

Cover Letter
Draft for TOC Review

RES 14

June 4, 2003

TO: Principals of the Consent Decree and Other Interested Parties (list attached)

RE: A Water Quality Exceedance from Interim Levels in the Arthur R. Marshall Loxahatchee Wildlife Refuge, July 2002

The attached letter report documents an exceedance from the total phosphorus (TP) Interim Levels for the Arthur R. Marshall Loxahatchee Wildlife Refuge (Refuge) set forth in the 1991 Settlement Agreement. Specifically, the July 2002 geometric mean TP concentration of 11.2 ppb exceeded the predicted TP level (9.7 ppb) by 1.5 ppb.

The report summarizes data on an exceedance in the monthly geometric mean within the 12-month period between August 2001 and July 2002, and provides information on contributing circumstances. Members of the Technical Oversight Committee (TOC) and other interested parties discussed this water quality information at their February 11, 2003 meeting and requested staff to prepare a report for the next committee meeting (June 3, 2003) to evaluate the exceedance and provide recommendations. At the June 3, 2003 TOC meeting, the members provided comments which have been incorporated into the attached letter report.

Contributing Circumstances: Evaluation by District staff and discussion by the TOC revealed several factors that could contribute to this exceedance:

- A dry period in May 2001 ended with a rapid increase in water depth from mid-June to mid-July, 2002.
- Increases in depth were accompanied by increases in phosphorus inputs to the Refuge although no immediate effect of these inputs was apparent in the monitoring data.
- Phosphorus levels actually dropped 2.2 ppb between June and July, while the calculated Interim Level dropped 6.3 ppb, leading to the 1.5 ppb exceedance of the predicted value.
- Phosphorus levels have been below the Interim Level for the eight months following the exceedance (data through March, 2003)
- Circumstances of this event follow a pattern seen in prior exceedances in the Refuge.

Recommended Action: Based upon the TOC's review of the July 2002 exceedance and relevant circumstances, TOC recommends continued implementation of phosphorus controls, compliance monitoring and data review.

If you have any questions or comments on this water quality exceedance and the attached letter report, please feel free to contact me (561 682-2200), Garth Redfield (561-682-6611) or Tim Bechtel (561-682-6392).

Sincerely,

Naomi S. Duerr, P.G.
Director, Department of Environmental Monitoring and Assessment

NSD/grs

Attachments: Letter Report with Attachments
Distribution List

Draft for TOC Review

June 4, 2003

TO: Principals of the Consent Decree and Other Interested Parties (list attached)

RE: A Water Quality Exceedance from Interim Level in the Arthur R. Marshall Loxahatchee Wildlife Refuge, July, 2002.

Background: This letter report was requested by the Technical Oversight Committee (TOC) at their February 11, 2003 meeting. The TOC asked that Garth Redfield, TOC Chair, and Tim Bechtel, Supervisor of the South Florida Water Management District's (District) Data Evaluation and Reporting Unit, provide a letter documenting an exceedance from the total phosphorus (TP) Interim Levels for the Arthur R. Marshall Loxahatchee Wildlife Refuge (Refuge) as set forth in the Settlement Agreement (1991, Case No. 88-1886-CIV-HOEVELER). The TOC requested us to summarize key facts relevant to determining whether these occurrences are due to "error or extraordinary natural phenomena" or represent a violation of the Settlement Agreement's Interim Level.

Appendix B to the Settlement Agreement specifies that two or more exceedances of the interim or long-term levels of total phosphorus in a 12 month period must be reviewed by the TOC as a potential violation of the Settlement Agreement. With information from this review and recommendations from TOC members, the TOC Principals of the five settling parties will then decide what actions may be appropriate under the Settlement Agreement.

The TP Exceedance: A rapid rise in Refuge stage due to inflows and local rainfall resulted in a geometric mean TP concentration for July 2002 of 11.2 ppb which is 1.5 ppb higher than the calculated Interim Level of 9.7 ppb. The 'Interim TP Level' for the Refuge became effective February 1, 1999. The Interim Level for TP was first exceeded within the 12-month period in October 2001. A second exceedance in the 12-month period occurred in July 2002. This letter concerns the second exceedance. Evaluations of two earlier exceedances were the subject of two letters to the Principals dated July 14, 2000 and October 24, 2001. Based upon their analysis of the data and relevant circumstances, TOC recommended no actions on these exceedances.

