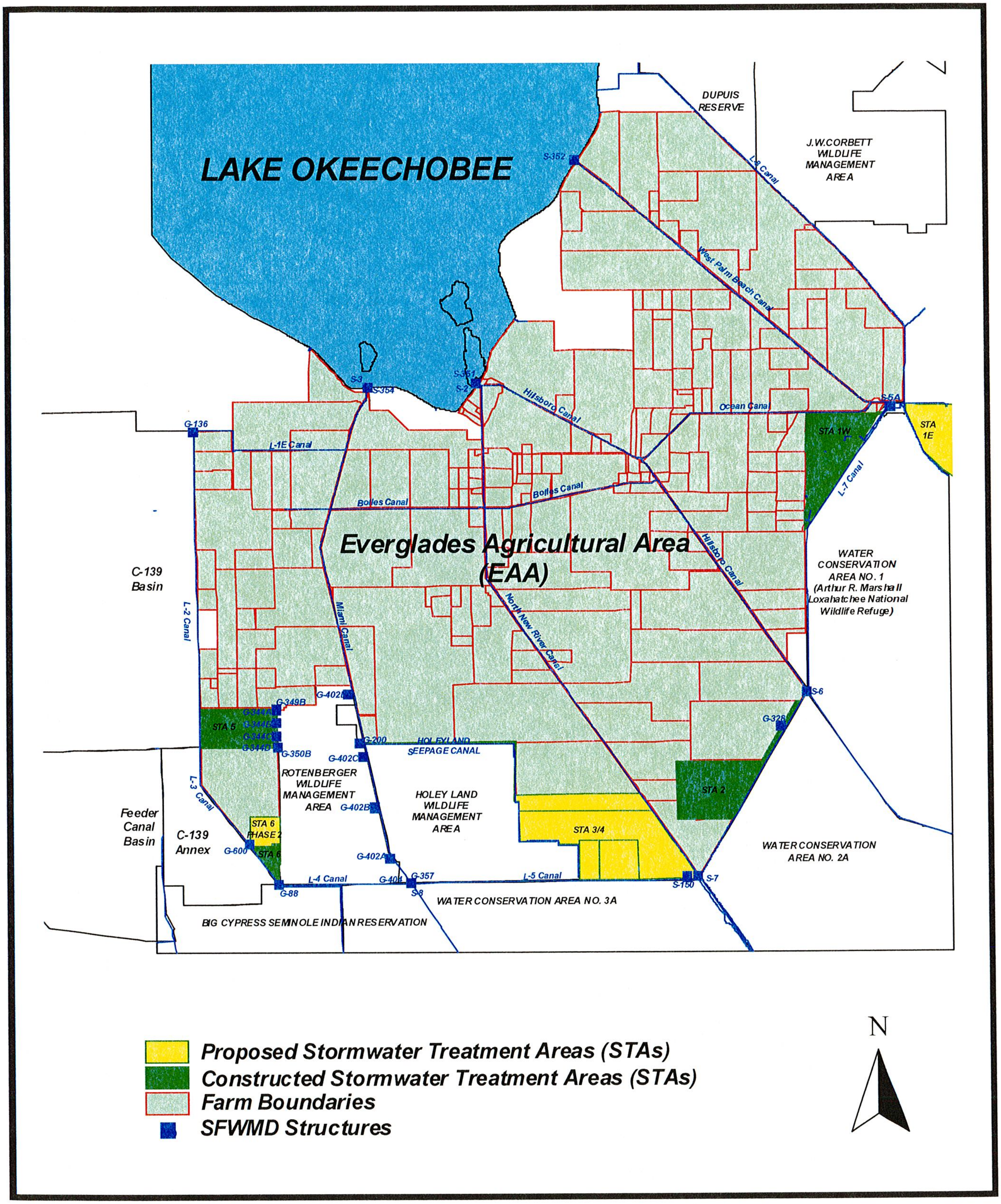
SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Water Year 2003

Everglades Program Best Management Practices

Annual Report



SFWMD Water Control Structures with the Boundaries defined by Chapter 40E-63, F.A.C.

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PERFORMANCE AND OPTIMIZATION OF AGRICULTURAL BEST MANAGEMENT PRACTICES

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EXECUTIVE SUMMARY

Nutrient-rich discharges from the Everglades Agricultural Area (EAA) and the C-139 basin have been identified as contributors to Everglades enrichment and are the primary focus of the Everglades Regulatory Program and the Everglades Construction Project. Substantial efforts in Best Management Practices (BMP) implementation, research, and education have been directed at reducing phosphorus (P) loading at the source as part of the Everglades Regulatory Program. The combined efforts of implementing BMPs and construction of the Stormwater Treatment Areas (STAs) are responsible for a declining trend in the loads and concentrations of total phosphorus (TP) attributable to the EAA basin and conveyed to the Everglades Protection Area (EPA).

The objective of this chapter is to provide an update on the effectiveness of controlling phosphorus at the source through the implementation of BMPs. Information in this chapter and its associated appendices include the current year's data, and recommendations and conclusions which are similar to those presented in previous years. This chapter discusses the methodology for compliance determination for the EAA and C-139 basins and includes a summary of the EAA and C-139 basin-level data and the permit-level data from individual permittee-operated discharge structures within the EAA basin. Permit-level data are not available for the C-139 basin because monitoring for individual permittees in the C-139 basin is optional and voluntary on the part of the permittees and none of them have elected to submit monitoring results for their discharge at this time.

The BMP Regulatory Program in the EAA and C-139 basins, mandated by State of Florida legislation, is one aspect of the South Florida Water Management District (SFWMD or District) Everglades Restoration Program. The overall effectiveness of BMPs in the EAA is best demonstrated by the measured TP load reduction in the basin since BMPs were implemented in Water Year 1996 (WY1996) as compared to a 10-year, pre-BMP base period. The goal of the BMP Regulatory Program is to reduce the TP load from the EAA and C-139 basins. This reduction is determined by comparing measured TP discharges from District structures for each water year (May 1 through April 30) to the pre-BMP base period of October 1, 1978 through September 30, 1988. To factor out variability caused by rainfall, the base period TP discharges are adjusted for differences in the amount and distribution of rainfall for the current period. The

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rule requires the District to evaluate the data collected to assess the general trend in TP load leaving the basins and determine whether the basins are in compliance with the TP load reduction requirement.

The EAA basin has been in compliance since WY1996. The EAA basin is required to reduce P loads by 25 percent when compared to the pre-BMP base period. The observed TP load discharged from the EAA basin is as follows:

- Observed TP load for WY2003, as measured with BMPs in place: 80.8 metric tons
- Base period predicted TP load discharge, adjusted for rainfall: 125.0 metric tons

The relative difference between the WY2003 measured tonnage and the predicted base period tonnage (adjusted for rainfall and prior to BMPs) indicates a 35-percent reduction in TP load. In analyzing data trends, the three-year trend ending with WY2003 equates to a 57-percent reduction of the TP load from the EAA basin, with a three-year, flow-weighted mean concentration of 69 parts per billion (ppb). The latest load reduction continues the trend of consistently exceeding the 25-percent load reduction requirement. In evaluating these data, it is important to note that only a portion of the load from the EAA goes directly to the EPA. The remaining load is apportioned to other receiving bodies, including the STAs, Lake Okeechobee, the Rotenberger Wildlife Management Area, the Holey Land Wildlife Management Area, and the C-51 canal. Additionally, this load reduction is specific to the EAA and does not account for all TP loads entering the Everglades from other sources, including environmental, urban water supply and regulatory releases from Lake Okeechobee, and contributions from "298 Water Control District" diversions, C-139, C-11 West, L-28, the Feeder Canal basin, ACME basin B, the North Springs Improvement District, the North New River Canal basin, C-111, and the STAs. These other sources and their relative contributions are discussed further in Chapter 1, Chapter 8A, and Chapter 8B of the *2004 Everglades Consolidated Report.*

Whereas the BMP program has been implemented in the EAA for several years, Chapter 40E-63, Florida Administrative Code (F.A.C.) was only recently amended (effective January 24, 2002) to include a BMP Regulatory Program in the C-139 basin. Unlike the EAA Regulatory Program's goal of achieving a 25-percent reduction of TP loads from historic baseline levels, the goal of the C-139 BMP Regulatory Program is to maintain TP loads at or below historic baseline levels. As in the EAA basin, the EFA specifically mandates a method to measure and calculate the annual C-139 basin export of phosphorus in surface water runoff from the basin. The initial compliance determination period for the C-139 basin is Water Year 2003 (WY2003) (May 1, 2002 through April 30, 2003). However, because of the initial permitting and implementation periods following the rule adoption, the program was not fully implemented in WY2003. Given these circumstances, the effect of the BMPs on water quality may not have been fully realized in WY2003. Subsequent annual TP loads will be evaluated annually as of April 30 for compliance.

The TP load discharged from the C-139 basin is as follows:

- C-139 basin observed TP load for WY2003: 77.3 metric tons
- C-139 limit load for WY2003, adjusted for rainfall: 70.3 metric tons
- C-139 target load for WY2003, adjusted for rainfall: 39.1 metric tons

To determine C-139 basin compliance, the observed load is compared to the base period target and limit loads predicted with WY2003 rainfall adjustment. The target load represents the basin data at the 50-percent confidence level whereas the limit represents the data at the 90-percent confidence level. If the observed load exceeds the target load for 3 or more consecutive years or exceeds the limit load in any single water year, then the C-139 basin is out of compliance. Since this is the first compliance year, the three-year test is not applicable for determining compliance. The observed load of 77.3 metric tons exceeds the limit load 70.3 metric tons by 7 metric tons. Based on the limit, the C-139 basin is out of compliance for WY2003. This out of compliance determination triggers rule required inspections to verify initial BMP implementation by individual landowners in accordance with their permits.

In addition to the Everglades Regulatory Program, the Everglades Forever Act and Chapter 40E-63, F.A.C. require EAA landowners, through the Everglades Agricultural Area - Everglades Protection District (EAA-EPD), to sponsor a program of BMP research, testing, and implementation to monitor the efficacy of established BMPs. This has been accomplished through the University of Florida Institute of Food and Agricultural Sciences (UF/IFAS) EAA BMP farm scale study sponsored by the EAA-EPD and the Florida Department of Environmental Protection. In addition to collecting data to assess the effectiveness of BMPs, the UF/IFAS research in the EAA includes identification of short- and long-term effects of BMPs on soils and crops, evaluation of specific conductance and dissolved TP in farm discharges, and evaluation of particulate matter in farm and EAA drainage canals. Their results are summarized in this chapter.

INTRODUCTION

A significant component of the Everglades Forever Act (EFA) establishes both interim and long-term water quality goals to ultimately achieve Everglades restoration and protection. As mandated by the EFA, the State of Florida Environmental Regulation Commission (ERC) has set the long-term phosphorus (P) standard for the Everglades based on available research, adopting a P concentration criterion of 10 parts per billion (ppb), although details of how the new criterion will be incorporated into standards for the Everglades Protection Area (EPA) are still being considered. The long-term goal is to combine point source, basin-level, Stormwater Treatment Area (STA) optimization and regional solutions in a systemwide approach to ensure that all waters discharged to the Everglades are achieving water quality goals. The interim design goal encompasses current activities, the Everglades Regulatory Program, and the Everglades Construction Project (ECP) to achieve an annual average total phosphorus (TP) discharge concentration of 50 ppb for the final discharge from the ECP (STA outflow). Surface water tributary sources to the ECP (STA inflows) include the discharges from the EAA basin, "298 Water Control District" diversions from Lake Okeechobee, the C-139 basin, and normal environmental, water supply, and regulatory releases from Lake Okeechobee. These locations are illustrated in **Figure 3-1**.

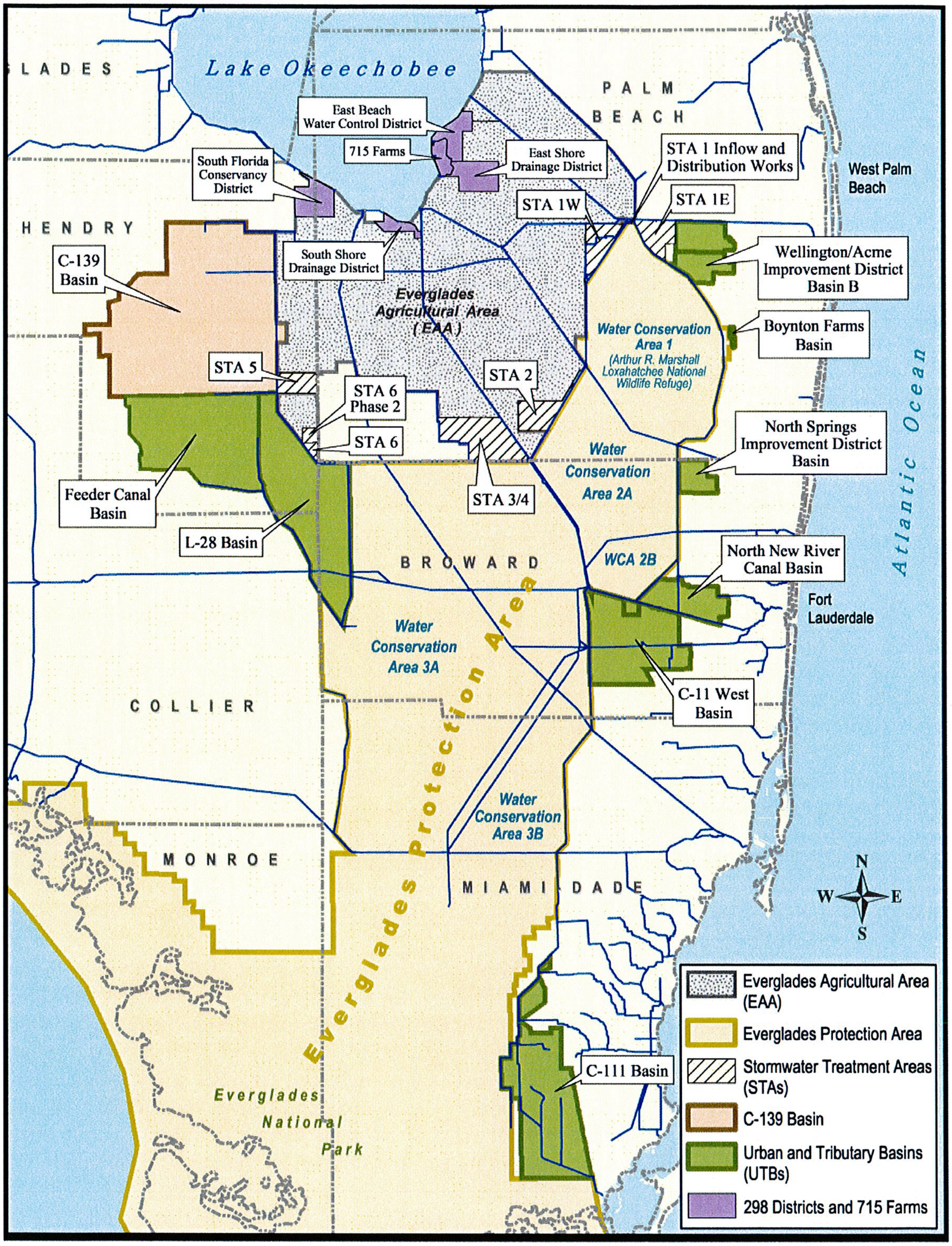

Figure 3-1. The Everglades Agricultural Area (EAA), C-139, and other tributary basins to the Everglades Protection Area (EPA).

Agriculture is the predominant land use in both the EAA and the C-139 basins. Nutrient-rich water from both areas contributes to Everglades enrichment and is the primary focus of the Everglades Regulatory Program and the ECP. The Everglades Regulatory Program provides for the implementation of Best Management Practices (BMPs) as a point-source treatment upstream of the STAs. The STA designs are based on the premise that the EAA basin discharges should have a 25-percent reduction, and the C-139 basin should not exceed the historic TP load when compared to the pre-BMP base period of October 1, 1978 through September 30, 1988, after proportional adjustments are made for rainfall variability.

The EAA basin covers approximately 500,000 acres located south of Lake Okeechobee within eastern Hendry and western Palm Beach counties, an area of approximately 1,122 square miles of highly productive agricultural land comprised of rich organic peat or muck soils. The area is considered to be one of Florida's most important agricultural regions with approximately 77 percent of the EAA devoted to agricultural production. The major crops in the EAA basin include sugar cane, vegetables, and sod, with secondary crops in rice and citrus. Under the ECP conceptual design, all discharges from the EAA basin to the Everglades will pass through Stormwater Treatment Areas 1 West, 2, and 6 (STA-1W, STA-2, and STA-6) and will eventually also discharge through STA-3/4 and STA-1 East when construction is complete during late 2003 and 2004, respectively. The BMP Regulatory Program, initiated in the EAA in 1992 and having reached full BMP implementation by EAA basin landowners in 1996, has resulted in annual TP loads from the EAA basin that have consistently been reduced by levels greater than those required by rule.

