

Settlement Agreement July – September 2006 Report



**Prepared for the
Technical Oversight Committee
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ARTHUR R. MARSHALL LOXAHATCHEE NATIONAL WILDLIFE REFUGE

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 in National Geodetic Vertical Datum (NGVD29). The monthly TP concentrations are determined from water samples collected at 14 interior marsh stations, LOX 3 through LOX 16 (**Figure 1**). 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.

The interim levels for July, August and September 2006 were 16.1, 13.5 and 9.1 parts per billion (ppb), respectively. The long-term levels were 13.0, 11.1 and 7.8 ppb, respectively. Because the total depth was less than 0.1 meter (m), no water samples were collected at stations LOX3, LOX4, LOX5, LOX9 and LOX13 on July 10, 2006 and LOX3, LOX5 and LOX11 on August 7, 2006. Average stages in the Refuge were 15.92, 16.22 and 16.96 feet in July, August and September 2006 respectively (**Figure 2** and **Table 1**). The geometric mean, calculated from TP concentrations measured in water samples collected in July, August and September 2006 were 11.7, 9.0 and 8.2 ppb, respectively. The geometric means were less than the interim and long-term levels for July and August and less than the interim level but higher than long – term level for September 2006.

However, the calculated long-term level reached a 2-year minimum (7.8 ppb) in September 2006 based on the elevated average stage (16.96 ft NGVD).

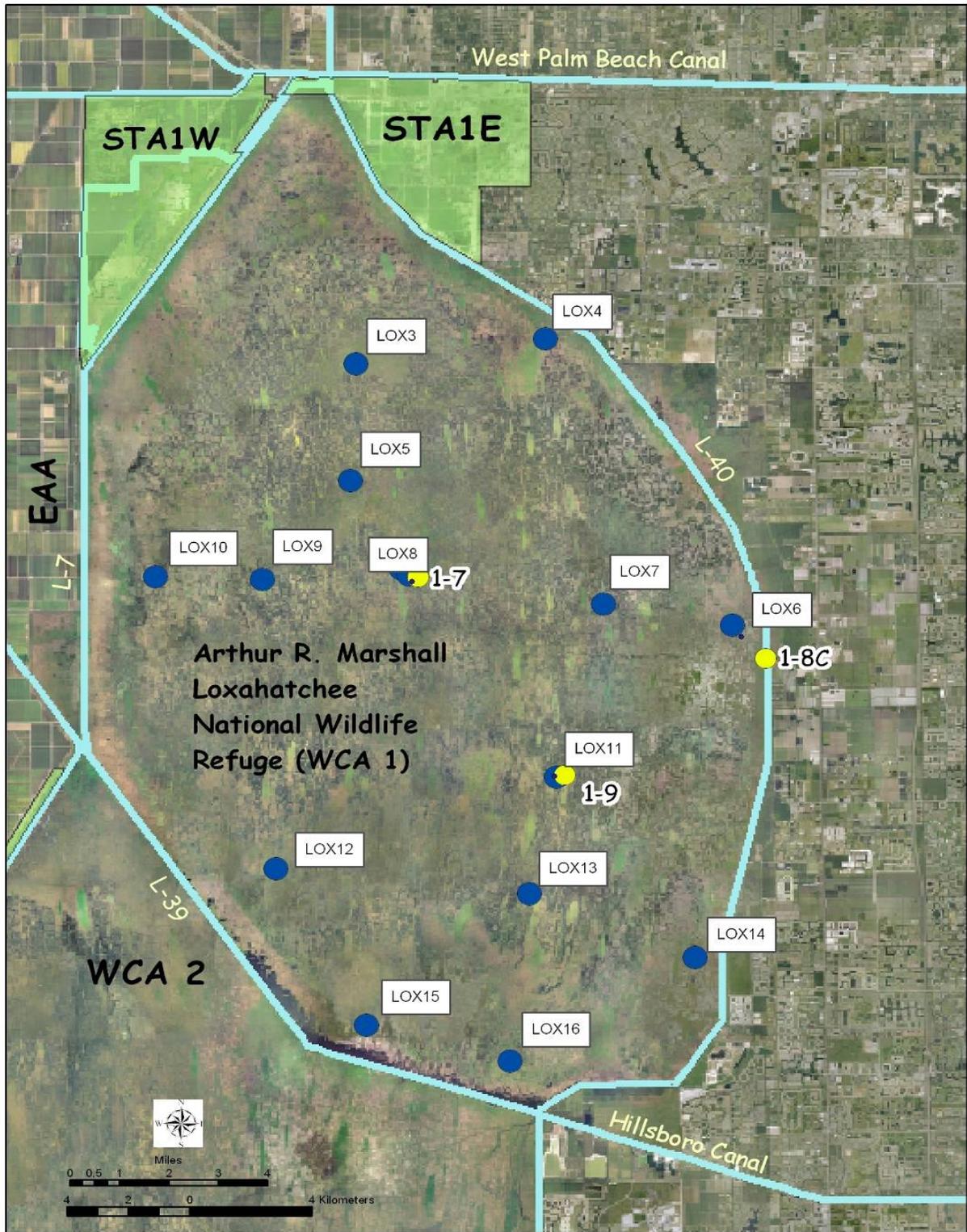


Figure 1. A.R.M. Loxahatchee National Wildlife Refuge Water Quality Sampling and Stage Measurement Sites