Geometric mean concentrations of TP, applicable TP limits, and water depths (stages) in the Refuge for the January 2001 through December 2002 period are presented in the April, 2003 Quarterly Water Quality Conditions Report, posted on the TOC website: <http://www.sfwmd.gov/org/ema/toc/index.html>. An updated

version of these data through March 2003 for the Refuge is provided in the attached **Table 1**. TOC members and interested parties were provided with water quality information, including data on the July 2002 and October 2001 exceedances, in quarterly reports to the TOC for the February and June 2003 meetings. The time lag between data collection and evaluation by the TOC normally runs 6 to 9 months due to typical field collection, laboratory analyses, quality control and data reporting times. The District is currently in the process of implementing a new system of reporting that will shorten this lag time substantially and provide updated data on the TOC website on a monthly basis.

The July 2002 excursion is summarized below in the table below:

Month 2002	Geometric Mean (ppb TP)	Interim Level (ppb TP)	Long-Term Level * (ppb TP)	Average Stage (ft.)
July	11.2	9.7	8.3	16.82

* Note that the Long-Term Level becomes effective December 31, 2006.

Contributing Circumstances: Discussion at the February 2003 TOC meeting and subsequent evaluation of Refuge monitoring data by District staff revealed proximal circumstances that should be considered when interpreting these data and deciding upon appropriate recommendations to the Settling Parties. Hydrological and nutrient conditions during June and July, 2002 are particularly important to consider.

Data on daily stage levels, inflow volumes, rainfall amounts, TP loads, and TP concentrations are provided in **Table 2**. The location of inflow points in the Refuge is given in the attached Figure 1 and the location of monitoring sites is shown on Figure 1 of each Settlement Agreement report to the TOC.

Based on data from S5A, over 17 inches of rain fell in June 2002 and the first half of July 2002 prior to Refuge sampling on July 15 and 16, 2003. This significant local rainfall was part of a pattern of very heavy rainfall in the central and northern sections of the District. The July 11, 2002 Water Conditions Summary to the Governing Board noted that rainfall in June and the first one-half of July was over 1.5 times normal and produced rapid increases in water levels in Lake Okeechobee and the Water Conservation Areas. This regional and local water input resulted in increased inflows to the Refuge in mid-June, and combined with direct rainfall, raised water stages in the Refuge from an average of 15.04 ft. in May to 16.82 ft. in July 2003 (**Table 1**). It is important to note that both the July 2002 and October 2001 events occurred during periods when water levels increased rapidly after a period of low water levels. In fact, since the Interim Level went into effective in February 1999, 6 of 7 exceedances were associated with increases in stage from the previous month of 0.5 to 1.3 feet. This pattern

does not appear to be random, and suggests that marsh TP levels do not respond as quickly to the dilution effects of increasing stage as is predicted by the equation used to calculate the Interim Level.

The data in **Table 2** also show phosphorus concentrations entering the Refuge during the June to July 2002 period of increasing inflows. For a brief period from June 21 to 27, 2002, G300 and G301 discharged relatively small volumes of untreated water into the L7 and L40 canals in the Refuge. From mid-June to mid-July, G302 contributed high TP concentrations and flows to STA-1W. Inflows to the Refuge from STA 1W through G251 and G310 showed much lower phosphorus concentrations after treatment by the STA and contributed substantial volumes particularly during the period from June 18 to July 16, 2002. The STA-1W inflow concentrations during this same period are consistent with the annual mean for WY 2002 of 38 ppb (2003 Everglades Consolidated Report, Chapter 4A). Inflows to the Refuge from the ACME basins were rich in phosphorus but flow amounts were much smaller than other inflows.

It is also informative to examine monthly data from the 14 individual stations in the Refuge (see **Table 3**) for the period between January 2001 and December 2002. Six stations showed increased TP levels in July 2002 after experiencing very low water levels in the May to June 2002 period (LOX 3, 4, 5, 9, 10, and 11). This tendency was counterbalanced by 5 stations that experienced low water levels in the May-June timeframe and showed a decreased phosphorus concentration in July relative to June (LOX 6, 7, 8, 13 and 16). Considering the changes at all these stations and the inconsistent pattern seen in the three stations that did not dry out (LOX 12, 14 and 15), we see no obvious pattern of concentration change in Refuge sampling stations associated with proximity to the canal and inflowing nutrients, with the possible exception of LOX 4 (**Table 3**). **Therefore, variation in TP levels due to short-term, natural hydrological and stage dynamics appears to be the primary source of the July 2002 TP exceedance.**

Longer Term Context of TP Inputs to the Refuge: Major changes in TP loading and inflow concentrations to the Refuge have been documented with STA-1W and STA-2 in full flow-through operations. The concentration values in **Table 2** show the major effect that STA treatment has on TP levels; untreated STA inflow water via G302 recorded TP levels far above the 30 – 40 ppb commonly seen in treated STA-1W inflows to the Refuge via G 251 and 310. More reductions can be expected with the completion and full operation of STA-1 East and the additional enhancements to STA-1W contemplated in the Conceptual Plan. When all sources of water entering the Refuge during Water Year 2002 are combined, they have a median concentration of 38 ppb, about one-half the value observed for the 1978-2000 base period (Chapter 2, 2003, Everglades Consolidated Report).

