Everglades Agricultural Area Regional Feasibility Study

Deliverable 1.2A – Inflow Data Sets for the Period 2010-2014 (Final Report)

(Contract No. CN040912-WO04 Phase 2)

Prepared for:

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September 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 2010-2014
B&McD Project No. 38318

Dear Mr. Vazquez:

Burns & McDonnell is pleased to submit this Final report on "Inflow Data Sets for the Period 2010-2014". This document constitutes Deliverable 1.2A 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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Date:________________

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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:

<u>Task 1.1</u> - 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.

<u>Task 1.2</u> - 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.

<u>Task 1.3</u> - 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.

<u>Task 1.4</u> - 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.

<u>Task 1.5</u> - 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 1.2A "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 based primarily on the results of the 2010 hydrologic simulation and are considered specifically applicable to the period 2010-2014. As compared to the 2006 simulation, the most significant changes in the 2010 model are listed below.

- Updated land use assumptions from estimated 2000 conditions to projected 2010 conditions
- The first phase of the EAA Storage Reservoir project will be complete and operational in Compartment A-1 (A-1 Reservoir)
- STA-2 will be expanded to include all of Compartment B
- STA-5 and STA-6 will be expanded to incorporate the balance of Compartment C

A more complete list of modeling assumptions is included in Appendix A.

For certain of the basins, the inflow data sets summarized herein are identical to those presented in the report for Task 1.5, Phase 2, which covers the period 2006–2009, and will also be considered applicable in 2015 and beyond.

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, 1.4 and 1.5.

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. While these recommendations are specific to the 2006-2009 period analyses to be conducted, the resultant data sets for runoff from the following basins would also be directly applicable to analyses for 2010 conditions:

- Chapter 298 districts;
- C-139 Basin;
- C-139 Annex;
- C-51 West Basin;
- Acme Improvement District Basin B.

The following recommendations were made in the final (June 27, 2005) report on that evaluation and are still considered applicable to the 2010-2014 period:

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 and 2010 ECP simulations do not well represent either the total discharges or distribution of discharges from these basins. Currently available record data on those discharges 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 employ simulated runoff volumes from the adjacent EAA basins.

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 and 2010 ECP simulations over WY 1966-2000. That adjustment should address the need for shifting simulated basin runoff from 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 or 2010 ECP simulations. 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): Given the uncertainty associated with much of the period of boundary condition inflows reflected in the 2006 and 2010 ECP simulations and because the planned construction projects and changes in operations are not expected to impact C-139 Basin runoff significantly, it is recommended that subsequent analysis of this basin and STA-5 be based on historic data. In addition, the ongoing efforts for development of additional Best Management Practices in this basin are expected to further reduce historic phosphorus concentrations in runoff so it is recommended these historic concentrations be reduced by 10 percent 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 and 2010 ECP simulations for analysis of C-139 Annex discharges and STA-6.

5. Acme Improvement District Basin B: It is recommended that daily runoff volumes from this basin resulting from the 2006 or 2010 ECP simulations be employed in subsequent analyses.

6. C-51 West Basin: It is recommended that the results of the 2006 and 2010 ECP simulations for <u>total</u> basin runoff over WY 1966-2000 be used in subsequent analyses.

7. L-8 Basin: It is recommended that the results of the 2006 and 2010 ECP simulations be used for subsequent analysis of runoff from the L-8 Basin.

8. Lake Okeechobee Releases: It is recommended that the results of the 2006 and 2010 ECP simulations for Lake releases directed to the stormwater treatment areas be employed in subsequent analyses.

9. 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. Some method for adjustement of STA-1E inflows should be utilized.

10. 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.

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 using long-term average monthly data as an estimate of inflow TP concentrations did not significantly impact the DMSTA modeling results.

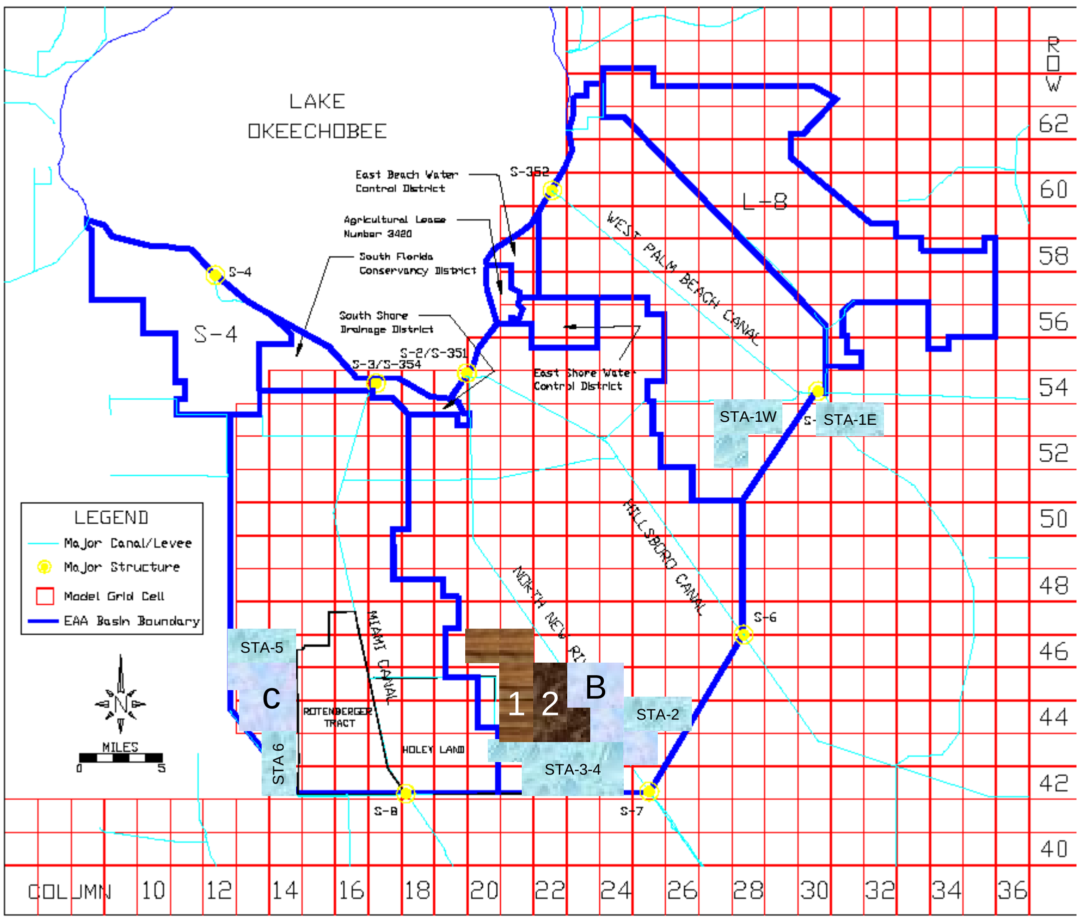
Under Task 1.3, Phase 2, Burns & McDonnell prepared an analysis of District-furnished historic data for WY 1995-2004 to develop estimated monthly flow-weighted mean TP concentrations in potential inflows from each basin or other sources tributary to the

STAs. It is these data on average monthly TP concentrations that were used for this analysis.

1.4. Modeling Assumptions for 2010 ECP Simulation

The 2010 SFWMM simulation includes a number of new construction projects and other operating assumptions that were not present in the 2006 simulation. The more significant of these model revisions are shown in Figure 1.1 and described below.

Figure 1.1: SFWMM Model Configuration for 2010



1.4.1. Updated Land Use

The 2006 SFWMM simulation is based on 1995 land use data that has been updated in the Lower East Coast urban areas using 2000 aerial photography. This base land use data has been updated to projected 2010 conditions for the 2010 simulation model.

1.4.2. STA-2 Expansion in Compartment B

In the 2006 ECP model, STA-2 has a total treatment area of 8,243 acres, which includes the new Cell 4. For 2010, this stormwater treatment area is assumed to be expanded by 7,575 acres into Compartment B, which is located within the historic S-7 Basin.

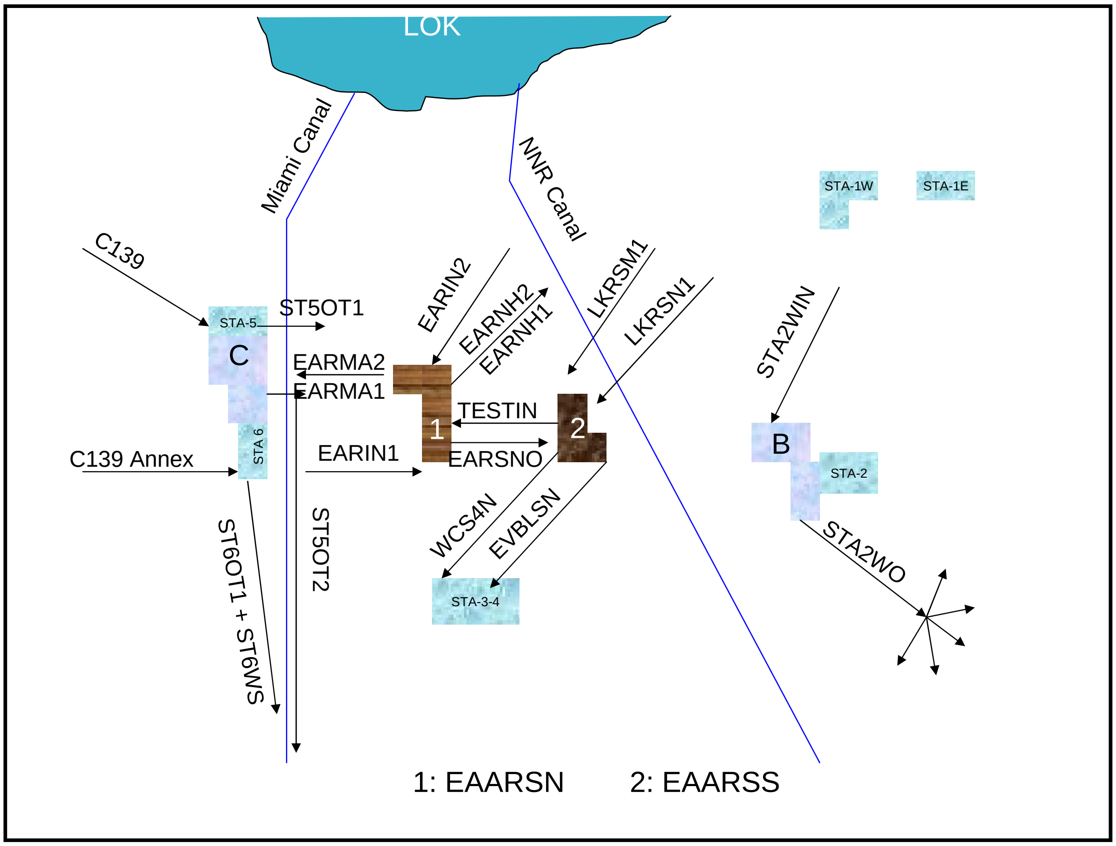
1.4.3. EAA A-1 Reservoir

By 2010, the planned A-1 Reservoir will be constructed within Compartment A, which is located just north of STA-3/4. This reservoir is modeled as two interconnected compartments with a total footprint of 16,000 acres. The A-1 Reservoir will also be located within the historic S-7 drainage basin.

