

# **Settlement Agreement January - March 2001 Report**



**Prepared for the  
Technical Oversight Committee  
July 31, 2001**

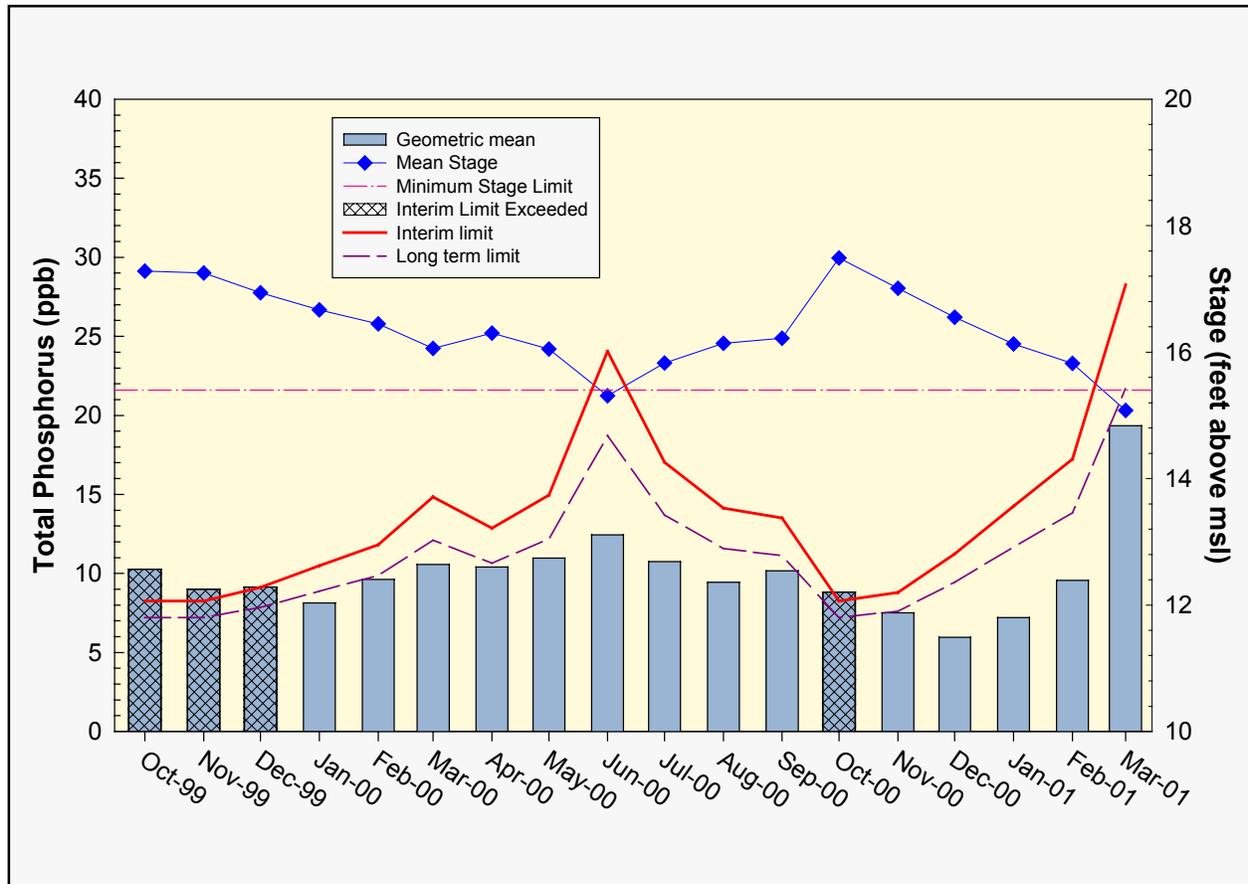
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# ARTHUR R. MARSHALL LOXAHATCHEE NATIONAL WILDLIFE REFUGE

## Phosphorus Concentrations

The 1995 Consent Decree approved modifications to the 1991 Settlement Agreement to end the Everglades lawsuit entered into by the federal government, the State of Florida and the South Florida Water Management District. The Consent Decree specified that interim and long-term phosphorus concentration levels for the Loxahatchee National Wildlife Refuge (Refuge) must be met by Feb. 1, 1999, and Dec. 31, 2006, respectively. The concentration levels vary monthly because they are calculated as a function of water stage measured at gaging stations 1-7, 1-8C and 1-9 within the Refuge. The stage range within which the interim and long-term level calculations are applicable is 15.42 to 17.14 feet (mean sea level). Total phosphorus concentrations are determined from water samples collected at 14 interior marsh stations (LOX 3 through LOX 16).