Working in tandem with STA treatment, the EAA BMP Program has resulted in significant reductions in TP loading derived from the Everglades Agricultural Area. Data summarized in Chapter 3 of the 2003 Everglades Consolidated Report documents that EAA phosphorus loads have been reduced 55 % for Water Year 2002, compared to what would have entered the WCAs under similar rainfall periods prior to BMP implementation. Prior to the STAs and the EAA BMPs, approximately 90-100 metric tons TP per year entered the Refuge from the EAA. During normal flow years, implementation of EAA BMPs, and the effectiveness of STA-1W and STA-2 should reduce phosphorus loads from the EAA to the Refuge by about 85%, meeting the load reduction goals contemplated in the Settlement Agreement. In addition, STA-1 East will bring additional water into the Everglades system (via the Refuge) for hydropattern restoration.

Conclusion: The rapid rise in Refuge stage due to inflows and local rainfall caused the interim TP level to decrease dramatically from 16.0 ppb to 9.7 ppb between June and July 2002. While the geometric mean TP concentration during this time period decreased from 13.4 to 11.2 ppb, it nevertheless exceeded the interim TP level by 1.5 ppb. The sharp increase in stage shifted the calculated Interim Level for TP downward while the observed ambient TP levels held within the range of values commonly seen in the Refuge since 1994 during periods with similar water depths. This pattern of exceedances associated with sharp increases in stage has been seen repeatedly in the Refuge since 1999. There is no evidence of any field, laboratory or computational error involved in this event.

For the last eight months (**Table 1**), TP levels have not only achieved interim levels but bettered the long-term levels not scheduled to go into effect until December 2006. Because there have not been two exceedances during the 12-month period ending March 2003, the Refuge is presently in compliance with the Interim Levels of the Settlement Agreement. Given the current TP levels, the hydrological circumstances discussed above (which are analogous to circumstances associated with the rapid rise in water levels seen in 1999, 2000 and 2001), the July 2002 TP exceedance is not indicative of any fundamental change in the nutrient status of the Refuge.

Recommended Actions: No actions are recommended at this time. Appendix B of the Settlement Agreement contemplates potential correction measures in the event the Interim or Long-Term TP Levels are not met in the Refuge. Long-term TP Levels do not go into effect until January 1, 2007. With regard to exceedances of Interim TP Levels, Appendix B (Page B-2) directs only that DEP implement control measures "to meet a maximum annual discharge limitation of 50 ppb for all discharges into the Refuge from the EAA." Outflows from STA-1W during the relevant time period averaged below 50 ppb. In addition, the District and DEP have continued to implement enhancements to the STAs to optimize

performance and this process will continue through the Conceptual Plan. These facts and review of the above information, the incomplete implementation of the STA and BMP programs, and the discussion of these facts and findings with the TOC on June 3, 2003, no immediate actions appear to be warranted. TOC may wish to consider examining the predictive ability of the compliance equations in Appendix B of the Settlement Agreement during periods when stage increases rapidly.

Respectfully Submitted,

Garth Redfield, Ph.D.

Chief Environmental Scientist

Environmental Monitoring and Assessment Department

Timothy Bechtel, Ph.D.

Senior Supervising Environmental Scientist

Distribution List for Electronic and Paper Copies

Principals of the Consent Decree

- Ernie Barnett, Director of Ecosystem Projects,
Florida Department of Environmental Protection;
- Henry Dean, Executive Director,
South Florida Water Management District
- Colonel James May,
U.S. Army Corps of Engineers, Jacksonville
- Mark Musaus, Manager,
ARM Loxahatchee National Wildlife Refuge
- Maureen Finnerty, Superintendent,
Everglades National Park

TOC Representatives

- Garth Redfield, SFWMD
- Frank Nearhoof, FDEP
- William Baxter, USACOE
- Michael Waldon, USFWS
- Michael Zimmerman, NPS

Other Interested Parties

All persons on the TOC electronic mailing list as of June 4, 2003 were provided with an electronic file of this letter and were notified of its posting on the TOC website: <http://www.sfwmd.gov/org/ema/toc/index.html>.