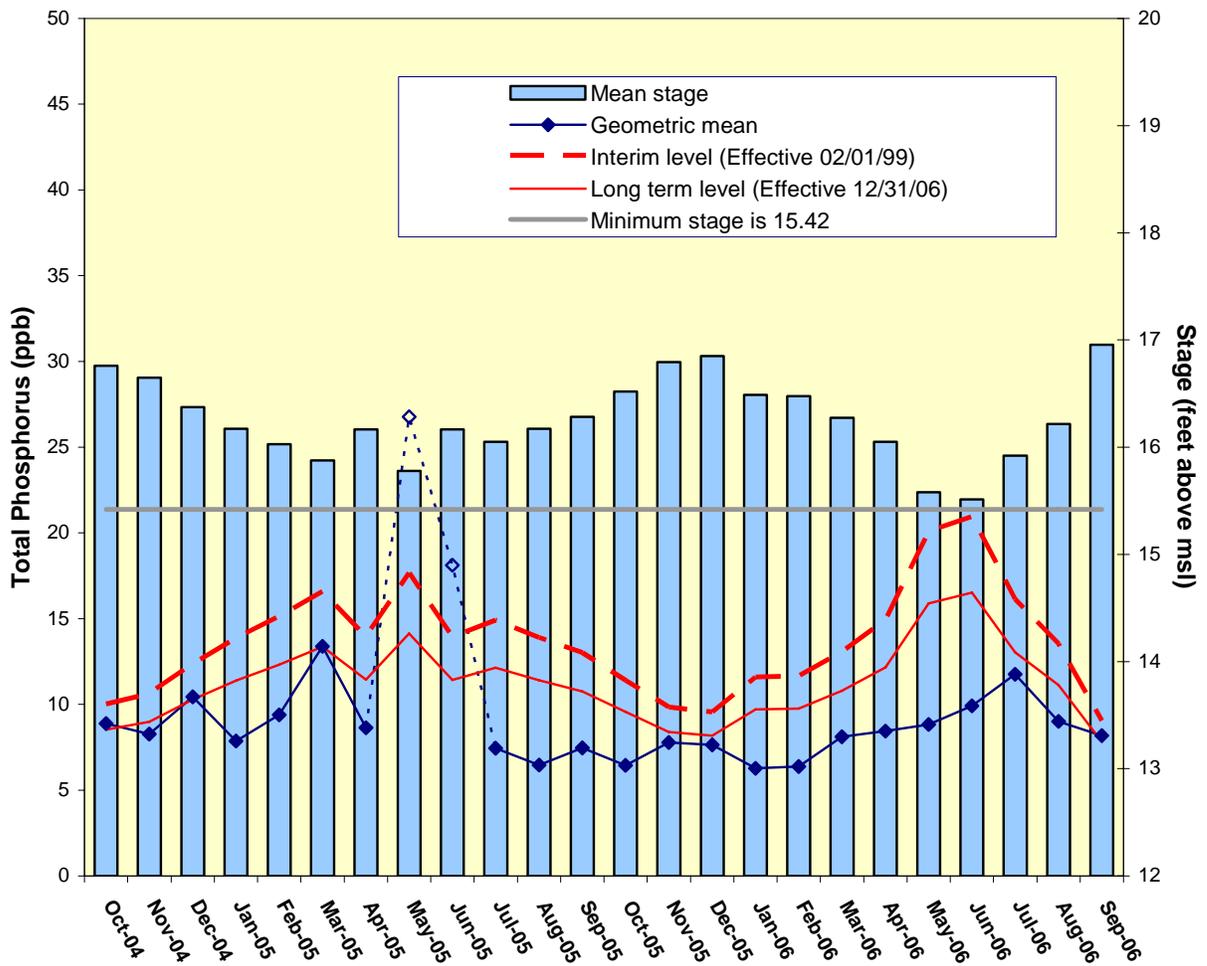


Figure 2. Monthly TP geometric mean concentrations for the Arthur R. Marshall Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. The calculated level concentrations are adjusted for fluctuations in stage.

The TP data from May and June 2005 have been qualified as questionable in accordance with Chapter 62-160 F.A.C. and should not be used. Geometric means for May and June 2005 are shown for reference only and were not considered for compliance purposes.

Table 1. Loxahatchee National Wildlife Refuge TP Compliance Tracking.

Month - Year	Geometric Mean Concentration	Interim Level (ppb)	Long Term Level (ppb)	Average Stage ^a (ft NGVD)	Number of TP Samples	Number of Stage Measurements
	(ppb)	Effective 2/1/99	Effective 12/31/06			
Oct-2004	8.9	10.0	8.5	16.76	13	3
Nov-2004	8.3	10.6	9.0	16.65	14	3
Dec-2004	10.4	12.4	10.3	16.37	13	3
Jan-2005	7.9	13.9	11.4	16.17	12	3
Feb-2005	9.4	15.1	12.3	16.03	11	3
Mar-2005	13.4	16.6	13.4	15.88	11	3
Apr-2005	8.6	13.9	11.4	16.17	11	3
May-2005 ^b	(26.8)	17.7	14.1	15.78	(10)	3
Jun-2005 ^b	(18.1)	13.9	11.4	16.17	(14)	3
Jul-2005	7.4	14.9	12.1	16.05	14	3
Aug-2005	6.5	13.9	11.4	16.17	12	3
Sep-2005	7.5	13.0	10.8	16.28	11	3
Oct-2005	6.5	11.4	9.6	16.52	13	3
Nov-2005	7.8	9.8	8.4	16.79	14	3
Dec-2005	7.6	9.6	8.2	16.85	14	3
Jan-2006	6.3	11.6	9.7	16.49	13	3
Feb-2006	6.4	11.7	9.8	16.48	13	3
Mar-2006	8.1	13.1	10.8	16.28	12	3
Apr-2006	8.4	14.9	12.2	16.05	12	3
May-2006	8.8	20.1	15.9	15.58	10	3
Jun-2006	9.9	21.0	16.5	15.51	5	3
Jul-2006	11.7	16.1	13.0	15.92	9	3
Aug-2006	9.0	13.5	11.1	16.22	11	3
Sep-2006	8.2	9.1	7.8	16.96	14	3

Notes: *a* Average Stage is calculated using stage elevations at stations 1-7, 1-8C, and 1-9 on the sampling date.
b The TP data from May and June 2005 have been qualified as questionable in accordance with Chapter 62-160 F.A.C. and should not be used.

EVERGLADES NATIONAL PARK

Shark River Slough

The Consent Decree of 1995 specified that interim and long-term total phosphorus (TP) concentration limits for discharges into the Everglades National Park (ENP) (**Figure 3**) 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. 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 1st through September 30th) from 1991 to 2006 (**Figure 4**). The 12-month flow-weighted mean TP concentration ending September 2006 was 8.7 ppb. Corresponding interim and long-term limits were 10.3 and 8.8 ppb, respectively.

Table 2 presents the 12-month flow-weighted mean concentrations for each month as well as the corresponding interim and long-term TP concentration limits, calculated using the 12-month period flow. Only the bi-weekly compliance monitoring concentration data were used for the calculations. For the 12-month periods ending in July, August and September 2006, the 12-month flow-weighted mean TP concentrations were 7.7, 8.1 and 8.7 ppb, respectively. The interim limits were 9.4, 9.9 and 10.3 ppb, respectively. The long-term limits were 7.6, 8.3 and 8.8 ppb, respectively. The July, August and September 2006 12-month flow-weighted mean concentrations were lower than the interim limits. The August and September 2006, 12-month flow-weighted mean concentrations were also lower than the long-term limit.

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 July, August and September 2006, the observed percentages of the sampling event flow-weighted mean TP concentrations greater than 10 ppb were 26.3, 36.8 and 45.0 percent, respectively. The observed percentage of the sampling event flow-weighted mean TP concentrations greater than 10 ppb were higher than the guidelines from May 2005 to December 2005 and lower than the guidelines since January 2006 (**Table 2**). The flow-weighted mean concentrations and the 12-month flow-weighted mean concentrations for individual sampling events are presented in **Figure 5**.