Average stages in the Refuge were 16.13, 15.82 and 15.08 feet in January, February and March 2001, respectively (**Figure 1**). The geometric means calculated from total phosphorus concentrations measured in water samples collected in January, February and March were 7.2, 9.6 and 19.3 ppb, respectively (**Table 1**). The geometric mean concentrations in January and February were within the calculated interim and long-term limits. The March total phosphorus concentration of 19.3 ppb was based on only two samples because many sites were dry or had water levels less than four inches, the minimum depth necessary to ensure a representative sample. The interim and long-term limits were not applicable in March since the Refuge average stage was less than 15.42 feet (**Table 1**).



**Figure 1.** Monthly total phosphorus geometric mean concentration levels for the Loxahatchee National Wildlife Refuge compared to the interim and long-term targets. The calculated target concentrations are adjusted for fluctuations in water level.

**Table 1.** Loxahatchee National Wildlife Refuge Total Phosphorus Compliance.

Month and Year	Geometric Mean	Interim Limit	Long Term Limit	Average Stage	Number of Phosphorus Samples	Number of Stage Measurements
	(ppb)			(ft, NGVD)		
Apr-1999	11.9	N/A	N/A	15.35	3	3
May-1999	16.4	N/A	N/A	15.20	2	3
Jun-1999	14.2	11.7	9.8	16.47	13	3
Jul-1999	11.1	14.4	11.8	16.11	10	3
Aug-1999	12.7	15.1	12.3	16.03	8	3
Sep-1999	10.3	9.9	8.4	16.79	14	3
Oct-1999	10.3	8.3	7.2	17.28	14	3
Nov-1999	9.0	8.3	7.2	17.25	14	3
Dec-1999	9.1	9.1	7.9	16.94	14	3
Jan-2000	8.1	10.5	8.9	16.67	14	3
Feb-2000	9.6	11.8	9.9	16.45	13	3
Mar-2000	10.6	14.8	12.1	16.06	12	3
Apr-2000	10.4	12.9	10.6	16.30	14	3
May-2000	9.3 <i>(11.0)</i>	14.6 <i>(15.0)</i>	11.9 <i>(12.2)</i>	16.09 <i>(16.05)</i>	11 <i>(14,11,13,12)</i>	3 <i>(3,3,3,3)</i>
Jun-2000	12.4	N/A	N/A	15.31	6	3
Jul-2000	10.8	17.0	13.7	15.83	6	3
Aug-2000	9.4	14.1	11.6	16.14	10	3
Sep-2000	10.2	13.5	11.1	16.22	11	3
Oct-2000	8.8	8.3	7.2	17.49	13	3
Nov-2000	7.5	8.8	7.6	17.01	14	3
Dec-2000	6.0	11.2	9.4	16.55	9	3
Jan-2001	7.2	14.3	11.7	16.13	8	3
Feb-2001	9.6	17.2	13.8	15.82	9	3
Mar-2001	19.3	NA	NA	15.08	2	3

**Notes:**

- (1) Average Stage is calculated using stage elevations at three stations on the sampling date.
- (2) The italicized values in parentheses for May-2000 include the Lake Okeechobee Recession special sampling data.
- (3) Highlighted values indicate months when exceedances occurred.
- (4) NA = Limits not applicable when Refuge stage is below 15.42 feet (mean sea level).