CC Paper Copies:

Carrie Trutwin
Tim Bechtel
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Dee Azeredo
Kirk Burns
Doug McLaughlin
Chip Merriam

Table 1. Loxahatchee National Wildlife Refuge Total Phosphorus Compliance Tracking (updated from April, 2003 report with data through March, 2003).

Month - Year	Geometric Mean Concentration (ppb)	Interim Level (ppb) Effective 2/1/99	Long Term Level (ppb) Effective 12/31/06	Average Stage (ft, NGVD)	Number of TP Samples	Number of Stage Measurements
	(ppb)					
Apr-2001	11.5	21.4	16.9	15.48	6	3
May-2001	18.3	0.0	0.0	14.88	2	3
Jun-2001	15.1	0.0	0.0	15.42	9	3
Jul-2001	11.4	17.2	13.8	15.82	11	3
Aug-2001	10.0	10.1	8.6	16.74	14	3
Sep-2001	9.6	11.1	9.3	16.57	14	3
Oct-2001	8.8	8.3	7.2	17.24	14	3
Nov-2001	6.6	8.3	7.2	17.46	14	3
Dec-2001	7.5	8.9	7.7	16.99	14	3
Jan-2002	6.4	10.4	8.8	16.69	14	3
Feb-2002	7.8	10.7	9.1	16.63	14	3
Mar-2002	7.3	11.5	9.7	16.50	14	3
Apr-2002	7.5	15.6	12.7	15.98	11	3
May-2002	10.0	0.0	0.0	15.04	3	3
Jun-2002	13.4	16.0	12.9	15.94	10	3
Jul-2002	11.2	9.7	8.3	16.82	14	3
Aug-2002	9.0	13.5	11.1	16.22	12	3
Sep-2002	8.2	10.6	8.9	16.66	12	3
Oct-2002	7.5	10.7	9.0	16.64	12	3
Nov-2002	6.9	10.5	8.9	16.66	12	3
Dec-2002	5.9	9.2	7.9	16.93	14	3
Jan-2003	5.7	10.0	8.5	16.76	13	3
Feb-2003	7.5	11.3	9.5	16.54	11	3
Mar-2003	8.0	13.4	11.0	16.23	9	3

Notes: (1) Average Stage is calculated using stage elevations at three stations on the sampling date
(2) Highlighted values indicate months when exceedances occurred