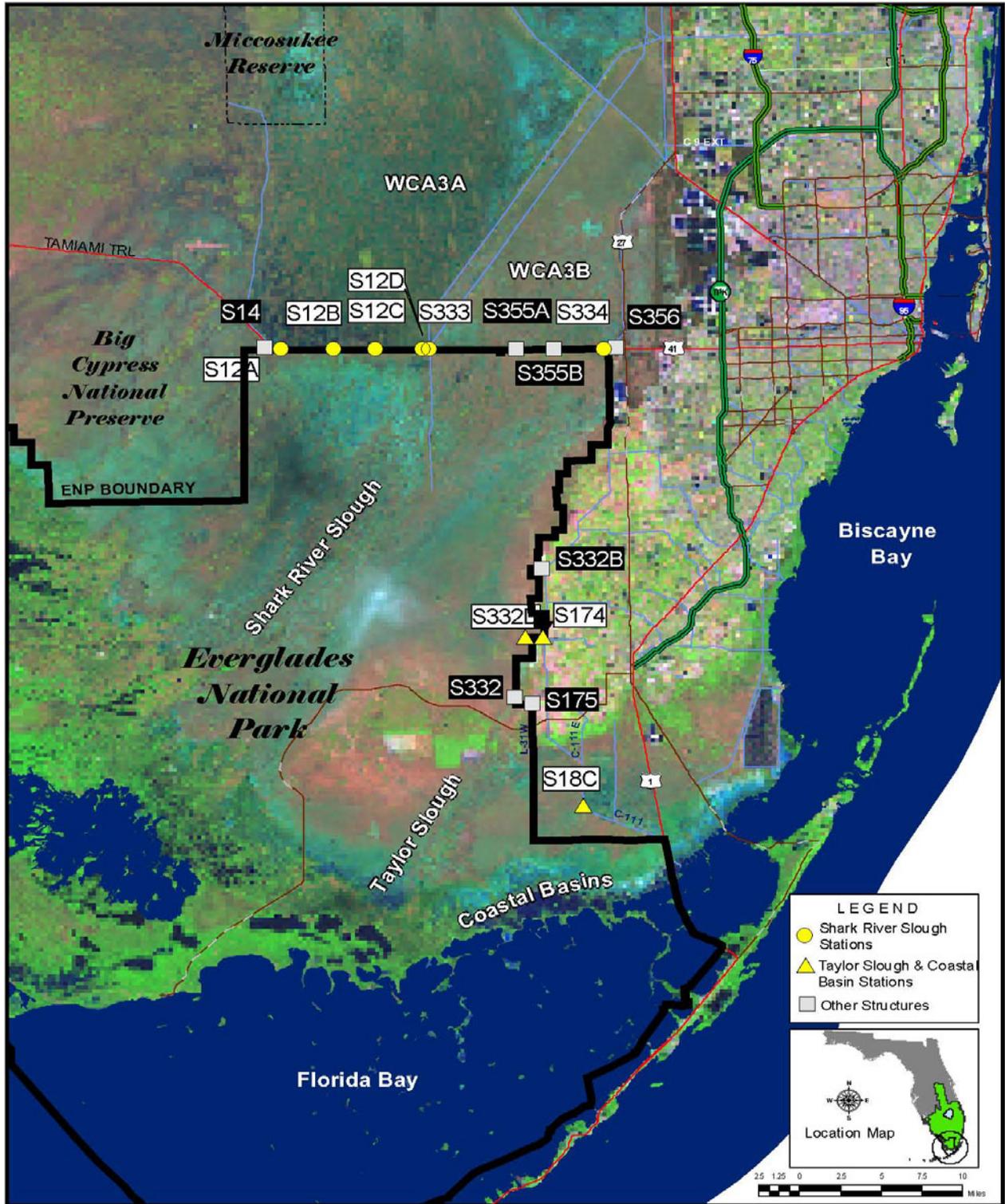


Figure 3. Everglades National Park flow structures

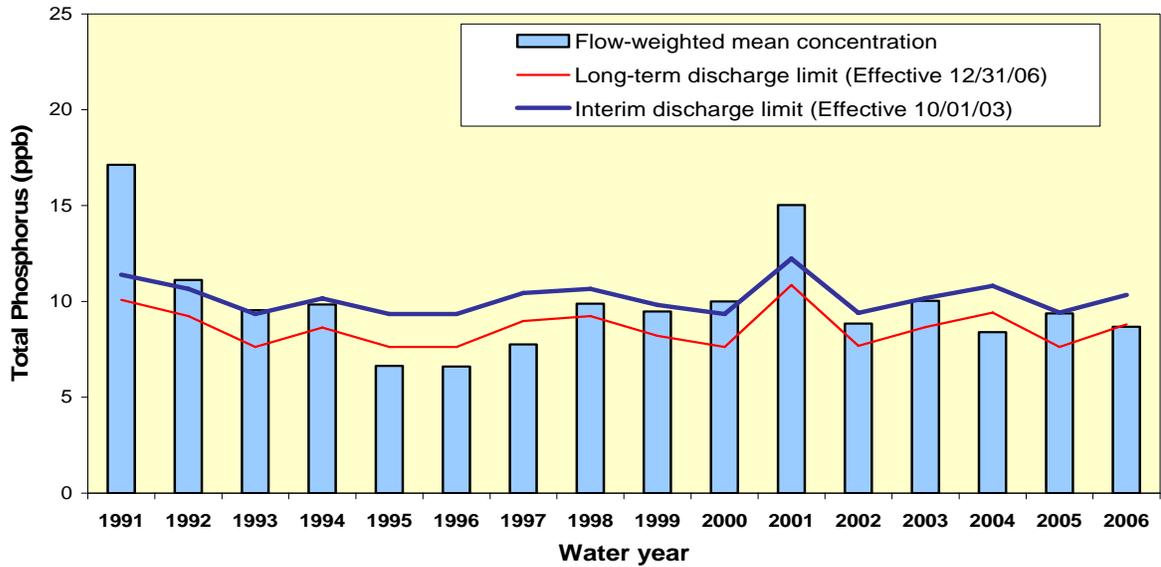


Figure 4. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Shark River Slough at the end of each water year compared to the TP interim and long-term limits. For the third consecutive compliance year, the 12-month flow-weighted mean concentration was within the interim limits, which became effective on October 1, 2003.

