

Settlement Agreement Report

Second Quarter
April – June 2009

Prepared for the
Technical Oversight Committee
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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 the Coastal Basins.

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ACRONYMS AND ABBREVIATIONS

ENP	Everglades National Park
FDEP	Florida Department of Environmental Protection
IOP	Interim Operational Plan
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
STA	Stormwater Treatment Area
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 second quarter of 2009 (April - June 2009). 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 the Coastal Basins (**Table 1** and **Figure 1**):

- **Refuge:** The geometric mean TP concentrations were above the long-term level in June 2009. An "exceedance," as defined in the Consent Decree, has occurred because the June 2009 excursion occurred within 12 consecutive sample collections of the preceding November 2008 excursion.
- **Shark River Slough:** The 12-month flow-weighted mean TP concentration was below the long-term limit for April and May 2009 and above long-term limit in June 2009.
- **Taylor Slough and the Coastal Basins:** The 12-month flow-weighted mean TP concentration was below the long-term limit for each month of the quarter.

Table 1. Total phosphorus compliance, second quarter 2009.

Arthur R. Marshall Loxahatchee National Wildlife Refuge					
Month	Geometric Mean TP Concentration (ppb)	Long-Term Level (ppb)	Mean Stage (ft NGVD 29)	Number of Samples	
Apr-2009	9.7	14.9	15.69	8	
May-2009	11.0	N/A	15.01	1	
Jun-2009	13.2	12.1	16.05	12	
Everglades National Park – Shark River Slough					
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
Apr-2009	1024.2	7.5	7.8	40.9	33.3
May-2009	992.8	7.4	8.0	41.6	31.8
Jun-2009	1035.1	8.4	7.8	40.7	36.4
Everglades National Park – Taylor Slough and the Coastal Basins					
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
Apr-2009	317.6	5.7	11.0	53.1	1.9
May-2009	329.2	6.6	11.0	53.1	3.7
Jun-2009	358.3	6.5	11.0	53.1	3.5

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.
- Highlighted rows with bold, italicized text indicate when an excursion over the long-term level occurred.
- Compliance for inflows to Everglades National Park (Shark River Slough, Taylor Slough and the Coastal Basins) is evaluated annually based on the 12-month flow-weighted mean TP concentration for the federal water year ending in September.
- N/A denotes that the level was not applicable because the average stage was less than 15.42 feet.

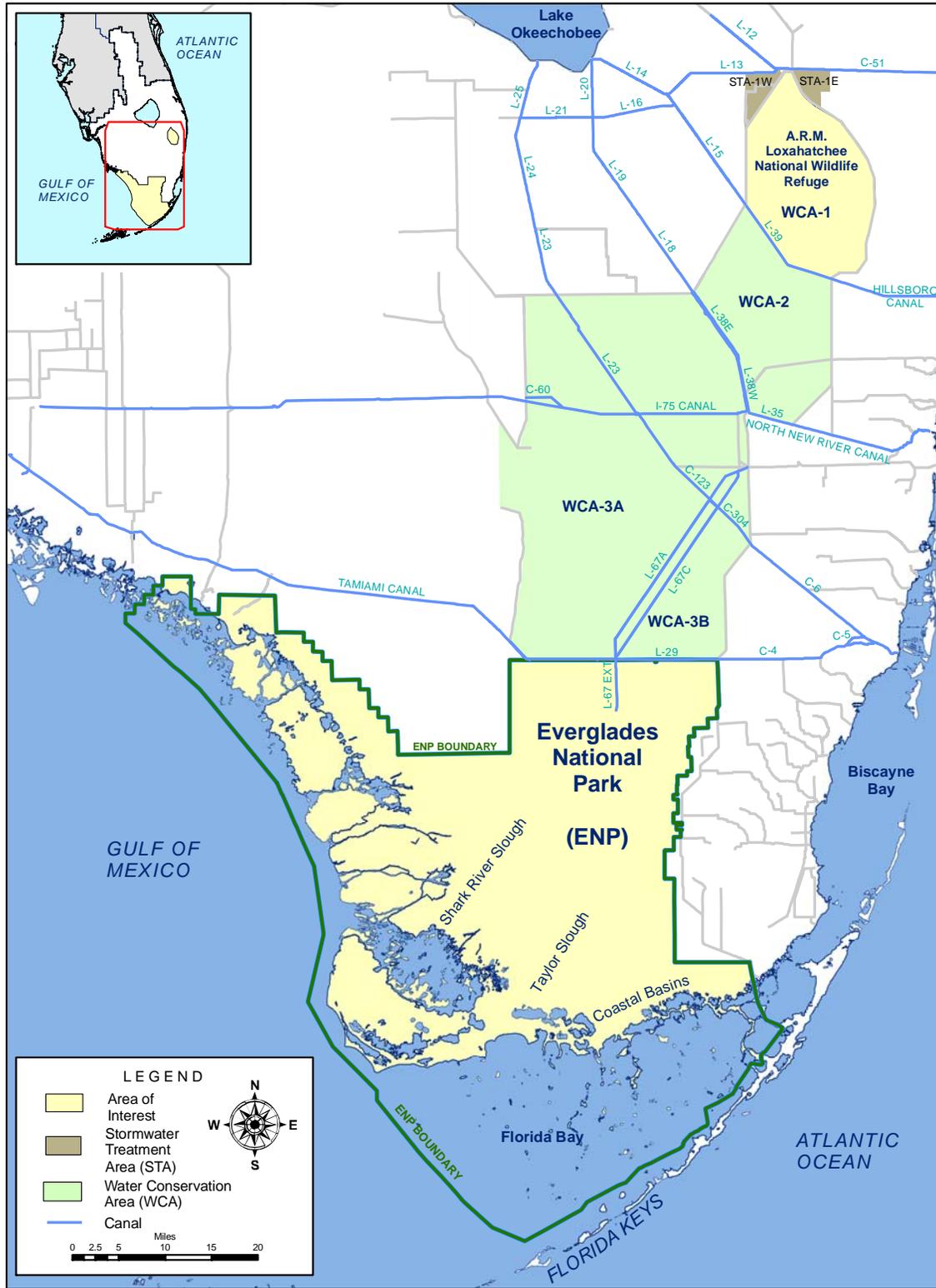


Figure 1. Areas of interest.

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 C**.

Reporting Period Update

Average stages in the Refuge were 15.69, 15.01, and 16.05 feet in April, May, and June 2009, respectively (**Figure 3** and **Table 2**). The geometric means, calculated from TP concentrations measured in water samples collected in April, May, and June 2009 were 9.7, 11.0, and 13.2 parts per billion (ppb), respectively. The geometric mean TP concentrations were below the long-term level in April 2009. Only one station was sampled in May 2009 and the long-term level was not applicable because the mean stage was less than 15.42 ft. The geometric mean TP concentration in June 2009 (13.2 ppb) exceeded the long-term level (12.1 ppb). However, a subsequent sampling event two weeks after the June compliance sampling event showed a significant decrease in the geometric mean TP concentration (9.7 ppb).

An “exceedance” as defined in the Consent Decree has occurred because the June 2009 excursion occurred within twelve consecutive sample collections of the preceding November 2008 excursion. In accordance with the terms of the Consent Decree, this exceedance prompted the Technical Oversight Committee (TOC) to direct a review of monthly trends and other relevant data and a Technical Working Group meeting was held on August 18, 2009. Principals of the Settling Parties have agreed to begin discussions to address this exceedance.