The A-1 Reservoir introduces a number of new flow terms to the SFWMM model (Figure 1.2). The new reservoir-related terms are defined below:

- EARIN1 = Inflow into proposed EAA reservoir (Compartment 1) from Miami Canal (runoff + LOK regulatory releases)
- EARIN2 = Inflow into proposed EAA reservoir (Compartment 1) from NNR Canal (runoff + LOK regulatory releases)
- EARMA1 = Outflow from proposed EAA reservoir (Compartment 1) to meet Miami Canal basin supplemental demands
- EARMA2 = Outflow from propose EAA reservoir (Compartment 1) to meet Miami Canal basin supplemental demands that EARMA1 does not meet
- EARNH1 = Outflow from proposed EAA reservoir (Compartment 1) to meet NNR-Hillsboro Canal basin supplemental demands
- EARNH2 = Outflow from the proposed EAA reservoir (Compartment 1) to meet NNR-Hillsboro canal basin supplemental demands that EARNH1 does not meet
- EVBLSN = Environmental water supply from subsurface water down to 1.5 feet below land surface from the northern surge tank in EAA reservoir
- EVBLSS = Environmental water supply from subsurface water down to 1.5 feet below land surface from the southern surge tank in EAA reservoir
- LKRSM1 = Excess water from Lake Okeechobee via Miami Canal to northern surge tank of the EAA reservoir

Figure 1.2: New Flow Terms in 2010 SFWMM Model



- LKRSM2 = Excess water from Lake Okeechobee via Miami Canal to southern surge tank of the EAA reservoir
- LKRSN1 = Excess water from Lake Okeechobee via NNRC to the northern surge tank of the EAA reservoir
- LKRSN2 = Excess water from Lake Okeechobee via NNRC to the southern surge tank of the EAA reservoir
- WCS4N = Outflow (surface water only) for environmental water supply purposes from northern surge tank of the EAA reservoir to WCA-3A via STA-3/4
- WCS4S = Outflow (surface water only) for environmental water supply purposes from southern surge tank of the EAA reservoir to WCA-3A via STA-3/4

1.4.4. STA-5 and STA-6 Expansion in Compartment C

For 2006, STA-5 includes a total treatment area of 6,165 acres, which includes the new third flow way. STA-6, including the Phase 2 expansion, has a total treatment area of

2,254 acres in 2006. For 2010, both of these STAs are expanded within Compartment C, the former U.S. Sugar Corporation Southern Division Ranch Unit 2. STA-5 is expanded by 4,916 acres and STA-6 by 600 acres.

Consistent with its current configuration, all of the treated discharge from STA-5 is discharged to the east in the 2006 model, with much of this discharge intended as water supply to the Rotenberger Tract (flow term ST5OT1). In the 2010 model, there is a second discharge vector from STA-5 (ST5OT2), which discharges directly to WCA-3A.

1.4.5. L-8 Reservoir

The initial phase of the L-8 Reservoir project, one of the Upper East Coast CERP projects, is assumed to be operational in the 2010 SFWMM model. This reservoir is simulated as occupying 870 acres. The L-8 Reservoir, sometimes referred to as the borrow pits, is located on the west side of Levee 8 within the historic S-5A drainage basin.

* * * * *

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. The inflow datasets for these Chapter 298 districts for 2006–2009, which are documented in the Task 1.5 report, are based on this recommendation. This same deficiency applies to the 2010 ECP simulation results as well so the assumptions and input data sets summarized below for these Chapter 298 districts are identical to those presented in the Task 1.5 report.

The currently available record data on discharges from these drainage districts (summarized in the task report prepared under Phase 2, Task 1.3) encompasses WY 1995-2004. As a result, only the data for WY 1995-2000 can be directly imported for the analysis. For WY 1966-1994, it was necessary to estimate those inflow volumes by indirect methods.

As described in the Task 1.5 report, it was contemplated that this indirect estimation would 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; however, these regression results were unsatisfactory so an alternate approach was adopted. With this alternate method 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 to all analyses on or after 2006.

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:

$$\text{EBWCD Runoff} = 0.0531*(\text{RFWPBB} - \text{EBDST1} + \text{DIVERS})$$

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:

ESWCD/715 Runoff = 0.1024*(RFWPBB – EBDST1 + 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 directly to STA-2 or STA-3/4, delivered to the A-1 Reservoir, 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 2010 SFWMM simulation, the daily runoff volumes that would be delivered to STA-2 are calculated using the following equation:

Runoff = [RFTST2–715ST2–ESDST2–DIVERS]+0.351*[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

Similar to the assumption used with the 2006 model results, the right half of the above equation reflects redistribution of 35.1 percent of the simulated runoff from the North New River Canal to the Hillsboro Canal. This redistribution factor is based on the assumption that the rate of runoff should be relatively uniform across the entire S-2/S-6/S-7 basin and therefore the runoff volumes from the S-2/S-6 and S-2/S-7 basins will be proportional to their respective drainage areas. The development of this redistribution factor is discussed below.

For the 2010 ECP simulation, the net basin runoff delivered to the STAs from the S-2/S-6 and S-2/S-7 basins is calculated respectively from the left and right portions of the above runoff equation, without application of the adjustment factor. Basin runoff delivered to the A-1 reservoir and backpumped to Lake Okeechobee are represented by the flow terms EARIN2 and S2PMP, respectively. Substituting average annual values for these terms, yields the values summarized in Table 3.1.

Table 3.1: Unadjusted Runoff for 2010 from S-2/S-6/S-7 Basin

Data Value	S-2/S-6 Basin	S-2/S-7 Basin	Combined S-2/S-6/S-7 Basin
Average Annual Runoff, 1965-2000 (acre-feet/year)			
To STAs	176,166	165,479	341,645
To A-1 Reservoir (Note 1)	---	72,884	72,884
To L. Okeechobee (Note 2)	12,699	12,699	25,398
Total Runoff	188,865	251,062	439,927
Drainage Area (acres) (Note 3)	119,900	94,085	213,985
Average Runoff Depth (feet)	1.58	2.67	2.06

1. All of the runoff delivered to the A-1 Reservoir was assigned to the S-2/S-7 Basin.
2. Half of the volumes backpumped to Lake Okeechobee were assigned to each subbasin.
3. Drainage area for S-2/S-6 Basin assumed unchanged from 2006 ECP simulation. Effective drainage area for S-2/S-7 Basin reduced from 2006 value (117,660 acres) to reflect removal of 7,575 acres in Compartment B and 16,000 acres in Compartment A.

In Table 3.1, all of the runoff delivered to the A-1 Reservoir was assigned to the S-2/S-7 Basin because the intake for this reservoir will be located in the southern portion of this basin along the North New River Canal. All of the significant land use changes in these basins are assumed to occur in the S-2/S-7 Basin: conversion of 7,575 acres in

Compartment B to STA-2 and development of 16,000 acres of Compartment A into the A-1 Reservoir. In order to balance the runoff depth between the two basins, the total runoff from the S-2/S-6 Basin should be 2.06 feet times 119,900 acres, or an average of 246,994 acre-feet/year. Achieving this average runoff requires shifting 58,129 acre-feet/year to the S-2/S-6 Basin. With the inflow station to STA-3/4 (G-370) being one of the most southerly structures on the North New River Canal, this runoff redistribution would logically reduce inflows to STA-3/4 from the S-2/S-7 Basin. Therefore, the runoff adjustment factor is calculated as 58,129 acre-feet divided by the net runoff to STA-3/4 from the S-2/S-7 Basin (165,479 acre-feet) yielding a redistribution factor of 35.1 percent.

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 3.2.

Table 3.2: 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 3.3.

Table 3.3: Summary of Annual STA-2 Inflows from S-2/S-6 Basin

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	269,657	31,120	94
1967	310,008	35,816	94
1968	205,378	24,797	98
1969	383,743	46,151	97
1970	419,112	51,511	100
1971	188,255	20,968	90
1972	300,816	38,673	104
1973	205,159	22,264	88
1974	159,970	18,448	93
1975	217,904	25,292	94
1976	286,155	34,737	98
1977	195,537	21,146	88
1978	239,188	28,321	96
1979	283,568	32,830	94
1980	306,360	39,407	104
1981	131,100	15,616	97
1982	198,122	24,575	101
1983	382,369	42,635	90
1984	200,854	26,910	109
1985	172,051	21,877	103
1986	260,119	32,188	100
1987	236,269	28,485	98
1988	142,720	17,047	97
1989	118,718	13,911	95
1990	138,616	16,913	99
1991	177,568	19,754	90
1992	180,447	20,938	94
1993	305,729	33,046	88
1994	211,962	25,506	98
1995	356,555	43,841	100
1996	244,422	30,779	102
1997	192,261	23,154	98
1998	272,195	33,086	99
1999	154,844	18,984	99
2000	234,104	30,731	106
Min. Annual	118,718	13,911	---
Max. Annual	419,112	51,511	---
Avg. Annual	236,624	28,327	97

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

The majority of the 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 directly to STA-3/4 via Pump Station G-370. From the 2010 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:

Runoff = (1-0.351)*[NNRST3+S7BPMR+WLES7]

The individual flow terms used in this equation are all defined in the previous section. This equation reflects the recommended redistribution of 35.1 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 3.4.

Table 3.4: 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 3.5.

Table 3.5: 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	132,398	11,986	73
1967	148,292	14,141	77
1968	87,601	8,556	79
1969	177,321	17,716	81
1970	225,752	22,712	82
1971	93,124	8,888	77
1972	129,696	14,082	88
1973	89,879	8,814	79
1974	76,374	7,120	76
1975	102,494	9,472	75
1976	122,436	11,885	79
1977	75,979	6,274	67
1978	99,658	10,742	87
1979	146,059	14,498	80
1980	116,626	12,500	87
1981	34,413	3,059	72
1982	73,532	7,676	85
1983	204,145	18,138	72
1984	102,309	10,565	84
1985	73,352	7,189	79
1986	131,401	12,046	74
1987	112,819	11,124	80
1988	52,838	6,901	106
1989	42,859	3,851	73
1990	48,964	4,482	74
1991	60,382	4,937	66
1992	93,235	8,988	78
1993	152,772	14,470	77
1994	91,535	8,225	73
1995	189,152	20,332	87
1996	128,752	12,266	77
1997	98,178	10,348	85
1998	153,472	15,551	82
1999	59,834	6,843	93
2000	98,234	9,770	81
Min. Annual	34,413	3,059	---
Max. Annual	225,752	22,712	---
Avg. Annual	109,310	10,747	80

3.1.3. S-2/S-7 Basin Runoff to A-1 Reservoir

A portion of the runoff from the S-2/S-7 Basin will also be delivered to the new A-1 Reservoir. From the 2010 SFWMM simulation, the daily runoff volumes that would be delivered to the A-1 Reservoir are represented by a single flow term EARIN2. The runoff diverted to this reservoir from the S-2/S-7 Basin is assumed to have the same TP concentrations as other runoff within this basin. Therefore, the same average monthly concentrations listed in Table 3.4 were used to estimate TP loads in this diverted runoff. Table 3.6 is a summary of the volumes, TP loads and flow-weighted TP concentrations in the S-2/S-7 Basin runoff that is diverted to the A-1 Reservoir.