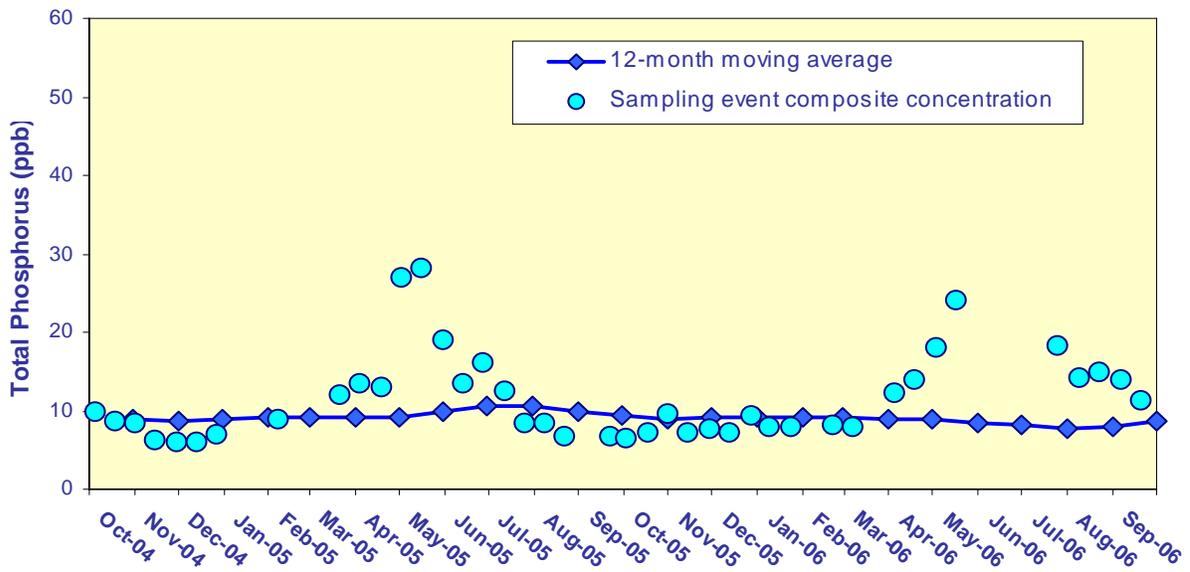


Figure 5. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Shark River Slough at the end of each month and the flow-weighted mean concentration for each sampling event. There are no sampling event values for January 2005 and June 2006 because there was no flow in those months.

Table 2. Shark River Slough TP Concentration Compliance Tracking.

12-Month Period Ending On	Total Period Flow (kac-ft)	Flow Weighted Mean Total Phosphorus (ppb)	Interim Limit (ppb)	Long Term Limit (ppb)	Percent of Sampling Events Greater than 10 ppb (%)	
			Effective 10/1/2003	Effective 12/31/2006	Guideline	Observed
31-Oct-04	727.8	8.9	10.7	9.3	48.3	35.0
30-Nov-04	760.3	8.7	10.6	9.1	47.4	33.3
31-Dec-04	738.5	9.0	10.7	9.2	48.0	35.0
31-Jan-05	717.3	9.0	10.7	9.3	48.6	38.9
28-Feb-05	709.8	9.1	10.8	9.4	48.8	37.5
31-Mar-05	698.3	9.2	10.8	9.4	49.2	46.7
30-Apr-05	732.6	9.1	10.7	9.3	48.2	46.7
31-May-05	767.1	10.0	10.5	9.1	47.3	50.0
30-Jun-05	836.0	10.5	10.2	8.7	45.4	55.6
31-Jul-05	1054.7	10.5	9.4	7.7	40.3	55.0
31-Aug-05	1269.2	9.8	9.4	7.6	40.1	47.6
30-Sep-05	1345.9	9.4	9.4	7.6	40.1	42.9
31-Oct-05	1338.1	9.0	9.4	7.6	40.1	40.9
30-Nov-05	1381.7	9.1	9.4	7.6	40.1	42.9
31-Dec-05	1447.6	9.1	9.4	7.6	40.1	42.9
31-Jan-06	1507.7	9.0	9.4	7.6	40.1	39.1
28-Feb-06 ^a	1497.6	9.0	9.4	7.6	40.1	39.1
31-Mar-06 ^a	1481.0	9.0	9.4	7.6	40.1	34.8
30-Apr-06 ^a	1436.0	9.0	9.4	7.6	40.1	34.8
31-May-06 ^a	1395.5	8.5	9.4	7.6	40.1	31.8
30-Jun-06 ^a	1326.6	8.2	9.4	7.6	40.1	25.0
31-Jul-06 ^a	1113.3	7.7	9.4	7.6	40.1	26.3
31-Aug-06 ^b	914.7	8.1	9.9	8.3	43.5	36.8
30-Sep-06 ^b	814.0	8.7	10.3	8.8	46.0	45.0

Notes: 1) Highlighted rows indicate the end of the water year (October 1- September 30), which are the compliance points.

2) Bold italicized values exceeded the guideline percentages.

3) When the total flow for Shark River Slough exceeds 1061 kac-ft/yr, a flow of 1061 kac-ft/yr is used in calculating the discharge limits.

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 in addition to the flow of 1.82 kac-ft in February 2006 at S355A and S355B structures.

All S12s have started being utilized in this quarter. S12A had been closed since November 16, 2005; S12B had been closed since December 30, 2005; S12C had been closed since January 19, 2006; S12D had been closed since April 6, 2006 - in accordance with the Interim Operational Plan (IOP) for protection of the Cape Sable Seaside Sparrow.

The daily flows through the individual Shark River Slough structures from October 2004 through September 2006 are presented in **Figure 6**. The S12s are operated to meet target discharges per the Shark River Slough Rainfall Plan which has been in effect since July 1985. There was very little inflow to Shark River Slough until mid July 2006. Since October 2004 a large portion of the flow in the L29 Canal that entered through S333 was released from the system through S334. However, almost all of the flow through S333 during this quarter (July to Sept 2006) was discharged to Shark River Slough and little was diverted to S334 (**Figure 7**).

For additional information on the S12s and S333 structures, please visit: <http://www.sfwmd.gov/org/ema/reports/sharkriver/index.html> .

A flow test of S355A (western structure) and S355B (eastern structure), which are located between S333 and S334 (**Figure 3**), was performed during February 2-20, 2006. The estimated daily mean flows were 32 cubic feet per second (cfs) at S355A and 19 cfs at S355B for a total of 1.82 kac-ft for the test period. The flow-weighted mean TP concentration taken on February 16, 2006 was 9 ppb.

Another flow test was performed at S356, which is along Tamiami Canal at S334 (**Figure 3**) during August 2-8, 2006. The flow rate was 120 - 250 cfs and a total of 3.33 kac-ft was discharged into L29 from the west side of S334. The average of all TP concentrations taken on July 18, 2006 and on August 14, 2006, was 13 ppb.

