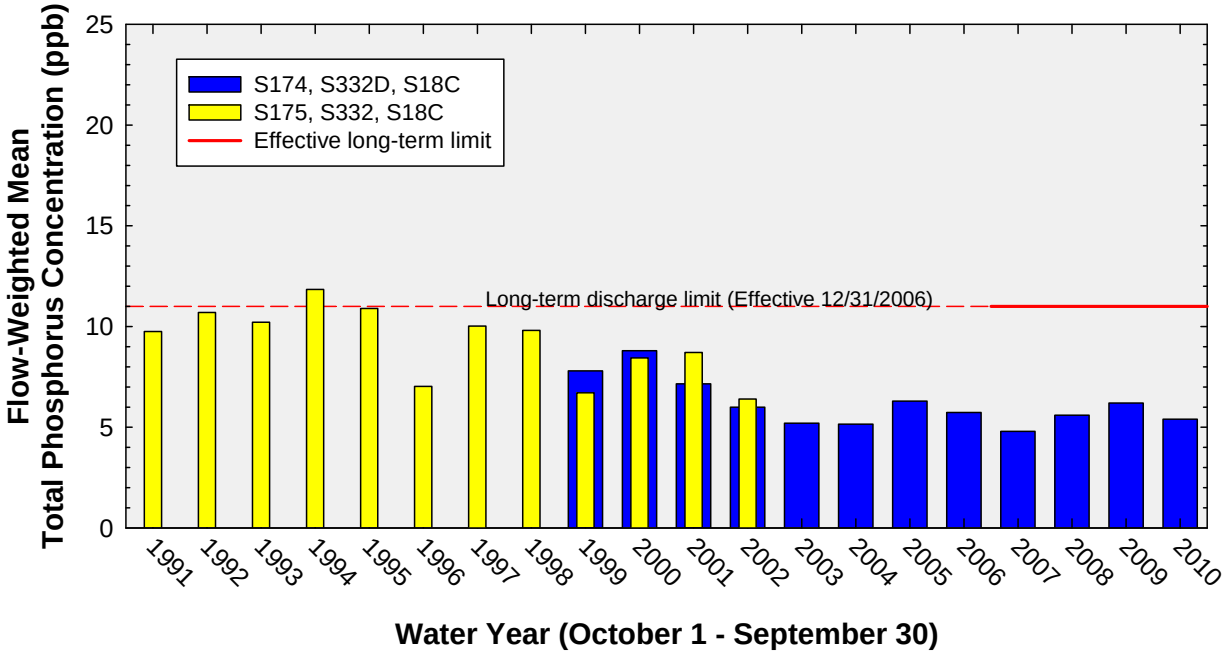

Figure 11. The 12-month flow-weighted mean total phosphorus concentrations in inflows to Everglades National Park through Taylor Slough and Coastal Basins at the end of each water year compared to the 11 ppb long-term total phosphorus limit.