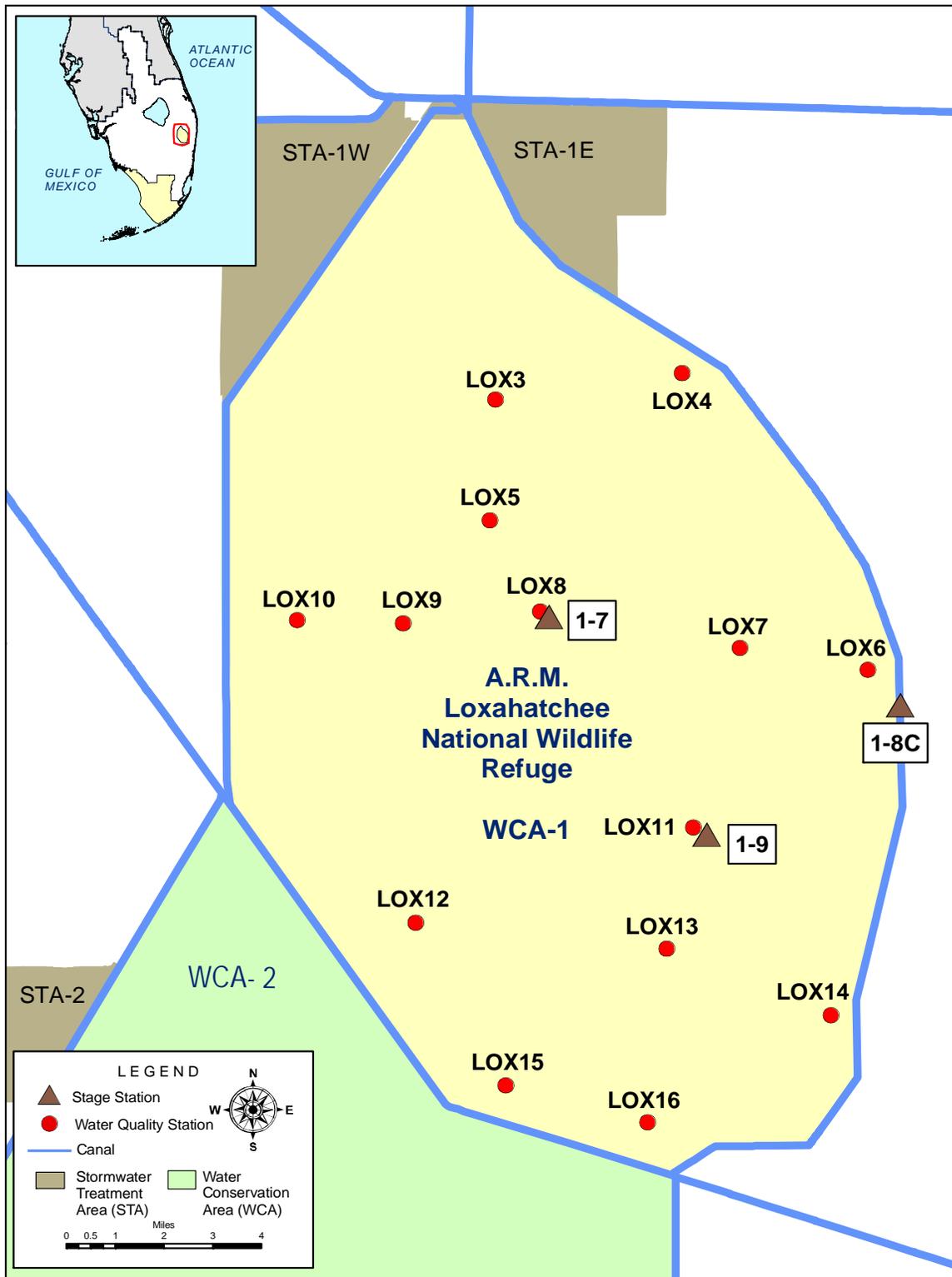


Figure 2. Arthur R. Marshall Loxahatchee National Wildlife Refuge water quality sampling and stage measurement sites.

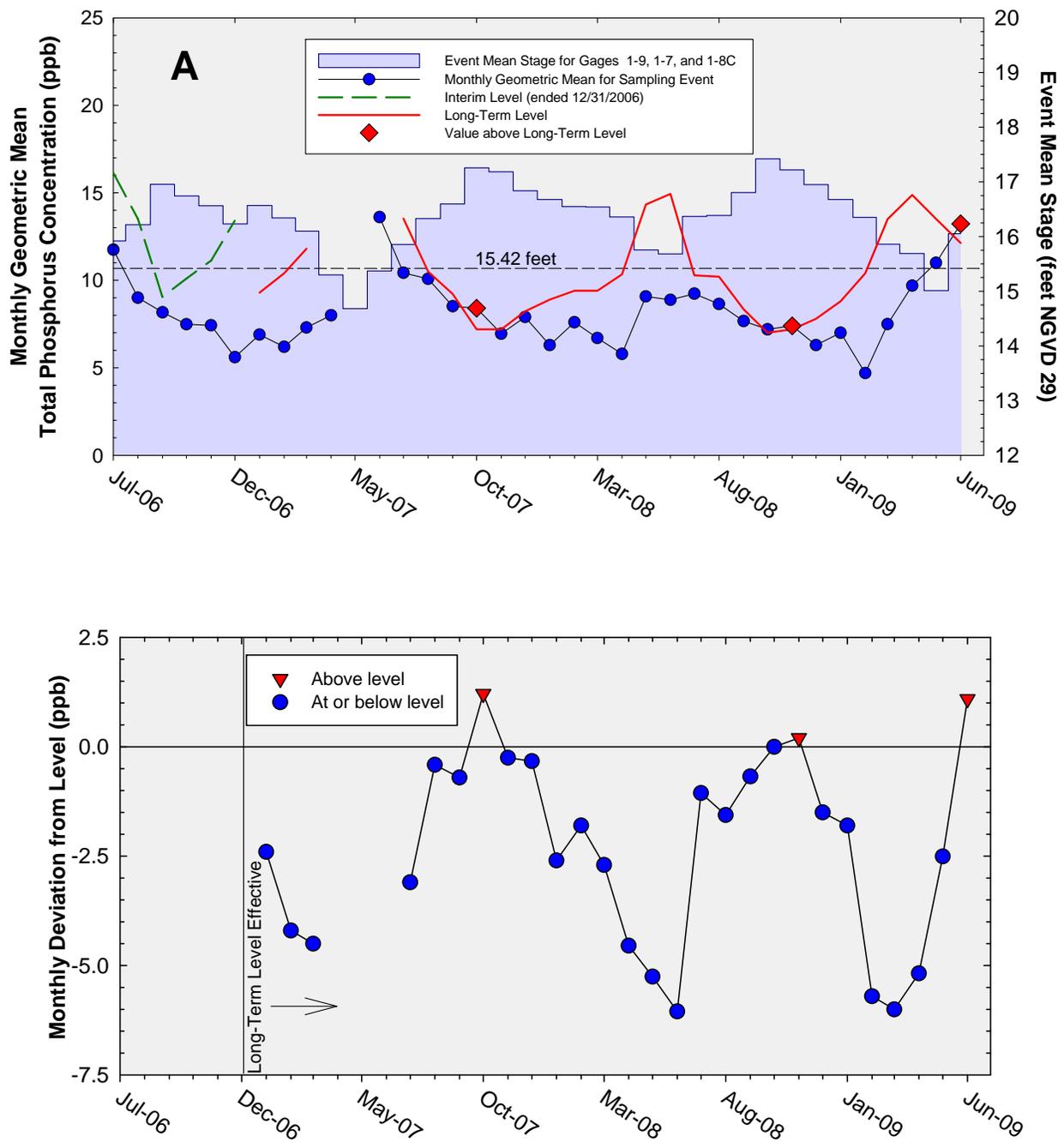


Figure 3. (A) Monthly total phosphorus geometric mean concentrations for the Arthur R. Marshall Loxahatchee National Wildlife Refuge compared to calculated long-term levels. These calculated long-term total phosphorus levels are adjusted for fluctuations in stage. The long-term levels were not applicable for April 2007 through June 2007 because the average stage was less than 15.42 feet. The geometric mean was greater than the long-term level in October 2007, 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)	Interim Level (ppb) 2/1/1999-12/30/2006	Long-Term Level (ppb) Effective 12/31/2006	Average Stage ^a (ft NGVD 29)	Number of Samples
Jul-2006	11.7	16.1		15.92	9
Aug-2006	9.0	13.5		16.22	11
Sep-2006	8.2	9.1		16.96	14
Oct-2006	7.5	10.1		16.74	14
Nov-2006	7.4	11.1		16.56	14
Dec-2006	5.6	13.4		16.23	11
Jan-2007	6.9		9.3	16.57	14
Feb-2007	6.2		10.4	16.34	13
Mar-2007	7.3		11.8	16.10	10
Apr-2007	8.0		N/A ^b	15.30	3
May-2007	---		N/A ^b	14.68	0
Jun-2007	13.6		N/A ^b	15.37	4
Jul-2007	10.4		13.5	15.86	13
Aug-2007	10.1		10.5	16.33	13
Sep-2007	8.5		9.2	16.59	14
Oct-2007	8.4		7.2	17.26	14
Nov-2007	7.0		7.2	17.19	14
Dec-2007	7.9		8.2	16.84	14
Jan-2008	6.3		8.9	16.68	14
Feb-2008	7.6		9.4	16.55	14
Mar-2008	6.7		9.4	16.54	14
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

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&3, 2009 compliance sampling data only.

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 C**). 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 2008 (**Figure 5**). The 12-month flow-weighted mean TP concentration for October 2007 through September 2008 was 10.2 ppb¹. The corresponding long-term limit, which became effective on December 31, 2006, was also 10.2 ppb.

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. Supplemental water quality samples were collected at some of the Shark River Slough monitoring sites from January 2006 through September 2007, but only the bi-weekly compliance monitoring grab concentration data were used for flow-weighted mean TP concentration calculations. 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 forward². For the 12-month periods ending in April, May, and June 2009, the 12-month flow-weighted mean TP concentrations were 7.5, 7.4, and 8.4 ppb, respectively. The long-term limits were 7.8, 8.0, and 7.8 ppb, respectively. The 12-month flow-weighted mean TP concentration was below the long-term limit for April and May 2009 and above long-term limit in June 2009.

¹ The 12-month flow-weighted mean TP concentration for September 2008 using all available weekly grab concentration data instead of bi-weekly grab data was 10.2 ppb; the 12-month flow-weighted mean TP concentration for September 2008 using the alternative set of bi-weekly grab concentration data was 9.9 ppb.