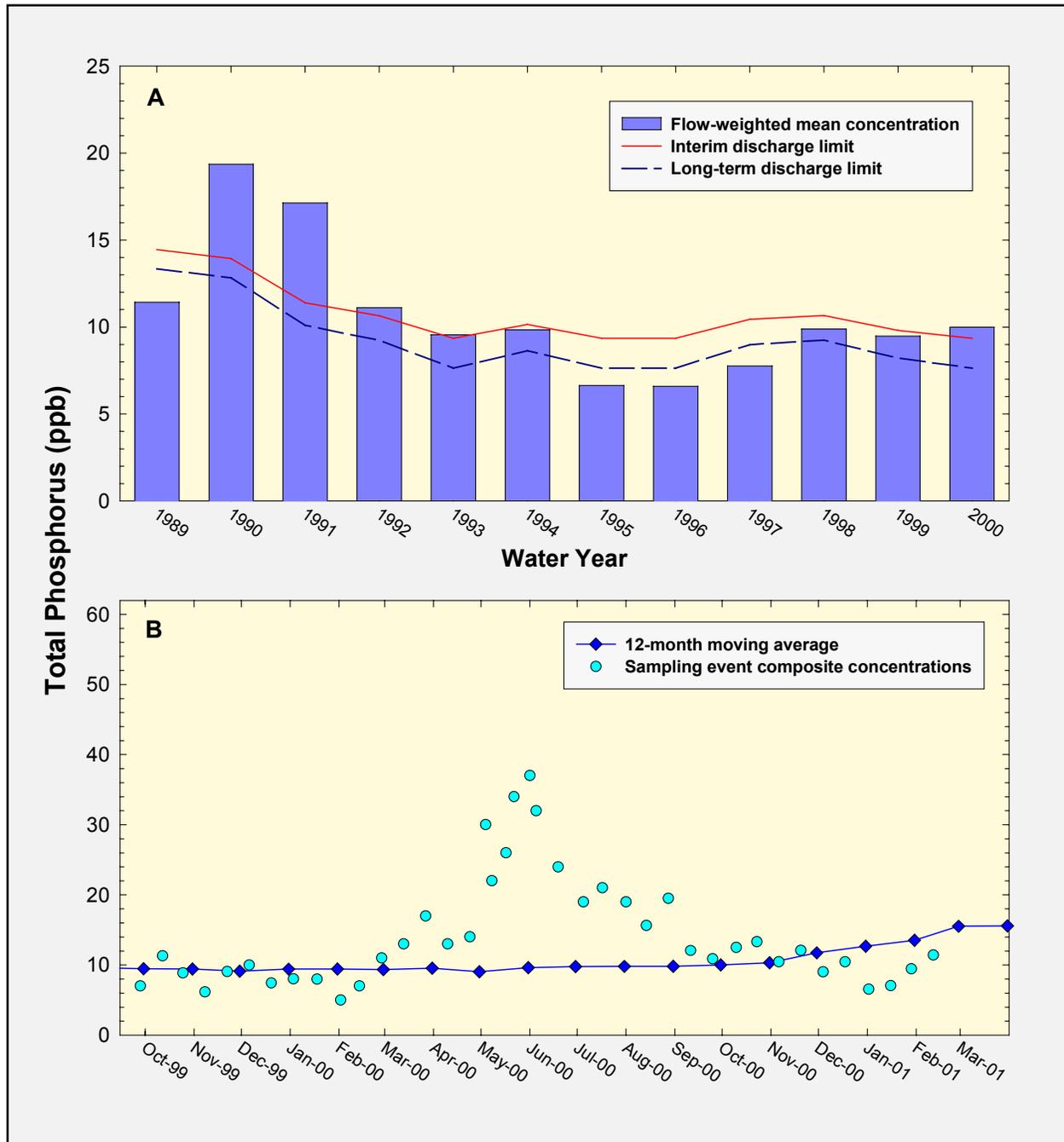
# EVERGLADES NATIONAL PARK

## Shark River Slough

The Consent Decree of 1995 specified that interim and long-term total phosphorus concentration limits for discharges into the Everglades National Park through Shark River Slough to be met by October 1, 2003, and December 31, 2006, respectively. The limits apply to the water year ending September 30. The long-term total phosphorus 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. In addition, the Settlement Agreement requires that phosphorus concentrations be presented as 12-month moving flow-weighted means.

Inflow concentrations of total phosphorus through Shark River Slough are compared to the interim and long-term limits at the end of each water year from 1989 to 2000 (**Figure 2a**). The 12-month moving flow-weighted mean total phosphorus concentration ending September 2000 was 10.0 ppb. Corresponding interim and long-term limits were 9.4 and 7.6 ppb, respectively. This is the first time since 1993 that both limits were exceeded for the water year ending in September.

The Settlement Agreement stipulates that the percent of flow-weighted mean total phosphorus concentrations greater than 10 ppb from each sampling event in any 12-month period must not exceed a maximum value based on flow into Shark River Slough for the same 12-month period (**Figure 2b**). For the 12-month periods ending January, February and March 2001, the percent of flow-weighted mean total phosphorus concentrations greater than 10 ppb was 80.0, 85.7 and 84.6, respectively. These percentages exceeded the allowed percentages for all three 12-month periods (see **Table 2**).