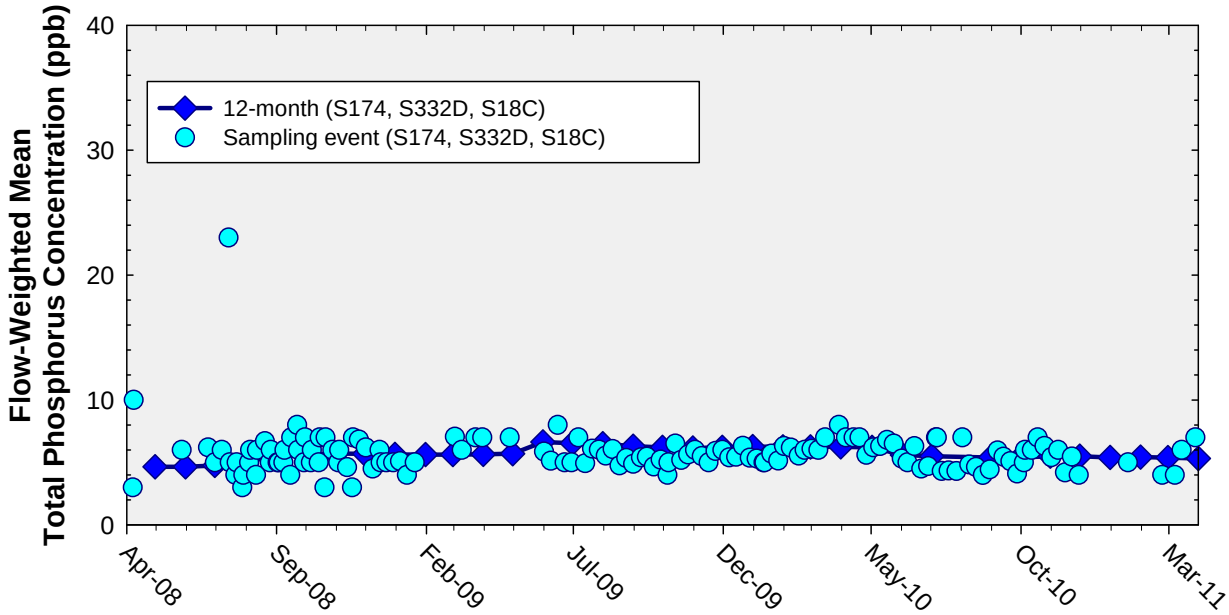

Figure 12. The 12-month flow-weighted mean total phosphorus concentrations in inflows to Everglades National Park through Taylor Slough and Coastal Basins at the end of each month and the flow-weighted mean total phosphorus concentration for each sampling event.

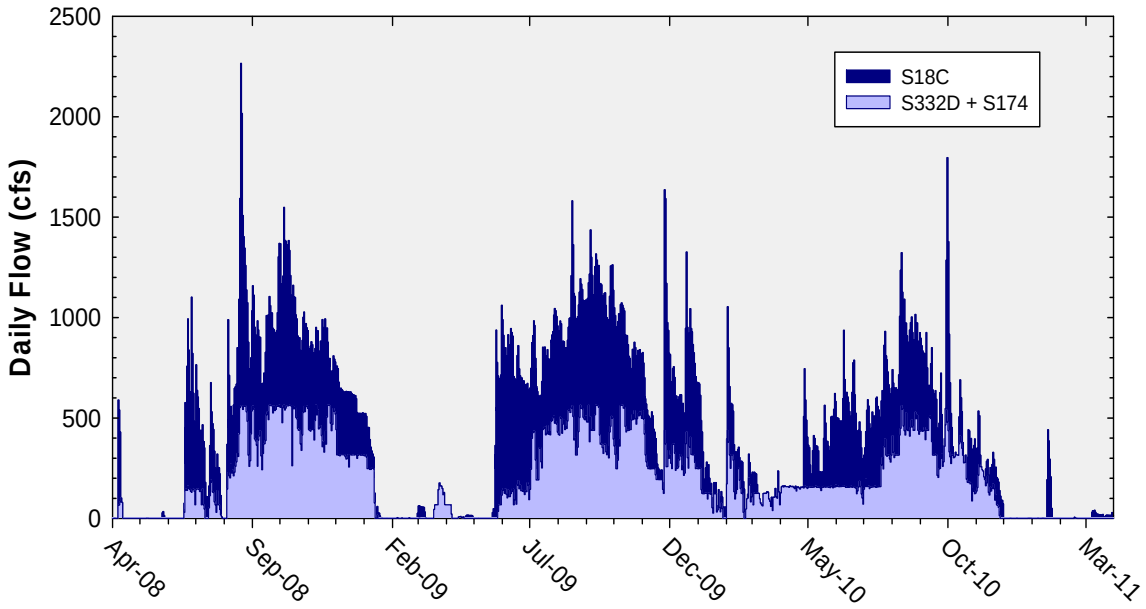

Figure 13. Daily flows into Everglades National Park as a stacked sum of Taylor Slough (structures S332D + S174) and Coastal Basins (structure S18C). Structure S174 was plugged in September 2007 and is no longer used.

