Everglades Agricultural Area Regional Feasibility Study

Deliverable 1.5.2 – Inflow Data Sets for the Period 2006-2009 (Final Report)

(Contract No. CN040912-WO04 Phase 2)

Prepared for:

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August 9, 2005

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South Florida Water Management District
EAA Regional Feasibility Study
ADA Contract No. CN040912-WO04 Phase 2
Inflow Data Sets for the Period 2006-2009
B&McD Project No. 38318

Dear Mr. Vazquez:

Burns & McDonnell is pleased to submit this Final report on "Inflow Data Sets for the Period 2006-2009". This document constitutes Deliverable 1.5.2 under ADA Engineering, Inc. Task Order No. BM-05WO04-02 dated April 27, 2005.

We gratefully acknowledge the valuable contributions of both your staff and that of the South Florida Water Management District in the development of the information presented herein.

Certification

I hereby certify, as a professional engineer in the State of Florida, that the information in this document was assembled under my direct personal charge. This report is not intended or represented to be suitable for reuse without specific verification or adaptation by the Engineer. This certification is provided in accordance with the provisions of the Laws and Rules of the Florida Board of Professional Engineers under Chapter 61G15-29, Florida Administrative Code.

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Table of Contents

List of Tables

1. INTRODUCTION

This document and the analyses it summarizes were prepared by Burns & McDonnell Engineering Co., Inc. under contract to ADA Engineering, Inc (ADA). The conduct of these analyses and preparation of this document were authorized by the South Florida Water Management District (SFWMD or District) through its March 27, 2005 issuance of Work Order No. CN040912-WO04 to ADA, and subsequently authorized by ADA through its April 27, 2005 issuance of Task Order BM-05WO04-02 to Burns & McDonnell.

1.1. Background

Under the Everglades Construction Project (ECP), the South Florida Water Management District has constructed several STAs and the U.S. Army Corps of Engineers has constructed STA-1E to help improve the quality of waters released to the Everglades Protection Area (EPA). In addition to the existing STAs, the District is planning certain STA expansions and enhancements, Everglades Agricultural Area (EAA) canal improvements, construction of the EAA Storage Reservoir Project, and other EAA improvements. With recognition of these planned improvements, the EAA Regional Feasibility Study (RFS) will evaluate alternatives for redistributing inflow volumes and phosphorus loads to the various STAs to optimize phosphorus removal performance. This study is not intended to define the final arrangement, location or character of these proposed projects but is a fact-finding exercise to develop the information necessary for the subsequent planning, design and construction of these future projects.

1.2. Scope of Work

This document is one of a series of deliverables to be prepared under Task 1 "Develop Baseline Data" of the SFWMD Work Order No. CN040912-WO04. The overall objective of Task 1 is the development of revised baseline data for use in the EAA RFS consistent to the extent practicable with recent actual data and capable of acceptance by other agencies and parties (such as the United States Department of the Interior and the EAA Environmental Protection District) as being representative of inflow volumes and total phosphorus (TP) loads to the various stormwater treatment areas. Basins considered in this Task include the following:

- C-51 West Canal
- S-5A (West Palm Beach Canal)
- Ch. 298 Districts:
  - East Beach Water Control District
  - East Shore Water Control District
  - 715 Farms (State Lease No. 3420)
  - South Shore Drainage District
  - South Florida Conservancy District, Unit 5 (S-236 Basin)
- S2/S-6/S-7 (Hillsboro and North New River Canals)
- S-3/S-8 (Miami Canal)
- C-139 and C-139 Annex
- L-8 Canal
- Lake Okeechobee deliveries south to the STAs and Everglades

The following subtasks were established in Work Order No. CN040912-WO04 as elements of the work necessary to achieve the overall objective of Task 1:

Task 1.1 - Evaluation of the 2006 hydrologic simulation results for reasonableness, particularly as compared to recent (WY 1995-2004) actual data adjusted for significant changes in regional hydrology and water management operations over that period.

Task 1.2 - Evaluation of the 2010 and 2015 hydrologic simulation results for reasonableness, related primarily to changes from the 2006 simulation resulting from implementation of incremental significant changes to basin hydrography and regional water management operations.

Task 1.3 - Development of inflow volumes and total phosphorus concentrations and loads segregated by source over WY 1995-2004, based on the District-furnished historic data. The intent of this activity is to develop relationships between discharge and total phosphorus concentration by source that can be subsequently applied to the 1965-2000 STA inflow simulation results.

Task 1.4 - Definition of a methodology for applying the relationships developed above to the simulated inflow data sets structured for use in DMSTA analyses of the treatment areas.

Task 1.5 - On the basis of the methodology defined under Task 1.4, development of inflow data sets for all six (6) STAs for each of the three (3) hydrologic simulations (2006, 2010, and 2015).

This document was prepared under Task 1.5 "Development of Inflow Data Sets", and summarizes the development and nature of projected discharges from the various basins and sources tributary to the STAs. The inflow data sets summarized herein are considered specifically applicable to the period 2006-2009. This period is assumed to follow the initial expansion of STA-2 and STA-5, and completion of STA-6, Section 2, but precede completion of Compartment A-1 of the Everglades Agricultural Area Storage Reservoir project (EAASR A-1). The inflow data summarized herein will be used in the completion of Task 2, Phase 2 (Optimum Allocation of Hydraulic and Phosphorus Loading to the Existing STAs) and of Task 3, Phase 1 (Draft Operating Strategy for Optimizing STA Performance with Existing EAA Canals). For certain of the basins, the inflow data sets summarized herein will also be considered applicable for analysis of the period 2010-2014 (following completion of the EAASR A-1 Project) and 2015 and beyond (following completion of the EAASR Compartment A-2).

1.3. Previous Studies and Analyses

Development of the inflow data sets summarized herein has been based on the conclusions and recommendations of analyses prepared under Tasks 1.1, 1.3 and 1.4.

1.3.1. Basin Runoff and Inflow Volumes from Other Sources

Under Task 1.1, Phase 2, Burns & McDonnell completed an evaluation of the results of the District's South Florida Water Management Model (SFWMM) simulation for conditions and water management practices expected to exist in 2006. The following recommendations were made in the final (June 27, 2005) report on that evaluation:

1. Chapter 298 Districts (including the East Beach Water Control District, East Shore Water Control District, 715 Farms, South Shore Drainage District, and S-236 Basin):

Runoff volumes from these basins should be based on historic data to the maximum extent practicable, as the 2006 ECP simulation does not well represent either the total discharges or distribution of discharges from these basins. Currently available record data on those discharges (summarized in the Task Report prepared under Phase 2, Task 1.3) encompasses Water Years (WY) 1995-2004. As a result, only WY 1995-2000 can be directly imported for the analysis. For WY 1966-1994, it will be necessary to estimate those inflow volumes by indirect methods. That indirect estimation will be made through an analysis of total daily runoff volumes from the various Chapter 298 Districts regressed against total daily runoff volumes from adjacent basins of the EAA, using historic data for WY 1995-2004. The relationships resulting from that regression analysis will then be applied to the daily simulated runoff from the adjacent EAA basins to develop a daily time series for runoff from the Chapter 298 Districts over WY 1966-1994. With one possible exception, it is further recommended that all runoff from these districts be included in the inflows to the STAs (e.g., assumption of 100% diversion efficiency). That possible exception is for discharges from the S-236 Basin to the Industrial Canal at Pump Station P-5-W; additional analysis would be necessary to confirm the reasonableness of an assumption of 100% diversion efficiency for that structure.

2. EAA Basins (including the S-5A, S-2/S-6, S-2/S-7, and S-3/S-8 Basins): With one adjustment, it is recommended that subsequent analyses employ the results of the 2006 ECP simulation over WY 1966-2000. That adjustment should address the need for shifting approximately 11% of the basin runoff simulated as entering the North New River Canal to the Hillsboro Canal.

3. C-139 Basin: Different recommendations are made for discharges from this basin at G-136 and to the L-3 Borrow Canal:

   - Discharges at G-136: As this structure discharges to the EAA, it is considered necessary to include daily time series over WY 1966-2000 in the analysis. It is recommended that the boundary condition data for discharges at this structure be taken from the 2006 ECP simulation. It is further recommended that only those discharges from this structure associated with the term G136SO be considered as

delivered to STA-3/4, as discharges for the term G136EA are typically consumed as water supply in the S-3/S-8 Basin.

- Discharges to the L-3 Borrow Canal at the present location of G-406 (essentially, possible inflows to STA-5): For at least conditions expected to exist at the end of 2006, it is unlikely that the analysis of STA-5 will impact or be impacted by regional operations. Given the uncertainty associated with much of the period of boundary condition inflows reflected in the 2006 ECP simulation, particularly prior to Water Year 1995, it is recommended that subsequent analysis of this basin and STA-5 be based on historic data. It is further recommended that the analyses in the Phase 2, Task 1.3 report be updated to include actual discharges in Water Year 2005, resulting in an 11-year period of analysis. Further, given the ongoing efforts for development of additional Best Management Practices in this basin, it is recommended that historic phosphorus concentrations be reduced by 10% from historic values in subsequent analyses.

4. C-139 Annex: It is recommended that historic data for WY 1997-2004 at station USSO be used in lieu of the boundary conditions input to the 2006 ECP simulation for analysis of C-139 Annex discharges and STA-6. Given limitations on available data for the other primary source of inflow to STA-6 (USSC Southern Division Ranch, Unit 2, see following recommendation), it is probable that analysis of STA-6 for conditions expected to prevail at the end of 2006 will be limited to WY 1998-2004.

5. Former USSC Southern Division Ranch Unit 2: It is recommended that, following certain adjustments, historic discharge data at G-600 for WY 1998-2004 be used in lieu of simulated runoff from this basin for analysis of STA-6. It will be desirable to separate the historic data into two primary components. Those components are basin discharges resulting from rainfall, and basin discharges resulting from seepage into Unit 2 from adjacent areas. Following that separation, each component would require further adjustment. Basin discharges resulting from runoff should be adjusted to reflect the conversion of approximately 20% of the basin to use in STA-5 and 15% of the basin to use in STA-6 (total adjustment of approximately -35% in historic

discharges from rainfall). Basin discharges resulting from seepage should be adjusted to reflect the reduced perimeter of the basin resulting from the conversion of lands to use in STA-5.

6. Acme Improvement District Basin B: It is recommended that, following certain adjustments, daily runoff volumes from this basin resulting from the 2006 ECP simulation for WY 1966-2000 be employed in subsequent analyses. The simulation results do not reflect increased basin discharges resulting from seepage into the basin from the Loxahatchee National Wildlife Refuge. It is recommended that the simulated discharge volumes from Acme Basin B be increased by 9% prior to the conduct of subsequent analyses. In addition, management options to be considered in subsequent analyses may include the possibility of direct return of accumulated seepage from the LNWR back to the LNWR, in lieu of diverting those inflows to STA-1E for treatment. It will therefore be desirable to approximate the influence of such management on the volumes discharged from Acme Basin B to the C-51 West Canal and STA-1E. It is presently anticipated that those seepage inflows might account for between 15 and 20 percent of the total runoff from this basin.

7. C-51 West Basin: It is recommended that the results of the 2006 ECP simulation for <u>total</u> basin runoff over WY 1966-2000 be used in subsequent analyses. However, with respect to that part of the overall basin runoff discharged to STA-1E at Pump Station S-361, the simulation results (term S1324P in the simulation) are clearly unreasonable. For any analysis in which those inflows to STA-1E are considered separately from the basin as a whole, it is recommended that those inflows be established at a fixed percentage of the overall basin runoff. On the assumption of a uniform depth of runoff over the entire basin, that percentage would be approximately 2.5%.

8. L-8 Basin: It is recommended that the results of the 2006 ECP simulation be used for subsequent analysis of runoff from the L-8 Basin.

9. Lake Okeechobee Releases: It is recommended that the results of the 2006 ECP simulation for Lake releases directed to the stormwater treatment areas be employed

in subsequent analyses. It will be necessary to confirm that the assumptions in the simulation concerning water supply bypass of the STAs be reflected in the adopted operating plans for the STAs.

10. Inflows to STA-1E: The simulation is inconsistent with the SFWMD's current intent for the combined interim operation of Pump Station S-319 and Structure S-155A. The simulation attempts to maximize that part of the total inflows to the C-51 West Canal directed to STA-1E, while the current operational intent is to bypass a volume at S-155A equivalent to the total inflow from the L-8 Basin (reference: letter dated May 24, 2005 from Chip Merriam, Deputy Executive Director of SFWMD, to Dennis Duke, P.E. of the Jacksonville District, U.S. Army Corps of Engineers). Full adjustment of inflows to STA-1E to reflect that change can be expected to directly impact other significant elements of the simulation (such as the potential need for additional Lake Okeechobee water supply releases to the LNWR to offset reductions in potential supply). For that reason, it is recommended that the 2006 ECP simulation be modified to properly reflect the full impact of L-8 Basin runoff and the SFWMD's interim operations plan prior to the conduct of subsequent analyses. Should that not be practicable, it will be necessary to adjust those inflows in some other fashion.

11. Distribution of Outflows from the STA-1 Inflow Basin (term L101 in the simulation): It will be necessary to confirm that the adopted operating plan for the various structures in the STA-1 Inflow Basin (S-5A, S-5AS, S-5AW, G-300, G-301, G-302, G-303 and G-311) are properly coordinated with and reflected in the SFWMM simulation, as the operation of those structures will directly impact inflows to both STA-1W and the westerly two flow paths of STA-1E.

While the above recommendations are specific to subsequent analyses to be conducted for conditions expected to exist at the end of 2006, it is anticipated that the resultant data sets for runoff from the following basins would also be directly applicable to analyses for 2010 and 2015 conditions:

- Chapter 298 districts;
- C-139 Basin;

- C-139 Annex;
- C-51 West Basin;
- Acme Improvement District Basin B.