Figure 1. STA-1W Structures & Flow*

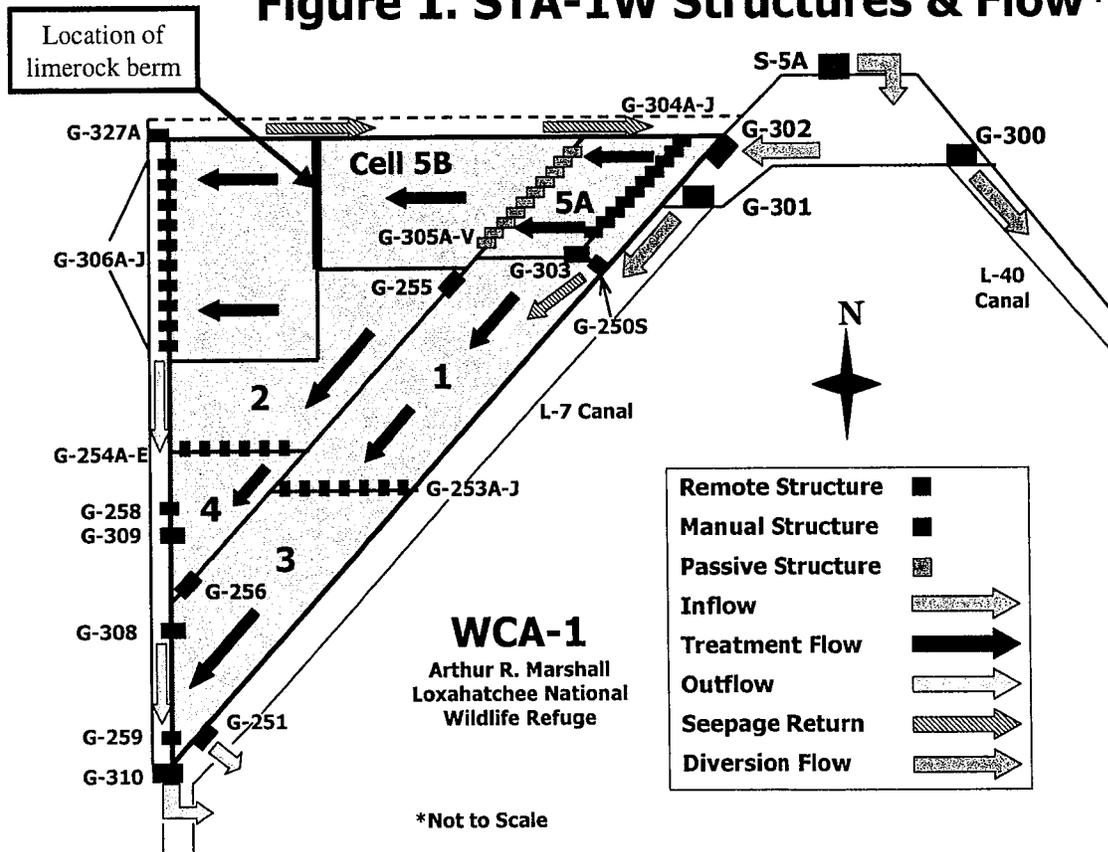


Figure 1. STA-1W Schematic

Tables 2 and 3 are attached as Excel files.

Table 3. Phosphorus levels at individual monitoring stations in the Refuge.

Month_Col	LOX3	LOX4	LOX5	LOX6	LOX7	LOX8	LOX9	LOX10	LOX11	LOX12	LOX13	LOX14	LOX15	LOX16	Geomean
Jan-01				0.006	0.011	0.011			0.009	0.004	0.008	0.007	0.007	0.005	7.21
Feb-01				0.008	0.019	0.013			0.009	0.007	0.011	0.007	0.007	0.01	9.57
Mar-01										0.017	0.022				19.34
Apr-01									0.014	0.011	0.011	0.014	0.009	0.011	11.53
May-01										0.021	0.016				18.33
Jun-01				0.013	0.017	0.02			0.018	0.013	0.017	0.02	0.009	0.013	15.11
Jul-01		0.011		0.013		0.009	0.01	0.009	0.016	0.01	0.017	0.012	0.01	0.011	11.38
Aug-01	0.013	0.015	0.012	0.009	0.01	0.011	0.012	0.01	0.007	0.008	0.01	0.009	0.007	0.01	9.99
Sep-01	0.011	0.013	0.014	0.007	0.011	0.01	0.009	0.008	0.007	0.009	0.012	0.007	0.008	0.012	9.60
Oct-01	0.009	0.01	0.009	0.006	0.011	0.009	0.008	0.008	0.012	0.008	0.011	0.008	0.008	0.008	8.80
Nov-01	0.006	0.006	0.01	0.006	0.008	0.0085	0.007	0.0085	0.01	0.0035	0.0085	0.0025	0.005	0.0085	6.57
Dec-01	0.006	0.006	0.009	0.006	0.007	0.008	0.006	0.008	0.009	0.006	0.024	0.007	0.006	0.006	7.48
Jan-02	0.011	0.007	0.007	0.005	0.006	0.008	0.005	0.005	0.009	0.004	0.008	0.006	0.005	0.007	6.41
Feb-02	0.007	0.009	0.01	0.007	0.009	0.008	0.008	0.008	0.009	0.007	0.008	0.006	0.006	0.008	7.77
Mar-02	0.008	0.008	0.013	0.006	0.007	0.008	0.006	0.006	0.01	0.005	0.008	0.007	0.005	0.008	7.26
Apr-02			0.01	0.007	0.009	0.008	0.008	0.008	0.007	0.009	0.007	0.005	0.007	0.007	7.52
May-02										0.007		0.013	0.011		10.00
Jun-02		0.02		0.012	0.014	0.013			0.013	0.009	0.014	0.015	0.01	0.017	13.37
Jul-02	0.014	0.021	0.011	0.009	0.01	0.01	0.012	0.011	0.013	0.009	0.011	0.014	0.006	0.012	11.22
Aug-02	0.013	0.009	0.01	0.007	0.011	0.007	0.009	0.007	0.011	0.008	0.016	0.007	0.008	0.01	8.99
Sep-02		0.014		0.006	0.008	0.009	0.007	0.007	0.01	0.008	0.016	0.007	0.005	0.007	8.20
Oct-02		0.009	0.009	0.006	0.009	0.009	0.007	0.007	0.008	0.009		0.005	0.005	0.009	7.49
Nov-02		0.009	0.007	0.005	0.006	0.006	0.004	0.012	0.009	0.009		0.006	0.006	0.007	6.87
Dec-02	0.007	0.006	0.006	0.006	0.006	0.007	0.004	0.004	0.007	0.006	0.008	0.005	0.006	0.006	5.90