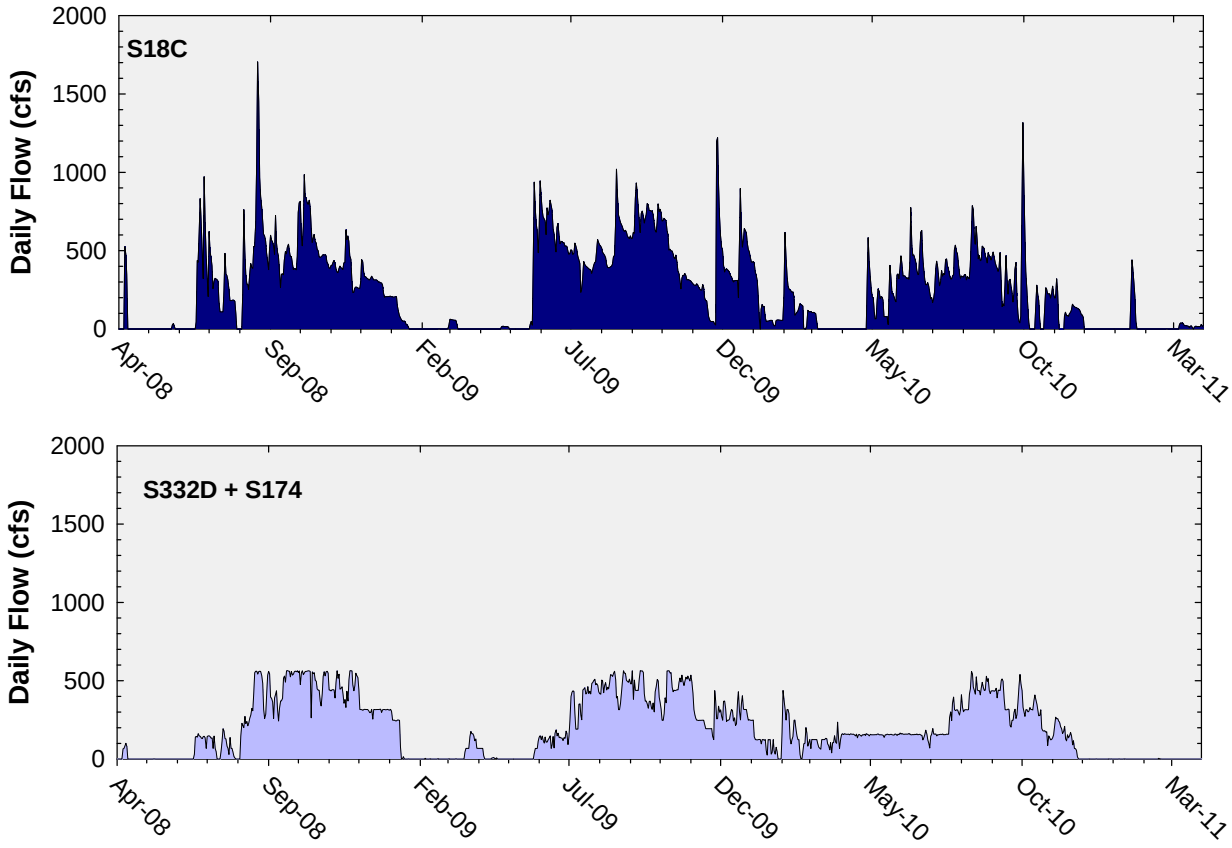

Figure 14. Daily flows at individual Coastal Basins (S18C) and Taylor Slough (S332D + S174) structures into the Everglades National Park.