1.3.2. Methodology for Establishing Inflow TP Concentrations

Under Task 1.4, Phase 2, Burns & McDonnell completed an evaluation of the sensitivity of STA outflow total phosphorus (TP) concentrations projected using the Dynamic Model for Stormwater Treatment Areas Version 2 (DMSTA2), Walker and Kadlec, to the manner in which TP concentrations are assigned on a daily basis to basin runoff and other sources of inflow. The principal conclusion of that evaluation was that, at least with respect to long-term flow-weighted and geometric mean outflow concentrations, the analytical results are not significantly different when monthly flow-weighted mean concentrations are assigned in the following manners:

- On the basis of daily flow-dependent variations. The inflow time series used was based on an analysis of measured TP concentrations regressed against measured discharges, with the results of the regression analysis applied to an extended period of simulated flows to estimate daily concentrations;

- On the basis of monthly flow-weighted mean concentrations. The inflow time series based on the regression analysis was modified to attach TP concentrations on the basis of a flow-weighted mean TP concentration for each month of the year (e.g., for the full 31-years of the original time series, a flow-weighted mean TP concentration was developed for all inflows during each of the twelve months of the year).

Projected outflow concentrations varied by 0.2 ppb or less. Given that minor variability in the outflow results, it was concluded that it is suitable to assign TP concentrations to basin runoff and other sources of inflow on the basis of flow-weighted means that vary by month.

1.3.3. Monthly Flow-Weighted Mean TP Concentrations

Under Task 1.3, Phase 2, Burns & McDonnell prepared an analysis of District-furnished data encompassing the period WY 1995-2004 (that is, May 1, 1994, through April 30, 2004). The principal purpose of that analysis was to, on the basis of historic data, develop estimated monthly flow-weighted mean TP concentrations in potential inflows from each basin or other source tributary to the STAs. It was determined in that analysis that the manner in which TP loads and concentrations associated with Lake Okeechobee flow-through releases are evaluated considerably influences the estimated TP concentrations and loads associated with basin runoff.

In general, it was observed that the TP concentration in Lake Okeechobee flow-through releases decreases as those releases travel through the primary canal system, being generally lower at the downstream end of the canals (at Pump Stations S-5A, S-6, S-7 and S-8) than the same-day concentrations at the points of release from the Lake. The June 27, 2005, final report on the Task 1.3, Phase 2 analyses presents estimated flow-weighted mean TP concentrations in basin runoff computed after adjusting total discharge loads on the basis of both:

- TP concentrations and loads in Lake Okeechobee flow-through discharges measured at the point of release from the Lake;
- TP concentrations and loads in Lake Okeechobee flow-through discharges measured at the downstream point of release (e.g., point of discharge to either the Everglades Protection Area or to the STAs).

The first of those two methods is consistent with the manner in which TP loads in basin runoff are computed under the EAA BMP rule (Chapter 40E-63, Florida Administrative Code). The second of those two methods is considered more applicable to assessing the influence of changes in Lake Okeechobee management and points of release on potential inflows to the STAs, and generally results in a more conservative estimate of inflow TP loads in basin runoff.

The inflow data sets summarized herein are developed employing the second method (except as noted below), in which TP concentrations and loads are assigned based on

water quality samples acquired at the downstream point of release. The daily flow-weighted mean TP concentrations in each source of runoff or potential inflow to the STAs are assigned on the flow-weighted mean for each of the twelve months of the year computed from the 10-year period of record encompassing WY 1995-2004.

There are two principal exceptions to the above statement. For the L-8 Basin, the average monthly concentrations in basin runoff were estimated using concentrations in flow-through volumes at the basin inlet. The second exception applies to runoff from the following basins, for which the STA inflow data sets are taken from the historic data. In those basins, the measured daily TP concentrations from the historic record are used in the analysis:

- The C-139 Basin (for those discharges to L-3/STA-5);
- The C-139 Annex;
- The former USSC Southern Division Ranch, Unit 2.

* * * * *

2. BASIN RUNOFF FROM CHAPTER 298 DISTRICTS

As noted above, the Phase 2, Task 1.1 final report recommended that runoff volumes for the Chapter 298 districts — East Beach Water Control District, East Shore Water Control District, 715 Farms, South Shore Drainage District, and S-236 Basin — should be based on historic data to the maximum extent practicable, as the 2006 ECP simulation does not well represent either the total discharges or distribution of discharges from these basins. Currently available record data on those discharges (summarized in the task report prepared under Phase 2, Task 1.3) encompasses WY 1995-2004. As a result, only WY 1995-2000 can be directly imported for the analysis. For WY 1966-1994, it will be necessary to estimate those inflow volumes by indirect methods.

It was contemplated in that previous report that the indirect estimation will be made through an analysis of total daily runoff volumes from the various Chapter 298 Districts regressed against total daily runoff volumes from adjacent basins of the EAA, using historic data for WY 1995-2004. The relationships resulting from that regression analysis would then be applied to the daily simulated runoff from the adjacent EAA basins to develop a daily time series for runoff from the Chapter 298 Districts over WY 1966-1994.

Subsequent analyses led to the conclusion that a regression of the daily discharges from the 298 districts to adjacent EAA basin runoff would not yield satisfactory results — coefficients of determination (r^2 values) were typically 0.5 or less, with standard errors roughly three times the average rate of discharge from those basins. Regression of daily 298 district discharges against rainfall was also attempted; the analyses considered both a single regression against daily rainfall, and multiple regression against daily and 7-day accumulated rainfall. The results of those analyses yielded similarly disappointing results.

An alternate approach was adopted in which daily discharges from the 298 districts are assigned as a fixed percentage of the daily runoff from the adjacent primary basin of the EAA, with that fixed percentage equal to the ratio of the overall discharge volume from each 298 districts over WY 1995-2004 to the overall discharge volume from the adjacent EAA basin over that same period.

A complicating factor in the computation was recognition that the effective contributing area of the adjacent EAA basins varied over the 1995-2004 period, due primarily to the intervening

construction of the various STAs. As the resulting ratios are to be applied to the results of the District's ECP 2006 SFWMM simulation, it was necessary to normalize the historic discharges from the EAA basins to the effective basin area reflected in the simulation.

The following sections present the results of that analysis and summarize the 298 district runoff estimated for use in the Regional Feasibility Study. The runoff estimates summarized herein for these Chapter 298 districts are considered applicable not only to the period 2006-2009, but to all periods thereafter.

2.1. East Beach Water Control District

Table 2.1 presents a comparison of the historic annual discharge volumes from the East Beach Water Control District (EBWCD) to those from the adjacent S-5A Basin.

Table 2.1 Comparison of EBWCD to S-5A Basin Discharge Volumes

Water Year	Historic Basin Runoff (acre/feet)		
	EBWCD (1)	S-5A (2)	Ratio
1995	12,857	454,167	0.0283
1996	11,269	307,340	0.0367
1997	3,551	230,666	0.0154
1998	10,040	306,005	0.0328
1999	18,596	185,995	0.1000
2000	29,283	287,105	0.1020
2001	5,227	152,643	0.0342
2002	18,023	257,435	0.0700
2003	16,701	290,241	0.0575
2004	19,353	255,239	0.0758
Ave. Annual	14,490	272,684	0.0531
Basin Area in Acres (3)	6,542	120,240	0.0544

(1) From Table 9.3, Phase 2 Task 1.3 Final Report
(2) From Table 2.10, Phase 2 Task 1.3 Final Report; values for WY 1995-2000 reduced by 2.5% for subsequent conversion of 3,000 acres to use in STA-1W (expansion of ENR Project)
(3) Basin areas from Table 6.1, Phase 2 Task 1.1 Final Report

For WY 1966-1994, daily discharges from the EBWCD are assigned at 0.0531 times the total S-5A Basin runoff taken from the ECP 2006 simulation. The specific formula employed in that computation, referenced to the terms of the simulation, is:

EBWCD Runoff = 0.0531*(RFWPBB – EBDST1 + DIVERS)

These individual flow terms are defined as follows:

- RFWPBB = Runoff from West Palm Beach Canal basin in EAA
- EBDST1 = Flow from East Beach Water Control District to STA-1
- DIVERS = Diversion of runoff from West Palm Beach Canal (S-5A) basin into Hillsboro Canal and STA-2

Daily total phosphorous concentrations in the estimated runoff from this district, for WY 1966–1994 only, are assigned at the monthly flow-weighted mean values developed in the Phase 2, Task 1.3 final report. These average monthly TP concentrations are listed in Table 2.2.

Table 2.2: Average TP Concentrations in East Beach Water Control District Runoff*

Month	Average TP Conc. (ppb)	Month	Average TP Conc. (ppb)
January	233	July	480
February	385	August	518
March	302	September	483
April	577	October	725
May	224	November	692
June	483	December	335

* Derived from Table 9.3 of final Task 1.3 report (June 27, 2005).

For the balance of the simulation period of record, WY 1995-2000, actual recorded historic discharge and TP concentration data were used without modification.

A summary of the estimated annual discharge volumes and TP loads for this composite record of generated and actual runoff data for the EBWCD is presented in Table 2.3.

Table 2.3 Summary of Annual EBWCD Discharges

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	19,092	11,925	506
1967	18,264	11,154	495
1968	11,767	7,549	520
1969	24,832	14,675	479
1970	24,709	14,357	471
1971	12,302	7,095	468
1972	16,664	10,864	529
1973	9,047	4,968	445
1974	10,677	6,363	483
1975	13,656	8,454	502
1976	15,862	9,744	498
1977	12,454	6,143	400
1978	15,707	8,574	443
1979	20,524	11,301	446
1980	14,993	8,789	475
1981	9,664	5,472	459
1982	11,678	6,836	475
1983	21,799	11,947	444
1984	18,000	11,187	504
1985	13,594	7,627	455
1986	14,164	8,396	481
1987	15,689	9,010	466
1988	13,059	9,263	575
1989	12,104	7,184	481
1990	10,108	6,274	503
1991	14,508	8,090	452
1992	10,782	6,452	485
1993	23,851	13,854	471
1994	17,256	10,430	490
1995	12,857	8,593	542
1996	11,269	10,869	782
1997	3,551	677	155
1998	10,041	6,707	542
1999	18,597	16,643	726
2000	29,284	21,058	583
Min. Annual	3,551	677	---
Max. Annual	29,284	21,058	---
Avg. Annual	15,212	9,386	500

2.2. East Shore Water Control District and 715 Farms

Table 2.4 presents a comparison of the historic annual discharge volumes from the East Shore Water Control District (ESWCD) and 715 Farms area to those from the adjacent S-5A Basin.

Table 2.4 Comparison of ESWCD/715 to S-5A Basin Discharge Volumes

Water Year	Historic Basin Runoff (acre/feet)		
	ESWCD/715 (1)	S-5A (2)	Ratio
1995	34,326	454,167	0.0756
1996	31,269	307,340	0.1017
1997	19,790	230,666	0.0858
1998	26,377	306,005	0.0862
1999	25,059	185,995	0.1347
2000	45,171	287,105	0.1573
2001	12,677	152,643	0.0830
2002	21,685	257,435	0.0842
2003	32,693	290,241	0.1126
2004	30,281	255,239	0.1186
Ave. Annual	27,933	272,684	0.1024
Basin Area in Acres (3)	11,534	120,240	0.0959

(1) From Table 9.7, Phase 2 Task 1.3 Final Report
(2) From Table 2.10, Phase 2 Task 1.3 Final Report; values for WY 1995-2000 reduced by 2.5% for subsequent conversion of 3,000 acres to use in STA-1W (expansion of ENR Project)
(3) Basin areas from Table 6.1, Phase 2 Task 1.1 Final Report

For WY 1966-1994, daily discharges from the ESWCD/715 drainage area are assigned at 0.1024 times the total S-5A Basin runoff taken from the ECP 2006 simulation. The specific formula employed in that computation, referenced to the terms of the simulation, is:

$$\text{ESWCD/715 Runoff} = 0.1024*(\text{RFWPBB} - \text{EBDST1} + \text{DIVERS})$$

Daily total phosphorous concentrations in that runoff, for WY 1966–1994 only, are assigned at the monthly flow-weighted mean values developed in the Phase 2, Task 1.3 final report for the combined ESWCD and /715 Farms area. These average monthly concentrations are listed in Table 2.5.

Table 2.5: Average TP Concentrations in ESWCD/715 Farms Runoff*

Month	Average TP Conc. (ppb)	Month	Average TP Conc. (ppb)
January	71	July	142
February	89	August	123
March	113	September	121
April	125	October	156
May	78	November	116
June	130	December	123

* Derived from Table 9.7 of final Task 1.3 report (June 27, 2005).

For WY 1995-2000, actual historic discharge and TP concentration data are used without modification. Table 2.6 is a summary of the estimated annual discharge volumes and TP loads from the ESWCD/715 Farms for this combined record.

Table 2.6 Summary of Annual ESWCD/715 Discharges

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	36,818	5,702	126
1967	35,221	5,602	129
1968	22,693	3,709	132
1969	47,887	7,403	125
1970	47,650	7,142	122
1971	23,724	3,619	124
1972	32,135	5,051	127
1973	17,446	2,535	118
1974	20,589	3,256	128
1975	26,336	4,147	128
1976	30,590	4,847	128
1977	24,016	3,177	107
1978	30,289	4,387	117
1979	39,580	5,766	118
1980	28,914	4,206	118
1981	18,637	2,741	119
1982	22,521	3,340	120
1983	42,037	5,989	115
1984	34,712	5,488	128
1985	26,214	3,713	115
1986	27,315	4,166	124
1987	30,256	4,632	124
1988	25,184	3,862	124
1989	23,341	3,677	128
1990	19,492	2,983	124
1991	27,978	3,906	113
1992	20,792	3,203	125
1993	45,995	6,612	117
1994	33,277	4,856	118
1995	34,327	7,220	171
1996	31,270	5,479	142
1997	19,790	2,512	103
1998	26,378	5,325	164
1999	25,060	2,999	97
2000	45,172	7,328	132
Min. Annual	17,446	2,512	---
Max. Annual	47,887	7,403	---
Avg. Annual	29,818	4,588	125

2.3. South Shore Drainage District

Table 2.7 presents a comparison of the historic annual discharge volumes from the South Shore Drainage District (SSDD) to those from the adjacent S-2/S-7 Basin.