The flows through S355A and S355B were included in **Table 2** since February 2006 and flow through S356 since August 2006. The 12-month flow-weighted mean concentrations and limits were re-calculated to include these TP loads and flow. The September 2005 through August 2006 long-term limit was changed from 8.4 ppb to 8.3 ppb. Frequency limit for the period was changed from 43.6 percent to 43.5 percent. The October 2005 through September 2006 long-term limit was changed from 8.9 ppb to 8.8 ppb. The frequency limit for the period was changed from 46.1 percent to 46.0 percent. No other limits and no 12-month flow-weighted mean concentration values in the Table 2 were affected by the inclusion of these flow and TP loads.

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 8**. Values had been following the strong inverse relationship between flow and TP concentration for waters entering the ENP through Shark River Slough. The elevated (12-24 ppb) bi-weekly sampling event flow-weighted mean TP concentrations, reflecting the low flow during the last reporting period, started to decrease in the current reporting months as the flows into Shark River Slough were increased.

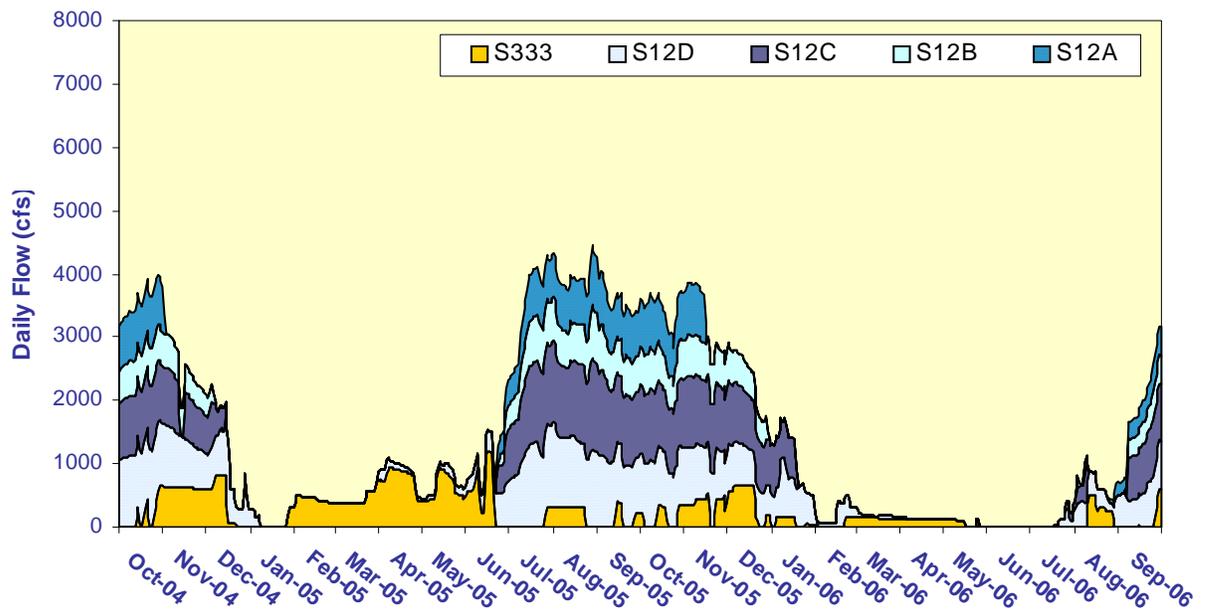


Figure 6. Daily flows into Shark River Slough by structure.