² S12A and S333 are sampled weekly if flowing, otherwise monthly. S12B, S12C, and S12D are sampled weekly if flowing.

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 April, May, and June 2009, the sampling event TP concentrations greater than 10 ppb were 33.3, 31.8, and 36.4 percent, respectively. The observed percentages of the sampling event flow-weighted mean TP concentrations greater than 10 ppb were lower than the guidelines for April, May, and June 2009 (**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 July 2006 through June 2009 are presented in **Figures 7 and 9**.

S12A, S12B and S12C remained closed during the quarter in accordance with the Interim Operational Plan for Protection of the Cape Sable Seaside Sparrow. S12D was closed until early June 2009.

The stage levels at Water Conservation Area (WCA) 3A remained in Zone E, below the regulation schedule until late June 2009.

A total of 65,512 acre-feet of water was discharged through S333; 23,185 acre-feet 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 web site

<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 had been following an inverse relationship in previous periods. However, high sampling event flow-weighted mean TP concentrations were observed in June 2009 with relatively high flow at S333.

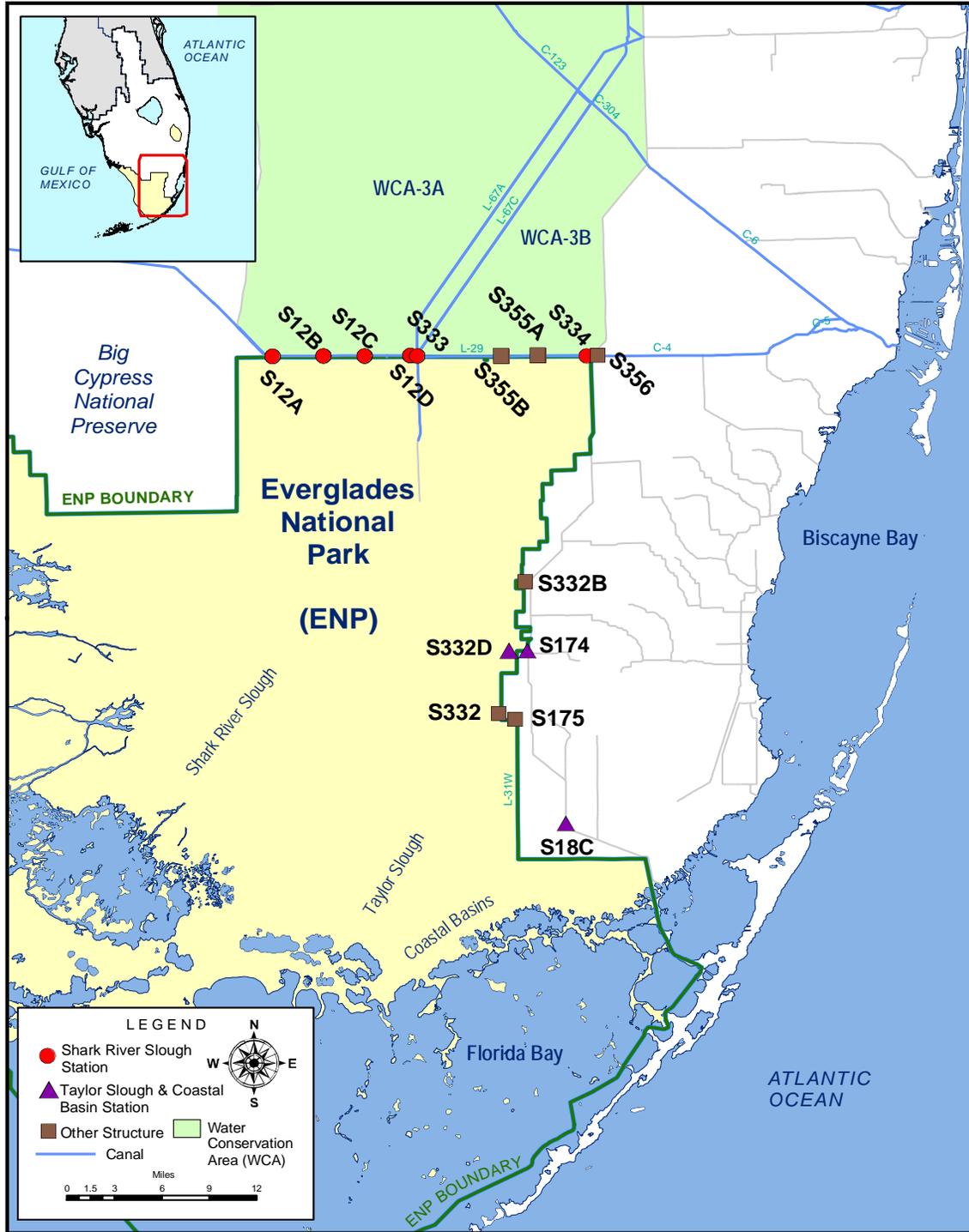


Figure 4. Everglades National Park flow structures.