Table 2.7 Comparison of SSDD to S-2/S-7 Basin Discharge Volumes

Water Year	Historic Basin Runoff (acre/feet)		
	SSDD (1)	S-2/S-7 (2)	Ratio
1995	13,847	348,153	0.0398
1996	10,848	239,081	0.0454
1997	8,927	182,614	0.0489
1998	9,499	202,893	0.0468
1999	9,192	191,891	0.0479
2000	14,877	263,490	0.0565
2001	3,777	175,716	0.0215
2002	5,354	222,120	0.0241
2003	9,626	161,275	0.0597
2004	7,632	150,603	0.0507
Ave. Annual	9,358	213,784	0.0438
Basin Area in Acres (3)	4,230	117,660	0.0360

(1) From Table 9.10, Phase 2 Task 1.3 Final Report
(2) From Table 4.10, Phase 2 Task 1.3 Final Report; values for WY 1995-1999 reduced by 17.2% (basin area = 142,160 during that period); value for WY 2000 reduced by 14.0% (basin area = 136,860 during that period); values for WY 2001-2004 reduced by 1.3% (basin area = 119,660 during that period)
(3) Basin areas from Table 6.1, Phase 2 Task 1.1 Final Report

For WY 1966-1994, daily discharges from the SSDD are assigned at 0.0438 times the total S-2/S-7 Basin runoff taken from the ECP 2006 simulation. Basin runoff as reflected in the simulation includes both discharges directed south along the North New River Canal and discharges pumped back to Lake Okeechobee at Pump Station S-2. Discharges back pumped at S-2 include runoff from both the S-2/S-7 Basin and the S-2/S-6 Basin; no differentiation as to source is available from the simulation results. From the Phase 2, Task 1.3 final report, the average annual basin runoff to the south from the S-2/S-7 Basin was estimated to average 203,628 acre-feet per year over the period WY 1995–2004 (from Table 4.11 of that document), equal to 95.2% of the total basin runoff. In the simulation results, S-2/S-7 Basin runoff to the south is represented by the sum of the

terms NNRST3, S7BPMR and WLES7. Total S-2/S-7 Basin runoff is therefore approximated as (NNRST3 + S7BMPR + WLES7) / 0.952.

As concluded in the Phase 2, Task 1.1 final report, the simulation results for runoff from the S-2/S-7 Basin are believed to be overstated; it was recommended that those simulation results be reduced by 11% to reflect S-2/S-7 Basin runoff (the difference being assigned to the S-2/S-6 Basin). As a result, total S-2/S-7 Basin runoff estimated from the results of the simulation would be (NNRST3 + S7BMPR + WLES7)*(1-0.11) / 0.952, or (NNRST3 + S7BMPR + WLES7)*0.935. Combining constant terms, the daily runoff volume from the SSDD is then estimated using the following equation:

SSDD Runoff = 0.041*(NNRST3 + S7BMPR + WLES7)

The flow terms from the 2006 SFWMM simulation used in this equation are defined as follows:

- NNRST3 = NNRC basin runoff routed to STA-3/4 through North New River Canal and G-370
- S7BMPR = Emergency bypass of untreated EAA runoff around STA-3/4 through S-7 into WCA-2A
- WLES7 = Portion of untreated runoff from NNRC basin in the EAA used to meet SA-2 demands in the LEC via existing S-7

Daily total phosphorous concentrations in these estimated runoff volumes are assigned at the monthly flow-weighted mean values developed in the Phase 2, Task 1.3 final report, for WY 1966–1994 only. These average monthly concentrations are listed in Table 2.8.

Table 2.8: Average TP Concentrations in South Shore Drainage District Runoff*

Month	Average TP Conc. (ppb)	Month	Average TP Conc. (ppb)
January	83	July	103
February	85	August	104
March	111	September	122
April	138	October	120
May	95	November	115
June	97	December	107

* Derived from Table 9.10 of final Task 1.3 report (June 27, 2005).

For the balance of the model simulation period, WY 1995-2000, historic discharge and TP concentration data are used without modification. A summary of the estimated annual discharge volumes and TP loads for this composite record of generated and actual runoff data for the SSDD is presented in Table 2.9.

Table 2.9 Summary of Annual SSDD Discharges

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	12,391	1,619	106
1967	12,984	1,696	106
1968	9,179	1,211	107
1969	14,640	1,922	106
1970	16,022	2,117	107
1971	8,081	1,031	103
1972	13,167	1,807	111
1973	9,518	1,187	101
1974	7,741	1,012	106
1975	9,363	1,236	107
1976	12,462	1,662	108
1977	9,951	1,274	104
1978	10,519	1,369	106
1979	13,100	1,704	105
1980	13,439	1,855	112
1981	7,273	963	107
1982	8,863	1,198	110
1983	14,231	1,802	103
1984	8,567	1,191	113
1985	7,955	1,093	111
1986	11,504	1,542	109
1987	10,320	1,347	106
1988	6,760	905	109
1989	6,071	789	105
1990	6,983	944	110
1991	8,828	1,122	103
1992	8,374	1,088	105
1993	13,436	1,725	104
1994	10,670	1,425	108
1995	13,847	1,663	97
1996	10,849	1,152	86
1997	8,928	906	82
1998	9,499	1,479	126
1999	9,192	1,442	127
2000	14,878	2,162	118
Min. Annual	6,071	789	---
Max. Annual	16,022	2,162	---
Avg. Annual	10,559	1,390	107

2.4. South Florida Conservancy District Unit 5 (S-236 Basin)

Table 2.10 presents a comparison of the historic annual discharge volumes from the South Florida Conservancy District Unit 5 (SFCD) to those from the adjacent S-3/S-8 Basin.

Table 2.10 Comparison of SFCD to S-3/S-8 Basin Discharge Volumes

Water Year	Historic Basin Runoff (acre/feet)		
	SFCD (1)	S-3/S-8 (2)	Ratio
1995	31,205	409,092	0.0763
1996	27,733	325,808	0.0851
1997	17,381	295,328	0.0589
1998	19,539	366,423	0.0533
1999	29,873	199,513	0.1497
2000	43,096	315,737	0.1365
2001	4,995	134,484	0.0371
2002	17,710	146,449	0.1209
2003	25,149	278,492	0.0903
2004	23,876	348,023	0.0686
Ave. Annual	24,056	281,935	0.0853
Basin Area in Acres (3)	9,775	117,420	0.0832

(1) From Table 9.13, Phase 2 Task 1.3 Final Report
(2) From Table 5.21, Phase 2 Task 1.3 Final Report; values for WY 1995-1997 reduced by 12.1% (basin area = 133,640 during that period); value for WY 1998 reduced by 4.2% (basin area = 122,520 during that period).
(3) Basin areas from Table 6.1, Phase 2 Task 1.1 Final Report

For WY 1966–1994, daily discharges from the SFCD are assigned at 0.0853 times the total S-3/S-8 Basin runoff taken from the ECP 2006 simulation. Basin runoff as reflected in the simulation includes both discharges directed south along the Miami Canal and discharges back pumped to Lake Okeechobee at Pump Station S-3. In the simulation results, runoff from the S-3/S-8 Basin may be taken as: MIAST3 – SSDST3 – S236SO – G136SO + S8BPMR + WLES8 + S3PMP. Therefore, daily basin runoff from the SFCD, for WY 1966–1994 only, is then calculated using the following equation:

$$\text{SFCD Runoff} = 0.0853*(\text{MIAST3}-\text{SSDST3}-\text{S236SO}-\text{G136SO}+\text{S8BPMR}+\text{WLES8}+\text{S3PMP})$$

The flow terms from the 2006 SFWMM simulation used in this equation are defined as follows:

- MIAST3 = Runoff from Miami Canal basin, 298 District, S-236 Basin, and G-136 to STA-3/4 through Miami Canal and G-372
- SSDST3 = Flow from South Shore Drainage District to STA-3/4
- S236SO = Portion of runoff from S-236 (SFCD) Basin routed south to appropriate STAs
- G136SO = Portion of G-136 flow routed south to STA-3/4
- S8BPMR = Emergency bypass of untreated EAA runoff around STA-3/4 through S-8 into WCA-3A
- WLES8 = Portion of untreated runoff from Miami Canal basin in the EAA used to meet SA-3 demands in the LEC via existing S-8
- S3PMP = Flow back pumped for flood control to Lake Okeechobee at S-3 from Miami Canal basin

Daily total phosphorous concentrations in that runoff are assigned at the monthly flow-weighted mean values developed in the Phase 2, Task 1.3 final report for WY 1966–1994. These average monthly concentrations are listed in Table 2.11.

Table 2.11: Average TP Concentrations in South Florida Conservancy District Runoff*

Month	Average TP Conc. (ppb)	Month	Average TP Conc. (ppb)
January	88	July	107
February	139	August	123
March	131	September	126
April	104	October	137
May	111	November	169
June	104	December	123

* Derived from Table 9.13 of final Task 1.3 report (June 27, 2005).

For the balance of the simulation period, WY 1995-2000, actual historic discharge and TP concentration data are used without modification. Table 2.12 is a summary of the estimated annual discharge volumes and TP loads from the SFCD for this combined record of estimated and historic data.

Table 2.12 Summary of Annual SFCD Discharges

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	25,465	3,694	118
1967	23,121	3,278	115
1968	19,884	2,946	120
1969	33,024	4,821	118
1970	34,018	5,183	124
1971	14,302	2,043	116
1972	25,165	3,804	123
1973	13,084	1,851	115
1974	11,256	1,583	114
1975	19,083	2,696	115
1976	23,601	3,477	119
1977	13,871	1,994	117
1978	21,702	3,456	129
1979	25,601	3,686	117
1980	23,964	3,569	121
1981	7,947	1,262	129
1982	10,813	1,683	126
1983	33,774	4,893	117
1984	18,301	2,737	121
1985	13,114	1,959	121
1986	17,516	2,581	119
1987	22,367	3,230	117
1988	14,645	2,487	138
1989	13,815	1,999	117
1990	12,115	1,787	120
1991	18,599	2,456	107
1992	21,871	3,295	122
1993	22,749	3,206	114
1994	16,467	2,464	121
1995	31,206	6,184	161
1996	27,733	3,765	110
1997	17,381	2,416	113
1998	19,539	3,143	130
1999	29,874	5,865	159
2000	43,096	5,910	111
Min. Annual	7,947	1,262	---
Max. Annual	43,096	6,184	---
Avg. Annual	21,145	3,183	122

3. RUNOFF FROM EAA BASINS

The majority of the inflow to the STAs will come from runoff within the principal EAA drainage basins: S-2/S-6/S-7, S-3/S-8, and S-5A. The runoff from each of these basins is discussed in the following sections.

3.1. S-2/S-6/S-7 Basin

Runoff from the combined S-2/S-6/S-7 Basin will be conveyed to STA-2, STA-3/4 or back pumped to Lake Okeechobee. These flow components are described separately below.

3.1.1. S-2/S-6 Basin Runoff to STA-2

Runoff from the S-6 Basin and that portion of the S-2 Basin which is tributary to the Hillsboro Canal will be delivered primarily to STA-2. From the 2006 SFWMM simulation, the daily runoff volumes that would be delivered to STA-2 are calculated using the following equation:

Runoff = [RFTST2–715ST2–ESDST2–DIVERS] + 0.11*[NNRST3+S7BPMR+WLES7]

These individual flow terms are defined as follows:

- RFTST2 = Flow to STA-2 from Hillsboro basin and 298 District runoff
- 715ST2 = Flow from 715 Farms to STA-2
- ESDST2 = Flow from East Shore Water Control District to STA-2
- DIVERS = Diversion of runoff from West Palm Beach Canal (S-5A) basin into Hillsboro Canal and STA-2
- NNRST3 = North New River Canal (NNRC) basin runoff routed to STA-3/4 through G-370
- S7BPMR = Emergency bypass of untreated EAA runoff around STA-3/4 through S-7 into WCA-2A
- WLES7 = Portion of untreated runoff from NNRC basin used to meet Service Area 2 (SA-2) demands in the Lower East Coast (LEC) via S-7

The right half of the above equation reflects the recommended redistribution of 11 percent of the simulated runoff from the North New River Canal to the Hillsboro Canal.

The daily TP loads in inflow to STA-2 were calculated using average monthly TP concentrations in S-2/S-6 Basin runoff that were developed from historic data. These average monthly concentrations are listed in Table 3.1.

Table 3.1: Average TP Concentrations in S-2/S-6 Basin Runoff*

Month	Average TP Conc. (ppb)	Month	Average TP Conc. (ppb)
January	52	July	93
February	78	August	88
March	127	September	108
April	160	October	115
May	79	November	104
June	80	December	108

* Derived from Table 3.9 of final Task 1.3 report (June 27, 2005).

A summary of the estimated annual inflow volumes, TP loads, and flow-weighted TP concentrations to STA-2 is presented in Table 3.2.

Table 3.2: Summary of Annual STA-2 Inflows from S-2/S-6 Basin

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	256,747	29,749	94
1967	287,103	32,867	93
1968	203,097	24,188	97
1969	348,667	41,569	97
1970	368,801	45,529	100
1971	177,980	19,597	89
1972	286,122	36,778	104
1973	199,734	21,717	88
1974	154,341	17,800	93
1975	208,868	24,028	93
1976	276,635	33,317	98
1977	205,847	22,171	87
1978	236,091	27,531	95
1979	268,187	31,208	94
1980	297,239	37,822	103
1981	146,163	17,164	95
1982	196,075	24,356	101
1983	353,930	39,138	90
1984	182,049	24,047	107
1985	167,536	21,639	105
1986	246,312	30,317	100
1987	226,180	27,152	97
1988	147,866	17,656	97
1989	125,262	14,743	95
1990	141,559	17,170	98
1991	192,510	20,920	88
1992	172,424	20,245	95
1993	290,484	31,399	88
1994	221,271	26,725	98
1995	315,926	38,593	99
1996	225,475	28,228	101
1997	177,122	21,575	99
1998	237,292	28,923	99
1999	152,009	18,428	98
2000	239,995	31,245	106
Min. Annual	125,262	14,743	---
Max. Annual	368,801	45,529	---
Avg. Annual	226,654	27,015	97

3.1.2. S-2/S-7 Basin Runoff to STA-3/4

Runoff from the S-7 Basin and that portion of the S-2 Basin which is tributary to the North New River Canal (NNRC) will be delivered primarily to STA-3/4 via Pump Station G-370. From the 2006 SFWMM simulation, the daily runoff volumes that would be delivered to STA-3/4 from the S-2/S-7 Basin are calculated using the following equation:

$$\text{Runoff} = 0.89*[\text{NNRST3}+\text{S7BPMR}+\text{WLES7}]$$

The individual flow terms used in this equation are all defined in the previous section. This equation reflects the recommended redistribution of 11 percent of the simulated runoff from the North New River Canal to the Hillsboro Canal.