The C-139 basin covers approximately 170,000 acres located southwest of Lake Okeechobee entirely within eastern Hendry County west of the EAA basin. A majority of the C-139 basin currently discharges to the Everglades through STA-5. A planned expansion of STA-6 (Section 2) is scheduled for completion in 2006 and will receive the remaining portions of C-139 basin loads prior to discharging to the Everglades. Amendments to Chapter 40E-63, Florida Administrative Code (F.A.C.), effective January 24, 2002, require implementation of a BMP Regulatory Program in the C-139 basin in accordance with the EFA. The rule establishes a compliance methodology similar to that of the EAA basin to determine the annual average TP load limitation for the C-139 basin and a plan for BMP implementation to minimize TP in offsite discharges, although there is not a corresponding 25-percent load reduction requirement. The amendments require basin landowners to obtain permits for BMP plans and report annually to the District on the status of BMP implementation. WY2003 is the first year of compliance determination for the C-139 basin.

The implementation of BMPs is the cornerstone of P source control in the EAA and in the C-139 basins. BMPs have been implemented in the EAA basin for eight complete compliance years and have proven successful. Additionally, ongoing BMP research, initiated as early as 1992 in the EAA basin, continues to confirm varying degrees of effectiveness in TP reduction through the implementation of combinations of water management practices, fertilizer application control practices, and particulate matter control practices. This chapter presents a summary of the Everglades Regulatory Program, describes the BMPs implemented, explains the compliance methodology, updates data summaries, and summarizes the findings of the ongoing University of Florida Institute of Food and Agricultural Sciences (UF/IFAS) research on BMPs. It is hoped that similar water quality improvements through implementation of BMPs will also be realized in urban areas that are tributary to the EPA. Chapter 8B presents a further discussion on how implementing BMPs is one of several strategies being administered in the urban and tributary basins within the Everglades Stormwater Program (ESP).

UPDATE ON EVERGLADES REGULATORY PROGRAM

The Everglades Regulatory Program, Chapter 40E-63, F.A.C. ("Rule 40E-63") states that users of Everglades Works of the District (EWOD) within the EAA and C-139 basins require a permit. Rule 40E-63 permits approve a BMP plan and a water quality monitoring plan for each sub-basin as applicable. The regulated areas are described by rule and thus remain static.

Currently, there are 33 EAA basin EWOD permits, including approximately 205 sub-basins and 286 privately owned water control structures discharging into the District canals in the EAA and encompassing an area of approximately 500,000 acres (**Figure 3-2**). Most of the sub-basins have muck soils and a highly managed drainage system utilizing pumps. The areas represented by single permits vary substantially between 120 and 92,000 acres. There are annual differences in the total permitted acreage, typically as the result of acreage being removed from permits as areas are converted from agricultural production to STAs.

There are currently 24 EWOD permits in the C-139 basin which include approximately 47 sub-basins encompassing an area of approximately 170,000 acres (**Figure 3-3**). Water is discharged from the sub-basins primarily by gravity discharge through sandy soils. The areas represented by single permits vary from 194 to 60,491 acres.

BEST MANAGEMENT PRACTICE PLANS

Each EWOD permit approves an onsite implementation plan for BMPs (BMP plan). The BMP plan includes operational programs or physical enhancements designed to reduce P levels in discharges to the EWOD. The District is responsible for ensuring that a base level of BMPs is established for each permit area and that BMP plans between different permittees are consistent and comparable. To accomplish this task, a system of BMP "equivalents" was developed by assigning points to BMPs within four basic categories consisting of water management practices, nutrient management practices, control of sediment and particulate matter, and pasture management. Points were originally based on the review of reports and publications produced by UF/IFAS, on the best professional judgment of District staff, and extensive cooperative workshops conducted among affected landowners, consultants, and the general public. The BMP points system has proven successful in ensuring a consistent base level of BMPs between permitted areas.

The minimum level of BMP plan implementation in the EAA and C-139 basins is established by rule as BMP equivalents or points. By using the BMP-equivalents approach, each permittee has the flexibility to develop a BMP plan that is best suited for site-specific soil types, hydrology, and crop conditions. For each proposed BMP, the permittee must consider how the BMP will be implemented, how staff responsible for BMP implementation will be trained, and how BMP implementation will be documented. If either basin is determined to be out of compliance, then there is a system outlined by rule for increasing the level of BMP implementation. A summary of the general categories available for BMP implementation is presented in **Table 3-1**. A more detailed listing of BMP practices and the points available for each practice is presented in the Appendix, Table 2.

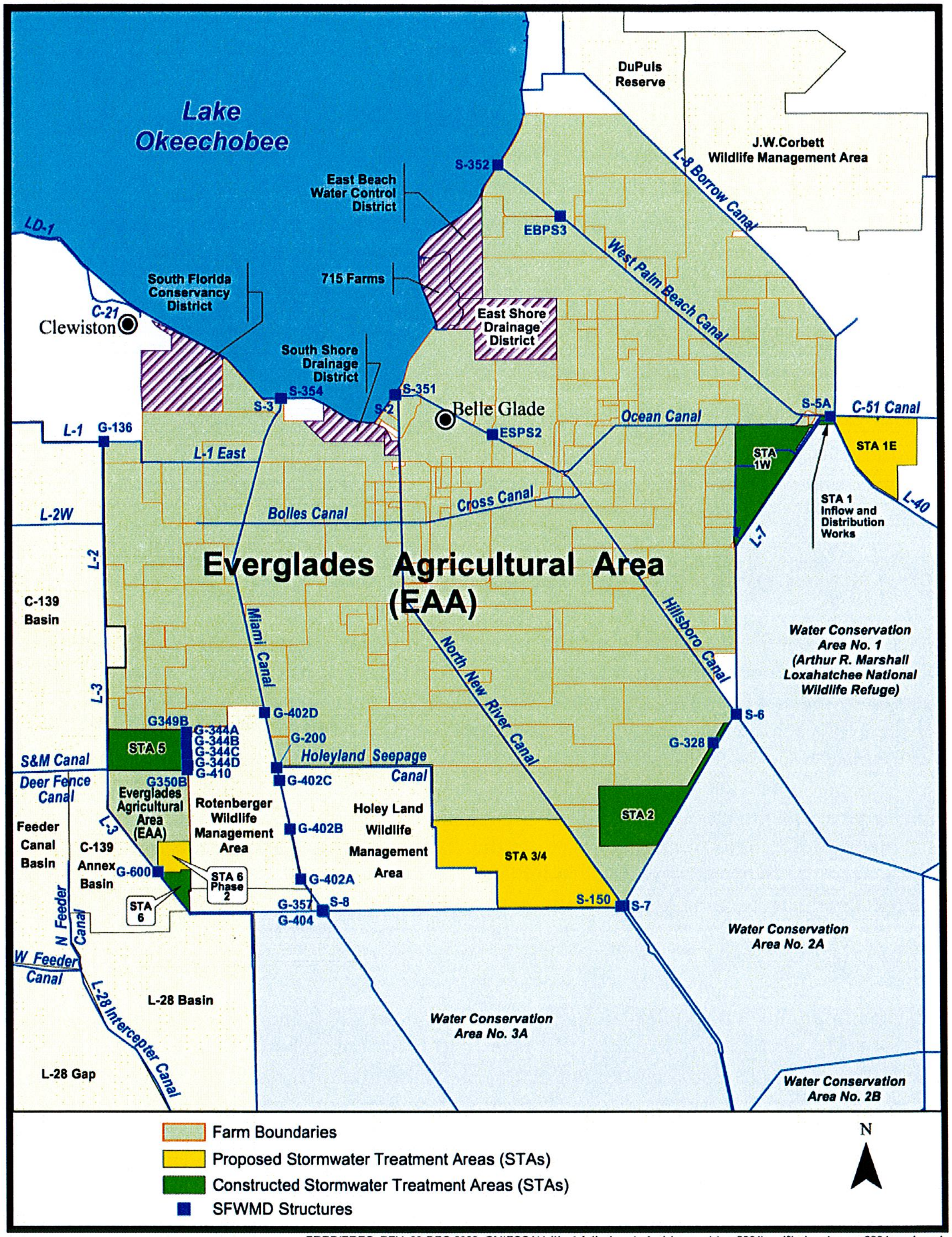

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Figure 3-2. The Everglades Agricultural Area (EAA) basin and primary compliance water control structures within the 40E-63 boundary.

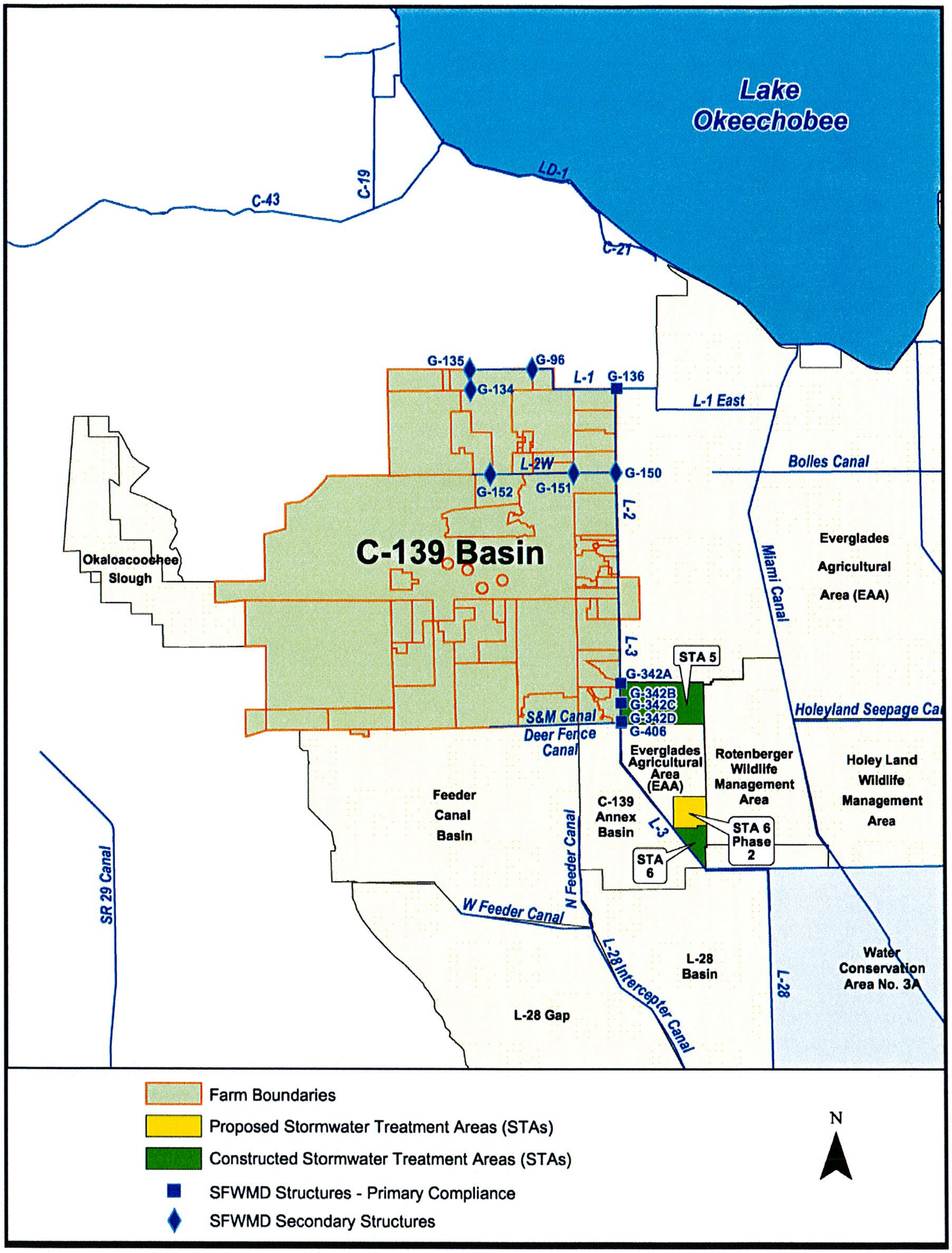

Figure 3-3. The C-139 basin and primary compliance water control structures within the 40E-63 boundary.

Table 3-1. Best Management Practice (BMP) summary and "BMP equivalent" points for the EAA[1] and C-139[2] basins.

BMP	PTS	DESCRIPTION
Nutrient Control Practices	2 ½ -15	Minimizes the movement of nutrients offsite
Nutrient Management Plan (Levels I&II, III, IV)	15 - 35	Managing the amount, source, placement, form, and timing of the application of nutrients on lands with cattle operations.
Water Management Practices	5 - 35	Minimizes the volume of offsite discharges
Particulate Matter and Sediment Controls	2 ½ - 15	Minimizes the off-site movement of particulate matter and sediments
Pasture Management	2 ½ - 10	On-farm site operation and management practices

Notes:

A BMP plan is required for each land use or crop, and shall be implemented across the entire farm acreage (drainage area).

[1] For the EAA, a minimum of 25 points are required for each BMP plan.

[2] For the C-139 basin, the minimum required points for each BMP plan are based on compliance status:

- Level I: Initial phase 15 points for each BMP plan.
- Level II: First incidence out of compliance, no additional BMPs; however, onsite verification of BMPs begin. Frequency of visits isbased on compliance record.
- Level III: Second incidence out of compliance; 10 additional BMP points for each BMP plan (25 points total).
- Level IV: Third incidence out of compliance; 10 additional BMP points for each BMP plan (35 points total).

The initial minimum levels of BMP implementation for the EAA and C-139 basins are 25 and 15 points, respectively. Additional levels of BMP practices to further reduce TP loads are required if the basins are shown to be out of compliance. Because the EAA basin has remained in compliance with the load reduction requirement, the permittees continue to implement the rule's required minimum of 25 points in BMP practices.

For the C-139 basin, the rule requires four specific levels of implementation, designated as Levels I, II, III, and IV. Level I is the initial level for BMP plan implementation and requires the selection of 15 points as a condition of permit issuance. The first time that compliance loads for the C-139 basin are collectively exceeded (i.e., if the C-139 basin is out of compliance), Level II is triggered. The rule does not require additional BMPs to be implemented under Level II but does require inspections to verify BMP implementation. If there is a second occurrence wherein the C-139 basin is out of compliance, then Level III is initiated. This level requires an additional 10 points of BMPs, bringing the total to 25 points. If the C-139 basin is out of compliance a third time, then Level IV is initiated. This level also requires an additional 10 points of BMPs, bringing the total to 35 points. If the C-139 basin is out of compliance a fourth time, then the District must initiate a rulemaking effort to establish a program to bring the C-139 basin into compliance.

Post-permit compliance activities include verification of the implementation of the approved BMP plans by review of BMP implementation reports prepared by the permittee and in-field visual observations and review of documentation. Onsite verifications allow the District staff to discuss BMP strategies and optimization of current BMP practices with permittees. Inspections in the C-139 basin will begin in late 2003 to verify that the initial levels of BMPs are implemented.

COMPLIANCE DETERMINATION

The primary means for determining the success of the Rule 40E-63 program is through District data collection at the EAA and C-139 basin level. Data from District structures are used to calculate the measured TP load discharged from each basin. TP load, as opposed to TP concentration, is a more representative measure of compliance for the basins, because it accounts both for concentrations and volume.

Discharge quantity is recorded at all current inflow and outflow points defining the boundary of the EAA and C139 basins. Thirty water control structures define this boundary for the EAA and six for C139. Discharge TP samples are collected at twenty-seven locations in the EAA and six in C139 where the concentrations are deemed to be representative of discharges for all boundary structures. All monitoring locations in the EAA and C139 are equipped with automatic samplers. During discharge events, TP samples are collected primarily by automatic samplers thatare programmed to collect samples on a flow proportional basis. The samples are collected regularly from the autosamplers (generally every seven days) and the samples are composited at the end of the collection period. Grab samples are also collected at the end of each period, regardless of whether flow has occurred, as a backup source of data for the autosamplers.

During WY03, 620 TP samples were collected by autosampler and 1091 were collected by grab methods for the EAA. For the C139 basin, 162 composite samples were collected by autosampler and 306 samples were collected by grab methods.