3.1.4. 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 2010 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 3.7.

Table 3.6: Summary of Annual A-1 Reservoir Inflows from S-2/S-7 Basin

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	74,200	7,351	80
1967	59,126	5,520	76
1968	84,364	8,272	79
1969	86,879	8,972	84
1970	8,306	937	91
1971	54,862	5,944	88
1972	117,140	11,525	80
1973	83,489	9,259	90
1974	59,951	5,652	76
1975	67,303	7,519	91
1976	105,953	10,063	77
1977	102,699	10,934	86
1978	97,242	10,403	87
1979	62,178	6,778	88
1980	113,151	10,323	74
1981	106,022	10,893	83
1982	140,343	13,933	80
1983	39,104	4,542	94
1984	50,380	4,909	79
1985	80,561	9,836	99
1986	63,819	6,249	79
1987	74,213	7,959	87
1988	71,262	6,792	77
1989	73,709	6,825	75
1990	79,675	7,481	76
1991	133,159	11,208	68
1992	36,591	3,924	87
1993	72,548	7,340	82
1994	85,372	8,275	79
1995	36,679	3,751	83
1996	15,524	1,516	79
1997	34,247	3,346	79
1998	9,431	1,048	90
1999	52,002	4,804	75
2000	91,229	9,126	81
Min. Annual	8,306	937	---
Max. Annual	140,343	13,933	---
Avg. Annual	72,078	7,235	81

Table 3.7: 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 3.7.

3.2. S-3/S-8 Basin

Runoff from the combined S-3/S-8 Basin will be conveyed directly to STA-3/4, delivered to the A-1 Reservoir, 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

A major portion of the runoff from the S-3/S-8 basin will be delivered directly to STA-3/4 via Pump Station G-372. From the 2010 SFWMM simulation, the daily runoff volumes that would be delivered to STA-3/4 are calculated using the following equation:

Runoff = [MIAST3–SSDST3–S236SO–G136SO] + S8BPMR+WLES8

Table 3.8: 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	68,658	6,877	81
1968	2,206	237	87
1969	54,524	5,730	85
1970	69,598	7,449	87
1971	3,451	373	88
1972	8,603	899	85
1973	26,648	2,952	90
1974	0	0	---
1975	9,158	922	82
1976	24,804	3,033	99
1977	0	0	---
1978	34,569	3,607	85
1979	0	0	---
1980	29,808	2,809	76
1981	0	0	---
1982	56,391	6,484	93
1983	106,985	10,922	83
1984	0	0	---
1985	9,213	1,034	91
1986	3,795	396	85
1987	0	0	---
1988	32,844	5,267	130
1989	0	0	---
1990	12,535	1,308	85
1991	32,466	1,767	44
1992	0	0	---
1993	38,825	3,127	65
1994	0	0	---
1995	69,399	10,267	120
1996	66,529	7,189	88
1997	837	85	82
1998	3,643	480	107
1999	61,270	9,826	130
2000	46,360	5,718	100
Min. Annual	0	0	---
Max. Annual	106,985	10,922	---
Avg. Annual	24,946	2,822	92

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 above equation may generate negative values, principally on days when runoff is being diverted to the A-1 Reservoir. Any negative values were replaced with zero. The daily total phosphorus (TP) loads in inflow to STA-3/4 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 3.9.

Table 3.9: 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 3.10.

Table 3.10: Summary of Direct STA-3/4 Inflow from S-3/S-8 Basin Runoff

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	218,285	22,120	82
1967	216,151	23,136	87
1968	127,390	14,496	92
1969	308,769	32,271	85
1970	361,817	32,518	73
1971	134,334	14,767	89
1972	181,839	21,306	95
1973	108,766	10,241	76
1974	68,861	7,346	86
1975	157,977	17,287	89
1976	223,791	24,778	90
1977	95,985	9,964	84
1978	151,323	16,046	86
1979	248,103	26,314	86
1980	199,326	19,721	80
1981	29,349	3,299	91
1982	75,634	7,616	82
1983	316,730	27,505	70
1984	175,013	16,247	75
1985	80,526	9,158	92
1986	115,677	11,403	80
1987	176,767	16,959	78
1988	85,014	11,512	110
1989	77,624	8,516	89
1990	88,305	8,733	80
1991	82,597	6,523	64
1992	195,002	20,338	85
1993	198,228	18,693	76
1994	117,433	10,489	72
1995	303,568	31,669	85
1996	254,174	27,875	89
1997	212,772	21,678	83
1998	271,480	24,557	73
1999	102,905	12,875	101
2000	210,314	23,144	89
Min. Annual	29,349	3,299	---
Max. Annual	361,817	32,518	---
Avg. Annual	170,624	17,460	83

3.2.2. S-3/S-8 Basin Runoff to A-1 Reservoir

Runoff from the S-3/S-8 basin will also be diverted into the proposed A-1 Reservoir. From the 2010 SFWMM simulation, the daily runoff volumes that would be delivered to this reservoir are represented by a single flow term (EARIN1) but these runoff volumes were reduced by the magnitude of any calculated negative values in runoff to STA-3/4, which was described in the previous section., to maintain the overall water balance within the basin. Therefore, the daily runoff volumes delivered to the A-1 Reservoir from the S-3/S-8 Basin were calculated using the following equation:

Runoff = EARIN1 + min[MIAST3–SSDST3–S236SO–G136SO + S8BPMR+WLES8,0]

The individual flow terms used in this equation are all defined in the previous section.

The runoff diverted to the A-1 Reservoir from the S-3/S-8 Basin should have TP concentrations similar to those for the basin as a whole. Therefore, the same average monthly concentrations listed in Table 3.9 were used to estimate TP loads in this diverted runoff.

A summary of the estimated annual inflow volumes, TP loads, and flow-weighted TP concentrations to A-1 Reservoir is presented in Table 3.11.

3.2.3. 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-3/S-8 Basin that is back pumped to the lake at Pump Station S-3. In the 2010 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 in Table 3.9. 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 3.12.

Table 3.11: Summary of Annual A-1 Reservoir Inflows from S-3/S-8 Basin

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	73,640	7,625	84
1967	22,611	1,851	66
1968	100,679	8,505	68
1969	69,753	6,084	71
1970	3,768	439	94
1971	28,705	3,008	85
1972	111,663	9,804	71
1973	45,133	4,731	85
1974	59,821	6,480	88
1975	57,116	5,867	83
1976	47,697	3,886	66
1977	60,987	5,935	79
1978	93,705	11,437	99
1979	46,848	4,492	78
1980	74,933	7,492	81
1981	61,561	6,450	85
1982	67,112	8,503	103
1983	61,363	6,066	80
1984	34,022	3,031	72
1985	70,835	7,429	85
1986	84,699	8,970	86
1987	78,865	6,554	67
1988	85,241	9,361	89
1989	78,625	8,375	86
1990	53,727	6,025	91
1991	127,478	11,246	72
1992	55,845	5,149	75
1993	57,978	4,617	65
1994	71,376	7,370	84
1995	19,167	1,694	72
1996	15,806	1,143	59
1997	35,098	3,662	85
1998	9,055	1,034	93
1999	51,437	5,761	91
2000	76,098	6,763	72
Min. Annual	3,768	439	---
Max. Annual	127,478	11,437	---
Avg. Annual	59,784	5,910	80

Table 3.12: 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	2,675	313	95
1967	26,327	3,127	96
1968	0	0	---
1969	568	56	81
1970	23,532	1,397	48
1971	0	0	---
1972	0	0	---
1973	0	0	---
1974	0	0	---
1975	0	0	---
1976	0	0	---
1977	0	0	---
1978	8,803	975	90
1979	0	0	---
1980	273	14	40
1981	0	0	---
1982	0	0	---
1983	9,738	800	67
1984	1,367	112	67
1985	0	0	---
1986	0	0	---
1987	487	40	67
1988	188	31	132
1989	0	0	---
1990	0	0	---
1991	9,152	454	40
1992	0	0	---
1993	2,967	301	82
1994	0	0	---
1995	1,367	223	132
1996	16,176	1,841	92
1997	0	0	---
1998	0	0	---
1999	27,401	4,467	132
2000	12,151	1,422	95
Min. Annual	0	0	---
Max. Annual	27,401	4,467	---
Avg. Annual	4,091	445	88

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 2010 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 3.13. 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 3.14.

Table 3.13: Average TP Concentrations in S-5A 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 3.14: 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	284,004	52,405	150
1967	274,576	50,914	150
1968	172,558	31,814	149
1969	369,554	70,440	155
1970	370,548	72,479	159
1971	182,161	33,836	151
1972	246,886	46,921	154
1973	129,528	25,198	158
1974	148,941	27,097	147
1975	198,490	36,641	150
1976	233,957	43,374	150
1977	182,978	34,844	154
1978	232,500	45,174	158
1979	304,394	57,859	154
1980	223,249	41,903	152
1981	143,581	26,037	147
1982	176,874	34,097	156
1983	313,925	59,441	154
1984	268,568	52,451	158
1985	205,518	39,839	157
1986	210,157	38,954	150
1987	232,666	45,432	158
1988	199,475	38,030	155
1989	179,858	33,483	151
1990	150,586	27,814	150
1991	217,817	42,096	157
1992	159,328	29,627	151
1993	360,410	67,765	152
1994	258,816	48,378	152
1995	376,815	73,997	159
1996	258,087	48,218	151
1997	199,528	38,386	156
1998	251,609	50,261	162
1999	193,336	36,127	151
2000	219,841	42,319	156
Min. Annual	129,528	25,198	---
Max. Annual	376,815	73,997	---
Avg. Annual	232,318	44,104	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 2010 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 3.13 were used to estimate TP loads in this diverted runoff. Table 3.15 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 3.15: Summary of Inflow to STA-2 from S-5A Basin Runoff

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	73,705	13,607	150
1967	67,239	12,458	150
1968	45,870	8,457	149
1969	94,824	18,047	154
1970	91,958	17,854	157
1971	48,199	8,954	151
1972	65,531	12,450	154
1973	34,432	6,698	158
1974	38,176	6,965	148
1975	51,846	9,573	150
1976	60,054	11,150	151
1977	48,640	9,262	154
1978	58,973	11,528	158
1979	79,912	15,168	154
1980	57,230	10,776	153
1981	37,150	6,748	147
1982	43,459	8,368	156
1983	81,864	15,518	154
1984	68,300	13,342	158
1985	49,093	9,502	157
1986	54,675	10,153	151
1987	60,956	11,891	158
1988	46,316	8,768	153
1989	46,724	8,716	151
1990	40,029	7,394	150
1991	53,193	10,337	158
1992	42,353	7,876	151
1993	85,879	16,183	153
1994	64,048	11,968	151
1995	91,898	17,935	158
1996	60,759	11,399	152
1997	53,039	10,204	156
1998	65,923	13,129	161
1999	41,117	7,584	150
2000	53,860	10,366	156
Min. Annual	34,432	6,698	---
Max. Annual	94,824	18,047	---
Avg. Annual	58,778	11,152	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.