The daily TP loads in the inflow to STA-3/4 were calculated using average monthly TP concentrations in S-2/S-7 Basin runoff that were developed from historic data. These average monthly concentrations are listed in Table 3.3.

Table 3.3: Average TP Concentrations in S-2/S-7 Basin Runoff*

Month	Average TP Conc. (ppb)	Month	Average TP Conc. (ppb)
January	40	July	74
February	61	August	71
March	65	September	72
April	88	October	92
May	96	November	144
June	83	December	106

* Derived from Table 4.11 of final Task 1.3 report (June 27, 2005).

A summary of the estimated annual inflow volumes, TP loads, and flow-weighted TP concentrations to STA-3/4 from this basin is presented in Table 3.4.

Table 3.4: Summary of Annual STA-3/4 Inflows from S-2/S-7 Basin

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	268,973	24,919	75
1967	281,851	26,734	77
1968	199,244	19,378	79
1969	317,791	32,159	82
1970	347,793	35,174	82
1971	175,408	17,002	79
1972	285,813	29,954	85
1973	206,605	21,010	82
1974	168,046	15,727	76
1975	203,237	19,908	79
1976	270,518	26,111	78
1977	216,015	20,446	77
1978	228,329	24,147	86
1979	284,367	28,723	82
1980	291,714	29,996	83
1981	157,873	15,544	80
1982	192,383	19,196	81
1983	308,914	27,496	72
1984	185,967	19,071	83
1985	172,678	18,370	86
1986	249,710	23,230	75
1987	224,010	22,681	82
1988	146,736	16,331	90
1989	131,789	12,044	74
1990	151,581	13,940	75
1991	191,624	16,798	71
1992	181,782	17,996	80
1993	291,650	27,825	77
1994	231,624	21,416	75
1995	313,523	33,563	87
1996	214,746	20,509	77
1997	184,997	19,242	84
1998	250,030	25,159	82
1999	150,843	16,736	90
2000	232,254	23,160	81
Min. Annual	131,789	12,044	---
Max. Annual	347,793	35,174	---
Avg. Annual	226,012	22,334	80

3.1.3. Runoff Back Pumped to Lake Okeechobee

Current and anticipated future management policies for Lake Okeechobee seek to minimize the amount of runoff from the S-2/S-6/S-7 Basin that is back pumped to the lake at Pump Station S-2. In the 2006 SFWMM simulation, the daily runoff volumes that are pumped back to the lake are represented by a single flow term (S2PMP).

The daily TP loads in these back-pumped volumes were estimated using average monthly TP concentrations in runoff from the combined S-2/S-6/S-7 Basin. In the EAA rule (40E-63, F.A.C.), any releases from or back pumping to Lake Okeechobee at S-2/S-351 are assumed to be distributed between the Hillsboro and North New River canals on a fixed ratio — approximately 34.8 percent to the Hillsboro Canal (S-2/S-6 Basin) and 65.2 percent to the North New River Canal (S-2/S-7 Basin). The data summarized separately in Task 1.3 for the S-2/S-6 and S-2/S-7 basins were developed using this fixed flow distribution. In order to estimate the TP concentrations in runoff from the combined S-2/S-6/S-7 basin, flow-weighted average monthly concentrations were developed by again using this assumed flow distribution. The resulting average monthly concentrations are listed in Table 3.5.

Table 3.5: Average TP Concentrations in S-2/S-6/S-7 Basin Runoff*

Month	Average TP Concentration (ppb)		
	S-2/S-6 Basin[1]	S-2/S-7 Basin[2]	Flow-weighted Average[3]
January	52	40	44
February	78	61	67
March	128	65	87
April	160	88	113
May	79	96	90
June	80	83	82
July	93	74	81
August	88	71	77
September	108	72	85
October	115	92	100
November	104	144	130
December	108	106	107

1. Derived from Table 3.9 of final Task 1.3 report (June 27, 2005).
2. Derived from Table 4.11 of final Task 1.3 report (June 27, 2005).
3. 0.348*S-2/S-6 Basin values + 0.652*S-2/S-7 Basin values.

A summary of the estimated annual volumes, TP loads, and flow-weighted TP concentrations in runoff back pumped to Lake Okeechobee at S-2 is shown in Table 3.6.

3.2. S-3/S-8 Basin

Runoff from the combined S-3/S-8 Basin will be conveyed to STA-3/4 or back pumped to Lake Okeechobee. These flow components are described separately below.

3.2.1. S-3/S-8 Basin Runoff to STA-3/4

Runoff from the S-3 and S-8 basins is tributary to the Miami Canal will be delivered primarily to STA-3/4 via Pump Station G-372. From the 2006 SFWMM simulation, the daily runoff volumes that would be delivered to STA-3/4 at G-372 are calculated using the following equation:

$$\text{Runoff} = [\text{MIAST3} - \text{SSDST3} - \text{S236SO} - \text{G136SO}] + \text{S8BPMR} + \text{WLES8}$$

These individual flow terms are defined as follows:

- MIAST3 = Runoff from Miami Canal, 298 District, S-236 Basin, and G-136 to STA-3/4 through Miami Canal and G-372
- SSDST3 = Flow from South Shore 298 District to STA-3
- S236SO = Portion of runoff from S-236 Basin routes south to appropriate STAs.
- G136SO = Portion of G-136 flow routed south to STA-3/4
- S8BPMR = Emergency bypass of untreated EAA runoff around STA-3/4 through S-8 into WCA-3A
- WLES8 = Portion of untreated runoff from Miami Canal basin used to meet SA-3 demands in LEC via S-8

The daily total phosphorus (TP) loads in inflow to STA-2 were calculated using average monthly TP concentrations in S-3/S-8 Basin runoff that were developed from historic data. These average monthly concentrations are listed in Table 3.7.

Table 3.6: Summary of Discharge to Lake Okeechobee from S-2/S-6/S-7 Basin

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	0	0	---
1967	88,814	8,912	81
1968	27,057	2,879	86
1969	121,483	12,868	86
1970	91,972	9,883	87
1971	33,936	3,636	87
1972	36,402	4,065	91
1973	45,187	4,993	90
1974	4,533	454	81
1975	30,721	3,090	82
1976	46,372	5,331	93
1977	5,836	318	44
1978	49,454	5,209	85
1979	799	76	77
1980	54,903	4,844	72
1981	112	12	85
1982	98,319	10,941	90
1983	159,135	16,175	82
1984	14,513	1,469	82
1985	28,026	3,052	88
1986	19,530	1,991	83
1987	19,021	1,759	75
1988	39,980	6,400	130
1989	7,356	736	81
1990	17,958	1,874	85
1991	64,662	3,519	44
1992	0	0	---
1993	71,432	6,215	71
1994	0	0	---
1995	92,211	13,428	118
1996	81,037	8,733	87
1997	2,579	261	82
1998	7,131	939	107
1999	65,030	10,328	129
2000	63,904	8,011	102
Min. Annual	0	0	---
Max. Annual	159,135	16,175	---
Avg. Annual	42,554	4,640	88

Table 3.7: Average TP Concentrations in S-3/S-8 Basin Runoff*

Month	Average TP Conc. (ppb)	Month	Average TP Conc. (ppb)
January	40	July	96
February	41	August	90
March	47	September	90
April	67	October	95
May	92	November	132
June	67	December	60

* Derived from Table 5.22 of final Task 1.3 report (June 27, 2005).

A summary of the estimated annual inflow volumes, TP loads, and flow-weighted TP concentrations to STA-3/4 from the S-3/S-8 Basin is presented in Table 3.8.

3.2.2. Runoff Back Pumped to Lake Okeechobee

Current and anticipated future management policies for Lake Okeechobee seek to minimize the amount of runoff from the S-3/S-8 Basin that is back pumped to the lake at Pump Station S-3. In the 2006 SFWMM simulation, the daily runoff volumes that are pumped back to the lake are represented by a single flow term (S3PMP).

The daily TP loads in these back-pumped volumes were estimated using the average monthly TP concentrations in basin runoff that are presented above in Table 3.7. A summary of the estimated annual volumes, TP loads, and flow-weighted TP concentrations in runoff back pumped to Lake Okeechobee at S-3 is shown in Table 3.9.

Table 3.8: Summary of STA-3/4 Inflow from S-3/S-8 Basin Runoff

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	295,391	30,079	83
1967	243,659	25,488	85
1968	233,105	23,494	82
1969	380,446	38,671	82
1970	373,833	33,722	73
1971	167,661	18,183	88
1972	295,020	31,286	86
1973	153,388	14,772	78
1974	131,960	14,179	87
1975	223,547	24,051	87
1976	276,683	29,219	86
1977	162,610	16,479	82
1978	244,346	27,238	90
1979	300,133	31,352	85
1980	280,942	27,808	80
1981	93,162	9,989	87
1982	126,769	14,322	92
1983	371,297	32,810	72
1984	207,596	19,203	75
1985	153,743	16,895	89
1986	205,350	20,875	82
1987	261,765	24,078	75
1988	171,391	21,040	100
1989	161,959	17,461	87
1990	142,030	14,675	84
1991	192,016	16,396	69
1992	256,270	26,070	82
1993	250,107	22,982	74
1994	193,047	18,282	77
1995	329,249	33,994	84
1996	273,459	29,386	87
1997	252,973	25,864	83
1998	286,159	26,102	74
1999	160,365	19,467	98
2000	293,484	30,692	85
Min. Annual	93,162	9,989	---
Max. Annual	380,446	38,671	---
Avg. Annual	232,712	23,617	82

Table 3.9: Summary of Discharge to Lake Okeechobee from S-3/S-8 Basin Runoff

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	3,142	368	95
1967	27,397	3,254	96
1968	0	0	---
1969	6,702	553	67
1970	24,967	1,489	48
1971	0	0	---
1972	0	0	---
1973	0	0	---
1974	0	0	---
1975	173	18	82
1976	0	0	---
1977	0	0	---
1978	10,079	1,116	90
1979	0	0	---
1980	0	0	---
1981	0	0	---
1982	0	0	---
1983	24,651	2,040	67
1984	6,953	572	67
1985	0	0	---
1986	0	0	---
1987	455	37	67
1988	294	48	132
1989	0	0	---
1990	0	0	---
1991	26,026	1,290	40
1992	127	14	92
1993	16,587	1,785	87
1994	0	0	---
1995	2,228	363	132
1996	18,604	2,118	92
1997	0	0	---
1998	0	0	---
1999	25,773	4,201	132
2000	13,062	1,528	95
Min. Annual	0	0	---
Max. Annual	27,397	4,201	---
Avg. Annual	5,921	594	81

3.3. S-5A Basin

Runoff from the S-5A Basin will be conveyed to STA-1E and STA-1W, or diverted to STA-2. These flow components are described separately below.

3.3.1. S-5A Basin Runoff to STA-1E and STA-1W

Runoff from the S-5A basin is tributary to the West Palm Beach Canal and most of this runoff will be delivered to the STA-1 Inflow and Distribution Works south of the S-5A complex. From these works, flow can be directed to STA-1E or STA-1W. The daily runoff volumes that would be delivered to these treatment areas are calculated using two flow terms from the 2006 SFWWM simulation: RFWPBB and EBDST1. The specific equation used to calculate these runoff volumes and definitions of these two flow terms are included below:

Runoff to STA-1E/STA-1W: RFWPBB – EBDST1

- RFWPBB = Runoff from West Palm Beach Canal basin in EAA
- EBDST1 = Flow from East Beach Water Control District to STA-1

The daily TP loads in inflow to STA-1E and STA-1W from the S-5A Basin were calculated using average monthly TP concentrations in S-5A Basin runoff that were developed from historic data. These average monthly concentrations are listed in Table 3.10. A summary of the estimated annual inflow volumes, TP loads, and flow-weighted TP concentrations to STA-1E and STA-1W from the S-5A Basin is presented in Table 3.11.

Table 3.10: Average TP Concentrations in S-3/S-8 Basin Runoff*

Month	Average TP Conc. (ppb)	Month	Average TP Conc. (ppb)
January	144	July	136
February	156	August	156
March	177	September	138
April	185	October	144
May	163	November	168
June	164	December	196

* Derived from Table 2.11 of final Task 1.3 report (June 27, 2005).

Table 3.11: Summary of Inflow to STA-1E and STA-1W from S-5A Basin Runoff

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	285,525	52,683	150
1967	276,319	51,233	150
1968	175,071	32,271	149
1969	372,306	70,972	155
1970	372,844	72,931	159
1971	183,221	34,026	151
1972	248,010	47,141	154
1973	134,594	26,239	158
1974	159,993	29,265	148
1975	203,928	37,713	150
1976	237,752	44,071	150
1977	185,280	35,283	154
1978	235,961	45,823	157
1979	306,194	58,193	154
1980	224,808	42,194	152
1981	144,605	26,222	147
1982	176,650	34,038	156
1983	326,228	61,889	154
1984	270,349	52,793	158
1985	206,726	40,071	157
1986	211,728	39,246	150
1987	234,159	45,724	158
1988	199,703	38,105	155
1989	180,963	33,685	151
1990	150,378	27,689	149
1991	219,652	42,446	157
1992	160,404	29,830	151
1993	362,832	68,217	152
1994	260,563	48,700	152
1995	379,795	74,574	159
1996	260,071	48,583	151
1997	201,381	38,739	156
1998	253,748	50,686	162
1999	194,736	36,394	152
2000	221,830	42,705	156
Min. Annual	134,594	26,222	---
Max. Annual	379,795	74,574	---
Avg. Annual	234,809	44,582	154

3.3.2. S-5A Basin Runoff to STA-2

As part of the Everglades Construction Project, the runoff from a portion of the S-5A Basin will be diverted into the S-2/S-6 Basin and contribute to the inflow at STA-2. These flow volumes are represented in the 2006 SFWMM simulation by the flow term DIVERS. The runoff diverted to STA-2 from the S-5A Basin should have TP concentrations similar to the runoff from the basin as a whole. Therefore, the same average monthly concentrations listed in Table 3.10 were used to estimate TP loads in this diverted runoff. Table 3.12 is a summary of the volumes, TP loads and flow-weighted TP concentrations in the S-5A Basin runoff that is diverted to STA-2.