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 2007 - Apr 2008	157.1	4.6	11.0	53.1	0.0
Jun 2007 - May 2008	155.9	4.6	11.0	53.1	0.0
Jul 2007 - Jun 2008	145.0	4.8	11.0	53.1	0.0
Aug 2007 - Jul 2008	130.0	5.0	11.0	53.1	2.6
Sep 2007 - Aug 2008	165.6	5.5	11.0	53.1	2.5
Oct 2007 - Sep 2008	***207.7***	***5.6***	***11.0***	***53.1***	***2.2***
Nov 2007 - Oct 2008	234.8	5.7	11.0	53.1	2.3
Dec 2007 - Nov 2008	273.0	5.7	11.0	53.1	2.2
Jan 2008 - Dec 2008	308.8	5.6	11.0	53.1	2.0
Feb 2008 - Jan 2009	317.1	5.6	11.0	53.1	1.9
Mar 2008 - Feb 2009	316.5	5.6	11.0	53.1	1.9
Apr 2008 - Mar 2009	320.0	5.6	11.0	53.1	1.8
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

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.

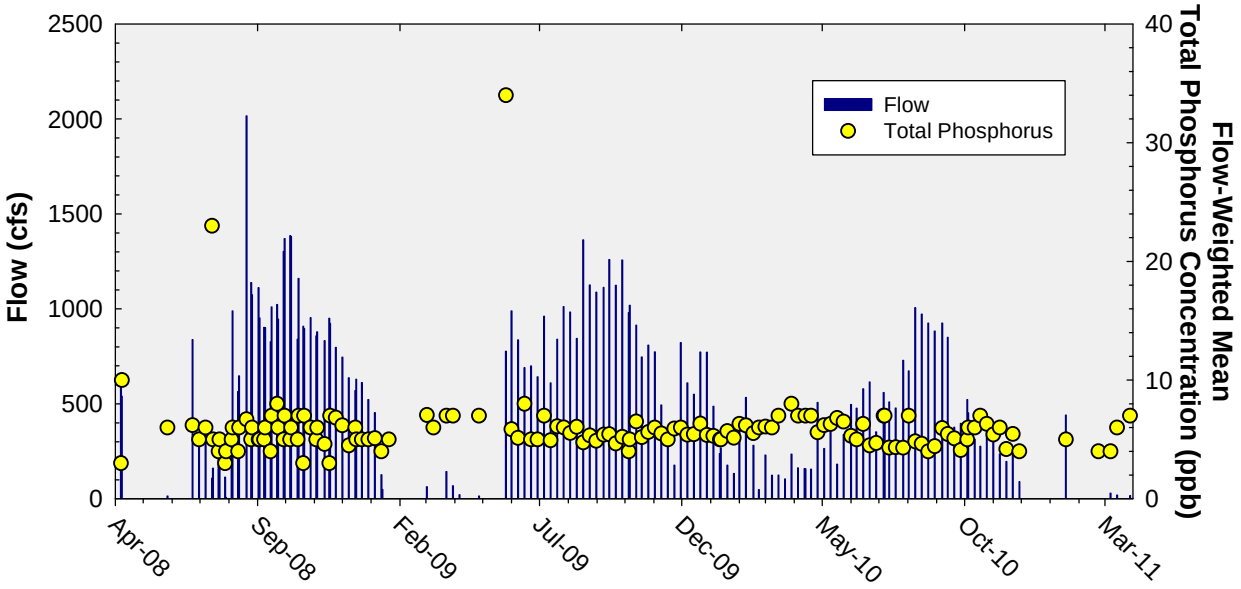

Figure 15. Flow from Taylor Slough and Coastal Basins structures (S332D + S174 and S18C) on the day of sampling and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

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-2008	7	7	8	4	6	13	8	8	4	4	4	4	6	4
May-2008	---	---	---	12	10	14	---	---	8	9	8	6	9	8
Jun-2008	---	---	---	---	10	10	---	---	8	6	10	9	10	9
Jul-2008	10	21	8	7	8	18	7	10	8	9	8	8	6	10
Aug-2008	7	11	7	18	8	12	6	9	7	6	8	7	11	10
Sep-2008	9	6	9	5	7	9	7	10	7	9	8	8	7	8
Oct-2008	8	15	7	6	9	9	6	8	7	7	5	6	5	7
Nov-2008	8	7	7	7	6	10	6	8	8	6	9	7	8	8
Dec-2008	8	9	6	4	7	8	4	7	6	7	6	6	6	6
Jan-2009	9	10	9	6	7	10	4	7	6	7	7	6	6	7
Feb-2009	---	5	---	4	5	9	4	6	5	4	5	3	4	5
Mar-2009	---	---	---	22	11	13	---	---	5	6	5	5	5	6
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	---	---	---	6	7	6	5	6	6	6	0	5	7	7
Aug-2010	6	10	6	5	6	6	6	6	6	8	6	6	7	8
Sep-2010	5	17	5	6	5	7	5	7	6	7	5	5	6	7
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	**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

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 no sample was 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.