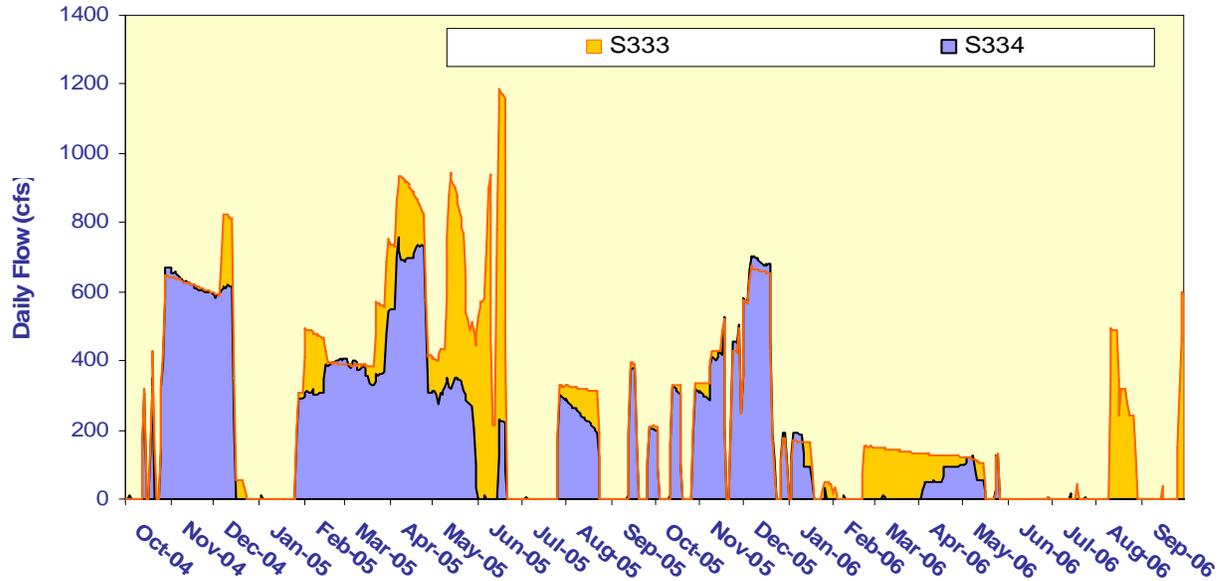


Figure 7. Daily flows comparison between S333 and S334

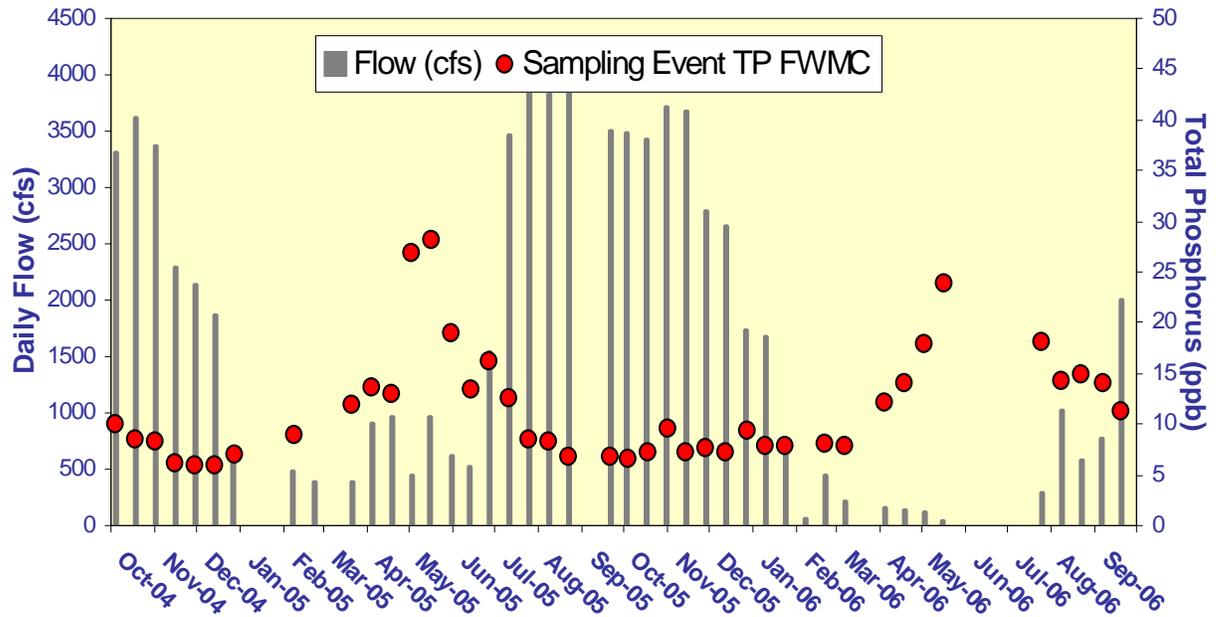


Figure 8. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean TP concentrations for individual sampling events. There were no sampling event flow-weighted mean concentrations in January 2005 and June 2006 because there was no flow in those months.

Taylor Slough and the Coastal Basins

Under the Consent Decree, a single total phosphorus (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). The 11 ppb limit applies to the water year ending September 30, 2006; the 12-month flow-weighted mean TP concentration (5.7 ppb) was much lower than the long-term limit.

C-111 Project Structures and Detention Areas

Beginning in August 1999, structure S332D, a new pump station constructed by the U.S. Army Corps of Engineers (USACE), began operation. The structure 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.

The USACE completed construction of the remaining C-111 project structures and detention areas along the eastern boundary of the ENP in June 2002. The project was authorized by the 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 9**). The flow way cell is the only location to routinely discharge surface water into the ENP from this project.

The construction of these facilities was accelerated to respond to U.S. Fish and Wildlife requirements to give immediate relief to water conditions that threaten the Cape Sable Seaside Sparrow, an endangered species. 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 (District) will monitor the implementation of the IOP under the terms and conditions of the C-111 Project Cooperation Agreement executed in 1995. The District, on behalf of the USACE, is implementing 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 District started the routine sampling in September 2003.

The monitoring plan treats the detention areas as a single project with five cells, three inflows and a single outflow to ENP. The diversion structures DS1 through DS4, previously referred to as EO1 through EO4, would discharge into the ENP if utilized. Overflows have periodically occurred at DS2 between September 2001 and September 2003. Data from these overflows were presented graphically in previous reports.

Discharges from the diversion structures DS1 and DS3 would 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 ground water seepage in an easterly direction from ENP.

The tail water stages at S332B were lower than the weir elevation (8.36 feet, NGVD29) for the reporting period indicating that **no overflow** occurred during the period at the weir.

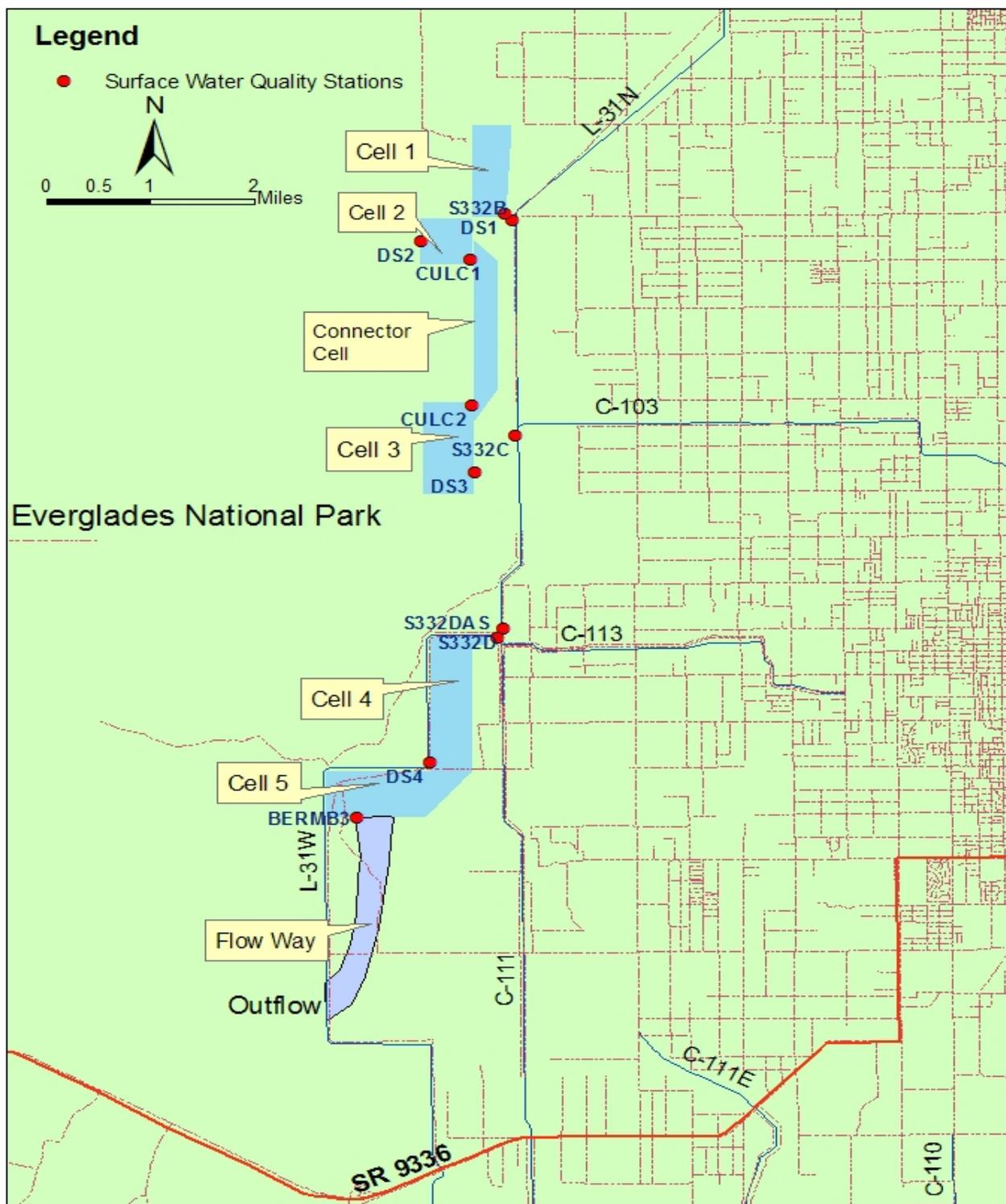


Figure 9. C-111 Project facilities.