* * * * *

Table 3.12: Summary of Inflow to STA-2 from S-5A Basin Runoff

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	74,026	13,666	150
1967	67,632	12,530	150
1968	46,538	8,578	149
1969	95,343	18,147	154
1970	92,484	17,956	157
1971	48,462	9,001	151
1972	65,808	12,504	154
1973	35,778	6,975	158
1974	41,073	7,535	149
1975	53,255	9,851	150
1976	60,975	11,319	150
1977	49,252	9,379	154
1978	59,832	11,690	158
1979	80,328	15,244	154
1980	57,552	10,837	153
1981	37,398	6,794	147
1982	43,279	8,329	156
1983	84,294	16,002	154
1984	68,638	13,408	158
1985	49,274	9,536	157
1986	55,017	10,217	151
1987	61,306	11,959	158
1988	46,238	8,760	154
1989	46,979	8,763	151
1990	39,974	7,360	149
1991	53,575	10,410	158
1992	42,639	7,930	151
1993	86,338	16,268	153
1994	64,403	12,033	151
1995	92,475	18,045	158
1996	61,181	11,477	152
1997	53,532	10,298	156
1998	66,463	13,235	161
1999	41,377	7,633	150
2000	54,266	10,445	156
Min. Annual	35,778	6,794	---
Max. Annual	95,343	18,147	---
Avg. Annual	59,342	11,260	154

4. RUNOFF FROM WESTERN BASINS

The Western Basins are the drainage basins located west of the EAA that still discharge primarily into the Everglades Protection Area. The portions of these basins that are or soon will be diverted into one of the STAs are addressed in this section.

4.1. C-139 Basin

The primary drainage canals in the C-139 Basin are the L-1 and L-2 borrow canals. Under normal conditions, most of the runoff from this basin is directed south into STA-5. During high runoff periods, portions of the runoff from the upper C-139 Basin are diverted into the S-3/S-8 Basin through structure G-136 or into the C-43 Basin via G-135. The principal components of C-139 Basin runoff are discussed in the following sections. The small portion of this runoff that is discharged to the C-43 Basin through G-135 (averaging about 2.3 percent for WY 1995-2005) is not considered further in this analysis.

4.1.1. C-139 Basin Runoff to STA-5

Most of the runoff from the C-139 Basin flows to the south and is diverted into STA-5 for treatment. The runoff from this basin is not explicitly modeled in the SFWMM but instead input as a boundary condition. Given the uncertainty associated with these inputs (see Item 3, Section 1.3.1), actual historic data were used to estimate inflow from this basin to STA-5. These data were collected and summarized in Task 1.3 for an 11-year period that includes WY 1995–2005.

Although historic runoff volumes were used without adjustment, TP concentrations and loads were adjusted to reflect the ongoing implementation of BMPs within this basin. As a result of these new management practices, TP concentrations are estimated to decrease by 10 percent in basin runoff so historic TP concentrations and loads were reduced by 10 percent. A summary of these runoff volume and TP data by water year is shown in Table 4.1.

Table 4.1: Summary of Inflow to STA-5 from C-139 Basin Runoff

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1995	183,005	35,696	158
1996	181,186	36,324	163
1997	151,442	38,434	206
1998	149,154	27,190	148
1999	122,060	28,239	188
2000	176,870	39,976	183
2001	53,198	14,978	228
2002	182,611	55,369	246
2003	209,268	63,928	248
2004	190,705	58,080	247
2005	149,832	32,013	173
Min. Annual	53,198	14,978	---
Max. Annual	209,268	63,928	---
Avg. Annual	159,030	39,111	199

4.1.2. C-139 Basin Runoff through G-136 to STA-3/4

During high runoff events, a portion of the runoff from the C-139 Basin is diverted to the east into the S-3/S-8 Basin through structure G-136. In the 2006 SFWMM simulation, a portion of this water is assumed to flow south and contribute to the inflow to STA-3/4 (flow term G136SO).

The daily TP loads in inflow to STA-3/4 from the C-139 Basin were calculated using average monthly TP concentrations in G-136 discharge that were developed from historic data. As discussed above, TP concentrations within the C-139 Basin are assumed to decrease by 10 percent. The measured and adjusted average monthly TP concentrations are listed in Table 4.2. A summary of the estimated annual inflow volumes, TP loads, and flow-weighted TP concentrations to STA-3/4 from the C-139 Basin is presented in Table 4.3.

Table 4.2: Average TP Concentrations in G-136 Discharge

Month	Average TP Concentration (ppb)	
	Measured[1]	Adjusted[2]
January	84	75
February	134	120
March	114	103
April	66	60
May	66	60
June	188	169
July	242	218
August	220	198
September	210	189
October	181	163
November	246	221
December	80	72

1 Derived from Table 8.1 of final Task 1.3 report (June 27, 2005).
2. Measured concentrations less 10 percent.

4.1.3. C-139 Basin Runoff through G-136 not Treated

As depicted in the 2006 SFWMM simulation, not all of the flow through G-136 is considered to flow south and pass through STA-3/4. The destination of the remainder (flow term G136EA) is not explicitly defined but may contribute to flow that is back pumped to Lake Okeechobee at S-3 or be used within the S-3/S-8 basin for irrigation. The TP concentrations applied to these discharges are the same as discussed in the previous section (that is, reduced 10 percent from historic data). Table 4.4 is a summary of the estimated annual volumes, TP loads, and flow-weighted TP concentrations through G-136 that are not delivered to STA-3/4 for treatment.

Table 4.3: Summary of Inflow to STA-3/4 from C-139 Basin Runoff through G-136

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	17,588	3,997	166
1967	19,274	4,638	176
1968	14,357	3,322	169
1969	17,677	4,259	176
1970	16,163	3,118	141
1971	6,240	1,387	162
1972	7,465	1,776	174
1973	5,089	1,183	170
1974	5,157	1,218	172
1975	28,988	7,117	179
1976	18,831	4,455	173
1977	5,216	1,141	160
1978	8,572	1,858	158
1979	9,487	2,093	161
1980	8,103	1,662	150
1981	1,943	469	176
1982	2,885	685	173
1983	49,318	10,739	159
1984	27,604	5,892	156
1985	5,924	1,458	180
1986	15,559	3,504	164
1987	29,386	6,842	170
1988	9,106	2,156	173
1989	5,792	1,402	177
1990	1,015	240	173
1991	2,631	456	126
1992	7,195	1,613	164
1993	9,378	2,273	177
1994	16,597	3,405	150
1995	27,454	5,321	141
1996	13,307	2,904	159
1997	7,225	1,647	166
1998	14,734	2,857	141
1999	9,881	2,444	180
2000	16,984	3,987	171
Min. Annual	1,015	240	---
Max. Annual	49,318	10,739	---
Avg. Annual	13,204	2,958	182

Table 4.4: Summary of C-139 Basin Runoff through G-136 That Is Not Treated

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	7,700	1,816	172
1967	6,084	1,504	180
1968	3,976	908	167
1969	7,939	1,966	181
1970	5,214	981	137
1971	1,227	210	125
1972	2,331	521	163
1973	902	193	156
1974	649	165	185
1975	13,016	3,226	181
1976	6,471	1,477	167
1977	599	133	162
1978	1,336	306	167
1979	2,043	487	174
1980	1,731	369	155
1981	155	36	171
1982	443	110	181
1983	19,516	4,079	152
1984	6,195	1,227	144
1985	1,188	274	168
1986	2,796	709	185
1987	9,404	2,115	164
1988	2,462	606	180
1989	2,170	538	181
1990	235	56	173
1991	867	79	67
1992	1,288	157	89
1993	2,293	534	170
1994	3,517	678	141
1995	8,533	1,651	141
1996	7,484	1,698	166
1997	5,866	1,026	128
1998	6,042	1,227	148
1999	3,853	991	188
2000	7,875	1,863	173
Min. Annual	155	36	---
Max. Annual	19,516	4,079	---
Avg. Annual	4,383	969	179

4.2. C-139 Annex

The C-139 Annex is a drainage basin that historically has discharged to the L-28 Borrow Canal, which conveys this drainage to WCA-3A via structure S-140. In the future plans are that this drainage will be conveyed to STA-6 for treatment prior to being discharge to the EPA. As with the C-139 Basin, the discharge data for the C-139 Annex were not modeled explicitly in the SFWMM but input as a boundary condition. It is recommended that actual historic flow data be used for this basin in lieu of this boundary condition dataset (Item 4, Section 1.3.1). These historic data, which were collected and summarized in Task 1.3, are shown below in Table 4.5.

Table 4.5: Summary of Runoff from C-139 Annex Basin

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1997	40,196	5,107	103
1998	46,081	4,022	71
1999	24,270	3,131	105
2000	46,366	6,416	112
2001	26,831	4,564	138
2002	37,722	3,846	83
2003	43,922	5,261	97
2004	46,859	5,731	99
2005	49,336	5,775	95
Min. Annual	24,270	3,131	---
Max. Annual	49,336	6,416	---
Avg. Annual	40,176	4,873	98

4.3. Former USSC SDR Unit 2

The area that was formerly the United States Sugar Corporation's Southern Division Ranch, Unit 2 (USSC SDR Unit 2) is located within the historic S-8 Basin; however, with the construction of STA-6 and Pump Station G-600, this area is now tributary to this stormwater treatment area so it has been treated separately from the remainder of the S-3/S-8 Basin. In Task 1.1, it was concluded that the SFWMM simulation results for this area are not valid for use during the 2006-2009 time period so actual historic data will be used to represent STA-6 inflow from this area. Because of planned STA construction within this area — construction of the third flow-way for STA-5 and completion of STA-6, Section 2 — these historic

discharge data will require adjustment. These adjustments are discussed in the following paragraphs.

Over the period summarized in the Phase 2, Task 1.3 report, the total area of SDR Unit 2 tributary to STA-6 at G-600 was approximately 10,000 acres. Recorded discharges at G-600 over WY 1998-2004 (all full water years available in the record) averaged 49,988 acre-feet per year at a flow-weighted mean TP concentration of 72 ppb (taken from Table 5.15 of the Phase 2, Task 1.3 final report), which is equivalent to an average depth of runoff of 5.0 feet from the tributary area. That average annual depth of runoff greatly exceeds that of the adjacent S-3/S-8 basin, which averaged roughly 2.5 feet over WY 1995-2004. That increased depth is ascribed primarily to influence of seepage to Unit 2 from adjacent water bodies. Unit 2 is bounded on the east by the Rotenberger Tract (length of common boundary approximately 5 miles), on the south by STA-6 (1.6 miles), on the west by the L-3 Borrow Canal (5.8 miles), and on the north by STA-5 (4 miles). Water surface elevations in each of those water bodies exceed normally maintained stages in Unit 2. On the north, Unit 2 is separated from STA-5 by a seepage collection canal, which serves to reduce, but not eliminate, seepage reaching Unit 2 from that source.

No direct means exists for segregating either discharge volumes or discharge TP loads at G-600 between basin runoff and seepage from adjacent water bodies. Based on the above summary of average annual runoff depths, it would appear that the total discharge volume at G-600 could reasonably be assumed to be composed of roughly 50% basin runoff and 50% seepage from adjacent water bodies. An appropriate distribution of TP load discharged at G-600 is less apparent; it can be reasonably postulated that the mean TP concentration in basin runoff should be higher than that in the seepage from adjacent water bodies.

For this analysis, the flow-weighted mean TP concentration in basin runoff from Unit 2 is simply assumed to be equal to that from the adjacent S-3/S-8 Basin (82 ppb from Table 5.21 of the Phase 2, Task 1.3 final report). Upon that assumption, the resultant flow-weighted mean TP concentration in seepage would be 62 ppb (maintaining the overall flow-weighted mean of 72 ppb).

For conditions expected to exist at the end of 2006, a total of roughly 2,500 acres of Unit 2 will have been converted to use in the development of a third flow path at STA-5. An additional 1,400 acres will have been converted to use in STA-6, Section 2. As a result, the area of the basin tributary to G-600 will have been reduced from 10,000 acres to 6,100 acres. Upon the assumption of no change in the unit depth of basin runoff, the basin runoff volumes can be assumed reduced by roughly 39%.

Upon the conversion of those lands to use in additional stormwater treatment area, the overall 16.4-mile perimeter of Unit 2 will have been reduced by two miles (a reduction of 12%). However, given no seepage collection system on the south side of the STA-5 expansion (the construction of which would be rendered superfluous upon full conversion of Unit 2 to use as stormwater treatment area), the total seepage inflow from that source (which is the higher of the four adjacent water bodies) could be expected to increase. On balance, it appears reasonable to assume no significant reduction in seepage inflows to Unit 2.

Given the above assumptions, the overall discharge volume at G-600 would be reduced from an average annual volume of 49,988 acre-feet per year to 40,240 acre-feet per year (reduction of 39% in the 50% of the historic discharge volume assigned as basin runoff), an overall reduction of 20% in the total discharge volume. The flow-weighted mean TP concentration in that reduced volume would be estimated as 70 ppb (a reduction of but 3%).

For analysis of the period 2006-2009 (following which all discharges from Unit 2 would be eliminated), total inflow time series at G-600 is developed by reducing historic discharge volumes by 20% while maintaining the historic daily TP concentrations, all as summarized in the Phase 2, Task 1.3 final report. With these assumptions, the resulting annual inflow volumes, TP loads, and flow-weighted TP concentrations are summarized in Table 4.6.