APPENDIX A

PHOSPHORUS LIMITS FOR INFLOWS INTO EVERGLADES NATIONAL PARK

Attachment I describes interim and long term total phosphorus limits for the combined inflow to Shark River Slough. These limits shall apply to the annual Water Year (October 1 - September 30) flow-weighted-mean concentration of inflows to Shark River Slough, composited across all structures, including S-12A, S-12B, S-12C, S-12D, S-333, and any subsequent inflow points from the WCAs established in the future. Attachment II describes long term discharge limits which will apply to the combined inflow to the Taylor Slough (S-332 and S-175) and Coastal (S-18C) basins. In each basin, long term discharge limits are the limits necessary to meet the OFW water quality criteria as measured at the structures discharging into the Park. These limits will also apply to areas immediately downstream in the Park and will be used to determine compliance. The adequacy of these OFW criteria to meet the State water quality standard Class III criteria (to prevent an imbalance of flora and fauna) will be verified by long term monitoring and research.

If research to determine the numeric value for the Class III narrative nutrient criteria results in a more stringent Park phosphorus limit, then the more stringent inflow limit shall apply.

Effective dates for the phosphorus inflow limits are as follows:

Water Body	Effective Dates
Shark River Slough-Interim Limits	July 1, 1997 <u>October 1 2003</u>
Shark River Slough-Long-Term Limits	July 1, 2002 <u>December 31 2006</u>
Taylor Slough and Coastal Basins	July 1, 2002 <u>December 31 2006</u>
-Long-Term Limits	July 1, 2002 <u>December 31 2006</u>

Phosphorus limits apply to flow-weighted-mean concentrations computed on an annual Water Year basis, with data reported and calculated on a monthly basis. To account for hydrologic variations in Shark River Slough, the limits vary with the previous 12-month's total flow in each basin. The long term limit for Taylor Slough and the Coastal Basin is fixed and does not vary with flow. The limits represent the 10% rejection level of the observed flow-weighted-mean concentration at a given total annual flow, adjusted to a baseline time period of March 1, 1978 to March 1, 1979 for Shark River Slough (OFW baseline). The baseline time period for the Taylor Slough and Coastal Basins is Water Year 1984. Compliance with these limits is expected to provide a long term average flow-weighted mean inflow concentration of approximately 8 ppb for the Shark River Slough Basin and 6 ppb for the Taylor Slough and Coastal Basins. Approximate values are as follows:

	Dry Year (117 Kac-ft/yr)	Wet Year (1061 Kac-ft/yr)
Shark River Slough - Interim Limits		
Flow-Weighted Mean	< 14 ppb	< 9 ppb
Shark River Slough - Long Term Limits		
Flow-Weighted Mean	< 13 ppb	< 8 ppb
Taylor Slough & Coastal Basins - Long Term Limit	is 11 ppb.	

Frequency of samples exceeding 10 ppb within a given 12-month period have also been developed to aid in tracking compliance. Approximate values are as follows:

	Dry Year	Wet Year
Shark River Slough - Frequency Exceedance		
Frequency > 10 ppb	< 70 %	< 40 %
Taylor Slough & Coastal Basins - Frequency Exceedance must be		< 53%

Precise values for the Shark River Slough flow-weighted-mean concentration limits and the frequency at which 10 ppb can be exceeded can be calculated for a given annual flow using the equations given in Attachment I.

A panel of scientists designated by the TOC will track and evaluate compliance with all aspects of state water quality standards including the phosphorus limits, concentration levels and criteria. The represented agencies may request technical assistance from others.

After each additional sampling round at intervals of every other week, the flow-weighted mean will be calculated based upon data from the previous 12 months and compared with the limits corresponding to the previous 12-month's total flow. If the flow-weighted-mean limit is exceeded, the panel will be convened to review recent monitoring data and assess potential causes. Any agency represented on the TOC may request an official review of the monthly mean and frequency calculations for potential violations of the phosphorus limits during the water year.

An exceedance occurs if the flow-weighted-mean concentration for the water year ending September 30th is greater than the 10% rejection level of the computed limit (see Attachments). Based

upon review of trends for flow-weighted means, trends for the frequencies of samples exceeding 10 ppb, and other information found relevant by the panel, the TOC members will forward their opinions and recommendations to their respective agencies for appropriate action. An exceedance will constitute a violation unless the TOC determines there is substantial evidence that it is due to error or extraordinary natural phenomena. A violation of a long term limit shall constitute a violation of this Agreement and of the OFW water quality standard for Park areas immediately downstream of the inflow structures.