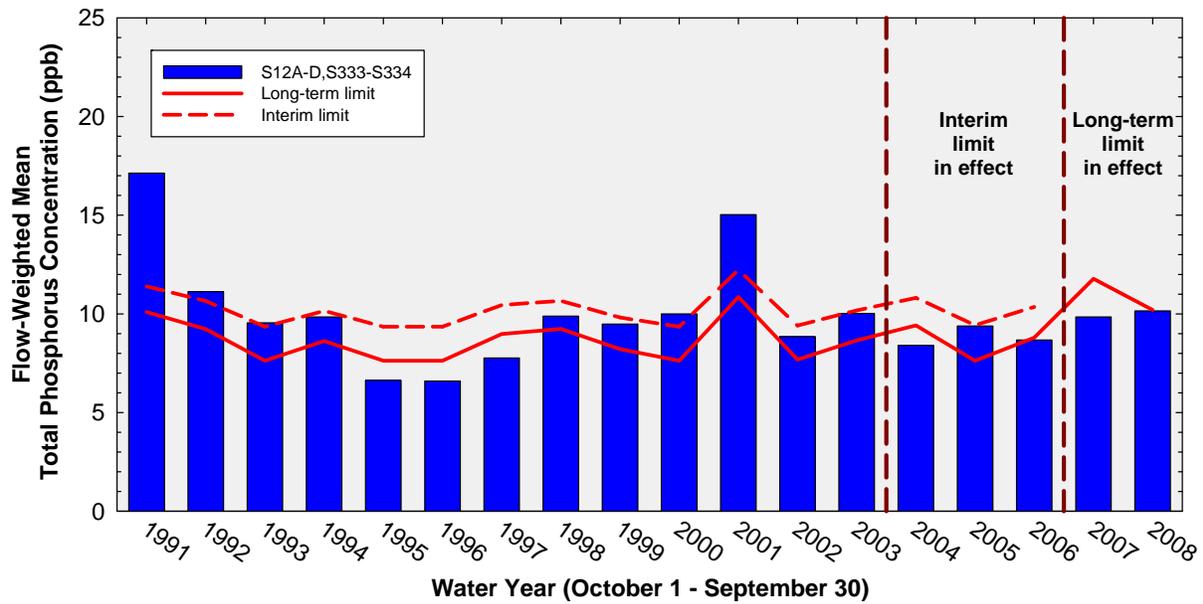


Figure 5. The 12-month flow-weighted mean total phosphorus concentrations at inflows to the Everglades National Park through Shark River Slough at the end of each water year compared to the interim and long-term total phosphorus limits. The 12-month flow-weighted mean concentrations have met the interim limits since they became effective on October 1, 2003. The 12-month flow-weighted mean TP concentration for the compliance year through September 2008 was 10.2 ppb and equal to 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)	Interim Limit (ppb) <i>10/1/2003-12/30/2006</i>	Long-Term Limit (ppb) <i>Effective 12/31/2006</i>	Percent of Sampling Events Greater than 10 ppb	
					Guideline	Observed
Aug 2005 - Jul 2006	1113.3 ^a	7.7	9.4		40.1	26.3
Sep 2005 - Aug 2006	914.7 ^{a,b}	8.1	9.9		43.5	36.8
<i>Oct 2005 - Sep 2006</i>	<i>814.1^{a,b}</i>	<i>8.7</i>	<i>10.3</i>		<i>46.0</i>	<i>45.0</i>
Nov 2005 - Oct 2006	779.6 ^{a,b}	9.5	10.5		46.9	50.0 ^c
Dec 2005 - Nov 2006	642.8 ^{a,b}	10.0	11.1		50.8	50.0
Jan 2006 - Dec 2006	507.9 ^{a,b}	10.3	11.8		55.0	50.0
Feb 2006 - Jan 2007	446.1 ^{a,b}	10.7		10.9	57.0	55.0
Mar 2006 - Feb 2007	442.4 ^b	10.8		10.9	57.2	52.4
Apr 2006 - Mar 2007	456.0 ^b	10.8		10.8	56.7	57.1 ^c
May 2006 - Apr 2007	449.5 ^b	10.8		10.8	56.9	52.6
Jun 2006 - May 2007	445.5 ^b	10.7		10.9	57.1	47.1
Jul 2006 - Jun 2007	447.6 ^b	10.8		10.8	57.0	50.0
Aug 2006 - Jul 2007	444.6 ^b	10.6		10.9	57.1	47.4
Sep 2006 - Aug 2007	401.0	10.3		11.1	58.6	44.4
<i>Oct 2006 - Sep 2007</i>	<i>289.7</i>	<i>9.8</i>		<i>11.8</i>	<i>62.6</i>	<i>37.5</i>
Nov 2006 - Oct 2007	147.9	11.7		12.7	67.9	50.0
Dec 2006 - Nov 2007	121.2	12.6		12.8	68.9	62.5
Jan 2007 - Dec 2007	118.2	12.8		12.8	69.1	71.4 ^c
Feb 2007 - Jan 2008	115.8	12.9		12.9	69.2	69.2
Mar 2007 - Feb 2008	106.8	12.9		12.9	69.5	81.8 ^c
Apr 2007 - Mar 2008	88.9	12.8		13.0	70.2	75.0 ^c
May 2007 - Apr 2008	110.9	12.4		12.9	69.4	78.6 ^c
Jun 2007 - May 2008	142.3	12.2		12.7	68.1	75.0 ^c
Jul 2007 - Jun 2008	153.6	11.8		12.6	67.7	70.6 ^c
Aug 2007 - Jul 2008	227.4	12.4		12.2	64.9	76.5 ^c
Sep 2007 - Aug 2008	356.8	12.0		11.4	60.1	77.8 ^c
<i>Oct 2007 - Sep 2008</i>	<i>562.0</i>	<i>10.2</i>		<i>10.2</i>	<i>53.3</i>	<i>70.0^c</i>
Nov 2007 - Oct 2008	775.9	8.0		9.0	47.0	55.0 ^c
Dec 2007 - Nov 2008	935.4	7.6		8.2	43.0	45.0 ^c
Jan 2008 - Dec 2008	1003.1	7.6		7.9	41.4	42.9 ^c
Feb 2008 - Jan 2009	1007.1	7.6		7.9	41.3	40.9
Mar 2008 - Feb 2009	1021.5	7.6		7.8	41.0	37.5
Apr 2008 - Mar 2009	1030.3	7.6		7.8	40.8	36.0
May 2008 - Apr 2009	1024.2	7.5		7.8	40.9	33.3
Jun 2008 - May 2009	992.8	7.4		8.0	41.6	31.8
Jul 2008 - Jun 2009	1035.1	8.4		7.8	40.7	36.4

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 in September. The compliance periods are shown as highlighted rows with bold, italicized text.

^a Flow of 1.82 kac-ft in February 2006 at S355A and S355B was included for the 12-month total flows.

^b Flow of 3.33 kac-ft in August 2006 at S356 structure was included for the 12-month total flows.

^c Value exceeded the guideline percentage.

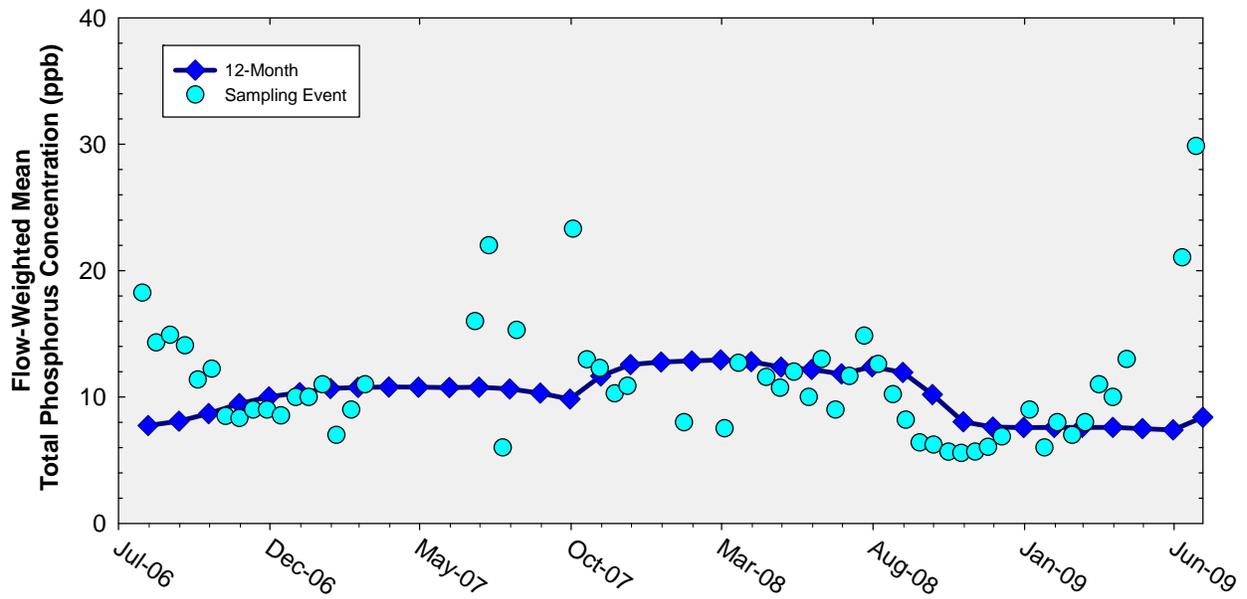


Figure 6. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Shark River Slough at the end of each month and the flow-weighted mean concentration for each sampling event. There are no sampling event values for some months because there was little or no flow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

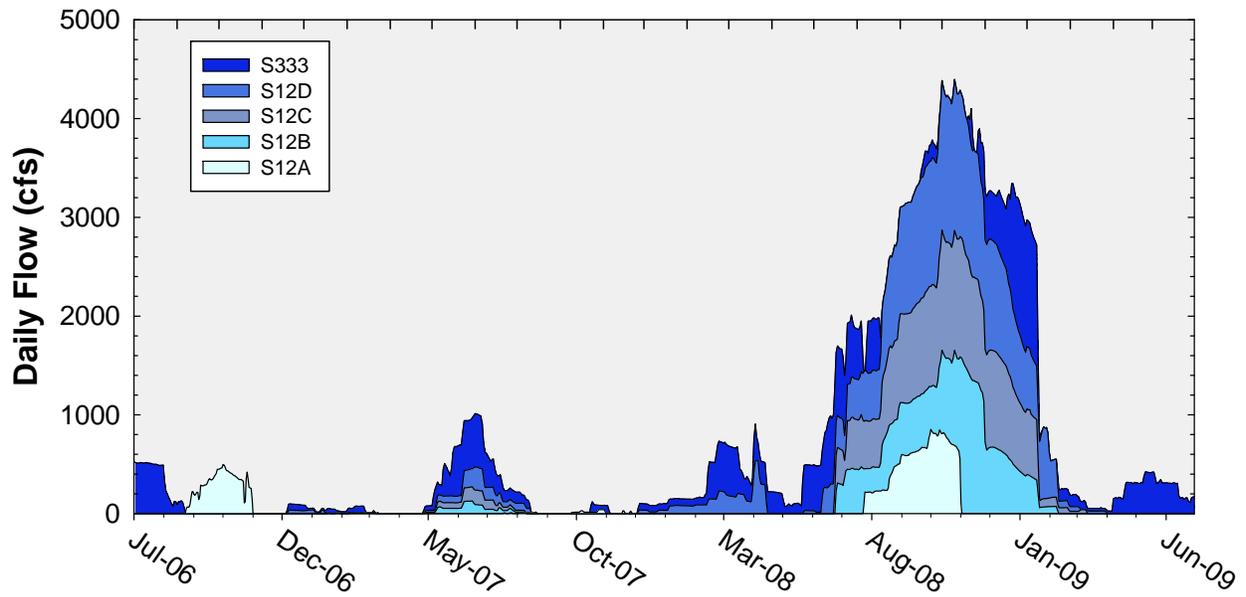


Figure 7. Daily flows at Shark River Slough structures as a stacked sum of five inflows.