As discussed previously in Chapter 1 (Item 3, Section 1.3.1), runoff from these Western Basins is not modeled explicitly in the SFWMM but input as a boundary condition. Because of uncertainty in these estimated inputs in the early years of the simulation period, it is recommended that historic data be used to characterize runoff from these basins. Therefore, the data summarized in the balance of this chapter are identical to those previously described in the Task 1.5 report.

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. 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 discharged 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 also referred to as Compartment C. By 2010 all of Compartment C will be converted into treatment area and incorporated into either STA-5 or STA-6. Therefore, the historic runoff from this area that is described in the Task 1.5 report is no longer germane to analyses for 2010 and beyond.

* * * * *

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 2010 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	0	0	---
1967	32,424	3,377	84
1968	0	0	---
1969	40,464	3,907	78
1970	95,732	9,922	84
1971	58,780	4,969	69
1972	0	0	---
1973	0	0	---
1974	0	0	---
1975	0	0	---
1976	0	0	---
1977	0	0	---
1978	0	0	---
1979	52,852	3,946	61
1980	0	0	---
1981	0	0	---
1982	0	0	---
1983	115,298	12,813	90
1984	132,643	12,509	76
1985	73,376	6,913	76
1986	0	0	---
1987	0	0	---
1988	0	0	---
1989	0	0	---
1990	0	0	---
1991	0	0	---
1992	0	0	---
1993	177,580	17,280	79
1994	13,087	1,483	92
1995	238,780	22,286	76
1996	134,708	13,572	82
1997	0	0	---
1998	29,207	4,439	123
1999	37,528	3,174	69
2000	36,505	3,597	80
Min. Annual	0	0	---
Max. Annual	238,780	22,286	---
Avg. Annual	36,256	3,548	79

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 2010 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	80,264	10,269	104
1967	88,365	11,582	106
1968	46,088	5,848	103
1969	130,367	17,179	107
1970	60,778	7,984	106
1971	363	52	116
1972	77,871	8,978	93
1973	94,913	13,203	113
1974	91,230	11,883	106
1975	88,833	11,558	105
1976	79,419	10,258	105
1977	79,745	10,132	103
1978	108,243	12,927	97
1979	133,448	16,529	100
1980	12,845	1,301	82
1981	20,659	2,095	82
1982	114,976	14,151	100
1983	84,460	11,247	108
1984	41,601	5,435	106
1985	6,228	1,035	135
1986	61,368	7,221	95
1987	81,418	10,266	102
1988	36,802	4,250	94
1989	63,358	6,954	89
1990	67,009	8,310	101
1991	144,001	19,932	112
1992	88,511	11,791	108
1993	77,141	9,285	98
1994	84,259	10,472	101
1995	97,660	12,454	103
1996	38,263	4,635	98
1997	78,467	10,970	113
1998	103,729	13,311	104
1999	27,693	3,209	94
2000	27,201	3,798	113
Min. Annual	363	52	---
Max. Annual	144,001	19,932	---
Avg. Annual	71,931	9,157	103

5.2. C-51 West Basin

Runoff from the C-51 West Basin can be routed to a number of different destinations. From the 2010 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 5.5.

Table 5.5: 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 5.6.

Table 5.6: Summary of C-51 West Basin Runoff

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	160,442	27,667	140
1967	152,639	26,441	140
1968	127,507	21,520	137
1969	165,858	30,660	150
1970	188,669	32,834	141
1971	101,802	17,908	143
1972	114,437	20,228	143
1973	125,091	22,231	144
1974	112,993	18,040	129
1975	110,341	18,524	136
1976	125,738	22,251	143
1977	105,446	17,764	137
1978	135,534	21,397	128
1979	141,161	23,905	137
1980	135,005	21,820	131
1981	97,564	16,056	133
1982	122,443	20,452	135
1983	197,488	33,994	140
1984	177,385	31,882	146
1985	126,313	22,912	147
1986	132,295	21,978	135
1987	134,123	22,554	136
1988	123,026	21,855	144
1989	106,448	17,461	133
1990	78,040	12,456	129
1991	136,348	20,975	125
1992	120,522	20,390	137
1993	170,583	27,696	132
1994	100,702	16,459	133
1995	193,342	33,478	140
1996	160,383	27,605	140
1997	148,062	25,632	140
1998	156,040	24,503	127
1999	128,097	21,833	138
2000	176,539	32,395	149
Min. Annual	78,040	12,456	---
Max. Annual	197,488	33,994	---
Avg. Annual	136,812	23,307	138

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 2010 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 5.7.

Table 5.7: 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 5.8 is a summary of the estimated annual runoff volumes, TP loads, and flow-weighted TP concentrations from Acme Basin B.

* * * * *

Table 5.8: Summary of Acme Basin B Runoff

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	40,017	6,142	124
1967	40,243	5,565	112
1968	31,012	4,437	116
1969	41,080	5,629	111
1970	44,204	6,130	112
1971	22,424	3,160	114
1972	31,134	4,323	113
1973	34,114	4,211	100
1974	34,260	4,646	110
1975	28,692	4,194	119
1976	34,937	5,152	120
1977	27,552	3,466	102
1978	35,834	4,682	106
1979	34,777	4,930	115
1980	37,830	5,412	116
1981	25,745	3,481	110
1982	33,806	4,460	107
1983	45,545	6,429	114
1984	40,549	5,895	118
1985	30,009	4,254	115
1986	37,023	5,185	114
1987	35,868	4,811	109
1988	32,127	4,639	117
1989	26,878	3,392	102
1990	22,235	2,999	109
1991	35,415	4,668	107
1992	29,235	3,974	110
1993	39,219	5,398	112
1994	30,695	4,402	116
1995	42,171	6,085	117
1996	37,573	5,574	120
1997	36,534	4,943	110
1998	42,290	5,395	103
1999	34,811	4,934	115
2000	45,199	6,757	121
Min. Annual	22,235	2,999	---
Max. Annual	45,545	6,757	---
Avg. Annual	34,887	4,850	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 2010 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:

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	42,031	4,931	95
1967	1,324	131	80
1968	15,592	1,944	101
1969	2,305	316	111
1970	0	0	-
1971	31,547	2,971	76
1972	26,118	3,258	101
1973	2,508	241	78
1974	32,123	3,052	77
1975	17,147	1,511	71
1976	7,109	975	111
1977	3,460	314	74
1978	4,367	446	83
1979	539	53	80
1980	0	0	-
1981	4,003	368	74
1982	23,760	2,818	96
1983	0	0	-
1984	20,709	2,042	80
1985	25,639	1,727	55
1986	15,390	1,549	82
1987	0	0	-
1988	0	0	-
1989	43,813	4,013	74
1990	91,913	8,968	79
1991	23,220	2,427	85
1992	0	0	-
1993	0	0	-
1994	0	0	-
1995	0	0	-
1996	0	0	-
1997	0	0	-
1998	14,006	1,246	72
1999	2,534	250	80
2000	5,051	692	111
Min. Annual	0	0	---
Max. Annual	91,913	8,968	---
Avg. Annual	13,035	1,321	82

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 2010 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 6.4 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 6.3: 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: Summary of Lake Okeechobee Flow-through Releases at S-352

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	23,367	3,064	106
1967	5,159	790	124
1968	44,547	7,280	132
1969	238	30	104
1970	0	0	-
1971	37,904	5,523	118
1972	31,765	4,491	115
1973	6,681	1,129	137
1974	22,243	4,107	150
1975	23,939	3,661	124
1976	39,720	7,204	147
1977	44,823	7,657	138
1978	32,618	5,263	131
1979	4,827	617	104
1980	10,574	1,747	134
1981	35,347	6,318	145
1982	1,749	307	142
1983	13	2	104
1984	1,970	252	104
1985	1,909	244	104
1986	13,162	1,774	109
1987	11,743	1,533	106
1988	22,709	3,156	113
1989	25,232	4,104	132
1990	11,738	1,626	112
1991	7,324	1,124	124
1992	86	11	104
1993	7,944	931	95
1994	0	0	-
1995	4,781	738	125
1996	1,545	197	104
1997	9,203	1,602	141
1998	2,166	277	104
1999	7,692	964	102
2000	2,386	305	104
Min. Annual	0	0	---
Max. Annual	44,823	7,657	---
Avg. Annual	14,203	2,229	127

6.1.3. Total Flow-Through Releases at S-354

Lake Okeechobee releases at S-354 pass into the Miami Canal. In the 2010 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-354*

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	102,099	9,546	76
1967	161,238	12,894	65
1968	142,767	12,576	71
1969	103,568	8,074	63
1970	258,253	19,201	60
1971	137,396	12,005	71
1972	121,531	10,022	67
1973	58,993	6,843	94
1974	154,363	11,323	59
1975	255,574	23,126	73
1976	87,903	7,390	68
1977	78,354	6,916	72
1978	37,220	3,217	70
1979	219,597	18,030	67
1980	274,059	22,299	66
1981	101,053	9,887	79
1982	66,151	7,375	90
1983	167,619	12,644	61
1984	177,975	15,704	72
1985	146,524	13,241	73
1986	85,904	8,720	82
1987	68,061	5,286	63
1988	131,256	11,533	71
1989	155,991	13,354	69
1990	250,587	20,975	68
1991	151,797	14,227	76
1992	206,567	15,585	61
1993	89,957	7,192	65
1994	63,853	5,123	65
1995	47,770	4,778	81
1996	184,262	14,418	63
1997	61,331	5,175	68
1998	122,188	8,770	58
1999	217,697	20,761	77
2000	65,625	4,492	55
Min. Annual	37,220	3,217	---
Max. Annual	274,059	23,126	---
Avg. Annual	135,860	11,506	69

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	42,031	4,931	95
1967	1,324	131	80
1968	15,592	1,944	101
1969	2,305	316	111
1970	0	0	---
1971	30,263	2,795	75
1972	26,118	3,258	101
1973	2,508	241	78
1974	32,123	3,052	77
1975	17,147	1,511	71
1976	7,109	975	111
1977	3,460	314	74
1978	4,367	446	83
1979	539	53	80
1980	0	0	---
1981	4,003	368	74
1982	23,760	2,818	96
1983	0	0	---
1984	0	0	---
1985	7,359	557	61
1986	15,390	1,549	82
1987	0	0	---
1988	0	0	---
1989	43,813	4,013	74
1990	91,913	8,968	79
1991	23,220	2,427	85
1992	0	0	---
1993	0	0	---
1994	0	0	---
1995	0	0	---
1996	0	0	---
1997	0	0	---
1998	0	0	---
1999	2,534	250	80
2000	5,051	692	111
Min. Annual	0	0	---
Max. Annual	91,913	8,968	---
Avg. Annual	11,484	1,189	84