Attachment I - Discharge Limits and OFW Standards for Shark River Slough

Interim Discharge Limit:

$$C = 11.16 - .00465Q + 1.397 [6.377 - .00591Q + .00000436Q^2]$$

Long-Term Discharge Limit & OFW Standard:

$$C = 11.38 - .00538Q + 1.397 [2.493 - .00231Q + .00000170Q^2]$$

Frequency Exceedance:

$$F = 48.411 - 0.02896Q + 1.397 [330.1 - 0.3071Q + 0.0002254Q^2]$$

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.

Attachment II - 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.

APPENDIX B

PHOSPHORUS LEVELS AND DISCHARGE LIMITS FOR LOXAHATCHEE NATIONAL WILDLIFE REFUGE

Attachments I and II describe interim and long term total phosphorus concentration levels for the 14 Loxahatchee National Wildlife Refuge interior marsh stations. These concentration levels shall apply to monthly samples collected at 14 interior stations (CA1-3 to CA1-16) (map attached) when the average stage at the CA1-7, CA1-9, and CA1-8C gauges is greater than 15.4 feet msl (mean sea level). Phosphorus concentration levels apply to individual sampling date means. Sample date means represent geometric means, calculated from measurements at all of the 14 stations with sufficient water for accurate sampling. To account for the observed correlation between marsh total phosphorus concentration and stage, the concentration levels vary with the average interior stage on the date of sample collection. Effective dates for the phosphorus concentration levels are as follows:

Interim Marsh Concentration Level (14 station geometric mean)	Effective Date July 1, 1997 <u>February 1, 1999</u>
Marsh - Class III Standard (Applies to entire marsh)	July 1, 2002 <u>December 31, 2005</u>

or

Long-Term Concentration Level
(14 station geometric mean)

Interim Concentration Levels

The interim levels represent the 10% rejection level of the observed 14 station interior marsh mean concentration at a given

mean daily stage, adjusted to a baseline time period of June 1978 - to June 1979. Compliance with these concentration levels is expected to provide a long term mean 14 station interior marsh concentration of approximately 10 ppb. Interim values for the 14 station mean concentration levels can be calculated for a given mean daily stage using the equations given in Attachment I. Approximate values are as follows:

	Low Stage (15.42 ft msl)	High Stage (17.14 ft msl)
Interior Marsh Interim Concentration Levels (14 station geometric mean)	22 ppb	8 ppb

The current control program, consisting of on-line STAs and BMPs, as described in Appendices C and E, is designed to achieve a long-term average annual flow-weighted concentration of 50 ppb for each discharge to the Refuge and WCAs from the EAA. < If the interim, or the lower of the long-term Refuge interior marsh station concentration levels or Class III criteria, are not met with the current control program, DER will require additional components to be added to the control program to meet a maximum annual discharge limitation of 50 ppb for all discharges into the Refuge from the EAA. The range of additional components will include increased STA acreage, more intensive management of STAs, a stronger regulatory program, or a combination of the above, based on actual performance achieved with the initial STA design and operation and the actual performance of BMPs as discussed in Appendices C and E. The State Parties shall not implement more intensive management of the STAs as the sole additional component. DER will modify the permit for

the operation of the Refuge inflow structures to include the additional components of the control program and to establish 50 ppb as a maximum annual discharge limitation which would be enforceable after the additional components are operational.

Class III Criteria

The numerical interpretation of the Class III criteria for total phosphorus for the Refuge shall be determined by a research program designed by a panel of scientists designated by the Technical Oversight Committee. The research program must be recommended by the TOC. Such research shall begin no later than July 1, 1992 and a final report shall be completed no later than ~~July 1, 1997~~ December 1, 2001. The purpose of the research will be to determine water column total phosphorus concentrations above which imbalances in populations of the natural flora and fauna within the Refuge will occur and to determine the numerical interpretation of the Class III nutrient criterion for total phosphorus. Effective ~~July 1, 2002~~ December 31, 2006, the long-term total phosphorus concentration levels for the Refuge will be the 10% rejection level of stations CA1-5, CA1-6 and CA1-16 at a given mean daily stage. These three stations had the lowest geometric mean total phosphorus concentrations during the 1978-1983 baseline period. The long term concentration levels will apply to all 14 stations. Compliance with these concentration levels is expected to provide a long term average 14 station interior marsh concentration of approximately 7 ppb. Precise values for the levels can be calculated for a given

mean daily stage using the equations given in Attachment II. Approximate values are as follows:

	Low Stage (15.42 ft msl)	High Stage (17.14 ft msl)
Interior Marsh - Long Term Concentration Levels (14 station geometric mean)	17	7

If the TOC determines Class III total phosphorus concentration levels are lower than the long term total phosphorus concentration levels then the lower levels shall apply.