Compliance with Consent Decree

Inflow concentrations of TP 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 10**). The bars in **Figure 10** represent the 12-month flow-weighted mean TP concentrations from S332, S175 and S18C for water years 1989 through 2002. The diamond point values for water years 1999 through 2003 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 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 made 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 10**.

Figure 11 presents the 12-month and individual sampling event flow-weighted mean TP concentrations at the S174, S332D and S18C structures. All TP grab sample concentrations taken on positive flow days reported for surface water monitoring at the 3 sites were used for the compliance calculations.

The 12-month flow-weighted mean concentrations for July, August and September 2006 were 6.7, 5.6 and 5.7 ppb, respectively, for the combined flow through S174, S332D and S18C (**Table 3**). 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 observed percentages of the sampling event flow-weighted mean TP concentrations greater than 10 ppb for the combined flow through S174, S332D and S18C were 4.7, 2.3 and 4.2 percent for the periods ending July, August and September 2006.

The daily flows into the ENP through S332D, S174 and S18C are presented in **Figure 12**. **Figure 13** shows the relationship between the daily inflows and the corresponding flow-weighted mean TP concentrations for each sampling event. From 1984 to 1990, there was no observable relationship between daily mean flow and flow-weighted mean TP concentrations at S332 and S18C structures. Some higher concentrations were observed during low flow periods during 2004 and 2005 at S332D, S174 and S18C. However, flow-weighted mean TP concentrations for all sampling dates have been less than or equal to 9 ppb since September 2005 except for May 17, 2006, sampling at S332D (13 ppb) and September 5, 2006, sampling at S18C (11 ppb).

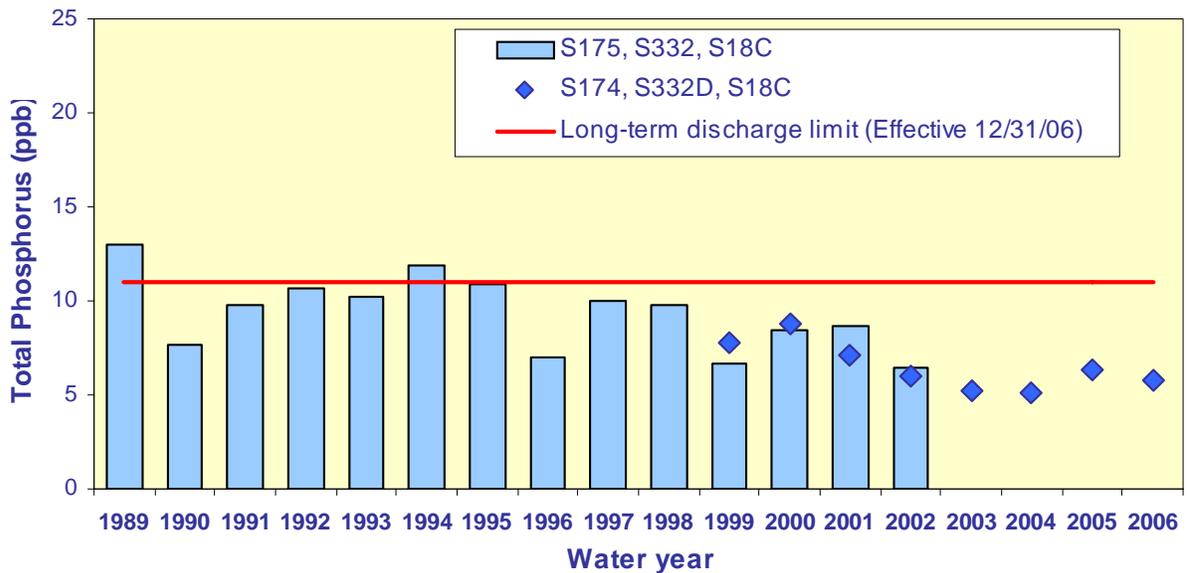


Figure 10. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each water year compared to the 11 ppb long-term TP limit.

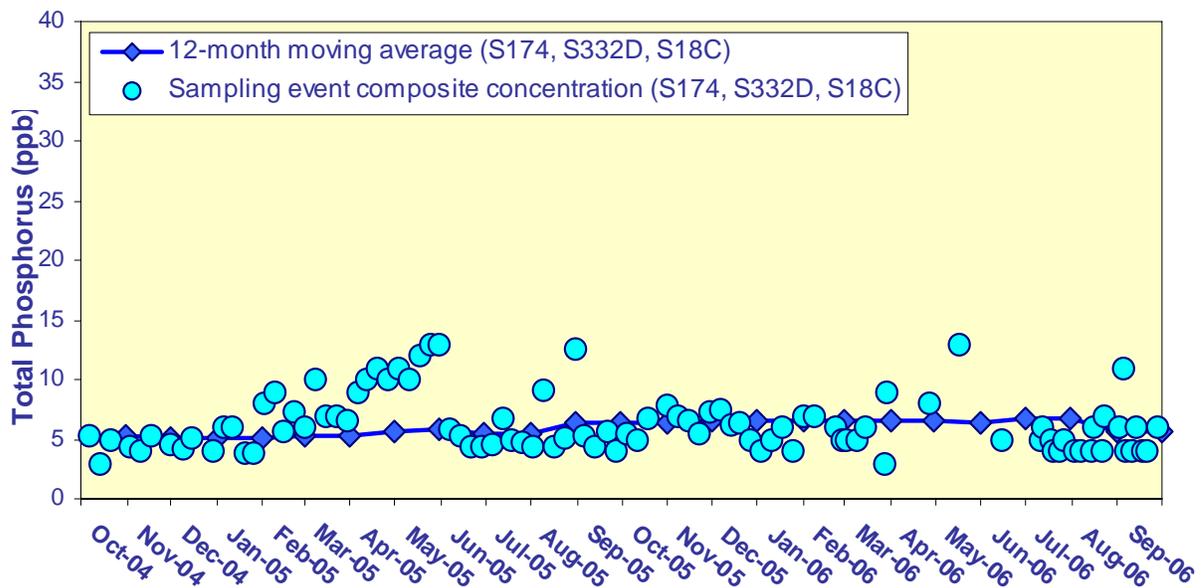


Figure 11. 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each month and the flow-weighted mean TP concentration for each sampling event.