[*] Data qualifier was removed for LOX7 and LOX8 collected in March 2011.

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
04/06/2010	22	---	---	7	13	N/A
04/14/2010	22	---	---	10	16	Compliance data
04/20/2010	10	---	---	11	13	N/A
04/27/2010	16	---	---	11	11	Compliance data
05/04/2010	31	---	---	10	17	N/A
05/11/2010	18	---	---	8	15	Compliance data
05/18/2010	16	---	---	9	15	N/A
05/25/2010	22	---	---	8	12	Compliance data
06/02/2010	18	---	---	8	11	N/A
06/08/2010	20	---	---	10	12	Compliance data
06/15/2010	14	---	---	11	12	N/A
06/22/2010	16	---	---	12	13	Compliance data
06/29/2010	16	---	---	9	11	N/A
07/08/2010	11	---	---	9	17	Compliance data
07/13/2010	18	---	---	---	12	N/A
07/15/2010	---	---	---	8	---	N/A
07/20/2010	9	---	6	11	18	Compliance data
07/28/2010	10	---	6	9	11	N/A
08/03/2010	8	---	8	13	11	Compliance data
08/10/2010	9	---	9	9	26	N/A
08/17/2010	7	7	12	11	10	Compliance data
08/24/2010	6	7	9	9	36	N/A
08/31/2010	6	6	8	9	9	Compliance ata d
09/08/2010	6	6	9	9	13	N/A
09/14/2010	6	5	7	8	9	Compliance ata d
09/21/2010	6	5	7	9	9	N/A
09/28/2010	6	6	7	8	7	Compliance ata d
10/06/2010	5	6	7	8	8	N/A
10/13/2010	6	5	6	7	8	Compliance ata d
10/19/2010	7	6	7	8	9	N/A
10/26/2010	6	5	7	9	8	Compliance ata d
11/02/2010	19	8	6	10	9	N/A
11/09/2010	9	---	6	7	7	Compliance data
11/16/2010	9	9	7	7	8	N/A
11/23/2010	12	13	9	9	8	Compliance ata d
11/30/2010	9	10	9	8	9	N/A
12/07/2010	7	7	6	6	7	Compliance ata d
12/14/2010	**J**	---	---	---	**J**	N/A
12/21/2010	7	---	---	---	6	Compliance data
12/28/2010	9	---	---	---	39	N/A
01/05/2011	10	---	---	---	6	Compliance data
01/01/2011	15	---	---	---	7	N/A
01/19/2011	15	---	---	---	6	Compliance data
01/25/2011	12	---	---	---	6	N/A
02/01/2011	11	---	---	---	7	Compliance data
02/08/2011	9	---	---	---	19	N/A
02/15/2011	18	---	---	---	9	Compliance data
02/23/2011	28	---	---	---	13	N/A
03/01/2011	34	---	---	---	15	Compliance data
03/08/2011	32	---	---	---	17	N/A
03/15/2011	66	---	---	---	27	Compliance data
03/22/2011	74	---	---	---	36	N/A
03/29/2011	50	---	---	---	31	Compliance data

Note:

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

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

"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.