EAA Basin

Within the EAA basin, monitoring is mandated by the rule at two levels:

1. EAA basin-level monitoring by the District
2. Individual sub-basin or farm-level monitoring by the owner/operator of private water control structures discharging within the EAA basin

For primary compliance, the EAA basin must demonstrate a 25-percent reduction in TP load annually compared to the pre-BMP base period. Basin-level monitoring includes the following structures: S-2/351 complex, S-3/354 complex, S-352, S-5A complex, S-6, S-7, S-150, S-8, G-136, G-200, G-328, G-344A, G-344B, G-344C, G-344D, G-349B, G-350B, G-600, G-410, G-402A, G-402B, G-402C, G-402D, G-404, G-357, EBPS3, and ESPS2 (**Figure 3-2**). The TP loads measured at these structures collectively determine primary compliance for all EWOD permits.

A secondary method of program compliance measurement is through individual sub-basin ("permit-level" or "farm-level") water quality monitoring conducted by the permittee. Permit-level monitoring is required by the rule but will only be used for compliance determinations if the EAA basin does not meet the 25-percent load reduction requirement. Permit-level data are also used to determine credits toward the Everglades Agricultural Privilege Tax mandated by the EFA. A summary table of the tax credits is presented in the Appendix, Table 3. Although permittee water quality monitoring results are not used to calculate the TP reduction at the EAA basin level, permit-level data for individual permittees are presented in the Appendix, Table 1.

C-139 Basin

Within the C-139 basin, monitoring is described by the rule as follows:

1. C-139 basin-level monitoring by the District mandated by the rule
2. Individual sub-basin or farm-level monitoring by the owner/operator of private water control structures discharging within the C-139 basin (described in the rule as optional)

In contrast to the EAA basin, primary compliance is based on the C-139 basin not exceeding the collective average annual TP load occurring during the baseline period. The determination requires annual calculation of the TP load leaving the outflow structures from the C-139 basin. Discharge TP concentrations and flow quantity are recorded at all outflow points, including the following structures: G-136, G-342A, G-342B, G-342C, G-342D, and G-406 (**Figure 3-3**). As in the EAA basin, the TP loads measured at these structures collectively determine primary compliance for all C-139 EWOD permits.

Similar to the EAA, the rule allows a secondary method of compliance for the C-139 basin determined through individual sub-basin (permit-level or farm-level) water quality monitoring conducted by the permittee. Under the Optional On-Farm Discharge Monitoring Program, owners/operators of private water control structures discharging within the C-139 basin may voluntarily monitor the discharge from their farms or sub-basins. Participants may also elect to discontinue voluntary participation at any time by submitting an application to modify their permit. In the event that the C-139 basin is found to be out of compliance, participants in the optional program will not be required to perform additional BMPs as long as the District determines that they have not exceeded their proportional share of the total C-139 basin TP load. Currently, no owners/operators of private water control structures discharging within the C-139 basin have elected to participate in the voluntary program.

BASIN-LEVEL MONITORING RESULTS

TP load reduction measurements are conducted and reported annually. The EFA specifically mandates a method to measure and calculate the annual basin export of TP in surface water runoff from EAA and C-139 lands (farms, cities, and industry). These calculations are measured using an adjustment for the hydrologic variability associated with rainfall and surface water discharges over time. These adjusted equations, calibrated to the base period Water Years 1980 through 1988 (WY1980-1988) (May 1, 1979 to April 30, 1988), attempt to predict what the average annual TP load would have been for the basins if the current water year's rainfall amount and monthly distribution had occurred during the base period. Compliance is determined by comparing the observed TP loads for the current year to the predicted TP loads from the base period.

EAA Basin

Since the implementation of BMPs required by the Everglades Regulatory Program, TP loads from the surface water runoff attributable to the lands within the EAA basin have shown a declining trend. To interpret TP measurements taken at inflow and outflow water control structures for the EAA basin (**Figure 3-2**), it is important to recognize that water leaving the EAA basin through these structures is a combination of EAA farm- and urban-generated runoff and water passing through the EAA basin canals from external basins. This "pass through" water includes discharges from Lake Okeechobee and from "298 Water Control District" diversion areas (refer to Chapter 4A for a description of the ECP diversion projects). These other sources influence the water quality within the EAA. For example, when compared on a water-year-by-water-year basis Lake Okeechobee discharges to the EAA typically have had higher TP concentrations than EAA basin discharges since the full implementation of BMPs in WY1996. Therefore, separate accounting of TP loads from various sources is required to develop accurate conclusions about TP loads originating from the EAA basin (refer to Chapter 8A for further discussion). The reported TP loads attributed to the farms, cities, and industries within the EAA basin should not be confused with the TP load being delivered to the Everglades. In fact, much of the flow leaving the EAA basin currently discharges to an STA for further treatment. With the completion of STA-3/4, all flow leaving the EAA basin will discharge to an STA prior to entering the Everglades. The accounting of tributary sources and flow configurations to the Everglades is complex. A comprehensive discussion of other sources and TP loads discharged to the Everglades for WY2003 is presented in Chapters 8A and 8B of the *2004 Everglades Consolidated Report.*

Basin Annual Phosphorus Measurements and Calculations

The first year of the 25-percent reduction compliance measurement mandated by statute occurred during WY1996 (May 1995 through April 1996). The EAA basin TP loads and concentrations are determined in accordance with procedures specified in the Everglades Regulatory Program (Rule 40E-63, Appendix A, F.A.C.) and the EFA. A summary of the WY2003 compliance calculation for the observed and predicted TP loads is provided in **Table 3-2**. The overall TP loads, flows, and flow-weighted TP concentrations at all inflows and outflow structures is summarized in **Table 3-3**.

The compliance-related data for all calculated years are summarized in **Table 3-4** including average concentration, the observed and predicted TP load (base period rainfall adjusted) data for the EAA, TP load reduction calculations and annual rainfall and flow measurements. The TP values presented in **Table 3-4** are attributable only to the EAA basin (farms, cities, and industry) and do not represent the cumulative TP being discharged to the Everglades from all sources. Although the data include TP concentrations, only the TP load is used to determine compliance.

Table 3-2. Summary of EAA total phosphorus (TP) basin compliance calculations.

WY2003 EAA Total Phosphorus Load	
Estimated TP load from the EAA during the base period years adjusted for WY2003 rainfall amount and distribution (1979 to 1988)	125.0 mt
Actual WY2003 TP load from the EAA with BMPs implemented	80.8 mt
WY2003 TP load reduction (relative difference)	35%
Three-year average TP load reduction	57%

WY2003 EAA Total Phosphorus Concentration	
Actual annual average EAA TP concentration prior to BMP implementation (1979 to 1988)	173 ppb
Actual WY2003 TP concentration from the EAA with BMPs implemented	66 ppb
Three-year flow-weighted mean TP concentration	69 ppb

Table 3-3. Summary of EAA TP basin calculations.

EAA Related Loads by Structure
Water Year 2003

This table represents the flows and loads at each structure leaving and entering the EAA. It does not attempt to make a determination as to where the loads originate.

EAA to Lake

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
S3	0.40	1.90	168
S2	0.23	0.93	199
S352	0	0.00	N/A
Total	**0.62**	**2.83**	179

Lake to EAA

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
S354 (S3)	6.81	70.09	79
S351 (S2)	27.41	256.25	87
S352	101.11	427.02	192
Total	**135.33**	**753.36**	146

EAA to WCAs

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
S8	29.42	291.69	81.62
G404	6.62	92.60	57.86
G357	0.00	0.00	N/A
S150	4.09	68.67	48.16
S7	9.67	142.93	54.77
Total	**49.80**	**595.89**	68

WCAs to EAA

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
S8	0.00	0.00	0.00
G404	0.00	0.00	N/A
G357	0.00	0.00	N/A
S150	0	0.00	0.00
S7	0.49	17.18	23.03
Total	**0.49**	**17.18**	23

EAA to STA1W Distribution Works

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
S5A	**120.99**	**630.07**	156

C-51 to EAA

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
S5AW	**0.08**	**2.22**	30

EAA to STA2

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
S6	21.46	276.75	62.75
G328	0.29	5.98	38.96
Total	**21.75**	**282.73**	62

STA2 to EAA

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
S6	0.00	0.00	N/A
G328	0.00	0.00	N/A
Total	**0.00**	**0.00**	N/A

EAA to STA6

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
G600	**5.48**	**56.25**	79

STA6 to EAA

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
G600	**0.00**	**0.00**	N/A

EAA to STA5

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
G344 (a,b,c,d)	0.000	0.00	N/A
G349B	0.00	0.00	N/A
G350B	0.001	0.014	74.70
Total	**0.001**	**0.014**	74

STA5 to EAA

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
G344 (a,b,c,d)	26.56	160.52	133.92
G349B	0.00	0.00	N/A
G350B	0.00	0.00	N/A
Total	**26.56**	**160.52**	134

EAA to Rotenberger

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
G410	6.57	54.31	97.83
G402(a,b,c,d)	0.00	0.00	N/A
Total	**6.57**	**54.31**	98

Rotenberger to EAA

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
G410	0.00	0.00	N/A
G402(a,b,c,d)	0.77	25.41	24.57
Total	**0.77**	**25.41**	25

EAA to Holeyland

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
G200	**4.33**	**45.89**	76

C-139 to EAA

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
G136	**4.97**	**15.15**	266

298 Districts to EAA

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
EBPS	6.15	16.17	308.08
ESPS	3.61	32.61	89.60
Total	**9.76**	**48.77**	162.02

EAA Total Outflows

Load(mtons)	Flow (kac-ft)	Conc. (ppb)
209.54	**1667.99**	**101.84**

EAA Total Inflows

Load(mtons)	Flow (kac-ft)	Conc. (ppb)
177.97	**1022.61**	**141.09**

Table 3-4. WY1980 through WY2003 EAA basin TP measurements and calculations.

Water Year	TP Annual Average Conc. (ppb)	Observed TP Load (mt)	Predicted TP Load[1] (mt)	% TP Load[2] Reduction	Annual Rain (in)	Annual Flow (kac-ft)	% Acres With BMPs	Base Period	Pre-BMP Period	LOK SWIM[3] BMPs	Everglades Rule BMPs
1980	116	167	154	-9%	53.50	1,162	0				
1981	126	85	98	13%	35.05	550	0				
1982	242	234	255	8%	46.65	781	0				
1983	195	473	462	-2%	64.35	1,965	0				
1984	155	188	212	11%	49.83	980	0				
1985	225	229	180	-27%	39.70	824	0				
1986	151	197	240	18%	51.15	1,059	0				
1987	183	291	261	-12%	51.97	1,286	0				
1988	161	140	128	-9%	43.43	701	0				
1989	197	183	274	33%	39.68	750	0				
1990	177	121	120	-1%	40.14	552	0				
1991	206	180	219	17%	50.37	707	0				
1992	94	106	179	41%	47.61	908	0				
1993	157	318	572	44%	61.69	1,639	0				
1994	112	132	160	17%	50.54	952	15				
1995	115	268	388	31%	67.01	1,878	63				[5]
1996	98	162	503	68%	53.86	1,336	100	First Compliance Year[4]			
1997	99	122	240	49%	52.02	996	100				
1998	102	161	244	34%	56.12	1,276	100				
1999	123	128	249	49%	43.42	833	100				
2000	119	193	425	55%	57.51	1,311	100				
2001	64	52	195	73%	37.28	667	100				
2002	77	101	227	55%	49.14	1,071	100				
2003	66	81	125	35%	45.55	992	100				

Table 3-4 Notes:

[1] "Predicted TP Load" represents the base period load, adjusted for rainfall variability. Load is calculated using *measured* flow and concentrations. When comparing loads between the water year (WY) and the base period, there is a confidence interval for the percent reduction value associated with the adjustment for rainfall variability. This confidence interval represents the uncertainty relative to the prediction model.

[2] "%TP Load Reduction" values for WY1980-1989 represent the model calibration period.

[3] Lake Okeechobee Surface Water Improvement and Monitoring. Lake Okeechobee SWIM BMP Program, 1992-1993, gave BMP credit for the following:

- Initiation of deep-well injection of domestic wastewater from Belle Glade, South Bay, and Pahokee
- Pump BMPs in S-2 and S-3 basins

[4] First year of compliance measurement, WY1996.

[5] The dashed vertical line indicates the period for which BMPs were not fully implemented (WY1992–1995).

Figures 3-4 through **3-8** represent the EAA basin TP data graphically. Each bar in **Figure 3-4** represents the percent TP load reduction for each water year, including the calibration base-period years. In **Figure 3-5**, each bar represents the actual measured (observed) annual TP tonnage from the EAA basin in each water year, and the line represents the annual TP tonnage predicted (rainfall adjusted) by the rule-mandated methodology. The annual percent reduction of TP is calculated as the relative difference between the actual measured (bar) EAA basin TP load and the predicted (line) base period TP load (adjusted for rainfall). The EAA basin percent TP load reduction trend is presented in **Figure 3-6**. The solid line shows the three-year trend of percent load reduction. The ♦ symbol represents the annual measurements. An upward trend shown as the solid line in **Figure 3-6** denotes a reduction in TP loads, that is, an improvement in the water quality of the EAA discharges. **Figure 3-7** shows the cumulative observed TP load reduction, as well as the cumulative EFA mandated 25-percent reduction. As this chart indicates, the EAA basin has outperformed its mandated goal. In the eight years that the program has been fully implemented, the discharge of more than 1,200 metric tons (mt) of TP was prevented from leaving the EAA basin as runoff compared to what would have been expected under the same hydrologic conditions during the base period. This exceeds the annual mandated 25-percent TP load reduction, equating to a cumulative reduction of over 550 mt since WY1996 if only the minimum level of TP load reduction had been achieved annually. The TP concentrations are calculated in addition to the TP load. However, the TP concentrations are not evaluated to determine EAA basin compliance, but flow-weighted concentrations allow for relative comparisons between years. Annual concentrations and three-year trends presented in the *2003 Everglades Consolidated Report* are true "annual flow-weighted" values calculated by dividing the total annual cumulative load by the total annual cumulative flow. **Figure 3-8** shows the TP concentration trends for the EAA discharges.

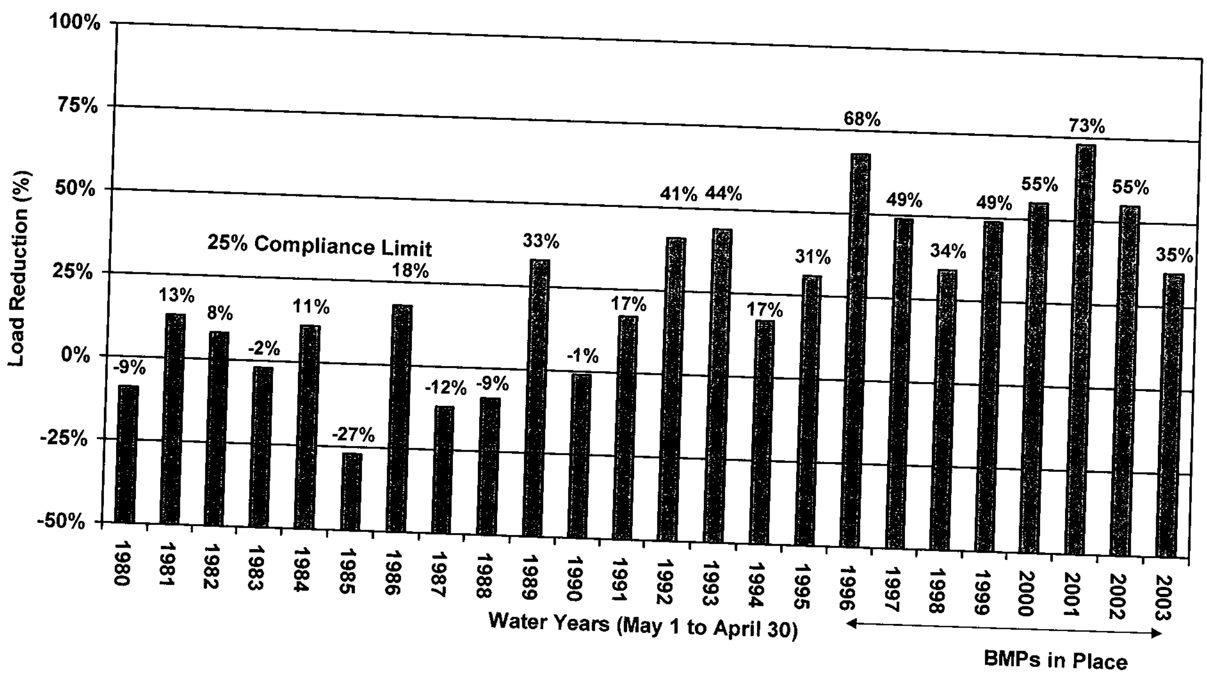

Figure 3-4. EAA basin TP percent reduction.