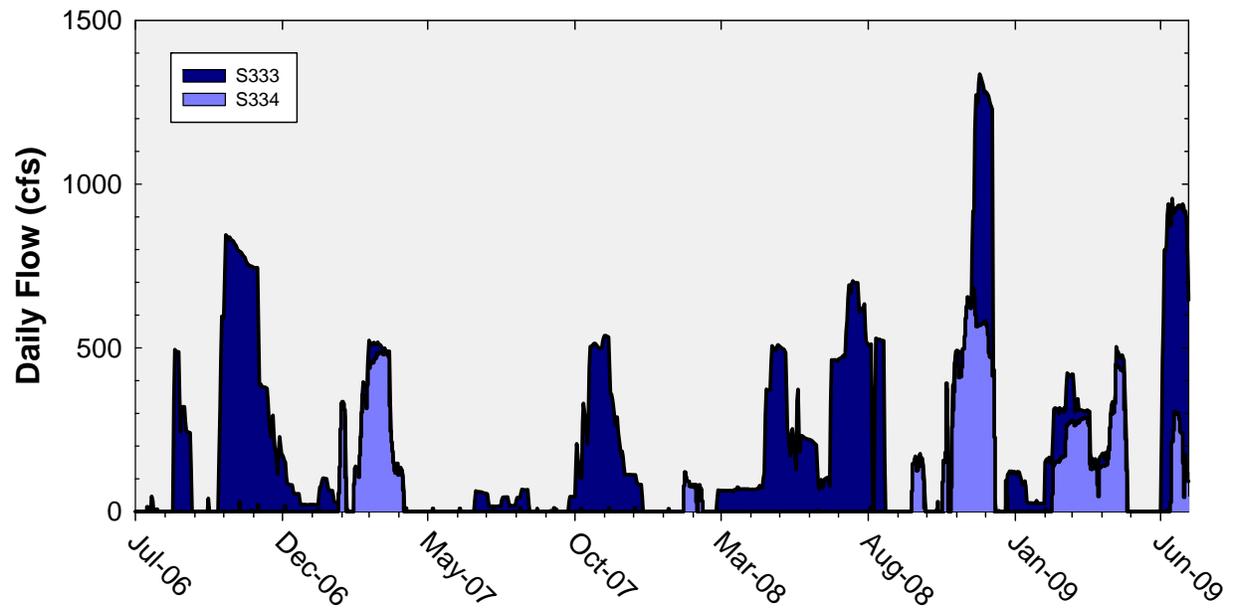


Figure 8. Daily flows at structures S333 and S334.

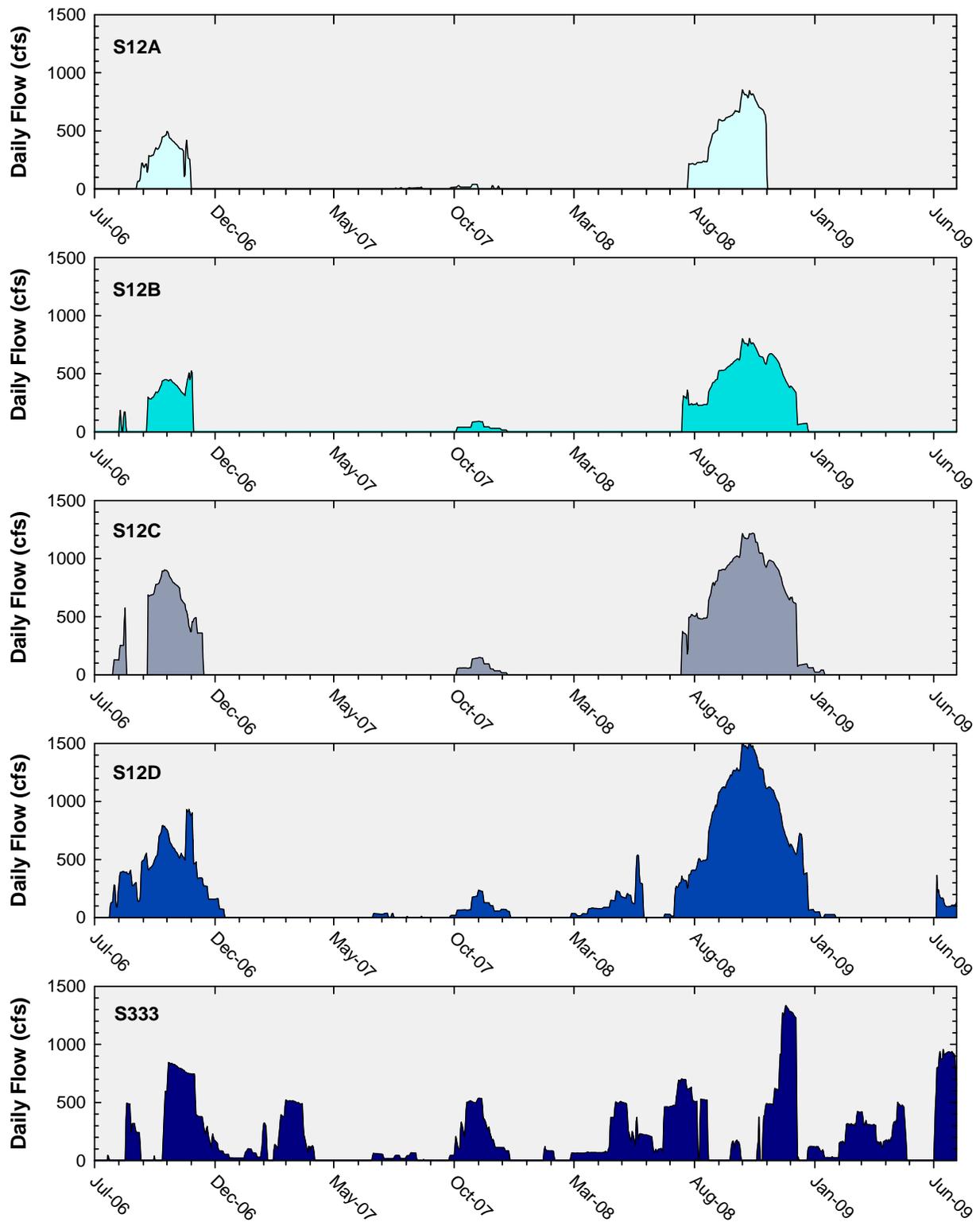


Figure 9. Daily flows at individual inflow structures to Shark River Slough. This figure includes most of the data illustrated in **Figures 7 and 8.**

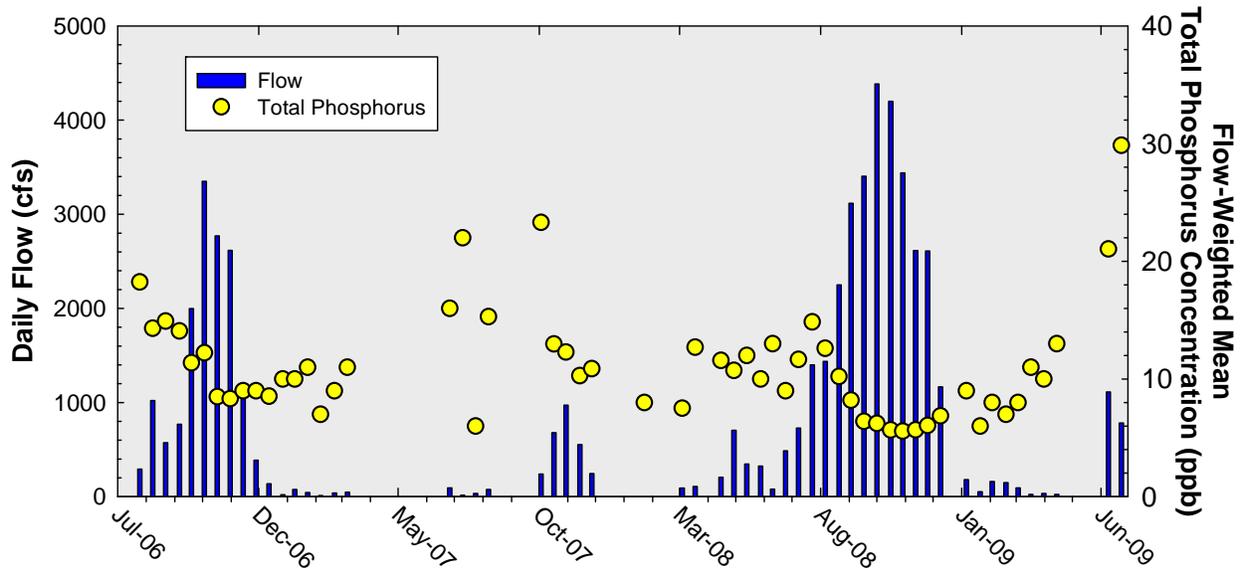


Figure 10. Total daily flow at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

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 the 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 1989 through 2002. The wider bars for water years 1999 through 2008 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.

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 the 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 12-month periods ending in April, May, and June 2009 were 5.7, 6.6, and 6.5 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 at S18C on July 14, 2008. **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 S-332B west discharge and continuing to the S-332D high head cell.

More details of the C-111 project and a site map are provided in **Appendix D**.