* * * * *

Table 4.6: Summary of STA-6 Inflow from USSC SDR Unit 2 Runoff

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1998	38,556	2,014	42
1999	32,096	2,470	62
2000	47,878	4,300	73
2001	31,516	5,457	140
2002	42,750	3,605	68
2003	45,002	4,379	79
2004	42,139	2,742	53
2005	27,261	2,607	78
Min. Annual	27,261	2,014	---
Max. Annual	47,878	5,457	---
Avg. Annual	38,400	3,447	74

5. RUNOFF FROM EASTERN BASINS

There are three drainage basins located east of the EAA that will contribute runoff to the STAs: L-8 Basin, C-51 West Basin and Acme Improvement District Basin B. Each of these basins is discussed in this chapter.

5.1. L-8 Basin

Runoff from the L-8 Basin may be conveyed south to the S-5A Complex or north to Lake Okeechobee. The simulated volumes and estimated TP loads in these deliveries are described in the next two sections.

5.1.1. L-8 Basin Runoff to S-5A Complex

L-8 Basin runoff that is routed south to the S-5A complex may be diverted in a number of directions. This runoff can contribute to the inflow to STA-1E or STA-1W, or be routed east to Lake Worth or to meet water supply demands. In the 2006 SFWMM simulation, the daily runoff volumes that would be delivered to the S-5A complex are represented by a single flow term, L8C51W.

The daily TP loads in this runoff were calculated using average monthly TP concentrations developed from historic data for L-8 Basin runoff that is delivered to the S-5A complex. These average monthly concentrations are listed in Table 5.1 and were developed using TP concentrations at basin inlets to estimate the corresponding load in basin flow-through volumes. This methodology is different from that used for the other primary EAA basins: the S-5A, S-2/S-6/S-7 and S-3/S-8 basins. For these latter basins, the TP loads in basin flow-through volumes were estimated using the results of TP sampling at the respective basin outlet for these flow-through quantities.

Table 5.1: Average TP Concentrations in L-8 Basin Runoff Delivered to S-5A Complex*

Month	Average TP Conc. (ppb)	Month	Average TP Conc. (ppb)
January	49	July	49
February	78	August	93
March	131	September	80
April	51	October	85
May	99	November	77
June	66	December	65

* Derived from Table 6.32 of final Task 1.3 report (June 27, 2005).

A summary of the estimated annual inflow volumes, TP loads, and flow-weighted TP concentrations in L-8 Basin runoff delivered to the S-5A complex is presented in Table 5.2.

Table 5.2: Summary of L-8 Basin Runoff Delivered to S-5A Complex

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	42,562	4,109	78.27
1967	106,887	9,799	74.32
1968	754	75	80.58
1969	168,235	15,115	72.84
1970	138,522	14,338	83.91
1971	66,582	5,648	68.77
1972	18,830	1,810	77.92
1973	3,939	318	65.54
1974	0	0	-
1975	51,933	5,662	88.39
1976	4,876	510	84.85
1977	0	0	-
1978	0	0	-
1979	185,501	16,806	73.45
1980	41,865	4,152	80.41
1981	13,087	1,295	80.19
1982	0	0	-
1983	178,434	18,781	85.33
1984	129,397	11,959	74.92
1985	88,664	8,295	75.85
1986	8,249	815	80.07
1987	8,633	547	51.34
1988	34,981	3,294	76.34
1989	46,417	4,838	84.49
1990	0	0	-
1991	223	14	49.31
1992	51,524	5,248	82.58
1993	254,040	24,188	77.19
1994	71,671	7,360	83.25
1995	265,068	24,794	75.83
1996	165,111	16,977	83.36
1997	70,181	5,690	65.73
1998	119,826	13,005	87.99
1999	88,691	8,232	75.25
2000	78,808	7,923	81.51
Min. Annual	0	0	---
Max. Annual	265,068	24,794	---
Avg. Annual	71,528	6,903	78

5.1.2. L-8 Basin Runoff to Lake Okeechobee

A portion of the runoff from the L-8 Basin is also routed back to Lake Okeechobee at Culvert #10A (C-10A). Flow term C10ABK in the 2006 SFWMM simulation is used to represent the daily runoff volumes delivered to the lake. The daily TP loads in this runoff were calculated using the average monthly TP concentrations listed in Table 5.3. Similar to the runoff TP concentrations discussed in the previous section, the concentrations listed in Table 5.3 were developed using TP concentrations at basin inlets to estimate loads in basin inflow.

Table 5.3: Average TP Concentrations in L-8 Basin Runoff*

Month	Average TP Conc. (ppb)	Month	Average TP Conc. (ppb)
January	126	July	93
February	145	August	94
March	92	September	75
April	133	October	112
May	94	November	83
June	143	December	103

* Derived from Table 6.17 of final Task 1.3 report (June 27, 2005).

Table 5.4 is a summary of the estimated annual inflow volumes, TP loads, and flow-weighted TP concentrations in L-8 Basin runoff delivered to the Lake Okeechobee.

Table 5.4: Summary of L-8 Basin Runoff Delivered to Lake Okeechobee at C-10A

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	44,448	5,618	102
1967	51,985	7,473	117
1968	48,122	6,142	103
1969	47,497	7,442	127
1970	44,325	6,120	112
1971	164	26	130
1972	57,654	6,812	96
1973	86,835	12,041	112
1974	77,547	9,924	104
1975	45,873	6,375	113
1976	73,864	9,448	104
1977	68,008	8,766	104
1978	89,214	10,294	94
1979	45,635	6,147	109
1980	159	15	75
1981	2,543	286	91
1982	108,802	13,139	98
1983	68,769	9,617	113
1984	57,320	7,250	103
1985	1,210	192	128
1986	57,982	6,827	95
1987	77,084	9,548	100
1988	30,630	3,640	96
1989	32,424	3,653	91
1990	68,607	8,420	99
1991	139,912	19,511	113
1992	65,586	8,935	110
1993	38,983	5,015	104
1994	29,664	3,486	95
1995	77,097	9,621	101
1996	31,418	3,869	100
1997	2,666	439	134
1998	50,110	7,126	115
1999	5,291	514	79
2000	19,262	2,861	120
Min. Annual	159	15	---
Max. Annual	139,912	19,511	---
Avg. Annual	49,905	6,474	105

5.2. C-51 West Basin

Runoff from the C-51 West Basin can be routed to a number of different destinations. From the 2006 SFWMM simulation, the daily runoff volumes from this basin are calculated using the following equation:

Runoff = [S319+C51LGQ+S155A+S1324P] - [L8C51W+ACMECU]

These individual flow terms are defined as follows:

- S319 = Flow from C-51 West Basin into STA-1E via S-319
- C51LGQ = Water supply to Loxahatchee Groves WCD from C-51
- S155A = Flow from C-51W Canal to C-51 Canal
- S1324P = S-361 pump discharging from sections 13 & 24 (R40E, T44S) to STA-1E for flood control
- L8C51W = Flood control discharges from L-8 into C-51W (i.e., C-51 west of G-124 or proposed S-155A
- ACMECU = Flood control gravity discharge from ACME Basin B through ACME Basin A to C-51 West Canal

Using the above equation, the calculated net runoff from this basin is negative on some days. Most likely this results when basin storage is being increased by raising canal stages. To avoid complications caused by these negative runoff values and corresponding negative TP loads, any negative runoff values were set to zero. This action has only a modest impact on the analysis results, increasing the average annual runoff from this basin by about 103 acre-feet (less than 0.1 percent).

The daily TP loads in C-51 West Basin runoff were calculated using average monthly TP concentrations developed from historic data. Because of limited data for this basin, these average concentrations are based on only about four years of data as compared to ten years for most of the other basins. The resulting average monthly concentrations are listed in Table 5.4.

Table 5.4: Average TP Concentrations in C-51 West Basin Runoff*

Month	Average TP Conc. (ppb)	Month	Average TP Conc. (ppb)
January	97	July	122
February	88	August	125
March	100	September	132
April	127	October	146
May	103	November	196
June	206	December	97

* Derived from Table 7.5 of final Task 1.3 report (June 27, 2005).

A summary of the estimated annual runoff volumes, TP loads, and flow-weighted TP concentrations in the C-51 West Basin is presented in Table 5.5.

Table 5.5: Summary of C-51 West Basin Runoff

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	143,258	25,033	142
1967	142,199	24,791	141
1968	104,897	17,789	137
1969	160,817	29,908	151
1970	183,542	32,015	141
1971	78,821	14,488	149
1972	103,948	18,676	146
1973	119,101	21,271	145
1974	107,071	17,144	130
1975	93,173	15,794	137
1976	117,530	21,036	145
1977	96,407	16,416	138
1978	130,209	20,570	128
1979	129,365	22,072	138
1980	129,655	20,964	131
1981	84,607	13,987	134
1982	116,450	19,519	136
1983	193,495	33,360	140
1984	171,519	30,897	146
1985	120,583	21,990	148
1986	126,892	21,103	135
1987	128,221	21,586	136
1988	117,225	20,914	145
1989	95,973	15,914	134
1990	67,213	10,807	130
1991	131,295	20,169	125
1992	116,175	19,701	137
1993	162,525	26,237	131
1994	95,246	15,572	133
1995	187,012	32,428	141
1996	154,079	26,550	140
1997	143,487	24,903	141
1998	151,589	23,771	127
1999	111,393	18,856	137
2000	165,488	30,725	151
Min. Annual	67,213	10,807	---
Max. Annual	193,495	33,360	---
Avg. Annual	128,013	21,913	139

5.3. Acme Improvement District Basin B

Runoff from the Acme Improvement District's Basin B is currently discharged directly to the Loxahatchee National Wildlife Refuge (WCA-1) at Pump Stations 1 and 2. In the future it is planned that these discharges will be routed through Basin A to the C-51 Canal. These daily runoff volumes are represented in the 2006 SFWMM simulation by the term ACMECU.

The daily TP loads in basin runoff were calculated using average monthly TP concentrations developed from historic data. The resulting average monthly concentrations are listed in Table 5.6.

Table 5.6: Average TP Concentrations in Acme Basin B Runoff*

Month	Average TP Conc. (ppb)	Month	Average TP Conc. (ppb)
January	88	July	102
February	95	August	100
March	99	September	117
April	92	October	205
May	84	November	137
June	91	December	88

* Derived from Table 10.3 of final Task 1.3 report (June 27, 2005).

Table 5.7 is a summary of the estimated annual runoff volumes, TP loads, and flow-weighted TP concentrations from Acme Basin B.

* * * * *

Table 5.7: Summary of Acme Basin B Runoff

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	38,045	5,889	125
1967	38,531	5,347	112
1968	29,030	4,186	117
1969	39,498	5,429	111
1970	42,740	5,941	113
1971	20,319	2,898	116
1972	29,288	4,087	113
1973	32,506	3,994	100
1974	32,432	4,416	110
1975	26,847	3,961	120
1976	33,117	4,923	121
1977	25,761	3,230	102
1978	34,141	4,457	106
1979	33,113	4,724	116
1980	36,261	5,210	116
1981	23,873	3,236	110
1982	32,048	4,229	107
1983	44,329	6,269	115
1984	39,003	5,698	118
1985	28,128	4,014	116
1986	35,532	4,996	114
1987	34,304	4,606	109
1988	30,494	4,429	118
1989	24,937	3,127	102
1990	20,411	2,760	110
1991	33,819	4,461	107
1992	27,965	3,809	110
1993	37,498	5,178	112
1994	28,963	4,184	117
1995	40,555	5,878	118
1996	35,884	5,360	121
1997	35,220	4,774	110
1998	40,947	5,216	103
1999	32,907	4,691	116
2000	43,425	6,535	122
Min. Annual	20,319	2,760	---
Max. Annual	44,329	6,535	---
Avg. Annual	33,196	4,633	113

6. LAKE OKEECHOBEE RELEASES

Releases can be made from Lake Okeechobee to satisfy a number of different purposes: regulatory releases to bring lake stages within target ranges, releases to satisfy EAA irrigation demands, and water supply releases for the EPA or Lower East Coast. Those lake releases that pass through the EAA on their way to the Lower East Coast or EPA are termed flow-through releases. Based on assumptions in the SFWMM, some of these flow-through releases will be routed through a STA for treatment before leaving the EAA and some will not. In the following sections, Lake Okeechobee releases are addressed at S-351, S-352 and S-354 into the Hillsboro and North New River, West Palm Beach, and Miami canals, respectively.

6.1. Total Flow-Through Releases

Total flow-through releases from Lake Okeechobee at structures S-351, S-352 and S-354 are described in the following sections.

6.1.1. Total Flow-Through Releases at S-351

Lake Okeechobee releases at S-351 can flow down either the Hillsboro or North New River canals. The distribution of these releases between the two canals will vary dynamically based on a number of factors so only the total releases at this location are addressed below. In the 2006 SFWMM simulation, the daily flow-through release volumes at S-351 are the summation of a number of individual flow terms as indicated by the following equation:

$$\text{Total Release} = [WL1351+WL2351+WL3351+S351PK] + [351RG+WSST2E+WSST2M+WSST2W]$$

These individual flow terms are defined as follows:

- WL1351 = Water supply from Lake Okeechobee to LEC SA-2 via NNRC in the EAA
- WL2351 = Water supply from Lake Okeechobee to LEC SA-3 via NNRC through S-150 in the EAA
- WL3351 = Water supply from Lake Okeechobee to LEC SA-3 via Hillsboro Canal in the EAA

- S351PK = Flow from Lake Okeechobee through S-351 to help meet Everglades National Park (ENP) flow targets
- 351RG = Lake Okeechobee regulatory discharge via S-351
- WSST2E = Water supply discharge from Lake Okeechobee to eastern portion of STA-2
- WSST2M = Water supply discharge from Lake Okeechobee to middle portion of STA-2
- WSST2W = Water supply discharge from Lake Okeechobee to western portion of STA-2

The daily TP loads in flow-through releases at S-351 were calculated using average monthly TP concentrations developed from historic data on flow-through releases to the North New River Canal. The resulting average monthly concentrations are listed in Table 6.1.

Table 6.1: Average TP Concentrations in Flow-through Releases at S-351*

Month	Average TP Conc. (ppb)	Month	Average TP Conc. (ppb)
January	71	July	70
February	72	August	40
March	51	September	79
April	80	October	75
May	111	November	69
June	73	December	64

* Derived from Table 4.4 of final Task 1.3 report (June 27, 2005).