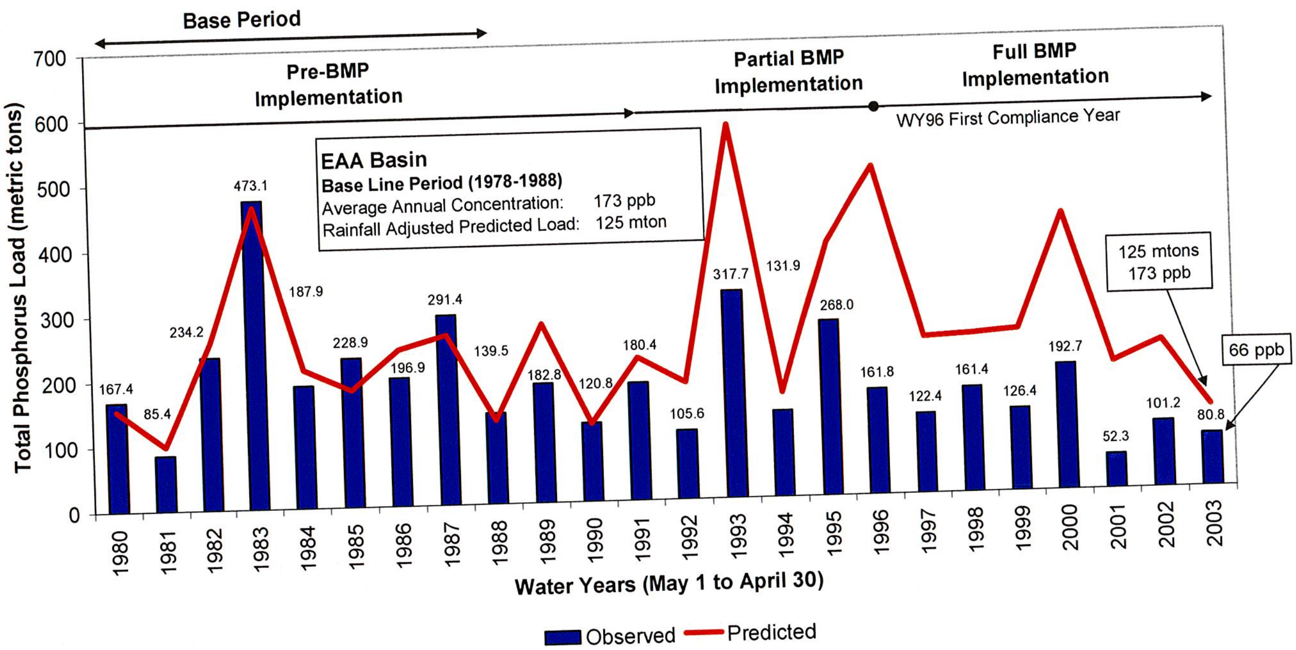

Figure 3-5. EAA basin TP load calculated.

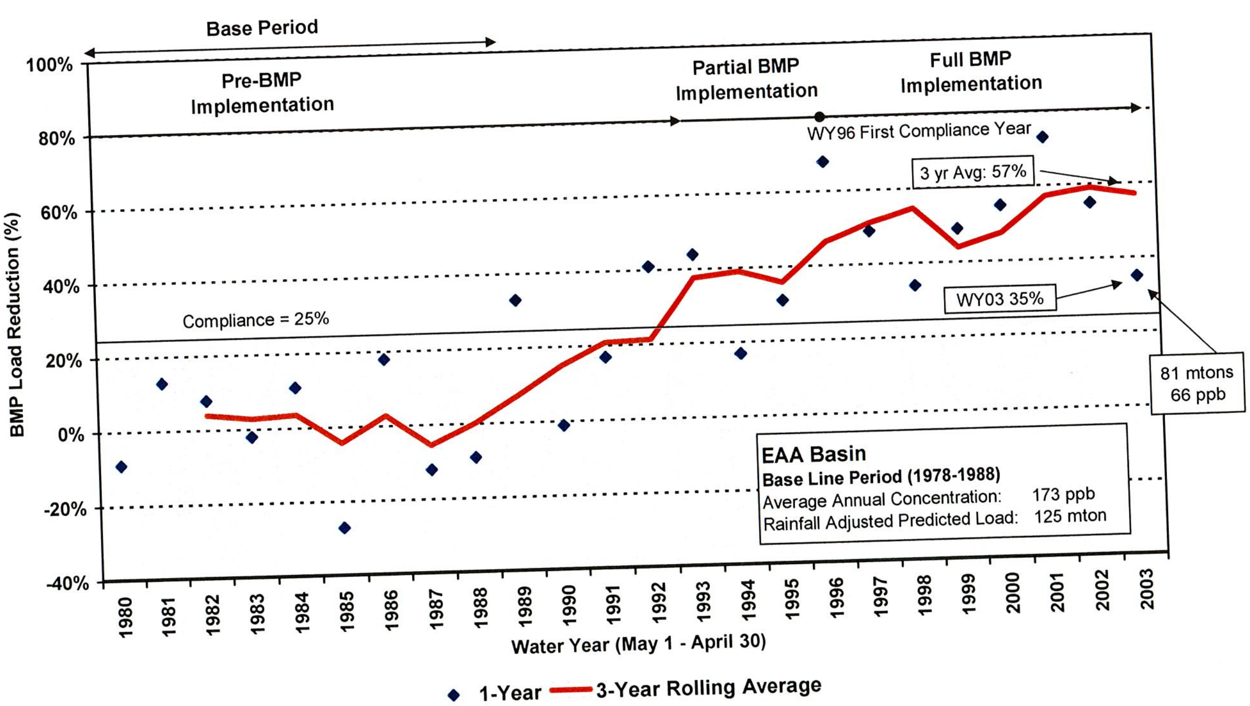

Figure 3-6. EAA basin percent TP load reduction trend.

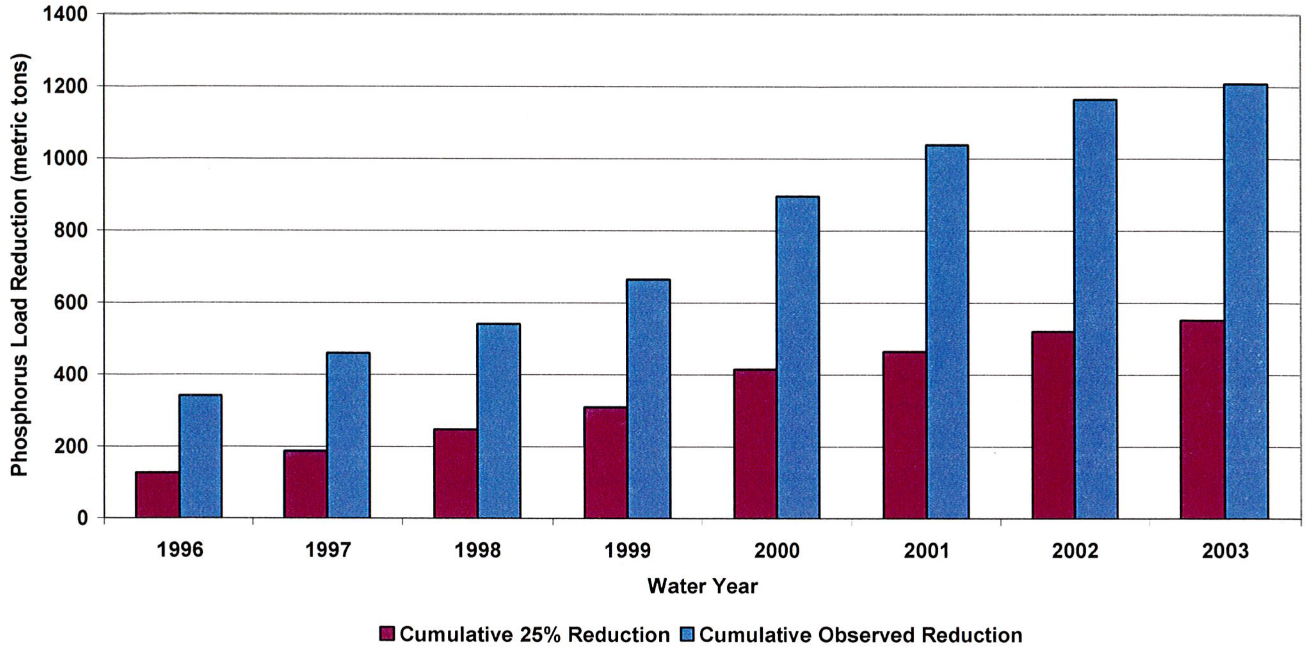

Figure 3-7. EAA basin cumulative percent TP load reduction.

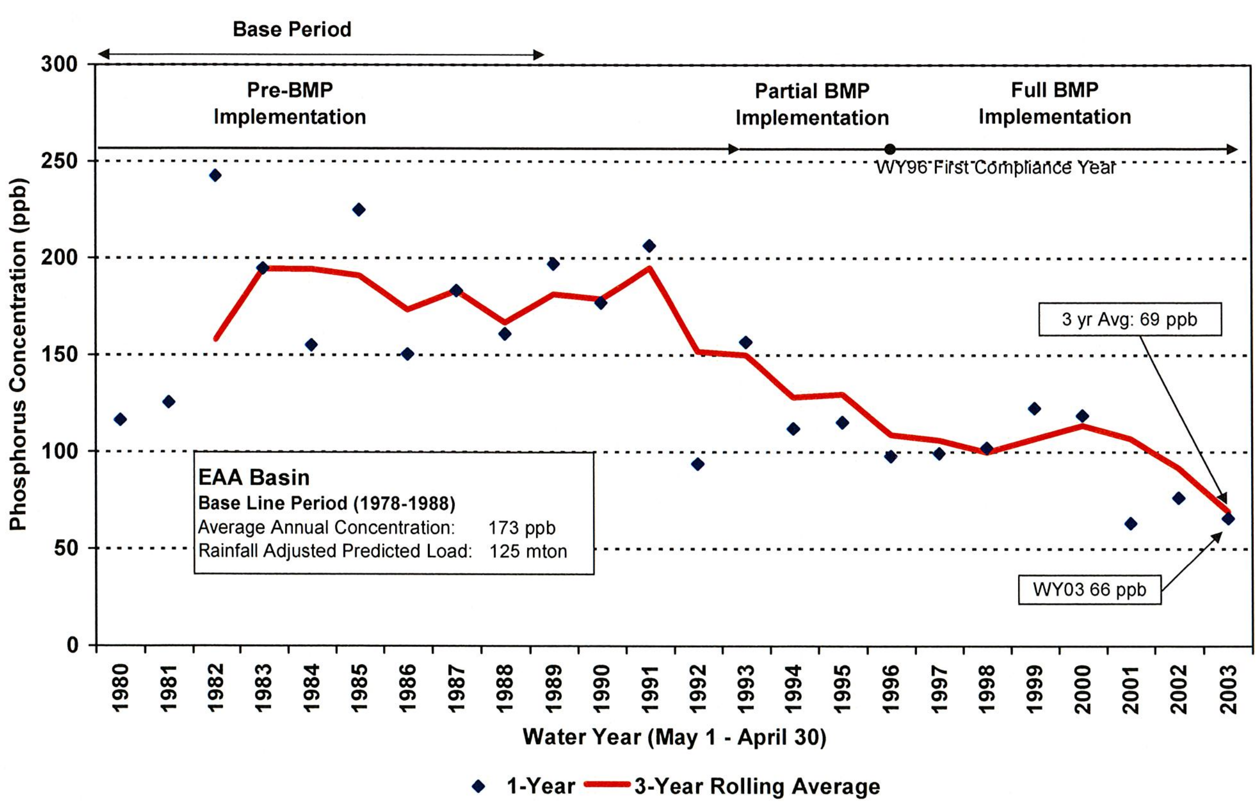

Figure 3-8. EAA basin flow-weighted TP concentrations.

C-139 Basin

Water leaving the C-139 basin is primarily from agricultural sources. The TP load delivered to the Everglades is not the same as the TP load leaving the outflow structures from the C-139 basin. Outfall structure G-136 discharges to the L-1 canal, which flows into the EAA basin. Outfall structures G-342A, G-342B, G-342C, and G-342D flow into STA-5. Outfall structure G-406 discharges only into the L-3 canal when STA-5 cannot receive additional discharges.

Basin Annual Phosphorus Measurements and Calculations

WY2003 was the first year of compliance measurements for the C-139 basin. The C-139 basin TP loads and concentrations are determined in accordance with procedures specified in the Everglades Regulatory Program (Rule 40E-63, Appendix B, F.A.C.) and the EFA. To determine C-139 basin compliance, the observed load is compared to the base period target and limit loads predicted with WY2003 rainfall adjustment. The target load represents the basin data at the 50-percent confidence level whereas the limit represents the data at the 90-percent confidence level. If the observed load exceeds the target load for 3 or more consecutive years or exceeds the limit load in any single water year, then the C-139 basin is out of compliance. Since this is the first compliance year, the three-year test is not applicable for determining compliance. Compliance for WY2003 is based only on the limit load comparison.

The C-139 basin WY2003 observed load of 77.3 metric tons exceeds the limit load 70.3 metric tons by 7 metric tons. Based on the limit, the C-139 basin is out of compliance for WY2003. This out of compliance determination triggers rule required inspections to verify initial BMP implementation by individual landowners in accordance with their permits.

A summary of the WY2003 compliance calculations for the observed load, predicted target load, and the limit load is provided in **Table 3-5**. The overall TP loads, flows, and flow-weighted TP concentrations at the six primary basin outflow structures is summarized in **Table 3-6**.

The data for all calculated years (pre-compliance and initial compliance) are summarized in **Table 3-7**, which presents the average concentrations and the observed, predicted target, and limit load data for the C-139 TP calculations, along with the annual rainfall and flow measurements. The TP values presented in **Table 3-7** are attributable only to the C-139 basin and do not represent the cumulative TP being discharged to the Everglades after treatment through STA-5 or pass-through in the EAA. These data for WY2003 are summarized below.

Table 35 . Summary of C-139 basin TP compliance calculations.

WY2003 C-139 Basin Total Phosphorus Load	
Estimated TP target load during the base period adjusted for WY2003 rainfall (1979 to 1988)	39.1 mt
Estimated TP limit load during the base period adjusted for WY2003 rainfall (target load at the upper 90% confidence interval)	70.3 mt
Actual WY2003 TP load with partial BMP implementation	77.3 mt

WY2003 C-139 Total Phosphorus Concentration	
Actual annual average TP concentration prior to BMP implementation (1979 to 1988)	227 ppb
Actual WY2003 TP concentration with partial BMP implementation	279 ppb
Three-year flow-weighted mean TP concentration	270 ppb

Table 36 . Summary of C-139 basin TP calculations.

C-139 Related Loads by Structure

Water Year 2003

This table represents the flows and loads at each structure leaving the C-139 Basin.

C-139 to EAA

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)	% of Total Load	% of Total Flow
G136	**4.97**	**15.15**	**266**	**6.4%**	**6.8%**

C-139 to STA5

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)	% of Total Load	% of Total Flow
G342A	11.06	43.73	205	14.3%	19.5%
G342B	11.56	44.34	211	15.0%	19.8%
G342C	15.01	39.38	309	19.4%	17.6%
G342D	20.82	42.66	396	26.9%	19.0%
Total	**58.45**	**170.12**	**279**	**75.7%**	**75.8%**

C-139 to WCA3

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)	% of Total Load	% of Total Flow
G406	**13.84**	**39.06**	**287**	**17.9%**	**17.4%**

C-139 Total	**Load(mtons)**	**Flow (kac-ft)**	**Conc. (ppb)**
	77.26	**224.33**	**279**

Table 3-7. WY1980 through WY2003 C-139 basin TP measurements and calculations.

Water Year	TP Ann. Average Conc. ppb	Observed TP Load (mt)	Predicted TP Load[1] (mt)	Limit TP Load[2] (mt)	Annual Rain (in)	Annual Flow (Kac-ft)	% Acres with BMPs [3]	Base Period	Pre-BMP Period
1980	164	34.7	42.1	76	56.39	172	0	↑	↑
1981	66	4.1	3.6	7	31.06	51	0		
1982	113	6.1	8.8	16	38.61	44	0		
1983	248	148.1	115.2	222	71.98	344	0		
1984	210	40.4	20.2	36	47.19	156	0		
1985	188	14.6	19.6	35	46.88	63	0		
1986	125	17.0	19.3	34	46.71	110	0		
1987	205	37.7	55.0	101	60.19	149	0		
1988	243	28.2	21.6	38	47.96	94	0		
1989	158	14.2	11.0	20	40.69	73	0	↓	
1990	97	5.5	9.8	18	39.62	46	0		
1991	89	5.0	20.8	37	47.53	45	0		
1992	100	12.3	27.9	50	51.04	100	0		
1993	155	26.3	39.4	71	55.49	137	0		
1994	129	21.8	30.2	54	52.03	136	0		
1995	184	61.9	53.8	98	59.85	272	0		
1996	167	48.5	55.2	101	60.24	236	0		
1997	226	45.9	40.1	72	55.74	165	0		
1998	170	35.6	42.9	77	56.65	170	0		
1999	212	35.6	29.9	53	51.92	136	0		
2000	210	52.4	36.4	65	54.46	202	0		
2001	246	17.1	6.4	12	35.70	56	0		
2002	267	65.9	35.8	64	54.23	200	0		↓
2003[4]	279	77.3	39.1	70	55.40	224	<100		

Notes:

[1] "Predicted Target TP Load" represents the Target base period load, adjusted for rainfall variability. Load is calculated using *measured* flow and concentrations. When comparing loads between the water year (WY) and the base period, there is a confidence interval for the percent reduction value associated with the adjustment for rainfall variability. This confidence interval represents the uncertainty relative to the prediction model.