6.2.2. Water Supply Bypass at S-352

At S-352, water supply bypass is represented by two terms in the 2010 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 2010 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	23,367	3,064	106
1967	5,159	790	124
1968	44,547	7,280	132
1969	238	30	104
1970	0	0	---
1971	37,904	5,523	118
1972	31,765	4,491	115
1973	6,681	1,129	137
1974	22,243	4,107	150
1975	23,939	3,661	124
1976	39,720	7,204	147
1977	44,823	7,657	138
1978	32,618	5,263	131
1979	4,827	617	104
1980	10,574	1,747	134
1981	35,347	6,318	145
1982	1,749	307	142
1983	13	2	104
1984	1,970	252	104
1985	1,909	244	104
1986	13,162	1,774	109
1987	11,743	1,533	106
1988	22,709	3,156	113
1989	25,232	4,104	132
1990	11,738	1,626	112
1991	7,324	1,124	124
1992	86	11	104
1993	7,944	931	95
1994	0	0	---
1995	4,781	738	125
1996	1,545	197	104
1997	9,203	1,602	141
1998	2,166	277	104
1999	7,692	964	102
2000	1,730	221	104
Min. Annual	0	0	---
Max. Annual	44,823	7,657	---
Avg. Annual	14,184	2,227	127

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	98,928	9,204	75
1967	141,863	11,623	66
1968	140,187	12,295	71
1969	99,610	7,763	63
1970	33,196	3,297	81
1971	88,681	7,008	64
1972	105,744	8,787	67
1973	52,377	6,007	93
1974	145,415	10,571	59
1975	243,704	22,211	74
1976	84,833	7,142	68
1977	70,051	6,222	72
1978	36,056	3,079	69
1979	197,579	16,331	67
1980	274,059	22,299	66
1981	85,914	8,300	78
1982	66,151	7,375	90
1983	40,830	3,331	66
1984	102,506	8,997	71
1985	119,446	10,373	70
1986	83,688	8,491	82
1987	66,290	5,080	62
1988	126,799	11,134	71
1989	150,483	12,942	70
1990	249,525	20,855	68
1991	146,016	13,709	76
1992	204,736	15,435	61
1993	83,549	6,525	63
1994	61,415	4,913	65
1995	22,201	2,322	85
1996	30,037	2,895	78
1997	57,750	4,898	69
1998	79,172	6,338	65
1999	175,440	16,750	77
2000	60,530	4,180	56
Min. Annual	22,201	2,322	---
Max. Annual	274,059	22,299	---
Avg. Annual	109,279	9,391	70

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 to maintain them in a hydrated condition during dry periods. 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 2010 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 2010 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 2010 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	0	0	---
1967	0	0	---
1968	0	0	---
1969	0	0	---
1970	0	0	---
1971	1,284	176	111
1972	0	0	---
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	20,709	2,042	80
1985	18,281	1,170	52
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	14,006	1,246	72
1999	0	0	---
2000	0	0	---
Min. Annual	0	0	---
Max. Annual	20,709	2,042	---
Avg. Annual	1,551	132	69

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	0	0	---
1967	0	0	---
1968	0	0	---
1969	0	0	---
1970	0	0	---
1971	0	0	---
1972	0	0	---
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	656	84	104
Min. Annual	0	0	---
Max. Annual	656	84	---
Avg. Annual	19	2	104

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	3,171	341	87
1967	19,375	1,270	53
1968	2,580	281	88
1969	3,958	311	64
1970	225,057	15,905	57
1971	48,715	4,997	83
1972	15,787	1,235	63
1973	6,616	836	102
1974	8,948	752	68
1975	11,870	915	62
1976	3,070	248	66
1977	8,304	694	68
1978	1,164	138	96
1979	22,018	1,699	63
1980	0	0	---
1981	15,138	1,586	85
1982	0	0	---
1983	126,789	9,313	60
1984	75,469	6,707	72
1985	27,078	2,868	86
1986	2,216	230	84
1987	1,771	207	95
1988	4,457	399	73
1989	5,508	412	61
1990	1,062	121	92
1991	5,781	518	73
1992	1,831	150	66
1993	6,408	667	84
1994	2,438	210	70
1995	25,569	2,456	78
1996	154,225	11,523	61
1997	3,582	277	63
1998	43,016	2,433	46
1999	42,256	4,012	77
2000	5,095	311	50
Min. Annual	0	0	---
Max. Annual	225,057	15,905	---
Avg. Annual	26,581	2,115	65

6.4. Lake Okeechobee Releases to A-1 Reservoir

With construction of the A-1 Reservoir, substantial quantities of water will be released from Lake Okeechobee for temporary storage in this reservoir. These releases are summarized below.

6.4.1. Lake Okeechobee Releases to A-1 Reservoir at S-351

Lake Okeechobee releases at S-351 that are to be diverted into the A-1 Reservoir are represented in the 2010 SFWMM simulation by a single flow term, LKRSN1. The daily TP loads in these releases were calculated using average monthly TP concentrations developed from historic data on lake releases at S-351. Unlike the concentrations used to estimate TP loads for flow-through releases, the concentrations used for these releases to the reservoir are based on data collected at the point of release (that is, S-351). The resulting average monthly concentrations are listed in Table 6.13.

Table 6.13: Average TP Concentrations in Lake Okeechobee Releases at S-351*

Month	Average TP Conc. (ppb)	Month	Average TP Conc. (ppb)
January	116	July	86
February	129	August	88
March	121	September	76
April	105	October	77
May	106	November	85
June	105	December	134

* Derived from Table 4.2 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 Lake Okeechobee releases to the A-1 Reservoir at S-351 is presented in Table 6.14.

Table 6.14: Summary of Lake Okeechobee Releases to A-1 Reservoir at S-351

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	141,071	19,142	110
1967	161,252	18,408	93
1968	44,098	6,286	116
1969	226,423	27,590	99
1970	150,350	19,270	104
1971	139,132	17,967	105
1972	16,566	2,362	116
1973	42,307	6,031	116
1974	58,849	8,389	116
1975	115,556	13,008	91
1976	17,987	2,564	116
1977	38,099	5,431	116
1978	49,877	7,110	116
1979	155,813	19,297	100
1980	345,840	45,730	107
1981	58,443	7,901	110
1982	0	0	-
1983	182,673	23,565	105
1984	388,928	48,614	101
1985	187,723	23,198	100
1986	39,731	5,664	116
1987	89,271	11,767	107
1988	88,652	13,408	123
1989	111,473	13,214	96
1990	39,051	5,567	116
1991	32,090	4,575	116
1992	184,289	18,970	83
1993	314,760	39,814	103
1994	147,254	18,801	104
1995	55,098	6,884	101
1996	183,000	26,106	116
1997	207,855	25,294	99
1998	184,995	24,349	107
1999	307,245	34,121	90
2000	111,728	13,729	100
Min. Annual	0	0	---
Max. Annual	388,928	48,614	---
Avg. Annual	131,928	16,689	103

6.4.2. Lake Okeechobee Releases to A-1 Reservoir at S-354

Lake Okeechobee releases intended for diversion into the A-1 Reservoir will also be made to the Miami Canal at S-354. In the 2010 SFWMM simulation, these daily lake releases are represented by a single flow term, LKRSM1.

The daily TP loads in Lake Okeechobee releases to the reservoir at S-354 were calculated using average monthly TP concentrations developed from historic data on releases to the Miami Canal. The resulting average monthly concentrations are listed in Table 6.15.

Table 6.15: Average TP Concentrations in Lake Okeechobee Releases at S-354*

Month	Average TP Conc. (ppb)	Month	Average TP Conc. (ppb)
January	93	July	79
February	99	August	108
March	102	September	93
April	98	October	84
May	93	November	74
June	84	December	80

* Derived from Table 5.2 of final Task 1.3 report (June 27, 2005).

Table 6.16 is a summary of the estimated annual runoff volumes, TP loads, and flow-weighted TP concentrations in Lake Okeechobee releases to the A-1 Reservoir at S-354.

* * * * *

Table 6.16: Summary of Lake Okeechobee Flows to Reservoirs at S-354

Water Year	Volume (acre-feet)	TP Load (kg)	TP Concentration (ppb)
1966	155,110	17,308	90
1967	208,513	23,281	91
1968	29,509	3,374	93
1969	225,637	24,414	88
1970	234,451	26,541	92
1971	159,767	16,913	86
1972	18,550	2,121	93
1973	49,331	5,640	93
1974	59,850	6,843	93
1975	109,642	12,517	93
1976	19,817	2,266	93
1977	54,106	6,186	93
1978	58,583	6,698	93
1979	168,122	19,721	95
1980	215,063	23,757	90
1981	60,538	6,901	92
1982	0	0	-
1983	201,144	20,783	84
1984	436,519	47,725	89
1985	222,693	24,170	88
1986	50,137	5,732	93
1987	100,596	11,950	96
1988	103,172	10,530	83
1989	125,777	14,865	96
1990	27,962	3,197	93
1991	36,568	4,181	93
1992	188,352	20,843	90
1993	399,161	44,182	90
1994	176,505	18,848	87
1995	118,564	13,191	90
1996	306,942	35,446	94
1997	290,138	32,952	92
1998	213,181	23,777	90
1999	348,710	38,439	89
2000	175,046	18,601	86
Min. Annual	0	0	---
Max. Annual	436,519	47,725	---
Avg. Annual	152,793	16,968	90

7. RESERVOIR RELEASES

Water will be released from the A-1 Reservoir to satisfy irrigation demands within the S-2/S-6/S-7 or S-3/S-8 basins, or for treatment in STA-3/4. The daily TP concentrations and loads in these releases have not yet been estimated so only discharge volumes are shown in this section.

7.1. Reservoir Releases to Meet S-2/S-6/S-7 Basin Irrigation Demands

From the 2010 SFWMM simulation, the daily reservoir releases that would be delivered to the S-2/S-6/S-7 basin are calculated using the following equation:

Discharge = [EARNH1 + EARNH2]

These individual flow terms are defined as follows:

- EARNH1 = outflow from proposed EAA Reservoir (Compartment 1) to meet NNR/HILL canal basin supplemental demands
- EARNH2 = outflow from proposed EAA Reservoir (Compartment 1) to meet NNR/HILL canal basin supplemental demands that EARNH1 does not meet

These releases are summarized in Table 7-1.

7.2. Reservoir Releases to Meet S-3/S-8 Basin Irrigation Demands

Water will also be released from the A-1 Reservoir to meet supplemental needs within the S-3/S-8 Basin. These release volumes are represented in the 2010 SFWMM simulation by two flow terms: EARMA1 and EARMA2. The total reservoir discharge to this basin is the sum of these two terms as indicated by the following equation:

Discharge = [EARMA1 + EARMA2]

These individual flow terms are defined as follows:

- EARMA1 = outflow from proposed EAA Reservoir (Compartment 1) to meet Miami canal basin supplemental demands

Table 7.1: Summary of Annual A-1 Reservoir Discharge

Water Year	To S-2/S-6/S-7 Basin (acre-feet)	To S-3/S-8 Basin (acre-feet)	To STA-3/4 (acre-feet)
1966	94,215	63,751	210,407
1967	107,042	71,638	374,690
1968	100,403	72,513	66,907
1969	71,761	52,747	382,465
1970	66,067	53,233	233,355
1971	166,061	116,496	254,047
1972	87,668	56,524	54,073
1973	95,384	75,259	10,079
1974	112,555	90,781	144,000
1975	71,733	57,129	225,296
1976	89,047	69,039	40,061
1977	120,510	77,685	52,207
1978	100,502	70,686	100,170
1979	73,239	57,008	334,271
1980	70,932	53,452	562,789
1981	155,195	128,514	86,362
1982	86,034	62,394	15,802
1983	83,024	61,879	242,637
1984	144,925	90,890	652,044
1985	183,407	112,186	382,826
1986	105,378	57,119	8,730
1987	90,511	90,942	208,172
1988	124,140	83,385	153,112
1989	124,693	92,283	190,378
1990	81,906	55,687	51,510
1991	81,411	77,786	6,104
1992	65,651	39,463	412,942
1993	126,087	81,914	560,738
1994	165,616	112,829	274,858
1995	75,336	63,075	52,111
1996	108,808	79,459	340,652
1997	121,293	81,428	361,065
1998	77,485	48,393	337,051
1999	142,229	95,479	596,960
2000	108,779	68,825	200,103
Min. Annual	65,651	39,463	6,104
Max. Annual	183,407	128,514	652,044
Avg. Annual	105,115	74,911	233,685

- EARMA2 = outflow from proposed EAA Reservoir (Compartment 1) to meet Miami canal basin supplemental demands that EARMA1 does not meet

These releases are summarized in Table 7-1.