**Figure 2.** 12-month moving flow-weighted mean total phosphorus concentrations at the inflows to the Everglades National Park (ENP) through Shark River Slough compared to the interim and long-term targets. **a.** Concentration at the end of each water year. **b.** 12-month moving average concentration at the end of each month and the composite concentration for each sampling event.

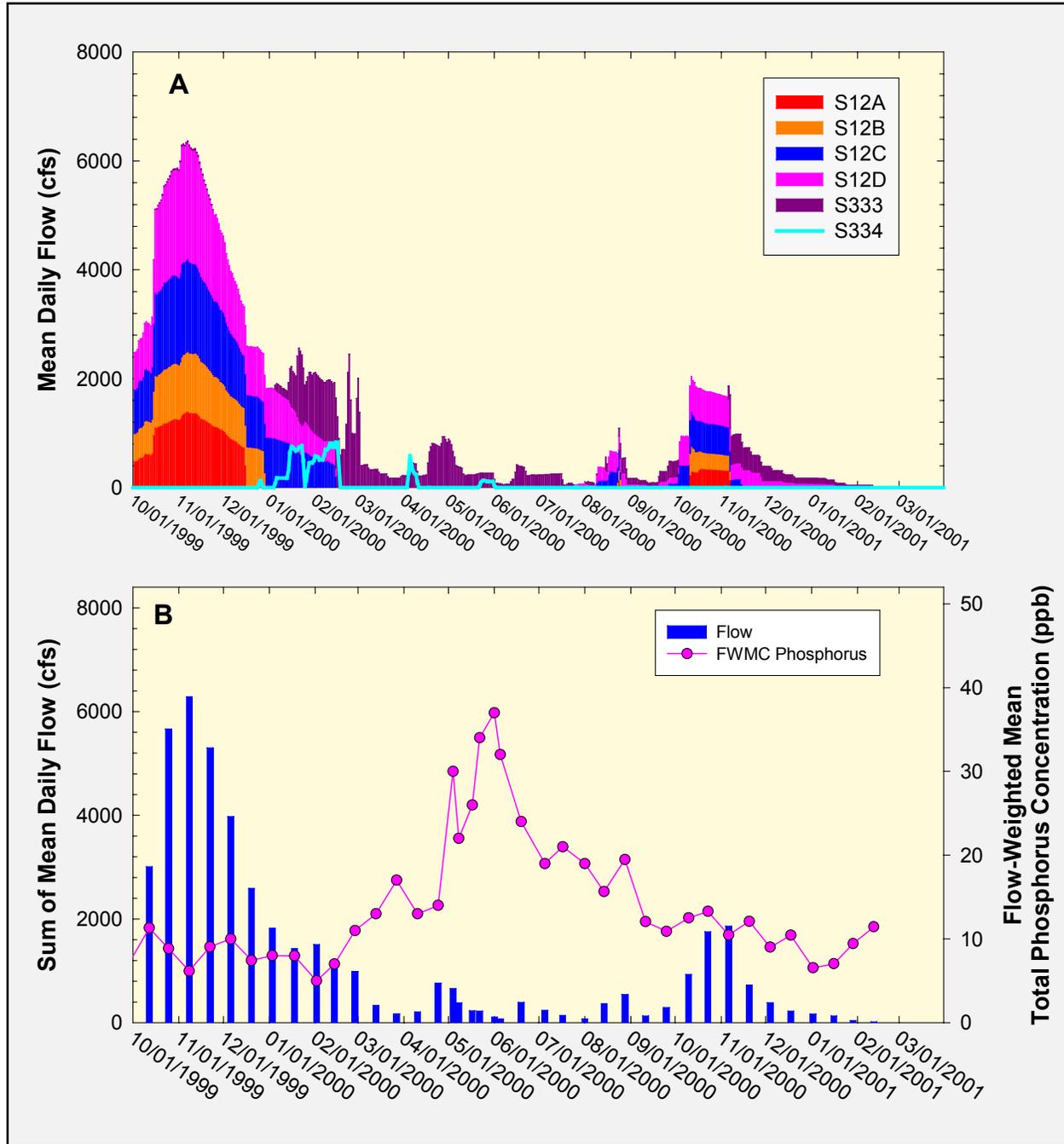
**Table 2.** Shark River Slough Total Phosphorus Concentration Compliance Tracking.