[2] "Predicted Limit TP Load" represents the Target base period load, at the upper 90% confidence interval.

[3] Full BMP implementation was not achieved during the entire year in WY2003, and an estimate of the acreage with partial BMP implementation is not available.

[4] First year of compliance measurement, WY2003.

Figures 3-9 and **3-10** represent the C-139 basin TP data graphically. In **Figure 3-9**, each bar represents the actual measured (observed) annual TP tonnage from the C-139 basin in each water year, and the lines represent the annual TP target and limit loads predicted (rainfall adjusted) by the rule-mandated methodology. **Figure 3-10** represents the annual flow-weighted mean TP concentration of discharge from the C-139 basin shown by both individual annual concentrations represented by the diamond symbols and the three-year rolling average flow-weighted mean concentrations represented by the solid line. As with **Figure 3-9**, the first year of compliance was WY2003. Compliance in the C-139 basin is determined by TP load discharged from the basin and not by the concentration.

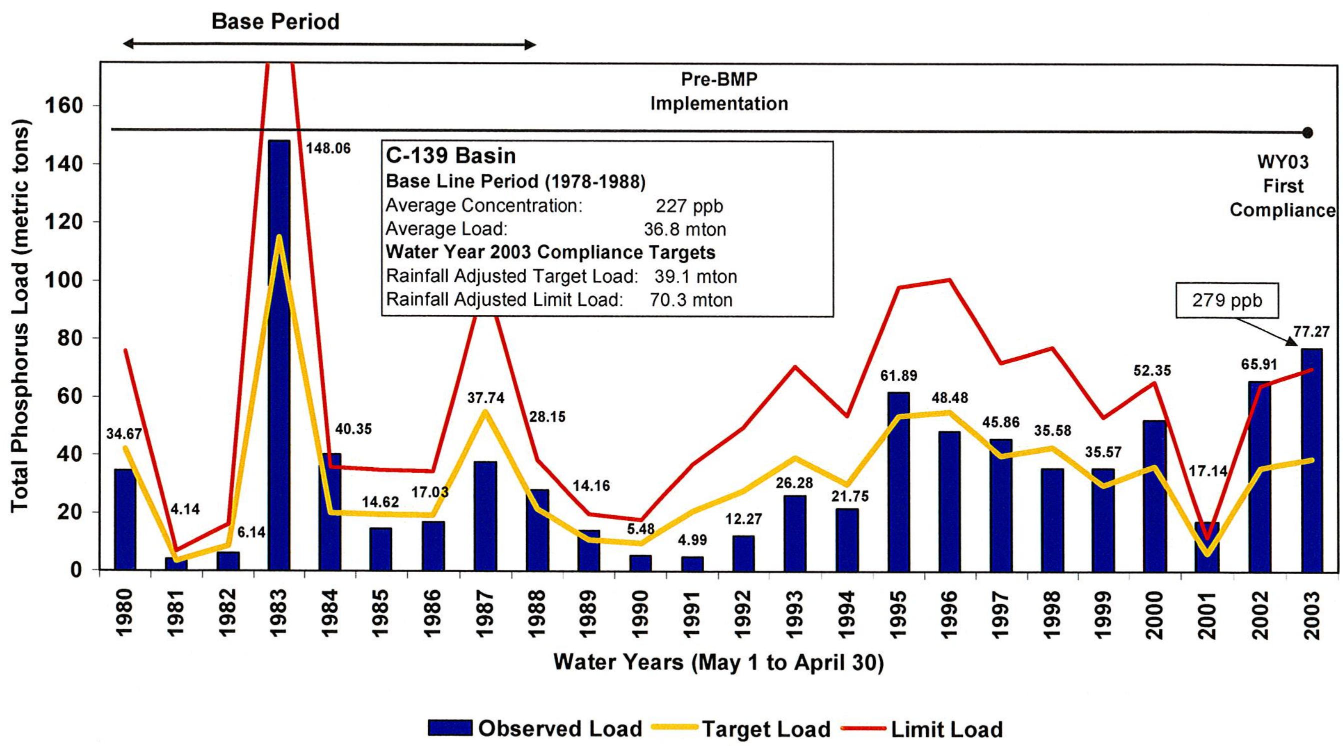

Figure 3-9. C-139 basin TP measured and calculated loads.

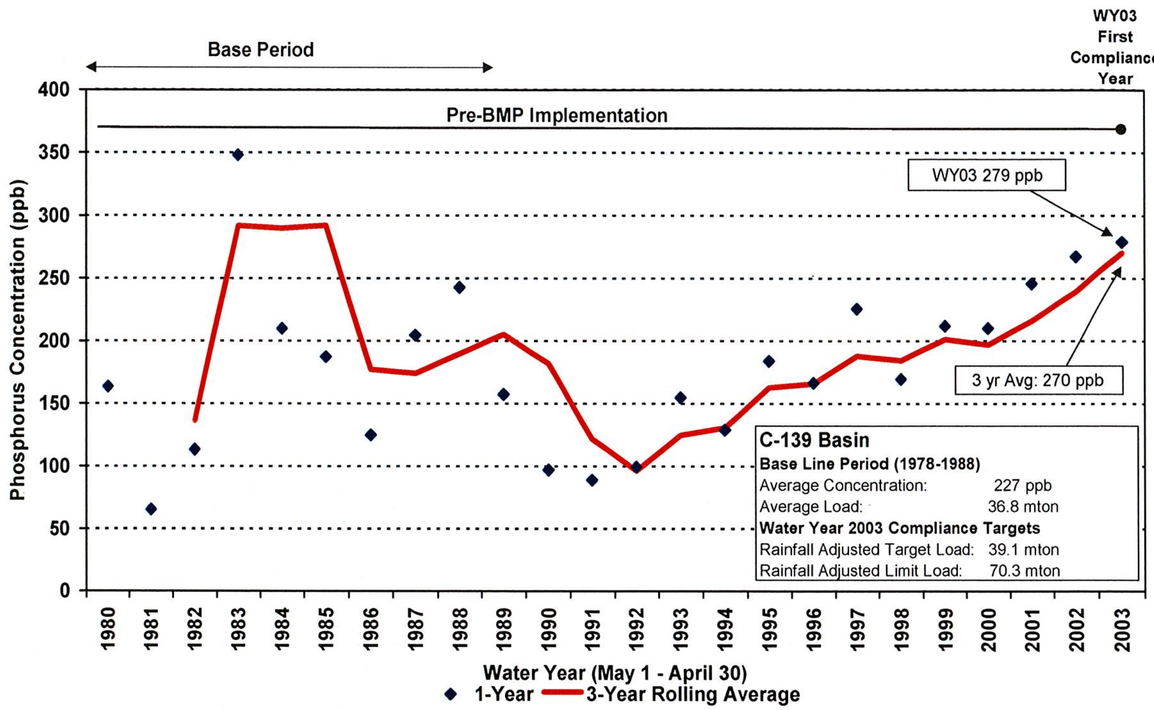

Figure 3-10. C-139 basin flow-weighted TP concentrations.

Although WY2003 is the first year for compliance determination in the C-139 basin, BMPs were not in effect for the entire year. Therefore, it was anticipated that the effects of newly implemented BMPs would be minimal. Efforts are currently under way to ensure that future discharges from the C-139 basin meet established TP load targets and limits in order to ultimately reduce this nutrient loading contribution to the northern Everglades.

In addition to the rule-required inspections to verify implementation of initial BMPs in the C-139 basin, the District is providing incentives for voluntary early implementation of additional BMPs through the Western Basins BMP Grant Program. These grants provide funding for local landowners and stakeholders to voluntarily implement additional water quality improvement strategies and BMPs.

PERMIT-LEVEL MONITORING RESULTS

Permit-level data are useful for making relative comparisons between farms or between water years for the same farm only when they are used in conjunction with in-depth knowledge of unique farm characteristics. The District currently uses such relative comparisons when discussing individual farm performance and BMP optimization with permittees.

In the EAA basin and in accordance with Rule 40E-63, F.A.C., this on-farm or permittee-level water quality monitoring will only be used for compliance determination if the basin does not meet the 25-percent TP load reduction requirement. The permittee water quality monitoring results are not used to calculate the TP reduction at the EAA basin level. The District currently conducts EAA basin-level monitoring at all inflow and outflow structures for this purpose.

At this time, permit-level monitoring does not occur in the C-139 basin. No owners/operators of private water control structures discharging within the C-139 basin have elected to participate in the Optional On-Farm Discharge Monitoring Program.

EAA Basin

In addition to the BMP plan, each Rule 40E-63 EAA permit is required to propose a discharge monitoring plan for individual drainage basins within the permitted area. The permit-level monitoring plans consist of flow measurements, collection, and compositing of discharge water samples and TP analysis. Discharges are generally quantified using site-specific calibration equations. Water quality samples are generally collected daily during discharge by automatic flow-weighted samplers and are composited for a sampling period of up to 21 days prior to being transported to a laboratory for analysis. Daily TP load is calculated by multiplying the TP concentration for the sampling period by each daily flow. Rule 40E-63 requires data to be submitted in an electronic format. Water quality samples are collected under the requirements of a Comprehensive Quality Assurance Manual in accordance with the FDEP requirements. In addition, any laboratory that analyzes TP for the Rule 40E-63 permit monitoring program is required to be certified by the Florida Department of Health for the analysis of TP in surface water.

Annual average flow-weighted TP concentrations (ppb) and load discharges (pounds per acre [lb/ac]) have been calculated from permittees' daily water quality monitoring data reported during WY2003. **Figures 3-11** and **3-12** present frequency distributions of WY2003 permittees' drainage basin TP loads and concentrations, respectively. The **Appendix** presents WY2003 data in tabular form and **Figures 1 and 2** in the Appendix map spatial distributions of TP loads and concentrations discharged by permit drainage basins. The EAA basin-level data verify that the individual farms have collectively reduced TP loads concurrent with BMP implementation. However, the permittee-level water quality monitoring cannot be used to determine the measure of TP discharged to the Everglades because the collective data do not account for the many exchanges occurring within the EAA District canals. In fact, the average annual cumulative total volume of water discharged from the 300+ permittee- or farm-level pump stations is greater than the volume released from the District water control structures surrounding the EAA. Individual farm discharges do not necessarily always leave the EAA. The EAA basin canal water (including rainfall, Lake Okeechobee discharges, and 298 diversions from Lake Okeechobee) and the surface water discharged from any one of the given 200+ defined permittee drainage sub-basins (farms) may be drawn back into the farm for irrigation or freeze protection by another farm. Each year, a tremendous amount of water is recycled in this manner within the EAA.

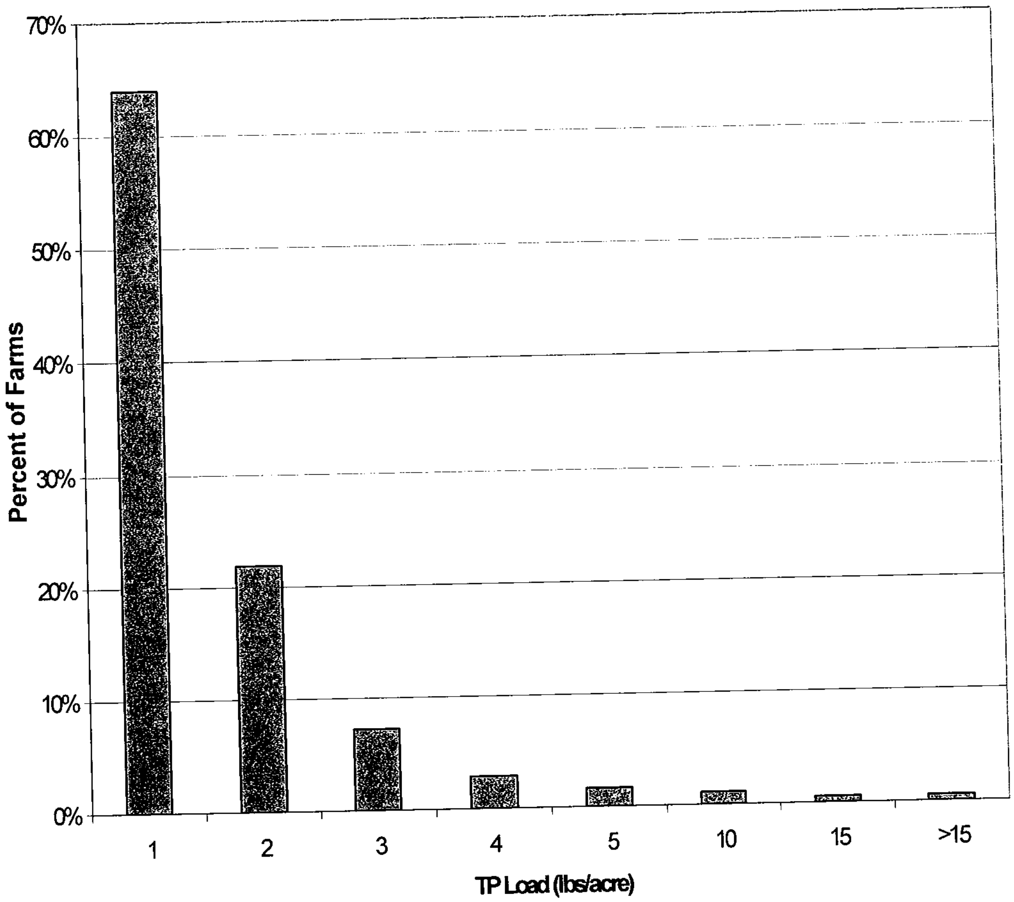

Figure 3-11. Permit-level TP load frequency

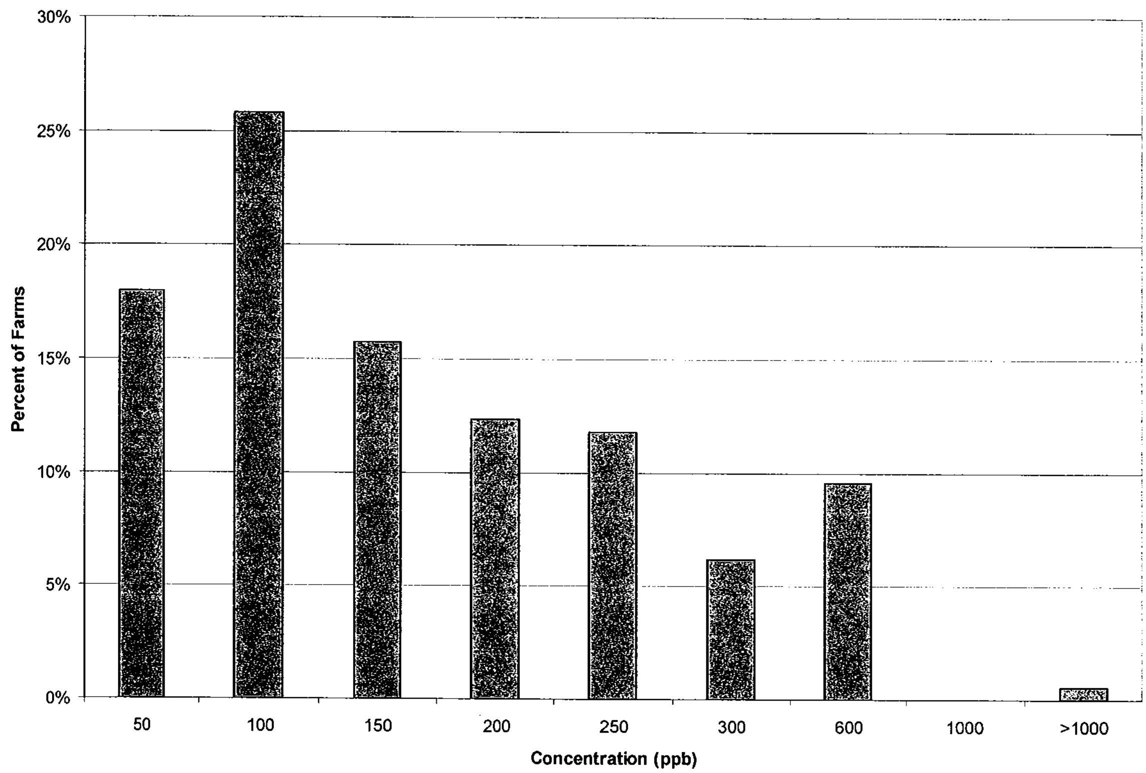

Figure 3-12. Permit-level TP concentration frequency distribution

There are also several factors affecting TP load at the farm level, thereby making it difficult to formulate comparisons and draw conclusions on the differences in the level of performance between farms. UF/IFAS studies, discussed later in this chapter, make the point that each farm has a characteristic "lowest achievable discharge TP concentration" that cannot be realized without an extensive implementation period and substantial financial impact. Consideration must also be given to the minimum TP required to support the agricultural production of specific crops. These factors are sometimes beyond the control of the permittee and also create differences in BMP effectiveness between sites, preventing an "apples-to-apples" comparison. They include variations related to historical and existing land use, fertilizer practices, soil characteristics, hydrology, land area, and geographic location. Examples of variables affecting individual farms include the following:

1. **Weather Patterns.** Timing and distribution of rainfall can affect an individual farm load. The model used to calculate the rainfall-adjusted unit area load for an individual permittee farm is dependent on the District's rainfall data collected for each EWOD sub-basin (e.g., S-5A, S-6, S-7, and S-8) within the EAA. Adjacent farms can be located in different EWOD sub-basins and therefore have a significantly different rainfall adjustment.