7.3. Reservoir Releases to STA-3/4

From the 2010 SFWMM simulation, the daily reservoir releases volumes that would be delivered to STA-3/4 are calculated using the following equation:

Runoff = [EVBLSS + WCS4S]

These individual flow terms are defined as follows:

- EVBLSS = environmental water supply from subsurface water down to 1.5 feet below land surface from southern surge tank in the EAA reservoir; (Alts. C&D only)
- WCS4S = outflow (surface water only) for environmental water supply purposes from surge tank of the EAA reservoir to WCA-3A via STA-3/4; (Alts. C&D)

A summary of these STA-3/4 deliveries is also included in Table 7-1.

* * * * *

8. SUMMARY

A summary of the inflow volumes and TP loads presented in the previous chapters is contained in this report section. These data are summarized in Table 8.1, which lists average annual flow volumes, TP loads and flow-weighted TP concentrations for WY 1966-2000 (unless noted otherwise). For convenient comparison, Table 8.1 includes the summary data for both the 2006 and 2010 SFWMM simulations. The details of the 2006 simulation are described in the report for Task 1.5, Phase 2. The balance of this section presents a comparison of these two simulations, with particular emphasis on the more significant differences between them.

8.1. Runoff from EAA Basins

The total average annual runoff from the EAA drainage basins — S-2/S-6/S-7, S-3/S-8, and S-5A — decreased from 1,028,004 acre-feet for 2006 to 968,553 acre-feet for the 2010 simulation, a decrease of approximately 5.7 percent. Because of several planned construction projects within these basins, their total effective drainage area has also decreased for the 2010 SFWMM simulation. These projects and their assumed footprints are listed below.

- Expansion of STA-2 into Compartment B in S-7 Basin – 7,575 acres
- Development of A-1 Reservoir within Compartment A in S-7 Basin – 16,000 acres
- Development of L-8 Reservoir project within S-5A Basin – 870 acres

As a result of these planned projects, the total effective drainage area of these basins decreased from approximately 475,220 acres to 450,775 acres, a decrease of 5.1 percent. Therefore, the average annual depth of runoff from these basins is virtually unchanged, as would be expected.

Comparing the runoff from these basins individually, there are only modest changes in the S-3/S-8 and S-5A basins. Most of the net runoff changes within the EAA occur in the S-2/S-6/S-7 basin where the majority of the planned construction impacts will be located.

For 2010, direct discharge of basin runoff to the STAs has decreased significantly, by approximately 19.3 percent, but much of this decrease results because of runoff that is diverted to the A-1 Reservoir instead. Over half of these reservoir deliveries are later delivered to STA-3/4.

Table 8.1: Estimates of Average Annual Flow Volumes and TP Loads

Basin or Source	Water Years	2006 SFWMM Simulation			2010 SFWMM Simulation		
		Volume (ac-ft)	TP Load (kg)	TP Conc. (ppb)	Volume (ac-ft)	TP Load (kg)	TP Conc. (ppb)
EAA Basin Runoff							
Discharge to South (STAs)							
S-2/S-6 Basin	1966-2000	226,654	27,015	97	236,624	28,327	97
S-2/S-7 Basin	1966-2000	226,012	22,334	80	109,310	10,747	80
S-3/S-8 Basin	1966-2000	232,712	23,617	82	170,624	17,460	83
S-5A Basin	1966-2000	294,151	55,842	154	291,096	55,256	154
Subtotal	1966-2000	979,529	128,808	107	807,654	111,790	112
Discharge to EAA A-1 Reservoir							
S-2/S-7 Basin	1966-2000	0	0	---	72,078	7,235	81
S-3/S-8 Basin	1966-2000	0	0	---	59,784	5,910	80
Subtotal	1966-2000	0	0	---	131,862	13,135	81
Discharge to Lake Okeechobee							
S-2/S-6/S-7 Basin[1]	1966-2000	42,554	4,640	88	24,946	2,822	92
S-3/S-8 Basin	1966-2000	5,921	594	81	4,091	445	88
S-5A Basin	1966-2000	0	0	---	0	0	---
Subtotal	1966-2000	48,475	5,234	88	29,037	3,267	91
Total From EAA Basins							
S-2/S-6/S-7 Basin	1966-2000	495,220	53,989	88	442,958	49,131	90
S-3/S-8 Basin	1966-2000	238,633	24,211	82	234,499	23,815	82
S-5A Basin	1966-2000	294,151	55,842	154	291,096	55,256	154
Subtotal	1966-2000	1,028,004	134,042	106	968,553	128,202	107
Chapter 298 Districts							
EBWCD	1966-2000	15,212	9,386	500	15,212	9,386	500
ESWCD/715 Farms	1966-2000	29,818	4,588	125	29,818	4,588	125
SSDD	1966-2000	10,559	1,390	107	10,559	1,390	107
SFCD	1966-2000	21,145	3,183	122	21,145	3,183	122
Total	1966-2000	76,734	18,547	196	76,734	18,547	196
Western Basins							
C-139 to L-3[2]	1995-2005	159,030	39,111	199	159,030	39,111	199
C-139 to STA-3/4[3]	1966-2000	13,204	2,958	182	13,204	2,958	182
C-139 to EAA Irr.[3]	1966-2000	4,383	969	179	4,383	969	179
USSC SDR Unit 2[4]	1998-2005	38,400	3,447	74	0	0	---
C-139 Annex	1997-2005	40,176	4,873	98	40,176	4,873	98
Total	Varies	255,193	51,358	163	216,793	47,911	179
Eastern Basins							
C-51 West	1966-2000	128,013	21,913	139	136,812	23,307	138
L-8 Basin to South	1966-2000	71,528	6,903	78	36,256	3,548	79
L-8 Basin to Lake	1966-2000	49,905	6,474	105	71,931	9,157	103
Acme Basin B	1966-2000	33,196	4,633	113	34,887	4,850	113
Total	1966-2000	282,642	39,923	115	279,886	40,862	118
Lake Okeechobee Releases							
Flow-Through Releases Included in STA Inflows[5]							
S-351	1966-2000	61,600	5,539	73	1,551	132	69
S-352	1966-2000	12	1	90	19	2	104
S-354	1966-2000	77,386	5,902	62	26,581	2,115	65
Subtotal	1966-2000	138,998	11,442	67	28,150	2,250	65

Table 8.1: Estimates of Average Annual Flow Volumes and TP Loads (cont.)

Basin or Source	Water Years	2006 SFWMM Simulation			2010 SFWMM Simulation		
		Volume (ac-ft)	TP Load (kg)	TP Conc. (ppb)	Volume (ac-ft)	TP Load (kg)	TP Conc. (ppb)
Lake Okeechobee Releases (cont.)							
Water Supply Bypass[5]							
S-351	1966-2000	14,521	1,523	85	11,484	1,189	84
S-352	1966-2000	16,726	2,468	120	14,184	2,227	127
S-354	1966-2000	35,624	3,255	74	109,279	9,391	70
Subtotal	1966-2000	66,871	7,246	88	134,947	12,807	77
Total Flow-Through Releases[5]							
S-351	1966-2000	76,121	7,062	75	13,035	1,321	82
S-352	1966-2000	16,738	2,469	120	14,203	2,229	127
S-354	1966-2000	113,010	9,157	66	135,860	11,506	69
Total	1966-2000	205,869	18,688	74	163,097	15,056	75
Lake Okeechobee Releases to EAA A-1 Reservoir[6]							
S-351	1966-2000	0	0	---	131,928	16,689	103
S-354	1966-2000	0	0	---	152,793	16,958	90
Total	1966-2000	0	0	---	284,721	33,658	96
EAA A-1 Reservoir Releases[7]							
S-2/S-6/S-7 Irrig.	1966-2000	0	0	---	105,115	---	---
S-3/S-8 Irrig.	1966-2000	0	0	---	74,911	---	---
STA-3/4	1966-2000	0	0	---	233,685	---	---
Total	1966-2000	0	0	---	413,711	---	---
Total Volumes and TP Loads							
Direct STA Inflow[8]	Varies	1,607,280	235,732	119	1,296,647	207,686	130
To A-1 Reservoir	1966-2000	0	0	---	416,583	46,803	91
To L Okeechobee	1966-2000	98,380	11,708	96	100,968	12,424	100
Other Destinations	1966-2000	142,782	21,592	123	175,586	17,324	80
Total (w/ L-8 Basin)	**Varies**	**1,848,442**	**269,032**	**118**	**1,989,784**	**284,236**	**116**
Total (w/o L-8 Basin)	**Varies**	**1,727,009**	**255,655**	**120**	**1,881,597**	**271,531**	**117**

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 concentrations in C-139 Basin in this analysis reduced from historic by 10% to reflect ongoing BMP implementation in this basin.
3. Via structure G-136.
4. For 2006, 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. For 2010, the balance of this area will be converted to use in STA-5 and STA-6.
5. TP concentrations in Lake Okeechobee flow-through releases are assigned on the basis of historic concentrations measured at the downstream end of the system (i.e., at S-5A, S-6, S-7, S-150, and S-8).
6. TP concentrations in releases to A-1 Reservoir assigned based on historic data at point of release (i.e., S-351 and S-354).
7. Estimation of TP loads in A-1 Reservoir discharge will require subsequent DMSTA modeling.
8. Values listed for "Direct STA Inflow" exclude all runoff from L-8 Basin, which is assumed directed elsewhere for the purpose of this analysis, and inflows to EAA A-1 Reservoir.

EAA basin runoff that is back pumped to Lake Okeechobee decreases from an annual average of 48,475 acre-feet to 29,037 acre-feet for 2010, a decrease of about 40 percent. The TP loads in the water back pumped to Lake Okeechobee decreased by nearly as much, approximately 38 percent. Reducing TP loads in discharge to the lake from the EAA and other agricultural basins is one of the principal goals of the Everglades Construction Project.

8.2. Chapter 298 Districts

The total runoff and distribution of this runoff from the Chapter 298 districts is not well represented in either the 2006 or 2010 SFWMM models; therefore, these simulation results were not used directly to estimate the runoff from these drainage basins. The runoff from the Chapter 298 districts was based on historic data when available and estimated from the 2006 simulated runoff for the nearest EAA basin otherwise. As a result, the estimated runoff volumes and TP loads from these districts is unchanged for 2010.