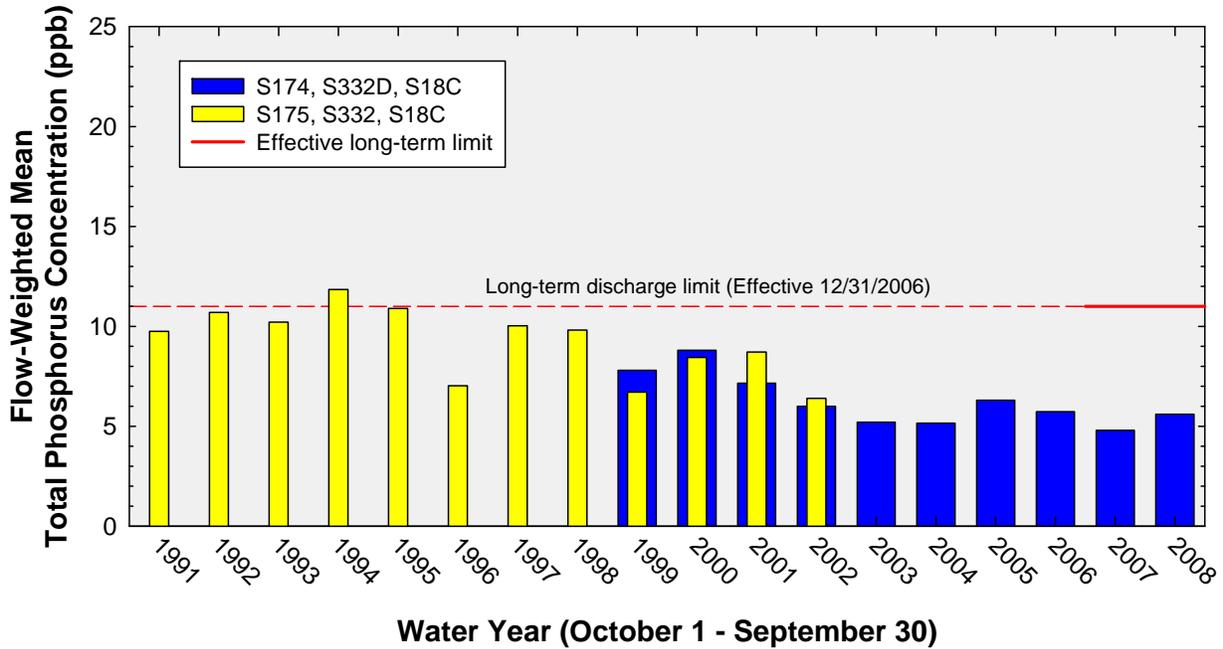


Figure 11. The 12-month flow-weighted mean total phosphorus concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each water year compared to the 11 ppb long-term total phosphorus limit.

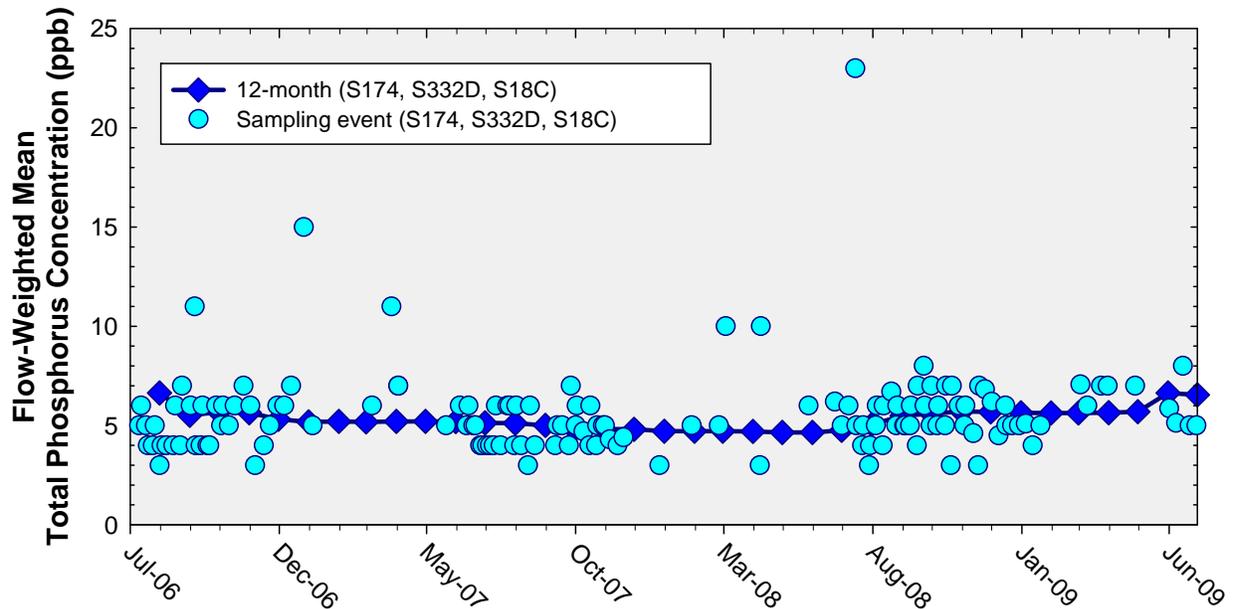


Figure 12. The 12-month flow-weighted mean total phosphorus concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each month and the flow-weighted mean total phosphorus concentration for each sampling event.

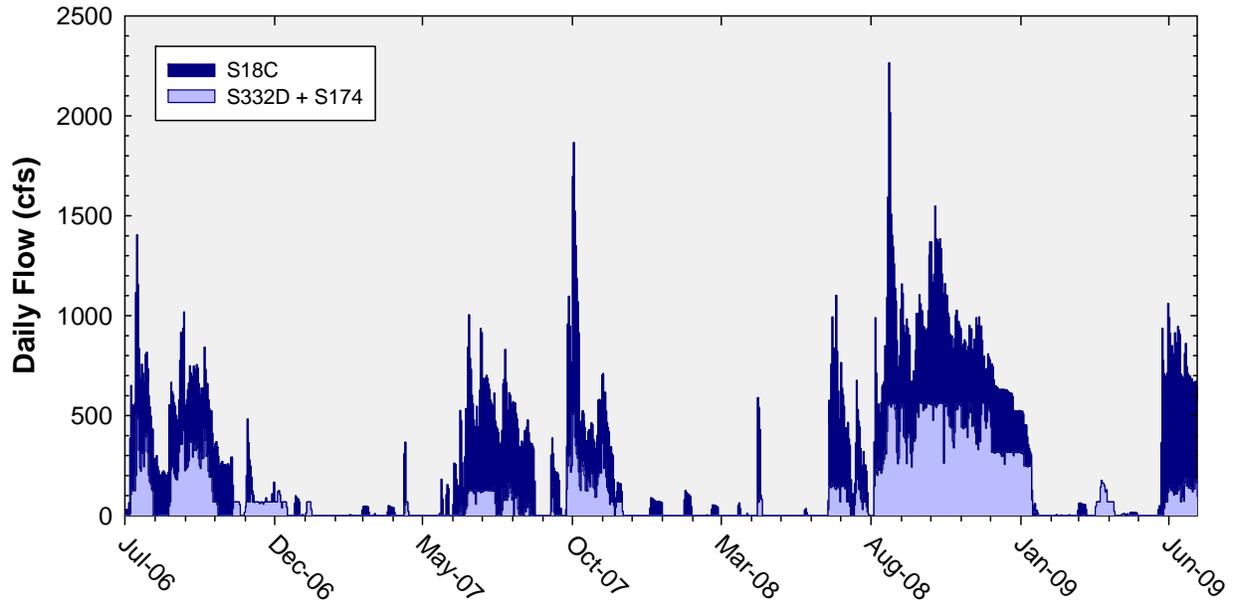


Figure 13. Daily flows into Everglades National Park through Taylor Slough as a stacked total of structures S332D + S174 and S18C. Structure S174 was plugged in September 2007 and is no longer used.