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
04/05/2010	7	5
04/12/2010	--	3
04/13/2010	7	--
04/19/2010	7	5
04/26/2010	7	5
05/03/2010	7	5
05/10/2010	8	5
05/17/2010	7	6
05/24/2010	7	6
06/01/2010	6	5
06/07/2010	5	5
06/14/2010	7	6
06/21/2010	6	4
06/28/2010	6	4
07/06/2010	7	--
07/07/2010	--	7
07/12/2010	5	4
07/19/2010	5	4
07/27/2010	6	3
08/02/2010	7	7
08/09/2010	6	4
08/16/2010	6	3
08/23/2010	5	3
08/30/2010	6	3
09/07/2010	7	5
09/13/2010	6	5
09/20/2010	6	4
09/27/2010	4	5
10/04/2010	--	5
10/05/2010	6	--
10/12/2010	6	5
10/18/2010	7	5
10/25/2010	8	5
11/01/2010	6	5
11/08/2010	6	33
11/15/2010	5	3
11/22/2010	6	5
11/29/2010	6	4
12/06/2010	8	5
12/13/2010	10	4
12/20/2010	4	5
12/27/2010	7	7
01/03/2011	--	7
01/04/2011	6	--
01/10/2011	6	7
01/18/2011	6	5
01/24/2011	5	7
01/31/2011	4	4
02/07/2011	5	4
02/14/2011	6	4
02/22/2011	9	4
03/07/2011	7	4
03/14/2011	8	6
03/21/2011	11	7
03/28/2011	--	7

Note: -- indicates water sample was not collected.

APPENDIX D

CALCULATION METHODS

Long Term Marsh Concentration Levels for Loxahatchee National Wildlife Refuge

Long Term Marsh Concentration Levels:

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

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:

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

Long-Term Discharge Limit & OFW Standard:

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

Frequency Exceedance:

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

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*)

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	Original	Revision
1, 5, 6, A-2		July 15, 2011 **Tables and Figures** Tables 1, 2, and A-1 were updated with notes detailing the revisions associated with removal of the data qualifier for the March 3, 2011, sampling. Values for March 2011 in Figure 3 were updated to include the previously qualified data.
3	March 23, 2011 **Reporting Period Update** "TP data for LOX7 and LOX8 were qualified because the proper field sample collection procedure for quality control blanks was not followed (see page 5, table 5 of the Quality Assessment Report for Water Quality Monitoring, January – March 2011, published on May 12, 2011). If the qualified data for LOX7 and LOX8 were determined to be usable (subject to a "to be determined" data usability protocol), the March 2011 geometric mean TP concentration would be 8.1 ppb (as opposed to 6.8 ppb). Including the data does not cause the geometric mean TP concentration to exceed the long-term level of 13.9 ppb."	July 15, 2011 **Reporting Period Update** "TP data for LOX7 and LOX8 for March 2011 were originally qualified because the proper field sample collection procedure for quality control blanks was thought not to have been followed (see page 5, Table 5 of the Quality Assessment Report for Water Quality Monitoring, January – March 2011, published on May 12, 2011). After an investigation, it was determined the proper field sample collection procedure was followed, and the validity of the data was confirmed. The March 2011 geometric mean TP concentration excluding the two data was 6.8 ppb. This value was revised to include LOX7 and LOX8 data. The revised geometric mean TP concentration for March 2011 was 8.1 ppb and did not exceed the long-term level of 13.9 ppb."
Appendix E		July 15, 2011 **Appendix E** Added Appendix E to list revisions.

Page	Original	Revision
1, 6		November 15, 2011 **Tables and Figures** The average stage and the long-term level values in Tables 1 and 2 were updated with notes to include March 3, 2011, stages in the average stage calculation and long-term level calculation. These revisions were associated with the removal of the data qualifier for the March 3, 2011, sampling.
3	July 15, 2011 **Reporting Period Update** "Average stages in the Refuge were 16.29, 16.19, and 15.81 feet in January, February, and March 2011, respectively (**Figure 3** and **Table 2**)." "The revised geometric mean TP concentration for March 2011 was 8.1 ppb and did not exceed the long-term level of 13.9 ppb."	November 15, 2011 **Reporting Period Update** "Average stages in the Refuge were 16.29, 16.19, and 15.79 feet in January, February, and March 2011, respectively (**Figure 3** and **Table 2**)." "The revised geometric mean TP concentration for March 2011 was 8.1 ppb and did not exceed the long-term level of 14.0 ppb, which was revised to include the additional sampling day stage values."