2. **Cropping Patterns.** The history of cropping patterns on a farm can affect loads by creating a phosphorus "sink," or accumulation. The implementation of nutrient application control BMPs should correct this situation over time.
3. **Hydrology.** The hydrology of a farm affects loads in many ways. Examples include the size of the farm relative to the discharge pump capacity, or the effects of seepage from an adjacent STA. Gradually, older pumps are being rebuilt or replaced to improve the capacity relationship between the farm area and the pump capacity.
4. **Soil Characteristics.** Soil depth and composition can also have a significant impact on a farm's performance. A farm may have high levels of calcium carbonate present in its soil, resulting in a high soil pH and precipitation of phosphorus. An adjacent farm may have much lower levels of calcium carbonate present in its soil and, therefore, it would have a lower soil pH.

These examples illustrate how each farm can be unique, with BMP selection and effectiveness dependent upon many factors. Permittees recognize unique effects on their farms and voluntarily adjust their operations and monitor the effects of these adjustments on water quality. Many of the adjustments require capital improvements that are phased in over time. For example, the installation of culverts to improve internal drainage, thereby minimizing discharges, on a 20,000-acre farm could be an eight-year project.

Farm level compliance includes inspections. The goal of the District on site inspections is to solicit input from the permittees on how their farms are different and how they are adjusting their BMPs to account for these differences, as well as to verify proper implementation of the base level of BMPs. The District shall continue these outreach and education efforts and research through cooperative relationships with the permittees to enhance the BMP Program in the EAA and C-139 basins.

UPDATE ON EAA BASIN BMP RESEARCH

BMP effectiveness has been demonstrated at different scales, in the EAA basin as a whole and through individual sub-basin or farm-level research projects in the EAA basin. In addition to BMP implementation, the EFA mandates landowners to sponsor a program of BMP research, testing, and implementation. Research projects to quantify BMP effectiveness are necessary to improve the understanding and predictability of TP relative to BMPs. To encourage BMP optimization as data become available, research results are provided to the industry through outreach programs sponsored by the District, UF/IFAS, EAA-EPD, and FDEP. The following is an update on active BMP research projects in the EAA.

UNIVERSITY OF FLORIDA/INSTITUTE OF FOOD AND AGRICULTURAL SCIENCE ON-FARM RESEARCH

The research conducted by the University of Florida Institute of Food and Agricultural Sciences represents the most comprehensive ongoing research program regarding BMP effectiveness in the EAA basin. Initiated in 1992, the project was funded primarily by the EAA-EPD, with supplemental monetary contributions from the FDEP and the District. Ten farms ranging in size from approximately 320 to 4,600 acres have been studied in an attempt to develop and verify the effectiveness of BMPs for reducing TP loading in the EAA basin. These farms are representative of the EAA basin with respect to soils, crops, water, and fertilizer management practices and geographic locations. Land use on the selected farms varies from monocultures of sugarcane and vegetables to multicultures of vegetables, rice, sod, and sugarcane. Since January 2002, research on three farms continues. The latest project evaluation and data summary is presented in the UF/IFAS Phase 11 Annual Report on Implementation and Verification of BMPs for Reducing P Loading in the EAA and EAA BMPs for Reducing Particulate P Transport (Daroub et al., 2003).

In earlier phases, the objective of the research was to implement and assess the effectiveness of BMPs in the EAA through a monitoring program and maintain a continuous database on drainage flows, cropping patterns, and water quality for sites representative of typical EAA farms. Other EAA BMP-related efforts have since been incorporated into the project. These efforts consist of the identification of short- and long-term effects of BMPs on soils and crops, the evaluation of specific conductance and dissolved TP in farm discharges, and the evaluation of particulate matter in farm and EAA drainage canals. The continued research on three farms that are representative of soils, crops, and operations in the EAA allows UF/IFAS to focus these research efforts into identifying sources, mechanisms of transport, and control of particulate P. Data analyses to answer questions regarding specific conductivity and other non-phosphorus species are ongoing.

With regard to BMP efficacy, the research results have shown that water management and crop rotation BMPs can have the greatest impact on TP loads and concentrations of farm discharges. Water management practices that have been proved most effective include the making of internal drainage improvements to the farm to allow more uniform drainage. For example, a farm could be hydraulically subdivided into different blocks with internal water control structures. This practice makes it less likely that the farm will be overdrained and allows water containing higher phosphorus levels from areas within the farm to be recirculated internally. This practice works particularly well for farms that utilize crop rotation practices. The study indicated that water table response and levels (i.e., drainage on the farm) are more heavily influenced by prevailing water table elevations rather than open-channel gradients from pump operation. Therefore, a combination of improved drainage uniformity over the farm area and a reduction in drainage from a farm through internal redistribution could significantly reduce TP concentrations and loads for all crops.

The UF/IFAS research project involves particulate P transport studies. The primary goals are to identify sources and mobility characteristics of particulate P on EAA farms and to modify management practices to reduce particulate transport off the farm. The project includes sampling farm discharges for TP and dissolved TP. Particulate P is then calculated as the difference between TP and dissolved TP. Studies have shown that particulate P accounted for 20 to 70 percent of TP exported from EAA farms, and that particulate P was frequently the cause of spikes in TP loads. A significant fraction of particulate P in the EAA originates from in-stream biological growth rather than from soil erosion. A major contributing factor to particulate P discharge is the biological contribution mechanism (BCM). Sediments that contribute significantly to P export were postulated to be recently deposited biological material such as settled plankton, filamentous algae, and macrophyte detritus (Stuck, 1996). The BCM includes bed sediment erosion as a source of exported particulate P. These sediments consist of a heterogeneous mixture of organic matter in various stages of decomposition, with various levels of P content and variable transport properties.

Management practices that were recommended by the study to control particulate P in discharges included practices that reduced the "first flush" and minimized the occurrence of continued high velocities. Aggressive weed control programs in the main canals are the most productive in reducing the supply of transportable, high P-content biomass, thereby reducing the first flush phenomenon. Retention booms should be placed well upstream of the pump station, preferably 300 to 500 meters. Relocating sediments upstream from the pump house is recommended in conjunction with irrigation events. High-velocity flow can cause particulate P to be mobilized in large amounts. Velocity is the key control parameter for reducing particulate P export. Recommended velocities in the canal are relative in that they must be within the operating framework of the farm's configuration. Given this information, velocities should be as low as possible, and velocity excursions should be avoided. Control of canal levels is critical in avoiding extreme velocity excursions. Canal levels should be controlled to give minimum canal depths that do not exceed the maximum velocity recommendations. In addition, short-term pump cycling (on the order of one hour) is always detrimental and should be avoided to reduce particulate P transport off the farm.

The future focus in this area of research will be to investigate other practices to reduce particulate P loads, including management of aquatic weeds, reducing velocity in canals, and the hydraulic redistribution of the plants and settled detritus. The EREC farm has been subdivided into two blocks for demonstration purposes. Traditional BMPs will be implemented in the control block, and improved particulate P BMPs will be implemented in the second block. The improved BMPs include those that underwent aggressive aquatic weed management (mechanical or chemical), velocity control in the canals (including critical canal-level control), and running pumps at lower revolutions per minute.

Evaluation is underway for both specific conductance and dissolved TP for monitored farm discharges. The purpose of the study was to identify causes for fluctuations in specific conductance and to quantify the components of the dissolved TP. The hypothesis is that agricultural practices, changes in hydrology occurring throughout the EAA, and connate seawater are contributing factors to the cause of elevated levels of specific conductance. A draft report on the findings of this study was issued (Daroub et al., 2003), and it is anticipated that a final report will be issued in late 2003. Data for seven out of the 10 farms monitored indicate general compliance with the Class III water quality standards for specific conductivity (i.e., less than 1275 micromhos per centimeter [µmhos/cm]). Three farms occasionally had specific conductivity levels that exceeded the Class III criterion. Preliminary analysis of the data indicated that rainfall and pumping have a positive correlation with conductivity. On the other hand, the data also indicated that irrigation has a negative correlation with conductivity, presumably because Lake Okeechobee water, which is the primary source of irrigation, has low specific conductivity. There is insufficient data to determine whether any of the implemented BMPs independently affect specific conductance. However, it is probable that the phosphorus load reduction BMPs are helping to mitigate specific conductance issues that may relate back to agricultural practices (such as reduced pumping). Additional data and analysis are necessary to support these suggestions.

These research projects confirm the effectiveness of existing BMPs and provide direction on areas of future focus.

Another key component to the UF/IFAS research goals is to promote the continued, uniform, and conscientious implementation and management of BMPs. This is accomplished through an extension program consisting of numerous seminars, workshops, and publications offered to the EAA community.

FINDINGS AND FUTURE DIRECTIONS

The basin-level reductions in TP coincide with implementation of the BMP Everglades Regulatory Program and are generally supported by the UF/IFAS on-farm research. In reviewing the farm level data, however, variations between farms and years can be significant, as indicated by the results of both the farm-level monitoring conducted by permittees and the UF/IFAS on-farm research.

Recent data continue to support the ongoing pursuit of past recommendations. That is, through continued research, monitoring, and education efforts, water quality improvements can be made by applying new information to existing situations and by applying "lessons learned" to other regions that discharge to the Everglades. Future BMP work should continue to be directed at the following:

1. Optimizing the effectiveness of existing BMPs in the EAA through inspections and permittee feedback
2. Continuing research to further investigate specific hydraulic-control and sediment-control BMPs
3. Determining the relationship between the EAA basin-level TP reductions and the farm-level BMP plans
4. Providing incentives for voluntary early implementation of higher level BMPs in the C-139 basin
5. Participate in BMP demonstration projects in the C-139 basin

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Appendix A

Water Year 2003
EAA Permit-Level Data

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This appendix includes the water quality (WQ) data for individual farms within the Everglades Agricultural Area (EAA) basin for Water Year 2003 (WY2003) in both tabular form and as a spatial distribution.

The permit-level data for the EAA basin is presented in **Table 1**. This table identifies separate hydraulic drainage areas (individual farms) within the permits according to the unit area or basin identification (ID) and includes each area's percent reduction for the water year compared to its baseline year. It also provides the area's flow-weighted mean concentration for the water year.

This permit-level data will only be used for compliance determination if the EAA basin does not meet the 25-percent total phosphorus (TP) load reduction requirement. The permit-level results are not used to calculate TP reduction at the EAA basin level. EAA basin-level monitoring is conducted by the South Florida Water Management District (SFWMD or District).

This table lists the WQ data using the following column designations:

- **Early Baseline** is a farm that qualifies for early baseline status by having implemented Best Management Practices (BMPs) and established a baseline by a specific deadline. "Y" indicates an early baseline farm; "N" indicates that a farm does not qualify for early baseline status.
- **Baseline Year** is the water year for which the farm established its pre-BMP base period load.
- **Rain Adjusted Unit Area Load (pounds per acre [lbs/ac]):**
  - Baseline is the TP load per unit area measured for the baseline year for a farm (includes 10-year base period rainfall adjustment).
  - WY2003 is the TP load per unit area for the current water year for a farm (includes 10-year base period rainfall adjustment).
- **WY2003 Percent (%) TP Reduction** is the WY2003 load reduction for the farm compared to the baseline year.
- **WY2003 TP Concentration** (parts per billion [ppb]) is the flow-weighted mean concentration for the farm for WY2003.

Table 2 provides a detailed list of BMP equivalent points that can be applied to both the EAA and C-139 basins. It also provides a summary of BMP practices that may be applied to meet compliance requirements for both basins. **Table 3** lists the current EAA agricultural privilege tax credits that apply for the current year in the EAA. **Figures 1** and **2** depict the spatial distribution of TP concentrations and loads, respectively, found in the EAA.

Table 1. Permit-level data for the Everglades Agricultural Area (EAA).

Basin ID	Basin Acreage	Early Baseline	Baseline Year	Rain Adjusted Unit Area Load (lbs/ac)		WY03 % TP Reduction	WY03 TP Conc. (ppb)	Comments
				Baseline	WY03			
26-001-01	767.8	Y	1994	2.12	1.32	38%	173.4	
26-002-01	897.8	N	2001	Unable to Calculate	0.00	Unable to Calculate	0.0	
26-003-01	599.2	N	1999	0.27	0.28	-7%	44.5	
26-004-01	4501.6	N	1999	1.22	0.57	53%	66.0	
26-006-01	1198.4	N	1998	1.19	0.42	65%	223.7	
26-007-01	653.3	N	1999	2.07	0.44	79%	53.2	
26-008-01	120.0	Y	1994	2.12	1.32	38%	173.4	
26-009-01	159.8	N	1999	0.74	0.44	40%	36.6	
26-010-01	1231.0	N	1995	1.81	Unable to Calculate	Unable to Calculate	Unable to Calculate	<75% annual load sampled (30.3% Sampled)
26-010-02	9961.3	N	1995	5.83	Unable to Calculate	Unable to Calculate	Unable to Calculate	<75% annual load sampled (52.6% Sampled)
50-002-01	5656.4	Y	1994	3.21	1.77	45%	196.0	
50-002-02	9285.4	Y	1994	2.90	1.48	49%	222.7	
50-003-01	242.0	Y	1994	0.40	3.49	-776%	307.5	
50-003-02	520.0	Y	1994	0.62	1.41	-129%	59.9	
50-003-03	117.6	N	1995	0.22	2.49	-1018%	163.6	
50-004-01	908.9	Y	1994	3.68	1.17	68%	158.3	
50-005-01	620.0	Y	1994	0.91	0.78	14%	55.7	
50-005-02	232.9	Y	1994	0.06	7.77	-12379%	814.5	
50-005-03	320.0	Y	1994	0.26	1.28	-400%	167.1	
50-005-04	309.6	Y	1994	1.49	0.19	88%	94.9	
50-005-05	747.0	Y	1994	1.95	2.03	-4%	302.8	
50-005-06	502.0	Y	1994	1.56	1.95	-25%	294.5	
50-006-01	397.2	Y	1994	4.53	0.74	84%	126.9	
50-006-02	359.3	Y	1994	5.50	1.72	69%	219.2	
50-006-03	640.3	Y	1994	3.55	0.75	79%	127.6	
50-007-01	6472.6	Y	1994	1.56	1.57	-1%	103.6	
50-007-02	5716.7	Y	1994	15.11	3.28	78%	238.9	
50-008-01	7261.2	Y	1994	0.34	0.65	-89%	88.3	
50-009-01	7058.6	Y	1994	1.13	0.51	55%	62.3	
50-009-02	4271.8	Y	1994	3.57	4.28	-20%	104.5	
50-009-03	965.3	Y	1994	4.15	1.10	73%	74.1	
50-009-04	317.0	N	1999	5.19	5.59	-8%	292.9	
50-009-05	1479.4	Y	1994	1.54	0.90	42%	58.5	
50-010-01	784.2	N	1995	2.42	2.20	9%	311.1	
50-010-02	5327.1	N	1994	1.80	1.66	8%	126.7	
50-010-03	5962.3	Y	1994	1.31	0.92	29%	87.1	
50-010-04	7159.0	Y	1994	4.76	2.99	37%	178.8	
50-010-05	2111.3	N	2001	1.31	0.39	70%	80.1	
50-011-01	1747.7	Y	1994	2.76	0.37	87%	79.1	
50-011-03	14337.8	Y	1994	5.79	Unable to Calculate	Unable to Calculate	Unable to Calculate	<75% annual load sampled (50.7% Sampled)
50-011-04	4066.0	Y	1994	5.21	Unable to Calculate	Unable to Calculate	Unable to Calculate	<75% annual load sampled (70.9% Sampled)
50-011-06	638.0	N	1999	0.02	0.25	-1558%	119.8	
50-012-01	1021.5	Y	1994	4.06	2.89	29%	129.8	
50-013-01	1362.6	Y	1994	24.22	1.00	96%	236.5	
50-014-01	1520.4	Y	1994	1.37	0.27	81%	128.7	
50-015-01	3276.4	Y	1994	2.62	1.69	35%	209.8	
50-015-02	2554.5	Y	1994	5.28	1.44	73%	347.1	
50-016-01	1497.3	Y	1994	15.11	1.89	87%	172.4	
50-017-01	895.0	Y	1994	3.22	2.53	21%	97.1	
50-018-01	5901.5	Y	1994	2.82	1.83	35%	201.0	
50-018-02	6594.0	Y	1994	3.54	1.04	71%	94.0	
50-018-03	9062.3	Y	1994	1.98	1.54	22%	145.7	
50-018-04	1913.1	Y	1994	3.88	0.90	77%	113.5	
50-018-05	1827.1	N	1995	3.64	1.08	70%	136.5	
50-018-06	1255.1	Y	1994	1.46	0.89	39%	131.9	
50-018-07	1117.4	Y	1994	2.12	1.32	38%	173.4	
50-018-08	3208.6	Y	1994	2.28	0.57	75%	81.0	
50-018-09	1736.6	Y	1994	4.22	1.96	54%	140.1	
50-018-10	8254.4	Y	1994	3.05	0.87	71%	99.8	
50-018-11	1871.1	Y	1994	19.73	2.22	89%	172.4	
50-018-12	1655.2	Y	1994	1.78	1.13	37%	101.2	
50-018-13	594.3	Y	1994	0.40	1.67	-317%	110.3	
50-018-14	569.9	N	1994	2.21	1.65	26%	76.9	
50-018-15	757.3	Y	1994	1.12	Unable to Calculate	Unable to Calculate	Unable to Calculate	<75% annual load sampled (65.1% Sampled)
50-018-16	240.0	Y	1994	4.11	3.62	12%	243.4	