12-Month Period Ending On	Total Period Flow (Kac-ft)	Flow Weighted Mean Total Phosphorus (ppb)	Limits (ppb)		Percent of Samples Greater Than 10 ppb (%)	
			Interim	Long Term	Observed	Allowed
4/30/99	750	9.9	10.6	9.2	<b>51.9</b>	47.7
5/31/99	675	9.8	11.0	9.6	48.0	49.9
6/30/99	680	9.6	10.9	9.6	40.9	49.7
7/31/99	788	9.7	10.4	9.0	41.7	46.7
8/31/99	858	9.6	10.1	8.6	39.1	44.9
9/30/99	940	9.5	9.8	8.2	39.1	42.9
10/31/99	1084	9.4	9.4	7.6	39.1	40.1
11/30/99	1298	9.1	9.4	7.6	39.1	40.1
12/31/99	1345	9.4	9.4	7.6	39.1	40.1
1/31/00	1395	9.4	9.4	7.6	39.1	40.1
2/29/00	1415	9.4	9.4	7.6	<b>41.7</b>	40.1
3/31/00	1386	9.6	9.4	7.6	<b>52.2</b>	40.1
4/30/00	1385	9.1	9.4	7.6	<b>52.2</b>	40.1
5/31/00	1401	9.6	9.4	7.6	<b>57.7</b>	40.1
6/30/00	1396	9.8	9.4	7.6	<b>60.7</b>	40.1
7/31/00	1295	9.8	9.4	7.6	<b>64.3</b>	40.1
8/31/00	1215	9.8	9.4	7.6	<b>65.5</b>	40.1
9/30/00	1096	10.0	9.4	7.6	<b>69.0</b>	40.1
10/31/00	925	10.3	9.9	8.3	<b>72.4</b>	43.2
11/30/00	642	11.7	11.1	9.8	<b>79.3</b>	50.8
12/31/00	464	12.7	12.0	10.8	<b>82.8</b>	56.4
1/31/01	367	13.5	12.5	11.3	<b>80.0</b>	59.8
2/28/01	298	15.5	12.9	11.7	<b>85.7</b>	62.2
3/31/01	276	15.6	13.0	11.9	<b>84.6</b>	63.1

**Note:** **Bold and italicized** values exceeded allowed percentage.

**Table 2** presents the moving flow-weighted mean concentrations for each 12-month period beginning in April 1999 as well as the corresponding interim and long-term total phosphorus concentration limits, which are calculated using the 12-month period flow. For the 12-month periods ending in January, February and March 2001, the flow-weighted mean total phosphorus concentrations were 13.5, 15.5 and 15.6 ppb, respectively. These concentrations were all greater than the interim and long-term limits for these respective months.

The daily mean flows through the individual Shark River Slough structures and S334 from October 1999 through March 2001 are presented in **Figure 3a**. From January 1 through February 12, 2001 flows into northeastern Shark River Slough through S12D and S333 averaged 40.3 and 49.2 cfs, respectively. There were no flows through either structure from February 13 through March 31. The relationship between the sum of the daily mean flows at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events is presented in **Figure 3b**. Decreasing flows into Shark River Slough in January and February resulted in gradually increasing total phosphorus flow-weighted mean concentrations.



**Figure 3. a.** Mean daily flows into Shark River Slough by structure. **b.** The relationship between sum of mean daily flow at Shark River Slough structures and flow-weighted mean total phosphorus concentration for individual sampling events.

## Taylor Slough and The Coastal Basins

Under the Consent Decree, a single total phosphorus 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. Beginning in August 1999, structure S332D, a new pump station constructed by the U.S. Army Corps of Engineers, 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. However, the Settlement Agreement's Technical Oversight Committee requested that data from both the old and new pairs of inflow structures to Taylor Slough be presented for one year. This request was made to determine if the observed differences between the two data sets from August 1999 through March 2000 would continue throughout a complete wet season/dry season cycle and what implications this might have on future compliance with the 11 ppb limit.