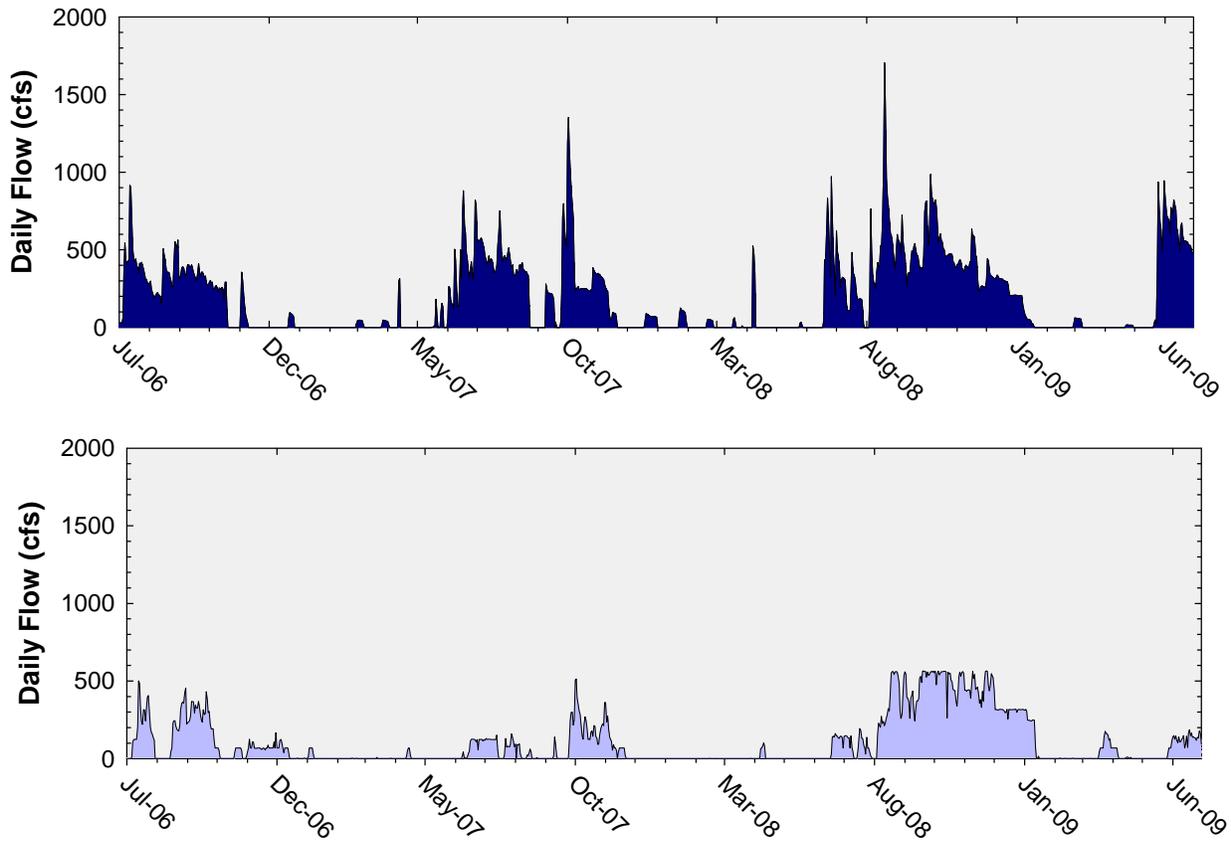


Figure 14. Daily flows at individual Taylor Slough structures (S332D + S174 and S18C) into the Everglades National Park.

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

12-Month Period	Total Flow (kac-ft)	Flow-Weighted Mean TP Concentration (ppb)	Long-Term Limit (ppb) <i>Effective 12/31/2006</i>	Percent of Sampling Events Greater than 10 ppb	
				Guideline	Observed
Aug 2005 - Jul 2006	280.0	6.6	11.0	53.1	4.5
Sep 2005 - Aug 2006	227.0	5.5	11.0	53.1	2.2
<i>Oct 2005 - Sep 2006</i>	<i>207.4</i>	<i>5.7</i>	<i>11.0</i>	<i>53.1</i>	<i>4.1</i>
Nov 2005 - Oct 2006	179.5	5.6	11.0	53.1	3.9
Dec 2005 - Nov 2006	158.8	5.3	11.0	53.1	3.9
Jan 2006 - Dec 2006	137.4	5.2	11.0	53.1	6.0
Feb 2006 - Jan 2007	127.6	5.2	11.0	53.1	6.4
Mar 2006 - Feb 2007	125.4	5.2	11.0	53.1	7.0
Apr 2006 - Mar 2007	123.8	5.2	11.0	53.1	10.0
May 2006 - Apr 2007	125.4	5.2	11.0	53.1	10.0
Jun 2006 - May 2007	126.0	5.2	11.0	53.1	7.5
Jul 2006 - Jun 2007	153.0	5.1	11.0	53.1	6.5
Aug 2006 - Jul 2007	153.4	5.1	11.0	53.1	6.4
Sep 2006 - Aug 2007	143.5	5.0	11.0	53.1	6.5
<i>Oct 2006 - Sep 2007</i>	<i>120.7</i>	<i>4.8</i>	<i>11.0</i>	<i>53.1</i>	<i>4.7</i>
Nov 2006 - Oct 2007	150.3	4.8	11.0	53.1	4.3
Dec 2006 - Nov 2007	155.7	4.8	11.0	53.1	4.4
Jan 2007 - Dec 2007	154.6	4.7	11.0	53.1	2.3
Feb 2007 - Jan 2008	155.5	4.7	11.0	53.1	2.3
Mar 2007 - Feb 2008	156.1	4.7	11.0	53.1	2.3
Apr 2007 - Mar 2008	155.4	4.7	11.0	53.1	0.0
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
<i>Oct 2007 - Sep 2008</i>	<i>207.7</i>	<i>5.6</i>	<i>11.0</i>	<i>53.1</i>	<i>2.2</i>
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

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 in September. The compliance periods are shown as highlighted rows with bold, italicized text.

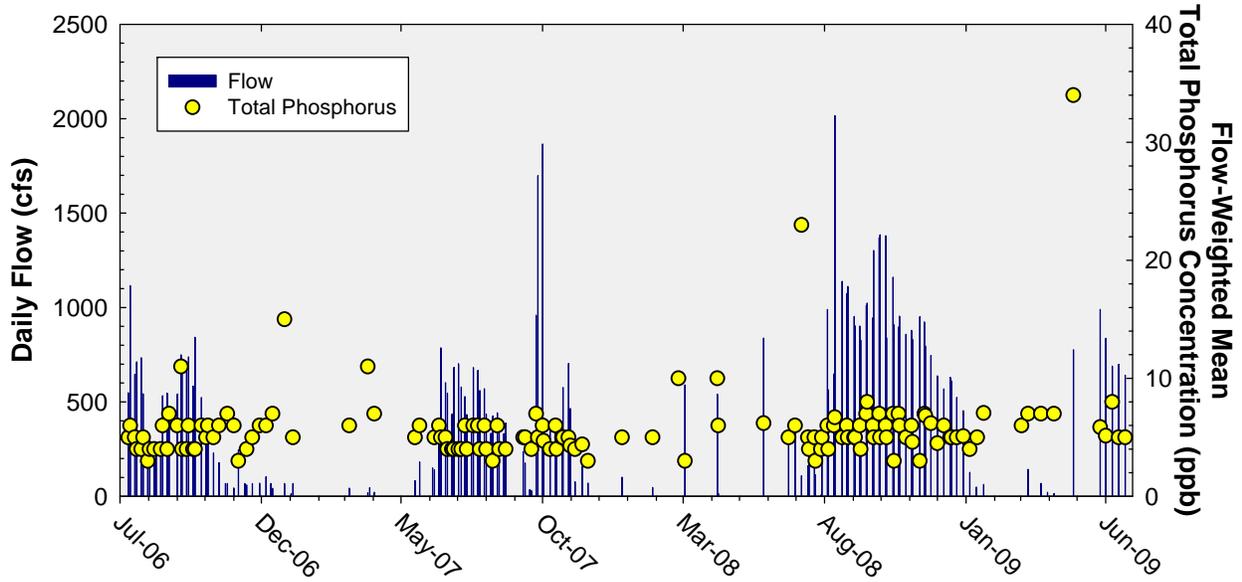


Figure 15. Total daily flow from Taylor Slough structures (S332D + S174 and S18C) and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

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
Jul-2006	---	---	---	10	27	15	---	10	13	10	---	9	10	9
Aug-2006	---	11	---	7	8	8	22	8	---	8	9	9	7	8
Sep-2006	9	11	9	6	9	11	7	8	8	8	8	7	7	8
Oct-2006	9	8	8	4	7	8	7	8	7	7	8	11	8	7
Nov-2006	16	9	10	6	7	8	8	7	6	6	8	5	8	5
Dec-2006	---	---	---	6	7	7	7	7	4	4	6	5	5	5
Jan-2007	9	7	8	6	7	7	5	6	6	7	7	7	8	8
Feb-2007	---	12	9	6	7	7	6	6	4	5	6	4	7	5
Mar-2007	---	12	---	6	10	10	---	---	6	6	7	6	7	6
Apr-2007	---	---	---	---	---	---	---	---	8	8	8	---	---	---
May-2007	---	---	---	---	---	---	---	---	---	J5	---	---	---	---
Jun-2007	---	---	---	---	---	15	---	---	13	---	16	11	---	---
Jul-2007	10	13	11	10	9	9	11	---	9	13	9	9	11	13
Aug-2007	9	17	8	10	10	8	8	15	10	12	---	9	8	11
Sep-2007	8	17	8	6	8	8	10	9	6.5 ^a	10	7	7	8	11
Oct-2007	8	11	7	6	9	10	8	8	10	9	8	8	8	9
Nov-2007	9	7	7	4	8	9	7	7	7	6	7	6	7	8
Dec-2007	11	9	8	5	9	11	8	8	7	9	7	7	8	6
Jan-2008	8	8	7	4	6	9	7	7	5	6	6	5	6	6
Feb-2008	10	8	8	5	7	11	8	8	7	8	7	7	7	7
Mar-2008	8	6	8	5	7	10	6	7	7	6	6	6	7	6
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 ^b	---	25	---	14	10	20	8	15	14	14	12	12	11	11

June 17 and 19, 2009 values are as following:

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.

J5 = the datum is qualified with the J5 code, which indicates improper laboratory or field protocols.

^a Average of two values: 6 and 7 ppb

^b 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.