Basin ID	Basin Acreage	Early Baseline	Baseline Year	Rain Adjusted Unit Area Load (lbs/ac)		WY03 % TP Reduction	WY03 TP Conc. (ppb)	Comments
				Baseline	WY03			
50-018-16	240.0	Y	1994	4.11	3.62	12%	243.4	
50-018-17	488.1	Y	1994	3.10	1.78	43%	241.6	
50-018-18	357.7	Y	1994	0.64	1.56	-145%	112.5	
50-018-19	314.3	Y	1994	35.32	12.84	64%	210.8	
50-018-20	380.6	Y	1994	3.59	3.12	13%	164.1	
50-018-21	10416.5	N	1998	1.06	1.83	-72%	76.5	
50-018-22	4481.2	Y	1994	8.18	1.26	85%	109.0	
50-018-23	2946.0	Y	1994	2.22	1.35	39%	96.7	
50-018-24	3800.3	Y	1994	1.96	0.87	56%	86.6	
50-018-25	3808.4	Y	1994	4.99	1.52	69%	184.9	
50-019-01	568.4	Y	1994	1.54	0.30	80%	42.2	
50-019-02	1210.0	Y	1994	1.38	1.40	-2%	61.0	
50-019-03	1051.4	Y	1994	0.58	0.26	56%	62.1	
50-020-01	320.0	Y	1994	3.32	2.00	40%	170.6	
50-021-01	2558.0	Y	1994	8.92	1.58	82%	158.7	
50-022-01	320.0	Y	1994	0.80	0.46	42%	72.0	
50-023-01	278.0	Y	1994	11.83	2.20	81%	522.2	
50-024-01	574.0	N	1995	6.43	2.55	60%	135.2	
50-025-01	823.7	Y	1994	3.68	1.07	71%	161.1	
50-027-01	2771.8	Y	1994	2.40	0.71	71%	96.5	
50-027-02	798.5	Y	1994	1.22	0.68	44%	78.0	
50-027-03	1353.1	Y	1994	2.32	0.78	66%	185.7	
50-027-04	2520.0	Y	1994	2.10	0.96	54%	179.7	
50-028-01	220.0	Y	1994	14.54	2.26	84%	86.5	
50-029-01	530.6	Y	1994	2.48	2.66	-7%	208.7	
50-030-01	446.1	Y	1994	14.14	2.34	83%	109.1	
50-031-01	1608.9	Y	1994	2.56	0.61	76%	43.0	
50-031-02	1387.0	Y	1994	5.48	2.89	47%	216.1	
50-031-03	602.4	Y	1994	8.57	2.39	72%	161.7	
50-032-01	305.7	Y	1994	0.84	1.81	-115%	97.3	
50-033-02	1158.8	Y	1994	12.52	3.49	72%	308.8	Acreage represents the portion of 50-033-02 that falls within the EAA basin baseline boundaries.
50-034-01	7897.1	Y	1994	1.68	0.49	71%	55.5	
50-034-02	600.5	Y	1994	3.37	0.48	86%	327.1	
50-034-03	4611.8	Y	1994	4.08	0.81	80%	82.6	
50-034-04	4138.0	Y	1994	1.54	1.24	19%	105.3	
50-035-01	478.5	Y	1994	5.74	1.59	72%	192.0	
50-035-02	1634.3	Y	1994	5.40	2.74	49%	308.3	
50-035-03	205.5	N	1999	8.71	14.15	-63%	58.5	
50-037-01	1773.4	Y	1994	6.70	0.53	92%	187.4	
50-038-01	1285.0	Y	1994	3.71	0.70	81%	169.9	
50-039-01	62.5	N	1995	4.01	0.00	100%	0.0	
50-039-02	143.1	N	1995	4.25	2.14	50%	106.4	
50-040-01	216.2	N	1995	1.40	4.97	-256%	280.4	
50-040-02	498.6	N	1995	3.61	2.25	38%	175.0	
50-041-01	108.8	N	1998	2.69	1.35	50%	87.0	
50-041-02	300.4	N	1998	2.44	7.31	-200%	139.3	
50-042-01	320.0	N	1995	0.14	0.21	-49%	44.3	
50-044-01	698.5	N	1997	6.13	1.17	81%	349.5	
50-045-01	281.8	N	1995	4.35	0.66	85%	111.9	
50-045-02	160.6	N	1995	1.41	0.78	45%	65.2	
50-046-01	35.0	N	1994	2.21	1.65	26%	76.9	
50-047-01	630.3	N	1996	1.46	0.66	55%	95.7	
50-047-02	640.0	N	1995	0.84	0.62	27%	111.3	
50-047-03	1832.0	N	1997	0.44	0.84	-94%	116.4	
50-047-04	198.5	N	1996	0.68	0.59	12%	128.0	
50-047-05	314.0	N	1997	0.55	3.61	-556%	239.7	
50-047-07	3494.2	N	1996	0.67	1.09	-62%	107.5	
50-047-08	1557.7	N	1996	0.96	2.01	-109%	139.0	
50-048-01	1185.1	N	1995	1.25	1.43	-15%	186.9	
50-048-02	640.0	N	1995	0.36	1.77	-390%	197.1	
50-049-01	1909.0	N	1996	2.35	1.61	31%	216.7	
50-050-01	1280.0	N	1996	0.36	0.26	28%	8.3	
50-051-01	811.4	N	1995	0.97	0.91	5%	68.4	
50-053-01	148.9	N	1995	5.16	1.71	67%	154.7	
50-054-01	7489.7	N	1996	0.84	0.61	28%	140.6	
50-054-02	960.0	N	1996	0.50	Unable to Calculate	Unable to Calculate	Unable to Calculate	<75% annual load sampled (54.7% Sampled)
50-054-03	1227.2	N	1996	0.35	0.03	91%	78.9	
50-054-04	3684.3	N	1996	0.82	0.87	-6%	78.2	
50-055-01	392.9	N	1997	0.86	0.24	72%	61.8	
50-055-02	810.4	N	1999	0.45	0.45	0%	54.1	
50-055-03	2871.2	N	1996	0.74	0.32	57%	83.5	

Basin ID	Basin Acreage	Early Baseline	Baseline Year	Rain Adjusted Unit Area Load (lbs/ac)		WY03 % TP Reduction	WY03 TP Conc. (ppb)	Comments
				Baseline	WY03			
50-056-01	849.8	N	1996	0.98	1.39	-41%	68.7	
50-058-01	157.0	N	1995	0.02	0.00	100%	0.0	
50-059-01	9613.9	N	1996	2.35	1.61	31%	216.7	
50-059-02	1767.6	N	1997	1.07	0.98	8%	85.1	
50-059-03	709.5	N	1996	1.65	2.88	-74%	244.1	
50-059-04	306.1	N	1996	1.14	2.34	-105%	273.3	
50-060-01	8137.2	N	1995	0.18	0.17	4%	36.0	
50-060-02	7613.8	N	1995	0.75	0.22	71%	33.8	
50-061-01	639.5	N	1995	1.44	0.07	95%	165.1	
50-061-03	3434.3	N	1995	0.76	0.56	27%	55.3	
50-061-04	158.8	N	1995	1.67	1.37	18%	81.7	
50-061-05	313.7	N	1995	1.89	0.94	50%	49.7	
50-061-06	237.0	N	1995	1.68	0.83	51%	212.9	
50-061-07	318.2	N	1995	1.24	1.29	-4%	101.9	
50-061-08	375.2	N	1999	1.76	0.50	72%	75.6	
50-061-10	23044.0	N	1996	0.49	0.45	8%	43.8	
50-061-11	12372.5	N	1995	0.95	0.38	61%	92.1	
50-061-12	730.0	N	1995	2.55	1.07	58%	126.3	
50-061-13	1059.6	N	1995	1.16	5.27	-353%	94.0	
50-061-15	6760.2	N	1995	1.91	0.27	86%	76.2	
50-061-17	1598.1	N	1995	12.22	4.19	66%	227.8	
50-061-18	1555.1	N	1995	9.82	0.96	90%	40.0	
50-061-20	156.1	N	1994	1.80	1.66	8%	126.7	
50-062-01	4625.8	N	1996	0.20	0.20	1%	59.8	
50-062-02	10754.2	N	1996	0.46	0.42	9%	64.3	
50-062-03	1188.3	N	1996	0.54	0.37	32%	42.7	
50-062-04	901.2	N	1996	0.26	0.44	-71%	123.4	
50-062-05	5249.6	N	1996	0.41	0.70	-69%	93.9	
50-062-06	2562.0	N	1996	0.62	0.33	46%	22.4	
50-062-07	4041.6	N	1996	1.41	1.34	5%	35.9	
50-062-08	11248.6	N	1996	0.51	1.26	-149%	59.0	
50-062-09	7658.9	N	1997	0.22	0.31	-42%	57.3	
50-062-10	8772.4	N	1997	0.72	0.11	84%	38.9	
50-062-11	1276.6	N	1996	0.44	0.45	-3%	74.0	
50-063-01	9792.2	N	1996	0.45	1.05	-133%	109.1	
50-064-01	898.7	N	1997	2.98	0.96	68%	110.5	
50-064-03	145.0	N	1997	2.98	0.96	68%	110.5	
50-064-04	1150.4	N	1997	2.98	0.96	68%	110.5	
50-065-02	938.1	N	1995	3.64	Unable to Calculate	Unable to Calculate	Unable to Calculate	<75% annual load sampled (68.6% Sampled)
50-065-03	3751.7	N	1997	2.98	0.96	68%	110.5	
50-065-05	929.8	N	1997	2.98	1.46	51%	282.2	
50-065-06	453.9	N	1997	2.98	1.31	56%	209.0	
50-065-07	513.0	N	1995	3.92	0.92	77%	132.7	
50-065-08	628.0	N	1997	2.98	0.96	68%	110.5	
50-065-10	792.3	N	1995	1.55	0.79	49%	43.8	
50-067-01	1143.9	N	1996	0.40	0.24	38%	53.4	
50-067-02	10257.1	N	1996	0.94	1.16	-24%	61.8	
50-067-03	681.6	N	1996	1.02	0.69	32%	30.8	
50-067-04	3819.5	N	1996	0.55	0.98	-78%	48.4	
50-067-05	7322.6	N	1996	0.42	0.80	-91%	50.5	
50-067-06	1277.2	N	1999	0.49	1.89	-285%	87.9	
50-067-07	1975.5	N	1999	0.54	0.66	-23%	24.4	
50-067-09	1277.7	N	1999	0.54	0.13	76%	50.4	
50-067-10	2551.8	N	1999	1.21	0.34	72%	80.5	
50-067-11	6179.0	N	1999	0.85	0.58	32%	47.8	
50-067-13	685.3	N	1997	2.29	0.61	74%	40.9	
50-068-01	2615.8	N	1996	1.13	0.74	35%	111.9	
50-068-02	1998.1	N	1997	2.30	1.33	42%	250.1	
50-069-01	317.5	N	1996	1.06	1.14	-8%	55.6	
50-070-01	245.0	N	1995	3.82	4.60	-20%	154.0	
50-070-02	244.0	N	1995	3.09	0.73	76%	182.4	
50-071-01	1470.3	N	1996	5.02	3.04	39%	347.9	
50-073-01	67.8	N	2001	Unable to Calculate	0.00	Unable to Calculate	0.0	
50-078-01	71.6	N	1999	8.71	12.06	-39%	286.6	
50-082-01	484.5	N	1995	9.82	0.53	95%	29.4	

Table 2. Best Management Practice (BMP) summary and "BMP equivalent" points for the EAA[1] and C-139[2] basins.

BMP	PTS	DESCRIPTION
NUTRIENT CONTROL PRACTICES		**MINIMIZES THE MOVEMENT OF NUTRIENTS OFF-SITE**
Nutrient Application Control	2 ½	Controlled application of nutrients with a 4' setback from canals: banding, pneumatic application - AIRMAX; fertigation; and fertilization placement near root under plastic.
Nutrient Spill Prevention	2 ½	Formal spill prevention protocols (storage, handling, transfer, and education/instruction).
Successive Vegetable Planting to Minimize P	2 ½	Successive planting of high P/low P demand crops to avoid P build up and no successive P application.
Plant Tissue Analysis	2 ½ 5	Determines plant nutrient requirements next growing season (crop specific). Citrus only – because plant tissue analysis provides information on current season, additional points are allowed.
Nutrient Application Control	5	Determine the P requirements of the soil and follow standard recommendations for application rates (crop specific).
Split Nutrient Application	5	Applying small portions of P at various times without exceeding the total recommendation.
Slow Release P Fertilizer	5	Specially treated fertilizer.
Reduced P Fertilization	5	P application rate is at least 30% below the recommendation.
No Nutrients Imported Via Direct Land Application	15	No application of P in any form. Native and semi-improved range may apply fertilizer at maintenance levels every 6-8 years.
No Nutrients Imported Indirectly Through Cattle Feed	15	No P import to the basin through cattle feed (Note: native range is not excluded by use of mineral supplements or molasses).
Nutrient Management Plan (Levels I&II/III/IV)	15/25/35	Managing the amount, source, placement, form, and timing of the application of nutrients on lands with cattle operations.
WATER MANAGEMENT PRACTICES		**MINIMIZES THE VOLUME OF OFF-SITE DISCHARGES**
½ Inch Detained 1 Inch Detained	5 10	Delay discharge (based on measuring daily rain events using a rain gauge).
Improved Infrastructure	5	Recirculate water inside farm boundaries to improve water quality prior to offsite discharge (e.g., rice and vegetables); fallow field flood water with no direct discharge (instead allow to "drain" via evapotranspiration, seepage, use as irrigation water); or increasing water detention using properly constructed canal berms.
Water Table Management	5	Optimize drainage and irrigation schedules and/or by using low volume irrigation methods to decrease discharge.
Approved and Operational Surface Water Reservoir	 10 10 15	Properly permitted, constructed, and maintained storage system meeting specified ERP Basis of Review criteria (version in effect at the time of permitting or in effect at the time of permit modification for modified systems): System meets Section 5.2.1, Water Quality Criteria-Volumetric Requirements System meets Section 6.2, Water Quantity Criteria-Discharge Rate System meets Section 6.3, Water Quantity Criteria-Design Storm (Note: must have a valid SFWMD construction and operation permit for the surface water system)
Temporary Holding Pond	15	Temporary agricultural activities (as described in Chapter 40E-400, FAC.) with a properly constructed and permitted temporary holding pond.
No Direct Discharge	15	Overland Sheet Flow, no direct discharge.