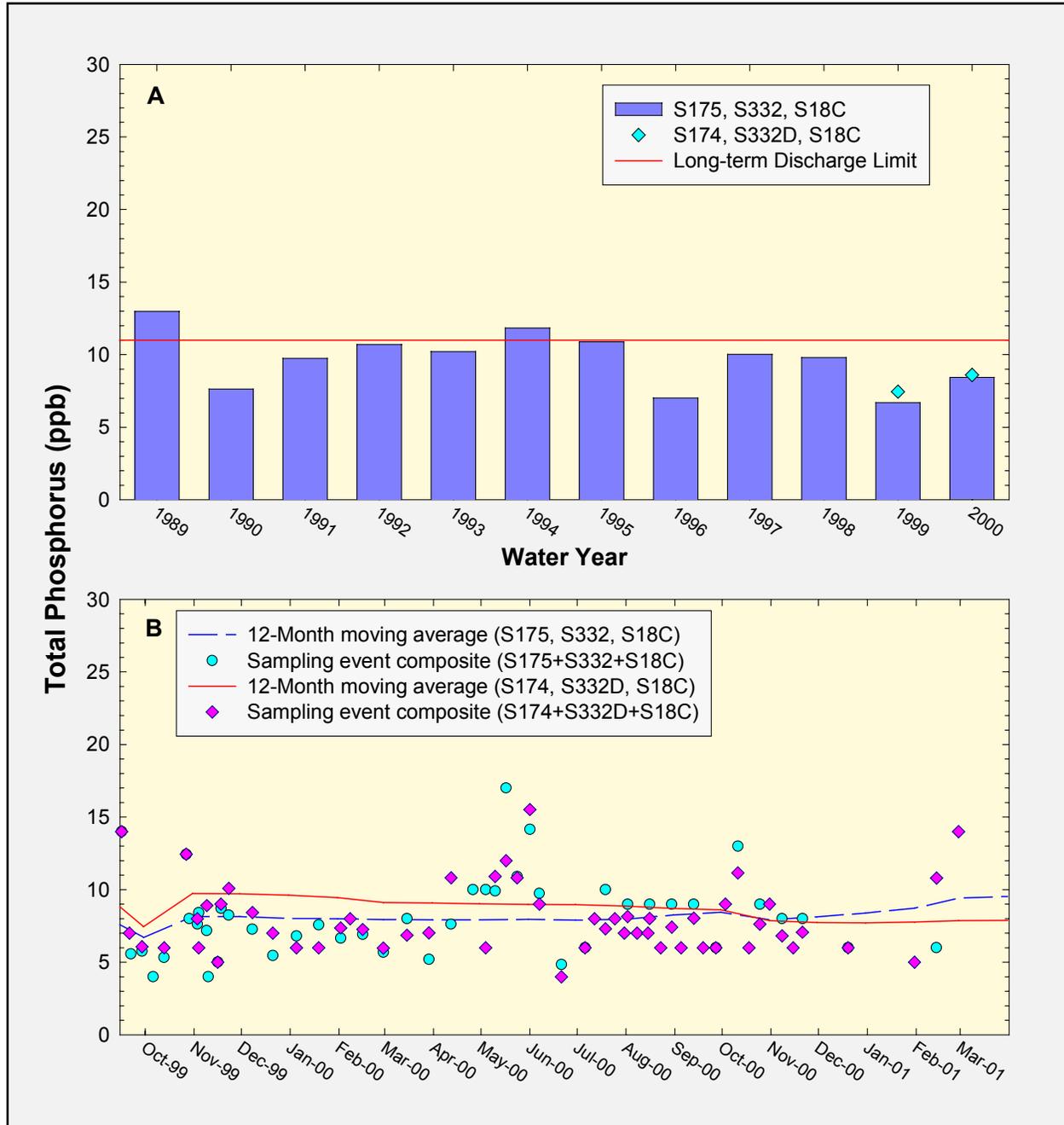
Inflow concentrations of total phosphorus to the Everglades National Park through Taylor Slough and the Coastal Basins are compared to the 11 ppb limit at the end of each water year using data from both the old (S175, S332, S18C) and new (S174, S332D, S18C) combinations of structures for the 2000 water year (**Figure 4a**). The bars in **Figure 4a** represent the flow-weighted mean total phosphorus concentrations from S332, S175 and S18C for water years 1989 through 2000. The diamond point value for water year 1999 represents the total phosphorus concentrations for S174 and S18C from October 1, 1998 through September 30, 1999 plus the S332D data from August 30, 1999 through September 30, 1999. The diamond point value for 2000 represents total phosphorus concentrations for the entire year from S174, S332D and S18C.

**Figure 4b** presents the 12-month moving average and individual sampling event flow-weighted mean total phosphorus concentrations at both the old and new combinations of structures. A lower than average number of individual sampling event flow-weighted mean total phosphorus concentrations exist from December 2000 through March 2001 due to periods of no flow at the Taylor Slough and S18C structures.