A summary of the estimated annual runoff volumes, TP loads, and flow-weighted TP concentrations in total flow-through releases at S-351 is presented in Table 6.2.

Table 6.2: Summary of Lake Okeechobee Flow-through Releases at S-351

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	84,233	7,810	75
1967	109,300	8,699	65
1968	14,812	1,757	96
1969	164,656	14,087	69
1970	163,699	14,323	71
1971	105,418	11,066	85
1972	41,373	5,326	104
1973	6,213	613	80
1974	52,444	5,349	83
1975	56,803	4,666	67
1976	20,146	2,764	111
1977	4,749	443	76
1978	806	111	111
1979	90,586	6,971	62
1980	254,644	23,144	74
1981	25,700	3,107	98
1982	47,143	5,122	88
1983	82,569	7,838	77
1984	52,644	3,783	58
1985	49,358	3,595	59
1986	21,314	2,648	101
1987	33,641	3,309	80
1988	49,052	6,730	111
1989	52,280	4,545	70
1990	105,380	9,988	77
1991	14,797	1,942	106
1992	138,478	11,157	65
1993	153,512	12,801	68
1994	52,987	4,768	73
1995	57,561	7,580	107
1996	171,276	14,274	68
1997	84,258	8,360	80
1998	187,719	16,810	73
1999	81,850	8,182	81
2000	32,829	3,497	86
Min. Annual	806	111	---
Max. Annual	254,644	23,144	---
Avg. Annual	76,121	7,062	75

6.1.2. Total Flow-Through Releases at S-352

Lake Okeechobee releases at S-352 pass into the West Palm Beach Canal. In the 2006 SFWMM simulation, the daily flow-through release volumes at S-352 are the summation of a number of individual flow terms as indicated by the following equation:

Total Release = [S352L8+WLC352] + [WSST1W+WST1EE+WST1EW]

These individual flow terms are defined as follows:

- S352L8 = Discharge from Lake Okeechobee via S-352 into L-8 Canal
- WLC352 = Water supply discharge to LEC from Lake Okeechobee via S-352
- WSST1W = Water supply discharge from Lake Okeechobee to STA-1W
- WST1EE = Water supply discharge from Lake Okeechobee to eastern portion of STA-1E
- WST1EW = Water supply discharge from Lake Okeechobee to western portion of STA-1E

The daily TP loads in flow-through releases at S-352 were calculated using average monthly TP concentrations developed from historic data on flow-through releases to the West Palm Beach Canal. The resulting average monthly concentrations are listed in Table 6.3.

Table 6.3: Average TP Concentrations in Flow-through Releases at S-352*

Month	Average TP Conc. (ppb)	Month	Average TP Conc. (ppb)
January	71	July	70
February	72	August	40
March	51	September	79
April	80	October	75
May	111	November	69
June	73	December	64

* Derived from Table 2.4 of final Task 1.3 report (June 27, 2005).

Table 6.4 is a summary of the estimated annual runoff volumes, TP loads, and flow-weighted TP concentrations in total flow-through releases at S-352.

Table 6.4: Summary of Lake Okeechobee Flow-through Releases at S-352

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	29,239	3,830	106
1967	7,112	1,009	115
1968	53,650	8,155	123
1969	3,043	389	104
1970	0	0	---
1971	35,548	5,203	119
1972	32,999	4,659	114
1973	40,034	6,480	131
1974	26,874	4,272	129
1975	14,906	2,223	121
1976	48,636	8,092	135
1977	41,514	6,322	123
1978	15,054	2,068	111
1979	22,238	3,347	122
1980	655	68	84
1981	27,125	3,937	118
1982	7,523	1,091	118
1983	2,613	334	104
1984	3,028	387	104
1985	3,719	503	110
1986	20,234	2,689	108
1987	9,740	1,246	104
1988	19,611	2,692	111
1989	19,416	2,998	125
1990	14,268	1,962	111
1991	22,487	4,098	148
1992	2,643	529	162
1993	7,360	838	92
1994	4,572	584	104
1995	9,423	1,454	125
1996	3,676	478	106
1997	1,170	177	123
1998	0	0	-
1999	15,006	1,707	92
2000	20,733	2,622	103
Min. Annual	0	0	---
Max. Annual	53,650	8,155	---
Avg. Annual	16,738	2,470	120

6.1.3. Total Flow-Through Releases at S-354

Lake Okeechobee releases at S-354 pass into the Miami Canal. In the 2006 SFWMM simulation, the daily flow-through release volumes at S-354 are the summation of a number of individual flow terms as indicated by the following equation:

Total Release = [FLIMPM+LKTSEM+S354PK+WSHOLY+WLC354] +
[354RG+WSSTA3+WSSTA5+WSSTA6]

These individual flow terms are defined as follows:

- FLIMPM = Import Glades water met by Lake Okeechobee via Miami Canal through S-354
- LKTSEM = Water supply from Lake Okeechobee to meet supplemental Big Cypress Reservation (BCR) Seminole demands
- S354PK = Flow from Lake Okeechobee through S-354 to help meet ENP flow targets
- WSHOLY = Water supply releases from Lake Okeechobee to Holeyland
- WLC354 = Water supply discharge to LEC from Lake Okeechobee via S-354
- 354RG = Lake Okeechobee regulatory discharge via S-354
- WSSTA3 = Water supply discharge from Lake Okeechobee to STA-3/4
- WSSTA5 = Water supply discharge from Lake Okeechobee to STA-5
- WSSTA6 = Water supply discharge from Lake Okeechobee to STA-6 via S-354 and Miami Canal

The daily TP loads in flow-through releases at S-354 were calculated using average monthly TP concentrations developed from historic data on flow-through releases to the Miami Canal. The resulting average monthly concentrations are listed in Table 6.5.

Table 6.5: Average TP Concentrations in Flow-through Releases at S-352*

Month	Average TP Conc. (ppb)	Month	Average TP Conc. (ppb)
January	58	July	85
February	46	August	104
March	46	September	103
April	68	October	125
May	96	November	68
June	89	December	52

* Derived from Table 5.4 of final Task 1.3 report (June 27, 2005).

Table 6.6 is a summary of the estimated annual runoff volumes, TP loads, and flow-weighted TP concentrations in total flow-through releases at S-354.

6.2. Water Supply Bypass

Flow-through releases from Lake Okeechobee that are intended to satisfy water supply demands downstream of the EAA may not be routed through a STA for treatment. The volumes and TP loads in this water supply bypass are characterized below.

6.2.1. Water Supply Bypass at S-351

As modeled in the SFWMM simulation, there are four flow terms that constitute water supply bypass volumes at S-351: WL1351, WL2351, WL3351 and S351PK. These flow terms are defined above in Section 6.1.1. The estimated TP loads in these bypass volumes were calculated using the average monthly concentrations listed above in Table 6.1. A summary of the resulting annual volumes, TP loads and TP concentrations is included as Table 6.7.

Table 6.6: Summary of Lake Okeechobee Flow-through Releases at S-354

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	128,029	10,643	67
1967	154,118	9,776	51
1968	32,248	3,117	78
1969	210,799	14,277	55
1970	198,635	13,484	55
1971	145,252	14,459	81
1972	47,068	4,933	85
1973	32,085	2,870	73
1974	114,674	10,049	71
1975	118,481	10,444	71
1976	44,678	4,162	76
1977	25,920	1,986	62
1978	16,522	1,609	79
1979	120,278	7,452	50
1980	354,745	30,783	70
1981	62,264	6,340	83
1982	63,436	6,937	89
1983	107,970	8,787	66
1984	69,745	4,462	52
1985	81,532	7,647	76
1986	63,227	6,817	87
1987	57,349	4,902	69
1988	80,518	8,913	90
1989	86,627	7,216	68
1990	231,799	19,400	68
1991	68,045	6,787	81
1992	164,487	10,226	50
1993	192,058	12,951	55
1994	85,976	6,072	57
1995	67,280	7,508	90
1996	214,471	14,705	56
1997	119,128	10,445	71
1998	226,077	16,539	59
1999	112,624	9,043	65
2000	57,188	4,758	67
Min. Annual	16,522	1,609	---
Max. Annual	354,745	30,783	---
Avg. Annual	113,009	9,157	66

Table 6.7: Summary of Water Supply Bypass from Lake Okeechobee at S-351

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	32,284	3,870	97
1967	256	25	80
1968	13,881	1,635	96
1969	1,491	205	111
1970	0	0	---
1971	42,406	3,899	75
1972	41,373	5,326	104
1973	6,213	613	80
1974	52,444	5,349	83
1975	21,264	2,026	77
1976	20,146	2,764	111
1977	4,749	443	76
1978	744	102	111
1979	0	0	---
1980	0	0	---
1981	10,247	987	78
1982	47,143	5,122	88
1983	0	0	---
1984	0	0	---
1985	16,978	1,468	70
1986	21,314	2,648	101
1987	0	0	---
1988	0	0	---
1989	52,280	4,545	70
1990	105,380	9,988	77
1991	14,797	1,942	106
1992	0	0	---
1993	33	3	73
1994	0	0	---
1995	0	0	---
1996	0	0	---
1997	0	0	---
1998	0	0	---
1999	1,142	113	80
2000	1,674	230	111
Min. Annual	0	0	---
Max. Annual	105,380	9,988	---
Avg. Annual	14,521	1,523	85

6.2.2. Water Supply Bypass at S-352

At S-352, water supply bypass is represented by two terms in the 2006 SFWMM simulation: S352L8 and WLC352. These flow terms are defined above in Section 6.1.2. The estimated TP loads in these bypass volumes were calculated using the average monthly concentrations listed above in Table 6.3. A summary of the resulting annual volumes, TP loads and TP concentrations is included as Table 6.8.

6.2.3. Water Supply Bypass at S-354

As modeled in the SFWMM simulation, there are five flow terms that constitute water supply bypass volumes at S-354: FLIMPM, LKTSEM, S354PK, WSHOLY, and WLC354. These flow terms are defined above in Section 6.1.3. The estimated TP loads in these bypass volumes were calculated using the average monthly concentrations listed above in Table 6.5. A summary of the resulting annual volumes, TP loads and TP concentrations is included as Table 6.9.

Table 6.8: Summary of Water Supply Bypass from Lake Okeechobee at S-352

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	28,980	3,804	106
1967	7,112	1,009	115
1968	53,650	8,155	123
1969	3,043	389	104
1970	0	0	-
1971	35,548	5,203	119
1972	32,836	4,638	115
1973	40,034	6,480	131
1974	26,874	4,272	129
1975	14,906	2,223	121
1976	48,636	8,092	135
1977	41,514	6,322	123
1978	15,054	2,068	111
1979	22,238	3,347	122
1980	655	68	84
1981	27,125	3,937	118
1982	7,523	1,091	118
1983	2,613	334	104
1984	3,028	387	104
1985	3,719	503	110
1986	20,234	2,689	108
1987	9,740	1,246	104
1988	19,611	2,692	111
1989	19,416	2,998	125
1990	14,268	1,962	111
1991	22,487	4,098	148
1992	2,643	529	162
1993	7,360	838	92
1994	4,572	584	104
1995	9,423	1,454	125
1996	3,676	478	106
1997	1,170	177	123
1998	0	0	-
1999	15,006	1,707	92
2000	20,733	2,622	103
Min. Annual	0	0	---
Max. Annual	53,650	8,155	---
Avg. Annual	16,726	2,468	120

Table 6.9: Summary of Water Supply Bypass from Lake Okeechobee at S-354

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	54,482	6,103	91
1967	18,715	1,567	68
1968	30,751	2,951	78
1969	4,234	303	58
1970	1,414	158	91
1971	53,643	4,140	63
1972	45,931	4,798	85
1973	30,375	2,744	73
1974	111,212	9,768	71
1975	76,677	7,469	79
1976	42,937	4,015	76
1977	24,996	1,909	62
1978	14,319	1,450	82
1979	6,952	664	77
1980	2,698	243	73
1981	34,318	3,071	73
1982	61,305	6,708	89
1983	9,378	850	73
1984	7,657	534	57
1985	34,486	2,799	66
1986	62,398	6,723	87
1987	13,528	1,341	80
1988	19,932	1,750	71
1989	84,347	7,038	68
1990	230,722	19,303	68
1991	67,308	6,710	81
1992	4,702	451	78
1993	8,349	917	89
1994	15,154	1,311	70
1995	4,510	389	70
1996	14,278	1,298	74
1997	15,163	1,117	60
1998	4,240	577	110
1999	18,226	1,438	64
2000	17,494	1,335	62
Min. Annual	1,414	158	---
Max. Annual	230,722	19,303	---
Avg. Annual	35,624	3,255	74

6.3. Flow-Through Releases to be Treated

The remainder of the flow-through releases from Lake Okeechobee, those which are not considered to be water supply bypass, will either be diverted through one of the STAs for treatment before being released to the EPA or are water supplies for the STAs themselves. The volumes and TP loads in this flow-through release component are summarized below.

6.3.1. Flow-Through Releases at S-351 to be Treated

As modeled in the SFWMM simulation, there are four flow terms that constitute lake flow-through releases at S-351 that will require treatment: 351RG, WSST2E, WSST2M, and WSST2W. These flow terms are defined above in Section 6.1.1. The estimated TP loads in these bypass volumes were calculated using the average monthly concentrations listed above in Table 6.1. A summary of the resulting annual volumes, TP loads and TP concentrations is included as Table 6.10.

6.3.2. Flow-Through Releases at S-352 to be Treated

At S-352, flow-through releases to be treated are represented by three terms in the 2006 SFWMM simulation: WSST1W, WST1EE and WST1EW. These flow terms are defined above in Section 6.1.2. The estimated TP loads in these bypass volumes were calculated using the average monthly concentrations listed above in Table 6.3. A summary of the resulting annual volumes, TP loads and TP concentrations is included as Table 6.11.

6.3.3. Flow-Through Releases at S-354 to be Treated

As modeled in the SFWMM simulation, there are four flow terms that constitute lake flow-through releases at S-354 that will require treatment: 354RG, WSSTA3, WSSTA5, and WSSTA6. These flow terms are defined above in Section 6.1.3. The estimated TP loads in these bypass volumes were calculated using the average monthly concentrations listed above in Table 6.5. A summary of the resulting annual volumes, TP loads and TP concentrations is included as Table 6.12.