BMP	PTS	DESCRIPTION
PARTICULATE MATTER AND SEDIMENT CONTROLS		**MINIMIZES THE MOVEMENT OF PARTICULATE MATTER AND SEDIMENTS**
Any 2 Any 4 Any 6 Any 8	2 ½ 5 10 15	• Leveling fields • Slow drainage velocity near pumps • Grassed swales/field ditch connections • Ditch bank berms • Canal cleaning program • Aquatic weed control • Field ditch drainage sumps • Barriers at discharge locations • Ditch bank stabilization • Sediment sump/trap in canals • Maintain forage to reduce soil erosion/range seedings • Soil stabilization through infrastructure improvements • Cover crops • Culvert bottoms above ditch bottoms • Vegetated ditch banks
PASTURE MANAGEMENT		**ON-FARM SITE OPERATION AND MANAGEMENT PRACTICES**
	2 ½ 2 ½ 5 5 10	• Restricted placement of feeders, cowpens, or feed and water to reduce "hot spots" near drainage ditches (2 ½ points each) • Provide shade structures to prevent cattle in waterways • Low cattle density (1 head/2 acres, non-irrigated pasture) • Reduced P in feed (by a minimum of 20%) • Restrict cattle from waterways through fencing of canals in a manner that protects the discharge water quality
Urban Xeriscape	5	Use of plants that required less water and fertilizer
Detention Pond Littoral Zone	5	Vegetative filtering area for on-site stormwater runoff.
Other BMPs	TBD[3]	BMPs proposed by permittee and accepted by SFWMD.

Notes:

A BMP plan is required for each land use or crop, and shall be implemented across the entire farm acreage (drainage area).

[1] For the EAA basin, a minimum of 25 points is required for each BMP plan.

[2] For the C-139 Basin, the minimum required points for each BMP plan are based on compliance status as follows:

- Level I: Initial phase 15 points for each BMP Plan.
- Level II: First incidence out of compliance, no additional BMPs; however, onsite verification of BMPs begin. Frequency of visits based on compliance record.
- Level III: Second incidence out of compliance, 10 additional BMP points for each BMP plan (25 points total).
- Level IV: Third incidence out of compliance, 10 additional BMP points for each BMP plan (35 points total)

[3] TBD - To be determined.

Table 3. EAA agricultural privilege tax credits for the EAA basin.[1]

Everglades Agricultural Privilege Tax
Area-Wide Incentive Credit Schedule

Calendar Year	Water Year	Min. Phos. Reduction Required (%)	Actual Phos. Reduction Achieved (%)	Credits Earned	Total Credits (Cumulative)	Credits Used	Credit Balance	Fiscal Year
1994	1993	25	44	19	19.00	0.00	19.00	FY95
1995	1994	25	17	0	19.00	0.00	19.00	FY96
1996	1995	25	31	6	25.00	0.00	25.00	FY97
1997	1996	25	68	43	68.00	0.00	68.00	FY98
1998	1997	25	49	24	92.00	3.91	88.09	FY99
1999	1998	25	34	9	97.09	3.91	93.18	FY00
2000	1999	25	49	24	117.18	3.91	113.27	FY01
2001	2000	25	55	30	143.27	3.91	139.36	FY02
2002	2001	25	73	48	187.36	10.02	177.34	FY03
2003	2002	25	55	30	207.34	10.02	197.32	FY04
2004	2003	25	**35**	10	207.32	10.02	197.30	FY05
2005	2004	25			197.30	10.02	187.28	FY06
2006	2005	25			187.28	15.55	171.73	FY07
2007	2006	25			171.73	15.55	156.18	FY08
2008	2007	25			156.18	15.55	140.63	FY09
2009	2008	25			140.63	15.55	125.08	FY10
2010	2009	25			125.08	15.55	109.53	FY11
2011	2010	25			109.53	15.55	93.98	FY12
2012	2011	25			93.98	15.55	78.43	FY13
2013	2012	25			78.43	15.55	62.88	FY14

Note: Water Year 2002 (Calendar Year 2003 / FY2004) subject to Governing Board approval at 09/09/03 public hearing.
Water Year 2002 = May 1, 2001 to April 30, 2002

Additional Information of Interest

Per Acre Charge	Years	Area-Wide Incentive Credit	Min. Phos. Reduction Required
$24.89	1994 - 1997	0.33	25%
$27.00	1998 - 2001	0.54	25%
$31.00	2002 - 2005	0.61	25%
$35.00	2006 - 2013	0.65	25%
$25.00	2014 - 2016	N/A	N/A
$10.00	2017	N/A	N/A

Note:

1. Vegetable classified acreage is never charged more than $24.89 pre acre.
2. Vegetable classified acreage is not eligible for incentive credits.
3. The minimum per acre charge will never drop below $24.89 through Nov 2013. If incentive credits would cause the per acre charge to drop below $24.89, any earned, unused credits will we carried forward and applied to the following year.
4. Any unused or excess incentive credits remaining after certification of the Everglades agricultural privilege tax roll for the tax notices mailed in November 2013 shall be canceled.
5. The annual Everglades agricultural privilege tax for the tax notices mailed in November 2014 through November 2016 shall be $25 per acre and for tax notices mailed in November 2017 and thereafter shall be $10 per acre. (Committee Substitute for Senate Bill No. 626) CS/SB 626 (Laws of Florida Chapter 2003-12) Amending s. 373.4592, F.S., EFA

Calculating Credits:

1994 - 1997	N/A
1998 - 2001	$27.00 - $24.89 = $2.11 / .54 = 3.91
2002 - 2005	$31.00 - $24.89 = $6.11 / .61 = 10.02
2006 - 2013	$35.00 - $24.89 = $10.11 / .65 = 15.55

[1] Calculated in accordance with the Everglades Forever Act, Section 373.4592(6), Florida Statutes.

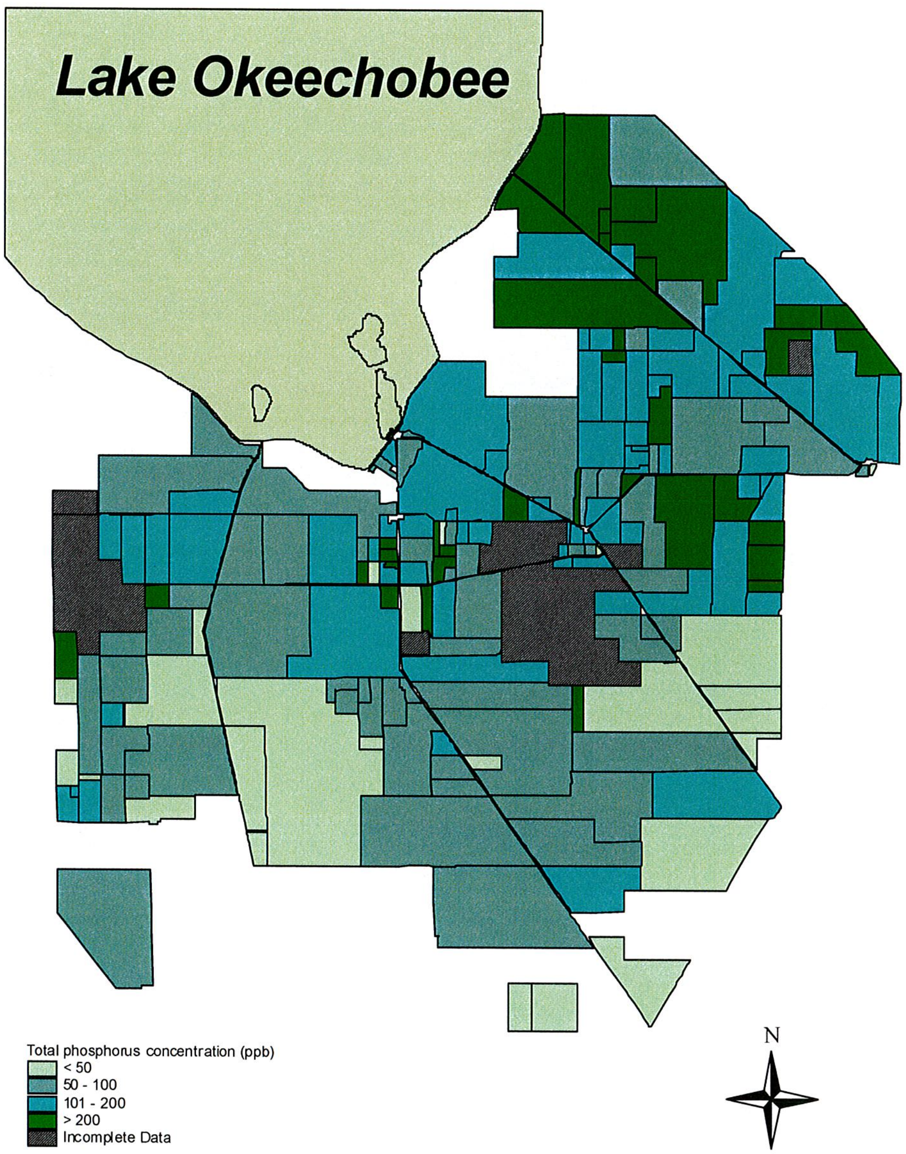


Figure 1. Total phosphorus (TP) concentrations (in ppb) in the Everglades Agricultural Area (EAA).

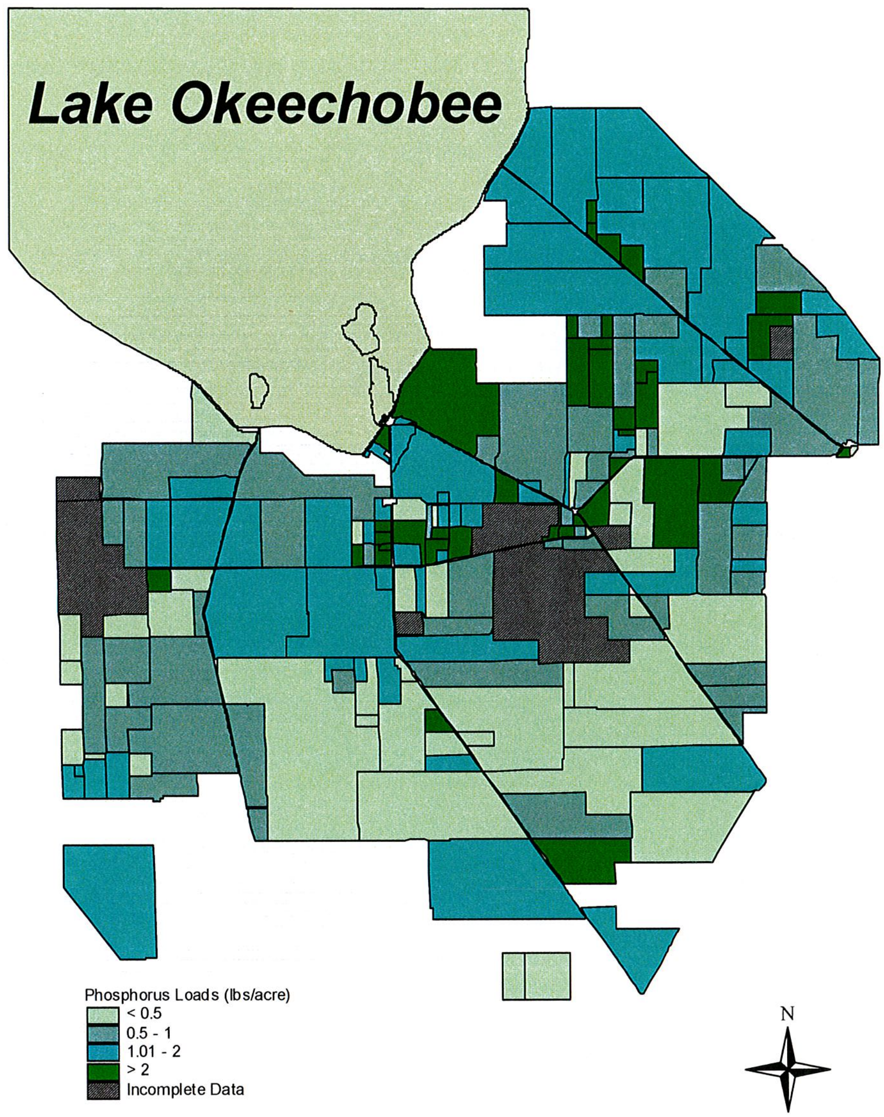
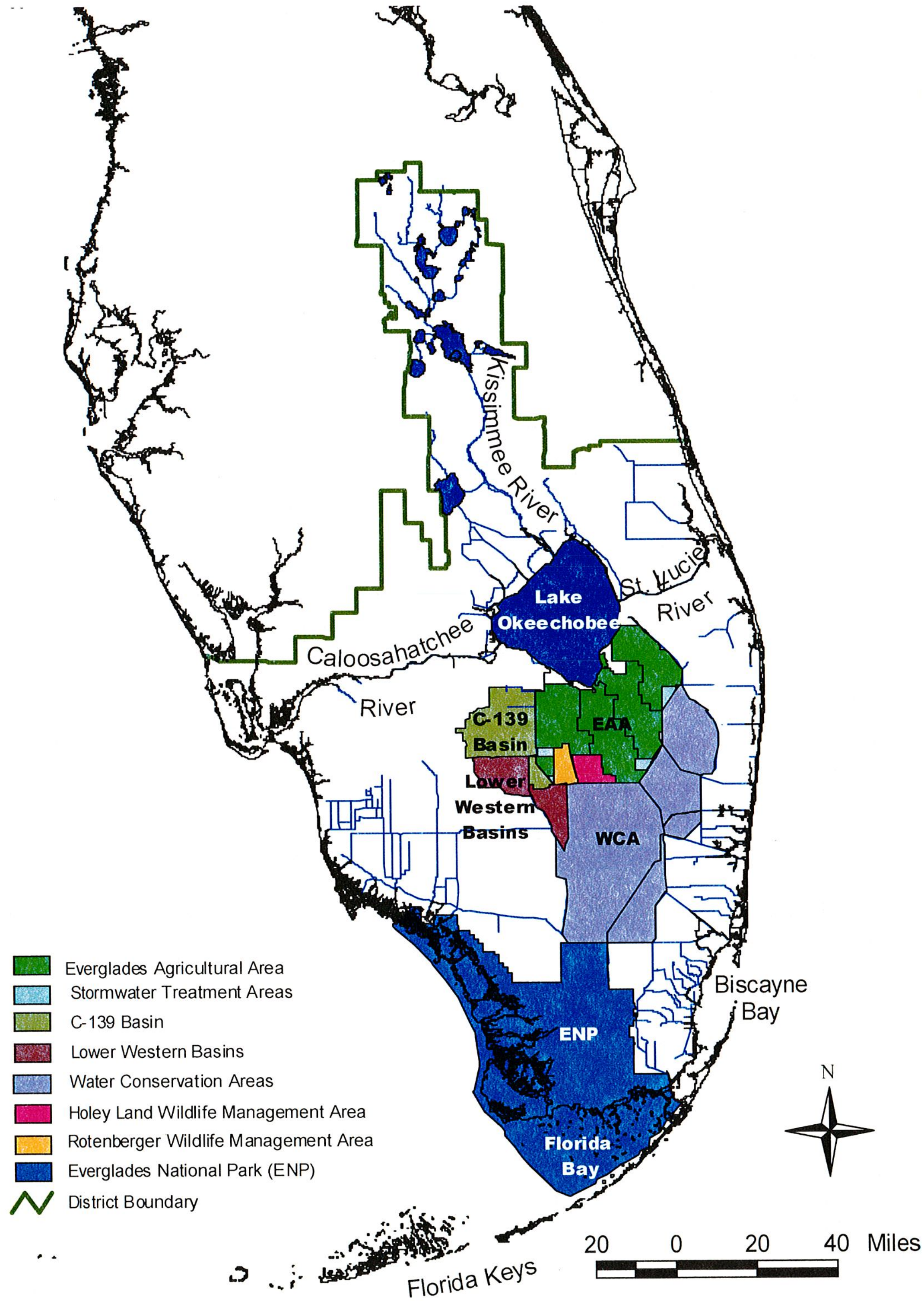


Figure 2. Total phosphorus (TP) loads (in lbs/ac) in the Everglades Agricultural Area (EAA).



South Florida Water Management District

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Everglades Regulation Division

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