~~With respect to STA 1, the original design, in operation by 1997, will include an effective treatment area of 7400 acres. The remaining acreage (4400 effective treatment area acres plus approximately 290 acres for berms, etc.) will be placed in service if the Refuge's long term concentration levels have not been met by the July 1, 2000.~~ If the lower of the Class III or long-term levels is not met by ~~the July 1, 2002~~ December 31, 2006 and the 50 ppb maximum annual discharge limit is being met at all inflow structures into the Refuge from the EAA, the TOC will recommend a lower maximum annual discharge limit for the structures to be enforced by DER. Additional actions, such as regulatory measures and increased STA acreage, as appropriate from the empirical data on performance of each program, will be required by either DER or the District to meet the lower discharge limit.

Compliance Review

A panel of scientists designated by the TOC will track and evaluate compliance with all aspects of state water quality standards including the phosphorus limits, concentration levels and criteria.

The represented agencies may request technical assistance from others. An exceedance occurs if the 14 station mean concentration is greater than the computed concentration level two or more times in any 12 consecutive sample collections. Based upon review of monthly trends for the 14 station mean and other relevant information, the TOC members will forward their opinions and recommendations to their respective agencies for relevant action. An exceedance will constitute a violation of this Agreement and relevant water quality criteria unless the TOC determines there is substantial evidence that it is due to error or extraordinary natural phenomena. If fewer than three sampling date geometric means collected within the past 12 consecutive sampling periods are below the mean interior marsh total phosphorus concentration level during the baseline period, then the panel will be convened to review monitoring data and assess the potential causes and recommend changes in the total phosphorus levels as necessary to meet the objectives of this Agreement.

Attachment I - Interim Marsh Concentration Levels for Loxahatchee
National Wildlife Refuge

Interim Marsh Concentration Levels:

$$C = 11.9187 - .603261S + 1.372[7.5311 - .9247S + .02882758S^2]$$

Terms:

C =The natural log of the geometric mean total phosphorus concentration across 14 marsh stations (CA1-3 to CA1-16).

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 concentration levels. The concentration levels should not apply to dates when the average stage is less than 15.42 feet.

Attachment II - Long Term Marsh Concentration Levels for
Loxahatchee National Wildlife Refuge

Long Term Marsh Concentration Levels:

$$C = 10.7172 - .541156S + 1.372[7.5819 - .9310S + .02902216S^2]$$

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.

APPENDIX C

STORMWATER TREATMENT AREAS (STAs)

The control program described below and in Appendix E is anticipated to meet interim and long term concentration levels and limits for Everglades National Park (Park) and Loxahatchee National Wildlife Refuge (Refuge). The control program is designed to achieve approximately an 80% reduction in phosphorus loads from the Everglades Agricultural Area (EAA) to the Everglades Protection Area (EPA) by ~~July 1, 1997~~ October 1, 2003 and greater than an 85% reduction in phosphorus loads to the Refuge by ~~July 1, 2002~~ December 31, 2006, relative to average annual loads measured in Water Years 1979 through 1988. This objective can be achieved through the combined use of agricultural best management practices (BMPs) and stormwater treatment areas (STAs) designed and operated to maximize phosphorus removal.

Key Assumptions for sizing STAs:

The sizes and locations of the STAs have been determined based upon the following assumptions:

- 1) It is assumed that the BMP Regulatory Program will achieve a 25% load reduction from each EAA watershed. The 25% load reduction will be assured through performance limitations associated with the BMP Regulatory Program. This represents a realistic estimate of the efficiency of a BMP program in removing phosphorus based upon BMP research conducted by the Institute of Food and Agricultural Science.

PUBLIC LAW 104-303—OCT. 12, 1996**WATER RESOURCES DEVELOPMENT ACT OF 1996****SEC. 315. CENTRAL AND SOUTHERN FLORIDA, CANAL 51.**

The project for flood protection of West Palm Beach, Florida (C-51), authorized by section 203 of the Flood Control Act of 1962 (76 Stat. 1183), is modified to provide for the construction of an enlarged stormwater detention area, Storm Water Treatment Area 1 East, generally in accordance with the plan of improvements described in the February 15, 1994, report entitled "Everglades Protection Project, Palm Beach County, Florida, Conceptual Design", with such modifications as are approved by the Secretary. The additional work authorized by this section shall be accomplished at Federal expense. Operation and maintenance of the stormwater detention area shall be consistent with regulations prescribed by the Secretary for the Central and Southern Florida project, and all costs of such operation and maintenance shall be provided by non-Federal interests.