The 12-month flow-weighted mean concentrations for January, February and March 2001 were 7.8, 7.9 and 7.9 ppb, respectively, at the new combination of structures and 8.7, 9.4 and 9.5 ppb, respectively, for the old combination of structures (**Table 3**). The Settlement Agreement stipulates that the percent of flow-weighted mean total phosphorus concentrations greater than 10 ppb from each sampling event in any 12-month period must not exceed a

fixed value of 53.1 percent. The percentage of flow-weighted mean total phosphorus concentrations greater than 10 ppb for the new combination was 15.4, 21.6 and 22.9 for the periods ending January, February and March, respectively. For these same periods, the percentage for the old combination was 15.4, 16.7 and 18.2, respectively (**Table 3**).

A comparison of flows between the old and new combination of structures is presented in **Figure 5**. The flow through S18C, along with the combined flows through S332 plus S175 and S332D plus S174, is presented in **Figure 5a**. The water discharged from the downstream structures, S175 and S332, is supplied through the upstream structures, S174 and S332D. From December 10, 2000 through March 31, 2001 there were no inflows through S332D. Flow through S174 occurred from January 26 through March 4, 2001. Flows through S18C ended on January 2, 2001 and had not resumed by March 31. These flow situations resulted in no flow within the Taylor Slough system from January 3 through January 25, 2001. **Figure 5b** shows the relationship between the sum of the daily mean flows at S18C and the Taylor Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for each sampling event at both the old and new combinations of structures. The very low flow existing at S174 from January 26 through March 4 resulted in the increase in flow-weighted mean total phosphorus concentrations observed in **Figure 5b**.



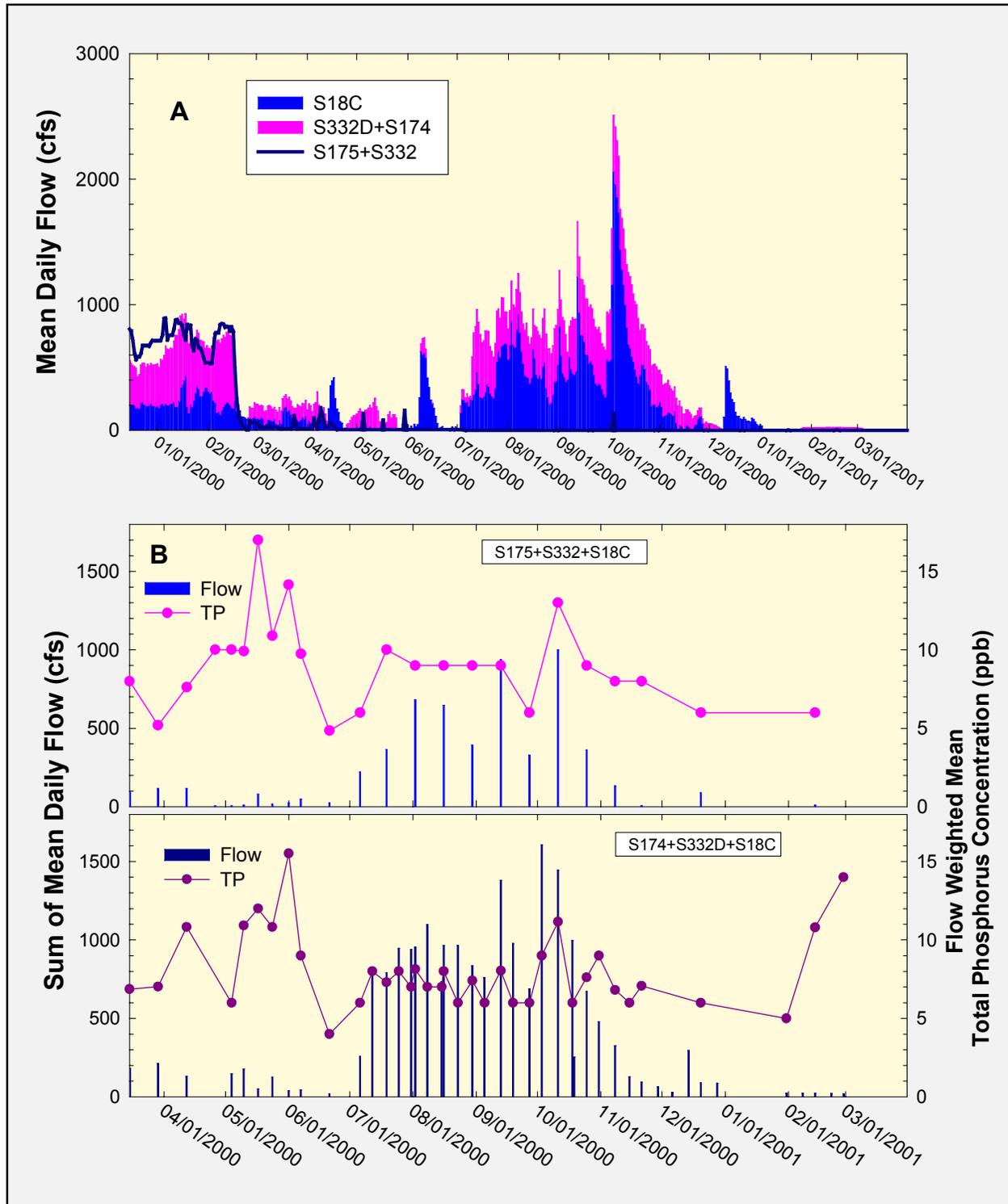
**Figure 4. a.** Flow-weighted mean total phosphorus concentration at the inflows to the Everglades National Park through Taylor Slough and the Coastal Basins compared to the 11 ppb long-term total phosphorus limit for each year. **b.** The 12-month moving average and individual sampling event flow-weighted mean total phosphorus concentrations at both the old and new combinations of compliance monitoring sites.