8.3. Western Basins

Runoff from the Western Basins is not directly modeled in the SFWMM but entered as boundary conditions instead. Because of uncertainty in some of the estimates used for these boundary conditions, historic data for WY 1995-2005 were used to represent the runoff from these basins instead. Therefore, the runoff volumes and TP loads from the Western Basins is unchanged for 2010 except for the elimination of the former U.S. Sugar Corporation Southern Division Ranch Unit 2. This entire drainage area, also known as Compartment C, is assumed to be converted into treatment area for 2010.

8.4. Eastern Basins

Within the Eastern Basins, the differences between the 2006 and 2010 SFWMM simulations are relatively modest except for in the L-8 Basin. In this basin, development of the initial phase of the L-8 Reservoir project has a significant effect on the quantity and distribution of basin runoff. The volumes and TP loads in runoff delivered to the south (to the S-5A complex) are reduced by nearly half for 2010. Deliveries of L-8 Basin runoff to Lake Okeechobee however are increased significantly for 2010, by over 40 percent. This increase in the amount of L-8 Basin runoff delivered to Lake Okeechobee would appear to be contrary to stated management goals.

8.5. Lake Okeechobee Releases

Perhaps the most dramatic changes between the 2006 and 2010 simulation results are reflected in the releases from Lake Okeechobee. Direct releases to the STAs decrease from an annual average of 138,998 acre-feet and 11,442 kg to 28,150 acre-feet and 2,250 kg for 2010, decreases of approximately 80 percent. The quantities of water supply bypass however, approximately double for 2010 with most all of the changes reflected in the bypasses released at S-354. These bypasses are supplies intended for the Lower East Coast and other destinations that are not treated in the STAs when stages in the water conservation areas are below their floor elevations. With development of the A-1 Reservoir by 2010, substantial quantities of water from Lake Okeechobee — an average of 284,721 acre-feet and 33,658 kg per year — will be delivered to this reservoir through S-351 and S-354.

8.6. EAA A-1 Reservoir

As a new feature of the 2010 simulation, the A-1 Reservoir has a significant impact on flow distributions within the EAA. The inflows to this reservoir have already been mentioned above but average 416,583 acre-feet and 46,793 kg, for a flow-weighted average TP concentration of 91 ppb. Approximately two thirds of this reservoir inflow is from Lake Okeechobee releases and the balance from EAA basin runoff. The modeled releases from the A-1 Reservoir will be used for basin irrigation (approximately 44 percent) and for delivery to the Everglades Protection Area (approximately 56 percent), after passing through STA-3/4 for treatment.

8.7. Total Volumes and TP Loads

Comparing flow volumes and TP loads between the 2006 and 2010 SFWMM simulations, total flow volumes and TP loads increase on average by about 8 and 5 percent, respectively, for 2010. These percentage increases go up slightly to 9 and 6 percent, respectively, when comparing the totals that exclude the L-8 Basin.

The entire increase in overall flow volumes and TP loads is associated with Lake Okeechobee discharges passed through the A-1 Reservoir and subsequently released from the reservoir as irrigation supply to the S-2/S-6/S-7 and S-3/S-8 basins. The 2006 modeling results presented in Table 8.1 and in the Task 1.5 report largely exclude consideration of any water deliveries from Lake Okeechobee and other sources for EAA basin irrigation. The exceptions to this statement include the quantities from the C-139 Basin via G-136 that are not treated in STA-3/4 and water supplies to the STAs themselves to keep them in a hydrated condition. However for 2010, a substantial portion of the deliveries to and releases from the new A-1 Reservoir (about 44 percent) are used for basin irrigation.

Another of the total quantities that is worthy of note is the total volumes and TP loads delivered to Lake Okeechobee. These quantities actually increase by about 2.6 and 6.1 percent, respectively for 2010 when including the significantly increased deliveries from the L-8 Basin.

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Appendix A
Everglades Construction Project: SFWMM Model Assumptions

Feature	ECP 2006 Base Condition Assumptions	ECP 2010 Condition Assumptions	ECP 2015 Condition Assumptions
Climate	• The climatic period of record is from 1965 to 2000. • Rainfall estimates have been revised and updated for 1965-2000. • Revised evapotranspiration methods have been used for 1965-2000.	Same as ECP 2006	Same as ECP 2006
Topography	Updated November 2001 and September 2003 using latest available information (in NGVD 29 datum). Nov 2001 update (Documented in November 2001 SFWMD memorandum from M. Hinton to K. Tarboton) includes: • USGS High Accuracy Elevation data from helicopter surveys collected 1999-2000 for Everglades National Park and Water Conservation Area (WCA) 3 south of Alligator Alley • USGS Lidar data (May 1999) for WCA-3A north of Alligator Alley • Lindahl, Browning, Ferrari & Helstrom 1999 survey for Rotenberger Wildlife Management Area. • Stormwater Treatment Area surveys from 1990s • Aerometric Corp. 1986 survey of the 8-1/2 square mile area • Includes estimate of Everglades Agricultural Area subsidence • Other data as in SFWMM v3.7 • FWC survey 1992 for the Holey Land Wildlife Management Area. September 2003 update includes: • Reverting to FWC 1992 survey data for Rotenberger Wildlife Management Area.	Same as ECP 2006	Same as ECP 2006

Feature	**ECP 2006 Base Condition Assumptions**	**ECP 2010 Condition Assumptions**	**ECP 2015 Condition Assumptions**
	• DHI gridded data from Kimley –Horn contracted survey of EAA, 2002-2003. Regridded to 2x2 scale for EAA outside of STAs and WMAs.		
Sea Level	Sea level data from six long-term NOAA stations were used to generate a historic record to use as sea level boundary conditions for the 1965 to 2000 evaluation period.	Same as ECP 2006	Same as ECP 2006
Land Use	All land use has been updated using most recent FLUCCS data (1995), modified in the Lower East Coast urban areas using 2000 aerial photography (2x2 scale). (Documented in August 2003 SFWMD memorandum from J. Barnes and K. Tarboton to J. Obeysekera).	Same projected land uses as 2010 ICU (2010 A8 interim simulation by IMC)	Same projected land uses as 2050 ICU (http://modeling. cerpzone.org/cerp_recover/pmviewer/pmviewer.jsp)
Natural Area Land Cover (Vegetation)	Vegetation classes and their spatial distribution in the natural areas comes from the following data: • Walsh 1995 aerial photography in Everglades National Park • Rutchey 1995 classification in WCA-3B, WCA-3A north of Alligator Alley and the Miami Canal, WCA-2A & 2B • Richardson 1990 data for Loxahatchee National Wildlife Refuge • FLUCCS 1995 for Big Cypress National Preserve, Holey Land & Rotenberger Wildlife Management Areas & WCA-3A south of Alligator Alley and Miami Canal. (Documented in August 2003 SFWMD memorandum from J. Barnes and K. Tarboton to J. Obeysekera).	Same as ECP 2006	Same as ECP 2006
Lake Okeechobee Service Area			
LOSA Basins	• Southern Indian Prairie Basin, S-4, North Lake Shore and Northeast Lake Shore demands and runoff based on AFSIRS (Agricultural Field-Scale Irrigation Requirement Simulation) modeling.	• Southern Indian Prairie and S-4 Basins demand and runoff time series based on AFSIRS* modeling using 2010 ICU land	• Southern Indian Prairie Basin same as in ECP 2010 • S-4 basin demand and runoff time series based on AFSIRS

Feature	**ECP 2006 Base Condition Assumptions**	**ECP 2010 Condition Assumptions**	**ECP 2015 Condition Assumptions**
		use projections	modeling with 2015 ICU land use projections
Lake Okeechobee	• Lake Okeechobee Regulation Schedule WSE according to WSE decision trees, with pulse releases in Zone D modeled as Level III pulse in upper third of the zone, Level II pulse in middle third of the zone, and Level I pulse in the lower third of the zone, when the decision tree calls for regulatory releases to the estuaries in that zone. • Lake Okeechobee Supply Side management policy for Lake Okeechobee Service Area water restriction cutbacks as per rule 40E-21 and 40E-22. • Emergency flood control backpumping to Lake Okeechobee from the Everglades Agricultural Area. • Kissimmee River inflows based on interim schedule for Kissimmee Chain of Lakes using the UKISS model. • Flood control releases south of Lake are constrained by WCA regulation schedules • Only STA-3/4 would be used to treat LOK regulatory releases to the south	Same as ECP 2006, plus: • WSE thresholds will be derived from the Class Limit Adjustment (CLA) simulation: Increase the frequency of Pulse Releases in Zone D of WSE. • Kissimmee River Restoration and Headwaters Revitalization Project is complete. • Lake Okeechobee operations modified to account for LOSA reservoirs in 2010 • Environmental deliveries to the WCA-3A according to Rainfall Driven Operations as means of operating the EAA Reservoirs • Supplemental release to supply Caloosahatchee and St. Lucie estuaries environmental needs	Same as ECP 2010, except: • Lake Okeechobee operations modified to account for LOSA reservoirs in 2015 • Environmental deliveries to the WCAs/ENP according to Rainfall Driven Operations as means of operating the EAA Reservoirs •
Lake Okeechobee Watershed CERP		Other Acceler8 Projects On Line by 2010 – See A8 Website. • C44 Reservoirs: 9315 acres, depth 5 .ft. • C43 Reservoirs: 11000 acres, depth 15 ft. • EAA Reservoirs- • A-1 Reservoir simulated as two interconnected compartments. • Compartment 1: irrigation, 9600 acres, depth 12 ft. • Compartment 2: environment	Same as ECP 2010, plus: • North Storage Reservoir: 20000 acres, depth 10 ft. • Taylor Creek/Nubbin Slough Reservoir/STA: 5000 acres, depth 10 ft. • EAA Reservoirs- • A-1 and A-2 Reservoirs simulated as four interconnected compartments. • Compartments 1 & 3: irrigation, 9600 acres, depth 12 ft. each

Feature	ECP 2006 Base Condition Assumptions	ECP 2010 Condition Assumptions	ECP 2015 Condition Assumptions
		6400 acres, depth 12 ft. • WPA's • Site 1 Impoundment: 1660 acres; depth 8 ft. • C-9 Impoundment: 2124 acres; depth 3.5 ft. • C-11 Impoundment: 1730 acres; depth 4 ft. • Acme Basin B discharge to C51W and then to STA1E • WCA-3A/3B Seepage • C111 Spreader Canal (includes) – enlarging S332E pump station, filling southern reach of C-111 Canal, and removing S-18C and S-197 structures.	• Compartments 2 & 4: environment 6400 acres, depth 12 ft. each
Caloosahatchee River Basin	• Caloosahatchee River Basin irrigation demands and runoff were estimated using the AFSIRS method based on existing planted acreage. • Public water supply daily intake from the river is included in the analysis.	Same as ECP 2006, with: • Caloosahatchee River Basin irrigation demands and runoff were estimated using the AFSIRS method based on 2010 land use. • C43 reservoir supplements basin irrigation needs and estuarine environmental needs	Same as ECP 2010, with: • Caloosahatchee River Basin irrigation demands and runoff were estimated using the AFSIRS method based on 2015 land use.
St. Lucie Canal Basin	• St. Lucie Canal Basin demands estimated using the AFSIRS method based on existing planted acreage. • Basin demands include the Florida Power & Light reservoir at Indiantown.	Same as ECP 2006, with: • St. Lucie Canal Basin demands estimated using the AFSIRS method based on 2010 land use. • C44 reservoir supplements basin irrigation needs and estuarine environmental needs	Same as ECP 2010