* * * * *

Table 6.10: Summary of Lake Okeechobee Releases at S-351 to be Treated

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	51,949	3,940	61
1967	109,044	8,673	64
1968	931	122	106
1969	163,165	13,882	69
1970	163,699	14,323	71
1971	63,012	7,167	92
1972	0	0	---
1973	0	0	---
1974	0	0	---
1975	35,539	2,640	60
1976	0	0	---
1977	0	0	---
1978	63	9	111
1979	90,586	6,971	62
1980	254,644	23,144	74
1981	15,453	2,120	111
1982	0	0	---
1983	82,569	7,838	77
1984	52,644	3,783	58
1985	32,380	2,126	53
1986	0	0	---
1987	33,641	3,309	80
1988	49,052	6,730	111
1989	0	0	---
1990	0	0	---
1991	0	0	---
1992	138,478	11,157	65
1993	153,479	12,798	68
1994	52,987	4,768	73
1995	57,561	7,580	107
1996	171,276	14,274	68
1997	84,258	8,360	80
1998	187,719	16,810	73
1999	80,707	8,070	81
2000	31,155	3,268	85
Min. Annual	0	0	---
Max. Annual	254,644	23,144	---
Avg. Annual	61,600	5,539	73

Table 6.11: Summary of Lake Okeechobee Releases at S-352 to be Treated

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	259	26	81
1967	0	0	---
1968	0	0	---
1969	0	0	---
1970	0	0	---
1971	0	0	---
1972	163	21	104
1973	0	0	---
1974	0	0	---
1975	0	0	---
1976	0	0	---
1977	0	0	---
1978	0	0	---
1979	0	0	---
1980	0	0	---
1981	0	0	---
1982	0	0	---
1983	0	0	---
1984	0	0	---
1985	0	0	--
1986	0	0	---
1987	0	0	---
1988	0	0	---
1989	0	0	---
1990	0	0	---
1991	0	0	---
1992	0	0	---
1993	0	0	---
1994	0	0	---
1995	0	0	---
1996	0	0	---
1997	0	0	---
1998	0	0	---
1999	0	0	---
2000	0	0	---
Min. Annual	0	0	---
Max. Annual	259	26	---
Avg. Annual	12	1	90

Table 6.12: Summary of Lake Okeechobee Releases at S-354 to be Treated

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	73,548	4,540	50
1967	135,403	8,209	49
1968	1,497	166	90
1969	206,565	13,974	55
1970	197,221	13,325	55
1971	91,609	10,320	91
1972	1,138	134	96
1973	1,709	126	60
1974	3,462	281	66
1975	41,805	2,975	58
1976	1,742	147	68
1977	925	77	68
1978	2,203	159	59
1979	113,326	6,788	49
1980	352,047	30,541	70
1981	27,946	3,269	95
1982	2,131	229	87
1983	98,592	7,938	65
1984	62,088	3,928	51
1985	47,046	4,849	84
1986	829	94	92
1987	43,821	3,561	66
1988	60,586	7,162	96
1989	2,280	178	63
1990	1,077	97	73
1991	737	77	85
1992	159,785	9,775	50
1993	183,709	12,034	53
1994	70,822	4,761	55
1995	62,770	7,118	92
1996	200,193	13,407	54
1997	103,965	9,328	73
1998	221,837	15,962	58
1999	94,399	7,605	65
2000	39,693	3,422	70
Min. Annual	737	77	---
Max. Annual	352,047	30,541	---
Avg. Annual	77,386	5,902	62

7. OVERALL SUMMARY OF AVERAGE ANNUAL VOLUMES AND TP LOADS

Table 7.1 presents a summary of the average annual volumes and TP loads taken from the more detailed listings included earlier in this document. It also presents a summary of parallel estimates taken from the March 2, 2005 (Draft) *Everglades Protection Area Tributary Areas, Supplemental Analysis*, prepared for the Everglades Agricultural Area Everglades Protection District by Burns & McDonnell.

Data taken from the draft Supplemental Analysis is specific to current conditions in the EAA (e.g., before construction of the 2,000-acre Cell 4 at STA-2, the third flow-way at STA-5, and STA-6 Section 2), modified to reflect redirection of historic Lake Okeechobee releases at S-352 to S-354.

Both estimates substantially exceed those considered in the October 27, 2003 *Everglades Protection Area Tributary Basins, Long-Term Plan for Achieving Water Quality Goals* (the Long-Term Plan). For the period 2006-2009, the estimated average annual inflow volume to the STAs (excluding inflows from the L-8 Basin) resulting from this analysis is 1,607,280 acre-feet per year, roughly 12.5% greater than those considered in the Long-Term Plan. The estimated average annual TP load in inflows to the STAs is 235,732 kilograms per year, roughly 19.5% greater than those considered in the Long-Term Plan. A significant assumption made in development of the current estimates of inflow volumes and TP loads to the STAs is that water supply releases from Lake Okeechobee destined for the Lower East Coast and certain other users (such as the Seminole Tribe's Big Cypress Reservation) will be permitted to bypass the stormwater treatment areas (for Lower East Coast water supply releases, only when the downstream water conservation areas are at or below "floor" elevations). An estimated average annual volume and TP load of 66,871 acre-feet and 7,246 kilograms TP per year, respectively, are associated with those releases.

Table 7.1 Summary of Estimated Average Annual Volumes and TP Loads

Basin or Source	Average Annual Discharge from This Analysis				Average Annual Discharge from draft Supp. Analysis			
	Water Years	Volume (Acre-Feet)	TP Load (kg)	TP Conc. (ppb)	Water Years	Volume (Acre-Feet)	TP Load (kg)	TP Conc. (ppb)
EAA Basins								
Discharge to South (STAs)								
S-2/S-6 Basin	1966-2000	226,654	27,015	97	1995-2004	262,902	31,550	97
S-2/S-7 Basin	1966-2000	226,012	22,334	80	1995-2004	170,206	14,659	70
S-3/S-8 Basin	1966-2000	232,712	23,617	82	1995-2004	248,346	21,875	71
S-5A Basin	1966-2000	294,151	55,842	154	1995-2004	261,642	47,432	147
Subtotal	1966-2000	979,529	128,808	107	1995-2004	943,096	115,516	99
Discharge to Lake								
S-2/S-6/S-7 Basin (Note 1)	1966-2000	42,554	4,640	88	1995-2004	45,464	8,736	156
S-3/S-8 Basin	1966-2000	5,921	594	81	1995-2004	22,166	2,867	105
S-5A Basin	1966-2000	0	0	---	1995-2004	0	0	--
Subtotal	1966-2000	48,475	5,234	88	1995-2004	67,630	11,603	139
Total From EAA Basins								
S-2/S-6/S-7 Basin (Note 1)	1966-2000	495,220	53,989	88	1995-2004	478,572	54,945	93
S-3/S-8 Basin	1966-2000	238,633	24,211	82	1995-2004	270,512	24,742	74
S-5A Basin	1966-2000	294,151	55,842	154	1995-2004	261,642	47,432	147
Total	1966-2000	1,028,004	134,042	106	1995-2004	1,010,726	127,119	102
Chapter 298 Districts								
EBWCD	1966-2000	15,212	9,386	500	N/A	21,528	8,104	305
ESWCD/715	1966-2000	29,818	4,588	125	N/A	30,897	3,262	86
SSDD	1966-2000	10,559	1,390	107	N/A	13,959	1,723	100
SFCD	1966-2000	21,145	3,183	122	N/A	32,258	5,416	136
Total	1966-2000	76,734	18,547	196	N/A	98,642	18,505	152
Western Basins								
C-139 to L-3 (Note 2)	1995-2005	159,030	39,111	199	1995-2004	170,154	42,834	220
C-139 at G-136 to STA-3/4	1966-2000	13,204	2,958	182	1995-2004	17,797	4,538	207
C-139 at G-136 to EAA Irr	1966-2000	4,383	969	179	1995-2004	0	0	---
USSC SDR Unit 2 (Note 3)	1998-2005	38,400	3,447	74	1998-2004	49,989	4,477	73
C-139 Annex	1997-2005	40,176	4,873	98	1995-2004	43,162	5,961	112
Total	Varies	255,193	51,358	163	Varies	281,102	57,810	167
Eastern Basins								
C-51 West	1966-2000	128,013	21,913	139	N/A	137,900	26,556	156
L-8 Basin to South	1966-2000	71,528	6,903	78	1995-2004	197,389	17,470	72
L-8 Basin to Lake	1966-2000	49,905	6,474	105	N/A	N/A	N/A	---
Acme Basin B	1966-2000	33,196	4,633	113	1995-2004	33,724	4,950	119
Total	1966-2000	282,642	39,923	115	Varies	369,013	48,976	108
Lake Okeechobee Flow-Through Releases (Note 5)								
Flow-Through Releases Included in STA Inflows								
S-351 Releases	1966-2000	61,600	5,539	73	1995-2004	85,746	8,904	84
S-352 Releases (Note 4)	1966-2000	12	1	90	1995-2004	0	0	---
S-354 Releases	1966-2000	77,386	5,902	62	1995-2004	142,181	17,504	100
Subtotal	1966-2000	138,998	11,442	67	1995-2004	227,927	26,408	94
Water Supply Bypass								
S-351 Releases	1966-2000	14,521	1,523	85	1995-2004	0	0	---
S-352 Releases	1966-2000	16,726	2,468	120	1995-2004	0	0	---
S-354 Releases	1966-2000	35,624	3,255	74	1995-2004	0	0	---
Subtotal	1966-2000	66,871	7,246	88	1995-2004	0	0	---
Total Flow-Through Releases								
S-351 Releases	1966-2000	76,121	7,062	75	1995-2004	85,746	8,904	84
S-352 Releases	1966-2000	16,738	2,469	120	1995-2004	0	0	---
S-354 Releases	1966-2000	113,010	9,157	66	1995-2004	142,181	17,504	100
Total	1966-2000	205,869	18,688	74	1995-2004	227,927	26,408	94
Total Volumes and TP Loads								
In STA Inflows		1,607,280	235,732	119		1,722,391	249,745	118
To Lake Okeechobee		98,380	11,708	96		67,630	11,603	139
To Other Destinations		142,782	15,118	86		197,389	17,470	72
Total (with L-8 Basin)		**1,848,442**	**262,558**	**115**		**1,987,410**	**278,818**	**114**
Total (without L-8 Basin)		**1,727,009**	**249,181**	**117**		**1,790,021**	**261,348**	**118**

Notes:

1. No separation of volumes back pumped to Lake Okeechobee from the S-2/S-6 and S-2/S-7 basins has been developed.
2. TP concentations in C-139 Basin in this analysis reduced from historic by 10% to reflect ongong BMP implemenation in the basin. Values from the draft Supplemental Analysis at L-3 also consider improvement due to BMP implementaiton in the basin.
3. In this analysis, total discharge from former USSC SDR Unit 2 reduced by 20% from historic due to conversion of lands to use in STA-5 and STA-6 Section 2.
4. In the draft Supplemental Analysis, historic flow-through releases at S-352 were considered redirected to S-354.
5. In the current analysis, TP concentrations in Lake flow-through releases are assigned on the basis of historic concentrations measured at the downstream end of the system (e.g., at S-5A, S-6, S-7, S-150 and S-8). In the draft Supplemental Analysis, those concentrations were assigned on the basis of measured concentrations at the point of release (e.g., S-351, S-352 and S-354). The net effect of the change in this analysis is to reduce TP loads assigned to Lake releases and increase TP loads assigned to basin runoff.

In Table 7.1, the values listed for "In STA Inflows" exclude all runoff from the L-8 Basin, which has, since publication of the 1994 *Everglades Protection Project*, *Conceptual Design*, been assumed to be eventually diverted and removed as a source of inflow to the STAs. The results of the SFWMM 2006 ECP simulation suggest that, at least for the period 2006-2009, an average annual volume of just over 71,000 acre-feet per year will continue to be discharged to the C-51 West Canal at S-5AE and must be addressed in some fashion.

The information presented in Table 7.1 was developed employing the following critical assumptions, each of which must be addressed in defined operations plans for the various stormwater treatment areas or be addressed in other, future analyses for conf1rmation.

1. Lake Okeechobee water supply releases destined for the Lower East Coast are assumed to bypass the stormwater treatment areas when the receiving Water Conservation Areas are below defined "floor" elevations (e.g., floor of their respective regulation schedules);

2. Lake Okeechobee water supply releases destined for the Seminole Tribe's Big Cypress Reservation are assumed to bypass STA-3/4;

3. TP loads in C-139 Basin runoff are assumed to be reduced from historic levels by 10% as a result of continued BMP implementation in the basin. That continued BMP implementation, coupled with anticipated changes in land use (such as the conversion of large parcels of land from private ownership to use in the Panther refuge), might also influence (reduce) runoff volumes from the basin. No such volumetric reductions have been considered in this analysis.

4. No provision has been made in the Everglades Construction Project as it is presently structured for accommodation of L-8 Basin runoff in either STA-1W or STA-1E. Given the significant overall increase in STA inflow volumes and TP loads projected herein as compared to those considered in the Long-Term Plan, it must be considered unlikely that significant inflows from the L-8 Basin can be accommodated in the treatment areas under conditions expected to exist in 2006-2009. Operations plans for STA-1W and STA-1E must be structured to avoid overloading of those treatment areas to the extent practicable. This consideration extends not only to L-8 Basin inflows arriving at the S-5A complex in

the L-8 Canal, but also to emergency releases from the upper basin of the Indian Trails Water Control District through the M-1 Canal at Royal Palm Beach to the C-51 West Canal. The magnitude of those releases have not to date been quantified.

5. TP loads in Lake Okeechobee releases have in this analysis been quantified on the basis of concentrations measured at the downstream point of release from the Everglades Agricultural Area. The net effect of this assumption is to reduce the loads associated with those releases and increase the loads ascribed to basin runoff as compared to the distribution which would be computed under Chapter 40E-63, Florida Administrative Code. While considered appropriate for analysis of the period 2006-2009, this assumption should be revisited for analysis of future conditions in which Lake releases may be substantially increased.

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