Month-Year	S12A	S12B	S12C	S12D	S333	Remarks
10/01/2008	6	5	5	8	7	Compliance data
10/08/2008	6	5	5	8	8	
10/16/2008	4	4	5	8	7	Compliance data
10/22/2008	5	4	5	7	8	
10/29/2008	5	4	5	7	8	Compliance data
11/05/2008	8	6	5	6	7	
11/12/2008	---	6	4	7	7	Compliance data
11/19/2008	---	6	5	8	8	
11/25/2008	11	6	4	6	8	Compliance data
12/02/2008	13	7	6	6	6	
12/09/2008	8	10	5	7	6	Compliance data
12/17/2008	9	7	7	8	8	
12/23/2008	8	---	---	---	9	Compliance data
12/29/2008	10	---	9	12	9	
01/06/2009	10	---	---	---	9	Compliance data
01/14/2009	10	---	---	---	8	
01/21/2009	6	---	---	6	6	Compliance data
01/27/2009	11	---	---	---	7	
02/03/2009	11	---	---	---	8	Compliance data
02/10/2009	8	---	---	---	5	
02/18/2009	12	---	---	---	7	Compliance data
02/24/2009	13	---	---	---	8	
03/03/2009	14	---	---	---	8	Compliance data
03/11/2009	19	---	---	---	9	
03/17/2009	27	---	---	---	11	Compliance data
03/24/2009	30	---	---	---	13	
03/31/2009	28	---	---	---	10	Compliance data
04/08/2009	28	---	---	---	14	
04/14/2009	30	---	---	---	13	Compliance data
04/21/2009	48	---	---	---	25	
04/28/2009	53	---	---	---	22	Compliance data
05/05/2009	65	---	---	---	24	
05/12/2009	60	---	---	---	21	Compliance data
05/19/2009	59	---	---	---	23	
05/27/2009	59	---	---	---	30	Compliance data
06/02/2009	79	---	---	---	22	
06/09/2009	41	---	---	16	22	Compliance data
06/16/2009	28	---	---	13	26	
06/23/2009	31	---	---	15	32	Compliance data
06/30/2009	32	---	---	16	22	

Notes:

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

APPENDIX C

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)

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 D

**C-111 PROJECT STRUCTURES
AND DETENTION AREAS**

C-111 Project Structures and Detention Areas

The C-111 project was authorized by the U.S. Army Corps of Engineers (USACE) 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. Project facilities consist 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) (**Figure C-1**). The flow-way cell is the only location to routinely discharge surface water into Everglades National Park (ENP) from this project.

Pump station S332D began operation in August 1999 and the USACE completed the remaining C-111 project structures and detention areas along the eastern boundary of the ENP in June 2002. Construction was accelerated to respond to U.S. Fish and Wildlife requirements to give immediate relief to water conditions that threaten the endangered Cape Sable seaside sparrow.

The USACE signed a Record of Decision on July 2, 2002, that authorizes the implementation of an Interim Operational Plan (IOP) to govern the operation of the new facilities. Since July 31, 2002, the USACE has been operating the project under Emergency Orders issued by the Florida Department of Environmental Protection (FDEP).

The USACE and the South Florida Water Management District (SFWMD) monitor the implementation of the IOP under the terms and conditions of the C-111 Project Cooperation Agreement executed in 1995. The SFWMD, on behalf of the USACE, has implemented a monitoring plan approved by FDEP that assesses the hydrologic, environmental, and surface and ground water quality changes that may occur as a result of the IOP. The SFWMD started the routine sampling in September 2003.

Monitoring activity is dependent on movement between parts of the C-111 project system. Pump station S332D is adjacent to spillway S174 and pumps water from the L31N Canal into the L31W Canal. The S332D and S174 structures became the new inflow compliance monitoring sites for Taylor Slough on October 1, 1999, replacing S332 and S175. 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 diversion structures DS2 and DS4 discharge into the ENP when utilized. Overflows periodically occurred at DS2 between September 2001 and September 2003. Data from these overflows were presented graphically in previous reports. When they occur, discharges from the diversion structures DS1 and DS3 flow onto District property and eventually into the L31N Canal.

The majority of the water pumped into the detention cells, as well as rainfall, is expected to seep into the Biscayne Aquifer directly below the project site and provide a hydrologic “curtain” to reduce groundwater seepage in an easterly direction from ENP.

The overflow weir at Cell 2 was the only surface water discharge point into the ENP for the S332B and S332C features. However, the levees have been rebuilt or raised to have the same height as the rest of the C-111 features. As part of these changes, the emergency overflow weir has been demolished as well to provide a continuous detention cell from S332B to the single surface water outflow into ENP at Berm B3.

The USACE construction work, conducted under the work package identified as Contract 7, was started in 2007 and completed in 2009. Upon completion of Contract 7, an interconnected detention system now exists from the S-332B West Discharge to the S-332D High Head Cell.

Contract 7 included several construction items. The existing S-332B west detention area was degraded and the northern and western levees were reconstructed at a higher elevation of 13 feet NGVD 29. The levee work continued south from the S-332B western and eastern levees and connected to the S-332C detention cell. The north and south S-332C levees were removed.

The levee construction continued from the S-332C west and east levees to the S-332D high head cell. The partial connector between the south discharge of S-332B and north discharge of S-332C west connected with the completion of the westernmost levee. The south partial connection levee from S-332B and the north partial connection from S-332B were removed to complete the partial connector levee. S-332DX1 was constructed between the east and west levee tie-ins to the S-332D high head cell. The L-31W levee canal was backfilled because the levees crossed the canal to connect to the C-111 high head cell.

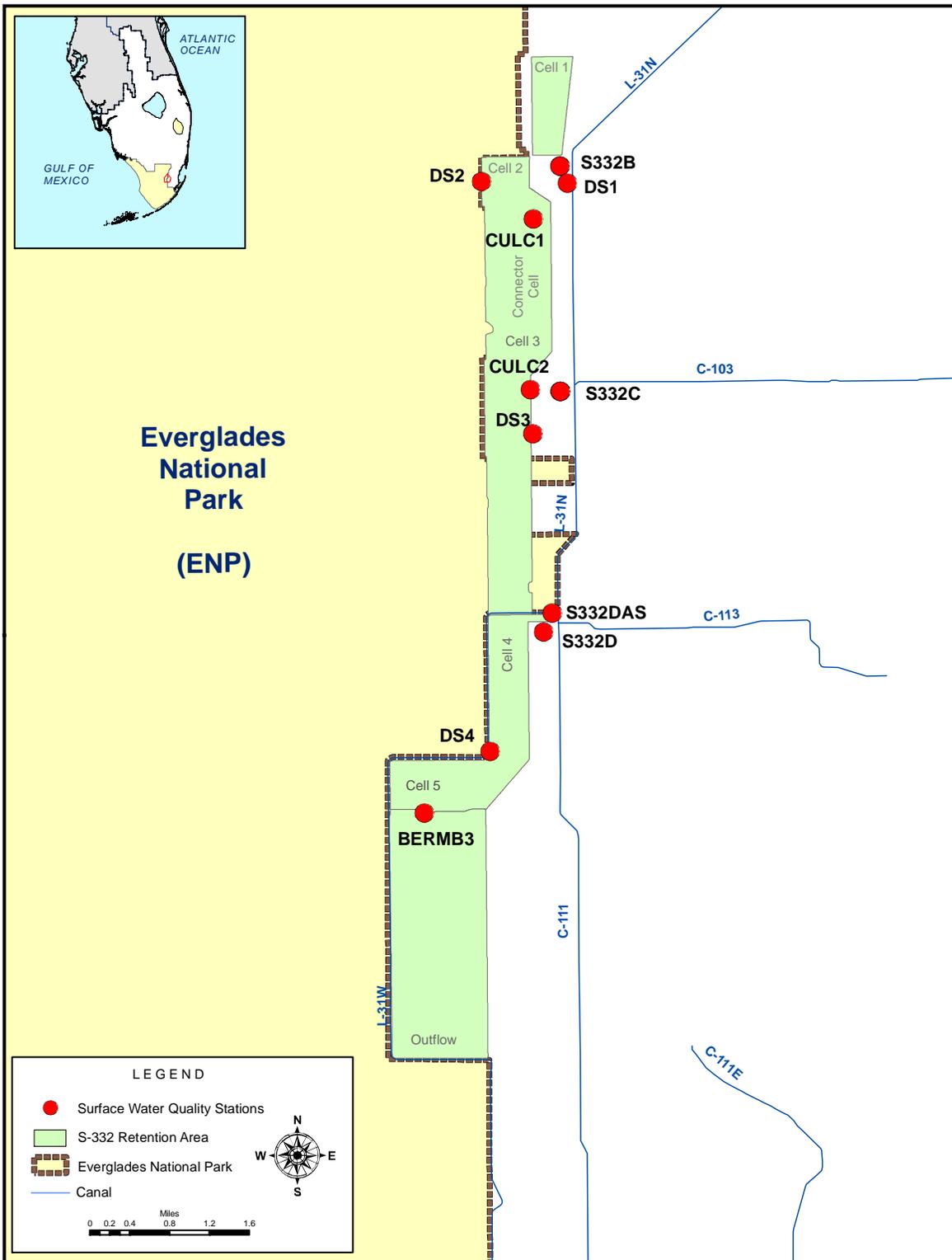


Figure C-1. C-111 project facilities.