Feature	**ECP 2006 Base Condition Assumptions**	**ECP 2010 Condition Assumptions**	**ECP 2015 Condition Assumptions**
Seminole Brighton Reservation	• Brighton reservation demands were estimated using AFSIRS method based on existing planted acreage in a manner consistent with that applied to other basins not in the distributed mesh of the SFWMM. • The 2 in 10 demand set forth in the Seminole Compact Work plan equals 2,262 MGM (million gallons/month). AFSIRS modeled 2 in 10 demands equaled 2,383 MGM. • While estimated demands, and therefore deliveries, for every month of simulation do not equate to monthly entitlement quantities as per Table 7, Agreement 41-21 (Nov. 1992), tribal rights to these quantities are preserved. • Supply-side Management applies to this agreement.	Same as ECP 2006	Same as ECP 2006
Seminole Big Cypress Reservation	• Big Cypress Reservation irrigation demands and runoff were estimated using the AFSIRS method based on existing planted acreage in a manner consistent with that applied to other basins not in the distributed mesh of the SFWMM. • The 2 in 10 demand set forth in the Seminole Compact Work Plan equals 2,606 MGM. AFSIRS modeled 2 in 10 demands equaled 2,659 MGM. • While estimated demands, and therefore deliveries, for every month of simulation do not equate to monthly entitlement quantities as per the District's Final Order and Tribe's Resolution establishing the Big Cypress Reservation entitlement, tribal rights to these quantities are preserved. • Supply-side Management applies to this agreement	Same as ECP 2006	Same as ECP 2006
Seminole Hollywood Reservation	• Hollywood Reservation demands are set forth under VI. C of the Tribal Rights Compact. • Tribal sources of water supply include various bulk sale agreements with municipal service suppliers.	Same as ECP 2006	Same as ECP 2006

Feature	ECP 2006 Base Condition Assumptions	ECP 2010 Condition Assumptions	ECP 2015 Condition Assumptions
Everglades Agricultural Area	• Everglades Agricultural Area irrigation demands are simulated using climatic data for the 36 year period of record and a soil moisture accounting algorithm, with parameters calibrated to match historical regional supplemental deliveries from Lake Okeechobee. • SFWMM EAA runoff and irrigation demand response to rainfall was calibrated for 1984-95 and verified for 1979-1983/1996-2000. No runoff reduction adjustment was necessary to account for Best Management Practices (BMPs). • EAA cells in the Miami Canal Basin between STA5 and STA6 are not production cells (shrub Land Use). Then, no irrigation demands are required in this area. Runoff from this area is part of the Miami Canal Basin.	Same as ECP 2006	Same as ECP 2006
Everglades Agricultural Area CERP Components		EAA Reservoirs: A-1 Reservoir simulated as two interconnected compartments. Compartment 1: irrigation, 9600 acres, depth 12 ft. Compartment 2: environment 6400 acres, depth 12 ft.	EAA Reservoirs: A-1 and A-2 Reservoirs simulated as four interconnected compartments. Compartments 1 & 3: irrigation, 9600 acres, depth 12 ft. each Compartments 2 & 4: environment 6400 acres, depth 12 ft. each 200% canal conveyance capacity increases for NNRC
Everglades Construction Project Stormwater Treatment Areas	• STA-1E: 5132 acres total treatment area • STA-1W: 6670 acres total treatment area • STA-2: expanded with cell 4: 8243 acres total treatment area • STA-3/4: 16543 acres total treatment area • STA-5: expanded with cell 3: 6165 acres total treatment area	Same as ECP 2010, plus: • STA-2 increased by 7575 acres from Compartment B • STA-5 increased by 4916 acres from Compartment C • STA-6 increased by 600 acres from Compartment C	Same as ECP 2010, plus: • Hydropattern restoration discharges from STA-3/4 to WCA-3A

Feature	ECP 2006 Base Condition Assumptions	ECP 2010 Condition Assumptions	ECP 2015 Condition Assumptions
	• STA-6: expanded with phase 2: 2254 acres total treatment area • Operation of STAs assumes maintenance of a 6" minimum depth.		
Holey Land Wildlife WMA	As per Memorandum of Agreement between the FWC and the District	Same as ECP 2006	Same as ECP 2006
Rotenberger Wildlife WMA	Interim Operational Schedule as defined in the Operation Plan for Rotenberger (SFWMD Jan 2001).	Same as ECP 2006	Same as ECP 2006
Water Conservation Areas			
Water Conservation Area 1 (ARM Loxahatchee National Wildlife Refuge)	• Current C&SF Regulation Schedule. Includes regulatory releases to tide through LEC canals. • No net outflow to maintain minimum stages in the LEC Service Area canals (salinity control), if water levels are less than minimum operating criteria of 14 ft. The bottom floor of the schedule (Zone C) is the area below 14 ft. Any water supply releases below the floor will be matched by an equivalent volume of inflow from Lake Okeechobee.	Same as ECP 2006	Same as ECP 2006
Water Conservation Area 2 A&B	• Current C&SF regulation schedule. Includes regulatory releases to tide through LEC canals. • No net outflow to maintain minimum stages in the LEC Service Area canals (salinity control), if water levels in WCA-2A are less than minimum operating criteria of 10.5 ft. Any water supply releases below the floor will be matched by an equivalent volume of inflow from Lake Okeechobee.	Same as ECP 2006	• Rainfall driven operations criteria for determining timing of deliveries to and discharges from WCA-2A. • No net outflow to maintain minimum stages in the LEC Service Area canals (salinity control), if water levels in WCA-2A are less than minimum operating criteria of 10.5 ft. Any water supply releases below the

Feature	**ECP 2006 Base Condition** Assumptions	**ECP 2010 Condition** Assumptions	**ECP 2015 Condition** Assumptions
			floor will be matched by an equivalent volume of inflow from Lake Okeechobee.
Water Conservation Area 3 A&B	• Current C&SF regulation schedule. Includes regulatory releases to tide through LEC canals. • No net outflow to maintain minimum stages in the LEC Service Area canals (salinity control), if water levels are less than minimum operating criteria of 7.5 ft in WCA-3A. Any water supply releases below the floor will be matched by an equivalent volume of inflow from Lake Okeechobee.	• Rainfall Driven Operations as means of operating EAA reservoirs. • No net outflow to maintain minimum stages in the LEC Service Area canals (salinity control), if water levels in WCA-2A are less than minimum operating criteria of 10.5 ft. Any water supply releases below the floor will be matched by an equivalent volume of inflow from Lake Okeechobee.	• Rainfall driven operational criteria for determining timing of deliveries to and discharges from WCA-3A. • Structural and operational modifications for L-67 canal conveyance and S-355 structures as in the federally authorized Modified Water Deliver Project. • No net outflow to maintain minimum stages in the LEC Service Area canals (salinity control), if water levels in WCA-2A are less than minimum operating criteria of 10.5 ft. Any water supply releases below the floor will be matched by an equivalent volume of inflow from Lake Okeechobee.
Lower East Coast Service Areas			
Public Water Supply and Irrigation	• Public water supply wellfield pumpages and locations are based on actual pumpage data for calendar year 2004. • Irrigation demands are based upon existing land use (updated through 2000) and calculated using AFSIRS, reduced to account for landscape and golf course areas irrigated using reuse water and landscape areas irrigated using public water supply.	• Projections based upon population changes by 2010 (2010 ICU) • Irrigation demands based upon 2010 ICU land use and calculated using AFSIRS, reduced to account for landscape/golf course areas irrigated using reuse water and landscape areas irrigated using public water supply.	• Projections based upon population changes by 2015 (2015 ICU) • Irrigation demands are based upon 2015 ICU land use and calculated using AFSIRS, reduced to account for landscape and golf course areas irrigated using reuse water and landscape areas irrigated using public water supply.

Feature	**ECP 2006 Base Condition** **Assumptions**	**ECP 2010 Condition Assumptions**	**ECP 2015 Condition Assumptions**
Other Natural Areas	• For the Northwest Fork of the Loxahatchee River, the District operates the G-92 structure and associated structures to provide approximately 50 cfs over Lainhart Dam to the Northwest Fork, when sufficient water is available in C-18 Canal. • Flows to Pond Apple Slough through S-13A are adjusted in the model to approximate measured flows at the structure. • Flows to Biscayne Bay are simulated through Snake Creek, North Bay, the Miami River, Central Bay and South Bay.	Same as ECP 2006	• For the Northwest Fork of the Loxahatchee River, the District operates the G-92 structure and associated structures to provide approximately 65 cfs over Lainhart Dam to the Northwest Fork, when sufficient water is available in C-18 Canal. • L-8 basin modifications: • G-160 and G-161 Flow deliveries to Loxahatchee • M canal widening • Control 2 pump station expansion and relocation • Target minimum levels at coastal structures as in 40E-8, FAC
Lower East Coast Operational CERP		• Biscayne Bay Coastal Wetlands • Water Preserve Area (Acceler8): • Site 1 Impoundment: 1660 acres; depth 8 ft. • C-9 Impoundment: 2124 acres; depth 3.5 ft. • C-11 Impoundment: 1730 acres; depth 4 ft. • Acme Basin B discharge to C51W and then to STA1E • WCA-3A/3B Seepage	Same as ECP 2010, plus: • Broward County Secondary Canal System • WPA Conveyance – Dade-Broward Levee
Upper East Coast Operational CERP		• L-8 Reservoir: 870 acres, depth 2 ft.	• L-8 Reservoir: 1200 acres, depth 3 ft.

Feature	ECP 2006 Base Condition Assumptions	ECP 2010 Condition Assumptions	ECP 2015 Condition Assumptions
Western Basins and Big Cypress National Preserve			
Western Basins	• Estimated and updated historical inflows from western basins at two locations: G-136 and G-406. The G-406 location represents potential inflow from the C-139 Basin into STA 5. Data for the period 1978 - 2000 is the same as the data used for the C-139 Basin Rule development. (Documented in June 2002 SFWMD memorandum from L. Cadavid and L. Brion to J. Obeysekera).	Same as ECP 2006	Same as ECP 2006
Big Cypress National Preserve	• Tamiami Trail culverts are not modeled in SFWMM due to the coarse (2x2 mile) model resolution.	Same as ECP 2006	Same as ECP 2006
Everglades National Park and Florida Bay			
Everglades National Park	• Water deliveries to Everglades National Park are based on Test 7 Phase 1 as per Restudy 1995 Existing Condition.	Same as ECP 2006	• Rain-driven operations • 8.5 SMA project implemented. • Mod Waters and C-111 project features and operations implemented
Region-wide Water Management and Related Operations			
Water Shortage Rules	• The existing condition reflects the existing water shortage policies in 2005 as reflected in South Florida Water Management District Chapters 40E-21 and 40E-22, FAC	Same as ECP 2006	Same as ECP 2006