**Table 3.** Taylor Slough and the Coastal Basins Total Phosphorus Concentration Compliance Tracking.

12-Month Period Ending On	Total Period Flow (ac-ft x 10 <sup>3</sup> )		Flow Weighted Mean Total Phosphorus (ppb)		Long Term Limit (ppb)	Percent of Samples Greater Than 10 ppb			
	New	Old	New	Old		Observed (%)		Allowed (%)	
						New	Old	New	Old
4/30/99	75	252	12.9	10.0	11.0	33.3	25.0	53.1	53.1
5/31/99	63	232	13.8	10.2	11.0	40.0	28.6	53.1	53.1
6/30/99	70	260	13.6	10.1	11.0	44.0	28.6	53.1	53.1
7/31/99	76	276	12.1	9.4	11.0	37.0	25.0	53.1	53.1
8/31/99	79	288	10.2	8.5	11.0	25.0	16.7	53.1	53.1
9/30/99	94	280	7.5	6.7	11.0	17.7	12.1	53.1	53.1
10/31/99	102	339	9.7	8.1	11.0	22.9	17.1	53.1	53.1
11/30/99	112	365	9.7	8.1	11.0	23.1	15.4	53.1	53.1
12/31/99	127	414	9.6	8.0	11.0	22.5	15.4	53.1	53.1
1/31/00	144	450	9.5	8.0	11.0	22.5	15.4	53.1	53.1
2/29/00	160	479	9.1	7.9	11.0	21.4	15.0	53.1	53.1
3/31/00	165	485	9.1	7.9	11.0	22.0	15.4	53.1	53.1
4/30/00	165	493	9.0	7.9	11.0	20.0	12.8	53.1	53.1
5/31/00	170	493	9.0	8.0	11.0	23.3	14.6	53.1	53.1
6/30/00	162	467	9.0	7.9	11.0	23.3	16.7	53.1	53.1
7/31/00	173	457	8.9	8.0	11.0	20.5	17.1	53.1	53.1
8/31/00	184	445	8.7	8.3	11.0	20.9	18.0	53.1	53.1
9/30/00	188	432	8.6	8.4	11.0	19.1	14.3	53.1	53.1
10/31/00	195	375	7.9	7.9	11.0	15.9	12.1	53.1	53.1
11/30/00	182	315	7.7	8.1	11.0	14.6	13.8	53.1	53.1
12/31/00	163	266	7.7	8.4	11.0	15.0	14.3	53.1	53.1
1/31/01	135	205	7.8	8.7	11.0	15.4	15.4	53.1	53.1
2/28/01	120	168	7.9	9.4	11.0	21.6	16.7	53.1	53.1
3/31/01	112	161	7.9	9.5	11.0	22.9	18.2	53.1	53.1

New= S174+S332D+S18C data

Old = S175+S332+S18C data



**Figure 5. a.** Daily mean flows into the Everglades National Park through Taylor Slough and the Coastal Basins control structure. **b.** Mean daily flows and corresponding flow-weighted mean total phosphorus concentrations at old and new combinations of Taylor Slough and Coastal Basin structures.