Table 3. Taylor Slough and the Coastal Basins TP Concentration Compliance Tracking.

12-Month Period Ending On	Total Period Flow (kac-ft)	Flow Weighted Mean Total Phosphorus (ppb)	Long Term Limit (Effective 12/31/06) (ppb)	Percent of Sampling Events Greater than 10 ppb (%)	
				Guideline	Observed
31-Oct-04	210.1	5.3	11.0	53.1	11.9
30-Nov-04	206.7	5.1	11.0	53.1	11.9
31-Dec-04	193.0	5.2	11.0	53.1	12.5
31-Jan-05	194.4	5.1	11.0	53.1	12.5
28-Feb-05	194.7	5.2	11.0	53.1	11.9
31-Mar-05	199.6	5.3	11.0	53.1	11.4
30-Apr-05	207.2	5.6	11.0	53.1	13.3
31-May-05	214.1	5.9	11.0	53.1	18.8
30-Jun-05	261.0	5.5	11.0	53.1	14.6
31-Jul-05	304.6	5.4	11.0	53.1	10.4
31-Aug-05	357.1	6.4	11.0	53.1	12.2
30-Sep-05	380.0	6.3	11.0	53.1	12.2
31-Oct-05	373.4	6.3	11.0	53.1	12.2
30-Nov-05	358.6	6.6	11.0	53.1	12.0
31-Dec-05	366.9	6.6	11.0	53.1	11.8
31-Jan-06	369.5	6.6	11.0	53.1	11.8
28-Feb-06	364.6	6.6	11.0	53.1	11.8
31-Mar-06	359.7	6.6	11.0	53.1	11.8
30-Apr-06	351.5	6.5	11.0	53.1	10.4
31-May-06	343.7	6.4	11.0	53.1	4.5
30-Jun-06	295.5	6.7	11.0	53.1	4.9
31-Jul-06	280.0	6.7	11.0	53.1	4.7
31-Aug-06	227.0	5.6	11.0	53.1	2.3
30-Sep-06	207.4	5.7	11.0	53.1	4.2

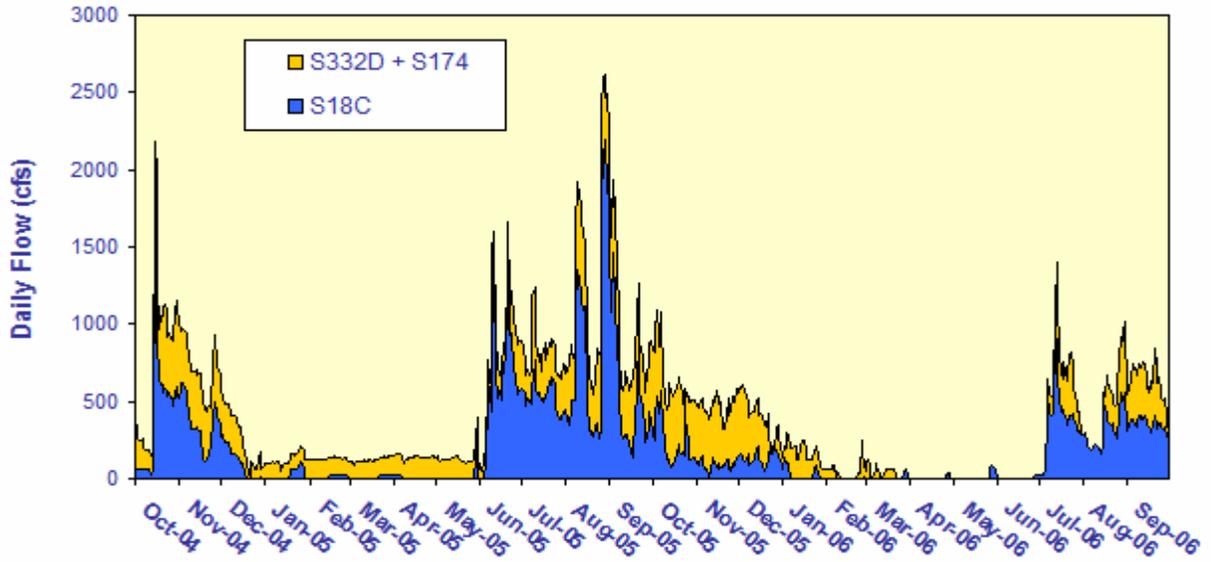


Figure 12. Daily flows into Everglades National Park through Taylor Slough (S332D+S174) and S18C.

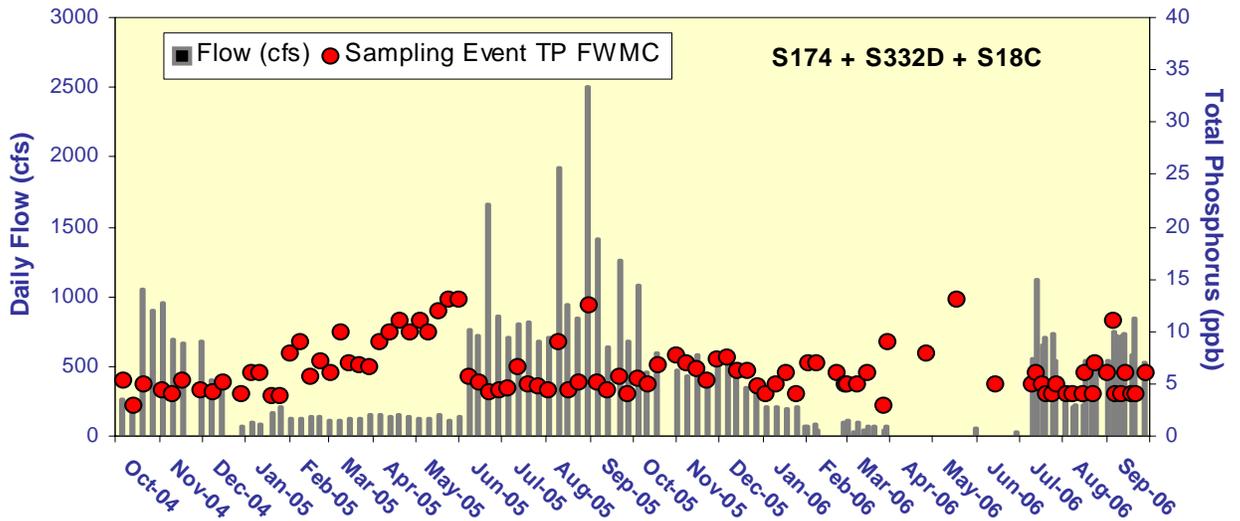


Figure 13. The relationship between daily flows at Taylor Slough structures (S332D + S174) and S18C and the corresponding flow-weighted mean TP concentrations for individual sampling events.